ICFO spotlight

The importance of rewards

Augustin Fresnel, a French physicist who back in the early 19th century helped establish the wave theory of light, received several awards for his pioneering work. In 1819, a memoir he wrote on light diffraction phenomena won him a prize from the French Academy of Sciences in Paris, France. In 1823, after building an innovative lens system able to amplify light in lighthouses--still in use in some places today--Fresnel was elected member of the French Academy of Sciences. A couple of years later, Fresnel became a foreign member of the Royal Society of London in the United Kingdom, and he was eventually presented with the Rumford Medal.

Fresnel probably still didn't receive all the recognition he deserved back then; the real importance of groundbreaking advances is often only realized as time goes by. Not that it mattered much to Fresnel anyway. "All the compliments," he once wrote to fellow scientist Thomas Young, "that I have received from Arago, Laplace, and Biot never gave me so much pleasure as the discovery of a theoretic truth, or the confirmation of a calculation by experiment."

Like Fresnel, the greatest rewards for most scientists today are to discover the unexpected, contribute to advancing the field, or see research findings benefit society. Fame rarely enters into a scientist's equation for success.

Yet awards and accolades are important milestones in a scientific career. They are recognition that you are doing good work, and work that matters.

Several ICFO scientists received a pat on the back from the larger scientific community this spring. ICFO group leader Romain Quidant received the prestigious 2009 Fresnel Prize in applied photonics for his outstanding contributions to the field of plasmon nano-optics. Ph.D. student Xiaojuan Shi got an award from the Chinese government for carrying out excellent work at ICFO. And some of the research papers produced in the labs of Antonio Acín, Valerio Pruneri, and Romain Quidant were also highlighted in specialist journals as some of the finest examples of last year's research.

In a broader context, ICFO joined the newly expanded Laserlab Europe--a network of major laser research facilities across Europe--and also hosted its inaugural ceremony. These two developments represent recognition of the excellence of the laser research being done both at ICFO and in Spain.

So, once more, this newsletter has many achievements to celebrate. Whether they are once-in-a-lifetime or small successes, and whether they occur in the spotlight or behind the scenes, these achievements all contribute to advancing the science of light a little bit further.

Enjoy your reading.

Elisabeth Pain – ICFO Spotlight Coordinating Editor

index

cover

ICFO group leader Romain Quidant has been announced as the winner of the 2009 Fresnel Prize in applied photonics for his outstanding contributions to the field of plasmon nano-optics.

ICFO
Institut de Ciències Fotòniques

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HAPPENINGS

ICFO news

2009 Fresnel Prize

Once every two years, the European Physical Society gives a Fresnel Prize each to two scientists under the age of 35 for their outstanding contributions in either fundamental or applied photonics. This year, the Fresnel Prize in applied photonics was offered to Romain Quidant, "for his groundbreaking and pioneering contribution to the concept of plasmon-based optical manipulation, in addition to his overall contribution to the field of plasmonics."

Romain Quidant currently holds a group leader position at ICFO supported by the Catalan Institution for Research and Advanced Studies (ICREA) and also receives generous research support from the Fundació Cellex Barcelona. He also collaborates with local company Endor Nanotechnologies on the development of plasmonics applications in cosmetics and dermatological products.

Flexible Organic Photonics

ICFO will now work together with the Technical University of Catalonia (UPC) and the local technology center Cetemmsa to develop flexible organic photonic devices using a technique derived from inkjet printing technology. The main devices they will produce are light emitting diodes (OLEDs) and photovoltaic cells for smart textile applications. The new OLEDs and photovoltaic devices are to be obtained in a six-stage process over the next two years.

ICFO group leader Gonçal Badenes and research fellow Stephanie Cheylan will bring in their expertise in nanophotonic devices and OLEDs technology. The UPC group, led by Ramon Alcubilla and Joaquim Puigdollers, will contribute their photovoltaics know-how. Cetemmsa is a technology center with 15 years' experience in helping companies and research institutions develop smart materials and devices.

ICFO Ph.D. Student Awarded Chinese Government Prize

Xiaojuan Shi, a quantum optics doctoral student in the group of Juan P. Torres, has received recognition from her home country for carrying out excellent work at ICFO. Xiaojuan Shi is among the 305 Chinese students in 27 different countries to receive an award from the Chinese government this year for doing outstanding research abroad.

