A Career in Physics: My Personal Journey

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Mid-Atlantic CUWiP
University of Maryland/NIST
Outline

- Some Statistics on Women in Physics
- What the American Physical Society has for women & students
- Personal journey (early interest in science, education, family life)
- My research at Harvard-Smithsonian Center for Astrophysics
- Opportunity to lead APS
- Engagement with APS – what’s in it for you
Female Fraction of Bachelor Degrees

Source: IPEDS
Percentage of Women in Physics

Source: IPEDS, AIP SRC
Percentage of Women in Physics

Source: IPEDS, AIP SRC
APS Headquarters in College Park, Maryland, shares a building with other physics societies:

- American Association of Physics Teachers
- American Association of Physicists in Medicine
- American Institute of Physics
APS Membership Statistics:

>50,000 members (mostly academics)

• 30% Students (22% Grads, 8% Undergrads)
• 22% International
• 9% Industrial
• 17% National Laboratories
What is the percent of women physicists in the APS?

4%

12%

23%

38%
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4%

12%

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Interesting fact:

2/3 of the women in the APS are < 40 years old
APS Programs for Women

• Professional Skills Development workshops
• Childcare grants for meetings
• Gender equity site visits
• CSWP gazette
• Female-friendly website
• Blewett fellowship
• Travel grants
• Woman physicist of the month

www.WomenInPhysics.org
Every year, APS and SPS team up at the annual meetings to plan a number of special events just for undergrads. Student registration is FREE!

- Graduate School Fair—meet face-to-face with representatives from graduate research programs
- Special Student Presentation Sessions—an opportunity for students to present their research.
- Mentor/Student Welcome Reception—students and mentors team up on a special quiz about physics careers
- Student Awards reception—student presenters are recognized, and given an opportunity to network with graduate school recruiters and employers.

Travel Awards are available to presenting students

- Support is available for March and April Meetings.
- All presenting students are eligible.

Visit: www.aps.org  KEYWORD: Future Physics  for more details
APS Webinars

APS webinars are designed to connect students with information on physics careers, educational programs, and professional development for students, working physicists, and educators.

Monthly broadcasts are free and open to the public.

Topics have included
- Becoming a Physics Teacher (with science educator Eugenia Etkina)
- Choosing a Graduate School (with physics professor Peter Collings)
- Careers in Patent Law (with physicist and patent attorney Hey Yeung Cheung)
- Interviewing without the Angst (with Northeastern University co-op faculty Karyn Rosen).

Visit: www.aps.org/careers/guidance/webinars
The APS Career Website is the gateway to physics career resources. Here you can find links to the APS Job Center, information on upcoming workshops and meetings, career advice, and other career and job related resources (such as APS webinars, the APS Job Blog, and more!).
APS Online Job Board

Our free 60-day summer internship promotion means that lots of employers are advertising internships on our site right now.

Job Seekers can:

- Search for jobs on the Job Center (totally free).
- Store your resume, cover letters, and other materials in your profile on the site.
- Apply for positions directly through the Job Center.

SPS Internships

SPS Internships are 9 ½ week long summer programs which provide opportunities for students in areas like:

- Science Outreach—at APS or SPS
- Science Policy—Mather Internships/Capitol Hill
- Science Research—NIST

www.spsnational.org/programs/internships
How about Med School?

Physics majors out-performed many other majors (including pre-med) on all three sections on the MCAT.

<table>
<thead>
<tr>
<th>Major</th>
<th>Physical Sciences</th>
<th>Biological Sciences</th>
<th>Verbal Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedical Eng.</td>
<td>10.9</td>
<td>10.7</td>
<td>9.6</td>
</tr>
<tr>
<td>Physics</td>
<td>11.1</td>
<td>10.3</td>
<td>9.6</td>
</tr>
<tr>
<td>Electrical Eng.</td>
<td>10.9</td>
<td>10.5</td>
<td>9.4</td>
</tr>
<tr>
<td>Mathematics</td>
<td>10.3</td>
<td>10.1</td>
<td>9.6</td>
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<tr>
<td>Biochemistry</td>
<td>9.9</td>
<td>10.3</td>
<td>9.1</td>
</tr>
<tr>
<td>Chemistry</td>
<td>9.8</td>
<td>9.9</td>
<td>9</td>
</tr>
<tr>
<td>Microbiology</td>
<td>9</td>
<td>9.9</td>
<td>8.7</td>
</tr>
<tr>
<td>Biology</td>
<td>8.7</td>
<td>9.5</td>
<td>8.7</td>
</tr>
<tr>
<td>Premed</td>
<td>8.3</td>
<td>9</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Scores above 9.5 in each section are considered competitive by most medical schools.

