

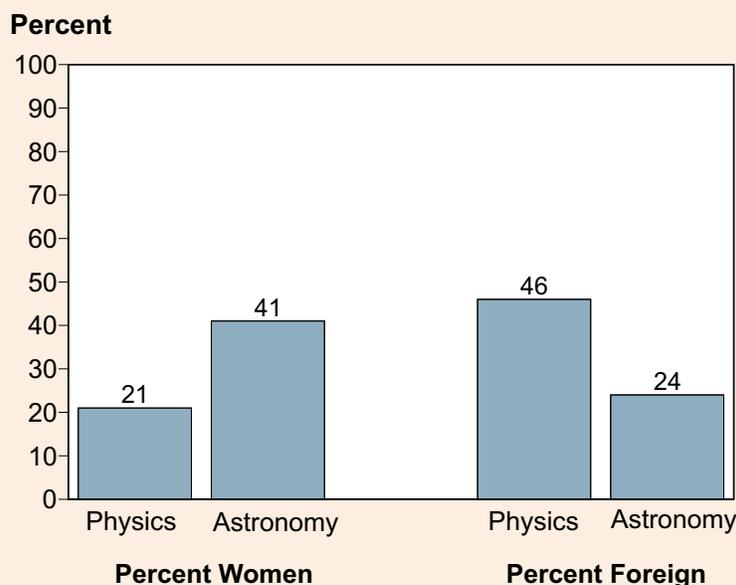
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Graduate Student Report: First-Year Physics and Astronomy Students, 2004

Characteristics of first-year physics and astronomy graduate students, 2003 - 2004.



* Foreign includes individuals with permanent resident status and temporary visas.

AIP Statistical Research Center, Graduate Student Report.

Highlights

- The number of US citizens enrolling in physics departments has risen 47% since 1998-99. They now comprise 55% of first-year physics and astronomy students (**Figure 1 & Table 1**).
- First-year astronomy student enrollments have increased 52% from a recent low in the fall of 1997. The 218 students enrolling in the fall of 2003 is the highest number ever recorded by this report series (**Figure 2**).
- China continues to supply US physics and astronomy graduate programs with more foreign students than any other country, and their proportion has been increasing in recent years. The gains seen from Asia are offset by declines in the proportion of students enrolling from Western Europe, and even more so, Eastern Europe (**Table 3**).

Highlights Continued

- Of the newly enrolled foreign students, about 9% indicated they experienced a delay in entering their current graduate department due to problems in obtaining their visa (**Page 6**).
- Eighty-six percent of first-year physics and astronomy graduate students received a full tuition waiver, with an additional 10% receiving a partial waiver. The likelihood of receiving a tuition waiver varied by the type of department in which the students were enrolled (**Table 7**).
- The median annual stipend reported by first-year physics and astronomy Teaching Assistants was \$14,500. Research Assistants had a median of \$16,000, and students with Fellowships had a median of \$18,000 (**Table 8**).
- The most popular subfield chosen by US students was astronomy & astrophysics, followed closely by condensed matter, and particles and fields. Among foreign students condensed matter was by far the most popular subfield (**Table 6**).

There are many factors that influence the number and characteristics of students enrolling in US physics and astronomy departments. The number of physics bachelors conferred at US institutions and those students' perceptions of physics as a career field are the most critical factors that affect the first-year graduate enrollment numbers for US citizens. The desire of international students to attend a US graduate program and their ability to secure visas are key influences on the number of non-US citizens who enroll.

This report will document the changes in the number and citizenship of incoming graduate physics and astronomy students. It will provide student characteristics, such as gender, age, and the type of program in which they are enrolled. It will also discuss the educational backgrounds of the incoming students, highlighting differences between US and foreign citizens. The subfields chosen by students, the types of financial support they received, and their sense of preparedness for graduate school will be discussed. Finally, students' career objectives are explored.

For this report, we define first-year students as all students who entered their departments during the

2003-2004 academic year, including entering students who may have transferred from another US department or have come from abroad with some previous physics or astronomy graduate studies behind them. Throughout much of this report, we will discuss physics and astronomy graduate students as a single group, only disaggregating between physics and astronomy departments where significant differences exist. Students pursuing astrophysics degrees at physics departments are included among the physics students.

