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AUTHOR Ivie, Rachel; Stowe, Katie; Czujko, Roman
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ABSTRACT

This report discusses trends in the physics academic workforce and the implications of these trends for the future academic job market. In March 2000, a survey was sent to 766 U.S. physics departments that grant at least a bachelor's degree in physics, and 725 responses were received, a response rate of 95%. Degree-granting physics departments in the United States employed an estimated 8,375 full-time equivalent physicists during the spring of 2000. Very few were African American or Hispanic, and two-thirds of the African American physicists worked at historically black colleges and universities. The turnover and retirement rates for physics faculty increased, and for the first time, the retirement rate was above 3% and expected to increase slowly. The numbers of new hires also increased. In 2000, U.S. physics departments hired an estimated 335 tenured and tenure-track faculty members, and for 20001, the departments recruited an estimated 509 tenured and tenure-track faculty. Physicists from the most recent U.S. Ph.D. Class are not likely to be hired directly into faculty jobs at physics departments that grant Ph.D.s. Most new full-time faculty have completed postdoctoral fellowships, have worked as faculty in other institutions, or have worked in nonacademic settings. The increased demand for physics faculty comes at a time when the pool of potential faculty is decreasing, but the academic job market is affected by many factors that must be considered in predicting its future. (Contains 11 tables, 3 figures, and 3 references.) (SLD)

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One Physics Ellipse
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AIP REPORT

STATISTICAL RESEARCH CENTER
Tel. 301-209-3070

E-mail: stats@aip.org
www.aip.org/statistics

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2000 PHYSICS ACADEMIC WORKFORCE REPORT

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HIGHLIGHTS

- Degree-granting physics departments in the US employed an estimated 8375 full-time equivalent physicists during the spring of 2000 **(Table 1)**.
- Very few academically employed physicists are African-American or Hispanic **(Table 3)**. Two-thirds of African-American physics faculty work at Historically Black Colleges and Universities.
- The turnover and retirement rates for physics faculty have increased. For the first time, the retirement rate is above 3% per year and is expected to increase slowly **(Table 5)**.
- The numbers of new hires and recruitments also have increased. In 2000, US physics departments hired an estimated 335 tenured and tenure-track faculty members **(Table 8)**. For 2001, the departments recruited an estimated 509 tenured and tenure-track faculty **(Table 7)**. Not all of these positions will be filled.

Table 1. Estimated Number of Full-Time Equivalent Physics Faculty and Mean Number of Faculty, 1994 and 2000

Type of Department		1994	2000
PhD	FTE	4900	5000
	Mean	27	27
Master's	FTE	800	775
	Mean	10	11
Bachelor's	FTE	2500	2600
	Mean	5	5
Total	FTE	8200	8375
	Mean	11	11

AIP Statistical Research Center: 2000 AWF Survey

- Physicists from the most recent US PhD class are unlikely to be hired directly into faculty jobs at physics departments that grant PhDs. Most new full-time faculty at PhD departments have completed postdocs, have worked as faculty in other institutions, or have worked in non-academic settings **(Table 10)**.
- The increased demand for physics faculty comes at a time when the pool of potential faculty (US PhD recipients) is decreasing. However, the academic job market is influenced by many factors, all of which must be considered in predicting its future.

The academic job market for physicists has been changing. Since the publication of the *1998 Academic Workforce Report*, we have seen increases in the number of vacancies and retirements. Along with these have come increases in the number of new hires and recruitments. We have heard anecdotal information that physics departments are not getting as many applicants when they post an opening as they did several years ago. This is good news for job seekers, but less welcome to physics departments. This report discusses trends in the physics academic workforce and the implications of these trends for the future academic job market.

A sizable percentage of PhD physicists work in academia, and this sector is a good indicator of the health of the entire discipline. Thus, we have measured this workforce every two years since 1986. The Academic Workforce Survey counts physicists doing research or teaching in US physics departments that grant physics degrees, but excludes postdocs and physicists working in other departments.

