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ABSTRACT

Results of the 1991-92 annual survey for 1991-92 on initial employment rates for recipients of doctoral, masters, and bachelors degrees in physics and astronomy are reported. Overall, responses indicated that the job market for recent physics degree recipients remains tight. Other findings include the following: (1) among new bachelors degree recipients, the numbers of those seeking jobs continues to decline while the numbers of those going on for graduate study is increasing; (2) those seeking jobs find that employment is scarce and may entail months of searching; (3) of 1991-92 graduates with bachelors degrees, 62 percent went on to further study, 18 percent found employment, 12 percent found temporary employment, and 8 percent continued to search; (4) of doctoral recipients, 63 percent were continuing with post-doctoral study, 23 percent had found employment, 12 percent found temporary employment, and 2 percent were still searching; (5) since the mid-1980s, doctoral degree recipients in plasma physics and optics/lasers have been most likely to find potentially permanent positions while graduates in mathematical physics and nuclear physics have been the least likely to find employment; and (6) 90 percent of foreign doctoral recipients continue for post-doctoral training. (JB)

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The overall U.S. economy has recently provided mixed signals on recovery, and this has been reflected in the employment picture in physics as well. While economic indicators showed some signs of rebound and job creation in specific areas, many sectors continued to languish, with persistent reports of layoffs and downsizing. Within the physics community, the negative news continued to predominate.

Every year, AIP's Education and Employment Statistics Division surveys physics and astronomy degree recipients across the country about their immediate plans for work and study. Those respondents who indicate their intention to seek work are followed up approximately six months later with an initial employment survey to evaluate their experiences in obtaining a position.

The overall tenor of the responses to the 1991-92 Employment Follow-up Survey, conducted near the beginning of 1993, points to a continued disheartening situation. The job market for recent physics degree recipients remains tight, with considerable competition for available jobs. The sections that follow provide a more detailed picture of the initial job search experiences of new PhD, Masters and Bachelors degree recipients in physics and astronomy. The findings were derived from information provided by those who had not yet secured employment as well as by those who had already found jobs.

One indication of a worsening job market can be seen in the proportion of graduates who immediately enter the job market to look for potentially permanent positions. New degree recipients have traditionally had an alternative to dealing with a soft job market, namely to extend their period of study or training in order to broaden their skills and enhance their marketability while waiting for conditions to improve. For Bachelors degree recipients, this means going on to graduate study, while for PhDs it means securing a postdoctoral fellowship.

Figure I. Postbaccalaureate plans of new physics Bachelors recipients, 1981 - 1992.

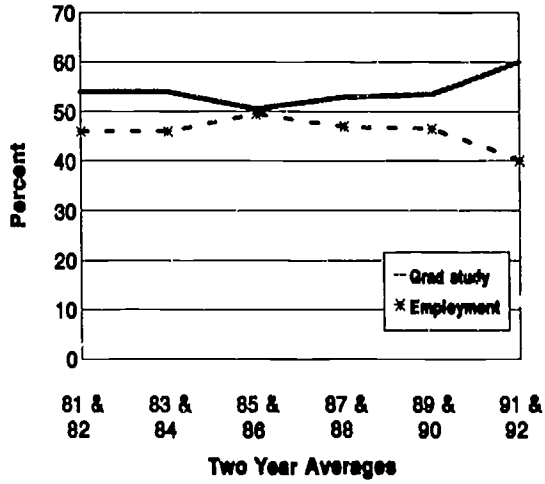
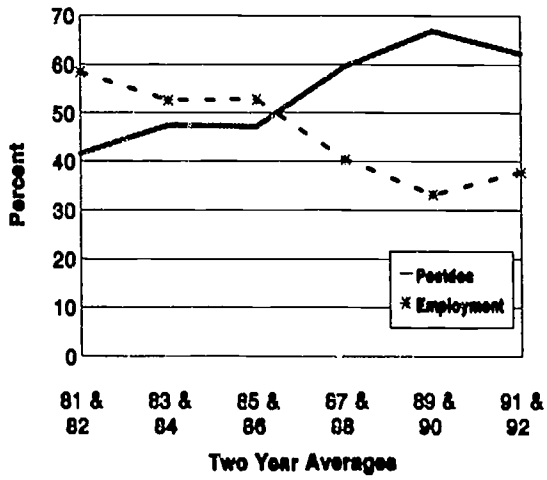


Figure II. Post-degree plans of new PhDs (U.S. citizens only) 1981 - 1992.



