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ABSTRACT

This report presents the results of a survey of 4,800 students who obtained bachelors degrees in physics and 190 students who obtained bachelors degrees in astronomy in 1993. Of the physics bachelors, 37 percent planned to pursue graduate study in physics or astronomy, 22 percent planned to pursue other graduate study, 37 percent planned to seek employment, and 4 percent had no immediate plans. Nearly 90 percent of the physics bachelor degree holders had taken physics in high school. Women receiving physics bachelors degrees were just as likely to pursue graduate study as men. Physics bachelors choosing graduate study in physics were more likely to receive departmental support than those going on to advanced study in other disciplines. Employer demand for individuals with bachelors degrees in physics remains low and the proportion receiving multiple job offers has declined. The trend toward more industrial service jobs has continued. The 59 departments that offered bachelor degrees in astronomy in 1993 conferred 190 such degrees. Fifty-one percent of the astronomy bachelors planned to pursue graduate study in astronomy or physics, 6 percent planned to pursue other graduate study, 34 percent planned to seek employment, and 9 percent were undecided. (MDM)

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AIP REPORT

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STATISTICS DIVISION
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There are many reasons why a student would choose to pursue an undergraduate degree in physics. For some it's an early curiosity about the basic workings of the world or a specific area of interest like astronomy. Others develop an inclination for the subject in high school, which for most is their first formal introduction to the subject. Only a small proportion of the physics bachelors first developed their interest in the discipline after they had enrolled in college. Whatever the influences were that first inspired this group to become physics and astronomy bachelors degree recipients, they comprise less than 1% of all bachelors degrees granted in this country.

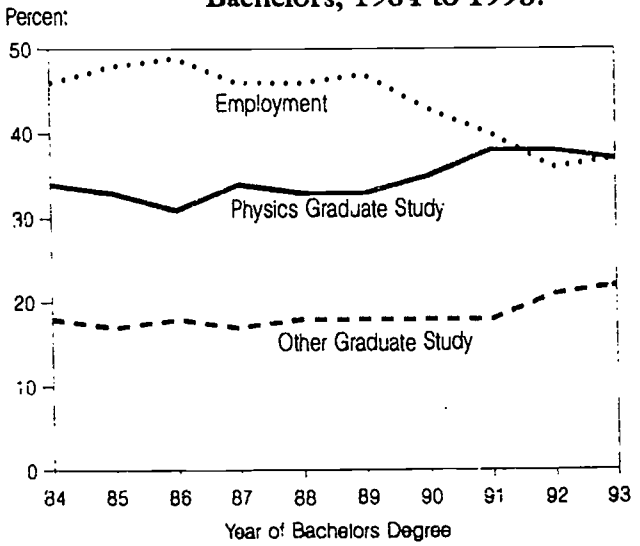
There are many career paths available for a new physics or astronomy bachelor to follow. This report takes a detailed look at the three main career paths for a physics bachelor: graduate study in physics or astronomy, graduate study in disciplines other than physics or astronomy, and employment. These initial career choices are examined from the perspectives of the characteristics of the students, the departments from which they graduated, and other features of their educational background.

AIP has been surveying physics and astronomy bachelors at the end of each academic year for over 25 years. This report is based primarily on the information contributed by the graduates in the class of 1993. The totals presented in the tables and figures are based on 4800 physics degrees and 190 astronomy degrees granted to the class of 1993 as reported by the department chairs in the AIP survey of *Enrollments and Degrees*. An overview of the astronomy bachelor degree recipients is presented in the closing pages of this report.

Highlights of the report include the following:

- Of all new physics bachelors, the proportion choosing to enter directly into the workforce has declined by 10% during the last five years (Figure I).
- Women are just as likely to pursue graduate study as men (Table 1).
- It continues to be true that physics bachelors choosing graduate study in physics are more likely to receive departmental support than those going on to advanced study in other disciplines (Figure IV).
- Employer demand for physics bachelors remains low and the proportion receiving multiple job offers has declined (Figure V).
- The trend toward more industrial service jobs continues (Figure VI).
- High school physics is an important stepping-stone to a degree in physics (Table 4).

