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ABSTRACT

This report presents 1991-92 data on enrollment trends in graduate physics as well as the educational backgrounds of physics and astronomy students, the proportions in which they chose their research specialties, career opportunities in terms of employers, and work activities and starting salaries. Highlights from the report show the following: that foreign physics doctoral graduates increased from 420 to 650 between 1987 and 1992; that doctorate recipients of the class of 1992 faced such employment difficulties that 10 percent of them took part-time or temporary (non-postdoctoral) positions; and that the median salary paid to physics doctoral graduates who accepted permanent positions rose by 5 percent. Among the information revealed by the data are the following: (1) the characteristics of physics graduate students, (2) comparative data of the characteristics of U.S. minorities with those of foreign graduate physics students; (3) numbers of graduates by subfields; (4) distribution of subfield and citizenship of doctorate recipients; (5) initial employment of physics doctorate recipients by citizenship; (6) employment characteristics and use of physics training of 1991-92 master's degree recipients; (7) initial employment status for physics doctorate recipients, in the United States by major subfield, type of research, and citizenship; and (8) median and monthly starting salaries paid by U.S. employers to new physics doctorate recipients. (GLR)

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GRADUATE STUDENT SURVEY

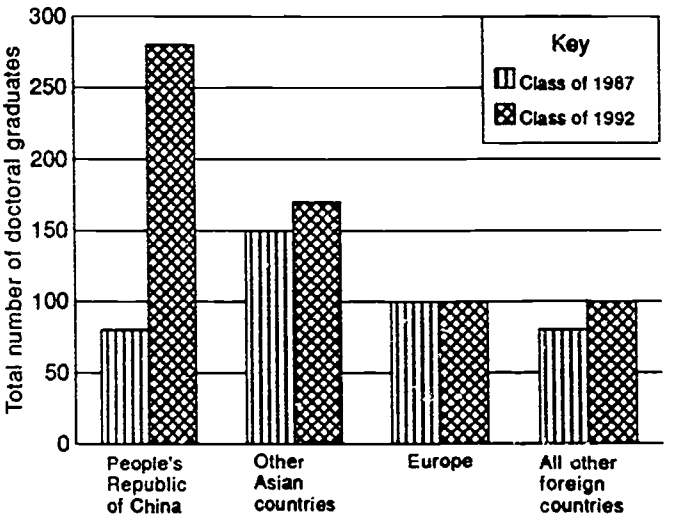
Graduate study in physics is the recommended method for producing new physicists, a topic that has evoked highly emotional debates in recent years. The controversy focuses on how many new physicists our graduate schools should educate in light of the employment opportunities that are projected for them. This report presents hard data on graduate physics enrollment trends which can provide a basis for judging past accomplishments in a way that will benefit future policy decisions.

For over thirty years, the annual Graduate Student Survey has monitored the educational backgrounds of physics and astronomy students, recorded the proportions in which they chose their research specialties and reported their career opportunities in terms of employers, work activities and starting salaries. The highlights of this report are:

- The number of foreign physics doctoral graduates increased from 420 to 650 between 1987 and 1992.
- The doctorate recipients of the class of 1992 faced such employment difficulties that 10% of them took part-time or temporary (non-postdoctoral) positions.
- The median salary paid to physics doctoral graduates who accepted permanent positions rose by 5%.

A much-debated issue revolves around what are the benefits that the United States derives from admitting, supporting and educating thousands of foreign graduate students who are enrolled in physics doctoral programs. Are they contributing significantly to our research efforts or are they taking away employment opportunities that would otherwise benefit U.S. citizens? To help with an analysis of those questions, we present **Figure I** which estimates the changes in total number of foreign physics doctoral graduates, by origin, between 1987 and 1992. The foreign contingents in those classes comprised 420 and 650 physics degree recipients respectively. As evident from the bar-graph, the citizens of the People's Republic of China are primarily responsible for that 55% increase during the five-year period. Smaller increases were recorded for Korea, India and Africa while Europe's number remained constant.

Figure I. Origin of foreign physics doctorate recipients, 1987 and 1992.



Member Societies: The American Physical Society • Optical Society of America • Acoustical Society of America • The Society of Rheology • American Association of Physics Teachers
American Crystallographic Association • American Astronomical Society • American Association of Physicists in Medicine • American Vacuum Society • American Geophysical Union

Table I. Characteristics of the graduate physics student population, 1991–92.

Characteristics		All graduate students	First-year graduate students	Degree recipients: terminal masters	Degree recipients: doctorate recipients
	*Total population:	14 534	3 306	752	1 346
	Number of respondents:	7 919	1 550	376	982
Sex	Female	15%	16%	19%*	11%*
	Male	85	84	81	89
Citizenship	U.S.	59%*	58%*	70%	52%
	South & Central America	2	2	1	2
	Europe, Canada, Australia & New Zealand	9	14	4	8
	East Asia	23	20	20	30
	Central Asia & Middle East	6	5	5	7
	Africa	1	1	–	1
Age	24 or younger	17%	47%	10%	–
	25–26	20	18	17	7%
	27–28	20	12	19	20
	29–32	27	13	32	45
	33 or older	16	10	22	28
Physics in high school	Yes	93%	92%	86%	96%
	No	7	8	14	4
Major of bachelor's degree	Physics	89%	86%	74%	90%
	Mathematics	2	2	4	2
	Engineering	7	9	17	7
	Other physical sciences	1	1	1	1
	Other	1	2	4	–
Type of bachelor's institution	PhD-granting	38%	40%	35%	38%
	MS-granting	6	7	13	3
	BS/BA-granting	17	19	23	14
	Foreign	39	34	29	45
Type of graduate institution*	PhD-granting	90%	86%	69%	100%
	MS-granting	10	14	31	–
	Public	71%	73%	81%	65%
	Private	29	27	19	35

* *These data were derived from the survey of Enrollments and Degrees.*

A broader perspective can be obtained from the seven characteristics presented in **Table I**, which compares the total graduate physics population with three of its subgroups, namely, the first-year graduate students, the terminal masters and the doctorate recipients. The first two rows of numbers compare the respondents to the 1991-92 survey with the total population for each of the four groups. To avoid misinterpreting the data shown for the first characteristic, it should be mentioned that a majority of the women doctorate recipients is foreign. The second characteristic also warrents an explanation: There was an eight percentage-point increase, from the previous year, in the proportion of foreign physics doctorate recipients. The responses from phyics departments to a new question are responsible for a more accurate total.

