UAM | IFIMAC Condensed Matter Physics Center | EXCELENCIA MARÍA DE MAEZTU

IFIMAC

CONDENSED MATTER PHYSICS CENTER



ACTIVITY REPORT

2023


UAM
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IfiMAC
Condensed Matter Physics Center

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IfiMAC
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OUR CENTER

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Letter from the Director

Welcome to the annual report of the Condensed Matter Physics Center (IFIMAC). Established in 2012, IFIMAC's mission is to pursue cutting-edge research and scientific excellence in this broad field, at the crossroads of Physics, Chemistry, Materials Science and Biology, fostering a truly multidisciplinary approach. Last March, before sending this report to print, IFIMAC was awarded its third consecutive award as a "Maria de Maeztu (MdM) research unit of excellence". I thank IFIMAC researchers and staff for their hard work and dedication, which have made possible this collective achievement. This highly competitive recognition will help us to strengthen our internationally recognized position in this very active research area that spans from Quantum Materials and Technologies, Nano and Quantum optics, and Nanotechnology, to Soft and Active Matter and Biophysics.

During this year, we have completed our current "Maria de Maeztu research unit of excellence" (MdM) project and made significant progress along two strategic goals for IFIMAC's future: the development of the IFIMAC Foundation and the procurement of an IFIMAC building. Both the change of legal status and the access to brand new facilities will help us to develop the ambitious proposal presented in the last MdM call, that aims (i) to advance in research and impact on key strategic areas, (ii) to strengthen IFIMAC structure and identity, and (iii) to improve the technical support to IFIMAC researchers in order to prepare the center for our next challenge: to reach the status of a Severo Ochoa Center in the 2028 call. These two initiatives, where we are working together with our host institution, the Universidad Autónoma de Madrid (UAM) since early 2022, are expected to be a reality in 2024, with the legal establishment of the Foundation, and the publication of the open call for the construction of the building as part of a novel public-private partnership scheme.

IFIMAC membership is awarded to individual researchers, based on the scientific excellence achieved at the different levels of the academic career. IFIMAC had 89 members in 2023, including 63 permanent research and teaching staff from UAM, 5 emeritus professors, two assistant professors and 19 young researchers associated with different programs of international talent attraction. These young researchers are supported by national (13 Ramón y Cajal contracts), regional (3 Atracción de Talento Comunidad de Madrid (AT-CM) modalidad 1 fellows) and private (3 Junior Leader La Caixa grants) programs. Two of our young researchers have been granted an Starting and a Consolidator ERC grants in the 2023 call. Work at IFIMAC is supported by a technical staff that included 2 IT and High-Performance Computing Infrastructure officers, 2 Laboratory Technicians, 2 Project Managers and an Outreach technician. This year, we had to say goodbye to Almudena Conde, our manager since the creation of IFIMAC back in 2012. Almudena has played a key role in making IFIMAC a thriving reality and we are going to miss her in the development of our future plans. Apart from its members, IFIMAC hosted in 2023 the research activity and training of 24 post-doctoral researchers (58% of them, non-spaniards), and 94 PhD students. They contribute significantly to the achievement of the IFIMAC's mission.

Our research outcome in 2023 consolidates the total number of articles (185) --with an increase in the publication in top-cited journals with respect to the previous year, 96.76% (62.16%) in Q1-- 68.11% (24.74%) in D1 according to Scopus (WoS)--, and patent applications (3). IFIMAC researchers have been very successful in the attraction of funding in 2023 (a 26% increase with respect to 2022), with 166 active projects representing a total budget of 11.3 million €. It is worth noticing that this increase is particularly high in national calls for projects and scientific infrastructure associated with Next Generation Funds, reducing the share of our budget directly provided by the EU through Horizon, ERA and ERC calls (16.8% in 2023) with respect to previous years. Together with this external funding, the seven collaborative projects, supported by past and current MdM funds, have played a key role in fostering synergies among IFIMAC researchers. The two last collaborative projects, "Disorder as a novel platform for topological superconductivity" and "Dynamically driving spinning colloidal particles in 2D lattices", expand the boundaries of two areas of intense activity, topological properties and active matter, in which IFIMAC has a unique position and great potential.

These research activities are complemented by the IFIMAC's involvement in training and outreach. We directly promote the Master in Physics of Condensed Matter and the Biological Systems (***https://www.masternanobio.es***) and the PhD Program in Physics of Condensed Matter, Nanoscience and Biophysics (***http://doctorate-nanobio-uam.es***), and are involved in another three master and three doctoral programs at UAM. Our outreach activities cover from lectures for primary and high schools to promote STEM studies and scientific careers in the areas covered by IFIMAC, 30 technical seminars, to the new monthly IFIMAC Colloquia, featuring top researchers including the Nobel Laureate Prof. Serge Haroche, from ENS and the College de France. Among the outreach activities, I would like to highlight the second edition of the mentoring program for women physics students (with 38 women mentees and 34 mentors --with no gender restriction--) organized by the IFIMAC Gender Committee, and the launch of the IFIMAC Newsletter. This platform for sharing our activities within IFIMAC and with the broader Condensed Matter Physics Community is released twice a year and aims to strengthen the identity of our organization, and to provide regular updates on our achievements.

I invite you to explore this annual report and, through its pages, to discover IFIMAC's reality.

Rubén Pérez

IFIMAC Director

Overview

The Condensed Matter Physcis Center is a Research Center within UAM, located in the campus of the Universidad Autónoma de Madrid pursuing cutting-edge research and scientific excellence. It comprises researchers from several university departments aiming to advance the limits of knowledge in both theoretical and experimental Condensed Matter Physics. 63 researchers constitute its permanent staff with nineteen young resarchers (RyC, talent grant, Junior leader, IFIMAC positions) and up to one hundred eighteen postdoctoral researchers and PhD students.

The IFIMAC – Condensed Matter Physics Center is a María de Maeztu Excellence Research Unit. The Center got the first Maria de Maeztu Excellence accreditation (MDM-20140377) on the 2014 call and it was renewed in 2018 (CEX2018-000805-M). The third Maria de Maeztu accreditation was evaluated during 2023 and awarded in April 2024.

Research performed in the institute has gained world reputation in the following areas:

- Advanced Materials
- First Principles Simulations and Modeling
- Nanophysics
- Nano and Quantum Optics
- Soft Condensed Matter and Biophysics

Research Lines

Resarch developed in the IFIMAC since it was set up in 2012 is organized in the following areas. Here we describe relevant general aspects of each line in the past years:

Advanced Materials

Today's devices and appliances require materials with ever increasing capabilities. Superconductors deliver considerable improvements in energy storage and transport and are fundamental in medicine for magnetic resonance imaging. Graphene and graphene-based materials promise to improve functionalities of many devices. New molecular systems are excellent sieves and are used in gas storage or photovoltaics.

IFIMAC works on the fundamental properties of materials with the aim to set the pace for future transformational changes in technology. For this, we carry an extensive research program in the synthesis, characterization, and modeling of new materials (Figure 1). We develop state-of-the-art instrumentation and techniques which we offer to other research groups through spin-offs or scientific collaborations.

Among them are computational techniques as well as atomic manipulation and surface characterization techniques (Figure 2). IFIMAC takes full advantages of the possibilities offered by the UAM, leveraging the use of fabrication, nanofabrication (Figure 3) and characterization facilities of the Campus. The Helium liquefaction unit of the UAM is unique nation-wide and recovers and liquefies Helium for science, often also delivering industry. The fabrication facilities include state-of-the-art machines, with a new metal 3D printer and a development center for new instrumentation. IFIMAC allows researchers to measure and characterize materials from atomic scale to large sizes, from low to high frequencies, at temperatures down to 7 mK and magnetic fields up to 22 T. IFIMAC includes the only laboratory contributing to the access system of a large-scale European infrastructure (the European high magnetic field laboratory), and collaborates very actively in synchrotron, neutron scattering and free electron laser facilities. Advanced calculations, from ab-initio to modeling, leverage experimental efforts in instrumentation to creating top level science. Practically any new idea in materials synthesis can be addressed at IFIMAC.

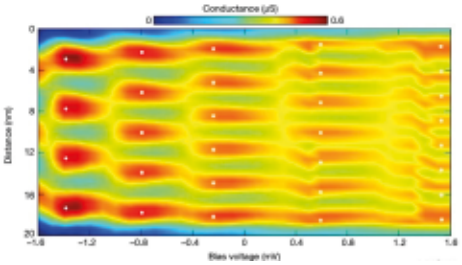


Figure 1: Conductance (color scale on the top) vs bias voltage (x-axis) and distance (y-axis) demonstrating lateral quantization of collective electronic states at the surface of the heavy fermion superconductor URu2Si2. Image taken at 100 mK. From ***Nature*** *616, 465 (2023).*

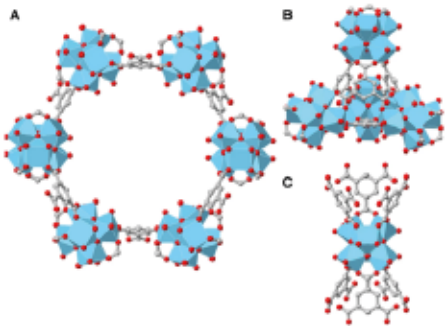


Figure 2: Hexagonal pore (A) and tetrahedral cavity (B) in the luminescent metal organic framework MOF-808, an emergent class of optical sensors. We show an unsaturated Zr6O8 cluster in C. Blue is Zr, grey is C and red is O, hydrogen is removed for clarity. From ***Nature Communications*** *14, 2506 (2023).*

IFIMAC studies all sorts of topical quantum materials, obtaining advances in magnetism, superconductivity, topological properties of materials, interfaces, optical properties (Figure 4), electronics and spintronics, surface physics, molecular systems, graphene and other two-dimensional materials. Regarding the material properties under study at IFIMAC, several groups are very active in the research on magnetism, superconductivity, spintronics and vortex physics.

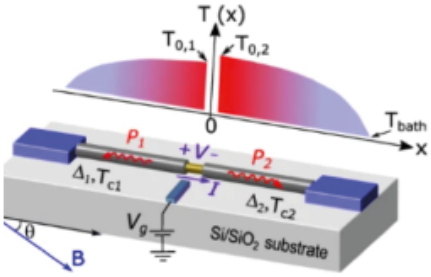


Figure 3: Device made of superconducting leads and a semiconducting nanowire. An etched part in the middle of the nanowire allows applying a gate. Heat flow (red lines) leads to a new characterization tool, Joule spectroscopy. From ***Nature Communications*** *14, 2873 (2023).*

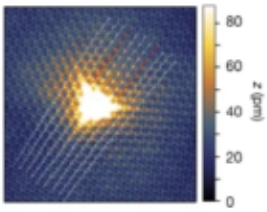


Figure 4: Friedel oscillations from H atoms in graphene. Additional wavefronts appearing due to dislocations are shown in red. From ***Nature****, 574, 219 (2019).*

First Principles Simulations and Modeling

Computer modeling has grown over the years into a scientific discipline on its own. Models are utilized to assess real-world phenomena maybe too complex to be analyzed in the laboratory or under hypotheses at a fraction of the cost of undertaking the actual activities. Models in industry, government, and educational institutions shorten design cycles, reduce costs, and enhance knowledge.

In Physics, the modeling of materials, through what is known as “first-principles”, has become a major research field. By “first-principles” one understands the use of the fundamental quantum mechanical laws of nature without any assumptions. The properties of the materials should emerge from the numerical solution of these laws. The models here are in fact a faithful representation of reality, but in a controlled environment.

Researchers at IFIMAC have a long-standing and well-deserved international reputation on computer modeling and, in particular, on the development of efficient first-principles codes for the simulation of the optoelectronic and structural properties of molecules, materials, and systems in general described down to the atomic level (SIESTA, ANT. Gaussian, FIREBALL, MOLCAS, EDUS, etc.). All the other research lines at IFIMAC benefit one way or another from this expertise. This knowledge not only benefits fundamental research, but can also be transferred directly into the society through spin-offs.

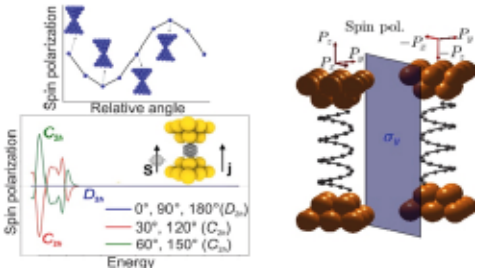


Figure 5: Different types of chiral systems such as those in the figure may exhibit the CISS effect. From ***ACS Nano****, 17, 6452 (2023).*

IFIMAC researchers exploit these simulation codes to explore a wide variety of problems, including electronic transport, catalysis on reducible oxides and out-of-equilibrium electron dynamics.

Spin-dependent electronic transport is an essential feature not only in engineered devices for spintronics, but also in chemical and biological processes involving the propagation of a current through molecules. In recent years, it has been experimentally verified that an initially unpolarized beam of electrons will emerge polarized (in some cases, significantly) upon traversing a chiral molecule such as a DNA-like helicene; a realization of the so-called chirality-induced spin selectivity (CISS) effect. In a recent article published in ACS Nano IFIMAC researchers show based on the use of representation theory within the scattering formalism for transport, that the appearance of such spin polarization is fundamentally allowed in a much wider family of systems, namely those that lack symmetry planes or axes containing the propagation direction (Figure 5). The role of the contacts is hence as qualitatively important as that of the molecules, to the point that the presence of the latter is not generally needed to observe spin polarization. These predictions are illustrated by DFT calculations where they also show that the polarization vector is accompanied by a net spin accumulation in the system for finite bias, which may be detected in magneto-conductance setups.

Proteins are key biological molecules that are responsible for numerous energy conversion processes such as photosynthesis or respiration. In recent years, proteins have been investigated in a new setting, namely in

solid-state electronic junctions, with the goal of understanding the charge transfer mechanisms in these biomolecules, but also with the hope of developing a new generation of bio-inspired nanoscale electronic devices. A new step towards this goal was reported in Angewandte Chemie by a collaboration between Weizmann Institute of Science (Israel) and IFIMAC researchers. In this work, the authors show that a redox protein, cytochrome C, can behave as an electrically driven switch when incorporated in a solid-state junction with gold electrodes (Figure 6). By changing the external bias voltage in the junction, it was shown that the relevant molecular orbitals of the protein can be brought in and out of resonance with the chemical potential of the electrodes, which leads to the current-switch behavior. Showing transition from off- to on- resonance can be very challenging and this is the first time it has been achieved for proteins within the same working junction. Extensive ab initio DFT calculations revealed that the charge transport proceeds through the heme unit in these proteins and that the coupling between the protein's frontier orbitals and the electrodes is sufficiently weak to prevent Fermi level pinning. The on-off change in the electrical current was shown to persist up to room temperature, demonstrating reversible, bias-controlled switching of a protein ensemble, which provides a realistic path to protein-based bioelectronics.

