CFM

Materialen Fisika Zentroa
Centro de Física de Materiales
Materials Physics Center

ACTIVITY REPORT 2024

CSIC
Consejo Superior de Investigaciones Científicas

eman ta zabal zazu
Universidad del País Vasco
Euskal Herriko Unibertsitatea

MPC-BERC
Materials Physics Center
Basic Excellence Research Centre

ACTIVITY REPORT 2024

CFM

CENTRO DE FÍSICA DE MATERIALES
MATERIALEN FISIKA ZENTROA
MATERIALS PHYSICS CENTER

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FOREWORD

The year 2024 has been one of transition and renewal for CFM. We began the year with a change in the management team, and we would like to take this opportunity to sincerely thank the previous team, led by Iñaki Juaristi and Daniel Sánchez-Portal, for their outstanding work over the past years. Thanks to their committed leadership and vision, CFM is now firmly positioned as an international reference center in materials science.

From the beginning of our mandate as the new management team, we set out to strengthen participation and shared decision-making within the center. We already had the Equality Committee in place, and throughout this year, we created four new committees: Science, Spaces, Training and Seminars, and Sustainability. These five internal committees advise the management on strategic, scientific, and organizational matters and have been key to making progress in a structured and participatory manner.

In 2024, we also renewed our International Scientific Advisory Committee, which was officially established in November. Before this renewal, we received valuable support from the previous committee, whose advice was particularly helpful during the development of a three-year excellence plan and a ten-year scientific strategy for the center, both of which were promoted through the Deep-Max initiative of the CSIC. This process allowed us to reflect collectively on our present and to design our future with ambition. As a result of this effort, in June 2024, CFM was awarded the Aspira-MaX Josefa Barba Seal of Excellence for successfully completing the first phase of the MaX Project. This recognition acknowledged our commitment to continuous improvement, enabling us to present the aforementioned scientific strategy and excellence plan in the second phase of the program. The anticipated awarding of the Aspira-MaX Sagrario Martínez Carrera Seal, which includes additional funding, will allow us to implement our plan and further strengthen CFM's leadership in materials physics, in alignment with initiatives such as IKUR and BasQ.

Direction team: Celia Rogero (Director, middle), Ion Errea (Vicedirector, left), and Silvina Cerveny (Vicedirector, right)

This year, we have welcomed new researchers who are helping to revitalize and strengthen CFM's scientific ecosystem. Talented young researchers have joined us through the Ramón y Cajal and Ikerbasque Fellows programs, along with two new CSIC permanent scientists who joined the center in December. We expect their arrival to contribute to maintaining—and hopefully surpassing—the already exceptional scientific level of CFM.

Equality, diversity, and inclusion remain top priorities for our community. In 2024, we approved CFM's Second Gender Equality and Diversity Plan, which aims to promote a respectful, safe, and fair work environment for everyone at the center. This plan includes concrete, measurable commitments and will be a key tool in advancing toward a more equitable organizational culture.

Scientifically, 2024 was once again an excellent year, with over 230 publications, many in top-tier international journals, and more than 100 active projects, along with competitive funding that continues to grow. 13 PhD theses were defended, and numerous collaborations with companies and technological institutions continue to reinforce our knowledge transfer capacity. As in previous years, our science outreach activities made a significant social impact and achieved record participation, especially among young audiences.

None of this would be possible without the dedication, commitment, and talent of everyone at CFM. Thanks to each and every one of you for making this center a place where cutting-edge science is done with passion, collaboration, and excellence.

GOVERNANCE

The Center is a unified research initiative supported by two institutional pillars: the *Centro de Física de Materiales* (CFM) and the Materials Physics Center Association (MPC). Although legally distinct, CFM and MPC are intrinsically interconnected, sharing scientific goals, infrastructure, and strategic direction in a fully coordinated and synergistic manner.

The CFM is a joint research institute of **the Spanish National Research Council (CSIC) and the University of the Basque Country (UPV/EHU)**. Its governance includes the Governing Board, which brings together representatives from both founding institutions. The Center Board, along with the Direction Board, forms the core leadership structure.

The MPC is a non-profit association recognized as a **Basque Excellence Research Center (BERC)**. Its governing body comprises representatives from **Ikerbasque** – the Basque Foundation for Science, the **Gipuzkoa Provincial Council**, and the **Donostia International Physics Center** (DIPC). These institutions jointly appoint the Scientific Director of the association.

Crucially, the same individual serves as Director of both CFM and MPC, a joint appointment that ensures coherence and continuity in the scientific leadership of the entire center. This unified governance model allows for the seamless integration of strategy and activity across both institutional bodies, reinforcing CFM as a cohesive and internationally competitive research institution.

The Scientific Board, the new internal committees, and the International Scientific Advisory Committee serve as consultative bodies for the entire center—CFM and MPC as a whole—providing independent guidance and supporting strategic scientific planning across all areas of activity.

CFM GOVERNING BOARD

President: Inmaculada Arostegui (Vice-Rector for Research, UPV/EHU)

Members:

Carlos Closa (Vice-President for Organisation and Institutional Relations, CSIC)

Guillermo Quindós Andrés (Vice-Rector for Science Development and Transfer, UPV/EHU)

Marisol Martín González/Antonio Chica (Global Materia Subject Area Coordinator, CSIC)

MPC GOVERNING BOARD

President: Pedro Miguel Echenique (DIPC)

Secretary: Adolfo Morais (IKERBASQUE)

Member: Jon Gurrutxaga (Gipuzkoa Provincial Council)

DIRECTION BOARD

Scientific Director: Celia Rogero

Deputy Directors: Ion Errea, and Silvina Cerveny

CENTER BOARD

Director: Celia Rogero

Vicedirector: Ion Errea

Secretary: Amaia González

Members: Maite Alducin, Ruben Esteban, Armando Maestro, Jorge S. Dolado, Lucia Vitaly, Iñigo Aldazabal, and Ivan Sasselli.

INTERNATIONAL ADVISORY COMMITTEE (ISAC)

In 2024, CFM renewed its External Scientific Advisory Committee, concluding the term of the committee established in 2016. Over the past eight years, the outgoing committee—comprising Professors Peter Saalfrank, Antonio Hernando Grande, Francisco J. García Vidal, and Dieter Richter—has played a pivotal role in guiding the strategic development of CFM. Their independent insights and constructive feedback have been instrumental in consolidating our scientific focus and enhancing our international visibility. We extend our deepest gratitude for their commitment, rigor, and valuable contributions throughout these years.

The newly appointed committee, formed in late 2024, brings together a distinguished group of scientists with deep expertise in materials physics and a broad international perspective. Their appointment marks the beginning of a new cycle of strategic reflection and scientific growth for CFM. We look forward to working closely with them to continue building a vibrant, competitive, and forward-looking research environment.

Pablo Ordejón

CSIC Research Professor, Group Leader and Director of ICN2, Barcelona

Prof. Pablo Ordejón is a physicist specializing in electronic structure calculations and nanoscale simulations. He earned his PhD from Universidad Autónoma de Madrid and held research positions in the U.S. and Spain before joining ICN2, where he became Director in 2012. With over 225 publications and 34,000 citations, he has significantly contributed to materials science. A fellow of the American Physical Society, he co-founded SIMUNE and collaborates with industry on atomistic simulations, focusing on 2D materials and electronic transport.

Marie Laure Bocquet

First-Class Research Director (LPENS, ENS Paris, and CNRS)

A specialist in surface chemistry, Profesor Bocquet investigates chemical processes in gas phase at metallic, oxide, and graphenic surfaces using high-resolution Scanning Tunneling Microscopy (STM) data. Her expertise in Density Functional Theory (DFT) supports the development of simulation tools for STM imaging, elastic and inelastic spectroscopy. More recently she is working on liquid-solid interfaces like water/graphene-based materials with applications in the water-energy nexus. With 98 publications, including articles in Science, Nature, and JACS, her work has received ~7,700 citations (H-index: 45). Research applications span heterogeneous catalysis, corrosion, graphene synthesis, gas sensors, and blue energy.

Cyril Aymonier

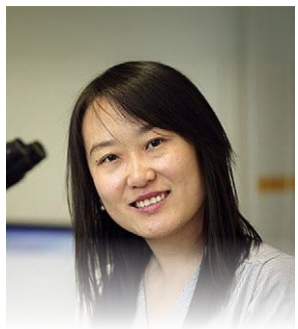
Director of ICMCB, Bordeaux

Cyril Aymonier, CNRS Senior Researcher at the Institute of Condensed Matter Chemistry of Bordeaux, specializes in high-pressure and high-temperature fluid chemistry, particularly supercritical fluids, for designing and recycling advanced nanostructured materials. With a PhD in Chemical Engineering from the University of Bordeaux and postdoctoral experience in Freiburg, his research includes nanomaterial synthesis, continuous multi-step processes, and sustainable recycling technologies. Author of over 200 publications with 7,000 citations (H-index: 43), he contribute to innovative materials science. His prolific teaching activity includes the international master's program Advanced Materials Innovative Recycling (AMIR).

Rodney D. Priestley

Dean of the Graduate School and Associate Director, Princeton Center for Complex Materials (PCCM)

Rodney D. Priestley, Ph.D. (Northwestern University, 2008), is a leading researcher in complex materials and processing, with a focus on nanoscale polymer characterization. His work explores how processing, confinement, and interfacial effects modify material properties for applications in membranes, coatings, nanocomposites, and colloidal systems. A 2023 Fellow of the American Physical Society, he has received numerous awards, including the ACS Marvel Award and AIChE Eminent Chemical Engineers Award. His research also emphasizes sustainable materials and green processing, contributing to advancements in polymer science and engineering. His influential work shapes the future of functional materials and nanotechnology.



Laura Na Liu

Director Physics Institute University of Stuttgart

Prof. Laura Na Liu received her Ph.D. in Physics at University of Stuttgart, Germany. She then worked as a postdoctoral fellow at the University of California, Berkeley and as a Texas Instruments visiting professor at Rice University, respectively. Before she became a professor at the Kirchhoff Institute for Physics at University of Heidelberg in 2015, she had worked as an independent group leader at the Max-Planck Institute for Intelligent Systems. In 2020, she joined University of Stuttgart and became the Director of the 2. Physics Institute. A pioneer of DNA nanotechnology, Professor Liu, has been working at the interface, where nanophotonics meets biology and chemistry.

INTERNAL COMMITTEES

In 2024, CFM strengthened its internal governance by consolidating a structure of advisory committees. These committees are composed of members from different areas of the center and contribute actively to collective decision-making. Each committee addresses a specific thematic area, providing recommendations and support to the Direction Team and the Center Board. This participatory model aims to foster a more inclusive, sustainable, and strategically aligned research environment.

Spaces Committee

Aims to assess the current use of space at the center and provide strategic recommendations to guide future decisions regarding its allocation and management.

MEMBERS: Ion Errea, Paula Angulo, Ester Verde, Ekain Ugalde, and Ruben Gonzalez.

Sustainability Committee

Works to promote environmental awareness and foster a culture of sustainability at CFM, aligning its initiatives with the CSIC Sustainability Plan and the UN Sustainable Development Goals.

MEMBERS: Silvina Cerveny, Jon Maiz, Ana Sanchez, Jorge S. Dolado, and Iker Cestero.

Gender Equality and Diversity Committee

Leads the center's efforts to advance gender equality and diversity, and oversees the development and implementation of CFM's Gender Equality and Diversity Plan.

MEMBERS: Ion Errea, Idoia Mugica Mendiola, Arkaitz Nagore Ibero, Jon Ganuza Jiménez, Zuzanna Lawera, Paschalis Agapitos, Divya Joti, Isabel Pascual Robledo, Rubén Pellicer Guridi, Arantza iturrioz Ezeiza, Nerea Zabala Unzalu, Gabriel Molina Terriza, and Ester Verde Sesto.

Training Committee

Focuses on developing and supporting academic and professional training opportunities for the CFM community, with special attention to doctoral education and cross-disciplinary learning.

MEMBERS: Silvina Cerveny, Miguel Varga, Gustavo A. Schwartz, Ivo Souza, Deung Jang Choi.

Science Committee

Provides strategic guidance on scientific matters, contributing to the definition and evolution of CFM's research priorities and fostering cross-group scientific dialogue.

MEMBERS: Celia Rogero, Marek Grzelczak, Julen Ibañez, Daniel Sánchez Portal, Silvina Cerveny, and Felix Fernández.

PROFILE

CFM COMMUNITY

295

Researchers from

43

countries

54%

of the Research Community is international

EDUCATION

12

PhD Theses defended

11

Master Theses Defended[1]

2

Undergraduate Projects

[1] In the framework of the nanoscience master or supervised by CFM staff

RESEARCH OUTPUT

ISI Publications

235

Q1 Publications

90%

H Index

171

International Collaborations

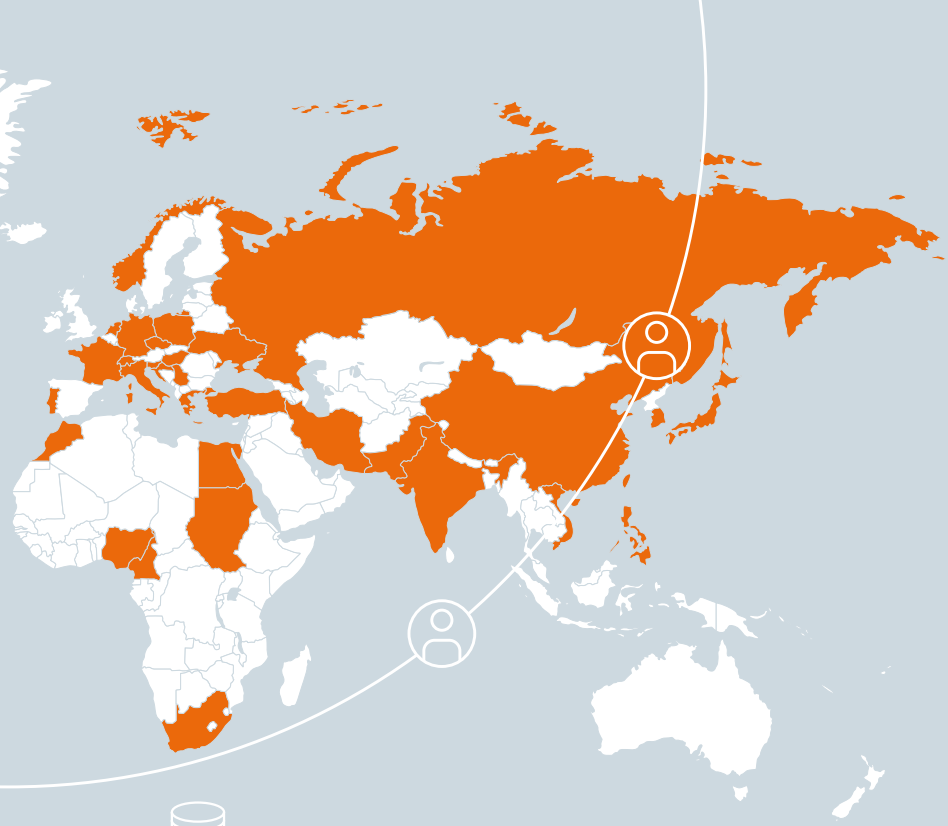
78%

Open Access

75%

57

Conferences, Workshops, Courses, and Seminars organized by CFM



SCIENCE AND SOCIETY

Science and Society

+70 Activities

+40 Volunteers

+12 500 Atendees

PROJECTS AND FUNDING

Ongoing Projects

106

Funding

6 103 946.34 €

EXCELLENT SCIENCE

4

ERC

1

Research Infrastructure Project

3

MSCA

GLOBAL CHALLENGES

1

project (Cluster 5)

INNOVATIVE EUROPE

4

EIC PATHFINDER

1

EIC Booster Grant

MORE ACHIEVEMENTS 2024

CFM RECEIVES THE ASPIRA-MAX JOSEFA BARBA SEAL OF EXCELLENCE FROM CSIC

The CFM received the **Aspira-MaX Josefa Barba Seal of Excellence** in 2024 for passing the first phase of the MaX Project. These ASPIRA-MaX CSIC seals of excellence were created to recognise the efforts towards excellence of research centres.

This programme includes, among other proposals, the granting of financial aid for research centres to draw up their own action plans, which outline actions aimed at strengthening areas for improvement. It should be noted that in 2025 the CFM has also passed the second phase, with the **ASPIRA-MaX Sagrario Martínez Carrera distinction.** This recognition, endowed with 300,000 euros, supports the implementation of the scientific project and excellence plan of the MPC-CFM, reinforcing its leadership in materials physics and aligning with strategic initiatives such as the IKUR and BasQ strategies.

CELIA ROGERO APPOINTED NEW DIRECTOR OF CFM

In 2024 Celia Rogero, senior scientist at CSIC, was appointed as the new director of CFM and MPC. She succeeds Daniel Sánchez Portal, who led the center for the past four years. Rogero has brought extensive experience in both research and leadership, having co-directed the Nanophysics Laboratory and currently serving as president of ASEVA.

Her vision for CFM **includes strengthening international collaboration, fostering the transfer of fundamental research to industry, and enhancing sustainability practices.** She also emphasizes the importance of scientific outreach and gender equality in research. Rogero aims to position CFM at the forefront of scientific and technological innovation, ensuring its findings contribute to real-world solutions and societal progress.

With this appointment, CFM enters a new chapter under a leader committed to excellence, inclusion, and the strategic growth of the center in both theoretical and applied materials science.

DESIGN AND LAUNCHING OF THE II GENDER EQUALITY AND DIVERSITY PLAN OF CFM

At CFM we are betting on a future full of **diversity** and based on **equal opportunities** as the only possible way forward. With this motto, and within the great objectives of **corporate social responsibility** and work ethics that we set ourselves in our centre, CFM assumed the responsibility for alleviating gender inequality. CFM showed its commitment by designing the first **Gender Equality Plan (GEP)**, which was born in 2020 with the vocation to respond and denounce a real problem that we suffer in each and every one of the areas of our society.

In 2024, we began the design stage of the II Gender Equality and Diversity Plan, which culminated with its presentation and the publication of the diagnosis carried out for it.

More information in section **Gender Equality and Diversity** of this report.

ANTTON BABAZE WINS THE CAF-ELHUYAR AWARD

The CAF-Elhuyar Awards recognise the dissemination work of researchers in the Basque Country. In its 30th edition, the prize in the category of article based on a doctoral thesis went to the CFM researcher Antton Babaze for his work 'Argi ibili kuantikarekin' based on his thesis 'Quantum many-body effects in the opto-electronic response of plasmonic nanostructures and their coupling to quantum emitters', carried out at the CFM. In this case, the jury wanted to highlight the 'passion' that the author transmits in a 'clear and easy to read' article.

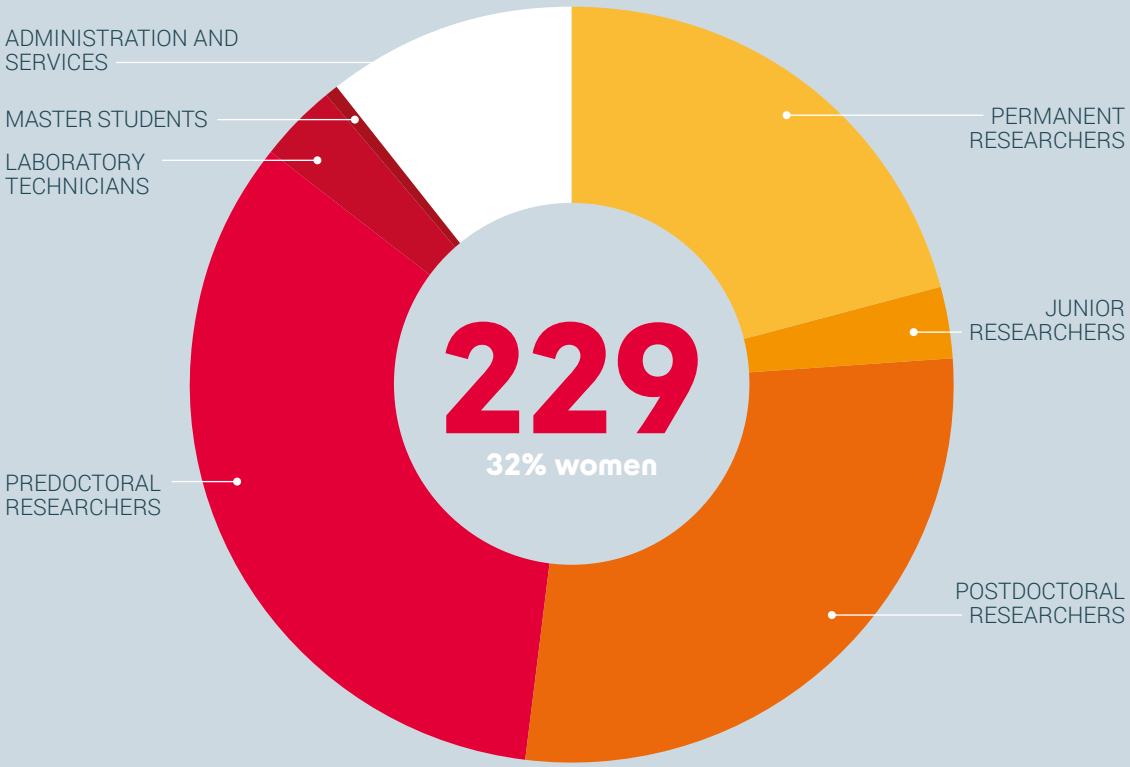
ACTIVITY IN MASS MEDIA

Press articles	Online press	Radio	TV
49	**179**	**47**	**7**

PEOPLE

ALL THE CFM COMMUNITY 295

CFM STAFF



Permanent Researchers	48
Junior Researchers	7
Postdoctoral Researchers	64
Predoctoral Researchers	77
Laboratory Technicians	8
Master Students	1
Administration and Services	24
Total	**229**

GUEST RESEARCHERS

66 40% women

ADMINISTRATION & SERVICES

ADMINISTRATION

Amaia González Azpeitia, Administration Manager
Ane Iturriza Senperena, Administrative Technician
Annia Vázquez Fernández, Administrative Technician
Arkaitz Nagore Ibero, Managing and Legal Director
Idoia Mugica Mendiola, Outreach Manager, and Gender Equality and Diversity coordinator
Iker Cestero Bueno, Administrative Technician
Jon Ganuza Jiménez, Administrative Technician
Laura Ferrando González, External Outreach Technician
María Formoso Ferreiro, Administrative Technician
María José Sánchez Álvarez, Executive Secretary
Marta López Pérez, Head of Accounting and Administrative Technician
Txema Ramos Fernández, Administrative Technician

COMPUTING AND IT SERVICES

Ander Ramos Montero, IT Systems Technician
Iñigo Aldazabal Mensa, Scientific Computing Service Manager
Ioritz Paulis Garmendia, IT Systems Technician
Irene Azáceta Elzaurdi, Scientific Computing Service
Mikel Arocena Errazquin, Scientific Computing Service
Urtzi Oliveras Egaña, IT Systems Technician

MAINTENANCE

Ekain Ugalde Goldarazena
Jarvin Adelci Baca Sánchez
Juan Manuel Burgos Jiménez

PROJECT MANAGEMENT AND TECHNOLOGY TRANSFER

Arantza Iturrioz Ezeiza
Oskitz Párraga Larrinaga
Tijn van den Berg

TECHNICAL STAFF

Amaia Iturrospe Ibarra
Laura Isabel Fernández Gómez-Recuero
Luis Botana Salgueiros
María Isabel Asenjo Sanz
Rubén González Moreno
Silvia Arrese-Igor Irigoyen

RESEARCH LINES

CFM focuses on the study of four main strategic aspects of matter that cover some of the main structures and systems in advanced materials research, within the general objective to target excellence in the research on materials physics, namely: Molecules, Solid State Systems, Photons, and Soft Matter. The research activities in the center have thus been structured during the last years into the corresponding four research lines that give response to the aforementioned targets. The current research lines in the center are: (i) **Chemical Physics of Complex Materials**, (ii) **Electronic Properties at the Nanoscale**, (iii) **Photonics** and (iv) **Polymers, Soft Matter & Sustainable Materials-P(SM)$_2$**.

Chemical Physics of Complex Materials

Combines advanced theoretical modeling and state-of-the-art experimental techniques to investigate the formation, properties, and reactivity of molecules and nanostructures at surfaces and interfaces. Our research spans from the fundamental understanding of energy- and environment-relevant reactions to the exploration of exotic quantum states in layered materials with tailored electronic and magnetic properties. Through a synergistic approach that integrates atomic-scale design, spectroscopy, and predictive simulations, we aim to uncover novel physical phenomena and functionalities relevant for catalysis, sensing, spintronics, and emerging quantum technologies.

PERMANENT RESEARCHERS

Andrés Arnau Pino, University Professor, UPV/EHU
Celia Rogero Blanco, Tenured Scientist, CSIC
Daniel Sánchez Portal, Research Professor, CSIC
Enrique Ortega Conejero, University Professor, UPV/EHU
Frederik Michael Schiller, Scientific Researcher, CSIC
Iñaki Juaristi Oliden, University Professor, UPV/EHU
Lucia Vitali, Ikerbasque Professor, UPV/EHU
Maite Alducin Ochoa, Tenured Scientist, CSIC
Martina Corso, Tenured Scientist, CSIC
Nicolás Lorente Palacios, Scientific Researcher, CSIC
Roberto Robles Rodríguez, Tenured Scientist, CSIC

IKERBASQUE ASSOCIATES

Deung-Jang Choi
Sara Barja Martínez

IKERBASQUE FELLOWS

Samrana Kazim
Sara Catalano

POST-DOCTORAL RESEARCHERS

Adriana Candia
Afaf El-Sayed
Andrew Patton Weber
Antoine Patt
Jose Eduardo Barcelon
María Camarasa Gómez
Maxim Ilin
Natalia Koval
Sabine Auras
Sebastien Elie Hadjadj
Sofia Sanz Wuhl
Stefano Trivini

PRE-DOCTORAL RESEARCHERS

Alaa Mohammed Idris Bakhit
Alfonso Yubero Navarro
Alfredo Serrano Jiménez
Amitayush Jha Thakur
Andrea Aguirre Baños
Angel Rodríguez Alcaraz
Aymeric Saunot
David Caldevilla Asenjo
Divya Jyoti
Ivan Zugec
Malen Etxeberria Etxaniz
Paula Angulo Portugal
Samuel Kerschbaumer
Sandra Sajan
Sebastian Negrete Aragón
Sruthibhai Palakkattu Kunnu Venugopalan

GUEST RESEARCHERS

Alberto Pablo Sánchez Muzas, Senior Scientist
Amaia Ortega Santos, Pre-doctoral Researcher
Daniela Hrubá, Master Student
Enakshi Dey, Pre-doctoral Researcher
Eric Switzer, Senior Scientist
Federico Javier Gonzalez, Pre-doctoral Researcher
Fernando Delgado Acosta, Senior Scientist
Ignacio Piquero Zulaica, Post-doctoral Researcher
In-Sang Yang, Senior Scientist
Javier García de Abajo, Senior Scientist
Leidy Johanna Suarez Taborda, Master Student
Mattia Bassotti, Pre-doctoral Researcher
Paula Abufager, Senior Scientist
Pietro Cattaneo, Master Student
Raúl Bombín Escudero, Post-doctoral Researcher
Stephan Roche, Senior Scientist

Electronic Properties at the Nanoscale

This research line investigates the electronic properties of solids, nanostructures, and low-dimensional systems aiming to understand the fundamental mechanisms that govern the behavior of matter. Our research explores both ground and excited electronic states and their response to various perturbations, across a wide spectrum of materials—from quantum materials like Weyl semimetals, superconductors, and altermagnets to everyday compounds such as cement. Spanning scales from the atomic to the mesoscopic and even macroscopic, this work provides key insights for applications ranging from advanced devices to structural materials.

