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**Summer Fellows  
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**Beyond ICFO  
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THE LAST WORD

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COLLABORATION

# High Impact Initiatives

In research, training, tech transfer  
and beyond





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## Mystery ICFonian

Solution Ed #49

## David Kernan

Research Engineer,  
Optoelectronics research group

## Science Quiz

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## ON THE COVER

## High Impact Initiatives

Meet ICFO's amazing sixteenth cohort of Summer Fellows. This annual program brings together talented students and gives them the chance to try a research career on for size. As Rob Sewell, Head of Academic Affairs remarks, "Over the years, we have witnessed the passion in many students who discover a calling to do research that they may not have known they had. It is exciting to be part of their eye-opening experience". Read more on pg 8.

## EDITOR'S CORNER

## Research impact

## The demonstrable contribution that excellent research makes to society and the economy

Reflecting on our work through the lens of impact allows us to see its **reverberations through many layers of society**, making the excellence that we strive so hard to achieve even more apparent.

Scrolling through ICFO's publication list, the academic impact of ICFO's research and publications is unquestionable. Not only do we publish prolifically and collaborate with leading researchers around the world (including recent Nobel Laureates), our work is cited frequently by our peers, thus helping to build and shape frontier knowledge.

Academic impact is the base of our institute's reputation for excellence, but ICFO has always aimed to go above and beyond. Consider ICFO's strong focus on education at all levels. Through an amazing **outreach agenda**, we help to give students and the general public an introduction to the wonders of science and the importance of the research enterprise for society (more on pg 10). Our Academic Programs are growing to reach more future scientists and technologists. **Sixteen generations of Summer Fellows** have learned from experts at ICFO and many have been inspired to pursue their PhD at ICFO or at other leading institutes around the world (more on pg 8). Over **260 PhD students to date have defended their theses at ICFO** and have gone on to build successful careers in academic research, teaching and industry (meet eight new graduates on pg 11). We partner with leading institution in the Barcelona area and around Europe to offer opportunities to masters level students to work with our research groups. Building on leadership in the international quantum ecosystem, in 2021 ICFO joined other world-leading institutes in the Barcelona area to launch the **Master in Quantum Science and Technology (MQST)** which

has just graduated its first class. Not only does this program illustrate the role that ICFO seeks to play in educating students, it also is an example of how we aim to support the growth, leadership and innovation potential for the future of quantum technologies in Europe. Through educational efforts at all levels, ICFO is impacting young minds and the future of society.

Another way of assessing research impact beyond academia is to look for ways in which advances and new knowledge affect, change, and benefit the economy, culture, and society. In this edition we follow **new technologies incubating in the KTT Launchpad** and celebrate the successful first steps in the **deployment of quantum communications in Catalonia** through a successful collaboration between the Government of Catalonia, ICFO and Cellnex (more on pg 7). The ongoing search for tools to protect information is of vital importance, and these advances are of indisputable impact as Catalonia takes a decisive step forward with a piece of the European Quantum Communications Infrastructure.

Impact-driven ICFOnians are moving mountains through their ambitious research projects and willingness to **collaborate and give-back to the ICFO community**. The strong participation of members of the Alumni Network who returned to ICFO from as far away as California (!) to participate in the *Beyond ICFO* event, sharing personal career stories in hopes of helping other ICFOnians navigate career options, is a perfect illustration of another dimension of impact.

Read on and take note of all that we have been up to over the past months- and stay tuned for more exciting things to come!



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Contributing Editor

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# Happenings

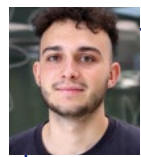
**ICFO NEWCOMERS**

# Welcome to ICFO

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



**Deeksha Dadhich**  
Student



**David Pérez Castro**  
Student



**Lisa Bombieri**  
Student



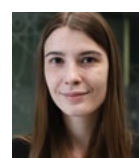
**Domenica R. Bermeo**  
Student



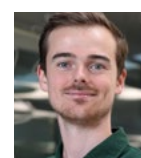
**Andrea Rogolino**  
Student



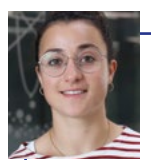
**Kacper Cybinski**  
Student



**Marlena Dziurawiec**  
Student



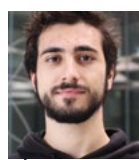
**Gijs Simons**  
Student



**Alexia Montesinos**  
Student



**Arturo Cabrera**  
Student



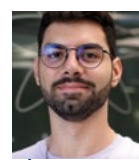
**David Ribes**  
Student



**Sandra Rodrigues**  
PhD Student



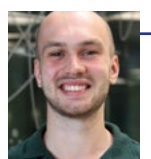
**Hamed Dehghanpour Baruj**  
PhD Student



**Sergio J. Salvia**  
PhD Student



**Ibtissam Ghailan Tribak**  
PhD Student



**Nikita Poljakov**  
PhD Student



**Julia Bergmann**  
PhD Student



**Raffaele Salvia**  
Visiting PhD Student



**Martin Hoermann**  
Visiting PhD Student



**Theis Rasmussen**  
Visiting PhD Student



**Adolfo Esteban Martin**  
Visiting Scientist



**Chaitanya Suddapalli**  
Visiting Scientist



**Sara de Vincentiis**  
Visiting Scientist



**Felix Hoffet**  
Postdoctoral Research



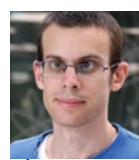
**Simone Mortal**  
Postdoctoral Research



**Sergi Julià**  
Postdoctoral Research



**Bárbara Burlini**  
Postdoctoral Research



**Rotem Liss**  
Postdoctoral Research



**Jinxing Xue**  
Postdoctoral Research



**Rubaiya Hussain**  
Postdoctoral Research



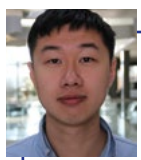
**Romain Veyron**  
Postdoctoral Research



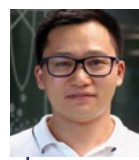
**Viktoriia Holovanova**  
Postdoctoral Research