According to the AIP departmental survey of Enrollments and Degrees, in the fall of 2003 there were 3,168 new students enrolled at the 253 physics departments with graduate programs across the US. Ten percent of these students were enrolled at the 68 departments where a master's is the highest degree available. There were also 218 new astronomy students enrolled at the 43 departments that offer graduate-level astronomy degrees. Six percent were enrolled at the 4 departments that offer a master's as their highest astronomy degree. Astronomy programs may be stand-alone departments or combined departments, where both physics and astronomy degrees are offered.

Of the total number of newly-entering students, we received usable surveys from 46% of the physics students and 55% of the astronomy students. Because not all of the departments supply us with the necessary students lists, and because the contact information given for individuals is sometimes out-of-date or incomplete, we estimate that we had an actual response rate of about 63% from the students who received a questionnaire. The vast majority (88%) of our respondents completed the survey online, while the remaining students submitted a paper version by mail.

We would like to thank all the physics and astronomy departments who make this report series possible by providing their department level information. We especially wish to thank all the students who took the time to complete the questionnaires that provide the data presented in this report.

First-year student enrollments have been on the rise in recent years at both physics and astronomy departments. The last five years of increasing enrollments at graduate physics departments have resulted in an overall increase of 31% from a recent low in the fall of 1998. The majority of this increase is a result of a sharp 47% rise in the number of US citizens enrolling (see **Figure 1**). Although erratic, foreign student enrollments have also increased (16%) during this same time period.

The number of students enrolling in astronomy programs has also risen dramatically in recent years (see **Figure 2**). First-year astronomy enrollments have increased 52% from a recent low in the fall of 1997. The 218 students enrolling in the fall of 2003 is the highest number recorded by this report series. Similar to physics, much of the increase is a result of more US students pursuing the field.

