AMERICAN INSTITUTE OF PHYSICS
AIP REPORT
One Physics Ellipse
College Park, MD 20740-3843
STATISTICAL RESEARCH CENTER
Tel. (301) 209-3070
E-mail: stats@aip.org
www.aip.org/statistics

By Patrick J. Mulvey
Starr Nicholson

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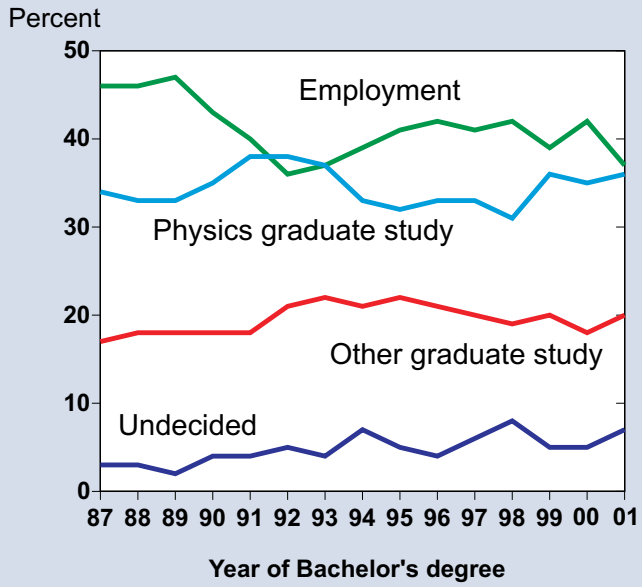
PHYSICS AND ASTRONOMY SENIOR REPORT: CLASS OF 2001

Postbaccalaureate plans of physics seniors, 1987 to 2001.



AIP Statistical Research Center, Physics and Astronomy Senior Report.

HIGHLIGHTS

- About one-third of the physics majors in the class of 2001 took more than 4 years to complete their undergraduate studies. The most common reasons were receiving a double major and changing majors. (**Table 4**)

- Seventy-one percent of the respondents reported that there was a Society of Physics Students chapter on their campus. Female students were more likely to participate than male students. (**Table 6**)

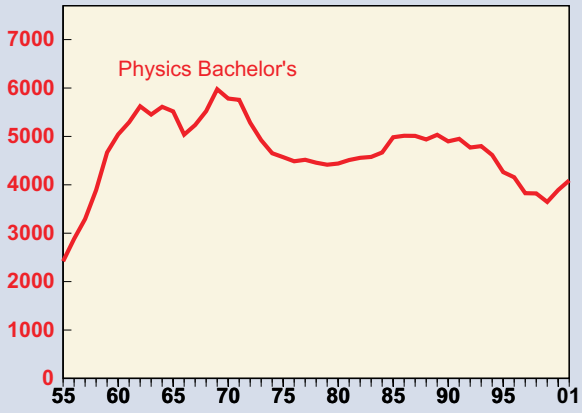
- Far more physics bachelors chose to continue with graduate studies than was true for all bachelors. (**Page 6**)

- Twenty-nine percent of physics seniors had a long-term career goal of teaching and research in a college or university setting. Career goals varied somewhat by gender. (**Tables 9 & 10**)

- Astronomy bachelor's degree production increased sharply in the class of 2001. The 274 astronomy bachelors represented a 36% increase from the previous year. (**Figure 6**)

- Thirty percent of astronomy seniors indicated plans to continue with graduate studies in astronomy or astrophysics, while 16% planned to shift to other physics subfields. (**Figure 7**)

Figure 1. Physics bachelor's produced in the US, 1955 to 2001.



Data from the Survey of Enrollments and Degrees

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There are 761 departments in the US that confer at least a bachelor's degree in physics. These programs produced 4091 bachelor's degrees in the class of 2001. The data in this report are based on responses from 1,581 physics seniors who indicated they had received or were going to receive their physics bachelors during the 2000-01 academic year. Each year about 35% of the physics students with senior status do not receive a bachelor's degree. These students, for a number of reasons, maintain their senior status for more than one year and are not included in this report. The amount of time it takes physics undergraduates to obtain their degrees will be discussed later in the report.

