Critical Issues Facing the Physics Community

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Director of Education and Diversity
American Physical Society
Outline

• Data
• APS Programs
  • PhysTEC
  • APS Bridge Program
  • Programs for Women in Physics
• Research
Physics / STEM Bachelor Degrees

Source: IPEDS Completion Survey
Fraction of Women Earning STEM Degrees
Percentage of Women in Physics

Source: IPEDS, AIP SRC

Δ=12 Years

Bachelor
Doctorate
PostDoctorate
Percentage of Women in Physics

Source: IPEDS, AIP SRC
US Demographics

White (Non-Hispanic)
Hispanic (of any race)
Black
Native Americans
Asian

Source: US Census
African American Physics Majors

Percentage of College-Age Black, Non-Hispanics in US Population

Source: IPEDS, US Census
Hispanic Undergraduate Majors

US College-Age Hispanic Population

- Engineering
- Biology
- Chemistry
- Math & Stats
- Earth Science
- Physics

1995 2000 2005 2010

- 105
- 273
URM Physics PhDs to Minority Population

9-10% of BS degrees in physics are granted to underrepresented minorities

52 PhDs awarded to minorities in 2010

Sources: IPEDS Completion survey by race, US Census
Relative Demand by Field: Highest Demand Fields

**Considerable Shortage (5.00 - 4.21)**
- Physics: 4.26

**Some Shortage (4.20 - 3.41)**
- Spec. Ed. – Multi-categorical: 4.15
- Mathematics: 4.13
- Chemistry: 4.12
- Spec. Ed.: 4.06
- Spec. Ed. – Mild/Moderate Disabilities: 4.04
- Spec. Ed. – Learning Disability: 4.03
- Spec. Ed. – Mental Retardation: 4.03

2010 AAEE (*American Association of Employment in Education*)
Educator Supply and Demand in the United States Report
High school classes taught by teacher with degree in the field

Source: Schools and Staffing Survey

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High School Students Studying Physics

Source: AIP Statistical Research Center
APS Programs for Women

• CUWiP
• Professional Skills Development workshops
• Childcare grants to attend meetings
• CSWP gazette
• Female-friendly website
• CSWP climate site visits
• Blewett fellowship
• Travel grants / Speakers list / Rosters
• Woman Physicist of the Month

Emma Ideal
Yale University
Conferences for Undergraduate Women in Physics

2014 Sites
- Stony Brook
- University of Maryland / NIST
- University of Chicago
- Penn State
- University of Utah
- Louisiana State
- Florida State
- Berkeley

APS Conferences for Undergraduate Women in Physics
January 17-19, 2014
aps.org/link/cuwip

Joint Diversity Statement

08.2 JOINT DIVERSITY STATEMENT
(Adopted by APS, NSBP, NSHP in 2008)

To ensure a productive future for science and technology in the United States, we must make physics more inclusive. The health of physics requires talent from the broadest demographic pool. Underrepresented groups constitute a largely untapped intellectual resource and a growing segment of the U.S. population.

Therefore, we charge our membership with increasing the numbers of underrepresented minorities in physics in the pipeline and in all professional ranks, with becoming aware of barriers to implementing this change, and with taking an active role in organizational and institutional efforts to bring about such change. We call upon legislators, administrators, and managers at all levels to enact policies and promote budgets that will foster greater diversity in physics. We call upon employers to pursue recruitment, retention and promotion of underrepresented minority physicists at all ranks and to create a work environment that encourages inclusion. We call upon the physics community as a whole to work collectively to bring greater diversity wherever physicists are educated or employed.
APS Bridge Program: Key Components

- Recruiting through graduate programs across the US (now 110+ institutions, representing 75% of all doctoral students)
- Spend 1-2 years in a “Bridging program”
  - Take advanced UG or entry-level graduate coursework
  - Graduate-level research
  - Demonstrate ability to do independent research and succeed in graduate-level coursework
  - Receive coaching on preparing graduate admissions package (letters, GRE, statements)
  - Accepted into doctoral program
- Receive mentoring in doctoral program (especially in first years)
- Research into barriers; disseminate successful program elements
- Build a national coalition of departments committed to improving participation
Bridge Types