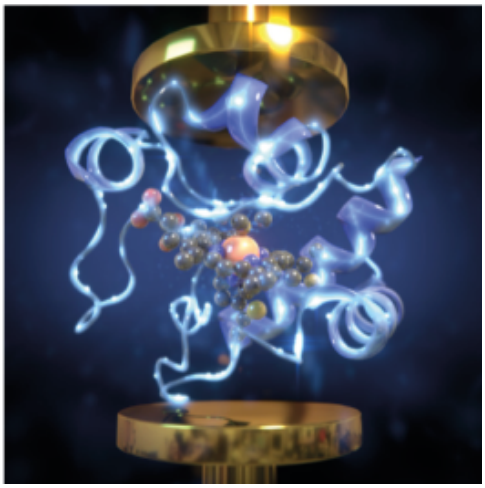


Figure 6: An electrically driven switch can be formed by a cytochrome C monolayer, sandwiched between a gold layer and a gold nanowire. From ***Angewandte Chemie****, 58, 11923 (2019).*

The unique catalytic properties of ceria for the partial hydrogenation of alkynes have been examined for acetylene hydrogenation (Figure 7). Catalytic tests over polycrystalline CeO2 at different temperatures and H2/C2H2 ratios reveal ethylene selectivities in the range of 75–85% at high degrees of acetylene conversion and hint at the crucial role of hydrogen dissociation on the overall process. DFT is applied to CeO2(111) in order to investigate reaction intermediates and to calculate the enthalpy and energy barrier for each elementary step. At a high hydrogen coverage, β-C2H2 radicals adsorbed on-top of surface oxygen atoms are the initial reactive species forming C2H3 species effectively barrierless. The high alkene selectivity is owed to the lower activation barrier for subsequent hydrogenation leading to gas-phase C2H4 compared to that for the formation of β-C2H4 radical species. These findings rationalize for the first time the applicability of CeO2 as a catalyst for olefin production and potentially broaden its use for the hydrogenation of polyunsaturated and polyfunctionalized substrates containing triple bonds.



Figure 7: Front cover artistic view of the catalytic process for acetylene hydrogenation. From ***J. Phys. Chem. C****, 118, 5352 (2014)*

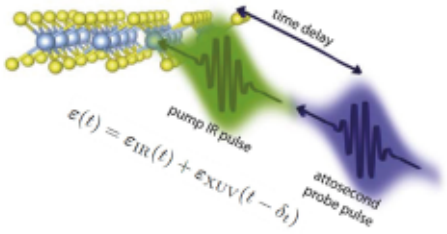


Figure 8: Schematics of a pump-probe experiment where a first laser pulse excites the material while a second one explores the time evolution of the excitation. From ***Journal of Chemical Theory and Computation****,19, 333 (2023)*

In a recent manuscript published in *Journal of Chemical Theory and Computation* a collaboration of IFIMAC researchers have presented a theoretical framework and its numerical implementation to simulate the out-of-equilibrium electron dynamics induced by the interaction of ultrashort laser pulses in condensed-matter systems (Figure 8). Their approach is based on evolving in real time the density matrix of the system in reciprocal space. It considers excitonic and nonperturbative light–matter interactions. They show some relevant examples that illustrate the efficiency and flexibility of the approach to describe realistic ultrafast spectroscopy experiments. The approach is suitable for modeling the promising and emerging ultrafast studies at the attosecond time scale that aim at capturing the electron dynamics and the dynamical electron–electron correlations via X-ray absorption spectroscopy.

Nanophysics

When the characteristic dimensions of a system or a device are shrunk to the nanoscale, their properties change dramatically. The reason for that is that at this scale quantum mechanical effects set in, which leads to novel physical phenomena that, in turn, are often the basis of unforeseen technological applications. One of the main goals of researchers at IFIMAC is the study of the electronic, mechanical, thermal, and optical properties of structures and devices with nanometric dimensions, for which classical laws do not longer apply. For this purpose, we make use of a wide range of nanofabrication techniques, experimental probes, and theoretical tools.

Some of our main activities in the field of Nanophysics are related to the theoretical and experimental study of novel low-dimensional systems such as graphene and graphene-based nanostructures. Antimonene, a single layer of antimony atoms, was firstly obtained at IFIMAC. This 2D material is attracting much attention due to its strong spin-orbit coupling and its potential in optoelectronics, thermoelectric applications, and biomedicine. This work was the result of an internal theoretical-experimental collaboration at IFIMAC, whose researchers are world leaders in this topic.

Making use of experimental techniques such as Angle Resolved Photoemission Spectroscopy (ARPES) or Low Energy Electron Diffraction (LEED), IFIMAC researchers also investigate topics like 2D structural phase transitions, surface charge density waves, or the electronic structure of laterally nanostructured systems. Furthermore, we study the growth and properties of nanometer-scale objects on solid surfaces with applications in spintronics, optoelectronics, magnetic recording, nanoscale catalysis, nanomechanical biosensing, medical nanoimaging, etc.

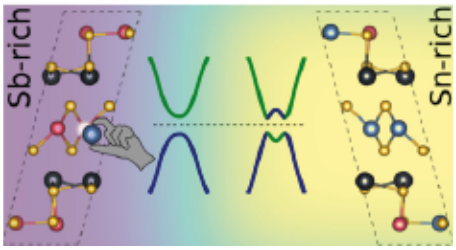


Figure 9: A quantum phase transition, predicted from DFT calculations and originating from stoichiometric changes in one of its composing layers (a large concentration of Sn in the quasihexagonal one) turns franckeite into a strong topological insulator. From ***Nano Lett****. 21, 7781 (2021).*

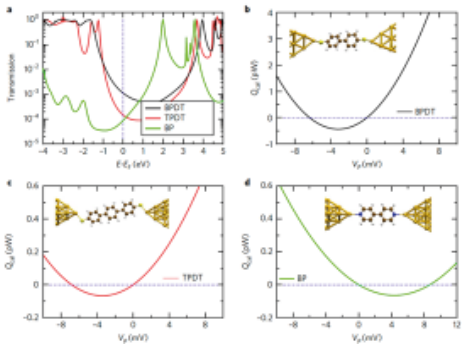


Figure 10: (b-d) Computed heating/cooling effect in the molecular junctions formed by gold electrodes and prototypical molecules(Au–biphenyl-4,4' -dithiol–Au, Au–terphenyl-4,4' ' -dithiol–Au and Au–4,4' -bipyridine–Au). The transmission (a) and its derivative at EF determine the electrical conductance and the Seebeck coefficient of the molecular junctions. From ***Nat. Nanotechnol****. 13, 122 (2018)*

IFIMAC researchers work actively in 2D materials and heterostructures, and its associated topological properties. Recently, they have predicted, on the basis of DFT, a quantum phase transition in franckeite (Figure 9), originating from stoichiometric changes in one of its composing layers (the quasihexagonal one). Franckeite is a natural superlattice composed of two alternating layers of different composition, easy to exfoliate into very thin heterostructures and which has shown potential for optoelectronic applications. Not surprisingly, its chemical composition and lattice structure are so complex that franckeite has escaped screening protocols and high-throughput searches of materials with nontrivial topological properties. Now, it has been predicted that, while for a large concentration of Sb, franckeite is a sequence of type-II semiconductor heterojunctions, for a large concentration of Sn, these turn into type-III, much alike InAs/GaSb artificial heterojunctions, and franckeite becomes a strong topological insulator. Transmission electron microscopy observations confirm that such a phase transition may actually occur in nature.

Other important areas of expertise in our center are the fields of Nanoelectronics and Quantum Transport. In particular, in recent years researchers at IFIMAC have played a leading role in the understanding of the electronic transport in a great variety of nanoscale systems such as metallic atomic-size contacts, single-molecule junctions, superconducting hybrid structures, or strongly correlated low-dimensional systems. The study of thermoelectricity in molecular junctions is of fundamental interest for the development of various technologies including cooling (refrigeration) and heat-to-electricity conversion. IFIMAC researchers have developed theoretical methods, based on self-energy-corrected density functional theory calculations, to characterize the electrical and thermoelectric properties of molecular junctions (Figure 10).

Within the area of nanoelectronics, our groups are currently developing a strong theoretical/experimental activity on hybrid superconducting devices. This work ranges from the understanding of their basic transport properties to their potential application for quantum information processing using microwave techniques of the so-called Andreev qubits. The qubit is based on a circuit that consists of a submicron indium arsenide (InAs) nanowire enclosed by a superconducting aluminum loop (Figure 11). Discrete localized states, known as “Andreev bound states,” form in the nanowire as a result of coupling to the superconductor. When absorption of a photon induces a transition between two of these states, the loop inductance changes. The absorption spectrum of the circuit can be measured

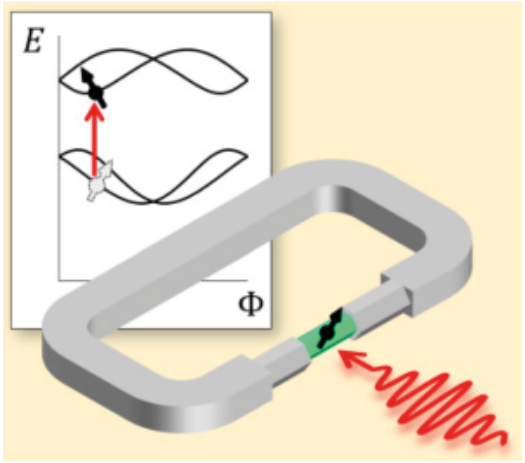
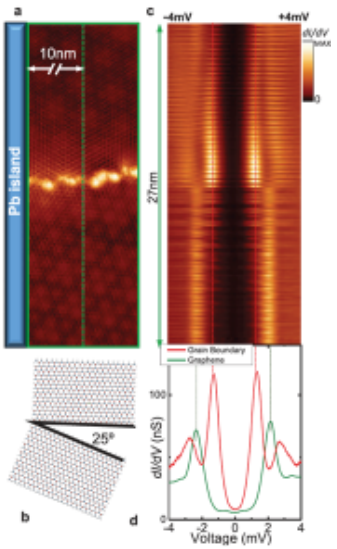


Figure 11 Spin-Orbit Splitting of Andreev States Revealed by Microwave Spectroscopy. The circuit includes an InAs nanowire enclosed by a superconducting aluminum loop. The spin state of a single electron in the nanowire has a measurable impact on the electrical properties of the circuit. From ***Phys. Rev. X*** *9, 011010 (2019).*



by monitoring the resulting frequency shift of a microwave resonator inductively coupled to the loop. The spectrum shows a fine structure of spin-split Andreev states, well accounted for by a simple model with spin-orbit coupling as the key ingredient.

A very important topic in our center is also the use and modeling of Scanning Probe Microscopes (SPMs). Atomic Force Microscopy (AFM) is being currently used for the study of the mechanical, electrical and frictional properties of low-dimensional materials. Another key subject is the use of cryogenic Scanning Tunneling Microscopy (STM) and Spectroscopy (STS) for the surface characterization of semiconductor and superconductor nanostructures. One recent example involves the first observation of Yu–Shiba–Rusinov (YSR) states in graphene (Figure 12). Superconductivity in graphene is induced by proximity effect brought by adsorbing nanometer-scale superconducting Pb islands. Using STM and STS the superconducting proximity gap is measured and YSR states are visualized, extending more than 20 nm away from the graphene grain boundaries. These observations provide the long-sought experimental confirmation that graphene grain boundaries host local magnetic moments and constitute the first observation of YSR states in a chemically pure system. From a theoretical point of view, IFIMAC researchers are among the worldwide leaders in the area of ab initio modeling of nanowires and SPMs.

*Figure 12: Grain Boundary (GB) magnetism induces Yu–Shiba–Rusinov states in superconducting graphene. From **Advanced Materials** 33, 2008113 (2021).*

Nano and Quantum Optics

The related areas of Nano and Quantum Optics are dedicated to the study of light-matter interactions at the nanoscale and at a quantum level and are two promising lines for the development of efficient, energy-saving, and compact platforms for future information technology. Nanophotonic systems offer a key advantage over other platforms: Their unique ability to concentrate light in the nanoscale (Figure 13) enables scalability and integration in the solid-state, and at the same time gives access to the quantum properties of photons. IFIMAC hosts a group of internationally recognised researchers working in this field and counts with extensive laser lab facilities for spatial, spectral, and angular characterization of nano and quantum optical effects.

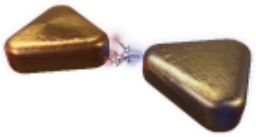


*Figure 13: Light focused on the nanoscale can interact with quantum emitters, including complex molecules From, **Angew. Chem. Int. Ed.** 58, 8698 (2019)*

Nano Optics is devoted to the study of electromagnetic field propagation, confinement, and interaction with matter at a sub-wavelength scale. Advances in fabrication and characterization techniques nowadays permit the study of optical phenomena at the nanoscale. Researchers at IFIMAC have made seminal contributions to the field through the study of nano-plasmonic systems, including the phenomenon of extraordinary optical transmission through subwavelength apertures or the proposal of spoof surface plasmon polaritons that mimic the light confinement properties of metals but at lower frequencies. Other important contributions were in the field of plasmon-assisted transport in atomic-scale junctions and the propagation of electromagnetic waves in magneto-plasmonic nanostructures (Figure 14). Light-matter interaction in two-dimensional systems, such as graphene and graphene-based heterostructures, graphene relatives, transition metal dichalcogenides and their combination in vertical stacks are also investigated at IFIMAC.



*Figure 14: Nanophotonic structures allow to confine light on the nanoscale From **ACS Photonics**, 5(9), 3447-3451 (2018)*

Quantum optics is a related field of research, merging the areas of quantum field theory and optics, and dealing with phenomena involving light and its interaction with matter at the quantum level. The field has evolved considerably from its early studies of coherence properties of radiation and parametric processes of light to recent topics of investigation such as quantum information, manipulation of single atoms, Bose-Einstein condensation, etc. Theorists at IFIMAC have produced seminal contributions to the understanding of light emission and absorption spectra in low-dimensional semiconductor structures. We have worked on the quantum optics produced by interacting bosonic complexes describing cavity polaritons and contributed with pioneering works on the superfluidity and coherence properties of polariton gases both under resonant and non-resonant pumping (Figure 15).

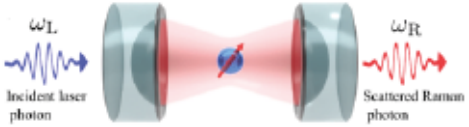


*Figure 15: Ultrastrong coupling enables the spontaneous Raman scattering of incident radiation. From **Phys. Rev. Lett.** 129, 273602 (2022)*

IFIMAC gathers leading theorists worldwide on **quantum nanophotonics**, the area of overlap between nano and quantum optics. The group has extensive experience on designing nanophotonic systems to achieve and control interactions between quantum emitters and photon modes and to generate quantum states of light, with a particular focus on hybrid plasmonic-photonic structures that combine the advantages of strong field confinement and long lifetimes. The group has also been at the forefront of a new interdisciplinary area of research aimed at taking advantage of QED phenomena such as strong light-matter coupling to manipulate atomic, molecular, and condensed-matter systems, and has participated actively in the birth and development of this new area of research through several seminal contributions (Figures 16 and 17).

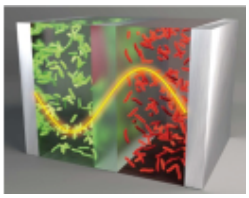


*Figure 16: Energy transfer between molecules is modified by the presence of vacuum fields in a photonic cavity. From, **Science** 373, eabd0336 (2021)*

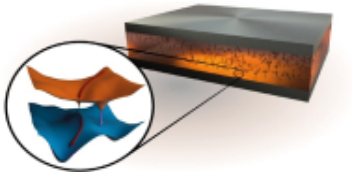


*Figure 17: With polaritonic chemistry, chemical structure can be manipulated through strong coupling between light and matter. From **ACS Photonics** 9, 1096 (2022)*

Experimental groups at IFIMAC have a long experience on optical spectroscopy of semiconductor low-dimensional systems, such as quantum optics based on semiconductor quantum dots. IFIMAC researchers have expertise in photon correlation techniques, properties of single photon emitters (Figure 18), time-resolved spectroscopy, quantum microcavities based on semiconductor nanostructures, exciton polaritons, and on the preparation of Bose-Einstein condensates in solid-state systems. Furthermore, we have also developed compact laser sources based on plasmonic nanoparticles. Another very active area of experimental research at IFIMAC is the study of exciton diffusion in complex semiconductors or perovskites to optimise their ability to harvest solar energy, in combination with artificial intelligence approaches (Figure 19).