In March 2000, we sent this survey to the 766 physics departments that grant at least a bachelor's degree in physics. We received 725 responses to the survey, for a response rate of 95%. We are indebted to each of the departments that responded to this survey. Because of the overwhelming response rate, our estimates are more accurate than ever. Most (but not all) of the numbers in this report are population estimates, where we divided the totals from the survey by the response rate. As in the past, this year's survey examined the numbers of physics faculty, vacancies, retirements, new hires, and recruitments. As in 1996, we collected data about the number of minorities on physics faculties. In this report, we refer to academic years by the year of the spring semester, i.e., 1999 refers to the academic year 1998-1999.

NUMBER OF FACULTY

We asked each department to report its number of full-time equivalent (FTE) faculty involved in teaching or research in physics or astronomy on March 1, 2000. In addition to the 725 responses that we received, we were able to estimate number of FTE faculty for an additional 32 departments by using other sources. We estimate that all degree-granting physics departments employed 8375 FTE faculty during the spring of 2000 **(Table 1)**. Most of these physicists worked in departments that grant a PhD in physics.

This survey does not attempt to count all physicists working in colleges and universities. It does not include postdocs, physicists working in departments that do not grant physics degrees, and physicists who conduct research in university institutes but are not included in departments' FTE count. However, the FTE count may include physicists working in physics departments on grants or soft money. In some departments, the number of FTE faculty is different from the number of physicists working there. Because of part-time faculty and joint appointments, some departments have a larger number of physicists than their FTE reflects.

Out of the 513 physics departments that grant a bachelor's as their highest physics degree, more than one-third have three or fewer faculty **(Table 2)**. In fact, there are as many of these small bachelor's-granting departments as there are departments that grant PhDs in physics. Nevertheless,

Table 2. Distribution of Physics Faculty by Department Type, 2000

	Type of Department		
	PhD	Master's	Bachelor's
Number of Departments	186	67	513
Median Number of Faculty	22	10	4
Number of Faculty in Smallest Third of Departments	3-18	3-9	≤3
Number of Faculty in Middle Third of Departments	18-30	9-13	3-5.5
Number of Faculty in Largest Third of Departments	30-78	13-26	5.6-35

AIP Statistical Research Center: 2000 AWF Survey

PhD departments, with a median number of 22 faculty, employ the majority of academic physicists.

MINORITY FACULTY*

Compared to their representation among all faculty, African-Americans at 1.8% are underrepresented on physics faculties **(Table 3)**. There are less than 150 African-American physics faculty members in the US. Out of the 38 African-Americans who are on faculties at PhD-granting physics departments **(Table 4)**, fourteen are at just two departments, Hampton University and Howard University. Both of these universities are HBCUs (Historically Black Colleges and Universities). Out of the 35 bachelor's-granting departments that have black faculty, 17 are HBCU departments that employ 43 of the 62 African-American physicists working at bachelor's degree-granting schools. Overall, two-thirds of African-American physics faculty work at HBCUs.

Table 3. Race and Ethnicity of Physics Faculty, 1996 and 2000

	Physics		All Disciplines[2]
	1996[1]	2000	1995
African-American	1.5	1.8	5.0
Asian	10.1	9.9	5.1
Hispanic	1.4	2.0	2.4
White	85.3	84.2	86.7
Other	1.8	2.0	0.8

AIP Statistical Research Center: 2000 AWF Survey

[1]Revised since the 1996 report
[2]Source: National Center for Education Statistics

Because of their concentration at HBCUs (most of which do not grant graduate degrees in physics), forty-four percent of all African-American physics faculty work at departments that grant only bachelor's degrees in physics. In contrast, less than one-third of all physics faculty work at bachelor's-granting departments. Approximately 20% of HBCU physics departments have no black faculty at all. On the other hand, 93% of non-HBCU departments have no black faculty. Less than one percent of physics faculty at non-HBCU departments are African-American. This is comparable to African-Americans' representation among physics PhD recipients from 1973-1998. This means that HBCUs are drawing a very large share of African-American physicists.

Table 4. Number of African-American and Hispanic Physics Faculty by Department Type, 2000

	Type of Department		
	PhD	Master's	Bachelor's
African-American	38	41	62
Hispanic	81	32	42

AIP Statistical Research Center: 2000 AWF Survey

These trends do not apply to Hispanic physicists, another small minority group on physics faculties. For example, less than one-third of Hispanic physicists work at bachelor's departments, as is true for all faculty. Hispanic physicists do not appear to be concentrated at certain colleges and universities.