Figure I. Postbaccalaureate Plans of Physics Bachelors, 1984 to 1993.



Note: Each year 2-5% of the graduates had no postbaccalaureate plans at the time the survey was conducted.

The initial career directions of physics bachelor degree recipients have a variety of influences, several of which are detailed in the following figures and tables. The trends in **Figure I** reflect a decade of these post-degree decisions for physics bachelors. After many years of stability, the increase in graduate study may be the result of students temporarily staying out of the workforce in hope that an advanced degree would give them the edge they need in a tight job market. It should be noted that more than one-quarter (28%) of physics bachelors who enter the labor force intend to go on to graduate study in about one year. Nearly half of them (42%) aspire to study physics.

Two groups with a small representation among the physics bachelors are women and foreign citizens (See **Table 1**). Comparing these characteristics by postbaccalaureate plans shows no differences by sex but reveals considerable variation by citizenship. With the majority of the foreign citizens holding temporary visas, immediate US employment is not a readily available option, causing their plans to be heavily weighted toward graduate study.

Table 2 describes the types of institutions attended by physics bachelors who are US citizens belonging to selected racial and ethnic backgrounds. A larger percentage of blacks earn their physics degrees at bachelor-granting institutions rather than PhD-

Table 1. Demographic Characteristics of New Physics Bachelors by Postbaccalaureate Plans, Class of 1993.

	Sex		Citizenship		
Post-degree Plans	Male %	Female %	US %	Foreign* %	Median Age
Physics Graduate Study	37	38	37	52	22
Other Graduate Study	23	22	21	31	22
Employment	36	36	38	14	23
Undecided	4	4	4	3	22
Total	3888	912	4512	288	22
	81%	19%	94%	6%	

* Includes students on both temporary and permanent visas.

Table 2. Type of Institution Attended by US Physics Bachelors of Selected Racial and Ethnic Backgrounds, Class of 1993.

Type of Bachelors Institution	Blacks %	Hispanics %	Asians %	Total Population %
Public	53	68	56	53
Private	47	32	44	47
PhD-granting	23	55	75	47
MS-granting	15	20	6	9
BS-granting	62	25	19	44
Estimated Totals	193	73	204	4800
	4%	2%	4%	

Note: The data in this table are taken from the AIP survey of Enrollments and Degrees.

Table 3. Types of High School Physics Taken Nationally in 1989 and the Physics Bachelors Class of 1993.		
Type of Physics Taken	All High School Seniors in 1989 %	Class of Physics Bachelors, 1993 %
Advanced Placement	1	25
General	19	65
None	80	10
Total	2.8 Million	4,800

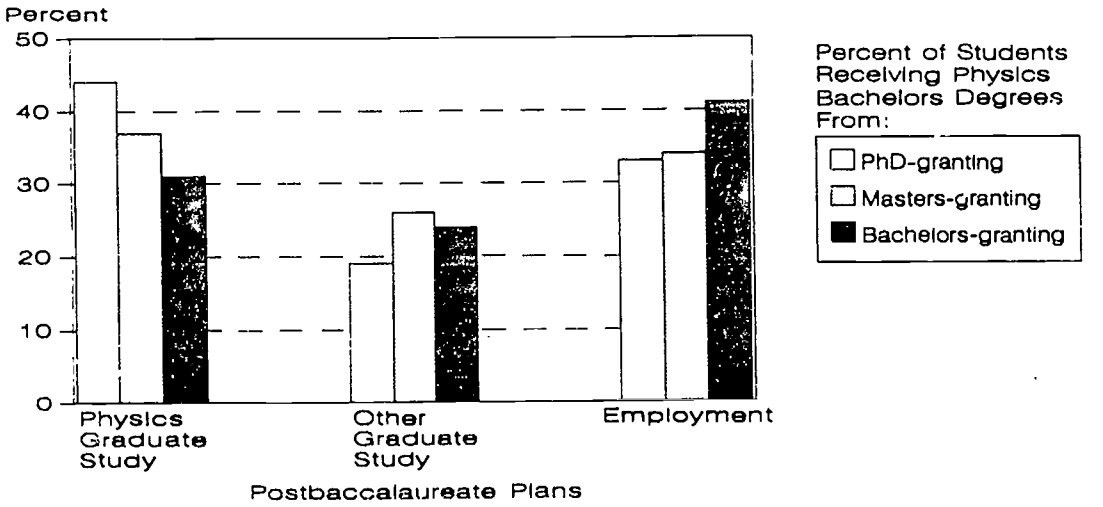
granting institutions. This is because about half of all blacks receive their physics bachelors degrees from historically black institutions, the majority of which are 4-year colleges.