There has never been a major influx into physics graduate study from other disciplines, and the fifth characteristic in **Table I** makes that clear by showing that close to 90% of the total graduate enrollment were physics majors as undergraduates. Widely differing attrition rates between public and private institutions are indicated by comparing the entering students with the doctoral graduates. The share of first-year students enrolled at private institutions was only 27%, but 35% of the doctorates were conferred by those institutions.

Since certain groups, that are considered minorities in the United States, form large proportions of the foreign graduate students, we designed **Table II** to compare the characteristics of each of these groups on the basis of citizenship. The numbers shown in the first row indicate how many graduate physics students, among the respondents to this survey, identified themselves as members of one of those groups. The varying response rates from these groups tend to exacerbate their widely differing sizes (42 foreign blacks and 1852 foreign Orientals); to facilitate any meaningful comparisons among them, it seemed appropriate to use percentages. Graduate degree production, on the other hand, is presented in terms of numbers because they are the totals reported by the physics department chairpersons as part of another survey. Thus we find that the foreign contingent in each

Table II. A comparison of the characteristics of U.S. minorities with those of foreign graduate physics students, 1991–92.

		Black		Native American Indian	Hispanic		Asian Indian		Oriental		Arab	
		U.S.	Foreign		U.S.	Foreign	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign
Number of respondents:		73	42	16	94	79	44	334	189	1852	24	93
Characteristics												
Sex	Female	22%	14%	6%	12%	18%	20%	22%	17%	18%	12%	15%
	Male	78	86	94	88	82	80	78	83	82	88	85
Enrolled in degree program	TMS	27%	–	13%	11%	10%	9%	6%	11%	8%	20%	16%
	Doctoral	70	98%	87	89	86	89	92	86	89	76	82
	None	3	2	–	–	4	2	2	3	3	4	2
Age	<24 yrs	23%	10%	–	13%	1%	34%	19%	21%	10%	20%	8%
	25–26	14	12	25%	18	13	27	23	27	13	20	20
	27–28	23	17	25	23	20	18	17	21	18	20	14
	29–32	22	32	31	32	43	16	27	18	37	28	24
	>33 yrs	18	29	19	14	23	5	14	13	22	12	34
Full-time equivalent years of graduate study	< 1	27%	22%	19%	13%	18%	27%	15%	20%	15%	24%	12%
	2	26	16	6	19	22	23	17	24	20	28	23
	3	18	22	31	18	14	11	12	17	15	20	19
	4–5	19	27	19	22	24	27	28	21	26	12	26
	> 6	10	13	25	28	22	12	28	18	24	16	20
Source of support	Teaching ass't	19%	43%	–	30%	38%	22%	53%	27%	40%	20%	42%
	Research ass't	22	26	44%	30	42	39	42	38	49	36	40
	Fellowship	44	10	25	28	7	29	3	18	4	24	2
	Personal funds/ other	15	21	31	12	13	10	2	17	7	20	16
Number of graduate degree recipients*	TMS	13	3	–	13	6	4	35	27	119	2	9
	Doctorates	6	6	3	13	16	6	88	36	395	4	21

* *These data were derived from the survey of Enrollments and Degrees.*

group tends to be older and that U.S. blacks are more likely to be supported by fellowships than the members of other groups.

The choice of physics as a career is usually accompanied by an interest in one of its subfields. Thus, an important classification of the graduate students is in terms of the major areas of concentration. **Table III** relates the major physics subfields to nine levels of graduate study and scales up the numbers to reflect the total population.

Table III. Number o graduate physics students, by subfield* and years of graduate study completed, 1991–92.

		Full-time equivalent years of graduate study									Total graduate students	
		< 1 yr.	2 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	8 yrs.	>9 yrs.	N	%
Distribution of students	N	3306	2935	2150	1775	1685	1235	755	350	343	14 534**	
	%	22.7	20.2	14.8	12.2	11.6	8.5	5.2	2.4	2.4		100%
Astrophysics		315	270	175	120	130	85	55	20	20	1190	8.2
Bio/medical physics		130	155	80	60	55	40	25	10	–	555	3.8
Condensed matter		875	870	715	635	605	435	285	110	130	4660	32.1
Electron, atomic, molecular		195	210	165	135	120	85	75	35	30	1050	7.2
Elementary particles		395	320	255	200	220	180	80	50	45	1745	12.0
Mathematical physics		220	175	150	125	115	55	30	15	15	900	6.2
Nuclear physics		220	155	140	130	140	100	70	45	20	1020	7.0
Optics/lasers		235	245	115	125	80	70	45	20	10	945	6.5
Plasmas/fluids/chaos		140	100	95	85	70	65	40	20	35	650	4.5
Physics applications		255	220	125	85	70	40	15	15	15	840	5.8
Other subfields		326	215	135	75	80	80	35	10	23	979	6.7

* *The distribution of students in each subfield is based on 7651 respondents to this question.*
** *The total was derived from the survey of Enrollments and Degrees.*

Table IV. Sources of support for graduate physics students, by type of institution and citizenship, 1991–92.

