ICFO




**Community News**
Winter 2023
**51**


ICFONIANS

# We've Got Talent

Creativity and collaboration extend far beyond our labs

# Community News

# 51

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ON THE COVER

## We've Got Talent

By mingling outside the lab, we discover who our colleagues are and connect on a variety of different levels. The ICFactor Talent Show, new this year to the ICFO Day agenda, was entertainment by and for ICFOnians and exceeded the expectations of all. Hugely successful by all accounts, this looks set to be a much anticipated addition to the annual event. Thanks to **Master of Ceremonies:** *Luca Bolzonello.* **Performers:** *Federico Centrone, Gianvito Lucivero, Alexia Montesinos, Hyppolite Dourdent, Javier García de Abajo, Leo Feldmann and Jonathan Hänni, Adriana González and Nawaphat Malaiwong, Natalia García and Niek van Hulst, Krystian Nowakowski (pending venue for flame throwing performance).* **Applausometer:** *Marta Cagetti.* **Organizers:** *Luca Bolzonello, Marta Cagetti, Federico Centrone, Andrea Morales, Giovanna Petrillo.*

EDITOR'S CORNER

# Who Knew?

### Sharing science, music and talent that goes above and beyond the expected

**Brook Hardwick**
Contributing Editor

Every day we write about ICFOnians' achievements: new publications in prestigious journals, prizes, projects awarded and coordinated, advances that are being converted into new technologies and services, etc. There is amazing science at ICFO, done by smart, insightful and ambitious individuals who are constantly breaking with expectations and pushing the limits of what we know, what we can see, and what we understand about the workings of nature.

Who knew that the same people responsible for all the amazing science, who spend their days in dark labs or immersed in equations have so many other hidden talents? You can also do flips, throw flames (ok- we didn't get to witness this in person because of ICFO safety regulations), sing, dance, hypnotize and entertain, and you showed this in the most spectacular way in the new ICFactor initiative on ICFO Day. I, who have spent 10+ year as an ICFOnian, thought I could no longer be surprised by the multi-talented ICFO community, but I was wrong. ICFO Day has a way of doing that to me, and the exposition of talent this year really blew me away. Thank you ICFOnians for once again surprising and delighting me with your talent and creativity.

As a way of following up the fantastic ICFO Day 2022, I would like to extend a heartfelt thanks to the ICFO community for a great number of things that you do that make ICFO a special place:

- Thank you for your collaborative spirit that inspires you to answer calls to share your science not just with the ICFO community on ICFO Day, but also with students who visit ICFO with their schools throughout the year or who come to spend time in our labs through programs that aim to inspire young people in STEM to pursue scientific careers.
- Thank you for being the kind of people who go the extra mile to make something WOW, just because of the personal satisfaction that you get out of a job well done.
- Thank you for generously sharing things you care about and find interesting with the rest of the community.
- Thank you for valuing the contributions of all ICFOnians.
- Thank you for being a principled group of people with high ethical standards and ideals.
- Thank you for daring to be different and for your positive appreciation of the unique contributions of others.
- Thank you for your energy, which is contagious. There is not a lazy ICFOnian at our institute.
- Thank you for being a welcoming place where people from all over the world and from all walks of life can feel at home.

Happy New Year ICFOnians.
Here's to a 2023 with lots more "ICFactor"!

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## Happenings

ICFO NEWCOMERS

# Welcome to ICFO

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

**Tomás Fernández**
Student

**Anna Almazán**
Student

**Ranit Ram**
Student

**Dilan Israel Pérez**
Student

**Aleksandra Deeva**
Student

**Cristina Vaca**
Student

**Sara Navarro**
Student

**Elsa Vázquez**
Student

**Isabel Rojas**
Student

**Bianca Turini**
PhD Student

**Carolina Fajardo**
PhD Student

**Ana Pérez**
PhD Student

**María Recasens**
PhD Student

**Paula Alonso**
PhD Student

**Leo Feldmann**
PhD Student

**Lukas Wangler**
PhD Student

**Kawa Rosta**
PhD Student

**Jacqueline Martínez**
PhD Student

**Christian Knapp**
PhD Student

**Goretti Torres**
PhD Student

**Rémy Avila**
Visiting Scientist

**Alexander Gresch**
Visiting Scientist

**Niklas Käming**
Vistiting PhD Student

**Owidiusz Makuta**
Vistiting PhD Student

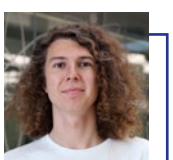
**Chiara Michelini**
Vistiting PhD Student

**Yintao Ma**
Vistiting PhD Student

**Przemysław Grzybowski**
Research Fellow

**Charikleia Troullinou**
Postdoctoral Researcher

**Leonardo Zambrano**
Postdoctoral Researcher



**Markus Teller**
Postdoctoral Researcher

**Javier Argüello**
Postdoctoral Researcher

**Nishigandha Patil**
Postdoctoral Researcher

**Dario Lago**
Postdoctoral Researcher

**Eduardo Dias**
Postdoctoral Researcher

**Raja Yehia**
Postdoctoral Researcher

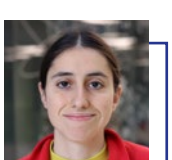
**Likun Wang**
Postdoctoral Researcher

**Alvaro Rodríguez**
Postdoctoral Researcher

**Egle Pagliaro**
Research Engineer

**Iris Cusini**
Research Engineer

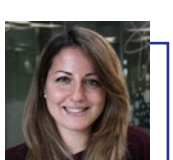
**Christian García**
Electronics Workshop



**Marina Pérez**
Biology Lab Research Technician

**Jowita Pawlak**
Pre-Award Project Management

**Zoi Melissari**
KTT Project Manager, Outreach



**Nicoletta Liguori**
Group Leader

**Not pictured** **Manel Madrid,** Student **Desirée Gutierrez,** Travel Support

# Happenings

ICFO NEWS

## New Director General of BIST

The Board of Trustees of the Barcelona Institute of Science and Technology (BIST) approved the appointment of **Dr Eduard Vallory as the new Director General**, following a competitive selection process. He succeeds Dr Gabriel M. Silberman, who was at the helm of BIST for five years, and brings to BIST his experience in research management, strategy, and education transformation.

Eduard Vallory participated in the creation of BIST in 2015 and was one of the founding Board members, a position he maintained until his recent appointment. Immediately prior to assuming the responsibility of Director General of BIST, Vallory held the position of Associate Director for Strategic Initiatives at ICFO.

## Optica Foundation 20th Anniversary Challenge

The Optica Foundation announced that **Dr Michela Florinda Picardi**, a postdoctoral researcher in the **Thermal Photonics research group** led by ICFO Prof Dr Georgia Papadakis, is one of ten finalists of the **Optica Foundation 20th Anniversary Challenge**, chosen from nearly 100 applications from around the globe, for the project THUNDER - THermal UNpolarized radiation Design for Energy Recycling. The project aims to design thermal emitters to harvest the power of thermal radiation, exploiting intrinsic properties of light at the nanoscale, such as chirality or reactive power, to achieve tailored thermal radiation that is, for example, directional, monochromatic or possesses a high degree of polarization.

The Optica Foundation launched its 20th Anniversary Challenge to draw out novel ideas from early-career professionals, and provide the seed money to investigate impactful hypotheses in the **areas of environment, health, and information**. Awardees receive funding to explore their ideas and take steps toward addressing critical global issues.

## Highly Cited Researchers

***Clarivate Web of Science*** has included two ICFO Group Leaders, **Prof Dr Pelayo Garcia 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 create this list of influential researchers, Clarivate surveyed papers produced and cited over an 11-year period from January 2011 to December 2021 that at the end of 2021 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.

## American Physical Society Fellow for 2022

**ICREA Prof at ICFO Dr Frank Koppens** has been elected fellow of the American Physical Society for 2022 for "***pioneering work in the science and applications of 2D material optoelectronics, quantum photonics, and nano-photonics. This includes the demonstration of record-strong compression of light, the control and detection of 2D polaritons, and the creation of broadband and ultrafast photodetectors***".

The APS Fellowship Program was created to recognize members of the physics community who have made exceptional contributions to the physics enterprise in physics research, important applications of physics, leadership in or service to physics, or significant contributions to physics education. Each year, no more than one half of one percent of the Society's membership (excluding student members) is elected by their peers to the status of APS Fellow.

## 2022 Physics Award RSEF-BBVA Foundation

Each year, the **Royal Spanish Physics Society-BBVA Foundation Physics Awards** recognize creativity, effort and achievement in the field of physics in order to serve as a stimulus to professionals who carry out their work both in research and in the fields of secondary and university education, innovation, technology and outreach.