TURNOVER, RETIREMENTS, RECRUITMENTS, AND NEW HIRES

There has been much speculation (e.g., Magner, 2000) that academic retirements are increasing. Our data show this to be true, but perhaps not as dramatically as some have predicted. The estimated retirement rate during the two academic years 1999 and 2000 was just over 3% annually. Prior to 1999, it did not rise above 2.6%. Even at 3.3% per year, there are fewer than 250 physics positions vacated due to

*The numbers in this section are not population estimates, but are the numbers reported to us by 92% of all physics departments.

Table 5. Estimated Annual Retirement Rates for Physics Faculty During Two Academic Years, 1999 and 2000

	Type of Department			
	PhD	Master's	Bachelor's	Total
Estimated Number of Retirements per Year	127	25	85	237
Estimated Percent of Departments with Retirements per Year	32	23	13	19
Estimated Annual Retirement Rate	2.9	3.8	3.9	3.3

AIP Statistical Research Center: 2000 AWF Survey

retirement every year **(Table 5)**. However, due to the increasing age of the physics faculty, retirement rates will probably continue to increase slowly throughout the coming decade. In spite of this, prospects for new faculty to be hired may not increase at the same pace. Retirement for faculty is often a multi-step process, with many faculty members reducing their status to part-time for several years before retiring completely.

Turnover rates among tenured or tenure-track faculty were also higher during the 1999 academic year than they had been in previous years **(Table 6)**. During that year, an estimated 388 tenured or tenure-track faculty left their positions. The turnover rate of 7.3% was particularly high at bachelor's-granting departments. At all departments, at least part of the turnover increase is due to an increase in retirement rates, since turnover includes retirements, resignations, and deaths. To the extent that increases in turnover rates are caused by an aging faculty, we may continue to see increasing turnover rates for several years.

Along with an increase in turnover comes an increase in recruitment and new hires. Recruitment in academics is conducted differently than in other job markets. When a faculty member leaves, the search for his or her replacement is often deferred until the following semester. Departments look for new faculty beginning in the fall, and the search continues until the spring. If offers are made to candidates who do not accept them, or if no suitable candidate is found, the search will be extended to the subsequent academic year. Meanwhile, the position may be temporarily filled with a visiting faculty member. In addition, the number of faculty on sabbatical leave means that there is a constant demand for visiting faculty. Large departments may even have enough faculty on sabbatical each year that they can hire tenure-track faculty to replace them.

We estimate that 41% of the departments were recruiting for an estimated 509 tenured or tenure-track faculty for the 2001 academic year **(Table 7)**. This is a large increase over the previous survey, which showed 34% of departments recruiting for an estimated 373 tenured or tenure-track positions for 1999. For 2001,

Table 6. Estimated Tenured and Tenure-Track Physics Faculty Turnover, 1997 and 1999

	Type of Department			
	PhD	Master's	Bachelor's	Total
Percent of Departments with Vacancies, 1999	58	44	27	36
Estimated Vacant Positions, 1999	188	40	160	388
Estimated Turnover, 1997*	3.4	5.4	5.1	4.1
Estimated Turnover, 1999	4.2	5.9	7.3	5.3

AIP Statistical Research Center: 2000 AWF Survey

*Revised since the 1998 report.

Table 7. Physics Departments Recruiting New Faculty Members for 2001				
	Type of Department			
	PhD	Master's	Bachelor's	Total
Percent of Departments Recruiting Tenured or Tenure-Track	74	52	28	41
Number of Tenured or Tenure-Track Recruitments	282	54	173	509
Percent of Departments Recruiting Visiting Faculty	17	8	19	17
Number of Visiting Recruitments	60	9	118	187
AIP Statistical Research Center: 2000 AWF Survey				

most (three-quarters) of the PhD departments were recruiting for tenured or tenure-track positions, while less than a third of bachelor's departments were recruiting tenured or tenure-track faculty. For the first time, we asked departments to tell us the number of visiting or sabbatical replacement positions for which they were recruiting. For the 2001 academic year, 17% of departments were recruiting for an estimated 187 visiting or sabbatical replacement positions.