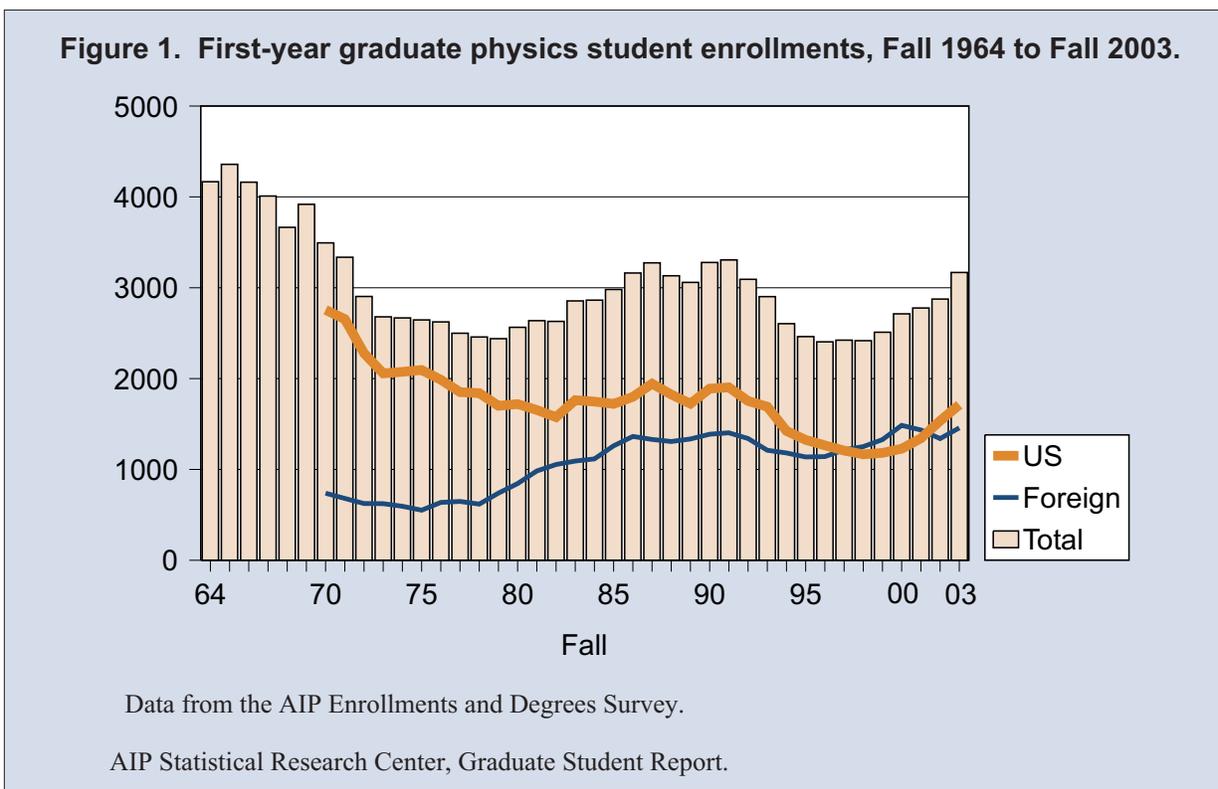
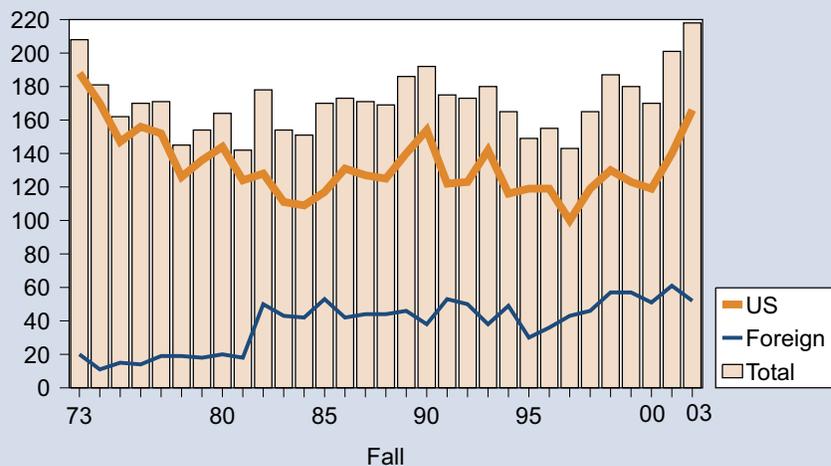


Figure 2. First-year graduate astronomy student enrollments, Fall 1973 to Fall 2003.



Data from the AIP Enrollments and Degrees Survey.

AIP Statistical Research Center, Graduate Student Report.

The characteristics of first-year graduate students in astronomy and physics departments vary considerably. **Table 1** illustrates the sharp differences in the proportion of women and foreign citizens between these two groups. Astronomy departments have a significantly higher proportion of women than their physics counterparts. Physics departments have a much higher proportion of foreign citizens than astronomy departments. The median age of first-year students at physics departments is one year greater than that of students at astronomy departments. For the most part this is due to the higher proportion of foreign citizens among the physics students who tend to be older than US students.

Table 2 looks at student characteristics by the highest degree offered by the department in which they are enrolled. As has been historically true, PhD-granting departments have a

Table 1. Characteristics of first-year physics and astronomy graduate students by broad discipline of department, 2003-2004.

	Physics	Astronomy	Overall
<u>Gender:*</u>			
Male	79%	59%	78%
Female	21	41	22
<u>Citizenship:*</u>			
US	54%	76%	55%
Foreign	46	24	45
<u>Median Age</u>			
	23	22	23
<u>Highest Degree Desired:</u>			
PhD	87%	95%	87%
MS	5	2	5
Unsure	7	3	6
No Degree intended	1	0	2
<u>Enrollment Status:</u>			
Full-time	96%	99%	97%
Part-time	3	1	3

* Data from the AIP Enrollments and Degrees Survey
AIP Statistical Research Center, Graduate Student Report.

Table 2. Characteristics* of first-year physics and astronomy graduate students by highest degree the department awards, 2003- 2004.

