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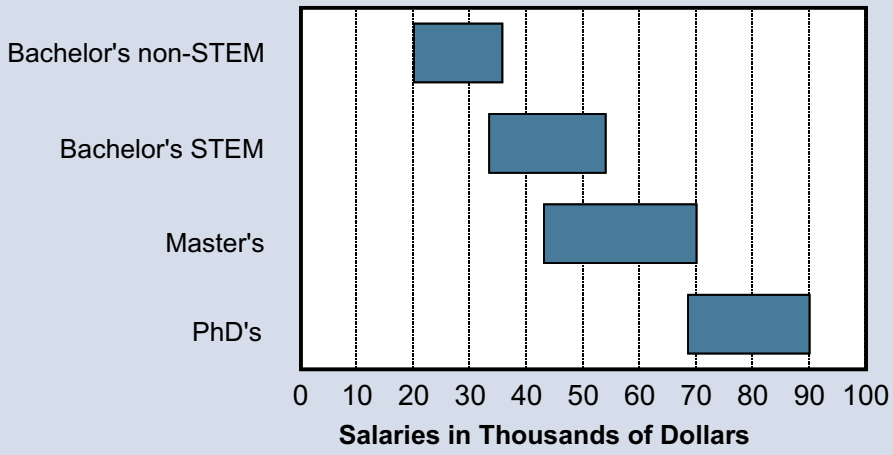
Initial Employment Report: Physics and Astronomy Degree Recipients of 2003 & 2004

Figure 1. Starting salaries for physics degree recipients in the private sector, classes of 2003 & 2004.



Note: Typical salaries are the middle 50%, i.e. between the 25th and 75th percentiles.

STEM refers to positions in science, technology, engineering and math.

AIP Statistical Research Center, Initial Employment Report.

Highlights

- For the fourth straight year the percentage of physics PhD's accepting postdocs has risen, and is now as high as this report series has ever recorded **(Figure 16)**. Foreign citizens accepted postdocs at a higher rate (77%) than US citizens (57%).
- After three years of steady decline, the proportion of new physics bachelor's entering directly into the job market has stabilized, at least temporarily, with the class of 2004 **(Figure 2)**. Forty-one percent of the class of 2004 entered or tried to enter the job market directly, compared to a recent high of 52% in 2000.

Highlights continued

- Just over two-thirds of physics bachelor's in the private sector found positions in science, technology, engineering or math **(Figure 9)**.
- What physics masters do directly after graduation varies greatly by citizenship. Foreign citizens are much more likely to pursue graduate study than their US counterparts **(Figure 12)**.
- Ninety-three percent of the physics master's employed in the private sector are in STEM (Science, Technology, Engineering or Math) related positions, with about 40% in the fields of physics or astronomy **(Page 11**).
- Only about a quarter of physics PhD's who accepted potentially permanent positions were employed primarily in the field of physics or astronomy. Engineering was the largest field of employment, encompassing a little over a third **(Page 16)**.
- Astronomy PhD's tend to use more of their training in their post-degree employment than Physics PhD's. A little over 90% hold positions that use their overall knowledge of basic astronomy principles, and almost three-quarters report that their position involves advanced astronomy principles **(Page 20)**.

Physics degree recipients have many options to choose from once they complete their studies. Many choose to continue their education, while others choose to enter the workforce directly. Some degree recipients accept potentially permanent positions, while others accept a fellowship or other temporary position. A few choose non-paid paths, such as volunteer programs or full-time parenthood. Many factors can influence their choices, including personal circumstances, long-term goals, and the economic conditions they encounter.

The US economy has changed significantly from the strong, technology-propelled successes of the late 1990s. It has gone through a recession followed by a slow, ongoing recovery strained by the demands of a wartime economy. Echoes of these broad economic changes can be seen in the initial post-degree status of physics and astronomy degree recipients of all levels.

Regardless of economic shifts, the private sector has consistently been the dominant employer for physics degree holders who accept potentially permanent positions. **Figure 1** gives a quick comparison of the typical starting salaries degree recipients receive in the private sector. The bachelor's salaries have been divided by whether or not they were employed in the fields of science, technology, engineering or mathematics (STEM). There is a stark contrast in salary ranges between STEM and non-STEM positions. Virtually all of the master's and PhD's are working in a STEM related position.

This report discusses the academic and employment pursuits of bachelor, master and PhD recipients in the physics and astronomy degree classes of 2002-03 and 2003-04. The data that forms the basis of the report comes from the American Institute of Physics' Initial Employment Survey. The AIP Statistical Research Center conducts this annual survey in the winter following the academic year in which physics and astronomy students receive their degree.

Recent degree recipients can be very difficult to reach because they tend to move after receiving their degree. We contact the advisors of

non-responding degree recipients in an attempt to gather basic outcome data and updated contact information for their advisees. For a number of years, the advisors of master's & PhD recipients have been a great help in tracking down the individuals we were unable to reach. Beginning with class of 2004, we expanded our survey methodology to include contact with the advisors of the bachelor's as well.

In addition to this major change, the questionnaire has transitioned from a simple paper and pencil form to a mixed mode survey with some respondents answering the traditional survey form and others answering a parallel form online. The majority of our respondents now complete the survey online.

We would like to thank the many physics and astronomy departments, degree recipients, and faculty advisors who made this report possible.

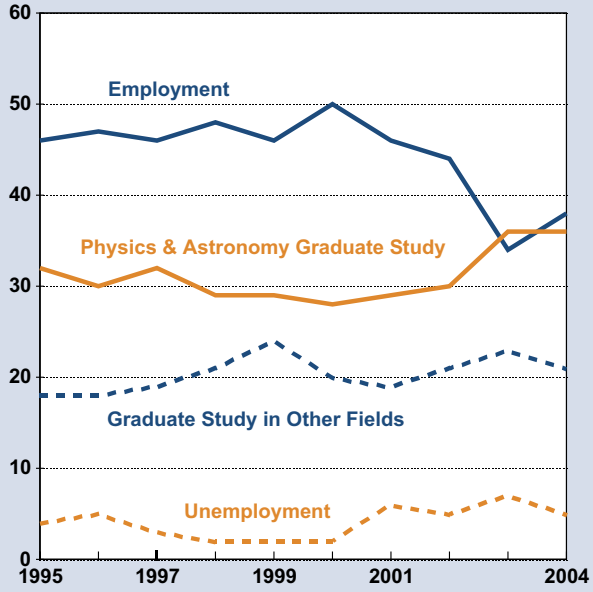
Physics Bachelor's Recipients

According to the AIP Survey of Enrollments and Degrees, physics bachelor's degree production has increased rapidly in recent years, up 36% from the recent low in 1999. The combined classes of 2003 and 2004 had 94% US citizens and 22% women. We were able to collect the names of 82% of the bachelor's recipients, but many of the names are supplied without current contact information. Overall, we heard from or heard about 32% of the combined classes of 2003 and 2004, a small improvement over past years because of the introduction of advisor contacts with the class of 2004. Over two-thirds of responding degree recipients in the combined classes of 2003 and 2004 answered the online version of the survey.

After three years of steady decline, the proportion of new physics bachelor's entering directly into the job market has stabilized, at least temporarily, with the class of 2004 **(Figure 2)**. Forty-one percent entered the job market directly (including the unemployed and seeking), compared with a recent high of 52% in 2000. The proportion of physics bachelor's pursuing graduate study in physics, although stable in the classes of 2003 and 2004, has increased over recent years. Over a third (37%) of bachelor's enrolled in physics graduate study, while almost a quarter (22%) enrolled in graduate study in other fields **(Figure 3)**.

The post-degree outcomes of physics bachelor's differ by the highest degree of the department they attended. Bachelor's from physics departments that contain a graduate program are more likely to proceed directly into physics graduate study than their counterparts emerging from departments that offer only a bachelor's degree in physics **(Figure 4)**. It is unclear whether this difference results from the research orientation of the programs or from the type of students attracted to research universities versus liberal arts colleges.

