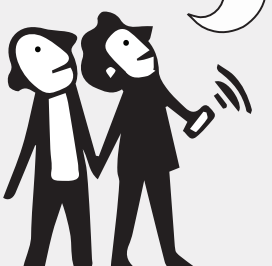


# ICFOnians

Community News from The Institute of Photonic Sciences



Worldwide quantum physics experiments  
powered by human randomness



## EDITOR'S CORNER

# Cuddling up to Schrodinger's Cat



**BROOK HARDWICK**  
Coordinating Editor



Due to the frontier nature of the work we do at ICFO, it can be a challenge to share the exciting but often highly complex details of our advances with the general public. Have a look at the "Latest Advances" section of this edition and you will see some pretty amazing findings, all of which have been published in top tier journals that our peers will study, test, and cite. However, the average man and woman on the street wants the big picture. They want to know if the findings will help cure cancer, give us a faster- better- smaller- smarter phone, save money, make the world cleaner and safer, or solve global warming,

But it IS possible to get people with no scientific background fully engaged and excited about the details of frontier research. The BIG BELL TEST - a worldwide scientific experiment coordinated by ICFO - managed to involve 100k+ people directly, and raise awareness in thousands more via mainstream media channels. This kind of "awakening" is almost as exciting as the scientific findings themselves.

The Big Bell Test is a rigorous frontier quantum physics experiment (or to be more exact, 12 experiments taking place simultaneously around the world) that aimed to verify whether or not particles can be intertwined by the "spooky action at a distance" that Einstein could not accept. As with any rigorous experiment, ICFO put together a motivated team to carefully plan and prepare every aspect of the project, including the key role of the general public in generating truly random sequences of bits that would fuel the experiments. The BBT team aroused the participation of the general public through explanations tailored to the audience, leaving LOTS of time for Q&A. They talked to colleagues, collaborators, teachers, students, friends, family, old people, young people and the media and thus the experiment came alive for people around the world who went on to share what they learned with others. While the scientists manned experiments to test entanglement and quantum correlations between particles in order to attempt to violate Bell's inequality, over 100,000 members of the general public became "Bellsters," providing their random bits to the experiment. Not only did they help test Bell's theorem to see if Einstein was right or wrong, but they also started to follow the science, became familiar with some of the basic concepts of quantum physics, and began to cuddle up to Schrodinger's cat. Who said you can't communicate complex scientific questions to the general public?

ICFO has a triple mission: to carry our frontier research, train the next generation of scientists and technicians, and to take our findings out of the lab and into society. In every issue of *ICFOians* we try to highlight a wide range of happenings at the institute that embody all aspects of this mission, something the Big Bell Test clearly does. Likewise, the second edition of ICFO Day demonstrated our dedication to this mission, this time with an internal audience. It provided a unique opportunity to explore the work of colleagues around the institute, get inspired by new ideas, and to connect with ICFOians outside our immediate circles, thus strengthening our research and opening our minds to unforeseen potential applications of our findings.

Thanks for taking the time to learn about the details of what is going on at ICFO... and feel free to share the excitement of what you learn!

## COVER



The Big Bell Test was a monumental undertaking based on the scientific rigor of the experiments conducted, and the outreach and communication efforts required to bring together the thousands of participants who provided the crucial contributions of human randomness. ICFO PhD Student Carlos Abellán was the instigator of the project, acting under the supervision of ICREA Prof at ICFO Morgan Mitchell as scientific coordinator. In addition, a large interdisciplinary team of researchers, members of ICFO's KTT and Communications teams, graphic designers, programmers, and science enthusiasts helped to ensure the success of this global experiment.

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## ICFO NEWS



### NATIONAL SENIOR RESEARCH AWARD 2016

The Foundation for Research and Innovation of Catalonia (FCRi) organizes the yearly National Research Awards to honor individual scientists and institutions for their outstanding contributions to society. For 2016, the FCRi has granted the National Senior Research Award, the organization's highest honor, to ICFO's Director, Lluís Torner. This prize specifically recognizes a significant contribution to scientific progress on an international scale - in human and social, life and health, engineering, technology or experimental sciences. Dr Torner conceived and founded ICFO and has been its director since its inception in 2002. Under his leadership, the institute has become a forerunner in global frontier photonic research and its numerous applications in biomedicine, renewable energy, nanotechnology, graphene, quantum technology and information technology.

