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PHYSICS IN CANADA
LA PHYSIQUE AU CANADA

CAP Annual Congress - Congrès annuel ACP

University of Prince Edward Island - Université de l'Ile du Prince-Edouard

2003 June 8-11 juin 2003

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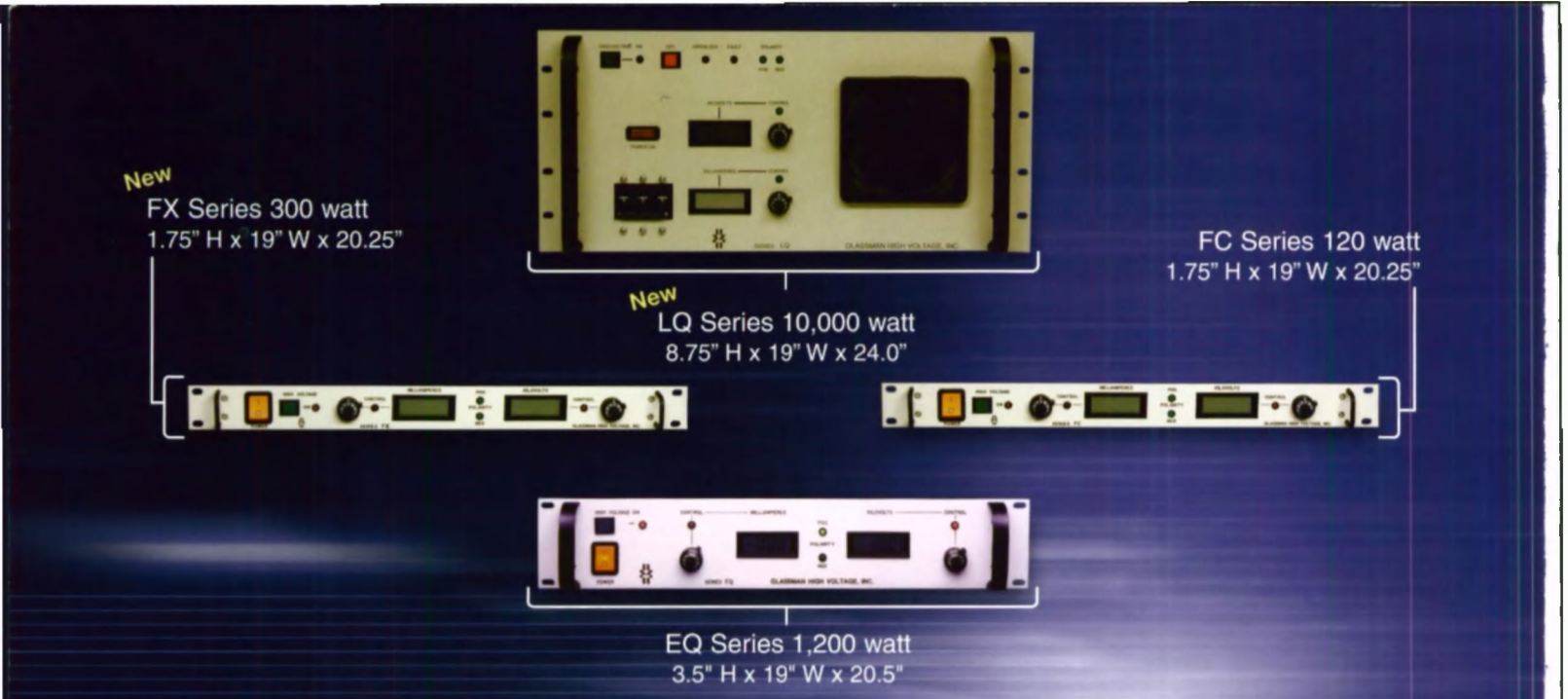

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5. Kelley Memorial Building
6. Cass Science Hall
7. Dr. Steel Building
8. Classroom Centre
9. Dalton Hall
10. Memorial Hall
11. Chaplaincy Centre
12. Duffy Science Building
13. Marian Hall (Residence)
14. Bernardine Hall (Residence)
15. Wanda Wyatt Dining Hall
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18. Atlantic Veterinary College
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20. Food Technology Centre

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- Designated Parking
- (RP) Reserved Parking
- ★ Emergency Station
- Weather Shelter

Revised 1992

PHYSICS IN CANADA
LA PHYSIQUE AU CANADA

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MAY / JUNE 2003
MAI / JUIN 2003

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CONGRÈS DE L'ACP 2003

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Avis aux membres de l'ACP

Veuillez apporter cet exemplaire gratuit du programme au congrès, à l'Université de l'Ile du Prince-Edouard. Des exemplaires de remplacement ou supplémentaires se vendront 10 $ chacun.

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-- EDITORIAL / ÉDITORIAL --
PHYSICS MAKES TRAFFIC FLOW
LA PHYSIQUE ET LA CIRCULATION

'Oh, what transport of delight?' [old hymn]

It is becoming more transparent day by day that in order to contribute effectively to modern society and its development, it is necessary for the educated citizen both to exhibit a talent and to possess a skill. The fact that the problems to be faced in today's world, and their solutions, are basically interdisciplinary, makes a career in physics even more valuable than has previously been the case.

For too long, colleges and universities have been turning out concerned citizens, acutely aware of many societal problems of an environmental or health-threatening nature, but lacking the basic tools for tackling such challenges. Today, what the college graduate needs more than anything else is a marketable skill, and the ability to tackle real problems in the simplest possible way. Physics stands alone in this regard, inculcating the ability to think creatively and simply about complex matters, with a basic skill that makes problem solving an art as well as a science.

As an illustration of this fact, the many faceted problem of mass transportation, and its social implications, comes to mind. In particular how can traffic congestion in major centres or even small rural towns be addressed as a matter of science and public policy? Are there models that can assist in the analysis of such a problem, and what scientific basis is appropriate or necessary for a complete solution? For example, since the late 1950s a stream of traffic has been often regarded as a liquid flowing through a pipe, or more recently as molecular flow in a gas. Interdisciplinary institutes and research groups consisting of mathematicians, engineers, physicists, psychologists, and others, have worked together in England and the United States to understand and produce solutions to specific traffic problems involving a single stream of cars.

Obviously, there is no flow if the road is clear of traffic; just as there is no flow in a traffic jam. Somewhere between these two limits lies the maximum number of cars for maximum rate of flow. For a start, it transpires that the average driver takes no notice of another vehicle more than 60 metres in front of him or her. For shorter distances the driver responds to the car in front and generates an induced response by a car behind. As a result there is a minimum distance between cars necessary to ensure that no collisions occur, in which case optimum conditions occur and can be predicted!

Confirmatory experiments can be carried out in the case of a single stream of cars travelling through a tunnel, and predictions of optimum speed and traffic volume checked against measurement. In many instances such as the Blackwall Tunnel in London and the Holland Tunnel in New York, agreement between prediction and measurement has been good. It transpires indeed that the greatest rate of flow occurs when gaps of a few seconds are deliberately induced in the stream of traffic, as a deliberate policy. So roads can be used to carry more traffic when we understand how to design them, and their control systems, effectively and efficiently. Several years ago, your Editor demonstrated that a volume-controlled single stoplight, activated only when the density of traffic flow along a particular road in Winnipeg exceeded a certain number of vehicles per hour, could solve a problem with excessive early morning, and evening flow.

Such challenges involved some physics and a little calculation; but so do many other opportunities in the world in which we live. City lighting, and the positioning of crosswalks and control systems, plus optimization of the distance of suburbs from the downtown, the number of locations of bridges across rivers, and the siting of railroad crossings, all involve problems of design and flow and are amenable to similar modelling and experimentation.

As John Lenihan, in Science in Action (1979) commented, "Historically the last man to have the traffic situation under good control was King Sennacherib, who mounted painted boards along the processional way into the city of Nineveh [at the junction of the Tigris and Euphrates Rivers] bearing the instruction: 'Royal Road, Let no man lessen it.'" Now, when it is realized that a concentration of 6 parked vehicles per kilometre reduces the effective width of a modern contemporary 10 metre carriageway by 15 percent, it can be appreciated why the King of Assyria was so peremptory in his command. But how did he implement his directive, you ask? Simple: Anyone who parked a chariot within sight of a 'No waiting' sign, was summarily executed!

Today we believe that physicists and engineers using their skills in an interdisciplinary team can develop more humane and indeed effective transport control systems. But, we must move outside our familiar boxes and feel confident in tackling interesting problems, different to those traditionally addressed. Our skills have much universal application; and our students must appreciate that!

There are new opportunities out there!

Jasper McKee, P.Phys.
Editor, *Physics in Canada*

LA PHYSIQUE ET LA CIRCULATION

Oh, quels transports de joie? [hymn]

Jour après jour, il est de plus en plus évident que, pour contribuer efficacement à la société moderne et à son développement, chaque citoyen doit démontrer du talent et posséder une compétence. La valeur d'une carrière en physique est beaucoup plus élevée qu'elle ne l'était auparavant parce que les problèmes, et leurs solutions, auxquels nous devons faire face dans le monde d'aujourd'hui, sont fondamentalement interdisciplinaires.

Depuis trop longtemps, les collèges et les universités ont produit des citoyens concernés, pleinement conscients des nombreux problèmes de nature dangereuse pour l'environnement ou la santé, mais n'ayant pas les outils nécessaires pour s'attaquer à ce genre de défis. Aujourd'hui, ce dont le diplômé universitaire a le plus besoin est une compétence cotée et une habileté à s'attaquer aux vrais problèmes de la façon la plus simple possible. La physique à cet égard est unique, inculquant l'habileté à réfléchir avec créativité et simplement sur des questions complexes, avec une compétence de base qui fait de la résolution des problèmes un art ainsi qu'une science.

Pour bien illustrer ce fait, vient à l'esprit le transport de masses avec ses multiples facettes et ses implications sociales. Particulièrement, en tant que sujet scientifique et politique publique, comment aborder les embouteillages dans les centres principaux ou même les petites villes rurales? Existe-t-il des modèles qui puissent aider à l'analyse d'un tel problème, et quelle base scientifique est appropriée ou requise pour une solution complète? Par exemple, depuis la fin des années 1950, le flot de la circulation fut souvent considéré comme un liquide coulant dans un tube, ou plus récemment, comme l'écoulement moléculaire d'un gaz. Des instituts et des groupes de recherche interdisciplinaires composés de mathématiciens, d'ingénieurs, de physiciens, de psychologues, et autres, ont travaillé ensemble en Angleterre et aux Etats-Unis afin de comprendre et de fournir des solutions aux problèmes spécifiques reliés aux embouteillages impliquant un flot linéaire simple d'autos.

Bien entendu, il n'y a pas de flot s'il n'y a pas de circulation sur la route; tout comme il n'y a pas de flot dans un embouteillage. Quelque part entre ces deux extrêmes se trouve le nombre maximum d'autos pour la plus grande vitesse de flot. D'abord, il semble que le conducteur moyen ne tient aucun compte d'un autre véhicule qui se trouve à plus de 60 mètres en avant d' elle ou de lui. Pour de plus courtes distances, le conducteur réagit à la voiture se trouvant à l'avant, et génère une réaction causée par l'auto se trouvant à l'arrière. En conséquence, il existe une distance minimum entre les autos qui est nécessaire afin d'éviter les collisions, et dans ce cas les conditions optimales se produisent et peuvent être prévisibles!

Des expérimentations de contrôle peuvent être menées pour le cas d'un seul flot d'autos traversant un tunnel, et des prévisions de vitesse et de volume de la circulation comparées aux mesures. Dans plusieurs occasions, par exemple le tunnel Blackwall à Londres et le tunnel Holland à New-York, l'accord entre les prédictions et les mesures furent bonnes. Il semble bien en effet que le meilleur rythme du flot se présente lorsque des interruptions de quelques secondes
sont délibérément causées dans le flot de la circulation, en tant que politique délibérée. Les routes peuvent être ainsi utilisées pour une plus grande circulation lorsque nous comprenons la façon de les concevoir, ainsi que leurs systèmes de contrôle, avec efficience et efficacité. Quelques années auparavant, votre rédacteur en chef a démontré qu'un seul feu de signalisation contrôlant le volume, activé seulement lorsque la densité du flot de la circulation le long d'une des routes de Winnipeg dépassait un certain nombre de voitures par heure, pouvait résoudre un problème de flot excessif tôt le matin et en soirée.

Ce genre de défis exige un peu de physique et un peu de calcul; ce qui est le cas pour bien d'autres opportunités dans le monde dans lequel nous vivons. L'éclairage d'une ville, et la détermination des endroits pour les trottoirs et les systèmes de contrôle, en plus de l'optimisation de la distance entre les banlieues et le centre-ville, le nombre d'emplacements pour les ponts sur les rivières, et l'emplacement des passages à niveau du chemin de fer, tout ceci implique des problèmes de conception et de flot, et relèvent du même genre de modélisation et d'expérimentation.

Comme John Lenihan, dans Science in Action (1979) l'a remarqué, "Historiquement, le dernier homme à avoir la situation de la circulation sous bon contrôle, était le Roi Sennacherib, qui avait élevé des pancartes peintes le long du chemin processionnel conduisant à la cité de Nineveh (à la jonction des rivières Tigris et Euphrates) qui se lisaient comme suit : 'Chemin royal, qu'aucun homme ne le réduise.'" Aujourd'hui, lorsque nous réalisons qu'un regroupement de 6 véhicules stationnés par kilomètre réduit la largeur véritable de la chaussée moderne contemporaine de 10 mètres par 15 pour cent, nous comprenons pourquoi l'ordre du Roi de l'Assyrie était si péremptoire. Mais comment appliquait-il cette directive, me demandez-vous? Simplement : Quiconque stationnait un chariot en vue d'une pancarte "Arrêt interdit" était sommairement exécuté!

Aujourd'hui, nous croyons que les physiciens et les ingénieurs utilisant leurs compétences dans une équipe interdisciplinaire peuvent développer des systèmes de contrôle des transports un peu plus humains et certainement efficaces. Il faut tout de même sortir des chemins battus et s'attaquer avec confiance à d'intéressants problèmes, différents de ceux qui sont traditionnellement abordés. Nos compétences ont une application universelle; et nos étudiants doivent en être conscients!

Il existe de nouvelles opportunités dans cet univers!

Jasper McKee, phys.
Rédacteur en chef, *La Physique au Canada*

FUTURE CAP CONFERENCES
PROCHAINS CONGRÈS DE L'ACP

Congrès annuel 2004 Annual Congress,
June 13-16, 2004
Delta Hotel / Hotel Delta, Winnipeg, MB

Congrès annuel 2005 Annual Congress,
June 5 - 8, 2005
University of British Columbia / Université de la Colombie Britannique, Vancouver, BC

Congrès annuel 2006 Annual Congress,
June 11 - 14 juin, 2006 (tentative)
Université Brock University, St. Catharine's, ON

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LETTERS / COMMUNICATIONS

2003 JANUARY/FEBRUARY PHYSICS IN CANADA
HISTORY OF CARLETON UNIVERSITY

The Editor, *Physics in Canada*

We wish to offer our apologies for a most egregious and totally incomprehensible omission in our recent article on the history of the Carleton Physics department. We omitted any mention of our late good friend and colleague Joe Wolfson. Professor J. L. Wolfson joined Carleton as Dean of Science in 1974. He served in that capacity until 1980. While he was Dean, he was also a member of the Physics Department, and after his retirement as Dean, he continued as a valued department member until his retirement in 1982.

The omission is doubly painful to one of us (RLC) because he was a fellow graduate student at McGill and a friend in Deep River and colleague at the Chalk River Laboratories of Atomic Energy of Canada for many years.

To his family, colleagues and many friends, we offer our sincere regrets for our lapse of memory.

R. L. Clarke
M. K. Sundaresan

2002 NOVEMBER/DECEMBER PHYSICS IN CANADA
EDITORIAL

Dear Jasper,

As I read your editorial in the November/December issue of *Physics in Canada*, it reminded me of two things. First, the quotation by John Buchan "To live for a time close to great minds is the best kind of education", reminded me of what my father wrote to me years ago, after I told him I had heard some lectures by Robert Oppenheimer, "It is always a great experience to hear in person a really great man even if one does not understand everything he says. (That also applied to Professor Dirac). I am sure I would not understand all that Oppenheimer said."

Secondly, the subject of your editorial that all physicists in Canada should belong to the Canadian Association of Physicists made me think of the quotation by Francis Bacon in the inside cover of the Mathematical Gazette (the Journal of the Mathematical Association):

> I hold every man a debtor to his professor, from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereunto.

I hope this is of some interest.

With best wishes,

A.M. Herzberg

PROFESSIONAL CERTIFICATION *PROFESSIONNELLE*

CONGRATULATIONS TO OUR NEW LICENSEES

We are pleased to announce that 7 additional licences have been granted. In alphabetical order, the new licensees are:

FÉLICITATIONS À NOS NOUVEAUX LICENCIÉS

Il nous fait plaisir de vous signaler que l'ACP a octroyé 7 nouvelles licences. Voici les nouveaux licensiés dans l'ordre alphabétique :


Laziz Bouzidi


Harold Haugen


Ahmed Hussein


Jolanta Lagowski


Ralph Nicholls


Mark Whitmore

Robert deKemp also received a licence/a aussi été licenciés .(photograph not available / photographie non disponibles)

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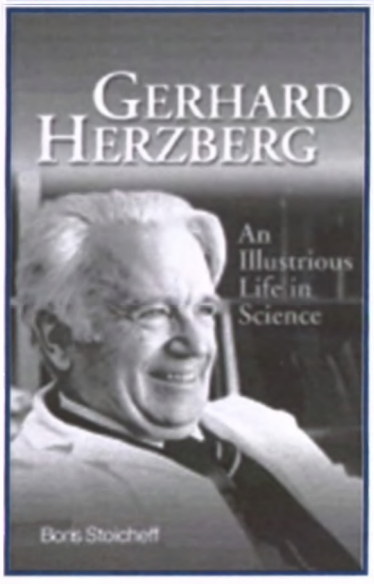
L'information relative au processus de certification, ainsi que les formulaires requis, sont disponibles sous la rubrique "Certification professionnelle" du site Internet de l'ACP qui se lit ainsi : http://www.cap.ca.

BOOK REVIEW / *CRITIQUE DE LIVRE*



GERHARD HERZBERG: An Illustrious Life in Science, Boris Stoicheff, NRC Press, McGill-Queens University Press, 2002, pp 468, ISBN 0-660-18757-4 (NRC Press Biography Series No. 1 ISSN-1701-1833, see www.monographs.nrc.ca) price $49.95

This magnificent biography of Gerhard Herzberg, by Boris Stoicheff, an illustrious member of the Canadian Physics community (and President of CAP between 1983 and 1984), should be read by all Canadian Physicists and many others, for enjoyment, for enlightenment, and for detailed study.

It is an immensely readable, yet scholarly account of the life and work of Gerhard Herzberg, the ikon of Canadian Physics, and 1971 Nobel prize winner who died at the age of 94 on March 3rd 1999. It is also a record of the people, ideas, and discoveries of atomic, molecular and quantum physics and astrophysics in their golden years of the 20th century, in Europe, the U.S, and in Canada. In this period, Spectroscopy, of which Herzberg was the world master, was the anvil on which quantum concepts were fashioned.

Boris Stoicheff is Gerhard Herzberg's official biographer, and had access to his archives and to the reminiscences of his family and close colleagues. He has distilled the essence of this massive collection of facts with consummate skill. He also traveled in Canada, the US, and Europe to recover and confirm facts and anecdotes. During part of his career he spent 13 years as a senior staff member of Herzberg's laboratory at NRC and writes of it with great authority.

The 23 chapter book is divided into four parts:

THE EARLY YEARS(1904-1934) (Family and Early Education, University Years, A Year in Gottingen, A Year in Bristol, Privatdozent in Damstadt, Searching the World for an Academic Position)

A SAFE HAVEN IN CANADA (1935-1947) (Guest Professorship at the University of Saskatchewan, Beginnings in Canada, The War Years in Canada, Interlude at the Yerkes Observatory, The University of Chicago, News of Family and Friends in War-Torn Europe)

THE GOLDEN YEARS (1948-1971)(Return to Canada, The National Research Council: The Temple of Science, The Spectroscopy Laboratory, Inspiring the Growth of Basic Research, Research and Worldwide Acclaim, Ambassador of Canadian Science, The Classic Volumes, Challenging the New Politics of Science, Nobel Laureate)

THE LATER YEARS (1972-1999) (Weathering the Aftermath, The Herzberg Institute of Astrophysics, Continuing Activities)

The fabric of the people, the science, and the Canadian science policy matters with which Herzberg was involved over his long life is skillfully woven in this book which also includes many pictures of great historical importance. The book is supplied with abundant bibliographic notes, references, appendices and lists, all of which have been compiled with great care.

Above all this book is beautifully written which makes it a joy to read.

Ralph Nicholls, York University, Toronto

A limited number of copies of Dr. Herzberg`s biography will be available for purchase at the 2003 CAP Congress. A copy will be available for viewing during the Opening Reception immediately following the Herzberg Memorial Lecture on Sunday, June 8th. Dr. Stoicheff will be available to answer questions.

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS ET PHYSICIENNES

ANNUAL GENERAL MEETING
ASSEMBLÉE GÉNÉRALE ANNUELLE

DATE: Tuesday, June 10, 2003
Mardi, le 10 juin, 2003

TIME/HEURE: 17h00

PLACE: Room/Salle 121, Duffy Science Building, UPEI

DRAFT AGENDA / ORDRE DU JOUR PROVISOIRE

1. Call to Order and Approval of the Agenda

2. Approval of the Minutes of the June 4, 2002 Annual General Meeting
   .1 Matters arising from the Minutes

3. Annual Report
   .1 Audited Financial Statements to December 31, 2002
   .2 Membership Report

4. Appointment of Auditors

5. Report on the Activities of the Association
   .1 Update on Engineering Acts
   .2 Update on Professional Certification / Trademark
   .3 Science Policy / Lobbying
   .4 Preliminary Results from CAP Membership Survey
   .5 Meetings with the APS
   .6 2005 Year of Physics
   .7 Other Matters

6. Report by the Chair of the 2003 Local Organizing Committee

7. Host Universities - Future Congresses

8. New Business
   .1 2004 Membership Fees (R. Hodgson)
   .2 Report of the Canadian National IUPAP Liaison Committee (G.W.F. Drake)
   .3 Report by the Editor of Physics in Canada (J.S.C. McKee)
   .4 Report by the Editor of the Canadian Journal of Physics (G.W.F. Drake)
   .5 CUPC 2003 at McGill University

9. Report of the Nominating Committee

10. Votes of Thanks and Change of the Chair

11. Date and Place of Next Meeting

12. Adjournment

Canadian Assocation of Physicists
Association canadienne des physiciens et physiciennes

MEDALLISTS 2003 LAURÉATS

CAP Medal for Achievement in Physics
Médaille de l'ACP pour contributions exceptionnelles en physique

Arthur B. McDonald
Queen's University/SNO

Herzberg Medal / *Médaille Herzberg*

Michael Luke
University of Toronto

CAP Medal for Excellence in Teaching Undergraduate Physics
Médaille de l'ACP pour l'excellence en enseignement de la physique au premier cycle

Anthony (Tony) Key
University of Toronto

CAP Medal for Outstanding Achievement in Industrial and Applied Physics
Médaille de l'ACP pour des réalisations exceptionnelles en physique industrielle et appliquée

Kenneth G. Standing
University of Manitoba

CAP-DCMMP Brockhouse Medal / *Médaille Brockhouse de l'ACP-DPMCM*

Louis Taillefer
Université de Sherbrooke

CAP/CRM Prize in Theoretical and Mathematical Physics
Prix ACP-CRM en physique théorique et mathématique

Matthew Choptuik
University of British Columbia

Prize Exam Results 2003 Résultats de l'examen

124 students from 25 post-secondary institutions competed this year. The exam was administered by members of the Physics Department of the Université de Sherbrooke. The names of the first, second and third prize winners are shown, followed by the fourth to tenth ranking marks.

Max Metliski	**First Prize / Premier Prix**	Univ. of British Columbia / Univ. de la Colombie-Britannique
Nicholas Gutenberg	**Second Prize / Deuxième Prix**	McGill University / Université McGill
Daragh Rooney	**Third Prize / Troisième Prix**	Univ. of British Columbia / Univ. de la Colombie-Britannique

4.	Guillaume Chabot-Couture	UBC
5.	David Press	SFU
6.	Olivier Landry	McGill U.
7.	Alex Wright	Queen's U.
8.	Michael Bailey	U. Toronto
9.	Charles Starling	Victoria U.
10.	Roy Wilds	SFU

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Brock University
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Concordia University
Dalhousie University
École Polytechnique
Laurentian University
McGill University
McMaster University
Memorial University of Newfoundland
Mount Allison University
Okanagan University College
Queen's University
Saint Mary`s University
Simon Fraser University
St. Francis Xavier University
Trent University
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(as at 2003 May 15 / au 15 mai 2003) :

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The Canadian Association of Physicists cordially invites interested corporations and institutions to make application for Corporate membership and will welcome the inquiries addressed to the Executive Director.

L'Association canadienne des physiciens et physiciennes invite cordialement corporations et institutions à faire partie des membres corporatifs. Renseignements auprès de la directrice exécutive.

CANADIAN ASSOCIATION OF PHYSICISTS / ASSOCIATION CANADIENNE DES PHYSICIENS ET PHYSICIENNES
Bur. Pièce 112, Imm. McDonald Bldg., Univ. of/d'Ottawa, 150 Louis Pasteur, Ottawa, Ontario K1N 6N5
Phone / Tél : (613) 562-5614; Fax / Téléc : (613) 562-5615 ; E-mail / courriel : CAP@physics.uottawa.ca
INTERNET - HTTP://WWW.CAP.CA

THE 58th CAP ANNUAL CONGRESS
LE 58e CONGRÈS ANNUEL DE L'ACP

INFORMATION / PROGRAMME

(See page 20 for the Session Codes / Voir page 20 pour les indicatifs des sessions)

2003 CAP CONGRESS / CONGRÈS DE L'ACP 2003

TECHNICAL PROGRAM COMMITTEE / COMITÉ DU PROGRAMME TECHNIQUE

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Medical and Biological Physics / physique médicale et biologique	Dr. William M. Whelan	bwhelan@acs.ryerson.ca
Nuclear Physics / physique nucléaire	Dr. N. Kolb	norm.kolb@usask.ca
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Particle Physics / physique des particules	Prof. Manuella Vincter	mvincter@phys.ualberta.ca
Physics Education / enseignement de la physique	Dr. Robert Hawkes	rhawkes@mta.ca
Plasma Physics / physique des plasmas	Dr. Y. Tsui	tsui@ee.ualberta.ca
Surface Science / physique des surfaces	Dr. D.B. Jack	davidb_jack@hotmail.com
Theoretical Physics / physique théorique	Dr. Randy Kobes	kobes@io.uwinnipeg.ca

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GENERAL INFORMATION / RENSEIGNEMENTS GÉNÉRAUX

2003 CAP Congress / Congrès de l'ACP 2003
Canadian Association of Physicists / Association canadienne des physiciens et physiciennes
Suite/Bur. 112, Imm. McDonald Bldg. , Univ. of/d'Ottawa
150, avenue Louis Pasteur Avenue OTTAWA, ON K1N 6N5
Tel/tél.: (613) 562-614; Fax/téléc.: (613) 562-5615; e-mail: cap@physics.uottawa.ca
web: http://www.cap.ca

REGISTRATION

The registration desk, located in the Chi-Wan Young Sports Centre, will be staffed according to the following schedule:

Saturday, June 7th	13h00 - 19h30
Sunday, June 8th	08h00 - 19h00
Monday, June 9th	07h30 - 17h00
Tuesday, June 10th	07h30 - 17h00
Wednesday June 11th	07h30 - 12h00

PARKING

Parking is available free of charge on campus, except for the 24 hrs. Reserved spaces. If you have a Handicapped sticker, please bring this with you to use the designated parking spaces on campus.

E-MAIL ACCESS

Details regarding e-mail access will be included in the registration packages.

EXHIBITORS (in alphabetical order)

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Canadian Institute for Photonic Innovations (CIPI)
Government of Prince Edward Island
Meetings PEI
Pearson Education Canada
The University of Prince Edward Island

INSCRIPTION

Le bureau d'inscription, situé dans le Centre de sports Chi-Wan Young, sera ouvert aux heures suivantes :

Samedi 7 juin	13h00 à 19h30
Dimanche 8 juin	08h00 à 19h00
Lundi 9 juin	07h30 à 17h00
Mardi 10 juin	07h30 à 17h00
Mercredi 11 juin	07h30 à 12h00

STATIONNEMENT

Le stationnement est gratuit sur le campus, sauf dans les espaces réservés en tout temps. Si vous avez un panonceau pour personne handicapée, veuillez vous en munir si vous voulez utiliser les espaces de stationnement désignés à cette fin sur le campus.

ACCÈS AU COURRIER ÉLECTRONIQUE

Les détails concernant l'accès au courrier électronique seront inclus dans votre trousse d'inscription.

EXPOSANTS (en ordre alphabétique)

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Gamble Technologies Limited
John Wiley & Sons Canada Ltd.
McGraw-Hill Ryerson Ltd.
Melles Griot Canada
Merian Scientific Ltd.
Nelson Thomson
Oxford Instruments Superconductivity
Pearson Education Canada
Plasmionique Inc.
Systems for Research

COMMANDITAIRES (en ordre alphabétique)

Gouvernement de l'Ile du Prince Edouard
Institut canadien pour les innovations en photonique (ICIP)
l'Université de l'Ile du Prince Edouard
Pearson Education Canada
Réunions IPE

2003 CAP CONGRESS

Welcome to the 58th Annual Congress of the Canadian Association of Physicists, hosted by the University of Prince Edward Island. A general outline of the program includes:

Saturday, June 7, Public Lecture
A public plenary session will feature Dr. Marc Garneau, President of the Canadian Space Agency, and the first Canadian astronaut in space, speaking on "The Space Between - From the Great, White North to the Final Frontier". This session will be held in the Chi-Wan Young Sports Centre at 19h30. A cash bar will follow, in the W.A. Murphy Student Centre.

Sunday, June 8, Welcoming Reception
A public plenary session will feature Dr. David John Southwood, Director of Science, European Space Agency, speaking on "Space Near and Far - Exploring our Universe and Our Place In It." This session will be held in the Chi-Wan Young Sports Centre at 19h00, followed by a welcome reception in the W.A. Murphy Student Centre. Light refreshments and one complimentary beverage will be offered (ticket in your registration package).

Monday, June 9, Beer and poster session
The Beer and Poster session will start at 19h00 in the Chi-Wan Young Sports Centre. One complimentary beverage ticket will be provided in your registration package.

Tuesday, June 10, Banquet and Awards
The congress banquet will take place at 19h30 in the Chi-Wan Young Sports Centre. The cost is $40 per person including taxes. A reception with cash bar will precede the banquet starting at 19h00.

REGISTRATION INFORMATION

After May 31, 2003, delegates should register on site.

Student discounts apply only to those who include a letter from the head of their department certifying their status. Conference fees are quoted in Canadian dollars.

Method of Payment
Payment can be made by credit card (VISA of MasterCard), cheque or money order payable to 'University of PEI (CAP 2003)".

Cancellation Policy
A full refund (less $50 administration fee) will be issued, provided written notification is received by Dr. Derek Lawther, Department of Physics, UPEI, on or before May 19, 2003. No refunds will be issued after May 19, 2003.

TRANSPORTATION TO ACCOMMODATION

Taxis are available from the Charlottetown Airport to any of the hotels in Charlottetown, and the University of Prince Edward Island, for $12 for one person, or $10 for first person and $6 for each additional person. There is no public transportation in Charlottetown, but one-way taxi fares within the city will cost about $5.50 for one person, and $1 extra for each additional person.

CONGRÈS DE L'ACP 2003

Bienvenue au 58e congrès annuel de l'Association canadienne des physiciens et physiciennes, au Centre des congrès de Québec. Voici un bref aperçu du programme.

Le samedi 7 juin, conférence publique
Un session publique mettra en vedette le Dr. Marc Garneau, Président de l'Agence spatiale canadienne et le premier astronaute canadien à aller dans l'espace, qui nous entretiendra du sujet suivant : "Du Grand Nord à la frontière ultime". Cette session aura lieu dans le Centre de sports Chi-Wan Young à 19h30. Un cocktail avec bar payant suivra dans le W.A. Murphy Student Centre..

Le dimanche 8 juin, réception de bienvenue
Un session publique mettra en vedette le Dr. David John Southwood, Directeur scientifique, Agence spatiale européenne, qui nous entretiendra du sujet suivant : "L'espace proche et lointain - L'exploration de notre univers et la place que nous y occupons". Cette session aura lieu dans le Centre de sports Chi-Wan Young à 19h00 et sera suivie d'une réception d'ouverture officielle où tous les congressistes sont invités dans le W.A. Murphy Student Centre. Des bouchées et un breuvage gratuit seront offerts (billet dans votre trousse d'inscription).

Le lundi 9 juin, session affiches et bière
La soirée commencera à 19h00 au Centre de sports Chi-Wan Young. Vous trouverez dans votre trousse d'inscription un billet pour une boisson gratuite.

Le mardi 10 juin, banquet et remise de prix
Le banquet du congrès aura lieu au Centre de sports Chi-Wan Young à 19h30. Le prix de 40$ par personne comprend les taxes. Un cocktail avec bar payant précédera le banquet, dès 19h00.

INSCRIPTION

Après le 31 mai 2003, les délégués doivent s'inscrire sur place.

Les étudiants qui veulent bénéficier d'un tarif réduit doivent joindre une lettre de leur chef de département pour attester leur statut. Les frais d'inscription sont en dollars canadiens.

Modalités de paiement
Le paiement peut être effectué par carte de crédit (Visa ou Master Card), ou par chèque ou mandat de banque libellé à l'ordre de: "University of Prince Edward Island (CAP 2003)".

Politique d'annulation
Un remboursement complet (moins une charge administrative de 50$) sera accordé jusqu'au 19 mai 2003. Une lettre devra être envoyer à Dr. Derek Lawther, Département de physique, UIPE. Aucun remboursement ne sera accordé après le 19 mai 2003.

TRANSPORT VERS L'HEBERGEMENT

Il est possible de vous rendre en taxi de l'aéroport de Charlottetown à n'importe quel hôtel de la ville et à l'Université de l'Île-du-Prince-Édouard pour 12 $ par personne, ou pour 10 $ pour la première personne et 6 $ pour chaque personne supplémentaire. Charlottetown n'a pas de transport en commun, mais une course aller en taxi dans la ville coûte environ 5,50 $ par personne, plus 1 $ pour chaque personne supplémentaire.

If you are travelling by air, note that there is a $10 airport tax on all flights out-bound from the Charlottetown airport. If you are travelling by automobile, there is a fee of $38.50 to cross the Confederation Bridge (out-bound traffic only). Comparable fares apply upon entering and exiting PEI by ferry.

ACCOMMODATION
Congress registrants can choose to stay either on campus at one of the residence halls, or off campus at a number of local hotels. Registrants are to make their own accommodation bookings as per the instructions posted on the congress website (www.upei.ca/~cap2003).

RECREATIONAL FACILITIES
Day passes can be obtained at a cost of $5 per day to use the facilities at the Chi-Wan Young Sports Centre. This is a multi-sport facility including an indoor track, but does not contain a pool.

MEALS
Meals can be purchased on campus at the Wanda Wyatt Dining Hall.

A City of Charlottetown map, and information about local restaurants and attractions will be available in your registration packages.

GENERAL INFORMATION ABOUT CHARLOTTETOWN
Charlottetown, "the birth place of Confederation", is the provincial capital of Prince Edward Island, and has a population of approximately 34,000. Visitors will discover that the city offers a variety of cultural events, fine dining, unique sights, attractions, and shopping opportunities to rival those of much larger cities. The City of Charlottetown, and the Island in general, plays host to over one million visitors each summer. For more information, consult the visitor guides available at the registration desk , or the on-line guide linked to the congress website (www.upei.ca/~cap2003)

The University of Prince Edward Island (UPEI) was established in 1969 from the merger of its predecessor institutions - Prince of Wales College (PWC) and St. Dunstan"s University (SDU). UPEI is primarily an undergraduate institution with a student enrolment of about 3500. The Atlantic Veterinary College (AVC), one of four veterinary colleges in Canada, is located on the UPEI campus. The UPEI Department of Physics has four full-time faculty, and offers B.Sc, B.Sc.(Honours), and B.Sc. Co-Op programs in physics. Visit the university (www.upei.ca), and department (www.upei.ca/~physics) websites for more information.

CLIMATE
The average daily minimum and maximum temperatures in Charlottetown during the second week of June are 10.4°C, and 19.4°C, respectively.

MAPS: see Congress information inside cover.

Si vous voyagez par avion, veuillez noter qu'il y a une taxe d'aéroport de 10 $ sur tous les vols en partance de l'aéroport de Charlottetown. Si vous voyagez en automobile, un droit de 38,50 $ est exigé pour emprunter le Pont de la Confédération (quittant l'île seulement). Des droits comparables sont exigés pour ceux qui viennent à l'Î.-P.-É. ou en partent par traversier.

HEBERGEMENT
Les personnes inscrites au congrès peuvent choisir de loger sur le campus, à l'une des résidences, ou à l'extérieur du campus dans différents hôtels locaux. Elles doivent faire leurs propres réservations suivant les directives données dans le site Web du congrès (www.upei.ca/~cap2003)

INSTALLATIONS RÉCRÉATIVES
Les billets d'admission aux installations du centre sportif Chi-Wan Young se vendent 5 $ par jour. Il s'agit d'un centre omnisports comprenant, entre autres, une piste intérieure, mais pas de piscine.

REPAS
Il est possible d'acheter des repas sur le campus à la salle à manger Wanda Wyatt.

Votre trousse d'inscription contiendra une carte de Charlottetown et des renseignements sur les attractions et restaurants locaux.

RENSEIGNEMENTS GENERAUX SUR LA VILLE
Charlottetown, « berceau de la Confédération », est la capitale provinciale de l'Île-du-Prince-Édouard et compte une population d'environ 34 000 habitants. Les visiteurs découvriront qu'on y trouve un vaste éventail d'activités culturelles, des tables raffinées, des panoramas uniques, des attractions et des boutiques dignes de villes beaucoup plus grandes. La ville de Charlottetown et l'île en général accueillent plus de un million de visiteurs chaque été. Pour de plus amples informations, veuillez consulter les guides du visiteur mis à votre disposition au bureau d'inscription ou le guide en ligne rattaché au site Web du congrès (www.upei.ca/~cap2003).

L'Université de l'Île-du-Prince-Édouard (UPEI), qui a vu le jour en 1969, est le résultat de la fusion des établissements qui ont été ses prédécesseurs : le Prince of Wales College (PWC) et l'Université St. Dunstan's (SDU). C'est un établissement destiné principalement aux études de premier cycle qui accueille environ 3500 étudiants. Le Atlantic Veterinary College (AVC), l'un des quatre collèges vétérinaires du Canada, est situé sur le campus de l'UPEI. Le Département de physique de l'UPEI compte quatre professeurs à plein temps et offre un programme en physique menant au B.Sc, avec ou sans spécialisation, et un programme coopératif menant aussi au B.Sc. Pour de plus amples informations, veuillez consulter les sites Web de l'université (www.upei.ca) et du Département (www.upei.ca/~physics).

CLIMAT
Les températures minimales et maximales moyennes à Charlottetown pendant la deuxième semaine de juin sont de 10,4 °C et de 19,4 °C, respectivement.

CARTES - Elles se trouvent à l'intérieur de la page couverture du programme du Congrès.

PUBLIC LECTURE / *PRÉSENTATION PUBLIQUE* — *CHI-WAN YOUNG SPORTS CENTRE*

Saturday, June 7, 2003 **19h30** **Samedi, le 7 juin 2003**

Dr. Marc Garneau

DR. MARC GARNEAU, PRESIDENT, CANADIAN SPACE AGENCY

"The Space Between – From the Great, White North to the Final Frontier"

The Canadian Space Program has been at the forefront of innovation in space science and technology. In fact, space science research in Canada dates back to 1840—before Confederation. Canada recently celebrated the 40th anniversary of the launch of Alouette-1, a groundbreaking space science satellite that provided Canada with the distinction of being the third nation in space. The space science program built upon this early success with three more scientific satellites in the 60's and 70's, the last of which, ISIS-2, obtained the first systematic observations of the Northern Lights from space. Canada's auspicious beginning in space science has spurred new undertakings in space with applications and technology thrusts. It has also lead to hallmarks of national pride, like the Canadarm and Radarsat-1, the world's first commercial Synthetic Aperture Radar satellite.

Dr. Marc Garneau, President of the Canadian Space Agency and Canada's first astronaut, will focus on such past and current successes, and on a vision for the future of Canada's Space Program. He will also discuss the challenges of studying the "infinite" with finite resources, ideas for cultivating a competitive space science community in Canada and potential areas of collaboration and nurturing the growth of next-generation technologies and emerging fields of research.

"Du Grand Nord à la frontière ultime"

Le Programme spatial canadien a été le moteur de l'innovation en sciences et technologies spatiales. En fait, la recherche en sciences spatiales au Canada date de 1840, avant même la création de la fédération canadienne. Le Canada a récemment célébré le 40e anniversaire du lancement d'Alouette-1, un satellite de sciences spatiales d'avant-garde qui a permis au Canada de se démarquer en devenant le troisième pays à assurer une présence continue dans l'espace. Fort de ces premiers succès, le programme des sciences spatiales a poursuivi sur sa lancée en procédant à la mise en orbite de trois autres satellites scientifiques dans les années 60 et 70. Le dernier de cette série, ISIS-2, a permis d'effectuer les premières observations systématiques des aurores boréales depuis l'espace.

Les débuts prometteurs du Canada dans le secteur des sciences spatiales ont constitué un tremplin pour les nouveaux projets spatiaux menant à la création d'applications et de technologies. Les succès comme ceux du Canadarm et de RADARSAT-1, le premier satellite commercial doté d'un radar à synthèse d'ouverture, ont fait naître un fort sentiment de fierté nationale.

Marc Garneau, président de l'Agence spatiale canadienne et premier astronaute canadien, mettra l'accent sur ces succès passés et actuels et abordera l'avenir du Programme spatial canadien. Il parlera d'abord des défis que pose l'étude de l'infini lorsque les ressources sont limitées. Il exposera ensuite certaines idées qui permettraient de maintenir la compétitivité du milieu des sciences spatiales au Canada et identifiera les domaines dans lesquels une collaboration potentielle pourrait favoriser l'apparition de technologies de prochaine génération et l'émergence de nouveaux domaines de recherche.

BIOGRAPHY / *BIOGRAPHIE*

Born in February 1949, in Quebec City, Canada. He received his early education in Quebec City, Saint-Jean-sur-Richelieu, Quebec and in London, England. He received a Bachelor of Science degree in engineering physics from the Royal Military College of Kingston in 1970, and a doctorate in electrical engineering from the Imperial College of Science and Technology, London, England, in 1973. Attended the Canadian Forces Command and Staff College of Toronto in 1982-1983. He became the first Canadian astronaut to fly in space as a payload specialist on Shuttle Mission 41-G, October 1984. A veteran of three space flights (STS-41G in 1984, STS-77 in 1996 and STS-97 in 2000), Dr. Garneau has logged over 677 hours in space. In February 2001, Dr. Garneau was appointed Executive Vice President, Canadian Space Agency. He was subsequently appointed President of the Canadian Space Agency, effective November 22, 2001.

Né en février 1949 à Québec, au Canada. Études primaires et secondaires à Québec et à Saint-Jean-sur-Richelieu, au Québec, ainsi qu'à Londres, en Angleterre. Baccalauréat en génie physique au Royal Military College de Kingston, en 1970, et doctorat en génie électrique à l'Imperial College of Science and Technology à Londres, en Angleterre, en 1973. Au cours des années 1982 et 1983, M. Garneau fréquente le Collège d'état-major et de commandement des Forces canadiennes à Toronto. Il devient le premier astronaute canadien à aller dans l'espace lors de la mission STS-41-G durant laquelle il assume les fonctions de spécialiste de charges utiles. Vétéran de trois missions spatiales (STS-41G en 1984, STS-77 en 1996 et STS-97 en 2000), Marc Garneau cumule plus de 677 heures de vol dans l'espace. En février 2001, il est nommé premier vice-président de l'Agence spatiale canadienne. Il devient officiellement président de l'Agence spatiale canadienne le 22 novembre 2001.

HERZBERG MEMORIAL PUBLIC LECTURE
CONFÉRENCE PUBLIQUE COMMEMMORATIVE HERZBERG

CHI-WAN YOUNG SPORTS CENTRE

Sunday, June 8, 2003 **19h00** **Dimanche, le 8 juin 2003**

Dr. David Southwood

DR. DAVID SOUTHWOOD,
DIRECTOR OF SCIENCE, EUROPEAN SPACE AGENCY

"Space Near and Far - Exploring our Universe and Our Place In it"

The exploration of space is more than a scientific endeavour, although science and physics, in particular, are at the root of it. Any modern technically developed society needs for its own health to look outwards and also backward to its origins. Space science does these tasks in the grandest ways, looking outwards to its limits of the ability to see and to measure, and backwards to whence our galaxy, our planet, indeed ourselves came. Such themes will be explored, using the Europe's space programme for illustration.

"L'espace proche et lointain - L'exploration de notre univers et la place que nous y occupons"

L'exploration de l'espace est plus qu'une entreprise scientifique, bien qu'elle tire son origine de la science et de la physique en particulier. Pour son propre bien, toute société moderne évoluée sur le plan technique doit regarder vers l'extérieur, mais aussi remonter jusqu'à ses origines. La science spatiale fait ces démarches de la façon la plus grandiose possible, regardant vers l'extérieur jusqu'aux limites de la capacité de voir et de mesurer, et vers les origines jusqu'à la naissance de notre galaxie, de notre planète et, en fait, de l'homme même. Ces thèmes seront explorés et le programme spatial européen servira à illustrer le propos.

BIOGRAPHY

Professor Southwood took up post as Director of Science at the European Space Agency (ESA) on May 1 2001.

From 1997 to 2000, he was head of Earth Observation strategy at the European Space Agency where he introduced a new programme in Earth science, "The Living Planet". After his going back to academia in April 2000, his return to ESA to lead the space science programme was announced in late 2000.

David Southwood is a space physicist who spent the bulk of his career at the Blackett Laboratory, the Physics Department of Imperial College London. He went to Imperial first as a PhD student in 1966. After postdoctoral work in the USA, in the Institute of Geophysics and Planetary Physics at University of California Los Angeles, he returned to the Imperial College faculty in 1971 eventually becoming head of the Blackett Laboratory, the Physics Department of Imperial College from 1994-1997. He has retained for many years links with UCLA and returned there as a Regents Professor in 2000. He completed a thesis on ULF waves in the Earth's magnetosphere, using both ground-based and early satellite data. Subsequent research interests ranged from the deployment of magnetometer arrays on the ground to exploring the magnetic environments of Jupiter and Saturn with spacecraft.

He has worked on a variety of space missions over the past thirty-five years, working with the American and Russian programmes as well as with European partners. His most recent instrumental work was building the magnetometer on the NASA Cassini Saturn orbiter, which has now passed Jupiter and will reach Saturn in 2004.

David Southwood has sat on many senior science committees in Britain and at the international level in Europe and in COSPAR. He has been chairman of the Science Programme Committee (SPC) and the Space Science Advisory Committee (SSAC).

He has published more than 200 publications and scientific articles.

Third Annual Physics Teacher Workshop
Monday June 9 2003
University of Prince Edward Island, Charlottetown, PEI

Monday, June 9 2003 - Duffy Science Building, Room 305

8:30 am **Keynote Lecture by Prof. Anthony Key, the 2003 Winner of the CAP Medal for Excellence in Physics Teaching** Professor Anthony Key of the University of Toronto was recently announced as the winner of this prestigious national medal "for his great enthusiasm in promoting the excellent teaching of Physics as a paramount goal, which impacted on his students, his institution, and the entire Canadian Physics Community".

9:15 am **What can you do with a Physics Degree?** by Dr. Joanne O'Meara, Univ. of Guelph. Joanne, who has been very active in physics education and science outreach activities, will explore some of the many career options open to graduates with physics degrees. In short this session will help us answer better the question: "So if I major in physics what can I do in life?"

9:45 am **The Magic of Light and Colours: More than Smoke and Mirrors (though we have some of that too)** by Dr. Marc Nantel, Manager of Photonics Education and Training - Photonics Research Ontario. Dr. Nantel has been involved in the development and delivery of photonics teaching activities from elementary grades through high school, and his presentation (with demonstrations) will concentrate on photonic related teaching activities for the high school grades.

10:15 am **Refreshment and Exhibits Break** As well as sharing refreshments, use this opportunity to browse the industrial, commercial and publisher displays, and to meet other physicists in an informal setting.

10:45 am **Taking Physics Ideas to the Marketplace** by Dr. Nancy Mathis, President Mathis Instruments. Fredericton NB based Mathis Instruments is one of Atlantic Canada's high technology success stories. Mathis Instruments have developed innovative measurement products which use physics principles for thermal conductivity measurements. In 1999 Mathis Instruments was awarded the prestigious R&D 100 award as one of the top 100 new product introductions in the world (previous winners are Polaroid instant photography and the ATM). Dr. Mathis, originally from Prince Edward Island, will talk about the challenges and joys of developing a high technology company.

11:15 am **Video Analysis - Making Measurements from Digital Video** by Dr. Peter Williams, Physics Department, Acadia University. We will explore the use of digital video to analyze two-dimensional motion. Participants will have an opportunity to experiment with this technique and will be provided with a take home copy of the video software. Dr. Williams is a frequent presenter to high school physics teachers, and has been instrumental in the development of studio physics teaching at Acadia University.

12:15 pm **Lunch Sponsored by Canadian Institute for Photonic Innovation (CIPI) with guest speaker**

1:30 pm **Better Fuel Cells** by Dr. Jeff Dahn, Canada Research Chair in Battery and Fuel Cell Materials at Dalhousie University. Dr. Jeff Dahn is one of Canada's leading industrial physicists, with extensive research in many areas of materials science including the development of better materials for lithium-ion batteries and fuel cell materials. He won the CAP Herzberg Medal and was recently elected a Fellow of the Royal Society of Canada. As well as being an internationally acclaimed researcher, Dr. Dahn has won teaching awards and is a en effective and engaging speaker. This presentation will deal with physics contributions, including those from Atlantic Canada, to the technology which will power future automobiles.

2:15 pm **An Introduction to Special Relativity using Diachronic Representations** by Dr. Michel Duguay. Dr. Duguay and colleagues have developed a new method for visualization and interpretation of spacetime situations and will apply these to problems in special relativity. Special relativity is an area well within the mathematical capabilities of high school students, and inclusion in high school courses help to underscore the philosophic importance of modern physics. Dr. Duguay teaches at the Dépt. Génie électrique et de génie informatique, Université Laval, , Québec, Canada, as well as directing a small photonics firm, and has developed visualization tools and innovative new frameworks for studying special relativity in recent years.

2:45 pm **Refreshment and Exhibits Break**

3:15 pm **Bright Ideas: Understanding Light-Emitting Diodes** by Dr. Kristin Poduska, York University. The physics of light-emitting diodes (including issues of waves, energy, and materials) can be explored in a classroom setting using several low-cost activities. While a Ph.D. student at Cornell University Dr. Poduska was very active in the Cornell University Science Outreach program where she spoke to numerous student and teacher groups.

3:45 pm **Medical Physics: Physics Principles and Career Opportunities** by Dr. John Andrews, Chief Medical Physicist Nova Scotia Cancer Clinic, and Mr. Grant MacNevin, Prince Edward Island Cancer Clinic This session will show how physics ideas are applied in medical physics, and will discuss career opportunities in medical physics.

4:15 pm **Sharing of Ideas for Teaching Physics** Please bring to this session your favourite physics demonstrations, problems or ideas to share with other teachers. (session will conclude by 5:00 pm)

Other Congress Activities:

- Teachers who are planning to arrive early are invited to the public lecture by Marc Garneau, President of the Canadian Space Agency at 7:30 pm Saturday, June 7.
- A second public lecture is held Sunday evening, June 8 at 7:00 pm by Dr. David Southwood, Director of Science for the European Space Agency, on the topic "Space near and far: exploring our universe and our place in it".
- The day after the Teacher Workshop (i.e. on Tuesday June 10), the Division of Physics Education is holding a series of sessions on university physics teaching around the theme of Innovations in Physics Education.

Troisième atelier annuel pour les enseignant(e)s de physique
le lundi 9 juin 2003
University of Prince Edward Island, Charlottetown, PEI

Lundi, le 9 juin 2003 -- Duffy Science, Salle 304

8:30 am **Plénière, Prof. Anthony Keys**, University of Toronto, récipiendaire de la médaille de l'ACP pour l'excellence en enseignement de la physique. (en anglais)

9:15 am **Une Introduction à la Relativité Spéciale en les Représentations de Diachronic** par Dr. Michel Duguay. Dr. Duguay et ses collègues ont développé une nouvelle approche OE,diachronique,, pour la visualisation et l'interprétation d,événements dans l,espace-temps et ils appliquent celles-ci à des problèmes de la relativité restreinte. La relativité restreinte est un domaine utilisant les mathématiques du niveau de l'école secondaire, et son inclusion à ce niveau souligne l'importance philosophique de la physique moderne. Le professeur Duguay enseigne au Dépt. de génie électrique et de génie informatique, Université Laval à Québec au Canada, et dirige une petite firme de dispositifs photoniques. Ces dernières années il a développé des outils de visualisation et des concepts innovateurs pour faciliter la compréhension de la relativité restreinte.

10:00 am **Pause-santé et expositions**. En prenant un café ou des rafraîchissements vous pourrez profiter de cette occasion pour visiter les exposants industriels et commerciaux ainsi que les éditeurs, et rencontrer d'autres physiciens dans une atmosphère détendue.

10:45 am **La Magie des Couleurs et de la Lumière: Tout un Spectre de Possibilités** Marc Nantel, Directeur de l'Education et de la Formation en Photonique - Photonics Research Ontario Venez voir comment on peut animer l'enseignement de l'optique et d'autres sujets avec trois ensembles de démonstrations (cellules photovoltaiques, spectroscopie d'absorption and optique géométrique).

11:30 am **Sur les façons d'intéresser le public aux séances d'observations astronomiques** par Dr. Francis Weil, Directeur, Physique & Astronomie, Université de Moncton On se propose de montrer comment on peut utiliser des explications sur la taille de l'univers ainsi que des diapositives du système solaire pour intéresser les jeunes aux observations astronomiques.

12:15 pm Le déjeuner est parrainé par l,Institut canadien pour les innovations en photonique (ICIP)

1:45 pm **Partage d'idées pour enseigner la physique**. Nous vous prions d,apporter à cette session vos démonstrations de physique préférées, ou des problèmes et des idées à partager avec les autres enseignant-e-s.

2:45 pm Pause-santé et expositions

3:15 pm **Les Idées brillantes: le secret de diodes électro-luminescentes (Bright Ideas: Understanding Light-Emitting Diodes)** (en anglais) by Dr. Kristin Poduska, York University The physics of light-emitting diodes (including issues of waves, energy, and materials) can be explored in a classroom setting using several low-cost activities. While a Ph.D. student at Cornell University Dr. Poduska was very active in the Cornell University Science Outreach program where she spoke to numerous student and teacher groups.

3:45 pm **La Physique médicale: la physique en jeu et les opportunités de carrière (Medical Physics: Physics Principles and Career Opportunities)** (en anglais) by Dr. John Andrew, Chief Medical Physicist Nova Scotia Cancer Clinic, and Mr. Grant MacNevin, Prince Edward Island Cancer Clinic This session will show how physics ideas are applied in medical physics, and will discuss career opportunities in medical physics.

Les autres activités au Congrès:

- Les enseignants qui ont l'intention d'arriver tôt sont invités à la conférence publique par Marc Garneau, le Président de l'Agence Spatial Canadienne à 7:30 du soir le samedi, le 7 juin.
- Une deuxième conférence publique sera présentée dimanche soir, le 8 juin à 19 heures par Dr. David Southwood, Directeur scientifique de l'Agence Spatiale européenne, sur le sujet "l'Espace près de nous et loin de nous: explorer notre univers et notre place en son sein".
- Le lendemain de l'Atelier pour les enseignant-e-s (le mardi 10 juin), la division d'enseignement de la physique (DEP) aura des sessions sur l'enseignement universitaire de la physique avec comme thème: les innovations en enseignement de la physique.

BECOMING LEADERS – A PRESENTATION AND DISCUSSION LEAD BY CAROLYN EMERSON

A special event organized by the Committee to Encourage Women in Physics

CAP Congress
Tuesday June 10
5:00 pm
Reception to Follow

Carolyn Emerson is currently a consultant on women in science issues and formerly director of the NSERC/Petro-Canada Office for Women in Science and Engineering, Memorial University. As part of the NSERC project, she and the NSERC/Petro-Canada Chair, Dr. Mary Williams, co-authored a resource for women in science, engineering and technology entitled Becoming Leaders: a Handbook for Women in Science, Engineering and Technology (for further information, please see the review in this issue p. 117). In this special CEWIP event, she will discuss the Handbook and its value as a resource - its rationale, content, audiences, feedback, etc. and will discuss a series of workshops that has been developed as part of this project.

NEW FACULTY LUNCHEON / DÉJEUNER POUR LES NOUVEAUX PROFESSEUR(E)S

We extend a special invitation to new Faculty members to attend the CAP Congress, to be held in Charlottetown, Prince Edward Island, from the 7th to the 11th of June 2003. The CAP Congress is a unique opportunity to meet and hear colleagues from universities across Canada, and to discover a part of our country. For new Faculty members who choose to attend the Congress, we have organized a special luncheon at 12:30 p.m. on Wednesday, June 11th. This luncheon will be hosted by the CAP's Director of Academic Affairs. NSERC representatives will give a short presentation followed by a question period and a round table discussion of issues of interest to new professors.

If you would like to attend, please let us know by e-mail at cap@physics.uottawa.ca. We welcome any suggestions regarding information that you would like to obtain from NSERC, or topics that you would like to hear discussed at the round table.

I hope to see you in Charlottetown.

Béla Joós, P.Phys.
Vice President of the CAP

N.B. A new professor is any regular Faculty member who started after December 31st, 2001.

Nous lancons une invitation spéciale aux nouveaux professeurs d'assister au Congrès de l'ACP à Chalottetown sur l'Ile du Prince Edouard du 7 au 11 juin. Le Congrès de l'ACP est une occasion unique de rencontrer et d'écouter vos collègues des autres universités canadiennes, en plus de découvrir un joli coin de notre pays. Pour les nouveaux professeurs, qui assisteront au Congrès, nous avons aussi organisé un déjeuner spécial à 12h30 le mercredi 11 juin. Le déjeuner sera animé par le Directeur des affaires académiques de l'ACP Des représentants du CRSNG vont faire une courte présentation sur les programmes disponibles aux professeurs de physique au Canada et demeureront pour répondre à vos questions. La discussion sera suivie d'une table ronde sur les sujets d'intérêt aux nouveaux professeurs.

Si vous aimeriez assister au déjeuner, veuillez nous le laisser savoir en envoyant un courrier électronique à cap@physics.uottawa.ca. Toutes les suggestions que vous auriez sur les sujets que vous aimeriez entendre discuter par les représentants du CRSNG ou à la table ronde seront bienvenue.

J'espère vous voir à Charlottetown.

Béla Joós, phys.
Vice-Président de l'ACP

N.B. Un nouveau professeur est tout professeur régulier qui est entré en fonction après le 31 décembre 2001.

NSERC Workshop

How to Prepare a Research Grant Application
Comment préparer une demande

Wednesday/Mercredi, June 11 juin
13h30 ; Room/salle KC-104

Representatives from NSERC and members of the Physics Grant Selection Committees (GSCs) will make a presentation to familiarize researchers with the peer review process and the way in which Grant Selection Committees function. Advice will be given on how to prepare an application. While the workshop will be most helpful to new faculty members and those preparing applications this fall, all researchers are welcome to attend. The workshop will cover topics such as research grants, grant selection committees, criteria for evaluation, application forms and equipment grants. A question period will follow the presentation.

Des représentants du CRSNG et des membres des comités de sélection des subventions (CSS) en physique feront une présentation afin de familiariser les chercheurs avec le processus d'évaluation par les pairs et le fonctionnement des CSS. On donnera des conseils sur la manière de préparer une demande. Bien que l'atelier s'adresse plus particulièrement aux nouveaux chercheurs et à ceux qui prévoient présenter une demande cet automne, tous les chercheurs sont invités. La présentation portera sur des sujets tels que les subventions de recherche, les comités de sélection des subventions, les critères d'évaluation, les formulaires de demande ainsi que les subventions d'appareillage. Une période de questions suivra la présentation.

The 2003 Canadian Association of Physicists' Annual Congress
University of Prince Edward Island
June 8-11, 2003

Public Events – Free Admission

In conjunction with the 2003 Congress, there are a number of public events that precede and continue throughout. We welcome, encourage, and invite members of the public to join us in this exploration of physics.

Saturday June 7th to Wednesday Jun. 11th

THE ART OF PHYSICS EXHIBIT
UPEI Library — Time: Normal Library Hours

This exhibit showcases past and present winners of the annual CAP photography contest. Each beautiful picture shows a physical principle in action, and is accompanied by a short explanation of the physics involved.

Saturday, June 7th

"The Space Between—From the Great, White North to the Final Frontier"
PUBLIC LECTURE
UPEI Campus — Time: 7:30 pm

Dr. Marc Garneau, President of the Canadian Space Agency and Canada's first astronaut, will focus on past and current successes, and on a vision for the future of Canada's Space Program. He will also discuss the challenges of studying the "infinite" with finite resources, ideas for cultivating a competitive space science community in Canada and nurturing the growth of next-generation technologies and emerging fields of research.

Sunday, June 8th

"See the Sun on Sunday"
TELESCOPE VIEWING
UPEI Observatory — Time: 1 - 4 pm

The Royal Astronomical Society of Canada is hosting a drop-in, day-time viewing session of our sun. Safely view sunspots, flares and other details. Open to all ages and experience. No registration required.

"Space near and far - Exploring our Universe and our place in it"
PUBLIC LECTURE
UPEI Campus — Time: 7 pm

David Southwood, Director of Science, European Space Agency: The exploration of space is more than a scientific endeavour, although science and physics, in particular, are at the root of it. Any modern society needs for its own health to look outwards and also backward to its origins. Space science does these tasks in the grandest ways, looking outwards to see and to measure, and backwards to whence our galaxy, our planet, indeed ourselves came. Such themes will be explored, using the Europe's space programme for illustration. Open to the general public.

For more information, contact Lisa Steele at ldsteele@upei.ca or 566-0745. You can also go to the conference website at www.upei.ca/~cap2003. We look forward to seeing you!

ABBREVIATION KEY / CODES DES ABBREVIATIONS

Buildings / Immeubles

AV	=	Atlantic Veterinary College
CS	=	Cass Science Hall
CY	=	Chi-Wan Young Sports Centre
DS	=	Duffy Science Building
FL	=	Faculty Lounge (Main Building)
IT	=	ITEC Teletheatre (Robertson library)
KC	=	K.C. Irving Chemistry Centre
KM	=	Kelley Memorial Building
MN	=	Main Building
SC	=	W.A. Murphy Student Centre

Divisions

DAMP	Division of Atomic and Molecular Physics
DPAM	Division de physique atomique et moléculaire
DASP	Division of Atmospheric and Space Physics
DPAE	Division de physique atmosphérique et de l'espace
DCMMP	Division of Condensed Matter and Materials Physics
DPMCM	Division de physique de la matière condensée et matériaux
DMBP	Division of Medical and Biological Physics
DPMB	Division de physique médicale et biologique
DIAP	Division of Industrial and Applied Physics
DPIA	Division de physique industrielle et appliquée
DIMP	Division of Instrumentation and Measurement Physics
DPIM	Division de physique des instrumentation et mesures
DNP	Division of Nuclear Physics
DPN	Division de physique nucléaire
DOP	Division of Optics and Photonics
	Division d'optique et photonique
DPE	Division of Physics Education
DEP	Division de l'enseignement de la physique
DPP	Division of Plasma Physics
	Division de physique des plasmas
DSS	Division of Surface Sciences
	Division de la science des surfaces
DTP	Division of Theoretical Physics
DPT	Division de physique théorique
PPD	Particle Physics Division
	Division de physique des particules
CEWIP	Committee to Encourage Women in Physics
CEFEP	Comité d'encourager les femmes en physique

Sessions

SU-KEY	Sunday Keynote Speaker / Session plénière publique le dimanche soir
SU-PLEN#	Sunday Plenary Speaker / Conférencier plénière (dimanche)
SU-A#	Sunday A.M. Session / Session le dimanche matin
SU-P#	Sunday P.M. Session / Session le dimanche après-midi
MO-PLEN#	Monday Plenary Speaker / Conférencier plénière (lundi)
MO-A#	Monday A.M. Session / Session le lundi matin
MO-P#	Monday P.M. Session / Session le lundi après-midi
MO-LUM#	Monday Best Student Paper Competition / Compétition meilleur présentation, le lundi après-midi
MO-P#	Monday evening Poster Session / Session d'affiche le lundi soir
TU-PLEN#	Tuesday Plenary Speaker / Conférencier plénière (mardi)
TU-A#	Tuesday A.M. Session / Session le mardi martin
TU-P#	Tuesday P.M. Session / Session le mardi après-midi
WE-PLEN#	Wednesday Plenary Speaker / Conférencier plénière (mercredi)
WE-A#	Wednesday A.M. Session / Session le mercredi matin
WE-P#	Wednesday P.M. Session / Session le mercredi après-midi

INVITED SPEAKERS / *CONFÉRENCIERS INVITÉS*

(in alphabetical order / *selon l'ordre alphabétique*)

ALLAIS, Fabrice (DPP)
INRS-Université du Québec

Atomic Physics Rates and non-local Electron Parallel Heat Transport in Divertor Plasmas

ARGALL, P. Stephen (DASP)
University of Western Ontario

Development of the Gravity Wave Imager (GWIM) Mission at University of Western Ontario

ASHCROFT, Neil W. (DCMMP-DMBP / *DPMCM-DPMB*)
Cornell University

Classical and Quantal Order in the Light Elements at High Densities

AZZOUZ, Mohamed (DTP / *DPT*)
Laurentian University

Rotating Antiferromagnetism and The Pseudogap Phase of Copper-Oxide Superconductors

BARZDA, Virginijus (DOP)
University of Toronto

Imaging Cardio-Myocytes Simultaneously with Second- and Third-Harmonic Generation and Multi-Photon Excitation Fluorescence Microscopy

BERNATH, Peter F. (DASP)
University of Waterloo

The Atmospheric Chemistry Experiment (ACE): Overview and Status

BRABEC, Thomas (DAMP / *DPAM*)
University of Ottawa

Matter in Strong Laser Fields

BRUNET, François (DOP)
INO, Centre d'optique, photonique et laser (COPL), Université Laval

Ytterbium-Doped Fiber Lasers for Frequency Conversion Applications

BURGESS, Cliff (DTP / *DPT*)
McGill University

Are Inflationary Predictions Sensitive to Very High Energy Physics?

BURNS, Peter N. (DMBP / *DPMB*)
University of Toronto

Measuring Tissue Perfusion with Microbubbles and Nonlinear Ultrasound Imaging

CARBOTTE, Jules (DCMMP-DMBP / *DPMCM-DPMB*)
Dalhousie University

Superconductivity Past and Future

CHARB0NNEAU, Sylvain (DIMP / *DPIM*)
National Research Council of Canada

Nanotechnology - an Integration Challenge

CHBIHI, Abdelouahad (DNP / *DPN*)
Ganul, Caen

Dynamical and Statistical Aspects of the Nuclear Multifragmentation

CHEN, Alan (DNP / *DPN*)
McMaster University

The ISAC Program in Experimental Nuclear Astrophysics

CHEN, Jeff (DMBP / *DPMB*)
University of Waterloo

Understanding Protein Folding from Polymer Models

CHOPTUIK, Matthew
University of British Columbia
(CAP/CRM Medal winner - *récipiendaire de la médaille ACP/CRM*)

Critical Phenomena in Gravitational Collapse

CHRISTOFIDES, Constantinos (DIMP / *DPIM*)
University of Cyprus, CYRPUS

Detection of Hydrogen via Modulated Thermoreflectance

CORRIVEAU, François (PPD / *PPD*)
McGill University

Report on the Linear Collider

CZAJKOWSKI, Andrzej (DAMP / *DPAM*)
National Research Council

Development and Study of a 1.5 micron Optical Frequency Standard at National Research Council

CZEREMUSZKIN, Grzegorz (DPP / *DPP*)
École Polytechnique de Montréal

Plasma Enhanced Chemical Vapor Deposition of Barrier Coatings on Plastics

DAMASCELLI, Andrea (DCMMP / *DPMCM*)
University of British Columbia

Probing the Electronic Structure of Complex Systems by State-of-the-Art ARPES

DEKEMP, Robert (DMBP / *DPMB*)
University of Ottawa Heart Institute

Absolute and Relative Flow Imaging with PET

DJORDJEVIC, B. Boro (DIMP / *DPIM*)
Johns Hopkins University

Remote Non-Contact Ultrasonic Sensing

DONOVAN, Eric (DASP)
University of CalgaryWaterloo

Energy Dependence of the Latitude of The Ion Isotropy Boundary

DOSANJH, Ranpal Singh (PPD / *PPD*)
Carleton University

Recent Results from the Sudbury Neutrino Observatory

DRUMMOND, James R. (DASP)
University of Toronto

The Atmosphere from Space - the Future of Space Measurements

DUCK, Thomas J. (DASP)
Dalhousie University

Lidar Measurements in Canada – Past, Present, and Future Prospects

ELIAS, Victor (DTP / *DPT*)
Perimeter Institute for Theoretical Physics

Radiative Spontaneous Symmetry-Breaking Revisited

EMERSON, Carolyn (CEWIP / *CEFEP*)
Memorial University of Newfoundland

Becoming Leaders: Career Success for Women in Science

FEDER, David (DAMP / *DPAM*)
University of Calgary

Rotating Bose-Einstein Condensates in Optical Lattices

FLEMING, David E.B. (DMBP / *DPMB*)
Mount Allison University

Detecting Lead in Bone Using X-ray Fluorescence

FUNDAMENSKI, W. (DPP / *DPP*)
Euratom/UKAEA Fusion Association

Energy Transport in Tokamak Boundary Plasmas: laminar or turbulent?

GANGAVARAPU, Kiran (DIMP / *DPIM*)
University of Pennsylvania

Recent Developments in Photon Migration

GARNEAU, Marc (CAP / *ACP*)
Canadian Space Agency

The Space Between - From the Great, White North to the Final Frontier / Du Grand Nord à la frontière ultime

GAULIN, Bruce D. (DCMMP / *DPMCM*)
McMaster University

Canadian Participation at the Spallation Neutron Source

GEGENBERG, Jack (DTP / *DPT*)
University of New Brunswick

Using Gravity to Understand Topology

GLYDE, Henry R. (DCMMP / *DPMCM*)
University of Delaware

Elementary Excitations, Bose-Einstein Condensation and Superfluidity in Liquid 4He

GOERRES, Joachim (DNP / *DPN*)
Notre Dame University

Alpha-Capture in Stellar Evolution and Explosion

GREEN, John-Bruce (DMBP / *DPMB*)
University of Alberta

Developments of Atomic Force Microscopy for Enhanced Chemical and Biological Discrimination

GREVEN, Martin (DCMMP / *DPMCM*)
Stanford University

Quantum versus Geometric Disorder in a Two-Dimensional Heisenberg Antiferromagnet

GRUTTER, Peter (DCMMP / *DPMCM*)
McGill University

The NSERC Nano Innovation Platform: an Update

GUNN, James P. (DPP / *DPP*)
CEA Cadarache, France

The Tunnel Probe : A DC Probe Diagnostic for Electron Temperature Measurements in Magnetized Plasmas

HACKMAN, Greg (DNP / *DPN*)
TRIUMF

A New Era of High Resolution Gamma-Ray Spectroscopy at TRIUMF-ISAC

HAWKES, Bob (DPE / *DEP*)
Mount Allison University

Learning Physics by Experiencing Physics

HEINRICH, B. (DCMMP-DMBP / *DPMCM-DPMB*)
Simon Fraser University

Non Equilibrium Spin Momentum Transport in Magnetic Ultrathin Film Structures

HOCKING, Wayne K. (DASP)
University of Western Ontario

The Role of Canadian Radars in Middle Atmosphere Studies

HOCKING, Wayne K. (DASP)
University of Western Ontario

Applications of a World-Wide Network of Mesospheric Radars

HUNT, James (DPE / *DEP*)
University of Guelph

On-line Learning in Physics Courses and Thoughts About Aiding Problem Solving

JENNINGS, Byron (PPD / *PPD*)
TRIUMF

SNOING on Nuclear Theory

JOSE, Jordi (DNP / *DPN*)
Universitat Politecnica de Catalunya

Classical Novae as Laboratories for Nuclear Astrophysics: from Lithium to Calcium

KAGANOVICH, Igor (DPP / *DPP*)
Princeton University

Analytical and Numerical Studies of Ion Beam Plasma Interactions for Heavy Ion Driven Inertial Fusion

KANAYA, Naoko (PPD / *PPD*)
University of Victoria

Physics beyond the Standard Model at the LHC experiments

KHAKZAD, Mohsen (PPD / *PPD*)
Carleton University

ATLAS Experiment and the Canadian Contribution

KIEFFER, Jean-Claude (DPP / *DPP*)
INRS - Université du Québec

The Advanced Laser Light Source (ALLS) International Facility

KIEFL, Robert (DCMMP-DMBP / *DPMCM-DPMB*)
TRIUMF, CIAR and University of British Columbia

Beta- Detected NMR with Low Energy Spin Polarized Radioactive Nuclei and its Applications in Condensed Matter

KONAKA, Akira (PPD / *PPD*)
TRIUMF

JHF-SuperK Long Baseline Neutrino Oscillation Project

KREUZER, Jurgen (DSS)
Dalhousie University

Theory of Surface Processes: From Atoms to Polymers

LAUE, Hans (DPE / *DEP*)
University of Calgary

Concept Teaching and Learning with MAP

LAWRIE, David (DCMMP / *DPMCM*)
University of Illinois

Isotope Effects in Superconductors and Oxide Materials

LEE, Ting-Yim (DMBP / *DPMB*)
Lawson Health Research Institute

Measurement of Tissue Perfusion with CT

LE HUR, Karyn (DCMMP / *DPMCM*)
Université de Sherbrooke

Revival of Kondo physics with Nanotechnology

LINHANANTA, Apichart (DMBP / *DPMB*)
Lakehead University

Molecular Simulation Models of Protein Folding: New Insights on the Levinthal Paradox and the Occurrence of Protein-Folding Diseases

LITVINYUK, Igor (DAMP / *DPAM*)
National Research Council

Molecules in Strong Laser Field: Ionization, Re-scattering and Coulomb Explosion

LIU, Dazhi (DPP / *DPP*)
University of Saskatchewan

Development of Curved Drift Tube for Vertical Compact Torus Injection into STOR-M Tokamak

LIU, William (DASP)
Canadian Space Agency

Scientific Challenges of International Living With a Star

LLEWELLYN, Edward J. (DASP)
University of Saskatchewan

OSIRIS - Some Highlights of Two Years Successful Operation

LONGTIN, Jon P. (DIMP / *DPIM*)
SUNY - Stony Brook, U.S.A.

Ultrafast Laser Micromachining of Thermal Spray Materials Using Laser Induced Breakdown Spectroscopy

LOPINSKI, Gregory (DSS)
Steacie Institute, NRC Ottawa

Molecular Electronics on Silicon Surfaces

LUKE, Michael E.
University of Toronto

(CAP Herzberg Medal winner - *récipiendaire de la médaille ACP Herzberg*)

The Heavy Quark Expansion: Recent Results

LUNDEEN, Jeffrey S. (DOP)
University of Toronto

Playing Games with Quantum Information: Experiments with Photons and Laser-Cooled Atoms

MACKENZIE, Hugh A. (DIMP / *DPIM*)
Heriot Watt University, UK

Applications of Photoacoustic Spectroscopy to the Life Sciences

MACKENZIE, Richard (DTP / *DPT*)
Université de Montréal

Interaction Between Vortices in Models With Two Order Parameters

MAEV, Roman G. (DIAP / *DPIA*)
University of Windsor

Recent Development in Quantitative Acoustic Microscopy Methods

MAEVA, Elena (DIAP / *DPIA*)
University of Windsor

Method of Acoustic Microscopy for Sex Determination of Sea Lamprey, Petromyzon Marinus Larvae

MANDELIS, Andreas (DIMP / *DPIM*)
University of Toronto

Infrared Photo-Carrier Radiometry of Semiconductors: Physical Principles, Quantitative Depth Profilometry and Scanning Imaging of Deep Sub-surface Electronic Defects

MANN, Ian Robert (DASP)
University of Alberta

The Role of Global Scale ULF Waves in Driving Magnetospheric Dynamics: CANOPUS and Beyond

MANN, Robert (DTP / *DPT*)
University of Waterloo

Chaos in 3-body Relativistic Self-Gravitating Systems

MARSHALL, Glen (PPD / *PPD*)
TRIUMF

First Data from the TWIST Experiment

MARSIGLIO, Frank (DCMMP / *DPMCM*)
University of Alberta

How Do You Determine the Mechanism of Superconductivity

MARTIN, John (PPD / *PPD*)
University of Toronto

News and Results from ZEUS at HERA

MCDADE, Ian C. (DASP)
York University

SWIFT - The Stratospheric Wind Interferometer For Transport studies

MCDONALD, Art
Queen's University

(CAP Medal of Achievement winner - *récipiendaire de la médaille de l'ACP pour contributions exceptionnelles à la physique*)

A Deeper Understanding of Our Universe from 2 km Underground

MCELROY, C. Thomas (DASP)
ARQX, Meteorological Service of Canada

Ozone Measurement in Canada: From Research to Operations

MCKELLAR, A.R.W. (DAMP / *DPAM*)
National Research Council Canada

Far Infrared Beamline at the Candian Light Source

MCKENNA, Janis (PPD / *PPD*)
University of British Columbia

CP Violation in the B Meson System

MCKEON, Gerry (DTP / *DPT*)
University of Western Ontario

Extracting Information from the Renormalization Group

MCWILLIAMS, Kathryn (DASP)
University of Saskatchewan

SuperDARN - The Super Dual Auroral Radar Network

MENON, Ravi (DMBP / *DPMB*)
Robarts Research Institute

Measurement of Oxygen Consumption Using MRI

MOEWES, Alexander (DCMMP / *DPMCM*)
University of Saskatchewan

Soft X-Ray Spectroscopy at the Canadian Light Source: A Powerful Tool for Condensed Matter Physics

MONCHESKY, Theodore L. (DCMMP / *DPMCM*)
Dalhousie University

Electron Beam Stimulated Magnetic Domain Wall Motion

MORELLI, Jordan (DPP / *DPP*)
University of Saskatchewan

Plasma Position Control in the STOR-M Tokamak Using A Fuzzy Logic Approach

MORROW, Michael R. (DMBP / *DPMB*)
Memorial University of Newfoundland

Pressure-Induced Ordering in Lipid Bilayers

NANTEL, Marc (DPP / *DPP*)
Photonics Research Ontario/University of Toronto

Pulsetrain-Burst Laser-Matter Interactions in Solids and Tissues

NUMAO, Toshio (PPD / *PPD*)
TRIUMF

Status of rare kaon decay experiments at BNL

OPPER, Allena (DNP / *DPN*)
Ohio University

Measuring Charge Symmetry Breaking in n+p - ¿ d pi0

PAGE, Shelley (DNP / *DPN*)
University of Manitoba

Measurement of the Parity-Violating Asymmetry in Radiative Neutron-Proton Capture

PARANJAPE, Manu B. (DTP / *DPT*)
Université de Montréal

Vortices in Noncommutative Chern-Simons Theory and the Quantum Hall Effect

PARKER, Peter (DNP / *DPN*)
Yale University

Laboratory Studies of Explosive Nucleosynthesis

PEARSON, Matthew (DNP / *DPN*)
TRIUMF

Nuclear Physics with Atomic Tools at ISAC

PEJOVIC-MILIC, Ana (DIMP / *DPIM*)
Ryerson University

Quantifying Strontium and Aluminum in Human Bone

PETERSEN, Nils O. (DMBP / *DPMB*)
University of Western Ontario

Molecular Domains in Membrane Systems

POLLAK, Fred H. (DIMP / *DPIM*)
Brooklyn College of the City University of New York

Non-Destructive Room-Temperature Characterization of Wafer-sized III-V Semiconductor Device Structures using Contactless Electromodulation and Surface Photovoltage Spectroscopy

POPPITZ, Erich (DTP / *DPT*)
University of Toronto

Issues in Deconstruction and Lattice Supersymmetry

RAGAN, Ken (PPD / *PPD*)
McGill University

Ground-based gamma-ray astronomy with STACEE and VERITAS

RATHER, John (DIAP / *DPIA*)
Wayne State University

PAMELA Technologies for Ultra-Large, Low Cost Imaging Telescope

REDDISH, Tim (DAMP / *DPAM*)
University of Windsor

Photo-Double Ionisation of D2 and He

ROBBIE, Kevin (DCMMP / *DPMCM*)
Queen's University

Geometrical Effects in Ballistic Aggregation of Thin Films

ROY, René (DNP / *DPN*)
Université Laval

Time Scale in Heavy Ion Collisions at Intermediate Energy

RUTENBERG, Andrew D. (DMBP / *DPMB*)
Dalhousie University

Pattern Formation Inside Bacteria

RUTT, Brian K. (DMBP / *DPMB*)
Robarts Research Institute

Cardiovascular MRI

SAMOKHIN, Kirill (DCMMP-DMBP / *DPMCM-DPMB*)
Brock University

Superconductivity in Ferromagnets

SAMSON, John Craig (DASP)
University of Alberta

Major Scientific Results From the CANOPUS Experiment

SÁNCHEZ-SINENCIO, Feliciano (DIMP / *DPIM*)
Centro de Investigación y Estudios Avanzados (CINESTAV), Mexico

Biomaterials Research Activities in CINVESTAV

SAWATZKY, George A. (DCMMP / *DPMCM*)
University of British Columbia

Resonant Soft X Ray Scattering ; A New Tool to Study Spin Charge and Orbital Distributions

SCHLESINGER, Mordechay (DCMMP / *DPMCM*)
University of Windsor

Numeric Methods in Solving Rough Surface Contact Problems

SCOTT, Douglas (PPD)
University of British Columbia

The Cosmic Microwave Background vs the Universe

SHEPHERD, Gordon G. (DASP)
York University

Canadian Contributions to International Investigations of the Atmospheric Environment: What Were They, and How Did They Come About?