The number of graduating seniors in the class of 2001 grew for the second year in a row, gaining 12% from the 40-year low reached in 1999. Results from the survey of Enrollments and Degrees show that an increase in bachelor's degree production has continued in 2002 and 2003.

Physics bachelors represent a very small proportion of the overall number of bachelors produced in the US. For every 1,000 bachelor's degrees awarded, only about 3.3 are in physics, approximately a third of one percent. **(Figure 1)**

Table 1. Characteristics* of physics bachelors, class of 2001.

Gender	Men	77
	Women	23
Citizenship	US	94
	Non-US	6
Race & Ethnicity**	White	87
	African-American	4
	Hispanic-American	4
	Asian-American	4
	Other	1

*Data from the Survey of Enrollments and Degrees.

**US citizens only.

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Table 2. Percent of degree recipients by control of institution.

Control	Physics bachelors 2001	Physical Science majors, 2000	All bachelors, 2000
Public	56	65	65
Private	44	35	35
	100%	100%	100%

Source: National Center for Education Statistics, Integrated Postsecondary Education Database System (IPEDS), 2001.

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The representation of women among physics bachelors has been increasing slowly but steadily. The 23% women in the class of 2001 represents a significant increase from the 15% of a decade earlier. The representation of foreign citizens and US minorities has remained relatively stable for many years. **(Table 1)**

A greater proportion of physics majors attend private institutions than is true for physical science majors and all bachelors (**see Table 2**).

Table 3. Percent of students starting at a two-year college.

	Physics seniors, class of 2001*	All bachelor's, class of 2000**
Overall	12%	20%
Control		
Public	20%	21%
Private	4%	17%

*Survey of Enrollments and Degrees.

** U.S. Department of Education, National Center for Education Statistics. A Descriptive Summary of 1999-2000Bachelor's Degree Recipients 1 Year later: with Analysis of Time to Degree, NCES 2003-165.

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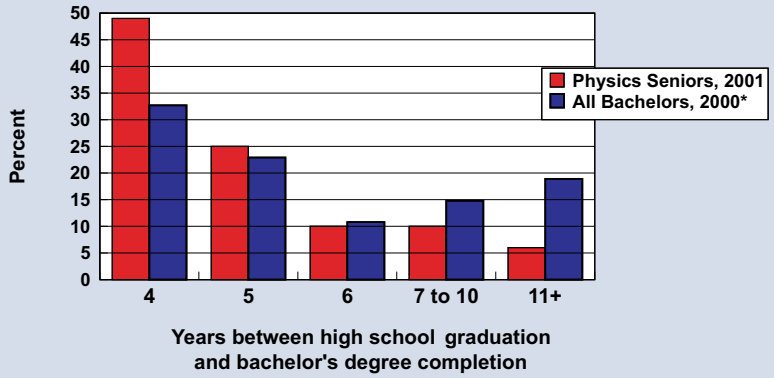
Twelve percent of the seniors indicated they had started their post-secondary education at a two-year college. In comparison, 20% of all bachelors in the class of 2000, regardless of major, started their post-secondary education at a two-year college **(see Table 3)**. Physics bachelors receiving their degrees from a private institution were far less likely to have attended a two-year college than is true for all bachelors who had attended a private institution.

The likelihood of a student starting at two-year college is highly correlated with the state in which he/she received a bachelor's degree. This state-by-state difference reflects the different structure of the higher education system in each state. Some states, such as California, have a large two-year college system which is fully integrated with the public colleges and universities in that state.

The amount of elapsed time between graduating from high school and completing an undergraduate degree is considerably shorter for physics majors than for bachelor's degree recipients as a whole. About half of the graduating physics seniors were on course to complete their undergraduate degree within four years. In comparison, only a third of all bachelors' recipients in the class of 2001 completed their degree in four years **(see Figure 2)**. This difference, in part, is the result of fewer

Figure 2. Time elapsed between high school graduation and bachelor's degree completion.



