

ICFOnians

Community News from the Institut de Ciències Fotòniques



EDITOR'S CORNER

Welcome to 'ICFOnians' -our newly rebranded newsletter

LLUÍS TORNER
ICFO Director

When our in-house magazine was launched, two years and 7 great issues ago, we had a long and interesting discussion regarding how it should be named. Together with the editorial committee we debated various suggestions, some of which really bold. Eventually, we settled for ICFO Spotlight, a nice name that also does a good job of capturing the spirit of the publication: a quarterly summary of our activities highlighting the most telltale of our successes and joint activities, portraying the diversity of our lives at ICFO and beyond ICFO, and conveying our common values and concerns.

For a young institution in constant evolution like ICFO, two years is a long time. Still now, we continue to change and to grow, pursuing an always greater internal efficiency, a higher scientific and technological impact, and a larger number of collaborators within academia, health centers, hospitals, and industry alike. We continue to adapt to the ever-changing economy and to new conditions for doing science. We continue to nurture our passion for discovering and creating new things, and for contributing, within the confines of our ability, to the progress of Humanity.

Over the years, many of us have obtained international awards, published in the best scientific journals, filed valuable patents, or initiated industrial projects with a great potential for economic impact. We attended and gave talks at the international congresses and technical conferences where the latest advances in our field are being presented and discussed. Some of us also appeared, sometimes being a little nervous but always beaming, in the international media outlets that expressed an interest in our results. Our students also went one step further than most other student chapters, not only putting in place new outreach and social activities at ICFO but also spurring the creation of novel, further-reaching international student associations. And while working at ICFO, all of us have made good friends as well as valuable professional contacts.

At the heart of all of these achievements are always the same protagonists: Men and women who work at ICFO, who fund ICFO, or who collaborate with ICFO. Whether they are partners of ICFO from within ICFO, after ICFO, with ICFO, or for ICFO, these people are all giving the best of themselves to help ICFO pursue its goals and ambitions.

The time has now come to name things by their real name. It is our pleasure to introduce you to 'ICFOnians', our newly renamed -- and redesigned -- newsletter. This newsletter is about every one of us ICFOnians, whatever our role, wherever we are.

COVER



ICFO Director Lluís Torner shows the institute's state-of-the-art research facilities to Spanish First Vice-President Mr. Alfredo Pérez Rubalcaba and Spanish Minister of Science and Innovation Ms. Cristina Garmendia.

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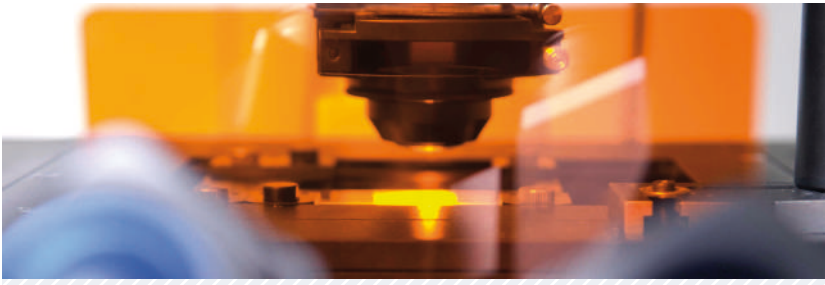
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D.L.: B-15885-2011

ICFO NEWS



BARCELONA SUPER-RESOLUTION LIGHT NANOSCOPY ALLIANCE

ICFO and the Barcelona-based Centre for Genomic Regulation (CRG) have partnered up to launch the Barcelona Super-Resolution Light Nanoscopy Alliance. So-called SLN@BCN, the new alliance promotes the application, study, and further development of high-resolution micro and nanoscopy technologies in the field of biomedicine and provides in-house and outside researchers access to advanced techniques and relevant training. “The super-resolution biomedical imaging program which the initiative instigates will result in great technological innovation and economic impact. SLN@BCN is open to all of the community,” explains ICFO director Lluís Torner. Both ICFO and CRG are involved in the larger-scale Euro-BioImaging Project, which aims to address the needs of the European biomedical imaging community by putting in place a network of research nodes that will together deploy a comprehensive pan-European imaging infrastructure.

