

By Patrick J. Mulvey
 Starr Nicholson

AIP Pub No. R-211.33

June 2006

PHYSICS AND ASTRONOMY SENIOR REPORT: CLASS OF 2003

HIGHLIGHTS

- Almost three-fourths of the physics seniors indicated that they had participated in some type of undergraduate research project (**Table 1**).
- Over a third of the physics seniors and almost half of the astronomy seniors indicated they would graduate with a double major. This compares to only 5% for all bachelor's degree recipients (**Table 4**).
- Sixty-three percent of graduating physics seniors received their bachelor's degrees four years after graduating from high school. This compares to a third of all bachelor's (**Page 4**).
- The primary reasons students gave for choosing their undergraduate institution were reputation and location (**Figure 3**).
- Physics seniors who had participated in an undergraduate research project were 3 times more likely to plan to immediately continue with physics or astronomy graduate study than students who had not (see **Table 6**).
- The plans of physics seniors have shifted in recent years, with a larger percentage choosing to pursue graduate studies in physics or astronomy immediately after receiving their degree (see **Figure 5**).
- Forty-one percent of physics seniors have a long-term goal of securing an academic position at a college or university. A similar proportion of astronomy seniors had the same aspirations (see **Table 7 and 8**).
- When asked if they would major in physics again if given the opportunity, 72% answered with a definite yes and an additional 21% were unsure (see **Figure 8**).

Table 1. Types of research experiences taken by 2003 physics seniors.

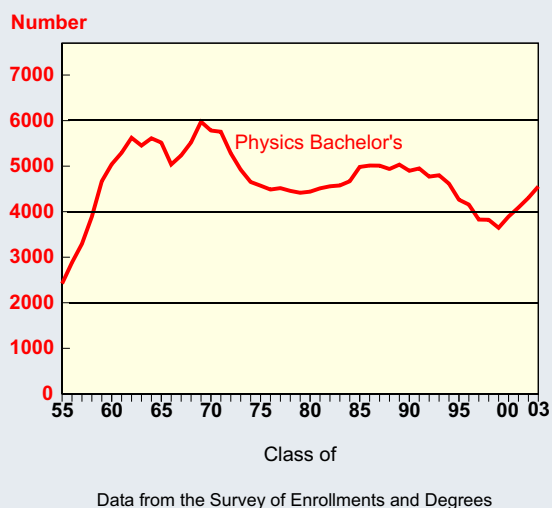
	%
Non-thesis department research project	37
As part of a thesis	28
REU (1)	26
Non-dept employment	25
Co-op or Internship	13
None	29

(1) National Science Foundation funded: Research Experience for Undergraduates.

Note: Percentages add to more than 100% because respondents were allowed to choose more than one type of research.

AIP Statistical Research Center, Physics and Astronomy Senior Report.

Figure 1. Physics bachelor's degrees awarded in the US, 1955 - 2003.



Data from the Survey of Enrollments and Degrees.
AIP Statistical Research Center, Physics & Astronomy Senior Report.

BACKGROUND

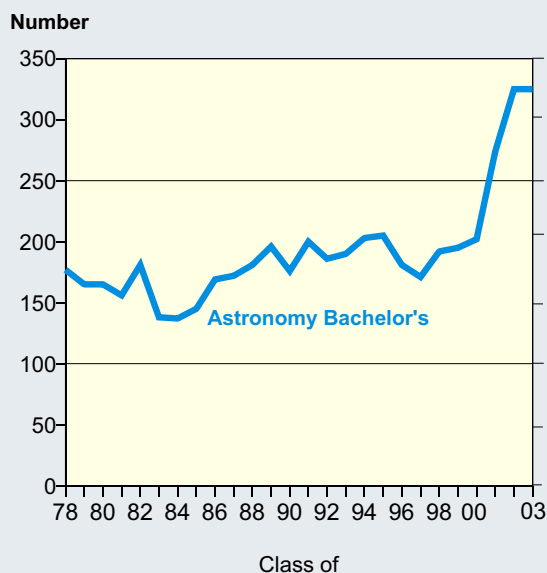
During the 2002-2003 academic year there were 756 departments in the US that offered a bachelor's degree in physics. Thirty-four of these departments also offered an undergraduate degree in astronomy. There are an additional 33 separate bachelor's-granting astronomy departments that are not administered in connection with a physics department. These departments produced 4553 physics and 325 astronomy bachelor's in the class of 2003. These degree totals represent a substantial increase of 25% from a recent low four years earlier for physics bachelor's, and an unprecedented 66% increase during the same time period for astronomy bachelor's (see **Figure 1** and **Figure 2**).

