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Clean Planet Program

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Mystery ICFOnian

Solution Ed #48

Lynn Lin
PhD student,
Neurophotonics and Mechanical Systems Biology group

Science Quiz

Answers from p.12

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

ON THE COVER

Environmental Research

Photonics plays a vital role in promoting a sustainable future by enabling innovative renewable energy generation. ICFO launched the Clean Planet Program to strengthen and expand its clean energy and environmental sensing research focus, bringing together all internal related activities, nurturing a multidisciplinary environment and facilitating exploitation-focused approaches. (read more pg 7)

EDITOR'S CORNER

The Glass Half Full

Uncovering solutions to problems facing humanity

Brook Hardwick
Contributing Editor

Contrary to doomsday reports inundating the conversations on social media, I believe that there has never been a better time to be alive. It is true that we are facing enormous challenges related to security, the economy, health, and the environment, to name a few, but we also possess an enormous creative capacity that is allowing us to advance towards solutions to pressing problems at an ever-increasing speed. Think of this: **every single research group at ICFO is engaged in one way or another in work that is having a positive effect on humankind** either by uncovering new knowledge that is helping us to better understand how nature works, or by developing specific pieces of the complex puzzle that will enable future game-changing technologies.

This makes me hopeful and optimistic about the future, not to mention proud of our institute.

This quarterly newsletter about ICFO happenings is, in effect, a plot of small, medium and large milestones on an institutional timeline. Over the years, we have documented a great number of achievements. I anticipate that in the not so distant future, we will look back at the recent launch of ICFO's Clean Planet program (pg 7), creating a collaborative, multidisciplinary research environment in clean energy, and realize that it was one of the important milestones for our institute, providing an impetus for work that began here some time ago, and bringing in reinforcements in terms of resources, talent and collaborations (pg 12 High Profile Interview) that will facilitate meaningful advances in the coming years.

ICFO is going about the business of working towards solutions to major challenges from all angles. Our research focus is wide, interdisciplinary, basic and applied, and we **share our results** regularly in top journals (pg 5). We are **recruiting talented researchers at all levels from around the world** who will bring the wealth of perspectives needed to make unique contributions (jobs@icfo.eu). Through **training efforts** like the June 2022 *Frontiers School on Quantum Materials* (pg 8), we partner with leaders in their fields to **inspire young researchers and students** with introductions to major research areas, opportunities for presenting their own work and interactions with students and experts. And through a number of outreach initiatives (pg 10), we transmit the great transformative potential of science to schools (Maciej Lewenstein Quantum School for Teachers), to the general public (science fairs) and to young people in whom we hope to awaken a scientific vocation (*Be an ICFOnians for one day* program).

We take great pleasure in celebrating milestones and achievements. What an honor to see our colleague and friend, ICREA Prof at ICFO Dr Maciej Lewenstein, receive the Premi Nacional de Catalunya (pg 9) on June 7th, a reflection of achievements in a dizzying range of topics in atomic physics and quantum optics spanning the 40+ years of his career to date. The impact of the Maciej's research will be seen for many years to come in areas we are yet to fathom.

I hope you will come away from this edition convinced as I am that we have reasons to see the glass half full as we look towards the future.

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Happenings

ICFO NEWCOMERS

Welcome to ICFO

Many of us joined ICFO or took a new position at the institute between April and June

Chiara Michelini
Student

Zachary Toscanini
Student

Eva Caravaca Crespo
Student

Adam Radek Martinez
Student

Matis Marcadier
Student

Alejandra Padilla
Student

Sofie Castro
Student

Misael Samir Malqui
Summer Fellow

Martí Xargay
Summer Fellow

Maria Chiara Corsi
Summer Fellow

Maria Martorell Ruiz
Summer Fellow

Adriano Macarone
PhD Student

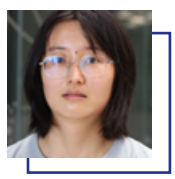
Alessia Mezzadrelli
PhD Student

Adamantios Synanidis
PhD Student

Fionnuala Curran
PhD Student

Jonathan Hänni
PhD Student

Ignacio Velasco
PhD Student



Yurong Ren
PhD Student

Luca Fagiani
Visiting PhD Student

Shadi Karimi
Visiting Scientist

Mehrdad Saremi
Visiting Scientist

Josep Cabedo
Visiting Scientist

Seham Kamal
Visiting Scientist

Esteban Gerbino
Visiting Scientist

Victor Román
Postdoctoral Researcher

Themistoklis Mavrogordatos
Postdoctoral Researcher

Lu Wang
Postdoctoral Researcher

Zahra Jalalimola
Postdoctoral Researcher

Pavlo Perkhun
Postdoctoral Researcher

Susana Tagliabue
Postdoctoral Researcher

Soeren Wengerowsky
Postdoctoral Researcher

Yatzil Avalos
Postdoctoral Researcher

Hippolyte Dourdent
Postdoctoral Researcher

Evelyn Ortega
Postdoctoral Researcher

Ariane Stucki
Postdoctoral Researcher

Erik Recio
Research Engineer

Eduard Vallory Subirà
Staff Scientist / Associate Director for Strategic Initiatives

Rosa Casals Alis
Administration / Project Manager Strategic Project

María T. Arias Escobar
Administration

Not pictured

Jayagreav Kannan
Student

Sasha Meek
Student

Joel Compte
Summer Fellow 2022

Katarzyna Ludwiczak
Visiting PhD Student

Michal Lipka
Visiting PhD Student

Mukhtar Lawan
Visiting PhD Student

Julia Bergmann
Visiting PhD Student

Anissa Aouni
Visiting Scientist

María Cano Cabedo
Administration

Amal Zarrouk
Administration

Happenings

ICFO NEWS

EIC Pathfinder projects

With its Pathfinder program, the European Innovation Council (EIC) supports the exploration of bold ideas for radically new technologies. It welcomes the high-risk / high gain and interdisciplinary cutting-edge science collaborations that underpin technological breakthroughs. **ICFO participates in three separate projects that were funded in the May 25, 2021 call**. 868 proposals were evaluated in this call, with 56 projects in total funded to develop novel technologies for future applications across a very wide range of topics. Selected projects will receive not only grants, but also access to tailored-made coaching under the EIC business acceleration services. Promising results can receive substantial follow up funding through the EIC Transition scheme to create a commercial venture, or use the Fast Track scheme to access the EIC Accelerator to bring innovations to market. Projects in which ICFO participates are as follows:

- **TWISTEDNANO**: Twisted nanophotonic technology for integrated chiroptical sensing of drugs on a chip. *Attoscience and Ultrafast Optics group leader ICREA Prof at ICFO Dr Jens Biegert*
- **PLAST_CELL**: A multiplexed biomimetic imaging platform for assessing single cell plasticity (Plastomics) and scoring of tumor malignancy. *SLN Team leader Dr Pablo Loza-Alvarez*
- **TROPHY**: ulTRafast hOlograPHic FTIR microscopy. *Molecular Nanophotonics group leader ICREA Prof Dr Niek van Hulst*

Optica 2021 Diversity & Inclusion Advocacy Recognition

At Optica's annual CLEO event in San Jose, California, Optica CEO Elizabeth Rogan was able to personally present ICFO Director, Lluis Torner, in representation of all ICFOnians, with the Optica 2021 Diversity and Inclusion Advocacy Recognition.

"Thesis in 4 minutes" competition

The open day of the UPC Doctoral School was the scene of the institutional final of the 'Present your thesis in 4 minutes' competition. The initiative, promoted by the Catalan Foundation for Research and Innovation (FCRI) with the support of the Generalitat de Catalunya, challenges doctoral students, from any scientific discipline, to explain their research in a 4 minutes max presentation in a format that is easily understood, using simple language and geared for a general audience.

Javier Argüello-Luengo, PhD student in the Theoretical Quantum-Nano Photonics Group led by ICREA Prof at ICFO Dr Darrick Chang, won the competition with the presentation 'Building Quantum Simulations' and went on to represent the UPC in the final competition.

BBVA Foundation Leonardo Grant

ICFO Prof Pelayo García de Arquer has been named one of five awardees of the BBVA Foundation Leonardo Grants for researchers in physics. This grant, awarded to mid-career level researchers whose work has shown to be highly innovative, allows great flexibility to adapt to the specific needs of each selected project, and can be carried out over a period of between 12 and 18 months. Prof Garcia de Arquer's project is titled *Accelerated discovery of catalysts in solution* (Descubrimiento Acelerado de catalizadores en SOLución-DASOL).

1st place in Innovation Village

ICFOnians Umut Karadeniz and Manish Verma who are currently incubating in the KTT Launchpad core proprietary technology developed within the Medical Optics research group led by ICREA Prof Turgut Durduran, were selected to participate in the Innovation Village this year at the SPIE Photonics Europe Exhibition (Strasbourg, FR). In this exhibit space they were given the opportunity to present their innovations to a team of industry leaders for a chance to win prizes. The user-friendly, real-time muscle hemodynamics and metabolism monitor for effective, personalized and safe physical training that they presented called Rhytmion, won the first-place prize, as well as valuable exposure and publicity.

BIST Mothers of Science Supporting Grants

Barcelona Institute of Science and Technology

The Barcelona Institute of Science and Technology's (BIST) **Mothers of Science supporting grant** aims to address the gap that exists between the number of women in the BIST Community who are research associates or senior postdoctoral researchers and the percentage of women who are group leaders or directors. The grants recognize the recipient's roles as scientists and mothers and aims to support them along their way to becoming pioneers in their fields.

In its third edition, it has recently awarded grants to ten powerful women including **Dr Monica Marro, an ICFO research engineer in the SLN group led by Dr. Pablo Loza-Alvarez**. The grant winners will receive individual coaching sessions, an economic stipend and networking sessions.

"E. Pérez Payá" SBE 40 Prize

The Spanish Biophysical Society (Sociedad de Biofísica de España, SBE) announced that ICFO Postdoctoral fellow Dr Felix Campelo from the Single Molecule Biophotonics group led by ICREA Prof at ICFO Dr María García-Parajo, is one of two winners of the 2022 "E. Pérez Payá"- SBE 40 Prize for biophysicists 40 years of age or younger. He has been recognized *"for his outstanding contributions to the investigation of membrane biophysics in the cellular context."* He shares the prize with Dr Javier García Nafría from BIFI, Universidad de Zaragoza. The prize was awarded in person in June at the 8th International Iberian Biophysics Congress in Bilbao.

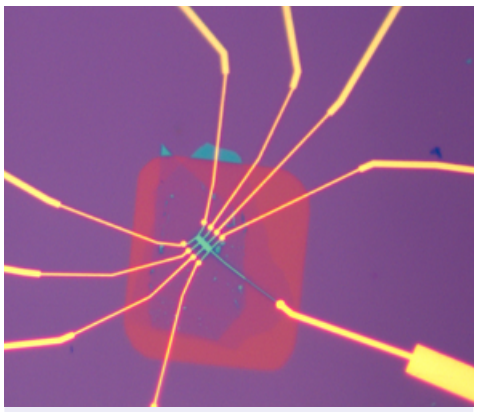
ICFO Mobility Grant

ICFO strongly encourages its PhD students to have at least one international secondment during their PhD to ensure that they get the proper exposure to international institutions and to other sectors. This exposure allows students to expand their experience, and promote their career development. It is also a condition for the International Doctoral Mention.

Some external fellowships include funding to support such secondments. To expand this opportunity to all ICFO PhD students, ICFO has launched the ICFO Mobility Grant, providing financial aid as an additional support to those PhD Students who do not have specific mobility grants within their fellowships.