Xiaojuan Shi left China in 2005 to do a Ph.D. at ICFO after earning a M.Sc. degree in Optics from Shanxi University's School of Physics and Electronics Engineering.

This is not the first time an ICFOnian from China wins this award however: three years ago, it went to Zhiyong Xu, who back then was a Ph.D. student investigating optical solitons in Lluís Torner's group.

Publishing Matters

The research paper 'Waveguide electro-optic modulation in micro-engineered $LiNbO_3$' written by Davide Janner, Domenico Tulli, Valerio Pruneri, and collaborators at the Avanex Corporation Sede Secondaria in Milan, Italy was highlighted in the 2008 collection of the Journal of Optics A's most popular publications. Also included was the review article 'Light-induced manipulation with surface plasmons' written by Maurizio Righini, Romain Quidant, and collaborators at the Center for Material Elaboration and Structural Studies (CEMES) in Toulouse, France.

The New Journal of Physics also highlighted in its Best of 2008 the article 'A convergent hierarchy of semidefinite programs characterizing the set of quantum correlations' written by Antonio Acín and two former members of his group, Miguel Navascués and Stefano Pironio.

ICFO newcomers

A warm welcome to all of you who joined ICFO between February and May this year!


Gerald John Lapeyre
Postdoctoral Researcher


Rafael Porcar
Project Research Engineer


Lars Erik Würflinger
Ph.D. Student


Joyee Ghosh
Postdoctoral Researcher


Rafael Giner
Financial Coordinator


Omar Olarte
Ph.D. Student


Philipp Hauke
Ph.D. Student


Salvatore Minissale
Postdoctoral Researcher


Antoine Perron
Master Student


Daniel Mitrani
Electronics Technician


Jon Shon Donner
Ph.D. Student


Gabriele Anzolin
Postdoctoral Researcher


Seth Lucien Cousin
Master Student


Kavita Devi
Ph.D. Student


Amel Fatima Houyou
Undergraduate Student


Ioan Costin Stan
Master Student


Nicolas Rahuel
Master Student


Francisco J. Rodríguez
Postdoctoral Researcher


Mathieu Alloing
Master Student


Mónica Marro
Master Student


Peyman Zirak
Postdoctoral Researcher


Alexandre Thai
Master Student


Mehmet Ali Süzen
Postdoctoral Researcher


Anne Gomez
Project Research Engineer


Tobias Hero
Undergraduate Student


Néstor Hugo Oliverio
Optoelectronics Technician


Anton Bauer
Undergraduate Student


Thomas Estruch
Undergraduate Student


Parisa Farzam
Master Student


Emmanuel Giner
Master Student


María Barrera
Undergraduate Student


José Gabriel Aguirre
Visiting Scientist


Servando López
Visiting Scientist


Rachele Fermani
Visiting Scientist


Sébastien Perseguers
Visiting Scientist


José María Beato
Mechanic


Nicolas Thiebaut
Master Student


Carme Gómez
Post-Processing Techn.


Christian Prommesberger
Undergraduate Student

welcome to ICFO

LATEST ADVANCES

research highlights

Rotating Superfluids
Materials in the superfluid state lose all viscosity and slide effortlessly over the surface of their containers when shaken. Like in normal fluids, vortices can form within superfluids when they are rotated fast; but in superfluids, vortices appear only above a threshold velocity, and more than one can form in a single superfluid sample. Together with researchers at the University of Barcelona and the Laboratoire Kastler Brossel in Paris, France, Maciej Lewenstein's group have described for the first time the quantum state giving place to the formation of vortices in rotating superfluids. The result sheds light on the dramatic structural changes that can take place in nanoscale systems ranging from superconductors to ultracold atoms. The work was published in May in online Nature Physics.

Peering into Nanocavities
Optical cavities are small mirror arrangements able to control the properties of incoming light waves by making them bounce back and forth and interfere with each other. Optical cavities are used to control the emission of light in lasers and parametric oscillators, for example. Researchers in Niek van Hulst's group, together with collaborators at the University of Burgundy in France, have for the first time taken a peek into optical cavities as small as a few micrometers. They probed the nanoscale position, orientation, and fluorescence lifetime of single light-emitting molecules and mapped the distribution of the emitted light inside nanocavities. This work on single molecule mapping is paving the way for further research in photonic crystals, nanoantennas, and other plasmonic nanostructures. The findings were published in Nano Letters in February.