**Jessica Almeida**  
Postdoctoral Research



**Xinyao Liu**  
Postdoctoral Research



**Sen Mou**  
Postdoctoral Research



**Hassan Termos**  
Postdoctoral Research



**Rajesh Bera**  
Postdoctoral Research



**Anku Guha**  
Postdoctoral Research



**Sunil Kadam**  
Postdoctoral Research



**Valeria Pais**  
Research Engineer



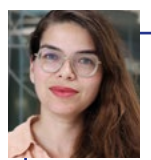
**Jana Ockova**  
Research Engineer



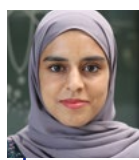
**Sergio Lucio De Bonis**  
Research Engineer



**Eman Ahmed**  
Visiting Scientist



**Darisbel Correa**  
Pre-Award Project Management



**Fariha Aslam**  
Project Management Support



**Óscar Gimeno**  
Head of Strategic Management Initiatives

**Not pictured**

**Giacomo Franceschetto**  
Student

**Monica Sanchez**  
Student

**Diana Méndez**  
Student

**Max Zayas Orihuela**  
Student

**John Brandon Cardenas**  
Student

**Martina Recchia**  
Visiting PhD Student

**Neil Parker**  
Student



## Happenings

### ICFO NEWS

### The Minister of Science and Innovation of Spain at ICFO

Ms. Diana Morant, **Minister of Science and Innovation of the Government of Spain**, visited ICFO, touring the facilities and learning about several key research areas.

(see High Profile Interview pg 12)



Prof Frank Koppens presented the goals of the new macro-project **TWIST**, for which the Ministry recently **allocated 3.7M€ financing** as approved in the "Presupuestos Generales del Estado 2022", allowing ICFO to team up with MIT's Professor and ICFO's Distinguished Invited Professor Pablo Jarillo-Herrero and Professor Claudia Felser from the Max-Planck Institute for Chemical Physics of Solids, **to study the fundamental properties of emerging synthetic quantum materials** and their potential future applications in nano-optoelectronics. She also visited the laboratory of Prof Leticia Tarruell to learn about the landmark experiment, **QUIONE**, in which ICFOrians are working to achieve and configure one of the **first quantum simulators** which will facilitate the understanding of the behavior of materials and their properties. Both of these projects are part of a strategic quantum technologies program led by ICFO that will position Catalunya as a **quantum innovation hub**.



### Creu de Sant Jordi

In a formal ceremony that took place in July, the President of the Generalitat, Pere Aragonès, **honored ICFO's director Lluís Torner with the Creu de Sant Jordi for "his leadership in research in photonic sciences, an area that is key to addressing the challenges of humanity during the 21<sup>st</sup> century"**. In addition to citing his many international awards and recognitions, the award recognized Torner for "placing ICFO, which he himself created, as a world reference in its discipline". Asked to comment on this award, Prof Torner declared that "this recognition is for all ICFO. It is in my name because I am privileged to have a particularly visible role in the organization, but it is actually for each and every ICFOnian".

### Postdoctoral Junior Leader "la Caixa" Fellowships



The "la Caixa" Foundation has announced and awarded fellowships for the 2021 call of their prestigious **Postdoctoral Junior Leader program**. Of the forty-five fellowships awarded this year, three are for ICFO Research Fellows, and two for ICFO Group Leaders who have recently started their own group at the institute.

- **ICFO Prof Dr Pelayo García de Arquer**
- **Dr Manuel Gessner**
- **Dr Allan Johnson**
- **ICFO Prof Dr Georgia Papadakis**
- **Dr Alejandro Turpín Avilés**

Co-funded by the European Commission through the **Marie Skłodowska-Curie COFUND** Action under Horizon 2020, the Postdoctoral Junior Leader program aims to recruit excellent researchers of any nationality who wish to continue their research career in Spanish or Portuguese territory, supporting the best scientific talent by providing them with an attractive, competitive environment in which to conduct excellent research.

### Accreditation of PhD in Photonics



The focused PhD in Photonics program offered by ICFO in partnership with the Doctoral School of the Universitat Politècnica de Catalunya • Barcelona Tech (UPC) **has recently passed the 10-year evaluation by the Catalan University Quality Assurance Agency (AQU Catalunya) with the highest possible grade**. Designed to prepare PhD students for leadership in the academic and the industrial worlds, the program has an emphasis on intensive research-based training. It promotes a multidisciplinary, international research environment with opportunities to undertake research in the most advanced topics in optical sciences and technologies.

### Finalist for the ERC PERA Award

In 2016, ICFO coordinated the **Big Bell Test** in which 100,000 volunteers contributed to a unique worldwide experiment run in twelve laboratories around the world that **tested the laws of quantum physics using random numbers generated by humans**. The experiment was instigated by then ICFO PhD student Carlos Abellan (co-founder of Quside Technologies) and coordinated by ICREA Prof at ICFO Morgan Mitchell, in collaboration with a team of ICFO researchers including ICREA Professors Antonio Acín, Hugues de Riedmatten, and Valerio Pruneri, Jordi Tura, Georg Heinze, Pau Farrera, and ICFO's KTT and Communications units.



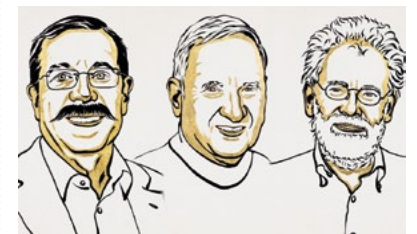
This year, the BIG Bell Test Project was **selected as one of the nine finalists of the European Research Council's Public Engagement with Research Award**, established to recognize those ERC grantees who successfully engage audiences outside their domain. While the BBT did not take home the first prize, it was runner up in the public vote and allowed ICFO to celebrate once again the success of this high impact citizen science experiment.

### BIST celebrates the graduation of the 5<sup>th</sup> class of MMRES

In a ceremony that took place at La Pedrera Auditorium on September 12<sup>th</sup>, BIST celebrated the graduation of the 2021/2022 class of the Master of Multidisciplinary Research in Experimental Sciences (MMRES), the 5<sup>th</sup> promotion since the Master Program was launched in September 2017.



