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Graduate Student Report: First-Year Physics and Astronomy Students in 2002 and 2003

Highlights

- There were a total of 2,947 first-year graduate physics and astronomy students in 2002 and 3,076 in 2003, the highest level since 1994.
- After dropping steadily for the last 30 years to a low of 47% in 2001, the percentage of incoming students who are US citizens rose to 54% in 2003.
- Among foreign countries, China continues to supply the most graduate students, with India a distant second. Despite reported visa problems, the percentage of students from these two countries has grown since the last time the survey was conducted in 2000.
- The primary type of support for both full-time PhD-level and masters students is teaching assistantships. Part-time students are much more likely to depend on their non-departmental employment or personal savings.
- The way that students apply for graduate school is changing, with 55% submitting at least one application electronically in 2002 & 2003, up from 10% in 1999 and 2000.
- For US students, the most popular subfields are astronomy and astrophysics (16%), condensed matter (14%), and particles and fields (11%). Among foreign students, condensed matter (22%) is first, followed by particles and fields (10%). A quarter of all students had not yet chosen a subfield by the end of their first-year.
- Most PhD students aspire to work in an academic setting (70%). For those expecting to earn a masters in physics or astronomy as their highest degree, the most popular goal is to work in an industrial setting (40%), followed by work in academia (23%).

The American Institute of Physics has regularly reported information about physics and astronomy graduate students since 1968. In more recent years the survey has shifted to focus on first-year graduate students, with a survey of the full population of graduate students every few years. This report covers

surveys of first-year students for the academic years ending in 2002 and 2003. Response rates for the known population were 48% and 46% respectively (**Table 1**). Almost 90% of the responses were collected electronically. Differences in response rates by citizenship were minimal.

Table 1. Number of physics & astronomy graduate students in 2002 & 2003		
	2002	2003
1st Year Students*	2,947	3,076
1st Year US Students*	1,462	1,675
1st Year Foreign Students*	1,485	1,401
US Respondents	633	754
Foreign Respondents	692	611
Respondents with unknown citizenship	101	61
Total Respondents	1,426	1,426
	48%	46%

*Data from AIP Survey of Enrollments and Degrees
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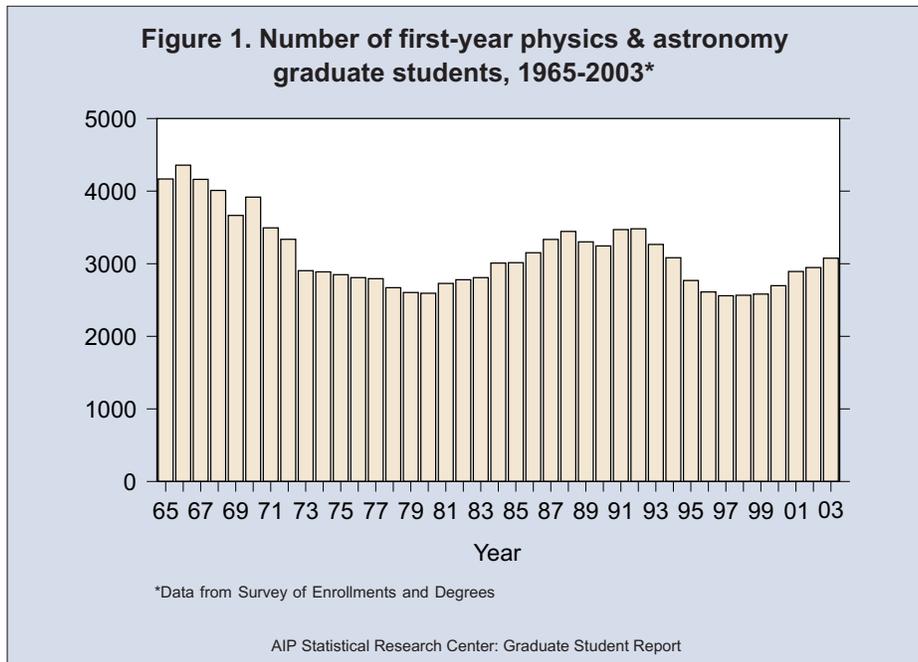
For the purposes of this report, first-year students are defined as those entering a particular department for the first time. Thus, students who have completed previous graduate study in one department and then transferred to a new department would be considered as first-year in their new department.