MINISTERIAL VISIT TO ICFO

Spanish First Vice-President and Minister of Interior Mr. Alfredo Pérez Rubalcaba and Spanish Minister of Science and Innovation Ms. Cristina Garmendia visited ICFO’s premises on 14 December. They were welcomed by ICFO Director Lluís Torner and guided through a tour of the labs and facilities. Catalan Minister of Innovation, Universities and Enterprise Mr. Josep Huguet, former Catalan Minister of Universities, Research and the Information Society Professor Andreu Mas-Colell, Rector of the Technical University of Catalonia Professor Antoni Giró, and Mayor of Castelldefels Mr. Joan Sau also joined the event, among many other local authorities.

AWARDS AND PRIZES

ICFO Ph.D. student Omar Olarte won the Best Poster Award in the Ph.D. category at the BioPhotonics and Imaging Conference (BioPIC), which was held in Ireland last October. The poster describes the use of femtosecond nanosurgery techniques to dissect single nerve axons *in vivo* without destroying the neighboring tissues. Omar Olarte conducted the work in the lab of Pablo Loza-Alvarez together with Ph.D. student Sotiris Psilodimitrakopoulos, Dr Susana Santos, and former Ph.D. student at ICFO Manoj Mathew.

Stefan Balint, a former Ph.D. student in the group of Dmitri Petrov and currently a postdoctoral researcher in the group of Melike Lakadamyali also at ICFO, has been distinguished for his Ph.D. research by the Hungarian Academy of Sciences as the best young researcher working abroad in 2010.

Maciej Lewenstein received the Hamburger Preis für Theoretische Physik last November for his outstanding work in the field of theoretical quantum optics. The prize was given by the Frontiers in Quantum Photon Science Cluster of Excellence, which is funded by the Joachim Herz Foundation and gathers Hamburg University, the Max Planck Research Department for Structural Dynamics (MPSD) in Hamburg, and the German electron synchrotron DESY.

RECENT ICFO GRADUATES

ICFO Ph.D. student Marc Almendros obtained his doctorate last September for his work on long-distance quantum communication based on an experimental setup using two ion traps. The work was supervised by ICFO Group Leader Jürgen Eschner.

In October, Ph.D. student Maurizio Righini graduated with a thesis on plasmon-based optical trapping describing the design and implementation of a lab-on-a-chip device. The thesis was supervised by ICFO Group Leader and ICREA Professor Romain Quidant.

The same month, Nicolas Piro, also from the Jürgen Eschner group, successfully defended his Ph.D. thesis aimed at experimentally studying the absorption of single photons and entangled photon pairs by single trapped atoms.

Finally, in December, Armand Niederberger graduated with a thesis on disorder-induced order in ultracold atomic gases. The work was supervised by ICFO Group Leader and ICREA Professor Maciej Lewenstein and Research Fellow Fernando Cucchietti.

ICFO NEWCOMERS



Michael Keller
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Postdoctoral Researcher



Taisuke Minagawa
Postdoctoral Researcher



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Ph.D. Student



Mustafa Gündogan
Ph.D. Student



Norman Brede
Postgraduate Student



Gonzalo De La Torre
Ph.D. Student



Fernando Favero
Visiting Scientist



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Giacomo Corrielli
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Arup Kumar Rath
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Adam Vallés
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Ángel Sandoval
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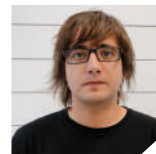
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Postdoctoral Researcher



Michela Badioli
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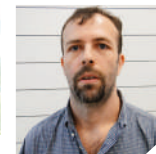
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Alberto Agudo
Electronics Technician



Dane Austin
Postdoctoral Researcher



Anne Kristoffersen
Postdoctoral Researcher



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Eduard Benasques
Undergraduate Student



Jonatan Bohr Brask
Postdoctoral Researcher



Louis Gaudreau
Research Engineer



Fabio Gatti
Research Engineer



Valeria Rodríguez
Ph.D. Student



Nela Durisic
Postdoctoral Researcher



Pau Mestres
Undergraduate Student



Ignacio de Miguel
Research Engineer



G.Elaine Prawiroatmodjo
Postgraduate Student



Luis Crespo
Visiting Scientist



Pelayo García
Ph.D. Student



Stefan Balint
Postdoctoral Researcher



Nadia Formica
Ph.D. Student



Igor Blanco
Ph.D. Student

Many of you joined or took a new position at ICFO between last August and December.