Figure 2. Trends in initial outcomes of physics bachelor's, classes of 1995-2004.



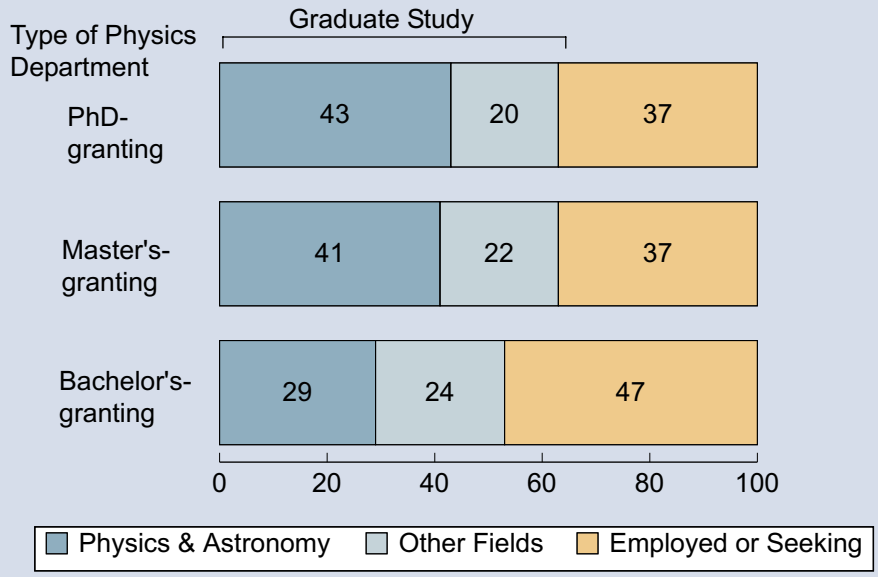
AIP Statistical Research Center, Initial Employment Report.

Figure 3. Initial outcomes of physics bachelor recipients, classes of 2003 & 2004.

AIP Statistical Research Center, Initial Employment Report.

Physics bachelor's recipients continue to look favorably upon their educational choices. Over three-quarters of the class of 2004 were pleased with the career prospects available to them, and the majority (86%) would still study physics or astronomy if they had it to do over again. However, attitudes do vary by the post degree outcomes of the degree recipients **(Figure 5)**. Similar to past survey findings, bachelor's who entered directly into graduate programs in physics or astronomy have the most favorable attitudes toward their education. Surprisingly, even a majority of the small group of unemployed physics bachelor's would study physics or astronomy again, given the opportunity.

Figure 4. Initial outcomes by type of department attended, physics bachelor's classes of 2003 & 2004.



AIP Statistical Research Center, Initial Employment Report.

The following sections on bachelor's recipients will discuss the fields of study and types of financial support received by the bachelor's who went straight on to graduate school, the types of employment secured by those who went into the workforce, and the career goals of all physics bachelor's at this early stage of their career. About 2% of responding physics bachelor's from the combined classes left the US after receiving their degree. Those who left the US, those who are employed in full-time volunteer positions and those who were unemployed but not seeking at the time they completed the survey are excluded from the discussions of graduate study and employment.

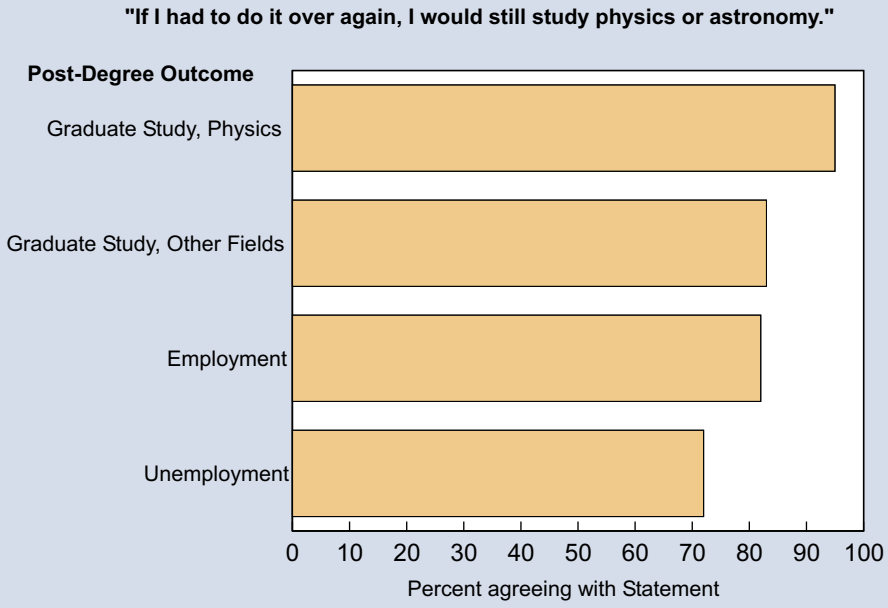
Physics Bachelor's: Graduate Study

About three-fifths of the physics bachelor's in the combined classes of 2003 & 2004 entered directly into graduate programs upon completing their degree. Nearly two-thirds of these bachelor's chose to continue their studies in physics or astronomy. As in the past, the most frequently chosen field of graduate study outside of physics and astronomy was engineering, representing 14% of the physics bachelor's pursuing graduate studies. The variety of other graduate fields chosen by physics bachelor's is represented in **Figure 6**.

Physics bachelor's continuing their graduate studies in physics are more likely to pursue a PhD than those continuing in other fields. Nearly 80% of the physics bachelor's pursuing graduate study in physics or astronomy enrolled in a doctoral program, compared to 37% of the degree recipients pursuing other fields. Forty-five percent of the degree recipients pursuing other fields enrolled in masters programs, including just over half of those studying engineering. The remaining bachelor's are scattered across programs that include medical degrees, law degrees and even additional bachelor's.

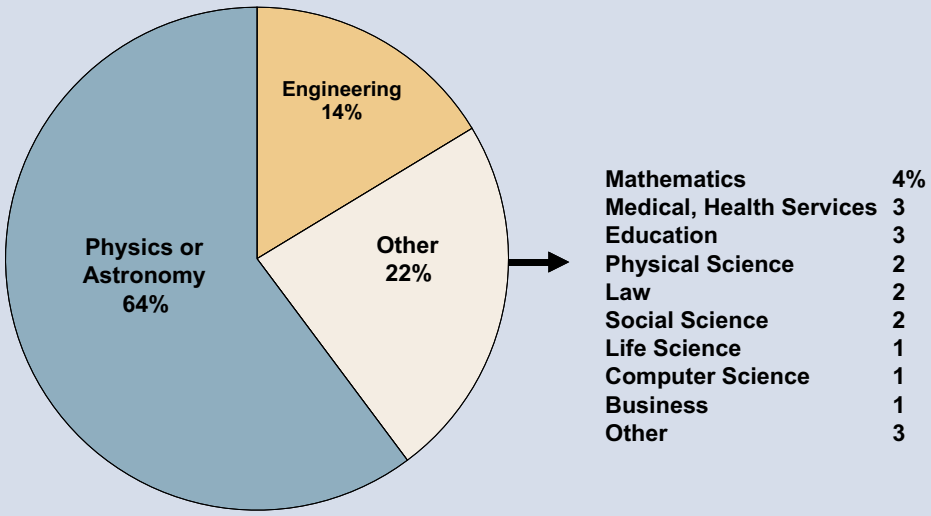
Over half (59%) of physics bachelor's received their degree from a department that also offers a physics graduate degree (MS or PhD). The bachelor's from these departments often have the ability to continue with physics graduate study without changing institutions. Physics bachelor's who continued on to graduate study in physics and

Figure 5. Satisfaction with degree field, physics bachelor's classes of 2003 & 2004.



