

ISSUES AND EVENTS

Spanish Physicists Hungry for Fresh Infusion of Jobs, Money

Science in Spain has thrived in the quarter century since Francisco Franco's 40-year fascist dictatorship came to an end. Funding for science has risen slowly, albeit with setbacks, and the numbers of students, scientists, universities, and research institutes have multiplied.

But the country still has catching up to do. Science spending, industrial links, and the number of scientists remain below average for European Union countries. The most dire problem, it's widely agreed, is a dearth of jobs for scientists.

"The challenge now is to become really competitive at an international level in strategic areas of fundamental science and technology," says the Universidad de Santiago de Compostela's Félix Vidal, who represented materials science and technology in the government's agency for evaluating R&D proposals from 1995 to 1999. "That will be an even more difficult evolution than the past 30 years. It demands not only financial support from both the state and industry, but a change in mentality."

New ministry, new money?

Once democracy got its feet wet in the post-Franco years, science became a high priority, for awhile. From 1983 to 1992, state R&D funding went up from 0.50% to a peak of 0.91% of the gross domestic product. Then R&D spending slipped, only recently climbing back toward 0.9% of the GDP.

In 1990, R&D got 208 billion pesetas (roughly \$2.3 billion). In 1999, that figure was 318 billion pesetas (in 1990 currency). Subtract defense-related technology, and those numbers become 199 billion pesetas and 157 billion pesetas, respectively. "The investment now per researcher is smaller than a few years ago," says Mariano Moles, an astrophysicist at Madrid's Institute of Mathematics and Fundamental Physics, one of the roughly 100 Consejo Superior de Investigaciones Científicas (CSIC) national research centers. "Equipment is getting older. These problems are all over Europe, but in Spain they are particularly acute.

Tighter ties between research and industry, money for basic science, and jobs, jobs, and more jobs are needed to continue strengthening physics in Spain.

Those are bad signs."

"It's true, there has been a standby situation," says Juan Rojo of the Universidad Complutense de Madrid, who served as secretary of state for universities and research from 1985 to 1992. "But in the last two or three years, momentum has been gaining again in every area of science."

The ministry of science and technology, created last year, aims to up Spain's R&D budget to 1.3% of the GDP by 2003, inching closer to the European average of 2%. "It would be marvelous, but I can't see how they can do it that fast," says CSIC president Rolf Tarrach. "It doesn't get into my brain." The new ministry, he adds, "is still trying to make itself work properly and efficiently. We will have to see how the budget goes for science—that's the main indicator for how seriously Spain takes science."

Ending isolation

As is typical in countries where science has endured fiscal starvation, Spain's traditional strength is in theoretical physics. Spain now also has world-class experimental research,

notably in high-energy physics—which got a boost after Spain joined CERN in 1982—condensed matter physics, astronomy and astrophysics, fusion energy research, and materials science. Measured by impact factor—the number of citations per paper—physics is the top science in Spain, notes Tarrach. For the period 1996–2000, Spain had an impact factor in physics 11% above the world average.

"We went from having nearly no researchers, except for a few high-quality individuals, to having an appreciable quantity of competitive groups, mainly in fundamental physics," says Vidal. In the 1980s, for example, says Carlos Alejandre, director of the fusion lab at CIEMAT, Spain's national center for energy research, "about 10 people were working in fusion. That's grown to 100." Now, when Spain is mentioned as a possible site for the International Thermonuclear Experimental Reactor, he adds, "it causes no surprise and is viewed with interest."

When Spain joined the European Union in 1985, says Rojo, "it meant the end of a long period of isolation for Spanish science." The European Commission supports research projects involving three or more countries, Vidal adds, "so scientists from Germany and France often ask Spanish scientists to work with them." One danger is that Spanish partners take a back seat, he says, "but such collaborations are also a real opportunity for Spanish scientists."

The country has an edge in astronomy and astrophysics, thanks to the Canary Islands, west of Morocco in the Atlantic Ocean. The 2400-meter-high mountains, still air, and laws against light pollution provide some of the best seeing in the northern hemisphere, on a par with Hawaii's Mauna Kea. The islands are home to telescopes—from a solar observatory to a high-energy cosmic-ray detector to cosmic microwave background experiments—run by various European countries. Spain is building a 10-meter-class optical and infrared



INSTITUTO DE ASTROFISICA DE CANARIAS

LA PALMA (shown above) and Tenerife in the Canary Islands boast first-rate observing conditions, giving Spain, as host to some 20 European telescopes, a leg up in astronomy and astrophysics.

telescope, the Gran Telescopio Canarias, due to see first light in 2003. Spanish astronomers also hope to join the European Southern Observatory, or at least arrange time swaps so they can use ESO's telescopes in Chile.

