

Anne Marie Porter and Susan White are survey researchers in the Statistical Research Center at the American Institute of Physics in College Park, Maryland.



The road taken

Anne Marie Porter and Susan White

Survey data show that PhD physicists find satisfaction in a wide range of careers, from academia to government to industry.

*Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.*

—Robert Frost, 1916

In his poem “The Road Not Taken,” Robert Frost famously wrote about choices. For graduate students in physics, the most familiar road is the academic path, but many other career paths are available to PhD physicists—far more than Frost’s two roads. According to NSF’s Survey of Doctorate Recipients, almost half of the 130 000 PhD physical scientists living and working in the US in 2017 were employed in the private sector, about 40% were employed in academia, and 9% worked in government settings (see figure 1).



STUART KINLOUGH/ALAMY STOCK PHOTO

ROAD TAKEN

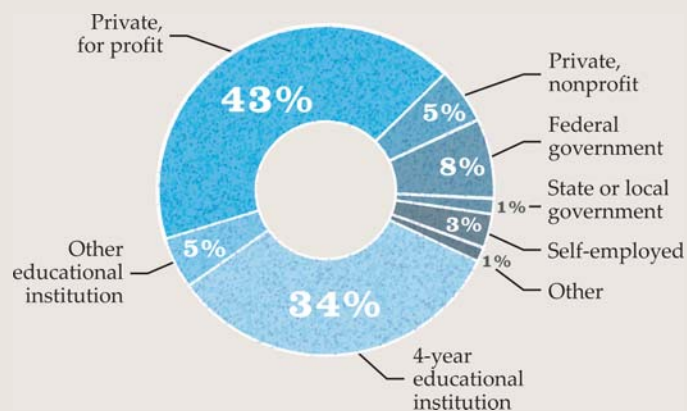


FIGURE 1. EMPLOYMENT OF PHYSICAL SCIENCES PHDS BY SECTOR, 2017. (Adapted from NSF, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients, 2017.)

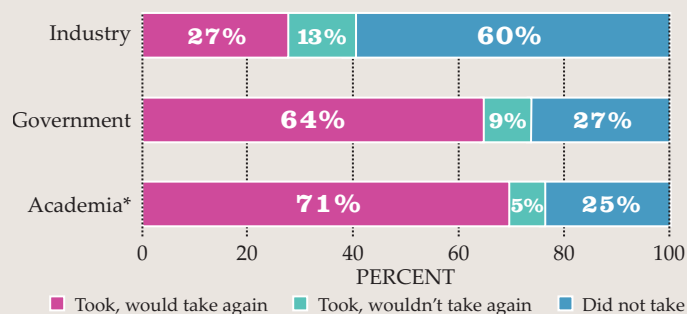


FIGURE 2. PERCENTAGE OF PHD PHYSICISTS IN EACH SECTOR WHO ACCEPTED POSTDOCTORAL POSITIONS, physics PhD classes of 1996, 1997, 2000, and 2001. Respondents were also asked if they would accept their postdoc again if given the chance.

*Percentages do not total 100 due to rounding.

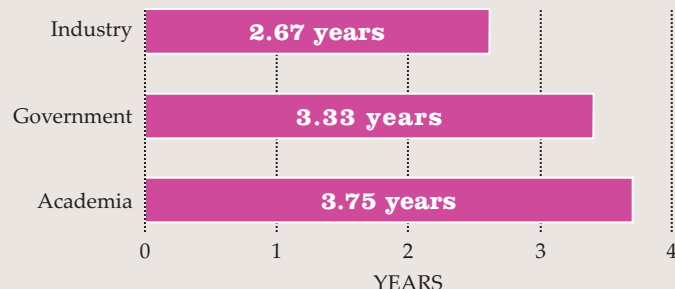


FIGURE 3. NUMBER OF YEARS IN POSTDOCTORAL POSITIONS BY SECTOR, physics PhD classes of 1996, 1997, 2000, and 2001. PhD physicists in academia spent the most time in postdoc positions; those in industry spent the least.

In this article we examine the different career paths of PhD physicists working in private industry, academia, and government, and we describe what physicists in different sectors find rewarding about their chosen careers.

In the first-ever 10-year follow-up survey of physics PhD recipients, the Statistical Research Center at the American Institute of Physics (AIP), which also publishes *PHYSICS TODAY*, contacted physics PhD recipients from the classes of 1996, 1997, 2000, and 2001 who were in the US during 2011. Data used in this article were collected from more than 1800 respondents who participated in that PhD Plus 10 Study. We asked a variety of questions about respondents' postdoctoral positions, their first jobs after receiving their doctorates, and their jobs at the time of the survey. Respondents reported whether they worked in academia (universities or other two- or four-year institutions), for the government (military; national labs; or a local, state, or federal agency), or in the industrial sector (government contractor, private company, or self-employed).

Who pursues a postdoc?