AIP Statistical Research Center, Initial Employment Report.

Figure 6. Fields of study for physics bachelor's continuing directly on to graduate school, classes of 2003 & 2004.



AIP Statistical Research Center, Initial Employment Report.

received their degree from a department that offered a master's as its highest degree were more likely (47%) to continue their studies at the same department than bachelor's from departments where a PhD was the highest degree available (32%).

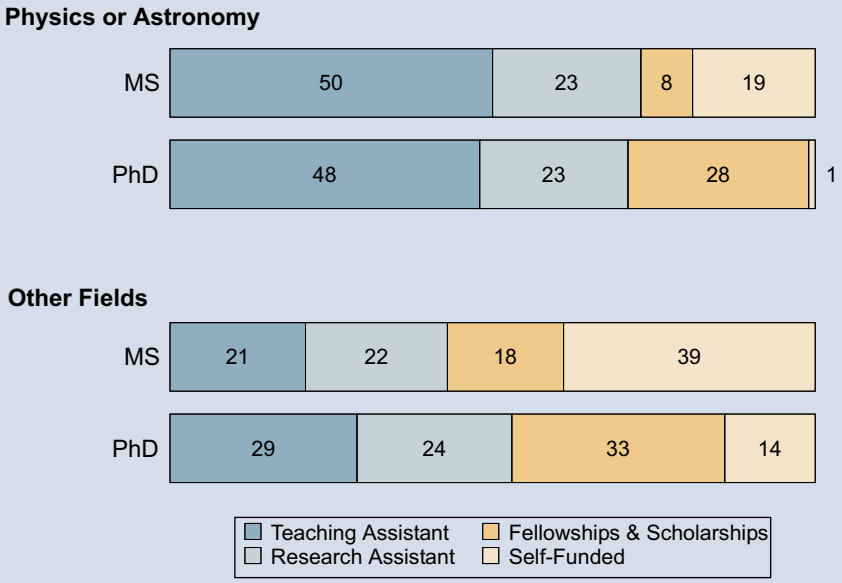
Figure 7 shows the type of support that bachelor's received to fund their graduate study. Students in PhD programs traditionally rely less on savings and loans and are more likely to receive TA's, RA's and fellowships to fund their graduate study than students in MS programs. Students who continue with graduate study in physics and astronomy graduate programs tend to be better supported with TA's and RA's than students who chose to continue in other fields. In addition, the vast majority of physics bachelor's continuing their education at the graduate level receive either a full or partial tuition waiver. The likelihood of receiving a tuition waiver is very high for students who hold assistantships or fellowships, regardless of field of study.

Physics Bachelor's: Employment

After declining for 3 years, the proportion of new physics bachelor's entering directly into the work force has leveled off **(Figure 2)**. However, the proportion of employed physics bachelor's who accept part-time positions has been on the rise. In the combined classes of 2003 & 2004, 13% of bachelor's who secured employment after receiving their degree took part-time positions, up from 3-4% in the early 1990's. The part-time positions vary greatly across sectors and fields, although 39% are in teaching positions. The employment discussion that follows is limited to full-time US employed bachelor's.

We asked employed physics bachelor's how many job offers they received. In the combined classes of 2003 and 2004, almost 40% received more than one job offer. The proportion of recent physics bachelor's receiving multiple offers hit a peak near 60% during stronger economic times in the late 1990's. Although the proportion of physics bachelor's not working and seeking employment in

Figure 7. Primary types of support for graduate study, physics bachelor's classes of 2003 & 2004.



AIP Statistical Research Center, Initial Employment Report.

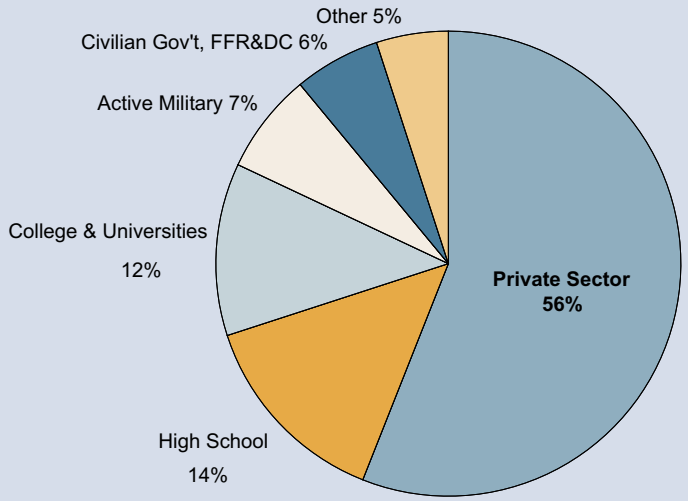
the winter following their degree year is typically small (2-7%), that percentage tends to vary inversely with the proportion receiving multiple job offers. None of these measures - initial unemployment, the proportion of employed bachelor's receiving multiple offers, and the proportion accepting part-time positions - are reliable as stand-alone job market indicators, but as a group reflect the general economic conditions that different bachelor classes encountered.

Although the private sector does not employ as large a proportion of physics bachelor's as it did in the mid 1990's, when it employed nearly two thirds of the physics bachelor's who entered the workforce, it continues to employ the largest proportion **(Figure 8)**. The employment sectors and work activities that physics bachelor's choose can be quite varied. Some choose to teach at the secondary school level or to work at a college or university, while others accept positions at national labs, hold active military positions, or work at nonprofit organizations or medical centers.

For physics bachelor's entering the workforce, obtaining a position in the fields of science, technology, engineering, or math (STEM) seems like an appropriate employment outcome. Indeed, just under three-quarters of employed bachelor's overall and just over two-thirds of physics bachelor's in the private sector accepted STEM positions in the class of 2004. Although the proportion of physics bachelor's in the private sector who are employed in STEM positions had been declining in recent years, it appears that the decline may have ended with an upturn in the class of 2004. We are unable to make direct comparisons to earlier years due to changes in how the data was collected for this item on the 2004 form. Although many non-STEM related positions are often excellent career choices for physics bachelor's, this possible shift toward more STEM related positions should be considered a positive job market indicator.

Engineering was the dominant field of employment for physics bachelor's employed in the private sector, followed by computer or information systems and other technology related positions

Figure 8. Initial employment sectors of physics bachelor's, classes of 2003 & 2004.



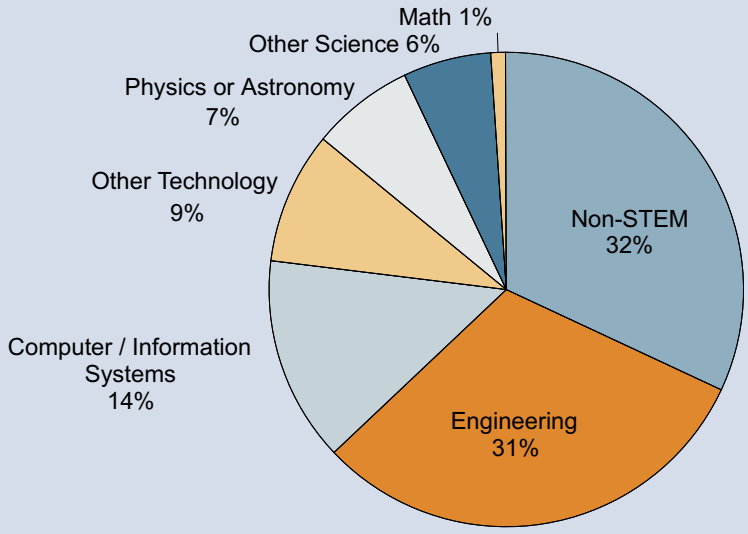
AIP Statistical Research Center, Initial Employment Report.

physics bachelor's. However, in 2004, bachelor's encountered higher salaries in the private sector for both STEM and non-STEM positions. Bachelor's who are continuing the job that they held before they received their degree (less than 10%) are not included in **Figure 10**.

