Admissions to Physics Graduate Programs: Challenges to Diversity

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• Thanks to the NSF for supporting the Bridge Program and, thus, providing a vehicle for this study.
• Thank you for listening!
Introduction
Master’s degrees in the U.S.

Physics Master’s Degrees Conferred by Type of Degree and Department, 1983 through 2012.

Number
1,100
1,000
900
800
700
600
500
400
300
200
100
0

Master’s En Route at PhD Departments
Master’s Exiting from PhD Departments
Master’s Exiting from Master’s Departments*

Degree Year
83 86 88 90 92 94 96 98 00 02 04 06 08 10 12

*These departments offer a master’s as their highest physics degree.

http://www.aip.org/statistics

Source: AIP Statistical Research Center
Introduction

Doctoral degrees in the U.S.

Source: AIP Statistical Research Center
Introduction
Trends in Bachelor’s degrees for African American and Hispanic American students

Number of Physics Bachelor’s Degrees Earned by African Americans and Hispanic Americans, Classes of 1994 through 2010.

http://www.aip.org/statistics

Source: AIP Statistical Research Center
# Introduction
Recent graduate degrees by race/ethnicity


<table>
<thead>
<tr>
<th></th>
<th>3-Yr Average Number</th>
<th>Percent* of all Physics Master’s</th>
<th>Percent of U.S. Physics Master’s**</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>450</td>
<td>58</td>
<td>86</td>
</tr>
<tr>
<td>Asian American</td>
<td>26</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Hispanic American</td>
<td>27</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>African American</td>
<td>18</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Other U.S. Citizens</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Non-U.S. Citizens</td>
<td>250</td>
<td>32</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>777</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Note: Exiting physics master’s are individuals who upon receiving their degrees leave their current departments. They include graduates from departments where the master’s is the highest degree offered as well as master’s leaving departments that offer a PhD.

* Percents for all master’s do not add to one hundred due to rounding.
**Based on a three year average of 527 U.S. citizens.

http://www.aip.org/statistics

Source: AIP Statistical Research Center
Introduction
Recent graduate degrees by race/ethnicity

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>3-Year Average Number</th>
<th>Percent of all Physics PhDs</th>
<th>Percent of U.S. Physics PhDs*</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>744</td>
<td>45</td>
<td>88</td>
</tr>
<tr>
<td>Asian American</td>
<td>41</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Hispanic American</td>
<td>28</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>African American</td>
<td>17</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Other U.S. Citizens</td>
<td>13</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Non-U.S. Citizens</td>
<td>826</td>
<td>49</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,669</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Based on a 3-year average of 843 U.S. citizens.

http://www.aip.org/statistics

Source: AIP Statistical Research Center
Introduction
What happens between undergraduate and graduate school?

- There are \(~ 400\) students who identify as African American, Hispanic American or American Indian/Alaskan Native who complete Bachelor’s degrees in physics every year.
  - A disproportionate number of these students do not go on to enroll in graduate programs.
- Graduate admissions are difficult (and intimidating for applicants), so a thorough investigation is warranted.
  - We should be conscientious to ensure that admissions decisions are based on valid and appropriate criteria.
  - The messages we translate to prospective students determines, in part, who attempts to get into graduate school.
Data Collection
Survey development and sampling

- A survey was developed based on earlier research (e.g. Project Crossover) as well as through discussions with the Bridge Program Management Team and contacts in the physics community.
  - The initial draft was given to participants (faculty and students) at the 2\textsuperscript{nd} Graduate Education in Physics Conference (January 2013).
  - Feedback was solicited from these and other focus groups.
  - The finalized instrument was put online for data collection.
- Two separate samples of data:
  - Doctoral programs were surveyed from August to November 2013.
  - The survey was modified minimally and deployed to Master’s-granting institutions from January to March 2014.
  - Recipients of the solicitation email and periodic reminders (two lists of department chairs and program directors maintained by the APS) were asked to respond to the survey and distribute to others at their institution.
Data Collection
Final response rates

• Doctoral programs:
  • The APS list of program coordinators and department chairs contained 199 different institutions.
  • The survey received responses from 170 individuals, who identified themselves as being at 153 different institutions.
  • The institutional responses rate is estimated to be at least 77% of those solicited (including about 85% of active PhD programs).
  • A few departments did offer responses from more than one individual; at most we received three individual responses from a single institution.