These factors make Physics majors stand out compared to other med school applicants.

Physics majors also account for less than 1% of individuals taking the exam.

Source: AIP Statistical Research Center compiled data from the Data Warehouse of the American Association of Medical Colleges
Physics majors also received the highest average LSAT scores compared to several other majors (including Pre Law).

So, a physics bachelor’s degree provides excellent training for careers in medicine and in law.
A physics bachelor’s degree now ranks higher in starting salary than many other technical fields (including mechanical engineering).

The typical starting salary for a physics bachelor degree has increased by nearly $10,000 since 2003.
Not surprisingly, physics master’s degree holders also earn more than physics bachelor’s:

Bottom line: A physics master’s degree will open the door to more advanced positions in a variety of technical fields, with higher salaries.
Wait!! I want a life!
Wait!! I want a life!

You CAN have a life and a productive, satisfying career in physics
Wait!! I want a life!

You CAN have a life and a productive, satisfying career in physics

My particular career path, as an example
Childhood

Early interest in Science – MEDICINE
Childhood/High School

• Early interest in Science – MEDICINE

• Excellent high school education; lots of encouragement (my mother; Latin teacher)

• High school love of chemistry -- appreciation of the role of math in science; intrigued by mathematical models describing scientific problems
College

- Harvard/Radcliffe College – greatly disappointing my mother
- Intended to major in biochemistry – BUT I hated organic chemistry; loved math & physics  → majored in Chemistry & Physics
- Joined a research group in my junior year
- Convinced me to apply to grad school
Graduate School

• Got married just before starting graduate school at University of Chicago
• Husband was just starting medical school
• Funded by NASA Traineeship
• Joined a research group: theoretical molecular structure calculations (heavily computational)
Challenging Times

1st child, Andrew, born during my 2nd year of grad school!

Finding daycare was difficult!
Challenging Times (cont’d)

Received my PhD degree!

Marriage fell apart….

Became a single mom, looking for a postdoc position….
Luck Changed….

• Post-doc position at Harvard College Observatory: theor. atomic and molecular physics w. applications to atmospheric phys. and astrophysics

• After several years, met a great guy…

• My position became a tenured one at Harvard-Smithsonian Center for Astrophysics
My research career in Atomic and Molecular Astrophysics

• Studying the very small (interactions of atoms, molecules and ions with light) in order to understand the very large objects in the universe – stars, planets, interstellar clouds, supernovae, black holes, etc.
Atomic and Molecular Astrophysics

- The Universe reveals its secrets through photons
Atomic and Molecular Astrophysics

• The Universe reveals its secrets through photons
• The photons are most useful when they have been analyzed with a spectrometer
• A large part of A & M Astrophysics is directly motivated by the need to understand what the photons are telling us
• The range of wavelengths -- many decades in the electromagnetic spectrum, from radio wavelengths (searches for interstellar molecules) through the x-ray region where the most energetic objects in the universe are seen (hot gas around black hole)
HD 141556 = Chi Lupi (Hg–Mn star)
Brief Tutorial on Spectroscopy

- Atoms and molecules emit or absorb radiation only at particular wavelengths (frequencies)
- A spectrum is like a set of “fingerprints”, useful in identifying the presence of atoms, ions, and molecules
Spectra tell us so much...