Table 2 shows the characteristics of first-year physics and astronomy graduate students. While both disciplines continue to be predominantly male, there is a significantly higher percentage of women in astronomy departments. Physics departments, on the other hand, have a higher percentage of foreign students. Students at astronomy departments tend to be younger than their physics counterparts, due to the higher percentage of typically younger US citizens. The vast majority of students in both disciplines also earned their bachelors degrees in either physics or astronomy.

Table 2. Profile of first-year physics & astronomy graduate students by type of department, 2002 & 2003		
	Physics	Astronomy
Total	5,652	371
Gender*		
Male	79%	67%
Female	21	33
Citizenship*		
US	51%	70%
Foreign	49	30
Median Age	24	23
Highest Physics or Ast. Degree Expected		
PhD	86%	91%
Masters	6	2
Undecided	7	5
No degree intended	1	2
Field of Bachelor's Degree**		
Physics	85%	59%
Astronomy	2	33
Other	13	8

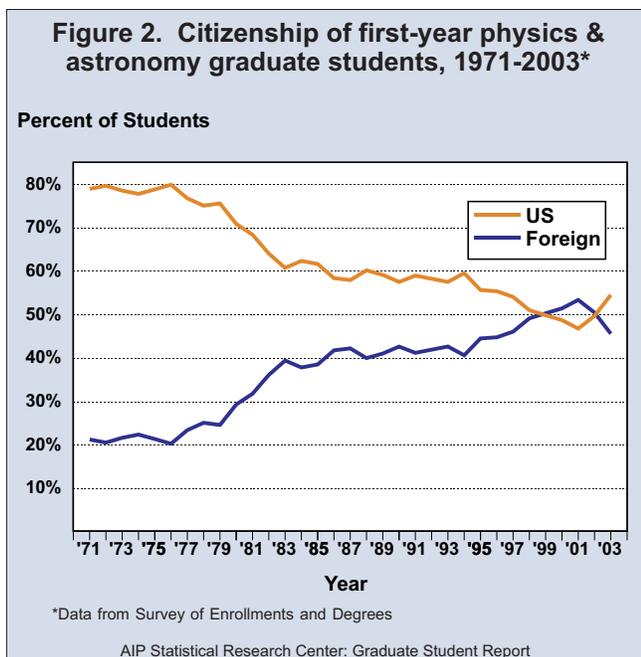
*Data from the AIP Survey of Enrollments and Degrees
**US citizens only
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Total enrollment of first-year physics and astronomy graduate students has fluctuated considerably over time (**Figure 1**). After reaching a recent peak of 3,481 in 1992, the number fell to a low of 2,559 by the end of the decade. Since then, the number has been rising slowly but steadily, reaching the latest high of 3,076 in 2003. Whether this trend of increasing enrollments will continue will depend on several factors, including the economic outlook in the US and the ease with which foreign students can enter this country to study.



The percentage of incoming students who are from the US has taken an interesting turn in recent years (**Figure 2**). For nearly 30 years, the percentage of first-year students who were from the US slowly dropped, from a high of 80% in 1976 to 47% in 2001. Beginning with

the students who entered in the fall of 2001, the percentage of students who were from the US began to rise, reaching 54% in 2003. **Table 3** shows how the number of students from the US rose 30% from 1999 to 2003.



Although it might be tempting to ascribe this shift to the impact of the events of September 11, 2001, the shift actually started with students who had already begun their studies in the US prior to that date. While difficulties in obtaining

Table 3. Number of first year physics and astronomy graduate students by year*

	Foreign	US
1999	1,297	1,285
2000	1,385	1,312
2001	1,542	1,351
2002	1,485	1,462
2003	1,401	1,675

*Data from Survey of Enrollments and Degrees

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visas may have exacerbated the change in subsequent years, it appears that at least some of the shift should be attributed to the recent increase in the number of US physics and astronomy bachelors, along with an overall weak US economy and a poor job market in many technical areas, which encouraged many of these individuals to continue with graduate study in physics.