Of course, even in good times, many students go on to further post-degree study for reasons totally unrelated to the job market. But in difficult times, the proportion choosing this route tends to rise noticeably. **Figure I** shows the proportion of new Bachelors choosing immediate employment versus graduate study in recent years, expressed as two-year averages to smooth out the year-to-year fluctuations. **Figure II** shows a similar view for new PhDs taking jobs versus postdocs. Both figures exclude those who intended to leave the country after graduation, had not yet secured a position, or did not specify immediate plans. **Figure II** also excludes the large and growing fraction of non-U.S. citizens among PhD recipients, most of whom were in this country on temporary visas and thus faced additional hurdles in taking potentially permanent jobs following graduation.

However, these findings give only part of the picture. Even among those who are confident enough in their prospects to test the job market immediately, many find that jobs are scarce and that locating a suitable position may entail months of searching and unemployment. **Figure III** tracks, over the past dozen years, the proportion of currently employed Bachelors and Masters degree recipients in physics who took three or more months to find their position. Finding employment after earning a doctorate normally takes even longer on average than securing a post after graduating with a less-advanced degree. This is due in part to the traditional rhythms of the academic year and in part to the lengthier and more extensive search employers undertake for more advanced positions. Thus, **Figure IV** plots the proportion of employed PhD recipients who took seven months or more to find potentially permanent positions. All of these curves reflect the slow but noticeable deterioration in the job market for new graduates in recent years.

Those who decide to extend their training rather than face a tough market are undoubtedly pursuing a rational strategy to maximize their individual chances of success. However, the ultimate effect of such decisions on the part of many degree recipients may be to confront students with an even worse situation later on. Moreover, the prospect of a substantial and growing overhang of recent graduates who have postponed their job search is especially worrisome in light of indications that the current weak demand for physicists may not be merely temporary but may partly stem from more fundamental forces.

Thus, although the market for new physics graduates at all degree levels commonly undergoes year-to-year fluctuations, intermediate-range influences and even long-term changes in our nation's economic structure and geopolitical position now seem to be playing a more significant role. The movement to contain government budget deficits, along with changes in the global balance of power, have resulted in substantial decreases in military-driven research and the cancellation of some large civilian science projects. At the same time, many large technology-based corporations are cutting back sharply on the basic research they conduct intramurally. Not only does this suggest that the jobs being eliminated today may not reappear for

Figure III. New Bachelors and Masters Degree recipients taking 3 or more months to find permanent jobs, 1981 - 1992.

