ICFO

Community News
Winter 2024
55

ICFONIANS

ICFO Day

Celebrating science, achievements and community

INDEX

Mystery ICFOnian
Solution Ed #54

Núria Beltri
Projects Head

Science Quiz
Answers from pg. 16

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

ON THE COVER

Science as Art

The nature of ICFO's research requires that laboratories are closed, carefully controlled spaces which makes it difficult for outsiders to know what is going on inside. On ICFO Day, participating research groups open their doors, share their amazing set-ups and explain their work to ICFOnians in other groups and administrative areas, making it possible for everyone to have a better understanding of the scope of activities taking place at the institute. Read more on pg. 10.

EDITOR'S CORNER

It all adds up

Huge and impactful scientific discoveries are not made in a vacuum, but rather are the result of many eureka moments, collaborations, and achievements

Brook Hardwick
Contributing Editor

When you look at the Nobel Prizes awarded each October to a maximum of three scientists per award, there is always a long list of contributions in the award citation. There are also so many other contributions that helped to pave the way for the ground-breaking discoveries or that have taken these discoveries in amazing new directions, that they would be impossible to list. This year's Nobel Prize in Physics, awarded to Pierre Agostini, Ferenc Krausz and Anne l'Huillier "for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter" was especially exciting for the ICFO community because of our own proximity to the award. ICFO group leaders Drs. Jens Biegert and Maciej Lewenstein are both leaders in this field, and collaborate with the laureates both experimentally and theoretically. The 1994 ***Physical Review A*** collaboration noted in the Nobel text, co-authored by Lewenstein, Balcou, Ivanov, L'Huilier and Corkum, has been cited over 5000 times. Likewise, Biegert has made significant contributions through a series of landmark papers in this field, and he has built a world-leading attoscience infrastructure at ICFO, the only one of its kind in Spain. The Nobel in Chemistry, awarded to Alexei Ekimov, Louis Brus, and Moungi Bawendi "for the discovery and synthesis of quantum dots", also hit close to home for ICFO group leader Gerasimos Konstantatos, having made multiple noteworthy contributions to the areas of light emission, photodetection and renewable energies using quantum dots especially in the infrared.

Many experimental and theoretical scientists represented by this year's laureates can be proud of making important contributions to these extremely fast-growing new fields. Contributions to truly monumental scientific advances come in all shapes and sizes, and they all add up, creating something that is much larger than the sum of its parts.

Let's look at this under the lens of ICFO's PhD program. Can you believe that **over 300 colleagues have defended their theses at ICFO** since our founding in 2002? This is a hugely important personal and professional achievement for each graduate, and also a formal recognition of a unique contribution to science with each thesis defended. Likewise, ICFOnians in all areas of the institute, from the group members and leaders that collaborated directly on the scientific advances, to the numerous administrative and logistical units that work behind the scenes to contribute to the creation, maintenance and advancement of the research structure that enables scientific advance, are to be congratulated for this institutional landmark.

Zoom out, as we have done in this edition of *ICFOnians*, and we have examples of many initiatives that simply would not be possible without the contributions of ICFOnians and/or our stakeholders and allies- from publications in leading journals to training programs around the world, outreach events right here in Catalonia, and new support that we receive to fund ambitious, high risk research programs that aim at the kind of advances that may one day have a positive transformative impact on society.

As we head into 2024 and all the challenges and achievements that it has in store, I congratulate ICFOnians on the contributions made at all levels to science, and encourage you to read this edition, cover to cover, as a reminder that all of our actions add up when it comes to enabling scientific discoveries that will make the world a better place.

Coordinating Editor
Brook Hardwick
Corporate Communications Head

Editorial Committee
Silvia Carrasco
Knowledge & Technology Transfer Director
Brook Hardwick
Corp. Communications Head
Dolors Mateu
ICFO Manager
Laia Miralles
HR and Education Head
Morgan Mitchell
ICREA Group Leader, Atomic Quantum Optics
Andrea Morales
Alumni, Communications
Robert Sewell
Academic Affairs Head

Contributors
Tomás Charles
Visual Communications
Elena Enrique
Corporate Communications
Brook Hardwick
Corporate Communications Head
Alina Hirschmann
Science Communication Head
Marta Martín
Science Communication
Sarah Keary
Postdoctoral Researcher, Single Molecule Biophotonics Group
Pablo Jarillo-Herrero
Massachusetts Institute of Technology
Zoi Melissari
Outreach, Knowledge & Technology Transfer
Morgan Mitchel
ICREA Group Leader, Atomic Quantum Optics
Andrea Morales
Alumni, Communications

Pictures By
© ICFO, Elena Enrique, Getty Images, Ramon Josa, Vanessa Montero, Raquel Puras, Jelena Stanisavljevic, Sebastian Haegele, Eduardo Beattie, Sarah Keary, Renata Lei & Álvaro Cuevas, Generalitat de Catalunya

Layout
Sergio Simón · Diseño & Web

D.L.: B-54464-2008
Icfonians® is a registered trademark

Trustees:
Generalitat de Catalunya · Fundació Privada CELLEX · Universitat Politècnica de Catalunya BarcelonaTech · Fundació Privada Mir-Puig

Cerca center:
CERCA Centres de Recerca de Catalunya

Member of:
BIST Barcelona Institute of Science and Technology

Supported by:
Excelencia Severo Ochoa 2020 - 2023
Unió Europea Fons europeu de desenvolupament regional Una manera de fer Europa

Happenings

ICFO NEWCOMERS

Welcome to ICFO

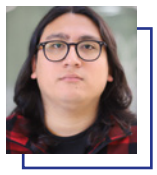
Many of us joined ICFO or took a new position at the institute between October and December

Giacomo Guarda
Student

Keneth Escobar
Student

Paul Winkler
Student

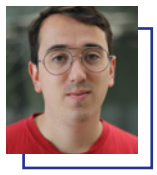
Anna Kristha Almazán
Student



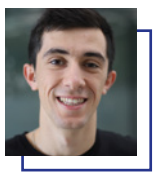
José Luis Reyes
Student

Irene Prieto
Student

Ricardo Constantino
Student



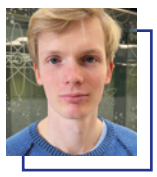
Jofre Abellanet
Student



Alejandro Martín
Student

Martín Fernández
Student

Èlia Solé
Student



Constantin Lescow
Student

Catalina Morales
Student

Marina Isabel de la Higuera
Student

Gloria Davidova
Student

Alessandro Marcia
PhD Student

Teodor Parella
PhD Student

Egle Pagliaro
PhD Student

Emmanouela Andrioti
PhD Student

Alejandra Padilla
PhD Student

Elsa Vázquez
PhD Student

Chiara Cortese
PhD Student

Mark Oehlgrien
PhD Student

Lena Schumacher
PhD Student

Gregor Hill
PhD Student

Giacomo Franceschetto
PhD Student

Murad Al-Nusaif
PhD Student

Yang Liu
Visiting PhD Student

Ilektra Karakosta
Visiting PhD Student

Ron Riumy
Visiting PhD Student

Evelyn Ortega
Postdoctoral Research

Andreas Leitherer
Postdoctoral Research

Marcin Plodzien
Postdoctoral Research

Andrea Tononi
Postdoctoral Research

Marinos Dimitropoulos
Postdoctoral Research

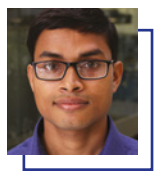
Josep Cabedo
Postdoctoral Research

Daniel Urrego
Postdoctoral Research

Emanuele Distante
Research Fellow

Valerio Di Giulio
Visiting scientist

Mohammad Maghrebi
Visiting scientist



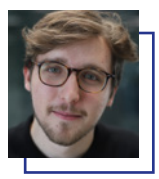
Mohit Lal Bera
Visiting scientist

Utso Bhattacharya
Visiting scientist

Andreas Meyer
Project Engineer

Manish Verma
Project Engineer

Bernat Martín
Procurement Specialist



Jordi Piñol
KTT Quantum Technologies Project Manager

Lucía Castillo
Outreach

Paul Youngman
Academic Affairs Project Manager

Not pictured

Klaudia Dilcher
Visiting PhD Student

Kyrylo Simonov
Post Doctoral Researcher

Iñaki Barettini
Quantum Technologies Business Developer

Jorge Fuenzalida
Visiting Scientist

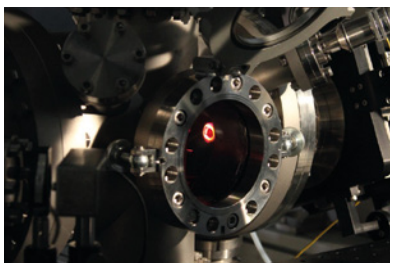
Laila El Bakhti
Student Managment

Vanessa Sáez
Suport Finanaces

Happenings

ICFO NEWS

NEXT COST ACTION Network



Through the world-leading **attoscience infrastructure at ICFO**, built by the Attoscience and Ultrafast Optics research group led by **ICREA Prof. Dr. Jens Biegert**, ICFO is now a part of a new COST Action for Non-linear Extreme Ultraviolet to hard X-ray techniques (NEXT) which will capitalize on pioneering promising results, reported over the last decade, to create the first concerted experimental and theoretical effort aimed at implementing EUV/X-ray non-linear spectroscopy at table-top HHG and XFEL sources. This Action will have a strong **impact on technology supporting the development of novel materials, nanodevices, quantum computing and chemistry**, as well as on the training of young scientists as the next generation of researchers that will fully exploit these novel methodologies and tools. NEXT will also act as a key research and innovation bridge between academic and industrial partners.

