

HAPPENINGS

Roy J. Glauber  
(1925 -2018)

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HAPPENINGS

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Quantum Technologies  
foster a new initiative

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THE LAST WORD

Interview with  
Tommaso Calarco

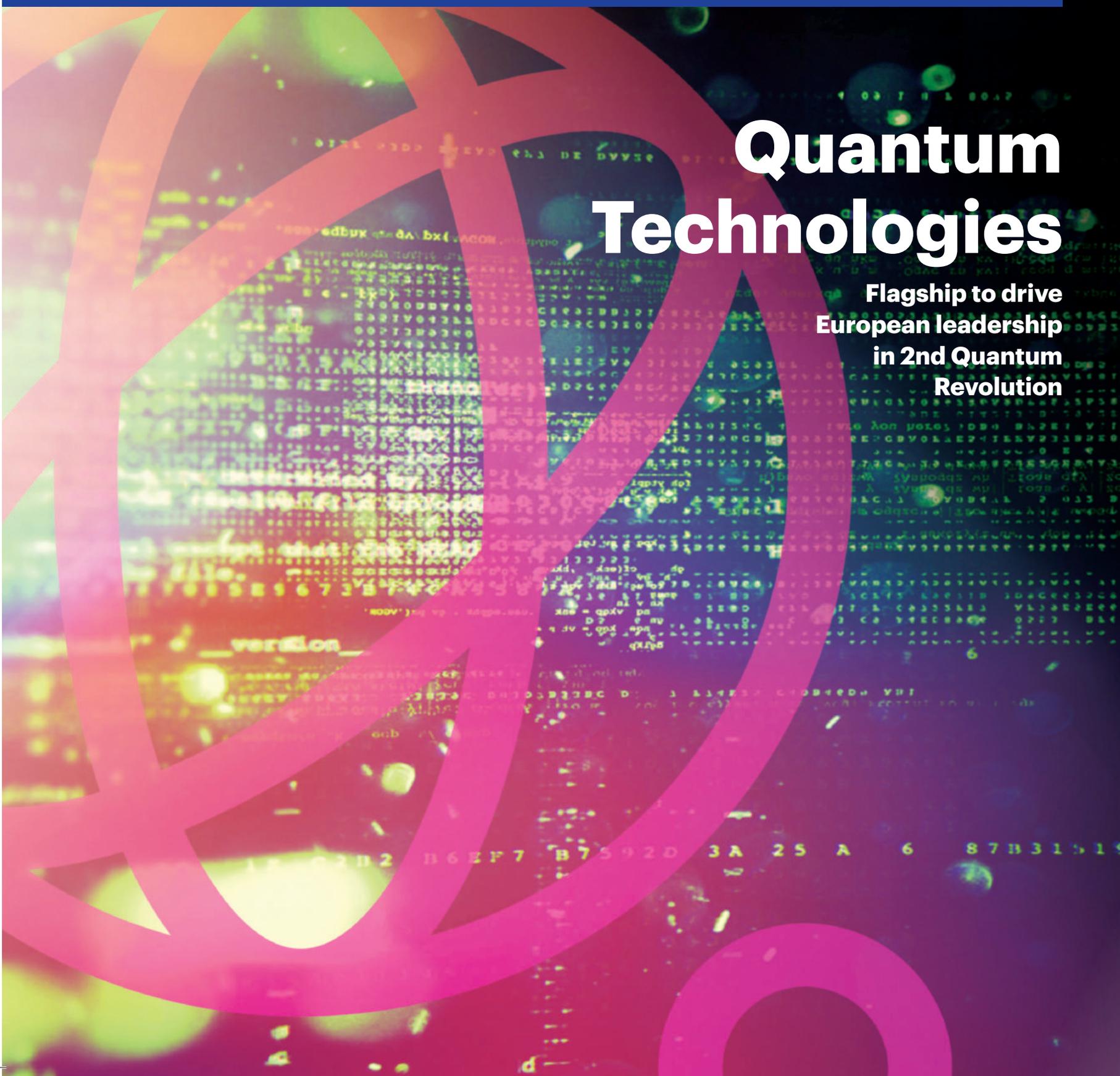
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# ICFONIANS 38

Community News Winter 2019

## Quantum Technologies

Flagship to drive  
European leadership  
in 2nd Quantum  
Revolution



## EDITOR'S CORNER

**Brook Hardwick**  
Coordinating  
Editor



# With a little help from my Friends

**African Proverb: "If you want to go fast, go alone. If you want to go far, go together."**

**The important events in and around our institute over the past months are a reflection of many strong collaborations and friendships.**

To begin, the long anticipated launch of the FET Flagship on Quantum Technologies in October represented a coming together of a diverse community that clearly saw the need to combine forces to achieve something big and paradigm changing through the harnessing of quantum mechanics. Many of us signed the Quantum Manifesto back in 2016 which was a blueprint for what today has become an ambitious new €1b European program. ICFO is proud and excited to coordinate two of the twenty projects that received funding in this ramp-up stage and to participate as a partner in five additional pan-European Flagship projects (see pgs 7-8). We will work together with some old and new friends towards meaningful advances that will transform what Einstein referred to as "spooky action at a distance" into knowledge and applications.

ICFO Day on December 14th (pg 9) highlighted collaborations and friendships cultivated and cemented right here at our institute. The achievements that we celebrate at ICFO are examples of how we "get by with a little help from (our) friends." Scientific advancements and landmark publications by ICFonians are joint efforts within and beyond individual research groups. ICFO's management units provide crucial support that makes the labs run, the computers compute, and the resources needed to conduct and disseminate research flow.

ICFO Day was a manifestation of the collaborative spirit that has been behind ICFO's success through the years. The Festive Dinner that was the culmination of the day-long event allowed us to celebrate the friendships that have formed through all of these productive interactions, making our work more satisfying and fruitful.

As the year drew to a close, we were on a high, taking stock of all that we had achieved together in 2018 and looking forward to the exciting challenges of 2019. Onward and upward!

And then came the sad news of the loss of our friend, Roy Glauber (Nobel Laureate 2005). Roy became a Distinguished Invited Professor at ICFO in 2009, and we considered him "one of us" - an ICFonian. We were honored to benefit from his advice, collaboration and friendship for many years, and were always pleased when he and his wife Atholie visited ICFO. Upon learning of his death at the end of December, Lluís Torner reminisced, "We will always remember Roy's insightful remarks on many matters, as well as his contagious laughter."

While we ended the year on a sad note, it was also a moment to reflect on what can be accomplished when we work together - especially when collaborators become trusted partners and friends. As the African proverb goes "If you want to go fast, go alone. If you want to go far, go together." Working together, we have reason to be optimistic about all we can achieve.

