PHYSICS IN CANADA
LA PHYSIQUE AU CANADA
Vol. 65 No. 2 (supplement)
Congress 2009
Congrès 2009

CONGRÈS DE L'ACP 2009 CAP CONGRESS

JUNE 7-10 JUIN
UNIVERSITÉ DE MONCTON
MONCTON, N.-B.

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Travel Information / Comment se rendre à la conférence

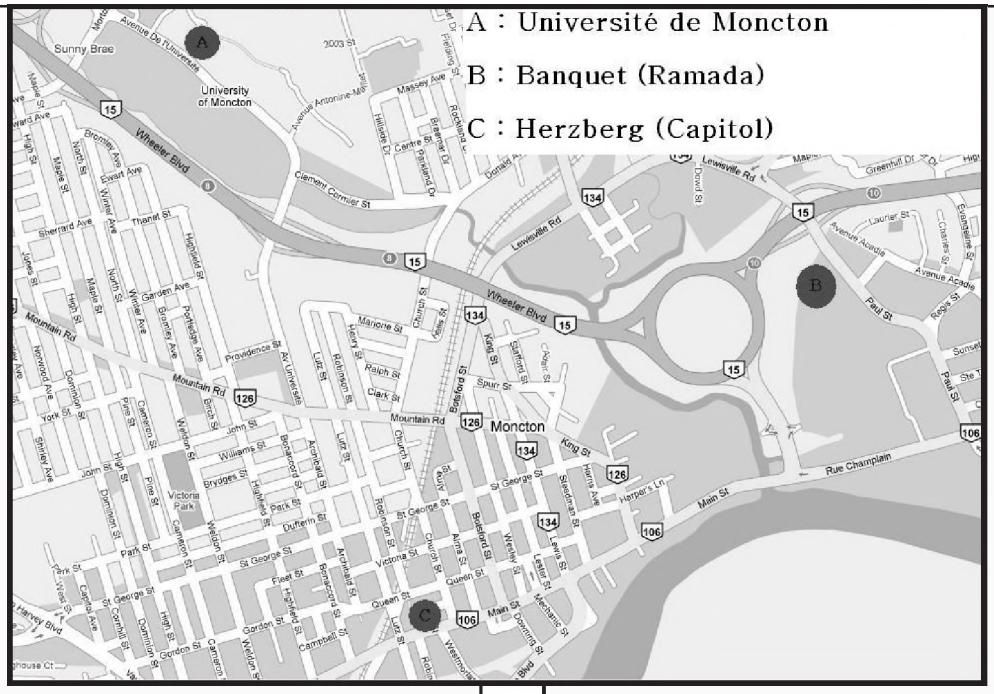
Université de Moncton is about 15 minutes away from the Greater Moncton International Airport and 5 minutes from the Crystal Palace Ramada Plaza hotel.

Taxi to the University from the Airport

Approximately $20 to $25.

Main Conference Venue

Most of the conference events, including registration, will take place in the Rémi-Rossignol Pavilion on campus at Université de Moncton. The rest will be at Engineering Pavilion and Jeanne-de-Valois Pavilion. The cafeteria is located at the Léopold-Taillon Pavilion and the students reception will be held at the Centre Étudiant. The residences are Médard –Collette, Pierre-Amand-Landry and Lafrance. See page iii for a campus map, pages iv-v for room locations, and page 5 for registration hours and information.



Walking from the Crystal Palace Ramada Plaza Hotel

(40 min) - Head northwest on Paul St toward Kennedy then continue on Lewisville Rd and stay slight left to stay on Lewisville Rd. You should pass a small bridge then turn right at Elmwood drive. Walking up this street, you turn left on Donald Ave then right at Clement Cormier St. If you turn right at Avenue De l'Université you should clearly see the campus at your right.

Bussing from Crystal Palace Ramada hotel to University

The nearest bus stop is located on the left side of the Champlain Place mall's Wal-Mart (at entrance 9). Monday to Friday, bus 22 goes at Université de Moncton in the morning (at 7:55 and 8:15) and in the afternoon (at 4:30, 5:00 and 5:30). Monday to Saturday evening, you can take bus 5 (at 7:10, 8:10 and 9:15). Finally, on Sunday, you can take bus 5 to go from the mall to the university from 8:15 am to 6:15 pm, leaving every 60 minutes. The rate is $2.00 for a ride.

Driving from Airport to University

(15 min) - Head east on De l'Aviation Ave toward Airport Access then turn left to stay on De l'Aviation Ave. Turn right on Adélard-Savoie Blvd then right at Dieppe Blvd. You should pass under a bridge then turn left to merge onto NB-15 W/Route 15 W. At the roundabout, take the 1st exit onto Route 15 W heading to Riverview. Finally, Take exit 8 toward Ave Universite Ave and turn right at Av Université (signs for Ave Université Ave). The campus will be at your right.

L'université de Moncton est située à environ 15 minutes de l'Aéroport International du Grand Moncton et 5 minutes de l'hôtel Ramada Plaza du Palais Crystal.

Taxi vers l'Université à partir de l'aéroport De Moncton

Environ 20$ à 25$.

Site Principal du Congrès

La plupart des activités du congrès, y compris l'inscription, auront lieu au Pavillon Rémi-Rossignol sur le campus de l'Université de Moncton. Les autres activités auront lieu au Pavillon de l'Ingénierie et au Pavillon Jeanne-de-Valois. La cafétéria est située dans le Pavillon Léopold-Taillon et la réception des étudiants aura lieu dans le Centre Étudiant. Les résidences sont Médard –Collette, Pierre-Amand-Landry et Lafrance. Voir la page iii pour une carte du campus, les pages iv-v pour l'emplacement des salles et la page 5 pour l'horaire d'inscription et d'information.

Marche vers l'Université à partir de l'hôtel Ramada Plaza du Palais Crystal

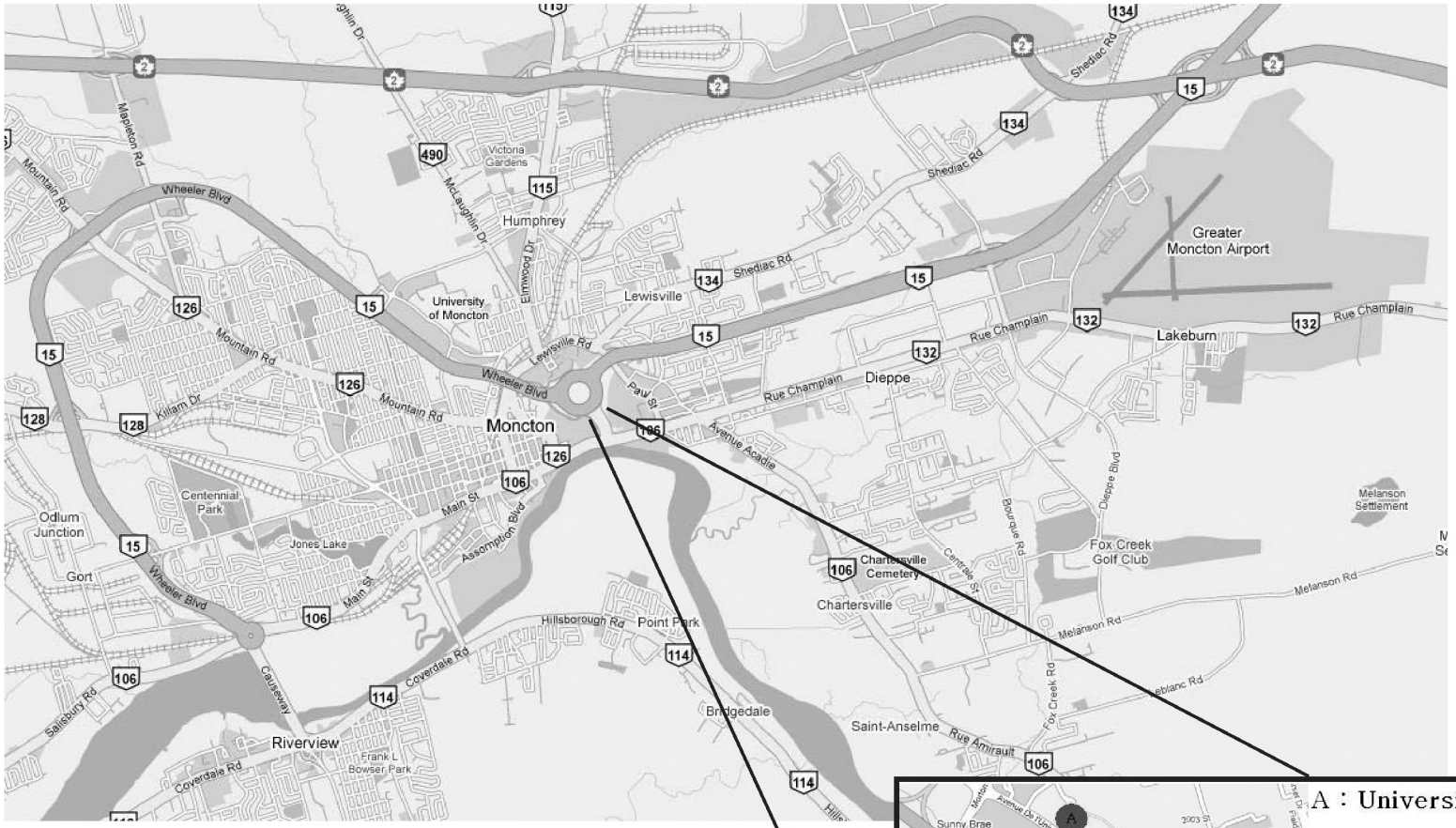
(40 min) – Allez en direction nord-ouest sur Paul St vers Kennedy puis continuez sur Lewisville Rd en tournant légèrement à gauche afin de demeurer sur Lewisville Rd. Vous devriez traverser un petit pont puis tourner à droite sur la Elmwood Dr. Remontez cette rue puis tournez à gauche sur la Donald Ave puis à droite sur la Clément Cormier St. Si vous tournez à droite sur Avenue De l'Université, vous devriez apercevoir le campus à votre droite.

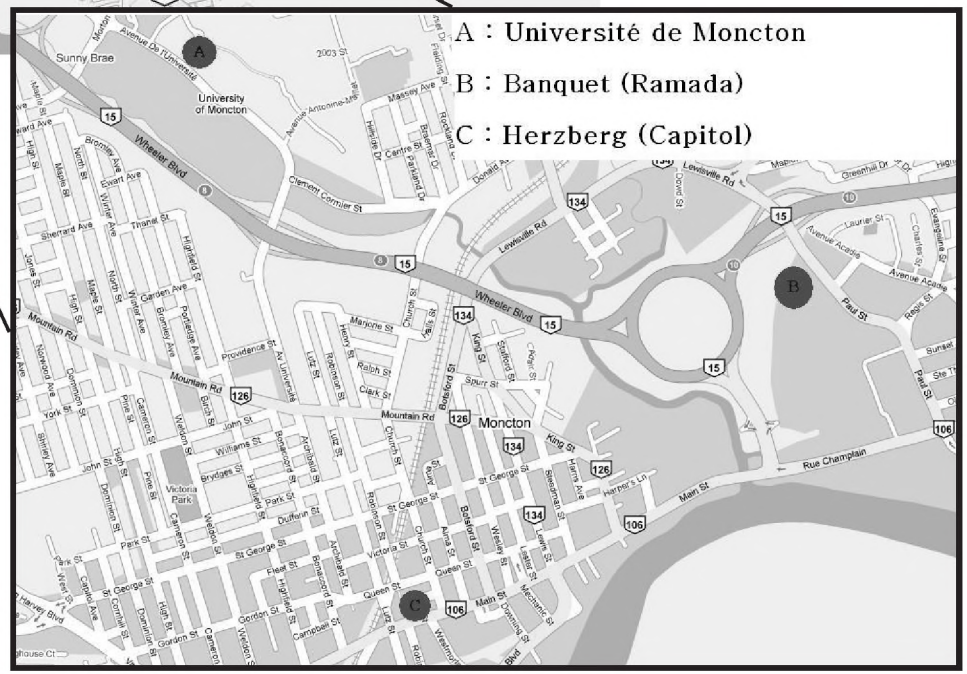
Autobus vers l'Université à partir de l'hôtel Ramada Plaza du Palais Crystal

L'arrêt d'autobus le plus près de l'hôtel est situé à la gauche du Wal-Mart du centre commercial la Place Champlain (devant l'entrée 9). Du lundi au vendredi, l'autobus 22 va jusqu'à l'Université de Moncton en matinée (à 7:55 et 8:15) puis en après-midi (à 16:30, 17:00 et 17:30). Du lundi au samedi en soirée, il est possible de prendre l'autobus 5 à 19:10, 20:10 et 21:15. Finalement, le dimanche il est possible de prendre l'autobus 5 toute la journée, de 8:15 à 18:15, partant à toutes les 60 minutes. Tarif de 2,00$ pour chaque voyage.

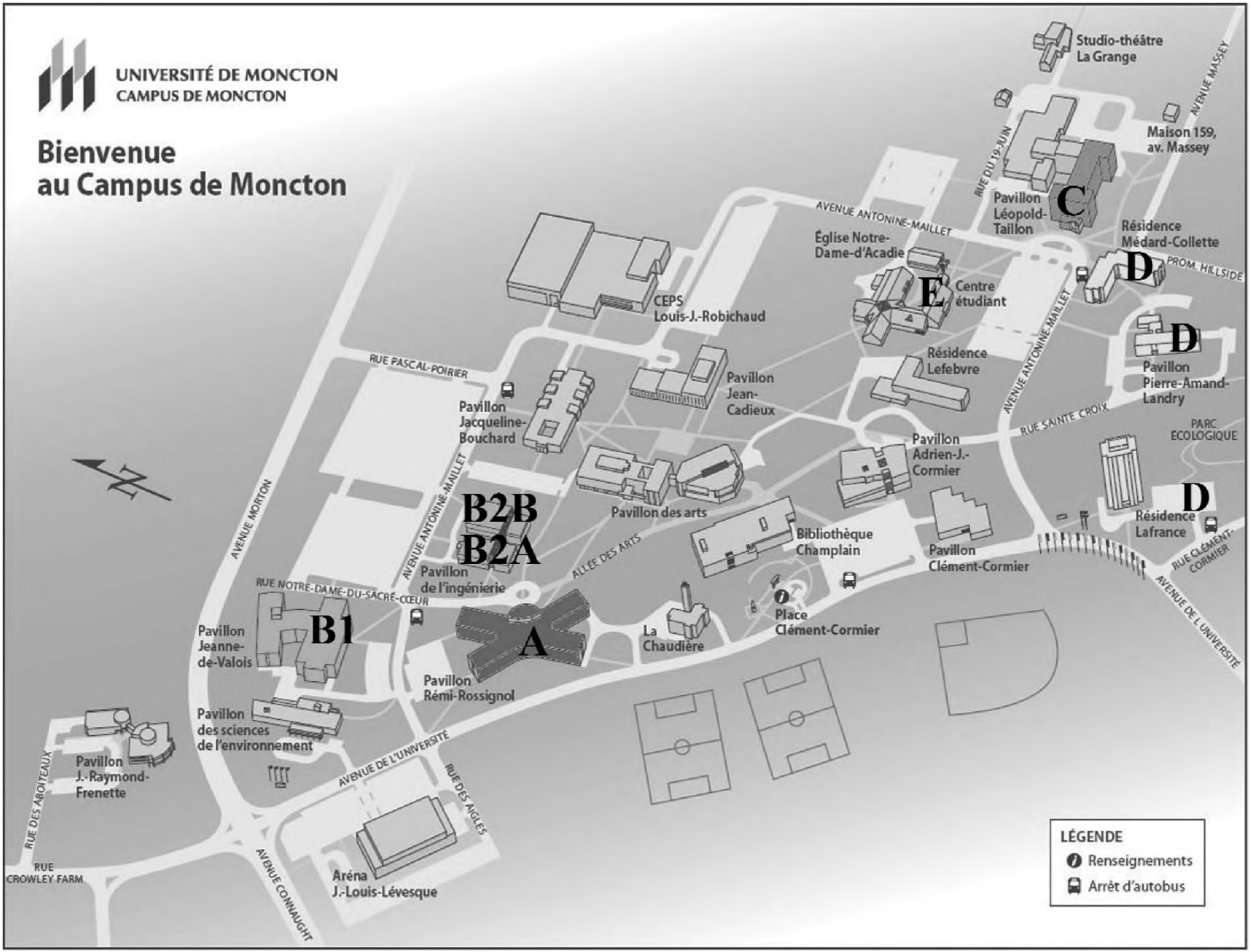
En voiture jusqu'à l'Université, à partir de l'aéroport

(15 min) - Aller en direction est sur De l'Aviation Ave vers Airport Access puis tournez à gauche pour continuer sur De l'Aviation Ave. Tournez à droite sur Adélard-Savoie Blvd puis de nouveau à droite sur Dieppe Blvd. Vous devriez passer sous un pont puis tournez à gauche pour rejoindre NB-15 W/Route 15 W. Au rond-point, prendre la 1ère sortie sur Route 15 W en direction de Riverview. Finalement, prenez la sortie 8 vers Ave Universite Ave et tournez à droite sur Av Université. Le campus sera à votre droite.





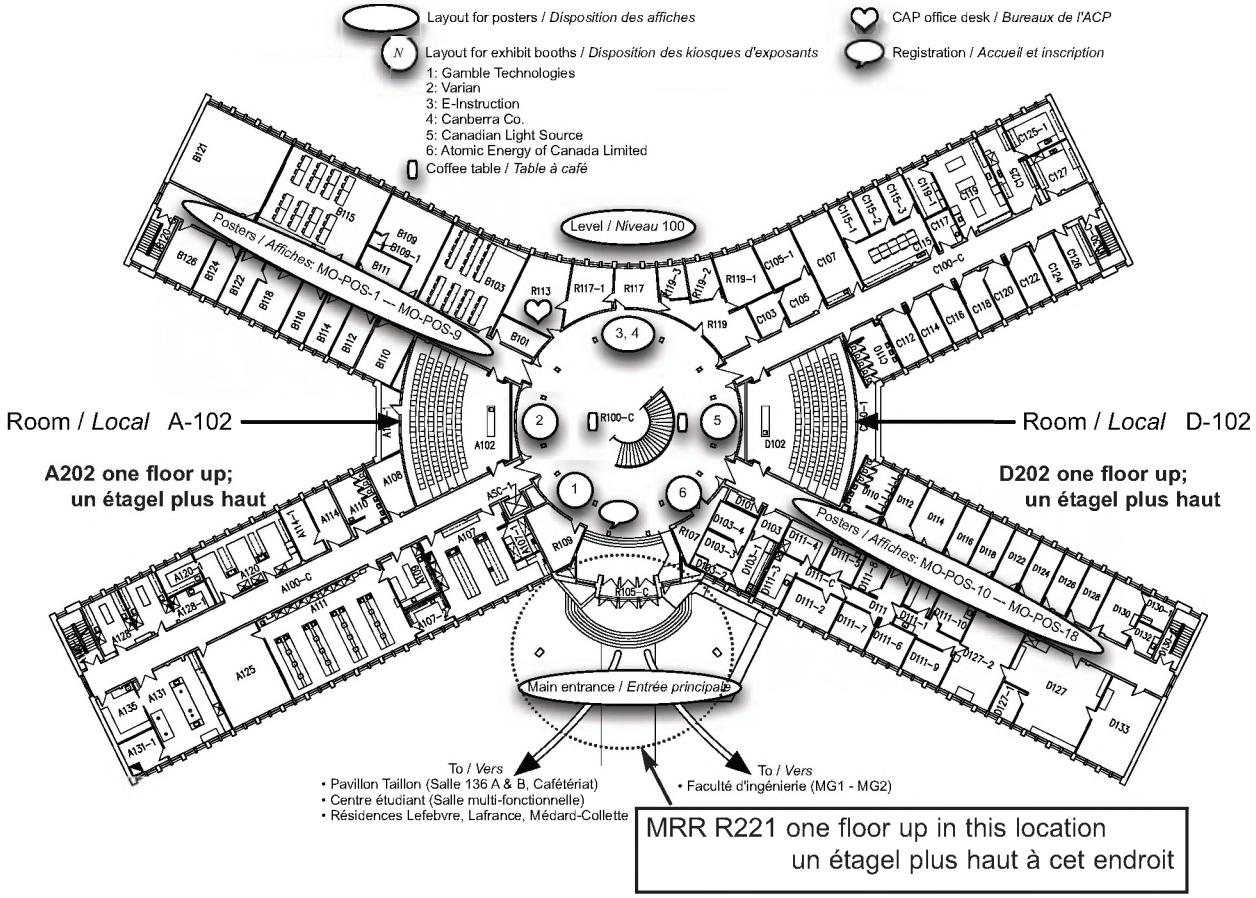
MONCTON, NEW BRUNSWICK



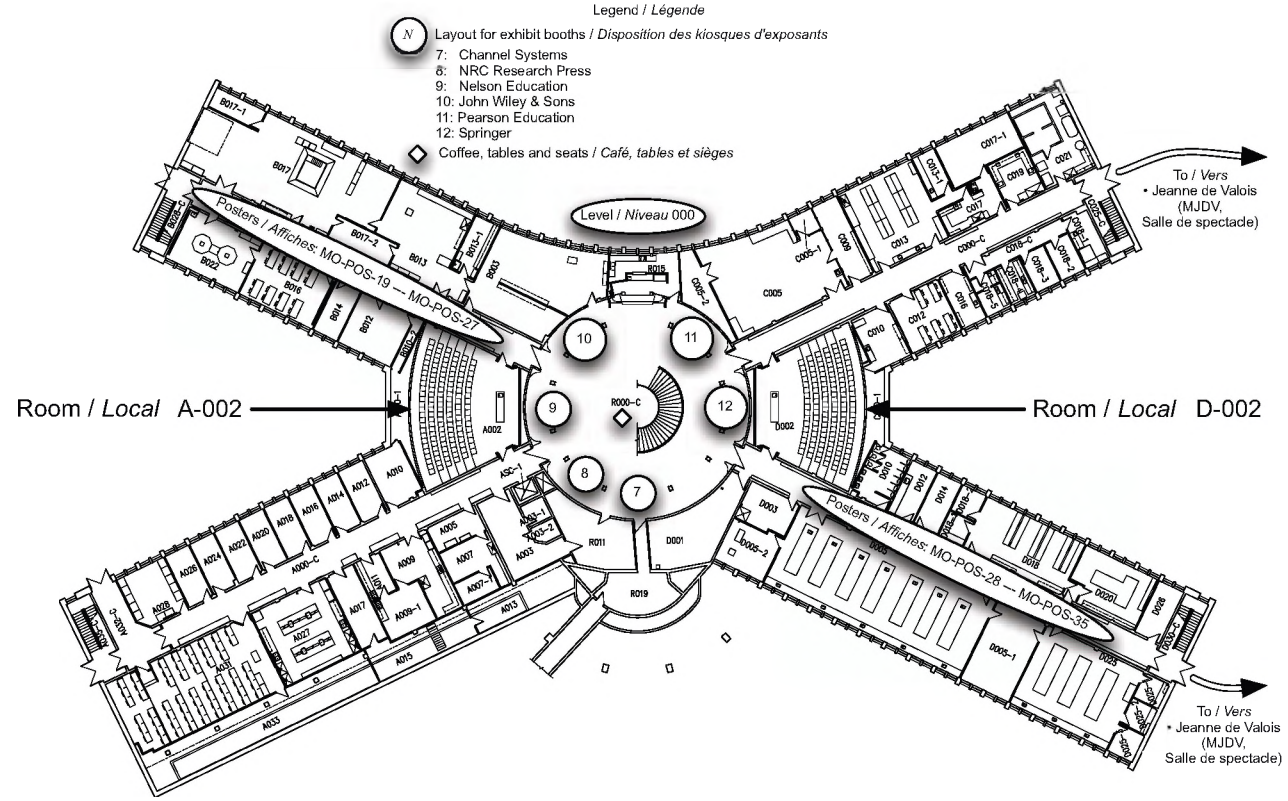
A = Main building / Édifice principal (MRR)
B = Other locations / Autres endroits (B1) JdeV; (B2) A= MG1; B=MG2
C = Cafeteria / Caféteria (Taillon)
D = Residences / Résidences
E = Room/salle multi-fonctionnelle

MRR - Pavillon Remi-Rossignol (A on campus map)

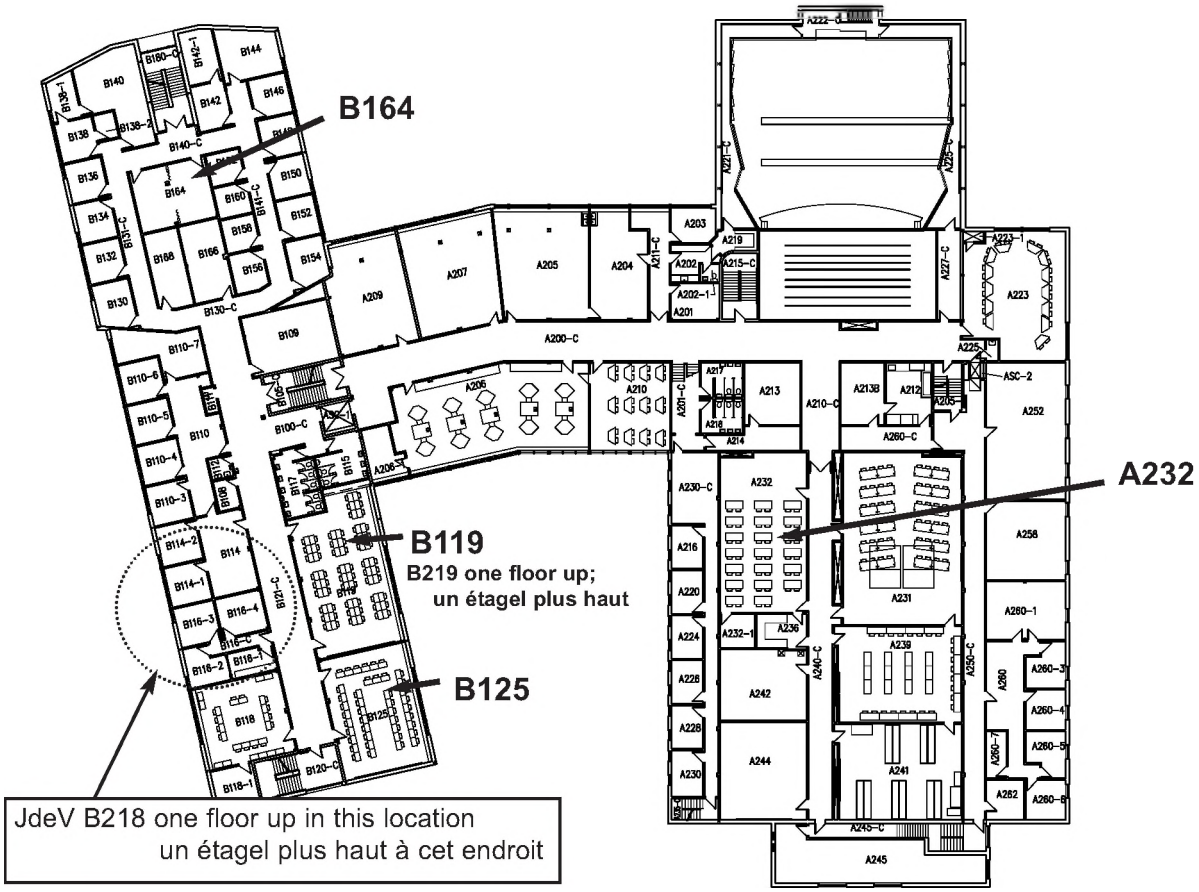
LEVEL 100 - Main Entrance (Registration) / Entrée principale (inscription)



LEVEL 000

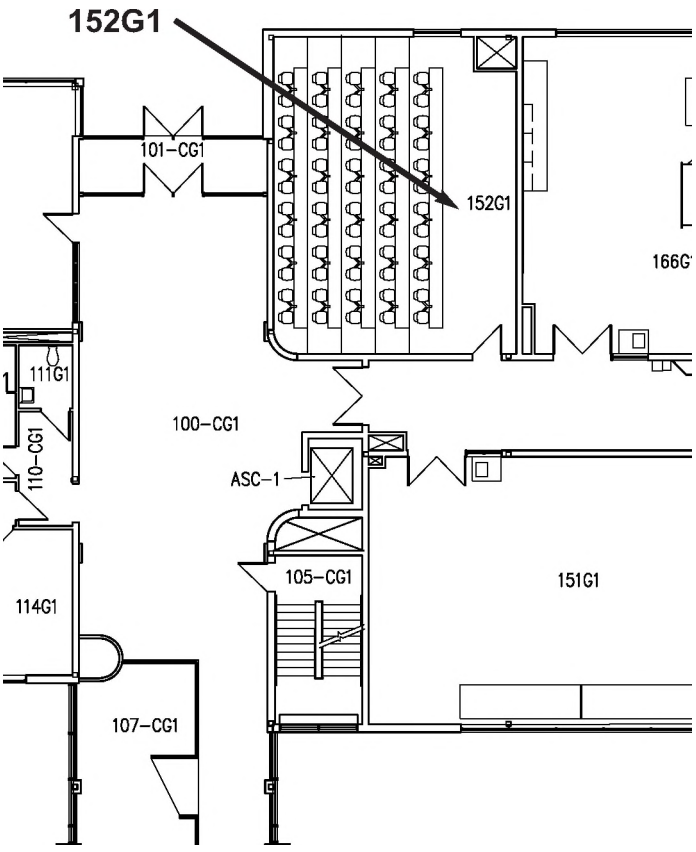


JdeV - Pavillon Jeanne de Valois (B1 on campus map)

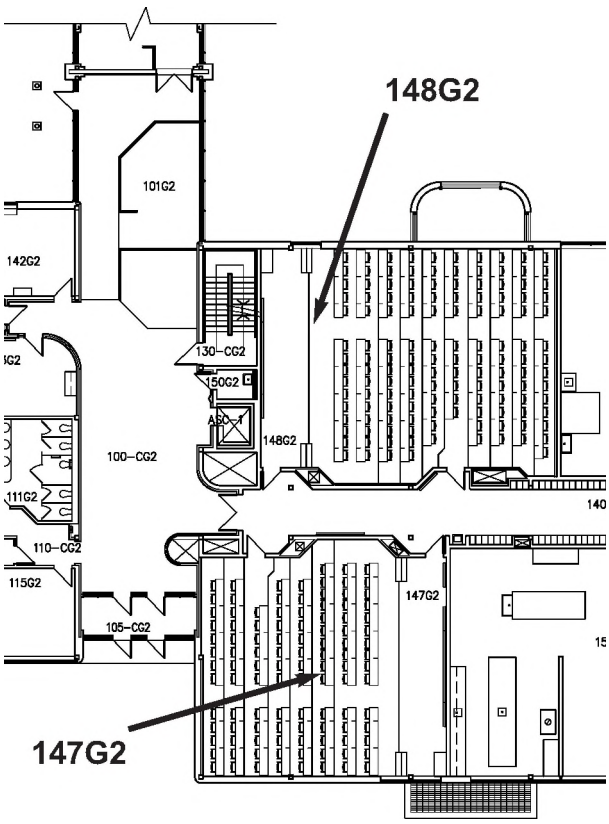


Faculté d'ingénierie

MG1- Phase 1 (B2A on campus map)

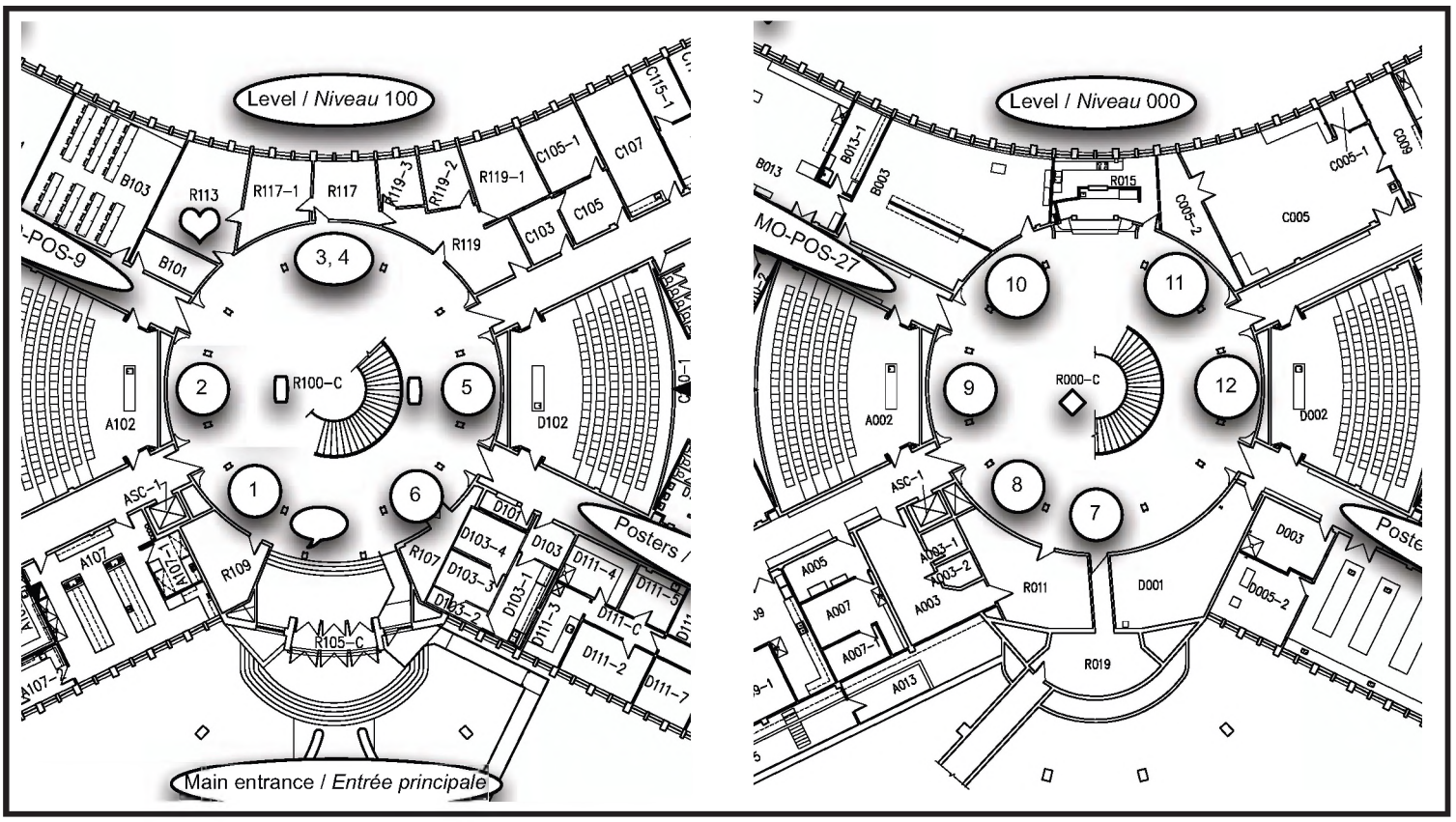


MG2 - Phase 2 (B2B on campus map)



Exhibitors / Exposants

1. Gamble Technologies Ltd.
2. Varian Inc.
3. E-Instruction
4. Canberra Co.
5. Canadian Light Source / Centre canadien de rayonnement synchrotron
6. Atomic Energy of Canada Ltd. / Énergie atomique du Canada Ltée.
7. Channel Systems
8. NRC Research Press / Presses scientifiques du CNRC
9. Nelson Education Ltd.
10. John Wiley & Sons Canada
11. Pearson Education Canada
12. Springer



Sponsors

The Congress organizers thank each of the sponsors and partners for their generous contributions. As the time of printing they are:

Canadian Institute for Photonics Innovation (CIPI)
Canadian Light Source
Gamble Technologies Limited
Institute for Quantum Computing
Perimeter Institute
TRIUMF
Université de Moncton
Varian Inc.

(Sponsoring student competitions)
Atomic Energy of Canada Ltd.
John Wiley & Sons Canada
Pearson Education Canada
Plasmionique Inc.

A final list of all exhibitors and sponsors will be distributed at the Congress.

Commanditaires

Les organisateurs du congrès remercient tous les commanditaires et partenaires de leurs généreuses contributions. Au moment d'aller sous presse, ce sont :

Institut canadien pour les innovations en photonique (ICIP)
Centre canadien de rayonnement synchrotron
Gamble Technologies Ltée.
Institute for Quantum Computing
Institut Perimeter
TRIUMF
Université de Moncton
Varian Inc.

(Commanditaires pour les compétitions étudiantes)
Énergie atomique du Canada Ltée.
John Wiley & Sons Canada
Pearson Education Canada
Plasmionique Inc.

La liste finale de tous les exposants et commanditaires sera distribuée lors du congrès.

PHYSICS IN CANADA
LA PHYSIQUE AU CANADA

Vol. 65 No. 2 Supplement
MAY / JUNE 2009
MAI / JUIN 2009

TABLE OF CONTENTS / TABLE DES MATIÈRES

2009 CAP CONGRESS
CONGRÈS DE L'ACP 2009

Notice to Delegates

A copy of the printed Congress program will be provided to delegates at the Annual Congress at the Université de Moncton in Moncton, NB

Avis aux délégués

Une copie du programme imprimé sera donnée aux délégués au Congrès annuel, à l'Université de Moncton à Moncton, N-B.

FRONT COVER / *COUVERTURE*

New Brunswick landscape extracted from the 2009 CAP Congress poster designed by the Local Organizing Committee at the Université de Moncton.

Paysage du Nouveau-Brunswick extraites d'affiche du congrès 2009 de l'ACP dessinée par le Comité d'organization local à l'Université de Moncton.

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS ET PHYSICIENNES

ANNUAL GENERAL MEETING
ASSEMBLÉE GÉNÉRALE ANNUELLE

DATE: Tuesday, June 9, 2009
Mardi, le 9 juin, 2009

TIME/HEURE: 16h45

PLACE: Room/Salle MRR R221, Université de Moncton, Moncton, NB.

DRAFT AGENDA / ORDRE DU JOUR PROVISOIRE

1. Call to Order and Approval of the Agenda

2. Approval of the Minutes of the June 19, 2008 Annual General Meeting
   .1 Matters arising from the Minutes

3. Annual Report
   .1 Audited Financial Statements to December 31, 2008
   .2 Membership Report

4. Appointment of Auditors

5. Presidential Address summarizing year's activities

6. Report by the Chair of the 2009 Local Organizing Committee

7. Host Universities - Future Congresses

8. New Business
   .1 2010 Membership Fees (R. Hemingway)
   .2 By-law amendments (S. Page)
   .2 Report of the Canadian National IUPAP Liaison Committee (G. Drake)
   .3 Report by the Editor of Physics in Canada (B. Joos)
   .4 Report by the Editor of the Canadian Journal of Physics (M. Steinitz)
   .5 CUPC 2009 at U.Alberta
   .6 Other matters

9. Report of the Nominating Committee

10. Votes of Thanks and Change of the Chair

11. Date and Place of Next Meeting

12. Adjournment

THE 64th CAP ANNUAL CONGRESS
64e CONGRÈS ANNUEL DE L'ACP

INFORMATION / PROGRAMME

(See page 18 for the Session Codes /
Voir les indicatifs des sessions à la page 18)

2009 CAP CONGRESS / CONGRÈS DE L'ACP 2009

TECHNICAL PROGRAM COMMITTEE / *COMITÉ DU PROGRAMME TECHNIQUE*

Chair / *Président*	R. Mann	rbmann@sciborg.uwaterloo.ca
Atmospheric & Space Physics / *physique atmosphérique et de l'espace*	T. Jayachandran	jaya@unb.ca
Atomic & Molecular Physics and Photon Interactions / *physique atomique et moléculaire et d'interactions avec les photons*	D. Tokaryk	dtokaryk@unb.ca
Condensed Matter and Materials Physics / *physique de la matière condensée et des matériaux*	I. Hill	ian.hill@dal.ca
History of Physics / *histoire de la physique*	W. Davidson	walter.davidsonn@nrc-cnrc.gc.ca
Industrial and Applied Physics / *physique industrielle et appliquée*	E. Maeva	maeva@uwindsor.ca
Instrumentation and Measurement Physics / *physique des instruments et mesures*	K. Michaelian	michaeli@nrcan.gc.ca
Medical and Biological Physics / *physique médicale et biologique*	A. Linhananta	apichart.linhananta@lakeheadu.ca
Nuclear Physics / *physique nucléaire*	M. Butler	mbutler@ap.smu.ca
Optics and Photonics / *optique et photonique*	R. Corriveau	robert.corriveau@cipi.ulaval.ca
Particle Physics / *physique des particules*	W. Taylor	taylorw@yorku.ca
Physics Education / *enseignement de la physique*	R. Thompson	thompson@phas.ucalgary.ca
Plasma Physics / *physique des plasmas*	J. Morelli	morelli@physics.queensu.ca
Surface Science / *science des surfaces*	S. Morin	smorin@yorku.ca
Theoretical Physics / *physique théorique*	R. MacKenzie	richard.mackenzie@umontreal.ca

LOCAL ORGANIZING COMMITTEE / COMITÉ ORGANISATEUR LOCAL

Chair / *Président*	P. Ashrit
Vice-Chair / *Vice-président*	F. LeBlanc
Coordinator and treasurer / *Coordinateur principal et trésorier*	P. Losier
Secretary / *Secrétaire*	F. Mallet
Posters, Exhibits and Signalisation / *Responsable session d'affiche/exposant/l'affichage*	S. Gauvin
Accommodation / *Responsable logement*	N. Beaudoin
Food services / *Responsable nourriture*	R. Sandapen/P. St-Onge
Banquet / *Responsable banquet*	A. Haché
Public lecture / *Responsable conférence publique*	J. Desforges
Student reception / *Responsable réception étudiantes*	Student council/conseil étudiant
Teachers' Workshop / *Responsable d'atelier des enseignants de physique*	F. Benkabou/F. Weil
Audio-visual and Poster / *Responsable audio-visuel et affiche publicitaire*	D. McIntyre
Support Services - abstract and program Info / *Services de support - résumés et programmes*	F. Ford/C. Harvey
Student Competition / *Compétition étudiante*	L. Marchildon

CAP OFFICE STAFF / PERSONNEL DE L'ACP

Executive Director / *Directrice exécutive*	F.M. Ford	CAP@uottawa.ca
Administrative Assistant / *Adjointe administrative*	C. Harvey	charvey@uottawa.ca

GENERAL INFORMATION / RENSEIGNEMENTS GÉNÉRAUX

2009 CAP Congress / *Congrès de l'ACP 2009*

Département de physique et d'astronomie
Université de Moncton
Moncton, N.-B. E1A 3E9
Tel/tél. : (506) 858-4511
Fax/téléc. : (506) 858-4541
e-mail/courriel : pierre.losier@umoncton.ca
website: http://www2.umoncton.ca/cfdocs/cap/index.cfm

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) 562-5614; Fax/téléc.: (613) 562-5615
e-mail/courriel : cap@uottawa.ca
website: http://www.cap.ca

REGISTRATION

From Sunday to Wednesday, the Congress registration and information desk will be located in the rotunda on the main floor of Pavillion Remi-Rossignol (Science Faculty) and will be staffed according to the following schedule:

Sunday June 7th	09h00 - 20h00
Monday June 8th	08h00 - 16h30
Tuesday June 9th	08h00 - 16h30
Wednesday June 10th	08h00 - 16h30

NAME BADGES

All registered conference participants will be issued with a name badge and a copy of the conference program. Badges should be worn at all congress events to identify registered participants. To facilitate the identification of individuals whom you may ask for assistance, please note that these will be designated by coloured name badges as follows:

Local Organizing Committee: *Yellow badges;*
Student Volunteers and Audi-Visual assistants:
Red t-shirts and badges;
CAP Executive: *Blue badges;*
Student Competition Judges: *Green badges.*

PARKING

Parking on Université de Moncton campus is free for all the registered delegates during the course of the congress.

E-MAIL ACCESS

Wireless internet is available on campus. Specific information on how to access the wireless service will be included in the registration package.

The computer lab, A-031 in the Remi-Rossignol building with around 45 work stations with internet, will be available for those who don't carry a laptop.

WHERE TO EAT

Meals on campus are available in the Pavillon Léopold Taillon main cafeteria, except for Sunday when lunch will be available in Jeanne de Valois. During lunch, two smaller cafeterias located in Pavillion Remi-Rossignol (Science building) and Pavillion Jeanne de Valois (Education Faculty) will also be open during lunch hours. Located within a 10-15 minute walk or 5 minute drive from Université de Moncton campus are a variety of restaurants or fast food counters.

EXHIBITORS / SPONSORS -- (see list on page vi)

INSCRIPTION

De dimanche à mercredi, le kiosque d'inscription et d'information pour le congrès sera situé dans la rotonde à l'étage principal du Pavillion Rémi-Rossignol (Faculté des sciences). Le personnel sera disponible aux heures suivantes :

Dimanche 7 juin	09h00 - 20h00
Lundi 8 juin	08h00 - 16h30
Mardi 9 juin	08h00 - 16h30
Mercredi 10 juin	08h00 - 16h30

PORTE-NOMS

Tous les participants inscrits à la conférence recevront un porte-nom et une copie du programme. On doit avoir sur soi le porte-nom pour s'identifier comme participant inscrit à toutes les activités du congrès. Pour faciliter l'identification des personnes à qui vous pouvez demander de l'aide, veuillez noter qu'elles auront des porte-noms avec le code de couleurs suivant:

Comité organisateur local: *porte-noms jaunes*;
Étudiants bénévoles et assistants audio-visuel:
porte-noms et t-shirts rouges;
Membres de l'exécutif de l'ACP: *porte-noms bleus*;
Juges des concours étudiants: *porte-noms verts*

STATIONNEMENT

Le stationnement sur le campus de l'Université de Moncton est gratuit pour tous les participants du congrès.

ACCÈS AU COURRIEL

L'accès à l'Internet sans fil est disponible sur le campus. Des renseignements spécifiques sur la façon d'accéder au service sans fil seront inclus dans la documentation remise sur place.

Le local informatique A-031 du Pavillon Rémi-Rossignol, qui possède environ 45 postes de travail avec Internet, sera disponible pour ceux qui n'ont pas d'ordinateur portable avec eux.

OÙ MANGER

La cafétéria principale du campus se trouve dans le pavillon Léopold-Taillon et sera disponible aux participants, sauf dimanche quand le dîner sera disponible au pavillon Jeanne de Valois. Les midis, deux petites cafétérias situées dans le pavillon Rémi-Rossignol (Faculté des sciences) et le pavillon Jeanne de Valois (Faculté d'éducation) seront aussi ouvertes. Plusieurs restaurants sont situés à 10 à 15 minutes de marche (ou à 5 minutes en voiture) du campus.

EXPOSANTS / COMMANDITAIRES -- (Voir la liste à la page vi)

CAP-NSERC NEW FACULTY BREAKFAST / *DÉJEUNER ACP-CRSNG POUR LES NOUVEAUX PROFESSEUR(E)S*

07h00-08h30, MONDAY/LUNDI, JUNE 8 JUIN, 2009 -- ROOM B219, JEANNE DE VALOIS

Guidelines for the Best Student Oral and Poster Competitions
- https://www.cap.ca/congress/abstracts/beststudpaper.html
Directives pour les concours des meilleures communications étudiantes (orales ou affiches)
- https://www.cap.ca/congress/abstracts/beststudpaper-f.html

2009 CAP CONGRESS

Greater Moncton

The Greater Moncton region is constituted by the three municipalities: Dieppe, Moncton and Riverview. With its own international airport, Greater Moncton is the hub of the Maritimes. With its 124,000 population of which one third is French speaking, both Moncton and Dieppe are officially bilingual. Greater Moncton is a multicultural region. It is situated on the banks of the Petitcodiac River, which joins the Bay of Fundy after a short run.

Plan to spend some extra time, before or after the meeting, exploring the multitude of things to do and see in and around Moncton. Within the Greater Moncton region are the very famous tourist attractions such as the Magnetic Hill, Tidal Bore, Capitol Theatre, Moncton Museum, Acadian Museum (on Université de Moncton campus), Moncton and Dieppe Farmers Markets, and more. Also take time to visit the surrounding region with such world famous attractions such as the Hopewell Rocks and Fundy National Park as well as the dunes of Bouctouche.

For more information visit:
http://www.moncton.org/SplashPages/MonctonIndex.htm
http://www.tourismnewbrunswick.ca/

Congress venue

The conference will be held at Université de Moncton campus in Moncton. Pavillion Remi-Rossignol (Faculty of Science) will be the center of most of the conference activities with some activities taking place in Pavillion d'ingénierie (Engineering Faculty) and Pavillion Jeanne-de-Valois (Education Faculty) each of which are a short walk from Pavillion Remi-Rossignol.

The main cafeteria and the campus book store (Librairie acadienne) are located in the Pavillon Léopold Taillon. Sports and training facilities are located in the CEPS (Louis-J.-Robichaud) building. The main library on the campus is the Bibliothèque Champlain. Please take time to visit the Acadian Museum located in Pavillion Clément Cormier to learn more about the Acadian history and culture. Entrance fee is $4.

CONGRESS 2009 HIGHLIGHTS

Sunday June 7th

- **Special Plenary session at 11h45: Isabelle Blain, NSERC Vice president** on "Update from NSERC", followed by lunch for participants, sponsored by NSERC and CAP.

- **Plenary talk at 13h30: CAP Brockhouse Medal winner, Michel Gingras, University of Waterloo** on "*Exotic Collective Phenomena in Geometrically and Randomly Frustrated Rare-Earth Magnetic Systems*".

- **5th Annual CAP Congress Student Reception, 16h30 - 18h00**
  Graduate and undergraduate students are cordially invited to a reception in the **Student's Centre (m-f)**. Come meet and network with other students from all over Canada.

- **CAP Welcome Barbeque, 17h00-18h45**

- **Plenary talk at 19h00: CAP Herzberg Medal winner, Guy Moore, McGill University** on "*Is quark-gluon matter nearly transparent or very opaque?*"

- **Poster session:**
  The CAP09 poster session will be held from 19h30 to 22h00 on level 0 and 1 of Pavillion Remi-Rossignol (Faculty of Science). Posters can be set up starting at 09h00 Sunday, June 7th 2009. Posters should have a maximum size of 4' high x 8' wide. Student competitors must be at their posters between 19h30 and 20h30. The poster session features a light snack and a bar service.

Monday June 8th

- **New Faculty Breakfast with NSERC at 07h00;** come and meet representatives from NSERC and new faculty members from across the country! Sponsored by NSERC.
- **Plenary talk at 08h45 by Dava Sobel, InkWell Management,** on "*Galileo and the International Year of Astronomy*".

CONGRÈS DE L'ACP 2009

Le grand Moncton

Le grand Moncton est constitué de trois villes: Dieppe, Moncton et Riverview. Le grand Moncton compte environ 124,000 habitants dont le tiers est francophone. Les villes de Moncton et Dieppe sont officiellement bilingue. La région de Moncton est également très multiculturelle. Avec son aéroport international, Moncton est un pôle important des Maritimes. Moncton est situé sur la rive de la rivière Petitcodiac qui se déverse dans la baie de Fundy.

On vous invite de prendre le temps de visiter plusieurs sites intéressants dans la région de Moncton. Par exemple, il y a la fameuse côte magnétique, le mascaret dû aux énormes marées dans la baie de Fundy, le théâtre Capitol, le musée de Moncton, le musée Acadien (se trouvant sur le campus de l'Université de Moncton), les marchés du fermier de Moncton et de Dieppe, ... Il y a aussi d'autres sites très intéressants se trouvant dans cette région comme Hopewell Rocks, le parc national de Fundy et les dunes de Bouctouche.

Pour plus d'information visitez :
http://www.moncton.org/SplashPages/MonctonIndex.htm
http://www.tourismenouveaubrunswick.ca/Accueil.aspx

Site du congrès

Le congrès aura lieu sur le campus de l'Université de Moncton. La plupart des activités auront lieu dans le pavillon Rémi-Rossignol (Faculté des sciences). Cependant certaines conférences auront lieu aux pavillons Jeanne-de-Valois (Faculté d'éducation) et d'ingénierie (Faculté d'ingénierie) qui se trouvent à proximité du pavillon Rémi-Rossignol.

La cafétéria principale et la librairie se trouvent au pavillon Léopold Taillon et le centre sportif se trouve au CEPS (pavillon Louis-J-Robichaud). La bibliothèque principale sur le campus est la bibliothèque Champlain et elle se trouve près de la Faculté des Sciences. Nous vous invitons également à visiter le musée Acadien qui se trouve dans le pavillon Clément Cormier. Le coût d'admission est 4$.

LES "HIGHLIGHTS" DU CONGRÈS 2009

Dimanche 7 juin

- **Conférence plénière spéciale à 11h45 : Isabelle Blain, vice-présidente du CRSNG** sur « Mise à jour par le CRSNG », suivie d'un lunch pour les participants, commandité par le CRSNG et l'ACP.

- **Conférence plénière à 13h30 : le gagnant de la médaille Brockhouse de l'ACP, Michel Gingras, de l'Université de Waterloo** sur « *Phénomènes collectifs exotiques dans les systèmes magnétiques à base de terres rares frustrés de façon géométrique et aléatoire* ».

- **5e réception annuelle d'étudiants au congrès de l'ACP, 16h30 - 18h00**
  Les étudiants de tous les cycles sont cordialement invités à une réception au Centre Étudiant. Venez fraterniser avec des confrères de partout au Canada.

- **Barbeque d'accueil de l'ACP, 17h00-18h45**

- **Conférence plénière à 19h00: le gagnant de la médaille Herzberg ACP: Guy Moore, Université McGill:** « *La matière de quarks et de gluons est-elle presque transparente ou très opaque?* »

- **Session d'affiches :**
  La session d'affiches de 2009 de l'ACP aura lieu de 19h30 à 22h00 sur les niveaux 0 et 1 du pavillon Rémi-Rossignol (Faculté des sciences). Les affiches peuvent être montées à partir de 09h00 dimanche le 7 juin 2009. Les dimensions maximales des affiches permises sont de 4' x 8'. Les étudiants prenant part à des compétitions doivent être à leur affiche entre 19h30 et 20h30. Un gouter léger et un service de bar seront présents lors de cette activité.

Lundi 8 juin

- **Déjeuner-rencontre des nouveaux professeurs avec le CRSNG à 07h00;** rencontrez les représentants du CRSNG ainsi que d'autres nouveaux professeurs de partout au pays! Commandité par le CRSNG.
- **Conférence plénière à 08h45 par Dava Sobel, InkWell Management,** sur « *Galilée et l'Année mondiale de l'astronomie* ».

- **Plenary talk at 13h30: CAP Teaching Medal winner Jeff Dahn, Dalhousie University,** on "*If It's Fun For You, It's Fun For Them*".

- **The Committee to Encourage Women in Physics will meet at 16h30: Rachel Ivie, American Institute of Physics,** will speak on *Women in Physics and Astronomy*".

- **Public lecture at 19h30:**
The Herzberg Memorial Public Lecture will be given at the Capitol Theatre by Laurent Drissen of the Université Laval, who will speak on "*The Splendours and Miseries of Massive Stars*". A reception for delegates and guests will follow.

Tuesday, June 10th

- **Plenary talk at 08h45 by Greg Flato, Environment Canada,** on "*Global Climate Models: Development and Application*".
- **Special plenary talk at 13h30 by Paul Corkum, University of Ottawa, (2009 NSERC Herzberg Medal Winner),** on "*Extreme Nonlinear Optics -- Attosecond-Angstrom Science*".
- **The 9th CAP High School Teachers' Workshop will take place from 08h15 - 16h00.**
- **The CAP Annual General Meeting** will be held in Room R-221 of the Pavillon Remi-Rossignol (Faculty of Science) from 16h45 to 18h00. The list of finalists for the student oral competition will be available at the CAP desk after 5 p.m.
- **Congress 2009 Reception/Banquet at 19h00 :**
will be held at the Crystal Palace Ramada Plaza Hotel.

Wednesday, June 10th

- **Plenary talk at 08h45 by Achim Schwenk, TRIUMF,** on "A tour of neutron matter in the universe ".
- **Plenary CAP/CRM Prize winner talk at 13h30 by Hong Guo, McGill University,** on "*Quantum transport theory: from atoms to devices*".
- **Plenary CAP-DIAP Medal winner talk at 13h30 by Andreas Mandelis, University of Toronto,** on "*Diffusion-Wave Diagnostic Techniques in Industrial, Applied and Biomedical Physics: They go where no light has gone before*!"

ORAL PRESENTATION INSTRUCTIONS:

Presentations/Audio-visual equipment:
All the major conference rooms are equipped with:

- Overhead projector
- Wired internet
- PC (Windows XP with the Office 2003 suite)
- Overhead data projector with a standard RGB connector (Mac users MUST bring their video adaptor)
- VCR

Large theatres are also equipped with overhead projectors and microphones. For smaller classrooms, microphones are available upon request at least 48hr ahead of time.

All presenters are encouraged to bring their presentation on a USB memory stick, CD or DVD in one of the formats compatible with the recent versions of:

- Acrobat Reader v. 7
- Microsoft Office 2003 (with compatibility package for Office 2007)

You are welcome to bring your own laptop computer. If your laptop is a Mac, you must bring your video adapter.

If you plan to use your PC or Mac for a presentation, make sure you contact the AV technical assistant in your room 15 minutes before your session starts, in order to pre-connect your laptop to the multimedia system and test your presentation. Since all talks must keep to the schedule, any time lost in setting up your computer will reduce the time available for your talk.

If you need a codec to run video clips, please contact Denis McIntyre at denis.mcintyre@umoncton.ca before your arrival on campus.

- **Conférence plénière pour la médaille d'enseignement de l'ACP à 13h30 par Jeff Dahn, Université Dalhousie,** sur « *Si c'est amusant pour vous, ça l'est pour eux* ».

- **Le comité pour encourager les femmes à la physique se réunira à 16h30,** pour entendre «*Les femmes dans la physique et l'astronomie*» par Rachel Ivie, American Institute of Physics; hommes et femmes intéressés aux questions des femmes en physique sont invités à paticiper. .

- **Conférence publique à 19h30:**
La conférence Herzberg aura lieu au théâtre Capitol. Le conférencier sera Laurent Drissen, Université Laval, «*Splendeurs et misères des étoiles massives*». Une réception pour les délégués et leurs invités aura lieu suite à cette conférence.

Mardi 10 juin

- **Conférence plénière à 08h45, Greg Flato, Environment Canada,** sur « *Modèles climatiques mondiaux : élaboration et application* ».
- **Plénière spéciale à 13h30, Paul Corkum, Université d'Ottawa (récipiendaire de la Médaille d'or Herzberg 2009 du CRSNG),** sur « *Optique non linéaire extrême – science attoseconde-angström* ».
- **Le 9e atelier des enseignants de physique du secondaire de l'ACP aura lieu de 08h15 à 16h00.**
- **L'assemblée générale annuelle de l'ACP** aura lieu au local R-221 du pavillon Rémi-Rossignol (Faculté des sciences) de 16h45 à 18h00. Les noms des finalistes du concours de présentations orales seront affichés au bureau de l'ACP après 17h00.
- **Banquet et réception de l'ACP09** aura lieu à 19h00 au Palais de Crystal, Hotel Ramada Plaza.

Mercredi 10 juin

- **Conférence plénière à 08h45, Achim Schwenk, TRIUMF,** sur « *Aperçu de la matière neutronique dans l'Univers* ».
- **Conférence plénière par le récipiendaire du prix ACP-CRM à 13h30, Hong Guo, Université McGill,** sur « *Théorie du transport quantique : des atomes aux dispositifs* ».
- **Conférence plénière par le récipiendaire de la médaille de la physique industrielle et appliquée à 13h30, Andreas Mandelis, Université de Toronto,** sur «*Techniques de diagnostic des ondes de diffusion en physique industrielle, appliquée et biomédicale : elles vont là où la lumière n'a jamais pénétré auparavant!* ».

DIRECTIVES CONCERNANT LES PRÉSENTATIONS ORALES

Matériel audio-visuel pour les présentations orales :
Toutes les salles de conférences sont équipées avec:

- Projecteur à acétate
- Prise internet câblée
- Ordinateur PC (Windows XP avec la suite Office 2003)
- Projecteur numérique au plafond avec prise RGB standard (les usagers avec un Macintosh DOIVENT apporter leur adaptateur video)
- Magnétoscope VHS

Les grandes salles de présentation sont équipées avec des projecteurs à acétates et des microphones. Pour les plus petites salles, un microphone est disponible sur demande 48 heures à l'avance.

Tous les conférenciers sont invités à emmener leur présentation sur une clé de mémoire USB, un CD ou un DVD dans un format compatible avec :

- Adobe Acrobat 7
- Office 2003 de Microsoft (avec la suite de compatibilité Office 2007)

Vous pouvez utiliser votre propre portable si vous le désirez. Les conférenciers équipés d'un portable Macintosh doivent apporter leur adaptateur vidéo afin de le brancher au projecteur numérique.

Si vous pensez utiliser votre propre portable pour une présentation, nous vous demandons de vous présenter 15 minutes avec le début de celle-ci afin de vous assurer de tester les connexions et éviter des problèmes techniques. Toutes les conférences doivent être ponctuelles et le temps requis pour régler un éventuel problème technique réduira le temps que vous aurez à votre disposition pour votre conférence.

Si vous avez besoin d'une codec vidéo spéciale pour votre présentation, vous devez contacter Denis.McIntyre@umoncton.ca avant votre arrivée sur le cam-

RECREATIONAL FACILITIES:

Université de Moncton's Physical Education and Sports Centre (CEPS) is the site of numerous sports events. Inaugurated officially in 1976, CEPS is the main training site for university athletes participating in various sports events. Thousands of students and residents of the Greater Moncton area use it for regular recreational and sports activities. It is recognized as the most complete indoor sports center in the Atlantic region. For more information contact: (506) 858-4545 or visit www.umoncton.ca/ceps

WEATHER:

Expect moderate to warm climate with average temperatures from 11°C - 22°C.

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INSTALLATIONS RÉCRÉATIVES :

Le Centre d'éducation physique et de sport (CEPS) de l'Université de Moncton accueil un grand nombre d'évènements sportifs. Inauguré en 1976, c'est le site principal d'entrainement des athlètes de notre université. Il est aussi utilisé par des milliers d'étudiants et de gens du public pour des activités sportives de récréation. Il est reconnu comme le complexe sportif intérieur avec la plus grande variété d'installations dans la région atlantique. Pour plus d'information veuillez téléphoner le (506) 858-4545 ou visitez www.umoncton.ca/ceps

TEMPÉRATURE :

On peut s'attendre à un temps doux ou assez chaud, avec des températures moyennes allant de 11°C à 22°C.

The *Physics in Canada* 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 de *La Physique au Canada* 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.

MARK YOUR CALENDARS / *PRENEZ NOTE SUR VOTRE CALENDRIER*

2010 CAP CONGRESS - CONGRÈS DE L'ACP 2010 — **June 7-11 juin**
University of Toronto / Université de Toronto

2011 CAP CONGRESS - CONGRÈS DE L'ACP 2011 — **June 13-17 juin**
Memorial Univ. of Newfoundland / Univ. Mémorial de Terre-Neuve

2012 CAP CONGRESS - CONGRÈS DE L'ACP 2012 — **tba/à déterminer**
University of Calgary / Université de Calgary

SUNDAY, JUNE 7 — DIMANCHE, LE 7 JUIN

16h30 - 18h00

STUDENT RECEPTION
RÉCEPTION POUR LES ÉTUDIANT(E)S
ROOM-SALLE MULTI-FONCTIONNELLE

Graduate and undergraduate students are cordially invited to a reception. Come meet and network with other students from all over Canada / *Les étudiants de tous les cycles sont cordialement invités à une réception. Venez fraterniser avec des confrères de partout au Canada.*

17h00 - 18h45

CAP WELCOME BARBEQUE
BBQ D'ACCUEIL DE L'ACP
ROOM-SALLE MULTI-FONCTIONNELLE

Delegates are cordially invited to a welcome BBQ. Come meet and network with other delegates. / *Les délégués sont cordialement invités à un BBQ d'accueil. Venez fraterniser avec d'autres délégués.*

19h00 - 19h30

CAP HERZBERG MEDAL PLENARY TALK
PRÉSENTATION PAR LE RÉCIPIENDAIRE DE LA MÉDAILLE HERZBERG DE L'ACP
JEANNE DE VALOIS, SALLE DE SPECTACLE
(see pg. 10 for details / Voir p. 10 pour renseignments)

19h30 - 22h00

POSTER SESSION AND STUDENT COMPETITION
SESSION D'AFFICHES ET CONCOURS ÉTUDIANTS
2009 JUNE 7 JUIN -- ROOM-SALLE MRR CORRIDORS
(with beer and light refreshments / bière et petit goûter servis)

MONDAY, JUNE 8 19h30 LUNDI, LE 8 JUIN

2009 HERZBERG MEMORIAL PUBLIC LECTURE
CONFÉRENCE COMMÉMORATIVE PUBLIQUE HERZBERG 2009

Théâtre Capitol, Centre-ville, Moncton

The Splendours and Miseries of Massive Stars
Splendeurs et misères des étoiles massives

Laurent Drissen, Université Laval

The most massive stars in the universe are also the most fascinating. Exceedingly rare, they nevertheless play an important role in galactic ecology and in the chemical evolution of the cosmos. They are born in gigantic molecular clouds and they light up with an enormous outpouring of ultraviolet radiation. Pressure exerted by these forms of light on heavy elements present in the stellar atmosphere results in a very powerful wind which enriches the regions between the stars and injects large amounts of energy in their surroundings. The life of massive stars is brief – a hundredth of that of ordinary, sun-like stars - and ends in a gigantic explosion detectable to distances of billions of light-years. With the help of beautiful images obtained by the largest ground-based and space telescopes, I will describe the life and death of these stars which illuminate our universe.

Les étoiles les plus massives de l'univers sont aussi les plus fascinantes. Excessivement rares, elles jouent pourtant un rôle de premier plan dans l'écologie galactique et dans l'évolution chimique du cosmos. Elles naissent dans de gigantesques nuages moléculaires qu'elles illuminent rapidement d'un énorme flux de rayons ultraviolets. Leurs vents violents, qui leur fait perdre plus de la moitié de leur masse au cours de leur vie, perturbe considérablement leur environnement en y injectant non seulement de grandes quantités d'énergie mais aussi des éléments chimiques lourds tels que l'oxygène. Ces étoiles sont aussi éphémères que spectaculaires: leur vie, qui est des centaines de fois plus courte que celle des autres étoiles, se termine par une gigantesque explosion souvent visible à des milliards d'années-lumière. À l'aide de merveilleuses images obtenues par les plus grands télescopes terrestres et spatiaux, je décrirai la vie et la mort de ces étoiles qui illuminent l'univers.

BIOGRAPHY / BIOGRAPHIE

Laurent Drissen grew up between Montreal and the countryside of the Eastern Townships where he spent most of his week-ends and his summer vacations. Obviously, the country sky was lit up with stars, and it is there that his passion for the Galaxy and the cosmos was born. He obtained his Ph.D. (1990) from the Université de Montréal under the supervision of Prof. Anthony Moffat, one of the world experts on Wolf-Rayet stars. His first experiences as a professional astronomer were at the Mont Mégantic Observatory, then at the Canada-France-Hawaii telescope. He also observed at the AAT (Australia), the Wise Observatory (Israel), CTIO and ESO (Chile) and Mount Lemmon (Arizona). He then moved to Baltimore, Maryland, where he worked at the Space Telescope Science Institute in the early times of the Hubble Telescope (from 1990 to 1994). He came back to Québec in 1995 to work with the astrophysics group at Laval University. Since 2001, he has held the Canada research chair in astrophysics (massive stars and hyperspectral imagery) at the same university. He works on massive stars and their influence on their surroundings, and he also builds, in collaboration with his fantastic students, innovative astronomical instruments such as a wide-field imaging spectrometer. He teaches classical physics, quantum mechanics, stellar structure and evolution, and he supervises four graduate students.

Laurent Drissen a grandi entre Montréal et la campagne des Cantons de l'Est où il passait la plupart de ses fins de semaines et ses vacances. Évidemment, le ciel de l'Estrie était parsemé d'étoile, et c'est là qu'est née sa passion pour les étoiles et le cosmos. Après un baccalauréat en physique à l'Université de Montréal, il a poursuivi ses études de maîtrise (1985) et de doctorat (1990) en astrophysique dans la même université, sous la direction du Prof. Anthony Moffat, un passionné des étoiles massives. Il a fait ses premières armes d'astronome professionnel à l'Observatoire du mont Mégantic, puis au télescope Canada-France-Hawaii. Il a aussi observé aux télescopes AAT (Australie), Wise (Israël), CTIO et ESO (Chili) et Mount Lemmon (Arizona). Parenthèse très enrichissante comme chercheur à la NASA, à Baltimore au Maryland, où il a collaboré au projet du télescope Hubble (entre 1990 et 1994). Il fait partie depuis 1995 du groupe d'astrophysique de l'Université Laval, dont il assume la direction depuis 2005. Il est depuis 2001 titulaire de la chaire de recherche du Canada sur les étoiles massives et l'imagerie hyperspectrale. Il s'intéresse particulièrement à l'influence des étoiles massives sur leur environnement, et au design d'instruments astronomiques de pointe. Il fait partie de l'équipe scientifique du télescope spatial UVIT, une collaboration entre les agences spatiales canadienne (ASC) et indienne (ISRO), et qui sera mis en orbite en 2009. Il enseigne la mécanique classique, la physique quantique, l'évolution stellaire et la structure interne des étoiles, et il supervise actuellement quatre étudiant(e)s à la maîtrise et au doctorat.

TUESDAY, JUNE 9 — *MARDI, LE 9 JUIN*

07h45-16h15

9th Annual Physics Teachers' Workshop

9e Atelier annuel des enseignants de physique

On Tuesday, June 9th, a workshop specifically directed towards high school teachers is going to be held as a part of the annual national conference of the Canadian Association of Physicists at the Université de Moncton.

Several interesting presentations are going to be given during this workshop, including:

1) "*The stars and the Hertzsprung-Russell diagram"* by Professor Francis LeBlanc, Université de Moncton

and

2) "*Opening Doors in Physics Education: Challenges (and Solutions?) from High School to University*" by Professor Adam Sarty, Saint Mary's University

Dr. Robert Corriveau of the Canadian Institute for Photonic Innovation will be the luncheon speaker.

An invitation was sent to high school teachers inviting any interested teacher to give a talk to share their teaching experience with others.

A full program should be available at the registration for this workshop on Tuesday morning.

Mardi le 9 juin, un atelier spécifiquement conçu pour les enseignants du secondaire aura lieu dans le cadre de la conférence nationale annuelle de l'Association canadienne des physiciens et physiciennes à l'Université de Moncton.

Plusieurs exposés captivants seront présentés à cet atelier, en particulier:

1) *"Les étoiles et le diagramme de Hertzsprung-Russell" par le professeur Francis LeBlanc, Université de Moncton*

et

2) *"Ouvrir des portes dans l'enseignement de la physique: défis (et solutions?) du secondaire à l'université" par le professeur Adam Sarty, Saint Mary's University*

Le Dr Robert Corriveau de l'Institut canadien pour les innovations en photonique sera le conférencier du midi.

Un message a été lancé aux enseignants du secondaire invitant tout enseignant intéressé à présenter un exposé pour partager son expérience d'enseignement.

Le programme complet de l'atelier sera disponible mardi matin lors de l'inscription.

SUNDAY, JUNE 7 DIMANCHE, LE 7 JUIN

Jeanne de Valois, Salle de spectacle
11h45-13h30

ISABELLE BLAIN
VICE-PRESIDENT, NSERC / VICE-PRÉSIDENTE, CRSNG

Update from NSERC / Mise à jour par le CRSNG

NSERC will provide an update on various activities, particularly the progress in implementing the recommendations of the International Review of the Discovery Grants Program and the Grant Selection Committee Structure Review. This forum will also be an opportunity to engage in a discussion on the Canadian physics community's emerging and priority issues

Le CRSNG fera le point sur diverses activités, notamment les progrès accomplis dans la mise en ouvre des recommandations de l'examen international du Programme de subventions à la découverte et de l'examen de la structure des Comités de sélection des subventions. Ce forum sera aussi l'occasion d'entamer une discussion portant sur les nouveaux défis auxquels fait face la collectivité canadienne de physique ainsi que les priorités de cette dernière.

Jeanne de Valois, Salle de spectacle
13h30-14h00

MICHEL GINGRAS
UNIVERSITY OF WATERLOO / UNIVERSITÉ DE WATERLOO

CAP Brockhouse Medal Winner / Récipiendaire de la médaille Brockhouse de l'ACP

Exotic Collective Phenomena in Geometrically and Randomly Frustrated Rare-Earth Magnetic Systems

Magnetic materials and theoretical models of magnetic systems have long afforded physicists with some of the best test benches to study collective phenomena in nature. The 1987 discovery of high-temperature superconductivity in copper oxide materials generated an impetus for the search of exotic and intrinsically quantum mechanical ground states in magnetic systems. In this context, both on theoretical and experimental fronts, "frustration" has been the most popular microscopic mechanism considered to induce large quantum spin fluctuations in quasi-two and three dimensional settings. Geometric frustration arises when a magnetic system cannot minimize its total classical ground state energy by minimizing the energy of its pairwise interactions, pair by pair. Over the past twenty years, a large number of insulating and metallic geometrically frustrated oxide materials that comprise rare-earth ions carrying localized magnetic moments have been found to display a plethora of highly interesting phenomena. Just to name a few, examples include spin liquid, spin ice, spin glass, antiglass, long range order, hidden order, random field effects and quenched quantum criticality, field and pressure induced quantum phase transitions, anomalous Hall effect, Kondo-like behavior, persistent low-temperature spin dynamics and topological phase transitions. Most of these phenomena were first discovered by experimentalists and provided a number of exciting theoretical challenges, many having yet to be resolved. In this talk, I shall briefly review some of these fascinating phenomena, emphasizing the contributions made by Canadian researchers at the University of British Columbia and TRIUMF, McMaster University and the University of Waterloo.

Phénomènes collectifs exotiques dans les systèmes magnétiques à base de terres rares frustrés de façon géométrique et aléatoire

Les matériaux magnétiques et les modèles théoriques de systèmes magnétiques fournissent depuis longtemps aux physiciens certains des meilleurs bancs d'essais pour étudier les phénomènes collectifs de la nature. La découverte de la supraconductivité des matériaux d'oxyde cuivreux à haute température, en 1987, a suscité un élan pour la quête d'états normaux exotiques et intrinsèquement mécaniques quantiques dans les systèmes magnétiques. Dans ce contexte, sur les plans tant théorique qu'expérimental, la « frustration » a été le mécanisme microscopique le plus couramment considéré comme déclenchant de vastes fluctuations de spins quantiques en milieux à près de deux et à trois dimensions. Il y a frustration géométrique si un système magnétique ne peut minimiser son énergie totale à l'état normal classique en minimisant l'énergie de ses interactions par paire, de paire à paire. Depuis 20 ans, on a trouvé beaucoup de matériaux de métal oxyde isolant géométriquement frustré, comprenant des ions de terres rares et des moments magnétiques localisés, qui affichaient une foule de phénomènes fort intéressants. En voici quelques exemples : liquide, glace ainsi que verre de spin, antiverre, ordre à longue portée et caché, effets de champ aléatoire et criticité quantique figée, changements d'état quantique par champ et pression, effet anormal de Hall, comportement quasi Kondo, dynamique du spin persistant à basse température et changements d'état topologiques. La plupart de ces phénomènes ont d'abord été découverts par des expérimentateurs et ont suscité diverses difficultés théoriques passionnantes, dont beaucoup demeurent insolubles. Dans mes propos, je passerai brièvement en revue certains de ces phénomènes fascinants, soulignant les contributions de chercheurs canadiens de l'Université de la Colombie-Britannique et de TRIUMF ainsi que de l'Université McMaster et de l'Université de Waterloo

SUNDAY, JUNE 7 — DIMANCHE, LE 7 JUIN

Jeanne de Valois, Salle de spectacle
19h00-19h30

GUY MOORE
McGILL UNIVERSITY / UNIVERSITÉ McGILL

CAP Herzberg Medal Winner / Récipiendaire de la médaille Herzberg de l'ACP

Is quark-gluon matter nearly transparent or very opaque?

I will present the seemingly contradictory behavior of matter made up of quarks and gluons. Nuclei are built of quarks and gluons, and when two nuclei strike each other at very high energy most of the material in each nucleus passes through the other, suggesting near-transparency. But the matter which is stopped subsequently displays a pattern of flow which indicates that it interacts very strongly and behaves collectively, in fact as a fluid which is more nearly perfect than any other we know. I discuss how far we have gotten theoretically towards understanding this seemingly puzzling dichotomy.

La matière de quarks et de gluons est-elle presque transparente ou très opaque?

Je vous parlerai du comportement apparemment contradictoire de la matière faite de quarks et de gluons. Les noyaux sont faits de quarks et de gluons et, lorsque deux d'entre eux se heurtent à très haute énergie, la majeure partie de la matière de chacun passe à travers l'autre, ce qui laisse croire à une quasi-transparence. Mais la matière par la suite stoppée montre un type d'écoulement indiquant la très forte interaction et le comportement global d'un fluide qui, en fait, avoisine davantage la perfection que tout autre fluide connu. Nous verrons où nous en sommes, théoriquement, dans la compréhension de cette dichotomie apparemment curieuse.