***U.S. Department of Education, National Center for Education Statistics. A Descriptive Summary of 1999-2000 Bachelors Degree Recipients 1 Year Later: with Analysis of Time to Degree, NCES 2003-165.**

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physics students starting their education at a two-year college as illustrated in Table 2. Students who start their post-secondary education at a two-year college typically take longer to get their degree.

Table 4. Primary reasons for needing more than 4 years of undergraduate study, 2001 physics seniors.

	%
Elected a double major	29
Changed major	20
Took leave of absence	15
Worked while in school	10
Transferred institutions	9
Other	17
	100%

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The time between high school and college graduation consists of two intervals: the time a student waited before enrolling in a post-secondary institution and the number of years a student took to receive his or her degree once enrolled. Focusing on just the second of these intervals, about one third of the graduating physics seniors indicated that they were enrolled in college for more than 4 years prior to receiving their degree. Graduating with a double major was the most frequently cited reason for a delayed graduation, followed by having changed majors (**see Table 4**).

A student's reasons for choosing a major is influenced by many factors although their perspective on what first interested them in a particular subject may change over time. When the question was directed to physics seniors, the most popular answer by far was that they were intrigued by the subject matter. The next most popular response was the influence of a high school teacher, followed by the career and job prospects that would be available to them. Although interest in the subject matter was the highest ranked influence for all students regardless of gender, men ranked it as their most influential factor more frequently than women. On the other hand, women were more likely to be influenced by the people they encountered in the course of their physics studies, such as their high school teachers and college professors.

Table 5. Major influences in choice of college, 2001 physics seniors.

	%
Proximity to home	61
Reputation of school	56
Cost	41
Size of school	40
Offered a scholarship	34
Setting (urban, rural, climate)	31
Curriculum offered	20
Other	17

Note: "Major influence" represents the proportion of students who listed an influence as one of their 3 most significant.

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The students were asked what influenced them in selecting the institution from which they were receiving their bachelor's degree (**see Table 5**). It is clear from their responses that students took a variety of factors into account when deciding which institution to attend. Reputation of the school and proximity to home were ranked as being the most influential factors in making their decision. Ironically, the only factor that departments have control over is the curriculum they offer, which ranked low among the influences.

Seventy-one percent of the students indicated that there was a Society of Physics Students (SPS) chapter on their campus. Students attending departments that included a doctoral program were the most likely to have an SPS chapter available **(see Table 6)**. However, where a chapter was present, it was students at bachelor's and master's-granting departments who tended to be more actively involved. Women tended to be more actively involved in SPS activities than their male counterparts, 77% vs. 62% respectively.

Table 6. Presence of a Society of Physics Students chapter on campus and percent actively involved, 2001 physics seniors.

	Type of department		
	PhD-granting	MS-granting	BS-granting
Yes	84	68	59
Unsure	13	19	15
No	3	13	26
	100%	100%	100%
Percent active where SPS present	56%	72%	78%

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Interaction with faculty has been identified as another important factor promoting student retention and successes. Overall, two-thirds of the responding seniors indicated that there was a faculty member who they considered to be their mentor. The likelihood of a student having a mentor varied by the type of departments they attended. Seventy-three percent of the students attending undergraduate-only departments indicated having a mentor compared to 69% at master's-granting departments and 59% at doctoral granting departments.

Table 7. Research experience, 2001 physics seniors.

	%
None	25
Department research project	35
As part of a thesis	31
REU (1)	27
Non-dept employment	27
Co-op or Internship	13

(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.

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The opportunity for physics majors to work on a research project is an important part of many departments' undergraduate curriculum. Three-quarters of the respondents indicated that they had participated in some type of research project. **(see Table 7)**. Participation in research projects was generally evenly distributed, with men and women participating equally, as well as students from all types of departments. The proportion participating in a research project was higher among students who indicated they had a mentor or were very active in their SPS chapter.

Table 8. Double majors, 2001 physics seniors.

