

Why Would *Anyone* Major in Physics?

Robert Ehrlich

For most physicists, the question posed by the title of this piece is nonsensical. But let's for a minute walk in the shoes of a typical college freshman, and try to understand why physics is such an unlikely choice of major—one currently chosen by a mere 0.4% of all college graduates (down from a post-Sputnik peak of 1.6% in 1961). We physicists may wonder why so few students major in physics, but from the point of view of today's typical freshman, the question is, Why would anyone major in physics? a subject that is . . .

...highly mathematical. Even to begin your first physics course for the major, you need to take a semester of calculus, and along the way you need to take perhaps five other advanced math courses, nearly as many as a math major.

...demanding. Almost all physics courses involve doing problem sets, and students often find themselves spending long hours struggling to get the book's answer—not an issue in many other subjects, where there is no single correct response (and sometimes no homework). Apart from the homework itself, just the task of reading a physics text can be daunting. Physics texts even weigh more than other texts! Try holding down a full-time job and maintaining an active social life while majoring in physics. It's virtually impossible, particularly if you want to get the grades to which your tuition entitles you.

...unrewarding. The grading standards used in physics, like those in the other sciences, are typically much stricter than the grading standards in, say, the humanities or the social sciences. We often hear about grade inflation, but the degree of inflation has been far less in the sciences than in many other subjects. At most schools, anywhere from a half grade point to a full grade point now separates physics and the other sciences from other subjects. If you want to graduate with honors without doing a lot of work, better not major in physics.

...incomprehensible. For many people, physics appears to defy com-

mon sense, particularly in such areas as relativity and quantum mechanics. Even the outcome of simple experiments may seem counterintuitive. Why, physics is now so specialized that even physicists themselves don't understand many recent developments in subfields outside their own.

...arcane. Physics is essentially a foreign language in which everyday words such as force, work and energy have precise meanings that are at odds with their more common definitions. Physicists may use cute terms such as "charm" and "strangeness," but these come across as jokes for the cognoscenti rather than as terms that make the underlying concepts more intelligible.

...restrictive. The laws of physics continually place restrictions on phenomena, arbitrarily "forbidding" their occurrence. Who are physicists to say that things cannot go faster than the speed of light? And the outlook of physics is a closed one that consigns to the category of pseudoscience many areas of interest to the general public. How can physicists be so certain that extrasensory perception or UFOs are trash when we continually see apparent evidence for such things in the media?

...old-fashioned. Most physics professors are getting quite long in the tooth—and just look at the way they dress! Beyond that, they use mostly outdated ways of teaching, simply lecturing at you, rather than letting you discover the concepts for yourself. Even the subject matter is hopelessly old. In most schools, you have to study physics for two or three semesters before getting to the "modern" stuff—and even that is now over 60 years old.

...impersonal. Physics courses offer little room for self-expression. Few professors care about your own theories of the universe, especially if they differ from what is generally accepted. And your feelings about Maxwell's equations or Gauss's law would be of little interest or value to anyone.

...lonely. Pursuing a physics major can be a solitary endeavor, particularly when your nerdy fellow majors are lacking in social skills. Try introducing yourself as a physics major at a party—it's a real conversation stopper.

...useless. Physics is widely perceived to have little relevance to ev-

eryday life—certainly to the aspects of life that many of today's students are most concerned about. The employment situation for PhD physicists is widely known to be grim, and at the bachelor's level, few jobs exist in physics *per se*, outside of high school teaching. For today's career-oriented students, undecided between physics and, say, engineering, the idea that there are few jobs in physics is enough for them to lose interest in the subject as a major, and view it merely as a hurdle to overcome.

...misogynistic. Some feminists believe that physics is dominated by a male-oriented way of thinking, and that this partly explains why there have been so few female physicists. Even at the undergraduate level, the percentage of women in physics lags far behind that in mathematics and virtually all the other natural sciences.

...antisocial. In some folks' minds, physics is mainly associated with destruction—that is, nuclear weapons. Physicists are also seen as casting doubt on environmental problems of concern to many people—most recently the health problems associated with electromagnetic fields from power lines. Perhaps these dark-minded physicists are trying to use the public for some kind of mass experiment on the effects of EMFs, just as they did with radiation in the early days of nuclear testing.

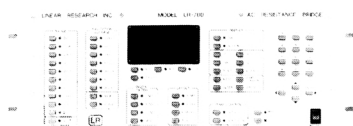
...sacrilegious. Physicists deny God's creation through their theories of cosmic evolution. To any right-thinking creationist, the Big Bang is a profoundly antireligious idea, right up there with the notion that all systems, including living ones, obey the same natural laws.

...dead. Some observers think we have reached the end of science, or at least of the era in which big discoveries can still be made. Others pronounce the end merely of physics. Even if this isn't true, what are your chances of making a big physics discovery?

Having said all that, let me now remove my tongue from my cheek. The reasons given above may explain why many students avoid physics, but they are also based mostly on unwarranted perceptions, not necessarily reality. So before I am blamed for scaring off the nation's few remaining physics majors,

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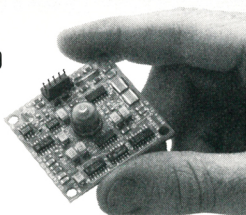
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let's consider what teachers can do to address these perceptions that are driving students—even promising ones—away from physics.

One approach to promoting physics might be to rework the US Marines' slogan: "The few, the proud, the physics majors." We can honestly tell our students that while physics is very challenging, if they have the aptitude and are not afraid to work hard, physics is truly one of the most exciting and interesting subjects they can study. Its discoveries have revolutionized our world, mostly for the good, and they most certainly will continue to do so.

We should also let our students know that apart from experiencing a wonderful intellectual challenge, physics graduates have also done quite well in the marketplace. Comparative studies of college graduates ten or more years after graduation show that those who got their bachelor's degree in physics are near the top of all majors in terms of average salary (see PHYSICS TODAY, June 1996, page 52). Apparently, many employers do realize that physics majors can transfer their problem-solving skills to a wide variety of areas, including business, engineering and medicine. Despite the recent employment difficulties of PhD physicists, the marketability of the bachelor's degree in physics continues to be relatively good, particularly when a student has supplemented the major with a few courses in such areas as computer science and business. Admittedly, it may be difficult to convince today's career-oriented students that physics bachelors can compete successfully for jobs in engineering or computer science, especially when their college has majors in those areas and when potential physics majors find themselves in a sea of engineering students in the introductory physics course. The case for the good employability of physics bachelors would obviously be much more persuasive coming from a guest speaker

who works in industry than from a physics faculty member eager to recruit majors.

To help improve the perception of physics and make the major more attractive, some physics departments and individual professors have adopted new teaching innovations in the introductory course. These include reduced content, collaborative learning, hands-on work with simple equipment and the introduction of more applications and modern topics. Many of these efforts are worthwhile in their own right, but it remains to be seen whether they will significantly increase the percentage of students majoring in physics. (And a cynic might argue that all these reform efforts will have no more effect on the popularity of the major than would the much easier step of lowering the grading standards in physics to match those of other subjects.)

For all our efforts, physics will probably never be a popular major. Nor should we aim to make it one, lest we wind up with something that most physicists would no longer recognize as physics. For the foreseeable future, physics departments at most institutions will have to continue to justify their existence based on their service and general education courses. And we must do our best to welcome and encourage those few students who choose to enter our field. ■