MONDAY, JUNE 8 — LUNDI, LE 8 JUIN

Jeanne de Valois, Salle de spectacle
08h45-09h30

DAVA SOBEL
AUTHOR, INKWELL MANAGEMENT

Galileo and the International Year of Astronomy

I will discuss Galileo as a physicist who was waylaid by his interest in the telescope, and how his astronomical findings derailed his studies of motion. Had he not observed mountains on the Moon and spots on the Sun, had he never discovered the moons of Jupiter or the phases of Venus, we would remember him today "merely" as the father of modern physics. Rather than lionize him, I will endeavor to show some of the problems he encountered (with funding, for example) that remain all too familiar to scientists today.

Galilée et l'Année mondiale de l'astronomie

Je vais vous parler de Galilée, le physicien qui a été emporté par son intérêt pour le télescope de la manière et dont les découvertes astronomiques ont fait avorter les études sur le mouvement. S'il n'avait pas observé les montagnes sur la Lune et les taches solaires, s'il n'avait jamais découvert les satellites de Jupiter ou les phases de Vénus, nous nous rappellerions aujourd'hui de lui « simplement » comme le père de la physique moderne. Au lieu de chanter ses louanges, je m'efforcerai de faire ressortir certains problèmes auxquels il s'est heurté (le financement, par exemple) et qui ne sont que trop connus des scientifiques aujourd'hui.

NOTE: The winner of the CAP Medal of Achievement, Dr. Richard Peltier, is unable to attend this Congress. He will be invited to give a talk at the 2010 Congress at the University of Toronto.

NOTE: Le gagnant de la médaille de l'ACP pour contributions exceptionnelles, le Dr Richard Peltier, ne participera pas à ce congrès. Il sera conférencier invité au congrès de 2010 à l'Université de Toronto.

MONDAY, JUNE 8 LUNDI, LE 8 JUIN

Jeanne de Valois, Salle de spectacle
13h30-14h00

JEFF DAHN
DALHOUSIE UNIVERSITY / UNIVERSITÉ DALHOUSIE

CAP Teaching Medal Winner / Récipiendaire de la médaille d'enseignement de l'ACP

If It's Fun for You, It's Fun for Them

Coupling virtually non-stop lecture demonstrations with 1st year Physics teaching makes lecturing fun for me. When I'm having fun, the students get engaged and enjoy the lectures too. My teaching style has evolved primarily due to the influences of Ernie Guptill, Gerhard Stroink, Frank Curzon, Jeff Rudd, Albert Curzon and Melvin Calkin. In this lecture, using virtually non-stop demonstrations, I will describe how each of these gentlemen influenced what I do in class.

Si c'est amusant pour vous, ça l'est pour eux

Joindre les démonstrations presque ininterrompues à la 1re année d'enseignement de la physique fait que les conférences m'amusent. Et, si je m'amuse, les étudiants embarquent et adorent les conférences eux aussi. Mon style d'enseignement a évolué surtout sous l'influence d'Ernie Guptill, de Gerhard Stroink, de Frank Curzon, de Jeff Rudd, d'Albert Curzon et de Melvin Calkin. Dans cette conférence faisant appel à des démonstrations presque ininterrompues, je vais vous expliquer comment chacun de ces messieurs a influencé ce que je fais dans mes cours.

TUESDAY, JUNE 9 MARDI, LE 9 JUIN

Jeanne de Valois, Salle de spectacle
08h45-09h30

GREG FLATO
ENVIRONMENT CANADA / ENVIRONNEMENT CANADA

Global Climate Models : Development and Application

Global climate models are essentially computer simulations of the climate system. They are physically based, in that they rely on mathematical representation of the many complex processes that constitute the climate system. They are extremely computationally expensive, and they are typically run on some of the most powerful supercomputing facilities available. Such models allow us to understand and attribute cause to past climate change, and to make quantitative projections of future climate. They therefore serve as an important tool in providing climate change information for adaptation, mitigation and decision making. In this talk I will provide a basic overview of what constitutes a global climate model and a description of how they are used. This will focus primarily on the Canadian global climate model developed at CCCma over the past 20 years or so. I will then provide some example results to illustrate what we have learned about past climate change and what such models tell us about the climate of the future. I will conclude with a description of the 'new frontier' in climate modelling, using so-called 'Earth System Models' which represent not only the physical climate system, but also the biogeochemical cycles involved in the climatically relevant carbon, sulphur and ozone cycles.

Modèles climatiques mondiaux : élaboration et application

Les modèles climatiques mondiaux sont essentiellement des simulations informatisées du système climatique. Ils ont un fondement physique du fait qu'ils misent sur la représentation mathématique des nombreux processus complexes constituant le système climatique. Ils sont extrêmement exigeants du point de vue informatique, et généralement traités à l'aide de certaines des superinformatiques les plus puissantes qui existent. Ces modèles permettent de comprendre et d'attribuer la cause aux changements climatiques passés ainsi que de faire des projections quantitatives du climat futur. Ils sont donc une source d'information précieuse sur le changement climatique pour l'adaptation, l'atténuation et la prise de décision. Dans mes propos, je vous donnerai un aperçu de base de ce qui constitue un modèle climatique mondial et une description de son mode d'utilisation. Je me concentrerai surtout sur le modèle climatique mondial canadien élaboré à CCCma au cours des 20 dernières années environ. Je vous citerai ensuite des exemples de résultats illustrant ce que nous avons appris du changement climatique passé et ce que ces modèles montrent du climat de l'avenir. Je conclurai par une description de la « nouvelle frontière » en modélisation climatique à l'aide de modèles, dits du « système terrestre », qui représentent non seulement le système climatique physique, mais aussi les cycles biogéochimiques en cause dans les cycles du carbone, du soufre et de l'ozone ayant trait au climat.

TUESDAY, JUNE 9 — MARDI, LE 9 JUIN

Jeanne de Valois, Salle de spectacle
13h30-14h00

PAUL CORKUM

UNIVERSITY OF OTTAWA / NRC / UNIVERSITÉ D'OTTAWA / CNRC

NSERC Herzberg Medal Winner / Récipiendaire de la médaille Herzberg du CRSNG

Extreme Nonlinear Optics - Attosecond-Angstrom Science

During the past six years the minimum duration of optical (XUV) pulses has fallen from 5 femtoseconds ($5x10^{-15}$ sec) to about 100 attoseconds ($\sim10^{-16}$ sec)—less than the classical period of a ground-state electron in a hydrogen atom. Lasers drove this revolution by forcing electron wave packets to tunnel from the atom or molecules, move under the force of the time dependent electric field and then re-collide with their parent ions. From the ion's perspective, an attosecond electron wave packet re-collides. I will discuss how attosecond XUV pulses are the by product of this collision and how they are measured. The attosecond electron, controlled by light, is something unique in science. With wavelength ~ 0.5-3 Angstrom, it allows us to measure spatial information using optical methods. The "shutter speed" can be attoseconds. It also allows us to transfer optical methods to collision physics. It may even be possible to time resolve some aspects of nuclear dynamics stimulated by collisions. Using N_2, O_2 and CO_2 as examples, I illustrate three new molecular spectroscopic methods. Each provides a different approach to molecular imaging.

Optique non linéaire extrême – science attoseconde-angström

Depuis six ans, la durée minimale des impulsions optiques (XUV) a diminué de 5 femtosecondes ($5x10^{-15}$ sec.) à environ 100 attosecondes ($\sim10^{-16}$ sec.), moins que la période classique d'un électron à l'état normal dans un atome d'hydrogène. Les lasers ont mené cette révolution en forçant les paquets d'ondes d'électrons à traverser de l'atome ou des molécules par effet tunnel, à se déplacer sous la force du champ électrique à variable chronologique, puis à heurter à nouveau leurs ions parents. Sous l'angle des ions, un paquet d'ondes d'électrons attosecondes entre à nouveau en collision. Nous verrons en quoi les impulsions XUV attosecondes découlent de cette collision et la façon de les mesurer. L'électron attoseconde contrôlé par la lumière est une chose unique en science. Avec une longueur d'ondes de ~ 0,5-3 angströms, il permet de mesurer des données spatiales par des méthodes optiques. La « vitesse d'obturation » peut être de quelques attosecondes. Elle permet aussi de reporter les méthodes optiques à la physique des collisions. Il peut même être possible de repousser certains aspects de la dynamique nucléaire stimulée par les collisions. En citant en exemple N_2, O_2 et CO_2, j'illustre trois nouvelles spectroscopies moléculaires. Chacune fournit une approche différente à l'imagerie moléculaire.

WEDNESDAY, JUNE 10 — MERCREDI, LE 10 JUIN

Jeanne de Valois, Salle de spectacle
08h45-09h30

ACHIM SCHWENK

TRIUMF

A tour of neutron matter in the universe

I will take you on a tour of the physics of neutrons in the universe. The tour leads us through astrophysics, atomic, nuclear and particle physics and highlights ? the physics of strong interactions between neutrons, ? universal properties of neutrons and ultra-cold atoms, ? neutron superfluidity in neutron stars, ? the limits of existence and novel forms of matter at the neutron drip line, ? how neutrinos interact with neutrons in supernovae, and ? the role of neutrons for the creation of the heavy elements.

Aperçu de la matière neutronique dans l'Univers

Je vous ferai faire un tour d'horizon de la physique des neutrons dans l'Univers. Ce tour d'horizon nous mènera à l'astrophysique, à la physique atomique, nucléaire et corpusculaire et aux points forts suivants : la physique des interactions puissantes entre les neutrons, les propriétés universelles des neutrons et des atomes ultrafroids, la superfluidité des neutrons dans les étoiles à neutrons, les limites de l'existence et les nouvelles formes de la matière au point d'égouttement des neutrons, le mode d'interaction des neutrinos avec les neutrons dans les supernovae et le rôle des neutrons dans la création des éléments lourds.

WEDNESDAY, JUNE 10 MERCREDI, LE 10 JUIN

Jeanne de Valois, Salle de spectacle
13h30-14h00

HONG GUO

MCGILL UNIVERSITY / UNIVERSITÉ MCGILL

CAP-CRM Prize Winner / Récipiendaire du Prix ACP-CRM

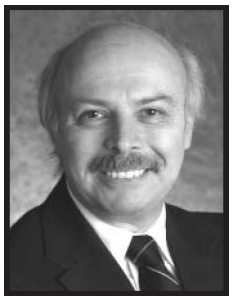
Quantum Transport Theory : From Atoms to Devices

In order to quantitatively predict device characteristics of nanoelectronic systems, quantum transport theory must be developed to include atomic, chemical and material properties of the device structure. It has been a long standing theoretical challenge to calculate nonlinear and nonequilibrium quantum transport features from atomistic first principles without relying on any phenomenological parameter. Over the past fifteen years or so, we have attempted to solve this challenge by seeking viable theoretical formalisms that can be reduced to practical computation of realistic nanoelectronic device structure. In this talk, I will review the present status of nanoelectronic device theory, the progress achieved so far as well as the existing mathematical difficulties and some important physical problems. Several important nanoelectronic devices will be used as examples, including quantum transport properties of magnetic tunnel junction, molecular transport structure, device interconnects, and carbon nanostructures. I will outline my view on the existing challenges of nanoelectronics theory, and on developing mathematical tools powerful enough for nanoelectronics design automation.

Théorie du transport quantique : des atomes aux dispositifs

Pour prédire quantitativement les caractéristiques des dispositifs de systèmes nanoélectroniques, il faut élaborer la théorie du transport quantique de manière à inclure les propriétés atomiques, chimiques et matérielles de la structure des dispositifs. C'est depuis longtemps un défi théorique de calculer les caractéristiques non linéaires et hors d'équilibre du transport quantique à partir de principes de base atomistiques sans miser sur aucun paramètre phénoménologique. Depuis environ 15 ans, nous avons tenté de résoudre cette difficulté en cherchant des formalismes théoriques viables qui soient réductibles au traitement pratique d'une structure réaliste de dispositifs nanoélectroniques. Dans mes propos, j'examinerai l'état actuel de la théorie des dispositifs nanoélectroniques, les progrès à ce jour ainsi que les difficultés mathématiques existantes et certains problèmes physiques importants. Voici plusieurs dispositifs nanoélectroniques importants qui seront cités en exemples : propriétés de la jonction tunnel magnétique pour le transport quantique, structure du transport moléculaire, interconnecteurs de dispositifs et nanostructures de carbone. J'exposerai mes vues sur les défis existants de la théorie des dispositifs nanoélectroniques et sur l'élaboration d'outils mathématiques suffisamment puissants pour automatiser la conception de ces dispositifs.

MRR, Room/Salle R221
13h30-14h00



ANDREAS MANDELIS

UNIVERSITY OF TORONTO / UNIVERSITÉ DE TORONTO

CAP Industrial and Applied Physics Medal Winner /
Récipiendaire de la médaille pour la physique industrielle et appliquée de l'ACP

Diffusion-Wave Diagnostic Techniques in Industrial, Applied and Biomedical Physics: They go where no light has gone before!

The introduction of photothermal phenomena in the 1970's has generated a wealth of diagnostic techniques which have grown into diverse fields spanning disciplines from fundamental physics, spectroscopy and analytical chemistry to food science, semiconductor properties, materials science and non-destructive evaluation, agricultural and environmental sciences and sensors. In this talk I will present a review of non-conventional ultrasensitive photothermal, photoacoustic and diffusion-wave techniques, instrumentation methodologies and technologies introduced at the CADIFT, precisely aimed at enhancing and optimizing the unique and considerable diagnostic non-destructive capabilities of these parabolic waves. Highlights will be selected among: the thermal-wave resonant cavity sensor for environmental gas, fluid pollution monitoring and infrared emissivity measurements; photopyroelectric non-radiative spectroscopy of optical materials; the Common Mode Rejection Demodulation (CMRD) contrast amplification technique as a platform signal generation and processing methodology of optimal contrast dynamic range in deeply embedded signals; the thermal-wave harmonic oscillator and depth profilometric inverse problem with applications to industrial case-hardened steels; subsurface crack detection in automotive transmission gears; dental thermophotonics of sensitivity and specificity higher than dental x-rays; and biophotoacoustic tissue imaging of cancerous lesions ("the photoacoustic radar").

Techniques de diagnostic des ondes de diffusion en physique industrielle, appliquée et biomédicale : elles vont là où la lumière n'a jamais pénétré auparavant!

L'introduction de phénomènes photothermiques dans les années 70 a suscité une foule de techniques de diagnostic qui ont pris leur envol dans divers champs englobant les disciplines de la physique fondamentale, de la spectroscopie et de la chimie analytique, aux sciences de l'alimentation et aux propriétés des semiconducteurs, à la science des matériaux et à l'évaluation non destructive, en passant par les sciences agricoles et environnementales et les capteurs. Mes propos porteront sur les techniques photothermiques et photoacoustiques ultrasensibles non classiques et sur les techniques d'ondes de diffusion, les méthodes et technologies d'instrumentation instaurées au Center for Advanced Diffusion-Wave Technologies et visant précisément à améliorer et à optimiser la capacité unique et considérable de diagnostic non destructif de ces ondes paraboliques. En voici quelques-uns des points forts : capteur à cavité résonante d'ondes thermiques pour environnement gazeux, surveillance de la pollution par fluides et mesure de l'émissivité de rayons infrarouges; spectroscopie photopyroélectrique non radiative des matériaux optiques; technique d'amplification du contraste de la réjection en mode commun à titre de plateforme pour la méthode d'émission de signaux et de traitement de la gamme optimale dynamique des contrastes en signaux solidement ancrés; oscillateur harmonique d'ondes thermiques et problème inverse de profil de concentration et applications aux aciers cémentés industriels; détection des fissures sous-surfaciques dans les pignons de boîtes de vitesse automobiles; thermophotonique dentaire de sensibilité et spécificité supérieures aux radiographies dentaires; et imagerie photoacoustique des tissus de lésions cancéreuses (« le radar photoacoustique »).

Canadian Assocation of Physicists
Association canadienne des physiciens et physiciennes

PRIZE WINNERS / GAGNANTS DES PRIX

University Prize Exam Results 2009
Résultats de l'examen du prix universitaire 2009

101 students from 22 post-secondary institutions competed this year. The exam was run by representatives from the University of British Columbia and was held on February 3rd, 2009. The examining committee was led by Ian Affleck. / 101 étudiants de 22 universités ont écrit l'examen cette année. *Le concours universitaire 2009 de l'ACP a eu lieu 3 février, 2009. Cet examen fut administré par Ian Affleck, de l'Université de la Colombie-Britannique.*

Cedric Lin	**First Prize / Premier Prix**	Univ. of B.C. / Univ. de la C.-B.
Junjiajia Long	**Second Prize / Deuxième Prix**	Univ. of Toronto / Univ. de Toronto
Boris Braverman	**Third Prize / Troisième Prix**	Univ. of Toronto / Univ. de Toronto

4.	Yuk Fung Chan	U. of Toronto	8.	Mathieu Goulet	Laval U.
5.	Alan Robinson	UBC	9.	Avery Berman	U. of Victoria
6.	Patrick Kaifosh	U. of Toronto	10.	Kyle Shiells	U. of Manitoba
6.	Sam Posen	Queen's U.			

2009 University Prize Examination - *Examen du prix universitaire 2009*
(Highest scoring student from each participating University
***L'étudiant supérieur à chaque université participante*)**

Brock University / *Université Brock*
- Christian Schroeder
Carleton University / *Université Carleton*
- Stephen Turnbull
Dalhousie University / *Université Dalhousie*
- J. Chris Lavell
Laval University / *Université Laval*
- Mathieu Goulet
McGill University / *Université McGill*
- Julian Haw Far Chin
McMaster University / *Université McMaster*
- Nathan Cheng
Polytechnique Montréal / *Polytechnique Montréal*
- Jean-Philippe Coutu
Queen's University / *Université Queen's*
- Sam Posen
Simon Fraser University / *Université Simon Fraser*
- Savanna Shaw
Trent University / *Université Trent*
- Eric Brown
University of Montréal / *Université de Montréal*
- Nicolas Berube
University of Sherbrooke / Université de Sherbrooke
- Giovanni Iacovone
Univ. of British Columbia / *Univ. de la Colombie*-Brit.
- Cedric Lin
University of Guelph / *Université de Guelph*
- Olivier Parlavecchio
University of Manitoba / *Université du Manitoba*
- Kyle Shiells
University of P.E.I. / *Université de l'I.P.E.*
- Mostafa Fatehi
University of Saskatchewan / *Université de la Saskatchewan*
- Brenna Wilson
University of Toronto / *Université de Toronto*
- Junjiajia Long
University of Victoria / *Université de Victoria*
- Avery Berman
University of Waterloo / *Université de Waterloo*
- Dan Riley
University of Western Ontario / *Université Western Ontario*
- Sam Chippin
Wilfrid Laurier University/ *Université Wilfrid Laurier*
- Christopher McMahon

The first prize winner receives an all-expense paid trip to the CAP Congress to receive his cash award during the banquet. / *Le gagnant du premier prix est invité à participer au congrès annuel de l'ACP, toutes dépenses payées, pour recevoir son prix au banquet.*

ABBREVIATION KEY / CODES DES ABRÉVIATIONS

Divisions

DAMPhi	Division of Atomic and Molecular Physics and Photon Interactions
DPAMip	*Division de physique atomique et moléculaire et d'interactions avec les photons*
DASP	Division of Atmospheric and Space Physics
DPAE	*Division de physique atmosphérique et de l'e-space*
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*
DHP	Division of History of Physics
DHP	*Division de l'histoire de la physique*
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
DOP	*Division d'optique et photonique*
DPE	Division of Physics Education
DEP	*Division de l'enseignement de la physique*
DPP	Division of Plasma Physics
DPP	*Division de physique des plasmas*
DSS	Division of Surface Sciences
DSS	*Division de la science des surfaces*
DTP	Division of Theoretical Physics
DPT	*Division de physique théorique*
PPD	Particle Physics Division
PPD	*Division de physique des particules*
CEWIP	Committee to Encourage Women in Physics
CEFEP	*Comité pour encourager les femmes en physique*

(G) = Graduate student
étudiant diplômé
(U) = Undergraduate student
étudiant de première cycle
* = Student competitor
compétiteur étudiant

Sessions

SA-Exec	Saturday Executive Meeting / Réunion de l'exécutif du samedi
SA-Coun	Saturday Council Meeting / Réunion du conseil du samedi
SA-xx	Saturday meeting / Réunion du samedi
SU-xx	Sunday meeting / Réunion du dimanche
SU-A#	Sunday A.M. Session / Session du dimanche matin
SU-P#	Sunday P.M. Session / Session du dimanche après-midi
SU-POS#	Sunday evening Poster Session / Session d'affiches du dimanche soir
MO-xx	Monday meeting / Réunion du lundi
MO-A#	Monday A.M. Session / Session du lundi matin
MO-P#	Monday P.M. Session / Session du lundi après-midi
MO-KEY	Monday night public (Herzberg) session / Session plénière publique (Herzberg) du lundi soir
TU-xx	Tuesday meeting / Réunion du mardi
TU-A#	Tuesday A.M. Session / Session du mardi martin
TU-P#	Tuesday P.M. Session / Session du mardi après-midi
WE-xx	Wednesday meeting / Réunion du mercredi
WE-A#	Wednesday A.M. Session / Session du mercredi matin
WE-STUD	Wednesday Best Student Paper Competition / Compétition pour les meilleures communications étudiantes, le mercredi matin
WE-P#	Wednesday P.M. Session / Session du mercredi après-midi
xx-Plen	Plenary session on Sunday (SU), Monday (MO), Tuesday (TU) or Wednesday (WE) / Session plénière du dimanche (SU), lundi (MO), mardi (TU), ou mercredi (WE)

INVITED SPEAKERS / *CONFÉRENCIERS INVITÉS*

(in alphabetical order / *en ordre alphabétique*)

ADAM, Allan G. (DAMPhi / *DPAMip*)
University of New Brunswick
High Resolution Laser Spectroscopy of Transition Metal Monophosphides and Halides

BARONI, Simone (DNP / *DPN*)
TRIUMF/INT
Nuclear structure with low momentum interactions

BELLERIVE, Alain (PPD / *PPD*)
Carleton University
The Final Cut at the Sudbury Neutrino Observatory

BENNETT, Craig (DIMP-DIAP / *DPIM-DPIA*)
Acadia University
Ni-Mn-Ga Ferromagnetic Shape Memory Alloys

BENSLAMA, Kamal (PPD / *PPD*)
University of Regina
Extra Dimensions, Supersymmetry and the origin of Mass: Exploring the nature of the Universe using the Large Hadron Collider at CERN

BERCIU, Mona (DCMMP / *DPMCM*)
University of British Columbia
Momentum Average Approximations

BLAIN, Isabelle (CAP-NSERC / *ACP-CRSNG*) **PLENARY-*PLÉNIÈRE***
NSERC / CRSNG (see pg. 12 / *voir pg. 12*)
Update from NSERC / Mise à jour par le CRSNG

BLAIS, Alexandre (DAMPhi-DOP / *DPAMip-DOP*)
Université de Sherbrooke
Quantum information processing with circuit quantum electrodynamics

BONN, Douglas (DPE / *DEP*)
University of British Columbia
Learning about data and statistics in freshman physics

BOULAY, Mark (PPD / *PPD*)
Queen's University
Dark Matter Search at SNOLAB with DEAP-1 and DEAP-3600

BRABEC, Thomas (DAMPhi-DOP / *DPAMip-DOP*)
University of Ottawa
Attosecond science: Correlated few electron dynamics in small molecules and clusters

BURGESS, Clifford (DTP / *DPT*)
McMaster University
Quantum Gravity, Dark Matter and Dark Energy

CHEN, Alan A. (DNP / *DPN*)
McMaster University
Nuclear Astrophysics at McMaster: Indirect Approaches

CONNOR, Robert (Robin) (DHP / *DHP*)
University of Manitoba
The August 1909 meeting of the BAAS in Winnipeg at the University of Manitoba

CORKUM, Paul (CAP / *ACP*) **PLENARY-*PLÉNIÈRE***
University of Ottawa / NRC (see pg. 15 / *voir pg. 15*)
Extreme Nonlinear Optics -- Attosecond-Angstrom Science / Optique non linéaire extrême – science attoseconde-angström

DAHN, Jeff (CAP / *ACP*) **PLENARY-*PLÉNIÈRE***
Dalhousie University (see pg. 14 / *voir pg. 14*)
If It's Fun For You, It's Fun For Them / Si c'est amusant pour vous, ça l'est pour eux

DAHN, Jeff (DCMMP / *DPMCM*)
Dalhousie University
Experimental and Theoretical studies of the electrochemical reaction of lithium with amorphous silicon: Understanding the next generation of Li-ion batteries

DAVIDS, Barry (DNP / *DPN*)
TRIUMF
Recent Progress in Nuclear Astrophysics at TRIUMF

DE BRUYN, John R. (DPE / *DEP*)
University of Western Ontario
Promoting educational research and innovation in a "research intensive" department

DELHEIJ, Paul (DNP / *DPN*)
TRIUMF
TITAN Penning Trap Mass Measurements of Light Neutron-Rich Halo Nuclei

DESERNO, Markus (DMBP / *DPMB*)
Carnegie Mellon University
A generic coarse-grained model for protein folding and aggregation

DICK, Rainer (PPD-DTP / *PPD-DPT*)
University of Saskatchewan
Cross sections for direct Minimal Dark Matter signals

DRISSEN, Laurent (CAP / *ACP*) **PLENARY-PLÉNIÈRE**
Université Laval (see pg. 10 / voir pg. 10)
The Splendours and Miseries of Massive Stars / Splendeurs et misères des étoiles massives

DUTCHER, John (DCMMP-DMBP / *DPMCM-DPMB*)
University of Guelph
Biopolymers From Bacteria - Nature's Nanotechnology

ENT, Rolf (DNP / *DPN*)
Jefferson Lab
How does QCD transition from the meson-nucleon non-perturbative regime to the quark-gluon perturbative regime?

FEDOSEJEVS, Robert (DOP / *DOP*)
University of Alberta
Laser Fusion: A Route to a Sustainable Energy Future

FENSTER, Aaron (DMBP-DIAP-DIMP-DOP/ *DPMB-DPIA-DPIM-DOP*)
Robarts Research Institute
3D Ultrasound guided minimally invasive therapy and biopsy

FINKELSTEIN, Noah (DPE / *DEP*)
University of Colorado
Applying Education Research to Implement and Sustain Transformation in Undergraduate Physics

FLATO, Greg (CAP / *ACP*) **PLENARY-PLÉNIÈRE**
Environment Canada (see pg. 14 / voir pg. 14)
Global Climate Models: Development and Application / Modèles climatiques mondiaux : élaboration et application

FROLOV, Andrei (DTP / *DPT*)
Simon Fraser University
Primordial Non-Gaussianity from Preheating

GARNSWORTHY, Adam (DNP / *DPN*)
TRIUMF
Recent Highlights from the TIGRESS Collaboration

GAULIN, Bruce D. (DCMMP / *DPMCM*)
McMaster University
Exotic Magnetic Ground States in XY Pyrochlores

GERICKE, Michael (DNP / *DPN*)
University of Manitoba
The Hadronic Weak Interaction and Parity Violation in Cold Neutron Capture

GERL, Juergen (DNP / *DPN*)
GSI
In-beam and decay γ spectroscopy at GSI and FAIR

GHOSE, Shohini (DAMPhi-DOP / *DPAMip-DOP*)
Wilfrid Laurier University
Relationship between tripartite entanglement and genuine tripartite nonlocality in 3-qubit states

GINGRAS, Michel (CAP-DCMMP / *ACP-DPMCM*) **PLENARY-PLÉNIÈRE**
University of Waterloo (see pg. 12 / voir pg. 12)
Exotic Collective Phenomena in Geometrically and Randomly Frustrated Rare-Earth Magnetic Systems / Phénomènes collectifs exotiques dans les systèmes magnétiques à base de terres rares frustrés de façon géométrique et aléatoire

GINGRAS, Michel (DCMMP / *DPMCM*)
University of Waterloo
Transverse Field, Random Fields and Glass Transition in the Quantum Magnetism of $LiHo_xY_{1-x}F_4$

GRIMM, Klaus (DNP / *DPN*)
Louisiana Tech University
Electron Parity Violation Experiments and Tests of the Standard Model

GUENETTE, Roxanne (PPD / *PPD*)
McGill University
Recent exciting results from the VERITAS observatory

GUO, Hong (CAP-CRM / *ACP-CRM*) **PLENARY-PLÉNIÈRE**
McGill University (see pg. 16 / voir pg. 16)
Quantum transport theory: from atoms to devices / Théorie du transport quantique : des atomes aux dispositifs

HORMES, Josef (DCMMP / *DPMCM*)
Canadian Light Source
The Canadian Light Source: the next ten years

HUSAIN, Viqar (DTP / *DPT*)
University of New Brunswick
Critical behavior in quantum gravitational collapse

IVES, Joss (PPD / *PPD*)
University of the Fraser Valley
Final BNL E949 results on the measurement of the rare decay K+ to pi+, nu, nubar

IVIE, Rachel (CEWIP / CEFEP)
American Institute of Physics
Women in Physics and Astronomy

JESSOP, Paul (DOP / *DOP*)
McMaster University
Defect Engineering of Silicon for Long Wavelength Photodetectors

KATSARAS, John (DMBP / *DPMB*)
National Research Council
Cholesterol Sequestered in a Membrane and Nanoparticles for Imaging and Treating Disease

KLEIMAN, Rafael (DCMMP / *DPMCM*)
McMaster University
Silicon-based Multi-Junction Solar Cells

KLEPPNER, Daniel (DHP / *DHP*)
Dept. of Physics, MIT, and MIT-Harvard Center for Ultracold Atoms
The Fabulous Life of Albert A. Michelson

KOTLICKI, Andrzej (DIAP / *DPIA*)
University of British Columbia
Sensors used to Characterize Musical Instruments

KRAUSS, Carsten (PPD / *PPD*)
University of Alberta
The Particle and Astrophysical Properties of the Neutrino: News from the SNO+ Experiment

KREPLAK, Laurent (DCMMP / *DPMCM*)
Dalhousie University
Design and mechanical properties of fibrous protein scaffolds

KUMARATUNGA, Sujeewa (PPD / *PPD*)
Université de Montréal
PICASSO

KUNSTATTER, Gabor (DTP / *DPT*)
University of Winnipeg
Dynamical Singularity Resolution in Spherically Symmetric Black Hole Formation

LASRY, Nathaniel (DPE / *DEP*)
John Abbott College
Getting Started in Physics Education Research

LEBLANC, Francis (DPE / *DEP*)
Universite de Moncton
Stellar astrophysics in undergraduate physics curricula

LEONENKO, Zoya (DMBP / *DPMB*)
University of Waterloo
Application of Scanning Probe Microscopy in Nanoscale Lipid Biophysics

LINDNER, Thomas (PPD / *PPD*)
University of British Columbia
Status of the T2K Experiment

LOLOS, George J. (DNP / *DPN*)
University of Regina
Do hybrids, glueballs, and other exotics exist?

MACASKILL, John (DAMPhi-DPP / *DPAMip*-DPP)
Jet Propulsion Laboratory
From Highly Charged Ions to Complex Molecular Formation: An Overview of Experiments and Results from the JPL Highly Charged Ion and Fast Atom Facilities

MADEJ, Alan (DIMP-DAMPhi / *DPIM-DPAMip*)
INMS, National Research Council of Canada
Probing Time and Physics Using an Optical Atomic Clock based on a Single Trapped Ion

MAEV, Roman Gr. (DIMP-DIAP / *DPIM-DPIA*)
University of Windsor
Advanced High Resolution Digital Imaging Technique in Non-destructive Investigations and Diagnostics of Cultural and Environmental Heritage

MALYARENKO, Eugene (DIAP / *DPIA*)
Tessonics Corp.
Objective percussion for diagnostics of pulmonary traumas

MANDELIS, Andreas (DIMP-DIAP / *DPIM-DPIA*)
M.I.E., University of Toronto
Deep Level Photo-Thermal Spectroscopy of Defect States in Semi-Insulating GaAs: A Combined Temperatures, Pulse-Rate and Time-Domain Study of Defect State Kinetics

MANDELIS, Andreas (CAP-DIAP / *ACP-DPIA*) **PLENARY-PLÉNIÈRE**
M.I.E., University of Toronto (see pg. 16 / voir pg. 16)
Diffusion-Wave Diagnostic Techniques in Industrial, Applied and Biomedical Physics: They go where no light has gone before! / Techniques de diagnostic des ondes de diffusion en physique industrielle, appliquée et biomédicale : elles vont là où la lumière n'a jamais pénétré auparavant!

MARTIN, Jeff (DNP-DTP / *DPN-DPT*)
University of Winnipeg
Ultracold Neutrons in Canada

MARZLIN, Karl-Peter (DCMMP / *DPMCM*)
St-Francis Xavier University
Propagation of photon pulses in strongly nonlinear atomic media

MATTISON, Thomas (PPD / *PPD*)
University of British Columbia
A BaBar Retrospective

MAVROMATOS, Nick (DNP / *DPN*)
Kings College London/CERN
CPT Symmetry, Quantum Gravity and Entangled Particle States

MOORE, Guy (CAP / *ACP*) **PLENARY-PLÉNIÈRE**
McGill University (see pg. 13 / voir pg. 13)
Is quark-gluon matter nearly transparent or very opaque? / La matière de quarks et de gluons est-elle presque transparente ou très opaque?

MUIR, David (DCMMP / *DPMCM*)
University of Saskatchewan
A Soft X-Ray Emission Spectrometer for the REIXS Beamline at the CLS

NEWLING, Benedict (DPE / *DEP*)
University of New Brunswick
"Please, Sir, I want some more examples": Inducers and Deducers in Our Classrooms

O'DELL, Duncan (DAMPhi-DOP / *DPAMip-DOP*)
McMaster University
Bloch Oscillations of cold atoms inside an optical cavity: a proposal for ultra sensitive measurement of forces

O'NEIL, Dugan (PPD / *PPD*)
Simon Fraser University
Status of the Large Hadron Collider and the ATLAS Experiment

ORR, Robert (PPD / *PPD*)
University of Toronto
The International Linear Collider

PAGE, Shelley A. (CAP / *ACP*) **PLENARY-PLÉNIÈRE**
University of Manitoba (see pg. 103 / voir pg. 103)
Transformation and Change: A path forward for the CAP / Transformation et changement: l'ACP en marche

PENNA, Paul (DHP / *DHP*)
NRC Institute for Aerospace Research
Alexander Graham Bell, Baddeck and Thin Airfoils

RAMSEY-MUSOLF, Michael (DNP / *DPN*)
University of Wisconsin
Nuclear Physics and the New Standard Model

RAUSSENDORF, Robert (DCMMP / *DPMCM*)
University of British Columbia
Fault-Tolerant Quantum Computation with High Threshold in Two Dimensions

REZNIK, Alla (DMBP-DIAP-DIMP-DOP / *DPMB-DPIA-DPIM-*DOP)
Lakehead University
Avalanche Multiplication in Amorphous Selenium: Physics and Application

ROBAR, James (DMBP / *DPMB*)
Dalhousie University
Exploring novel x-ray beams for image-guidance in radiation oncology

ROHRAFF, Damian (DPP / *DPP*)
University of Saskatchewan
STOR-M tokamak diagnostics for plasma edge and SOL regions

ROMALIS, Michael (DNP / *DPN*)
Princeton University
Low-energy searches for new interactions involving nuclear spins

ROOT, John (DCMMP / *DPMCM*)
National Research Council
Materials Research at the Canadian Neutron Beam Centre

SANTATO, Clara (DCMMP / *DPMCM*)
Ecole Polytechnique de Montréal
Organic Electronics Materials and Devices

SANZ, Veronica (PPD-DTP / *PPD-DPT*)
York University
Physics at the LHC

SARGENT, Ted (DCMMP / *DPMCM*)
University of Toronto
Solution-processed wide-spectrum solar cells

SCHEFFLER, Matthias (DSS-DCMMP / *DSS-DPMCM*)
Fritz Haber Institute
Get Real! Ab initio description of materials properties and function -- the example of heterogeneous catalysis

SCHWENK, Achim (CAP / *ACP*) **PLENARY-PLÉNIÈRE**
TRIUMF (see pg. 15 / voir pg. 15)
A tour of neutron matter in the universe / Aperçu de la matière neutronique dans l'Univers

SEMENOFF, Gordon W. (DTP / *DPT*)
University of British Columbia
Giant loop holography

SHAM, Tsun-Kong (DCMMP / *DPMCM*)
University of Western Ontario
Synchrotron radiation spectroscopy and related phenomena in materials research

SHIELL, Ralph (DAMPhi / *DPAMip*)
Trent University
Heavy Rydberg Systems: Their Properties, Their Formation, and Their Control

SIPE, John E. (DTP / *DPT*)
University of Toronto
Towards a QED for dispersive and absorptive media

SKOROBOGATIY, Maksim (DOP / *DOP*)
Ecole Polytechnique de Montréal
Introducing Nanotechnology into Optical Fibers

SOBEL, Dava (CAP / *ACP*) **PLENARY-PLÉNIÈRE**
InkWell Management (see pg. 13 / voir pg. 13)
Galileo and the International Year of Astronomy / Galilée et l'Année mondiale de l'astronomie

SOWA, Michael (DMBP-DIAP-DIMP-DOP / *DPMB-DPIA-DPIM-DOP*)
National Research Council Canada
Photonics Technologies for Vascular Imaging - Tools for Understanding Atherogenesis

STAUDTE, André (DAMPhi-DOP / *DPAMip-DOP*)
National Research Council of Canada
Single Molecule Scanning Tunneling Microscopy

STELZER, Bernd (PPD / *PPD*)
Simon Fraser University
Highlights from the Tevatron

THOENNESSEN, Michael (DNP / *DPN*)
Michigan State University
Discovery of New Isotopes at the NSCL

THOMPSON, Robert I. (DNP / *DPN*)
University of Calgary
The Pursuit of Antihydrogen Trapping and Spectroscopy

TROTTIER, Howard D. (DNP / *DPN*)
Simon Fraser University
High-precision lattice QCD confronts experiment

VAN WIJNGAARDEN, William (DAMPhi-DPP / *DPAMip-*DPP)
York University
Critical Examination of Isotope Shift and Fine Structure Measurements for Transitions in $^{6,7}Li$

VAN ZYL, Brandon (DCMMP / *DPMCM*)
St. Francis Xavier University
Novel physics of low-dimensional, ultra-cold quantum gases

VOGT, Erich (DNP / *DPN*)
TRIUMF
Willem T.H. van Oers - A Canadian Nuclear Physics Career

WHELAN, William (DMBP / *DPMB*)
University of Prince Edward Island
Optoacoustic Detection of Tissue Damage During Thermal Therapy

WHELAN, William (DMBP-DIAP-DIMP-DOP / *DPMB-DPIA-DPIM-DOP*)
University of Prince Edward Island
Point Radiance Spectroscopy in Turbid Media

WHITE, Mary Anne (DCMMP / *DPMCM*)
Departments of Chemistry and Physics, and Institute for Research in Materials, Dalhousie University
Thermoelectric Materials for Power Generation

WOLKOW, Robert (DCMMP / *DPMCM*)
University of Alberta
Some highlights from NINT: Controlled Coupling and Occupation of Silicon Atomic Quantum Dots

WOOLGAR, Eric (DTP / *DPT*)
University of Alberta
The Ricci flow and Bartnik's quasi-local mass

XIAO, Chijin (DPP / DPP)
University of Saskatchewan
Design Features of the STOR-U Tokamak

ZUCKERMANN, Martin J (DMBP / *DPMB*)
Simon Fraser University
Synthetic Molecular Motors: Concepts and Numerical Simulations

CAP Congress

Listeners, Speakers, and Session Chairs

SPECIAL INSTRUCTIONS FOR TIMED PAPERS

In order to ensure that listeners can transfer from one session to another, the oral presentations will be timed. As a courtesy to all conference participants, we would ask that the following simple guidelines be observed. Your cooperation is appreciated.

EVERYONE - Ensure that you are wearing your Congress name badge at all times.

LISTENERS

- Please arrive at a lecture room promptly before the next paper is to begin.
- Please leave a session unobtrusively, preferably during or at the end of the question and answer period.

SPEAKERS

- Make your computer arrangements before the start of your session.
- Be ready to start your talk on time.
- Pace your talk to end well before the next talk begins: about 3 minutes for a contributed paper and about 5 minutes for an invited paper.
- Answer questions and comments as efficiently as possible; defer any follow-up discussions to be continued after the session or in a coffee break.
- Obey your session chair's instructions.

SESSION CHAIRS

- Arrive at the session room no later than 15 minutes before your session begins. Check that all needed projection and auxiliary equipment are present and operational. Check that your speakers, AV technician, and any required judges for student competition entries are also present.
- Introduce yourself to the assistant in room and verify that session timer is working.
- Start each paper right on time.
- Make sure each speaker stops talking well before the next paper begins.
- Keep the question periods interesting, lively, and productive. Read over the papers in your session beforehand. If necessary, prepare comments and questions.
- Do not let any discussion period get out of hand, either on the speaker's or the questioner's side.
- **Under no circumstances may the order or time of a presentation differ from that in the Congress program. If a speaker fails to appear, either recess the session until the start of the next scheduled talk, or introduce an ad-hoc discussion of earlier presentations to fill the time slot.**
- Make note in your program if a speaker fails to show or a replacement speaker was sent. Send this information to the CAP office (in person at the CAP desk at Congress or by e-mail to cap@uottawa.ca no later than one week following Congress).

Congrès ACP

Auditeurs, conférenciers et présidents de sessions

INSTRUCTIONS POUR LES PRÉSENTATIONS CHRONOMÉTRÉES

Pour s'assurer que les auditeurs puissent passer d'une session à une autre, les présentations orales sont chronométrées. Par courtoisie envers l'ensemble des participants, nous vous demandons de suivre les directives suivantes, et vous remercions de votre collaboration.

TOUS - Assurez-vous de toujours avoir bien en vue votre porte-nom du congrès.

AUDITEURS

- Présentez-vous rapidement à la salle, avant que l'exposé suivant ne commence.
- Quittez la salle discrètement, de préférence pendant ou à la fin de la période de questions.

CONFÉRENCIERS

- Préparez l'ordinateur avant le début de votre session.
- Soyez prêt à commencer votre présentation à temps.
- Planifiez votre exposé de manière à terminer bien avant le suivant: environ 3 minutes pour une présentation contribuée et 5 minutes pour une présentation invitée.
- Répondez aux questions et commentaires le plus efficacement possible; reportez les discussions plus longues à la fin de la session ou à la pause-café.
- Respectez les instructions de votre président de session.

PRÉSIDENTS DE SESSIONS

- Arrivez à la salle au moins 15 minutes avant le début de la session. Vérifiez que tous les appareils sont là et fonctionnent bien. Vérifiez que les conférenciers, le technicien audio-visuel et, s'il y a lieu, les juges des concours d'étudiants sont présents.
- Présentez-vous à l'assistant de la salle et vérifier que le chronomètre fonctionne.
- Annoncez à l'heure exacte le début de chaque exposé.
- Assurez-vous que chaque conférencier cesse de parler bien avant que l'exposé suivant ne commence.
- Animez de manière vivante et productive la période de questions. Lisez d'avance les résumés de votre session. Si nécessaire, préparez des commentaires et des questions.
- Ne laissez ni les questions ni les réponses s'éterniser.
- **Sous aucune circonstance l'ordre ou le moment des présentations ne doivent différer de ceux du programme du congrès. Si un conférencier ne se présente pas, interrompez la session jusqu'au début de l'exposé suivant, ou alors amorcez une discussion impromptue des présentations précédentes.**
- Notez dans votre programme les conférenciers qui ne se présentent pas ou qui désignent un substitut. Faites parvenir cette information au personnel de l'ACP (à la table de l'ACP lors du congrès ou la semaine qui suit à cap@uottawa.ca).

LEGEND/LÉGENDE (see map / voir carte, p. iii)

MRR = Pavillon Remi-Rosignol (bldg/édifice A)
JdeV = Pavillon Jeanne de Valois (bldg/édifice B1)
MG = Pavillon de l'ingénierie (bldg/édifice B2)
Taillon = Pavillon Léopold-Taillon (bldg/édifice C)
m-f = Salle multi-fonctionnelle (bldg/édifice E - Centre étudiant)

CAP CONGRESS / CONGRÈS DE L'ACP

UNIVERSITY OF MONCTON / UNIVERSITÉ DE MONCTON
MONCTON, NEW BRUNSWICK / NOUVEAU-BRUNSWICK
JUNE 7-10 JUIN 2009

Saturday / Samedi, June 6 juin

09h30 - 13h30	CAP Executive Meeting (Old and New) / *Réunion de l'exécutif* (ancien et nouveau) *de l'ACP* (SA-Exec)	salle 136A&B Taillon
14h00 - 17h30	CAP Council Meeting (Old and New) / *Réunion du conseil (ancien et nouveau) de l'ACP* (SA-Coun)	salle 136A&B Taillon
18h30 - 22h00	CJP Editorial Board Meeting / *Réunion du comité de rédaction de RCP* (SA-CJP)	Windjammer Rest. Delta Hotel

Sunday / Dimanche, June 7 juin

09h00 - 20h00	**Conference Registration and Information / *Inscription au Congrès et information***	**MRR Rotunde**
08h15 - 11h00	Meeting of Heads/Chairs of Physics Depts / *Réunion des directeurs de départements de physique* (SU-Hd-Chr)	136A&B Taillon
09h00 - 11h30	Canadian Institute of Nuclear Physics (CINP) Board of Trustees Breakfast meeting / *Réunion-déjeuner du conseil d'administration de l'Institut canadien de la physique nucléaire (ICPN)* (SU-CINP-Bd)	B218 JdeV
09h00 - 11h30	IPP Board of Trustees Meeting / *Réunion du conseil d'administration de l'IPP* (SU-IPP-Bd)	B219 JdeV
09h15 - 11h30	DCMMP Symposium - Facilities for Materials Science / *Symposium DPMCM - Installations pour la science des matériaux* (SU-A1)	MRR D002
09h15 - 11h30	Neutrino Physics / *Physique des neutrinos* (SU-A2)	MRR A002
10h00 - 11h30	DMBP Best Student Paper Competition I / *Compétition pour les meilleures communications étudiantes DPMB I* (SU-A3)	MRR A102
11h45 - 13h30	**Plenary - Lunch and Discussion with Isabelle Blain from NSERC / *Plénière - dîner et discussion avec Isabelle Blain du CRSNG* (SU-NSERC-LUNCH)**	**JdeV Salle de spectacle**
13h30 - 14h00	**Plenary - Michel Gingras, U. Waterloo (Brockhouse Medal) / *Plénière - Michel Gingras, U. Waterloo, (Médaille Brockhouse de l'ACP)* (SU-Plen1)**	**JdeV Salle de spectacle**
14h15 - 15h45	CINP Annual General Meeting / *Assemblée générale annuelle de l'ICPN* (SU-CINP-Gen)	MRR A202
14h15 - 15h45	IPP General Meeting / *Assemblée générale de l'IPP (SU-IPP-Gen)*	MRR D202
14h15 - 16h45	Controlled Fusion Plasmas and Basic Plasma Physics / *Physique des plasmas de base et plasmas en fusion contrôlée* (SU-P1)	MRR D102
14h15 - 16h45	Centenaries on the 9's / *Centenaires sur les 9's* (SU-P2)	MRR A002
14h15 - 16h30	Best Student Paper Competition - DTP (Sun) / *Compétition pour la meilleure communication étudiante - DPT (dimanche)* (SU-P3)	MRR A102
14h15 - 16h45	Education Workshop / *Atelier sur l'enseignement* (SU-P4)	MRR D002
16h00 - 16h45	Joint IPP/CINP Session for GSC-19 Presentation / *Session conjointe IPP/ICPN pour la présentation du Comité de sélection des subventions 19* (SU-IPP-CNILC)	MRR R221
16h30 - 21h00	CAP-NSERC Liaison Committee Meeting / *Réunion du comité de liaison ACP-CRSNG* (SU-NSERC)	136A&B Taillon
16h30 - 18h00	**Student Reception / *Réception pour les étudiant(e)s* (SU-GRAD)**	**salle m-f**
17h00 - 18h45	**CAP Welcome Barbeque / *BBQ d'accueil de l'ACP* (SU-BBQ)**	**salle m-f**
19h00 - 19h30	**Plenary - Guy Moore, McGill U. (CAP Herzberg Medal) / *Plénière - Guy Moore, U. McGill (Médaille Herzberg de l'ACP)* (SU-Plen2)**	**JdeV Salle de spectacle**
19h30 - 22h00	**Poster Session and student competition,** with beer and light refreshments / ***Session d'affiches et concours étudiants,*** *bière et petit goûter servis* **(SU-POS)** DAMPhi/*DPAMip* (4); DASP/*DPAE* (2); DCMMP/*DPMCM* (7); DIMP/*DPIM* (5); DMBP/*DPMB* (4); DOP (7); DPE/*DEP* (2); PPD (3); DTP/*DPT* (1)	**MRR Corridors**

Monday / Lundi, June 8 juin

08h00 - 16h30	**Conference Registration and Information / *Inscription au Congrès et information***	**MRR Rotunde**
07h00 - 08h30	DPE Business Meeting (with breakfast) / *Réunion d'affaires DEP (avec petit-déjeuner)* (MO-DPE)	B125 JdeV
07h00 - 08h30	"Friends of CAP" Breakfast and Meeting / *Déjeuner et réunion des "Ami(e)s de l'ACP"* (MO-Friends)	A232 JdeV
07h00 - 08h30	New Faculty Breakfast with NSERC / *Déjeuner-rencontre des nouveaux professeurs avec le CRSNG* (MO-NSERC)	B219 JdeV
08h45 - 09h30	**Plenary - Dava Sobel (author of Galileo's Daughter) / *Plénière - Dava Sobel (auteure de 'La Fille de Galilée')* (MO-Plen1)**	**JdeV Salle de spectacle**
09h30 - 10h00	**Health Break, with refreshments / *Pause-santé, avec goûter (MO-AM-Break)***	**MRR Rotunde**

10h00 - 11h30	DCMMP Best Student Paper Competition I / *Compétition pour les meilleures communications étudiantes DPMCM I* (MO-A1)	MRR D002
10h00 - 12h15	Atomic and Molecular Spectroscopy and Dynamics I (in honour of the memory of Dr. Barry Wallbank, ST-FX / *Spectroscopie et dynamique des atomes et molécules I (à la mémoire du Dr. Barry Wallbank, ST-FX) (MO-A2)*	MRR D102
10h00 - 12h15	Curriculum Revitalization / *Revitalisation des programmes* (MO-A3)	MG2 147G2
10h00 - 12h15	Precision Measurements Testing Fundamental Symmetries / *Mesures de précision comme tests de symétries fondamentales* (MO-A4)	MG2 148G2
10h00 - 12h15	Applied Industrial and General Instrumentation / *Instrumentation industrielle appliquée et générale* (MO-A5)	MRR A002
10h00 - 11h15	Advanced Materials and Photonic Crystals / *Matériaux avancés et cristaux photoniques* (MO-A6)	MRR A102
10h00 - 12h15	Energy Frontier I / *Frontière de l'énergie I* (MO-A7)	MRR A202
10h00 - 10h30	Best Condensed Matter Paper Published in CJP / *Meilleur article sur la matière condensée publié dans la RCP* (MO-A8)	MRR D202
10h30 - 12h15	Theoretical Condensed Matter Physics / *Théorie de la matière condensée* (MO-A9)	MRR D202
12h15 - 13h30	DHP Business Meeting (lunch available) / *Réunion d'affaires DHP (dîner disponible)* (MO-DHP)	MRR C012
12h15 - 13h30	DIAP Business Meeting (lunch available) / *Réunion d'affaires DPIA (dîner disponible)* (MO-DIAP)	MRR A002
12h15 - 13h30	DIMP Business Meeting (lunch available) / *Réunion d'affaires DPIM (dîner disponible)* (MO-DIMP)	MRR D002
12h15 - 13h30	DNP Business Meeting (lunch available) / *Réunion d'affaires DPN (dîner disponible)* (MO-DNP)	MG2 148G2
12h15 - 13h30	DOP Business Meeting (lunch available) / *Réunion d'affaires DOP (dîner disponible)* (MO-DOP)	MRR A102
12h15 - 13h30	DPP Business Meeting (lunch available) / *Réunion d'affaires DPP (dîner disponible)* (MO-DPP)	MRR D102
12h30 - 13h30	DCMMP Business Meeting (lunch available) / *Réunion d'affaires DPMCM (dîner disponible)* (MO-DCMMP)	MRR D202
13h30 - 14h00	**Plenary - Jeff Dahn, Dalhousie U. (Teaching Medal) / *Plénière - Jeff Dahn, U. Dalhousie (Médaille de l'enseignement)* (MO-Plen2)**	**JdeV Salle de spectacle**
14h15 - 16h30	Magnetism & Frustrated Magnetism / *Magnétisme et magnétisme frustré* (MO-P1)	MRR R221
14h15 - 16h15	Quantum Optics - Cold Atoms / *Optique quantique - atomes froids* (MO-P2)	MG2 148G2
14h15 - 17h30	Applied Physics / *Physique appliquée* (MO-P3)	MRR A002
14h15 - 17h00	Interactive Teaching / *Enseignement interactif* (MO-P4)	MRR A102
14h15 - 17h45	Non-Accelerator Particle Physics I / *Physique des particules sans accélérateur I* (MO-P5)	MRR A202
14h15 - 15h15	DCMMP Best Student Paper Competition II / *Compétition pour les meilleures communications étudiantes DPMCM II* (MO-P6)	MRR D002
14h15 - 16h30	Fields & Strings / *Théorie des champs et cordes* (MO-P7)	MRR D202
14h15 - 15h30	Special Topics in Optics / *Sujets spéciaux en optique* (MO-P8)	MG2 147G2
14h15 - 16h30	Exotic Nuclear Structure / *Structure nucléaire exotique* (MO-P9)	MRR D102
16h30 - 18h30	Women in Physics / *Les femmes en physique* (MO-CEWIP)	MRR R221
19h30 - 20h30	**CAP Herzberg Memorial Public Lecture - Laurent Drissen, U.Laval / *Conférence publique commémorative Herzberg de l'ACP - Laurent Drissen, U.Laval* (MO-KEY)**	**Capitol Theatre, Downtown**
20h30 - 22h30	**Opening Reception (light refreshments) / *Réception d'ouverture (avec petit goûter)* (MO-RECEPT)**	**Capitol Theatre, Downtown**

Tuesday / Mardi, June 10 juin

08h00 - 16h30	**Conference Registration and Information / *Inscription au Congrès et information***	MRR Rotunde
07h00 - 08h30	CNILC Breakfast meeting / *Réunion du comité de liaison national canadien de l'UIPPA* (TU-CNILC)	B164 JdeV
07h00 - 08h30	PiC Editorial Board Meeting / *Réunion du Comité de rédaction de La physique au Canada* (TU-PiC)	B219 JdeV
07h45 - 08h30	**High School Teachers' Welcoming Reception / *Réception d'accueil pour les enseignants du secondaire* (TU-HS-REGN)**	**B119 JdeV**
08h45 - 09h30	**Plenary - Greg Flato, Environment Canada / *Plénière - Greg Flato, Environnement Canada* (TU-Plen1)**	**JdeV Salle de spectacle**
09h30 - 10h00	**Health Break, with refreshments / *Pause-santé, avec goûter* (TU-AM-Break)**	**MRR Rotunde**
10h00 - 11h30	Young Investigators in CMP and Materials / *Nouveaux chercheurs(ses) en matière condensée et matériaux* (TU-A1)	MRR D002
10h00 - 12h15	Molecular Biophysics / *Biophysique moléculaire* (TU-A2)	MRR A102
10h00 - 12h30	Non-Accelerator Particle Physics II / *Physique des particules sans accélérateur II* (TU-A3)	MG2 147G2
10h00 - 11h00	Information and Telecom / *Information et télécommunication* (TU-A4)	MRR A002
10h00 - 12h00	Mathematical Physics / *Physique mathématique* (TU-A5)	MG2 148G2
10h00 - 11h30	Explosive Astrophysics Environments in Stars / *Milieux astrophysiques explosifs dans les étoiles* (TU-A6)	MRR D102
10h00 - 12h15	Biological and Soft Materials / *Matériaux biologiques et mous* (TU-A7)	MRR R221
10h00 - 11h00	Photon Interactions / *Interactions des photons* (TU-A8)	MRR D202
10h00 - 10h15	Willem T.H. van Oers - A Canadian Nuclear Physics Career / *Willem T.H. van Oers - Une carrière canadienne en physique nucléaire* (TU-A9)	MRR A202
10h00 - 12h15	High School Teachers' Workshop- am / *Atelier des enseignant(e)s en physique - avant-midi* (TU-HS-1)	MG1 152G1
10h15 - 12h15	Intensity Frontier - Testing the Standard Model / *Frontière d'intensité - la vérification du modèle standard* (TU-A10)	MRR A202

11h15 - 12h00	Femto- and Atto-second Science / *Science des femto- et atto-secondes* (TU-A11)	MRR D202
12h00 - 13h30	**Past Presidents' Luncheon / *Dîner des ancien(ne)s président(e)s* (TU-Past-Pres)**	**B219 JdeV**
12h15 - 13h30	DAMPhi Business Meeting (lunch available) / *Réunion d'affaires DPAMip (dîner disponible)* (TU-DAMPhi)	MRR D202
12h15 - 13h30	DMBP Business Meeting (lunch available) / *Réunion d'affaires DPMB (dîner disponible)* (TU-DMBP)	MRR A102
12h15 - 13h30	DTP Business Meeting (lunch available) / *Réunion d'affaires DPT (dîner disponible)* (TU-DTP)	MG2 148G2
12h15 - 13h30	HS Workshop Luncheon / *Dîner de l'atelier des enseignant(e)s en physique* (TU-HS-LUNCH)	B119 JdeV
12h30 - 13h30	PPD Business Meeting (lunch available) / *Réunion d'affaires PPD (dîner disponible)* (TU-PPD)	MG2 147G2
13h30 - 14h00	**Special Plenary - Paul Corkum, 2009 NSERC Herzberg Medal Winner / *Plénière spéciale - Paul Corkum, récipiendaire de la Médaille Herzberg 2009 du CRSNG* (TU-Plen2)**	**JdeV Salle de spectacle**
14h15 - 16h15	High School Teachers' Workshop - pm / *Atelier des enseignant(e)s en physique - après-midi* (TU-HS-2)	MG1 152G1
14h15 - 15h45	Semiconductor Materials and Devices / *Matériaux et dispositifs des semiconducteurs* (TU-P1)	MRR D002
14h15 - 15h45	Energy Frontier and Phenomenology / *Frontière de l'énergie et phénoménologie* (TU-P2)	MRR D202
14h15 - 16h00	Cellular Biophysics / *Biophysique cellulaire* (TU-P3)	MRR A102
14h15 - 16h15	Open Questions in Hadronic Physics / *Problèmes ouverts en physique des hadrons* (TU-P4)	MRR A202
14h15 - 15h45	Quantum Information and Computing I / *Informatique et calculs quantiques I* (TU-P5)	MRR D102
14h15 - 16h30	Surfaces and Thin Films / *Les surfaces et les couches minces* (TU-P6)	MRR A002
14h15 - 16h30	Teaching with Technology and Curriculum Development / *Enseigner avec la technologie et développement du curriculum* (TU-P7)	MRR R221
16h15 - 16h45	**Health Break, with refreshments / *Pause-santé, avec goûter* (TU-PM-Break)**	**MRR Rotunde**
16h45 - 18h00	**CAP Annual General Meeting / *Assemblée générale annuelle de l'ACP* (TU-AGM)**	**MRR R221**
19h00 - 22h30	**Reception and Banquet / *Réception et banquet* (CAP-Banq)**	**Palais Crystal**

Wednesday / Mercredi, June 11 juin

08h00 - 16h30	**Conference Registration and Information / *Inscription au Congrès et information***	MRR Rotunde
07h00 - 08h15	CAP Executive Meeting (New and Old) / *Réunion de l'Exécutif (nouveau et ancien) de l'ACP* (WE-Exec)	B125 JdeV
08h45 - 09h30	**Plenary - Achim Schwenk, TRIUMF / *Plénière - Achim Schwenk, TRIUMF* (WE-Plen1)**	**JdeV Salle de spectacle**
09h30 - 10h00	**Health Break, with refreshments / *Pause-santé, avec goûter* (WE-AM-Break)**	**MRR Rotunde**
10h00 - 12h00	CAP Best Student Presentations Final Competition / *Compétition finale de l'ACP pour les meilleures communications étudiantes* (WE-A1)	MRR D102
10h00 - 12h00	Atomic and Molecular Spectroscopy and Dynamics II / *Spectroscopie et dynamique des atomes et molécules II* (WE-A2)	MRR A102
10h00 - 12h15	Medical Physics / *Physique médicale* (WE-A3)	MRR D202
10h00 - 12h00	Relativity / *Relativité* (WE-A4)	MRR D002
10h00 - 11h15	Synchrotron Science / *Science des synchrotrons* (WE-A5)	MG2 147G2
10h00 - 12h00	Collider Physics / *Physique des collisionneurs* (WE-A6)	MRR A002
10h00 - 11h45	Materials for Sustainable Energy / *Matériaux pour l'énergie durable* (WE-A7)	MG2 148G2
10h00 - 12h30	Biophotonics and Applied Biomedical Physics / *Biophotonique et physique biomédicale appliquée* (WE-A8)	MRR R221
12h30 - 13h30	Meeting of CAP Science Policy Committee / *Réunion du Comité de politique scientifique de l'ACP* (WE-SCIPOL)	B125 JdeV
13h30 - 14h00	**Parallel Medal Talk - Hong Guo, McGill U. (CAP-CRM Prize) / *Plénière en parallèle - Hong Guo, Univ. McGill (Prix ACP-CRM)* (WE-Plen2a)**	**MJDV Salle de spectacle**
13h30 - 14h00	**Parallel Medal Talk - Andreas Mandelis, U.Toronto (Industrial & Applied Physics Medal) / *Plénière en parallèle - Andreas Mandelis, U. Toronto (médaille en physique industrielle et appliquée)* (WE-Plen2b)**	**MRR R221**
14h15 - 15h45	Low dimensional systems / *Systèmes à basse dimension* (WE-P1)	MRR D102
14h15 - 15h15	Precision Frontier / *Frontière de la précision* (WE-P2)	MRR D002
14h15 - 15h15	Heavy Ion Collisions and Instrumentation / *Collisions d'ions lourds et instrumentation* (WE-P3)	MRR A202
14h15 - 15h30	Quantum Information and Computing II / *Informatique et calculs quantiques II* (WE-P4)	MRR A102
14h15 - 15h30	Preparing for the next long-range plan for subatomic physics / *Se préparer pour le prochain plan à long terme pour la physique subatomique* (WE-P5)	MRR D202
16h00 - 17h30	**CAP Council Meeting (New and Old) / *Réunion du conseil (nouveau et ancien) de l'ACP* (WE-Counc)**	**A232 JdeV**

2009 DETAILED CONGRESS SUMMARY
PROGRAMME DÉTAILLÉ DU CONGRÈS 2009

(SEE PAGE 18 FOR DESCRIPTION OF CODES-ABBREVIATIONS / VOIR PAGE 18 POUR UNE DESCRIPTION DES CODES-ABRÉVIATIONS)
(ABSTRACTS START ON PAGE 40 / LES RÉSUMÉS COMMENCENT À LA PAGE 40)

Legend / Légende : **(c) - contributed abstract ; (G) or (U) - Graduate/Undergraduate student ; (G/U*) - competitor in best student presentation**

MRR - Pavillon Remi-Rossignol | JdeV - Pavillon Jeanne de Valois | Taillon - Pavillon Taillon
m-f - Salle multi-fonctionnelle | MG - Pavillon de l'ingénierie

Saturday, June 6 / *Samedi, 6 juin*

09h30 - 13h30	CAP Executive Meeting (Old and New) / *Réunion de l'exécutif (ancien et nouveau) de l'ACP* (SA-Exec)	**136A and B, Taillon**
14h00 - 17h30	CAP Council Meeting (Old and New) / *Réunion du conseil (ancien et nouveau) de l'ACP* (SA-Coun)	**136A and B, Taillon**
18h30 - 22h00	CJP Editorial Board Meeting / *Réunion du comité de rédaction de la Revue canadienne de physique* (SA-CJP)	**Windjammer Rest., Delta Hotel**

Sunday, June 7 / *Dimanche, 7 juin*

TIME HEURE	Other locations autres endroits	Other locations autres endroits	MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR D002 (cap. 135)
08h15	**136A and B, Taillon** Physics Department Heads/Chairs Meeting / *Réunion des directeurs de départements de physique* **(SU-Hd-Chr)** **(ends at / *se termine à* 11h00)**		**SU-A2** (PPD / *PPD*) **NEUTRINO PHYSICS / *PHYSIQUE DES NEUTRINOS*** Chair: A. Noble, Queen's U.		**SU-A1** (DCMMP / *DPMCM*) **FACILITIES FOR MATERIALS SCIENCE / *INSTALLATIONS POUR LA SCIENCE DES MATÉRIAUX*** Chair: I.G. Hill, Dalhousie U.
09h00	**Room B219 JdeV** IPP Board of Trustees Mtg. / *Réunion du conseil d'administration de l'IPP* **(SU-IPP-Bd)**	**Room B218 JdeV** CINP Board of Trustees Mtg. / *Réunion du conseil d'administration de l'ICPN* **(SU-CINP-Bd)**			
09h15	↓	↓	**LINDNER, Thomas** *Status of the T2K Experiment* **(SU-A2-1)**	**SU-A3** (DMBP / *DPMB*) **DMBP BEST STUDENT PAPER COMPETITION I / *COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES DPMB I*** Chair: A. Linhananta, Lakehead U.	**ROOT, John** *Materials Research at the Canadian Neutron Beam Centre* **(SU-A1-1)**
09h45	↓	↓	**A. Gaudin (G)** *Photo-electron Calibration System for the T2K Time Projection Chambers* **(SU-A2-2)**		↓
10h00	↓	↓	**M. Hartz (c)** *Initial Data from the T2K Optical Transition Radiation Detector* **(SU-A2-3)**	**H. Assi (G*)** *Laser Interstitial Thermal Therapy (LITT): Modeling and Dose Evaluation* **(SU-A3-1)**	**HORMES, Josef** *The Canadian Light Source: The Next 10 Years* **(SU-A1-2)**
10h15	↓	↓	**J. Zalipska (c)** *Performance of Fine Grained Detector (FGD) designed for Tokai-to-Kamioka (T2K) long-baseline neutrino experiment* **(SU-A2-4)**	**A. Hassanzadeh (G*)** *Waveguide Evanescent Field Fluorescence Microscopy: A Novel Technique for Investigating Chemical Compounds Effects on the Cells* **(SU-A3-2)**	↓
10h30	↓	↓	**BELLERIVE, Alain** *The Final Cut at the Sudbury Neutrino Observatory* **(SU-A2-5)**	**M. McDonald (G*)** *Effect of Glycophorin-A Dimerization Motif Position on Transmembrane Polypeptide Orientation in Multilamellar Vesicles* **(SU-A3-3)**	↓
10h45	↓	↓	↓	**N. Prent (G*)** *Second harmonic generation microscopy reveals dynamics in contracting and non-contracting muscle cells* **(SU-A3-4)**	**WOLKOW, Robert** *Some highlights from NINT: Controlled Coupling and Occupation of Silicon Atomic Quantum Dots* **(SU-A1-3)**
11h00	↓	↓	**H. O'Keeffe (c)** *Scintillator characterization for the SNO+ neutrinoless double beta decay experiment* **(SU-A2-6)**	**M. Radey (U*)** *On cellular effects of moderate intensity static magnetic fields* **(SU-A3-5)**	↓
11h15	↓	↓	**K. Graham (c)** *Searching for double beta decay with the Enriched Xenon Observatory* **(SU-A2-7)**	**J. Thiessen (G*)** *Correlation of Myelin Content to Quantitative Magnetic Resonance Imaging Parameters Using a Cuprizone Mouse Model of Demyelination* **(SU-A3-6)**	↓
11h30	**Meeting ends / *Fin de la réunion***	↓	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***
11h45	**SU-NSERC-LUNCH**	**Plenary session, followed by lunch / *Session plénière, suivi par le dîner*** (Chair: S. Page, U. Manitoba)			(CAP-NSERC / ACP-CRSNG)
		ISABELLE BLAIN, Vice-President, NSERC — *Update from NSERC / Mise à jour par le CRSNG* **(ends at 13h30 / se termine à 13h30)**		**Jeanne de Valois, Salle de spectacle**	(cap. 410)

Sunday, June 7 / *Dimanche, 7 juin* *(cont'd / suite)*

MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR D002 (cap. 135)	MRR D102 (cap. 134)	Other locations / autres endroits		TIME / HEURE
SU-Plen1	**Plenary session / *Session plénière*** (Chair: H. Guo, McGill U.)				(CAP-DCMMP / ACP-DPMCM)	13h30
	MICHEL GINGRAS, University of Waterloo (Brockhouse Medal recipient / *Récipiendaire de la médaille Brockhouse*) Exotic Collective Phenomena in Geometrically and Randomly Frustrated Rare-Earth Magnetic Systems / *Phénomènes collectifs exotiques dans les systèmes magnétiques à base de terres rares frustrés de façon géométrique et aléatoire* **(ends at 14h00 / se termine à 14h00)**				**Jeanne de Valois Salle de spectacle** (cap. 410)	
SU-P2 (DHP / *DHP*) CENTENARIES ON THE 9'S / *CENTENAIRES SUR LES 9'S* Chair: W. Davidson NRC	**SU-P3** (DTP / *DPT*) BEST STUDENT PAPER COMPETITION / *COMPÉTITION POUR LA MEILLEURE COMMUNICATION ÉTUDIANTE* Chair: R. Dick U. Saskatchewan	**SU-P4** (DPE / *DPE*) EDUCATION WORKSHOP / *ATELIER SUR L'ENSEIGNEMENT* Chair: R. Hawkes Mount Allison U.	**SU-P1** (DPP / *DPP*) CONTROLLED FUSION PLASMAS AND BASIC PLASMA PHYSICS / *PHYSIQUE DES PLASMAS DE BASE ET PLASMAS EN FUSION CONTROLÉE* Chair: J. Morelli Queen's U.			
CONNOR, Robert (Robin) *The August 1909 meeting of the BAAS in Winnipeg at the University of Manitoba* **(SU-P2-1)**	**A. Alam-Samimi** (G*) *Phase Transitions and Magneto-electric Coupling in the Spiral Multiferroic $TbMnO_3$: A Group Theoretical Approach* **(SU-P3-1)**	**T. Antimirova** (c) *Introduction to Video-Based Motion Analysis* **(SU-P4-1)**	**XIAO, Chijin** *Design Features of the STOR-U Tokamak* **(SU-P1-1)**	**MRR A202 (135)** CINP Annual General Meeting / *Assemblée générale annuelle de l'ICPN* **(SU-CINP-Gen)**	**MRR D202 (135)** IPP Annual General Meeting / *Assemblée générale annuelle de l'IPP* **(SU-IPP-Gen)**	14h15
↓	**R. Arseneault** (G*) *On the commutator of hermitian operators and the angle of rotation of their eigenvector bases* **(SU-P3-2)**	**Discussion**	↓	↓	↓	14h30
PENNA, Paul *Alexander Graham Bell, Baddeck and Thin Airfoils* **(SU-P2-2)**	**D. Janzen** (G*) *The cosmological constant as 'dark energy'* **(SU-P3-3)**	**M. Milner-Bolotin** (c) *Clickers beyond the first year* **(SU-P4-2)**	**ROHRAFF, Damian** *STOR-M tokamak diagnostics for plasma edge and SOL regions* **(SU-P1-2)**	↓	↓	14h45
↓	**A. Bayntun** (G*) *Dynamical p-Branes in D-Dimensional Supergravity* **(SU-P3-4)**	**Discussion**	↓	↓	↓	15h00
Coffee Break / *pause café*	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**Coffee Break / *pause café***	↓	↓	15h15
	J. Kavka (G*) *Quantum Tunnelling of a Molecule with a Single Bound State* **(SU-P3-5)**	**D. Ahrensmeier** (c) *Labatorials - a step towards concept-based instruction using blended learning* **(SU-P4-3)**		↓	↓	15h30
J. Barrette (c) *The early days of the McGill Physics Department* **(SU-P2-3)**	**O. Landon-Cardinal** (G*) *Decoherence of a quantum reference frame* **(SU-P3-6)**	**J. Donev** (c) *A Pre-test / Post-test Approach to Evaluating the Effectiveness of Individual Instructional Sessions* **(SU-P4-4)**	**S. Posen** (U*) *Design of a Neutral Beam Injector for STOR-U* **(SU-P1-3)**	**Move to Room MRR R221 / *Démenage à la salle MRR R221***	**Move to Room MRR R221 / *Démenage à la salle MRR R221***	15h45
↓	**S. Stotyn** (G*) *Supergravity on an Atiyah-Hitchin Base* **(SU-P3-7)**	**Discussion**	**M. Bradley** (c) *Electroluminescent Devices Fabricated from Plasma-Ion-Implanted Silicon* **(SU-P1-4)**	**16h00-16h45** **MRR R221** Joint IPP/CINP Session for GSC-19 Presentation / *Session conjointe IPP/ICPN pour la présentation du Comité de sélection des subventions 19* **(SU-IPP-CNILC)** Chair: K. Sharma, U. Manitoba / W. Trischuk, U. Toronto		16h00
KLEPPNER, Daniel *The Fabulous Life of Albert A. Michelson* **(SU-P2-4)**	**K.E. Wunderle** (G*) *Transformation properties and symmetry behaviour of ELKO spinors* **(SU-P3-8)**	**M. Pavan** (c) *TRIUMF's "Physics in Action" physics education video series* **(SU-P4-5)**	**Discussion**			16h15
↓	**Session ends / *Fin de la session***	**Discussion**	↓	**16h30-21h00** **136A&B, Taillon** CAP-NSERC Liaison Committee Meeting / *Réunion du comité de liaison ACP-CRSNG* **(SU-NSERC)**	**16h30-18h00** **Room/salle Multi-fonctionnelle** Student Reception / *Réception pour les étudiant(e)s* **(SU-Grad)**	16h30
Session ends / *Fin de la session*		**Session ends / *Fin de la session***	**Session ends / *Fin de la session***			16h45
SU-BBQ (ends at 18h45)	**CAP Welcome BBQ** ***BBQ d'accueil de l'ACP***				(CAP / *ACP*) **Room/*Salle* multi-fonctionnelle** (se termine à 18h45)	17h00
SU-Plen2 (ends at 19h30)	**Plenary session / *Session plénière*** (Chair: S. Page, U.Manitoba.) **GUY MOORE, McGill U. (CAP Herzberg Medal Recipient / *Récipiendaire de la médaille Herzberg ACP*)** *Is quark-gluon matter nearly transparent or very opaque? / La matière de quarks et de gluons est-elle presque transparente ou très opaque*				(CAP / *ACP*) **Jeanne de Valois, Salle de spectacle** (cap. 410) (se termine à 19h30)	19h00
MRR Corridors Ends at 22h00	**Poster Session and student competition, with beer and light refreshments** ***Session d'affiches et concours étudiants, bière et petit goûter servis***				**Les corridors du MRR** Se termine à 22h00	**19h30**

Monday, June 8

07h00	(MO-DPE) DPE Business Meeting (with breakfast) - 07h00-08h30 - JdeV Room B125
07h00	(MO-Friends) "Friends of CAP" Breakfast and Meeting - 07h00-08h30 - JdeV Room A232
07h00	(MO-NSERC) New Faculty Breakfast with NSERC - 07h00-08h30 - JdeV Room B219
08h45	**MO-Plen1** **Plenary session** (Chair: W. Davidson, NRC) (CAP-DHP) **DAVA SOBEL (author of Galileo's Daughter)** *Galileo and the International Year of Astronomy* **Jeanne de Valois, Salle de spectacle** (cap. 410)
09h30	**Health Break, with refreshments** **MRR Rotunde**