2024 Optica Fellows Class

The Board of Directors of Optica (formerly OSA) recently elected 129 members from 26 countries to the Society's 2024 Fellow Class. **ICREA Professor at ICFO Dr. Maciej Lewenstein** was among the members selected to belong to this year's Fellows Class **"for outstanding theoretical contributions to atto-optics, atto-science, quantum optics, and quantum information"**. The Fellow Members Committee reviewed 216 nominations submitted by current Fellows. As Fellows can account for no more than 10 percent of the total membership, the election process is highly competitive.

UPC Special Doctoral Awards 2023

The Extraordinary PhD Awards, given annually by the Technical University of Catalonia· Barcelona Tech (UPC), aim to recognize the best doctoral theses which have obtained "cum laude" in their final PhD defense evaluation. This year, the UPC announced the list of 12 awardees in the broad area of "Sciences", which includes the thesis of ICFO PhD graduate **Dr. Jonas Fischer** among the list of extraordinary doctoral works for the academic period 2020/2021. Jonas carried out his PhD studies on neuromonitoring within the BitMap project. His thesis entitled ***"Transcranial Diffuse Optical Measurements of Pulsatility Derived Parameters for Neuromonitoring Applications"*** was supervised by Prof. Dr. Turgut Durduran and Dr. Udo M. Weigel.

Highly Cited Researchers

Clarivate Web of Science has included two ICFO Group Leaders, **Prof. Dr. F, Pelayo García de Arquer** and **ICREA Prof. Dr. Frank Koppens**, in its annual Highly Cited Researchers list, both in the Cross-Field Category.

The Highly Cited Researchers are individuals at universities, research institutes and commercial organizations who have demonstrated a disproportionate level of significant and broad influence in their field or fields of research. To determine the recently published list of influential researchers, Clarivate surveyed papers produced and cited over an 11-year period from January 2012 to December 2022 that at the end of 2022 **ranked in the top 1% by citations for their Essential Science Indicators (ESI)**. Researchers are selected for their exceptional influence and performance in one of more of the 21 fields used in the ESI.

Lasers4EU

The European Union approves the successor of the Laserlab-Europe project.

ICFO is one of 35 leading European institution in laser-based inter-disciplinary research from 18 countries participating in the current Laserlab- Europe project, within the H2020 EU Research and Innovation programme. 24 laboratories, including ICFO's **Attoscience and Ultrafast Optics facility** and the **Super-resolution-Light Nanoscopy & Microscopy facility**, offer access to their facilities for research teams from Europe and beyond, supported by EC funding.

The Laserlab user community celebrates the approval by the EU of **the project proposal of Lasers4EU, the successor of the Laserlab-Europe project**, which will begin in October 2024.

2023 RSEF-BBVA Foundation Physics Awards

Prof. Dr. Valerio Pruneri takes home the Physics, Innovation and Technology award.

In the Physics Awards ceremony which took place on December 13th at the BBVA Foundation headquarters, **Valerio Pruneri, ICREA professor at ICFO, Corning, Inc. Chair and leader of the Optoelectronics research group**, received the 2023 RSEF-BBVA Foundation Physics Awards in the area of Physics, Innovation and Technology for *"his contributions to the study of quantum nature and its exploitation for applications in biosensors and cryptography, which have given rise to a large number of patents"*.

Research and Innovation Council

ICFO's Director Lluís Torner was named by the Parliament of Catalunya to join the Research and Innovation Council of Catalonia (**CORICAT**), a consultative body for strategic decision on science and innovation in Catalonia, along with six other prestigious members of the research and university community.

They join seven members of the council who were announced in July of this year, including ICFO Scientific Advisory Board Member, Anna Fontcuberta, head of the Semiconductor Materials Laboratory at the Federal Polytechnic School of Lausanne, and also José Manuel Silva Rodríguez, the Director General of Research of the European Commission who played a key role in the creation of the European Research Council (ERC).

Marie Skłodowska-Curie Actions

In the most recent call for Postdoctoral Fellowships in the Marie Skłodowska-Curie Actions (MSCA), the EU's flagship funding program for doctoral education and postdoctoral training of researchers, **five ICFOnians** were selected for funding from a total of 7,044 applicants. ICFO's success rate in this call was **29.4%**, well above the 17.5% global rate.

Congratulations to **Drs. Markus Teller** and **Félicien Appas** (both from the Quantum Photonics with Solids and Atoms group), **Nishigandha Patil** (Medical Optics group), **Julien Barrier** (Quantum Nano-Optoelectronics group), **Stefan Forstner** (Quantum Nanoelectronics and NanoMechanics group) for their successful applications.

Happenings

LATEST ADVANCES

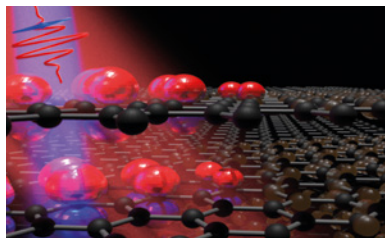
A change in rigidity switches the function of protein condensates involved in sensing touch

ICFO researchers **Neus Sanfeliu, Frederic Català, Iris Ruider, Montserrat Porta and Stefan Wieser**, led by **Prof. Dr. Michael Krieg**, in collaboration with researchers at IRB Barcelona, publish a study in ***Nature Cell Biology*** identifying the mechanism by which the MEC-2 protein condensates of the touch receptor neurons transition from liquid to solid states, enabling the stability and transmission of the mechanical forces.

The researchers created transgenic animals carrying a single copy of the MEC-2 protein marked with a fluorescent label. Combining fluorescence imaging in an inverted confocal microscope and the FRAP technique, a fluorescence microscopy method, they identified two different MEC-2 populations within the touch receptor neurons: a liquid and mobile pool, close to the cell body, that facilitates transport along the thin neurons; and a solid-like mature population in the distal neurites. They applied mechanical stimuli to the animal's body wall using a hybrid microfluidic-pneumatic device and observed that only mature populations sustain mechanical forces during touch.

Researchers identified that another protein, UNC-89, was responsible for promoting MEC-2 condensates rigidity maturation in vivo. This structural shifted their biological function from facilitating the transport of the protein to facilitating the integration and conversion of mechanical cues during mechanosensation. These findings describe a new biological function of the liquid-to-solid phase transition of the MEC-2 proteins and draw a new role for the UNC-89 proteins in the neurons.

Attoscience unveils a light-matter hybrid phase in graphite reminiscent of superconductivity



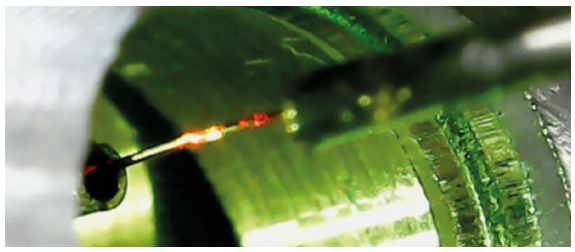
In a recent study published in ***Nature Communications***, ICFO researchers **Themis Sidiropoulos, Nicola Di Palo, Adam Summers, Stefano Severino, Maurizio Reduzzi**, and **ICREA Prof. at ICFO Dr. Jens Biegert** report on having observed a light-induced increase and control of the conductivity in graphite by manipulating the many-body state of the material.

The researchers used carrier-envelope-phase-stable sub-2-cycle optical pulses at 1850 nm to induce the light-matter hybrid state. They probed the electronic dynamics with attosecond soft-X-ray pulses with 165 as duration at the carbon K-edge of graphite at 285 eV. The attosecond soft-X-ray absorption measurement interrogated the entire electronic structure of the material at attosecond-interval pump-probe delay steps. The pump at 1850 nm induced a high conductivity state in the material, which only exists due to the light-matter interaction.