ICFO postdoctoral researcher **Dr Javier Argüello** and **Dr Alejandro González Tudela**, researcher at the Instituto de Física Fundamental-CSIC, co-supervisor of Javier's doctoral thesis, were awarded the **RSEF-BBVA prize for the best Outreach contribution in the publication of the Royal Spanish Society of Physics (RSEF)**. The prize was awarded for their article, "Analog quantum simulators: a tool for understanding the matter that surrounds us", published in the *Revista Española de Física*, Vol. 35, nº 1, January-March 2021.


The jury recognized the clear and entertaining way in which the authors presented their work in quantum simulations, and valued the originality of the comparison with the work of the architect Antonio Gaudí, illustrating the transversality that some brilliant ideas can have. They also highlighted the article's ability to successfully convey the connections between applied and fundamental physics in a unique and novel way.

## UPC Special Doctoral Awards 2022

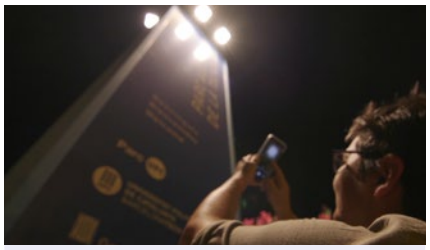
The Extraordinary PhD Awards, given annually by the Technical University of Catalonia· Barcelona Tech (UPC), aim to **recognize the best doctoral theses which have obtained "cum laude" in their final PhD defense evaluation.** This year, the UPC announced the list of 7 awardees in the broad area of "Sciences", which include the extraordinary doctoral works for the academic period 2019/2020 of two ICFO PhD graduates.

**Dr Pamina Winkler** for the thesis entitled "*Novel Planar Photonic Antennas to Address the Dynamic Nanoarchitecture of Biological Membranes*", supervised by ICREA Prof at ICFO Dr María García-Parajo.

**Dr Daniel González Cuadra** for the thesis entitled "*A Cold-Atom Approach to Topological Quantum Matter Across the Energy Scales*", supervised by ICREA Prof. at ICFO Dr Maciej Lewenstein and Prof Alejandro Bermúdez.

# Happenings

**LATEST ADVANCES**



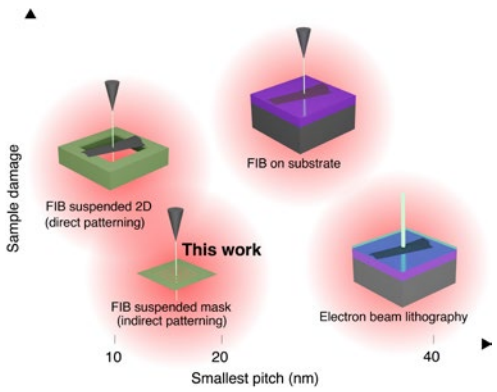
## Citizen Science to Effectively Monitor Light Pollution in Cities

To study the effects of light on living beings, it is important to collect information about the brightness and also the color of artificial light at night. These parameters also allow experts to compute economic and ecological parameters with more precision. **The NightUp citizen science experiment was launched to tackle the lack of data in urban areas, aiming to show that a wide range of low-cost and ubiquitous light sensors – smart phone cameras – can be used to characterize the color spectrum of streetlights.** The project at ICFO was coordinated by **Federica Beduini** from the ICFO Outreach team. **Outreach and Communications** units organized volunteers from the Castelldefels, Barcelona and El Prat del Llobregat communities to collect streetlight photos from their neighborhoods. In parallel, ICFO researchers **Gorka Muñoz-Gil**, and **Alexandre Dauphin**, along with **Alejandro Sánchez de Miguel** from Universidad Complutense de Madrid, developed an automatic method to analyze the images and rigorously extract information on the illumination colors in multiple urban areas.

For over 5 months, the team carried out a pilot phase gathering over 1000 photographs from more than 70 unique smartphone users, as well as additional useful information recorded through the NightUp mobile application developed for the project. ICFO researchers rigorously benchmarked their color extraction algorithm, validating it manually to confirm image quality and the algorithm's accuracy. After a thorough data analysis processing, they compared the extracted colors with the ones gathered by the NightUp method, finding the NightUp photos far richer in useful data.

Published in ***Remote Sensing***, which is scalable to larger areas, retrieves useful high-quality **data for scientists working on the study of light pollution**, as well as for local governments to optimize outdoor lighting and address light pollution effectively.

## A Novel Nanofabrication Technique for Patterning Periodic Structures




Electron beam lithography has been one of the most common and widespread nanopatterning fabrication techniques in academic research but it poses certain limitations. An alternative to this technique is the helium-focused ion beam (He-FIB) milling approach for direct patterning of features. Although it achieves a very high resolution, it presents two major limiting factors: ion implantation in the substrates and damage in the patterned material due to secondary collisions.

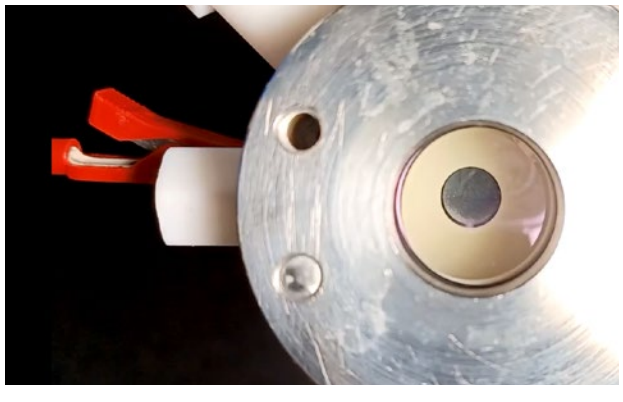
In a recent study published in ***Nature Communications***, ICFO researchers David Barcons Ruiz, Hanan Herzig Sheinfux, Rebecca Hoffmann, Iacopo Torre, Roshan Krishna Kumar, Lorenzo Vistoli, and Adrian Bachtold, led by ICREA Professor Frank Koppens, in collaboration with researchers from the National Institute for Materials Science (Japan), have reported on a new technique based on ultra-thin suspended etching masks that are implemented to pattern periodic nanostructures. By using this new strategy, they have been able to fabricate graphite electrodes to engineer high-quality graphene superlattices.

This new solution opens the door towards the realization of a very short period superlattices in 2D materials, but with the ability to control lattice symmetries and strength. This can pave the way for a versatile solid-state quantum simulator platform and the study of correlated electron phases.

## Controlling the Hydrogen Generation and Storage in Graphene Oxide

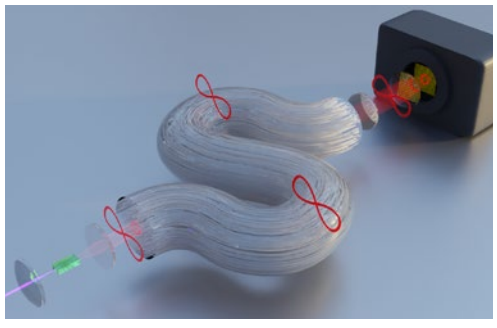
In a paper published in ***Carbon***, researchers in the EU's Horizon 2020 project ***LESGO*** determined the starting point of the electrochemical reduction and hydrogen storage in different electrolytes, substances that, when dissolved in water, disassociate into charged particles called ions. They further describe the influence of several parameters using in-situ Raman spectroscopy, a chemical analysis technique which provides detailed information about the chemical features such as the structure, phase and polymorphy, crystallinity and molecular interactions.

The team of scientists from CERCA centers that carried out the study included ICFO researchers **Adrián Pinilla-Sánchez, Sidney M. Palardonio, Jordi Martorell** and **Carles Ros**, together with Sebastián Murcia-López and Nina M. Carretero from **IREC** and **ICN2** members Emigdio Chávez-Angel, Peng Xiao, Daniel Rueda-García, Clivia M. Sotomayor Torres and Pedro Gómez-Romero.



The results of the study **define the precise electrical potential needed for electrochemical hydrogen storage in different electrolytes, allowing for better control of the energy storage in such systems based on graphene oxide**. A next step will be to upscale the technology in order to fabricate the hydrogen-rich graphene in larger amounts in flow electrochemical cell conditions.

