Women in Physics: Context, Challenges, and Changes

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Context
The number of women receiving physics PhDs and bachelor's degrees are both at all-time highs, 365 and 1,550 respectively. The percentage of physics PhDs awarded to women has been increasing, whereas the percentage of physics bachelors awarded to women has been declining in recent years.
This report has examined the representation of under-represented minority faculty members in physics and astronomy departments. Documenting the low number of minority faculty members is important, but does not present the whole picture. Counting numbers of people cannot tell us about the everyday experiences and workplace environments of academic physicists. It also does not tell us about possible inequities in salaries and in promotion and tenure rates.

Representation of URMs on physics and astronomy faculties could increase in the future, but URMs could still experience less than desirable situations on the job. Focusing on representation alone also does not tell us reasons for any inequities that we may observe. More data are needed about the working lives of URM faculty members in order to document additional areas of needed change.

Number of Women in Physics and Astronomy Departments, 2012 by Highest Degree Awarded

- **PhD**
  - 2008: 465
  - 2012: 563
- **Master's**
  - 2008: 147
  - 2012: 64
- **Bachelor's**
  - 2008: 340
  - 2012: 411

There are fewer than 75 female physics and astronomy faculty members who are African-American and Hispanic in the entire U.S. (faculty members)

[www.aip.org/statistics](http://www.aip.org/statistics)
The “scissors plot” summarizing these results reveals a relative scarcity of women physicists. This is a problem for Physics... and STEM!
THE FUNDING GAP
Women are earning an increasing share of research grants from the US National Institutes of Health (NIH) but the average size of their awards has consistently lagged behind what men receive.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of NIH Research Grants</th>
<th>Proportion going to women</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>31,801</td>
<td>24%</td>
</tr>
<tr>
<td>2012</td>
<td>30,768</td>
<td>30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Size of Grant</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>$403,047</td>
</tr>
<tr>
<td>2012</td>
<td>$507,279</td>
</tr>
</tbody>
</table>

THE SALARY GAP
Female scientists in the United States earn much less than men, on average, with the difference varying strongly by field.

<table>
<thead>
<tr>
<th>Field</th>
<th>2008 Median Salaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>$65,000</td>
</tr>
<tr>
<td>Chemistry</td>
<td>$79,000</td>
</tr>
<tr>
<td>Physics and Astronomy</td>
<td>$89,000</td>
</tr>
</tbody>
</table>

Nature, Vol 495, 7 March 2013
There are 189 such departments and the median number of faculty is 25.
Causes for Concern
[adapted from APS Women in Physics site
http://www.aps.org/programs/women/reports/bestpractices/ ]

No effort to develop a sense of community or improve the climate. Denial that such issues matter to people.

A sub-critical mass of female employees; premature departure of female employees.

Lack of investment in and/or promotion of female employees at all levels. No visible leadership roles for female employees in the unit.

Isolation or marginalization of female employees.

Derogatory comments about female employees to reduce their ability to bring about change (e.g., “difficult” or “troublemaker”).

A highly politicized climate where decision-making processes are not transparent.

Inability on the part of senior female scientists or engineers to get sufficient laboratory space, research funding, or other resources needed to become leaders in their fields.

Strong support for more junior employees who are not in a position to drive change, but weak support for senior female employees who attempt to change the climate.
Who has access to professional resources?

Table 1. Percentage of respondents with access to key resources.

<table>
<thead>
<tr>
<th></th>
<th>Less developed countries</th>
<th>Very highly developed countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Funding</td>
<td>34</td>
<td>51</td>
</tr>
<tr>
<td>Office space</td>
<td>64</td>
<td>74</td>
</tr>
<tr>
<td>Lab space</td>
<td>42</td>
<td>47</td>
</tr>
<tr>
<td>Equipment</td>
<td>42</td>
<td>49</td>
</tr>
<tr>
<td>Travel money</td>
<td>31</td>
<td>47</td>
</tr>
<tr>
<td>Clerical support</td>
<td>22</td>
<td>38</td>
</tr>
<tr>
<td>Employees or students</td>
<td>42</td>
<td>53</td>
</tr>
</tbody>
</table>
Who has access to career-advancing experiences?

Table 2. Percentage of respondents with career-advancing experiences.*

<table>
<thead>
<tr>
<th></th>
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<th>Very highly developed countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Gave a talk at a conference as an invited speaker</td>
<td>51</td>
<td>67</td>
</tr>
<tr>
<td>Served on committees for grant agencies</td>
<td>22</td>
<td>37</td>
</tr>
<tr>
<td>Conducted research abroad</td>
<td>54</td>
<td>71</td>
</tr>
<tr>
<td>Acted as a boss or manager</td>
<td>38</td>
<td>53</td>
</tr>
<tr>
<td>Served as editor of a journal</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>Advised graduate students</td>
<td>63</td>
<td>77</td>
</tr>
<tr>
<td>Served on thesis or dissertation committees (not as an adviser)</td>
<td>52</td>
<td>66</td>
</tr>
</tbody>
</table>
Challenges
Implicit Bias

• We are all (women and men) prone to unintentional bias
  Think not? try the Implicit Associations Test at
  https://implicit.harvard.edu/implicit/demo

• This affects many decisions we make in the course of our professional duties

*The Gender Equity Project, Virginia Valian*  
www.hunter.cuny.edu/genderequity/
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.