PERMANENT RESEARCHERS

Aitor Bergara Jauregi, University Professor, UPV/EHU
Andrés Ayuela Fernández, Scientific Researcher, CSIC
Ángel Rubio Secades, University Professor, UPV/EHU
Eugene Tchoulkov, Emeritus Professor, UPV/EHU
F. Sebastián Bergeret Sbarbaro, Research Professor, CSIC
Ion Errea Lope, Associate Professor, UPV/EHU
Ivo Souza, Ikerbasque Professor, UPV/EHU
Jorge Sánchez Dolado, Scientific Researcher, CSIC
José María Pitarke de la Torre, University Professor, UPV/EHU
Pedro Miguel Echenique Landiribar, Emeritus Professor, UPV/EHU

IKERBASQUE ASSOCIATES

Julen Ibañez Azpiroz
Vitaly Golovach

IKERBASQUE FELLOW

Stepan Tsirkin

POST-DOCTORAL RESEARCHERS

Alberto Fraile García
Andrei Mazanik
Antton Babaze Aizpurua
Daniel da Silva Passos
Diego Martínez Gutiérrez
Djordje Dangic
Eleni Chatzikyriakou
Emre Bölen
Ghizlane Moutaoukil
Guido Goracci
Hao Gao
Mikel Arruabarrena Larrarte
Mohammad Rahjoo
Óscar Pozo Ocaña
Peio Garcia Goiricelaya
Prodip Kumar Sarkar
Rafael Ramis Cortés
Ridwan Olamide Agbaoye
Trinidad Novoa Aguirre
Yao Lu
Yuewen Fang
Yun Chen

PRE-DOCTORAL RESEARCHERS

Alberto Hijano Mendizabal
Alvaro Ruiz Puente
Asier Ribechini Álvarez
Ebtisam Tarek Mohammed Saeed
Javier Sivianes Castaño
Jon Ortuzar Andrés
Josu Diego López
Jozef Janovec
Manex Alcorta Lopetegui
Martín Gutiérrez Amigo
Mohamad Barzegar
Rainer Bravo Pino

GUEST RESEARCHERS

Cheol-Hwan Park, Senior Scientist
Florette Corinne Fobasso Mbognou, Post-doctoral Researcher
João Oliveira Pinho, Pre-doctoral Researcher
Karolina Slowik, Senior Scientist
Marta Zuzanna Pelc, Senior Scientist
Rodrigo Humberto Aguilera del Toro, Senior Scientist
Samir Lounis, Senior Scientist
Silvia Cavagnoli, Pre-doctoral Researcher
Tim Kokkeler, Master Student
Zahra Alizadeh Dashbolagh, Pre-doctoral Researcher

Photonics

The control of the interaction of light with a variety of nanostructures and novel (hybrid) materials opens new possibilities to discover and explore novel classical and quantum phenomena at the nanoscale. The potential of these effects to develop sustainable and quantum applications, as well as to improve health and well-being, can be studied by combining new active devices, custom-made metallic and phononic nanostructures, quantum emitters with complementary properties, and a variety of theoretical methods. These advances can be pursued through the use of sophisticated experimental and theoretical methodologies.

PERMANENT RESEARCHERS

Gabriel Molina Terriza, Ikerbasque Professor, MPC
Marek Grzelczak, Scientific Researcher, CSIC
Nerea Zabala Unzalu, University Professor, UPV/EHU
Rolindes Balda de la Cruz, University Professor, UPV/EHU
Rubén Esteban Llorente, Tenured Scientist, CSIC
Yury P. Rakovich, Ikerbasque Professor, UPV/EHU

POST-DOCTORAL RESEARCHERS

Adam Olejniczak
Alexey Brodoline
Ane Escobar Fernández
Angel Sergio Cifuentes Castro
Anish Rao
Aurelian Loirette-Pelous
Jason Tarunesh Francis
Jose Luis Montaño Priede
Mario Zapata Herrera
Miguel Lopez Varga
Nikolaos Iliopoulos
Quimey Martin Pears Stefano
Ruben Pellicer Guridi
Sergio Sánchez Martín
Victor Krivenkov

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Adrián Juan Delgado
Alba María Jumbo Nogales
Asier Mongelos Martínez
Benjamín Tirado Heras
Bruno Candelas Peñalba
Carlos Maciel Escudero
Enrique Ayllón García
Iker Gómez Viloria
Isaac Tribaldo Ramírez
Isabel Pascual Robledo
Jehyeok Ryu
Jonathan Antonio Sepúlveda Henríquez
María García Alonso
Martín Molezuelas Ferreras
Mikel Elorza Romera
Shah Jee Rahman
Xabier Arrieta Aristi
Zuzanna Lawera

GUEST RESEARCHERS

Aimar López Berruezo, Undergraduate Student
An Wei, Pre-doctoral Researcher
Antonio Zelaquett Khoury, Post-doctoral Researcher
Esteban Araspin, Master Student
Gabriel Alejandro Cwilich, Senior Scientist
Jiaxin Lin, Pre-doctoral Researcher
Kaysiyavash Kaykavoosi, Pre-doctoral Researcher
Lander Ethan Lema Salaverria, Undergraduate Student
Marek Czyszczon, Pre-doctoral Researcher
Robin Quinxac, Master Student
Romane Ballion, Master Student
Shiyue Zhang, Master Student

Polymers, Soft Matter & Sustainable Materials

Designs sustainable, biocompatible, and non-cytotoxic functional materials using green synthesis strategies, such as eco-friendly solvents and safer catalysts. Our research follows a multi-pronged approach that combines quantum beams—including neutron scattering—advanced simulations, and experimental techniques to interrogate and understand the structure, dynamics, and properties of soft matter and hybrid systems. This integrated strategy enables the development of novel materials for energy applications, nanoelectronics, lighting, sensing, medicine, and environmental remediation.

PERMANENT RESEARCHERS

Ángel Alegría Loinaz, University Professor, UPV/EHU
Ángel Moreno Segurado, Tenured Scientist, CSIC
Arantxa Arbe Méndez, Research Professor, CSIC
Daniele Cangialosi, Tenured Scientist, CSIC
Felix Fernández Alonso, Ikerbasque Professor, MPC
Fernando Álvarez González, University Professor, UPV/EHU
Gustavo A. Schwartz Pomeraniec, Tenured Scientist, CSIC
Josetxo Pomposo Alonso, Ikerbasque Professor, UPV/EHU
Juan Colmenero de León, Emeritus Professor, UPV/EHU
Silvina Cerveny Murcia, Tenured Scientist, CSIC

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RESEARCH OUTPUT

At a glance

235
ISI Publications

78%
Published in the Framework of International Collaborations

75%
Open Access

90%
Q1

54%
D1

H-Index
171

ISI Web of Science citations
16 830* in 2024

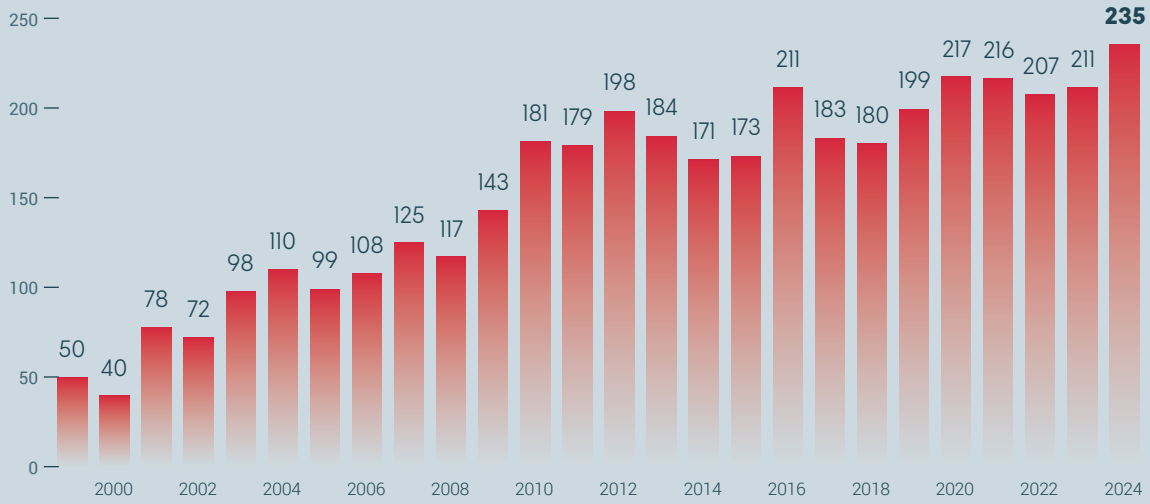
*As of April 2025

In 2024, continuing with the line of excellent scientific results of recent years, the CFM published 235 articles **in top journals** of the area, 90% in Q1 journals and 50% in D1.

More than 78% of the indexed publications correspond to articles published in **collaboration with international entities**, fact that reflects the international excellence of the work carried out in the area of materials science at CFM. Some outstanding institutions with which the CFM has collaborated in 2024 are: Max Plank Society, Massachusetts Institute of Technology (MIT), University of Cambridge, and Lawrence Berkeley National Laboratory.

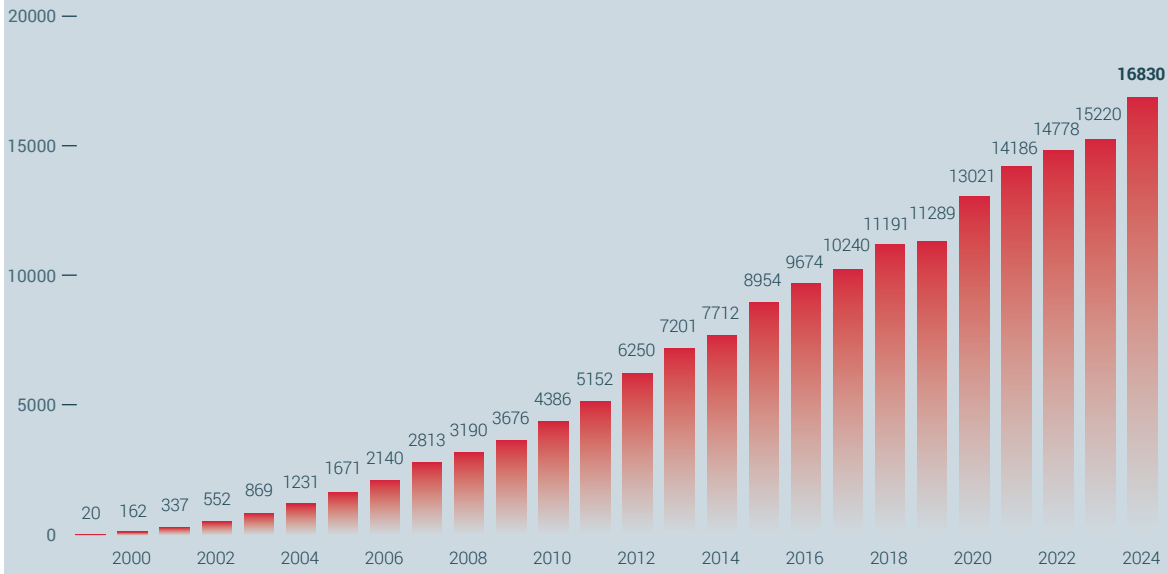
On top of this, the bast majority of the publications are published in **open access** format (75%).

PUBLICATIONS



Evolution of the publications of CFM over the years.
Total number of ISI Publications since 1999 as of April 2025: 3985

CITATIONS



Evolution of the citations of CFM over the years.
Total number of citations since 1999 as of April 2025: 172 725
H index (April 2025): 171

Total number of top publications: 70

JOURNAL	Nº OF PUBLICATIONS	IMPACT FACTOR*
Reviews of Modern Physics	1	45,9
Nature Materials	2	37,2
Nature Nanotechnology	1	38,1
Nature Reviews Chemistry	1	38,1
Advanced Materials	4	27,4
Advanced Energy Materials	2	24,4
Nature Physics	5	18,1
Advanced Functional Materials	5	18,5
Angewandte Chemie - International Edition	2	16,1
ACS Nano	7	15,8
Nature Communications	9	14,7
Journal of the American Chemical Society	6	14,5
Applied Physics Reviews	1	11,9
Physical Review X	1	11,6
ACS Catalysis	2	11,7
Advanced Science	1	14,3
Small	3	13
Materials Horizons	1	12,2
Cement and Concrete Research	1	10,9
Journal of Materials Chemistry A	2	10,8
Small Methods	1	10,7
Carbon	1	10,5
Nano Letters	6	9,6
Proceedings of the National Academy of Sciences of the United States of America	1	9,4
Physical Review Letters	4	8,1

* Journal Impact Factor (2023) from Clarivate Analytics

HIGHLIGHTS

HIGHLIGHT 1

Rotational symmetry influences the mechanical properties of graphene

Unai Aseginolaza, Josu Diego, Tommaso Cea, Raffaello Bianco, Lorenzo Monacelli, Francesco Libbi, Matteo Calandra, Aitor Bergara, Francesco Mauri, and Ion Errea.

Nature Physics 20, 1288 (2024)

Understanding why 2D materials are stable remains in some ways unsolved. This paper, led by the quantum Theory of Materials group at CFM, brings together various factors that are important — symmetry and anharmonicity — and combines them to propose a resolution to this long-standing puzzle

This study addresses a longstanding puzzle in the mechanical understanding of graphene and all two-dimensional (2D) materials: how out-of-plane flexural vibrations (bending modes) behave and how they affect physical properties like sound propagation and bending rigidity. The core finding is that rotational symmetry protects the quadratic dispersion of these flexural modes, even when accounting for anharmonic phonon–phonon interactions. This makes the bending rigidity non-divergent, challenging previous theories.

In the standard harmonic approximation, flexural vibrations in graphene are predicted to have a quadratic dispersion. However, this leads to the unphysical result that in-plane acoustic waves cannot propagate sound, prompting some to argue that interactions between phonons must linearize the dispersion. While this explanation permits sound propagation, it leads to a paradox: the bending rigidity becomes dependent on the system size, suggesting it diverges — an unsatisfactory outcome for a material known for its remarkable strength.

The authors propose a resolution based on a symmetry principle. Both harmonic and anharmonic phonons are derived from second derivatives of energy functions — the potential energy in the harmonic case and the full free energy in the anharmonic case — both of which are rotationally invariant. This symmetry requires that the dispersion of flexural modes remains quadratic even with anharmonic interactions.

The theory was tested using atomistic simulations and membrane models, and both confirmed that the quadratic nature of the flexural modes is preserved. Importantly, while a quadratic dispersion in the harmonic theory prevented sound propagation, in the anharmonic framework sound still propagates as it has to.

One major implication is that the bending rigidity remains finite, regardless of the system size — overturning the common assumption that it diverges due to linearized flexural modes.

While these results significantly improve our understanding of 2D materials' mechanical behavior, they

apply only to ideal, unstrained, flat systems. In real-world applications, substrates or external strains might break rotational symmetry, altering such behavior. Future work will investigate whether static ripples naturally form in unstrained graphene and if their formation is energetically favorable.

Ultimately, this work provides a new, symmetry-based framework for understanding thermal and mechanical properties of all 2D materials like graphene.

"This paper addresses the long-standing puzzle of 2D material stability by unifying key factors such as symmetry and anharmonicity into a proposed resolution."

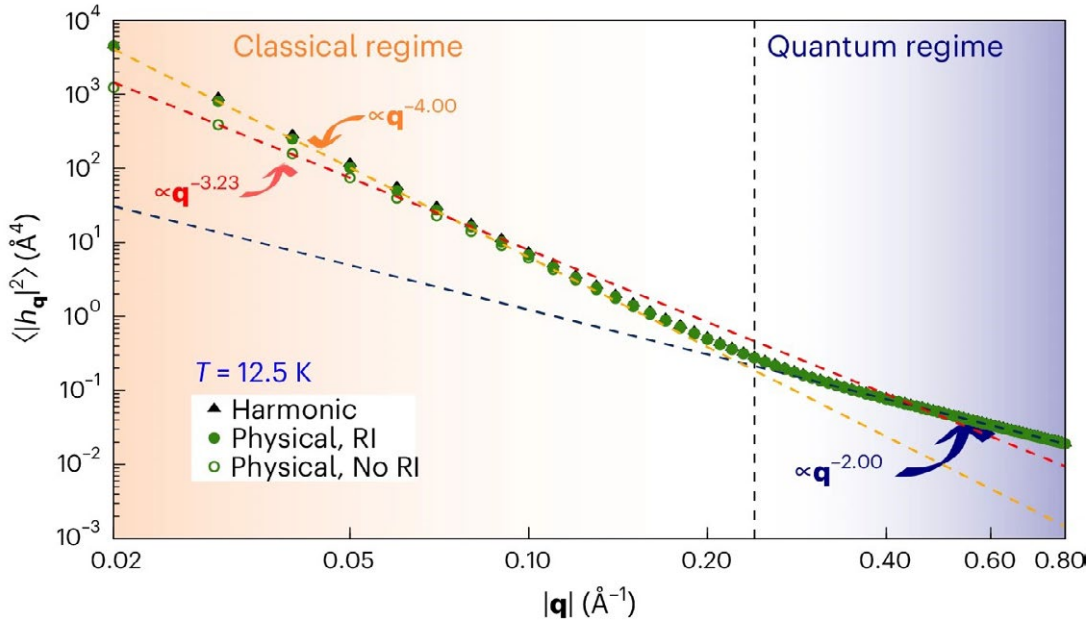


Figure: *The amplitude of ripples in a membrane are typically studied via the height correlation function in momentum space, 〈|hq|2〉 . Here, the height fluctuations of graphene are presented from the Fourier transform of the height–height correlation function, versus the wave number q, at 12.5 K. When there is the full rotational invariance (RI), the physical result scales as q−4 in the classical regime; but the exponent is lower when rotational invariance is broken (no RI). The physical RI results coincides practically with the harmonic solution. Bending rigidity scales as the correlation function times q4 and so diverges in the absence of rotational symmetry, though not when rotational symmetry holds.*

Original publication: Bending rigidity, sound propagation and ripples in flat graphene

HIGHLIGHT 2

Giant tunnelling electroresistance in atomic-scale ferroelectric tunnel junctions for non-volatile memories

Yueyang Jia, Qianqian Yang, Yue-Wen Fang, Yue Lu, Maosong Xie, Jianyong Wei, Jianjun Tian, Linxing Zhang, and Rui Yang.

Nature Communications 15, 693 (2024)

The collaborative team, led by Rui Yang from the University of Michigan-Shanghai Jiao Tong University Joint Institute, Linxing Zhang from Beijing University of Science and Technology, and Yue-Wen Fang from CFM, reported the construction of nanoscale ferroelectric tunnel junctions. These 1 nm junctions achieved a giant tunnelling electroresistance of 700,000, setting a new record for resistance ratio in ferroelectric tunnel junctions at atomic-scale thicknesses. The 4 nm tunnel juctions even show higher performance than commercial flash.

Ferroelectric tunnel junctions (FTJs) hold promise for the next generation of high-reliability, low-power non-volatile storage and in-memory computing devices due to their small size, excellent repeatability, and low read/write energy consumption. The ferroelectric thin film allows the quantum mechanical tunneling of electrons, with the average tunneling barrier and thus the tunneling electroresistance (TER) modulated by the polarization of the ferroelectric layer. Generally, the high TER of ferroelectric tunnel junctions is advantageous for reducing power consumption and improving the stability of devices. However, maintaining a high TER is challenging with the decreased thickness of the ferroelectric tunneling layer.

Guided by crystal structure design, the team has previously achieved robust room-temperature ferroelectricity in 1 nm samarium-doped bismuth oxide (BSO) thin films (DOI: 10.1126/science.abm5134). Based on these thin films, this work proposes FTJs of Au/Cr/BSO/NSTO where NSTO refers to niobium-doped strontium titanate (see Fig. 1). This junction structure significantly improves the on/off ratio because both barrier height and width are modulated upon the polarization reversal. For the FTJs with ferroelectric layer thickness as low as 1 nm, a giant TER exceeding 700,000 has been achieved, representing an improvement of over three orders of magnitude compared to same-thickness devices in previous studies. Moreover, as the thickness of the film increases, the TER of the devices can be further enhanced, with the highest TER exceeding one billion obtained in the FTJs with a ferroelectric layer thickness of 4.6 nm, which is higher than commercial flash memories.

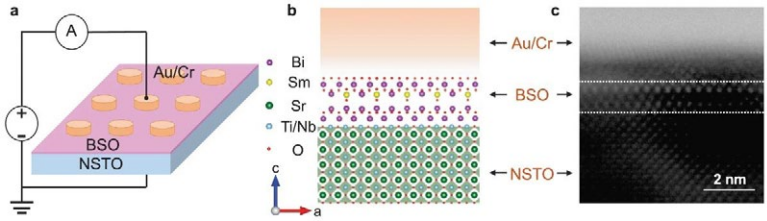


Figure 1: *The structure of ferroelectric tunnel junction in this work.*

In addition, by varying the reset stop voltages, 32 distinct resistance states (5 bits of data storage) are realized in a single FTJ, implying the multi-level information storage can be realized in such devices. Moreover, the devices demonstrate linear conductance modulation, more than five billion endurance cycles, and over 10 years of retention time (see Fig. 2). These BSO-based FTJs hold high promise towards reliable, high-performance, high-density and low-power non-volatile memory and in-memory computing applications.

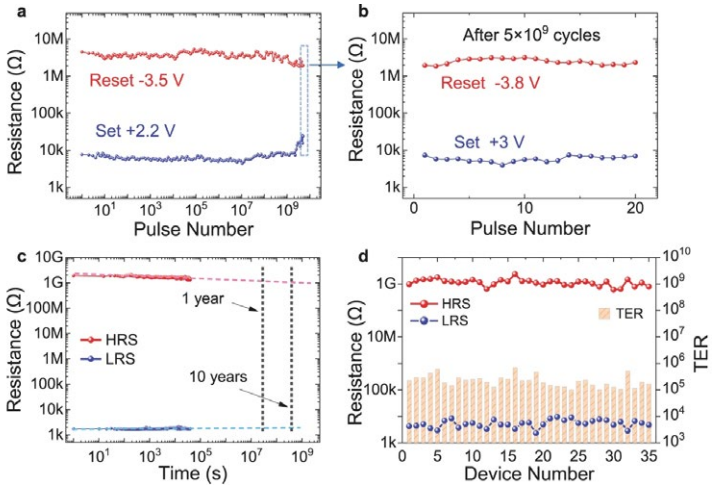


Figure 2: *(a) Measured endurance properties showing more than five billion cycles under +2.2 V/−3.5 V programming pulses. (b) high-resistance state (HRS) and low-resistance state (LRS) after five billion programming cycles, showing that the device can maintain robust tunneling electroresistance (TER) effect by applying slightly larger programming voltages. (c) Measured retention property showing that TER over 100,000 can be maintained for more than 10 years. (d) HRS, LRS, and TER measured for 35 devices, showing small device-to-device variation.*

HIGHLIGHT 3

Near-ambient pressure oxidation of silver in the presence of steps: electrophilic oxygen and sulfur impurities

Frederik Schiller , Khadiza Ali, Anna A Makarova, Sabine V Auras , Fernando García-Martínez , Alaa Mohammed Idris Bakhit , Rodrigo Castrillo Bodero , Ignacio J Villar-García , J Enrique Ortega, and Virginia Pérez-Dieste.

ACS Catalysis 14, 12865 (2024)

This study investigates trace sulfur impurities that are essential for the silver-catalyzed epoxidation of ethylene to ethylene oxide. Using curved crystal analysis and spectroscopy, CFM researchers and international collaborators show that specific Ag surfaces promote sulfur accumulation, enhancing catalytic activity. These findings advance understanding of industrial catalysis and inform future catalyst design.

Catalysis in industry often relies on empirical methods, with scientific understanding developing more slowly. Ideally, scientific insights would precede applications, but even delayed understanding can lead to significant advancements. This study, led by researchers from CFM, UPV/EHU, and DIPC Donostia, in collaboration with Chalmers University and the ALBA synchrotron, investigates a long-used catalytic process involving silver (Ag).

Silver has been used for nearly a century in key industrial reactions, e.g., converting methanol to formaldehyde, or for the epoxidation of ethylene and propylene to produce ethylene oxide (EO) and propylene oxide. These processes contribute to the annual production of nearly 50 million tons of valuable chemicals. Industrially, the reactions are carried out under high temperature and pressure, with Ag serving as the catalyst in oxidation reactions involving oxygen and hydrocarbons.

The Ag-catalyzed conversion of ethylene to EO has been extensively studied due to its importance and high selectivity—over 90% in industry. However, the mechanism behind this selectivity remained unclear despite decades of research. A breakthrough came five years ago when scientists discovered that trace sulfur impurities—previously unaccounted for in industrial models—play a crucial role in facilitating EO formation.

In this recent study, the team confirms sulfur's involvement and further investigates how surface structures of silver affect sulfur accumulation, using a unique curved crystal technique and photoemission spectroscopy at the ALBA synchrotron. The curved crystal setup allowed them to analyze various surface orientations simultaneously under reaction conditions.

Their findings show that different crystal surfaces accumulate sulfur differently. Flat (111) surfaces showed the least sulfur accumulation, while B-type stepped surfaces accumulated nearly twice as much. Spectroscopic data revealed that sulfur presence correlates with increased electrophilic oxygen species, key to catalytic activity, while pure silver oxide diminished over time.

This study offers significant insights into how silver surface structure and sulfur impurities influence EO formation. It opens the door to designing more efficient and selective catalysts by targeting surface structures that promote beneficial interactions with sulfur, offering a more scientifically grounded approach to industrial catalysis.

"Sulfur impurities that drive the catalytic ethylene epoxidation accumulate mainly at B-type vicinal surfaces.."

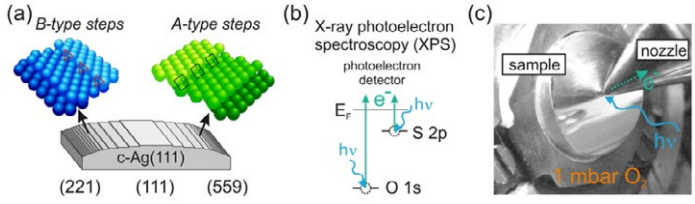


Figure 1: *Curved Crystal Approach for Investigating Silver Catalysts. (a) The sample consists of a cylindrical segment of a single crystal, which exhibits various types and densities of surface steps. (b) A schematic illustrating the photoemission process employed in this investigation. (c) The experimental setup for the sample used in the ALBA experiment.*

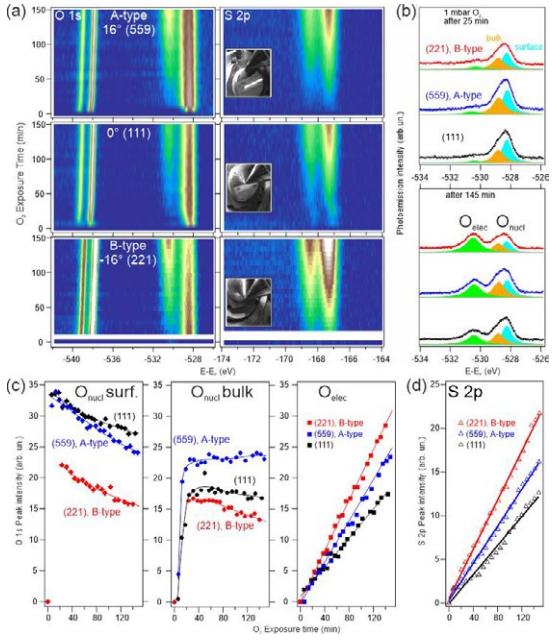


Figure 2: *Photoemission spectroscopy images and its analysis for O 1s and S 2p core levels during 1 mbar O2 gas pressure. (a) Photoemission uptake images featuring the O2 gas lines (E-EF = -539eV), electrophilic O (E-EF = -530.2eV), nucleophilic O (-528.5eV) as well as the S 2p doublet structure at three relevant positions of the curved crystal substrate, namely the (221), (111), and (559) surfaces. (b) Examples of peak fit analysis at the O 1s core level region. (c),(d) results of the analysis reveal a parallel increase of the electrophilic O and the S 2p core level following that both emissions derive from SO4. Accumulation of SO4 is larger at the steps, particularly at the B-step type Ag(221) site.*

HIGHLIGHT 4

Artificial photo-synthases: single-chain nanoparticles with manifold visible-light photocatalytic activity for challenging "in water" organic reactions

Davide Arena, Ester Verde-Sesto, Iván Rivilla and José A. Pomposo.