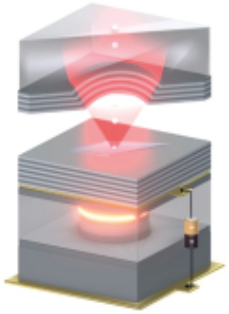


Figure 18: Sketch of a room temperature single photon source for quantum communication proto- cols. A quantum emitter (such as a defect in hBN) couples to the open cavity, enhancing the single photon emission.

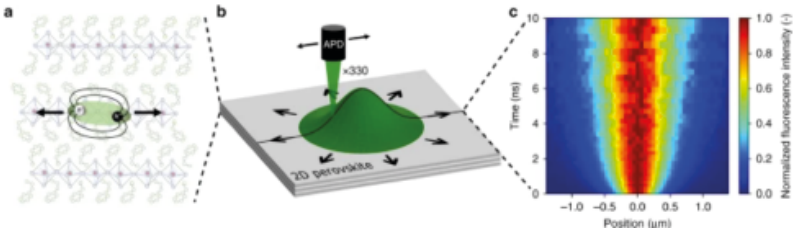
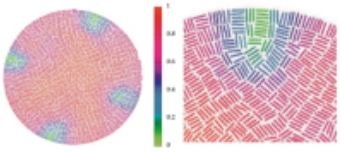


*Figure 19: Excitons in a two-dimensional perovskite are schematically represented in a. Excitons are imaged as shown in b and produce a time and position dependent fluorescence. From **ACS Energy Lett**. 7, 358 (2022)*



*Figures 20: Exotic liquid crystalline phases in monolayers of vertically vibrated granular particles. From **Liquid Crystals**, 2023. https://doi.org/10.1080/02678292.2023.2200262*

Soft Matter and Biophysic

Soft condensed matter comprises a variety of mesoscopic physical systems that are easily deformed by small thermal or mechanical stresses, including liquids, colloids, polymers, liquid crystals, gels, membranes, foams, etc. The relevant length and time scales of these systems are thus naturally larger than those of atoms or molecules, which facilitates experimentally accessing the microscopic states of these systems to understand and predict their emergent macroscopic properties, using the framework of statistical mechanics. Using vibrated granular particles, a variety of fluid patterns with orientational order that resemble equilibrium liquid-crystal phases were found, exhibiting topological defects due to confinement, much as molecular liquid crystals (Figure 20). This system represents a novel approach to study order in 2D fluids of hard particles.



*Figure 21: Aqueous two-phase systems within selectively permeable membranes. From **ACS MacroLetters**, 12, 132 (2023).*

Biological systems are also soft and built on the rich diversity of mesoscale structures mentioned. A tissue is a soft hydrogel, a hierarchical dynamic structure composed by many cells, which in turn are made up of many molecular assemblies orchestrating processes at different length and time scales. These systems set the most outstanding challenge in our goal to understand the spontaneous self-assembly of matter. Bottom-up approaches to recreate biological systems may enable to isolate fundamental physical principles from the complex set of signaling and metabolic pathways of natural systems. With this in mind, we have recently transferred microfluidic technologies from Harvard to IFIMAC, to fabricate vesicles as cell mimetics with exquisite control, enabling to study physical phenomena such as adhesion, fusion, and motility in model systems. These vesicles can also mimic the complex organization of the cell cytoplasm. IFIMAC researchers have used this technology to fabricate vesicles enclosing aqueous compartments to study the effect of permeable membranes in phase separations (Figure 21). Importantly, these vesicles may also find applications in biomedicine, pharmacy, and cosmetics.



Figure 22: Trapping flocking particles with asymmetric obstacles. From ***Soft Matter****, 16, 4739, 2020.*

Moreover, biological systems are active, they constantly produce and consume energy, which results in the emergence of sometimes unintuitive collective properties. The emergent subdiscipline of Active Matter focuses on understanding such collective properties, which frequently requires out-of-equilibrium physics descriptions. Using bacteria, modeled as run-and-tumble particles, IFIMAC researchers are studying the emergence of collective motion in confined environments (Figure 22).

Molecular Dynamics (MD) simulations are a powerful tool to understand biological processes at the atomic scale. IFIMAC researchers are applying them to the study of proteins, nucleic acids and viruses in their native liquid environment. The elasticity of double-stranded DNA (dsDNA) is a key molecular determinant in the many cellular contexts in which this molecule is found, as it affects the binding affinity of dsDNA with proteins as well as the dsDNA response to the mechanical action exerted by proteins. Using all-atom MD simulations, IFIMAC researchers have proposed that parts of the DNA sequence act as a physical code that controls the structure and mechanical properties of dsDNA at short scales, paving the way for protein-DNA interaction and organization of the genomic material (Figure 23). This work has been extended to dsRNA, where they identified a sequence motif consisting of alternating adenines and uracils, or AU-tracts, that strongly bend the RNA double-helix. This result may be exploited in the emerging field of RNA nanotechnology and might also constitute a natural mechanism for proteins to achieve recognition of specific dsRNA sequences.

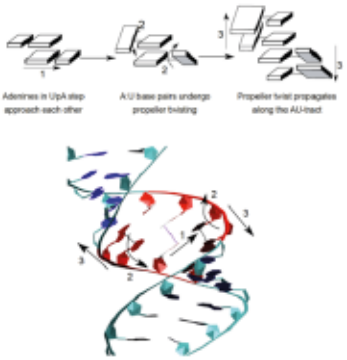


Figure 23: Proposed mechanism for AU-tract induced bending. AU-tract bending is illustrated using rigid blocks representation (top) and a snapshot of the molecular dynamics trajectory (bottom, AU-tract is marked in red). From ***Nucleic Acid Research*** *22, 12917 (2020).*

IFIMAC has a strong tradition in the construction and use of scanning probe microscopes, in particular in Atomic Force Microscopy (AFM). One of the most exciting applications of AFM is the characterization of biological material at the single-particle level. **Physical Virology**, the study of viruses usually involve bulk experiments, which gather average data from large ensembles of structures, thus considering all the particles as indistinguishable. However, biochemical processes are highly asynchronous and intermediate states are poorly populated. Therefore, average measurements might conceal details of the processes taking place in viruses. AFM allows the imaging and manipulation of individual virus particles adsorbed on a surface in liquid milieu by using a sharp tip (~10 nm) located at the end of a microcantilever. In this way, IFIMAC researchers study the electrostatic charge of virus structures, monitor differences between wild type and mutant viruses during disassembly, and resemble the disruption process of viruses taking place during infection (Figure 24). Some of these studies are supported by MD simulations using coarse-grained models and simulation codes developed at IFIMAC.

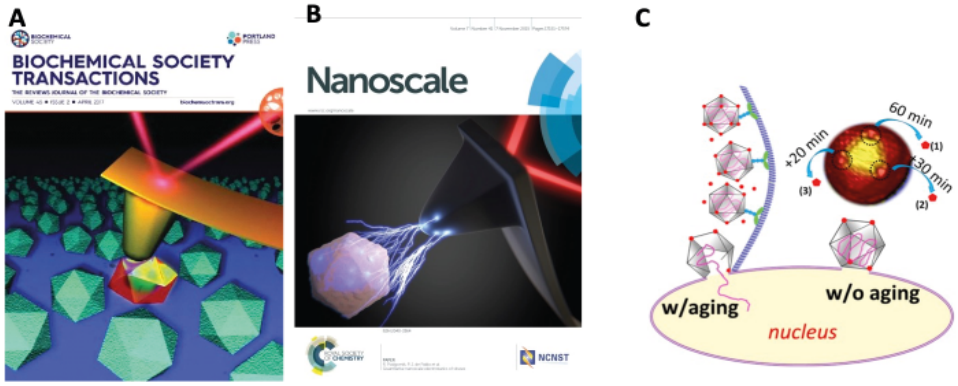


Figure 24: AFM is the perfect tool for seeing and touching individual viruses (A), allowing the study of the electrostatic charge of virus structures (B), and resemble the disruption process of viruses taking place during infection (C). From ***Biochem Soc Trans*** *45, 499 (2017);* ***Nanoscale*** *7, 1728 (2015) and* ***Phys. Rev. X*** *11, 021025 (2021).*

Organization/Management

Steering Committee



Rubén Pérez Pérez

IFIMAC Director

Full Permanent Professor at the Department of Theoretical Condensed Matter Physics, Universidad Autónoma de Madrid.



Luisa E. Bausá López

IFIMAC Deputy Director

Full Permanent Professor at the Department of Materials Physics, Universidad Autónoma de Madrid.



Antonio I. Fernández-Domínguez

Member

Professor at the Department of Theoretical Condensed Matter Physics, Universidad Autónoma de Madrid.



Cristina Gómez-Navarro González

Member

Professor at the Department of Condensed Matter Physics, Universidad Autónoma de Madrid.



Félix Zamora Abanades

Member

Full Permanent Professor at the Department of Inorganic Chemistry, Universidad Autónoma de Madrid.



Hermann Suderow

Infrastructure development

Full Permanent Professor at the Department of Condensed Matter Physics, Universidad Autónoma de Madrid.

Scientific Advisory Board



Prof. Juan Ignacio Cirac
Scientific Director at the Max-Planck Institut für Quantenoptik (Germany).



PhD. Enrique Espi Guzman
Technical Advisor, Repsol DeepTech (Spain)



Prof. Nicola Marzari
Director at MARVEL, National Centre of Competence in Research on Computational Design and Discovery of Novel Materials, École Polytechnique Fédérale de Lausanne (Switzerland)



Prof. Monica Olvera de la Cruz
Lawyer Taylor Professor at the Department of Materials Science, Northwestern University (USA)

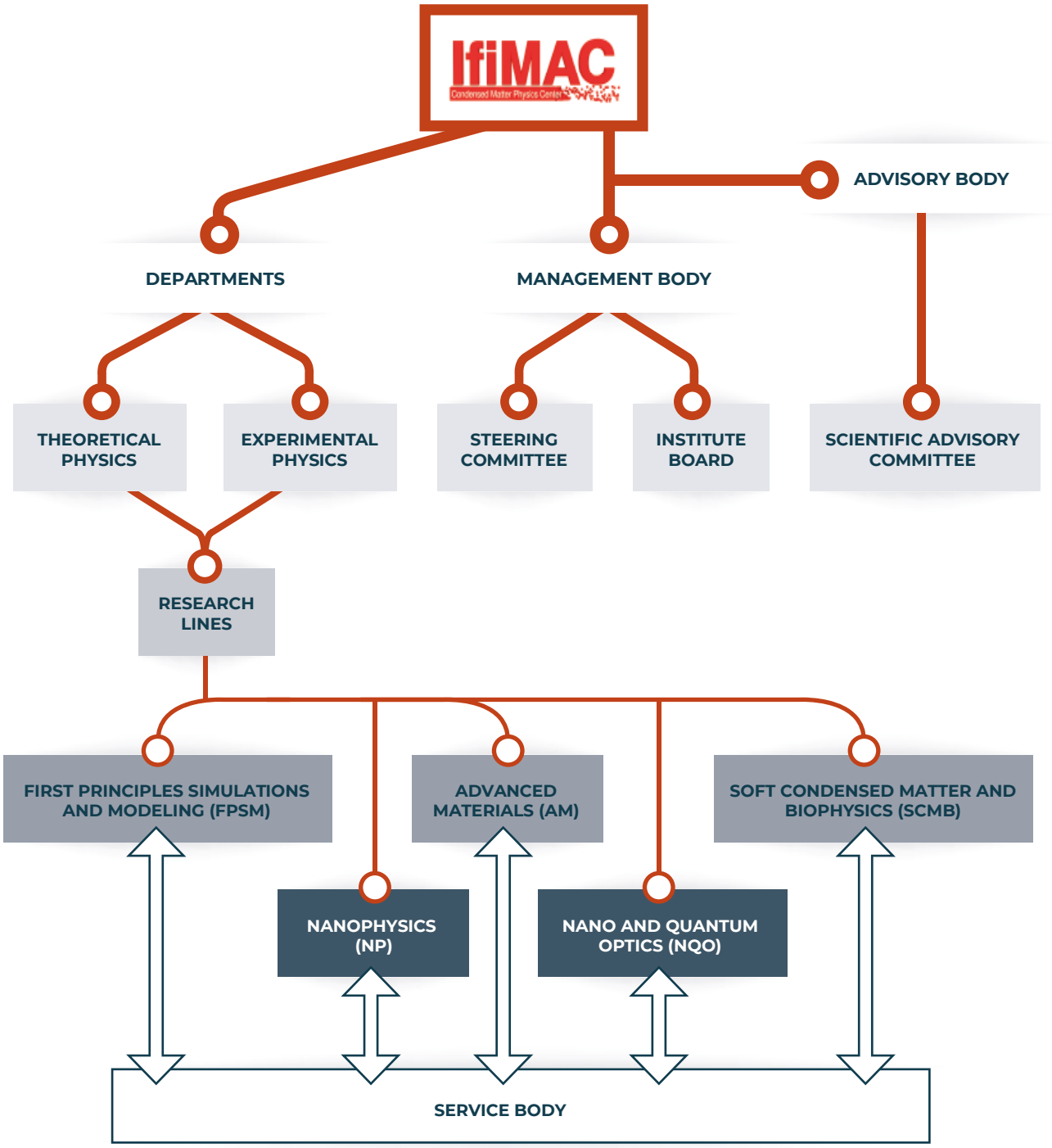


Prof. Päivi Törmä
Professor at the Department of Applied Physics, Head of the Quantum Dynamics (QD) research group. Aalto University (Finland)



Prof. Roser Valentí
Professor at the Institut für Theoretische Physik, Goethe Universitat Frankfurt am Main, Frankfurt, Germany.

Organization Chart



Gender Equality Committee

On April 2021 the Gender Equality Committee was created at IFIMAC. The main task of this Committee is to generate good practices and promote specific activities targeted at strengthening the role of women in Science, also particularly inside IFIMAC, as well as raising awareness of the IFIMAC members on gender equality issues in science. Currently the gender committee is composed by six researchers: I. Guillamón, J. Feist, M. Jaafar, C. Polop, F. Marchetti and C. Gomez-Navarro

The activities designed to reach these broad goals are organised in different areas: diagnosis and monitoring, participation, visibility and awareness, and support for students. Each of these areas and their specific actions are promoted and carried on by different female and male members of IFIMAC.

During 2023 the activity of this committee has focused on:

1. **Monitoring gender balance at IFIMAC**, following our initial diagnostic report regarding gender equality at IFIMAC. We analyse IFIMAC indicators and statistics with gender disaggregated data collection. We evaluate indicators such as the number of hired personnel and Principal Investigators on competitive projects fellowship or grant awardees.
2. Stablishing the **second edition of our mentoring program** for female students. One of the first initiatives of this committee was setting-up a mentoring program for undergraduate female physics students. This program seeks at-offering a close and friendly contact with research activities. In addition, it aims at:

   - promoting the scientific career of women students of the graduate and master's degree.
   - providing female role models.
   - empowering mentors.
   - building a strong network between women in the academic field of physics.

The first edition of this program started with great success in September 2022, with the participation of 34 female mentees and 34 mentors (with no gender restriction). During the 23/24 academic year we improved our number and we enrolled 38 mentees and 38 mentors. These numbers imply that 30% of the female physics students at UAM are enrolled in this mentoring program and more than 40% of senior researchers of IFIMAC participate as mentors.



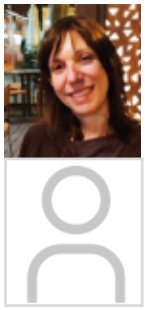
Both mentees and mentors received an introductory course to mentoring before the launching of the program, and an evaluation-training session at the middle of the academic year, both imparted by the external expert from Skills4Science. The mentoring program was launched with an initial meeting starting by a gender equality talk and finished by a gathering coffee. The mentoring program is currently running and it includes monthly or twice-monthly meetings between mentor and mentee of 1 hour and the possibility of visiting the mentor's research group.