## Mystery ICFonian

Solution Ed #37

## Laurent Ladepêche

Postdoctoral Researcher, SLN- Team Loza

## Science Quiz

Answers from p.12

1. B 2. A

3. D

## COVER



The Quantum Flagship, launched in October 2018, is a €1b pan-European initiative that brings together research institutions, academia, industry, enterprises, and policy makers to consolidate and expand Europe's scientific

leadership and excellence in the field. It aims to transfer quantum physics research from the lab to the market by means of commercial applications, and position the region as a global knowledge-based industry and technological leader in disruptive technologies.

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# HAPPENINGS



**BUSINESS NEWS**  
DROPLITE becomes  
ICFO's 7th Spin-off  
p.6

**ICFO NEWCOMERS**

## Welcome to ICFO

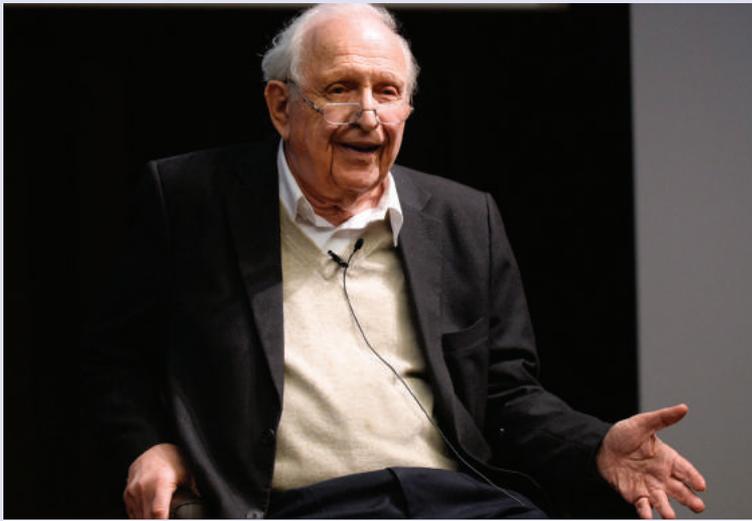
Many of us joined ICFO or took a new position at the institute between October and December

	 <b>Umberto Matera</b> Student	 <b>Kasra Amini</b> Postdoctoral Researcher	 <b>Ignacio De Miguel</b> Research Engineer	 <b>Biswajit Kundu</b> Postdoctoral Researcher		
	 <b>Domenico De Fazio</b> Postdoctoral Researcher	 <b>Christina Graham</b> PhD Student	 <b>Alexia Stollmann</b> PhD Student	 <b>Paolo Abiuso</b> PhD Student		
	 <b>Korbinian Kottman</b> PhD Student	 <b>Samuele Grandi</b> Postdoctoral Researcher	 <b>Arturo Villegas</b> PhD Student	 <b>Olaf Zimmermann</b> PhD Student		
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 <b>Moniruzzaman Shaikh</b> Postdoctoral Researcher	 <b>Mariela Baron</b> Research Engineer	 <b>Ignasi Burgués</b> Postdoctoral Researcher	 <b>Wei Du</b> Visiting PhD Student	 <b>Ainoa Guinart</b> Student	 <b>Sofia Martinez</b> Student	 <b>Blanca Belsa</b> Student
 <b>Neus Sanfeliu</b> Research Engineer	 <b>Jacopo Surace</b> Visiting PhD Student	 <b>Isabel Penon Bosom</b> Financial Accountant	 <b>Ricard Ravell</b> Student	 <b>Aniello Lampo</b> Postdoctoral Researcher	 <b>Kavitha Kalavoor</b> Postdoctoral Researcher	 <b>Roland Terborg</b> Postdoctoral Researcher
 <b>José García Guirado</b> Postdoctoral Researcher	 <b>Ion Hancu</b> PhD Student	 <b>Nikos Fayard</b> Postdoctoral Researcher	 <b>Daniel Rivas</b> Visiting Scientist	 <b>Sven Bodenstedt</b> PhD Student	 <b>Florian Haberstroh</b> PhD Student	 <b>Nicolau Molina Bom</b> Postdoctoral Researcher
 <b>Ivan Company</b> Student	 <b>Frederic Català</b> Research Engineer	 <b>Sergi Del Castillo</b> Procurement Specialist	 <b>Luke Maidment</b> Postdoctoral Researcher	 <b>Anna Dawid</b> Visiting PhD Student	 <b>Michael Tayler</b> Postdoctoral Researcher	 <b>Albert Albesa</b> Student
 <b>Emmanuel Amuah</b> PhD Student	 <b>Adam Teixidó Bonfill</b> Student	 <b>Daniel Urrego</b> PhD Student	 <b>Enok Skjolstrup</b> Visiting PhD Student	 <b>Maxime Durand-Gasselin</b> PhD Student	 <b>Antonios Oikonomou</b> Business Developer	 <b>Robert Bettles</b> Postdoctoral Researcher
 <b>Cuauhtemoc Araujo</b> Visiting Scientist	 <b>Alvaro Cuevas</b> Postdoctoral Researcher	 <b>Krystian Nowakowski</b> PhD Student	 <b>Sandra Ortonobes</b> Communications	 <b>Marc Botifoll</b> Student	 <b>Jia Kong</b> Visiting Scientist	

## HAPPENINGS

## ICFO NEWS

## Roy J. Glauber (1925-2018)



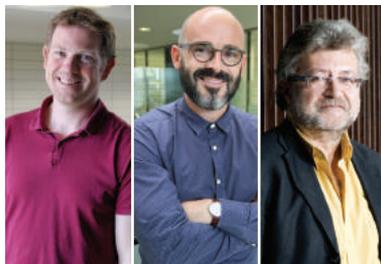
**Roy J. Glauber, Nobel Laureate and Distinguished Invited Professor at ICFO since 2009, passed away on December 26th at the age of 93.** Known for his prize winning work that advanced the understanding of light by describing the behavior of light particles, his advances have had a profound impact on the field of quantum optics and on the many activities carried out at our institute and by scientists around the world today. ICFO as a whole had the exceptional honor of benefitting from his advice, collaboration and friendship for many years and will miss him.

## New ICONS Leadership Team



**ICONS is the ICFO Organization and Network of Students**, promoting long-term educational activities for students and helping to improve career opportunities by drawing them closer to the photonics community. Each year the organization elects a new board of officers. The board members for the 2018-2019 term are Pamina Winkler, taking over from Sandra de Vega as President; Pilar Pujol Closa relieving Juan Miguel Perez Rosas as Vice President; Samyabrata Mukherjee taking on the role of Secretary recently vacated by Pamina Winkler; and Sarah Keary, who will continue as Treasurer.