Researchers used soft-X-ray attosecond pulses for the first time to "look inside the material". Instead of manipulating the sample, they optically excited the material with a powerful light pulse, thus exciting the electrons into high energy states, and observed how these relaxed as a whole system within the material.

To see how this relaxation occurred, they observed, firstly, how each energy state relaxed individually and, secondly, how the whole electron system was excited, to observe the many-body interaction between light, carriers, and nuclei at different energy levels. Then, they saw that the material's optical conductivity increased at a point, showing signatures or reminiscence of a superconductivity phase.

The results of this study offer novel ways to investigate and manipulate correlated phases of matter in real-time, something crucial for modern technologies and with promising applications in the field of photonic integrated circuits or optical computing.



Single ions in nano-sized particles: a new platform for quantum information processing

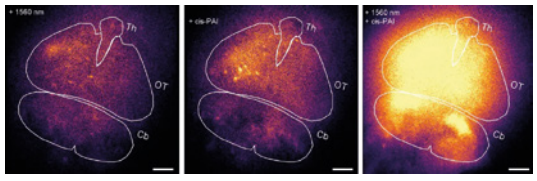
In a study published in ***Optica***, ICFO researchers **Chetan Deshmukh, Eduardo Beattie, Bernardo Casabone**, and **Samuele Grandi**, led by **ICREA Prof. at ICFO Hugues de Riedmatten**, in collaboration with researchers from Institute de Recherche de Chimie de Paris and Karlsruher Institute für Technologie have addressed and detected single rare-earth ions in an ensemble of atoms.

The demonstration has been done within a nanoparticle that was coupled to a fiber-microcavity, which allowed for an efficient light-matter interaction. Their experiment used erbium ions emitting single photons at telecommunication wavelength and packed in a volume two orders of magnitude smaller than in previous realizations. While the average physical distance between ions remained low, the difference between their frequencies was high enough to actually make them fully distinguishable.

The most apparent sign of a single ion is the fact that it can emit only one photon at a time. This property can be tested by dividing the emission of the ion equally between two detectors, and checking that only one would click at any given time. The authors confirmed this property, proving that they were indeed detecting emission from a single ion.

The results of this study may enable a new way of achieving quantum processors using hundreds of qubits in a nanoscale volume, which can be detected and manipulated individually and efficiently coupled to single photons for quantum networking.

Researchers induce brain activation using infrared light-controlled drugs



A new study, published in ***Angewandte Chemie*** journal and led by **Dr. Pau Gorostiza**, ICREA Research Professor at IBEC and by **Dr. Pablo Loza-Álvarez**, head of the Super-resolution microscopy and Nanoscopy (SNL) lab at ICFO, introduced the first method for controlling brain activity in living organisms using drugs activated by three-photon excitation and mid-infrared light. This method is based on activating a specific receptor for acetylcholine, a vital neurotransmitter involved in various brain processes such as learning, attention, and memory.

To achieve this, researchers utilized PAI, a light-responsive molecule previously developed at IBEC, employing the lowest drug concentration and the longest photoactivation wavelength ever recorded.

These results have unveiled a method to control brain activity in living organisms using drugs activated by infrared light, which is gentler on tissues than the ultraviolet and visible spectrum. This cutting-edge technique activates a specific neurotransmitter receptor using light that can penetrate deep into tissue and offers unparalleled pharmacological and spatiotemporal submicrometric precision in all three dimensions.

These results showcase the potential of three-photon pharmacology and open up new horizons for fundamental research in neurobiology and the development of light-based non-invasive neuromodulation therapies.

Happenings

BUSINESS NEWS

ICFO and VITALA Technologies awarded a “Proyecto en colaboración público-privada 2022”

The project will use quantum sensors to facilitate the use of hyperpolarized carbon-13 MRI for clinical and pre-clinical metabolic imaging

Carbon-13 (^{13}C) Magnetic Resonance Imaging (MRI) is an emerging molecular-imaging tool that has huge potential to transform the understanding of disease diagnosis and treatment, especially in early stage detection. A chemical compound of interest, usually a small-molecule metabolite, is prepared in a special hyperpolarized (HP) state with a boosted ^{13}C magnetization of around 10,000 times its normal level.

VITALA & ICFO’s teams during SEE-13-MRI kick-off meeting

Then, after its administering to a patient, the anatomical distribution of the compound plus its metabolic products are mapped spatially and temporally by MRI. The technique allows rapid and pathway-specific investigation of metabolic processes which provides information on diseases such as cancer, ischemia, inflammation, necrosis, acute renal failure, cardiovascular disease and diabetes, among others.

The new project, called **“SEE-13-MRI – Scope and Efficiency Extended ^{13}C Magnetic Resonance Imaging”**, is funded as part of the *“Proyecto de Colaboración Público-Privada 2022”* (Project for Public-Private Collaboration 2022) by the Spanish Ministry of Science and Innovation and the State Research Agency (la Agencia Estatal de Investigación). It involves ICFO and **VITALA Technologies**, S.L., a biotech spin-off from IBEC, also a CERCA center and fellow member of the BIST scientific community.

The project will provide a two-fold approach to widen what clinicians and researchers are able to “see” using ^{13}C MRI: VITALA will work on new routes to produce hyperpolarized tracer metabolites with long lifetimes, while ICFO will focus on techniques to continuously and non-destructively monitor their polarization using quantum sensors. In particular, microfabricated quantum atomic magnetometers with outstanding sensitivity will be developed at ICFO, enabling improved quality control of HP tracers as compared to the procedures currently performed, which are slow and strongly degrade the polarization state of the tracers. Combined, these technologies seek to **widen access to early detection of disease** and **break barriers towards future commercial exploitation of HP-^{13}C imaging in preclinical and clinical stages of drug discovery.**

The project is coordinated by **Dr. Maria Alejandra Ortega Machuca**, co-founder and current COO/CTO of **VITALA Technologies**. VITALA has recently developed and patented organ-on-chip (OoC) devices to accurately emulate in vivo cell and tissue models in vitro. ICFO’s team is led by **Dr. Michael Tayler** from ICFO’s **Atomic Quantum Optics** (AQO) research group headed by **ICREA Professor Morgan Mitchell**. Earlier this year, the group demonstrated a prototype atomic magnetometer device for monitoring hyperpolarized [1-^{13}C]-pyruvate, the most widely used tracer in ^{13}C metabolic imaging. The development of the device will demonstrate the competitive potential for high-throughput in vitro MRI screening studies that are currently part of VITALA’s services, as well as in ^{13}C MRI human clinical trials.

* The *“Proyecto de Colaboración Público-Privada”* program is part of the Spanish Research, Development and innovation program that is oriented to the challenges facing society.

Quside Technologies secures European Innovation Council Accelerator funding

ICFO spin-off is successful in the highly competitive call

Quside Technologies, spun out of ICFO in 2017, is one 47 companies that has been selected to receive **European Innovation Council (EIC)** funding, **combining grants and equity investment**, following the third 2023 EIC Accelerator cut-off in June.

The EIC Accelerator offers start-ups and SMEs grants of **up to €2.5 million combined with equity investments** through the EIC Fund ranging from €0.5 to €15 million or more.

In addition to financial support, all projects benefit from a range of business acceleration services that provide access to leading expertise, corporates, investors and ecosystem actors. In this funding round, the companies were selected in a highly competitive process, in which 140 companies were interviewed by juries of experienced investors and entrepreneurs, out of a total of 648 full proposals submitted.

The 47 selected companies will together receive nearly €350 million of funding. A large majority of selected companies (68%), including Quside, will receive blended finance option, which is a combination of grants and equity investments. The equity investments will be made through the EIC Fund. The selected companies have a geographical spread spanning 15 countries, including four widening countries.

The project, for which Quside receives funding, known as **“Quantum-Based Randomness Processing Units (RPUs) for High-Performance Computation and Data Security”** aims to revolutionize computation and enhance data security through quantum-based randomization technology.

Congratulations to the entire Quside team for this important accomplishment!

Collaboration

RESEARCH

The Gordon and Betty Moore Foundation awards ICFO's research on hybrid states of matter

New grant for Prof. Frank Koppens underscores ICFO's international leadership in frontier science

In constant pursuit of pioneering ideas, the **Gordon and Betty Moore Foundation** seeks to advance basic science by funding research in high-risk, emerging fields, to develop new disruptive technologies, support imaginative and "out-of-the-box" research scientists and help create new collaborations and synergies to go beyond the frontiers of traditional scientific disciplines. Through their grants, they offer scientists highly prized freedom to explore and advance novel concepts.

Frank Koppens, ICREA Professor at ICFO, has recently been awarded a **$1.4 million grant** to expand his world-leading research which involves the confinement of light into nanocavities and using these to manipulate materials with light. **This grant will enable Koppens' team to explore new, previously uncharted hybrid states of light and matter.** These exotic states can facilitate the engineering and manipulation of completely new materials properties.