SHIMODA, Tadashi (DNP / *DPN*)
Osaka University

Novel Structure of a Neutron Rich Nucleus 11Be Proved by Spin-Polarized ^{11}Li Beam at TRIUMF-ISAC

SOUTHWOOD, David John
European Space Agency

(CAP Herzberg Lecturer - Conférencier Herzberg de l'ACP)

Space Near and Far - Exploring our Universe and our Place in It

STANDING, Kenneth G.
University of Manitoba

(CAP Medal for Outstanding Achievement in Industrial and Applied Physics winner - *récipiendaire de la médaille de l'ACP pour contributions exceptionnelles en physique industrielle et appliquée*)

Clocking the Big Ones: Time-of-Flight Mass Spectrometry of Biomolecules– One Thousand to One Million u

STERNIN, Edward (DMBP / *DPMB*)
Brock University

Recent Developments in the Measurement and Interpretation of Biomembrane Order Parameters by ^{2}HNMR

ST-MAURICE, Jean-Pierre (DASP)
University of Western Ontario

What Can Be Learned From The Properties Of Two-Step Type I waves In The Equatorial Electrojet

STORRY, C.H. (DAMP / *DPAM*)
Harvard University

Antihydrogen Production and Detection

STRONG, Kimberly (DASP)
University of Toronto

Observation of Atmospheric Composition Using Balloon-Borne and Ground-Based Instruments

TAILLEFER, Louis
Université de Sherbrooke

(Brockhouse Medal winner - *récipiendaire de la médaille Brockhouse*)

Probing New States of Matter With Heat and Sound

TEMPESTA, Piergiulio (DTP / *DPT*)
CRM Université de Montréal

Symmetry Preserving Discretization of Quantum Systems

TERAZIMA, Mosahide (DIMP / *DPIM*)
Kyoto University, Japan

A Novel Method to Study Structural and Energy Dynamics of Proteins From a View Point of Time-Resolved Thermodynamics

THYWISSEN, Joseph H. (DAMP / *DPAM*)
University of Toronto

One-Dimensional Phase Fluctuations in "Quasi" Bose-Einstein Condensates

TIMUSK, Tom (DCMMP / *DPMCM*)
McMaster University

The Two Pseudogaps in High Temperature Superconductors

TOENNIES, J. Peter (DSS)
Max-Planck Institut für Stromungsforschung

Diffraction of Matter Waves from Nanostructures: Novel Applications to Cluster and Surface Science

TOKARYK, Dennis (DAMP / *DPAM*)
University of New Brunswick

Spectroscopy of Carbon-Bearing Radicals: from the Interstellar Medium to the Hydrogen Fuel Cell

TOKARYK, Dennis (DPE / *DEP*)
University of New Brunswick

Research and Teaching: Synergetic Partners or Adversarial Antagonists?

TOWNER, Ian (DNP / *DPN*)
Queen's University

Superallowed Beta Decay: the Determination of Vud

TOYODA, Taro (DIMP / *DPIM*)
University of Electro-Communications

Photo-Acoustic and Photo-Electrochemical Characterization of Nanostructured TiO2 Electrodes

TRISCHUK, William (PPD / *PPD*)
University of Toronto

The CDF-II Experiment at Fermilab

TYSHETSKIY, Yuriy (DPP / *DPP*)
University of Saskatchewan

Anomalous and Nonlinear Effects in Inductively Coupled Plasmas

VAN OERS, Willem T.H. (DNP / *DPN*)
University of Manitoba

Qweak, A Search for New Physics

VARMA, Pravin (DPE / *DEP*)
Mount Allison University

Learning Physics by Experiencing Physics

VENUS, David (DCMMP / *DPMCM*)
McMaster University

Magnetic Relaxation in Exchange-Coupled Ferromagnetic/Antiferromagnetic Bilayer Films

VILLENEUVE, David (DPP / *DPP*)
National Research Council of Canada

Molecular Imaging at the Advanced Laser Light Source (ALLS)

VITKIN, Alex (DIAP / *DPIA*)
University of Toronto

Polarized Light as a Tool for Biological Tissue Investigation

WALKER, Philip (DNP / *DPN*)
TRIUMF

Nuclear Isomers: Energy and Spin

WEI, John (DCMMP / *DPMCM*)
University of Toronto

Nanoscale Phase Decoherence in High-T_c Superconductors

WILLIAMS, P.J. (DPE / *DEP*)
Acadia University

The Effectiveness of Computer-Based Studio Teaching of Physics

WORTIS, Rachel (DCMMP / *DPMCM*)
Trent University

Nuclear Magnetic Resonance in the Vortex State of Cuprate Superconductors

YANG, Victor X.D. (DMBP / *DPMB*)
University of Toronto

Doppler Optical Coherence Tomography of Tissue Microcirculation

YAU, Andrew (DASP)
University of Calgary

Ion Outflow and The Enhanced Polar Outflow Probe (e-POP) Project

YIP, Christopher M. (DMBP / *DPMB*)
University of Toronto

Protein-Based Supramolecular Architectures: Controlling Self-Assembly at Molecular Interfaces

ZACEK, Viktor (PPD / *PPD*)
Université de Montréal

Status of the PICASSO Dark Matter Search Project

ZEDEL, Len (DIAP / *DPIA*)
Memorial University of Newfoundland

High Frequency Wind Generated Sound in the Ocean

ZEDEL, Len (DIAP / *DPIA*)
Memorial University of Newfoundland

The Capabilities and Limitations of Doppler Sonar for Monitoring Fish Movements

CAP ANNUAL CONGRESS / CONGRÈS ANNUEL DE L'ACP

UNIVERSITY OF PRINCE EDWARD ISLAND / UNIVERSITÉ DE L'ILE DU PRINCE-EDUOARD

JUNE 7-11 JUIN 2003

Saturday / Samedi, June 7 juin

13h00 - 19h30	**Conference Registration and Information / *Inscription et Information***	Chi-Wan Young Sports Centre
09h00 - 14h00	CAP Executive Meeting / Réunion de l'Exécutif de l'ACP	ITEC Teletheatre
14h00 - 19h00	CAP Council Meeting (Old and New) / *Réunion du Conseil de l'ACP (ancien et nouveau)*	ITEC Teletheatre
19h30 - 20h30	**Public Lecture - Dr. Marc Garneau / *Conférence publique - Dr. Marc Garneau***	Chi-Wan Young Sports Centre
20h30 - 22h00	Cash Bar / *Cocktail avec bar payant*	W.A. Murphy Student Centre

Sunday / Dimanche, June 8 juin

08h00 - 19h00	**Conference Registration and Information / *Inscription et Information***	Chi-Wan Young Sports Centre
08h00 - 12h00	Physics Departments Heads-Chairs Workshop *Réunion pour les chefs des départements de physique*	Faculty Lounge
09h00 - 12h00	IPP Board of Trustees Meeting é *Réunion du conseil d'administration de l'IPP*	ITEC Teletheatre
09h30 - 12h20	Large Scale Initiatives in Condensed Matter Physics / *Initiatives d'envergure en matière condensée* (SU-A1)	Duffy Science, Room/salle 121
10h00 - 12h45	Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond *Observation de l'ionosphère et de la magnétosphère à partir su sol - CANOPUS et au delà* (SU-A2)	K.C. Irving, Room/salle 104
13h30 - 14h15	**Brockhouse Medal Winner - Louis Taillefer** ***Récipiendaire du médaille Brockhouse - Louis Taillefer***	Duffy Science, Room/salle 121
14h15 - 17h05	New Methods and Novel Materials / *Nouveaux méthodes et matériaux* (SU-P1)	Duffy Science, Room/salle 121
14h15 - 16h45	Observing the Ionosphere and Magnetosphere from Ground and Space - Canadian Contributions and Innovations *Observation de l'ionosphère et de la magnétosphère à partir su sol - Les contributions et innovations canadiennes* (SU-P2)	K.C. Irving, Room/salle 104
14h30 - 18h00	IPP General Meeting / *Assemblée générale (IPP)*	Kelley Memorial, Room/salle 237
19h00 - 20h30	**Herzberg Memorial Lecture - Dr. David Southwood** ***Conférence publique commémmorative Herzberg - Dr. David Southwood***	Chi-Wan Young Sports Centre
20h30 - 22h30	Opening Reception / *Réception d'accueil*	W.A. Murphy Student Centre

Monday / Lundi, June 9 juin

07h30 - 17h00	**Conference Registration and Information / *Inscription et Information***	Chi-Wan Young Sports Centre
07h30 - 09h00	"Friends of CAP" Breakfast / *Déjeuner des "Ami(e)s de l'ACP"*	Faculty Lounge
08h30 - 17h00	Teachers' Workshop	Duffy Science, Room/salle 305
08h30 - 17h00	*Atélier pour les enseignant(e)s de physique*	Duffy Science, Room/salle 304
09h15 - 10h00	**Plenary Session / *Session plénière* - PETER TOENNIES**	Duffy Science, Room/salle 121
10h00 - 12h30	Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond *Observation de l'ionosphère et de la magnétosphère à partir su sol - CANOPUS et au delà* (MO-A1)	Atlantic Veterinary, Room/salle D
10h00 - 12h30	Observing the Atmosphere from Ground and Space - Canadian Contributions and Innovations *Observation de l'atmosphère à partir su sol - Les contributions et innovations canadiennes* (MO-A2)	Atlantic Veterinary, Room/salle C
10h00 - 12h30	Atomic and Molecular Spectroscopy and Dynamics I *Spectrscopie et dynamique atomique et moléculaire I* (MO-A3)	Main Building, Room/salle 40
10h00 - 12h30	Young Investigators in Condensed Matter and Materials Physics *Jeunes chercheurs en matière condensée et en physique des matériaux* (MO-A4)	Duffy Science, Room/salle 121
10h00 - 13h00	The Precision Frontier / *À la limite de la précision* (MO-A5)	Cass Science, Room/salle 104
10h00 - 12h30	Frontiers in Theory and Experiment in Surface Science *Les frontières théoriques et expérimentales en physique des surfaces* (MO-A6)	Atlantic Veterinary, Room/salle A
10h00 - 12h30	Biomaterials / *Biomatériaux* (MO-A7)	K.C. Irving, Room/salle 128

12h30 - 13h30	DCMMP Business Meeting / *Réunion d'affairs DPMCM* (with lunch / *avec repas*)	Duffy Science, Room/salle 210
12h30 - 13h30	DASP Business Meeting / *Réunion d'affairs DPAE* (with lunch / *avec repas*)	Atlantic Veterinary, Room/salle D
12h30 - 13h30	DTP Business Meeting / *Réunion d'affairs DPT* (with lunch / *avec repas*)	K.C. Irving, Room/salle 128
12h30 - 13h30	Past President's Lunch / *Déjeuner des anciens présidents*	Faculty Lounge
13h30 - 14h15	**Herzberg Medal Winner - Michael Luke** ***Récipiendaire du médaille Herzberg* - Michael Luke**	Duffy Science, Room/salle 121
14h15 - 17h00	Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond *Observation de l'ionosphère et de la magnétosphère à partir su sol - CANOPUS et au délà* (MO-P1)	Atlantic Veterinary, Room/salle D
14h15 - 17h00	Observing the Atmosphere from Ground and Space - Canadian Contributions and Innovations *Observation de l'atmosphère à partir su sol - Les contributions et innovations canadiennes* (MO-P2)	Atlantic Veterinary, Room/salle C
14h15 - 16h45	Atomic and Molecular Spectroscopy and Dynamics II *Spectrscopie et dynamique atomique et moléculaire II* (MO-P3)	Main Building, Room/salle 40
14h15 - 16h45	Memorial Session Honouring Jurgen Franck *Session commémmorative honorant Jurgen Franck* (MO-P4)	Duffy Science, Room/salle 121
14h15 - 17h00	Biomedical and Biological Diagnostic Instrumentation Methodologies *Méthodologie et instrumentation de diagnostique biomédical et biologique* (MO-P5)	K.C. Irving, Room/salle 128
14h15 - 17h15	The Energy Frontier / *La frontière énergétique* (MO-P6)	Cass Science, Room/salle 104
14h15 - 17h00	Radioactive Beam Science / *La science des faisceaux radioactifs* (MO-P7)	Atlantic Veterinary, Room/salle B
14h15 - 17h15	Gravity / *Gravité* (MO-P8)	Main Building, Room/salle 120
14h15 - 16h15	Plasma Physics / *La physique des plasmas* (MO-P9)	Main Building, Room/salle 220
14h15 - 16h15	Semiconductor Physics / *Physique des semi-conducteurs* (MO-P10)	K.C. Irving, Room/salle 104
14h15 - 17h00	Frontiers in Scanning Probe Microscopy / *Frontières de la microscopie par sonde à balayage* (MO-P11)	Atlantic Veterinary, Room/salle A
17h00 - 18h00	Becoming Leaders : Careers for Women in Physics *Devenir des patrons : Des carrières pour femmes en science* (MO-P12)	Atlantic Veterinary, Room/salle A
17h00 - 19h00	Best Student Paper Competition / *Competition meilleur communication*	Atlantic Veterinary, Room/salle B
17h30 - 19h00	*Physics in Canada* Editorial Board Meeting *Réunion de la Comité de rédaction de La Physique au Canada*	Main Building, Room/salle 111
18h00 - 20h30	CJP Editorial Board Meeting / *Réunioin de la Comité de rédaction de la RCP*	Faculty Lounge
19h00 - 21h00	Poster Session, with Beer *Session d'affiches, avec la bière*	Chi-Wan Young Sports Centre

Tuesday / Mardi, June 10 juin

07h30 - 17h00	**Conference Registration and Information / *Inscription et Information***	Chi-Wan Young Sports Centre
07h00 - 09h00	Meeting of the Canadian National IUPAP Liaison Committee *Réunion du comité de liaison national Canadien (IUPAP)*	Faculty Lounge
08h30 - 09h15	**CAP-CRM Medal Winner - Matthew Choptuik** ***Récipiendaire du médaille ACP-CRM* - Matthew Choptuik**	Duffy Science, Room/salle 121
09h15 - 10h00	**Plenary Session / *Session plénière* - NEIL ASHCROFT**	Duffy Science, Room/salle 121
10h00 - 12h30	Innovations in Physics Education I / *Innovations en enseignement de la physique I* (TU-A1)	Atlantic Veterinary, Room/salle A
10h00 - 12h15	Cooling and Trapping of Atoms and Molecules / *Refroidir et piéger les atomes et les molécules* (TU-A2)	Kelley Memorial, Room/salle 237
10h00 - 12h30	Soft Matter Physics / *Physique de la matière molle* (TU-A3)	Main Building, Room/salle 40
10h00 - 12h00	Superconductivity, Magnetic and Correlated Electronic Systems I *Supraconductivité, systèmes électroniques corrélés et magnétiques I* (TU-A4)	K.C. Irving, Room/salle 104
10h00 - 12h15	Instrumental Techniques, Microscopy and Sensors *Techniques instrumentales, microscopie et senseurs* (TU-A5)	Atlantic Veterinary, Room/salle B
10h00 - 12h30	Instrumentation and the Future of Particle Physics *L'instrumentation et le futur de la physique des particules* (TU-A6)	Atlantic Veterinary, Room/salle C
10h00 - 11h45	Laser Plasmas / *Plasmas des lasers* (TU-A7)	Cass Science, Room/salle 104
10h00 - 12h30	Quantum Theory / *Théorie quantique* (TU-A8)	Atlantic Veterinary, Room/salle D
10h00 - 12h30	Heavy Ions and Nuclear Structure / *Ions lourds et structure nucléaire* (TU-A9)	Kelley Memorial, Room/salle 211
10h00 - 12h45	Quantum Optics and Photonic Devices / *Optique quantique et dispositifs photoniques* (TU-A10)	Main Building, Room/salle 220
10h00 - 12h45	Imaging Blood Flows in Tissues / *Imagerie de la circulation sanguine dans les tissus* (TU-A11)	Duffy Science, Room/salle 121
10h00 - 12h30	Acousto and Optical Applied Physics / *Physique appliquée en acoustique et optique* (TU-A12)	Main Building, Room/salle 340
12h30 - 13h30	DPE Business Meeting / *Réunion d'affairs DEP* (with lunch / *avec repas*)	Atlantic Veterinary, Room/salle A
12h30 - 13h30	DAMP Business Meeting / *Réunion d'affairs DPAM* (with lunch / *avec repas*)	Kelley Memorial, Room/salle 237
12h45 - 13h30	DMBP Business Meeting / *Réunion d'affairs DPMB* (with lunch / *avec repas*)	Duffy Science, Room/salle 210
12h30 - 13h30	PPD Business Meeting / *Réunion d'affairs PPD* (with lunch / *avec repas*)	Atlantic Veterinary, Room/salle C
12h30 - 13h30	DPP Business Meeting / *Réunion d'affairs DPP* (with lunch / *avec repas*)	Cass Science, Room/salle 104

13h30 - 14h15	**Medal of Achievement Winner - Arthur B. McDonald** ***Récipiendaire de la médaille ACP* - Arthur B. McDonald**	Duffy Science, Room/salle 121
14h15 - 17h00	Innovations in Physics Education II / *Innovations en enseignement de la physique II* (TU-P1)	Atlantic Veterinary, Room/salle A
14h15 - 16h45	Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond *Observation de l'ionosphère et de la magnétosphère à partir su sol - CANOPUS et au délà* (TU-P2)	Atlantic Veterinary, Room/salle B
14h15 - 16h15	Superconductivity, Magnetic and Correlated Electronic Systems II *Supraconductivité, systèmes électroniques corrélés et magnétiques II* (TU-P3)	K.C. Irving, Room/salle 104
14h15 - 17h00	Dynamics of Magnetic Systems and Thin Films (General) *Dynamique des systèmes magnétiques et couches minces (Général)* (TU-P4)	Main Building, Room/salle 40
14h15 - 16h45	Instrumentation and Measurement Methods in Materials Science *Instrumentation et méthodes de mesure en science des matériaux* (TU-P5)	Cass Science, Room/salle 104
14h15 - 16h45	Particle Astrophysics / *Astrophysique des particules* (TU-P6)	Atlantic Veterinary, Room/salle C
14h15 - 15h30	Advances in Medical Imaging / *Progrès en imagerie médicale* (TU-P7)	Duffy Science, Room/salle 121
14h15 - 16h15	Advanced Light Sources / *Sources de lumière modernes* (TU-P8)	Kelley Memorial, Room/salle 237
17h00 - 18h45	**CAP Annual General Meeting / *Assemblée générale de l'ACP***	Duffy Science, Room/salle 121
19h00	**Banquet Reception / *Réception de banquet***	Chi-Wan Young Sports Centre
19h30	**Banquet**	Chi-Wan Young Sports Centre

Wednesday / Mercredi, June 11 juin

07h30 - 12h00	**Conference Registration and Information / *Inscription et Information***	Chi-Wan Young Sports Centre
07h00 - 09h00	Meeting of the CAP-NSERC Liaison Committee / *Réunion du comité de liaison ACP-CRSNG*	Faculty Lounge
08h30 - 09h15	**Industrial and Applied Physics Medal Winner - Kenneth G. Standing** ***Récipiendaire du médaille en physique industrielle et appliquée* - Kenneth G. Standing**	Duffy Science, Room/salle 121
09h15 - 10h00	**Plenary Session / *Session plénière* -- DOUGLAS SCOTT**	Duffy Science, Room/salle 121
10h00 - 12h15	Ultrafast Science and Applications / *Phénomènes ultrarapides et applications* (WE-A1)	Duffy Science, Room/salle 121
10h00 - 12h15	Materials Science I / *Science des matériaux I* (WE-A2)	Main Building, Room/salle 40
10h00 - 12h45	Overview of Instrumentation and Measurement Research in North America I *Survol de la recherche en instrumentation et mesures en Amérique du Nord* I (WE-A3)	Kelley Memorial, Room/salle 237
10h00 - 12h30	Theory I / *Théorie I* (WE-A4)	Atlantic Veterinary, Room/salle C
10h00 - 12h30	Special ITER Session / *Session ITER spéciale* (WE-A5)	Atlantic Veterinary, Room/salle B
10h00 - 12h30	Computational Biophysics / *Biophysique computationnelle* (WE-A6)	Cass Science, Room/salle 104
10h00 - 12h30	Nuclear Astrophysics / *Astrophysique nucléaire* (WE-A7)	Atlantic Veterinary, Room/salle A
10h00 - 12h30	Biomedical Applied Physics / *Physique biomédicale appliquée* (WE-A8)	Atlantic Veterinary, Room/salle D
12h30 - 13h30	DNP Business Meeting / *Réunion d'affairs DPN* (with lunch / *avec repas*)	Atlantic Veterinary, Room/salle A
12h30 - 13h30	DOP Business Meeting / *Réunion d'affairs DOP* (with lunch / *avec repas*)	Duffy Science, Room/salle 210
12h30 - 13h30	DIAP Business Meeting / *Réunion d'affairs DPIA* (with lunch / *avec repas*)	Atlantic Veterinary, Room/salle D
12h30 - 13h30	DIMP Business Meeting / *Réunion d'affairs DPIM* (with lunch / *avec repas*)	Kelley Memorial, Room/salle 237
12h30 - 13h30	New Faculty Luncheon / *Déjeuner pour les nouveaux professeurs*	Faculty Lounge
13h30 - 14h15	**NSERC Workshop - How to Prepare a Grant Application** ***Session spéciale avec CRNSG - Comment préparer une demande***	K.C. Irving, Room/salle 104
13h30 - 14h15	**Plenary Session / *Session plénière* -- JEAN-CLAUDE KIEFFER**	Duffy Science, Room/salle 121
14h15 - 16h30	Materials Science II / *Sciences des matériaux II* (WE-P1)	Main Building, Room/salle 40
14h15 - 16h15	Overview of Instrumentation and Measurement Research in North America II *Survol de la recherche en instrumentation et mesures en Amérique du Nord II* (WE-P2)	Kelley Memorial, Room/salle 237
14h15 - 17h00	Symmetries in Nuclear Physics / *Symétries en physique nucléaire* (WE-P3)	Atlantic Veterinary, Room/salle D
14h15 - 16h30	ITER-Fusion Session / *Session ITER-Fusion* (WE-P4)	Atlantic Veterinary, Room/salle B
14h15 - 17h15	Theory II / *Théorie II* (WE-P5)	Atlantic Veterinary, Room/salle C
14h15 - 15h30	Frontiers in Medical and Biological Physics / *Frontières en physique médicale et biologique* (WE-P6)	Atlantic Veterinary, Room/salle A
17h00 - 18h30	**CAP Council Meeting (New and Old) / *Réunion du Conseil de l'ACP (nouveau et ancien)***	ITEC Teletheatre

DETAILED CONGRESS SUMMARY
PROGRAMME DÉTAILLÉ DU CONGRÈS

(SEE PG. 20 FOR DESCRIPTION OF CODES-ABBREVIATIONS / VOIR PG. 20 POUR UNE DESCRIPTION DES CODES-ABBRÉVIATIONS)
(ABSTRACTS START ON PAGE 50 / LES RÉSUMÉS COMMENCENT À LA PAGE 50)

Saturday, June 7, 2003 / *Samedi, le 7 juin*

09h00	CAP Executive Meeting / Réunion de l'Exécutif de l'ACP	ITEC Teletheatre
14h00	CAP Council Meeting (Old and New) / Réunion du Conseil de l'ACP (ancien et nouveau)	ITEC Teletheatre
19h30	Public Lecture / Conférence publique Dr. Marc Garneau, President, Canadian Space Agency (see page 14 for bio and abstract) *"The Space Between - From the Great, White North to the Final Frontier / Du Grand Nord à la frontière ultime"* *(voir page 14 pour le bio et résumé)*	Chi-Wan Young Sports Centre

Sunday, June 8, 2003 / *Dimanche, le 8 juin*

TIME HEURE	Room / Salle DS 121	Room / Salle KC-104	Other Rooms/Autres salles
	SU-A1 (DCMMP/DPMCM) **LARGE SCALE INITIATIVES IN CONDENSED MATTER PHYSICS / *INITIATIVES D'ENVERGURE EN MATIÈRE CONDENSÉE*** Chair: T. Timusk, McMaster Univ.	**SU-A2 (DASP/DPAE)** **OBSERVING THE IONOSPHERE AND MAGNETOSPHERE FROM GROUND ANDSPACE - CANOPUS AND BEYOND / *OBSERVATION DE L'IONOSPHÈRE ET DE LA MAGNÉTOSPHÈRE A PARTIR DU SOL – CANOPUS ET AU DÉLÀ*** Chair: R. Rankin, Univ. of Alberta	**08h00-12h00 Faculty Lounge** Physics Department Heads/Chairs Workshop / *Réunion pour les chefs des départements de physique*
09h30	**KIEFL, Robert** CIAR & UBC *Beta-Detected NMR with Low Energy Spin Polarized Radioactive Nuclei and its Applications in Condensed Matter* (see SU-A1-1)		**09h00-12h00 ITEC Teletheatre** IPP Board of Trustees Meeting *Réunion du conseil d'administration de l'IPP*
10h00	↓	**SAMSON, John** U. Alberta *Major Scientific Results From the CANOPUS Experiment* (see SU-A2-1)	
10h05	**MOEWES, Alexander** U. Sask *Soft X-Ray Spectroscopy at the Canadian Light Source: A Powerful Tool for Condensed Matter Physics* (see SU-A1-2)	↓	
10h30	↓	**DONOVAN, Eric** U. Calgary *Energy Dependence of the Latitude of The Ion Isotropy Boundary* (see SU-A2-2)	
10h40	Coffee break / Pause café	↓	
11h00	↓	Coffee break / Pause café	
11h10	**GAULIN, Bruce** McMaster U. *Canadian Participation at the Spallation Neutron Source* (see SU-A1-3)	↓	
11h15	↓	**McWILLIAMS, Kathryn** U. Sask. *SuperDARN - The Super Dual Auroral Radar Network* (see SU-A2-3)	
11h45	**GRUTTER, Peter** McGill U. *The NSERC Nano Innovation Platform: an Update* (see SU-A1-4)	**R. Rankin (c)** U. Alberta *Auroral Arc Theory and Modeling: a CANOPUS Case Study* (see SU-A2-4)	
12h00	↓	**J.S. Murphree (c)** U. Calgary *The Ravens of Norse Mythology: An Auroral Imaging Mission for ILWS* (see SU-A2-4)	
12h15	↓	**LIU, William** CSA *Scientific Challenges of International Living With a Star* (see SU-A2-5)	

Sunday, June 8, 2003 / *Dimanche, le 8 juin* *(cont'd / suit)*

Room / Salle DS 121	Room / Salle KC-104	Other Rooms / Autres salles	TIME HEURE
Morning Session ends / Fin de la session du matin Lunch / déjeuner			**12h20**
	Morning Session ends / Fin de la session du matin Lunch / déjeuner		**12h45**
		SU-Plen-1 **Room/Salle DS 121** **Plenary Session plénière** (Brockhouse Medal winner / récipiendaire de la médaille Brockhouse) Chair: B. Joos, U. Ottawa **TAILLEFER, Louis** U. Sherbrooke *Probing New States of Matter With Heat and Sound* (See SU-Plen-1)	**13h30**
SU-P1 **(DCMMP/DPMCM)** **NEW METHODS AND NOVEL MATERIALS / *NOUVEAUX MÉTHODES ET MATÉRIAUX*** Chair: R. Kiefl, TRIUMF	**SU-P2** **(DASP/DPAE)** **OBSERVING THE ATMOSPHERE FROM GROUND AND SPACE - CANADIAN CONTRIBUTIONS AND INNOVATIONS / *OBSERVATION DE L'IONOSPHÈRE ET DE LA MAGNÉTOSPHÈRE À PARTIR DU SOL – LES CONTRIBUTIONS ET INNOVATIONS CANADIENNES*** Chair: W. Ward, UNB	↓	
WEI, John U. Toronto *Nanoscale Phase Decoherence in High-Tc Superconductors* (see SU-P1-1)	**SHEPHERD, Gordon** York U. *Canadian Contributions to International Investigations of the Atmospheric Environment: What Were They, and How Did They Come About?* (see SU-P2-1)	**Room/Salle KM 237** IPP General Meeting *Assemblée générale (IPP)* (starts at 14h30 / commence à 14h30)	**14h15**
↓	**HOCKING, Wayne K.** UWO *Applications of a World-Wide Network of Mesospheric Radars* (see SU-P2-2)		**14h45**
SAWATZKY, George UBC *Resonant Soft X Ray Scattering ; A New Tool to Study Spin Charge and Orbital Distributions* (see SU-P1-2)	↓		**14h50**
	Coffee break / Pause café		**15h15**
Coffee break / Pause café			**15h25**
↓	**LLEWELLYN, Edward J.** U. Sask. *OSIRIS - Some Highlights of Two Years Successful Operation* (see SU-P2-3)		**15h30**
GREVEN, Martin Stanford U. *Quantum versus Geometric Disorder in a Two-Dimensional Heisenberg Antiferromagnet* (see SU-P1-3)	↓		**15h55**
↓	**V.J. Hipkin** (c) U. Toronto *Canadian Contributions to the 2007 Mars Volcanic Emission and Life (MARVEL) Scout Proposal* (see SU-P2-4)		**16h00**
↓	**DRUMMOND, James R.** U. Toronto *The Atmosphere from Space - the Future of Space Measurements* (see SU-P2-5)		**16h15**
MARSIGLIO, Frank U. Alberta *How Do You Determine the Mechanism of Superconductivity* (see SU-P1-4)	↓		**16h30**
17h05 - Session ends / Fin de la session	16h45 - Session ends / Fin de la session		

Herzberg Memorial Public Lecture / Conférence publique commémmorative Herzberg **19h00**
[SU-KEY] Chi-Wan Young Sports Centre (see pg. 15 for details / voir pg. 15 pour les détails)

TIME HEURE	Other locations autres endroits	Room/salle AV-D	Room/salle AV-C	Room/salle MN-40
07h30	"Friends of CAP" Breakfast / Déjeuner des 'Ami(e)s de l'ACP' (07h00-08h20) - Faculty Lounge			
	The all-day High School Teachers Workshop, organized by the CAP's Division of Physics Education, will be held in Room DS-305 starting at 08h30 L'atélier pour les professeurs du secondaire/CEGEP, coordonnée par le Division d'enseignement de l'ACP, aura lieu dans Salle DS-304, commençant à 0h830			
09h15	**MO-Plen-1** **DS 121** Plenary Session plénière Chair: D. Jack, Concordia U. **TOENNIES, Peter** Max-Planck-Inst. *Diffraction of Matter Waves from Nanostructures: Novel Applications to Cluster and Surface Science* (MO-Plen-2)			
	↓	**MO-A1** **(DASP/DPAE)** OBSERVING THE IONOSPHERE AND MAGNETOSPHERE FROM GROUND AND SPACE - CANOPUS AND BEYOND / *OBSERVATION DE L'IONOSPHÈRE ET DE LA MAGNETOSPHÈRE À PARTIR DU SOL – CANOPUS ET AU DELÀ* Chair: J. Samson, U. Alberta	**MO-A2** **(DASP/DPAE)** OBSERVING THE ATMOSPHERE FROM GROUND AND SPACE - CANADIAN CONTRIBUTIONS AND INNOVATIONS / *OBSERVATION DE L'ATMOSPHÈRE À PARTIR DU SOL – LES CONTRIBUTIONS ET INNOVATIONS CANADIENNES* Chair: W. Ward, UNB	**MO-A3** **(DAMP / DPAM)** ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS I / *SPECTROSCOPIE ET DYNAMIQUE ATOMIQUE ET MOLÉCULAIRE I* Chair: W.-K. Liu, U. Waterloo
10h00		**MANN, Ian Robert** U. Alberta *The Role of Global Scale ULF Waves in Driving Magnetospheric Dynamics: CANOPUS and Beyond* **(MO-A1-1)**	**MCELROY, C.T.** ARQX/MSC *Ozone Measurement in Canada: From Research to Operations* **(MO-A2-1)**	**STORRY, Cody H.** Harvard U. *Antihydrogen Production and Detection* **(MO-A3-1)**
10h30		**R. Choudhary** (c) UWO *Origin of Two Types of Quasi-Periodic Backscatter as Observed With the Gadanki Radar* **(MO-A1-2)**	**BERNATH, Peter** U. Waterloo *The Atmospheric Chemistry Experiment (ACE): Overview and Status* **(MO-A2-2)**	**REDDISH, Tim** U. Windsor *Photo-Double Ionisation of D_2 and He* **(MO-A3-2)**
10h45		**J.W. Labelle** (c) U.S.A. *Review of LF/MF/HF Radio Observations at CANOPUS Observatories* **(MO-A1-3)**	↓	↓
11h00		**M. Watanabe** (c) U. Sask. *Polar Cap Bifurcation During Steady-State Northward Interplanetary Magnetic Field With $\|BY\|\sim BZ$* **(MO-A1-4)**	**C. Nowlan** (c) U.Toronto *The MAESTRO Space Instrument Model: Pre-Launch and On-Orbit Characterization* **(MO-A2-3)**	**E. Pinnington** (c) U. Alberta *M1 Transition Rate for the Coronal Green Line of Fe XIV measured with an EBIT* **(MO-A3-3)**
11h15		Coffee Break / Pause café	Coffee break / Pause café	Coffee Break / Pause café
11h30		**D. Knudsen** (c) U. Calgary *Gyro-radius-scale Density Depletions Caused by Localized Ion Heating in Space Plasmas* **(MO-A1-5)**	**D. Dufour** (c) U.Toronto *A Comparison of Simultaneous Gas Absorption Measurements with the ACE-FTS and MAESTRO Space Instruments* **(MO-A2-4)**	**R. Wehr** (c) U. Toronto *CO Lineshapes: A Comparison between Ab Initio Calculations and High-Resolution Measurements* **(MO-A3-4)**
11h45		**C. Watt** (c) U. Alberta *Kinetic Simulations of Electron Response to Shear Alfven Waves in Collisionless Plasmas* **(MO-A1-6)**	**STRONG, Kimberly** U.Toronto *Observations of Atmospheric Composition Using Balloon-Borne and Ground-Based Instruments* **(MO-A2-5)**	**Z.-D. Sun** (c) UNB *CO_2-MWSB Generation with High-J Sequence, and Hot Band CO_2 Laser Lines and Broad-Band Scan Capability* **(MO-A3-5)**
12h00		**E. Donovan** (c) U.Calgary *Dusk-Sector Pc5 Pulsation Activity Related to Magnetopause Oscillations During a High Solar Wind Speed Event* **(MO-A1-7)**	↓	**J.R. Cooper** (c) U.Calgary *The μ_5 Band of CH_3CD_3: High Resolution Spectrum and Global Three-Band Analysis* **(MO-A3-6)**
12h15		**P.T. Jayachandran** (c) UWO *Substorm Associated Changes in High-latitude Convection* **(MO-A1-8)**	**J.R. Taylor** (c) U.Toronto *Instrument Characterization and Ozone Measurements from the Ground-Based Fourier-Transform InfraRed Spectrometer at Toronto* **(MO-A2-6)**	**S. Hopkins** (c) UNB *High Resolution Laser Spectroscopy of Hafnium Monofluoride* **(MO-A3-7)**
12h30	Session ends / Fin de la session **Room/Salle DS-210** **DCMMP Business Mtg** **Ends at 13h30** **Réunion d'affaire DPMCM** **Se termine à 13h30**	Session ends / Fin de la session **Room/Salle AV-D** **DASP Business Mtg** **Ends at 13h30** **Réunion d'affaire DPAE** **Se termine à 13h30**	Session ends / Fin de la session **Room/Salle KC-128** **DTP Business Mtg** **Ends at 13h30** **Réunion d'affaire DPT** **Se termine à 13h30**	Session ends / Fin de la session **Faculty Lounge** **Past Presidents' Lunch / *Déjeuner des anciens présidents*** **(Ends at 13h30** ***Se termine à 13h30)***

Room/salle DS-121	Room/salle CS-104	Room/salle AV-A	Room/salle KC-128	TIME HEURE
				07h30
The all-day High School Teachers Workshop, organized by the CAP's Division of Physics Education, will be held in Room DS-305 starting at 08h30 L'atélier pour les professeurs du secondaire/CEGEP, coordonnée par le Division d'enseignement de l'ACP, aura lieu dans Salle DS-304, commençant à 0h830				
MO-A4 (DCMMP / DPMCM) YOUNG INVESTIGATORS IN CONDENSED MATTER ANDMATERIALS PHYSICS / *JEUNES CHERCHEURS EN MATIÈRE CONDENSÉE ET EN PHYSIQUE DES MATÉRIAUX* Chair: B. Gaulin, McMaster U.	**MO-A5 (PPD)** THE PRECISION FRONTIER / *À LA LIMITE DE LA PRÉCISION* Chair: W. Trischuk, U.Toronto	**MO-A6 (DSS)** FRONTIERS IN THEORY AND EXPERIMENT IN SURFACE SCIENCE / *LES FRONTIÈRES THÉORIQUES ET EXPÉRIMENTALES EN PHYSIQUE DES SURFACES* Chair: D. Jack, Concordia U.	**MO-A7 (DCMMP-DMBP/ DPMCM-DPMB)** BIOMATERIALS / *BIOMATÉRIAUX* Chair: A. Rutenberg, Dalhousie U.	
LE HUR, Karyn U.Sherbrooke *Revival of Kondo Physics with Nanotechnology* **(MO-A4-1)**	**MCKENNA, Janis** UBC *CP Violation in the B Meson System* **(MO-A5-1)**	**KREUZER, H.Jurgen** Dalhousie U. *Theory of Surface Processes: From Atoms to Polymers* **(MO-A6-1)**	**STERNIN, Edward** Brock U. *Recent Developments in the Measurement and Interpretation of Biomembrane Order Parameters by ^2H NMR* **(MO-A7-1)**	10h00
SAMOKHIN, Kirill Brock U. *Superconductivity in Ferromagnets* **(MO-A4-2)**	**NUMAO, Toshio** TRIUMF *Status of rare kaon decay experiments at BNL* **(MO-A5-2)**	↓	**PETERSEN, Nils O.** UWO *Molecular Domains in Membrane Systems* **(MO-A7-2)**	10h30
↓	↓	**A.J. Slavin (c)** Trent U. *Growth and oxidation of lead layers on a gold substrate using a high-stability quartz-crystal microbalance* **(MO-A6-2)**	↓	10h45
Coffee break / Pause café	Coffee break / Pause café	Coffee break / Pause café	Coffee break / Pause café	11h00
↓	**MARSHALL, Glen** TRIUMF *First Data from the TWIST Experiment* **(MO-A5-3)**	↓	↓	11h15
DAMASCELLI, Andrea UBC *Probing the Electronic Structure of Complex Systems by State-of-the-Art ARPES* **(MO-A4-3)**	↓	**G. Ross (c)** INRS-EMT *Modification of Wetting Properties of SiOx Surfaces by Ar Implantation* **(MO-A6-3)**	**J. Katsaras (c)** NRC *The Relationship Between the Unbinding and Main Transition Temperatures in Phospholipid Bilayers is a Universal Constant* **(MO-A7-3)**	11h30
↓	**M. Donkers (c)** Carleton U. *Determination of alpha$_s$ using Jet Rates at LEP2* **(MO-A5-4)**	**I. Mahmoud (c)** MUN *An Examination of the Surface-Pressure Isotherms in End-Tethered Polymer Layers* **(MO-A6-4)**	**MORROW, Michael R.** MUN *Pressure-Induced Ordering in Lipid Bilayers* **(MO-A7-4)**	11h45
WORTIS, Rachel Trent U. *Nuclear Magnetic Resonance in the Vortex State of Cuprate Superconductors* **(MO-A4-4)**	**A. Datta (c)** U.Toronto *T-Violation in B decays* **(MO-A5-5)**	**K.M. Poduska (c)** York U. *Characterizing Ultrathin Electrodeposits in Solution: Linking Morphology and Magnetic Properties* **(MO-A6-5)**	↓	12h00
↓	**A. Warburton (c)** McGill U. *Measurement of the CKM Matrix Element V_{ub} using the CLEO Detector* **(MO-A5-6)**	**D. Jack (c)** Concordia U. *Structures of H2 layers on MgO(001)* **(MO-A6-6)**	**M.-P. Nieh (c)** NRC *Spontaneous Formation of Monodispersed Unilamellar Vesicles Suitable as Carriers for Drugs and Bio-Molecules* **(MO-A7-5)**	12h15
Session ends / Fin de la session	**C. Hearty (c)** UBC *Search for $B \to J/\psi$ Baryon Antibaryon* **(MO-A5-7)**	Session ends / Fin de la session	Session ends / Fin de la session	12h30

12h45

13h00

TIME HEURE	Other Locations Autres endroits	Room/salle AV-D	Room/salle AV-C	Room/salle MN-40	Room/salle DS-121	Room/salle KC-128
13h30	**MO-Plen-3 DS-121** Plenary Session plénière (Herzberg Medal winner - récipiendaire de la médaille Herzberg) Chair: W.J. McDonald, UofA **LUKE, Michael** U.Toronto *The Heavy Quark Expansion: Recent Results* (MO-Plen-3)					
		MO-P1 (DASP/DPAE) OBSERVING THE IONOSPHERE AND MAGNETOSPHERE FROM GROUND AND SPACE - CANOPUS AND BEYOND / OBSERVATION DE L'IONOSPHERE ET DE LA MAGNETOSPHERE À PARTIR DU SOL – CANOPUS ET AU DELÀ Chair: M.Connors, Athabasca	**MO-P2 (DASP/DPAE)** OBSERVING THE ATMOSPHERE FROM GROUND AND SPACE - CANADIAN CONTRIBUTIONS AND INNOVATIONS / OBSERVATION DE L'ATMOSPHERE À PARTIR DU SOL – LES CONTRIBUTIONS ET INNOVATIONS CANADIENNES Chair: W. Ward, UNB	**MO-P3 (DAMP/DPAM)** ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS II / SPECTROSCOPIE ET DYNAMIQUE ATOMIQUE ET MOLÉCULAIRE II Chair: A. Madej, NRC	**MO-P4 (DCMMP/DPMCM)** MEMORIAL SESSION HONOURING JURGEN FRANCK / SESSION COMMÉMORATIVE HONORANT JURGEN FRANCK Chair: F. Marsiglio, U.Alberta	**MO-P5 (DIMP-DMBP/ DPIM-DPMB)** BIOMEDICAL AND BIOLOGICAL DIAGNOSTIC INSTRUMENTATION METHODOLOGIES / METHODOLOGIE ET INSTRUMENTATION DE DIAGNOSTIQUE BIOMÉDICAL ET BIOLOGIQUE Chair: W. Whelan, Ryerson
14h15		**YAU, Andrew** U. Calgary Ion Outflow and The Enhanced Polar Outflow Probe (e-POP) Project **(MO-P1-1)**	**MCDADE, Ian** York U. *SWIFT - The Stratospheric Wind Interferometer For Transport studies* **(MO-P2-1)**	**CZAJKOWSKI, Andrzej** NRC *Development and Study of a 1.5 micron Optical Frequency Standard at National Research Council* **(MO-P3-1)**	**LAWRIE, David** U. Illinois *Isotope Effects in Superconductors and Oxide Materials* **(MO-P4-1)**	**MACKENZIE, Hugh A.** Heriot Watt U. *Applications of Photoacoustic Spectroscopy to the Life Sciences* **(MO-P5-1)**
14h30		↓	↓	↓	↓	↓
14h45		**J. Burchill (c)** U.Calgary *Core Ion Energization and Associated Plasma Waves in the Auroral Ionosphere* **(MO-P1-2)**	**DUCK, Thomas J.** Dalhousie U. *Lidar Measurements in Canada - Past, Present, and Future Prospects* **(MO-P2-2)**	**TOKARYK, Dennis** UNB *Spectroscopy of Carbon-Bearing Radicals: from the Interstellar Medium to the Hydrogen Fuel Cell* **(MO-P3-2)**	**CARBOTTE, Jules** McMaster U. *Superconductivity Past and Future* **(MO-P4-2)**	**TERAZIMA, Masahide** Kyoto U. *A Novel Method to Study Structural and Energy Dynamics of Proteins From a View Point of Time-Resolved Thermodynamics* **(MO-P5-2)**
15h00		**F.R. Fenrich (c)** U. Alberta *Investigation of Lobe Convection with SuperDARN HF Radar and Global MHD Simulation* **(MO-P1-3)**	↓	↓	↓	↓
15h15		**K. Kabin (c)** U. Alberta *Open-Closed Field Line Boundary in a Global MHD Simulation of Earth Magnetosphere: A Comparison With Ground-Based and Satellite Measurements* **(MO-P1-4)**	**F. Nichitiu (c)** U. Toronto *The South Atlantic Anomaly as Seen by the MOPITT Instrument* **(MO-P2-3)**	**R.A. Holt (c)** UWO *Beam-Laser Oscillator-Strength Measurements in Sm II* **(MO-P3-3)**	Coffee break / Pause café	Coffee break / Pause café
15h30		Coffee break / Pause café	Coffee break / Pause café	Coffee Break / Pause café	↓	↓
15h45		**V.-G. Winter (c)** RMC *The Importance of the Hall Current in the Self-Consistent Modeling of Small-Scale Auroral Structures* **(MO-P1-5)**	**ARGALL, P. Stephen** UWO *Development of the Gravity Wave Imager (GWIM) Mission at University of Western Ontario* **(MO-P2-4)**	**Z. Abusara (c)** U. Calgary *Infrared diode laser spectroscopy of CCO radical: The v_3 Band of the Ground Electronic State* **(MO-P3-4)**	**TIMUSK, Tom** McMaster U. *The Two Pseudogaps in High Temperature Superconductors* **(MO-P4-3)**	**FLEMING, David E.B.** Mount Allison U. *Detecting Lead in Bone Using X-ray Fluorescence* **(MO-P5-3)**

S.H. Robertson (c) SLAC — 12h45
A search for $B \to K \nu\bar{\nu}$ **(MO-A5-8)**

Session ends / Fin de la session — 13h00

Room/salle CS-104	Room/salle AV-B	Room/salle MN-120	Room/salle MN-220	Room/salle KC-104	Room/salle AV-A	TIME HEURE
						13h30
MO-P6 (PPD) THE ENERGY FRONTIER / *LA FRONTIÈRE ÉNERGÉTIQUE* Chair: F Corriveau, McGill	**MO-P7 (DNP/DPN)** RADIOACTIVE BEAM SCIENCE / *LA SCIENCE DES FAISCEAUX RADIOACTIFS* Chair: G Ball, TRIUMF	**MO-P8 (DTP/DPT)** GRAVITY / *GRAVITÉ* Chair: M.Paranjape, U. Montreal	**MO-P9 (DPP)** PLASMA PHYSICS / *LA PHYSIQUE DES PLASMAS* Chair: M. Nantel, PRO	**MO-P10 (DCMMP/DPMCM)** SEMICONDUCTOR PHYSICS / *PHYSIQUE DES SEMI-CONDUCTEURS* Chair: R. Fletcher, Queen's	**MO-P11 (DSS)** FRONTIERS IN SCANNING PROBE MICROSCOPY / *FRONTIÈRES DE LA MICROSCOPIE PAR SONDE À BALAYAGE* Chair: D. Jack, Concordia U	
MARTIN, John U. Toronto *News and Results from ZEUS at HERA* **(MO-P6-1)**	**WALKER, Philip** TRIUMF *Nuclear Isomers: Energy and Spin* **(MO-P7-1)**	**BURGESS, Cliff** McGill U. *Are Inflationary Predictions Sensitive to Very High Energy Physics?* **(MO-P8-1)**	**CZEREMUSZKIN, Grzegorz** École Polytechnique *Plasma Enhanced Chemical Vapor Deposition of Barrier Coatings on Plastics* **(MO-P9-1)**	**O. Moutanabbir (c)** INRS *Arrays of Sub-100-nm Blisters and Craters Produced by Low keV Ion Implantation* **(MO-P10-1)**	**LOPINSKI, Gregory** NRC *Molecular Electronics on Silicon Surfaces* **(MO-P11-1)**	14h15
↓	↓	↓	↓	**W. Sheng (c)** NRC *Electronic Structure of Intermixed Self-Assembled InGaAs/GaAs Quantum Dots by the Effective Bond-Orbital Method* **(MO-P10-2)**	↓	14h30
KANAYA, Naoko U. Victoria *Physics Beyond the Standard Model at the LHC experiments* **(MO-P6-2)**	**HACKMAN, Greg** TRIUMF *A New Era of High Resolution Gamma-Ray Spectroscopy at TRIUMF-ISAC* **(MO-P7-2)**	**K. Martel (c)** U. Guelph *Propagation of Gravitational Waves in the Background of a Kerr Black Hole* **(MO-P8-2)**	**TYSHETSKIY, Yuriy** U. Sask. *Anomalous and Nonlinear Effects in Inductively Coupled Plasmas* **(MO-P9-2)**	**M. Florescu (c)** NRC *Spin Relaxation in Lateral Quantum Dots* **(MO-P10-3)**	**A. Touhami (c)** Dalhousie U. *Aggregation of Microbial Cells: Direct Measurement of Discrete Lectin-Carbohydrate Interactions* **(MO-P11-2)**	14h45
↓	↓	Coffee break / Pause café	↓	Coffee break / Pause café	**S.M. Tadayyon (c)** UWO *CuPc Buffer Layer Role in OLED Performance: A Band Engineering and Interface Properties Study* **(MO-P11-3)**	15h00
Coffee break / Pause café	**G.F. Grinyer (c)** U. Guelph **The Half-Life of ^{176}Lu (MO-P7-3)**	↓	Coffee break / Pause café	↓	Coffee break / Pause café	15h15
TRISCHUK, William U. Toronto *The CDF-II Experiment at Fermilab* **(MO-P6-3)**	Coffee break / Pause café	**GEGENBERG, Jack** UNB *Using Gravity to Understand Topology* **(MO-P8-3)**	↓	**S.J. Cheng (c)** NRC *Excitonic Artificial Atoms in Strong Magnetic Fields* (MO-P10-4)	↓	15h30
↓	↓	↓	**J. McMahon (c)** York U *The Interaction Between Cylinders and a Drifting Collisionless Plasma containing Two Ion Species* **(MO-P9-3)**	**A. Botha (c)** UWO *Comparison of Electron-Spin Polarisation From Bulk and Structural Asymmetry in Type-II Heterostructures* **(MO-P10-5)**	**J.-S. McEwen (c)** Dalhousie U. *Adsorption and Desorption of CO/Pt(111): A Comprehensive Analysis* **(MO-P11-4)**	15h45

TIME HEURE	Other Locations Autres endroits	Room/salle AV-D	Room/salle AV-C	Room/salle MN-40	Room/salle DS-121	Room/salle KC-128
16h00		G.J. Sofko (c) U. Sask. *Dispersed Ions in the Plasma at High - an Auroral Source?* (MC-P1-6)	↓	C. Linton (c) UNB *Laser Spectroscopy of Dysprosium Monochloride* (MC-P3-5)	↓	↓
16h15		M. Connors (c) Athabasca U. *Relation of Convection Bays, Poleward Border Intensifications and Pc 6 Disturbances* (MC-P1-7)	HOCKING, Wayne K. UWO *The Role of Canadian Radars in Middle Atmosphere Studies* (MC-P2-5)	N. Moazen-Ahmadi (c) U. Calgary *A Frequency Analysis of the A Band of Experiment and Ab Initio Calculations* (MC-P3-6)	GLYDE, Henry R. U. Delaware *Elementary Excitations, Bose-Eins ein Condensation and Super-Fluidity in Liquid 4He* (MC-P4-4)	PEJOVIC-MILIC, Ana Ryerson U. *Quantifying Strontium and Aluminum in Human Bone* (MC-P5-4)
16h30		K.F. Tapping (c) DRAO, NRCan *The Future of Solar Radio Monitoring in Space Weather Forecasting* (MC-P1-8)	↓	A. Adam (c) UNB *Analysis of the Hyperfine Structure in the [20.6]5 - X4 Transition of Cobalt Monofluoride* (MC-P3-7)	↓	↓
16h45		D. Boteler (c) DRAO, NRCan *March 13, 1989: The Night When Space Physics Came Down to Earth* (MC-P1-9)	W.E. Ward (c) UNB *Applications of Spectral Imaging with a Michelson Interferometer* (MC-P2-6)	Session ends Fin de la session	Session ends Fin de la session	I. Mastikhin (c) UNB *1D Imaging With Portable Surface NMR* (MC-P5-5)
17h00		Session ends Fin de la session	Session ends Fin de la session			Session ends Fin de la session

17h00 - Best Student Paper Competition Compétition meilleur communication ---- Room Salle AV-B

17h00 (DSS)	17h15 (DCMMP)	17h30 (DCP)	17h45 (DNP)
yad Mahmoud, MUN	Michael D. Fleischauer, Dalhousie U.	Steven Harbour, Laval U.	Jason A. Clark, U. Manitoba
An Examination of the Surface-Pressure Isotherms in End-Tethered Polymer Layers (MC-A6-4)	*Combinatorial Investigations of the Si-Al-Mn Ternary System* (WE-A2-4)	*Diffraction Properties of Anisotropic Gratings Made From Near Infrared Sensitive Liquid Crystal Photopolymerizable Materials - Theoretical Modelling* (TU A10-7)	*Stellar Measurements Using the Canadian Penning Trap Mass Spectrometer* (WE-A7-5)

17h30 Room/Salle MN-111	Physics in Canada Editorial Board Meeting *Réunion de la Comité de rédaction de La Physique au Canada*

18h00 Faculty Lounge	CJP Editorial Board Meeting *Réunion de la Comité de rédaction de la RCP*

19h00 Poster Session, with Beer — Chi-Wan Young Sports Centre

Atmospheric and Space Physics / *Physique atmosphérique et de l'espace*	Atomic and Molecular Physics / *Physique atomique et moléculaire*	Condensed Matter and Materials Physics / *Physique des matières condensée et matériaux*	Medical and Biological Physics / *Physique médicale et biologique*	Nuclear Physics / *Physique nucléaire*	Optics and Photonics / *Optique et photonique*
MC-PCS-1 - 21	MC-PCS-22 - 37	MC-PCS-38 - 72	MC-PCS-73	MC-PCS-74 - 75	MC-PCS-76 - 88

Room/salle CS-104	Room/salle AV-B	Room/salle MN-120	Room/salle MN-220	Room/salle KC-104	Room/salle AV-A	TIME HEURE
P.-H. Beauchemin (c) McGill U. *Search for Graviscalar at LHC* **(MC-P6-3)**	**SHIMODA, Tadashi** Osaka U. *Novel Structure of a Neutron Rich Nucleus 11Be Proved by Spin-Polarized 11Li Beam at TRIUMF-SAC* **(MC-P7-4)**	**MANN, Robert** U. Waterloo *Chaos in 3-body Relativistic Self-Gravitating Systems* **(MC-P8-4)**	J.G. Laframboise (c) York U. *RF Effects on BIDED PUSH-CAP Floating Voltages* **(MC-P9-4)**	M. Singh (c) UWO *A Study of the Variable Range Hopping Mechanism in Nanoscale DNA Crystals* **(MC-P10-6)**	**GREEN, John Bruce** U. Alberta *Developments of Atomic Force Microscopy for Enhanced Chemical and Biological Discrimination* **(MC-P11-5)**	16h00
I.E. Vollrath (c) U. Toronto *Improving W Boson Mass Templates for Run II at CDF* **(MC-P6-4)**	↓	↓	**Session ends Fin de la session**	**Session ends Fin de la session**	↓	16h15
J.F. Arguin (c) U. Toronto *Prospects for Measuring the Top Quark Mass in CDF Run II* **(MC-P6-5)**	**PEARSON, Matthew** TRIUMF *Nuclear Physics with Atomic Tools at ISAC* **(MC-P7-5)**	P. Grenier (c) McGill U. *Scalar Fields Generating the Acceleration of the Universe* **(MC-P8-5)**			**YIP, Christopher** U. Toronto *Protein-Based Supramolecular Architectures: Controlling Self-Assembly at Molecular Interfaces* **(MC-P11-6)**	16h30
P. Savard (c) U. Toronto *Top Quark Production Cross Section Results from CDF* **(MC-P6-6)**	↓	S.R. Valluri (c) UWO *Spindown of a Periodic Gravitational Wave Pulsar Signal and the Zak-Gelfand Integral Transform* **(MC-P8-6)**			↓	16h45
G. Trayling (c) U. Windsor *W and Z Masses in a Geometric Approach to the Left-right Symmetric Model* **(MC-P6-7)**	**Session ends Fin de la session**	S. Das (c) UNB *Asymptotically Anti-de Sitter Black Holes and the Holographic Hypothesis* **(MC-P8-7)**			**MC-P11 Session ends Fin de la session MC-P11**	17h00
MC-P6 Session ends at 17h15 Fin de la session MC-P6 à 17h15		**MC-P8 Session ends at 17h15 Fin de la sessionh MC-P8 à 17h15**			**MC-P12 (CEW P/CEFEP)** **BECOMING LEADERS: CAREERS FOR WOMEN IN SCIENCE** ***DEVENIR DES PATRONS : DES CARRIERES POUR FEMMES EN SCIENCE*** Chair: F. Sken SFU	
					EMERSON, Carolyn MUN *Becoming Leaders: Career Success for Women in Science* **(MC-P12-1)**	

17h00 - Best Student Paper Competition Compétition meilleur communication ---- Room Salle AV-B

18h00 (DIMP)
Pierre Losier, NRS
Propriétés électrochromiques des nanocouches de WO_3 et de V_2O_5 déposées par évaporation spontanée <<Flash evaporation>> **(TC-P4-4)**

18h15 (DCMP)
Farhad Fazileh, Queen's U.
Examining the Metal-to-Insulator Transition in $U_{1-x}Al_xTi_{2-y}O_4$ in a Search for Evidence of Strong Electronic Correlations **(TC-A4-3)**

18h30 (DAMP)
Matthew Weel, York U.
Observation of Ground State Ramsey Fringes **(MC-POS-25)**

18h45 (DNP)
Geoff F. Grinyer, U. Guelph
The Half-Life of ^{71}Ga **(MC-P7-3)**

19h00 Session d'affiches, avec la bière — Chi-Wan Young Sports Centre

Particle Physics / *Physique des particules*	Physics Education / *L'enseignement de la physique*	Plasma Physics / *Physique des plasmas*	Theoretical Physics / *Physique théorique*	Industrial and Applied Physics *Physique industrielle et appliquée*
MC-POS-89	MO-POS-90	MC-POS-91 - 97	MC-POS-98 - 101	MC-POS-102 - 107

TIME HEURE	Other Locations Autres endroits	Room/salle KM-237	Room/salle MN-40	Room/salle KC-104	Room/salle AV-B	Room/salle AV-C
07h00	Meeting of the Canadian National UPAP Liaison Committee (07h00-09h00) - Faculty Lounge					
08h30	**TU-Plen-1 DS 121** Plenary Session plénière (CAP/CRM Medal winner récipiendaire de la médaille ACP/CRM) Chair: M. Morrow, MUN CHOPTUIK, Matthew UBC *Critical Phenomena in Gravitational Collapse* (TU-Plen-1)					
09h15	**TU-Plen-2 DS 121** Plenary Session plénière Chair: M. Sawatzky UBC ASHCROFT, Neil Cornell U. *Classical and Quantal Order in the Light Elements at High Densities* (TU-Plen-2)					
	TU-A1 (DPE/DEP) INNOVATIONS IN PHYSICS EDUCATION / *INNOVATIONS EN ENSEIGNEMENT DE LA PHYSIQUE* Chair: R. Hawkes, Mount A. ROOM/SALLE AV-A	**TU-A2 (DAMP/DPAM)** COOLING AND TRAPPING OF ATOMS AND MOLECULES / *REFROIDIR ET PIÉGER LES ATOMES ET LES MOLÉCULES* Chair: K. King, M. Master U.	**TU-A3 (DCMMP/DPMCM)** SOFT MATTER PHYSICS / *PHYSIQUE DE LA MATIÈRE MOLLE* Chair: J. Bechhoefer SFU	**TU-A4 (DCMMP/DPMCM)** SUPERCONDUCTIVITY, MAGNETIC AND CORRELATED ELECTRONIC SYSTEMS / *SUPRACONDUCTIVITÉ, SYSTÈMES ÉLECTRONIQUES CORRÉLÉS ET MAGNÉTIQUES* Chair: J. Wei, U. Toronto	**TU-A5 (DMP/DPM)** INSTRUMENTAL TECHNIQUES, MICROSCOPY AND SENSORS / *TECHNIQUES INSTRUMENTALES, MICROSCOPIE ET SENSEURS* Chair: A. Mandelis, U.Toronto	**TU-A6 (PPD)** INSTRUMENTATION AND THE FUTURE OF PARTICLE PHYSICS / *L'INSTRUMENTATION ET LE FUTUR DE LA PHYSIQUE DES PARTICULES* Chair: J. McKenna, UBC
10h00	**LAUE, Hans** U. Calgary *Concept Teaching and Learning with MAP* (TU-A1-1)	**FEDER, David** U. Calgary *Rotating Bose Einstein Condensates in Optical Lattices* (TU-A2-1)	**C. Bracher (c)** Dalhousie U. *The Persistent Random Walk in Two Dimensions* (TU-A3-1)	**B.W. Southern (c)** U. Manitoba *Off Equilibrium Study of the Fluctuation-Dissipation Relation in the Easy-Axis Heisenberg Antiferromagnet on the Pyrochlore Lattice* (TU-A4-1)	**CHRISTOFIDES, Constantinos** U. Cyprus *Detection of Hydrogen via Modulated Thermoreflectance* (TU-A5-1)	**KHAKZAD, Mohsen** Carleton U. *ATLAS Experiment and the Canadian Contribution* (TU-A6-1)
10h15	↓	↓	**J.R. Dutcher (c)** U. Guelph *Radial Thickness Profiles of Spincoated Polymer Wedge Flmsy* (TU-A3-2)	**S.H. Curnoe (c)** MUN *Quadrupolar Interactions in Pr-Filled Skutterudites* (TU-A4-2)	↓	↓
10h30	**HUNT, James** U. Guelph *On line Learning in Physics Courses and Thoughts About Aiding Problem Solving* (TU-A1-2)	**THYWISSEN, Joseph H.** U. Toronto *One-Dimensional Phase Fluctuations in "Quasi" Bose Einstein Condensates* (TU-A2-2)	**Z. Chen (c)** Dalhousie U. *The Importance of Polymer Design in Lithium Ion Battery Electrodes* (TU-A3-3)	Coffee break Pause café	**H. Hébert (c)** NRC *Non-Contact Thickness Measurement of 10-50 µm Metallic Coatings using High Frequency Ultrasounds Generated by an Ultrafast Laser* (TU-A5-2)	**CORRIVEAU, François** McGill U. *Report on the Linear Collider* (TU-A6-2)
10h45	↓	↓	**J.R. Dutcher (c)** U. Guelph *Investigation of Hole Growth in Freely-Standing Polymer Films* (TU-A3-4)	↓	**B. Newling (c)** UNB *Rapid Magnetic Resonance Imaging of Turbulent Gas Flow* (TU-A5-3)	↓
11h00	Coffee break Pause café	Coffee Break Pause café	Coffee break Pause café	**F. Razavieh (c)** Queen's U. *Examining the Metal-to-Insulator Transition in $Li_{x+y}Al_yTi_{2-y}O_4$ in a Search for Evidence of Strong Electronic Correlations* (TU-A4-3)	Coffee break Pause café	Coffee break Pause café
11h15	**J. Earnshaw** Trent U. *Teaching Physics to Future Elementary Teachers* (TU-A1-3)	↓	↓	**K.J.E. Vos (c)** U. Lethbridge *The Formation of Stripes and the Enhancement of Pairing in the Extended t-J Model* (TU-A4-4)	↓	↓

Room/salle CS-104	Room/salle AV-D	Room/salle KM-211	Room/salle MN-220	Room/salle DS-121	Room/salle MN-340	TIME HEURE
Réunion du comité de liaison national Canadien (IUPAP) (07h00-09h00) - Faculty Lounge						07h00
						08h30
						09h15
TU-A7 (DPP) **LASER PLASMAS / *PLASMAS DES LASERS*** Chair: R. Marchand, U.Alberta	**TU-A8 (DTP/DPT)** **QUANTUM THEORY *THÉORIE QUANTIQUE*** Chair: R. Kobes, U.Winnipeg	**TU-A9 (DNP/DPN)** **HEAVY IONS AND NUCLEAR STRUCTURE *IONS LOURDS ET STRUCTURE NUCLÉAIRE*** Chair: J. Tarrette, McGill U.	**TU-A10 (DOP)** **QUANTUM OPTICS AND PHOTONIC DEVICES / *OPTIQUE QUANTIQUE ET DISPOSITIFS PHOTONIQUES*** Chair: M. Duguay, U.Laval	**TU-A11 (DMBP/DPMB)** **IMAGING BLOOD FLOWS IN TISSUES *IMAGERIE DE LA CIRCULATION SANGUINE DANS LES TISSUS*** Chair: A. Vitkin, UC	**TU-A12 (DIAP)** **ACOUSTO AND OPTICAL APPLIED PHYSICS / *PHYSIQUE APPLIQUÉE EN ACOUSTIQUE ET OPTIQUE*** Chair: R. Maev, U.Windsor G. Beer, U.Victoria	
NANTEL, Marc PRO *Pulsetrain-Burst Laser-Matter Interactions in Solids and Tissues* **(TU-A7-1)**	**POPPITZ, Erich** U. Toronto *Issues in Deconstruction and Lattice Supersymmetry* **(TU-A8-1)**	**ROY, René** U. Laval *Time Scale in Heavy Ion Collisions at Intermediate Energy* **(TU-A9-1)**	**LUNDEEN, Jeffrey** U. Toronto *Playing Games with Quantum Information: Experiments with Photons and Laser-Cooled Atoms* **(TU-A10-1)**	**DEKEMP, Robert** U. Ottawa Heart Institute *Absolute and Relative Flow Imaging with PET* **(TU-A11-1)**	**MAEV, Roman** U. Windsor *Recent Development in Quantitative Acoustic Microscopy Methods* **(TU-A12-1)**	10h00
↓	↓	↓	↓	↓	↓	10h15
R. Fedosejevs U. Alberta *Investigation of Pressure and Energy Dependence of Emission Intensity in Femtosecond LIBS* **(TU-A7-2)**	**I. Ivanovic (c)** Carleton U. *A Visualization of a Two Qubit Entangled and Disentangled States Via Unbiased Projector Bases* **(TU-A8-2)**	**F. Grenier (c)** U. Laval *Neural Network Applied to Heavy Ions Collisions at Intermediate Energies* **(TU-A9-2)**	**M. Korkusinski (c)** NRC *Optical Detection of Aharonov-Bohm Oscillations of a Single Electron on a Quantum Ring* **(TU-A10-2)**	**LEE, Ting-Yim** Lawson Health Research Inst. *Measurement of Tissue Perfusion with CT* **(TU-A11-2)**	**ZEDEL, Len** MUN *High Frequency Wind Generated Sound in the Ocean* **(TU-A12-2)**	10h30
T.W. Johnston (c) NRS-EMT *Propagating Acoustic Structure with Trapped Electrons) — A New Phenomenon in Plasma Physics* **(TU-A7-3)**	Coffee break / Pause café	**A. Vallée (c)** U. Laval *Effets du Terme de Symétrie sur le Col de Réaction Lors de Collisions D'ions Lourds aux Énergies Intermédiaires* **(TU-A9-3)**	**H.M. van Driel (c)** U. Toronto *Quantum Interference Injection and Control of Transient Spin Current Grating in GaAs* **(TU-A10-3)**	↓	↓	10h45
Coffee break / Pause café	↓	Coffee Break / Pause café	Coffee break / Pause café	Coffee break / Pause café	Coffee break / Pause café	11h00
↓	**MACKENZIE, Richard** U. Montréal *Interaction Between Vortices in Models With Two Order Parameters* **(TU-A8-3)**	↓	**BRUNET, François** NRC/U. Laval *Ytterbium-Doped Fiber Lasers for Frequency Conversion Applications* **(TU-A10-4)**	**RUTT, Brian K.** Robarts Research Inst. *Cardiovascular MR* **(TU-A11-3)**	↓	11h45

TIME HEURE	Other Locations Autres endroits	Room/salle KM-237	Room/salle MN 40	Room/salle KC-104	Room/salle AV-B	Room/salle AV-C
11h30	**HAWKES, Robert** Mount Allison U. *Learning Physics by Experiencing Physics* **(TU-A1-4)**	**A.A. Madej (c)** NRC *Toward the Optical Atomic Clock: Hertz Level Measurements of the Strontium Ion Frequency Standard* **(TU-A2-3)**	**B. Jones (c)** U. Ottawa *Reversible Gelation in Polymer Melts with van der Waals Interactions* **(TU-A3-5)**	**V. Sergienko (c)** MUN *Structural Order Parameter and Elastic Constants of the Pyrochlore Superconductor $Cd_2Re_2O_7$* **(TU-A4-5)**	**Z.-F. Liu (c)** UNB *User-Friendly Computer Interface and Dual-channel Balanced Detector for External Cavity Tunable Diode Laser Spectrometer* **(TU-A5-4)**	**K. NAKA, Akira** TRIUMF *JHF-Super K Long Baseline Neutrino Oscillation Project* **(TU-A6-3)**
11h45	↓	**T.J. Harmon (c)** U. Calgary *Instability Heating of Sympathetically Cooled Ions in a Linear Paul Trap* **(TU-A2-4)**	**A.A. Tetervak (c)** LWO *Continuous Model of Mesh Growth in the Presence of Kinetic Inhibitors* **(TU-A3-6)**	**A.D. Beath (c)** McGill U. *Phase Diagrams of Site Frustrated Heisenberg Spin Glass Models* **(TU-A4-6)**	**J. Seabrook (c)** UNB *Trace Gas Detection Using COS Integrated Cavity Output Spectroscopy* **(TU-A5-5)**	↓
12h00	**M. Connors (c)** Athabasca U. *Successes in Distance Education Physics at Athabasca University* **(TU-A1-5)**	**S.C. Ross (c)** UNB *Diatomic Molecules in a Strong External Field* **(TU-A2-5)**	**J.L. Huber (c)** LWO *Modifying Wax Crystallization Behaviour with Polymeric Inhibitors* **(TU-A3-7)**	Session ends Fin de la session	**J.G. Cormier (c)** NIST *Prospects for Mid-Infrared CRDS* **(TU-A5-6)**	**S. Menary (c)** York U. *The Status of KaNOE: Tenora Off-axis NuMu Oscillation Experiment* **(TU-A6-4)**
12h15	**W.J. Slater (c)** Malaspina U. College *Preparation by Students for First-Year Physics Course* **(TU-A1-4)**	Session ends Fin de la session	**L. Livadaru (c)** Dalhousie U. *Confinement of a Polymer Chain in a Tube* **(TU-A3-8)**		Session ends Fin de la session	**D. Karlen (c)** U. Victoria *Development of a Time Projection Chamber with Gas Electron Multiplier Readout* **(TU-A6-5)**
12h30	Session ends Fin de la session Room/Salle AV-A **DPE Business Mtg** **Ends at 13h30** **Réunion d'affairs DEP** **Se termine à 13h30**	**DAMP Business Mtg** **Ends at 13h30** **Réunion d'affairs DPAM** **Se termine à 13h30**	Session ends Fin de la session	Room/Salle DS-2710 **DMBP Business Mtg** **Ends at 13h30** **Réunion d'affairs DPMB** **Se termine à 13h30**		Session ends Fin de la session **PPD Business Mtg** **Ends at 13h30** **Réunion d'affairs PPD** **Se termine à 13h30**
12h45						

TIME HEURE	Room/salle AV-A	Room/salle AV-B	Room/salle KC-104	Room/salle MN-40
13h30				
	TU-P1 (DPE DPE) **INNOVATIONS IN PHYSICS EDUCATION II** / ***INNOVATIONS EN ENSEIGNEMENT DE LA PHYSIQUE II*** Chair: D. Hunter, St.F-X	**TU-P2 (DASP DPAE)** **OBSERVING THE IONOSPHERE AND MAGNETOSPHERE FROM GROUND AND SPACE - CANOPUS AND BEYOND** / ***OBSERVATION DE L'IONOSPHERE ET DE LA MAGNETOSPHERE À PARTIR DU SOL ET DE L'ESPACE – CANOPUS ET AU DELÀ*** Chair: D. Knudsen, U Calgary	**TU-P3 (DCMMP / DPMCM)** **SUPERCONDUCTIVITY, MAGNETIC AND CORRELATED ELECTRONIC SYSTEMS** / ***SUPRACONDUCTIVITÉ, SYSTÈMES ÉLECTRONIQUES CORRÉLÉS ET MAGNÉTIQUES*** Chair: K. Vos, U. Lethbridge	**TU-P4 (DCMMP / DPMCM)** **DYNAMICS OF MAGNETIC SYSTEMS AND THIN FILMS (GENERAL)** ***DYNAMIQUE DES SYSTÈMES MAGNÉTIQUES ET COUCHES MINCES (GÉNÉRAL)*** Chair: J. Dahn, Dalhousie U.
14h15	**WILLIAMS, P.J.** Acadia U. *The Effectiveness of Computer-Based Studio Teaching of Physics* **(TU-P1-1)**	**ST-MAURICE, Jean-Pierre** LWO *What Can Be Learned From The Properties Of Two-Step Type I waves In The Equatorial Electrojet* **(TU-P2-1)**	**W. Buyers (c)** NRC *Stripes, Resonance and D-Wave Superconducting Gap Spin Fluctuations-A Precursor of High-Temperature Superconductivity: $YBa_2Cu_3O_{6+x}$* **(TU-P3-1)**	**HEINRICH, B.** SFU *Non Equilibrium Spin Momentum Transport in Magnetic Ultrathin Film Structures* **(TU-P4-1)**

Room/salle CS-104	Room/salle AV-D	Room/salle KM-211	Room/salle MN-220	Room/salle DS-121	Room/salle MN-340	TIME HEURE
H. Sang (c) U. Alberta *Magnetic Guiding of Laser Plasmas* **(TU-A7-4)**	↓	**CHBIHI, Abdelouahad** Ganil, Caen *Dynamical and Statistical Aspects of the Nuclear Multifragmentation* **(TU-A9-4)**	↓	↓	**RATHER, John** Wayne State U. *PAMELA Technologies for Ultra-Large, Low Cost Imaging Telescope* **(TU-A12-3)**	11h30
Session ends Fin de la session	**PARANJAPE, Manu** U. Montréal *Vortices in Noncommutative Chern-Simons Theory and the Quantum Hall Effect* **(TU-A8-4)**	↓	**V. Roy** (c) U. Laval *Pulse Collision in a Stretched-Pulse Erbium-Doped Fiber Ring Laser* **(TU-A10-5)**	**YANG, Victor X.D.** U. Toronto *Doppler Optical Coherence Tomography of Tissue Microcirculation* **(TU-A11-4)**	↓	11h45
	↓	**R. Roy** (c) U. Laval *Brisure Dynamique du Projectile* **(TU-A9-5)**	**M. Olivier** (c) U. Laval *Stable Bound States of Pulses in the Stretched-Pulse Fiber Ring Laser* **(TU-A10-4)**	↓	**A. Kotlicki** (c) UBC *Fibre and Multilayer Reflector Based Radiometric Integrator* **(TU-A12-4)**	12h00
	G.N. Ord (c) Ryerson U. *The Geometry of Space-time: Can it Quantize a Classical System?* **(TU-A8-5)**	**R. Austin** (c) McMaster U. *Lifetimes of Superdeformed States in ^{36}Ar* **(TU-A9-6)**	**S. Harbour** (c) U. Laval *Diffraction Properties of Anisotropic Gratings Made From Near Infrared Sensitive Liquid Crystal Photopolymerizable Materials: Theoretical Modelling* **(TU-A10-7)**	**BURNS, Peter N.** U. Toronto *Measuring Tissue Perfusion with Microbubbles and Nonlinear Ultrasound Imaging* **(TU-A11-5)**	**M. Nantel** (c) PRO *Solid-State Diode-Pumped Lasers Micromachining of Silicon and Simulations* **(TU-A12-5)**	12h15
DPP Business Mtg **Ends at 13h30** **Réunion d affairs DPP** **Se termine à 13h30**	Session ends Fin de la session	Session ends Fin de la session	**G.V. Morozov** (c) McMaster U. *One-Dimensional Photonic Crystals: A New Theory for Calculation of Omnidirectional Reflection* **(TU-A10-8)**	↓	Session ends Fin de la session	12h30
			Session ends Fin de la session	Session ends / Fin de la session		12h45

Room/salle CS-104	Room/salle AV-C	Room/salle DS-121	Room/salle KM-237	TIME HEURE
		TU-Plen-3 **DS 121** Plenary Session plénière (CAP Medal of Achievement Winner - Récipiendaire de la médaille ACP) Chair: A.J. McDonald, U. Alberta **McDONALD, A.B.** Queen's U. *A Deeper Understanding of Our Universe from 2 km Underground* **(TU-Plen-1)**		13h30
TU-P5 **(DIMP DPM)** **INSTRUMENTATION AND MEASUREMENT METHODS IN MATERIALS SCIENCE / *INSTRUMENTATION ET MÉTHODES DE MESURE EN SCIENCE DES MATÉRIAUX*** Chair: A. Mandelis, U. Toronto	**TU-P6** **(PPD)** **PARTICLE ASTROPHYSICS / *ASTROPHYSIQUE DES PARTICULES*** Chair: D. Karlen, U. Victoria	**TU-P7** **(DMBP-DCP DPMB-DCP)** **ADVANCES IN MEDICAL IMAGING / *PROGRÈS EN IMAGERIE MÉDICALE*** Chair: A. Pejovic-Milic, Ryerson U.	**TU-P8** **(DPP-DAMP DPP-DPAM)** **ADVANCED LIGHT SOURCES / *SOURCES DE LUMIÈRE MODERNES*** Chair: R. Fedosejevs, U. Alberta	
KARI, Tetsuo Miyazaki U. *Detection of Non-Radiative Electron Transition in Semiconductor Thin Film and Quantum Well Structures* **(TU-P5-1)**	**DOSANJH, Ranpal Singh** Carleton U. *Recent Results from the Sudbury Neutrino Observatory* **(TU-P6-1)**	**MENON, Ravi** Robarts Research Institute *Measurement of Oxygen Consumption Using MRI* **(TU-P7-1)**	**VILLENEUVE, David** NRC *Molecular Imaging at the Advanced Laser Light Source (ALLS)* **(TU-P8-1)**	14h15

TIME HEURE	Room/salle AV-A	Room/salle AV-B	Room/salle KC-104	Room/salle MN-40
14h30	↓	↓	**R. Harris** (c) UBC *Inferring d-wave Quasiparticle Properties from Microwave Conductivity Measurements on $YBa_2Cu_3O_{6+x}$* **(TU-P3-2)**	↓
14h45	**TOKARYK, Dennis** UNB *Research and Teaching: Synergetic Partners or Adversarial Antagonists?* **(TU-P1-2)**	**L. Benkevitch** (c) U. Sask. *Magnetometer-Inferred Convection Patterns for High-Latitude TCV Events and Super DARN Velocities* **(TU-P2-2)**	**F. Marsiglio** (c) U. Alberta *Critical Analysis of the Migdal Approximation for Electron-Phonon Coupling in Metals* **(TU-P3-3)**	**VENUS, David** McMaster U. *Magnetic Relaxation in Exchange-Coupled Ferromagnetic/Antiferromagnetic Bilayer Films* **(TU-P4-2)**
15h00	↓	**A. Koustov** (c) U. Sask. *Solar Radiation Effects in the SuperDARN F-Region Echo Occurrence* **(TU-P2-3)**	Coffee break Pause café	↓
15h15	**D. Mathewson** (c) Surrey, BC *Forget Cross and Dot Products* **(TU-P1-3)**	**R. Marchand** (c) U. Alberta *3D Modelling of Wave Propagation in the Earth Magnetosphere* **(TU-P2-4)**	↓	Coffee break Pause café
15h30	Coffee break Pause café	Coffee break Pause café	**S.C. Kale** (c) Dalhousie U. *Superconducting Potential of Lithium Borocarbides* **(TU-P3-4)**	**MONCHESKY, Theodore L.** Dalhousie U. *Electron Beam Stimulated Magnetic Domain Wall Motion* **(TU-P4-3)**
15h45	**M.A. Duguay** (c) U. Laval *Animated Diachronic Representation of the Twins Paradox in Special Relativity* **(TU-P1-4)**	**J. MacDougall** (c) UWO *Polar Cap Influx* **(TU-P2-5)**	**H. Saadaoui** (c) Laurentian U. *Analysis of the Optical Conductivity of the High-Temperature Supeconductors Using Rotating Antiferromagnetic Theory* **(TU-P3-5)**	↓
16h00	**M. Nantel** (c) PRO *Photonics Education and Training: From Grade School to Grad School* **(TU-P1-5)**	**J. Drexler** (c) UWO *The Consequences of Wave Advection for the Evolution of Slowly-Growing Plasma Irregularities* **(TU-P2-6)**	**R.J. Gooding** (c) Queen's U. *Exact Particle Spectral Functions in a BCS-Like Theory Above Tc in Three Dimensions: Demonstration of a Robust Pseudogap* **(TU-P3-6)**	**P. Losier** (c) U. Moncton *Propriété électrochromique des nanocomposites de WO_3 et de V_2O_5 déposées par évaporation spontanée «Flash evaporation»* **(TU-P4-4)**
16h15	**E. McFarland** (c) U. Guelph *"Seeing" Infrared* **(TU-P1-6)**	**L. Kagan** (c) UWO *Method to Observe Winds and Electric Fields in the Ionospheric E Region* **(TU-P2-7)**	Session ends Fin de la session	**T.D. Hatchard** (c) Dalhousie U. *Electrochemical Properties of Si-Al-Sn Ternary Films Prepared By Combinatorial Sputtering* **(TU-P4-5)**
16h30	**Revitalizing the Undergraduate Physics Curriculum: Student Voices (Round Table Discussion)**	**H.G. James** (c) CRCC *Radiation From Sounder-Accelerated Electrons* **(TU-P2-8)**		**R. Kolarova** (c) U. Montréal *The ^{15}N External Beam for Hydrogen Profiling in Metal Hydrides* **(TU-P4-6)**
16h45	↓	Session ends Fin de la session		**F. Schiettekatte** (c) U. Montréal *Information Provided by Ion Beam Analysis Techniques* **(TU-P4-7)**
17h00	Session ends Fin de la session			Session ends Fin de la session

19h00	**Banquet Reception**	Chi-Wan Young Sports Centre
19h30	**Banquet**	

Room/salle CS-104	Room/salle AV-C	Room/salle DS-121	Room/salle KM-237	TIME HEURE
↓	↓	↓	↓	14h30
MANDELIS, Andreas U. Toronto *Infrared Photo-Carrier Radiometry of Semiconductors: Physical Principles, Quantitative Depth Profilometry and Scanning Imaging of Deep Sub-surface Electronic Defects* **(TU-P5-2)**	**ZACEK, Viktor** U. Montréal *Status of the PICASSO Dark Matter Search Project* **(TU-P6-2)**	**BARZDA, Virginijus** U. Toronto *Imaging Cardio-Myocytes Simultaneously with Second- and Third-Harmonic Generation and Multi-Photon Excitation Fluorescence Microscopy* **(TU-P7-2)**	↓	14h45
↓	↓	↓	Coffee Break Pause café	15h00
Coffee break Pause café	Coffee break Pause café	Coffee break Pause café	↓	15h15
↓	↓	Session ends Fin de la session	**MCKELLAR, A.R.W.** NRC *Far Infrared Beamline at the Canadian Light Source* **(TU-P8-2)**	15h30
TOYODA, Taro U. of Electro-Communications *Photo-Acoustic and Photo-Electrochemical Characterization of Nanostructured TiO_2 Electrodes* **(TU-P5-3)**	**RAGAN, Ken** McGill U *Ground-based gamma-ray astronomy with STACEE and VERITAS* **(TU-P6-3)**		↓	15h45
↓	↓		↓	16h00
LONGTIN, Jon P. SUNY - Stony Brook *Ultrafast Laser Microchemical machining of Thermal Spray Materials Using Laser Induced Breakdown Spectroscopy* **(TU-P5-4)**	**JENNINGS, Byron** TRIUMF *SNOING on Nuclear Theory* **(TU-P6-4)**		Session ends Fin de la session	16h15
↓	↓			16h30
Session ends Fin de la session	Session ends Fin de la session			16h45
		CAP Annual General Meeting / Assemblée générale de l'ACP (see pg 6 / voir à la page 6)		17h00

