



Seeing the Light in Spain

Kim Douglass

The Institut de Ciències Fotòniques (ICFO) in Barcelona, Spain, is two years old. Already it has drawn a team of 40 faculty, post-docs and doctoral students. By 2007, organizers hope to more than triple that number. Here's how a group of scientists is trying to turn this Mediterranean community into a home to one of Europe's most sophisticated photonics centers.



(Top) ICFO is based temporarily in this office building on the campus of the Universitat Politècnica de Catalunya. Later this year, the program's new building will open near the Barcelona airport. (Above) An aerial view of the new facility, under construction.

Early this year, Lluís Torner wrote an article for his local newspaper entitled, "Llum, t'estimo," or, "Light, I love you!" In it, Torner explained to his fellow residents of Barcelona, Spain, that light is about more than illumination. Light nourishes, he wrote. It makes possible the elegant plane trees that line the city's wide boulevards.

And "when you go buy a PlayStation for your kid, or your grandmother wants to get Lasik treatment ... that's light," Torner said in a recent interview. "Many

people don't realize that photonics is everywhere."

The response to the article was fascinating, he said. People all across the city wanted to know more about the topic. "I got calls from taxi drivers saying, 'Wow! That's great!'"

Torner, a researcher in the field of nonlinear optics and a longtime member of OSA, is on a mission to help develop one of the most sophisticated and multifaceted photonics centers in Europe. He seems to be well on his way: the Institut



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de Ciències Fotòniques (ICFO) is two years old, and the program has already drawn a team of 40 faculty, post-docs and doctoral students. ICFO is overseen by a scientific advisory board that includes prominent names in optics, including OSA Vice President Eric Van Stryland.

Torner understands that the success of the program also is linked to how well it is received at home. The institute is made possible in part by a new commitment to basic science by the region of Catalonia, of which Barcelona is the capital. Torner wants to make sure that everyone—from ministers of science to taxi drivers—understands and appreciates the value of light research.

“In the U.K., in France, in Germany, in the U.S., you will find that many people value science as something that’s crucial,” Torner said. “That’s not yet the case in Spain. We still need to convince part of the population that ... if we want to play in the first world league, we have to have companies that build products that are based in knowledge and in high technology. That is a lesson that history has taught us.”

The start of a dream

Torner is from a community that sits in a valley of the Pyrenees, a mountain range that straddles Spain and France. He received his undergraduate degree from the Universitat Autònoma de Barcelona and his doctoral degree from the

Universitat Politècnica de Catalunya. In 1992, he went to the University of Central Florida’s Center for Research and Education in Optics and Lasers (CREOL), where he spent two years as a post-doc. There, he experienced a dramatically different approach to scientific research.

In many parts of Europe, programs tend to be smaller and focused on a single topic, he said. They tend to draw students from neighboring regions. At CREOL, Torner worked alongside researchers from around the globe, all studying different areas of optics. “In a large center, you can learn many things over a coffee. There’s a guy near you who’s doing biophotonics, another guy who’s doing nanophotonics, another guy who’s doing quantum optics. You learn just by osmosis. I found that really, really important.”

Torner returned to the Universitat Politècnica de Catalunya as a full professor in 2000. He credits a former Catalan minister of research with helping to get the new photonics program off the ground.

Andreu Mas-Colell is a former Harvard University economist who served as Catalonia’s minister of universities, research and the information society from 2000 through 2003. Catalonia has doubled its financial commitment to local research over the past four years, Mas-Colell said. “I think that Catalonia is representative of the whole

of Spain and it exemplifies an interesting phenomenon: the vitality and dynamism of ... R&D. I like to say that we cannot yet compete with the more advanced European countries on indices of ‘level.’ We compete very well on indices of ‘rates of growth.’”

Mas-Colell has been part of a “very assertive movement toward the creation of research centers that are outside of—but strongly tied to—universities,” said Emilià Pola, who is the director of a two-year-old non-profit association in Barcelona, Associació Catalana d’Entitats de Recerca. The organization was created to offer assistance and resources to research programs such as ICFO, several of which have sprung up around the region in recent years.

Pola was working in technology transfer at the University of Barcelona in the late 1990s when Mas-Colell asked him to spearhead a study of scientific research centers across Europe. Pola found that the most successful centers share some characteristics: they are scientifically and financially independent and they attract and reward talent. “And after about 10 years, they had a place on the map,” Pola said.