TIME HEURE	MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR A202 (cap. 133)	MRR D002 (cap. 135)
	MO-A5 (DIMP-DIAP / *DPIM-DPIA*) **APPLIED INDUSTRIAL AND GENERAL INSTRUMENTATION / *INSTRUMENTATION INDUSTRIELLE APPLIQUÉE ET GÉNÉRALE*** Chair: K. Michaelian, CANMET, NRCan	**MO-A6** (DOP / *DOP*) **ADVANCED MATERIALS AND PHOTONIC CRYSTALS / *MATÉRIAUX AVANCÉS ET CRISTAUX PHOTONIQUES*** Chair: R. Fedosejevs, U. Alberta	**MO-A7** (PPD / *PPD*) **ENERGY FRONTIER / *FRONTIÈRE DE L'ÉNERGIE*** Chair: K. Benslama, U. Regina	**MO-A1** (DCMMP / *DPMCM*) **DCMMP BEST STUDENT PAPER COMPETITION I / *COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES DPMCM I*** Chair: I. Hill, Dalhousie U.
10h00	**MAEV, Roman Gr.** *Advanced High Resolution Digital Imaging Technique in Non-destructive Investigations and Diagnostics of Cultural and Environmental Heritage* **(MO-A5-1)**	**SKOROBOGATIY, Maksim** *Introducing Nanotechnology into Optical Fibers* **(MO-A6-1)**	**ORR, Robert** *The International Linear Collider* **(MO-A7-1)**	**A. Almudallal (G*)** *Simulation study of a colloidal system under the influence of an external electric field* **(MO-A1-1)**
10h15	↓	↓	↓	**P. Ashby (G*)** *Spontaneous Supercurrents in Chiral p-Wave Superconductor* **(MO-A1-2)**
10h30	**MANDELIS, Andreas** *Deep Level Photo-Thermal Spectroscopy of Defect States in Semi-Insulating GaAs: A Combined Temperatures, Pulse-Rate and Time-Domain Study of Defect State Kinetics* **(MO-A5-2)**	**A. Haché (c)** *The nonlinear optical properties of chitin and chitosan, the backbone of many natural photonic crystals* **(MO-A6-2)**	**F. Corriveau (c)** *International Linear Collider Detector Studies* **(MO-A7-2)**	**M. Giuliani (G*)** *Understanding the formation of colloidal crystal by spin coating technique* **(MO-A1-3)**
10h45	↓	**J. Khalack (c)** *Electrochromic shift of the reflectance peak in finite thickness tungsten trioxide inverse opal photonic crystals* **(MO-A6-3)**	**W. Trischuk (c)** *Superconducting Radiofrequency Cavity R&D in Canada* **(MO-A7-3)**	**H. Newman (G*)** *Structure and Dynamics of a Charged-Screened Colloidal Suspension: Deviations from the Hard-Sphere Equation of State* **(MO-A1-4)**
11h00	**BENNETT, Craig** *Ni-Mn-Ga Ferromagnetic Shape Memory Alloys* **(MO-A5-3)**	**F. LeBlanc (G*)** *Fixed and graded refractive index MgF2 antireflection coatings by glancing angle deposition* **(MO-A6-4)**	**O'NEIL, Dugan** *Status of the Large Hadron Collider and the ATLAS Experiment* **(MO-A7-4)**	**M. Wesolowski (G*)** *Pulsed-laser deposition of amorphous diamond-like carbon thin films* **(MO-A1-5)**
11h15	↓	**Session ends / *Fin de la session***	↓	**F. Soltani (G*)** *Fabrication and analysis of self-terminated pressure-driven quantum point contacts* **(MO-A1-6)**
11h30	**A.M.L. MacLeod (G*)** *Studies of an All-Scintillator Compton Gamma Imager* **(MO-A5-4)**		**S. Beale (G*)** *CP Asymmetry in Semileptonic Bs decays at D0* **(MO-A7-5)**	**Session ends / *Fin de la session***
11h45	**I. Mastikhin (c)** *MRI Measurements of dissolved gas dynamics in a cavitating fluid* **(MO-A5-5)**		**A. Buzatu (G*)** *Search for Higgs Bosons Produced in association with W bosons at CDF* **(MO-A7-6)**	
12h00	**Z. Papandreou (c)** *Large Area Silicon Photomultipliers for use in the GlueX Experiment* **(MO-A5-6)**		**M. Barbi (c)** *Study of Dark Matter with the International Linear Collider* **(MO-A7-7)**	
12h15	**DIAP Business Meeting / Réunion d'affaires DPIA** (lunch available / *dîner disponible*)	**DOP Business Meeting / *Réunion d'affaires DOP*** (lunch available / *dîner disponible*)	**Session ends / *Fin de la session***	**DIMP Business Meeting / Réunion d'affaires DPIM** (lunch available / *dîner disponible*)
13h30	**MO-Plen2** **Plenary session - Teaching Medal** (Chair: H. Rotermund, Dalhousie U.) (CAP) **Jeff Dahn, Dalhousie U.** *If It's Fun for You, It's Fun for Them* **(ends at 14h00)** **Jeanne de Valois, Salle de spectacle** (cap. 410)			

Lundi, 8 juin

(MO-DPE) Réunion d'affaires DEP (avec petit-déjeuner) - 07h00-08h30 - JdeV, Salle B125		07h00
(MO-Friends) Déjeuner et réunion des "Ami(e)s de l'ACP" - 07h00-08h30 - JdeV, Salle A232		07h00
(MO-NSERC) Déjeuner-rencontre des nouveaux professeurs avec le CRSNG - 07h00-08h30 - JdeV, Salle B219		07h00
MO-Plen1 ***Session plénière*** (Chair: W. Davidson, CNRC)	(ACP-DHP)	08h45
DAVA SOBEL (auteure de 'La fille de Galilée') *Galilée et l'Année mondiale de l'astronomie*	**Jeanne de Valois, Salle de spectacle** (cap. 410)	
Pause-santé, avec goûter	**MRR Rotunde**	09h30

MRR D102 (cap. 134)	MRR D202 (cap. 134)	MG2 147G2 (cap. 108)	MG2 148G2 (cap. 132)	TIME HEURE
MO-A2 (DAMPhi-DPP / *DPAMip-DPP*) ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS I (IN MEMORY OF BARRY WALLBANK) / *SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES I (À LA MEMOIRE DE BARRY WALLBANK)* Chair: K. LeBris, St. F-X U.	**MO-A8** (DCMMP / *DPMCM*) BEST CONDENSED MATTER PAPER PUBLISHED IN CJP / *MEILLEUR ARTICLE SUR LA MATIÈRE CONDENSÉE PUBLIÉ DANS LA RCP* Chair: B. van Zyl, St. F-X U.	**MO-A3** (DPE / *DEP*) CURRICULUM REVITALIZATION / *REVITALISATION DES PROGRAMMES* Chair: T. Antimirova, Ryerson U.	**MO-A4** (DNP / DPN) PRECISION MEASUREMENTS TESTING FUNDAMENTAL SYMMETRIES / *MESURES DE PRÉCISION COMME TESTS DE SYMÉTRIES FONDAMENTALES* Chair: M. Fujiwara, TRIUMF	
MacASKILL, John *From Highly Charged Ions to Complex Molecular Formation: An Overview of Experiments and Results from the JPL Highly Charged Ion and Fast Atom Facilities* **(MO-A2-1)**	**BERCIU, Mona** *Momentum Average Approximations* **(MO-A8-1)** ↓ **(Ends at 10h30 / *Se termine à 10h30*)**	**DE BRUYN, John** *Promoting Educational Research and Innovation in a "Research Intensive" Department* **(MO-A3-1)**	**THOMPSON, Robert I.** *The Pursuit of Antihydrogen Trapping and Spectroscopy* **(MO-A4-1)**	10h00
↓	**MO-A9** (DCMMP-DTP / *DPMCM-DPT*) THEORETICAL CONDENSED MATTER PHYSICS / *THÉORIE DE LA MATIÈRE CONDENSÉE* Chair: B. van Zyl, St. F-X U.	↓	↓	10h15
J. Lepson (c) *Spectra of highly charged iron in the extreme ultraviolet wavelength region of laboratory and astrophysical plasmas* **(MO-A2-2)**	**MARZLIN, Karl-Peter** *Propagation of photon pulses in strongly nonlinear atomic media* **(MO-A9-1)**	**A. Kotlicki** (c) *Evolution and Refinement of an Environmentally Themed Introductory Physics Course* **(MO-A3-2)**	**ROMALIS, Michael** *Low-energy searches for new interactions involving nuclear spins* **(MO-A4-2)**	10h30
W. Rozmus (c) *Interaction of Relativistic Laser Pulses with Plasmas* **(MO-A2-3)**	↓	**K. Jaffer** (c) *Building a Better Learner: Cross-level Curriculum Design* **WITHDRAWN** **(MO-A3-3)**	↓	10h45
Break / *Pause*	**D. Guclu** (c) *Electronic and optical properties of graphene quantum dots* **(MO-A9-2)**	**FINKELSTEIN, Noah** *Applying Education Research to Implement and Sustain Transformation in Undergraduate Physics* **(MO-A3-4)**	**Break / *Pause***	11h00
VAN WIJNGAARDEN, William *Critical Examination of Isotope Shift and Fine Structure Measurements for Transitions in $^{6,7}Li$* **(MO-A2-4)**	**K. Tanaka** (c) *Electronic structure in the vortex state of a two-band superconductor with mixed dimensionality* **(MO-A9-3)**	↓	**MAVROMATOS, Nick** *CPT Symmetry, Quantum Gravity and Entangled Particle States* **(MO-A4-3)**	11h15
↓	**R. Wortis** (c) *Effect of nonlocal interactions on the disorder-induced zero-bias anomaly in the extended Anderson-Hubbard model* **(MO-A9-4)**	**J.L. Hutter** (c) *The Exam as a Learning Experience: Evaluating the Immediate Feedback Assessment Technique for Physics Education* **(MO-A3-5)**	↓	11h30
D. Forthomme (c) *Population Depletion Spectroscopy of Strontium Monomethoxide* **(MO-A2-5)**	**D. Sprung** (c) *Asymptotic Approximations to Clebsch-Gordan Coefficients from a Tight-Binding Model* **(MO-A9-5)**	**N. Didis** (G*) *Models in Modern Physics Textbooks* **(MO-A3-6)**	**S. Menary** (c) *Antihydrogen Detection with ALPHA* **(MO-A4-4)**	11h45
D. Tokaryk (c) *Measuring the Temperature of a Neutral Plasma Using the $C^3\Pi_u$-$B^3\Pi_g$ Emission Spectrum of Molecular Nitrogen* **(MO-A2-6)**	**R. Meyer** (c) *Computer Simulations of the Sintering of Metallic Nanoparticles* **(MO-A9-6)**	**Discussion** **(Session ends at 12h15 /** **Fin de la session à 12h15)**	**K. Leach** (G*) *Spectroscopic Factors from the Single Neutron Pickup Reaction $^{64}Zn(d,t)$* **(MO-A4-5)**	12h00
DPP Business Meeting / ***Réunion d'affaires DPP*** (lunch available / *dîner disponible*)	**DCMMP Business Meeting /** ***Réunion d'affaires DPMCM*** (lunch available / *dîner disponible*)	**Room MRR C012** **DHP Business Meeting /** ***Réunion d'affaires DHP*** (lunch available / *dîner disponible*)	**DNP Business Meeting /** ***Réunion d'affaires DPN*** (lunch available / *dîner disponible*)	12h15

MO-Plen2 ***Session plénière - Médaille de l'enseignement*** (Chair: H. Rotermund, Dalhousie U.)	(ACP)	13h30
Jeff Dahn, Université Dalhousie *Si c'est amusant pour vous, ça l'est pour eux* **(se termine à 14h00)**	**Jeanne de Valois, Salle de spectacle** (cap. 410)	

Monday, June 8 (cont'd)

TIME HEURE	MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR A202 (cap. 133)	MRR D002 (cap. 135)	MRR D102 (cap. 134)
	MO-P3 (DIAP / *DPIA*) **APPLIED PHYSICS / *PHYSIQUE APPLIQUÉE*** Chair: E. Maeva U. Windsor	**MO-P4** (DPE / *DEP*) **INTERACTIVE TEACHING / *ENSEIGNEMENT INTERACTIF*** Chair: A. Sarty St. Mary's U.	**MO-P5** (PPD / *PPD*) **NON-ACCELERATOR PARTICLE PHYSICS I / *PHYSIQUE DES PARTICULES SANS ACCÉLÉRATEUR I*** Chair: S. Robertson McGill U.	**MO-P6** (DCMMP / *DPMCM*) **DCMMP BEST STUDENT PAPER COMPETITION II / *COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES DPMCM II*** Chair: I. Hill Dalhousie U.	**MO-P9** (DNP / *DPN*) **EXOTIC NUCLEAR STRUCTURE / *STRUCTURE NUCLÉAIRE EXOTIQUE*** Chair: R. Kanungo St. Mary's U.
14h15	**KOTLICKI, Andrzej** *Sensors used to Characterize Musical Instruments* **(MO-P3-1)**	**LASRY, Nathaniel** *Getting Started in Physics Education Research* **(MO-P4-1)**	**KRAUSS, Carsten** *The Particle and Astrophysical Properties of the Neutrino: News from the SNO+ Experiment* **(MO-P5-1)**	**M. Jakubinek (G*)** *Thermal and Electrical Conductivity of Carbon Nanotube Materials* **(MO-P6-1)**	**THOENNESSEN, Michael** *Discovery of New Isotopes at the NSCL* **(MO-P9-1)**
14h30	↓	↓	↓	**B. Boates (G*)** *First-principles thermodynamics of carbon dioxide at high pressure* **(MO-P6-2)**	↓
14h45	**MALYARENKO, Eugene** *Objective percussion for diagnostics of pulmonary traumas* **(MO-P3-2)**	**R.I. Thompson (c)** *RAISE and its Faculty Teaching Engagement Survey at the University of Calgary* **(MO-P4-2)**	**B. Jamieson (c)** *Status of the T2K time projection chambers* **(MO-P5-2)**	**O. Reshef (U*)** *Spectral shifts and spectral jumps in quantum dots by colour* **(MO-P6-3)**	**GERL, Juergen** *In-beam and decay γ spectroscopy at GSI and FAIR* **(MO-P9-2)**
15h00	↓	**J. Ives (c)** *Analysis of student cheat sheets and other predictors of exam performance* **(MO-P4-3)**	**T. Shantz (G*)** *Monte Carlo Simulations of Detector Sensitivity for the Helium and Lead Observatory (HALO)* **(MO-P5-3)**	**B. Lorin (G*)** *A definition of the phenomenon of nano-size particles* **(MO-P6-4)**	↓
15h15	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**Session ends / *Fin de la session***	**Coffee Break / *pause café***
15h30					**GARNSWORTHY, Adam** *Recent Highlights from the TIGRESS Collaboration* **(MO-P9-3)**
15h45	**W. Diamond (c)** *My Years as a Physicist at Chalk River Laboratories* **(MO-P3-3)**	**NEWLING, Benedict** *"Please, Sir, I want some more examples": Inducers and Deducers in our Classrooms* **(MO-P4-4)**	**GUENETTE, Roxanne** *Recent exciting results from the VERITAS observatory* **(MO-P5-4)**		**BARONI, Simone** *Nuclear structure with low momentum interactions* **(MO-P9-4)**
16h00	**D. Gavrilov (G*)** *Finite-difference modelling of layered structures for thermal NDE analysis simulation* **(MO-P3-4)**	↓	↓		**DELHEIJ, Paul** *TITAN Penning Trap Mass Measurements of Light Neutron-Rich Halo Nuclei* **(MO-P9-5)**
16h15	**W. Li (G*)** *High Efficiency Wireless Power Transfer at Low Frequencies* **(MO-P3-5)**	**A. Ibrahim (G*)** *Choice and Confidence Transitions to Conceptual Tests as Fine Indicators of Learning: An analysis of ten years of Peer Instruction data* **(MO-P4-5)**	**K. Mizouchi (c)** *The FGD Electronics System* **(MO-P5-5)**		**J. Bangay (G*)** *Breakdown of Vibrational Motion in ^{110}Cd* **(MO-P9-6)**
16h30	**C. Mosquera (c)** *Implementation of Associated Particle Imaging System for the Detection of Landmines and Improvised Explosive Devices* **(MO-P3-6)**	**R.I. Thompson (c)** *A Discussion of the Present and Future of Physics Education Research in Canada* **(MO-P4-6)**	**A.J. Noble (c)** *The Physics Program of SNOLAB: A new International Facility for Astroparticle Physics Research* **(MO-P5-6)**		**Session ends / *Fin de la session***
16h45	**K. Pastor (U)** *Time and Linearity Studies of $LaBr_3$ (Ce) as Part of an Associated Particle Imaging System* **(MO-P3-7)**	**Discussion**	**M. Kuziak (c)** *Monte-Carlo simulations for the DEAP experiment* **(MO-P5-7)**		
17h00	**M-P. Nieh (c)** *New Development of Small Angle Neutron Scattering (SANS) Capability and Application at Canadian Neutron Beam Centre* **(MO-P3-8)**	**Session ends / *Fin de la session***	**E. O'Dwyer (G*)** *Design and Testing of Radon Trap for DEAP-1* **(MO-P5-8)**		
17h15	**E. Watanabe (G*)** *Pneumatical Switching of the Optical Power of a Fresnel Lens for Control of Solar Illumination* **(MO-P3-9)**		**W. Rau (c)** *CDMS and SuperCDMS* **(MO-P5-9)**		
17h30	**Session ends / *Fin de la session***		**S. Korte (G)** *Supernova Detection at SNOLAB* **(MO-P5-10)**		
17h45			**Session ends / *Fin de la session***		

Lundi, 8 juin (*suite*)

MRR D202 (cap. 135)	MG2 147G2 (cap. 108)	MG2 148G2 (cap. 132)	MRR R221 (cap. 292)	OTHER LOCATIONS / AUTRES ENDROITS	TIME / HEURE
MO-P7 (DTP / *DPT*) FIELDS AND STRINGS / *THÉORIE DES CHAMPS ET CORDES* Chair: M. Paranjape U. de Montréal	**MO-P8** (DOP / *DOP*) SPECIAL TOPICS IN OPTICS / *SUJETS SPÉCIAUX EN OPTIQUE* Chair: R. Corriveau CIPI/ICIP	**MO-P2** (DAMPhi-DOP / *DPAMip-DOP*) QUANTUM OPTICS - COLD ATOMS / *OPTIQUE QUANTIQUE - ATOMES FROIDS* Chair: A. Madej NRC	**MO-P1** (DCMMP / *DPMCM*) MAGNETISM AND FRUSTRATED MAGNETISM / *MAGNÉTISME ET MAGNÉTISME FRUSTRÉ* Chair: J. Dutcher U. Guelph		
BURGESS, Clifford *Quantum Gravity, Dark Matter and Dark Energy* **(MO-P7-1)**	**FEDOSEJEVS, Robert** *Laser Fusion: A Route to a Sustainable Energy Future* **(MO-P8-1)**	**O'DELL, Duncan** *Bloch Oscillations of cold atoms inside an optical cavity: a proposal for ultra sensitive measurement of forces* **(MO-P2-1)**	**GAULIN, Bruce** *Exotic Magnetic Ground States in XY Pyrochlores* **(MO-P1-1)**		14h15
↓	↓	↓	↓		14h30
SEMENOFF, Gordon *Giant loop holography* **(MO-P7-2)**	**J-M. Menard** (G*) *Spin Hall Effect of Light in a Semiconductor* **(MO-P8-2)**	**S. Beattie** (G*) *Atom Interferometric Studies of Light Scattering* **(MO-P2-2)**	**GINGRAS, Michel** *Transverse Field, Random Fields and Glass Transition in the Quantum Magnetism of $LiHo_xY_{1-x}F_4$* **(MO-P1-2)**		14h45
↓	**B. Ramamoorthy** (c) *RF sputtered ITO films over the evaporated WO_3 films on plastic substrates* **(MO-P8-3)**	**I. Chan** (G*) *Properties of Magnetic Sublevel Coherences for Precision Measurements* **(MO-P2-3)**	↓		15h00
Coffee Break / ***pause café***	**R. Wong** (G*) *Sub-micron pitch variable diffraction grating using nanoporous electrodes and electrophoresis of dye ions* **(MO-P8-4)**	**Coffee Break /** ***pause café***	**Coffee Break /** ***pause café***		15h15
N. Barnaby (c) *Cosmological Fluctuations from Infra-Red Cascading During Inflation* **(MO-P7-3)**	**Session ends /** ***Fin de la session***	**STAUDTE, André** *Single Molecule Scanning Tunneling Microscopy* **(MO-P2-4)**			15h30
↓		↓	**M. Plumer** (c) *Trigonal spin interactions in magnetoelectric $CuFeO_2$ and $HoMnO_3$* **(MO-P1-3)**		15h45
KUNSTATTER, Gabor *Dynamical Singularity Resolution in Spherically Symmetric Black Hole Formation* **(MO-P7-4)**		**G. Humphrey** (G*) *A Method of Transferring the Frequency Stability of a Single Reference Laser to Multiple Lasers with Disparate Wavelengths Using a Transfer Cavity* **(MO-P2-5)**	**R. Nechache** (c) *Magnetic ordering and exchange interactions in multiferroic Bi_2FeCrO_6 thin films* **(MO-P1-4)**		16h00
↓		**Session ends /** ***Fin de la session***	**E. Karhu** (G*) *Enhanced Curie Temperature in epitaxial MnSi films* **(MO-P1-5)** ↓ **(Ends at 16h30 / *Se termine à 16h30*)**		16h15
Session ends / ***Fin de la session***			**(CEWIP / *CEFEP*)** Chair: J. McKenna, UBC **IVIE, Rachel** *Women in Physics and Astronomy* **(MO-CEWIP-1)** Followed by Women in Physics Committee meeting / *Suivi par la réunion du Comité pour encourager les femmes en physique.*		16h30
					16h45
			↓		17h00
			↓		17h15
			↓		17h15
			Session ends at 18h30 / ***Se termine à 18h30***		17h15

Monday, June 8 (cont'd)

19h30 [MO-KEY]

CAP Herzberg Memorial Public Lecture M-Cs: P. Ashrit, U. Moncton / S. Page, U. Manitoba

Laurent Drissen, Laval University
"The Splendours and Miseries of Massive Stars"

Followed by a Reception — Capitol Theatre, Downtown Moncton (see page 10 for details)

Tuesday, June 9

TIME HEURE	MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR A202 (cap. 133)	MRR D002 (cap. 135)	MRR D102 (cap. 134)
07h00	(TU-CNILC)	CNILC Breakfast meeting - 07h00-08h30			JdeV Room B164
07h00	(TU-PiC)	PiC Editorial Board Meeting - 07h00-08h30			JdeV Room B219
07h45	(TU-HS-REGN)	High School Teachers' Welcoming Reception - 07h45-08h30			JdeV Room B119
08h45	**TU-Plen1** **Plenary session** (Chair: R.B. Mann, U. Waterloo) **GREG FLATO, Environment Canada** *Global Climate Models: Development and Application*				(CAP-DASP) **Jeanne de Valois, Salle de spectacle** (cap. 410)
09h30	**Health Break, with refreshments**				**MRR Rotunde**
	TU-A4 (DOP / *DOP*) INFORMATION AND TELECOM / *INFORMATION ET TÉLÉCOMMUNICATION* Chair: R. Corriveau, CIPI/ICIP	**TU-A2** (DMBP / *DPMB*) MOLECULAR BIOPHYSICS / *BIOPHYSIQUE MOLÉCULAIRE* Chair: A. Linhananta, Lakehead U.	**TU-A9** (DNP / *DPN*) WILLEM T.H. VAN OERS - A CANADIAN NUCLEAR PHYSICS CAREER / *WILLEM T.H. VAN OERS - UNE CARRIÈRE CANADIENNE EN PHYSIQUE NUCLÉAIRE* Chair: M. Butler, St. Mary's U.	**TU-A1** (DCMMP / *DPMCM*) YOUNG INVESTIGATORS IN CMP AND MATERIALS / *NOUVEAUX CHERCHEURS(SES) EN MATIÈRE CONDENSÉE ET MATÉRIAUX* Chair: M. Gingras, U. Waterloo	**TU-A6** (DNP / *DPN*) EXPLOSIVE ASTROPHYSICS ENVIRONMENTS IN STARS / *MILIEUX ASTROPHYSIQUES EXPLOSIFS DANS LES ÉTOILES* Chair: C. Andreoiu, SFU
10h00	**JESSOP, Paul** *Defect Engineering of Silicon for Long Wavelength Photodetectors* **(TU-A4-1)**	**LEONENKO, Zoya** *Application of Scanning Probe Microscopy in Nanoscale Lipid Biophysics* **(TU-A2-1)**	**VOGT, Erich** *Willem T.H. van Oers - A Canadian Nuclear Physics Career* **(TU-A9-1)**	**KREPLAK, Laurent** *Design and mechanical properties of fibrous protein scaffolds* **(TU-A1-1)**	**CHEN, Alan** *Nuclear Astrophysics at McMaster : Indirect Approaches* **(TU-A6-1)**
10h15	↓	↓	**TU-A10** (DNP / *DPN*) INTENSITY FRONTIER - TESTING THE STANDARD MODEL / *FRONTIÈRE D'INTENSITÉ - LA VÉRIFICATION DU MODÈLE STANDARD* Chair: W. van Oers, U. Manitoba **MARTIN, Jeff** *Ultracold Neutrons in Canada* **(TU-A10-1)**	↓	
10h30	**T. Stuart** (G*) *Budget Entanglement: A Compact and Intrinsically Stable Source of Polarization Entangled Photons* **(TU-A4-2)**	**DESERNO, Markus** *A generic coarse-grained model for protein folding and aggregation* **(TU-A2-2)**	↓	**RAUSSENDORF, Robert** *Fault-Tolerant Quantum Computation with High Threshold in Two Dimensions* **(TU-A1-2)**	**DAVIDS, Barry** *Recent Progress in Nuclear Astrophysics at TRIUMF* **(TU-A6-2)**
10h45	**I. Lucio** (G*) *Quantum Key Distribution with Quantum Frames* **(TU-A4-3)**	↓	**GERICKE, Michael** *The Hadronic Weak Interaction and Parity Violation in Cold Neutron Capture* **(TU-A10-2)**	↓	
11h00	**Session ends / *Fin de la session***	**N. Mousseau** (c) *Le dimère de la séquence pathologique de polyglumanime favorise la formation de nanotubes* **(TU-A2-3)**	↓	**SANTATO, Clara** *Organic Electronics Materials and Devices* **(TU-A1-3)**	**J. Fallis** (G*) *Mass measurements of neutron-deficient isotopes of Mo, Tc, Ru and Rh for rp- and vp-process models performed with the Canadian Penning trap mass spectrometer* **(TU-A6-3)**
11h15		**C. Gradinaru** (c) *Characterization of quantum dot-DNA biosensors by single-molecular fluorescence spectroscopy* **(TU-A2-4)**	**RAMSEY-MUSOLF, Michael** *Nuclear Physics and the New Standard Model* **(TU-A10-3)**	↓	**K. Sharma** (c) *Opportunities for the Canadian Penning Trap Mass Spectrometer at the new CARIBU facility at the Argonne National Laboratory* **(TU-A6-4)**
11h30		**M. Rheinstadter** (c) *Collective Molecular Dynamics in Membranes and Proteins* **(TU-A2-5)**	↓	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***
11h45		**A. Linhananta** (c) *Hard-sphere models of proteins in solutions of osmolytes and denaturants* **(TU-A2-6)**	**GRIMM, Klaus** *Electron Parity Violation Experiments and Tests of the Standard Model* **(TU-A10-4)**		

Lundi, 8 juin (suite)

M-Cs: P. Ashrit, U. Moncton / S. Page, U. Manitoba
[MO-KEY]

Conférence publique commémorative Herzberg de l'ACP 19h30

Laurent Drissen, Université Laval
"Splendeurs et misères des étoiles massives"

Suivie d'une réception

Théâtre Capitol, centre-ville de Moncton (voir page 10 pour les détails)

Mardi, 9 juin

MRR D202 (cap. 135)	MG2 147G2 (cap. 108)	MG2 148G2 (cap. 132)	MRR R221 (cap. 292)	MG1 152G1 (cap. 60)	TIME HEURE
(TU-CNILC)	Réunion du Comité de liaison national canadien de l'UIPPA - 07h00-08h30			JdeV, Salle B164	07h00
(TU-PiC)	Réunion du Comité de rédaction de la PaC - 07h00-08h30			JdeV, Salle B219	07h00
(TU-HS-REGN)	Réception d'accueil pour les enseignants du secondaire - 07h45-08h30			JdeV, Salle B119	07h45
TU-Plen1	***Session plénière*** (Chair: R.B. Mann, U. Waterloo)			(ACP-DPAE)	08h45
	GREG FLATO, Environnement Canada *Modèles climatiques mondiaux : élaboration et application*			**Jeanne de Valois, Salle de spectacle** (cap. 410)	
	Pause-santé, avec goûter			**MRR Rotunde**	09h30
TU-A8 (DIMP-DAMPhi / *DPIM-DPAMip*) PHOTON INTERACTIONS / *INTERACTIONS DES PHOTONS* Chair: D. Tokaryk, UNB	**TU-A3** (PPD / *PPD*) NON-ACCELERATOR PARTICLE PHYSICS II / *PHYSIQUE DES PARTICULES SANS ACCÉLÉRATEUR II* Chair: K. Graham, Carleton U.	**TU-A5** (DTP / *DPT*) MATHEMATICAL PHYSICS / *PHYSIQUE MATHÉMATIQUE* Chair: S. Das, U. Lethbridge	**TU-A7** (DCMMP-DMBP / *DPMCM-DPMB*) BIOLOGICAL AND SOFT MATERIALS / *MATÉRIAUX BIOLOGIQUES ET MOUS* Chair: B. Gaulin, McMaster U.	**TU-HS-1** (CAP-DPE / *ACP-DEP*) HIGH SCHOOL TEACHERS' WORKSHOP - A.M. / *ATELIER DES ENSEIGNANT(E)S EN PHYSIQUE - AVANT-MIDI* Chair: F. Weil, U. de Moncton	
MADEJ, Alan *Probing Time and Physics Using an Optical Atomic Clock based on a Single Trapped Ion* **(TU-A8-1)**	**KUMARATUNGA, Sujeewa** *PICASSO* **(TU-A3-1)**	**SIPE, John** *Towards a QED for dispersive and absorptive media* **(TU-A5-1)**	**DUTCHER, John** *Biopolymers from Bacteria - Nature's Nanotechnology* **(TU-A7-1)**	**Session ends at 12h15 - Presentation details will be provided to participants in registration package**	10h00
↓	↓	↓	↓		10h15
P. Beiersdorfer (c) *Microcalorimeters for use in atomic physics and magnetic fusion* **(TU-A8-2)**	**P. Nadeau** (G) *Development of a Non-invasive Technique to Measure the Droplet Size Distribution of a PICASSO Detector* **(TU-A3-2)**	**WOOLGAR, Eric** *The Ricci flow and Bartnik's quasi-local mass* **(TU-A5-2)**	**R. Wickham** (c) *Understanding the stability of self-assembled microstructures in cylindrically-confined diblock copolymer melts from their geometrical characteristics* **(TU-A7-2)**		10h30
K. Michaelian (c) *Photoacoustic Spectroscopy of Polymer Beads* **(TU-A8-3)**	**G. Cully** (U*) *Analysis of Superheated States of C_4F_{10} for PICASSO Dark Matter Experiment* **(TU-A3-3)**	↓	↓		10h45
Session ends / *Fin de la session* **TU-A11** (DAMPhi-DOP / *DPAMip-DOP*) FEMTO- AND ATTO- SECOND SCIENCE / *SCIENCE DES FEMTO- ET ATTO-SECONDES* Chair: D. Tokaryk, UNB	**S. Archambault** (G*) *Fourier Transforms to Discriminate Events in Superheated Droplet Detectors* **(TU-A3-4)**	**D. Sprung** (c) *Memory effects induced by initial switching conditions in a Fano-Anderson model* **(TU-A5-3)**	**B. Joos** (c) *Entropic Rigidity of Polymeric Loops* **(TU-A7-3)**		11h00
BRABEC, Thomas *Attosecond science: Correlated few electron dynamics in small molecules and clusters* **(TU-A11-1)**	**BOULAY, Mark** *Dark Matter Search at SNOLAB with DEAP-1 and DEAP-3600* **(TU-A3-5)**	**M. Walton** (c) *Damped harmonic oscillator in phase-space quantum mechanics* **(TU-A5-4)**	**J. Hutter** (c) *A Diffusionless Transition in a Normal Alkane* **(TU-A7-4)**		11h15
↓	↓	**W.E. Baylis** (c) *Quantum Entanglement, Nonlocality, and Special Relativity* **(TU-A5-5)**	**S. Barhoum** (G*) *NMR Study of Dynamics in Multi-component Macromolecular Solutions* **(TU-A7-5)**		11h30
S. Barmaki (c) *Imaging electron and proton dynamics in molecules with sub-femtosecond laser fields* **(TU-A11-2)**	**V. Golovko** (c) *Monte-Carlo simulation and Calibration of the neutron response of the DEAP-1 Detector* **(TU-A3-6)**	**A. Edery** (c) *Topological Casimir effect and the Proca connection* **(TU-A5-6)**	**R. Brüning** (c) *Polymerization and structure of $(B_2O_3)_{1-x}(H_2O)_x$ glasses and liquids* **(TU-A7-6)**		11h45

Tuesday, June 9 (cont'd)

TIME HEURE	MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR A202 (cap. 133)	MRR D002 (cap. 135)	MRR D102 (cap. 134)
12h00		**C. Harnagea** (c) *Electromechanical properties of isolated type I collagen fibrils* **(TU-A2-7)**	↓		
12h15		**DMBP Business Meeting /** ***Réunion d'affaires DPMB*** (lunch available / dîner *disponible*)	**Session ends /** ***Fin de la session***		
12h30					
13h30	**TU-Plen2** **Plenary session - 2009 NSERC Herzberg Medal Winner** (Chair: S. Page, U. Manitoba) (CAP) **Paul Corkum, NRC / U. Ottawa** *Extreme Nonlinear Optics -- Attosecond-Angstrom Science* **(ends at 14h00)** **Jeanne de Valois, Salle de spectacle** (cap. 410)				

TIME HEURE	MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR A202 (cap. 133)	MRR D002 (cap. 135)
	TU-P6 (DSS-DCMMP / *DSS-DPMCM*) SURFACES AND THIN FILMS / *LES SURFACES ET LES COUCHES MINCES* Chair: T. Sargent U. Toronto	**TU-P3** (DMBP / *DPMB*) CELLULAR BIOPHYSICS / *BIOPHYSIQUE CELLULAIRE* Chair: A. Linhananta Lakehead U.	**TU-P4** (DNP / *DPN*) OPEN QUESTIONS IN HADRONIC PHYSICS / *PROBLÈMES OUVERTS EN PHYSIQUE DES HADRONS* Chair: G. Huber U. Regina	**TU-P1** (DCMMP / *DPMCM*) SEMICONDUCTOR MATERIALS AND DEVICES / *MATÉRIAUX ET DISPOSITIFS DES SEMICONDUCTEURS* Chair: C. Santato École polytechnique
14h15	**SCHEFFLER, Matthias** *Get Real! Ab initio description of materials properties and function -- the example of heterogeneous catalysis* **(TU-P6-1)**	**KATSARAS, John** *Cholesterol Sequestered in a Membrane and Nanoparticles for Imaging and Treating Disease* **(TU-P3-1)**	**LOLOS, George** *Do hybrids, glueballs, and other exotics exist?* **(TU-P4-1)**	**SARGENT, Ted** *Solution-processed wide-spectrum solar cells* **(TU-P1-1)**
14h45	↓	**ZUCKERMANN, Martin** *Synthetic Molecular Motors: Concepts and Numerical Simulations* **(TU-P3-2)**	**ENT, Rolf** *How does QCD transition from the meson-nucleon non-perturbative regime to the quark-gluon perturbative regime?* **(TU-P4-2)**	**J.D. Mason** (G) *A high speed RF-QPC charge detector for time resolved readout applications of spin qubits* **(TU-P1-2)**
15h00	**M. Gallagher** (c) *Self-Assembled Atomic Chains on Ge (100) Surfaces* **(TU-P6-2)**	↓	↓	**A. Sachrajda** (c) *Mitigating Telegraph Noise in Lateral Nano-Devices* **(TU-P1-3)**
15h15	**M.B. Haider** (c) *Room Temperature demonstration of Quantum Cellular Automata formed by Single Si Atom Quantum Dots* **(TU-P6-3)**	**M. Morrow** (c) *Comparison of how ceramide and ceramide-1-phosphate mix with phosphatidylcholines in bilayers* **(TU-P3-3)**	**TROTTIER, Howard** *High-precision lattice QCD confronts experiment* **(TU-P4-3)**	**F. Cicoira** (c) *Conducting polymer transistors for biosensing applications* **(TU-P1-4)**
15h30	**J. Mea** (G) *A novel image processing approach to nucleus identification* **(TU-P6-4)**	**M-P. Nieh** (c) *Detailed Structure of a Magnetically Alignable Phospholipid Mixture - "Bicelles'* **(TU-P3-4)**	↓	**O. Moutanabbir** (c) *Semiconductor stable isotopes in nanoscience* **(TU-P1-5)**
15h45	**A. Slavin** (c) *Modelling the Diffusion of Pb Atoms on the Reconstructed Au(111) Surface using the Surface Embedded-Atom Method* **(TU-P6-5)**	**F. Lin** (c) *Immune Cell Migration Directed by DC Electric Fields* **(TU-P3-5)**	**A. Coppens** (G) *The G0 experiment Parity Violation of Delta photoproduction* **(TU-P4-4)**	**Session ends /** ***Fin de la session***
16h00	**C. Lupien** (c) *Study of the charge density wave of $NbSe_2$ by STM/STS* **(TU-P6-6)**	**Session ends /** ***Fin de la session***	**R. Pywell** (c) *Photonuclear reaction for the Lithium Isotopes* **(TU-P4-5)**	
16h15	**D. Riabinina** (c) *Oxidation of Au nanoparticles under laser irradiation* **(TU-P6-7)** Ends at 16h30 / *Se termine à 16h30*	**Health Break, with refreshments** **MRR Rotunde**		
16h45	**CAP Annual General Meeting - Transformation and Change: A path forward for the CAP** (Chair: S. Page, U. Manitoba) **(ends at 18h00)** **Room MRR R221** (cap. 292)			

19h00	Banquet Reception	Crystal Palace (Ramada Hotel) Moncton
19h30-22h30	Banquet	

Mardi, 9 juin (suite)

MRR D202 (cap. 135)	MG2 147G2 (cap. 108)	MG2 148G2 (cap. 132)	MRR R221 (cap. 292)	OTHER LOCATIONS / *AUTRES ENDROITS*	TIME / HEURE
Session ends / ***Fin de la session***	**T. Pollmann** (G) *Alpha Backgrounds in the DEAP-1 Detector* **(TU-A3-7)**	**Session ends /** ***Fin de la session***	**M. Niknam** (c) *Water in MCM-41: An NMR Study* **(TU-A7-7)**	**JdeV, Salle B219** **Past Presidents' Luncheon /** ***Dîner des ancien(ne)s présidents(e)s*** *Ends at 13h30 / Se termine à 13h30*	12h00
DAMPhi Business Meeting / ***Réunion d'affaires DPAMip*** (lunch available / dîner *disponible*)	**R. Bayes** (G*) *Approaching the Final Results of the TWIST Experiment* **(TU-A3-8)**	**DTP Business Meeting /** ***Réunion d'affaires DPT*** (lunch available / *diner disponible*)	**Session ends /** ***Fin de la session***	**JdeV, Salle B119** **HS Workshop Luncheon /** ***Repas du midi de l'atelier des enseignants du secondaire*** *Session ends at 13h30 / Session se termine à 13h30*	12h15
	PPD Business Meeting / ***Réunion d'affaires PPD*** (lunch available / *diner disponible*)				12h30
TU-Plen2 ***Session plénière - Récipiendaire de la médaille Herzberg 2009 du CRSNG*** (Chair: S. Page, U. Manitoba) (ACP) **Paul Corkum, CRNC / U. d'Ottawa** *Optique non linéaire extrême – science attoseconde-angström* **(se termine à 14h00)** **Jeanne de Valois, Salle de spectacle** (cap. 410)					13h30

MRR D102 (cap. 134)	MRR D202 (cap. 134)	MG1 152G1 (cap. 60)	MRR R221 (cap. 292)	TIME / HEURE
TU-P5 (DAMPhi-DOP / *DPAMip-DOP*) **QUANTUM INFORMATION AND COMPUTING I /** ***INFORMATIQUE ET CALCULS QUANTIQUES I*** Chair: B. Sanders, U. Calgary	**TU-P2** (PPD-DTP / *PPD-DPT*) **ENERGY FRONTIER AND PHENOMENOLOGY /** ***FRONTIÈRE DE L'ÉNERGIE ET PHÉNOMÉNOLOGIE*** Chair: R. MacKenzie, U. de Montréal	**TU-HS-2** (CAP-DPE / *ACP-DEP*) **HIGH SCHOOL TEACHERS' WORKSHOP - P.M. /** ***ATELIER DES ENSEIGNANT(E)S EN PHYSIQUE - APRÈS-MIDI*** Chair: F. Weil, U. de Moncton	**TU-P7** (DPE / *DEP*) **TEACHING WITH TECHNOLOGY AND CURRICULUM DEVELOPMENT /** ***ENSEIGNER AVEC LA TECHNOLOGIE ET DÉVELOPPEMENT DU CURRICULUM*** Chair: P. Mitchler, Kelvin High School	
BLAIS, Alexandre *Quantum information processing with circuit quantum electrodynamics* **(TU-P5-1)**	**DICK, Rainer** *Cross sections for direct Minimal Dark Matter signals* **(TU-P2-1)**	**Session ends at 16h15 - Presentation details will be provided to participants in registration package**	**LEBLANC, Francis** *Stellar astrophysics in undergraduate physics curricula* **(TU-P7-1)**	14h15
C. Erven (G*) *Entangled Quantum Key Distribution with a Biased Basis Choice* **(TU-P5-2)**	**G. Landry** (G*) *A proposal for a new hadron nomenclature* **(TU-P2-2)**	↓	**N. Lasry** (c) *Peer Instruction: The role of discussion, technology and academic setting* **(TU-P7-2)**	14h45
N. Sinclair (G*) *Tm:LiNbO$_3$ waveguides: a novel material candidate for quantum memories* **(TU-P5-3)**	**SANZ, Veronica** *Physics at the LHC* **(TU-P2-3)**	↓	**M.J. Carvalho** (c) *Using Mobile Technology in Physics Labs* **(TU-P7-3)** **WITHDRAWN**	15h00
G. Passante (G*) *Evaluation of the Jones Polynomial using one bit of quantum information: a Liquid State NMR experiment* **(TU-P5-4)**	↓	↓	**BONN, Douglas** *Learning about data and statistics in freshman physics* **(TU-P7-4)**	15h15
O. Landon-Cardinal (G*) *Suppressing decoherence by preparing the environment* **(TU-P5-5)**	**R. Sandapen** (c) *Diffractive Upsilon production at the Tevatron and LHC* **(TU-P2-4)**	↓	↓	15h30
Session ends / ***Fin de la session***	**Session ends /** ***Fin de la session***	↓	**M. Milner-Bolotin** (c) *HP Grants for Tablet Technologies in Science Teaching: From Dream to Innovation (Part I)* **(TU-P7-5)**	15h45
		↓	**T. Antimirova** (c) *HP Mobile Science Lab: Using Tablet PCs for Physics Teaching (Part II)* **(TU-P7-6)**	16h00
Pause-santé, avec goûter **MRR Rotunde**			**DISCUSSION** Session ends at 16h30 / *Fin de la session à 16h30*	16h15
Assemblée générale annuelle de l'ACP - Transformation et changement: l'ACP en marche (Chair: S. Page, U. Manitoba) **(se termine à 18h00)** **Salle MRR R221** (cap. 292)				16h45

19h00	Réception du banquet	Palais Crystal (Hôtel Ramada) Moncton
19h30-22h30	Banquet	

Wednesday, June 10

07h00 (WE-Exec) CAP Executive Meeting (New and Old) - 07h00-08h15 JdeV, Room B125

08h45 **WE-Plen1** **Plenary session** (Chair: M. Butler, St. Mary's U.) (CAP-DNP)

ACHIM SCHWENK, TRIUMF
A tour of neutron matter in the universe

Jeanne de Valois, Salle de spectacle (cap. 410)

09h30 **Health Break, with refreshments** **MRR Rotunde**

TIME HEURE	MRR A002 (cap. 134)	MRR A102 (cap. 134)	MRR D002 (cap. 135)	MRR D102 (cap. 134)
	WE-A6 (PPD / *PPD*) COLLIDER PHYSICS / *PHYSIQUE DES COLLISIONNEURS* Chair: D. O'Neil SFU	**WE-A2** (DAMPhi / *DPAMip*) ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS II / *SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES II* Chair: D. Tokaryk UNB	**WE-A4** (DTP / *DPT*) RELATIVITY / *RELATIVITÉ* Chair: V. Faraoni Bishop's U.	**WE-A1** (CAP / *ACP*) CAP BEST STUDENT PRESENTATIONS FINAL COMPETITION / *COMPÉTITION FINALE DE L'ACP POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES* Chair: L. Marchildon UQTR
10h00	**STELZER, Bernd** *Highlights from the Tevatron* **(WE-A6-1)**	**SHIELL, Ralph** *Heavy Rydberg Systems: Their Properties, Their Formation, and Their Control* **(WE-A2-1)**	**HUSAIN, Viqar** *Critical behavior in quantum gravitational collapse* **(WE-A4-1)**	**tba** (G*) *Student competitor #1 / Compétiteur étudiant #1* **(WE-A1-1)**
10h15	↓	↓	↓	**tba** (G*) *Student competitor #2 / Compétiteur étudiant #2* **(WE-A1-2)**
10h30	**S. Robertson** (c) *Searches for rare non-hadronic B decays with BABAR* **(WE-A6-2)**	**L-H. Xu** (c) *Millimeter Wave and Terahertz Spectra of C-13 Methanol* **(WE-A2-2)**	**FROLOV, Andrei** *Primordial Non-Gaussianity from Preheating* **(WE-A4-2)**	**tba** (G*) *Student competitor #3 / Compétiteur étudiant #3* **(WE-A1-3)**
10h45	**F. Corriveau** (c) *Particle Production with ZEUS at HERA* **(WE-A6-3)**	**R.M. Lees** (c) *IR Spectroscopy at the Canadian Light Source: The Methyl-Rocking and OH-Bending Bands of O-18 Methanol* **(WE-A2-3)**	↓	**tba** (G*) *Student competitor #14/ Compétiteur étudiant #4* **(WE-A1-4)**
11h00	**BENSLAMA, Kamal** *Extra Dimensions, Supersymmetry and the origin of Mass: Exploring the nature of the Universe using the Large Hadron Collider at CERN* **(WE-A6-4)**	**Break / Pause**	**S. Das** (c) *The Generalized Uncertainty Principle and Quantum Gravity Phenomenology* **(WE-A4-3)**	**tba** (G*) *Student competitor #5 / Compétiteur étudiant #5* **(WE-A1-5)**
11h15	↓	**ADAM, Allan** *High Resolution Laser Spectroscopy of Transition Metal Monophosphides and Halides* **(WE-A2-4)**	**B. Tippett** (c) *Violating the Penrose Inequality with Designer Horizons* **(WE-A4-4)**	**tba** (G*) *Student competitor #6 / Compétiteur étudiant #6* **(WE-A1-6)**
11h30	**D. Asner** (c) *Accomplishments of the CLEO/CESR Program* **(WE-A6-5)**	↓	**R. Mann** (c) *Galilean Black Holes and Solitons* **(WE-A4-5)**	**tba** (G*) *Student competitor #7 / Compétiteur étudiant #7* **(WE-A1-7)**
11h45	**C. Hearty** (c) *The SuperB Project* **(WE-A6-6)**	**J. Crouse** (U) *High resolution Fourier transform spectroscopy of pyrazole: a synchrotron-based study conducted at the Canadian Light Source* **(WE-A2-5)**	**S. Seahra** (c) *Braneworld cosmological perturbations* **(WE-A4-6)**	**tba** (G*) *Student competitor #8 / Compétiteur étudiant #8* **(WE-A1-8)**
12h00	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***
12h15				
12h30				**JdeV, Room B125** **Meeting of the CAP Science Policy Committee / *Réunion du Comité de politique scientifique de l'ACP*** (lunch available / *dîner disponible*)

13h30 **WE-Medal-1** **Plenary session - 2009 CAP-CRM Prize Winner** (Chair: R. MacKenzie, U. Montréal) (CAP-CRM)
Session plénière - Récipiendaire de la médaille ACP-CRM 2009

Hong Guo, McGill U.
Quantum transport theory: from atoms to devices **(ends at 14h00)**
Théorie du transport quantique : des atomes aux dispositifs **(se termine à 14h00)**

Jeanne de Valois, Salle de spectacle (cap. 410)

Mercredi, 10 juin

(WE-Exec)	Réunion de l'Exécutif (nouveau et ancien) de l'ACP - 07h00-08h15	JdeV, Salle B125	07h00
WE-Plen1	***Session plénière*** (Chair: M. Butler, St. Mary's U..) **ACHIM SCHWENK, TRIUMF** *Aperçu de la matière neutronique dans l'Univers*	(ACP-DNP) **Jeanne de Valois, Salle de spectacle** (cap. 410)	08h45
	Pause-santé, avec goûter	**MRR Rotunde**	09h30

MRR D202 (cap. 135)	MG2 147G2 (cap. 108)	MG2 148G2 (cap. 132)	MRR R221 (cap. 292)	TIME HEURE
WE-A3 (DMBP / *DPMB*) MEDICAL PHYSICS / *PHYSIQUE MÉDICALE* Chair: D. Fleming, Mount Allison U.	**WE-A5** (DCMMP / *DPMCM*) SYNCHROTRON SCIENCE / *SCIENCE DES SYNCHROTRONS* Chair: L. Kreplak, Dalhousie U.	**WE-A7** (DCMMP / *DPMCM*) MATERIALS FOR SUSTAINABLE ENERGY / *MATÉRIAUX POUR L'ÉNERGIE DURABLE* Chair: I. Hill, Dalhousie U.	**WE-A8** (DMBP-DIMP-DIAP-DOP / *DPMB-DPIM-DPIA-DOP*) BIOPHOTONICS AND APPLIED BIOMEDICAL PHYSICS / *BIOPHOTONIQUE ET PHYSIQUE BIOMÉDICALE APPLIQUÉE* Chair: A. Linhananta, Lakehead U.	
ROBAR, James *Exploring novel x-ray beams for image-guidance in radiation oncology* **(WE-A3-1)**	**SHAM, Tsun-Kong** *Synchrotron radiation spectroscopy and related phenomena in materials research* **(WE-A5-1)**	**DAHN, Jeff** *Experimental and Theoretical studies of the electro-chemical reaction of lithium with amorphous silicon: Understanding the next generation of Li-ion batteries* **(WE-A7-1)**	**WHELAN, William** *Point Radiance Spectroscopy in Turbid Media* **(WE-A8-1)**	10h00
↓	↓	↓	↓	10h15
M. Gherase (c) *Detecting Arsenic and Defining its Micro-distribution in Skin Phantoms* **(WE-A3-2)**	**MUIR, David** *A Soft X-Ray Emission Spectrometer for the REIXS Beamline at the CLS* **(WE-A5-2)**	**KLEIMAN, Rafael** *Silicon-based Multi-Junction Solar Cells* **(WE-A7-2)**	**FENSTER, Aaron** *3D Ultrasound guided minimally invasive therapy and biopsy* **(WE-A8-2)**	10h30
K. Hewitt (c) *Imaging cancerous cells using surface enhanced Raman Spectroscopy* **(WE-A3-3)**	↓	↓	↓	10h45
WHELAN, William *Optoacoustic Detection of Tissue Damage During Thermal Therapy* **(WE-A3-4)**	**R. Gordon** (c) *Natural Dichroism and Momentum-Transfer Dependence in Cubic Systems* **(WE-A5-3)**	**WHITE, Mary-Anne** *Thermoelectric Materials for Power Generation* **(WE-A7-3)**	**REZNIK, Alla** *Avalanche Multiplication in Amorphous Selenium: Physics and Application* **(WE-A8-3)**	11h00
↓	**Session ends / *Fin de la session***	↓	↓	11h15
E. Galiano-Riveros (c) *An analysis of inter-operator registration variability in helical tomotherapy* **(WE-A3-5)**		**M. Reda** (c) *Defect Mediated Hydrogen Sorption in Mechanically Activated Carbon Nano Materials. A Mechanism for the Effect of Impurities on Hydrogen Absorption* **(WE-A7-4)**	**SOWA, Michael** *Photonics Technologies for Vascular Imaging - Tools for Understanding Atherogenesis* **(WE-A8-4)**	11h30
M. Gertner (c) *Molecular Targeted Contrast Agent-Enhanced Ultrasound Imaging for Chronic Inflammation of the Prostate* **(WE-A3-6)**		**Session ends / *Fin de la session***	↓	11h45
J. Frimeth (G) *Determining Accuracy of a DXA Using Phantoms in Bone Densitometry* **(WE-A3-7)**			**M. Campbell** (c) *Optical changes in the eye during normal development and the development of refractive error* **(WE-A8-5)**	12h00
Session ends / *Fin de la session*			**D. Leaist** (c) *Unusual Multicomponent Diffusion Properties of Surfactant Solutions Near Critical Micelle Concentrations* **(WE-A8-6)**	12h15
			Session ends / *Fin de la session*	12h30

We-Medal-2	**Plenary Session - 2009 Industrial and Applied Medal Winner** (Chair: R. Maev, U. Windsor) ***Session plénière - Récipiendaire de la médaille 2009 en physique industrielle et appliquée*** **Andreas Mandelis, U. Toronto** *Diffusion-Wave Diagnostic Techniques in Industrial, Applied and Biomedical Physics: They go where no light has gone before!* **(ends at 14h00)** *Techniques de diagnostic des ondes de diffusion en physique industrielle, appliquée et biomédicale : elles vont là où la lumière n'a jamais pénétré auparavant!* **(se termine à 14h00)**	(*ACP-DPIA*) **MRR R221** (cap. 292)	13h30

Wednesday, June 10 (cont'd / *suite*)

TIME HEURE	MRR A102 (cap. 134)	MRR A202 (cap. 133)	MRR D002 (cap. 135)	MRR D102 (cap. 134)	MRR D202 (cap. 134)
	WE-P4 (DAMPhi-DOP / *DPAMip-DOP*) QUANTUM INFORMATION AND COMPUTING II / *INFORMATIQUE ET CALCULS QUANTIQUES II* Chair: C. Erven IQC / U. Waterloo	**WE-P3** (DNP / *DPN*) HEAVY ION COLLISIONS AND INSTRUMENTATION / *COLLISIONS D'IONS LOURDS ET INSTRUMENTATION* Chair: M. Butler St. Mary's U.	**WE-P2** (PPD / *PPD*) PRECISION FRONTIER / *FRONTIÈRE DE LA PRÉCISION* Chair: C. Hearty UBC	**WE-P1** (DCMMP / *DPMCM*) LOW DIMENSIONAL SYSTEMS / *SYSTÈMES À BASSE DIMENSION* Chair: J. Dahn Dalhousie U.	**WE-P5** (DNP / *DPN*) PREPARING FOR THE NEXT LONG RANGE PLAN FOR SUBATOMIC PHYSICS / *SE PRÉPARER POUR LE PROCHAIN PLAN À LONG TERME POUR LA PHYSIQUE SUBATOMIQUE* Chair: K. Sharma U. Manitoba
14h15	**GHOSE, Shohini** *Relationship between tripartite entanglement and genuine tripartite nonlocality in 3-qubit states* **(WE-P4-1)**	**F. Gagnon-Moisan** (G) *Étude d'un signal de transition de phase dans les noyaux* **(WE-P3-1)**	**IVES, Joss** *Final BNL E949 results on the measurement of the rare decay K+ to π+ ν, $\bar{\nu}$* **(WE-P2-1)**	**VAN ZYL, Brandon** *Novel physics of low-dimensional, ultracold quantum gases* **(WE-P1-1)**	↓
14h30	↓	**J. Gauthier** (G) *Mid-rapidity composition in the ^{36}Ar+^{58}Ni reaction detected by INDRA and further experiments with HERACLES* **(WE-P3-2)**	↓	↓	↓
14h45	**C. La Mela** (c) *Photon-echo based N-path interferometers for precision measurements and quantum communication* **(WE-P4-2)**	**C. Pruneau** (c) *Search for Conical Emission in A+A collisions at RHIC* **(WE-P3-3)**	**MATTISON, Thomas** *A BaBar Retrospective* **(WE-P2-2)**	**R. Mann** (c) *Enhancement of two-electron entanglement in quasi one-dimensional systems* **(WE-P1-2)**	↓
15h00	**E. Saglamyurek** (G) *Spectral tailoring of inhomogeneously broadened absorption profiles using notch-filtered light* **(WE-P4-3)**	**P. Wang** (G) *Zero crossing analysis and its application in toroidal magnetic field mapping* **(WE-P3-4)**	↓	**G. Granger** (c) *Magnetotransport in 2DEG ribbons in InAsP/InP and InGaAs/InP ridge structures fabricated by nanotemplate technology* **(WE-P1-3)**	↓
15h15	**R. Mann** (c) *Speeding up Entanglement Degradation* **(WE-P4-4)**	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**J. Page** (c) *Subwavelength Imaging in Phononic Crystals* **(WE-P1-4)**	↓
15h30	**Session ends / *Fin de la session***			**E. Taylor** (c) *Second sound in a trapped strongly interacting Fermi gas* **(WE-P1-5)**	**Session ends / *Fin de la session***
15h45				**Session ends / *Fin de la session***	
16h00	**WE-Counc** (CAP/ACP) **CAP Council Meeting (New and Old) / *Réunion du conseil (nouveau et ancien) de l'ACP*** **(ends at 17h30 / *se termine à 17h30*)** **Room A232, Jeanne de Valois** (cap. 45)				

Come and visit the Art of Physics exhibition on display at the 2009 Congress. Entry forms for the 2010 competition will be available at the CAP Information Desk (deadline Apr. 15/10). Winning entries will be added to the travelling exhibition.

Venez visiter l'exposition l'<<Art de la Physique>> tenue lors du Congrès 2009. Les formulaires d'inscription pour le concours 2010 seront disponibles au bureau d'information (la date limite est le 15 avril 2010). Les gagnants verront leurs œuvres ajoutées à l'exposition itinérante.

Next CAP Annual Congress
2010 June 7-11
at the University of Toronto, Toronto, ON

Prochain Congrès annuel de l'ACP
7-11 juin 2010
à l'Université de Toronto, Toronto, ON

2009 CONGRESS ORAL SESSION ABSTRACTS
RÉSUMÉS DES SESSIONS ORALES – CONGRÈS 2009

The oral session abstracts presented here are organized by session codes (SU-A1 to WE-P5). Each presentation is cross-referenced in the Author Index (pg. 127). *Les résumés des sessions orales ci-après sont par code (SU-A1 à WE-P5). L'index des auteurs (p. 127) établit des renvois à cette liste de présentations.*

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 2009 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 conjonction avec le Congrès 2009.*

Saturday, June 6 - Samedi, 6 Juin

[SA-Exec] (CAP/*ACP*)
CAP Executive Meeting (Old and New) /
Réunion de l'exécutif (ancien et nouveau) de l'ACP
SATURDAY, JUNE 6 / *SAMEDI, 6 JUIN*
09h30 - 13h30

ROOM / *SALLE* 136 A & B Taillon (cap.16) *Chair: S.A. Page, University of Manitoba*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 **Meeting Ends / *Fin de la la réunion***

[SA-Coun] (CAP/*ACP*)
CAP Council Meeting (Old and New) /
Réunion du conseil (ancien et nouveau) de l'ACP
SATURDAY, JUNE 6 / *SAMEDI, 6 JUIN*
14h00 - 17h30

ROOM / *SALLE* 136 A & B Taillon (cap.40) *Chair: S.A. Page, University of Manitoba*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

17h30 ***Meeting* Ends / *Fin de la réunion***

[SA-CJP] (CJP/*RCP*)
CJP Editorial Board Meeting /
Réunion du comité de rédaction de la Revue canadienne de physique
SATURDAY, JUNE 6 / *SAMEDI, 6 JUIN*
18h30 - 22h00

ROOM / *SALLE* Windjammer Restaurant, Delta Hotel (cap.15) *Chair: M.O. Steinitz, St. Francis Xavier University*

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément.*

22h00 **Session Ends / *Fin de la réunion***

Sunday, June 7 - Dimanche, 7 Juin

[SU-Hd-Chr] (Heads/*Directeurs*)
Meeting of Heads/Chairs of Physics Depts /
Réunion des directeurs de départements de physique
SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*
08h15 - 11h00

ROOM / *SALLE* 136 A & B Taillon (cap.35) *Chair: F. LeBlanc, Université de Moncton*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

11h00 ***Meeting* Ends / *Fin de la réunion***

[SU-CINP-Bd] (DNP/*DPN*) CINP Board of Trustees Breakfast meeting / *Réunion-déjeuner du conseil d'administration de l'ICPN*

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

09h00 - 11h30

ROOM / ***SALLE*** **B218 JdeV (cap.20)**

Chair: K.S. Sharma, University of Manitoba

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

11h30 ***Meeting* Ends / *Fin de la réunion***

[SU-IPP-Bd] (IPP/*IPP*) IPP Board of Trustees Meeting / *Réunion du conseil d'administration de l'IPP*

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

09h00 - 11h30

ROOM / ***SALLE*** **B219 JdeV (cap.20)**

Chair: W. Trischuk, University of Toronto

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

11h30 ***Meeting* Ends / *Fin de la réunion***

[SU-A1] (DCMMP/*DPMCM*) DCMMP Symposium - Facilities for Materials Science / *Symposium DPMCM - Installations pour la science des matériaux*

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

09h15 - 11h30

ROOM / ***SALLE*** **MRR D002 (cap.135)**

Chair: I.G. Hill, Dalhousie University

SU-A1-1 **09h15**

JOHN ROOT, National Research Council

Materials Research at the Canadian Neutron Beam Centre

The NRC's Canadian Neutron Beam Centre (CNBC) is centred at the National Research Universal (NRU) reactor, which has been running at Chalk River Laboratories since 1957. The NRU is a 135 MW, multipurpose source of thermal neutrons, that continues to rank in the top five of research reactors worldwide. The NRC-CNBC operates six neutron instruments, which enable a range of experiments including powder diffraction, stress-scanning, polarized and unpolarized neutron spectroscopy, characterization of nanostructured thin films and interfaces, small-angle scattering and diffraction from aligned or single-crystal materials. Some detailed examples will include fundamental materials research on hydrogen ingress in zirconium alloys, and characterizing the nano-structure of electrochemical oxide growth on titanium. The neutron beam instruments and the CNBC staff comprise a multidisciplinary scientific resource, which enables researchers from physics, chemistry, biosciences, earth sciences, materials science and engineering from over 20 Canadian universities and about 100 foreign institutions to incorporate neutron scattering methods into their research programs. A new full-time neutron reflectometer was recently installed, and work is underway to develop a small-angle scattering capability. These new instruments will strengthen our capability to support research in areas such as polymer chemistry, biochemistry and nano-layered materials, and to develop a community of knowledgeable Canadian researchers in anticipation of acquiring more advanced neutron facilities for materials research in the 21st century.

SU-A1-2 **10h00**

JOSEF HORMES, Canadian Light Source

The Canadian Light Source: The Next Ten Years

On March 31, 1999 the Canadian Foundation for Innovation (CFI) announced a contribution of $56.4M for the building of the Canadian Light Source (CLS) a 3rd generation synchrotron radiation facility in Saskatoon. The $173M project is the largest science project in Canada in 30 years, and one of the largest single CFI grants to date. After the first light was detected in December 2003, the facility was officially opened on October 22, 2004. The core of the facility is a 2.9 GeV storage ring with a characteristic energy for the radiation in the hard X-ray region (~7.5 keV). Today, the performance of the machine and the insertion devices that are used as sources for the radiation are comparable and in some cases better than those of the other leading 3rd generation medium energy SR sources in the world. Together with the machine, seven beamlines were built in Phase I covering the spectral range from the far IR to the hard Xray region with a broad range of experimental techniques such as IR-microscopy, UV-VUV photoelectron spectroscopy, and protein crystallography. These beamlines are fully commissioned and open for general user operation. Phase II beamlines (seven beamlines) are in the final stage of commissioning and are expected to be open for general users in the second part of 2009. Phase III beamlines (an additional seven beamlines) are in the planning phase and will be built over the next 2-3 years. The CLS is a "User Facility" and open for users from all research areas: academia, government and industry. For non proprietary research, access and beam time are based on proposals that are peer reviewed and ranked by a committee of external experts. In 2008 more than 500 scientists used the capabilities of the CLS. For proprietary research projects, there is a "Fee for Service" program and a special group of "industrial scientists" that works closely together with industry to find the best

technique/procedure for solving actual problems and for developing new products. In this talk, the properties of synchrotron radiation in general and, more specifically, those of the CLS will be discussed. The beamlines and techniques that are available either now or early in 2009 will be presented and the potential of these facilities for research will be highlighted by actual examples from various research areas such as gas-phase spectroscopy, surface science, polymer physics, environmental research, material sciences, and bio-physics. Finally, access policy, proposal writing and the possibilities for test experiments will be discussed.

SU-A1-3 **10h45**

ROBERT WOLKOW, University of Alberta

Some highlights from NINT: Controlled Coupling and Occupation of Silicon Atomic Quantum Dots

After a brief over view of some ongoing research at NINT, the focus will turn to new silicon atomic quantum dots. It has been demonstrated that the silicon atom dangling bond (DB) state serves as a quantum dot. Coulomb repulsion causes DBs separated by < 2 nm to exhibit reduced localized charge enabling electron tunnel-coupling of DBs. Scanning tunneling microscopy measurements and theoretical modeling reveal that fabrication geometry of multi-DB assemblies determines net occupation and tunnel-coupling strength among dots. Electron occupation of DB assemblies can be controlled at room temperature. Electrostatic control over charge distribution within assemblies is demonstrated.

Reference: "Controlled Coupling and Occupation of Silicon Atomic Quantum Dots at Room Temperature", M. Baseer Haider, Jason L. Pitters, Gino A. DiLabio, Lucian Livadaru, Josh Y. Mutus and Robert A. Wolkow, *Physical Review Letters* **102**, 046805, 2009

11h30 **Session Ends / *Fin de la session***

[SU-A2] Neutrino Physics / *Physique des neutrinos*

(PPD/*PPD*)

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

09h15 - 11h30

ROOM / *SALLE* MRR A002 (cap.134)

Chair: A.J. Noble, Queen's University

SU-A2-1 **09h15**

THOMAS LINDNER, University of British Columbia

Status of the T2K Experiment †,*

The Tokai-to-Kamioka (T2K) long-baseline neutrino-oscillation experiment will measure neutrino oscillation parameters using an intense neutrino beam produced at the newly constructed J-PARC accelerator in Japan. In order to make precision measurements of muon neutrino disappearance and electron neutrino appearance a new detector complex is being constructed 280m from the production site. This near detector will be used to characterize the profile and composition of the neutrino beam before any oscillations have occurred. We are currently in the final stages of construction of both the neutrino beamline and the near detector, with a view towards first data taking this year. This talk will focus on the exciting current status and future capabilities of T2K, with emphasis on the strong Canadian contribution to the project.

† In collaboration with T2K Canada
* This work is being supported by NSERC, NRC

SU-A2-2 **09h45** **(G)**

Photo-electron Calibration System for the T2K Time Projection Chambers*, **André Gaudin**, *University of Victoria* — Tokai-to-Kamioka (T2K) is a long baseline neutrino oscillation experiment operating between the JPARC accelerator facility and the Super-Kamiokande detector in Japan. To measure the flavour content, energy spectrum, and interaction rates of the initial beam a near detector (ND280) is being constructed which will be located 280 m downstream from the primary production target. An integral component of ND280 is the tracking detector, consisting of two fine grain detectors and three time projection chambers (TPC). The TPCs are designed to measure momenta and charges as well as determine the identity of charged particles produced in the near detector. A UV laser-based photo-electron system that calibrates the TPC electric field, gas gain, and drift velocity has recently been tested at TRIUMF. The design of this system and the initial test results will be discussed.

* This work is being supported by NSERC and TRIUMF

SU-A2-3 **10h00**

Initial Data from the T2K Optical Transition Radiation Detector, **Mark Hartz** [1,2], John Martin [1], Sampa Bhadra [2], Vyacheslav Galymov [2], Patrick de Perio [1], Alysia Marino [1], [1] *University of Toronto*, [2] York University — The neutrinos studied in the T2K long baseline neutrino experiment will be generated by the decay of hadrons produced when a 30 GeV/c^2 proton beam interacts with a graphite target. Measuring the characteristics of the proton beam is necessary to ensure the safety of nearby experimental components and understand the neutrinos produced by the interacting protons. Designed and built by Canadian institutions, the Optical Transition Radiation (OTR) detector will measure properties of the proton beam by imaging transition radiation produced by the protons as they traverse a metallic foil placed immediately upstream of the graphite target. This talk will include a brief introduction to the theory of transition radiation, a discussion of the T2K OTR detector design and implementation and a presentation of initial measurements of the 30 GeV/c^2 proton beam collected in the spring of 2009.

SU-A2-4 **10h15**

Performance of Fine Grained Detector (FGD) designed for Tokai-to-Kamioka (T2K) long-baseline neutrino experiment [*], **Joanna Zalipska** [1], for FGD group (T2K)[2], [1]*University of British Columbia* , [2]University of British Columbia, TRIUMF, University of Victoria, University of Regina — The Fine Grained Detector (FGD) is one of the major Canadian contribution to the Tokai-to-Kamioka (T2K) long-baseline neutrino-oscillation experiment that will start collecting physics data this year in Japan. In order to understand characteristics of the neutrino beam produced by the J-PARC accelerator complex, a sophisticated near detector system (ND280) is being built. ND280 contains a tracking system consisting of two FGDs and three time projection chambers (TPCs) that can provide precise measurements of neutrino interactions. The FGD is a combination of both established scintillation tracker techniques together with a novel photosensor technology, the multi-pixel photon counter (MPPC), that allows an enhancement of the granularity and performance over previous detectors employing similar technologies. This talk will summarize the current status of the FGD with an overview of various laboratory measurements and beam tests performed recently at TRIUMF.

[*] This work is being supported by University of British Columbia

SU-A2-5 **10h30**

ALAIN BELLERIVE, Carleton University

The Final Cut at the Sudbury Neutrino Observatory [*]

The Sudbury Neutrino Observatory (SNO) was a water Cherenkov detector dedicated to investigate elementary particles called neutrinos. It successfully took data between 1999 and 2006. The detector was unique in its use of heavy water as a detection medium, permitting it to make a solar model-independent test of solar neutrino mixing. In fact, SNO conclusively showed that solar neutrinos oscillate on their way from the core of the Sun to the Earth. This groundbreaking observation was made during three independent phases of the experiment. Even if data taking ended, SNO is still in a mode of precise determination of the solar neutrino oscillation parameters because all along SNO had developed several methods to tell charged-current events apart from neutral-current events. This ability is crucial for the final and ultimate data analysis of all the phases. The physics reach of a combined three-phase solar analysis will be reviewed together with results and subtleties about solar neutrino physics.

[*] This work is being supported by NSERC and CRC

SU-A2-6 **11h00**

Scintillator characterization for the SNO+ neutrinoless double beta decay experiment. **Helen O'Keeffe**, Erin O'Sullivan, Mark Chen, Christine Kraus, Shirley Liu, Alex Wright, *Queen's University* — The SNO+ liquid scintillator neutrino experiment will be built in the SNOLAB facility, located approximately 2 km underground in Sudbury, Ontario. The addition of neodymium to the linear alkyl benzene scintillator will allow a search for the elusive neutrinoless double beta decay process, which is the primary focus of our experiment. A detailed understanding of the scintillator is crucial to the success of the experiment and a series of laboratory experiments were designed to this end. A small quantity of SNO+ scintillator was deployed in the SNO detector to enable the study of several important scintillation optical properties directly in the detector. This talk will present results from this experiment and their implications for the SNO+ experiment.

SU-A2-7 **11h15**

Searching for double beta decay with the Enriched Xenon Observatory. **Kevin Graham**, *Carleton University* — The EXO collaboration aims to measure the regular double beta of 136Xe and carry out a sensitive search for neutrinoless double beta decay. Discovery of the neutrinoless decay would provide information on the neutrino mass scale and provide the first measurement of a lepton number violating process. The status of the EXO efforts will be provided including the latest update for the 200 kg liquid phase detector efforts and a summary of gas-phase R&D.

11h30 **Session Ends** / ***Fin de la session***

[SU-A3] (DMBP/*DPMB*) DMBP Best Student Paper Competition I / *Compétition pour les meilleures communications étudiantes DPMB I*

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

10h00 - 11h30

ROOM / *SALLE* **MRR A102 (cap.134)**

Chair: A. Linhananta, Lakehead University

SU-A3-1 **10h00** **(G*)**

Laser Interstitial Thermal Therapy (LITT): Modeling and Dose Evaluation[*]. **Hisham Assi** [1], J. Carl Kumaradas [1], William Whelan [2], [1] *Ryerson University*, [2] Ryerson University and University of Prince Edward Island — Laser Interstitial Thermal Therapy (LITT) is a minimally invasive technique for destroying localized solid tumors. The objective of thermal therapy is to achieve irreversible thermal damage in a targeted tumor region while saving healthy tissues. Thermal damage can be predicted using thermal dose models based on time-temperature information. One model that is heavily utilized is the t43 model which was originally developed for hyperthermia applications (temperatures less than 47 C). The validity and accuracy of this model for high temperature applications (greater than 55 C) is an area of active research. We posit that this existing t43 model over-estimates the accumulation of thermal damage for high temperature treatments such as LITT. Hence, a new thermal dose approach, based on published experimental results, was developed. A finite-element LITT simulation code was developed using the COMSOL Multiphysics® software package (COMSOL AB, Stockholm). This simulator models optical and thermal propagation in tissues during laser heating. The simulator was used to compare the thermal damage volumes predicted by the existing t43 model and our new thermal dose model. Differences in the predicted damage volumes are more pronounced as laser power increases and exposure duration decreases. In addition, the accuracy of the two models was evaluated using surface temperature measurements acquired during laser heating of 24 excised bovine liver samples. The difference between predicted

and actual lesion dimensions for the two models will be presented. This work indicates that the current t43 thermal dose model may not be accurate for high temperature tissue heating applications.

* This work is being supported by an NSERC Discovery Grant held by W. Whelan

SU-A3-2 10h15 (G*)

Waveguide Evanescent Field Fluorescence Microscopy: a novel technique for investigating chemical compounds effects on the cells. **Abdollah Hassanzadeh**, Silvia Mittler, *The University of Western Ontario* — Despite the fact that great advances have been made during the last two decades to quantify physiological activities in cultured cells using optical microscopes, quantification has been difficult. Electrical cell-substrate impedance sensing, ECIS, is a method which detects morphological changes and movements in cultured cells. However, direct observation of the cell-substrate interface is not possible in this technique. In addition, attachment and interaction of any other biological materials can affect the results. Most importantly the system cannot distinguish different biological interactions and cell behaviours, such as motion, spreading and attaching. Direct observation of the dynamic processes in the cell membrane in real time in a natural aqueous environment can provide a new tool for studying cell behaviour on substrates, the bio-surface interaction and the reaction of the cells to different agents and drugs. We introduced 'waveguide evanescent field fluorescence (WEFF) microscopy. It was utilized for visualizing and quantifying cell-substrate distances and solid thin films. Recently, we used WEFF microscopy to investigate the cell-substrate interactions *in vitro* and in real time in the presence of toxic chemical substances. The images of single cell-substrate contact regions and the induced change at the focal and close contact regions by an external toxic and lethal agent in real time in an aqueous medium were monitored and captured. This method can be a new and powerful way to investigate and quantify the dynamics of biological interface phenomena in vitro and has potential as an alternative to animal testing for toxicology studies.

SU-A3-3 10h30 (G*)

Effect of Glycophorin-A Dimerization Motif Position on Transmembrane Polypeptide Orientation in Multilamellar Vesicles*, **Mark McDonald**, Michael Morrow, *Memorial University of Newfoundland* — Deuterium nuclear magnetic resonance spectroscopy was used to study synthetic, single-pass transmembrane polypeptides in 1-palmitoyl-2-oleoyl-*sn*-glycero-3-phosphatidylcholine (POPC) multilamelar vesicles. The polypeptides consisted of a glycophorin A (GpA) dimerization motif incorporated into a poly-alanine-leucine helix terminated with lysine residues. Polypeptides were labelled on selected alanine residues. The orientation of the dimerization motif about the helix axis, relative to the lysine terminal residues, has been varied synthetically to investigate the effect of motif location on peptide orientation, dynamics, and aggregation. Quadrupole splittings and echo decay measurements indicate that the correlation time for fast, axially-symmetric polypeptide orientation about the bilayer normal is ~100ns and that peptides with the dimerization motif adopt a preferred average azimuthal orientation about the helix axis, in agreement with previous studies. Polypeptide orientation does appear to be sensitive to motif location within the polypeptide. This may be a result of motif-induced peptide-peptide interaction or a result of interaction between motif residues and surrounding lipids.