The MMRES program has an important hands-on component in which students spend most of their time developing research projects within the host research groups in the seven BIST Centers and MELIS-UPF. The ceremony looked back to celebrate the 5-year MMRES trajectory, recognized the professional and vital trajectories of the alumni, and gave a warm welcome to the incoming class.

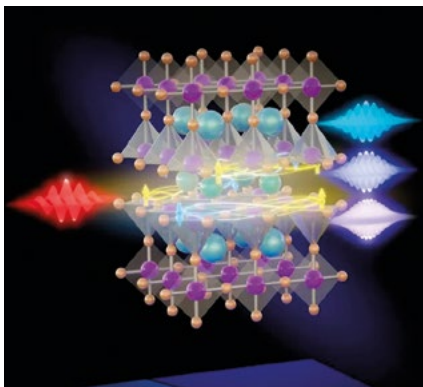


### 2022 Nobel Prize in Physics

The 2022 Nobel Prize in Physics has been awarded to **three fathers of Quantum Physics**, Alain Aspect, John F. Clauser, and Anton Zeilinger for "experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science". We congratulate these friends and colleagues for their landmark contributions to the field of quantum physics, and also congratulate current and Alumni ICFOrians Sören Wengerowsky, Carlos Abellan (Quside), Waldimar Amaya (Quside), Timothy H. Taminiau, Fabien Steinlechner, Daniel Cavalcanti, Stefano Pironio, and Professors Morgan Mitchell and Valerio Pruneri whose publications were listed in the Nobel Committee's award citation. The findings for which this year's Nobel was awarded have helped usher the world into the Second Quantum Revolution, and are facilitating a tremendous scientific and technological transformation that will shape the future.

## Happenings

### LATEST ADVANCES



### Phase transitions of high-temperature superconductors

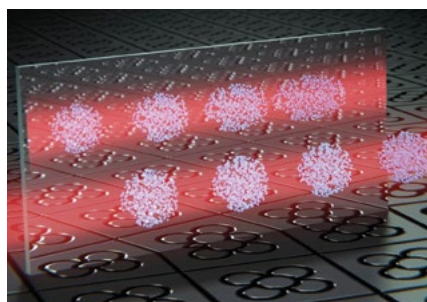
The detection of the different microscopic quantum phases in superconductors is a challenge.

Not only are their physical processes still incomplete due to their wide array of quantum states, but the current methods used to explore their dynamics at microscopic scales are lagging sensitivity. In an international study published in *PNAS*, ICFO researchers Utso Bhattacharya, Ugaitz Elu, Tobias Grass, Piotr T. Grochowski, Themistoklis Sidiropoulos, Tobias Steinle, and Igor Tyulnev, led by ICREA Professors Jens Biegert and Maciej Lewenstein, in collaboration with researchers from ICMA-B-CSIC, and Guangdong Technion-Israel Institute of Technology, **propose a new methodology based on the use of High Harmonic spectroscopy (HHS) to investigate the transitions between the different phases of YBCO.**

This study represents a major scientific breakthrough since it is the first time that highly non-linear and non-perturbative diagnostics/detection methodology is used to understand the behavior of strongly correlated materials. In addition to the impressive experimental results obtained, the researchers have also presented a new theoretical model to identify the connection between the measured optical spectra and the transition between the different quantum states of the YBCO: strange metal, pseudogap, and superconductor.

This work provides a “first striking example” of how High Harmonic Spectroscopy can be used to distinguish correlated phases of matter.

### Ultracold atoms dressed by light simulate gauge theories



In a study published in *Nature*, ICFO experimental researchers Anika Frölian, Craig Chisholm, Ramón Ramos, Elettra Neri, and Cesar Cabrera, led by ICREA Prof at ICFO Leticia Tarruell, in collaboration with Alessio Celi, a theoretical researcher from the Talent program at the Autonomous

University of Barcelona, were able to **simulate a gauge theory other than electromagnetism for the first time, using ultracold atoms.**

The team set out to realize in the laboratory a gauge theory belonging to the class of topological gauge theories, different from the class of dynamical gauge theories to which electromagnetism belongs. To make it a reality and to simulate it in their experiment, they used a cloud of atoms cooled down to temperatures about a billionth of a degree above absolute zero. They chose potassium as the atomic species, because one of its isotopes has two states that interact with different strengths and can be used as the quantum bricks to construct the chiral BF gauge theory. They then shone laser light to combine the two states into a single new one, “**dressing the atoms with light**”, which made them acquire peculiar interactions whose strength and sign depended on the velocity of the cloud. Finally, they created an optical waveguide that would restrict the motion of the atoms to a line, and used additional lasers to kick the cloud and make it move at different velocities along the line.

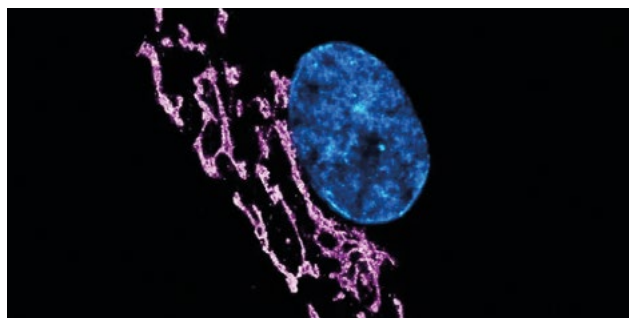
They saw that when the atoms move to the right, their interactions are attractive and cancel the behavior of the atoms trying to expand, creating a soliton. However, when the atoms move to the left, these atoms expand like normal gas, two different atomic behaviors that together demonstrate that the system is chiral.

Since results of the experiment never seemed to agree with their expectations, they contacted theoretical physicist Alessio Celi, who after several discussions, came up with a **model that could properly explain the experimental results.** The team is now trying to expand the experiments and the theory from a line to a plane, allowing them to observe the fractional quantum Hall effect without the need of a quantum material.