Journal of the American Chemical Society 146, 14397 (2024)

Artificial photo-synthases (APS), based on single-chain nanoparticles, enable multiple visible-light-driven organic reactions in water, including previously unreported transformations. Mimicking enzyme behavior, APS function efficiently under mild conditions. Kinetic analysis reveals enzyme-like activity, demonstrating APS's potential as next-generation catalysts for sustainable aqueous-phase photochemistry.

In nature, only three types of enzymes carry out purely photocatalytic organic reactions. Indeed, designing abiotic protein nanoreactors capable of custom photoreactions requires extensive genetic engineering effort. In organic photochemistry, scarce solubility of reactants in aqueous media and severe catalyst deactivation is of central concern for the replacement of organic solvents with water. While several strategies have been recently proposed, only a few works have been devoted to the use of ultra-fine soft nano-objects as efficient visible-light photocatalysts of "in water" organic reactions.

Single-chain nanoparticles (SCNPs) as intramolecularly self-folded synthetic polymer chains with ultra-small size (2-20 nm) are posed as perfect candidates for advanced, next-generation enzyme-mimetic catalysts preparation. Despite the extensive use of SCNPs as nanoreactors for a plethora of organic reactions, only a few works disclosed the use of SCNPs for photocatalytic applications.

The present work reports the construction of unimolecular soft nano-objects endowed with broad, manifold photocatalytic activity in water and constructed by taking advantage of the protein-mimetic architecture of polymeric SCNPs. These Artificial Photo-Synthases (APS) are used to perform a collection of four organic transformations in aqueous solution at room temperature and under LED illumination (λmax = 450 nm): two reactions unprecedently reported in water, namely, [2+2] photocycloaddition of vinyl arenes, and α-arylation of N-arylamines which since its discovery by McMillan (2021 Nobel Laureate in Chemistry) was never reported in water . Additionally, these APS allowed aerobic oxidation of 9-substituted anthracenes and β-sulfonylation of -methylstyrene (see Figure).

Due to the similarities of these APS to enzymes, kinetics data of the [2+2] photocycloaddition of vinyl arenes in water photocatalyzed by APS were analyzed in terms of the classical Michaellis-Menten model. The apparent values of k_{cat} and K_M obtained were 2.6 s^{-1} and 4.6 × 10^{-2} M, respectively. Comparatively, *Chymotrypsin* shows k_{cat} = 0.14 s^{-1} and K_M = 1.5 × 10^{-2} M, *Pepsin* k_{cat} = 0.50 s^{-1} and K_M = 3.0 × 10^{-4} M, and *tRNA synthetase* k_{cat} = 7.6 s^{-1} and K_M = 9.0 × 10^{-4} M.

In summary, this pioneering work broadens the possibilities for performing challenging "in water" organic transformations via APS-mediated visible-light photocatalysis.

"This study introduces Artificial Photo-Synthases (APS) that enable novel organic transformations in water under LED light, expanding the scope of visible-light photocatalysis."

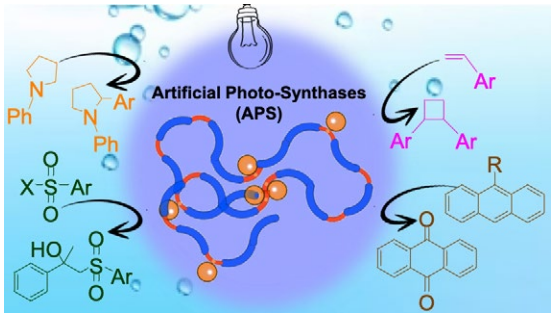


Figure: *Illustration of an Artificial Photo-Synthase (APS) endowed with manifold photo-catalytic activity towards "in water" reactions.*

HIGHLIGHT 5

Ferromagnetism on an atom-thick & extended 2D metal-organic coordination network

Jorge Lobo-Checa, Leyre Hernández-López, Mikhail M. Otrokov, Ignacio Piquero-Zulaica, Adriana E. Candia, Pierluigi Gargiani, David Serrate, Fernando Delgado, Manuel Valvidares, Jorge Cerdá, Andrés Arnau, and Fernando Bartolomé.

Nature Communications 15, 1858 (2024)

The appearance of ferromagnetic order at finite temperatures in extended two-dimensional (2D) systems requires the existence of magnetic anisotropy, so that a gap emerges in the magnon (spin wave) excitation spectrum. The magnitude of this gap plays a role in the determination of the value of the critical Curie temperature (T_C) that also depends on other system parameters.

Recently, 2D single layers of different van der Waals materials have been isolated. For example, the case of a CrI_3 monolayer is, nowadays considered a benchmark system for 2D ferromagnetism, presenting a value of T_C close to 40 K, as well as an acoustic magnon mode [1]. A counterpart of such magnetic two-dimensional systems are the so-called metal-organic coordination networks (MOCNs), which consist of magnetic atoms linked by organic molecules. However, these systems have eluded, so far, the observation of ferromagnetism at finite temperatures. The main reason for such absence is that in most of the MOCNs exchange coupling strength and magnetic anisotropy are too low to deliver a large enough value of T_C.

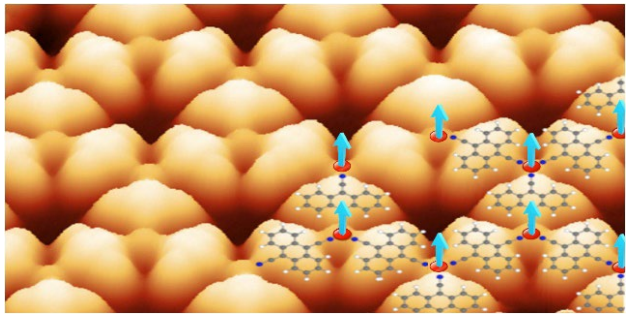
In this work, the authors have clearly observed ferromagnetism in a 2D MOCN. In particular, they have successfully grown a two-dimensional coordination network made of Fe atoms and DCA organic molecules (see Figure). They also have explained its remarkable magnetic properties. The resulting MOCN shows ferromagnetic order at relatively high critical temperatures (TC =35 K), as well as a large coercive field (H_c = 2 Tesla), a value comparable to the one corresponding to a neodymium magnet. Such high value of H_c could be considered a hard magnet, since it can maintain a given magnetization direction under the influence of a strong external magnetic field applied in the opposite direction, as defined by a hysteresis loop in the magnetization curve. In the figure below, the measured magnetization curves, as obtained from X-ray magnetic circular dichroism data, clearly show both the large out-of-plane anisotropy and large coercive field.

These findings represent a substantial advance in basic science as they show that *single layers* at its ultimate thickness can be *ferromagnetic*. Such finding has potential practical applications in technological devices requiring extreme miniaturization and strong magnetic fields, e. g., in spintronics devices. Moreover, the production costs become very low as this MOCN is composed of organic atoms (C, N and H) and only 5% of elemental Fe, whose atoms are located at distances of the order of 1 nm when incorporated in the MOCN.

"The thinnest hard magnet ever created."

References

[1] Nat. Phys. 17, 20 (2021). https://doi.org/10.1038/s41567-020-0999-1



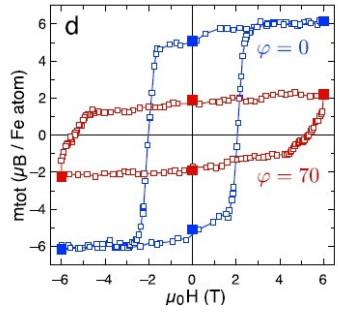


Figure: *On the left, a high-resolution scanning tunneling image of the Fe-DCA MOCN is shown with Fe atoms (red circles) and DCA molecules overlayed on top. The blue arrows indicate the spin direction of the coordination magnetic atoms in this system. On the right, the hysteresis loops (open symbols) obtained at the L_3 edge of Fe at normal (φ = 0°, blue) and grazing (φ = 70°, red) incidence are shown. The solid symbols are the result of applying the sum rules to the XAS and XMCD spectra obtained at remanence after conveniently cycling the field from ±6 T to zero for both incidence angles.*

HIGHLIGHT 6

Gold nanoparticles dance to the beat of light

Anish Rao, Ana Sánchez Iglesias, and Marek Grzelczak.

Journal of the American Chemical Society 146, 18236 (2024)

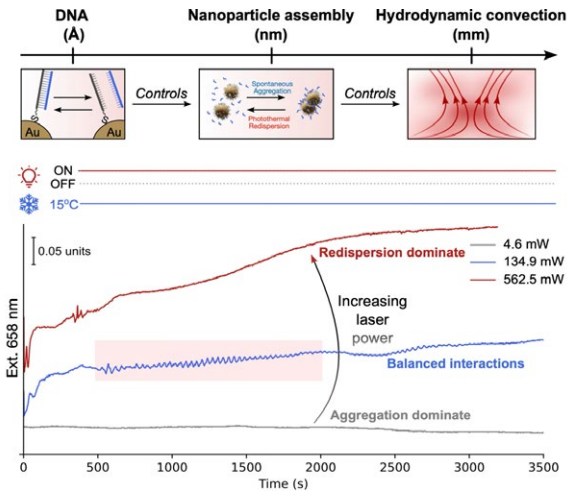
In this work, the team developed a DNA-coated gold nanoparticle system that exhibits oscillatory hydrodynamic flows in response to non-periodic light. The system uses hierarchical feedback loops and thermal hysteresis to create self-oscillating patterns, offering a new approach to nanoscale dynamic behaviors with potential applications in light-powered technology and machinery.

Just like a heart beating rhythmically, living things often show repeating patterns in response to steady inputs. Such a rhythmic behaviours found in nature remains a challenge for synthetic systems.

A group of researchers led by Marek Grzelczak have engineered a novel nanosystem using DNA-coated gold nanoparticles that exhibits oscillatory hydrodynamic flows when exposed to a continuous, non-periodic light source. This behaviour arises from a hierarchical response where light-induced heating triggers reversible DNA hybridisation, leading to nanoparticle aggregation and dispersion. The system employs slow aggregation as positive feedback and rapid photothermal disassembly as negative feedback, with thermal hysteresis introducing a crucial time delay. This combination of asymmetric feedback loops and time delay orchestrates the observed oscillating patterns in the nanoparticle dispersion, demonstrating a unique approach to creating self-oscillating systems at the nanoscale.

These findings demonstrate that a hierarchical design, where molecular interactions at the nanoscale govern nanoparticle assembly, can be translated into millimetre-scale oscillating fluid flows. From a broader perspective, this work shows how simple components at the nanoscale can be programmed to create complex, dynamic behaviours, mimicking some of the rhythmic phenomena seen in living systems. By understanding and controlling self-oscillating systems, one can potentially develop new technologies, for example, in light-powered pumps and machinery.

Original publication: Choreographing Oscillatory Hydrodynamics with DNA-Coated Gold Nanoparticles



"Nanoparticles-based system featuring hierarchical photothermal effect generating convective forces and oscillatory hydrodynamic flows."

Figure: *Thermosensitive hybridization of DNA-based ligands controls the reversible assembly of nanoparticles, setting conditions for oscillatory convection at the macro scale. The oscillations originate from temperature-dependent changes in the buoyancy of the dispersion, leading to organized convective flows.*

HIGHLIGHT 7

Understanding the photoinduced desorption and oxidation of CO on Ru(0001) using a neural network potential energy surface

Ivan Žugec, Auguste Tetenoire, Alberto S. Muzas, Yaolong Zhang, Bin Jiang, Maite Alducin, and J. Iñaki Juaristi.

Journal of The American Chemical Society Au 4, 1997 (2024)

Upon femtosecond pulse laser irradiation on the Ru(0001) surface with coadsorbed CO and O, both CO desorption and oxidation take place. Using a Neural Network Potential Energy surface to perform molecular dynamics simulations, experimental results are reproduced and the mechanisms governing the underlying ultrafast photochemical processes are revealed.

CO oxidation on Ru(0001) is a reaction that, being thermally forbidden in ultra-high vacuum, can be activated by femtosecond laser pulses. Still, it is observed that CO desorption is much more likely than CO_2 desorption with a branching ratio of around 35. Examining these experiments requires conducting molecular dynamics simulations in an excited environment. This can be performed at the level of density functional theory (DFT), by means of the so-called ab initio molecular dynamics with electronic friction and thermostats. In this approach, a set of coupled Langevin equations of motions are solved for the adsorbates and lattice atoms coupled to the electrons excited by the laser pulse, calculating the adiabatic forces on the fly using the Hellman-Feynman theorem. A key limitation of this approach is its substantial computational demand that, in practice, means that only a few hundred of trajectories restricted to an integration time of few picoseconds can be computed for specific experimental conditions.

In the present work, using the embedded atom neural network method, a multidimensional neural network potential energy surface (NNPES) is constructed, trained on configurations extracted from previous abi-nitio molecular dynamics simulations. This allows to perform simulations for different laser fluences F in the experimental range F=125-200 J/m^2. The number of trajectories (2500-7500) and integration time (30-50 ps) vary for each fluence to ensure statistically accurate and time-converged results, allowing us a quantitative comparison with the experimental data. The calculated probabilities align remarkably well for both CO and CO_2 desorption with the experimental data. First, the large branching ratio for CO desorption over CO_2 desorption is reproduced. Second, both probabilities clearly exhibit the usual nonlinear dependence on F that characterizes photoinduced processes involving multiple electronic excitations. More importantly, the simulations are able to reproduce quantitatively the experimental data.

HIGHLIGHT 7

Finally, by analyzing the movement of the molecules along the dynamics, it is found the existence of dynamic trapping of CO that, in some cases, acts as a precursor for CO desorption. The simulations show that the energy landscape seen by the desorbing CO under equilibrium conditions and in the highly excited environment created by the laser pulse are drastically different, suggesting that the observed dynamic trapping is a consequence of the strong distortions and concomitant complex interactions created in the system.

All in all, the constructed NNPES is a powerful tool to describe at the DFT level the dynamics of the CO/O/Ru(0001) system under strong excitation conditions and makes it possible to perform statistically full converged realistic molecular dynamics simulations of complex laser induced processes that involved highly excited electronic and phononic sytems.

"Molecular dynamics simulations in a multidimensional Neural Network Potential Energy Surface reproduce and explain the ultrafast photoinduced desorption and oxidation of CO on Ru(0001)."

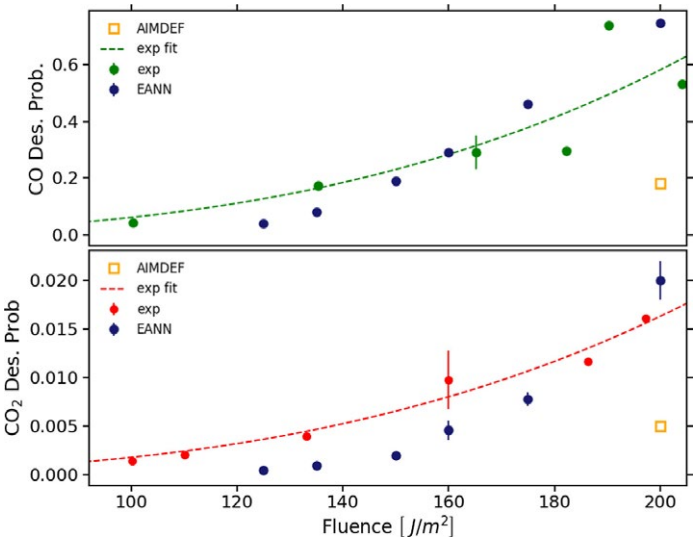


Figure 1: *Fluence dependence of CO (top panel) and CO_2 (bottom panel) desorption probabilities upon irradiating the CO/2O/Ru(0001) surface with an 800 nm laser pulse of fwhm 110 fs. Green (top panel) and red (bottom panel) circles are the experimental results for CO and CO_2 desorption, respectively. Dashed lines in both panels are obtained by fitting the experimental data and should be used to guide the eye. Blue circles and error bars (the latter masked in many cases by the symbol size) are the results of the NNPES-based molecular d dynamics simulations with 30-50 ps simulation time. Open orange squares are the abinitio molecular dynamics results for F = 200 J/m² with 4 ps simulation rtime.*

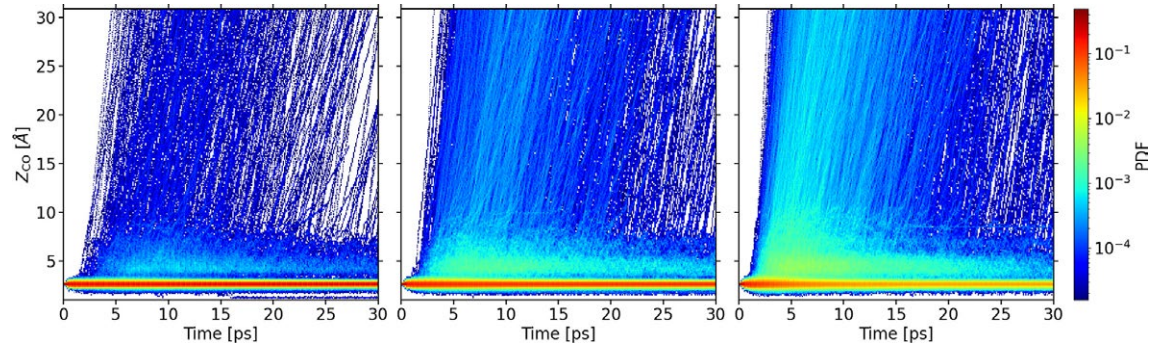


Figure 2: *Normalized probability density of the CO center of mass height Z_{CO} as a function of time for three different absorbed laser fluences: 125 J/m² (left), 160 J/m² (middle), and 200 J/m² (right). Z_{CO} is measured from the mean position of the Ru topmost layer. Bin area for all figures is 0.01 Å ps.*

HIGHLIGHT 8

Unified understanding of the structure, thermodynamics, and diffusion of single-chain nanoparticle fluids

Baicheng Mei, Angel J. Moreno, and Kenneth S. Schweizer.

ACS Nano 18, 15529 (2024)

Single-chain nanoparticles exhibit protein-like tunable architectures and versatile applications. Combining simulations and theory, we link their internal structure to anomalous dynamics and thermodynamics, revealing correlation holes, exponential scaling of properties, and weak caging. Universal trends emerge with implications for soft nanomaterials and glass formation.

Single-chain nanoparticles (SCNPs) are soft nano-objects synthesized via intramolecular cross-linking of polymer chains. Their tunable architectures—ranging from globular to sparse, akin to proteins—endow them with remarkable deformability and versatile functionalities, making them promising for applications in protein condensates, nanocomposites, nanomedicine, bioimaging, catalysis, and drug delivery.

To unravel their dynamic and thermodynamic behavior, we combine molecular dynamics simulations with a generalized Langevin equation theory, capturing mode-coupling effects and weak caging in SCNP fluids. Our framework bridges microscopic conformations to macroscopic properties, elucidating how internal SCNP structure governs intermolecular packing, thermodynamics, and center-of-mass diffusion across concentrations—from dilute solutions to dense melts.

Key findings reveal a distinctive correlation hole in intermolecular pair correlations, arising from SCNP connectivity and repulsive interactions at macromolecular scales. Concentration-dependent deviations emerge at small separations, while theoretical predictions—confirmed by simulations—uncover anomalous exponential-like scaling of pressure, osmotic compressibility, and diffusivity with packing fraction. Despite system-specific variations tied to internal architecture, universal trends emerge, rationalized

HIGHLIGHT 8

through an effective globule model at macromolecular scales. The pronounced diffusivity decline with concentration stems from a nonactivated, excluded-volume-driven weak caging process, mediated by spatiotemporal intermolecular forces.

Our theory aligns closely with simulations and experimental viscosity data, offering testable predictions. The approach is extensible to other soft nanoparticles with intricate internal organization, paving the way for studies of kinetic arrest in macromolecular glasses.

"The dynamic and thermodynamic anomalies in fluids of single-chain nanoparticles stem from their unique internal architectures."

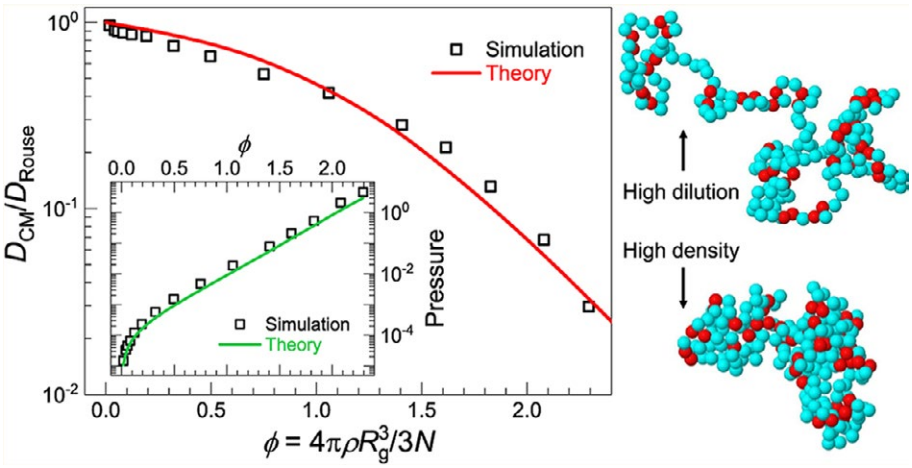


Figure: *Left: Rouse-normalized SCNP diffusivity (main plot) and pressure (inset) vs. macromolecular packing fraction. Simulation results (symbols) are in excellent agreement with the theory (lines). Right: Typical conformations of a sparse (disordered protein-like) SCNP at low and high concentration. Red beads are cross-linked monomers.*

HIGHLIGHT 9

Complexity of confined water vitrification and its glass transition temperature

Jorge H. Melillo, Daniele Cangialosi, Valerio Di Lisio, Elisa Steinrücken, Michael Vogel, and Silvina Cerveny.

Proceedings of the National Academy of Sciences 121, e2407030121 (2024)

The precise temperature at which water transforms into glass- a disordered, non-crystalline solid that lacks the long-range order of a crystal yet is rigid like a solid and not fluid like a liquid- remains a mystery because water tends to crystallize at low temperatures.

This temperature, known as the glass transition temperature (T_g), is crucial for various applications, including organ preservation, food freezing, and even insights into climate. This is due to the fact that, similar to conditions in the upper atmosphere, especially in polar stratospheric clouds, water can exist in amorphous (non-crystalline) forms, including glassy water. These amorphous ice structures can influence chemical reactions, radiative transfer, and phase transitions, each contributing to the climate system. Thus, understanding the T_g of water is essential for enhancing our climate process models and making more precise climate change predictions.

Here, we elucidate the glass transition of water by analyzing the calorimetric behavior of nano-confined water across various pore topologies (diameters: 0.3 to 2.5 nm). Our approach involves subjecting the confined water to annealing protocols to identify the temperature and time evolution of nonequilibrium glass kinetics. Furthermore, we enhance this calorimetric approach with the dynamics of confined water, as observed through broadband dielectric spectroscopy and linear calorimetric measurements, including the fast scanning technique. This study demonstrates that confined water undergoes a glass transition in the temperature range of 170 to 200 K, influenced by the confinement size and the interactions with the confinement walls. Moreover, we also illustrate that the thermal event recorded at ~136 K must be understood as an annealing prepeak, commonly referred to as the "shadow glass transition." Calorimetric measurements also facilitate the detection of a specific heat step above 200 K, which is unaffected

HIGHLIGHT 9

by annealing and, therefore, interpreted as a genuine thermodynamic transition. Lastly, by linking our findings to bulk water behavior, we comprehensively understand confined water vitrification.

"The glass transition of confined water occurs between 170 and 200 K."

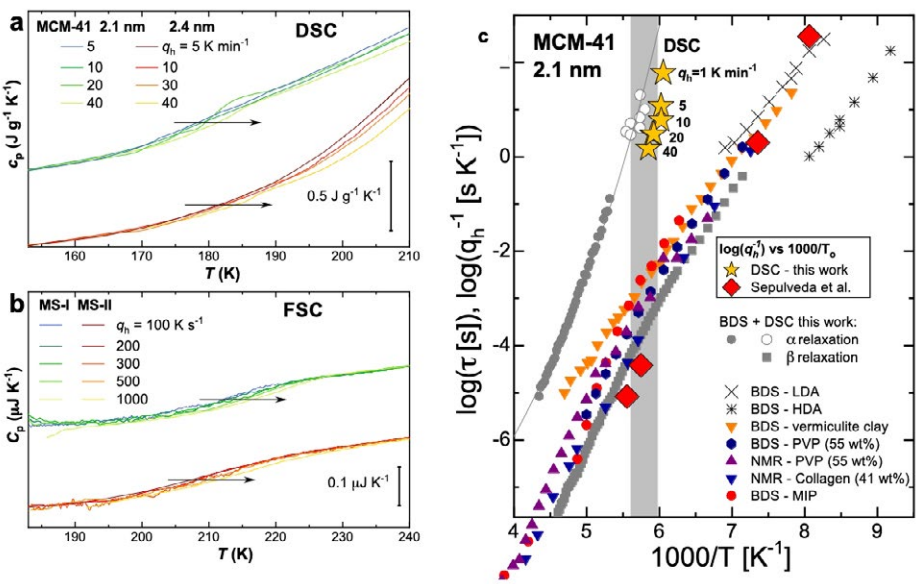


Figure: *Dependence of heat capacity with the heating ratio q_h for (a) MCM41 (2.1 and 2.4 nm) and MS-I (0.3 nm) and II (0.4 nm). Logarithmic relaxation times of water confined in MCM41 2.1 nm as a function of inverse temperature, compared to the heating rate dependence of the glass transition onset in (a) yellow stars. For comparison, the heating rate dependence of the glass transition onset of bulk water is included as red diamonds. Relaxation times for bulk LDA and HDA water, along with those of water confined in other systems, are added.*

HIGHLIGHT 10

Magnetically tunable supercurrent in dilute magnetic topological insulator-based Josephson junctions

Mandal P, Mondal S, Stehno MP, Ilic S, Bergeret FS, Klapwijk TM, Gould C, and Molenkamp LW.

Nature Physics 20, 984 (2024)

Through a collaboration between theory and experiment by the Würzburg and San Sebastián groups, a proximity-induced Fulde–Ferrell–Larkin–Ovchinnikov (pFFLO) state was realized in (Hg,Mn)Te-based Josephson junctions. Using tunable Zeeman fields, the team identified clear signatures of pFFLO behavior via critical current re-entrance and 0–π transitions under accessible experimental conditions.

The Fulde–Ferrell–Larkin–Ovchinnikov (FFLO) state, theorized over half a century ago, describes a superconducting state with a spatially modulated order parameter emerging under a spin-splitting field. Historically elusive in experiments, especially under accessible conditions, the FFLO state and its proximity-induced counterpart (pFFLO) have drawn considerable recent interest. In this collaborative work between the theory group in Würzburg and the experimentalists in San Sebastián, a breakthrough was achieved in realizing and controlling the pFFLO state in Josephson junctions based on a two-dimensional dilute magnetic topological insulator, (Hg,Mn)Te.

The key to this success lies in the unique tunability of the Zeeman energy enabled by manganese doping in (Hg,Mn)Te. The experimental team exploited this feature to finely adjust the spin-splitting field using modest in-plane magnetic fields. As predicted by theoretical modeling from Würzburg, this setup creates ideal conditions for the emergence of a pFFLO state. The observed multiple re-entrant behaviors of the supercurrent—transitions from superconducting to normal and back again—as a function of magnetic field and temperature are clear hallmarks of transitions between 0 and π ground states in the junction. This behavior strongly indicates the presence of a spatially modulated superconducting state.

Unlike prior systems, where tuning the exchange field was either impossible or impractically destructive to the superconductivity, this platform allows for

HIGHLIGHT 10

the observation of phase shifts and critical current re-entrance with unprecedented control. The synergy between theoretical predictions and targeted experiments was crucial for the interpretation.