- Presence of a line
- Position of a line
- Strength of absorb.line
- Emission line ratios for two transitions of the same ion
- Line widths
- Atom, ion or molecule
- Velocity of source (Doppler shift)
- Density along LOS
- Electron temperature, electron density in the source
- Collision-broadening, gas pressure, temperature
Astronomical Needs for Atomic and Molecular Physics

- Spectroscopic information on atoms, ions, and molecules (wavelengths, line intensities)
- Astronomical Spectra can be used to deduce physical conditions of objects (temperatures, electron density, ambient radiation field, velocities, opacities, ionization balance, etc.) if one has a knowledge of a variety of atomic collision processes
- Building theoretical models (e.g. chemistry of the Early Universe) requires knowledge of both spectroscopy and collision processes
Some of my research topics

• Formation/destruction of interstellar molecules
• Molecule formation in the Early Universe
• Molecules in cool stellar atmospheres, brown dwarfs, and extrasolar giant planets
• Developed accurate diagnostics for X-ray astrophysical plasmas: excitation of highly-charged ions by collisions with electrons
Exciting Time for Atomic and Molecular Astrophysics

New space missions, new ground-based facilities, with higher spectroscopic resolution and greater sensitivities --> New Discoveries.

A knowledge of atomic and molecular physics is essential in understanding the observations and extracting the science.
More Research, More Family

My 2nd child, Elizabeth, was born…

Research career thrived

My 3rd child, Carolyn, born 2 ½ yrs later

My 4th child, Jonathan, born 5 yrs later…
And they grew up...
Recent Family Photo
Key to Work/Family Balance

• A supportive partner
• A willingness to forego “me”-time
• Availability of excellent day-care (for my latter 3 children we had a wonderful nanny)
• Living close to work (in my case, 5 blocks away)
• Having perspective
Administrative Responsibilities in addition to my research

• Appointed Assoc. Dir. of H-S Center for Astrophysics, heading up the Atomic and Molecular Physics Division (13 years)

• Became Director of the Institute for Theor. Atomic, Molecular and Optical Physics – NSF funded (8 yrs)

• Prepared me for the unexpected opportunity to become the Executive Officer of the Am. Phys. Soc.
Executive Officer of APS (starting in July 2009)

• Very energizing to do something new and completely different!
• The opportunity to have a position with a broad perspective across all of physics was irresistible.
• Great familiarity with APS – elected as Chair of the Division of AMO Physics; served on committees, Exec. Bd. and Council of APS
APS Journals:  ~ 20,000 physics articles/yr

One month of APS Journal publications

- Rev. Mod. Phys.
- Phys.Rev. E
- Phys.Rev. D
- Phys.Rev. C
- Phys.Rev. B
- Phys.Rev. A
- + 3 online only publications
APS General Meetings:
March, 2014 - Denver
5 days
~10,000 attendees
45% students
27% international
Focus areas: Condensed Matter, Materials, Polymers, Chemical Physics, Biological Physics, Computational Physics, Industrial & Applied Physics
The American Physical Society

APS General Meetings:
April, 2014 – Savannah, GA

4 days
~1,400 attendees
  37% students
  8% international

Focus areas: Nuclear Physics, Particles & Fields, Astrophysics, Gravitation, plus Forum sessions
The American Physical Society

Programmatic Activities Include:

**Education** – improving the quality of physics education from high school through college and graduate school (studies for M.S. and Ph.D. degrees);

**Outreach** – communicating the excitement and value of physics to the general public;

**International Affairs** – fostering opportunities for global engagement for members of the physics community; partnering with physics societies internationally

**Public Affairs** – advocating for government funding of physics research; and contributing physics expertise in addressing problems of national interest.
What APS can do for you!
(APS membership is free for undergrads)

• Opportunity to attend meetings (particularly section meetings) – broaden your horizons, meet new people, discuss your interests

• Actively engage/volunteer
  – More people get to know you
  – You expand your range of contacts (helpful for jobs)
  – Expand your range of research and career options
Some Take-aways

• An example in which atomic and molecular physics plays a critical role in building an astrophysical model – molecules in the E.U.

• Taking on administrative responsibilities as well as doing the science can lead to new opportunities

• Adding in family responsibilities (children) creates challenges, but adds incredible emotional richness to one’s life

• APS has many resources to help you on your own individual journeys in physics