Not only has the overall percentage of students who are from foreign countries changed, but also the regional composition has shifted as well (**Table 4**). Asia is by far the region from which the most students come, with China and India providing an increasing number of students. Europe showed significant declines in the number of students, particularly Eastern Europe. These findings are a bit surprising, considering many recent press reports about visa difficulties being especially severe for prospective Chinese students. However, as noted earlier, the class of 2002-03 was the first to enter after 9/11, and delays in the implementation of many of the new regulations means that the full impact may not show up until we analyze the responses of those entering in the fall of 2003.

There are some significant differences between US and foreign citizens (**Table 5**). There are more US students enrolled at masters institutions, which also gives rise to the finding that there are more part-timers among US students, because part-time students are almost exclusively found at masters institutions. Finally, there are significant differences in the percentage who had prior graduate level study in physics. Ten percent of US students had completed some physics or astronomy graduate

study prior to entering their current department, with a little over half of these even having earned a masters degree in the subjects. Among foreign students, the proportion with prior graduate level work in physics and astronomy jumps to almost half of the total, and nearly 75% of these had a masters equivalent in either physics or astronomy. Most of this study occurred outside of the US. The difference in age between US and foreign students is attributable to the more advanced standing of foreign students.

Table 4. Citizenship of non-US first-year physics & astronomy graduate students, 1999 & 2000 vs. 2002 & 2003

	1999 & 2000	2002 & 2003
Asia		
People's Republic of China	25%	29%
India	6	10
South Korea	5	6
Pakistan, Sri Lanka, Nepal, Bangladesh	4	6
Taiwan	2	2
Japan	2	2
Other Asia	2	3
Europe		
Eastern and Central	22	12
Western	15	13
Americas		
Mexico, South and Central America	4	6
Canada	3	2
Middle East	6	6
Africa	3	2
Australia, New Zealand	1	<1

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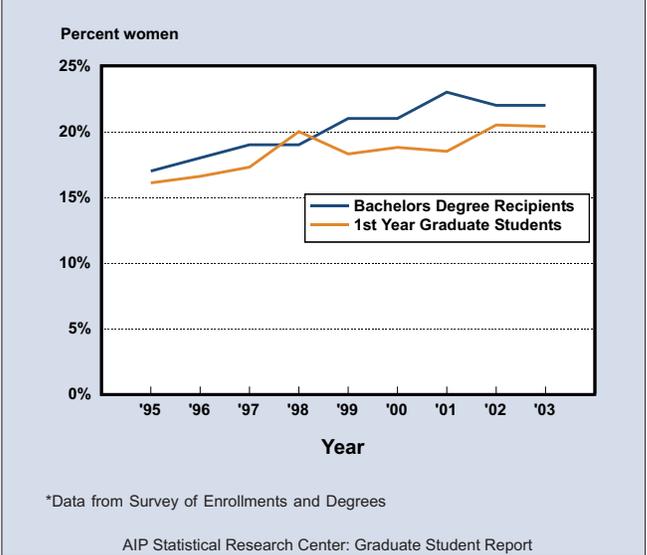
Table 5. Characteristics of first-year physics & astronomy graduate students by citizenship, 2002 & 2003

	US	Foreign
Total*	3,137	2,886
Gender*		
Male	79%	79%
Female	21	21
Median Age	23	24
Highest Physics or Astronomy Degree Expected		
PhD	81%	92%
Masters	7	4
Undecided	11	3
No degree intended	1	1
% with one or more years of prior graduate level physics or astronomy study	10%	47%
Field of Bachelors Degree		
Physics	82%	84%
Astronomy	5	5
Other	13	11
Status		
Full-Time	94%	99%
Part-Time	6	1
Current Institution Type*		
Masters-granting	11%	7%
PhD-granting	89	93

*Data from Survey of Enrollments and Degrees
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There has been significant growth in the enrollment of women among first-year physics and astronomy graduate students in recent years (**Figure 3**), rising from 16% in 1995 to slightly more than 20% in 2003. As expected, the 1st-year graduate student number has closely followed the rise in the percentage of women among bachelors degree recipients.