Only a small group of students who get a physics bachelor degree did so without first having taken a high school physics course(See **Table 3**). An even stronger correlation exists if a student took an advanced placement (AP) course in high school. The AP course is often the second physics course high school students will have taken and provides college credit for about half the participants. About one-quarter of all physics bachelors degree recipients took AP physics in high school.

A larger percentage of the physics bachelors graduating from PhD-granting departments choose to continue with their study of physics than is the case with those graduating from departments whose highest physics degree is the bachelors (See **Figure II**). One possible explanation for this trend is that the environment at the PhD-granting departments encourages students to continue on in the subject. Conversely, the curriculum in some bachelor-granting departments is structured to prepare students for that region's job market. It is also possible that students who are intending to pursue graduate study in physics from the start choose a doctoral-granting institution to do their undergraduate studies because they believe the environment there would better prepare them for their own future graduate study. Of the students who earned their bachelors degree in a PhD-granting department and are intending to continue studying physics, only 25% remain in the same department.

The immediate post-degree plans of physics bachelors are related to the educational background of the students prior to enrolling in a university that

Figure II. Postbaccalaureate Plans of Physics Bachelors Class of 1993 by Type of Undergraduate Institution.



Note: Four percent of the students at each institution type had not decided upon a postbaccalaureate plan at the time the survey was conducted.

grants an undergraduate degree. Table 4 illustrates that students who did not take physics in high school are more likely than students who did take a high school physics course to enter directly into employment upon completion of their bachelors degree. Students taking AP physics in high school go on to graduate study in proportions similar to the students who took the general level course. Degree recipients who initially transferred from a 2-year institution are also more likely to enter directly into employment than degree recipients who had not. There is considerable overlap between these two education characteristics, with 40% of the physics bachelors who did not take physics in high school also having transferred from a 2-year institution.

Table 4. Educational Background of New Physics Bachelors by Postbaccalaureate Plans, Class of 1993.

	Took Physics in HS		Transferred from 2-yr. institution	
Post-degree Plans	Yes %	No %	Yes %	No %
Physics Graduate Study	38	35	36	38
Other Graduate Study	23	16	17	23
Employment	35	47	44	35
Undecided	4	2	3	4
Total	4368	432	528	4272
	91%	9%	11%	89%

Graduating with a double major or attending school on a part-time basis in the senior year influences the postbaccalaureate plans of new graduates, as demonstrated in **Table 5**. Graduates with double majors are more likely to enter adnvanced study in other disciplines that students who majored in physics only. Mathematics, engineering and astronomy were the three most popular other majors for physics bachelors, at 45%, 17% and 8% respectively.

Table 5. Undergraduate Characteristics of New Physics Bachelors by Postbaccalaureate Plans, Class of 1993.