This report looks at the characteristics, educational experiences and the short and long-term goals of senior-level physics and astronomy majors at a point just before their graduation. It will examine the factors that influenced them to study physics or astronomy as well as what they considered important when choosing which institution to attend.

Departments reported enrollments of about 7100 senior level physics majors in the fall of 2002 and 576 senior level astronomy majors. The discrepancy between these senior-level enrollment totals and the number that ultimately received a bachelor's degree results from the many students who maintain their senior status for more than one year. In the 2002-03 academic year 36% of physics and 44% of the astronomy seniors did not receive a bachelor's degree. The issues of time taken to degree and the reasons commonly cited for it will be discussed later in this report

The findings in this report are based on responses from 1,740 physics seniors and 85 astronomy seniors who reported that they had received or were going to receive their bachelor's during the 2002-03 academic year. Responding seniors who indicated they were not graduating in the class of 2003 were excluded from the analysis.

Figure 2. Astronomy bachelor's degrees awarded in the US, 1978-2003.



Data from the Survey of Enrollments and Degrees.

AIP Statistical Research Center, Physics & Astronomy Senior Report.

Table 2. Characteristics of physics and astronomy bachelor's, class of 2003.			
		Physics	Astronomy
		%	%
Gender*	Men	78	54
	Women	22	46
Citizenship*	US	94	94
	Non-US	6	6
Median Age	Years	22.4	22.1

*Data from the Survey of Enrollments and Degrees.

AIP Statistical Research Center, Physics and Astronomy Senior Report.

FINDINGS

Physics undergraduate programs make up a very small portion of all bachelor's degrees produced in the US. For every 1,000 bachelor's degrees awarded in the US, only about 3, or one third of one percent are in physics or astronomy. Even among just the undergraduate degrees conferred in the natural sciences, math and engineering, bachelor's degrees in physics and astronomy only make up about 2%.

The proportion of women among astronomy bachelor's is more than double that of physics (see **Table 2**). There have been significant gains in the representation of women at the undergraduate level for both physics and astronomy over the past decade, with both increasing by about 50%.

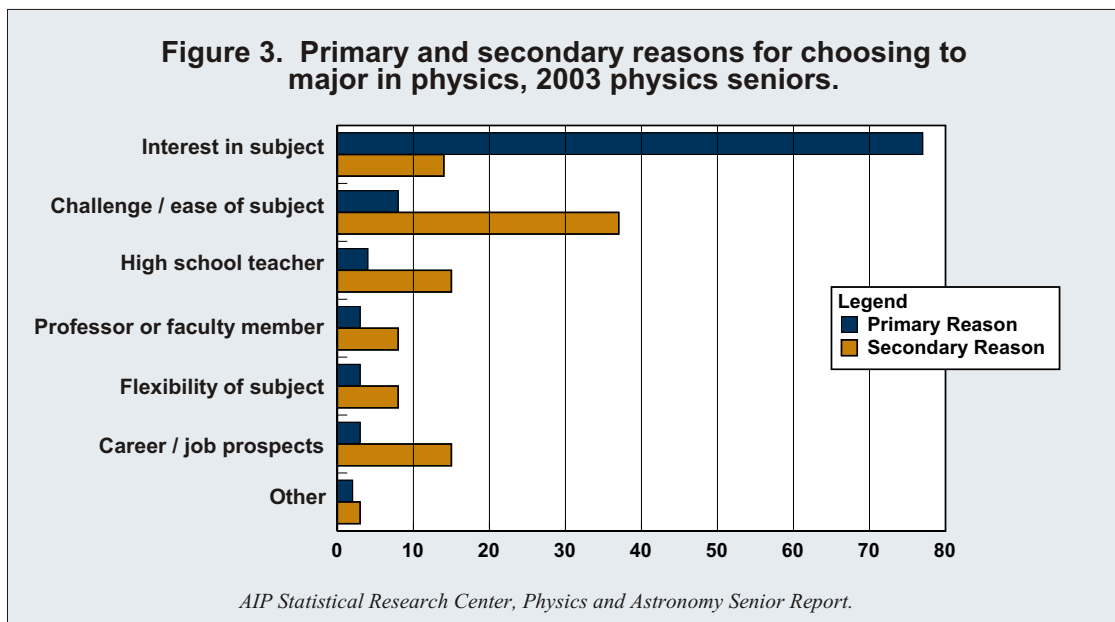
The median age for both physics and astronomy seniors at their anticipated graduation date is 22 years (see **Table 2**). Sixteen percent of the physics majors are 24 years or older by the time they graduate, this compares to only 8% of the astronomy majors.