This collaborative work not only confirms the existence of the pFFLO state under widely tunable and accessible conditions, but also opens the door to future studies on exotic superconducting states and novel quantum devices.

"A theory–experiment collaboration between the Würzburg and CFM teams reveals controllable pFFLO states in topological Josephson junctions."

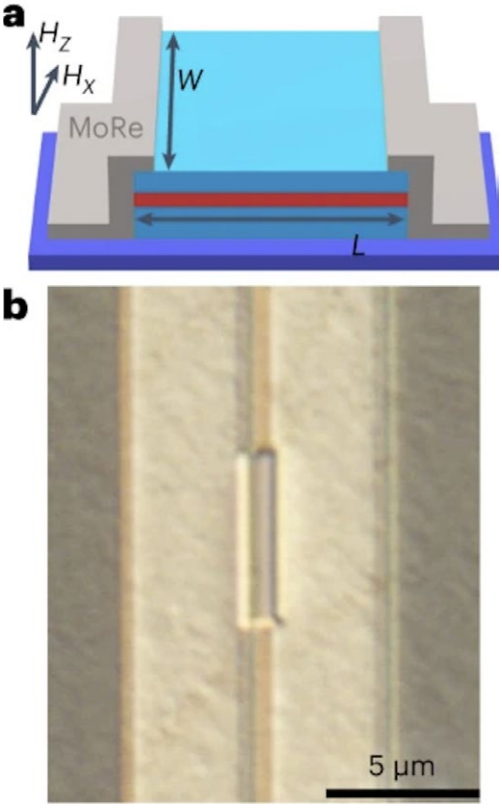


Figure 1: *Experimental setup*

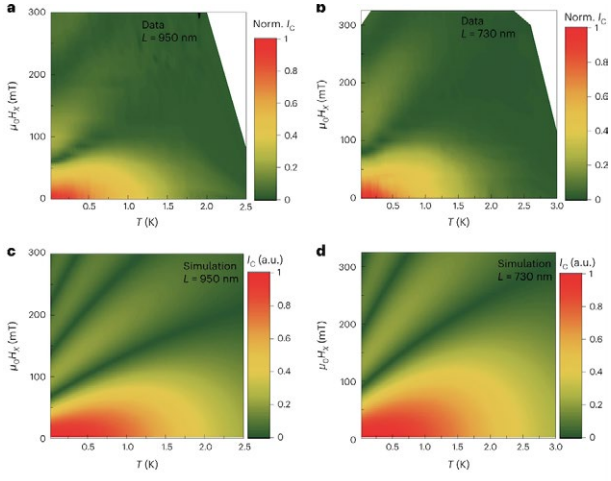


Figure 2: *Comparison between experiment (a,b) and theory (c,d): Critical current vs temperature and magnetic field.*

HIGHLIGHT 11

Modelling light emission from tunnelling nanojunctions

Unai Muniain, Ruben Esteban, Javier Aizpurua, and Jean-Jacques Greffet.

Physical Review X 14, 021017 (2024)

The tunnelling current established between two metallic electrodes at a nanojunction induces light emission, a not-yet-fully-understood process that can be leveraged to design novel sources of light. A unified description is developed that describes the light emission induced by inelastic processes in the entire nanojunction, including the metal electrodes.

A voltage applied at a junction formed by two metal electrodes separated by an insulator nanogap induces a continuous tunnelling current when the gap separation is small enough, of the order of a few nanometers. This continuous current can then lead to the emission of light at optical frequencies, as experimentally demonstrated.

A first explanation of light emission from the tunnelling junction considers inelastic tunnelling processes occurring in the insulator nanogap. However, recent experiments measure stronger emission than predicted by this model, a finding that can be assigned to the action of an alternative mechanism, the generation of hot charges at the metal itself.

In this work, performed by the "Theory of Nanophotonics" group at the Centro de Física de Materiales and the Donostia International Physics Center in San Sebastián, together with Prof. Jean-Jacques Greffet at the Institut d'Optique Graduate School in France, a unifying theoretical model of the light emission process is developed, the Quantum Device Solution (QDS). The QDS describes, within a single unified framework, the generation of photons by inelastic tunnelling processes occurring both at the insulator nanogap and at the metal electrodes, without invoking hot charge generation as a separate mechanism of light emission. The QDS also establishes the equivalence of the two previous descriptions of photon generation by inelastic tunnelling processes in the insulator nanogap, which considered either Fermi's golden rule or the excitation of resonant modes by quantum fluctuations of the current.

The predictions of the QDS, evaluated for a configuration of metallic layers of current experimental interest, show that under certain conditions more light is expected to be emitted when the inelastic processes at the metal electrodes are taken into account. The possibility of a strong additional increase of the emitted light due to non-local effects is also explored.

HIGHLIGHT 11

The QDS can thus guide the design of novel light sources based on photon emission induced by tunnelling currents in nanojunctions, and could be extended to describe the statistical properties of the emitted light.

Original publication: Unified Treatment of Light Emission by Inelastic Tunneling: Interaction of Electrons and Photons beyond the Gap

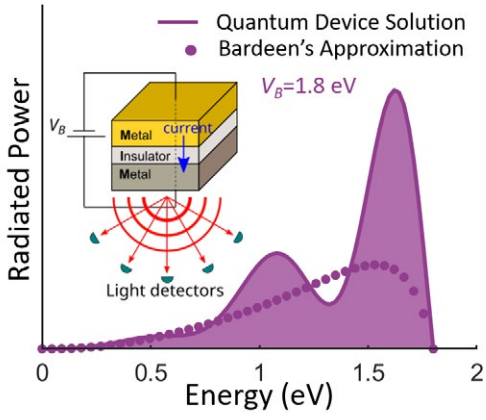


Figure: *Example of the spectrum of the light generated by a tunnelling current flowing through the sketched nanojunction. The results obtained with the Quantum Device Solution developed in this work predict much more light emission than Bardeen's approximation, an alternative approach that only consider the generation of photons by inelastic processes in the insulator nanogap*

"The Quantum Device Solution describes, within a single unified framework, the generation of photons by inelastic tunnelling processes occurring both at the insulator nanogap and at the metal electrodes."

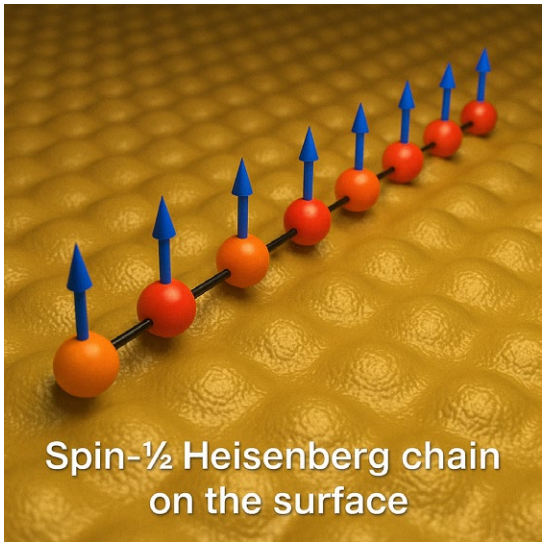
HIGHLIGHT 12

Unravelling topological states in quantum spin chains

Deung-Jang Choi, and Dario Bercioux.

Nature Nanotechnology 19, 1763 (2024)

Experimental realizations of a dimerized spin-½ Heisenberg chain using scanning tunneling microscopy have been reported. By tuning exchange interactions, they explore topological and trivial phases. These findings provide insight into low-dimensional quantum magnetism and offer direct evidence of edge states, advancing the study of symmetry-protected topological phases.



Low-dimensional spin systems have long served as essential models in classical and quantum physics, helping researchers explore complex phenomena such as synchronization and magnetism. Among these, the spin-½ Heisenberg model with dimerized exchange interactions has gained attention for its topological properties, particularly its resemblance to the spin-1 Haldane chain, a system known for exhibiting symmetry-protected topological (SPT) phases. This idea, proposed by F. D. M. Haldane in 1983, played a central role in his 2016 Nobel Prize in Physics.

Now, two independent studies—by Wang et al. and Zhao et al.—report experimental realizations of the dimerized spin-½ Heisenberg chain using low-temperature scanning tunneling microscopy (STM). In these systems, two types of exchange couplings (J_1 and J_2) define the magnetic interactions between spins. The model exhibits a gapped spectrum, and its topological or trivial nature depends on the relative strength of these couplings.

Zhao et al. synthesized chains of Clar's goblets ($C_{38}H_{18}$) on Au(111) surfaces, each carrying a spin-½. By controlling the chain's length, parity, and termination using STM tip-induced dehydrogenation, they tuned the system into topological or trivial phases.

Figure: *Schematic representation of a dimerized spin-½ Heisenberg chain in a topological phase, assembled on a surface. The alternating strong (J_2) and weak (J_1) exchange couplings lead to the emergence of unpaired edge spins, represented at both ends of the chain.*

HIGHLIGHT 12

Inelastic tunneling spectroscopy revealed zero-bias peaks at chain ends in the topological phase, indicating the presence of Kondo-screened edge spins.

Meanwhile, Wang et al. used atomic manipulation to construct spin chains of titanium atoms on MgO surfaces. By adjusting the spacing between atoms, they could control J_1 and J_2, effectively tuning the system through different topological regimes. This method enabled real-time observation of the appearance or disappearance of edge states, depending on the phase.

These two approaches provide direct experimental access to the topological features predicted in dimerized Heisenberg chains. Together, they mark a significant advancement in the manipulation and understanding of spin-based quantum systems, offering a new platform for exploring SPT phases and their associated quantum phenomena.

"Two pioneering experiments have successfully realized dimerized spin-½ Heisenberg chains, offering direct insight into topological quantum phases through atomically engineered spin systems."

HIGHLIGHT 13

Thermoelectric properties of the main species present in Portland cement pastes

Ridwan O. Agbaoye, Jozef Janovec, Andrés Ayuela, and Jorge S. Dolado.

Cement and Concrete Research 183, 107587 (2024)

We transform cement from passive structure to active power source. Advanced quantum simulations reveal that strategic doping in Portland cement components unlocks remarkable thermoelectric performance (Z) up to 0.79. This breakthrough paves the way for smart, energy-harvesting materials that turn everyday infrastructure into clean energy generators

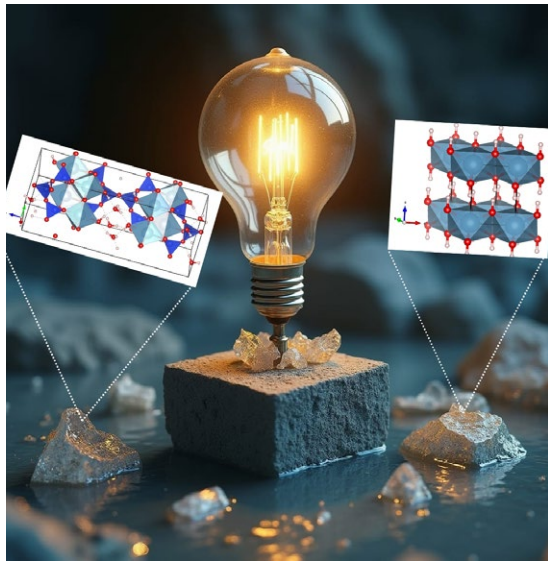


Figure 1: *Thermoelectricity in ordinary Portland cement.*

In the pursuit of sustainable energy solutions, thermoelectricity offers a compelling pathway converting wasted heat into usable electrical energy. While promising, its success hinges on enhancing the efficiency of thermoelectric materials. Cement and concrete, despite their ubiquity, remain under-explored in this context, with reported figures of merit still lingering between 10^{-7} and 10^{-9}. Unlocking their energy-harvesting potential requires improving the intrinsic thermoelectric properties of their core components. Notably, portlandite and tobermorite-11 exhibit inherently low lattice thermal conductivity, a critical advantage that significantly boosts their thermoelectric performance and positions them as promising candidates for next-generation smart construction materials.

Tobermorite-11, a key mineral found in cement, has shown unexpected promise as a thermoelectric material capable of converting heat into electricity. Within a hole carrier concentration range of 10^{20} to 10^{21} cm^{-3}, it delivers an impressive Seebeck coefficient of up to 400 μV/K, and a thermoelectric figure of merit (Z) between 0.5 and 0.79 across a practical temperature window of 350 K to 600 K. To enhance these properties, we explored p-type doping by replacing a silicon atom in the tobermorite structure with aluminum. This substitution introduces one hole per unit cell, effectively reaching an ideal carrier concentration of 10^{21} cm^{-3} and

HIGHLIGHT 13

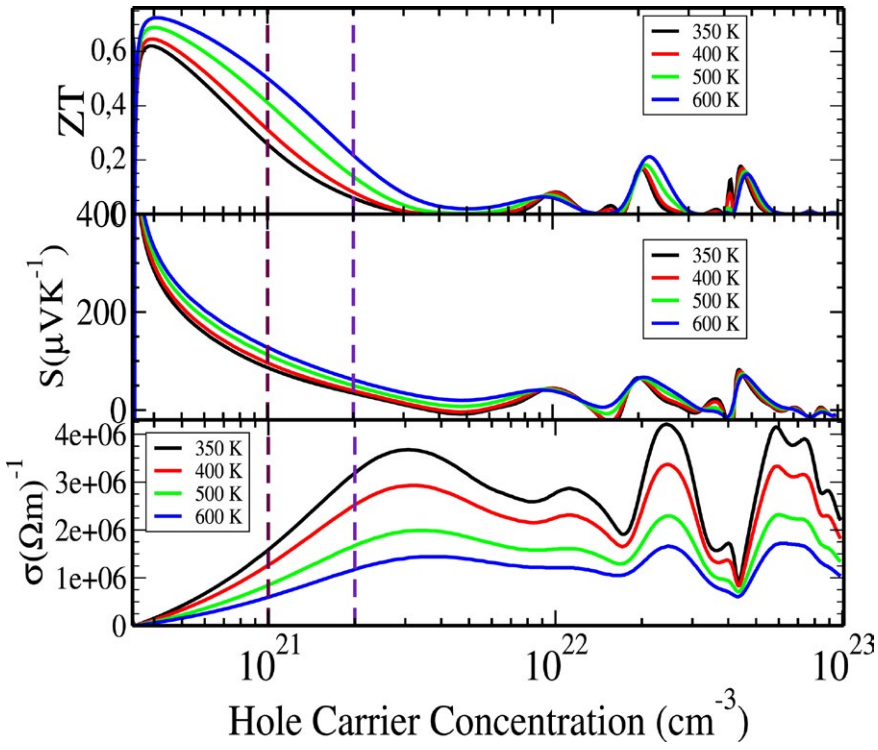


Figure 2: *Hole carrier Concentration-based thermoelectric properties of normal tobermorite-11 (Brown dashed line indicates doping tobermorite with one Al atom; Violet dashed line indicate doping tobermorite with two Al atom). (a) Figure of merit. (b) Seebeck coefficient. (c) Electrical conductivity.*

achieving a Z value of 0.5 at 600 K. However, while adding more aluminum increases electrical conductivity, it comes at a cost reducing both the Seebeck coefficient and the overall efficiency. Our findings reveal that optimal performance is achieved when one silicon atom is replaced by aluminum in every ten unit cells, maintaining a balance between conductivity and thermoelectric efficiency. These insights highlight a powerful strategy: through selective n- and p-type doping, we can engineer cement-based materials not just to build, but to actively harvest energy transforming concrete into a functional component of sustainable, energy-aware infrastructure.

"Imagine cement that doesn't just build, it powers. This study dives deep with atomistic simulations to awaken the hidden thermoelectric potential of cement materials. With precise p-type doping-elegantly replacing silicon with aluminum in tobermorite, we unlock a dramatic rise in performance. The result? A bold leap toward energy-harvesting cement composites that redefine what infrastructure can do."

HIGHLIGHT 14

Watching hybrid perovskites fall apart – a journey across physical space

Pelayo Marin-Villa, Mattia Gaboardi, Boby Joseph, Frederico Alabarse, Jeff Armstrong, Kacper Drużbicki, and Felix Fernandez-Alonso.

Journal of Physical Chemistry Letters 16, 184 (2024)

Hybrid perovskites constitute a promising platform for next-generation photovoltaics. But they are intrinsically unstable. For the first time, a combination of state-of-the-art radiation-scattering experiments and *ab initio* calculations across temperature and pressure identifies the mechanisms underpinning phase transformations, all the way up to the onset of structural collapse and eventual amorphization.

Hybrid organic-inorganic perovskites (HOIPs) continue to attract substantial attention owing to their remarkable photophysical response, of direct relevance to the deployment of next-generation photovoltaics. In spite of this promise, HOIPs exhibit hard-to-tame intrinsic and extrinsic instabilities that hamper further progress. Exploring how HOIPs may be stabilized or destabilized upon the application of external stimuli constitutes a key step in the journey. The use of physical pressure represents a means of achieving this goal, and the present work has capitalized from ongoing advances in radiation-scattering methodologies, along with extensive Ab-Initio Molecular Dynamics (AIMD) simulations. The figure presented below summarizes our experimental and computational results for the paradigmatic HOIP MethylAmmonium Lead Iodide (hereafter MAPI). The first thing to note is the richness of the phase diagram for this (seemingly simple!) HOIP, exhibiting five distinct phases below 350 K and 20 kbar. Previous high-pressure studies had been restricted to near-to-ambient conditions, where it is practically impossible to discern the static or dynamical nature of the disorder at the atomic and molecular scales. In particular, one is to note the marked negative slope of the phase boundary between the low-temperature (ordered) -phase and the two high-pressure (disordered) phases – that is, MAPI undergoes a clear contraction upon heating above the low-temperature triple point at 1 kbar. This result alone is already indicative of intrinsic instabilities at relatively modest pressures. The variation of the Formula-Unit Density (FUD) across the P-T diagram shown in the figure provides us with a model-independent assessment and validation of different structural models and the simulations. In particular, we find that the (high-symmetry) *Pnma* model inferred from previous studies at ambient pressure cannot give rise to the abrupt

HIGHLIGHT 14

structural contraction above 5 kbar observed in the experiments, marking the onset of structural collapse. Instead, relaxing the symmetry of the unit cell by avoiding the end-to-end ordering of the MA cations leads to an overall weakening of the N-H···I hydrogen bonds between organic and inorganic sub-lattices, in quantitative agreement with experiment. AIMD shows that eventual and irreversible amorphization is then driven by further and quite pronounced octahedral distortions of the inorganic framework, which becomes possible only under these circumstances.

Original publication: Methylammonium Lead Iodide across Physical Space: Phase Boundaries and Structural Collapse

"Radiation-scattering experiments and *ab initio* calculations across temperature and pressure reveal how methylammonium lead iodide breaks apart."

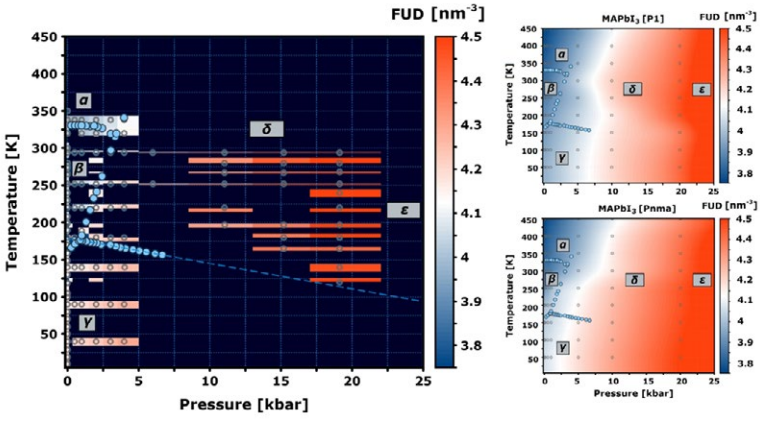


Figure: *The left panel shows the phase diagram of MAPI as a function of temperature and up to 25 kbar, obtained from the neutron and synchrotron X-ray data. The two figures on the right show the corresponding AIMD phase diagrams for the two structural models presented in the main text – low-symmetry (top) and high-symmetry (bottom). The heat maps in these figures give the corresponding formula-unit densities across the P-T plane. Grey (blue) symbols correspond to the specific points explored in our (previous) experiments. Greek letters denote the different phases of MAPI explored in this work.*

HIGHLIGHT 15

Ferromagnetic order in 2D layers of transition metal dichlorides

Andrea Aguirre, Andrés Pinar Solé, Diego Soler Polo, Carmen González-Orellana, Amitayush Thakur, Jon Ortuzar, Oleksandr Stesovych, Manish Kumar, Marina Peña-Díaz, Andrew Weber, Massimo Tallarida, Ji Dai, Jan Dreiser, Matthias Muntwiler, Celia Rogero, José Ignacio Pascual, Pavel Jelínek, Maxim Ilyn, and Martina Corso.

Advanced Materials 36, 2402723 (2024)

The fast increase of the family of magnetic two-dimensional materials led to the observation of different types of magnetic order in the 2D limit, as anti or ferromagnetism, non-collinear order or magnetic moiré effects. Here we demonstrate that the transition metals dichlorides $FeCl_2$ and $NiCl_2$ are soft ferromagnets. We explore the ferromagnetic order by surface sensitive techniques in ultra-high vacuum by combing averaging techniques as X-rays Magnetic Circular Dichroism (XMCD) with atomic scale scanning tunneling microscopy (STM). Decorating STM tips with a nickelocene molecule, we achieve high-resolution spin sensing due to exchange interactions between the molecule and the chlorides even at zero applied external magnetic field, thus demonstrating the effectiveness of combining both techniques to probe surface magnetism.

Transition metals dihalides are an ideal class of van der Waals layered materials that enable the study of magnetic phases as function of the transition metal and halide composition as predicted by theory. In this work, we characterize the magnetic and electronic properties of two-dimensional magnets based on metallic dichlorides. The materials can be epitaxially grown on the inert Au(111) surface in ultra-high vacuum and form flat layers electronically decoupled from the substrate. The materials are easily grown by thermal sublimation of molecular powders that lead to the formation of stoichiometric layers as confirmed by X-ray Photoelectron spectroscopy. Both materials exhibit semiconducting properties with a bandgap of about 4 eV. By synchrotron-based X-Ray Magnetic Circular Dichroism (XMCD) measurements we find that single layers of $FeCl_2$ and $NiCl_2$ are soft ferromagnets on Au(111) and their magnetization can be switched from out-of-plane to in-plane by substituting the metal ion from Fe to Ni. Using low temperature scanning tunneling microscopy (STM) with tips functionalized with a nickelocene molecule as magnetic sensor, we confirm the magnetic order of the materials at the atomic scale even at zero applied magnetic field. The spin-sensing is enabled by the exchange interaction occurring between the nickelocene and the metallic dichloride layer across the vacuum barrier that leads to changes in the spin excitation spectrum of nickelocene.

We thus established a correlation between the mesoscopic magnetic properties probed by XMCD and the atomic spins. Our results suggest that these 2D semiconducting magnets could be implemented in van der Waals heterostructures for applications in spintronics and opto-spintronics.

HIGHLIGHT 15

"Exploring the ferromagnetic order in the new class of 2D materials transition metal dichlorides at the macroscopic and atomic scale."

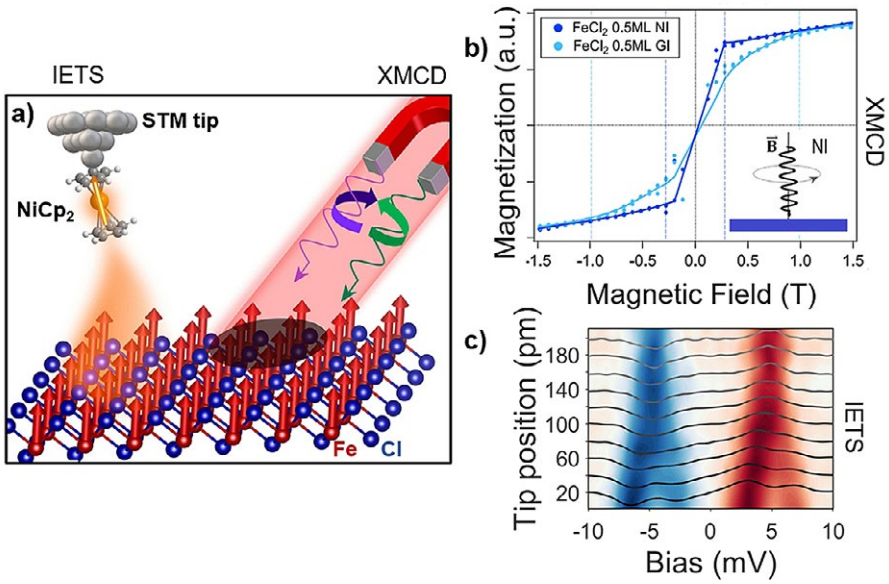


Figure a) *Experimental characterization of the ferromagnetic order at the single layer limit of van der Waals materials based on transition metal dichlorides.* **b)** *XMCD Magnetization loop measured at the L_3 Fe edge for a submonolayer of $FeCl_2$ grown on Au(111) at normal (NI) and grazing incidence (GI) at 3 K. Saturation is reached at NI before than at GI. The inset is a scheme of the incidence angle corresponding to the out-of-plane easy axis of magnetization direction for $FeCl_2$.* **c)** *Inelastic tunneling spectroscopic measurement showing the second derivative conductance map taken by approaching a nickelocene molecule (NiCp2) on $FeCl_2$ without external magnetic field applied. The splitting of the IETS peaks corresponds to the breaking of the degeneracy of the excited states of $NiCp_2$ due to the presence of the effective magnetic field of $FeCl_2$.*

HIGHLIGHT 16

Better together: a multiscale, multitechnique look at the electrochemical interface

Ernest Pastor, Zan Lian, Lu Xia, David Ecija, José Ramón Galán-Mascarós, Sara Barja, Sixto Giménez, Jordi Arbiol, Núria López, and F. Pelayo García de Arquer.

Nature Reviews Chemistry 8, 159 (2024)

Understanding electrochemical interfaces is vital for advancing energy conversion technologies. Innovative combinations of optoelectronic techniques and modeling now allow researchers to visualize and interpret the complex, evolving nature of these interfaces. This multiscale approach enables deeper mechanistic insight, accelerating the design of efficient, stable, and sustainable electrochemical systems.

Electrochemical systems such as fuel cells, electrolyzers, and batteries rely on dynamic interfaces where solid materials interact with liquid or gaseous environments. These electrochemical interfaces (EIs) govern critical processes like charge transfer, catalysis, and surface restructuring, but their complexity makes them notoriously difficult to study in real time.

Recent research has demonstrated how combining advanced probing techniques can provide a much more complete picture of these interfaces in action. By integrating methods such as X-ray diffraction, Raman spectroscopy, and in situ microscopy, scientists can now observe the morphological, chemical, and electronic evolution of materials during operation. These complementary approaches allow for the identification of active sites, detection of transient intermediates, and monitoring of catalyst reconstruction under applied potentials.

In addition to experimental strategies, theoretical models—based on density functional theory, microkinetic simulations, and increasingly powered by artificial intelligence—are being refined using experimental data. AI helps accelerate pattern recognition, extract trends across large datasets, and guide the exploration of materials space. This synergy facilitates the prediction of stable phases and optimal reaction pathways, aligning simulations with operando observations. Such dual approaches are essential to decode the structure–function relationships that dictate catalytic activity and selectivity.

Particularly notable are the insights gained into processes like CO_2 reduction and hydrogen evolution, where surface morphology, strain effects, and chemical environment play pivotal roles. Techniques like

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surface-enhanced infrared absorption spectroscopy, X-ray photoemission and scanning probe microscopy reveal localized behavior at the nanoscale, while spectroelectrochemical imaging provides spatially resolved maps of activity.

By bridging multiple spatial and temporal scales with cross-disciplinary tools, this multitechnique exploration is reshaping how electrochemical systems are understood and optimized.

Original publication: Complementary probes for the electrochemical interface

"Key to the green transition, the electrochemical interface shapes how we convert and store energy."