In summary, recent physics bachelor's who have entered the job market have seen difficulties that parellel the strains in the US economy. However, increasing starting salaries, along with the apparent shift toward more new bachelor's accepting STEM-related positions, may reflect a change to a more positive initial employment outlook for physics bachelor's.

(Figure 9). Many physics bachelor's use their physics training and problem solving skills in their positions. In general, degree recipients employed in civilian government positions and at universities or colleges are more likely to be employed in the fields of physics or astronomy and less likely to have non-STEM positions than degree recipients in the private sector. A little over half of those teaching high school were primarily teaching physics.

Figure 9. Field of employment for physics bachelors in the private sector, class of 2004.

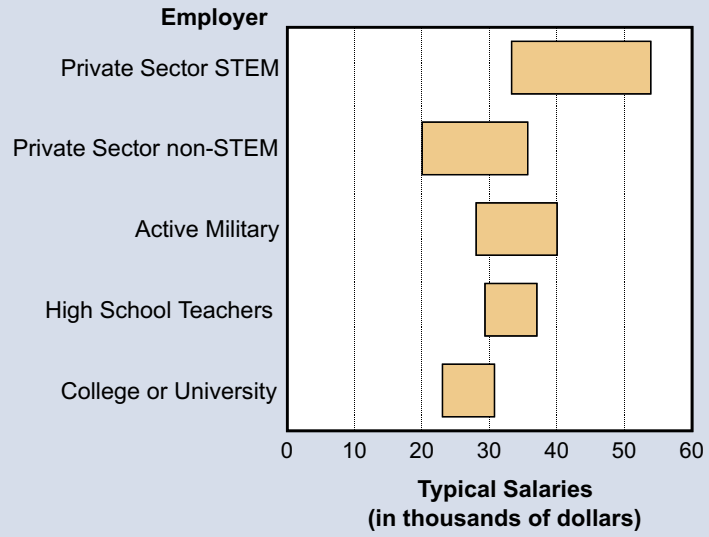


STEM: Science, Technology, Engineering and Math

AIP Statistical Research Center, Initial Employment Report.

Figure 10 presents the starting salary ranges for physics bachelor's in the classes of 2003 and 2004. It illustrates the clear salary differences between STEM and non-STEM positions in private sector. Beginning with the class of 2001, an increase in the proportion of bachelor's accepting non-STEM positions in the private sector greatly contributed to a decline in starting salaries for

Figure 10. Starting salaries for physics bachelor's , classes of 2003 & 2004.



Note: Typical salaries are the middle 50%, i.e. between the 25th and 75th percentiles.

STEM refers to positions in science, technology, engineering and math

AIP Statistical Research Center, Initial Employment Report.

physics or astronomy and the least likely to have secured potentially permanent employment. Two-thirds of the bachelor's who hoped to work in academia hoped to be primarily doing research, and the other third would prefer to have teaching as their primary work activity. Bachelor's who aspired to a career in the private sector were fairly evenly split between enrolling in graduate programs and entering the job market and less likely to pursue graduate studies. The types of work they hoped to do varied greatly, and included research, design and development, management or administration, programming or system software, and legal or financial services. Just under three-quarters of the bachelor's who hoped to work in civilian government or national lab positions hope to be performing research.

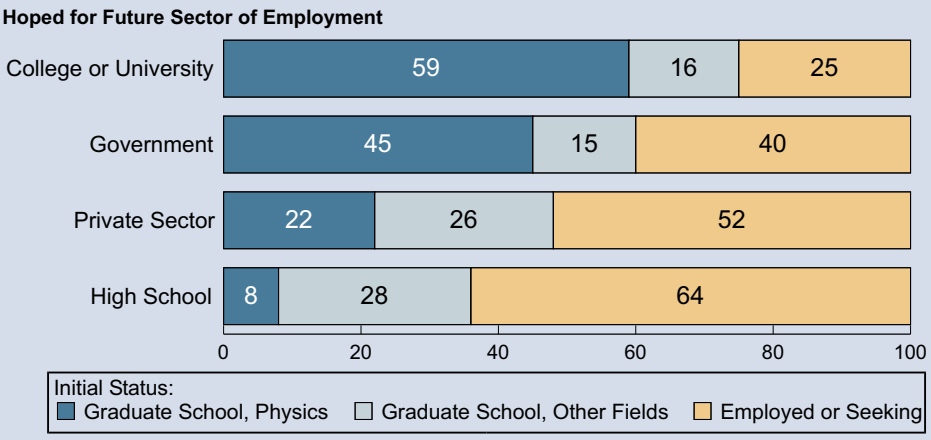
Physics Bachelor's: Long Term Goals

We asked physics bachelor's about their long-term career aspirations **(Figure 11)**. Bachelor's who aspired to a career at a college or university were the most likely to continue with graduate study in

Physics Master's Recipients

Master's degrees in physics are granted both as exiting degrees and as degrees enroute to a PhD at the same department. This section is limited to exiting master's, individuals who leave their

Figure 11. Long-term career goals for physics bachelor's by immediate outcome, classes of 2003 & 2004.



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current department (master's or doctoral-granting) and who may then enter the workforce or continue with graduate study at another department.

Master's recipients are also a difficult group to follow-up. They are very mobile, and many departments are unable to provide updated contact information for them. We obtain supplemental information about the degree recipients by asking the advisors of non-responding degree recipients a few very general questions about their advisees' post-degree status. Even this approach has limited success, because master's recipients frequently do not keep in touch with their advisors.

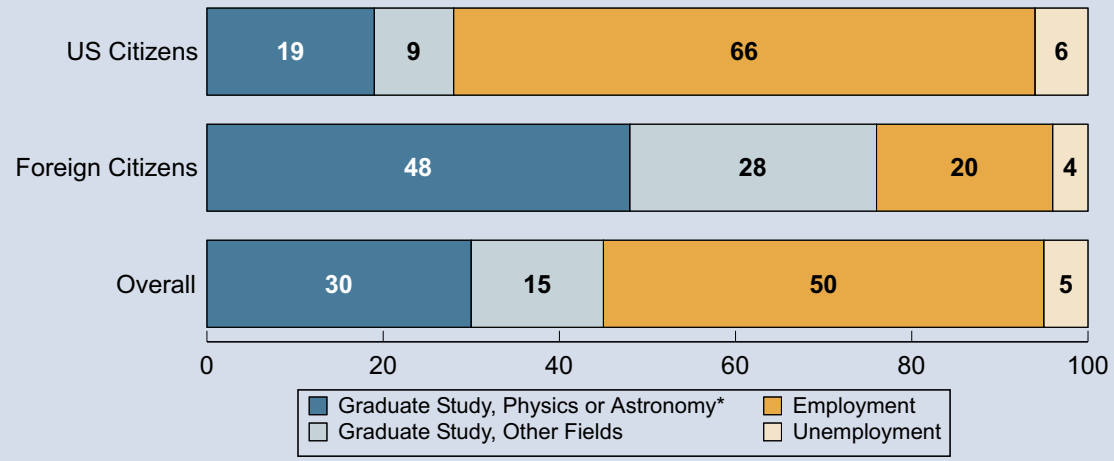
The classes of 2003 and 2004 had 672 and 716 exiting master's, respectively. We heard from or about 655 of the exiting master's from these combined classes, 47% of the combined total. About half of the responses came from the students directly, and the other half came from their advisors. According to the AIP Survey of Enrollments and Degrees, the combined classes contained 22% women and 39% foreign citizens. A small percentage of physics master's left the US after receiving their degree (4% of US citizens and 14% of foreign citizens). They are not included in the following discussion.

As with the bachelor's recipients, exiting master's chose either to continue with their graduate studies or to enter the workforce. The initial paths chosen by physics master's in the classes of 2003 and 2004 are shown in **Figure 12**. Initial outcomes of physics master's vary greatly by citizenship. Foreign citizens are much more likely to pursue graduate study, than their US counterparts.