## Achieving a Quantum Fiber



In a study published in ***Communications Physics***, ICFO researchers **Alexander Demuth, Robin Camphausen, Alvaro Cuevas**, led by **ICREA Prof at ICFO Valerio Pruneri**, in collaboration with **Nick Borrelli, Thomas Seward, Lisa Lamberson** and **Karl W. Koch** from Corning, together with **Alessandro Ruggeri** from Micro Photon Devices (MPD) and **Federica Villa** and **Francesca Madonini** from Politecnico di Milano, were able to successfully **demonstrate the transport of two-photon quantum states of light through a phase-separated Anderson localization optical fiber (PSF)**.

By using a spontaneous parametric down-conversion source, multi-photon detection with a single-photon avalanche diode array camera, and signal post-processing techniques, the researchers demonstrated quantum light transport, where spatial correlations between photon pairs are preserved after propagation. In order to better understand and improve light transport, they studied light localization, observing a dependence on wavelength.

Study results show this approach to be potentially attractive for scalable fabrication processes in real-world applications in quantum imaging or quantum communications, especially for the fields of high-resolution endoscopy, entanglement distribution and quantum key distribution.

# Happenings

LATEST ADVANCES

## Lens-less Ultrafast X-Ray Method to Image Phase Transitions

In the new study published in ***Nature Physics***, ICFO researchers **Allan S. Johnson** and **Daniel Pérez-Salinas**, led by former ICFO Prof **Simon Wall**, in collaboration with colleagues from Aarhus University, Sogang University, Vanderbilt University, the Max Born Institute, the Diamond Light Source, ALBA Synchrotron, Utrecht University, and the Pohang Accelerator Laboratory, have pioneered a new imaging method that **allows the capture of the light-induced phase transition in vanadium oxide ($VO_2$) with high spatial and temporal resolution**.

The new technique is based on coherent X-ray hyperspectral imaging at a free electron laser, which has allowed researchers to visualize and better understand, at the nanoscale, the insulator-to-metal phase transition in this very well-known quantum material.

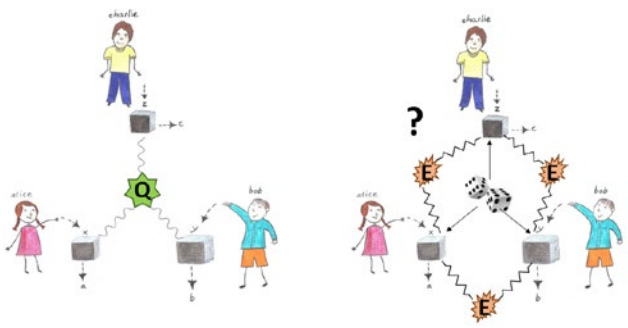
In their experiment, researchers prepared thin samples of VO2 with a gold mask to define the field of view. Then, the samples were taken to the X-ray Free Electron Laser facility at the Pohang Accelerator Laboratory, where an optical laser

pulse induced the transient phase, before being probed by an ultrafast X-ray laser pulse. A camera captured the scattered X-rays, and the coherent scattering patterns were converted into images by using two different approaches: Fourier Transform Holography (FTH) and Coherent Diffractive Imaging (CDI). Images were taken at a range of time delays and X-ray wavelengths to build up a movie of the process with 150 femtosecond time resolution and 50 nm spatial resolution, but also with full hyperspectral information.

Although the researchers describe the present work as fundamental research, the potential applications of this technique could be diverse, potentially allowing to look at polarons moving inside catalytic materials, attempt imaging superconductivity itself, or even to help understand novel nanotechnologies by viewing and imaging inside nanoscale devices.

## Bell Theorem Generalized

Quantum correlations are obtained when multiple parties perform independent measurements on a shared quantum state. For instance, in a scenario where quantum correlations arise from Alice, Bob and Charlie each performing measurements on the quantum state Q.




Bell's seminal theorem proves that certain correlations predicted by quantum theory resist explanation in terms of any local theory based on local hidden variable, also called shared randomness. But what about alternative explanations for quantum correlations, in terms of an exotic bipartite resources E of an undiscovered causal theory generalizing quantum theory and shared randomness?

In two theoretical studies published in ***Physical Review Letters*** and ***Physical Review A***, **Xavier Coiteux-Roy** from USI Lugano, **Elie Wolfe** from PI Waterloo, led by ICFO researcher **Marc-Olivier Renou**, have shown that no exotic causal theory can account for all quantum correlations, thus generalizing Bell's theorem.

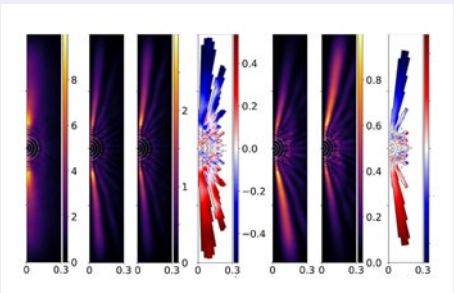
They proposed a concrete experiment which achieves correlations impossible to simulate with one of the before mentioned alternative explanations for quantum correlations. This certifies the fact that **Quantum Nonlocality is Genuinely Tripartite**. They generalized this result, showing that **Quantum Nonlocality is Genuinely N-partite**, for any N.

The team constituted by researchers **Huan Cao, Chao Zhang, Bi-Heng Liu, Yun-Feng Huang, Chuan-Feng Li, Guang-Can Guo** from USTC Hefei together with original authors **Coiteux-Roy, Wolfe, Renou** and ICFO researcher **Gaël Massé**, was able to accomplish the proposed experiment, producing a study that was published in *Physical Review Letters*. In parallel, a second similar experimental work performed in Shenzhen was communicated the same day, and a third experimental work closing the so-called locality loophole was realized in the Hefei National Laboratory a month after, showing the transcendence of the theoretical results.

## Deciphering Molecular Chirality with a New Ultrafast Imaging Technique

Developing methods to image molecular chirality with high temporal resolution is a key step towards understanding the molecular dynamics of not-so-simple systems. In a recent study published in ***Physical Review Letters***, ICFO researchers **Xavier Barcons** (now at the German Aerospace Center), **Andres Ordoñez**, and **Andrew Maxwell** (now at Aarhus University), led by **ICREA Prof at ICFO Maciej Lewenstein**, have **identified a phenomenon that could permit the imaging of molecular chirality with extremely high temporal resolution** (on the order of $10^{-16}$ s), which depends on a fundamental property of electrons, unexploited in this way until now.

In their theoretical approach, they considered the photoionization of a chiral molecule using a very short and rather intense infrared pulse. The team found that upon ionization of the molecule with linearly polarized light, the molecular chirality is imprinted in the OAM-helicity of the photoelectron. They observed that emitted electrons carry information about the chirality of the molecule they are emitted from, through the OAM retrieved information, a fundamental phenomenon that they were completely unaware of until now.



This is the first study that explores the role that the orbital angular momentum (OAM) of free electrons play in the context of photoionization of chiral molecules. This will not only mark the commencement of collaborations aimed to design an attosecond experiment, where the scientists will seek to measure the electron's OAM and demonstrate their key theoretical results. It will also provide insights on an improved description of the chiral molecule, which at the moment relies on a toy model that captures the essence of the phenomenon, but which does not include important aspects such as the anisotropy of the molecular potential, or recollision scenarios that lead to interesting strong-field phenomena such as high-harmonic generation and light-induced electron diffraction, among others.

# Happenings

BUSINESS NEWS

# Quside Technologies

## Celebrating 5 years, new products, new financing, and proven technology

*Quside Technologies, a deep-tech spin-off company that set out to develop quantum technologies for the cyber-security and super-computation worlds, incubated in the ICFO KTT LaunchPad before its constitution in 2017. Carlos Abellan (CEO) and Waldimar Amaya (COO) worked on the technology development of Quside for 6 years, with the advice and supervision of co-founders ICREA Professors Valerio Pruneri and Morgan Mitchell as well as members of the KTT unit.* Today Quside is succeeding in delivering quantum-enhanced randomness generation, monitoring and processing solutions for world-leading innovators that are building the strongest cybersecurity and the best decision-making tools for the benefit of everyone, everywhere.

Quside Technologies team

2022 was a big year for the company and as the Quside team celebrated their 5th anniversary, they had reason to be optimistic about the future.

> *One of the most exciting things in the creation of Quside is to have travelled from the investigation of the fundamental concepts on which our technology is based to its industrial implementation. Today belonging to the European Quantum community is quite an achievement for the entire Quside team.*
>
> **Waldimar Amaya**
> Quside co-founder and COO

### Series A Funding

At the end of November 2022, Quside announced that they had secured a seven-digit investment from Trumpf Ventures, the investment branch of Trumpf, a world-leading industrial manufacturer of photonic components, and Bullnet Capital, an experienced deep tech investor in Spain. Demium Capital and TechVision Capital also joined the round. The new investors will support and accelerate the next stage of growth for Quside.