Masters degree as a “transition” to PhD
• Take advanced UG and entry-level graduate coursework
• Do research with doctoral faculty
• Demonstrate ability to do independent research and succeed in graduate-level coursework
• Become “known” to graduate faculty
• Separate doctoral-level admissions
• Receive graduate-assistantship

Post-baccalaureate year
• Similar attributes to Masters program, but not formally admitted
• Begin research in summer
Bridge Programs in Physics

• Fisk / Vanderbilt
• Columbia University
• University of Michigan
• MIT

APS Sites (will add 3 more):
• Ohio State
• South Florida
Bridge Sites

- Recruitment (APS, and institution)
- Admission decisions (criteria, process)
- Financial support (timing, amount)
- Multiple Mentoring (timing, intervention)
- Progress monitoring (coursework, tutors if needed, research “fit”)
- Coursework (induction advising critical)
- Community (induction, socialization)
- Research (appropriate match)
- Application coaching (GRE, statements, schools)
Student Eligibility

- Bachelor’s degree in physics or closely related discipline
- US citizen or permanent resident
- Either:
  - Did not apply to graduate program this year
  - Applied but was not accepted
- Be committed to improving diversity in physics
- Meet individual requirements of the institution

Students may not be currently enrolled or have an existing physics graduate degree
Bridge Program
First Year Achievements

[Bar chart showing the number of students (in red and blue) for each project year from 1 to 5. The red bar represents the project achievement, and the blue bar represents the project goal.]
2013 Bridge Students

Ohio State University:

- Brian (bridge fellow, AA, APS)
- Brady (bridge fellow, HA, APS)
- Kevin (Grad direct admit, HA, OSU)
- Meron (bridge fellow, A, OSU) [external recruitment, non-US]

University of South Florida:

- Carlos (bridge fellow, AA/HA, APS)
- Manuel (bridge fellow, HA, USF) [external recruitment]
- Kristin (bridge fellow, C, USF)
- Brian (Grad direct admit, HA, USF)

12 Applicants sent to other programs (7 others not sent), 6 selected for graduate programs.
Research Efforts

• Project progress
  • Students get accepted into PhD programs
  • Students make progress
  • Elements of successful programs
  • Sustainability

• Graduate admissions
  • Admissions practice (85% completion rate)
  • Perceptions by students

• Retention

• Non-cognitive admissions measures
The APS Bridge Program Summer Meeting will bring together experts to discuss efforts to increase the number of underrepresented minorities (URMs) who receive PhDs in physics. This year’s conference will focus on exploring and understanding the role of the M.S. degree in promoting URMs in physics.

Workshops, panel discussions, and presentations will address topics including:

- Establishing MS/PhD institutional relationships
- Role of Masters’ degrees for URM students
- Barriers to student advancement to the PhD
- Mentoring
- Non-cognitive admissions measures

Who should attend: faculty, students, and administrators interested in increasing the number of underrepresented students pursuing PhDs in physics.
PhysTEC Project Goals

• Transform physics departments to engage in preparing physics teachers
• Demonstrate successful models for increasing the number of highly-qualified physics teachers
• Spread best-practice ideas throughout the physics teacher preparation community
PhysTEC Project Outcomes