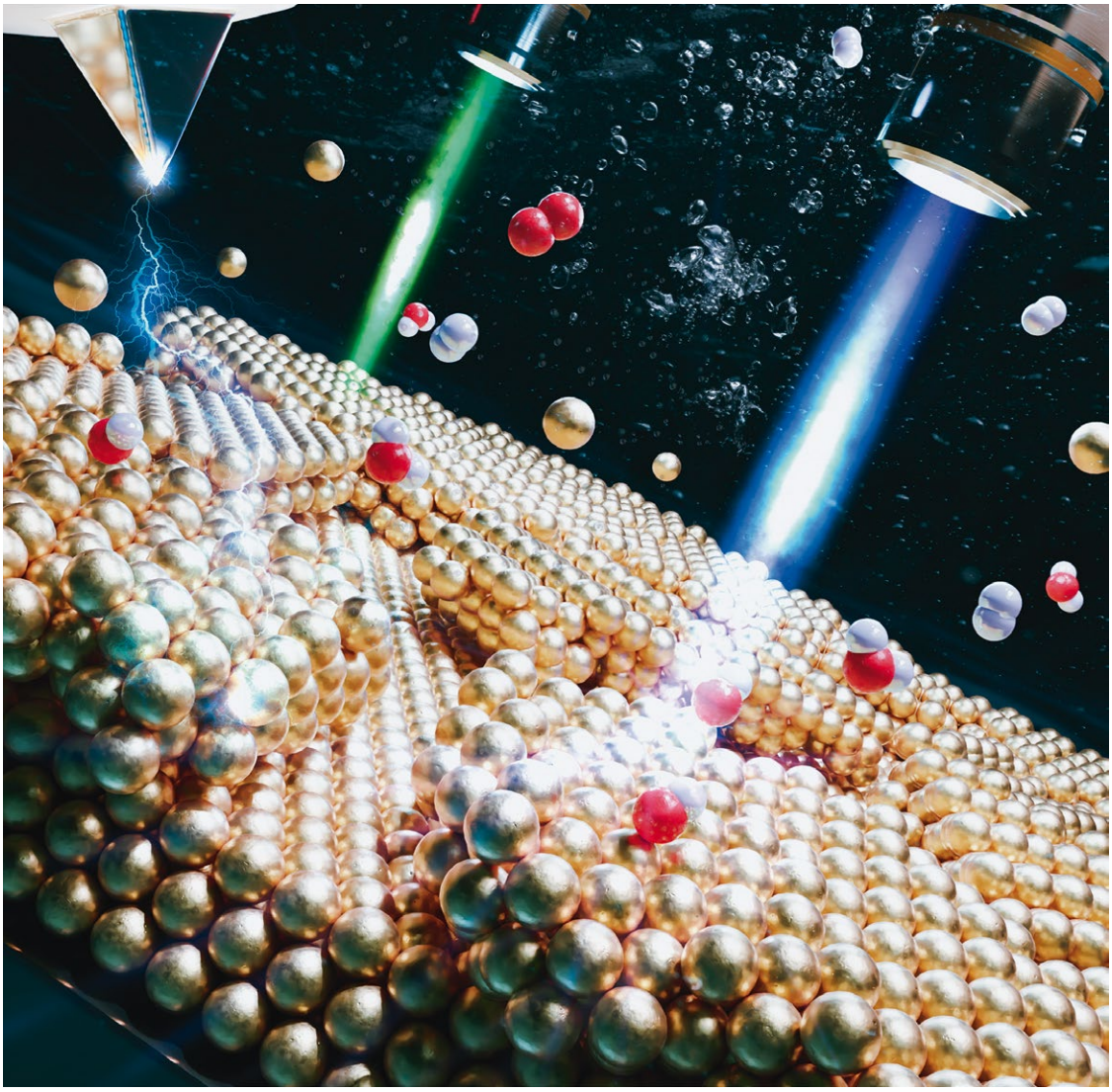

Figure: *Artistic visualization of the electrochemical interface as a dynamic frontier—explored through the integration of optoelectronic, mechanical, and electrochemical techniques, revealing the multiscale processes driving energy transformation. Cover Nature Reviews Chemistry March 2024.*

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Diego J, Subires D, Said AH, Chaney DA, Korshunov A, Garbarino G, Diekmann F, Mahatha SK, Pardo V, Wilkinson JM, Lord JS, Strempfer J, Perez PJB, Francoual S, Popescu C, Tallarida M, Dai J, Bianco R, Monacelli L, Calandra M, Bosak A, Mauri F, Rossnagel K, Fumega AO, Errea I, and Blanco-Canosa S.
Physical Review B 109, 35133 (2024)

192 **Probing surface and bulk ground states of lanthanides: 4f moment orientation through 4d X-ray absorption spectroscopy**
Usachov DY, Bokai KA, Klimovskikh II, Ali K, Schiller F, Poelchen G, Stolyarov VS, Kliemt K, Krellner C, and Vyalikh DV.
Physical Review B 110, 075157 (2024)

193 **Origin of spin reorientation and intrinsic anomalous Hall effect in the kagome ferrimagnet $TbMn_6Sn_6$**
Jones DC, Das S, Bhandari H, Liu XX, Siegfried P, Ghimire MP, Tsirkin SS, Mazin II, and Ghimire NJ.
Physical Review B 110, 115134 (2024)

194 **Computing Floquet quasienergies in finite and extended systems: role of electromagnetic and quantum-geometric gauges**
Puente-Uriona AR, Modugno M, Souza I, and Ibañez-Azpiroz J.
Physical Review B 110, 125203 (2024)

PUBLICATIONS

195 **Interplay between strain and size quantization in a class of topological insulators based on inverted-band semiconductors**
Khaetskii A, Golovach V, and Kiefer A.
Physical Review B 110, 155301 (2024)

196 **Theoretical model for multiorbital Kondo screening in strongly correlated molecules with several unpaired electrons**
Calvo-Fernández A, Kumar M, Soler-Polo D, Eiguren A, Blanco-Rey M, and Jelínek P. Physical Review B 110, 165113 (2024)

197 **Molecularity: a fast and efficient criterion for probing superconductivity**
di Mauro ME, Braïda B, Errea I, Novoa T, and Contreras-García J.
Physical Review B 110, 174515 (2024)

198 **Interplay between Dirac and Rashba surface states specific for topologically nontrivial van der Waals superlattices**
Shvets IA, Chulkov E, and Eremeev S.
Physical review B 110, 205113 (2024)

199 **In-gap states induced by magnetic impurities on wide-band s-wave superconductors: self-consistent calculations**
Jyoti D, Choi DJ, and Lorente N.
Physical Review B 110, 205404 (2024)

200 **Diluted Yu-Shiba-Rusinov arrays on the anisotropic superconductor β-Bi_2Pd**
Trivini S, Ortuzar J, Zaldivar J, Herrera E, Guillamón I, Suderow H, Bergeret FS, and Pascual JI.
Physical Review B 110, 235405 (2024)

201 **Superconducting diode effect in diffusive superconductors and Josephson junctions with Rashba spin-orbit coupling**
Ilic S, Virtanen P, Crawford D, Heikkila TT, and Bergeret FS.
Physical Review B 110, L140501 (2024)

202 **Understanding the interlayer coupling in 1T/1H-$NbSei_2$ heterobilayers**
Pico R, Abufager P, Hamad I, Robles R, and Lorente N.
Physical Review B, 075427 82024)

203 **Atomically precise step grids for the engineering of helical states**
Ortega JE, Vasseur G, Schiller F, Piquero-Zulaica I, Weber AP, Rault J, Valbuena MA, Schirone S, Matencio S, Sviatkin LA, Terenteva DV, Koroteev YM, Chulkov EV, Mugarza A, and Lobo-Checa J.
Physical Review B, 109 (2024)

204 **Odd nonlinear conductivity under spatial inversion in chiral tellurium**
Suárez-Rodríguez M, Martín-García B, Skowronski W, Calavalle F, Tsirkin SS, Souza I, De Juan F, Chuvilin A, Fert A, Gobbi M, Casanova F, and Hueso LE.
Physical Review Letters 132, 046303 (2024)

205 **Twofold facet of kinetics of glass aging**
Di Lisio V, Rocchi LA, and Cangialosi D.
Physical Review Letters 133, 048201 (2024)

206 **Large orbital moment and dynamical Jahn-Teller effect of AlCl-phthalocyanine on Cu(100)**
Li C, Bocquet ML, Lu Y, Lorente N, Gruber M, Berndt R, and Weismann A.
Physical Review Letters 133, 126201 (2024)

PUBLICATIONS

207 **Direct evidence of induced magnetic moment in Se and the role of misplaced Mn in MnBi Se -based intrinsic magnetic topological insulator heterostructures**
Fukushima R, Antonov VN, Otrokov MM, Sasaki TT, Akiyama R, Sumida K, Ishihara K, Ichinokura S, Tanaka K, Takeda Y, Salinas DP, Eremeev S, Chulkov E, Ernst A, and Hirahara T.
Physical Review Materials 8, 084202 (2024)

208 **Weak localization at arbitrary disorder strength in systems with generic spin-dependent fields**
Hijano A, Ilic S, and Bergeret FS.
Physical Review Research 6, 023100 (2024)

209 **Tailoring the statistics of light emitted from two interacting quantum emitters**
Juan-Delgado A, Esteban R, Nodar A, Trebbia JB, Lounis B, and Aizpurua J.
Physical Review Research 6, 023207 (2024)

210 **Topological phase diagram of optimally shaken honeycomb lattices: a dual perspective from stroboscopic and nonstroboscopic Floquet Hamiltonians**
Puente-Uriona AR, Pettini G, and Modugno M.
Physical Review Research 6, 023244 (2024)

211 **Computational study of elastic waves generated by ultrafast demagnetization in fcc Ni**
Korniienko I, Nieves P, Fraile A, Iglesias R, and Legut D.
Physical Review Research 6, 023311 (2024)

212 **Probing magnetic and triplet correlations in spin-split superconductors with magnetic impurities**
Huang CH, Skurativska A, Bergeret FS, and Cazalilla MA.
Physical Review Research 6, 033022 (2024)

213 **Spheres of maximum electromagnetic chirality**
Olmos-Trigo J, Nieto-Vesperinas M, and Molina-Terriza G.
Physical Review Research 6, 043192 (2024)

214 **Origin of the Kerker phenomena**
Lasa-Alonso J, Devescovi C, Maciel-Escudero C, García-Etxarri A, and Molina-Terriza G.
Physical Review Research 6, 043311 (2024)

215 **Capturing near-field circular dichroism enhancements from far-field measurements**
Olmos-Trigo J, Lasa-Alonso J, Gómez-Viloria I, Molina-Terriza G, and García-Etxarri A. Physical Review Research 6, 13151 (2024)

216 **Unified treatment of light emission by inelastic tunneling: interaction of electrons and photons beyond the gap**
Muniain U, Esteban R, Aizpurua J, and Greffet JJ.
Physical Review X 14, 021017 (2024)

217 **Connecting dynamics and thermodynamics in polymer-resin cured systems**
Miccio LA, Sill C, Wehlack C, and Schwartz GA.
Polymers 16, 3508 (2024)

218 **Gold nanoclusters synthesized within single-chain nanoparticles as catalytic nanoreactors in water**
Pinacho-Olaciregui J, Verde-Sesto E, Taton D, and Pomposo JA.
Polymers 16, 378 (2024)

PUBLICATIONS

219 **Complexity of confined water vitrification and its glass transition temperature**
Melillo JH, Cangialosi D, Di Lisio V, Steinrücken E, Vogel M, and Cerveny S.
Proceedingsof the National Academy of Sciences of the United States of America 121, e2407030121 (2024)

220 **Diverse crystalline protein scaffolds through metal-dependent polymorphism**
Liutkus M, Sasselli IR, and Rojas AL.
Protein Science 33, e4971 (2024)

221 **Hetero-functionalization of polyitaconates for developing improved polymer dielectrics: merging sulfones with bulky/rigid cycles**
Bonardd S, Maiz J, Alegria A, Pomposo JA, Sesto EV, Kortaberria G, and Diaz D.
Reactive & Functional Polymers 196, 105842 (2024)

222 **Wannier-function software ecosystem for materials simulations**
Marrazzo A, Beck S, Margine ER, Marzari N, Mostofi AA, Qiao JF, Souza I, Tsirkin SS, Yates JR, and Pizzi G.
Reviews of Modern Physics 96, 045008 (2024)

223 **Influence of barium substitution on the physical, thermal, optical and luminescence properties of Sm^{3+}-doped metaphosphate glasses for reddish orange light applications**
Mrabet H, Khattech I, Bouzidi S, Kechiche L, Jbeli A, Al Harbi N, Bouzidi C, Munoz F, and Balda R.
RSC Advances 14, 2070 (2024)

224 **Low density phases of TiO_2 by cluster self-assembly**
Aguilera-Granja F, and Ayuela A.
Scientific Reports 14, 12491 (2024)

225 **Quantum-inspired clustering with light**
Varga M, Bermejo P, Pellicer-Guridi R, Orús R, and Molina-Terriza G.
Scientific Reports 14, 21726 (2024)

226 **Efficient computational modeling of electronic stopping power of organic polymers for proton therapy optimization**
Matias F, Silva TF, Koval NE, Pereira JJN, Antunes PCG, Siqueira PTD, Tabacniks MH, Yoriyaz H, Shorto JMB, and Grande PL.
Scientific Reports 14, 9868 (2024)

227 **Nonreciprocal superconducting transport and the spin Hall effect in gyrotropic structures**
Kokkeler T, Tokatly I, and Bergeret FS.
Scipost Physics 16, 55 (2024)

228 **The role of rare-earth atoms in the anisotropy and antiferromagnetic exchange coupling at a hybrid metal-organic interface**
Blanco-Rey M, Castrillo R, Ali K, Gargiani P, Ilyn M, Gastaldo M, Paradinas M, Valbuena MA, Mugarza A, Ortega JE, Schiller F, and Fernández L.
Small 20, 2402328 (2024)

229 **Thermoplasmonic effect enables indirect ON-OFF control over the Z-E isomerization of azobenzene-based photoswitch**
Tarnowicz-Staniak N, Staniak M, Dudek M, Grzelczak M, and Matczyszyn K.
Small 20, 2404755 (2024)

PUBLICATIONS

230 **Exploring the interaction of lipid bilayers with curcumin-laponite nanoparticles: implications for drug delivery and therapeutic applications**
Pawar N, Peña-Figueroa M, Verde-Sesto E, Maestro A, and Alvarez-Fernandez A.
Small 20, 2406885 (2024)

231 **Amplifying sensing capabilities: combining plasmonic resonances and Fresnel reflections through multivariate analysis**
Etxebarria-Elezgarai J, Bergamini L, Lopez E, Morant-Miñana MC, Adam J, Zabala N, Aizpurua J, and Seifert A.
Small Methods, 2301445 (2024)

232 **Softness matters: effects of compression on the behavior of adsorbed microgels at interfaces**
Gerelli Y, Camerin F, Bochenek S, Schmidt MM, Maestro A, Richtering W, Zaccarelli E, and Scotti A.
Soft Matter 20, 3653 (2024)

233 **Multifaceted design of surface passivator for upgraded charge extraction in perovskite solar cells**
Gassara M, Kazim S, and Ahmad S.
Solar RRL 8, 2400438 (2024)

234 **Straight sections of step edges on a NiAl(110) curved single crystal surface used to calculate an approximation of step formation energy**
Piñeiros-Bastidas JM, Auras S, and Juurlink LBF.
Surface Science 749, 122545 (2024)

235 **Effect of ferrocene on physicochemical properties of biochar extracted from windmill palm tree (Trachycarpus fortunei)**
Adel AM, Martinez-Sabando J, Al-Shemy MT, and Cerveny S.
Waste and Biomass Valorization 15, 1031 (2024)

BOOK CHAPTERS

Advances in Atom and Single Molecule Machines

Robles R and Lorente N.
Asymmetric Energy Barriers in Unidirectional Molecule-Rotors

Lecture Notes of the Joint EPS-SIF International School on Energy - Course 7: Global Challenges for Energy Sustainability

T.S. Northam de la Fuente, I. Vettori, K.M. Ismail, M. Gaboardi, V. Di Lisio, D.Cangialosi, P.B. Coto, A. Otero-de-la-Roza, F. Fernandez-Alonso
New Materials for the Recovery and Storage of Thermal Energy

EDUCATION

As a joint center which belongs to the University of the Basque Country (UPV/EHU), the training activities at CFM include the participation in both the Master and PhD program through the Department of Material Physics of UPV/EHU, as well as setting complementary training activities and post-doctoral researchers training. All these activities are strongly related to and coordinated with the research activities of the different research groups at CFM. In the following we note the main aspects of the education program at CFM.

POST-DOCTORAL EDUCATION

CFM encourages the research groups to hire post-doctoral researchers through internal calls, which support around 2-3 post-doc positions every year. Post-doctoral researchers make extremely valuable contributions to the research activities, but they are at an early stage of their scientific careers, which means that they still need to acquire further research skills to successfully develop their scientific careers at a later stage. Therefore each research group makes an individual follow-up and training program for these young researchers.

PHD PROGRAM: PHYSICS OF NANOSTRUCTURES AND ADVANCED MATERIALS

"Physics of Nanostructures and Advanced Materials" is a PhD program of UPV/EHU that has been recognized as a highly qualified PhD program by the Spanish Ministry of Education (MEE2011-0591 citation of excellence). Within this program, more than 70 pre-doctoral researchers develop their research fully embedded in the daily life of the research groups in the center.

The aforementioned PhD program participates in the European Doctorate Program of "Physics and Chemistry of Advanced Materials" (PCAM). PCAM is a European research network of doctoral programs focusing on various aspects of the physics and chemistry of advanced materials.

DEFENDED PHD THESES

- **Tuning the dimensionality of supramolecular functional materials based on the rational design of biomolecules**
  Author: Laura Perez-Chirinos Lallana
  Supervisors: Ivan Sasselli Ramos
  26/01/2024

- **Probing nanoscale light-matter interactions with fast electrons and near-field optical probes**
  Author: Carlos Alberto Maciel Escudero
  Supervisors: Javier Aizpurua Iriazabal, and Rainer Hillenbrand (CIC nanoGUNE)
  09/02/2024

- **Non-equilibrium properties of superconducting structures in the presence of spin-dependent fields**
  Author: Alberto Hijano Mendizabal
  Supervisors: F. Sebastián Bergeret Sbarbaro, and José María Pitarke de la Torre
  23/02/2024

- **Multi-scale modelling and design of Thermal Energy Storage (TES) devices based on cement-based materials**
  Author: Mohammad Rahjoo
  Supervisors: Jorge Sánchez Dolado, and María Esther Rojas Bravo (CIEMAT-Solar Platform of Almería)
  23/02/2024

- **Vitrocerámicos nanocristalinos luminiscentes de alta calidad óptica**
  Author: Mercedes Sedano
  Supervisors: María Jesús Pascual (Instituto de Cerámica y Vidrio), and Rolindes Balda
  07/03/2024

- **Synthesis of Copper-free Stable Single-Chain Nanoparticles**
  Author: Agustín Blázquez Martín
  Supervisor: José A. Pomposo, and María Ester Verde Sesto
  08/03/2024

- **A Rigorous Exploration of the Plexcitonic Phenomena: Hybridized Light-Matter States using Gold Nanoparticles and J-aggregates**
  Author: Alba María Jumbo Nogales
  Supervisors: Yury Rakovich, and Marek Grzelczak
  10/05/2024

- **Lattice effects and phase transitions in topological materials**
  Author: Martín Gutierrez Amigo
  Supervisors: Juan Luis Mañes Palacios (UPV/EHU), and Ion Errea Lope
  22/07/2024

- **Bright Shining Single-Chain Nanoparticles: Advanced Applications in Photocatalysis and Photodynamic Therapy**
  Author: Davide Arena
  Supervisors: José A. Pomposo, and María Ester Verde Sesto
  27/09/2024

- **Synergistic study of surface science and electrochemistry: Unraveling the mechanism of oxygen evolution reaction**
  Author: Marina Peña Díaz
  Supervisors: Sara Barja Martínez, and Celia Rogero Blanco
  04/10/2024

- **Gold Nanoparticles as Components of Advanced Hybrid Materials Employing Light to Control the Course of Chemical Processes**
  Author: Nina Tarnowicz-Staniak (Wrocław University of Science and Technology)
  Supervisor: Marek Grzelczak
  28/11/2024

- **Anharmonic effects in two-dimensional systems: charge density wave transitions and their mechanical stability**
  Author: Josu Diego López
  Supervisors: Ion Errea Lope, and Raffaello Bianco (University of Modena and Reggio Emilia)
  05/12/2024

SHORT STAYS AT FOREIGN UNIVERSITIES

A very important aspect of the PhD training program consists of supporting short stays in foreign universities and centers for PhD students. This year 6 pre-doctoral researchers have spent about 2-3 months in some of the best international centers on their topics. This training activity combines aspects of internationalization and excellence, and has been strongly supported by CFM over the last years. The following pre-doctoral researchers benefited from an internship abroad supported by CFM in 2024:

- **Zuzanna Lawera**
  NeuroTechnology Center at Columbia University, USA
  01/01/2024 - 30/03/2024

- **Xabier Arrieta Aristi**
  Institute of Physics of the Czech Academy of Sciences
  05/04/2024 - 07/06/2024

- **Vasiliki Maria Stavropoulou**
  Université libre de Bruxelles (UlB) in Brussels, Belgium
  08/04/2024 - 8/07/2024

- **Isaac Tribaldo Ramírez**
  University of Graz Institute of Physics, Austria
  01/05/2024 - 31/07/2024

- **Alaa Mohammed Idris**
  Physics Department of the University of Trieste, Italia
  01/09/2024 - 30/11/2024

- **Álvaro Ruiz Puente**
  Università degli Studi di Firenze, Italia
  16/09/2024 - 16/12/2024

TRANSFERABLE SKILLS PROGRAM

Equipping researchers with skills beyond the purely scientific is a challenge that institutions are beginning to take up in the framework of what is known as the "transferable skills" education programs. Organized by Aitzol García-Etxarri (DIPC, Ikerbasque) and Gustavo A. Schwartz Pomeraniec (DIPC, CFM-CSIC) a full program was launched in 2024 covering issues like stress management, time and career management or transformative leadership. 40 researchers joined these courses in 2024.

Oral presentation skills training

Sofía Facal
Skills for Science and Industry

First Edition: 14, 21 and 28/05/2024

Second Edition: 7, 13 and 21/06/ 2024

DIPC Josebe Olarra Auditorium, Donostia/ San Sebastián

The ability to communicate complex topics in a clear and efficient way is a key skill in the academic field, as the success of bright ideas, great initiatives and promising projects can depend significantly on how they are presented.

SESSION 1: Before the presentation	SESSION 2: During the presentation	SESSION 3: After the presentation
• Understanding your audience	• Body language	• Delivering the 10 mins talk you have prepared
• Structuring your message	• Voice and articulation	• Constructive feedback
• Designing effective slides	• Anti-nervousness program	• Techniques for a Successful Q&A session
• Timing your talk	• Stress management	• Designing and presenting scientific posters
• What do people care most about scientific talks		

Generative AI: useful tools or expensive toys?

Tim Smithers

13/06/2024

DIPC Josebe Olarra Auditorium, Donostia/San Sebastián

The purpose of this course was to examine the benefits and risks of Generative AI systems, such as ChatGPT, in common research practices.

Generative AI systems now cover text, sound (speech and music), image, and video, generation, and combinations of these. A basic understanding of how these systems work and what they really do is needed to be able to judge well if and how they may be used in professional research practices, such as preparing research publications, funding proposals, presentations and talks, and computer code. Understanding how ChatGPT works and how the (so-called) Large Language Model (LLM) inside it is built does provide a good basis for deciding how and when good use might be made of any of the Generative AI systems. The important ethical issues and hazards raised by using ChatGPT in research practices are also common across the other kinds of Generative AI systems.

Balancing science and self: advanced soft skills for PI's

Sofía Facal
Skills for Science and Industry

16, 23 and 30/10/2024

CFM Auditorium & DIPC Josebe Olarra Auditorium, Donostia/San Sebastián

The training program "Balancing Science and Self: Advanced Soft Skills for PIs" was designed to address the need for soft skills development among Principal Investigators (PIs). The role of a PI goes beyond technical expertise, as they are responsible for shaping the direction of their research teams and fostering a good working culture.

Stress management, effective communication, emotional intelligence, and interpersonal skills form the backbone of successful leadership, creating a positive and collaborative environment where team members feel valued and supported. This training recognized the importance of soft skills and provided tools, the necessary self-reflection for each PI to lead, influence, and nurture within their own unique style, their research groups.

This training program was designed for researchers who seek to improve the art of balancing their scientific career with personal well-being. Through interactive sessions, they reflected on advanced soft skills, discovered effective stress management techniques, and explored strategies to achieve a healthy work-life balance. Our goal was to foster resilient, mindful, and highly effective leaders in the research community.

SESSION 1: Mastering self-awareness and mindfulness in leadership	SESSION 2: Effective stress management for research leaders	SESSION 3: Advanced communication and conflict resolution
• Techniques to increase self-awareness and understand its impact on leadership style and team dynamics.	• Tools to recognize and address common stressors.	• Communication Skills: Advanced strategies for clear, empathetic, and effective communication within diverse research teams.
• Practical mindfulness exercises for busy schedules to enhance focus, reduce stress, and improve decision-making.	• A toolkit of stress reduction methods, including time management, prioritization, and relaxation techniques.	• Conflict Resolution: Approaches to resolving disagreements and conflicts in a way that promotes growth, understanding, and cohesion within the team.
• Strategies to manage emotions and understand the emotional needs of team members, fostering a supportive and productive research environment.	• Strategies to cultivate a research environment that promotes mental health, resilience, and well-being among team members.	• This training aims to improve P.I.s' abilities to lead with empathy, manage stress effectively, and maintain a fulfilling work-life balance, therefore improving both their personal well-being and the working environment of their research teams.
	• Understanding the importance of balance for long-term productivity and personal well-being.	

I PHD DAY

In 2024 we celebrated the first edition of the CFM PhD Day. During the day, all the mid-career PhD students, supervised by the CFM scientific staff, gave a short talk to a general scientific audience. It brought together more than 100 researchers from our centre, being a unique opportunity to learn about the ongoing projects, promote the exchange of knowledge and strengthen ties between all members of the community, as it is a meeting point for all CFM scientific staff.

MASTER EDUCATION PROGRAM

MASTER IN NANOSCIENCE

The Master in Nanoscience, an official UPV/EHU program held at CFM, offers students the chance to complete a Master thesis with research groups at the center. They gain hands-on experience in advanced materials research and can choose between applied or fundamental research paths, potentially leading to a PhD program.