	Department Type	
	PhD Granting %	Master's Granting %
<u>Gender*</u>		
Male	78%	75%
Female	22	25
<u>Citizenship*</u>		
US	46%	66%
Foreign	54	33
<u>Highest Degree Desired</u>		
PhD	90%	57%
MS	4	21
Unsure	5	19
No degree intended	1	3
<u>Enrollment Status</u>		
Full-time	98%	89%
Part-time	2	11
* Data from the AIP Enrollments and Degrees Survey AIP Statistical Research Center, Graduate Student Report.		

higher proportion of foreign students enrolled than master's-granting departments. The masters departments have a considerably higher proportion of students attending on a part time basis than the PhD-granting departments. All of the respondents enrolled at master's-granting departments who were studying on a part-time basis were US citizens.

Many students, especially foreign students, after receiving a degree from a master's-granting department, transfer to a PhD-granting department

to pursue the higher degree. Evidence of this being their original intention is illustrated in **Table 2**. A significant proportion (57%) of first-year students enrolled at master's-granting departments indicate that their highest intended degree is a physics or astronomy PhD.

Table 3 illustrates some recent shifts in the countries from which international students come to study physics and astronomy in the US. Not only does Asia (especially China), continue to be

Table 3. Region & countries of citizenship of foreign first-year physics and astronomy graduate students.

	1999 %	2004 %
<u>Asia</u>	47	63
People's Republic of China	26	33
India	6	12
South Korea	5	5
Pakistan	<1	5
Other Asia	10	8
<u>Europe</u>	36	21
Eastern	21	11
Western	15	10
<u>Americas</u>	7	9
Mexico, South and Central America	4	6
Canada	3	3
<u>Middle East</u>	7	5
<u>Africa</u>	2	2
<u>Australia, New Zealand</u>	1	0
AIP Statistical Research Center, Graduate Student Report.		

the region that supplies the most students, but its share has been increasing in recent years. This increase is offset by declines in the proportion of students enrolling from Western and especially Eastern Europe.

First-year foreign students were asked if they experienced a delay in entering their current department due to problems obtaining a visa. These visa-related statistics exclude the foreign students who had permanent resident status or who had attended another US institution prior to enrolling in their current departments. About 9% of newly enrolled foreign students indicated they experienced a delay in entering their current graduate department due to problems in obtaining their visa. These enrollment delays varied significantly, from one month to a full year. Students from China and Eastern Europe had the greatest proportion of their students experiencing delays (see **Table 4**). Students attending departments that were ranked higher in the National Research Council's most recent ranking of physics doctorate programs generally were able to obtain their visa in less time, and were less likely to experience a delay in entering their current departments.

Table 4. Delayed entry experienced by first-year foreign physics and astronomy graduate students, 2003-2004.

Region / Country	Experiencing Delay %
China	15
India	5
Other Asia	6
Eastern Europe	11
Western Europe	5
Americas	0

Table is limited to countries or regions with 50 or more responding students who were on temporary visas and who were not previously studying in the US.

AIP Statistical Research Center, Graduate Student Report.

It should be kept in mind that these statistics on enrollment delays and length of time to secure a visa are based on students who actually arrived in the US

Table 5. Educational background of first-year physics and astronomy graduate students by citizenship, 2003 - 2004.

	US Citizens %	Foreign Citizens %
BS in physics or astronomy	90	91
<u>Prior physics/ astronomy graduate level training</u>		
None	76	52
Master's degree from a US institution	5	6
Master's or equivalent degree from foreign institution	0	27
Course work at a US institution	18	3
Course work at a foreign institution	1	12

AIP Statistical Research Center, Graduate Student Report.