The number of new hires is usually less than the number of recruitments, but the number of new hires has increased as well. For the 2000 academic year, we estimate that the departments hired 335 tenured and tenure-track faculty members **(Table 8)**. This is a large increase from our estimate of 264 tenured or tenure-track faculty hired for 1998. In 2000, the percentage of departments hiring tenured or tenure-track faculty also increased, from about one-fourth in 1996 and 1998 to 35% in 2000. The average number of new tenured or tenure-track faculty per hiring department was 1.3, relatively unchanged from about 1.4 in 1996 and 1.3 in 1998.

The departments hired an additional estimated 323 faculty on a part-time or temporary full-time basis, for an estimated total of 658 new faculty, including tenured, tenure-track, part-time, and temporary full-time. In 1998, the estimated new hires totaled 512. The percentage of departments hiring new faculty members increased from 38% in 1996, to 45% in 1998, to 54% in 2000.

Physics departments reported about vacancies for 1999, new hires for 2000, and recruitment efforts for 2001. The number of tenured or tenure-track recruitments for 2001 is higher than the number of new hires for 2000, but this does not necessarily mean that the number of faculty actually hired for 2001 will be significantly higher. The number of new hires is usually less than the number of recruitments because departments are sometimes unable to find the right candidate or lose funding for the position and extend their search another year. This is supported by the fact that there were fewer tenured or tenure-track new hires in 2000 than there were vacancies in 1999.

Table 8. Estimated Number of Physics Faculty Hired, 2000				
	Type of Department			
	PhD	Master's	Bachelor's	Total
All Faculty	285	69	304	658
Tenured and Tenure-Track	191	28	116	335
Percent of Depts. Hiring any Faculty	76	62	46	54
Percent of Depts. Hiring Tenured and Tenure-Track	65	41	24	35
AIP Statistical Research Center: 2000 AWF Survey				

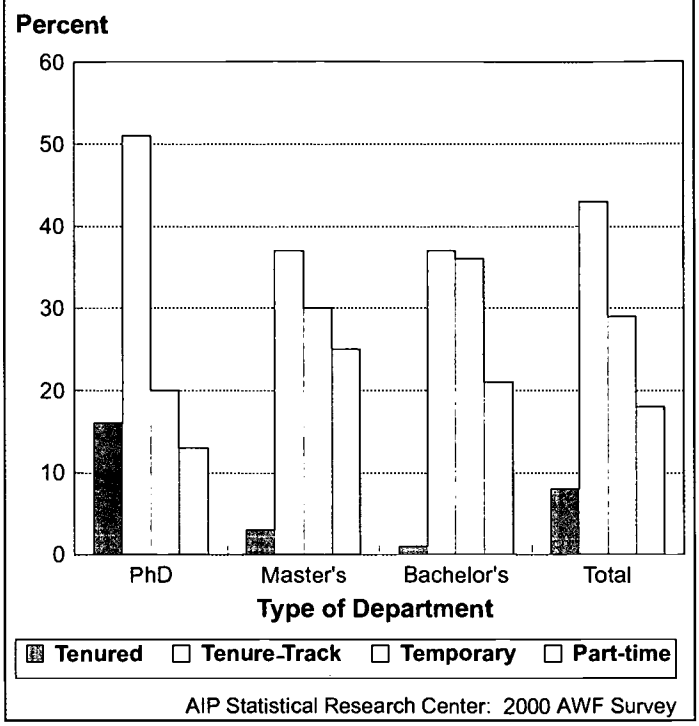
TYPES OF NEW HIRES

Examination of the data about the kinds of physicists who are hired into faculty positions makes it clear that departments are very selective about whom they hire, especially into tenured and tenure-track positions. Departments want to find the "right" faculty member, and their search is made more intense by the rising start-up costs for experimental physicists. For job seekers, this means that new PhDs are seldom hired directly into tenure-track jobs at graduate departments.