SCHOLARSHIPS

The Materials Physics Center (MPC) research association offers scholarships to highly motivated graduates who are planning to complete their studies with a Master's degree. In 2024, two graduates were awarded scholarships for the Master in Nanoscience program:

- **Irene Chamborro Martinez**
- **Lucia Suarez Menéndez**

THESES OF THE NANOSCIENCE MASTER SUCCESSFULLY DEFENDED IN 2024

- **Fabrication and characterization of Ag_2Te nanostructures**
  Author: Jakub Stastny
  Supervisors: Rainer Hillenbrand (CIC nanoGUNE) and Maria Barra Burillo (CIC nanoGUNE)

- **Area Selective Infiltration of polymers with inorganics**
  Author: Silvia Mirallas
  Supervisor: Mato Knez (CIC nanoGUNE)

- **Investigation of the interfaces between chemisorbed charge transfer complexes and rare earth surface alloys**
  Author: Daniela Hruba
  Supervisor: Celia Rogero Blanco

- **Hybrid Perovskites for Photovoltaics: A Critical Appraisal of Synthetic Routes towards Deuteration**
  Author: Irene Chamborro
  Supervisor: Felix Fernandez

- **Organic intercalation of 2H-TaS_2**
  Author: Enrique Ayllon
  Supervisors: Luis Hueso (CIC nanoGUNE) and Maider Ormaza (UPV/EHU)

- **Study of the formation of lipid membranes and their interactions with polypeptides (CTPR) and endocytic proteins (CALM)**
  Author: Lucía Suárez Menéndez
  Supervisors: Armando Maestro Martin and Alberto Álvarez Fernández

- **Aromatic poly(ester)s incorporating sulfur-based amino acid residues as high-dielectric polymer materials**
  Author: Chioma I. Aja
  Supervisors: Jose A. Pomposo and Jon Maiz

- **Growth of two-dimensional transition metal dihalides (TMH2) heterostructures on Au(111) and Ag(111)**
  Author: Leidy Johanna Suarez
  Supervisor: Martina Corso

OTHER MASTER THESES DEFENDED IN 2024 SUPERVISED BY CFM RESEARCHERS

- **Dipolar glass polymers containing anthracenyl pendant groups as potential precursors for the elaboration of high-dielectric single-chain polymer nanoparticles**
  Author: Javier Maisueche
  Supervisors: Jose A. Pomposo and Sebastián Bonard

- **Numerical study of the optical response of nanodimer-on-mirror plasmonic nanocavities**
  Author: Zhang Shiyue
  Supervisor: Mario Zapata

- **Characterization of superconducting junctions by spin-polarised electron tunnelling spectroscopy**
  Author: Pietro Cattaneo
  Supervisor: Sara Catalano

UNDERGRADUATE EDUCATION PROGRAM

COURSES

In addition to the Master's and PhD programs, the staff at CFM also participates in a variety of undergraduate courses in 4 Faculties and University Schools of the University of the Basque Country (UPV/EHU). In total, more than 1400 teaching hours spread over 6 undergraduate degrees and 2 Master degrees at UPV/EHU are delivered by CFM staff.

END OF COURSE PROJECTS AND SHORT VISITS

In the framework of this teaching activity, undergraduate students can join a research group at CFM for a short stay or to fulfill their End of Course Project during the academic year. CFM hosted the visit of 6 undergraduate students, and supported the defense of 2 of those.

DEFENDED BACHELOR PROJECTS

- **Redes poliméricas con enlaces enamina reversibles**
  Author: Katy Andrea Domínguez Farinango
  Supervisors: Fabienne Barroso and Jose A. Pomposo

- **Structure and dynamics of polyisoprene-based polymers**
  Author: Aikaterini Kadianaki
  Supervisor: Arantxa Arbe

COMPETITIVE FUNDING FOR RESEARCH PROJECTS

Boosting the participation of researchers in competitive public projects is a strategic priority of our center. Particularly, participating in collaborative projects is key to building the basis of competitive networks capable of facing the current and future challenges in advanced materials science in a synergetic way. Research groups are very active in submitting applications to local, national and international calls launched by the principal funding agencies. As a result, the number of ongoing competitive projects has significantly increased in the last years. Regarding international projects, it is worth noting the intense participation of researchers in EIC (European Innovation Council) Pathfinder calls and ERC (European Research Council) calls, both in the framework of Horizon Europe. The projects and networks ongoing during 2024 (a total of 106 projects/networks) are listed below according to the source of competitive funding.

Regarding public funds for research activity, the center obtained more than 6 million euros in 2024, including funds provided by the Basque Government in the framework of the IKUR strategy and BERC 2022-2025 contribution for 2024.

EXCELLENT SCIENCE

4 ERC
3 Starting Grants
1 Synergy Grant

1 RESEARCH INFRASTRUCTURE PROJECT

3 MSCA
2 Postdoctoral Fellowships
1 Doctoral Network

GLOBAL CHALLENGES

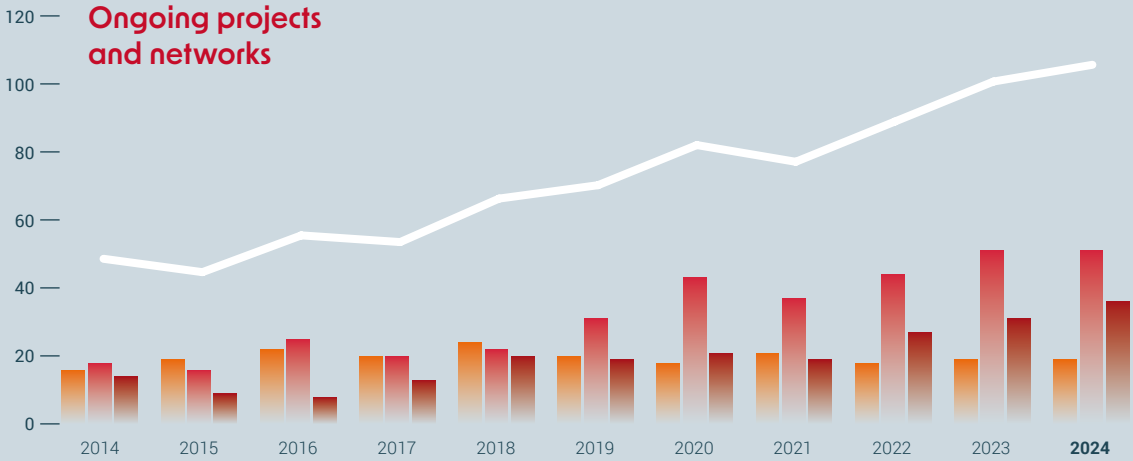
1 project
(Cluster 5)

INNOVATIVE EUROPE

4 EIC PATHFINDER
2 Pathfinder Open
2 FET-Open

1 EIC Booster Grant

Ongoing projects and networks



Research projects and networks	Competitive public funds obtained in 2024
INTERNATIONAL	370 990,31 €
SPANISH MINISTRY	1 996 414,53 €
BASQUE	2 357 225,50 €
MPC-BERC	1 379 316,00 €
Total	**6 103 946,34 €**

EUROPEAN AND INTERNATIONAL RESEARCH PROJECTS AND NETWORKS

- **ERC Starting Grant (ERC-2021-StG), GA 101040193.**

  COSAS - Controlling oxygen selectivity at the atomic scale.

  PI: Sara Barja Martínez.

- **ERC Starting Grant (ERC-2020-StG), GA 946629.**

  PhotoNow – Discovery and Characterization of Third-Generation Nonlinear Photovoltaics.

  PI: Julen Ibañez Azpiroz.

- **ERC Starting Grant (ERC-2018-StG), GA 802533.**

  SuperH – Discovery and characterization of hydrogen-based high-temperature superconductors.

  PI: Ion Errea Lope.

- **ERC Synergy Grant (ERC-2020-SyG), GA 951281.**

  BOLD - A background-free experiment to discover the nature of neutrinos based on single Barium Atom Light Detection.

  PI: Celia Rogero Blanco.

- **HORIZON EUROPE Pathfinder Open (HORIZON-EIC-2023-PATHFINDEROPEN-01-01).**

  JOSEPHINE: High-TC Josephson neurons and synapses: towards ultrafast and energy efficient superconducting neuromorphic computing.

  PI: Sebastián Bergeret Sbarbaro.

- **HORIZON EUROPE Pathfinder Open (HORIZON-EIC-2021-PATHFINDEROPEN-01-01).**

  ESiM: Energy Storage in Molecules.

  PI: Nicolas Lorente Palacios.

- **FET-OPEN: Novel Ideas for Radically New Technologies (H2020 FETOPEN-01-2018-2019-2020), GA 964450.**

  MIRACLE - Photonic Metaconcrete with Infrared RAdiative Cooling capacity for Large Energy savings.

  PI: Jorge Sánchez Dolado.

EUROPEAN AND INTERNATIONAL RESEARCH PROJECTS AND NETWORKS

- **FET-OPEN: Novel Ideas for Radically New Technologies (H2020 FETOPEN-01-2018-2019-2020), GA 863170.**

  ArtiBLED - Engineered Artificial Proteins for Biological Light-Emitting Diodes.

  PI: Pedro Braña Coto.

- **HORIZON EUROPE Booster (HORIZON-EIC-2023-BOOSTER-IBA-01).**

  COOLCRETE - Radiative Cooling Concrete.

  IP. Jorge Sánchez Dolado.

- **HORIZON EUROPE Research infrastructure services to support health research, accelerate the green and digital transformation, and advance frontier knowledge (HORIZON-INFRA-2023-SERV-01).**

  RIANA - Research Infrastructure Access in Nanoscience & Nanotechnology.

  IP. Silvina Cerveny Murcia.

- **NMBP: Integration of Energy Smart Materials in non-Residential Buildings, LC-EEB-01-2019 (H2020-NMBP-EEB-2019), GA 870114.**

  NRG-Storage - integrated porous cementitious Nanocomposites in non-Residential building envelopes for Green active/passive energy STORAGE.

  PI: Jorge Sánchez Dolado.

- **HORIZON EUROPE Cluster 5 (HORIZON-CL5-2021-D3-03), GA 101084348.**

  NATURSEA-PV: Novel eco-cementitious materials and components for durable, competitive, and bio-inspired offshore floating PV substructures.

  PI: Jorge Sánchez Dolado.

- **MSCA Postdoctoral Fellowship (HORIZON-MSCA-2022-PF-01), GA 101106809.**

  CavityMag - Cavity quantum electrodynamics control of magnetic phases in twisted van der Waals heterostructures.

  PI: Angel Rubio Secades.

EUROPEAN AND INTERNATIONAL RESEARCH PROJECTS AND NETWORKS

- **MSCA Postdoctoral Fellowship (HORIZON-MSCA-2022-PF-01), GA 101066965.**
  CURVEO - Selective ethylene oxidation on novel curved model catalysts.
  IP. Enrique Ortega Conejero.

- **MSCA Doctoral Networks (HORIZON-MSCA-2021-DN-01), GA 101072964.**
  QLUSTER - Quantum and Classical Ultrasoft Matter.
  PI: Angel Moreno Segurado.

- **COST Action 2024, CA23111.**
  SNOOPY - Searching for Nanostructured or Pore Forming Peptides for Therapy.
  WG1 Leader. Iván Sasselli Ramos.

- **COST Action 2021, CA20116.**
  OPERA - European Network for Innovative and Advanced Epitaxy.
  Management Committee Member. Sara Barja Martínez.

- **ONR Global basic and applied scientific research grant (N62909-22-1-2031).**
  Microspherical Superlens windows to the quantum world.
  PI: Yury Rakovich.

- **INT-NOCORE 2024, SFI-MPS-NFS-00006741-10.**
  Simons Collaboration on New Frontiers in Superconductivity.
  PI: Ion Errea Lope.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Proyectos de I+D+i de Generación de Conocimiento 2023 (PID2023), PID2023-146442NB-I00.**

  Towards Tunable Nanoporous Assemblies - Emerging Opportunities for Carbon-based Molecular Materials.

  IP. Félix Fernández Alonso.

- **Proyectos de I+D+i de Generación de Conocimiento 2023 (PID2023), PID2023-147324NA-I00.**

  NanoLIGHT - Light harvesting in transition-metal dichalcogenide nanostructures.

  IP. Julen Ibañez Azpiroz.

- **Proyectos de I+D+i de Generación de Conocimiento 2023 (PID2023), PID2023-147324NA-I00.**

  AQUACARE - Advanced Adsorbents based on nanotechnology and artificial intelligence for Quality and Cleaning of aquatic resources.

  IP. Silvina Cerveny Murcia.

- **Proyectos de I+D+i de Generación de Conocimiento 2023 (PID2023), PID2023-148225NB-C31.**

  SUNRISE: Fabrication of Hybrid Heterostructures and Theory of the Electronic Transport for Superconducting Spintronics.

  IP. Sebastián Bergeret Sbarbaro.

- **Proyectos de I+D+i de Generación de Conocimiento 2023 (PID2023), PID2023-147466OB-C22.**

  GREEN-BEAMS - Activation of Greenhouse Gases for Clean Energy Applications: A Combined Molecular Beams and XPS Approach.

  IP. Enrique Ortega Conejero.

- **Proyectos de I+D+i de Generación de Conocimiento 2023 (PID2023), PID2023-149158OB-C44.**

  Aigap - Advance Instrumentation for bridging the pressure GAP.

  IPs: Sara Barja Martínez, Fred Schiller.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-137363OA-I00.**

  NeuroGold: Nanoestructuras de oro fototérmicas para modular la actividad neuronal Photothermal gold nanostructures for neural activity modulation.

  PI: Ane Escobar Fernández.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-136392NA-I00.**

  ArtEMis: Impulsando la Optimización de Ensamblajes Peptídicos Supramoleculares como Matrices Extracelulares Artificiales.

  PI: Ivan Sasselli Ramos.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-141017OB-I00.**

  PREST: Data-Driven Approach for Accelerating Pulsed Plasmonic Catalysis.

  PI: Marek Grzelczak.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-138210NB-I00.**

  MAPEVDW: Magnetism, electronic properties and epitaxial growth of monolayers of non-centrosymmetric two-dimensional van der Waals materials.

  PI: Mikhail Otrokov.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-137845NB-C22.**

  Photonic Metaconcrete with Photothermoelectric capacity.

  PI: Jorge Sánchez Dolado.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-139230NB-I00.**

  EIEEDyNaCoS: Exploring the Interplay of Electronic Excitations and Dynamics in Nanostructures and Complex Systems.

  PI: Andrés Ayuela Fernández.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-140163NB-I00.**

  TADEO: Theory and Applications of complex gas/surface Dynamics in highly Excited envirOnments.

  PI: Maite Alducin Ochoa.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-140845OB-C65.**

  ChemSense: Chemical, electronic and optical characterisation of atomically precise molecular architectures for sensing applications.

  PI: Martina Corso.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-143268NB-I00.**

  HeliForces: Controlling optical forces with helical beams.

  PI: Gabriel Molina Terriza.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-139579NB-I00.**

  QuEVEDO: Tratamiento cuántico de la interacción de excitones y vibraciones moleculares con nanoresonadores ópticos: fluorescencia, dinámica electrónica ultrarrápida y optomécanica.

  PI: Ruben Esteban Llorente.

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-142861NA-I00.**

  SUPERTRANS: Propiedades vibracionales complejas a partir de cálculos ab initio: superconductividad de alta temperatura, transiciones de fase y transporte térmico.

  PI: Ion Errea Lope.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Proyectos de I+D+i de Generación de Conocimiento 2022 (PID2022), PID2022-137685NB-I00.**

  CompuMaBo: Metodologías Computacionales para Problemas de Muchos Cuerpos en Física de la Materia Condensada: Vibraciones, Magnetismo y Alta Correlación.

  PI: Andrés Arnau Pino.

- **Proyectos de I+D+i de Generación de Conocimiento 2021 (PID2021), PID2021-124080OB-I00.**

  TESEO: Diseño y caracterización teórica de nuevos materiales sostenibles para iluminación y la producción de energía solar.

  PI: Pedro Braña Coto.

- **Proyectos de I+D+i de Generación de Conocimiento 2021 (PID2021), PID2021-123438NB-I00.**

  DYNANET: Redes Dinámicas en Materia Blanda: De las Moléculas Pequeñas a los Polímeros Complejos.

  PIs: Angel Moreno Segurado, Josetxo Pomposo Alonso.

- **Proyectos de I+D+i de Generación de Conocimiento 2021 (PID2021), PID2021-127917NB-I00.**

  MAMI: Moléculas como Impurezas Magnéticas para tecnologías cuánticas.

  PIs: Deungjang Choi, Nicolás Lorente Palacios.

- **Proyectos de I+D+i de Generación de Conocimiento 2021 (PID2021), PID2021-129054NA-I00.**

  BIOINTER: Diseño racional de interfases biológicas: de las cuestiones fundamentales a las aplicaciones en la administración de fármacos.

  PI: Armando Maestro Martín.

- **Proyectos de I+D+i de Generación de Conocimiento 2021 (PID2021), PID2021-123438NB-I00.**

  HigherOrder: Teoría ab initio de respuestas de transporte y ópticas de orden superior en cristales.

  PIs: Ivo Souza, Stepan Tsirkin.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Proyectos de I+D+i de Generación de Conocimiento 2020 (PID2020), PID2020-114506GB-I00.**

  HYPER - Facing the hybrid-perovskite challenge - new insights into the stability, degradadation and performance of next-generation photovoltaic & photonic materials.

  PI: Félix Fernández Alonso.

- **Proyectos de I+D+i de Generación de Conocimiento 2020 (PID2020), PID2020-114252GB-I00.**

  SPIRIT - Spintronics and Spin-orbitronics in Hybrid Nanostructures: From classical to Quantum Technologies.

  PIs: Sebastián Bergeret Sbarbaro, Vitaly Golovach.

- **Proyectos de I+D+i de Generación de Conocimiento 2020 (PID2020), PID2020-115419GB-C22.**

  Vidrios y vitrocerámicos nanoestructurados dopados con tierras raras para aplicaciones fotónicas (subproyecto).

  Proyecto coordinado: LUMGLASS - Proccesing and photonic applications of luminescent glasses and glass-ceramics.

  PI: Rolindes Balda de la Cruz.

- **Proyectos de I+D+i de Retos Investigación 2020 (PID2020), PID2020-116093RB-C44.**

  MODCAT - Unveiling structure-function relationships on model catalyst for the clean generation of high added value chemical products (subproyecto).

  Proyecto Coordinado: ECOCAT - Electrocatalysis for the sustainable production of fuels and high added-value chemicals.

  PIs: Sara Barja Martínez, Frederik Michael Schiller.

- **Proyectos de I+D+i de Generación de Conocimiento 2019 (PGC2019), PID2019-105488GB-I00.**

  2EDiSNa - Excitaciones electrónicas y dinámicas en superficies y nanoestructuras.

  PIs: Andrés Ayuela Fernández, Silkin Vyacheslav (DIPC, Ikerbasque).

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Proyectos de I+D+i de Generación de Conocimiento 2019 (PGC2019), PID2019-103910GB-I00.**

  VIMAGSOC - Vibraciones y magnetismo en sistemas nanoscópicos con acoplamiento spin-órbita.

  PIs: Andrés Arnau Pino, Asier Eiguren Goyenechea (UPV/EHU).

- **Proyectos Estratégicos Orientados a la Transición Ecológica y a la Transición Digital 2021, Tipo B individual, TED2021-129457B-I00.**

  Materiales metaestables y activos basados en el carbono para el almacenamiento y gestión de energías limpias: nuevas estrategias físico-químicas (MACMAT).

  PIs: Félix Fernández Alonso, Pedro Braña Coto.

- **Proyectos Estratégicos Orientados a la Transición Ecológica y a la Transición Digital 2021, Tipo A individual, TED2021-130107A-I00.**

  Polímeros y Nanocompuestos Altamente Polares para Almacenamiento de Energía: desde el Diseño y la Síntesis hasta la Caracterización Estructural y Dinámica (POLARAGE).

  PIs: Jon Maiz Sancho, Ester Verde Sesto.

- **Proyectos Estratégicos Orientados a la Transición Ecológica y a la Transición Digital 2021, Tipo B coordinador, TED2021-132074B-C31.**

  Hormigón fotónico para soluciones medioambientales (PCES).

  PIs: Jorge Sánchez Dolado, Juan José Gaitero Redondo (TECNALIA).

- **Proyectos Estratégicos Orientados a la Transición Ecológica y a la Transición Digital 2021, Tipo B subproyecto, TED2021-132074B-C32.**

  Propiedades de Respuesta en Hormigones Fotónicos para Soluciones (RePro-PCES).

  PI: Andrés Ayuela Fernández.

- **Proyectos Estratégicos Orientados a la Transición Ecológica y a la Transición Digital 2021, Tipo B subproyecto, TED2021-130292B-C42.**

  Desarrollo de nuevos materiales para dispositivos cuánticos (NEMATODE).

  PIs: Celia Rogero Blanco, Sebastian Bergeret Sbarbaro.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Proyectos en Líneas Estratégicas 2021, colaboración público-privada (PLEC2021), PLEC2021-008251.**

  Few-qubit quantum hardware, algorithms and codes, on photonic and solid-state systems.

  PI: Gabriel Molina Terriza.

- **Redes Investigación 2022 - Red Temática, RED2022-134508-T.**

  CAT&SCALE: (Foto-) Electrocatalisis: de la escala atómica a dispositivos avanzados.

  PI, Network Coordinator: Sara Barja Martínez.

- **Ayudas Juan de la Cierva (JdC) 2022, JDC2022-048665-I.**

  Magnetic and transport properties of pi-conjugate graphene-like nanostructures.

  Beneficiary: Sofia Sanz Wuhl.

- **Ayudas Juan de la Cierva (JdC) 2021, FJC2021-047090-I.**

  Chiral Anapoles / Fuentes quirales no radiantes.

  Beneficiary: Jorge Olmos Trigo.

- **Ayudas Juan de la Cierva (JdC) 2021, FJC2021-047710-I.**

  Non-equlibrium self-assembly and catalysis with metal nanoparticles.

  Beneficiary: Anish Rao.

- **Ayudas Ramón y Cajal (RyC) 2022, RYC2022-037590-I.**

  Development of innnovative functional polymeric materials. Design and synthesis of "smart" single chain nanoparticles.

  PI: Ester Verde Sesto.

- **Ayudas Ramón y Cajal (RyC) 2021, RYC2021-031705-I.**

  Advanced materials for spin- and opto-electronics.

  PI: Marco Gobbi.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **Ayudas Ramón y Cajal (RyC) 2021, RYC2021-033294-I.**
  Amphiphilic peptides for the development of supramolecular polymers.
  PI: Ivan Sasselli Ramos.

- **Programa de Formación de Profesorado Universitario (FPU) 2024, FPU24/00480.**
  Beneficiary: Xabier Arrieta Aristi.

- **Ayudas para Personal Técnico de Apoyo (PTA) 2022, PTA2022-021877-I.**
  Apoyo técnico al Servicio TIC avanzado en el ámbito I+D+i del CFM – Centro Mixto CSIC-UPV/EHU
  Lab Technician: Mikel Arocena.

- **Ayudas para Personal Técnico de Apoyo (PTA) 2021, PTA2021-021175-I.**
  Apoyo técnico al laboratorio del grupo Polymers and Soft Matter para la especialidad de cromatografía líquida para la caracterización de materiales del CFM - Centro Mixto CSIC-UPV/EHU.
  Lab Technician: Isabel Asenjo Sanz.

- **Ayudas para Personal Técnico de Apoyo (PTA) 2021, PTA2021-020084-I.**
  Apoyo técnico al laboratorio del grupo Ceramic and Cement-based Materials para el desarrollo de Photonic Metaconcrete y Thermoelectric Concrete del CFM - Centro Mixto CSIC-UPV/EHU.
  Lab Technician: Guido Goracci.

- **CSIC, Fondo de Apoyo a los Servicios Científico Técnicos (FAS) 2024, FAS2024_072.**
  Servidor con GPUs para aprendizaje automático.

- **CSIC, CONEXIONES 2023, Creación de redes de colaboración en el área de la biología computacional y bioinformática.**
  PI: Pedro Braña Coto.

SPANISH RESEARCH PROJECTS AND NETWORKS

- **CSIC, JAE-PRE 2023, JAEPR23046.**

  Short Peptide Induced Gelation of Electrostatically Charged Supramolecular Assemblies.

  IP. Ivan Sasselli.

- **CSIC, ImpulsaT 2023, IMPUL23009.**

  PHOTOCRETE - Hormigón fotónico con capacidad de enfriamiento radiactivo diurno.

  IP. Jorge Sánchez Dolado.

- **CSIC, Programa de cooperación bilateral CONICET – CSIC 2024, BILAT23076.**

  WATER-HEALTH: Multi-adsorbentes de arsénico y contaminantes emergentes desarrollados a partir de sales de hierro y residuos de biomasa agrícola (cáscara de soja).

  IP. Silvina Cerveny Murcia.

BASQUE RESEARCH PROJECTS AND NETWORKS

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, IKERTALDE 2022, Grupo Consolidado IT1526-22.**

  Q-NANOFOTONIKA: Nanofotónica para la identificación y desarrollo de nuevos procesos y aplicaciones en espectroscopías moleculares, microscopía de campo cercano y tecnologías cuánticas.

  PI: Javier Aizpurua Iriazabal.

  Co-PI: Nerea Zabala Unzalu.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, IKERTALDE 2022, Grupo Consolidado IT1566-22.**

  Polimeros y materia blanda / Polymers and soft matter (PSMG).

  PI: Arantxa Arbe Méndez.

  Co-PI: Angel Alegria Loinaz.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, IKERTALDE 2022, Grupo Consolidado IT1569-22.**

  Grupo de Fisicoquímica de Superficies y Nanoestructuras.

  PI: Iñaki Juaristi Oliden.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, IKERTALDE 2022, Grupo Consolidado IT1591-22.**

  Nanophysics Lab San Sebastian: desde la ciencia de superficies a los dispositivos.

  PI: Celia Rogero Blanco.

  Co-PI: José Enrique Ortega Conejero.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, IKERTALDE 2022, Grupo Consolidado IT1707-22.**

  From protein folding prediction to personalized medicine with artificial intelligence.

  PI: Aitor Bergara Jauregi.

  Co-PI: Álvaro Villarroel (no CFM).

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, IKERTALDE 2022, Grupo Consolidado IT1453-22.**

  FunThEMaS: Fundamental Theoretical and Experimental Materials Science.

  Partner: Lucia Vitali.

BASQUE RESEARCH PROJECTS AND NETWORKS

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, IKERTALDE 2022, Grupo Consolidado IT1527-22.**

  Desarrollo de nuevas metodologías en problemas destacados de Física de la Materia Condensada.

  Partner: Ion Errea.

- **EJ/GV, Ekonomiaren Garapen, Jasangarritasun eta Ingurumen Saila / Departamento de Desarrollo Económico, Sostenibilidad y Medio Ambiente, ELKARTEK 2022, Programa de Ayudas a la Investigación Colaborativa en áreas estratégicas (KK-2022/00062).**

  QFIRST: Dispositivos en Tecnologías Cuánticas.

  PI: Gabriel Molina Terriza.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, Proyectos de Investigación Básica y/o Aplicada 2024-2026 (PIBA), PIBA_2024_1_0008.**

  Diseño de nuevas fases de la materia con manipulación atómica de estructuras híbridas en superconductores.

  PI: Deungjang Choi.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, Proyectos de Investigación Básica y/o Aplicada 2024-2026 (PIBA), PIBA_2024_1_0011.**

  MAiTe-URA - Materiales Innovadores en Tratamiento de Aguas: Síntesis, Caracterización y Funcionalidad.

  PI: Lucia Vitali.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, Proyectos de Investigación Básica y/o Aplicada 2023-2025 (PIBA), PIBA_2023_1_0006.**

  Desarrollo y caracterización de materiales micro-nano-estructurados activados con colorantes orgánicos y/o tierras raras para la elaboración de láseres aleatorios con aplicaciones optoelectrónicas.

  PI: Rolindes Balda de la Cruz.

BASQUE RESEARCH PROJECTS AND NETWORKS

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, Proyectos de Investigación Básica y/o Aplicada 2023-2025 (PIBA), PIBA_2023_1_0054.**

  Design of intelligent drug delivery systems based on polymer nanoparticles for overcoming cellular membrane barriers.

  PI: Armando Maestro.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, Ayudas para la adquisición de equipamiento científico 2024 (INKER), EC_2024_1_0010.**

  Low temperature sub-nanometer-resolved photon microscope.

  PI: Max Ilin.

- **EJ/GV, Zientzia, Unibertsitate eta Berrikuntza Saila / Departamento de Ciencia, Universidades e Innovación, Ayudas para el Programa Predoctoral de Formación de Personal Investigador No Doctor correspondiente al curso 2023-2024.**

  3 ayudas para la contratación de personal investigador predoctoral.

- **Lanbide - Servicio Vasco de Empleo, Programa INVESTIGO (2022/IKER/000022).**

  Gestión de sistemas de supercomputación y Servicios TIC avanzados en el ámbito I+D+i.

- **Lanbide - Servicio Vasco de Empleo, Programa PRIMERA EXPERIENCIA (2022/PEX/000014).**

  Técnico/a de sistemas TIC.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Fellows Gipuzkoa – Atracción 2024, 2024-FELL-000007-01.**

  Propiedades Ópticas Emergentes en Sistemas de Baja Dimensionalidad con Inteligencia Artificial.