## Three ICFO Highly Cited Researchers



**Clarivate Analytics** annually produces a Highly Cited Researchers list identifying researchers from around the world who are some of the world's most influential scientific minds. The list is compiled using indicators taken from Incites Essential Science Indicators (ESI) across 21 broad fields and, for the first time, in a "Cross Field" category. Highly Cited Researchers are determined by the number of papers that rank in the top 1% by citations for field and publication year in journals indexed in the Web of Science Core Collection during the 11- year period 2006-2016. **The 2018 compilation in the field of Physics includes ICREA Professors at ICFO Maciej Lewenstein and Frank Koppens. ICREA Prof. at ICFO Romain Quidant was listed in the new "Cross Field" category**, recognizing his interdisciplinary work and publications of highly cited papers in several fields.

## UPC Thesis Awards 2018



**The Extraordinary PhD Awards, given annually by the Technical University of Catalonia (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 9 awardees, which include the theses of ICFO PhD graduates **Dr. Domink Kufer** and **Dr. Martí Perarnau** among the list of extraordinary doctoral works for the academic period 2015/2016.

## Junior Leader "la Caixa" Fellowship



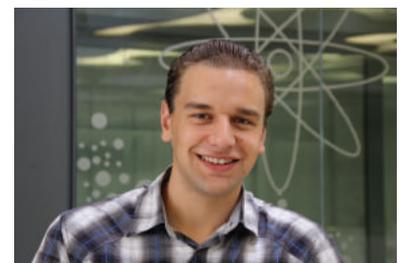
In the first call for the new postdoctoral fellowships program, **Junior Leader "la Caixa", ICFO Prof. Dr. Dmitri Efetov has been awarded a prestigious fellowship.** This program is aimed at hiring excellent researchers—of any nationality—who wish to continue their research career in Spanish territory on any discipline. Sponsored by Obra Social "la Caixa", the objectives of this program are to foster high-quality, innovative research in Spain and to support the best scientific talents by providing them with an attractive, competitive environment in which to conduct excellent research. Within the Junior Leader program, fellowships are awarded to attract incoming talent, and also to retain talented researchers of any nationality. By means of a complementary training program, these fellowships are intended to consolidate research skills and to foster an independent scientific career as an option for the future.

## ICFO Welcomes the Minister of Enterprise and Knowledge of Catalonia



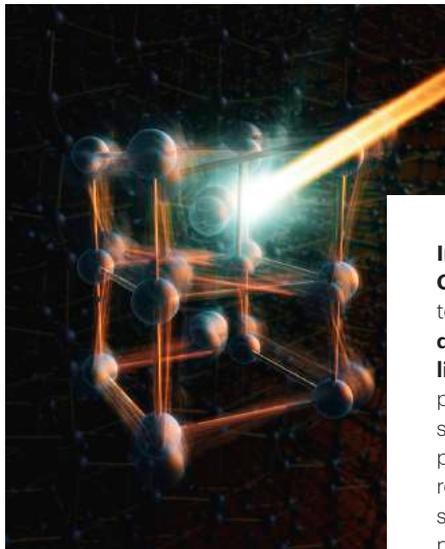
**The Hble Àngels Chacón, Minister of Enterprise and Knowledge of the Government of Catalonia and Chair of the ICFO Board of Trustees, visited ICFO on October 23** accompanied by Dr. Joan Gómez Pallarès, General Director of Research. The Minister was eager to learn first-hand about the research conducted at ICFO, to meet members of ICFO's management unit who help to provide the structure that makes research at the highest level possible, and to learn about the accomplishments and challenges that the institutes faces. In addition to touring ICFO's facilities, the Minister addressed the Management unit with words of encouragement and commendation for a job well done.

## IBM Q Best Paper Award



**The IBM Q Awards** are a series of prizes for professors, lecturers and students who use the IBM Q Experience quantum computing platform and QISKit in the classroom or for their research. In the "Best Paper" contest, a total of five students and postdoctoral workers were recognized for their highest-impact scientific papers using the IBM Q Experience and QISKit as tools to achieve their results. **ICFO PhD student Alejandro Pozas** in the Quantum Information Theory group led by ICREA Prof. at ICFO Antonio Acín was recognized as a runner-up for his paper entitled "Bayesian Deep Learning on a Quantum Computer".

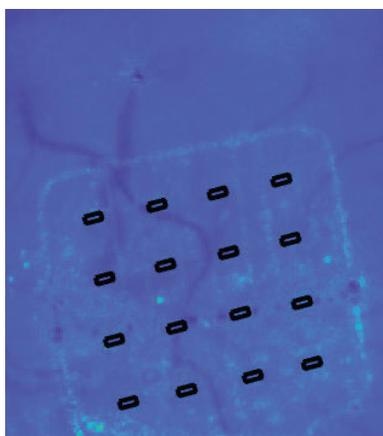
## LATEST ADVANCES



## Disorder in Phase Transitions of Materials

Researchers used a new technique that is capable of resolving the atomic pathways through the use of the world's first X-ray laser situated in the SLAC National Accelerator Laboratory.

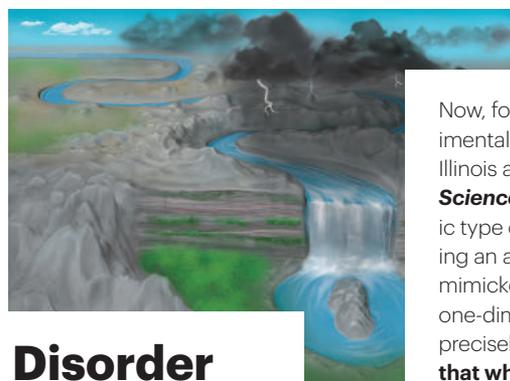
In a study published in *Science*, researchers **Luciana Vidas** and former post doctoral researcher **Timothy Miller** led by **Cellex Nest fellow at ICFO Prof. Simon Wall**, in collaboration with scientists from Duke University, SLAC National Accelerator Laboratory, Japan Synchrotron Radiation Research Institute, Stanford University and Oak Ridge National Laboratory, **have discovered that disorder is part of the structural transition of Vanadium Dioxide from an insulator state to a metallic state at extremely small time resolutions.** Researchers used a new technique that is capable of resolving the atomic pathways through the use of the world's first X-ray laser situated in the SLAC National Accelerator Laboratory. This new light source allowed them to examine the crystal structure with unprecedented details using total X-ray scattering. In contrast to the prevailing view, the authors found that the break-up of the vanadium pairs was extremely disorderly. This is the first time that researchers have been able to observe how atoms re-arrange in a phase transition without assuming the motion is uniform, and suggests that the textbook understanding of these transitions needs to be re-written. The group now plans to use this technique to explore more materials to understand how wide-spread the role of disorder is.