In fact, a large percentage of new faculty are not hired into tenured or tenure-track positions but into part-time or temporary full-time positions **(Figure 1)**. Since the 1998 survey, about half of new hires have been tenured or tenure-track. However, the percentage of temporary full-time hires has increased from 22% of all new hires in 1998 to 29% of all new hires in 2000. At the same time, the percentage of part-time hires has decreased from 26% in 1998 to just 18% in 2000. PhD departments reported hiring larger percentages of tenured and tenure-track faculty members than master's and bachelor's departments. Likewise, master's and bachelor's departments reported hiring larger percentages of temporary full-time and part-time faculty.

At all departments, the most common rank for new hires was assistant professor **(Table 9)**. Departments also had significant percentages of hires at the instructor or adjunct level. PhD departments had greater percentages of hires at the upper ranks of associate and full professor than other types of departments.

Figure 1. Employment Status of New Physics Faculty, 2000



AIP Statistical Research Center: 2000 AWF Survey

Taking a visiting position more often leads to a tenure-track job than taking a part-time, instructor, or adjunct job does. Almost forty percent of the new faculty members who had been visiting faculty at their previous jobs were hired as tenure-track in their new jobs. On the other hand, only about twenty percent of the new faculty who had been part-time, instructors, or

Table 9. Current Positions of New Physics Faculty, 2000

	Type of Department		
	PhD (%)	Master's (%)	Bachelor's (%)
Full Professor	13	1	2
Associate Professor	9	5	5
Assistant Professor	50	52	63
Research Professor	6	1	1
Instructor/Adjunct	15	39	23
Visiting Professor	7	2	6

AIP Statistical Research Center: 2000 AWF Survey

adjuncts in their previous jobs were hired as tenure-track in their new jobs. Thus, visiting or temporary full-time positions are an important step for many physicists in obtaining a tenure-track job.

Departments are not only selective about whom they hire into tenured and tenure-track jobs, but they hire similar types of people for visiting positions. Among the faculty hired into full-time positions at PhD departments, the most common previous position was a postdoc **(Table 10)**. Other common previous positions for full-time new hires at PhD departments were research scientist and tenured or tenure-track professor. Hiring someone from the most recent PhD class directly into a tenure-track position was very unusual at PhD-granting departments. In fact, only two new hires whose most recent occupation was "graduate student" obtained tenure-track positions at PhD departments. New PhDs were more frequently hired at bachelor's departments and account for about one-fifth of new full-time hires there.

Table 10. Previous Positions of New Physics Faculty, 2000*

Type of Department			
PhD	(%)	**Bachelor's**	(%)
Post Doc	35	Graduate Student	19
Research Scientist	32	Post Doc	18
Tenured or Tenure-Track Prof.	19	Tenured or Tenure-Track Prof.	16
		Visiting Professor	16

AIP Statistical Research Center: 2000 AWF Survey

*Tenured, tenure-track, temporary full-time, and permanent non-tenured faculty only.

PhD departments were evenly divided among the three main groups on Table 11, with about one-third earning PhDs in the US within the last five years, one-third earning PhDs outside the US, and one-third earning PhDs in the US more than five years ago. In contrast, the majority of new full-time faculty at bachelor's departments earned their PhDs in the US within the last five years.

Both bachelor's and PhD departments showed an increase in the percentage of full-time hires who earned PhDs outside the US. In 1998, 23% of new full-time faculty at PhD departments earned PhDs outside the US. In 2000, this percentage had increased to 34%. At bachelor's departments, only 4% of new full-time faculty in 1998 earned PhDs abroad, but by 2000, the percentage increased to 12%.

Table 11. Backgrounds of New Physics Faculty, 2000*

	Type of Department	
	PhD (%)	**Bach.** (%)
Earned PhD in US within last 5 years	35	60
Earned PhD outside US, any year	34	12
Earned PhD in US > 5 years ago		
Previous Employer:		
US Academic Institution	21	22
Industry, National Lab, Other	10	6

AIP Statistical Research Center: 2000 AWF Survey

*Tenured, tenure-track, temporary full-time and permanent non-tenured faculty only.