A greater proportion of physics bachelor's receive their degrees from private institutions than is true for individuals majoring in other science fields or engineering (see **Table 3**).

Table 3. Percent of bachelor's degree recipients by public or private status of institution, class of 2003.					
	Physics	Astronomy	Physical Sciences	Engineering	All bachelor's
Control					
Public institution	57	63	66	75	65
Private institution	43	37	34	25	35
	100%	100%	100%	100%	100%

Sources: Physics and Astronomy: Survey of Enrollments and Degrees
 Other degrees: National Center for Education Statistics, Digest of Education Statistics, 2004 (Table 255).

AIP Statistical Research Center, Physics and Astronomy Senior Report.

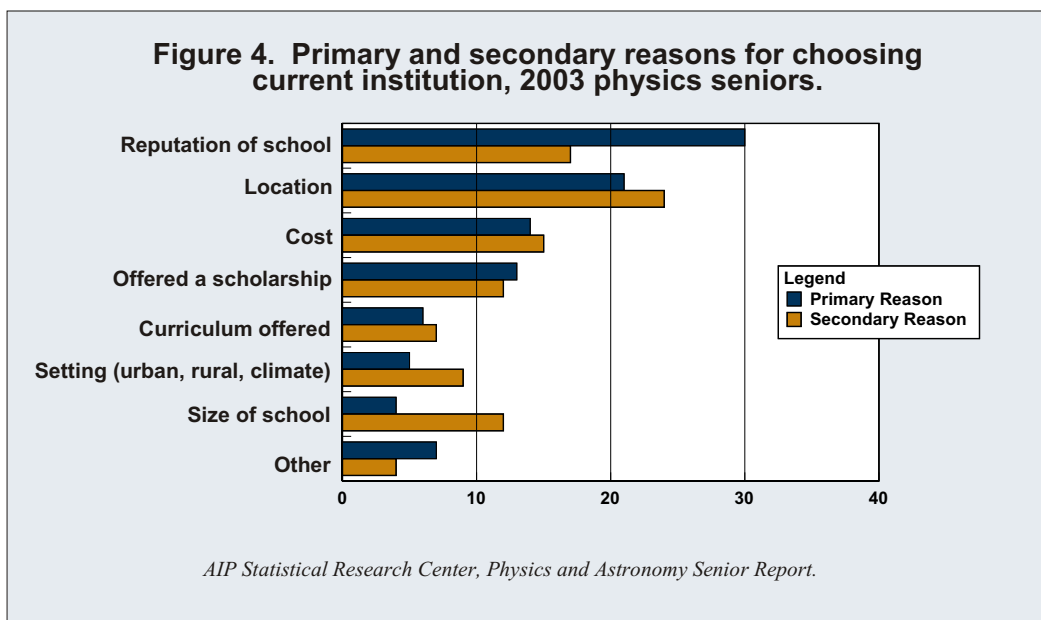


The time taken between graduating from high school and receiving a bachelor’s degree can be broken out into two distinct segments. The time between high school graduation and college entrance, and the number of years it took to receive your degree after first enrolling as a freshman in college. Only about 15% of the graduating physics seniors in the class of 2003 did not immediately enter college (includes 2-year colleges) after graduating from high school, with about half taking one year off. About twice as many seniors (31%) indicated they were taking more than four years from the time they first enrolled in college to earn their undergraduate degree. Overall, 63% of graduating physics seniors received their bachelor’s degrees four years after graduating from high school. This compares to a third of all bachelor’s in the class of 2000. (*NCES: A Descriptive Summary of 1999-2000 Bachelor’s Degree Recipients 1 Year Later: With Analysis of Time to Degree*).

Half of the seniors attending public institutions versus only 16% of the seniors at private institutions anticipated it taking longer than four years to complete their bachelor’s after having first enrolled in college. As might be expected, students who delayed their entry into college by a year or more after high school were more likely to report taking more than four years of study to complete their degree compared to students enrolling immediately after graduating from high school.