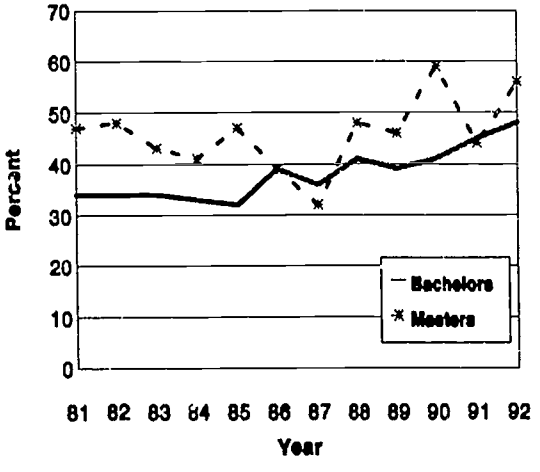
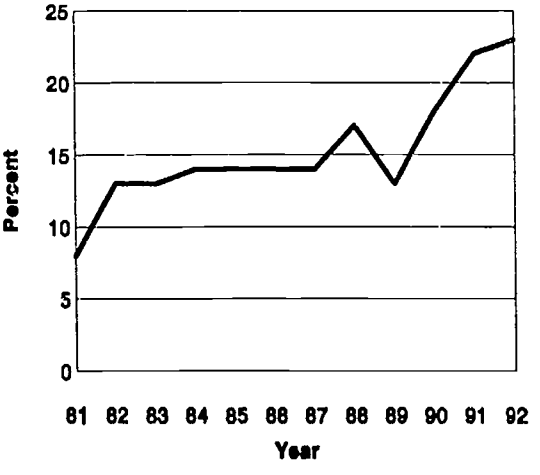


Figure IV. New PhDs taking more than 6 months to find permanent jobs, 1981 - 1992.



many years, but it also means that new graduates now often find themselves competing with seasoned researchers who have been released in the downsizing process. However, it also should be remembered that, in a small field like physics, there is always a rather fragile relationship between job market supply and demand, and the potential exists for a few breakthrough developments to drastically alter the demand side of the picture.

Tables I and II below look more closely at the post-graduation work/study status of 1991-92 physics degree recipients who planned to remain in the U.S. Table I depicts the situation for those responding to AIP's undergraduate and graduate student surveys near the end of the 1991-92 academic year. Table II shows employment outcomes six months later for respondents to the employment follow-up survey, carrying over the status of Bachelors degree recipients who went on to graduate study, and hence were not part of the employment follow-up.[1] Among the PhDs, less than one-fourth at both time periods indicated that they had secured potentially permanent employment. The lion's share opted for a postdoc or accepted a temporary position, and a small but not negligible group is still unemployed and seeking work.

The situation among Bachelors recipients is not dissimilar when we include the 62% who indicated that they intended to pursue graduate studies and thus were not part of the employment follow-up. One

Table I. Post-degree outcomes of Bachelors and Doctoral degree recipients, summer 1992

	Bachelor	PhD
Postdoc / Graduate study	62%	63%
Potentially permanent employment	18%	23%
Temporary employment	12%	12%
Seeking	8%	2%

Table II. Post-degree outcomes of Bachelors and Doctoral degree recipients, winter 1992-93

	Bachelor	PhD
Postdoc / Graduate study	63%*	58%
Potentially permanent employment	24%	23%
Temporary employment	9%	14%
Seeking	4%	5%

*Taken from Survey of Physics Bachelors Degree Recipients, adding in 1% who switched to graduate study after initially considering employment.

1 Difficulties in locating respondents -- highly mobile after graduation -- worked to depress response rates on this latter survey. Among those who did respond, rapidly changing individual circumstances occasionally made it difficult to accurately determine current employment status. As a result, the findings from Table II, and comparisons between the two tables, should be treated with caution.

modest difference is in the higher proportion of Bachelors who secured potentially permanent positions in the interim between the two surveys. The next section provides greater detail on the employment situation among physics PhD recipients, while subsequent sections detail the experience of those earning Bachelors and Masters degrees in physics, with a final section on astronomy doctorates.

THE OUTLOOK FOR NEW PhDs

While the overall proportion of physics PhDs taking postdocs has been steadily rising in recent years, a more complex picture emerges when we disaggregate this finding by major subfield. As in **Figure II, Table III** looks only at those graduates taking postdocs or potentially permanent jobs, setting aside the smaller numbers taking other temporary positions (generally lasting a year or less), leaving the country, or whose employment situation remains unresolved. As the table shows, there are marked differences among the subfields, with the overwhelming majority in some areas (astrophysics and electron/atomic/molecular studies) choosing postdocs while three-fourths of those in optics/lasers secured jobs immediately.