Five percent of the combined master's classes of 2003 and 2004 were unemployed and seeking employment in the February following their degree. The proportion of physics master's who were unable to secure employment in the half year after graduating has not changed appreciably in recent years.

A little over one-third of the employed physics master's had more than one job offer to choose from. About 10% of the employed master's accepted a part-time job, half of which were teaching positions. Those in part-time positions are excluded from this discussion.

Figure 12. Initial outcomes of exiting physics master's by citizenship, classes of 2003 & 2004.



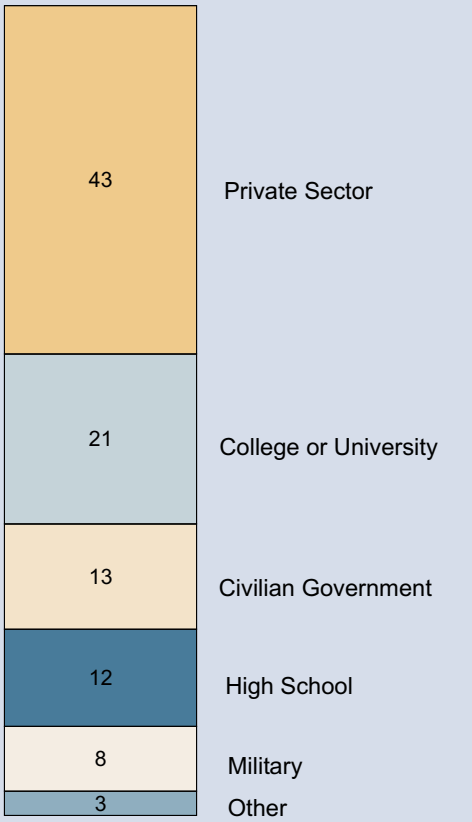
* At a different department from the one where they received their Master's degree.

AIP Statistical Research Center, Initial Employment Report.

The private sector continues to employ more new physics master's than any other sector **(Figure 13)**. The typical salary range for physics master's employed in the private sector is $43,000-$70,000 (**Figure 1**). The vast majority (95%) of the physics masters in the private sector are in STEM related positions. Physics and astronomy are the most common fields for STEM employment, followed by engineering. Research was the most common work activity across all employment sectors.

Overall, less than one third of the physics master's pursued graduate study in physics at another institution **(Figure 12)**. Among the students pursuing other fields, engineering was the most frequently chosen field of study. Overall, master's continuing their graduate studies were well supported. About three-quarters received a teaching or research assistantship.

Figure 13. Employer distribution of full-time US employed physics master's, classes of 2003 & 2004.



AIP Statistical Research Center, Initial Employment Report.

We asked physics master's about their long-term employment goals, and 46% hope to work in academia (70% of the master's who continued their studies in physics or astronomy), performing research or teaching. Over a third (37%) hope to work in the private sector, conducting research, doing design or development work, or a variety of other kinds of work. A smaller proportion of masters desired careers in civilian government or at national labs (13%), or teaching high school (4%).

Physics master's had a generally positive opinion about their choice of degree field. When asked if they would still study physics if they had it to do over again, 81% agreed that they would. There were no significant differences in attitude by citizenship or post-degree circumstance, but, unlike the bachelor's, there was a modest difference in attitude by sex. Whereas 83% of the males would study physics again given the opportunity, only 74% of women felt the same.

Physics PhD Recipients

After having declined steadily from a recent high in the mid 1990's, physics PhD production has leveled off at about 1100 doctorates in the classes of 2002, 2003 and 2004. This represents an overall decline of 26% from the number of PhD's conferred a decade earlier.

Although physics PhD's are mobile, departments and advisors frequently know the whereabouts of their graduates. We were able to gather information from or about 65% of the physics PhD recipients in the combined classes of 2003 and 2004. When we were unable to contact the degree recipient directly, we were often able to collect some basic information from their advisors, including subfield of study, initial employment status and location (in or out of the US). About 40% of our responses

came from advisors, and the rest came from the students themselves. Because foreign citizens were more likely to leave the US after receiving their PhD, their responses were more likely to come in via advisors (43%), compared with 32% of their US counterparts.

According to the AIP Enrollments and Degrees Survey, about half (53%) of the physics PhD classes of 2003 & 2004 were foreign citizens. Although the proportion of foreign citizens receiving physics PhD's in the US has been increasing in recent years and has in fact surpassed the proportion of US citizens receiving PhD's, the proportion of incoming graduate students who are US citizens has been on the rise. This change in the incoming student population foretells a change back to a US majority of physics PhD's in the future.

The median age of our respondents was 29.6 for US citizens and 30.9 for foreign citizens. Twelve percent of our respondents were over 35 years old. Seventeen percent of the combined PhD classes were female.

Physics PhD's took a median of 6 full-time equivalent (FTE) years of graduate study in the US to complete their degree **(Figure 14)**. Fourteen percent of PhD's took 8 years or more. The number of years of graduate study did not vary by citizenship for PhD's who completed all of their graduate study in the US. When reported years of graduate study outside the US are also taken into account, foreign citizens took longer to receive their degree than US citizens.

The number of FTE years students take to complete their degree varies by educational circumstances. Overall, students in more experimental subfields took slightly longer to finish their degree than students in the more theoretical subfields. Also, students who completed some of their graduate study at an institution other than their doctoral degree-granting institution took longer to obtain their PhD's than students who remained in one department for all of their PhD study. Foreign students were more likely to have completed part of their graduate study at another institution. Seventeen percent transferred into their degree granting institution from another US institution (compared to 15% of US citizens) and 41% had been enrolled in a physics graduate program abroad before they began graduate study in the US, and only 5% having done both.

Condensed matter remains the largest subfield of study for physics PhD's, representing 25% of the combined physics and astronomy degree classes of 2003 & 2004 **(Figure 15)** The second largest subfield continues to be astronomy and astrophysics, representing 17% of the combined classes. Forty percent of the astronomy and astrophysics PhD's came from physics departments, and the rest came from astronomy departments that are separate from or combined with physics departments. Some of the subfields that appear to be much smaller (e.g. Biophysics)

Figure 14. Total years of physics graduate study, PhD classes of 2003 & 2004.

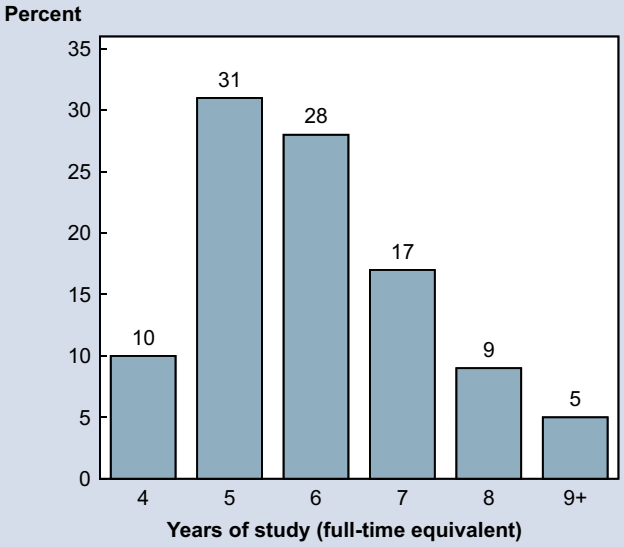


Figure includes all years of graduate study in the US and excludes PhDs with previous foreign graduate study.

AIP Statistical Research Center, Initial Employment Report.

can overlap with other departments (like Biology) and represent much larger fields of study in a wider perspective. The two most popular subfields of study, condensed matter and astronomy or astrophysics, represent 42% of PhD recipients in physics and astronomy. Interestingly, astronomy has a majority of US citizens, and condensed matter has a majority of foreign citizens (**Figure 15**).

