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Fall 2024

Focusing on the Future

Meet the 2024 Summer Fellows

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HIGH PROFILE
SCIENCE QUIZ

Mystery ICFOnian

Solution Ed #57

David Alcaraz Iranzo
Staff Researcher, Quantum Nano-Optoelectronics group

Science Quiz

Answers from p.12

1:A **2**:C **3**:B **4**:D

ON THE COVER

Focusing on the Future

Meet the 2024 Summer Fellows, the 18th cohort of undergraduate and Master's students who have spent the summer at the institute, carrying out challenging research projects under the supervision of a Group Leader and with the assistance of Postdocs or PhD students. They are an important reflection of ICFO's mission to inspire and train the next generation scientists and technologists. Read all about it on page 7.

EDITOR'S CORNER

Looking Ahead

Brook Hardwick
Contributing Editor

The best way to predict the future is to build it

Cuqui Silva, our High Profile interviewee (pg. 12), who spearheaded the launch of the European Research Council (ERC) during his tenure as Director General of Research at the European Commission, aptly stated: "*The ERC produces intangibles—it generates things for the future. In fact, it's about future science.*" This sentiment captures the essence of this edition of ICFOnians. Much of what we do at ICFO revolves around the future: nurturing young minds to become leaders in science and technology, undertaking projects to generate new knowledge that might one day answer questions we haven't yet imagined, and aiming high and crafting strategies to ensure ICFO remains relevant and impactful in a rapidly evolving world.

Since receiving our first ERC grant in 2007, when the program was first launched, ICFO has proudly secured **50 ERC grants**. These have been instrumental in supporting the ambitious scope of our research programs, and in some key cases facilitating the translation of findings into market innovations. They have also played a pivotal role in attracting talented PhD students and postdoctoral researchers, giving them opportunities to grow through challenging projects. They have helped us lay strong foundations and achieve remarkable milestones, and encouraged us to set ever higher goals for the future.

The **Training and Outreach programs** at ICFO are a strategic investment in the future of both science and society. This future depends on young minds, new ideas, an endless supply of human brain power and motivation.

Enthusiastic students converge at ICFO during the summer months for the **Summer Fellows program** which has been inspiring students since 2007, and also through more recent programs like Fundación Catalunya la Pedrera's **Barcelona International Youth Science Challenge**. ICFOnians, passionate about exploring the frontiers of knowledge, generously share their expertise, leaving a lasting impression on these students, many of whom go on to successful careers in academia, technology, and beyond.

Our already significant commitment to education has expanded further through our coordination of the **Catalonia Quantum Academy (CQA)**, a collaborative platform that is the educational pillar of the Quantica- Mediterranean Valley of Quantum Science and Technologies initiative of the Generalitat of Catalunya. The CQA will bolster existing programs and introduce new initiatives designed to attract and develop talent essential for advancing quantum technologies and realizing their vast potential.

Founded in 2002, ICFO remains committed to the mission to conduct frontier research, train future scientists and technologists, and translate advances in our labs into societal impact. This mission guided our founding director, Lluis Torner, who has always had one eye on the future to keep ICFO at the forefront of scientific progress. This September, Oriol Romero-Isart began transitioning into the role of ICFO's director, where he will oversee the next chapter of ICFO's story. This change marks a continuation of our voyage into the future—one committed to excellence, and filled with opportunities to expand our horizons and amplify our impact.

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Happenings

ICFO NEWCOMERS

Welcome to ICFO

Many of us joined ICFO or took a new position at the institute between July and September

Xin Jin
Student

Marc Camús
Student

Alejandra Gómez
Student

Prathama Haldar
Student

Jakub Wronski
Student

Joaquín Gabriel Márquez
Student

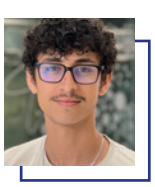
Claudio Fierri
Student

Claudia Román
Student

Paula Pertegaz
Student

Zoi Sargianni
Student

Ana Sánchez
Student



Achraf El Ouaadouni
Internship Student

Mustafa Berkay Sökmen
Summer Fellow

Guillem Masdemont
Summer Fellow

Albert Jiménez
Summer Fellow

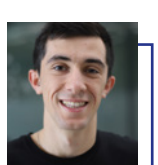
Martina Berglund
PhD Student

Tengyu Chen
PhD Student

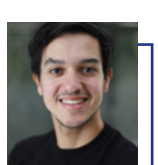
Mariia Shevchenko
PhD Student

Bertrán Soria
PhD Student

Marta Martos
PhD Student



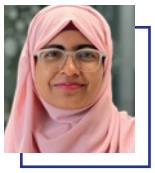
Alejandro Martín
PhD Student



Martín Fernández
PhD Student

Hümeyra Azize Malay
Visiting PhD Student

Sumana Chetia
Postdoctoral Researcher



Sumaiya Parveen
Postdoctoral Researcher

Alimuddin Mir
Postdoctoral Researcher

Niccoló Baldelli
Postdoctoral Researcher

Manuel Gundín
Postdoctoral Researcher

Jorge Fuenzalida
Postdoctoral Researcher

Yaotong Chen
Postdoctoral Researcher

Ediz Herkert
Postdoctoral Researcher

Marina Cunquero
Postdoctoral Researcher

Kaiqi Zhao
Postdoctoral Researcher

Heba Abdelmaksoud
Visiting Scientist

Belen Albela
Visiting Professor

Tamar Pereg-Barnea
Visiting Professor

Teri Odom
Visiting Professor

Ariane Stucki
Project Engineer

David Kernan
Project Engineer

Luca Bolzonello
Staff Researcher

Ewa Wójtowicz
Management

Nicolás Fuenmayor
Management

Natalia Tuttolomondo
Management

Iñaki Barettini
KTT

Not pictured

Albert de Miguel, Student

Timon Damböck, Student

Emilio Pérez, PhD Student

Esther Alarcon, Visiting Professor

Júlia Cajas, Management

Happenings

ICFO NEWS

Passing the baton

On September 1st, 2024, **Prof. Oriol Romero-Isart formally assumed the responsibilities of director and legal representative of the ICFO Foundation**, reporting to the Board of Trustees.

He becomes the second director to lead ICFO, succeeding Lluis Torner, who has been at the helm of the institute since its founding in 2002.