Has time cured this? Alas no... see Moss-Racusin et al., PNAS 12111286109 (2012).
Our beliefs about pre-requisites for success are part of the problem:
Family Responsibilities


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

![Bar Chart]

**Total Hours per Week**

<table>
<thead>
<tr>
<th></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
Who does the Housework around the world?

Figure 1. The majority of housework is more likely to be done by women than by men. The results shown here were derived from the responses to a global survey conducted by the American Institute of Physics and filled out by almost 15,000 physicists. To generate this graph we disregarded the responses of those physicists whose spouse or partner was not employed. The disproportionate burden of housework on women holds independent of level of development of the respondent’s country.
Leaks in the Pipeline: PhD to Tenure Track Position

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
Figure 2. Having children tends to slow the career progress of women physicists but not that of their male counterparts. To generate the data that produced this graph, a global survey analyzed responses from some 15,000 physicists to compare their career progress with that of their colleagues.
A 2009 survey of postdoctoral fellows at the University of California showed that women who had children or planned to have them were more likely to consider leaving research.

**POSTGRADUATE POSITIONS**

No children or plans to have them

- **MEN:** 19%
- **WOMEN:** 20%

No children, but plan to have them

- **MEN:** 17%
- **WOMEN:** 28%

Children previous to postdoc

- **MEN:** 19%
- **WOMEN:** 32%

New children since start of postdoc

- **MEN:** 20%
- **WOMEN:** 41%

**POSTDOCS WHO DECIDED AGAINST CAREERS AS RESEARCH FACULTY MEMBERS (2009)**

“The plan to have children in the future, or already having them, is responsible for an enormous drop-off in the women who apply for tenure-track jobs.”

Wendy Williams, Cornell University

**EARLY CAREER**

Female representation among science and engineering faculty members in the United States has lagged behind gains in graduate education, in part because many women do not apply for tenure-track jobs. But women who do apply are more likely than men to receive interviews and offers.

“At least part of the lack of applications is due to the fact that women look at these careers and don’t see people like themselves.”

Hannah Valantine, Stanford University

**MEN**

- Female PhDs (1999–2003): 45%
- Female applicants for academic jobs: 26%
- Female interviewees for academic jobs: 28%
- First job offers that went to women: 34%

**WOMEN**

- Female PhDs (1999–2003): 32%
- Female applicants for academic jobs: 18%
- Female interviewees for academic jobs: 25%
- First job offers that went to women: 29%

**BIOLOGY**

- Female PhDs (1999–2003): 45%
- Female applicants for academic jobs: 26%
- Female interviewees for academic jobs: 28%
- First job offers that went to women: 34%

**CHEMISTRY**

- Female PhDs (1999–2003): 32%
- Female applicants for academic jobs: 18%
- Female interviewees for academic jobs: 25%
- First job offers that went to women: 29%

**PHYSICS**

- Female PhDs (1999–2003): 14%
- Female applicants for academic jobs: 12%
- Female interviewees for academic jobs: 19%
- First job offers that went to women: 20%
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)
Changes

• **Context & Challenge**: Scarcity!
  – Women’s participation rate in physics (and other STEM fields) remains low compared to that of men.
  – Social Science research reveals numerous causes: family responsibilities, dual-career issues, implicit bias, negotiation skills, isolation...

• The sessions you will participate in during this ICTP workshop will identify **solutions** that can make a difference — and equip you with **skills** to help you advance in your career.

• Let’s start working together!
Resources:

AIP Statistical Research Center:  www.aip.org/statistics/

American Physical Society
   C-LGBT Report:  go.aps.org/lgbtphysics

Faculty Family Friendly Edge:  ucfamilyedge.berkeley.edu/

Gender Equity Project:  www.hunter.cuny.edu/genderequity/

Implicit Associations Test  https://implicit.harvard.edu/implicit/demo

lgbt+physicists
   Website, with Out and Ally lists  lgbtphysicists.org

NSF ADVANCE
   Portal Website:  www.portal.advance.vt.edu/
   Michigan State’s ADAPP-ADVANCE Project:  www.adapp-advance.msu.edu/
   StratEGIC Gender Equity Toolkit:  www.colorado.edu/eer/research/strategic.html


More Resources:

Books:
• L. Babcock and S. Laschever [negotiation], *Women Don’t Ask* and *Ask For It*
• S.E. Page [diversity and teams] *The Difference*
• C. Steele [stereotype threat] *Whistling Vivaldi*
• J. Williams & R. Dempsey [patterns of bias] *What Works for Women at Work*
• E. Ideal & R. Meharchand, eds. [women role models in STEM] *Blazing the Trail*
• T. Wilson [conscious & unconscious mental processes] *Strangers to Ourselves*

Articles:
• *Nature* special issue: Vol. 495, 7 March 2013
• Inside Higher Ed, column: *Mend The Gap* [E.H. Simmons]
• Inside Higher Ed, column: *Mentoring 101* [Kerry Ann Rockquemore]

Organizations:
• National Center for Faculty Development & Diversity [http://www.facultydiversity.org](http://www.facultydiversity.org)
• MentorNet [http://mentornet.org](http://mentornet.org)
• National Society of Black Physicists [http://nsbp.org](http://nsbp.org)
• National Society of Hispanic Physicists [http://www.hispanicphysicists.org](http://www.hispanicphysicists.org)
• SACNAS [http://sacnas.org](http://sacnas.org)