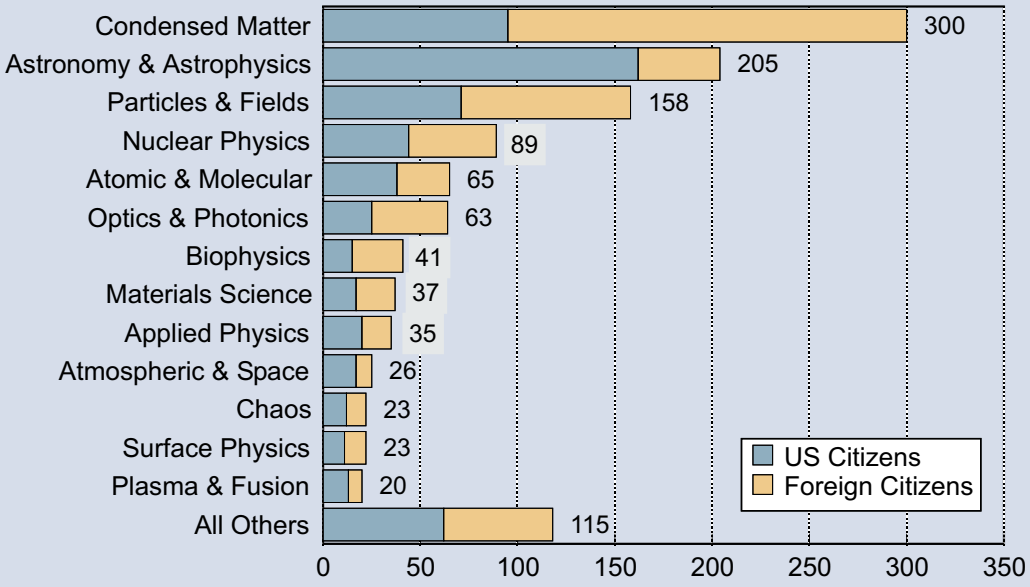
The post-degree outcomes of PhD's that received their doctorates from degree-granting astronomy or astrophysics programs will be discussed in the astronomy section of the report, with the exception of **Figures 15 and 17**. The physics PhD recipient section of this report is limited to PhD's from physics departments, but it does include individuals who studied astrophysics at these departments.

Physics PhD's: Employment

In the winter following the year they received their PhD, about 22% of the foreign citizens and 6% of the US citizens had left the US. Those who left the country after receiving their degree and the less than 3% of the PhD recipients employed in the US that were working part-time are not included in the following discussion about initial employment of physics PhD's. The proportion of new physics PhD's that are unemployed and seeking in the winter after receiving their degree has remained at about 3% in recent years.

Thirty percent of physics PhD's from the classes of 2003 and 2004 found their jobs in less than 2 months of searching. The median length of time employed physics PhD's spent searching for employment was 3 months, and less than 10% took more than 6 months.

Figure 15. Number of PhD's granted in selected subfields by citizenship, classes of 2003 & 2004.



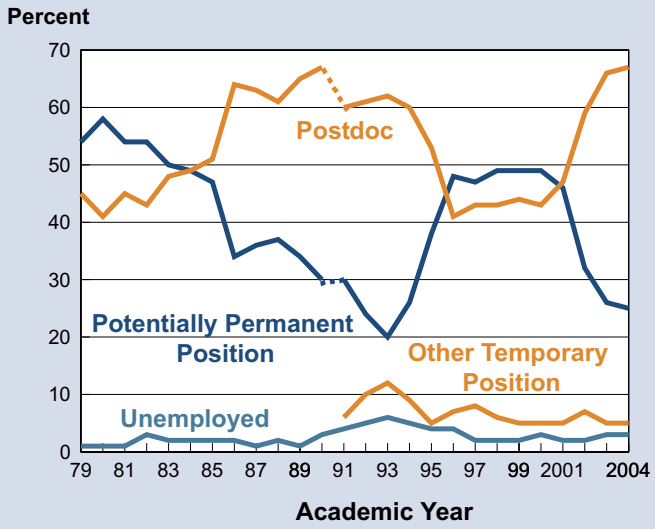
This figure was derived by combining response data from the classes of 2003 and 2004 and applying it to 1200 individuals to represent the average number of physics and astronomy PhDs conferred in these two years.

AIP Statistical Research Center, Initial Employment Report.

Although the average amount of time spent seeking employment is affected by current economic conditions, it does not vary much and is only a partial indicator of how physics PhD's are faring in the present economy. Similarly, initial unemployment rates are not a good job market indicator. Physics PhD's, and PhD scientists in general, usually do not experience high levels of unemployment, even during difficult economic periods.

The proportion of PhD's accepting postdocs, on the other hand, tends to better reflect the initial employment market that new doctorates encounter. While many PhD's plan to take postdocs to further their training, the proportion of PhD's who accept postdocs rises when potentially permanent positions are scarce and falls when conditions improve. 2004 was the fourth straight year in which the percentage of new physics PhD's accepting postdocs has risen. This proportion is now as high as this report series has ever recorded, similar to that seen during the poor job market of the early 1990's **(Figure 16)**.

Figure 16. Initial employment of physics PhD's , 1979-2004.

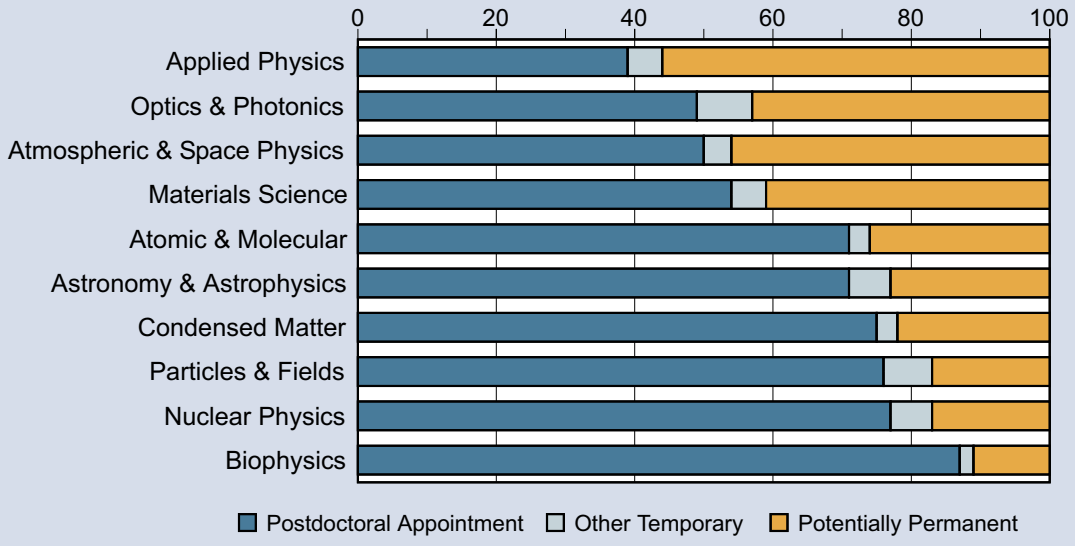


In 1991, the survey questionnaire was changed to measure "other temporary" employment as a separate category.

AIP Statistical Research Center, Initial Employment Report.

The distribution of initial employment type by dissertation subfield is shown in **Figure 17**. PhD's with more applied subfields such as applied physics, and optics & photonics were the most

Figure 17. Initial employment of physics and astronomy PhD's by subfield of dissertation , classes of 2003 & 2004.



AIP Statistical Research Center, Initial Employment Report.

likely to go directly into a potentially permanent position. PhD's in biophysics were the most likely to take postdocs, perhaps following the prevailing pattern throughout the biosciences, where a very high proportion of PhD's typically take postdocs. The initial employment outcomes of physics PhD's in the classes of 2003 and 2004 also vary by citizenship **(Table 1)**. Foreign citizens were more likely to take postdocs (77%) than their US counterparts (57%).