Welcome to ICFO!

RESEARCH HIGHLIGHTS

NETWORKED QUANTUM INFORMATION

Researchers at ICFO reported in *Nature Physics* an important new step towards networked quantum information processing and communication. While experimental work on controlling the emission of single photons by single atoms is well advanced, controlling the reverse phenomenon, that is, the absorption of single photons by single atoms has only received preliminary experimental efforts. Using a single trapped ion and a pair of entangled photons, the authors have now shown that it was possible to signal the absorption of one photon by detecting the quantum properties of the other photon.

The work was performed by ICFO researcher engineer Marc Almendros, Ph.D. student Jan Huwer, and Research Fellow François Dubin in the lab of ICFO Group Leader Jürgen Eschner, together with former lab members Nicolas Piro, Felix Rohde, Carsten Schuck, Joyee Ghosh, Albrecht Haase, and Markus Hennrich.

UNIDIRECTIONAL OPTICAL ANTENNAS

Nanoscale quantum emitters are key elements in quantum optics and sensing. The efficiency is however limited by the fact that they are emitting and absorbing light in all directions. But a team of researchers at ICFO has now used a specially nanofabricated optical antenna to coax single quantum dots into instead emitting light in a unique direction. The new research paves the way for the use of optical nanoantennas to exchange light to, from, and between quantum dots and other nanoemitters.

The work, which was published in *Science*, was done by ICFO Ph.D. students Alberto Curto, Giorgio Volpe, and Tim Taminiau, research fellow Mark Kreuzer, and ICFO Group Leaders and Catalan Institution for Research and Advanced Studies (ICREA) Professors Romain Quidant and Niek van Hulst. "This step forward in the field of nano-optics has potential applications in quantum optical technologies and the detection of minute amounts of chemicals," Alberto Curto said to *Physics World*. The findings were highlighted in *MIT Technology Review*, French magazine *La Recherche*, and Spanish newspaper *El País*.

NON-DIFFRACTING LIGHT

Due to its wave-like nature, light deviates from its linear trajectory when passing close to the edges of an object, an optical phenomenon known as diffraction. Non-diffracting light beams are however a key component in the optical trapping of micro-objects with optical tweezers and other applications where it is important for the shape of the beam to remain constant. Up to now, beams with only a few different simple shapes had been successfully engineered to yield non-diffracting beams. ICFO researchers and collaborators have now generated quasi-non-diffracting light beams with complex shapes that have important applications for the manipulation of both matter and light.

The work was highlighted in the December issue of *Optics and Photonic News* as one of the most important advances in the field in 2010. The research, which was partially sponsored by Fundació Cellex Barcelona, was a collaborative effort between former ICFOnian Servando López-Aguayo, Visiting Professor at ICFO Victor Vysloukh of the Universidad de las Américas at Puebla in Mexico, ICFO Research Fellow Yaroslav Kartashov, and ICFO Director Lluís Torner.

IN MEMORY by Elisabeth Pain



A Tribute to Professor Britton Chance

Professor Britton Chance, a pioneer in biophysics and physical biochemistry and member of the U.S. yachting team that won the gold medal in the 1952 Olympics, died on 16 November at age 97. Professor Chance was emeritus professor of biophysics, physical chemistry, and radiologic physics at the University of Pennsylvania in Philadelphia. He was a researcher who advanced theoretical knowledge in a diverse range of fields, invented novel instrumentation and devices, and impacted today's clinical practice. Among his many contributions, Professor Chance was renowned for transforming the field of biomedical optics with his pioneering research on the use of magnetic resonance spectroscopy imaging and then of near-infrared optics as noninvasive tools for clinical diagnosis.

Professor Chance earned two Ph.D. degrees in the early 1940s, one in physical chemistry from the University of Pennsylvania and another in biology and physiology from the University of Cambridge in the United Kingdom. Professor Chance developed

much of his research career at the University of Pennsylvania and received many recognitions for his work, including the U.S. National Medal of Science, the Benjamin Franklin Medal for Distinguished Achievement in the Sciences, and membership to the U.S. National Academy of Science, the Royal Swedish Academy of Sciences, and the British Royal Society.