Barcelona's Strategic Plan for Science and Innovation

Barcelona's Mayor, Mr. Jaume Collboni, presented the new Strategic Plan for Science and Innovation 2024-2027, which for the first time explicitly **incorporates technology and knowledge transfer to the business sector as a highlight of the growth of the city.**

Leading research entities in the Barcelona metropolitan area, including ICFO, participated in an Advisory Board which led to the creation of the Plan calling for Barcelona to be decisive in the design and production of electronic and photonic chips, to consolidate itself as the capital of biotechnology and health sciences, especially in the fight against neurodegenerative diseases such as Alzheimer's and dementias, and also be one of the European capitals in the creation and use of quantum technologies.

2023 JAP Early Career Investigator Selection's Best Paper Award

The Journal of Applied Physics (JAP) announced the winners of the 2023 ***JAP*** **Early Career Investigator Selection's Best Paper award,** including **Prof. Georgia T. Papadakis,** leader of the Thermal Photonics group at ICFO. She is recognized for the paper ***"Dynamic modulation of thermal emission – a tutorial,"*** co-authored with group members **Michela F. Picard and Kartika N. Nimje.**

Highlighting the exceptional work of PIs who received their PhDs less than 10 years ago, this award is an annual featured collection covering all areas of applied physics research. This year's collection consists of 45 papers, which a Selection Committee whittled down from 119 eligible entries. Prof. Papadakis is one of three winners who will have their papers highlighted in this year's virtual collection. They will also be invited to join the JAP Editorial Advisory Board and to serve on the Selection Committee for next year's Early Career Investigator Selection and Best Paper award.

The ERC awards ICFO its 50th Grant

The European Research Council, founded in 2007 by the European Commission with the mission of encouraging excellence in frontier research across Europe through competitive funding, has succeeded over the past 17 years in supporting top researchers across all fields and at different career levels, helping to strengthen the European scientific community and in turn, providing the building blocks for a strong and innovation driven economy.

ICFO researchers have reached the 50th grant milestone, an important moment for reflection on the impact that ERC funding has had on the center's frontier research program as well as the role that it has had in facilitating the innovation journey of frontier advances from our labs to society.

ICFO has proactively sought out ERC funding for research and to advance the TRL of new technologies developed in our labs through the different modalities that support the needs of researchers at different moments in their career trajectories. ICFOnians have been remarkably successful in their applications, reaching a milestone that is even more remarkable considering the size of the institute.

"Advancing the very frontiers of knowledge is a fascinating and challenging endeavor. It is championed by motivated and talented people that have proper resources and support. The ERC has made it possible for top researchers from anywhere in the world to do the very best science in Europe, a vision that ICFOnians fully support," remarked ICFO founder Prof. Lluis Torner.

GEIC Award for Best Doctoral Thesis in Information and Quantum Technologies

The first edition of the thesis award of the **Specialized group on Quantum Information (GEIC) of the Royal Spanish Society of Physics** recognizing the best thesis in the field of quantum information and technology, theoretical or experimental, defended in Spain between January 1, 2022 and December 31, 2023, has been awarded to **ICFO PhD graduate Dr. Paolo Abiuso.**

Dr Abiuso defended his thesis titled *'Optimization and Geometry for Quantum Information tasks'* in December 2022. His work, cited for its broad theoretical contributions in the area of quantum information, including thermodynamics, metrology, and non-locality, was **supervised by ICREA professor at ICFO Dr Antonio Acín,** leader of the Quantum Information Theory group.

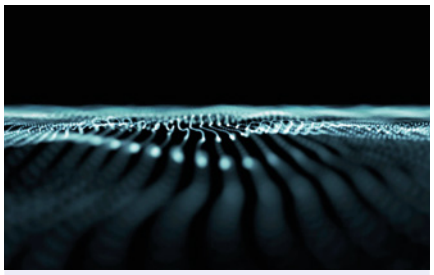
2024 RSEF-BBVA Physics Awards

The **Royal Spanish Physics Society-BBVA Foundation Physics Awards** recognizes creativity, effort and achievement in the field of physics, with the aim of serving as an incentive for professionals who carry out their work in research, secondary and university education, innovation, technology and dissemination.

This year's jury awarded the **Young Investigator award in Theoretical Physics to ICFO PhD graduate Dr. Martí Perarnau Llobe**t who carried out his doctoral studies in the Quantum Information Theory group led by **ICREA professor at ICFO Prof. Antonio Acín.** This award recognizes Martí's significant contributions to the field of quantum information, in particular **quantum and stochastic thermodynamics.** In this field, he has explored the nanoscale thermodynamic properties of physical systems with a major impact on quantum technologies. His pioneering work opens new avenues for the optimization and manipulation of open quantum systems, information processing, and metrology.

Happenings

LATEST ADVANCES



Going beyond energy: ground-state properties unlocked in a certifiable and scalable way

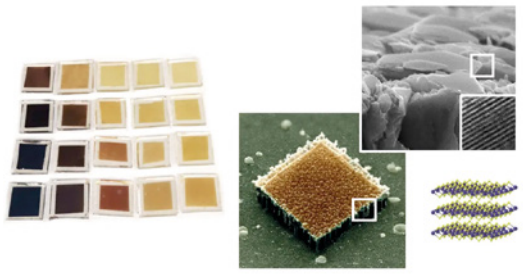
Discovering the exact value of ground-state properties becomes harder as the number of particles increases, reaching a point where even a supercomputer would not be able to find the solution.
To circumvent this obstacle, there are two numerical methods that bound the energy of the ground state: the variational and the relaxation methods. They provide an upper and a lower bound, respectively. Although the exact ground-state energy is still uncertain, it will be for sure contained between those two values. The closer the bounds are, the less uncertainty there will be on the energy.

Nevertheless, when these techniques are applied to other different properties, it is not possible to know whether the obtained quantities are close to the real value, as they are no longer ensured to be upper or lower bounds.