Figure 3. Percent women in physics and astronomy by academic level, 1995-2003*



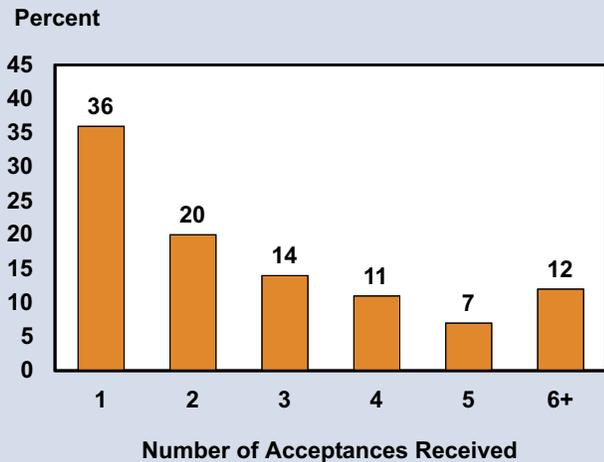
The way that students are applying for entry to graduate school is changing rapidly. As recently as 1999 and 2000, only 10% of accepted students had submitted an application electronically. By 2002 and 2003, 55% of students had submitted at least one online application (60% of US citizens and 49% of foreign students). Counting both online and paper applications, foreign students submitted more applications than US students, averaging 6.3 applications per student compared to 4.7 for US students. **Figure 4** shows the number of acceptances that successful applicants received. US and foreign students were accepted to roughly the same number of institutions.

To ensure success at the graduate level, it is crucial that students be well prepared by their undergraduate education. Over 90% of students indicated that their undergraduate preparation to study physics was at least adequate. The high levels of preparation are undoubtedly due to the very high percentage of students who earned

bachelors degrees in either physics or astronomy. As shown in **Figure 5**, a higher percentage of foreign students considered themselves to be at least "well prepared". As had been found in previous years, students who had earned their physics bachelors degree at a doctoral department were more likely to consider themselves "very well prepared" than those who earned their physics degree at a masters- or bachelors-level department.

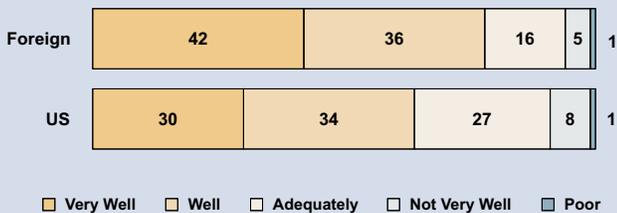
Table 6 shows the types of financial support that first-year students receive, with teaching assistantships being the most common. From

Figure 4. Number of acceptances received by first-year physics & astronomy graduate students, 2002 & 2003



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Figure 5. Self-assessed preparation for graduate study of first-year physics and astronomy students by citizenship, 2002 & 2003



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Table 6. Primary type of financial support for first-year physics & astronomy graduate students by department type, 2002 & 2003

	Department Type	
	PhD-Granting	Masters-Granting
Teaching assistantship	60%	69%
Research assistantship	18	13
Fellowship	18	3
Savings or loans	1	11
Non-Dept. employment	0	2
Other	3	2

Note: Table includes only full-time enrolled students.

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Table 7. Primary type of financial support for first-year physics and astronomy graduate students at PhD departments by citizenship, 2002 & 2003

	US Citizens	Foreign Citizens
Teaching assistantship	56%	63%
Research assistantship	17	19
Fellowship	23	14
Other	4	4

Note: Table includes only full-time enrolled students.