• Master’s programs:
  • Solicited responses from 57 different institutions.
  • Received surveys from 45 individuals identified as being at 43 different institutions.
  • $\geq 75\%$ institutional response rate.
  • At most, received two individual responses from a single institution.
Admissions Decisions

What matters most?

Q12. Please indicate the importance of each of the following factors to your admissions decisions:

-> 21 different factors, all rated from “1 - Least important” to “7 - Most important” or indicated as “Don’t Use”:

| a. GPA/grades - general          | m. Quality of interviews (conducted by your department) |
| b. GPA/grades - physics/math    | n. Proximity/familiarity to department                 |
| c. Undergraduate courses taken  | o. Personal statements                                 |
| d. Undergraduate institution    | p. Prior research experiences                          |
| type/reputation                 | q. Prior publications                                  |
| e. GRE quantitative scores      | r. Prior conference publications                       |
| f. GRE verbal scores            | s. Student research interests and/or stated faculty advisor preferences |
| g. GRE written scores           | t. Departmental research opportunities                 |
| h. GRE physics subject scores   |                                                     |
| i. TOEFL scores                |                                                     |
| j. Quality of letters of        |                                                     |
| recommendation                  |                                                     |
| k. Reputation of recommenders   |                                                     |
| l. Recommenders’ rankings of    |                                                     |
| students                        |                                                     |
| u. Other                        |                                                     |
**Q12.** Please indicate the importance of each of the following factors to your admissions decisions:

- Average importance from 1 to 7 for each factor:

```
a. GPA/grades - general
b. GPA/grades - physics/math
c. Undergraduate courses taken
d. Undergraduate institution type/reputation
e. GRE quantitative scores
f. GRE verbal scores
g. GRE written scores
h. GRE physics subject scores
i. TOEFL scores
j. Quality of letters of recommendation
k. Reputation of recommenders
l. Recommenders’ rankings of students
m. Quality of interviews (conducted by your department)
n. Proximity/familiarity to department
o. Personal statements
p. Prior research experiences
q. Prior publications
r. Prior conference publications
s. Student research interests and/or stated faculty advisor preferences
t. Departmental research opportunities (specific availability in research groups)
```
Q12. Please indicate the importance of each of the following factors to your admissions decisions:

- > Fraction of “Don’t Use” responses for each data set:

- a. GPA/grades - general
- b. GPA/grades - physics/math
- c. Undergraduate courses taken
- d. Undergraduate institution type/reputation
- e. GRE quantitative scores
- f. GRE verbal scores
- g. GRE written scores
- h. GRE physics subject scores
- i. TOEFL scores
- j. Quality of letters of recommendation
- k. Reputation of recommenders
- l. Recommenders’ rankings of students
- m. Quality of interviews (conducted by your department)
- n. Proximity/familiarity to department
- o. Personal statements
- p. Prior research experiences
- q. Prior publications
- r. Prior conference publications
- s. Student research interests and/or stated faculty advisor preferences
- t. Departmental research opportunities (specific availability in research groups)
Admissions Decisions
What matters most?

• Takeaways from Q12:
  • Shared high priorities:
    • GPA/grades in physics/math
    • Quality of letters of recommendation
    • Undergraduate courses taken
  • Differences in priorities between two samples:
    • Importance of GRE quantitative and physics subject scores
    • Overall use of any parts of GRE
    • Prior conference publications
  • Overall, Master’s-granting institutions appear to be using fewer criteria in admissions, perhaps reflecting the lower number of applications they receive.
  • Are there really multiple, distinct “strategies” in admissions practices?
    See Jacqueline Doyle’s poster at PERC tomorrow morning (P2-94)!
• The ETS guide book states

The GRE Board believes that GRE scores should never be the sole basis for an admissions decision and that it is inadvisable to reject an applicant solely on the basis of GRE scores. A cutoff score below which every applicant is categorically rejected without consideration of any other information should not be used. (p. 14)

• Casey Miller has noted how the use of a cutoff score may have a significant impact on graduate diversity.

• The predictive validity of GRE scores should also be understood appropriately: GRE scores are significantly correlated to first-year graduate GPA and success in qualifying exams, but much more weakly related to outcomes like citations and research products.
Q13. Are GRE scores (quantitative, verbal, written, or physics subject) used as a minimum cutoff in admissions decisions?