* This work is being supported by NSERC

SU-A3-4 10h45 (G*)

Second harmonic generation microscopy reveals dynamics in contracting and non-contracting muscle cells*, **Nicole Prent** [1], Catherine Greenhalgh [2], Richard Cisek [2], Arkady Major [3], Bryan Stewart [2], Virginijus Barzda [2], [1] *University of Toronto Mississauga*, [2] University of Toronto, [3] University of Manitoba — Second harmonic generation (SHG) microscopy favourably lends itself to investigations of contraction dynamics of striated myocytes, due to their inherent nonlinear optical properties and the ability to noninvasively image for prolonged periods of time with negligible tissue damage. Structurally, striated muscle cells contain longitudinal myofibrils which are mainly made up of myosin and actin filaments. The fundamental unit of the myofibril is called the sarcomere, which are made up of two main regions coined the isotropic (I-) band and anisotropic (A-) band. Myocytes efficiently generate second harmonic radiation from the intrinsic semi-crystalline arrangement of myosin molecules in the A-bands. Since the I-bands do not generate SHG, the alternating bands can be clearly visualized and individual sarcomere dynamics of myocytes can be investigated. Interestingly both contracting and non-contracting samples exhibit fluctuations in their sarcomere lengths. The dynamics of interactions between neighbouring sarcomeres is investigated to understand the principles of contractility. In addition, the SHG intensity is positively correlated to sarcomere length. During elongation, increased force is applied on the myosin filament, which effectively alters the arrangement of the myosin molecules in such a way that the central region loses its symmetry. This is supported by forced stretching experiments that showed the intensity increasing with elongation. These results lead to the development of SHG based muscle cell diagnostic tools, such as, determining heart muscle irregularities during surgery or investigating various muscle disorders.

* This work is being supported by NSERC, OCE, CFI

SU-A3-5 11h00 (U*)

On cellular effects of moderate intensity static magnetic fields*, **Melissa Radey** [1], Robert Lafrenie [2], Carly Buckner [1], Allison Buckner [1], [1] *Laurentian University*, [2] Sudbury Regional Cancer Center — Studies have shown that moderate intensity static magnetic fields (SMF) have effects on biological processes. Our work examines cells as aggregates of matter governed by complex processes that are subject to external forces and torques. More specifically, the application of a moderate intensity SMF will induce forces or torques on different structures of the cell, which may result in altered physiology. Some analytical tools are borrowed from molecular biology in order to quantify the effects. Cells are exposed to an SMF for 1 to 4 hours a day over the course of five days and results are compared to sham exposed cells. Cell proliferation work was done on B16-BL6, an aggressive murine melanoma cell line. The number of viable cells was measured following each exposure using a Trypan blue dye exclusion technique. No significant reduction or increase in cell proliferation was found under specified experiment conditions. Activation of two cell signalling pathways was measured using Western blot analysis to measure specific protein levels in the cells. The SMF was found to activate MAPK, a growth pathway as well as PKC, a differentiation pathway in the B16-BL6 cell line. Finally, the orientation of cells was explored for the same cell line as well as MRC-5, human fibroblasts.

* This work is being supported by Sudbury Regional Cancer Center

SU-A3-6 **11h15** **(G*)**

Correlation of Myelin Content to Quantitative Magnetic Resonance Imaging Parameters Using a Cuprizone Mouse Model of Demyelination*,
Jonathan Thiessen [1], Yanbo Zhang [2], Handi Zhang [2], Lingyan Wang [2], Richard Buist [3], Jiming Kong [4], Xin-Min Li [2], Melanie Martin [5], [1] *Physics and Astronomy, University of Manitoba* , [2] Psychiatry, University of Manitoba, [3] Radiology, University of Manitoba, [4] Human Anatomy and Cell Science, University of Manitoba, [5] Physics, Universities of Manitoba & Winnipeg — Myelinated axons transfer information between centres within the central nervous system (CNS). Demyelination, a hallmark of neurodegenerative autoimmune diseases such as multiple sclerosis (MS), can cause nerve damage and degrade signal propagation. Magnetic resonance imaging (MRI) methods capable of quantifying the presence of myelin can improve both the diagnosis and understanding of white matter diseases such as MS. Healthy and cuprizone-fed mice (a toxic model of demyelination) were imaged *in vivo* and *ex vivo* after 4- and 6-weeks of feeding. Three MRI methods were used: T_2-weighted imaging (RARE, 3 slices, 12 averages, (2.5 cm)^2 FOV, 98x98x750 μm^3 resolution, effective T_E 80ms, T_R 1640ms, RARE factor 8, acquisition time 10m), magnetization transfer imaging (FLASH, proton density and MT contrast images acquired with 3 slices, 48 averages, (2.5 cm)^2 FOV, 98x98x750 μm^3 resolution, T_E 6 ms, T_R 70 ms, acquisition time 2x14m; MT image acquired with a 10.25ms, 10μT, 6000Hz off-resonance Gaussian MT saturation pulse), and diffusion tensor imaging (PGSE, tetraorthogonal gradient-encoding scheme, 2 b-values: 300 and 800 s/mm^2, 10 slices, 2 averages, (2 cm)^2 FOV, 156x156x500 μm^3 resolution, T_E 28ms, T_R 5000ms, acquisition time 5h20m). All three MRI methods demonstrated changes in contrast and quantitative metrics in the cuprizone-fed mouse model of demyelination. Demyelination was further verified with Luxol fast blue staining and electron microscopy. This study lays the groundwork for correlating myelin-sensitive T_2-weighted and MTI methods with axonal geometry-sensitive DTI metrics. Ultimately, a hybrid MRI approach could be an important diagnostic method for measuring myelin content in the CNS.

* This work is being supported by NSERC, CFI, and the Manitoba Research and Infrastructure Fund

11h30 **Session Ends / *Fin de la session***

[SU-NSERC-LUNCH] (CAP-NSERC / *ACP-CRSNG*)

Lunch and Discussion with Isabelle Blain from NSERC / *Dîner et discussion avec Isabelle Blain du CRSNG*

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

11h45 - 13h30

ROOM / *SALLE* JdeV (cap.292)

Chair: S.A. Page, University of Manitoba

SU-NSERC-LUNCH-1 **11h45**

ISABELLE BLAIN, NSERC

Update from NSERC / Mise à jour par le CRSNG

NSERC will provide an update on various activities, particularly the progress in implementing the recommendations of the International Review of the Discovery Grants Program and the Grant Selection Committee Structure Review. This forum will also be an opportunity to engage in a discussion on the Canadian physics community's emerging and priority issues. *Le CRSNG fera le point sur diverses activités, notamment les progrès accomplis dans la mise en œuvre des recommandations de l'examen international du Programme de subventions à la découverte et de l'examen de la structure des Comités de sélection des subventions. Ce forum sera aussi l'occasion d'entamer une discussion portant sur les nouveaux défis auxquels fait face la collectivité canadienne de physique ainsi que les priorités de cette dernière.*

13h30 **Session Ends / *Fin de la session***

[SU-Plen1] (CAP-DCMMP / *ACP-DPMCM*)

Plenary - Michel Gingras, U.Waterloo (CAP Brockhouse Medal) / *Plénière - Michel Gingras, U. Waterloo (Médaille Brockhouse de l'ACP)*

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

13h30 - 14h00

ROOM / *SALLE* JdeV (cap.292)

Chair: H. Guo, McGill University

SU-Plen1-1 **13h30**

MICHEL GINGRAS, University of Waterloo

Exotic Collective Phenomena in Geometrically and Randomly Frustrated Rare-Earth Magnetic Systems *

Magnetic materials and theoretical models of magnetic systems have long afforded physicists with some of the best test benches to study collective phenomena in nature. The 1987 discovery of high-temperature superconductivity in copper oxide materials generated an impetus for the search of exotic and intrinsically quantum mechanical ground states in magnetic systems. In this context, both on theoretical and experimental fronts, "frustration" has been the most popular microscopic mechanism considered to induce large quantum spin fluctuations in quasi-two and three dimensional settings. Geometric frustration arises when a magnetic system cannot minimize its total classical ground state energy by minimizing the energy of its pairwise interactions, pair by pair. Over the past twenty years, a large number of insulating and metallic geometrically frustrated oxide materials that comprise rare-earth ions carrying localized magnetic moments have

been found to display a plethora of highly interesting phenomena. Just to name a few, examples include spin liquid, spin ice, spin glass, antiglass, long range order, hidden order, random field effects and quenched quantum criticality, field and pressure induced quantum phase transitions, anomalous Hall effect, Kondo-like behavior, persistent low-temperature spin dynamics and topological phase transitions. Most of these phenomena were first discovered by experimentalists and provided a number of exciting theoretical challenges, many having yet to be resolved. In this talk, I shall briefly review some of these fascinating phenomena, emphasizing the contributions made by Canadian researchers at the University of British Columbia and TRIUMF, McMaster University and the University of Waterloo.

* This work is being supported by NSERC, CRC, CIFAR, CFI, OIT, MMO

14h00 **Session Ends** / ***Fin de la session***

[SU-CINP-Gen] CINP Annual General Meeting / *Assemblée générale annuelle de l'ICPN*

(DNP/*DPN*)

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

14h15 - 15h45

ROOM / *SALLE* **MRR A202 (cap.133)**

Chair: K.S. Sharma, University of Manitoba

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

15h45 ***Meeting* Ends** / ***Fin de la réunion***

[SU-IPP-Gen] IPP Annual General Meeting / *Assemblée générale annuelle de l'IPP*

(IPP/*IPP*)

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

14h15 - 15h45

ROOM / *SALLE* **MRR D202 (cap.135)**

Chair: W. Trischuk, University of Toronto

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

15h45 ***Meeting* Ends** / ***Fin de la réunion***

[SU-P1] Controlled Fusion Plasmas and Basic Plasma Physics / *Physique des plasmas de base et plasmas en fusion controlée*

(DPP/*DPP*)

SUNDAY, JUNE 7 / ***DIMANCHE, 7 JUIN***

14h15 - 16h45

ROOM / *SALLE* **MRR D102 (cap.134)**

Chair: J.E. Morelli, Queen's University

SU-P1-1 **14h15**

CHIJIN XIAO, University of Saskatchewan

Design Features of the STOR-U Tokamak †,*

In the Plasma Physics Laboratory (PPL) at the University of Saskatchewan, the STOR-U tokamak is being designed to take the magnetic fusion energy research activities in Canada to a new level. The major and minor diameters of the STOR-U tokamak will be 80 cm and 36 cm respectively. The aspect ratio is A=2.2, an optimal choice for an efficient fusion reactor. The system will be equipped with two 1.5-MW neutral beam injectors for plasma heating and a suite of diagnostics equipments. The research program is oriented to reactor relevant tokamak physics and engineering studies including high beta plasma physics, coaxial helicity injection for current start-up, liquid lithium divertor for studies of new first-wall materials, and compact torus injection for development of an efficient fuel delivery system. The STOR-U will serve as a major domestic magnetic fusion research facility for training future Canadian fusion reactor experts and for collaboration with leading international fusion researchers. The STOR-U program has been endorsed by ITER. Researchers from more than ten domestic and international (China, Japan, Russia, and USA) institutions have contributed to the development of STOR-U proposal submitted to CFI and to the Saskatchewan government through the University of Saskatchewan.

† In collaboration with Akira Hirose, Mykola Dreval, University of Saskatchewan
* This work is being supported by NSERC and CRC program

SU-P1-2 **14h45**

DAMIAN ROHRAFF, University of Saskatchewan

STOR-M tokamak diagnostics for plasma edge and SOL regions †,*

The fusion research and tokamak plasma physics understanding depend on adequate plasma parameters measurements, determining by plasma diagnostics. The selection and design of some diagnostics equipment for the new STOR-U tokamak will draw upon past experience with the STOR-M tokamak. Extensive studies

of edge and SOL physics performed in STOR-M have exploited various diagnostics, including Langmuir probe array, Gundestrup probe, and H_α spectroscopy. All terms of the radial force balance equation except for the ion pressure gradient has been measured in the STOR-M tokamak [1]. It is necessary to obtain measurements of the ion pressure gradient in order to adequately understand the edge and SOL physics. Retarding Field Energy Analyzers (RFA) is considered one of the most reliable diagnostics for ion temperature measurements in the edge region of fusion devices. RFA diagnostics have been recently developed and successfully tested in the STOR-M tokamak.

1. M. Dreval, C. Xiao, D. Trembach, A. Hirose, S. Elgriw, A. Pant, D. Rohraff and T. Niu , *Plasma Phys. Control. Fusion* **50** 095014 (2008)

† In collaboration with Chijin Xiao, Akira Hirose, Sayf Gamudi Elgriw, Mykola Dreval, Andre Pant, Dazhi Liu, University of Saskatchewan
* This work is being supported by Natural Sciences and Engineering Research Council (NSERC) of Canada and the Canada Research Chair (CRC) Program

15h15 Coffee Break / *Pause Café*

SU-P1-3 15h45 (U*)

Design of a Neutral Beam Injector for STOR-U, **Sam Posen**, Jordan Morelli, *Queen's University* — An estimate was made of appropriate parameters for the neutral beam injector (NBI) system that will provide auxiliary heating for the STOR-U tokamak. Having considered the effects of the beam on the tokamak plasma and extrapolated from data collected about NBIs built for previous tokamaks, 2MW of heating power provided by neutralized H^+ ions with energy between 20 and 100keV was chosen. It was determined that the gas pressure in the neutralizer should be high enough that an equilibrium charge state fraction can be achieved in a reasonable distance, but as low as possible to avoid heating due to stripping, which restricts the neutralizer to be at least 0.3m long in this energy range. Beamline losses were evaluated to determine a required ion source current of ~60A. Of the ion sources that fit the constraints, magnetic multipole ion sources were found to perform best under the criteria of uniformity, monatomic fraction, and noise, but modified DuoPIGatron sources were found be satisfactory for STOR-U, and it was recommended that a used DuoPIGatron source be sought to save money. The chosen accelerator design was three grids, curved for focusing. Comparable grid designs from previous NBIs were used to estimate divergence, and it was found that the beam will become larger than the calculated maximum port size after ~5m. The parameters found were within an order of magnitude of those chosen by the STOR-U team: 3MW and 40keV. However, the ion source will have to be larger than predicted, capable of producing ~80A.

SU-P1-4 16h00

Electroluminescent Devices Fabricated from Plasma-Ion-Implanted Silicon*, **Michael Bradley**, *University of Saskatchewan* — We have recently demonstrated electroluminescent semiconductor light-emitting-diodes (LEDs) fabricated from plasma-ion-implanted silicon. This is remarkable given that the indirect bandstructure of silicon is expected to prevent significant photon emission from silicon devices, and indeed non-implanted devices do not exhibit any electroluminescence. We have modelled this light emission process and have gained some clues as to its origin. This talk will discuss the role of plasma ion implantation in forming luminescent centers and discuss the physics of these centers and the resulting LED devices based on our recent data.

* This work is being supported by NSERC, CFI

16h15 Discussion Break / *Pause de Discussion*

16h45 Session Ends / *Fin de la session*

[SU-P2] (DHP/*DHP*) Centenaries on the 9's / *Centenaires sur les 9's*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*
14h15 - 16h45

ROOM / *SALLE* MRR A002 (cap.134) *Chair: W.F. Davidson, National Research Council*

SU-P2-1 14h15

ROBERT (ROBIN) CONNOR, University of Manitoba

The August 1909 meeting of the BAAS in Winnipeg at the University of Manitoba

The fledgling University of Manitoba, with its six science professors only appointed in 1904, (through the generosity of Lord Strathcona, the railway magnate) and with the university having but one 3 - storied building to its name (1900), may appear an unlikely recipient of the annual meeting of so prestigious a body. The idea came from the Royal Society of Canada and no time was lost in inviting the group which was accepted at the 1906 meeting in York. Immediately all arrangements went into high gear. Every hotel was booked and rooms in private houses arranged for. The President was to be Sir J.J. Thomson with Ernest Rutherford as chair of the Physics and Mathematics section. Other sections had equally prestigious chairs and in attendance were Lord Rayleigh, Profs. Helmholtz, Roentgen and Millikan, Otto Hahn and J. H. Poynting. Lectures were given wherever there was space, theatres, classrooms, the law courts, etc. The total attendance was 1468, more than Toronto's 1362 (in 1897) but less than Montreal's 1777 (in 1884). Winnipeg's hospitality was everywhere in evidence, with dinners, banquets and receptions. As Sir J.J. Thomson told the press, "This has been the most successful meeting in the history of the Association."

SU-P2-2 14h45

PAUL PENNA, NRC Institute for Aerospace Research

Alexander Graham Bell, Baddeck and Thin Airfoils

On February 23, 1909, a biplane constructed of wood, light fabric and tensioned wires made the first heavier-than-air powered flight in the British Empire from the ice-covered surface of Baddeck Bay in Nova Scotia. That aircraft was known as the Silver Dart and it was piloted by J.A.D. McCurdy, a member of Alexander

Graham Bell's Aerial Experiment Association, founded in 1907. How is it that, slightly more than five years after the Wright Brothers made their pioneering powered flight at Kitty Hawk in the USA (December 1903), the first powered flight in the British Empire took place at Baddeck, Nova Scotia? This presentation will answer not only the historical "how?" but also the technical "how?" by providing a short summary of Alexander Graham Bell's research into aeronautics and by showing how the extremely thin airfoils of the early aviation experimenters were capable of producing the aerodynamic lift (and relatively low drag) required to achieve successful heavier-than-air, controlled flight.

15h15 Coffee Break / *Pause Café*

SU-P2-3 15h45

The early days of the McGill Physics Department, **Jean Barrette**, *McGill University* — The teaching of physics at McGill University dates from 1854, when the Department of Mathematics and Natural Philosophy was set up within the Faculty of Arts. In 1889, it was decided to split the Department into separate units of Mathematics (including Mathematical Physics) and Experimental Physics, and two years later the first Chair of Experimental Physics was endowed by Sir William Macdonald. John Cox, MA, a Fellow of Trinity College, Cambridge, was appointed to this post. A second Chair of Natural Philosophy was created in 1894 and this post was filled by Hugh L. Callendar who left in 1907 and was replaced by Ernest Rutherford in 1908. When Macdonald endowed the Chair of Experimental Physics in 1891 he also provided funds for erecting and equipping a Physics building that was formally opened on February 24, 1893. The building was considered to be one of the finest of its kind in North America. The Department grew slowly but with considerable fluctuations and was comprised of only eight members (professors, lecturers, and demonstrators) at the beginning of the First World War. Besides the well known work on radioactivity led by Rutherford, the staff of the Department had many other interests including precision measurements of physical quantities, ice research, the scattering and absorption of light in gaseous media, etc. This presentation will discuss this early period, in particular some of the research activities carried on at the time.

SU-P2-4 16h15

DANIEL KLEPPNER, Dept. of Physics, MIT, and MIT-Harvard Center for Ultracold Atoms

The Fabulous Life of Albert A. Michelson

A.A. Michelson is remembered primarily for the Michelson-Morley experiment, though he himself regarded the experiment as a serious failure. Raised in a California mining camp, he was a prodigy in experimental physics. Largely self-educated in research, and working in the age of iron and steam, he founded the field of precision measurements, created the first natural physical standard by measuring the meter in terms of the wavelength of an atom, invented Fourier transform spectroscopy, provided the first experimental confirmation of Maxwell's kinetic theory, provided vital data for Lorentz's theory of the electron, made the first measurement of the diameter of a star, and became the United States' first Nobel Laureate. In spite of these successes, however, he never fully recovered from his belief that the Michelson-Morley experiment failed.

16h45 Session Ends / *Fin de la session*

[SU-P3] (DTP/*DPT*) Best Student Paper Competition - DTP / *Compétition pour la meilleure communication étudiante - DPT*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

14h15 - 16h30

ROOM / *SALLE* MRR A102 (cap.134) *Chair: R. Dick, University of Saskatchewan*

SU-P3-1 14h15 (G*)

Phase Transitions and Magnetoelectric Coupling in the Spiral Multiferroic $TbMnO_3$: A Group Theoretical Approach*, **Arash Alam-Samimi**, S.H. Curnoe, *Memorial University of Newfoundland* — The spiral multiferroic $TbMnO_3$ is an orthorhombically distorted perovskite (space group *Pbnm*) in which a magnetic transition into a transverse incommensurate spiral spin structure leads to ferroelectricity below $T_c \approx 28$ K. Phase transitions and magnetoelectric coupling in $TbMnO_3$ are studied using group theory, as follows: First, we study the magnetic and ferroelectric transitions by considering the symmetry breaking associated with each transition. Second, we write the exchange interactions for the Mn magnetic ions in terms of the magnetic order parameters which are associated with various irreducible representations of the magnetic space group. Third, we use symmetry analysis to introduce a spin-displacement term which couples the magnetic order and the polarization in the ferroelectric phase. It is also shown that the coupling terms between the order parameters favor competing interactions which describe the spiral spin structure. Our group theoretical approach is capable of describing the phenomenology of $TbMnO_3$ in the most general way and can be applied to other spiral multiferroics.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada

SU-P3-2 14h30 (G*)

On the commutator of hermitian operators and the angle of rotation of their eigenvector bases*, **Ryan Arseneault**, Normand Beaudoin, *Université de Moncton* — The Hilbert vector spaces are the general background of quantum theory. Vectors and operators defined in these spaces are usually represented in some basis in order to perform calculations. Incidentally, there are many possible bases in any vector space. We are interested in studying eigenvector bases (or eigenbases) constructed from hermitian operators (encountered in quantum mechanics). Since these bases are linked by a unitary transformation, we can associate the passage of one basis to another as a rotation of a certain angle around a pivot vector in the vector space. We will then study the link between this rotation of eigenbases and the commutator of their operators. Specifically, we will study the coordinate and the momentum operators X and P.

* This work is being supported by NSERC, FESR and Université de Moncton

SU-P3-3 14h45 (G*)

The cosmological constant as 'dark energy'*, **Daryl Janzen**, Rainer Dick, *University of Saskatchewan* — In the past decade observational cosmology has presented us with a picture of our Universe which is not yet understood conceptually. Every viable model used to measured the expansion dynamics of the cosmos is at least consistent with an energy component with present equation of state $p_X=-\rho_X$, and type Ia supernova and CMB anisotropy measurements have shown that this 'dark energy' is in fact required with greater than 99% confidence. In addition, this dark energy is most likely a cosmological constant. I will therefore argue for a purely geometrical interpretation of the cosmological constant, which has a more natural interpretation than the formally equivalent dark energy, but provides an alternate perspective for the observed accelerated expansion of the Universe.

* This work is being supported by NSERC

SU-P3-4 15h00 (G*)

Dynamical p-Branes in *D*-Dimensional Supergravity*, **Allan Bayntun** [1], Andrew Tolley [2], Cliff Burgess [3], [1] *McMaster University*, [2] Perimeter Institute, [3] McMaster University/Perimeter Institute — We provide a prescription for finding special time-dependent solutions of *p*-branes in a general *D*-dimensional supergravity. While static brane solutions have been studied extensively [1], very little is known about time-dependent solutions. The inherent scaling symmetry in the supergravity equations of motion are exploited to find a power-law time dependence of the surrounding space-time. Various conditions are then found for the radial profile of these branes, giving solutions that are generically not asymptotically flat at any fixed time t_0. In fact, the radial profiles are also a power-law at large distances directly related to the exponent of time. Consequences of this may then be explored in the context of brane-world inflation, and possibly cosmologies in general.

1. K.S. Stelle, *"Lectures on Supergravity p-Branes"*, arXiv:hep-th/9701088v3

* This work is being supported by NSERC and the Philomathia Foundation

15h15 Coffee Break / *Pause Café*

SU-P3-5 15h30 (G*)

Quantum Tunnelling of a Molecule with a Single Bound State*, **Jeremy J. Kavka**, Mark R.A. Shegelski, *University of Northern British Columbia* — We investigate, in one spatial dimension, the quantum mechanical tunnelling of a homogeneous, diatomic molecule incident upon a delta potential barrier. The binding potential of the molecule is selected such that the molecule has a single bound state, whose binding strength is progressively weakened. In this way, the reflection and transmission amplitudes of increasingly weakly bound molecules are calculated. Both time-independent and time-dependent tunnelling are investigated, using both analytical and numerical methods. In the time-independent case, we use Green=s functions methods to derive a formal solution for the molecule=s wavefunction, assuming a double square well binding potential with a continuum of unbound states. We then numerically calculate the probabilities of reflection and transmission, in either a bound or an unbound state, using an elegant technique known as the method of variable reflection and transmission amplitudes. In the time-dependent case, we consider a molecule with discrete unbound states. We model the molecular wavefuntion as a Gaussian wavepacket, and calculate the propagation of the molecule numerically using Crank-Nicholson integration. The probabilities of reflection and transmission are then calculated directly from the wavefunction.

* This work is supported by the National Science and Engineering Research Council of Canada's Alexander Graham Bell Canada Graduate Scholarship (Formerly Postgraduate Scholarship), class M.

SU-P3-6 15h45 (G*)

Decoherence of a quantum reference frame*, **Olivier Landon-Cardinal**, *Université de Montréal* — A quantum reference frame is a quantum state that can be used as a valuable physical resource by allowing the measurement of relational observables on other systems. In a theory restricted by a superselection rule, *e.g.* lacking a reference direction in space, those measurements would otherwise be impossible to perform. One important question is to quantify the longevity of the reference, *i.e.* how many times it can be used before producing unreliable measurements. This question is answered by studying the dynamics of the quantum reference frame. Poulin and Yard have shown that a quantum gyroscope prepared in a coherent state would evolve semi-classically and be useful to measure spin-½ particles along a direction. Here, we push the analysis further by focusing on the decoherence of the reference. We demonstrate that their model is equivalent to another physically motivated model where the quantum reference interacts with several spin-½ particles, one after the other, through a Heisenberg interaction. Techniques used to establish this result could be used for interaction with spins of higher order. We also show that a superposition of two coherent states will decohere into a statistical mixture of those two states. Preliminary results indicate that these coherent states minimize purity loss. Thus, the decoherence of such a quantum reference exhibits an interesting transition between quantum and semi-classical behaviour.

* This work is being supported by CRSNG/NSERC

SU-P3-7 16h00 (G*)

Supergravity on an Atiyah-Hitchin Base*, **Sean Stotyn**, Robert Mann, *University of Waterloo* — Higher dimensional supergravity solutions continue to receive a lot of attention because such solutions describe low-energy supersymmetry-preserving states of string theories. Gauntlett et al. have set forth a prescription for constructing minimal supergravity solutions in 5d using a hyper-Kaehler metric as a base space and performing a fibration over time. In this talk I will discuss the solution generated when one considers the Atiyah-Hitchin metric as the base, radically dependent metric functions and an appropriate ansatz for the 1-form connection. By examining the behaviour of null geodesics I will show that the solution typically exhibits a velocity of light surface (VLS) which the null geodesics are unable to cross and inside of which closed timelike curves (CTC's) exist. In looking at curvature invariants, such solutions generically contain curvature singularities hidden inside the VLS. I will show that the spacetime exterior to the VLS is CTC-free, geodesically complete and asymptotically a twisted U(1) fibration over 4d Minkowski spacetime. As such this solution may possess a well-defined holographic dual despite the CTC's present in the bulk.

* This work is being supported by NSERC

SU-P3-8 **16h15** **(G*)**

Transformation properties and symmetry behaviour of ELKO spinors*, **Kai Erik Wunderle**, Rainer Dick, *University of Saskatchewan* — We review the transformation properties of ELKO spinors under charge conjugation, parity and time reversal. Our calculations confirm that ELKO spinors are not eigenspinors of the parity operator and satisfy $(CPT)^2 = -1$ which identifies them as representation of a nonstandard Wigner class. However, we find that ELKO spinors transform symmetrically under parity instead of the previously assumed asymmetry. Furthermore, we demonstrate that ELKO spinors transform asymmetrically under time reversal which is opposite to the previously reported symmetric behaviour. These changes affect the (anti)commutation relations that are satisfied by the operators acting on ELKO spinors. We are also able to show that ELKO spinors actually satisfy the same (anti)commutation relations as Dirac spinors, even though they belong to two different representations.

* This work is being supported by NSERC

16h30 **Session Ends / *Fin de la session***

[SU-P4] (DPE/*DEP*) Education Workshop / *Atelier sur l'enseignement*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

14h15 - 16h45

ROOM / *SALLE* MRR D002 (cap.135) *Chair: R. Hawkes, Mount Allison University*

SU-P4-1 **14h15**

Introduction to Video-Based Motion Analysis*, **Tetyana Antimirova**, Marina Milner-Bolotin, *Ryerson University* — Video-Based Motion Analysis has become a valuable tool in teaching topics on motion. It can be used effectively for both in-class and homework activities. In Video-Based Motion Analysis, the experiments or real-life events involving motion (roller-coaster rides, car race, sports events, objects falling, etc.) are recorded on short digital video clips and later uploaded on a computer and analyzed using Logger Pro or other similar data acquisition/analysis software. The software allows to obtain the motion data (time and position) from each time frame. This workshop will introduce the participants to the basics of Video-Based Motion Analysis. The examples of recording and analysis of short video clips will be demonstrated.

* This work is being supported by FEAS, Ryerson University

14h30 **Discussion Break / *Pause de Discussion***

SU-P4-2 **14h45**

Clickers beyond the First Year*, **Marina Milner-Bolotin**, Tetyana Antimirova, *Ryerson University* — The participants of the workshop will have an opportunity to experience and discuss the use of the electronic response system (clickers) in the physics courses beyond the introductory level. At Ryerson University, we started using clickers in our second year Modern Physics and third year Electricity and Magnetism courses. The impact of the clicker-enhanced pedagogy on student physics learning and their course interest and engagement will be discussed. We will also shed some light on the students' attitudes toward using clickers in upper level courses and the challenges faced by the students and the instructors. The workshops participants will brainstorm possible ways of addressing these challenges and incorporating clickers effectively in their courses.

* This work is being supported by eInstruction

15h00 **Discussion Break / *Pause de Discussion***

15h15 **Coffee Break / *Pause Café***

SU-P4-3 **15h30**

Labatorials - a step towards concept-based instruction using blended learning, **Daria Ahrensmeier**, J.M.K.C. Donev, R.B. Hicks, A. Louro, R. Stafford, L. Borvayeh, R.I. Thompson, *University of Calgary* — Large first year service courses in physics are rarely successful in achieving their stated goals. Students are not internalizing basic physics concepts and are often frustrated by the learning process, leaving the course without an appreciation of physics. In order to improve the student learning experience as well as their understanding of physics, the Department of Physics and Astronomy at the University of Calgary has started to remodel the small group learning sessions of its large, multi-section first-year courses into "labatorials". These weekly units are being designed to teach one or two specific concepts and are strongly linked to the content of the lectures. They employ a broad range of available technologies and techniques including experimental mini-labs, demonstrations, computer simulations, conceptual questions, and calculation problems. The design concept of the labatorials will be illustrated with examples, and the differences to traditional laboratories as well as to some other new interactive instructional concepts currently being implemented at other North American institutions will be pointed out.

SU-P4-4 **15h45**

A Pre-test / Post-test Approach to Evaluating the Effectiveness of Individual Instructional Sessions*, **Jason M.K.C. Donev**, Daria Ahrensmeier, Alfredo Louro, Randall Stafford, Robert I. Thompson, *University of Calgary* — The Department of Physics and Astronomy at the University of Calgary is currently re-structuring the small group learning sessions in its large, multi-section first-year physics courses. Integrated "labatorials" will replace formal laboratories and tutorials. A major challenge in developing this new implementation is assessing the effectiveness of the labatorials themselves. Pre-tests and post-tests are given to assess our success at the level of individual instructional periods. The students are given a 1-3 question test at the beginning of the period to establish their baseline understanding. After the students finish the group work, another similar test is administered, before the end of the period. The results are compared to determine

the level of improvement in student understanding. Questions on the tests are often multiple choice and focus on physical concepts. Commonly held misconceptions in introductory physics are often used as decoy answers. Teaching assistants are also given the same sets of pre-tests and post-tests during training sessions the week before they teach their labatorial sections. These scores are also compared to test the level of understanding of the teaching assistants and effectiveness of the training session.

* This work is being supported by Teaching and Learning Fund, University of Calgary

16h00 **Discussion Break / *Pause de Discussion***

SU-P4-5 **16h15**

TRIUMF's "Physics in Action" physics education video series*, **Marcello Pavan**, *TRIUMF* — TRIUMF has undertaken a rather ambitious program of a series of freely-available physics education videos for high schools. These videos use a mix of animation and live-action to demonstrate how high school physics is manifest in the 'real world' *e.g.* at TRIUMF. To date two such videos have been completed, with two others nearing completion at the time of this meeting. This talk will discuss the content of these videos and how they can be used, and will outline TRIUMF's experience with the video-production for others contemplating videos of their own.

* This work is being supported by NSERC PromoScience

16h30 **Discussion Break / *Pause de Discussion***

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

[SU-IPP-CINP] (IPP-CINP / IPP-ICPN)

Joint IPP/CINP Session for GSC-19 Presentation / *Session conjointe IPP/ICPN pour la présentation du Comité de sélection des subventions 19*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

16h00 - 16h45

ROOM / *SALLE* MRR R221 (cap.292) *Chair: K.S. Sharma, U of Manitoba / W. Trischuk, U of Toronto*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

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

[CAP-NSERC] (CAP-NSERC / *ACP-CRSNG*)

CAP-NSERC Liaison Committee Meeting / *Réunion du comité de liaison ACP-CRSNG*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

16h30 - 21h00

ROOM / *SALLE* 136 A & B Taillon (cap.16) *Chair: B.D. Gaulin, McMaster University*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

21h00 ***Meeting* Ends / *Fin de la réunion***

[SU-GRAD] (CAP/*ACP*)

Student Reception / *Réception pour les étudiant(e)s*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

16h30 - 18h00

ROOM / *SALLE* Multi-fonctionnelle (cap.80) *Chair: L. Marchildon, Université du Québec à Trois-Rivières*

Graduate and undergraduate students are cordially invited to a reception. Come meet and network with other students from all over Canada / *Les étudiants de tous les cycles sont cordialement invités à une réception. Venez fraterniser avec des confrères de partout au Canada.*

18h00 **Reception Ends / *Fin de la réception***

[SU-BBQ] (CAP/*ACP*)

CAP Welcome Barbeque / *BBQ d'accueil de l'ACP*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

17h00 - 18h45

ROOM / *SALLE* Multi-fonctionnelle (cap.250) *Chair: L. Marchildon, UQTR*

Delegates are cordially invited to a welcome BBQ. Come meet and network with other delegates. / *Les délégués sont cordialement invités à un BBQ d'accueil. Venez fraterniser avec d'autres délégués.*

18h45 Barbeque Ends / *Fin de le bbq*

[SU-Plen2] (CAP/*ACP*)

Plenary - Guy Moore, McGill U. (CAP Herzberg Medal) / *Plénière - Guy Moore, U. McGill (Médaille Herzberg de l'ACP)*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

19h00 - 19h30

ROOM / *SALLE* JdeV Salle de spectacle (cap.410) *Chair: S.A. Page, University of Manitoba*

SU-Plen2-1 19h00

GUY MOORE, McGill University

Is quark-gluon matter nearly transparent or very opaque?

I will present the seemingly contradictory behavior of matter made up of quarks and gluons. Nuclei are built of quarks and gluons, and when two nuclei strike each other at very high energy most of the material in each nucleus passes through the other, suggesting near-transparency. But the matter which is stopped subsequently displays a pattern of flow which indicates that it interacts very strongly and behaves collectively, in fact as a fluid which is more nearly perfect than any other we know. I discuss how far we have gotten theoretically towards understanding this seemingly puzzling dichotomy.

19h30 Session Ends / *Fin de la session*

[SU-POS] (CAP/*ACP*)

Poster Session and Student Competition (with beer and light refreshments)/ *Session d'affiches et concours étudiants (bière et petit goûter servis)*

SUNDAY, JUNE 7 / *DIMANCHE, 7 JUIN*

19h30 - 22h00

ROOM / *SALLE* MRR Corridors (cap.300) *Chair: L. Marchildon, UQTR*

See page 119 for abstracts / *Voir page 119 pour les résumés*

22h00 Session Ends / *Fin de la session*

Monday, June 8 - Lundi, 8 Juin

[MO-DPE] (DPE/*DEP*)

DPE Business Meeting (with breakfast) / *Réunion d'affaires DEP (avec petit-déjeuner)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

07h00 - 08h30

ROOM / *SALLE* B125 JdeV (cap.30) *Chair: R.I. Thompson, University of Calgary*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

08h30 *Meeting* Ends / *Fin de la réunion*

[MO-Friends] (CAP/ACP) "Friends of CAP" Breakfast and Meeting / *Déjeuner et réunion des "Ami(e)s de l'ACP"*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

07h00 - 08h30

ROOM / *SALLE* A232 JdeV (cap.40)

Chair: H.M. Van Driel, University of Toronto

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

08h30 ***Meeting* Ends / *Fin de la réunion***

[MO-NSERC] (CAP/ACP) New Faculty Breakfast with NSERC / *Déjeuner-rencontre des nouveaux professeurs avec le CRSNG*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

07h00 - 08h30

ROOM / *SALLE* B219 JdeV (cap.15)

Chair: B.D. Gaulin, McMaster University

Come and meet representatives from NSERC and new faculty members from across the country! Sponsored by NSERC. (NB This includes any new faculty member who was appointed after September 1, 2007.) / *Rencontrez les représentants du CRSNG et vos nouveaux collègues de partout au pays! Commandité par le CRSNG. (NB Incluant tous les professeurs qui sont entrés en fonction après le 1er septembre 2007.)*

08h30 **Session Ends / *Fin de la session***

[MO-Plen1] (CAP/ACP) Plenary - Dava Sobel (author of Galileo's Daughter) / *Plénière - Dava Sobel (auteure de 'La Fille de Galilée')*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

08h45 - 09h30

ROOM / *SALLE* JdeV Salle de spectacle (cap.410)

Chair: W. Davidson, National Research Council

MO-Plen1-1 **08h45**

DAVA SOBEL, InkWell Management

Galileo and the International Year of Astronomy

I will discuss Galileo as a physicist who was waylaid by his interest in the telescope, and how his astronomical findings derailed his studies of motion. Had he not observed mountains on the Moon and spots on the Sun, had he never discovered the moons of Jupiter or the phases of Venus, we would remember him today "merely" as the father of modern physics. Rather than lionize him, I will endeavor to show some of the problems he encountered (with funding, for example) that remain all too familiar to scientists today.

09h30 **Session Ends / *Fin de la session***

[MO-AM-Break] (CAP/ACP) Health Break, with refreshments / *Pause-santé, avec goûter*

Room / Salle MRR Rotunda

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

09h30 - 10h00

[MO-A1] (DCMMP/*DPMCM*) DCMMP Best Student Paper Competition I / *Compétition pour les meilleures communications étudiantes DPMCM I*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

10h00 - 11h30

ROOM / *SALLE* MRR D002 (cap.135)

Chair: I.G. Hill, Dalhousie University

MO-A1-1 **10h00** **(G*)**

Simulation study of a colloidal system under the influence of an external electric field*, **Ahmad Almudallal**, Anand Yethiraj, Ivan Saika-Voivod, *Memorial University of Newfoundland* — In a colloidal dispersion where there is a dielectric mismatch between the colloidal particles and the solvent, an external electric field induces a dipole moment in the colloids and therefore provides a way of tuning particle interactions. Such systems have recently become the focus of several

experimental and theoretical studies. At sufficiently high field and moderate to low volume fraction, particles will form long chains along the direction of the applied field. The system can then be modelled as a 2D system of interacting hard disks, where each disk represents a chain of dipolar particles viewed along the field axis. The disk-disk interaction varies with chain length, but has the general feature of strong short range attraction and weak long range repulsion, features that will produce finite clustering, *i.e.* clustering without bulk phase separation. We perform Monte Carlo computer simulations to study the structural properties of the 2D fluid across a wide range of packing fraction and dipolar strength, and study how the system behaviour changes when we add other interactions that may be present experimentally. In particular, we wish to determine what interactions are responsible for producing an interesting "void phase" seen in experiments at very low volume fractions.

* This work is being supported by NSERC and ACE-net

MO-A1-2 10h15 (G*)

Spontaneous Supercurrents in Chiral p-Wave Superconductor*, **Phillip Ashby**, Catherine Kallin, *McMaster University* — Strontium ruthenate is an unconventional superconductor that is believed to be described by chiral p-wave order. An ideal chiral p-wave superconductor breaks time reversal symmetry and spontaneous currents are expected to flow at both the sample edge, as well as between domains of different chirality. Recent magnetic microscopy measurements place upper limits on the magnetic signals generated by these supercurrents and are as much as two orders of magnitude smaller than for an ideal chiral p-wave superconductor. The effect of a variety of surface effects on the spontaneous currents is explored, and the region of parameter space in which the currents are greatly suppressed is very limited. The implications on the interpretation of strontium ruthenate as a simple chiral p-wave superconductor are discussed.

* This work is being supported by NSERC, CIFAR

MO-A1-3 10h30 (G*)

Understanding the formation of colloidal crystal by spin coating technique*, **Maximiliano Giuliani** [1], Andrew Bartlett [2], Wenceslao Gonzalez-Vinas [3], Anand Yethiraj [2], [1] *University of Navarra - Memorial University of Newfoundland*, [2] Memorial University of Newfoundland, [3] University of Navarra — In the last decade interest in colloidal crystals had increased considerably due to its potential technological relevance. Despite this, little achievement had been obtained in terms of good quality crystals at short processing times and low cost. Recently, it had been observed that the spin coating technique can produce large-area crystals with long-range orientational correlation in very short times. Previous work using evaporative spin coating has shown that the crystals obtained present hexagonal and square structures [1]. In particular experimental conditions both structures can be obtained in the same crystal [2]. The objective in our study is to reveal the physical processes that take part in the formation of these crystals. We present the result obtained from 0.5μm diameter silica spheres suspended in acetone. We use direct imaging of the drying process to relate it with the final crystallographic structure and film thickness. We observe that the drying process occurs in two different stages resulting in different predominant structures at each stage. This process can be controlled by modifying both the concentration of the suspension as well as the acetone vapour pressure in the atmosphere. Furthermore our study of the dynamics during the drying process provides insights into the underlying physical mechanisms.

1. A. Mihi, M. Ocaña and H. Míguez, *Adv. Mater.***18**, 2244-2249, 2006.
2. C. Arcos, K. Kumar, W. González-Viñas, R. Sirera, K.M. Poduska and A. Yethiraj, *Phys. Rev. E*, **77(5)**, 050402(R), 2008.

* This work is being supported by Spanish MEC (FIS2008-01126) - Departamento de Educación (Gobierno de Navarra) - NSERC - scholarship (Asociacion de Amigos)

MO-A1-4 10h45 (G*)

Structure and Dynamics of a Charged-Screened Colloidal Suspension: Deviations from the Hard-Sphere Equation of State*, **Hugh Newman** [1], Manuel Valera [2], Ivan Saika-Voivod [1], Anand Yethiraj [1], [1] *Memorial University of Newfoundland*, [2] Memorial University of Newfoundland* now at Slippery Rock University — The thermodynamic equation of state for a system of colloidal particles is obtained from a direct measurement of the particle concentration as a function of height in a gravitational field. Charged-screened colloids show excellent agreement with the equation of state for a hard-sphere system in a bulk suspension [1]. However the validity of this equation of state in thin colloidal sediments, which is relevant for most microscopy experiments, has not been tested. Laser scanning confocal microscopy is used to image a thin sediment of Brownian colloidal spheres in 3 dimensions. The particle concentration as a function of height in the sediment is found to be much more extended than expected for a hard-sphere system. From the density profile we calculate the equation of state for this system and make quantitative comparisons to simulations of charged-screened colloids. We also studied the Brownian dynamics of the colloids as a function of height in the sediment. We obtain lateral and vertical diffusion coefficients and correlate them to the structure in the different regions of the sediment.

1. Rutgers *et al, Physical Review B*, **53**(9):5043–5046, 1996)

* This work is being supported by NSERC

MO-A1-5 11h00 (G*)

Pulsed laser deposition of amorphous diamond-like carbon thin films*, **Michal Wesolowski**, Walter Duley, *University of Waterloo* — Diamond-like carbon (DLC) films have been actively studied for over thirty years[1] and remain a vibrant topic of research. The properties of DLC films are predominantly controlled by the ratio of carbon hybridization[2] within the material, ranging from graphitic (sp^2 hybridization) to diamond like (sp^3 hybridization). The structure of these films, in turn, varies greatly due to the initial conditions in which they are formed. Pulsed laser deposition (PLD) allows for rigorous control of the deposition parameters[3] and is therefore an ideal technique for creating DLC films. Ultrashort pulses (120 fs) from an amplified Ti:sapphire laser operating at 800nm were used to ablate a high purity graphitic target (>99%). Films of approximately 200nm thickness were deposited on quartz substrates and subsequently studied. The evolution of various film properties (sp^2/sp^3 content, Raman activity, photoluminescence etc.) due to variations in deposition conditions will be presented.

* This work is being supported by NSERC

MO-A1-6 11h15 (G*)

Fabrication and analysis of self-terminated pressure-driven quantum point contacts*, **Fatemeh Soltani**, Alex Wlasenko, Geoff Steeves, *University of Victoria* — A self-terminated electrochemical method was used to fabricate atomic–scale contacts between two Au electrodes in a microfluidic channel. The conductance of the contacts varies in a stepwise fashion as a quantum point contact (QPC) with a tendency to quantize near the integer multiples of the conductance quantum (G_0) The mechanism works by a pressure–driven flow parallel with a pair of Au electrodes with a 100 μm gap in an electrolyte of HCl. When applying a bias voltage between two electrodes, metal atoms are etched off the anode and deposited onto the cathode. Consequently, the two electrodes form an atomic-scale contact. Without applied flow, dendrite growth and dense branching morphology were typically observed at the cathode. The addition of applied pressure-driven flow resulted in a densely packed gold structure that filled the channel. The electrochemical fabrication approach introduces large variance in the formation and location of individual junctions. Understanding and controlling this process will enable the precise positioning of reproducible geometries into nano–electronic devices. To investigate the high speed behaviour of a QPC, it can be integrated with a transmission line structure patterned on a photoconductive GaAs substrate. The nonlinear conductance of the QPC (due to the finite density of states of the conductors) can be examined and compared with recent theoretical studies. By optically exciting photoconductive switches, high speed picoseconds electrical pulses can be generated to interrogate QPC samples. Samples are fabricated in situ using an electrochemical procedure to produce QPCs along the transmission line structure. This method may provide insight into Terahertz Optoelectronic devices and ultrafast communication systems.

* This work is being supported by NSERC

11h30 Session Ends / *Fin de la session*

[MO-A2] (DAMPhi-DPP/*DPAMip-DPP*) Atomic and Molecular Spectroscopy and Dynamics I (in honour of the memory of Dr. Barry Wallbank, STFX) / *Spectroscopie et dynamique des atomes et molécules I (à la mémoire du Dr Barry Wallbank, STFX)*

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***
10h00 - 12h15

ROOM / *SALLE* MRR D102 (cap.134) *Chair: K. LeBris, St. Francis Xavier University*

MO-A2-1 10h00

JOHN MACASKILL, Jet Propulsion Laboratory

*From Highly Charged Ions to Complex Molecule Formation: An Overview of Experiments and Results from the JPL Highly Charged Ion and Fast Atom Facilities**

The Atomic and Molecular Collisions Group at the Jet Propulsion Laboratory has several research facilities devoted to developing science packages for space flight programs as well as for performing numerous experiments of astrophysical and astrochemical relevance. Our miniature Mass Spectrometer development efforts have culminated so far with the Trace Gas Analyzer (TGA), and Vehicle Cabin Air Monitor (VCAM), and may eventually lead to missions to explore Venus, Enceladus, Titan, and Europa. Our Fast Atom Facility is capable of producing high flux, high purity ground state atomic hydrogen and oxygen beams of variable kinetic energy for performing measurements of dissociative electron attachment and photodetachment, effects of magnetic fields on these same processes, or for creating complex molecules on a frozen surface to simulate chemistry of dust grains in the InterStellar Medium. Our Highly Charged Ion Facility currently employs an Electron Cyclotron Resonance Ion Source to form beams simulating solar winds or solar atmosphere conditions for use in electron excitation measurements, measuring various charge exchange processes, and for measuring lifetimes. I will give a brief overview of these facilities and experiments as well as discuss recent developments and results.

* This work is being supported by JPL/Caltech through agreement with NASA.

MO-A2-2 10h30

Spectra of highly charged iron in the extreme ultraviolet wavelength region of laboratory and astrophysical plasmas*, **Jaan Lepson** [1], Peter Beiersdorfer [1], [1] *Space Sciences Laboratory, University of California, Berkeley*, [2] Lawrence Livermore National Laboratory — Iron is one of the most abundant heavy elements in extreme ultraviolet (EUV) spectra of astrophysical and laboratory plasmas, and its various ions radiate profusely in this wavelength band. Iron emission in the EUV provides important diagnostic tools for such properties as plasma temperature and density, and perhaps even magnetic field strength. Despite its importance to astrophysics and magnetic fusion, knowledge of the EUV spectrum of iron is incomplete. Identification of iron emission lines is hampered by the paucity of accurate laboratory measurements and by the uncertainty of even the best atomic models. We measured spectra of highly charged iron, Fe VII through Fe XVI, from 40 to 170 Å, using a flat-field grating spectrometer on the Lawrence Livermore electron beam ion trap. We determined line positions to 0.02 Å and relative intensities with an accuracy of .05, identifying many new lines. We were able to identify previously unknown lines of iron in sounding rocket spectra of the sun and Chandra X-Ray Observatory spectra of Procyon, a "solar twin" in the EUV region.

* Part of this work was performed under the auspices of the U S Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and was supported by NASA's Astronomy and Physics Research and Analysis Program under Contract NNH07AF811.

MO-A2-3 10h45

Interaction of Relativistic Laser Pulses with Plasmas*, **Wojciech Rozmus** [1], Neda Naseri [1], Konstantin Popov [1], V. Yu. Bychenkov[2], [1]*University of Alberta*, [2] P.N. Lebedev Physics Institute, RAS, Russia — Interaction of relativistic laser pulses with charged particles and plasmas is a subject of intense studies because of its relevance to plasma-based acceleration schemes, inertial confinement fusion by fast ignition and new basic physics and applications of super intense laser pulses. We have analyzed relativistic self-focusing and laser pulse channeling, vacuum acceleration in tightly focused laser pulses and effects of radiative damping

on electron dynamics in the ultra relativistic regime of interactions by means of kinetic simulations and analytical theories. Our main numerical tool has been particle-in-cell code MK2. Among new and important processes we will describe: destruction of plasma channels and electron heating by surface modes excited during propagation of self-focused relativistic pulses in underdense plasmas, acceleration of attosecond electron bunches in the fields of tightly focused laser pulses and limits on electron acceleration due to radiative damping forces. We will discuss experimental implications of these theoretical findings.

* This work is being supported by NSERC

11h00 Break / *Pause*

MO-A2-4 11h15

WILLIAM VAN WIJNGAARDEN, York University

Critical Examination of Isotope Shift and Fine Structure Measurements for Transitions in $^{6,7}Li$

A number of experiments have precisely measured isotope shifts. Each experiment was checked whether data found for different transitions yielded consistent values for the relative nuclear charge radius squared Δr^2 of ^{6,7}Li. Experiments that passed this test found $\Delta r^2 = 0.735 \pm 0.036$, 0.755 ± 0.023 and 0.739 ± 0.013 fm^2 by studying the Li^+ 1s2s $^3S \rightarrow$ 1s2p ^3P transition, Li D lines and Li 2S $\rightarrow$ 3S transition, respectively. These data determine the relative nuclear charge radius 25 times more accurately than electron scattering. Similarly, averaging the most reliable fine structure data gives $62,678.75 \pm 0.55$ MHz for the $^7Li^+$ 1s12p $^3P_{1\text{-}2}$ interval in good agreement with theory. The results for the ^{6,7}Li 2P fine structure intervals, $10,052.954 \pm 0.049$ and $10,053.154 \pm 0.040$ MHz, exceed computed values by 2 MHz and yield a specific isotope shift which is nearly a factor of 2 lower than a theoretical estimate.

MO-A2-5 11h45

Population Depletion Spectroscopy of Strontium Monomethoxide*, **Damien Forthomme** [1], Laura Downie [1], Aaron Granger [1], Allan Adam [1], Colan Linton [1], Dennis Tokaryk [1], Scott Hopkins [2], [1] *University of New Brunswick* , [2] Oxford University — High resolution laser induced fluorescence excitation spectra have been obtained of the origin bands of the $\tilde{A}\,^2E - \tilde{X}\,^2A_1$ and $\tilde{B}\,^2A_1 - \tilde{X}\,^2A_1$ transitions for two isotopologues, $SrO^{12}CH_3$ and $SrO^{13}CH_3$, of strontium monomethoxide. The molecules were produced by laser ablation of a strontium target rod followed by reaction with ^{12}C- or ^{13}C- substituted methanol seeded in helium, prior to expansion into vacuum to form a pulsed supersonic jet. The spectra were complex and more congested than those we previously reported for the isoelectronic calcium monomethoxide molecule. Rotational J assignments were established from common ground state combination differences. Definitive assignments of the K structure and of the F_1 F_2 spin rotation components of the $\tilde{B}\,^2A_1$ state were, however, much harder to establish and could only be achieved using optical optical double resonance (OODR) population depletion spectroscopy. We will report the latest results and analysis and also show how, by employing OODR, we were able to resolve and quantify the very small spin rotation splitting in the ground $\tilde{X}\,^2A_1$ state.

* This work is being supported by NSERC

MO-A2-6 12h00

Measuring the Temperature of a Neutral Plasma Using the $C^3\Pi_u \rightarrow B^3\Pi_g$ Emission Spectrum of Molecular Nitrogen*, Jeff Crouse, **Dennis Tokaryk**, *University of New Brunswick* — While techniques for characterization of parameters like the electron density and electron temperature are quite well established, rather few diagnostics exist for measurement of the temperature of the neutral gas in a plasma environment. A number of papers have recently proposed that the neutral gas temperature can be measured by adding a trace amount of nitrogen to a plasma, measuring bands of the $C^3\Pi_u \rightarrow B^3\Pi_g$ emission spectrum at modest resolution, and then fitting the band profile to a theoretical model (assuming a Maxwell-Boltzman population among the upper state rotational levels). While this is appropriate in principle, in previous work the molecular models used were often faulty, and the line strength factors used were wrong or only approximate. In this work we demonstrate that with a full and correct Hamiltonian, taking into account higher order effects such as spin-orbit coupling, lambda doubling, and nuclear spin statistics, both line positions and line strength factors can be calculated exactly with minimal computational cost. When broadening appropriate to the instrumentation used is applied, very satisfactory temperature measurements can be made from even low-resolution observations of the $C^3\Pi_u \rightarrow B^3\Pi_g$ v=0 spectrum in a plasma.

* This work is being supported by NSERC, the Canadian Light Source, University of New Brunswick

12h15 Session Ends / *Fin de la session*

[MO-A3] (DPE/*DEP*) Curriculum Revitalization / *Revitalisation des programmes*

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***

10h00 - 12h15

ROOM / *SALLE* MG2 147G2 (cap.108) *Chair: T. Antimirova, Ryerson University*

MO-A3-1 10h00

JOHN R. DE BRUYN, University of Western Ontario

Promoting educational research and innovation in a "research intensive" department

A typical university professor's job is part teaching and part research. Where does "research on teaching" fit into this? How can faculty be encouraged to devote time and creative effort to invesitgating new ideas in teaching, or to orignal research on educational issues, and how should such activity be evaluated? I will

discuss these issues from the perspective of a department chair. I will describe some ways in which educational research and innovation can be supported and encouraged at the departmental and institutional levels, and some things that can be done to make work in this area culturally acceptable in a milieu in which success at "real" physics research has always been the primary measure of achievement. Along the way I will describe some of the work being done by faculty in the Department of Physics and Astronomy at the University of Western Ontario.

MO-A3-2 10h30

Evolution and Refinement of an Environmentally Themed Introductory Physics Course*, **Andrzej Kotlicki**, Mathew Martinuk, Georg Rieger, *University of British Columbia* — In 2007, we implemented fundamental changes into the curriculum and course structure of Phys 100, a large introductory course for non-physics majors at UBC. These changes were motivated by research showing that students often don't make connections between classroom physics and real-world phenomena. Learning from our experience in 2007 we continued to evolve the course in 2008 with the goal of improving our students' ability to use their scientific knowledge to critically think about real world problems such as transportation and climate change. The course teaches introductory physics with strong connections to applications in the real world. For example the concepts of conservation of energy are explored using the context of home heating and the Earth's energy balance. Kinematics is discussed in the context of transportation, energy consumption, and fuel efficiency, and the basic concepts in electricity are applied to examples of home wiring, transmission lines and electrical energy savings. These real-world connections are reinforced through weekly tutorials in which students apply physics to context-rich real world problems, and through explicit discussion of real-world analogues to lab experiments. The results of the 2007 CLASS attitudes survey were disappointing, but the 2008 results of CLASS surveys, midterm, exam, and our custom problem solving test and survey indicate a substantial improvement in students' perception of the real world connections in physics. This presentation will discuss last year's evolution of the course materials and the survey and test results. One particularly interesting student's point of view will be discussed in detail.

* This work is being supported by Carl Wieman Science Education Initiative

MO-A3-3 10h45

Building a Better Learner: Cross-level Curriculum Design Teams*, **Karim Jaffer** [1], Silvia D'apollonia [2], Christie Brown [3], [1] *John Abbott College*, [2] QEMSAP, [3] MELS — The Quebec Secondary School curriculum is undergoing a reform towards an emphasis on inquiry-based learning in cross-curricular contexts. While teachers receive pedagogical training, many struggle with the content expertise needed to create curriculum. CEGEP pre-university programs (providing a transition experience equivalent to Gr. 12 and 1st year University) traditionally provide instruction in a predominantly lecture-based environment with recent shifts towards project-based learning and more exploratory lab situations, despite a lack of mandatory pedagogical training. CEGEP career programs already present a project-based environment which cuts across traditional disciplines. In Fall'08, 10 collaborative work-teams were established with members from each level with an aim to design curricula for the Secondary 4 (Gr.10) Science & Technology reform programs, with extension modules to be delivered at the CEGEP level. This talk will discuss the process, results, and next steps from this project.

* This work is being supported by QEMSAP, MELS, Quebec-Canada Entente, Quebec Anglophone CEGEPs & School Boards

MO-A3-4 11h00

NOAH FINKELSTEIN, University of Colorado

Applying Education Research to Implement and Sustain Transformation in Undergraduate Physics

It is now well documented that traditionally taught, large-scale introductory physics courses fail to teach our students the basics. In fact, these same courses have taught students things we do not want. At the University of Colorado, we have transformed a variety of our physics courses to employ many of the tools developed by physics education researchers over the last few decades. We demonstrate improved learning (as much as three times that of non-transformed classes), and study the conditions to sustain and potentially scale these reforms.

MO-A3-5 11h30

The Exam as a Learning Experience: Evaluating the Immediate Feedback Assessment Technique for Physics Education*, **Jeffrey L. Hutter**, Margaret Campbell-Brown, Carol Jones, *University of Western Ontario* — Multiple-choice (MC) examinations allow a greater range of topics to be tested than do short-answer and numerical questions, and can be efficiently graded. However, construction of a *good* MC exam—one that tests comprehension and ability to apply knowledge, rather than rote memorization—requires additional effort. As a result, instructors are understandably reluctant to release MC solutions, limiting the value of the exam to students. The Immediate Feedback Assessment Technique (IFAT) [1] is a new technique in which students respond to MC questions by removing an opaque coating from the rectangles corresponding to their answers on specially-prepared forms similar to "scratch-and-win" lottery tickets. A correct answer reveals a star. In the event of an incorrect answer, they can review their logic and try again for reduced credit. In this way, the exam itself is turned into a learning experience. We are studying the use of the IFAT in a standard first-year physics course with an enrollment of ~400. Using an IFAT-based MC component in both tutorial quizzes and midterm examinations allows us to determine whether students previously tested on a concept perform better than groups who were not asked the same question in previous tutorials. This talk will present the results of that study: the efficacy of the IFAT technique, acceptance by physics students, and advice for others interested in adopting this format.

1. Epstein, *et al.*, *Psychological Reports* **88**, 889 (2001)

* This work is being supported by The University of Western Ontario Teaching Support Centre

MO-A3-6 11h45 (G*)

Models in Modern Physics Textbooks*, **Nilüfer Didis**, Ali Eryilmaz, *Middle East Technical University* — A model can be defined as "a surrogate object, a conceptual representation of real thing" [1]. Models are the basic elements for explanation of the scientific ideas. For this reason, they have great importance in science, and also in science education. In physics instructions, instructors may use different type of models due to the taught topics. Mathematical, visual, analogical models are widely used in physics lectures to explain the physical ideas and clarify the events. This study aims to identify the fundamental and widely

used models in the explanation of introductory quantum mechanics topics in Modern Physics textbooks in undergraduate level. Purposively selected Modern Physics textbooks were analyzed in terms of used models with the content analysis. Manifest and latent content analyses provide evidences about percentages about model types, and their distribution per topic and per textbook. The findings may help physics instructors about their selection of proper models for students in their lectures. Key words: Physics Education, Models, Content Analysis.

1. Hestenes, D., "Toward a modeling theory of physics instruction", *American Journal of Physics,* **55(5)**, 440-454 (1987).

* This work is being supported by The Scientific and Technological Research Council of Turkey

12h00 **Discussion Break** */ Pause de Discussion*

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

[MO-A4] (DNP/*DPN*) Precision Measurements Testing Fundamental Symmetries / *Mesures de précision comme tests de symétries fondamentales*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN* **10h00 - 12h15**

ROOM / *SALLE* **MG2 148G2 (cap.132)** *Chair: M.C. Fujiwara, TRIUMF*

MO-A4-1 **10h00**

ROBERT I. THOMPSON, University of Calgary

The Pursuit of Antihydrogen Trapping and Spectroscopy †

Antihydrogen, or more specifically high precision spectroscopy of antihydrogen, offers some of the most promising avenues for extremely sensitive tests of CPT symmetry. However, such precision studies would require that the antihydrogen be stored at low temperature while being probed with microwave or ultraviolet laser radiation. There are currently two independent experiments, ALPHA and ATRAP, underway at the Antiproton Decelerator (AD) at CERN, each designed to generate, trap, and study antihydrogen as a test of CPT. Focusing primarily on the ALPHA (Antihydrogen Laser PHysics Apparatus) Experiment, this presentation will describe the techniques employed to generate and attempt to trap antihydrogen. I will discuss the challenges of mixing antiprotons and positrons to form, detect, and analyze low temperature antihydrogen in the presence of the inhomogeneous magnetic fields that make up the neutral particle trap, and provide an overview of techniques being developed to manipulate the positron and antiproton plasmas to optimize the antihydrogen formation process. Finally, I will offer an outlook towards the future spectroscopic studies that could be carried out on a trapped antihydrogen sample using the techniques of laser and microwave spectroscopy.

† In collaboration with M. Fujiwara [1], D. Gill [1], W.N. Hardy [2], M.E. Hayden [3], R. Hydomako [4], L. Kurchaninov [1], S. Menary [5], K. Olchanski [1], A. Olin [1], S. Seif El Nasr [2], J.W. Storey [1], [1] TRIUMF, [2] University of British Columbia, [3] Simon Fraser University, [4] University of Calgary, [5] York University

MO-A4-2 **10h30**

MICHAEL ROMALIS, Princeton University

Low-energy searches for new interactions involving nuclear spins

I will review recent progress in precision low-energy experiments searching for new interactions involving nuclear spins. New limits have recently been set on Time-reversal violating interactions leading to a permanent Electric Dipole Moment, Lorentz and CPT violating interactions, and long-range nuclear spin-dependent forces. These experiments constrain a variery of new physics beyond the Standard Model. I will discuss common experimental features of such experiments, such as very long nuclear spin-coherence times, and techniques for further improvement in the precision of experiments involving nuclear spins.

11h00 **Break** */ Pause*

MO-A4-3 **11h15**

NICK MAVROMATOS, Kings College London/CERN

CPT Symmetry, Quantum Gravity and Entangled Particle States

In certain models of quantum gravity, with "foamy" space-time backgrounds, there may be induced decoherence of quantum matter propagating in them. In such a case, in the effective theory, where quantum-gravitational degrees of freedom (playing the role of an `environment') have been integrated out, the generator of the CPT symmetry might not be well defined, according to a theorem by R. Wald (1979). This may have rather unique consequences for entangled particle states, such as those of neutral mesons in a meson factory, namely induced modifications to the Einstein-Podolsky-Rosen correlators. I estimate such effects in a particular theoretical model of space-time foam, inspired from string theory, and argue that such models might actually be falsifiable at the next generation facilities of meson factories, such as an upgrade of DAPhiNE or future B systems. The key to the enhancement of such effects lies on the near degeneracy of the particle energy eigenstates involved. The decoherence aspects of the foam have actually a plethora of other effects, notably one associated with damped flavour oscillations in neutrino physics. In this sense, neutrino tests of quantum gravity decoherence could provide complementary constraints on such models. However, in this particular model of string-inspired space-time foam, such damping appears suppressed by the relatively small neutrino mass differences, and hence its experimental detection is a major challenge. A brief discussion on quantum-gravity decoherence tests using cosmic neutrinos in this context will also be given.

MO-A4-4 11h45

Antihydrogen Detection with ALPHA*, **Scott Robert Menary** [1], Makoto Fujiwara [2], David Gill [2], Walter Hardy [3], Michael Hayden [4], Richard Hydomako [5], Leonid Kurchaninov [2], Konstantin Olchanski [2], Art Olin [2], Sarah Seif El Nasr [3], James Storey [2], Robert Thompson [5], [1] *York University*, [2] TRIUMF, [3] UBC, [4] SFU, [5] Calgary — The aim of the ALPHA (Antihydrogen Laser PHysics Apparatus) experiment at CERN's Antiproton Decelerator is to produce and trap antihydrogen in order to perform spectroscopic measurements. The experiment is presently at the stage of perfecting the techniques for producing and trapping antihydrogen. I will describe some of the detectors used to verify the methodology of the experiment, with special emphasis on those detectors with heavy Canadian involvement; the silicon strip vertex detector, the scintillator detector with APD readout, and the proposed CVD diamond antiproton beam monitor.

* This work is being supported by NSERC

MO-A4-5 12h00 (G*)

Spectroscopic Factors from the Single Neutron Pickup Reaction ^{64}Zn(d,t), **Kyle Leach**, *University of Guelph* — A great deal of attention has recently been paid towards high precision superallowed β-decay *Ft* values. With the availability of extremely high precision (<0.1%) experimental data, precision on the individual *Ft* values are now dominated by the ~1% theoretical corrections [1]. This limitation is most evident in heavier superallowed nuclei (*e.g.* ^{62}Ga) where the isospin-symmetry-breaking correction calculations become more difficult due to the truncated model space. Experimental spectroscopic factors for these nuclei are important for the identification of the relevant orbitals that should be included in the model space of the calculations. The single-nucleon transfer reaction ^{64}Zn(d,t) ^{63}Zn was conducted at the Maier-Leibnitz-Laboratory (MLL) of TUM/LMU in Munich, Germany, using a 22~MeV polarized deuteron beam from the tandem Van de Graaff accelerator and the TUM/LMU Q3D magnetic spectrograph, with angular distributions from 10° to 60°. Preliminary results from this experiment will be presented and implications for calculations of isospin-symmetry breaking corrections in the superallowed β^+ decay of ^{62}Ga will be discussed.

1. I.S. Towner and J.C. Hardy, *Phys. Rev.* ***C*** **77**, 025501 (2008).

12h15 Session Ends / *Fin de la session*

[MO-A5] Applied Industrial and General Instrumentation / *Instrumentation industrielle appliquée et générale*

(DIMP-DIAP /*DPIM-DPIA*)

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

10h00 - 12h15

ROOM / *SALLE* MRR A002 (cap.134) *Chair: K.H. Michaelian, CANMET, Natural Resources Canada*

MO-A5-1 10h00

ROMAN GR. MAEV, University of Windsor

Advanced High Resolution Digital Imaging Technique in Non-destructive Investigations and Diagnostics of Cultural and Environmental Heritage

Continuous innovations in advanced High Resolution Imaging Technologies and Methods have caused unique applications for non-destructive investigations of surface and subsurface microstructures in the conservation of cultural and environmental heritage. It became a preferred approach even in cases where microanalysis sampling is permitted. The synergy between experts in science and culture will lead to continuous development and adjustments of new innovative scientific methods, their applications in the field of preservation, reconstruction and diagnostics of museum, and archeological objects. High resolution digital imaging techniques are powerful methods that can bring a revolution in the conservation work of art-objects. There is an ancient saying that "A picture is worth a thousand words". Never this is truer than when it is applied to nondestructive characterization of materials of various natures. It is also true that it was the very first nondestructive test when after God created the universe he stopped and "saw that it was good". It may be difficult for modern research scientists and engineers to believe, but visual inspection is still the nondestructive testing most often used in practical applications. The goal of this invited talk is to introduce advanced physical research results, which have been achieved by our group. In that presentation we will demonstrate our results in the new field of Nondestructive Investigations and Diagnostics of Cultural and Environmental Heritage. We strongly believe that this new technical approaches will benefit art museum community, and further emphasize scientist's contribution to the world heritage as well.

MO-A5-2 10h30

ANDREAS MANDELIS, Center for Advanced Diffusion-Wave Technologies, University of Toronto

Deep Level Photo-Thermal Spectroscopy of Defect States in Semi-Insulating GaAs: A Combined Temperatures, Pulse-Rate and Time-Domain Study of Defect State Kinetics †

The new technique of Deep Level Photo-Thermal Spectroscopy (DLPTS) will be presented covering a wide temperature range in order to cover several defect states in semi-insulating GaAs. Measurements taken at three different modes, temperature-scanned, pulse-rate-scanned, and time-scanned DLPTS will be discussed. It will be demonstrated that each mode provides unique information about the defect configuration, and the combination of the different modes offers a powerful tool for DLPTS studies of physical optoelectronic processes in SI-GaAs. The nonexponentiality/broadening of experimental data was extensively studied using the two prevalent broadening theories: the stretched exponential and the Gaussian distribution of activation energies. A hierarchical carrier emission model has been proposed for the stretched exponential behavior. Simulations indicate that the two broadening theories exhibit roughly similar broadening effects and good fits to the experimental data. The origin of this similarity indicates an ergodic equivalence of random energy distribution and the constrained hierarchical emission process.

† In collaboration with Jun Xia, Center for Advanced Diffusion-Wave Technologies, University of Toronto

MO-A5-3 11h00

CRAIG BENNETT, Acadia University

Ni-Mn-Ga Ferromagnetic Shape Memory Alloys *

Ni-Mn-Ga ferromagnetic shape memory alloys (FSMA) are a class of actuator materials which develop large strains in response to an external magnetic field. This phenomenon combines the advantageous aspects of traditional magnetostriction (its high frequency limit) and the conventional shape memory effect (strains of 5-10%). As a result, these alloys may have a wide range of potential applications if problems related to manufacture and property optimization can be solved. For most of these applications, large single crystals with a high degree of compositional uniformity are required. We will discuss the preparation of single crystals as it relates to the solidification behavior of this alloy system. A thermoelastic transformation from a B2 or $L2_1$ ordered parent phase to martensite occurs in these alloys with the shape memory effect arising from the rearrangement of the martensite variants by the external magnetic field. Depending on the chemical composition of the alloys and the temperature range, several distinct martensitic phases are observed. Using transmission electron microscopy, we have examined the crystallography of the martensitic transformation in detail. The results will be discussed in terms of an atomic model describing the propagation of the martensitic intervariant boundaries.

* This work is being supported by NSERC

MO-A5-4 11h30 (G*)

Studies of an All-Scintillator Compton Gamma Imager*, **A.M.L. MacLeod** [1], D.S. Hanna [1], P.R.B. Saull [2], H.C.J. Seyerd [3], L.E. Sinclair [3], [1]*McGill University*, [2] Institute for National Measurement Standards, National Research Council, [3] Geological Survey of Canada, Natural Resources Canada — The government of Canada has identified a need for improved detection methods which can be used prior to, or following, an incident involving radioactive material. In the former case the detector would aid in prevention and in the latter it would aid in mitigation efforts. With this in mind, we are developing an imaging detector based on the Compton scattering technique which is used in high-energy gamma-ray astronomy at energies of the order of 1 MeV. The aim is to provide an image of radioactive hot-spots which can be overlaid on a optical photograph of the surroundings to provide intuitive visual information to first-responders. In a Compton imager, a gamma ray produces a recoil electron in a scattering layer and deposits its remaining energy in an absorbing layer. Both layers are pixellated; the direction and energy of the incident gamma ray can be computed from the sizes and positions of the resulting two signals. To be rugged, portable and inexpensive, our design is based on scintillators and photomultiplier tubes. Design features and results from initial tests on device components will be presented in this contribution.

* This work is being supported by NSERC, Chemical, Biological, Radiological-Nuclear and Explosives Research and Technology Initiative (CRTI Project 07-0193RD)

MO-A5-5 11h45

MRI Measurements of dissolved gas dynamics in a cavitating fluid*, **Igor Mastikhin**, Benedict Newling, Samuel Kristoffersen, *University of New Brunswick* — A strong acoustic field in a liquid separates the liquid and dissolved gases by the formation of bubbles (cavitation). Bubble growth and collapse is the result of active exchange of gas and vapor through the bubble walls with the surrounding liquid. This work investigates a new approach to the study of cavitation, not as an evolution of discrete bubbles, but as the dynamics of molecules constituting both the bubbles and the fluid. Direct Magnetic Resonance Imaging measurements of dynamics of the liquid and the dissolved gas show that the motions of dissolved gas (freon-22, $CHCLF_2$) and liquid (water) can be very different during acoustic cavitation and are strongly affected by the ultrasonic power, filtration or previous cavitation of the solvent. The observations suggest that bubbles can completely refresh their content within two acoustic cycles and that long-lived (minutes) microbubbles act as nucleation sites for cavitation. The technique is complementary to the traditional optical and acoustical techniques.

* This work is being supported by NSERC

MO-A5-6 12h00

Large Area Silicon Photomultipliers for Use in the GlueX Experiment*, **Zisis Papandreou**, Kathryn Janzen, George Lolos, Andrei Semenov, *University of Regina* — The goal of the GlueX experiment is to search for exotic hybrid mesons as evidence of gluonic excitations in an effort to understand confinement in QCD. A key subsystem of the GlueX detector is the electromagnetic barrel calorimeter (BCAL) located inside a superconducting solenoid of approximately 2.5 Tesla. Because of this arrangement, traditional vacuum photomultiplier tubes (PMTs) cannot be used. The use of Silicon photomultipliers (SiPMs) as front-end detectors has been proposed. While the largest SiPMs that have been previously employed by other experiments have an active area of a few mm^2, GlueX proposes to use large area SiPMs each composed of sixteen 3x3 mm^2 cells arranged in a 4x4 array. This puts the GlueX collaboration in the unique position of driving the technology for larger area sensors. In this talk I will discuss tests carried out in Regina regarding performance parameters of prototype SiPM arrays delivered by SensL, a low light-sensing company based in Ireland.

* This work is being supported by NSERC and Jefferson Lab/DOE

12h15 Session Ends / *Fin de la session*

[MO-A6] (DOP/*DOP*) Advanced Materials and Photonic Crystals / *Matériaux avancés et cristaux photoniques*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

10h00 - 11h15

ROOM / *SALLE* MRR A102 (cap.134)

Chair: R. Fedosejevs, University of Alberta

MO-A6-1 10h00

MAKSIM SKOROBOGATIY, École Polytechnique de Montréal

Introducing Nanotechnology into Optical Fibers

I will present several examples of how a well established field of fiber optics is revitalised by nanotechnology. Particlularly, I will talk about the design and fabrication of bio- and chemical plasmonic sensor based on the photonic crystal fibers. Such sensors are created by introducing metal nanoparticles or nanolayers of metals into the microchannels of a photonic crystal fiber. Another example is a new generation of photonic textiles which use nanostructred photonic bangap fibers.

MO-A6-2 10h30

The nonlinear optical properties of chitin and chitosan, the backbone of many natural photonic crystals*, **Alain Haché**, Torriss Badr, *Université de Moncton* — Optical iridescence in living organisms is caused by photonic crystals often made of orderly networks of chitin, as seen in some species of butterflies and other insects. After cellulose, chitin is the most abundant polymer found in nature. Its derivative, chitosan, is equally important for its biomedical and agricultural applications. We measured the optical nonlinearity of chitin and chitosan using femtosecond laser pulses at 800 nm (a wavelength where the materials are mostly transparent). Using techniques such as z-scans, we measured the nonlinear refractive index and absorption coefficients, as well as other relevant parameters like damage thresholds and thermal lensing. Considering the relatively low melting point of these polymers, it is important to use pulsed lasers with low fluence (low repetition rate). Still, the role of thermal effects can be important and will be discussed in details. This work is a preliminary step towards the optical control of natural photonic crystals.