3. Promoting **outreach** activities on the **International Day of Women and Girls in Science:**

On 11 February, IFIMAC organized a science fair consisting of a series of workshops to celebrate the International Day of Women and Girls in Science in a central location in Madrid (La Corrala, UAM). This event brought together more than 200 participants and provided them with a unique opportunity to explore soft and hard matter and optics. The overall aim of the event was to stimulate curiosity and interest in science among the general public. In addition, these activities make visible the scientific activities of women working at IFIMAC and highlight the careers of pioneering women in the history of science.

During this science fair, participants explored the behaviour of soft matter, including liquids and gels, through hands-on experimental engagements and learned about the practical applications of advances in the field. At the same time, participants explored the metamorphosis of matter from one state to another under the guidance of IFIMAC members specialising in 'hard matter'. The optics workshop allowed a hands-on exploration of light, spectrally dissecting it to reveal its myriad colours and demonstrating the properties of light using everyday objects such as olive oil or gummy bears.

In addition to the science fair in La Corrala, members of the Condensed Matter Physics Center participated in the celebration of the International Day of Women and Girls in Science by giving a series of **talks** at various **primary and secondary schools** in the Comunidad de Madrid:



Linda Zotti and **Paloma Cerezo** gave a talk ***"Simulaciones de sistemas biológicos y la carrera en física"*** at Colegio Altair (Madrid) on February 9th .



María Dolores Martín gave a talk at CEIP Fuente Santa (Colmenar Viejo) on February 10th.



Nerea Alcázar Cano gave a talk at IES Francisco de Goya (Madrid) on February 13rd.





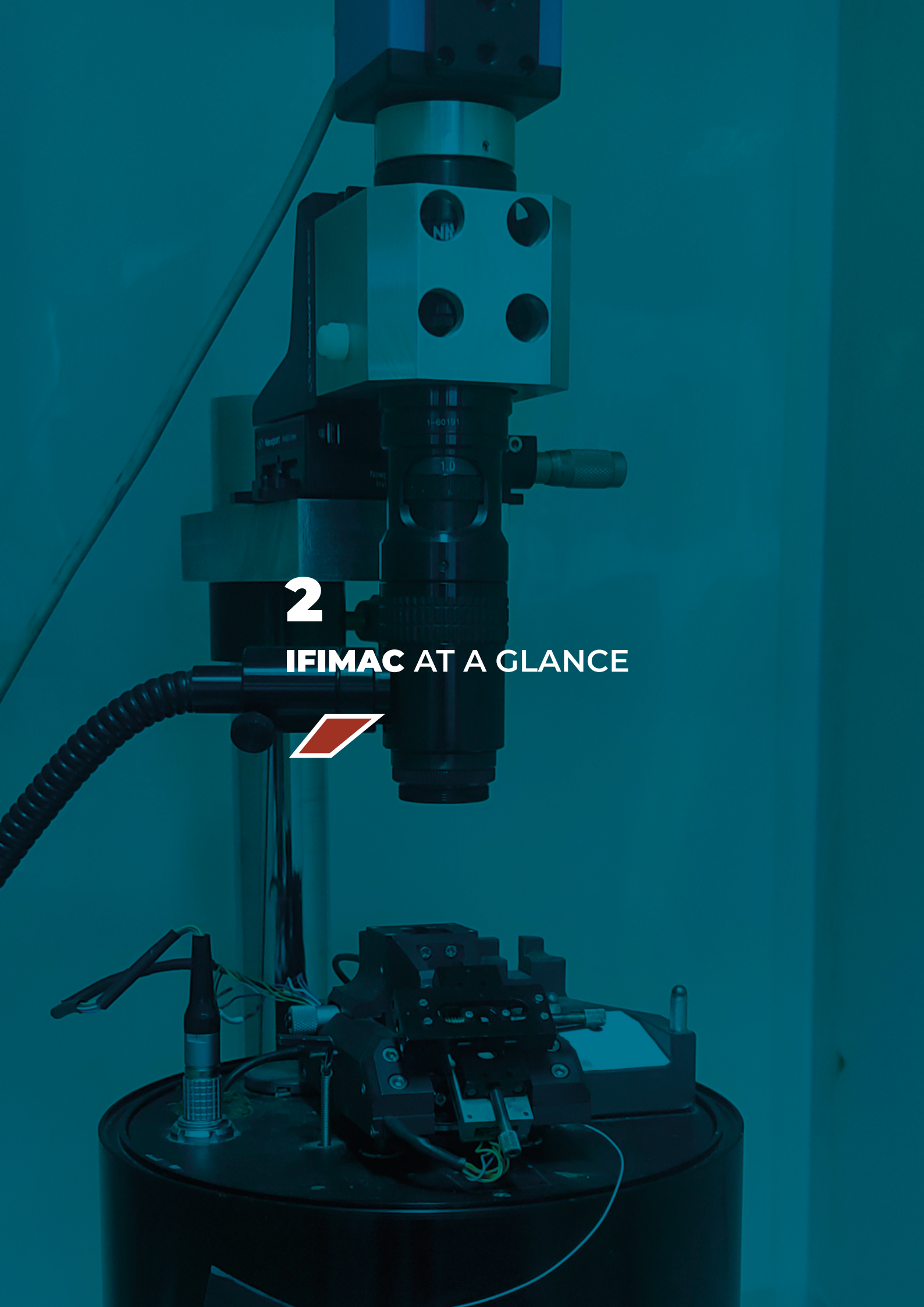
Eva Osuna Bris and **Beatriz Viña Bausá** gave a talk ***"Charla-taller sobre física de la materia condensada y nuestra experiencia como jóvenes investigadoras en esta área"*** at IES Severo Ochoa (Alcobendas) on February 17th.



Celia González Sánchez gave a talk ***"La ciencia también es cosa nuestra"*** at IES Leonardo Da Vinci (Majadahonda) on February 6th, at IES Gran Capitán (Madrid) February 7th and at CEIP Gustavo Adolfo Bécquer (Madrid) February 9th and 14th.

4. **Promoting participation**: The work of the Gender Equality Committee has also been focusing in achieving an increased participation in decision making commissions. We currently achieved a 2/5 of female members in the Steering Committee, 3/6 in the Scientific Advisory Board and we actively pursue to improve our percentages in Project evaluation committees, Grant commissions, Recruitment commissions, Thesis Defense Committees and Invited seminars.

IfiMAC
Condensed Matter Physics Center



2

IFIMAC AT A GLANCE

IfiMAC
Condensed Matter Physics Center

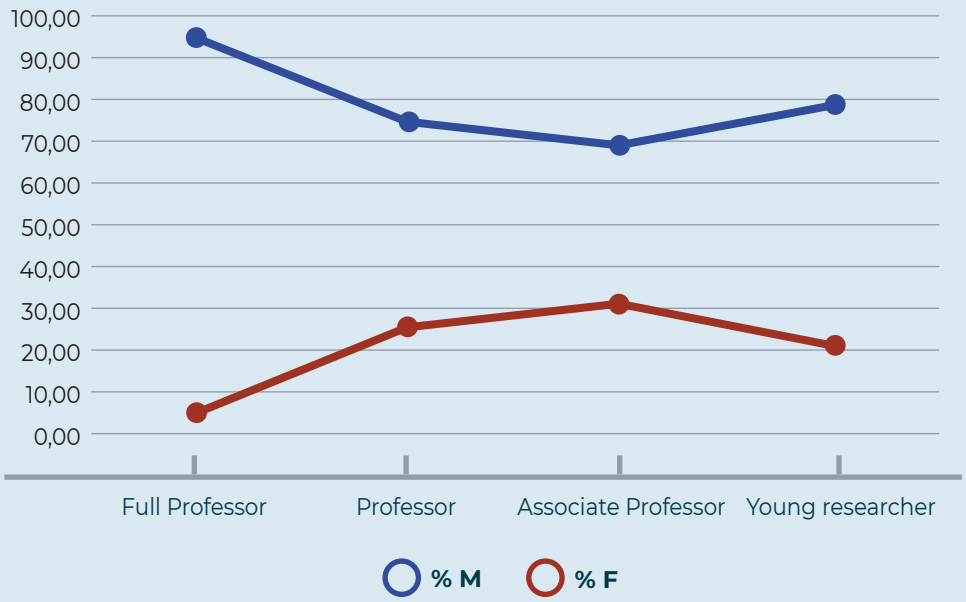
Human resources / IFIMAC Researchers

89 researchers

- **20** Full Professor
- **27** Professor
- **16** Associate Profesor
- **2** Assistant Professor
- **19** Young researcher (RyC, Talent Grant, Junior Leader)
- **5** Emeritus Professor

NEW **3** new researchers affiliated during 2023

By gender:



IFIMAC Staff

7 Administration staff

- **2** IT and High-Performance Computing Infrastructure
- **2** Laboratoty Technician.
- **2** Project Manager
- **1** Outreach

By gender:

Male: **57.14 %**

Female: **42.86 %**

IFIMAC Predoctoral

94 Predoctoral researchers



67 MALE **27 FEMALE**



81 SPANISH **13 NON SPANISH**

By gender:

Male: **71.27 %**

Female: **28.72 %**

IFIMAC Postdoctoral

24 Postdoctoral researchers



19 MALE 5 FEMALE



10 SPANISH 14 NON SPANISH

By gender:

Male: 79.17 %

Female: 20.83 %

Scientific activity / Competitive projects

166 Active projects

- **17** INTERNATIONAL
- **99** NATIONAL
- **29** REGIONAL
- **21** OTHERS

Others: Includes private projects and UAM projects.

4 ERC projects (By gender: 2 male and 2 female). Total funding 2023: 921,359.93€

European Research Council

Type of competitive projects

166 Active projects

- **159** PUBLIC
- **7** PRIVATE

95.78 % are **publics projects**

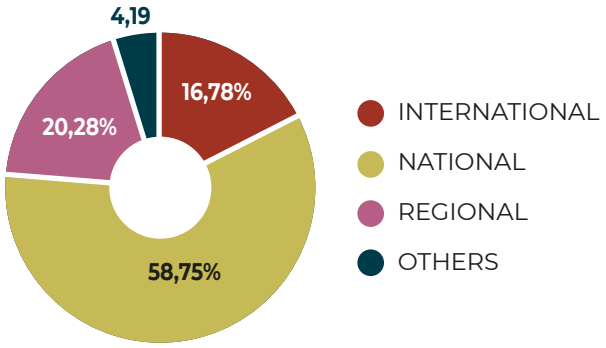
4.21 % are **private projects**

Funding

166 Active projects

INTERNATIONAL	1,888,305.68 €
NATIONAL	6,612,610.93 €
REGIONAL	2,282,434.13 €
OTHERS	471,995.52 €
TOTAL FUNDING 2023	**11,255,346.26 €**

126,464.56 € by **IFIMAC** researcher

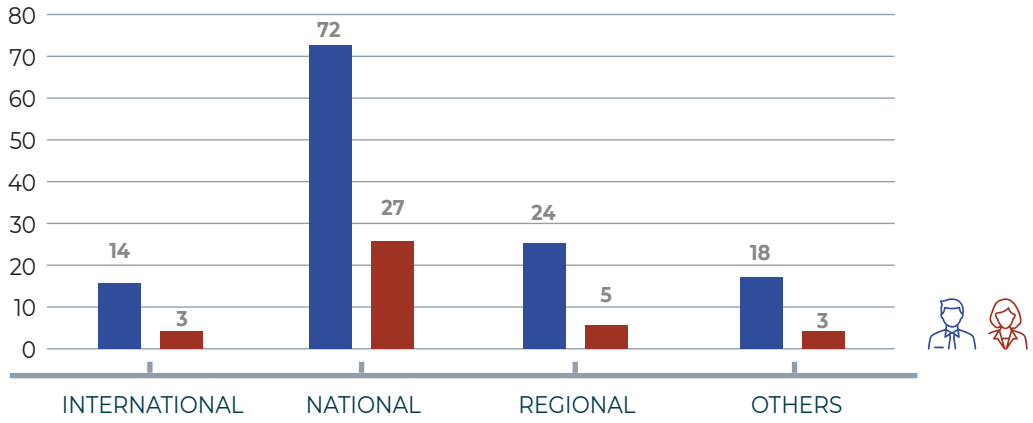


Competitive projects by gender IP and funding

166 Competitive project



128 MALE 38 FEMALE



By gender:

MALE

INTERNATIONAL	1,302,279.72 €
NATIONAL	5,570,509.55 €
REGIONAL	2,195,946.40 €
OTHERS	459,763.50 €

FEMALE

INTERNATIONAL	586,025.96 €
NATIONAL	1,042,101.39 €
REGIONAL	86,487.72 €
OTHERS	12,232.02 €

- IFIMAC **Collaborative Projects**: 2
- **PATENT** applications: 3

Scientific production

185 **Nº of Docs (WoS & Scopus)** **97.84** % citable items

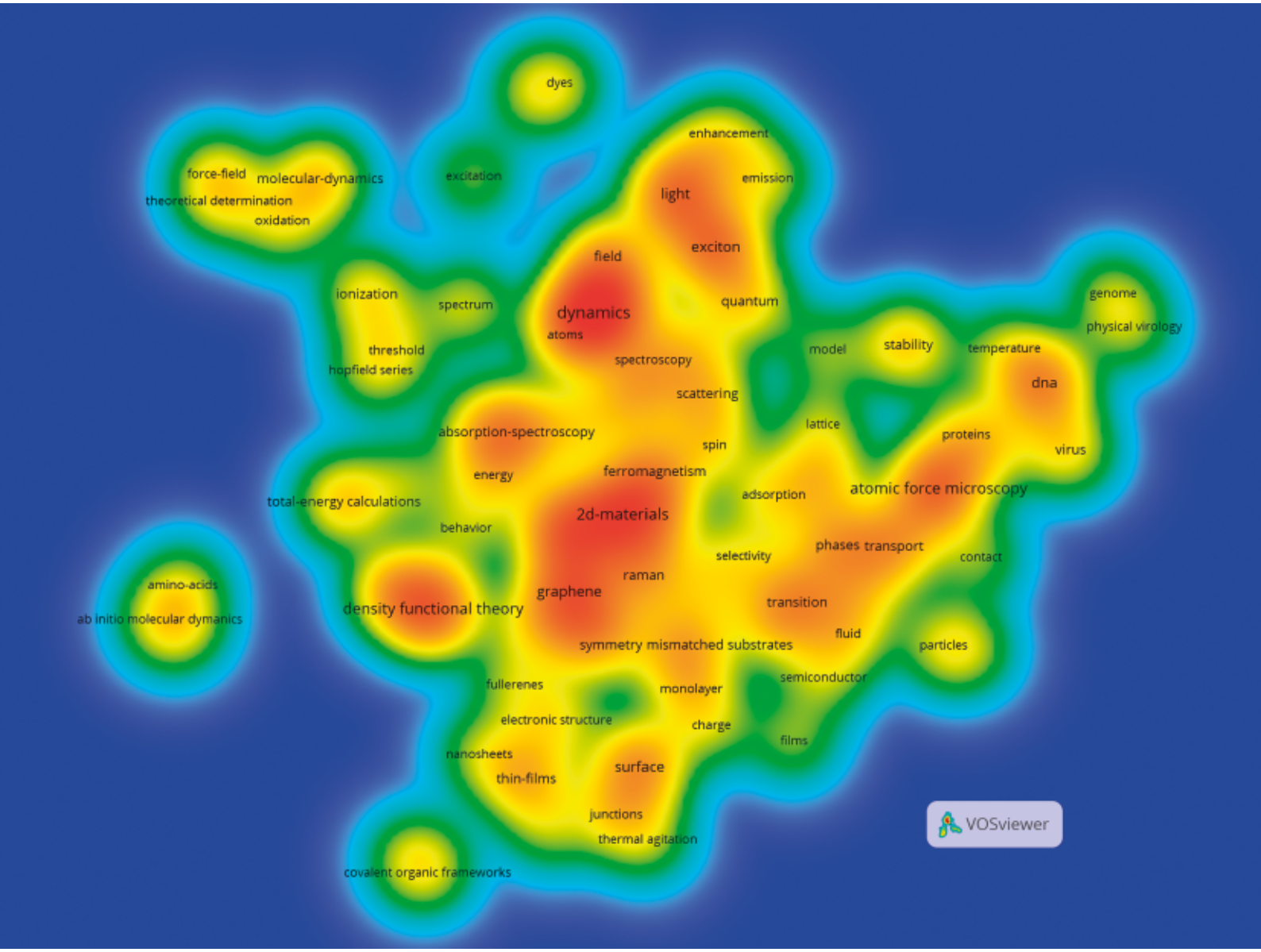
Q1 (JCR)	% Q1 (JCR)	D1 (JCR)	% D1 (JCR)	NO JCR
115	62.16	50	27.03	16