Source of support		Doctor's-granting institutions				Master's-granting institutions			
		U.S. students		Foreign students		U.S. students		Foreign students	
		First-year students	Advanced students	First-year students	Advanced students	First-year students	Advanced students	First-year students	Advanced students
Teaching assistantship		48%	22%	62%	36%	35%	35%	58%	64%
Research assistantship		11	50	16	54	5	10	18	17
Fellowship		24	16	12	5	5	3	4	2
Foreign government		–	–	3	2	–	–	–	2
Family, savings, loan		4	2	5	2	14	10	16	10
Full-time employment		7	5	-	1	34	32	4	3
Other*		6	5	2	–	7	10	–	2
		100%	100%	100%	100%	100%	100%	100%	100%
Estimated distribution of all graduate students	N**	1631	6027	1200	4260	272	619	203	322
	%	11	42	8	29	2	4	2	2

* *"Other" includes the military and part-time employment.*
** *These data were derived from Tables VII and VIII in the survey of Enrollments and Degrees.*

Three major characteristics influence the type of support a graduate student can expect; they are: level of graduate study, citizenship and type of graduate institution. In relating these three characteristics, **Table IV** singles out the first-year students from all others to show the extent to which this group depends on teaching assistantships; the

Table V. Number* of advanced graduate physics students specializing in selected experimental or theoretical subfields by years of graduate study completed, 1991–92.

Physics subfield	Type of research	Full-time equivalent years of graduate study							N	% Exp.	Total % Theo.	% Comp. sim.
		3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	8 yrs.	>9 yrs.				
Astrophysics	experimental	75	60	80	60	30	20	10	335	6.0		
	theoretical	80	45	45	35	20	5	5	235		10.6	
	computer sim.	25	15	25	5	15	–	–	85			16.8
Bio/medical	experimental	60	35	45	35	30	10	–	215	3.9		
Condensed matter	experimental	520	455	450	335	210	100	85	2155	38.7		
	theoretical	150	125	110	75	50	10	5	525		23.6	
	computer sim.	35	30	30	25	15	5	5	145			28.7
Electron, atomic, molecular	experimental	140	90	90	70	55	30	20	495	8.9		
	theoretical	20	35	30	10	20	–	5	120		5.4	
	computer sim.	10	5	10	5	–	5	5	40			7.9
Elem. particles	experimental	185	140	150	160	55	35	20	745	13.4		
	theoretical	90	80	85	35	25	10	5	330		14.8	
Math. physics	theoretical	150	125	120	50	30	10	10	495		22.3	
	computer sim.	15	10	15	10	5	5	–	60			11.9
Nuclear	experimental	95	115	115	90	60	35	15	525	9.4		
	theoretical	40	25	45	20	10	5	–	145		6.5	
Optics/lasers	experimental	80	75	60	50	30	15	5	315	5.7		
Plasmas/ fluids/chaos	experimental	60	45	45	40	15	15	25	245	4.4		
	theoretical	15	35	15	20	15	5	5	110		5.0	
	computer sim.	15	10	15	15	10	5	5	75			14.9
Physics applications	experimental	95	70	55	30	15	10	10	285	5.1		
Other subfields	experimental	70	65	45	35	15	10	10	250	4.5		
	theoretical	95	65	25	40	25	10	3	263		11.8	
	computer sim.**	35	10	30	15	–	10	–	100			19.8
Subtotal	experimental	1380	1150	1135	905	515	280	200	5565	100.0%		
	theoretical	640	535	475	285	195	55	38	2223		100.0%	
	computer sim.	135	80	125	75	45	30	15	505			100.0%
Total		2155	1765	1735	1265	755	365	253	8293			

* *The numbers in this table have been scaled up to reflect the total number of graduate students who completed three or more years of graduate study.*
** *Includes all subfields not specified above.*

further division on the basis of citizenship lends even greater emphasis to that statement. On the other hand, there are many master's institutions that have no assistantships for their graduate students; consequently, their enrollments consist primarily of students whose support is full-time off-campus employment. Research assistantships are more likely to be offered to advanced students at PhD-granting institutions. And even though the number of foreign graduate students is large, very few of them are supported by their native governments.

The normal pattern of a graduate education in physics consists of approximately two years of comprehensive course work followed by a minimum of three years of research in a subfield that ultimately leads to a doctoral dissertation. **Table V** relates ten major subfields, grouped by type of research, to the full-time equivalent years of graduate study. For each level of study the table shows the estimated number of doctoral candidates. Computer simulation, listed separately this year in Table V, was included with the theoreticians in earlier reports.

Table VI. Distribution by subfield and citizenship of doctorate recipients, 1991–92.

