Women in Physics in the United States

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FOR FURTHER INFORMATION

American Institute of Physics Statistical Research Center:  www.aip.org/statistics/

American Physical Society Gender Equity Report:  
www.aps.org/programs/women/workshops/gender-equity/

Univ. of California Faculty Family Friendly Edge (including articles by  
Prof. Mary Ann Mason)  ucfamilyedge.berkeley.edu/

The Gender Equity Project (including articles by Prof. Virginia Valian):  
www.hunter.cuny.edu/genderequity/

*Women Don’t Ask [Negotiation and the Gender Divide]*:  www.womendontask.com/

National Science Foundation ADVANCE Program:  www.nsf.gov/crssprgm/advance/  
ADVANCE Portal Website:  www.portal.advance.vt.edu/  
Michigan State’s ADAPP-ADVANCE Project:  www.adapp-advance.msu.edu/
The Numbers
Figure 1. Physics Enrollment in U.S. High Schools, 1948-2005

% of seniors who have taken or are taking physics

Figure 3. Females as a Percentage of Total Enrollment in High School Physics

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>39%</td>
</tr>
<tr>
<td>1990</td>
<td>41%</td>
</tr>
<tr>
<td>1993</td>
<td>43%</td>
</tr>
<tr>
<td>1997</td>
<td>47%</td>
</tr>
<tr>
<td>2001</td>
<td>46%</td>
</tr>
<tr>
<td>2005</td>
<td>47%</td>
</tr>
</tbody>
</table>

Career Choices Begin Early

Only 8% of US students earning a B.A. in Physics have not taken Physics in High School (AIP Pub. # R392.3, 1998).

<table>
<thead>
<tr>
<th>Table 2. Timing of Career Choice for Responding Women Physicists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before secondary school (high school)</td>
</tr>
<tr>
<td>During secondary school</td>
</tr>
<tr>
<td>During undergraduate school</td>
</tr>
<tr>
<td>During graduate school</td>
</tr>
</tbody>
</table>


National Center for Education Statistics. Data for Academic Year 1999 were not available.

Compiled by American Institute of Physics Statistical Research Center.
Percent of PhDs earned by women in selected fields, 1958-2006

AIP Statistical Research Center. Compiled from data collected by National Science Foundation.
<table>
<thead>
<tr>
<th>Year</th>
<th>All Physics*</th>
<th>Elementary Particle Physics</th>
<th>Atomic, Molecular &amp; Optics</th>
<th>Condensed Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total N</td>
<td>Female %</td>
<td>Total N</td>
<td>Total N</td>
</tr>
<tr>
<td>2004 to 2006</td>
<td>3879</td>
<td>16</td>
<td>551</td>
<td>667</td>
</tr>
<tr>
<td>2000 to 2003</td>
<td>4591</td>
<td>15</td>
<td>557</td>
<td>768</td>
</tr>
<tr>
<td>1996 to 1999</td>
<td>5484</td>
<td>13</td>
<td>687</td>
<td>884</td>
</tr>
<tr>
<td>1992 to 1995</td>
<td>5829</td>
<td>12</td>
<td>682</td>
<td>822</td>
</tr>
<tr>
<td>1988 to 1991</td>
<td>4884</td>
<td>10</td>
<td>652</td>
<td>618</td>
</tr>
</tbody>
</table>

* Not including astronomy & astrophysics

Source: AIP Statistical Research Center; Compiled from data collected by the National Science Foundation.
Figure 1. Percent of faculty positions in physics held by women.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Professor</td>
<td>3</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Associate Prof.</td>
<td>10</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Assistant Prof.</td>
<td>17</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Instructor/Adjunct</td>
<td>N/A</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Other ranks</td>
<td>13</td>
<td>15</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Department</th>
<th>1998</th>
<th>2002</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhD</td>
<td>6</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Master’s</td>
<td>9</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Bachelor’s</td>
<td>11</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td><strong>OVERALL</strong></td>
<td><strong>8</strong></td>
<td><strong>10</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>

AIP Statistical Research Center, 2006 Academic Workforce Survey.
Summarizing these results yields the famous “leaky pipeline” for **women** physicists [data from AIP Statistical Division]

This is a problem for Physics!
Causes and Solutions

As the NSF ADVANCE website notes:

... women’s representation and advancement in academic STEM positions are affected by many external factors that are unrelated to their ability, interest, and technical skills...
Implicit Bias

The Gender Equity Project, Virginia Valian

- We are all (women and men) prone to unintentional bias
- This affects many decisions we make in the course of our professional duties
- Relevant concepts include:
  - gender schemas
  - accumulation of disadvantage
  - stereotype threat
What are Gender Schemas?

- Gender schemas are hypotheses about what it means to be male or female.
- We all - male and female alike - share these hypotheses.
- Schemas assign different psychological traits to males and females (Martin and Halverson, 1987).
Gender Bias in Peer Review

Although women constituted 46% of the applicant pool, they received only 20% of the fellowships.

Study of the peer-review system of the Swedish Medical Research Council postdoctoral fellowship program. (Wenneras & Wold, 1997)

- Developed a model of "total impact points", which took into account productivity and prestige of the journals the applicant published in.
- Women had to receive 100 or more impact points to get the same rating from the judges that a man with 40 or fewer impact points.
- This model found that, in addition to productivity, gender had a significant influence on the scores.

IMPACT: Women have to meet a higher standard in order to receive the same recognition that men do.
Accumulation of Disadvantage

Martell, Lane, and Emrich's (1996) model assumed a tiny bias in favor of men, which accounted for only 1% of variance in promotion.

After many iterations the top level was 65% male.

Operating at a systematic minute disadvantage can have substantial long term effects.
There are 189 such departments and the median number of faculty is 25.