Scopus	Q1 (SJR)	% Q1 (SJR)	D1 (SJR)	% D1 (SJR)	NO SJR
	179	96.76	126	68.11	7

142 **OA** **76.75** % OA

2.07 **paper** by IFIMAC researcher

IFIMAC´s scientific production by keywords



Training activity

14 Doctoral thesis defended

By gender:

Male: 64.28 %

Female: 35.72 %

- IFIMAC's **Master Fellowships**: **10**
- **Research Awards** for Physics Students: **2**
- IFIMAC **Mentoring Program**: **38** mentees and **38** mentors

Other research and outreach activities

- Organization of congresses: 18
- Invited lectures: 54
- Sponsorships: 7
- NEW IFIMAC Colloquium: 7
- IFIMAC Seminars: 24
- IFIMAC ICMM Seminars: 6
- Outreach activities: 23



3
RESEARCH

Main Research Activities
Research Projects
Scientific Results

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Condensed Matter Physics Center

Main Research Activities

IFIMAC Collaborative Projects

As a part of our strategic program (2019-2023) within the Maria de Maeztu Excellence Accreditation, IFIMAC launched the third call for collaborative projects within different groups (between 3 and 5) working at IFIMAC. The projects funded with a budget of 160.000 euros each that are being carried out at IFIMAC are the following. A short summary of the progress of these projects during 2023 is given below:

1. Disorder as a novel platform for topological superconductivity.

Isabel Guillamón, Hermann Suderow, Miguel Ángel Ramos, Roberto Otero, Juan José Palacios

The aim of this project is to start a new collaborative action gathering efforts in the study of topological materials. The field of topological materials has been growing steadily for the last decade or so. By now, we know that many binary and ternary compounds are found to be topological. But materials are not perfect, and it is relevant to ask about the role of defects and, more generally, if topological properties can arise in disordered systems too. On the other hand, only a few compounds are topological and superconducting. A main thrust is to achieve topological protection in a quantum circuit and superconducting devices are prime candidates for this. Superconductivity appears much more often in disordered systems. The idea is to design disordered superconducting materials with topological properties. Furthermore, the project has gathered experimental and theoretical approaches that were traditionally close within IFIMAC but had not really get into touch. With this project, we have been able to address new problems benefitting strongly from the internal collaboration.

To address the issue of disorder, we have taken as a basis the well-known element Bismuth (Bi). First, we have addressed Bismuth (Bi) and Antimony (Sb) mixtures. There are no intermediate compounds in the Bi-Sb phase diagram. Instead, Sb is fully miscible in Bi and viceversa. This means that we can have a single crystal with substitutional disorder. It was previously shown that substitution with Sb leads to band inversion and a topological insulator in single crystals. It was also shown that disordered Bi and Bi-Sb mixtures are superconducting below 6 K. The challenge is to overcome the strong tendency of Bi to crystallize even in single crystals of very small size, producing polycrystalline (non-superconducting) instead of amorphous behavior. We need to create inside the samples sufficiently large amorphous areas. To this end, we have irradiated Bi and Bi-Sb samples using Bi ions and obtained small-gap semiconductors. We also prepared thin films of amorphous Bi and of Bi_xSb_{1-x} alloys (x=0, 0.05, 0.10 and 0.15), and subsequently irradiated these with protons and Bi ions (up to 35 MeV). The resulting materials have been characterized by means of SEM and XRD (publication accepted in Low Temperature Physics). Until now, we have found mostly semiconducting behavior and we are working on modifying deposition processes to obtain superconductivity. On the theory side, approaches to calculate the electronic properties of amorphous Bi are under development. Theory results have been published (Physical Review B 105, 155128, 2022), reporting the use of convolutional neural networks to predict the topological character of simple models of disordered systems. The technique seems promising, and the theory side is extending it to more realistic models using a Slater-Koster parametrization of amorphous Sb and Bi in two-dimensional form (for the time being, an extension to three dimensions might come later). We have also made advances towards designing with AI an energy functional that will allow us to simulate Bi amorphization and recrystallization dynamics. This is done by training a graph-based neural network with DFT calculations of small clusters.

On the other hand, we have also grown high quality single crystals of Bi and are going to make a thorough study of the surface properties, with the aim to induce superconductivity close to the surface. We have studied the natural defects in Bi(111) surfaces using tunneling microscopy/spectroscopy and tunneling electroluminescence. In particular, the spatial dependence of the electronic structure has been characterized around the different types of atomic defects found on the surface as well as the atomic steps, finding that the quasiparticle interference maps are very different depending on the nature of the defect. Likewise, plasmonic luminescence spectra have been obtained, which is surprising given the low density of electronic states at the Fermi level.

We have also made a collaborative effort to measure the superconducting properties of single crystals of the high Tc superconductor Bi2212, obtaining neat surfaces and homogeneous superconducting properties, with amazing tunneling spectroscopy results at defects and areas with disorder.

Finally, as collateral work, we have also obtained new insight in the conduction through single atom point contacts under magnetic fields as high as 20 T. We observe spin sensitive transport and a strong influence of the magnetic field in the formation of the single atom point contact. The role of atomic arrangements close to the junction and adsorbed molecules have been carefully considered by theory, obtaining an excellent agreement with experiments. Furthermore, the sixfold fermion system $PdSb_2$ was analyzed from tunneling spectroscopy and theory, highlighting the role of surface states in the tunneling conductance.

2. Dynamically driving spinning colloidal particles in 2D lattices.

Juan. L. Aragonés, Laura. R. Arriaga, Salvatore Assenza, José. V. Álvarez.

Controlled transport at the microscale is challenging not only because viscous forces dominate over inertial forces, and thus directed motion is difficult to achieve, but also because the environments are complex and dynamic. Inspired by the robust unidirectional transport exhibited by topological mechanical metamaterials whose dynamical matrices have edge states lying at finite frequencies when time-reversal symmetry is broken, we proposed the design of a novel topological active material able to overcome the dissipation constrain at the microscopic scale. Our system comprises two key constituents: a suspension of colloidal particles that rotate under the external actuation of a homogenous magnetic field perpendicular to the substrate (so-called spinners) and an array of obstacles. We observe that, contrarily to intuition and most of the systems at thermodynamic equilibrium, there is not net transport of spinners in ordered arrays of obstacles, whereas we can achieve transport in the presence of small amounts of disorder in the lattice positions of the obstacles. We have thoughtfully analyzed this behavior, fingerprint of the out-of-equilibrium nature of our system, demonstrating that the critical component is the dynamic balance between the hydrodynamics repulsion and conservative attraction between the obstacles and the spinner driven by the external actuation frequency on the spinner, Ω. We have shown and described this behavior both, experimentally and using numerical simulations (article in preparation). This part of the project has been carried out by J.L. Aragonés, L.R. Arriaga, S. Assenza and J.V. Álvarez.

Nevertheless, the transport of spinner in disordered arrays of obstacles is diffusive and thus, of stochastic nature. To achieve directed transport, we have shown using numerical simulations that time modulation of the spinner actuation frequency allows the crossover between the two steady states of the system, resulting in controlled transport. We are working on the functionalization of the obstacle lattice, by means of soft lithography, to demonstrate this experimentally. In parallel, we are modelling the dynamics of this system, using a mean field approximation by means of the Fokker-Planck equation (FPE), to explore the robustness of the system transport properties and find new routes to tune the system transport properties. We have demonstrated that the hydrodynamic repulsive force between the spinner and the lattice obstacles only changes the diffusion term in the FPE. In addition, analyzing the probability current of the system, we have shown that the irreversible part cancels out when the system reaches the steady states and thus, at constant angular velocity of the spinner the steady state trajectory is a close loop trajectory where the translational velocity is given by the velocity field generated by the spinner rotation. We observe that at a constant attractive force, the equilibrium eigenstates at low Ω corresponds to circular densities of probability around the obstacle, while at higher Ω the equilibrium eigenstate corresponds to a close probability density around the four obstacles of the square lattice. These results are in perfect agreement with results obtained from the discrete system integrating the Langevin equation, being the validation point to further use the Fokker-Plank equation to analyze the transport properties of this system (article in preparation). Moreover, this formalism opens the door to analyze the transport properties of our system using well-established methods to describe the topological properties described in different quantum systems. Right now, we are developing the Bloch theorem and the Bloch-Floquet theory for the Fokker-Planck equation, which will allow us to make the connection between the transport exhibited in our system with the topological transport described in the quantum world. We also observe that the solutions obtained from the Fokker-Plank equation for this system depends only on one trajectory in the parameter space, analogous to the Berry phase. This part of the project is being carried out by J.L. Aragonés, L.R. Arriaga and J.V. Álvarez.

In addition to the transport properties of spinners in obstacles lattices, we are studying the transport of other type of active particles that, instead of spin in place, they roll onto the substrate under the actuation of a rotating magnetic field parallel to the substrate. Their motion is driven by the shear stresses between the particle and the substrate. Interestingly, depending on the density of the obstacle lattice, these rollers translate in the rolling direction at low densities, the one dictated by the shear stresses, or they roll backwards at higher densities (article in preparation). This phenomenon arises from the intricate hydrodynamic interactions between the obstacles and the flows generated by the particle's rotation on a solid substrate (article under consideration by PRL, arXiv:2402.17707v3). This part of the project has been carried out by J.L. Aragonés and L.R. Arriaga.

Finally, both systems, spinners and rollers, in obstacle lattices, are ideal candidates to develop actuation protocols to learn how to optimize the transport properties of surface-enabled micro-robots in complex environments, empowering them with sensing capabilities using machine learning models. Therefore, this project has opened a new research avenue in our group to explore the potential application of artificial intelligence to develop smart micro-robots at microscopic scale.

First Call for collaborative projects

Virus as molecular containers: transport, delivery and nanoreactors *(Pedro J de Pablo Gómez, José Ortega Mateo, Rafael Delgado Buscalioni)*

Visualizing, understanding and controlling Andreev bound states down to atomic scale *(Hermann Suderow Rodríguez, Alfredo Levy Yeyati, Álvaro Martín Rodero, Miguel Ángel Ramos Ruiz, José Gabriel Rodrigo Rodríguez, Isabel Guillamón Gómez)*

Second call for collaborative projects

Single-photon generation in 2D crystalsfor quantum information *(Juan José Palacios Burgos, Elsa Prada, Gabino Rubio Bollinger, José Manuel Calleja Pardo, Snezana Lazic, Carlos Tejedor de Paz, Luis Viña Liste)*

Ultrahigh pressure chemistry at the nanoscale *(Julio Gómez Herrero, Enrique García Michel, José María Gómez Rodríguez, Daniel Farías Tejerina, Félix Zamora Abanades, Fernando Martín García)*

Charge and heat transport in atomic, molecular and protein-based junctions *(Nicolás Agrait de la Puente, Juan Carlos Cuevas y Rubén Pérez Pérez)*

Young Researchers

One of the most important and decisive **actions** within the **Maria de Maeztu Grant** has been the hiring of three brilliant international young researchers. Thanks to the financial support of this grant, IFIMAC was able to **offer three new *four-year contracts*** plus an additional money to develop their research group to these three researchers:

Saül Veléz pursed his master's (2008) and PhD studies (2012) at the University of Barcelona under the supervision of Prof. Tejada, receiving in both the Extraordinary award for his results on quantum magnetism. In April 2013, Saül joined the nanodevices group at CIC nanoGUNE to work with Prof. Hueso with the purpose to transition towards spintronics and nanodevices, areas in which he is now a reference. From September 2017 to May 2021, Saül also hold a senior postdoctoral position in the groups of Prof. Gambardella and Prof. Fiebig at ETH Zürich.

With interest in spintronics, magnetotransport, and optoelectronics phenomena, his recent research focused on exploring magnetoresistive effects and magnetic dynamic phenomena in metal/oxide heterostructure devices. Among his discoveries, he has demonstrated that interfacial interactions and spin currents can be used for probing and manipulating the magnetic moments of electrically insulating materials, opening a new research field with profound fundamental and technological impacts. His contributions to polaritonics and optoelectronics in low dimensional materials and heterostructures are also multiple.

Saül joined IFIMAC in June 2021 as Junior Group Leader and founded the Spintronics and Nanodevices group. In his lab, he aims at exploring non-conventional materials and new device concepts for spintronic applications.

Saül Vélez was awarded with a RyC grant (that he rejected to incorporate to his talent grant) and a Talent Attraction grant from the Community of Madrid in year 2021. On January 2022 he started his talent grant contract at IFIMAC.

Akashdeep Kamra obtained his master degree in Electrical Engineering from the Indian Institute of Technology Kanpur and a PhD in Physics from the Delft University of Technology, Netherlands. Then he worked as an Alexander von Humboldt postdoc fellow at the University of Konstanz, Germany before joining Norwegian University of Science and Technology as an independent researcher. His primary interest lies in the theory of spin-dependent phenomena in magnetic insulators, (super)conductors and their hybrids. Akash especially enjoys working on research problems that exploit knowledge from different sub-fields of Physics. While being a "theorist", he has performed several experiments first hand in the past and continues to collaborate closely with experimentalists. When not enjoying Physics, Akash likes to go hiking and exploring new places.

Akashdeep Kamra was awarded with a Ramón y Cajal grant (2021 call), starting his contaract as RyC researcher at the beginning of 2023.

Pablo Ares research interests have a marked multidisciplinary character within the framework of nanoscience and nanotechnology. They are focused on the use and development of scanning probe microscopies, mainly atomic force microscopy (AFM), for the study of low-dimensional systems, with particular attention to 2D materials.

He received his B.S. and Master degree in Physics at the Universidad Complutense de Madrid (Spain) in 2003. He then joined the company Nanotec Electrónica S.L. (devoted to the design, development and commercialization of scanning probe microscopes) as an Application Scientist. In 2014, he moved to the Universidad Autónoma de Madrid (Spain), where in 2017 he obtained his PhD in Condensed Matter Physics and Nanotechnology under the supervision of Prof. Julio Gómez-Herrero and Dr. Adriana Gil. His thesis presented a double scientific-technical aspect, with advances on the AFM technique itself, as well as with more fundamental science studies, such as the isolation and study of antimonene, pioneering the worldwide experimental research on this novel 2D material. After this, he joined the Graphene Group at the Condensed Matter Physics department of the University Of Manchester (UK) as a Research Associate working with Prof. Konstantin S. Novoselov and Dr. Laura Fumagalli. Once there he gained a Marie Sklodowska-Curie Individual Fellowship in 2018. His research during this time focused on basic properties of 2D materials and their combination in van der Waals heterostructures, and their use for the study of electrical properties of molecules under extreme confinement.

Pablo Ares was awarded with a Ramón y Cajal grant (2020 call), and he started his contract as RyC researcher in 2022.