Teachers Graduating from PhysTEC "Legacy" Sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of Teachers (3 year totals)</th>
<th>funding period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona (2001-2007)</td>
<td>3</td>
<td>Pre funding</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Y1-Y3</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Y4-Y6</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Post funding</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Post funding</td>
</tr>
<tr>
<td>Arkansas (2001-2008)</td>
<td>2</td>
<td>Pre funding</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Y1-Y3</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Y4-Y6</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Post funding</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Post funding</td>
</tr>
<tr>
<td>W. Michigan (2001-2007)</td>
<td>5</td>
<td>Pre funding</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Y1-Y3</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Y4-Y6</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>Post funding</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>Post funding</td>
</tr>
<tr>
<td>Cal Poly (2003-2006)</td>
<td>2</td>
<td>Pre funding</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Y1-Y3</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Y4-Y6</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Post funding</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Post funding</td>
</tr>
<tr>
<td>Colorado (2004-2007)</td>
<td>3</td>
<td>Pre funding</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Y1-Y3</td>
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<tr>
<td></td>
<td>18</td>
<td>Post funding</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>Post funding</td>
</tr>
<tr>
<td>Non-PhysTEC*</td>
<td>2</td>
<td>Pre funding</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Y1-Y3</td>
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<td>7</td>
<td>Y4-Y6</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Post funding</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>Post funding</td>
</tr>
</tbody>
</table>

*Number of physics certifications averaged over 319 institutions in 15 states. Note that all PhysTEC teachers are more highly qualified than the minimum standard in most states.
PhysTEC Project Outcomes

Future Teachers at Currently Funded Sites

<table>
<thead>
<tr>
<th>Year</th>
<th>Sites Funded</th>
<th>Before PhysTEC Funding</th>
<th>During PhysTEC Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-2013</td>
<td>4</td>
<td>10</td>
<td>40</td>
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<tr>
<td>2011-2013</td>
<td>4</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>2012-2013</td>
<td>6</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>

Total Number of Future Teachers

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Annual PhysTEC Graduates

The graph shows the number of Annual PhysTEC Graduates from 2002 to 2012. The number of graduates increased significantly from 2002 to 2012, with a peak in 2012.
Physics Departments with Teacher Education Programs (36% of all)
PhysTEC Member Institutions

Physics Teacher Education Coalition Member Institutions

Institutions in red have received PhysTEC funding
- Supported Sites
- Member Institutions

* 5 additional Member Institutions are outside of the United States

Updated August 2013
Teacher Education is a Local Issue

Teach within X miles of their institution
- 60% 50 miles
- 25% 50-200 miles
- 15% >200 miles

PhysTEC Teachers: 54 respondents

33 of 54 respondents teach at a school that is within 50 miles of their PhysTEC institution
13 of 54 respondents teach at a school that is 50 to 200 miles from their PhysTEC institution
8 of 54 respondents teach at a school that is more than 200 miles from their PhysTEC institution

*NOTES
The 54 respondents account for less than one-third of all PhysTEC graduates, so it does not necessarily follow that this distribution pattern holds for all PhysTEC graduates.

In this small sample, there were no statistically significant differences for graduates from schools located in smaller versus larger cities (less than 100,000 versus more than 100,000).

The placement of the dots in this graph is representative only and does not necessarily indicate the actual location of respondents.
The PhysTEC institution is indicated by the star.
Admissions Bias?

GRE Scores for Physics Subject Test

<table>
<thead>
<tr>
<th>Before Graduate Admission</th>
<th>After Graduate Admission</th>
<th>Graduate GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (580)</td>
<td>Female (560)</td>
<td>3.7</td>
</tr>
<tr>
<td>Male (640)</td>
<td>Male (640)</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Source: PhD Recipients from Oregon State University
GRE Physics Scores: Impact of Cutoff Scores

Source: ETS

- Fraction (F): 0.25
- Fraction (M): 0.46

Score: 650
GRE Physics Scores: Impact of Cutoff Scores

0.09 (Black)
0.34 (Hispanic)
0.44 (White)
0.61 (Asian)

Fraction (White)
Fraction (Hispanic)
Fraction (Black)
Fraction (Asian)
• Entrepreneurship Education (4-6 June; American Center for Physics, College Park, MD)
• Department Chairs (6-8 June; ACP)
• New Faculty Workshop (23-26 June; ACP)
• APS Bridge Program (25-27 June; ACP)
• New Faculty Workshop (November; ACP)
• PhysTEC (19-20 May; Austin, TX)
• Building Thriving Programs (summer 2014)