  Beneficiary: María Camarasa.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Fellows Gipuzkoa – Retención 2024, 2024-FELL-000003-01.**

  Nanopartículas fototérmicas de oro biofuncionalizadas para su retención en la membrana de neuronas y evocar potenciales de acción.

  Beneficiary: Ane Escobar Fernández.

BASQUE RESEARCH PROJECTS AND NETWORKS

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Fellows Gipuzkoa – Retención 2024, 2024-FELL-000006-01.**

  Ingeniería de arquitecturas mesoporosas a través del autoensamblaje de copolímeros de bloque para la fabricación de biosensores electroquímicos.

  Beneficiary: Alberto Álvarez Fernández.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Fellows Gipuzkoa – Atracción 2023, 2023-FELL-000014-01.**

  Ingeniería de arquitecturas mesoporosas a través del autoensamblaje de copolímeros de bloque para la fabricación de biosensores electroquímicos.

  Beneficiary: Alberto Álvarez Fernández.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Fellows Gipuzkoa – Retención 2023, 2023-FELL-000013-01.**

  Nanopartículas fototérmicas de oro biofuncionalizadas para su retención en la membrana de neuronas y evocar potenciales de acción.

  Beneficiary: Ane Escobar Fernández.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Gipuzkoa QUANTUM 2024, 2024-QUAN-000014-01.**

  SUPERINT - Superconductividad no convencional y uniones de Josephson ultradelgadas en compuestos de intercalación.

  PI: Marco Gobbi.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Gipuzkoa QUANTUM 2024, 2024-QUAN-000018-01.**

  ESRPiN- Resonancia magnética nuclear potenciada cuánticamente.

  PI: Rubén Pellicer Guridi.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Gipuzkoa QUANTUM 2023, 2023-QUAN-000022-01.**

  Quantum correlations in nanostructures for quantum applications.

  Proyecto I+D con la Fundación Donostia International Physics Center (DIPC)

  PI: Marek Grzelczak.

BASQUE RESEARCH PROJECTS AND NETWORKS

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Gipuzkoa QUANTUM 2023, 2023-QUAN-000027-01.**

  ## Líquidos y Diamantes. Resonancia magnética nuclear de bolsillo.

  Proyecto I+D con la empresa Microliquid y Fundación Tekniker.

  PI: Gabriel Molina Terriza.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Gipuzkoa QUANTUM 2023, 2023-QUAN-000029-01.**

  ## Quantum register based on molecular spins and graphene nanostructures.

  Proyecto I+D con el CIC Nanogune.

  PI: Frederik Schiller.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Gipuzkoa Coopera 2024, 2024-IZEN-000005-01.**

  ## Ellas investigan X: Afrikar emakumezko ikertzaile batek egonaldi bat egin dezan MPCn / Ellas investigan X: Estancia de investigación en el MPC de una investigadora africana.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, Gipuzkoa Coopera 2023, 2023-IZEN-000010-01.**

  ## Ellas investigan IX: Afrikar emakumezko ikertzaile batek egonaldi bat egin dezan MPCn / Ellas investigan IX: Estancia de investigación en el MPC de una investigadora africana.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, SAREA2024-RED2024, Proyectos de I+D, 2024-CIE4-000014-01.**

  ## Impacto de la Topología Macromolecular en la estructura Complejos coacervados.

  PI: Paula Malo de Molina, Ester Verde Sesto.

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, SAREA2023-RED2023, Proyectos Next, 2023-CIEN-000077-01.**

  ## PEMA: Propiedades electrónicas y magnéticas de metales escasos, sus óxidos y materiales alternativos.

  PI: Frederik Schiller.

BASQUE RESEARCH PROJECTS AND NETWORKS

- **Gipuzkoako Foru Aldundia/Diputación Foral de Gipuzkoa, SAREA2023-RED2023, Proyectos de I+D, 2023-CIEN-000069-01.**

  PEMA: Propiedades electrónicas y magnéticas de metales escasos, sus óxidos y materiales alternativos.

  PI: Jon Maiz.

- **Donostia Sustapena/Fomento San Sebatián – Mujeres Investigadoras 2022.**

  Synthesis and electronic structure of one-atom-thick hexagonal boron nitride on curved crystals: toward boron nitride nanostripes.

  Beneficiary: Alaa Mohammed Idris Bakhit.

- **Euskal Herriko Unibertsitatea / Universidad del País Vasco (EHU/UPV), Grupos de Investigación UPV/EHU 2021, GIU21/006.**

  Grupo de Espectroscopía Láser y Materiales Fotónicos (LASES).

  PI: Rolindes Balda de la Cruz.

- **Euskal Herriko Unibertsitatea / Universidad del País Vasco (EHU/UPV), Azpiegitura zientifikoa - Infraestructura científica 2024, INF24/01.**

  Calorimetro diferencial con modulación de temperatura.

  PI: Ángel Alegría Loinaz.

- **Euskampus Fundazioa, LTC Green Concrete: Joint Transborder Laboratory for the development of more sustainable production processes and materials for cement composites.**

  Co-coordinator: Jorge S. Dolado.

- **Euskampus Fundazioa, LTC TRANSLIGHT: Joint Transborder Laboratory in Light sciences and Photonics.**

  Co-coordinator: Javier Aizpurua Iriazabal.

- **Euskampus Fundazioa, LTC QuantumChemPhys: Joint Transborder Laboratory in Theoretical Chemistry and Physics at the Quantum Scale.**

  Co-coordinator: Ricardo Díez Muiño.

TRANSFER OF KNOWLEDGE

Despite being a mainly fundamental research center, the CFM is committed to have an impact on society through knowledge transfer. The center implements a technology transfer strategy with the objective of boosting the collaboration with industry and sharing the results of its scientific activity with local and international private initiatives. This includes large international corporations and SMEs, as well as technology centers, with the ultimate goal of identifying and creating applications with the potential to transform society and contribute to progress.

PRIVATE SECTOR COLLABORATORS

The portfolio of competitive research projects (from HE-EIC projects to Basque Government's ELKARTEK projects), contracts and collaboration agreements involving companies and private entities has been very productive during 2024.

PATENTS

Patents requested in 2020-2024 **12**

PATENTS APPLIED FOR IN 2024

A Daytime Radiative Cooling Cementitious Composite (DRCCC)

PCT/EP24/073036

Jorge Sanchez Dolado, Andres Ayuela Fernandez, Guido Goracci, and Silvia Arrese-Igor Irigoyen.

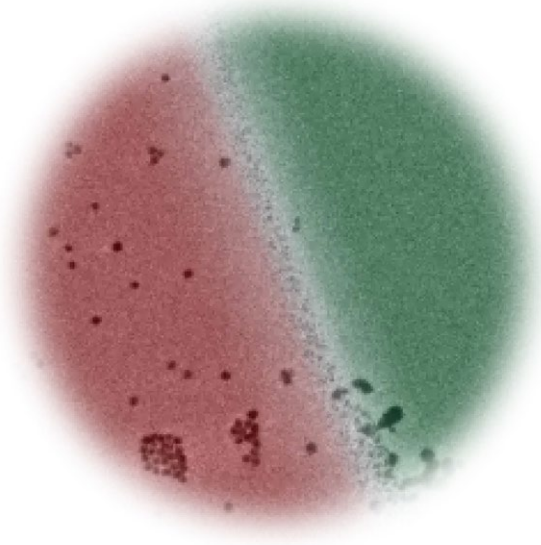
Ownership: Technical University Of Darmstadt - Tu Darmstadt, UPV/EHU, Microlight3d Sas, Katholieke Universiteit Leuven, Politecnico Di Torino, and Universidad Publica De Navarra, and CSIC.

Flow cells for liquid-phase transmission electron microscopy and methods

WO/2025/021689, PCT/EP2024/070572

Andrey Chuvilin, Stefan Merkens, Christopher Tollan, and Marek Grzelczak

Ownership: CIC nanoGUNE, UPV/EHU and CSIC.



WORKSHOPS, CONFERENCES, SEMINARS & COURSES ORGANIZED BY CFM

CFM scientists organized or co-organized several international workshops and conferences during 2024. Many of these meetings were held in close cooperation with the Donostia International Physics Center (DIPC), which is an example of the excellent results brought by the synergistic collaboration between both institutions. These activities improve the impact and relevance of the individual and groups' research outcome dramatically.

In 2024, the research staff organised twelve (12) international meeting events for the scientific community including congresses, workshops and specific courses. In addition, the CFM hosts regular seminars for the local community. These include the Quantum Breakfast lecture series, the CFM colloquium series, and the PhD Seminars. Eleven (11) researchers in the area of quantum physics participated in the Quantum breakfasts in 2024, consolidating this educational space in a relaxed atmosphere that allows for an in-depth knowledge of quantum technologies, and closer ties between research staff. The CFM Colloquiums kicked off in 2024 with 3 talks given by internationally renowned researchers who participated in an open colloquium for the staff of the MPC-CFM and surrounding centres.

In addition, the PhD Seminar series is a platform for young researchers to share their research progress, exchange ideas and receive constructive feedback from peers and experts. It is designed to bring together the scientific community of the CFM-DIPC-Nanogune. They are held fortnightly and in 2024 gave a voice to 16 pre-doctoral researchers.

Moreover, CFM researchers attended requests to give more than 40 invited and plenary talks in international conferences, showing their leadership in their respective fields.

The list of conferences, workshops, courses, and seminars organized or co-organized by CFM researchers during 2024 is as follows:

CONFERENCES

International Quantum Matter Conference & Expo - QUANTUMatter 2024

Organizers: Antonio Correia (Phantoms Foundation, Spain), Ricardo Muiño (DIPC), Juan Jose Garcia-Ripoll (IFF-CSIC), Stephan Roche (ICREA / ICN2), Daniel Sanchez-Portal (CFM), Javier Aizpurua (IKERBASQUE & DIPC), Nacho Pascual (CIC nanoGUNE), Enrique Rico (UPV-EHU), and Celia Rogero (CFM)

Kursaal Congress Centre-Auditorium - Donostia / San Sebastian

7-10/5/2024

III International Conference on Novel 2D Materials Explored Via Scanning Probe Microscopy & Spectroscopy (2DSPM2024)

Organizers: Miguel M. Ugeda (DIPC, CFM-MPC, Ikerbasque), and Iván Brihuega (UAM-IFIMAC)

Miramar Palace, Donostia / San Sebastián

24-28/06/2024

The XXXIX RSEF Physics Biennial

Organizers: Jenaro Guisasola (UPV/EHU) , Ion Errea (CFM, UPV/EHU), Idoia G. Gurtubay (UPV/EHU) , Josu M. Igartua (UPV/EHU) , Mikel Sanz (Ikerbasque Research Fellow, UPV/EHU) , and Mikel Garmendia (UPV/EHU)

Musikene / School of Engineering of Gipuzkoa (Donostia / San Sebastián)

15-19/07/2024

Quantum Designer Physics (QDP2024)

Organizers: Vitaly Golovach (CFM-UPV/EHU, DIPC, Ikerbasque), Daniel Loss (University of Basel), and Paco Guinea (IMDEA Nanociencia, DIPC, Ikerbasque)

Miramar Palace, Donostia / San Sebastián

15-19/07/2024

Challenges in Chemical Sensing with Graphene Derivatives and 2D materials (SENSE)

Organizers: Martina Corso (CFM), Aran Garcia-Lekue (DIPC, Ikerbasque), Aitor Mugarza (ICN2), Diego Peña (CiQUS-USC), and Dimas G. de Oteyza (CINN; CSIC-UNIOVI-PA) Igartua (UPV/EHU) , Mikel Sanz (Ikerbasque Research Fellow, UPV/EHU) , and Mikel Garmendia (UPV/EHU)

Miramar Palace, Donostia / San Sebastián

09-11/09/2024

Frontiers in phonon-mediated superconductivity of General Conference of the Condensed Matter Division

Organizers: Tiago Cerqueira (University of Coimbra, Portugal), Yue-Wen Fang (CFM), and Simone di Cataldo (Sapienza University of Rome, Italy)

Forum Braga, Braga, Portugal

2-4/09/2024

General Meeting of the Spanish Neutron Society SETN 2024

Organizer: Felix Fernandez-Alonso (CFM)

Valencia

23-25/09/2024

EMRS 2024 Fall Meeting: Biogenic and bio-derived materials for sustainable energy systems

Organizers: Pedro B. Coto (CFM-CSIC), Claudia Barolo (University of Torino), and Rubén D. Costa (TUM)

Warsaw (Poland)

17-19/09/2024

Second International Meeting on Opportunities and Challenges for HiCANS

Organizers: Felix Fernandez-Alonso (CFM), and Paula Malo de Molina (CFM)

Bilbao

15-17/10/2024

WOKSHOPS

CodeRefinery Workshop

Organizers: Radovan Bast (UiT The Arctic University of Norway), Iñigo Aldazabal Mensa (CFM, local coordination), Abel Carreras (DIPC, local coordination)

Ignacio María Barriola Center (Donostia - San Sebastián)

12, 13, 14, 19, 20 and 21/03/2024

Optics, Electronics and Magnetism in 2D Materials (OEM-2D Workshop)

Organizers: Andrés Ayuela (DIPC, CFM), Garnett Bryant (JQI, NIST/UMD), Thomas Weitz (Georg-August University Göttingen), Anna Seiler (Georg-August University Göttingen), Marta Pelc (Nicolaus Copernicus University), and Karolina Slowik (Nicolaus Copernicus University)

HEFA I - UPV/EHU, Donostia / San Sebastian

21-24/05/2024

On-Surface Synthesis International Workshop (OSS224)

Organizers: Martina Corso (CFM), Dimas G. de Oteyza (CINN; CSIC-UNIOVI-PA), and Roman Fasel (EMPA, Switzerland)

Sant Feliu de Guíxols, Girona

2-7/06/2024

COURSES

9th International Doctoral Training Session "Frontiers of Condensed Matter"

Organizers: Sebastien Bergeret (DIPC, CFM/CSIC), Julia Meyer (Université Grenoble Alpes, France), Jörg Schmalian (KIT,Germany), Christian Schönenberger (University of Basel, Switzerland), Gary Steele (TU Delft, The Netherlands)

Les Houches, France

16-27/09/2024

QUANTUM BREAKFAST

Starting in 2021, and promoted by CFM researcher Miguel Varga, "The Quantum Breakfast seminar series" intended to be educational in a relaxed atmosphere. They are a great opportunity to gain insight in quantum technologies, as well as to bring together the local community.

JANUARY 31	APRIL 26	JUNE 28
Quantum and structured light from optical parametric oscillators Antonio Zelaquett Khoury Instituto de Física - Universidade Federal Fluminense (Brasil) **Simulation of Control Sequences in NV-based Quantum Sensing** Ainitze Biteri Uribarren Science and Technology Faculty, EHU-UPV	**Using AI for Accelerating Nanoparticle Synthesis** Anish Rao CFM **Bending rigidity and the nature of ripples in graphene** Josu Diego López CFM	**Synchronized nuclear spin manipulation in the nanoscale regime** Ana Martín Fernández Quantum Design and Nanoscale Technologies Team, UPV/EHU **Magnetization dynamics features in φ0 Josephson junctions** Andrei Mazanik CFM and DIPC
JULY 19	**NOVEMBER 29**	**DECEMBER 12**
Design Strategies to Optimize Light Emission from Plasmonic Antenna-Emitter Hybrids Mario Zapata CFM	**Self-consistent calculations of in-gap states induced by magnetic impurities on a superconductor** Divya Jyoti CFM and DIPC **Models of random deposition (RSA), jamming and all that** Gabriel Cwilich Yeshiva University	**Double-Resonance Measurements on a Single Nuclear Spin Using STM** Cristina Mier Delft University of Technology (Netherlands) **From nanoGUNE to Attocube** Lars Mester Attocube Systems (Germany)

CFM COLLOQUIUM SERIES

Starting in 2024, the CFM colloquium series are targeted not only at specialists working on similar topics but also at a broader audience of researchers. Each talk follows a "Meet the Speaker" session with coffee and cookies, with immense opportunities to discuss in a distended atmosphere. To this end, an expert is invited to give a pedagogical talk about a topic of current interest in each session.

Non-crystalline topological matter

Adolfo Grushin (Univ. Grenoble Alpes, CNRS, Grenoble INP, Institut Néel)

06/05/2024

Interfaces of active fluids

Margarida Telo da Gama (Centro de Física Teórica e Computacional, Faculdade de Ciências, Universidade de Lisboa)

04/06/2024

Chiral Gain Photonics

Mário Silveirinha (Instituto Superior Técnico and Instituto de Telecomunicações, University of Lisbon)

26/06/2024

PHD SEMINAR SERIES

The PhD Seminar Series aims to foster a vibrant research community by providing PhD students a platform to share their research progress, exchange ideas, and receive constructive feedback from peers and experts. It is designed to bring together the scientific community of CFM, DIPC, and CIC nanoGUNE.

MARCH 6

Ferromagnetic order in 2D layers of transition metal dihalides
Andrea Aguirre

1D chains of nickelocene fragments on single crystal Au(111)
Divya Jyoti

MARCH 20

Computational characterization of the reaction mechanisms for the polymerization of glycidol with B(C6F5)3 and Lewis bases
Xuban Gastearena Irigoyen

The diet of Massive Black Holes
Markos Polkas

APRIL 10

Theoretical characterization of on-demand IR to VIS conversion by tip-enhanced molecular vibrational activation in nanocavities
Isabel Pascual-Robledo

Switch of Periselectivity in the Cycloaddition between Butadiene and Perfluoroethylene Under High Pressure
Mohammed Loukili

APRIL 24

Formation of Europium-transition metal surface compound and protection of Eu below hexagonal boron nitride (h- BN)
Alaa Mohammed Idris Bakhit

Characterization of vertical superconducting Al-based Tunneling Junctions proximitized by a ferromagnetic insulator
David Caldevilla-Asenjo

MAY 22

Novel tool for recording neuronal activity - Membrane voltage change detection via Colloidal Quantum Dots
Zuzanna Lawera

Dynamical pumping of topological lasing mode in bilayer photonic gratings
Nguyen Duy Hoang Minh

JUNE 5

Neutrinoless double beta decay in NEXT experiment
Marian del Barrio-Torregrosa

Single Photon Source of a CsPbBr3 Perovskite Quantum Dot and FEM Study of Plasmonic Effects
Jehyeok Ryu

JUNE 19

Mapping superconductivity in the incoherent CDW mosaic phase of a transition metal dichalcogenide
Sandra Sajan

Magnetism in Computational Chemistry
Antonio Cebreiro

NOVEMBER 21

Exploring Isotope-driven Stabilization in Hybrid Perovskites
Pablo Gila Herranz

Assessing the capabilities of state-of-the-art low-flux neutron sources – Scientific demonstrators to date
Cristina Macia Castello

OTHER SEMINARS ORGANIZED BY CFM

Structured light nonlinear optics

Antonio Zelaquett Khoury (Universidade Federal Fluminense, Niterói-RJ, Brasil)

16/02/2024

Electron transport from electron relaxons and improved Wannier interpolation of position and other matrix elements

Cheol-Hwan Park (Seoul National University)

22/02/2024

Smart Organic Crystalline Materials: From design to practical applications

Berta Gómez-Lor (Institute of Materials Science of Madrid (CSIC))

08/03/2024

Circular chemistry in supercritical fluids: Synthesis, shaping and recycling of materials

Cyril Aymonier (ICMCB, Bordeaux, France)

25/04/2024

State of the art and short future of the Gender Equality and Diversity Plan of CFM

Naiara Arri Garcia (Elhuyar) and Idoia Mugica Mendiola (CFM)

14/05/2024

AI-aided synthesis and characterization of plasmonic nanocrystals

Marek Grzelczak (CFM)

05/06/2024

Combining solid-state NMR and computational methods: from inorganic to biomaterials

Mariana Sardo, Luis Mafra and Ildefonso Marín-Montesinos (CICECO - Aveiro Institute of Materials, University of Aveiro, Portugal)

05/07/2024

Neutron beams for irradiation applications at the Rutherford Appleton Laboratory

Carlo Cazzaniga, UK Research & Innovation (United Kingdom)

30/05/2024

Spinarons: A new view on emerging spin-driven many-body phenomena in nanostructures

Prof. Samir Lounis (Forschungszentrum Jüllich)

23/07/2024

AI-assisted reconstruction of the chemical structure for a single molecule from atomistic level

Yao Zhang (University of Science and Technology of China)

06/08/2024

Outreach at CFM overview

Idoia Mugica Mendiola (CFM)

19/09/2024

Update on the European Spallation Source

Giovanna Fragneto (Scientific Director of the European Spallation Source ERIC)

14/10/2024

2D Materials: A Tunable Materials Platform for Electronics and Optoelectronics

M. Reyes Calvo (BCMaterials, Basque Center for Materials, Applications and Nanostructures)

15/11/2024

Understanding the role of excitons in the nonlinear Bulk Photovoltaic response of two-dimensional materials

Juan Jose Esteve-Paredes (Universidad Autónoma de Madrid)

09/12/2024

RIKEN Accelerator-driven compact neutron systems, RANS project, and their capabilities

Yoshie Otake (RIKEN, Japan)

14/10/2024

SCIENCE & SOCIETY

+ 70
activities and events, many of them in collaboration with other institutions

+ 17 000
participants

+ 6 500
views of the virtual contents

The goal of the CFM's Science and Society program is to bridge the gap between science and the public, to enhance public awareness and appreciation of science, and foster a more informed and scientifically literate society, encouraging more active and meaningful participation in scientific research and innovation.

+ 40
researchers of CFM's staff (50% women)

THANKS

The efforts at CFM have been devoted to achieve mainly three objectives:

- **Spreading scientific culture**
- **Inspiring scientific vocation**
- **Mainstreaming gender equality in all the activities organized.**

Moreover, at CFM we are proud to have a strong community of volunteers ready to spread the message; CFM appreciates the effort and encourages all the scientific staff to join the team, offering training on all the activities organized to those participating.

Over the years, CFM has implemented a comprehensive scientific outreach program, and during 2023 more than 70 activities and events were organized, many of them in collaboration with other institutions.

#scienceandsociety

CFM takes full responsibility for science education and communication, as a way to foster a scientifically literate citizenship

Culture, Vocation, Gender perspective and Diversity: We do care

Including the **gender and diversity perspective** in all the activities organized is a commitment acquired by CFM and is materialized as follows:

- **Maximizing the visibility of our women researchers**
- **Ensuring the gender balance in the talks organized**
- **Promoting the awareness on the situation**
- **Promoting diversity as the only possible way forward**

SCHOOL VISITS

Starting in 2013, together with the Donostia International Physics Center (DIPC), CFM offered a program of visits where both centers opened their doors to high school students.

In 2024 this successful program reached more than **750 students** from **18 different schools** that had the chance to interact with more than **20 professionals** from DIPC and CFM. Moreover, the opportunity to participate in the online visits turned out to be a great way to reach schools from further territories like Biscay and small villages that usually could not travel to attend the face to face visit.

The video collection of the premises visited virtually is available on our YouTube channel:

- **Polymer synthesis lab**
- **Dielectric spectroscopy lab**
- **Nanophysics lab**
- **Quantum Nanophotonics lab**

Available at **CFM's YouTube channel** *or scanning this code*

In addition to this visits, since 2021, CFM joined the EGOKITU program. EGOKITU offers young students in the last years of their high school training the possibility to participate in a summer science camp at the UPV/EHU. The Faculty of Chemistry of Donostia / San Sebastián has joined this program for years, offering an immersive experience to two group of students over two weeks that now includes the visit to DIPC and CFM.

FEBRUARY 10 **Emakumeak Zientzian** Colegio San Viator Ikastetxea Nazaret IES Botikazar BHI IES Miguel de Unamuno BHI La Salle-Legazpi Ikastetxea Avellaneda Ikastetxea Txorierri BHI Etxebarri BHI J. A. Zunzunegui BHI Angeles Custodios La Salle Beasain	**MARCH 22** IES Axular BHI	**APRIL 17** Xabier Zubiri Manteo	**MAY 17** Axular Lizeoa Antigua-Luberri BHI	**JUNE 27** EGOKITU
	JULY 4 EGOKITU	**OCTOBER 11** San Ignacio Jesuitak Donostia La Anunciata Ikastetxea	**NOVEMBER 15** Urretxu-Zumarraga Ikastola Beasain BHI	**DECEMBER 15** Koldo Mitxelena BHI Toki Ona BHI Antigua - Luberri BHI Maristak Durango

FACE TO FACE ONLINE

EMAKUMEAK ZIENTZIAN 2024

emakumeakzientzian.eus

8-16/02/2024

Since its inception in 2017 *Emakumeak Zientzian* initiative has evolved into a powerful coalition of different research centers and science institutions, consolidating an unprecedented network and workforce. In 2024 this nonstop wave expanded to Bizkaia reaching **32 entities**, gathering more than 300 volunteers actively participating in the comprehensive program with more than 60 activities and events aimed at all the public, including teenager women, school kids, elder women (above 55), and also the scientific community.

CFM together with CIC biomaGUNE, Achucarro, BCMaterials, the Faculties of Chemistry and Informatics from the University of The Basque Country (UPV/EHU), and Deusto University assumed the coordination of the initiative supported by Gipuzkoa and Bizkaia Provincial Councils, Fomento DSS and Ikerbasque, among other major sponsors. The main objectives remain to be:

- **Make visible the activity of women in science**
- **Break with the typically masculine roles attributed to scientific-technical activities**
- **Encourage the choice of scientific careers among girls and adolescents.**

+60
Activities

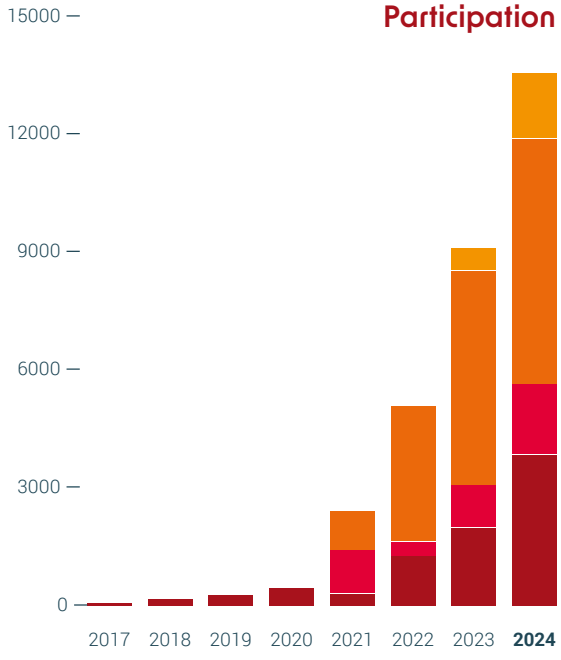
+13 500
Attendees

+300
Volunteers **(87% women)**

32
Research centers and science-related institutions

63 000
of funding

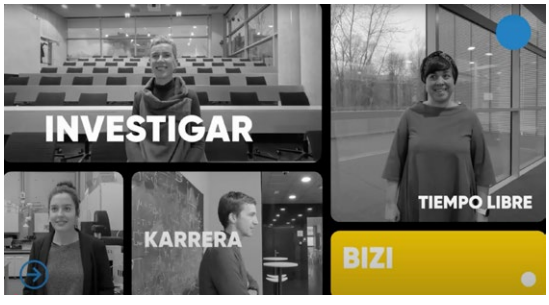
Participation



"In the field of science, as in so many others, there is a demand to change the standards of excellence and the idea that a professional vocation leaves little time to devote to family, leisure or personal development. We don't want super heroines who manage to do everything, nor do we want people to give up trying to achieve success. These are real lives trying to achieve a balance in the different stages of a professional career"

Life beyond science

In the 8th edition of the Emakumeak Zientzian the moto was to highlight that people in the scientific and technological field still have their personal needs, their passions, their commitments and their hobbies. Therefore, a video featuring various people from the scientific and technological field focusing on their lives beyond science was produced.