> *Securing Series A investment has been a huge milestone for us. Having Trumpf and Bullnet trusting us will allow Quside to expand into the consumer market and use our photonic integrated technology to increase the security of every connected device.*
>
> **Domenico Tulli**
> Quside co-founder and CTO

### New Product Launch: World's 1st Randomness Processing Unit

Shortly after the announcement of the successful Series A funding investment, Quside unveiled its vision for the **Randomness Processing Unit (RPU), a device designed to simultaneously accelerate the execution of intensive randomized workloads with reduced energy consumption and execution time savings.**

Many of the most relevant simulation, optimization, and prediction workloads rely on stochastic processes. In turn, they require an ever-increasing source of high-quality, high-speed random numbers and associated processing tasks. Current approaches using pseudo-randomness generation in high-performance environments often lead to significant energy consumption and performance inefficiencies, as well as potentially introducing artifacts and co-dependencies in the statistical results.

> *Pseudo-random number generation subroutines may involve up to 50% of the total computing resources for stochastic workloads.*
>
> **Jose Martinez**
> Lead Scientist at Quside

Quside's new Randomness Processing Unit **allows customers to off load their randomness generation and processing tasks from the CPU, boosting the efficiency of their infrastructure and improving the quality of their simulation, optimization, and prediction needs. Quside has demonstrated full-workload performance improvements of up to 10X and energy-saving efficiencies of up to 20X.**

### Other products currently in QUSIDE's portfolio

**FMC Series**
High quality randomess.
Main application areas: cryptographic appliances, high-performance computing systems and gambling.

**QN100 Chipsets**
Enable gigabit per second quantum entropy generation on a millimiter-squared footprint.

> *The Quside journey has been thrilling and exciting so far. Working with leading industry players and getting support from top investors is rewarding. However, the most rewarding to me is pushing the line continuously on innovative products and seeing how they get adopted in real-world environments.*
>
> **Carlos Abellan**
> Quside co-founder and CEO

**+INFO**
www.quside.com

### Technology Alliance Partnership Agreement with Juniper Networks

October 2022, Quside signed a Technology Alliance Partnership Agreement with Juniper Networks, a leader in secure, AI-driven networks, to explore together how network providers can leverage high-quality, high-performance and measurable quantum entropy sources, such as the one provided by Quside, in support of the transition to new innovative approaches to cryptography. This effort aligns with the on-going transition to quantum-resistant encryption solutions providing quantum-safe security features.

### Random numbers in Nobel Prize winning experiments

As we all know, this year's Nobel Prize in physics was awarded to John F. Clauser, Alain Aspect and Anton Zeilinger for *"experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science"*.

Quside founders had the opportunity to collaborate with Anton Zeilinger's Nobel winning loophole-free Bell test experiments in 2015. Today, as a company, Quside is industrializing and scaling the same quantum randomness technology used in the experiment as they seek broad societal impact via safer connectivity and improved decision-making applications.

## Collaboration

RESEARCH

# Research for Quantum Secure Communications

**In the short term, quantum communications are of great interest in the world of telecommunications, especially in the field of cybersecurity, because of the additional layer of security they offer to the currently existing technologies for secure transmission of data and information over the internet**

The ultimate goal is the implementation of the so-called 'Quantum Internet', which will connect all kinds of quantum systems, such as computers, processors, simulators and sensors, through a network capable of rigorously distributing quantum resources, such as the so-called quantum entanglement, through a conventional telecommunications network reinforced with quantum elements.

The European Commission has selected 'quantum internet' as a strategic area for investment to build a global quantum internet made in Europe. **ICFO will play important roles in recently launched and future programs in varying funding schemes**, working on different pieces of the large and complex quantum secure communications puzzle.

## Complementary Plan on Quantum Communications

In November 2022, six research institutions based in Catalonia, **ICFO** (coordinator), the Catalan Institute of Nanoscience and Nanotechnology (**ICN2**), the Institute of High Energy Physics (**IFAE**), the University of Barcelona (**UB**), the Polytechnic University of Catalonia (**UPC**) and the Autonomous University of Barcelona (**UAB**), met for the kick-off meeting of a **research program on quantum technologies** ultimately applicable in the future European Quantum Internet. The project has been funded with 15 M EUR over the next three years, of which 9.7M EUR have been funded by the **European Union Recovery and Resilience Mechanism***, through the Ministry of Science and Innovation, and 5.3M EUR allocated by the Generalitat de Catalunya through the Department of Research and Universities.

COMUNICACIONES CUÁNTICAS

ICREA Professor at ICFO **Dr Valerio Pruneri** is the coordinator of this macro program whose main objective is the **development of concepts and technologies that are currently not commercially available in communications and in computing, sensors and quantum materials**. ICFO research groups led by Professors Antonio Acín, Adrian Bachtold, Hugues de Riedmatten, Gerasimos Konstantatos, Frank Koppens, Morgan Mitchell, Maciej Lewenstein, Valerio Pruneri and Leticia Tarruell will work on projects funded in this scheme, in collaboration with researchers at other institutes. Some of the challenging areas that will be addressed include:

- Hardware and software that can be integrated into telecommunications networks.
- Identification and development of technological solutions that are optimal for long distances.
- Development of quantum repeaters and memories to achieve quantum communication through optical fibers over distances of more than 100km.
- Technologies for the ultra-precise distribution of time signals, for the connectivity of quantum sensors and distributed quantum computing.
- Exploration of the properties of quantum materials.

Consortia members at kick-off meeting at ICFO

The program includes transversal lines focusing on the **training of personnel**, with a special emphasis on the capacity for **entrepreneurship**, the creation of an **industrial ecosystem** and the **development of new circuits for the dissemination and exploitation of results**. Through these efforts, the program aims to effectively transfer the scientific and technological knowledge from the laboratory to the market, with a significant and beneficial impact on society. Important efforts will be made to support technology transfer as well as to consolidate and create new technology-based companies in the field.

The "Quantum Communication" program is focused on research projects and will be developed in parallel to other programs, financed mainly by the European Commission, aimed at a gradual deployment of technologies for the creation of the Quantum Internet. The first phase of the aforementioned deployment will take place throughout the decade and will involve companies from the telecommunications infrastructure sector. In **Catalonia, Cellnex Telecom has a leading role in the terrestrial sector**.

***Recovery, Transformation and Resilience Plan:** a project established by the country aiming to outline the roadmap for the modernization of the Spanish economy, the recovery of economic growth and job creation, for a solid, inclusive and resilient economic recovery after the COVID crisis. It also aims to respond to the challenges of the next decade. It is funded through the Recovery and Resilience Mechanism of the European Union which is the key instrument at the heart of NextGenerationEU to help the EU emerge stronger and more resilient from the current crisis.*

## The Quantum Internet Alliance

The Quantum Internet Alliance (QIA), a new Horizon Framework Partnership Agreement (FPA) led by QuTech, will implement a **seven-year program aiming to develop a full-stack prototype network connecting distant cities**. This way, QIA will drive an innovative European quantum internet ecosystem capable of leveraging QIA world-leading developments that translates into innovative engineering solutions. The prototype network will be able to connect users in two metropolitan areas, hundreds of kilometers apart. The first phase of the program, which will run for 3.5 years starting in October 2022, has a total budget of 24M EUR.

# Collaboration

The Quantum Internet Alliance was initially established in 2017 as a Quantum Flagship project involving European leaders in the field QuTech, ICFO, University of Innsbruck, and the Paris Centre for Quantum Computing. It is  an established world-leading team consisting of 40 partners across Europe, including academic institutions, telecom operators, system integrators and quantum tech startups. Their common goal is to address all challenges towards building a world-first prototype of a large-scale quantum network in Europe.

> *QIA is on a moonshot mission to build a prototype quantum network that has the potential to become the first of its kind.*
>
> **Prof Dr Stephanie Wehner (QuTech)**
> Director of the QIA

The objective is to **build two metropolitan scale networks containing quantum processors and photonic clients, connected by a long-distance fiber backbone using quantum repeaters**. This network will be fully programmable to allow the realization of any application supported by the hardware using platform-independent software. Photonic clients will enable a cost-effective access to quantum internet technology in the future.

**QIA consortia members at kick-off meeting at TU Delft**

> *Developing the ability to interconnect metropolitan networks via quantum repeater based long-distance links will be a game changer. It will demonstrate the ability for inter-networking, paving the way for industrial scaling towards a true Quantum Internet that connects many more metropolitan networks via long-distance backbones between them.*
>
> **ICREA Professor at ICFO**
> **Dr Hugues de Riedmatten**
> Will lead the Quantum Repeaters work package of the QIA

Quantum Internet technology promises to provide various benefits to diverse sectors, such as the security of the telecommunications and financial sectors. In phase 1, QIA aims to identify several pilot use cases that can be showcased on early stage quantum internet technology.