Professor Chance "had a profound knowledge of physiology, biochemistry, optics, medical imaging, electronics, and many other fields. You can imagine how these can come together into a unique source of information and a unique approach to science," says Turgut Durduran, who leads the Medical Optics Group at ICFO. Turgut Durduran started collaborating with Professor Chance back in the mid-1990s when he was a student researching optical mammography in Arjun Yodh's laboratory at the University of Pennsylvania. "To this day, I still find out that he has thought about and published about things that we are just starting to appreciate and begin to work on."

Professor Chance "had a profound knowledge of physiology, biochemistry, optics, medical imaging, electronics, and many other fields," says ICFO Group Leader Turgut Durduran

BUSINESS NEWS

2010 ICFO-Corporate Liaison Day

ICFO celebrated its 2010 ICFO-Corporate Liaison Day on 15 October, a one-day program of networking events open to ICFO industrial partners and all other collaborators.

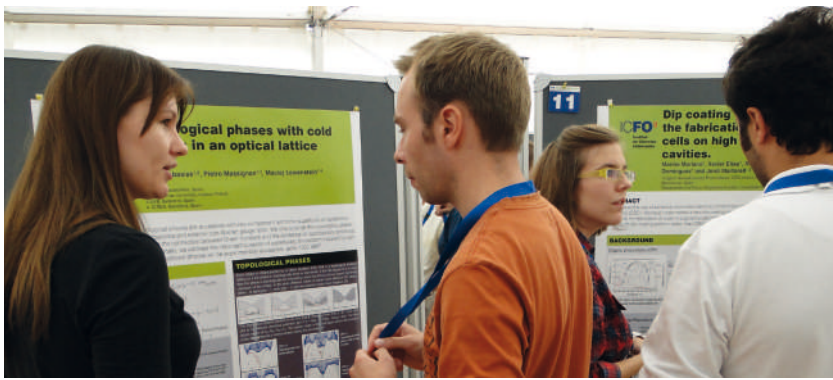
The theme of the 2010 ICFO-Corporate Liaison Day was 'Light for Energy'. The program featured a series of talks given in the morning by four ICFO industrial partners and leading experts, followed by a networking lunch. The afternoon program included a Student Poster Session and a tour of the research labs.

Ambitious collaborative projects in areas like ultra-secure space communications and organic building integrated photovoltaics (OBIPV) were further discussed with industrial partners during separate afternoon meetings. ICFO EU partners also joined the event with the EU Network of Excellence Nanophotonics for Energy Efficiency also hosting a session.

Now in its second year, the 2010 ICFO-Corporate Liaison Day was organized by the Knowledge and Technology Transfer (KTT) Unit at ICFO. Altogether, around 150 people attended the

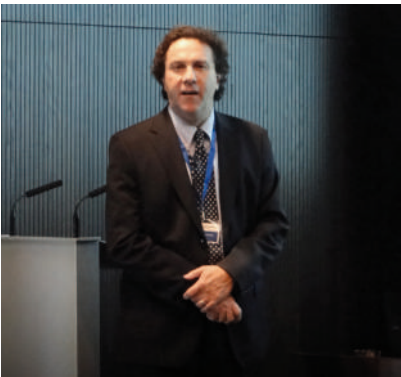
event, with industry representatives coming from more than 25 different companies. "An excellent atmosphere was created, and the meetings in the afternoon were highly productive," says Head of the KTT Unit Silvia Carrasco.

To date, ICFO counts more than 30 collaborative research projects in its Corporate Liaison Program (CLP). The ICFO CLP program is dedicated to building mutual knowledge and trust with all kinds of corporations with the common aim of boosting mutual benefits.