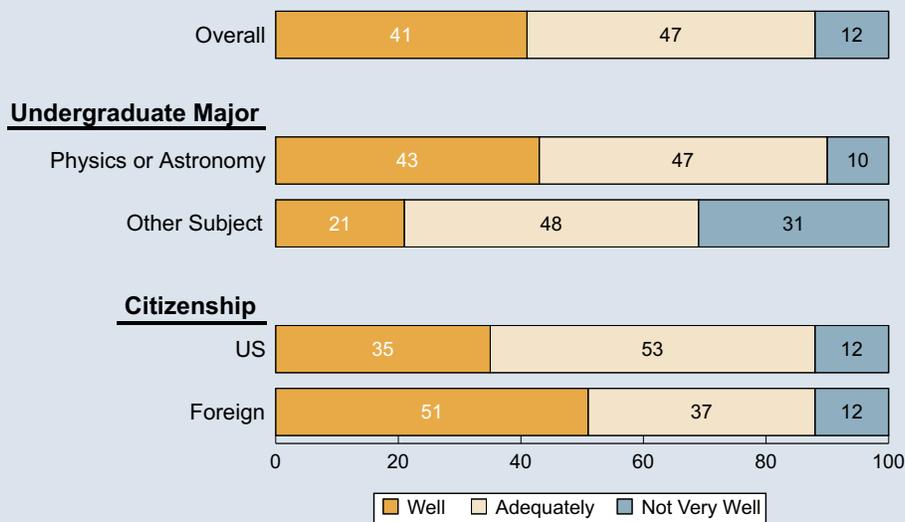
to study in the 2003-2004 academic year. The AIP report *Physics Students From Abroad: Monitoring the Continuing Impact of Visa Problems* provides a more in-depth look at the proportion of accepted international students who were substantially delayed or completely unable to secure visas at all. It is available on our website at: <http://www.aip.org/statistics/trends/intltrends.html>.

The main source of first-year physics or astronomy graduate students are physics or astronomy undergraduate majors. As **Table 5** shows, about 90% of entering physics and astronomy graduate students had received a bachelor's degree or foreign equivalent in physics or astronomy. Among students without a physics or astronomy degree, a bachelor's in engineering was the most common degree held. Of the students enrolled in astronomy departments, almost half had a bachelor's in physics.

Due to differences in educational systems around the world, it is difficult to make accurate comparison between the educational backgrounds of US and foreign students. The data in **Table 5** portray the student's perceptions of their educational backgrounds. The proportion of first-year students who had graduate-level training in physics or astronomy prior to enrolling at their current institution varies considerably by citizenship. Foreign students were twice as likely as US students to report having received prior graduate level training, 48% and 24% respectively. One-third of the foreign students indicated that they had a physics or astronomy master's upon enrolling in their current department, compared to only 6% of the US students.

Students were asked to rate how well they thought their undergraduate education prepared them for graduate study. On the whole, 88% of entering physics and astronomy graduate students felt at least adequately prepared by their undergraduate

Figure 3. Sense of preparedness for graduate study, first-year physics and astronomy graduate students, 2003 - 2004.



* limited to students with no prior physics or astronomy graduate study.

AIP Statistical Research Center, Graduate Student Report.

education. Not surprisingly, those with bachelor's degrees in physics or astronomy felt better prepared than those with bachelor's degrees in other subjects. Although the same proportion (12%) of US and foreign students felt they were not well prepared for graduate study, foreign students tended to feel better prepared than their US counterparts (see **Figure 3**).

Virtually all students enrolled in PhD programs, and 87% of those enrolled in master's programs, are required to choose a subfield in which to specialize. **Table 6** shows the major subfields of study chosen by first-year students enrolled in PhD programs. Because this survey was conducted in the spring of the students first year of study, about a quarter of the students had not yet chosen a field in which to specialize. Some interesting differences in the distribution of subfields appear when the students are divided by citizenship. Condensed matter is by far the most common subfield chosen by foreign citizens,

whereas astronomy & astrophysics is most frequently pursued by US citizens.

First-year physics and astronomy students continue to be well supported, with only 2% needing to rely primarily on family, savings, loans, and outside employment to fund their graduate study (see **Table 7**). Students at master's departments rely more heavily on their own funds (8%) than students at PhD-granting departments (2%). Students at Master's departments also did not receive full tuition waivers as often as students enrolled in departments that offered a doctorate. For students attending doctoral granting departments, the higher the NRC ranking of the department, the more likely they were to receive a full tuition waiver.

Although teaching assistantships (TAs) are the dominant type of support for both physics and astronomy first-year students, astronomy students

Table 6. Major subfields of PhD-seeking first-year physics and astronomy graduate students by citizenship, 2003 - 2004.