RESEARCH

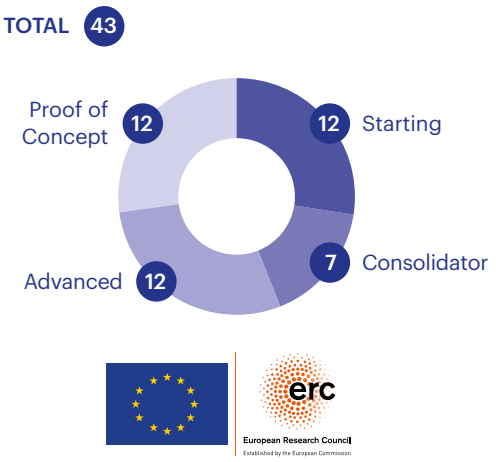
# European Research Grants for Frontier Research

**ICFOnians launch exciting research projects in the Advanced Grant and Starting Grant funding schemes**

Set up by the European Union in 2007, the European Research Council's mission is to encourage the highest quality research in Europe through competitive funding and to support investigator-driven frontier research across all fields, based on scientific excellence.

ICFOnians have been extremely successful in their applications for these sought-after grants to date. In the most recent calls, one new ERC Advanced Grant and one Starting Grant were launched at ICFO. Two postdoctoral researchers at ICFO were also awarded grants that they will take with them to help build their own research programs at other European institutions.

**ERC Grant projects awarded to ICFO Group Leaders through 2022**




## ERC Advanced Grant

Designed to support excellent scientists and scholars in any field at the career stage when they are already established research leaders, with a recognized track record of research achievements.

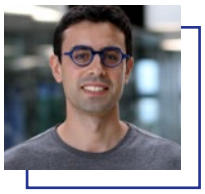
**ICREA Prof at ICFO Niek van Hulst**, leader of the Molecular Nanophotonics research group, receives his 3rd AdG for his project entitled ***FastTrack: Photons and Electrons on the Move*** which will run through 2027. Niek will investigate the dynamic organization of the natural light-harvesting membrane architecture, its packing, order, diffusion, and re-organization in response to light stress. The research will address questions related to which pathways are taken to charge separation and the role of fluctuations, coherences, color and vibrations.

## ERC Starting Grants

Targeting talented scientists with 2-7 years' experience post PhD and a track record showing great promise. It helps them to build their own teams and conduct pioneering research across all disciplines.

**ICFO Prof Pelayo García de Arquer** leader of the $CO_2$ Mitigation Accelerated by Photons group at ICFO. Pelayo has been awarded funding to pursue the project ***NASCENT: Nanoscale Advance of $CO_2$ Electroreduction*** which seeks to advance the understanding of electrochemical interfaces using a novel combination of operando spectroscopies; and, using this information, programming them using atomically designed materials to bring $CO_2$ electroreduction closer to viability.

**Dr Matz Liebel** applied to and was awarded his Starting Grant while a *research fellow in the Molecular Nanophotonics group at ICFO, but soon to move his research pursuits to* ***VU Amsterdam*** *(NL)*. Matz was awarded funding to pursue the project ***PIRO: Phototransient InfraRed Holograph***, in which he will use combine holographic imaging methodologies with ultrafast spectroscopy tools, to build innovative biomedical imaging platforms to impact diagnostics.



**Dr Ernest Pastor** applied to and was awarded his Starting Grant while a *research fellow in the Ultrafast Optical Dynamics group at ICFO. He is now conducting research at the* ***Institute of Advanced Materials*** *(Castelló, ES)*. In Ernest's project entitled ***PhotoDefect***, he will tailor lattice oxygen and photo-induced polarons to control reaction mechanisms and boost catalytic activity, allowing him to develop new tools to learn how to master photoactive solids.

## Collaboration

TRAINING

# Training Future Generations of Scientists and Technologists for Academia and Industry

**Academic programs at ICFO stress scientific excellence, transversal skills, international mobility and collaboration**

ICFO was founded with the central mission of training the next generation of scientists and technologists, helping to foster careers in the academic and industrial worlds. Since its founding in 2002, training programs have matured and expanded so that today the institute is able to offer a broad range of tailor-made career development programs starting with university students, and advancing through the flagship PhD program in partnership with the Doctoral School of the Universitat Politècnica de Catalunya • Barcelona Tech (UPC).

Over the past months, new programs at ICFO and pan-European collaborations have launched that will positively impact the learning experience of students at ICFO and also the institute's ability to connect its frontier research focus with the needs of society.

## International Training Alliances: helping Europe win the global race for quantum talent

### DigiQ- Digitally Enhanced European Quantum Technology Master

In order to meet the emerging **need for a quantum-ready workforce in the coming decade**, university training efforts within Quantum Technology (QT) will not only have to be **massively scaled** up but also **comprehensively reformed**. There is an urgent need for a wider understanding of the underpinnings of the quantum revolution as well as an increased awareness for the commercial potential of quantum innovations in the coming generations of quantum physicists.


A large number of ICFO research groups conduct research in Quantum Science and Technology. With this expertise, ICFO is already an active member of the coordinating team of the **Barcelona Master in Quantum Science and Technologies** (coordinating Institute: Universitat de Barcelona), preparing graduates in Physics, Physical Engineering or equivalent degrees who want to continue specialization studies in Quantum Science and Technologies.

It also organizes a series of Frontier Schools for talented young researchers and students worldwide to introduce them to thematic research areas like Quantum Technologies, and runs a rich Outreach program with special activities that aim to motivate students in STEM to consider careers in Quantum Technologies.

Now, ICFO will apply its extensive experience in academic programs in the Quantum Technologies arena to **DigiQ**, a new European project **coordinated by Aarhus University** (DK), that aims to **spearhead a transformation of the educational ecosystem by introducing both a series of didactical innovations as well as a multinational program structure ready to be scaled up to the rest of the European Higher Education Area.**

> *DigiQ is a great opportunity for ICFO to enhance the strong academic and outreach programs that we offer with inputs and know-how from internationally renowned leaders in the European quantum network. We are also keen to share what we have learned over the years through programs that we have designed and implemented to help train the quantum workforce, both in academia and industry, of the future.*
>
> **Prof Robert Sewell**
> Head of Academic Affairs at ICFO

The program is designed to be flexibly implemented within a broad range of university partners covering core Physics and other areas, to support the transformation across universities of all levels of QT-specialization. This will involve upgrading existing QT Master programs, supporting the development of entirely new programs, and offering abridging program to transform non-specialist degrees to specialized ones which align to the needs of the QT work force.

### Quantum Technology Courses for Industry

Also addressing the growing needs of the quantum-ready workforce, **QTIndu (Quantum Technology Courses for Industry)**, coordinated by the company QURECA SPAIN, SL, will complement the DigiQ program by upskilling professionals now to prepare them to work in Quantum Technologies. The training programs developed in this initiative will be mapped to the Quantum Technology Competence Framework and aligned with the emerging Qualification Profiles specifications for individuals working in QT developed by the Quantum Flagship. These SME-based training programs are tailored to different business sectors and industry needs covering all the aspects of quantum workforce landscape.

✱ ICFO will partner in this Pan-European program not only as an expert in the area of quantum technologies, but also by acting as a bridge to its strong network of SMEs in Catalunya.

# Collaboration

TRAINING

## FLIGHT- Marie Skłodowska-Curie COFUND action

### Funding for up to 30 new doctoral students for projects in academic, industrial and clinical research

ICFO has recently been awarded highly competitive funding for a new doctoral fellowship program via the European Commission's **Marie Skłodowska-Curie COFUND action.** This project, entitled ***FLIGHT (Fostering research careers in LIGHT sciences)***, will recruit up to **30 outstanding, international, early stage researchers** (ESRs) to carry out fellowships at ICFO of 36 months duration in **Academic, Industrial or Clinical tracks**. This is ICFO's sixth COFUND action (Stepstone I and II, NEST and NEST+, Enlighten and FLIGHT) in addition to having also been an implementing partner in PREBIST and PROBIST.

FLIGHT aims to foster the **career mobility of researchers beyond the academic sector**. The program includes an extensive training program of multidisciplinary scientific workshops and training events where all Fellows are **exposed to the interdisciplinary mix between academic research and industrial/ clinical work**. ESRs in the Industrial and Clinical tracks will undertake research projects in collaboration with one of **14 Industrial and Clinical partners**, from innovative start-ups to multinational companies and leading local hospitals, who will co-finance research projects, and provide co-supervision, extended secondments, research and training resources.