When we disaggregate the trend data in **Figure II** by the major subfields delineated in **Table III**, we find that the differences between the subfields have been present for quite some time, with a few relative shifts. Thus, degree recipients in plasma physics and optics/lasers have been the most likely to find potentially permanent positions right out of graduate school since at least the mid-1980's. Graduates in mathematical physics and nuclear physics, on the other hand, have moved counter to the overall trend. A decade ago, they were more likely than those in other subfields to take a postdoc, but in recent years the proportion getting immediate jobs has grown. For the other four major subfields, astrophysics, condensed matter, electron/atomic/molecular physics, and elementary particles, the decline in the proportion landing immediate potentially permanent positions has matched or exceeded the downward slope of the aggregate curve in **Figure II.**

Table IV looks at background factors other than subfield which might serve to distinguish which doctorate recipients take postdocs and which go directly into potentially permanent jobs. Not unexpectedly, given the work restrictions placed on those studying under temporary visas in this country, nine out of ten non-citizens end up in postdocs, while more than a third of U.S. citizens land potentially permanent positions. There is also a modest difference according to whether a student had focused on the theoretical or experimental side of physics, with the theoreticians only a bit more than half as likely as the experimentalists to have landed immediate jobs. This generally reflects long-standing patterns in postdoctoral study as well as higher current market demand for experi-

Table III. Subfield of study by post-degree outcomes, 1992 PhD recipients

	Permanent Job	Postdocs	N
Astrophysics	14%	86%	22
Elementary particles	18%	82%	33
Electron, atomic, and molecular physics	19%	81%	26
Nuclear physics	22%	78%	23
Condensed matter	27%	73%	109
Mathematical physics	33%	67%	12
Plasma physics	37%	63%	19
Optics, lasers	75%	25%	20

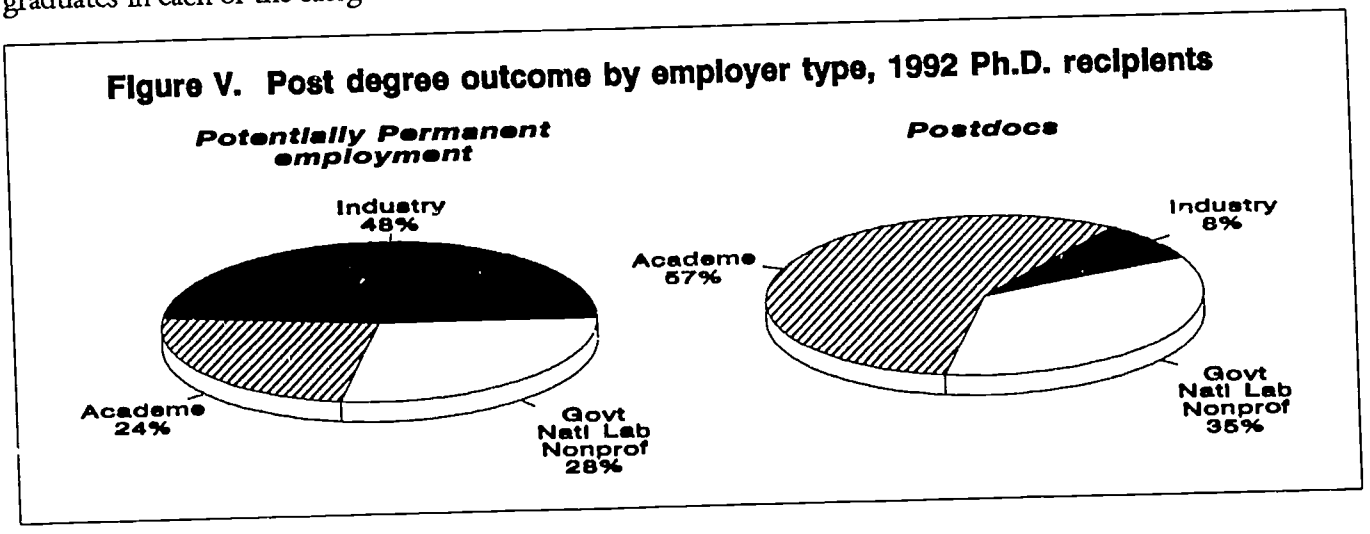
Table IV. Background characteristics by post-degree outcomes, 1992 PhD recipients		Permanent Job	Postdocs
Citizenship	Foreign	10%	90%
	U.S.	36%	64%
Type of research	Theoretical	17%	83%
	Experimental	30%	70%
Gender	Female	26%	74%
	Male	29%	71%