The first step in a new PhD's career is typically the decision of whether to pursue a postdoc. According to AIP's most recent follow-up survey of physics degree recipients in 2015–16, 47% of PhD graduates accept postdoc positions. Not all physicists pursue postdocs, and our PhD Plus 10 data show that postdoc decisions were different across sectors. We found that far fewer physicists working in industry accepted postdoc positions. When we asked if they would do so again, nearly a third of industrial physicists who took a postdoc said they would not (see figure 2). Furthermore, those in in-

ONLINE RESOURCES

If you are interested in reading more about the careers of PhD physicists or gaining inspiration for job searches outside academia, the following reports are available on the American Institute of Physics website.

► Who's Hiring Physics PhDs

(www.aip.org/statistics/whos-hiring-physics-phds) lists employers who have recently hired a physics PhD in various sectors, along with common job titles, salaries, and skills needed.

► Common Careers of Physicists in the Private Sector

(www.aip.org/sites/default/files/statistics/phd-plus-10/PhysPrivSect.pdf) contains data on salaries and skills used in eight types of industrial jobs.

► Physics PhDs Ten Years Later: Duties and Rewards in Government Positions

(www.aip.org/sites/default/files/phd%2B10-gov-duties-nrewards.pdf) indicates the job titles of physicists in government positions and what those jobs entail.

► Physics PhDs Ten Years Later: Duties and Rewards in Academic Positions

(www.aip.org/sites/default/files/phd%2B10-acad-duties-nrewards.pdf) indicates the job titles of physicists in academic positions and what those jobs entail.

dustry who did accept a postdoctoral position spent the least amount of time in it (see figure 3).

Of the physicists in our survey, 8% declined postdoc offers and reported their reasons for doing so. They made that choice because they found permanent positions elsewhere, they were no longer interested in an academic career, the postdoc salary was too low, they could not relocate, or they wanted to start a family. Those responses suggest that financial and family considerations are important factors in a PhD physicist's decision to pursue the postdoctoral path.

Do careers change over time?

Since we knew PhD physicists' first and current jobs, we were able to look at different types of movement across careers. Our survey analysis focused on three questions about career movement:

- Did respondents move across sectors during their careers?
- Did respondents stay with the same employer?
- Did respondents change fields during their careers?

We found little movement across career sectors. Almost all PhD physicists were still working in the same broad sector—industry, academia, or government—in which they had accepted their first job after a postdoc (see figure 4).

We saw wide variation in physicists' tendency to switch employers depending on their job sector (see figure 5). About two-thirds of the physicists working in the academic sector were with the same employer who gave them their first non-postdoctoral job, and almost three-fourths of government employees were still with the same employer. Those working in industry, however, were more likely to have moved; less than 40% were still with the same employer.

Lastly, we examined movement between job fields (figure 6). How common was it for physicists to, for example, move from a physics-focused job to an engineering-focused job or to a nonscience position? Most academic and government physicists began their careers in the field of physics or astronomy, and the majority stayed in their job field. Most industry physicists worked in engineering fields, and those who began in physics or astronomy were more likely to move to a nonscience field. It's possible that trend reflects a tendency for industry physicists to move to management or nonscience business positions as their careers progress.

What rewards do jobs in the different sectors offer?

We also asked physicists, "What are the most rewarding aspects of your current job?" In examining more than 1300 quotes from our respondents, we found far more similarities than differences across the three sectors (see figure 7). For example, PhD physicists in all three sectors felt rewarded when they collaborated with others, mentored younger employees or students, helped society with their work, and had the autonomy to decide their research and work schedules. Regardless of which job path physicists choose, it appears that working in academia, government, and industry can be fulfilling in similar ways.

Each sector is also unique, and physicists in the three sectors identified specific aspects of their jobs as rewarding. For example, academic physicists felt rewarded when teaching

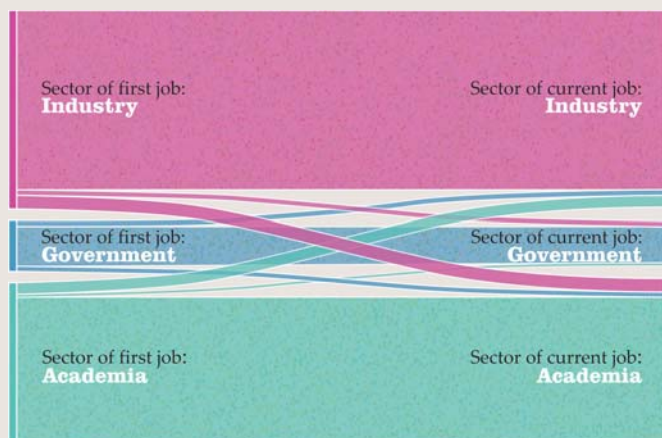


FIGURE 4. MOVEMENT BETWEEN FIRST AND CURRENT JOB SECTORS, physics PhD classes of 1996, 1997, 2000, and 2001. The width of the bar corresponds to the proportion of people in a particular sector.