FLIGHT will equip recruited Fellows with unique capabilities to launch a research career at the intersection of photonic sciences with a wide range of industrial and clinical applications, and **enhance the European talent base in a field – photonic sciences – identified as vital to the ongoing competitiveness of the European Research Area.**

**Partners**

ICFO · sixsenso · Parc Sanitari Pere Virgili · Clínic Barcelona Hospital Universitari · Vall d'Hebron Institut de Recerca · Parc Taulí Hospital Universitari Fundació Parc Taulí · LUXQUANTA · IRTA · QUSIDE · qurv · SJD Sant Joan de Déu Fundació de Recerca · inefc Generalitat de Catalunya · PicoQuant · ZEISS · vitsolc

In addition to scientific training in which students are able to conduct research at the very highest international level and in collaboration with academic and industrial experts around the world, training programs also include personal and professional development opportunities.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 101081441

## Plus+ Training

In addition to scientific training in which students are able to conduct research at the very highest international level, ICFO offers the Plus+ Training and Development Program of Excellence. The program encompasses a series of activities designed to equip PhD students and young post-docs with extensive scientific and technical training, as well as opportunities for professional and personal development.

### PhD retreat

ICFO's newest cohort of PhD students attended the annual Initial PhD Retreat, a two-day training workshop designed to provide participants with a grounding in key transferable skills and a valuable opportunity to get to know one another.

This year's retreat took place at "Campus La Mola", in the heart of the Sant Llorenç del Munt natural park.

The informal atmosphere helped foster positive peer relationships and establish a cohesive group identity, thus creating a motivating and stimulating workplace.


**Anna Oddone**

### Inspiring Career Seminars

This new series of seminars, designed by the post-docs who are part of the PosDoc Committee, aims at inspiring ICFO's researchers by highlighting successful careers of scientists that have taken unconventional paths, with the goal to open new opportunities when it comes to deciding on the next career step.

In the opening seminar, **Dr Montserrat Vendrell**, Biocat co-founder, former BIST director and partner at ALTA Life Sciences, explained how she made such great achievements and gave advice to ICFO researchers who are looking for alternatives to academic careers. **Anna Oddone**, in the second seminar of this series, explained how she combined her two passions, science and sailing, now working at Plankton Planet, a collaborative project aimed at understanding plankton ecosystems around the world via a citizen science approach.

**Dr Montserrat Vendrell**

### Python Basic and Advanced

Python is the most compatible programming language for machine learning and artificial intelligence and a language widely used by researchers at ICFO. These courses provided both a pragmatic and hands-on introduction to the Python programming language, and insights into several advanced features to take programming to the next level.

## Apply for an ICFO Mobility Grant

ICFO strongly encourages its PhD students to have at least one International secondment during their PhD to ensure their exposure to International institutions or other sectors. Some external fellowships include funding to support such secondments. To expand this opportunity to all ICFO PhD students, there are 6 2023 grants available for PhD students who do not have any specific mobility grants within their fellowships.

**Information on funding for mobility, as well as on the application process for these grants**

## Collaboration

OUTREACH

# CARLA Draws to a Close

### Recapping highlights and setting the stage for continued actions supporting careers and diversity in photonics

The CARLA project is an EU Horizon 2020 funded initiative aimed at boosting the numbers of students and young researchers pursuing careers in photonics and encouraging innovation and entrepreneurship, all with special attention to empowering gender diversity. CARLA as a collaborative initiative has involved a **consortium of 11 European partners in different countries** working together with over **100 stakeholders, including academia, industry, entrepreneurs, policymakers, HR, training experts, students and researchers**. It has been actively promoting careers in photonics through 13 camps (standalone events) and 8 capsules (sessions within another event) that focused on reinforcing the knowledge of the participants regarding vast opportunities and careers in the photonics landscape and providing them with a roadmap for better employability.

Panel discussion at final CARLA Camp, (ICFO, December 2022)

These events took place all **over Europe between 2020 and 2022**, with the participants of over **2000 attendees, 200 speakers, and the participation of 250 academic institutions and 375 companies**. Moreover, CARLA has put special emphasis on highlighting the importance of diversity and inclusion, with the percentage of women participating in the camps and capsules between 20 and 47%. Overall, the outcomes of the project have been very positive, indicating a bright future ahead for the continued CARLA-related activities, even past the official close of the program.

CARLA camps include networking opportunities with stakeholders in academia and industry

Over the past months, consortium members hosted **events in Lausanne, Milan and Bratislava. ICFO, the CARLA coordinator, hosted the last CARLA camp event within the European project on December 1st and 2nd** at its facilities in Castelldefels while also streaming live on YouTube. 200 participants took part, including students, researchers and speakers, from 25 different countries and from diverse STEM backgrounds. The panels throughout the event offered an overview of the vast career opportunities in photonics to university students and early-stage researchers, principally focusing on academia, industry, entrepreneurship. In keeping with the focus on diversity, special attention went to assure that speakers, on top of representing gender diversity, also came from a range of career backgrounds and levels. Hands-on workshops around innovation and career development complemented the panel discussions and were organized together with visits to ICFO laboratories and networking opportunities with the speakers. Participants reported being inspired by the speakers and having discovered new career opportunities in photonics, while presenters were enthusiastic about sharing their experiences and interacting with the engaged audience!

Now as the formal European CARLA project has come to an end, all who are interested can find a comprehensive handbook in the resources section of the CARLA website, created as part of the project, that will serve as a tested and reproducible instrument to support the growth, leadership and innovation potential in photonics at a European level, including details on the methodology and scalability of events.

CARLA will continue its mission to promote opportunities in photonics and, in order to measure the impact of the program over time, will stay in contact with attendees to gather information on career paths taken. Planning for a follow-up CARLA program is underway.

PHOTONICS 21

PHOTONICS PUBLIC PRIVATE PARTNERSHIP

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 871457

**FIND OUT MORE**
www.carlahub.eu

**Follow us**

# Barcelona Science Week

### November 11th-20th

Every year the Catalan Foundation for Research and Innovation (FCRi) organizes Science Week (Setmana de la Ciència), where a number of institutions who work in science and technology offer engaging activities to the public to spread the passion for science. ICFOnians were actively involved in the 2022 annual event:

- **November 11th: 90 high school students from a Greek high school** discovered ICFO through inspiring talks from Greek ICFOnians: ICREA Prof at ICFO Dr Gerasimos Konstantatos, ICFO Prof Dr Georgia Papadakis, Dr Charikleia Trollinou and Stella Avtzi. The event ended with a quick lab tour.
- **November 16th:** More than 300 students connected to the **Setmana de la Ciència edition of *Fotónica en 5 minutos***, a successful online format that brings ICFO researchers closer to high school students. It includes short engaging talks followed by lively Q&A: Valentina Gacha Mendoza, Dr Ignacio López and Dr Marta Zanoletti.
- **November 16th:** Dr Federica Beduini brought the ICFO Decide Game to the Institut Alexandre Galí in Sant Pere de Ribes on the *Dia de la Ciència a les Escoles* (November 16th- Day of Science at School) program organized by the FCRi.
- **November 19th:** At BCNspiracy, a large science dissemination event organized every year at CosmoCaixa Barcelona, Dr Stefano Signorini offered a talk about how quantum physics can help us "see" invisible things .

Dr Stefano Signorini at BCNspiracy at CosmoCaixa

***Thanks to the following ICFOnians who have recently participated in other Outreach events*** *Jennifer Aldama, Jessica Angulo Capel, Craig Chisholm, Hamed Dehghanpour Baruj, Prof. Dr. Turgut Durduran, Michael T. Enders, Dr. Stefan Forstner, Rajashree Haldankar, Teresa Karanikolau, Lukas Lau, Jan Lowinski, Dr. Vasiliy Makhalov, Dr. Kostas Mouloudakis, Dr. Katerina Nikolaidou, Kartika Nimje, Veronika Parfentyeva, Dr. Aleksandra Pidde, Dr. Ramón Ramos, Dr. Dimitrios Raptis, Davide Rizzotti, Dr. Antonio Rubio Abadal, José Javier Ruiz González, Neus Sanfeliu, Dr. Luis Trigo Vidarte, Dr. Clara Vilches Caubet, Dr. Lu Wang, Dr. Marta Zanoletti, Laura Zarraoa.*

# Collaboration

COMMUNITY

## ICFO Day 2022

**December 15th and 16th**

### The 7th edition of ICFO Day was a two-day event, adapting to the needs of our growing institute

ICFO Day is a 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. This year we needed two days to cover everything!