Blue Babies
A new blood-flow monitoring system developed by Turgut Durduran's group is being tested in the medical care of 'blue babies', in collaboration with the Sant Joan de Déu Children's Hospital in Barcelona and the Children's Hospital of Philadelphia in the United States. The group of 'blue babies' to take part in the study were born with a congenital heart defect resulting in the transposition of the great arteries, and poor oxygen circulation. The non-invasive device consists in a headband incorporating optical fibers that can then be placed on the baby's head. The device monitors the brain's blood flow and oxygenation using laser light of multiple wavelengths, as these are absorbed differently by oxygenated and deoxygenated hemoglobin. The work was featured in the national newspaper El País in May.

Thermal Imaging
Researchers in Romain Quidant's group have developed a new thermal imaging technique able to map temperature landscapes around nanometer-sized heat sources with unprecedented accuracy. The research was originally published in Optics Express in March and was subsequently explained by the researchers in Laser Focus World. "Basically, the technique consists of surrounding the area of interest with a solution of appropriate fluorescent molecules and mapping the fluorescence polarization anisotropy," the researchers wrote in Laser Focus World. The new technique "enables fast and accurate temperature mapping," Laser Focus World commented. The journal also described the new technique as a "breakthrough" that "should give an impetus to novel branches of nanotechnology such as thermoplasmonics, which are in need of an efficient thermal imaging tool."

business news
by Silvia Carrasco

ICFO Welcomes a New CLP Member

Local company Easy Laser joins ICFO's Corporate Liaison Program (CLP)

Founded in Terrassa in 2002, Easy Laser focuses on the manufacturing of industrial laser machinery with a strong commitment to research, development, and industrial innovation. Easy Laser's activities range from the development of custom projects to the mass production of systems for applications like marking, engraving, cutting, microdrilling, and welding for the packaging, coding, textile, metallurgic, and ceramic industries, among others. To date, there are more than 1,300 Easy Laser systems operating in 61 different countries. Among the companies currently using Easy Laser systems are Grupo Inditex, Nestlé, Skis Rossignol, Levi's, El Corte Inglés, Coca Cola, Procter & Gamble, Heineken, and Ralph Lauren, to name but a few.

Easy Laser became a CLP member with the aim of building a long-lasting relationship with ICFO that will benefit both partners. ICFO and Easy Laser have already signed a research agreement for the joint development of a new generation of laser systems for the marking industry.

Working on the Next Generation of Video Communication Tools

What will the videoconferences of the future look like? How far are we from seeing 3D images of our colleagues around the world as we speak to them over the phone?

ICFO will help provide the answer to those questions as part of the VISION research consortium for the development of next-generation video communication tools.

The project, funded by the Spanish Center for the Development of Industrial Technology (CDTI) and coordinated by the Spanish telecommunications company Telefónica, gathers 25 partners from both the public and the private sectors.

Together with AD Telecom S.L. and the Technical University of Catalonia (UPC), ICFO is currently working on developing advanced displays able to show videoconference interlocutors in three dimensions. "Now that flat screen and high definition TV technology have been developed, the next challenge for the audio-visual industry is the three-dimensional television," says AD Telecom Chief Executive Officer, Antonio Alcayde.

The ICFO Optoelectronics research group led by Valerio Pruneri will contribute their expertise in optical engineering, optical design of complex systems, liquid crystals, and thin film technology. "It is a great opportunity for us to make use of our patented ultrathin film technology to develop such a challenging product," Valerio Pruneri says.

Courtesy of Easy Laser


Courtesy of Telefonica I+D

Left: Easy Laser systems are being used by companies around the world

Right: The VISION consortium is working on designing the videoconference platform of the future

COLLABORATIONS

ICFO joins Laserlab Europe

by Michele Catanzaro

Last March, ICFO hosted the inaugural ceremony of the newly expanded Laserlab Europe consortium

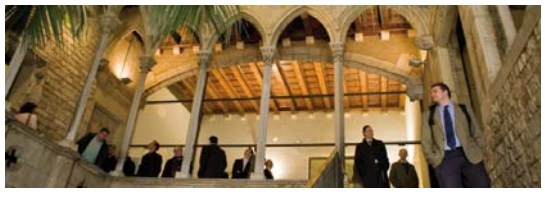
Launched in 2003 with funding from the European Commission, Laserlab Europe aims to give the European laser research community access to high-tech and expensive laser infrastructures as well as to coordinate research activities across Europe. Until March this year, Laserlab Europe counted 17 laser research institutions in 9 different countries. The network has now expanded, thanks to further European funding, to gather 46 facilities in 19 countries.