Physics subfield	U.S. citizens	Foreign citizens	Total in subfield
Astrophysics	5.1%	1.5%	6.6%
Biophysics	1.1	1.3	2.4
Condensed matter	16.1	18.9	35.0
Electron, atomic, molecular	4.3	3.3	7.6
Elementary particles	7.2	5.6	12.8
Mathematical physics	3.0	3.0	6.0
Nuclear	3.8	4.5	8.3
Optics/lasers	3.5	1.5	5.0
Plasmas/fluids/chaos	4.7	1.7	6.4
Physics applications	2.7	1.5	4.2
All other subfields	0.4	5.3	5.7
Total %	51.9%	48.1%	100%

Degree Recipients

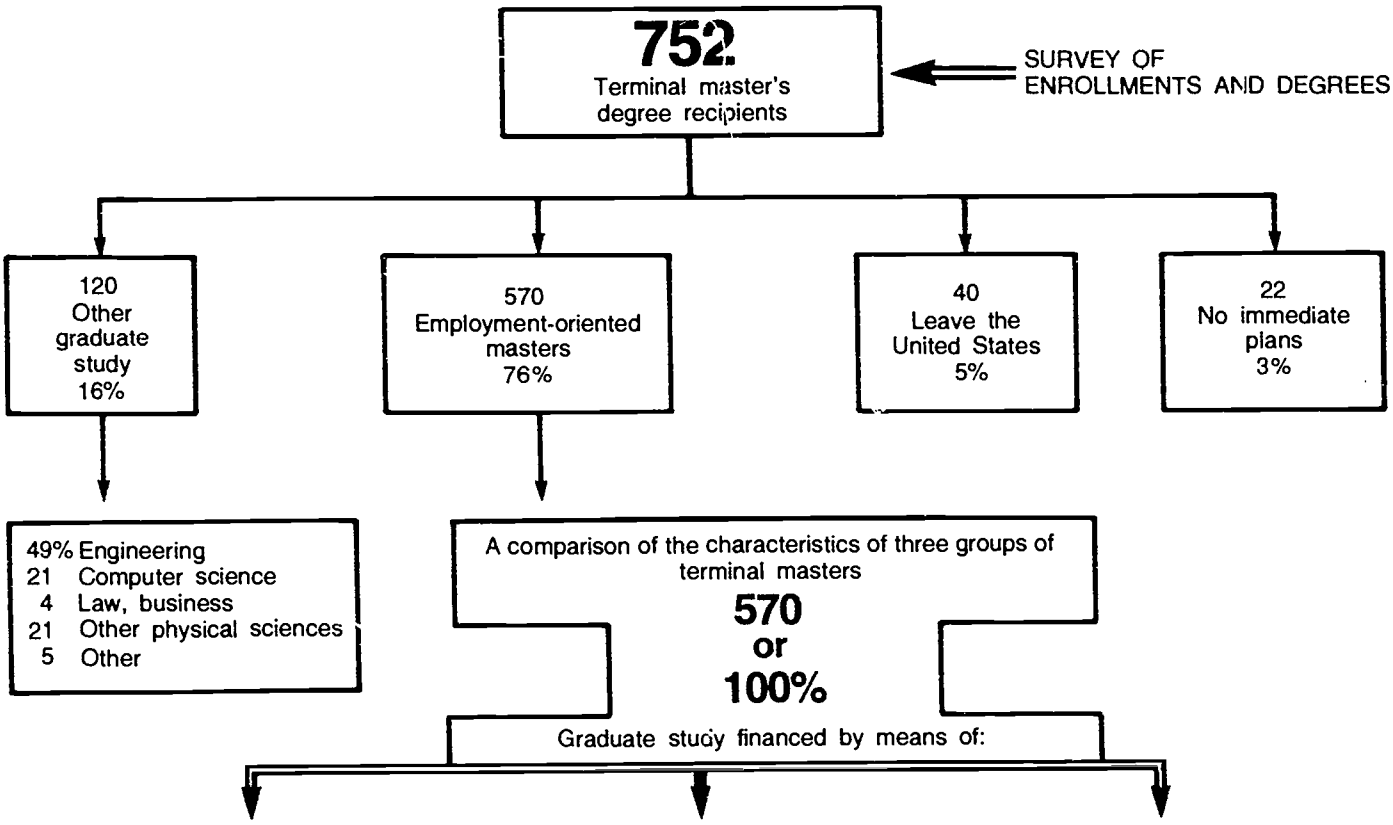
Because of the intensive professional training physicists receive, they identify strongly with the subfield of their dissertation. **Table VI** presents a listing of the ten major subfields and shows for each one the proportion of U.S. as well as foreign doctoral graduates.

Upon completion of the doctorate, a number of graduates accept initial employment outside the United States; details on that group are shown in **Figure III**. What **Table VII** focuses on, is the initial employment of new physicists in the United States. To present an all-inclusive account of this group, it became necessary to create the new employment category, "Temporary or part-time positions," and to show what employers and work activities these positions involve. The foreign contingent among these graduates comprised 44%; hence a division on the basis of citizenship appeared to anticipate a number of questions. For example, we found that far fewer permanent positions are available to foreign graduates, that 'postdocs' for them are primarily offered at universities and unless a foreign graduate has become a permanent resident, he or she cannot accept a 'postdoc' from the government laboratories.

Table VII. Initial employment of physics doctorate recipients by citizenship, 1991–92.

		'Posdocs'		Potentially permanent positions		Temporary or part-time positions	
		U.S.	Foreign	U.S.	Foreign	U.S.	Foreign
	No. of contributors:	258	259	146	44	47	50
	Total population:	354	355	200	60	64	69
Type of employer	University	58%	76%	12%	10%	55%	54%
	College/High school	–	–	13	17	29	24
	Industry	6	4	52	50	10	10
	FFRC	22	11	9	5	–	–
	Government	12	4	12	12	–	–
	Other	2	5	2	6	6	12
Work activity	Research	90%	95%	14%	10%	29%	34%
	Teaching	–	–	8	17	50	32
	Teaching & Research	–	–	11	5	5	10
	Research & Development	10	5	56	40	5	5
	Nonphysics professional	–	–	7	5	5	8
	Other	–	–	4	23	6	11

Figure II. Post-degree plans of physics terminal master's degree recipients, 1991–92.



