

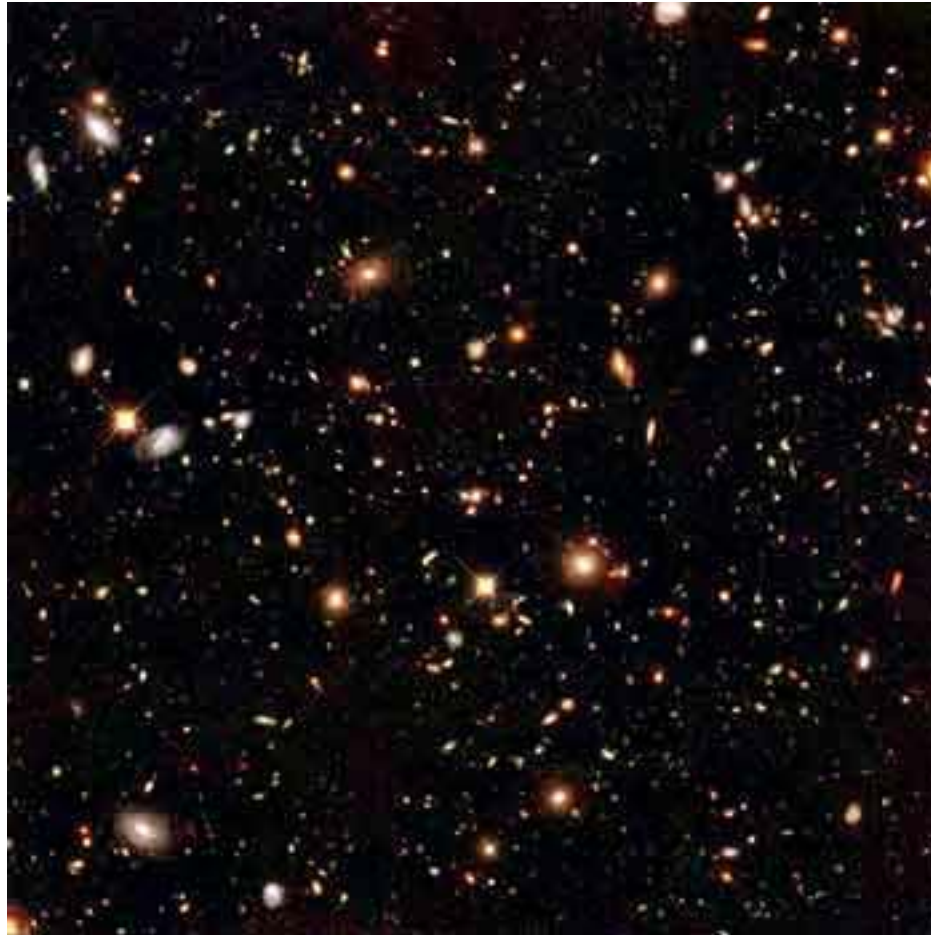


# **What your Mother .er .Advisor Never Told You: The Need for Entrepreneurship Education**

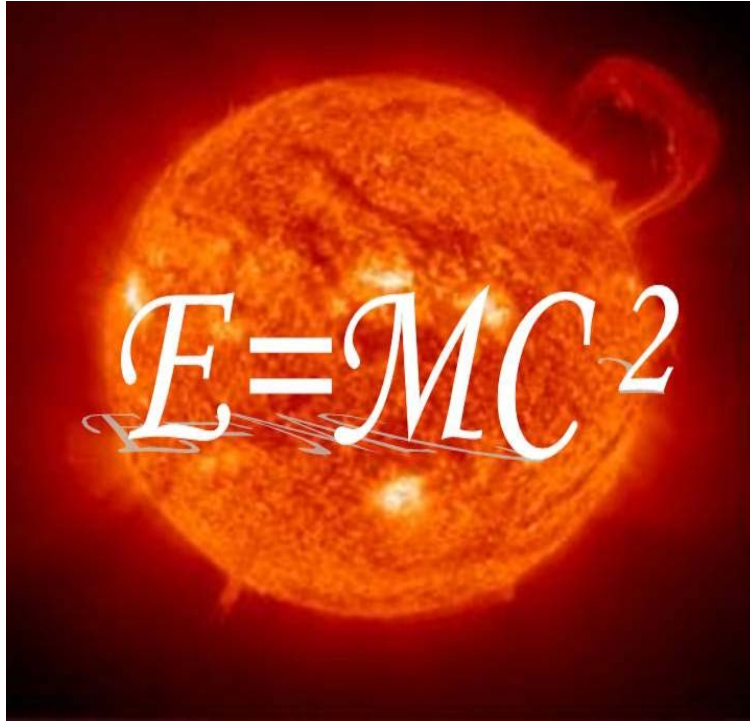
*Douglas N. Arion, PhD*

Donald Hedberg Distinguished Professor of Entrepreneurial Studies  
Director, *ScienceWorks* Entrepreneurial Studies Program  
Professor of Physics and Astronomy  
*Carthage College*