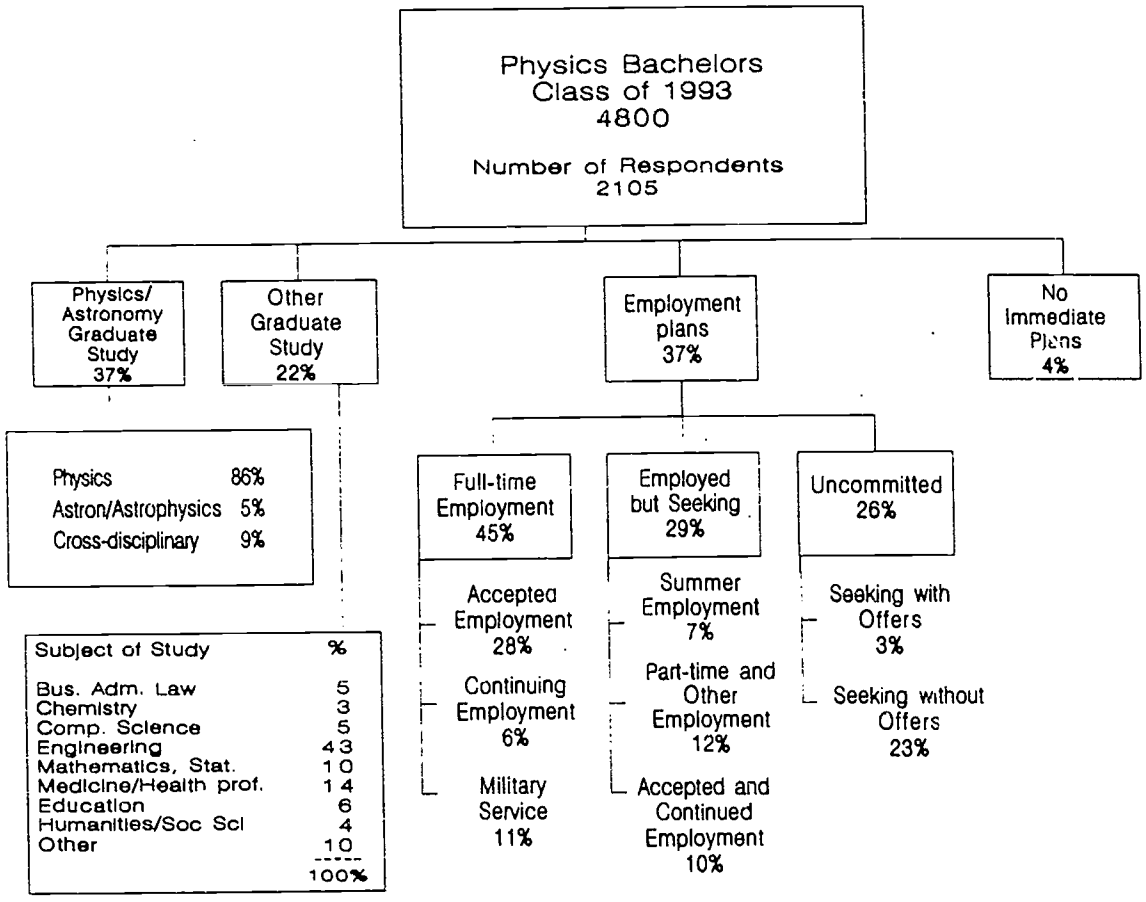
	Graduating with a double major		Enrolled part-time in senior year	
Post-degree Plans	Yes %	No %	Yes %	No %
Physics Graduate Study	37	39	27	39
Other Graduate Study	30	19	10	24
Employment	29	39	59	33
Undecided	4	3	4	4
Total	1296	3504	528	4272
	27%	73%	11%	89%

The majority of the degree recipients who were part-time students in their final year of undergraduate study indicated employment as their immediate postbaccalaureate plan. It should be noted that about 50% of the part-time students also stated they held some type of employment while completing their degrees.

Presented in **Figure III** is an overview of the 1993 class of physics bachelors with detail on three of the postbaccalaureate plans. The majority of the degree recipients plan to go on to graduate study upon completing their degree. As in the past, physics and engineering continue to be the most popular graduate disciplines to pursue.