### HIGHLY CITED RESEARCHER

*Clarivate Analytics*, formerly the IP and Science business of Thomson Reuters, annually produces a *Highly Cited Researchers* list identifying international researchers who are some of the world's most influential scientific minds. The list is compiled using indicators taken from InCites' *Essential Science Indicators* across 21 broad fields. It is determined by the number of papers that rank in the top 1% according to citations for field and publication year in journals indexed in the WoS Core Collection between 2004-2014. The 2016 compilation in the field of physics gathers 107 influential thinkers, including ICREA Prof at ICFO Maciej Lewenstein. This is the third consecutive year in which Prof Lewenstein has made this prestigious list.

### ATLANTE AWARD

Through the Atlante Award, *Foment del Treball Nacional* (the Institute of National Employment Promotion, a division of the Office of Prevention of Labor Risks), aims to encourage and stimulate companies to take initiatives towards the effective implementation of occupational risk prevention. In receiving this award, ICFO was singled out in the category of "integration of risk prevention", recognizing the implementation of risk prevention actions in the enterprise management system that aim at the effective and stable integration of security in the organization and operation of the institute.

### 2016 GEFES PRIZE FOR BEST EXPERIMENTAL THESIS

Dr Nicolò Accanto is the 2016 recipient of the GEFES Prize for the Best Experimental Thesis based on his work on condensed matter physics. Accanto developed his thesis entitled "Coherent Control of Nonlinear Optical Processes in Individual Nanoparticles" under the supervision of ICREA Prof at ICFO Niek van Hulst. The goal of his research was to actively control the fundamental interactions between laser pulses and individual nanoparticles, extending the concept of coherent control to the nanoscale and ultrafast scale. The awarding organization GEFES (Specialized Group of Solid State Physics) is part of the Spanish Royal Society of Physics (RSEF).

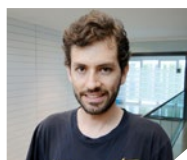
### 2 ERC CONSOLIDATOR GRANTS

The ERC announced the awarding of its Consolidator Grants to 314 top researchers in Europe. Among these are two ICREA Professors at ICFO - Gerasimos Konstantatos and Frank Koppens - for their projects HEINSOL and TOPONANOP respectively. For this call, the ERC evaluated 2,274 research proposals, out of which 13.8% have been selected for funding. The grants fall under the Excellent Science Pillar of Horizon 2020, the EU's research and innovation program.

## ICFO NEWCOMERS



**Johannes Ziegler**  
Research Engineer



**Luis José Salazar**  
Postdoctoral Researcher



**Charikleia Troullinou**  
PhD Student



**Francesca Cella**  
Visiting Scientist



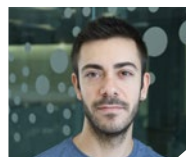
**David Moreno**  
PhD Student



**Niels Hesp**  
PhD Student



**Mariia Kramarenko**  
PhD Student



**Roger Guiu Tort**  
Research Engineer



**Zahra Raissi**  
PhD Student



**Pilar Pujol Closa**  
Student



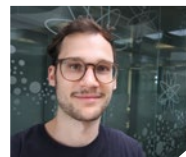
**Gabriel Comerón**  
Student



**David Masip**  
Student



**Awoke Negash**  
PhD Student



**Philip Thomas**  
Student



**Álvaro Rodríguez**  
Student



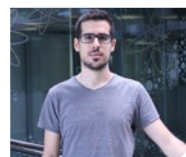
**Joseph Bowles**  
Postdoctoral Researcher



**Carles Milian**  
Postdoctoral Researcher



**Carles Urgell**  
PhD Student



**Daniel González**  
PhD Student



**Patrick Hümbeli**  
PhD Student



**Slaven Tepsic**  
PhD Student



**Marymar Becerra**  
Visiting PhD Student



**Kelin Vélez**  
Projects Unit



**Dario De Santis**  
PhD Student



**Samyobrata Mukherjee**  
PhD Student



**Matteo Lostaglio**  
Postdoctoral Researcher



**Norma Medina**  
Visiting PhD Student



**Itandehui Gris**  
Postdoctoral Researcher



**Marco Valentini**  
Student



**Nadine Meyer**  
Postdoctoral Researcher



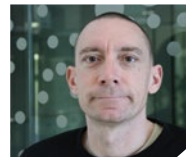
**Job Mendoza**  
Postdoctoral Researcher