About 10% of physics seniors indicated that they started their postsecondary education at a 2-year or community college. Fifty-eight percent of those who did said it took them longer than four years to complete their degree. Among physics seniors who enrolled directly into a 4-year college or university the comparable figure is only 28%.

Reasons for requiring more than four years to complete their degree varied widely, with many seniors reporting more than one reason. Some of the reasons cited in order of frequently were: taking additional course work for a double major, changing major, taking a leave of absence, working and attending school on a part-time basis, and transferring from another institution. Only a small proportion of the seniors indicated it took them longer than four years because they were in a 5-year program.



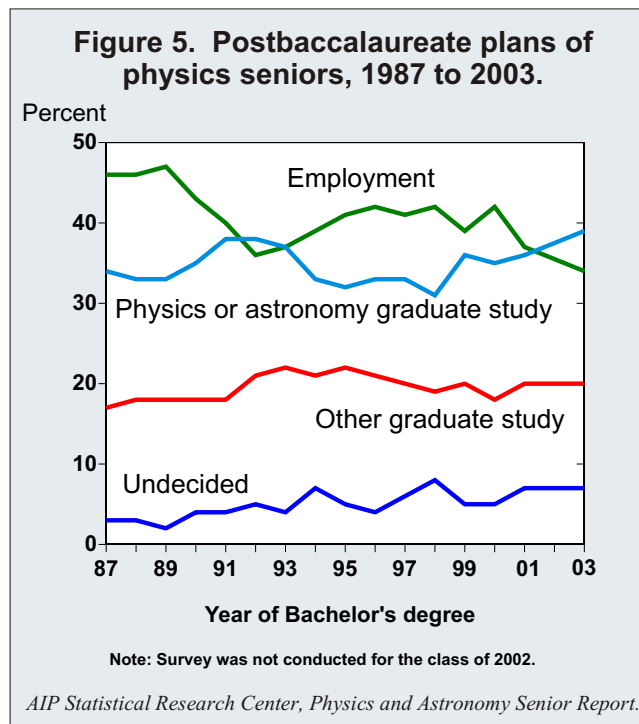
By far, the most frequently cited reason physics seniors chose to study physics was an interest in the subject matter, with almost 90% of the students listing it as either their primary or secondary reason for choosing to study physics (see **figure 3**). Twenty-eight percent of the students listed a high school teacher or college faculty member as one of their top two reasons. Women were more likely to indicate that the reason they pursued physics was an individual such as a high school teacher or professor than their male counterparts.

Seniors were asked to list their primary and secondary reasons for choosing the institution in which they were receiving their bachelor's degree (see **figure 4**). Reasons varied but the reputation of the school and its location were the most frequently cited reasons. Students attending private institutions, particularly those at PhD-granting departments, were more likely to indicate the importance of the school's reputation for making their choice. Students attending public institutions and those at master's-granting departments were more likely to indicate the school's location and cost as reasons for their selection of institution.

Over a third of the physics seniors graduating in the class of 2003 indicated they would graduate with a double major. The broad range of other subjects can be seen in the **Table 4**, with mathematics by far being the most common. Almost half of the astronomy majors indicated they were receiving a double major, with over half of those doubling with physics.