## Graphene-based Implant to Record Brain Activity

The study published in *Nature Materials* show an unprecedented mapping of the kind of low frequency brain activity

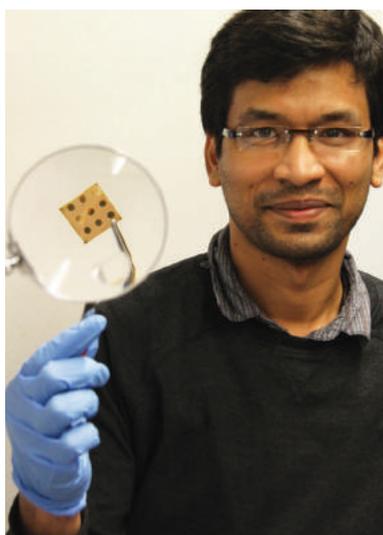
A study recently published in *Nature Materials*, led by researchers from the **Barcelona Microelectronics Institute (IMB-CNM, CSIC)** and the **Catalan Institute of Nanoscience and Nanotechnology (ICN2, a center of BIST and CSIC)**, in collaboration with researchers from **CIBER in Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN)**, **ICFO researchers Tanja Dragojević, Ernesto E. Vidal-Rosas, led by ICREA Prof at ICFO Turgut Durduran**, and August Pi i Sunyer Biomedical Research Institute (IDIBAPS), **reports on the development of an innovative transistor-based architecture that amplifies the brain's signals in situ before transmitting them to a receiver.** The use of graphene to build this new architecture means the resulting implant can support many more recording sites than a standard electrode array, plus it is slim and flexible enough to be used over large areas of the cortex without being rejected or interfering with normal brain function. The result is an unprecedented mapping of the kind of low frequency brain activity (below 0.1 Hz) known to carry crucial information about different events in the brain such as the onset and progression of epileptic seizures and strokes.



## Disorder Induces Topological Anderson Insulator

**Topological Insulators (TIs) show great potential for new technological applications including quantum computing, next-generation miniaturized data storage, and spintronics, motivating scientists to work in trying to understand the microscopic properties of these materials that freely conduct electricity along their edges even though their bulk is an insulator.**

Now, for the first time, a team of experimental physicists at the University of Illinois at Urbana-Champaign report in *Science* on the observation of a specific type of TI induced by disorder. By using an atomic quantum simulation, they mimicked the physical properties of one-dimensional electronic wires with precisely tunable disorder. **They saw that while disorder typically inhibits transport and destroys nontrivial topology, in this system it helps to stabilize a topological phase.** The observation was made possible through a close collaboration with an international team of theoretical physicists including **ICFO researchers Alexandre Dauphin, Dr. Maria Maffei, and Dr. Pietro Massignan** (co-affiliation with the Universitat Politècnica de Catalunya (UPC), who elucidated the quantum physics at work and identified the key signature the experimentalists should look for in the system. The results of the study open the door to finding real materials that are almost topological, which could be manipulated, through doping, to imbue them with these topological properties, giving quantum simulation a tremendous advantage over real materials.



## Colloidal Quantum Dots Make LEDs Shine Bright in the Infrared

So far, optoelectronic semiconductor materials that are **both strong light emitters** (highly efficient light emitting diodes) as well as efficient charge conductors (solar cells) and that meet the Shockley-Queisser limit have failed to integrate monolithically to CMOS electronics, limiting their applicability in a wide range of next generation devices. In a recent study published in *Nature Nanotechnology*, ICFO researchers **Santanu Padhan, Francesco Di Stasio, Yu Bi, Shuchi Gupta, Sotirios Christodoulou, and Alexandros Stavrinnadis, led by ICREA Prof. at ICFO Gerasimos Konstantatos, report on a solution processed nanocomposite system comprising infrared colloidal quantum dots (CQDs).** Not only does

it meet this limit, it also offers **low cost and facile CMOS integration.** They developed CQD infrared emitting LEDs, which have achieved unprecedented values in the infrared range, with an external quantum efficiency of 7.9% and a power conversion efficiency of 9.3%, a value never attained before with this type of device. Engineering of QCD infrared-emitting LEDs at the nanoscale integrated in solar cells can significantly improve the performance efficiency of these devices in the infrared range, offering amazing new applications, such as on-chip spectrometers for food inspection, environmental monitoring, active imaging systems for biomedical or night vision applications.

## HAPPENINGS

## BUSINESS NEWS



## DROPLITE Becomes ICFO's 7th Spin-off

Brining low-cost, accurate and rapid solutions to current laboratory tests

On December 20th, DROPLITE officially became ICFO's 7th spin-off company to take flight. The official signature gathered members of the spin-off company as well as representatives from ICFO and ICREA.

DROPLITE is developing a lab-on-a-chip biosensing device, fully developed by ICFO and the tech SME COSINGO, which combines advanced microfluidics, customized chemistry, a proprietary optical detection system, electronics and signal processing to test and monitor health conditions in humans as well as animals in a very rapid and accurate way.

The company's main goal is to bring low-cost, accurate and rapid solutions to current laboratory tests, such as the ELISA kits used in hospitals and clinics. These current tests are very reliable although rather expensive and need considerable volumes of blood to obtain accurate results. DROPLITE's technology offers an advantage by providing an on-site quantitative automated test solution based on immunoassay techniques that can run in less than 10 minutes while using one single drop of blood, saliva or urine to test and monitor health conditions of human beings.

DROPLITE has been in development for more than 4 years. It emerged from an idea and collaboration between the Plasmon Nano-optics research group led by ICREA Prof. at ICFO Romain Quidant and SME COSINGO. Initial stages of technology development received funding from the European Union. Upon entry in ICFO's LaunchPad, it received support and guidance from the KTT team leading up to the official launch, as well as additional financing from the CELLEX Foundation, the Barcelona City Council, and the Castelldefels City Council.

*"The KTT team works intensively and creatively to bring ICFO technology to society. Hand in hand with the KTT team members Dr. Sergi Ferrando and Dr. Sol Royo, all the DROPLITE team has managed to make ICFO's point of care ambitious vision a reality"*

**Silvia Carrasco**  
Director of KTT

DROPLITE is currently exploring different applications and markets such as veterinary medicine, allergies, food safety and infectious diseases to seek opportunities to exploit the maximum potential of the technology in these sectors.