Happenings

LATEST ADVANCES



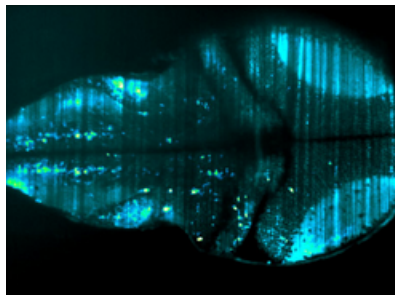
Revealing the strange metallic behavior of twisted bilayer graphene

In a recent study published in ***Nature Physics***, ICFO researchers Alexandre Jaoui, Ipsita Das, Giorgio Di Battista, Jaime Díez-Mérida and Xiaobo Lu, led by ICFO Prof Dmitri K. Efetov and colleagues from MIT (USA) and the National Institute for Material Sciences (JAPAN) conducted transport measurements on a gate-screened magic-angle device designed to suppress the insulating states obscuring the metallic phase. They revealed that **the metallic ground state of magic-angle twisted bilayer graphene can be electrostatically tuned** from a conventional Fermi liquid behavior to a 'strange' metal in the vicinity of the superconducting dome down to the lowest temperatures. In the latter state, electrons are scattered at an ultra-fast rate which is observed across the various families of strongly correlated metals.

Studying the role of the *ywhaz* gene in brain activity and behavior

In a study published in ***Molecular Psychiatry***, ICFO researchers Gustavo Castro, and Emilio Gualda, led by SLN team leader Dr Pablo Loza, collaborated with researchers from Barcelona, Madrid, the UK and Japan to study zebrafish larvae and adults, focusing on the role of the *ywhaz* gene.

The team measured the gene expression of the animals finding that although the *ywhaz* gene was expressed in all the neurons during the early stages of the larvae, in adults it was expressed only in a specific group of neurons in the cerebellum. **The SLN team performed whole-brain imaging experiments using a light-sheet microscope on the fish with a calcium-fluorescent marker** that allowed them to see, in real-time, the neuronal activity and connectivity. **Behavioral tests** conducted on the adults showed that when adult individuals with the altered gene were exposed to new stimuli, their activity and connectivity of the lower back part of the brain was altered. They also **noted lower levels of certain neurotransmitters** and problems synthesizing them, and were able to test two types of medical treatments to revert these behavioral alterations.

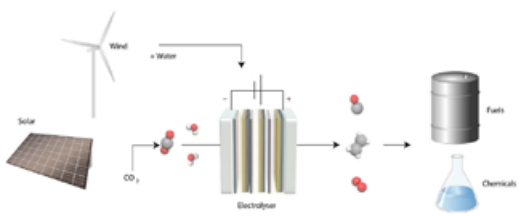


The findings show the relevance of the *ywhaz* gene in neurodevelopment, clarifying the mechanisms of its role in disorders. It also highlights the potential of the 3D imaging techniques in such studies, adding spatial and temporal resolution currently unavailable with other techniques. Moreover, it outlines the use of specific treatments to revert various symptoms associated with psychiatric diseases.

The present and future of carbon-efficient CO_2 conversion systems

Electroreduction of CO_2 (CO_2R) has bloomed in recent years as a promising solution to mitigate the environmental impacts of CO_2 emissions by the chemical industry, however CO_2R technology now faces another challenge: the overall system energy efficiency. A large fraction of CO_2 is converted into unwanted carbonates, and their processing imposes extremely high energy (and hence cost) penalties.

A new study recently published in the journal ***Nature Sustainability*** offers an analytical overview of **four novel approaches that could achieve carbon-efficient electrosynthesis, minimizing the CO_2 loss to carbonate, enabling a high Single Pass Conversion (SPC) efficiency, and lowering crucial energy penalties**.



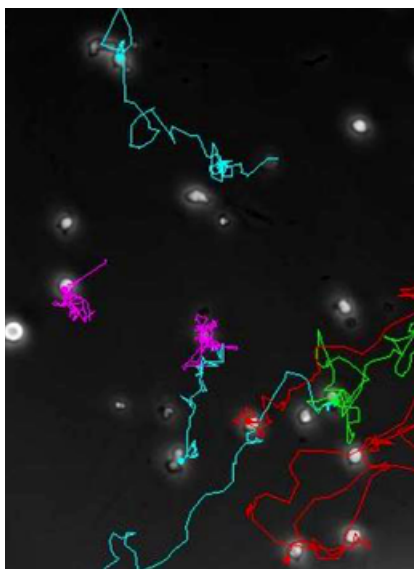
In the study, ICFO Prof Pelayo García de Arquer and researchers from the University of Toronto offer a **quantitative comparison of the advantages, drawbacks, and challenges of the most promising technologies enabling a high SPC**. These encompass CO_2R based on novel membranes (e.g. bipolar membranes); CO_2R operation in acidic media; tandem reactions; and direct conversion capture solutions.

The authors describe the characteristics of the different routes and highlight the main technical challenges for each of these CO_2 conversion pathways. They provide several solutions to address these limitations at the catalyst, membrane, and reactor level, and offer a roadmap towards the technoeconomic viability of ethylene synthesis from CO_2R in the path to its large-scale deployment.

Single-molecule imaging to study the molecular mechanisms of a rare immunodeficiency disorder

Researchers already know that in WHIM patients (a rare disease), the receptor CXCR4 has an excessive activity due to a failure to down-regulate. However, it is still unclear if this excess affects B cells, the ones in charge of producing antibodies, and if it can lead patients to be more susceptible to the papillomavirus.

A study recently published in ***PNAS*** by ICFOnians **Nicolas Mateos** and **ICREA Prof at ICFO María García-Parajo in collaboration with an international team of researchers**, provides insights into **how mutations in the chemokine receptor CXCR4 influence immune cell trafficking**. The team studied the molecular mechanisms directing the CXCR4 function using quantitative single-molecule imaging and detailed data algorithm analysis, tracking the spatial receptor dynamics. They were able to see that CXCR4 receptors carrying specific mutations associated with the WHIM syndrome failed to cluster after being stimulated by chemokines.