Table 4. Double majors, 2003 physics seniors.	
Physics seniors with a double major	37%
Other majors for these physics seniors	%
Mathematics	43
Engineering	12
Astronomy	10
Computer Science	8
Chemistry	5
Philosophy & Theology	4
Music & Fine arts	3
Other	15
<small>Note: For comparison, in 2003 5% of all bachelor's received a double major. (NCES)</small>	
<small>AIP Statistical Research Center, Physics and Astronomy Senior Report.</small>	

Table 5. Characteristics of undergraduate research experiences, 2003 physics seniors.	
Participation in more than one project	63%
Compensation received*	
Monetary	80%
Credit hours	51%
None	12%
Paper submitted to peer reviewed journal:	28%
Work presented at a national meeting:	35%
*Total adds to more than 100% as seniors were permitted to indicate more than one source of compensation.	
<i>AIP Statistical Research Center, Physics and Astronomy Senior Report.</i>	



The majority (71%) of the physics seniors indicated that they had participated in some type of research project (see **Table 1**). Participation in research projects was generally evenly distributed, with men and women participating equally, as well as students from all types of departments. However, students who originally started their college education at a 2-year college were less likely to have had the experience of a research project.

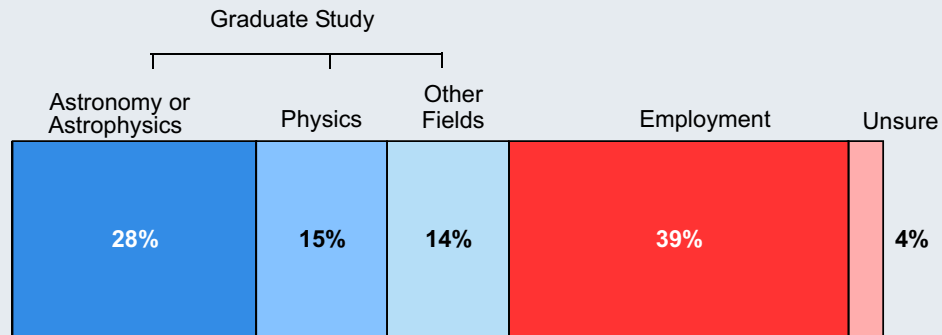
Most of the seniors who participated in a research project participated in more than one. Only a small percentage (12%) of the students did not receive some type of compensation. Almost half (48%) of the students capped off their research experience by submitting their results to a peer reviewed journal, or by presenting their findings at a national meeting, with 16% having an opportunity to do both (see **Table 5**).

Astronomy majors also had a high rate (83%) of research project participation. The types and number of projects undertaken were very similar to their physics counterparts, as were the types of compensation and their opportunity to formally presenting their results.

The post degree plans of physics seniors have shifted in recent years, with a larger percentage choosing to pursue graduate studies in physics or astronomy immediately after receiving their degree. This shift has been offset by a decline in the percentage of seniors planning to enter directly into the workforce (see **Figure 5**). Many students who initially pursue employment enroll in graduate school in physics and other subjects after working a year or more .

Forty-three percent of the astronomy seniors in the class of 2003 planned to immediately continue their education at the graduate level in astronomy (28%) or physics (15%) (see **Figure 6**).