### ICFO-SJD Joint Lab collaboration proves gene therapy against muscular dystrophy

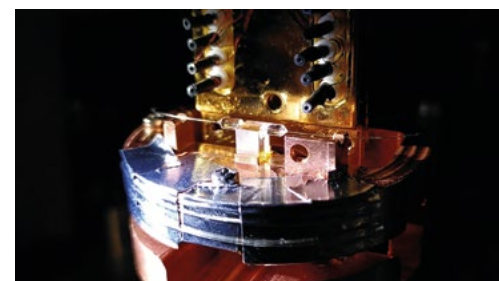
A study led by the Sant Joan de Déu Research Institute (IRSJD) and ICFO within the **ICFO-SJD Joint Lab program**, with the participation of the Center for Biomedical Network Research on Rare Diseases (CIBERER) and the ALBA Synchrotron has shown **promising results with gene therapy to combat muscular dystrophy.**

The research team aimed to use a genetic editing technique based on the CRISPR/Cas system to **silence a genetic mutation** that prohibits the correct formation of networks of collagen fibers between cells. Scientists successfully achieved this by using gene therapy in the lab on fibroblast cells taken from biopsies from children diagnosed with muscular dystrophy. In affect rewriting these collagen-coding genes, they achieved **that the patient’s cells once again took on the appearance of healthy cells.**



To verify the effectiveness of the gene therapy treatment, the research team analyzed the cells of the patients with **advanced microscopy techniques.** Among them, the **super-resolution microscopy** carried out in the Confocal Microscopy and Cell Imaging platform of the IRSJD, the **Super-resolution Light Microscopy & Nanoscopy (SLN) laboratory** at ICFO, and the **X-ray microscopy with synchrotron light** in the MISTRAL beamline of ALBA. The joint work between these platforms has been key to understanding the results of the experiments.

### A boost in performances in fiber-integrated quantum memories



Much work has focused on improving the scalability of existing quantum memories to facilitate their integration and deployment in a real-work network. Notably, the improvements come with the caveat that they should be performed while reaching the same level of performance obtained in “standard” bulk versions of the device. Current realizations of fiber-integrated quantum memories fall far behind what can be reached in bulk memories, however in a recent work published in *Science Advances*, ICFO researchers Jelena Rakonjac, Dario Lago-Rivera, Alessandro Seri and Samuele Grandi, led by ICREA Prof at ICFO Hugues de Riedmatten, in collaboration with Giacomo Corrielli and Roberto Osellame from IFN-CNR and Margherita Mazzera from Heriot-Watt University, have been able to **demonstrate entanglement between a fiber-integrated quantum memory and a telecommunications-wavelength photon**, an important accomplishment for fibre integrated memories. The results are an important step, closing in on the performance levels of bulk memories. In the future, extending the storage to spin states are expected to allow on-demand retrieval of the stored photons and lead to the long storage times that scientists have been aiming for. This fiber-integrated quantum memory shows great promise for future use in quantum networks.



## Happenings

### BUSINESS NEWS

# ICFO and Cellnex Telecom launch Q-networks

## Joining forces to bring quantum technologies from the lab into the real world

In spring 2021, ICFOrians in the group led by ICREA Prof at ICFO Hugues de Riedmatten, accomplished a landmark result in quantum communications when they demonstrated that they could store one single photon in two quantum memories placed 10m apart (*Nature* 594, 37-40). Having achieved this important step towards the goal of building the quantum internet, the group was prepared to embark on the next challenge of taking their experiment outside the stable environment of the lab. This entails developing a real functional quantum repeater link and connecting different links together, increasing the distance between the quantum memories, to distribute entanglement along them.

The research groups led by ICREA Profs at ICFO Hugues de Riedmatten (coordinator) and Valerio Pruneri have joined forces with Europe's leading operator of telecommunications infrastructures, Cellnex Telecom, owner of the largest optical fiber network in Barcelona and Catalunya, managing its services through the Xarxa Oberta de Catalunya (XOC), to advance in their quest for the quantum internet. **Together, they were granted funding from the Spanish Ministry of Science and Innovation (MCIN) to carry out projects related to quantum technologies.**

**The consortium will develop and deploy, for the first time, a quantum repeater node outside the**



**lab in the Barcelona area, and distribute entanglement between repeater nodes at ICFO and in Barcelona, using the installed fiber optic network.** It will also develop novel practical sources of photonic quantum entanglement and use them to **implement cryptography protocols, such as Quantum Key Distribution (QKD)**, establishing a completely secure quantum communication between the two sites to demonstrate a quantum secure link and the effect of entanglement between both nodes. This will demonstrate that quantum communication technologies can be easily integrated into current classical telecom networks.

During the first in-person meeting of this project known as **Q-networks**, ICFO and Cellnex representatives from the Global Innovation and New Business Initiatives unit discussed the technicalities of the deployment, as well as the various possibilities, opportunities, risks, etc., that the project could encounter during its 3-year lifespan.

This project offers a glimpse of exciting advances on the horizon in the years to come in quantum communications.

\* The project PLEC2021-007669 is funded by MCIN/AEI/10.13039/501100011033 and by the "European Union NextGenerationEU/PRTR"

# New ICFO CLP Member

## ICFO's Corporate Liaison Program (CLP) helps to strengthen relationships between industry and science



Through this program, the Knowledge and Technology Transfer team at the institute proactively establishes partnerships with industrial corporations, creating trusting and long-lasting relationships that enable the achievement of common goals.

**Quantum Exponential PLC**, an investment company based in the UK, is the newest member of ICFO's Corporate Liaison Program. The company is assembling a **portfolio of potential investments in leading Quantum technology companies** around the world and has a team of experts with unparalleled market knowledge and access so as to establish, maintain and keep developing a global lead in Quantum portfolio management.

“

*ICFO is regarded globally as a European leader in developing cutting edge quantum technologies relating to photonics. Joining as a member of the program offers up significant opportunity for Quantum Exponential to increase its access to early-stage quantum technology companies and industry spin-offs. We are confident that being part of its Corporate Liaison Program aligns with our existing investment strategy and will allow us to create lucrative partnerships in order to access, finance and help develop early-stage quantum companies emerging from ICFO.*

**Steven Metcalfe**  
Quantum Exponential's CEO

“

*The next few years will see an upsurge in commercialisation of numerous and varied quantum enabled applications. We anticipate Quantum Exponential's experience in investing and nurturing early-stage quantum technology companies, combined with their deep sector relationships, will help such fledgling businesses flourish and create a rich eco-system.*

**Silvia Carrasco**  
KTT Director at ICFO

# ICFOrians win Ignite Award at SLAS Europe 2022

## Shinephi start-up project incubating in the KTT Launchpad wins award for best start-up / emerging company

At the SLAS Europe 2022 conference that took place in Dublin, start-up and emerging companies exhibiting at the conference competed for the IGNITE Award where the panel of judges evaluates key concepts such as scientific innovation, market potential, team and clarity of vision, among other qualities.