This failure to cluster after stimulation caused an abnormal activation of the protein β-arrestin1, resulting in impaired remodeling of the actin cytoskeleton and the alteration of the lateral mobility and spatial organization. These defects, associated with the mutant expression, explain the severe immunological symptoms associated with WHIM syndrome.

The findings add more information about the molecular mechanisms of the CXCR4 receptor, pointing out the links between the spatiotemporal organization of CXCR4 and the symptoms of WHIM syndrome. Moreover, the study also **highlights the importance of new imaging-based techniques**, allowing researchers to unveil more details about several biological processes.

Happenings

BUSINESS NEWS

Digital Innovation Hub for Catalonia

Partnering to promote the digital transformation of Catalan SMEs

The **Digital Innovation Hub for Catalonia (DIH4CAT)** is a **public-private consortium** promoted by the Department of Business and Labor through ACCIÓ, the Vice-Presidency and Digital Policies and Territory Departments of the Catalan government, Foment del Treball, PIMEC, Eurecat, CVC, ICFO, i2CAT, Leitat, the Polytechnical University of Catalonia (UPC- BarcelonaTech), the Barcelona Supercomputing Center (BCS) and IESE Business School.

As a **regional innovation ecosystem, DIH4CAT** aims to meet the challenges of industry, with a special focus on SMEs as well as public administrations through the testing of advanced technology as a step prior to implementation. **ICFO partners with CD6-UPC and SECPhO** to participate in DIH4CAT as the **leader of its photonics node on behalf of PHOTONCAT**, the Catalan photonics hub.

Formally joining the wider European project that aims to help 75% of European SMEs to carry out advanced digitization processes by 2030, the DIH4CAT has recently become one of the European Digital Innovation Hubs (EDIH). Thanks to this new agreement, the European Commission will allocate €2.8 M to the project. In addition, the Generalitat de Catalunya, the Ministry of Economy and Competitiveness and the project partners will contribute with up to €4M to the initiative.

The first grants will be allocated to 100 companies so that they can carry out proof of concepts, development of prototypes or tests in laboratories and facilities within the DIH4CAT ecosystem. The technologies they will be able to test will be linked to **3D printing, robotics, supercomputing / quantum, cybersecurity, blockchain, artificial intelligence, big data, IoT, 5G and photonics**.

In parallel, pre-testing technological consulting services will be offered, such as specialized technological training, connection to the innovation ecosystem, and advice on how to find and secure funding.

ICFO aims, through PHOTONCAT and the DIH4CAT, to provide comprehensive orienteering to companies that can benefit from photonics in their innovation. If the required solution cannot be found in Catalonia through DIH4CAT, we will accompany companies to find solutions via linked pan-European initiatives like PhotonHUB EU.

Dr Sergi Ferrando
Member of ICFO's KTT Team and PHOTONCAT Manager

DIH4CAT is configured as a networked service center- a "one-stop shop" concept through which companies and public institutions can have access to trained experts to gain new capabilities, solutions and technological infrastructures to help them drive their digital transformation within their companies.

Kick-off meeting of the DIH4CAT

DIH4CAT also provides companies with a self-analysis tool to assess their degree of digital maturity in a fast, easy and agile way. After this self-diagnosis, companies can automatically obtain a personalized report with their digital maturity assessment, followed by a set of recommendations and next steps to advance the digital transformation, and accompanied by the identification of the main resources of interest of the DIH4CAT and of the technological nodes like PHOTONCAT that form part of it.

+INFO
www.dih4cat.cat

InnoDelta PECT

Improving the competitiveness of the Llobregat Delta territory

Five cities in the Llobregat territory (Castelldefels, Gavà, el Prat, Viladecans, and Sant Boi) as well as two research centers in the area, ICFO and CIMNE, are partners in InnoDelta, a Territorial Specialization and Competitiveness Project (PECT). PECTs are projects promoted by the Generalitat de Catalunya through local administration, within the framework of the RIS3CAT Strategy which is co-funded by the European Regional Development Fund 2014-2020 (PO FEDER).

The Council of the Territorial Specialization and Competitiveness Project (PECT) InnoDelta

InnoDelta
Projecte d'especialització i competitivitat territorial

The objectives of the InnoDelta PECT are to provide an improvement in the competitiveness of the Llobregat Delta territory by **enhancing the innovative capacity of SMEs, the promotion of entrepreneurship in strategic sectors, and society in general through actions from a network of territorial public "laboratories"**.

At ICFO, the InnoDelta project funds the **incubation of promising cutting-edge technologies** in the form of proof-of-concept projects to increase the maturity of technologies and prototypes, while at the same time creating intellectual property packages that accelerate the arrival to market of these new tools.

These activities take place in the **KTT Launchpad**, which offers activities including business development (through market analysis and positioning among others), support in the search for financing, new partners and investors, as well as facilitating connections with companies to develop industrial collaborations, among others.

Ultimately, through participation in the InnoDelta project, ICFO aims to:

- Create new technology-based companies in the Baix Llobregat
- Offer opportunities to young people
- Create new high value-added jobs in Castelldefels
- Promote collaboration and technology transfer to companies to increase their competitiveness

During 2021, the first year of the InnoDelta Project, ICFO constituted two new spin-off companies. The first of these companies, LuxQuanta, provides cryptographic solutions to implement an extra layer of security for companies and telecommunication networks. The second, Vitsolc, is developing transparent photovoltaic modules to be fully integrated in electric vehicles, electronic devices or infrastructures. In addition, the InnoDelta project has facilitated the planting of seeds for new projects which are currently incubating at the institute.

+INFO ON SPIN-OFFS
www.luxquanta.com
www.vitsolc.com

Happenings & Collaboration

BUSINESS NEWS

The Corporate Liaison Program (CLP) Day is a periodic meeting where ICFOnians, representatives of international platforms, multinational corporations, local business representatives and researchers of other institutions have the opportunity to interact with experts from around the world in a particular sector to review the latest advances in photonic technologies while focusing on the generation of joint research projects.