Physics Seniors	36%
All Bachelors (1)	7%

Other major for physics seniors	%
Mathematics	39
Engineering	10
Astronomy	9
Computer science	8
Chemistry	7
Philosophy & Theology	4
Biology	4
Music & Fine arts	3
Other	16

(1) National Center for Education Statistics, Integrated Postsecondary Education Database System (IPEDS), 1998.

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Thirty-six percent of the seniors indicated they were going to graduate with a double major. This compares to about 7% for all undergraduate majors combined. Physics majors anticipated receiving their double majors in a broad range subjects, but because undergraduate study in physics requires students to take a considerable amount of coursework in mathematics, it was by far the most common other major. (**Table 8**)

The post degree plans of the seniors in the class of 2001 show a slight shift away from directly entering the workforce and toward graduate studies, both in physics and other disciplines. **(see Cover Figure)**. Overall, 36% of the physics seniors planned to pursue graduate studies in physics and 20% planned to pursue studies in other subjects. Another 37% indicated plans to get a job, while 7% were undecided about their plans at the time the survey was conducted.

The percent of physics seniors choosing to immediately continue with graduate studies (56%) is considerably higher than for bachelor's degree recipients as a whole. For all bachelor's degree recipients in the class of 2000[(1)], only 14% were enrolled full-time and only 7% were part-time in any type of post-baccalaureate degree or certificate programs in 2001. (1) U.S. Department of Education, 2003-165.

Although a significant proportion (37%) of the physics seniors planned to get a job upon completing their degree, even among this group over half indicated plans to continue their education at some point in the future. About half (49%) planned to receive a masters and 37% aspired to a PhD, with physics being the most frequently cited future subject. The remaining14% planned to pursue a variety of professional fields or another undergraduate degree.

As in the past, seniors who attended departments that also had graduate programs in physics were more likely to immediately pursue graduate studies in physics than those attending departments that only offer a bachelor's in physics **(see Figure 3)**.

A senior's post-degree plans were also affected by other factors. Students who had higher levels of involvement in their SPS chapters were more likely to indicate plans to pursue graduate study in physics (50%) than those who were not active in their chapter or attended a department that did not have a chapter (28%). Graduating with a double major also had a correlation with post-degree plans. Twenty-six percent of students graduating with a double major planned to continue their studies at the graduate level in a subject *other* than physics, compared to 14% of the students receiving only a physics bachelor's degree.

Figure 3. Postbaccalaureate plans by type of physics department, 2001 physics seniors.

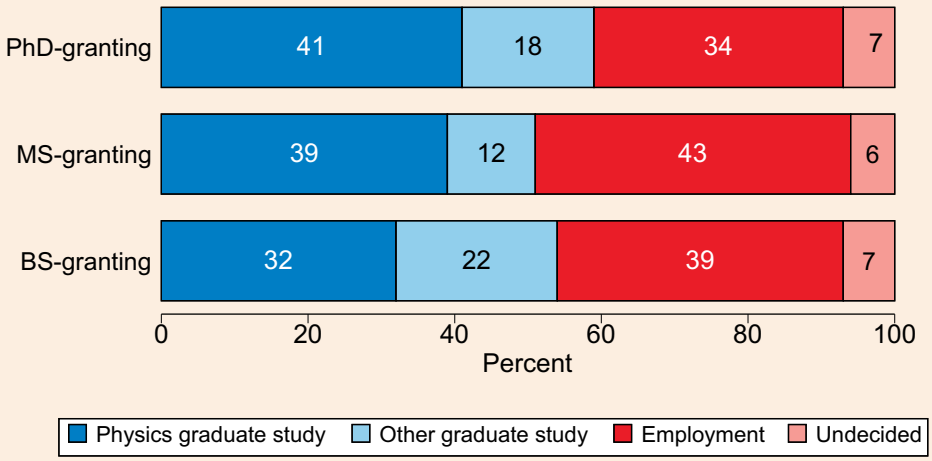

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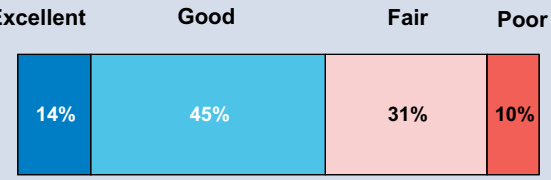
Figure 4. Perception of job market, 2001 physics seniors.