- Master’s institutions: 6 indicated Yes, 39 indicated No.
- Doctoral institutions: 56 indicated Yes, 115 indicated No.

Q13a. Please briefly describe how GRE scores are used:

- Master’s institutions: 4 out of the 6 Yes responses provided more details, 5 out of the 39 No responses did as well.
- Doctoral institutions: 49 out of the 56 Yes responses provided more details, 29 out of 115 No responses did as well.
Q13a. Please briefly describe how GRE scores are used:

-> In the Doctoral data, an analysis of the No responses indicates the long shadow cast by GREs:
   -> Several indicate a process in which the GRE **effectively acts as a cutoff**, despite answering No to Q13.
   e.g. “No fixed cutoff, but GRE quantitative should be about 90 [sic] percentile or higher.”
   e.g. “No hard cutoff, but used as a first cut in going through applications and GRE scores trump GPA scores in assessing students.”
   -> Another typical sentiment is that **low GRE scores need to be compensated** for by some other outstanding quality:
   e.g. “There is no strict cutoff, but a very low score means other parts of the application must compensate and explain why the student may nonetheless be successful in our program.”

-> In the Master’s data, of the 5 No responses that provided more details, one person reported a similar, effective use of a cutoff.
Q16. Please explain how applicants’ gender is factored into application reviews and decisions, if at all:

- ~ 51 indicated it is not factored in at all (17 non-responses)
- Of the ~ 103 responses indicating some consideration, a few themes are evident:

  - A number of respondents indicate that their institution offers diversity fellowships (some before admissions, some after)
    
    e.g. “Some fellowships are available only for female students.”

  - Some programs review female applicants first, or make sure to spend a little more time reading female applications.

  - Some respondents report not being very successful as they would like at attracting female students:

    e.g. “Approximately 15%-20% of our applicants are female. We make an effort to increase the representation of women in our program and, other things being equal, we always give priority to female applicants in our admissions. Even then, we end up with only 10%-15% female students in our incoming classes.”
Q17. Please explain how applicants’ race/ethnicity (e.g. students who identify as underrepresented minorities) is factored into application reviews and decisions, if at all:

-> Doctoral data: \(\sim 48\) indicated it is not factored in at all (19 non-responses). Themes from the \(\sim 104\) responses indicating some consideration:

- A significant number of respondents focus solely on the availability of diversity fellowships.
- A number of responses outline policies that give priority to domestic and/or underrepresented students if “other factors are equal”.
- Notably, several respondents indicate that not enough students (sometimes, zero) from underrepresented backgrounds apply to their program.

  e.g. “Unlike the male/female situation, we are not very successful in recruiting underrepresented minorities. If we find a candidate, we find a fellowship. The numbers are just not there in our pool.”

  e.g. “We get very few (to none) applicants that identify themselves at underrepresented minorities, the ones we get we look at carefully to see if we can accept them.”

-> Master’s data: \(\sim 21\) indicated it is not factored in (12 non-responses). The 12 responses primarily indicate a similar sense that there is lack of applicants from underrepresented students.
• Takeaways:
  • For student applicants:
    • Consider applying to at least a few different graduate programs.
    • Before applying to graduate school, find out how schools make decisions, what factors they consider important, etc.
  • For faculty:
    • GRE cutoffs are used explicitly or implicitly by a sizable number of doctoral institutions, and GRE scores cast a long shadow elsewhere. Consider the ETS’ recommendations.
    • GRE physics subject test – many doctoral programs consider it highly important, but several institutions (both doctoral and Master’s) are not using it at all.
Discussion
Considerations for the future

• What are appropriate and effective uses for GREs? Should the answer be different for doctoral and Master’s programs?
• Do programs (of all types) need to think more explicitly about the compositions of their annual cohorts?
• Messaging and marketing – how much effort is really being made to identify and attract a larger, more diverse pool of graduate students?
  • Are we transmitting what we really care about to potential applicants?
  • Connecting Master’s and doctoral programs – will coordination between programs help facilitate the diversification of the physics community?
  • There are many potential applicants!
• What happens after students are admitted and enrolled?
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Enhancing Diversity in Graduate Education

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.