André Guedes, DROPLITE CEO, comments *"We are thrilled to take DROPLITE's technology out to the world, after years of novel and demanding research and business development at ICFO (KTT) and COSINGO. As a biotech company with its technology core in photonics, DROPLITE enters the challenging world of lab-on-a-chip devices and medical rapid diagnostics, with the goal of bringing key health benefits and innovation to society."*

ICFO's Launchpad gives innovative ideas a space to develop into new technology spin-offs. DROPLITE and the six previously launched companies are already bringing the value of research "made at ICFO" directly to society in the fields of quantum technologies, light and laser safety solutions, photonics technologies, astronomy, bio-imaging, visual sciences applications, among others.

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**DROPLITE**

## Awarding Innovative and Commercially Viable Research

Dr. Carlos Abellan received two prizes for the innovative research behind QuSide Technologies



QuSide Technologies, ICFO's sixth high-tech company incubated in the KTT LaunchPad, was built based on the PhD thesis entitled 'Quantum Random Number Generators for Industrial Applications' by Dr. Carlos Abellan, carried out under the supervision of ICREA Professors at ICFO Valerio Pruneri and Morgan Mitchell. This spin-off venture is currently commercializing quantum random number generators with technology that is an essential element for guaranteeing long term protection of our data in an increasingly complex hyper-connected society.

The excellence and relevance of this work has been recognized in two separate awards for innovation:

**01. "Innovators Under 35"** is an annual list published by the **MIT Technology Review** that recognizes outstanding innovators who are younger than 35 years old. The award spans a wide range of fields and recognizes individuals whose outstanding technical work and results promise to define the future technological path for the following decades. It rewards ingenious and elegant work that matters to the world at large; not just to peers in a particular field or industry.

**02. The CERCA (Centres de Recerca de Catalunya) PIONEER Prizes** aim to distinguish researchers from CERCA Research centers who have recently prepared and defended a doctoral thesis and have obtained results that have a clear potential for commercial exploitation.

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# COLLABORATION



COMMUNITY  
ICFO Day

p. 9

## EU FLAGSHIP

# Quantum Technologies Foster a New Initiative in Europe

On October 29th, Europe witnessed the start of a new and promising initiative known as the Quantum Flagship.

This initiative is already positioning itself as one of the most ambitious of the European Union with a 1b€ budget funded by the European Commission. It will support large-scale and long-term research and innovation projects that will have the main goal of transferring quantum physics research from the lab to the market by means of commercial applications.

Over these next 10 years, the initiative intends to place Europe at the forefront of the second quantum revolution, which is now unfolding worldwide. It aims to bring disruptive quantum technologies to the scientific arena and to society in general by bringing forward new commercial opportunities addressing global challenges, providing strategic capabilities for security and seeding yet unimagined applications for the future. It will build a network of European Quantum Technologies programs that will foster an ecosystem capable of delivering the knowledge, technologies and open research infrastructures and testbeds necessary for the development of a world-leading knowledge-based industry in Europe.

**Prof. Tommaso Calarco**, from the Institute for Quantum Control of Forschungszentrum Jülich and coordinator of the Quantum Coordination and Support Action in charge of successfully launching the Quantum Flagship mentions, *"The European Quantum Technologies community has worked long and hard towards realizing this initiative. We are very happy that the first research and innovation actions are now ready to start with high momentum. Together, we will further strengthen Europe's leading role in quantum research and transfer the insights from this into relevant applications for the benefit of all European citizens."*

The Flagship kick-off meeting took place in Vienna on October 29th, 2018 and summoned many of the most relevant quantum physicists and technologists in Europe. The European quantum community is very large and diverse, and throughout its 10-year lifespan, the Flagship will count with the



The Quantum Flagship, a 1b€ and 10yr initiative, launched in Vienna, Austria on October 29th

The overall initiative will involve the quantum community at large, with over 5000 European researchers in academia and industry searching to place Europe at the forefront of Quantum innovation.

20 projects have been selected out of 140 submitted proposals for the ramp-up phase of the initiative.

commitment and involvement of over 5000 researchers from the academia and industry communities.

The initiative has divided all topics in five main areas of study: **Quantum Communication (QComm)**, **Quantum Computing (QComp)**, **Quantum Simulation (QSim)**, **Quantum Metrology and Sensing (QMS)**, and finally, **Basic Science (BSci)**. The first 3-year phase of the Quantum Flagship, named the ramp-up phase, will run from October 2018 through September 2021. It will fund projects with an overall budget of 132 million euros with the goal of pushing the field to its farthest frontiers. From the 140 submitted proposals, 10 were for QComm, 11 for QComp, 6 for QSim, 22 for QMS, 90 for BSci, and one for a Coordination and Support Action. After a thorough peer-review evaluation, 20 projects, involving over 500 researchers, have been selected to be executed during these first three years.

The Quantum Flagship aims at a coordinated effort to bundle complementing efforts. This is reflected in its governance: A **Strategic Advisory Board (SAB)** monitors the Flagship progress and recommends to the EC appropriate measures. Prof. Dr. Jürgen Mlynek, former president of the Helmholtz Association of German Research Centers and chairman of the Falling Walls Foundation has been appointed as its chair.

**The Science and Engineering Board (SEB)**, with representatives from all funded projects plus four representatives of the Quant-Era projects, ensures a steady flow of information between the projects and foster synergies, such as joint use of fabrication facilities, and exploitation of project results in other projects. **The Quantum Community Network (QCN)** with representatives from the QT community of each EU member state and associated country is responsible for involving the broader QT community and helps to coordinate the interaction with national initiatives. Additionally, a **Coordination and Support Action (CSA)** has been called for to act as a support organization and to coordinate all non-scientific collaboration and public outreach.