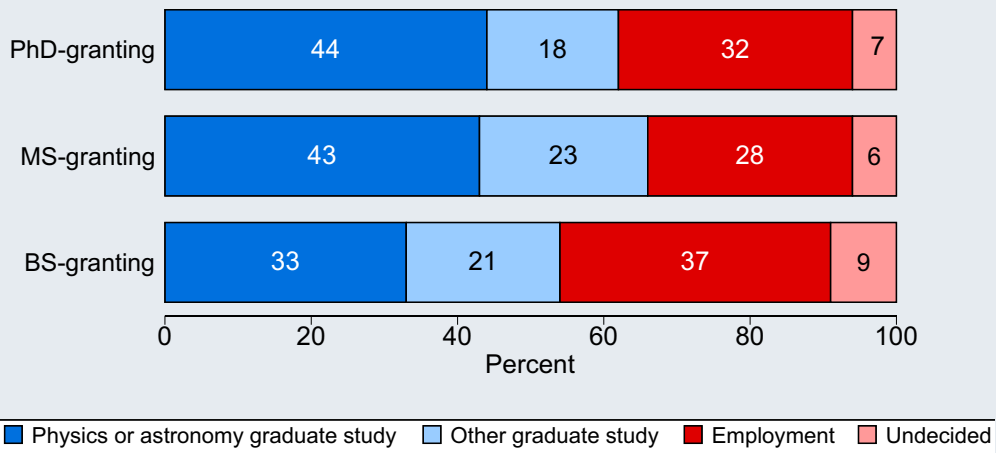
Figure 6. Postbaccalaureate plans, 2003 astronomy seniors.



AIP Statistical Research Center, Physics and Astronomy Senior Report.

Seniors at bachelor’s-granting departments were less likely to pursue graduate study in physics or astronomy than students at departments where a graduate-level degree was available (see **Figure 7**). On the other hand, beginning one’s college education at a 2-year college seemed to have no effect on post-graduate plans. Men were slightly more likely to plan to pursue graduate studies in physics or astronomy than women, 39% vs. 34% respectively.

Figure 7. Postbaccalaureate plans by type of physics department, 2003 physics seniors.



AIP Statistical Research Center, Physics and Astronomy Senior Report.

Table 6. Postbaccalaureate plans by research project participation, 2003 physics seniors.

Postbaccalaureate plans					
Participated in undergraduate research	Graduate Study		Employment	Undecided	
	Physics or Astronomy	Other Fields			
Yes	48	19	27	6	100%
No	16	24	49	11	100%
Overall	39	20	34	7	100%

AIP Statistical Research Center, Physics and Astronomy Senior Report.

Physics seniors who had participated in an undergraduate research project were 3 times more likely to plan to immediately continue with physics or astronomy graduate study than students who had not been involved in such a project (see **Table 6**).

Ninety-one percent of the physics seniors indicated they had considered their long-term goals. Overall, 41% hoped to secure an academic position involving science teaching and research at a college or university. Goals varied greatly depending on the senior's plans for after graduation. Individuals pursuing graduate studies in physics or astronomy were far more likely to aspire to a position at a college or university than seniors pursuing studies in other fields or entering the workforce (see **Table 7**).

The overall long-term career goal of astronomy seniors was similar to that of physics seniors with the exception of fewer aspiring to engineering positions (see **Table 8**). And again, as with physics seniors, the goal of an academic position was correlated with immediate plans for further physics or astronomy graduate study.

Students who aspire to a position at a college or university have the highest participation in undergraduate research. Students aspiring to pre-college teaching positions had the lowest research project participation rate. (see **Table 9**)

Table 7. First choice of long-term career goals by initial postbaccalaureate plans, 2003 physics seniors.				
Career Goal	Postbaccalaureate Plans			
	Graduate Study		Employment	Overall
	Physics or Astronomy	Other Fields		
College or University teaching and research	72	23	17	41
Engineering position	5	28	18	15
Other science or technical position	20	25	33	26
Pre-college teaching	1	7	9	5
Military	1	1	11	4
Other positions (non-science)	1	16	12	9
	100%	100%	100%	100%

AIP Statistical Research Center, Physics and Astronomy Senior Report.