The employment section of **Figure III** is broken into three distinct components. The first group, full-time employment, are degree recipients who had accepted civilian or military positions. The "employed but seeking" classification refers to degree recipients who accepted temporary positions or positions from which they were still actively

Figure III. Postbaccalaureate Plans of Physics Bachelors Class of 1993.



seeking employment. The third group, "uncommitted", consists of students who had not accepted a position at the time the survey was conducted. Taking into account the timing of the survey, many of the latter students may not have had the opportunity to start their employment searches or pursue them to any great extent.

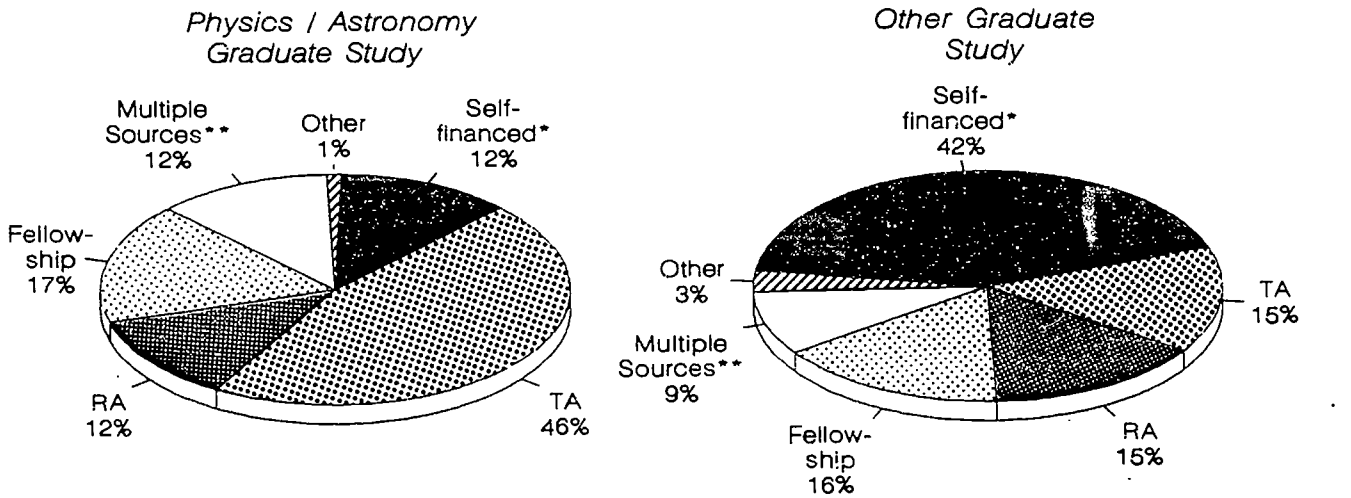
Regardless of the field of study, the vast majority of students entering graduate school plan to enroll on a full-time basis (See **Table 6**). However, students going on to other graduate study are twice as likely to attend on a part-time basis as those entering physics programs. These differences may be related to levels of available financial support.

Table 6. Enrollment Status of 1992-93 Bachelor Recipients Intending to Attend Graduate School in the Fall.

	Physics/Astronomy %	Other Subjects %
Full-time	94	88
Part-time*	6	12

* One half of the part-time students in both types of graduate study indicated that their primary postbaccalaureate plan was employment.

Figure IV. Sources of Anticipated Support for Students Planning to Begin Graduate Study in the Fall, Class of 1993.



* Self-financed includes: Funds from employment, family, savings and loans.

