ers? And there's a twist: One fear is that governments will cut off student subsidies beyond the bachelor's level. No one knows what will happen, says Ferdinande. "But industry is much more supple than universities. It will adapt. There are still fears, because it's something new."

And, while countries where degrees take a long time fear that switching to the bachelor's will degrade their education, places with shorter-duration programs worry that their degrees won't be recognized as high quality. Science and engineering students in England, for example, can choose to go straight to a four-year master's degree, which about a third of all physics students do. The "Mphys" should be recognized, says Gareth Jones, a physicist who represents Imperial College, London, on European issues. "The argument is that the more specialized preparation at high school, the selection of students by universities, and the rather focused curricula justify this."

Whether or not England's four-year master's wins wide recognition, many in the science and engineering communities are pushing to keep a longer straight-through master's option in parallel with a bachelor's/master's degree structure.

Reforms and risks

So far, Italy has made the most drastic reforms. This fall, the country is switching wholesale to a 3-5-8 structure from its traditional higher education system, under which the *laurea* was supposed to take four to six years but often dragged out longer. The number of students has exploded since the 1970s, and so has the dropout rate, to around 60%, says Paolo Blasi, a nuclear physicist and former rector of the University of Florence. "In the new scheme, we expect that at least 70% who attend will graduate. This is important from a psychological point of view." But, he adds, "if we really want to improve the level of education, we need more resources."

The Netherlands and the Flemish part of Belgium, for instance, are also switching to bachelor's/master's systems. Elsewhere, as in Germany and, to a lesser extent, France, bachelor's and master's degrees are starting in parallel with the traditional systems. Other countries are still just talking.

One danger is that universities will make only window-dressing changes, says Guy Haug, EUA senior adviser and coauthor of the main studies monitoring the Bologna process. Some universities start out making superficial changes "to be in line with the trend or the law—but later they actually change the curriculum." But the biggest threat to higher education in Europe, Haug says, is "transnational" education—by which degrees are typically offered over the Internet and are not subject to local regulations. Such degrees tend to be expensive, and it's hard to gauge their quality, he says. "Is it bona fide education or just a commercial venture?"

Students, for their part, support the Bologna Declaration with some hesitation. "Many countries have long tunnel-like educations," says Jacob Henricson, who is studying political science in Umeå, Sweden, and is active in the National Unions of Students in Europe (ESIB), an organization representing student unions in 32 countries. "If you choose to stop, you have nothing to show for it. We don't like that. We want to raise the quality in general. We want a credit system, quality assurance, and accreditation." So far, so good. But ESIB, in its Student Göteborg Declaration released this past March, says the Bologna Declaration "failed to address the social implications the process has on students. . . . It is the governments' responsibility to guarantee that all citizens have equal access to higher education, regardless of their social background." Students are not just consumers, explains Henricson. "We have fears that more and more countries are talking about introducing fees."

In the past six months, says Henricson, "there's been a step forward: Students are being included in the process." Henricson was among the student representatives at a meeting in late March in Salamanca, Spain, where university leaders took stock of progress and laid out recommendations for education ministers. ESIB will also be present at the ministers' meeting this month in Prague.

Intense discussion about the implementation of the Bologna Declaration continues at ministerial, regional, and university levels. Says Torsten Kälvemark, who oversees international developments in higher education for the Swedish government, "Any country with an old-fashioned or peculiar degree structure will run the risk of having problems in relation to other countries, and its students may suffer when their degrees are not understood by foreign employers. If we want to create a competitive common European labor market, a common degree structure will be essential. One can sometimes hear dissenting voices, but on the whole, it has been a remarkably swift change of mind in many quarters."

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Online Resources Related to the Bologna Declaration

http://www.salamanca2001.org The University of Salamanca's Web site includes the Bologna Declaration and a wealth of related documents. In particular, "Trends in Learning Structures in Higher Education (II)" details national and international progress to date.

http://www.unige.ch/eua The European University Association Web site has extensive documentation on the Bologna process. The site is under construction, so more information may still be available through its predecessor, **http://www.unige.ch/cre**.

http://www.esib.org The National Unions of Students in Europe is following the Bologna process closely, and this Web site provides many useful links. The Student Göteborg Declaration is available at **http://www.sfs.se/steudent2001/sgd.pdf**.

Dropout Rate among Chinese Physics PhD Students Seems High; Community Considers Why

With foreign students making up more than half the pool of US physics graduate students, it's not surprising that educators are worried by the seemingly disproportionate number who switch, mid-PhD, into areas such as computer science and engineering. Students from the People's Republic of China (PRC) are the biggest block of foreign students and are therefore the focus of concern over, and efforts to turn around, this budding trend. "I think that we, as faculty, are frustrated because we see students who could have gone on to a physics career," says Moses Chan, a physics professor at Pennsylvania State University. "And we love

US physics departments are starting to take measures to select students who are more dedicated to staying in physics.

physics, so we think it is a waste."