In a ***Physical Review X*** article, a team with the participation of ICFO researchers **Dr. Jacopo Surace** and **ICREA Prof. Antonio Acín** has now shown how, **by taking into account the variational and relaxation results for the energy, one can derive certifiable bounds on other ground-state properties in a scalable way.**

With their approach one can be sure that the actual value of a given ground-state property lays within the obtained range. Again, the ability to get the limiting bounds closer will increase the accuracy of the predictions. The novelty of the article lies in the fact that the energy bounds given by the variational and relaxation methods are now considered, which leads to a significant improvement (by an order of magnitude) with respect to previous attempts. **The resulting method exhibits, for the first time, competitive performance when certifying ground-state properties beyond the energy.**

Photoanodes made from 2D tin sulfide nanosheets enhance the visible light absorption of photoelectrochemical devices



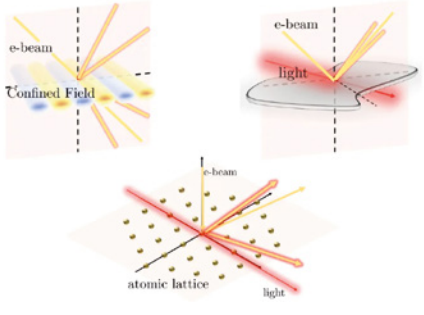
Photoelectrochemical (PEC) water splitting and CO_2 reduction based on solar energy is a promising approach for the production of green hydrogen and the conversion of CO_2 into renewable fuels or feedstock. However, the deployment of PEC systems is limited by inefficient absorption of visible light by metal oxide photoanodes.

Recently, 2D atomically thin transition metal chalcogenides have become the center of attention for their efficiency, tunability, and low cost, making them suitable for PEC applications due to their promising absorption features. Among these materials, tin sulfides have attracted interest due to the abundance of tin and sulfur, their fabrication simplicity, semitransparency, and enhanced photocatalytic activity.

In a new study published in the ***International Journal of Hydrogen Energy***, ICFO researchers and **SOREC2 team** members, **Dr. Carles Ros** and **Prof. Dr. Jordi Martorell**, in collaboration with other national institutes, **demonstrate the potential of solution processed photoanodes made of 2D tin sulfide nanosheets in photelectrochemical systems** by showing their ability to absorb and convert visible light into chemical energy. These results establish them as promising materials for enhancing PEC applications, including solar fuels and hydrogen production.

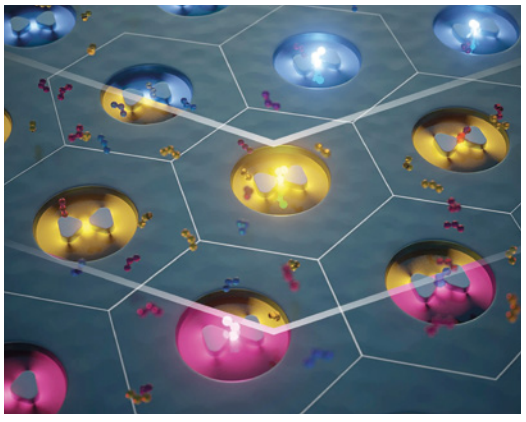
The interaction of low-energy electrons with light reveals quantum effects

In general, the electron beams employed in electron microscopes have kinetic energies significantly higher than those of the optical fields. Then, the probability of a single electron interacting with a single photon becomes much smaller than unity, which in turn implies a weak electron–light coupling. This hinders the capabilities of electron microscopy techniques for imaging atomic excitations and accessing the plethora of quantum nonlinear effects in nanostructures.



To access such phenomena, one needs to close the energy gap by lowering the electron energies until they are comparable to the photon ones. This approach has now been tackled in a ***Science Advances*** article led by ICFO researchers **Adamantios P. Synanidis, Dr. P. André D. Gonçalves,** and **ICREA Prof. Javier García de Abajo,** where they **theoretically show exotic quantum effects emerging from low-energy electron–light interactions** that do not manifest in the conventional high-energy regime.

Besides its fundamental interest, the study finds potential applications in ultrafast electron microscopy or metrology. In the long-term picture, these results could also contribute to build more compact electron microscopes, since low-energy electrons can greatly simplify some aspects of the current electron-microscope columns. Additionally, the use of low-energy electrons increases electron–light coupling without the need for strong light fields, which enables electron-based spectroscopy of sensitive samples, such as biological ones.



Novel nanoantennas enable sensitive multicolor single-molecule detection with unprecedented throughput

ICFO researchers **Ediz Kaan Herkert, Lukas Lau, Roger Pons Lanau,** led by **ICREA Prof. María F. García-Parajo**, have **developed a nanoantenna platform capable of enhancing fluorescence emission across the entire visible spectrum, enabling multicolor single-molecule detection at micromolar concentrations** (the concentration level at which many biological molecules, interactions, and reactions occur). The proposed method can also address more than a thousand nanoantennas in parallel, speeding up data acquisition times and leading to high throughput (that is, the amount of information that can be processed in a given temporal window).

These results, which have been published in ***ACS Applied Materials & Interfaces***, are unique milestones that were very hard to experimentally demonstrate in the past, but the ICFO team has now succeeded in unlocking them efficiently.

The proposed design, which utilizes high-density hexagonal closed-packed AiBs (HCP-AiBs) made of aluminum, could be used in multicolor biosensing applications to study interactions between different proteins on the cell membrane or to monitor biomolecular binding kinetics, both with enhanced single-molecule detection sensitivity.

Happenings

BUSINESS NEWS

Spain launches ESA Phi-LabNET in Barcelona to boost space innovation

ICFO will participate in the multidisciplinary consortium focused on space technologies and their application to boost climate resilience

Phi-Lab NET Spain, presented at the NewSpace Economy Congress 2024 in Barcelona, will be a new infrastructure headquartered in the RDIT building just opposite ICFO facilities in the 'Parc Mediterrani de la Tecnologia'. This new center will foster collaboration between academia, industry and investors, boosting space innovation **within the ScaleUp Programme of the European Space Agency (ESA).**

Consortium members:

- IEEC (Coordinator)
- i2CAT Foundation
- The Cartographic and Geological Institute of Catalonia (ICGC)
- Fundación General CSIC
- Knowledge Innovation Market Foundation (KIM)
- ARRIBES Enlightenment
- Universitat de València (UVEG)
- Universitat Politècnica de Catalunya (UPC)
- Barcelona Supercomputing Centre (BSC-CNS)
- Ricardo Valle Institute of Innovation (IRV)
- ESA's MELiSSA Pilot Plant (UAB)
- ICFO

23 ESA Member and Associate States have committed a total of 117.6 million euros to the ScaleUp programme and, thanks to the support of the **Spanish Government**, the **Ministry of Science**, **Innovation and Universities**, through the **Spanish Space Agency**, has contributed 12 million euros to the programme. The Spanish Phi-Lab will have an annual co-financing model including a 1.1 million euros provision for projects.