There is a small proportion (5%) of physics PhD's in the classes of 2003 and 2004 that accepted temporary, non-postdoc positions. Half of those who accepted these other temporary positions did so because they could not find a suitable permanent position. Four-fifths of PhD's in temporary non-postdoc positions are employed in academia, and their positions include visiting professors, research scientists, lecturers and sabbatical replacements.

The reasons cited by physics PhD's for taking a postdoc are displayed in **Table 2**. Just over one third chose their position because they believed it was a necessary step to get a desired future position. About one fifth chose their position because they wanted to work with a particular scientist or research group. Although for the most part postdocs at universities and in the government chose their temporary positions for similar reasons, postdocs in government were a little more likely to have selected their positions in order to work with a particular scientist or research group (27%) than their counterparts at universities (19%). A small proportion (8%) of postdocs accepted their position because they couldn't find a suitable permanent position. Although their citizenship may have influenced their employment options, few foreign citizens cited the unavailability of potentially permanent positions (10%) or visa issues (3%) as their primary reason for choosing postdocs.

Postdocs are often considered to be a continuation of graduate education, so it is no surprise that a large proportion (81%) of postdocs found positions in the fields of physics or astronomy, many within their dissertation subfield. Virtually all of the postdocs whose employment was not directly in physics or astronomy were in a field related to their dissertation, such as a biophysics PhD whose postdoc was in a life science related field.

Table 1. Initial employment status of physics PhD's by citizenship, classes of 2003 & 2004.

	US Citizens %	Foreign Citizens %	Overall %
Postdoc	57	77	66
Potentially permantent positions	33	16	26
Other temporary positions	7	4	5
Unemployed	3	3	3

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Table 2. Primary reason for taking a postdoc, classes of 2003 & 2004.

	Percent
Necessary step to get desired future position	34
Work with a particular scientist/research group	22
To obtain research experience in my field	22
Could not obtain a suitable permanent position	8
To switch to a different field	6
Personal or family related reasons	4
Visa restrictions limited my options*	1
Other	3

* 3% of foreign citizens took a postdoc because of visa restrcitions.

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Table 3. Skills used by physics PhD's, class of 2004.

	Some or Most of the time	
	Potentially Permanent %	Postdoc %
Scientific problem solving	88	96
Software development or modeling	76	75
Sophisticated or specialized equipment	60	69
Advanced physics principles	59	97
Advanced mathematics	59	70

Note: Percentages are based on a 4-point scale: Most of the time, Some of the time, Seldom, and Never.

In contrast, only about a quarter of those in potentially permanent positions were employed primarily in the field of physics or astronomy. Engineering was the largest field of employment for physics PhD's, with about a third of potentially permanent employed in that area. The remaining PhD's worked in a variety of fields, including business or finance and computer software and hardware.

Although physics training provides doctorates with a great variety of skills, scientific problem solving was the most frequently used skill, regardless of employment type **(Table 3)**. Another frequently used element of the PhD's training was software development or modeling. Three quarters of the PhD's used it some or most of the time. Postdocs were more likely to use their knowledge of advanced mathematics and specialized equipment than PhD's with potentially permanent positions.

As is historically true, the private sector employed the largest proportion (52%) of the physics PhD's who accepted potentially permanent positions **(Table 4)**. Academia employed just over a quarter of new physics PhD's (half on the tenure track), and the government employed just under a fifth.

The typical starting salaries for new physics PhD's with potentially permanent positions in the private sector ($68,5000-$90,000) has not changed much in the past few years **(Figure 18)**. Because the proportion of potentially permanent employed physics PhD's has decreased so significantly in recent years, and the types of academic and government positions are so diverse, we are unable to reliably report salaries for those who have accepted potentially permanent outside of the private sector. Salaries for postdocs have also been fairly stable in recent years. The typical salary range for postdocs in government, $48,000-$60,800 continues to be considerably higher than the typical salaries for postdocs at colleges and universities, $35,000-$43,000.

PhD's who took potentially permanent positions considered their positions less professionally challenging than individuals accepting postdocs did, and they were less likely than postdocs to consider physics an appropriate background for

Table 4. Initial employment sectors of physics PhD's by type of position accepted, classes of 2003 & 2004.

	Potentially Permanent %	Postdoc %	Other Temporary %	Overall %
Academic*	27	76	80	63
Private sector	52	1	8	15
Government	18	22	4	20
Nonprofit	1	1	2	1
Other	2	0	6	1

* Includes University Affiliated Research Institutes

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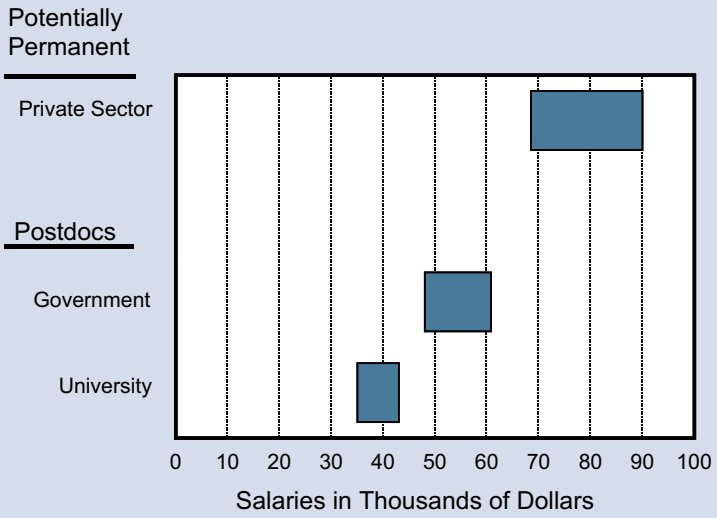
Figure 18. Typical range of starting salaries for physics PhD's, classes of 2003 & 2004.



Note: Typical salaries are the middle 50%, i.e. between the 25th and 75th percentiles. Government includes National Labs and other federal agencies.

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their positions **(Table 5**). This is not surprising, because fewer of the PhD's in potentially permanent positions are employed in the field of physics, and PhD's in potentially permanent positions say they use their knowledge of advanced physics principles less frequently. Females were slightly more satisfied and were less likely to describe themselves as underemployed than their male counterparts. Slightly more foreign citizens, especially postdocs, considered themselves underemployed than US citizens. Overall, 17% of PhD's considered themselves underemployed, regardless of the type of position they held.

Physics PhD's: Goals

The positions that PhD's choose once they receive their degree are influenced by the career ambitions they hold. A little over half (53%) of PhD's would like to be working at a university in 10 years, and 20% aspire to a career in the private sector **(Table 6)**. There was no difference in the long-term goals of PhD recipients by gender. **Table 7** shows the differences in initial career choices that PhD's made by the sectors they hoped to work in. Not surprisingly, those who hoped for a career at a university had the highest proportion accepting a postdoc.

The most common ambition for physics PhD's continues to be research. The vast majority (82%) of the PhD's who aspired to a career at a university

Table 5. Qualitative aspects of initial employment for physics PhD's, classes of 2003 & 2004.

	Initial Employment Status	
	Potentially Permanent	Postdoc
Percent agreeing	**%**	**%**
I am satisfied with this position	82	82
This position utilizes my overall knowledge of basic physics principles	76	91
This position is professionally challenging	74	86
A physics background is an appropriate background for this position	50	71
I consider myself underemployed in this position	17	17

Note: Percentages represent the two positive responses from a 4-point scale.