The scope of the field-jumping is far from clear, but in the past few years, the topic has come up at meetings of physics chairs and within departments. Some departments, prompted by PRC student departures, have changed their PhD programs to improve the retention rates of all students. Others have become more reluctant to admit PRC students. Indeed, their numbers have dropped over the last decade, although PRC students still make up more than one-fifth of the foreign physics graduate student population.

Students from everywhere, including the US, switch fields, of course. And better job opportunities in other fields can draw them away from physics. But professors also suspect that some PRC students arrive with the intention of switching fields. "Departments like physics, math, and chemistry have teaching assistantships available—and it's easier for students with assistantships to get a visa to come to this country," says Chan. "I think there are definitely some who come using physics as a ticket."

These days, about half of the handful of physics students who come each year from the PRC to Penn State don't complete physics PhDs there, Chan estimates. We also lose a couple of domestic students each year, he says, "but for different reasons."

"The ultimate problem is that we don't have enough well-prepared domestic students," continues Chan. "The worldwide pool of physics students has gone down—even in China it may be dropping." The physics department at Penn State receives about 300 applications each year—about half from China, and one-quarter from the US.

Admissions decisions

The situation at Penn State is certainly not unique, but departments differ. Until recently, the out-of-state fee structure at the University of California, Santa Barbara, made foreign students more expensive for the department, so only 10% of their physics graduate students were from abroad. This fee structure is now changing, and the department will try to push that figure up to 20%, says Phil Pincus, a member of the physics department's admissions committee. Culturally and academically, he adds, "It's an advantage to have foreign students."

But choosing the best, brightest, and most dedicated students can be difficult. The UCSB physics department received a couple hundred applications from the PRC this year. "We just don't know how to deal with them," says Pincus. A student might score 99% on an English language test, but speak poor English on arrival; students might write the letters of recommendation because their professors don't speak English; and the graduate record examination (GRE) scores from China are so universally high that they fail to differentiate between students.

In fact, China's GRE scores are high enough that the Educational Testing Service (ETS), which administers that exam, became suspicious. ETS is now suing, in Chinese courts, the most popular test preparation service there, Beijing's New Oriental School, for copyright infringement on old test materials. The ETS also alleges that the school has obtained current GRE test questions and passed them on to students. "There was a sharp increase in GRE scores during the time that we allege they were sharing questions," says Tom Ewing, a spokesman for the ETS.

With unreliable GRE scores and recommendations, admissions committees frequently turn to the graduate students they already have for advice, says Zhang Chen, a physicist at Manhattanville College in New York who experienced this when he was working on his PhD at Columbia University. If there are already students from, for example, a university in Shanghai, then more students will be admitted from that same university. "It's very random. If students in China knew how it was done, they would be very disillusioned," says Chen.

First wave

The first big wave of physics students from China came to the US in the early 1980s, through the China–US Physics Examination and Application (CUSPEA) program. CUSPEA did not use the GRE exam—it was not yet available in China—but instead created its own test and followed up with interviews in China. Spearheaded by Columbia University's Nobel laureate T. D. Lee, who was influential in inspiring many Chinese students to go into physics, the program admitted about 100 students each year for a decade. CUSPEA was discontinued in 1989, after other methods of evaluation had opened up.

CUSPEA participants had a high PhD completion rate. "Those students are now making a very important mark on physics in this country," says Penn State's Chan. But because many hit the job market in the lean days of the early 1990s, "some are working in areas like Wall Street," says William Que, one of the first CUSPEA students, who is now a physicist at Ryerson University in Toronto. "And some are working in engineering companies. Actually, not that many are still in academia."

Bleak job prospects continue to be a major reason for students leaving physics early in their careers. While some PRC students may use physics as a means to get to a US university, Cornell University graduate student Nai Gong Zhang says he doesn't believe it's "a giant conspiracy. Young people [from China] were shocked to find it's hard to get a job as a physicist."

Hanging on to students

To retain more students, the University of Southern California, where more than three-quarters of each year's 10 or so foreign graduate students in physics are from the PRC, changed its PhD program. Tu-nan Chang, chair of USC's physics department, had noticed that each semester some of the Chinese and eastern European graduate students would drop physics courses for engineering ones. After a couple of years, they'd accumulate enough credits to switch fields and leave with a master's degree in engineering. Now students are encouraged to start their PhD research early, and take a wider variety of courses later on. They can still earn an engineering master's, but they more often complete the physics PhD as well.

Chang, who is also president of the Overseas Chinese Physics Association, says interest in introducing CUSPEA-like programs is growing around the US. They would probably run at the institutional level, and be broader than just physics. "You'll be able to establish a university-to-university relationship [between US and Chinese institutions]," he says.

In fact, that's what Columbia University, New York University, and the City College of New York have been doing with Fudan University in Shanghai since the mid-1990s. Through this program, more dedicated students are selected, so fewer switch to other disciplines.

"Over the last 20 years, the PRC has produced some of the best students," says Chan. "After all, China is a big country, with 1.2 billion people. There have to be some people who love physics." **LYNLEY HARGREAVES**