314 or 55%	200 or 35%	56 or 10%
Accepted new employment 37% / Seeking initial employment 18%	Continue employment	Fulfill military obligations
Selected characteristics	**Selected characteristics**	**Selected characteristics**
Age	**Age**	**Age**
Median age: 28 years	Median age: 32 years	Median age: 31 years
Sex	**Sex**	**Sex**
Women: 22%	Women: 21%	Women: 10%
Men: 78	Men: 79	Men: 90
Citizenship	**Citizenship**	**Citizenship**
U.S.: 75%	U.S.: 91%	U.S.: 88%
Foreign: 25	Foreign: 9	Foreign: 12
Major employers	**Employers**	**Employer**
Industry: 45%	Industry: 60%	Government: 100%
Government: 15	Government: 20	
Educ. inst.: 35	Educ. inst.: 20	
Median salary $2680/month	**Median salary** $3330/month	**Median salary** $4000/month

As a result of anticipating changes in our economy, employers are apt to seek a more flexibly trained work force. The terminal master's program in physics provides a solid technical training for a large number of professional careers. The physics departments reported a total of 752 terminal master's degrees conferred in 1991-92 and **Figure II** outlines the diversified career plans of these graduates. A growing group of terminal masters is the one that considers two years of graduate-level physics an excellent technical background for graduate work in another discipline, and those who transfer to engineering top the list. It should also be mentioned that two thirds of the members of this group are foreign. But three out of four terminal masters are employment oriented and were led to this degree by a variety of circumstances based on their personal finances. There is the group of physics bachelors who started graduate study in physics without interruption but counted in large part on assistantships offered by their respective graduate physics departments. Then there are the physics bachelors who chose immediate full-time employment but were urged by their employers to enroll in a limited graduate program aimed at a specific applied subfield, possibly optics or medical physics, and stayed with the program until they completed a master's degree. A small but distinct third group are the masters whose graduate education was financed by the military. Members of the second and third groups are not competing for jobs upon completing their degrees. Members of the second group generally continue to work for the same employer, possibly with a promotion, and the third group needs to fulfill military obligations; each year the largest single contributor to this group is the Naval Postgraduate School in California.

The main portion of **Figure II** compares the characteristics of the three employment-oriented groups of graduates. To explain why 18% of this group were seeking employment we need to point out that the survey was conducted at the end of the academic year in which the degrees were granted, and that this subgroup of masters had little work experience. Compared to the previous year, we find a shift in major employers toward educational institutions and away from industry. The median starting salary for this group rose by 5% over that paid to the graduates in the class of 1991.

Table VIII. Distribution of terminal masters by subfield, 1991-92.

Physics subfield	% of degree recipients*
Acoustics	3%
Astro-geophysics	10
Bio-medical physics	7
Condensed matter	24
Elec., atomic, molecular	7
Nuclear	6
Optics/laser	11
Plasma/fluids/chaos	4
Physics applications	13
Physics education	4
General physics	5
All other subfields	6
Total	100%

* *Based on 373 respondents.*

Many master's programs make the writing of a thesis optional; nevertheless, degree candidates are expected to choose an area of concentration. For purposes of comparison with the doctoral candidates, we present a subfield distribution reported by physics masters in **Table VIII**.

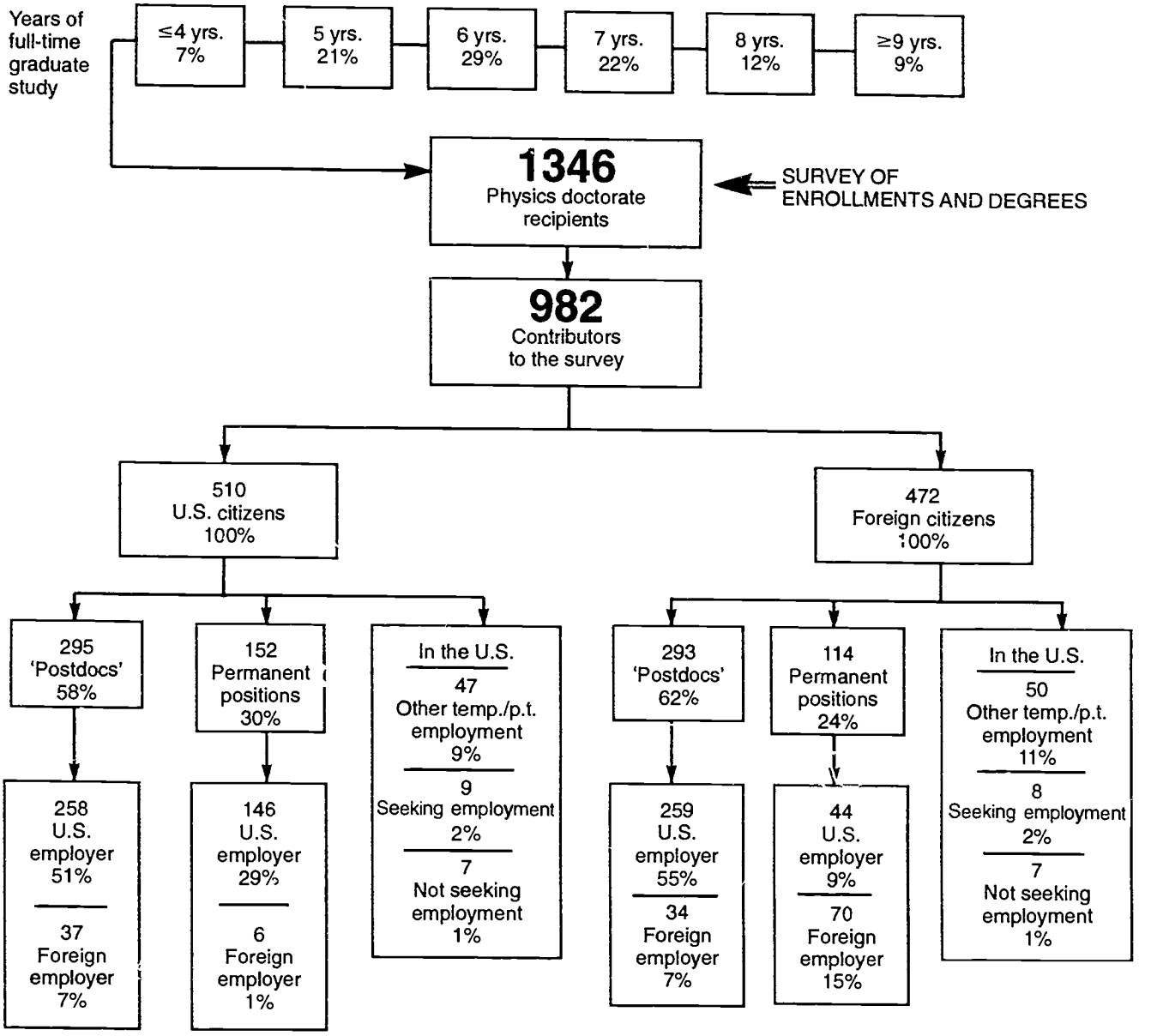
By combining the three subgroups of Figure II we form a comprehensive employment picture of the new physics masters in **Table IX**. Here we relate six types of employers to the major work activities and the extent to which these physicists utilize their training. Despite a two percentage-point decline from the previous year, industry remains the largest employer of physics masters but it is responsible for a substantial increase in the proportion of physics masters who make no use of their training. The changes in work activities included shifts away from the traditional research, development or engineering employment and toward management and nonphysics professional work.