What is it like to be 1 woman in a faculty of 25?
• **solutions** include:
  - *leaders* emphasize importance of diversity for achieving institutional goals
  - *institutions* make criteria and processes for hiring, tenure, promotion, awards clear and easily available to all
  - *departments* frame faculty searches broadly
  - *hiring/award committees*
    - are trained to recognize and minimize implicit bias
    - explicitly use multiple dimensions to evaluate candidates’ qualifications (e.g. number of publications, research impact, teaching accomplishments, potential for funding, area of specialization)
  - *departments and professional societies* offer professional development opportunities for women at all levels
Family Responsibilities


Mason, Stacy, and Goulden, 2004; Data from NSF Survey of Doctorate Recipients 1981-1995
For each year after the PhD, Married Men with Children under 6 are 50% more likely to enter a tenure track position than are Married Women with Children under 6.

Mason, Stacy, and Goulden, 2004; Data from NSF Survey of Doctorate Recipients 1981-1995
Leaks in the Pipeline: Tenure Track to Tenure

For each year after securing a tenure track position, Men are 20% more likely to achieve tenure than are Women.

Mason, Stacy, and Goulden, 2004; Data from NSF Survey of Doctorate Recipients 1981-1995
Everybody is Very Busy

<table>
<thead>
<tr>
<th>Category</th>
<th>Professional</th>
<th>Housework</th>
<th>Caregiving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women with Children</td>
<td>51.2</td>
<td>14.6</td>
<td>35.5</td>
</tr>
<tr>
<td>Men with Children</td>
<td>55.6</td>
<td>11.9</td>
<td>20.3</td>
</tr>
<tr>
<td>Women without Children</td>
<td>59.8</td>
<td>10.6</td>
<td>8.1</td>
</tr>
<tr>
<td>Men without Children</td>
<td>59.1</td>
<td>10.6</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Mason, Stacy, and Goulden, 2004; Data on UC faculty, ages 30-50
solutions include:

✿ **employers** provide parental leave, tenure-clock adjustment, modified duties for parental or elder care and ensure these will not impact evaluation for promotion or tenure

✿ **employers** ensure policies are clear, well-advertised, and framed as entitlements, not exceptions [to minimize “bias avoidance” behavior]

✿ **department heads and mentors** openly offer support and advice on work-life balance to all new faculty, so this is seen as a normal aspect of professional life

✿ **departments** schedule all meetings during business hours

✿ **departments and professional societies** offer childcare grants for faculty attending conferences
Dual-Career Couples

• a pervasive issue in physics
  (Dual-Science-Couple Survey, McNeil & Sher, 1998; 1990 APS Survey)
  - 68% (18%) of married physicists have scientist spouses
  - 31% (6%) of all physicists < 31yrs have scientist spouses
  - In 85% of couples, man is older [thus, more senior in job]
  - Dual-science-couples seeking first faculty jobs reported
    • short-term career goals affected by these issues (86%)
    • one partner (usually woman) was under-employed (60%)

• solutions include:
  ✴ Employers offer clear, well-advertised spousal hire policies
  ✴ Employers reframe dual-career assistance as recruitment tool
  ✴ Employers form Higher-Education Recruitment Consortia
  ✴ Job candidates raise dual-career issues with employers
Negotiation

Women Don’t Ask: Negotiation and the Gender Divide (Linda Babcock & Sarah Laschever, 2003)

• Women avoid negotiation because they are
  - unsure what they “deserve”; fear asking too much
  - worried about harm to relationships
  - less optimistic about benefits of negotiation
  - not confident of their negotiation skills
  - relatively risk-averse

• In negotiations, women tend to
  ✴ ask for less -- and therefore receive less
  ✴ use “interest-based” negotiation approach, focused on underlying needs/motives rather than narrow concrete goals

(Getting to Yes: Negotiating Agreement Without Giving In, Roger Fisher & William Ury, 1990)
• **Solutions include**

  ✴ **Professional organizations** offer workshops on negotiation skills e.g. APS Professional Skills Development Workshops offered annually at major physics meetings (sponsored by NSF); has impacted > 250 women physicists since 2005  

  ✴ **Mentors** teach women (and men) that interest-based negotiation is very effective and improve professional relationships

  ✴ **Employers** offer clear directions to job finalists to avoid unintended bias in discussions of salary and start-up packages
Toward large-scale solutions: the NSF “ADVANCE” Program

Increasing the representation and advancement of women in STEM (science, technology, engineering, mathematics) by

• helping universities and professional societies address aspects of academic culture and institutional structure & practice that pose differential barriers to women
• supporting research on effective practices
• creating a community of researchers and practitioners

Over the last 9 years, $130M has been invested in grants to 100+ universities and organizations across the country.
MSU’s ADVANCE project focuses on ensuring that clear, consistent policies are formulated and followed in faculty

- Recruitment and Hiring
- Annual Evaluation
- Promotion and Tenure
- Leadership Development
- Mentoring

Solutions include

- Establishing and communicating clear, consistent, objective evaluation criteria for faculty
- Training administrators
- Standardized electronic faculty records
- Resources & guides for administrators and faculty
- Assistance for units to develop mentoring programs, adopt inclusive search practices, etc.
Conclusions
• The Leaky Pipeline:

Women’s participation rate in physics continues to be low compared to that of men. The scope of the problem is larger than in many other science fields.

Social Science research reveals numerous causes: family responsibilities, dual-career issues, implicit bias, negotiation skills, isolation...

• Research also identifies solutions involving individuals, institutions, and funding agencies
  Clear, known, consistent, family-friendly practices
  Open discussion of the importance of inclusion
  Role models, skill-building and mentoring
What can you do?
What can you do?

EDUCATE YOURSELF
What can you do?

EDUCATE YOURSELF

ACT LIKE A LEADER