**Daniel Rivas Saenz**  
Postdoctoral Researcher



**Michael Stührenberg**  
Visiting PhD Student



**Cedric Hurth**  
Postdoctoral Researcher



**Tsuneto Kanai**  
Postdoctoral Researcher



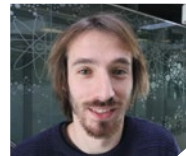
**Julius Huijts**  
Visiting PhD Student



**Arkadiusz Kosior**  
Visiting Scientist



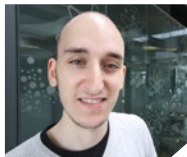
**Filippo Ponz de León**  
Projects Unit



**Marc Torrent**  
Student



**Wei Cai**  
Visiting Scientist



**Bernard Ciraulo**  
PhD Student



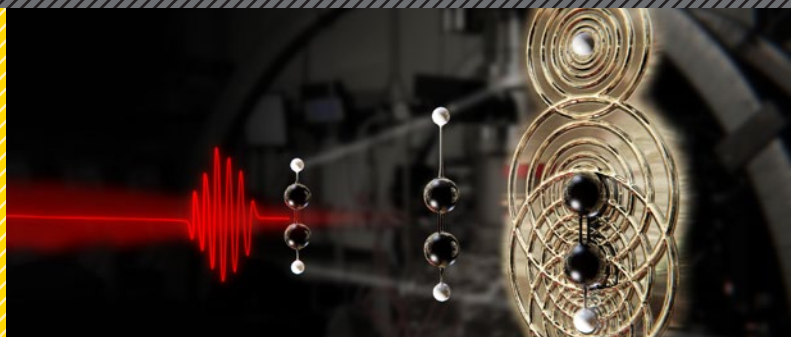
**Khannan Rajendran**  
Student

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

**Welcome to ICFO!**



## LATEST ADVANCES



## MOLECULAR SELFIE

■ In their recent study reported in *Science*, ICFO scientists from the Attoscience and Ultrafast Optics Group in collaboration with researchers from the USA, the Netherlands, Denmark and Germany reported on the imaging of molecular bond breakup in acetylene ( $C_2H_2$ ) 9 fs after its ionization. The team tracked the individual atoms of the isolated acetylene molecule with a spatial resolution as small as 0.05 Ångström – less than the width of an individual atom – and with a temporal resolution of 0.6 femtoseconds. In doing so, they were even able to trigger the breakup of only one of the bonds of the molecule and see how one proton leaves the molecule. With this they used one of the molecule's own electrons to image its structure – teaching the molecule to take a selfie!

## POLARITONS IN LAYERED 2D MATERIALS

■ An international group of experts led by the University of Minnesota, among them ICREA Prof at ICFO Frank Koppens, have published a review in *Nature Materials* that highlights how manipulation of 2D materials could make our modern day devices faster, smaller, and better, examining the optical properties of several dozens of 2D materials to ultimately unify understanding of light-matter interactions in these materials. They report on how polaritons, a class of quasiparticles formed through the coupling of photons with electric charge dipoles in solids, can unite the speed of photon light particles and the small size of electrons. By exciting the polaritons in 2D materials, electromagnetic energy can be focused down to a volume a million times smaller compared to when it's propagating in free space. Such results could have applications ranging from sensing and fingerprinting minute amounts of biomolecules, to optical communications, energy harvesting and security imaging.

## AN INVISIBLE ELECTRODE

■ An intensive effort has been devoted to the search of alternative transparent conducting materials that could definitively replace the semiconductor Indium Tin Oxide (ITO) as a transparent conducting material. Now, ICFO researchers Rinu Abraham Maniyara, Vahagn K. Mkhitarian, Tong Lai Chen, and Dhriti Sundar Ghosh, led by ICREA Prof at ICFO Valerio Pruneri, have developed a room temperature processed multilayer transparent conductor by applying an Al doped ZnO overcoat and a  $TiO_2$  undercoat layer with precise thicknesses to a highly conductive Ag ultrathin film. By using destructive interference, they showed that the proposed multilayer structure could lead to an optical loss of ~1.6% and an optical transmission greater than 98% in the visible. This result, published in *Nature Communications*, represents a record fourfold improvement in figure of merit over ITO and also presents superior mechanical flexibility in comparison to this material.