19h00 **Réception de banquet** Chi-Wan Young Sports Centre

19h30 **Banquet**

TIME HEURE	Room/salle DS-121	Room/salle MN-40	Room/salle KM-237	Room/salle AV-C
07h00	Meeting of the CAP-NSERC Liaison Committee (07h00-09h00) - Faculty Lounge			
08h30				
09h15				
	WE-A1 (DAMP-DCP DPAM-DCP) **ULTRAFAST SCIENCE AND APPLICATIONS / *PHENOMÈNES ULTRARAPIDES ET APPLICATIONS*** Chair: D. Villeneuve, NRC	**WE-A2 (DCMMP/DPMCM)** **MATERIALS SCIENCE / *SCIENCE DES MATÉRIAUX*** Chair: D. Taylor, Queen's U.	**WE-A3 (DAMP/DPAM)** **OVERVIEW OF INSTRUMENTATION AND MEASUREMENT RESEARCH IN NORTH AMERICA / *SURVOL DE LA RECHERCHE EN INSTRUMENTATION ET MESURES EN AMÉRIQUE DU NORD*** Chair: A. Mandelis, U.Toronto	**WE-A4 (DTP/DPT)** **THEORY / *THÉORIE*** Chair: R. MacKenzie, U.Montreal
10h00	**JUNGREUTHMAYER, Christian** U. Ottawa *Matter in Strong Laser Fields* **(WE-A1-1)**	**SCHLESINGER, Mordechay** U. Windsor *Numeric Methods in Solving Rough Surface Contact Problems* **(WE-A2-1)**	**POLLAK, Fred H.** Brooklyn College of the City University of New York *Non-Destructive Room-Temperature Characterization of Wafer-sized III-V Semiconductor Device Structures using Contactless Electromodulation and Surface Photovoltage Spectroscopy* **(WE-A3-1)**	**MCKEON, Gerry** UWO *Extracting Information from the Renormalization Group* **(WE-A4-1)**
10h30	**A.V. Pegarkov (c)** U. Toronto *Giant Above-Threshold Absorption and Cascade Ionization in Diatomic Molecules Induced by Femtosecond Pulses of Strong Lasers* **(WE-A1-2)**	**ROBBIE, Kevin** Queen's U. *Geometrical Effects in Ballistic Aggregation of Thin Films* **(WE-A2-2)**	↓	**M.N. Tran (c)** McMaster U. *Number Fluctuation and the Fundamental Theorem of Arithmetic* **(WE-A4-2)**
10h45	**A.V. Pegarkov (c)** U. Toronto *One-Photon Versus Three-Photon Control of Molecular Photo-Absorption: Role of Non-Linear Temporal Wave Interference* **(WE-A1-3)**	↓	Coffee break / Pause café	Coffee break / Pause café
11h00	Coffee Break / Pause café	Coffee break / Pause café	↓	↓
11h15	↓	↓	**CHARBONNEAU, Sylvain** NRC *Nanotechnology - An Integration Challenge* **(WE-A3-2)**	**ELIAS, Victor** Perimeter Institute *Radiative Spontaneous Symmetry-Breaking Revisited* **(WE-A4-3)**
11h30	**LITVINYUK, Igor** NRC *Molecules in Strong Laser Field: Ionization, Re-scattering and Coulomb Explosion* **(WE-A1-4)**	**M.D. Fleischauer (c)** Dalhousie U. *How a Physicist Can Do an Electrochemist's Work Sixty-Four Times Faster* **(WE-A2-3)**		
11h45		**M.D. Fleischauer (c)** Dalhousie U. *Combinatorial Investigations of the Si-Al-Mn Ternary System* **(WE-A2-4)**		**M.R.A. Shegelski (c)** UNBC *Quantum vs. Quasi-classical Decay Times* **(WE-A4-4)**

Room/salle AV-B	Room/salle CS-104	Room/salle AV-A	Room/salle AV-D	TIME HEURE
		Réunion du comité de liaison ACP-CRSNG (07h00-09h00) - Faculty Lounge		07h00
		WE-Plen-1 **DS-121** Plenary Session plénière (CAP Medal for Outstanding Achievement in Industrial and Applied Physics winner - Récipiendaire de la médaille de l'ACP pour contributions exceptionnelles en physique industrielle et appliquée) Chair: M. Tremblay SFU **STANDING, Kenneth** U. Manitoba *Clocking the Big Ones: Time-of-Flight Mass Spectrometry of Biomolecules- One Thousand to One Million u* (WE-Plen-1)		08h30
		WE-Plen-2 **DS-121** Plenary Session plénière Chair: M. Vincter, U Alberta **SCOTT, Douglas** JEC *The Cosmic Microwave Background vs the Universe* (WE-Plen-2)		09h15
WE-A5 (DPP) **SPECIAL TER SESSION / SESSION SPÉCIALE** Chair: C. Boucher, U.Québec	**WE-A6** (DMBP/DPMB) **COMPUTATIONAL BIOPHYSICS / BIOPHYSIQUE COMPUTATIONNELLE** Chair: J. Polson, UPEI	**WE-A7** (DNP/DPN) **NUCLEAR ASTROPHYSICS / ASTROPHYSIQUE NUCLÉAIRE** Chair: J. dAria, SFU	**WE-A8** (DAPP/DPA) **BIOMEDICAL APPLIED PHYSICS / PHYSIQUE BIOMÉDICALE APPLIQUÉE** Chair: R. Maev, U.Windsor R. Roy, U.Laval	
STEWART, M. *to be announced / à venir* (WE-A5-1)	**CHEN, Jeff** U. Waterloo *Understanding Protein Folding from Polymer Models* (WE-A6-1)	**GOERRES, Joachim** U. of Notre Dame *Alpha-Capture in Stellar Evolution and Explosion* (WE-A7-1)	**ZEDEL, Len** MUN *The Capabilities and Limitations of Doppler Sonar for Monitoring Fish Movements* (WE-A8-1)	10h00
↓	**LINHANANTA, Apichart** Lakehead U. *Molecular Simulation Models of Protein Folding: New Insights on the Levinthal Paradox and the Occurrence of Protein-Folding Diseases* (WE-A6-2)	**JOSE, Jordi** Universitat Politecnica de Catalunya *Classical Novae as Laboratories for Nuclear Astrophysics: from Lithium to Calcium* (WE-A7-2)	**MAEVA, Elena** U Windsor *Method of Acoustic Microscopy for Sex Determination of Sea Lamprey, Petromyzon Marinus Larvae* (WE-A8-2)	10h30
GUNN James P. CEA Cadarache *The Tunnel Probe : A DC Probe Diagnostic for Electron Temperature Measurements in Magnetized Plasmas* (WE-A5-2)	↓	↓	↓	10h45
↓	Coffee break Pause café	Coffee break Pause café	**John Rather** (c) Wayne State U. *Ultrasound Imaging - Tissue Diagnostics, and Treatment* (WE-A8-3)	11h00
Coffee Break Pause café	↓	**PARKER, Peter** Yale U. *Laboratory Studies of Explosive Nucleosynthesis* (WE-A7-3)	Coffee break Pause café	11h15
FUNDAMENSKI, W. Euratom/EUKAEA Fusion Assoc. *Energy Transport in Tokamak Boundary Plasmas: laminar or turbulent?* (WE-A5-3)	**RUTENBERG Andrew** Dalhousie U. *Pattern Formation Inside Bacteria* (WE-A6-3)	↓	**VITKIN, Alex** U. Toronto *Polarized Light as a Tool for Biological Tissue Investigation* (WE-A8-3)	11h30
↓	↓	**CHEN, Alan A.** McMaster U. *The SAC Program in Experimental Nuclear Astrophysics* (WE-A7-4)	↓	11h45

TIME HEURE	Room/salle DS-121	Room/salle MN-40	Room/salle KM-237	Room/salle AV-C
12h00	**T. Crawford** (c) McMaster U. *Femtosecond Laser Micromachining of Silicon at 400 nm and 800 nm Wavelengths* **(WE-A1-5)**	**W. Sears** (c) Lakehead U. *The Effect of Humidity on the Electrical Susceptibility of Mesoporous Silicates formed from Organosilane Substitution on Octylamine Micelles* **(WE-A2-5)**	**DJORDJEVIC, B. Boro** Johns Hopkins U. *Remote Non-Contact Ultrasonic Sensing* **(WE-A3-3)**	**J. Sakhr** (c) McMaster U. *The Riemann Zeta Function Zeros and the Prime Number Sequence* **(WE-A4-5)**
12h15	Session ends / Fin de la session	Session ends / Fin de la session	**Session Ends at 12h45 / Se termine à 12h45**	**G. Slater** (c) U. Ottawa *Building Lattice Random-Walk Models for Drift and Diffusion Problems* **(WE-A4-6)**
12h30	Room/Salle DS-210 **DOP Business Mtg** **Ends at 13h30** **Réunion d'affairs DOP** **Se termine à 13h30**		**DIMP Business Mtg** **Ends at 13h30** **Réunion d'affairs DPIM** **Se termine à 13h30**	Session ends / Fin de la session New Faculty Luncheon / Déjeuner pour les nouveaux professues - Faculty Lounge
13h30			**NSERC Workshop** KC-104 Special Session spéciale Chair: M. Beaudry, NSERC **Workshop on how to prepare a grant application.**	

TIME HEURE		Room/salle MN-40	Room/salle KM-237	Room/salle AV-D
		WE-P1 (DCMMP-DPMCM) **MATERIALS SCIENCE II / *SCIENCE DES MATÉRIAUX II*** Chair: M. Schlesinger, Windsor U.	**WE-P2** (DIMP/DPIM) **OVERVIEW OF INSTRUMENTATION AND MEASUREMENT RESEARCH IN NORTH AMERICA II / *SURVOL DE LA RECHERCHE EN INSTRUMENTATION ET MESURES EN AMÉRIQUE DU NORD II*** Chair: A. Mandelis, U.Toronto	**WE-P3** (DNP/DPN) **SYMMETRIES IN NUCLEAR PHYSICS / *SYMÉTRIES EN PHYSIQUE NUCLÉAIRE*** Chair: J. Svenne, U.Manitoba
14h15		**R. Bruening** (c) Mount Allison U. *Scanning Calorimetry Measurements of the Glass Transition in Vitreous Silica* **(WE-P1-1)**	**GANGAVARAPU, Kiran** U. Pennsylvania *Recent Developments in Photon Migration* **(WE-P2-1)**	**TOWNER, Ian** Queen's U. *Superallowed Beta Decay: The Determination of Vud* **(WE-P3-1)**
14h30		**J.H. Brewer** (c) UBC *μ^+SR with Nonzero-Spin Nuclei* **(WE-P1-2)**	↓	↓
14h45		**M. Bourgeois** (c) U. Laval *Optimizing Crystallization in RF-Sputtered YBCO Thin Films* **(WE-P1-3)**	↓	**VAN OERS, Willem** U. Manitoba *QWeak, A Search for New Physics* **(WE-P3-2)**
15h00		**G. Ross** (c) INRS-Énergie et Matériaux *Effect of Electric Charge Accumulation on Insulators During Low Energy Ion Implantation* **(WE-P1-4)**	Coffee break / Pause café	↓
15h15		Coffee break / Pause café	↓	**H.S. Sherif** (c) U. Alberta *Non-Locality Effects in the Photo-Production of Eta Mesons on Nuclei* **(WE-P3-3)**

Room/salle AV-B	Room/salle CS-104	Room/salle AV-A	Room/salle AV-D	TIME HEURE
MORELLI, Jordan U. Saskatchewan *Plasma Position Control in the STOR-M Tokamak Using A Fuzzy Logic Approach* **(WE-A5-4)**	**J. Chakrabarti** (c) S.N. Bose National Centre for Basic Sciences *Kinetics of a Sphere Attached to a Fluctuating Polymer* **(WE-A6-4)**		**G. Beer** (c) U. Victoria *From Particle Physics Detectors to Medical Applications* **(WE-A8-4)**	12h00
	J. Bechhoefer (c) Simon Fraser U. *Role of Polymer Loops in DNA Replication* **(WE-A6-5)**	**J.A. Clark** (c) U. Manitoba/Argonne *'Stellar' measurements using the Canadian Penning Trap Mass Spectrometer* **(WE-A7-5)**	R. Roy (c) U. Laval *Physics and Engineering Physics: an Education and Training Pathway to Radiation Oncology Physics* **(WE-A8-5)**	12h15
Session ends / Fin de la session	Session ends / Fin de la session	Session ends / Fin de la session **DNP Business Mtg** **Ends at 13h30** **Réunion d'affairs DPN** **Se termine à 13h30**	Session ends / Fin de la session **DIAP Business Mtg** **Ends at 13h30** **Réunion d'affairs DPIA** **Se termine à 13h30**	12h30
		WE-Plen-3 **DS 121** Plenary Session plénière Chair: Y. Tsui, U. Alberta **KIEFFER, Jean-Claude** INRS *The Advanced Laser Light Source (ALLS) International Facility* **(WE-Plen-3)**		13h30

Room/salle AV-B	Room/salle AV-C	Room/salle AV-A		TIME HEURE
WE-P4 **(DPP)** **ITER-FUSION SESSION / *SESSION ITER-FUSION*** Chair: C. Boucher, U.Québec	**WE-P5** **(DTP/DPT)** **THEORY II / *THÉORIE II*** Chair: M. Shegelski, UNBC	**WE-P6** **(DMBP/DPMB)** **FRONTIERS IN MEDICAL AND BIOLOGICAL PHYSICS / *FRONTIÈRES EN PHYSIQUE MÉDICALE ET BIOLOGIQUE*** Chair: A. Pejovic-Milic, Ryerson U.		
ALLAIS, Fabrice INRS/U. Québec *Atomic Physics Rates and Non-local Electron Parallel Heat Transport in Divertor Plasmas* **(WE-P4-1)**	**AZZOUZ, Mohamed** Laurentian U *Rotating Antiferromagnetism and The Pseudogap Phase of Copper-Oxide Superconductors* **(WE-P5-1)**	**R.L. Clarke** (c) Carleton U. *Tumour Treatment by High Intensity Focused Ultrasound Past Barriers* **(WE-P6-1)**		14h15
↓	↓	**D. Côté** (c) U. Toronto *Non-Invasive Blood Glucose Monitoring with Polarized Light* **(WE-P6-2)**		14h30
LIU, Dazhi U. Saskatchewan *Development of Curved Drift Tube for Vertical Compact Torus Injection into STOR-M Tokamak* **(WE-P4-2)**	**G.C. McGuire** (c) U.C.F.V. *The Trajectories of a Golf Ball that is Experiencing Nonlinear Lift and Drag* **(WE-P5-2)**	**L. Chin** (c) U. Toronto *Optical Monitoring of Interstitial Laser Photocoagulation* **(WE-P6-3)**		14h45
↓	Coffee break / Pause café	Coffee break / Pause café		15h00
R. Marchand (c) U. Alberta *Finite Element Modelling of the HT-7U SOL* **(WE-P4-3)**	↓	**S.C. Hardacre** (c) Ryerson U. *Influence of Strontium Levels in Bone on Dual-Energy X-Ray Absorptiometery* **(WE-P6-4)**		15h15

TIME HEURE	ITEC Teletheatre	Room/salle MN-40	Room/salle KM-237	Room/salle AV-D
15h30		↓	**SANCHEZ SINENCIO, Feliciano** CINESTAV *Biomaterials Research Activities in CINVESTAV* **(WE-P2-2)**	Coffee break / Pause café
15h45		**H. Arabshahi (c)** Tarbiat Moallem U. *Effect of Polarization Charges and Trapping Centers on Electron Transport Properties of $Al_{0.2}Ga_{0.8}N$/GaN HFETs* **(WE-P1-5)**	↓	↓
16h00		**S.D. Beattie (c)** Dalhousie U. *Comparison of Electrodeposited Copper-zinc Alloys Prepared Individually and Combinatorially* **(WE-P1-6)**	↓	**PAGE, Shelley A.** U.Manitoba *Measurement of the Parity-Violating Asymmetry in Radiative Neutron-Proton Capture* **(WE-P3-4)**
16h15		**T.D. Hatchard (c)** Dalhousie U. *Structure and Composition of $Gd_{1-x}Co_x$ and $Gd_{1-x}Fe_x$ Thin Films Produced by Combinatorial Sputtering* **(WE-P1-7)**	Session ends / Fin de la session	↓
16h30		Session ends / Fin de la session		**OPPER, Aliena K.** Ohio U. *Measuring Charge Symmetry Breaking in $n+p \rightarrow d\pi^0$* **(WE-P3-5)**
16h45				↓
17h00	CAP Council Meeting (New and Old) / Réunion du Conseil de l'ACP (nouveau et ancien)			Session ends / Fin de la session
17h15				

Next CAP Annual Congress

2004 June 13-16

at the Delta Hotel, Winnipeg, Manitoba

-- Joint with CASCA, COMP, and BSC --

Room/salle AV-B	Room/salle AV-C	Room/salle AV-A		TIME HEURE
Coffee break / Pause café	**G.C. McGuire** (c) U.C.F.V. *A Model and a Demonstration of the Strange Effects Produced by the Nonlinear Eardrum* **(WE-P5-3)**	Session ends / Fin de la session		15h30
KAGANOVICH, Igor Princeton U. *Analytical and Numerical Studies of Ion Beam Plasma Interactions for Heavy Ion Driven Inertial Fusion* **(WE-P4-4)**	**TEMPESTA, Piergiulio** U.Montréal *Symmetry Preserving Discretization of Quantum Systems* **(WE-P5-4)**			15h45
↓	↓			16h00
A. Ito (c) U. Saskatchewan *Non-local Analysis of Ion Acoustic Instability With Sheared Parallel Flow* **(WE-P4-5)**	**J. Sadler** (c) U. Windsor *Ultrasound Propogation in a Thin Anisotropic Layer Between Two Media: Theory, Computer Model, and Experiment* **(WE-P5-5)**			16h15
Session ends / Fin de la session	**L. Livadaru** (c) Dalhousie U. *Interacting Chain Model for Poly(ethylene glycol) from First Principles -- Stretching of a Single Molecule using the Transfer Matrix Approach* **(WE-P5-6)**			16h30
	M.-A. Vachon (c) U.Montréal *Critical Magnetic Fields in the SO(5) Model* **(WE-P5-7)**			16h45
	G.W. Semenoff (c) UBC *AdS/CFT and the Phase Diagram of Super-Yang-Mills Theory* **(WE-P5-7)**			17h00
	Session ends / Fin de la session			17h15

Prochain Congrès annuel de l'ACP

13-16 juin 2004

à l'Hotel Delta, Winnipeg, Manitoba

-- En collaboration avec CASCA, OCPM, et SCB --

2003 CONGRESS ORAL SESSION ABSTRACTS
RÉSUMÉS DES SESSIONS ORALES - CONGRÈS 2003

The oral session abstracts presented here are organized by session codes (SU-A1 to WE-P6). Each presentation is cross-referenced in the Author Index (pg. 113). *Les résumés des sessions orales ci-après sont par code (SU-A1 à WE-P6). L'index des auteurs (pg. 113) établit des renvois à cette liste de présentatations.*

Please see the Congress Program Summary for details on the times and locations of each of the sessions as well as all other (non-session) meetings organized in conjunction with the CAP's 2003 Congress. *Veuillez vous référer au résumé du programme du congrès pour les heures et endroits de chaque session ainsi que pour toutes les autres rencontres organisées en conjunction avec le congrès 2003 de l'ACP.*

PUBLIC LECTURE / CONFÉRENCE PUBLIQUE — 19h30 — SATURDAY, JUNE 7 / SAMEDI, LE 7 JUIN

Chi-Wan Young Sports Center ***Chair: W.J. McDonald, U.Alberta***

MARC GARNEAU, Canadian Space Agency

The Space Between—From the Great, White North to the Final Frontier

The Canadian Space Program has been at the forefront of innovation in space science and technology. In fact, space science research in Canada dates back to 1840—before Confederation. Canada recently celebrated the 40th anniversary of the launch of Alouette-1, a groundbreaking space science satellite that provided Canada with the distinction of being the third nation in space. The space science program built upon this early success with three more scientific satellites in the 60's and 70's, the last of which, ISIS-2, obtained the first systematic observations of the Northern Lights from space. Canada's auspicious beginning in space science has spurred new undertakings in space with applications and technology thrusts. It has also lead to hallmarks of national pride, like the Canadarm and Radarsat-1, the world's first commercial Synthetic Aperture Radar satellite

Dr. Marc Garneau, President of the Canadian Space Agency and Canada's first astronaut, will focus on such past and current successes, and on a vision for the future of Canada's Space Program. He will also discuss the challenges of studying the "infinite" with finite resources, ideas for cultivating a competitive space science community in Canada and potential areas of collaboration and nurturing the growth of next-generation technologies and emerging fields of research.

Du Grand Nord à la frontière ultime

Le Programme spatial canadien a été le moteur de l'innovation en sciences et technologies spatiales. En fait, la recherche en sciences spatiales au Canada date de 1840, avant même la création de la fédération canadienne. Le Canada a récemment célébré le 40e anniversaire du lancement d'Alouette-1, un satellite de sciences spatiales d'avant-garde qui a permis au Canada de se démarquer en devenant le troisième pays à assurer une présence continue dans l'espace. Fort de ces premiers succès, le programme des sciences spatiales a poursuivi sur sa lancée en procédant à la mise en orbite de trois autres satellites scientifiques dans les années 60 et 70. Le dernier de cette série, ISIS-2, a permis d'effectuer les premières observations systématiques des aurores boréales depuis l'espace. Les débuts prometteurs du Canada dans le secteur des sciences spatiales ont constitué un tremplin pour les nouveaux projets spatiaux menant à la création d'applications et de technologies. Les succès comme ceux du Canadarm et de RADARSAT-1, le premier satellite commercial doté d'un radar à synthèse d'ouverture, ont fait naître un fort sentiment de fierté nationale.

Marc Garneau, président de l'Agence spatiale canadienne et premier astronaute canadien, mettra l'accent sur ces succès passés et actuels et abordera l'avenir du Programme spatial canadien. Il parlera d'abord des défis que pose l'étude de l'infini lorsque les ressources sont limitées. Il exposera ensuite certaines idées qui permettraient de maintenir la compétitivité du milieu des sciences spatiales au Canada et identifiera les domaines dans lesquels une collaboration potentielle pourrait favoriser l'apparition de technologies de prochaine génération et l'émergence de nouveaux domaines de recherche.

[SU-A1] 09h30 — Large Scale Initiatives in Condensed Matter Physics / *Initiatives d'envergure en matière condensée* — SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

ROOM / SALLE DS 121 ***Chair: T. Timusk, McMaster U.***

SU-A1-1 **09h30**

ROBERT KIEFL, TRIUMF, CIAR and University of British Columbia

*Beta-Detected NMR with Low Energy Spin Polarized Radioactive Nuclei and its Applications in Condensed Matter**

The new ISAC facility at TRIUMF provides intense beams of radioactive nuclei which have applications in many different areas of science, including condensed matter. We have recently commissioned a polarized beam line at ISAC which delivers a variable low energy beam (1-30 keV) of highly nuclear spin polarized ^{8}Li to two beta-NMR/NQR spectrometers. These instruments are designed to use the polarized radioactive nucleus as a sensitive probe of the local electrical and magnetic environment. The principles are very similar to muon spin rotation but beta-NMR/NQR at ISAC is much better suited to studies at ultra thin structures and interfaces Preliminary experiments have now been done which demonstrate the feasibility of the method. In this talk I will review the status of the facility and outline the experimental program which is now beginning.

* Work done in collaboration with D. Arseneau, R. Baartman, T. Beals, J.A. Behr, J. Chakhalian, K.H. Chow, S. Daviel, S. Dunsiger, A. Hatakeyama, S.R. Kreitzman, C.D.P. Levy, W.A. MacFarlane, R.I. Miller, G.D. Morris, K. Nicol, M. Olivo, R. Poutissou, E. Reynard, Z. Salman

SU-A1-2 **10h05**

ALEXANDER MOEWES, University of Saskatchewan

Soft X-Ray Spectroscopy at the Canadian Light Source: A Powerful Tool for Condensed Matter Physics

Materials research synthesizes and characterizes new and advanced materials that exhibit novel properties. Research in this area is motivated by the possibility of designing materials with novel electronic, optical, magnetic, photochemical and catalytic properties. The controlled preparation of these advanced materials with optimized properties requires the development of characterization methods. The electronic structure of a wide variety of condensed matter systems can be studied using soft x-ray spectroscopy with tunable synchrotron radiation. The presentation will demonstrate the following:

(1) Principles of Spectroscopy with synchrotron radiation as a characterization tool will be given with respect to the experiments planned at the Canadian Light Source (CLS).
(2) An overview of the status of the beamlines at CLS and the experiments planned will be presented
(3) The proposed XES beamline dedicated to photon-in photon-out will be highlighted. Current research topics include such different systems as metallic DNA and the electronic structure of ultra-hard materials such as the spinel phase Si_3N_4.

10h40 Coffee Break / Pause café

SU-A1-3 11h10

BRUCE GAULIN, McMaster University

Canadian Participation at the Spallation Neutron Source

The Spallation Neutron Source (SNS) is the next generation neutron source for materials research currently under construction at Oak Ridge National Laboratory. When it begins operation in 2006, it will have figures-of-merit exceeding those at the current best sources by about an order of magnitude. Canada's neutron beam community is seriously involved in the design and construction of two new time-of-flight neutron instruments at the SNS; VULCAN which will be optimized for materials engineering applications, and SEQUOIA which will be optimized for magnetic inelastic scattering. Our involvement follows from a succesful CFI International Access Fund application, which will make the Canadian community players in what will be the world's most powerful neutron facility. I will describe the SNS in general and the transformative research opportunities it will enable. I will then focus on new time-of-flight instrumentation for inelastic scattering being developed at SNS and elsewhere. To illustrate the power of this new instrumentation I will discuss magnetic inelastic scattering from quantum magnets $LiNiO_2$ and $NaNiO_2$ taken with the new Disk Chopper Spectrometer at the NIST Center for Neutron Research.

SU-A1-4 11h45

PETER GRUTTER, McGill University

The NSERC Nano Innovation Platform: an Update

The recently established NSERC Nano Innovation Platform has three main goals:

1. Develop a strategic document on the future of nano in Canada together with all stakeholders (National Institute of Nano Technology in Edmonton, NanoQuebec, CIAR, NRC, universities, funding agencies such as CFI, CIHR, SHERC, CSA and NSERC, provinces, cities, the business and the venture capital world). This document will provide a vision for the future of Canadian nanoscience built on ideas, ambitions and existing Canadian strength. This document should lead to the creation of a more coherent national strategy in nanoscience and nanotechnology and identify missing components.
2. NSERC Nano Innovation Platform Awards will support excellent, high risk, high gain projects in nanoscience and nanotechnology that will help put Canada on the 'nano' World map. They will provide a snapshot of cutting edge nano research in Canada. These projects challenge the best nano researchers in Canada to dream, to broadly develop platform technologies, intellectual property or products. Deadline: April 30th, 2003
3. Help create local communities of networked nano researchers, especially graduate and undergraduate students. These local NanoCommunities are crucial if nano is to make a socio-economic impact, as interdisciplinary trained and networked highly qualified personal (HQP) are crucial cornerstones in any strategy. This will be implemented through NSERC Nano Innovation Platform by financial and organisational support for the local organisers of periodic one day poster workshops where every interested researcher can present his or her research to a wide community. These workshops are modelled after a successful initiative within NanoQuebec, a nano initiative of the province of Quebec (www.nanoquebec.ca).

In this presentation I plan on giving an update on the NSERC Nano Innovation platform with an aim of obtaining feedback from part of the community.

12h20 Session Ends / Fin de la session

[SU-A2] 09h30 Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond / *Observation de l'ionosphère et de la magnétosphère à partir du sol - CANOPUS et au délà*

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

ROOM / SALLE KC-104 ***Chair: R. Rankin, U. Alberta***

SU-A2-1 10h00

JOHN CRAIG SAMSON, University of Alberta

Major Scientific Results From the CANOPUS Experiment

The CANOPUS array of magnetometers, optical devices (all sky imagers, meridian scanning photometers), and radar became fully operational in 1989 and has continued in operation to the present. CANOPUS data has been used in over one thousand scientific publications, highlighting the enormous success of this project. My talk will outline major scientific achievements arising from the use of the CANOPUS data set in a number of Canadian programs. I shall emphasize three areas, the auroral arc, the magnetospheric substorm and new methods in magnetoseismology for studies of the Earth's magnetosphere. One of the "grand challenge" problems in both space plasma physics and plasma physics in general is the understanding of the mechanism forming homogeneous and discrete auroral arcs. CANOPUS optical and magnetometer observations have established the fact that ultra low frequency (1-5 mHz), shear Alfven, field line resonances are responsible for the production of some auroral arcs. Complete and self consistent theoretical and computational models of electron acceleration in these resonances have now been developed by Canadian research teams. A second major space physics problem that has been resolved by using CANOPUS data is the location in the magnetosphere of the onset of the instability and the nature of the instability leading to auroral substorm intensifications. The intensification begins as a ballooning mode near the Earthward edge of the nightside plasmasheet at about 10-12 Earth radii and is not initially driven by a neutral line in the plasmasheet at about 30 Earth radii.

SU-A2-2 10h30

ERIC DONOVAN, University of Calgary

Energy Dependence of the Latitude of The Ion Isotropy Boundary *

The Ion Isotropy Boundary ("Ion IB") marks the transition between full and empty downgoing loss cones. Poleward of the IB, strong pitch angle diffusion fills the loss cone rapidly enough to completely compensate for loss of ions due to precipitation. At any instant, the latitude of the boundary depends on both local time and particle energy, the latter reflecting an energy dependence of the underlying scattering mechanism. On the basis of observations of 40 KeV to 1 MeV protons that showed the IB at higher latitudes for higher energy, simulations of particle motion in realistic magnetic field models, and the strong correlation between the latitude of the IB and the inclination of the magnetic field at geosynchronous orbit, it is widely held that the pitch angle diffusion is due to non-adiabatic effects on highly curved field lines in the vicinity of the neutral sheet [1]. This boundary is, however, more routinely identified using *in situ* observations of <30 KeV ions (ie from DMSP and FAST), or remotely through proxies such as the equatorward boundary of either the proton aurora or E-region SuperDARN echoes [2], both of which typically reflect the precipitation of <30 KeV protons. In this paper, we use data from the FAST ESA and TEAMS instruments to show that, in the sub 30 KeV energy range, the IB latitude often decreases with decreasing energy, inconsistent with scattering due to field line curvture. Moreover, this "reverse" energy dependence is seen for separate ion species, and preferentially in the morning sector. We discuss possible reasons for this unexpected result, and implications for use of the IB in remote sensing the inner magnetospheric magnetic field topology

1. Imhoff *et al.*, *JGR*, pp 9743-9752, 1977; Sergeev and Tsyganenko, *PSS*, pp 999-1006; Sergeev and Gvozdevsky, *AG*, pp 1093-1103, 1995.
2. Jayachandran *et al.*, *AG*, pp 1899-1904, 2002.

* In collaboration with I. Voronkov, L. Andersson and C. Carlson.

11h00 Coffee Break / Pause café

SU-A2-3 11h15

KATHRYN MCWILLIAMS, University of Saskatchewan

SuperDARN The Super Dual Auroral Radar Network

The Super Dual Auroral Radar Network (SuperDARN) is an international collaborative network of HF radars that monitors ionospheric plasma convection over the majority of the northern and southern polar regions. The main objective of SuperDARN is to measure ionospheric plasma convection with relatively high spatial and temporal resolution on a global scale. The polar cap convection patterns, which are equivalent to voltage maps of the polar regions, constitute one of the most recognizable data products in space

physics. SuperDARN currently is comprised of nine radars in the northern hemisphere and six radars in the southern hemisphere. Each SuperDARN radar has a very large field of view, covering approximately four million square kilometers. The radar network's vast coverage extends longitudinally over more than 18 hours of local time in the northern hemisphere, and latitudinally from equatorward of the auroral electrojet to well into the polar cap, thus sampling the ionospheric footprint of many magnetospheric regions. A complete radar scan is performed in one or two minutes in the common modes of operation, leading to data with time resolution good enough to improve the understanding of the dynamics of the ionosphere and the magnetosphere. Data from the SuperDARN radars have contributed significantly to studies of solar wind magnetosphere ionosphere coupling, and they provide key information about phenomena such as field aligned currents, magnetospheric pulsations, substorms, and magnetic reconnection. Selected SuperDARN science highlights will be presented, as well as a discussion of SuperDARN's role in international collaborative projects.

SU-A2-4 **11h45**

Auroral Arc Theory and Modeling: a CANOPUS case study. **Robert** Rankin, Jianyong **Lu** and Richard Marchand, *University of Alberta* — One class of auroral arcs can be attributed to latitudinally localized field line resonances (FLRs). The energization of auroral electrons in FLRs is often attributed to wave dispersion that results from finite electron (mass) inertia. However, thermal effects provide the dominant wave dispersion process through much of the plasma sheet, where a significant portion of geomagnetic field lines contains hot plasma. Using a new model of dispersive FLRs on dipolar or stretched geomagnetic field lines, we characterize the regions in Earth's magnetosphere where FLRs may be expected to preferentially form. We demonstrate that FLRs naturally form or migrate to regions where wave dispersion is small, approaching zero. Through nonlinear effects, and somewhat paradoxically, this situation is favorable for density cavity formation that leads to a strong nonlinear acceleration of dispersive effects and a highly localized and spatially structured FLR or arc. Without nonlinear effects, FLRs take hundreds of wave periods to phase mix to dispersive electron inertia scales, while hot plasma effects prevent such scales from emerging through most of the plasma sheet. We further discuss the situation where FLRs need not be excited by a monochromatic compressional wave driver.

SU-A2-5 **12h00**

The Ravens of Norse Mythology: An Auroral Imaging Mission for ILWS. **J. Murphree**, T. Trondsen, and E. Donovan, *University of Calgary* — The International Living With a Star (ILWS) program will elucidate plasma physical processes in the Sun-Earth system, identify those which have planetary-scale effects, and clarify the geoefficiency of the governing processes. ILWS magnetospheric missions will involve constellations and clusters providing global and localscale measurements of unprecedented quality. Examples include MMS, Magnetospheric Constellation, the Radiation Belt Storm Probes, and possibly THEMIS. At present, there is no auroral imaging mission planned within the ILWS time-frame. Canada has played a significant role in auroral imaging from space, beginning with the ISIS-II scanning photometer, continuing with UV imagers on Viking, Freja, and Interball, and presently through the use of a Canadian design for the IMAGE FUV WIC. Together with Polar, Akebono, DE, and DMSP, they have advanced our understanding of the global auroral distribution, magnetospheric dynamics and the solar-terrestrial interaction. They were/are single spacecraft missions with a limited number of hours of imaging per orbit, just one consequence of which is that no magnetospheric storm has been imaged from start to finish. Two microsats 180 degrees out of phase on the same eccentric polar orbit could continuously image the northern hemisphere for tens of months, creating an unbroken movie of the global auroral distribution spanning not only individual storms, but tens of solar rotations. The pragmatic advantages of a simple instrument complement are numerous, and even with only two instruments per spacecraft (UV and Lyman-alpha imagers) the mission would have enormous scientific impact. In this talk, we outline the technical specifications required for such a mission to meet clearly spelled out scientific objectives.

SU-A2-6 **12h15**

WILLIAM LIU, Canadian Space Agency

Scientific Challenges of International Living With a Star

Over the next 15 years, most of space research missions supported by the world's major space agencies in the area of Sun-Earth Connection will fall under the umbrella International Living With a Star (ILWS). Canada has established an important role in the ILWS program. In this presentation, I outline the overall science objectives of this unprecedented collaboration, with special focus on some major scientific questions of potential interest to Canadian scientists.

12h45 **Session Ends / Fin de la session**

[SU-PLEN-1] 13h30 Brockhouse Medal Winner / *Récipiendaire de la médaille Brockhouse* — SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

ROOM / SALLE DS 121 ***Chair: B. Joós, U. Ottawa***

SU-PLEN-1 **13h30**

LOUIS TAILLEFER, Université de Sherbrooke

Probing New States of Matter With Heat and Sound

I will discuss how in our lab we use the transport of heat at temperatures near absolute zero to probe the nature of low-lying excitations in different states of matter, to determine whether these are fermionic or not and localized or not. With this technique we have studied the ground state of cuprates in the various regions of their doping phase diagram. In particular, this has allowed us to shed light on the mysterious underdoped phase. We also use the propagation of ultrasound as a highly directional probe of electronic states. We have used this to investigate the first instance of p-wave superconductivity, in Sr_2RuO_4. Measurements of the sound attenuation show this material to be a multi-band superconductor of a remarkable kind. Measurements of sound velocity provide the first unambiguous proof of a vector order parameter in any superconductor

[SU-P1] 14h15 New Methods and Novel Materials / *Nouveaux méthodes et matériaux* — SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

ROOM / SALLE DS 121 ***Chair: R. Kiefl, TRIUMF***

SU-P1-1 **14h15**

JOHN WEI, University of Toronto

Nanoscale Phase Decoherence in High-T_c Superconductors

Many theories of high-T_c superconductivity have emphasized the importance of order-parameter phase fluctuations, which could destroy the superconducting phase coherence while the pairing amplitude remains robust. We have devised a new experimental method to probe this "pairing-without-condensation" scenario at the nanometer length scale, using cryogenic scanning tunneling spectroscopy on current-carrying $YBa_2Cu_3O_{7-\delta}$ thin-film structures. We observed systematic suppression of the phase-sensitive Andreev-reflection spectra by the applied current, with no variation in either the tunneling gap spectra or the *d*-wave pairing symmetry. These results are interpreted as evidence for nanoscale dephasing of the high-T_c order parameter under a pair current, shedding new light on the nature of the pseudogap in the enigmatic high-T_c phase diagram.

SU-P1-2 **14h50**

GEORGE A. SAWATZKY, University of British Columbia

Resonant Soft X Ray Scattering ; A New Tool to Study Spin Charge and Orbital Distributions

Recent advances in synchrotron radiation facilities and in the theoretical understanding of x ray spectroscopy of atoms, molecules and solids has opened the door to combining x ray spectroscopy with x ray scattering. Using resonance's in the x ray scattering with element , oxidation state, local symmetry and spin selectivity it is now possible to obtain the spatial distribution of each element or molecular group in a system in an x ray scattering experimental set up. I will describe some very recent results on ultra thin films of high

temperature superconductors and demonstrate the much increased sensitivity to small change in spin and charge distributions. I will describe the possible applications of this technique to a variety of problems in condensed matter physics and chemistry as well as some interesting ideas regarding biological macromolecular structures. The high coherence of modern soft x ray sources allows also for the study of disordered systems using Speckle and Speckle flicker to look at the dynamics with a spatial resolution of better than 1 nanometer.

15h25 Coffee Break / Pause café

SU-P1-3 15h55

MARTIN GREVEN, Stanford University

*Quantum versus Geometric Disorder in a Two-Dimensional Heisenberg Antiferromagnet**

Quantum phase transitions in the presence of quenched disorder are at the forefront of research in the field of strongly correlated electron systems, yet there have been relatively few experimental model systems. Complementary magnetometry, neutron scattering, and numerical experiments demonstrate that the randomly diluted square-lattice Heisenberg antiferromagnet $La_2Cu_{1-p}(Zn,Mg)_pO_4$ (Zn/Mg-LCO) is an excellent model material for the study of site percolation in the quantum-spin limit $S = 1/2$[1]. Quantum Monte Carlo for the bilayer Heisenberg antiferromagnet indicates that the properties of Zn/Mg-LCO near the percolation threshold are controlled by the effective proximity to a new quantum critical point[2]. It is furthermore demonstrated that as-grown, non-superconducting $(Nd,Ce)_2CuO_4$ at low and intermediate Ce doping is a good model material as well[3].

1. O.P. Vajk *et al.*, *Science* **295**, 1691 (2002); *Solid State Comm.* **126**, 93 (2003).
2. O.P. Vajk and M. Greven, *Phys. Rev. Lett.* **89**, 177202 (2002).
3. P.K. Mang, M. Greven, and O.P. Vajk (unpublished)

* Work supported by the US DOE, NSF, and by the A.P. Sloan Foundation.

SU-P1-4 16h30

FRANK MARSIGLIO, University of Alberta

How Do You Determine the Mechanism of Superconductivity

This talk will review how we best know about the mechanism for superconductivity in conventional superconductors, *i.e.* through single electron tunneling spectroscopy. More recent work in various classes of superconductors (cuprates, oxides, buckyballs, and M_9B_2) shows that measurements of the optical conductivity in the normal state can, in some cases, point to the mechanism of superconductivity.

17h05 Session Ends / Fin de la session

[SU-P2] 14h15 Observing the Ionosphere and Magnetosphere from Ground and Space - Canadian Contributions and Innovations / *Observation de l'ionosphère et de la magnétosphère à partir du sol - Les contributions et innovations canadiennes*

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

ROOM / SALLE KC-104 ***Chair: W. Ward, UNB***

SU-P2-1 14h15

GORDON G. SHEPHERD, York University

Canadian Contributions to International Investigations of the Atmospheric Environment: What Were They, and How Did They Come About?

The origins of Canadian international atmospheric science are inextricably linked with those of space science. The first "Canadian" space measurements were from the magnetic observatory established by the British military in 1840, to support the global magnetic field determination by Gauss. The observatory reverted to the University of Toronto in 1853 and in 1872 it became the kernel of the Canadian Meteorological Service. During the 1932 Second International Polar Year, it was the Meteorological Service which organized the measurements of aurora, magnetic fields and Earth currents, in addition to meteorological variables, at Chesterfield Inlet. Later, however, the magnetic, space and atmospheric components ended up in different federal agencies. When Sputnik- I heralded the beginning of the space age it was those who wintered at Chesterfield Inlet that knew how to respond and this they did through their own institutions, university and federal. Had Canada responded more officially, by creating a space agency, it might have found itself burdened with the costs and effort of building a satellite launcher, leaving the science to take second place. Instead, Canada responded by seeking international partners, first the USA, later Sweden, then Japan, and now the European Space Agency. To gain these partnerships, Canada focused on the science, but also on innovative space instrumentation which the partner country did not possess. As a Canadian space industry came into existence, new partnerships formed, within which university scientists created new and challenging instrument concepts that were implemented in industry, under the sponsorship and oversight of government agencies. This pattern was well established by the time the Canadian Space Agency was formed in 1989. Atmospheric measurements can be made from the ground, from balloons, from rockets, and from satellites. All of these methods have been employed in the development of Canadian space instrumentation, resulting in significant contributions to atmospheric science on the world stage. These contributions are described and discussed within the context outlined above.

SU-P2-2 14h45

WAYNE K. HOCKING, University of Western Ontario

*Applications of a World-Wide Network of Mesospheric Radars**

Dynamical motions in the mesosphere are some of the most intense in the Earth's atmosphere. Gravity waves, tides and planetary waves are in continual complex motion, and hurricane-strength winds exceeding 80 m/s (300 km/hr) are not unusual. Intense turbulence dissipation is not uncommon. The region is, however, often ignored, largely because (i) it is high above our heads and (ii) densities are so low that the impact of the motions are diminished compared to interactions in the much more dense troposphere. The region also has the possibility to affect rocket and Shuttle launches, but in general the effects are not severe because of the diminished densities at these heights. However, extrema in dynamical quantities can possibly have an impact. In this talk, we demonstrate the value of a world-wide network of middle atmosphere radars for understanding this region, and as a particular example we use data from a network of equatorial radars to reconstruct the wind field experienced by the Space Shuttle Columbia during its final minutes. An important result is a large wind shear deduced to have occurred at 60 to 65 km altitude over Texas at the time that Columbia passed through, due to an unfortunate alignment of the 2-day wave and the diurnal tide. The extent to which this may have contributed to the destruction of Columbia is under investigation.

* In collaboration with N. Mitchell, S. Franke, P. Batista, B. Clemesha, B. Fuller, T. Nakamura

15h15 Coffee Break / Pause café

SU-P2-3 15h30

EDWARD J. LLEWELLYN, University of Saskatchewan

OSIRIS - Some Highlights of Two Years Successful Operation

Odin is a joint Sweden, Canada, France and Finland astronomy/aeronomy satellite that was launched on February 20, 2001 from Svobodny in eastern Siberia. The satellite, which carries only two instruments — A sub-mm/mm radiometer (SMR) and an optical spectrograph infrared imager system (OSIRIS), is in sun-synchronous orbit time at 600 km altitude with the ascending node at 1800 LT. The SMR is used for both the astronomy and aeronomy missions while OSIRIS is only used with the aeronomy mission. The OSIRIS instrument uses novel limb scattered sunlight observational techniques and innovative tomographic limb imaging of passive airglow emissions to measure minor stratospheric and mesospheric constituent densities under both daytime and nighttime conditions. This paper presents a condensed overview of the results obtained during the first two years of normal operations of the Canadian OSIRIS. The unique 2-D and 3-D capabilities of OSIRIS will be explained and illustrated with some recent results on global distributions of ozone, NO_2, BrO and aerosol burdens as well as new findings for the airglow.

SU-P2-4 **16h00**

Canadian Contributions to the 2007 Mars Volcanic Emission and Life (MARVEL) Scout Proposal*. **V.J. Hipkin**[a], J.R. Drummond[a], J. Abbatt[b], P. Bernath[c], J.J. Caldwell[d], R. Deschaumbault[e], J. Hackett[e], J.C. McConnell[f], C.T. McElroy[a], S.M.L. Melo[a], D.V. Michelangeli[f], J.J. Sloan[c], K. Strong[a], B. Tolton[g], W. Ward[h] and M. Allen[i], [a]Dept of Physics, University of Toronto, [b]Dept of Chemistry, University of Toronto, [c]Dept of Chemistry, University of Waterloo, [d]Dept of Physics and Astronomy, York University, [e]COM DEV Ltd, Cambridge, Ontario, [f]Dept of Earth and Environment, York University, [g]Synadon Ltd, Edmonton, Alberta, [h]Dept of Physics, University of New Brunswick, [i]Jet Propulsion Laboratory, Pasadena, California — The MARVEL mission is one of four missions in the final stage of competition for the 2007 NASA Scout launch opportunity. Its primary goal is to detect active volcanism or life processes through the gases they emit or consume. In the course of its mission it will survey the distribution and composition of gas phase and aerosol components of the Martian atmosphere with sensitivity and resolution approaching state-of-the-art surveys of trace gas chemistry in the Earth's stratosphere. This remarkable mission has a payload of three high resolution instruments: the Mars ATMospheric Occultation Spectrometer (MATMOS), the Submillimeter Investigation for Geothermal Networks and Life (SIGNAL) and the Mars Imager for Cloud and Aerosol (MICA). The Mars Imager for Cloud and Aerosol (MICA) will be wholly designed and built and provided by Canada. Canada will also make contributions to the SIGNAL instrument and MARVEL science team activities. The MARVEL mission strategy is to use a highly sensitive solar occultation spectrometer, MATMOS, to make detections of trace gases at ultra high sensitivity, a microwave sounder, SIGNAL, to localise these detections on the surface of Mars and the MICA camera to image the surface locations where active volcanism or life signatures have been detected. In addition MICA will characterise the distributions and optical properties of Mars cloud and aerosol by imaging the twilight limb. In this paper the MARVEL mission and objectives will be described with particular focus on the Canadian contributions.

* This work is being supported by Crestech and the Canadian Space Agency.

SU-P2-5 **16h15**

JAMES R. DRUMMOND, University of Toronto

The Atmosphere from Space - the Future of Space Measurements

Almost since the first satellite was launched and certainly since Canada launched its first satellite over 40 years ago, satellites have been used as a platform for measuring the atmosphere. As time progressed we have seen a steady increase in capability, coverage, accuracy and the like. Today the idea of trying to understand the atmosphere without the use of satellite measurements would be considered distinctly "quaint".

As we look towards the future, we can see a number of new trends emerging. Small satellites have become more viable. Satellite networks are becoming more possible. Instrumentation is becoming more capable. New techniques are being developed, and old techniques are being revitalised by new technology. Within this range of choices we need to place the requirements of the atmospheric community and particularly the Canadian atmospheric community.

This talk will look at some of these future ideas. The aim will not be to predict the future of space measurements (much too risky!), but to examine how some of these new ideas could be incorporated into a measurement program that is appropriate for Canada and the scientific interests of the Canadian community.

16h45 **Session Ends / Fin de la session**

[SU-KEY] 19h30 Herzberg Memorial Public Lecture / *Conférence publique commemmorative Herzberg* — SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

Chi-Wan Young Sports Centre ***Chair: W.J. McDonald, U. Alberta***

SU-KEY 19h00

DAVID JOHN SOUTHWOOD, European Space Agency

Space Near and Far - Exploring our Universe

The exploration of space is more than a scientific endeavour, although science and physics, in particular, are at the root of it. Any modern technically developed society needs for its own health to look outwards and also backward to its origins. Space science does these tasks in the grandest ways, looking outwards to its limits of the ability to see and to measure, and backwards to whence our galaxy, our planet, indeed ourselves came. Such themes will be explored, using the Europe's space programme for illustration

"L'espace proche et lointain - L'exploration de notre univers et la place que nous y occupons"

L'exploration de l'espace est plus qu'une entreprise scientifique, bien qu'elle tire son origine de la science et de la physique en particulier. Pour son propre bien, toute société moderne évoluée sur le plan technique doit regarder vers l'extérieur, mais aussi remonter jusqu'à ses origines. La science spatiale fait ces démarches de la façon la plus grandiose possible, regardant vers l'extérieur jusqu'aux limites de la capacité de voir et de mesurer, et vers les origines jusqu'à la naissance de notre galaxie, de notre planète et, en fait, de l'homme même. Ces thèmes seront explorés et le programme spatial européen servira à illustrer le propos.

[MO-Plen-1] 09h15 Plenary Session / *Session plénière* — MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE DS 121 ***Chair: D. Jack, Concordia U.***

MO-PLEN 1 **09 h 15**

J. PETER TOENNIES, Max-Planck-Institut fur Strömungsforschung, Germany

Diffraction of Matter Waves from Nanostructures: Novel Applications to Cluster and Surface Science

Nanotechnology advances have made it possible to produce free standing transmission gratings with slits of 50 nm width. The diffraction of atoms, molecules and small clusters from such gratings provide beautiful textbook examples of matter wave phenomena. Since only the wave nature of the particles is involved even the exceedingly weakly bound ^{4}He dimers (binding energy ≈ 10^{-3} K (≈ 10^{-7} eV)) and other small ^{4}He clusters with up to N = 21 atoms can be resolved by virtue of their different de Broglie wavelengths. Magic numbers identified at N = 9, 15, 26 and 44 provide the first experimental evidence for the quantized collective excitations of these Bose condensed systems [1]. Deviations of the diffraction intensities from predictions by traditional optics have been used to measure for the first time the long range particle-surface potentials ($-C_3/z^3$) of ground state and electronically excited metastable rare gas atoms and several ground state molecules [2] as well as the geometrical sizes of the He dimer (≈ 50 A) [3] and of the trimer (10 A)

With three identical transmission gratings a Mach-Zehnder universal matter wave interferometer has been demonstrated. This device opens up a wide range of intriguing new experiments in surface and molecular physics. Transmission Fresnel zone plates have also been used to focus an atomic beam onto a 1 micron diameter spot [4], so that an essential part of a uniquely surface sensitive helium atom microscope is now available.

1. A. Kalinine, O. Kornilov, J.P. Toennies, R. Guardiola and J. Navarro, in preparation
2. R.E. Grisenti *et al.*, *Phys. Rev. Lett.* **83**, 1755 (1999); R. Bruhl *et al.*, *Europhys. Lett.* **59**, 57 (2002)
3. R.E. Grisenti, W. Schöllkopf, J.P. Toennies, G.C. Hegerfeldt, T. Köhler and M. Stoll, *Phys. Rev. Lett.* **85**, 2284 (2000)
4. R.B. Doak, R.E. Grisenti, S. Rehbein, G. Schmahl, J.P. Toennies and Ch. Wöll, *Phys. Rev. Lett.* **83**, 4229 (1999)

10h00 Session Ends

[MO-A1] 10h00 Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond / *Observation de l'ionosphère et de la magnétosphère à partir du sol - CANOPUS et au délà*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-D ***Chair: J. Samson, U. Alberta***

MO-A1-1 **10 h 00**

IAN ROBERT MANN, University of Alberta

The Role of Global Scale ULF Waves in Driving Magnetospheric Dynamics: CANOPUS and Beyond

Global scale ultra-low frequency (ULF) waves are increasingly recognised as playing an important role in solar-terrestrial coupling. Recent advances have shown how global scale ULF modes can inject significant energy into near-Earth space. Large amplitude electric fields in these modes drives significant magnetosphere-ionosphere coupling through the generation of field aligned currents and the modulation of auroral electron precipitation through both the generation of field line resonances on closed field lines, as well as through mode coupling on field lines threading the nightside plasmasheet boundary layer. These global mode electric fields can also cause significant wave-particle interaction, recent models proposing that ULF waves might play an important role in the acceleration of MeV energy so-called "killer" electrons in the outer radiation belt. In this paper we review these recent advances, highlighting how arrays of ground-based instruments can provide a unique global view of these energization processes. Historically, the CANOPUS array has provided an internationally important view of the ionospheric projection of the effects of these global scale modes. We finish by outlining the forthcoming three-fold expansion to the CANOPUS magnetometer array, reviewing the scientific targets for this expansion and highlighting the expected future scientific rewards.

MO-A1-2 **10h30**

Origin of Two Types of Quasi-Periodic Backscatter as Observed With the Gadanki Radar. **R.K. Choudhary**, J.-P. St.-Maurice, L.M. Kagan and K.K. Mahajan, *University of Western Ontario* — Analyzing the field-aligned backscatter observed over Gadanki, India (13.5°N, 79.2°E) we distinguish two types of quasiperiodic backscatter in connection with their Doppler signature. The first type is observed below 110 km. In this case the line of sight Doppler velocity associated with each striation presents a vortex-like structure. The second type, observed above 110 km, shows a systematic pattern in which the predominantly negative Doppler velocity (motion towards the radar) decreases in magnitude with increasing height. The Doppler velocity reverses its sign and becomes predominantly positive (away from radar) above the neutral line. Despite the fact that at the neutral line the Doppler velocity is zero, the power associated with it is maximum. We show that these observations are consistent with the "Cat's eyes" that form in an unstable shear region.

MO-A1-3 **10h45**

Review of LF/MF/HF Radio Observations at CANOPUS Observatories. **James W. LaBelle**, *Dartmouth College, USA* — Dartmouth College has operated LF/MF/HF radio receivers in CANOPUS observatories since 1994. The primary purpose of these receivers is to detect radio emissions of auroral origin, especially LF auroral hiss, auroral MF-burst, and auroral roar. MF-burst is a broad band emission at 1.5-4.5 MHz occurring at sub-storm onset; auroral roar is a narrow band emission near two and three times the ionospheric electron gyrofrequency occurring before, during, and after sub-storm onsets. In addition to these emissions, the CANOPUS LF/MF/HF receivers measure interesting characteristics of sub-ionospherically propagating signals at 100 kHZ-5 MHz. This paper reviews briefly the contributions CANOPUS results have made to the field of auroral emissions. These contributions include the first observations of some of the emissions across a latitudinal chain, the first observations of the polarization of some of the emissions, measurements of fine structure of the emissions, and statistics of the emissions as functions of latitude, local time, magnetic activity, etc. There remains much about these emissions which can be learned from operation of sensitive high-resolution receivers in a network of auroral observatories.

MO-A1-4 **11h00**

Polar Cap Bifurcation During Steady-State Northward Interplanetary Magnetic Field With |BY|~BZ. **Masakazu Watanabe**, George J. Sofko, Dieter A. André, Takashi Tanaka, and Marc R. Hairston, *University of Saskatchewan* — We propose a polar cap configuration model that occurs for steady-state northward interplanetary magnetic field (IMF) with |BY|~BZ. When the IMF reconnects with the closed geomagnetic field on the dayside high-latitude magnetopause, two types of open geomagnetic field lines are created. For the first type, the neutral point and the foot point are in the same hemisphere; for the second type the neutral point and the foot point are in opposite hemispheres. The latter type of field lines slips on the magnetopause in the azimuthal direction opposite to the normal BY-associated flux transport and forms an overdraped tail lobe. The ionospheric signature of this overdraped lobe is the appearance of an open magnetic flux island inside the dawn/dusk plasma sheet (i.e., polar cap bifurcation). For BY>0 the island emerges in the duskside (dawnside) plasma sheet in the northern (southern) ionosphere, and conversely for BY<0. The overdraped field lines which have slipped on the magnetopause then reconnect with closed geomagnetic field lines in the opposite hemisphere to the foot points, thereby transferring the open magnetic flux to the nightside convection system and maintaining the steady-state magnetic flux circulation. As a result, there appears a pair of convection cells in the ionosphere that exchange magnetic flux with each other. For BY>0 the pair is located in the noon-dusk and midnight-dawn (dawn-noon and dusk-midnight) quadrants of the northern (southern) ionosphere; for BY<0 a mirror image with respect to the noon-midnight meridian applies to the convection pattern. We demonstrate observational evidence that supports this model.

11h15 **Coffee Break / Pause café**

MO-A1-5 **11h30**

Gyro-radius-scale Density Depletions Caused by Localized Ion Heating in Space Plasmas. **D.J. Knudsen**, B.J.J. Bock, J.K. Burchill, *University of Calgary* — Several sounding rockets have observed narrow, cylindrical plasma density depletions in the auroral ionosphere above 500 km altitude. These depletions are aligned with the geomagnetic field $\mathbf{B}_0$ and have a relatively narrow distribution of cross-$\mathbf{B}_0$ diameters – 18 ±13 m - indicating a very specific mechanism is responsible for setting their spatial scale. The density depletions trap ambient electric wave power in the lower-hybrid frequency range (several kHz); the enhanced waves in turn heat ions in the direction transverse to $\mathbf{B}_0$. These "lower-hybrid cavities" (LHC's) therefore represent a mechanism responsible for both fine structure and particle acceleration within space plasmas, and likely operate throughout the universe. It is clear that LHC's are formed when density depletions trap waves, and waves then heat ions. However, the cause of the original depletions remains unexplained. Inspired by observations from the Canadian GEODESIC and OEDIPUS-C sounding rockets, this presentation proposes that depletions are a direct result of localized ion heating, closing the chain of events and creating a self-consistent feedback loop. Specifically, ions heated on a localized flux tube will travel outside the flux tube, leading to a diminished plasma density on the parent flux tube, on average. Cooler ions outside the cavity will have smaller gyroradii and cannot compensate for reduced plasma density on the heated tube. We present semi-analytical and Monte-Carlo simulation results showing an idealized model that relates several-fold temperature enhancements to density depletions of 10% or more.

MO-A1-6 **11h45**

Kinetic Simulations of Electron Response to Shear Alfven Waves in Collisionless Plasmas*. **Clare E.J. Watt**[a], Robert Rankin[a], Richard Marchand[a] and Vladimir T. Tikhonchuk[b], [a]*University of Alberta*, [b]Institut de Physique Fondamentale, Université Bordeaux — Both standing and travelling shear Alfven waves (SAW) have been shown to contribute to electron acceleration along geomagnetic field lines, as well as the formation of parallel electric fields in the auroral acceleration region. We extend the linearized perturbation approach of Tikhonchuk and Rankin[1]. They use linearized kinetic theory to study the motion of the electrons along the field line due to SAW. We solve the full nonlinear coupled Vlasov-Maxwell system in one dimension. The Vlasov equation is gyro-averaged in order to minimize the number of dimensions in the problem. In order to avoid numerical problems with the direct evaluation of the parallel electric field, we describe the electron distribution function in terms of a spatial coordinate along the field line, the magnetic moment, and the canonical parallel momentum per unit mass. Here, we describe the code and present some preliminary studies of SAW propagating in both uniform and non-uniform magnetic fields, where we can demonstrate Landau damping of the SAW and observe the kinetic electron response and the parallel electric field.

1. *Physics of Plasmas*, **7**, 2630, 2000

* This work was supported by the Natural Sciences and Engineering Council (NSERC) of Canada

MO-A1-7 **12h00**

Dusk-Sector Pc5 Pulsation Activity Related to Magnetopause Oscillations During a High Solar Wind Speed Event. I.J. Rae, **E.F. Donovan**, F.R. Fenrich, G. Baker, M. Lessard, M. Henderson, G.J. Sofko, H. Rème, S.W.H. Cowley, B. Lavraud, and J.A. Wild, *University of Alberta* — We present an interval of long-lasting Pc5 pulsations following an extremely active day, which may shed light on the communication between ULF waves and high-energy electrons. Virtually monochromatic large amplitude highly-polarised pulsations were observed by the CANOPUS magnetometer chain at dusk for many hours, during which the Cluster spacecraft constellation traversed the dusk magnetopause. The solar wind conditions are very steady, the solar wind speed is fast, and time series analysis of the solar wind data shows no significant power concentrated in the Pc5 band. Many radars of the SuperDARN HF network observed clear pulsations of similar frequencies as these radars rotated into the dusk sector ionosphere. The pulsations are observed in geosynchronous LANL SOPA data at all local times. While Cluster is in the vicinity of the magnetopause, it provides clear evidence of boundary oscillations with essentially the same periodicity as the ground and geosynchronous observed pulsations. This event is an excellent example of global ULF activity driven by compressional waves which are in turn driven by magnetopause oscillations. These oscillations are clearly not present in the solar wind, and the frequency is clearly selected by the magnetopheric characteristics.

The fact that these oscillations are observed globally in the magnetosphere, but only in the dusk sector in the ionsphere, supports the idea that local time distribution of ground-observed ULF pulsations is at least partly due to the ionospheric response to ULF waves.

MO-A1-8 12h15

Substorm Associated Changes in High-latitude Convection. P.T. Jayachandran[a], J.W. MacDougall[a], E.F. Donovan[b], J.M. Ruohoniemi[c], K. Liou[c], D.R. Moorcroft[a] and J.P. St Maurice[a], [a]*University of Western Ontario.* [b]University of Calgary and [c]Johns Hopkins Applied Physics Laboratory — A study of polar cap/dayside convection response to substorm intervals using Canadian Advanced Digital Ionosondes (CADIs) situated well within the polar cap and SuperDARN radars during steady and prolonged southward IMF Bz conditions showed three distinct features: (1) gradual decrease of dayside/polar cap convection speed till the substorm onset, (2) sudden decrease of convection following the onset of the substorm, and (3) increase of convection during the recovery phase of the substorm. The observed features of the convection can be explained by the reduction and enhancement of the region 1 current system associated with the substorm. Magnetometers situated inside the polar cap shows features consistent with this explanation.

12h30 - Session Ends/Fin de la session

[MO-A2] 10h00 Observing the Atmosphere from Ground and Space - Canadian Contributions and Innovations / *Observation de Observation de l'atmosphère à partir du sol - Les contributions et innovations canadiennes*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-C ***Chair: W. Ward, UNB***

MO-A2-1 10h00

C. THOMAS MCELROY, ARQX, Meteorological Service of Canada

Ozone Measurement in Canada: From Research to Operations

Stratospheric ozone has been measured in Canada by a variety of instrumentation since the 1920's. The regular program of ozone network measurements operated by the Meteorological Service of Canada dates back to the 1957 International Geophysical Year (IGY). Originally, ozone observations were made as part of a research effort to understand the energetics and dynamics of the stratosphere and continued to grow throughout the later decades of the last century in connection with the stratospheric pollution issue. We have now come almost full circle with ozone measurements being considered as additional meteorological data for chemical-dynamical, environmental prediction models. What began as an intellectual curiosity has become part of the public forecast of ozone and Ultraviolet radiation. The Canadian ozone program, some of its history and its future will be discussed with emphasis on the scientific and technical evolution which has taken place in the program over the last 70 years.

MO-A2-2 10h30

PETER F. BERNATH, University of Waterloo

The Atmospheric Chemistry Experiment (ACE): Mission Overview and Status

The main goal of the ACE mission is to measure and to understand the chemical and dynamical processes that control the distribution of ozone in the upper troposphere and stratosphere, with a particular emphasis on the Arctic region. A comprehensive set of simultaneous measurements of trace gases, thin clouds, aerosols, and temperature will be made by solar occultation from a satellite in low earth orbit. A high inclination (74 degrees) low earth orbit (650 km) will give ACE coverage of tropical, mid-latitudes and polar regions. The vertical resolution will be better than 4 km from the cloud tops up to about 100 km. The solar occultation advantages are high sensitivity and self-calibration.

A high-resolution (0.02 cm^{-1}) infrared Fourier Transform Spectrometer (FTS) operating from 2 to 13 microns (750-4100 cm^{-1}) will measure the vertical distribution of trace gases, and the meteorological variables of temperature and pressure. The ACE concept is derived from the now-retired ATMOS FTS instrument, which flew on the Space Shuttle in 1985, 1992, 1993 and 1994. Aerosols and clouds (e.g., Polar Stratospheric Clouds, PSCs) will be monitored using the extinction of solar radiation at 0.525 and 1.02 microns as measured by two filtered imagers as well as by their infrared spectra. These two imager wavelengths match the two SAGE II channels used primarily for aerosols. A dual spectrograph called MAESTRO (1-2 nm resolution) has been added to the mission to extend the wavelength coverage to the 280-1000 nm spectral region. MAESTRO has a higher vertical resolution (1 km) than the ACE-FTS. The broad-band atmospheric extinction measured with high signal-to-noise ratio by MAESTRO is particularly useful for the derivation of aerosol and cloud properties. The PI for the MAESTRO instrument is T. McElroy from the Meteorological Service of Canada (MSC).

ACE is unique in that MAESTRO, the ACE-FTS and the imagers all share the same suntracker and make simultaneous measurements of the same scene. As secondary science, both the FTS and MAESTRO can record spectra in the near nadir direction. The FTS and imagers have been built by ABB-Bomem in Quebec City, while the satellite bus has been made by Bristol Aerospace in Winnipeg. ACE has been selected in the Canadian Space Agency's SCISAT-1 program for a planned launch by NASA in July 2003 for a 2 year mission.

MO-A2-3 11h00

The MAESTRO Space Instrument Model: Pre-Launch and On-Orbit Characterization. **Caroline R. Nowlan**[a], C. Thomas McElroy[a,b], Denis Dufour, Clive Midwinter[b], and James R. Drummond[b], [a]*University of Toronto and* [b]*Meteorological Service of Canada* — MAESTRO (Measurement of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation) is a UV-visible photodiode array grating spectrometer that will accompany the Atmospheric Chemistry Experiment (ACE) Fourier transform spectrometer onboard Canada's SCISAT-1 satellite. MAESTRO will make solar occultation and nadir measurements of the atmosphere to investigate the dynamical and chemical processes affecting ozone in the middle atmosphere. The primary measurement mode of solar occultation will provide vertical profiles of ozone, several trace gases involved in ozone chemistry, aerosols, and pressure and temperature at a vertical resolution of approximately 1km. In order to process the on-orbit data into meaningful spectra for atmospheric retrievals, a detailed instrument model has been developed to consider effects such as instrument temperature changes, electronic offsets, detector etaloning, and stray light. Pre-launch characterization of the MAESTRO instrument has provided us with the majority of our insight into the instrument's performance. Assessment of MAESTRO's performance on-orbit is also critical to the retrieval of quality spectra and information on atmospheric properties.

11h15 Coffee Break

MO-A2-4 11h30

A Comparison of Simultaneous Gas Absorption Measurements with the ACE-FTS and MAESTRO Space Instruments. **Denis Dufour**[a], James R. Drummond[a], Tom McElroy[b], Clive Midwinter[b], Peter Sinclair[c], Richard Berman[d], Caroline Nowlan[a], Wayne Evans[d], Eldon Puckrin[d], [a]*University of Toronto,* [b]Meteorological Service of Canada, [c]Spectral Applied Research, [d]Trent University — Scisat-1 is the first entirely Canadian scientific satellite to be launched in over thirty years. Its two principal instruments, the ACE-FTS (Atmospheric Chemistry Experiment Fourier Transform Spectrometer) and MAESTRO (Measurements of Aerosol Extinction in the Stratosphere through Retrievals of Occultations) are designed to retrieve vertical profiles of ozone and other stratospheric constituents by taking spectra as the sun rises and sets over the earth's limb. The ACE-FTS is a high resolution Michelson Interferometer operating in the 750 to 4100 cm^{-1} spectral range, while MAESTRO is a dual holographic grating spectrometer operating in the 280-1000 nm range. Simultaneous characterization of both instruments is important in order to assess whether or not they will provide conflicting measurements when in space. In order to address this issue, a novel experimental apparatus that sends the combined beam of a high temperature black body source and that of a Xenon arc lamp into Scisat-1 while it is in a thermal-vacuum chamber was developed at the University of Toronto Instrument Characterization Facility. This high powered, wide spectral range source allows us to take simultaneous measurements with both instruments, which is crucial for determining optical characteristics, inter-comparing gas cell absorption spectra and simulating occultation events. Absorption spectra for various quantities of ozone and nitrogen dioxide were obtained during pre-launch characterization tests performed in February and March 2003. Results based on these measurements will be presented along with a description of the optical apparatus.

MO-A2-5 11h45

KIMBERLY STRONG, University of Toronto

Observations of Atmospheric Composition Using Balloon-Borne and Ground-Based Instruments

The MANTRA (Middle Atmosphere Nitrogen TRend Assessment) series of high-altitude balloon flights is being undertaken to investigate the changing chemical balance in the mid-latitude stratosphere, with a focus on nitrogen and chlorine compounds. Three balloons have been launched to date, in 1998, 2000, and 2002, all from Vanscoy, Saskatchewan (52°N, 107°W). Each carried a suite of instruments to measure vertical profiles of stratospheric trace gases from a float altitude of about 35 km for one day. Several of these instruments were flown by Environment Canada 15-20 years ago, providing a link to historical data predating the onset of mid-latitude ozone loss. This presentation will provide an overview of the MANTRA project, including the scientific objectives, the instrumentation, and the measurements. Results from all three balloon campaigns will be discussed,

including comparisons with near-coincident space-based measurements obtained by instruments on the Odin and ENVISAT satellites, and with output from the Canadian Middle Atmosphere Model (CMAM), a fully interactive chemistry-climate model.

We are also involved in measuring atmospheric composition using two ground-based instruments. A UV-visible grating spectrometer has been deployed on five Arctic field campaigns between 1999 and 2003: four at Environment Canada's Arctic Stratospheric Ozone Observatory (ASTRO) at Eureka (80°N) and one at Resolute Bay (75°). At these locations, it has been used to measure ozone and NO_2 total columns, as well as NO_2 vertical profiles, during the crucial winter/spring period when the perturbed conditions leading to chemical ozone depletion occur. This instrument and the retrieval algorithms will be briefly described and data from the Arctic campaigns will be reviewed. At the recently established University of Toronto Atmospheric Observatory (TAO), located at 44°N, we are measuring both stratospheric and tropospheric constituents. The primary instrument at this facility is a Bomem DA8 high-resolution Fourier transform infrared spectrometer. It is used to record solar absorption spectra, from which total columns and vertical profiles of many trace gases can be derived. Daily measurements began in October 2001 for the purpose of building a long-term data set of key species related to climate change and mid-latitude atmospheric chemistry. The first vertical profiles and column amounts have been derived for CO, C_2H_2, HCN, CH_4, O_3, HNO_3, N_2O, NO_2, HCl, and HF. These results will be presented, along with a characterization of our retrievals. They will also be compared, where appropriate, with climatological output from the CMAM.

MO-A2-6 **12h15**

Instrument Characterization and Ozone Measurements from the Ground-Based Fourier-Transform InfraRed Spectrometer at Toronto. **J. Taylor**, D. Yashcov, A. Wiacek, K. Strong, R. Berman, H. Fast, R. Mittermeier and S. Pal, *University of Toronto* — A Bomem DA8 high-resolution Fourier-Transform InfraRed (FTIR) spectrometer is the primary instrument at the University of Toronto Atmospheric Observatory (TAO). Continuous measurements of solar absorption spectra were started in October 2001. Spectra are recorded in six filter bands from 750 to 4300 cm^{-1} at a resolution of 0.0026 cm^{-1}, which allows the absorption lines of a broad range of atmospheric trace gases to be distinguished. A blackbody source has recently been optically coupled to the FTIR to enable accurate calibration of the solar measurements. Characterization of the instrumental line shape with the LINEFIT algorithm (developed at the Institut fur Meteorologie und Klimaforschung, Karlsruhe, Germany) was also completed. The capabilities of the FTIR spectrometer and results from these blackbody measurements will be presented.

The retrieval of a number of atmospheric trace gases is performed using the SFIT-2 algorithm (developed at NASA Langley Research Center, USA, and NIWA, New Zealand), together with the HITRAN 2000+ spectral database, NCEP temperature and pressure profiles and volume mixing ratio *a priori* information. The first vertical profiles and total column amounts have been derived for CO, C_2H_2, HCN, CH_4, O_3, HNO_3, N_2O, NO_2, HCl, and HF. This presentation will focus on the O_3 measurements made over Toronto, and will include comparisons with O_3 profiles recorded at high vertical resolution with a nearby LIDAR instrument and with satellite measurements made by the Canadian Optical Spectrograph and InfraRed Imager System (OSIRIS).

12h30 **Session Ends / Fin de la session**

[MO-A3] 10h00 Atomic and Molecular Spectroscopy and Dynamics I / *Spectroscopie et dynamique atomique et moléculaire I*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE MN-40 ***Chair: W.-K. Liu, U. Waterloo***

MO-A3-1 **10h00**

C.H. STORRY, Harvard University

Antihydrogen Production and Detection

Antihydrogen is the simplest antimatter atom. Antihydrogen was produced at cryogenic temperatures for the first time at CERN[1,2] and may soon be trapped and laser cooled for high precision spectroscopy, providing a sensitive test of CPT invariance. In the ATRAP experiments, 10^5 antiprotons and 10^6 positrons, both produced at relativistic speeds, are captured and cooled in our Penning trap to 4 K, in a vacuum of better than $5x10^{-17}$ torr. The cold antihydrogen atoms were produced by collisions between antiprotons and a cloud of positrons in a nested Penning trap. They were detected, free of background, by ionizing the highly excited states with an electric field. The antiprotons were captured in a potential well, which provided the ionizing field. The antiprotons were later ejected and counted by detecting the annihilation products with scintillating detectors. The electric field required to ionize the atoms provides a measure of the atomic states of these Rydberg atoms[3].

A second process by which cold antihydrogen may have been produced is two-stage charge exchange using a laser-excited beam of Rydberg cesium atoms[4]. The first stage of this highly efficient process has been investigated using a thermal beam of cesium atoms, laser excited into an n = 37 state. The Rydberg atoms enter the trap through a hole in one of the ring electrodes that provide the axial confinement of the positrons. 4000/second excited cesium atoms enter the trap, where a cloud of ~$2x10^5$ cold positrons are held. In a gentle collision, the Rydberg electron is transferred from the cesium ion core to a positron, producing Rydberg positronium atoms in similar highly excited states to the incident excited cesium atoms. The neutral positronium atoms are not confined by the Penning trap fields and leave the cloud of trapped positrons. Adjacent potential wells provide a large electric field and ionize the positronium atoms. The positron is trapped and counted by detecting their axial oscillations in the potential well. Experiments to produce antihydrogen by two-stage change exchange are underway.

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2. *Phys. Rev. Lett.* **89**, 213401 (2002)
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MO-A3-2 **10h30**

TIM REDDISH, University of Windsor

Photo-Double Ionisation of D_2 and He

The break-up of D_2 following the absorption of a single photon, leading to four, free charged particles interacting via the long-range Coulomb force, possesses rich and interesting electron/ion dynamics. Despite significant theoretical progress over the last few years[1-6], this process is less well understood than photo-double ionisation (PDI) of helium[7]; the existence of a molecular axis and the two moving ionic centres add a significant degree of complexity to the PDI dynamics. Coincidence experiments[8-14] probing the correlated motion of these particles are both scarce and challenging. Recent D_2 mutual angular distribution measurements of the two escaping electrons will be presented. These triple differential cross sections (TDCSs) were obtained at the SuperACO synchrotron, using a toroidal photoelectron coincidence spectrometer. A photon energy corresponding to an excess energy of 25 eV above the double ionisation threshold was used for a variety of electron energy sharing ratios (R = E2/E1). Investigations of the changes in the mutual angular distribution of the faster electron as a function of R (with the emission direction of the slower electron fixed along that of the polarisation vector) have revealed that this excess energy is particularly sensitive probe of electron correlation. The D_2 results are compared with helium TDCSs obtained under near identical conditions and, although the respective angular distributions have similar features, there are surprising differences whose possible origins will be discussed qualitatively.

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MO-A3-3 **11h00**

M1 Transition Rate for the Coronal Green Line of Fe XIV measured with an EBIT*. **E. Pinnington**[a], E. Trabert[b] and P. Beiersdorfer[c], [a]*University of Alberta*, [b]Ruhr-Universitat Bochum, Germany and [c]Lawrence Livermore National Laboratory — The M1 transition at 530.286nm between the ground state fine-structure levels in thirteen-times ionized iron is frequently used for diagnostic studies of the solar corona. Not surprisingly, many calculations have been made of the A-value for this transition, these calculations (with one or two exceptions) have given consistent results, clustering around 60.3s^{-1}. In 1999, Moehs and Church measured the A-value as 57.1±1.0s^{-1}. In order to resolve this discrepancy, we have measured the A-value of the coronal green line using an electron-beam-ion-trap at the Lawrence Livermore National Laboratory, obtaining a value of 59.7 ± -0.4^{-1}, in agreement with the theoretical consensus.

* Work supported by NSERC, the US Dept of Energy, NASA and the German Research Foundation.

11h15 **Coffee Break / Pause café**

MO-A3-4 **11h30**

CO Lineshapes: A Comparison between Ab Initio Calculations and High-Resolution Measurements. R. **Wehr**[d], R. Ciurylo[b], F. Thibault[c], L. Zhan[d], A. Vitcu[a], W.-K. Liu[d], A.D. May[a], and J.R. Drummond[a], [a]*University of Toronto*, [b]UMR 6627 du CNRS, Université de Rennes, [c]Instytut Fizyki, Universytet Mikolaja Kopernika, [d]University of Waterloo - The role of inelastic collisions in the formation of infrared spectral line shapes is explored through a comparison of spectroscopic measurements and ab initio calculations. The shapes of a set of CO-Ar spectral lines in the fundamental band were recorded between -50°C and +25°C, and between 0.05 atm and 1 atm, by a difference-frequency laser spectrometer with a resolution of less than 2 MHz and a signal-to-noise ratio greater than 4000:1. The ab initio line shape calculations used broadening coefficients obtained from fully quantal close-coupled calculations, which were in turn based on an assumed molecular potential energy surface. It is found that a failure to distinguish elastic and inelastic collisions in the CO-Ar system leads to incorrect line shape calculations at low pressures.

MO-A3-5 **11h45**

CO_2-MWSB Generation with High-J Sequence and Hot Band CO_2 Laser Lines and Broad-Band Scan Capability. **Zhen-Dong Sun**[a], Qiang Liu[a], Vladimir Dorovskikh[b], M. Yu Tretyakov[b], R.M. Lees[a] and Li-Hong Xu[a], [a]*Université de Sherbrooke*, [b]Institute of Applied Physics, Nizhny Novgorod, Russia — A broadband tunable CO_2-laser/microwave sideband spectrometer is now in operation at UNBSJ with the following noteworthy features: (i) The source coverage has been significantly improved as we have obtained useful sideband power for regular CO_2 lines up to very high J (J_{upper} = 56) as well as hot and sequence band CO_2 laser lines, giving continuous coverage over significant spectral regions; (ii) The whole system has now been automated with sophisticated computer-controlled sweep and data capture in which the HP-MW synthesizer and Fabry-Perot etalon filter are scanned simultaneously to give wide-band continuous sweep over the full 7-18 GHz range for either sideband; (iii) Balanced detection of sample and reference has greatly improved the S/N ratio through compensation for background variations. Tests on the dense methanol spectrum in our room temperature multipass static cell around 10 μm have shown excellent resolution and S/N ratio using the hot and sequence band CO_2 lines. Use of the source in the first tests of our supersonic slit-jet cooled molecular beam with OCS have shown significantly reduced line width compared to room-temperature static-cell values.

MO-A3-6 **12h00**

The ν_5 Band of CH_3CD_3: High Resolution Spectrum and Global Three-Band Analysis. **J.R. Cooper**[a], A.R.W. McKellar[b], I. Ozier[c] and N. Moazzen-Ahmadi[a], [a]*University of Calgary*, [b]Steacie Institute for Molecular Sciences, National Research Council, [c]University of British Columbia — The lowest frequency parallel fundamental band ν_5 of CH_3CD_3 near 900 cm^{-1} was measured at low temperature with a resolution of 0.0021 cm^{-1} using Fourier transform spectroscopy. The band is weak, and an absorption path of 60m was used. Large torsional splittings due to inter-vibrational coupling have been observed. Building on previous studies of the torsional levels in the ground vibrational state and in the methyl rocking state (ν_{12} = 1), a three-band analysis including this most recent data has been completed. The combined data set of more than 2,200 frequencies was fitted to within experimental accuracy using a 43-term model Hamiltonian. The results were found to bear a striking resemblance to those of an earlier, analogous study of CH_3SiH_3. In both cases, Fermi coupling between the (ν_5 = 1) state and the ground state was found to be the dominant interaction responsible for the observed torsional splittings. Inclusion of this coupling results in a simplification of the ground-state Hamiltonian, so that only eight additional terms were required with the introduction of the ν_5 band.

MO-A3-7 **12h15**

High Resolution Laser Spectroscopy of Hafnium Monofluoride. **Scott Hopkins** and A.G. Adam, *University of New Brunswick* – High resolution laser spectra of HfF have been acquired in the visible region of the spectrum. The molecules were produced via laser ablation of a hafnium target rod, followed by reaction with SF_6 in a pulsed supersonic jet. Several electronic transitions have been observed and analysed between 17,000 and 23,000 cm^{-1}, all yielding an Ω'=3/2 ground state consistent with the $^2\Delta_{7/2}$ ground state of HfCl[1]. Curiously, two electronic transitions at 19,707 cm^{-1} and 19,977 cm^{-1}, which have both been assigned as [Ω'=½] - X[Ω''=3/2], exhibit $^2\Sigma$ - $^2\Pi$ structure. Work on this molecule is continuing and the results will be discussed.

1. R.S. Ram, A.G. Adam, A. Tsouli, J. Lievin, and P.F. Bernath, *J. Mol. Spectrosc.* **202**, 116(2000).

12h30 **Session Ends / Fin de la session**

[MO-A4] 10h00 Young Investigators in Condensed Matter and Materials Physics / *Jeunes chercheurs en matière condensée et en physique des matériaux*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE DS-121 ***Chair: B. Gaulin, McMaster U.***

MO-A4-1 **10h00**

KARYN LE HUR, Université de Sherbrooke

Revival of Kondo Physics with Nanotechnology

The existence of magnetic impurities in metals is well-known to give rise to unconventional electric transport and specific heat. In 1963, taking into account the interaction between the conduction electrons and the localized magnetic moments, J. Kondo already managed to explain the anomalous behavior of the resistivity as a function of the temperature of certain metals. The aim of this talk is to emphasize that the recent development of nanotechnology (quantum dots, nanotubes) allows us to reconsider the Kondo problem at a more mesoscopic scale and at the same time to answer fundamental questions like: "What is the conductance through a quantum dot? What is the capacitance of a dot coupled to external leads inducing charge fluctuations?

MO-A4-2 **10h30**

KIRILL SAMOKHIN, Brock University

Superconductivity in Ferromagnets

Superconductivity and ferromagnetism are two textbook examples of non-trivial collective phenomena in solids. For a long time, they were thought to be mutually exclusive, but the recent discoveries of several transition element compounds (UGe_2, $ZrZn_2$, URhGe) and carbon-based materials that exhibit unusual co-existence of the superconducting and ferromagnetic orders calls for a revision of our views on the interplay of the two phenomena. In particular, one of the striking features of these novel materials is that superconductivity exists only in the magnetic phase, *i.e.* seems to be promoted by ferromagnetism, in a sharp contrast with the theoretical expectation that it should be suppressed by a large internal field. In this talk, I will review the recent experimental and theoretical progress in this area, focussing on the possible explanations of the phase diagram and on the symmetry and the gap structure of the superconducting order parameter.

11h00 **Coffee Break / Pause café**

MO-A4-3 **11h30**

ANDREA DAMASCELLI, University of British Columbia

Probing the Electronic Structure of Complex Systems by State-of-the-Art ARPES

Angle-resolved photoemission spectroscopy (ARPES) is one of the most direct methods of studying the electronic structure of solids. By measuring the kinetic energy and angular distribution of the electrons photoemitted from a sample illuminated with sufficiently high-energy radiation, it is possible to gain information on both the energy and momentum

of the electrons propagating inside the material, which is essential in elucidating the interplay between the spin, charge, and orbital degrees of freedom. This is of vital importance because it is the intimate interplay between these characteristics that determines the macroscopic physical properties and application potential of novel complex materials.