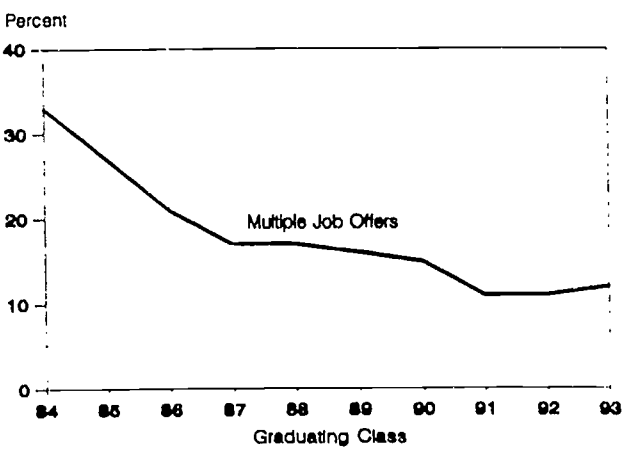
** Students may be anticipating support from more than one source or may have been unsure which type they were going to receive. Teaching assistantships combined with another source comprise the majority of the students indicating multiple sources.

Physics bachelors entering graduate study encounter different levels of financial support depending on the discipline they choose. The major distinction, as shown in **Figure IV**, is the proportion of students who are receiving teaching assistantships compared to those needing to support their graduate study themselves. Physics bachelors pursuing physics or astronomy graduate study are three times more likely to receive a teaching assistantship than those pursuing other disciplines. Graduates entering other areas of graduate study are three and a half times as likely to be personally financing their graduate education as their physics and astronomy counterparts. This imbalance is due, in a large part, to the fact that physics and astronomy graduate students are traditionally better supported than students in most of the other graduate level disciplines.

One indicator of the employment demand for physics bachelors is the number of job offers new degree recipients receive. **Figure V** presents the percent of students receiving two or more job offers in connection with their bachelors degree in each of the last ten years. The rapid decline in multiple job offers, which now seems to be leveling off, corresponds with the increasing interest in further graduate study among physics bachelors.

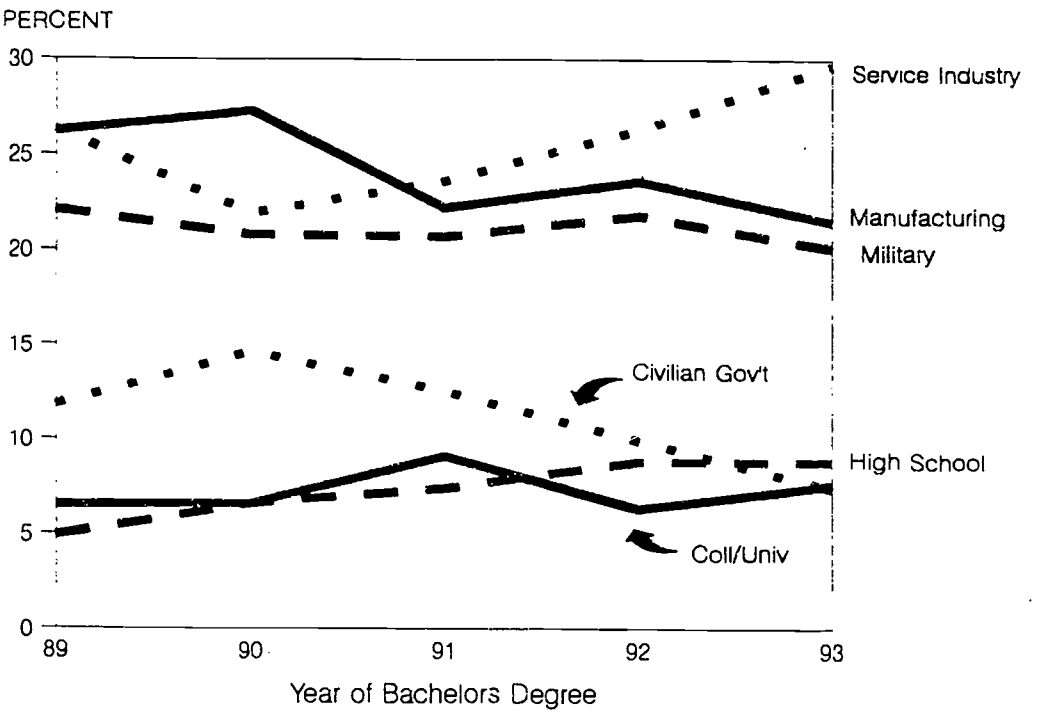
The decline in the proportion of students immediately entering the work force is accompanied by some changes in the employment sectors that hire them (See **Figure VI**). Industry, historically the largest employer of physics bachelors (about 50%), is made up of two main sectors: manufacturing and service. The manufacturing component, after having been the dominant employer throughout the history of this study, has now been succeeded by

Figure V. Percent of Physics Bachelors who Received Multiple Job Offers, Classes 1984 to 1993.