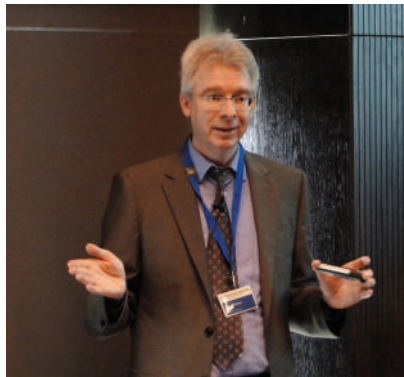


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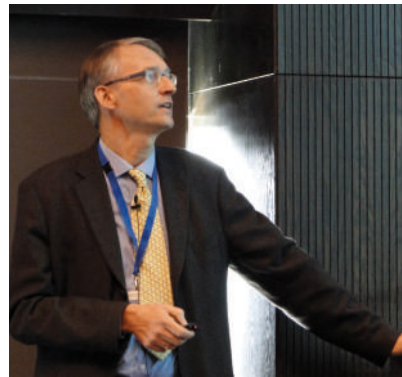
The next Corporate Liaison Day will be held at ICFO on Friday 14 October 2011. The focus theme is 'Light for Sensing'. CLP partners, interested companies, and other potential collaborators are all welcome to attend. For more info please contact us at clp@icfo.es



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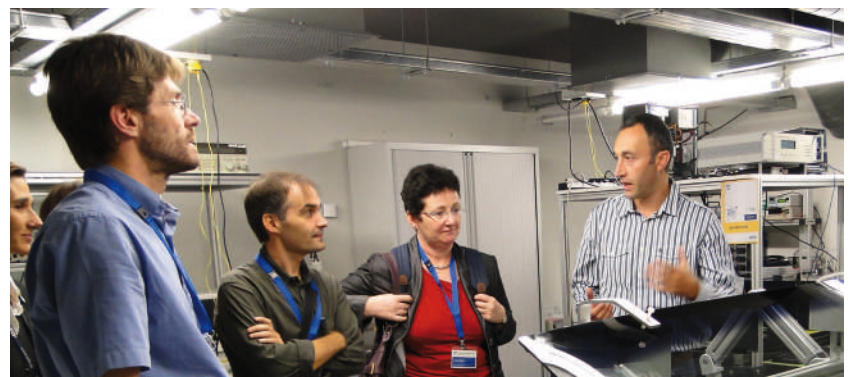
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1. ICFO Ph.D. students and postdocs presented their work in more than 20 different posters during the Annual Student Poster Session. An award for the two best posters went to former Ph.D. student Maurizio Righini and Ph.D. student Alberto Curto.

2. Giovanni Barbarossa, Member of the Board of Directors, Oclaro Corporation in San Jose, California discussing the development of energy efficient.

3. Albert Polman, Director of the Foundation for Fundamental Research on Matter (FOM) Institute for Atomic and Molecular Physics (AMOLF) in Amsterdam, The Netherlands giving his presentation on nanophotonics for energy.

4. Karl Leo, Director of the Fraunhofer Institute for Photonic Microsystems (IPMS) and co-founder of Novaled AG and Heliatek GMBH in Dresden, Germany, reviewing the field of organic photovoltaics.

5. Bruno Smets, Director of External Relations of Philips Lighting in Eindhoven, The Netherlands giving his talk on 'Emerging Lighting. Electronics and Displays.'

6. The program gave ICFOnians and ICFO industrial partners many opportunities for networking.

7. ICFO industrial partners and other collaborators were taken on a tour of ICFO's labs and state-of-the-art facilities.

IN FOCUS by Marta García Matos

Núria Beltri Jiménez:

“When I learn that a project succeeded, and the scientists are celebrating the publishing of their results, I can deeply share their joy”

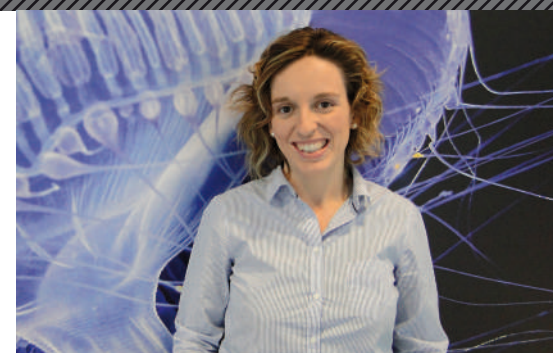
I'm listening with fascination to Núria Beltri Jiménez as she talks about ICFO as it was in its very early days, when she started working here (or, should I say, there) about eight years ago. Núria joined in 2003, after a friend who was already working at ICFO told her about an opening assistant position in accounting, she's telling me as we sit down together for our interview. Núria was offered the job, and took it, just one month before she graduated with her business degree from the University of Barcelona.