Spain's other large physics facilities are CIEMAT's TJ-II stellarator in Madrid and its solar energy research center in Almería in southern Spain; small ion linear accelerators in Seville, Madrid, and Valencia; a microelectronics facility in Barcelona; and an underground observatory in the Pyrenees on the French border. "We have plans for a synchrotron project in Barcelona," says Antoni Ferrer, a physicist at the University of Valencia. "It's been in the air for five years. It's difficult to get approved." Those discussions also bear on the level at which Spain will join Soleil, a synchrotron light source being built in France.

"There is no doubt that Spain is in the first row in physics," says Ferrer. "The only anomaly you can detect in Spain is that the number of physicists per million people is two to three times less than the average for developed countries."

Building technology transfer

Many physicists point to a second anomaly: Low investments by industry in research. The tightest links are in energy, space technology, and, because of Spain's tradition in ceramics, materials science.

José Moya, a physicist at CSIC's Materials Science Institute in Madrid, is collaborating with companies in Spain and other countries to turn his research on nanocomposites into long-lasting hip and knee prostheses. To reach the level of technology transfer in other European Union countries, industry needs to put more money into research and build closer ties to scientists, says Moya. "We have to fight against the old mentality of industries, which are not open to new things. We have to overcome this cultural problem."

As an incentive, the ministry of science and technology is offering 400 partial stipends for researchers at the doctoral and postdoctoral levels. The balance must come from some company, the goal being to induce industry to hire more PhD scientists. Another state initiative fosters technology transfer through negligible interest loans for companies.

While physicists admit that technology transfer is where the country's most yawning R&D gap lies, many are concerned that technology will be



LA PLATAFORMA SOLAR DE ALMERÍA in southern Spain's Tabernas desert is one of two major solar energy research centers in Europe. The reflection in the experimental stretched-membrane heliostat shows one of the center's 84-meter receiving towers.

stressed at the expense of basic research. "We have no objection to raising the investment in applied science," says Rafael Rebolo, an astronomer at the Instituto de Astrofísica de Canarias. "But the government needs to take seriously into consideration the need for balance to guarantee long-term benefits for society."

Brain gain is mainly on the wane

For its part, the ministry of science and technology is focusing not only on technology transfer, according to a spokeswoman, but also on improving scientific infrastructure and increasing the number of researchers in both the private and public sectors.

"In many laboratories, the [average] age of people is increasing rapidly," says Francisco J. Baltá Calleja, director of CSIC's Institute for the Structure of Matter in Madrid. "For instance, in my department, the last time a new member was hired was 12 or 14 years ago. The career future in physics is not very bright. Spain will die without scientists."

Fifteen thousand scientists in Spain are currently under- or unemployed, according to CSIC's Tarrach. That's largely because of the abrupt financial neglect of science after 1992, aggravated by a drop in the number of jobs due to falling student enrollments. Many scientists could lose their soft-money jobs in a matter of months, and others are leaving the country, Tarrach says. For example, says Ferrer, "There are 30 to 40 young people working abroad as postdocs in particle and

nuclear physics. We have an average of three or four positions a year. There is no occasion to come back."

Francisco Najarro returned to Spain three years ago after completing his PhD and a postdoc in astrophysics in Munich. "I was lucky to get a 'reincorporation' contract," he says. But his paycheck is tied to the project he works on, which is coming to an end. "It is really depressing trying to get a secure position in science nowadays," he says.

Najarro has applied for a Ramón y Cajal position. Named for the Spanish neurobiologist who won the 1906 Nobel Prize in Medicine, these posts will offer 2000 young researchers more independence than is typical in Spain. Salaries are supposed to be assumed in steps over five years by the host institutions. To avoid endogamy—the practice of departments hiring their own graduates—the Ramón y Cajal awards are being decided by the ministry.

But the new posts make only a dent in the unemployment problem, notes Baltá Calleja. "Spain needs not 2000 but 10 000 people to do research if we want to do it at the same level as Germany, the UK, and France." Still, Najarro says, "It is one of my last chances. If it turns out this doesn't happen, I will have to seriously think about quitting science."

"There are many, many very good physicists who cannot find jobs [in Spain]," says Ignacio Cirac, a Spanish quantum optics theorist in Innsbruck, Austria. "I remember when friends of mine were going abroad for a postdoc, they hesitated because they worried they would lose the opportunity to get a job in the department." Spain is expected to pass a law this year that would require universities to use external committees in hiring. That's a start, says Vidal. "It's almost impossible to get a position at another university. It's ridiculous. Scientific institutions must create the conditions to suppress endogamy—both in hiring people and in terms of their ideas and research lines."

Several universities have tried to lure Cirac back to Spain, but so far he has turned their offers down because, he says, "in Innsbruck, there are many people to talk to. Spain is more static. It's harder to interact with people." Moreover, he adds, one can't negotiate salary and other conditions. "I know that Tarrach wants to change that. It's not only good but necessary. Otherwise Spain will lag behind."

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