He passed that information about successful scientific research centers on to Mas-Colell, and in 2001, Mas-Colell asked Torner to help create a photonics center that would be affiliated with, but separate from, the Universitat Politècnica de Catalunya.



"We did some studies, and it appeared that photonics was a versatile technology with a substantial future," Mas-Colell said. "It also appeared that we had enough of a community that the synergies of a center would be substantial. And, being an economist, I cannot deny the fact that with reasonable investments, one could launch something."

Torner agreed. "He knew, and I knew, that light can be used for almost everything. So we had big potential to create companies and wealth. But this was not easy to implement. Experimental science, which is the expensive part, has not been a priority in Spain."

Torner turned to his colleagues in optics, including his friends at CREOL, the universities of Arizona and Rochester and Stanford University. "We found some very good models from people who know how to build wealth out of science," Torner said. "And they said, 'Start with basic science. If your main motivation is to train Ph.D. students, then some of them will build companies, succeed and stay here.'"

ICFO has been guaranteed annual base funding of 4 million Euros, which it will receive through support from the Catalan government, other local funding agencies and loans. "The creation of [ICFO] will certainly help to increase the number of experimental groups working in photonics in our country, and ... it makes it possible to undertake new long-term research programs," said Carles Solà, Catalonia's new minister of universities, research and the information society. "The research groups working in photonics in universities or other institutes or companies in Catalonia and Spain will have new opportunities through possible collaboration with the ICFO research groups."

By 2007, the program's organizers want to bring on a total of 150 students and faculty, support 25 research laboratories and fully develop a program that will be committed to nurturing doctoral students. ICFO's annual budget will eventually be closer to 8 million Euros, a figure that includes various grants researchers ultimately hope to be awarded.

Another 6 million Euros from the European Regional Development Fund has been set aside to construct a new



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building, which is going up near the city's airport. The fund was created in 1975 to stimulate economic development in the less prosperous regions of the European Union.

By 2012, Torner expects stage two of the project to be in place: 250 researchers and as many as 50 laboratories working in everything from telecommunications and laser chemistry to quantum optics and biomedicine. This gradual-growth approach is comparable to those of other thriving optics programs in Europe, including some in Scotland and France, he said.

"What Lluís is trying to do is, I think, rather unique in Europe, as our program is unique in the U.S.," said Eric Van Stryland, director of Florida's CREOL program. "I know a couple of the people he has hired and it looks like they are off to a good start."

What's really exciting, Torner said, is that "we started from ground zero."

Assembling a team

This vision of what is possible in Barcelona has struck a chord with some scientists.

Gonçal Badenes, originally from Spain, spent 10 years working on micro and nanotechnology for semiconductors at the Interuniversity MicroElectronics Center (IMEC) in Belgium. In early 2001, he learned about the ICFO program from a peer who was working at the Universitat Politècnica de Catalunya. Badenes traveled to Barcelona to meet Torner. "The way he was starting it seemed very promising," Badenes said. "He wasn't just hiring his friends. It was purely professional and very international, with a lot of ideas."

Majid Ebrahim-Zadeh said he had no plans to leave his faculty post at St. Andrews University in Scotland when he met Torner during a coffee break at a CLEO planning meeting last year. "What attracted me was the potential of this new program," he said. Also, it has grown increasingly difficult for scientists in the U.K. to secure research funding because of the growing number of grant requests, Ebrahim-Zadeh said. This was presenting an obstacle in his career development, he said. While he enjoyed his time in Scotland, the idea of being part of a



burgeoning research community in another part of Europe appealed to him.

Still, he wondered: "Will we be able to recruit good students?"

Competing for students

Gajendra Pratap Singh had studied biotechnology at home in India, where as part of his master's program he worked with bacterial heat shock proteins. When it came time to choose a doctoral program two years ago, Singh chose ICFO because he knew he would have access to technology he couldn't find at home. "In India, the kind of work I am doing now with living cells in optical tweezers has not started yet," he said.