**Discussions during PhD Poster Session**

**Thursday, December 15th**

We shared science through lab tours, poster sessions and short talks, and also participated in "not-necessarily-science" flash talks in the NEST Hall.

Member of ICFO's Management unit gathered to celebrate the screening of a creative team-building video where they played the starring roles. The biggest surprise came at the end of the day with the ICFactor show including musical performances, dance, and even hypnosis. Who knew ICFOnians had so much talent?

**Tour of future Clean Room Facility in the new Mir-Puig building**

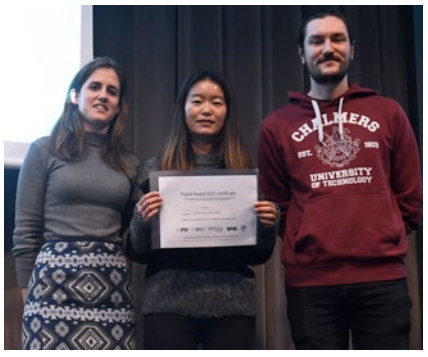
**Friday, December 16th**

It has been many years since ICFOnians were able to all sit together in the ICFO Auditorium. Since it was crucial that we were all together to celebrate the accomplishments of colleagues and friends, we all met at the Hotel Don Jaime in Castelldefels.

**Invited talk by Dr Pep Canadell**
*"Carbon Budgets, Net-Zero Emissions & How to Stabilize the Global Climate"*

## PhD Poster Session and Award

**The *ICFO Student Poster Session* is an opportunity for the exchange of ideas and knowledge among ICFOnians of different groups and areas.** The annual ICFO Student poster presentation took place in the week leading up to ICFO Day with the winners announced in the awards ceremony.



### ICONS Prize for Best Poster

Chosen through a popular vote from all ICFOnians and, sponsored by ICONS.

**Yina Wu:** *Non-singular near-touching plasmon modes in nanocube dimers.*
Group: Nanophotonics Theory led by ICREA Prof Dr Javier Garcia de Abajo.

### ICFO PhD Poster Prize

The official poster prize based on an assessment by the PhD Committee.

**1st Prize, Francesco Andreoli:** *The maximum refractive index of an atomic medium.*
Group: Theoretical Quantum-Nano Photonics led by ICREA Prof Dr Darrick Chang.

**2nd Prize, Craig Chisholm:** *Realizing a one-dimensional topological gauge theory in an optically dressed Bose-Einstein condensate.* Group: Ultracold Quantum Gases led by ICREA Prof Dr Leticia Tarruell.

## ICFO PhD Thesis Awards

**This award was created in order to distinguish particularly brilliant PhD theses presented at ICFO.** To determine the recipients of the 2021 PhD Thesis award, the PhD Committee launched an in-depth deliberation of the 18 PhD Theses defended at ICFO that year, highlighting and rewarding the extraordinary PhD students whose research progress at the Institute has proven to be highly creative and ambitious.

### In the experimental field

**Dr Niels Hesp,** in recognition of the exceptional thesis: *"Exploring twisted bilayer graphene with nano-optics"*, supervised by ICREA Prof Dr Frank Koppens.

**Dr Pau Gómez,** in recognition of the exceptional thesis: *"Spinor Bose-Einstein Comagnetometer and Interhyperfine Interactions in Rb87"*, supervised by ICREA Prof Dr Morgan Mitchell.

### In the industrial field

**Dr Jonas Fischer,** in recognition of the exceptional thesis: *"Exploring twisted bilayer graphene with nano-optics"*, supervised by ICREA Prof Dr Turgut Durduran.

## 15 and 20 Years Recognitions

ICFO has become what it is today thanks to the contributions of our gifted and diverse community of ICFOnians.

The following ICFOnians began their work at ICFO in 2007 and celebrated their 15th Anniversary:

**Juli Céspedes, Juan Manuel Fernández, Mery Gil, Santiago Martín, María José Martínez, Mónica Montaña**

As ICFO marks its 20th anniversary, we recognize those members of the community that have been with the institute since its start.


**Juan Manuel Fernández, Santiago Martín, Juli Céspedes and Lluis Torner**

***After ICFO's director, Dolors Mateu and Dr Pablo Loza-Alvarez were the first to join the ICFO adventure in 2002. Professors Ignacio Cirac and Eugene Polzik began their formative relationships with ICFO as Distinguished Invited Professors in that same year.***

Thank you for the years of dedication and for the mark that you have made on our institute.


**Dolors Mateu**

# Collaboration

COMMUNITY

## Get Involved

**There are so many ways to make a mark on the ICFO Community**

Opportunities abound for ICFOnians to collaborate and contribute to the institute, both through leadership in research and also by sharing hobbies and concerns for society.

## LA MARATÓ 2022: Cardiovascular Diseases

**For the third year, ICFOnians have come together to support La Marató de TV3, an annual telethon event that mobilizes citizens across Catalonia to raise money to promote scientific research of excellence and raise social awareness of diseases.**

This year, the topic was **cardiovascular diseases**, which include those that affect the heart and the circulatory system (arteries and veins).

**ICFO volunteers organized a wide range of fund-raising activities: from Bake Sales, Vermouth workshops and sports: Cycling, HITT Class and a Futbolin tournament**

We are very proud of the results and want to thank all volunteers and ICFOnians across the institute that help to raise €1530. Thank you!

## ACTIVITIES FAIR

**We have more in common that the science that brought us all together. ICFOnians are a group of people with a wide range of hobbies and interests, and we like to share that with each other whenever we have a chance.**

The first ICFOnians Activities Fair took place in the Nest Hall, creating a platform to familiarize all ICFOnians with activities organized by member of the ICFO community, and facilitating engagement. Different groups and associations participated such as the Hiking team, Football players, Baking Club, Trail running, Wakeboarding, Language Exchange Club, the Outreach team and ICONS student organization.


**ICFOnians Activities Fair**

Since the Fair, even more groups have been created. If you want to know what activities and events are being organized by people who share your passions and hobbies, join the 'Life Outside' Teams channel.

## New Board for ICONS

**The general assembly of the ICFO Organization and Network of Students (ICONS) appoints a new board of officers by an open vote.**

ICONS promotes educational activities for students, boosting their career opportunities by drawing them closer to the photonics community. Likewise, the network endeavors to intensify the interaction and collaboration of its members within ICFO by organizing social events like Social Friday, and in typical years, the annual International Food Festival, amongst others.

This team takes over from outgoing leaders **Blanca Belsa** (President); **Giulia Lo Gerfo** (Vice-President); **Carolina Fajardo** (Secretary); **Cristian Boghiu** (Treasurer); **Jessica Angulo** (Communications Officer); and **Julita Poborska** (Diversity and Inclusion Officer), who have invested time and energy in the ICONS organization in order to help fellow ICFOnians get the most out of their time at the institute.

Congratulations to the new ICONS leaders and many thanks to the outgoing team for all your efforts to enrich the experience of PhD students at ICFO.

**2022-2023 ICONS Leaders:**
(Left to Right) **Cristian Boghiu** (President); **Fionnuala Curran** (Communications Officer); **Julita Poborska** (Diversity and Inclusion Officer); **Rebecca Hoffmann** (Secretary); **Jessica Angulo** (Treasurer); and **Javier Arrés** (Vice-President).