## TAILORING SINGLE PHOTONS WAVESHAPES

■ Quantum information networks transmit information through material quantum nodes via the transmission of quantum light, i.e. single photons. Because the quantum nodes may be composed of different quantum systems with varying properties and capabilities, the shape of the single photons must be tailored to achieve a strong interaction between the various nodes. ICFO researchers Pau Farrera, Boris Albrecht and Dr Georg Heinze led by ICREA Prof at ICFO Hugues de Riedmatten, in collaboration with the University of Basel, report in *Nature Communications* on the creation of a heralded single photon source based on a quantum memory using a laser cooled Rubidium atom cloud. By tailoring the read-out optical pulse, they were able to generate photons with arbitrary waveforms and temporal durations varying over three orders of magnitude. Being able to generate ultra-narrowband, pure and storable single photons with widely tuneable wave shapes is an enabling step toward hybrid quantum networks that require interconnection of remote disparate quantum systems.

## BUSINESS NEWS



GRAPHENE FLAGSHIP



## Electronics and Photonics Integration Meeting

A meeting on *Electronics and Photonics Integration* within the FET Graphene Flagship project took place at ICFO bringing together academic and industrial partners

A meeting on *Electronics and Photonics Integration* within the FET Graphene Flagship project took place at ICFO on 14 and 15 December bringing together researchers working on electronic devices, photonics and optoelectronics, flexible electronics and wafer-scale system integration work packages of the Graphene Flagship. ICREA Prof at ICFO Frank Koppens, leader of the *WP8 Photonics and OptoElectronics* and deputy leader of Division 3, hosted this meeting.

The purpose of this forward-looking meeting was to define the future directions of the division in the next phase of the Flagship (Core 2), and focus on the most promising applications from a socioeconomic impact viewpoint. Over 135 participants from 56 entities, involving both academic and industrial partners, gathered to discuss the future of graphene-related technologies in the electronics field. The session dynamics were in general open discussions in which attendees had the chance to share their learnings, achievements and future directions in the fields of data communications, 2D logic devices, plasmonic sensors, Terahertz technologies, flexible detectors and electronics.

## UPCOMING INDUSTRY EVENTS

### 2017 MOBILE WORLD CONGRESS | 27 FEBRUARY - 2 MARCH

■ The **Graphene Flagship** and ICFO, with support from the GSMA, present the **Graphene Experience Zone** at the **2017 Mobile World Congress (MWC)** in Barcelona, the world's largest gathering for the mobile industry. The Graphene Experience Zone will showcase the latest achievements and innovations from 25 companies and research centers in an interactive and accessible way.

+ INFO ► [www.mobileworldcongress.com](http://www.mobileworldcongress.com)

SAVE THE DATE!

THE NEXT ELEMENT

MOBILE WORLD CONGRESS BARCELONA 27 FEB - 2 MAR 2017

### GRAPHENE CONNECT | 2 MARCH

■ The **Graphene Flagship** also organizes Graphene Connect, an event open to MWC attendees that aims to foster collaborative innovation projects within and outside of the Graphene Flagship consortium. *Graphene Connect - From Datacom to IoT, Enabled by Graphene*, will be held in the framework of the Mobile World Congress (Theatre in Hall 8). The program includes a keynote speech by **Nobel Laureate Konstantin Novoselov**, talks by experts in industry and academia as well as discussion panels.

+ INFO ► [www.graphene-flagship.eu/grapheneconnect/upcoming](http://www.graphene-flagship.eu/grapheneconnect/upcoming)

### 7TH EDITION OF GRAPHENE CONFERENCE SERIES | 28 - 31 MARCH

■ The seventh edition of the **Graphene Conference Series** taking place in Barcelona is the largest European event in graphene and 2D materials. Organized by **Phantoms Foundation, ICFO Prof Frank Koppens, ICN2 Prof Stephan Roche, IIT Prof Francesco Bonaccorso** and **Université Catholique de Louvain Prof Jean-Christophe Charlier** head the scientific organization committee. There are 83 keynote and invited speakers confirmed including **Nobel Laureates Andre Geim** and **Albert Fert**, and other renown experts in the field like **Toni Heninz** and **Philip Kim**. This conference will address both academia and industry, offering a two-day industrial forum with in-depth foresight by industrial experts regarding opportunities and challenges in graphene.