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Overall, the majority of physics seniors in the class of 2001 perceived the initial employment prospects for new physics bachelors to be excellent or good **(see Figure 4)**. Among the primary factors influencing students' perceptions were the views expressed by fellow students and by faculty, followed by experiences at career and job fairs. Seniors who indicated that a faculty member was the primary influence in forming their job market perceptions tended to be more optimistic about their employment prospects than the students whose perceptions were primarily influenced by a career or job fair. Seniors who attended an undergraduate-only department were more likely to rate the employment prospects for new bachelors excellent or good (63%) than those attending graduate departments (54%).

Over half of the students immediately continuing on with graduate studies in physics have hopes of an academic position involving teaching and research at a college or university. This contrasts greatly with individuals who plan to pursue graduate studies in another field, where only 19% aspire to such a position.

Thirty-eight percent of these latter students aim to work in the field of engineering, consistent with the large proportion pursuing graduate studies in that field. Finally, students entering directly into the workforce had the most diversified career aspirations, with only 9% aspiring to a college or university position **(see Table 9).**

Table 9. First choice of long-term career goals by initial post-degree outcome, 2001 physics seniors.

	Initial Postbaccalaureate Plan			
	Graduate Study			
Career Goal	Physics or Astronomy	Other Fields	Employment	Overall
College / University teaching and research	58	19	8	29
Engineering position	10	38	26	22
Other science or technical position	22	16	26	21
Pre-college science teaching	1	4	9	5
Other positions (non-science)	5	20	20	14
Unsure	4	3	11	9
	100%	100%	100%	100%

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Table 10. First choice of long-term career goals by gender, 2001 physics seniors.

Career Goal	Men	Women
College / University teaching and research	29	28
Engineering position	25	13
Other science or technical position	19	27
Pre-college science teaching	4	8
Other positions (non-science)	14	16
Unsure	9	8
	100%	100%

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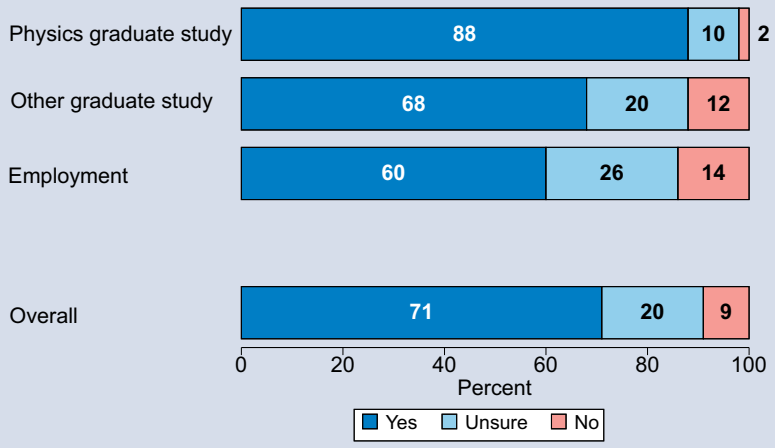
Career aspiration also varied somewhat by the student's gender and by type of department attended (**see Table 10**). Eight percent of the women aspired to a pre-college teaching position, compared to 4% of the men. Men were more likely (25%) to aspire to a position in the field of engineering than women (12%). On the other hand men and women aspired equally to college and university positions.

The overall response to the question, "If you could do it over again, would you still major in physics", was generally very positive, with only 9% indicating they would not. Not surprisingly, seniors choosing to continue their studies in physics were the most likely to indicate that they were satisfied with their choice of major **(see Figure 5)**. The most frequent reason given by the students for not majoring in physics again or

Figure 5. Response to the question, "If you could do it over again, would you still major in physics?", by post-degree plans, 2001 physics seniors.