While much is known about traditional states of matter like liquid and solid phases, there exist more exotic variations where light and matter interact so intensely that they merge to form a new hybrid state. There is growing optimism in the field that understanding these hybrid states could lead to groundbreaking discoveries that could profoundly impact a wide range of technologies, including quantum sensors, low-power photonic integrated circuits, and devices for advancing artificial intelligence systems. Furthermore, they could pave the way for quantum technologies developed for quantum communications, quantum memories, quantum simulations and quantum computing.

> *We are already in the middle of the second quantum revolution, however new hybrid states of light and matter are needed to fuel progress.*
>
> *This kind of grant supporting fundamental, curiosity driven and risky projects allows us to explore directions that were so far mostly explored only theoretically.*
>
> **Prof. Frank Koppens**
> ICREA Professor at ICFO

The Moore Foundation has awarded over a $1 billion USD in funding through research grants over the years, the majority of which have gone to US-based institutions, however their mission to "foster path-breaking scientific discovery" extends beyond the US borders and fosters international collaboration that is conducive to major breakthroughs.

Dr. Dusan Pejakovic, Program Director in the Moore Foundation's Science Program, remarked: "*ICFO is a world-leading site for research on interactions of light with matter. As such, it is a perfect place to launch this risky project that explores novel concepts of solid-light hybrids. Given Prof. Koppens' track record in conducting ground-breaking research, I expect exciting results from this grant*".

ICFO has to date benefitted tremendously from the generous support of philanthropic organizations, namely the Cellex and Mir-Puig Foundations which have played a decisive role in helping researchers to build ambitious research projects at the institute. **ICFO Director Lluis Torner** emphasizes, "*We are extremely proud to receive this grant from the Gordon and Betty Moore Foundation to advance the field of hybrid light-matter states, which are of paramount interest worldwide due to their potential to fundamental scientific discoveries and technological breakthroughs*".

IMPACT

Quantum Technologies in the Smart City Expo World Congress

ICFO was center stage in the Catalonia stand showcasing the impact and future of Quantum Technologies through an immersive multimedia Demo and a "Quantum Point" with ICFO Spin-off companies

November 7-9, 2023

Visitors to the stand of the Government of Catalonia at the Smart City Expo World Congress (SCEWC) were able to travel back in time to learn about the technological discoveries and developments based on quantum physics without which today's digital society would not be possible and, in the same space, discover the impact that photonic and quantum technologies will have in the near future in areas such as communications, mobility and health.

Led by the Department of Business and Labor, the **'Catalonia' stand** was a 600+m² space which included a 45m² closed demonstration space developed by ICFO, a key player in the European quantum community. This **'quantum zone'** was complemented by an annexed space, the 'Quantum Point', where ICFO and spin-off companies Quside and LuxQuanta offered information on the research, development and applications of quantum technologies in Catalonia.

The 'demo' consisted of an **immersive 360º audiovisual experience** designed to make visitors aware of the **transformative potential of quantum technologies and their importance in improving the lives of citizens**. It invited visitors to explore the past, present and future of quantum physics and discover, through everyday scenes such as an online purchase, the charging of an electric vehicle or the tele-diagnosis of a sports injury, how this innovative field will evolve over the coming years to bring benefits such as ultra-secure and fast communication, medical treatments and diagnoses in real time with revolutionary devices and technologies, and more efficient, sustainable and clean mobility.

The entourage from the Generatlitat visited ICFO's Quantum Technologies demo at the Smart City Expo

In this space, and under the slogan **'Catalonia is ready for the next quantum leap'**, the Government aimed to show the impact that quantum technologies will have on the cities, territories and citizens of Catalonia in a decade, and, at the same time, highlighted the pioneering role of the Government, in collaboration with the country's quantum ecosystem, in the promotion and development of innovations in this revolutionary field of technology.

The stand and the demo were inaugurated by the **Conseller of Business and Labor of the Regional Government of Catalonia, Roger Torrent i Ramió**, together with **the Secretary of Digital Policies, Gina Tost i Faus.**

Collaboration

TRAINING

Frontiers Research Schools

Introducing thematic research to students worldwide

Training the next generation of scientists and technologists has always been at the center of ICFO's mission and Frontiers Schools play an important role in introducing thematic research to students worldwide, as well as offering a taste of an international research environment. ICFO is able to magnify the reach of these Schools, which incorporate a dynamic and social learning environment including lectures, group discussions, direct interactions with the lecturers, student talks, and poster presentations, by partnering with leading international organizations.

The Schools have been operating since 2016, in recent years expanding in frequency and diversifying in structure and location. In 2019, ICFO teamed up with the Centre for Applied Physics and Advanced Technology of the Universidad Nacional Autónoma de México (CFATA-UNAM) in Mexico to organize its first International School and has since collaborated with them for three successful editions. It has likewise partnered with the Weizmann Institute of Science (WIS), Massachusetts Institute of Technology (USA) , University of Toronto (CA), and PTL- Stanford (USA) to offer amazing programs on exciting and relevant topics. This Fall marked the further expansion of the Frontiers schools with successful programs in Ghana and India.

The Kwame Nkrumah University of Science and Technology (KNUST)

Kumasi, Ghana **October 9-13**

ICFO, in collaboration with Professors Michael Kweku Edem Donkor, Akyana Britwum, Henry Martin, and Francis Among of the Physics Department in the College of Science at KNUST, ran the first ICFO Frontiers School in Africa within the **SPIE@ICFO Chair for Diversity in the Photonic Sciences**. **The ICFO-KNUST International School on the Frontiers of Light, titled *"Photonic Sciences: Applications and Opportunities"***, brought together around 50 physics students primarily from KNUST and other universities in Ghana, as well as students from other African universities in Kenya, Nigeria and Rwanda who received international travel fellowships to travel to Kumasi for the program sponsored by ICTP. The School also welcomed students attending from as far afield as India and Finland. Topics covered in this 5-day program included Clean Energy, Medical Photonics, Ultrafast Spectroscopy & Quantum Materials, Terahertz Spectroscopy, Quantum Sensing, and Optical Metrology presented by professors and speakers from industry and academia from ICFO, KNUST, the SPIE and from around the world.

The School was made possible thanks to generous sponsorship from the SPIE to provide the funds to cover accommodation, catering and travel costs for students attending from within Ghana. **SPIE Vice President Peter de Groot** (Zygo Corporation) and **Community Engagement and Chief Inclusion Officer at SPIE Allison Romanyshyn** joined as lecturers and participants, along with **SPIE lecturer Martin Leahy** from the University of Galway, Ireland, who joined via video link.

The seeds for the ICFO-KNUST School were planted shortly after the launch of the SPIE Chair at ICFO when **ICFO PhD student Emmanuel Amuah**, currently finishing his PhD research at Aarhus University in the group of former ICFO professor Simon Wall, suggested the possibility of a collaboration with his alma matter.

> *Being at ICFO has been a life-changing experience for me and from my early days as an ICFOnian I began wondering how others could benefit from the kinds of opportunities that ICFO offers. I was excited when I learned that ICFO had the support of the SPIE chair and was looking to expand the diversity of its training programs.*
>
> **Emmanuel Amuah**
> ICFO PhD student

Amuah helped to bring the institutes together and was actively involved in the success of this initiative.

Tata Institute of Fundamental Research (TIFR)

Hyderabad, India **October 25-27**

In June 2023, ICFO announced the appointment of its first ICFO Ambassador to India, **Prof. Dr. Chaitanya Kumar Suddapalli**. Chaitanya is an ICFO PhD graduate and former postdoctoral researcher in the Optical Parametric Oscillators group led by ICREA Prof Majid Ebrahim-Zadeh, and is now a Reader at the Tata Institute of Fundamental Research (TIFR), Hyderabad, India. Both his strong ties to ICFO and his new role at TIFR perfectly positions him to facilitate opportunities for collaborations between ICFO and India's extremely talented scientific community through the coordination, organization and promotion of ICFO events such as schools, workshops and career camps at TIFR and other Indian institutions. October 2023 saw the first such event, celebrated at the **TIFR campus in Hyderabad**, focusing on **hot topics in photonic sciences.**

The ICFO - TIFR School attracted 54 participants from all over India as well as neighboring countries. About half of these participants were doctoral researchers, while approximately 10% were junior research fellows and almost 40% Master students.

This school was the first of what is to be a series of opportunities for ICFO and the Indian scientific community to find common ground and interests.