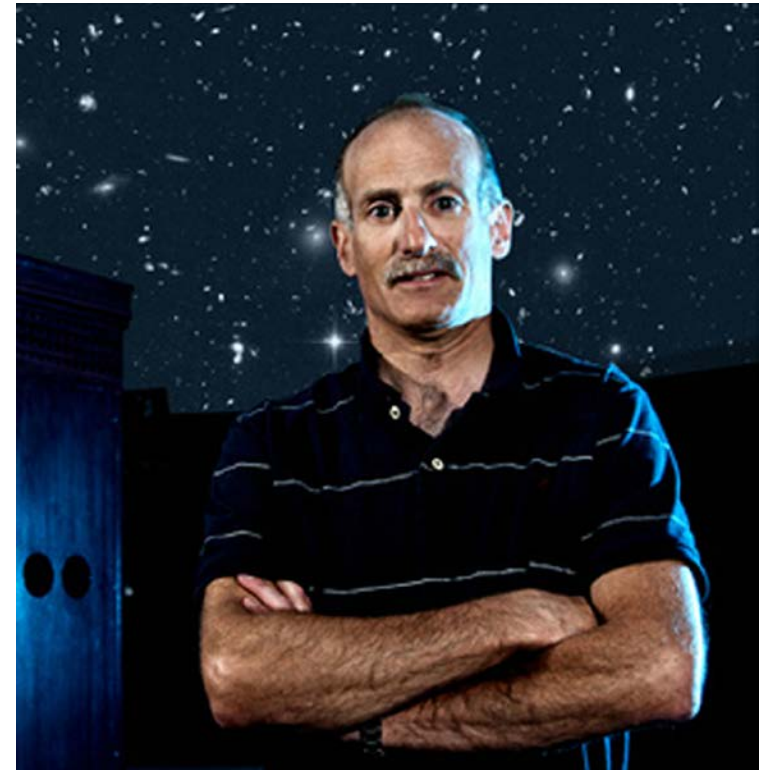
# Why we 'do' physics



# Doing Physics is NOT being a “Physicist”\*

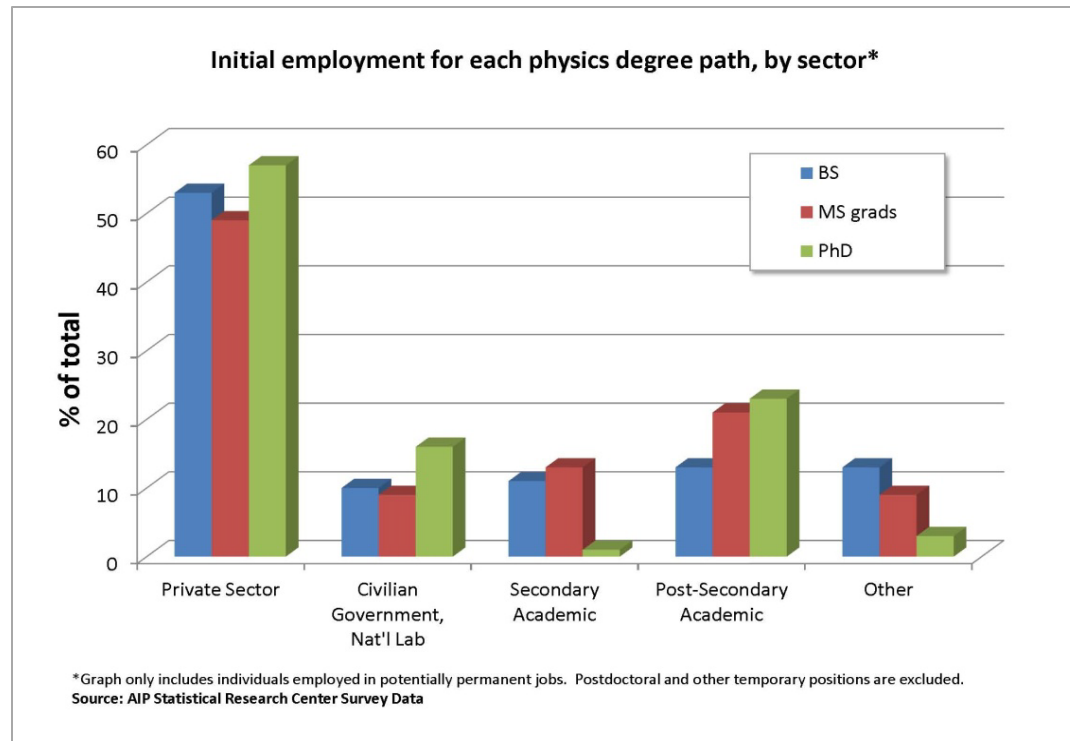


≠



\* Also true for *Every* field of study  
(Oh, and what *IS* a physicist, anyway?)

- Most physics students won't become 'physicists'



... and especially, not *faculty!* (less than 3%)



But



Physicists can do (nearly) anything!!

(That's how we sell physics to students...)

# Your Experience



- What skills and knowledge do you wish you had *before* you started your professional career?
  - Aren't those skills universal...applicable to any career?
- What was it like to learn 'on the job'?
- Is the school of 'hard knocks' the best way to prepare for the future?

# Two Areas Need Attention



- Career Development
  - Give everyone the skills/knowledge/attitudes needed for success
- Opportunity Recognition
  - Leverage *all* of the steps in physics research to create/improve products and services



# Getting Ready for the *REAL* *WORLD*



- College classes (typically) teach *knowledge* and *skills* in *physics*
- Success in the *Real World* requires *other* skills, such as:
  - Dealing with People
  - Dealing with Money
  - Dealing with Legal/Regulatory/Political issues
- *All careers* require these skills
  - Faculty may say otherwise...but *everything* is a business
  - Whether *starting a venture* or *taking a position* these skills are critical for success



# What Else Should be Learned?



- Knowledge
  - Business communications
  - Intellectual property
  - Business structures and cultures
  - Incorporation
  - Finance
  - Taxes
  - Legal Regulation
  - Bids and Proposals
  - Contracts
  - Purchasing and Property
  - Dress and Appearance
- Skills
  - Writing
  - Speaking
  - Listening
  - People Management and Teamwork
- Attitudes
  - Entrepreneurial Mindset!
  - Innovation and Commercialization



# Where is this Happening Now?



- Primarily in *Engineering Programs*
  - Freshman and Senior Design courses now typically include entrepreneurship
  - Career skills built into ABET standards
- Joint programs between Engineering schools and Business schools
  - Typically on ‘large’ campuses
  - Often graduate programs
- Supporting organizations: ASEE and NCIIA (More on this later...)