+ INFO ► [www.grapheneconf.com/2017](http://www.grapheneconf.com/2017)

Graphene 2017 March 28-31

PHANTOMS foundation



# The BIG Bell Test

More than 100,000 people challenge Einstein in a unique worldwide quantum physics experiment



On 30 November, everyone in the world had the opportunity to be part of an unprecedented global experiment gathering 12 labs around the globe in order to test the laws of quantum physics.

Coordinated by ICFO, *The BIG Bell Test (BBT): worldwide quantum experiments powered by human randomness* applied the unique value of human randomness to the study of fundamental processes of nature. Indeed, the BBT's goal was to show that the microscopic world is in fact as strange as quantum physics predicts; down to the fundamental level, causality and realism give way to pure randomness.

The idea of a large-scale, human-driven experiment using internet technologies came from Carlos Abellán, PhD student at ICFO and instigator of the BBT project. Carlos and ICREA Prof at ICFO Morgan Mitchell, the BBT scientific coordinator, participated in the 2015 loophole-free Bell tests, which inspired them to embark on one of the most amazing projects they had ever conceived.

On 30 November, from Australia to west coast USA, participants were called to contribute to this initiative through a videogame, and to introduce sequences of 0s and 1s as randomly as possible. Each of these bits was then used to control, in real-time, the elements of optical tables – mirrors, polarizing filters, waveplates – selecting the type of measurements to be performed on the different quantum systems.

Altogether more than 100,000 people completed over half a million videogame missions, providing scientists with approximately 95 million bits of unpredictable, independent decisions to measure their particles. This independence is a crucial feature for the conclusions of the experiments to be valid.



## A BIG SUCCESS BRINGING TOGETHER SCIENCE AND SOCIETY

■ The BBT team and all ICFOnians would like to thank the thousands of users whose generous contributions made this experiment possible.

Thanks also to all the institutions that helped support this project: the Generalitat de Catalunya, the Universitat Politècnica de Catalunya, the Cellex Foundation, the Mir-Puig Foundation, the Foundation Catalunya la Pedrera, "La Caixa" Foundation, AXA Research Fund, the European Research Council, Catalan Institution for Research and Advanced Studies (ICREA), and the Severo Ochoa program of the Ministry of Economy, Industry and Competitiveness.

+ INFO ► [www.thebigbelltest.org](http://www.thebigbelltest.org)

## THE EXPERIMENTS

- ICFO – The Institute of Photonic Sciences
- USA National Institute of Standards and Technology (NIST)
- Ludwig-Maximilians-Universität München
- Institute for Quantum Optics and Quantum Information (IQOQI) / OEAW
- Laboratoire de Physique de la Matière Condensée (LPMC) - Université Nice/CNRS
- Quantum Device Lab (QUDEV) - ETH Zurich
- Centre for Quantum Computation and Communication Technology (CQC2T) – Griffith University
- Arc Center of Excellence for Engineered Quantum Systems (EQUS) - University of Queensland
- Centro de Óptica y Fotónica (CEFOP) - Departamento de Ingeniería Eléctrica de la Universidad de Concepción with Linköping Universitet, Universidad de Sevilla, and Dipartimento di Fisica-Sapienza Università di Roma
- Dipartimento di Fisica-Sapienza Università di Roma with International Institute of Physics del Federal University of Rio Grande do Norte
- Center for Excellence and Synergetic Innovation Center of Quantum Information and Quantum Physics (CAS) / USTC – University of Science and Technology of China
- División Óptica Cuántica (CITEDEF) and Departamento de Física, FCEyN, Universidad de Buenos Aires.



## The Bell Test in a nutshell

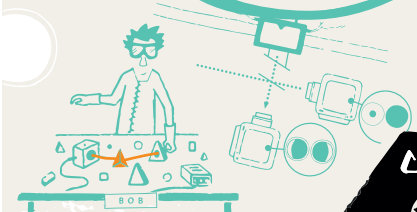
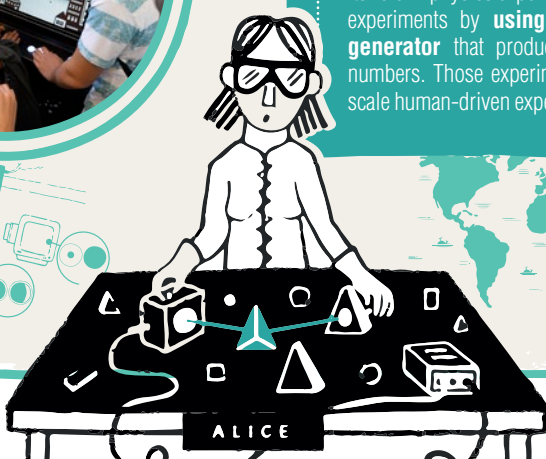
■ In 1964, John Stewart Bell put forward a method to verify if quantum mechanics exhibited properties that cannot be explained in the framework of local realism. With that, he radically changed the way we think about quantum mechanics, laying the foundations of quantum information science and technology. However, **it took 40 years to achieve the technological developments that would allow for the implementation of a conclusive test.**