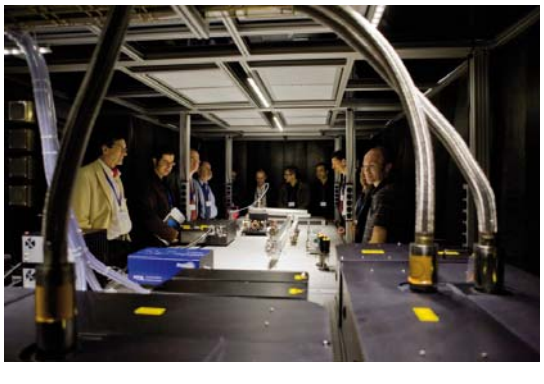
The new Laserlab Europe partners are Spain, Portugal, Poland, Slovakia, Romania, Hungary, and Latvia, with several associate partners in Bulgaria, Austria, and Denmark. The decision to celebrate the inauguration of the new Laserlab Europe in Spain represents recognition of the excellence of Spanish laser research. "Spain is an important partner in a consortium that has planned major investments in laser research," Wolfgang Sandner, Laserlab Europe Coordinator and Director of the Max Born Institute in Berlin, Germany said on the inauguration day.

Both ICFO and the Center for Ultraintense Pulsed Lasers (CLPU) in Salamanca are now members. "The Spanish centers are among the best of those who have entered the second phase of the consortium," said Director of the Lund Laser Center in Sweden and former Chairman of the Nobel Committee for Physics, Sune Svanberg. Montserrat Torné, General Director for International Cooperation at the Spanish Ministry of Science and Innovation, added that "participation in Laserlab Europe is an example of the internationalization of research infrastructures in Spain."

The use of lasers has led in the recent years to extraordinary developments in basic science, medicine, and frontier technologies. Internet technology, CD players, and an increasing number of medical applications have now made lasers a component of everyday life. But the best is yet to come, experts say. Devices developed at Laserlab Europe institutions will for example allow researchers to observe electrons orbiting around the atomic nucleus, monitor biochemical reactions, develop new X-ray sources, and explore power generation through the fusion of atomic nuclei. Yet another example is attoscience, which "tries to observe the most rapid phenomena in nature," said ICFO group leader and organizer of the inauguration day Jens Biegert.

"Europe united, truly united, will be world leader in photonics technology with initiatives like Laserlab," said CLPU Director Luis Roso. "It is an honor to host the launch of the European elite in laser technologies," said ICFO Director Lluís Torner. "The centers in Barcelona and Salamanca teamed up to give Spain the place it deserves and we are now available to the scientific and industrial community that can benefit from laser technology."





Top: Wolfgang Sandner (Laserlab Europe coordinator), Herve Pero (Head of Research Infrastructure-European Research Area, European Commission), Montserrat Torné (Director General of International Cooperation, Spanish Ministry of Science and Innovation), and Ramon Moreno (then Director of the General Research Directorate, Catalan Government) pressing the 'go' button for the new Laserlab Europe.

Center: The launch of the new Laserlab Europe was celebrated at ICFO in March.

Left: Celebration attendees took the opportunity to visit ICFO labs and facilities.

Right: The event ended with a visit to the Picasso Museum of Barcelona.

Photographer: Mattia Insolera

PEOPLE

in focus

by Francesca Arcara

Francesca Arcara · Head of the Public Research Projects Unit, Funding Department

I was born in Italy and studied classical archaeology at the University of Pisa. In spite of the common perception of classics as something dusty and useless, I am pretty convinced that if I got to be Head of Projects Unit today at a major international research institute like ICFO, it is also thanks to my education.