> *We were quite pleased with the caliber and engagement of the participants, not only from my institute (TIFR), but from the region. I was also very happy to be able to bring together experts from the ICFO Alumni community who are now in India, ICFO Group Leaders, as well as other leading experts in India, to build a really fantastic program. It felt very gratifying to be able to offer such a great program to students with these esteemed colleagues, many who are also dear friends.*
>
> **Dr. Chaitanya Kumar Suddapalli**
> Reader at the TIFR

Collaboration

TRAINING

2022 ICFO PhD Thesis Awards

Three ICFO PhD graduates awarded for their creative and ambitious research

The ICFO PhD Thesis Award distinguishes particularly brilliant PhD theses presented at ICFO. With the award, ICFO wishes to highlight and reward extraordinary PhD students whose research progress at the institute has proven to be highly creative and ambitious.

The award seeks to draw attention to the ICFOnians who have obtained particularly successful results and who have contributed to extend significantly the frontier of scientific and technological knowledge worldwide.

In 2022, 33 PhD students defended their theses at the institute. From this pool, the PhD Committee launched an in-depth deliberation to determine the recipients of the PhD Thesis Awards. The 2022 awards were presented during the annual ICFO Day event.

- **Dr. Paolo Abiuso** in recognition of the exceptional doctoral thesis ***"Optimization and Geometry for Quantum Information tasks"***, supervised by ICREA professor at ICFO Dr. Antonio Acín.
- **Dr. Ugaitz Elu**, in recognition of the exceptional doctoral thesis ***"High-peak-power mid-infrared OPCPAs for extreme nonlinear photonics"*** supervised by ICREA professor at ICFO Dr. Prof. Jens Biegert.
- **Dr. Dario Lago-Rivera** in recognition of the exceptional doctoral thesis ***"Remote distribution of quantum states assisted by multimode quantum memories"*** supervised by ICREA professor at ICFO Dr. Hugues de Riedmatten.

The entire ICFO community congratulates Paolo, Ugaitz and Dario for the dedication, hard work, and scientific insight that have earned them this ICFO 2022 PhD Award.

The Class of 2023

31 PhD students defended their thesis at ICFO this year. All were invited to attend ICFO Day and were recognized for the important achievements culminating in the presentation of their doctoral theses.

Beyond ICFO 2023: Branching out

Is it life choices that condition professional options, or professional choices that condition life options?

On Friday, October 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.

In order to incorporate as many perspectives as possible, the discussion was broken down into two panels, one online with Alumni connecting from China, Korea, Australia and India, and another with Alumni living in Europe who traveled to ICFO. All shared first-hand experiences about moving back home to pursue their careers or following opportunities outside their home country. This year alumni examined the question of whether it is the the professional or personal choices that we make that determine our career paths. Our community is highly international, and the dilemma of how to align professional opportunities and personal and family priorities often requires complicated choices about relocation that are very relevant to the development of scientific careers.

Moderators Giulia Lo Gerfo and Dr. Jelena Stanisavljevic led the discussions to navigate the experiences and career related decision of the panelists. And as usual, there are no definitive right or wrong answers. By sharing how both their professional and personal circumstances have been determining factors in deciding their next career moves, the alumni gave insights that may be applicable to the varying situations of current ICFOnians who, sooner or later, will be confronted with career planning of their own.

Panelists

- **JoonWoo Bae**
  Associate Professor at the School of Electrical Engineering, Korea Advanced Institute of Science and Technology (South Korea)
- **Chirag Dhara**
  Assistant Professor at Krea University (India)
- **Jia Kong**
  Vice Director of the Physics Department at the School of Science, Hangzhou Dianzi University (China)
- **Silvana Palacios**
  Lead Quantum Physicist at Nomad Atomics (Australia)
- **Marina Mariano**
  Senior Process Engineer, Vertical Furnace KPU, ASM International (Belgium)
- **Manoj Mathew**
  Software Solutions Manager, Asia Pacific at Carl Zeiss Microscopy GmbH (Germany)
- **Ivan Nikitskiy**
  Photonics Technology Expert at EPIC - European Photonics Industry Consortium (Spain)

Collaboration

COMMUNITY

ICFO Day 2023

The 8th edition of an all ICFO celebration of community

ICFO Day is an annual celebration of community in which we explore the interests and achievements of all ICFOnians

It is also a moment when we are able to discover the unique talents both in the lab and out, of our colleagues.

Thursday, December 14th

ICFOnians got warmed up with what was the 2nd edition of **ICFactor**. We discovered a side of some of our colleagues that few knew existed. We were thoroughly entertained and laughed, cheered and sang along to the performances of these talented ICFOnians.

Friday, December 15th

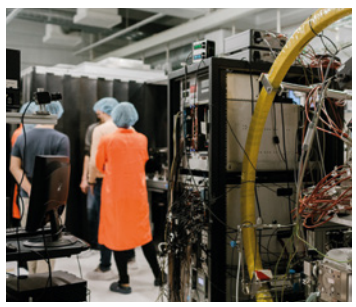
The official ICFO Day agenda was split, with interactive activities like the annual Gymkhana, lab tours and poster sessions taking place at ICFO in the morning, and then the entire institute gathering in the afternoon in the auditorium of the World Trade Center on Barcelona's waterfront where we celebrated science, as well as ICFOnians' contributions and achievements.

Nobel Prize Talks

ICREA professors at ICFO Jens Biegert and Maciej Lewenstein offered presentations that covered both the awarded experimental work of the Nobel Prize in Physics and the theoretical work that paved the way for this work. Prof F. Pelayo García de Arquer presented a talk on the Nobel Prize in Chemistry.

Lab Tours

Lab doors were opened and visitors were encouraged to learn what kind of science is developed in the participating research groups. Tours were also offered in the new Nano-Fabrication lab recently opened in the Mir-Puig building.



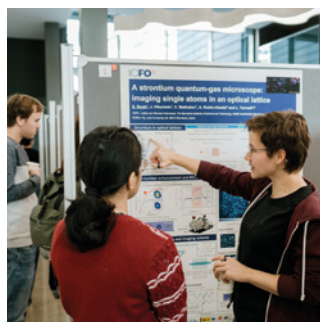
PhD Poster Session and Award

24 scientific posters were displayed in the Nest Hall and in the ensuing session the PhD authors had the opportunity to discuss their work with the ICFO community.

ICONS Prize for Best Poster

Chosen through a popular vote and sponsored by ICONS, VP Javier Arrés and Secretary Rebecca Hoffmann presented the award.

Sebastian Haegele: *Holographic amplitude and phase imaging for characterization of ultra-thin and 2-D materials.*
Group: Optolelectronics led by ICREA professor at ICFO Valerio Pruneri



ICFO PhD Poster Prize

This year there we two winners of the Poster award given by the PhD Committee.

Sandra Buob: *A strontium quantum-gas microscope: imaging single atoms in an optical lattice*
Group: Ultracold Quantum Gases led by ICREA professor at ICFO Leticia Tarruell

Geng Li: *Mid-infrared fingerprints of twisted bilayer graphene*
Group: Quantum Nano-Optoelectonics led by ICREA professor at ICFO Frank Koppens

Strategic Programs at a Glance

Many have heard of the **PIXSpain** and **QTwist** initiatives in which many of our research groups will be contributing over the coming years. Professors Valerio Pruneri and Frank Koppens, the respective leaders of these programs, offered overviews of what each aims to achieve.

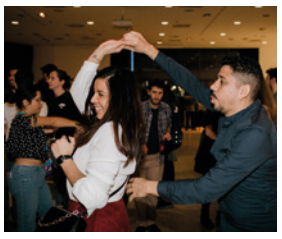
15-year ICFOnians Award

ICFO has become what it is today thanks to the contributions of all members of our gifted and diverse community. Five ICFOnians from the management units were recognized for their 15 years at the institute:

Noelia Cuesta, Javier Pérez, Magda Lara, Oscar Casellas (not pictured) **and Vittoria Finazzi** (not pictured)

And finally...

As we do each year, we ended the day with a festive cocktail dinner (and dancing!) where we were able to relax and celebrate in the company of our friends and colleagues.



Many thanks to each and every ICFOnians who contributed to the success of this enormous and important annual event, including those who organized, planned and executed on the logistics side, those who offered talks and tours, created posters, put together the Gymkhana, sang, danced, mixed the music,... all who participated and connected with the positive energy of this important community event.

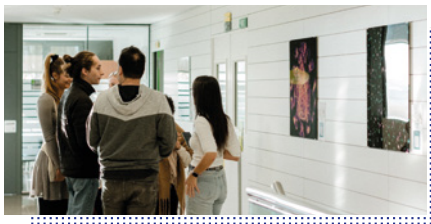
Collaboration

COMMUNITY

Science as Art

Images created for scientific purposes also inspire for their extraordinary beauty

Many groups at ICFO work diligently to create precise, miniscule, and accurate devices to take very detailed images of samples which are often imaged with extremely high-resolution techniques as a means of characterization or in order to visualize and understand details which go beyond what can be explained by words alone. Even though most of these images are created for a scientific purpose, their beauty and eye-catching features amplify the wonders of nature and its complexities.