IFIMAC Day 2023

In December 2023, IFIMAC celebrated its second annual IFIMAC DAY, a pivotal event highlighting the institute's achievements and fostering collaboration within the academic community. The opening of the event was presided by Manuel Chicharro, the Dean of the Faculty of Sciences. Following the opening remarks, the director of IFIMAC, Rubén Pérez Pérez, provided a comprehensive overview of the day's agenda, which included insightful research presentations by Junior Leaders and IFIMAC Committees, a roundtable discussion aimed at strategic reflection to further enhance IFIMAC's transversal research lines, and a poster session featuring the work of PhD students from the center. The event culminated with closing remarks from Amaya Medikoetxea, the Rector of the Autonomous University of Madrid, underscoring the importance of IFIMAC's contributions to the university's academic endeavors and the broader scientific community.



The talks given by IFIMAC "Junior leaders" were the following:

- **Pablo Ares García:** My experience as an IFIMAC Junior Group Leader.
- **Akashdeep Kamra:** My Research at IFIMAC - Opportunities and Challenges.
- **Laura Rodríguez Arriaga:** Vesicles - A Powerful Model to Understand Subcellular, Cellular and Multicellular Organization and Dynamics.
- **Paloma Arroyo Huidobro:** My Research at IFIMAC.
- **Saül Vélez:** Spintronics and Nanodevices Laboratory.

The talks given by the IFIMAC Committees on gender, seminars, communications, outreach, and the new criteria of evaluation under COARA, DORA, and the Open Science movement, were the following:

- Cristina Gómez-Navarro: **Introduction and common facilities**.
- Francesca Marchetti: **Gender equality commission.**
- Ferry Pins: **Outreach, communication and Open Science**.
- Diego Martín Cano: **Seminars and colloquia**.
- Celia González Sánchez: **STEMinist4future.**

All the talks of this meeting are available at **IFIMAC YouTube Channel**

In between the talks, we had a **poster session** where PhD students and postdocs were able to share their work at IFIMAC.

During IFIMAC Day, a special tribute was dedicated to Almudena Conde, who served as IFIMAC´s project manager for a decade. Almudena, who has been instrumental in the success of IFIMAC, is embarking on a new professional challenge at UAM. Her dedication and contributions to the center were acknowledged and celebrated during the event.



Seminars

In 2023, IFIMAC initiated the **IFIMAC Colloquium**, a platform designed to convene distinguished experts from various fields within condensed matter physics. This initiative complemented our existing programs, including the ongoing **IFIMAC Seminars** and the collaborative **IFIMAC+ICMM Seminars** established in 2020 and concluded this year.

Adapting to the challenges posed by the COVID-19 pandemic, we transitioned the IFIMAC Seminars to an online format. This adjustment proved to be advantageous in two significant ways. Firstly, it facilitated regular engagement with esteemed speakers, both internationall and national, on a weekly basis. Secondly, the online format expanded our reach, allowing us to connect with a global audience far beyond the confines of the UAM campus and Madrid.

In 2023, were held 7 IFIMAC Colloquium, 24 IFIMAC Seminars and 6 joint IFIMAC+ICMM Seminars.

NEW IFIMAC Colloquium



Andreas Heinrich: ***Towards Quantum Computing with Spins on Surfaces***
IBS Center for Quantum Nanoscience.
Ewha Womans University (Republic of Korea)
https://www.youtube.com/watch?v=zrQ-l5eKnb4



Allan MacDonald: ***Exciton Condensates Through the Years***
University of Texas Austin (USA)
https://www.youtube.com/watch?v=1zT6jMv4jUA



Roser Valentí: ***Strategies to design quantum materials with exotic properties***
Institut far Theoretische Physik, Goethe Universitiit Frankfurt am Main (Germany)
https://www.youtube.com/watch?v=fgpw61Scpy4



Atac Imamoglu: ***Optical investigation of strong electronic correlations: Magnetism in semiconductor moire materials.***
Institute for Quantum Electronics, ETH Zürich (Switzerland)
https://www.youtube.com/watch?v=2wy47amu1U0

IfiMAC colloquium



Jascha Repp: ***Accessing non-equilibrium states at atomic scales.***
Universität Regensburg (Germany)

IfiMAC colloquium



Olivier Dauchot: ***When active matter turns solid: from collective motion to collective actuation.***
CNRS ESPCI-Paris PSL (France)
https://www.youtube.com/watch?v=QVJgDlZecIg

IfiMAC colloquium



Serge Haroche: ***Quantum Science with Giant Rydberg Atoms.***
Nobel Prize in Physics 2012
École normale supérieure & College France (France)
https://www.youtube.com/watch?v=UWdc577PYzo

IFIMAC Seminars



Yanina Fasano
Impact of atomic defects in the electronic states of FeSe(1-x)Sx superconducting crystals
Instituto de Nanociencia y Nanotecnología, CNEA, Centro Atómico Bariloche and CONICET (Argentina)
February 8th 2023; 12:00h
IFIMAC



Nicola Carlon Zambon
Levitodynamics - A dance of light and matter
Photonics Laboratory, ETH Zürich (Switzerland)
February 24th 2023; 12:00h
IFIMAC



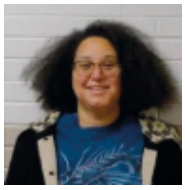
Elena Gati
Tuning iron-based superconductors and Eu-based semimetals by pressure and strain
Max-Planck-Institute for Chemical Physics of Solids (Germany)
March 22nd 2023; 12.00h
IFIMAC



Yonathan Anahory
Vortex manipulation: from collective behavior to single-vortex
Racah Institute of Physics
The Hebrew University of Jerusalem (Israel)
March 23rd 2023; 12.00h
IFIMAC



Paul C Canfield
The How and Why of New Materials Physics: insight and innovations
Ameslab and Iowa State University (USA)
March 27th 2023; 12.00h
IFIMAC



Raquel Ribeiro
Small moment antiferromagnetic ordering in single crystalline
La2Ni7
Ames Lab and Iowa State University (USA)
March 30th 2023; 16.00h
IFIMAC



Lukas Lackner
Exciton-Polaritons in van-der-Waals (Hetero)-structures
Institute of Physics, University of Oldenburg (Germany)
April 28th 2023; 12.00h
IFIMAC



Walter Lambrecht
Electronic structure and optical properties of 2D oxides
Case Reserve University (USA)
May 16th 2023; 12.00h
IFIMAC



Aitzol Garcia-Etxarri
Nanoneuro: the power of nanoscience to explore the frontiers of neuroscience
Donostia International Physics Center (DIPC) (Spain)
May 30th 2023; 12.30h
IFIMAC



Daniel Hernangómez Pérez
Ab initio charge transport, excitonic and magneto-optical properties of van der Waals interfaces with chalcogen vacancies
Department of Molecular
Chemistry and Materials Science, Weizmann Institute of Science (Israel)
June 5th 2023; 12.00h
IFIMAC



Yingjie Zhang
On the Fundamentals of Interfacial Solvation: Molecular Imaging, Atomistic Simulations, and Statistical Mechanics Models
University of Illinois Urbana-Champaign (USA)
June 13rd 2023; 12.00h
IFIMAC



Timur Shegai
Transition metal dichalcogenides for high-index nanophotonics, nonlinear optics and strong light-matter coupling.
Chalmers University of Technology (Sweden)
June 15rd 2023; 12.00h
IFIMAC



Timur Shegai
Casimir self-assembly as a tunable polaritonic platform
Chalmers University of Technology (Sweden)
July 4th 2023; 12.00h
IFIMAC

Hitoshi Seo
Anomalous Spin Transport in Collinear Antiferromagnets: Molecular Conductors and Perovskites
Riken (Japan)
July 5th 2023; 12.00h
IFIMAC



Mathias Weiler
Chiral magnetoacoustics
RPTU Kaiserslautern-Landau (Germany)
August 25th 2023; 12.00h
IFIMAC



Matthias Althammer
Chiral phonons and phononic birefringence in ferromagnetic metal - bulk acoustic resonator hybrids
Walther-Meissner-Insitute (Germany)
September 5th 2023; 12.00h
IFIMAC



Alec Talin
Computing with Ions: the journey from batteries to dynamically reconfigurable adaptive architectures.
Sandia National Laboratories (USA)
September 29th 2023; 12.00h
IFIMAC



Ori Katz
Coherent perfect absorption of arbitrary wavefronts
Institute of Applied Physics, The Hebrew University of Jerusalem (Israel)
October 17th 2023; 12.00h
IFIMAC



Joel Cox
Nonlinear Nanoplasmonics with Atomically Thin Materials
POLIMA—Center for Polariton-driven Light-Matter Interactions, University of Southern Denmark (Denmark)
October 23rd 2023; 12.00h
IFIMAC



Lina Johnsen Kamra
Magnetic control of superconducting heterostructures using compensated antiferromagnets
IFIMAC (Spain)
November 14th 2023; 12.30h
IFIMAC



Javier Cuerda
Quantum geometry and magneto-optical effects in plasmoniclattices
Department of Applied Physics, Aalto UniversitySchool of Science (Finland)
November 21st 2023; 12.00h
IFIMAC



Francesco Tafuri
Hybrid Josephson junctions opportunity for quantum hardware and advances in quantum science
Università di Napoli Federico II (Italy)
November 24th 2023; 9.30h
IFIMAC



Claudiu Genes
Cooperative quantum optics with molecules
Max Planck Institute for the Science of Light, Erlangen (Germany)
December 11st 2023; 15.00h
IFIMAC



Denis Seletskiy
Experimental Quantum Electrodynamics
Polytechnique Montréal (Canada)
December 19th 2023; 12.00h
IFIMAC

IFIMAC+ICMM Seminars



Alejandro González-Tudela
Nanophotonics for Quantum Technologies
Instituto de Física Fundamental-CSIC (Spain)
January 12th 2023; 12.00h (Hybrid)
IFIMAC+ICMM



Pablo Alonso-González
Nanooptics with 2D materials
CINN (CSIC-Universidad de Oviedo) (Spain)
January 26th 2023; 12.00h (Online)
IFIMAC+ICMM



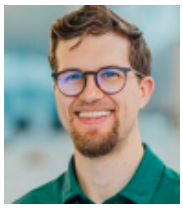
Björn Trauzettel
Topological Burning Gass Effect
Würzburg Universisty (Germany)
February 9th 2023; 12.00h (Online)
IFIMAC+ICMM



Alberto Amo
Localisation via drive and dissipation in lattices of photonic resonators
Laboratory PhLAM, CNRS – University of Lille (France)
February 23rd 2023; 12.00h (Hybrid)
IFIMAC+ICMM



Christian Flindt
Cooper pair splitting in real-time
Aalto University (Finland)
April 20th 2023; 12:00h (Online)
IFIMAC+ICMM



Sean Molesky
Duality in Inverse Design
Polytechnique Montréal (Canada)
May 18th 2023; 16:00h (Online)
IFIMAC+ICMM

PhD Position (predoctoral fellowships AEI)

We welcomed one new PhD student **Carlos Roldán Piñero** ***(Theory and simulation in condensed matter)***

He is pursuing his PhD working in the project Computational Simulations of Load Transportation in Biosystems, under the supervision of Linda Angela Zotti and José Ortega Mateo.

Research Projects

International R&D projects

1. **ANDREEV QUBITS FOR SCALABLE QUANTUM COMPUTATION - ANDQC**
   Reference. GA 828948
   Funding Institution: European Commission
   Period: 01/04/2019 31/03/2024
   PI. LEVY-YEYATI MIZRAHI, ALFREDO

2. **ATTOSECOND CHEMISTRY - ATTOCHEM**
   Reference. CA 18222
   Funding Institution: European Commission
   Period: 25/10/2019 24/04/2024
   PI. MARTIN GARCIA, FERNANDO

3. **DEVELOPMENT OF OPERANDO TECHNIQUES AND MULTISCALE MODELLING TO FACE THE ZERO-EXCESS SOLID-STATE BATTERY CHALLENGE - OPERA**
   Reference. GA101103834
   Funding Institution: European Commission
   Period: 01/06/2023 31/05/2026
   PI. POLOP JORDA, CELIA

4. **FUTURE DATA STORAGE USING COLLOIDAL MEMORY TECHNOLOGY - FASTCOMET**
   Reference. GA 101130615
   Funding Institution: European Commission
   Period: 01/11/2023 31/10/2026
   PI. DELGADO BUSCALIONI, RAFAEL

5. **IMPROVING THE SUSTAINABILITY OF THE EUROPEAN MAGNETIC FIELD LABORATORY**
   Reference. GA 871106
   Funding Institution: European Commission
   Period: 01/11/2020 31/10/2024
   PI. SUDEROW RODRIGUEZ, HERMANN JESUS

6. **INTEGRATIVE CHARACTERISATION OF NOVEL ADENOVIRUS VECTORS AIMED AT THERAPEUTIC APPLICATIONS - INVECTA**
   Reference. GA 101129778
   Funding Institution: European Commission
   Period: 01/12/2023 30/11/2027
   PI. DE PABLO GOMEZ, PEDRO JOSE

7. **MAGNETOELECTRIC 3D PRINTING TECHNOLOGY - THE REVOLUTION OF ACTUATABLE COMPOSITES - EVA**
   Reference. GA 101047081
   Funding Institution: European Commission
   Period: 01/10/2022 30/09/2026
   PI. ZAMORA ABANADES, FELIX JUAN

8. **MID-INFRARED QUANTUM TECHNOLOGY FOR SENSING - MIRAQLS**
   Reference. GA 101070700
   Funding Institution: European Commission
   Period: 01/10/2022 30/09/2025
   PI. FERNANDEZ DOMINGUEZ, ANTONIO ISAAC

9. **MODIFICATION OF MOLECULAR STRUCTURE UNDER STRONG COUPLING TO CONFINED LIGHT MODES - MMUSCLES**
   Reference. GA 714870
   Funding Institution: European Commission
   Period: 01/04/2017 31/03/2023
   PI. FEIST, JOHANNES MAXIMILIAN

10. **MOLECULAR DYNAMICS IN THE GAS PHASE**
    Reference. CA 18212
    Funding Institution: European Commission
    Period: 12/11/2019 11/11/2023
    PI. DIAZ-TENDERO VICTORIA, SERGIO

11. **NOTSOQUANTUM: REALISTIC SIMULATIONS OF POLARITONIC CHEMISTRY**
    Reference. GA101029384
    Funding Institution: European Commission
    Period: 01/09/2022 31/08/2025
    PI. FEIST, JOHANNES MAXIMILIAN

12. **PROTEIN NANOCAGES AS SINGLE MOLECULAR REACTORS TO UNDERSTAND BIOCATALYSIS IN CROWDED ENVIROMENTS**
    Reference. RGP0012/2018
    Funding Institution: THE INTERNATIONAL HUMAN FRONTIER SCIENCE PROGRAM ORGANIZATION
    Period: 01/06/2018 31/08/2023
    PI. DE PABLO GOMEZ, PEDRO JOSE

13. **SCANNING PROBE MICROSCOPY IN HIGH VECTORIAL MAGNETIC FIELDS: NEW DEVICE FOR IMAGING QUANTUM MATERIALS - VECTORFIELDIMAGING**
    Reference. GA 101069239
    Funding Institution: European Commission
    Period: 01/06/2022 30/11/2024
    PI. GUILLAMON GOMEZ, ISABEL

14. **SUPERCONDUCTING NANODEVICES AND QUANTUM MATERIALS FOR COHERENT MANIPULATION - SUPERQUMAP**
    Reference. CA 21144
    Funding Institution: European Commission
    Period: 06/10/2022 05/10/2026
    PI. SUDEROW RODRIGUEZ, HERMANN JESUS

15. **THE ULTIMATE TIME SCALE IN ORGANIC MOLECULAR OPTO-ELECTRONICS, THE ATTOSECOND**
    Reference. GA 951224
    Funding Institution: European Commission
    Period: 01/04/2021 31/03/2027
    PI. MARTIN GARCIA, FERNANDO