* This work is being supported by NSERC and CRC

MO-A6-3 10h45

Electrochromic shift of the reflectance peak in finite thickness tungsten trioxide inverse opal photonic crystals*, **Julia Khalack**, Pandurang Ashrit, *Université de Moncton* — Inverse opal photonic crystals have drawn a lot of attention because they can develop a complete band gap at high values of index contrast n>2.8 between photonic bands 8 and 9. At lower values of n, they demonstrate only a partial band gap between bands 2 and 3 in the direction normal to close-packed planes of air spheres. Manufacturing inverse opals of electrochromic materials gives one a possibility to influence *reversibly* the position of the band gap in the spectrum. Since the inverse opals are experimentally obtained usually in the form of thin films, we have undertaken the numerical (FDTD) investigation of the effect of the finite film thickness on the transmittance and reflectance spectra of WO_3 inverse opal. Tungsten trioxide being the most promising electrochromic material, its low refractive index gives rise to a partial band gap at $\lambda \approx 2d$, where d is air sphere diameter. To develop a significant reflectance peak, the film should be at least 9 sphere layers thick. With introduction of free electrons into WO_3 (we simulated its effect with the Drude model), the reflectance peak tends to shift in the direction suggested by our previous bulk simulations. However, the exact shift value is found to be influenced by the interference pattern due to the finite thickness of the film. As a result the stop-band position changes non-uniformly, that is in agreement with the experimental data on dry lithiation of WO_3 inverse opal films.

* This work is being supported by AIF/FIA

MO-A6-4 11h00 (G*)

Fixed and graded refractive index MgF2 antireflection coatings by glancing angle deposition*, **Francois LeBlanc**, *Université de Moncton* — We deposited high-performance MgF2 antireflection coatings using glancing angle deposition (GLAD). Accurate control of refractive index as a function of thickness is achieved by controlling the incidence angle of the material on the substrate and therefore the porosity of the coating. A stepwise or ideally a continuous variation of the refractive index from the outer surface to the glass substrate leads to significantly better performance of these antireflection coatings compared to those commonly created using normal deposition. Fixed angle oblique deposition coatings are also investigated.

* This work is being supported by NSERC, AIF

11h15 Session Ends / *Fin de la session*

[MO-A7] Energy Frontier / *Frontière de l'énergie*

(PPD/*PPD*)

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

10h00 - 12h15

ROOM / *SALLE* MRR A202 (cap.133)

Chair: K. Benslama, University of Regina

MO-A7-1 10h00

ROBERT ORR, University of Toronto

The International Linear Collider

Many, if not most, particle physicists expect that a Higgs will be observed at the LHC, and will have a mass of less that 200 GeV/c^2. It will be "a" Higgs rather than "the" Higgs in that it will likely be a scalar from some theory beyond the standard model. In order to figure out which theory beyond the standard model, there is a consensus that a 500 *GeV* center-of-mass energy e^+e^- collider will be required. The only feasible such collider is a linear collider, and it is generally agreed that this machine, known as the ILC, should be the next machine to be constructed after the LHC. The chosen design is based on superconducting radio frequency cavities. I will discuss the physics reach of this machine, but will concentrate on the technology and the status of the design and R&D efforts on the accelerator.

MO-A7-2 10h30

International Linear Collider Detector Studies*, **Francois Corriveau**, *Institute of Particle Physics / McGill University* — The Linear Collider could be the next international project to start in the coming decade. Already concensus has been reached in the design of the machine and a call for detector Letters of Intents has been made. The current work, progress and plans of the Canadian tracking and calorimeter groups will be reported.

* This work is being supported by NSERC

MO-A7-3 10h45

Superconducting Radiofrequency Cavity R&D in Canada*, **William Trischuk** [1], Bob Orr [1], Bob Laxdal [2], [1] *University of Toronto*, [2] TRIUMF — TRIUMF is proposing to build a 50 MeV electron linac as a driver to produce radioactive ion beams through photofission. The design is based on nine-cell 1.3 GHz Tesla type cavities. A 1.3 GHz Superconducting RF (SRF) cavity test program has been initiated with the goal to produce and test one nine cell cavity by the end of 2009. The program will utilize the existing clean room and SRF test facilities that support the ISAC-II heavy ion superconducting linac. In collaboration with the University of Toronto, TRIUMF has modified a vertical cryostat to allow single cell testing. This facility is being commissioned with cavities that have been manufactured at DESY and Fermilab. A single cell fabrication program is underway with a Vancouver-based company. The goal of the 1.3 GHz cavity programme is to not only produce cavities for the electron-linac but to broaden Canada's technical base for future potential accelerator collaborations. Results from the first cavity tests at TRIUMF, and possibly from a first 1.3 GHz SRF cavity manufactured in Canada, will be presented.

* This work is being supported by NSERC

MO-A7-4 11h00

DUGAN O'NEIL, Simon Fraser University

Status of the Large Hadron Collider and the ATLAS Experiment *

The Large Hadron Collider (LHC) represents a substantial leap forward in hadron collider energy and luminosity. Once it reaches design energy, it will define the energy frontier by colliding two beams of protons at 14TeV centre-of-mass. ATLAS is one of 2 multi-purpose experiments which has been built to take data at the LHC. The physics goals of ATLAS include understanding the mechanism of electroweak symmetry breaking and many direct searches for "new physics". Amid great excitement, the LHC achieved circulation of first proton beams in September 2008. However, a heating problem in the interconnection of two magnets forced early termination of the 2008 run. Subsequent repairs have postponed the start of 2009 data taking. I will present the current status of the LHC and the ATLAS experiment, including an up-to-date schedule for 2009 data.

* This work is being supported by NSERC

MO-A7-5 11h30 (G*)

CP Asymmetry in Semileptonic Bs decays at D0*, **Steven Beale**, Wendy Taylor, *York University* — The observed baryon asymmetry implies new sources of CP violation beyond the Standard Model (SM). CP violation is predicted by the SM to exist in oscillations of neutral B_s mesons and may be enhanced by new physics. We measure the CP asymmetry in a large sample of semileptonic $B_s \rightarrow \mu D_s$ decays with a total integrated luminosity of over 5fb^{-1} taken at the D0 experiment at Fermilab. This analysis is the first direct measurement of the CP asymmetry in B_s oscillations using a time dependent flavor-tagged technique.

* This work is being supported by D0 Collaboration

MO-A7-6 **11h45** **(G*)**

Search for Higgs Bosons Produced in association with W bosons at CDF*, **Adrian Buzatu**, *McGill University* — We present a search for the Higgs boson decaying to b bbar pairs and produced in association with a W boson in p pbar collisions at sqrt(s) = 1.96 TeV. We searched a dataset corresponding to an integrated luminosity of 3.2 fb^{-1}. Our candidate events have one high-p_T muon or electron, missing E_T, and two jets. We increased the purity of our sample by using advanced techniques to identify several categories of jets with b-quarks. We further improved our discrimination of Higgs signal from backgrounds through the use of an artificial neural network. We combined our searches in the separate tag categories and set a 95% confidence level upper limit on the production cross section times branching ratio.

* This work is being supported by NSERC

MO-A7-7 **12h00**

Study of Dark Matter with the International Linear Collider*, **Mauricio Barbi**, *University of Regina* — Supersymmetric particles called neutralinos are considered potential candidates for the unknown cold dark matter. If neutralinos do exist, the Large Hadron Collider will likely see their signals. However, it will take the International Linear Collider (ILC) experiment to measure their properties with sufficient precision and therefore establish whether they do significantly contribute to the total amount of dark matter needed to explain the dynamics of galaxy clusters and the structure of the Universe. Events with neutralino signals are simulated in the framework of a mSUGRA model to study possible scenarios of identification with the ILC at a center of mass energy of 800 GeV. The events are simulated with PYTHIA interfaced to ISAJET for generation of supersymmetric particle and TAUOLA for tau decays with polarized electron beam, and then passed through a full detector simulation based on a compact ILC detector concept. Gamma-gamma and standard model backgrounds are considered in the analysis.

* This work is being supported by NSERC

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

[MO-A8] Best Condensed Matter Paper Published in CJP / *Meilleur article sur la matière condensée publié dans la RCP*

(DCMMP/*DPMCM*)

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

10h00 - 10h30

ROOM / *SALLE* MRR D202 (cap.135) *Chair: B. van Zyl, St. Francis Xavier University*

MO-A8-1 **10h00**

MONA BERCIU, University of British Columbia

Momentum Average Approximations

We present a novel approach for obtaining simple, yet highly accurate approximations for interacting problems. We use the Holstein polaron as an example, and show that the so-called Momentum Average (MA) approximation's predictions are in good agreement with results of numerical simulations over most of the parameter space, and become exact in various asymptotic limits. The resulting Green's function satisfies exactly the first six spectral weight sum rules, and all higher order sum rules are satisfied with great accuracy. Furthermore, the accuracy can be improved systematically, at a slightly increased computational cost. Successful generalizations to wider classes of Hamiltonians will be discussed as well.

10h30 **Session Ends / *Fin de la session***

[MO-A9] Theoretical Condensed Matter Physics / *Théorie de la matière condensée*

(DCMMP-DTP /*DPMCM-DPT*)

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

10h30 - 12h15

ROOM / *SALLE* MRR D202 (cap.135) *Chair: B. van Zyl, St. Francis Xavier University*

MO-A9-1 **10h30**

KARL-PETER MARZLIN, St-Francis Xavier University

Propagation of photon pulses in strongly nonlinear atomic media

During the last decade considerable progress has been made towards nonlinear optical systems in which the presence of a single photon can strongly influence the dynamics of a second photon. This strongly interacting regime could best be achieved using Bose-condensed atomic gases and is of high interest for fundamental tests of quantum physics and for quantum information. In this talk I will give a brief overview of our recent work on the propagation of photons in such media. I will explain how careful matching of group velocities between two photons helps to build quantum logical gates or QND measurements of photon numbers and discuss the limitations of these proposals, including an upper limit of the atomic density and temperature, and the influence of quantum noise on their fidelity.

MO-A9-2 11h00

Electronic and optical properties of graphene quantum dots, **Devrim Guclu**, Pawel Potasz, Pawel Hawrylak, *National Research Council Canada* — We predict theoretically electronic and optical properties of graphene quantum dots, atomically thick nanometer-scale islands etched out of a single graphene sheet. We study quantum dots with triangular and hexagonal shape, and verify earlier predictions [1,2] that triangular dots with zig-zag edges lead to a band of degenerate states at the Fermi level (Dirac point). Electronic properties of triangular grapheme quantum dots are investigated using a tight binding method with first and second nearest neighbour interactions as a function of dot size and carrier density. The effects of electron-electron interactions are treated by a combination of tight-binding, Hartree-Fock and configuration interaction methods. We predict ground state magnetization, excitation spectra, and optical properties as function of island size and filling fraction of the band of zero-energy states.

1. J. Fernandez-Rossier and J.J. Palacios, *Phys. Rev. Lett.* **99**, 177204 (2007).
2. M. Ezawa, *Phys. Rev. B*, **77**, 155411 (2008).

MO-A9-3 11h15

Electronic structure in the vortex state of a two-band superconductor with mixed dimensionality*, **Kaori Tanaka**, *University of Saskatchewan* — We study vortex structure in a two-band superconductor, in which one band is ballistic and quasi-two-dimensional (2D), and the other is diffusive and three-dimensional (3D). Motivated by MgB_2 -- the best material discovered so far for studying multiple-band superconductivity, we assume that superconductivity is "weak", *i.e.*, mostly induced in the 3D diffusive band. Hybridization with the "weak" diffusive band has significant and intriguing influence on the electronic structure in the "strong" ballistic band. In particular, the Coulomb repulsion and the diffusivity in the "weak" 3D band lead to enhanced suppression of superconductivity by magnetic field, resulting in reduced critical temperature and field. A particularly interesting feature found in our model is the appearance of additional bound states at the gap edge in the "strong" 2D band. Furthermore, the band gaps and van Hove singularities of energy bands of the vortex lattice in the "strong" ballistic band are significantly reduced by coupling with the "weak" diffusive band.

* This work is being supported by NSERC

MO-A9-4 11h30

Effect of nonlocal interactions on the disorder-induced zero-bias anomaly in the extended Anderson-Hubbard model*, **Rachel Wortis**, Hongyi Chen, W.A. Atkinson, *Trent University* — Adding disorder to a system of correlated electrons moves single-particle states away from the Fermi surface. In the weakly correlated regime, consensus exists on the evolution of the resulting density of states anomaly between the limits of weak and strong disorder. Recently a number of groups have made progress in understanding the strongly correlated regime, mostly in the context of purely local interactions. We study the extended Anderson-Hubbard model using exact diagonalization on two-dimensional 12-site clusters, exploring the evolution of the zero-bias anomaly with the strength of the nonlocal interaction and with doping. At half filling, an exchange-driven Altshuler-Aronov-like anomaly develops Efros-Shklovskii-like atomic character and moves to a regime of strong charge-density correlations, whereas at quarter filling both the Efros-Shklovskii-like behavior and the charge density correlations are much weaker.

* This work is being supported by NSERC and SHARCNET

MO-A9-5 11h45

Asymptotic Approximations to Clebsch-Gordan Coefficients from a Tight-Binding Model*, **Donald Sprung** [1], D. Ben Criger [2], Wytse van Dijk [3], Joan Martorell [4], [1] *McMaster University*, [2] McMaster and University Waterloo, [3] McMaster and Redeemer Univ. College, [4] University of Barcelona, Spain — The recurrence relations of the angular momentum vector addition coefficients are interpreted as a tight-binding model of a one-dimensional potential. From this model we derive their semi-classical limits in a simple manner, treating separately large J approx L+S, (corresponding to the ground and low-lying states) and small J approx |L-S|, (corresponding to the highest lying states). The first case leads to oscillator wave functions; the second case gives the well known approximation of Edmonds [1] in terms of symmetric top wave functions. The resulting picture makes their qualitative behaviour transparent to beginners, without the use of advanced concepts. The case |L| = |S| and M=0 is especially simple; non-zero M slightly more complicated, and |S| < |L| doable [2]. In recent work, T.A. Heim, J. Hinze and A.R.P. Rau [3], have discussed the so-called 'non-trivial' zeroes of the 3-j symbols. These are cases where there is no "obvious" symmetry principle which causes the symbol to vanish. The asymptotic relations we have established in terms of oscillator and symmetric top wave functions provide an explanation, as they correspond to wave function nodes.

1. *Angular Momentum in Quantum Mechanics*, Princeton, (1957)
2. to appear in *Am. J. Phys.* (2009)
3. to appear in *J. Phys. A*, (2009)

* This work is being supported by NSERC and DGES-Spain

MO-A9-6 12h00

Computer Simulations of the Sintering of Metallic Nanoparticles*, **Ralf Meyer**, *Laurentian University* — The development of modern functional nanomaterials has spurred a growing interest in the production of nanoparticles with well defined physical properties. An important part of the gas-phase production of nanoparticles is the sintering step where agglomerated particles with irregular shapes are transformed into nearly spherical particles. In this work, molecular-dynamics simulations are performed in order to study the sintering of metallic nanoparticles at temperatures of 800 K and 1000 K over periods of up to 200 ns. In simulations of the sintering of two nanoparticles with a diameter of approximately 4 nm a small-angle grain boundary is formed shortly after the particles get in contact. This grain boundary leads to the formation of a grid of (partial) dislocations. The grain boundary remains stable over a period of several nanoseconds until the dislocations disappear from the system. The disappearance of the dislocations leads to a simultaneous rotation of the grains so that a single-crystalline particle is formed. Simulations of the sintering of larger particles are currently in progress.

* This work is being supported by the Deutsche Forschungsgemeinschaft (SFB 445) and Laurentian University

12h15 Session Ends / *Fin de la session*

[MO-DHP] (DHP/*DHP*) DHP Business Meeting (lunch available) / *Réunion d'affaires DHP (dîner disponible)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*
12h15 - 13h30

ROOM / *SALLE* MRR C012 (cap.12) *Chair: W.F. Davidson, National Research Council*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends / *Fin de la réunion***

[MO-DNP] (DNP/*DPN*) DNP Business Meeting (lunch available) / *Réunion d'affaires DPN (dîner disponible)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*
12h15 - 13h30

ROOM / *SALLE* MG2 148G2 (cap.132) *Chair: M.N. Butler, St. Mary's University*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends / *Fin de la réunion***

[MO-DOP] (DOP/*DOP*) DOP Business Meeting (lunch available) / *Réunion d'affaires DOP (dîner disponible)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*
12h15 - 13h30

ROOM / *SALLE* MRR A102 (cap.134) *Chair: R. Corriveau, CIPI/ICIP*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends / *Fin de la réunion***

[MO-DCMMP] (DCMMP/*DPMCM*) DCMMP Business Meeting (lunch available) / *Réunion d'affaires DPMCM (dîner disponible)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*
12h15 - 13h30

ROOM / *SALLE* MRR D202 (cap.135) *Chair: I.G. Hill, Dalhousie University*

Agenda circulated to participants separately. / Ordre du jour distribué aux participants séparément.

13h30 ***Meeting* Ends / *Fin de la réunion***

[MO-DIMP] (DIMP/*DPIM*) DIMP Business Meeting (lunch available) / *Réunion d'affaires DPIM (dîner disponible)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*
12h15 - 13h30

ROOM / *SALLE* MRR D002 (cap.134) *Chair: K.H. Michaelian, CANMET, Natural Resources Canada*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends / *Fin de la réunion***

[MO-DPP] (DPP/*DPP*) DPP Business Meeting (lunch available) / *Réunion d'affaires DPP (dîner disponible)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*
12h15 - 13h15

ROOM / *SALLE* MRR D102 (cap.16) *Chair: J.E. Morelli, Queen's University*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h15 ***Meeting* Ends / *Fin de la réunion***

[MO-DIAP] (DIAP/*DPIA*) DIAP Business Meeting (lunch available) / *Réunion d'affaires DPIA (dîner disponible)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

12h15 - 13h30

ROOM / *SALLE* MRR A002 (cap.134)

Chair: E. Maeva, University of Windsor

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends / *Fin de la réunion***

[MO-Plen2] (CAP/*ACP*) Plenary - Jeff Dahn, Dalhousie U. (Teaching Medal) / *Plénière - Jeff Dahn, U. Dalhousie (Médaille de l'enseignement)*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

13h30 - 14h00

ROOM / *SALLE* JdeV Salle de spectacle (cap.410)

Chair: H.H. Rotermund, Dalhousie University

MO-Plen2-1 **13h30**

JEFF DAHN, Dalhousie University

If It's Fun For You, It's Fun For Them

Coupling virtually non-stop lecture demonstrations with 1st year Physics teaching makes lecturing fun for me. When I'm having fun, the students get engaged and enjoy the lectures too. My teaching style has evolved primarily due to the influences of Ernie Guptill, Gerhard Stroink, Frank Curzon, Jeff Rudd, Albert Curzon and Melvin Calkin. In this lecture, using virtually non-stop demonstrations, I will describe how each of these gentlemen influenced what I do in class.

14h00 **Session Ends / *Fin de la session***

[MO-P1] (DCMMP/*DPMCM*) Magnetism and Frustrated Magnetism / *Magnétisme et magnétisme frustré*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

14h15 - 16h30

ROOM / *SALLE* MRR R221 (cap.292)

Chair: J.R. Dutcher, University of Guelph

MO-P1-1 **14h15**

BRUCE D. GAULIN, McMaster University

Exotic Magnetic Ground States in XY Pyrochlores

Geometrical frustration arises quite generally when pairwise interactions in magnetic materials are incompatable with their local geometry. This often involves magnetic materials made up of assemblies of triangles or tetrahedra. The frustration is manifest by disordered low temperature states for the magnetic material - some of which are described by spin liquids, spin glasses, and spin ice. I will discuss new neutron scattering work on two magnetic pyrochlores $Er_2Ti_2O_7$ and $Yb_2Ti_2O_7$, which can be thought of in terms of XY magnetic moments decorating a network of corner-sharing tetrahedra. The ferromagnet, $Yb_2Ti_2O_7$, displays a disordered ground state, but can be brought to order in an applied magnetic field. The antiferromagnet, $Er_2Ti_2O_7$, displays a long range ordered state at low temperatures which can be driven into a quantum disordered state by application of a magnetic field.

MO-P1-2 **14h45**

MICHEL GINGRAS, University of Waterloo

Transverse Field, Random Fields and Glass Transition in the Quantum Magnetism of $LiHo_xY_{1-x}F_4$

The Ising model of magnetism constitutes the simplest example of a system exhibiting a phase transition driven by thermal fluctuations. Similarly, the transverse field Ising model (TFIM) where Ising spins are subject to an magnetic field applied perpendicular to the direction of the magnetic moments is one of the simplest system that possess a quantum phase transition at zero temperature driven by quantum fluctuations. In this latter context, the $LiHo_xY_{1-x}F_4$ material has over the past twenty years attracted most attention from experimentalists as a physical realization of the TFIM. A magnetic field perpendicular to direction of the Ho^{3+} spins causes quantum tunneling between the up and the down directions. A field larger than a few Teslas destroys the magnetic order via a quantum phase transition at zero temperature. In this talk, I will review the problem of transverse field induced quantum fluctuations in pure LiHoF4 and dilute $LiHo_xY_{1-x}F_4$, putting emphasis on the problem of induced longitudinal random fields in the latter, as well as discuss the problem of the zero field spin glass transition in dilute $LiHo_xY_{1-x}F_4$.

15h15 **Coffee Break / *Pause Café***

MO-P1-3 **15h45**

Trigonal spin interactions in magnetoelectric $CuFeO_2$ and $HoMnO_3$[*], **Martin Plumer**, Stephen Condran, *Memorial University of Newfoundland* — The interplay between magnetic and electric properties in a wide variety of geometrically frustrated antiferromagnets has been revealed in recent years. The observed magnetoelectic response is often associated with unusual types of non-collinear spin order and depends crucially on crystal symmetry. A large class of such compounds are formed from stacked triangular layers and allow for the possibility of unusual trigonal interactions involving all three components of the spin vector [1]. Several examples of the importance of this term in stabilizing exotic magnetic configurations in magnetoelectric compounds are explored within the framework of a non-local Landau-type free energy. In the case of rhombohedral $CuFeO_2$, the trigonal interaction is responsible for a canting of the cyclodial spin structure which gives rise to an induced electric polarization vector [2]. In hexagonal $HoMnO_3$, it is shown that this term provides a crucial interaction between basal-plane Mn magnetic order and c-axis Ho moments resulting in a series of reorientation transitions [3].

1. See, e.g., R.A. Cowley and J. Jensen, *J. Phys. Condens. Matter* **4**, 9673 (1992).
2. M.L. Plumer, *Phys. Rev. B* **78**, 094402 (2008).
3. S.G. Condran, M.Sc. Thesis, Memorial University of Newfoundland (2009).

[*] This work is being supported by NSERC and CFI

MO-P1-4 **16h00**

Magnetic ordering and exchange interactions in multiferroic Bi_2FeCrO_6 thin films[*], **Riad Nechache** [1], Catalin Harnagea [1], Mangala P. Singh [2], Louis-Philippe Carignan [3], Patrick Fournier [2], David Ménard [3], Alain Pignolet [1], [1] *INRS-EMT*, [2] Université de Sherbrooke, [3] École Polytechnique de Montréal — Complex oxides exhibit a large range of interesting physical properties; they can be insulating, metallic, semiconductor, supraconductor, ferroelectric, ferri/ferromagnetic as well as they could exhibit phenomena such as supraconductivity, charge ordering (CO), spin-orbit coupling, magnetoresistance and multiferroicity. In the latter case, two or three ferroic properties (i.e. ferroelasticity, ferroelectricity, as well as ferro or –ferri-magnetism) occur simultaneously in the same material. Beside their potential applications, the fundamental physics of multiferroic materials is rich and fascinating. Good magnetic and ferroelectric properties have recently been observed at room temperature in pulsed laser deposition (PLD) grown epitaxial single phase Bi_2FeCrO_6 (BFCO) thin film, which makes them a promising candidate for building integrated devices. Earlier studies have shown that BFCO exhibits a double perovskite structure with a cationic ordering on the B-site, where the Fe^{3+} and Cr^{3+} ions alternate along the crystallographic <111> direction, making up a rock-salt type magnetic cation lattice. BFCO magnetic insulating properties are basically governed by the Goodenough-Kanamori rules, with their ferro-ferrimagnetic coupling arising from a 180° superexchange interaction between Fe^{3+} and Cr^{3+} transition metal ions through the oxygen ion of the Fe-O-Cr bond. In order to study the nature of Fe^{3+}-Cr^{3+} exchange interaction, we grew epitaxial thin films with several thicknesses and on various single crystalline substrates. The variation of the epitaxial strain imposed on the film allows investigating the effect of the structure distortion (i.e. bond distances and angles) on the magnetic interactions between Fe and Cr, as well as on the cationic order. The structural parameters were mainly characterized by X-ray diffraction and reciprocal space mapping. Experimental results about the influence of the epitaxial strain on the films properties and the relationship between them will be presented. A particular attention will be paid on the evolution of the magnetic properties of BFCO thin films with the variation strain states in the film, and the exchange integral J of all films has been estimated from the temperature dependence of the magnetization measurements.

[*] This work is being supported by NSERC

MO-P1-5 **16h15** **(G*)**

Enhanced Curie Temperature in epitaxial MnSi films[*], **Eric Karhu** [1], Samer Kahwaji [1], Krista Raffel [2], Michael Robertson [2], Christian Maunders [3], Theodore Monchesky [1], [1] *Dalhousie University*, [2] Acadia University, [3] McMaster University — Bulk MnSi has attracted a lot of recent interest due to the discovery of pressure induced non-Fermi-liquid together with a change from helical magnetic order to a partially ordered state. In contrast to bulk, relatively little work has been done on MnSi thin films. These films potentially provide an interesting system for investigating the use of helical magnets in spintronics studies. We present the magnetic properties of single crystal epitaxial MnSi(111) thin films grown by both solid phase epitaxy and molecular beam epitaxy. Transmission electron microscopy and x-ray diffraction show that the 3% lattice mismatch between the Si(111) substrate and the MnSi is partially relaxed by misfit dislocations. SQUID magnetometry measurements show that the films are very sensitive to strain and defects. With an epitaxially induced in-plane tensile strain of 0.7 % we observed magnetic ordering temperatures as large as T_C = 43K, compared to T_C = 29.5 K in bulk. The field dependence of the magnetization is consistent with helical magnetic order. However, unlike bulk MnSi, the thin films show glassy behaviour below the ordering temperature.

[*] This work is being supported by NSERC and the Canada Research Chairs program. The authors are grateful to Dr. G. Botton and the Canadian Centre for Electron Microscopy for their support.

16h30 **Session Ends** / ***Fin de la session***

[MO-P2] Quantum Optics - Cold Atoms / *Optique quantique - atomes froids*

(DAMPhi-DOP/ *DPAMip-DOP*)

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

14h15 - 16h15

ROOM / *SALLE* **MG2 148G2 (cap.132)**

Chair: A.A. Madej, National Research Council

MO-P2-1 **14h15**

DUNCAN O'DELL, McMaster University

Bloch Oscillations of cold atoms inside an optical cavity: a proposal for ultra sensitive measurement of forces

When a quantum particle in a periodic potential is subjected to an external force it does not accelerate uniformly like a free particle but instead undergoes oscillatory motion known as Bloch oscillations. Recent experiments on ultracold atoms in optical lattices have used Bloch oscillations to measure gravity and also

the fine structure constant to high precision. I will discuss theoretical calculations upon a variant of this idea, namely atoms that move in the optical lattice formed inside an optical cavity pumped by a laser. A cavity allows for a very strong atom-light interaction and the signature of the atomic Bloch oscillations can become imprinted onto the light transmitted by the cavity thus allowing for very high precision measurements.

MO-P2-2 14h45 (G*)

Atom Interferometric Studies of Light Scattering.* **S. Beattie** [1], B. Barrett [1], I. Chan [1], C. Mok [1], I. Yavin [2], A. Kumarakrishnan[1] [1]*York University* [2]Princeton University — We use an echo-type atom interferometer (AI) that manipulates laser-cooled atoms in a single ground state to investigate the effects of light scattering. The AI uses two standing-wave pulses at time t = 0 and t = T to diffract and recombine momentum states separated by $2\hbar k$ at t = 2T. Matter wave interference is associated with the formation of a density grating with period $\lambda/2$ in the vicinity of this echo time. The grating contrast is measured by recording the intensity of backscattered light. If the AI is perturbed by a standing wave pulse at t = 2T-δT, the contrast exhibits a periodic modulation at the atomic recoil frequency as a function of δT. The signal shape is accurately described using a coherence function, which is the Fourier transform of the momentum distribution of the perturbing pulse. This technique allows the atomic recoil frequency and the populations of momentum states to be measured easily and precisely. The signal can also be derived analytically using the theory of echo formation so that it is possible to understand effects of spontaneous emission and spatial profile of the laser beam and test predictions for scaling laws that define the width of interference fringes. If the AI is perturbed by a traveling wave, the contrast can be modeled by a quasi-periodic coherence function as in previous experiments in atomic beams. We also study the effects of continuous wave light on the AI. Details are described in PRA 79, 021605 (R) (2009).

* This work is supported by CFI, OIT, NSERC, OCE and York University

MO-P2-3 15h00 (G*)

Properties of Magnetic Sublevel Coherences for Precision Measurements*, **I. Chan**, S. Beattie, B. Barrett, C. Mok, A. Kumarakrishnan, *York University* — We excite a sample of laser cooled Rb atoms with two pairs of excitation pulses separated by t = T. Each excitation pulse consists of a pair of traveling waves that drive two photon transitions between adjacent magnetic sublevels of the same hyperfine ground state. The first set of pulses creates a spatially periodic superposition of magnetic sublevels. The superposition dephases due to the velocity distribution of the sample. The second pulse rephases the superposition producing a magnetic grating echo (MGE) at t = 2T. We have studied the MGE in the presence of static magnetic fields. The MGE can be described using simulations based on rate equations. We find that the amplitude of the MGE envelope exhibits oscillations as a function T that depend on the Rabi frequencies of the excitation pulses and on the magnetic field. However, Rabi frequency oscillations average out due to the effect of the spatial profile of the excitation beam allowing magnetic field dependent oscillations to be observed. This effect can be explained in analogy with optical Bloch equations that model a two level atomic system. The magnetic field oscillations can be exploited for a precise measurement of the atomic g factor ratio using two isotopes of Rb. We also find that the magnetic field produces Larmor oscillations within the envelope of the MGE. The functional form of these envelope oscillations can be described on the basis of a rotation matrix approach. Details of this work are published in PRA 78, 033418 (2008).

* This work is being supported by CFI, OIT, NSERC, OCE and York University

15h15 Coffee Break / *Pause Café*

MO-P2-4 15h30

ANDRÉ STAUDTE, National Research Council of Canada

Single Molecule Scanning Tunneling Microscopy †,*

Molecular multiphoton ionization in the tunneling limit is similar to tunneling in a scanning tunneling microscope (STM). In both cases, electrons escape from the outer regions of the orbital to the continuum; that is, to the vacuum for multiphoton ionization of gas phase molecules or to the conduction band of the metal tip in a STM. In a STM, the sample is fixed and the tip is moved. Rotating the molecule with respect to the field direction is the analog of moving the tip. The resulting angle-dependent ionization probability provides information for a molecule analogous to the position dependence of the tunneling current in a STM. However, whereas the total tunneling current is one observable, the electron wave packet that emerges into the vacuum from the tunnel retains more information about the orbital. In my talk I will present the experimental results for three different molecules where we have used the tunneled electron wavepacket to map out the molecular orbital. The results were obtained by employing the experimental technique of COLTRIMS, which has also been dubbed "momentum microscope". In particular we have measured the angular ionization probability in the molecular frame of hydrogen, nitrogen and HCl molecules.

† In collaboration with Hiroshi Akagi [1], Moritz Meckel [2], Domagoj Pavicic [3], Serguej Patchkovskii [3], Reinhard Doerner [2], David Villeneuve [3], Misha Ivanov [3], Paul Corkum [3], [1] Japan Atomic Energy Agency, [2] Goethe University of Frankfurt, Germany, [3] National Research Council of Canada

* This work is being supported by NSERC, AvH, AFOSR, DFG

MO-P2-5 16h00 (G*)

A Method of Transferring the Frequency Stability of a Single Reference Laser to Multiple Lasers with Disparate Wavelengths Using a Transfer Cavity*, **Gideon Humphrey** [1], Alan Madej [2], [1] *Department of Physics and Astronomy, York University*, [2] Institute for National Measurement Standards, National Research Council of Canada — In many laser cooling and atom trapping experiments, it is critically important to prevent the frequency drift of multiple laser sources operating at different wavelengths. It is often the case that such laser wavelengths exist in regions of the spectrum where there are few or no nearby atomic or molecular transitions to provide a reliable frequency reference. We describe a technique to frequency stabilize a series of laser wavelengths at the sub-MHz level and have applied the method to an optical atomic clock based on a trapped single strontium ion. A scanned transfer cavity consisting of two optical resonators sharing a common spacer is locked to a reference laser. Servo stabilization of the controlled lasers is accomplished by comparing the positions of their transmission peaks to those of the reference laser. In this work, the reference laser used is a polarization-stabilized HeNe at 633 nm. The technique is then used to frequency stabilize a diode-pumped fiber laser operating at 1092 nm that is used to prevent shelving of the strontium ion in a metastable state during laser cooling. A standard deviation of the locked fiber laser relative to the reference laser was measured over 2.5 days as 380 kHz. In addition, the stabilized fiber laser relative to

an optical frequency comb reference yielded a standard deviation of 530 kHz over a 20 minute measurement run. The system is also being extended toward simultaneously locking an external cavity diode laser operating at 1033 nm used for state preparation of the ion.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada.

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

[MO-P3] (DIAP/*DPIA*) Applied Physics / *Physique appliquée*

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***

14h15 - 17h30

ROOM / *SALLE* **MRR A002 (cap.134)**

Chair: E. Maeva, University of Windsor

MO-P3-1 **14h15**

ANDRZEJ KOTLICKI, University of British Columbia

Sensors used to Characterize Musical Instruments †,*

The study of the physics of musical instruments is often hampered by the high cost of instrumentation. We describe the construction and calibration of a simple impact hammer, and of cheap sensors that can be used to analyze string motion. Impact hammers are used for rapid testing of the frequency-dependent response of structures to excitation. This work demonstrates how one can be made from a piezo-electric crystal of the type widely available in barbeque lighters. The hammer was tested by measuring the inertance of a known, mobile mass, and by measuring the calculable driving-point admittance of rectangular wooden bars. It was shown to be robust, easily reproduced, and to have a low-noise, linear output over a wide range of applied forces. The full characterization of a stringed musical instrument requires measuring the motion of the strings in at least two dimensions. Traditionally this has been done using electromagnetic means or by optical transmission. However in many instruments the strings are not made of steel, nor are the strings easily accessible on both sides. In this work it is shown that string positions can be measured by inexpensive optical reflection sensors which neither require metallic strings nor obtrusive access. We have demonstrated a versatile and non-invasive technique for measuring the position of a vibrating string in a 1 mm^2 area with an accuracy of tens of microns for thin strings, and better than 0.1 mm for thick ones.

† In collaboration with Chris Waltham, University of British Columbia
* This work is being supported by Department of Physics and Astronomy, UBC

MO-P3-2 **14h45**

EUGENE MALYARENKO, Tessonics Corp.

Objective percussion for diagnostics of pulmonary traumas †

Pulmonary traumas occurring in various emergency cases require fast and accurate diagnosis. Percussion is a traditional technique used for physical examination of pulmonary injuries and diseases. It is a method of tapping body parts with fingers or small instruments to evaluate the size, consistency, borders, and presence of fluid/air in the lungs and abdomen. Percussion has been successfully used for the diagnostics of such potentially lethal conditions as traumatic and tension pneumothorax. A significant impact on the mortality rates could be made if pulmonary traumas could be identified rapidly and on site, when thorough clinical examination is impossible, and by unskilled personnel. One of the main objectives of this work was to develop algorithms and percussion methodology procedure for detection and recognition of pulmonary injury through signal processing. The subjective factor is removed by using a standardized percussion source and computerized classification of digitized signals. Our algorithms extract several time- and frequency-domain parameters and automatically classify percussion signals into three main groups, historically known as "tympanic", "resonant", and "dull". The groups are well separated in the chosen parameter space thus allowing for reliable automatic diagnostics of the air/liquid inclusions in the thorax and abdomen. We have completed a volunteer pilot study and collected a database of signals that allowed us to refine the algorithms and the examination procedure.

† In collaboration with M. Pantea, F. Seviaryn, M. Bhuiyan, and R. Gr. Maev, University of Windsor, A. Baylor and R. Bachusz, Wayne State University, Michigan.

15h15 **Coffee Break** / ***Pause Café***

MO-P3-3 **15h45**

My Years as a Physicist at Chalk River Laboratories*, **William Diamond**, *Atomic Energy of Canada Limited* — The Chalk River Nuclear Laboratories (CRNL) were established by the end of World War 2 and the new laboratory soon attracted an elite group of scientific and engineering talent focusing on Nuclear Physics, Material Science, Neutron and Solid State Physics and Reactor Technology. During the 1960's, CRNL agreed to take students for cooperative work terms in Applied Physics and Engineering from the newly established University of Waterloo. The author was fortunate enough to start his scientific career as one of those students in Applied Physics and, with the exception of 13 years from the late 1970's through the 1980's, has worked at Chalk River as a student, graduate student, Postdoctoral Fellow and Scientist since that time. This talk will cover some of the research areas investigated during that career at Chalk River, mostly with a common thread of applying physics to solving complex technical problems. Often, the differences between underlying and applied physics research are quite subtle. This will be illustrated by several examples including one in which a five-year development program was needed to solve an important operational issue on the superconducting cyclotron under development during the 1990's. During the last 20 years, the focus at Chalk River has shifted from physics research to engineering and development of the CANDU reactor. Throughout this transition, Atomic Energy of Canada Limited and the research laboratories at Chalk River have continued to be one of the largest employers of physicists in Canada. The talk will conclude with a sampling of several recent investigations supporting the CANDU reactor.

* This work is being supported by Atomic Energy of Canada Limited

MO-P3-4 16h00 (G*)

Finite-difference modelling of layered structures for thermal NDE analysis simulation, **Dmitry Gavrilov** [1], Ghodsi Ghazal [1], Elena Maeva [1], Roman Gr. Maev [2], [1] *University of Windsor*, [2] Institute for Diagnostic Imaging Research — Theory and applications of thermographic NDE methods are described. For simulation of this type of analysis a finite-difference model has been developed. Based on the model, various heat-propagation processes were studied and compared to experimental data. A possibility of quantitative analysis of thermal properties of materials (thermal diffusivity) has been studied. The model was applied to simulation of Lock-In and Pulsed Phase thermographic methods and demonstrated high agreement with experimental results.

MO-P3-5 16h15 (G*)

High Efficiency Wireless Power Transfer at Low Frequencies*, **Weilai Li**, Lorne Whitehead, *University of British Columbia* — A new method of wireless power transfer has been devised capable of transferring large amounts of electrical power across a distance several times the size of the transfer devices, with high efficiency and at low coupling frequency (60 Hz). This method offers advantages over high frequency coupling technologies, especially with regard to potential health concerns associated with kHz and MHz electromagnetic (EM) radiation and its interaction with living tissue. The technique employs the fact that the position and orientation of one permanent magnet will affect the position and orientation of another, even over a considerable separation distance. When mechanical energy, such as rotary motion, is supplied to the transmitting magnet, that motion is transferred to the receiving magnet with minimal loss. Electrical-mechanical power conversion is implemented at both sides with common EM machines such as motors and generators with high efficiency. Experimentally, this method has shown promising performance results at various size scales. An example of a small-scale application is the transcutaneous powering of an artificial heart. Proof-of-principle demonstrations at this relatively small size scale have achieved 60W transfer across 10cm separation at 150Hz. An example of a large-scale application is the wireless charging of an electric car. Demonstrations at this large size scale have achieved 3kW transfer across 15cm separation. The experimental results confirm that the efficiency of the transfer is limited only by the losses in the motor, the generator, and the bearings with no measurable magnetic coupling losses. Other results also agree closely to simple models.

* This work is being supported by NSERC and the 3M Company

MO-P3-6 16h30

Implementation Of Associated Particle Imaging System For The Detection Of Landmines And Improvised Explosive Devices, **Cristian Mosquera** [1], Anthony A. Faust [1], John McFee [1], Kyle Pastor [2], [1] *Defence R&D Canada - Suffield*, [2] McMaster University/Defence R&D Canada - Suffield — There has been an growing recognition of the need to develop and improve non-intrusive explosives detection technologies to apply to the challenging tasks of landmine and Improvised Explosive Device (IED) detection. In response, Defence R&D Canada – Suffield has been investigating the material-characterization capabilities of Fast Neutron Analysis as implemented through an Associated Particle Imaging (API) system. API is predicated on the the time and spatial correlation of the alpha and 14 MeV neutron produced in the deuterium-tritium reaction. Measuring the direction and time of flight of the alpha allows one to infer the associated neutron's flight path. Measuring the energy and time-of-arrival of a subsequent characteristic gamma-ray allows one to develop a elemental fingerprint of a specific region of interest. Exploiting the deep penetrability of fast neutrons and their characteristic inelastic scattering gamma-ray signatures from different elements, this technique will allow us to measure the elemental composition of a spatially-defined target volume with the goal of identifying explosive or hazardous materials through their H, C, N and O ratios. This presentation will describe our experimental setup and present recent results from proof-of-principle experiments.

MO-P3-7 16h45 (U)

Time and Linearity Studies of $LaBr_3$(Ce) as Part of an Associated Particle Imaging System*, **Kyle Pastor** [1], Cristian Mosquera [2], John Elton McFee [2], Anthony A. Faust [2], [1] *McMaster University/Defence R&D Canada - Suffield*, [2] Defence R&D Canada - Suffield — The task of clearing explosives presents many practical and technical challenges. Due to the unpredictable shape, size, location and content of many of today's explosive hazard - ranging from undetonated mines from previous conflicts to Improvised Explosive Devices (IEDs) in present war zones - the detection and identification of these threats is vital to determine the correct course of action necessary to both clear the hazards and protect those who do. With the Associated Particle Imaging (API) system being constructed at Defense R&D Canada – Suffield, we hope to be able to characterize the composition of materials placed beneath the ground through the determination of their stoichometric ratios in union with the approximate depth of the explosives. Once the explosive content of a target volume is ascertained, neutralization and remediation can then be conducted. This system uses a Deuterium-Tritium neutron generator to produce an alpha-neutron pair. Since the direction of one is opposed to the other, the detection of the alpha can be used to indicate the direction of the paired neutron. Detection of subsequent characteristic gamma-rays produced from inelastic neutron scattering in the target volume allows us to determine both the time-of-production and energy of the photon, thus the target depth and elemental composition. This technique requires good energy resolution at high energies and input rates along with sub-nanosecond timing. To achieve this, we have been investigating the properties of Lanthanum Bromide as the principal candidate for the detection element of this system. This poster presents results from an experimental evaluation of linearity and efficiency of 3"x3" $LaBr_3$:Ce scintillators in high-rate, high-energy environments.

MO-P3-8 17h00

New Development of Small Angle Neutron Scattering (SANS) Capability and Application at Canadian Neutron Beam Centre*, **Mu-Ping Nieh**, Zahra Yamani, Norbert Kucerka, John Katsaras, *National Research Council* — Small angle neutron scattering (SANS) instruments typically cover a q (scattering vector) range from 0.001 $Å^{-1}$ to 0.6 $Å^{-1}$. This range in q is achieved through a combination of cold neutrons ($\lambda > 4$ Å) and a highly collimated beam. However, as a direct result of the unavailability of a cold source at the Canadian Neutron Beam Centre (CNBC), we have adapted a triple-axis spectrometer to perform SANS measurements. This is achieved through the use of multiple converging incident beams which enhance the neutron flux on the sample by a factor of 20, compared to a single beam of the same spot size. Furthermore, smearing effects due to vertical divergence from the slit geometry are reduced through the use of horizontal Soller collimators. As a result, this modified triple-axis spectrometer enables SANS measurements to a minimum q value (q_{min}) of ~ 0.006 $Å^{-1}$. We have applied this SANS capability to varieties of soft materials to characterize their structures.

* This work is being supported by NRC, Canada

MO-P3-9 **17h15** **(G*)**

Pneumatical Switching of the Optical Power of a Fresnel Lens for Control of Solar Illumination*, **Eri Watanabe**, Lorne Whitehead, *University of British Columbia* — A pneumatic-based illumination switch has been developed for use in conjunction with a sunlight collection system that collects sunlight on the façade of a multi-story building and distributes it throughout the core areas of the building. Sunlight collection systems are currently of interest since they have the potential to significantly reduce the need for electrical lighting in workplaces, thus reducing the required electrical energy and associated greenhouse gas emissions. In one particular system, sunlight is distributed by hollow light guides and redirected into light fixtures positioned along the guides. The illumination switch can be used in the light guides to control the amount of sunlight that is directed into each fixture. The device consists of a Fresnel lens positioned next to a layer of silicone gel that has the same refractive index as the lens. In one mode of operation, the gel layer is separated from the lens so that the lens focuses the sunlight into a second hollow light guide that carries the sunlight to a fixture. In the second mode of operation, when the index-matching gel layer is pressed into contact with the prism of the Fresnel lens, the switch allows sunlight to pass substantially undeflected through the lens and continue down the guide. The switch is activated by a vacuum pump that pulls the silicone gel into and out of contact with the Fresnel lens. Experimental tests show that intensity of the light in a fixture can be reduced by about 75% when the switch is activated.

* This work is being supported by NSERC and the 3M company

17h30 **Session Ends** */ Fin de la session*

[MO-P4] Interactive Teaching / *Enseignement interactif*

(DPE/*DEP*)

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***

14h15 - 17h00

ROOM / ***SALLE*** **MRR A102 (cap.134)**

Chair: A. James Sarty, St. Mary's University

MO-P4-1 **14h15**

NATHANIEL LASRY, John Abbott College

Getting Started in Physics Education Research

Data collected over the past three decades show that traditional methods of instruction fail in many regards. These data also show that one can approach educational research with the same rigor used to approach our research projects in physics. The purpose of this talk is to give an overview and a few examples of how physics instructors can collect and analyze meaningful educational data.

MO-P4-2 **14h45**

RAISE and its Faculty Teaching Engagement Survey at the University of Calgary*, **Robert I. Thompson** [1], Cindy Graham [2], James Stallard [3], Anthony Russell [2], Helen P. Gardiner [4], Ian R. Hunt [5], Alfredo Louro [1], Leslie Reid [6], Ben Stephenson [7], [1]*Dept. of Physics and Astronomy, University of Calgary*, [2] Dept. of Biological Sciences, University of Calgary, [3] Dept. of Mathematics & Statistics, University of Calgary, [4] Faculty of Medicine, University of Calgary, [5] Dept. of Chemistry, University of Calgary, [6] Dept. of Geoscience, University of Calgary, [7] Dept. of Computer Science, University of Calgary — RAISE, Research And Instruction in Science Education, is a community of scholars at the University of Calgary committed to the study, application, and promotion of high quality undergraduate education in the Faculty of Science. The initial actions of RAISE have been to undertake an extensive survey of the academic staff within the Faculty to determine the current level of knowledge, skills and attitudes towards undergraduate teaching. The intent is to identify the causes of any problem areas and to assemble a needs assessment that will address how to rectify problems and promote best teaching practices. This is an on-going two-stage process that began with an interview-based qualitative component, which is being followed by a fully inclusive quantitative survey. This presentation will include a brief introduction to RAISE and discussion of the structure and implementation of the academic staff survey.

* This work is being supported by Teaching and Learning Fund, University of Calgary

MO-P4-3 **15h00**

Analysis of student cheat sheets and other predictors of exam performance*, **Joss Ives** , *University of the Fraser Valley* — The use of a "cheat sheet", a page of formulae and notes created by each individual student to use as a resource when taking an exam, is common in many introductory physics courses. The wide variety in the structure of cheat sheets raises several interesting questions: Which characteristics of a student's cheat sheet can be used as predictors of exam performance? Are there different predictors for different types of questions, such as conceptual questions, quantitative "end-of-the-chapter" problems and "explain-your-reasoning" questions? This study examines the relationship between characteristics of cheat sheets, other student behaviors (self-reported study habits, achievement/effort in various elements of the course), and exam performance. The primary goals of this study are to identify at-risk students early in the term, and to quantitatively characterize the study behavior of high-achievement students and share these successful study behaviors with future students.

* This work is being supported by University of the Fraser Valley

15h15 **Coffee Break** */ Pause Café*

MO-P4-4 **15h45**

BENEDICT NEWLING, University of New Brunswick

"Please, Sir, I want some more examples": Inducers and Deducers in Our Classrooms

in•duc•tion n. the inference of a general law from particular instances. Often contrasted with deduction. The bias in traditional physics education is towards deduction. Part of the satisfaction of actually *doing* physics lies in the deduction of a particular behaviour from the simplest, most general set of rules about how the universe works. It seems natural that our students should be exposed to the Beauty of Physics in this way: first the general principles and then some special cases, first the "theory" and then some "examples". Our students are rarely of the same opinion. Consistently, student opinion surveys ask for more examples, students tell us that the examples are more useful than that which comes before and tutorials are preferred over lectures. Is that actually more natural? After all, we learn our first language inductively and most of our "common sense" is constructed in an inductive fashion. Educators have long recognised the power of inductive learning, particularly in motivating and engaging our students. Approaches such as problem-based learning and just-in-time teaching inherently encourage induction. However, it is frighteningly easy to induce the wrong or incomplete general principles from a particular set of examples. We will examine some of the traps for learners who prefer to induce and consider classroom/extracurricular techniques to help balance the delivery of material for both deducers and inducers. We will discuss whether a preference for induction is nurtured, for good or bad, in some educational contexts. The units of the presentation will be millihenries throughout.

MO-P4-5 **16h15** **(G*)**

Choice and Confidence Transitions to Conceptual Tests as Fine Indicators of Learning: An analysis of ten years of Peer Instruction data, **Ahmed Ibrahim** [1], Nathaniel Lasry [2], [1] *McGill University*, [2] Dawson College — We report results of an analysis of FCI-1 and FCI-2 data from ten years of Peer Instruction (PI) in Physics in a large university setting. Our results include the proportions of choice transitions or stability in student responses to the items of the FCI tests pre and post Peer instruction. The results also include the proportions of confidence intransitions or stability in student responses. We then report data that includes choice transitions or stability per confidence level, as well as confidence transition or stability per choice. We report results that show conceptual learning in terms of transition from wrong answers to right answers to FCI data, as well as results that show un-learning in terms of transition from right answers to wrong answers to the FCI data, and contrast the results. We report the same contrast for confidence levels. The paper highlights the importance of looking at choice and confidence transitions as indicators of learning as opposed to an overall gain.

MO-P4-6 **16h30**

A Discussion of the Present and Future of Physics Education Research in Canada, **Robert I. Thompson** [1], Shelley Page [2], Carl Wieman [3], [1] *University of Calgary*, [2] University of Manitoba, [3] University of British Columbia — In response to an initiative from the membership of the CAP's Division of Physics Education (DPE), during the fall and winter of 2008-09 the President of the CAP commenced a dialog with NSERC and SSHRC to discuss the future of Discipline-Based Education Research (DBER) and Physics Education Research (PER) in Canada. This effort included preparation of a discussion paper on DBER in Canada, completion of a survey of the members of the DPE on current PER activities, and meetings with the granting agencies at the Vice-Presidential level. This presentation will provide an overview of the current state of PER in Canada based on the results of the survey, and will discuss the results of the discussion paper and funding agency meetings in reference to the possible future of Canadian PER. Drs. Page and Thompson will be available for a general discussion at the end of the presentation.

16h45 **Discussion Break** / ***Pause de Discussion***

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

[MO-P5] (PPD/*PPD*) Non-Accelerator Particle Physics I / *Physique des particules sans accélérateur I*

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***

14h15 - 17h45

ROOM / *SALLE* **MRR A202 (cap.133)**

Chair: S. Robertson, McGill University

MO-P5-1 **14h15**

CARSTEN KRAUSS, University of Alberta

The Particle and Astrophysical Properties of the Neutrino: News from the SNO+ Experiment *

Many properties of neutrinos are still unknown, including mass, Majorana or Dirac character and their roles in cosmological models. SNO+ is a neutrino experiment that is currently being prepared at SNOLAB. SNO+ will measure the lifetime of neutrinoless double-beta decaying Neodymium in order to determine the Majorana mass of electron neutrinos. In addition SNO+ has a rich program to measure solar, reactor, geo, and supernova neutrinos. The SNO+ experiment will use the infrastructure constructed for the SNO experiment and convert it for the use with liquid scintillator. This talk will introduce the progress in the design of the detector and the projected experimental reach of the finished detector.

* This work is being supported by NSERC, FedNor

MO-P5-2 **14h45**

Status of the T2K time projection chambers*, **Blair Jamieson**, *University of British Columbia* — The Tokai-to-Kamiokande (T2K) experiment is a second generation long baseline neutrino oscillation experiment which will start taking data at the end of 2009. A near detector (ND280) located 280 m from the pion

production target will measure the neutrino beam properties before oscillation. Critical components of the ND280 detector are the three time projection chambers (TPCs). The TPCs were designed to measure the charge, the momentum with a 10% resolution at 1 GeV/c, and the identity of charged particles that pass through them. The unique features of the TPCs are the combination of ~1 m drift volume and gas amplification with micromegas. The design goals for the TPCs, the present construction status, and the test beam measurements with the first TPC at TRIUMF will be presented.

* This work is being supported by NSERC

MO-P5-3 15h00 (G*)

Monte Carlo Simulations of Detector Sensitivity for the Helium and Lead Observatory (HALO)*, **Taylor Shantz**, *Laurentian University* — The Helium and Lead Observatory (HALO) is a dedicated supernova neutrino detector under development for construction at SNOLAB. The HALO experiment uses 80 tonnes of lead as a detector medium which will be instrumented with approximately 384 meters of 3He neutron detectors. Charged- and Neutral-Current neutrino interactions in lead expel neutrons from the lead nuclei making a burst of detected neutrons the signature for the detection of a supernova. Large neutron excess of a heavy nucleus like Pb acts to Pauli-block p to n transitions induced by electron anti-neutrinos, making HALO primarily sensitive to electron neutrinos. The sensitivity of the detector depends on the material, geometry and placement of the moderator and shielding. The results from Monte Carlo Simulations using the Geant4 toolkit will be discussed.

* This work is being supported by Laurentian University

15h15 Coffee Break / *Pause Café*

MO-P5-4 15h45

ROXANNE GUENETTE, McGill University

Recent exciting results from the VERITAS observatory †,*

The VERITAS experiment is an imaging atmospheric Cherenkov array for gamma-ray astronomy in the energy range from 100 GeV to greater than 10 TeV and is located at the Whipple observatory in Arizona. It is currently the most sensitive gamma-ray detector at energies over 100 GeV in the northern hemisphere. It has recently completed its first season of observations with a full array of four telescopes. A number of astrophysical gamma-ray sources, both galactic and extragalactic, have been discovered and many different astrophysical sources have been studied, including blazars, pulsar wind nebulae, supernova remnants, dark matter annihilation, massive star systems and more. Here we will present the instrument and show exciting new results from recent observations.

† For the VERITAS collaboration
* This work is being supported by NSERC, FQRNT

MO-P5-5 16h15

The FGD Electronics System, **Kentaro Mizouchi**, *TRIUMF* — The T2K is a long-baseline neutrino experiment aiming to study neutrino properties through precise measurements of neutrino oscillation parameters. In the T2K experiment, two scintillator tracking instruments named "Fine Grained Detector" (FGD) will be placed at the near site 280 m downstream from a proton target. Canadian group is responsible for the construction of FGD, including its readout electronics. The detector employs 8,448 channels of newly developed silicon based multi-pixel photon counters (MPPC), which is capable of single photon counting. T2K is the first physics experiment to use this type of device in a large scale. The readout electronics consists of low cost 50MHz waveform digitizers (~less than $50 per channel for the entire readout system) with a depth of 10micro-sec using ASIC switching capacitors. FPGA is used to provide data compaction and fast readout. This talk will summarize the current status of the electronics system and the performance of the MPPC and electronics obtained from the beam test of the first of the two FGD modules with a full chain of readout.

MO-P5-6 16h30

The Physics Program of SNOLAB: A new International Facility for Astroparticle Physics Research*, **Anthony J. Noble**, *Queen's University* — SNOLAB, Canada's new facility for Astroparticle Physics Research, has now completed the construction phase and the experimental program is gearing up. In this talk, the status of SNOLAB will be presented, along with a description of the scientific goals and an overview of the planned experimental program into dark matter, neutrino physics, supernovae, and other research interests.

* This work is being supported by NSERC, CFI, ORF-RE, NOHFC, OIT

MO-P5-7 16h45

Monte-Carlo simulations for the DEAP experiment*, **Marcin Kuzniak**, *Queen's University* — The first generation detector (DEAP-1) with a 7-kg liquid argon target mass is currently operating underground at SNOLAB, searching for dark matter particle interactions on liquid argon. Monte-Carlo simulation based on Geant4 is an important tool necessary to better understand the data, calibrate the detector and reduce backgrounds. The experience gained helps to optimize a larger detector (DEAP-3600) containing a total of 3600 kg of LAr. Status of simulation results for this detector will be presented.

* This work is being supported by NSERC/CFI

MO-P5-8 17h00 (G*)

Design and Testing of Radon Trap for DEAP-1, **Eoin O'Dwyer**, *Queen's University* — The reduction of alpha backgrounds is critical for the success of the DEAP experiment. To minimize this contamination, a radon trap was designed through which the argon used for scintillation could be filtered. The trap was tested by injecting a known quantity of radon into the trap, and then flowing argon through the system at the flow rate used for filling DEAP-1 until the volume required to

fill the chamber was reached. An alpha counter was used to measure the levels of radon and its polonium daughter products in the gas once it left the trap. An overview of the design and testing of the trap is provided.

MO-P5-9 17h15

CDMS and SuperCDMS*, **Wolfgang Rau**, for the CDMS and SuperCDMS Collaborations, *Queen's Universtiy* — The Cryogenic Dark Matter Search experiment (CDMS) employs cryogenic detectors to search for Weakly Interacting Dark Matter Particles (WIMPs). The simultaneous readout of thermal and charge signals allows a highly efficient background discrimination, making CDMS presently the only background free experiment in the field. Based on the latest published data CDMS is one of the most sensitive experiments for direct dark matter search worldwide and the one with the highest discovery potential. The amount of data under analysis right now represents a roughly threefold increase in exposure over the published data. SuperCDMS builds on the CDMS technology, increasing the target mass with improved detectors. First steps are done at the present location in the Soudan underground laboratory in Minnesota while the aim is to build a new experimental infrastructure for a considerably larger target mass at SNOLAB near Sudbury, Ontario in order to be able to probe a significant part of the parameter space proposed for WIMPs by theoretical calculations.

* This work is being supported by National Science Foundation (US), Department of Energy (US), NSERC

MO-P5-10 17h30 (G)

Supernova Detection at SNOLAB, **Stephen Korte**, *SNO+ Collaboration* — The only place where neutrinos interact is within supernovae where their density is extreme. Depending upon the properties of neutrinos, they may undergo a collective flavour transition where all neutrinos of one flavour will swap with neutrinos of another flavour. An observation of this phenomenon would allow the conclusion that the neutrino mass hierarchy is inverted and that the mixing angle (13) is nonzero. The sensitivity of two neutrino detectors, SNO+ and HALO (Helium and Lead Observatory) was studied using a supernova generator program (SNGEN). Originally designed for the Sudbury Neutrino Observatory, SNGEN generates the neutrino flux from a supernova based on modeling predictions and calculates the number of interactions that would be present in each of these detectors. Other Monte Carlo programs propagate the final state particles from the interactions to produce the final electronic signals in the detectors. Through the analysis of the electronic signals, the effect of changing supernova parameters such as distance, to the sensitivity of the detectors to the collective neutrino transition phenomenon was studied and will be discussed.

17h45 Session Ends / *Fin de la session*

[MO-P6] (DCMMP/*DPMCM*) DCMMP Best Student Paper Competition II / *Compétition pour les meilleures communications étudiantes DPMCM II*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

14h15 - 15h15

ROOM / *SALLE* MRR D002 (cap.135) *Chair: I.G. Hill, Dalhousie University*

MO-P6-1 14h15 (G*)

Thermal and Electrical Conductivity of Carbon Nanotube Materials*, **Michael Jakubinek** [1], Mary Anne White [2], Jingwen Guan [3], Yadienka Martínez-Rubí [3], Benoit Simard [3], [1] *Department of Physics and Institute for Research in Materials, Dalhousie University*, [2] Departments of Physics and Chemistry and Institute for Research in Materials, Dalhousie University, [3] National Research Council Steacie Institute for Molecular Sciences — Single walled carbon nanotubes (SWCNTs) have generated much excitement due to their exceptional properties, which include high strength, flexibility, electrical conductivity and thermal conductivity. These properties, combined with high aspect ratios, suggest that SWCNT materials – including nanotube composites, films and papers – offer a route to achieve improved performance in applications. While dramatic increases in electrical conductivity have been observed following addition of a small fraction of nanotubes to a polymer matrix, the thermal conductivity enhancements achieved in nanotube/polymer composites are very poor in comparison to early expectations. This is attributed to a large contribution from interfacial thermal resistance at the nanoscale level and the introduction of covalent bonding between nanotubes and the matrix has been suggested as the most promising route to improve thermal conductivity. Here we report experimental measurements for composites containing SWCNTs that are covalently bonded, to varying degrees, to an epoxy matrix. Results for SWCNT films and papers, which have potential applications in electronic devices and as flexible, transparent conductors, also will be discussed.

* This work is being supported by NSERC, CFI and NRC

MO-P6-2 14h30 (G*)

First-principles investigations of carbon dioxide at high-pressure*, **Brian Boates**, Stanimir Bonev, *Dalhousie University* — Recent breakthroughs in high-pressure experimental techniques have allowed for the exploration of high pressure (P) and temperature (T) phase diagrams of materials. Upon compression, weakly bound molecular crystals such as N_2, CO_2, and N_2O often transform to polymeric covalently bonded materials. It had been proposed [1] that a high-pressure phase of carbon dioxide (phase IV) consisting of bent molecules served as an intermediate phase to the higher-pressure polymeric phase V [2,3]. Later calculations [4] showed that the experimental data could be well interpreted by solid phases containing linear CO_2 molecules. Gaining insight into solid phases by drawing analogies with local structural characteristics of liquids has proven to be quite useful [5]. As such, we have performed *ab initio* simulations of liquid CO_2 above the melting curve of phase IV. Our calculations reveal surprising changes in the molecular bonding properties upon compression. The focus of this study is to understand the changes of bonding properties with P and T as well as gain insight into the equilibrium structures of high-pressure CO_2 phases.

1. Yoo *et al.*, *PRL* 2001
2. Iota *et al.*, *Science* 1999
3. Serra *et al.*, *Science* 1999
4. Bonev *et al.*, *PRL* 2003
5. Tamblyn *et al.*, *PRL* 2008

* This work is being supported by NSERC, ACE-net, and IRM.

MO-P6-3 **14h45** **(U*)**

Spectral shifts and spectral jumps in quantum dots by colour*, **Orad Reshef**, Monica Turner, Lina Carlini, Jay Nadeau, *McGill University* — Spectral shifts and spectral jumps in quantum dots by colour, Orad Reshef, Monica Turner, Lina Carlini, Jay Nadeau, McGill University — Quantum dot (QD) fluorescence intermittency (blinking) is usually measured as off and on states at a single wavelength. However, this overlooks significantly red- or blue-shifted emission that might occur from trap states or dot oxidation, respectively. Using fast multispectral imaging, we examined spectral shifts and drifts in two colours of QD-streptavidin conjugates (585 and 605 nm). We detected an average fluctuation of 2.8±0.4nm from the mean wavelength for both types of dots, and a blueshift in the overall wavelength of all dots, ranging from -1.87±0.04nm/min to 0.07±0.03nm/min. The 585nm quantum dots blueshifted at a higher rate than the 605nm dots. These measurements help shed insight into the mechanisms of blinking and may help in the design of non-blinking QDs

* This work is being supported by NSERC

MO-P6-4 **15h00** **(G*)**

A Definition of the Phenomenon of Nano-Size Particles*, **Briand Lorin** [1], Mike Reda [2], [1] *University of Saskatchewan/Engineering physics*, [2] CanadElectrochim — Many researchers in different laboratories all over world claimed the magic trick that nano-size particles can do in heat transfer (order of magnitude increase in thermal conductivity), catalysis (much higher rate of reaction) and many other areas of physics and bio-physics and material science. The purpose of this publication is to give a possible definition for the term nano-sized particle. Nano-sized particles are a system of particles that not only of a nano-sized but also must satisfy the following: 1-A single nano-particles must perfectly obey the Gibbs phase rule. 2-A single nano-particle must be a nano-sized actuator. The driving force for actuation is the microstructure change during service (heat transfer, chemical reaction or others). 3- A single nano-particle must be a nano-sized actuator and show oscillation between a single microstructure phase and two microstructure phase behaviors (according Gibbs phase rule). This change in microstructure phase occurs at finite frequency. (Must prove that it is not infinite) 4-The oscillations of the nano-particles at high frequency produces a nano-convection aerodynamics or Brownian motion. This Brownian motion is the reason for the higher order of magnitude in heat transfer, catalysis and others. 3-A system of nano-sized particles can display nano-sized phenomenon if and only if this system of particles can be considered as phase locked oscillators (e.g. see the work of Prof.Guckenheimer from Princeton University). Examples from bio-physics (insect flight and coloring), heat transfer (nano-fluid), chemical catalysis (carbon encapsulated nickel particles) and many other will be given to show that the above hypothesis is correct.

* This work is being supported by CanadElectrochim

15h15 **Session Ends** */ Fin de la session*

[MO-P7] Fields & Strings / *Théorie des champs et cordes*

(DTP/*DPT*)

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***

14h15 - 16h30

ROOM / *SALLE* **MRR D202 (cap.135)**

Chair: M.B. Paranjape, Université de Montréal

MO-P7-1 **14h15**

CLIFFORD BURGESS, McMaster University

Quantum Gravity, Dark Matter and Dark Energy

Reconciling general relativity with quantum field theory has been a long-standing goal for theoretical physics. Normally efforts to do so have focussed on short distance scales, but recently there has been great interest in the question of whether modifications to general relativity are possible over *long* distance scales, due to the discovery of Dark Energy and Dark Matter. Since the existence of these two unknown forms of matter are inferred purely from their gravitational interactions, it might be more economical to modify gravity instead. In this talk I will summarize the modern understanding of quantum gravity as an effective field theory, the options available in modifying gravity sensibly at long distances, and what these are likely to mean for Dark Matter and Dark Energy.

MO-P7-2 **14h45**

GORDON W. SEMENOFF, University of British Columbia

Giant loop holography

The Hawking-Page phase transition is the collapse, at sufficiently high temperature, of hot anti-de Sitter space to a black hole. A beautiful picture of the holographic dual of this phenomenon has emerged, where it is a quark deconfinement phase transition that occurs in maximally supersymmetric Yang-Mills theory. In this lecture, a probe of this transition which uses large representation Polyakov loops in the gauge theory will be discussed. It is known that the string theory dual of such operators are D-branes and it will be argued that, to some extent, the properties of large representation operators are reflected in the behavior of their D-brane duals in the presence of a black hole.

15h15 **Coffee Break** */ Pause Café*

MO-P7-3 **15h30**

Cosmological Fluctuations from Infra-Red Cascading During Inflation*, **Neil Barnaby**, *Canadian Institute for Theoretical Astrophysics (CITA)* — I will discuss a new mechanism for generating cosmological fluctuations from infra-red cascading during inflation. The prototype example of this scenario is a simple model with inflaton and iso-inflaton fields coupled in such a way that the latter becomes massless momentarily during inflation. Iso-inflaton particles are produced at this instant, slowing down the motion of the background. Very quickly the produced iso-inflaton particles become non-relativistic and their multiple rescatterings off

the condensate leads to bremschtrahlung radiation of light inflaton infrared fluctuations. For modest values of the coupling these nongaussian fluctuations dominate over the usual vacuum fluctuations during inflation. This mechanism can (but need not) operate in conjunction with trapped inflation. I will discuss the dynamics of infra-red cascading during inflation as well as possible realizations of this scenario in string theory.

* This work is being supported by CITA, NSERC

MO-P7-4 **16h00**

GABOR KUNSTATTER, University of Winnipeg

Dynamical Singularity Resolution in Spherically Symmetric Black Hole Formation

A successful theory of quantum gravity should, among other things, resolve the singularities that are inevitable in classical general relativity and determine the endpoint of the Hawking evaporation of black holes. We study these issues semi-classically by numerically solving quantum corrected equations for the gravitational collapse of a spherically symmetric massless scalar field. We use adapted coordinates that allow the evolution to proceed past horizon formation. We find, as did Husain, a mass gap below which horizons do not form. In addition, the quantum corrected collapse exhibits a radiation-like phase which resolves the singularity. The static event horizon is replaced by a smooth trapping horizon that bounds a compact region of space-time. The "evaporation" is not complete but leaves behind a small outward moving wave.

16h30 **Session Ends / *Fin de la session***

[MO-P8] Special Topics in Optics / *Sujets spéciaux en optique*

(DOP/*DOP*)

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***

14h15 - 15h30

ROOM / *SALLE* MG2 147G2 (cap.108)

Chair: R. Corriveau, CIPI/ICIP

MO-P8-1 **14h15**

ROBERT FEDOSEJEVS, University of Alberta

Laser Fusion: A Route to a Sustainable Energy Future

Fusion energy research has advanced dramatically over the past decade with a few large scale national and international projects pursuing full scale proof of concept demonstrations within the next several years. Fusion power offers virtually limitless energy with no green house gas emission and no stockpile of radioactive waste byproducts. Inertial confinement fusion using laser drivers is a very promising approach that is rapidly growing in prominence due to recent advances in laser driver technology and target concepts. The multi-billion dollar National Ignition Facility (NIF) at Lawrence Livermore National Laboratory in USA will strive to demonstrate ignition and large scale fusion energy gain in 2010. This will be accomplished with 1.2 to 1.8 MJ of laser driver energy by igniting the fusion reactions at the very centre of an extremely compressed spherical target. Backed by decades of research and advanced computer simulation models there is high expectation that these demonstration experiments will be successful, opening the door to the design of practical reactor systems. At the same time, the technology of laser drivers is advancing very rapidly with a new generation of high efficiency diode pumped laser amplifiers which are scalable to the repetition rate and energy requirements of a fusion driver. Recently, a new exciting concept of employing ultra-intense laser pulses to initiate fusion reactions, like a match igniting combustible fuel, is being explored. This process, called fast ignition, has the possibility of reducing the laser energy requirements for an initial fusion power plant by a factor of 5 to 10 times from several Megajoules per pulse to around 500 kilojoules per pulse and is the basis of a new billion Euro European project which has been initiated under the Framework 7 program to build a full scale fast ignition demonstration experiment. Based on these developments a 20 year roadmap entailing an intermediate repetition rate Engineering Test Facility and a prototype low power reactor system is under discussion by leading groups around the world. If pursued vigorously these concepts could lead to commercial reactors by 2040 which would arrive just in time to give a long term solution to the greenhouse gas and energy crisis that we are facing. Canada is asleep at the switch with regards to fusion energy research in general and in laser fusion research in particular. We have proposed, based on all these promising developments and based on the energy wealth that we currently enjoy, that Canada initiate a world leading program in laser fusion research. This program would act as a tremendous stimulus to a broad based optical industry in Canada and could nucleate future opportunities to become suppliers of optical components and systems for the anticipated deployment of such reactors and other emerging high power laser application areas in the future. The current status of laser fusion will be reviewed together with a proposal outlining how Canada could become a major world player in this area.

MO-P8-2 **14h45** **(G*)**

Spin Hall Effect of Light in a Semiconductor*, **Jean-Michel Menard** [1], Adam Mattacchione [1], John Sipe [1], Arthur Smirl [2], Henry van Driel [1], [1] *University of Toronto*, [1] University of Iowa — The Spin Hall Effect of Light (SHEL) is the transverse spatial shift of left- and right-handed circular polarizations of a light beam non-normally incident at an interface between media of different refractive index. The effect can be regarded as a consequence of conservation of angular momentum or of the different Fresnel coefficients for the p- and s-polarization components of a spatially confined beam. Until now, these shifts have been measured at interfaces of low index and non-absorbing media such as air/glass interfaces. Here we demonstrate the SHEL for an air/GaAs at a wavelength (α = 830 nm) for which the absorption of the right- and left-circular components of the light generate opposite spin polarized carriers, thereby allowing us to observe the SHEL through the transverse separation of up and down electron spins. We optically detect this separation by measuring the change of polarization of a linearly polarized transmitted probe beam incident on the sample at normal incidence as it is scanned across the pump beam spot. The pump beam is directed at the sample, which is a 800nm thick layer of bulk GaAs mounted on BK7 substrate, at a 60 degree incidence angle relative to the sample normal. For a p-polarized pump, we measure a separation of 200 nm in agreement with previous theoretical works and corresponding to a much larger shift than can be obtained with low index dielectrics.

* This work is being supported by NSERC

MO-P8-3 **15h00**

RF sputtered ITO films over the evaporated WO_3 films on plastic substrates*, **Balu Ramamoorthy**, P.V. Ashrit, *Université de Moncton* — Deposition of ITO is being carried out successfully on various substrates starting from glass to various plastic materials. These depositions employ different deposition techniques including both physical and chemical techniques. However, when the underlying layers are different, the deposition parameters differ accordingly and optimization of ITO layers becomes challenging. Most often annealing or high temperature deposition might be essential to get the low resistivity which makes the film useful. In this presentation we report the successful deposition of ITO films on evaporated WO_3 films on plastic substrates. WO_3 films were deposited by evaporation on plastic substrates at room temperature to a thickness of 200nm. On to this template, ITO films were then sputtered using RF magnetron sputtering. Because of the amorphous and porous nature of the underlying WO_3 film, the issue of ITO adhesion on to the template also creeps in. By varying the process parameters like oxygen pressure, substrate temperature, substrate target distance, ITO films were successfully deposited yeilding a high transmission and low resistivity. The results of this study are discussed in detail.

* This work is being supported by AIF

MO-P8-4 **15h15** **(G*)**

Sub-micron pitch variable diffraction grating using nanoporous electrodes and electrophoresis of dye ions*, **Richard Wong**, Peter Hrudey, Lorne Whitehead, *University of British Columbia* — Active diffraction devices comprised of ionic dye solution and patterned transparent electrically-conductive nanoporous thin films have been demonstrated to be a promising approach to non-mechanical beam steering. This approach involves modifying the effective refractive index in certain regions of a transparent nanoporous electrode by electrically attracting dye ions into its pores. In a simple case, beam steering can be achieved by using a diffraction grating formed by two nanoporous interdigited electrodes. The diffractive orders can have their diffraction angles altered by attracting dye ions into some of the grating lines, but not others, in order to effectively change the pitch of the grating. Electrodes with sub-micron features are of particular interest, since it is possible for the resulting grating to generate no diffractive orders when no electrical potential is applied and for diffractive orders at large angles to appear and disappear entirely when the ions are drawn into and out of specific grating lines. Using a nanoporous zinc antimonate layer deposited using a standard spin coating technique, we have fabricated a sub-micron grating using direct patterning by focused ion beam milling. Modulation of a diffractive order was observed when dye ions were electrically attracted into one set of the nanoporous grating lines. The diffractive order was observed to vary substantially in intensity and have a fast response time. These observations demonstrate the potential of this method to achieve large angular deflection and fast operating speed for non-mechanical beam steering applications.

* This work is being supported by NSERC and the 3M Company

15h30 **Session Ends / *Fin de la session***

[MO-P9] Exotic Nuclear Structure / *Structure nucléaire exotique*

(DNP/*DPN*)

MONDAY, JUNE 8 / ***LUNDI, 8 JUIN***

14h15 - 16h30

ROOM / *SALLE* MRR D102 (cap.134)

Chair: R. Kanungo, St. Mary's University

MO-P9-1 **14h15**

MICHAEL THOENNESSEN, Michigan State University

Discovery of New Isotopes at the NSCL *

The discovery of new isotopes is the first step in the exploration of the properties of the most exotic nuclei. At the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University we applied several different techniques to produce and identify new isotopes towards the proton and neutron dripline. The discovery of new isotopes at the proton and neutron dripline will be presented. In addition, we have produced and studied new nuclei even beyond the neutron dripline with the Modular Neutron Array (MoNA). These nuclei have lifetimes of less than 10^{-20}s and spectroscopic information can be extracted using neutron-decay spectroscopy.

* This work is being supported by National Science Foundation, Grant # PHY 06-06007

MO-P9-2 **14h45**

JUERGEN GERL, GSI

In-beam and decay γ spectroscopy at GSI and FAIR

At the SIS/FRS facility at GSI exotic beams at relativistic energies were employed for Coulomb excitation and secondary fragmentation experiments with the fast beam RISING γ spectroscopy set-up. Shell evolution far off stability, pn-pairing, symmetries and nuclear shapes were studied in nuclei ranging from ^{36}Ca to ^{136}Nd. Recently the compact detector arrangement of RISING -providing about 15% full energy efficiency- went into operation. Seniority isomers in medium heavy nuclei at the proton drip line have been investigated as well as new isomers found in neutron rich nuclei, e.g. ^{204}Pt. Most recently the decay properties of ^{100}Sn were investigated successfully. The observation of a I = 27 ħ state demonstrated that high spin states can be obtained in massive fragmentation reactions. At future FAIR/GSI the Super-FRS facility within the NUSTAR project will provide an enormously enlarged variety of exotic beams. The HISPEC/DESPEC project aims to develop, build and operate optimized experimental set-ups. Based on the experience with RISING novel particle identification and tracking detectors will be employed. For in-beam γ detection AGATA detectors are foreseen as well as a dedicated compact Ge tracking and imaging array for decay experiments. In addition, a suite of ancillary detectors is planned to complete the experimental set-ups.