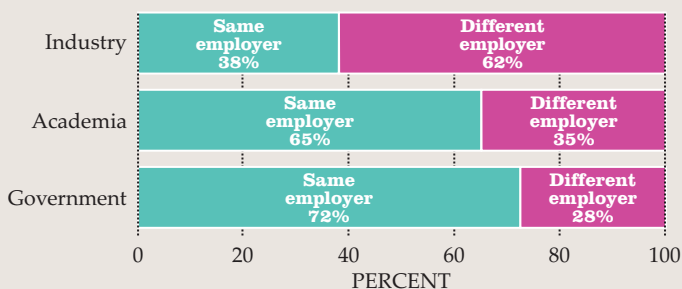


FIGURE 5. MOVEMENT BETWEEN EMPLOYERS BY SECTOR, physics PhD classes of 1996, 1997, 2000, and 2001. PhD physicists working in industry were more likely to have changed employers than those in the academic or government sectors.

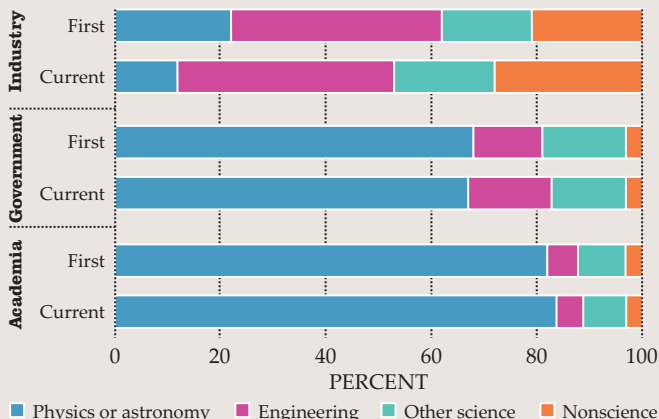


FIGURE 6. MOVEMENT BETWEEN EMPLOYMENT FIELDS BY SECTOR, physics PhD classes of 1996, 1997, 2000, and 2001. Most PhD physicists working in industry were in a field other than physics or astronomy.



FIGURE 7. JOB REWARDS BY SECTOR, physics PhD classes of 1996, 1997, 2000, and 2001. Some job rewards are universal across sectors; others tend to be mentioned more often by PhD physicists working in a specific sector.

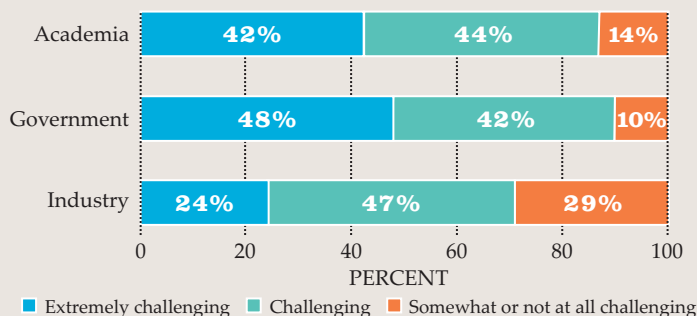


FIGURE 8. RESPONSES TO THE QUESTION "IS THIS JOB INTELLECTUALLY CHALLENGING?" by sector, physics PhD classes of 1996, 1997, 2000, and 2001. Even though PhD physicists working in industry were less likely to report that their job was intellectually challenging, they did not report lower job satisfaction than their peers in the academic or government sectors.

students, performing public outreach to improve science literacy, and helping their departments or the larger scientific field. Industry physicists felt rewarded when helping their clients, supporting their company, and receiving financial benefits like higher salaries and stock options. Government physicists appreciated that they had more job security and conducted research at a faster pace than academics; they also felt rewarded when addressing larger societal issues such as climate change and national security.

When we asked PhD physicists whether they found their jobs intellectually challenging, those in government and academic positions were more likely to respond in the affirmative than those in industry (see figure 8). However, there is no evidence that industrial physicists are less satisfied with their jobs than their counterparts in academia and government. Although industry physicists may feel less intellectually challenged, they may encounter different types of problems that they enjoy tackling and solving.

Diverging or converging roads?

The career options available to PhD physicists are varied. Our data provide insight into the satisfaction that midcareer PhD physicists have found (see online resources on page 34). We should, however, note that the past does not necessarily predict the future. The pace of technological change suggests that career options that do not currently exist may be viable options in 2040. In the same vein, current occupations may become obsolete. Therefore, we cannot give a comprehensive overview of the career paths that today's PhD students may travel.

The roads in Frost's poem diverge, and the narrator chooses one. Later, the narrator notes, "Yet knowing how way leads on to way, I doubted if I should ever come back." We do not know whether the narrator ever went back. Can a PhD physicist? We have seen that most remain in the same sector as their first full-time job. However, some do change their career path over time. The options are many and varied. Which road will you take?

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