Back in 2003, ICFO was still in its first year of existence. It consisted of just two departments on each side of a corridor on the second floor of the Technical University of Catalonia (UPC)'s Nexus Building in Barcelona. On one side of the corridor was the Administration Department with its five members of staff, and on the other was the research unit with its four ICFO Group Leaders and their postdoctoral researchers and Ph.D. students. “In the Administration Department, even though we each had well-determined tasks, every one

of us used to do a little bit of everything,” Núria says. “Together with the researchers, we were like a big family. I learned by doing, and it was there that I grew the habit of working as a team with my colleagues.”

Since those early days, Núria has watched ICFO move to a new building of its own in its current location of Castelldefels and continue to grow and expand; nowadays, there are about 40 people working in three Administration Departments located on three different floors. In 2010, Núria became Head of the Projects Unit, which handles all administrative tasks related to R&D projects from beginning to end. Her job entails “justifying the costs in a proposal, preparing reports, coordinating efforts, managing unexpected things as they come up,” she says. Altogether, Núria coordinates the work of five people in her unit.

The context may have changed over the years, but what Núria enjoys most about her job at ICFO remains the



same: the feeling of belonging to the ICFO community and of being part of the machinery that helps ICFO move forward. “When I learn that a project succeeded, and the scientists are celebrating the publishing of their results, I can deeply share their joy,” Núria says. It usually involved many months of Núria being around to help support the project as it grew.

On the downside, “Once a project is over, I feel a kind of a void. The final report is written, the accounts are closed, and the team” of researchers and administrative staff from ICFO and other centers “gets dissolved,” she says. But the nature of her job gives her little time to think about that, Núria adds. “New projects come up all the time, new partners, new rules, new challenges... That's something I love about my job, the constant change, the constant learning, and the constant fun!”

**Núria Beltri Jiménez holds the position of Head of the Projects Unit at ICFO*

BEYOND ICFO by Miguel García Granda

As a kid, I grew up fascinated by the natural and the technological worlds... Then, at the University of Oviedo in my native Spain, I also very much enjoyed studying physics. But my experience there and, later on, during a Ph.D. in optoelectronics at the University of Paderborn in Germany, always involved only basic research. Attracted by the possibility of working closer to real-life applications, I decided to join ICFO for a postdoc after doing a joint project with ICFO Group Leader Valerio Pruneri as a Ph.D. student.

I started my postdoc in 2008 in Valerio's optoelectronics research group. My work focused on designing and developing new fabrication processes for electro-optical devices such as high-speed, low-power modulators for the next generation of high-bandwidth optical fiber communications. Such modulators are expected to allow transmission speeds at least 10 times greater than those we know today, enable the development of all-optical networks, and reduce the costs and energy consumption of optical communications.

At ICFO, I had the opportunity to learn more about the equipment and the ‘off-stage’ work required before research can even start than I probably would have in other places. As a brand new research institute, ICFO offered many new facilities and a broad range of technologies but, on the other hand, much remained to be done in terms of setting up new equipment, new processes, and even whole new labs... which proved a lot of fun! With the help of my research colleagues and support staff at ICFO, I developed a new electrodeposition



Miguel García Granda:
“While working at ICFO, I had the opportunity to learn about the equipment and ‘off-stage’ work needed before the research can even start”



setup from scratch to fabricate high-speed micro-electrodes and other fabrication processes.

At the same time, I had the chance to take part in applied projects in collaboration with outside partners, developing a laser link to download data from satellites in orbit and also designing and fabricating novel components to be used in experiments related to quantum optical communications. These experiences all helped me get a better idea of what kind of research is going on in other institutions and countries as well as how industry works.

This allowed me, after spending 20 months at ICFO, to take a job as a R&D engineer at greenTEG, a company located in Zürich, Switzerland that develops novel types of thermo-electric generators. GreenTEG's technology is based on microfabrication and electrochemical processes, and although these are not related to photonics, I actually felt much at home with my new tasks, which include designing and simulating thermo-electrical devices and developing new fabrication processes. At my new place, I also took on some responsibilities on the safety management side of things, for example taking care of chemicals inventories and protection equipment.