15h15 Coffee Break / *Pause Café*

MO-P9-3 15h30

ADAM GARNSWORTHY, TRIUMF

Recent Highlights from the TIGRESS Collaboration [*]

The TIGRESS array is a highly-segmented, Compton-suppressed germanium Clover array located at TRIUMF. Experiments performed at TIGRESS take advantage of the ISAC II facility which delivers post-accelerated radioactive ion beams, produced by spallation of a heavy target. In 2009, TIGRESS is moving from a construction to an operating phase of the project with exciting prospects. Recent highlights are presented from several astrophysically and nuclear structure motivated experiments.

[*] This work is being supported by NSERC

MO-P9-4 15h45

SIMONE BARONI, TRIUMF/INT

Nuclear structure with low momentum interactions

Effective field theory and renormalization group methods lead to low-momentum realistic interactions that can be easily employed in nuclear structure studies. I will discuss recent results on superfluid properties for finite nuclei in a large mass number range. I will also present a global study of odd-even mass staggering, where $V_{low\,k}$ interactions can provide key guidance for the construction of a universal density functional.

MO-P9-5 16h00

PAUL DELHEIJ, TRIUMF

TITAN Penning Trap Mass Measurements of Light Neutron-Rich Halo Nuclei [†],[*]

An important part of the experimental program of the newly commissioned TITAN facility at TRIUMF-ISAC is the mass measurements of light, neutron-rich halo nuclei. Halo nuclei are characterized by one or more loosely bound nucleons which "orbit" the core nucleons, dramatically increasing the rms matter radius of the nucleus. In conjunction with laser spectroscopy and high-precision atomic physics calculations, relative charge-radii for these exotic nuclei can be determined. An important question concerning halo nuclides is whether the core is inert, or is somehow coupled to the halo nucleon(s), and the charge radius is a critical indicator of this characteristic. Recently, TITAN was used to measure the masses of the halo nuclides ^{11}Be, ^{6,8}He, and ^{11}Li. With a half life of 8.6 ms, ^{11}Li is the shortest-lived nuclide ever measured in a Penning trap. In parallel with this program the development of the Titan facility continues. The first online beams ^{106,107}In were captured in the Electron Beam Ion Trap. There, through charge breeding the accuracy of the mass measurement can be improved. The last major component of TITAN is the Cooler Penning Trap of which the construction has recently started. The purpose is the cooling of the highly charged ions that are produced in the EBIT.

[†] In collaboration with R. Ringle [1], M. Brodeur [2], T. Brunner [3], J. Dilling [1], S. Ettenauer [2], A. Gallant [2], G. Gwinner [4], A. Lapierre [1], D. Lunney [5], V. Ryjkov [1], M. Smith [2], [1] TRIUMF, [2] TRIUMF/UBC, [3] TRIUMF/Tech. Univ. Munich, [4] Univ. of Manitoba, [5] CNRS-Orsay

[*] This work is being supported by NSERC

MO-P9-6 16h15 (G*)

Breakdown of Vibrational Motion in ^{110}Cd, **Jack Bangay**, Paul Garrett, Greg Demand, Kyle Leach, Paul Finlay, Katie Green, Andrew Phillips, Evan Rand, Mike Schumaker, Carl Svensson, Chandana Sumithrarachchi, James Wong , *University of Guelph* — The Cadmium isotopes, in particular ^{110}Cd, have long been considered paradigms of vibrational nuclei. However recent work with other even-even Cadmium isotopes show a breakdown of the vibrational model at the 2 and 3-phonon levels, suggesting the need for more precise measurements on ^{110}Cd. The structure of ^{110}Cd is studied with the (n,n'γ) reaction at the University of Kentucky, as well as with the high statistics β-decay of ^{110}In performed at the TRIUMF-ISAC facility using the 8π spectrometer. Excitation functions and angular distributions from the (n,n'γ) reaction provide spectroscopic information on the level scheme, including level lifetimes and spins, while the β-decay allows the observation of extremely weak γ branches. Details of analysis to date will be presented.

16h30 Session Ends / *Fin de la session*

[MO-CEWIP] (CEWIP/*CEFEP*) Women in Physics / *Les femmes en physique*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

16h30 - 18h30

ROOM / *SALLE* MRR R221 (cap.292)

Chair: J.A. McKenna, University of British Columbia

MO-CEWIP-1 **16h30**

RACHEL IVIE, American Institute of Physics

Women in Physics and Astronomy

In the U.S., aggregated data show that the main drop off point for women in physics occurs before earning a bachelor's degree. Once women have earned a PhD in physics, a small, but representative, number of them are able to advance up the academic ladder. However, this does not mean that U.S. women in physics do not encounter barriers to advancement in their careers. One area of inequality is salary. Controlling for years of experience and sector of employment, women physicists in academe earned 5% less on average than men. In addition to receiving lower salaries, women often work in hostile environments and are deeply affected by this. Surveys show that similar issues affect women physicists outside the U.S. Most women physicists chose a career in physics before entering university, highlighting the importance of pre-university experiences. Women physicists across the world report that gender discrimination and negative attitudes about women are serious problems for them. In spite of this, most women physicists of all nationalities agree that they would choose a career in physics again.

18h30 **Session Ends / *Fin de la session***

[MO-KEY] (CAP/*ACP*) CAP Herzberg Memorial Public Lecture - Laurent Drissen, Laval University / *Conférence publique commémorative Herzberg de l'ACP - Laurent Drissen, Université Laval*

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

19h30 - 20h30

ROOM / *SALLE* Capitol Theatre, Downtown (cap.1000)

MCs: P. Ashrit, U Moncton/S.A. Page, U Manitoba

MO-KEY-1 **19h30**

LAURENT DRISSEN, Université Laval

The Splendours and Miseries of Massive Stars / Splendeurs et misères des étoiles massives

The most massive stars in the universe are also the most fascinating. Exceedingly rare, they nevertheless play an important role in galactic ecology and in the chemical evolution of the cosmos. They are born in gigantic molecular clouds and they light up with an enormous outpouring of ultraviolet radiation. Pressure exerted by these forms of light on heavy elements present in the stellar atmosphere results in a very powerful wind which enriches the regions between the stars and injects large amounts of energy in their surroundings. The life of massive stars is brief – a hundredth of that of ordinary, sun-like stars - and ends in a gigantic explosion detectable to distances of billions of light-years. With the help of beautiful images obtained by the largest ground-based and space telescopes, I will describe the life and death of these stars which illuminate our universe. *Les étoiles les plus massives de l'univers sont aussi les plus fascinantes. Excessivement rares, elles jouent pourtant un rôle de premier plan dans l'écologie galactique et dans l'évolution chimique du cosmos. Elles naissent dans de gigantesques nuages moléculaires qu'elles illuminent rapidement d'un énorme flux de rayons ultraviolets. Leurs vents violents, qui leur fait perdre plus de la moitié de leur masse au cours de leur vie, perturbe considérablement leur environnement en y injectant non seulement de grandes quantités d'énergie mais aussi des éléments chimiques lourds tels que l'oxygène. Ces étoiles sont aussi éphémères que spectaculaires: leur vie, qui est des centaines de fois plus courte que celle des autres étoiles, se termine par une gigantesque explosion souvent visible à des milliards d'années-lumière. À l'aide de merveilleuses images obtenues par les plus grands télescopes terrestres et spatiaux, je décrirai la vie et la mort de ces étoiles qui illuminent l'univers.*

20h30 **Session Ends / *Fin de la session***

[MO-RECEPT] (CAP/*ACP*) Opening Reception (light refreshments) / *Réception d'ouverture (avec petit goûter)*

Capitol Theatre, Downtown

MONDAY, JUNE 8 / *LUNDI, 8 JUIN*

20h30 - 22h30

Tuesday, June 9 - Mardi, 9 Juin

[TU-CNILC] (CNILC/*CNCLU*)
CNILC Breakfast meeting /
Réunion du comité de liaison national canadien de l'UIPPA
TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
07h00 - 08h30

ROOM / *SALLE* B164 JdeV (cap.8) *Chair: G.W.F. Drake, University of Windsor*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

08h30 Meeting Ends / *Fin de la réunion*

[TU-PiC] (CAP/*ACP*)
PiC Editorial Board Meeting /
Réunion du Comité de rédaction de La physique au Canada
TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
07h00 - 08h30

ROOM / *SALLE* B219 JdeV (cap.8) *Chair: B. Joos, University of Ottawa*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

08h30 Meeting Ends / *Fin de la réunion*

[TU-HS-REGN] (CAP/*ACP*)
High School Teachers' Welcoming Reception /
Réception d'accueil pour les enseignants du secondaire
Room / Salle B119 JdeV
TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
07h45 - 08h30

[TU-Plen1] (CAP/*ACP*)
Plenary - Greg Flato, Environment Canada /
Plénière - Greg Flato, Environnement Canada
TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
08h45 - 09h30

ROOM / *SALLE* JdeV Salle de spectacle (cap.410) *Chair: R.B. Mann, University of Waterloo*

TU-Plen1-1 08h45

GREG FLATO, Environment Canada

Global Climate Models: Development and Application

Global climate models are essentially computer simulations of the climate system. They are physically based, in that they rely on mathematical representation of the many complex processes that constitute the climate system. They are extremely computationally expensive, and they are typically run on some of the most powerful supercomputing facilities available. Such models allow us to understand and attribute cause to past climate change, and to make quantitative projections of future climate. They therefore serve as an important tool in providing climate change information for adaptation, mitigation and decision making. In this talk I will provide a basic overview of what constitutes a global climate model and a description of how they are used. This will focus primarily on the Canadian global climate model developed at CCCma over the past 20 years or so. I will then provide some example results to illustrate what we have learned about past climate change and what such models tell us about the climate of the future. I will conclude with a description of the 'new frontier' in climate modelling, using so-called 'Earth System Models' which represent not only the physical climate system, but also the biogeochemical cycles involved in the climatically relevant carbon, sulphur and ozone cycles.

09h30 Session Ends / *Fin de la session*

[TU-AM-Break] (CAP/*ACP*)
Health Break, with refreshments /
Pause-santé, avec goûter
MRR Rotunde
TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
09h30 - 10h00

[TU-A1] (DCMMP/*DPMCM*) Young Investigators in CMP and Materials / *Nouveaux chercheurs(ses) en matière condensée et matériaux*

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
10h00 - 11h30

ROOM / *SALLE* MRR D002 (cap.135) *Chair: M.J.P. Gingras, University of Waterloo*

TU-A1-1 10h00

LAURENT KREPLAK, Dalhousie University

Design and mechanical properties of fibrous protein scaffolds

I will present a few example of how you can use recombinant proteins to form filamentous scaffolds and macroscopic fibers. The assembly process is generally controlled at the protein sequence level and supplemented by a physical effect such as polyelectrolyte condensation. I will also present AFM based approaches to measure the nanomechanics of the filamentous structure we have designed.

TU-A1-2 10h30

ROBERT RAUSSENDORF, University of British Columbia

Fault-Tolerant Quantum Computation with High Threshold in Two Dimensions †

We present a scheme of fault-tolerant quantum computation for a local architecture in two spatial dimensions. The error threshold is 0.75% for each source in an error model with preparation, gate, storage, and measurement errors. Our scheme uses topological methods to protect encoded quantum gates.

† In collaboration with Jim Harrington [1], Kovid Goyal [2], [1] Los Alamos National Laboratory, [2] Caltech

TU-A1-3 11h00

CLARA SANTATO, École Polytechnique de Montréal

Organic Electronics Materials and Devices

Organic -conjugated molecules and polymers, are semiconducting films, based on attractive for their low manufacturing costs (solution processing), flexibility of the devices, and the possibility to achieve the desired optoelectronic properties by easily tailoring their molecular structure through chemical synthesis. The interest in organic semiconductors has been recently augmented by the realization of organic light emitting field effect transistors (OLEFETs), devices combining the current modulating function of a transistor with electroluminescence (EL) [1][2]. OLEFETs are excellent test systems to investigate processes such as charge carrier injection, transport, and EL in organic semiconductors. OLEFETs with unipolar or ambipolar electrical characteristics have been realized with a number of molecular and polymeric semiconductors, processed by thermal evaporation or from solution. The shelf lifetime and the operational stability of OLEFETs (i.e. the possibility to store and operate the devices in ambient conditions) are key issues for their development. We recently demonstrated OLEFETs based on 2-(4-pentylstyryl)tetracene able to operate in ambient air with a shelf lifetime of several months [3].

1. F. Cicoira, C. Santato, *Adv. Funct. Mater.* **17**, 3421, 2007.
2. F. Cicoira, C. Santato, M. Melucci, L. Favaretto, M. Gazzano, M. Muccini, G. Barbarella, *Adv. Mater.* **18**, 169, 2006.
3. F. Cicoira, C. Santato, A. Dadvand, C. Harnagea, A. Pignolet, P. Bellutti, Z. Xiang, F. Rosei, H. Meng, D.F. Perepichka, *Journal of Materials Chemistry,* **18**, 158, 2008.

11h30 Session Ends / *Fin de la session*

[TU-A2] (DMBP/*DPMB*) Molecular Biophysics / *Biophysique moléculaire*

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
10h00 - 12h15

ROOM / *SALLE* MRR A102 (cap.134) *Chair: A. Linhananta, Lakehead University*

TU-A2-1 10h00

ZOYA LEONENKO, University of Waterloo

Application of Scanning Probe Microscopy in Nanoscale Lipid Biophysics *

Scanning Probe Microscopy is a big and growing family of many nanoscale characterization methods which are widely used in many areas including physics, chemistry, biology, biomedical and nano-technology. One of them, Atomic force microscopy (AFM) is a well-known scanning probe microscopy technique which allows imaging and nanomanipulation on a single molecule and nm scale. In this talk I will give introduction to several scanning probe microscopy methods, and focus on Atomic Force Microscopy (AFM), and Kelvin Probe Force Microscopy (KPFM), which is used to address electrostatic interactions, as well as AFM based force spectroscopy, and demonstrate how we use these methods in my laboratory to investigate complex structure and function of lipid films and lipid-protein

interactions. Molecular arrangement of lipids and proteins in monolayer or membrane gives rise to complex film morphology as well as an electrical surface potential or non-uniform charge distribution, which rule many biological processes and diseases. I will discuss the structure and function of pulmonary surfactant (PS). PS is a lipid – protein mixture and forms a monomolecular film, which covers lung epithelia to provide stability to the alveolar structure and reduce the work of breathing. PS films are characterized by a specific molecular architecture and non-uniform surface potential distribution, which define its function and interaction of PS film with nanoparticles and biomolecules. Data on AFM topography, local surface potential distribution, and force measurements correlate well and provide insight into the understanding of the molecular function of pulmonary surfactant. Effects of surface compression and the presence of cholesterol as well as a presence of surfactant specific protein on the monolayer structure and surface potential distribution will be discussed.

* This work is being supported by NSERC, CFI, ORF

TU-A2-2 10h30

MARKUS DESERNO, Carnegie Mellon University

A generic coarse-grained model for protein folding and aggregation

The aim to understand slow large-scale processes in protein biophysics – such as folding, assembly or membrane insertion – is a major driving force for the development of coarse grained protein models. Existing models not only differ by their overall degree of resolution, but also by the set of phenomena they try to preserve on the simpler level. For instance, one might sacrifice the capability of secondary structure formation but preserve a high level of amino acid specificity – or vice versa. In this talk I will present a protein model in implicit solvent, recently developed by us, in which we retain the capability of secondary structure formation, aim at a good a/b balance, and incorporate amino acid specificity through side chain attractions mapped essentially via a known hydrophobicity scale. To illustrate that the model works, I will look at various aspects of folding and aggregation of simple peptides.

TU-A2-3 11h00

Le dimère de la séquence pathologique de polyglumanime favorise la formation de nanotubes*, **Normand Mousseau**, Rozita Laghaei, *Université de Montréal* — Plusieurs maladies neurodégénératives, telles que la maladie de Huntington, sont associées avec des protéines contenant une chaîne de polyglutamine (polyQ) qui dépasse le seuil pathologique de 35 à 40 Gln. Bien que les données expérimentales montrent que ces longues chaînes favorisent la formation de structures amyloïdes toxiques, on ne connaît pas les détails atomiques de celles-ci. Afin de comprendre les premières étapes de l'auto-assemblage, nous étudions les monomères et dimères de polyQ à l'aide de dynamique moléculaire par réplique. Pour les monomères de 30 à 50 résidus, les simulations montrent une transition unique d'hélice alpha à pelote aléatoire. La situation est complètement différente pour les dimères. Alors que les chaînes de 30 polyQ ne montrent aucune structure bêta, les chaînes de 40 résidus forment spontanément des feuillet bêta qui se transforment en structures bêta-hélicoïdales antiparallèles. Des simulations plus poussées montrent que ces structures sont instables et se transforment en nanotube de 32 Å qui relaxe, avec le temps, en nanotube de 22 Å, similaire en taille au modèle proposé par Perutz et collaborateurs. Une analyse énergétique de ces structures montrent que les feuillets bêta sont favorisés pour des chaînes de 37 résidus et moins tandis que les nanotubes sont plus stables pour des séquences au-dessus du seuil pathologique.

* Ce travail est financé en partie par le CRSNG et la Fondation des chaires de recherche du Canada.

TU-A2-4 11h15

Characterization of quantum dot-DNA biosensors by single-molecule fluorescence spectroscopy*, **Claudiu Gradinaru**, *University of Toronto Mississauga* — Hybridization of single-stranded oligonucleotide (ssDNA) probes immobilized on quantum dots (QDs) with fluorescently labeled target oligonucleotides provides the proximity needed for Förster Resonance Energy Transfer (FRET). However, it is necessary to achieve control of the density and molecular dynamics of surface-bound ssDNA to tune the recognition selectivity, the detection sensitivity and the speed of signal development to be able to resolve single nucleotide polymorphisms. Time-resolved single-molecule fluorescence spectroscopy - a powerful and versatile tool for studying the conformational dynamics of biological molecules - has been used to monitor interactions of ssDNA and hybridized oligonucleotides attached to individual QDs. Fluorescence intensity trajectories, (sub)nanosecond fluorescence decay analysis, and interpretation of power spectra associated with 'blinking' of emission from individual QDs can resolve processes that are associated with molecular dynamics of oligonucleotides. Preliminary ensemble experiments suggest that: 1) saturation of energy transfer occurs prior to maximum possible ssDNA loading of the QDs; and, 2) the intensity of FRET signals due to hybridization show a dependence on ssDNA probe loading of QDs. Single-molecule spectroscopy experiments allow interpretation of the saturation effects and to quantify maximum probe loading in 1). Similarly, such experiments allow elucidation of whether 2) is a result of reduced hybridization efficiency, or reduced FRET efficiency due to DNA conformational changes.

* This work is being supported by NSERC

TU-A2-5 11h30

Collective Molecular Dynamics in Membranes and Proteins, **Maikel Rheinstadter**, *McMaster University* — The understanding of dynamics and functioning of biological membranes and in particular of membrane embedded proteins is one of the most fundamental problems and challenges in modern biology and biophysics. The impact of membrane composition and properties and of structure and dynamics of the surrounding hydration water on protein function can be addressed by modern experimental and computational techniques. New instrumentation and more powerful neutron sources offer greatly enhanced sensitivities and are capable to access larger ranges of time and length scales, covering microscopic to mesoscopic dynamics. The optimized intensity even allows to study dynamics in single bilayers. We discuss how membrane properties, such as permeability and elasticity, can be determined from inelastic scattering experiments. Very recently, inter protein motions in a protein crystal were reported from a molecular dynamics simulation [1] and phonon like excitations were found in protein molecules by inelastic x-ray scattering [2]. We present first experimental evidence for a cooperative long range protein-protein interaction in a biological membrane. Even in simple models, biological system must be considered as an array of units interacting through coherent reactions. Coherence must therefore possibly be considered as a fundamental property of biomolecular systems [3].

1. *Phys. Rev. Lett.* **100**, 138102 (2008)
2. *Phys. Rev. Lett.* **101**, 135501 (2008)
3. *Phys. Rev. Lett.* **101**, 248106 (2008)

TU-A2-6 **11h45**

Hard-sphere models of proteins in solutions of osmolytes and denaturants*, **Apichart Linhananta**, *Lakehead University* — The stability of proteins depends on the nature of the solution. In the presence of chemical denaturant, such as urea, folded proteins are denatured into random structures. This is believed to be due to the denaturants ability to destabilize proteins' hydrophobic core and/or their tendency to disrupt the surrounding water network. In contrast to denaturants, osmolytes tend to stabilize folded proteins. Since osmolytes are relative inert towards proteins, it is believed that their stabilizing properties are entropic effects, similar to the depletion force. These effects will be examined simple models. Proteins are modeled by standard Go models, but are generalized so that they are dissolved in solutions. Denaturants and osmolytes are modeled as hard spheres. The main physical results and the limitations of the models will be discussed.

* This work is being supported by NSERC

TU-A2-7 **12h00**

Electromechanical properties of isolated type I collagen fibrils*, **Catalin Harnagea** [1], Martin Vallières [1], Christian P. Pfeffer [2], François Légaré [1], Alain Pignolet [1], [1] *INRS-EMT*, [2] Harvard School of Dental Medicine — Electromechanical phenomena play an important role in the accomplishment of biological functions in organic structures and tissues. Collagen, the most abundant protein in mammals, is particularly important because it gives strength to the connective tissue. While the macroscopic piezoelectric properties of collagen have been extensively investigated, only few reports are available on the electromechanical behavior of collagen at the nanoscale. An extensive investigation of the electromechanical properties of isolated type I collagen from intramuscular fascia fibers laid down on a conductive substrate will be presented. The technique used to investigate their electromechanical properties with a spatial resolution down to 10 nm is, known as piezoresponse force microscopy (PFM). It employs an atomic force microscope with a conductive tip in combination with a lock-in modulation technique. The mechanical vibrations, driven by the AC-electrical excitation applied to the conductive atomic force microscope (AFM) tip are along the fibril axis and are transmitted to the tip via friction. Remarkably, we detect in-plane piezoactivity not only in the lateral (usually friction) signal but also in the out-of-plane signal implying a strong induced cantilever buckling. Studies of individual collagen fibrils (less than 100 nm in diameter) reveal that the measured piezoelectric deformation depends on the angle between the fiber and the cantilever axis. An analysis of this dependence shows that the amplitude of the resultant piezoresponse (considered a 2-dimensional vector) is constant along the fiber. Therefore, the dominant components of the piezoelectric tensor are the shear coefficients $d_{\alpha\beta} = 1, 2$with $\alpha = 4, 5$, consistent with macroscopic data. The dependence of the type I and β collagen fibers piezoelectricity on the contact force (compressive stress perpendicular to the fiber axis) and on the frequency of testing will also be presented.

* This work is being supported by NSERC

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

[TU-A3] (PPD/*PPD*) Non-Accelerator Particle Physics II / *Physique des particules sans accélérateur II*

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***

10h00 - 12h30

ROOM / *SALLE* **MG2 147G2 (cap.108)**

Chair: K. Graham, Carleton University

TU-A3-1 **10h00**

SUJEEWA KUMARATUNGA, Université de Montréal

PICASSO

The PICASSO experiment is a spin dependant Weakly Interacting Massive Particle (WIMP) search based in SNOLAB, Sudbury, Ontario. It uses superheated C_4F_{10}, perfluorobutane, as its active detector component. The superheated liquid C_4F_{10} droplets dispersed in the elastic polymer gel act as individual bubble chambers. The detector is now complete and has a total active mass of 2248.6 g with 1795.1 g of Freon mass. When an ionizing particle moves through the C_4F_{10} droplet, the energy it deposits causes the F^{19} nuclei to recoil which causes the liquid to vaporize forming small bubbles along its track. This bubble grows explosively until the entire droplet is transformed into a vapour bubble. Piezo electric sensors on the wall of the detector, register the accompanying acoustic signal. Since these signals contain information about the nature of the primary event, they can be used to discriminate efficiently between WIMP signals, alpha particles and other background sources. The PICASSO experiment exploits this feature to very successfully discriminate the signal nuclear recoils from its background. In this talk we will present the latest results of this separation technique and our improved limits on the WIMP-proton cross section.

TU-A3-2 **10h30** **(G)**

Development of a Non-invasive Technique to Measure the Droplet Size Distribution of a PICASSO Detector*, **Patrick Nadeau**, *Laurentian University* — The PICASSO dark matter search experiment employs Special Bubble Detectors (SBD) that consist of superheated liquid droplets of Freon dispersed uniformly throughout a gel matrix, each having a droplet size distribution that is directly related to the method of detector fabrication. The successful detection of a WIMP-based dark matter particle will require a full characterization of the detectors, including a complete understanding of the effects of different droplet sizes on the quality of measured data and background suppression. We have previously developed an invasive technique at Laurentian University to measure the droplet size distributions of PICASSO detectors. This presentation will discuss a non-invasive technique we are developing that correlates droplet size with the energy released upon phase transition.

* This work is being supported by NSERC

TU-A3-3 10h45 (U*)

Analysis of Superheated States of C_4F_{10} for PICASSO Dark Matter Experiment*, **Gregory Cully**, *Laurentian University* — The Project in Canada to Search for Supersymmetric Objects (PICASSO) is a direct dark matter search experiment whose aim is to detect dark matter interactions using the superheated droplet technique. The collaboration has designed and built special bubble detectors which contain millions of microscopic droplets of superheated freon. When an incoming particle interacts inside the droplet it can trigger a violent phase transition producing a shock wave that can be detected by piezoelectric transducers installed on the walls of the detector. We have studied the response of the detectors as a function of the various modes (i.e. different pressures and temperatures) of common superheated states. A newly designed pressure system which allows the detectors to reach lower than ambient pressure was used to explore regions of low pressure and compare the characteristics of the events to those of normal operating conditions. Superheat phenomena and the results of studying various modes of common superheated states are discussed.

* This work is being supported by NSERC

TU-A3-4 11h00 (G*)

Fourier Transforms to Discriminate Events in Superheated Droplet Detectors*, **Simon Archambault**, *Université de Montréal* — The PICASSO experiment uses droplet detectors to search for WIMPs (Weakly Interacting Massive Particles), likely candidates of dark matter. If the WIMPs hit a nucleus in a droplet, that nucleus recoils and deposits its energy in a heat spike, which triggers a phase transition. However, these phase transitions can be caused by many other reasons, and it is primordial to understand what those other causes are and how to discriminate them so a clear WIMP signal can be detected. The phase transitions are mini-explosions that give acoustic signals recordable with piezoelectric transducers. The form of this signal can help determine what the origin of the primary event can be. Two variables have been identified to do just that. One, named pvar, uses the acoustic power and tells the difference between noise, neutrons and alpha particle events (which are the main sources of background noise). The other one, named fvar, is a new variable, developed through the observation of the Fourier Transform of the acoustic signals. Using that, it is now possible to discriminate between events caused by chain reactions (through a fracture formed in the gel encompassing the droplets), and hopefully will be able to tell if an event was actually an air bubble instead of a nuclear recoil. Also, used in conjunction with pvar, it can make for a more complete cut between noise and good events.

* This work is being supported by NSERC

TU-A3-5 11h15

MARK BOULAY, Queen's University

Dark Matter Search at SNOLAB with DEAP-1 and DEAP-3600 *

The DEAP/CLEAN experiment will search for WIMPs (Weakly Interacting Massive Particles) through elastic scattering on liquid argon. The first generation detector (DEAP-1) with a 7-kg liquid argon target mass is currently operating underground at SNOLAB. An overview of that experiment, including pulse-shape discrimination results for reducing beta/gamma backgrounds, and results from operation at SNOLAB will be presented. The DEAP-3600 detector, containing 3600 kg of liquid argon, is currently being constructed. It will have a target sensitivity to spin-independent scattering on nucleons of 10^{-46} cm^2, several hundred times more sensitive than current dark matter experiments. The design and construction status of DEAP-3600 will be outlined.

* This work is being supported by NSERC and CFI

TU-A3-6 11h45

Monte-Carlo simulation and Calibration of the neutron response of the DEAP-1 Detector*, **Victor Golovko**, Marcin Kuzniak, Mark Boulay, Bei Cai, for the DEAP/CLEAN collaboration, *Queen's University* — The detailed simulation of the neutron interaction with the detector is a crucial tool for optimizing detector configurations and analyzing experimental data for direct search of the dark matter using pulse-shape discrimination technique [1]. Therefore, accurate Monte Carlo simulations of the neutron transport and detection in a precisely modeled laboratory and experimental setup for DEAP-1 liquid argon detector using the GEANT4 toolkit have been compared to the measurements with neutron Am-Be source. Status and progress of this work will be discussed.

1. M. Boulay and A. Hime, *Astropart. Phys.* **25**, 179 (2006)

* This work is being supported by National Science and Engineering Research Council of Canada (NSERC), by the Canada Foundation for Innovation (CFI) and by the Ontario Ministry of Research and Innovation (MRI)

TU-A3-7 12h00 (G)

Alpha Backgrounds in the DEAP-1 Detector*, **Tina Pollmann**, Mark Boulay, *Queen's University* — The DEAP-1 detector will search for interactions of Weakly Interacting Massive Particles (WIMPs) with argon. In order for a possible signal to be considered a WIMP detection candidate, all backgrounds and the signals they leave in the detector have to be understood thoroughly. In the DEAP-1 detector, an acrylic container is coated on the inside with the wavelength shifter TPB and filled with liquid argon. Alpha particles from primordial U and Th in the acrylic can reach the TPB layer and deposit varying amounts of energy there, causing scintillation in the TPB that might be indistinguishable from the liquid argon scintillation. In this talk, the scintillation of TPB under alpha particle excitation will be studied with the goal of quantifying how much it might look like a WIMP signal in the detector.

* This work is being supported by NSERC and CFI

TU-A3-8 **12h15** **(G*)**

Approaching the Final Results of the TWIST experiment*, **Ryan Bayes** [1], [1]*University of Victoria*, [2] For the TWIST Collaboration — The TWIST (TRIUMF Weak Interaction Symmetry Test) experiment probes the Lorentz structure of the weak interaction using muon decay. This structure has a very well defined form under the Standard Model (SM) which makes precise predictions for the shape of the decay positron spectrum with respect to momentum and angle. The shape of the spectrum is described under some rather general assumptions using a set of decay parameters whose values according to the SM are $\rho = \delta = 3/4$, $\eta = 0$, and $\xi = 1$. TWIST uses a large sample of muon decays in a large acceptance spectrometer to measure the decay parameters to an order of magnitude greater precision than previous measurements. This experiment saw its last year of data collection in 2007 and is now nearing the completion of its final analysis. As TWIST is a systematics dominated experiment, much of the recent effort has been spent on refinements of the estimates of the systematic uncertainties over previous TWIST results. This talk will discuss the measures taken to achieve the precision goal of parts in 10^4, and the physics implications for the current and future results of the experiment.

* This work is being supported by NSERC

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

[TU-A4] (DOP/*DOP*) Information and Telecom / *Information et télécommunication*

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***

10h00 - 11h00

ROOM / *SALLE* **MRR A002 (cap.133)**

Chair: R. Corriveau, CIPI/ICIP

TU-A4-1 **10h00**

PAUL JESSOP, McMaster University

Defect Engineering of Silicon for Long Wavelength Photodetectors †

One of the essential elements in silicon photonic chips is a high speed photodetector that is compatible with CMOS fabrication techniques and sensitive at telecommunications wavelengths near $\lambda = 1.55$ μm. We report the fabrication of p-i-n silicon waveguide photodetectors in which the silicon is made to absorb light at these sub-bandgap photon energies by the localized introduction of point defects through the implantation of Si^+ or other ions. The enhanced optical absorption is modelled in terms of Shockley-Read-Hall generation/recombination at defect centres that are assumed to be negatively charged silicon divacancies. Detector responsivity is found to increase as a function of defect density only up to an optimum density, beyond which carrier trapping and recombination dominate over generation. The attainable quantum efficiency is highly dependent upon the device geometry. The background doping level also plays an important role since this determines the charge state of the point defects and hence the strength of the optical absorption at sub-bandgap wavelengths. With sub-micron waveguide dimensions, detectors can be made with responsivities approaching 1 A/W and bandwidths in the 10 GHz range.

† In collaboration with D.F. Logan, A.P. Knights , McMaster University

TU-A4-2 **10h30** **(G*)**

Budget Entanglement: A Compact and Intrinsically Stable Source of Polarization Entangled Photons*, **Terence Stuart** [1], Félix Bussières [1], Joshua Slater [1], Wolfgang Tittel [2], [1] *Institute for Quantum Information Science at the University of Calgary*, [2] Institute for Quantum Information Science at the University of Calgary, Department of Physics, University of Calgary — Quantum theory predicts the existence of entanglement, a bizarre and counterintuitive property that some once viewed as being incompatible with any "reasonable definition of reality" [1]. Experimental results, such as tests of Bell inequalities [2], have since shown that entanglement is not merely a mystery of quantum theory, but also, a resource that exists, can be observed, and can be exploited to expand the realm of what is possible in fields such as computation and communication. In this talk we will present a novel source of entanglement and some experimental results of its characterization. This inexpensive, compact, and robust source produces polarization entangled photon pairs at non-degenerate wavelengths of 810 nm and 1550 nm, uses commercially available non-linear crystals configured in a Sagnac interferometer, and is pumped by an inexpensive laser pointer. It requires no active stabilization and produces uncorrected entanglement visibilities exceeding 96%. This source shows great promise for future applications in practical systems as well as for use in testing Bell inequalities that require high visibility sources [3].

1. A. Einstein, B. Podolsky, N. Rosen, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?", *Physical Review* **47** , 777-780, 1935
2. A. Aspect, "Bell's inequality test: more ideal than ever", *Nature*, **398**, 189-190, 1999.
3. N. Brunner, N. Gisin, "Partial list of Bell inequalities with four binary settings", *Phys. Rev. A*. **372**, 3162-3167, 2008.

* This work is being supported by IQIS

TU-A4-3 **10h45** **(G*)**

Quantum Key Distribution with Quantum Frames*, **Itzel Lucio** [1], Philip Chan [1], Steve Hosier [2], Xiaofan Mo [1], Wolfgang Tittel [1], [1] *University of Calgary*, [2] Southern Alberta Institute of Technology Polytechnique — We report on a proof-of-principle demonstration of quantum key distribution [1, 2]. Our QKD system is all fiber-based and employs the BB84 protocol [3]. It has been designed to allow sending of classical framing information via sequences of strong laser pulses (quantum frames) and allows in principle encoding of qubit states at Gb/s clock rates. The quantum frames allow synchronization, sender and receiver identification, encoding of implementation specific information such as the QKD protocol used, and compensation of time-varying birefringence in the communication channel. These features will facilitate the integration of our QKD system into existing telecommunication networks. In this system, a DFB laser diode is used to generate 500ps-width laser pulses, which are strongly attenuated to the single-photon level. These pulses are modulated using a 10GHz polarization modulator to create four polarization qubits. To remove the threat of eavesdropping based on photon-number-splitting attacks, the decoy protocol can

be implemented via a 10 GHz intensity modulator [4]. At Bob's side the qubits are randomly projected onto two conjugate bases by means of a 50/50 beamsplitter, two polarization beamsplitters and four single photon detectors. We realized a proof-of-principle demonstration of quantum key distribution over a 12 km real-world fibre link. Our system worked continuously during 37 hours and thanks to the active polarization compensation, the quantum bit error rate we observed was of only around 3%.

1. N. Gisin, G. Ribordy, W. Tittel and H. Zbinden, "Quantum cryptography", *Rev. Mod. Phys*, **74**, 145, 2002.
2. I. Lucio-Martinez, P. Chan, X. Mo, S. Hosier, W. Tittel. "Proof-of-Concept of Real World Quantum Key Distribution with Quantum Frames", arXiv: 09010612.
3. C.H. Bennett and G. Brassard, in *Proc. IEEE Int. Conf. Comput. Syst. Signal Process.*, Bangalore India, 1984, pp 175- 179.
4. W.-Y. Hwang, Phys. *Rev. Lett.* **91**, 057901 (2003), X. Ma *et al.*, *Phys. Rev. A* **72**, 012326 (2005), X.-B. Wang, *Phys. Rev. Lett.* **94**, 230503 (2005).

* This work is being supported by General Dynamics Canada, iCore, NSERC, CFI, AET, CMC Mycrosystems and CONACyT

11h00 Session Ends / *Fin de la session*

[TU-A5] (DTP/*DPT*) Mathematical Physics / *Physique mathématique*

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

10h00 - 12h00

ROOM / *SALLE* MG2 148G2 (cap.132) *Chair: S. Das, University of Lethbridge*

TU-A5-1 10h00

JOHN E. SIPE, University of Toronto

Towards a QED for dispersive and absorptive media

Artificially structured materials such as nanowires, waveguides, and photonic crystals are typically constructed of semiconductors or metals that are highly dispersive or even absorptive at frequencies of interest. When these nanophotonic structures are studied for applications in quantum optics, a quantum electrodynamics that includes the effects of dispersion and absorption is required. A full microscopic treatment would be excessive, of course. From experiment or theory one usually has the frequency dependence of the position dependent dielectric constant, and at least at the linear level the goal is to build an effective QED for the medium from this alone. We present one approach based on a mode expansion of the fields. It fits naturally into the usual framework used in classical integrated optics to treat fields in nanophotonic structures.

TU-A5-2 10h30

ERIC WOOLGAR, University of Alberta

The Ricci flow and Bartnik's quasi-local mass *

Consider a Riemannian manifold M with an asymptotic end and a compact (i.e., inner) boundary. On this boundary, fix the boundary metric and mean curvature. Bartnik's "static minimization conjecture" is that, of all asymptotically flat Riemannian metrics on M with (i) nonnegative scalar curvature, (ii) containing no minimal hyperspheres, and (iii) inducing the given metric and mean curvature on the boundary; there will be a metric which minimizes the ADM mass of M, and that this metric obeys the static Einstein equations on M. B List in his PhD thesis described a geometric flow, now recognized to be a certain Ricci flow, which leads to an approach to this problem. I will describe a study of List's flow in the rotationally symmetric case. This is joint work with T Oliynyk and L Gulceva.

* This work is being supported by NSERC

TU-A5-3 11h00

Memory effects induced by initial switching conditions in a Fano-Anderson model*, **Donald Sprung** [1], Joan Martorell [2], Wytse van Dijk [3], J. Gonzalo Muga [4], [1] *McMaster University*, [2] University of Barcelona, Spain, [3] McMaster and Redeemer Univ. College, [4] Univ. of the Basque Country, Bilbao — Exponential decay is observed in a wide variety of physical systems. It has long been known that in quantum mechanics, exponential decay cannot persist at long times, but must be replaced by a slower decay, generally a power law. The predicted slower decay rate at long times has proven difficult to verify, but it is a universal feature present in theoretical models. This applies not only to a particle trapped by a potential barrier, but also to the decay of a discrete state coupled to a continuum. It is less well-known that when the confining barrier, or the coupling between discrete state and continuum, is time-dependent in the initial stages of decay, so-called "memory effects" affect the post-exponential survival probability of the system. These "initial-switching" effects were proposed as a means of enhancing the survival probability, to make it feasible to detect the post-exponential regime experimentally. We study initial-switching in the context of Longhi's version of the Fano-Anderson model. Generally the sudden approximation, where the coupling is turned on instantaneously, is assumed. Here we consider a finite rise time T, both numerically and analytically. When the coupling is ramped up linearly over a switching time T, we show that the asymptotic survival amplitude acquires a phase T and is modulated by a factor (sin T)/T.

* This work is being supported by NSERC, DGES, Spain and UPV-EHU, Bilbao.

TU-A5-4 11h15

Damped harmonic oscillator in phase-space quantum mechanics*, **Mark Walton**, Borislav Belchev, *University of Lethbridge* — Quantum mechanics can be done in phase space with a star product, a deformation of the ordinary product of functions parameterized by Planck's constant. Classically, a harmonic oscillator can be damped by deforming its Poisson brackets. Combining these two deformations, one finds the damped star product of Dito and Turrubiates. The damped product is non-Hermitian and c(ohomologically)-equivalent to the usual Moyal star product, however, leading to complications in the treatment of the dynamics - the classical

limit is wrong and the Wigner function is not real! We show how to overcome these difficulties and correctly incorporate Wigner functions. We find that the Wigner function satisfies the classical equation of motion. This seems appropriate since non-dissipative systems with quadratic Hamiltonians share this property.

* This work is being supported by NSERC

TU-A5-5 11h30

Quantum Entanglement, Nonlocality, and Special Relativity*, **William E. Baylis**, Crystal McKenzie, *University of Windsor* — The instantaneous collapse of a nonlocal wave function to an eigenstate of the measurement operator can conflict with relativistic causality when events are interpreted classically. The conflict is especially striking for wave functions of entangled particle pairs with large spatial separations. The measurement of the state of one particle of the pair immediately determines the state of the other, and this process has given rise to conclusions such as "quantum mechanics embraces ('instantaneous', 'spooky') action at a distance" that would violate the principle of relativistic causality, namely that influences or actions cannot propagate faster than light. The conflict can be resolved by avoiding classical constructs and accepting that nature uses amplitudes (wave functions) and their superpositions to determine the probability of events. Consistency with causality does constrain possible interpretations of the wave function. In particular, it cannot be an amplitude for energy, mass, or charge density, and its interpretation as a probability amplitude is consistent only if the time evolution of the probability is allowed to differ for observers in relative motion. Our study uses the mathematical framework of the algebra of physical space [1] to provide a relativistic quantum treatment with clear geometric meaning and close ties to a classical description.

1. W.E. Baylis, "A Relativisitc Algebraic Approach to the Q/C Interface: Implications for 'Quantum Reality'", *Adv. Appl. Clifford Alg* **18**, 395-415 (2008); W.E. Baylis and J.D. Keselica, "A Classical Spinor Approach to the Quantum/Classical Interface", *Can. J. Phys.* **86**, 629-634 (2008).

* This work is being supported by NSERC

TU-A5-6 11h45

Topological Casimir effect and the Proca connection*, **Ariel Edery** [1], Valery Marachevsky [2], [1] *Bishop's University*, [2] Laboratoire Kastler Brossel, CNRS, ENS, UPMC and V.A. Fock Institute of Physics, St. Petersburg State University — We study the Casimir effect in the presence of an extra dimension compactified on a circle of radius R (M4 x S^1 spacetime). Our starting point is the Kaluza Klein decompo- sition of the 5D Maxwell action into a massless sector containing the 4D Maxwell action and an extra massless scalar field and a Proca sector containing 4D gauge fields with masses $m_n = n/R$ where n is a positive integer. An important point is that, in the presence of perfectly conducting parallel plates, the three degrees of freedom do not yield three discrete (reflected) modes but two discrete modes and one continuum (penetrating) mode. The perfect conductor becomes partially transparent due to the topology of the spacetime. The massless sector reproduces Casimir's original result and the Proca sector yields the corrections. The contribution from the Proca continuum mode is obtained within the framework of Lifshitz theory for plane parallel dielectrics whereas the discrete modes are calculated via novel 5D formulas for the piston geometry. An interesting manifestation of the extra compact dimension is that the Casimir force between perfectly conducting plates depends on the thicknesses of the slabs.

* This work is being supported by NSERC, CNRS grant ANR-06-NANO-062, grants RNP 2.1.1.1112, SS 5538.2006.2, RFBR 07-01-00692-a and NSF (grant no. PHY05-51164)

12h00 Session Ends / *Fin de la session*

[TU-A6] Explosive Astrophysics Environments in Stars / *Milieux astrophysiques explosifs dans les étoiles*

(DNP/*DPN*)

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

10h00 - 11h30

ROOM / *SALLE* MRR D102 (cap.134)

Chair: C. Andreoiu, Simon Fraser University

TU-A6-1 10h00

ALAN A. CHEN, McMaster University

Nuclear Astrophysics at McMaster: Indirect Approaches

The goal of understanding the energy generation and nucleosynthesis in stars brings together progress in nuclear astrophysics from observations, theory, meteoritics, and laboratory experiments. In recent experimental work, significant progress has been made in light of new developments in unstable ion beam production at laboratories worldwide, complemented by important experiments at stable beam accelerator facilities. Our group at McMaster University has recently carried out a number of studies at such facilities, including RIKEN, the NSCL, and Yale, in order to probe indirectly some of the key reactions responsible for nucleosynthesis under the extreme conditions found in exploding stars. This presentation will discuss these experiments, ongoing analysis, their results, and astrophysical implications.

TU-A6-2 10h30

BARRY DAVIDS, TRIUMF

Recent Progress in Nuclear Astrophysics at TRIUMF

Recent experimental and theoretical work in nuclear astrophysics at TRIUMF has focused on explosive nuclear burning on accreting neutron stars and novae, as well as on nuclear reactions important for big-bang nucleosynthesis, solar neutrino production, and the ages of the oldest stars. I will review some of the highlights of this research.

TU-A6-3 11h00 (G*)

Mass measurements of neutron-deficient isotopes of Mo, Tc, Ru and Rh for rp- and νp-process models performed with the Canadian Penning trap mass spectrometer*, **Jennifer Fallis** [1], K.S. Sharma [1], A. Chaudhuri [1], G. Gwinner [1], J.A. Clark [2], G. Savard [2], D. Lascar [3], J. Van Schelt [4], F. Buchinger [5], J.E. Crawford [5], S. Gulick [5], *et al.*, [1] *University of Manitoba*, [2] Argonne National Laboratory, [3] Northwestern University, [4] University of Chicago, [6] McGill — Several nucleosynthetic processes that occur in various astrophysical environments have been proposed to explain the observed abundances of the chemical elements. The reaction paths of two of these processes, the *rp* and *νp* processes, pass through several neutron-deficient isotopes of Mo, Tc, Ru and Rh whose masses have only recently been measured. Of these, 18 mass measurements have been performed with the Canadian Penning Trap (CPT) mass spectrometer. These new measurements provide some of the first experimental determinations of the proton-separation energies, S_p, for these nuclides and result in significant improvements in the precision of S_p values where previously known. Precise S_p values are needed to properly model the paths and reaction products of the *rp* and *νp* processes. Our most recent measurements in this region provide the remaining masses for all but one nuclide along the primary path of the *νp* process between ^{86}Nb and ^{96}Pd. As the *rp*-process path lies further from stability than the *νp*-process path measurements along the *rp*-process path are still ongoing. These results and some of their astrophysical implications will be discussed.

* This work is being supported by NSERC, Canada and the U.S. DOE, Office of Nuclear Physics, under Contract Nos. DE-AC02-06CH11357 and DE-FG02-91ER-40609.

TU-A6-4 11h15

Opportunities for the Canadian Penning Trap Mass Spectrometer at the new CARIBU facility at the Argonne National Laboratory*, **Kumar Satish Sharma** [1], J. Fallis [1], A. Chaudhuri [1], F. Buchinger [2], J.E. Crawford [2], G. Li [2], J.A. Clark [3], C.M. Diebel [3], G. Savard [3], A.F. Levand [3], T. Sun, *et al* [3], [1] *University of Manitoba* , [2] McGill University, [3] Argonne National Laboratory — The Canadian Penning Trap Mass Spectrometer (CPT) will temporarily move from its current position, on-line to the ATLAS accelerator at the Argonne National Laboratory (ANL), to a new location at the Californium Rare Isotope Breeder Upgrade (CARIBU) scheduled to be installed in 2009 at the ATLAS accelerator facility. During its commissioning period CARIBU will provide intense, low-energy, beams of short-lived, neutron-rich nuclides produced by a, 1 Ci, ^{252}Cf fission source. These low energy ions will be cooled and injected into the CPT for mass measurement. The intensities available at this new facility will allow the CPT to measure the masses of many nuclides near or on the path of astrophysical r-process. An overview of the new system and its capabilities will be presented.

* This work is being supported by NSERC, Canada and by the U.S. DOE, Nuclear Physics Division, under Contract Nos. DE-AC02-06CH11357 and DE-FG02-91ER-40609.

11h30 Session Ends / *Fin de la session*

[TU-A7] Biological and Soft Materials / *Matériaux biologiques et mous*

(DCMMP-DMBP *DPMCM-DPMB*)

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***

10h00 - 12h15

ROOM / *SALLE* MRR R221 (cap.292)

Chair: B.D. Gaulin, McMaster University

TU-A7-1 10h00

JOHN DUTCHER, University of Guelph

Biopolymers from Bacteria - Nature's Nanotechnology

Bacteria are microorganisms that have evolved over billions of years and are responsible for a wide range of phenomena in the world around us, from causing diseases to helping us to digest food to shaping the surface and sub-surface of the earth. In response to their environment, they have evolved an amazing set of specialized mechanisms and materials to ensure their survival. I will discuss our multidisciplinary approach to the study of bacteria and bacterial colonies, while focusing on bacteria as a source of unique biopolymers and emphasizing the underlying materials physics. In particular, I will discuss our recent atomic force microscopy studies of the peptidoglycan sacculus, and our ability to produce monodisperse polysaccharide nanoparticles from bacterial biomass and to functionalize the nanoparticles for a broad range of industrial and biomedical applications.

TU-A7-2 10h30

Understanding the stability of self-assembled microstructures in cylindrically-confined diblock copolymer melts from their geometrical characteristics*, **Robert Wickham**, Jason Crann, Christopher Heggemann, *University of Guelph* — We compute the AB interfacial area, interfacial mean curvature, and deviations from constant mean curvature for the self-assembled structures that form in a diblock copolymer melt confined in a cylindrical nanopore, recently discovered via self-consistent field-theory. By relating these geometrical measures to the interfacial free-energy, chain stretching, and packing frustration, we are able to suggest reasons for the regions of stability observed for confined structures, as the pore diameter varies. The spatially-resolved degree of chain stretching in these confined systems can be directly computed, and will be discussed.

* This work is being supported by NSERC

TU-A7-3 11h00

Entropic Rigidity of Polymeric Loops*, **Bela Joos**, Martin Bertrand, Martin Forget, *University of Ottawa* — Proteins are typically long inhomogeneous macromolecules folded in specific ways determined by their primary structure (ordering of the components along the chain). Classical dynamical analysis is a powerful tool to obtain their zero temperature elastic constants. At room temperature, however, a significant entropic contribution is expected. An estimate of this contribution can be made by considering the entropic forces produced by the linear segments and the loop configurations within the folded structure. We report in

this work the little studied contributions of the loops, using Molecular Dynamics simulations to calculate the restoring forces and torques as a loop is respectively dilated and twisted in a radial direction. We find that radial dilation of a polymer ring is analogous to stretching its linear counterpart, while adding a twist to it further increases its entropic elastic response.

* This work is being supported by NSERC

TU-A7-4 11h15

A Diffusionless Transition in a Normal Alkane*, **Jeffrey L. Hutter** [1], Shailesh Nene [1], Erik Karhu [2], Roberta Flemming [1], [1] *University of Western Ontario*, [2] Dalhousie University — The normal alkanes, chemical formula C_nH_{2n+2}, are the simplest hydrocarbons, consisting of a single continuous chain. These materials have received attention because their importance in the petroleum industry and due to the fact that many biological molecules contain hydrocarbon domains. Normal alkanes display a wide range of solid phases, some of which—the so-called "rotator phases"—are characterized by positional order without long-range orientational order. We have found a striking pattern of twinned domains consisting of stripes of width ~1 μm that occurs in the monoclinic rotator RV phase of tricosane ($C_{23}H_{48}$). We have studied this structure by X-ray diffraction, as well as by optical and atomic-force microscopy. Intriguingly, transitions between the RV phase and the RI orthorhombic phase lying at higher temperatures appear to be diffusionless, with the same patterns of stripes appearing at the same locations, and with the same molecular-scale features, even after multiple transitions between the phases. These properties are reminiscent of martensitic transformations, which are better-known in metal alloys at higher temperatures. The tricosane system may be a convenient model for such transitions: since tricosane is a weakly-bound van der Waals solid, the transition occurs at convenient temperatures and with slow kinetics.

* This work is being supported by NSERC

TU-A7-5 11h30 (G*)

NMR Study of Dynamics in Multi-component Macromolecular Solutions*, **Suliman Barhoum**, Anand Yethiraj, *Memorial University of Newfoundland* — The system poly (ethylene glycol) (PEO) and sodium dodecyl sulfate (SDS) in aqueous solution has been studied at different SDS concentrations. It is a simple model system which is useful in developing techniques applicable to more complicated multi-component bio-molecular systems. Using pulsed-field-gradient diffusion NMR spectroscopy, we obtain the self-diffusion coefficients of PEO and SDS simultaneously and as a function of SDS concentration. The self-diffusion measurements show a mono-exponential attenuation in the signal amplitude ratios for SDS peaks over all range of SDS concentrations which gives an indication that the measured self-diffusion coefficient of SDS is the average diffusion coefficient due to rapid molecular exchange between the free and bound species of SDS. Within the context of a simple model, our results yield the onset of aggregation of SDS on PEO chains, the saturation concentration for this aggregation, as well as the fraction of free SDS surfactant.

* This work is being supported by NSERC

TU-A7-6 11h45

Polymerization and structure of $(B_2O_3)_{1-x}(H_2O)_x$ glasses and liquids*, **Ralf Brüning** [1], Justine B. Galbraith [1], Katherine E. Braedley [1], Subramanian Balaji [2], Yahia Djaoued [2], [1] *Mount Allison University*, [2] Université de Moncton – Campus de Shippagan — The goal of this project is to understand how the network of covalent bonds in vitreous B_2O_3 transforms to the hydrogen-bonded structure of liquid water. X-ray scattering and Raman spectroscopy data have been obtained for $(B_2O_3)_{1-x}(H_2O)_x$ mixtures in the glass and homogeneous liquid phase across the whole composition range. The first and second x-ray diffraction peaks of pure borate glass merge into one sharp diffraction peak around x=0.80. The degree of polymerization of $B(OH)_3$ monomers can be estimated based on Raman spectroscopy data. The sharp Raman line at 877 cm^{-1}, associated with the symmetric stretching frequency of the B-O bond in the $B(OH)_3$ molecule, is observed for mixtures with $x > 0.381$. At this composition the Raman mode at 595 cm^{-1}, associated with $B_3O_3(OH)_3$, ring molecules can still be detected. The Raman mode near 650 cm^{-1}, characteristic of boron atoms participating in an extended boron-oxygen random network, vanishes between x=0.690 and x=0.786.

* This work is being supported by NSERC Discovery Grant

TU-A7-7 12h00

Water in MCM-41: An NMR Study*, **Mohamad Niknam**, Jianzhen Liang, Claude Lemaire, Hartwig Peemoeller, *University of Waterloo* — MCM-41 is a class of mesoporous material with a very high surface to volume ratio, which makes it an attractive candidate for catalysis applications. In the majority of cases an aqueous medium is involved and in order to fully exploit this material in this connection it is necessary to understand the water molecule dynamics and the interactions between water molecules as well as between water and the pore surface. We report on a Nuclear Magnetic Resonance (NMR) study of the behaviour of water in MCM-41 with pore diameter of 27 Angstroms. The analysis of proton spectra and relaxation, measured as a function of temperature and hydration at 500 MHz, has revealed that two different water phases reside in these uniform pores. Magnetization exchange between these phases and between water and surface OH groups will be discussed.

* This work is being supported by NSERC

12h15 Session Ends / *Fin de la session*

[TU-A8] Photon Interactions / *Interactions des photons*

(DIMP-DAMPhi / *DPIM-DPAMip*)

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

10h00 - 11h00

ROOM / *SALLE* MRR D202 (cap.135)

Chair: D.W. Tokaryk, University of New Brunswick

TU-A8-1 10h00

ALAN MADEJ, INMS, National Research Council of Canada

Probing Time and Physics Using an Optical Atomic Clock based on a Single Trapped Ion †,*

The remarkable union of laser cooling and trapping methods, frequency comb technology, and extremely narrow linewidth lasers has resulted in the recent development of optical atomic clocks whose accuracies now exceed that of the current cesium based realization of the SI second. Our team is investigating a reference based on a single atomic ion of strontium suspended in an electro-dynamic trapping field and laser cooled to kinetic temperatures such that the ion's motion produces negligible shifts and broadening. When probed on an ultra-narrow (0.4 Hz) optical transition at 445 THz (674 nm), the system can be used as an extremely accurate atomic frequency/time reference. In this talk, we will describe our results that include the resolution of spectral features at the 5 Hz level (1 part in 10^{14}) and the ability of our laser probe source to reach frequency instabilities of 5×10^{-16} for averaging times of 3000 s together with continuous measurement periods exceeding 24 hrs. A new ion trap apparatus is now being developed that will fully characterize of the ion's minuscule perturbations and shifts so that an evaluated uncertainty of 10^{-17} or better can be achieved. At this level of accuracy, it will be possible to measure the distortion of local time due to Earth's gravitational field by changes of the clock height at the centimeter level. Some comments will be made as to what we expect these improvements to yield in terms of sensitive tests of relativity and the stability of fundamental constants with time.

† In collaboration with Pierre Dubé [1], John Bernard [1], Gideon Humphrey [2], Louis Marmet [1], [1] INMS, National Research Council of Canada, [2] Department of Physics and Astronomy, York University

* This work is being supported by Natural Sciences and Engineering Research Council

TU-A8-2 10h30

Microcalorimeters for use in atomic physics and magnetic fusion*, **Peter Beiersdorfer** [1], M. Bitter [2], G.V. Brown [1], J. Clementson [1], K.W. Hill [2], R. Kelley [3], C.A. Kilbourne [3], F.S. Porter [3], [1] *Lawrence Livermore National Laboratory*, [2] Princeton Plasma Physics Laboratory, [3] Goddard Space Flight Center — Microcalorimeters were originally developed for the observation of x rays from astrophysical sources [1]. For more than a decade they have found uses for atomic physics studies on electron beam ion trap facilities [2], and they are currently under study for use on the ITER magnetic fusion project. State-of-the-art calorimeters operate at near absolute zero and consist of multi-pixel arrays (> thirty pixels) with high energy resolution (better than 1000 at an x-ray energy of 6 keV). Calorimeters with 1000 pixels or more and energy resolution of 3000 at 6 keV are now being built. They have fast time resolution for event-mode data acquisition at speeds faster than tens of microseconds. By varying the absorber material and the thickness of the thermal shields x rays with energies between about 100 eV and >100 keV can be recorded. We will present examples of the uses of calorimeters in atomic physics research, and we will outline their use for measuring impurity concentrations and ion temperature profiles of ITER plasmas.

1. C.K. Stahle, D. McCammon, and K.D. Irwin, *Phys. Today* **52**, 32 (1999).
2. F.S. Porter, P. Beiersdorfer, K. Boyce, G.V. Brown, H. Chen, J. Gygax, S.M. Kahn, R. Kelley, C.A. Kilbourne, E. Magee, D.B. Thorn, *Can. J. Phys.* **86**, 231 (2008).

* Work at LLNL was performed under auspices of the DOE under contract DE-AC52-07NA2344 and supported in part by NASA's APRA program, PPPL Subcontract ICP008450-R, and LDRD project 09-ERD-016.

TU-A8-3 10h45

Photoacoustic Spectroscopy of Polymer Beads, **Kirk H. Michaelian**, Qing Wen, *CANMET, Natural Resources Canada* — Photoacoustic (PA) spectra of four types of polymer resin beads, ranging in size from 35 to 150 micrometres, were acquired using a Fourier transform infrared (FT-IR) spectrometer capable of both rapid- and step-scan mirror movement. The thermal diffusion length (approximately equal to the sampling depth) was on the order of the particle sizes in this study. The PA magnitude spectra resembled conventional absorption spectra, while both positive- and negative-going features occurred in the phase spectra. The dependence of PA intensity on modulation frequency differed for strong and weak bands, with partial saturation causing a more gradual variation for the strong bands. The PA signal originated from within the beads, whereas absorption occurred near the surface for the reference carbon sample.

11h00 Session Ends / *Fin de la session*

[TU-A9] (DNP/*DPN*) Willem T.H. van Oers - A Canadian Nuclear Physics Career / *Willem T.H. van Oers - Une carrière canadienne en physique nucléaire*

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
10h00 - 10h15

ROOM / ***SALLE*** **MRR A202 (cap.133)**

Chair: M.N. Butler, St. Mary's University

TU-A9-1 **10h00**

ERICH VOGT, TRIUMF

Willem T.H. van Oers - a Canadian Nuclear Physics Career

Willem T.H. van Oers has achieved national and international recognition for his work on symmetries and symmetry violations in nuclear physics. In this, his 75th year, we wish to honour his achievements and his contributions to the growth and strength of nuclear physics in Canada.

10h15 **Session Ends /** ***Fin de la session***

[TU-HS-1] (CAP-DPE /*ACP-DEP*) High School Teachers' Workshop – a.m. / *Atelier des enseignant(e)s en physique - avant-midi*

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
10h00 - 12h15

ROOM / ***SALLE*** **MG1 152G1 (cap.60)**

Chair: F. Weil, Université de Moncton

See page 11 for details / *voir la page 11 pour plus de détails.*

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

[TU-A10] (DNP/*DPN*) Intensity Frontier-Testing the Standard Model / *Frontière d'intensité - la vérification du modèle standard*

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
10h15 - 12h15

ROOM / ***SALLE*** **MRR A202 (cap.133)**

Chair: W.T.H. van Oers, University of Manitoba

TU-A10-1 **10h15**

JEFF MARTIN, University of Winnipeg

Ultracold Neutrons in Canada

When neutrons are taken out of atomic nuclei and cooled down, they have weird properties: they bounce off walls, they can be stored in magnetic bottles, and they form quantized energy levels in Earth's gravitational field. Once they've been trapped using such methods, their properties can be studied very carefully to search for deviations from expectations based on the standard model of particle physics. If a deviation is found, it would signify new physics beyond the standard model. We're planning to build a source of ultracold neutrons in Canada (at TRIUMF, Vancouver, BC). It will provide the highest density of ultracold neutrons ever produced in the world, and we'll use the neutrons to push some very interesting physics experiments to unprecedented levels of precision, as I'll describe.

TU-A10-2 **10h45**

MICHAEL GERICKE, University of Manitoba

The Hadronic Weak Interaction and Parity Violation in Cold Neutron Capture

The study of the hadronic weak interaction has a long tradition, starting with the first observation of parity violation in the nucleon-nucleon (NN) interaction in cold neutron capture experiments, in the early 60's (Y. Abov *et al.,* 1964). Since then, there has been intense effort in gaining a better understanding of the weak NN interaction, both on the theoretical side, as well as on the experimental side. The existence of the NN weak interaction was first predicted in the generalization of Fermi's theory of nuclear beta decay (Feynman, Gell-Mann, Sudarshan, and Marshak) to include a universal charged weak current. In other words, a consistent theory for nuclear beta decay required the existence of the NN weak interaction. This basic framework has survived within the Standard Model (SM), with the crucial addition of the neutral weak hadronic currents. To this day, the latter remains a very poorly tested (and poorly understood) sector of the SM. The basic weak currents, as they occur in the SM, are modified by the strong interactions at low energy. At the same time, the large mass of the weak bosons requires close proximity of the quarks engaged in the interaction. The precision measurement of parity violating observables in few body NN systems can therefore provide important benchmarks for models that aim to describe low-energy, non-perturbative QCD, as well as effective models that seek to describe the NN weak interaction itself. Progress in measuring parity violating observables in cold neutron capture experiments has historically been hampered by a lack in high intensity neutron sources and other technological problems. Recently, significant technological advancements on all fronts and, especially, the completion of new, high intensity neutron sources have spurred renewed experimental activity in this area. I will present a brief overview of recent theoretical efforts and talk about current and proposed experimental work.

TU-A10-3 **11h15**

MICHAEL RAMSEY-MUSOLF, University of Wisconsin

Nuclear Physics and the New Standard Model

Experimental and theoretical studies in nuclear physics are poised to discover key ingredients of what will become the new Standard Model of fundamental interactions. In this talk, I review some of the forefront studies of neutrino properties and fundamental symmetries in nuclear physics and how they complement what may be learned from the Large Hadron Collider.

TU-A10-4 **11h45**

KLAUS GRIMM, Louisiana Tech University

Electron Parity Violation Experiments and Tests of the Standard Model

In electron scattering, the weak neutral current can be accessed by measuring a parity violating (PV) asymmetry caused by the interference term between weak and electromagnetic scattering amplitudes. Precision measurements play a central role in tests of the electro-weak theory and in search for new dynamics at very high-energy scales. Recent advances in the quality of polarized electron beam made it possible to study the structure of the nucleon, and in particular the strangeness content of the nucleon. A whole series of experiments have indicated that the strange quark contributions to the charge and magnetization distributions of the nucleon are tiny. With the next upcoming generation of experiments the 'running' of $\sin^2\theta_W$ or the electro-weak mixing angle has become within reach. The Q_{weak} experiment at JLab will the first precision measurement of the proton's weak charge, $Q^p_{weak} = 1-4\sin^2\theta_W$. The advent of the 12 GeV upgrade at JLab allow high-precision PV experiments such as a Møller scattering experiment, similar to SLAC E158, that will measure the weak charge of the electron. In addition parity violating deep inelastic scattering experiments will be used to extract the weak neutral-current vector-electron x axial-quark coupling constants C_{2q}. 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 significant constraints on possible Standard Model extensions.

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

[TU-A11] Femto- and Atto-second Science / *Science des femto- et atto-secondes*

(DAMPhi-DOP / *DPAMip-DOP*)

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***

11h15 - 12h00

ROOM / *SALLE* MRR D202 (cap.135)

Chair: D.W. Tokaryk, University of New Brunswick

TU-A11-1 **11h15**

THOMAS BRABEC, University of Ottawa

Attosecond science: Correlated few electron dynamics in small molecules and clusters

Attosecond science holds the promise to temporally and spatially resolve microscopic dynamics in matter. This ability will allow us to establish a more complete understanding of the interplay between electrons and ions in fundamental processes, such as the making and breaking of molecular bonds. Besides the experimental challenges associated with performing these measurements, there exist also formidable theoretical challenges. Modelling of attosecond experiments requires the solution of a combination of two of the most difficult problems of theoretical physics, i.e. calculating the non-perturbative dynamics of few-/many-body systems. The key to success lies in an accurate description of the correlation between electrons, which can change appreciably even over time scales as short as a few attoseconds. This talk will be focused on the theoretical challenges of attosecond science. After a brief overview of the experimental state-of-art/motivation, contemporary few-/many-body dynamics methods will be reviewed. As these methods only partially account for electron correlation, their accuracy is not controlled. In contrast to that, the multi-configuration time-dependent Hartree-Fock (MCTDHF) method can fully account for electron correlation. Our code can solve 2D and 3D problems for a few electrons on single processor machines. This allows us to investigate so far uncharted territory, such as the attosecond few-electron dynamics in small molecules and clusters. The results of these investigations will be discussed in the main part of the talk.

TU-A11-2 **11h45**

Imaging electron and proton dynamics in molecules with sub-femtosecond laser fields*, **Samira Barmaki**, Stéphane Laulan, *Université de Moncton - Campus de Shippagan* — We numerically simulate experiments to probe and image the nuclear and electronic wave packets in the H_2+ molecular ion at sub-femtosecond time scales. We have solved exactly the time-dependent Schrödinger equation (TDSE) describing the motion of the electron and protons in H_2+ in the Born-Oppenheimer approximation. The first study simulates a pump-probe experiment with an intense IR pump laser field and an ultrashort (sub-fs) XUV probe laser pulse. The pump step creates a non-dissociative nuclear wave packet with H_2+ initially taken in its fundamental state. We wait for the nuclear wave packet to propagate for a certain time delay then we ionize H_2+ with the sub-femtosecond XUV Laser pulse. By analyzing the kinetic energy distributions (KED) of the ejected protons, the coherent wave packet can be reconstructed from the KED and compared with the initial distribution. The pump–probe technique permits us to explore both the nuclear coherent motion and to bring information on the pulse characteristics. The second study is the interaction of H_2+ fixed at different internuclear distances with an intense attosecond laser pulse. The analyses of the KED of the ejected electrons help to image the electron dynamic at attosecond time scale.

* This work is being supported by FESR

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

[TU-Past-Pres] (CAP/*ACP*)
Past Presidents' Luncheon / *Dîner des ancien(ne)s président(e)s*
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
12h00 - 13h30

ROOM / *SALLE* **B219 JdeV (cap.12)** *Chair: L. Marchildon, Université du Québec à Trois-Rivières*

13h30 Session Ends / ***Fin de la session***

[TU-DAMPhi] (DAMPhi/*DPAMip*)
DAMPhi Business Meeting (lunch available) / *Réunion d'affaires DPAMip (dîner disponible)*
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
12h15 - 13h30

ROOM / *SALLE* **MRR D202 (cap.135)** *Chair: D.W. Tokaryk, University of New Brunswick*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends** / ***Fin de la réunion***

[TU-DMBP] (DMBP/*DPMB*)
DMBP Business Meeting (lunch available) / *Réunion d'affaires DPMB (dîner disponible)*
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
12h15 - 13h30

ROOM / *SALLE* **MRR A102 (cap.134)** *Chair: A. Linhananta, Lakehead University*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends** / ***Fin de la réunion***

[TU-DTP] (DTP/*DPT*)
DTP Business Meeting (lunch available) / *Réunion d'affaires DPT (dîner disponible)*
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
12h15 - 13h30

ROOM / *SALLE* **MG2 148G2 (cap.132)** *Chair: R. MacKenzie, Université de Montréal*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends** / ***Fin de la réunion***

[TU-HS-LUNCH] (CAP/*ACP*)
HS Workshop Luncheon / *Dîner de l'atelier des enseignant(e)s en physique*
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
12h15 - 13h30

ROOM / *SALLE* **B119 JdeV (cap.60)** *Chair: R.I. Thompson, University of Calgary*

Talk by R. Corriveau, Canadian Institute for Photonic Innovation.

13h30 Session Ends / ***Fin de la session***

[TU-PPD] (PPD/*PPD*)
PPD Business Meeting (lunch available) / *Réunion d'affaires PPD (dîner disponible)*
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
12h30 - 13h30

ROOM / *SALLE* **MG2 147G2 (cap.108)** *Chair: W.J. Taylor, York University*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends** / ***Fin de la réunion***

[TU-Plen2] (CAP/ACP) Special Plenary - Paul Corkum, 2009 NSERC Herzberg Medal Winner / *Plénière spéciale - Paul Corkum, récipiendaire de la Médaille d'or Herzberg 2009 du CRSNG*

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

13h30 - 14h00

ROOM / *SALLE* JdeV Salle de spectacle (cap.410)

Chair: S.A. Page, University of Manitoba

TU-Plen2-1 **13h30**

PAUL CORKUM, University of Ottawa / NRC

Extreme Nonlinear Optics -- Attosecond-Angstrom Science

During the past six years the minimum duration of optical (XUV) pulses has fallen from 5 femtoseconds (5x10-15 sec) to about 100 attoseconds (~10-16 sec)—less than the classical period of a ground-state electron in a hydrogen atom. Lasers drove this revolution by forcing electron wave packets to tunnel from the atom or molecules, move under the force of the time dependent electric field and then re-collide with their parent ions. From the ion's perspective, an attosecond electron wave packet re-collides. I will discuss how attosecond XUV pulses are the by product of this collision and how they are measured. The attosecond electron, controlled by light, is something unique in science. With wavelength ~ 0.5-3 Ångstrom, it allows us to measure spatial information using optical methods. The "shutter speed" can be attoseconds. It also allows us to transfer optical methods to collision physics. It may even be possible to time resolve some aspects of nuclear dynamics stimulated by collisions. Using N_2, O_2 and CO_2 as examples, I illustrate three new molecular spectroscopic methods. Each provides a different approach to molecular imaging.

14h00 **Session Ends / *Fin de la session***

[TU-HS-2] (CAP-DPE / ACP-DEP) High School Teachers' Workshop - pm / *Atelier des enseignant(e)s en physique - après-midi*

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

14h15 - 16h15

ROOM / *SALLE* MG1 152G1 (cap.60)

Chair: F. Weil, Université de Moncton

See page 11 for details / *voir la page 11 pour plus de détails.*

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

[TU-P1] (DCMMP/DPMCM) Semiconductor Materials and Devices / *Matériaux et dispositifs des semiconducteurs*

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

14h15 - 15h45

ROOM / *SALLE* MRR D002 (cap.135)

Chair: C. Santato, École Polytechnique

TU-P1-1 **14h15**

TED SARGENT, University of Toronto

Solution-processed wide-spectrum solar cells

Half of the sun's power lies in the infrared; yet the overwhelming majority of low-cost, large-area, physically-flexible solar cells absorb visible light exclusively. As a result these solar cells – based on organics, polymers, and colloidal quantum dots in various combinations - at best achieve 6.5% overall solar power conversion efficiency [1]. The consensus in industry and academe is that, even when cost per unit area is very low, such solar cells will have little commercial impact until they reach 10% power conversion efficiency. However, if they absorb visible light only, they are unlikely to meet that target. If, on the other hand, low-cost visible photovoltaics were complemented by solution-processed large-area infrared cells, they could achieve well into the tens of percent power conversion efficiencies. In January 2005, the first solution-processed IR solar cell was reported [2]. This first report was low in its IR monochromatic power conversion efficiency. In the past three years, this efficiency has been increased more than ten-thousand-fold [3-5]. Solution-processed infrared PV devices are now approaching performance parity with their visible counterparts. We will review progress in this field, focusing on four themes: (1) progress on the application-relevant performance of the devices; (2) the materials chemistry insights that have led to this rapid progress – for example, the novel exploitation of bidentate crosslinkers to modify the surface chemistry of nanoparticles, control their doping [3], and passivate the nanoparticles to produce air-stable infrared photovoltaics [5]; (3) the novel device architectures that have been key to these achievements – such as the first realization and investigation of Schottky-barrier solar cells based on colloidal quantum dots [4]; (4) the ways in which these insights are specific to the infrared PV field (due, for example, to a much smaller bandgap and a greater diversity of chemically-controlled trap states in PbS and PbSe), versus the extent to which these new findings are broadly applicable to the field of CQD materials and devices.

1. Y.K. Jin, K. Lee, N.E. Coates, D. Moses, T.-.Nguyen, M. Dante, A.J. Heeger, "Efficient tandem polymer solar cells fabricated by all-solution processing", *Science* **317**, 222 (2007).
2. S.A. McDonald, *et al.*, "Solution-processed PbS quantum dot infrared photodetectors and photovoltaics", *Nat. Mater.* **4**, 138-142 (2005).

3. E.J.D. Klem, D.D. MacNeil, P.W. Cyr, L. Levina, E.H. Sargent, "Efficient solution-processed infrared photovoltaic cells: Planarized all-inorganic bulk heterojunction devices via inter-quantum-dot bridging during growth from solution", *Appl Phys Lett* **90** (2007).
4. K.W. Johnston, *et al.*, "Schottky-Quantum Dot Photovoltaics for Efficient Infrared Power Conversion", *Applied Physics Letters* **92** (2008).
5. G. Koleilat, *et al.*, "Efficient, Stable Infrared Photovoltaics based on Solution-Cast Colloidal Quantum Dots", *ACS Nano* **2** (2008).

TU-P1-2 14h45 (G)

A high speed RF-QPC charge detector for time resolved readout applications of spin qubits*, **J.D. Mason** [1], L. Gaudreau [2], S.A. Studenikin [2], A. Kam [2], A.S. Sachrajda [2], J.B. Kycia [1], [1] *University of Waterloo* , [2] National Research Council Canada — Time resolved charge detection is one of the most important tools for measuring spin qubits [1]. Standard systems, for example measuring changes in the current through a quantum point contact, operate successfully down to about 20 microseconds. To be able to approach timescales shorter than the T2 decoherence time, one needs other approaches. We are implementing a radio-frequency quantum point contact (rf-QPC) charge detector which measures reflected power from a resonant tank circuit [2, 3]. This scheme utilizes an LC resonator to transform the resistance of the QPC to a value close to the 50 ohm cable impedance. In this way, radio-frequency components can be used which allow the resolution of changes in charge at a 50 nanosecond timescale. We determine the state of the quantum dot system by measuring the signal reflected off of the circuit composed of the QPC resistance and the LC resonator. This circuit has a resonance frequency of 1 GHz allowing the use of an isolator which reduces the influence of the HEMT amplifier noise on the quantum dot system. The progress towards the implementation of the readout will be presented.

1. J.M. Elzerman, R. Hanson, L.H. Willems van Beveren, B. Witkamp, L.M.K. Vandersypen, L.P. Kouwenhoven, *Nature* **430**, 431 (2004).
2. R.J. Schoelkopf, P. Wahlgren, A.A. Kozhevnikov, P. Delsing, D.E. Prober, *Science* **280**, 1238 (1998).
3. D.J. Reilly, C.M. Marcus, M.P. Hanson, A.C. Gossard, *Appl. Phys. Lett.* **91**, 162101 (2007).