# What is Available for The 'General' Population?



- 'Bridge' Programs
  - Tuck Business Bridge Program
  - MiddCORE Program at Middlebury College
- MBA Programs
  - Entrepreneurship concentrations are now common
  - Technical content added to MBAs
    - Example: *Lab to Market* program at Univ. of Maryland
- Business Majors and Minors
  - What some parents see as the 'right answer'

# What is Being Done in Physics?



- Undergraduate entrepreneurship programs
  - Carthage *ScienceWorks* program
  - UC-Denver innovation program (Randall Tagg)
- Professional Master's Degrees
  - Case Western Reserve University started the paradigm
  - 14 Programs around the US

# One Example: *ScienceWorks* at Carthage

**Courses  
(Aimed at Juniors)**

ESNS 310/320:  
Core Business Content  
ESNS 325 (J-Term)  
Commercial Technologies  
[Total: 8 Credit Hours]



**Supporting Coursework**

Accounting/Finance/Marketing  
Ethics  
GIS  
Public Speaking  
[4 Credit Hours]



**Senior-Level Business Plan Courses**

ESNS 410/430  
Full-fledged Business Plan  
• New Product  
• New Business/Spinoff  
• SBIR/IR&D Proposal  
Defended before Advisory Board of Experts  
[Total 8 Credit Hours]



Carthage



- Goals and Plans
- Technology/Innovation
- Writing/Correspondence
- Entrepreneurs/characteristics
- Marketing Principals
- Product Lifecycle
- Project Management
- Financial Needs
- Marketing and Sales
- Searching for Business Info.
- Speaking/Presentations
- Information Systems
- Web Design/Social Media
- Economics
- Budgeting: Personal and Business
- Business Plans
- Stocks and Bonds
- Investing/Retirement
- Resumes and Interviewing
- Creativity and Ideation
- Business Models
- Incorporation and Business Organization
- Management and Team Skills
- Intellectual Property
- Accounting and Financial Management
- International Business and Cultures
- Legal and Regulatory
- Geographic Information Systems
- Finance and Funding
- Taxes
- Bankruptcy
- Ethics
- Bid and Proposal
- Contracts/Subcontracts/Purchasing
- Insurance/Risk Reduction

# Does this Work?



- *ScienceWorks* has helped Carthage science students succeed
  - Jason Benes: \$1.1M Royalties from Nike
  - Matija Maretic: Marvelsoft - Paris, London, Zurich – Million dollar deals
  - Liz Zona: Abbott Labs
  - Brian Jones: Medical administration executive
  - Chris Duffy: Epic Systems
  - Melissa Lowe: Ortho McNeill
  - Keith Kobelt: Marsh and McClennan finance
  - Charlie Staniger: Walgreen's management





# Assessment Results



- Carthage *ScienceWorks* graduates are the most successful produced by the college
- More rapidly hired
- More rapid promoted
- More accepted into graduate schools
- More highly rated by employers and advisers

# Ancillary Benefits



- Recruiting!!
  - Prospective students are more interested in physics *if* career preparation included
  - PARENTS are particularly positive
- Alumni engagement
  - More successful alumni reflect back and contribute to department success
- Competition
  - Physics viewed as a career path – like (or even better) than engineering

# Other Modalities

# Too big a mouthful?



- Speaker Series
- Guest lecturers
- In-course projects/content
  - Innovation projects
- Visiting businesspersons (‘Entrepreneur in Residence’)
- Interdisciplinary courses and projects (cross-department)
- Industrial internships