Following two years of COVID-19 related restrictions, ICFO held the 2022 CLP Day on **Friday, 22 April 2022**, which is also Earth Day, the international day in which citizens around the world champion actions that will protect the planet, addressing the unavoidable impact of a changing climate. Focusing on the theme of **Green Tech and The Energy Transition**, the 2022 CLP Day served as a formal presentation of ICFO's new Clean Planet Program, highlighting topics currently being developed in ICFO such as solar fuels, photovoltaics, CO_2 valorization and green hydrogen. All of these topics contribute to Europe's transition towards a CO_2 neutral economy, as put forward by the *Green Deal*.

Participants and speakers from 2022 CLP Day

The event enabled speakers to showcase their activities in these critical areas of energy research.

SPEAKERS

Dr Joanna Kargul
Member Executive Board, *Sunergy*

Dr Pere Margalef
CTO Hydrogen, *Snam*

Dr Pelayo García de Arquer
CO_2MAP Group Leader, *ICFO*

Dr Laura Miranda
Head of Materials Research, *Oxford PV*

Rafic Hanbali
CEO, *SwissINSO*

RESEARCH

Clean Planet Program

New ICFO research program targets pressing barriers faced in clean energy and the environment

Photonics plays a vital role in promoting a sustainable future by enabling innovative renewable energy generation. ICFO launched the **Clean Planet Program** to strengthen and expand its clean energy and environmental sensing research focus by bringing together all internal related activities, nurturing a multidisciplinary environment and facilitating exploitation-focused approaches.

Strong links between academia and industry can accelerate the development and deployment of novel technologies. Engaging in such partnerships will be crucial to meeting the objectives of the Clean Planet Program.

Alastair Cunningham
Project Portfolio Manager, KTT Unit

Research into renewable sources of energy and novel clean technologies are a strategic priority for ICFO as our expanding research program aims to face these challenges head on.

Lluis Torner
Lluis Torner, ICFO Director

The program offers a structure for training young researchers within the scope, teaming-up with external partners and industries, and joining larger national and international efforts. Through the Clean Planet Program, ICFO will seek out partners in academia and industry to achieve these important goals.

The program at large is supported by a number of funding agencies, in particular by **Fundació Joan Ribas Araquistain**, whose philanthropic generosity was the seed that ignited the program.

FUNDACIÓN
JOAN RIBAS ARAQUISTAIN
Un Buen Amigo Siempre Ayuda

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www.cleanplanet.icfo.eu

Research Lines

Artificial Photosynthesis: Unveiling the natural processes that govern nanoscale energy transfer could lead to promising advances in the fields of solar fuels, organic photovoltaics, and carbon capture.

- **Molecular Nanophotonics** group led by ICREA Prof at ICFO Dr Niek van Hulst
- **Photon Harvesting in Plants and Biomolecules** group led by CELLEX NEST Fellow Prof Nicoletta Liguori

Energy Storage: Renewable energy, which is intrinsically intermittent and sometimes unpredictable, requires a reliable storage method any time surplus generation occurs, guaranteeing its utilization at a later stage.

- **Organic Nanostructured Photovoltaics** group led by UPC Prof at ICFO Dr Jordi Martorell
- **CO_2 Mitigation Accelerated by Photons** group led by CELLEX NEST Fellow Prof Dr F. Pelayo García de Arquer

Pb-free Nanocrystal-based Solar Cells: In the future, QD applications will include quantum dot solar cells (QDSCs), in which QDs act as the absorbing material in the photovoltaic device

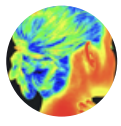
- **Functional Optoelectronic Nanomaterials** group led by ICREA Prof at ICFO Dr Gerasimos Konstantatos

Renewable Fuels & Chemicals: Solar energy can be used to convert CO_2 and water into fuels and chemicals which we depend on, but potentially in a completely sustainable manner.

- **CO_2 Mitigation Accelerated by Photons** group led by CELLEX NEST Fellow Prof Dr F. Pelayo García de Arquer
- **Organic Nanostructured Photovoltaics** group led by UPC Prof at ICFO Dr Jordi Martorell

Sustainable Agriculture: Alternative production schemes based on renewable energy would open the door to resource-sovereignty and sustainable circular economies.

- **CO_2 Mitigation Accelerated by Photons** group led by CELLEX NEST Fellow Prof Dr F. Pelayo García de Arquer



Thermophotovoltaics: The conversion of heat to electricity via photons could prove to be a key enabling technology to recover energy lost as waste heat thus reducing the amount of CO_2 released to the atmosphere.

- **Thermal Photonics** group led by CELLEX NEST Fellow Prof Dr Georgia Papadakis

Transparent photovoltaics: By implementing a PV technology that is truly transparent and capable of generating electricity at a competitive cost, a completely new market will be born, contributing towards a net-zero CO_2 economy.

- **Organic Nanostructured Photovoltaics** group led by UPC Prof at ICFO Dr Jordi Martorell

Collaboration

TRAINING

ICFO International School on New Horizons in Quantum Materials

Led by ICFO group leaders Professors Frank Koppens and Adrian Bachtold, ICFO's annual summer school was held in June and organized in partnership with MIT's Prof Pablo Jarillo-Herrero

Seminars from 12 leading experimentalists and theorists from the USA and the EU addressed hot topics in Quantum Materials, from advanced superconducting materials, to van der Waals materials, moiré quantum matter, collective phenomena, strong light-matter interactions and more.

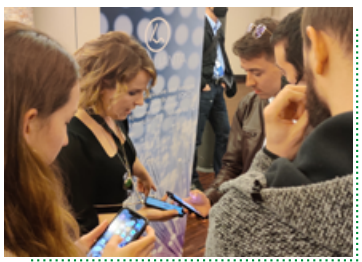
Over 130 students attended the school in-person, and benefited not only from the lectures, but also extensive opportunities to talk informally with the lecturers, visit the ICFO labs, interact with one another through several social activities, and share their own research in short talks and poster sessions.