### HOW THE BIG BELL TEST IDEA WAS BORN

■ The **BIG Bell Test** was born from ICFO's contributions to the famous loophole-free Bell tests of 2015, which required an extraordinary attention to the nature of randomness and its role in physics experiments. **ICFO contributed** to these experiments by **using a physical random number generator** that produced very fast, very pure random numbers. Those experiments inspired the idea of a large-scale human-driven experiment using internet technologies.

### THE BIG EVENT AT COSMOCAIXA, BARCELONA

■ In collaboration with "La Caixa" Foundation, the **BIG Bell Test** team had the opportunity to share this project with an audience of more than 300 people at CosmoCaixa's auditorium. In addition, the event included real time connections to the experiments running in Shanghai (China), Concepción (Chile), Nice (France) and Castelldefels (Spain). **By streaming the event live around the world**, the organizers reached an even broader audience, **with over 300,000 people connecting from China alone.**





## ICFO COMMUNITY

13 December 2016

ICFO  
Day

■ On 13 December, ICFO Day, a unique institution-wide event planned by ICFO-nians for ICFO-nians took place, allowing us all to have a better idea of the wide range of research and accomplishments that take place in the groups, labs and various divisions and departments of the institute.

This year's theme was "Humanizing Science", in which participants learned about interesting scientific results and a lot more: they gained insight into the stories behind those results, the people behind the stories and the collaboration on all levels at ICFO that makes really great science possible. The day's activities included debates, lab tours, short talks, poster sessions, challenges, an ICFO Family photo, the announcement of the 2015 ICFO Thesis Awards and Poster Awards, and a surprise rhythmic demonstration of the concepts of Super Resolution Microscopy by some creative and energetic ICFO-nians. An intense community event concluded on a high note with the annual Festive Dinner.



## 2015 ICFO PhD Thesis Award



From left to right:  
Juan A. Torrefiño, Jordi Tura and  
Federica Beduini.

■ Among more than 15 theses defended by ICFO PhD Students in 2015, the selection committee had an in depth deliberation to select the winner of the **PhD Thesis Award**. This award was created in order to distinguish particularly brilliant PhD theses defended at ICFO and in doing so, to highlight and reward extraordinary PhD students whose research progress while at the institute has proven to be highly creative and ambitious. **This year, the committee conferred the awards as follows:**

- **In the theoretical field to: JORDI TURA**, in recognition of the exceptional thesis: "Characterizing Entanglement and Quantum Correlations Constrained by Symmetry" supervised by Prof Dr Maciej Lewenstein & Dr Remigiusz Augusiak
- **And, in the experimental field, ex aequo to: FEDERICA BEDUINI**, in recognition of the exceptional thesis: "Entanglement and State Characterisation from Two-Photon Interference", supervised by Prof Dr Morgan Mitchell, and to **JUAN A. TORREÑO**, in recognition of the exceptional thesis: "Membrane Protein Nanoclustering as a Functional Unit of Immune Cells - from nanoscopy to function" supervised by Prof Dr María García Parajo and Dr Carlo Manzo.
- **JORDI, FEDERICA** and **JUAN A.** received their awards in the ceremony held on 13 December during the ICFO Day.

## PhD Poster Session &amp; Award

## Congratulations to the winners of 7th edition of the ICFO PhD Student Poster Session



From left to right:  
Irene Alda, Achim Woessner  
and Kavitha Kalavoor.

■ The **ICFO Student Poster Session** was created as an opportunity for the exchange of ideas and knowledge among ICFO-nians of different groups and areas. Now in its seventh edition, it took place in the scope of the ICFO Day event.