During the past decade, a great deal of effort has been invested in further improving this technique which now allows for unprecedented energy and angular resolution, thus ushering in a new era in electronic spectroscopy. This allows a detailed comparison between theory and experiment and, as exemplified by our recent work on unconventional superconductors such as Sr_2RuO_4 and the high-T_c copper oxides, has led to critical new discoveries[1]. In this talk I will review some of the most recent results in the field focussing, in particular, on Sr_2RuO_4 and $Bi_2Sr_2CaCu_2O_{8+\delta}$, which, because of their exotic superconducting mechanism and rich electronic structure, are extremely interesting materials and, at the same time, very good test cases to illustrate the capability of state-of-the-art ARPES.

1. For a review, see: A. Damascelli, Z.-X. Shen, Z. Hussain, *Rev. Mod. Phys.*, in press (cond-mat/0208504).

MO-A4-4 **12h00**

RACHEL WORTIS, Trent University

Nuclear Magnetic Resonance in the Vortex State of Cuprate Superconductors

The so-called normal state of high T_c materials is arguably far more mysterious than the superconducting state. Moreover, some understanding of the normal state would appear to be key in determining the still controversial mechanism of superconductivity. The vortex state offers the possibility of dipping one's toe into the normal state while standing on the firmer ground of the superconducting state. This talk will describe how the vortex state transforms the technique of nuclear magnetic resonance into a local probe on precisely the length scale of interest, and will discuss both the current status and future potential of such measurements.

12h30 **Session Ends / Fin de la session**

[MO-A5] 10h00 The Precision Frontier / *À la limite de la précision*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE CS-104 ***Chair: W. Trischuk, U. Toronto***

MO-A5-1 **10h00**

JANIS MCKENNA, University of British Columbia

CP Violation in the B Meson System

Modern Big Bang theories in particle astrophysics tend to predict equal quantities of matter and antimatter in our universe. CP violation, first observed 38 years ago in the neutral kaon system, has now also been observed in the B meson system and will be a key element in understanding the matter-antimatter asymmetry in our universe. Our Standard Model of Particle Physics accommodates CP violation, but at a level orders of magnitude too small to explain the matter-antimatter asymmetry. In studying the decays of millions of B mesons using the BaBar detector at the Stanford Linear Accelerator Center (SLAC) B Factory, we have been examining CP violation and measuring CP violating parameters in the B meson system to great precision. We hope to ascertain the origin of CP violation and find hints of physics beyond the Standard Model, which may help in reconciling CP violation's role in the matter-antimatter asymmetry of the universe. The experiment, recent results and outlook will be presented.

MO-A5-2 **10h30**

TOSHIO NUMAO, TRIUMF

Status of rare kaon decay experiments at BNL

In the decays $K \to \pi\nu\nu$, the dominant second-order loop-diagrams with a top quark make these flavor-changing neutral current modes very sensitive to V_{td}. The E787 group at Brookhaven National Laboratory (BNL) recently reported two events in the K^+ mode at a branching ratio of $1.57^{+1.75}_{-0.82} \times 10^{-10}$ which is consistent with a fit-based prediction of $(0.82 \pm 0.32) \times 10^{-10}$. The goal of the subsequent experiment E949 is to improve the event statistics by a factor of five (a 15 % measurement of $|V_{td}|$). The KOPIO experiment at BNL plans to reach a sensitivity of 10^{-13} or to measure about 50 events from the CP-violating decay, $K_L \to \pi^0\nu\bar{\nu}$ suppressing backgrounds by hermetic photon detection and complete reconstruction of decay kinematics using a low-energy micro-bunched K^0_L beam to allow determination of the incident kaon momentum. The status of both kaon decay experiments will be presented.

11h00 **Coffee Break / Pause café**

MO-A5-3 **11h15**

GLEN MARSHALL, TRIUMF

First Data from the TWIST Experiment†

TWIST is an experiment to measure precisely the parameters describing the energy and angular dependence of positrons (e^+) emitted from the decay of polarized positive muons (μ^+). It uses a beam of highly polarized surface muons guided axially into a spectrometer consisting of a large, uniform, 2-T solenoidal magnetic field and a precisely constructed, low-mass array of planar drift chambers. The measured distribution of decay e^+ is predicted by the Standard Model, and can parametrized by four quantities, ρ, η, δ, and ξ, known as Michel parameters. The eventual goal of *TWIST* is to provide a stringent test of the Standard Model by reducing the uncertainties of the Michel parameter measurements by up to an order of magnitude. The first data have been obtained, and analysis is underway to extract values of ρ and δ to a precision better than that currently available. The experiment will be described, and preliminary data will be presented, accompanied by descriptions of systematic uncertainties.

* Representing the *TWIST* Collaboration.
† Work supported by NSERC and by DOE.

MO-A5-4 **11h45**

Determination of alpha$_s$ using Jet Rates at LEP2. **Michael Donkers**, *Carleton University and the OPAL Collaboration* — Data collected at LEP in the energy range of 189 to 207 GeV using the OPAL detector is analysed using jet-multiplicity based observables. The goal of the analysis is to determine the energy dependence of the strong coupling constant, alpha$_s$. The values are determined at 7 energy points by fitting the differential 2-jet rate and the average jet rate to several QCD predictions. The fits are performed on the distributions that arise using both the Durham and Cambridge jet clustering algorithms. The running of alpha$_s$ is demonstrated by comparing the values of the strong coupling constant with those determined at lower energies.

MO-A5-5 **12h00**

T-Violation in *B* Decays. **A. Datta** and D. London, *University of Toronto* — We study T-violation in B decays to two vector mesons, B → VV.If CPT is conserved then violation of T implies the violation of CP and vice versa. However, T- violation is proportional to the cosine of the strong phase while direct CP violation is proportional to the sine of the strong phase. Hence T-violation and CP- violation are complementary to each other and the simultaneous measurement of both asymmetries is very useful to test the standard model or to look for new physics. We find several B → VV decays which have no T-violation in the standard model. Hence a measurement of non-zero T-violation in these decays would be a clear signal of new physics. We discuss models of new physics that can lead to large T-violation in these modes.

MO-A5-6 **12h15**

Measurement of the CKM Matrix Element V_{ub} using the CLEO Detector. **Andreas Warburton***, *McGill University* — We report on studies of exclusive semileptonic $b \to u l \nu$ decays in 9.7 million $B\bar{B}$ events accumulated with the CLEO detector in symmetric e^+e^- collisions produced in the Cornell Electron Storage Ring (CESR). Various experimental techniques, including the inference of neutrino candidates using the hermeticity of the CLEO detector, are used in conjunction with theoretical calculations to provide estimates of the CKM matrix element $|V_{ub}|$.

*Representing the CLEO collaboration

MO-A5-7 **12h30**

Search for $B \rightarrow J/\psi$ Baryon Antibaryon. **Christopher Hearty**, *University of British Columbia* — Studies of charmonium (c c-bar mesons) produced in the decay of B mesons by BaBar, CLEO and Belle all indicate a significant excess of J/ψ at low center-of-mass momentum. Possible sources for this excess include B decays of the type $B \rightarrow J/\psi$ baryon antibaryon. The rate of such decays could be enhanced by the intermediate production of exotic resonances predicted by QCD but not yet observed. We will report the results of a search by BaBar for these decays and the associated exotic resonances.

MO-A5-8 **12h45**

A search for $B^- \rightarrow K^- \nu\bar{\nu}$. **Steven H. Robertson** and the BaBar collaboration, *SLAC, Stanford* — We present a search for the rare flavour-changing neutral-current decay $B^- \rightarrow K^- \nu\bar{\nu}$ based on a sample of $(86.9 \pm 1.0) \times 10^6 \Upsilon(4S) \rightarrow B\bar{B}$ events collected by the *BABAR* experiment at the SLAC *B*-factory. Signal candidate events are selected by fully reconstructing a $B^- \rightarrow K^- \nu\bar{\nu}$ decay, where X^+ represents a combination of up to three charged pions or kaons and up to two π^0 candidates. The charged tracks and calorimeter clusters not used in the B^+ reconstruction are required to be compatible with a $B \rightarrow D^* X^+$ decay. We observe a total of three signal candidate events with an expected background of 2.7 ± 0.8, resulting in a preliminary limit of $\mathcal{B}(B^- \rightarrow K^- \pi\bar{\pi}) < \infty^{\nabla \times \infty^{\prime\prime}}$ at the 90% confidence level. This search is combined with the results of a previous and statistically independent preliminary *BABAR* search for $B^- \rightarrow K^- \nu\bar{\nu}$ to give a limit of $\mathcal{B}(B^- \rightarrow K^- \nu\bar{\nu}) < \cdot^{\prime} \times \infty^{\prime\nabla}$ at the 90% confidence level.

13h00 **Session Ends / Fin de la session**

[MO-A6] 10h00 Frontiers in Theory and Experiment in Surface Science / *Les frontières théoriques et expérimentales en physique des surfaces*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-A ***Chair: D. Jack, Concordia U.***

MO-A6-1 **10h00**

H. **JURGEN KREUZER**, Dalhousie University

Theory of Surface Processes: From Atoms to Polymers

Non-equilibrium thermodynamics serves as the basis for a theory of surface processes under conditions where fast surface diffusion guarantees local equilibrium. As recent examples we will show results for the photodesorption of helium from Pt(111), multilayers of Ag on Re, and an old favorite CO/Pt(111) and others. If surface diffusion is slow we have to resort to the kinetic lattice gas model. In the second part of the talk I will present a new master equation approach (and of course results) on the growth kinetics of polymer brushes based on the idea of confinement to account for conformational conversion. Results on polyethylene and poly (ethylene glycol) brushes will be shown and compared with experimental data.

MO-A6-2 **10h45**

Growth and Oxidation of Lead Layers on a Gold Substrate Using a High-Stability Quartz-Crystal Microbalance. Laziz Bouzidi and **Alan Slavin**, *Trent University* — The growth processes, and the thermal stability and oxidation of Pb overlayers formed by vacuum deposition on a Au surface were studied using a high-resolution quartz crystal microbalance (QCM) combined with Auger electron spectroscopy (AES) and electron energy-loss spectroscopy (EELS). Using polished quartz crystals allows for an absolute measurement of the deposited mass. At room temperature, the Pb layers grow by the formation of a simple monolayer (ML) with relatively loose packing equal to 0.83 times the close-packed bulk Pb value, followed by the formation of an alloy in a metastable state. The stable state as evidenced by AES intensities is reached in less than 5 min at 120 C. The QCM provides an absolute value of the stoichiometry of surface oxides, which resolves earlier contradictory findings for the oxidation process. At all stages of deposition, starting from the submonolayer level, only the PbO stoichiometry was found. Oxidation kinetics have been studied as a function of sample temperature and oxygen gas pressure. PbO stoichiometry was found for oxidized Pb deposits up to 2 ML thick. For thicker Pb layers followed by saturation oxidation, the oxygen uptake was found to be the same as that for only 2 ML of lead, implying that only the top two layers of Pb oxidize, as found in earlier work with other techniques. Pb deposits less than 1ML are fully oxidized at O_2 pressures of around 10^{-6} torr with characteristic times of 3 to 8 min at 60 C. However, after the deposition and oxidation of the first monolayer, the oxidation of subsequent Pb deposits was found to be strongly dependent on O_2 pressure, with oxidation not starting until almost 10^{-4} torr.

11h00 **Coffee Break / Pause café**

MO-A6-3 **11h30**

Modification of Wetting Properties of SiO_x Surfaces by Ar Implantation. M. Chassé and **G.G. Ross**, *INRS-ÉMT* — The aim of this experiment is to better understand the mechanism leading to the modification of the wetting properties of insulating (quartz) and non insulating (Si) surfaces by ion and atom implantation. Coupons of quartz and silicon (with its native oxide layer) have been irradiated by means of 3 keV Ar ions and atoms with a fluence of 1.8×10^{16} Ar/cm^2. Some exposures to Ar ions have been performed under oxygen partial pressure (~5×10^{-5} Torr). The samples have been characterized before and after implantation by means of contact angle hysteresis measurements, Rutherford backscattering spectroscopy (RBS) and angle resolved x-ray photoelectron spectroscopy (ARXPS). Irradiation with argon ions or atoms has produced a more hydrophilic surface immediately after implantation. Ar depth profiling by means of RBS has shown that 4% of implanted (atoms and ions) Ar has been retained in quartz, while 13% and 21% of Ar has been retained in silicon after Ar implantation with and without oxygen partial pressure, respectively. However, no difference in the depth distribution has been measured Characterization by means of ARXPS has shown a noticeable change in the composition of the quartz and silicon oxide surfaces (implantation of Si under an O_2 partial pressure producing a thicker oxide layer), which can explain the differences in the reported Ar retention. In general, the irradiation have removed a large portion of oxygen present in the pre-existing carbonaceous layer on the surface of the samples. The ion beam irradiation has been more efficient than atom beam to both, increase the wettability of the quartz surfaces and enhance the concentration of the carbonaceous layer in "dispersed islands" on the surfaces. Ageing (increase of the contact angles with time) has been recorded and studied. The ageing mechanisms vary according to the kind of treatment. A new model based on the spreading carbonaceous layer is proposed.

MO-A6-4 **11h45**

An Examination of the Surface-Pressure Isotherms in End-Tethered Polymer Layers. **Iyad Mahmoud** and M.D. Whitmore, *Memorial University of Newfoundland* — End-tethered polymer layers are formed when a collection of polymers is anchored by one end to a surface, with the reminder dangling into solvent. These systems have been studied extensively both experimentally and theoretically, and numerical self-consistent field (NSCF) theory can now explain their structure very well. However, the behaviour of the surface pressure isotherms remains an unsolved problem. Kent and coworkers found that the surface pressure increases relatively weakly with polymer coverage up to a certain threshold but, beyond that, it increases much more rapidly. This rapid increase has never been explained theoretically. Recently, however, Bijsterbosch *et al* performed similar experiments and found no sudden increase, even well beyond the expected threshold. We provide a detailed, numerical examination of these systems and results, using NSCF theory.

MO-A6-5 **12h00**

Characterizing Ultrathin Electrodeposits in Solution: Linking Morphology and Magnetic Properties*. **Kristin M. Poduska**, Erwin S. Lin, and Sylvie Morin, *York University* — There is a growing technological interest in applying electrodeposition methods to the synthesis of magnetic multilayer films and nanometer-range structures for data storage and retrieval applications. Even with the increasing technological applicability of electrodeposition for production of multi-component materials, there is still much to be learned about the ways thin deposits of a single ferromagnetic element (such as Co, Fe, or Ni) form and perform. Thus, *in situ* (in solution) property studies of single-component magnetic layers are of both fundamental and applied importance. We present magnetic investigations of ultrathin Ni and Co films electrodeposited on Ag and Au single crystal substrates as a function of deposit thickness. These *in situ* measurements are made possible by use of a custom electrochemical cell which allows electrochemical control during magnetic measurements. For Ni deposits on Ag(111) and Au(111) substrates, we observe a trend of increasing coercivity with increasing deposit thickness. We suggest that these increases in coercivity are likely related to changes in deposit roughness with coverage, analogous to the surface roughness effects discussed by Zhao and colleagues[1]. Seeking a quantitative relationship between morphology and coercivity, we present preliminary data for roughness versus deposit thickness, as obtained from *in situ* scanning tunneling microscopy (STM) images.

1. Y.-P. Zhao, R.M. Gamache, G.-C. Wang, T.-M. Lu, G. Palasantzas, and J.Th.M. De Hosson, *J. Appl. Phys.*, **89**. 1325 (2001).

* Work supported by NSERC, Canada Foundation for Innovation, Ontario Innovation Trust, Canada Research Chair Program, and York University

MO-A6-6 **12h15**

Structures of H_2 layers on MgO(001). J.N. Dawoud, A.K. Sallabi, and **D.B. Jack**, *Concordia University* — Monte Carlo simulations predict that H_2 forms a series of interesting structures on the MgO(001) surface. These structures, $p(2 \times 2) \rightarrow p(4 \times 2) \rightarrow p(6 \times 2)$ occur at coverages of Θ=0.5, 0.75 and 0.83 respectively, and are stable up to 9 K. The

unit cell of the p (2 x 2) structure contains two H_2 molecules, each with different azimuthal orientations (φ=±45 and ±135), that lay flat on the surface (θ=90°) over top of an Mg^{2+} ion. This structure matches the recent experimental Helium Atom Scattering (HAS) results in terms of the coverage and stability, but is not in agreement with the c (2 x 2) structure found by HAS. To resolve this issue, we performed a quantum mechanical calculation on this system using perturbation theory and found that H_2 molecules are azimuthally delocalized and thus form the c (2 x 2) structure. For the other two structures p (4 x 2) → p (6 x 2), there are two kinds of adsorption sites: a parallel site (θ=90°), as in the p (2 x 2), and tilted sites, where H_2 molecules are displaced towards O^{2-} sites with polar angles of θ=55°; 62°. Again, azimuthal delocalization allows the "p" type structures to form "c" type structures.

12h30 **Session Ends / Fin de la session**

[MO-A7] 10h00 Biomaterials / *Biomatériaux*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE KC-128 ***Chair: A. Rutenberg, Dalhousie U.***

MO-A7-1 **10h00**

EDWARD STERNIN, Brock University

Recent Developments in the Measurement and Interpretation of Biomembrane Order Parameters by ^2H NMR

Several recent advances in high-fidelity NMR spectroscopy combined with a powerful numerical inversion method based on Tikhonov regularization have led us to an unprecedented quantitative access to the average molecular order in model membrane systems. In turn, this reveals structural and functional details that have not been visible before. For example, a complex temperature-dependent phase behaviour of a bicelle-forming lipid mixture has been measured. The observed coexistence of multiple structural phases changes the interpretation of multiple sets of structural constraints often seen in partially aligned preparations of membrane-associated proteins and peptides. Molecular alignment in general plays a significant role in the structural organization of biomembranes. The orientational distribution functions can now be precisely measured, in a model-independent manner. For example, glass-aligned preparations that have been assumed to be the "gold standard" of aligning media, in fact exhibit a surprisingly broad distribution of molecular orientations. Similarly, partial magnetic alignment occurs spontaneously in the ever-increasing in strength magnetic fields of the NMR spectrometers. The resulting spectroscopic "artifacts" in fact contain important clues about the structure and molecular motion in model membrane systems. For example, the role of polyunsaturation of the lipid chains is beginning to be understood. The incorporation of guest substances (e.g. drugs) and its influence on the molecular order of the membrane can now be quantified. These are exciting times in ^{2} H NMR spectroscopy of biomembranes!

MO-A7-2 **10h30**

NILS O. PETERSEN, University of Western Ontario

Molecular Domains in Membrane Systems

The cell membrane is a complex mixture of lipids and proteins that distribute heterogeneously within the bilayer membrane. There are several real and putative domains including coated pits, caveolae and rafts. Each appears to have a distinct function and to sequester specific lipids and proteins. Here we will describe how we study these domains and their dynamic behaviour using modern imaging tools - particularly confocal microscopy, atomic force microscopy and time-of-flight secondary ion mass spectrometry. The focus will be on understanding the intermolecular interactions and how they are controlled. We use examples from studies of lung surfactants, virus fusion and protein receptors that promote cell differentiation.

11h00 **Coffee Break / Pause café**

MO-A7-3 **11h30**

The Relationship Between the Unbinding and Main Transition Temperatures in Phospholipid Bilayers is a Universal Constant. **J. Katsaras,** T.A. Harroun and M.-P. Nieh, *National Research Council.* — Using neutron diffraction and a specially constructed high-pressure cell suitable for aligned multibilayer systems, we have studied, as a function of pressure, the much observed anomalous swelling regime in dimyristoyl phosphatidylcholine bilayers (DMPC). From our experimental results, we can now say that the relative distance of the unbinding critical point $T*$, from the main transition T_M, *i.e.* ~ (T_M - $T*$/ T_M), is a universal constant and is a direct reflection of the predicted power law behavior of the bending rigidity, K_c. We also predict a further pseudo-critical point where K_c changes monotonically with temperature and where the effect of anomalous swelling is completely suppressed.

MO-A7-4 **11h45**

MICHAEL R. MORROW, Memorial University of Newfoundland

Pressure-Induced Ordering in Lipid Bilayers

Lipids dispersed in water form bilayers that are of interest both for their properties as anisotropic soft materials and for their relevance to understanding of biological membranes. At high temperature and ambient pressure, bilayers are in a liquid crystalline state. Application of hydrostatic pressure increases chain orientational order and bilayer thickness. The response of a given bilayer component to pressure reflects both the ordering effect of pressure and interactions with other bilayer components that may be more or less sensitive to pressure. This behavior will be illustrated by results from recent pressure response studies of single-component and mixed-lipid bilayers

*Supported by NSERC. Done in collaboration with Andre Brown, Ian Skanes, and Isaac Yankey

MO-A7-5 **12h15**

Spontaneous Formation of Monodispersed Unilamellar Vesicles Suitable as Carriers for Drugs and Bio-Molecules. **M.-P. Nieh**, T.A. Harroun and **J.** Katsaras, *National Research Council* — Liposomal preparations have been extensively used for the delivery of drugs and are constituted from either, biomolecules (e.g., lipids), polymers, or some combination of the two. Nevertheless, the efficacy of the delivery system is dependent on the carrier's stability, level of encapsulation and homogeneous size. Using small-angle neutron scattering we have studied a system composed entirely of lipid molecules, which spontaneously forms unilamellar vesicles (ULVs) that are stable, monodisperse, and whose size is insensitive to lipid concentration. The ULVs are stable over a temperature range of between 10 and 45 °C for periods of time > 2 weeks. We are presently working on systematically controlling the size of the ULVs while retaining the above-mentioned properties of the system.

12h30 **Session Ends / Fin de la session**

[MO-PLEN-3] 13h30 Herzberg Medal Winner / *Récipiendaire de la médaille Herzberg*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE DS-121 ***Chair: W.J. McDonald, U. Alberta***

MO-PLEN-3 **13h30**

MICHAEL LUKE, University of Toronto

The Heavy Quark Expansion: Recent Results

The heavy quark expansion has become a standard tool in the analysis of bottom and charmed hadron decays since its formulation about fifteen years ago. The recently-commissioned B factories at SLAC and KEK are producing tens of millions of bottom quarks per year, allowing quark flavour-changing transitions to be studied with unprecedented precision. In this talk I discuss some applications of the heavy quark expansion to precision measurements of B meson properties, including some recent results.

[MO-P1] 14h15 Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond / *Observation de l'ionosphère et de la magnétosphère à partir du sol - CANOPUS et au délà*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-D ***Chair: M. Connors, Athabasca College***

MO-P1-1 **14h15**

ANDREW YAU, University of Calgary

Ion Outflow and The Enhanced Polar Outflow Probe (e-POP) Project

The escape of plasma from the polar ionosphere - and its subsequent acceleration and transport towards the magnetosphere - is one of the most important processes in the global dynamics of near-Earth space environment. The Enhanced Polar Outflow Probe (e-POP) project comprises three important and interconnected components: a small-satellite component to investigate atmospheric and plasma flows and related wave-particle interaction processes in the topside ionosphere, a coordinated ground-based and a theoretical assimilation component. Canada's first space environment and second Earth and Environment small satellite to be launched in this decade, e-POP will carry a suite of 8 scientific instruments, including plasma sensors, radio wave receivers, magnetometer, CCD cameras, and a beacon transmitter.

Its scientific objectives are to quantify the micro-scale characteristics of plasma outflow and related micro- and meso-scale plasma processes in the polar ionosphere, explore the occurrence morphology of neutral escape in the upper atmosphere, and study the effects of auroral currents on plasma outflow and those of plasma microstructures on radio propagation. The plasma sensors will make in-situ measurements at unprecedented precision. The radio wave receivers will perform near real-time tomography of the ionosphere in conjunction with ground-based radars.

MO-P1-2 **14h45**

Core Ion Energization and Associated Plasma Waves in the Auroral Ionosphere. **J.K. Burchill**, D.J. Knudsen, B.J.J. Bock, R.F. Pfaff, D.D. Wallis, J.H. Clemmons and S.R. Bounds, *University of Calgary* — We present high resolution observations of particles and waves in the topside ionosphere from the Canadian GEODESIC sounding rocket. The payload flew into an active auroral substorm, carrying a high speed, two dimensional low energy ($0 < E < 20$ electron volts (eV)) arrival angle spectrograph, in addition to other particle, electric field, and magnetic field instruments. It traversed regions of low frequency electromagnetic fluctuations from a few Hertz to tens of kilohertz, encompassing Alfvén waves, broadband extremely low frequency (BB ELF) waves, and lower hybrid waves. While BB ELF waves of the observed level have been shown on other spacecraft to cause strong ion heating, these waves caused no detectable heating during the GEODESIC flight. Similarly, large amplitude Alfvén waves have been shown elsewhere to be conducive to strong ion heating, but again no such heating was observed on GEODESIC, despite the fact GEODESIC flew through the leading edge of an intense substorm surge. We found ion heating to occur only in the narrow density cavities associated with lower hybrid waves called lower hybrid solitary structures (LHSS). A comparison of the ion distributions inside LHSS's with the ambient plasma showed no indication of wave interactions with the lowest energy "core" ions below 1 eV. We will discuss the significance of this result as it pertains to theories of LHSS formation.

MO-P1-3 **15h00**

Investigation of Lobe Convection with SuperDARN HF Radar and Global MHD Simulation. **Frances R. Fenrich** [a], I. Jonathan Rae [a], Steve P. Slinker [b], Joel A. Fedder [c], George J. Sofko [d], [a] *University of Alberta*, [b] Naval Research Laboratory, Washington, DC, [c] George Mason University, Fairfax, Virginia; [d] University of Saskatchewan — On June 5, 1998 a number of the Northern Hemisphere SuperDARN HF radars recorded good backscatter in the cusp region from ~14:00 to 16:00 UT, from which maps of ionospheric convection were made. For comparison the time-varying Lyon-Fedder Global MHD model of this event has been simulated using IMP-8 and WIND spacecraft measurements of solar wind input. The time interval of interest is characterized by negative IMF Bz and negative IMF By following a positive IMF Bz interval. Good correspondence is found between the MHD model and the SuperDARN ionospheric convection patterns confirming that this is an excellent event for a detailed comparison of model and observation. In this presentation we will focus on the occurrence of fast sunward convection on open field lines, *i.e.* lobe convection, in the local dawn sector. This lobe convection is seen in both the MHD model and in the SuperDARN observations. Large backscatter widths collocated with the large sunward flows confirms that the flows occur on open field lines. The global MHD model suggests that magnetic merging along the dawn flank of the magnetosphere is the physical mechanism responsible for the lobe convection. Other SuperDARN events during similar solar wind conditions will be investigated for the occurrence of lobe convection. non-stoechiometry are reported.

MO-P1-4 **15h15**

Open-Closed Field Line Boundary in a Global MHD Simulation of Earth Magnetosphere: A Comparison With Ground-Based and Satellite Measurements. **K. Kabin**, R. Rankin, I.J. Rae, G. Rostoker, F.R. Fenrich, T.I. Gombosi, D.L. DeZeeuw, and A.J. Ridley, *University of Alberta* — The separatrix between open and closed magnetic field lines is one of the most important boundaries in Earth's magnetosphere. This boundary determines the poleward extension of the auroral oval and is related to the general size and shape of the magnetosphere. Identifying the morphology of this boundary is one of the primary goals of the Geospace Environment Modeling community. We discuss the dependence of the open closed field line boundary obtained in a global MHD simulation on the IMF and solar wind parameters and find that, for cases of steady magnetospheric convection, our simulation results agree well with the open-closed field line boundary measured by the CANOPUS meridian scanning photometers. We also present a time-dependent simulation of the evolution of the open-closed field line boundary during a 2 hour interval following a southward turning of the IMF on June 5th, 1998. For this time interval the open-closed field line boundary can be inferred globally from a combination of measurements taken by the Polar spacecraft, the SuperDARN Radar network, and several low altitude satellites. Although the general trend in the MHD model agrees with the observations, we find noticeable discrepancies for some local time sectors.

15h30 **Coffee Break / Pause café**

MO-P1-5 **15h45**

The Importance of the Hall Current in the Self-Consistent Modeling of Small-Scale Auroral Structures*. **V.-G. Winter**[a], J.-M. Noël[a], J.-P St.-Maurice[b] and P.-L. Blelly[c], [a]*The Royal Military College of Canada*, [b]Le Centre d'étude spatiale des rayonnements, Toulouse, France — A model of small-scale electrodynamic structures in the auroral ionosphere, developed originally by Noël *et al.*[1], has been modified to include Hall currents and to remove the symmetry condition that was imposed by the original model. The new model is capable of simulating the creation of an auroral arc by precipitating electrons into the ionosphere. By adjusting the precipitating electron spectral flux and the latitudinal pattern of the precipitation, we can create sharp gradients in the electron density. This results in the creation of correspondingly sharp horizontal gradients in the ionospheric conductivities. The sharp horizontal gradients in turn lead to intense and highly localized field-aligned currents that are on the order of hundreds of times larger than the spatially averaged value. A positive feedback between the composition and energy of the ionospheric species and the electrodynamics has been found. In addition, a positive feedback between E-region electron heating due to waves and the generation of large field-aligned current densities was found. Electron heating combined with sharp horizontal gradients leads to large increases in the field-aligned currents.

1. J.-M. Noël,, J.-P. St.-Maurice and P.-L. Blelly, Nonlinear model of short-scale electrodynamics in the auroral ionosphere., *Ann. Geophysicae* **18**, 1128-1144 (2000).

MO-P1-6 **16h00**

Dispersed Ions in the Plasmatrough - an Auroral Source?. **George J. Sofko**, *ISAS, University of Saskatchewan* — During magnetically disturbed periods, as the DMSP satellites traverse the plasmatrough region, ion observations show signatures of dispersed low-energy ions. The energy dispersion is such that these trough ions, all below 1 keV, have their lowest energies at the latitudes near the plasmapause, and higher energies (a few hundred eV more) near the inner edge of the central plasmasheet. The ions appear to be low-energy secondary ionospheric ions, and the question then arises as to whether they were produced by primary particles from the plasmasheet at high latitudes or the plasmasphere at low latitudes. Hirahara *et al.* (JGR, 102, 2513, 1997; JGR 102, 4821, 1997) have explained the dispersion as resulting from precipitation of primary auroral (plasmasheet) particles into auroral arcs, after which the ionospheric ions may undergo weak acceleration along the magnetic field lines, raising their energies by up to a few hundred eV. As they then bounce along the field lines between hemispheres, these low energy particles are subject to E x B drift that results in dispersion, which increases after each interhemispheric traversal. DMSP results are presented for the premidnight sector on the very disturbed night of April 06, 2000. It is proposed that these results are related to ionospheric ions resulting from auroral activity at higher latitudes near midnight, followed by westward drift to low latitudes along the equipotential contours of the afternoon cell of the two-cell convection pattern. Previous studies have relied on satellite data alone, but in this talk, those data are supplemented by ground-based data, including convection along the equipotentials as deduced from SuperDARN radar measurements.

MO-P1-7 **16h15**

Relation of Convection Bays, Poleward Border Intensifications, and Ps 6 Disturbances. **M. Connors**, *Athabasca University* — Convection bays as observed by the CANOPUS magnetometers generally include periods when the electro-jets were intensified, yet without the onsets characteristic of typical sub-storm disturbances. In comparing data from higher latitudes, especially in the evening sector, it can be found that poleward border intensifications may take place during convection bays. It is, on the other hand, clear that normal expansive phase activity, taking place relatively near the Earth in the magnetotail, does not take place. In the morning sector, Ps 6 magnetic signatures and accompanying

omega band emission may take place and their initiation may coincide with the poleward border intensification in the evening sector. We present results from the event of June 1, 2001, which has an extensive data set during a convection bay event featuring coincident poleward border intensification and Ps 6. Quantitative aspects of the current systems may be deduced from magnetic data using the new technique of Automated Forward Modelling. We are able to relate perturbations seen on the ground and at synchronous orbit to deduce characteristics of the current systems responsible for the convection bay and the Ps 6 disturbances.

MO-P1-8 **16h30**

The Future of Solar Radio Monitoring in Space Weather Forecasting. **K.F. Tapping**[a], and D.H. Boteler[b], [a]*DRAO, HIA, NRC, Penticton, B.C.* and [b]Geomagnetic Laboratory, Natural Resources Canada, Ottawa — The advent of new space-borne solar monitoring systems has provided new data streams to help in forecasting space weather and geophysical activity (henceforth called geospace activity). However their patchy effectiveness in this regard underlines the conclusion that there is no single-instrument solution to the problem of adequately understanding the Sun's role in driving geospace phenomena. The answer lies in the coordinated use of different instruments in a unified programme. Monitoring and understanding solar radio emissions is a critical component of such a system. We have now monitored solar radio emissions for more than 50 years, over many wavelengths, using a variety of techniques. The Sun has been imaged, radio spectra have been obtained, and the effective solar activity indices produced. We have a good idea of the nature of the emissions, their pluses and minuses, and well-established connections with other solar phenomena. Knowing what we now know, and what is technically achievable, how can solar radio emissions provide improved input into the issues of forecasting and understanding geospace activity? In this paper we will review the current situation, and then focus mainly on three specific problems. Firstly, how do we get better radio indices of magnetic activity? Secondly, what may be achievable in the detection of coronal mass ejections, both those connected with flares and those that are not? Thirdly, how accurately can we expect to estimate their velocity?

MO-P1-8 **16h45**

March 13, 1989: The Night When Space Physics Came Down to Earth. **D.H. Boteler**[a], K.F. Tapping[b], G. Rostoker[c], D.D. Wallis[d], F. Creutzberg[e], L. Trichtchenko[a], H.-L. Lam[a], E.F. Donovan[f], and E. Spanswick[f], [a]*Geomagnetic Laboratory, Natural Resources Canada*, [b]DRAO, NRC, Penticton, [c]University of Alberta, [d]Magnametrics, Ottawa, and [e]Keometrics, Ottawa, [f]University of Calgary — On March 13 and 14, 1989 one of the largest magnetic storms of the 20th century caused the unthinkable: the blackout of a major power system. Across the province of Quebec, industries were forced to shut down and residents woke up to find themselves without power. The details of the power outage and the fact that it was caused by a magnetic storm were widely reported at the time. However, there are many details of this event that have been uncovered since and have not received the same attention. This presentation will provide a detailed analysis of the March 1989 disturbance, starting with the solar eruptions that led to the disturbance and the response of the Earth's magnetosphere to the solar particles. We then describe the characteristics of the magnetic disturbance observed on the ground and how it caused problems for the power system. Presentation of this event is used to showcase the wealth of information available from the Canadian space physics community: ranging from radio observations of solar eruptions to monitoring the magnetosphere response through the resulting auroral displays, ionospheric radio absorption and current systems measured by arrays of photometers, riometers and magnetometers. Finally it is shown how information obtained from such studies is being used to reduce the dangers of extreme space weather events.

17h00 **Session Ends / Fin de la session**

[MO-P2] 14h15 Observing the Atmosphere from Ground and Space - Canadian Contributions and Innovations / *Observation de l'atmosphère à partir du sol - Les contributions et innovations canadiennes*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-C ***Chair: W. Ward, UNB***

MO-P2-1 **14h15**

IAN C. MCDADE, York University

SWIFT - The Stratospheric Wind Interferometer For Transport Studies

The Stratospheric Wind Interferometer For Transport studies (SWIFT) is a satellite instrument designed to measure wind profiles between 20 km and 45 km in the stratosphere with an accuracy of about 5 m/s. It simultaneously provides co-located ozone density profiles. SWIFT was originally proposed to the European Space Agency (ESA) in response to the first call for ideas for Earth Explorer Opportunity Missions and, with the support of the Canadian Space Agency (CSA), was subsequently selected by the National Space Development Agency of Japan (NASDA) for possible deployment on NASDA's first Global Change Observation Mission (GCOM-A1) scheduled for launch in 2007. In this paper the observational technique and the scientific objectives of SWIFT will be described. These objectives include (a) studies of ozone transport from SWIFT's co-located wind and ozone measurements, (b) determination of transport across the subtropical mixing barrier, which is relevant to green house gases and halogen lifetimes, and (c) studies of tropical stratospheric winds, including the QBO (Quasi Biennial Oscillation) and the SAO (Semi Annual Oscillation).

MO-P2-2 **14h45**

THOMAS J. DUCK, Dalhousie University

Lidar Measurements in Canada – Past, Present, and Future Prospects

Laser radar, or "lidar", systems provide an indispensable instrument for observational atmospheric research. Lidars can obtain measurements at unparalleled spatial and temporal resolutions, from the ground to over 100 km in altitude. A vast range of atmospheric properties and constituents can be obtained, including atmospheric temperatures, gravity waves, ozone, aerosols, clouds and winds. Canada has long played a major role in the lidar community, both in the development of new techniques and in the discovery of new atmospheric phenomena. A brief outline of how a lidar works will be given, and the specific contributions by researchers in Canada will be described. Although the basic lidar technique is reasonably well established, the full capabilities of lidars for atmospheric science have not nearly been realized. The prospects for future lidar systems will be discussed, and new ideas for instrumentation and techniques will be proposed.

MO-P2-3 **15h15**

The South Atlantic Anomaly as Seen by the MOPITT Instrument. **Florian Nichitiu**[a], James R. Drummond[a], Jiansheng Zou[a], Robert Deschambault[b], [a]*University of Toronto* and [b]COM DEV, Cambridge — The MOPITT instrument was launched on the Terra satellite on the 18th December 1999 to measure lower atmosphere composition. However our experience is that it can measure other quantities as well. This paper reports on Device Single Events (DSE) occurring in an accelerometer within the instrument, and their correlation with high energy radiation environment and solar activity. For more than three years the accelerometer has shown short and intense anomalous signals due to interaction with high energy particles. The number of these events (more than 1000) is large enough to permit a statistically meaningful analysis. Analysis of these anomalous accelerometer signals shows a direct correlation of the DSE daily rate with solar activity, an asymmetry Day/Night caused probably by interaction of trapped particles with the neutral atmosphere , and a direct correlation with high intensity solar proton events (SPE). The high energy particles - the source of anomalous accelerometer signals - are localized mainly in South Atlantic Anomaly region. The Earth polar regions are also areas of high risk for satellites mainly during intense SPE.

15h30 **Coffee Break / Pause café**

MO-P2-4 **15h45**

P. STEPHEN ARGALL, University of Western Ontario

*Development of the Gravity Wave Imager (GWIM) Mission at University of Western Ontario**

The Gravity Wave Imager (GWIM) is a planned space based imager that will measure the intensity of two atmospheric airglow layers OH(9-6) (~87 km, 1355nm) and O_2 A(0-0) (~92 km, 760 nm). Density fluctuations characteristic of gravity waves lead to fluctuations in the intensity of the emission from the airglow layers providing a means of detecting and characterizing the gravity waves (GW's). GWIM will provide a large area survey (20 deg. S to 20 deg. N) of mesopause GW occurrence rates as a function of geographic location. GWIM will also allow the determination of both horizontal and vertical GW parameters, including the vertical-flux-of-horizontal-momentum. The concept of GWIM has evolved through a CSA funded concept study and Phase A study. An overview of the GWIM mission will be presented including the science goals, a description of the instrument and its capabilities, and the current status of the project.

* In collaboration with R.P. Lowe, University of Western Ontario, N. Rowlands, EMS Technologies and K.L. Gilbert, formerly University of Western Ontario.

MO-P2-5 **16h15**

WAYNE K. HOCKING, University of Western Ontario

The Role of Canadian Radars in Middle Atmosphere Studies

Canadian researchers operate a variety of radars which are important for upper atmosphere studies. These include meteor radars, medium frequency radars, and VHF windprofiler radars. The meteor radars can measure winds at heights from 80 to 100 km, and the MF radars are especially important for measurements from 60 to 90 km altitude. The wind profilers are important for stratospheric studies, and also upper mesospheric studies in summer, using so-called polar mesosphere summer echoes. Canadian researchers operate radars at London (Ont.), Resolute Bay (Nunavut), Yellowknife (NWT), Saskatoon (SK), Socorro (New Mexico), Tromso (Norway), among other sites, and work closely with collaborators around the world. The capabilities of these radars, and some recent results of special interest, are outlined in this talk.

MO-P2-6 **16h45**

Applications of Spectral Imaging with a Michelson Interferometer. **William E. Ward**, *University of New Brunswick* — In remote sensing applications, interferometry allows information about three aspects of a spectral feature to be measured: the wavelength, the line width and the radiance. In reference to this capability the terms tridimensional spectroscopy in astronomy and spectral imaging in atmospheric remote sensing have been coined. This capability can be harnessed to develop instruments which can simultaneously measure several complementary aspects of a planetary atmosphere. The wavelength measurement can be used to provide information on winds, the linewidth on the temperature or pressure and the intensity on constituent concentrations. When an imaging capability is added to the interferometer additional measurement possibilities become available. Several emission lines can be observed simultaneously so that measurements of rotational temperature or pressure can be undertaken. Developments along these lines are being explored for an improved version of the near-IR Michelson interferometer originally proposed for SciSat I. Alternatively, this imaging capability can be used to take images of waves in the airglow in both intensity and wind. An instrument, termed MIADI (Michelson Interferometer for Airglow Dynamics Imaging) with this capability is being designed at the University of New Brunswick. This talk will summarize both these developments.

17h00 **Session Ends / Fin de la session**

[MO-P3] 14h15 Atomic and Molecular Spectroscopy and Dynamics II / *Spectroscopie et dynamique atomique et moléculaire II*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE MN-40 ***Chair: A. Madej, NRC***

MO-P3-1 **14h15**

ANDRZEJ CZAJKOWSKI, National Research Council

Development and Study of a 1.5 micron Optical Frequency Standard at National Research Council

I describe a recently developed optical frequency standard based on the saturated absorption of the P(16) transition of the $\nu_1+\nu_3$ overtone band of $^{13}C_2H_2$. Results of studies of stability, reproducibility and sensitivity to various parameters are also presented. The current stability of the system has been measured to reach 4×10^{-13} for an averaging time of 100s. I report what are to my knowledge, the first results of study of the parameter shifts of the P(16) line. Control of these parameters should allow kilohertz reproducibilities of the device in the long term.

MO-P3-2 **14h45**

DENNIS TOKARYK, University of New Brunswick

Spectroscopy of Carbon-Bearing Radicals: from the Interstellar Medium to the Hydrogen Fuel Cell

Small molecules containing carbon are among the most commonly observed species in the spectra of the interstellar medium, and of astrophysical objects like comets, carbon stars, and protoplanetary nebulae. Many of these molecules are radicals, which normally are destroyed quickly through reactions when they collide with other species. However, the low density of atoms and molecules in space allows the radicals to survive for relatively long times, and consequently their signatures are an important component in the spectra of many astrophysical objects. A simple glow discharge through 1-2 Torr of helium seeded with a trace of methane is a rich source of radicals composed of carbon and hydrogen. We employ techniques of very high sensitivity (concentration modulation and cavity ring down spectroscopies) to detect their spectra. This talk will focus on our studies of CCH and C3, and on the implications of our findings for astrophysical spectroscopy.

Our work has recently found application in alternative energy research. One proposed method for producing hydrogen gas for fuel cells involves conducting a discharge through natural gas (primarily methane.) We will discuss an approach to characterization of the natural gas plasma based on the techniques developed for our laboratory astrophysics experiments.

MO-P3-3 **15h15**

Beam-Laser Oscillator-Strength Measurements in Sm II. **A.** Sharikova, S. Rehse, S.D. Rosner, T.J. Scholl, and **R.A. Holt**, *University of Western Ontario* — We have measured spontaneous-emission lifetimes and branching ratios in singly-ionized Sm and used them to infer oscillator strengths of astrophysical interest. We produce a 10-keV beam of Sm+ and excite it perpendicularly (for lifetime measurements) or collinearly (for branching-ratio measurements) with a cw beam from an argon-ion-laser pumped Stilbene dye laser. Two highly efficient fiberoptic arrays collect laser-induced fluorescence from the fixed excitation point and a variable downstream location and feed the light to individual monochromator/photomultiplier detection systems. We employ both magic-angle and sine-weighted fiber arrays to avoid systematic errors from the anisotropic excitation due to the linearly-polarized laser beam. The detector efficiency is calibrated with a NIST-traceable tungsten-halogen lamp and is further checked against well-studied Ar branching ratios. We have achieved typical accuracies of a few per cent in lifetime measurements with 5 min of data taking, and below 10% in branching-ratio measurements with 15 min of data collection.

15h30 **Coffee Break / Pause café**

MO-P3-4 **15h45**

Infrared Diode Laser Spectroscopy of CCO Radical: the ν_3 Band of the Ground Electronic State. **Z. Abusara**[a], T.S. Sorensen[b], N. Moazzen-Ahmadi[a], [a]*Dept. of Physics and Astronomy*, University of Calgary, [b]Dept. of Chemistry, University of Calgary — The CCO radical is postulated to act as an intermediate in a variety of chemical reactions and has been detected in interstellar space toward the dark molecular cloud TMC. In the past few years, our group has carried out infrared diode laser spectroscopy in the region of the C-O stretching fundamental (ν_1 band). Several rotationally resolved infrared bands of CCO were observed. These include the ν_2 fundamental and three hot bands in the ground electronic state ($X\,^3\Sigma$) as well as the ν_1 fundamental of the lowest lying metastable electronic state ($a\,^1\Delta$). The detection of the C-C stretching fundamental (ν_3 band) is more challenging because the C-C stretching fundamental is much weaker and it occurs in a spectral region where much less sensitive detectors are used. In spite of these difficulties, we have measured a rotational series in the C-C stretching region. A preliminary analysis indicates that these lines belong to the ν_3 fundamental of $X\,^3\Sigma$ state. The ν_3 band of the $a\,^1\Delta$ state is predicted to occur in the same spectral region. The search for this band is currently underway. In this talk I will discuss the generation and detection of the CCO radical as well as some future directions.

MO-P3-5 **16h00**

Laser Spectroscopy of Dysprosium Monochloride. R.K. Ghosh, M.J. Dick and **C. Linton**, *University of New Brunswick* — A preliminary investigation into the spectroscopic properties of Dysprosium Monochloride is in progress. To date three transitions from a common upper state have been studied at high resolution and identified as the [16.3]8.5-X7.5, [16.3]8.5-[0.1]8.5, and [16.3]8.5-[0.8]7.5 transitions respectively. A global fit including all these transitions has been completed and the results of the analyses of the rotational structure will be presented and discussed in terms of the electron configurations of the electronic states and an attempt will be made to correlate the observed states with those predicted by Ligand Field theory. In addition, the results for DyCl will be compared with those obtained from previous work on DyF and with those from other lanthanide halides

MO-P3-6 **16h15**

A Frequency Analysis of the n_9 Band of CD_3CD_3: Experiment and *Ab Initio* Calculations. A.C. Szott[a], J.R. Cooper[a], R.I. Thompson[a], A.R.W. McKellar[b], and **N. Moazzen-Ahmadi**[a], [a]*University of Calgary and* [b]National Research Council of Canada — The infrared gaseous spectrum of CD_3CD_3 has been measured in the range of 530-670 cm^{-1} to investigate vibration-torsion effects in the n_9 band. Three separate spectra all taken under different experimental conditions were recorded. The lines with $\Delta K = -1$ and with high values of K

show torsional splittings that are substantially larger than expected from the observed barrier height. These splittings are caused primarily by Coriolis-type interactions between the torsional stack of $v_9 = 1$ and the corresponding stack for the ground vibrational state. Because of a near-degeneracy that exists between the states ($v_9 = 1$, $v_4 = 0$) and ($v_9 = 0$, $v_4 = 3$), three subbands (K,σ) = (15,1),(16,2),(17,3) are resonantly perturbed. For these cases, perturbation-allowed $3\nu_4$ torsional transitions have been identified. Here σ = 0,1,2, or 3 labels the torsional sublevels. Measurements from the ν_4 and $3\nu_4$ bands, frequencies from the far-infrared torsional spectra in the ground vibrational state, and lower state combination differences from $\nu_9+\nu_4-\nu_4$ band were fitted to within experimental uncertainty using an effective Hamiltonian which considered three torsional stacks; one for the ground vibrational state and two for $v_9 = 1$. In all, 22 parameters were determined using a total of 2001 lines. Two barrier dependent torsion-rotation parameters that were essential for obtaining a satisfactory fit were calculated by *ab initio* methods.

MO-P3-7 **16h30**

Analysis of the Hyperfine Structure in the [20.6]5 - X4 Transition of Cobalt Monofluoride. **A G. Adam** and Wei Sha, *Chemistry Dept., University of New Brunswick* — The high resolution visible laser spectrum of the 484 nm band system of cobalt monofluoride has been obtained. The molecules were produced by reaction of laser ablated cobalt atoms with 1% SF_6 seeded in He under supersonic jet conditions. The 0-0 and 1-0 bands of the system were probed with a Coherent 699-29 cw ring dye laser giving experimental linewidths on the order of 200 MHz. The appearance of the spectrum at low resolution showed a strong R-, and weaker Q- and P-branches which is indicative of $\Delta\Lambda=\Delta\Omega=+1$. This and analysis of the first lines yields a value of Ω=4 for the ground state, consistent with earlier work, and a value of Ω=5 for the upper state. Comparison with calculations on CoH has allowed this transition to be assigned as the $[20.6]^3\Gamma_5 - X^3\Phi_4$ transition. The molecular constants derived from a nonlinear least squares fit to the data will be presented.

16h45 **Session Ends / Fin de la session**

[MOP4] 14h15 Memorial Session Honouring Jürgen Franck / *Session commémorative honorant Jürgen Franck*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE DS-121 ***Chair: F. Marsiglio, U. Alberta***

MO-P4-1 **14h15**

DAVID LAWRIE, University of Illinois

Isotope Effects in Superconductors and Oxide Materials

Jurgen Franck first became involved in isotope effect studies in 1988 as a probe of the mechanism behind superconductivity in the then recently discovered HTSC materials. Since that time, he was involved in the publication of 34 different papers concerning isotope effects in HTSC, borocarbides, CuO and most recently the CMR manganites. In this talk, I will describe what is meant by an isoptope effect, outline the basics of isotope effect experiments and present a summary of Jurgen's, my and other's work in these various areas.

MO-P4-2 **14h45**

JULES CARBOTTE, McMaster University

Superconductivity Past and Future

I will review some of the past achievements and argue for a bright future of new discoveries. New materials are constantly being found and new measurement techniques are available which may accelerate the pace of future progress.

15h15 **Coffee Break / Pause café**

MO-P4-3 **15h45**

TOM TIMUSK, McMaster University

The Two Pseudogaps in High Temperature Superconductors

The pseudogap phenomenon is one of the central puzzles of high temperature superconductivity. It now appears that there are two distinct pseudogaps, a higher energy one seen in the NMR Knight shift, the interplane optical conductivity, photoemission and tunnelling experiments and a lower energy one associated with scattering from a mode that governs the ab-plane scattering rate as measured by infrared reflectance spectroscopy. This mode shows up in a number of other experiments, as a kink in ARPES dispersion and a resonance at 41 meV in magnetic neutron scattering. Recent oxygen isotope experiments, initiated by Jurgen Franck, show that the mode is not caused by phonons but must be of electronic origin.

MO-P4-4 **16h15**

HENRY R. GLYDE, University of Delaware

Elementary Excitations, Bose-Einstein Condensation and Super-Fluidity in Liquid ^{4}He

The interdependence of super-fluidity, Bose-Einstein condensation (BEC) and the elementary excitations of Bose systems remains a topic of great interest. Historically, it is a topic which has a long and rich history of development in Canada. It was equally a topic of great interest to Jurgen Franck along with his work in superconductivity. There is current interest in bulk liquid ^{4}He, disordered liquid ^{4}He and in atomic gases in traps. In Landau's original theory, super-fluidity in bulk ^{4}He followed from the nature of the elementary phonon-roton excitations there. There was no reference to BEC. Independently, super-fluidity can be shown to follow from BEC, at least in 3D and in the absence of disorder. From old and recent measurements of both excitations and BEC in bulk liquid ^{4}He and their interpretation, we argue that well-defined phonon-rotons and super-fluidity exist because there is BEC. From extensive recent measurements on liquid ^{4}He in disorder, we suggest that the condensate can be localized by disorder and this localization is associated with the loss of super-fluidity in porous media. Comparison with recent theory and with atoms in traps will be made.

16h45 **Session Ends / Fin de la session**

[MO-P5] 14h15 Biomedical and Biological Diagnostic Instrumentation Methodologies / *Méthodologie et instrumentation de diagnostique biomédical et biologique*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE KC-128 ***Chair: W. Whelan, Ryerson***

MO-P5-1 **14h15**

HUGH A. MACKENZIE, Heriot Watt University

Applications of Photoacoustic Spectroscopy to the Life Sciences

In situations where the effectiveness of conventional spectroscopy may be limited by high background absorption or optical scattering, the photoacoustic technique may have significant advantages. The technique benefits from the spectral selectivity of optical absorption but the detection is achieved by measurement of the pressure wave generated by the subsequent thermal expansion. In some cases, the combination of thermal parameters involved in this process can give additional discrimination between spectrally overlapping species. In this talk, after an outline of the principles, environmental applications of the technique for measuring ppm concentrations of oil in seawater and volcanic gas analysis will be discussed along with healthcare applications.

MO-P5-2 **14h45**

MASAHIDE TERAZIMA, Kyoto University

A Novel Method to Study Structural and Energy Dynamics of Proteins from a View Point of Time-Resolved Thermodynamics

The thermodynamic properties (enthalpy, thermal expansion coefficient, compressibility, partial molar volume, etc.) as well as the transport property (diffusion coefficient) of proteins are of fundamental importance to understand the structural fluctuation and the dynamics of protein molecules. Traditional techniques that can access to these quantities are certainly useful and powerful to characterize the proteins. However, since they are applicable only to steady state protein structures, knowledge of these properties of time-dependent or unstable (intermediate) species during biological reactions is very limited, which prevents us from using the compiled data to characterize the intermediate structures of proteins. It is most desirable to develop and use a method that can measure these properties in the time domain so that reaction intermediates can be characterized in a similar way. Here, we report a novel way for time-resolved studies of energies and volume changes as well as the diffusion coefficients of intermediate proteins by a combination of the pulsed laser-induced transient grating, transient lens, and photoacoustic spectroscopies. Here I will present some examples such as the photodissociation reaction of carboxymyoglobin to show how this technique is powerful for understanding physics as well as chemistry of proteins.

15h15 **Coffee Break / Pause café**

MO-P5-3 **15h45**

DAVID E.B. FLEMING, Mount Allison University

Detecting Lead in Bone Using X-ray Fluorescence

Exposure to lead has been associated with a number of health effects. Blood lead measurement is often used to assess the absorption of lead, but this approach largely reflects recent exposure. An indicator of long-term exposure is the concentration of lead in bone tissue. Bone lead measurement may be made *in vivo* using an X-ray fluorescence (XRF) technique. Recent improvements and planned alterations in XRF bone lead measurement will be outlined in this presentation. Additionally, several applications of the XRF bone lead technique will be briefly reviewed.

MO-P5-4 **16h15**

ANA PEJOVIC-MILIC, Ryerson University

Quantifying Strontium and Aluminum in Human Bone

In vivo elemental analysis is a diagnostic tool that is not widely available. Instead of collecting a sample from a person for in vitro analysis, the stored quantity of the element is determined non-invasively and without pain. Two *in vivo* elemental analyses are designed to improve our understanding of the role of strontium and aluminum in the human bone and their related diseases. A beneficial effect of low strontium doses has been recently found in osteoporosis patients. These findings point to a promising new agent, strontium ranelate (S12911), for the treatment of osteoporosis in humans. The medication is currently undergoing human trials and should be available to the public within 3-5 years. Apart from the strontium-based treatment of osteoporosis, high bone strontium concentration is found in children with rickets who have high strontium intake in their diet, and in dialysis patients with osteomalacia. The *in vivo* X-ray fluorescence technique has been developed to measure strontium stored in the bone. A pilot human study illustrated that this technique is a promising diagnostic tool to measure strontium concentrations *in vivo*, and thus opens a possibility to assess the strontium effect on the human health.

Aluminum is a toxic element. It is documented that increased aluminum levels are detected in dialysis patients causing a variety of health problems and even deaths. Furthermore, it has been vigorously debated whether aluminum in any form is associated with Alzheimer's disease. To measure aluminum levels an in vivo neutron activation analysis of bone aluminum is developed, using a low-energy accelerator. A critical feature of this neutron source is that the interfering reactions with silicon and phosphorus, which are present in human bone, are not energetically permitted. Additional simplification of the technique is achieved by normalizing aluminum concentration with calcium present in bone, and reporting the Al/Ca ratio as an index of elevated aluminum per unit bone mass. Further refinements of the two *in vivo* elemental techniques will be presented as well as their future application.

MO-P5-4 **16h45**

1D Imaging with Portable Surface NMR. **I.V. Mastikhin**, G. LaPlante, A. Marble, *MRI Centre, University of New Brunswick* — Nuclear Magnetic Resonance (NMR) is a ubiquitous laboratory tool for evaluation of molecular structure and dynamics of materials. This method requires positioning a measured object inside a magnetic field homogeneity region (NMR) and cannot be applied in-situ. Recent progress in development of portable surface NMR devices eliminates the sample-positioning problem. The NMR device is applied to the surface of the object under study, so the sample size is not a limit. Inherent features of existing surface NMR devices are: poor spatial localization and strong magnetic field inhomogeneties. We decided to turn the surface NMR in surface 1D-MRI by utilizing underlying magnetic field gradients, in a way similar to STRAFI Fourier method. The inhomogeneities of B0 and B1 and size of sensitive spot were corrected via optimization of RF coil and ferromagnetic yoke. The spatial resolution of 0.1 mm was achieved for thin films and epoxy layers.

17h00 **Session Ends / Fin de la session**

[MO-P6] 14h15 The Energy Frontier / *La frontière énergétique*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE CS-104 ***Chair: F. Corriveau, McGill U.***

MO-P6-1 **14h15**

JOHN MARTIN, University of Toronto

News and Results from ZEUS at HERA

ZEUS is a large experiment at the world's largest electron microscope, the HERA electron-proton collider, where the structure of the proton can be probed down to 1/1000 of its diameter. Some of the final results from data taken in an 8 year run ending in 2000 will be presented, including tests of the Electro-weak and QCD parts of the Standard Model. HERA has been upgraded to provide longitudinal electron polarization and increased luminosity for the collider experiments. A new run is underway and a report of the progress will be given.

MO-P6-2 **14h45**

NAOKO KANAYA, University of Victoria

Physics Beyond the Standard Model at the LHC Experiments

The LHC experiments will probe energy scales beyond any previously achieved, and will provide the best opportunity to discover physics beyond the Standard Model. Many theoretical models have been developed to address limitations of the Standard Model, and they share the common feature of TeV scale new physics accessible to the ATLAS experiment. While opportunities will also exist at the LHC for precision measurements, I will focus on searches for physics beyond the Standard Model with the ATLAS experiment

15h15 **Coffee Break / Pause café**

MO-P6-3 **15h30**

WILLIAM TRISCHUK, University of Toronto

The CDF-II Experiment at Fermilab

The Collider Detector at Fermilab (CDF) and Fermilab Tevatron have undergone major upgrades over the last 5 years, increasing the collision energy from 1.8 to 2.0 TeV and instantaneously luminosities from 2 to 4 x 10^{31} cm^{-2} s^{-1} currently with an eventual goal of 10^{32} in the next year. We have now recorded 100 pb^{1} of physics quality data and have new results on a wide range of topics. After a brief review of the upgrades I will show electroweak, top and *b* physics results from the new data. Particular emphasis will be

placed on the physics being done by members of the Canadian CDF groups.

MO-P6-4 **16h00**

Search for Graviscalar at LHC. **Pierre-Hugues Beauchemin**, Cliff Burgess and Georges Azuelos, *McGill University* — Recent developments (ADD scenario of large extra-dimensions) have shown that the scale of gravitational physics could be as low as the weak scale, and therefore be accessible to upcoming experiments. So far, as we know now, there is only one theory which makes sense of gravity at the gravitational scale and this is string theory. Better yet, string theory can be weakly coupled at the string scale and so allows predictions to be made. One of these predictions is that there should be an enormous number of degrees of freedom running around the extra dimensions, among which there are scalars. The discovery of a graviscalar particle would then give stronger support for a string theory. The purpose of this talk is to look at the most general theoretical assumptions required for the production of a gravitational scalar particle and at the condition that are imposed on its parameters in order to be testable at LHC.

MO-P6-5 **16h15**

Improving W Boson Mass Templates for Run II at CDF. **Ian Vollrath**, *University of Toronto* — With center of mass energy of 1.96 TeV the Tevatron collider at Fermilab is currently the highest energy collider in the world. Over the course of Run II the CDF detector is expected to measure the W boson mass with a precision of approximately 40 MeV. This presents new challenges in the Monte Carlo generation of W boson mass templates. Currently there is no full calculation that incorporates both QCD and electroweak corrections to the W mass, however, there are separate calculations that deal with these quantities. This talk presents the results of a numerical method of merging these calculations. The implications on the Run II W mass measurement will be discussed.

MO-P6-6 **16h30**

Prospects for Measuring the Top Quark Mass in CDF Run II. **J.-F. Arguin** and P.K. Sinervo, *University of Toronto* — The top quark mass is currently one of the most important parameters to be measured in particle physics. Together with the W boson mass, its value constrains the Higgs boson mass, the last particle of the Standard Model yet to be discovered. The Run II CDF and DZero experiments offer the opportunity to improve the current knowledge of the top quark mass with an upgraded accelerator and detectors. I will discuss the prospects for improvement of this measurement using the CDF detector, and present the work carried out at the University of Toronto in this direction. I will emphasize the importance of the jet energy calibration.

MO-P6-7 **16h45**

Top Quark Production Cross Section Results from CDF. **P. Savard**, B. Stelzer and R. Tafirout, *University of Toronto* — The latest top quark production cross-section results from the CDF II experiment at the Tevatron will be presented. Particular emphasis will be given to the search for single top production and the measurement of the top anti-top cross section in the dilepton decay channel.

MO-P6-8 **17h00**

W' and Z' Masses in a Geometric Approach to the Left-right Symmetric Model. **Greg Trayling** and W.E. Baylis, *University of Windsor* — Advances in the algebraic formulation of Higgs scalars in left-right symmetric models will be discussed. The talk will focus on how the structure of the Higgs fields is unambiguous in the geometric approach, and slightly different than the conventional choices. The effects of the new diagonalization of the gauge fields and Higgs corrections to the running of the coupling constants will be detailed. A general procedure for determining the Higgs structure for any number of extra dimensions will also be presented.

17h15 **Session Ends / Fin de la session**

[MO-P7] 14h15 Radioactive Beam Science / *La Science des Faisceaux radioactifs*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-B ***Chair: G. Ball, TRIUMF***

MO-P7-1 **14h15**

PHILIP M. WALKER, TRIUMF/University of Surrey

Nuclear Isomers: Energy and Spin

Isomers are excited, metastable states of atomic nuclei, with half-lives ranging from fractions of a second to billions of years. Their excitation energies can be several MeV, and they typically carry up to 30 units or more of spin. After a brief historical introduction, some recent research results will be presented, with examples that relate to topical nuclear structure problems, nuclear astrophysics, and the possibility of controlled energy release.

MO-P7-2 **14h45**

GREG HACKMAN, TRIUMF

A New Era of High Resolution Gamma-Ray Spectroscopy at TRIUMF-ISAC

Gamma-ray spectroscopy is an invaluable tool for studying the nature of the atomic nucleus. The repatriated and reconfigured 8π spectrometer at TRIUMF-ISAC is poised to be the best decay-studies facility in the world. A state-of-the-art new facility, TIGRESS (TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer), will explore novel nuclear physics with the accelerated beams from ISAC-II. Current experimental results from the 8π, in particular on the exotic decays ^{11}Li and ^{178}Hf, and the future outlook for both the 8π and TIGRESS will be discussed.

MO-P7-3 **15h15**

The Half-Life of ^{176}Lu. **G.F. Grinyer**, J.M. O'Meara, C.E. Svensson, R.A.E. Austin, J.C. Waddington, G.C. Ball, G. Hackman, C. Osborne, F. Sarazin, H.C. Scraggs, H.D.H. Stover, *University of Guelph* — Measurements of the half-lives of certain long-lived isotopes are typically dominated by uncertainties in detector efficiencies, solid angle coverage, internal conversion, self-absorption, angular correlations, and true coincidence summing. In particular, published half-life values for ^{176}Lu, of interest for geochronological studies, range from 21 to 73 billion years and show scatter far greater than the experimental uncertainties. This presentation will explain a unique γ-γ coincidence method that eliminates many of the above uncertainties. We have used this method with the 8π γ-ray spectrometer at the ISAC (Isotope Separator and Accelerator) facility at TRIUMF in Vancouver, B.C., to redetermine the half-life of ^{176}Lu. Our result, 40.8 $\pm$ 0.3 billion years, is now sufficiently precise for geochronological work.

15h30 **Coffee Break / Pause café**

MO-P7-4 **16h00**

TADASHI SHIMODA, Osaka University

Novel Structure of a Neutron Rich Nucleus ^{11}Be Proved by Spin-Polarized ^{11}Li Beam at TRIUMF-ISAC

Exotic structures of light neutron-rich nuclei, such as neutron halo, single-particle level inversion, molecular structure, and so forth, have been attracting much interest both in experimental and theoretical nuclear physics. By taking advantage of high potential of polarized beam facility of ISAC at TRIUMF, we successfully applied a new method of β delayed spectroscopy for a very neutron rich nucleus ^{11}Li ? β-ray asymmetry measurements in coincidence with the delayed neutrons and γ-rays from a *spin-polarized* ^{11}Li. As well as the decay scheme of ^{11}Li, the spins and parities of the excited states in ^{11}Be have been determined. The level sequence in ^{11}Be and the β-decay probabilities of ^{11}Li are in accord with the theoretical predictions by a fully microscopic theory of Antisymmetrized Molecular Dynamics (AMD)[1]. It is understood that both the well-developed α-cluster structures forming molecular rotational bands and the cluster broken structures appear in the excited states of ^{11}Be.

1. Y. Kanada-En'yo and H. Horiuchi, *Phys. Rev. C* **66** (2002) 024305

MO-P7-5 **16h30**

MATTHEW R. PEARSON, TRIUMF

Nuclear Physics with Atomic Tools at ISAC

TRINAT (TRIumf's Neutral Atom Trap) is on-line to the ISAC radioactive beam facility and provides a localised ($\sim 1\text{mm}^3$), cold ($\sim 1\mu$ K), isotopically pure sample of alkali atoms in a controllable environment. When this is combined with efficient ion detection and two step (one resonant, one non-resonant) photoionisation a highly sensitive probe of both atomic hyperfine structures and isotope shifts is obtained. This has resulted in the measurement of the mean squared charge radius and nuclear quadruple moment of ^{36}K ($t_{1/2}$ = 342ms).

Recent developments have also resulted in the ability to produce highly polarised samples within the trap. This allows for the investigation of spin-correlated decay parameters. Preliminary results from a recent experimental run with polarised ^{37}K, looking for the time reversing *D*-coefficient as well as neutrino asymmetry parameter B_ν will also be shown.

17h00 **Session Ends / Fin de la session**

[MO-P8] 14h15 Gravity / *Gravité*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE MN-120 ***Chair: M. Paranjape, U. Montreal***

MO-P8-1 **14h15**

CLIFF BURGESS, McGill University

Are Inflationary Predictions Sensitive to Very High Energy Physics?

It has been proposed that the successful inflationary description of density perturbations on cosmological scales is sensitive to the details of physics at extremely high (even trans-Planckian) energies. I will critically analyse this idea by examining how inflationary predictions depend on higher-energy scales within a simple model where the higher-energy physics is well understood. The result is the best of all possible worlds: inflationary predictions are robust against the vast majority of high-energy effects, but "can" be sensitive to some effects in certain circumstances, in a way which does not violate ordinary notions of decoupling. This implies both that the comparison of inflationary predictions with CMB data is meaningful, and that it is also worth searching for small deviations from the standard results in the hopes of learning about very high energies.

MO-P8-2 **14h45**

Propagation of Gravitational Waves in the Background of a Kerr Black Hole. **Karl Martel** and Eric Poisson, *University of Guelph* — The detection of gravitational waves, by detectors such as LIGO and LISA, relies on an a priori knowledge of the gravitational radiation emitted by astrophysical systems. Part of the current effort is the production of gravitational waves from a rotating black hole. In this talk, I will present a numerical method for integrating the Teukolsky equation in the time domain, which describes the propagation of gravitational waves in the background of a Kerr black hole. I will discuss the quasi-normal mode of the black hole and the tails of the radiation field.

15h00 **Coffee Break / Pause café**

MO-P8-3 **15h30**

JACK GEGENBERG, University of New Brunswick

Using Gravity to Understand Topology

The Thurston Geometrization Conjecture says that the topology partially determines the local geometry of three dimensional space - and vice-versa. If true, it has deep implications for the structure of the quantum theory of gravity, and for cosmology. In this talk, it will be shown that the proof of the conjecture might follow from techniques associated with gravitational physics.

MO-P8-4 **16h00**

ROBERT MANN, University of Waterloo

Chaos in 3-body Relativistic Self-Gravitating Systems

I present results from the first study of three body motion in a relativistic one-dimensional self-gravitating system. From an exact expression for the Hamiltonian, I show how to map the system into that of a single particle moving in a two-dimensional well with hexagonal symmetry. In this representation the equations of motion can be numerically solved, and Poincare sections can be obtained as a function of the relativistic energy parameter η. Two broad categories of periodic and quasi-periodic motions exist as well as a set of intermediate chaotic motions. Despite the high degree of non-linearity in the relativistic system, the global structure of its phase space remains qualitatively the same as its non-relativisitic counterpart for all accessible values of η. However the post-Newtonian expansion experiences a KAM breakdown for $\eta \sim 0.26$: above which the near integrable regions degenerate into chaos.

MO-P8-5 **16h30**

Scalar Fields Generating the Acceleration of the Universe. **Patrick Grenier**, *McGill University* — The evidences for an accelerating expansion of the Universe at our epoch have led us to look for an energy component which could generate it. That can consist in quintessence, in the form of a system of scalar fields $\{\phi_i\}$ rolling down a potential $V(\{\phi_i\})$. I will present the equations relevant to the cosmological evolution of such a system and the different conditions required for a viable cosmology. Also, with a particular example for $V(\{\phi_i\})$, I will discuss how we can partially alleviate the fine-tuning of the initial conditions by deforming the target-space on which $\{\phi_i\}$ lives.

MO-P8-6 **16h45**

Spindown of a Periodic Gravitational Wave Pulsar Signal and the Zak-Gelfand Integral Transform. **S.R. Valluri**[a], J.J. Drozd[b], A. Vajda[c], B.S. Sathyaprakash[d], S.V. Dhurandhar[e], [a]*Department of Physics and Astronomy and Department of Applied Mathematics, University of Western Ontario*, [b]Department of Applied Mathematics, University of Western Ontario, [c]Department of Computer Science, University of Western Ontario, [d]Department of Physics and Astronomy, University of Cardiff, UK, [f]Inter University Centre of Astronomy and Astrophysics, Pune, India — We present detailed analytical and numerical studies of the Fourier transform (FT) of the gravitational wave (GW) signal from a pulsar, taking also into account the spindown of a pulsar in addition to the rotation and orbital motion of the Earth. We also briefly discuss the Zak-Gelfand integral transform and a special class of the generalized hypergeometric function of potential relevance. The Zak-Gelfand integral transform that arises in our analytic approach has also been useful for Schrödinger operators in periodic potentials in condensed matter physics (Bloch wavefunctions) and holds promise for the study of periodic GW signals for long integration times. The numerical analysis will also include parallel implementation of the multiparameter gravitational waveform that also considers the spindown of a pulsar. This is an important computational problem for gravitational wave detection analysis.

MO-P8-7 **17h00**

Asymptotically Anti-de Sitter Black Holes and the Holographic Hypothesis. **Saurya Das** and Viqar Husain, *University of New Brunswick* — We show that a d-dimensional asymptotically anti-de Sitter black hole has a holographic dual, in the sense that its thermodynamic properties including free energy and entropy can be captured by a perfect fluid residing at the boundary. We examine various implications of this result.

17h15 **Session Ends / Fin de la session**

[MO-P9] 14h15 Plasma Physics / *La physique des plasmas* — MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE MN-220 ***Chair: M. Nantel, PRO***

MO-P9-1 **14h15**

GRZEGORZ CZEREMUSZKIN, Ecole Polytechnique de Montreal

*Plasma Enhanced Chemical Vapor Deposition of Barrier Coatings on Plastics**

Low-pressure plasma technology offers the possibility of excellent uniformity and homogeneity in the surface treatment and coating of solid substrates. Plasma Enhanced Chemical Vapor Deposition (PECVD) is a powerful method for depositing ceramic transparent barrier coatings on plastic materials. Recent progress in the technology allowed us to produce PECVD coatings with extremely low gas transmission values, which may be used to encapsulate organic flat panel displays and to produce flexible plastic substrates for this application. For less demanding food- and pharmaceutical packaging applications, transparent barrier coatings show many advantages over conventional composite barrier plastics and metallized plastic films: They are fully recyclable, microwave compatible, impermeable to plastic additives, sterilizable, insensitive to humidity, chemically inert, and are deposited in a solvent-free, environmentally friendly process. PECVD coatings are superior compared with ones deposited using other methods, in regard to low defect counts in the coatings as well as improved adhesion, stretchability, and flexibility. Although thin ceramic-barrier-coated plastic films and containers are being introduced into packaging industries on continuously growing scale, the mechanisms of gas- and especially moisture permeation through such materials are only partly understood and still need intensive research. Permeation through barrier coated plastic films will be discussed, summarizing our very extensive studies on permeation mechanisms. The discussion will include permeation model, defect detection techniques, early stages of formation of PEVCD coatings, potential reasons for barrier failure, and methods for further improving PECVD and other barrier coatings.

* In conjunction with G. Dennler, M. Latreche and M.R. Wertheimer

MO-P9-2 **14h45**

YURIY TYSHETSKIY, University of Saskatchewan

Anomalous and Nonlinear Effects in Inductively Coupled Plasmas

Modern Inductively Coupled Plasma (ICP) sources typically operate in a regime when the plasma electron thermal motion is significant. This regime is known as anomalous, or nonlocal, regime. All the basic plasma processes in such regime (such as electromagnetic wave penetration into plasma and electron heating) are strongly affected by the electron thermal motion and by the resonant interaction of the electromagnetic wave with the plasma electrons. A brief overview of ICP sources and their technological use will be made. Then the introduction to the theory of anomalous skin effect, electron heating and ponderomotive force will be given. The typical experimental results on measuring the electron heating and ponderomotive effects in anomalous regime of ICP will be presented, revealing some interesting peculiarities, such as the reduction of ponderomotive effects due to electron thermal motion and the negative power absorption. These peculiarities cannot be explained by the classical theory of ponderomotive force and collisional heating. Thus we present our theory that takes into account both collisions and electron thermal motion. We compare theoretical results with the experimental data, finding a reasonable agreement. The physical reasons for the peculiarities of anomalous regime mentioned above are discussed.

A new effect of reduction of anomalous electron heating compared to the ohmic (purely collisional) value at low driving frequencies is predicted by our theory. To verify this effect, as well as to investigate the influence of nonlinear effects on the electron heating, we developed a Particle-In-Cell (1d3v PIC) code for modeling of the ICP discharge in the anomalous regime. Some results of the PIC simulations will be presented and their comparison with our theory will be made.

15h15 **Coffee Break / Pause café**

MO-P9-3 **15h45**

The Interaction Between Cylinders and a Drifting Collisionless Plasma Containing Two Ion Species*. **J.C. McMahon** and J.G. Laframboise, *York University* — The interaction between a cylindrical conducting object, representing a spacecraft or electrostatic probe, and a collisionless plasma through which it moves transversely, is investigated numerically. The calculation is self-consistent, solving the coupled set of Boltzmann-Vlasov equations and Poisson equation in an iterative manner until convergence is achieved. The plasma contains two ion species, each at a different temperature T_i with respect to the electrons at T_e. The ion current collected, the ion density distributions, and the potential distributions surrounding the probe are presented. Calculations are presented for various ratios of collector potential to electron thermal energy $e\phi_c / kT_e$ and ratios of collector radius to electron Debye length r_c / λ_D. Various ratios of drift speed to ion thermal speed $S = U / \sqrt{2kT / m}$ and electron-to-ion temperature ratios T_e / T_i for the two different ion species were also modelled. The fraction which each ion species represented of the total plasma was also varied. The purpose of these calculations is to evaluate the effect of a multiple-ion plasma on spacecraft-plasma interactions.

*Work supported by NSERC e-POP CRO grant (principal investigator A. Yau) and by NSERC operating grant A-4638.

MO-P9-4 **16h00**

RF Effects on OEDIPUS-C Floating Voltages*. **J.G. Laframboise**[a], D.D. Wallis[b], and H.G. James[c], [a]*York University*, [b]National Research Council Canada and [c]Communications Research Centre — The OEDIPUS-C tethered payload was launched on 7 November 1995 from the Poker Flat Research Range, Alaska. The Tether Current Monitor (TCM) instrument operated the two subpayloads and the conducting tether as a double electrostatic probe. During the part of the experiment discussed here, the flight upleg, the angle between the tether and the geomagnetic-field direction was less than 5 degrees. The TCM configured the payload cyclically as a high-impedance voltage probe and as a low-impedance current probe. OEDIPUS C also carried a high-frequency exciter (HEX) on its forward subpayload. With the HEX connected to the forward subpayload dipoles and with the frequency swept from 25 kHz to 8.0 MHz, the transient response of the TCM voltage showed a number of reproducible features. At the lowest frequencies of the sweep, the RF pulses drove the forward subpayload potential negative with respect to the aft by several tens of volts. The time-constant of relaxation of the payload's potential between the HEX pulses increased as background density decreased. The TCM voltmeter data showed a steady rise in the time-averaged floating voltage of the forward subpayload as the HEX transmitter was swept from lower to higher frequencies. This is as expected when ponderomotive effects become relatively more important relative to rectification. Superposed on this was another feature in which the forward subpayload was driven increasingly negative as the frequency approached the electron gyrofrequency from below, and increasingly positive as it approached it from above. This suggests that RF forcing of the electrons counteracted geomagnetic restriction of the electron collection below the gyrofrequency, but enhanced it above the gyrofrequency. In order to verify this explanation, we have performed a model calculation of electron collection in the combined RF near-field and steady geomagnetic field in the neighbourhood of an antenna element, assumed to be an infinite cylinder perpendicular to the geomagnetic field. Our model includes effects of time-dependent sheath expansion following the start of RF pulses, and of time-dependent sheath collapse following their end.

* Work supported by NSERC operating grant A-4638.

16h15 **Session Ends / Fin de la session**

[MO-P10] 14h15 Semiconductor Physics / *La physique des semi-conducteurs* — MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE KC-104 ***Chair: R. Fletcher, Queen's Univ.***

MO-P10-1 **14h15**

Arrays of Sub-100-nm Blisters and Craters Produced by Low keV Ion Implantation. **O. Moutanabbir**, B. Terreault and G.G. Ross, *INRS-Énergie et Matériaux* — Cavity formation, blistering and flaking induced by hydrogen and/or helium implantation followed by annealing have actual and potential applications in impurity gathering, and in silicon-on-insulator and molecular sieve fabrication. We have found that using low keV ions to produce such structures with sub-100 nm dimensions poses particular problems which challenge the usual models that were inferred from higher energy processing. This work aims at improving our understanding of the underlying mechanisms and increasing the effi-

ciency of the process in terms of ion dose and annealing conditions. We implanted (100), (110) and (111) silicon crystals with 5 or 8 keV H, D and/or He ions at doses of 1 x 10^{16} to 1x10^{17} cm^{-2}. We used Atomic Force Microscopy to quantitatively characterize the surface morphology, Thermal Desorption Spectrometry as a fingerprint of gas-lattice interaction, and the resistivity as an indication of defect evolution. The critical blistering doses and optimal annealing conditions have been determined for each ion singly or in combination. H and D ions behave remarkably differently: while a dose of 6 x 10^{16} D cm^{-2} induced abundant blistering, no blisters were observed with the same H dose, due to insufficient defect production by low-keV H implantation to stably trap H. The density, size and morphology of the blisters and craters depend on the crystal orientation. Co-implantation of H and He decreases radically the critical blistering dose, and the order of implantation has a crucial effect on formation of blisters. No blisters were observed in samples implanted with H before He, while blisters and craters were very successfully produced by He implantation before H B contrary to the belief that H implantation would "prepare the ground" for blistering by nucleating platelets parallel to the surface. The resistivity measurements show neat correlations with the morphology and the gas evolution, and in particular with the order of the implantation. Though convenient as an empirical signature of the underlying events, the resistivity is difficult to interpret physically, because it depends on both the carrier density, through the charge state of the H associated vacancies, and the carrier mean free path, through the nature and density of defects.

MO-P10-2 **14h30**

Electronic Structure of Intermixed Self-Assembled InGaAs/GaAs Quantum Dots by the Effective Bond-Orbital Method. **Weidong Sheng**, Marek Korkusinski, and Pawel Hawrylak, *National Research Council of Canada* — The electronic structure and optical properties of intermixed InGaAs quantum dots are investigated theoretically. The strain profile is obtained by applying the continuum elasticity theory while the electronic structure is calculated using effective bond orbital model (EBOM). The parameters of the EBOM are determined by the comparison with the eight-band k*p models. The effect of strain is incorporated in the electronic structure calculation via the Bir-Pikus Hamiltonian. Several different approximations are used to generate effective bond parameters across the interface between the quantum dot and barrier materials. The EBOM method and the Peierls substitution are applied to generate a tight-binding Hamiltonian for quantum dots in the presence of magnetic field. An efficient Lanczos eigenvalue solver is applied to calculate the energy levels and wave functions of confined states in the conduction and valence bands. The simulation results are compared with those obtained by the eight-band k*p method and the experimental data.

MO-P10-3 **14h45**

Spin Relaxation in Lateral Quantum Dots. **M. Florescu**, S. Dickman, M. Ciorga, A. Sachrajda and P. Hawrylak, *National Research Council of Canada* — We report results of calculations of the effect of spin-orbit interaction on electron spin in lateral quantum dot. These calculations are motivated by puzzling results of high source-draintransport measurements of singlet-triplet transition of two electrons in lateral and vertical devices. On the low magnetic field side of the singlet-triplet transition both the singlet ground state and the excited triplet state are observed. Once the triplet becomes the ground state, the singlet excited state is no longer observed. We associate the quenching of the current through the upper (singlet) state with an inelastic spin-flip relaxation mechanism mediated by spin-orbit interaction and involving the emission of a longitudinal acoustic phonon. This dephasing mechanism presents a built-in magnetic field asymmetry compatible with the experimental observations and predicts an accelerated decay of the excited levels in the vicinity of the single-triplet transition.