The lectures were broadcast online to over 200 interested students and researchers from more than 28 countries worldwide, and recordings remain available through the event website.

Quantum Careers Symposium

In April, ICFO organized the first *Quantum Careers Symposium*, an event dedicated to careers in quantum science and technologies

Hosted at La Pedrera in Barcelona and organized in the framework of the inter-university Master in Quantum Science and Technology launched in September 2021, the event brought together students and researchers interested in careers in this exciting emerging sector, to listen to talks and round table discussions with academics and industry experts with experience in high-tech companies, start-ups, entrepreneurship and innovation.



The event was inspired by the EU project CARLA, led by ICFO's KTT team, and aimed to inspire the participants to pursue a career in this deep-tech field. Streamed online, the event was offered to masters students throughout Europe through the QTOM pilot project of the quantum education working group in the EU's Quantum Flagship, and to interested participants world-wide.

BIST Symposium on Microscopy, Nanoscopy and Imaging Sciences

In May ICFO hosted the fifth edition of the BIST Symposium on Microscopy, Nanoscopy and Imaging Sciences, part of the MMRES masters program, with talks from international scientists and researchers from the BIST community

Invited Speakers:

Prof Leopoldo Molina-Luna
TU Darmstadt, Germany

Prof Erin Tranfield
Instituto Gulbenkian de Ciência, Portugal

Prof Dr. Jascha Repp
Universitaet Regensburg, Germany

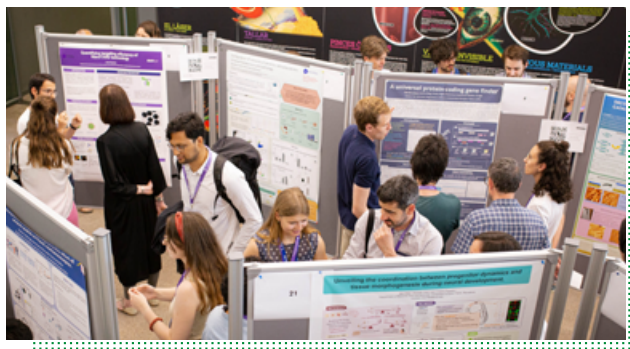
Prof Neus Domingo
Oak Ridge National Lab, USA

Prof. Markus Saue
Biozentrum University Wuerzburg, Germany

Prof Jan Tonnesen
Achucarro Basque Center for Neuroscience, Spain

Prof Gail McConnell
University of Strathcycle, Glasgow

Prof Francesca Bottanelli
Institute for Chemistry and Biochemistry, Freie Universität Berlin, Germany



Collaboration

TRAINING

Training for BIST Researchers

The Barcelona Institute of Science and Technology (BIST) offers a series of courses and activities throughout the year that aim to provide opportunities for researchers at the seven BIST centers to obtain transversal skills and experiences that will help them to grow professionally

Thesis Writing Bootcamp

The Writing Bootcamp was a multi-session online course for final-year PhD students at different institutions associated with BIST, who aim to submit their theses at the end of 2022. Several ICFO PhD students joined the Bootcamp, which included a mix of theory and tools, practical experience and discussions to help progress with writing their doctoral thesis.

BIST Career Week + Job Market Place

In June, BIST organized a Career Week and Job Market Place. The initiative gave participants some tools and resources to help make career decisions, boost their employability, prepare for interviews, and more. The week included four days packed with workshops and round table discussions, and a Science and Technology Talent Marketplace organized in collaboration with Barcelona Activa, connecting companies looking for science and technology talent with scientists and technologists interested in developing a professional career in the private industry.

BIST Scientific Project Management

This course set out to help participants learn to manage projects with impact, excellence, and efficacy. It introduced the basic concepts, techniques and procedures of project management, allowing participants to learn the vocabulary and general guidelines and to understand the process in its entirety. Dr Claudia Valdés, post-doctoral researcher in the SLN team led by Dr Pablo Loza, won one of the prizes for the best project presented: "Building the bases for a spin-off creation".

IN FOCUS

ICREA Prof at ICFO Maciej Lewenstein: 2021 National Research Award

ICFOnians congratulate our esteemed colleague and friend, ICREA Prof at ICFO Dr Maciej Lewenstein who received the 2021 National Research Prize (Premi Nacional de Recerca - PNR) organized by the Foundation for Research and Innovation of Catalonia (FCRi) and the Government of Catalonia

The PNR is the **highest award for research excellence in Catalonia**, recognizing the researcher who has contributed significantly and internationally during their career to the advancement of a scientific discipline in any field.

In a ceremony that took place on June 7th at the Teatre Nacional de Catalonia, the **President of the Generalitat de Catalunya, Pere Aragonès, and the Consellera for Research and Universities, Gemma Geis**, presented Prof Lewenstein with this prestigious award.

Prof Maciej Lewenstein and Consellera for research and Universities, Gemma Geis

Prof. Lewenstein is **one of the most prominent theoretical physicists working in atomic physics and quantum optics worldwide.**

Landmark Achievements

Formulation of the quantum theory of high harmonic generation (HHG) resulting in most cited paper in the history of Phys. Rev. A. *[Theory of high-harmonic generation by low-frequency laser fields, M Lewenstein, P Balcou, MY Ivanov,...; Physical Review A 49 (3), 2117]*

Pioneered theoretical studies of Bose-Einstein condensation (BEC), in particular, pioneering studies of coherent excitations in BEC systems, such a solitary stable wave packets *[Dark solitons in Bose-Einstein condensates, S Burger, K Bongs, S Dettmer, W Ertmer, ...; Physical Review Letters 83 (25), 5198]*

Active in the area of Quantum Information Science, together with world renown colleagues, he wrote one of the first reviews on quantum simulations with ultracold atoms. *[Ultracold atomic gases in optical lattices: mimicking condensed matter physics and beyond, M Lewenstein, A Sanpera, V Ahufinger, ... ; Advances in Physics 56 (2), 243-379]*

During the 40+ years of his professional career, he has on several occasions either opened or stimulated new ground-breaking directions and even entire areas, with many of his seminal papers stimulating new experiments or prepared in collaboration with world leading experimental groups in the field. His work is best characterized as broad and wide scope.