# Building the Skill Set

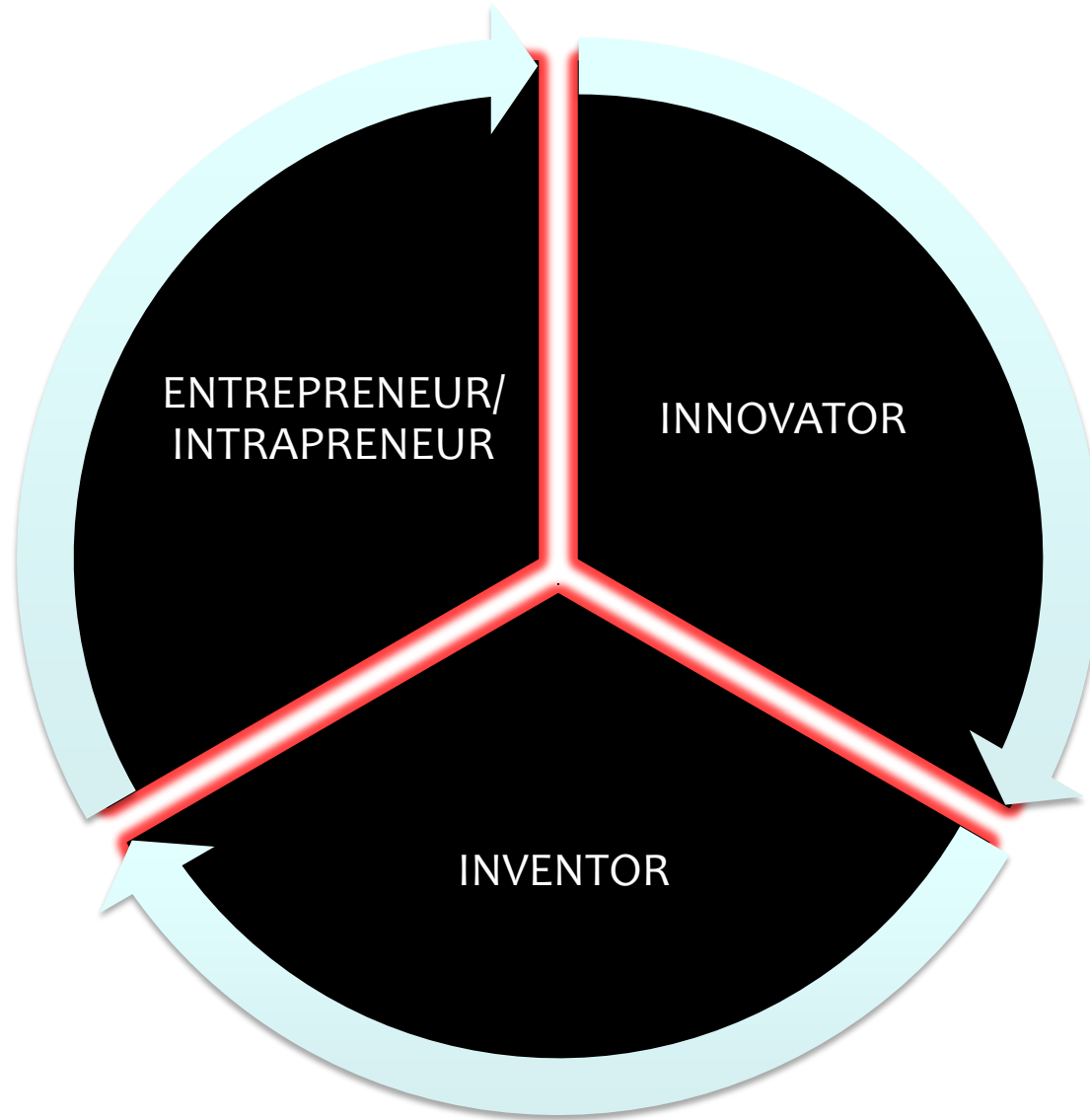


- Hire ‘Professors of Practice’
  - Started by UT-Austin as a staffing model
- Take advantage of National Collegiate Inventors and Innovators Alliance meetings and resources/publications
  - Large body of information, curriculum, documentation, roadmaps, etc., already available
  - A great community looking to work together
- Engage alumni, regional businesses, economic development organizations