Twenty-nine posters were exhibited in the Nest Hall for more than two weeks ensuring that all ICFO-nians could view them and benefit from the broad range of topics covered. ICFO-nians were asked to vote for the best poster. The poster awardees were chosen based on the PhD Commission's deliberation and the recommendation of an external Committee in addition to this popular vote. **Congratulations to the following winners:**

- **1st place: KAVITHA KALAVOOR GOPALAN** Optoelectronics group led by Prof Dr Valerio Pruneri  
**Poster #18** "Pyro-resistive infrared detector using graphene on LiNbO<sub>3</sub>"
- **2nd place: ACHIM WOESSNER** Quantum Nano-Optoelectronics group led by Prof Dr Frank Koppens  
**Poster #12** "Non-invasive photocurrent nanoscopy on bare and h-BN encapsulated graphene"
- **3rd place: IRENE ALDA** Plasmon Nano-Optics group led by Prof Dr Romain Quidant  
**Poster #19** "Planar Paul traps for trapping and manipulation of single nanoparticles"



BEYOND ICFO



# Alejandra Valencia

*“ICFO taught me the value of a high quality administrative organization and the importance of thinking beyond the optical table when doing frontier research.”*

When I was asked to give you an idea of how I have grown professionally since I left ICFO, the first thing that came to my mind was the idea of independence. My work today has been directly shaped by the varied experiences that I had in my six + years at ICFO as a postdoc and in Outreach in the KTT unit.

I am now an associate professor at Universidad de los Andes in Bogotá, Colombia, which involves research, teaching and administrative work. In one way or another, I also did all these activities when I was at ICFO; I carried out my research as a

postdoc in Juan Perez’s group, and when working in KTT, I worked under Silvia Carrasco’s supervision. In my current work, I have become the group leader, the reference point for those in my group. The independence and responsibility that comes with my role are the newest aspects of my professional life.

I left ICFO in July 2012 and moved to Colombia after 12 years of living abroad between the US and Europe. I arrived in Bogotá to establish the country’s first laboratory in experimental quantum optics. Now, four and a half years later, I am very

*“In Colombia, I am also doing some outreach. I have always been interested in outreach but ICFO definitely got me motivated to do more in this area.”*

proud of what has been achieved. In my group, we run experiments where we generate and characterize pairs of entangled photons and heralded single photons. We have published in international peer review journals, presented our work in international conferences and engaged students at all levels in experimental quantum optics research.

This has all been possible thanks to the scientific and not-strictly scientific skills that I learned at ICFO. Obviously, from a scientific perspective my PhD studies in the US and my postdoctoral experience are central to my daily work. However, from a wider perspective, ICFO taught me the value of a high quality administrative organization and the importance of thinking beyond the optical table when doing frontier research. At ICFO, I started seeing light as a tool for many applications. I try to convey this to my current students in hopes of motivating them to think of bringing photonics out of the lab.

In Colombia, I am also doing some outreach. I have always been interested in outreach but ICFO definitely got me motivated to do more in this area. Current ICFOnians and Alumni will probably recall that I was always looking for “guides” to show the labs to visitors. (I remember that we even showed visitors the mechanical and electrical workshops.) I still do that at my university, where I encourage high school students, the general public and people from industry to visit as a way of enhancing the scientific culture in Colombia and exploring possibilities for technology transfer.

So now that you know about my research, if you ICFOnians happen to be around Colombia, come and visit me. But if in your mind Colombia means hot tropical weather, be aware that Bogotá is 2600 meters (8530 feet) above sea level, so remember to bring a coat and also your ICFO coffee cup to talk about photons and enjoy a wonderful Colombian coffee.

GO & FLY



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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 together 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 13  
2016

IONE VERDENY

*Unravelling 3D Cargo Transport Dynamics at the Microtubule Network with Super-Resolution Microscopy*

TD: Prof Dr Melike Lakadamyali



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October 13  
2016

LUIS JOSÉ SALAZAR

*Weak Value Amplification: New Insights and Applications.*

TD: Prof Dr Juan Pérez Torres



121  
October 14  
2016

VITO GIOVANNI LUCIVERO

*Quantum Metrology with High-Density Atomic Vapors and Squeezed States of Light.*

TD: Prof Dr Morgan W Mitchell



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October 19  
2016

DAVID SO

*Copper Indium Sulfide Colloidal Quantum Dot Solar Cells.*

TD: Prof Dr Gerasimos Konstantatos



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November 11  
2016

ANSHUMAN SINGH

*Optical Nanoantennas as Cavities: Nanoscale Control of Coupling Strength and Single Photon Emission.*