The launch of the **Phi-LabNET Spain in Barcelona**, which will form part of the Phi-Lab NET, represents a fundamental pillar of the ScaleUp Programme, **an initiative designed to accelerate the commercialization of space and foster the growth of private investment in the space sector.** The Barcelona program, **focused on space technologies and their application to boost climate resilience,** will have important co-funding from the consortium entities, whose main contribution comes from the **Government of Catalonia**, with more than 8 million euros, through the three entities that collaborate in the deployment of the **NewSpace Strategy of Catalonia:** the IEEC, the i2CAT Foundation and the Cartographic and Geological Institute of Catalonia (ICGC).

With the mission to bring innovation and application together, Phi-LabNET will open the way for pioneering ideas to reach the market, thus supporting Spain in its goal to become a European leader in space exploration and technology. Phi-LabNET Spain will offer, in addition to funding and a large knowledge network, IP management, technical support, access to infrastructure and business coaching. It will provide comprehensive support to all selected projects.

New ICFO CLP Member

Thorlabs join's ICFO's Corporate Liaison Program

ICFO's Corporate Liaison Program (CLP) helps to strengthen relationships between industry and science. Through this program, the Knowledge and Technology Transfer team proactively establishes partnerships with industrial corporations, creating trusting and long-lasting relationships that enable the achievement of common goals. CLP members represent a wide range of market sectors, illustrating the versatility and range of applications in which photonics technologies may have an impact, as well as ICFO's mission to contribute to the knowledge based economy on all levels.

New CLP member THORLABS is a vertical integrated photonics products manufacturer serving the Photonics Industry from research to industrial, life science, medical, and defense segments. Its manufacturing assets include fabrication facilities for semiconductors, optical fibers, epitaxial wafer growth, glass and metal shops, thin film deposition, and optomechanical as well as optoelectronic shops.

THORLABS

More info
www.thorlabs.com

New Proof of Concept Grant

ERC Funding to develop Heterogeneous Integrated Short-wave Infrared Colloidal Quantum Dot Lasers

The European Research Council, in its efforts to help ERC grant-holders to bridge the gap between their research and the earliest stage of a marketable innovation, created the Proof of Concept (PoC) funding scheme for researchers who have already been awarded an ERC grant. Not only does this program help ERC grantees to explore the innovation potential of their research and/or commercialize the results of their ERC-funded research, the program complements the efforts of ICFO's Knowledge and Technology Transfer Unit (KTT), which proactively searches for ways to translate newly generated knowledge into new technologies.

In a press release from the ERC announcing the award of 100 new Proof of Concept Grants, Iliana Ivanova, European Commissioner for Innovation, Research, Culture, Education and Youth, put into context the importance of these grants, stating:

> *Since 2011 when the scheme started, ERC grantees have received over €300 million in Proof of Concept grants. Thanks to Horizon Europe funding, they could advance on the path from ground-breaking research to innovation. These researchers are a great example of how to translate and commercialise the strong research output funded by the EU.*

ICREA professor at ICFO Gerasimos Konstantatos is one of the recipients of the Proof of Concept grant in this, the first round of the 2024 competition. His new project, entitled **IRQUAL**, is his fourth PoC to date, the sixteenth award of this kind for ICFO since the launch of the PoC grant scheme. **The main goal of this project is to explore and develop a new generation of solution-processed, versatile infrared laser technology that can be produced at scale and be compatible with CMOS electronics.**

IRQUAL addresses the critical need for compact, low-cost and integrated lasers operating in the short-wave infrared (SWIR) spectrum (1.3 – 2.5 μm) for diverse applications such as consumer electronics, automotive, IoT, and AR/VR. It will further focus on the potential commercialization and exploitation of this technology by developing a strong intellectual property portfolio as well as engaging with leading industrial figures that could assist in the development and validation of the technology. **In summary, this project pioneers a new era in SWIR laser technology, featuring compactness, cost-effectiveness, and scalability for a multitude of high-impact applications.**

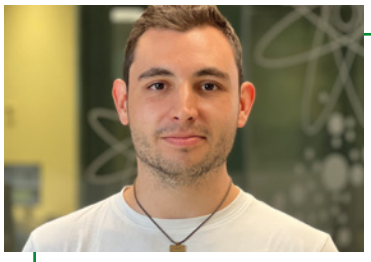
Collaboration

TRAINING

ICFO Summer Fellows 2024

ICFO welcomed 10 undergraduate and Master's students to spend the summer at the institute, carrying out challenging research projects under the supervision of a Group Leader and with the assistance of Postdocs or PhD students

The Summer Fellows attended a full program of activities, including a series of Summer Lectures that introduce newcomers to the many different research lines at ICFO, as well as lab tours and other activities that allow young scientists to experience ICFO as a researcher.



Llorenç Balada

Quantum Information Theory group led by ICREA Prof. at ICFO Antonio Acín

"During my university studies I heard about ICFO as a leading center in quantum information theory, the field I am most interested in. The SF program let me meet the main researchers in the subject and to do research with them.

Albert Jiménez

Attoscience and Ultrafast Optics group led by ICREA Prof. at ICFO Jens Biegert

"One of the best experiences of the program where the lectures and lab tours that were offered throughout the three months. We were able to learn about new interesting research fields that we weren't aware of.

Alice Lorrach

Neurophotonics and Mechanical Systems Biology group led by Prof. Michael Krieg

"I loved the way that I was given an actual project to work on autonomously. This experience has allowed me to immerse in the life of a researcher and to confirm my interests.

Maria José Londoño

Molecular Nanophotonic group led by ICREA Prof. at ICFO Niek van Hulst

"I wanted to gain some research experience before completing my undergraduate studies and ICFO provided me with the ideal opportunity to make that goal a reality.

Guillem Masdemont

Thermal Photonics group led by Prof. Georgia Papadakis

"After this internship, I feel much more confident and better equipped to learn complex topics on my own.

Sara Mollo

Ultracold Quantum Gases group led by ICREA Prof. at ICFO Leticia Tarruell

"The labs were what surprised me the most- it all looked very complex. But I also felt very welcomed in my group and was comfortable to ask and learn.