# People

GO & FLY

## Congratulations to 12 New ICFO PhD Graduates

### 275 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.

**264**

**Chung-Yun Hsieh**

*Resource Theories of Quantum Dynamics*

October 13, 2022
ICREA Prof Dr Antonio Acín and Dr Matteo Lostaglio

**265**

**Dr Korbinian Kottmann**

*Investigating Quantum Many-Body Systems with Tensor Networks, Machine Learning and Quantum Computers*

October 14, 2022
ICREA Profs Dr Antonio Acín and Dr Maciej Lewenstein

**266**

**Dr Pablo de Roque**

*Contributions to nanophotonics: linear, nonlinear and quantum phenomena*

October 18, 2022
ICREA Prof Dr Niek van Hulst

**267**

**Dr Javier Argüello**

*Laser-induced electron interferences from atoms and molecules*

October 21, 2022
ICREA Prof Dr Darrick Chang and Dr Alejandro González Tudela

**268**

**Stefano Grava**

*Novel quantum interactions between light and dense atomic media*

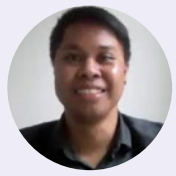
October 28, 2022
ICREA Prof Dr Darrick Chang

**269**

**Dr Darío Lago**

*Remote distribution of quantum states assisted by multi-mode quantum memories*

November 2, 2022
ICREA Prof Dr Hugues de Riedmatten



**270**

**Nestor Bareza**

*Mid-Infrared Surface Sensing Based on Two-Dimensional Materials*

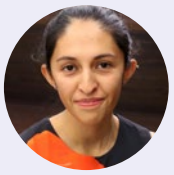
November 7, 2022
ICREA Prof Dr Valerio Pruneri and Dr Bruno Paulillo

**271**

**Eduardo Dias**

*Nanoscale manipulation of optical fields*

November 18, 2022
ICREA Prof Dr Javier García de Abajo



**272**

**Monserrat Álvarez**

*Controlling the strong interaction between quantum emitters and plasmonic roddimers*

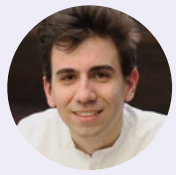
November 28, 2022
ICREA Prof Dr Niek van Hulst and Dr Pawel Wozniak

**273**

**Gerard Jiménez**

*Fundamentals of nonlinear interferometers and its use for optical coherence tomography*

December 2, 2022
ICREA Profs Dr Antonio Acín and Dr Maciej Lewenstein

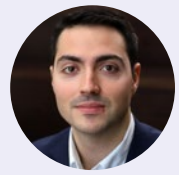


**274**

**Paolo Abiuso**

*Optimization and Geometry for Quantum Information tasks*

December 12, 2022
ICREA Prof Dr Niek van Hulst



**275**

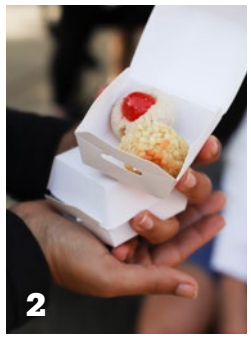
**Álvaro Rodríguez**

*Nonlocal and nonlinear effects in nanophotonics*

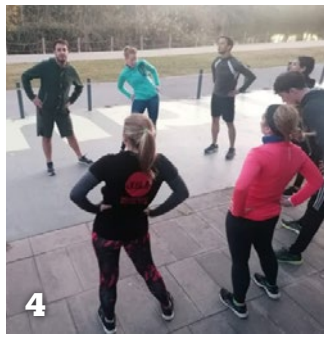
December 12, 2022
ICREA Prof Dr Javier Garcia de Abajo and Asst Prof Dr Joel Cox

COMMUNITY

1


2


3


4

**1.** ICFOnians at Port Aventura

**2.** La Castanyada is a Catalan and ICFO annual tradition

**3.4.** Biking adventure and HITT class for La Marató de TV3

# Mystery ICFOnian

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

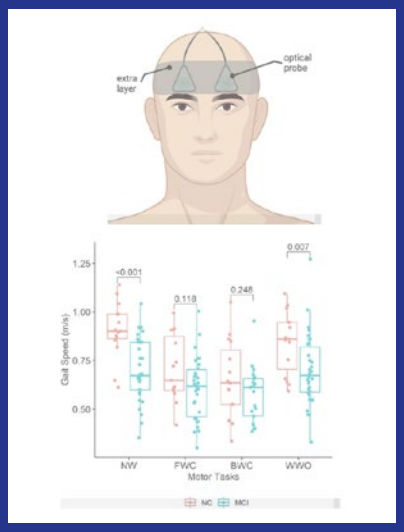
ICFOnians are a fascinating group, with hobbies, interests and talents that may surprise you. Have a look around and see if you can guess who this edition's Mystery ICFOnian is!

Look for the answer in the next edition of ICFOnians.

1. He likes to swim in the sea all year long
2. He is a fan of classic movies
3. He always wears t-shirts
4. His car has the steering wheel on the right-hand side (English car)
5. He likes to have it 'his way' ☺

# The Last Word

SCIENCE QUIZ




Researchers from the group of Turgut Durduran recently published "Dual-task related frontal cerebral blood flow changes in older adults with mild cognitive impairment: A functional diffuse correlation spectroscopy study" in Frontiers in *Aging Neuroscience*. They measured the speed of people with normal cognition (NC) or mild cognitive impairment (MCI) as they walked (NW), walked while counting up by twos (FWC), down by threes (BWC), or avoiding obstacles (WWO), and the resulting blood flow in their pre-frontal cortex.

**1. Diffuse correlation spectroscopy quantifies changes in laser speckle due to**

**A)** Movement of red blood cells

**B)** Oxygenation of red blood cells

**C)** Movement of platelets

**2. The pre-frontal cortex is important for this study because**

**A)** It is easily damaged by impacts

**B)** It is involved in both language and motion tasks

**C)** It cannot be visualized by MRI

**3. The graph shows a "box plot." What do the lines and boxes indicate?**

**A)** Mean and standard deviation

**B)** Frazier information

**C)** Quartiles

**4. What does the graph tell us?**

**A)** MCI and counting backward similarly reduce walking speed

**B)** Counting downward is harder than counting upward

**C)** Both of the above

Answers on pg 2

HIGH PROFILE

# Alain Aspect

**Professor at Institut d'Optique and Ecole Polytechnique, Augustin Fresnel Chair of the Institut d'Optique, Emeritus Distinguished Scientist at CNRS. Winner of the 2022 Nobel Prize in Physics jointly with John Clauser and Anton Zeilinger.**

> *"Do not calculate if it would be a good idea to do this or that because it will be popular, you don't know what subjects will be popular in 5 years*

**Can you tell us what drew you to the work of John Bell and ultimately how you conceived the experiment that settled the debate between Einstein and Bohr?**

I was lucky to already have a permanent position with freedom to do any kind of research I wanted. After much searching for a subject for a PhD, I finally found a young professor at Institut d'Optique, Christian Imbert, who handed me a file about Bell's inequalities. It was 1974, and the recently published Clauser-Freedman and Holt-Pipkin papers (1972) were both in the file, but the first one in the box was the paper of John Bell. It took me 2 hours to make sure that I understood what it was about, and by that time I knew that this was the subject in which I wanted to work... It was love at first sight. Bell 's paper showed that you could settle an everlasting debate between Einstein and Bohr- two giants- with an experiment. How could you not be absolutely enthusiastic about this subject?

Bell explained that one should do experiments changing the settings of the polarizers while the particles were in flight, which neither of the previous experiments had done. I told myself, "I know a lot of Optics - I am going to find a way." Finally, I got the idea of a standing acoustic wave for switching light alternatively between two different directions. With two polarizers in two different orientations, I had the equivalent of a single polarizer switched very fast between one orientation and the other. This idea was the beginning, and it was implemented at the end, in the Nobel winning experiment of 1982.

**What advice would you give PhD students from your own experience convincing those who did not believe in the value of what you were trying to achieve?**

Make all efforts to explain to non-specialists why your subject is interesting. In '74, most physicists thought that the debate between Bohr and Einstein had been settled in the Solvay meeting of 1927, so what was the point of doing another experiment? In fact, EPR and Bell papers were about a different problem- with 2 entangled particles, while the Solvay discussions were about 1 particle. When I was invited to give a first seminar to only about a dozen people, I prepared it like it was a major international conference, putting all effort into explaining about Bell's Theorem and why it was an interesting subject... and it worked. People began to understand the interest of the question! I would tell PhD students that even if their subject is not so controversial, it is very important that they are able to explain the big picture in simple words. First, they will convince themselves of the reason why what they are doing is interesting and important, and then they will be able to explain it to others.

**In parallel to your seminal discoveries, you have had a distinguished teaching career. What do you find most fulfilling about teaching?**

I follow a tradition of many French scientists who make a lot of effort to be good teachers- and I like teaching I must say. I like to explain things that I had a hard time understanding, and when I prepare my lectures I discover yet more subtle aspects in them. When I have made that effort, I am happy to communicate what I have understood. I am glad to be a teacher and that students know that they can ask me difficult questions. Eventually this may result in an advance in my research.

**What advice would you give to ICFOnians who may be contemplating their next careers moves?**

Do not calculate if it would be a good idea to do this or that because it will be popular, you don't know what subjects will be popular in 5 years. My advice is: if you like fundamental science, go to it, if you like applications, go to application. If you want to go to a different fundamental subject, convince your boss that it is a good idea and go there. Try to do what you would LIKE to do and once you have chosen, then make all efforts to show that your choice was a good one. And if eventually it is not the case, showing that it is a dead end is a valuable result provided it is done scientifically.

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