During my studies, I learnt Latin and Ancient Greek. Like all dead languages, the only possible approach to learning them is to study ancient texts. This requires a particular state of mind, as you cannot approach a text written 2,500 years ago in the same way you would read a modern text: it is essential that you understand and respect the cultural distance that separates you from the authors if you really want to get what they meant. I believe that respecting such distance is a basic requirement for any kind of investigation. It is also a key principle for efficient communication, which you need when you work in a foreign country where people do things completely differently from what you are used to.

This interpreter's mindset is probably the most important quality for the job I now have at ICFO. I am constantly in relation with two different worlds: the world of research and the world of bureaucracy and administration. Both have different ways of thinking and approaching issues. I am a kind of interpreter in charge of translating a researcher's request for funding into words and figures that fit the forms imposed by funding institutions.

So how did I move from classics to the management of funding applications for physics projects?

After getting my *Laurea* in classical archaeology and spending some time in Germany as an Erasmus student, I won a fellowship for a traineeship in Brussels where I got acquainted with the Research Directorate-General of the European Commission. Back in Pisa, I worked as a European Project Manager in the university's physics department while also starting graduate studies in archaeology. My managing job was more absorbing than expected however: it became a full position, which I kept for three years. I was then offered to manage physics projects at the European Commission's Marie Curie Training Network Unit. There, I learned a lot about the financing of projects and the structure of the EC Framework Program for funding, but after a while I realized I was becoming more of a bureaucrat than I really wanted to be.

So I then took a position at the Institut d'Optique in Paris, where I spent four years managing the coordination of several big research projects in quantum optics and cold atoms physics. I was really at the frontline of research, and I also learned the French bureaucracy so well that I passed a national competition for a civil servant position as manager of the European research contracts at the Ecole Normale Supérieure of Cachan. During that time, I also earned my degree as *Dottore Specialista* in classical archaeology. This demanded quite an effort, but I believe it was worth it, even though by then it was clear it would never become my profession.

I especially enjoy the daily contact I have with researchers here, even more so when it has an international dimension

I thought I would stay in France for a while, but destiny, in the person of Lluís Torner, changed my path again. Lluìs offered me to come and work at ICFO, which I already knew from some projects I had worked on before. I liked ICFO's international atmosphere and the fact that it is young and dynamic. And I also liked the idea of leaving the grey sky of Paris to live closer to the sun and the sea! So I decided to pack my things once more, make my third international move, and learn my fifth language.

I am now in charge of the Unit for Public Research Projects at ICFO. We assist researchers with funding proposals and keep in touch with national and international funding institutions. We interact with other management units within ICFO, mainly the one in charge of the financial follow-up of the projects and the Human Resources Department. We also complement the Knowledge and Technology Transfer Unit, since many projects involve private entities, and all projects could ideally lead to new intellectual property we then need to protect.

I especially enjoy the daily contact I have with researchers here, even more so when it has an international dimension and involves different ways of thinking and working together--something that in my domain we call 'European added value.'

I am an archaeologist working on research projects in physics. I am an Italian citizen who is also a French civil servant and lives and works in Spain.

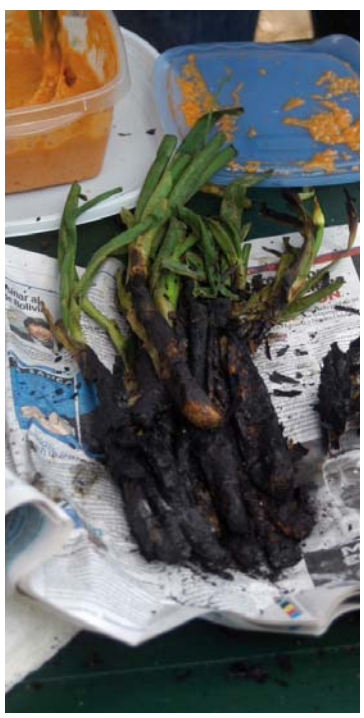
How much European added value is that?!?

community pictures

by Laura Grau

Calçotada

ICFOnians gathered this April to enjoy a traditional Catalan meal of calçots--large spring onions cooked on the barbecue that make the party all the more fun that they are messy to eat! This year, the winner for the best romesco sauce was IT Technician Juli Céspedes (top center), with Ph.D. student Florian Wolfgramm also winning a prize for preparing the best dessert (bottom center)



PERSPECTIVES

beyond ICFO

by Elisabeth Pain

Caitriona Creely · International Liaison Officer, Irish Health Research Board

Caitriona Creely has always loved challenges. She chose to study experimental physics for her first degree at Trinity College Dublin, in her native Ireland, because "it was actually the subject that was the hardest for me," she says. She stayed on at Trinity College to do a Ph.D. in biophysics, looking at electron transfer in DNA binding complexes using ultrafast spectroscopy.