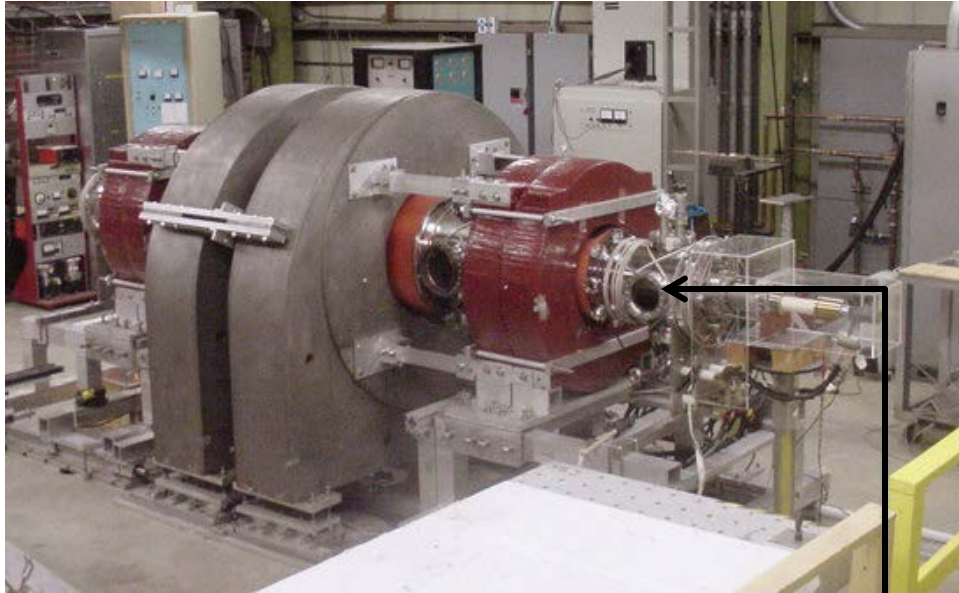
# Innovation in Physics







# Where could ideas come from?



- Every step in the research process could result in innovation
- Research has an *end goal* in mind
  - But the innovation may be an *intermediary step*

# What Needs to Happen? A Shift in Mindset



- How could my research have *commercial value*?
  - *Directly or Indirectly?*
- Can I recognize *opportunities*?
- Can I answer ‘*Who needs it?*’
- Do I document/record information to allow me to *protect my ideas*?
- Can I develop *partnerships* and *linkages* to bring products and processes to market?

# What Can Be Done?



- Step One: Implement *innovation* as an attitude
  - In research
  - In teaching and education
- Step Two: Look at every step in the process as an opportunity to develop viable products or services
  - Take appropriate IP precautions
- Step Four: Seek out expertise!
  - There is a community of entrepreneurial faculty and national organizations
- Step Five: Promote student creativity at all levels
  - Young creativity is *Powerful*
- Finance, inventory control, order tracking - it's all just *data!*



- Changes needed in goals/outcomes/assessments
  - What is the right set of assessable outcomes for students and faculty?
  - Do ‘traditional’ curricular structures achieve these goals?
  - Do ‘traditional’ delivery methods work in this environment?
- A shift in the traditional research process
  - Grant supported research with other than ‘predictable’ outcomes
- Changes in academic IP policies
  - Technology Transfer offices can be a help or hindrance



# Resources: You are not alone



- National Collegiate Inventors and Innovators Alliance ([www.nciia.org](http://www.nciia.org))
  - Technology entrepreneurship and innovation
  - Come to the meeting in three weeks!
- General entrepreneurship organizations:
  - Collegiate Entrepreneurs Organization (CEO)
  - United States Association of Small Business and Entrepreneurship (USASBE)
- Engineering Education:
  - American Society for Entrepreneurship Education (ASEE)

# Join the Crowd



- Conferences in 2014 on Entrepreneurship in Physics:
  - *Reinventing the Physicist* (sponsored by APS)
    - College Park, MD, June 2014
  - AIP/ACTP Industrial Physics Forum
    - Sao Paulo, Brazil, Sept. 28- Oct. 3, 2014
- Note the National Collegiate inventors and Innovators Alliance – Annual meeting March, 2015, Washington, DC