“

*During the conference and especially in the Innovation AveNEW, where Shinephi had its booth, we were surrounded by really amazing companies, start-ups and projects, each with a unique and smart solution. The interaction with all of them was already a very rewarding experience, which became even better after winning the SLAS IGNITE Award. This was a great chance to shine a spotlight on Shinephi and gives us extra motivation moving forward.*

**Dr Roland Terborg**  
ShinePhi's CEO

The 2022 IGNITE Award was given to Shinephi, a spin-off project led by Dr Roland Terborg. The project is based on the phase-imaging technology developed in the research group led by ICREA Prof at ICFO Dr Valerio Pruneri and is being incubated in the KTT Launchpad at ICFO.

## Collaboration

### QUANTUM COMMUNICATION

# Quantum Cryptography in Critical Communications

**ICFO and Cellnex Telecom present results of project funded by Department of Vice Presidency and Digital and Territorial Policies of the Generalitat de Catalunya focusing on the transmission of critical information in an ultra-secure manner using a quantum key distribution protocol**

At the beginning of September, recently returned from the long days of summer, the Vice President of the Government and Minister for Digital Policies and Territory, **Jordi Puigneró**, accompanied by the Minister for Research and Universities, **Gemma Geis**, officiated the presentation of the results of the **'Quantum Cryptography in Critical Communications' project**, an initiative born in the framework of the Research and Innovation Program in Advanced Digital Technologies (TDA) promoted by Digital Policies, whose objective was to develop and validate a system of quantum keys for the encryption and ultra-secure transmission of critical information.

The project, **promoted and funded with €1.2 M by Digital Policies and carried out by ICFO** was implemented as a pilot test in a quantum communication link, through a point-to-point fiberoptic link, covering a distance of 30 km, between the headquarters of ICFO in Castelldefels, and the Center for Telecommunications and Information Technologies of the Government of Catalonia (CTTI) in Hospitalet del Llobregat.

This first and successful quantum connection, which has permitted the testing and validation of the methodology and technology used in the field, was reproduced during the presentation of the project's results, objectives and next steps, with a videoconference between Vice President **Puigneró** and **Silvia Carrasco**, Director of the ICFO Knowledge and Technology Transfer Unit, through the quantum communication link established in the pilot test. Also participating in the presentation were the general director of Innovation and Digital Economy, **Daniel Marco**; the director of ICFO, **Lluís Torner**; and the director of Business Development at LuxQuanta, **Vanesa Diaz**.

## LUXQUANTA

**ICFO's 10<sup>th</sup> Spin-off company, LuxQuanta, founded in May 2021, was born as a result of the Quantum Cryptography in Critical Communications project with the mission of facilitating ultra-secure communications through the use of quantum technologies.**

The company provided the necessary know-how for the implementation of the technology, the manufacturing of the transmitting and receiving devices and their integration into the current fiberoptic telecommunications network. It also made possible the development of QKD protocols that guarantee a secure connection.

## The Project

Two years ago, Digital Policies joined forces with ICFO to launch a project that would promote quantum technologies, with the aim of deploying quantum communications in Catalonia, strengthening the security in communications and overcoming the main barriers detected in the democratization of the use of quantum technologies, using low-cost solutions that can be easily integrated into the current technological ecosystem.

1

### First step

Quantum key encryption methods were developed that could be integrated as an additional layer to traditional telecommunications lines.

2

### Second Step

A team of researchers from **ICFO**, **Cellnex Telecom** -manager of the Xarxa Oberta de Catalunya-, and ICFO spin-off company **LuxQuanta**, carried out a pilot test deploying hardware and software for the fiberoptic network of the Generalitat de Catalunya. The pilot test consisted in establishing a 30 km point-to-point quantum communication link between ICFO (Castelldefels) and CTTI (L'Hospitalet del Llobregat).

3

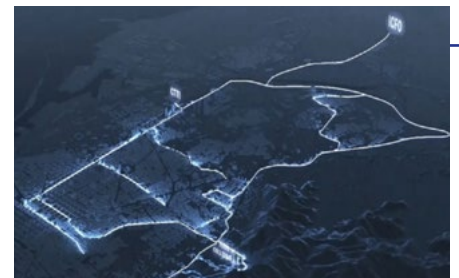
### Third Step

To test and validate the equipment, LuxQuanta used video conferences between ICFO and CTTI as test beds. These utilized quantum technologies based on quantum random number generators manufactured by **Qside**, a company that spun out of ICFO in 2017. The quantum keys were generated and each message was encrypted. Through a control screen, it was possible to monitor the performance of the communication channel and see how the system alerted users of the presence of a hacker who could be listening to the call.



Presentation of the project Quantum Cryptography in Critical Communications at CTTI

This successful project is an **example of the 'mission driven' research and innovation model** promoted by the Government of Catalonia -where the Administration poses its own challenges- and of 'dual-use', where the results of the research are used by the public sector and transferred to the private sector for the generation of economic growth, the creation of jobs and the achievement of technological sovereignty and global leadership.



## The Quantum Internet in Barcelona

This successful link is the **first step towards the deployment of the quantum ring in Barcelona**, traced through the fiber optic network of the Government of Catalonia and Cellnex Telecom, which will ultimately form part of the deployment of the quantum Internet in Europe. The physical ring will surround the city of Barcelona, and will aim to connect various infrastructures and key facilities, demonstrating, on one hand, the scalability of this technology to larger areas, and on the other, that the transmission of critical information can be carried out in an ultra-secure way. In future phases of the deployment, it is planned that the Barcelona ring will be connected via land and satellite with other national and international locations.