Caitriona then decided to experience life abroad, and an ad for a postdoctoral position at ICFO caught her eye. That this was the same day as the closing date didn't deter her from applying. "I quickly wrote a CV and sent it," she says. She was soon offered a job in Dmitri Petrov's lab, which she took right after earning her Ph.D., in January 2004.

The research Caitriona did at ICFO had little to do with her graduate work. She used optical tweezers and Raman spectroscopy to capture biochemical processes as they occurred within dying human cancer cells. "It was different, challenging, interesting," she says. She had never worked with living cells before, and collaborated with the Molecular Biology Institute of Barcelona to get her project off the ground. But when ICFO moved from Barcelona to its current location in Castelldefels, Caitriona used one of the empty rooms in the new building to set up an in-house cell culture facility. "That took a bit of work," she says. But her efforts paid off. ICFO was the "first to get a Raman spectroscopy image of a cell" in suspension.

Caitriona left ICFO in December 2006. She went back to Ireland, spending a few months setting up optical tweezers at University College Dublin with a part-time postdoctoral position. But meanwhile, Caitriona was looking for a career change, and when she heard an Irish Health Research Board (HRB) employee present her job at a local careers event one day, it clicked. "'There's a job as international liaison officer'" coming up soon, she remembers that person telling her. "'You should apply. "' Caitriona did, and got the job.

Courtesy of Caitriona Creely/Irish HRB

The bulk of Caitriona's job today is to act as a National Contact Point for the European Commission's Framework Program 7 (FP7). "I… offer hands-on support and advice to researchers that apply for European funds," she says. She disseminates information about funding opportunities, helps researchers find project partners, checks their funding proposals, and advises them on legal, ethical, and financial issues. Caitriona is also in charge of representing her country's interests in Brussels as the Irish National Delegate for Health in FP7 and of developing relationships with other European organizations.

> It is ICFO's multicultural environment which made me succeed for this kind of job

Having left the lab behind, her new job really "tests my networking and communication skills," Caitriona says. She feels that her experience at ICFO helped her both get the job and settle in. It is ICFO's "multicultural environment which made me succeed for this kind of job because I felt comfortable going up and talking to people no matter what country they're from," she says. Also, the HRB very much values it "if you have spent some time abroad and learnt a different language, because it shows that you are not afraid of challenges," Caitriona adds. So even though the world she entered back in Ireland was new to her, "I felt quite at home."

photonics in everyday life

by Jordi Martorell

Nano-Structuring Solar Cells

In just 40 minutes, the amount of solar energy striking the Earth is equivalent to the energy consumption of the entire world during a year. Developing more efficient ways to convert a small portion of this tremendous amount of energy into electricity is a challenge many researchers are now tackling.

There is, of course, a limit as to how efficient this conversion can be. Physics laws and the limited spectral response of the devices most commonly used for converting light into electricity limit this efficiency to approximately 40%. But so far, commercial modules based on first-generation silicon solar cells offer an energy conversion efficiency of approximately 15%. A good efficiency is not the only thing researchers must consider however: Production costs and environmentally-friendly production and disposal must also be taken into account.

Nature, over the course of 3.8 billion years, has come to master the conversion of solar photons into chemical energy in a mechanism extremely well adapted to environmental conditions. In photosynthetic organisms such as plants, chlorophylls and other molecules are indeed responsible for collecting light and transferring it to the core of light-harvesting complexes. As essential as this trapping of light is the funneling of the photon's excitation energy achieved via the so-called Förster mechanism. In this remarkable process, the chlorophyll molecule that collects a photon's energy does not lose it, passing it on instead to an adjacent molecule until the energy gets into the core of the light-harvesting complex. Once there, the photon's energy is eventually used for chemical reactions in turn leading to the production of chemical energy.