	US	Foreign	Overall
	%	%	%
Undecided	29	25	27
Condensed Matter	13	22	17
Astronomy & Astrophysics	16	7	12
Particles & Fields	10	9	9
Biophysics	4	9	7
Atomic & Molecular	5	2	4
Nuclear Physics	4	4	4
Optics & Photonics	2	4	3
Materials Science	1	4	3
Plasma Fusion	3	0	2
Other	13	14	12

AIP Statistical Research Center, Graduate Student Report.

received TAs less often (49%) than physics students (65%). Conversely, the astronomy students received a higher percentage of research assistantships (RAs) and fellowships.

Students were asked what type of career they would most like to be involved in 10 years after receiving their highest physics or astronomy degree. It is likely that these long-term career aspirations will evolve as these first-year physics and astronomy students progress through graduate school. **Table 9** and **Figure 4** groups their aspirations at this particular point in their studies by general employment sector.

The median stipend for RAs was \$1,400 greater than for TAs (see **Table 8**). On the other hand, the number of service hours that RAs were contracted to work tended to be greater than TAs. Within a type of support (TA and RA), the stipend level amount did not have a strong correlation to the number of service hours a student was contracted to work. Previous graduate student surveys based on the entire graduate student population have shown that a large proportion of TAs move into RAs by their third year of study.

Table 9 shows that the majority (62%) of the students who aspire to receive a PhD hope to ultimately work in a research university setting. Students planning to complete their studies at the Master’s level were more likely to want to work in the private sector, at medical facilities, or in primary or secondary schools. There is also a clear difference in career aspirations of physics and astronomy students. The vast majority (87%) of the latter are aiming for a career in an academic setting, compared to 61% of the students enrolled in physics departments.

Table 7. Primary type of financial support and proportion receiving tuition waivers for first-year physics and astronomy graduate students, 2003 - 2004.					
	Highest Degree of Department		Citizenship		Overall %
	PhD %	MS %	US %	Foreign %	
Type of support					
Teaching Assistantship	64	68	58	69	64
Research Assistantship	15	20	16	16	16
Fellowship	18	3	21	12	17
Self-funded*	2	8	4	1	2
Other	1	2	1	2	1
Type of tuition waiver					
Full	87	66	89	83	86
Partial	9	20	6	13	10
None	4	14	5	4	4

*Self-financed includes savings, loans, and non-departmental employment.
 Table is limited to full-time students.
 AIP Statistical Research Center, Graduate Student Report.

Table 8. Annual stipend amount and hours of service per week for first-year physics and astronomy graduate students*, 2003 - 2004.

	Teaching Assistantship	Research Assistanship	Fellowship
Median Stipend	\$14,500	\$16,000	\$18,000
Hours of service	%	%	%
20	66	81	-
15	17	10	-
10	17	9	-

* Limited to full-time doctoral seeking students at PhD-granting departments
AIP Statistical Research Center, Graduate Student Report.

Long-term career goals vary only slightly by gender. Among the students whose highest intended degree was a physics or astronomy PhD, 63% of the men aspired to careers at a research university compared to 56% of the women. Long-term goals vary somewhat more by citizenship, with 69% of the foreign PhD students

aspiring to a career in a research university, compared to 54% of their US counterparts. On the other hand, US citizens were more likely to aspire to a career at a 2- or 4-year college (10% vs. 2%) or a career with the government or at a national lab (15% vs. 9%) than their foreign counterparts.

Table 9. Desired employment sector of first-year physics and astronomy graduate students, 2003 - 2004.