While new PhDs are unlikely to be hired directly into full-time jobs at PhD-granting departments, some of those who earned their PhDs within the last five years and worked elsewhere do get jobs at PhD departments. In fact, 35% of the new full-time faculty at PhD departments earned their degrees in the US within the last five years **(Table 11)**. New full-time faculty at

The representation of women in physics overall has been increasing, but our data indicate that fewer of the new faculty for 2000 are women. In 2000, 14% of new faculty are women, but in 1998, 17% of the new faculty were women. In addition, women generally are hired into less prestigious positions than men.

Figure 2. Employment Status of New Physics Faculty by Gender, 2000

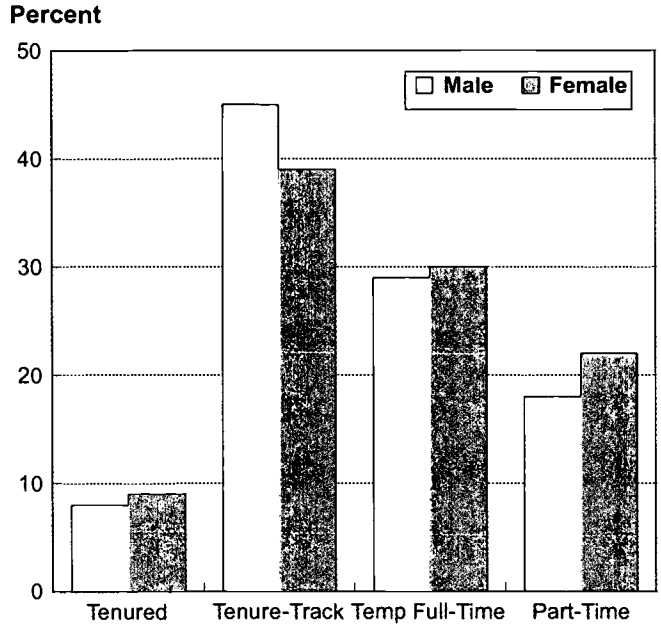
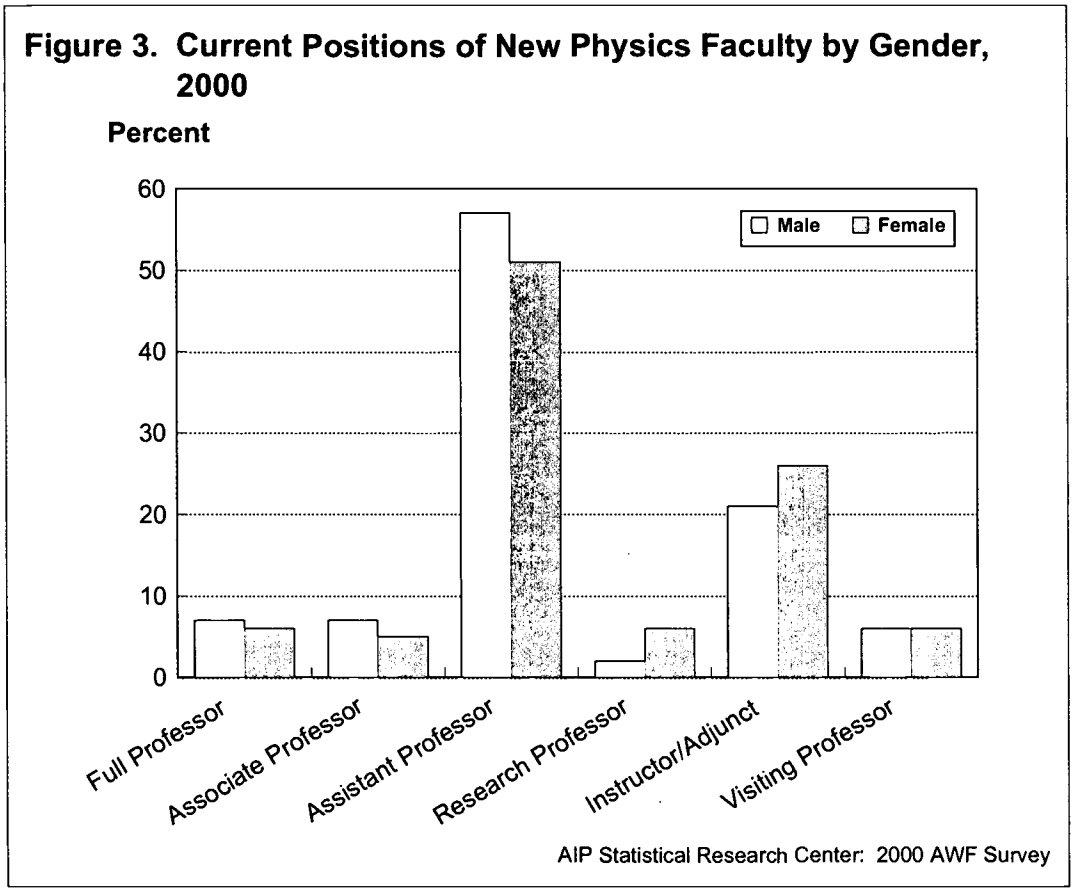