My time at ICFO was rather short, but it was intense. It was an opportunity for me to learn very fast, in a way that was very different to what I had been used to before. This helped me tackle new research challenges and adapt quickly to my new, industry environment.

**Miguel García Granda holds the position of R&D engineer at GreenTEG, Zürich*

IN THE FRAME

European Research Council Grantees at ICFO

Starting in 2007, the European Research Council (ERC) has been supporting frontier research projects through the prestigious Starting Independent Researcher Grants and Advanced Investigator Grants. ERC Grantees at ICFO tell us how the funding will benefit their research



ANTONIO ACÍN

ERC Starting Grant, July 2008

My research is in quantum information theory. The main goal of the field is to understand how quantum laws could modify the way information is processed and transmitted. While classical information theory has governed our communication society since 1949, combining it with quantum physics -- the physics of the microscopic world -- offers the promise of powerful computers and unbreakable cryptographic protocols.

The quantum communication scenario of the future will consist of quantum networks: nodes that are connected as in today's communication networks but with the extra capability of sending information encoded on quantum particles. A crucial problem is to understand how entanglement, an intriguing form of quantum correlation, gets distributed in such network, and this forms the topic of my ERC project.

The Grant gave a very important boost to my group's activities and opened up nice perspectives, both from a theoretical and experimental point of view. For instance, we have started applying the concept of networks to different problems and recently showed that quantum networks offer a promising scenario for the detection of quantum non-locality. Looking to the future, it would be nice to collaborate with an experimental group for the realization of some of the theoretical ideas that we are developing as part of our project.



MACIEJ LEWENSTEIN

ERC Advanced Grant, August 2008

How much particles move around within a system depends on the temperature. That's one of the basic principles of physics, but its manifestation depends on the scale you're looking at. In our everyday world, all particle motion stops at the temperature of absolute zero. But, in the quantum world, even at absolute zero particles continue to be agitated with minute, quantum fluctuations. Since the famous realization of Bose-Einstein condensation in 1995, we know that particularly useful to study these ultralow temperatures are ultracold atomic and molecular gases. My group studies these kinds of systems and their properties and applications from a fundamental point of view.

At stake are various open questions in condensed matter physics, for instance why some electrical conductors stop showing resistance or heat loss when they reach temperatures that are low but nonetheless much higher than for most other electrical conductors (hence their name of 'high temperature superconductors'). Better understanding this phenomenon could help us create novel states of quantum matter such as Bose metals.

The impact of the ERC Grant on my work has been enormous and my group has grown quite significantly since. We have also spurred a truly international interest in the subject with both theoretical and experimental groups getting onboard, and I expect that this area will bring many seminal results, not only from us but also from many other groups.



NIEK VAN HULST

ERC Advanced Grant, November 2009

My ERC project aims to push forward the ICFO research on nano-antennas. Just like TV antennas and radio signals, the job of optical nano-antennas is to optimize the emission and reception of a light signal. We recently made nano-optical antennas with detail as small as 25nm and used them to control the direction of photon emission from single quantum dots for the first time. These pioneering results on close encounters between nano-antennas and photon emitters open the door to new physical phenomena that include super-emission, single photon beaming, and quantized plasmons.

The ERC research paves the way for a profound understanding of the fundamental limits of optical control at the nanoscale. The new tunable photon super-emitters and nano-antennas also offer new perspectives for the control of single photon sources for quantum information, light harvesting, energy conversion, efficient biosensors, and optical imaging with 10 nm resolution.

The ERC Advanced Grants are truly competitive and getting one came as a nice surprise. The grant has given me enormous flexibility in my research and allowed me to attract several new postdocs. It also made it possible for us at ICFO to purchase an expensive, focused ion beam microscope for the Nanophotonics Fabrication Laboratory.



ROMAIN QUIDANT

ERC Starting Grant, October 2010

The ERC Grant will enable us to advance our research in the field of plasmon nano-optics. Plasmon nano-optics studies the extraordinary optical properties of metallic nanostructures with a size typically ranging from 10 to 100 nm. The last 5 years of research in the field have demonstrated that it is possible to control light or heat at the nanometer scale through the use of plasmonic nanoparticles.