* This work is being supported by QuantumWorks, NSERC

TU-P1-3 15h00

Mitigating Telegraph Noise in Lateral Nano-Devices*, **Andrew Sachrajda** [1], Alicia Kam [1], Peter Zawadzki [1], Louis Gaudreau [1], Ghislain Granger [1], Jan Kycia [2], Jeff Mason [2], Sergei Studenikin [1], Zbig Wasilewski [1], [1] *National Research Council* , [2] Waterloo University — One of the most important hurdles to be overcome before the routine application of lateral 2DEG nanostructures in quantum information circuits such as spin qubits is the common prevalence of telegraph noise in these devices. Recently we demonstrated that the origin of these time fluctuations lay in an interrupted leakage current into the semiconductor arising from the submicron gates defining the nanostructure itself. Two strategies have been adopted in the field to minimize the leakage current and hence the noise; (i) bias cooling and (ii) the use of a global gate. Both of these realize the noise reduction with the same principal consistent with the model. Specifically they achieve a reduction in the operating voltage of the nanostructure defining gates which automatically maximizes the tunnel barrier at the metal-semiconductor interface. In this paper we take this approach to the limit by exploring the possibility of eliminating the metal semiconductor interface all together through the use of a MOS (metal-oligomer-semiconductor) architecture. We demonstrate how this approach can actually transform a 'noisy wafer' into a 'quiet wafer'. Finally we apply this approach to real quantum dots and discuss remaining issues such as device drift.

* This work is being supported by NRC, NSERC, QuantumWorks

TU-P1-4 15h15

Conducting polymer transistors for biosensing applications*, **Fabio Cicoira**, George G. Malliaras, *Cornell University* — In the last decades organic semiconductors have attracted enormous interest for fabrication of devices for low-cost flexible electronics, such as light emitting diodes, transistors and solar cells. A more recent development in the field involves the use of organic electronics devices in sensing applications. In this context, organic electrochemical transistors (OECTs) represent a very attractive class of devices. OECTs can be operated in aqueous environment as ion to electron converters, thus providing an interface between the world of biology and electronics. This property, together with the well-known advantages or organic devices such as low cost and flexibility, makes OECTs the ideal devices for sensing applications. In addition, OECTs represents model system to explore fundamental properties of organic electronics devices exhibiting mixed ionic/electronics conduction. Despite the significant progresses in the field of sensors based on OECTs, the understanding of the basic physics and the working principle of these devices are still limited. Efforts in these directions, besides their fundamental interest, are needed to design and engineer of specific material and devices, which would make OECTs sensor competitive with other well-established sensing technologies. We studied the effect of device geometry on the electrical properties of hydrogen peroxide sensors based on organic electrochemical transistors (OECTs). We demonstrated that the limit of detection, the sensitivity and the detection range of OECTs sensors to H_2O_2 depend on the ratio between the double layer capacitances at the electrolyte/channel (C_{ch}) and at gate electrode/electrolyte (C_g) interfaces. Our best devices were able to detect sub-micromolar H_2O_2 concentrations.

* This work is being supported by European Community

TU-P1-5 15h30

Semiconductor stable isotopes in nanoscience, **Oussama Moutanabbir**, *Max Planck Inst. of Microstructure Physics* — The availability of silicon and germanium enriched isotopes improved our understanding of subtle physical properties of bulk materials. It is well establish now that the isotopic composition affects several properties, such as phonon energies, band structure, and lattice constant. Large isotopic effects were also reported for thermal conductivity. More subtle nuclear spin-related isotopic effects have led to the development of new concepts in solid-state quantum information and spintronics. In this presentation, we show that the controlled manipulation of the isotopic composition of Si- and Ge-based nanostructures creates new opportunities to explore fundamental science and the physical properties of semiconductor low dimensional systems. In the first part, we address the atomic transport during strain-driven self-assembly of Ge/Si quantum dots. By using purified 70Ge and 76Ge isotopes, we developed a method to highlight subtle mechanisms in Ge diffusion from the 2D metastable layer towards the growing dots. The small change in the atomic mass between the two isotopes allows the observation of faint variations in Ge-Ge Raman vibrational modes, which allow the quantification of the surface mass transport during the nucleation and growth. In the second part, we demonstrate that the manipulation of 28Si, 29Si, and 30Si isotopic content in one dimensional Si nanostructures provides a rich playground to develop and investigate systematically nanowire-based devices in a wide range of applications.

Heartfelt thanks are extended to S. Miyamoto, K.M. Itoh (Keio University, Japan) S. Senz and U. Goesele (Max Planck Institute of Microstructure Physics, Germany) E.E. Haller (UC Berkeley, USA)

15h45 Session Ends / *Fin de la session*

[TU-P2] Energy Frontier and Phenomenology / *Frontière de l'énergie et phénoménologie*

(PPD-DTP / *PPD-DPT*)

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

14h15 - 15h45

ROOM / *SALLE* MRR D202 (cap.135)

Chair: R. MacKenzie, Université de Montréal

TU-P2-1 **14h15**

RAINER DICK, University of Saskatchewan

Cross sections for direct Minimal Dark Matter signals *

The first part of the talk will provide an introduction to minimal dark matter models. In the second part, I will discuss nuclear recoil cross sections for direct dark matter search experiments, and creation cross sections for minimal dark matter particles at the LHC.

* This work is being supported by NSERC

TU-P2-2 **14h45** **(G*)**

A proposal for a new hadron nomenclature, **Gaëtan Landry**, *Université de Moncton* — The current nomenclature is based on the concept of isospin, introduced in 1932 by Werner Heisenberg. Isospin was based on the idea that particles of similar mass were identical and differed only by electric charge. For example protons and neutrons were thought to be the same particles (nucleons), but in different isospin states. However, in light of the quark model, isospin is revealed to be nothing more than the difference between the number of up and down quarks, and the similarity between protons and neutrons to be a byproduct of the similar mass of the up and down quarks. The choice of isospin as the basis of hadron nomenclature is shown to be unnatural, and introduces oddities such as the hypercharge concept. A revised nomenclature based on quark content is proposed. It can easily be extended to exotic hadrons if need be, and gets rid of the oddities.

TU-P2-3 **15h00**

VERONICA SANZ, York University

Physics at the LHC

Many hopes hang on the Large Hadron Collider. Among many conundrums in Particle Physics, the LHC is expected to reply to these questions: what is the origin of mass? Which particle is responsible of Dark Matter in the Universe? Are there more dimensions than the four we experience everyday? Are matter and energy secretly related? In this brief talk we will outline how the LHC is going to look for those answers during its first years of running.

TU-P2-4 **15h30**

Diffractive Upsilon production at the Tevatron and LHC*, **Ruben Sandapen** [1], Jeff Forshaw [2], Brian Cox [2], [1] *Université de Moncton*, [2] University of Manchester — We compute the rate for diffractive Upsilon meson production at the Tevatron and the LHC. The Upsilon is produced diffractively via the subprocess photon + proton -> Upsilon + proton, where the initial photon is radiated off an incoming proton (or antiproton). We consider the possibility to use low angle proton detectors to make a measurement of the photon-proton cross-section and conclude that a measurement of the cross-section at a centre of mass energy in excess of 1 TeV is possible at the LHC. This is the region where saturation effects are likely to reveal themselves.

* This work is being supported by Royal society and STFC

15h45 **Session Ends / *Fin de la session***

[TU-P3] Cellular Biophysics / *Biophysique cellulaire*

(DMBP/*DPMB*)

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

14h15 - 16h00

ROOM / *SALLE* MRR A102 (cap.134)

Chair: A. Linhananta, Lakehead University

TU-P3-1 **14h15**

JOHN KATSARAS, National Research Council

Cholesterol Sequestered in a Membrane and Nanoparticles for Imaging and Treating Disease

Cholesterol is an essential component of animal cell membranes, required for membrane permeability and fluidity. Normally, in membranes cholesterol is found in the commonly known upright position with its hydroxyl group residing within the membrane's hydrophobic/hydrophilic interfacial region, while its short hydrophobic tail extends toward the middle of the membrane. Recently we have carried-out studies using dipolyunsaturated phosphatidylcholine (PC) bilayers, where the entire hydrocarbon matrix consists of polyunsaturated fatty acid (PUFA) chains. Our neutron scattering measurements indicate that cholesterol relocates to the center of the bilayer, challenging our notions of membrane structure. Treatment of disease can involve surgery and/or therapies such as radiation, chemo, hormonal and biological. In the course of these treatments, healthy tissues can be damaged resulting in unwanted side effects. However, the use of drugs specifically targeted to a disease can minimize the toxic side effects associated with many conventional therapies (*e.g.* chemotherapy). Using the so-called bicelle mixture of lipids (i.e. di-14:0 PC and di-6:0 PC) we have developed novel, self-assembled nanoparticles with the potential to simultaneously target, image and treat

disease. Specifically, in collaboration with industry these nanoparticles are presently being tailored to enhance the efficacy of various medical imaging techniques (*i.e.* MRI and PET) and drug treatments (*e.g.* cancers and diseases of the brain).

TU-P3-2 14h45

MARTIN J. ZUCKERMANN, Simon Fraser University

Synthetic Molecular Motors: Concepts and Numerical Simulations †,*

Molecular motors are vital elements of biological systems which are responsible for molecular motors operate in a thermally dominated environment and in many cases rely on binding, diffusion and fluctuations to achieve directed motion. Even with recent advances in single-molecule microscopy and protein crystallography, precise structure-function relationships for many protein-based molecular motors are still unknown. In an initial attempt to resolve this problem, we present a new approach to understanding biological molecular motors by designing and building synthetic molecular motors using a combination of natural and designed protein-based components. We first present data from overdamped Langevin Dynamics (OVLD) simulations for a new protein motor concept, the Tumbleweed. This is a tri-pedal self-assembling complex in which each foot binds to a unique binding site located periodically on an effective 1D track, and where the binding of each foot is controlled by a unique ligand in solution. Next we present results from Monte Carlo (MC) and OVLD simulations of coarse-grained models for constructs based on the motion of a DNA-enzyme-based nanostructure known as the molecular spider. In the MC simulations, the molecular spider is modeled by a dimer composed of two connected enzymes which can jump diffusively between neighboring sites on a 1D lattice. Each site represents the substrate to be cleaved and can be in one of two states, cleaved and uncleaved, where both binding and cleavage are controlled by rate constants. The OVLD simulations are used to examine more complex motors such as spiders with multiple polymer "legs" having "enzymes" at their extremities. We will focus on several important themes including experimental viability, the effect of a stall force and the capacity to perform useful work.

† In collaboration with Elizabeth Bromley [1], Nathan Kuwada [2], Roberta Donaldini [3], Laleh Samii [4], Gerhard Blab [2], G.J. Gemmen [2], Ben Lopez [2], Paul Curmi [3], Nancy Forde [4], Dek Woolfson [1], Heiner Linke [2], [1] Bristol University, UK, [2] University of Oregon, [3] UNSW, Sydney, Australia, [4] Simon Fraser University

* This work is being supported by Human Frotier Science Program and NSERC

TU-P3-3 15h15

Comparison of how ceramide and ceramide-1-phosphate mix with phosphatidylcholines in bilayers*, **Michael R. Morrow** [1], Joshua Perry [1], Anne Helle [2], Ilpo Vattulainen [3], Susanne K. Wiedmer [2], Juha M. Holopainen [2], [1] *Memorial University of Newfoundland*, [2] University of Helsinki, [3] Helsinki University of Technology — Sphingolipids are key lipid regulators of cell viability: ceramide is implicated in programmed cell death (apoptosis), whereas other sphingolipids, such as ceramide 1-phosphate, promote cell division. The phase behaviors of bilayers comprising binary mixtures of N-hexadecanoyl-D-erythro-ceramide (C_{16}-ceramide) or N-hexadecanoyl-D-erythro-ceramide-1-phosphate (C_{16}-ceramide-1-phosphate; C_{16}-C1P) with dipalmitoyl-phosphatidylcholine (DPPC) were studied by differential scanning calorimetry (DSC) and deuterium nuclear magnetic resonance (^{2}H-NMR). Partial phase diagrams (up to sphingolipid mole fractions of X=0.40) were constructed for both mixtures. For C_{16}-ceramide-containing bilayers, DSC and ^{2}H-NMR observations through the bilayer main transition indicated phase separation and coexistence of gel and liquid crystal domains over broad temperature ranges (~21° for X_{cer}=0.4). Observations of C_{16}-C1P/DPPC mixtures at corresponding concentrations indicated that two-phase coexistence was limited to significantly narrower ranges of temperature for mixtures containing C_{16}-C1P compared to those containing C_{16}-ceramide. These observations, which suggest that phosphorylation of ceramide to yield C_{16}-C1P likely inhibits or reverses the formation of laterally segregated gel-like ceramide-enriched domains, are relevant to understanding the roles of these sphingolipids as second messengers.

* This work is being supported by NSERC (MRM), the Sigrid Juselius Foundation (JMH), the Finnish Cultural Foundation (JMH), Evald and Hilda Nissi Foundation (JMH), The Finnish Eye Foundation (JMH), the Academy of Finland (AH, IV, SW)

TU-P3-4 15h30

Detailed Structure of A Magnetically Alignable Phospholipid Mixture - "Bicelles", **Mu-Ping Nieh** [1], John Katsaras [1], Ronald Soong [2], Peter M. MacDonald [2], [1] *National Research Council*, [2] University of Toronto — The structures of phospholipid mixtures known as "Bicelles", which are composed of dimyristoyl- and dihexanoyl- phosphatidylcholines (known as "bicelles") with addition of pluronic acid were studied using small angle neutron scattering (SANS). The SANS results reveal that the system forms discoidal micelles and multilamellar vesicles at low (< 298K) and high temperature (> 312K), respectively. At the intermediate T (298 K < T < 312 K) where the "bicelle" mixture exhibits the most magnetically alignability, the structure is proposed to be lamellae composed of ribbons, which are correlated with loosely with a spacing of 120 ~ 140 Å. The ribbon-meshed lamellae exhibit a constraint of swelling since they are neutral in charge. Upon a small addition of a charged lipid, e.g., dimyristoyl-phosphatidylglycerol as low as 1 mol.%, the lamellae become freely-swelling, perforated lamellae, where little or none correlation is found among the perforations. Moreover, the doped DMPG stabilizes the lamellar phase over a wider range of temperatures, inhibiting the formation of multilamellar vesicles.

TU-P3-5 15h45

Immune Cell Migration Directed by DC Electric Fields, **Francis Lin**, *University of Manitoba* — Electric fields are generated *in vivo* in a variety of physiologic and pathologic settings, including penetrating injury to epithelial barriers. An applied electric field with strength within the physiologic range can induce directional cell migration (i.e. electrotaxis) of epithelial cells, endothelial cells, fibroblasts, and neutrophils suggesting a potential role in cell positioning during wound healing. In the present study, we investigated the ability of lymphocytes to respond to applied direct current (DC) electric fields. Using a modified transwell assay and a simple microfluidic device, we show that human peripheral blood lymphocytes migrate toward the cathode in physiologically relevant DC electric fields. Additionally, electrical stimulation activates intracellular kinase signaling pathways shared with chemotactic stimuli. Finally, video microscopic tracing of GFP-tagged immunocytes in the skin of mouse ears reveals that motile cutaneous T cells actively migrate toward the cathode of an applied DC electric field. Lymphocyte positioning within tissues can thus be manipulated by externally applied electric fields, and may be influenced by endogenous electrical potential gradients as well.

16h00 Session Ends / *Fin de la session*

[TU-P4] (DNP/DPN) Open Questions in Hadronic Physics / *Problèmes ouverts en physique des hadrons*

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

14h15 - 16h15

ROOM / *SALLE* MRR A202 (cap.133)

Chair: G.M. Huber, University of Regina

TU-P4-1 **14h15**

GEORGE J. LOLOS, University of Regina

Do hybrids, glueballs, and other exotics exist?

Confinement remains an important and still open question in QCD. It was established by experimental observation that quarks do not exist as free but always in combinations of two quarks (mesons) or three quarks (nucleons). QCD-based theoretical models, such as the Flux Tube Model, and Lattice QCD calculations provide an explanation based on the strength of the quark-quark interaction that the energy stored in their bond increases with distance. Thus it's energetically advantageous to create a new quark pair rather than increase the separation between the original quarks any further. In essence, the gluons, that provide the bond, form a flux tube due to their self-interaction. The notion of a gluon flux tube in QCD gives rise to gluonic excitations that will manifest themselves as specific gluonic degrees of freedom in exotic states of matter consisting of hybrid mesons with quantum numbers that cannot be reproduced by quark-quark spins and orbital angular quantum momentum numbers alone. Such exotic hybrid mesons (if indentified) are unique fingerprints of gluonic contributions and cannot mix with regular quark-quark pairs (known as quarkonia states) and a mapping of their nonets will provide an invaluable insight in our understanding of QCD in the confinement regime and offer the all too important experimental input to theoretical developments in this topic. A review of the experimental evidence for gluonic excitations (glueballs and exotic hybrid mesons) will be presented and compared to Lattice QCD predictions, together with a look at new experiments under preparation to explore this topic.

TU-P4-2 **14h45**

ROLF ENT, Jefferson Lab

How does QCD transition from the meson-nucleon non-perturbative regime to the quark-gluon perturbative regime?

At high energies the property of QCD known as asymptotic freedom, which causes quarks to interact very weakly at short distances, allows for an efficient perturbative description of the interior landscape of nucleons in terms of a sea of quarks and gluons with a few ever-present valence quarks. In contrast, at low energies the effects of confinement hide the quarks and gluons of QCD, and protons and neutrons are identified with color singlet states that have strong interactions very different from that of the gluon exchange by colored quarks and gluons. These strong interactions imply a more efficient non-perturbative description in terms of nucleons and evanescent mesons at distance scales comparable to their sizes (~1 fm). The availability of high-energy beams provides the opportunity to search for the signatures of the elementary quarks and gluons when dialing in distance scales smaller than 1 fm. An overview will be given how this has led to new insights on the transition from the nucleon-meson to the quark-gluon descriptions of the building blocks of atomic nuclei.

TU-P4-3 **15h15**

HOWARD D. TROTTIER, Simon Fraser University

High-precision lattice QCD confronts experiment [*]

Quantum Chromodynamics has been accepted as the theory of the strong interactions for more than thirty years, ever since the discovery of asymptotic freedom by Gross, Politzer and Wilczek, whose work was recognized with the 2004 Nobel Prize. Despite many successful quantitative predictions for high-energy processes, applications of QCD to strongly-coupled, low-energy hadronic physics have historically been much less successful. A space-time lattice discretization of QCD (proposed by Ken Wilson the year after asymptotic freedom) lends itself to direct numerical simulation, but the enormous computational burden of lattice QCD has, until recently, precluded accurate simulations of the full theory. Happily, dramatic improvements in the predictive power of lattice QCD have occurred in the past few years, due to major theoretical progress in our understanding of lattice effective field theories. These developments are having a significant impact, including the use of lattice QCD to confront certain classes of existing hadronic data, and to constrain the search for physics beyond the so-called standard model. This talk will give a review of some of recent developments in lattice effective field theories for QCD, and the use of these methods to confront QCD theory with experiment.

[*] This work is being supported by NSERC

TU-P4-4 **15h45** **(G)**

The G0 experiment Parity Violation of Delta photoproduction[*], **Alexandre Coppens**, *University of Manitoba* — The G0 experiment performed at the Jefferson Laboratory is a nuclear physics experiment that enables measurements of parity violating asymmetries of the process $\gamma + n \rightarrow \Delta^0 \rightarrow p + \pi^-$. The motivation of this measurement is to attempt the first extraction of the low energy constant characterizing the Parity-violating $\gamma N \Delta$ coupling, d_Δ. Pion photoproduction on the Δ resonance was observable due to the very intense electron beam from the JLab accelerator, which produced a secondary beam of collinear photons within the G0 liquid deuterium target. This Bremsstrahlung beam was used to study the interaction between this photon beam and the neutrons inside the target via the process described above. The measured pion asymmetry is in fact directly proportional to d_Δ. This measurement will also provide an additional test of the resonance saturation model which explains the surprisingly large asymmetry seen in hyperon decays, also predicting a potentially large value for d_Δ. The status of the data analysis for this reaction, taken in backward angle mode between September 2006 and March 2007, will be discussed.

[*] This work is being supported by NSERC

TU-P4-5 **16h00**

Photonuclear reaction for the Lithium Isotopes*, **Robert Pywell**, Ward Wurtz, *University of Saskatchewan* — The current suite of photonuclear measurements being carried out at the Duke University High Intensity Gamma Source (HIGS) are designed to advance our knowledge of fundamental nucleon properties and the nucleon-nucleon interaction. Current theoretical techniques now have sufficient accuracy for precision measurements of photonuclear cross sections to differentiate between nuclear models. Unfortunately current experimental results are not up to the challenge. Measurements at HIGS have the potential to address this challenge. This presentation will describe results from recent measurements of photonuclear cross section for the lithium isotopes. Measurements have been made using monoenergetic, polarized photons between 10 MeV and 35 MeV. Neutrons have been detected using Blowfish a highly segmented large solid angle detector.

* This work is being supported by Natural Science and Engineering Research Council

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

[TU-P5] Quantum Information and Computing I / *Informatique et calculs quantiques I*

(DAMPhi-DOP / *DPAMip-DOP*)

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***

14h15 - 15h45

ROOM / *SALLE* MRR D102 (cap.135)

Chair: B.C. Sanders, University of Calgary

TU-P5-1 **14h15**

ALEXANDRE BLAIS, Université de Sherbrooke

Quantum information processing with circuit quantum electrodynamics

Coupling of superconducting qubits to quantized microwave fields stored in electrical circuits has opened new possibilities for quantum optics and quantum information processing in solid-state devices. With the steady improvements of the coherence time of superconducting qubits and because of the large qubit-field coupling that can be achieved, these on-chip realization of cavity QED, also known as circuit QED, can reach new parameter regimes currently unexplored in atomic based quantum optics. In this talk, I will explain how the quantum nature of microwave fields can be preserved for long times in electrical circuits and how this field can be strongly coupled to artificial on-chip atoms. I will also discuss first steps towards quantum information processing and new ideas for realizing quantum optics with large linearities in this system.

TU-P5-2 **14h45** **(G*)**

Entangled Quantum Key Distribution with a Biased Basis Choice*, **Chris Erven** [1], Xiongfeng Ma [1], Raymond Laflamme [2], Gregor Weihs [3], [1] *Institute for Quantum Computing - University of Waterloo*, [2] Institute for Quantum Computing - University of Waterloo & The Perimeter Institute, [3] Institute for Quantum Computing - University of Waterloo and Institut fur Experimentalphysik - Universitat Innsbruck — Quantum key distribution (QKD) allows two distant parties, Alice and Bob, to create a random secret key even when the quantum channel they share is accessible to an eavesdropper, Eve, so long as they also have an authenticated public classical channel. Alice and Bob make preparations and measurements randomly in one of two complementary bases in order to generate the key. The security of QKD is built on the fundamental laws of physics, which prevent accurate measurements in both bases, in contrast to existing classical public key cryptography whose security is based on unproven computational assumptions. A key feature of most QKD protocols is that the bases used are chosen randomly, independently, and uniformly. However, uniformly chosen bases have the consequence that on average half of the raw data is rejected leading to an efficiency limited to at most 50%. However, this symmetry requirement was removed by Lo *et al.* [1] in 2004 when they proposed a simple modification that could in principle allow one to asymptotically approach an efficiency of 100%. We implement this biased QKD scheme in a local entangled QKD system in order to study the practicalities associated with its operation. The optimal bias between the two measurement bases, a more refined error analysis, and finite key size effects are all studied in order to assure the security of the final key with the system. In the experiments, we are able to improve the efficiency of the protocol by 79% using the biased techniques compared to the unbiased case.

1. H.K. Lo, H.F. Chau, and M. Ardehali. "Efficient quantum key distribution scheme and a proof of its unconditional security." *Journal of Cryptology*, **18**: 133-165, 2002

* This work is being supported by NSERC, QuantumWorks, CIFAR, CFI, CIPI, ORF, ORDCF, ERA, and the Bell Family Fund

TU-P5-3 **15h00** **(G*)**

Tm:$LiNbO_3$ waveguides: a novel material candidate for quantum memories*, **Neil Sinclair**, Erhan Saglamyurek, Cecilia La Mela, Wolfgang Tittel, *Institute for Quantum Information Science, University of Calgary* — Quantum memories, a key resource for many quantum communication and computing applications, require the possibility to reversibly transfer quantum information between photos and atoms. For instance, quantum memories are the main ingredient of quantum repeaters, essential components in long distance quantum cryptography. High recall efficiency, long storage times, and the possibility to store short pulses with high fidelity are the most important properties to be achieved in these devices. Determining the best approaches for implementation of quantum memories, as well as finding appropriate storage materials, is a field of extensive current research. In this presentation, we introduce our approach to quantum memories, which is based on controlled reversible inhomogeneous broadening (CRIB) of a narrow absorption line [1-3], and we present first spectroscopic investigations of a novel and promising material candidate: Thulium doped Lithium Niobate waveguides. We discuss our findings in view of the requirements for quantum memories.

1. M. Nilson, and S. Kroll, *Opt. Commun.* **247**, No. 4-6 (2005).
2. A.L. Alexander, J.J. Longdell, M.J. Sellars, and N.B. Manson, *Phys. Rev. Lett.* **96**, 043602 (2006).
3. B. Kraus, W. Tittel, N. Gisin, M. Nilsson, S. Kroll, and J.I. Cirac, *Phys. Rev.* A. **73**, 020302(R) (2006)..

* This work is being supported by AAET, CFI, General Dynamics, iCORE, NSERC

TU-P5-4 15h15 (G*)

Evaluation of the Jones Polynomial using one bit of quantum information: a Liquid State NMR experiment*, **Gina Passante**, Osama Moussa, Colm Ryan, Raymond Laflamme, *University of Waterloo* — The class of problems efficiently solvable on quantum computers with one bit of quantum information is known as DQC1 [1]. This model is believed to be strictly weaker than standard quantum computers, but still more powerful than their classical counterparts. Recently, Shor and Jordan [2] proved that the problem of approximating the Jones polynomial at the fifth root of unity completely encapsulates the power of DQC1. The Jones polynomial is a knot invariant that is not only important to knot theory, but also to statistical mechanics and quantum field theory. We present an adaptation of the algorithm developed by Shor and Jordan suitable for implementation on a liquid state NMR quantum information processor, and report on the experimental implementation of the algorithm to evaluate the Jones polynomial for all knots whose braid representation has four strands and three crossings.

1. E. Knill and R. Laflamme. *Phys. Rev. Lett.*, **81**, 5672 (1998).
2. P. Shor and S. Jordan. *Quant. Inf. and Comm.*, **8**, 681-714, (2008).

* This work is being supported by NSERC

TU-P5-5 15h30 (G*)

Suppressing decoherence by preparing the environment*, **Olivier Landon-Cardinal**, *Université de Montréal* — Decoherence provides a framework explaining why an open quantum system coupled to its environment will exhibit a set of preferred states, usually ruling out a coherent superposition of arbitrary states. This framework relies essentially on the interaction between the system and its environment. Usually, it is assumed that the environment cannot be controlled. However, this might not be the case in specific experimental setup. For instance, a recent experiment demonstrates that decoherence in quantum dots can be limited by nuclear state preparation (Science, 321, 2008). We therefore investigate to what extent preparing the environment can help suppress decoherence, in a toy model that mimics/captures the essential dynamics of quantum dots. For a single electron interacting with a spin environment, we show that there are states of the environment that allow for unitary evolution of the electron. However, preparing the environment requires a precision that scales as the inverse of the size of the environment, thus becoming very restrictive for a large environment. Moreover, the existence of an adequate state of the environment is compromised by the self-evolution of the environment. Thus, preparing the environment would only restrict decoherence on a limited timescale and should be repeated periodically. Extensions to the case of two electrons interacting with a spin environment are also discussed.

* This work is being supported by CRSNG/NSERC

15h45 Session Ends / *Fin de la session*

[TU-P6] Surfaces and Thin Films / *Les surfaces et les couches minces*

(DSS-DCMMP *DSS-DPMCM*)

TUESDAY, JUNE 9 / *MARDI, 9 JUIN*

14h15 - 16h30

ROOM / *SALLE* MRR A002 (cap.134) *Chair: T. Sargent, University of Toronto*

TU-P6-1 14h15

MATTHIAS SCHEFFLER, Fritz Haber Institute

Get Real! Ab initio description of materials properties and function -- the example of heterogeneous catalysis

This talk describes recent developments of computational materials science and engineering,that have changed in recent years from a descriptive to a predictive description and on to modeling of properties and function of materials. A proper link of electronic structure theory and statistical methods is necessary to describe and understand the systems chemistry that governs the properties and processes at surfaces of materials under realistic temperature and pressure conditions. The main examples of this talk are concerned with heterogeneous catalysis at transition metal surfaces, from Ru to Ag. It is generally assumed that catalysis is driven by "active centers". They are ubiquitous, and their function and concentrations were frequently analyzed. Still no one has ever seen such thing. The talk identifies the key elements, that actuate efficient catalytic turn over frequencies as (i) a significant modification of the catalyst material, happening (only) under operating conditions,(ii) structural instability, and(iii) fluctuations. The concept of an "active center" is found to be misleading, at least in its the traditional understanding.

TU-P6-2 15h00

Self-Assembled Atomic Chains on Ge(100) Surfaces*, **Mark Gallagher**, Stephanie Melnik, *Lakehead University* — Due to their high degree of correlation, electrons in one dimension (1-d) are predicted to exhibit many exotic properties. Even the identity of individual electrons in 1-d is lost, and is instead replaced by separate spin and charge excitations. While these predictions give glimpses of exotic physics, finding direct experimental evidence has proven elusive. Possible candidates include atomic chains on semiconductor surfaces. The deposition of submonolayer Ag and Au atoms onto vicinal Si(111) surfaces produces 1-d atomic chain structures. These chains exhibit metallic states with highly 1-d character, however upon cooling many of these chains undergo a Peierls distortion at temperatures above which the onset of exotic behaviour is expected to occur. Recently, similar Au–induced structures on Ge(100) surfaces have been observed [1]. At approximately 0.5 ML Au coverage the surface exhibits 1-d chains spaced 16 Å apart. Measurements indicate the presence of extended Bloch states along the chain direction, and no evidence of a Peierls distortion at temperatures as low as 80K. The authors suggest that these chains on Ge(001) constitute a model system to study unconventional physics in 1-d. We will present details of our recent Scanning tunneling microscopy (STM) and low energy electron diffraction (LEED) experiments on this promising system.

1. Schäfer *et al.*, *Phys. Rev. Lett.* **101**, 236802 (2008).

* This work is being supported by NSERC

TU-P6-3 **15h15**

Room Temperature demonstration of Quantum Cellular Automata formed by Single Si Atom Quantum Dots*, **M. Baseer Haider** [1], Jason Pitters [2], Gino Dilabio [2], Lucian Livadaru [1], Josh Mutus [1], Robert Wolkow [1], [1] *University of Alberta* , [2] National Institute for Nanotechnology/NRC Canada — A device architecture for computing with quantum dots, Quantum Cellular Automata, points to a new paradigm for computation that goes beyond the conventional semiconductor technology roadmap to achieve ultra low power consumption. The Quantum Cellular Automata scheme is based upon "cells" of tunnel coupled quantum dots and electrostatic interaction between adjacent cells to transmit binary information and perform computations. Efforts to fabricate Quantum Cellular Automata devices have so far been limited by the need for extreme cryogenic conditions and by the debilitating effects of stray charges. It is conceivable that fabrication on a smaller scale can circumvent these limitations. Here we demonstrate that single atoms in a solid state environment can serve as quantum dots and that such quantum dots can be controllably tunnel coupled to embody the building block of a Quantum Cellular Automata Cells. Such cells exhibit "selfbiasing" effect, that is, the electron occupation is set by cell geometry. The binary state of the cell may be controlled electrostatically. This cell operates at room temperature and is largely immune to stray charges that are more than 30 Angstroms away from the cell.

* This work is being supported by CIFAR, NSERC, iCORE, Alberta Ingenuity, and the CEIN

TU-P6-4 **15h30** **(G)**

A novel image processing approach to nucleus identification, **Jesse Mea**, *GCMP* — A novel algorithm for distinguishing and identifying tightly packed nuclei, or grains, from materials surface scans is proposed. The method does not rely on thresholding or erosion, giving it the advantage of analyzing all nuclei in an image and their complete visible surfaces. The algorithm also guarantees complete grain separation, a quality often compromised by edge detection methods. The proposed process therefore yields more accurate grain statistics.

TU-P6-5 **15h45**

Modelling the Diffusion of Pb Atoms on the Reconstructed Au(111) Surface using the Surface Embedded-Atom Method*, **Alan Slavin** [1], Johnathan Braekman [1], Tefo Toai [2], [1] *Trent University*, [2] University of Trento — Scanning tunnelling microscopy measurements in our laboratory have shown that Pb atoms embedded in the reconstructed Au(111) surface diffuse a few atomic positions in a few seconds at room temperature [1]. This paper explores possible mechanisms for this diffusion, using the Surface Embedded-Atom Method (SEAM) [21] and molecular dynamics. The SEAM modifies the EAM by including the surface energy as a fitting parameter to allow the model to predict surface properties correctly. This presentation includes an introduction to the SEAM, validation of it for these materials, and its use to study diffusion of the Pb atoms. An important conclusion is that transition-state theory--which determines the diffusion barrier height as the difference in energy of the system for the diffusing atom at the energy minimum and at the barrier maximum--can under-estimate barrier heights by not considering the process dynamically. Computer animations of the diffusion will be used to illustrate a novel diffusion pathway involving atoms from the sub-surface layer.

1. Robinson, De'Bell and Slavin; *Surf. Rev. and Lett.* **6**, 793 (1999).
2. Haftel and Rosen, *Phys. Rev. B* **64**,195495 (2001).

* This work is being supported by NSERC

TU-P6-6 **16h00**

Study of the charge density wave of $NbSe_2$ by STM/STS*, **Christian Lupien**, Behnaz Behmand, *Université de Sherbrooke* — The high temperature (high-Tc) superconductors have shown electronic structures at the atomic scale. One possible description of these is a conventional charge density wave. However it is difficult to clearly identify the behavior because it is accompanied by many others such as superconducting heterogeneity. In order to have a better comprehension of the issues we used the scanning tunneling microscopy and spectroscopy (STM/STS) techniques to explore the charge density wave (CDW) of the quasi two dimensional superconductor $NbSe_2$. This material CDW is well documented and the superconducting energy scale is well separated form the it. We explore the energy dependence of the amplitude and the phase of the CDW on the local density of states. We compare our results to the theoretical predictions and discuss their applicability to the high-Tc superconductors.

* This work is being supported by NSERC and FQRNT

TU-P6-7 **16h15**

Oxidation of Au nanoparticles under laser irradiation*, **Daria Riabinina** [1], Joëlle Margot [1], JianMing Zhang [2], Mohamed Chaker [2], Dongling Ma [2], Peter Tijssen [3], [1] *Université de Montréal* , [2] INRS-EMT, Université du Québec, [3] Institut Armand-Frappier, Université du Québec — At present, there is a growing interest to the fabrication of nanomaterials, preferably in liquid environment, due to their applications in bioimaging and biosensing. In particular, metal nanoparticles attracted significant attention of scientific community regarding their plasmon-related properties. Numerous investigations were devoted to the chemical synthesis of gold and silver colloids. However, chemical methods were often related to the presence of contamination which could limit biological applications of these nanoparticles. Pulsed laser ablation in aqueous media (PLAL) was suggested as an alternative method for synthesis of gold colloids free of contaminants. It is also one of few methods that allow production of gold nanoparticles with variable chemical composition. In this work, we investigated the influence of gold oxidation on plasmon resonance of gold nanoparticles. We demonstrated that laser irradiation of chemically synthesized gold nanoparticles in water yields their partial oxidation up to 28%. Metastable gold oxide coverage resulted in significant changes in plasmon-related optical properties of gold colloids. The aging effect revealed surface modifications in gold nanoparticles induced by laser irradiation.

* This work is being supported by NSERC

16h30 **Session Ends / *Fin de la session***

[TU-P7] (DPE/*DEP*) Teaching with Technology and Curriculum Development / Enseigner avec la technologie et développement du curriculum

TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***

14h15 - 16h30

ROOM / *SALLE* MRR R221 (cap.134)

Chair: P.D. Mitchler, Kelvin High School

TU-P7-1 **14h15**

FRANCIS LEBLANC, Université de Moncton

Stellar astrophysics in undergraduate physics curricula

Undergraduate physics curricula are generally composed of mathematics and core physics courses, in addition to a number of optional courses in various fields of physics (*i.e.* elementary particles, plasma physics, medical physics, astrophysics, general relativity, etc.). These optional courses serve two purposes: to widen the number of physics fields seen during an undergraduate degree and to apply, and deepen the comprehension of, the physics concepts seen in the core physics courses. In this talk, the benefits of studying stellar astrophysics within the undergraduate physics curriculum will be presented. Stellar astrophysics has not only the advantage of introducing the students to the interesting field of astrophysics, but also encompasses concepts from a large number of fields of physics.

TU-P7-2 **14h45**

Peer Instruction: The role of discussion, technology and academic setting*, **Nathaniel Lasry** [1], Elizabeth Charles [2], Chris Whittaker [2], Michael Lautman [1], [1] *John Abbott College* , [1] Dawson College — Peer Instruction (PI) is an educational approach developed at Harvard by physicist Eric Mazur. Data collected in Canadian colleges show that, although developed at Harvard University, PI works across academic settings and equally well with or without technology. Among the reasons PI works so well is the central role of peer discussions. We show empirical results that display the added value of peer discussions in class.

* This work is being supported by Programme d'Aide a la Recherche sur l'Enseignement et l'Apprentissage (PAREA)

TU-P7-3 **15h00**

Using Maple to teach Introductory Physics, **Maria Juliana Carvalho**, *Ryerson University* — Many of the introductory courses for non Physics majors encounter the difficulty that the students enrolled have a diverse background and a low level of interest in the discipline. Many did not take grade 12 physics and being freshmen, differential or integral calculus is unknown to them. This is true of the Physics course offered to Computer Science students at Ryerson. For some years now, I have been using Maple software not only as a tool that helps them to learn how to solve problems but also to help them visualize physics concepts and situations through programmed simulations. I believe Maple's powerful capabilities for symbolic computation, programming and graphical display, make it an excellent tool to teach/learn physics concepts and problem solving techniques. Lecture notes prepared for this course consist of a Maple introductory section followed by chapters on Mechanics, Waves, Electromagnetism and Electric Circuits where the use of Maple to solve problems and create simulations is amply emphasized. In this presentation, I will explain how Maple is embedded in the course curriculum and, as evidence of tool's usefulness, I will show/demonstrate a few of the most creative student Maple simulation projects.

TU-P7-4 **15h15**

DOUGLAS BONN, University of British Columbia

Learning about data and statistics in freshman physics

The freshman physics laboratory at UBC is undergoing a transformation in which an emphasis is being placed on learning broadly-applicable skills for handling data. These start at basic concepts and skills such as statistical distributions, histograms, mean and standard deviation. Although taught in high school, our experience shows that most students are often unable to apply these skills and ideas to novel situations in the laboratory. By the end of the course, however, they are performing more advanced tasks such as least squares fitting, and are adept at scaling data in search of power laws and exponentials. Much of this is taught through 'invention activities', a means of improving knowledge transfer by getting students to try to invent things for themselves before teaching it to them.

TU-P7-5 **15h45**

HP Grants for Tablet Technologies in Science Teaching: From Dream to Innovation (Part I)*, **Marina Milner-Bolotin**, Tetyana Antimirova, Leonardo Zambito, *Ryerson University* — Modern technologies open endless possibilities for science teaching and learning at all levels. One of them is an electronic pen technology utilized in tablet computers. Hewlett Packard – a leader in the field of tablet technologies – provides science educators all over the world, interested in transforming their teaching via utilizing tablet computers, with exciting educational innovations grant opportunities. HP has a number of grants for K-12 teachers, as well as college and university faculty, that amount to more than $80,000. The grant recipients for the HP Higher Education Educational Innovation grant will receive 21 tablet computers, a large computer screen, computer projector, special HP poster printer and a convenient movable cart for the tablets. In addition, grant winners will get $20,000 US for educational research and will be invited to a special HP conference on educational technology. This is a unique opportunity for Canadian science educators. As past grant recipients we would like to share our experience with the potential grant applicants.

* This work is being supported by The Hewlett Packard Educational Innovation Grant: http://h10084.www1.hp.com/canada/corporate/philanthropy/

TU-P7-6 **16h00**

HP Mobile Science Lab: Using Tablet PCs for Physics Teaching (Part II)[*], **Tetyana Antimirova**, Marina Milner-Bolotin, Leonardo Zambito, *Ryerson University* — Thanks to the generous HP Educational Technology Initiative grant, we were able to create HP Mobile Science Lab for Science students at Ryerson. Currently the Tablet PCs are used in our second year Modern Physics and third year Electricity and Magnetism courses. Our goal is to create a student-centered learning environment where students work in small collaborative groups. They annotate lectures, collaborate on problem solving and submit their work using tablets. In-class use of tablets offers the instructor an unparalleled opportunity to receive an instant open-ended feedback on class understanding of the material and adjust the teaching accordingly. We will demonstrate the use of two different tablet PC free academic software packages: InkSurvey (by the Colorado School of Mines) and Classroom Presenter (by the University of Washington). We will discuss an effect of tablet PCs on students learning and course satisfaction.

[*] This work is being supported by HP Innovations in Education Initiative

16h15 **Discussion Break** */ Pause de Discussion*

16h30 **Session Ends** */ Fin de la session*

[TU-PM-Break] (CAP/*ACP*)
Health Break, with refreshments / ***Pause-santé, avec goûter***
MRR Rotunde
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
16h15 - 16h45

[TU-AGM] (CAP/*ACP*)
CAP Annual General Meeting / ***Assemblée générale annuelle de l'ACP***
TUESDAY, JUNE 9 / ***MARDI, 9 JUIN***
16h45 - 18h00

ROOM / ***SALLE*** **MRR R221 (cap.100)** *Chair: S.A. Page, University of Manitoba*

TU-AGM-1 **16h45**

SHELLEY A. PAGE, University of Manitoba

Transformation and Change: A path forward for the CAP [†]

The Canadian Association of Physicists has undergone significant growth and change since its inception, over 6 decades ago, beginning with 122 founding members. Today, the CAP is a broadly-based national network of over 1500 physicists working in Canadian educational, industrial, and research settings. The association exists with a unique and vital mandate to represent and to serve the Canadian physics community. The CAP is a strong advocate for support of, and excellence in, physics research and education. We represent the voice of Canadian physicists to government, granting agencies, and many international scientific societies. We are an enthusiastic sponsor of events and activities promoting Canadian physics and physicists, including the CAP's annual congress and national physics journal, Physics in Canada. We offer and strive to continually enhance our web site as an important resource for individuals pursuing careers in physics and physics education. The scope of what the CAP can achieve depends to a large extent on the participation of the Canadian physics community, both in terms of membership and in volunteer service to the association. Our long term success as an organization demands that we continually review our priorities and operational methods, striving to most effectively meet the needs of the community that we exist to serve. I will review the path the CAP has followed for the past year, highlighting new approaches and initiatives that have been undertaken to help position the association for a bright future.

[†] In collaboration with Robert Mann, University of Waterloo

Transformation et changement: l'ACP en marche

L'Association canadienne des physiciens et physiciennes a connu une croissance et des changements importants depuis ses débuts, il y a plus de six décennies, avec 122 membres fondateurs. Aujourd'hui, l'ACP est un vaste regroupement de plus de 1500 physiciens oeuvrant dans les milieux canadiens de l'éducation, de l'industrie et de la recherche. L'Association existe avec le mandat unique et vital de représenter et servir la collectivité canadienne de physique. L'ACP constitue un groupe de pression solide ayant pour objectif le soutien de la recherche et de l'éducation en physique, et leur excellence. Nous sommes le porte-parole des physiciens canadiens face au gouvernement, aux organismes subventionnaires et à plusieurs sociétés scientifiques internationales. Nous nous faisons le promoteur enthousiaste d'événements et d'activités mettant à l'avant-scène la physique et les physiciens canadiens, en particulier le congrès annuel et la revue de physique nationale, La Physique au Canada. Nous offrons et cherchons à développer continuellement notre site Web pour en faire une ressource-clé pour ceux qui poursuivent leur carrière en physique et dans l'enseignement de la physique. Ce que l'ACP peut accomplir dépend dans une large mesure de la participation de la collectivité de physique canadienne, en termes d'adhésion et de service bénévole à l'Association. Notre succès à long terme comme organisation requiert de revoir continuellement nos priorités et modes d'opération, en essayant de rencontrer le plus efficacement possible les besoins de la communauté dont le service est notre raison d'être. Je vais survoler le chemin que l'ACP a suivi au cours de l'année qui se termine, insistant sur les nouvelles approches et initiatives mises de l'avant pour préparer à l'Association un brillant avenir.

En collaboration avec Robert Mann, Université de Waterloo

18h00 **Session Ends** */ Fin de la session*

[CAP-Banq] (CAP/ACP)
Reception and Banquet / *Réception et banquet*
Room / Salle – Palais Crystal Palace, Ramada Hotel
TUESDAY, JUNE 9 / *MARDI, 9 JUIN*
19h00 - 22h30

Wednesday, June 10 - Mercredi, 10 Juin

[WE-Exec] (CAP/ACP)
CAP Executive Meeting (new and old) / *Réunion de l'Exécutif de l'ACP (nouveau et ancien)*
WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*
07h00 - 08h15

ROOM / *SALLE* B125 JdeV (cap.16) *Chair: R.B. Mann, University of Waterloo*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

08h15 ***Meeting* Ends / *Fin de la réunion***

[WE-Plen1] (CAP/ACP)
Plenary - Achim Schwenk, TRIUMF / *Plénière - Achim Schwenk, TRIUMF*
WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*
08h45 - 09h30

ROOM / *SALLE* JdeV Salle de spectacle (cap.410) *Chair: M. Butler, St. Mary's University*

WE-Plen1-1 **08h45**

ACHIM SCHWENK, TRIUMF

A tour of neutron matter in the universe *

I will take you on a tour of the physics of neutrons in the universe. The tour leads us through astrophysics, atomic, nuclear and particle physics and highlights – the physics of strong interactions between neutrons, – universal properties of neutrons and ultracold atoms, – neutron superfluidity in neutron stars, – the limits of existence and novel forms of matter at the neutron drip line, – how neutrinos interact with neutrons in supernovae, and – the role of neutrons for the creation of the heavy elements.

* This work is being supported by NSERC and TRIUMF receives funding via a contribution through NRC Canada

09h30 **Session Ends / *Fin de la session***

[WE-AM-Break] (CAP/ACP)
Health Break, with refreshments / *Pause-santé, avec goûter*
MRR Rotunde
WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*
09h30 - 10h00

[WE-A1] (CAP/ACP)
CAP Best Student Presentations Final Competition / *Compétition finale de l'ACP pour les meilleures communications étudiantes*
WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*
10h00 - 12h00

ROOM / *SALLE* MRR D102 (cap.134) *Chair: L. Marchildon, Université du Québec à Trois-Rivières*

The list of student competitors will be available at the CAP desk near the registration area after 5 p.m. on Tuesday, June 9.
La liste des participants aux concours d'étudiants sera disponible à la table de l'ACP, près de l'aire d'inscription, après 17h00 mardi le 9 juin

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

[WE-A2] (DAMPhi/*DPAMip*) Atomic and Molecular Spectroscopy and Dynamics II / *Spectroscopie et dynamique des atomes et molécules II*

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***
10h00 - 12h00

ROOM / *SALLE* MRR A102 (cap.134) *Chair: D. Tokaryk, University of New Brunswick*

WE-A2-1 10h00

RALPH SHIELL, Trent University

Heavy Rydberg Systems: Their Properties, Their Formation, and Their Control †,*

Conventional (electronic) Rydberg atoms and molecules comprise an electron occupying a high-*n* orbital, and have exaggerated properties compared to more familiar atomic and molecular states. Each atom or molecule can be viewed as a two-body system experiencing a predominately Coulombic potential, on which we can superimpose fields in the laboratory of a type and magnitude we desire. "Heavy Rydberg systems" correspond to replacing the highly excited electron by a negatively charged ion, thereby creating a system with similar dimensions and binding energy, but much slower rate of evolution. This increased timescale allows more precise measurements and control of this system, and provides new insights into the behavior of molecules with very high internal energies.

This talk will discuss some recent results from heavy Rydberg systems, and discuss the interactions between valence and ion-pair states that influence their formation and subsequent evolution. I shall present recent progress from an experiment designed to study excited- and ground-state collisions between laser-cooled lithium atoms. As part of this project, we have developed new optical tools based on programmable microcontrollers: these easily programmed and readily modified devices have been used to stabilize lasers, determine wavelengths, and image laser modes. Extensions of these developments will also be discussed.

† In collaboration with Jeffrey Philippson [1], Matthew Ugray [1], Elmar Reinhold [2], Wim Ubachs [2], [1] Trent University, [2] Vrije Universiteit, The Netherlands
* This work is being supported by NSERC, CFI, Trent U, EU Integrated Infrastructure Initiative

WE-A2-2 10h30

Millimeter Wave and Terahertz Spectra of C-13 Methanol*, **Li-Hong Xu** [1], R.M. Lees [1], H.S.P. Muller [2], C.P. Endres [2], F. Lewen [2], S. Schlemmer [2], K.M. Menten [3], [1] *University of New Brunswick*, [2] Universitat zu Koln, Germany, [3] MPI fur Radioastronomie, Germany — Methanol is a very ubiquitous molecule in space. A previous combined analysis of microwave and millimeter wave spectra of C-13 methanol together with Fourier transform far-infrared spectra was limited to the first two torsional states (i.e. $\nu_t = 0$ and 1 for J values up to 20) [1]. We have recently carried out new millimeter and terahertz measurements for $^{13}CH_3OH$ on several different spectrometers in the Cologne laboratory to overcome the limits in frequency and quantum number coverage. The new measurements have been carried out in the frequency windows 34-70 GHz, 75-120 GHz, 240-340 GHz, 370-500 GHz and 1.12-1.35 THz. With the new data, we are extending our previous global treatment to include the first three torsional states (i.e. $\nu_t = 0$, 1 and 2 for J values up to 30). We hope to provide the radio astronomical community with a C-13 methanol database that will have been improved substantially compared to the existing one [2]; also available in the CDMS [3]. The new database will be available in the Cologne Database for Molecular Spectroscopy, CDMS, in support of present and future astronomical studies associated with the launch of HIFI (Heterodyne Instrument for the Far-Infrared) on board the Herschel Space Observatory, the flying of SOFIA (Stratospheric Observatory For Infrared Astronomy) and the commissioning of ALMA (Atacama Large Millimeter/Submillimeter Array).

1. Li-Hong Xu, M.S. Walsh, R.M. Lees, *J. Mol. Spectrosc*, **179**, 269-281, 1996.
2. Li-Hong Xu, F.J. Lovas, *J. Phys. Chem. Ref. Data*, **26**, 17-156, 1997.
3. H.S.P. Muller, S. Thorwirth, D.A. Roth, G. Winnewisser, *Astron. Astrophys.* **370**, L49-L52, 2001; H.S.P. Müller, F. Schlöder, J. Stutzki, G. Winnewisser, *J. Mol. Struct.* **742**, 215-227, 2005; web-page: http://www.astro.uni-koeln.de/cdms/.

* This work is being supported by NSERC

WE-A2-3 10h45

IR Spectroscopy at the Canadian Light Source: The Methyl-Rocking and OH-Bending Bands of O-18 Methanol*, **R.M. Lees** [1], Saibei Zhao [1], Dominique R.T. Appadoo [2], [1] *University of New Brunswick* , [2] Canadian Light Source — High-resolution Fourier transform infrared spectra of O-18 methanol involving the ν_7 in-plane and ν_{11} out-of-plane CH_3-rocking and the ν_6 OH-bending vibrational fundamentals plus a variety of combinations with the large-amplitude ν_{12} torsion have been recorded at the Far-Infrared beamline of the Canadian Light Source synchrotron in Saskatoon. The ν_7, ν_{11} and ν_6 bands are nominally centered at around 1073, 1150 and 1335 cm^{-1}, respectively, but the spectrum is widely spread across the whole region from 1050 – 1400 cm^{-1} due to strong torsion-mediated coupling among the $\nu_7+\nu_{12}$, $\nu_{11}+\nu_{12}$ and ν_6 states as well as the $\nu_8+\nu_{12}$ torsionally excited CO-stretch. Most of the stronger spectral structure has been assigned to a wide variety of subbands, and the wavenumbers fitted to power-series expansions to obtain *J*-independent substate origins and effective rotational *B*-values. Upper-state energy term values have been obtained using known ground-state energies, and the rotation-torsion-vibration energy manifold has been mapped to explore the torsion-vibration energy structure.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada.

11h00 Break / *Pause*

WE-A2-4 **11h15**

ALLAN G. ADAM, University of New Brunswick

High Resolution Laser Spectroscopy of Transition Metal Monophosphides and Halides [†],[*]

Simple transition metal-containing molecules are ideal systems for studying the bonding and reactivity of transition metal centres, and therefore they have been the subject of numerous theoretical and experimental studies. Their reactivity is extremely important in catalytic applications; for example, rhodium is widely used to catalyze carbonylation, hydrogenation, and hydroformylation reactions used in industrial processes. One of the most famous catalysts in use today is chlorotris (triphenylphosphine) rhodium or Wilkinson's catalyst. The molecule involves a rhodium metal complex with three large triphenylphosphine ligands coordinated to the metal centre and one chlorine bond. The catalytic cycle involves loss of one or two of the phosphorous linkages. Wilkinson's catalyst is an example illustrating the importance of knowing something about the bonding between transition metals with phosphorous and halide (F, Cl, Br) ligands. At UNB, high resolution laser spectra of various transition metal monophosphides and monohalides have been acquired in the visible region of the spectrum. The molecules were produced by laser ablation of a metal target rod followed by reaction with a suitable precursor in a pulsed supersonic jet. Laser induced fluorescence spectra were gathered following excitation of the molecules using a cw ring dye laser. Dispersed fluorescence from the observed electronic transitions has allowed the ground state vibrational intervals to be measured. It has also indicated the presence of low-lying electronic states. The electronic transitions have been characterized for the first time by vibrational and rotational analyses. Examples of some of the molecules that have been observed will be presented.

[†] In collaboration with Aaron D. Granger, Laura E. Downie , Dennis W. Tokaryk , Colan Linton , University of New Brunswick

[*] This work is being supported by NSERC

WE-A2-5 **11h45** **(U)**

High resolution Fourier transform spectroscopy of pyrazole: a synchrotron-based study conducted at the Canadian Light Source[*], **Jeff G. Crouse**, Dennis W. Tokaryk, *University of New Brunswick* — Pyrazole ($C_3H_4N_2$) is a simple 5-membered aromatic ring in which two adjacent nitrogen atoms and the three carbon atoms form a closed planar loop. Members of the 5-membered ring family have been extensively studied via low-resolution far-infrared vibrational spectroscopy, but only in the last decade has instrumentation improved to the point where vibrational bands could be fully resolved. Our group has used the intense and well-collimated far-infrared light from the Canadian Light Source synchrotron to collect spectra of pyrazole below 1200 cm^{-1} at very high resolution (0.00096 cm^{-1}) using a Fourier transform spectrometer. We will present the results of our rotational analysis for several bands of pyrazole, and compare them to our recent investigations of the related 5-membered rings pyrrole (C_4H_5N), furan (C_4H_4O), and thiophene (C_4H_4S).

[*] This work is being supported by NSERC, the Canadian Light Source, University of New Brunswick

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

[WE-A3] Medical Physics / *Physique médicale* (DMBP/*DPMB*)

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

10h00 - 12h15

ROOM / *SALLE* MRR D202 (cap.135)

Chair: D.E.B. Fleming, Mount Allison University

WE-A3-1 **10h00**

JAMES ROBAR, Dalhousie University

Exploring novel x-ray beams for image-guidance in radiation oncology [*]

The technology used to plan and deliver external beam radiation therapy (RT) has advanced dramatically over the past decade. Multiple imaging modalities combine in synergy to allow improved accuracy in delineating the tumor volume to be treated. New methods for treatment planning allow accurate calculation and optimization of the radiation dose deposition. Photon beam intensity-modulation by clinical linear accelerators allows intricate 3D dose distributions to be delivered. A lingering challenge, however, is coping with dynamic patient anatomy throughout the course of treatment. Due to, for example, involuntary motion, tumor regression, weight loss or edema, spatial changes in tumor volumes and surrounding normal organs occur within one treatment session and between successive treatment fractions. This situation, which limits the achievable accuracy, necessitates imaging of the patient *in situ* during the treatment delivery. In this presentation we describe research into modification of the photon beam produced by the linear accelerator—which has been optimized previously for therapeutic purposes—to allow high contrast patient imaging. The beam-line is altered to recover a significant population of photons in the diagnostic range (below 200 keV) through redesign of the x-ray target design and removal of flattening filtration. Improvement in image quality, relative to imaging with the standard MV beam, is possible for both planar imaging and Cone-Beam Computed Tomography (CBCT). A mechanism for rapid switching between therapy and imaging beams has been developed. The potential of this approach for image-guided RT will be described with initial imaging results.

[*] This work is being supported by Varian Medical Incorporated

WE-A3-2 **10h30**

Detecting Arsenic and Defining Its Micro-distribution in Skin Phantoms[*], **Mihai Gherase** [1], David Fleming [1], Chang-Yong Kim [2], [1] *Mount Allison University*, [2] Canadian Light Source, Inc. — Chronic exposure to arsenic (As) can have significant health implications. Most often, long-term effects of As result from exposure through drinking water. Contamination of water supplies is notable in many locations throughout the world, including parts of Canada. After ingestion

into the body, if As is not excreted, it binds with sulfhydryl groups of keratin. This makes skin a primary location for accumulation and effect. In recent years, potential *in vivo* techniques based on x-ray fluorescence have been introduced to assess As concentration in human skin. The goal of these approaches is to quantify As exposure and better understand its accumulation in the human body. A requirement for the application and interpretation of these methods, however, is a detailed understanding of how As distributes in skin as a function of depth. This is an area of research ideally suited to synchrotron radiation. We report on a pilot study using the Hard X-ray Micro-Analysis (HXMA) microprobe of the Canadian Light Source (CLS) to analyze As within specially prepared skin phantoms. Detection limits are quantified and signal examined as a function of incident beam angle. Results will also be presented from a non-uniform As concentration (or "layered") skin phantom. Finally, an application to a skin phantom containing both As and selenium (Se) will be demonstrated.

* This work is being supported by NSERC, CRC

WE-A3-3 10h45

Imaging cancerous cells using surface enhanced Raman Spectroscopy*, **Kevin Hewitt** [1], Leanne Lucas [1], Michael Chen [2], Aaron Smith [2], Mladen Korbelik [3], Haishan Zeng [3], Patrick Lee [1], [1] *Dalhousie University*, [2] Simon Fraser University, [3] BC Cancer Agency — A number of cancers are characterized by overexpression of the Epidermal Growth Factor receptor (EGFR), a membrane protein which mediates cell growth, proliferation and differentiation in multiple tissues. Many epithelial tumors have been found to express high numbers of EGF receptors, and receptor levels are associated with poor clinical prognosis in cancers of the bladder, breast and lung. Antibodies for EGFR tagged with fluorescent probes have been used as contrast agents to image EGFR overexpression. The EGFR induced shift in the Plasmon resonance has also been used as an image contrast method. Both these methods provide at most a 10-fold intensity contrast factor. To overcome the limited contrast, we explore the use of surface enhanced Raman spectroscopy (SERS). 40 nm gold nanoparticles (AuNPs) tagged with antibodies to EGFR are incubated with cells of the A431 human epidermoid carcinoma cell line as well as normal human bronchial epithelial (NHBE) cells. Using the 632.8 nm excitation line of a He-Ne laser, Raman spectroscopy measurements are performed using a point mapping scheme. SERS signals are observed with an overall enhancement of 4-7 orders of magnitude. Raman intensity maps of the 1480 and 1583 cm^{-1} peaks correlate well with the expected distribution of AuNPs and EGFR. The results present a simple yet effective means to image EGFR expression. Comparison of the signal generated by non-cancerous (NHBE) and cancerous (A431) cells provide evidence of improved contrast.

* This work is being supported by NSERC, CIHR, NCIC, CDF

WE-A3-4 11h00

WILLIAM WHELAN, University of Prince Edward Island

Optoacoustic Detection of Tissue Damage During Thermal Therapy *

Minimally invasive thermal therapy involves heating tissues to greater than 55 C over a period of a few minutes, which results in coagulative necrosis. Thermal therapy has been investigated as an alternative treatment modality for solid tumours including breast, liver and prostate. In recent years there has been considerable research and development of optoacoustic (OA) imaging techniques that take advantage of the high optical contrast of tumors at near-infrared light, associated with optical imaging, and with the high resolution possible with ultrasound imaging. We previously demonstrated that optoacoustic signals are sensitive to changes in tissue optical and mechanical properties that occur when tissues are thermally damaged. In this study, thermal lesions, 5 mm to 15 mm in diameter, were induced in bovine muscle *ex vivo*. Optoacoustic signals were obtained using a novel optoacoustic imaging system comprised of an Nd:YAG pumped Titanium-Sapphire laser delivering 6 ns pulses at 757 nm and a 8-channel annular transducer array, operating in reflection mode. All experiments were conducted in a waterbath, required for good acoustic coupling. Thermal lesions up to 2 cm below the illumination surface were imaged. Regions of tissue carmelization and tissue coagulation were visible with well-demarcated boundaries and optoacoustic contrast of up to 5-fold compared to non-coagulated tissues. Imaged-predicted and actual lesion dimensions were in good agreement. In addition, we demonstrated that detected optoacoustic signals increase with maximum temperature achieved in tissues. This work demonstrates the potential of optoacoustic imaging for guiding the progress of thermal therapies.

* This work is being supported by NSERC (CHRP and Discovery Programs) and CIHR

WE-A3-5 11h30

An analysis of inter-operator registration variability in helical tomotherapy, **Eduardo Galiano-Riveros** [1], Dave Cooper [2], Mehdi Saberi [2], [1] *Laurentian University*, [2] Ottawa Cancer Centre — This study aims to determine the image registration interoperator variability using the image fusion interface on the TomoTherapy system. The study focused on the registration results among five radiation therapy professionals comparing 15 retrospective prostate, bladder, and head and neck patients from day 2 megavoltage computed tomography images with planning computed tomography images. Personnel were instructed to manually adjust the fused images after automatic bony registration matching disease-specific criteria. The Pearson correlation matrix was applied to the summed vector lengths of the personnel's overall translations in all three disease sites. The results were compared with a chosen benchmark personnel and were analyzed for significance in correlation. Finally, the overall translations compared with the automatic bony registration were analyzed for any trends in the data. In each disease site, the average correlation from all personnel compared to a benchmark registering prostate, bladder, and head and neck patients were 0.94, 0.94, and 0.64, respectively. Then, analysis of the interuser overall translations illustrated that each disease site had its own trends with regard to interfraction image fusion corrections. Finally, the mean translational variations were assessed over all personnel for each disease site in X (lateral), Y (longitudinal), and Z (vertical) directional planes. The results demonstrate that consistent, accurate image registration is dependent on factors involving overall user experience with TomoTherapy software and user knowledge of human sectional anatomy, among others.

WE-A3-6 11h45

Molecular Targeted Contrast Agent-Enhanced Ultrasound Imaging for Chronic Inflammation of the Prostate*, **Mark Gertner**, *Ontario Cancer Institute/Princess Margaret Hospital, University Health Network and Ryerson University* — The traditional use of ultrasound contrast agents (UCA's) has been to image them while they pass unimpeded through the circulation, to uncover vascular disease by recognizing regions of abnormal blood flow. But now, antibodies or peptide sequences against endothelial molecular markers of disease states can be attached to these agents, causing them to be retained directly within regions of the vascular endothelium expressing these markers. These diseased regions then show up preferentially on ultrasound compared to un-diseased regions. For inflammation an alternate form of targeting is also possible that does not rely on antibody attachment, rather, the UCA binds through serum complement protein

mediation. These targeted approaches enable identifying vascular dysfunction at the very early stages and therefore, earlier intervention because expression of endothelial markers is a preliminary step in the conversion to disease. This presentation will set the stage for using molecular targeted UCA's to detect chronic inflammation of the prostate. The goals are to identify men who might benefit from definitive therapy, to distinguish the symptoms of chronic inflammation from those of benign prostatic hyperplasia and treat accordingly, and, with recent evidence of a link between chronic inflammation and prostate cancer, identify those who might be at increased risk of developing prostate cancer and intervene even earlier to prevent its onset. UCA targeting schemes will be reviewed. Results of a feasibility pilot that demonstrated adherence of targeted UCA's to inflamed prostate endothelial cells *in vitro* will be presented. Animal and human studies suggestive of the ability to identify chronic inflammation in situ in the human prostate will be proposed.

* This work is being supported by The National Cancer Institute of Canada / Canadian Prostate Cancer Research Initiative

WE-A3-7 12h00 (G)

Determining Accuracy of a DXA Using Phantoms in Bone Densitometry, **Jeff Frimeth** [1], Eduardo Galiano-Riveros [1], Dave Webster [2], [1] *Laurentian University*, [2] Sudbury Regional Hospital - St. Joseph's Site — Bone densitometry is used to quantify an individual's Bone Mineral Density (BMD) so that a fracture risk for the person can be determined. The most commonly used technology to measure BMD currently is Dual Energy X-ray Absorptiometry (DXA). DXA measures an areal bone density (mass per unit area, seen by an incoming x-ray beam) as opposed to a volumetric density. Among random errors associated with patient positioning and with DXA operator intervention, there are also accuracy errors directly associated with the DXA itself. The accuracy of the DXA at the Sudbury Regional Hospital – St. Joseph's site was determined through measurements with three sets of lumbar spine phantoms. The phantoms were in the shapes of a rectangular parallelepiped, cylinder, and trapezoid. Each shaped phantom consisted of four separate pieces of aluminum to represent the first four lumbar vertebrae and were placed in a Tupperware water container, which was used to simulate soft tissue. Initially our results were approximately only 60% of the physical areal densities which were measured in the laboratory. We hypothesized that the DXA was calculating a water subtracted BMD. The hypothesis was verified experimentally. Our results compare favourably with other published phantom studies.

12h15 Session Ends / *Fin de la session*

[WE-A4] Relativity / *Relativité* (DTP/*DPT*)

WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*

10h00 - 12h00

ROOM / *SALLE* MRR D002 (cap.135) *Chair: V. Faraoni, Bishop's University*

WE-A4-1 10h00

VIQAR HUSAIN, University of New Brunswick

Critical behavior in quantum gravitational collapse

I will describe a study of gravitational collapse of an inhomogeneous scalar field with quantum gravity corrections associated with singularity avoidance. Numerical simulations indicate that there is critical behaviour at the onset of black hole formation as in the classical theory, but with the difference that black holes form with a mass gap.

WE-A4-2 10h30

ANDREI FROLOV, Simon Fraser University

Primordial Non-Gaussianity from Preheating

The idea of inflation (a period of rapid quasi-exponential expansion of the Universe) neatly solves several issues in cosmology. While the Universe is inflating, its contents is cold. Eventually, inflation ends and the field driving the inflation must decay, depositing energy into high-energy particles. This process, known as reheating, starts the hot big bang history as we know it. I will discuss a few scalar field models of reheating, which for all their simplicity have rich physics involving parametric resonance, non-linear evolution, and turbulence, and illustrate their dynamical behavior with simulations using a new numerical solver I developed. Most interestingly, preheating can create primordial non-Gaussian fluctuations at potentially observable levels, which could give a glimpse of physics at energies we know very little about.

WE-A4-3 11h00

The Generalized Uncertainty Principle and Quantum Gravity Phenomenology*, **Saurya Das** [1], Ahmed Farag Ali [1], Elias C. Vagenas [2], [1] *University of Lethbridge*, [2] Academy of Athens — Various approaches to Quantum Gravity, as well as Black Hole Physics, predict a minimum measurable length, or a maximum observable momentum, and suggest modifications of the Heisenberg Uncertainty Principle to a so-called Generalized Uncertainty Principle (GUP). We propose a GUP consistent with all of the above theories, and show that it gives rise to an additional term in all quantum mechanical Hamiltonians, which become important near the Planck scale. We examine its implications for some well-known systems. For example, when applied to a particle in a box, it requires the box length to be quantized in units of a fundamental length (which can be the Planck length). This suggests that space itself is discrete and that the space-time continuum picture breaks down near that scale. We ask whether such discreteness can have observable consequences at length scales much larger than the Planck scale.

* This work is being supported by NSERC, Perimeter Institute

WE-A4-4 **11h15**

Violating the Penrose Inequality with Designer Horizons, **Benjamin Tippett**, *University of New Brunswick* — The Penrose inequality has so far been proven in cases of spherical symmetry and in cases of zero extrinsic curvature. The next simplest case worth exploring would be non-spherical, non-rotating black holes with non-zero extrinsic curvature. Following Karkowski et al.'s construction of prolate black holes, we define initial data on an asymptotically flat spacelike 3-surface with nonzero extrinsic curvature that may be chosen freely. This gives us the freedom to define the location of the apparent horizon such that the Penrose inequality is violated. We show that the dominant energy condition is violated at the poles for all cases considered."

WE-A4-5 **11h30**

Galilean Black Holes and Solitons, **Robert Mann**, *University of Waterloo* — Spacetimes containing black holes with Galilean asymptotics have been proposed as being holographically dual to a non-relativistic conformal field theory at finite temperature. Under certain circumstances such black holes can undergo phase transitions to solitons. I discuss the nature of these black holes and solitons, and the phase transitions between them.

WE-A4-6 **11h45**

Braneworld cosmological perturbations, **Sanjeev Seahra**, *University of New Brunswick* — I discuss recent advances in the modeling of cosmological perturbations in braneworld scenarios, paying special attention to comparison with observations and testing extra-dimensional models of dark energy.

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

[WE-A5] Synchrotron Science / *Science des synchrotrons*

(DCMMP/*DPMCM*)

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

10h00 - 11h15

ROOM / *SALLE* MG2 147G2 (cap.108) *Chair:L. Kreplak, Dalhousie University*

WE-A5-1 **10h00**

TSUN-KONG SHAM, University of Western Ontario

Synchrotron radiation spectroscopy and related phenomena in materials research

Synchrotron is an accelerator-based light source, such as the Canadian Light Source, a national facility located in Saskatoon, that delivers photons with unprecedented tunability in energy and polarization (continuous spectrum from IR to hard X-ray, linear to circular to variable polarization), brightness (highly collimated) and time structure (short pulse). In this talk, the properties of synchrotron radiation will be noted. The applications of a variety of synchrotron techniques taking advantage of these properties and the interaction of light and matter via absorption, such as XAFS (X-ray absorption fine structures), XES (X-ray emission) and XEOL (X-ray excited optical luminescence) in materials research will be illustrated with examples, from d- band filling of noble metals to revealing the interplay of surface and size effects in Au nanoparticles to the origin of morphology-dependent luminescence from Si nanowires and ZnO nanostructures. Several emerging photon-in photon-out techniques that blur the absorption and scattering processes will also be noted.

Research at the University of Western Ontario is supported by NSERC, CFI, CRC, OIT; synchrotron research was conducted at CSRF (SRC, Madison, supported by NRC, NSERC and US NSF), APS (Chicago, supported by US DOE), ALS (Berkeley, supported by US DOE) and CLS (Saskatoon, supported by NSERC NRC, CIHR and University of Saskatchewan)

WE-A5-2 **10h30**

DAVID MUIR, University of Saskatchewan

A Soft X-Ray Emission Spectrometer for the REIXS Beamline at the CLS [†],[*]

Our group has completed the design of a soft X-ray (50-1100 eV) emission spectrometer for the Resonant Elastic and Inelastic X-ray Scattering (REIXS) beamline at the CLS. The optical design employed techniques and software tools we developed using ray-tracing and diffraction grating efficiency calculations to analyze and compare existing designs and to propose a new design with superior performance. This design employs Rowland circle geometry to achieve a resolving power in excess of 2,500 in our range of interest. In addition, a novel optical design for a larger extreme resolution spectrometer has been completed providing resolving powers exceeding 10,000 throughout the higher end of the spectrum. The results of this analysis, the design constraints and resulting specifications, as well as the current status of the commissioning and the first measurements from the end station, will be presented.

[†] In collaboration with Mark Boots, Mikhail Yablonskikh , Alexander Moewes , University of Saskatchewan
[*] This work is being supported by NSERC and the Canada Research Chair Program

WE-A5-3 **11h00**

Natural Dichroism and Momentum-Transfer Dependence in Cubic Systems[*], **Robert Gordon** [1], Maurits Haverkort [2], Subhra Sen Gupta [3], George Sawatzky [3], [1] *PNCSRF/Simon Fraser University*, [2] Max Planck Institute for Solid State Research, [3] University of British Columbia — Information on valence orbitals and electronic interactions in single crystal systems can be obtained through orientation-dependent x-ray measurements, but this can be problematic for a cubic system. Polarisation-dependent x-ray absorption measurements are common, but are dominated by dipole transitions which, for a cubic system, are isotropic even though a cubic system is not. Many edges, particularly for transition metals, do have electric quadrupole features that could lead to dichroism [1] but proximity to the dipole transition can make interpretation challenging. Non-resonant inelastic x-ray scattering (NIXS) can also be used to perform orientation-dependent measurements -

not only dependent on the direction of the momentum transfer but also its magnitude, q. Previous NIXS measurements on polycrystalline materials revealed that multipole (higher order than dipole) transitions are readily observable [2] in the pre-threshold region of rare earth $N_{4,5}$ edges, actually replacing the dipole at high-q. We have extended these studies to examine orientation-dependent NIXS for CeO_2 and MnO single crystals, as prototype systems for theoretical treatment. Dichroism is observed at both the Ce $N_{4,5}$ and Mn $M_{2,3}$ edges in these cubic materials.

1. A. Juhin *et al*, *Phys. Rev. B* **78**, 195103 (2008).
2. R.A. Gordon *et al*., *EPL* **81** 26004 (2008).

* This work is being supported by NSERC, Max Planck Society, CIAR

11h15 **Session Ends** / ***Fin de la session***

[WE-A6] (PPD/*PPD*) Collider Physics / *Physique des collisionneurs*

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

10h00 - 12h00

ROOM / *SALLE* MRR A002 (cap.134)

Chair: D.C. O'Neil, Simon Fraser University

WE-A6-1 **10h00**

BERND STELZER, Simon Fraser University

Highlights from the Tevatron

We present recent results from the Tevatron experiments CDF and D0. Both experiments have analyzed datasets in excess of 4/fb of proton anti-proton collisions at sqrt(s) = 1.96 TeV. This talk will cover highlights and selected topics from top, electroweak, Higgs, QCD and flavor physics, as well as searches addressing physics beyond the standard model. Attention will be given to the recent observation of electroweak single top quark production and progress in searches for the standard model Higgs boson.

WE-A6-2 **10h30**

Searches for rare non-hadronic B decays with BABAR*, **Steven Robertson**, *Institute of Particle Physics* — The asymmetric B factories provide a clean, hermetic environment which can be used to enable searches for a variety of rare and exotic B meson decays with potential sensitivity to physics beyond the Standard Model. The ability to search for final states containing missing energy, and to perform fully inclusive measurements of rare B decays, are unique features of the electron-positron B factories. In this presentation I will present the results of a number of recent BABAR rare-decay searches and discuss the techniques that make these analyses possible.

* This work is being supported by NSERC

WE-A6-3 **10h45**

Particle Production with ZEUS at HERA*, **Francois Corriveau**, *Institute of Particle Physics / McGill University* — The HERA collider stopped running in June 2007, but the data accumulated by ZEUS has continued to be analyzed ever since. In the framework of particle production, the latest results on charge multiplicity measurements, searches for resonant states and heavy quark production will be presented.

* This work is being supported by NSERC

WE-A6-4 **11h00**

KAMAL BENSLAMA, University of Regina

Extra Dimensions, Supersymmetry and the origin of Mass: Exploring the nature of the Universe using the Large Hadron Collider at CERN

Beams have now been put into the Large Hdron Collider (LHC), and the first collisions are expected soon. The LHC will collide protons at energies not accessible since the time of the early Universe. The study of the reactions produced at the LHC has the potential to revolutionize our understanding of the most fundamental forces in nature. Within the Standard Model of particle physics, the LHC's primary objective is the Higgs boson, which is thought to be responsible for the masses of the elementary particles. Beyond the Standard Model, the LHC may discover supersymmetry or extra space-time dimensions, and reveal the nature of dark matter. This talk will review the physics program of the ATLAS experiment at the LHC.