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Table 6. Long-term career goals of physics PhD's, classes of 2003 & 2004.	
Hoped for Employment Sector	**Percent**
University	53
Private sector	20
Civilian Government or National Labs	12
4-Year College	11
Other	4

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would like research to be their primary work activity. By contrast, only 29% of those who aspired to a career at a four-year college would like research to be their primary work activity, and 71% wanted to primarily teach. Research was also the dominant goal for 86% those who aspired to a career within the civilian government or at national labs. Fifty seven percent of them would like to perform research in the private sector, and the rest were scattered over a wide range of prospective work activities.

Astronomy Degree Recipients

About half of the 75 astronomy degree-granting departments are combined with physics departments, and half are independent, stand-alone departments. Students who received astrophysics degrees from physics departments were included with physics degree recipients earlier in this report, and astrophysics students from astronomy departments are included here.

Following an unprecedented two-year increase (61%) in astronomy bachelor production with the classes of 2000 & 2001, astronomy bachelor's degree production has remained relatively stable for the last 3 years. There were 325 astronomy bachelor's awarded in 2003 and 316 awarded in 2004. We heard from 215, or one third, of the combined total. According to the AIP Survey of Enrollments and Degrees, the combined classes include 42% women and 6% foreign citizens. Five percent of astronomy bachelor's left the US after receiving their degree. They're not included in the discussion below.

A little over half of astronomy bachelor's chose to continue their studies at the graduate level **(Figure 19)**. Of those students continuing their studies, 55% chose to pursue an advanced astronomy degree, and 20% chose to pursue graduate study in physics. The majority of the astronomy bachelor's in graduate school are funded with teaching or research assistantships and received full tuition waivers, and a little under three-quarters are pursuing PhD's.

Table 7. Long-term career goals of physics PhD's, classes of 2003 & 2004.

	Hoped for Employment Sector			
Initial Employment Status	**University* %**	**Private Sector %**	**Civilian Gov't or National Labs %**	**4-Year College %**
Potentially permanent position	6	47	22	21
Postdoc	90	45	75	58
Other temporary position	4	8	3	21
	100%	100%	100%	100%

* Includes University Affiliated Research Institutes

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Almost half of astronomy bachelor's entered the workforce after receiving their degree. About a third of the astronomy bachelor's in full-time positions had received multiple job offers. The private sector continues to be the largest employer of astronomy bachelor's, encompassing about half of employed bachelor's, followed by academia, which employed about a quarter. Over three-quarters of the astronomy bachelor's who entered the workforce indicated they were working in a position related to science, technology, engineering or math.

We also asked astronomy bachelor's to identify their long-term career goals. Over half (56%) hope to work in academia, 21% hope to work in the private sector, and almost 10% hope to work in civilian government positions or at national labs. As with the physics bachelors, those who want to work in academia were more likely to continue their studies (59%) and more likely to desire careers in research (69%), than those who want to work in the private sector (26% and 31%, respectively). Almost all of the bachelor's who hoped to work in the civilian government or at national labs hope to focus on research.

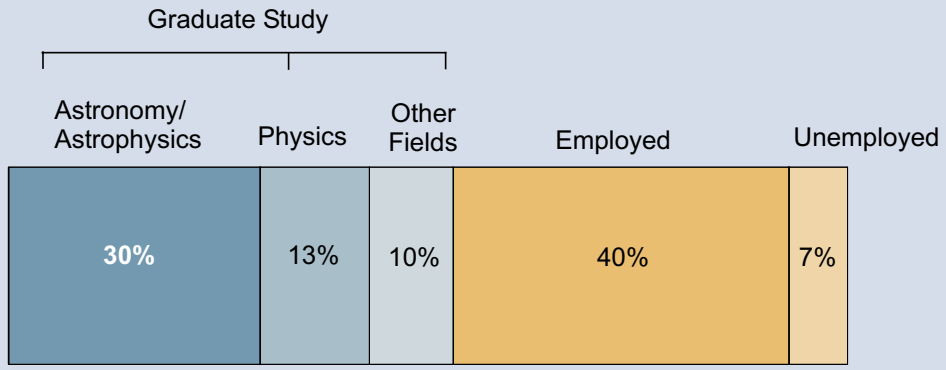
As with the physics bachelor's, astronomy bachelor's who are continuing with graduate study in physics and astronomy are more likely to desire positions in a college or university (74%) and less likely to desire positions in the private sector (5%) than their employed counterparts (45% and 30%, respectively). Careers involving research are the aspiration of the majority of astronomy bachelor's, regardless of initial post-degree outcome, with about three-quarters aspiring to work in such a position.

Astronomy bachelor's held very positive attitudes toward their degrees. Fully 90% would still study astronomy if they had it to do over again, and about three quarters were pleased with the career prospects available to them.

The population of exiting astronomy master's degrees is very small. Twenty-two were granted in the class of 2003, and 27 in the class of 2004. Although we heard from or about 30 of them, the group of respondents is too small to report about in any detail. According to the AIP survey of Enrollments and Degrees, 61% were male and 80% were US citizens. A little over half of them entered the workforce after receiving their degree, and the rest continued with graduate study, either in a different department at the school that granted their masters, or at another institution altogether.

There were 88 astronomy PhD's conferred in the class of 2003 and 116 in 2004. We heard from or about a total of 124 of them. PhD recipients took a median of 6 years to earn their degrees. According to the AIP Survey of Enrollments and Degrees, the

Figure 19. Post-degree outcomes for astronomy bachelor's, classes of 2003 & 2004.



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combined classes were 73% male, and 75% were US citizens.

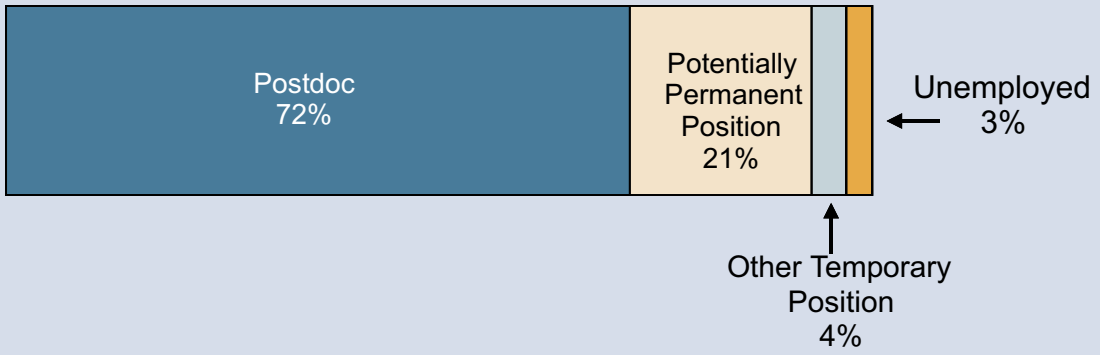
Eleven percent of astronomy PhD's in the combined classes of 2003 & 2004 left the country after receiving their degree, and they are not included in the discussion of employment below.

Almost three-quarters of astronomy PhD's secured a postdoc **(Figure 20)**. The primary reasons that they chose a postdoc were: the position was a necessary step toward a desired future position, to gain research experience, or in order to work with a particular professor or research group. The majority of postdocs are employed in academia, with less than a quarter in the government. Over three-quarters of the postdocs cited basic research as their primary work activity. The typical salary range for a postdoc in academia was $40,000-$48,000, up slightly from recent years.

Overall, astronomy PhD's tend to use much of their training in their post-degree employment. A little over 90% hold positions that utilize their overall knowledge of basic astronomy principles, and almost three-quarters report that their position involves advanced astronomy principles. About 90% have positions that involve their software development or modeling skills, and almost 90% use their scientific problem solving skills. With these large proportions of astronomers using skills they accrued as a graduate student, it's no surprise that almost all respondents found astronomy to be an appropriate background for their positions, and were satisfied with their position.

Astronomy PhD's held very high opinions of their degree. Over 90% would, if they had the opportunity to do it over again, still get a PhD in astronomy.

Figure 20. Initial employment status of astronomy PhD's, classes of 2003 & 2004.



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