15h00 **Coffee Break / Pause café**

MO-P10-4 **15h30**

Excitonic Artificial Atoms in Strong Magnetic Fields. **S.J. Cheng**[a], W. Sheng[a], P. Hawrylak[a], S. Raymond[a], S. Studenikin[a], A. Sachrajda[a], Z. Wasilewski[a], A. Babinski[b], M. Potemski[b], G. Ortner[c], M. Bayer[c], [a]*National Research Council Canada*, [b]Grenoble High Magnetic Field Laboratory, MPI/FKF and CNRS, France, [c]Experimental Physik II, Universitat Dortmund, Germany — Excitonic artificial atoms are formed by electron-hole complexes in self-assembled quantum dots under high excitation conditions. We present results of calculations and experiments on excitonic artificial atoms in InAs/GaAs self-assembled quantum dots in high magnetic fields. The dots are obtained using In-flush technique and subsequently annealed. The single particle properties of annealed dots are based on calculations using eight-band *k p* theory coupled with strain calculation using classical elasticity theory. The annealing process is found to result in significant reduction of shear strain and energy spacing of excited states, leading to nearly equally spaced energy levels in both conduction and valence bands. Therefore, the single particle energy levels are fitted to the harmonic oscillator (HO) basis - the Fock-Darwin spectrum. The HO basis is used for the exact diagonalisation studies of the ground and excited states and recombination spectrum as a function of the number of electron-hole pairs N and the magnetic field B. The exact diagonalisation employs a combination of conjugated gradient and folded spectrum techniques. This allows the calculation of recombination spectra as a function of B and N. At B = 0 we recover hidden symmetries for partially filled shells. The symmetries are removed with the application of the magnetic field. New degeneracies, corresponding to the crossing of levels characteristic of the FD spectrum, are created at some special finite values of magnetic field. In the vicinity of the crossing of levels, the chemical potential of a multi-exciton system turns out to be insensitive to the magnetic field as well as the exciton number due to the strong coupling between the configurations with opposite B-dependence of energy. This replaces sharp cusps in the chemical potential of noninteracting system by plateaus. In the regime without level crossing, the excitonic chemical potential follows the evolution of single-particle FD spectra with the magnetic field. Hence the emission spectrum of electron-hole pairs is found to directly map out the FD spectrum in a magnetic field. Results of calculations are compared with extensive measurements of emission spectra from InAs/GaAs quantum dot ensembles as a function of excitation power in magnetic fields up to 28Tesla.

MO-P10-5 **15h45**

Comparison of Electron-Spin Polarisation From Bulk and Structural Asymmetry in Type-II Heterostructures. **André E. Botha** and Mahi R. Singh, *University of Western Ontario* — The zero-field spin splitting in III-V semiconductor quantum wells is due to the spin-orbit interaction. It has two distinct contributions: 1.) microscopic – arising from the bulk inversion asymmetry (BIA) of the materials, and 2.) macroscopic – arising from the structural inversion asymmetry (SIA) of the quantum well. The latter contribution is due to asymmetry in the confining potential of the quantum well. These two contributions are often referred to in the literature as, the k3 contribution, and the Rashba contribution, respectively. So far, much work on spin splitting in type-II semiconductor quantum wells has focussed on the spin splitting due to the application of a uniform magnetic field. The field strength is typically assumed to be large enough to allow the zero-field contributions to be neglected, or else treated as small perturbations (usually only up to third order). However, to compare the relative importance of these two effects in type-II quantum wells, even in the absence of an applied magnetic field, both contributions to the zero-field splitting should be taken into account explicitly by including the higher conduction bands. In this paper, the zero-field electron-spin splitting, arising from the bulk inversion asymmetry is compared to that from the lack of specular symmetry along the growth direction in type-II quantum wells manufactured from InAs and GaSb. By using a modified 14x14 matrix Hamiltonian, which includes the anisotropy, non-parabolicity and non-sphericity of the energy band structure, analytical expressions for the transmission coefficient and the electron-spin polarization are obtained. Spin dependent boundary conditions and the transfer matrix method are employed to calculate the total zero-field spin splitting for a variety of well widths. It is predicted that the two contributions to the splitting are in general approximately of equal importance even though they are found to be non-additive.

MO-P10-6 **16h00**

A Study of the Variable Range Hopping Mechanism in Nanoscale DNA Crystals. **Mahi R. Singh** and Chi-Ming Tsang, [a]*University of Western Ontario* — Biomolecular electronics (BE) is raising a worldwide interest due to possibility of realizing cheap and easy-to-fabricate devices by exploiting the natural self-assembling and self-repairing of biological materials[1]. BE has deep roots in the field of organic molecules. The most of the research in BE has been directed toward the identification of molecules combining good conductivity with good self-assembling and self-recognition properties. DNA has been one of the most investigated classes of biomolecules, leading to a somewhat controversial description of its electrical properties. DNA and its derivatives have been one of the most investigated classes of biomaterials whose electronic properties are not well understood and are very controversial. Depending on the interconnection mechanism, the DNA molecules have been found to be conductive, non-conductive or rectifying, and hence, of its potentiality for electronic applications. Electrical transport measurements on micro-meter-long DNA ropes and also on large number of DNA molecules in films have been studied. These crystals and their derivatives behave like semiconductors with energy gap of about 3.5 eV. Recently, Cingolani *et al.* have studied the I-V characteristics of these crystals. They have also measured the temperature dependence of conductivity. They found that conductivity also depends on the size of the sample. Their experiments cannot be explained by using existing theories based on the band structure. In this paper, we proposed a theory of variable range of hopping based on the electron hopping model in the quasi-one and quasi-two dimensional systems. We use the model where the electron transfer through DNA is based on overlap between pi orbitals in adjacent base pairs. We consider that irregular base-pair sequences lead to localization of charge carriers and these states are responsible for the hopping mechanism. The localized states are randomly distributed in the energy and spatial coordinates. It is assumed that states are occupied according to Fermi-Dirac statistics. The electrons hop from one localized state to another with the help of absorption and emission of phonons. The states below and above Fermi level in the calculation of hopping range and conductivity are included. Mobility and the hopping range are calculated as function energy with respect to Fermi level. Then the conductivity is calculated with the help of mobility by integrating over energy. The present method differs significantly from the method used to calculate the hopping conductivity by Mott and others. In the presence of electric field E, we found that the logarithmic of conductivity has E power law. The present theory is able to explain the experimental temperature and size dependence of the conductivity.

1. Henk *et al.*, *Science* **293**, 76 (01).

16h15 **Session Ends / Fin de la session**

[MO-P11] 14h15 Frontiers in Scanning Probe Microscopy / *Frontières de la microscopie par sonde à balayage*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-A ***Chair: D. Jack, Concordia U.***

MO-P11-1 **14h15**

GREGORY P. LOPINSKI, National Research Council of Canada

*Molecular Electronics on Silicon Surfaces**

Controlled attachment of organic molecules to silicon surfaces offers the potential to integrate the wide range of functionality of these molecules with existing silicon based microelectronics, creating a new class of hybrid devices. We will discuss progress towards understanding the organic molecule/silicon interface and fabricating hybrid devices focussing on results from the Molecular Interfaces Program at SIMS-NRC. Scanning tunneling microscopy (STM) studies of single molecules adsorbed on clean Si(100) surfaces in ultra-high vacuum not only provide information on adsorbate bonding geometries but also reveal insights into mechanisms of electron transport. The STM has also been used to trigger and observe a self-directed chain reaction that may be useful for the parallel fabrication of molecular nanostructures. Finally, organically-modified Si(111) surfaces produced by wet chemical methods have been used to fabricate tunnel diodes and have demonstrated chemical sensing capabilities.

MO-P11-2 **14h45**

Aggregation of Microbial Cells: Direct Measurement of Discrete Lectin-Carbohydrate Interactions. **A. Touhami**[a], F.A. Denis[b], Y.F. Dufrene[b], [a]*Dalhousie University*, [b]Unité de Chimie des Surfaces, UCL, Belgium — Knowledge of the molecular interactions between lectins and carbohydrates is a key to understand cellular interactions and develop new bioanalytical applications. Here we used atomic force microscopy (AFM) to measure individual lectin-crabohydrate interactions involved in the aggregation of yeast cells. To this end, AFM probes functionalized with oligoglucose carbohydrates were used to record force-distance curves on living yeast cells. Flocculating cells showed adhesion forces of 121 ± 53 pN, reflecting the specific interaction between individual cell surface lectins and glucose residues. Similar adhesion forces, 117 ± 41 pN, were measured using probes functionalized with the lectin concanavalin A and attributed to the specific binding to cell surface mannose residues. By the contrast, specific interaction forces were not observed in non-flocculating conditions, i.e. in the presence of mannose or when using non-flocculating cells, pointing to their involvement in yeast flocculation. The single molecule force spectroscopy measurements presented here provide a means to study a variety of cellular interactions at the molecular level, such as the adhesion of bacteria to animal and plants tissues.

MO-P11-3 **15h00**

CuPc Buffer Layer Role in OLED Performance: A Band Engineering and Interface Properties Study. **S.M. Tadayyon**[a], M.H. Grandin[a], K. Griffiths[a], P.R. Norton[a], H. Aziz[b]*, and Z. Popovic[a], [a]*University of Western Ontario* and [b]Xerox Research Center of Canada — Copper phthalocyanine (CuPc) is a very well-known dye pigment with a number of interesting properties, *e.g.* it is an organic semiconductor, it is chemically and thermally very stable, it can easily form ordered thin films, and it exhibits photoconductivity and catalysis. Lately, it has been studied for electronic and photonic device applications, in particular for organic light emitting devices (OLEDs)[1-3]. It has been shown that a CuPc layer inserted between the anode (typically indium-tin-oxide (ITO) on glass) and the hole-transport layer (HTL) of an OLED structure[2-3] produces a significant improvement in device performance by reducing device lifetime-shortening problems, caused for example by interface degradation at the HTL/ITO interface; it also stabilizes the hole-injection barrier[4]. Recently, CuPc has also been used as a buffer layer in transparent cathodes[5-6], where it does not seem to impede electron transport[6]. Despite this technical progress, the understanding of the basic mechanisms underlying charge injection and transport in CuPc are still very limited. A new understanding of the concept of vacuum levels for band engineering has been developed, and its viability has been confirmed. As a result of this improvement in the understanding, many calculations relating to band engineering have to be revised and corrected. We have developed a system in which we have excellent control of the vacuum environment for producing stable interfaces which permits band engineering of the OLED multilayer. The scatter in the data published in the literature for UPS measurements of ionization potentials (IP) and energy barriers has been addressed. The reasons for unstable surface electronic properties has also been investigated. Our careful study of the electronic band structure of OLEDs with and without CuPc buffer layers was performed to improve the understanding of the hole injection mechanism at the anode. The change in band structure with different CuPc thicknesses was investigated using UPS techniques. The interfacial properties were also studied using XPS and AFM to determine changes in chemical and topographical properties.

1. S.A. Van Slyke and C.W. Tang, US Patent 472,043,2 (1998)
2. C.W. Tang and S.A. Van Slyke, *Appl. Phys. Lett* **51** (1987) 913.
3. C.W. Tang, S.A. Van Slyke, and C.H. Chen, *J. Appl. Phys.* **65** (1989) 3610.
4. S.A. Van Slyke, C.H. Chen, and C.W. Tang, *Appl. Phys. Lett.*, **69** (1996) 2160.
5. G. Pathasarathy, P.E. Burroughs, V. Kahifin, V.G. Kozolov, and S.R. Forrest, *Appl. Phys. Lett.* **72** (1998) 2138.
6. I.S. Hung and C.W. Tang, *Appl. Phys. Lett* **74** (1999) 3209.

15h15 **Coffee Break / Pause café**

MO-P11-4 **15h45**

Adsorption and Desorption of CO/Pt(111): A Comprehensive Analysis Phase Diagrams of Site Frustrated Heisenberg Spin Glass Models. **J.-S. McEwen**, S.H. Payne and H.J. Kreuzer, *Dalhousie University* — We review the theoretical and experimental work done on CO/Pt(111). A lattice gas model with top and bridge sites is used to model recent experimental isotherms of the partial coverage of these sites. The interactions deduced are then used to model absorption and desorption kinetics. Our theory produces excellent agreement with all available experimental data.

MO-P11-5 **16h00**

JOHN BRUCE GREEN, University of Alberta

Developments of Atomic Force Microscopy for Enhanced Chemical and Biological Discrimination

This presentation will describe the development of a scanning probe-based method called inverted atomic force microscopy, i-AFM, that is aimed at the rapid measurement of intermolecular interactions between hundreds of combinations of molecular couples. Our research involves 1) the microfabrication of cantilevers and tip arrays; 2) the patterning of both the tip array and the cantilever with an group of molecules; 3) the measurement of intermolecular interactions for each of the possible molecular combinations; and **4**) the introduction of analytes, which may affect these interactions. The entire process combines self-assembly techniques with scanning probe methods to create and characterize these intermolecular interactions. Details of each step in the assembly of i-AFM and its operation for the measurement of these forces will be discussed. Furthermore, the results of the measurements made with these model systems will be presented and some conclusions drawn as to future applications i-AFM.

MO-P11-5 **16h30**

CHRISTOPHER M. YIP, University of Toronto

Protein-Based Supramolecular Architectures: Controlling Self-Assembly at Molecular Interfaces

The rational design of protein-based supramolecular architectures requires careful consideration of not only intra-molecular structure but also the intermolecular interactions that control their self-association into higher order structures. Our recent research efforts have focused on the development and application of new integrated imaging tools that combine scanning probe microscopy (SPM) with the functional aspects of high-resolution optical imaging and spectroscopy to address questions related to the interplay between molecules, cells, and surfaces. We will explore how in situ SPM studies have provided us with novel insights into the role of electrostatic and hydrophobic forces on the assembly of oriented protein nanostructures. Our recent efforts to combine in situ fluorescence spectroscopy with SPM are helping us to resolve the kinetics and phenomenological basis for structural transitions in supported planar lipid bilayers. Such systems are ideal for investigating the transmembrane receptor association, ligand binding, and signaling. We will describe how the functional coupling of high resolution optical imaging tools (confocal and TIRF microscopies) with *in situ* SPM has been applied to the study of cellular and molecular dynamics at interfaces. The potential benefit of computational approaches, such as MD simulations, for studying the initial stages of self-assembly will be discussed in the context of our initial work on protein nanostructure formation.

17h00 **Session Ends / Fin de la session**

[MO-P12] 14h15 Becoming Leaders: Careers for Women in Science / *Devenir des patrons: Des carrières pour femmes en science*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

ROOM / SALLE AV-A ***Chair: B. Frisken, SFU***

MO-P12-1 **17h00**

C.J. EMERSON. Memorial University of Newfoundland

Becoming Leaders: Career Success for Women in Science

A key aspect of reaching a critical mass of women in science and benefiting from their full participation is the advancement of women into senior and leadership positions. The NSERC/Petro-Canada Chair for Women in Science and Engineering, Atlantic Region, has produced the Becoming Leaders Handbook[1], a series of workshops, and a facilitators guide, to support career success and encourage leadership self-awareness in young academic women and senior students in science. This presentation will describe how, through these initiatives, women recognize common experiences, and gain the tools and confidence to achieve positive results and advance in their career. The initiatives also show potential mentors, supervisors and deans how to enhance diversity in their organization and support women in their career objectives.

1. *Becoming Leaders: A Handbook for Women in Science, Engineering and Technology* by F. Mary Williams & Carolyn J. Emerson (2002). ISBN 0-88901-359-4. www.mun.ca/cwse

[TU-Plen-1] 08h30 CAP/CRM Medal Winner / *Récipiendaire de la médaille ACP-CRM*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE DS-121 ***Chair: M. Morrow, MUN***

TU-PLEN-1 **08h30**

M.W. CHOPTUIK, University of British Columbia

Critical Phenomena in Gravitational Collapse

I will present a brief overview of the critical phenomena that appear at the threshold of black hole formation in models of general relativistic collapse. These phenomena, which include scaling laws and a type of universality, are completely analogous to those familiar from statistical mechanics. The role of "computational laboratories" in the discovery of this critical behaviour will also be highlighted..

[TU-Plen-2] 09h15 Plenary Session / *Session plénière*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE DS-121 ***Chair: G. Sawatzky, UBC***

TU-PLEN-2 **09h15**

N.W. ASHCROFT, Cornell University

Classical and Quantal Order in the Light Elements at High Densities

For condensed phases of the elements (and the elements in combination) three primary length scales can generally serve to establish the physics, and experimentally the relations between these can be altered by pressure. The first is the linear measure of the valence electron density, r_s; the second, r_c, is a measure of the extent (in a Pauli principle sense) of the remaining electrons bound in cores, and the third, $r_{..}$ is a measure of the internal fluctuational physics of these localized electrons via, for example the polarizability (of increasing importance in some heavier systems). Progressive pressure impelled interference between these scales can have a dramatic influence on spatial structures which are otherwise quite symmetric under normal conditions. While ground-state structural complexity may well be anticipated from progressive interference of the basic length scales, electronic order is also projected to be a consequence. Thus core-valence exclusion has the dual effect of increasing electron-ion (and hence electron-phonon) interactions but it also increases the density of states through a diminishing of band-widths. Together they suggest that s-p systems might be further assayed at high pressures (possibly induced by chemical strategies) for higher temperature superconductivity; from solutions of the Eliashberg equation the likelihood of this appears most favourable in structures leading to compensated systems. Discussions of electronic order in metallic forms of dense hydrogen require quite different arguments (there is but a single length-scale) but paired phases with a band-overlap metallic character remain most favourable for high temperature superconductivity.

* In collaboration with J.B.Neaton, (supported by the National Science Foundation).

[TU-A1] 10h00 Innovations in Physics Education I / *Innovations en enseignement de la physique I*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE AV-A ***Chair: R. Hawkes, Mount Allison U.***

TU-A1-1 **10h00**

HANS LAUE, University of Calgary*

Concept Teaching and Learning With MAP

The presentation will demonstrate how one might teach the concept of acceleration using the Web-based computer tutorial system MAP (Modular Approach to Physics) and how students might interact with MAP to learn a concept like acceleration. It will also be shown how instructors can select from the material in MAP and arrange it in a suitable manner, and how they can add material of their own.

* In collaboration with D. Austen[a], W. Brouwer[a] and B. Martin[b], [a]University of Alberta and [b]King's University College.

TU-A1-2 **10h30**

JAMES HUNT, University of Guelph

On-line Learning in Physics Courses and Thoughts About Aiding Problem Solving

There is considerable reluctance among teachers in the exact sciences to consider on-line courses as a satisfactory medium for learning. While teachers are increasingly using the web for quick access for students in administrative details and for reinforcement of lessons, there is a belief that certain special "mysteries" of science require face-to-face interaction. Prominent among these "mysteries" is the development of problem-solving skills and laboratory experience. A successful web-based qualitative science course will be described and demonstrated, and some ideas on an introductory physics course, under development, will be presented.

11h00 Coffee Break / Pause café

TU-A1-3 11h15

Teaching Physics to Future Elementary Teachers. **John Earnshaw**. *Trent University* — Most future elementary teachers are fearful of teaching science, yet they have to do it. They also have well documented misconceptions. This paper will describe how the author has created a large, safe and popular course for this audience without lectures using constructivist methods. There is a huge potential audience for courses like this for a largely female, arts group of students who need our help as they prepare to become teachers of the next generation of scientists.

TU-A1-4 11h30

ROBERT HAWKES, Mount Allison University

*Learning Physics by Experiencing Physics**

About six years ago Mount Allison University embarked on a department wide program to introduce (or in some cases expand) the experiential mode of physics teaching. To the degree possible students learn physics by being involved in processes similar to those of physicists. The most apparent change is the way in which our first year courses are taught - rather than separate lecture and laboratory components all learning is done in our experiential lab, which includes an integrated mix of demonstrations and succinct lectures followed by collaborative learning experiences. The collaborative learning experiences frequently utilize computerized data acquisition and analysis tools. Individualized instruction and rapid feedback are key to the success of the program. Similar methods are used in many, but not all, of our upper level physics courses. Other ways in which we foster experiential physics include extensive opportunities for undergraduate student teaching assistants (including a certificate program to recognize their contributions), a vibrant program of undergraduate research (both during the summer and to some degree during the academic year) and a collegial atmosphere in which students are involved in most aspects of the life and operation of the department. The presentation will provide examples from our experiential approach and our reflections and future plans.

* In collaboration with P. Varma, J. Flynn and C. Pettipas, Mount Allison University

TU-A1-5 12h00

Successes in Distance Education Physics at Athabasca University. **M. Connors**[a], C. Tkachuk[b], F. Al-Shamali[b], and J. Ponto[b], [a]*Athabasca University*, [b]also at University of Alberta — Athabasca University has offered home study physics courses for slightly over a decade. The distance education model is based on printed materials guiding a student through a textbook, supplemented by regular contact with a tutor. A particular challenge for this model is the presentation of laboratories featuring real experiments, which will easily be recognized for transfer credit by other institutions. Our courses are all at first year level, so that introductory labs must be presented to students having no laboratory experience. Early on, the approach was simply to require students to come to a central location to do labs. This conflicted with the reason many students take our courses, resulting in a limited appeal of the courses to our main clientele. Only after switching to a system allowing students to do all course work, including labs, at home, did our enrollments grow dramatically. We now serve over 200 students a year with introductory courses. Current labs focus on experiments that can be done simply with common or easily supplied materials, and on those based on CBL technology. An example of the former is Atwood's pulley, where we supply pulleys, a stopwatch, and masses in a lab kit, and the student must supply coins as the variable masses. CBL-based labs are in practice mainly based on CBR (Calculator Based Ranger) allowing accurate measurements of distance as a function of time, during relatively short time intervals. The bouncing ball problem is a good example where the CBL technology is used to allow detailed analysis of the motion using Vernier's Graphical Analysis program. The lab kits are relatively expensive and in limited supply, but a distribution mechanism through the university library has proven very effective. Our latest efforts in distance education labs focus on remote labs, where an experiment takes place in a laboratory and the student, who could be thousands of kilometers away, controls its parameters. The action is observed via a webcam, and the quantitative results are measured by a microcontroller with an Ethernet link. Our laboratory technologies have implications not only for distance education, but can propel any institution into a new regime of cost effectiveness in implementation of introductory laboratories.

TU-A1-6 12h15

Preparation by Students for First-Year Physics Course. **W. James Slater**. *Malaspina University-College* — Packages of materials for the first-year, calculus-based physics course at Malaspina University-College were mailed in July to the students who had enrolled in or on the waiting list for the course for the following fall semester. The packages included the course description, schedule for the semester, first ten assignments (there were 40 assignments in the course), hints for solving problems and writing quizzes, examples of questions involving calculus, guide on significant digits, and a bookstore order form for the textbook, student's guide and other items. The students were asked to purchase the textbook, hand in the first assignment by the beginning of the first class and be ready to write the first quiz at the end of the first week of classes (although they were also given the option of writing it later). Assignments which were received by August 15th were graded and mailed back to the students. Of the 45 students who were at the first class of the fall semester 1999, 43 had their textbooks and had already submitted the first assignment earlier or had it ready at the beginning of the class. The other two students had only put their names on the waiting list a few days before the semester began. The results, some advantages and disadvantages of this method will be presented. A copy of some of the materials in the packages is at http://www.mala.ca/physics/.

12h30 Session Ends / Fin de la session

[TU-A2] 10h00 Cooling and Trapping of Atoms and Molecules / *Refroidir et piéger les atomes et les molécules* — TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE KM-237 ***Chair: B. King, McMaster U.***

TU-A2-1 10h00

DAVID FEDER, University of Calgary

Rotating Bose-Einstein Condensates in Optical Lattices

In recent years there has been tremendous interest in the properties of a trapped Bose-Einstein condensate (BEC) subject to rotation. When a condensate is spun very rapidly, either by an anisotropic external potential or a rotating thermal cloud, many quantized vortices penetrate the cloud. The experimental observation of these vortices has provided striking confirmation that alkali-vapor BECs are in fact superfluids. Vortices signal the local breakdown of superfluidity, however, since the cores are singularities in the superfluid velocity and are therefore in the normal' (nonsuperfluid) state. In analogy with the upper critical field in type-II superconductors, one might expect superfluidity to cease completely when the density of vortices becomes so large that the cores begin to overlap. An interesting open question is then: does the system simply become a normal gas, or could it undergo a zero-temperature quantum phase transition into something like a quantum Hall insulator? The main criterion for a quantum Hall state is that the number of vortices becomes comparable to the number of particles. One possible way to reach this threshold is to apply an optical lattice, so that the BEC breaks up into many smaller pancakes.' I will describe current work in this area, with emphasis on new physics that might emerge from these systems.

TU-A2-2 10h30

JOSEPH H. THYWISSEN, University of Toronto

One-Dimensional Phase Fluctuations in "Quasi" Bose-Einstein Condensates

One of the most striking features of Bose-Einstein condensates is their complete phase coherence. This coherence has been probed in several experiments with dilute atomic gases. However, in low-dimensional systems, the long-range order of the system can be reduced by thermally driven phase fluctuations. Complete phase coherence is only established below Tphi, which can be much lower than the critical temperature T_c. In the range Tphi < T < T_c, the high-density fraction of the cloud is a "quasi-condensate" instead of a true Bose-Einstein condensate. To characterize phase fluctuations, we use Bragg spectroscopy to measure the axial momentum distribution of quantum degenerate clouds whose aspect ratio is greater than 100:1. We observe the Lorentzian-like momentum distribution characteristic of one-dimensional phase fluctuations. The temperature dependence of the distribution width provides a quantitative test of quasi-condensate theory. Measurements of density fluctuations will also be presented.

11h00 Coffee Break / Pause café

TU-A2-3 11h30

Toward the Optical Atomic Clock:Hertz Level Measurements of the Strontium Ion Frequency Standard. **A.A. Madej**, J.E. Bernard, P. Dubé, and L. Marmet, *National Research Council of Canada* — The revolutionary development of femtosecond laser based frequency combs which link traditional atomic clocks and the optical frequency spectrum has

led us to perform a new series of absolute frequency measurements on the NRC single ion optical frequency standard. A single ion of Sr^+ is suspended in an electro-dynamic trapping field and laser cooled to mK kinetic temperatures. A 0.4 Hz wide, dipole-forbidden, transition is probed with an ultra-stable laser and is used to control the laser frequency at 445 THz. Heterodyne frequency beat measurements of the stabilized probe laser light on the ion transition versus the NRC femtosecond frequency comb locked to the Canadian realization of the SI second have resulted in an absolute frequency measurement of the Sr^+ reference transition. Based on measurements spanning a period of 4 months, a final value with an uncertainty of ± 50 Hz (1 sigma) is obtained. This represents a factor of four (4) improvements over our best frequency chain studies and is one of the most accurate measurements of an atomic system. The accuracy of the result is now approaching the limits of the current national standard for time based on Cs atomic clocks and hydrogen masers. The future prospects for the creation of an optical atomic clock which will have accuracies surpassing the 10^{-15} level and which will probe fundamental aspects of physics will be discussed.

TU-A2-4 11h45

Instability Heating of Sympathetically Cooled Ions in a Linear Paul Trap. **T. J. Harmon**, N. Moazzan-Ahmadi, and R.I. Thompson, *University of Calgary* — Sympathetic laser cooling of ions stored within a linear-geometry, radio-frequency, electric-quadruple trap has been investigated using computational and theoretical techniques. The computational simulation, which allows 5 molecular ions to interact with 35 laser cooled atomic ions, revealed an instability heating mechanism which can prevent ions below a certain critical mass from being sympathetically cooled[1]. This critical mass can however be varied by changing the trapping parameters thus allowing ions of any mass to be sympathetically cooled using a single ion species. A theoretical explanation of this instability heating mechanism is presented which predicts that the cooling-heating boundary in trapping parameter space is in a line of constant q, the ion trap stability coefficient, a result supported by the computational results. The threshold value of q depends on the masses of the interacting ions. A functional form of this dependance is given[2]. Our current research is now looking into the possibility of a coupling, between the internal degrees of freedom of molecular ions and their cooler translational counterparts, in the hope that we can cool molecular ions internally as well as translationally, through sympathetic cooling.

1. T. Baba and I. Waki, *Jpn. J. Appl. Phys*, **Part 1 74**, 375 (2002).
2. T. J. Harmon, N. Moazzan-Ahmadi, and R. I. Thompson, *Phys. Rev.* **A 67**, 013415 (2003).

TU-A2-5 12h00

Diatomic Molecules in a Strong External Field*. Koichi M.T. Yamada[a] and **Stephen. C. Ross**[b], [a]AIST Tsukuba-West, Japan and [b]*University of New Brunswick* — The rotational motion of a molecule in an external field is a hindered rotation. In the case of weak fields a perturbation treatment based on free-rotor states can easily be used to evaluate the shifts in energy levels and transition moments. This is what is usually done, for instance, in Stark-effect calculations. However, when the field is strong, the rotational quantum number J is no longer a good quantum number and the energy levels can be better understood as vibrational states. In this case a free-rotor basis set becomes less appropriate. In the case of a strong Stark-effect such strongly-hindered states are referred to as "pendular states"[1]. It is not only in electric fields that aligned states can arise. Molecules adsorbed on a surface or trapped in a matrix can also experience alignment. In these cases a richer range of possibilities presents itself as the potential may have multiple minima. By direct numerical solution of the Schrödinger equation we can calculate energy levels and transition moments of aligned states in an axial symmetric field of arbitrary strength. Here we present results in the form of correlation diagrams for the case of an external potential with two minima differing in energy and separated by a potential barrier.

* Work supported in part by NSERC
1. J.M. Rost, J.C. Griffin, B. Friedrich, and D.R. Herschbach, *Phys. Rev. Lett.* **68**, 1299 (1992); P.A. Block, E.J. Bohac, and R.E. Miller, *Phys. Rev. Lett.* **68**, 1303 (1992).

12h15 Session Ends / Fin de la session

[TU-A3] 10h00 Soft Matter Physics / *Physique de la matière molle*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE MN-40 ***Chair: J. Bechhoefer, SFU***

TU-A3-1 10h00

The Persistent Random Walk in Two Dimensions. **Christian Bracher**, *Dalhousie University* — In the persistent random walk, the probability of a certain configuration depends on the relative orientation of successive steps, and is governed by an angular bias function. I will present a novel mathematical approach based on an eigenfunction expansion of the end-to-end probability distribution function (PDF) that yields simple series solutions for the PDF and its derivatives, as well as its moments, for a planar persistent walk. The scheme provides a numerically stable, rapidly converging algorithm for all but the shortest walks. Besides two-dimensional locomotion problems in biology and medicine, the persistent walk model is attractive in the study of polymer chains, where the inherent stiffness of chemical bonds restricts the relative orientation of adjacent monomers. As a practical example of the formalism, I will display force-extension diagrams for short planar polymer chains that were calculated for various choices of the angular bias function. With increasing joint stiffness, a marked transition from rubber-type behavior to elastic response, resembling that of a stiff rod, is observed.

TU-A3-2 10h15

Radial Thickness Profiles of Spincoated Polymer Wedge Films. Jason Thomas, Bernie Nickel and **John Dutcher**, *University of Guelph* — We have used spincoating to deposit wedge-shaped polymer films in which the film thickness varies in the radial direction. The radial dependence of the film thickness of the polymer wedge films was measured using focused ellipsometry and atomic force microscopy. By considering radial flow of a Newtonian fluid and requiring that the film thickness decrease to zero at a nonzero radial position, we have derived an analytical expression for the radial dependence of the film thickness that contains only two adjustable parameters. Using this expression, we have performed nonlinear least squares fits of the measured radial film thickness profiles for a variety of polymer wedge films prepared under different deposition conditions.

TU-A3-3 10h30

The Importance of Polymer Design in Lithium-Ion Battery Electrodes. **Zonghai Chen**[a], L. Christensen[c] and J.R. Dahn[a,b], [a]*Dept. of Chemistry*, [b]Dept. of Physics & Atmospheric Science, Dalhousie University, [c]3M Co., St. Paul, MN, USA — Lithium-ion batteries are the state-of-the-art power sources for consumer electronics. Recently, new electrode materials based on amorphous alloys have been proposed which enable a doubling of the energy density of Li-ion cells. However, these electrode materials store so much lithium that volume changes of up to 250% during charge-discharge cycling are observed[1]. A typical electrode is comprised of a 40 micrometer thick coating of 5 micrometer diameter particles that is bonded to a current collector with a polymeric binder. The choice of the polymer is critical when particles can expand by 250%, causing severe motion of the particles, including collisions, within the electrode. Here, we show how basic polymer mechanics experiments allowed a cross-linked elastomer to be optimized to maintain electrode integrity under these severe conditions.

1. L.Y. Beaulieu, T.D. Hatchard, A. Bonakdarpour, M.D. Fleischauer, and J.R. Dahn, "The Reaction of Li with Alloy Thin Films Studied by *In-Situ* Atomic Force Microscopy", *J. Electrochem. Soc.*, accepted for publication (2003).

TU-A3-4 10h45

Investigation of Hole Growth in Freely-Standing Polymer Films. Connie Roth, Ben Deh, Bernie Nickel and **John Dutcher**, *University of Guelph* — Optical microscopy measurements of hole growth in high molecular weight freely-standing polymer films have revealed a transition from linear to exponential growth of the hole radius with time at temperatures close to the bulk glass transition temperature T_g. These results will be discussed within the context of recent work on the dewetting of polymer films at temperatures near T_g.

11h00 Coffee Break / Pause café

TU-A3-5 11h30

Reversible Gelation in Polymer Melts with van der Walls Interactions. Matthew Wallace[a], **Béla Joós**[a] and Michael Plischke[b], [a]*University of Ottawa* and [b]Simon Fraser University — The temperature induced gelation of short polymer chains interacting with a Lennard Jones potential is studied by Molecular Dynamics simulations. We look at the structural changes as the melt solidifies into a disordered structure. There is evidence of a glass like transition identified by the temperature at which the stress autocorrelation function $G(t)$ develops a plateau. The build-up of the plateau is gradual with lowering temperature, so at very long time scales the glass may very well flow. The viscosity η is obtained by integrating $G(t)$'s whose tails are fitted with stretched exponentials. η shows a power law behavior of the form $\eta \sim (T-T_c)^{-\lambda}$. The glassy phase is also investigated by comparing the shear module obtained by the $G_\infty = \lim_{\ldots} G(t)$ with the ones calculated by performing a simple shear deformation. Other structural properties being monitored near the transition are the diffusion constant and the stress autocorrelation function in the limit $G(w \to \infty) = G(t=0)$. The signatures of this transition are compared with those for gelation induced by crosslinks, which follows the predictions of percolation theory.

TU-A3-6 **11h45**

Continuous Model of Mesh Growth in the Presence of Kinetic Inhibitors. **Alexander A. Tetervak** and Jeffrey L. Hutter, *The University of Western Ontario* — Solidification often results in a sparse aggregate of separate microcrystals, rather than a single crystalline domain. For instance, polymers typically crystallize as spherulites composed of lamellae separated by uncrystallized polymer; similarly, impurities that kinetically inhibit growth by adsorbing to crystal faces can lead to highly branched structures. We present a model of mesh growth that includes diffusion and surface poisoning by the inhibitors. We are performing numerical studies of this model under different conditions, such as uniform cooling and a moving temperature gradient, for different sample geometries. In addition to stable, non-dense fronts, our model shows curious transitional effects and patterns under certain conditions. This suggests an explanation for banded structures that we observe in wax crystallization in the presence of additives used by the petroleum industry to prevent diesel fuel gelatin in cold weather.

TU-A3-7 **12h00**

Modifying Wax Crystallization Behaviour with Polymeric Inhibitors. **Jeffrey L. Hutter**, Jizhong Zhang, and Alexander A. Tetervak, *The University of Western Ontario* — The crystallization of normal alkanes from diesel fuels in cold climates represents a significant problem for the petroleum industry. The traditional remedy is to dilute the fuel with other distillates, such as kerosene. The depletion of high-quality resources and the demand for kerosene to produce jet fuels has created the need for other approaches. Recently, attention has turned to the use of polymeric additives that dramatically alter crystallization kinetics. Although the utility of these kinetic inhibitors has been well demonstrated in the field, the mechanisms by which they act remain poorly understood. We are studying the effects of additives on the crystallization of long-chain n-alkanes from solution. The additives change the growth morphology from plate-like crystals to a microcrystalline mesh. When we impose a front velocity by moving the sample through a temperature gradient, the mesh forms a macroscopic banded pattern. Studying variations in this pattern with wax and additive concentrations, imposed velocity, and temperature gradient improves our understanding of how the inhibitor effects growth dynamics.

TU-A3-8 **12h15**

Confinement of a Polymer Chain in a Tube. **L. Livadaru** and H.J. Kreuzer, *Dalhousie University* — We adapt the transfer matrix method to the confinement of a single polymer molecule in tube-like cavities. The method is exact and numerically efficient for realistic polymer models such as the freely rotating chain and the rotationally isomeric chain models. It allows us to calculate the chain end distribution function from which the longitudinal end-to-end distance and the free energy is obtained. The confinement is modeled as a cylindrical potential with soft walls or as a harmonic potential. Known scaling laws are recovered for long chains and strong confinement and new scaling behavior is found in the intermediate regime. The effect of anchoring one chain end to a base plate of a semi-infinite tube is also studied.

12h30 **Session Ends / Fin de la session**

[TU-A4] 10h00 Superconductivity, Magnetic and Correlated Electronic Systems I / *Supraconductivité, systèmes électroniques corrélés et magnétiques I*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE KC-104 ***Chair: J. Wei, U. Toronto***

TU-A4-1 **10h00**

Off Equilibrium Study of the Fluctuation-Dissipation Relation in the Easy-Axis Heisenberg Antiferromagnet on the Kagome Lattice. S. Bekhechi and **B.W. Southern**, *University of Manitoba* — Violation of the fluctuation-dissipation theorem (FDT) in a frustrated Heisenberg model on the Kagome lattice is investigated using Monte Carlo simulations. The model exhibits glassy behaviour at low temperatures accompanied by very slow dynamics. Both the spin-spin auto-correlation function and the response to an external magnetic field are studied. Clear evidence of a constant value of the fluctuation dissipation ratio and long range memory effects are observed for the first time in this model. The breakdown of the FDT in the glassy phase follows the predictions of the mean field theory for spin glasses with one-step replica symmetry breaking.

TU-A4-2 **10h15**

Quadrupolar Interactions in Pr-Filled Skutterudites. **S.H. Curnoe**, H. Harima, K. Takegahara, K. Ueda and I. Vekhter, *Memorial University of Newfoundland* — All symmetry allowed couplings between the $4f^2$-electron E_- doublet of trivalent praseodymium in $PrRu_4P_{12}$ and $PrFe_4P_{12}$ and displacements of the phosphorus, iron or ruthenium ions are considered. A_{1g} and E_- displacements couple to the E_+ quadrupole doublet and can lower the crystal structure from body-centred cubic to simple cubic. The E_- distortion lifts the degeneracy of the $4f^2$ doublet into states with opposite quadrupole moment, which then leads to anti-quadrupolar ordering. Either kind of displacement conspires with nesting of the Fermi surface to cause the metal-insulator or partial metal-insulator transition observed in these materials. In the heavy fermion material $PrOs_4Sb_{12}$ there is no nesting of the Fermi surface but the system undergoes a superconducting transition. We consider quadrupole fluctuation mediated superconductivity and the symmetry of the order parameter.

10h30 **Coffee Break / Pause café**

TU-A4-3 **11h00**

Examining the Metal-to-Insulator Transition in $Li_{1+x}Al_yTi_{2-x-y}O_4$ in a Search for Evidence of Strong Electronic Correlations. **F. Fazileh**[a], R.J. Gooding[b], and D.C. Johnston[b], [a]*Queen's University* and [b]Ames Laboratory, Iowa State University, Iowa — Superconductivity among spinel systems is very rare: of the 300 or so known spinels, only four of them are superconductors, only one of these four is an oxide, and that oxide, $LiTi_2O_4$, has the highest transition temperature ($T_c \sim 13K$) of any spinel. The mechanism of superconductivity in this compound has not yet been identified. Photoemission studies of Fujimori, *et al.*, provided an estimate of the 3d on-site Hubbard energy, *viz.* $U_{dd} \approx 2 - 3$ *eV*, which would suggest that this system is a strongly correlated electronic system with intermediate coupling. Indeed, the notion that Lithium Titanate's superconductivity is due to electronic correlations was first suggested by high-temperature superconductivity co-discoverer Alex Muller. As evidence supporting the hypothesis that strong electronic correlations are important in understanding the low temperature behaviour of this system, we have investigated the metal-to-insulator transitions of the cation-substituted Lithium Titanate $Li_{1+x}Al_yTi_{2-x-y}O_4$. In a one-electron picture, one would expect that the metal-to-insulator transition can be modelled very accurately by an electron density driven transition in a quantum site percolation model. We have studied these transitions, and find that quantitative predictions for the critical dopant concentration at which the metal-to-insulator sets in are in disagreement with those predicted experimentally; *e.g.*, experimentally for the ($x = 0$) LiAl$_y$Ti$_{2-y}$O$_4$ compound, an Al concentration of $y_c = 0.33$ produces a metal-to-insulator transition, whereas a quantum site percolation model identifies a lower bound of $y_c > 0.8$. One proposal that is consistent with this result is that strong correlations are ignored in a quantum site percolation (effectively Anderson) model of the transition, and thus y_c is grossly overestimated.

TU-A4-4 **11h15**

The Formation of Stripes and the Enhancement of Pairing in the Extended t – J Model*. **K.J.E. Vos** and J.M. Tipper, *The University of Lethbridge* — We have examined the formation of stripes and pairing in the extended t - J model. We have used exact diagonalization methods on a 20-site cluster with periodic boundary conditions to examine the underdoped region and found a relation between the hole correlations and the parameters used. As the values of the long-range hopping parameters increase, the holes are found to separate while enhancing the strength of the binding, resulting in a bi-directional stripe-like configuration of charge carriers. Evidence of unidirectional stripe formation in the hole and spin correlations is found upon consideration of the phase transition between the high-temperature tetragonal and low-temperature orthorhombic phases of $La_{2-x}Sr_xCuO_4$, represented by an anisotropic next-nearest neighbor hopping parameter. Upon examination of the magnetic structure factor, the values closest to (π,π) are found to increase rapidly as a function of doping, indicative of the formation of incommensurate peaks. This data is in agreement with experimental results for this compound.

* This work is supported by NSERC of Canada.

TU-A4-5 **11h30**

Structural Order Parameter and Elastic Constants of the Pyrochlore Superconductor $Cd_2Re_2O_7$. **I.A. Sergienko** and S.H. Curnoe, *Memorial University of Newfoundland* — $Cd_2Re_2O_7$ is the only known superconductor in the pyrochlore family. Besides the superconducting phase transition at $T_c = 1$ K, it also undergoes two structural phase transitions accompanied by changes of transport properties. The room temperature ideal pyrochlore phase is semimetallic with resistivity weakly dependent on temperature. The two low temperature phases ($I4m2, T_{s1} = 200$K and $I4_122, T_{s2} = 120$K) are good metals. We analyze phonon modes and find a single order parameter that describes both structural phase transitions. The order parameter is an E_u long-wavelength phonon. We calculate anomalies of the elastic constants associated with the structural transitions.

TU-A4-6 **11h45**

Phase Diagrams of Site Frustrated Heisenberg Spin Glass Models. **A.D. Beath** and D.H. Ryan, *McGill University* — In this talk we will present phase diagrams of periodic ordered site frustrated Heisenberg spin glass models for various lattice types, simple cubic (SC), body centered cubic (BCC) and face centered cubic (FCC) determined using the Monte Carlo method and a detailed finite size scaling analysis. The site frustrated model consists of two types of randomly chosen sites, ferromagnetic (F) and antiferromagnetic (A), with concentration $(1 - x)$ and x coupled with nearest neighbor bonds $J_{FF} = +1$, $J_{AA} = -1$ and $J_{FA} = -1$ and should be a good model of binary alloys of the form $F_{1-x}A_x$, such as $Fe_{1-x}Mn_x$, which contain competing ferromagnetic and antiferromagnetic interactions. The site frustrated model contains both ingredients thought necessary for spin glass ordering, 1) randomness and 2) frustration, and so it might be expected that this model should exhibit spin glass order over a certain concentration regime. However, for SC and BCC lattices, spin glass ordering does not occur and the model orders as either ferromagnetic (FM) or antiferromagnetic (AF), or both, over the entire concentration regime. The ordering is qualitatively, and in some sense quantitatively, identical to the ordering that takes place in the absence of frustration which can be achieved with the choice $J_{FA} = 0$. In this case the model simply describes decoupled, co-existing, A and F networks which percolate and order independently above a critical concentration of sites. The phase diagrams of the non frustrated model with $J_{FA} = 0$ will also be presented for comparison with the frustrated model with $J_{FA} = -1$. We attribute the lack of a spin glass phase to insufficient frustration which, in the site frustrated model, occur only on the surfaces separating A and F clusters. To produce a spin glass we need to increase the frustration content by considering FCC lattices which are geometrically frustrated with respect to AF order. Although FM order occurs for FCC lattices over a wide concentration regime, spin glass order is in principle possible since there is no conventional AF phase for FCC lattices.

12h00 **Session Ends / Fin de la session**

[TU-A5] 10h00 Instrumental Techniques, Microscopy and Sensors / *Techniques instrumentales, microscopie et senseurs* — TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE AV-B ***Chair: A. Mandelis, U. Toronto***

TU-A5-1 **10h00**

CONSTANTINOS CHRISTOFIDES, University of Cyprus

Detection of Hydrogen via Modulated Thermoreflectance

Laser photomodulated thermoreflectance has been used as a means of detecting low concentrations of hydrogen using optically thin films of palladium. Data indicate that concentrations as low as a few parts per billion can easily be detected at 100oC. Recent results have also shown that hydrogen detection down to 0.1 ppb is possible, and the response time to those hydrogen concentrations is the fastest presented until now. It has also been shown that the decay constant following saturation with hydrogen of the Pd films and subsequent recovery due to purge with nitrogen is intensity dependent. From the fundamental point of view, a semi quantitative phenomenological understanding has been achieved by showing that the PMTR response is consistent with elementary Langmurian adsorption mechanism.

TU-A5-2 **10h30**

Non-Contact Thickness Measurement of 10-50 um Metallic Coatings using High Frequency Ultrasounds Generated by an Ultrafast Laser. **Hélène Hébert**[a], A. Nadeau[a], F Blanchard[a], F. Martin[a], J.C. Kieffer[a], F. Vidal[a], N. Perret[a], T.W. Johnston[a], A. Blouin[b], A. Moreau[b], J.P Monchalin[b], [a]*NRS-Énergie, Matériaux et Télécommunications*, [b]National Research Council Canada — Ultrasounds have been extensively used to measure the thickness of metallic samples. However, it is difficult to measure the thickness of metallic coating in the 10-50 µm range since it requires high frequency ultrasounds in the GHz range. We have demonstrated that such high frequency ultrasounds can be generated when an ultrashort laser pulse interacts with matter. Using a sensitive interferometric technique to measure the surface displacement produced by the ultrasound pulse, we have caracterized the ultrasound amplitude as a fonction of laser fluence in both the ablation and thermoelastic regimes for femtosecond and picosecond pulse lengths on different metallic materials. A comparison with a theoritical model will also be presented.

TU-A5-3 **10h45**

Rapid Magnetic Resonance Imaging of Turbulent Gas Flow. **Ben Newling** and Yang Zhi, *University of New Brunswick* — Magnetic resonance imaging (MRI) of substances with short signal lifetimes has been made possible by recent developments in hardware and in measurement methods. In particular, the direct visualisation of gas samples in an MR scanner is possible[1,2]. The contrast in MR images may be manipulated, so that the flow field is visualised and quantified. A time-averaged (over minutes) spectrum of the velocity component in the direction of an applied magnetic field gradient may be obtained in each image pixel for mean flow velocities on the order of 1 - 5 m/s. With increasing Reynolds number (up to mean flow velocities on the order of 12 m/s) and the development of unsteady flows, the time-averaged nature of the measurement becomes critical. Signal attenuation becomes an indicator of the intensity of the turbulence[2]. We present improvements to the speed of the MRI interrogations, which allow us to reduce the imaging time and, hence, improve the time resolution of the measurements.

1. Prado, Balcom, Mastikhin, Cross, Kennedy, Armstrong, Logan, *J. Magn. Reson.* 1999, **137**, 324-332.
2. Koptyug, Altobelli, Fukushima, Matveev, Sagdeev, *J. Magn. Reson.* 2000, **147**, 36-42.
3. Newling, Coristine, Balcom, CAP Congress 2002

11h00 **Coffee Break / Pause café**

TU-A5-4 **11h30**

User-Friendly Computer Interface and Dual-Channel Balanced Detector for External Cavity Tunable Diode Laser Spectrometer. **Zheng-Feng Liu**, R.M. Lees and Li-Hong Xu, *University of New Brunswick* — A compact near-IR ECTDL spectrometer with open path multipass optics has been assembled for environmental monitoring applications. We will describe our effort on building a user-friendly Windows-based computer interface including necessary parameter input dialogues in addition to a real-time graphic display of the scanning spectral signal. As well, we have performed systematic studies for our New Focus Model 2017 Nirvana photo-receiver, which includes single, balance, auto-balance detection functions. Comparison of results for these modes as well as recommended optimum operating conditions will be presented. The auto-balance detection mode greatly simplifies the system requirements, with no need for a lock-in amplifier, and gives the best background fluctuation cancellation..

TU-A5-5 **11h45**

Trace Gas Detection Using ICOS (Integrated Cavity Output Spectroscopy*. **Jeff Seabrook** and Dennis Tokaryk, *University of New Brunswick* — An instrument capable of detecting trace amounts of impurity gases in the atmosphere is of great value for scientific, commercial and security reasons. Ideally, the device would be very sensitive, highly selective for the species of interest, easy to use and maintain, and could operate in real time. We will report on the implementation of the ICOS technique using an inexpensive cw-telecommunications grade diode laser in the 1.55 µm region to obtain absorption spectra of CO and CO_2. In addition, we will discuss the principles of ICOS, details of our implementation, and unexpected physical effects in our data. This technique's potential for determining absolute number densities of the gases we hope to monitor will be discussed.

* Work supported in part by CIPI

TU-A5-6 **12h00**

Prospects for Mid-Infrared CRDS. **John G. Cormier**, *National Institute of Standards and Technology* — CRDS is a powerful technique for gas-phase spectroscopy that permits high spectral resolution and high sensitivity to weak absorption, in a compact and relatively inexpensive apparatus. Although CRDS is now widely used in the visible and near-infrared regions of the spectrum, it has been comparatively slow to develop in the mid-infrared wavelengths. In this talk, I will discuss the details of a quantitative mid-infrared CRDS experiment and present our latest water vapor continuum measurements. Finally, I will sketch out some exciting new applications of mid-infrared CRDS we have begun to pursue. Examples include the detection of atmospheric trace gases at the parts-per-trillion level and the detection of ammonia and other VOCs in human breath.

12h15 **Session Ends / Fin de la session**

[TU-A6] 10h00 Instrumentation and The Future of Particle Physics / *L'instrumentation et le futur de la physique des particules*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE AV-C ***Chair: J. McKenna, UBC***

TU-A6-1 **10h00**

MOHSEN KHAKZAD, Carleton University

ATLAS Experiment and the Canadian Contribution

The Large Hadron Collider (LHC) at CERN will provide 14 TeV centre-of-mass proton-proton collisions. The ATLAS detector, is designed to take full advantage of the LHC discovery potential. The ATLAS detector and its experimental program will be briefly discussed, with emphasis on its Canadian content. Canada's contribution to the detector is focussed on the Liquid Argon Calorimeter, particularly Endcap Hadronic Calorimeter, Forward Hadronic Calorimeter, Front-End-Board Electronics, and Endcap Signal Cryogenic Feedthroughs.

TU-A6-2 **10h30**

FRANÇOIS CORRIVEAU, McGill University

Report on the Linear Collider

Europe, North America and Japan are each pushing forward studies for a next generation linear collider which would be run as an international consortium. The machine should complement and extend the physics beyond reach of the CERN LHC. After a short review of the expected physics goals, the current status of the linear collider studies will presented, along with a description of the Canadian projects and intentions.

11h00 **Coffee Break / Pause café**

TU-A6-3 **11h30**

AKIRA KONAKA, TRIUMF

JHF-SuperK Long Baseline Neutrino Oscillation Project

The tiny neutrino masses indicated by the neutrino oscillations provide important clue of the physics at the grand unification scale. CP violation in neutrino oscillation provides natural explanation of the baryon asymmetry in the universe (Leptogenesis). The neutrino oscillations are established in solar (U_{e2}) and atmospheric ($U_{\mu 3}$) neutrinos, and their mixing parameters and mass differences are reasonably well determined. The next step is to measure the three generation mixing angle (U_{e3}) and the CP violation in the neutrino oscillations. JHF-Kamioka project is the leading project in measuring these parameters. A neutrino beam from a 50GeV-0.75MW proton accelerator (JHF) in Japan will be sent to Super-Kamiokande water Aerenkov detector located 295km away. The first phase of the project, which is expected to start in 2007, is sensitive to $|U_{e3}|^2$ twenty times beyond the current reactor (CHOOZ) upper limit. In the second phase, with an upgraded 4MW accelerator and 1Mton Hyper-Kamiokande detector, the experiment will be sensitive to CP violation phase down to 10-20 degrees. Canadian group has been involved in this project from the very beginning. A letter of intent by an international group, which consist of 139 physicists from 11 countries and 51 institutions, has been submitted in January 2003. The JHF accelerator is under construction and will be commissioned in 2006. Neutrino experiment is the flagship experiment of the JHF project. The budget approval of the neutrino beamline is expected this year.

TU-A6-4 **12h00**

The Status of KaNOE: Kenora Off-axis NuMI Oscillation Experiment. **Scott Menary**. *York University* — A Letter of Intent to build a detector to study $\nu_\mu \rightarrow \nu_e$ oscillations using the off-axis NuMI beam was submitted to Fermilab in the summer of 2002 (see http://www-off-axis.fnal.gov/). I will describe the status of the project, witn particular emphasis on the choice of site.

TU-A6-5 **12h15**

Development of a Time Projection Chamber with Gas Electron Multiplier Readout. **D. Karlen**, R. Carnegie, M. Dixit, H. Mes, K. Sachs, *University of Victoria* — In the initial North American and European Linear Collider experimental designs, the leading candidate for the central tracker is a Time Projection Chamber (TPC). A research and development program is underway in Canada to improve the performance of TPCs for this purpose by using Gas Electron Multipliers (GEMs) for reading out the drifting electrons at the endplates of the detector. By replacing the conventional wire-grid amplification stage with GEMs, the "E x B" effect, which limits the spatial resolution of a conventional TPC, should be eliminated. This presentation will show the current status of this research project, including results from cosmic ray tracking studies.

12h30 **Session Ends / Fin de la**

[TU-A7] 10h00 Laser Plasmas / *Plasmas des lasers*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE CS-104 ***Chair: R. Marchand, U. Alberta***

TU-A7-1 **10h00**

MARC NANTEL, Photonics Research Ontario/University of Toronto

Pulsetrain-Burst Laser-Matter Interactions in Solids and Tissues

One can go beyond the "energy, wavelength, pulse duration" parameter space in laser-matter interaction by playing with how the fluence is delivered, including pulse-shaping and multiple-pulse arrangements. The discovery of ultrafast-laser pulsetrain-burst machining at the University of Toronto has prompted new research into the physics involved in this regime of laser-matter interactions. We have been able to explore the effects on material and tissue microprocessing of using a train of up to 1,000 (1.4 ps) pulses at a high repetition rate of 133 MHz. Pulsetrain 'burst' machining combines some of the advantages of single pulse ultrashort pulses (solid-density interactions, high-efficiency ablation) with some of CW laser machining (reduction of shock and heat stress through less thermal cycling). The pulsetrain 'burst' technique is particularly convenient for laser-material processing of brittle materials, especially glasses. In the present work, we will explore optical phenomena behind depth saturation in hole-drilling in metal, and survey our progress in laser-tissue interactions in the pulsetrain-burst regime. Comparisons will be made with single-pulse interactions.

TU-A7-2 **10h30**

Investigation of Pressure and Energy Dependence of Emission Intensity in Femtosecond LIBS. S. Yalcin, Y.Y. Tsui and **R. Fedosejevs**, *University of Alberta* — Understanding the influence of variables on the spectral emission intensities from femtosecond laser produced plasmas is essential in exploring the analytical performance and limitations of femtosecond laser induced breakdown spectroscopy (fs-LIBS) for spectrochemical analysis. In this study, the effect of energy and ambient pressure on the emission intensities from aluminum and silicon plasma was investigated. Ti:sapphire laser pulses, 130 fs pulse duration and 1-50 μJ pulse energy, were used for the generation of plasma on solid targets. Imaging and optical emission measurements of the plasma have been performed with the use of a gated ICCD detector. It has been observed that characteristic atomic lines, (Al : 394.6 nm and 396.15 nm, Si: 288.1 nm), exhibited significant changes, up to 20-fold enhancement in signal intensity, as the pressure is reduced from atmospheric pressure to the range of 2-4 torr. However, further reduction in pressure down to 10^{-3} torr resulted in a decrease in signal intensity. Optical and scanning electron microscope measurements are used to investigate the changes in ablated mass as the energy and pressure are varied. The experimental measurements will be presented and discussed in terms of expansion of the plasma plume into the ambient atmosphere.

TU-A7-3 **10h45**

Propagating Acoustic Structure with Trapped Electrons) — A New Phenomenon in Plasma Physics. **Tudor Johnston**[a], Bedros Afeyan[b], Pierre Bertrand[c], Francois Vidal[a] and Alain Ghizzo[c], [a]*INRS-EMT*, [b]Polymath Research Inc.,USA and [c]Univ. Henri Poincaré, France — Interest has arisen in the possibility of exciting long-lived space-time periodic excitations in plasmas with phase velocities of the same order as the electron thermal velocity. Small amplitude waves with such low phase velocities are indeed heavily damped, but if one persists in forcing such excitations with a moderately strong sinusoidal driver, one can create a very long-lived purely kinetic mode we call PASTE (see title). PASTE is quite unlike ordinary waves in the plasma. It is essentially nonlinear with important contributions up to the 4th or 5th harmonics which are nearly locked. There is no well-defined resonance relation between frequency and wavenumber that could be called a dispersion relation, and there is a soft lower limit in amplitude below which PASTE will not form. The dominant contributions to the PASTE are from the trapped electrons and their neighbours in phase (X-V) space, so PASTE could considered as a pure BGK mode, rather than, say, as a plasma Langmuir wave with BGK modification to the part of the velocity distribution contributing to Landau damping. The relation with earlier work by Schamel and his successors will be discussed.

11h00 **Coffee Break / Pause café**

TU-A7-4 **11h30**

Magnetic Guiding of Laser Plasmas. **H. Sang, R. Rankin and Y.Y. Tsui**, *University of Alberta* — The guiding of plasmas produced by a KrF laser using straight solenoidal magnetic fields has been studied as a mean of giving a low debris, controlled deposition source for the production of thin films. Experimental study on the guiding efficiency of the laser plasmas at various magnetic field strength as measured by Faraday cups and Langmuir probes has been carried out. These results will be presented and compared to predictions of plasma guiding using numerical plasma simulation models.

11h45 **Session Ends / Fin de la session**

[TU-A8] 10h00 Quantum Theory / *Théorie quantique* — TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE AV-D ***Chair: R. Kobes, U. Winnipeg***

TU-A8-1 **10h00**

ERICH POPPITZ, University of Toronto

Issues in Deconstruction and Lattice Supersymmetry

The idea of "deconstructed" dimensions and its relation to branes on orbifold singularities has recenlty lead to the hope that it might be possible to provide a lattice formulation of some supersymmetric theories. We will discuss various issues that arise on the road to successful implementation of this idea: the realization of global symmetries, anomalies, the fluctuating nature of the lattice and the structure of the explicit and enhanced supersymmetry.

TU-A8-2 **10h30**

A Visualization of a Two Qubit Entangled and Disentangled States Via Unbiased Projector Bases. **I.D. Ivanovic**, *Carleton University* — A visualization of the two qubit set of states is given using unbiased set of ray projectors $tr\,(P_i^{(k)} P_j^{(r)}) = 1/4 + \delta_{kr}\,(\delta_{ij} - 1/4)$. Several measures of entanglement are visualized and compared.

10h45 **Coffee Break / Pause café**

TU-A8-3 **11h15**

RICHARD MACKENZIE, Université de Montréal

Interaction Between Vortices in Models With Two Order Parameters

The interaction energy and force between widely separated strings is analyzed in a field theory having applications to superconducting cosmic strings, the SO(5) model of high-temperature superconductivity, and solitons in nonlinear optics. The field theory has two order parameters, one of which is broken in the vacuum (giving rise to strings), the other of which is unbroken in the vacuum but which could nonetheless be broken in the core of the string. If this does occur, there is an effect on the energetics of widely separated strings. This effect is important if the length scale of this second order parameter is longer than that of the other fields in the problem.

TU-A8-4 **11h45**

MANU B. PARANJAPE, Université de Montréal

Vortices in Noncommutative Chern-Simons Theory and the Quantum Hall Effect

We study vortex dynamics in noncommutative Chern-Simons theory with a Maxwell term added which describes the quantum Hall effect.

TU-A8-5 **12h15**

The Geometry of Space-time: Can it Quantize a Classical System?. **G.N. Ord**, *MPCS Ryerson University* — The Heisenberg uncertainty principle is universally recognized as a harbinger of quantum mechanics. Less well-known is the fact that there is a classical analog of this principle associated with the Fractal geometry of random walks. Thus the Schrödinger and diffusion equations are linked by the geometry of 'Brownian' paths, and the Dirac and Telegraph equations are linked by the geometry of Poisson paths. Until recently, the formal analytic continuation that separates quantum from classical PDE's was an algebraic requirement without a known analog in the underlying geometry of paths. In this talk, we sketch a new model in which the algebraic requirement is obtained constructively from the geometry of paths alone. The new model is a version of the Feynman Chessboard model which uses 'entwined paths' to construct the propagator from a single continuous space-time path. The resulting construction yields an ontological model for the Dirac propagator in one dimension.

12h30 **Session Ends / Fin de la session**

[TU-A9] 10h00 Heavy Ions and Nuclear Structure / *Ions lourds et structure nucléaire* — TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE KM-211 ***Chair: J. Barrette, McGill U.***

TU-A9-1 **10h00**

RENÉ ROY, Université Laval

Time Scale in Heavy Ion Collisions at Intermediate Energy

Study of collision dynamics at intermediate energy, around the Fermi energy, provides insights of complex phenomena generated by the interacting nuclei. When the later two are heavy ions, nuclear deformation at the contact region between them becomes an important source of information on reaction dynamics. Several observables and their correlations are used in the analysis; a very important and meaningful one is the time. Nuclear time scale is not a directly accessible experimental observable, but correlations between particles and fragments are a useful way to follow the collision development to provide the unfolding of how dynamics lead the nuclei. Different physics results, taken from our heavy ion collision dynamics studies, will be exploited to show how the breakup of the neck (common region at midrapidity between the two nuclei) can be made of a succession of complex steps or of competitioning mechanisms. Evidence of fast pre-equilibrium particles, multiple neck ruptures and alternative phenomena from delayed breakups will be discussed.

TU-A9-2 **10h30**

Neural Network Applied to Heavy Ions Collisions at Intermediate Energies. F. **Grenier**, M. Samri, L. Beaulieu, J. Gauthier, G.P. Gélinas, L. Gingras, Y. Larochelle, J. Moisan, R. Moustabchir, R. Roy, C. St-Pierre, D. Thériault, A. Vallée, *Université Laval* — Les collisions d'ions lourds aux énergies intermédiaires sont propices à l'étude de différents mécanismes de réaction. La première étape de toutes analyses est vouée à la sélection d'un mécanisme de réaction particulier. La problématique des petits systèmes (Mg+C) a été traité par des analyses statistiques multidimensionnelles telles que l'analyse par composantes principales et l'analyse factorielle discriminante qui sont des combinaisons linéaires de variables. L'approche à l'aide des réseaux de neurones permet d'ajouter des composantes non linéaires aux combinaisons. Les méthodes seront comparées dans leur fonctionnement et leur résultat. Heavy ion collisions at intermediate energies are the domain of different reaction mecanisms. The first step of any analysis is dedicated to the selection of one of these reaction mecanisms. Multi-dimensionnal statistical analysis has been used to favour the discrimination of small systems (Mg+C) via linear combination of different variables. Neural network approach allow non linear component in the combination. Methods will be compared for their procedure and their results.

TU-A9-3 **10h45**

Effets du Terme de Symétrie sur le Col de Réaction Lors de Collisions D'ions Lourds aux Énergies Intermédiaires. **A. Vallée**, *Université Laval* — Dans le domaine des collisions d'ions lourds aux énergies intermédiaires, l'étude de la forme du terme de symétrie de l'équation d'état de la matière nucléaire asymétrique est maintenant plus accessible. Le problème est abordé par l'étude de l'impact du terme de symétrie sur le ratio N/Z dans la zone de mi-rapidité. Un enrichissement potentiel (migration) de neutrons est surveillé dans le cadre de simulations dynamiques BUU.

11h00 **Coffee Break / Pause café**

TU-A9-4 **11h30**

ABDELOUAHAD CHBIHI, Ganul, Caen

Dynamical and Statistical Aspects of the Nuclear Multifragmentation

In this contribution dynamical and statistical aspects of nuclear multifragmentation will be presented. This multi-intermediate mass fragment (IMF) emission process is often associated to the liquid-gas phase transition. Therefore its study might contribute to establishing the nuclear equation of state. One efficient experimental way to produce copiously the IMF's is in heavy ion collisions at intermediate energies. The problem with this tool arises from the reaction dynamics which makes it difficult to disentangle the thermal and dynamical aspects. Through experimental measurements of the system Xe + Sn at a wide range of incident energies (25 to 150 A MeV) performed with INDRA and by comparing the data to statistical and dynamical calculations we will contribute to the understanding of different origins of production of intermediate mass fragments.

TU-A9-5 **12h00**

Brisure Dynamique du Projectile. Rachid Moustabchir, **René Roy** et le Groupe des ions lourds, *Université Laval* — L'étude des mécanismes des réactions dans les collisions d'ions lourds aux énergies de Fermi montre la domination du caractère binaire de la collision. Les deux sources formées (le quasi-projectile QP et la quasi-cible QC) peuvent se désexciter selon différents modes, de l'évaporation jusqu'à la multifragmentation. Afin d'étudier les mécanismes à l'origine de la production de particules légères et de fragments, nous avons analysé les cassures binaires du QP formé dans les collisions entre un projectile de ^{58}Ni et des cibles de ^{12}C et ^{70}Zn à 34.5 et 40 MeV/nucléon. Les distributions angulaires indiquent que les cassures binaires sont alignées dans la direction du QP. Ce comportement ne peut pas être expliqué exclusivement par un processus de «fission» standard. Les fonctions de corrélation entre les fragments et les particules légères suggèrent que la brisure binaire du QP se fait à proximité de la cible, et que c'est la déformation du QP engendrée lors de la collision entre la cible et le projectile qui provoque sa cassure binaire. Dans ce cas la déformation donnée au QP est trop importante pour que celui-ci atteigne l'équilibre, que ce soit de forme ou thermique. Le comportement entre la taille et la vitesse des fragments corrobore ces effets dynamiques, et le plus gros fragment serait la réminiscence du projectile.

TU-A9-6 **12h15**

Lifetimes of Superdeformed States in ^{38}Ar. **Roby Austin**, D.E. Appelbe, G.C. Ball, M.P. Carpenter, R.M. Clark, M. Cromaz, R.V.F. Janssens, A.O. Macchiavelli, D.G. Sarantities, C.E. Svensson, and J.C. Waddington, *McMaster University* — Superdeformation is the phenomenon of nuclear shapes with ratios of long to short axes of 3:2 or even 2:1. Superdeformed bands in light nuclei have recently been observed in ^{36}Ar[1], and ^{40}Ca[2]. Lifetime measurements of highly deformed bands in ^{38}Ar[3] establish that a superdeformed band in ^{38}Ar has been discovered in that nucleus also. The lifetimes of the superdeformed states will be presented. There will be discussion of the import of superdeformation in this region.

1. C.E. Svensson *et al*, *Physical Review Letters*, **85**:2693(2000).
2. E. Ideguchi *et al*, *Physical Review Letters*, **87**:222501-1(2001).
3. D. Rudolph *et al*, *Physical Review*, **C65**:034305-1(2002).

12h30 **Session Ends / Fin de la session**

[TU-A10] 10h00 Quantum Optics and Photonic Devices / *Optique quantique et dispositifs photoniques*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE MN-220 ***Chair: M. Duguay, U. Laval***

TU-A10-1 **10h00**

JEFFREY S. LUNDEEN, University of Toronto

Playing Games with Quantum Information: Experiments with Photons and Laser-Cooled Atoms

Roughly ten years ago, the theoretical discovery that quantum information processing could perform tasks impossible for a normal computer signaled the commencement of the race to build a quantum computer. Intense efforts around the world to create suitable systems have yet to yield some of the basic elements necessary. First, one must identify and manipulate quantum processes to implement quantum logic gates. And second, the exquisite sensitivity of a quantum computer to noise means that one must characterize and correct for any errors in these processes. In this talk, I will describe a variety of experiments we are performing with photons and with laser-cooled atoms. These include a two-photon switch based on spontaneous parametric downconversion. Among other things this is useful for dense coding, the ability to send two bits of information with one particle. We have also developed techniques to do quantum process tomography (QPT) with polarized photons and with atoms in an optical lattice. QPT fully characterizes any unitary or nonunitary evolution of a system. In these and other experiments, we are developing the tools to characterize and perform the operations necessary for quantum communication and computation.

TU-A10-2 **10h30**

Optical Detection of Aharonov-Bohm Oscillations of a Single Electron on a Quantum Ring. **Marek Korkusinski**, Pawel Hawrylak, and Manfred Bayer, *National Research Council of Canada* — We demonstrate that emission from a negatively charged exciton on a quantum ring allows for optical detection of Aharonov-Bohm oscillations of a single electron. This claim is based on results of theoretical and experimental study of an exciton and a charged exciton (X-) localized on a quantum ring in an external magnetic field. In the case of a single electron or a single hole the magnetic field couples to the phase of the single-particle wave function via charge resulting in the Aharonov-Bohm (AB) oscillations. If both carriers are present, they form a charge neutral exciton complex and AB oscillations are suppressed. By adding a second electron, the negatively charged complex, X-, is formed. In the case of an X- the weak AB oscillations are present for all ring radii due to the charged character of the complex. In the recombination process from X- the outgoing photon energy is dominated by the clear AB oscillations of the final state electron. We compare our theoretical results to recent interband magneto-photoluminescence measurements on large InGaAs/GaAs rings manufactured by etching and lithography.

TU-A10-3 **10h45**

Quantum Interference Injection and Control of Transient Spin Current Grating in GaAs. Y. Kerachian[a], P. Nemec[a], R.D.R. Bhat[a], J.E. Sipe[a], A.L. Smirl[b] and **H.M. van Driel**[a], [a]*University of Toronto* and [b]Laboratory for photonics and Quantum Electronics, University of Iowa — All-optical quantum interference and control techniques based on interference of single and two-photon absorption processes have been used to generate spin currents in a non-magnetic semiconductor. Two 150 fs pulses at 1550 nm and 775 nm propagating non-collinearly produce pure spin current gratings in bulk [100]-oriented Ga. As at room temperature; the relative phase between the beams and therefore the amplitude of the spin current is modulated periodically across the sample. The current grating forces carriers with different spin orientations to accumulate at different positions producing a spin population grating. Spin current dynamics are studied by the diffraction of a time-delayed probe pulse at 840 nm which is sensitive to state filling effects. We have measured a grating decay time of 3.2 ps which is consistent with electron diffusion.

11h00 Coffee Break / Pause café

TU-A10-4 **11h15**

FRANÇOIS BRUNET, INO and Centre d'optique, photonique et laser (COPL), Université Laval

*Ytterbium-Doped Fiber Lasers for Frequency Conversion Applications**

Only ten years ago, fiber lasers were perceived as a curiosity only suitable for academic research. These were often fragile laboratory setups, delivering a few milliwatts of laser power. This technology has matured impressively over the last few years however, as commercial off-the-shelf devices reach the kilowatt level. Ytterbium-doped fiber lasers nowadays compete with solid-state lasers in a variety of high-power applications, including lidar, materials processing, and optical frequency conversion. This talk briefly reviews double-clad ytterbium-doped fiber laser technology. We have developed an ytterbium-doped Q-switched fiber laser for optical frequency conversion. We present our experimental results and discuss the modeling of such fiber lasers.

* In collaboration with Yves Taillon[a] , Pierre Galarneau[a] and Sophie LaRochelle[b] , [a]INO and [b]Centre d'optique, photonique et laser (COPL), Université Laval

TU-A10-5 **11h45**

Pulse Collision in a Stretched-Pulse Erbium-Doped Fiber Ring Laser*. **V. Roy**[a], M. Olivier[a], F. Babin[b] and M. Piché[a], [a]*Université Laval* et [b]EXFO Ingénierie Électro-Optique inc — We report the observation of pulse interactions in a polarization additive-pulse mode-locked stretched-pulse erbium-doped fiber ring laser. The interferometric nature of the artificial saturable absorber mechanism, in the saturated regime, leads to several (stable) pulse interaction scenarios. Among these are the grouping of two or more pulses in distinct bunches and the collision of pulses and pulse bunches, both of which display several interesting features. The coherence inside bunches of two or more pulses as well as the apparently undistorted colliding pulse structures are still raising questions about the nature of these interactions.

* Work supported (in part) by NSERC, Fonds Nature et Technologies du Québec.

TU-A10-6 **12h00**

Stable Bound States of Pulses in the Stretched-Pulse Fiber Ring Laser. **Michel Olivier**, Vincent Roy, Michel Piché and François Babin, *Université Laval* — We report on the observation of stable bound states of pulses in the Stretched-Pulse Fiber Ring Laser. This laser is made up of two segments of optical fiber with opposite signs of Group Velocity Dispersion (GVD). The laser is mode locked through the Polarization Additive-Pulse-Mode-locking (P-APM) mechanism. Due to the fact that the net dispersion of the cavity is normal and close to zero, the width of the pulses is approximately 100 fs at minimum chirp. The creation of multiple pulses takes place when the laser gain is increased such that the P-APM mechanism becomes saturated. For a given configuration of the P-APM system which minimizes the pulsing threshold, we observe the occurrence of stable single-pulse, two-pulse and three-pulse states as the value of the gain is increased. The transition from one stable state to the next stable state is often associated with an unstable behaviour of the laser dynamics. In the multiple pulse regime, the separation between the pulses is fixed and is of the order of several picoseconds. The pulses are also locked in phase as can be seen from their power spectrum which is stable and exhibits a modulation with a period inversely proportional to the time interval between pulses.

TU-A10-7 **12h15**

Diffraction Properties of Anisotropic Gratings Made From Near Infrared Sensitive Liquid Crystal Photopolymerizable Materials: Theoretical Modelling. **Steven Harbour**[a], Tigran Galstian[a,b], Rafik S. Akopyan[c], and Artur V. Galstyan[c], [a]*Center for Optics, Photonics and Laser, Laval University*, [b]Potintech inc., and [c]Yerevan State University, Armenia — Over the last decades, growing attention has been devoted to holographic polymer dispersed liquid crystal (H-PDLC) materials, a dispersion of liquid crystal (LC) submicrometer sized droplets in a polymeric binder. This interest is due to the large anisotropy and large electric field-induced birefringence change in LC droplets that allow the easy control of optical properties of components made of these materials. In those systems, the whole mixture is divided into polymer-rich and LC-rich regions, thereby setting a periodic perturbation in the refraction index of the material. The refractive index modulation as well as the diffraction efficiency of such H-PDLC materials strongly depend on LC droplet size, density, and shape as well as director orientation in the droplet. These materials being strongly anisotropic, one of the most important challenges here is the understanding of the LC role in the angular and polarization properties of obtained systems. It is well known that the key parameter for volume holographic applications is the Bragg condition. Many research groups have attempted to analyze non-Bragg or near-Bragg readouts of single and multiple gratings. The most widely used technique is the coupled-wave or coupled-mode analysis. This theory has been successfully extended to include volume gratings that are made from birefringent materials. Since there is no specific application for polymer-LC composite gratings and no explicit expression for the angular dependence of Bragg diffraction, we include the anisotropy of the composite grating in that model to explain the diffraction properties, which were observed in a recently developed H-PDLC. We will explain the angular selectivity when probing with TE and TM polarized light and the assymetry observed with gratings in the Bragg and intermediate regimes. We then present a simple definition of the angular selectivity assymetry along with three known mechanisms responsible for it.

TU-A10-8 **12h30**

One-Dimensional Photonic Crystals: A New Theory for Calculation of Omnidirectional Reflection. **G.V. Morozov**[a] , D.W.L Sprung[a] and J. Martorell[b] , [a] *McMaster University*, [b] Universitat Barselona — Photonic crystals are dielectric materials in which the refractive index is periodic in one, two or three dimensions. The validity of the Floquet-Bloch theorem for Maxwell's equations implies the existence of allowed and forbidden frequency bands for light propagation. Within the field of photonic crystals, theory plays a very important role not only for the interpretation of experiments, but also for the design of structures. We have devised a new analytic method, based on the Kogelnik coupled wave theory, for the calculation of photonic bands and optical properties of 1-D photonic crystals. The essence of the method is to seek a solution for the field in terms of two counter-propagating waves not only with variable amplitudes, as in conventional Kogelnik theory, but also with variable (geometric-optics) phases. A good correspondence with exact numerical calculations will be shown. The method allows us to optimize the forbidden band of a 1-D photonic crystal for all incident directions of light propagation (omnidirectional reflector).

12h45 Session Ends / Fin de la session

[TU-A11] 10h00 Imaging Blood Flows in Tissues / *Imagerie de la circulation sanguine dans les tissus*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE DS-121 ***Chair: A. Vitkin, OCI***

TU-A11-1 **10h00**

ROBERT A. DEKEMP, University of Ottawa Heart Institute

Absolute and Relative Flow Imaging with PET

Positron emission tomography (PET) is a nuclear medicine imaging technique to evaluate physiological and biochemical processes in the living body using molecular tracers labelled with isotopes of carbon, nitrogen, oxygen and other elements. The volume imaging capabilities of PET are ideal to measure the regional non-uniformities or relative flow in organs such as the brain and heart. O-15-water is a freely diffusible tracer that is the gold-standard for absolute blood flow quantification in ml/min/g with PET. C-11-butanol is also freely diffusible and has the advantage of longer half-life and shorter positron range, producing higher SNR images. Several physiologically extracted tracers such as Rb-82, N-13-ammonia, Cu-62-PTSM and C-11-acetate are used for flow imaging in the heart. N-13-ammonia is the clinical standard for absolute flow quantification. However, recent studies suggest that C-11-acetate may have superior precision, and can provide a simultaneous assessment of oxidative metabolism. Cu-62 and Rb-82 are generator produced, removing the need for an onsite cyclotron. Rb-82 has the added advantage of a 76 sec half-life, permitting rapid serial imaging for clinical stress-rest studies and research investigations of short-term flow alterations. In the future, combined perfusion / anatomic fusion imaging with PET / CT or PET / Angiography methods has great potential to evaluate coronary artery stenosis and the hemodynamic effect on blood flow to the heart muscle.

TU-A11-2 **10h30**

TING-YIM LEE, Lawson Health Research Institute

Measurement of Tissue Perfusion with CT

Until recently, tissue perfusion, which delivers nutrients and oxygen to tissue to ensure its normal function, can only be measured with positron emission tomography requiring a on site cyclotron to produce water labeled with O-15. We have developed an alternative way to achieve the same goal with a relatively inexpensive CT scanner. The advantage of using CT is its universal accessibility for stroke, heart attack and cancer patients. The method we have developed is generic such that it is neither flow nor diffusion limited. In practice, this generality enables us to measure perfusion in all organs/tissues of the human body.

11h00 Coffee Break / Pause café

TU-A11-3 11h15

BRIAN K. RUTT, Robarts Research Institute

Cardiovascular MRI

Magnetic Resonance Imaging (MRI) allows for non-invasive assessment of many aspects of the cardiovascular system in the human body, including blood flow, vascular wall disease, cardiac dysfunction and disease and abormalities of the microcirculation. Present-day research challenges include the technological difficulty of obtaining extremely high resolution images of the vascular system in short periods of time. This is first and foremost a physics, biophysics and engineering problem. During this overview presentation, efforst to overcome the technological challenges will be addressed, and results of state-of-the-art cardiovascular MRI research will be shown.

TU-A11-4 11h45

VICTOR X.D. YANG, University of Toronto

Doppler Optical Coherence Tomography of Microcirculation †

Microcirculation in biological tissues is difficult to assess, and direct visualization of blood flow in subsurface microvasculature is challenging using existing medical imaging modalities. Doppler optical coherence tomography (DOCT) is an emerging imaging technology with excellent spatial and velocity sensitivity. We have developed a DOCT system with hand-held and endoscopic probes, suitable for detecting microvascular blood flow in near-surface tissues (depth of imaging ~ 2 mm). We will present the physical background of DOCT, its comparison to Doppler ultrasound, and *in vivo* imaging of blood flow in embryonic heart, rodent esophagus, human skin and gastrointestinal tract. We will discuss the possible clinical and scientific uses of this technology, and also address the future developments that can improve the frame rate, resolution, and sensitivity of DOCT

* Work supported by the Natural Sciences and Engineering Research Council of Canada, Canadian Institutes of Health Research, Photonics Research Ontario, and St. Michalel's Hospital.
† Maggie L. Gordon, Bing Qi, Shou J. Tang, Norman E. Marcon, Brian C. Wilson, I. Alex Vitkin

TU-A11-5 12h15

PETER N. BURNS, Sunnybrook/University of Toronto

Measuring Tissue Perfusion with Microbubbles and Nonlinear Ultrasound Imaging

More than 100 years ago Lord Rayleigh described how a gas bubble can be induced into resonant oscillation by an acoustic field. His analysis has been used to investigate phenomena as diverse as the babbling babbling a brook to the cavitation around a ship's propeller. Most recently stable, encapsulated microbubbles which are smaller than red blood cells (5 micron diameter) can be introduced into the bloodstream quite harmlessly. We have developed a number of simple acoustic methods that can detect the relatively weak echoes from these bubbles in the midst of clutter from the surrounding tissue. All of these rely on the nonlinear scattering of a resonant bubble. These methods have provided the first real-time, non-invasive images of microvascular flow in the muscle of the heart ? the myocardium; and as such have widespread potential application in medicine. In addition to detecting microbubbles, ultrasound at conventional diagnostic intensities can disrupt them too. This provides new methods for both the quantitative measurement of tissue blood flow and the targeted delivery of drugs or genetic material into chosen regions of living tissue.

12h45 Session Ends / Fin de la session

[TU-A12] 10h00 Acoustic and Optical Applied Physics / *Physique appliquée en acoustique et optique* — TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE MN-340 — ***Chair: R. Maev, U. Windsor; G. Beer, U. Victoria***

TU-A12-1 10h00

ROMAN G. MAEV, University of Windsor

Recent Development in Quantitative Acoustic Microscopy Methods

The goal of this review is to introduce recent advances in high-resolution quantitative acoustic microscopy. The theoretical basis as well as experimental fundamentals for quantitative characterization of the contrast response in the acoustic microscope will be described. As well as the well known V(z) method, new techniques for the measurement of acoustical parameters will be discussed. These methods include: the V(x,t) method; ultrasonic micro-spectrometry; the air-coupling pair measurement technique for the reflection mode; and the A(z) method for the transmission mode in both immersion liquid and air-coupling cases. One of the possible methods of improvement of the quality of ultrasound images is to exploit the effect of nonlinear propagation on the acoustic signal using higher harmonics. New opportunities will also be discussed for non-linear material quantitative characterization using parametric acoustic imaging. The last part of this review is related to recent developments of high-resolution imaging techniques for practical uses. New principles for rapid 2D and 3D image quantitative evaluation of bulk acoustical properties based on new concepts of portable electronic systems together with a matrix array will be reviewed. Based on the most successful experimental results, some examples of different applications will be provided including: evaluation of advanced material structure; quality control of joints; adhesive bonding; and layer structures.

TU-A12-2 10h30

LEN ZEDEL, Memorial University of Newfoundland

High Frequency Wind Generated Sound in the Ocean

It is well known that ocean ambient sound at below 75 kHz is generated by wind through the process of wave breaking and bubble injection. The resulting sound levels are highly correlated with wind speed and, even though the physical process is not fully understood, sound levels can be used to estimate wind speeds with accuracies comparable to other marine wind measurement techniques. At higher frequencies, thermal noise has been identified as masking any wind signals. A demonstration by Visbeck and Fischer (1995) that background noise levels in 150 kHz Acoustic Doppler Current Profiler (ADCP) data is proportional to wind speed is then inconsistent with the accepted understanding. To further investigate this inconsistency, background sound levels in 75, 150, and 300 kHz ADCPs have been calibrated to an absolute level and compared to wind speed records. A clear wind dependence was only found in the 150 kHz data. The presence of this unexpected signal is explained by subsurface bubbles that absorb sound preferentially at around 100 kHz. At 150 kHz, a lower concentration of resonant bubbles provides an opportunity in the sound spectrum where wind generated sound can be detected above the thermal noise level.