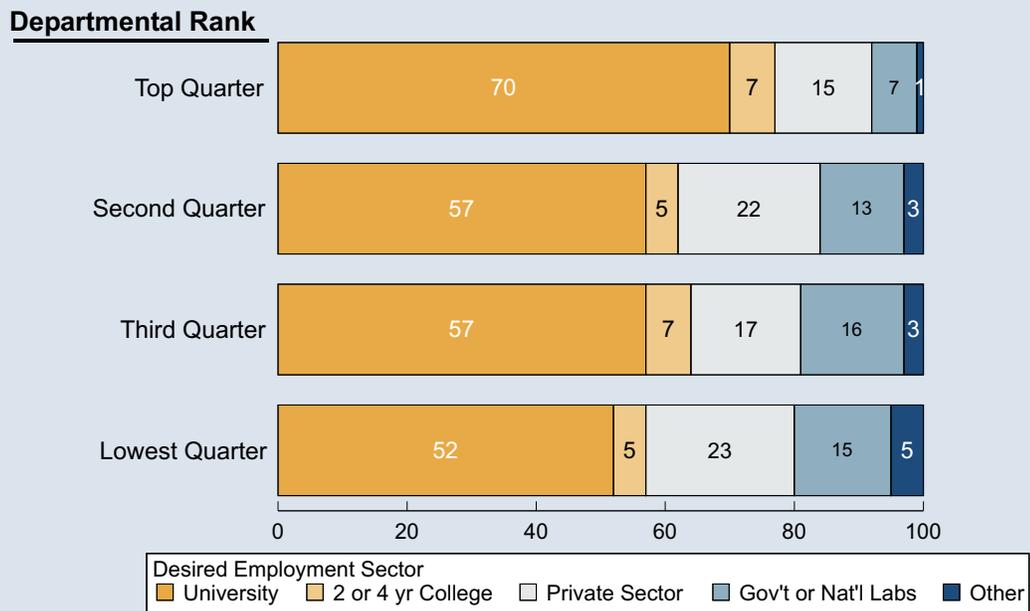
Sector	Highest Anticipated Degree		Broad Discipline of Department		Overall %
	MS %	PhD %	Physics %	Astronomy %	
University	10	62	54	77	56
2 or 4 Year College	10	6	6	10	7
Elementary or High School	8	1	1	0	1
Private Sector	43	17	21	2	20
FFRD&C* or National Labs	11	12	12	8	12
Medical, Hospital	9	2	3	0	2
Other	9	1	2	3	2

*FFRD&C: Federally Funded Research and Development Center.
AIP Statistical Research Center, Graduate Student Report.

The overall rank of the department in which a student has enrolled also shows a relationship to their long-term career aspirations. **Figure 4** divides the physics departments into four even groups by a ranking system developed by the National Research Council in 1993. There are currently 37 PhD granting departments that were not ranked by the NRC in 1993, and whose data are not included in the figure. Sixteen of these departments were not ranked because they were not doctoral-granting at the time the rankings were established. For the 147 departments with a

rank, we are assuming that there has not been any major shifts in their overall rank or prestige levels since these rankings were developed. The higher ranked departments tend to be the larger departments. As a result, the number of students represented by the highest-ranked departments is almost three times that represented by the lowest-ranked departments. The type of student attracted to and accepted by the larger, more prestigious departments is undoubtedly related to the larger proportion of their students who desire to work at a research university.

Figure 4. Desired employment sector of first-year physics graduate students by rank of school, 2003 - 2004.



Limited to full-time doctoral seeking students at PhD-granting departments.

AIP Statistical Research Center, Graduate Student Report.

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An examination of academic enrollments and degrees conferred in physics and astronomy programs nationwide.

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A description of the initial employment and continuing education of physics and astronomy degree recipients.

2004 Physics and Astronomy Academic Workforce (December 2005)

A detailed analysis of faculty openings and new hires in universities and four-year colleges.

Physics Academic Workforce in the Two-Year Colleges 2001-02 (July 2003)

A report on a recent survey of graduate physics departments nationwide. A look at the impact of tightened visa regulations in the post-9/11 era on students from other countries.

Women in Physics and Astronomy, 2005 (February 2005)

Data on the current and historic trends in the representation of women in physics, including comparative data on women in related fields.

Physics Students from Abroad: Monitoring the Continuing Impact of Visa Problems (September 2005)

This report documents the impact of visa regulations on international students in the U.S. physics graduate programs during the Fall of 2004. It describes changes in visa denial rates and international student enrollment patterns compared to two years earlier.

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2002 Salaries Society Membership Survey Tables (April 2003)

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