TD: Prof Dr Niek F. van Hulst



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November 24  
2016

DANIEL RIELÄNDER

*Quantum Light Source Compatible with Solid-State Quantum Memories and Telecom Networks.*

TD: Prof Dr Hugues de Riedmatten



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2016

MIQUEL RUDÉ

*Micro-Nano Structured Optical Devices using Ge2Sb2Te5.*

TD: Prof Dr Valerio Pruneri



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December 2  
2016

PETER WEBER

*Graphene Mechanical Resonators Coupled to Superconducting Microwave Cavities.*

TD: Prof Dr Adrian Bachtold



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December 16  
2016

GIORGIO COLANGELO

*Quantum Measurements with Cold Atomic Ensembles.*

TD: Prof Dr. Morgan Mitchell and Dr Rob Sewell

## HIGH PROFILE



### John Mather:

*“We learned in school about Occam’s razor as a guide to good explanations. But we see now that nature acts in the opposite way: if something can be improved by being more complicated, it will be.”*

JOHN MATHER is the Senior Astrophysicist and Senior Project Scientist for the James Webb Space Telescope at NASA’s Goddard Space Flight Center. He is the recipient of numerous awards, including the Nobel Prize in Physics in 2006 with George Smoot, for his work on the Cosmic Background Explorer (COBE) confirming the expanding universe model to extraordinary accuracy, and initiating the study of cosmology as a precision science.



#### What is the scientific discovery that has most awed you?

I’m still astonished at the accomplishments of molecular biology, which are pouring in at an incredible rate. With human hands and minds, we’ve discovered some of nature’s tools that let us see the details of cell-to-cell combat and disaster repair. We know that bacteria keep digital records of viral attacks, for use in future defense. We know that cells repair chromosome damage and we’ve learned how to use that mechanism to do genetic engineering. We’ve learned the physical structures of the nano-machines that process DNA and RNA for replication and control. We’ve learned about micro-motors that convert incoming molecular energy into the ATP molecules the cells use to power everything. The list goes on and on. It depends on many tools the physicists have invented, as well as on higher math and computers. And every day is a surprise. We learned in school about Occam’s razor as a guide to good explanations. But we see now that nature acts in the opposite way: if something can be improved by being more complicated, it will be.

#### Which of your professional accomplishments would have most surprised the young John Mather?

The young John Mather had no idea how far the space program would go. When Sputnik went up in 1957 and the Apollo astronauts walked on the moon in 1969, I never guessed that astronomers would be able to see so much better, that we would be able to hunt for life on other planets in the solar system and beyond, that optics could be developed so far beyond classical lens design and diffraction. And I certainly had no idea that I would become a NASA employee helping to lead a team in building the most powerful telescope yet, or that I would have helped to lead a team to Nobel-prize winning discoveries.

*“I admire my colleagues immensely, for the intellect and talent, for their drive and determination to ensure success, and for their commitment to public service. And we laugh a lot too!”*

#### What has been the most rewarding aspect of the JWST project for you so far?

I really enjoy working with brilliant scientists and engineers, to build something that’s never been built before, to discover something that’s never been known before. I admire my colleagues immensely, for the intellect and talent, for their drive and determination to ensure success, and for their commitment to public service. And we laugh a lot too!

#### What kind of advice would you give to a young PhD student starting his/her career in science?

Science is more than ever a team sport, so choose your team with thought to how people work together. Good leadership can bring joy; cranky people can bring sorrow. So before choosing your PhD advisor, talk with the other students, see how they like their advisor, see how they talk with each other, see whether they are being well prepared to prosper in an uncertain world.

## CHALLENGE

### SUDOKU

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### 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 next edition’s Challenge section!



1. She has a delicious creative streak.
2. Her favorite vacation was a trip to Graceland.
3. She sometimes dreams of having the chance to study something new like Oriental Art History.
4. The *force* that guards her home is a 1.5-year-old German Shepherd named Lukas Skywalker.
5. There are few ICFOnians that she does not know by name.
6. With all her experience in and around airports, she can recite almost all of the FAA security check-in speech from memory.

Ed. #29 (Fall) solution: Carlos Abellán (Optoelectronics Research group)

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