Carles Roqué

Photon Harvesting in Plants and Biomolecules group led by Prof. Nicoletta Liguori

"At first, I experienced "impostor syndrome", feeling that I might not be up to ICFO's standards. My group was incredibly supportive, teaching me everything I needed to know and showing how I could actively contribute to their research.

Mustafa Sökmen

Functional Optoelectronic Nanomaterials group led by ICREA Prof. Gerasimos Konstantatos

"One month before I would start my position as a Summer Fellow in the Ultracold Quantum Gases group, I was invited by the group leader, Prof. Dr. Leticia Tarruell, to visit their laboratories. This friendly welcome reinforced my decision of applying to their group and helped me to fearlessly integrate into their working atmosphere.

David Vera

Neurophotonics and Mechanical Systems Biology group led by Prof. Michael Krieg

"At the begging I was a little nervous because I don't have in depth knowledge in physics, but ICFO is a place where different branches of science can converge and become a network for the different researchers. It was a wonderful experience that opened my mind to how to do science.

Ángel Vilar

Photon Harvesting in Plants and Biomolecules group led by Prof. Nicoletta Liguori

"I was struck by ICFO's modern facilities and the dynamic atmosphere of the labs. Even though my work was focused on biochemistry and biophysics, I quickly realized that ICFO was a place where different scientific disciplines intersected.

Collaboration

TRAINING

Beyond ICFO 2024: Machine Learning and AI

Bringing together hot topics in European policy, science, and industry with career opportunities for ICFOnians

On Friday, September 20th, the ICFO Alumni Network hosted the annual Beyond ICFO careers event that serves as an opportunity for current ICFOnians to listen to the experiences and get professional advice from members of the Alumni Network.

You would need to live under a rock to have missed the buzz surrounding Machine Learning and AI that have been the subjects of discussions from a European research funding standpoint and under active inquiry by the scientific community for some time. Now, thanks to the advent of generative AI apps available to the general public for scientific and non-scientific use, they are part of the daily discourse that is all over the media.

So, how does this effect our community, our research, and the careers of scientists as they head out of academia to pursue roles in industry? Thanks to expertise on this subject amongst members of the ICFO Alumni Network, we were able to bring together a wide range of career perspectives of interest to ICFOnians.

Keynote Address: Quantum Technologies in Europe

Christian Trefzger, Principal Administrator of Quantum Technologies & High-Performance Computing at the European Commission (ICFO PhD graduate 2010)

The talk offered insights on the European Commission's policy on quantum science and technology, including the AI innovation package. Christian highlighted EU plans to organize funding for different strategic sectors of Quantum Technologies.

Alumni Panel

- **Alexandre Dauphin**
  VP Quantum Simulation, Pasqal
  (postdoc ICFO 2015-2023)
- **Anna Kubasiak**
  AI Global Black Belt, Microsoft
  (ICFO PhD graduate 2011)
- **Gorka Muñoz**
  Marie Skłodowska-Curie Postdoc Fellow, AI for Science, Leopold-Franzens Universität Innsbruck
  (ICFO PhD graduate 2020)

* *Moderated by ICFO PhD student* ***Krystian Nowakowski***

The panel discussion explored the evolution of AI and machine learning in science and industry, tracing its development to the present and speculating on near-future possibilities. We examined the role of machine learning in physics research, concluding that its use will continue to expand, making it essential for everyone to gain proficiency in this area.

Panelists discussed potential entry points for PhD graduates interested in applying machine learning in industry. While the field is becoming increasingly competitive, ICFO graduates retain a strong edge thanks to their analytical skills.
This advantage is even greater when complemented by proficiency in Python and, ideally, a personal project showcasing machine learning applied to intriguing problems-preferably shared on GitHub.

Strengthening Interdisciplinary Collaboration at the Frontiers of Research Schools

Frontiers of Research School: Light for Energy and Information Processing

The most recent Frontiers Research school, hosted by **ICFO in collaboration with AMOLF**, highlighted the importance of interdisciplinary collaboration—essential for advancing science, yet often challenging to achieve. This year's event was designed to create lasting connections among participants. Professors from both institutes were paired to deliver joint tutorials, showcasing the complementarity of their research projects, and spent an afternoon off-site for collaborative discussions.

> *Frontiers Schools have always been a great opportunity to network with scientists from other centers. The original idea of a joint complementary talk by two PIs turned out to be very stimulating to get-to-know and connect. As a result the brainstorm discussion was a great networking success. This new format definitely gave us many ideas for future collaborations, and we are looking forward to a future edition at AMOLF.*
>
> **ICREA professor at ICFO Dr. Niek van Hulst**

Students had unique opportunities to connect through a structured "speed dating" activity, facilitating networking and the exchange of scientific interests. A creativity training session, led by an expert trainer, further promoted innovative thinking and cross-disciplinary dialogue.

> *I was excited to attend a school alongside AMOLF because it was a great opportunity to meet bright scientists from a different environment. It provided us with ample time to discuss our research, but also to connect on a personal level. I'm looking forward to seeing them again at the next school, or in conferences all around the world.*
>
> **Leila Prélat,** Nanophotonics Theory group led by ICREA professor at ICFO Dr. Javier García de Abajo

The program underscored the commitment to equipping young scientists with the tools to navigate the complexities of interdisciplinary work, fostering a network of collaboration that will drive future scientific breakthroughs.

Collaboration

TRAINING

The Catalonia Quantum Academy: building a solid educational base for the quantum future

New training platform brings together Catalonia's strong established quantum educational programs and new learning opportunities for students starting at the undergraduate level

As the world races to explore the future applications of quantum technologies, it is becoming increasingly reliant on a quantum-ready workforce, both in academia and for future quantum industries. The launch of the **Catalonia Quantum Academy (CQA),** a collaborative platform that is the educational pillar of the ***Quantica- Mediterranean Valley of Quantum Science and Technologies*** initiative of the Generalitat of Catalunya, will leverage the region's internationally recognized expertise in **Quantum Science and Technology (QST)**, to strengthen education, training and potential to create impact on a global scale through scientific and technological innovations.