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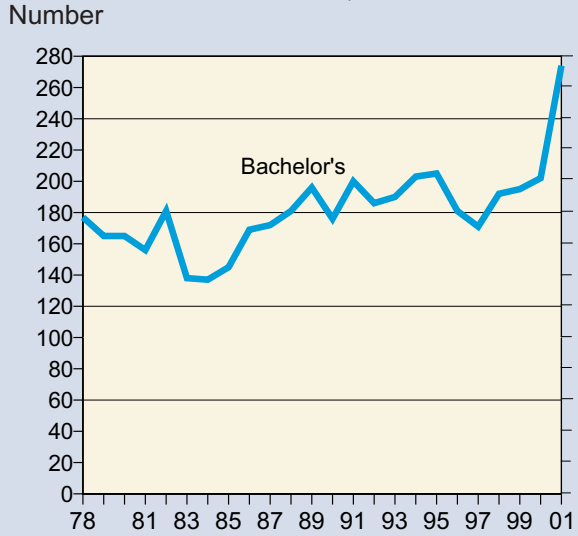
being unsure was that they had developed an interest in another subject. Other reasons cited were: a loss of interest in physics, poor job prospects, and the preference to study a more applied field.

Astronomy

In the academic year 2000-2001 there were 70 degree-granting astronomy departments, of which 62 offered undergraduate degrees in astronomy. About half of these departments are administered in combination with a physics department while the other half are stand-alone departments. These departments conferred 274 astronomy bachelors, a 36% increase from the previous degree class (**see Figure 6**). This is the largest single-year increase ever recorded in the 30 years that AIP has been collecting data on astronomy degree production and the total represents the largest number of astronomy bachelors ever documented by AIP. Moreover, results from the AIP Enrollments and Degrees survey show that astronomy bachelor's degree production continued to increase for the class of 2002 and leveled out in 2003. The following data on astronomy undergraduates are based on the responses from 104 graduating seniors in the class of 2001.

Figure 6. Astronomy bachelors degrees awarded in the US, 1978-2001.



Data from the Survey of Enrollments and Degrees.

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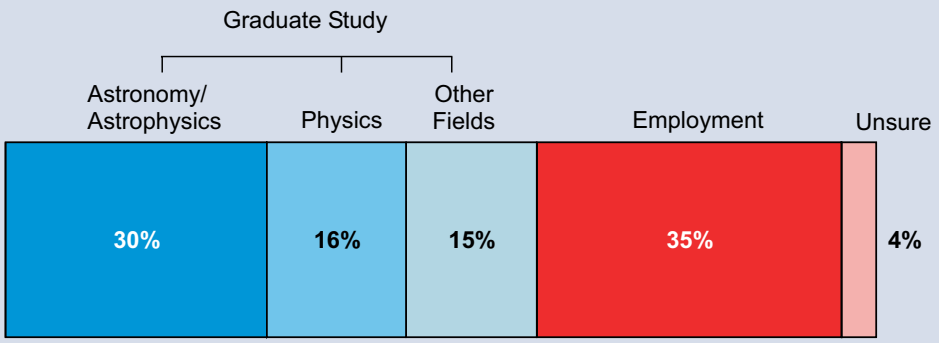
Over half (58%) of the astronomy seniors indicated they either had or were going to graduate with a double major. The course work required for undergraduate majors in physics and astronomy typically overlap a good deal, explaining why over two-thirds of the astronomy seniors graduating with a double major indicated that their other major was physics.

One contributing factor to the jump in degrees may be the increased presence of women, who in 2001 comprised 41% of astronomy degree recipients. This is also an all time high for astronomy undergraduates, and is considerably higher than the corresponding figure of 23% for physics undergraduates.

As with physics, more than two-thirds of astronomy seniors studied on a campus where a Society of Physics Students chapter was present. Moreover, when such a chapter did exist, about half of the astronomy students reported taking part in chapter activities. This is only a little less than the level of activity reported by physics seniors.