QUANTUM  
FLAGSHIP

## COLLABORATION

## INTERNATIONAL CONFERENCE

# Strong ICFO Presence in Quantum Flagship

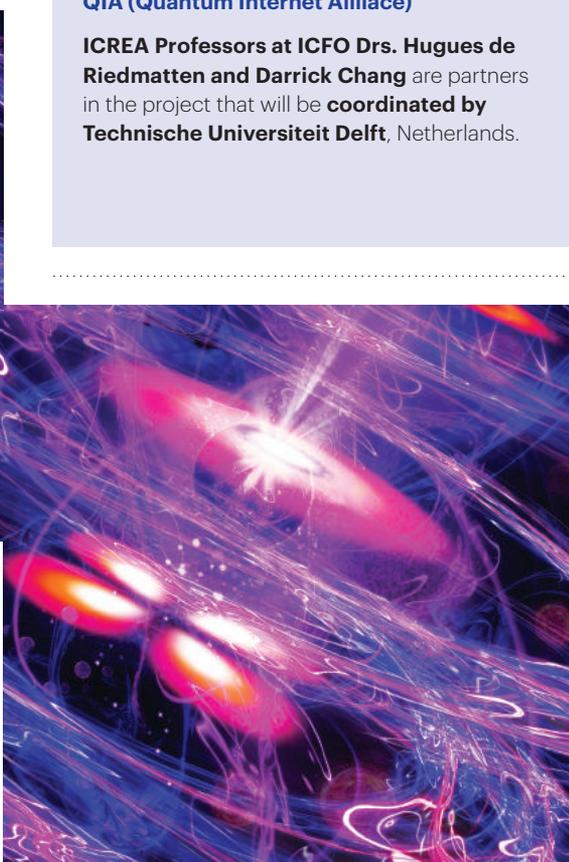
Two coordinated projects and five additional project participations reflect ICFO expertise

140 proposals were submitted for the ramp-up phase (October 2018- September 2021) of the Quantum Technologies Flagship in the five main areas of study: Quantum Communication (QComm), Quantum Computing (QComp), Quantum Simulation (QSim), Quantum Metrology and Sensing (QMS), and Basic Science (BSci), plus for a Coordination and Support Action. After a thorough peer-review evaluation, 20 projects, involving over 500 researchers, were selected for execution during these first three years.

ICFO, a veritable powerhouse in the field of Quantum Physics, is the only research institute to coordinate two projects in the ramp-up phase. In addition, ICFO is a partner in five additional Quantum Flagship projects.



ICFO, a veritable powerhouse in the field of Quantum Physics, is the only research institute to coordinate two projects in the ramp-up phase



## ICFO COORDINATED PROJECTS

## CiViQ

**CiViQ (Continuous Variable Quantum Communications)**

CiViQ will be coordinated by ICREA Prof. at ICFO Valerio Pruneri with the participation of ICREA Prof. at ICFO Antonio Acín and ICFO spin-off QuSide Technologies. The project aims to develop low cost, flexible, adaptable secure devices, services and protocols that can be easily integrated into existing telecommunication networks.

## 2D-SIPC

**2D-SIPC (Two-dimensional quantum materials and devices for scalable integrated photonic circuits)**

2D-SIPC will be coordinated by ICFO Prof. Dmitri Efetov with the participation of ICREA Prof. at ICFO Frank Koppens. The project aims to develop and demonstrate the first all optical on-chip quantum components based on 2-D materials for their future integration into quantum networks.

## PROJECTS WITH ICFO PARTNERSHIPS



**QFLAG (Quantum Technology Flagship Coordination and Support Action)**

Dr. Lydia Sanmartí from the ICFO KTT unit and Dr. Alina Hirschmann from the ICFO Communications Unit will lead the Outreach and Communications work package. **Project Coordinator: VDI Technologiezentrum, Germany.**

## QRANGE

**QRANGE (Quantum Random Number Generators: cheaper, faster and more secure)**

ICREA Professors at ICFO Drs. Valerio Pruneri and Antonio Acín, as well as the ICFO spin-off QuSide Technologies are partners in the project that will be coordinated by Université de Geneve, Switzerland.



**QIA (Quantum Internet Alliance)**

ICREA Professors at ICFO Drs. Hugues de Riedmatten and Darrick Chang are partners in the project that will be coordinated by Technische Universiteit Delft, Netherlands.

## macQsimal

**MACQSIMAL (Miniature Atomic vapor-Cells Quantum devices for Sensing and Metrology Applications)**

ICREA Prof. at ICFO Dr. Morgan Mitchell is a partner in this project that will be coordinated by CSEM, Centre Suisse d'Electronique et de Microtechnique SA - Recherche et Developpement, Switzerland.

## S(QUARE

**SQUARE (Scalable Rare Earth Ion Quantum Computing Nodes)**

SQUARE aims at establishing individually addressable rare earth ions as a fundamental building block of a quantum processor node, where multiple qubits can be used for quantum storage, quantum gates, and optical interfacing. **ICREA Prof. at ICFO Dr. Hugues de Riedmatten is a partner in this project that will be coordinated by Karlsruhe Institut fuer Technologie, Germany.**

COMMUNITY

# ICFO Day 2018



## Responsible and Healthy Research

ICFO celebrated its fourth annual ICFO Day on December 14th, organized by ICFOnians for ICFOnians. The theme of this year's all-ICFO event was "Responsible and Healthy Research".

The day began with an introduction by ICFO's Director Lluís Torner, followed by the official launch of **ICFOnians Community Connect**, an institutional initiative that gives organizational resources to ICFOnians who are looking for ways to get involved with society in constructive ways, promoting values such as solidarity, cooperation, and respect.

Discussions continued in the auditorium covering themes such as scientific publications, research integrity, inclusivity and career turning points. In parallel, other activities were being carried out throughout the institute, including the "Grand ICFO Prix", a TV game-show inspired activity, talks by ICFOnians and tributes to the 2018 Nobel Prize achievements given by ICFO Group Leaders working in related research areas.

After lunch and the annual ICFO family photo, there were lab tours, flash talks, discussions on timely subjects, poster sessions and the ICFO Awards ceremony, including the PhD Thesis Awards and a special Appreciation and Recognition for ICFOnians who have been at the institute for 15 years. As is now tradition, the day ended with the annual Festive Dinner, which this year took place in Barcelona's Estació de França.

- 01. ICFOnians Community Connect
- 02. The annual ICFO Family portrait
- 03. ICFOnians test their institutional knowledge in the Grand ICFO Prix game show



ICFO AWARDS



## 2017 ICFO PhD Thesis Awards

Marco and Mathieu received the award in the ceremony held on December 14 in the scope of the ICFO Day.

From a pool of over 18 theses defended by ICFO PhD Students in 2017, the PhD Committee had an in depth deliberation to select the PhD Thesis Awards. This award was created in order to distinguish particularly brilliant PhD theses presented at ICFO. With this award, ICFO wishes to highlight and reward extraordinary PhD students whose research progress at the institute has proven to be highly creative and ambitious. **This year, the award was given:**

**In the theoretical field to:**

**Marco Manzoni** in recognition of the exceptional thesis: *New Systems for Quantum Nonlinear Optics* Supervised by **Prof. Dr. Darrick Chang**.