This is a strategic project for Catalonia that will be one of the lines of action of **Quantica - the Mediterranean Valley of Science and Quantum Technologies** initiative promoted by the Government and which seeks funding from state funds and NextGenerationEU European funds, in order to accelerate its implementation.



## Collaboration

### TRAINING

# ICFO Summer Fellows 2022

With the support of **Fundación Catalunya-La Pedrera**, the SF program reaches its 16<sup>th</sup> edition

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



Summer Fellows during the guided visit to La Pedrera

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

The Summer Fellows program is part of ICFO's efforts to attract young top talent at an early academic career stage. Carolina Fajardo is a Summer Fellow who

will continue to advance in the field by pursuing her PhD at ICFO in the Medical Optics research group led by ICREA Prof Turgut Durduran. Regarding her experience in the program, she explains, "I needed to work on my master's thesis, so I applied to be a SF at ICFO. With outstanding facilities, cutting-edge technology, and an outstanding workforce, ICFO is unmatched. This was the logical next step in my career advancement to achieve my objectives."

“

*The program is designed to give the Fellows a wide vision of what is possible in a research career.*

*Over the years, we have witnessed the passion in many students who discover a calling to do research that they may not have known they had. It is exciting to be part of their eye-opening experience.*

**Prof Robert Sewell**  
Director of Academic Affairs



Summer Fellows visiting the SLN Lab



#### Carla Caro Villanova

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



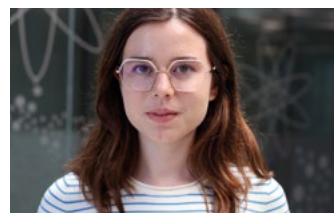
#### Maria Chiara Corsi

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



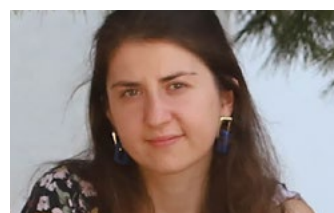
#### Marina Garcia Romero

Atomic Quantum Optics group led by ICREA Prof at ICFO Morgan Mitchell



#### María Martorell Ruiz

Medical Optics research group led by ICREA Prof at ICFO Turgut Durduran



#### Laia Serradesanferm Cordova

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

#### Joel Compte Prades

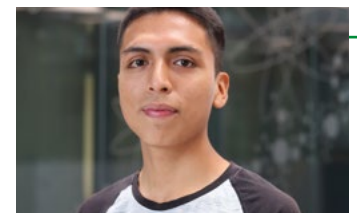
Nonlinear Optical Phenomena group led by UPC Prof at ICFO Juan P. Torres

\* Not pictured



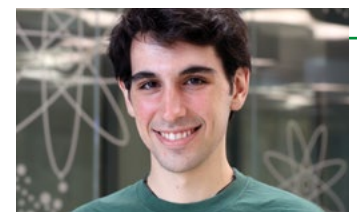
#### Carolina Fajardo

Medical Optics group led by ICREA Prof at ICFO Turgut Durduran



#### Misael Samir Malqui Cruz

Theoretical Quantum Nano-Photonics group led by ICREA Prof at ICFO Darrick Chang



#### Daniel Rodrigo Albert

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



#### Martí Xargay Ferrer

SLN group led by Dr Pablo Loza



# Collaboration

BEYOND ICFO

## Beyond ICFO 2022: Alumni Careers Around the World

### Networking with ICFO Alumni for Career perspectives

On Friday, September 30<sup>th</sup>, over thirty members of the Alumni Network joined the annual **Beyond ICFO** event to share their know-how and professional advice with current ICFOnians. ICFO Director Lluís Torner welcomed both current ICFOnians and Alumni to the event, and thanked them for their commitment to ICFO's community.



**Beyond ICFO**, organized by the Alumni Network, is just one of the activities in which Alumni are invited to stay engaged with the ICFO community, offering insights that may illuminate opportunities for those contemplating the next steps in their careers.







Andrea Morales, the coordinator of the Alumni Network followed the director's introduction, gave a full **overview of the network, its purpose and benefits**. Rob Sewell, Head of Academic Affairs, continued the institutional segment of the program, **introducing the new Mentoring Program that will be fully functioning in 2023**, through which PhD students at ICFO will be able to access a pool of **mentors from the Alumni Community** to support them in their career evolutions in academia or industry.

Two panel discussions were organized to allow Alumni to answer pointed questions from the audience. In the first panel dedicated to careers in academia, ICFOnians working in research and teaching roles in academic institutions at different levels and in different areas of the world fielded questions.







### Academic Panel

-  **Margherita Mazzera**  
Associate Professor at Heriot-Watt University
-  **Agustín Mihi**  
Tenured Scientist at ICMAB-CSIC
-  **Michele Sclafani**  
Physics Teacher at Col·legi Badalónés and freelance illustrator
-  **Armand Niederberger**  
Executive Director at Stanford Photonics Research Center (SPRC)

In the second panel, Alumni who have transitioned to industry to conduct research, launch start-ups, consult, or apply their training in a number of other areas offered a complementary perspective.


### Industry Panel

-  **Michael Geiselmann**  
Co-Founder at Ligentec
-  **Yu Bi**  
Team Leader of fabrication at Qurv Technologies
-  **Sandra de Vega**  
Sales Engineer at Menlo Systems GmbH
-  **Achim Woessner**  
Architect at ASML



Connecting in-person with cherished members of our Alumni Community after two years of pandemic induced engagement limitations was a great homecoming opportunity. To celebrate, there was a very special add-on to the event: a **Career Fair** where ICFO Alumni and current ICFOnians networked over coffee in the NEST Hall, catching up on evolving careers and sharing experiences.

This event, conceived as an opportunity for learning about different career paths, allowed ICFOnians to see that there are many opportunities for them once they Go and Fly from the Institute. It was clear that the scientific training received at ICFO in both technical know-how and soft skills opens doors to multiple positions and career paths.