Prof Lewenstein is also a **devoted teacher** who has supervised almost 100 Diploma, MSc and PhD theses at various universities and departments, as well as 60 postdoctoral researchers. Many of his group members have gone on to have brilliant scientific careers, winning their own prestigious prizes and securing permanent/ tenure track faculty positions at institutions around the world.

Prof Lewenstein is one of the elite scientists who have obtained **three successive European Research Council (ERC) Advanced Grants**. He has also obtained **prestigious international awards** such as the Humboldt Senior Research Award 2007, the Joachim Hertz Foundation Prize of University of Hamburg 2010, the Prize of the Polish Science Foundation 2011, the Gutenberg Research Award 2013, the European Physical Society Quantum Electronics and Optics Senior Prize 2013, Doctorate Honoris Causa University of Warsaw 2016, Physics of Quantum Electronics (PQE) Willis E. Lamb Medal for Laser Science 2016, Medalla de la Real Sociedad Española de Física 2017, among other recognitions which position him among the leading scientists in the world.

*In addition to a stellar scientific career, **Maciej is an acclaimed jazz critic and writer**. His passion for jazz led him to publish two editions of the guide "Polish Jazz Recordings and Beyond". He also regularly writes liner notes to CD and vinyl albums and has organized 10 concerts of Polish and Spanish jazz musicians in Spain and in Poland.*

Collaboration

OUTREACH

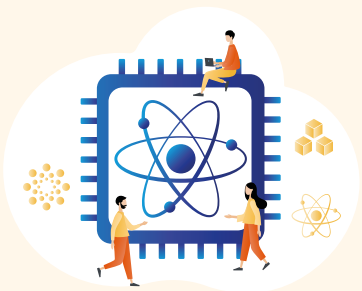
Be an ICFOnian for a Day

A new Outreach program was launched in June to increase gender diversity in photonics careers

Be an ICFOnian for a Day is directed to women and non-binary people in STEM Undergraduate and Master programs and consists of 4 events that will be hosted at ICFO through the academic year, with the first cohort starting in the 2022-23 academic year. The program will increase the visibility and understanding of the importance of frontier research with the ultimate goal of supporting talent in deep-tech. One of the events gives its name to the entire program as students will be invited to spend a day with an ICFO research group to have a taste of the daily life of researchers, breaking stereotypes of the profession and stimulating a sense of belonging to the scientific community. The other three activities will revolve around career and personal development as well as networking, providing knowledge, tools and contacts for a great start to a STEM career.

As is the case for all outreach activities, the active participation of ICFOnians is of crucial importance for the design of this program, as they will share their professional experience and their passion for photonics with the goal of inspiring a new generation of scientists.

+INFO
www.outreach.icfo.eu/be-icfonian-day



ICFO Maciej Lewenstein Quantum School for Teachers

On April 14, *World Quantum Day*, ICFO launched the **ICFO Maciej Lewenstein Quantum School for Teachers**, a collection of tools and materials for secondary school educators who want to prepare their pupils for the ongoing second quantum revolution.

This project was made possible thanks to the idea and support of ICREA Prof at ICFO Maciej Lewenstein, who decided to donate the Physics Prize he received in 2017 from the Spanish Royal Society of Physics (RSEF) and BBVA Foundation to a project to educate new generations about the wonders of quantum physics and the promising technologies that may shape their lives in the future.

The course is organized in four modules that lead the teachers from basic concepts of quantum physics like quantum superposition and entanglement, to the upcoming technologies, such as quantum sensors, computers, simulators and communications, that are based on these concepts. People can also discover innovative research projects that are being developed at ICFO through different resources, like a 360º photo of a lab, a comic booklet or short videos. There are also many tools, contents and activities that teachers can bring directly to the classroom, like the Decide Game: Quantum Technologies or the Quantum Tour.

All the materials are freely available online in English, Catalan and Spanish
www.outreach.icfo.eu/quantum-school-teachers

Discovering ICFO in Barcelona Science Fairs

This spring, many ICFO scientists have helped spread passion for photonics in two important science fairs taking place in Barcelona

At the end of April, ICFO took part in the *Fira Recerca en Directe* (Live Research Fair), a renowned research fair that each year attracts around 2000 visitors and where research centers from all around Catalonia show their research. A group of ICFOnians including Jennifer Aldama, Eduardo Beattie, Federica Beduini, Dario Lago, Ignacio López, Auxiliadora Padrón, Samael Sarmiento, Luis Trigo, and Laura Zarraoa went to CosmoCaixa over the course of 4 days to explain quantum cryptography to high school students and the general public visitors of the museum using an engaging activity involving optical fibers, locks and colored lights.

Half of this team carried out this same activity in the Rambla del Raval on the morning of May 29 as part of *la Festa de la Ciència* (the Science Festival), organized by the Barcelona City Council, attracting the participation of many curious people. In the afternoon, Lorenzo Cortese and Vindhiya Prakash explained their research from a stage in the middle of the Rambla del Raval, in an in-person edition of *Photonics in 5 minutes!* While the presentations were short, they engaged the interest of the attendees, who actively participated with many questions.

People

GO & FLY

Congratulations to 7 New ICFO PhD Graduates

255 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.