11h00 Coffee Break / Pause café

TU-A12-3 11h30

JOHN RATHER, Wayne State University

PAMELA Technologies for Ultra-Large, Low Cost Imaging Telescope

The Phased Array Mirror Extendible Large Aperture (PAMELA) principle was proposed in 1988 by the author. Extensive R&D activities supported by NASA and other agencies have established the feasibility and superiority of PAMELA for both ground and space-based applications. Recent advances in MEMS technologies support near-term deployment of telescopes having revolutionary capabilities for astronomy and laser applications.

TU-A12-4 12h00

Fibre and Multilayer Reflector Based Radiometric Integrator. L. Whitehead, **A. Kotlicki**, and I. Holloway, *University of British Columbia* — A challenging measurement problem in radiometry and photometry involves determining the total flux leaving a radiator. Mechanically scanning a detector through the entire solid angle around the radiator is very time consuming, and the alternative use of integrating spheres requires special baffling procedures and presents difficult calibration and maintenance problems. We present a fundamentally different integrating structure, based on the use of high reflectance specular mult-layer reflective films, a non-spherical geometry, and a multiple fibre-optic sampling probe that yields unprecedented reproducibility and ease of use.

TU-A12-5 **12h15**

Solid-State Diode-Pumped Lasers Micromachining of Silicon and Simulations. **Marc Nantel**, Yuri Yashkir, Seong Kuk Lee, and Bernard Hockley, *Photonics Research Ontario* — This paper presents recent work in the laser micromachining of silicon. A kilohertz-repetition-rate diode-pumped YLF laser (sub-100-ns, in infrared, green or ultraviolet modes) is focused on the surface of silicon wafers in a chlorine atmosphere for enhanced magnitude and control of the etching rate. In the chlorine atmosphere, much less debris is generated on the surface around the cut, sub-damage threshold machining is achieved for a better control of the feature depth, and etching rates ranging from 20-100,000 micron-cube/second have been measured. In particular, use of the infrared wavelength "not available on excimer and argon lasers traditionally used for chlorine-assisted laser micromachining of silicon" greatly enhance the etching rate. 3D numerical modeling of the laser light absorption, heat transfer and material phase transitions including material removal are presented to help explain why.

12h30 **Session Ends / Fin de la sessic:**

[TU-Plen-3] 13h30 CAP Medal of Achievement Winner / *Récipiendaire de la médaille ACP* — TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE DS-121 ***Chair: W.J. McDonald, U. Alberta***

TU-PLEN-3 **13h30**

ART MCDONALD, Queen's University

A Deeper Understanding of Our Universe from 2 km Underground

The Sudbury Neutrino Observatory (SNO) is a 1,000 tonne heavy water Cerenkov-based neutrino detector situated 2,000 meters underground in INCO's Creighton Mine near Sudbury, Ontario. SNO has found clear evidence for neutrino flavour change by using the neutrinos from 8B decay in the Sun to observe one neutrino reaction sensitive only to solar electron neutrinos and others sensitive to all active neutrino types. This result provides evidence for new physics beyond the Standard Model of elementary particles and confirms solar models with good accuracy. Results from the multi-year SNO observation program and objectives for future measurements will be presented. The implications of the present SNO result and other recent neutrino results for particle physics theory and solar physics will be discussed, along with the prospects for further fundamental measurements in the future SNOLAB underground facility.

[TU-P1] 14h15 Innovations in Physics Education II / *Innovations en enseignement de la physique II* — TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE AV-A ***Chair: D. Hunter, St. F-X***

TU-P1-1 **14h15**

P.J. WILLIAMS, Acadia University

The Effectiveness of Computer-Based Studio Teaching of Physics

We have performed a comparison study between a lecture section (N = 92) and a studio section (N = 20) of calculus-based Introductory Physics. The comparison included high school marks, scores on the Force Concept Inventory (FCI) administered before and after instruction, as well as assignment, mid-term, lab-test and final examination results. For nearly all of the pre-instruction indicators, Mann-Whitney tests indicate that the two groups were statistically similar. Mann-Whitney tests for traditional post-instruction indicators show that the two groups are statistically different, with the studio class outperforming the lecture class in all cases. However, the conceptual learning gains for the two classes were found to not be statistically different. We conclude that while the studio model is more effective in improving student performance on traditional course activities, it does not promote a significant improvement in conceptual understanding as measured using the FCI.

TU-P1-2 **14h45**

DENNIS TOKARYK, University of New Brunswick

Research and Teaching: Synergetic Partners or Adversarial Antagonists?

Research and teaching are the two primary functions of most academic careers. Oftentimes the two activities are in conflict, competing for an instructor's time and energy, yet they can also be mutually beneficial and supportive. This talk will examine the teaching/research interrelationship, and will offer thoughts on bringing research experiences and ideals into the classroom, and on the power of teaching to greatly enhance a research program.

TU-P1-3 **15h15**

Forget Cross and Dot Products. **Don Mathewson**, *Surrey, B.C.* — Physicists use mathematical operations to represent physical laws. The vector operations of dot and cross product are particularly useful for determining work, torque, and magnetic forces. To say however that work is a dot product or torque is a cross product is counter-productive to student learning. An alternative, conceptual development will be presented.

15h30 **Coffee Break / Pause café**

TU-P1-4 **15h45**

Animated Diachronic Representation of the Twins Paradox in Special Relativity. **Michel A. Duguay** and Thierry Ahoyo, *Université Laval* — We will present a new solution of the twins paradox in the framework of an animated diachronic representation of spacetime[1]. The diachronic approach, which is intrinsically visual, lends itself well to a presentation in the form of animated drawings and it facilitates the understanding of time relationships and relative aging. The celebrated twins paradox has arisen because in the spirit of special relativity twin-symmetric scenarios should lead to twin-symmetric experiences for the twins, which is not what traditional solutions have presented. The solution we present calls for two *nearly* twin-symmetric scenarios. In the first scenario, fraternal twin Alice flies by Earth at t = 0 at speed v = 0.99 c, headed towards the star Sirius which is at a look-distance D = 8.6 lk-y. After a sharp U-turn at Sirius she returns to Earth having aged $2D/\gamma v = 2.4508$ years while her stay-home fraternal twin Bob has aged $2D/v = 17.373$ years, i.e. the time dilation factor $\gamma = 7.0888$ more than Alice. In the second scenario Alice flies by Earth as before at t = 0 at speed v = 0.99 c, and goes on to and past Sirius without ever stopping or changing her course. Bob leaves Earth $D(1 - v)/v = 31.707$ days later and chases after Alice at a speed of approach $v_{B/A} = 0.99$ c relative to her, which is a speed $v_{B/E} = 2v/(1 + v^2) = 0.999949497$ relative to Earth, and he also goes on without ever changing his course. His diachronic receding speed relative to Earth is $2v/(1 + v)^2$, while Alice's is $v/(1 + v)$. We on Earth directly see Bob catch up with Alice at point "Kappa" which is $D(1 - v)/(1 + v) = 15.773$ look-days beyond Sirius. From Earth we directly see that Bob has aged at Kappa by $2D(1 - v)/v = 63.41$ days, while at the same time and place Alice has aged $2D\gamma(1 - v)/v = 1.23159$ years, *i.e.* a factor of γ more than Bob. As a result, Alice has had in the second scenario an experience that is symmetric to the one her twin brother had in the first, viz. that the twin who went away and came back is now younger than she by the same factor γ. As Alice saw it, Bob had at first receded from her and had aged 31.707 days by the time Sirius flew by her. Bob had then made a U-turn (by accelerating from Earth) and homed in to fly by her while aging an additional 31.707 days. The *overall asymmetry in the amount of the other twin's aging*, viz. 1.23159 years versus 63.414 days comes from *the asymmetry in the choice of Sirius* as the trip's target in the first scenario. The Earth-Sirius U-turn course is *stationary* in Bob's coordinate system in the first scenario but is *moving* in Alice's system in the second scenario; this breaks the symmetry of the overall story. The diachronic representation is based on displays similar to the type of displays used in airport control towers, *i.e.* on constantly up-dated situation diagrams showing what one would immediately see thanks to space-based communication systems. Combined with animation it offers an easily understood solution of the twins paradox

1. Diachronic representation of spacetime applied to problems in special relativity and in quantum optics", M.A. Duguay Canadian Journal of Physics, 27 Feb. 2003.

TU-P1-5 **16h00**

Photonics Education and Training: From Grade School to Grad School. **Marc Nantel**, *Photonics Research Ontario* — Photonics and photonics-related companies are the backbone of Canada's high-tech future. Incredible growth - followed by an equally impressive downturn in the telecom sector - has marked the recent past for some of these. While it is clear that telecom will rebound and that other photonics sectors are still booming, one of the crucial issue still unresolved for its long-term growth is the availability of highly-qualified personnel. Photonics education and training must be approached with a holistic view of the big picture. We must foster photonics throughout the education pyramid, from grade school to grad school. In this paper, I will present an overview of photonics education and training in Ontario "most of which is new at all levels" and highlight the particular aspects with which Photonics Research Ontario has had a impact.

TU-P1-6 **16h15**

"Seeing" Infrared. **Ernie McFarland** and Tom Kehn, *University of Guelph* — Two lecture demonstrations are described that involve "seeing" the infrared (IR) pulses from remote-control devices. One demonstration simply uses a video camera or digital still camera to show the flash of IR light emitted by a remote control. The second demonstration uses an oscilloscope connected to an IR-sensitive photocell to display the coded time-dependence of the pulses from various buttons on a remote control.

16h30-17h00 **Round Table Discussion/Discussion à table ronde (Session Ends at 17h00 / La session se termine à 17h00)**

[TU-P2] 14h15 Observing the Ionosphere and Magnetosphere from Ground and Space - CANOPUS and Beyond / *Observation de l'ionosphère et de la magnétosphère à partir du sol - CANOPUS et au délà*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE AV-B ***Chair: D. Knudsen, U. Calgary***

TU-P2-1 **14h15**

JEAN-PIERRE ST-MAURICE, University of Western Ontario

*What Can Be Learned From The Properties Of TwoStep Type I waves In The Equatorial Electrojet**

We have studied a particularly strong vertical type I event with the equatorial VHF radar at Pohnpei. During that event, which lasted several hours, we routinely obtained type I waves of both signs in the vertical beam. The phase velocity associated with these type I waves showed an increase with decreasing height. As the type I phase speed saturates at the ion acoustic speed, the increase in Cs with decreasing height was consistent with the presence of thermal fluctuations expected in the electrons if the aspect angle is very close to zero. This data set has further allowed us to revisit the question of the equatorial electrojet up down asymmetry. This asymmetry is known to favor down shifted (or upward propagating) waves during the daytime electrojet. In our study we have contrasted the spectra obtained in the east and west beams when receiving type I echoes of both signs, in addition to analyzing the vertical beam data. We observed the expected behavior, but with a notable exception when the asymmetry changed sign near 104 km, at times when the echoes were particularly strong for that height. We show that both the up down and west east asymmetries were consistent with the nonlinear idea which favors "blobs" over "holes". The reversal in the asymmetry above 104 km could either be due to a local dynamo effect or to the advection of holes and blobs away from the generation region. The observations appear to favor the latter explanation.

* In collaboration with R.K. Choudhary, Warner L. Ecklund, and Roland T. Tsunoda, *University of Western Ontario*

TU-P2-2 **14h45**

Magnetometer-Inferred Convection Patterns for High-Latitude TCV Events and SuperDARN Velocities. **L. Benkevitch**[a], A. Koustov[a], R. Makarevitch[b], [a]*University of Saskatchewan*, [b]University of Lancaster — The nature of the high-latitude transient events is currently under intensive study with ground-based magnetometer data and in-situ satellite measurements. In those studies, it is typically assumed that the magnetic equivalent currents ideally reproduce spatial and temporal variations of the plasma convection. In this study we involve SuperDARN line-of-sight velocities integrated over 7-s to check if this assumption is correct for one type of transient events, the traveling convection vortices (TCVs). We compare velocity measurements from the Stokkseyri HF radar with 2-D equivalent currents inferred from CANOPUS, MACCS and DMI (Greenland) magnetometer data. For the events considered, reasonable agreement between the two data is shown. Attempt has been made to explore the effect of large conductance gradients in the vicinity of terminator on the magnetometer/SuperDARN relationship. Most likely mechanism of the TCV excitation is discussed.

TU-P2-3 **15h00**

Solar Radiation Effects in the SuperDARN F-Region Echo Occurrence. **A.V. Koustov**, G.J. Sofko, D. Andre, D.W. Danskin, and L. Benkevitch, *University of Saskatchewan* — The Sun affects SuperDARN echo occurrence in several ways. First of all, some electron density enhancement (produced by the solar radiation) is typically required for HF radio waves to propagate to the scattering region. On the other hand, too high an electron density may reduce the amount of scattering either because recombination effects lower the growth of the gradient-drift instability or because the electric fields of unstable waves are shorted out by the highly conducting E region. The relative importance of the above effects varies with latitude, time of the day, season and perhaps the solar cycle, which makes it difficult to evaluate which factor is more important for echo detection at certain observational conditions. There are additional complicating factors such as variations in the intensity of the ionospheric electric field. In this study we use long-term data (1994-2001) for a number of SuperDARN radars in both northern and southern hemispheres to study the solar radiation effects upon echo occurrence in the high-latitude F region.

TU-P2-4 **15h15**

3D Modelling of Wave Propagation in the Earth Magnetosphere. R. **Marchand**, R. Rankin, K. Kabin, *University of Alberta* — We study the three-dimensional global mode structure of Shear Alfvén waves propagating in the Earth magnetosphere. The plasma is described in the one-fluid ideal MHD approximation. The equations governing the wave propagation and the background plasma dynamics are discretized using finite elements on an unstructured tetrahedral mesh. Because of the strong anisotropy that characterizes magnetized plasmas, the unstructured mesh needs to be rigorously aligned along the local magnetic field lines. In practice, this implies that every tetrahedron must have two of its vertices along the same magnetic field line. The system of plasma-wave equations is first linearized, and the coupling between the standard Shear Alfvén and compressional waves is studied, in the presence of curved magnetic field lines. A consistent set of nonlinear equations is then presented and the effect of nonlinearities is considered for a weakly driven system. Comparisons are made between these results and those obtained from earlier two-dimensional simulations.

15h30 **Coffee Break / Pause café**

TU-P2-5 **15h45**

Polar Cap Influx. **John MacDougall**, and P.T. Jayachandran, *University of Western Ontario* — The influx of plasma to the open polar cap region is measured by digital CADI ionosondes and SuperDARN radars in this study. We identify an interval from 11-14 LMT as the 'cusp gap' and show that the convection through this gap is insufficient to account for the flux in the open polar cap (the potential across the gap is compared with the cross-cap potential). We show that including the earlier and later times when there is also convective flow into the polar cap gives satisfactory agreement with the cross cap potential. The remaining question is whether the flux going into the polar cap before and after the cusp gap time is on open or closed field lines.

TU-P2-6 **16h00**

The Consequences of Wave Advection For the Evolution of Slowly-Growing Plasma Irregularities. **J. Drexler** and J.-P. St.-Maurice, *University of Western Ontario* — The vertical group velocity of high latitude irregularities can easily exceed its horizontal phase velocity by an order of magnitude or more. A direct consequence of this feature is that for the slowly-growing modes associated with HF radar echoes, the fast vertical group speed takes over the evolution of the structures through convection in and out of the unstable region. In turn, the dominance of vertical advection means that conservation of wave energy tends to be a dominant feature of the evolution of slowly-growing structures. In the presence of important changes in the background plasma density, the density of structures therefore has a tendency to be proportional to the square root of the ambient density. In this sense, a structure can grow without ever being locally unstable; it simply needs to be created somewhere and be allowed to move in a region of increased densities. Somewhat paradoxically, we also note that, by contrast, the density fluctuation level relative to the background actually increases as the wave train moves in a region of reduced density. This situation is entirely analogous to atmospheric gravity waves moving away from a low altitude source into a region of reduced atmospheric densities. We explore the consequences of this growth factor using numerical calculations of amplitudes and show that if the structures grow to large enough amplitudes to become nonlinear they have a tendency to be observed in smaller background density regions. By contrast, if the amplitude is not large enough to evolve through nonlinear processes, it will have a larger amplitude in regions of enhanced background densities.

TU-P2-7 **16h15**

Method to Observe Winds and Electric Fields in the Ionospheric E Region. **L.M. Kagan**[a], S. Fukao[b], M. Yamamoto[b] and P.B. Rao[c], [a]*University of Western Ontario*, [b]Radio Science Center for Space and Atmosphere, Kyoto University, Japan and [c]National Remote Sensing Agency, Department of Space Balanagar, Hyderabad, India — We propose an experiment, a data-processing procedure, and a method to recover the electric fields and neutral winds, which are the driving forces for field-aligned irregularity (FAI) generation, from the range-time distribution of line-of-sight Doppler velocities during backscatter events. In doing so we proceed from the assumption that the ionospheric parameters, specifically the collisional frequencies, change with altitude much faster than do the energy sources (the electric fields and neutral winds). The proposed technique is based on our knowledge of the mechanisms for FAI generation, the models of ionospheric parameters and the morphology of the observed velocities. The method proposed does not require any additional funding and may be used at sites (*e.g.* MU and Gadanki radars) where the coherent scatter radar has a height resolution much less than a typical scale of collisional frequencies (roughly < 1 km).

TU-P2-8 **16h30**

Radiation from Sounder-Accelerated Electrons. **H.G. James**, *Communications Research Centre Canada Ottawa* — During the OEDIPUS-C rocket double-payload experiment, waves were emitted from a dipole on a transmitting subpayload and received at a distance of about 1200 m on a similar dipole connected to a synchronized receiver. Quasi-electrostatic Z-mode waves were observed at frequencies f in the range $max\{f_c, f_-\} < f < f_{uh}$, where f_- is the electron gyrofrequency, f_- the plasma frequency, and f_{uh} the upper-hybrid-resonance frequency. This "slow" Z mode of propagation is characterized in the cold-plasma limit by a dispersion surface with a resonance cone. The complete electromagnetic dispersion relation for plane waves in a hot plasma has been solved. No solutions are found having direct ray paths along the transmitter-receiver separation direction with the observed signal delays for the observed frequencies in CMA Region 3. In previous publications, energetic particle detectors on the receiving subpayload demonstrated that, at the same time that the transmitting dipoles of OEDIPUS-C were being excited at CMA3 frequencies, the RF near fields of the same antennas were also accelerating electrons up to energies of 10 keV. An interpretive model is proposed in which sounder-accelerated electrons (SAE) radiate incoherently as they spiral along the magnetic field axis in the general direction of the receiving subpayload. Test-particle theory combined with the hot-plasma dispersion solution is used to predict the total electric field for the known SAE flux levels. It is found that voltage levels measured on the receiving dipoles lie close to the theoretically predicted values. One objective of the ongoing analysis is to determine whether the effective length of the receiving dipole is significantly greater than its physical length, a situation known to exist for whistler-mode propagation near the lower oblique resonance cone.

16h45 **Session Ends / Fin de la session**

[TU-P3] 14h15 Superconductivity, Magnetic and Correlated Electronic Systems II / *Supraconductivité, systèmes électroniques corrélés et magnétiques II*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE KC-104 ***Chair: K. Vos, U. Lethbridge***

TU-P3-1 **14h15**

Stripes, Resonance and D-Wave Superconducting Gap Spin Fluctuations-A Precursor of High-Temperature Superconductivity $YBa_2Cu_3O_{6.5}$. **W.J.L. Buyers**[a], C. Stock[b], R. Liang[c], D. Peets[c], D. Bonn[c], W.N. Hardy[c], Z. Tun[a] and R.J. Birgeneau[b], [a]*National Research Council Canada*, [b]University of Toronto, [c]University of British Columbia — We have examined the relation between spin fluctuations and superconductivity in a highly-ordered sample of $YBa_2Cu_3O_{6.5}$. We find that the spin susceptibility encompasses a low-lying hydrodynamic domain of dynamic stripes that extends and curves upward to an intense well-defined triplet resonance at 33 meV with a precipitous high-energy cut-off. Surprisingly, both features persist clearly in the normal gapless phase. Our results suggest that dynamic *d*-symmetry incoherent superconducting gap fluctuations exist in the normal phase in the resonance energy regime, and are visible through coupling to the neutron spin spectrum. The spin response at all energies grows on cooling and indicates that a pseudogap, as inferred from charge and low-frequency probes, does not occur at the energies of importance for the spin sector.

TU-P3-2 **14h30**

Inferring *d*-Wave Quasiparticle Properties from Microwave Conductivity Measurements on $YBa_2Cu_3O_{6+x}$. **R. Harris**, P.J. Turner, S. Kamal, R. Liang, D.A. Bonn and W.N. Hardy, *University of Bntish Columbia* — Broadband spectroscopic measurements (0.3 → 20 *GHz*) of the microwave conductivity of ultrahigh purity oxygen ordered $YBa_2Cu_3O_{6+y}$ have provided an unprecedented tool for studying charge carrier dynamics in a cuprate superconductor. Data from these experiments allow for meaningful comparison with detailed models of the self energy of *d*-wave superconductor quasiparticles. I will present a model of the electrical conductivity due to nodal *d*-wave quasiparticles whose properties are renormalized by interactions with a low density of screened finite sized Coulomb defects. While this model is capable of capturing the broad general features of the observed conductivity spectra in overdoped $YBa_2Cu_3O_{\sim 993}$ (T_c = 89 *K*) and underdoped $YBa_2Cu_3O_{6.5}$ (T_c = 60 *K*), it will be argued that additional pair breaking effects are needed in order to explain the observed temperature dependence of the quasiparticle oscillator strength.

TU-P3-3 **14h45**

Critical Analysis of the Miodal Approximation for Electron-Phonon Coupling in Metals. F. Dogan and **F. Marsiglio**, *University of Alberta* — The "standard" theory of a normal metal consists of an effective electron band which interacts with phonons and impurities. The effects due to the electron-phonon interaction are often delineated within the Migdal approximation; the properties of many simple metals are reasonably well described with such a description. On the other hand, if the electron-phonon interaction is sufficiently strong, a polaron approach is more appropriate. The purpose of this paper is to examine to what degree the Migdal approximation is self-consistent, as the coupling strength increases. We find that changes in the electron density of states become significant for very large values of the coupling strength; however, there is no critical value, nor even a crossover regime which can be identified. Moreover, the extent to which the electron band collapses is strongly dependent on the detailed characteristics of the phonon spectrum.

15h00 **Coffee Break / Pause café**

TU-P3-4 **15h30**

Superconducting Potential of Lithium Borocarbides. **S. Kale**, R.J. Sanderson, and K.C. Hewitt, *Dalhousie University* — The surprising discovery of superconductivity in MgB_2 at ~ 40 K in January 2001 sparked an interest in studying isostructural compounds hoping to unveil higher T_c superconducting materials. Calculations by Warren Pickett and co-workers predict hole doping in LiBC may lead to a 100K superconductor. Several groups have used solid state reaction techniques but have been unable to achieve hole doping. This presentation will provide motivation for the investigation of superconductivity in lithium borocarbide, Li_xBC, 0<x<1, to review the novel experimental approach used, and to present preliminary results.

TU-P3-5 **15h45**

Analysis of the Optical Conductivity of the High-Temperature Supeconductors Using Rotating Antiferromaonetic Theory. **Hassan Saadaoui** and Dr. Mohamed Azzouz, *Laurentian University* — Using the rotating antiferromagnetic theory[1], we calculate the optical conductivity of high-temperature superconductors. This theory consists of a quantum state characterized by a rotating order parameter. The evaluation of the optical conductivity is done using the Matsubara and Nambu formalisms. The dependence of this conductivity on doping and temperature and the behaviour of the resistivity are analyzed, and will be presented in this talk.

1. To be published in: *Phys.Rev. B*, April, (2003).

TU-P3-6 **16h00**

Exact 1-Particle Spectral Functions in a BCS-Like Theory Above Tc in Three Dimensions: Demonstration of a Robust Pseudogap. S. Verga, K.S.D. Beach, **R.J. Gooding**[a], and F. Marsiglio[b], [a]*Queen's University*, [b]University of Alberta — The non-self-consistent (NSC) T-matrix approximation to the electron self energy gives rise to the presence of a pseudogap in lower dimensions, due to pairing fluctuations. In three dimensions we have found that even for weak coupling a prominent pseudogap is present above T_c. This illustrates that pseudogap phenomena are not restricted to lower dimensionalities, but occur even in three dimensions over some temperature range.

16h15 **Session Ends / Fin de la session**

[TU-P4] 14h15 Dynamics of Magnetic Systems and Thin Films (General) / *Dynamique des systèmes magnétiques et couches minces (Général)*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE MN-40 ***Chair: J. Dahn, Dalhousie U.***

TU-P4-1 **14h15**

B. HEINRICH, Simon Fraser University

*Non Equilibrium Spin Momentum Transport in Magnetic Ultrathin Film Structures**

The interest of the magnetic community shifts increasingly from the static to the dynamic properties of the magnetization. This is partly motivated by curiosity, partly by the fact that the switching time of magnetizations in mass data storage devices and magnetic random access memories is a real technological issue. A good grasp of the fundamental physics of the magnetization dynamics, in the head as well as the medium, becomes of essential importance to sustain the exponential growth of device performance factors. In this talk I will describe a largely unexplored spin and magnetization dynamics of spin valves in a regime where there is no static coupling. Surprisingly, the magnetizations still turn out to be linked through the normal metal spacer by emitting and absorbing non-equilibrium spin currents in the absence of electrical current. This dynamic coupling is an entirely new concept with profound effects on magnetic relaxation and switching in hybrid structures and devices. In our recent studies the relaxation processes were studied by Ferromagnetic Resonance (FMR) using magnetic single, Au/Fe/GaAs(001), and double layer, Au/Fe/Au/Fe/GaAs(001), structures prepared by Molecular Beam Epitaxy (MBE). Single and double layer structures were grown on (4x6) reconstructed GaAs(001) templates. These structures have provided an excellent opportunity to investigate a non local damping which is caused by spin transport across a non-magnetic spacer. Theoretical models of non-local damping will be reviewed. It will be shown that the non-local interface damping can be described by spin pump and spin sink concepts. The strength of the spin pumping effect is proportional to the interface spin mixing conductance which is also a part of the angular dependence of CPP GMR. By using a time delayed linear response Kubo theory one can demonstrate that this effect is directly related to dynamics of inter-layer exchange coupling. It will be shown that the emission of non-equilibrium spin currents can be significantly enhanced by electron-electron correlation effects.

* In collaboration with G. Woltersdorf and R. Urban

TU-P4-2 **14h45**

DAVID VENUS, McMaster University

Magnetic Relaxation in Exchange-Coupled Ferromagnetic/Antiferromagnetic Bilayer Films

Ferromagnetic (F) films which are grown on an antiferromagnetic (AF) substrate often display a hysteresis loop whose centre is displaced in magnetic field from H=0. This "exchange bias" is understood to arise from frustration of the local magnetic exchange interaction between the F and AF spins at an imperfect interface. Locally, the number of interface spins on the two spin sublattices of the AF will not be precisely equal, and the net uncompensated AF spins can be aligned with the F spins by cooling the sample in an applied field. Once the cooling field is removed, the interface is in a metastable state where the exchange interaction of the uncompensated AF spins with the F can then be represented as an effective exchange field Hex. This effective field adds to the applied field to shift the F hysteresis loop. This phenomenon is used in magnetoresistive read heads to pin a F layer along a reference direction, such that the switching of a second F layer by the stray field of the magnetic memory bits can be detected. An understanding of the pinning of the F layer by the exchange field can be gained by studying the relaxation of the metastable spin state of the interface towards equilibrium. Some of the mechanisms by which this might occur include the reorientation of the alignment of AF spins within an AF domain or particle along an equivalent AF easy axis, or the propagation of AF domain walls created at the interface into the bulk of the AF. In each case, the magnetic relaxation is described by the thermal activation of magnetic degrees of freedom with activation energies Ea. Traditionally, this process has been studied using large fields (kOe) to trace a hysteresis loop of the exchange-coupled film to determine the exchange field by its offset from H=0. In a collaboration with the group of E. Dan Dahlberg (U. Minnesota), our more nuanced approach is to make small field (1 Oe) measurements of the ac-susceptibility as a function of temperature, using the anisotropic magnetoresistance of the F film. This can be related to the magnetic relaxation and the distribution of activation energies contributing to the effective exchange field. Results will be presented for Co/CoO interfaces.

15h15 **Coffee Break / Pause café**

TU-P4-3 **15h30**

THEODORE L. MONCHESKY, Dalhousie University

*Electron Beam Stimulated Magnetic Domain Wall Motion**

Using Scanning Electron Microscopy with Polarization Analysis (SEMPA), we observed the electron beam induced switching of the magnetic state of epitaxial single-crystal Fe(110) films grown on GaAs(110). If Fe films are grown to a thickness greater than the critical thickness, the magnetization is caught in a metastable state, oriented along [-110]. We discovered that we can locally switch the metastable state to the stable [001] direction by irradiating the metastable magnetic state with a suitable electron current density. The reversal proceeds by the nucleation and growth of lancet-shaped domains that move in discrete jumps between pinning sites. Our results show that there is a permanent reduction of the strength of defect sites without a permanent change in the overall anisotropy. We have also grown body-centered-cubic (bcc)-Co films on GaAs(110). SEMPA studies of Co films of varying thickness revealed three distinct magnetic phases. Below a thickness of 4 monolayers (ML), the film is not magnetic at room temperature. Between 4 ML and 7 ML, we find a new phase of bcc Co, where the easy axis lies along the [-110] direction. At a critical thickness of 7 ML, an in-plane spin reorientation transition occurs, where the magnetization rotates to point along [001]. The magnetic structure is correlated with Auger and Reflection High Energy Electron Diffraction data. These studies give insight into how an electron beam can be used to locally control domain structure of the Fe films.

*This work is supported in part by the Natural and Sciences and Engineering Research Council of Canada and by the Office of Naval Research.

TU-P4-4 **16h00**

Propriété électrochromique des nanocomposites de WO_3 et de V_2O_5 déposées par évaporation spontanée « Flash evaporation », **Pierre Losier** et P.V. Ashrit, *Université de Moncton* — La propriété électrochrome par laquelle on peut faire induire une coloration réversible dans certains matériaux est devenue très importante du point de vue d'applications echnologiques. De ma part, je m'intéresse plus particulièrement aux oxydes de métaux de transition tels que le trioxyde de tungstène (WO_3) et le Pentoxyde de Vanadium (V_2O_5). Avec l'évaporation spontanée, il m'est possible d'obtenir un nanocomposite constitué de ces deux matériaux. Lors de cette étude, j'ai réalisé des nanocomposites de WO_3 et de V_2O_5 qui contenaient une concentration de WO_3 qui variait entre 85% et 100%. J'ai également étudié les propriétés d'une couche mince constituée de 100% de V_2O_5. J'étudie particulièrement leur structure ainsi que leurs propriétés optiques et électrochrome. L'étude de leur propriété électrochrome a été effectuée par différentes méthodes d'intercalation de lithium.

TU-P4-5 **16h15**

Electrochemical Properties of Si-Al-Sn Ternary Films Prepared by Combinatorial Sputtering, **Tim Hatchard**, Mike Fleischauer, Jessica Topple and Jeff Dahn, *Dalhousie University* — Silicon based intermetallic compounds are currently being studied in order to determine their suitability as a replacement for graphite as anodes for Li-ion cells. At Dalhousie, we have been using a combinatorial sputtering technique to produce films with wide ranges of compositional variation. We also employ a 64-channel combinatorial electrochemical cell in order to rapidly test the electrochemical properties of the materials produced (this cell will be described in detail in a separate presentation given by Mike Fleischauer at this conference). This presentation will report the electrochemical properties of the Si-Al-Sn ternary system as a function of the composition of the film. Also reported will be the effects of composition on the structure, including the large amorphous range found in our sputtered films. Efforts will be made to relate the composition and structure changes in the film to the electrochemical performance. In particular, it will be shown that amorphous materials demonstrate better electrochemical cycling behaviour than crystalline materials with similar compositions.

TU-P4-6 **16h30**

The ^{15}N External Beam for Hydrogen Profiling in Metal Hydrides, **R. Kolarova** and S. Roorda, *Université de Montréal* — The metal hydrides are the most promising materials for the hydrogen storage. The evolution of hydrogen concentration in the region close to the surface during the hydrogen uptake and release is crucial for the optimal selection of materials, thickness and of the thermodynamical conditions. Commonly used methods allow the measurement of total hydrogen amount in the sample. We propose a technique, allowing the measurement of the concentration depth profile evolution of hydrogen during the uptake and release. It is the nuclear reaction analysis (NRA) method using the ^{15}N external beam as a probe. We've developed the setup for measurements of hydrogenation kinetics in the multilayers during the charging and discharging. The concentration depth profiles in the Pd/Mg/Ni multilayers measured with this technique will be presented.

TU-P4-7 **16h45**

Information Provided by Ion Beam Analysis Techniques. **F. Schiettekatte**, *Université de Montréal* — In this presentation, we give a summary of the type of information provided by different Ion Beam Analysis (IBA) techniques, as well as their advantages and limitations over other techniques. As depth profiling techniques, IBA is recognized as quantitative, providing depth resolution down to 10 nm in certain cases. Rutherford Backscattering Spectrometry (RBS) is straightforward and especially useful for heavy elements profiling. However, it shows low sensitivity for light masses in heavy matrices and, unless heavier incident ion beams are used, offers poor mass resolution for heavy elements. Elastic Recoil Detection (ERD) used with a mass separation detection system (such as a Time-of-Flight (TOF) camera) overcomes this kind of problem, but heavy ion beams used in this case may affect the analysed material. Nuclear Reactions Analysis and ion beam-induced photon emission can also be used with light atoms. Finally, in the case of single crystals, by an alignment of the beam and/or the detector along crystal axes, IBA techniques can provide detailed information about the material such as lattice location of the constituting elements and defects, or the surface atoms configuration. Examples of IBA measurements will be provided in each case to illustrate the capabilities of each technique.

17h00 **Session Ends / Fin de la session**

[TU-P5] 14h15 Instrumentation and Measurement Methods in Materials Science / *Instrumentation et méthodes de mesure en science des matériaux*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE CS-104 ***Chair: A. Mandelis, U. Toronto***

TU-P5-1 **14h15**

TETSUO IKARI, Miyazaki University

Detection of non-radiative electron transition in Semiconductor thin film and quantum well structures

Non-radiative electron transitions in semiconductors play an important role for the photo-electronic device application. We have recently developed new methodology of Piezoelectric Photo-thermal Spectroscopy (PPTS) for investigating those transitions. Deep lying defect levels such as EL2 and EL6 with very low concentrations in bulk GaAs were sensitively detected. We also discussed photo-induced defect dynamics from a point of view of electron non-radiative transition[1]. Since a degradation of Laser (LD) and Light Emitting diodes (LED) is strongly affected by such non-radiative transition, it becomes very important to understand the mechanism. We have studied the electron non-radiative transition by the present PPTS technique for the single quantum well structures of extremely thin GaInNAs (3nm) film and observed a quantum confinement effect and exciton formation of photo-excited carriers. The electron non-radiative transition at the interface of InAlP/InGaAlP LEDs was also investigated and the device degradation mechanism due to the unexpected diffusion of dopant was studied. I will introduce our developed PPTS methodology that enables one to investigate the electron non-radiative transitions and to obtain absorption spectra for extremely thin layer sample.

1. T. Ikari and A. Fukuyama, Progress in Photothermal and Photoacoustic Science and Technology Vol.4, Chap.5, 2000, pp.147-176, ed. A. Mandelis and P. Hess.

TU-P5-2 **14h45**

ANDREAS MANDELIS, University of Toronto

*Infrared Photo-Carrier Radiometry of Semiconductors: Physical Principles, Quantitative Depth Profilometry and Scanning Imaging of Deep Sub-surface Electronic Defects**

Laser-induced infrared photo-carrier radiometry (PCR) is introduced theoretically and experimentally through deep sub-surface scanning imaging and signal frequency dependencies from Si wafers. A room-temperature InGaAs detector (0.8 - 1.8 μm) with integrated amplification electronics is used instead of the liquid-nitrogen cooled HgCdTe photodetector (2 - 2 μm) of conventional photothermal radiometry (PTR). PCR measures purely purely electronic carrier-wave (CW) recombination. The InGaAs detector completely obliterates the thermal infrared emission band (8-12 μm), unlike the known photothermal signal types, which invariably contain combinations of carrier-wave and thermal-wave infrared emissions due to the concurrent lattice absorption of the incident beam and nonradiative heating. The PCR theory is presented as infrared depth integrals of CW density profiles. Experimental aspects of this new methodology are given, including the determination of photo-carrier transport parameters through modulation frequency scans, as well as CW scanning imaging. PCR coordinate scans at the front surface of 500-μm-thick Si wafers with slight back-surface mechanical defects can easily "see" and create clear images of the defects at modulation frequencies up to 100 kHz, at laser-beam optical penetration depth ~ 1 μm below the surface (at 514 nm). The physics of the contrast mechanism for the non-thermal nature of the PCR signal is described: it involves self-reabsorption of CW-recombination-generated IR photons emitted by the photoexcited carrier-wave distribution depth profile throughout the wafer bulk. The distribution is modified by enhanced recombination at localized or extended defects, even as remote as the back surface of the material. The high-frequency, deep-defect PCR images thus obtained prove that very-near-surface (where optoelectronic device fabrication takes place) photo-carrier generation can be detrimentally affected not only by local electronic defects as is commonly assumed, but also by defects in remote wafer regions much deeper than the extent of the electronically active thin surface layer.

* In conjuction with Jerias Batista and Derrick Shaughnessy

15h15 **Coffee Break / Pause café**

TU-P5-3 **15h45**

TARO TOYODA, University of Electro-Communications

Photo-Acoustic and Photo-Electrochemical Characterization of Nanostructured TiO_2 Electrodes

TiO_2 is a promising candidate for dye sensitized solar cells. We report the effect of voltage in a electrolyte applied to nanostructured TiO_2 electrodes during final preparation processes on photo-acoustic (PA) and photo-electrochemical (PEC) current spectra and their modulation frequency dependence to clarify their response characteristics. The PA intensities with applied voltage treatment are higher than that without the treatment below the fundamental absorption edge, suggesting an increase in carrier concentration. The modulation frequency dependence of the PA intensity suggests the increase in the interfacial thermal resistance between the nanostructured TiO_2 film and the substrate. The PEC measurements confirms the increase on carrier concentration following the applied voltage treatment. The modulation frequency dependence of the PEC current is related to the applied voltage treatment, suggesting the enhancement of the photo-excited electron diffusion response with the increase in applied voltage. Preliminary laser-flash-induced PEC current transient measurements show that the electron diffusion coefficient with the applied voltage treatment is larger than that without the treatment.

TU-P5-4 **16h15**

JON P. LONGTIN, SUNY – Stony Brook

Ultrafast Laser Micromachining of Thermal Spray Materials Using Laser Induced Breakdown Spectroscopy

Ultrafast laser processing and micromachining of thermal spray materials has opened up innovative novel capabilities for sensor and electronics fabrication. Thermal spray is particularly adept at fabricating multilayer structures from a wide variety of material combinations. A major obstacle in ultrafast laser micromachining of multi-layer or heterogeneous micro-structures, however, is the lack of an online diagnostic method to determine which material is being ablated during the material removal process. This problem arises because ultrafast lasers are generally insensitive to the material being processed. One promising technique to address this problem is the use of *laser-induced breakdown spectroscopy* (LIBS) by which the plasma generated during the laser-material interaction is collected and analyzed to provide information regarding the elemental composition of the material being ablated. In this work, a real-time feedback control system for the ultrafast laser micromachining process based on the LIBS technique is presented. Characteristics of spectral emission, temporal evolution, spatial heterogeneity of the ultrafast LIBS signal, effects from laser machining factors, etc., are discussed. Comparison methods for identifying the material emission patterns are then studied. Effective algorithms from the study are implemented into the control system software, SPECOMP, developed in the laboratory. Issues on the real-time control process are discussed. The real-time controlled machining process has then been applied to the machining of microheater structures on thermal sprayed material. Compared to the passive machining process without any such feedback control, SPECOMP system provides several important advantages including shortened machining time, less damage to the substrate layer and more uniform feature sizes.

16h45 **Session Ends / Fin de la session**

[TU-P6] 14h15 Particle Astrophysics / *Astrophysique des particules*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE AV-C ***Chair: D. Karlen, U. Victoria***

TU-P6-1 **14h15**

RANPAL DOSANJH, Carleton University

Recent Results from the Sudbury Neutrino Observatory

The neutral current measurement from the Sudbury Neutrino Observatory (SNO) in the pure D_2O phase provided strong evidence for neutrino flavour mixing. In June 2001, SNO began operating with salt added to the heavy water, in order to enhance the neutral current signal. This talk will present the status of the experiment, including an overview of the detector and experimental method.

TU-P6-2 **14h45**

VIKTOR ZACEK, Université de Montréal

Status of the PICASSO Dark Matter Search Project

The nature of the main constituents of the mass of the universe is one of the outstanding riddles of cosmology and astro-particle physics. Current models explaining the evolution of the universe, and measurements of the various components of its mass, all have in common that an appreciable contribution to that mass is non-luminous and non-baryonic, and that a large fraction of this so-called dark matter must be in the form of non-relativistic massive particles (Cold Dark Matter: CDM). The PICASSO dark matter detector is based on the phase transition induced by nuclear recoils in superheated droplets. This technique is a promising alternative to other, more conventional detector approaches and has an interesting background suppression feature: we could show that, depending on the temperature of operation, the detector can be either fully sensitive to CDM or completely insensitive to nuclear recoils produced by neutralinos, while responding in a well understood manner to residual background, such as that produced by alpha-emitting contaminations of the detector material. A pilot experiment with six detectors and 100g active mass is presently taking data at the Sudbury underground laboratory and we will discuss ongoing work to decrease radioactive background and to increase the size of the detector modules.

15h15 **Coffee Break / Pause café**

TU-P6-3 **15h45**

KEN RAGAN, McGill University

Ground-based gamma-ray astronomy with STACEE and VERITAS

Ground based gamma-ray astronomy in the energy regime above approximately 50 GeV is being pursued with two different, and complementary approaches. Both efforts use the air Cherenkov technique to detect the Cherenkov signal from high energy secondaries produced by the interaction of gamma rays of astrophysical origin with the atmosphere. The first is the STACEE detector using the large mirror area of a solar power installation as the basis for a wave-front detector; it aims at reducing the energy threshold compared to existing instruments, at the expense of sensitivity. The second approach is the construction of an array of imaging detectors similar to the venerable Whipple telescope, to achieve unprecedented sensitivity at slightly higher thresholds. This second approach is pursued in the VERITAS project which is in the initial stages of construction in Arizona. We will report on some of the results from the STACEE detector, now operational in New Mexico, and on the status of the VERITAS project.

TU-P6-4 **16h15**

BYRON JENNINGS, TRIUMF

SNOING on Nuclear Theory

The solar neutrinos observed at SNO come predominately from the decay of Boron 8. This isotope is produced in the Be7(p,γ)B8 reaction. Thus in order to interpret the SNO result we need the Be7(p,γ)B8 reaction rate. Due to the low temperature of sun we need the rate at 18keV; well below any earthly experiment. In this talk I will discuss the nuclear theory required to understand this reaction. The extrapolation from the experimental results to the needed low energy reaction has less uncertainty than might be expected from a simple analysis.

16h45 **Session Ends / Fin de la session**

[TU-P7] 14h15 Advances in Medical Imaging / *Progrès en imagerie médicale*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE DS-121 ***Chair: A. Pejovic-Milic, Ryerson U.***

TU-P7-1 **14h15**

RAVI MENON, Robarts Research Institute

Measurement of Oxygen Consumption Using MRI

For over 100 years we have known that increases in brain activity brought about by thinking, seeing, hearing etc. are accompanied by increases in blood flow to the brain. In fact, this coupling between neural activity and blood flow is very specifically localized to the areas of the brain participating in the things like the processing of a visual cue or a hand movement. The coupling between blood flow and neural activity allows us to use a new technique known a functional MRI to image brain function in a completely noninvasive manner. The research I will talk about is aimed at extending the functional MRI technique to measuring oxygen consumption in the brain in absolute units. The only way to do this currently is by injecting or inhaling radioactive oxygen and studying humans in a PET scanner. A noninvasive method would be invaluable for both establishing basic biophysics of the fMRI technique, as well as for extending the technique to areas like stroke and cancer, where the oxygenation state of the tissue is important to know.

TU-P7-2 **14h45**

VIRGINIJUS BARZDA, University of Toronto

*Imaging Cardio-Myocytes Simultaneously with Second- and Third-Harmonic Generation and Multi-Photon Excitation Fluorescence Microscopy**

We have imaged isolated adult rat myocytes with femtosecond laser pulses at several excitation wavelengths. Simultaneous detection of second harmonic generation (SHG), third harmonic generation (THG) and multiphoton excitation fluorescence was utilized during the imaging. The simultaneous detection enabled us to visualize different organelles of myocytes based on the different contrast mechanisms. Imaging with 800 nm Ti:sapphire laser showed that laser pulses had lethal effect on myocytes after imaging them for several minutes. The best results for the measurements with Ti:sapphire laser were achieved by tuning the oscillator wavelength to 837 nm, and adjusting the repetition rate of the laser to 3.1 MHz and pulse energy to 1 nJ. The damage of the myocytes was inflicted by the multiphoton absorption of NADH and FAD. Fluorescence images showed only non-specific structures, highlighting the whole body of myocyte. The SHG image revealed characteristic pattern of sarcomeres in myofilament lattice and several bundles of collagen. The THG image revealed different structures that were anticorrelated with the SHG signal. The THG structures had the regular pattern implying that the third harmonic is generated from mitochondria arranged regularly along the myofilaments. For further investigation on the origin of the THG signal we switched to a Nd Glass laser emitting pulses at 1064 nm. Since the absorption of NADH and FAD at this wavelength is negligible, we could use higher laser power to obtain stronger SHG and THG signals. In fact, myocytes were imaged for hours without detectable damage. This opens new exciting possibilities for dynamic investigations of intracellular interaction between organelles of myocyte in vivo. Most importantly, we were able to locate mitochondria by labeling myocytes with mitochondrial dye TMRM. The 1064 nm excitation led to the TMRM fluorescence, without exciting autofluorescence of NADH and FAD. We compared the TMRM fluorescence image with images of THG and SHG. Preliminary analysis of obtained data shows that there

is a certain degree of correspondence between the fluorescence image of TMRM dye and the THG image, suggesting that part of the THG signal originates from mitochondria. However, there are some structural features of myocyte that are not highlighted in the TMRM fluorescence image. This is expected, since the THG is sensitive to interfaces, where change in the refractive index or third order non-linear susceptibility takes place. Observed THG signals from mitochondria are stronger most likely due to the folded multilamellar structure inside mitochondria that may create more favorable phase matching conditions than for the case of a single lipid membrane.

* In conjunction with Jeff Squier [a], Juerg Aus der Au [a] Steve Elmore [b] and Hans van Beek [b], [a] Department of Physics, Colorado School of Mines, [b] Department of Molecular Cell Physiology, Vrije Universiteit Amsterdam

15h15 **Coffee Break / Pause café**

15h30 **Session Ends / Fin de la session**

[TU-P8] 14h15 Advanced Light Sources / *Sources de lumière modernes*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

ROOM / SALLE KM-237 ***Chair: R. Fedosejevs, U. Alberta***

TU-P8-1 **14h15**

DAVID M. VILLENEUVE, National Research Council of Canada

Molecular Imaging at the Advanced Laser Light Source (ALLS)

The Advanced Laser Light Source (**ALLS**) is under construction at **INRS**. It is composed of a number of laser beamlines with various combinations of repetition rate and peak power. The initial experimental drive is in the area of molecular imaging. Mature imaging methods, such as **NMR**, electron diffraction and x-ray diffraction, lack the time resolution required to observe dynamical changes. ALLS will use both x-ray and electron pulses, produced by ultrafast laser pulses, that will enable pump-probe measurements of structural changes. We will also use an electron, pulled from a molecule and rescattered from the same molecule, to take a picture of the molecule itself

15h00 **Coffee Break / Pause café**

TU-P8-2 **15h30**

A.R.W. MCKELLAR, National Research Council of Canada

Far Infrared Beamline at the Candian Light Source

Two infrared beamlines are currently under construction at the Canadian Light Source (CLS) synchrotron facility in Saskatoon, a mid-infrared facility for spectromicroscopy and industrial applications, and a far infrared (FIR) facility. Operations are planned to begin in January, 2004. The FIR end station will be equipped with a large Fourier transform spectrometer for ultra-high spectral resolution (<0.001 cm^{-1}) gas-phase studies, as well as for high spatial resolution condensed-phase studies (high pressure samples, microstructures, surfaces, and interfaces). Gas phase infrared spectroscopy represents a new application for synchrotron radiation whose potential has not been fully realized, though promising results have recently been obtained at facilities in Sweden and France. The FIR region ($\lambda \approx 10$-200 μm, or $1/\lambda \approx 50$-1000 cm^{-1}, or $\nu \approx 2$-30 THz) is particularly challenging for a number of reasons, in particular the weakness of conventional thermal continuum radiation sources. Synchrotron radiation provides a high-brightness infrared continuum with a potential gain of 2 to 3 orders of magnitude in signal strength compared to normal infrared sources. The CLS FIR team, consisting of 20 researchers from university and government laboratories across Canada, is looking forward to applying this advanced new facility to problems in physics, chemistry, astronomy, and material sciences.

16h15 **Session Ends / Fin de la session**

[WE-Plen-1] 08h30 CAP Industrial and Applied Physics Medal Winner / *Récipiendaire de la médaille industrielle et appliquée*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE DS-121 ***Chair: M. Thewalt, SFU***

WE-PLEN-1 **08h30**

K.G. STANDING, University Of Manitoba

Clocking the Big Ones: Time-of-Flight Mass Spectrometry of Biomolecules– One Thousand to One Million u.

Over the last 25+ years, time-of-flight mass spectrometry has evolved from a niche technique to one of the main tools for characterizing biomolecules. Milestones on this path will be discussed, with some emphasis on the part played by the Manitoba group in defining the physics of the process and in improving instrumentation. Some applications will also be described, including our recent sequencing of proteins from the SARS coronavirus.

[WE-Plen-2] 09h15 Plenary Session / *Session plénière*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE DS-121 ***Chair: M. Vincter, U. Alberta***

WE-PLEN-2 **09h15**

DOUGLAS SCOTT, University of British Columbia

The Cosmic Microwave Background vs the Universe

The anisotropies on the Cosmic Microwave Background (CMB) sky contain a wealth of information about the Universe in which we live. Detailed measurement of those anisotropies with the latest experiments have launched cosmology into a new era, where it has clearly become a precision science. We now have a clear picture of exactly what sort of Big Bang model describes our Universe, and very strong clues about what might have happened before the Big Bang. Combining CMB data with other cosmological probes allows us to arrive at a model which has close to flat geometry, with the census being about 1/4 matter (most of which is cold dark matter) and the other 3/4 made of some kind of "dark energy".

Several parameters, such as the expansion rate and age of the Universe are determined to a few percent accuracy. The initial perturbations appear to be adiabatic, Gaussian, and close to scale-invariant, pointing to something like inflation. The overall cosmological picture seems to be remarkably consistent, although there are a few hints of surprises to come. If we now have a "Cosmological Standard Model", then one needs to ask "Is the end in sight for cosmology?".

[WE-A1] 10h00 Ultrafast Science and Applications / *Phénomènes ultrarapides et applications*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE DS-121 ***Chair: D. Villeneuve, NRC***

WE-A1-1 **10h00**

CHRISTIAN JUNGREUTHMAYER*, University of Ottawa

Matter in Strong Laser Fields

Due to recent progress in laser technology laser pulses with unprecedented pulse duration and peak intensity (10^{23} W/cm^2) can be generated. The feasibility of such pulses has opened new areas of research. An overview over the latest developments will be given, including attosecond physics, laser nuclear- and astro-physics, laser plasma physics, and strong laser imaging of molecular reactions.

* On behalf of Thomas Brabec

WE-A1-2 **10h30**

Giant Above-Threshold Absorption and Cascade Ionization in Diatomic Molecules Induced Byfemtosecond Pulses of Strong Lasers. **Alexander I. Pegarkov** *Chemical Physics Theory Group, University of Toronto* — Molecular processes in short and strong laser pulses are the most attractive topic of modern laser physics due to the new non-linear effects which occur as the laser - molecule interaction becomes comparable with or larger than energy of electronic transitions. Recent experiments demonstrate, that although the laser pulse intensity is high, the inter-electron interaction makes a visible impact upon multi-electron ionization. Moreover the dynamics of the laser – molecule interaction in strong pulses containing only few optical cycles is clearly different from that in the multi-cycle pulses. In the present talk the molecular non-linear excitation and multi-electron ionization are considered for the cases of few-cycle and multi-cycle pulses of strong lasers with resonant and off-resonant frequency. A numerical method is developed to allow for the quantum-mechanical dynamics of correlated electron motion. It is shown that in some cases the molecule can undergo cascade ionization and giant above-threshold absorption. In the cascade ionization the molecule emits one electron with the same probability as an electron pair. This phenomenon arises due to the one-photon resonance with an intermediate electronic state. In the giant above threshold absorption the molecule absorbs a big amount of laser energy far above the second ionization threshold but can still exist like a whole molecule. This phenomenon is invoked by rapid energy transmission from the laser pulse to the molecule. The detailed analysis of physics of both phenomena is presented.

WE-A1-3 **10h45**

One-Photon Versus Three-Photon Control of Molecular Photo-Absorption: Role of Non-Linear Temporal Wave Interference. **Alexander I. Pegarkov** and P.W. Brumer, *University of Toronto* — It is well - known that the quantum interference between two pathways, created by the fundamental laser wave and its third harmonic, provides one scenario for the laser control over molecular processes. Here we consider the effect of various factors previously neglected on the extent of control. Included are the effects of radiative decay times, the finite frequency bandwidth of the pulsed laser, and the frequency mismatch between the fundamental and the third harmonic. The problem is solved via a time-dependent non - perturbative approach to the laser excitation of a two level bound system. We show that the non-linear time-dependent interference of quantum transitions induced by the two electromagnetic waves plays a crucial role in the extent of control. We obtain that the triple wave frequency mismatch, even if small, creates additional time-dependent phase shifts which reduces the control. The computational analysis confirms that the more stable molecular states are better controlled and are less sensitive to the frequency mismatch. We further demonstrate that shortening the laser pulse duration from nanoseconds to picoseconds or changing the peak intensity of fundamental pulse between 10^{10} W/cm^2 and 10^{12} W/cm^2 can strongly improve phase control. non-stoechiometry are reported.

11h00 **Coffee Break / Pause café**

WE-A1-4 **11h30**

IGOR LITVINYUK, National Research Council

Molecules in Strong Laser Field: Ionization, Re-scattering and Coulomb Explosion

Molecules, unlike atoms, in addition to electronic degrees of freedom also possess nuclear (rotational and vibrational) degrees of freedom. Strong ultra-short laser pulses interact with molecules, coupling electronic and nuclear motion in a complex way. For example, rate of strong field ionization depends on molecular orientation with respect to the electric field vector. We studied this dependence using dynamic alignment created by intense femtosecond pulses. Also, nuclear vibrational motion can be used to measure the dynamics of multiple ionization. We used this "molecular clock" to measure relative probability of the shake-off process in deuterium. In linearly polarized field, the ionized electrons may re-collide with the ion core undergoing elastic or inelastic scattering. Electron-ion re-scattering can be used for studying ultrafast molecular dynamics. Finally, using ultra-short (8 fs) intense pulses one can produce highly charged molecular ions with geometries close to their neutral ground state structures. Such ions undergo rapid dissociation (Coulomb explosion). Measuring momenta of all the fragments in coincidence, one can reconstruct the molecular structure right before the explosion. We present the results of Coulomb explosion experiments with sub-10 fs pulses for deuterium, heavy water and carbon dioxide molecules.

WE-A1-5 **12h00**

Femtosecond Laser Micromachining of Silicon at 400 nm and 800 nm Wavelengths. **T.H.R. Crawford**, A. Borowiec, and H.K. Haugen, *McMaster University* — The micromachining of (100) silicon with ~150 femtosecond laser pulses at center wavelengths of 800 nm and 400 nm is presented. The machined groove depth and morphology is investigated as a function of pulse energy, translation speed of the silicon, and number of consecutive passes over the same region.

12h15 **Session Ends / Fin de la session**

[WE-A2] 10h00 Materials Science I / *Science des matériaux I*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE MN-40 ***Chair: D. Taylor, Queen's U.***

WE-A2-1 **10h00**

MORDECHAY SCHLESINGER, University of Windsor

Numeric Methods in Solving Rough Surface Contact Problems

A recently developed multiscale finite element numerical modelling method will be discussed. The aim in developing the method was to investigate the elastic contact of two-dimensional rough surfaces. The method is useful in finding the microscopic curve, which describes the deformed shape of a solid with smooth boundry surface in frictionless contact with a rigid rough surface. In addition the real contact area is studied through the surface deformation. The contact traction on the contact surface and the maximum shear stress around the contact region may be analyzed based on the above solution. The method is based on the variational inequality approach for solving the elastic frictionless contact problem. The strategy of the modelling method is to separate a small slice within the contact region and solve it as an independent system. Next, the contact traction is obtained through iterations between the solution of the independent small slice and the solution of the total solid body. The advantage of the method is that the effects of the total geometric shape of the solid body with various loading and the impact of rough surface topography may be taken into account at the same time without increasing computing demands. Through simple numeric implementation of the method we have observed that a much higher pressure exists around asperities than Hertz's theory would predict. It is also seen that the location of maximum shear stress tends to be shifted towards the surface compared with the case of smooth surface contact. It is feasible to use the method to investigate the contact properties of surfaces whose roughness is determined directly from measurements. Finally, the method converges and thus has the potential to be extended to solve three-dimensional rough surface problems.

WE-A2-2 **10h30**

KEVIN ROBBIE, Queen's University

Geometrical Effects in Ballistic Aggregation of Thin Films

Atomic vapour impinging onto flat surfaces forms thin film coatings with morphologies that strongly depend on the time-varying angular distribution of arriving vapour. Recent studies have probed the effects of vapour-substrate geometry on crystallographic and morphological structure, and magnetic and optical response. X-ray texture measurements show evolution of preferred texture with substrate tilt, with induced twinning at high substrate tilt (copper films on amorphous silica). Silicon thin films with highly anisotropic morphology were produced with a zigzag-type growth, accomplished with periodic rapid half-turn rotations of the substrate. The magnitude of observed birefringence varies with wavelength and substrate tilt, with a maximum refractive index difference of 0.4 or 20% at 630nm wavelength, and 0.25 or 10% at 1500nm, both for a film deposited with a tilt of 60 degrees. Silicon films with varying porosity were used to demonstrate novel interference filters, including rugates with sinusoidal index variation, index-matching layers with a quintic match to ambient, and omnidirectional reflectors with a large photonic bandgap at near-infrared wavelengths. To enable predictive design of these interference filters, we have calibrated a Monte Carlo growth model (with spectroscopic ellipsometry of as-growth films) to produce accurate electromagnetic response calculations. Evolving porosity in both the model and in grown films suggest power-law scaling phenomena, supported with morphological structures observed with electron microscopy

11h00 **Coffee Break / Pause café**

WE-A2-3 **11h30**

How a Physicist Can Do an Electrochemist's Work Sixty-Four Times Faster. **M.D. Fleischauer**, T.D. Hatchard, G.P Rockwell, J.M. Topple, S. Trussler, S.K. Jericho, M.H. Jericho and J.R. Dahn, *Dalhousie University* — Combinatorial methods hold promise in speeding the discovery of new materials. We have designed and built a system capable of producing all possible combinations of a set of up to four starting materials. However, there is no advantage to rapidly producing hundreds or thousands of different compositions if the characterization must be performed one sample at a time. We designed and tested a 64-channel combinatorial electrochemical cell to investigate 64 different compositions simultaneously. Each composition is tested for suitability as an electrode in Li-ion rechargeable batteries. This talk will present the combinatorial electrochemical cell, describe the testing procedure and demonstrate how this cell is speeding our Li-ion battery material investigations.

WE-A2-4 **11h45**

Combinatorial Investigations of the Si-Al-Mn Ternary System. **M.D. Fleischauer**, J.M. Topple, T.D. Hatchard and J.R. Dahn, *Dalhousie University* — Combinatorial methods hold promise in speeding the discovery of new materials. This talk presents the first completely combinatorial investigation of a materials system at Dalhousie University. Last year at the CAP Congress, we described how we fabricate and determine the structure and composition of our thin film combinatorial libraries. This year, we include electrochemical results collected with our combinatorial electrochemical cell (to be described in detail in a separate presentation by M.D. Fleischauer *et. al.*). Our aim is to improve Li-ion rechargeable battery performance by optimizing the battery electrode materials. Si can store a large amount of Li relative to its weight. The large storage capacity comes at a price: large and uneven volume changes in crystalline anode materials can lead to cracking and a loss of electrical contact. Amorphous materials expand and contract uniformly, and could thereby be ideal anode materials. However, many of the additions required to make bulk amorphous materials, such as Mn, dramatically reduce the Li-ion storage capacity. We will present Li-ion battery performance data for a broad range of Si-Al-Mn compositions. This data is part of an investigation of the effect of transition metal content on the Li-ion specific capacity of amorphous alloys.

WE-A2-5 **12h00**

The Effect of Humidity on the Electrical Susceptibility of Mesoporous Silicates formed from Organosilane Substitution on Octylamine Micelles. **W.M. Sears**, J.T. Banks, K. Hardy, and S. Hartzke, *Lakehead University* — Mesoporous silicates are formed when organosilanes aggregate around octylamine micelles in aqueous solution, with the silicon part on the outside forming siloxane linkages that form the backbone of the structure. The octylamine is removed with an ethanol wash to produce the network of pores. By using different organosilanes the degree of hydrophilic interaction of the silicate, with humid air, can be varied. The silicates are then ground to a fine powder and placed between a co-axial tube capacitor arrangement connected to a standard impedance bridge. From this the frequency variation of the complex susceptibility is measured from 20 Hz to 1 MHz at three fixed humidity values of 11, 43, and 75%, using standard salt solutions. The best performing sample was (3-mercaptopropyl)trimethoxysilane (MPTMS) mixed with tetraethylorthosilicate (TEOS), where at 5 kHz the conductance was enhanced by a factor of 12 for the medium over the low humidity, and a factor of 4.5 for the high over the medium humidity conditions. The capacitance value is enhanced by factors of 4.4 and 1.6 respectively. This may mean that there is an optimal balance of hydrophobic versus hydrophilic interaction, as MPTMS is intermediate in these properties for the compounds tested. The absolute value of the conductivity is also important as higher levels are easier to measure. MPTMS performs best by this criteria as well, at about 4x10-6 S/m for high humidity. The susceptibility of a mesoporous powder containing absorbed water vapour follows Jonscher's universal dielectric response more closely then other Debye or non-Debye models

12h15 **Session Ends / Fin de la session**

[WE-A3] 10h00 Overview of Instrumentation and Measurement Research in North America I / *Survol de la recherche en instrumentation et mesures en Amérique du Nord I*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE KM-237 ***Chair: A. Mandelis, U. Toronto***

WE-A3-1 **10h00**

FRED H. POLLAK, Brooklyn College of the City University of New York,

Non-Destructive Room-Temperature Characterization of Wafer-sized III-V Semiconductor Device Structures using Contactless Electromodulation and Surface Photovoltage Spectroscopy

This talk will review the instrumentation and use of the contactless methods of photoreflectance (PR), contactless electroreflectance (CER), surface photovoltage spectroscopy (SPS), and wavelength modulated SPS for the nondestructive, room temperature characterization of a wide variety of wafer-scale semiconductor device structures. Some systems that will be discussed include heterojunction bipolar transistors such as graded emitter GaAlAs/GaAs and AlInAs/InGaAs as well as GaInP/GaAs (including the determination of the built-in fields/doping levels in the emitter and collector regions, doping level and minority carrier lifetime in the base, alloy composition, and the degree of ordering in the GaInP), pseudomorphic GaAlAs/InGaAs/GaAs high electron mobility transistors (including the determination of the composition, width, and two-dimensional electron gas density in the channel), quantum well edge emitting lasers [InGaAsP/InP (including the detection of p-dopant interdiffusion), graded index of refraction separate confinement heterostructure GaAlAs/GaAs/InGaAs], vertical-cavity surface-emitting lasers (determination of fundamental conduction to heavy-hole excitonic transition and cavity mode in 1.3 micron, 980 nm and 860 nm systems), and InAs/GaAs quantum dot lasers. These methods are already being used by more than a dozen industries world-wide for the production-line qualification of these device structures.

10h45 **Coffee Break / Pause café**

WE-A3-2 **11h15**

SYLVAIN CHARBONNEAU, National Research Council Canada

Nanotechnology- An Integration Challenge

Nanotechnology, or the innovation of science and engineering to developing new materials and processes by manipulating molecular and atomic particles, has enjoyed significant investment internationally over the last decade. Although the experimental verification of quantum mechanic is being tested with every new nanoscale components produced, there remains the challenge of integrating these into functional systems. Integration covers a wide range of scientific and technical endeavours from the basic understanding of the organic/inorganic interface in molecular devices to connecting nanostructures to micron scale contacts for functional devices and circuits. The bottom-up approach to nanotechnology crosses the boundaries of conventional scientific disciplines, using the physicist's, biologist's or chemist's toolbox to address novel materials, device and circuit designs marrying chemical or biological complexity with simple device architectures. During my presentation, I will report on some of the exciting results and challenges in organic and inorganic photonics and electronics based devices made possible by integration of tools and competencies.

WE-A3-3 **12h00**

B. BORO DJORDJEVIC, Johns Hopkins University

Remote Non-Contact Ultrasonic Sensing

Johns Hopkins University, Center for Nondestructive Evaluation has performed extensive development and application of ultrasonic to structural evaluation for the civil, transportation and aerospace applications. Ultrasonic measurements can be extended and applied for range of materials and structural tests using remote and non-contact transduction methods. This paper will review the application of hybrid remote ultrasonic work using laser generation and air-coupled detection sensing arrangement. Hybrid ultrasonic configuration provides improved signal to noise in 100 kHz to 2 MHz frequency regimes that is most useful in practical engineering materials and structures. The approach has been successfully applied to ultrasonic measurements on aircraft structures as well as for in-motion testing of railway track. Spatially formed laser-source generation methods that control directivity and waveform shape are used to select and enhance stress wave modes for improved acoustical energy partitioning in the test structures. The experimental tests with advanced signal analysis enable single impulse testing of rail track and advanced aerospace components including composite materials. The remote and non-contact acoustical sources are very flexible and enable generation of plate (Lamb waves) or surface waves (Rayleigh waves) that cannot be generated using conventional contact transducers. This paper presents the methodology, instrumentation and signal processing used in the application of the non-contact hybrid ultrasonic measurements.

12h45 **Session Ends / Fin de la session**

[WE-A4] 10h00 Theory I / *Théorie I*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE AV-C ***Chair: R. MacKenzie, U. Montreal***

WE-A4-1 **10h00**

GERRY MCKEON, University of Western Ontario

Extracting Information from the Renormalization Group

The process of renormalization inevitably introduces a mass scale into radiative corrections. Demanding that physical quantities be independent of this scale results in the renormalization group equation; we explore the consequences of this equation in QCD calculations and in the effective action. It is shown that there are two consequences of this equation: the standard occurance of mass scale dependent couplings and the ability to predict parts of uncomputed higher order corrections. This considerably reduces the mass scale dependence of perturbative results.

WE-A4-2 **10h30**

Number Fluctuation and the Fundamental Theorem of Arithmetic. **Muoi N. Tran** and Rajat K. Bhaduri, McMaster University — We consider N bosons occupying a discrete set of single-paticle quantum states in an isolated trap. Usually, for a given excitation energy, there are many combinations of exciting different number of particles from the ground state, resulting in a fluctuation of the ground state population. As a counter example, we take the quantum spectrum to be logarithms of the prime number sequence, and using the fundamental theorem of arithmetic, find that the ground state fluctuation vanishes exactly for all excitations. The use of the canonical or grand canonical ensembles, on the other hand, gives substantial number fluctuation for the ground state. This is an example of a system where canonical and grand canonical averaging are not valid because of the peculiar nature of the quantum spectrum.

10h45 **Coffee Break / Pause café**

WE-A4-3 **11h15**

VICTOR ELIAS, Perimeter Institute for Theoretical Physics

Radiative Spontaneous Symmetry-Breaking Revisited

In the absence of a tree-level scalar-field mass, renormalization group methods permit the explicit summation of leading-logarithm contributions to all orders of the perturbative series within effective potentials for massless-scalar-field electrodynamics and for SU(2) X U(1) electroweak symmetry. This improvement of both effective potential functions is seen to reduce residual dependence on the renormalization mass scale. For scalar-field electrodynamics, such a summation of leading logarithm contributions leads to upper bounds on the magnitudes of both gauge and scalar field coupling constants, and suggests the possibility of an additional phase of spontaneous symmetry breaking characterized by a scalar-field mass comparable to that of the theory's single gauge boson. For electroweak theory, the all-orders summation of leading logarithm terms involving the dominant three couplings contributing to radiative corrections (the quartic scalar-field coupling, the t-quark Yukawa coupling, and the QCD gauge coupling) is suggestive of a potential characterized by a more manageable quartic scalar-field coupling, as well as a realistic Higgs boson mass.

WE-A4-4 **11h45**

Quantum vs. Quasi-Classical Decay Times. **M.R.A. Shegelski**, *University of Northern B.C.* — We compare fully quantum mechanical decay times with quasi-classical decay times. We use an initially localized state. The quasi-classical time is often used when the required conditions are not met. The quantum time differs from the quasi-classical time not only quantitatively, but qualitatively as well. We compare for cases of piece-wise potentials and for smooth potential barriers.

WE-A4-5 **12h00**

The Riemann Zeta Function Zeros and the Prime Number Sequence. Rajat K. Bhaduri, **Jamal Sakhr,** Brandon P. van Zyl, *McMaster University* — The spectral density of a quantum system can be related to the underlying classical dynamics through so-called trace formulas which are sinusoidal sums over periodic orbits. This paper is motivated by the question: Is there a trace formula for the prime number sequence ? If so, then this would give support to the notion that there exists a Hamiltonian system whose quantum spectrum is the primes. It would also mean that there is a formula that can generate the primes. Riemann gave an exact formula for the density of the primes that can be expressed as the sum of a smooth function and an infinite series of oscillatory terms involving the complex zeros of the zeta function. The smooth part has been well-studied in the context of the prime number theorem whereas the oscillatory part has been largely ignored. Interestingly, it is the latter that contains the essential information about the location of the primes. This oscillatory contribution at first sight resembles the generic form of a trace formula, but closer inspection reveals that it is not. Nevertheless, we show that the truncated Riemann formula produces sharp spectral lines at the primes. This is remarkable since it is well-known that the statistical properties of the zeros are described by the chaotic distributions of random matrix theory whereas the primes possess Poissonian-like behaviour. This illustrates how a chaotic sequence can interfere to produce a highly regular sequence.

WE-A4-6 **12h15**

Building Lattice Random-Walk Models for Drift and Diffusion Problems. **Gary W. Slater** and Michel G. Gauthier, *Université d'Ottawa* — Lattice random-walk models are one of the workhorses of modern statistical mechanics. For instance, it is quite easy to use such models with Monte Carlo simulations to study a wide variety of problems in the Natural Sciences. In a recent series of papers, we have shown how one can actually solve the Monte Carlo algorithm to compute the exact drift velocity of a particle, even in the presence of fixed lattice obstacles. However, it is not possible to then compute the diffusion coefficient of the drifting particle, not even with computer simulations. We examine why these models fail and we present a general model that can be used to compute exact free-solution diffusion coefficients and drift velocities using lattice Monte Carlo algorithms. We focus on the importance of using the fluctuations of the jumping time to get the proper diffusivity and how this can be done by adding a probability to remain on the same lattice site. We also show how to extend these concepts from one to many dimensions. Our objective is to derive random-walk models that can be used with external fields of arbitrary magnitude.

12h30 **Session Ends / Fin de la session**

[WE-A5] 10h00 Special ITER Session / *Session ITER spéciale*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE AV-B ***Chair: C. Boucher, U. Québec***

WE-A5-1 **10h00**

M. STEWART

To be announced / à venir

WE-A5-2 **10h45**

JAMES P. GUNN, CEA Cadarache, France

The Tunnel Probe : A DC Probe Diagnostic for Electron Temperature Measurements in Magnetized Plasmas

The tunnel probe (TP) is a new kind of Langmuir probe (LP) for use in the tokamak scrape-off layer. It provides simultaneous dc measurements of electron temperature and parallel ion current density at the same point in space, and is therefore ideal for making fluctuation measurements without the expensive electronics that are needed to perform fast sweeping of classical LPs. It consists of a hollow conducting tunnel a few millimetres in diameter and typically 5 mm deep that is closed at one end by an electrically isolated conducting back plate. Both conductors are biased negatively to collect ions and repel electrons. The tunnel axis is parallel to the magnetic field. Plasma flows into the open orifice and the ion flux is distributed between the tunnel and the back plate. The ratio of the two ion currents is determined by the magnetic sheath thickness at the concave surface of the tunnel, and is therefore a strong function of temperature. A self-consistent, two-dimensional kinetic code is used to determine the theoretical relation between the current ratio and the electron temperature. Combined with the measured sum of the two currents, the density at the sheath entrance can also be estimated. The physical phenomena governing the TP are fundamentally different than for a classical LP. The applied voltage on the LP is swept in order to measure a restricted part of the electron distribution function. The TP, on the other hand, is biased to a fixed negative potential to repel all electrons. The temperature of the electrons is measured even though none are collected. The two methods were compared during a radial scan of the TP in the edge plasma of the CASTOR tokamak. The voltage of all conductors was swept from -200 V to floating potential. The I-V characteristics were analyzed to give standard LP measurements, and the ion saturation branch was used for TP current ratio analysis. We thus obtain simultaneous, independent measurements of electron temperature at the same point in space. It is systematically observed that the TP evaluation of temperature is 2-3 times lower than the LP Possible reasons for this are investigated.

11h15 **Coffee Break / Pause café**

WE-A5-3 **11h30**

W. FUNDAMENSKI, Euratom/UKAEA Fusion Association

Energy Transport in Tokamak Boundary Plasmas: Laminar or Turbulent?

The radial extent of a magnetised boundary plasma, or scrape-off layer (SOL), is determined by competition between transport processes parallel (||) and perpendicular ($\perp$) to the magnetic field B. Whereas most aspects of || transport are well understood, $\perp$ transport is generally anomalous, determined largely by turbulent processes, a situation common to many areas of plasma physics. In nuclear fusion devices, the radial extent of the SOL determines the peak heat flux on the divertor tiles which poses a key constraint on the design and successful operation of next-step tokamaks, such as ITER. In order to improve our predictive capability, physical understanding of the underlying $\perp$ transport mechanisms is essential, especially in the reference regime of ITER, the so called ELMy H-mode. With this aim, a series of experiments were recently carried out on JET in which power deposition widths on the divertor plates λ_{-} were measured in 22 discharges, including scans in toroidal field B_t, the magnetic safety factor $q_{\sim 5} \sim aB_t/RB_\theta$, neutral beam power P_{NB}, line average density $\langle n_e \rangle$ and ion mass and charge (D^+ vs. He^{++}). The above measurements were compared with predictions of two dozen candidate theories of perpendicular energy transport, using both a simplified model of the scrape-off layer (SOL) and a fluid/Monte-Carlo code (EDGE2D/NIMBUS). The results of the comparison indicate a strong reduction/suppression of ion turbulence in the SOL during the inter-ELM phase. Radial energy transport in the SOL during H-mode appears to be dominated by classical ion conduction (**CIC**) for moderately collisional conditions ($\nu^*_i > 3$), and by direct ion orbit loss (**IOL**) for $\nu^*_i < 1$. A transitional collisionality estimate of the power width, $\lambda_{-}^{CIC} = C\xi x \lambda_{-}^{IOL} + (1-\xi)\lambda_{-}^{CIC}$, $\xi = \nu^* / (1+\nu^*)$ provides an excellent fit to the JET data with $C \sim 2.4$. Extrapolating the above expression to ITER predicts an outer target power width of 3±0.5 mm (in outer mid-plane co-ordinates) at the entrance into the divertor volume (cf. 5 mm design value).

WE-A5-4 **12h00**

JORDAN MORELLI, University of Saskatchewan

Plasma Position Control in the STOR-M Tokamak Using A Fuzzy Logic Approach

Fuzzy logic based controllers are known for their ability to provide reliably a high quality of control over systems for which no analytical model exists, or for which the system is highly nonlinear. The plasma column within a tokamak is such a system. In fact, obtaining adequate control over most of the parameters of a tokamak discharge is extremely difficult and requires a great deal of effort. Traditionally, the controller design requires considerable system modeling and simulation before the controller can be built, and due to the inadequacies of the models, the controller that is implemented requires considerable empirical fine-tuning. Clearly a more efficient process is desirable, and fuzzy controllers offer a viable solution. A fuzzy controller developed for use on the STOR-M tokamak for the purpose of stably maintaining the position of the plasma column within the discharge chamber is presented. This controller is capable of constraining the plasma column within STOR-M to an average deviation of ±0.8 mm from the equilibrium position during normal mode operation. The success of this fuzzy controller on STOR-M suggests that fuzzy controllers are suitable for use on other tokamaks, and may improve the efficiency with which future plasma parameter controller are developed.

* This research was supported by NSERC.

12h30 **Session Ends / Fin de la session**

[WE-A6] 10h00 Computational Biophysics / *Biophysique computationnelle*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE CS-104 ***Chair: J. Poison, UPEI***

WE-A6-1 **10h00**

JEFF Z.Y. CHEN, University of Waterloo

Understanding Protein Folding from Polymer Models

The current understanding of the characteristics of protein folding is widely based on statistical-physics models of polymers that capture the essential interactions in real protein systems. The reduction of the degree of freedoms of the involved coordinates in such a model, in comparison with the all-atom modelling approach, allows for accumulation of adequate statistics in computer simulations. This type of models has been successfully used to explore the underlying physical mechanism of structural formation, folding dynamics and protein-protein interaction. We have recently presented a unified potential-energy model that successfully reproduces the hydrogen bonding effect and hydrophobicity in proteins and can be used to represent well-defined secondary structures, both a-helices and b-sheets. The model provides structural insight into the physical mechanism of such problems as structural conversion due to mutation and double native conformations with different a-helix and b-sheet contents in a prion protein

[WE-Plen-3] 13h30 Plenary Session / *Session plénière* — WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE DS-121 ***Chair: Y. Tsui, U. Alberta***

WE-PLEN-3 **13h30**

JEAN-CLAUDE KIEFFER, INRS Université du Québec

The Advanced Laser Light Source (ALLS) International Facility

The Canadian community is establishing at INRS in Varennes, near Montreal, a Canadian based International Research Facility that will explore a completely new approach to dynamic investigation of matter. The facility, called the Advanced Laser Light Source (ALLS), will be a central facility open to users from Universities, Governmental laboratories and Industries. It will enable the combination of all of the most advanced laser technologies for exploiting light-matter interactions. The overview will give some idea of the breadth and impact that the ALLS facility will have on many fronts and over a broad range of disciplines. I will also discussed the most important and distinctive areas that would immediately benefit on a short term from a light source with extremely short pulse durations, broad tunability, and high intensity.

[WE-P1] 14h15 Materials Science II / *Science des matériaux II* — WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE MN-40 ***Chair: M. Schlesinger, U. Windsor***

WE-P1-1 **14h15**

Scanning Calorimetry Measurements of the Glass Transition in Vitreous Silica*. **R. Bruening**, *Mount Allison University* — The properties of vitreous silica for photonic materials and optical communication fibers can be improved by controlling structural relaxation [1]. Scanning calorimetry is a commonly used technique to characterize the glass transition and relaxation of glasses, yet no scanning calorimetry data have been published for vitreous silica, and it is thought that the glass transition temperature of silica glass cannot be determined by this method[1]. The best prior results, obtained with drop calorimetry, indicate a glass transition near 1480 K with an increase of the specific heat by 8 J/mol-K [2]. A glass with 120 wt. ppm hydroxyl groups was measured with differential thermal analysis. The onset of the glass transition is near 1260 K. The sample reaches the supercooled liquid state near 1470 K, and the step in the specific heat of 2.9 J/mol-K. All glasses exhibit an increased endothermic peak at the glass transition after annealing. In vitreous silica, an additional exothermic peak occurs for a narrow range of annealing temperatures. The exothermic peak is attributed to the diffusion of hydroxyl groups during annealing, which enables relaxation processes which require slightly higher temperatures. This picture agrees with data based on infrared spectroscopy [3].

* Work supported by NSERC.
1. K. Saito and A. J. Ikushima, *Appl. Phys. Lett.* **70** (1997) 3504.
2. P. Richet *et al. Geochim. Cosmochim. Acta* **46** (1982) 2639.
3. M. Tomozawa, Silicon-Based Materials and Devices, Academic Press, NY, 2001, Ch. 3.

WE-P1-2 **14h30**

μ^SSR with Nonzero-Spin Nuclei. **J.H. Brewer**, *University of British Columbia* — Applications of μ^+SR to materials science are legion, but the uses of μ^SSR are relatively rare, due to the formation of *muonic atoms* in which the μ^S orbits a positive nucleus roughly 200 times closer than a 1s electron. One result is *giant hyperfine interactions*: Most nuclei have spins of their own, which couple so strongly to the muon's spin that the two are "locked" into net F states which precess at their own characteristic Larmor frequencies different from that of the free muon. Thus μ^SSR as a condensed matter probe has so far been restricted to materials with *spinless* nuclei, primarily $^{16}O\,\mu^S$ in oxides. I will show some new TF-μ^SSR spectra from $^{19}F\mu^S$, $^{14}N\mu^S$ and $^{23}Na\mu^S$ in *chemical compounds*, where the F^+ frequency is easily separated from that of the uncoupled μ^S. An anomalously fast $^{14}N\mu^S$ spin relaxation is seen in melamine ($C_3H_6N_6$). These examples show that a number of nuclei with *spin* produce μ^SSR signals of sufficient strength to be used as magnetic probes of materials, but that the "Coulomb explosion" caused by the muon's initial capture leaves behind paramagnetic species that may confound the interpretation of such results until their nature is better understood.

WE-P1-3 **14h45**

Optimizing Crystallization in RF-Sputtered YBCO Thin Films*. **Martin Bourgeois**, *Université Laval* — It has been shown in the last decade that YBCO, a material mostly known for its outstanding superconducting properties, can also be used as a radiation detector. Although amorphous films may be of interest for this application, it is believed that crystalline films are preferable. In this work, we attempt to optimize YBCO film crystallization by annealing RF-sputtered films. As various film deposition and annealing conditions are experimented with, atomic force microscopy, scanning electron microscopy, and x-ray diffraction are used to evaluate film morphology and quality. Spectrophotometry and ellipsometry are also used to obtain optical characteristics.

* This work is possible thanks to NSERC: CG0589, CG66857, CG70568, CG64167 and to FQNRT: FR051731, FT073270.