Table IX. Employment characteristics and use of physics training of 1991-92 master's degree recipients.

Work activity		Type of employer: Secondary school	Post-secondary institutions	Industry	Government	Military service	Non-profit organization	Total N	Total %
Teaching		42	29	–	–	6	2	79	17
Research		–	9	16	17	2	3	47	10
Research and development		–	8	51	10	2	4	75	16
Engineering		–	–	90	14	1	–	105	23
Programming		–	2	18	16	1	–	37	8
Management		–	3	26	11	1	5	46	10
Nonphysics professional		–	–	22	11	43	–	76	16
Total	N	42	51	223	79	56	14	465	
	%	9	11	48	17	12	3		100%
Use of physics training	Extensive	31	41	104	26	11	6	219	47
	Little	6	10	80	38	45	8	187	40
	None	5	–	39	15	–	–	59	13

Note: The data in this table reflect the employment information contributed by individual degree recipients as well as department chairpersons.

Figure III. Post-degree plans of physics doctorate recipients, 1991–92.



For several years, we found it necessary to change the format of **Figure III** so as to call attention to the growing number of foreign physics doctorate recipients. For the class of 1992, **Figure III** reflects a further change in format because the citizenship of the graduates was inserted into the flow diagram before the analysis of their initial employment is presented. Collectively, the physics department chairpersons reported 652 foreign citizens among the 1346 doctorates granted in 1991-92, and thereby recorded the largest percentage (48%) of foreign doctoral graduates since these statistics began to be gathered. And having two groups so similar in size, percentages facilitate a meaningful comparison between them. For example, foreign graduates accepted 'postdocs' in the United States in a slightly higher proportion to their numbers than did U.S. citizens (55% compared with 51%); on the other hand, for every three U.S. doctoral graduates, only one foreign graduate had accepted a permanent position in the United States. The number of graduates totally uncommitted is small, but we found that approximately 10% of the new physicists, who chose to remain in the U.S., were obliged to resort to temporary or part-time positions primarily created for them by the physics departments that granted their doctorates. It was necessary to create this new employment category, which includes the teaching of summer courses, because those positions are sufficiently different from the traditional 'postdocs.'

Table X. Initial employment status for physics doctorate recipients, in the U.S., by major subfield, type of research and citizenship, 1991–92.

Major subfields		'Postdoc'	Permanent positions	Other temporary/part-time	Total %	Total in major subfield N*	%
Astrophysics		79%	15%	6%	100%	70	6.4%
Condensed matter		63	23	14	100	354	32.1
Electron, atomic, molecular		76	18	6	100	79	7.2
Elementary particles		78	14	8	100	123	11.2
Nuclear		72	15	13	100	79	7.2
Optics		25	64	11	100	53	4.8
Plasmas, fluids, chaos		61	29	10	100	70	6.4
Total All subfields combined		65%	24%	11%	100%	828	75.3%
All experimentalists	U.S. citizens	59%	33%	8%	100%	508	65%
	Foreign citizens	72	14	14	100	274	35
Total		64%	26%	10%	100%	782	100%
All theoreticians	U.S. citizens	61%	23%	16%	100%	130	49%
	Foreign citizens	82	7	11	100	135	51
Total		72%	15%	13%	100%	265	100%
All graduates in computer simulation	U.S. citizens	41%	50%	9%	100%	38	69%
	Foreign citizens	80	10	10	100	17	31
Total		53%	38%	9%	100%	55	100%

* *These numbers are scaled up to the total population.*

To offer additional details on the initial employment of the 1992 graduates we present **Table X**, which relates the three employment categories to the major subfields and to the types of dissertation research. Among the subfields, optics appears to be the specialty favored by employers who seek to fill potentially permanent positions. The lower portion of this table, to which we added computer simulation as the third type of research, shows the relative demand for new physicists by citizenship.