16. **THEORETICAL INVESTIGATION OF SURFACE PHONON POLARITON-BASED QUANTUM PHOTONIC CIRCUITS**
Reference. GA 101067180
Funding Institution: European Commission
Period: 01/10/2022 30/09/2024
PI. FERNANDEZ DOMINGUEZ, ANTONIO ISAAC

17. **TIME-VARYING NANOPHOTONICS FOR NEW REGIMES OF QED LIGHT-MATTER INTERACTIONS - TIMELIGHT**
Reference. GA 101115792
Funding Institution: European Commission
Period: 31/12/2023 31/12/2028
PI. ARROYO HUIDOBRO, PALOMA

National R&D Projects

1. **ACELERANDO LA TRANSICIÓN DIGITAL CON NANOFOTÓNICA CUÁNTICA: PLATAFORMAS**
Reference. TED2021-130552B-C21
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. MARTIN CANO, DIEGO

2. **ACTIVATION OF GREENHOUSE GASES FOR CLEAN ENERGY FUELS: A COMBINED MOLECULAR BEAMS AND XPS STUDY**
Reference. TED2021-130446B-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. FARIAS TEJERINA, DANIEL

3. **CANALIZACIÓN DE ENERGÍA EN SEMICONDCUTORES NANOESTRUCTURADOS**
Reference. PID2022-141579OB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. PRINS, FERRY

4. **CARACTERIZACIÓN DE EXCITACIONES ÓPTICAS EN MATERIALES 2D CON RESOLUCIÓN ATÓMICA**
Reference. PID2021-128011NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. LOPEZ VAZQUEZ DE PARGA, AMADEO

5. **CARACTERIZACIÓN DE EXCITACIONES ÓPTICAS EN MATERIALES 2D CON RESOLUCIÓN ATÓMICA**
Reference. PID2021-128011NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. OTERO MARTIN, ROBERTO

6. **CENTRO DE INVESTIGACION DE FISICA DE LA MATERIA CONDENSADA (IFIMAC)**
Reference. CEX2018-000805-M
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 16/12/2019 30/06/2024
PI. GARCIA VIDAL, FRANCISCO JOSE

7. **CONEXIÓN ENTRE ÓPTICA CUÁNTICA Y NANOFOTÓNICA**
Reference. EUR2023-143478
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2023 30/11/2025
PI. FEIST, JOHANNES MAXIMILIAN

8. **CONFIGURACIÓN DE LA ESTRUCTURA ELECTRÓNICA DE MATERIALES 2D: FOTORRESPUESTA Y PROPIEDADES DE ESPÍN**
Reference. PID2021-123295NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. GARCIA MICHEL, ENRIQUE

9. **CONTROL A LA NANOESCALA DE NUEVAS PROPIEDADES INCORPORADAS AL GRAFENO: SUPERCONDUCTIVIDAD, MAGNETISMO Y GAP ELECTRÓNICO**
Reference. PID2020-115171GB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. BRIHUEGA ALVAREZ, IVAN

10. **CONTROL QUÍMICO DE REDES METAL-ORGÁNICAS DE ZIRCONIO PARA LA CAPTURA Y DETECCIÓN ÓPTICA DE CONTAMINANTES AMBIENTALES**
Reference. PID2021-123839OB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. PLATERO PRATS, ANA EVA

11. **CORRELACIONES CUÁNTICAS E INTERFERENCIA DE FOTONES INTERACTÚANTES EN ESTRUCTURAS MATERIA-LUZ BIDIMENSIONALES**
Reference. PID2020-113415RB-C22
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. MARCHETTI, FRANCESCA MARIA

12. **CORRIENTES DE CALOR EN LA ESCALA NANOMÉTRICA: FLUCTUACIONES Y EFECTOS NO LINEALES**
Reference. PID2022-142911NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2025
PI. SANCHEZ RODRIGO, RAFAEL

13. **DEFORMACIÓN DEL MATERIAL Y DINÁMICA EXCITÓNICA**
Reference. CNS2022-135803
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/07/2023 30/06/2025
PI. PICON ALVAREZ, ANTONIO

14. **DESCIFRANDO LAS PROPIEDADES MAGNÉTICAS DE SISTEMAS BASADOS EN NANOHILOS Y NANOPARTÍCULAS PARA IMANES PERMANENTES**
Reference. TED2021-130957B-C55
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 31/05/2025
PI. JAAFAR RUIZ-CASTELLANOS, MIRIAM

15. **DIFRACTOMETRO DE RAYOS X DE MONOCRISTAL CON FUENTE DUAL**
Reference. EQC2021-007518-P
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2021 31/12/2023
PI. ZAMORA ABANADES, FELIX JUAN

16. **DINÁMICA DE ATTOSEGUNDOS INDUCIDA POR LUZ XUV Y DE RAYOS X EN ÁTOMOS Y MOLÉCULAS EN FASE GAS**
Reference. PID2022-138288NB-C32
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. PALACIOS CAÑAS, ALICIA

17. **DINÁMICA ELECTRÓNICA Y TÉCNICAS ULTRARRÁPIDAS**
Reference. PID2021-126560NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. PICON ALVAREZ, ANTONIO

18. **DINÁMICA, TRANSPORTE DE ESPÍN Y RUIDO EN ANTIFERROMAGNÉTICOS EPITAXIALES Y OTROS SISTEMAS NOVEDOSOS PARA PROCESAMIENTO ULTRARRÁPIDO Y POCO DISIPATIVO DE SEÑALES**
Reference. PID2021-124585NB-C32
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. ALIEV KAZANSKI, FARKHAD

19. **DISEÑO DE MATERIALES 2D PARA APLICACIONES DE ENERGÍA: MEMBRANAS Y BATERÍAS**
Reference. PID2019-106268GB-C32
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/01/2020 30/09/2023
PI. ZAMORA ABANADES, FELIX JUAN

20. **DISEÑO DE MATERIALES 2D PARA APLICACIONES EN ENERGÍA II: DISEÑO Y PROCESABILIDAD**
Reference. PID2022-138908NB-C31
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. ZAMORA ABANADES, FELIX JUAN

21. **DISEÑO DE MATERIALES 2D PARA APLICACIONES EN ENERGÍA: NANOELECTROMECANICA**
Reference. PID2019-106268GB-C31
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/01/2020 30/09/2023
PI. GOMEZ-NAVARRO GONZALEZ, CRISTINA

22. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. AKASHDEEP KAMRA KAMRA**
Reference. RYC2021-031063-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/01/2023 31/12/2025
PI. KAMRA, AKASHDEEP

23. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. HECTOR GONZALEZ HERRERO**
Reference. RYC2021-031050-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/01/2023 31/12/2025
PI. GONZALEZ HERRERO, HECTOR

24. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. MERCEDES HERNANDO PEREZ**
Reference. RYC2021-030929-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/01/2023 31/12/2025
PI. HERNANDO PEREZ, MERCEDES

25. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. PALOMA ARROYO HUIDOBRO**
Reference. RYC2021-031568-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2025
PI. ARROYO HUIDOBRO, PALOMA

26. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. RAFAEL SANCHEZ RODRIGO**
Reference. RYC-2016-20778
Funding Institution: MINISTERIO DE ECONOMIA Y COMPETITIVIDAD
Period: 16/02/2018 15/02/2023
PI. SANCHEZ RODRIGO, RAFAEL

27. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. ALBERTO CORTIJO FERNÁNDEZ**
Reference. RYC2018-023938-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/01/2020 31/12/2024
PI. CORTIJO FERNANDEZ, ALBERTO

28. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. ANA EVA PLATERO PRATS**
Reference. RYC2018-024328-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/11/2020 31/10/2025
PI. PLATERO PRATS, ANA EVA

29. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. DIEGO MARTÍN CANO**
Reference. RYC2020-029730-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/05/2022 30/04/2027
PI. MARTIN CANO, DIEGO

30. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. ENRIQUE BURZURI LINARES**
Reference. RYC2019-028429-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2026
PI. BURZURI LINARES, ENRIQUE

31. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. FERRY PRINS**
Reference. RYC-2017-23253
Funding Institution: MINISTERIO DE ECONOMIA Y COMPETITIVIDAD
Period: 01/09/2019 31/08/2023
PI. PRINS, FERRY

32. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. JUAN LUIS ARAGONÉS GÓMEZ**
Reference. RYC2019-028189-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/05/2021 30/04/2026
PI. ARAGONES GOMEZ, JUAN LUIS

33. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. LAURA RODRIGUEZ ARRIAGA**
Reference. RYC2018-025575-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/01/2020 31/12/2024
PI. RODRIGUEZ ARRIAGA, LAURA

34. **DOTACIÓN ADICIONAL RAMÓN Y CAJAL. PABLO ARES GARCÍA**
Reference. RYC2020-030302-I
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/03/2022 28/02/2027
PI. ARES GARCIA, PABLO

35. **ECOSISTEMA SIESTA DE TÉCNICAS DE SIMULACIÓN DE MATERIALES (SIESTA-UAM)**
Reference. PID2022-139776NB-C64
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. SOLER TORROJA, JOSE MARIA

36. **EFECTOS DE MUCHOS CUERPOS Y TRANSPORTE EN SEMIMETALES TOPOLÓGICOS**
Reference. PID2021-127240NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. CORTIJO FERNANDEZ, ALBERTO

37. **ELECTRÓNICA COHERENTE EN DISPOSITIVOS SUPERCONDUCTORES**
Reference. PID2020-117992GA-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2025
PI. BURSET ATIENZA, PABLO

38. **ELECTRÓNICA CUÁNTICA COHERENTE SUPERCONDUCTORA**
Reference. CNS2022-135950
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2025
PI. BURSET ATIENZA, PABLO

39. **ENHANCING THE MECHANICAL STABILITY OF INTERFACES IN SOLID-STATE LI-ION BATTERIES FOR ENERGY-INTENSIVE APPLICATIONS**
Reference. PCI2022-132998 (plan MRR)
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/05/2022 30/04/2025
PI. POLOP JORDA, CELIA

40. **ENHANCING THE MECHANICAL STABILITY OF INTERFACES IN SOLID-STATE LI-ION BATTERIES FOR ENERGY-INTENSIVE APPLICATIONS**
Reference. PCI2022-132998
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/05/2022 30/04/2025
PI. POLOP JORDA, CELIA

41. **ESCALADO INDUSTRIAL DE TINTAS BASADAS EN MATERIALES BIDIMENSIONALES: CARACTERIZACIÓN Y RECUBRIMIENTOS**
Reference. PDC2021-120782-C22
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2021 30/11/2023
PI. GOMEZ HERRERO, JULIO

42. **ESCALADO INDUSTRIAL DE TINTAS BASADAS EN MATERIALES BIDIMENSIONALES: PREPARACIÓN Y RECUBRIMIENTOS**
Reference. PDC2021-120782-C21
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2021 30/11/2023
PI. ZAMORA ABANADES, FELIX JUAN

43. **ESTRATEGIAS DE DESACOPLO PARA LA CARACTERIZACIÓN DE SUPERCONDUCTORES 2D EN CONDICIONES CASI IDEALES**
Reference. PID2020-116619GA-C22
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. MARTINEZ GALERA, ANTONIO JAVIER

44. **ESTRUCTURA LOCAL DE MATERIALES NANO-POROSOS EN ACCIÓN**
Reference. EUR2020-112294
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2020 30/11/2023
PI. PLATERO PRATS, ANA EVA

45. **ESTUDIOS COMPUTACIONALES DE MATERIALES BIOMOLECULARES Y BIOINSPIRADOS**
Reference. PID2021-125604NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. ZOTTI, LINDA ANGELA

46. **EXPLORANDO INTERACCIÓN Y FUERZAS LUZ-MATERIA EN REDES COMPLEJAS DE PARTÍCULAS**
Reference. PID2022-137569NB-C43
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. MARQUES PONCE, MANUEL IGNACIO

47. **EXPLORANDO LOS DETERMINANTES FÍSICOS Y ESTRUCTURALES DE LA DESACTIVACIÓN DE VIRUS INDIVIDUALES SOBRE SUPERFICIES: ATRAPAMIENTO, BIOMECÁNICA Y DESEMPAQUETAMIENTO GENÓMICO**
Reference. PID2021-126608OB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. DE PABLO GOMEZ, PEDRO JOSE

48. **EXTENDIENDO LOS LÍMITES DE LA FÍSICA DE ATTOSEGUNDOS: VISUALIZACIÓN Y CONTROL DE PROCESOS DE TRANSFERENCIA ELECTRÓNICA EN SISTEMAS DE INTERÉS QUÍMICO Y BIOLÓGICO**
Reference. PID2019-105458RB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2020 30/11/2023
PI. PALACIOS CAÑAS, ALICIA

49. **FABRICACIÓN ADITIVA DE MATERIALES POROSOS**
Reference. PDC2022-133498-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. ZAMORA ABANADES, FELIX JUAN

50. **FABRICACIÓN ADITIVA EN METAL PARA LA INSTRUMENTACIÓN CIENTÍFICA AVANZADA**
Reference. EQC2021-007318-P
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2021 31/12/2023
PI. GOMEZ HERRERO, JULIO

51. **FLUJO DE CARGA Y ENERGÍA EN PROCESOS QUÍMICOS COMPLEJOS**
Reference. PID2019-110091GB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2020 31/05/2023
PI. DIAZ-TENDERO VICTORIA, SERGIO

52. **FUNDAMENTOS MICROSCÓPICOS DEL MICROSCOPIO DE FUERZAS ATÓMICAS Y MICROBALANZAS DE CUARZO PARA SENSAR BIOMOLÉCULAS**
Reference. PID2020-117080RB-C51
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. TARAZONA LAFARGA, PEDRO JOSE

53. **GRAFENO Y MATERIALES BIDIMENSIONALES PARA APLICACIONES EN ENERGÍA LIMPIA**
Reference. PID2019-109525RB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2020 29/02/2024
PI. FARIAS TEJERINA, DANIEL

54. **HACIA UN NUEVO QUBIT DE SHIBA BASADO EN PUNTOS CUÁNTICOS HÍBRIDOS SUPERCONDUCTOR-SEMICONDUCTOR**
Reference. TED2021-130292B-C41
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. LEVY-YEYATI MIZRAHI, ALFREDO

55. **IDENTIFICACIÓN QUÍMICA Y CONTROL DE LAS PROPIEDADES ELECTRÓNICAS Y MECÁNICAS DE SISTEMAS MOLECULARES MEDIANTE MICROSCOPIAS DE PROXIMIDAD Y APRENDIZAJE AUTOMÁTICO**
Reference. PID2020-115864RB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. POU BELL, PABLO

56. **INFLUENCIA DE LA NANOESTRUCTURACIÓN EN LAS PROPIEDADES MECANOQUÍMICAS DE CÁTODOS COMPOSITE ZERO-STRAIN PARA BATERÍAS DE ION LI DE ESTADO SÓLIDO**
Reference. PID2021-124667OB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. POLOP JORDA, CELIA

57. **INGENIERÍA CUÁNTICA DE LUZ Y MATERIA EN LA NANOESCALA**
Reference. PID2021-126964OB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. MARTIN CANO, DIEGO

58. **INTEGRACIÓN MONOLÍTICA DE MATERIALES HÍBRIDOS FERROELÉCTRICOS/PLASMÓNICOS/2D PARA NANOFOTÓNICA INTEGRADA**
Reference. PID2022-137444NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. RAMIREZ HERRERO, MARIA DE LA O

59. **INTERACCIÓN ENTRE MECANISMOS FÍSICOS Y MOLECULARES EN LA REGULACIÓN DE LA FORMACIÓN DE LA RETINA DE VERTEBRADOS**
Reference. PID2022-140421NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. MIGUEZ GOMEZ, DAVID