Figure 7. Immediate postbaccalaureate plans, 2001 astronomy seniors.



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Again like physics, a large proportion (84%) of the astronomy undergraduates had participated in a research project. Many of these research experiences occurred within the department, but a significant number of students also participated in extramural research efforts. These research experiences frequently involved employment, often a co-op or internship arranged through their program.

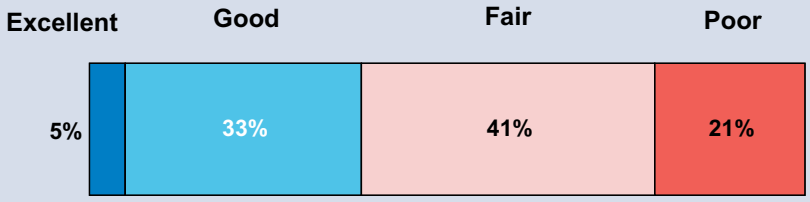
About half of the astronomy seniors indicated they were completing their undergraduate studies in astronomy within 4 years of graduating from high school. This is the same proportion as reported by the physics seniors and larger than what is experienced by all bachelors, only a third of whom received their degree within four years. One-quarter of the astronomy seniors indicated they were enrolled in college for more than 4 years prior to receiving their degree. Graduating with a double major and changing majors were the most frequently cited reasons for taking more than four years to complete their degree.

Astronomy bachelors continue on with graduate study at a similar rate as physics bachelors, but a slightly larger proportion stay within the fields of either astronomy or physics (**see Figure 7**). A little over a third indicated plans to enter directly into the workforce. Again, similar to physics, astronomy seniors receiving their degrees from departments with doctoral programs were more likely to continue their education at the graduate level, and a higher proportion of seniors from undergraduate-only departments planned to enter directly into the workforce.

When all seniors were asked for their perception of the current employment prospects for new astronomy bachelors, 38% felt it was excellent or good (**see Figure 8**). This outlook was more pessimistic than the perceptions of physics seniors, 59% of whom felt that their employment prospects were excellent or good.

Overall about one-third of the astronomy seniors hoped to ultimately obtain an academic position involving teaching and research at a college or university. Another quarter aimed to work in a non-academic technical or science-related position (**see Table 11**). As would be expected, seniors

Figure 8. Perception of job market, 2001 astronomy seniors.



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whose immediate post-degree plans involved graduate studies were more likely to aspire to a position at a college or university than seniors entering the workforce.

More than two-thirds of the astronomy seniors felt positive about their choice of major. When asked, "If you could do it over again, would you still major in astronomy ", only 11% said no (**see Figure 9**). Seniors with plans to pursue graduate studies in fields other than astronomy and physics, or those entering the workforce were more likely to answer "no" or "unsure". The most frequent reason given by the students with reservations over their choice of major was that they had developed an interest in another subject. Another common reason involved the perception of poor job prospects.

Table 11. First choice of long-term career goals, 2001 astronomy seniors.

Career Goal	%
College / University teaching and research	34
Engineering position	6
Other science or technical position	25
Pre-college science teaching	4
Other positions (non-science)	23
Unsure	8
	100%

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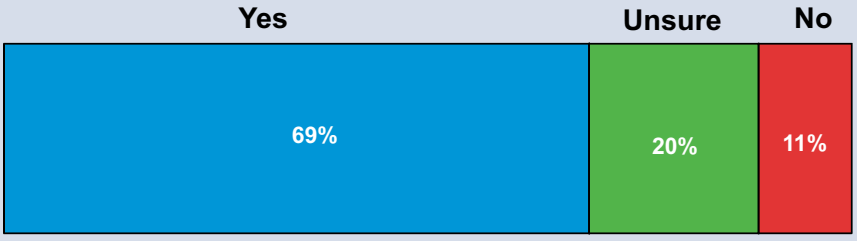
Figure 9. Response to the question, "If you could do it over again, would you still major in astronomy?", 2001 astronomy seniors.



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