Taking the current emphasis on flexibility into account, we examined the types of employers and work activities of those physicists who reported newly-accepted permanent positions, in **Table XI**. Based on approximately the same number of respondents, we found a notable increase from the previous year in the proportion of graduates employed in industry. Research and development as a work activity remained at 41% but engineering rose by six percentage-points.

Table XI. Employment with potential permanence in the U.S. for 1991–92 physics doctorate recipients.

Work activity		Type of employer: University	College	Secondary school	Industry	FFR&DC	Government	Other	Total N	Total %
Teaching		2	11	4	1	–	–	–	18	10
Research		4	–	–	10	5	7	1	27	15
Research and teaching		10	9	1	–	–	–	–	20	11
Research and development		4	–	–	49	6	12	2	73	41
Engineering		–	–	–	19	2	1	1	23	13
Consulting		–	–	–	7	1	2	1	11	6
Nonphysics professional		1	–	–	6	–	–	–	7	4
Total	N	21	20	5	92	14	22	5	179	
	%	12	11	3	51	8	12	3		100%
Extensive use of:	research method	86%	62%	50%	68%	91%	93%	40%	92*	74%
	subject matter	87%	86%	100%	49%	83%	100%	40%	85*	67%

**Number of respondents to this question.*

Table XII. Median monthly starting salaries paid by U.S. employers to new physics degree recipients, 1991–92.

Type of employer	Bachelor's degree recipients		Terminal master's degree recipients		Doctorate recipients			
	Percentage accepting positions	Monthly starting salaries	Percentage accepting positions	Monthly starting salaries	Percentage accepting: 'postdocs'	potentially perm. pos.	Monthly starting sal. for: 'postdocs'	potentially perm. pos.
Secondary school	11%	$2330	9%	*	–	1%	–	*
College	1	*	[11	$2540]	–	3	–	$2940
University	4	2100			49%	3	$2330	2875
Industry	42	2290	48	2710	4	14	3830	4330
Gov't. incl. military	35	1930	26	2580	6	3	3000	3750
Fed. Funded R&D Ctr.	3	2420	3	*	13	2	2800	4165
Other	4	1920	3	*	2	–	*	–
All employers	100%	$2085	100%	$2680	100%		$2500	$3830

*Insufficient data.

The starting salaries presented in **Table XII** include only those paid by U.S. employers for newly accepted positions. Although the Graduate Student Survey collects data only from the terminal masters and doctoral graduates, for purposes of comparison we have added the salaries of physics bachelors. The doctoral physicists are divided into two groups because those who accepted potentially permanent employment are paid significantly higher salaries than the graduates who start out as postdoctoral fellows. Three of the four median salaries shown for all employers combined remained essentially the same for those degree levels; the exception is that shown for the doctorate recipients who had accepted permanent positions. Their median salary rose 4.6%. Academic salaries were adjusted for the varying lengths of the school year so that the dollar amounts apply to a month when a teacher is working.

ASTRONOMY

Astronomy can be defined as applied physics on a cosmic scale. It is a science where the experimentalists use observations of great precision to build up a picture of the universe that becomes more detailed as research is carried forward. The comments from graduate astronomy students, who contribute their data to this annual Graduate Student Survey, suggested a revision of the research specialties with which the students identify themselves. The major subfields listed in **Table XIII** reflect revisions that are based on the American Astronomical Society's abstract classification list.

Table XIII. Graduate astronomy students* by subfield and years of graduate study, 1991–92.

		Full-time equivalent years of graduate study						Total	
		1 yr.	2 yrs.	3 yrs.	4. yrs.	5 yrs.	>6 yrs.	N	%
Distribution of students	N	175	171	144	126	135	150	901	
	%	19%	19%	16%	14%	15%	17%		100%
Major subfields									
Astronomical instruments and techniques		4%	5%	5%	6%	1%	6%	50	6%
Solar system planetary science		8	6	7	4	8	8	62	7
White dwarfs/neutron stars/black holes/ degenerate binaries		8	2	7	3	9	3	49	5
Interstellar material/dust/H II regions		9	4	11	10	8	12	79	9
Novae/supernovae/planetary nebulae/ supernova remnants		7	9	2	7	6	3	51	6
Stellar spectra/atmospheres/populations/ abundances		4	5	6	4	7	6	46	5
Star formation/molecular clouds/ young stars		12	11	10	12	7	9	91	10
Galactic structure/galactic dynamics		8	8	8	4	5	6	59	7
Active galaxies/quasars		4	9	8	10	8	12	75	8
Groups and clusters of galaxies		4	5	8	6	6	4	46	5
Cosmology/early universe		4	10	6	14	6	3	62	7
All other		28	22	22	20	29	28	231	25
		100%	100%	100%	100%	100%	100%		

* *The percentages shown in this table are based on 684 respondents to the Graduate Student Survey. Astronomy department chairpersons reported a total of 901 graduate students for the survey of Enrollments and Degrees.*

As in past years, this table presents the distribution of graduate students by level of study.