Available at **Emakumeak Zientzian´s YouTube channel** *or scanning this code*

MATH CLUB

In 2024 CFM researcher Stepan Tsirkin created the Math Club Donostia, aimed at kids from primary to secondary school, as a space to solve complicated mathematical problems (Olympics-style), talk about mathematics beyond the school curriculum and also watch and discuss scientific videos, seeking to have fun with mathematics and develop the creativity and critical thinking of young people.

Dr Tsirkin and his team of volunteers organised 50 sessions on weekends, involving more than 800 children in a space that was seen as an active and engaging club.

They also held a grand final battle in which 12 members of the club participated.

50 sessions

+800 kids

Final battle with **12** participants

All the information is available on their website: **math.dipc.org**

FOTCIENCIA 20

24/05-23/06/2024

In 2024 FOTCIENCIA celebrates its 20th anniversary!

CFM hosted the opening and celebration of the 20th edition of FOTCIENCIA.

Science and art go hand in hand in this inspiring photography exhibition that brings together 49 images, in various modalities, selected for their beauty, impact and ability to reflect scientific facts.

They are nano, micro and macroscopic views of the world taken by science professionals, amateur photographers, students and artists. Their different views reflect the phenomena studied by science, its instruments and installations, the technologies that result from the progress of research or the artistic vision that arises from scientific work. The whole is a fascinating collection of photographs that encourages dialogue between science, art and society.

MORE INCLUSIVE THAN EVER

As a novelty FOTCIENCIA20 included a physical version in high relief of the 10 winning images of this edition so that they could be enjoyed by visually impaired people. In addition, the explanatory texts that accompany the 49 snapshots, written by their authors, could be listened to as audio guides on the main online platforms.

Each edition of FOTCIENCIA tours the peninsula and travels abroad annually, this being the only opportunity to enjoy it in the Basque Autonomous Community.

DSS WEEK INN and EMAKUMEAK ZIENTZIAN

Women scientists of yesterday and today

30/10/2024

Plenary Hall of the San Sebastian City Hall

CFM and Emakumeak Zientzian regularly collaborate in the Innovation Week “Donostia WeekINN” that Fomento of San Sebastian organizes every year. In 2024, this collaboration was materialized in the event “Women scientists of yesterday and today”.

Three women scientists working in research centers in Gipuzkoa took the stage of the Plenary Hall of the San Sebastian City Hall to talk about the research in which they are immersed and pay tribute to some of the most pioneering women scientists in history through the story of their fascinating lives and scientific contributions.

Usue Mori (UPV/EHU)
Paying tribute to **Ada Lovelace**

Sofia Ferreira (CIC nanoGUNE)
Paying tribute to **Petra Rudolf**

Montse Galceran (CIC energiGUNE)
Paying tribute to **Vicenta Arnal**

PINT OF SCIENCE

pintofscience.com

13-15/05/2024

Donostia / San Sebastián

The “Pint of Science” festival aims to deliver interesting and relevant talks on the latest science research in a really informal format: they take place in bars and pubs. The goal is to provide a platform, which allows to discuss research with the people who carry it in a friendly environment. Since 2018, CFM sponsors this festival that fills up our city with science. Cheers!!!

Furthermore, in the framework of this festival, in 2024, a group of volunteers from CFM, coordinated by Dr. Ivan Sasselli, researcher at CFM and member of the organizing committee, joined the organization crew. The program included the talks of the following CFM researchers participated:

El túnel entre superconductores e innovación

David Caldevilla

14/05/2024

Polímeros inteligentes: imitando a la naturaleza

Ester Verde

15/05/2024

Programar moléculas para curar lesiones medulares

Ivan Sasselli

15/05/2024

ELHUYAR ZIENTZIA AZOKA

zientzia-azoka.elhuyar.eus/eu

02-04/06/2023

Arenal (Bilbao)

The 12th edition of Elhuyar Zientzia Azoka gathered more than 200 projects developed by young students during the course. Since 2019, CFM supports this science fair actively contributing in the mentorship and judging the projects in the fair.

The awards consisted of study grants, trips to national and international fairs and stays in research companies and research centers such as the CFM.

In July CFM hosted the visit of the winners from San Fermin Ikastola.

"INSPIRA LIFES" IN EUREKA! ZIENTZIA MUSEOA

21 and 28/10/2024

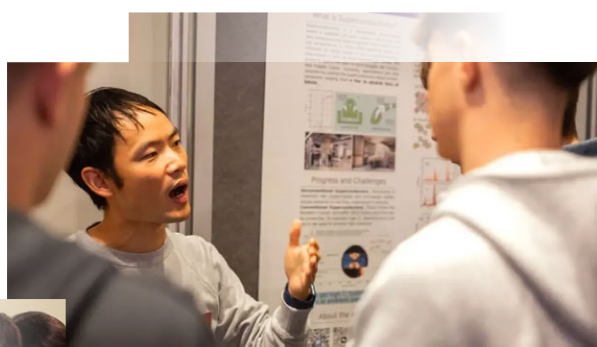
Eureka! Zientzia Museoa, Donostia / San Sebastián

Since 2010, Eureka! Zientzia Museoa (the science museum in Donostia / San Sebastián) organizes a meeting that resembles the format of a scientific congress, where active professionals of different scientific disciplines present their "life in science" to high school students with poster sessions and oral contributions. It is a great opportunity for both researchers and students to meet and share experiences and inquiries.

CFM supports this successful initiative by sponsoring the meeting, as well as by participating actively with researchers of different backgrounds of the center who share their experiences.

In 2024, the following researchers from CFM joined this activity, attended by more than 1000 students and 50 professionals:

- **Ivan Sasselli**
- **Yuewen Fang**
- **Beatriz Robles**



"QUÉ SABEMOS DE..." TALK SERIES

cfm.ehu.es/outreach/quesabemosde

Kutxakultur plaza at Tabakalera, Donostia / San Sebastián

For the eighth consecutive year, the CFM, in collaboration with Kutxa Fundazioa, presents the series Qué sabemos de... in Donostia / San Sebastián. This peculiar series of talks, promoted by the Consejo Superior de Investigaciones Científicas (CSIC), is driven by humanity's innate curiosity and features professionals from the realms of science and science communication.

Available at **CFM´s YouTube channel** *or scanning this code*

This edition included 4 appointments with cutting-edge science that is shaping the present to transform the future. The talks were accompanied by a dialogue between peers so that we met firsthand not only the science, but the people who carry it out.

La aventura cósmica y polar de los neutrinos

15/10/2024

Speaker: Carlos Pobes (Instituto de Nanociencia y Materiales de Aragón)

Interviewer: Leire Larizgoitia Arcocha (DIPC)

Inteligencia artificial y medicina

29/10/2024

Speaker: Lara Lloret Iglesias (Instituto de Física de Cantabria)

Interviewer: Koldo Garcia Etxebarria (BioGipuzkoa)

Cómo se meten 8 millones de especies en un planeta

19/11/2024

Speaker: Ignasi Bartomeus (Estación Biológica de Doñana)

Interviewer: Beatriz Díaz Martín (Sociedad de Ciencias de Aranzadi)

La fisica cuántica: exitos, aplicaciones y retos

10/12/2024

Speaker: Sara Catalano (CFM)

Interviewer: Gabriel Molina Terriza (CFM)

XVII SCIENCE WEEK (UPV/EHU)

7-9/11/2024

Tabakalera, Donostia / San Sebastián

Stand "Exploring the world of materials"

In this stand DIPC, CIC nanoGUNE, CFM and POLYMAT join forces with a common goal: to bring the science that governs the nature of materials to all audiences. Knowing the properties of matter, studying its physics from an experimental and theoretical point of view, and moving at the nanoscale is essential for the development of new smart materials with multiple applications.

A series of demonstrations and experiments that serve to illustrate the scientific universe behind these "new" materials were presented.

Scale up your world

Tailor designed workshop on the world of scales, from macro to nano, devoted to families.

How far do our eyes see? With this moto, around 25 kids and their families participated in this workshop. Guided by researchers and experts in the field, the explorers discovered the world of macro, micro and nanoscopic scales, by collecting samples in the park of Cristina Enea and putting them under different microscopes and magnifying glasses.

Zientzia Kluba

Humor and a lot of science were the components of the Zientzia Kluba formula. At this show organized by UPV/EHU, monologues, talks, performances, or the perfect mix of it all were welcome.

In 2024, CFM members participated with the following monologues:

¿Quién manda en nuestro cuerpo?

Ane Escobar

Los diamantes son los mejores amigos de la física (cuántica)

Gabriel Molina Terriza

Doblando proteínas

Paula Malo de Molina

Bailando con las microondas

Idoia Mugica Mendiola

CINEMA AND SCIENCE

Cycle organized by DIPC and Filmoteka Vasca. CFM researchers participated in the presentation and discussion on the following movies:

OPPENHEIMER

Pedro Miguel Etxenike Landibar

11/01/2024

Tabakalera (Donostia)

13/01/2024

Bizkaia Aretoa (Bilbao)

16/01/2024

Golem Baiona (Pamplona)

BRINGING UP BABY

Idoia Mugica Mendiola

02/03/2024

Bizkaia Aretoa (Bilbao)

05/03/2024

Golem Baiona (Pamplona)

OTHER OUTREACH TALKS

NAUKAS PI

Sara Barja

Soy de letras

14/03/2024

BCAM, Bilbao

TEDX VITORIA

Sara Barja

El papel crucial de la microscopía en la Ciencia de Materiales

11/05/2024

Europa Biltzar Jauregia, Vitoria

NAUKAS BILBAO 2024

Sara Barja

¿Dónde están mis hidrógenos?

20/09/2024

Palacio Euskalduna, Bilbao

JORNADA DE FÍSICA-FISIKA JARDUNALDIA

Nerea Zabala

02/10/2024

Facultad de Ciencia y Tecnología de la UPV/EHU, Bilbao

QUANTUM CIRCLE – ROUND TABLE: LITERATURAS CUÁNTICAS (2024)

Rubén Esteban

02/10/2024

Tabakalera, Donostia /San Sebastián

ACTIVITY IN MASS MEDIA

Press articles
49

Online press
179

Radio
47

TV
7

Many researchers were invited to participate in debates, interviews or articles in the general press.

Science, and particularly Material Physics Science, is presented in a simple and close language, in an effort to make scientific concepts and properties understandable and attractive to the general public. To this end, Idoia Mugica Mendiola, outreach manager at CFM, collaborated with "Goiz Kronika" radio show running the section "Zientzia Gosaria" in Euskadi Irratia radio (science breakfast) that is now available as a podcast in the new platform **GUAU**. She also collaborated in the EITB2 TV program **"A bocados"**, mixing materials science and cooking.

@CFMDONOSTIA

CFM is also present and active online and in the social media, and can be officially found in **X**, **Instagram**, **YouTube** and, **LinkedIn**, as well as in our **CFM website**. At the end of 2024 CFM also joined the new growing community of **Bluesky**.

As of April 2024, CFM had more than **1600 followers in Twitter, 650 in Instagram,1600 in LinkedIn** and **160 in Bluesky**. CFM's YouTube channel already contains 48 videos featuring different events. Besides, the CFM website is very regularly updated with news, workshops, seminars, and much more.

Users can **subscribe to CFM's mail list** to be updated on the information about the activities and events organized at CFM and stay tuned following CFM in our social media channels.

OUTREACH COLLABORATION NETWORK

Over the years, the CFM has managed to consolidate a network of active collaboration in the area of scientific dissemination that includes more than 30 science and technology agents in the Basque Country. Thanks to all our allies, it is a pleasure to work side by side to ensure that science reaches all citizens.

GENDER EQUALITY & DIVERSITY AT CFM

Since the I Gender Equality and Diversity Plan (GEDP) was launched in 2020, CFM succeeded in its implementation over the past 4 years.

The fourth year of implementation (2024) included the execution of **27 actions, 95% of which have been implemented**. In 2024, the main focus of the plan was the **evaluation of the plan** aimed at undertaking the **design of the 2nd Gender Equality and Diversity Plan**, so the efforts of the gender committee were focused on this task, without detriment to the consolidated and regular actions.

A gender plan goes far beyond the goal of achieving parity in the gender balance. It must be an active instrument to guarantee a safe, friendly and attractive work environment for any person, regardless of gender, race, religion or sexual orientation.

DESIGN AND LAUNCHING OF THE II GENDER EQUALITY AND DIVERSITY PLAN (GEDP) OF CFM

EVALUATION OF THE I GEDP AND IN DEPTH DIAGNOSIS

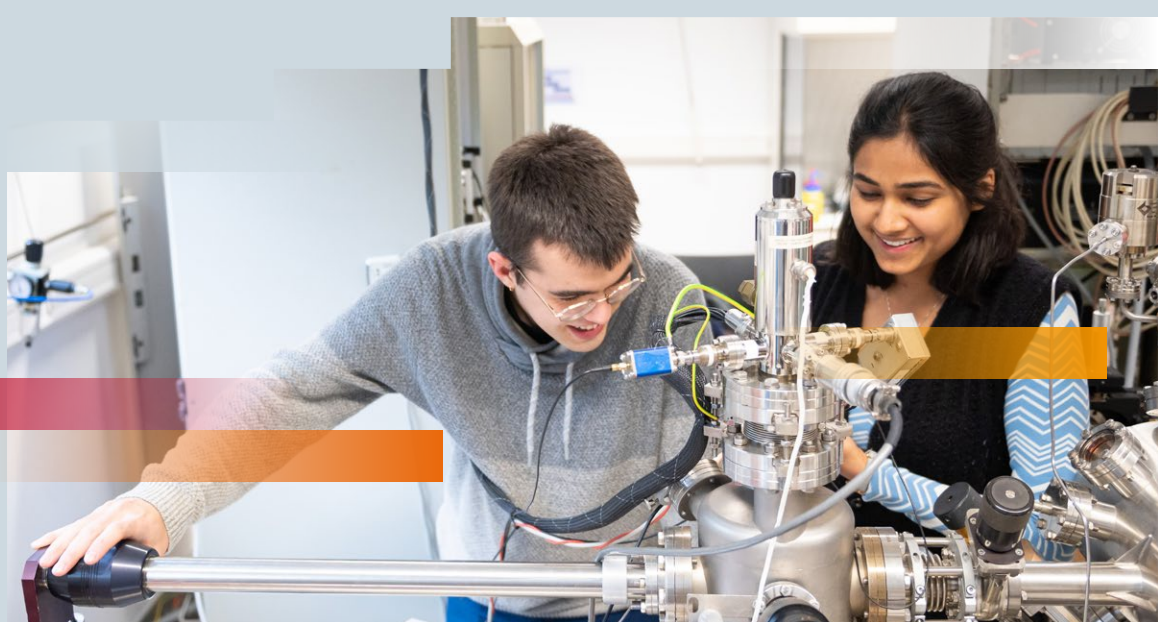
For the evaluation and preparation of the **complete diagnosis**, both **quantitative and qualitative information was collected**, taking into account Emakunde's criteria for the development of diagnoses and equality plans in companies, as well as the aspects defined in Royal Decree 901/2020 and the requirements of Horizon Europe.

Read here the full diagnosis *by scanning this code or visit the* **Gender Equality section at CFM's website** *for related content.*

TOOLS FOR THE EVALUATION AND DIAGNOSIS

- Documents and reports related to the organisation.
- Data collection on MPC-CFM staff disaggregated by gender.
- Online survey to gather the perceptions and experiences of all staff.
- In-depth interviews to gain a deeper insight into the opinions of research staff (Pre-doctoral researchers and post-doctoral researchers).
- Working session with the Equality Committee (GEC) to present the results of the analysis, complete the diagnosis of the current situation, identify the main strengths and weaknesses and agree on the challenges for the future.

The full diagnostic report was shared with the MPC-CFM community and is published on our website.



GENDER BALANCE ANALYSIS IN MPC-CFM 2024

NUMBERS AT A GLANCE

Table 1 shows the data for the distribution of staff by activity and gender in 2024, and Figure 1 expresses these data as a percentage.

		♀	♂
PERMANENT RESEARCHERS	**48**	13	35
JUNIOR RESEARCHERS	**7**	4	3
POSTDOCTORAL RESEARCHERS	**64**	17	47
PREDOCTORAL RESEARCHERS	**77**	24	53
LAB. TECHNICIANS	**8**	5	3
MASTER STUDENTS	**1**	1	0
ADMINISTRATION AND SERVICES	**24**	10	14
TOTAL	**229**	74	155

Percentage distribution by gender according to activity in the MPC-CFM in 2024

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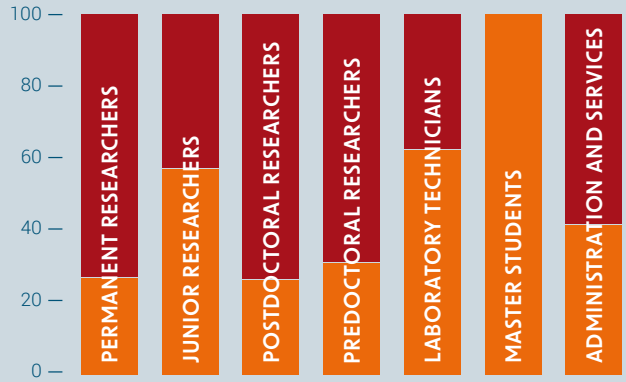
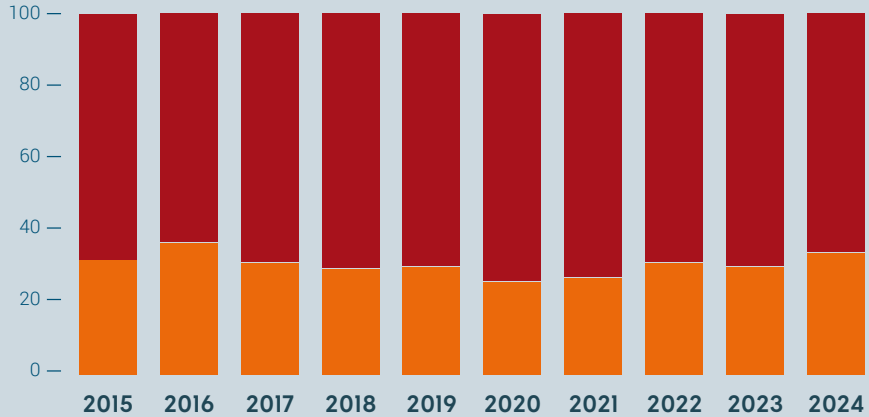


Figure 2 shows the evolution of the percentage distribution of gender, taking into account the entire scientific and technical community of the centre (including visiting researchers) over the last few years. The distribution is stable at a 30/70 female/male ratio.

Percentage evolution of the gender distribution of the MPC-CFM's scientific and technical staff over the years

♀ ♂



As shown in Figure 2, the gender distribution of the MPC-CFM scientific staff (including technical staff) has remained at a ratio of around 30/70 (women/men) in recent years. These data are in line with the data provided by the **CSIC in its annual report on women and science.**

Percentage distribution of scientific staff in the MPC-CFM, according to category and gender in 2024

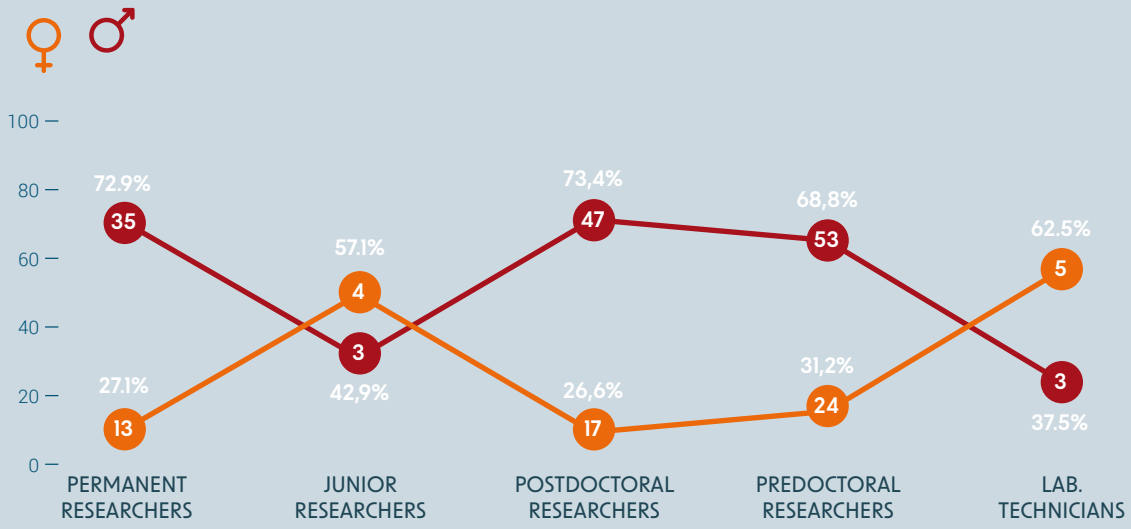


Figure 3 shows the percentage of women and men in different research ranks at the centre. Currently, only around 30% of PhD students at MPC CFM are women. The gender imbalance is maintained as the responsibility of the job and level in the research career increases, corroborating the general trend observed in the Basque Country, in Spain and in Europe. The proportion of women is higher than men only in the categories of 'junior researchers' and 'laboratory technicians', but it should be noted that these categories are made up of very few people (7 and 8 people respectively), so it is not possible to draw conclusions from this fact.

CONCLUSSIONS OF THE DIAGNOSIS

- **Need to develop a specific systematised welcoming and exit policy of the centre.**
- **Explore avenues for the inclusion of the gender perspective in research, especially focused on providing tools and strategies for proposal writing.**
- **Pay special attention to ensuring a satisfactory relationship between predoctoral staff and supervisors.**
- **To analyse strategies for the development of inclusive leadership models in the centre.**
- **To assess improvements for updating the workplace bullying protocol based on the experience of recent years.**

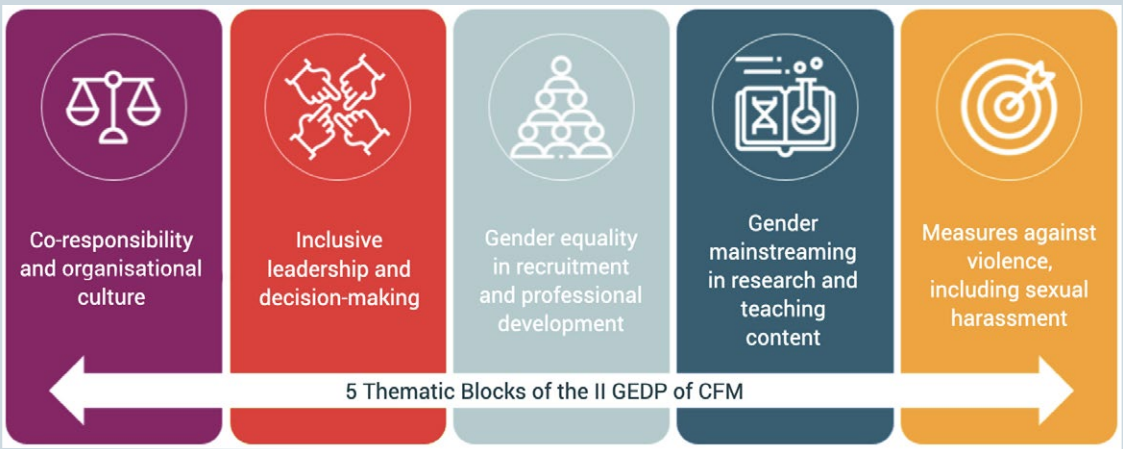
II GEDP OF MPC-CFM

KEY CHALLENGES IDENTIFIED FOR THE II GEDP

- **Strengthen the gender perspective within MPC's organisational structures, defining a leadership model that is aligned with it.**
- **Ensure that the centre's staff is aware of the Gender Equality and Diversity Policy that has been developed, focusing on communication campaigns.**
- **Take steps to incorporate a gender perspective in research.**
- **Improve mechanisms to combat sexual and gender-based harassment.**

Read here the full plan *by scanning this code or visit the* **Gender Equality section at CFM's website** *for related content.*

The MPC-CFM's GEDP will be implemented over four years, starting in 2025 and concluding in 2028, with a total of **55 actions planned**, divided into **five different thematic blocks** or lines of work, which are derived from the main challenges identified in the equality diagnosis.



In addition, the MPC-CFM has established three working structures to address the responsibilities and tasks of the implementation of the 2nd Gender Equality and Diversity Plan (GIDP) within the organisation:

- **GIDP Coordinator**
- **The Driving Group**
- **The gender Equality and Diversity Committee (GEDC).**

HIGHLIGHTED ACTIONS

Presence in gender panels of relevant decision making institutions such as Donostia San Sebastian's town hall gender council, Ikerbasque and Emakunde's specific science and technology panel

Gathering yearly records of gender distribution

Specific gender training for the community

Zero tolerance policy

Harassment protocol in place

Ensuring the representation of 50% of women in all the dissemination lectures organized by CFM.

Encouraging women researchers to participate in the different dissemination programs, especially those aimed at children, families and young people.

Using the CFM social media to highlight the research results of the women scientists working at CFM.

Promoting other initiatives that share the fundamental contributions of women in science, such as "Women with Science" by Marta Macho (Chair in Scientific Culture), "Women and Girls in Science Day", Donostia WeekInn, etc.

PREVENTION AND ATTENTION ON HARASSMENT AT CFM

Any issue regarding harassment at CFM can be shared by email **harassment.cfm@ehu.eus** or talking directly with the personal counselors:

Gabriel Molina Terriza and/or Idoia Mugica Mendiola.

Privacy and anonymity will be guaranteed throughout the process

Read here the full Harassment Protocol
by scanning this code

AWARENESS

EMAKUMEAK ZIENTZIAN

Since its first edition in 2017, **"Emakumeak Zientzian"** has grown to be a consolidated, award winning, and participation record-breaking consortium, standing out in the set of actions devoted to raising awareness about gender issues at STEM among the society. Nevertheless, it has also been key to build a much-needed network of institutions committed to work together to break the gender divide in the scientific and technological field. **Emakumeak Zientzian** has been further described in depth in section **Science and Society** of this report and constitutes the main achievement regarding social awareness on gender issues.

GIPUZKOA COOPERA

Gipuzkoa Coopera explores the possibility of working together with researchers from countries with less presence in the international scientific community, while involving Gipuzkoa society in the responsibility of collaborating with these countries, promoting scientific activity as an engine of change and progress in any society. With this program CFM also wants to establish its commitment to other social aspects, actively contributing to promoting the development of science in countries with fewer resources.

CFM has been part of the program since its very beginning and over the last six years this has materialized in five collaborations with the foundation **Women for Africa**, through the programs **Ellas Investigan** devoted to senior researchers, aimed at promoting African women's access to science and technology, supporting them in their research careers, making their achievements visible and promoting their leadership in the international scientific community. Table 2 lists the African women researchers who have carried out research stays at the centre in recent years.

Call	Women Researcher	Year of intership	Host at CFM
Gipuzkoa Coopera - Ellas investigan 2019	**Dra. Mary B. Ogundiran (Nigeria)**	2021	Jorge Sánchez Dolado
Gipuzkoa Coopera - Ellas investigan 2020	**Dra. Abeer Adel (Egipto)**	2021	Silvina Cerveny
Gipuzkoa Coopera - Ellas investigan 2022	**Dra. Florette Corinne Fobasso Mbognou (Camerún)**	2023	Ion Errea
Gipuzkoa Coopera - Ellas investigan 2023	**Dra. Yasmeen Elkony (Egipto)**	2024	Félix Fernández Alonso
Gipuzkoa Coopera - Ellas investigan 2024	**Dra. Omamuyovwi Rita Elkony (Nigeria)**	2026 (previsto)	Félix Fernández Alonso

In addition to the *Ellas investigan* programme, MPC-CFM, on its own initiative and in conjunction with the DIPC, collaborates in the **Learn Africa** programme, also promoted by the Women for Africa Foundation, aimed at promoting knowledge transfer, exchange and training of African undergraduate and postgraduate students through scholarships. MPC-CFM and DIPC provide scholarships, that covered enrolment, travel, board and lodging in Donostia/San Sebastián, to African students to study the UPV/EHU's Master's Degree in Nanoscience taught at MPC-CFM, an initiative that has been maintained in 2024.

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