WE-A6-5 **11h30**

Accomplishments of the CLEO/CESR Program*, **David Asner**, *Carleton University* — The CLEO experiment at the Cornell Electron Storage Ring (CESR), accumulated data from Nov. 1979 to Mar. 2008. Both the machine and the detector underwent several different major phases defined by the implementation of new technologies, mostly locally developed. The improved sensitivities usually resulted in major discoveries. Many particles were first seen at CLEO and many important decay modes were first seen, or measured with far more accuracy than done before. Discoveries include the first observations of the $\Upsilon(3S)$, $\Upsilon(4S)$, B^0, B^-, D_S, $\Upsilon(1D)$ and $D_{SJ}(2460)$ mesons, and the Σ_c^+, Σ_c^{*+}, Σ_c^{*++}, Σ_c^{*0}, Ξ_c^0, Ξ_c^{*0}, and Ξ_c^{*+} baryons. First observations of new processes include b-quark semileptonic decays, the rare semileptonic decay $b\to u l\nu$, the ``Penguin" process b->sγ, and the important exclusive decays $B\to$-J/ψK_S , and $D^+\to\mu\nu$. Recently, the differential decay rates for $D\to\pi e\upsilon$ and $D\to Ke\upsilon$ and the decay rates for $D_S^+\to\mu^+\upsilon$ and $D_S^+\to\tau^+\nu$ have been measured with unprecedented accuracy, posing a challenge to Lattice QCD calculations. Finally, quantum correlations in charm produced at threshold are exploited to provide unique contributions to charm mixing and to enable the precision determination of the CKM angle γ.

* This work is being supported by NSERC

WE-A6-6 **11h45**

The SuperB Project, **Christopher Hearty** [1], David Asner [2], Robert Henderson [3], Janis McKenna [4], Popat Patel [5], Steven Robertson [6], Michael Roney [7], [1] *University of British Columbia / Institute of Particle Physics*, [2] Carleton University, [3] TRIUMF, [4] University of British Columbia, [5] McGill University, [6] McGill University / Institute of Particle Physics, [7] University of Victoria — SuperB will use flavor physics to play a crucial role in studying physics beyond the standard model. Using novel technology, it will collide electrons and positrons at energies near the $\Upsilon(4S)$ (~10.6 GeV) at ~100× the luminosity of existing B-Factories, but using comparable power and with comparable backgrounds. SuperB will produce an exciting heavy flavor program, including CP-violation asymmetries and rare decays in B and D mesons and τ leptons. These measurements are sensitive to new physics through the presence of virtual heavy particles in higher order loops. When collisions begin in 2015, SuperB will provide unique and complementary data for interpreting results from the LHC. The project has completed a Conceptual Design Report and has now begun R&D for a Technical Design Report. We will report on the development of this exciting new venture.

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

[WE-A7] Materials for Sustainable Energy / *Matériaux pour l'énergie durable*

(DCMMP/*DPMCM*)

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

10h00 - 11h45

ROOM / *SALLE* **MG2 148G2 (cap.132)**

Chair: I.G. Hill, Dalhousie University

WE-A7-1 **10h00**

JEFF DAHN, Dalhousie University

Experimental and Theoretical studies of the electrochemical reaction of lithium with amorphous silicon: Understanding the next generation of Li-ion batteries †

Silicon-based negative electrode materials will be used in the next few years to replace graphite as the negative electrode material in lithium-ion batteries. Silicon alloys with up to 3.75 lithium atoms per silicon atom leading to a volume expansion of 300% which leads to numerous challenges from a practical point of view. In addition, when lithium reacts electrochemically with silicon the resulting lithiated silicon becomes amorphous, which leads to numerous experimental challenges in understanding the physics of this electrode material. Using in-situ Mossbauer spectroscopy during the reaction of Li with Sn-doped Si, it was possible to gain some understanding of the structural changes that occur with lithium:silicon ratio. First principles studies of lithiated Si were also used to successfully reproduce electrochemical experimental results and better understand Si as an electrode material.

† In collaboration with Vincent Chevrier, Jing Li , Aaron Smith , Richard Dunlap , Tim Hatchard , Dalhousie University

WE-A7-2 **10h30**

RAFAEL KLEIMAN, McMaster University

Silicon-based Multi-Junction Solar Cells

Silicon offers many advantages as a high quality substrate for multi-junction solar cells, including its established base in the photovoltaic industry for single junction cells and its low cost relative to its high performance. However, to date multi-junction device technology has primarily been based on the more expensive Ge or GaAs substrates, limiting this approach to space-based or concentrator applications. I will discuss the challenges and opportunities associated with the fabrication of multi-junction Silicon-based solar cells and the approaches we are taking to their successful development.

WE-A7-3 **11h00**

MARY ANNE WHITE, Departments of Chemistry and Physics, and Institute for Research in Materials, Dalhousie University

Thermoelectric Materials for Power Generation *

We are all aware of the unsustainable rate of consumption of energy to support our first-world lifestyle. However, fewer people realize how much energy is actually wasted. For example, only about 25% of the combustion energy of gasoline goes to running a car; more than 60% of the energy is lost out the tailpipe as waste heat. Thermoelectric materials can be used to scavenge waste heat and generate power, but not yet with such efficiency that they are commonplace. The principles on which thermoelectric materials work, and some recent advances in thermoelectric materials and existing challenges, will be discussed. In addition, matters concerning sustainable approaches to thermoelectrics and other materials will be presented.

* This work is being supported by NSERC, Canada Foundation for Innovation, Atlantic Innovation Fund, and other sources that support the Facilities for Materials Characterization at the Institute for Research in Materials, Dalhousie U.

WE-A7-4 **11h30**

Defect Mediated Hydrogen Sorption in Mechanically Activated Carbon Nano Materials: A Mechanism For The Effect of Impurities on Hydrogen Absorption, **Mike Reda** [1], Alexander Moewes [2], [1] *CanadElectrochim*, [2] Engineering Physics, University of Saskatchewan — For practical hydrogen-storage applications, studies on hydrogen adsorption on the surfaces and interfaces of various materials are of importance. Carbon-related materials have been investigated for hydrogen storage because they are relatively light and inexpensive compared to metallic hydrogen-storage materials. Carbon nanotubes (CNTs) were expected to be a promising hydrogen-storage candidate material. However, pure CNTs were found not to be able to stably store hydrogen at ambient temperature and pressure. It is currently known that CNTs physically adsorb hydrogen but only at temperatures lower than 100 K. It was found that nano-structured graphite prepared by mechanical milling in a hydrogen atmosphere [referred to as hydrogenated nano-structured graphite (HNG) hereafter] showed a high capacity for hydrogen storage, yielding a composition as high as $CH_{0.9}$ [1]. It is confirmed that ball milling of carbon nano materials using Steel, Chromium or Zirconium balls resulted in different

amount of hydrogen absorption. This probably can explain why the amount of hydrogen absorbed, diffusion coefficients and activation energy for hydrogen absorption can differ by more than five orders of magnitude [2]. The purpose of this article is to elucidate a new possible mechanism for the effect of transition metal impurities on hydrogen storage efficiency.

1. *J. Appl. Phys.* **104**, 044311 (2008)
2. *Physica Scripta*, **T103**, 77, 203

11h45 Session Ends / *Fin de la session*

[WE-A8] Biophotonics and Applied Biomedical Physics / *Biophotonique et physique biomédicale appliquée*

(DMBP-DIAP-DIMP-DOP/ *DPMB-DPIA-DPIM-DOP*)

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

10h00 - 12h30

ROOM / *SALLE* MRR R221 (cap.292)

Chair: A. Linhananta, Lakehead University

WE-A8-1 10h00

WILLIAM WHELAN, University of Prince Edward Island

Point Radiance Spectroscopy in Turbid Media *

Diffuse interstitial spectroscopy is currently under investigation for the optical characterization of tissues with applications in cancer diagnosis and treatment response (photodynamic therapy and thermal ablation). Of particular interest is the quantitative determination of known endogenous and exogenous absorbers (i.e. chromophores), as well as information regarding the scattering properties of tissues. Our approach uses directional light intensity, or radiance measurements as opposed to conventional fluence measurements. We have developed a new optical technique, point radiance spectroscopy (PRS), to directly recover chromophore concentrations and the reduced optical scattering coefficient spectrum from continuous wave interstitial point radiance measurements at a single source-detector separation in turbid, tissue-like media. The method employs a spectral algorithm to fit the relative radiance data, using the P3 approximation, at only two detection angles (0 and 90 degrees). The spectral fitting algorithm is applied to simulated data of relative point fluence and relative point radiance data with added 1% noise, and shows that even under realistic experimental conditions, only point radiance information is able to provide quantitative information regarding chromophore concentrations and scattering power at distances greater than 2-3 mean free paths from the source. Furthermore, experimental measurements in tissue simulating phantoms demonstrate that dye concentrations and scattering parameters can be recovered to within ~ 10%. The developed point radiance technique bridges a technological gap between local surface reflectance and spatially resolved interstitial fluence methods in the optical assessment of biological tissues.

* This work is being supported by NSERC Discovery Grant and CIHR Operating Grant

WE-A8-2 10h30

AARON FENSTER, Robarts Research Institute

3D Ultrasound guided minimally invasive therapy and biopsy

Definitive clinical diagnosis of prostate adenocarcinoma (PCa) requires histopathological confirmation of a tissue sample drawn from a 2D transrectal ultrasound (TRUS) guided biopsy. The prostate biopsy procedure, however, is plagued by high false negative rates (up to 34%) as early-stage PCa is generally not visible on ultrasound. As a result, a negative biopsy does not rule out a diagnosis of PCa, as many tumors are missed on initial biopsy. In such circumstances, patients will undergo multiple repeat prostate biopsy (RPBx) to find undetected PCa. In a repeat biopsy, the physician must either avoid previously biopsied tissue (in cases of prior negative biopsy) or target the same anatomical site for patients with non-diagnostic, atypical small acinar proliferations (ASAP). In cases of ASAP, there is a 40-50% chance of finding PCa on RPBx in the same anatomic location, so accurate targeting of prior biopsy locations is essential. 3D TRUS is hypothesized to be superior to 2D TRUS for accurate guidance and recording of the prostate biopsy procedure. Patients undergoing RPBx might benefit most from the hypothesized improvements, as previous Bx core locations can be viewed in 3D and used to guide a RPBx. Accuracy is also important when suspicious findings exist on other diagnostic imaging modalities, such as MRI or PET, are used to direct a TRUS-guided biopsy. In this paper, we describe a new method to guide prostate biopsy procedures using 3D ultrasound. This new approach allows us to guide the biopsy to specific 3D targets in the prostate, record the biopsy locations in 3D, and register the intra-biopsy procedural 3D ultrasound image with an MR image to guide the biopsy to specific locations in the prostate.

WE-A8-3 11h00

ALLA REZNIK, Lakehead University

Avalanche Multiplication in Amorphous Selenium: Physics and Application

Impact ionization leading to avalanche multiplication was discovered in amorphous selenium (a-Se) in 1980. While this discovery was initially greeted with scepticism over the years avalanche multiplication has been not only confirmed by numerous experiments, but has been also utilized in commercial a-Se photoconductive targets used in ultra-sensitive TV camera tubes and CMOS imagers. Even though the experimental evidence for avalanche multiplication in a-Se is clear-cut, the theoretical understanding of the origin and nature of this phenomenon in amorphous semiconductors has remained unresolved. Here we show that the modified lucky-drift (LD) model is capable for an explanation of the avalanche multiplication mechanism in a-Se. Furthermore, it allows to explain why avalanche multiplication is delayed in other amorphous semiconductors including a-Si:H. Finally, we show that avalanche a-Se photosensors is a promising approach for low dose x-ray imaging detectors and a viable alternative to photomultiplier tubes for gamma-rays medical imaging (*i.e.* positron emission tomography or PET).

WE-A8-4 **11h30**

MICHAEL SOWA, National Research Council Canada

Photonics Technologies for Vascular Imaging - Tools for Understanding Atherogenesis

In Canada as in much of the world, heart attacks, stroke and peripheral vascular disease kill and disable more people than any other disease. Atherosclerosis, once thought of as a passive accumulation of fatty deposits in the artery, is generally the underlying culprit responsible for these deaths and disability. Recent research reveals a more complex disease where the body plays an active role in the progression of atherosclerosis. Photonics tools relying on imaging and spectroscopy offer considerable promise to further our understanding of the disease and potentially provide new diagnostic methods for clinicians. However, developing photonics tools to study the wall of a vessel in real-time presents challenges in device miniaturization, reliable and robust catheter development, as well as challenges in image capture, analysis, display and visualization. This talk will look at these challenges and review optical coherence tomography (OCT), Raman spectroscopy and nonlinear optical microscopy methods used at the Institute for Biodiagnostics to further elucidate the response of the vascular wall to advancing atherosclerotic disease. These tools can detect various stages of disease and provide a complimentary view of the effects of atherosclerosis on the structure and biochemistry of the artery wall. The steps required to move these technologies closer to clinical application will be discussed with intravascular OCT imaging being highlighted as a photonics technology that is approaching clinical use for vascular imaging.

WE-A8-5 **12h00**

Optical changes in the eye during normal development and the development of refractive error*, **Melanie C.W. Campbell** [1], Jennifer J. Hunter [2], Marsha L. Kisilak [1], Kaitlin Bunghardt [1], Elizabeth L. Irving [1], [1] *University of Waterloo*, [2] University of Rochester — Optical quality improves during normal eye development. In simple models of growth, which consider that the eye uniformly scales, the optics of the eye are represented by a wavefront. If each of the optical elements scales upwards, then so does the wavefront. For a fixed pupil, the retinal quality will improve with growth. If the pupil scales as the rest of the eye, the angle of the geometrical point spread function (PSF) on the retina and its metric, equivalent blur will remain constant. However, the angular blur due to diffraction decreases. In a new optical model of eye growth, the root mean square higher order-aberration aberration (rms aberration) remains unchanged but now occurs across an increasing pupil with growth. Human measurements are consistent with the new model. In chick and monkey, linear retinal blur due to aberrations decreases during development. In all three species, aberration blur is less than predicted by simple ocular scaling. Furthermore, within hours of the imposition of optical blur in the chick eye, optical properties of the treated eyes (in addition to defocus) differed from those of the control eyes. This suggests that the optical properties of eyes change in a manner which differs from that predicted by simple changes in the dimensions of the eye.

* This work is being supported by NSERC, Canada, CRC Canada, PREA

WE-A8-6 **12h15**

Unusual Multicomponent Diffusion Properties of Surfactant Solutions Near Critical Micelle Concentrations*, **Derek Leaist**, Jonathan Moulins, Jennifer MacNeil, *St. Francis Xavier University* — Solutions of surfactant micelles have unusual multicomponent diffusion properties. Cross-diffusion coefficients D_{ik} ($i \neq k$) for these systems are routinely larger than the main D_{ii} coefficients, indicating strongly coupled transport. More remarkably, incongruent diffusion ($D_{ii} < 0$) was reported recently for ternary mixed surfactant solutions. This means that a surfactant can diffuse "up" its own concentration gradient. Incongruent and strongly coupled diffusion are well documented for solutions at compositions approaching phase separation. Recognizing that chemical potential gradients are the driving forces for diffusion, the thermodynamic stability constraint $\mu_{11}\mu_{22} - \mu_{12}\mu_{21} \geq 0$ on the concentration derivatives $\mu_{ik} = \partial\mu_i/\partial C_k$ of the chemical potentials causes $D_{11}D_{22} - D_{12}D_{21}$ to vanish at critical points or phase separation boundaries. Although surfactant micelles are not true phases, a close analogy between diffusion in surfactant solutions and diffusion in solutions approaching instability is developed by using the chemical equilibrium model for the formation of polydisperse mixed micelles to show that $\mu_{11}\mu_{22} - \mu_{12}\mu_{21}$ drops almost to zero near critical micelle concentrations. This result, which is generalized to other association colloids, points to thermodynamics as the underlying cause of strongly coupled fluxes, incongruent diffusion, and other unusual features of transport in solutions of micelles, solubilizates, and microemulsions.

* This work is being supported by Natural Sciences and Engineering Research Council

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

[WE-SCIPOL] (CAP/ACP)

Meeting of CAP Science Committee (lunch available) / *Réunion du Comité de politique scientifique de l'ACP (dîner disponible)*

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

12h30 - 13h30

ROOM / *SALLE* **B125 JdeV (cap.30)**

Chair: N. Mousseau, Université de Montréal

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 ***Meeting* Ends** / ***Fin de la réunion***

[WE-Plen2a] (CAP-CRM / ACP-CRM)

Parallel Medal Talk - Hong Guo, McGill U. (CAP-CRM Prize) / *Plénière en parallèle - Hong Guo, Univ. McGill (Prix ACP-CRM)*

WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*

13h30 - 14h00

ROOM / *SALLE* JdeV Salle de spectacle (cap.410)

Chair: R. MacKenzie, Université de Montréal

WE-Plen2a-1 **13h30**

HONG GUO, McGill University

Quantum transport theory: from atoms to devices

In order to quantitatively predict device characteristics of nanoelectronic systems, quantum transport theory must be developed to include atomic, chemical and material properties of the device structure. It has been a long standing theoretical challenge to calculate nonlinear and nonequilibrium quantum transport features from atomistic first principles without relying on any phenomenological parameter. Over the past fifteen years or so, we have attempted to solve this challenge by seeking viable theoretical formalisms that can be reduced to practical computation of realistic nanoelectronic device structure. In this talk, I will review the present status of nanoelectronic device theory, the progress achieved so far as well as the existing mathematical difficulties and some important physical problems. Several important nanoelectronic devices will be used as examples, including quantum transport properties of magnetic tunnel junction, molecular transport structure, device interconnects, and carbon nanostructures. I will outline my view on the existing challenges of nanoelectronics theory, and on developing mathematical tools powerful enough for nanoelectronics design automation.

The work presented here were contributed by many students and postdocs over many years: Drs. Jian Wang, Jeremy Taylor, Jose-Luis Mozos, Hatem Mehrez, Brian Larade, Gianni Tarachi, Qingrong Zheng, Wengang Lu, Eric Zhu, Chaocheng Kaun, Pawel Pomorski, Derim Guclu, Yi Liu, Dan Robutsov, Nicolai Sergueev, Chuncheng Wan, Derek Waldron, Lei Liu, and Vladimir Timochevski. I thank my group members who carried out the calculations presented in this talk: Drs. Yibin Hu, Wei Ji and Ferdows Zahid, Mr. Jesse Masson, Zhanyu Ning, Youqi Ke, Zimin Feng, Tao Ji, Dylan McGuire, Etienne Marcotte, and Manuel Smeu.

14h00 **Session Ends / *Fin de la session***

[WE-Plen2b] (CAP-DIAP / ACP-DPIA)

Parallel Medal Talk - Andreas Mandelis, U.Toronto (Industrial & Applied Physics) / *Plénière en parallèle - Andreas Mandelis, U. Toronto (physique industrielle et appliquée)*

WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*

13h30 - 14h00

ROOM / *SALLE* MRR R221 (cap.292)

Chair: R. Maev, University of Windsor

WE-Plen2b-1 **13h30**

ANDREAS MANDELIS, University of Toronto

Diffusion-Wave Diagnostic Techniques in Industrial, Applied and Biomedical Physics: They go where no light has gone before

The introduction of photothermal phenomena in the 1970's has generated a wealth of diagnostic techniques which have grown into diverse fields spanning disciplines from fundamental physics, spectroscopy and analytical chemistry to food science, semiconductor properties, materials science and non-destructive evaluation, agricultural and environmental sciences and sensors. In this talk I will present a review of non-conventional ultrasensitive photothermal, photoacoustic and diffusion-wave techniques, instrumentation methodologies and technologies introduced at the CADIFT, precisely aimed at enhancing and optimizing the unique and considerable diagnostic non-destructive capabilities of these parabolic waves [1]. Highlights will be selected among: the thermal-wave resonant cavity sensor for environmental gas, fluid pollution monitoring and infrared emissivity measurements; photopyroelectric non-radiative spectroscopy of optical materials; the Common Mode Rejection Demodulation (CMRD) contrast amplification technique as a platform signal generation and processing methodology of optimal contrast dynamic range in deeply embedded signals; the thermal-wave harmonic oscillator and depth profilometric inverse problem with applications to industrial case-hardened steels; subsurface crack detection in automotive transmission gears; dental thermophotonics of sensitivity and specificity higher than dental x-rays; and biophotoacoustic tissue imaging of cancerous lesions ("the photoacoustic radar").

1. A. Mandelis, *"Diffusion Waves and their Uses", Physics Today,* **53**, Part I, August 2000, pp. 29-34.

14h00 **Session Ends / *Fin de la session***

[WE-P1] (DCMMP/*DPMCM*) Low dimensional systems / *Systèmes à basse dimension*

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

14h15 - 15h45

ROOM / *SALLE* MRR D102 (cap.134)

Chair: J.Dahn, Dalhousie University

WE-P1-1 14h15

BRANDON VAN ZYL, St. Francis Xavier University

Novel physics of low-dimensional, ultra-cold quantum gases

Ultra-cold trapped degenerate quantum gases are now readily created in many laboratories around the world. Experimentalists can now reliably control the geometry, dimensionality and even the interactions between the neutral atoms. As a result, cold atoms have become the ideal tool for studying interacting, quantum many-body systems in a variety of confinement geometries and spatial dimensions. In this talk, I will discuss the novel physics exhibited by low-dimensional (*i.e.*, 1D and 2D), trapped ultra-cold quantum gases, along with the interesting applications some of these systems may provide.

WE-P1-2 14h45

Enhancement of two-electron entanglement in quasi one-dimensional systems*, Victor Villalba, **Robert Mann**, Ewan Hill, *Department of Physics and Astronomy, University of Waterloo* — One-dimensional barriers such as quantum dots are promising systems for producing and manipulating fermion entanglement because their physical parameters can be fully controlled. Here we analyze the role of channel mixing in the entanglement created by the scattering of two electrons from a quasi one-dimensional barrier. We solve exactly the problem of scattering a pure two-electron state from a double delta-function potential when channel mixing is present. We find that the presence of channel mixing modifies the two-particle concurrence of the post-selected state, and allows the existence of entangled states when one delta-function potential.

* This work is being supported by NSERC

WE-P1-3 15h00

Magnetotransport in 2DEG ribbons in InAsP/InP and InGaAs/InP ridge structures fabricated by nanotemplate technology*, **Ghislain Granger**, S.A. Sudenikin, A.S. Sachrajda, A. Kam, P.J. Poole, G.C. Aers, R.L. Williams, *Institute for Microstructural Sciences, National Research Council of Canada* — In this work we explore magnetotransport properties of 2DEG ribbon-like wires made of $In_xGa_{1-x}As$ and $In_xAs_{1-x}P$ quantum wells inserted in ridge structures grown by chemical beam epitaxy on pre-patterned InP substrates [1]. The long term objective of this work is to develop a new material system for making quantum dot electronic circuits for quantum information applications. There are potential advantages to this material, in particular, large values of effective electron g*-factor and spin-orbit interaction that make it attractive for fast spin qubit devices. To optimize the growth and fabrication processes, we study the contact resistance, electron density, and mobility of the wires as a function of the wire width and growth parameters. The electron mobility reaches values of up to 100,000 cm^2/Vs i.e. comparable to planar InGaAs/InP 2DEG structures. We have also fabricated gated ridge structures with ~ 150 nm wide finger gates. Preliminary measurements show good gating and pinch-off characteristics. At temperatures down to 250 mK, the ridge structures reveal rich mesoscopic patterns which change in tilted magnetic field.

1. P.J. Poole *et al.*, *J. Crystal Growth* **310**, 1069-1074 (2008)

* This work is being supported by National Research Council of Canada

WE-P1-4 15h15

Subwavelength Imaging in Phononic Crystals*, **John Page** [1], Alexey Sukhovich [1], Bassam Merheb [2], K. Muralidharan [2], Pierre Deymier [2], Jerome Vasseur [3], Yves Pennec [3], [1] *University of Manitoba*, [2] University of Arizona, [3] Institut d'Electronique, de Micro-électronique et de Nanotechnologie, Villeneuve d'Ascq — Since focusing of acoustic waves by negative refraction in phononic crystals was first demonstrated several years ago [1], there has been increasing interest in the possibility that focusing with resolution better than the diffraction limit may be achievable. In this presentation, we show, both experimentally and theoretically, how super-resolution can be realized with a two-dimensional phononic crystal in which the equifrequency contours inside and outside the crystal are well matched. This phenomenon is related to the coupling between the incident evanescent waves and a bound slab mode of the phononic crystal lens, leading to amplification of evanescent waves by the slab mode. Super-resolution is only observed when the source is located very close to the lens, and is very sensitive to the location of the source parallel to the lens surface, as well as to site disorder in the phononic crystal lattice.

1. Suxia Yang, J.H. Page, Zhengyou Liu, M.L. Cowan, C.T. Chan and Ping Sheng, *Phys. Rev. Lett.* **93**, 024301 (2004).

* This work is being supported by NSERC

WE-P1-5 15h30

Second sound in a trapped strongly interacting Fermi gas, **Edward Taylor** [1], H. Hu [2], X.-J. Liu [2], L.P. Pitaevskii [1], A. Griffin [3], S. Stringari [1], [1] *BEC Center and University of Trento,* [2] Swinburne, [3] University of Toronto — Ultracold, trapped quantum gases have gained prominence in recent years as systems where fundamental theories of many-body physics can be tested in a clean environment with "tunable" parameters. One of the most exciting prospects is the possibility of observing second sound in a strongly interacting Fermi gas superfluid at unitarity, where the s-wave scattering length diverges. Never found (so far) outside quantum liquids, second sound is a pure temperature wave: a collective mode that has no analogue in classical, non-superfluid liquids. Naturally, this mode is quite different in trapped Fermi gases than in liquid Helium. In this talk, I discuss the nature of second sound in these gases and outline a scheme to excite and detect these modes.

15h45 Session Ends / *Fin de la session*

[WE-P2] Precision Frontier / *Frontière de la précision*

(PPD/*PPD*)

WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*

14h15 - 15h15

ROOM / *SALLE* MRR D002 (cap.135)

Chair: C. Hearty, University of British Columbia

WE-P2-1 14h15

JOSS IVES, University of the Fraser Valley

Final BNL E949 results on the measurement of the rare decay K+ to π+, ν, $\bar{\nu}$ [*]

Brookhaven National Lab experiment E949 was designed to measure the rare K meson decay K+ to π+, ν, $\bar{\nu}$, a flavor-changing neutral current process which is very sensitive to new physics contributions. In the Standard Model this decay proceeds via a second-order weak transition which is calculated with high precision resulting in a branching ratio prediction of (0.85 +/- 0.07) E(-10). Final analysis of the E949 data for the momentum region below the 2-body K+ → π+, π_0 peak has been completed. Details of this analysis and the results for the combined E787/E949 data will be presented. Other current and future rare K meson experiments will also be discussed.

* This work is being supported by NSERC, DOE

WE-P2-2 14h45

THOMAS MATTISON, University of British Columbia

A BaBar Retrospective [*]

The BaBar Experiment at the PEP-II Collider at SLAC was approved in 1993, and has recently completed data-taking. While analysis of the rich data set will continue for some years, this is an apt time to review the major scientific accomplishments of BaBar. It is also interesting to review some of the arguments made at the time for technical decisions about the collider, the detector, and the analysis software, and make some comparisons to our "friendly competition" from the Belle Experiment at KEK.

* This work is being supported by NSERC

15h15 Session Ends / *Fin de la session*

[WE-P3] Heavy Ion Collisions and Instrumentation / *Collisions d'ions lourds et instrumentation*

(DNP/*DPN*)

WEDNESDAY, JUNE 10 / *MERCREDI, 10 JUIN*

14h15 - 15h15

ROOM / *SALLE* MRR A202 (cap.133)

Chair: M.N. Butler, St. Mary's University

WE-P3-1 14h15 (G)

Étude d'un signal de transition de phase dans les noyaux[*], **Francis Gagnon-Moisan**, René Roy, Marie-France Rivet, Bernard Borderie, *Université Laval* — L'étude des réactions d'ions lourds est un domaine en pleine effervescence. Depuis plusieurs années, la recherche d'une preuve expérimentale d'une transition de phase dans les noyaux est l'un des principaux objectifs de ce domaine. Afin d'y parvenir, le multidétecteur 4π INDRA (situé au GANIL) est utilisé. Lors des réactions centrales, il y aura composition d'une source unique formée du projectile et de la cible. Un des modes de désexcitation possible pour un système (avec une énergie d'excitation $\varepsilon^* > 3$ A.MeV) est la multifragmentation. Ce processus s'apparente à une transition de phase. Différentes signatures expérimentales doivent exister si le système subit une telle transition. La décomposition spinodale, implique que le système sera divisé en fragments possédant une charge similaire. Il s'agit de la signature de transition de phase recherchée dans les analyses effectuées sur la 5ième campagne d'INDRA à l'IPN d'Orsay (France), dans le cadre d'une cotutelle de thèse entre l'Université Laval et l'Université Paris-Sud XI. L'étude spécifique des corrélations en charge dans les réactions $^{136}Xe+^{124}Sn$ et $^{124}Xe+^{112}Sn$ à 32 et 45 A.MeV devrait permettre de conclure définitivement sur la présence d'une décomposition spinodale, signe d'une transition de phase dans les noyaux. Les derniers résultats et analyses sont présentés.

* This work is being supported by CNRS

WE-P3-2 14h30 (G)

Mid-rapidity composition in the $^{36}Ar+^{58}Ni$ reaction detected by INDRA and further experiments with HERACLES, **Jérôme Gauthier**, René Roy, *Université Laval* — The existence of a third emission source between the target and the projectile in heavy ions reactions has been shown several years ago. Some recent studies seem to show that this zone has a N/Z ratio higher than the N/Z of the whole system. These results suggest a neutron enrichment of the mid-rapidity. The first campaign of the INDRA detector produced a very high amount of well identified and calibrated data. So, this allows us to make a good selection of the mid-rapidity in the reaction $^{36}Ar+^{58}Ni$ at 32, 40 and 52 A MeV. But INDRA is designed to study the most central collisions. Therefore, it is not the ideal instrument to study the peripheral collisions. Our own detector, HERACLES, which will receive the ISAC-II beams this summer, has been designed to detect this type of reaction and the presence of some neutron detectors around the chamber is useful to study N/Z ratios. The capacity of ISAC-II to deliver radioactive beams is another very useful feature allowing us to add the isospin variable to the experiment.

WE-P3-3 **14h45**

Search for Conical Emission in A+A collisions at RHIC*, **Claude Pruneau**, *Wayne State University* — The passage of high energy partons through a quark gluon plasma is predicted to lead to the formation of shock waves through this medium. Various calculations suggest these shock waves might be observable in the form of a Mach cone or conical emission of particles. This notion is particularly intriguing in the context of A+A collisions at RHIC because the opening angle of the cone potentially provides a measure of the sound velocity in the QGP. Conical particle emission has been invoked to explain the away side shape of two-particle correlations observed in heavy colliding systems at RHIC. Unfortunately, the observed two-particle correlations may also be attributed to other reaction mechanisms such as jet deflection, and radial flow. We thus sought to carry measurements enabling better constraints on the models and possibly enabling a unique identification of conical emission. I will present one such study in the form of three-particle correlations expressed in terms of particles relative azimuthal angles measured in the transverse plane. Using a 3-particle cumulant technique.

* This work is being supported by US Department of Energy

WE-P3-4 **15h00** **(G)**

Zero crossing analysis and its application in toroidal magnetic field mapping*, **Peiqing Wang** [1], Willie Falk [1], Larry Lee [2], Shelley Page [1], [1] *University of Manitoba*, [2] TRIUMF — The zero crossing points of a 3-d magnetic field are defined the locations where individual magnetic field components change sign. The full magnetic field of an iron-free toroidal magnetic spectrometer can be characterized by the zero crossing points in its fringe area, since these points are determined by the driven current distribution in the magnet. The current distribution can be described by means of the shape and location of individual current-carrying coils; thus, a precision determination of the locations of zero crossing points enables us to infer the locations of the coils, leading to a complete determination of the toroidal magnetic field. One advantage of this technique is that, rather than a full field measurement on a 3d grid, only very limited field points need to be measured, and hence the field mapping cost is greatly suppressed. In this talk, I shall introduce this zero crossing analysis technique and its recent application in field mapping of a toroidal magnetic spectrometer for the upcoming Qweak electron-proton parity violation experiment at Jefferson Laboratory (USA).

* This work is being supported by NSERC

15h15 **Session Ends / *Fin de la session***

[WE-P4] Quantum Information and Computing II / *Informatique et calculs quantiques II*

(DAMPhi-DOP *DPAMip-DOP*)

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***

14h15 - 15h30

ROOM / *SALLE* MRR A102 (cap.134)

Chair:C. Erven, Institute for Quantum Computing - University of Waterloo

WE-P4-1 **14h15**

SHOHINI GHOSE, Wilfrid Laurier University

Relationship between tripartite entanglement and genuine tripartite nonlocality in 3-qubit states

Multiqubit entanglement is a crucial ingredient for large-scale quantum information processing and has been the focus of several recent studies. Entanglement between qubits can lead to violations of Bell-type inequalities that are satisfied by local hidden variable models, indicating the nonlocal nature of the correlations between qubits. For 2-qubit pure states, bipartite entanglement is simply related to the Bell-CHSH nonlocality parameter. No such relation between multipartite entanglement and nonlocality has yet been obtained for systems of three or more qubits. We have derived relationships between genuine tripartite entanglement and nonlocality for families of 3-qubit pure states. Our results show that these relationships can be quite different from the 2-qubit case. Within the set of generalized GHZ states, we identify tripartite entangled states that do not violate the Svetlichny inequality that tests for genuine tripartite nonlocal correlations. On the other hand, we show that all members of a set of states called the maximal slice states violate the Svetlichny inequality and analogous to the 2-qubit case, the amount of violation increases with the amount of entanglement. The generalized GHZ states and the maximal slice states have unique tripartite entanglement and nonlocality properties in the set of all pure states.

WE-P4-2 **14h45**

Photon-echo based N-path interferometers for precision measurements and quantum communication*, **Cecilia La Mela**, Ahdiyeh Delfan, Erhan Saglamyurek, Wolfgang Tittel, *Institute for Quantum Information Science, University of Calgary* — The possibility to store and recall information encoded into quantum states of light is at the heart of many applications of quantum information processing, including a quantum repeater [1]. A recently proposed approach to such a quantum memory employs controlled reversible inhomogeneous broadening (CRIB) [2,3,4]. Beyond storage, a modified version of CRIB allows quantum state manipulations [5]. CRIB is currently still challenging, however, it is possible to study closely related atom light interaction via stimulated photon echoes [6]. Nonorthogonal state discrimination based on POVMs (positive operator valued measure) has become an interesting problem in quantum information processing from a fundamental [7] as well as applied [8] point of view. In this kind of measurement a set of nonorthogonal states is mapped onto a set of orthogonal ones by a non unitary transformation. We propose a novel, robust implementation of POVMs that combines quantum state storage with state rotations and is based on stimulated photon echoes. We will present simulations based on numerically solving Maxwell Bloch equations in an inhomogenously broadened medium, and discuss the experimental results.

1. H.J. Briegel, *Phys. Rev. Lett.* **81**, 5932(1998)
2. A.L. Alexander *et al*, *Phys. Rev.Lett.* **96**, 043602(2006)
3. B. Kraus *et al, Phys. Rev. A* **73**, 020302(2006)
4. M. Nilsson *et al, Opt. Comm.* **247**, 393 (2005)
5. M. Underwood *et al*, in preparation.
6. M.U. Staudt *et al*, *Phys. Rev. Lett.* **98**, 113601 (2007)

7. Y. Sun *et al, Phys. Rev A.***64**, 022311(2001)
8. V. Scarani *et al, Phys. Rev.Lett.***92**, 057901(2004)

* This work is being supported by NSERC/General Dynamics Canada/iCORE

WE-P4-3 **15h00** **(G)**

Spectral tailoring of inhomogeneously broadened absorption profiles using notch-filtered light*, **Erhan Saglamyurek** [1], Cecilia La Mela [1], Sergey A. Moiseev [2], Wolfgang Tittel [1], [1] *Institute for Quantum Information Science, University of Calgary*, [2] Kazan Physical-Technical Institute of the Russian Academy of Sciences, Russia — Manipulation of absorption spectra of inhomogeneously broadened media [1-3] has great importance for various spectroscopic investigations and quantum information processing applications [4]. In particular, the creation of narrow absorption lines on a non-absorbing background has attracted a lot of interest, as it allows the interaction of coherent light with selected subgroups of atomic and molecular centers. We propose a novel technique for the generation of such lines. This technique is based on optical pumping with incoherent, notch-filtered light that is provided from the back reflection of broad band light on a Fabry-Perot cavity. In this approach, all atoms in a large spectral interval, except some subgroups within narrow frequency ranges whose transition frequencies match the notch frequencies, are excited at the same time. Provided a suitable atomic shelving level exists, a sufficiently long interaction time results in a tailored absorption profile that consists of narrow absorption lines on a non-absorbing background. We will present the results of a theoretical analysis, and discuss possible experimental realizations of this technique with rare-earth-ion doped crystals at cryogenic temperatures.

1. M. Nilsson, L. Rippe, and S. Kröll, R. Clieber and D. Suter, *Phys. Rev. B* **70**, 214116 (2004)
2. G. J. Pryde, M. J. Sellars, and N. B. Manson, *Phys. Rev. Lett.* **84**, 1152 (2000).
3. F. de Seze, V. Lavielle, I. Lorgere, and J. L. Le Gouet, *Opt. Commun.* **223**, 321 (2003).
4. W. Tittel, M. Afzelius, R. L. Cone, T. Chanelière, S. Kröll, S. A. Moiseev, M. Sellars, arXiv:0810.0172 (2008)

* This work is being supported by AAET, CFI, General Dynamics, iCORE, NSERC

WE-P4-4 **15h15**

Speeding up Entanglement Degradation*, Victor Villalba, **Robert Mann**, *Department of Physics and Astronomy University of Waterloo* — Entanglement between two modes of a free scalar field can be determined via detection of each mode by different observers and then observing the correlations between their measurements. We show that the entanglement is degraded as a function of time when one observer begins in a state of inertial motion but ends in a state of uniform acceleration while the other remains inertial. We show that the entanglement degradation decreases as the acceleration of the non inertial observer increases. At late times we recover previously established results for observers in relative uniform acceleration.

* This work is being supported by NSERC

15h30 **Session Ends / *Fin de la session***

[WE-P5] (DNP/*DPN*) Preparing for the next long-range plan for subatomic physics / *Se préparer pour le prochain plan à long terme pour la physique subatomique*

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***
14h15 - 15h30

ROOM / *SALLE* MRR D202 (cap.135) *Chair: K.S. Sharma, University of Manitoba*

The next 12 months may see the launch of a new long-range planning process for subatomic physics. Even if that is not the case, it is opportune for the nuclear physics community to review its progress since the last long-range plan and to begin thinking about priorities for the coming 5-10 years. This session will review the status in the field and feature short presentations on new directions under consideration by the community.

15h30 **Session Ends / *Fin de la session***

[WE-Counc] (CAP/*ACP*) CAP Council Meeting (New and Old) / *Réunion du conseil (nouveau et ancien) de l'ACP*

WEDNESDAY, JUNE 10 / ***MERCREDI, 10 JUIN***
16h00 - 17h30

ROOM / *SALLE* A232 JdeV (cap.40) *Chair: R.B. Mann, University of Waterloo*

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

17h30 ***Meeting* Ends / *Fin de la réunion***

2009 CONGRESS POSTER SESSION ABSTRACTS
RÉSUMÉS DE LA SESSION D'AFFICHES – CONGRÈS 2009

The poster session abstracts presented here will be on display in this order in the Corridtors of the Pavillon Rémi-Rossignol, from 19h30 -22h00 on Sunday, June 7th. *Les résumés présentés en affiches publiés ci-après seront en montre de 19h30 à 22h00, le dimanche 7 juin dans les corridors du pavillon Rémi-Rossignol.*

Sunday, June 7 - Dimanche, 7 Juin 19h30 – 22h00

(DAMPhi/ DPAMip) **Atomic and Molecular Physics**
Physique atomique et moléculaire

SU-POS-1

Hyperfine-induced n $^3D_1$ - 2 $^1P_1$ Intercombination Transitions in ^3He*, **Gordon Drake**, Qixue Wu, *University of Windsor* — In heliumlike ions with nuclear spin, the one-photon electric dipole transition 2 ^3P_J - 1 $^1S_0$ is allowed since hyperfine interaction causes mixing between two hyperfine states with different J but the same F (due in part to fine-structure interactions for J = 1). Since the pioneering works of Garstang and Mohr, the hyperfine-induced intercombination transition has been a subject of experimental and theoretical interest. However, previous works treated only the more highly charged He-like ions since the singlet-triplet mixing caused by hyperfine interaction is so small for low-Z ions that the induced intercombination line 2 ^3P_J - $^1S_0$ is difficult to observe. In contrast, we have found theoretically that for ^{3}He, the hyperfine-induced intercombination transitions n $^3D_1$ (F = 3/2) - 2 $^1P_1$ (F = 1/2) with higher n have comparable intensities to normal E1 transitions between two hyperfine states. The calculated results show that hyperfine-induced intercombination transitions contribute 46% percent for n = 10, and 35% for n = 9 of all E1 transitions n $^3D_1$ (F = 3/2) - 2 ^1P_J (F). Similar results of this induced transition have been obtained as well for several other states. High precision variational calculations in Hylleraas coordinates of the line strength will be presented.

* This work is being supported by NSERC

SU-POS-2

High resolution laser spectroscopy of iridium monochloride, A.G. Adam, S.J. Foran, **A. Granger**, *University of New Brunswick* — High resolution laser spectra of iridium monochloride have been acquired in the visible region of the spectrum. The molecules were produced by laser ablation of an iridium target rod followed by reaction with $CHCl_3$ in a pulsed supersonic jet. A strong electronic transition with an upper state vibrational progression has been observed in the 530 – 575 nm region although other weaker transitions have also been seen in the red. The bands are degraded to longer wavelengths and at high resolution exhibit two strong R-heads due to the $^{193}Ir^{35}Cl$ and $^{191}Ir^{35}Cl$ isotopologues. At low resolution, the heads of the much weaker $^{193}Ir^{37}Cl$ and $^{191}Ir^{37}Cl$ isotopologues are also observed. Dispersed fluorescence from the bands gives the ground state vibrational constants, ω_e=413.2 cm^{-1}, and $\omega_e x_e$= 1.0 cm^{-1}. Rotational analysis has allowed the characterization of the electronic transition as $^3\Phi_4$ - $X^3\Phi_4$. Molecular constants for the ground and excited states will be presented

SU-POS-3 (G*)

High resolution laser spectroscopy of iridium monofluoride*, **Aaron Granger** [1], Allan Adam [1], Laura Downie [1], Dennis Tokaryk [2], Colan Linton [2], [1] *Department of Chemistry, University of New Brunswick*, [2] Department of Physics, University of New Brunswick — High resolution rotationally resolved spectra of iridium monofluoride, IrF were obtained by laser induced fluorescence spectroscopy in the visible region. Two electronic transitions have been observed and assigned as $A^3\Phi_i$–$X^3\Phi_i$ and $B^3\Phi_i$–$X^3\Phi_i$ based on the rotational analysis. Only the lowest, Ω = 4 spin-orbit components have been observed for the X (ground) and B states, while the Ω = 4 and 3 components of the A state were observed. A global fit to eleven bands observed at high resolution (six bands from A-X and five from B-X) provided a complete set of molecular constants for all three states in both the ^{193}IrF and ^{191}IrF isotopologues. The v = 3 level of the $A^3\Phi_i$ state was found to be perturbed and extra branches belonging to the perturbing state were observed for both isotopologues. A deperturbation analysis indicated that the perturber is an Ω = 5 state and yielded molecular parameters for this state.

* This work is being supported by NSERC, UNB

SU-POS-4 (G*)

Laser spectroscopy of Iridium Monosulfide*, **Damien Forthomme** [1], Colan Linton [1], Allan Adam [1], Dennis Tokaryk [1], Laura Downie [2], Aaron Granger [2], [1] *University of New Brunswick*, [2] University of Ottawa — High resolution laser spectra of Iridium Monosulphide, IrS, have been acquired in the visible region of the spectrum. The molecules were produced by laser ablation of an iridium target rod followed by reaction with CS2 seeded in He in a pulsed supersonic jet. To date, four bands have been partially analyzed, at 434, 441, 477 and 479nm. Dispersed fluorescence from the bands give a ground state vibrational interval of approximately 486cm-1. The data and analysis will be presented

* This work is being supported by NSERC - University of New Brunswick

(DASP/ DPAE) Atmospheric and Space Physics / *Physique atmosphérique et de l'espace*

SU-POS-5 (G*)

The E-Region Wind Interferometer (ERWIN-2) at Eureka*, **Samuel Kristoffersen** [1], Stephen Brown [2], William Ward [1], [1] *University of New Brunswick*, [2] York University — A field-widened Michelson interferometer (ERWIN-2) has been operating at Eureka, Nunavut at the Polar Environment Atmospheric Research Laboratory (PEARL) for over a year. This instrument provides measurements of winds and airglow in the meospause region at three different heights. Radial winds in the four cardinal directions and in the vertical are measured using Doppler shifts in isolated airglow emission lines (hydroxyl, oxygen green line and O2). The measurement cycles takes place on a three minute cadence making this instrument the highest temporal resolution wind instrument in the world for this region of the atmosphere. In this paper the instrument is described, the data analysis procedure discussed and initial results presented.

* This work is being supported by CFCAS, NSERC

SU-POS-6 (G)

Michelson Interferometer for Airglow Dynamics Imaging (MIADI): Instrument Development and Science, **Jeffery Langille** [1], Alan Scott [2], Ian Miller [3], William Ward [1], [1] *University of New Brunswick*, [2] COM DEV Ltd, [3] Light Machinery — The MIADI instrument (a field widened Michelson interferometer) is being developed at the University of New Brunswick to image wind and airglow in the mesopause region. These observations allow atmospheric gravity waves to be unambiguously analysed. Part of the instrument development includes the calibration, characterization and implementation of the mirror scanning system. This system involves a new low voltage capacitive feedback system developed by COM DEV ltd. Although the physical system was provided, substantial work is required to make the instrument functional. This includes the setting up of the mirror parallelism and associated system parameters, the determination and calibration of the stepping process and the testing and validation of the systems. In this paper, this calibration and characterization process is summarized and the instrument operation outlined and initial results presented.

(DCMMP/ DPMCM) Condensed Matter and Materials Physics / *Physique de la matière condensée et matériaux*

SU-POS-7

Effect of Hydrodynamics on the Dynamics of a Polymer in a Brownian Motor*, **James Polson** [1], Brian Bylhouwer [1], Martin J. Zuckermann [2], [1] *University of Prince Edward Island*, [2] Simon Fraser University — Brownian motors are non-equilibrium systems in which thermal fluctuations of colloidal particles are rectified by breaking the spatial or temporal symmetry of the system to achieve directed transport. One means to achieve such symmetry breaking is to use a "flashing ratchet", which is an asymmetric, spatially periodic potential that is toggled on and off at regular intervals. In this study, we have used computer simulation methods to investigate the dynamics of a bead-spring model polymer subject to a flashing ratchet potential. We have employed Brownian dynamics simulations with fluctuating hydrodynamic interactions to study the drift velocity, motor efficiency and coherency of the system, as well as the internal modes of oscillation of the polymer. The effects of solvent hydrodynamics are investigated by comparing these results with data obtained from Langevin simulations on the same model polymer. We find that hydrodynamic interactions have a pronounced effect on all of the dynamical properties of the polymer. The qualitative trends can be explained using simple theoretical arguments.

*This work is supported by NSERC

SU-POS-8

Growth of Se Nanoparticles in the Presence of BSA*, **Gurinder Ahluwalia** [1], Mohammad Iqbal, Mandeep Bakshi [2], [1] *College of the North Atlantic*, [2] Acadia University — We present a systematic study of structure controlled growth of selenium nanoparticles in the presence of the carrier protein Bovine Serum Albumin (BSA). BSA has been found to be a shape directing agent for the synthesis of crystalline Se nanobars (NBs) and amorphous nanospheres in aqueous phase at relatively low temperature of 85°C. Sodium selenite (Na_2SeO_3) has been used as the Se source to achieve nanoselenium following reduction by hydrazine. Well defined multifacet NBs and amorphous spheres were obtained for different Na_2SeO_3: BSA ratios. Both morphologies have been fully characterized by Field Emission Scanning Electron Microscopy (FESEM), High Resolution Transmission Electron Microscopy (HRTEM), Energy Dispersive X-ray (EDX), X-ray Diffraction (XRD) and X-ray photoelectron spectroscopy (XPS) analysis. Results have shown that the shape directing ability of denatured BSA helped to achieve the formation of crystalline NBs, while its soft template effect directed the nanosphere formation.

* This work is being supported by IRIF, NL, OAR, college of The North Atlantic,

SU-POS-9

Ionic and electronic conductivity measurements on layered nanocomposite materials*, **Douglas Dahn** [1], Kenneth MacLean [1], Stephen Scully [2], Rabin Bissessur [2], [1] *Physics, University of Prince Edward Island*, [2] Chemistry, University of Prince Edward Island — We have begun a series of measurements of the ionic and electronic conductivities of nanocomposite materials formed by intercalating polymers into layered structures such as graphite, FeOCl, MoS_2, etc. Ionic conductivity is measured using impedance spectroscopy. DC electrical conductivity measurements can also be made. Using a closed-cycle helium refrigerator, the sample temperature can be controlled between 30 and 320K. This poster will describe the experimental system, and give results on a composite

formed by complexing the highly ionically conducting polymer poly[bis(methoxyethoxyethoxy)phosphazene] (MEEP) with lithium triflate and intercalating it between the layers of graphite oxide (GO).

* This work is being supported by UPEI (Dahn) and NSERC (Bissessur)

SU-POS-10 (U*)

Polymer translocation through a nanopore*, **Mostafa Fatehi Hassanabad**, James Polson, *University of Prince Edward Island* — Recent experimental advances demonstrate that DNA sequencing may be possible using a technique called Nanopore Sequencing. Here, a DNA fragment is threaded through a small nanopore by a process called nanopore translocation. As the DNA passes through the base pair sequence is determined in real time. Conventional techniques are very expensive and time consuming; and thus there is great interest in finding quicker, cheaper and more reliable technologies. Because of the potential advantages of Nanopore Sequencing, many theoretical studies of the physical properties of polymer translocation have been conducted in the past decade. These studies will form the foundation of future experimental advances in the technique. Our study aims to better understand the generic physical properties of the nanopore/polymer system using a Monte Carlo computer simulation. We have focused on determining the free-energy barrier for polymer translocation through a nanopore. We have systematically varied parameters such as polymer length and nanopore geometry to study the effects of such variations on the free energy barrier. Furthermore, we have compared our results with existing predictions and found good qualitative agreement.

* This work is being supported by NSERC

SU-POS-11

Carbopol - model yield-stress fluid*, **Barbara Frisken** [1], Iris Gutowski [1], David Lee [1], John de Bruyn [2], [1]*Simon Fraser University*, [2] University of Western Ontario — Carbopol, a family of cross-linked acrylic acid-based polymers, is a well-known thickener used in personal care products such as shampoo and toothpaste. Relatively low concentration aqueous dispersions also exhibit the properties of a yield-stress fluid; at low stress, Carbopol dispersions behave as an elastic solid but they will flow when the applied stress exceeds a sample-dependent yield value. Carbopol is often used as a model yield-stress fluid because it is transparent and its rheological properties can be precisely tuned by sample preparation conditions. Other practical examples of yield-stress fluids include mayonnaise and fresh concrete. Both the phenomena involved and the range of potential applications recommend study of the microscopic structure and properties of yield stress fluids as this will lead to a fundamental understanding of this behaviour. We have studied Carbopol 2050 dispersed in water at concentrations ranging from 0.1 to 5 wt% and a large pH range. This poster will highlight recent results from rheological studies and discuss them in the context of our light scattering studies.

* This work is being supported by NSERC

SU-POS-12 (G*)

Soft Optical Mode in the Ferroelastic $Rb_4LiH_3(SO_4)_4$, **Oktay Aktas**, Maynard J. Clouter, Guy Quirion, *Memorial University of Newfoundland* — Raman scattering measurements were performed on the ferroelastic compound $Rb_4LiH_3(SO_4)_4$ to determine whether the phase transition at $T_c = 132$ K is proper or pseudoproper ferroelastic. A double grating spectrometer was used to measure the frequency of the Raman active B mode at 31 cm^{-1} in $Rb_4LiH_3(SO_4)_4$ in the temperature range from 60 K up to 285 K. Our Raman measurements reveal that the square of the frequency of the optical B mode shows two linear temperature dependencies corresponding to temperatures above and below T_c. This behavior has been analyzed using a pseudoproper ferroelastic Landau Model which accounts well for the temperature dependence of a soft optical mode. Our Raman investigation clearly indicates that the nature of the phase transition in $Rb_4LiH_3(SO_4)_4$ is pseudoproper ferroelastic.

SU-POS-13 (G*)

Monte Carlo simulation of an Ising model for magnetic recording media*, **Martin LeBlanc**, Martin Plumer, John Whitehead, *Memorial University of Newfoundland* — Modern perpendicular recording media is composed of strongly anisotropic Co-based grains on the nanometer scale which are weakly coupled by inter-grain exchange interactions. Grains themselves are composed of thousands of atoms which are strongly exchange coupled. The effect of thermal fluctuations on these two coupling effects is important for the understanding of superparamagnetism, where smaller grain magnetic moments spontaneously flip direction leading to a degradation or loss of stored information. We report here the results of computer simulations using the standard Metropolis Monte Carlo technique on a model constructed from a 2D square lattice with square arrays of Ng grains composed of groups of Na Ising spins. Intra-grain spins are modeled to experience a strong exchange interaction J. A weaker inter-grain exchange J' is used to couple spins across grain boundaries. Results are presented on how internal degrees of freedom can impact various thermodynamic quantities dependent on the relative interaction strengths and grain size.

* This work is being supported by NSERC

(DIMP/DPIM) Instrumentation and Measurement Physics / *Physique d'instrumentation et mesures*

SU-POS-14

Precision Spectroscopy with Ultracold Atoms*, **William Van Wijngaarden**, Brad Schultz, George Noble, *York University* — Laser cooled atoms are ideal for precision spectroscopy as the Doppler shift is negligible. This experiment observed the transmission of a probe laser through an ultracold cloud of Rb atoms to determine the natural linewidth of the D2 transition. The full width half maximum linewidth extrapolated to zero optical depth and zero laser intensity was 6.062 ± 0.017 MHz. This corresponds to a $5P_{3/2}$ lifetime of 26.25 ± 0.07 nsec which agrees with the most accurate results found by measuring the temporal decay of fluorescence or photoassociation spectroscopy but is slightly below that calculated using many body theory.

* This work is being supported by NSERC

SU-POS-15

Optical method for thermal conductivity measurement in thin films, carbon nanotubes, and liquid droplets*, **Jean-Phillipes Bourgoin** [1], Alain Haché [1], Benoit Cardin St-Antoine [2], David Ménard [2], Richard Martel [2], [1] *Université de Moncton*, [2] École Polytechnique, Montréal — Thermal conductivity measurements in thin films and other small samples are notoriously difficult to achieve. Yet, thermal flow around small components is an important problem in many technologies. Here we present a technique based on thermal lensing self-effects in a laser beam which shows promises in that area. Tightly focussed laser beams are used to heat and probe the evolution of temperature in small volumes. Demonstration is made in metal thin films (gold, silver and aluminum), carbon nanotubes thin films, and liquid droplets. A gradual transition from film to bulk properties is observed as the film thickness is increased.

* This work is being supported by NSERC and CRC

SU-POS-16 (G*)

Fresh Approach to bobsleigh runner design*, **Louis Poirier** [1], Edward Lozowski [2], Sean Maw [3], Darren Stefanyshyn [1], Robert Thompson [1], [1] *University of Calgary*, [2] Universty of Alberta, [3] Mount Royal College — Our group is developing a numerical model to compute the coefficient of friction of a blade sliding on ice. We will use this model to optimize the profile of a bobsleigh runner in order to reduce friction and improve performance. The appropriateness of the model has been improved by an analysis of existing runners as well as artificial and natural ice surfaces. We will also discuss the steps taken to design a set of runners with the Foothills Bobsleigh Club that will be tested on the 2010 Olympic track in Whistler this year. Testing the designed runners in a controlled environment will be used to validate our numerical model.

* This work is being supported by NSERC, Foothills Bosleigh Club and the Calgary Olympic Oval

SU-POS-17 (G*)

Use of inverse-theory algorithms to extract orientation-dependent relaxation rates from partially-relaxed NMR spectra, **M. Sedigh Ghamari**, Edward Sternin, *Physics department, Brock University* — Second-rank tensor interactions, such as quadrupolar interactions between the spin-1 deuterium nuclei and the electric field gradients created by chemical bonds, are affected by rapid random molecular motions that modulate the orientation of the molecule with respect to the external magnetic field. In biological and model membrane systems, where a distribution of dynamically averaged anisotropies is present and where, in addition, various parts of the sample may undergo a partial magnetic alignment, the numerical analysis of the resulting NMR spectra is a mathematically ill-posed problem. However, numerical methods (dePakeing, Tikhonov regularization) exist that allow for a simultaneous determination of both the anisotropy and orientational distributions. An additional complication arises when relaxation is taken into account. This work presents a method of obtaining the orientation dependence of the relaxation rates that can be used for the analysis of the molecular motions on a broad range of time scales. An arbitrary set of exponential decay rates is approximated by a three-term truncated Legendre polynomial expansion in the orientation dependence, as appropriate for a second-rank tensor interaction, and a linear approximation to the individual decay rates is made. Thus a severe numerical instability caused by the presence of noise in the experimental data is avoided. At the same time, enough flexibility in the inversion algorithm is retained to achieve a meaningful mapping from raw experimental data to a set of intermediate, model-free parameters suitable for further analysis in terms of specific kinds of molecular motions such as vibrations, flexing, kink and jog deformations etc. .

SU-POS-18 (G)

One-dimensional profiling of samples with a Unilateral Magnetic Resonance system*, **Bushy Keakabetse**, Igor Mastikhin, *University of New Brunswick* — Unilateral Magnetic Resonance instruments have gained much interest in recent years in material science due to their portability and ability to measure samples inaccessible by conventional MRI systems. However, the static magnetic field generated by instruments' magnet arrays is very inhomogenous, resulting in a limited, irregular sensitive volume. We have developed a methodology of designing unilateral MR systems with well-defined magnetic field configurations. This paper studies one-dimensional profiling of samples with a unilateral MR system with built-in linear magnetic field gradient. The sensitive volume lies half a centimetre above the magnet array and has a cylindrical shape of 8 mm diameter. We investigate optimum selective and hard RF pulses that will give us a well-defined profile. 1-D profiles of several phantom samples are reported. Because of the different T_2 relaxation times, the various layers can be easily differentiated with a spatially-resolved CMPG pulse train sequence.

* This work is being supported by UNB MRI Centre

(DMBP/DPMB) Medical and Biological Physics / *Physique médicale et biologique*

SU-POS-19

Time to revisit lipid areas, **Norbert Kucerka** [1], Jana Gallova [2], Daniela Uhrikova [2], Pavol Balgavy [2], John Katsaras [1], [1] *National Research Council of Canada*, [2] Comenius University, Slovakia — Despite their importance, published lipid areas have been relatively scarce, and for the most part, inconsistent. Noteworthy are the discrepancies between lipid areas as determined by x-ray and neutron scattering - arguably two of the most widely used experimental techniques in structural biology. On the other hand, these inconsistencies have also been highlighted by the disparate results arising from MD simulations using different force fields. For example, MD simulations based on CHARMM potentials are performed at non-zero surface tension in order to agree with x-ray scattering data, while GROMOS potentials do not seem to require this additional "tweaking". Since the MD force fields are considered to be "well tuned" if they are able to reproduce experimental data, there is clearly much work that needs to be done in order to reconcile simulations and experiment. We have studied the structural properties of lipid bilayers made up of monounsaturated phosphatidylcholines (*i.e.* diCn:1PC, where n=14, 16, 18, 20, 22 and 24). High-resolution x-ray scattering data were analyzed in conjunction with contrast varied neutron scattering data, using the recently developed technique by Kučerka *et al.* [*Biophys. J.* **95**, 2356 (2008)]. Analyses of the data show that with increasing n lipid bilayers do not thicken in a linear fashion, as is often assumed, but quadratically, and that lipid area assumes a maximum value for n~18 bilayers. More importantly, compared to previous data our results strongly suggest that lipid areas are smaller by about 10%. This observation highlights the need to revisit lipid areas as they are extensively used in molecular dynamics simulations and for calibrating their force fields.

SU-POS-20 **(G*)**

Effect of pressure on chain order and orientation in DMPC/DHPC bicelles*, **Md. Nasir Uddin**, Michael R. Morrow, *Memorial University of Newfoundland* — Dispersions of long and short chain lipid mixtures can form bicelles with bilayer disk regions enriched in the longer chain saturated lipid and disordered edges enriched in the shorter chain lipid. ^{2}H-NMR observations of DMPC/DHPC mixtures, with one or the other lipid deuterated, have previously been used to examine bicelle phase behaviour and magnetic orientation at ambient pressure [1]. In this work, ^{2}H NMR has been used to study the effect of pressure on chain orientational order and bicelle orientation in DMPC/DHPC (3:1) mixtures with one or the other lipid chain-perdeuterated. Application of hydrostatic pressure raises the micelle to oriented bicelle transition temperature by about 0.22K/MPa, a rate that is nearly same as for the DMPC gel to liquid crystal transition. As temperature is increased at fixed pressure, observed spectra indicate the DMPC/DHPC mixture transforms from a micellar to a bicelle phase and then from a bicelle phase to a mixed micelle/bilayer phase in general agreement with the scheme reported previously [1]. The temperature range over which bicelles remain oriented is found to decrease with increasing pressure. The pressure dependence of the micelle to oriented bicelle transition observed in this work is consistent with earlier high pressure observations of D_2O interacting with DMPC/DHPC mixtures containing a bicelle stabilizing agent (CTAB) [2].

1. E. Sternin, D. Nizza and K. Gawrisch, *Langmuir* **17**, 2610 (2001)
2. E. Brunner, M. R. Arnold, W. Kremer and H. R. Kalbitzer, *Journal of Biomolecular NMR* **21**, 173 (2001)

* This work is being supported by NSERC

SU-POS-21 **(G*)**

A dynamic light scattering study of hydroxyapatite crystal growth in the presence of osteopontin*, **Ron Dauphinee**, John R. de Bruyn, Graeme K. Hunter, Harvey A. Goldberg, *The University of Western Ontario* — Hydroxyapatite (HA), $Ca_{10}(PO_4)_6(OH)_2$, is an important compound from a biomineralization perspective as it is the major mineral component of all calcified tissue within the body. HA is also present in kidney stones and arterial plaque calcification. We are interested in understanding the mechanism of action of the protein osteopontin (OPN), a known inhibitor of HA formation. Using dynamic light scattering (DLS) we are able to monitor the precipitation of mineral (shown to be HA from other studies) from calcium phosphate solutions in real time. From the photon count rate and the measured hydrodynamic radius obtained from the DLS measurements, the effects of increasing concentrations of bone-derived OPN are monitored. Preliminary results indicate that concentrations as low as 0.1 μg/ml OPN reduce the number of particles in solution, but not their rate of precipitation. With increasing concentrations of OPN there is an increase in lag time (time of initial precipitation), and a decrease in both rate of growth and number of particles. At 0.4 μg/ml OPN, precipitation of calcium phosphate was not observed during the 4.5 hour incubation. These studies suggest that OPN affects mineral formation at both nucleation and growth stages. Furthermore these results demonstrate the utility of DLS to assess the effects of proteins and peptides on mineral formation in real time.

* This work is being supported by CIHR

SU-POS-22

A 2H-NMR Study of POPC-Sterol Bilayers: Some Exciting Anomalies, **Martin J. Zuckermann**, Mehran Shaghaghi, Jenifer Thewalt, *Simon Fraser University* — In a recent article, Y-W Hsueh *et al* showed that the 2H-NMR order parameter, M_1, of POPC-ergosterol multi-bilayers at 25C first saturated as a function of ergosterol concentration for 25 mol% ergosterol and then Y-W Hsueh has just shown that the value of M_1 decreased slightly at 50 mol% cholesterol. By contrast, M_1 for POPC-cholesterol bilayers increases linearly over this concentration range. Now the difference structural difference between cholesterol and ergosterol is that that ergosterol has an additional double bond in its fused ring (C7-C8) and a trans double bond (C22-C23) plus a methyl group at C24 in its ethyl chain. The question then arises as to which of these structural changes is responsible for the saturation of the order parameter in POPC-ergosterol bilayers. In the recent article, it was shown that M_1 for POPC-7-dehydrocholesterol (7-DHC) bilayers has the same behavior at 25C as POPC-cholesterol. Note that 7-DHC has an egosterol fused ring structure but a cholesterol acyl tail. Now brassicasterol, a phytosterol, has the same fused ring structure as cholesterol with the acyl tail of egosterol and we have shown that POPC-brassicasterol bilayers [1] exhibit the same saturation behavior in M_1 at 25C as POPC-ergosterol bilayers but at a lower value of M_1. We will present our recent data for POPC-camposterol bilayers which allows us to evaluate the role of the trans double bond in the saturation effect. Other POPC-sterols are also being investigated in this context.

1. We are most grateful to Till Boecking for suggesting brassicasterol.

(DOP) Optics and Photonics
Optique et photonique

SU-POS-23

Spatial and Temporal Wave Front Variation in a Pulsed Laser, **Scott Teare**, Ted Schuler-Sandy, Karl Neiman, Vanessa Salas, Berle Wooton, *New Mexico Tech* — Aberration correction of consecutive laser pulse wave fronts using adaptive optics techniques requires consistency between the characteristics of laser pulses. The performance and low cost of constructing Shack-Hartmann wave front sensors has made it practical to use them in support of numerous monitoring applications including laser wave front profiling. In this paper we demonstrate the conversion of a USB CMOS camera into a wave front sensor and its application to monitoring a short pulse fiber optic laser. The changes in the wave front over normal operating time periods is shown along with the analysis techniques used to generate the data profiles.

SU-POS-24

Photochromic photonic band gap materials*, **Jason Riordon**, Alain Haché, Tahar Ben Messaoud, Alexandre Melanson, Pandurang Ashrit, *Université de Moncton* — Transition metal oxides such as MoO_3 demonstrate intense photochromic (PC) coloration under UV irradiation. MoO_3 has been incorporated to numerous photochromic devices, including smart windows and high-density optical memory. In this paper we show that UV-sensitive photonic band gap materials are made

possible using MoO_3 as one of the constituent material. Our study includes MoO_3/SiO_2 and WO_3/SiO_2 multilayers as well as 3D MoO_3 inverse opals. Because the properties of periodic structures critically depend on the properties of the constituent materials – and especially absorption – photochromism strongly influence the photonic bands. Furthermore, in the case of multilayers, we found that presence of interface with a dielectric constitutes an enhancing factor in itself. This finding is supported by earlier studies showing that the addition of a single metallic (Au or Pt) or semiconductor (CdS) layer increases photoactivity.

* This work is being supported by NSERC and CRC

SU-POS-25

Enhanced Photochromism in Obliquely-Deposited Molybdenum Trioxide Films*, **Gisia Beydaghyan**, Serge Doiron, Jason Riordon, Alain Haché, P.V. Ashrit, *Université de Moncton* — We present evidence of enhancement of photochromism in nanostructured thin films of molybdenum trioxide fabricated by glancing angle deposition (GLAD). The most efficacious enhancement is observed in films fabricated with a substrate tilt of 60 degrees. The strong correlation of coloration response with the internal surface area of the films provides further evidence of the importance of nanostructuring on the photochromic effect and the vital role played by the internal water content in the photochromic mechanism.

* This work is being supported by AIF-FIA

SU-POS-26 (G)

Intensification of parametric fluorescence in high finesse cavities as a consequence of vacuum field manipulation*, **Cory Walker**, Serge Gauvin, *Université de Moncton* — It as long been established that the vacuum field fluctuations play a very important role in quantum physics. In quantum optics, the parametric fluorescence (PF) is one of the best example know. PF has been studied for a long period of time and is shown to be a non linear optical process resulting in the breaking of a single photon into a pair of photons. Here, we are explicitly interested in the manipulation of the vacuum field fluctuations in the form of electromagnetic field and the use PF as a revealing probe. A better understanding of the manipulation of vacuum field fluctuations could eventually lead to the design of new optical devices. Our study is based on a generalization of the theory of PF while it occurs in a high finesse cavity and when the electromagnetic field outside the cavity is taken into account. This allows us to identify the specific role of the external field in confined environment and gives an approach in the manipulation of the vacuum field fluctuations. Our results reveal that the commutation relation for the creation and annihilation of photons of the internal field is profoundly modified. Indeed, the canonical commutation must be replaced by a generalized commutation relation, which is no longer a constant, but a modulation function depending on frequency of the radiation field. Such a result leads us to predict that an intense amplification of the PF at some specific wavelength is possible inside a high finesse cavity. This intensification could be used as a probe to reveal the manipulation of the vacuum field fluctuations.

* This work is being supported by CRSNG, Fondation de l'innovation du Nouveau-Brunswick, Faculté des études supérieures et de la recherche de l'Université de Moncton

SU-POS-27 (G*)

Modification of Single Crystal Diamond by Femtosecond Laser Pulses*, **Nicholas Mailman**, Eugene Hsu, Harold Haugen, Gianluigi Botton, *McMaster University* — Femtosecond laser pulse irradiation of solids at high peak intensities (yet modest pulse energies) provides an excellent means of micro-modifying a wide range of materials including wide bandgap dielectrics. Femtosecond pulse irradiation of the surfaces of many semiconductors and dielectrics has produced periodic structures (or ripples) with periods much less than those predicted by the theory for laser induced periodic surface structures [1]. The underlying mechanism for their formation is still a topic of investigation. Recent work has also revealed nanoplanes that form inside dielectrics, such as fused silica and sapphire, when femtosecond pulses are focused inside the bulk [2]. I will provide an overview on results from single crystal CVD grown diamond irradiated with femtosecond laser pulses. The effects of both surface and bulk irradiation have been investigated. A focused ion beam (FIB) instrument was used to investigate subsurface modification by preparing samples for study in a transmission electron microscope to determine changes in the local crystal structure. Changes in surface topology have also been studied using different forms of microscopy. By studying the evolution of these structures under different irradiation conditions, we will provide insight into the underlying physics for their formation.

1. E. M. Hsu *et al.*, *Appl. Phys. Lett.*, **92**, 221112-3 (2008)
2. V. Bhardwaj *et al.*, *Appl. Phys. Lett.*, **96**, 057404-4 (2006).

* This work is being supported by NSERC

SU-POS-28 (G*)

Selected Applications of Ultrafast Terahertz Spectroscopy*, **Clare Armstrong**, Eugene Hsu, Henry Tiedje, Harold Haugen, *McMaster University* — Terahertz radiation (300GHz-30THz, 1mm-10μm) lies between microwave and infra-red radiation in the electromagnetic spectrum. Until recently this region of the spectrum had not been fully exploited due to limitations in the generation and detection of this frequency range. Broadband terahertz radiation is a useful tool for time domain spectroscopy as well as imaging, and can be generated using femtosecond lasers and nonlinear optical processes. Our system employs a mode-locked Ti:Sapphire laser producing ~50fs, 800nm pulses which undergo optical rectification, in a ZnTe crystal, to generate THz pulses with durations on the order of ps and in the frequency range of 0.5-3THz. Here we provide an introduction to the THz generation and detection processes, and discuss the unique advantages of the different experimental setup geometries available in our laboratory: transmission, reflection and attenuated total reflection (ATR) [1]. Reflection and ATR geometries provide a more effective method of examining absorbing and scattering samples under certain circumstances. Preliminary ATR data examining solvents (water, ethanol, and methanol) and sucrose solutions will be presented. In addition to spectroscopic information, carrier lifetime can be determined by optically pumping the sample, while the THz pulse acts as a probe to monitor the carrier relaxation. We will also discuss our future plans of coupling this pump-probe technique with the imaging process, creating a dynamic aperture with which one can achieve sub-wavelength resolution images [2].

1.H. Hirori, K. Yamashita, *et al.*, *Jpn J. Appl. Phys.*, **43,** 1287 (2004)
2.Q. Chen., Z. Jiang, *et al.*, *Optics Letters*, **25**, 1122 (2000).

* This work is being supported by NSERC

SU-POS-29 **(U*)**

Characterization of Bragg mirrors created with a single material (MoO_3) using the glancing angle deposition (GLAD) technique*, **Mathieu Boudreau**, Gisia Beydaghyan, Serge Gauvin, P.V. Ashrit, *Université de Moncton* — We report on the successful fabrication of Bragg mirrors with a single material (MoO_3). The study of the optical and morphological characterization of the mirrors and of the reproducibility of the fabrication method is also reported. We have used the glancing angle deposition (GLAD) technique to nanostructure the layers, and to control the porosity of the layers, therefore controlling their index of refraction. The morphological study of the surface of the films was made using atomic force microscopy (AFM). The optical spectra of the films were obtained and compared to theoretical prediction. Over time, the optical spectra of the films undergo some changes, which may be explained by the electrochromic effect resulting from the reaction of the humidity in ambient air with MoO_3.

* This work is being supported by AIF-FIA

(DPE/ DEP) Physics Education / *L'enseignement de la physique*

SU-POS-30

Comparison of Two Active Learning Teaching Methods: Conceptual Conflict Collaborative Group and Peer Instruction*, **Marina Milner-Bolotin** [1], Tetyana Antimirova [1], Calvin Kalman [2], [1] *Ryerson University*, [2] Concordia University — There have been proposed some effective ways of eliciting and addressing student misconceptions in the physics "gateway" courses. Two of these teaching methods have been especially popular among physics instructors: peer instruction, as proposed by Eric Mazur, and Conceptual Conflict Collaborative Learning Pedagogy, as proposed by Calvin Kalman. Both methods rely on social interactions in the process of learning, but they are structured quite differently. The goal of the current study is to compare the effectiveness of both approaches in a large lecture setting (N=250 students) in an undergraduate physics course at a large urban university. The poster will present the preliminary findings of the study.

* This work is being supported by Faculty of Engineering, Architecture and Science Ryerson University

SU-POS-31

Physics Education Research in Canada - a Physicist's Wish List, **Daria Ahrensmeier**, *University of Calgary* — A growing number of physicists is interested in improving the impact of their instruction, especially since the student audience is rapidly changing and becoming more diverse in their educational background. Improving the efficacy of teaching physics is also a goal of physics education research (PER), but its results are often considered with some reservation by physicists. I will present possible reasons for this skepticism, particularly regarding the main focus areas of the research and the communication of the results. Then, I will make some suggestions for future PER in Canada, which has a unique opportunity since it is still in its infancy: building on results from the US PER community, PER in Canada could take a direction that would allow for stronger interaction with the physics community by addressing common goals and establishing a common language.

(DTP/ DPT) Theoretical Physics / *Physique théorique*

SU-POS-32

Level Spacing Fluctuations of a Chaotic Optical Billiard*, **Ahmad Hosseinizadeh**, Jean Francois Laprise, Joel Lamy-Poirier and Helmut Kroger, *Université Laval* — We study level spacing statistics to analyze the chaotic behavior of a two-dimensional optical stadium billiard model. We construct a matrix of travel time along trajectories corresponding to a set of initial fixed data. We present the nearest-neighbor level spacing distribution and Dyson-Mehta rigidity. These statistical properties are approximately described by Gaussian orthogonal ensemble (GOE) statistics. The results establish the universality of the level spacing distribution for this classical model.

* This work is being supported by NSERC

(PPD) Particle Physics / *Physique des particules*

SU-POS-33 **(G*)**

Scintillation Timing Studies for SNO+ Experiment, **Erin O'Sullivan**, Mark Chen, Helen O'Keeffe, *Queen's University* — SNO+ is a scintillator-based neutrino experiment which will be housed in the SNOLAB facility located two km underground in Sudbury, Ontario. In order to execute the physics goals of the experiment, it is imperative to understand the properties of our scintillator. This poster will describe the laboratory measurements designed to investigate the light timing profiles due to alpha and beta excitation of linear alkyl benzene scintillator. By differentiating between these two timing signatures, it may be possible to identify and reject alpha events which can be a source of background in our detector.

SU-POS-34 **(G*)**

Searching for Dark Matter with PICASSO*, **Marie-Cécile Piro**, *Université de Montreal* — The PICASSO dark matter search experiment is fully installed at SNOLAB in Sudbury, Ontario. The experiment is based on the bubble chamber principle and is presently taking data with 32 detector modules with a total active mass of 2.6 kg of superheated C4F10 droplets. New features for background discrimination are discussed as well as new calibration data and results of our most recent data analysis.

* This work is being supported by CRSNG

SU-POS-35 **(G)**

Precision Measurement of Neutral B Meson Oscillations with BaBar*, **David Asgeirsson**, Thomas Mattison, *University of British Columbia* — We present a novel method of measuring neutral B meson oscillations using "dilepton" events. The "dilepton" sample of events allows a high-statistics measurement of the mixing of neutral B mesons, requiring only the presence of two leptons in the event. The high statistics requires a data model with high systematic accuracy, more than is easily obtained even with the sophisticated RooFit package. Instead, we have developed a method of fitting by re-weighting Monte Carlo events, which avoids ad-hoc parameterizations, and allows fitting for an arbitrary number of physics and detector resolution parameters. The status of verification of the method with fully reconstructed BaBar Monte Carlo events will be shown.

* This work is being supported by NSERC

Author index / Index des auteurs

Exhibitors
Exposants

NOTES ** NOTES **

Sponsors
Commanditaires

Exhibitors
Exposants

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Commanditaires

Exhibitors
Exposants

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