The CQA launch took place within the graduation ceremony of the Master in Quantum Science and Technology on September 13, 2024

> *As an institute, we have always been convinced that it is important to make the training of the next generation of scientists and technologists a top priority, Catalonia is well positioned to capitalize on its ecosystem and to contribute on the international stage. The CQA will reinforce and strengthen this position.*
>
> **Prof. Robert Sewell**
> Head of Academic Affairs at ICFO

The CQA's course offering complement and support the educational offering in Catalonia's universities. Some well-established course offerings in Catalonia include:

- **The Master in Quantum Science and Technology,** offered by the UB, UAB, UPC, ICFO, BSC, IFAE and ICN2, with the collaboration of local and international companies working on Quantum Technologies.
- **The Master in Photonics,** a comprehensive Master's degree in the science and technology of light offered by the UPC (coordinator), UAB, UB and ICFO.

Research Excellence

From the European *Quantum Flagship to Quantum Spain* and projects within the *Complementarias* framework, research centers and Universities in Catalonia are leading a surge of activities in QST and are positioned to participate as important partners to share frontier knowledge with students for careers in academia and/or industry. The research focus **spans basic and applied topics, from theoretical and experimental perspectives** across various domains.

Building on a strong history of education in quantum sciences

Catalonia is home to a network of universities and research centers that offer scientific and technical undergraduate and postgraduate education in the area QST across various domains. The CQA, **with its technical office at ICFO**, will harness this broad experience and expand it to meet the growing needs of quantum-oriented research and innovations.

This is a proactive strategy investing in the future of Catalonia by developing young scientific and technological minds, attracting international talent, enabling mobility for students and researchers, and ensuring the relevance and competitivity of the region's higher educational system.

Actions supported by the CQA include:

- Scholarships and internships for students at the masters and undergraduate level
- Support for mobility of students and young researchers
- Visiting Scholar program
- Creation of a Career Development program
- Organization of schools and training and career development events
- Fostering of collaboration among the participating institutions

Partners

Members

ICFO · UAB Universitat Autònoma de Barcelona · Universitat de Barcelona · Universitat Politècnica de Catalunya BARCELONATECH · ICN2 Institut Català de Nanociència i Nanotecnologia · IFAE Institut de Física d'Altes Energies · i2cat · ttc Centre Tecnològic de Telecomunicacions de Catalunya

Associate Members

Barcelona Supercomputing Center · CNM · eurecat · ICMAB · IEEC

Corporate Members

cellnex · gmv · LUXQUANTA · Kilimanjaro Quantum Tech · Quside · SATELIOT · SECPhO

IN FOCUS

The Women for Africa Foundation

Supporting African women scientists like Dr. Laure Megne Tiam

ICFO has had the honor of participating in the ***"Science by Women"*** program of the **Women for Africa Foundation** since its first edition in 2016. The program has brought women scientists to ICFO to collaborate with research groups on projects of mutual interest and is an opportunity for ICFO to expand and diversify our research network. Through this program, the Women for Africa Foundation seeks to enable African women researchers to play a leading role in the transition of Africa to a knowledge-based and innovation-led economy through research that can be transferred into products, processes, services and technologies having impact on people´s lives.

Dr. Laure Megne Tiam has been a visiting scientist and Women for Africa Foundation Fellow at ICFO since April 2024 in the Nonlinear Optical Phenomena group led by Prof. Lluis Torner. She received her PhD in Physics from the Laboratory of Mechanics, Materials and Structures of the University of Yaounde and is a part-time lecturer at the National Advanced School of Engineering of Yaounde (NASEY) and at the University of Yaounde 1, Cameroon.

What is your area of research?
I work in the field of Nonlinear Optics, in particular the stability and self-organization of dissipative solitons in nonlinear metamaterials.

How do you hope to advance your research during your stay at ICFO?
I am a theoretical physicist, and this experimental experience is very important for me insofar as I am acquiring additional knowledge that I can pass on to my younger colleagues back home. In addition to my knowledge in this field, I will be able to propose a project for the creation of a non-linear optical laboratory, already knowing what type of apparatus, laser, nanoparticle, microscope, etc. we need in order to manufacture metamaterials. The most important area of application for metamaterials in Africa is in the field of telecommunication where we have the miniaturization of circuits, and in the field of security or defense where we have the invisibility cap or cloaking. This experience will make it possible for me to compete or discuss experimental metamaterials intellectually with other laboratories around the world.

Collaboration

OUTREACH

Inspiring Future Generations

Specially designed activities act as a bridge to frontier research for secondary school students

ICFO is continuously opening its doors to the next generation of curious minds, inviting students to embark on a journey of discovery of photonics and its fascinating applications. At our institute, photons are more than just particles of light; they are keys to understanding our world and developing technologies that can transform society.

Complementing science in high schools

The ICFO Outreach team curates a series of hands-on activities designed to spark young learners' interest and boost their passion for science. Students can dive into a variety of exciting projects for their high school research projects known as ***"Treball de Recerca"*** (TdR, in English Research Project), each offering a unique glimpse into the science and application of photonics for health, information and energy. Discovering the remarkable properties of graphene, uncovering the fascinating phenomena of light waves and their interactions, exploring the cutting-edge field of quantum communication, and delving into the applications of light in medicine are just a few of the projects students undertake. These are more than just experiments, they are **opportunities to engage with advanced scientific concepts and techniques, laying the foundation for original and creative research projects.**

It was a very enriching activity that turned out to be one of the most important parts of my project. The explanation of the activity was very accurate as well as the material that was used in it. The experimental part was also very fun to do and very insightful.

TdR student feedback

ICFO provides a selection of resources and links to bright ideas that can spark new projects. Those who already have a project idea but need expert advice are connected to researchers who, seeing younger versions of themselves in these students, generously offer their expertise to clarify doubts and guide their research.

Celebrating and making visible the achievements of young collaborators helps reinforce students' motivation. This was the impetus for the creation of the annual **Young Photonics Congress (YPC)** and also the close collaboration with **Exporecerca Jove**, a young science event that celebrated its 25th anniversary this year. As part of the collaboration, ICFO awarded a student prize for the best photonics project, which included participation in the YPC and a stay in an ICFO research group.