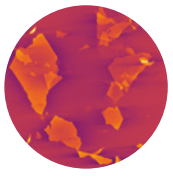
Inauguration of the Science as Art exhibit in the ICFO Day 2023 *Gymkhana*

While working on her PhD studies in the Single Molecule Biophotonics Group led by ICREA Prof. at ICFO María Garcia Parajo, **Sarah Keary**, now a postdoctoral researcher at ICFO, was often struck by the beauty of the images she and her colleagues were seeing under the microscopes. At the same time, she was frustrated that, while of high value scientifically, their aesthetics were rarely appreciable. "*Unfortunately, most of the time scientists need to shrink down their images to fit small panels of a journal publication or to include them in the supplementary information of an article. In this format, so many of their exquisite details and features are lost*", explains Sarah. Her imagination ran to an initiative where a wide range of **images could be displayed in a visual format and at a grand scale to allow all their details to be seen, observed, and admired.**

She called out to fellow ICFOnians in all groups to join her in turning visually appealing, high resolution images into an art exhibit. Over 50 images were submitted of the technology and setups created by groups, microscopic images collected of samples, and interesting looking data plots that resemble artistic illustrations. Of these, 27 were eventually printed as 80x80 works of art that became the ***Science as Art*** exhibit which can now be viewed in shared spaces around the institute.

To ensure that the ICFO community would properly inaugurate and appreciate each and every piece, **the exhibit became the central point of the annual Gymkhana competition at ICFO Day**, with contestants guessing not only the scientific content presented, but also offering their own creative interpretation.

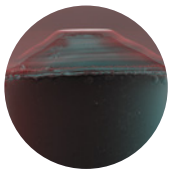
"*The main goals for me with this project were to make science more accessible both within our scientific community and for the general public, and to show the beauty in what many might think is mundane,*" comments Sarah. "*Even though we work in close proximity, we seldomly have opportunities to share our research in a casual yet informative, and beautiful way. It would make me really happy if this exhibit helps to create more synergies and collaborations between groups.*"



Solar Explosion

Image by Sebastian Haegele

Using a proprietary interferometry technique, we are able to image atomically thin flakes of 2D materials, in this case 2D Hexagonal boron-nitride (hBN). 2D materials are made up from single to multiple atomic layers, where each layer is less than one nanometer thin (<10^-9 m).



Volcano

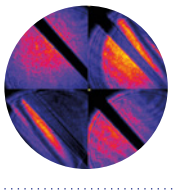
Image by Eduardo Beattie

The image is a collage of electron microscopy photos of an optical fiber before and after the reflective coating has been broken off, allowing us to see exactly which part is lost. Some remaining layers of the coating are visible a the tip.

Manta Ray

Image by Sarah Keary

Confocal Microscopy has been a critical development for research in fundamental cell biology and the growing field of biophysics. This image shows the cell's focal adhesions (magenta/yellow) which together with the actin (cyan) enable cells to attach explore and move on different surfaces.



Saturn

Image by Renata Lei & Álvaro Cuevas

Two sections of a common light beam are reflected by two longitudinally displaced mirrors. The system makes them interfere by implementing relative lateral displacement on the beam sections. Working principle of a next generation 3D imaging method.

A Sustainable Holiday Tree

ICFO Biolab users give a festive second life to clean plastic waste

Since 2021, the Biolab has been giving all clean plastic waste a second life. Hundreds of boxes, bags, bottles, and other plastic items have been donated to schools, art studios, and organizations to reuse and recycle this material.

Recylcling became festive this December when ICFOnians converted 373 pipette tip boxes and 135 tip racks used in the biology lab and rescued from the usual waste system thanks to the invaluable collaboration of Biolab users, into a holiday tree.

At ICFO we are working on improving all our processes to make them as sustainable as possible. From 2024 we are launching a Sustainability Committee to address all these actions.

Marina Pérez , María Marsal, Merche Rivas and Clara Vilches

La Marató 2023: ICFOnians amb La Marató activities

Volunteers have organized activities to raise money to promote scientific research and raise social awareness of diseases

This year, La Marató de TV3 will dedicate its fundraising efforts to investigate pathologies and complications connected with the reproductive apparatus, reproductive medicine and aspects related to pregnancy and childbirth, among others.

Once again, ICFO volunteers have organized diverse fundraising activities: yoga classes, the photo contest, chess tournament, bake sales, a book club and a futbolin tournament to collaborate with this annual fundraising drive.

Seminar by Dr Francisco Carmona about endometriosis, the historic research and advances in this area

*

Thank you to all volunteers and ICFOnians for your efforts. Together we helped to raise €1,630.

Collaboration

ALUMNI

New Board of Alumni Representatives

This 2024 the Alumni Network welcomes a new board of Honorary Alumni Representatives who join forces with the Alumni Committee

The Alumni Committee is the heart behind all of the actions and events made to maintain and strengthen the ICFO Alumni network. Every three years, the Committee nominates a board of Honorary Alumni Representatives that will participate in the meetings and help us develop the strategies to make the most of the network to benefit all ICFOnians. Meet the new board of representatives!

Dr. Parisa Farzam

Director of AI in Medical Imaging Product at Bayer
Former PhD student in the Medical Optics group

ICFO served as my ladder, enabling me to stand tall and reach for the highest fruit. Now, it's my time to give back. I want to be there for current students, helping them appreciate the privilege of being an ICFOnian. I'll see our mission at the Alumni Network as a success if we can share the lessons we've learned and assist current researchers in discovering the exciting opportunities that await them after ICFO.

Prof. Dr. Chaitanya Kumar Suddapalli

Tata Institute of Fundamental Research Hyderabad
Former PhD student and postdoctoral researcher in the Optical Parametric Oscillators group

As an alumnus and ICFO Ambassador in India, I continue my long-term research collaboration as well as personal connection with ICFO and continue to engage by actively organizing ICFO alumni get-togethers and Frontier Schools at TIFR Hyderabad, India.

Prof. Dr. Alejandra Valencia

Associate Professor, Universidad de los Andes, Department of Physics
Former postdoctoral researcher in the Quantum Engineering of Light group and Outreach manager in the KTT unit

While at ICFO, I had the opportunity to do work outside the laboratory specifically working in scientific outreach. This experience also helped me to broaden my perspectives about the professional career as a scientist and helped me to develop science communication skills to disseminate scientific research to non-specialized public.

Because of all these past experiences and what I have seen of the Alumni Network in the last 10 years, I feel honored to be part of it. I believe it is an important tool in professional networking and through it, I find an opportunity to be closer to ICFO.

Prof. Dr. Carsten Schuck

Department for Quantum Technology, Center for NanoTechnology (CeNTech), Center for Soft Nanoscience (SoN), University of Münster
Former PhD student in the Quantum information and quantum optics with single trapped atoms group

At ICFO we are very fortunate to have a strong alumni community, which has become professionally invaluable for me and keeps many fond memories alive whenever I run into former and current ICFOnians at meetings around the world. I am very much looking forward to connecting past, present and future alumni through effective communication in a growing network.

Dr. Lisa Saemisch

Trainer and Training Manager, ThePaperMill
Former PhD student in the Molecular Nanophotonics group

I have profited a lot from the alumni network during my time at ICFO, and I genuinely want to give back to that network. I would like to make the Alumni network more visible (and accessible) to all ICFOnians, pointing out its great possibilities. Strengthening connections between current ICFOnians and alumni is definitely an important objective, stimulating knowledge sharing, mentorship, and career development opportunities.

Honorary Alumni Representatives Board 2019-2023

For the past 4 years, I've worked with Naeimeh Behbood, Roser Juanola, Danny Krautz and Giovanni Volpe.

Their ideas and suggestions have been key to improving and to strengthening the Alumni Network. They have been beyond helpful, and I'm very happy to have been able to work with them since I started at ICFO as Alumni Coordinator.

Thank you for your support!

Andrea Morales
Alumni Coordinator

ICFO Alumni Reunion 2024, save the date!

This 2024, ICFOnians are celebrating our 22nd anniversary as an institution. We are commemorating the occasion by hosting an Alumni Reunion.

In this multi-generational gathering we want to bring together the anecdotes and experiences lived at the institute by those who have been within the walls of ICFO in the last 22 years.

Come and share your ICFO story!