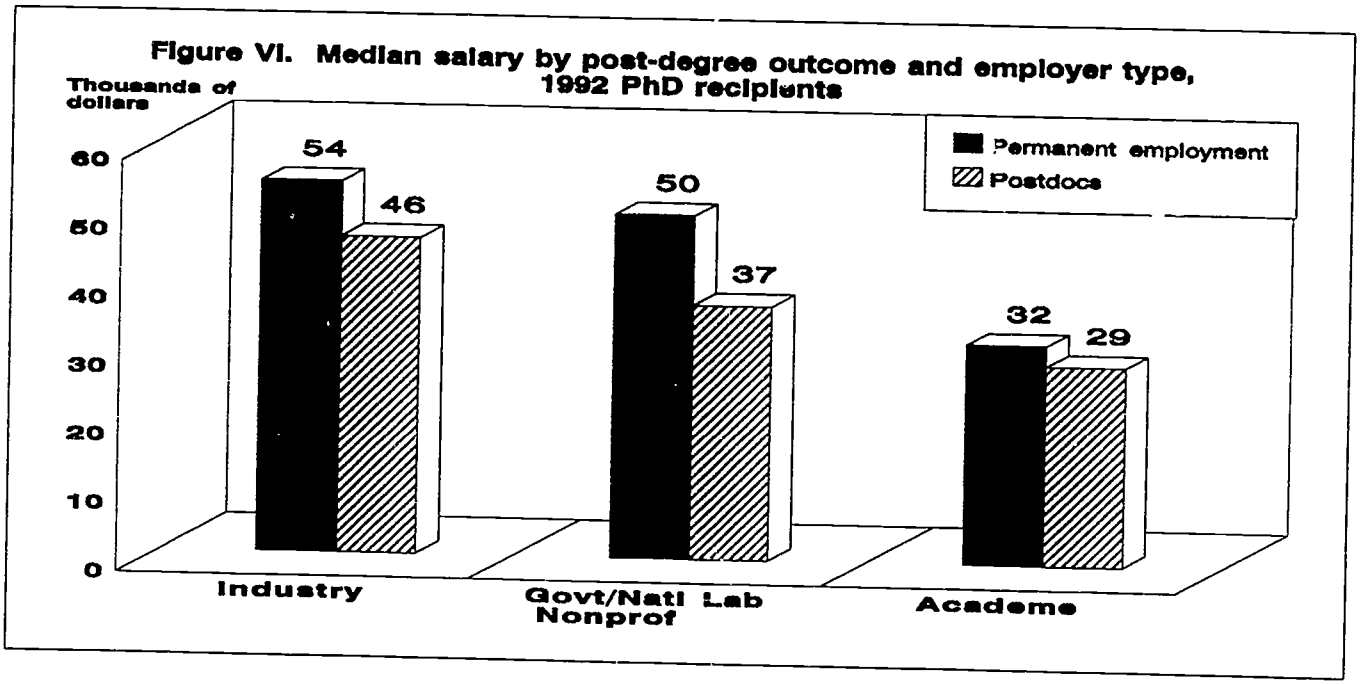
mental skills. Finally, the table shows that there was no discernible difference in initial career choice between male and female graduates.