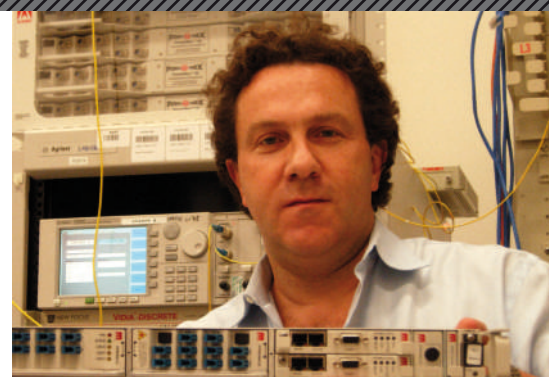
In our ERC project we set to use plasmonics to help address some major roadblocks in other fields of science like chemistry and quantum optics. In particular, our research is expected to contribute to the development of integrated quantum platforms, which should in turn help us advance our fundamental understanding of matter and design a whole new generation of devices.

Receiving an ERC Starting Grant has been great news. It was a nice acknowledgement of all the hard work we did over the last several years and of its international impact. The ERC funding also offers a unique opportunity to initiate new research lines that are high risk but that could potentially have a great impact on science. The ERC Grant will enable us to hire new staff, both at the Ph.D. and postdoctoral level, and set up a range of new experiments.

HIGH PROFILE



Giovanni Barbarossa: “Look at what the world needs, not wants”



GIOVANNI BARBAROSSA is Member of the Board of Directors at Oclaro Corporation in San Jose, California, a tier 1 provider of innovative optical and laser components and solutions for telecommunications, industrial, consumer electronics, medical, and scientific applications

Where do you see the most exciting scientific challenges lie in the field today?

Fifty years after the invention of the laser, and 40 years after the first optical waveguides were made on a chip, large-scale photonic integrated circuits are not a commercial reality yet. I believe this is still a major challenge. The support of the scientific community in bringing to the next step what is already working will be crucial. Sometimes I think that there have been more efforts in coming up with new technologies than in improving existing technologies, delaying, therefore, the advent of the photonics equivalent of the CMOS technology.

You went from doing a Ph.D. in electrical engineering to working in business management. How did you make the transition?

I think it is important to keep in mind that as long as a scientist makes one step at a time, the chances to fail are lower. The most critical step for me was when I moved with the technology I developed at Bell Labs from a research organization to a business division. It gave me a great opportunity to see the results of my work being deployed. I could have delegated the task to others, but I would have not learned what I learned. Therefore, that step of the

transition came from abandoning a comfortable position and taking a new, challenging one. This is true in general to advance in your career. Obviously, it is all about opportunities -- sometimes they just come, but if they don't you need to find them.

Also, mentoring comes from where you are. Moving to a business organization will be challenging, but only there will you have the opportunity to learn, hands-on, about business one step at a time.

What do you find most exciting or challenging about your job?

In research, your results depend on the resources you have and on your own efforts. In business management, your results depend on the resources you have and on the efforts of several other people with skills and experiences substantially different than yours. Team efforts are common in research too, but an individual researcher can produce results alone and research teams are made of scientists. This is quite difficult to accomplish in business: you need lawyers, sales people, market researchers, etcetera...

What skills and attitudes does one need to work in business management?

Business is about many things, but probably most

importantly it is about making money. And in order to seek that objective decisions need to be taken. I think the ability to take very difficult decisions is quite rare. Sometimes your heart tells you one thing, but your brain tells you another. If you want to be successful in business, never do what your heart is telling you.

Also, your customers ultimately pay the bills and decide your success. So you want to make sure you know how to deal with customers, you must know what they need, and if you know that better than your competitors, even better.

Finally, never underestimate your competitors. This is generally true in any competitive environment. The business environment though is sometimes very aggressive and does not leave room for cavalry.

Any advice for young scientists on how to make the transition?

Focus on research that is not just beautiful but also useful. Look at what the world needs, not wants. Make sure you advertise your results so people are aware of them, and if what you came up with is indeed needed, you will have a chance to move out of research if you want to.

SUDOKU

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