WE-P1-4 **15h00**

Effect of Electric Charge Accumulation on Insulators During Low Energy Ion Implantation. **G.G. Ross**, C. Sévigny, and M. Yedji, *INRS ÉMT.* — Ionic bombardment of insulators induces accumulation of electric charges at and under the insulator surfaces. In recent papers [1,2], we showed that the charge accumulation modifies both the depth distribution of deuterium implanted at low energy (~1 keV) in a thick (1mm) polystyrene sample, and the charge fractions of hydrogen scattered from insulators. However, when the insulator (polymer) is spin coated onto a silicon substrate, no modification was observed because the electric charges can migrate out the implanted zone. Our aim in this paper is to better understand the experimental conditions leading to charge accumulation and its effect on both the ion surface interaction and the modification of the surface properties. Coupons of insulators (polystyrene, polymethylmethacrylate, polycarbonate, polyethylene) with different thicknesses and dimensions (relative to the irradiation area) have been irradiated with low energy (0.6 to 1.5 keV) deuterium ions. Depth profile of implanted deuterium have been obtained by means of the ERD ExB technique and compared to Monte Carlo simulation. The ion leak current has been recorded during the implantation and related to the sample dimension (thickness and area)and to the accumulated implanted dose. The wetting properties of surfaces irradiated with atoms and ions have been compared. As expected, results show that the charge accumulation strongly influences the depth profile of implanted ions. Also, the irradiation increases the conductivity of the surface. When the sample is thin (~ 500 nm) or the distance of the irradiated zone and the sample edge is relatively small, the charge can migrate efficiently out the surface and then no charge accumulation is observed. Finally, the wetting modification as well as the molecular composition of the surface after an irradiation by atoms is different from the one induced by ions. The trend varies according to the atom/ion dose and the nature of the material.

1. G.G. Ross, G. Granger, M. Gauthier, *Nucl. Instrum. Meth.* **B** 164165 (2000)324.
2. G.G. Ross and M. Gauthier, *Nucl. Instrum. Meth.*, **B** 193/14(2002) 449.

15h15 **Coffee Break / Pause café**

WE-P1-5 **15h45**

Effect of Polarization Charges and Trapping Centers on Electron Transport Properties of $Al_xGa_{1-x}N$/GaN HFETs. **Hadi Arabshahi**, *Tarbiat Moallem University*, Sabzevar, Iran — Results are presented from self-consistent Monte Carlo simulations of $Al_{0.2}Ga_{0.8}N$/GaN HFETs considering the strain-induced piezoelectric polarization fields. The simulations were performed in order to investigate the effects of electron accumulations in the channel region which occur in wurtzite phase $Al_xGa_{1-x}N$/GaN heterojunction FETs. The band structure of wurtzite GaN is modeled with five conduction band valleys, with masses and non-parabolicity factors estimated from pseudopotentional band structure. The Monte Carlo simulations includes impurity scattering and all of the standard phonon scattering processes. It also allows for alloy scattering and piezoelectric scattering. The channel in the simulated device is formed in response to the piezoelectric charge at the $Al_{0.2}Ga_{0.8}N$/GaN interface. This charge is modeled as a sheet of ionized donors placed at the interface, and the concentration is chosen as 2×10^{17} em^{-2} to obtain approximate agreement with the measured pinch-off voltage. The influence of trap centers on electron transport characterization are also explored. It is assumed that trap centers present only in the buffer layer at a density of 10^{23} cm^{-3}. Simulated I-V characteristics for the polarization device leads to an enhancement of the drain saturation current compared to polarization-free device. The polarization effect is shown to not only increase the current density but also the average electron velocity as a result of concentrating the transport closer to the GaN-AlGaN interface and away from the buffer layer.

WE-P1-6 **16h00**

Comparison of Electrodeposited Copper-zinc Alloys Prepared Individually and Combinatorially. **S.D. Beattie** and J.R. Dahn, *Dalhousie University* — Combinatorial methods provide a new paradigm for advancing scientific discovery. Thousands of similar, but unique, materials can be created in a single experiment and then tested for desired properties. These methods have captured the attention of the materials industry with the promise of providing new discoveries "faster, better and cheaper". Typical methods for creating these "libraries" of materials are complex, expensive and slow. Electrodeposition, however, is simple, inexpensive and fast. I will describe a simple method for creating a composition-spread library of Copper-Zinc alloys, where composition varies as a function of position, via electrodeposition. As a comparison, seven Copper-Zinc alloys with different compositions were prepared, in bulk, by one-at-a-time-electrodeposition methods. The composition and structure of alloys prepared by both methods is studied. It will be shown that the structure and composition of Copper-Zinc alloys prepared using combinatorial methods via electrodeposition are representative of bulk alloys prepared by one-at-a-time-methods. Therefore, combinatorial methods via electrodeposition embodies, and even extends, the advantages of combinatorial methods: "faster, better, cheaper, simpler and scalable".

WE-P1-7 **16h15**

Structure and Composition of $Gd_{1-x}Co_x$ and $Gd_{1-x}Fe_x$ Thin Films Produced by Combinatorial Sputtering. **Tim Hatchard**, Mike Scheinfein and Jeff Dahn, *Dalhousie University* — A combinatorial sputtering method has been applied to the Gd-Co and Gd-Fe binary systems. The complete binary system form $0 < x < 1$ in $Gd_{1-x}M_x$ (M = Co, Fe) can be produced in a single sputtering run. A quick overview of the production method will be presented. Composition of the films is determined with electronmicroprobe and structure is determined with x-ray diffraction. These results will also be shown. If time permits, a brief discussion of magnetic properties may also be included.

16h30 **Sesison Ends / Fin de la session**

[WE-P2] 14h15 Overview of Instrumentation and Measurement Research in North America II / *Survol de la recherche en instrumentation et mesures en Amérique du Nord II*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE KM-237 ***Chair: A. Mandelis, U. Toronto***

WE-P2-1 **14h15**

KIRAN GANGAVARAPU, University of Pennsylvania

Recent Developments in Photon Migration

The field of photon migration spectroscopy and imaging started in its theoretical and experimental phase in 1989 with the use of time domain spectroscopy and later imaging. The explanation for the empirical results of Jobsis on human brain showed that the scattering factor of the skin and the skull were such that NIR propagation through them and into the brain cortex was readily detectable as a diffusion signal several centimeters from the point of entry on the human head. Application of the diffusion equation and simplifications thereof showed that the terminal slope of the photon kinetics through brain, muscle and breast gave the absorption coefficient for the passage through hemoglobin containing blood vessels. At the same time, contemporaneous development of frequency domain equipment, conventional heterodyne or homodyne using IQ circuitry were developed in this laboratory. The great advantage of time and frequency domain system is that they readily deconvolute scattering from absorption in systems where the scattering factor μ_s' approximately 10 cm^{-1} is very much larger than the absorption factor μ_a approximately 0.04 cm^{-1}. Thus time and frequency domain systems conveniently separate these two quantities. Nevertheless where scattering factor is not needed, the low frequency "CW" systems come to the fore in simplicity and economy.

The most completely studied system is muscle exercise in elite athletes, for example Olympic aspirants where exercise leads to nearly complete deoxygenation of myoglobin and hemoglobin (both are measured) and the recovery time therefrom is a measure of the muscle mitochondria's capability to use oxygen and generate ATP This technology in its imaging form is used currently at the Olympic center at Colorado Springs. Breast cancer detection depends upon the significant increase of blood in the tumor region readily measured at 805 nanometers and a decrease in its oxygenation state due to highly active tumor metabolism. Both time and frequency domain are also used, particularly coregistering NIR images with NMR in-magnet. The most rapidly developing feature of NIR imaging is the prefrontal region of the human brain, a difficult region for MRI due to the large effect of the eye sockets, but convenient for NIR imaging where cognitive function in problem solving, as stressed by learning difficulties, by emotional stress and by the stresses of malevolence and deceit. Here low frequency CW measurements have come to the fore and afford possibilities for autonomous telemetered "cognosensors" the size of a postage stamp, adhesived to the forehead and of interest to the military mind. However, interest in applying our early measurements of light scattering in electric tissues (1964) suggest that neuronal activation in human brain tissue may follow a similar pattern and has stimulated activity in a number of laboratories. The whole field is in a very rapid state of development and in many ways comparable to the flurry of activity in NMR spectroscopy and imaging of the '87s.

15h00 **Coffee Break / Pause café**

WE-P2-2 **15h30**

FELICIANO SANCHEZ SINENCIO, Centro de Investigación y Estudios Avanzados (CINESTAV), Mexico

Biomaterials Research Activities in CINVESTAV

During more than 30 years the Solid State Group at the Center of Research and Advanced Studies (CINVESTAV) has been working mainly on bulk and thin films of semiconductors, insulators and metals. More recently this Group started to work on the broad field of Biomaterials. In this talk, we will show results on several areas:

1) Phase transitions of starch, in flour used to elaborate Mexican tortillas, were studied using an adiabatic scanning calorimeter and the photopyroelectric technique. In addition, calcium salts of carboxylic acids were analized by x-ray diffraction using synchrotron radiation.
2) Mice skin and blood were studied using photoacoustic spectroscopy. A kinetic study of aminolevulinic acid induced porphyrins has been carried out in mice skin and blood. Porphyrins are among the most efficient photosensitisers used in Photodynamic Therapy for the treatment of neoplastic disorders.
3) Biopolymers. Water vapor permeability in biodegradable films was studied using a special photothermal arrangement.
4) Biochips construction and operation. High density microarrays of oligonucleotides have been used for the study of cancer due to papillomavirus
5) Atmospheric pollution profiles in Mexico City. A CO_2 laser based photoacoustic spectrometer was used to monitor on-line the atmospheric content of ethylene. Peak concentrations of about 70 ppb were detected at 8:00 a.m., showing that this profile follows the daily automobile traffic intensity.

16h30 **Session Ends / Fin de la session**

[WE-P3] 14h15 Symmetries in Nuclear Physics / *Symétries en physique nucléaire*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE AV-D ***Chair: J. Svenne, U. Manitoba***

WE-P3-1 **14h15**

IAN S. TOWNER, Queen's University

Superallowed Beta Decay: the Determination of Vud

The value of the Vud matrix element of the CKM matrix can be derived from nuclear superallowed beta decays, neutron decay, and pion beta decay. Today, the most precise value comes from nuclear decays; however the precision is limited not by experimental error but by the estimated uncertainty in theoretical corrections. The value of Vud so obtained, when combined with the Particle Data Group's recommended values for Vus and Vub, leads to a result that differs at the 98% confidence level from the unitarity condition for the CKM matrix. I will discuss the calculated corrections that have been applied to the data, which lead to this provocative result, and comment on the prospects for the future.

WE-P3-2 **14h45**

WILLEM T.H. VAN OERS, University of Manitoba

QWeak: A Search for New Physics

New precision measurement of parity violation electron scattering from the proton at very low Q^2 and forward angles is being prepared for execution at Jefferson Laboratory. The experiment is a direct challenge to the predictions of the Standard Model of quarks and leptons and is a search for new physics. There exists a unique opportunity to carry out the first precision measurement of the weak charge of the proton, $= 1 - 4\sin^2\theta_W$, by building on technical advances that have been made at Jefferson Laboratory's world-leading parity violating electron scattering program and by using the results of earlier experiments to constrain hadronic corrections. A 2200 hour measurement of the parity violating asymmetry in elastic electron-proton scattering at $Q^2 = 0.03$ (GeV/c)^2 employing 180 μA of 80% polarized beam on a 0.35 m long liquid hydrogen target will determine the proton's weak charge with 4% combined statistical and systematic errors. The Standard Model makes a firm prediction of , based on the 'running' of the weak mixing angle $\sin^2(\theta_W)$ from the Z^0 pole down to lower energies, corresponding to a 9σ effect at the envisaged experiment. Any significant deviation of $\sin^2(\theta_W)$ from the Standard Model prediction at low Q^2 would be a signal of new physics, whereas agreement would place new and strict constraints on possible Standard Model extensions. In the absence of new physics the envisaged experiment will provide a 0.3% determination of $\sin^2(\theta_W)$.

WE-P3-3 **15h15**

Non-Locality Effects in the Photo-Production of Eta Mesons on Nuclei*. M. Hedayati-Poor[a], **H.S. Sherif**[b], [a]On leave from Arak University, Iran and [b]*University of Alberta* — We discuss further developments in the relativistic model for the photo-production of eta mesons on nuclei. The model is based on the use of an effective Lagrangian for the elementary production process on a free nucleon. This is combined with a relativistic mean field approach to nuclear dynamics to provide a description of the photo-production process on complex nuclei. In our earlier calculations we used a local approximation with free propagators to obtain a simpler version of the production amplitude. In the present work we perform more exact calculations, which do not invoke these approximations, for the case of quasifree photo-production proceeding through the dominant S11 resonance. We include non-locality effects as well as allow for the resonance to interact with the nuclear medium. These effects are assessed in a model that includes the Dirac mean fields in the propagator. We also look at possible effects due to changes in the resonance width in the medium. We discuss a calculational technique that simplifies the complicated integrals associated with the absence of the approximations mentioned above. The effects of the final state interactions of the outgoing nucleon and eta meson are also discussed

* Work supported in part by NSERC.

15h30 **Coffee Break / Pause café**

WE-P3-4 **16h00**

SHELLEY A. PAGE, University of Manitoba

Measurement of the Parity-Violating Asymmetry in Radiative Neutron-Proton Capture

The NPDGamma experiment[a] at the Los Alamos Neutron Science Centre (LANSCE) will measure the parity-violating gamma ray asymmetry A_γ in the reaction $n + p \rightarrow d + \gamma$. This new measurement of A_γ will be almost two orders of magnitude more precise than previous attempts using reactor beams, and will constitute the first measurement in the *np* system of sufficient accuracy to challenge modern theories of nuclear parity violation, providing a theoretically clean determination of the weak pion-nucleon coupling. A new high intensity beamline at LANSCE will deliver pulsed cold neutrons to the apparatus, where they will be polarized by transmission through a large volume polarized ^{3}He spin filter and captured in a liquid para-hydrogen target. The 2.2 MeV gamma rays from the capture reaction will be detected in an array of CsI(Tl) scintillators read out by vacuum photodiodes operated in current mode. The pulsed nature of the beam provides a crucial capability to distinguish systematic error contributions through their unique time-of-flight dependences. The apparatus will be installed and commissioned during the summer of 2003; one full calendar year of data taking is planned for 2004-2006.

[a] Supported by the US DOE, NSF, TRIUMF and NSERC, Canada

WE-P3-5 **16h30**

ALLENA K. OPPER, Ohio University

Measuring Charge Symmetry Breaking in $n+p \rightarrow d\pi^0$

Charge symmetry breaking (CSB) in the nucleon-nucleon system offers one of the most stringent tests of our understanding of physics, be it at the level of meson exchange or the underlying quark degrees of freedom. Indeed, charge symmetry is conserved if one ignores electromagnetic corrections and the mass difference between *up* and *down* quarks; that mass difference is not determined by chiral symmetry and experimental data from pion-nucleon scattering do not constrain it. A precision measurement of CSB, which was carried out at TRIUMF and complements elastic neutron-proton scattering experiments at both IUCF and TRIUMF, may help constrain the *up* and *down* quark mass difference and lead to a richer understanding of the quark effects in the *NN* system. The observable of interest is the forward-backward asymmetry (A_{fb}) in $np \rightarrow d\pi^0$, which must be zero in the center-of-mass system if charge symmetry is conserved. A_{fb} has a predicted value that ranges between (35 → +70) x 10^{-4} with the dominant contributions being an order of magnitude larger than those of the elastic scattering CSB measurements

The experiment was carried out with a 279.5 MeV neutron beam, a liquid-hydrogen target, and the SASP spectrometer positioned at 0 . With these kinematics and the large acceptance of SASP, the full deuteron distribution was detected in one setting of the spectrometer, thereby eliminating many systematic uncertainties. The data have the accumulated effects of multiple scattering, energy loss, and other physical processes that make extracting A_{fb} directly from the locus impossible. As such, Monte Carlo techniques were used to extract the angle-integrated A_{fb}. Like other measurements of "fundamental symmetries" this is a highly intriguing experiment in that the physics being investigated is of high interest and the experiment itself is challenging. The experimental challenges and results will be discussed.

17h00 **Session Ends / Fin de la session**

[WE-P4] 14h15 ITER-Fusion Session / *Session ITER-Fusion*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE AV-B ***Chair: C. Boucher, U. Québec***

WE-P4-1 **14h15**

FABRICE ALLAIS, INRS-Université du Québec

Atomic Physics Rates and Non-Local Electron Parallel Heat Transport in Divertor Plasmas

In divertor plasmas, it is well known that the parallel electron temperature gradient is so steep that the electron distribution function becomes non-Maxwellian. As a consequence classical heat transport formulas are no longer valid. The study of non classical heat flow and non Maxwellian effects is made possible by using our electron kinetic code **FPI**, which has recently been upgraded by adding a full atomic module for atomic hydrogen. We study the corrections to be implemented in the fluid code UEDGE which models divertor plasmas in detail using classical transport formulas. Results are presented for the parallel heat transport coefficients for the electrons and also for the atomic effective ionization and recombination rates. Future work and improvements will be discussed.

WE-P4-2 **14h45**

DAZHI LIU, University of Saskatchewan

Development of Curved Drift Tube for Vertical Compact Torus Injection into STOR-M Tokamak

Compact torus (CT) injection is a viable technique being developed to fuel large sized fusion reactors. CT injection has so far been conducted with horizontal injection which is subject to a decelerating force due to the gradient of tokamak toroidal magnetic field. Vertical injection eliminates the force and the more penetration of CT is expected. It is of great importance to understand the interaction between vertically injected CT and target plasma. The CT injection experiment has been performed on STOR-M tokamak by using a USCTI. To perform vertical CT injection, we have developed a curved drift tube (inner radius: 50 mm; curvature radius: 160 mm) to bend a trajectory of transported CT. The behaviour of the injected CT, which is investigated with magnetic probe, Langmuir probe and Hα radiation measurement, will be presented.

* Supported by NSERC

WE-P4-3 **15h15**

Finite Element Modeling of the HT-7U SOL. **R. Marchand** and Y.P Chen, *University of Alberta* — We present results from two dimensional simulations of the SOL region in the HT-7U tokamak. This tokamak is presently under construction at the Hefei Institute of Plasma Physics in China. HT-7U is superconducting divertor tokamak designed to study advanced fusion concepts. It is scheduled to first operate in a double null configuration and, later, in a single null configuration. Its commissioning and the creation of the first plasma are expected to take place in the year 2004. In our model, the transport equations for hydrogen and impurity plasmas are discretized in two dimensions using finite elements on an unstructured triangular mesh. The strong transport anisotropy that characterizes the magnetized plasma in the SOL requires that the mesh, while unstructured, be strictly aligned along the magnetic flux surfaces. In our simulations, we consider a number of double null equilibria, and study the effect of slight disconnections in the two X points. That is, we consider the effect on particle and power imbalances in the upper and lower divertors, associated with the two X points not being on exactly the same magnetic flux surface.

15h30 **Coffee Break / Pause café**

WE-P4-4 **15h45**

IGOR KAGANOVICH, Princeton University

*Analytical and Numerical Studies of Ion Beam Plasma Interactions for Heavy Ion Driven Inertial Fusion**

Heavy ion beams are envisioned as one of the principal drivers for inertial confinement fusion. In heavy ion fusion design concepts, the ion beams are focussed onto an indirect-drive target, to produce x-ray radiation, which compresses the deuterium-tritium pellet and initiates the fusion process. The space-charge potential of a typical beam with parameters at the chamber entrance corresponding to about 4kA current, 10ns pulse duration, and about 0.2c directed beam velocity, where c is the speed of light, is few megavolts. Such high space-charge potentials inhibit beam focusing, and therefore ballistic focusing relies on various neutralization schemes to reduce the space-charge potential to acceptable levels. Comprehensive analytical, numerical and experimental studies are underway to investigate the influence of charge and current neutralization on the focusing of the ion beam. A suite of particle-in-cell codes has been developed for calculating the degree of charge and current neutralization of the ion beam pulse by the background plasma An analytical theory has been developed using the assumption of long charge bunches and conservation of generalized vorticity. The analytical results agree well with the results of the numerical simulations. The visualization of the data obtained in the numerical simulations shows complex collective phenomena during beam entry into and exit from the plasma.

* Research supported by the U. S. Department of Energy

WE-P4-5 **16h15**

Non-Local Analysis of Ion Acoustic Instability With Sheared Parallel Flow. **A.** Ito and A. Hirose, *University of Saskatchewan* — Current driven ion acoustic modes appear to play important roles in numerous plasma environments. Recently, a local analysis[1] has shown that the threshold current for the instability is lower than the ion-cyclotron branch and insensitive to the ion-electron temperature ratio if a sheared parallel plasma flow exists. In this paper, results of non local analysis of the global instability of IA mode in the presence of non-uniform shear flow will be presented. The non local behavior of the mode is examined by taking the width of shear layer L as a control parameter. The eigenfunction tends to be unlocalized for smaller L. For larger L, the eigenfunction shifts away from the center of the shear layer. In both cases, the instability tends to be stabilized suggesting an optimum shear profile for the instability.

1. V.V. Gavrishchaka *et. al.*, *Phys. Rev. Lett.* **80**, 728 (1998).

16h30 **Session Ends / Fin de la session**

[WE-P5] 14h15 Theory II / *Théorie II*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE AV-C ***Chair: M. Shegelski, UNBC***

WE-P5-1 **14h15**

MOHAMED AZZOUZ, Laurentian University

Rotating Antiferromagnetism and The Pseudogap Phase of Copper-Oxide Superconductors

In this talk, the phenomenon of rotating magnetism will be explained. Then the emphasis will be put on the case of rotating antiferromagnetism that is proposed to describe the puzzling properties of the pseudogap state in high-temperature superconductors. I will discuss some of the consequences of the rotating antiferromagnetic state on the thermodynamic quantities as well as on zero temperature superconducting properties.

WE-P5-2 **14h45**

The Trajectories of a Golf Ball that is Experiencing Nonlinear Lift and Drag. **G.C. McGuire**. *UCFV* — A computer algebra system (CAS), Maple 8, will be used to model the flight of a golf ball that is experiencing nonlinear drag and lift. Although many physics texts discuss drag forces, not many discuss lift forces. For a golf ball, the lift drag force is very important because it can significantly increase the ball's range and the time it is in the air. In an effort to help visualize the golf ball's various trajectories, animated three dimensional plots of the motion will be shown. The validity of the model is demonstrated by comparing its predictions with known values. A number of novel trajectories are examined. What is the trajectory of a spinning golf ball that is fired vertically? What is the launch angle that gives the maximum range? What is the maximum flight time of a golf ball?

15h00 **Coffee Break / Pause café**

WE-P5-3 **15h30**

A Model and a Demonstration of the Strange Effects Produced by the Nonlinear Eardrum. **G.C. McGuire**, *UCFV* — This is a discussion of how the nonlinear loading of an eardrum creates and lets humans hear frequencies that are not present in the incident sound waves. A mathematical model for the eardrum's behaviour is discussed and its resulting nonlinear equation is solved using a computer algebra system. A fast Fourier transform will be used to show that the solution does contain the predicted extra frequencies. A simple nonlinear electrical circuit is then used to demonstrate the validity of the model. As the circuit is switched from its linear to nonlinear mode, the audience will be able to hear the extra frequencies in the nonlinear output.

WE-P5-4 **15h45**

PIERGIULIO TEMPESTA, CRM, Université de Montréal

Symmetry Preserving Discretization of Quantum Systems

A general formulation is proposed of the theory of Lie symmetries of linear difference equations in the context of the so called Umbral Calculus. It is shown how this approach can be used in order to discredit the Schroedinger equation preserving its symmetry and integrability properties.

WE-P5-5 **16h15**

Ultrasound Propogation in a Thin Anisotropic Layer Between Two Media: Theory, Computer Model, and Experiment. **Jeff Sadler**, Brian O'Neil, Fedar Severin and Roman Gr. Maev, *University of Windsor* — Computer simulation model of the propation of an acoustic wave across an anisotropic and or nonlinear thin interface layer (thickness << wavelength). The model is based upon an approach where one uses a set of boundary conditions for the interface to develop solutions to the problem. Experimental work is done by sandwitching specialized thin anisotropic layers between two half spaces. Acoustic signals reflected and refracted from this layer can be analysed and compared with the theoretical model.

WE-P5-6 **16h30**

Interacting Chain Model for Poly(ethylene glycol) from First Principles — Stretching of a Single Molecule using the Transfer Matrix Approach. L. **Livadaru**[a], R.R. Netz[b,c] and H.J. Kreuzer[a], [a]*Dalhousie University*, [b]Max-Planck-Institute for Colloids and Interfaces, Germany and [c]Sektion Physik, Ludwig-Maximilians-Universitat, Germany — Based on ab initio quantum mechanical calculations on short segments (up to four subunits) of poly(ethylene glycol), we construct n-state interacting chain models with n=3 or 7 with nearest neighbor interactions that also account fully for the geometrical structure of the molecule (bond lengths, bond and dihedral angles). For chains up to N=21 subunits we construct, in the 3-state model, all 3^N conformers exactly. For longer chains we apply the transfer matrix method in the Gibbs ensemble in the presence of an external force. The force-extension curve is calculated with high accuracy by both methods, and the results are compared with each other and with experimental data. We show that the infinite chain length limit is reached at about N=200. We analyze the effect of variation of geometrical and energy parameters in the model, as well as the effect of chain length on our final results. Chain end distribution functions, probabilities of rotational states and the persistence length are calculated. We show that additional rotational states beyond those of the potential minima used in the Rotational-Isomeric-State approximation can be included for an accurate description.

WE-P5-7 **16h45**

Critical Magnetic Fields in the SO(5) Model. **M.-A. Vachon**, R. MacKenzie, and M. Juneau, *Université de Montréal* — Within the SO(5) model, which attempts to unify High T_c Superconductivity (SC) with Antiferromagnetism (AF), we have calculated two important critical magnetic fields. The first one, the thermodynamic critical field Hc, is given by equating the Gibbs free energies of the SC phase and the AF phase in a external magnetic field H. The second one, the upper critical field H_{c2}, is found when the external magnetic field destroys the SC phase leading to an AF phase transition. These calculations lead to an analytic expression for the border between a type I and a type II SC which is quite different from the conventional case. Some consequences will be discussed.

1. M. Juneau, R. MacKenzie , and M.-A. Vachon, "Magnetic Properties of SO(5) Superconductivity", *Annals of Physics* **298**,421-434 (2002)

WE-P5-8 **17h00**

AdS/CFT and the Phase Diagram of Super-Yang-Mills Theory. **Gordon W. Semenoff**, *University of British Columbia* — Implications of AdS/CFT duality for the structure of the finite temperature phase diagram of supersymmetric Yang-Mills theory are discussed. In particular, the interpretation of the Hagedorn phase transition in string theory and the Hawking-Page transition of anti-de-Sitter supergravity as de-confinement in Yang-Mills theory is analyzed.

17h15 **Session Ends / Fin de la session**

[WE-P6] 14h15 Frontiers in Medical and Biological Physics / *Frontières en physique médicale et biologique*

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

ROOM / SALLE AV-A ***Chair: A. Pejovic-Milic, Ryerson U.***

WE-P6-1 **14h15**

Tumour Treatment by High Intensity Focused Ultrasound Past Barriers. **R.L. Clarke**[a], G.R. ter Haar[b], and J.E. Kennedy[c], [a]*Carleton University*, [b]Royal Marsden Hospital, England and [c]Churchill Hospital, England — The techniques of applying highly focused ultrasound (frequencies 0.9 to 4 MHz) to cancer treatment are developing rapidly, with applications to the treatment of tumors in liver, prostate, brain, breast and other sites. The sites are limited by the fact that ultrasound penetrates bone with great difficulty, owing to attenuation and velocity shifts. The possibility of passing between the ribs to access the lungs has been studied experimentally and theoretically. Experimental measurements were made with a rib(s) phantom, using a transducer having diameter 8.4 cm, focal length 15 cm, and frequency 1.7 MHz. Representative results showing the changes to the focal region will be shown. Opaque barriers produce remarkably slight changes to the shape of this region, attenuation is according to the fraction of wave front removed by the barrier, and side lobes tend to be increased relative to the main peak. The linear theory of the effects of barriers located on various planes between the transducer and the focus will be presented, with numerical modeling of the experimentally studied cases. Good agreement is found for the central maximum and first side lobes, in the fundamental frequency.

WE-P6-2 **14h30**

Non-Invasive Blood Glucose Monitoring With Polarized Light*. **D. Côté**, J. Zic, and I.A. Vitkin, *Ontario Cancer Institute, University of Toronto* — In recent years, there has been an increased interest in using light for studying, diagnosing and treating human pathologies. While the propagation of light in clear transparent media is well described by Maxwell's equations, the propagation of light in tissue is more complicated and can be modeled as a combination of scattering and bulk dielectric propagation. Because of the high number of scattering events that randomize the polarization of photons in tissues, the amount of observable polarization that survives (the degree of polarization) is dramatically reduced. Polarimetric measurements are therefore often challenging to perform and to analyze. Nevertheless, the polarization of light has been shown to carry important quantitative information about the birefringence and optical activity of the optically-thick tissues with which it interacts. For instance, molecules such as glucose that are optically-active rotate the plane of linearly polarized light, and the amount of rotation can be related to the glucose concentration in the tissue. One medical condition that will greatly benefit from such an approach is diabetes with its associated need for pain-free blood glucose monitoring. Our experimental approach for non-invasive glucose monitoring in turbid media as well as our theoretical modeling of the polarization-sensitive light-tissue interactions will be discussed. The use of balanced detection for making low-noise polarimetric measurements in turbid solution is demonstrated. The technique is shown to reduce the intensity noise originating from the laser and to make possible a direct measurement of the Stokes vector parameters. We will present our measurements of optical activity and degree of polarization in clear and turbid media containing glucose at near physiologically-relevant concentration. Monte Carlo simulations of light-tissue interactions in optically-active media will also be presented.

*Work supported by the Natural Sciences and Engineering Research Council of Canada

WE-P6-3 **14h45**

Optical Monitoring of Interstitial Laser Photocoagulation*. **Lee Chin**[a,b], Sean R.H. Davidson[a,b], William Whelan[b,c], Michael Sherar[a,b,c], and Alex Vitkin[a,b,c], [a]*Ontario Cancer Institute/Princess Margaret Hospital University Health Network*, [b]*Department of Medical Biophysics, University of Toronto*, [c]Department of Radiation Oncology, University of Toronto and [d]Department of Mathematics, Physics and Computer Science, Ryerson University — Interstitial laser photocoagulation (ILP) is a novel therapy that delivers optical energy to tissues via thin flexible optical fibers to thermally coagulate solid tumors of, for example, the prostate, brain, and breast. The goal of the treatment is to maximize damage to the target volume while minimizing damage to surrounding healthy tissues. On-line monitoring of ILP is essential because pre-treatment predictions of damage are difficult due to the dynamic changes in optical, thermal and blood perfusion properties of the tumor that occur during treatment. Typically, point temperature sensors placed at the tumor boundary are employed to monitor ILP. However, temperature measurements can only indirectly infer the extent of thermal damage and their response is limited by the slow thermal conduction times in tissue. As an alternative, we are exploring the potential of interstitial point optical measurements to provide a direct and near-instantaneous method of monitoring thermal coagulation. We present a novel strategy based on relative light intensity measurements and photon diffusion theory that has the potential to (1) evaluate the specific absorption rate of the target tissue *in vivo* and (2) provide on-line, real time localization of the coagulation boundary. An important feature of this work is that it does not appear to be sensitive to the absolute optical properties of the treatment volume but rather only to the relative change between normal and coagulated tissue. Therefore, this methodology may prove robust with respect to calibration errors, and hence, amenable to clinical implementation.

* Work supported (in part) by the National Cancer Institute of Canada (with funds from the Canadian Cancer Society) and Natural Sciences and Engineering Research Council of Canada

15h00 **Coffee Break / Pause café**

WE-P6-4 **15h15**

Influence of Strontium Levels in Bone on Dual-Energy X-Ray Absorptiometery. **Sarah Hardacre**[a], Ana Pejovic-Milic[a] and Colin E. Webber[b], [a]*Ryerson University* and [b]Hamilton Health Sciences — Bone density measurements using dual-energy X-ray absorptiometry (DXA) units are one of the key ways of diagnosing osteoporosis. Testing usually involves the measuring of the bone mineral content (BMC) and the bone mineral density (BMD) of the lumbar spine. A strontium based medication, strontium ranelate, may be introduced to treat osteoporotic patients, since it is currently undergoing human trials. However it has been hypothesized that an increase in concentrations of strontium in the bone may affect the accuracy of DXA measurements. In this pilot study, phantoms of the lumbar spine were developed using constant levels of hydroxyapatite solutions. Increasing levels of strontium replaced calcium in the first set of phantoms, while in the second, the amount of calcium present remained constant and increasing levels of strontium were added. Both sets of phantoms were tested using two commonly used clinical DXA units, to observe the effects of increased concentrations of strontium in bone on the expected densitometry readings in patients being treated with strontium ranelate. Preliminary findings show that an increase in the strontium levels produces inconsistent area measurements, and thus the BMD findings, which is the ratio of BMC to area, are inaccurate. The results and discussion will focus on the validity of DXA testing on patients being treated with the new strontium based medication.

15h30 **Session Ends / Fin de la session**

2003 CONGRESS POSTER SESSION ABSTRACTS
RÉSUMÉS DES SESSIONS AFFICHES - CONGRÈS 2003

The poster session abstracts presented here will be on display in this order in the Chi-Wan Young Sports Centre of the University of Prince Edward Island from 19h00 - 22h00 on Monday, June 9th. *Les résumés présentés en affiches publiés ci-après seront en montre de 19h00 à 22h00, le lundi, 7 juin dans le Centre de sports Chi-Wan Young à l'Université de l'Ile du Prince-Edouard.*

[MO-POS] ATMOSPHERIC AND SPACE PHYSICS / *PHYSIQUE ATMOSPHÉRIQUE ET DE L'ESPACE* — Monday / *Lundi*

MO-POS-1

Nonlinear Dispersive Field Line Resonances in Stretched Magnetic Field Lines: Non-perturbative Simulation Results and Theory. J.Y. Lu[a], R. Rankin[a], R. Marchand[a] and V.T. Tikhonchuka[b] [a]*University of Alberta*, [b]Université Bordeaux, France — Field line resonance (FLR) frequencies calculated for the dipolar magnetosphere on shells L = 6 to L = 10 are at least one order of magnitude larger than those observed. It has previously been shown that field line stretching can bring FLR frequencies to the range of observations (Rankin *et al.*, JGR, 27, 3265, 2000). We discuss dispersion, nonlinearity and ionospheric heating in FLRs by solving the full set of dispersive nonlinear reduced MHD equations for shear and slow waves self consistently. We present results in stretched magnetic fields that are approximated by the T96 model, and show that compared to the dipolar case, strong dispersive effects are present that try to prevent localized discrete arcs from forming. We show that in appropriate parameter ranges, discrete arcs can form through an interaction between time dependent dispersion, ionospheric heating by FAC's, and ponderomotive density steepening. We discuss how this can lead to a strong localization of highly structured FLRs within ionospheric (equatorial) density cavities (bumps). We identify appropriate nonlinear space and timescales, and provide a unified model view of observational features, such as the FLR frequency, density cavity at low altitudes, parallel currents and perpendicular electric fields.

MO-POS-2

The Two Step Response of the Ionosphere to a Stepwise Southward Turning of the Interplanetary Magnetic Field. **Masakazu Watanabe**, Michael Pinnock, Per Even Sandholt, George J. Sofko, Mark Lester, and Natsuo Sato *University of Saskatchewan* — We have found observational evidence that the ionospheric response to a stepwise southward turning of the interplanetary magnetic field (IMF) occurs in a two step manner. The primary response, characterized by linearly growing geomagnetic disturbances, commences about 3 min after the estimated arrival time of the southward IMF at the magnetopause. This response is what we call the DP 2 geomagnetic disturbance. We define this onset time as T = 0. The velocity disturbance associated with the primary response is of the order of several tens of m/s in the polar cap region just poleward of the cusp, so the disturbance does not change the pre existing convection pattern appreciably. However, the primary response propagates very quickly in the ionosphere, spreading over the entire polar region within 1 min. The secondary response, characterized by a clockwise convection vortex associated with enhanced flow, starts at T = 1 min 45 seconds (01:45) and develops to the east of the cusp. The onset of the secondary response is soon followed by an initial cusp aurora starting at T = 02:00. These last two phenomena are the traditional ionospheric signatures of flux transfer events (FTEs), with the clockwise vortex corresponding to one of the twin vortices in the standard FTE model.

MO-POS-3

Field Testing of Pulse Counting Magnetometers. **M. Connors**[a], C. Tkachuk[b] and M. Foote[b], [a]*Athabasca University*, [b]also at University of Alberta — Commercial pulse counting fluxgate magnetometer heads have been field tested toward the goal of low cost geomagnetic field monitoring. We present geomagnetic data acquired and compare it to that from nearby instruments. Having an entirely digital output consisting of pulses in the tens of kHz, the heads are well suited to use with micro-controllers. In turn the magnetic data storage and transmission requirements are well handled by personal computers (PCs) running linux, to which we have successfully interfaced the micro-controllers. A further relevant technology is that of Global Positioning, which gives a precision time base to be used both for pulse counting and for absolute timing of the measurements (for the latter, web connected computer can use NTP with adequate precision). All of these technologies can be integrated to produce a magnetometer with a cost of several hundred dollars. Since the PC required is not expensive, a triaxial magnetometer deployable in large quantities for education or research is possible. Here we assess the quality of magnetic data acquired by sample instruments in the field. We find that resolutions of down to 1/3 nT are attained by thermally insulated devices. We prefer to avoid thermal control and have developed calibration techniques to avoid this. This resolution is suitable for applications such as monitoring geomagnetic activity or currents in pipelines. With the present family of commercial sensors this threshold will be difficult to surpass since an error of one pulse per second corresponds to roughly one nT at current device frequencies. These sensors are well suited to studies of morphology of auroral currents, where availability of a large number of stations of limited resolution would enhance the ability to do data inversion.

MO-POS-4

Low Cost All Sky Camera Systems for Auroral Studies. **Martin Connors**[a], M. Foote[b], B. Martin[c], D.P. Hube[d], T. Trondsen[e], M. Syrjasuo[e], and K. Tsuruda[f], [a]Athabasca University, [b]also at University of Alberta; [c]King's University College; [d]University of Alberta; [e]University of Calgary and [f]Institute of Space and Astronautical Sciences, Japan — Recent use of low light all sky cameras, originally supplied by Sandia National Laboratories for meteor monitoring, has shown that modern cameras, monitoring continuously, can provide valuable data for auroral studies. The most sensitive modern cameras record in black and white in the visible and near IR. We describe quantitative aspects of the sensitivity and field of view of several cameras, as tested in the laboratory and the field. The updated meteor camera systems will be very well suited for low cost monitoring of auroras simultaneously from multiple locations. Other relevant camera configurations are also described. The new camera network will feature triggered acquisition, digitally logged, but will also be able to demonstrate remotely controlled campaign mode operation. Images can be acquired using low cost TV cards, and event detection, data storage, and networking facilitated by use of low cost PC based linux systems. A case study of the unusual auroral onset of October 1, 2002, shows how magnetic and optical data may be combined to relate currents and luminosities during an auroral event.

MO-POS-5

Statistics of Lower Hybrid Heating Cavities. **B.J.J. Bock**[a], D.J. Knudsen[a], J.K. Burchill[a], D.D. Wallis[b], R.F. Pfaff[c], and S.R. Bounds[d], [a]*University of Calgary*, [b]Magnametrics, [c]NASA Goddard Space Flight Center and [d]University of Iowa — Lower Hybrid Heating Cavities (LHHC) are structures observed in our upper ionosphere. As their name suggests, there are three defining characteristics to these cavities: 1) Gaussian shaped density depletions of up to tens of percent, 2) enhanced lower hybrid plasma waves (frequencies of a few kHz), and 3) ions heated in the direction perpendicular to the geomagnetic field. These properties were established by LaBelle *et al.* [1] and Kintner *et al.* [2]. The heating inside these cavities can reach tens of thousands of K, starting with an ambient temperature of 2,0003,000 K. This heating is contained within small cylindrical cavities aligned along the geomagnetic field and are about ~20m across. Why the heating is confined in this manner is unclear. The plasma waves tie into the heating in that they, and not ion collisions, are the cause of this heating. In this talk we will present statistics collected on the above mentioned properties and correlations between them. We found average cavity diameters of 15.7 ± 9.7m. Surprisingly, the average diameter does not depend on background density, in contradiction to some theories of cavity formation. Average depletion depths, on the other hand, do depend on background density, ranging from 4% in high density regions (> 10^4 cm^3 to 22% in low density regions) < 10^3 cm^3. We have also identified a new property of these cavities, namely density enhancements or "shoulders" around cavity perimeters. These shoulders have an average height of 19 ± 14% relative to cavity depth. Finally, we characterized ion heating within 100 LHHC's using the GEODESIC Suprathermal Ion Imager, and found that ion temperature inside these cavities was as high as 9eV (~100,000 K) compared to an ambient temperature of 0.2eV (~2,000 K) just outside the cavity. These observations form the basis of a new theory of cavity formation that will be discussed in a separate talk.

1. *J. Geophys. Res.*, **91**, 7113, 1986
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MO-POS-6

Observations of HF E Region Doppler Spectra Along the Electrojet Flow. **D.W. Danskin**, A.V. Koustov, *University of Saskatchewan* — The Doppler spectrum of E region SuperDARN echoes from the Finland radar, which observes perpendicular to the electrojet flow showed a double peaked nature. This double peaked spectrum was interpreted as being related to scatter from different altitudes in the electrojet layer. Now we look along the flow by using data from the HF radar in Syowa, Antarctica to see if this nature is also prevalent. We will try to ascertain if there is dependence in the spectra due to Type I and Type II irregularity contamination, another possible explanation for double peaked spectra.

MO-POS-7

On the Association Between Substorm Onset at Near-Geosynchronous Orbit and Fast Flows in the Mid Tail. J. Liang, G.J. Sofko, *University of Saskatchewan* — There are two competing models for the substorm onset: (1) current disruption and substorm current wedge (SCW) formation in the near geosynchronous plasma sheet, and (2) reconnection in the magneto-tail. From

the convection, magnetic, and optical auroral measurements, we found that some auroral intensifications associated with weak substorm onset/pseudo-breakup are accompanied by enhanced equatorward flows. The optical auroras are located in quite a different latitude range from the enhanced flows, which could suggest that they are two distinct processes. However, very good correlation between the optical aurora and the enhanced flows shows that they are strongly related. We suggest that the correspondence between the substorm onset at near geosynchronous orbit and the magnetic reconnection in the farther tail is not one to one but some substorms may tend to develop following the reconnection and the subsequent fast earthward flows in the midtail. A model is presented to explain the timing and association between them

MO-POS-8

Modeling the Alfven Continuum with Global MHD Models and ULF Wave Analysis. **Robert Rankin**, Konstantin Kabin, Steven Bekhor and Richard Marchand, *University of Alberta* — ULF Alfven waves, propagating inside closed magnetic flux tubes, can form standing wave Field Line Resonances (FLRs) in Earth's magnetosphere. FLRs are commonly detected by CANOPUS instrumention and by satellites. The properties of FLRs are related to global magnetospheric topology and the plasma density along their path. Therefore, their study can provide three-dimensional information about the structure of the magnetosphere, and of the processes driving large scale magnetospheric dynamics. To model FLRs, it is necessary to compute global eigenmode frequencies that account for stretched and twisted geomagnetic field lines under specific solar wind conditions. We present results based on an analysis of coupled toroidal-poloidal Alfven modes. We compute the global distribution of eigenfrequencies based on magnetic field lines and ion densities generated by the BATS-R-US global MHD model. We estimate FLR frequencies for several characteristic sets of solar wind parameters, as well as for several specific dates when FLRs were observed.

MO-POS-9

Magnetic Field Variations at Geostationary Orbit and the b2i Boundary Latitude. **Brian Jackel** and Eric Donovan, *University of Calgary* — It is common to use the inclination of the magnetic field at geostationary orbit as a quantitative indicator of the state of the inner magnetosphere. This is based on the fact that the inclination is controlled almost exclusively by the intensity of the cross tail current, and the location of its inner edge. It is, however, complicated by the fact that the inclination is most meaningful relative to the local orientation of the current sheet, and the distance from it that the measurement is made. In particular, the shape of the current sheet varies with season, UT, and magnetospheric activity and geosynchronous spacecraft at different geographic latitudes are on average at significantly different distances from the current sheet. Although recent work has demonstrated a clear correlation between the latitude of the b2i boundary inferred directly via *in situ* ion data or remote sensed from the ground via optical data, little thought has been given to the coordinate systems in which the magnetic field data is represented. In this study we utilize the ~300000 optical b2i boundary determinations obtained from the Gillam MSP data set and simultaneous GOES East and West magnetic field measurements to explore the effect of choice of coordinate system in which inclination is calculated on the correlation between the b2i boundary and that inclination. The motivation for this work is to advance our ability to remote sense the state of the inner magnetosphere with this simple proton auroral index

1 Donovan *et al.*, *JGR*, 2003

MO-POS-10

Canadian Instruments for Hydroxyl Airglow Studies at Davis Station, Antarctica. **W.J.R. French**[a,b], R.P. Lowe[a], G.B. Burns[b], K. Ward[a], F.A. Phillips[b], and D.N. Turnbull[a], [a]*University of Western Ontario and* [b]*Australian Antarctic Division* — In recent years collaborative research opportunities between the Australian Antarctic Division and the University of Western Ontario have seen two Canadian developed instruments deployed at Davis Station, Antarctica (68.6S, 78.0E). These are a scanning radiometer (UWOSCR), installed in Jan 1999 and a Fourier transform spectrometer (FTS) installed in Jan 2002, both of which observe the 8km thick hydroxyl layer centred around 87km altitude. Small scale gravity waves propagating through the hydroxyl layer produce variations in emission intensity and temperature. The UWOSCR instrument continuously scans a 16x16 degree field in the zenith to produce low resolution images of the hydroxyl layer every minute, from which gravity wave parameters can be deduced. Typical results from the gravity wave field over Davis are presented. Rotational temperatures in the hydroxyl layer can be derived from measurement of the relative strengths of lines within the hydroxyl emission bands. The FTS routinely monitors several bands in the 1.5 micron region each night at Davis. This instrument also incorporates innovative sun-tracking polarizer fore-optics, developed at the University of Western Ontario, to extend observations into twilight by preferentially rejecting the polarized scattered sunlight. Its aim is to maximize both diurnal and seasonal coverage of hydroxyl temperature measurements. Analysis methods and preliminary results from the first year of operation are presented.

MO-POS-11

Numerical Simulation of Interstellar Meteoroids Ejected from a 5 Solar Mass Pre-Main Sequence Star. B.A. Quirt and **R.L. Hawkes**, *Mount Allison University* — Radiation pressure from the early stages of formation of a highly luminous star will cause small meteoroids in the dust envelope of the star to reach escape speed and to be ejected into interstellar space. We used a quartic Runge Kutta iterative approach with adaptive step size control to track the orbital motion of meteoroids from a 5 solar mass pre-main sequence star taking into account gravitational, radiation pressure and Poynting Robertson forces. A standard time-dependent astrophysical model for stellar luminosity was used. A variety of initial velocity, albedo, mass, density and shape values for the meteoroids were employed. Even relatively large meteoroid grains (10^5 kg) were ejected with velocities of more than 200 km/s in the case of low density, porous meteoroid structure after initial ejection close to the stellar radius, with even higher velocities resulted from smaller meteoroid masses. These velocities are higher than those yet observed for interstellar meteoroids detected by meteor radar, intensified CCD and radio telescope detections, and higher than velocities usually inferred from space impact detectors. Detectability in the Earth's atmosphere of these high speed interstellar origin meteoroids will be discussed.

MO-POS-12

Satellite and Ground-Based Perspectives of Growth-Phase Auroral Arcs. **M. Lessard**, W. Lotko, W. Peria, C. Carlson, F. Creutzberg, D. Wallis, *Thayer School of Engineering, Dartmouth College, USA* — Perhaps the most widely-accepted aspect of magnetospheric substorms is that onset begins with the brightening of a pre-existing auroral arc. The presence of this arc during a substorm growth phase implies that a region with enhanced coupling between the magnetosphere and ionosphere exists before onset. In fact, a growth-phase arc invariably marks the region where onset will occur and basically, it can act as a predictor of at least the location of an impending substorm. Stated somewhat differently, the properties and context of a growth-phase arc form an important part of the initial conditions for substorm onset, leading to the question "Why do substorms preferentially release energy along field lines that map to these arcs"? Previous studies examined the nature of these arcs and have shown that they are typically stationary and that the associated electron precipitation energy flux increases gradually. In this study, we investigate the nature of growth-phase arcs, including the acceleration mechanism and the relationship of growth-phase arcs to ionospheric currents on both small and large scales and discuss the arcs in relation to region 1,2 currents as well as the substorm current wedge

MO-POS-13

The Autonomous Real-Time Remote Observatory (ARRO). **M. Lessard**, J. LaBelle, T. Rosenberg, U. Inan, G. Blaisdell, K. Rancourt, *Thayer School of Engineering, Dartmouth College, USA* — The Autonomous Real-time Remote Observatory (ARRO) is nominally being developed to replace the Automated Geophysical Observatories (AGO) currently deployed on the polar plateau in the vicinity of the South Pole in Antarctica. The existing observatories have shown the importance of being able to precisely locate observatories for making geophysical measurements, but the ARRO replacement will add improved reliability, as well as some important options. Specifically, the new observatories will incorporate real-time, bi-directional communications (including data transfer), using Iridium modems. In addition, the new observatories will be modular (for scaling to specific projects) and will be capable of deployment using only a Twin Otter airplane

MO-POS-14

Measurements of Ozone and NO_2 Using a Ground-Based UV-Visible Grating Spectrometer. **A. Fraser**, E. Farahani, S.M.L. Melo, K. Strong, *University of Toronto* — A ground-based UV-visible spectrometer has been assembled for the purpose of measuring stratospheric ozone and NO_2. The instrument's permanent home is at the University of Toronto Atmospheric Observatory (TAO), where it was most recently operated from December 2002 through February 2003. It has also been deployed on eight field campaigns: three MANTRA balloon campaigns at Vanscoy, Saskatchewan (1998, 2000, 2002), four times at Environment Canada's Arctic Stratospheric Ozone Observatory in Eureka, Nunavut (1999, 2000, 2001, 2003), and once at the Solar Winds Observatory in Resolute Bay, Nunavut (2002). The instrument consists of a commercial triple-grating spectrometer and a cooled CCD detector. It is used to record spectra of sunlight scattered from the zenith-sky at ultraviolet and visible wavelengths. Operation in zenith-sky mode is fully automated so that twilight spectra are recorded daily. Using the differential optical absorption spectroscopy (DOAS) technique, total columns of ozone and nitrogen dioxide are retrieved. Vertical profiles of NO_2 can also be derived from the observed variation of the slant column density with solar zenith angle. In this presentation, we will describe the instrument and the retrieval techniques and present some of the measurements that have been obtained to date. Comparisons with available data from other instruments, including those on the Odin and ENVISAT satellites will be shown.

PO-MOS-15

Recent Space Weather Events and their Effects on Power Systems. **L.Trichtchenko**, *National Research Council of Canada* — Significant geomagnetically induced currents in power systems during geomagnetic storms are the observed result of a chain of events initiated by increased solar activity. We review space weather activity, based on the solar (coronal mass ejections, solar flares, coronal holes), interplanetary (magnetic field and plasma disturbances in solar wind) and global geomagnetic characteristics (Kp index) around maximum of the current solar cycle. We present the impact of these events in terms of local geomagnetic activity and geomagnetically induced currents (GIC) in power systems and pipelines in North America. The largest events are examined more closely, showing their onset time on the Sun, propagation through the interplanetary media, variations of the Earth magnetic field and GIC in several locations.

PO-MOS-16

Simulation Studies of E-POP Radio Experiments. **Lan Wang**, John W. Macdougall and H. Gordon James, *University of Western Ontario* — The Polar Outflow Probe satellite (e-POP) is a micro-satellite to explore plasma and atmospheric outflow processes in the polar ionosphere and upper ionosphere, and will be launched in the future. HF waves from the CADI (Canadian

Advanced Digital Ionosonde) will be observed and measured by the satellite when it passes the nearby ionosphere. This process is simulated using ray-tracing method. The simulation results will give useful information about the wave properties, such as the angle of arrival , group delay, signal strength etc. at the e-POP spacecraft. In the presence of irregular structures in the ionosphere, ray tracing results show that these irregularities produce dramatic effects on the propagated radio waves. This paper presents these irregularity effects and discusses the relationship between irregularities and behavior of wave parameterst.

MO-POS-17

Impact of the Solar Activity on the Upper Atmosphere. L. Sangalli, M. Welland, G. Wade and J.M. Noel, *Royal Military College of Canada* — Atmospheric drag represents the single largest uncertainty in position determination of artificial satellites (RSOs). Punctuated thermospheric density variations of up to 500% are associated with major solar activity events and geomagnetic storms, leading to significant acceleration of RSOs with semimajor axes in the 500-1000 km range (*e.g.* Knowles *et al.* 2001). The sensitivity of the kinematics of low orbit satellites to variations in thermospheric density makes them ideal probes of outer atmospheric conditions (*e.g.* Jacchia 1970). In this poster, we present preliminary results of a study aimed at investigating the response of the thermospheric density field to changes in a wide range of solar a geomagnetic parameters.

MO-POS-18

The Canadian Network for the Detection of Atmospheric Change. James R. Drummond[a], Tom Duck[b], Jim Sloan[c], Kim Strong[a], and William Ward[d], [a]*University of Toronto*, [b]Dalhousie University, [c]University of Waterloo and [d]University of New Brunswick — Three great challenges confront the atmospheric community: air quality, climate change and ozone depletion. These are important issues for Canada because of its large land mass and varying climates. Their effect on the Arctic is particularly significant. The Canadian Network for the Detection of Atmospheric Change (CANDAC) is a network of researchers and resources dedicated to addressing the issues outlined above. A primary initial focus of CANDAC will be the revitalization of Arctic measurements at the Eureka Arctic Stratospheric Ozone (ASTRO) observatory. The CANDAC network objectives are 1) Understanding atmospheric change over Canada, 2) Integration of measurements taken from space, aircraft, balloons and the ground, 3) Provision of quality-controlled research datasets to researchers, 4) Linkage with international networks for data exchange and supranational planning, 5) Maintenance of research-critical resources, 6) Training of skilled personnel, 7) Public Education. It will collaborate with Canadian government, university and industrial research organizations to further mutual goals. It will also interact with international organizations to ensure that the research is placed in a global context.

MO-POS-19

The Measurements Of Pollution In The Troposphere (MOPITT) Instrument: 40 Months of Carbon Monoxide Measurements. James R. Drummond[a], Holger Bremer[a], Jane Liu[a], Florian Nichitiu[a], Jason Zou[a], J.C. Gille[b], Merritt Deeter[b], David Edwards[b], Gene Francis[b], Ben Ho[b], Dan Ziskin[b], Debbie Mao[b], Jarmei Chen[b], Valery Yudin[b], Louisa Emmons[b], Jonguan Niu[b], and Gabrielle Pfister[b], [a]*University of Toronto* and [b]National Center for Atmospheric Research — The MOPITT experiment was launched on NASA's Terra satellite on December 18th, 1999. The mission was to measure carbon monoxide and methane in the troposphere. In the last three years much data have been gathered and these data continue to shed new light on tropospheric pollution events and transport on a global scale. Data from the first 14 months of the mission have been successfully validated and are available for use by the scientific community. This talk will present some of the "new views" that MOPITT allows on the globe and will outline some of the new studies which now become possible with these data.

MO-POS-20

Comparison of Lidar Measurements of Mesospheric Inversion Structures with a General Circulation Model. R.J. Sica[a], P.S. Argall[a], T.G. Shepherd[b], and J. Koshyk[b], [a]*University of Western Ontario* and [b]University of Toronto — Mesospheric inversions layers are a well documented, large scale phenomenon. These features are extended in longitude and despite their temporal variability are evident even in nightly averaged temperature profiles. Despite their large scale structure they have not been documented in general circulation models. While suggestions have been made that gravity waves are responsible for the generation of the inversions, no theory has been directly tested against measurements and models. Three runs of the Canadian Middle Atmosphere Model (CMAM) using different gravity wave parameterizations have been analyzed for the occurrence of mesospheric inversions. Mesospheric inversions appear to be a ubiquitous feature of the model, with little dependence on the choice of gravity wave parameterization. To further test the interpretation of the results as inversions, CMAM temperature profiles near London, Ontario were compared to the inversion frequency, amplitude and thickness of over 350 nights of measurements by the Purple Crow Lidar (PCL). The results compare favourably in both seasonal behavior and overall characteristics. Thus, it is reasonable to suppose that inversion layers are caused by processes explicitly represented in CMAM. A theory based on wave saturation has been developed that specifically predicts the relation between the temperature amplitude and thickness of the inversion, as well as the relation of the lapse rate in the inversion layer to the background lapse rate. The theory is tested using temperature measurements from the CMAM and the PCL. Preliminary results indicate that either large scale (*e.g.* model resolved) gravity waves and/or tides obtain sufficient amplitude to generate the inversions seen in both the measurements and the model calculations.

* Now at Toronto Dominion, Ontario.

MO-POS-21

61-Day Intra-Seasonal Oscillation found in Mid-Latitude Atomic Oxygen Profiles. Jason P. Russell[a], W.E. Ward[b], and R.P. Lowe[a], [a]*University of Western Ontario* and [b]University of New Brunswick — The use of satellite measurements of the volume emission rates of the hydroxyl airglow and the atomic oxygen greenline are used to infer atomic oxygen profiles of the mesopause region. We use data from the WINDII instrument that observed these emissions for a space of many years in the early to mid 1990's. The atomic oxygen derived from both emissions was combined for a total altitude range from 82 to 115 km which included several kilometres above and below the peak in concentration. When analysing annual and seasonal trends in the data, a prominent 61-day oscillation was found. This feature only appeared at latitudes higher than 30 degrees and its amplitude increased with latitude. This feature does not appear to be an artifact of the sampling of the data.

[MO-POS] ATOMIC AND MOLECULAR PHYSICS / *PHYSIQUE ATOMIQUE ET MOLÉCULAIRE* — Monday / *Lundi*

MO-POS-22

Polarizabilites of the Hydrogen Molecular Ions. Zong-Chao Yan, Jun-Yi Zhang, and Yue Li, *University of New Brunswick* — The nonrelativistic dipole polarizabilities of the hydrogen molecular ions H_2^+, D_2^+, T_2^+, HD^+, HT^+, and DT^+ in their ground states are evaluated variationally in Hylleraas coordinates, where the ions are treated as three-body Coulombic systems. Our results for the dipole polarizabilities represent the most precise calculations reported so far. For H_2^+, for example, the dipole polarizability is 3.168 725 802 67(1), with the uncertainty of three parts in 10^{12}.

MO-POS-23

Tunable Diode Laser Observations of Auto Exhaust at 5 mm. K. Vaage, R.M. Lees and Li-Hong Xu, *University of New Brunswick* — In the process of calibrating the tuning behaviour of our infrared lead-salt tunable diode laser (TDL) against the OCS spectrum in the 5 mm spectral region, we examined several samples of auto exhaust. In addition to strong H_2O and CO absorption lines plus the stronger OCS lines, about 20 further absorption features were observed in the spectrum from 1960 – 2100 cm^{-1}. Comparison with the HITRAN atlas of atmospheric spectra indicates close agreement with absorption lines of H_2S. As well, to explore the sensitivity of the TDL spectrometer for atmospheric trace measurements, we investigated detection limits for OCS isotopic species, and looked at line-broadening by atmospheric air.

MO-POS-24

Electron Collisions with Ground and Excited State Cesium*. J.A. MacAskill, C. McGrath, W. Kedzierski, J.W. McConkey, and I. Bray, *University of Windsor*. — Our recent studies of electron collisions with a target of Magneto-Optically Trapped cesium atoms have given the first ever measurement of an excited state, total cross section for cesium. This cross section is determined by performing trap-loss measurements of the MOT for a target that contains both ground and excited state atoms. The excited state cross section is then isolated with the use of the ground state cross section and the excited state population fraction. The experimental results for both ground and excited state cross sections are compared with recent CCC calculations. Full details of the experiment and measurement process will be presented.

* We are pleased to acknowledge support for this research from NSERC, CIPI, and CFI (Canada), and to the ARC (Australia).

MO-POS-25

Observation of Ground State Ramsey Fringes*. M. Weel, S. Beattie and A. Kumarakrishnan, *York University* — We have used trapped ^{85}Rb atoms to demonstrate an atom interferometric measurement of atomic recoil in the frequency domain. The measurement uses ground state echo techniques to generate a Ramsey fringe pattern. The pattern exhibits recoil components consistent with theoretical predictions. We have reported a precision of $1\theta^{-}$ in a preliminary measurement of the recoil frequency[1]. By improving the transit time of ground state atoms in the interferometer, we expect to achieve a precision of 10^{-8}. The measurement is expected to be insensitive to systematic effects due to magnetic fields, magnetic field gradients and AC-Stark shifts. The echo signal is generated by applying two sets of off-resonant counter-propagating pulses, with frequency difference δ, separated by time T. The directions of the travelling wave components are reversed for the second set of excitation pulses. A ground state population grating forms in the atomic sample in the vicinity of $2T$. A travelling wave "readout" pulse is then used to generate backscattered light from the grating(echo). This signal is detected using balanced heterodyne detection. It is therefore possible to measure the amplitude and phase of the grating. When the frequency difference δ, is varied, the phase of the echo signal exhibits an oscillatory dependence. By averaging the results for a range of T we obtain a Ramsey fringe pat-

tern showing spectral feature separated by ω /2, where ω is the recoil frequency given by $\hbar\Delta k^2/2m$. Here, Δk is the momentum transferred to the atoms from the laser field and m is the atomic mass of ^{85}Rb.

* This work is supported by NSERC, CFI, OIT, and York University.
1. M. Weel, A. Kumarakrishnan, Submitted *Phys. Rev. A* (2003).

MO-POS-26

Measurement of Temperature and Zeeman Shift Using Magnetic Sublevel Coherences in Trapped Rb Atoms. **A. Andreyuk**, M. Weel, A. Vorozcovs and A. Kumarakrishnan, *York University* — We establish a spatially periodic coherence (grating) between adjacent magnetic sublevels of the F = 3 hyperfine ground state using two off resonant traveling waves with orthogonal linear polarizations at t = 0. The excitation pulses are applied at an angle of a few mrad. The grating decays on a time scale of approximately 100 microseconds due to the Gaussian velocity distribution of the trapped sample. The decay can be measured by applying a readout pulse along the direction of one of the excitation pulses and recording the light scattered from the sample along the direction of the second excitation pulse. This signal known as free induction decay or FID can be used to measure the temperature of a cold gas. We have compared the temperature measured using the FID with the temperature obtained by photographing the ballistic expansion of the sample using a CCD camera. Both techniques show that the temperature is a linear function of the trap Laser intensity. This dependence is consistent with expectations for polarization gradient cooling. We present details of systematic effects on the FID measurement of the temperature. The FID exhibits Larmor oscillations in the presence of a magnetic field. We have studied the frequency of oscillations as a function of the field and measured the Zeeman shift of the ground state to a precision of 2%. Since the precision is limited only by the stability of the magnetic field, high precision studies can be considered. We have also used a second set of excitation pulses at time t = T so that an echo signal from the rephased grating can be observed at t = 2T. Since T is limited only by the transit time of atoms through the Laser beams, it is possible to improve the precision in the value of the Zeeman shift using the echo if the magnetic field can be stabilized. This work was supported by NSERC, CFI, OIT and York University.

MO-POS-27

Progress Toward a Precision Measurement of the ^{85}Rb $5S_{1/2}$ (F = 3) – $5P_{3/2}$ (F' = 4) Natural Linewidth*. **S. Cauchi**, A. Vorozcovs, M. Weel, and A. Kumarakrishnan, *York University* — We have measured the linewidth of the ^{85}Rb $5S_{1/2}$ (F = 3) Rb $5P_{3/2}$ (F' = 4) transition in a sample of laser-cooled atoms by scanning a weak probe laser across the atomic resonance. This measurement is carried out by turning off the trapping laser beams and magnetic field gradient, and then briefly turning on and scanning the probe. The probe beam is scanned by controlling the RF applied to a dual-pass AOM. This technique allows the probe beam's frequency to be scanned without altering the alignment. The absorption signal yields a lineshape that has contributions from the natural linewidth, laser linewidth, power broadening, and residual Doppler broadening. Systematic effects of magnetic fields and power broadening on the lineshape have been studied. The Doppler contribution to the lineshape has been obtained by determining the temperature of the cloud. This is carried out by observing the ballistic expansion of the cloud using a CCD. We show that a precise measurement of the natural linewidth can be obtained by measuring the laser linewidth in real-time. We have also determined the peak density of the sample from the absorption spectrum using the method of equivalent widths. We compare our results to an independent measurement that relies on PMT and CCD detectors to provide the number of atoms and size of the cloud respectively.

* This work is supported by NSERC, CFI, OIT, and York University

MO-POS-28

Superfluorescence Polarization - A Signature of Collisional Redistribution*. **S. Chudasama**[a], A. Kumarakrishnan[a] and X.L. Han[b], [a]*York University* and [b]Butler University — We have studied effects of magnetic sublevel degeneracy on the polarization of superfluorescent pulses generated on the Ca 4s4p $^1P_1$-3d4s $^1D_2$ transition at 5.5 μm. These pulses were generated from a cell of length 50cm by optically pumping calcium vapor on the $4s^2\ ^1S_0$-4s4p $^1P_1$ transition in the presence of Ar gas. The axis of ellipticity of superfluorescence (SF) polarization is oriented parallel to the axis of the pump laser polarization at large detunings, and undergoes an abrupt rotation through 90° for detunings close to resonance. The distribution of populations in the magnetic sublevels of the $^1P_1$ state can be estimated using a simple model based on previously calculated cross sections for collisionally aided absorption in the presence of an intense (pump) field. For large detunings, these estimates are consistent with the polarized SF intensity measured in the experiment. A direct measurement of the populations of the $^1P_1$ magnetic sub-levels also supports the collisional redistribution predicted by the calculated cross sections. We therefore suggest that SF polarization can be a useful signature of collisional redistribution. However, the change in ellipticity is unexpected, and probable causes for this effect are discussed.

* The experimental work was supported by NSF PYI, NSF EPSCOR (Idaho) and AFWL. Subsequent analysis was supported by NSERC, CFI, OIT and York University.

MO-POS-29

Laser Spectroscopy of Niobium Monofluoride. **Scott Shepard** and A.G. Adam, *University of New Brunswick* – Laser spectra of NbF have been acquired in the visible region of the spectrum. The molecules were produced via laser ablation of a niobium target rod, followed by reaction with SF_6 in a pulsed supersonic jet. Several transitions have been observed in low resolution in the red region of the spectrum. This marks the first observation of the spectrum of niobium monofluoride. Work is ongoing in an attempt to describe the ground and excited states. Preliminary results will be presented.

MO-POS-30

Photodouble Ionisation of Helium using Linearly and Elliptically Polarised Synchrotron Light. **T.J. Reddish**[a], D.P. Seccombe[a] and A. Huetz[b], [a]*University of Windsor* and [b]LIXAM, Université Paris Sud, France — Photodouble ionisation (PDI) is the emission of two electrons from a target, following the absorption of a single photon. PDI in helium is the simplest case, resulting in three charged particles, *i.e.* two electrons and one bare nucleus. The dynamic evolution of the system is a 3-body coulomb continuum problem and for that reason has attracted much interest from theoreticians and experimentalists[1]. The triple differential cross section (TDCS), in which the directions and energies of the two escaping electrons are defined, is particularly sensitive to electron-electron correlation. Such measurements, beginning with those of Schwarzkopf *et al* [2], have only become possible because of advances in synchrotron sources and electron detection techniques. As a result, the last decade has seen a marked increase in the understanding of the problem, which because of its fundamental nature, is of general importance. At this meeting, the results of our recent experimental studies will be presented[3,4]. In one study, TDCSs were measured using linearly polarised synchrotron radiation at 25 eV in excess of the PDI threshold (threshold = 79 eV)[3]. These electron-electron coincidence measurements were made with a toroidal-hemispherical spectrometer. Mutual angular distributions were obtained for a variety of energy sharing ratios. Some of these kinematic conditions proved to be extremely challenging for theory, especially when the angular distribution of the slower electron, relative to a fixed faster one, is measured. If circularly/elliptically polarised radiation is used, and the two energies of the escaping electrons are different, then under some geometrical conditions, the photodoubly ionised system has a "handedness". For this reason, Berakdar and Klar[5] predicted that circular dichroism in the TDCS could be observed; the first experimental observation was made by Viefhaus *et al* [6]. The results of our recent experiment study utilising elliptically polarised light from a helical undulator at the Photon Factory in Japan, will be presented[4]. These measurements, taken using a dual-toroidal spectrometer[7], have been compared with TDCSs obtained with the hyperpherical R matrix-with semiclassical outgoing waves (HRM-SOW) method[8]. Very good agreement was obtained and it was found that circular dicroism is an extremely sensitive probe of the correlated electron dynamics.

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MO-POS-31

Measurements of Temperature and Scaling Laws in an Optically Dense Trap Using a CCD Camera*. **A. Vorozcovs**, M. Weel, S. Cauchi and A. Kumarakrishnan, *York University* — We have investigated the temperature of a magneto-optical trap containing ^{85}Rb atoms in a regime dominated by radiation trapping. The temperature is obtained by turning off the confining forces and imaging the ballistic expansion of the cloud as a function of time using a CCD camera. For optically thin traps, it is well established that the temperature scales as $\Omega^2\Delta^{-1}$ due to polarization gradient cooling. Here, Ω and Δ are the Rabi frequency and detuning of the trapping Laser, respectively. Our investigations carried were out in an optically thick sample and show that the temperature scales as $N^{1/3}\Omega$ and as $n^{2/3}\Omega$ for D>1.0Γ. Here N is the number of trapped atoms, n is the density and Γ is the natural line width of the trapping transition. These scaling laws suggest that N should scale as R^6, where R is the radius of the cloud. The data shows that $N \propto R^p$, where p~6 at high density. These results are consistent with the predictions of [1]. We have also measured the temperature of the trapped sample along the axial and radial directions of the magnetic field gradient coils. We find that the ratio of axial to radial temperatures is ~1.2 and that this ratio is largely independent of trapping laser intensity and magnetic field gradient. However, the anisotropy is strongly influenced by the relative intensities of three orthogonal pairs of trapping beams. As a result, the temperature ratio is found to vary between ~0.5 and 2. Another measurement involves the determination of the gravitational acceleration by tracking the center of the falling cloud. In the presence of a magnetic field gradient, the effective value of the acceleration is reduced, in a manner consistent with expectations.

* Work supported by CFI, OIT, NSERC and York University.
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MO-POS-32

A Calculation of the Time-of-Flight Distribution of Trapped Atoms and the Transfer Efficiency Between Dual Magneto-Optical Traps*. I. Yavin, and **A. Kumarakrishnan**, *York University* — We consider the ballistic expansion of a cloud of trapped atoms falling under the influence of gravity. Using a simple coordinate transformation, we derive an analytical expression for the time-of-

flight signal. The properties of the signal can be used to infer the initial temperature of the cloud. We first assume a point size cloud with an isotropic velocity distribution to explain the physical basis of the calculation. The treatment is then generalized to include a finite-size cloud with an anisotropic velocity distribution, and an exact result for the signal is derived. The properties of the signal are discussed, and an intuitive picture is presented to explain how initial conditions determine the features of the signal. We also consider the problem of transferring a cold atomic cloud from a low vacuum chamber to an ultra-high vacuum (UHV) chamber, where it can be recaptured and cooled to the transition temperature for Bose-Einstein condensation (BEC). Our calculation assumes an initial Maxwell-Boltzman velocity distribution for the trapped cloud and a Gaussian spatial density distribution that is characteristic of magneto-optical traps (MOTs). A coordinate transformation enables us to find the density of the recaptured atomic cloud as a function of time. This allows us to investigate the effect of experimental parameters on the transfer efficiency. These parameters include the distance of separation between the two chambers, the duration of the initial on-resonant laser used to push the trapped cloud, and the initial cloud temperature.

* This work is supported by CFI, OIT, NSERC and York University.

MO-POS-33

Forbidden Transitions in Helium Measured using Cavity Ring-Down Spectroscopy*. R.L. **Brooks**[1], R. deLaat[2], N.P.C. Westwood[2] and C. Winslade[1], [1]*Guelph-Waterloo Physics Institute*, [2]*Guelph-Waterloo Centre for Chemistry and Biochemistry, University of Guelph* — We have employed cavity ring-down spectroscopy, using a microwave discharge close to the center of a one meter long sample cavity, to excite and measure transitions in atomic helium. In the spectral region from 605-680 nm, three transitions have been observed in absorption from the 2p ^{1}P level. Besides the intense, dipole allowed, 2 ^{1}P - 3 ^{1}D transition at 667.81 nm, we have observed the forbidden quadrupole 2 ^{1}P - 3 ^{1}P line at 663.17 nm, as well as the forbidden intercombination 2 ^{1}P - 3 ^{3}D line at 667.95 nm. The quadrupole transition is approximately 7 orders of magnitude weaker than the allowed dipole transition and the line intensities have been measured for all three lines. The integrated line intensities yield the *f*-values for the observed transitions if the number density in the lower level is known. Because all three transitions share the same lower level, the well-calculated value for the *f*-value of the quadrupolar transition allow the first measurement of the *f*-value of an intercombination transition in atomic helium. Besides the intrinsic interest for theorists of such a measurement, the demonstrated sensitivity of this technique offers interesting possibilities for further studies in laboratory astrophysics.

* Work supported by NSERC.

MO-POS-34

A Tunable Infrared Spectrometer Based on Difference-frequency Generation in $AgGaS_2$: Application to Lineshape Studies in N_2O. **A. Vitcu**, R. Wehr, R. Ciurylo, James R. Drummond, and A.D. May, *University of Toronto* — A high resolution (2MHz) and high signal-to-noise ratio, cw, tunable, infrared spectrometer is presented. It is based on the difference-frequency generation technique and consists of combining two tunable ring dye lasers in a nonlinear crystal of $AgGaS_2$. The present output wavelength range is 7.8 to 9.1 microns. With total input power of 400 mW, the output power exceeds 100 nW at the peak of the emission curve. The characteristics of the spectrometer have been tested on one of the weakest and most dense Q branch of N_2O ($03^1\,0 \leftarrow 01\,^10$), at 8.6 microns. For the first time, results for the broadening and pressure shift coefficients are derived, as well as direct measurements of the line asymmetries due to line mixing are presented.

MO-POS-35

Bethe Logarithms and QED Shifts for Lithium*. Z.-C. **Yan**[a] and **G.W.F. Drake**[b], [a]University of New Brunswick, and [b]*University of Windsor* — The calculation of Bethe logarithms for atoms more complicated than hydrogen has been a long-standing problem in atomic physics. The Bethe logarithm determines the main part of the lowest-order quantum electrodynamic (QED) energy shift of order $\alpha^5 mc^2$. The problem was recently solved for the case of helium and He-like ions[1] by the use of a discrete variational basis set constructed to span a huge range of distance scales. This same technique has now been successfully applied to lithium. For the ground state, our calculated value for the Bethe logarithm is 2.98093(3) for the case of infinite nuclear mass, in units of Z^2 Ry. The results provide the first complete calculation of the energies for the states of lithium up to and including the lowest order QED contribution. Results for other states and the recoil correction due to finite nuclear mass, together with comparisons with high precision measurements, will be presented at the conference.

*Work supported by NSERC.
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MO-POS-36

Dynamic Spectroscopic Measurements of the Temperature and Pressure Cycles in a MOPITT Pressure Modulator Cell. R. **Wehr**[a], E. McKernan[a], A. Vitcu[a], R. Ciurylo[b], and J.R. Drummond[a], [a]*University of Toronto* and [b]Instytut Fizyki, Uniwersytet Mikolaja Kopernika) — The temperature and pressure cycles inside a pressure modulator cell (PMC) of the type used for gas correlation radiometry aboard the MOPITT satellite instrument have been determined from dynamic measurements of the spectral line shapes of the R(0) and R(18) transitions in the fundamental band of carbon monoxide. This method for measuring gas properties remotely is not only non-invasive, but also allows for the observation of large (>40K) temperature swings in the gas on a timescale of milliseconds. The line shape measurements were obtained while the PMC was oscillating at ~50 Hz by a difference-frequency laser spectrometer with a spectral resolution of better than 2 MHz and a temporal resolution of 200 μs, or 1/100 of a PMC cycle. The line strengths and line widths were then used to calculate the temperature and pressure, respectively. The spectroscopically determined gas cycles are compared to those predicted by a thermodynamic box model of the PMC.

MO-POS-37

Laser Spectroscopy of Holmium Monochloride. **M.J. Dick** and C. Linton, *University of New Brunswick* — As part of a continuing investigation of the properties and structure of lanthanide molecules, a laser spectroscopic study of the lanthanide halides is presently in progress. High-resolution spectra are obtained via a Broida oven source using a cw ring laser. At present, high-resolution spectra of three electronic transitions of Holmium Chloride have been obtained. A global fit of the A9-X8, B8-X8 and C9-X8 transitions has been completed and other transitions are presently being investigated. The results and analysis will be presented and discussed in terms of the electron configurations of the electronic states. In addition, work continues on constructing a map of the low-lying electronic states. The nature and energy of these states will be compared and contrasted with calculations done via the Ligand Field Theory and previous work completed on HoF.

[MO-POS] CONDENSED MATTER AND MATERIALS PHYSICS / *PHYSIQUE DES MATIÈRES CONDENSÉE ET MATÉRIAUX* — Monday / *Lundi*

MO-POS-38

Simulation of Positron Lifetime Spectra Using Monte Carlo Techniques. **D.W. Lawther** and Brandon Mol, *University of Prince Edward Island* — The goal of the simulation program is to generate "realistic" positron lifetime spectra. The approach taken utilizes Monte Carlo techniques to simulate the diffusion of post-thermalized positrons prior to annihilation in a sample volume. Incorporated into the diffusion process is a provision for trapping at atomic-scale defects. The type of defects, concentration of each defect type, and location of each defect within the sample volume are all input parameters controlled via a convenient, Java-enabled, user interface. The program is also designed to take advantage of parallel processor capabilities. Recent progress toward developing the program will be presented.

MO-POS-39

Are All Waves Localized in Two Dimension Random Media?. **Zhen Ye**, *National Central University, China* — It has been the prevailing view over the last two decades that all waves have to be localized in two dimensions for any given amount of randomness. Here I point out that this view may not be necessarily always valid. In this talk, I will discuss this controversial issue from four perspectives. First, we examine the predictions of the current theory, and check their validity against exactly computable cases. Second, we examine the previous numerical and experimental supports for their appropriateness. Third, we examine the self-conflicting points in the current diffusion mechanism based theory, and propose an apparent mechanism for localization, which is absent from the current theory. Finally I will discuss some possible ambiguities in the previous scaling analysis of Anderson localization in 2D which has provided the fundamental basis for a vast body of literature. All the points are supported by the recently published or to be published materials and have also been partially supported by investigations in other groups. I hope this talk can stimulate more discussion so a new theory can be formulated, be it a simple or embarrassing fact.

MO-POS-40

Thin Film MRI - High Resolution Depth Imaging with a Local Surface Coil and Spin Echo SPI. **Alexei V. Ouriadov**, Rodney P. MacGregor, and Bruce J. Balcom, *MRI Centre, University of New Brunswick* — A multiple echo single point imaging technique is presented for examination of thin film samples, with a local surface coil probe. Depth images with nominal resolution of 5 μm were acquired with acquisition times on the order of ten minutes. The method may be used to observe dynamic phenomenon such as polymerization, wetting, and drying in thin film samples. It is readily adapted to spatially resolved diffusion coefficient and T_2 relaxation time mapping.

MO-POS-41

Half-k Space SPRITE Imaging. **Kumud Deka**, Alexei V. Ouriadov, Rodney P. MacGregor and Bruce J. Balcom, *MRI Centre, University of New Brunswick* — This presentation will discuss recent developments in the half k space SPRITE Imaging method. These developments are intended to yield quantitative density profiles of both H and hetero-nuclear species. The hardware, software and pulse programming developments required to meet this goal will be discussed. Experimental density profiles will be shown as proof the technique.

MO-POS-42

Dynamical Spin Response of Heisenberg Antiferromagnets. **Kofi Asante** and Mohamed Azzouz, *Laurentian University* — Heisenberg spin bilayers and ladders have attracted considerable attention recently. We investigate the spin -1/2 Heisenberg bilayer and 3-leg ladder using a generalized Jordan -Wigner transformation. The dynamic spin response function is evaluated using Nambu formalism. In this poster, we will present our preliminary results.

MO-POS-43

Photoluminescence in Molybdenite. **Luc Charron**[a], L. Culiuc[b], Emery Fortin[a], Y. Braik[a], [a]*University of Ottawa*, [b]Academy of Science of Moldova — Photoluminescence was observed for the first time in both synthetic and natural transition metal dichalcogenide MoS_2. The emission is in the near infra-red between 1000 and 1500 nanometers. Two distinct regions were identified. The first region centered at 1054 nm and observed only in the synthetic material is produced by bound excitons related to the halogen transport agent intercalated within the layers during the growth process. The second weaker region consists of a broad band centered at 1300 nm and observed in both synthetic and natural molybdenite. A kinetic model based on zero-phonon bound exciton recombination is proposed to explain the temperature dependence of the radiative processes. Attempts are presently made to intercalate natural MoS_2 with halogen molecules in order to induce excitonic luminescence in that material.

MO-POS-44

Mn-Based Nano-Magnets in GaAs: The Role of Implantation Temperature. **C. Beaudoin**[a], F. Zavaliche[a b], S. Roorda[a], R. Cochrane[a] and T. Veres[b], [a]*Université de Montreal* and [b]Conseil National de Recherche du Canada — Magnetic nano-crystallites have been produced in bulk GaAs by ion implantation of $2(10^{16}$ Mn+/cm^{-2} at 1 MeV followed by annealing at 700(C. We found that the temperature during implantation is an important parameter in determining the final structure. When implanted at room temperature, transmission electron microscopy shows a high defect density and a strongly asymmetric depth distribution of crystallites. By contrast, when implanted at 150(C, samples have a low defect density and a spatial distribution of the nano-crystallites following that of the implanted ions. We will discuss the role of the implantation temperature in terms of defect concentration and mobility. Results of an initial magnetic investigation will be reported.

MO-POS-45

Exfoliated Single Molecular Layers of $MNPS_3$ and $CDPS_3$. **R.F. Frindt**, D. Yang and P. Westreich, *Simon Fraser University* — The layered compounds $MnPS_3$ and $CdPS_3$ have been exfoliated by ion exchange to form single molecular layers in suspension in water. The single layers have a layer size of about 400Ax400A and a thickness of 6.5A. The X-ray diffraction Bragg peaks of the single layer suspensions show the asymmetrical line shapes which are characteristic of two dimensional systems. Diffraction patterns generated by computer simulation are in excellent agreement with the observations. The single layers are highly transparent and have been characterized by XRF, optical and infrared absorption. New layered nanocomposites have been synthesized by restacking the single layers with organic molecules included between the layers.

MO-POS-46

A Structural and Electronic Study of Self-Organised Bi Antiwires*. **J.M. MacLeod**, J.A. Lipton-Duffin, A.G. Mark and A.B. McLean, *Queen's University* — Antiwires have successfully been grown on Si(001) by depositing Bi in the desorption regime. Scanning tunneling microscopy (STM) images indicate that the self-organised antiwires are almost completely devoid of defects or imperfections even though the surface on either side of the wires can cases contain a high areal density of silicon dimer vacancies. The wires have a width of approximately 1nm and wires with lengths in excess of 500 nm have been grown. Kinks have not been observed in the wires, suggesting that the energy penalty associated with kink formation is large. In agreement with previous work[1,2], our bias dependent imaging of the wires suggests that they are semiconducting and that they have an energy gap that exceeds the energy gap of silicon (hence their name). High-magnification images suggest the formation of Bi dimers within the antiwires. The images are compared with structural models of the antiwire system[2]. Low-magnification images reveal details of the fascinating antiwire growth mechanism on Si(001). Of particular interest is a dramatic re-arrangement of the silicon type-A step edges that allows the antiwires to extend over the step edges in 'peninsulas'. The antiwires also plough into type-B steps creating 'inlets'. The unusual growth mode is thought to be a consequence of anisotropic strain within the overlayer[3] and a detailed understanding of the growth mechanism may lead to methods for fabricating quasi-periodic semiconductor heterostructures and other nanowire structures on Si(001). The unoccupied antiwire bands lying between the Fermi level and the vacuum level are also being studied with k-resolved inverse photoemission (KRIPES), and the results of these studies will be presented.