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Valeria Venturini
Mechanisms and functions of the nucleus as a mechano-controller of cell contractility and migration plasticity

April 8, 2022
Prof Dr Stefan Wieser and Dr Verena Ruprecht

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Anika Frölian
Simulating a topological gauge theory in a Raman-dressed Bose-Einstein condensate

April 26, 2022
ICREA Prof Dr Leticia Tarruell

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Chetan Deshmukh
Detection of a single erbium ion in a nanoparticle

April 29, 2022
ICREA Prof Dr Hugues de Riedmatten

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Susanna Tagliabue
Comprehensive monitoring of the injured brain by hybrid diffuse optics: towards brain-oriented theranostics

April 29, 2022
ICREA Prof Dr Turgut Durduran and Dr Michal Kacprzak

253

Ugaitz Elu Etxano
High-peak-power mid-infrared OPCPAs for extreme nonlinear photonic

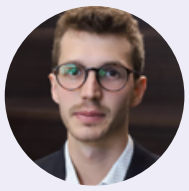
May 3, 2022
ICREA Prof Dr Jens Biegert

254

Matteo Bernardello
Development of novel multimodal light-sheet fluorescence microscopes for in-vivo imaging of vertebrate organisms

June 14, 2022
Dr Pablo Loza Álvarez and Dr Emilio Gualda

255



Sergi Julià Farré
Controlling interactions in quantum materials: from a microscopic description to quantum simulation

June 28, 2022
ICREA Prof Dr Maciej Lewenstein

COMMUNITY

1. ICONS Futbolin Tournament Winning Team
(L) Javier Encomienda and (R) Pol Conesa

2. ICONS Futbolin Tournament

3. 4. ICFO Excursionistas hike the Costa Brava

5. Sharing our favorite books on Sant Jordi

6. New language exchange program-Tuesdays at 16h in the cafeteria

7. Alumni Dinner at CLEO San Jose May 17
(L) Anshuman Singh, Lluís Torner, Armand Niederberger (R) Matěj Hejda, Michael Geiselmann, Maurizio Righini

8. 9. Postdoc Coffee

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. There are only 3 people at ICFO from his same country

2. On Fridays he always eats an "Especial de Pollo" in the cafeteria

3. He worked in a Zoo in Chicago

4. He played in the highest football minor league in his country

The Last Word

SCIENCE QUIZ

In 2016, Nobel laureate John Mather, Senior Scientist of the James Webb Space Telescope, gave a colloquium at ICFO describing plans for this innovative astronomical observatory. The telescope recently released its first images (see above).

1. Why can't this kind of telescope be operated on Earth?

A) Seismic vibrations

B) Atmospheric turbulence

C) Light absorption by atmosphere

2. Where is Lagrange point L2 relative to the Earth?

A) Closer to the Sun

B) Farther from the Sun

C) Equally far from the Sun

3. The five-layer sunshield is made of which aluminum-coated plastic?

A) Mylar

B) Kapton

C) Teflon

4. In May, the telescope suffered an unexpected problem. What was it?

A) Hit by a "big" micrometeor

B) Spherical aberration

C) Disturbing revelations about former NASA director James Webb

HIGH PROFILE

Dr Joanna Kargul

Group leader of the Solar Fuels Laboratory, Centre of New Technologies (CeNT), University of Warsaw and member of SUNERGY's Executive Board

> *"It is not only great scientific fun to develop such well performing biomolecular systems, but it is also my personal scientific quest to contribute to the challenge of shifting from the current linear fossil fuel-based economy to the sustainable fossil-free circular energy system*

What is SUNERGY?

SUNERGY is a large-scale pan-European research and innovation initiative that aims to significantly accelerate the transition from fossil fuels to renewable fuels and chemicals by combining renewable energy sources with widely abundant molecules to produce green fuels and chemicals. The SUNERGY consortium brings the very valuable but presently very scattered efforts in solar fuel and chemical technologies together. Because of the environmental and geopolitical urgency to provide viable alternatives to fossil fuels, we cannot afford to have scattered R&D efforts which will complicate reaching critical targets. SUNERGY colleagues share the passion of making the real change in the EU's energy landscape by creating the unique platform that brings together researchers, engineers and other stakeholders from various sectors of the society to work towards replacing fossil fuels.

Can you tell us the focus of your group's work at the University of Warsaw and the importance of this research in the overall SUNERGY context?

I lead the Solar Fuels Laboratory at CeNT where we work on solar fuels and natural photosynthesis, applying the principles of natural photosynthesis in semi-synthetic (or biomolecular) solar-to-fuel conversion systems. We want to simplify the natural process of photosynthesis by using solar energy to convert water and atmospheric CO_2 molecules into simple green chemicals that can serve as fuel or high value products. The research fits perfectly with the pillar of SUNERGY's technological portfolio dedicated to direct solar conversion technologies based on (bio)molecular conversion systems. I am convinced that by applying a rational design of the molecular interface between biotic and abiotic components, we can tremendously boost the efficiencies of solar-to-product conversion, and thus move quickly to a much higher TRL and wide scale implementation of the decentralized solar fuel and chemical production based on such systems.

Your focus has shifted over the years. What has driven this change?

In my PhD I worked on the membrane transporter that is involved in hormone signaling in plants and later joined the group of Prof Jim Barber at Imperial College London as a postdoc at an exciting time when his lab provided the first de novo structure of photosystem II (PSII), the water splitting enzyme that is at the heart of natural photosynthesis. Now, to be able to use highly efficient photoenzymes to drive solar fuel production is not only scientifically exciting but is also part of much needed global R&D efforts to develop highly efficient solar conversion systems that utilize the evolutionary optimized highly efficient, non-toxic, self-renewing and fully sustainable biological photocatalysts for solar fuel and chemical production. I firmly believe that as scientists, we owe this to present and future generations.

How do you envisage ICFO contributing to SUNERGY moving forward?

The ICFO scientists and associated partners offer the highest level of research in optoelectronics, molecular and quantum nanophotonics, photocatalysis, and organic nanostructured photovoltaic materials to name but a few. It is a perfect R&D environment where under one roof, some of the best brains in these fields in the world design and develop the high-performance materials and systems for solar conversion.

Over the next three years SUNERGY will be developing the technological roadmap for solar fuels and chemicals with the view of establishing the strong EU partnership to implement this roadmap in a timely and effective manner. We very much rely on the scientific expertise of ICFO colleagues to actively contribute to this important milestone of SUNERGY's activities, and to continue to actively support the SUNERGY's efforts at the national and EC levels to shape the energy landscape of Europe.

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

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