Summer Science Fun

Since 2018, the summer holidays have afforded time for young science enthusiasts to take part in the **Barcelona International Youth Science Challenge (BIYSC)** program, a two-week international science camp organized by the Fundació Catalunya La Pedrera for young people aged 16 to 18, providing them with the opportunity to explore frontier topics in research centers. BIYSC students at ICFO work closely with nine enthusiastic scientists who guide them through theoretical and experimental sessions, stimulating their curiosity by revealing how quantum physics enhances the security in communications. The researchers teach students linear algebra, the basic principles of classical cryptography and quantum physics, computer simulation, and programming, leading up to their first hands-on experience with the emerging technologies in the quantum physics world when they are able to implement experimentally the BB84 protocol, the first quantum cryptography protocol.

I have learned a lot from the ICFO researchers, they were amazing.

It taught me a lot about research life, quantum physics and cryptography, which I hope to make use of int he future.

BIYSC participants

Throughout, students learn more about ICFO's research in quantum science and technology and engage with experts from ICFO spin-offs who open the doors of their facilities and explain their products. This exposure allows participants to get a deeper appreciation for the research and innovation, witnessing how groundbreaking discoveries translate into practical applications that safeguard our communications.

Just the beginning....

ICFO's Outreach team is always excited to welcome back former BIYSC, YPC, and TdR students who want to expand their ICFO experience and participate in university programs such as the "**Be an ICFOnian for a Day**" and the **CARLA** events.

Thank you ICFO Outreach Volunteers

The following ICFOnians participated in outreach activities (July – September 2024) sharing their enthusiasm for science with new audiences:

Prof. Dr. Adrian Bachtold, Alejandra Padilla Camargo, Dr. Aleksandra Sierant, Anna Steffinlongo, Prof. Dr. Antonio Acín, Antonio Sampaoli, Dr. Carmelita Roda, Dr. Daniel Urrego, Prof. Dr. Darrick Chang, Eduardo Beattie, Dr. Felicien Appas, Prof. Dr. Georgia Papadakis, Prof. Dr. Gerasimos Konstantatos, Prof. Dr. Hugues de Riedmatten, Jonathan Hänni, Prof. Dr. Juan P. Torres, Katrin Brache, Laura Zarraoa, Leo Feldmann, Prof. Dr. Leticia Tarruell, Dr. Lorenzo Cortese, María Hernández Ruiz, Mariana Navarro Asan-Srain, Martina Berglund Solé, Mirko Fornasier, Miguel Dosil, Prof. Dr. Nicoletta Liguori, Dr. Pere Mujal, Dr. Raja Yehia, Rajashree Haldankar, Dr. Romain Veyron, Roxana Wedowski, Dr. Stefan Forstner, Dr. Sumana Chetia, Teresa Karanikolaou, Prof. Dr. Turgut Durduran.

Become an Outreach Volunteer
outreach@icfo.eu

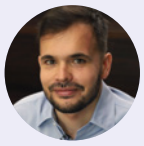
People

GO & FLY

Congratulations to 11 New ICFO PhD Graduates

331 ICFOnians have successfully defended their theses at ICFO

Each of these ICFOnians has played an important role in ICFO's success and reputation as a leading international research institute.



321

Niccolò Baldelli

Classical and Quantum simulation of quantum matter beyond symmetry breaking

July 5, 2024
ICREA Prof. Dr. Maciej Lewenstein and Dr. Luca Barbiero

322

Emanuel Cristian Boghiu

Bell nonlocality and causal networks

July 9, 2024
ICREA Prof. Dr. Antonio Acín

323

Li-Chun Lin

Deciphering the Role of Mechanical Stress during Aging and in Neurodegenerative Diseases

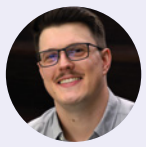
July 15, 2024
Prof. Dr. Michael Krieg

324

Katerina Gratsea

Introducing tools to quantify the performance of quantum computing algorithms and their applications

July 18, 2024
ICREA Prof. Prof. Dr. Maciej Lewenstein and Dr. Patrick Hümbeli

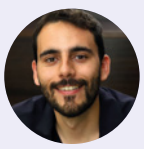


325

Sebastian Hägele

Compact Phase Imaging Platform and its Application to Material Science and Manufacturing

July 23, 2024
ICREA Prof. Prof. Dr. Valerio Pruneri and Dr. Roland Alfonso Terborg



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Rafael Luque Merino

Optoelectronic studies of correlated 2d materials

September 2, 2024
Prof. Dr. Dmitri K. Efetov

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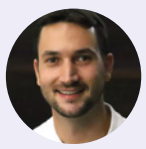
María Balanzó Juandó

Certification in quantum information theory: key distribution, self-testing and entanglement

September 12, 2024
ICREA Prof. Antonio Acín



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Ediz Kaan Herkert

Advanced Nanoantenna Platforms for Enhanced Single-Molecule Detection at High Concentrations

September 13, 2024
ICREA Prof. Dr. María García-Parajo

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Marina Cunquero Navarro

Use of Advanced Imaging Tools for Assessing the Performance of Novel Therapeutic Techniques for Restoring Vision

September 16, 2024
Dr. Pablo Loza-Alvarez and Dr. Maria Marsal-Terés

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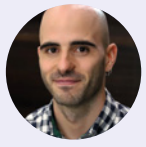
Karuppasamy Pandian Soundarapandian

Graphene based photodetectors for on-chip and free-space data communication applications

September 20, 2024
ICREA Prof. Dr. Frank Koppens



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David Cirauqui Garcia

Optimization with spin glass models

September 27, 2024
ICREA Prof. Dr. Maciej Lewenstein, Dr. José Ramón Martínez and Dr. Przemyslaw Ryszard Grzybowsi

COMMUNITY

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9

Summer brings a change of scenery for many ICFOnians

1. **Andrea Morales:** Visiting Imperial College, London, with Alumni **Vindhiya Prakash** and **Natalia Bruno**
2. **Olga Lorente:** Posing in Death Valley, CA
3. **ICFO PhD Students: Matteo Ceccanti, Sara Fogli, Teresa Karanikolau, Lorenzo Orsini, Francisco Bernal, Luisa Zago**
4. **Alina Hirschmann:** In Tokyo, blending in
5. **Anita Kosmalska:** A family holiday in Sri Lanka
6. **Zoi Melissari:** In the waters of Diaporos, Halkidiki
7. **David Alcaraz:** Summer Cycling
8. **Patricia An Peña** & **Carlos Gas:** Holidays in Tokyo
9. Alumni Gathering after the ICAP Conference: **Sandra Buob, Tristan Valenzuela, Riccardo Sapienza, Rob Sewell, Natalia Bruno, Klara Theophilo, Vindhiya Prakash, Sandhya Ganesh, Andrea Morales, Paula Cordero, Veronika Parfentyeva, Sarah Hirthe and Peter Schmidt.**

Mystery ICFOnian

How much do you know about the people you work with?