Friday 26th April, 2023

Collaboration

ALUMNI

The Stories of 300+ PhD Graduates at ICFO

Some may believe that a Thesis Defence is a cookie-cutter event: a nervous PhD candidate, the auditorium, supervisors and committees, an audience full of colleagues, friends and family... However, over the 22 years of history of ICFO, each thesis d efence has been as different as the research and lived experience of each PhD candidate.

Locations of theses defences have varied over time, from the first ones taking place in the ETSET building on the UPC campus in Barcelona, to the inauguration of ICFO's facilities in Castelldefels and with that, our own auditorium. In between, PhD candidates have defended their theses in Seminar Rooms, most recently in the Mir Puig Elements room or from their own living room via Teams.

In 2020, the COVID pandemic tested our resilience and ICFOnians adapted to new formats and challenges. The total lockdown meant that all defenses went online. Despite the social distance, we were witnesses of all kinds of celebrations: pets saluting their owners through the cameras, families toasting their graduates and dancing from afar, and friends and colleagues connecting to wish them luck from all around the globe.

We don't know yet what the future holds for our future PhDs. Where, when and how they will defend their theses or what they will bring to the great and diverse community of ICFOnians that they are shaping with their experiences, but we are looking forward to finding out!

Do you have any anecdote regarding a thesis defence or time spent working at ICFO? The Alumni Network is gathering ICFO stories for the Alumni Reunion on Friday 26th April.

Share your story! contact@alumni.icfo.eu

Thesis Defence of **1.** Rinu Maniyara **2.** César Cabrera **3.** Gorka Muñoz **4.** Mariia Kramarenko **5.** Ana Predojevic **6.** Pamina Winkler

What do Group Leaders remember about their first ICFO PhD students?

"

***Joonwoo Bae**, or Junu, joined my group from South Korea. He was my first PhD student, so I was quite worried about his possible integration in Europe. But then, a few months after his arrival, I saw him walking in the metro stop of Plaça Catalunya with a Korean girl. I believe Junu did not see me, but I realised that his integration was smoother than what I expected... And, in fact, in the end he made a very successful PhD!*

Prof. Antonio Acín
Quantum Information Theory research group

"

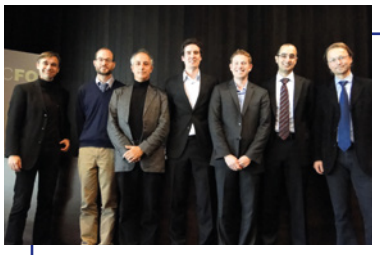
***Goutam Kumar Samantha** became my first PhD student at ICFO. In spite of his limited knowledge in the field at the time, Goutam was assigned the challenging experiment of developing the first continuous-wave OPO of its type at ICFO, which he achieved with great success. He had a very clear and specific goal: to get his PhD and return to a very clear and specific place in India to continue his scientific career- and as an extremely motivated and talented guy, he did it. He memorably showed up for his first day as a PhD student in a suite, but now that he is a renowned scientist with his own flourishing lab at PRL in India, he is content with a T-shirts and trainers.*

Prof. Majid Ebrahim-Zadeh
Optical Parametric Oscillators group

"

***Emilio Gualda** was my first PhD student to defend his PhD at ICFO. Someone had the "bright" idea that it should be a PhD graduation tradition to bathe in the "clean" lake beside ICFO after the thesis defense. Emilio was the first, and for the moment the last, to honor this tradition.*

Prof. Juan P. Torres,
Quantum Engineering of Light group



"

*The last night before we moved the lab from University of Twente (NL) to ICFO, my then Masters student **Tim Taminiau**, was collecting his final data for his Master's thesis, before moving the set-up. He came to ICFO to look at and work on the data and then he eased his way into being my first PhD student here. Expanding this work during his PhD earned Tim the cover of a special edition on antennas for light of the then new journal **Nature Photonics**, a paper in **Nature** and another in **Science**. Former ICFO Professor Romain Quidant and I would go on to earn the City of Barcelona award in 2010 for these advances.*

Prof. Niek van Hulst
Molecular Nanophotonics group

"

***Anisha Thayil** began her PhD studies at ICFO under the supervision of Dr. Silvia Soria. When Silvia left ICFO, Anisha joined my group and was my first ICFO PhD student. Anisha was very detail oriented and a great student. Twice she had very nice papers accepted "as is" - i.e. no revision required! Fun fact: She met and married her husband, also a PhD student at the time, while at ICFO.*

Dr. Pablo Loza-Alvarez
SLN group

Collaboration

OUTREACH

CARLA Camp

The CARLA program has gained its own identity and is continuing with the organisation of events and activities centred around career development in photonics and even more specialised fields

The core events are the so-called CARLA camps. The generalist events are designed to give an overview of the photonics landscape and the vast career opportunities available. Targeting university students (undergraduates and master's) and early-stage researchers (PhD, postdoc) across all STEM studies, the camps also emphasize encouraging innovation and entrepreneurship with a special attention to empower diversity.

On Thursday 30th of November **the fourth generalist CARLA camp** took place at ICFO in a hybrid format. Starting with the welcome words from Dr. Silvia Carrasco and the photonics landscape talk by Dr. Robert Sewell, participants also received an overview of how they can complement their training at ICFO. Following, the camp included inspiring talks from 12 speakers from academia, industry and beyond, in which speakers talked about their work and professional progression. It was followed by a networking lunch session and the workshop "Navigating Your Career Path in Photonics".

> *I've been able to learn about the landscape of Photonics and talk and listen to professionals.*
>
> *It was good to gain perspective on what career paths are possible, getting in touch with people, taking time to think about my ambitions differently than usual.*
>
> *This experience was motivating for me. Meeting so many people that work in the field inspired me.*
>
> Quotes from Carla Camp participants

More than 240 participants had registered for the CARLA Camp coming from over 23 countries

A networking lunch allowed participants to connect informally with each other and the speakers. The day concluded with a training session by Frank Wolfs and Ben Wienk from JointheDutch, covering interview preparation, strengths identification, and guidance on exploring diverse career opportunities. In addition, it was offered an opportunity to the attendees to meet with the trainers in a one-to-one meeting for personalized advice and insights on their CV; either in person or online.

THE PHOTONICS PROFESSIONALS THAT PARTICIPATED IN THE PANELS WERE:

Dr. Carmen Rubio (ICFO), Dr. Hugues di Riedmatten (ICFO), Dr. Joanna Kargul (University of Warsaw), and Dr. Mireia Mora (Hospital Clínic Barcelona) participated in the *Academia* panel; Dr. Ata Almasi (ASML), Dr. Bárbara Buades (Meetoptics), Dr. Mustafa Balci (Qurv), Dr. Santiago Simón (Das Photonics) participated in the *Industry* panel; and Dr. Alexandros Stravrinadis (Balder IP), Dr. Alina Hirschmann (ICFO), Dr. Ariadna Martinez (ICFO), Dr. Giorgio Colangelo (Nora Health) participated in the *Photonics is Everywhere* panel.

In total, more than 240 participants had registered for the CARLA camp coming from over 23 countries. They actively engaged during the Q&A sessions with interesting comments and insights. Since the talks and panel discussions were streamed live on ICFO's YouTube channel, online participants also had the opportunity to pose questions directly to the speakers through the live chat. The feedback received was positive and revealed that 73% of participants found the camp beneficial, and 95% would recommend CARLA camp to a friend, which brings a bright future ahead for the following CARLA activities.

Plans are underway for the Quantum Career Symposium, a spin-off CARLA event scheduled for March 22nd that will take place in the Auditorium and Gaudi rooms of La Pedrera. This event will provide insights into career paths and job opportunities in deep-tech fields, such as quantum technologies.

Aligned with the new Horizon Europe project, 360 CARLA, launching in 2024 and coordinated by ICFO, the initiative aims to expand the CARLA program by creating career development programs focused on application verticals, including health, quantum technologies, energy, environment and sustainability, and manufacturing/industry 4.0. This promises a bright future for upcoming CARLA activities.

THANK YOU ICFO OUTREACH VOLUNTEERS

The following ICFOnians participated in outreach activities (October – December 2023) sharing their enthusiasm for science with new audiences: Antonio Sampaoli, Dr. Carmelita Rodà, Dr. Chunyu Li, Dr. Clara Vilches Caubet, Dr. Claudia Valdés, Dr. Javier Argüello Luengo, Dr. Lorenzo Cortese, Lukas Lau, Dr. Marta Zanoletti, Miguel Dosil, Rajashree Haldankar, Dr. Samuele Grandi, Dr. Stefan Forstner, Dr. Vasiliy Makhalov, Dr. Viktoriia Golovanova.

BECOME AN OUTREACH VOLUNTEER

outreach@icfo.eu

Photonics in 5 minutes!