Figure V shows the distribution of postdocs and those accepting potentially permanent positions by employment sector. An examination of data from previous surveys reveals that this division has been essentially stable for over a decade. Among those entering the market for permanent employment, about half have consistently accepted positions in industry, while the other half split more-or-less evenly into those taking academic jobs on the one hand, or positions in government or federally-funded research and development labs on the other. Among postdocs, in contrast, well over half found their positions at academic institutions, and most of the rest signed on at government agencies or national labs. Less than a tenth secured postdocs with industrial employers.

Figure VI depicts the median salaries earned by the graduates in each of the categories broken out in the preceding figure. As might be expected, there is a substantial difference in the earning power of those taking postdocs and those starting potentially permanent employment, with the former reporting median salaries of $31,500 against the latter's $47,000. However, **Figure VI** reveals that this difference is to no small extent a product of the differing distributions by employer type shown in **Figure V.** This is consistent with findings from AIP's *1992 Salaries: Society Membership Survey,* drawn from physicists at all career stages, showing similar substantial salary differences by sector of employment. Data from that survey also suggest that the smaller difference in academic salaries shown in **Figure VI** may be partly a result of differences by employer type within that sector. While postdocs working in academe are found exclusively at universities with doctoral programs in physics, which generally tend to have the highest pay scales in the sector, many of those finding potentially permanent jobs right out of graduate school are working at lower-paying four-year colleges.

Figure V. Post degree outcome by employer type, 1992 Ph.D. recipients





PROSPECTS FOR EMPLOYMENT-ORIENTED BACHELORS

Figure I graphically illustrated the change in recent years in the relative proportions of physics Bachelors degree recipients choosing to go directly on to graduate study versus those going into the job market. **Table I** gave a more detailed breakdown of the type of position which students in the latter group reported securing by the end of the academic year in which they earned their degree, while **Table II** provided a glimpse of their status six months later, showing moderate progress for those who had initially landed only temporary positions or who were still looking for their first job. **Table V** below focuses on those who were successful in securing potentially permanent employment by the time of the second survey, and provides additional information on the type of employer and starting salaries they reported, and the extent to which they felt their new position required them to use their physics training.

The use of physics training provides one of the stronger contrasts in the table.[2] At the low extreme are those going into service industries, while the highest levels are reported by those going into high school teaching. The other three sectors occupy the middle ground, with little significant difference among them. These findings reflect patterns that have shown up consistently for a number of years. Interestingly, salary levels show very little correlation with use of physics training. As has been generally true in recent years, those entering manufacturing do markedly better than their counterparts taking academic positions, with those choosing service sector, government or non-profit employers coming out in the middle.

The table also shows the relatively low percentage of women (already underrepresented in the discipline as a whole) getting jobs in manufacturing or at colleges/universities. These are two sectors of the physics labor market which have historically shown lower than average receptivity for women. Much higher numbers are found in secondary school teaching, service industry and the government/non-profit sector. These are areas where women have traditionally been somewhat more likely to find employment.

2 This last question asked for the student's subjective assessment of their use of physics in their work, and may reflect a more traditional, narrowly-defined view of physics training. Future surveys will aim to encompass the broader range of skills taught in physics programs.

EMPLOYMENT AMONG GRADUATE STUDENTS STOPPING AT THE MASTERS LEVEL

The Masters degree has traditionally represented a number of very different outcomes in physics graduate education. Many, though certainly not all, doctoral students earn a Masters on the way to getting their PhD in the field. Since their primary objective is the doctorate, these degree recipients are not incorporated into this study until they have earned their ultimate degree. Other graduate students, however, end their academic training with the Masters degree. For some, this was the intended goal, while others may have initially aspired to earn a doctorate but for various reasons stopped after the Masters. These "terminal Masters" recipients have generally followed career paths that were distinct from either those who ended their physics training at the Bachelors level or those who went on to a doctoral degree.