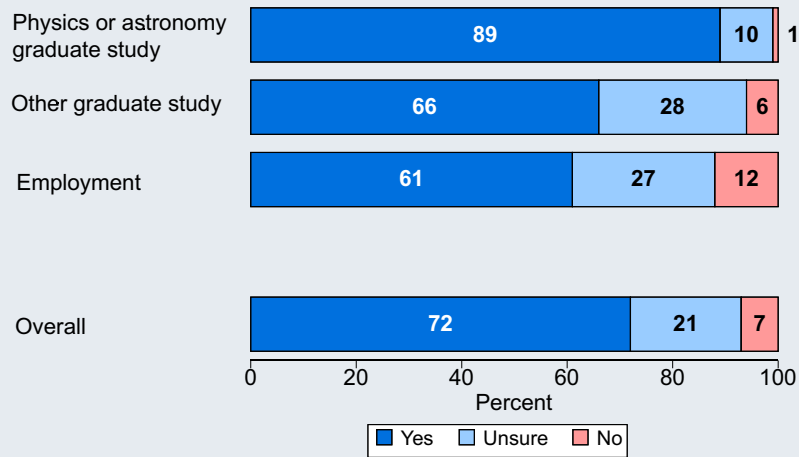
Table 8. First choice of long-term career goals, 2003 astronomy seniors.	
Career Goal	%
College or University teaching and research	43
Engineering position	4
Other science or technical position	24
Pre-college teaching	5
Military	10
Other positions (non-science)	14
	100%

AIP Statistical Research Center, Physics and Astronomy Senior Report.

Table 9. Research project participation by long-term career goals, 2003 physics seniors.	
Career Goal	% with a research project
College or University teaching and research	85
Engineering position	60
Other science or technical position	71
Pre-college teaching	53
Other positions (non-science)	59
Overall	71%

AIP Statistical Research Center, Physics and Astronomy Senior Report.

Figure 8. Response to the question, “If you could do it over again, would you still major in physics?”, by postbaccalaureate plans, 2003 physics seniors.



AIP Statistical Research Center, Physics and Astronomy Senior Report.

The overall response to the question, “If you could do it over again, would you still major in physics”, was very positive, with only 6% indicating they would not. Seniors choosing to continue their studies in physics or astronomy were the most likely to indicate that they were satisfied with their choice of major. There was only a slight difference by gender, with 74% of the men responding with a definite yes compared to 68% of the women (see **Figure 8**).

When indicating they would not choose physics again, both men and women cited similar reasons the most frequent being that they had developed an interest in another subject.

STATISTICAL RESEARCH CENTER - PARTIAL LIST OF PUBLICATIONS

The Statistical Research Center collects data on the composition and dynamics of the scientific labor force and the education system. Below is a partial list of the Center's current publications along with a brief description of each. Unless otherwise indicated, single copies can be downloaded for free at www.aip.org/statistics or by writing to:

American Institute of Physics
Statistical Research Center
One Physics Ellipse
College Park, MD 20740-3843
(301) 209-3070
stats@aip.org
www.aip.org/statistics

2004 Physics & Astronomy Academic Workforce Report (December 2005)

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

Broadening the Base: High School Physics Education at the Turn of a New Century (August 2003)

An analysis and interpretation of information collected in a nationwide survey of teachers of physics at the secondary level.

Enrollments and Degrees Report, 2003 (July 2005)

An examination of academic enrollments and degrees conferred at the bachelors, masters, and PhD levels in physics and astronomy programs.

Physics Bachelors with Master's Degrees (March 2003)

This report documents the employment patterns of those who earned physics bachelor's degrees in the early 1990s, earned master's degrees in a variety of fields, and were working five to eight years later.

Does it Matter Where I Go to College? Effects of Physics Departments on Students Outcomes (June 2004)

Compares the outcomes for physics bachelors from large and small departments, defined by number of bachelor's degrees awarded. It also looks at differences in physics bachelors' outcomes between departments that grant PhDs in physics and those that award only a bachelor's degree in physics.

Rosters of Physics and Astronomy Departments with Enrollments and Degree Data, 2004 (August 2005)

Two reports detailing data for both physics and astronomy degree-granting departments in the U.S.

2004 Salaries: Society Membership Survey Tables (April 2003)

Collection of twelve tables each focusing on different aspects of PhD employment. The statistical data are based on salaries reported by U.S.-resident members of AIP's ten Member Societies during March 2004. Tables can be purchased individually for \$5.00 each or as a collection for \$25.00. Members of AIP's Member Societies and the Society of Physics Students receive a 20% discount. To order visit the AIP iStore at <http://www.aip.org/statistics/salaries/>