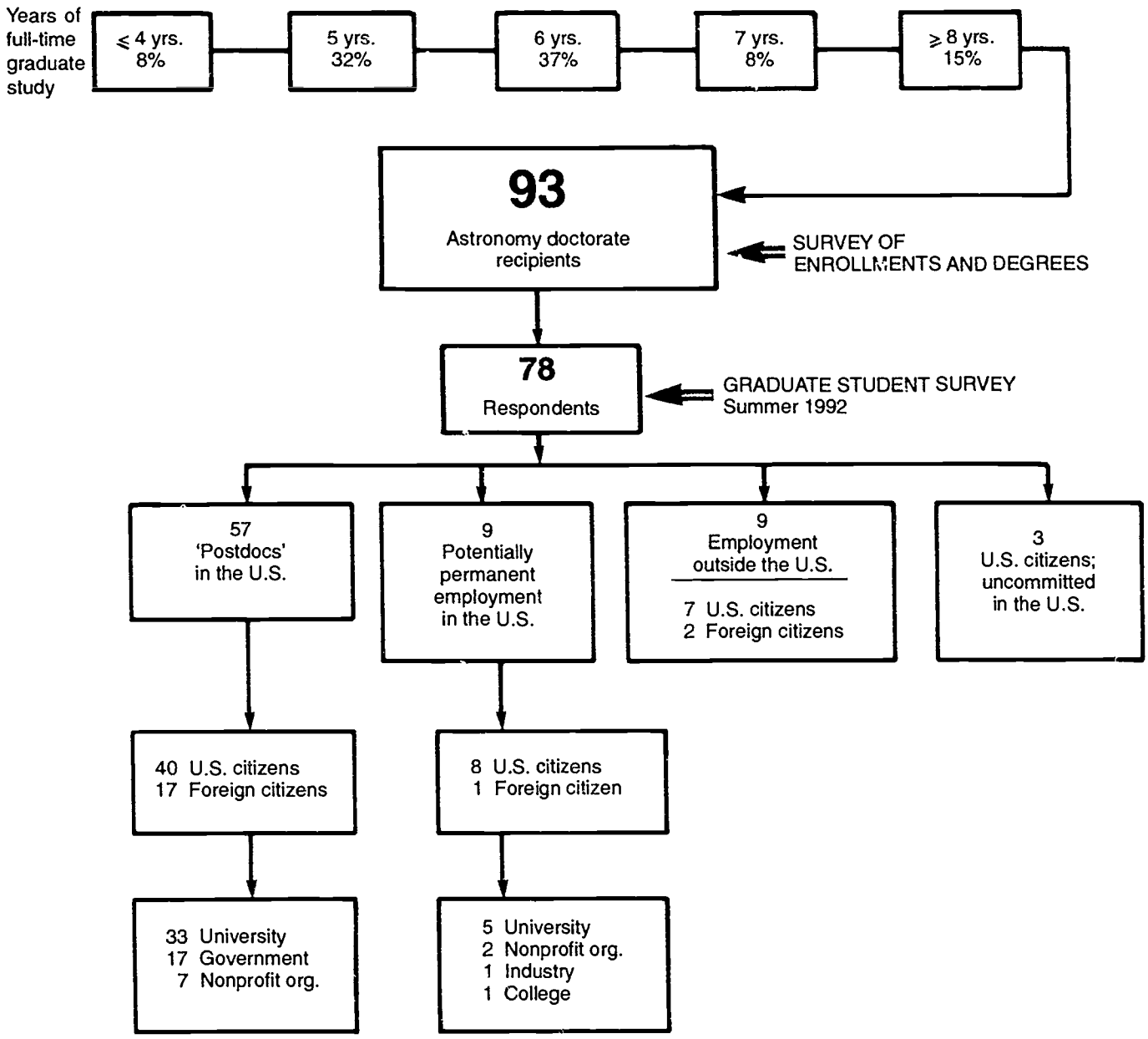
Fewer than 5% of the graduate astronomy students terminate their study at the master's level; hence those degree recipients are not included in **Table XIV**, which otherwise has the same format as **Table 1**. A comparison of the first two characteristics in each table reveals that astronomy, at all levels, includes a larger proportion of women, whereas physics can point to a larger contingent of foreign students. In the ten years since 1982, the proportion of foreign first-year graduate astronomy students has risen by only five percentage-points to 30%. A comparison of the age groups of first-year students indicates that it is more common to enter graduate study in astronomy, than in physics, straight out of college.

Table XIV. Characteristics of the graduate astronomy student population, 1991–92.

Characteristics		All graduate students	First-year graduate students	Doctorate recipients
	*Total population:	901	175	93
	Number of respondents:	684	137	78
Sex	Female	21%	27%	18%*
	Male	79	73	82
Citizenship	U.S.	71%	70%	84%
	Foreign	29	30	16
Age	24 or younger	21%	61%	–
	25–26	23	17	5%
	27–28	24	9	28
	29–32	21	9	40
	33 or older	11	4	27
High school physics	Yes	96%	96%	94%
	No	4	4	6
Major of bachelor's degree	Astronomy	33%	30%	29%
	Physics	57	61	63
	Engineering	4	2	3
	Mathematics	3	2	1
	Other	3	5	4
Type of bachelor's institution	PhD granting	56%	53%	58%
	MS granting	3	5	4
	BS/BA granting	17	15	12
	Foreign	24	27	26
Type of graduate institution*	PhD granting	96%	93%	100%
	MS granting	4	7	–
	Public	67%	66%	62%
	Private	33	34	38
Source of support	Teaching assistantship	26%	51%	9%
	Research assistantship	49	19	68
	Fellowship	20	24	17
	Family, savings, loan	1	1	4
	Foreign government	1	1	–
	Other	3	4	2

* *These data were reported by astronomy department chairpersons as part of the survey of Enrollments and Degrees.*

Figure IV. Characteristics and post-doctorate status of 1991–92 astronomy graduates.



The traditional initial employment for a doctoral astronomer is a 'postdoc' and **Figure IV** shows that the graduates in the class of 1992 adhere to that precedent. The major employer of astronomers are the National Observatories, which are often administered by a university but funded by the federal government; the classification of employers shown in **Figure IV** is that reported by the respondents.

Almost half of the 57 graduates who had accepted 'postdocs' in the U.S. received multiple postdoctoral offers and their median monthly salary of $2665 was somewhat higher than the one reported by the physicists.

This report was prepared with the help of Thomas N. Stovall.