Table VI provides background and job information from the employment follow-up survey for those students earning a terminal Masters degree in physics during the previous academic year. In addition to the familiar categories of securing a new position and remaining unemployed but seeking work, we have added the category of continuing previous employment. This is done to accommodate a significant number of students with Masters who attended graduate school with financial assistance from an ongoing employer, to whom the student is expected to return upon graduation. As **Table VI** illustrates, this group of students includes a somewhat higher proportion of women as well as jobholders who make more extensive use of their physics training than do students obtaining posts with a new employer. Not surprisingly given their higher seniority levels, students continuing in previous employment also reported earning higher salaries.

Table VI also provides a breakdown, for those who were employed at the time of the survey, by whether they worked within or outside of the industrial sector. The two categories are of similar size, but women are better represented among non-industrial employers. Consistent with findings at other degree levels, there is also a modest difference by salary, favoring those

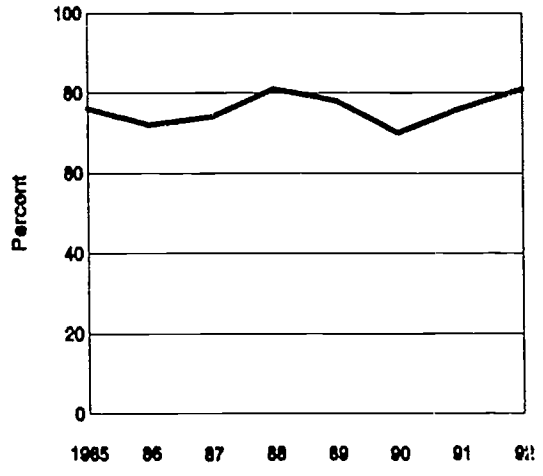
Table V. Background and job characteristics by employer type, 1992 Bachelors recipients

		Govt./ Non Profit	Service Industry	Manufacturing Industry	High School Teaching	Colleges/ Universities
Use of training	Extensive	18%	1%	9%	34%	19%
	Moderate	34	16	43	40	27
	Little	35	35	32	22	31
	None	13	38	15	3	23
Median Salary		$24,000	$24,500	$29,000	$21,000	$20,000
Gender	Female	22%	23%	10%	26%	10%
	Male	78	77	90	74	90
	N	139	113	107	38	31
	%	33	26	25	9	7

Table VI. Background and job characteristics by employment status and employer type, 1992 Masters recipients						
		Employment Status			Type of Employer	
		Newly Employed	Continuing Employment	Not Employed & Still Seeking	Industry	Non-Industry
Use of training	Extensive	25%	33%	N/A	16%	36%
	Moderate	33	48		41	36
	Little	23	15		27	15
	None	19	4		16	13
Median Salary		$30,000	$40,000	N/A	$35,100	$31,000
Gender	Female	17%	30%	25%	14%	27%
	Male	83	70	75	86	73
	N	64	30	12	43	51

employed in industry. A small difference can also be seen in the use of physics training, with those working outside of industry more likely to report using the skills they learned in school.

Figure VII. Percent of Astronomy PhDs* taking postdocs.



*excluding those taking temporary jobs, leaving the country, or still unemployed in the winter following receipt of degree.

DOCTORAL RECIPIENTS IN ASTRONOMY

During the 1991-92 academic year, 93 doctorates were granted by astronomy departments across the U.S. This represents a small increase from the previous year and a return to the level reached during the late 1980's. Such a low total, less than one-tenth the figure for physics PhDs awarded, largely precludes the more detailed and extensive type of analysis done for physics above.

One of the few comparisons that these small numbers will support is the proportion of Astronomy doctorate recipients taking postdocs relative to those landing jobs directly out of graduate school. Unlike physics PhDs, there has been no long-term change in the ratio of the two groups. As **Figure VII** shows, this may be largely because the former group already outnumbered the latter by a factor of three or four reaching back to the mid-1980's. In 1992, about half of those postdocs found positions with universities, with the other half scattered among government agencies and labs and non-profit organizations.