 **As an ICFOnian you already have access to the Alumni Platform.**  
If you have questions about or need assistance to access the platform to connect with ICFO's Alumni Network, contact Andrea Morales: [contact@alumni.icfo.eu](mailto:contact@alumni.icfo.eu)

## Collaboration

### OUTREACH



### Kick-off event of the *Be an ICFOnian for a Day* program

At the end of September, ICFO hosted the kick-off event of *Be an ICFOnian for a Day*, a program directed to women and non-binary people in STEM Undergraduate and Master programs

27 women, accepted to the program by an application and review process, are participating in this first edition, each matched to a hosting ICFO research group. The kick-off event was the first of the program's four activities. During the event, the students were introduced to their peers as well as their host research groups. In addition, they played the *ICFO Decide Game* to familiarize themselves with ICFO and the research done at the center. The event was very well received and rated by the students, who are looking forward to the next activity in which they will return to ICFO to be part of one of our research groups for one day.

## “Survival vs Resilience”

### A unique collaboration with Fundació Epica La Fura dels Baus

This summer, ICFO was involved in an exciting collaboration at the **interface between science and art** inspiring the creative workshop “Survival vs Resilience” organized by **Fundació Epica La Fura dels Baus**. The Fundació Epica is a center that unites the learning and experience derived from 40 years of creative work in “Anticipatory Arts” of La Fura dels Baus, a theatrical group known for their use of disruptive settings and for blurring the boundaries between audience and actor.



Fruitful contacts between ICFO, ICN2, BIST and La Fura dels Baus planted the seeds for this collaboration, which presented an opportunity for the **GraphCAT community to disseminate the potential of Graphene and 2D materials** to a wider audience.

During the first part of this interaction, ICFO researchers **Lorenzo Orsini** and **Rajashree Haldankar** interacted with Pep Gatell, president of the Fundació Épica La Fura dels Baus and artistic director of La Fura dels Baus, and shared scientific notions on **twisted bilayer graphene, superconductivity and other unique properties of the material**. This productive exchange of ideas and views was recorded in an episode of the series “**Diálogos Épicas**”. In parallel, Dr Damià Viana from ICN2 underwent a similar process with a discussion about their INBRAIN project on the use of graphene for neurological applications.

These dialogues created the framework for collaboration in the new project with Fundació Epica La Fura dels Baus on “Survival vs Resilience”.



Here, a group of **30 creators interacted with scientists from ICFO, ICN2, BIST, UOC, HLRS and UB** to create, in two intensive weeks, a unique **performance inspired by science and technology**. The result was a show in four different acts, tackling the concepts of graphene and its properties, **fake news generation, brain-computer interfaces and their ethical risks, and finally the role of memory in personality formation**. The show took place on July 23-24 in Badalona and it was an intriguing, disturbing and impactful mix of visual and interactive elements that left no one indifferent.

#### +INFO

[www.epicalab.com/workshops/survival-vs-resilience/](http://www.epicalab.com/workshops/survival-vs-resilience/)

#### +IMAGES FROM THE EVENT

[www.flickr.com/photos/epicalab/sets/72177720300739307/](https://www.flickr.com/photos/epicalab/sets/72177720300739307/)

#### MULTIMEDIA

Diálogos Épicas: Researchers talk science with Fundació Épica La Fura dels Baus



## The Makers movement meets frontier research

Makers all around the world are using technology and creativity to invent new objects that spark curiosity and have a positive impact on society

They believe in sharing their experiences and skills, and that is why events like the **Maker Fair** were born. The same values are at the base of scientific endeavours, where creativity and technology go together to push the frontiers of knowledge. At ICFO, many people use tools dear to the maker community, such as Arduino or Raspberry Pi, to quickly build prototypes of new technologies that have the potential to improve the world.

**ICREA Prof Dr Turgut Durduran**, leader of the Medical Optics group at ICFO, participated to the 2022 edition of the Maker Fair Barcelona showing how, with a few DIY elements, it is possible to build a simple vein viewer.



In his research group, he often uses **consumer electronics to build more sophisticated devices for non-invasive medical diagnostics**, as part of the **Vascovid** and **Tiny Brains** European Projects. **Dr Michael Tyler**, from the Atomic Quantum Optics group, showed a small but very sensitive **magnetometer**, demonstrating the principle of the quantum-based atomic magnetometers that they are building in his group, as part of the Quantum Flagship European project **maQsimal**.



# People

## GO & FLY

### Congratulations to 8 New ICFO PhD Graduates

263 ICFOnians have successfully defended their theses

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.

 <p><b>256</b></p> <p><b>Rubaiya Hussain</b>  <i>Detection of particles, bacteria and viruses using consumer optoelectronic components</i></p> <p>📅 July 1, 2022              ICREA Prof Dr Valerio Pruneri</p>	 <p><b>257</b></p> <p><b>Juan Rombaut Segarra</b>  <i>Multifunctional optical surfaces for optoelectronic devices</i></p> <p>📅 July 12, 2022              ICREA Prof Dr Valerio Pruneri</p>	 <p><b>258</b></p> <p><b>Bruna Gabrielly de Moraes Araujo</b>  <i>Quantum Information in Lattices</i></p> <p>📅 July 22, 2022              ICREA Prof Dr Antonio Acin and ICREA Prof Dr Stephan Roche (ICN2)</p>	 <p><b>259</b></p> <p><b>Aurelien Sanchez</b>  <i>Laser-induced electron interferences from atoms and molecules</i></p> <p>📅 July 25, 2022              ICREA Prof Dr Jens Biegert</p>
 <p><b>260</b></p> <p><b>Xinyao Liu</b>  <i>Atomic imaging of complex molecular structures with laser-induced electron diffraction</i></p> <p>📅 July 27, 2022              ICREA Prof Dr Jens Biegert</p>	 <p><b>261</b></p> <p><b>Jessica Oliveira de Almeida</b>  <i>Quantum Optics at its best: from quantum interferometry to quantum metrology</i></p> <p>📅 July 28, 2022              ICREA Prof Dr Maciej Lewenstein and Dr Michail Skoteiniotis</p>	 <p><b>262</b></p> <p><b>Anna Dawid</b>  <i>Quantum many-body physics with ultracold atoms and molecules: exact dynamics and machine learning</i></p> <p>📅 September 20, 2022              ICREA Prof Dr Maciej Lewenstein and Dr Michal Tomza</p>	 <p><b>263</b></p> <p><b>Charikleia Troullinou</b>  <i>Squeezed-light-enhanced magnetometry in a high density atomic vapor</i></p> <p>📅 September 29, 2022              ICREA Prof Dr Morgan Mithcell</p>