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earlier studies of entire graduate student populations, it is expected that a large proportion of the teaching assistants will move into research assistantships by the time they are in their third year of study. Masters students were more likely to depend on non-departmental employment and savings. While this table excludes part-time students, it should be noted that most of these also depend

Table 8. Major subfields of first-year physics & astronomy graduate students who have plans to receive a PhD, 2002 & 2003.

	US	
	Citizens	Foreign
Undecided	27%	23%
Astronomy and Astrophysics	16	7
Condensed Matter	14	22
Particles and Fields	11	10
Atomic and Molecular	6	3
Biophysics	4	5
Nuclear Physics	3	3
Optics and Photonics	3	7
Other	16	20

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on other forms of support. Interestingly, support for foreign students differed from those from the US, mostly in that US students were more likely to have fellowships, while beginning foreign students were more likely to be teaching assistants (**Table 7**).

Table 8 shows the major subfields physics PhD hopefuls have chosen. Almost a quarter of students have not yet chosen their subfield. For US students, apart from astronomy and astrophysics (which includes all students studying at astronomy departments), condensed matter remains the most popular subfield, with particles and fields second and atomic and molecular third. Among foreign students, condensed matter is an even more popular choice, with particles and fields second.

The biggest surprise when comparing students by the highest physics or astronomy degree

Table 9. Characteristics of first-year physics & astronomy graduate students by highest degree of department, 2002 & 2003

	Institution Type	
	PhD Granting	Masters Granting
Total N	5,444	579
Gender*		
Male	79%	75%
Female	21	25
Citizenship*		
US	51%	62%
Foreign	49	38
Highest Intended Physics or Astronomy Degree		
PhD	88%	51%
Undecided	6	22
Masters	5	25
No degree intended	1	2

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their department offers is how few of the students who are enrolled at masters-granting departments actually plan on ending their physics studies with a masters (**Table 9**). In fact, of all first-year graduate students who had decided what the highest physics or astronomy degree that they would like to earn, 93% said that they were aiming for a PhD. Though such a large proportion may set their sights on a PhD, every year at least a third of the graduate degrees conferred in physics are masters, most exiting from PhD departments, indicating that a significant number of students do not reach the goal they had when they began their graduate studies.

Future plans of graduate students vary greatly by the highest degree they intend to earn, and

Table 10. Plans to continue graduate study in the upcoming year for first-year physics & astronomy graduate students, by highest degree student plans to earn*, 2002 & 2003

	PhD Aspirants		Masters Aspirants	
	Enrolled at PhD Dept. (90%)	Enrolled at Masters Dept. (3%)	Enrolled at PhD Dept. (5%)	Enrolled at Masters Dept. (2%)
	Yes, in physics or astronomy in the same department	96%	69%	79%
Yes, in physics or astronomy at another institution	3	20	11	2
Yes, but in another subject	1	9	6	10
No, I will no longer be a graduate student	0	2	4	12

*students who are undecided or have no degree intended excluded

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the highest degree that their department offers (Table 10). For first-year PhD students at PhD departments, the overwhelming majority (96%) indicated that they plan on remaining in the same department in the upcoming year. More masters students enrolled at PhD departments and students at masters institutions reported plans to move on to other institutions, to transfer to other disciplines, or to leave graduate study altogether (possibly after earning their degree). Much of this is the result of the path they have chosen: for instance, someone who hopes to earn a PhD in physics but is enrolled at a masters institution obviously must transfer to a PhD institution at some point to reach their goal.

Not surprisingly, long-term career goals differ significantly by the highest intended physics or astronomy degree a student plans to earn (Figure 6). The majority of those who intend to earn a PhD in physics indicated that they would like to work in an academic setting. A fairly significant proportion of students aspiring to a masters indicated a desire to work in an industrial setting, and they were also more likely to indicate a desire to work at two-year

colleges and high schools, and to work in the medical field. When comparing the career aspirations of US citizens and foreign citizens, roughly the same percentage in both categories wanted work in academe, although almost all foreigners indicated a desire to go into university research and teaching, while 11% of US students preferred a four-year college setting.

Figure 6. Long-term* career goals by intended highest degree of first-year physics & astronomy graduate students, 2002 & 2003