Would it be technologically feasible to reproduce a photosynthetic mechanism in man-made devices? So far, attempts have, for the most part, failed. Success may not even be environmentally desirable, since photosynthesis implies a large consumption of water. Still, there is a lot that researchers may learn from such harvesting mechanisms. Luat Vuong and Rafael Betancur at ICFO are working, together with Gregory Kozyreff of the Free University of Brussels in Belgium, on designing an organic nanostructure that somehow mimics the funneling of energy seen in photosynthesis to enhance the efficiency of third-generation solar cells.

Moreover, third-generation photovoltaic cells may be given physical properties for applications where silicon modules may not be used. It would for example be possible to make them partially transparent for window glazing or architectural covering. In another project carried out in collaboration with several local companies, ICFO researchers Marc Maymó and Xavier Elias are also developing, together with Valerio Pruneri's group, a new type of organic transparent solar cells with thin metal films.

ICFO researchers are designing new organic photovoltaic cells that somehow mimic energy production mechanisms found in nature

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THE LAST WORD

high profile

Professor David Payne is director of the Optoelectronics Research Centre at the University of Southampton in the United Kingdom. He received the prestigious 2007 Photonics Award for his contributions to the development and commercialization of optical fiber-based technologies for communications, sensors, and high-power applications from The Institute of Electrical and Electronics Engineers. Professor Payne visited ICFO in May to give a talk as part of the Institute's Colloquium series

Q: What made you go into the field of optical fiber communications?
A: I did an electrical and nuclear power engineering degree and I needed to spend an extra year at university because my future wife's course was one year longer than mine. So I decided that this new photonics stuff would be interesting.

It was shortly after the invention of the laser. What this did of course is provide us with one of the components that was missing for the great concept of optical communications. It was bandied around that perhaps optical fibers would be the way to go. So my professor said to me, 'Well, David, you should do a Ph.D. and why don't you see if you can reduce the loss of the transmission signal in these fibers.' So there was I, drawing fibers at the tender age of 22.

Q: What has been the impact of your research?
A: I have been fortunate enough with my close colleagues to change the world. Today the great majority of phone calls are going along an optical fiber. The Internet was enabled by optical fibers. When you fly on a Boeing 777, you will be navigated by an optical fiber which is made here in Southampton.

Q: What have been the most trying times for you?
A: Every scientist has times of great productivity and then times which are a little slower. To feel that maybe you have run out of steam during those times is challenging. Then of course the next big success comes and it's wonderful again, so it's ups and downs.

Q: What has been your experience working with industry?
A: I discovered that there's a very different culture in industry. You get stimulated by it but you also get frustrated by it. On the other hand, what I found is that you can find some hugely stimulating and difficult problems from discussions with industry. I benefited immensely from working with companies that we've put together in Southampton because they provide us with a stimulation and a much better understanding of what the world needs.

Q: What has been key to your success?
A: Being fortunate enough to be at the beginning of a revolution in telecommunications that has changed the entire planet. I was one of the world's first Ph.D. students in the field and I had no idea at that time that it would lead where it has done. The other thing is the opportunity to work with extremely high quality people to enhance your own thinking.

Also, never be afraid of failure. Try as many things as you possibly can because it's the unexpected you're looking for. And always pursue an idea. That requires a certain passion in the early stages; then, you need to be prepared to abandon the idea very quickly if you realize that it is not as good as you thought it was!

Q: What challenges do you see next in the field?
A: The next big challenge is found by looking to the future and asking, 'what could we do next that will make a huge difference?' That gets harder with time because of course the field matures. Now, with so many people working in the field it's kind of hard to have totally unique and original ideas.

Young people are essential to this whole process. We all need to understand that (ICFO certainly appears to have understood that) and to celebrate our young people; and bring them on into the world to see if they can create the same wondrous scientific career that we had ourselves.

As part of the ICFO colloquium series, Professor David Payne reviewed the greatest successes of optical fibers in telecommunications and explored the prospects for future technologies

sudoku

easy

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medium

	4	8	6		5			2
	2	3						6
1			7					
8	3				7			
	5	4				9	3	
			2				5	1
					9			3
3						4	1	
9			3		2	6	8	

difficult

		9					2	
6	8						7	9
		4	9			6	5	
8				9	7		6	
				4				
	9		6	1				5
	1	3			8	7		
4	7						8	3
	2					5		

very difficult

5			1					9
			2	8		6		
	9				5			
		4					7	3
	7			9			8	
6	3					4		
			8				2	
		1		6	4			
3					2			7

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