**In the experimental field, to:**

**Mathieu Massicotte** in recognition of the exceptional thesis: *Ultrafast optoelectronics in 2D materials and their heterostructures* Supervised by **Prof. Dr. Frank Koppens**.

## PhD Poster Session and Award



The ICFO Student Poster Session was created as an opportunity for the exchange of ideas and knowledge among ICFOnians of different groups and areas. Now in its 9<sup>th</sup> edition, it took place in the scope of the ICFO Day event.

This year, the poster presentation took place at the end of the day during ICFO Day, with the announcement of the Best Poster Awards during the Festive Dinner. One prize was awarded for the best overall poster, chosen through a popular vote from all ICFOnians and sponsored by ICONS. Another official prize was awarded based on an assessment by the PhD Committee, for which only PhD students were eligible.

This year, the same poster was chosen from both collectives and therefore **Valeria Venturini**, from **Dr. Stefan Wieser** group won both prizes.

## COLLABORATION / PEOPLE

## TRAINING



## Initial Training Retreat

**Maximizing integration and productivity for ICFO's newest PhD students.**

**ICFO's newest cohort of PhD students attended the third annual Initial Training Retreat, which included professional skills training and an opportunity to get to know one another.**

The retreat was conceived to help maximize integration and productivity in the first stages of the PhD. It focused on skills crucial for the successful launch of doctoral studies, including topics such as time and project management and communication skills.

The participants also took part in team-building activities designed to reinforce interactions between research teams. Not only did these activities serve to encourage the cross-fertilization of ideas, they also helped to strengthen the ICFO network and create a motivating and stimulating place to work.

For newly incorporated PhD students, the retreats are their first experience within the well-established ICFO+ Training and Development program.



## ICONS Training Session

**A day with Alaina Levine on Career Development**

**ICONS (ICFO Organization and Network of Students), hosted Alaina Levine from Quantum Success Solutions, a SPIE Students travel lecturer, for a full day of events on professional career development for early-stage researcher at ICFO.** Levine describes herself as an award-winning entrepreneur, STEM career consultant, science journalist, professional speaker and corporate comedian.

The workshop on career development for direction-seeking students took place in early October after many months of preparation. It received a great deal of support, active participation, and positive feedback from the student community. The information packed program included two keynote lectures, two workshops and networking events over lunch, plus a Social Friday and dinner in Barcelona.



**+INFO**  
icons.icfo.eu

## BEYOND ICFO

## Anicet Tibau

**ICFO is where I discovered the world of research**

**My first contact was when I was just 14 years old through the Fundació Catalunya · La Pedrera's "Joves i Ciència" program.** For two weeks, ICFO researchers taught us about lasers. On top of that, thanks to an invitation from Maciej Lewenstein, we had the chance to meet and talk with Nobel Laureate Roy Glauber. This opportunity, along with everything I learned from Jordi Tura and Alessio Celi, made me fall in love with quantum theory and convinced me to pursue a career in research in theoretical physics.

A year later, "Joves i Cència" allowed me to visit ICFO for a month in Antonio Acín's group, working on the "Quantum non-locality games" project. I experienced ICFO from the inside and discovered what it is like to be a researcher, and learned a lot about quantum theory and Bell inequalities from Belén Sainz.



*"ICFO got me started in my research career, allowing me to test my desire to pursue a career in research and giving me an impressive CV at a very young age."*

I returned to ICFO as a Summer Fellow in 2016 while I was working on a double degree in Math and Physics at the Universitat Autònoma de Barcelona. I joined Maciej Lewenstein's group and developed a project called "The Black Hole Information Paradox" that combined all my main areas of interest. My supervisors, Arnau Riera and Manabendra Nath Bera, gave me the perfect mix of advice and freedom, and I was very happy to be back at ICFO, this time contributing a little bit to the work of the group.

It went so well in fact that I returned yet again as a Summer Fellow in 2017, this time in Antonio Acín's group, still supervised by Arnau and Manabendra, developing a quantum theory for finite fermionic systems. It was the best opportunity that I had ever had and confirmed my aspirations to do research.

ICFO got me started in my research career, allowing me to test my desire to pursue a career in research and giving me an impressive CV at a very young age. I always recommend ICFO to other students so that they too can experience the amazing vibe of the institution and benefit from the high quality research programs that open doors for those who want to pursue an academic career.

Once I finished my Bachelors' degree, I decided to explore Quantum Gravity theories based on my 2016 Summer Fellow experience and the encouragement that I received at ICFO to explore different regions of science. My experience at ICFO helped me to win a place in the MSc in Mathematical and Theoretical Physics at the University of Oxford with funding from "La Caixa" Foundation. I am applying a lot of what I learned about Information Theory from ICFO in my dissertation about Constructor Theory applied to Quantum Gravity theories.

The future is a little scary, but I hope to find a PhD opportunity that suits me. ICFO has been a formative experience and my research home. I will always carry with me a cozy feeling thinking of walking through ICFO's automatic doors or hanging out in el Café de la Llum.

## GO &amp; FLY

# 176 Women and Men

have successfully defended their theses at ICFO since its founding in 2002.

Together they have helped us measure what we have learned, how far we have come, and how much we have yet to learn. The following ICFOnians have recently succeeded in defending their PhD theses. Honoring ICFO's tradition, ICFOnians gather to celebrate your accomplishments and encourage you to Go & Fly! Remember that wherever you go, you will always be a part of the ICFO community.



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October 24, 2018

**Miguel Mireles**

*"Hybrid diffuse optics for translational oncology and nanobiophotonics: Towards a theranostic approach for emerging cancer therapies"*

**TD: Prof. Dr. Turgut Durduran and Dr. Johannes Johansson**



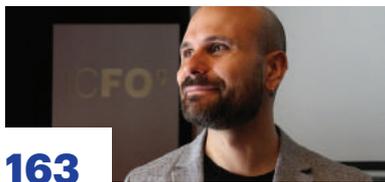
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December 10, 2018

**José Ramón Martínez**

*"Classical and Quantum Aspects of the Optical Response at the Nanoscale"*

**TD: Prof. Dr. Javier Garcia de Abajo**



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October 2, 2018

**Aniello Lampo**

*"Quantum Brownian Motion Revisited: Extensions and Applications"*

**TD: Prof. Dr. Maciej Lewenstein**



166

October 18, 2018

**Josep Canals**

*"Picosecond, High-Repetition-Rate, Optical Parametric Sources from the Ultraviolet to the Deep-Infrared"*