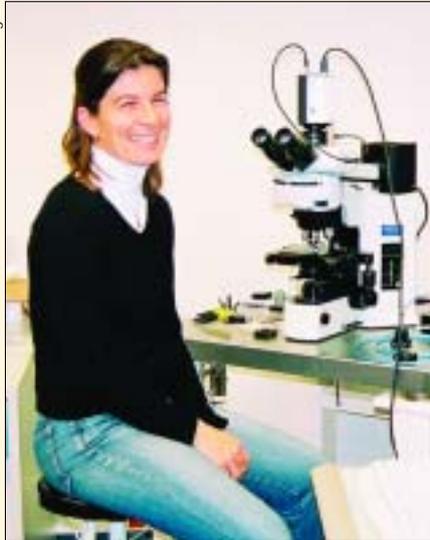
Ivan Amat-Roldán, who is originally from Barcelona, left Spain to get a master's degree at the University of Maryland. He started his doctoral degree there before learning about the plan to create ICFO. Amat-Roldán wanted to study biophotonics, specifically multiphoton imaging and nonlinear microscopy, and Barcelona's program, it turns out, better met his needs. "At the beginning, I was not convinced that cutting edge research in Spain was a possibility." He found that it was. "At ICFO you can really push yourself to the limit and perform cutting edge technology." He was glad to have lived and worked in another part of the world, but he also was delighted to come home, he said. "If you want to do serious research, why should you have to leave?"

Stephanie Cheylan is from France. After receiving her doctoral degree in Australia she chose to come to ICFO as a post-doc because she wanted to return to Europe to study light emission from organic and inorganic materials. ICFO won out over other programs on the continent in part because of the sense of ownership Cheylan feels about it. "We are starting the program," she said. "We have a lot of input. Usually you go to a place and they say, 'This is what you're to do. Here, they say, 'What do you want to do?'"

Forging bonds

ICFO has an energy that is palpable; it's got the feel of a startup. Until the elegant postmodern glass building is completed later this year, staff, students and faculty

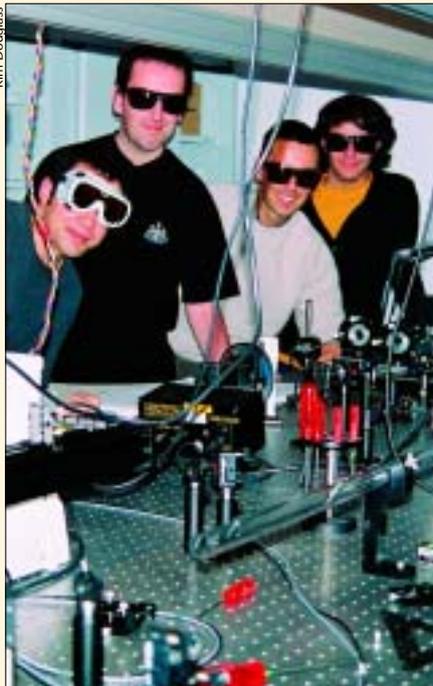
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In one of the ICFO laboratories, scientists are exciting multiphoton processes as part of a larger project to study human heart disease and neurons in the brains of mice fetuses.

are working out of rented offices on the Universitat Politècnica de Catalunya campus. Their temporary space includes conference rooms with floor-to-ceiling windows that overlook the Collserola mountains.

Their laboratory equipment consumes a series of small, crowded basement rooms in another building across campus, but no one seems to mind.

In one such room, Amat-Roldán's team is exciting multiphoton processes as part of a larger project to study human heart disease and neurons in the brains of mice fetuses. A few yards away, Singh's group is using optical tweezers and Raman microspectroscopy to study living cells and identify cancerous ones. Next door, Cheylan is studying light emission from organic materials for photonic applications.

"The future labs will be just great," Amat-Roldán said. "However, in some aspects, I will miss the [close] contact with the other researchers in the lab. If you have a world's expert on something working next to you, it is so natural and easy to go and ask him about what he is doing. If anyone needs help, you go and help him. This creates links between people, and collaboration becomes a spontaneous thing."

"I have been impressed by the quality of the students," Ebrahim-Zadeh said. "They have surpassed my expectations." Says Juergen Eschner, another member of the ICFO faculty, "I couldn't have asked for more. They are first class."

The fact that the program is so young does not give its supporters pause.

"I have no doubt that the commitments made will be honored by the new government," Mas-Colell said. "In matters of R&D, there is a substantial amount of bipartisanship, both in Catalonia and in Spain. In my years as minister, I had my share of political sparring with the opposition. But it was ... not on research [issues]. We all know that our future in Europe ... depends crucially on making Spain and Catalonia a center of intense research activity."

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