Figure 2 shows that although a few more of the tenured hires were women, women are less likely than men to be hired into tenure-track positions. Women are more likely than men to be hired as temporary full-time or as part-time. **Figure 3** shows similar differences by academic rank, where women are less likely than men to be hired as full, associate, and assistant professors. Women are more likely than men to be hired as research professors, instructors, and adjunct faculty.

Figure 3. Current Positions of New Physics Faculty by Gender, 2000



IMPLICATIONS FOR THE PHYSICS ACADEMIC JOB MARKET

These data show that there have been significant increases in the number of academic jobs available for physicists. Turnover and retirement rates are higher than we have seen in previous surveys, and the numbers of new faculty hired and recruited are higher as well. However, these increases come at a time when the number of new PhDs has been decreasing. PhD production has been declining since 1994, and was down to 1262 for the class of 1999 (AIP Survey of Enrollments and Degrees). In addition, the number of incoming graduate students declined during the early 1990s and was still low in 1999 (Mulvey and Nicholson, 2000). Based on this, we project that PhD production will continue to be low for the next several years and may be around 1050 by 2003.

This trend is clearly disquieting, but what is more troubling is that the number of US citizens entering graduate school is in a free fall. Over the last three years, the number of first-year students in graduate physics programs has stabilized, but this is due entirely to a continued increase in foreign students. The number of Americans entering graduate physics programs is the lowest we have seen in the more than 30 years that our unit has conducted such studies (Mulvey and Nicholson, 2000).

The pool of potential physics faculty is indeed getting smaller, and it is tempting to compare the increasing number of openings to the decreasing number of new PhDs awarded each year. However, such a comparison does not take into account the complexities of the academic job market for physicists. We have seen that PhD departments are unlikely to hire new faculty directly from the most recent PhD class. Bachelor's-granting departments hire some of these PhDs, but the majority of their new hires are not right out of school. Physics departments hire faculty who have worked as postdocs, as faculty in other departments, and who have worked in non-academic settings.

The physics academic job market will also be affected by the increasing retirement rate. Since more physics faculty are over the age of 60 than under the age of 40 (AIP Membership Survey), we project that the retirement rate will continue to increase through most of this next decade. At the same time, we also see that deferred retirements are increasing. The median retirement age for PhD physicists retiring from universities is 66. However, we now have a growing number of physics faculty who are over the age of 70 (AIP Membership Survey). Retirement for faculty is rarely an event that happens at one point in time. Academic physicists often retire from their faculty positions and are then rehired either as part-time faculty or work for pay in other sectors of the economy.

The exact future of the academic job market is impossible to predict because it is affected by economic and social developments at both the national and international level. Fifteen years ago, few of us would have been able to predict how the academic job market would be affected by the development of the world wide web, by the international recession of 1990-91, and by the collapse of the Soviet Union. Currently, there are fewer applicants and more jobs than there have been in the last several years, and we do not foresee this situation changing over the next several years.

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Physicists in Government (April 1997) - An examination of the common career paths of Sigma Pi Sigma members with bachelor's, master's and PhDs employed in FFR&DCs, federal agencies, state and local government and the active military.

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What Are Masters Doing? (September 1996) - An examination of the common career paths of Sigma Pi Sigma members who obtained their master's degrees.

Women in Physics, 2000 (June 2000) - Data on the current and historic trends in the representation of women in physics, including comparative data on women in related fields.

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