## COMMUNITY



### ICFOnians' Summer Adventures

- 1-3. Organic Nanostructured Photovoltaics group in the Pyrenees
4. Chiara Michelini and Davide Rizzotti Scuba Diving in Costa Brava
5. José Javier Ruiz and Jacqueline Martínez in Pyramid of the Sun in Teotihuacán
6. ICFOnians (also in #10) in "Cinema a la Fresca" Montjuïc
7. Javi Perez, Elena Nolla, Stefano Signorini at Trail Fonts del Montseny in Viladrau
8. Anne Gstöttner in Gorgs de Carança
9. Olga Lorente in the Valley of Ten Peaks, Rockies Canada
10. Stefano Signorini, David Kernan, Elena Nolla, Judith Salvador and Carles Ros in the Pyrenees.

# Mystery ICFOnian

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

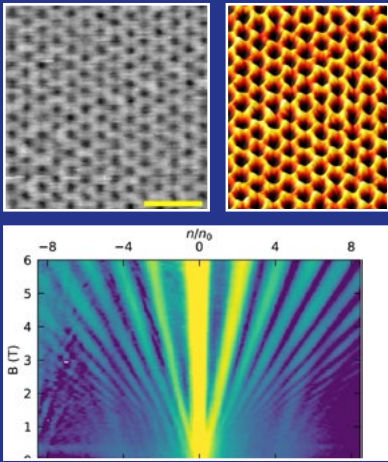
ICFOnians are a fascinating group, with hobbies, interests and talents that may surprise you. Have a look around and see if you can guess who this edition's Mystery ICFOnian is!

Look for the answer in the next edition of ICFOnians.

1. His oldest daughter has a Greek middle name even though she is half Scottish
2. He interviewed the Oscar winner Fernando Trueba
3. He is terrible at cooking and is overwhelmed if a dish requires combining over three ingredients
4. One of his degrees is in History
5. Parenting is the activity that consumes most of his energy these days

## The Last Word

### SCIENCE QUIZ



Researchers from the ICFO groups led by Professors Frank Koppens and Adrian Bachtold, together with researchers from Japan, recently published "Engineering high quality graphene superlattices via ion milled ultra-thin etching masks" in *Nature Communications*. Above left is an atomic force micrograph of few-layer graphene from the article. Beside it is a scanning tunneling micrograph of graphene from Wikipedia. On the bottom is a Hofstadter butterfly.

#### 1. The lattice from the article is

- A) Triclinic
- B) Hexagonal
- C) Triangular

#### 2. The lattice from Wikipedia is

- A) Triclinic
- B) Hexagonal
- C) Triangular

#### 3. The yellow scale bar is 50 nm. What is the bond length in graphene?

- A) 0.14 nm
- B) 1.4 nm
- C) 14 nm

#### 4. What is a Hofstadter butterfly?

- A) An insect made out of graphene
- B) A fractal response to magnetic fields
- C) An adult Mössbauer larva

Answers on pg 2

### HIGH PROFILE

## Diana Morant Ripoll

### Minister of Science and Innovation, Government of Spain

#### What role do you think research will play in the future of Spain?

The pandemic amply demonstrated this: scientific research is key to protecting people and moving the country forward. Today science, as the seed of innovation, is the cornerstone on which we are reindustrializing Spain, creating a new model of sustainable development that is more competitive and fairer, that generates progress, well-being and resilience. More than ever, the Government of Spain is betting on R&D+I through the largest investment in science and innovation in the history of our country and an in-depth reform, the new Law of Science, Technology and Innovation, that reinforces a growing and stable public financing in R&D, dignifies the working conditions of our research community and improves the transfer of knowledge to our productive fabric.

#### How is Spain positioned in the international research and technology panorama?

Our scientists are truly productive worldwide and their contributions to the progress of knowledge are of the highest excellence. Today Spain occupies around position 11 in worldwide scientific production, but in the Innovation ranking we are at 30. From the Government we have proposed a reversal of this imbalance. We are working hard to increase our capacity to convert the great scientific advances made in our country into more patents, more technology-based companies, more quality employment and more prosperity and well-being in Spain. This will ultimately contribute to improve the lives of people all over the world. Spain is pressing the innovation accelerator through a new paradigm of the Entrepreneurial State and new instruments based on public-private collaboration in R&D&I in strategic areas.

#### In your recent visit to ICFO, an important collaborative project with MIT was launched. How does this project play into the Ministry's international strategy?

This new program, dedicated to the study of the fundamental properties of synthetic quantum materials and their future applications, allows the pooling of capacities from different countries to achieve a greater global scientific impact. International collaboration projects like this contribute to improving our position in the world as a destination for scientific talent, creating nationally owned technology and training a new generation of researchers and technologists in a field of maximum strategic interest both at a scientific and industrial level.



“

*We are working hard to increase our capacity to convert the great scientific advances made in our country into more patents, more technology-based companies, more quality employment and, ultimately, more prosperity and well-being in Spain and more solutions that improve the lives of people all over the planet.*

#### The NextGeneration funds present an extraordinary opportunity for research in Spain. What programs would you highlight where ICFO can play an important role?

The European Union has prioritized two investment areas for the coming years: technologies that help us achieve climate neutrality and those that speed up the digitization process. This dual ecological and digital transition is the cornerstone of Spain's Recovery, Transformation and Resilience Plan, the change agenda promoted by European funds. Within this framework, the Government of Spain has decided that a very significant part of these resources will be used to reinforce our R&D&I system. In this context, ICFO plays an important role through its research, which contributes to solving problems in areas such as energy, care for the environment, health, or security. The scientific community is also a key player in the eleven Strategic Projects for the Recovery and Economic Transformation of Spain (PERTE), the tool to convert Spain to a leading country of innovation, with the capacity to develop, manufacture and export the industrial solutions of the future: clean energy, zero-emission aircraft, electric vehicles, chips or the new precision personalized medicine based on data integration and genomics.

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