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1. Miki *et al.*, *Physical Review B*, **59**, 23, 14868 (1999)
2. Miwa *et al.*, *Surface Science*, 507-10, 368-73 (2002)
3. Owen *et al.*, *Physical Review Letters*, **88**, 22 (2002)

MO-POS-47

Charge Density Waves in Quasi-One-Dimensional Compounds $A_vNb_3X_4$ (A = Tl, In, Zn; X = S, Se, Te; $0 < v < 1$). **J.C. Bennett**[a] A. Prodan[b], H.J.P. van Midden[b], F.W. Boswell[c] and H. Böhmd, [a]*Acadia University*, [b]Jo ef Stefan Institute, Slovenia, [c]University of Waterloo and [d]Institute of Geosciences, Johannes Gutenberg University, Germany — The crystal structure of the isostructural family of compounds Nb_3X_4 possesses zigzag chains of Nb atoms and, parallel to these, large hexagonal tunnels bounded by a network of deformed NbX_6 octahedra. These tunnels are large enough to accommodate the intercalation of foreign atoms without appreciably affecting the crystal structure of the host. As a result, this family constitutes a model system for examining directly the electronic effects of intercalation without accompanying structure related changes in the host band structure. One important aspect of this is related to charge density wave (CDW) formation. Electron diffraction observations of the associated periodic lattice distortion show that the intercalation of Tl and In into these compounds enhances CDW formation. Significantly, CDW may be induced by intercalation in hosts where they are not otherwise observed. Calculations carried out within the Huckel tight binding method (EHTB) reveal that these intercalates produce additional flattening and hence nesting of the Fermi surface. In contrast, Zn intercalation has been found to strongly suppress CDW formation in these compounds. The results of ETHB calculations for Zn intercalation will also be discussed in order to further elucidate the effects of charge transfer between the intercalate and host on CDW formation.

MO-POS-48

Critical Susceptibility of KDP with Random Fields. **D.R. Taylor** and J.G.A. Dane, *Queen's University* — It is postulated that the critical properties at the ferroelectric phase transition of As-doped KH_2PO_4 differ from pure KH_2PO_4 (KDP) because the As/V size mismatch introduces random fields. This substitution should not much alter the interactions, so As-doped KDP should provide a good test system for the random-field Ising model. We carried out precision capacitance bridge measurements to compare the susceptibility critical exponents for pure KDP and $KH_2As_{0.4}P_{0.6}O_4$. For KDP, for which the critical behaviour is still not entirely established, our results indicate classical exponents with logarithmic corrections over most of the measured temperature range. Close to the transition there is evidence for a crossover to classical behaviour consistent with a coupling to a uniform strain. For the As-doped sample, the results again show classical exponents with logarithmic corrections over most of the temperature range. Closer to the transition temperature, the effective exponent increases rather than decreasing as in KDP, a change in this direction is consistent with random-field theory. As the temperature is further lowered, however, the data show oscillatory behaviour which is not consistent with any model, but which might arise from equilibration problems.

MO-POS-49

Electrochromic Performance of Nanostructured Sputter Deposited Molybdenum Oxide Thin Films*. A. Taj and **P.V. Ashrit**, *Université de Moncton* — The ability to induce reversible coloration in transition metal oxide thin films such as Tungsten Trioxide (WO_3) and Molybdenum Oxide (MoO_3) has attracted lot of attention of researchers both from the application point of view as well as from the understanding point of view of the underlying electrochromic (EC) phenomenon. Much of the work in this area has been focused for the last couple of decades on the EC performance of WO_3 films. Although, these films exhibit a highly efficient EC coloration, recent work carried out in our laboratory and elsewhere strongly suggests that the EC performance of other transition metal oxide (TMO) thin films can be improved significantly by working with the nanostructured (NS) forms of these films. The high degree of porosity found in such films is expected to enhance the diffusion of the intercalated species and to lead to a more efficient EC coloration. The EC performance of nanostructured (NS) sputter deposited Molybdenum Oxide (MoO_3) thin films has been examined under lithium insertion. A dry method of insertion of neutral lithium atoms is used for this study. The evolution of the optical properties (T,R,n,k) and nanostructure is followed carefully as a function of the quantity of lithium inserted. Results show a very efficient EC coloration in such films, especially, in the visible region of the spectra.

* NSERC support is gratefully acknowledged

MO-POS-50

AFM Measurement of Cell Elasticity as a Possible Tool for Cell-Culture Studies of Drug Action*. **D.C. Dahn**, S. Arsenault, F. Solomon, and R.A. Younker, *University of Prince Edward Island* — Drugs and other chemical agents that affect the cell membrane are expected to influence cell elasticity and strength. It may be possible to detect adverse effects at concentrations below those necessary to cause cell mortality, by monitoring the mechanical properties of cells before and during the introduction of such a chemical agent into the medium surrounding them. We have modified a home-built AFM in preparation for this work. Force-distance measurements and force mapping techniques can be used. This poster describes the AFM system, and reports on preliminary work with normal cells.

*Work supported by NSERC.

MO-POS-51

Single Crystal Growth of Si$_{1-x}$Ge$_x$ Alloys using the Traveling Solvent Method*. D. Labrie[a], A.E. George[a], S. Obruchkov[a], M. Jamieson[a], D.C. Mackay[a], B.E. Paton[a] and M.Z. Saghir[b], [a]*Dalhousie University* and [b]Ryerson University — Recently, there has been a resurgence in the crystal growth of Si$_{1-x}$Ge$_x$ alloys due to the fabrication of high speed electronic and optoelectronic devices based on Si$_{1-x}$Ge$_x$/Si heterostructures. Although Si and Ge are completely miscible in the alloy throughout the whole composition range, the Si$_{1-x}$Ge$_x$ system suffers from strong segregation and, together with the large density difference between molten Si and Ge lead to macro- and micro-segregation in the alloy system. Bridgman, Czochralski, and Float Zone techniques were employed toward the growth of bulk Si$_{1-x}$Ge$_x$ crystals but with limited success. The grown crystals exhibited macro segregation and microscopic striation along the growth axis, polycrystallinity, and high etch pit density. In this study, we present results on the crystal growth of Si$_{1-x}$Ge$_x$ alloy with [Si] composition ranging from 2 to 15 at. %, using the TSM method and theoretical predictions on the fluid flow dynamics within the molten SiGe solvent in 1g and μg.

* Work supported in part by NSERC (and the Canadian Space Agency).

MO-POS-52

Embedded Molecular Clusters: Group III Nitrides*. J.M. Vail[a], M.A. Blanco[b], A. Costales[b], H. Jiang[c], R. Pandey[c], O. Penner[a], Q.C. Qiu[d], Y. Xu[e], and A. Yang[a], [a]*University of Manitoba*, [b]Universidad de Oviedo, Spain, [c]Michigan Technological University, [d]Shantou University, PR China and [e]Lanzhou University, PR China — We are examining the applicability of embedded molecular clusters to local properties in Group III nitndes. Their applicability to highly ionic materials has been extensively demonstrated. Their special merits are accurate treatment of long-range dielectric polarization for charged point defects, and optical transitions based on the Hartree-Fock approximation. Heretofore, density-functional large-unit-cell methods have been extensively applied to ground state properties in these materials. We hope to complement these studies. Our first objective is optical excitation of nitrogen vacancies in different charge states. Our approach is based on consistent treatment of band structure, host-species pseudopotentials, and local properties based on molecular clusters embedded in a classical shell-model crystal. We report early results for AlN and GaN, identifying current shortcomings of the model, and presenting some ground-state results for nitrogen vacancies in charge states +3 and +1 in AlN.

* Work supported in part by NSERC Canada, Spanish DGICyT grant BQU2000-0466, and by NATO, Spanish MEC and Principado de Astrias scholarships.

MO-POS-53

The Use of Thermopower to Investigate Reduced Dimensionality Materials*. R. Fletcher, *Queen's University* — During the last decade, 2-dimensional semiconductor systems have provided almost ideal test cases for comparing theories and experiments on thermoelectricity. Agreement, usually with no free parameters, is now typically excellent so that thermoelectric properties have become a reliable tool for investigating new systems, *e.g.* composite Fermions. This presentation uses some recent examples, both published and unpublished, to bring this to the attention of a general audience. The thermopower has two contributions, diffusion and phonon-drag. The former gives information about the elastic scattering of electrons and the well-known Mott relation connecting resistivity and diffusion thermopower has been tested in various 2D systems to a precision of a few percent making use of magnetic quantization. Experimental 2D examples are known which demonstrate the expected fundamental relation between diffusion thermopower and entropy, and the relation has also been demonstrated in a 3D system at high magnetic fields for the first time. Phonon-drag has been shown to give the electron-phonon (momentum) relaxation time, exactly the same quantity as measured by resistivity. However, unlike resistivity, phonon-drag can be measured accurately even when electron-impurity scattering is overwhelmingly dominant. This has enabled electron-phonon scattering to be investigated in some interesting situations where it might otherwise have been inaccessible, *e.g.*, in double quantum wells with tunneling, and in systems showing weak or strong localization.

* Work supported by NSERC.

MO-POS-54

Systematic Study of Optical Surface Relief Grating Formation in Azobenzene Polymer Thin Films. K. Yager, and C. Barrett, *McGill University* — The free surface of azobenzene-polymer thin films exhibits peculiar mass transport at optical lengthscales when exposed to laser-light intensity and/or polarization gradients. The formation of Surface Relief Gratings (SRGs) in these films is a function of writing parameters, such as inscription power and time, as well as material properties, such as nature of the chromophore, and polymer molecular weight. SRG formation was investigated in very thin films as a novel nano-fabrication technique, based on controlled substrate dewetting. It was found, however, that mass transport is hindered in very thin films, highlighting material resolution limitations. Solid-state combinatorial techniques were then used to more fully elucidate the dependence of grating inscription on parameters such as light intensity, film thickness, and substrate surface energy. These results are combined with studies of heating effects in order to suggest origins for the driving force in SRG formation.

MO-POS-55

Model Colloids for Viscoelastic Studies. B.J. Frisken, J. Gao, and Y. Sun, *Simon Fraser University* — We have been investigating properties of microgel particles made by free-radical polymerization of N-isopropylacrylamide (NIPAM) in water. Usually, these particles are formed during polymerization in the presence of an added crosslinker, typically N,N'-methylene bis(acrylamide) (BIS), but we have also found that we can make stable particles in the absence of added crosslinker. These particles decrease in size upon heating as the polymer undergoes a coil-globule transition. The temperature-dependence of their size, as well as crosslinking-dependent physical properties, make them good candidates for viscoelastic studies of colloidal solutions. Requirements for stable particle formation, physical properties of the particles, and viscoelastic properties of particle solutions will be discussed.

MO-POS-56

The Effects of Hydrodynamics on Polymer Collapse: A Computer Simulation Study. James M. Polson, Emma Falck and Ilpo Vattulainen, *University of Prince Edward Island* — Polymer collapse is a process in which a single polymer molecule undergoes a transition from a swollen coil to a compact globule upon a sudden change in solvent conditions. It is believed to be similar to the early stages of protein folding. The rate of collapse and the dynamical pathway the polymer follows through the transition are expected to be strongly affected by the properties of the solvent. Analytical theories of polymer collapse predict that indirect monomer-monomer interactions mediated by the solvent hydrodynamic modes lead to a considerably different scaling behaviour of the collapse times than that predicted in the case where hydrodynamic interactions are not included. In this study, we employ the novel simulation method of Malevanets and Kapral (*Journal of Chemical Physics*, **112**, 7260 (2000)) which uses a coarse-grained description of a solvent that is designed to preserve the hydrodynamic modes, to investigate the effects of hydrodynamics on polymer collapse. We investigate the time-dependence of the polymer radius of gyration during collapse, and determine the scaling behaviour of the associated collapse times and prefactors with polymer length. The simulation results are compared to the theoretical predictions of Pitard (*European Physical Journal B*, **7**, 665 (1999)). We find some quantitative agreement between simulation and theory, though we find considerable disagreement, as well. We attribute the discrepancy primarily to the approximations used in the theory. Finally, we describe the advantages and limitations of employing the coarse-grained model solvent to study collapse dynamics of polymers.

MO-POS-57

Effect of Annealing of Polystyrene Films in the Freely-Standing State. Chris Murray and John Dutcher, *University of Guelph* — Spincoating of dilute polymer solutions is a powerful technique to prepare thin, uniform polymer films. Spincoated films on substrates are typically annealed under vacuum at temperatures above T_g and it is supposed that the interaction between the substrate and the polymer is small enough to allow equilibration of the film. We have removed the films from the substrate after annealing and then annealed the films in the freely-standing state to temperatures low enough that hole formation was not observed. Using ellipsometry, optical and atomic force microscopy, we have observed small, irreversible changes in the indices of refraction parallel and perpendicular to the plane of the film and in the radial thickness profiles of the freely-standing portions of the films. The measured values for the freely-standing portions of the films approach constant values with time, and they are compared to those measured for the supported portions of the films. Based on these observations, we suggest a mechanism for the observed changes to the optical anisotropy and film thickness and discuss the implications of these results on previous studies.

MO-POS-58

Ion-Cutting 100-nm Silicon Slices. N. Desrosiers and B. Terreault, *INRS- Énergie, Matériaux et Télécommunications* — We investigate the ion-cut process using low keV H and He ions instead of the standard H ions of tens of keV. We target an ion projected range of 100 nm or less, hopefully allowing the transfer of silicon layers of sub-100-nm thickness. However, we have found that: (i) the extrapolation to low energy is not straightforward; and (ii) the conditions required for ion-cutting then differ to an unexpected extent from those leading to simple blistering. Numerous Si samples with (100) and (110) orientation were implanted at room temperature with 5 keV H or D ions or 8 keV He ions, singly or in combination, to total fluences of 2×10^{16} to 1×10^{17} atom/cm^2, also interchanging the order of the successive implantations. Following a modified RCA treatment, the implanted samples were then hydrophilically bonded to a handle wafer, before submitting them to linear ramp anneals at 10°C/min up to 800°C. Annealing was performed under vacuum to allow simultaneous thermal desorption spectrometry measurements. The optimal parameters (ion type, dose, implantation order) to split off the implanted layers and transfer them to the handle wafer were determined. Finally, we inspected the transferred surfaces by atomic force microscopy to characterize their quality, *i.e.* their flatness and absence of debris, in order assess their suitability for device fabrication. With H ions, for both Si(100) and Si(110), a higher dose (more than 1×10^{17} H/cm^2) than for the standard ion-cut process (5×10^{16} H/cm^2) is required, due to early desorption (around 300°C) during annealing; for He alone, a rather high threshold (7×10^{16} He/cm^2) was also found. Co-implantation is an efficient way to reduce the total dose required. The splitting occurs for combined doses of 2.5×10^{16} H/cm^2, followed by 1×10^{16} He/cm^2 – which are still higher, however, than the minimum doses at high energy (1×10^{16} each). If we inverse the implantation order (He before H), the flatness of the transferred layers is poor. This result is in marked contrast with that obtained for blistering at the same energies, where it was found that blistering occurred at very much smaller doses if He was implanted first. This indicates that the initial configuration of the defects, before a second gas is implanted, sets the stage for the subsequent evolution of the implants during the thermal treatment. We hypothetize that the basically spherical cavities produced by helium implantation constitute natural precorsors for dome-shaped blisters, and moreover that the high amount displacements efficiently traps the subsequently implanted H, preventing its premature release during the anneal. On the other hand, layer splitting requires lateral coalescence of the gas bubbles; in that case, the flat platelets produced by a preliminary H implantation are essential.

MO-POS-59

Nanocalorimetry: Thermal Processes Studied at the Atomic Scale. **R. Karmouche**, J.-F. Mercure and F. Schiettekatte, *Université de Montréal* — Nanocalorimetry is a promising technique to look at thermal processes at the microscopic scale. This analysis method is derived from differential scanning calorimetry (DSC) and adapted to systems involving processes with energies of the order a few nanojoules, typically thin layers or surface phenomena. Our calorimeters consist of a thin Si_3Nx membrane. A metal strip is deposited on one face, which will be used to heat a sample by simple induction of a current, at rates reaching 106 K/s. The fast heating rate and the small thickness of the membrane both contribute to minimize radiative and conductive losses. The different steps of calorimeter fabrication will be reviewed. First, a thin Si_xNx layer (90 nm) is deposited on both faces of a silicon wafer by LPCVD. The wafer is then etched by Reactive Ion Etching and selective chemical etching in order to open Si_3Nx windows of a few millimeters in width. A thin (20-50 nm) platinum layer is deposited on the membrane, which will be used both as a heater and thermistor in order to measure the temperature in real-time during the experiments. Different applications of the technique will then be discussed, including the thermal properties of thin indium layers.

MO-POS-60

Effects of Higher Order Harmonics in the Gap on High T_c Superconducting Properties. **Hitomi Kumakura**, *University of Guelph* — Effects of higher-order harmonics in the *d*-wave gap have recently been suggested by some experiments on high-T_c superconductor. For some materials, electron-doped ones for example, properties calculated using only the first harmonic in the d-wave gap do not agree with experiments. By including the effects of higher-order harmonics, we can reproduce variations in the d-wave gap symmetry, such as non-monotonic variations revealed by Raman scattering (G. Blumberg *et al.*, 2002). We investigate the effects of those harmonics, in the cases of a circular Fermi Surface and a tight-binding Fermi Surface, by calculating important properties such as the energy-dependent density of states, the specific heat jump at T_c, the gap ratio, and the temperature-dependent penetration depth.

MO-POS-61

Surface Stress, Kinetics and Structure of Alkanethiol Self-Assembled Monolayer. **Peter Williams**, Michel Godin, Olivier Laroche, Vincent Tabard-Cossa, L.Y. Beaulieu, Bruce Lennox and Peter Grutter, *Acadia University* — The surface stress induced during the formation of alkanethiol self-assembled monolayers (SAM) on gold from the vapor phase was measured using a micromechanical cantilever-based chemical sensor. Simultaneous *in-situ* thickness measurements were carried out using an ellipsometer. *Ex-situ* scanning tunneling microscopy was performed in air to ascertain final monolayer structure. The evolution of the surface stress induced during SAM formation exhibits features associated with the structural phase transitions of the monolayer. Our results show that both the kinetics of SAM formation and the resulting SAM structure are strongly influenced by the surface structure of the underlying gold substrate and by the diffusion rate of the vapor alkanethiol towards the gold surface. The adsorption onto gold surfaces having large, flat grains produced high quality self-assembled monolayers, as opposed to those formed on gold with smaller grains. An induced surface stress of 31.78 ± 0.01 N/m was measured for the formation of a C(4x2) dodecanethiol SAM on gold.

MO-POS-62

Characterization of Magnetron Sputtered Metallic Thin Film Coatings Using Atomic Force Microscopy and X-Ray Photoelectron Spectroscopic Techniques. **Andranik Sarkissian** and Claude Côté, *Plasmionique Inc.* — Surface Engineering applications using physical vapor deposition (PVD) and plasma-enhanced chemical vapor deposition (PECVD) are increasingly becoming important in variety of fields. The domain and the extent of the application of the deposited thin films are defined by their optical, electrical, mechanical and chemical characteristics of the film. We have used Atomic Force Microscopy (AFM) to study the surface morphology of the treated surfaces before and after film deposition. Some tribological properties of the deposited films, such as friction on nano scale can also be studied using AFM. The chemical composition and purity of the deposited films have been studied using x-ray photoelectron spectroscopic (XPS) techniques. In this presentation we report on studies that we have carried out on deposition of Gold and Silver thin films on metallic and polymeric surfaces. Some preliminary studies related to factors influencing the film adhesions characteristics have also studied and will be discussed.

MO-POS-63

Influence of Poly (Ethylene Glycol) on the Formation of Nonocrystalline TiO_2 Thin Films Subjected to a Low Temperature Water Treatment. **Jacques Robichaud** and Yahia D. Djaoued, *Université de Moncton* — Sol-gel solutions of titanium dioxide were prepared by hydrolyses and polycondensation of tetrabutyl titanate. In order to see the influence of poly (ethylene glycol) (PEG) on thin films formation, solutions were prepared in the presence of PEG with different molecular weight PEG (200, 400, 600, 1000). A reference solution with no PEG was also prepared. Films were subsequently deposited on soda-lime glass and silicon wafer substrates by a sol-gel dip coating method followed by a hot water treatment. Densification and crystallization of the films was found to result from the thermal treatment of the dip coated films in hot water. The films were characterized using UV-Vis, FTIR and Raman sprectroscopy, AFM and ellipsometry. The film thickness ranged from 136 nm to 396 nm and showed high transmittance, with a refractive index in the 1.62 to 1.87 range. The calculated porosity was from 53% to 70%. FTIR and Raman spectroscopy confirmed the presence of the anatase phase of TiO_2.

MO-POS-64

Electrical Resistance and Microstructure of Bi-In Alloy Films. **O. Rajora**[a], and K.L. Kavanagh[b], [a]*University College of the Cariboo* and [b]Simon Fraser University — Bi-In alloy films are of interest because of their potential applications as extreme UV, thermal resists for microfabrication of electronic components[1]. Little is known about basic properties including the relationships between electrical resistance, composition, and the microstructure of Bi-In films as a function of temperature. Films were prepared by thermally evaporating In and Bi simultaneously from separate tungsten filaments in a vacuum of about $7x10^{-6}$ torr. The film composition was varied by changing the electrical power input to the filaments. Depositions were carried out at room temperature onto glass slide substrates for resistance measurements, and onto carbon-coated, 200 mesh, copper grids for electron microscopy. The microstructure of the films was examined in a Hitachi-8000 transmission electron microscope. The resistance, R, of Bi-rich alloy films decreased as the temperature, T, was increased above room temperature. This R versus T variation is similar to that observed for pure Bi films and is believed to be due to an increase in the number of charge carriers with increasing temperature[2]. As the film temperature approached the melting point, the resistance increased at first slowly and then discontinuously. The resistance of In-rich alloy films increased linearly with increasing temperature as long as the film temperature was below its melting point. However, the increase in R became very rapid near and beyond the melting point of the film. The microstructure of the films was composition dependent. The In-rich films had an island structure and tended to be electrically discontinuous until the film thickness became fairly large (about 50 nm). Bi-rich films, on the other hand, became electrically continuous at fairly low thickness values. Some alloy films were heated in air in a furnace to 4000C for a few hours. As-deposited films had a silvery metallic appearance and were opaque and electrically conducting. After heating, most of the samples became non-metallic in appearance, were semi- to almost totally transparent in visible light, and non-conducting. A Bi-In film with 61 at % Bi, however, became purple in appearance after heating and was electrically conducting. Auger analysis showed that all films oxidized after the heat treatment in the furnace.

1. Glenn H. Chapman, Yuqiang Tu, Marinko V. Sarunic, "Bi/In Bimetallic Thermal Resist for Microfabrication, Photomasks and Micromachining Applications": Proceedings SPIE Microlithigraphy conference, Advances in Resist Technology and Processing XIX, San Jose, CA, 2002
2. R.A.Hoffman and D.R. Frankl, *Phys. Rev. B*, 3, 1825, 1971

MO-POS-65

AFM Studies of the pH-Dependant Mechanical and Structural Properties of Polyelectrolyte Multilayer Assemblies. **O. Mermut**, J. Lefebvre, D.G. Gray, C.J. Barrett, *McGill University* — The structural properties of multilayer films prepared from weakly charged polyelectrolytes, poly(allylamine hydrochloride),PAH, and azobenzene-containing P-Azo were investigated as a function of their assembly pH by AFM. The relative elastic modulus of the multilayer films, as well as the adhesion forces between the assembled polymer layers were determined by force-distance measurements obtained in order to compare films assembled at varying polymer charge densities. Films prepared from polymers having a reduced charge density (assembly pH = 9.0 and pH = 10.5) exhibited a reduced elastic modulus, by at least an order of magnitude, in comparison to multilayer films made from highly charged polyelectrolytes (assembly pH = 5.0 and pH = 7.0). The differences in the film elasticity can be related to the difference in the ionic crosslink density formed between polycation and polyanion repeat units in films prepared at varying pH values. This provides an estimate of loop length between ionic contacts in the film. The adhesion between polycation and polyanion layers was measured by performing nano-indentation experiments in water on a multilayer film using a modified AFM tip coated with the same multilayer film but containing an oppositely charged surface polymer layer. The values of adhesion were also found to be dependent on the ionic crosslink density of PAH/P-Azo multilayer films produced from polyelectrolytes having varying ionization fraction.

MO-POS-66

Nanostructure dependent Electrochromic and Photochromic Performance of Molybdenum Oxide (MoO_3) Thin Films. R. Taj and **P.V. Ashrit**, *Université de Moncton* — Chromogenic materials are those in which a reversible coloration can be induced through the influence of an electric field (electrochromics) or light (photochromics) or heat (thermochromics) and other stimuli. The study of such materials has become important both from the point of view of grasping the underlying physics as well as from their application point. Transition metal oxides (TMO) with their multiple oxidation states have been found to be the most suitable candidates in which these external stimuli can induce reversible transition between these states producing the optical changes in these materials. Lately, it has been found that the nanostructuring of these materials in thin film form leads to a significant improvement in their chromogenic performance. Thermally evaporated Molybdenum oxide (MoO_3) films have been studied for their photochromic (PC) and electrochromc (EC) performance as a function of the film nanostructure. Variation of the film structure is induced through different degrees of heat treatment of the films. Results show a fairly efficient EC and PC performance which can be tailored as per need. The high coloration efficiency of the as deposited films in the visible region can be spread to a broader wavelength region by altering their nanostructure.

* The research support of NSERC is gratefully acknowledged.

MO-POS-67

Exact Diagonalization of the S = 1/2 Ferromagnet on a New Set of Finite Triangular Lattices at T = 0. **D.D. Betts**, K.S. Lee and H.Q. Lee, *University of Dalhousie* — This paper introduces a much larger number, 85, finite triangular lattices from 7 to 36 vertices. They are used via exact diagonalization to obtain precisely several properties of the spin one-half XY ferromagnet at zero temperature on the infinite triangular lattice.

MO-POS-68

A New Method for the S = 1/2 Antiferromagnetic Ising Model's Properties at any Temperature and any Magnetic Field on the Infinite Square Lattice. S.J. Penney, V.K. Cumyn, **D.D. Betts**. *Dalhousie University* — Since the introduction of the spin one-half Ising model on the square lattice, many hundreds of articles have dealt with several properties of the ferromagnetic Ising model, but very few articles had included the antiferromagnetic Ising model. We have known that the Ising antiferromagnetism on a bipartite lattice is not zero in a considerable area of the magnetic field, H, and temperature, T. Now we present the dimensionless specific heat, C, and susceptibility, x, per vertex using a new method to obtain the data in about ten thousand points in the interesting (T, H) area. Our last four Figures show the contours and the smooth hills and valleys of C and of x.

MO-POS-69

Finding Low-Energy Atomic Cluster Conformations using Evolutionary Algorithms. **R.J.W. Hodgson**. *University of Ottawa* — The study of the structures and properties of small clusters of atoms, such as Si and C, have been the focus of numerous experimental and theoretical investigations in recent years. The structures of clusters are known to be quite different from those in bulk material. Studies indicate that there are various kinds of isomers for these clusters. The problem of determining the lowest energy conformations of the different isomers is a very challenging one. The number of local minima on the energy surface increases exponentially with the number of atoms in the cluster. Hence finding the lowest energy conformations requires new and novel techniques. In this study we use this test bed to evaluate a few evolutionary algorithms in order to find their strengths and weaknesses.

MO-POS-70

Investigation of the Temperature-Pressure Phase Diagram of $Rb_4LiH_3(SO_4)_4$. W.L. **Wu**, G. Quirion and B. Mroz, *Memorial University of Newfoundland* — The ferroelastic compound $Rb_4LiH_3(SO_4)_4$ is known to undergo a second order phase transition around 135 K. It is now believed that this transition is associated to a 4 – 2 point-group symmetry change rather than a 4mm - mm2 type as initially proposed. By mean of ultrasonic sound velocity measurements, we have investigated the elastic properties of $Rb_4LiH_3(SO_4)_4$ along different directions using longitudinal and transverse waves. Excepted for the results obtained along the [100] direction, our measurements agree with the data previously obtained by Brillouin scattering measurements. We have also measured the temperature dependence of the sound velocity at different pressures. Our results on $Rb_4LiH_3(SO_4)_4$ single crystals show that the transition temperature T_c increase rapidly with pressure at a rate of dTc/dP = 19.1 K/kbar. The experimental results are also compared to predictions based on a Landau type analysis.

MO-POS-71

Gravity Effects on the Nucleation Stage of Organic Thin Film Growth*. Jesse **Mea**, Serge Gauvin and P.V. Ashrit, *Université de Moncton* — Physical vapour transport method (PVT) of thin film preparation is found to be the most suitable one for preparation of organic thin films in order to exploit their molecular level structure and crystal orientation properties. However, the gravity induced convection effects play an important role in film formation and to a large extent hinder the ultimate optimization of the required microstructure when these films are produced in 1-g conditions. Our earlier work[1] on the growth of organic PTCDA thin films by the physical vapor transport (PVT) method in microgravity and unit gravity conditions confirmed the strong influence the gravity has on the film microstructure. In comparison with the 1-*g* (laboratory) grown samples, the microgravity (space) grown films showed a much higher degree of homogeneity and uniform crystal orientation. These interesting results prompted us to examine the nucleation phase of organic thin films growth and the influence of gravity on the film formation at this phase. Nucleation being the early stage growth of the films, occurs in a short time period and hence the related experiments are amenable to the short duration microgravity conditions produced aboard the parabolic flights. The work presented here pertains to the study of gravity effects on the nucleation stage growth of *N,N'*-Bis-(3-methyphenyl)-*N,N*-bis-phenylbenzidine, a well known *triphenyl derivative* (TPD), working as an organic hole transporting material used in a two layer organic light emitting diodes (OLED). The nucleation experiments on TPD growth have been carried out in 1-*g* and low-*g* conditions using PVT cells. With the ultimate aim of examining the electroluminescence (EL) properties of these film in device form, the films for this study were deposited on ITO coated glass substrates. NRC's Falcon-20 parabolic flight aircraft, which is capable of producing short duration (20 seconds) low-g conditions, is used for the low-*g* set of experiments. The important challenge of this study was to achieve the sublimation and condensation of the film in this short duration. This important issue of experimental adaptation to the short duration restrictions of parabolic flights has been addressed adequately and presented here in detail. For the 1-g studies the TPD thin film samples have been prepared under different relative g orientations, aspect ratios and different deposition times. The results on the effect of gravity and aspect ratio on the TPD microstructure are discussed.

* Work supported by the Canadian Space Agency

1. P.V.Ashrit, Vo-Van Truong, *Organic Materials Processing in microgravity by the physical vapor transport (PVT) method*. Symposium on Microgravity and Crystal Growth, Shizuoka University, Hamamatsu, Japan, 8-11, November, 1998.

MO-POS-72

A Metastable Lamellar Phase, Populated with Defects and Induced by Macroscopic Confinement. J. Katsaras, M.-P. Nieh and T.A. Harroun, *National Research Council* — Using small-angle neutron scattering we have studied the structure of a negatively charged lipid mixture composed of long- and short-chain phosphatidylcholines namely, DMPC/DMPG and DHPC, respectively. In a sample cell with a 1 mm gap and as a function of increasing temperature, the system underwent a phase transition from a bilayered micelle to a perforated lamellar phase consisting of two highly aligned, orientationally distinct lamellar domains. Moreover, scattering was observed which we attributed to defects lying on a two-dimensional lattice. These defects occur at the interfaces between the two lamellar domains and can be annealed away either in time or by perturbation of the sample by centrifugation, into aligned lipid bilayer stacks of single orientation.

[MO-POS] MEDICAL AND BIOLOGICAL PHYSICS / *PHYSIQUE MÉDICALE ET BIOLOGIQUE* — Monday / *Lundi*

MO-POS-73

Elasticity of Membrane Vesicle Isolated from Pseudomonas Aeruginosa. **O. Stoica**[a], A. Tuanyok[a], X. Yao[a], M. Jericho[a], D. Pink[b], and T. Beveridge[c], [a]*Dalhousie University*, [b]St. Francis Xavier University and [c]University of Guelph — Most Gram-negative bacteria produce membrane vesicle (MV's) during normal growth. Since MV's retain the intrinsic asymmetry of lipids unique to Gram-negative outer membrane (*i.e.* lipopolysaccharide [LPS] on the outer membrane face and phospholipids on the inner face) they form an important biological bilayer system to study. In recent years their biochemical properties have been extensively investigated and an effective vesicle-derived drug delivery system is being developed. Little is known about their physical properties, however. Using Atomic Force Microscopy we have investigated both dried and hydrated LPS micelles and MV's form Pseudomonas aeruginosa. Micelles allowed the measurement of thickness of pure LPS bilayer. The minimum measured thickness of MV's bilayers was consistent with the LPS layer thickness plus the known thickness of phospholipid layers. The average thickness of dried MV's was larger than observed minimum suggesting that considerable amounts of periplasmic material was trapped inside MV's. Contact mode imaging of hydrated MV's was impossible because of weak adhesion of MV's to the substrate. For overcoming this problem we developed a modified AC method for imaging which enabled us to carry on elasticity measurements simultaneously. Our measurements show a linear, spring like, response (k=0.05...0.1 N/m) which can not be accounted for in terms of Hertz model or envelope bending energy and we advance the hypothesis that the linear response is caused by an osmotic pressure effect due to the protein content trapped inside.

[MO-POS] NUCLEAR PHYSICS / *PHYSIQUE NUCLÉAIRE* — Monday / *Lundi*

MO-POS-74

Photonuclear Physics with the Blowfish Detector at HIGS. B. Bewer[a], D. Chabot[a], A. Del Frari[a], R. Igarashi[a], J. Ives[a], N. Kolb[a], W.E. Norum[a], R. Pywell[a], T. Regier[a], B. Norum[b], B. Sawatzky[b], K. Wang[b], M. Ahmed[c], C. Howell[c] and H. Weller[c], [a]*University of Saskatchewan*, [b]University of Virginia and [c]Duke University — Blowfish is an 88-cell neutron detector array that covers approximately one quarter of 4 Pi. It's construction and use are a collaborative effort between the University of Saskatchewan, the University of Virginia, and Duke University. The Blowfish detector is undergoing upgrades which include a faster data acquisition system and an online gain monitoring system. Also included in the upgrade is a beam monitor, which will determine the beam profile and flux. Blowfish's large solid angle is ideal for many experiments at the High Intensity Gamma Source (HIGS). The Blowfish detector has been used to examine asymmetries in the photo-disintegration of unpolarized deuterium by linearly polarized gamma-rays (2.5 - 6.0 MeV). Future experiments at HIGS using Blowfish include the Gerasimov-Drell-Hearn sum rule for the deuteron and few-body physics through photo-disintegration.

MO-POS-75

Unusual Residual Nucleus Feeding Patterns from Fusion-Evaporation Reactions. **Roby Austin**, D.E. Appelbe, G.C. Ball, M.P. Carpenter, R.M. Clark, M. Cromaz, R.V.F. Janssens, A.O. Macchiavelli, D.G. Sarantites, C.E. Svensson and J.C. Waddington, *McMaster University* — In fusion-evaporation reactions, the usual pattern of feeding of the residual nucleus is that particle decays populate states in regions of very high level density. The residual nucleus then de-excites by statistical γ decays to discrete states followed by discrete γ decays to the ground state. What will be presented here is evidence from one reaction that some of the feeding of final nuclei takes place by an atypical direct particle decay to discrete states followed by discrete γ-ray emission. Moreover, the strong preference of this feeding for some states over others is used as an indication of the spin of the final particle.

[MO-POS] OPTICS AND PHOTONICS / OPTIQUE ET PHOTONIQUE — Monday / Lundi

MO-POS-76

Focusing Properties of the Pattern-Polymerized Liquid Crystal/Polymer Composites. **V.V. Presnyakov**, A. Yavrian and T.V. Galstian*, *Université Laval* — We discuss a new approach to create a tunable liquid crystal lens. The approach is based on curing of a liquid crystals/polymer mixture with Gaussian shaped laser beam to induce spatially inhomogeneous polymer network formation. Applying a uniform voltage to the on-pixilated cell leads to circular-symmetric (lens-like) distribution of refractive index in the cell. In this paper we carry out numerical analysis of the focusing properties of such lenses and compare them with our experimental results.

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MO-POS-77

Conception d'un spectromètre optique basé sur un réseau à pas variable*. **G. Fortin**, M. Duval, N. McCarthy et M. Piché, *Université Laval* — Les réseaux de surface permettent de séparer angulairement les différentes longueurs d'onde d'un faisceau lumineux. Ces réseaux sont fréquemment utilisés en rotation dans des spectromètres optiques dont les dimensions augmentent avec la résolution spectrale. Pour améliorer cette situation, nous avons conçu un spectromètre utilisant un réseau à pas variable produit à l'aide d'une technique holographique que nous avons développée. La technique consiste à introduire une différence de rayons de courbure entre les faisceaux d'écriture, incidents sur un substrat recouvert de résine photosensible, au moyen de lentilles cylindriques. Le pas variable obtenu donne au réseau des propriétés de focalisation qui affranchissent le spectromètre des miroirs courbes usuels et qui permettent de diminuer significativement ses dimensions. Nous utilisons un réseau dont la réflectivité dans l'ordre -1, pour une longueur d'onde de 632.8 nm, demeure supérieure à 10 % sur une largeur de 1.9 cm et atteint 64% au centre. La valeur du pas passe de 495 à 619 nm sur cette distance. Une fois calibré à l'aide de deux longueurs d'onde connues, le spectromètre détermine correctement les longueurs d'onde des raies émises par un laser argon continu, avec un écart maximal de 0.06 nm par rapport aux valeurs établies. Notre résolution d'acquisition des mesures est de 0.02 nm, ce qui est plus précis que celle de certains spectromètres optiques compacts à matrice linéaire CCD. Nous procédons actuellement à la comparaison des mesures de notre spectromètre, pour un faisceau dont le spectre contient une structure beaucoup plus fine, avec celles d'un spectromètre commercial à haute résolution pour lequel l'acquisition des données atteint une résolution de 0.001 nm.

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MO-POS-78

Wavelength Tunable Ultra-Short Optical Pulses From Asymmetric Quantum Well Semiconductor Devices*, M.J. Brennan, **A.J. Budz**, J.N. Milgram, P. Mascher and H.K. Haugen, *McMaster University* — In this paper, we report on the generation of ultra-short light pulses with a broad tuning range using a passively mode-locked asymmetric-quantum-well (AQW) laser. One of the key design features of the laser used in this experiment is the incorporation of a bend in the waveguide, which allows the device to be mounted in a compact, linear external cavity. Using this configuration, pulses 2 to 4 ps in duration have been generated, tunable from 954 to 10^{15} nm. The shortest pulse obtained with post-compression measured 470 fs in duration. Post-amplification of the pulses using AQW semiconductor optical amplifiers (SOA's) makes the system much more attractive from an application standpoint. Current SOA devices under study include both narrow stripe and flared waveguide geometries.

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MO-POS-79

Materiaux hybride organique- inorganique pour l'optique non lineaire. **Mireille Ellaya**, Nathalie Perret, Inna Perepichka, Jean-Claude Kieffer, Lê Dao, *INRS-EMT* — Les matériaux organiques possédant des propriétés optiques non linéaires sont intensement étudiés aujourd'hui du fait de leurs applications potentielles aux technologies opto-electroniques. Integrer ces molecules dans une matrice inorganique réticulée permettrait une plus grande stabilité des propriétés optiques en température et dans le temps. Ces matériaux sont particulièrement intéressants pour l'industrie du fait de la facilité et du faible coût de fabrication. Nous développons une technique de fabrication de films minces ,basée sur la méthode Sol-gel. Les films possèdent une structure soit de type chromophores dispersés dans une matrice reticulée SiO_2, soit de type chromophores liés au réseau SiO_2. Des mesures optiques de l'intensité de seconde harmonique, et une étude du comportement thermique montrent que ces matériaux sont de bons candidats pour les applications futures.

MO-POS-80

Conception de cavités laser accordables. M. Duval, G. Fortin, **V. Zambon**, N. McCarthy et M. Piché, *Université Laval* — Les lasers accordables trouvent nombre d'applications dans des champs d'activités aussi différents que la spectroscopie, la télédétection et l'étalonnage de dispositifs photoniques pour les télécommunications. La plupart de ces lasers utilisent des filtres accordables spectralement qui sont insérés dans des cavités laser en anneau ou du type Fabry-Perot. Par exemple, les filtres biréfringents ou interférentiels sont le plus souvent utilisés dans des cavités en anneau, tandis que les réseaux le sont couramment dans des cavités de type Fabry-Perot. Au moyen d'une analyse de faisceau, nous établissons les propriétés d'accordabilité des cavités laser munies d'un réseau à pas constant. Nous généralisons ensuite cette analyse pour les cavités laser dans lesquelles sont insérés des réseaux à pas variable. Nous montrons les avantages de cette approche, inexplorée jusqu'à présent. Nous montrons également comment on peut généraliser cette approche pour faire osciller un laser sur deux longueurs d'onde accordables, indépendamment. Nous présenterons des résultats expérimentaux sur la mise en marche des lasers accordables basés sur ces nouveaux éléments de conception.

MO-POS-81

Multiphoton Microscopy System Using a Quasi-Bessel Beam. **P. Dufour**, G. Rousseau, N. McCarthy and Y. De Koninck*, *COPL, Université Laval* — Studies of dynamic interactions between nerve cells in live tissue requires imaging from multiple cells simultaneously. Conventional microscopy systems have the inherent problem of limited focal plane, which restricts imaging from cells that are confined to a thin layer. Ideally, for simultaneous imaging from several cells in a thick live tissue sample, the depth of field should be significantly increased. To this end, we introduce a multiphoton microscopy system that incorporates an axicon mirror that focuses light in a quasi-Bessel beam. The use of such a beam in a multiphoton microscopy system provides a focal line along the longitudinal axis with a constant intensity in the absorbing medium as well as a high resolution in the transverse plane. Consequently, we only need to scan a sample in 2D to obtain a complete image of its entire volume, hence considerably reducing the scanning time. In our experiment, a mode-locked Ti:sapphire laser emitting femtosecond pulses is used to increase the transverse resolution through the two-photon absorption phenomenon. The experimental results of generation of a quasi-Bessel beam by an axicon will be described. These results will be compared to theoretical predictions, particularly for the on-axis intensity distribution of the beam.

* Y. De K. is at Centre de recherche Université Laval Robert-Giffard

MO-POS-82

Optical Constants Of Amourphous Hydrogenated Carbon Thin Films Prepared By Sputtring Radio-Frequency. **I. Aboudihab**[a,b], E. Ech-Chamikh[a], R.A. Lessard[b], [a]*Faculté des Sciences Semlalia, Marrakech, Morocco and* [b]*COPL, Université Laval* — Amorphous hydrogenated carbon (a-C:H) thin films, deposited on glass substrates, were fabricated by sputtering radio frequency (RF) from a pure graphite target. The optical properties of these layers were determined from measurements of X ray reflectometry and optical transmission and reflexion. X-ray Reflectometry allows the precise measurement of the layer thickness and density. The thickness is then used in the analysis of the results of optical transmission and reflexion. The determination of optical constants of a-CH thin films from optical transmission and reflexion measurements, is based on numerical method to resolve two equation of two variables (n,k). Where n is the refraction coefficient, and k the exinction coefficient.

MO-POS-83

Photon Statistics of the Random Laser. **Lucia Florescu** and Sajeev John, *University of Toronto* — We derive the coherence properties of the emission from a random amplifying medium. The master equation of a conventional laser is generalized to a space-dependent random laser master equation that includes terms relevant to the diffusion of the photons within the sample. The dependence of the photon statistics on scatterer density, gain concentration and position is investigated. We find that the addition of scatterers into the system reduces the amount of fluctuations. We also show that the radiation emitted at different positions within the sample has different degrees of coherence.

MO-POS-84

Azo-Polymer as a Dynamic Recording Medium for an Optical Cross-Correlator. M. Ivanov and **P. Rochon**, *Royal Military College of Canada* — A scheme determining the angular orientation of an object is proposed. In this experiment we use 2 metal wires, one being the reference and the other is the sample whose angular orientation is to be determined. The wires are illuminated by a collimated laser beam. The Fourier spectrum of the light diffracted from the wires is projected onto an azo-polymer film. When the two diffraction patterns coincide (corresponding to parallel wires) they produce an interference pattern that is recorded in the polymer by changing its birefringence. This forms a diffraction grating that can be probed by a non-perturbing laser beam. The diffraction efficiency is a sensitive measure for the angular displacement between the two wires. In addition, the low frequency spot in the Fourier plane is reflected by a small mirror and is also directed onto the sample. It provides a fast erasure of the recorded diffraction grating when the recording beam is stopped and the film is ready to record a new pattern. The sample is capable of many measuring cycles without fatigue. With a 10mW recording laser the setup can distinguish between 00 and 0.50 in less than a second and after a few seconds of erasure, the azo-polymer film is ready for the next measurement cycle.

MO-POS-85

Some Applications of Nonlinear Pattern Recognition. **Henri H. Arsenault**, Daniel Lefebvre and Steeve Perreault, *Université Laval* — We have recently developed some techniques for non-linear pattern recognition that do not require segmentation and that maintain shift invariance, that is localization of multiple targets simultaneously. Additional invariances such as changes of illumination, changes of orientation and changes of scale can be added. Experimental results will be shown.

MO-POS-86

The Speed of Light Identified With the Flow of Time. **Michel A. Duguay**, *Université Laval* — In the diachronic timing technique first considered by Einstein[1] a central observer on Earth assigns his central clock time to a remote luminous event, say, at Jupiter one light-hour away, at the moment it's observed optically through the vacuum of space. Einstein had discarded diachronic time in favor of synchronic time, which is read *on a local clock* close to the event, a clock synchronized with Einstein's well-known technique[1]. Diachronic time leads to diachronic speeds v_d. For a space ship going from A to nearby B along a vector AB parallel to the z axis, $v_{d\,z}$ is related to the conventional speed v_z by: $v_{d\,z} = v_z/(1 + v_z \cos q)$, q being the angular distance to the z-axis. When a light pulse moves from A to B, the diachronic speed of the point of action of light is $c_{d\,z}(q) = 1/(1 + \cos q)$, where 1 is c = 1 light-year/year. For us observers B on Earth and a space-based source of light A, the angle q in detection is 180°, so that the *diachronic speed of light is infinite*, a result which is implicit in the definition of diachronic time[1,2]. In the diachronic picture the astronaut observer at Jupiter that is real for us here is the one we see now, either optically or through television. She is one hour in the past relative to us on our past light cone. As she looks at Earth she sees us one hour in the past relative to her on her past light cone, *i.e.* us as of two hours ago. On a constantly up-dated Minkowski diagram, when a bright explosion occurs here now, we have to wait two hours for the event to travel far enough down our Minkowskian past time axis so that it comes into her view from Jupiter. Once the event is there, she instantly sees it, and we instantly see her see it. In this picture *the conventional speed of light becomes identified with the flow of time*. In the diachronic representation the occurrence of a past event relative to us here now is dynamically mapped onto the radial axis r of a spherical coordinate system and moves away from us, thus displaying time's asymmetry. Roger Penrose has argued that an element of asymmetry in time needs to be introduced in order to assure further progress in physics[3].

1. A. Einstein, "Zur Elektrodynamik bewegter Koerper", *Annalen der Physik*, **XVII**, 891-921 (1905).
2. M.A. Duguay, "Diachronic and synchronic views of physical reality in special relativity", *Physics in Canada*, vol. **58**, paper MO-POS-60 (2002).
3. Roger Penrose, "The Emperor's New Mind", Oxford University Press, Oxford (1989).

MO-POS-87

Anomolous Polariton Stark Effect in Dispersive and Photonic Band Gap Materials 0pt. **Mahi R. Singh** and S. Barrie, *University of Western Ontario* — In this paper we study the phenomenon of polariton resonance fluorescence in dispersive and photonic band gap (PBG) materials. The fluorescence provides an interesting manifestation of the quantum theory of light in materials and has applications for making different type of devices. Considerable attention has been paid to study the dispersive and photonic band gap materials due to their unusual optical properties and potential applications[1-3]. There is also considerable interest in studying the physical behavior of polaritons in low dimensional semiconductor systems[4]. We consider a quantum dot acting as a two-level atom doped in dispersive and PBG materials and the system is driven by an intense monochromatic laser field. The dispersive and PBG materials have a energy gap in their dispersion relation. In dispersive materials the coupling of laser field photons and elementary excitations produces polaritons which have an energy gap in their dispersion relation. In PBG materials, the existence of the PBG is due to multiple laser photon scattering by spatially correlated scatters. In the presence of strong driving field when the Rabi frequency (Ω) associated with the driving field becomes larger than that of the atomic linewidth (Γ), the ground state $|g\rangle$ of the combined atom and polariton field splits into an upper state $|g_u\rangle$ and a lower state $|g_l\rangle$ with energy difference equal to Ω. Similarly the excited state $|e\rangle$ splits into an upper state $|e_u\rangle$ and a lower state $|e_l\rangle$ with energy difference Ω[3]. The spectral and quantum statistical properties of emitted polaritons by the atom are calculated by using the master equation method. The regression theorem is used to evaluate the two-point correlation function. Numerical simulations are performed for the spontaneous decay power spectrum as a function of the excitation intensity in SiC and GaAs. The following interesting results are found: a) When $|e_u\rangle$ and $|e_d\rangle$ lie out side the energy gap, the polariton spontaneous decay spectrum consists of four transitions lines (i) transition $|e_u\rangle \rightarrow |g_u\rangle$ emitting a polariton with energy $\omega = \omega_0$, (ii) transition $|e_u\rangle \rightarrow |g_d\rangle$, emitting a polariton with energy $\omega = \omega_0 + \Omega$, (iii) transition $|e_d\rangle \rightarrow |g_l\rangle$ emitting a polariton with energy $\omega = \omega_0 - \Omega$, and (iv) transition $|e_d\rangle \rightarrow |g_d\rangle$ emitting a polariton with energy $\omega = \omega_0$. The central peak at energy $\omega = \omega_0$ and is made of (ii) an (iv); b) When $|e_u\rangle$ lies out side the energy gap and $|e_l\rangle$ lies within the energy gap, the polariton spectrum consists of two transition lines (i) transition $|e_u\rangle \rightarrow |g_u\rangle$ and $\omega = \omega_0$, (ii) transition $|e_u\rangle \rightarrow |g_d\rangle$ and $\omega = \omega_0 + \Omega$). Other two transitions are prohibited due to the localization of two polaritons near the atom; c) When $|e_l\rangle$ lies within the energy gap and $|e_d\rangle$ lies outside the energy gap, the polariton spectrum consists of two transition lines (i) transition $|e_l\rangle \rightarrow |g_d\rangle$ and $\omega = \omega_0$ and (ii) transition $|e_d\rangle \rightarrow |g_u\rangle$ and $\omega = \omega_0 - \Omega$. Other two transitions are prohibited due to the localization of two polaritons near the atom;. d) Finally, when $|e_u\rangle$ and $|e_d\rangle$ lie within the energy gap, no transition lines are observed since all four transitions are forbidden due localization all polaritons near the atom.

1. S. John, *Phys. Rev. Lett.* **58**, 2486 (1987);E. Yablonovitch, *Phys. Rev. Lett.* **58**, 2059 (1987).
2. V.I. Rupasov and M. Singh, *Phys. Rev. Lett.* **77**, 338 (1996); *Phys. Rev.* A **56**, 898 (1997).
3. M. Singh, Solid State Comm. (in press 2002).
4. F. Quochi *et al.*, *Phys. Rev. Lett.* **80**, 4733 (1998) and references therein.

MO-POS-88

Interférométrie à l'aide de faisceaux Bessel*. **M. Fortin**, M. Piché et E.F. Borra, *COPL, Université Laval* — Le but de ce projet est d'appliquer à la caractérisation de surface un nouveau type d'interféromètre optique développé à l'Université Laval. Cet interféromètre repose sur la superposition cohérente de faisceaux optiques spéciaux dits faisceaux Bessel. Ces faisceaux sont générés par une méthode d'optique de Fourier: on illumine un masque transparent sur des anneaux minces et concentriques, et on place ce masque au foyer d'une lentille. Au-delà de la lentille, chaque anneau produit un faisceau Bessel. Un faisceau Bessel possède un profil qui ne change pas le long de l'axe de propagation, et sa distribution d'intensité est donnée par le carré d'une fonction de Bessel de première espèce et d'ordre zéro, *i.e.* par le carré de $J_0(x)$. La superposition cohérente de ces faisceaux Bessel donne naissance à une figure d'interférence dont la structure dépend du faisceau incident sur le masque. On a montré comment on pouvait utiliser cette figure pour en extraire le rayon de courbure d'un faisceau laser. On peut aussi s'en servir pour caractériser la courbure d'une surface, même si cette surface est diffusante. Ce projet vise à utiliser cette technique d'interférométrie en prenant un miroir liquide comme surface déformable. Plusieurs expériences ont été entreprises dans le but d'augmenter la sensibilité de la méthode par une technique d'imagerie entre la surface à caractériser, ici le miroir liquide, et le masque. On peut ainsi atteindre une précision de quelques nanomètres et étudier l'applicabilité de la méthode à l'inspection en temps réel. Il existe un besoin de capteurs de déformation de pièces mécaniques qui soit le plus simple et performant possible; nous proposons cette technique qui présente l'avantage d'être sans contact.

*Travail appuyé par le CRSNG et l'ICIP.

[MO-POS] PARTICLE PHYSICS / PHYSIQUE DES PARTICULES — Monday / Lundi

MO-POS-89

Observation of Enhancements of the Apparent Fraction of Four-Quark Configurations in Four-Jet Events from Hadronic Decays of the Z-Boson. **H. Jeremie**, D. Davignon, E. Lefebvre and G Karapetian, *Université de Montreal* — We measure the apparent fraction of four-quark configurations contained in a sample of four-jet events from hadronic decays of the Z-boson by comparing leading order theoretical angular correlations of four-jet events with those of data obtained with the OPAL detector*). We investigate the dependency of R_4q, the ratio of the measured apparent fraction of four-quark events over the predicted one, on several parameters. We observe enhancements (R,q>1) as a function of the sum of the intrinsic masses of the two least energetic jets, the invariant mass formed by these jets and of the four-jet resolution parameter. Models which include nigher order effects such as a combination of matrix elements with a parto shower produce qualitatively simillar enhancements. The possibility that these results might be compatible with a suggestion by Berger et al. (1), who postulate the existence of gluinos in the 12 to 16 GeV range, is also examined.

(1) E.L.Berger *et al.*, *Phys.ReV.Lett.* **86**, (2001) 4231.
* These preliminary results have not yet been endorsed by the OPAL collaboration.

[MO-POS] PHYSICS EDUCATION / L'ENSEIGNEMENT DE LA PHYSIQUE — Monday / Lundi

MO-POS-90

Projects for University Physics. **Don Mathewson**, *Surrey, B.C.* — Applied physics projects are an excellent means to help students connect with the physics they are being taught. Examples of projects for first and second year students will be presented.

[MO-POS] PLASMA PHYSICS / PHYSIQUE DES PLASMAS — Monday / Lundi

MO-POS-91

Investigation of Plasma Flow with Gundestrup Probe in TOMAS Toroidal Device. **Philippe Sicard**[a], Andrey Litnovsky[a,b], Claude Boucher[a]. [a]*Université du Québec-INRS*, and [b]Institut fur Plasmaphysik, Forschungszentrum Julich, Germany — Investigations of plasma flows are of prime importance in understanding the physics of edge and divertor plasmas of fusion devices. The Gundestrup probe, an electrostatic probe array, is one of the tools available for these investigations and is now being used in several tokamaks. Plasma flow velocities in directions both parallel and perpendicular to the magnetic field are detectable with this probe. Various theoretical models are used to deduce flow velocity from the Gundestrup data, but these models need to be validated. In an effort to validate these models an experiment is under way in the toroidal device TOMAS at the Intitut fur Plasmaphysik in Forschungszentrum Julich, Germany. Flow measurements made with Gundestrup probe will be verified against data from a Laser Induced Fluorescence (LIF) system. The results of flow measurements will be presented and discussed.

MO-POS-92

Short Wavelength Temperature Gradient Driven Modes in Tokamak Plasmas. A. **Smolyakov**[a], M. Yagi[b], Y. Kishimoto[c] and R. Sydora[d]. [a]*University of Saskatchewan*, [b]Research Institute for Applied Mechanics, Kyushu University, Japan. [c]Department of Fusion Research, Japan Atomic Energy Research Institute, Japan, and [d]University of Alberta — A new temperature gradient driven instability in the short wavelength region (with a wavelength shortern that ion Larmor radius) is identified. The mode is driven by the ion temperature gradient but is also affected by electron dynamics. It exists for adiabatic electrons but may be further enhanced by resonant electrons effects. In the toroidal limit, the ion short wavelength mode is similar to the "ubiquitous" mode but does not require the trapped electrons. Both local and non-local (differential equation) approaches that are used to investigate the short wavelength mode give similar results.

MO-POS-93

Study of Nitrogen Implantation for the Improvement of Carbon Properties used as PFC's. **G.G. Ross**, D. Bourgoin, É. Adam, C. Sévigny and M. Pellerin, *INRS-ÉMT* — Many properties of carbon make it suitable for plasma facing components (PFC). However, carbon blooms and chemical erosion by oxygen cause a dilution of the plasma and an important loss of energy by radiation. Diffusion of hydrogen in carbon as well as its poor retention constitute other major obstacles concerning the use of carbon in PFCs. In 1990, Liu and Cohen presented a study [14] of the structural and electronic properties of a hypothetical compound C_3N_4. The calculated bulk modulus of C_3N_4 was found to be comparable to that of diamond. In addition, the velocity of sound in the C-N compound was predicted to be about 1.1×10^6 cm/s, suggesting a high thermal conductivity. Several techniques have been used for synthesizing C_3N_4. There is no macroscopic evidence for none of these techniques concerning the formation of the compound but some clues tend to show existence of nanocrystals. Inspired by this work and knowing that ion implantation is an efficient tool for the modification of surface properties of materials, we have studied the use of carbon implanted with nitrogen as PFC. Thermal annealing used in combination with surface analysis tools (ERD ExB, RBS, XPS) allows to measure in the laboratory the influence of nitrogen ion implantation on the retention of hydrogen and the chemical erosion of three kinds of carbon (a-C, vitreous and CFC). Results from laboratory experiments show that nitrogen implantation in carbon causes an improvement of hydrogen retention without a significant increase in methane and ethylene emission during thermal annealing for an appropriate implantation dose (N/C~0,2). These results suggest that implantation of nitrogen in carbon is a valuable tool to improve the properties of carbon in PFC. Nitrogen implantation could be easily made in a tokamak by some conditioning between the discharges.

1. A. Y. Liu and M. C. Cohen, *Phys. Rev.* **B41** (1990) 10727.

MO-POS-94

Laser Induced Breakdown Spectroscopy of Contaminants in Water Limits of Detection with Different Detectors. Mike Taschuk, Sherife Yalcin, Ying Tsui and **Robert Fedosejevs**, *University of Alberta* — Laser-induced breakdown spectroscopy (LIBS) is a rapid material characterization technique that makes use of a laser-induced plasma to obtain knowledge of the composition of materials. As the expanding laser-induced plasma cools, it radiates at wavelengths which are characteristic of the constituents of the original target. The limit of detection for any given element depends on the emission strength of the line of interest, optimization of the spatial and temporal detection window, and the noise characteristics of the detectors used. In this paper we present a comparison of the noise and sensitivity characteristics of an intensified CCD (ICCD), an intensified diode array (OMA), a compact CCD spectrometer and a photomultiplier detector. The impact of the different detector characteristics on the limit of detection for contaminants in water is explored, and experimental measurements will be presented.

MO-POS-95

Study of Ion Emission from ns and fs Laser Produced Plasmas. R. Janmohammed, D.V. Romanov, C. Capjack, W. Rozmus, R. Fedosejevs and **Y.Y. Tsui** — Study of ion emission is important for many current and potential applications such as pulsed laser deposition of thin films, the fast ignitor concept in laser fusion and as high brightness MeV ion sources. In this study the ion emission from plasmas produced by low intensity 248nm 15ns UV laser pulses of interest for pulsed laser deposition and much higher intensity 800nm 120fs femtosecond pulses are characterized using the same set of Faraday cups and Langmuir probes. A particle in cell code has been developed for modelling the high intensity femtosecond interactions. Experimental results will be presented and compared with results from theoretical models.

MO-POS-96

Proposal of A New Experimental Technique for Edge Transport Studies and Benchmarking of the Numerical Transport Codes. **Andranik Sarkissian**[a,b] and Barry Stansfield[a]. [a]*INRS-EMT and* [b]*PLASMIONIQUE Inc* — The design of the internal components of a fusion reactor, like ITER, relies on results produced from the numerical simulation codes that predict the severity of plasma interaction with wall and divertor components under various operating conditions. The physics used in these numerical models relies on transport coefficients that were determined from various scaling studies carried out on different machines. Given the dynamic nature of plasma-material interaction and particle transport, it is difficult to evaluate the accuracy of simulations. We propose the use of trace amounts of radioisotopes to carry out experimental Monte-Carlo simulations in existing tokamaks, and test the predictive power of the existing numerical codes. The trace amounts of the various short-lived radioisotopes can be introduced into the plasma edge, by laser ablation, sputtering or gas injection techniques, or into plasma core by pellet injection. We will propose an experimental set up to carry out such experiments, and will address issues related to measurement methods and safety issues.

MO-POS-97

Effect of Electrode Biasing on the Radial Propagation of Elctrostatic Fluctuations in STOR-M Tokamak. **A.K. Singh** and A. Hirose, *University of Saskatchewan* — We have recently reported experimental observation of radically outward propagation in STOR-M tokamak (B_T = 0.7T, I_p = 25 kA, average electron density ~ 10^{13} cm^{-3}). The radial propagation of electrostatic fluctuations in the edge region of STOR-M has been measured using Langmuir probes, 1-2 cms in side the last closed surface. Linear theories of drift ballooning modes in tokamaks do not predict radial propagation. But in some recent numerical simulations and some theoretical works, the importance of radial modes have been emphasized. The decorrelations of radial correlations is now considered to be an important mechanism underlying improved confinement regimes of H-mode discharges. Our measurements of radial correlations with electrode bias in plasma edge shows a reduction in the radial correlations lengths. The results will be discussed in detail in the paper.

[MO-POS] THEORETICAL PHYSICS / PHYSIQUE THÉORIQUE — Monday / Lundi

MO-POS-98

Quantum Associative Memory. **M. Andrecut** and M.K. Ali, *University of Lethbridge* — The unique characteristic of quantum mechanics may be used in the near future to create a quantum associative memory with a capacity exponential in the number of neurons. Here, we discuss some quantum computational ideas and algorithms necessary to develop a quantum associative memory.

MO-POS-99

Two-Particle Interference in Bohmian and Standard Quantum Mechanics. **E. Guay** and L. Marchildon, *Université du Québec à Trois-Rivières* — In Bohmian quantum mechanics, particles follow definite trajectories governed by deterministic laws. To the classical potential acting on a particle, however, a quantum potential is added which depends on the particles' total wave function. We investigate Bohmian trajectories in the context of two-slit interference between two identical bosons or fermions. For each particle two spatial coordinates are involved, one (y) along the axis going from one slit to the other, and the other (x) perpendicular to the plane of the slits. For wave functions defined by plane waves in x and Gaussian functions in y, the equations of motion are derived analytically and then numerically integrated. Next a method is outlined to treat the more complicated case where the system's wave function is known only at some initial time t_0. A moving four-dimensional grid is defined by the Bohmian particles themselves. We illustrate how the statistical distribution of trajectories reproduce quantum mechanical probabilities. Depending on the particles' initial positions, trajectories may or may not cross the symmetry plane between the slits (y=0). Our results help in clarifying a recent debate on whether Bohmian and standard quantum mechanics do or do not make identical predictions in two-particle interference devices.

MO-POS-100

The Effects of Landscape Fragmentation on the Movement Patterns of a Generic Walker. **Sheldon Opps**, Michael Arthurs, and Marina Silva, *University of Prince Edward Island* — A simulation model has been developed to examine the movement patterns of a generic walker in complex environments. This model is based on percolation theory and incorporates a novel technique for generating fractional Brownian landscapes on a two-dimensional lattice. The principle features of the habitat, for example trees, coral reef, sand, etc, are attributed different fractal dimensions, D, and quality factors, Q, which measures the strength of interaction between the walker and the local environment. Additionally, the landscape is randomly decorated with obstacles, such as bumps and holes. The walker moves across the habitat according to a set of rules which depend on Q, and has a "field of vision" that permits her to move according to a correlated random walk. In this study, we have systematically investigated how variations in D affect the connectivity of the landscape which, in turn, affects the movement patterns of a generic walker

MO-POS-101

Test of Modified Newtonian Dynamics: Modified Newtonian. **R.J. Slobodrian**, *Université Laval* — Dynamics (MOND) may provide an alternative to the dark matter hypothesis, established to account for a discrepancy between Newtonian dynamical mass and the observable mass in large astronomical systems. The MOND proposal consists in changing the effective gravitation at accelerations close to $a_o = 10^{-8}$ cm/s^2 such that the effective acceleration is given by $(g_n\ a_o)^{1/2}$ where g_n is the Newtonian acceleration. The hypothesis may be tested experimentally in an environment of very low gravity with a two body system of low density material. The best conditions for tne experiment could be met launching a probe along a trajectory perpendicular to the planetary orbits, in order to reduce gravity to extremely low values. The two body system can be constructed along the lines of Ref. 1 and the probe should be automated and monitored remotely. The observation of a quasi harmonic motion of the system during times in the range of 22 hrs could provide an incontrovertible test of MOND, as the non Newtonian force would reduce the period of oscilation by about 40%.

1. R.J. Slobodrian in Class. *Quantum Gravity*, **9** (1992) 1115-1119.

[MO-POS] INDUSTRIAL AND APPLIED PHYSICS / *PHYSIQUE INDUSTRIELLE ET APPLIQUÉE* — Monday / *Lundi*

MO-POS-102

A High Soeed Retro reflector for Free Soace Communication Based on Electro Optic Phase Modulation*. T. Mikaelian[a], M. Weel[a], A. **Kumarakrishnan[a]**, P.R. Battle[b] and R.C. Swanson[c], [a]*York University*, [b]AdvR Inc., and [c]Resonon Inc., — We have demonstrated that an Electro-Optic phase Modulator (EOM) can be used as a constituent of a corner-cube based modulated high-speed retro-reflector. We have performed experiments to investigate the efficiency of phase modulation produced by an EOM as a function of the angle of a laser beam incident on it. Our experiments demonstrate that the field of view of the EOM is determined by its dimensions and the diameter of the laser beam. This suggests that the device may be suitable for applications involving high-speed (Ghz), free space communication. In these applications, the retro-reflector can be mounted on a moving platform such as a satellite. We find that it is possible to detect the retroreflected signal with adequate signaltonoise ratio using heterodyne detection. We also discuss some practical considerations necessary for the implementation of such a device.

* This work is supported by CFI, OIT, NSERC and York University

MO-POS-103

A High Soeed Modulated Retro-reflector for Lasers using an Acousto-Ootic Modulator*. G. Spirou[a], I. Yavin[a], M. Weel[a], A. Vorozcovs[a], A. **Kumarakrishnan[a]**, P.R. Battle[b] and R.C. Swanson[c], [a]*York University*, [b]AdvR Inc., and [c]Resonon Inc., — We have used an acousto-optic modulator (AOM) to impose a frequencymodulated signal on an incident laser beam. The incident laser beam is focussed into the AOM where it undergoes Bragg diffraction and is then retro-reflected. The diffracted beam is also retro-reflected so that it is diffracted again by the AOM and overlaps the incident beam. The overlapped beams are frequency shifted with respect to each other. These features allow us to detect the frequency-modulated signal with high signal to noise ratio using heterodyne detection. Since the optical setup is simple and can be made very compact, this device may be ideal for certain forms of high-speed, free-space optical communication. We have demonstrated a 1 MHz data transmission rate in the Bragg regime. We have measured the acceptance angle of the device and find that it is limited only by the divergence of the focussed laser beam and the divergence of the acoustic waves in the AOM crystal. We have also studied the range of acoustic frequencies and drive power of the AOM, for which the retroreflected beam can be detected with adequate signal to noise.

* This work is supported by CFI, OIT, NSERC and York University.

MO-POS-104

Excimer Laser Micromachining at Photonics Research Ontario. Yuri Yashkir, Seong Kuk Lee, **Marc Nantel**, and Bernard Hockley, *Photonics Research Ontario*, — Excimer laser ablation is used in conjunction with the mask projection techniques to fabricate novel and complex microstructures. The use of mask projection allows great flexibility in the types of processing and the geometries of the structures created, such as micro-channels, ramps, contoured surfaces with channels, micro-lens etc. Many scientific and industrial areas are advancing rapidly, enabled by the use of the unique structures that can be produced by excimer laser micromachining. In particular, micro-fluidic systems, where one or more fluids are mixed, separated and/or transported, are utilizing laser-produced features, such as ramps, reservoirs, channels and contoured shapes are being incorporated into production devices. In this paper, details of the excimer laser micromachining techniques are given along with examples of the types of structures, from simple grooves to micro-lens arrays, which have been fabricated at Photonics Research Ontario's Laser Micromachining Facility.

MO-POS-105

Ultrasound Propogation in a Thin Anisotropic Layer Between Two Media: Theory, Computer Model, and Experiment. **Jeff Sadler**, Brian O'Neill, Fedar Severin and Roman Gr. Maev, *University of Windsor*. — Computer simulation model of the propagation of an acoustic wave across an anisotropic thin interface layer (thickness << wavelength). The model is based upon an approach where one uses a set of boundary conditions for the interface to develop solutions to the problem. Experimental work is done by sandwiching specialized thin anisotropic layers between two half spaces. Acoustic signals reflected and refracted from this layer can be analysed and compared with the theoretical model.

MO-POS-106

Experimental Study of Photo Acoustical Nonlinearity in CdS crystal. Wesley Arthur, B. O'Neil, **R. Maev**, and I. Solodov, *University of Windsor* — The paper reports on experimental study of the higher harmonic generation due to nonlinear acousto-electronic interaction in a piezoelectric semiconductor. Ritec SNAP 1-30-11 system is applied to measurements of the interaction characteristics in the frequency range up to 30 MHz in a CdS single crystal. The SNAP unique capabilities enables extensive and detailed measurements of the higher harmonic amplitudes as functions of distance and the crystal conductivity in a wide range of the input voltages. The contributions of attenuation, dispersion and nonlinearity into the acousto-electronic interaction are identified and analyzed based on the measured space and dynamic characteristics of the higher harmonic generation. The experimental results obtained are compared with theoretical calculations relevant to a small signal approximation.

MO-POS-107

Acoustic Visualization of Interface Deterioration in Adhesive Bond Joints. E. Yu. Maeva, I.A. Severina, G.B. Chapman II, F.M. Severin and R.Gr. Maev, *University of Windsor* — The present work represents practical aspects of an imaging technique for the quality control of adhesive bonding in automotive manufacturing. Acoustical images of basic types of defects in models and real industrial samples were obtained using an acoustical scanning microscope in the frequency range of 5 B 250 MHz. The material variety includes a few metals and plastics with epoxy-based or polyurethane-based adhesive compounds. Classification of defects is given according to detectability. Acoustical inspection is proven by comparison with the results of destructive testing. Special attention was paid to the microstructure of the material-adhesive interface. The B- and C-scans are used to refine the adhesion mechanisms. The represented results are applicable to the quantitative estimation of adhesion quality in real industrial environments and the development of specialized ultrasonic equipment.

Author Index / Index des auteurs

POSTDOCTORAL RESEARCH ASSOCIATE

Experimental High Energy Physics
McGill University

A postdoctoral research associate position in Experimental High Energy Physics is available at McGill University. The position is being offered to work on the Collider Detector at Fermilab (CDF-II) experiment at the Fermi National Accelerator Laboratory. Our group is presently involved in the CDF Run II offline project. Our main responsibilities currently lie in the area of large-scale production of Monte Carlo samples covering a wide range of physics studies: top and electroweak physics, heavy quark physics, QCD and jet physics, and exotic searches. The successful candidate will be expected to have a PhD in physics and take a leading role in our analysis of CDF data and in our Monte Carlo production commitments, as well as any future hardware efforts.

Candidates should supply a cover letter, a resume, and a description of research interests, and arrange to have three letters of reference sent to

Prof. Andreas Warburton,
Physics Department, McGill University,
3600 University St.,
Montreal, Quebec, H3A 2T8, Canada.

Applications can also be e-mailed to the address indicated at http://www.physics.mcgill.ca/~awarburt. The review of applications will begin immediately, and will continue until the position is filled.

McGill University is committed to equity in employment.

RESEARCH ASSOCIATE

Department of Physics
McGill University

The Kaspi research group is looking for a research associate with a PhD in theoretical astrophysics specializing in high energy astrophysics, in particular radio pulsar emission mechanisms and pulsar winds. Breadth of knowledge in other areas of high energy astrophysics, such as gamma ray bursts and relativistic magnetohydrodynamics, would also be an asset. The position is for one year. The salary will be commensurate with experience.

Please send your CV, publications list and the contact information of three references to:

Prof. V. Kaspi,
Department of Physics, McGill University
3600 University St.
Montreal, Quebec, H3A 2T8

All qualified candidates are encouraged to apply; however, Canadian citizens and permanent residents of Canada will be given priority. *McGill University is committed to equity in employment.*

NSERC UNIVERSITY FACULTY AWARD

Department of Physics and Astronomy
McMASTER UNIVERSITY

The Department of Physics and Astronomy at McMaster University invites applications from women and Aboriginal peoples for a tenure-track faculty position at the Assistant Professor level, which will commence July 2004. The successful candidate will be nominated for an NSERC University Faculty Award (www.nserc.ca/guide/sf/3g_e.htm) and must meet NSERC's eligibility criteria for this award. The goal of the University Faculty Awards Program is to decrease the under-representation of women and Aboriginal peoples in faculty positions in the natural sciences and engineering by encouraging Canadian universities to appoint very promising researchers in those groups to tenure-track or tenured positions in science and engineering.

Candidates must have a Ph.D. degree, a strong research record, an excellent aptitude for undergraduate and graduate teaching, and be a Canadian citizen or permanent resident. The competition is open to any subfield of physics or astronomy that fits with the Department's interests and plans (see www.physics.mcmaster.ca). Applications from outstanding experimentalists are particularly encouraged.

Applicants should send a curriculum vitae, a statement of research interests and plans, a statement regarding teaching, and arrange for three letters of reference to be sent to: **Dr. A. John Berlinsky, Chair, Department of Physics & Astronomy, McMaster University, 1280 Main Street West, Hamilton, Ontario L8S 4M1**. E-mail and FAX applications will not be accepted. Complete applications must be received by August 15, 2003.

McMaster University is strongly committed to employment equity within its community, and to recruiting a diverse faculty and staff. The University encourages applications from all qualified candidates, including women, members of visible minorities, Aboriginal persons, members of sexual minorities, and persons with disabilities.

The Editorial Board welcomes articles from readers suitable for, and understandable to, any practising or student physicist. Review papers and contributions of general interest are particularly welcome.

Le comité de rédaction invite les lecteurs à soumettre des articles qui intéresseraient et seraient compris par tout physicien, ou physicienne, et étudiant ou étudiante en physique. Les articles de synthèse sont en particulier bienvenus.

FACULTY POSITION
DEPARTMENT OF PHYSICS & ASTRONOMY
THE UNIVERSITY OF BRITISH COLUMBIA

The Department of Physics and Astronomy invites applications for a tenure-track faculty position, funded for the first five years jointly by UBC and the Natural Sciences and Engineering Research Council (NSERC) under the NSERC University Faculty Awards Program, directed to women and Aboriginal peoples. The position will commence July 1st, 2004. The competition will be open to any sub-field of physics or astronomy that fits with the department's interests (see www.physics.ubc.ca). The preferred candidate will be nominated for an NSERC University Faculty Award and must meet NSERC's eligibility criteria for this award, which may be found at http://www.nserc.ca. The goal of the University Faculty Awards program is to increase the representation of women and Aboriginal peoples in faculty positions in the natural sciences and engineering by encouraging Canadian universities to appoint very promising researchers in those groups to tenure-track positions in science and engineering.

Candidates must have a Ph.D. degree, an outstanding research record, an aptitude for undergraduate and graduate teaching, and be a Canadian citizen or permanent resident. The appointment is intended to be at the Assistant Professor level. However, an appointment at a higher level may be considered provided the applicant has not previously held a tenure-track position at a Canadian university. UBC hires on the basis of merit and is committed to employment equity.

Applicants should send a curriculum vitae, a statement of research interests and future plans, and arrange for three letters of reference to be sent by **August 22nd, 2003** to: **Head, Department of Physics and Astronomy, University of British Columbia, 6224 Agricultural Road, Vancouver, B.C. V6T 1Z1, Canada.**

Inquiries only by e-mail to: lore@physics.ubc.ca, Lore Hoffmann, Assistant to the Head. **Applications WILL NOT be accepted via e-mail, hardcopy only please.**

RESEARCH ASSOCIATE
The TWIST Experiment at TRIUMF
Competition #825

TWIST has an immediate opening for a Research Associate. The **TRIUMF** Weak Interaction Symmetry Test is an international collaboration whose goal is to search for possible deviations from Standard Model predictions by measuring precisely the distribution in energy and angle of positrons in polarized positive muon decay. The **TWIST** detector consists of a symmetric set of high precision, low mass, planar drift chambers in a superconducting solenoidal magnetic field. It utilizes a high quality polarized beam of positive muons which stop in a thin target foil at the centre of the detector. The apparatus is now fully operational and data taking has begun. **Please see http://twist.triumf.ca for more information, or email Glen.Marshall@triumf.ca.**

The successful candidate will be expected to provide leadership and expertise in different aspects of **TWIST**, such as verification of simulations using the GEANT package, track reconstruction, analysis, detailed studies of systematics, and operation of the detector. A PhD in nuclear or particle physics, or the equivalent, is required. Preference will be given to those applicants within five years of their degree.

The initial term of the appointment will be one year, renewable upon mutual consent, and subject to continued project funding. The position will be based at **TRIUMF**, Canada's national research laboratory for particle and nuclear physics, located in Vancouver, British Columbia. Applications from qualified candidates should include a CV and three reference letters, and should be sent to the following address or fax, prior to **June 30th, 2003: TRIUMF Human Resources, Competition #825, 4004 Wesbrook Mall, Vancouver, BC V6T 2A3, Canada. Fax: (604) 222-1074.**

TRIUMF is an equal opportunity employer, and advises that in the event where two final applicants are equally qualified, preference will be given, if applicable, to the Canadian citizen or permanent resident.

FACULTY POSITIONS IN NANOSCIENCE
DEPARTMENTS OF CHEMISTRY AND PHYSICS & ASTRONOMY
THE UNIVERSITY OF BRITISH COLUMBIA

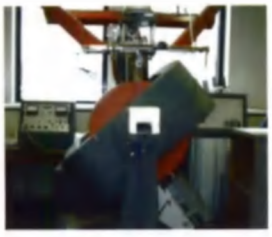
The Department of Chemistry and the Department of Physics and Astronomy at the University of British Columbia invite applications from outstanding candidates for a number of faculty positions, which will be opening over the next few years. At least one of the positions will be a Canada Research Chair (CRC) appointment (http://www.chairs.gc.ca/). The positions are all in the general area of nanoscience, which is one of the selected priority areas of the University of British Columbia. The application deadline for this competition is July 1st, 2003. The successful candidate(s) will be appointed in January 2004 at the level of assistant professor, but a higher rank may be considered for applicants with exceptional qualifications and experience.

Examples of areas of research in nanoscience in which appointments are anticipated include:

- Fabrication of nanostructures including ultra-thin films, quantum dots, magnetic quantum dots, photonic crystals, and superconducting devices utilizing electron beam and ion beam writing methods as well as scanning force probes etc.
- Optical and electronic properties of nanostructured solids including photonic materials, ultrathin films, multiple-quantum wells, superconducting and magnetic quantum dots, and spintronic materials.
- Solid state chemistry routes to nanostructured materials such as semiconducting quantum structures, magnetic clusters, nanotubes, molecular magnets and optoelectronic devices.
- Development of techniques to study the structure and dynamics of nanostructures including macromolecular systems utilizing, for example, synchrotron based (resonant) X-ray scattering methods combined with femtosecond laser pump probe methods.
- Macromolecular, and biomolecular approaches to nanoscience including, for example, the preparation of self-assembled nanostructures using polymers and biomolecules.

UBC hires on the basis of merit and is committed to employment equity. We encourage all qualified persons to apply. In accordance with Canadian Immigration requirements, for the regular tenure track appointments, preference will be given to Canadian citizens and permanent residents. For the Canada Research Chairs all candidates will have equal status. Applicants should send a curriculum vitae, a statement of research interests and plans, and arrange to have three reference letters sent directly to: **Chair, Nanoscience Search Committee, Department of Chemistry, University of British Columbia, 2036 Main Mall, Vancouver, B.C. V6T 1Z1, Canada.**

Information on the Departments of Chemistry and of Physics and Astronomy may be found on the web at www.chem.ubc.ca and www.physics.ubc.ca. **Applications will not be accepted by e-mail but inquiries can be directed to Prof. G.A. Sawatzky at: sawatzky@physics.ubc.ca.**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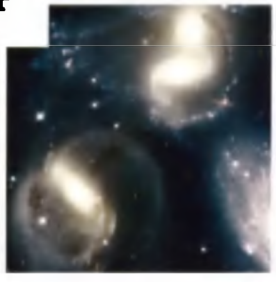
CAP/CASCA/COMP 2004 CONGRESS
Canadian Association of Physicists
Canadian Astronomical Society
Canadian Organization of Medical Physicists
Biophysical Society of Canada

CONGRÈS ACP/CASCA/OCPM 2004
Association canadienne des physiciens et physiciennes
Société canadienne d'astronomie
Organisation canadienne des physiciens médicaux
Société de biophysique du Canada



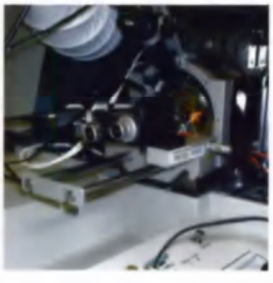


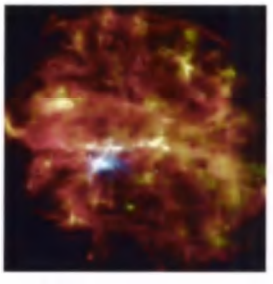
Delta Winnipeg Hotel, Winnipeg, Manitoba
Organized by the Department of Physics and Astronomy,
University of Manitoba

JUNE 13-16, 2004

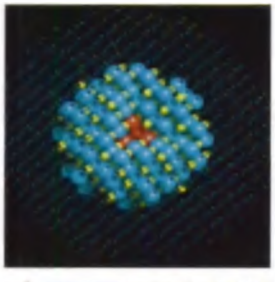
13-16 JUIN, 2004
Hôtel Delta Winnipeg, Manitoba
Organisé par le département de physique et astronomie,
Université du Manitoba



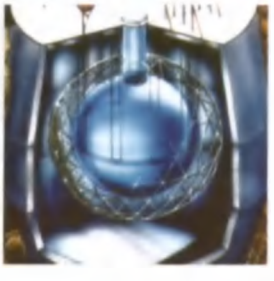










For more information and forms:
www.physics.umanitoba.ca/Congress2004

Pour de plus amples renseignements et formulaires :
www.physics.umanitoba.ca/Congress2004

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