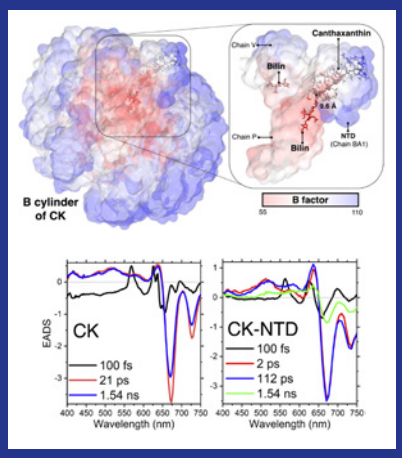
ICFOnians are a fascinating group, with hobbies, interests and talents that may surprise you. Have a look around and see if you can guess who this edition's Mystery ICFOnian is!

Look for the answer in the next edition of ICFOnians.

1. She is an indie rock fan and is starting to play (horribly but enthusiastically) the electric guitar.
2. She is a descendant of the Saint credited with writing the most famous Italian Christmas song "Tu scendi dalle stelle".
3. In her garden, she grows Carolina Reapers and loves all chili peppers- the hotter the better!
4. Just before she came to ICFO, she became a Mom.
5. She has a dog named Noir.

The Last Word

SCIENCE QUIZ



ICFO Group Leader Prof. Nicoletta Liguori, together with researchers at the Vrije Universiteit Amsterdam and Université Paris-Saclay, recently used ultrafast spectroscopy to show how photosynthetic bacteria regulate their response to light.

"The Orange Carotenoid Protein Triggers Cyanobacterial Photoprotection by Quenching Bilins via a Structural Switch of Its Carotenoid" *Journal of the American Chemical Society*, July 2024.

1. How does excess sunlight harm photosynthetic organisms?

A) excess photoexcitation leading to photooxidation

B) overconsumption of CO_2

C) cytokine storm

2. Carotenoids are *not* an evident component of:

A) carrots

B) rovellons

C) cauliflower

D) flamingos

3. What does "quench" mean in photochemistry/photobiology?

A) to slake a thirst

B) to convert excitation energy to heat

C) to rapidly cool

4. The bilins of the title are light-harvesting Phycobilins. Which of these is not a bilin?

A) Micromatabilin – an arachnid coloring molecule

B) Biliverdin - green bile

C) Bilirubin - red bile

D) Bilicrystal – clear bile

Answers on pg. 2

HIGH PROFILE

Jose Manuel Silva

Director General of Research of the European Commission 2005-2010

> *"Knowledge shouldn't just stay in the drawer; it needs to be transferred into spin-offs, collaboration contracts, and patent development.*

You have had a long career with the European Commission including Director General of Research that launched the ERC. What did you find most fulfilling?

Three major things have happened in my professional life. One was being present at the signing of Spain's Accession Treaty to the European Union. Another was the 2003 agricultural reform, and the third was the European Research Council.

President Barroso called me to propose that I take on the role of Director-General for Research in 2005. As a Galician, I would never say no to a Portuguese, but I wasn't thrilled about it because I had been managing one of the three EU common policies- Agriculture- and research was a far cry from what I was used to. He told me I'd have to bring order to the management of that Directorate-General, which I had proven I could do in Agriculture. At the same time, I would have to launch the most important research program in the history of Europe- the 7th Framework Program. He had a lot of faith in me and knew that I enjoy new things. He told me about the "*Ideas programme*", where scientists would decide the main lines of research, under the management of the European Research Council. He assured me, "Even though your whole life has been in agriculture, and you've set many records there, in 20 years you will be remembered more for your work as the Director-General of Research."

The first few months I was like an elephant in a china shop implementing all types of changes. I think I was rather poorly received. Some even called me the "pig farmer" because they said, "This guy comes from agriculture, what the heck does he know about research?"

President Barroso gave me full flexibility to implement the new programs, within the rules. I had a particularly good relationship with Fotis Kafatos, the first president of the scientific committee. The first call for proposals was launched on December 22nd, 2006 the day of the Spanish lottery, which I have always thought was a good omen.

What was the most important challenge you faced in launching the ERC?

For the scientific community, independence was very important. They wanted a system very similar to the American one—with very little oversight. I went to the US and spoke with their agencies to ask how they managed things and learned that in fact, after a grant is given, it's rarely controlled. So, I asked, "And if someday there's an audit and something unusual is found, what happens?" The response was that in the US, Federal funds are sacred; if someone misuses them, they're blacklisted for good.

European law does not allow us to do that, which meant we had to create different rules. Our mandate was to make them as flexible as possible, and they are the most flexible rules in research management and, I would say, in almost all community policies...even though I know it bothers centers to fill out paperwork!

I don't think anyone expected the success it has had. Today, you can go anywhere in the world, ask about ERC mechanisms, and they know it—in the U.S., in Japan... But it's probably the only thing they know, which means it has been quite successful.

What do you think is the ERC's biggest contribution to European science?

The ERC produces intangibles—it generates things for the future. In fact, it's about future science. Like all intangibles, it's difficult to measure. Having 12 Nobel Prizes in a program that's been around for 18 years, with scientists in some way connected to the ERC, is undoubtedly a good indicator. If you read a scientist's CV and see that they've received ERC grants, you think they're highly qualified. If you see a center that has ERC grants, you see it as a valid, competent center. I believe ICFO is one of the centers with the most ERC grants in Spain.

You have invested a great deal of your career in strengthening the capabilities of the European Union. What recommendations would you have for ICFOnians, with their skill sets, that would like to prepare Europe for a strong future?

The first step to making Europe stronger is to perform well in its flagship research program, which is the ERC. I would even dare to say that it must be one of the best research programs in the world. Doing well in this program is already contributing to Europe. I also think it's crucial to focus on technology transfer. Knowledge shouldn't just stay in the drawer; it needs to be transferred into spin-offs, collaboration contracts, and patent development. This is an important area, and I recommend it to every center I visit.

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Please send questions, comments and suggestions to communications@icfo.eu