Note: Data are based on those physics bachelors who planned to enter labor force after degree

Figure VI. Employer Distribution of Full-time Employed Physics Bachelors During Summer Following Academic Year, 1989 to 1993.



Note: Table also includes students continuing employment which they held prior to graduation.

the service sector. The rapid decline of manufacturing positions during the 1980s has leveled off as the number of jobs taken in the service industries continues to rise. This decrease in the number of industry manufacturing positions accepted by physics bachelors reflects the overall direction of the nation's economy.

There have been changes in job opportunities in some of the other employment sectors as well. During the last five years, the proportion of physics bachelors accepting secondary school positions increased from 5 to 9 percent. As in the past, women accepted a disproportionate number of these positions. The percentage of physics bachelors accepting civilian government positions has dropped to its lowest level since the early 1980s. Military positions, predominantly filled by men, continue to provide a consistent area of employment for physics bachelors. Approximately one third of these military positions reflect graduates from the military academies. Overall, one-fifth of the employed bachelors are continuing in non-military service employment they held prior to graduation.

ASTRONOMY

There were 59 departments that offered astronomy bachelor degrees in 1993. These departments conferred 190 astronomy bachelors degrees, only 4% the size of the physics bachelor production. Table 7 presents the trends in degree production and postbaccalaureate plans for astronomy bachelors during the last five years.

Table 7. Postbaccalaureate Plans of Astronomy Bachelors, Classes 1989 to 1993.

Post-degree Plans	1989 %	1990 %	1991 %	1992 %	1993 %
Astronomy/Physics Graduate Study	46	46	41	52	51
Other Graduate Study	7	14	10	11	6
Employment	44	37	45	31	34
Undecided	3	3	4	6	9
Total Astronomy Bachelors Degrees	196	176	200	186	190

Table 8. Characteristics of Astronomy Bachelors, Class of 1993.				
		Postbaccalaureate Plans		
Characteristics		Graduate Study %	Employ-ment %	Total %
Sex	Female	41	26	34
	Male	59	74	66
Citizenship	US	94	97	96
	Foreign	6	3	4
Type of Bachelors Institution	PhD-granting	69	71	68
	MS-granting	-	3	2
	BS/BA-granting	31	26	30
	Public	51	52	53
	Private	49	48	47
Total Respondents		49	29	86*
Total Number of Astronomy Bachelors		108	65	190

* Eight respondents to the survey had not decided on a post-baccalaureate plan.

Although astronomy bachelors enter graduate school in proportions similar to physics bachelors, the disciplines they choose differ greatly. Only 6% of the astronomy degree recipients enter graduate study in subjects other than physics or astronomy, this compares to 22% for the physics bachelors.

Women make up a larger percent of the astronomy bachelors degrees than they do among physics bachelors. Similarly to the physics bachelors, foreign citizens earn a very small proportion of the astronomy degrees granted. Demographic characteristics and types of bachelors institutions for the astronomy bachelor class of 1993 are presented in **Table 8**.

Figure VII summarizes the initial employment breakdown for degree recipients entering the work force. For astronomy degree recipients who obtained full time employment, about one-third are involved in teaching activities and one-fourth work in industry. Of the students choosing to immediately enter the job market, the percent still unemployed and seeking employment at the time the survey was conducted rose to 30%, up from 20% reported by the class of 1992.

Figure VII. Postbaccalaureate Plans of Astronomy Bachelors of the Class of 1993.