Science Week 2023

On Tuesday 14th of November 2023, ICFO live broadcasted the popular "Photonics in 5 minutes!" in the framework of the 28th Science Week which was celebrated between 10th and 19th of November 2023. This engaging activity brings scientists directly into classrooms where they share their work in a simple and understandable way, inspiring younger generations.

Targeted at secondary school students aged 14-18, the event garnered interest from 14 different schools in Catalonia, with over 400 registered participants. The live session was streamed on the ICFO YouTube channel, allowing participants to pose questions to the researchers through the live YouTube chat.

Dr. Lydia Sanmartí-Vila kicked off the session with an introduction, providing a brief overview of ICFO, its main research topics, and emphasizing the significance of photonic sciences in society and everyday life. Following, three ICFO scientists specializing in quantum physics, health, and energy each delivered a dynamic 5-minute flash talk, highlighting the importance of photonics in their research and society.

Namely, Dr. Javier Argüello-Luengo, gave hints about quantum physics and gave an overview of the Physics Nobel Prize for 2023 in a student-friendly manner. Dr. Lorenzo Cortese switched to biomedical and health applications of photonics highlighting collaborations between ICFO and clinics. Closing the round of flash talks, Dr. Viktoria Golovanova addressed global warming and how renewable energy tools and CO_2 mitigation can reduce its consequences.

After the presentations, the students had the opportunity not only to ask about the scientific part of the talks, but also to delve into the daily life of a researcher. The Q&A session fostered a fun and enriching roundtable discussion, where participants posed questions to all the speakers, creating an engaging and educational experience.

People

GO & FLY

Congratulations to 5 new ICFO PhD Graduates

306 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. Honoring ICFO's tradition, ICFOnians celebrate this important personal, professional and institutional milestone and encourage you to Go & Fly! Remember that wherever you go, you will always be a part of the ICFO community.

302

Nawaphat Malaiwong

Molecular and Cellular Aspects of Proprioceptive Control in C. elegans

October 24, 2023
Prof. Dr. Michael Krieg

303

Lukas Heller

Exploring quantum memory schemes in cold atoms for quantum repeaters

November 6, 2023
ICREA Prof. Dr. Hugues de Riedmatten

304

Daniel Urrego

Demonstration of new experimental schemes for imaging and sensing: from quantum to classical and back

November 14, 2023
UPC Prof. Dr. Juan P. Torres

305

Jana Ockova

Vibrations and energy transfer in molecules enhanced by single nanoantennas

December 13, 2023
ICREA Prof. Dr. Niek van Hulst

306

Jennifer Aldama

Toward integrating continuous-variable quantum key distribution technology

December 20, 2023
ICREA Prof. Dr. Valerio Pruneri & Dr. Sebastián Etcheverry Cabrera

COMMUNITY

1


2


3


4


5


6


7


8


9


10


11

1. 2. ICFO Activities Fair

3.- 5. La Castanyada is a Catalan and ICFO annual tradition

6.- 11. ICONS International Food Festival

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. Once he sold hand-knitted house slippers made by his grandmother as 'Last-Minute Christmas Gifts' in Barcelona.
2. He has lentils for breakfast every day.
3. He is a coffee lover, and he's experimenting to achieve the perfect cold brew!
4. He is writing a book about his life anecdotes and has created social media channels with thousands of followers to reach his future readers.

The Last Word

HIGH PROFILE

Pablo Jarillo-Herrero

Cecil and Ida Green Professor of Physics at the Massachusetts Institute of Technology and Distinguished Invited Professor at ICFO

You have received many global recognitions for your demonstration of the magic angle twisted bilayer graphene. Was this a serendipitous discovery or what clued you in to the potential of this line of research?

It's a little bit of both. There was some theoretical work about the electronic properties of magic angle twisted bilayer graphene, and we had been working in this field for about eight years before we made the discovery, so it's not something that happened randomly or accidentally. On the other hand, the type of physics we were pursuing was different from the one that we found, and no one had theoretically predicted the actual properties that we discovered. In that sense, it was a serendipitous discovery because we found something that was much bigger than what we were looking for.

Almost six years have passed since the famous experiment. How do you see the future of Twistronics now?

There are still many, many things to learn. In addition to graphene, several other materials have now been twisted on top of themselves and very interesting physics has been discovered, but there are hundreds of 2D materials and endless possibilities. Now scientists are using the analog of twisting things in many other fields of physics. At ICFO and many other places, people are doing twisted photonics, for example, for photons, and others are doing twisted phononics, for

> *In addition to graphene, several other materials have now been twisted on top of themselves and very interesting physics has been discovered, but there are hundreds of 2D materials and endless possibilities.*

classical or quantum vibrations of objects. People are doing twisted cold atom lattices. In other places people are doing twisted electrochemistry... This is expanding into many other areas of physics and neighboring fields.

It's been mostly scientists, physicists in particular, working on this so far but engineers are starting to pay attention. I joke that my PhD students are like medieval monks that are making one manuscript at a time, which takes an enormous amount of time. That manuscript is unique and cannot be easily copied or repeated. If you want a new device, you have to write another manuscript by hand. We need something similar to what happened with the printing press - the quantum press, or the twistronics press- which will enable us to, in an automated, controlled, robotic way, make thousands of devices. This could make it possible to incorporate Twistronics into applications, moving beyond science.

You are currently on sabbatical at ICFO. What drew you here and what do you hope to accomplish?

I have been collaborating for many years with colleagues at ICFO, mostly with the group of Frank Koppens but also with Adrian Bachtold and now with Carmen Rubio Verdú. When I thought about taking a sabbatical, ICFO was the natural place for me to take it and the Cellex Foundation helped to make this possible. I am originally from Valencia so geographically it was very appealing, but also scientifically it made great sense. To begin, I wanted to strengthen collaborative projects that we have between MIT and ICFO. I had strong collaborations and many shared papers with ICFO PIs, but now I also know the researchers in their groups and that's very rewarding and interesting. The sabbatical is an opportunity to strengthen the ties between MIT and Spain's research community in general, with ICFO as a home base.

You are co-leading the QTwist program at ICFO with Prof. Frank Koppens and Prof. Claudia Felser. What do you find most exciting about this initiative?

QTWIST is something of an umbrella initiative that encompasses several collaborations and a growing list of projects. Together with Claudia and Frank, as well as with Amir Yacoby from Harvard University who has also been spending part of his sabbatical here, and a number of very strong researchers from around the world who are starting to spend more time at ICFO, we are looking forward to working on some collaborative projects linking both sides of the Atlantic.

We want to work on things which few people are exploring right now. In particular, one of the things that we are quite interested in is making chiral structures. We aim to explore the quantum electronic properties of different twisted 2D materials, but in a more scalable way. An important component of this could be the automatic robotic exploration of 2D materials, which is something that no one in the world has accomplished yet. We think that a collaboration between ICFO, MIT, Max Planck and other leading institutions may be able to achieve it.

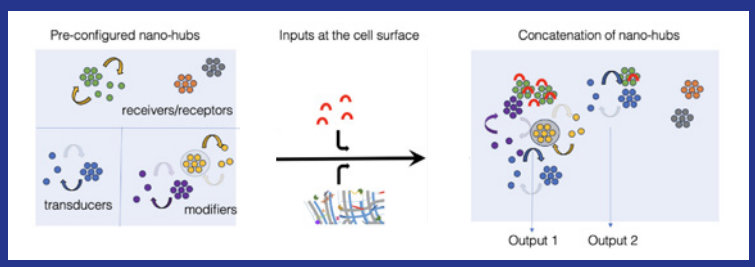
Follow us

@ICFOnians

This edition and back-issues of ICFOnians are available at www.icfo.eu/newsroom/newsletter

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

SCIENCE QUIZ



ICFO GL Maria Gracia-Parajo, together with Satyajit Mayor, Director of the National Centre for Biological Sciences in Bangalore, India, published this month **"The ubiquitous nanocluster: A molecular scale organizing principle that governs cellular information flow".** This work argues that clusters of biomolecules act as "nano-hubs" that process chemical and physical information on the cell surface, using cooperative processes to be stable against thermal noise while being reconfigurable through their interactions.

1. What imaging technology makes it possible to observe dynamic biomolecule clustering?

A) multi-dimensional NMR

B) super-resolution light microscopy

C) cryo-electron microscopy

D) nano-diamond magnetometry

2. Which of these is *not* a nano-hub information-processing function?

A) positive/negative feedback

B) coincidence detection

C) Fourier transform

D) amplification of small signals

3. The CD4 co-receptor, and molecules Lck, Zap70 and LAT are involved in regulating what?

A) Electrical response

B) B-cell development

C) T-cell activation

4. Galectins are...

A) Intra- and extra-cellular proteins

B) Intra- and extra-terrestrials

C) Invert and normal sugars

D) Lipids

Answers on pg. 2