**TD: Prof. Dr. Majid Ebrahim-Zadeh and Dr. Chaitanya Kumar Suddapalli**



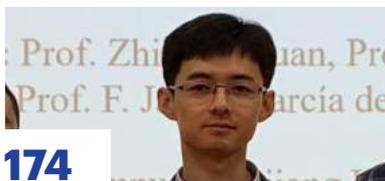
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October 26, 2018

**Kyra Borgman**

*"A Journey from the Membrane into the Nucleus of Human Dendritic Cells"*

**TD: Prof. Dr. María García-Parajo**



174

December 12, 2018

**Lijun Meng**

*"Thermal and optical-gain effects in nanophotonics with applications to sensing and perfect absorption"*

**TD: Prof. Dr. Javier Garcia de Abajo and Prof. Dr. Min Qiu (Zhejiang University)**



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October 10, 2018

**César Cabrera**

*"Quantum Liquid Droplets in a mixture of Bose-Einstein Condensates"*

**TD: Prof. Dr. Leticia Tarruell**



167

October 19, 2018

**Roland Terborg**

*"Lens-Free Interferometric Microscope for Transparent Materials"*

**TD: Prof. Dr. Valerio Pruneri**



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October 30, 2018

**José M. García-Guirado**

*"New Lab-on-a-Chip Strategies for Enantio-Selective and Non-Diffusion-Limited Biosensing"*

**TD: Prof. Dr. Romain Quidant**



175

December 17, 2018

**Nicolás Morell**

*"Optomechanical resonators based on transition metal dichalcogenide monolayers"*

**TD: Prof. Dr. Adrian Bachtold**



165

October 11, 2018

**Florian Curchod**

*"Nonlocal Resources for Quantum Information Tasks"*

**TD: Prof. Dr. Antonio Acín**



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October 22, 2018

**Kavitha Kalavoor**

*"Optical surfaces for mid-infrared sensing"*

**TD: Prof. Dr. Valerio Pruneri**



172

November 12, 2018

**Jil Schwender**

*"Mass Sensing with Graphene and Carbon Nanotube Mechanical Resonators"*

**TD: Prof. Dr. Adrian Bachtold**



176

December 18, 2018

**Junxiong Wei**

*"Novel nonlinear frequency conversion sources in the mid-infrared"*

**TD: Prof. Dr. Majid Ebrahim-Zadeh and Dr. Chaitanya Kumar Suddapalli**

## 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 worked as a cook in a Montreal restaurant
2. He is a certified Capoeira teacher
3. During high-school he hiked the Kokoda trail with schoolmates
4. His undergraduate thesis was about medieval Chinese forensic science

# THE LAST WORD

## HIGH PROFILE

## Tommaso Calarco

**The European Commission's Quantum Technology Flagship is intrinsically associated with Prof. Dr. Tommaso Calarco because of the integral role he played in getting it off the ground. Calarco is currently the Coordinator of the Quantum Coordination and Support Action (QSA), a role that he has maintained in parallel with his intense scientific activity at the University of Ulm and now the Peter Grünberg Institute (PGI), Forschungszentrum Jülich.**

### What attracted you to Quantum Physics?

I was originally drawn by its absurdity and uselessness; it was a purely philosophical interest. One of my big joys today is that there are a lot of ideas that come from the crazy paradoxes of quantum mechanics and the fun is that we can make these paradoxes useful. When Alain Aspect was doing his first experiments on entanglement, no one thought that it would lead to an application, but now we see that this is the basis for most of the quantum technologies that we know.

### What motivated you to publish the Quantum Manifesto?

I wrote the Quantum Manifesto with Ignacio Cirac and Charlie Marcus, with the support of officers from the Dutch Presidency of the Council of the European

*“Quantum technologies will make Europe technologically more competitive.”*



Union, the European Commission and the innovation agency from the United Kingdom, Innovate UK. For several years, we had been involved in coordination projects and road mapping activities with the whole European Quantum Information Processing community and I really saw a potential to convince politicians that this would be a good moment to start a big initiative. The Manifesto was not created out of the blue. This long iterated executive summary of ideas gathered from the entire Quantum Community had been developing over time. We knew that this was already connected to a process in which the European Commission and member states were willing to start some initiative on Quantum Technologies.

### How did you manage to get the Quantum Flagship off the ground?

Our success in launching the Quantum Flagship came because, through persistent legwork, we were able to close the communication gap between

the knowledge of the Quantum community and the decision makers.

In every member state of the European Union, we have prominent scientists who had contributed to the Manifesto that are listened to by their government and by representatives in Brussels. Through this community input we were able to create awareness and momentum, convincing member states that this is something important. The Commission started appointing a High-Level Steering Committee that consulted very deeply with the community throughout the whole of Europe to start mapping out the details and strategy of a large pan-European Quantum initiative involving both academia and industry.

### What will be your new role when QSA ends and QFlag begins in March?

I am the German representative to the Quantum Community Network, one of the three governing bodies of the Flagship. I have been elected the Network Chair and will hold this role as long as my colleague have the trust that I represent the ideas and goals of the community at a transnational level and bring this into the Brussels discussion. At any point, someone else may be elected Chair who may be better equipped to do the job. This rotation is important for the health of this undertaking.

### Why is the Quantum Flagship Initiative a good investment for the European Citizens who are financing this project?

We are able to manipulate quantum objects- the smallest objects that exist. This will give us access to computers with much higher performance than previous computers- and everybody uses computers. It gives us the possibility to have secure communication, and the privacy and security of our data is important to everyone. It gives us the possibility to measure much more accurately a lot of things that are connected to health and the functioning of our bodies, and this is once again something that affects each of us deeply. In a word, quantum technologies will make Europe technologically more competitive. Here, the Flagship is key.

## Science Quiz

In a recent article: S. Wall et al. "Ultrafast disordering of vanadium dimers in photoexcited  $\text{VO}_2$ ," *Science* 362, 572 (2018), the authors used two ultra-fast lasers, one at 800 nm and the other at 9.5 keV (or 1.3 Å). The first heated a solid target of vanadium dioxide, and the second observed the atoms as they rearranged into a different phase.

### 1) What happens when you heat vanadium dioxide from 295K to 350K ?

- A) it melts
- B) it becomes a metal
- C) it releases oxygen, becoming  $\text{V}_2\text{O}_2 + \text{O}_2$ .

\* Find answers on pg. 2

### 2) What kind of laser can produce ultra-short, 1.3 Å pulses ?

- A) a free-electron laser
- B) a laser-induced plasma
- C) an excalibur laser.

### 3) Vanadium

- A) is named after a Norse goddess of beauty and fertility
- B) is present in hallucinogenic mushrooms
- C) in dioxide form has been proposed as a coating for "smart windows"
- D) all of the above.

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