60. **LA FÍSICA DE LA MATERIA CONDENSADA SALE AL ENCUENTRO**
Reference. FCT-21-17475
Funding Institution: FECYT FUNDACIÓN ESPAÑOLA PARA LA CIENCIA Y LA TECNOLOGÍA
Period: 01/07/2022 30/06/2023
PI. GOMEZ-NAVARRO GONZALEZ, CRISTINA

61. **MAGNÓNICA CUÁNTICA PARA ESPINTRÓNICA EN EL LÍMITE 2D**
Reference. PID2022-140923NB-C22
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2027
PI. BURZURI LINARES, ENRIQUE

62. **MANIPULAR LA MATERIA MEDIANTE LAS FLUCTUACIONES DEL VACÍO**
Reference. PID2021-125894NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. GARCIA VIDAL, FRANCISCO JOSE

63. **MATERIALES CON ORDENAMIENTO FERROELÉCTRICO Y ANTIFERROMAGNÉTICO PARA APLICACIONES ESPINTRÓNICAS ULTRARRÁPIDAS Y CONTROLABLES ELÉCTRICAMENTE**
Reference. PID2021-122980OA-C53
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. VELEZ CENTORAL, SAUL

64. **MATERIALES NO CENTROSIMÉTRICOS DE BAJA DIMENSIONALIDAD: TEORÍA Y EXPERIMENTOS**
Reference. PID2022-141712NB-C21
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. RUBIO BOLLINGER, GABINO

65. **MATERIALES PARA LA INFORMACIÓN CUÁNTICA BASADOS EN EXCITONES EN SEMICONDUCTORES**
Reference. PID2020-113445GB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. MARTIN FERNANDEZ, MARIA DOLORES

66. **MATERIALES POROSOS AVANZADOS EN SEPARACIONES ENERGÉTICAS DE BAJA ENERGÍA DE GASES DE INTERÉS MEDIOAMBIENTAL**
Reference. TED2021-129886B-C42
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. ZAMORA ABANADES, FELIX JUAN

67. **MATERIALES TOPOLÓGICOS PARA FOTOVOLTAICA**
Reference. TED2021-131323B-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. RUBIO BOLLINGER, GABINO

68. **MATERIALES Y SENSORES CUÁNTICOS MEDIANTE IMPLANTACIÓN DE IONES A MEV**
Reference. PID2021-127498NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2022 31/08/2025
PI. RAMOS RUIZ, MIGUEL ANGEL

69. **MECÁNICA DEL CALOR: UNIENDO TRANSPORTE DE CALOR Y FRICCIÓN EN LA NANOESCALA**
Reference. TED2021-132219A-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. ARES GARCIA, PABLO

70. **MEDIOS CON VARIACIÓN TEMPORAL PARA ELECTRODINÁMICA CLÁSICA Y CUÁNTICA**
Reference. PID2022-141036NA-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. ARROYO HUIDOBRO, PALOMA

71. **METASUPERFICIES TOPOLOGICAS PARA INTERACCIÓN LUZ-MATERIA EN LA NANO-ESCALA**
Reference. EIN2020-112272
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/11/2020 31/10/2023
PI. ARROYO HUIDOBRO, PALOMA

72. **MICROSCOPÍAS DE BARRIDO A BAJAS TEMPERATURAS EN CAMPOS MAGNÉTICOS VECTORIALES**
Reference. PDC2021-121086-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2021 30/11/2024
PI. SUDEROW RODRIGUEZ, HERMANN JESUS

73. **MICROSCOPIO ELECTRÓNICO DE BARRIDO DE EMISIÓN DE CAMPO DE ULTRA ALTA RESOLUCIÓN PARA APLICACIONES EN NANOLITOGRAFÍA, IMAGEN, ANÁLISIS QUÍMICO Y NANO-INGENIERÍA**
Reference. EQC2021-007091-P
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2021 31/12/2023
PI. AGRAIT DE LA PUENTE, MARIO NICOLAS

74. **NANODISPOSITIVOS FOTÓNICOS DE ESTADO SOLIDO OBTENIDOS POR COMBINACIÓN DE EMISORES DE TIERRAS RARAS, NANOESTRUCTURAS PLASMÓNICAS Y MATERIALES 2D**
Reference. PID2019-108257GB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2020 29/02/2024
PI. RAMIREZ HERRERO, MARIA DE LA O

75. **NANOINGENIERÍA DE DISPOSITIVOS DE ESTADO SÓLIDO PARA COMPUTACIÓN NEUROMÓRFICA**
Reference. PID2020-116181RB-C31
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. CAMARERO DE DIEGO, JULIO

76. **NUEVOS CONCEPTOS Y MÉTODOS PARA LA COMPRENSIÓN Y CARACTERIZACIÓN DE MATERIA CUÁNTICA TOPOLÓGICA FUERTEMENTE INTERACTUANTE**
Reference. PID2022-139995NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. MERINO TRONCOSO, JAIME

77. **NUEVOS SUPERCONDUCTORES PARA TECNOLOGÍAS CUÁNTICAS: VISUALIZANDO Y MANIPULANDO CORRELACIONES TRIPLETE**
Reference. PID2020-114071RB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. SUDEROW RODRIGUEZ, HERMANN JESUS

78. **OPTIMIZACIÓN DE MATERIALES BIDIMENSIONALES PARA APLICACIONES EN ENERGÍA II: RECOLECCIÓN DE ENERGÍA MEDIANTE DISPOSITIVOS TERMO Y FLEXOELÉCTRICOS**
Reference. PID2022-138908NB-C32
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. GOMEZ HERRERO, JULIO

79. **OPTIMIZACIÓN DE NANOCATALIZADORES PARA ELECTRODOS DE CELDAS DE HIDRÓGENO**
Reference. TED2021-131788A-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. MARTINEZ GALERA, ANTONIO JAVIER

80. **OSCAR, AN OBJECT SEGMENTATION, COUNTER, ANALYSIS RESOURCE**
Reference. PDC2022-133147-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. MIGUEZ GOMEZ, DAVID

81. **PESCANDO NANOPLASTICOS EN AGUA DESALINIZADA**
Reference. TED2021-129937B-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. HERNANDO PEREZ, MERCEDES

82. **PLANTA DE LICUEFACCIÓN DE HELIO PARA LA CIENCIA Y TECNOLOGÍA CERCA DEL CERO ABSOLUTO**
Reference. EQC2021-007277-P
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2021 31/12/2023
PI. SUDEROW RODRIGUEZ, HERMANN JESUS

83. **PRODUCCIÓN DE HIDRÓGENO POR DISOCIACIÓN ELECTROQUÍMICA DE AGUA ASISTIDA POR FOTOCATALIZADORES CON CONTROL DE ESPÍN**
Reference. TED2021-131042B-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. MIGUEL LLORENTE, JUAN JOSE DE

84. **PROPIEDADES FÍSICAS INTRÍNSECAS DE MATERIALES 2D EN LA NANOESCALA**
Reference. PID2022-142331NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. GOMEZ-NAVARRO GONZALEZ, CRISTINA

85. **QUIRALIDAD Y HELICIDAD EN LA NANOESCALA DESDE PRIMEROS PRINCIPIOS**
Reference. PID2019-109539GB-C43
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2020 29/02/2024
PI. PALACIOS BURGOS, JUAN JOSE

86. **REACTIVIDAD ULTRARRÁPIDA EN LA NANOESCALA**
Reference. PID2022-138470NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2026
PI. DIAZ-TENDERO VICTORIA, SERGIO

87. **REDES METAL-ORGÁNICAS COMO PLATAFORMAS PARA LA DETECCIÓN DE CONTAMINANTES AMBIENTALES**
Reference. CNS2022-135261
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/07/2023 30/06/2025
PI. PLATERO PRATS, ANA EVA

88. **RETOS Y OPORTUNIDADES DE LAS TECNOLOGÍAS SUPERCONDUCTORAS EN LA AVIACIÓN COMERCIAL SIN EMISIONES DE GASES INVERNADERO**
Reference. TED2021-130546B-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. SUDEROW RODRIGUEZ, HERMANN JESUS

89. **SIMULACIÓN DE OPTOELECTRÓNICA MOLECULAR RESUELTA EN EL TIEMPO CON EL CÓDIGO XCHEM**
Reference. PDC2021-121073-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2021 30/11/2023
PI. PALACIOS CAÑAS, ALICIA

90. **SIMULACIÓN MULTIESCALA DE MATERIALES POROSOS AVANZADOS**
Reference. TED2021-129886B-C44
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. VELASCO CARAVACA, ENRIQUE

91. **SUPERANDO LA DIFUSIÓN: TRANSPORTE DINÁMICO EN MEDIOS COMPLEJOS**
Reference. PID2022-143010NB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2023 31/08/2027
PI. RODRIGUEZ ARRIAGA, LAURA

92. **SUPERCOMPUTACIÓN, ALMACENAMIENTO Y BIG DATA**
Reference. EQC2021-007589-P
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2021 31/12/2023
PI. GARCIA VIDAL, FRANCISCO JOSE

93. **SUPERCONDUCTIVIDAD EN LA NANOESCALA: DISPOSITIVOS CUÁNTICOS DE 0 A 2D**
Reference. PID2020-117671GB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. LEVY-YEYATI MIZRAHI, ALFREDO

94. **TENSIONES MECÁNICAS EN COMPONENTES LAMINARES DE IONES LITIO: LA MURALLA A FRANQUEAR PARA EL USO DE BATERÍAS DE LI EN APLICACIONES INTENSIVAS**
Reference. PCI2019-103594
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/03/2019 28/02/2023
PI. POLOP JORDA, CELIA

95. **TRANSPORTE DE CALOR Y TERMOELECTRICIDAD EN CONTACTOS MOLECULARES**
Reference. PID2020-114880GB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/09/2021 31/08/2024
PI. CUEVAS RODRIGUEZ, JUAN CARLOS

96. **TRANSPORTE Y MANIPULACIÓN DEL CALOR EN EL RÉGIMEN CUÁNTICO**
Reference. PID2019-110125GB-I00
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/06/2020 31/01/2024
PI. SANCHEZ RODRIGO, RAFAEL

97. **UNIONES JOSEPHSON BASADOS EN ACOPLAMIENTO ESPIN-ORBITA PARA MEMORIAS CRIOGÉNICAS NO DISIPATIVAS**
Reference. TED2021-130196B-C22
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. ALIEV KAZANSKI, FARKHAD

98. **VIRTUAL-QCM: SOFTWARE CIENTÍFICO PARA REPRODUCIR EXPERIMENTOS EN MICROBALANZAS DE CUARZO A PARTIR DE PRIMEROS PRINCIPIOS**
Reference. PDC2021-121441-C21
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2021 31/05/2024
PI. DELGADO BUSCALIONI, RAFAEL

99. **VISUALIZING CARRIER INTERCONVERSION IN LAYERED PEROVSKITES.**
Reference. TED2021-131018B-C21
Funding Institution: AGENCIA ESTATAL DE INVESTIGACION
Period: 01/12/2022 30/11/2024
PI. PRINS, FERRY

Regional R&D Projects

1. **AYUDA PARA LA REALIZACION DE DOCTORADO INDUSTRIAL EN LA COMUNIDAD DE MADRID. DOCTORANDO CRISTINA ARQUEROS ALBAY. CONVOCATORIA 2020**
Reference. IND2020/IND-17321
Funding Institution: COMUNIDAD DE MADRID
Period: 05/02/2021 04/02/2024
PI. ZAMORA ABANADES, FELIX JUAN

2. **AYUDA PARA LA REALIZACION DE DOCTORADO INDUSTRIAL EN LA COMUNIDAD DE MADRID. DOCTORANDO EVA ORTIZ MANSILLA. CONVOCATORIA 2022**
Reference. IND2022/IND-23536
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2023 31/12/2025
PI. CUEVAS RODRIGUEZ, JUAN CARLOS

3. **AYUDA PARA LA REALIZACION DE DOCTORADO INDUSTRIAL EN LA COMUNIDAD DE MADRID. DOCTORANDO MIGUEL ÁNGEL CHAMORRO VILLANUEVA. CONVOCATORIA 2019**
Reference. IND2019/AMB-17242
Funding Institution: COMUNIDAD DE MADRID
Period: 03/02/2020 02/02/2023
PI. ZAMORA ABANADES, FELIX JUAN

4. **CARACTERIZACIÓN MECANO-ÓPTICA MEDIANTE MICROSCOPIA DE FUERZAS DE NANOPARTÍCULAS CON APLICACIONES BIOMÉDICAS**
   Reference. SI3/PJI/2021-00216
   Funding Institution: COMUNIDAD DE MADRID
   Period: 01/01/2022 31/12/2023
   PI. HERNANDO PEREZ, MERCEDES

5. **CENTRO DE INNOVACIÓN DIGITAL EN BIOCIENCIAS, BIOTECNOLOGÍA Y SALUD (DIH-BIO)**
   Reference. OI2020-UAM-7.0
   Funding Institution: COMUNIDAD DE MADRID
   Period: 29/11/2021 30/06/2023
   PI. ZAMORA ABANADES, FELIX JUAN

6. **CONVENIO ENTRE LA COMUNIDAD DE MADRID Y LA UNIVERSIDAD COMPLUTENSE DE MADRID PARA LA CONCESION DE UNA SUBVENCION DIRECTA PARA LA REALIZACIÓN DEL PROYECTO MATERIALES DISRUPTIVOS BIDIMENSIONALES (2D) DENTRO DEL PLAN COMPLEMENTARIO EN EL ÁREA DE MATERIALES A**
   Reference. MAD-2D-CM
   Funding Institution: COMUNIDAD DE MADRID
   Period: 29/11/2022 31/03/2025
   PI. LOPEZ VAZQUEZ DE PARGA, AMADEO

7. **DESARROLLO DE NANOCATALIZADORES MÁS EFICIENTES PARA LA OXIDACIÓN DE HIDROCARBUROS**
   Reference. SI3/PJI/2021-00500
   Funding Institution: COMUNIDAD DE MADRID
   Period: 01/01/2022 31/12/2023
   PI. MARTINEZ GALERA, ANTONIO JAVIER

8. **DOTACIÓN ADICIONAL CAPTACIÓN DE TALENTO COMUNIDAD DE LA MADRID**
   Reference. 2021-5A/IND-20959
   Funding Institution: CONSEJERIA DE EDUCACION DCION GRAL UNIVERSIDADES E INVESTIGACION COMUNIDAD DE MADRID
   Period: 24/06/2022 23/06/2023
   PI. PICON ALVAREZ, ANTONIO

9. **DOTACION ADICIONAL CAPTACION DE TALENTO COMUNIDAD DE MADRID. PABLO BURSET ATIENZA**
   Reference. 2019-T1/IND-14088
   Funding Institution: COMUNIDAD DE MADRID
   Period: 01/05/2020 30/04/2024
   PI. BURSET ATIENZA, PABLO

10. **DOTACIÓN ADICIONAL CAPTACIÓN DE TALENTO COMUNIDAD DE LA MADRID**
    Reference. 2020-T1/IND-20041
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2022 31/12/2026
    PI. VELEZ CENTORAL, SAUL

11. **DOTACIÓN ADICIONAL CAPTACIÓN DE TALENTO COMUNIDAD DE LA MADRID**
    Reference. 2020-T1/IND-19785
    Funding Institution: COMUNIDAD DE MADRID
    Period: 25/02/2022 24/02/2027
    PI. ANTON SOLANAS, CARLOS

12. **ELECTRON TRANSPORT THROUGH PROTEIN-BASED HYBRID JUNCTIONS AND ROLE OF MUTATIONS**
    Reference. SI3/PJI/2021-00191
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2022 31/12/2023
    PI. ZOTTI, LINDA ANGELA

13. **EXCELENCIA PROFESORADO UNIVERSITARIO CATEDRÁTICO DE UNIVERSIDAD - FÍSICA DE LA MATERIA CONDENSADA**
    Reference. UAM2020-A472CU
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2020 31/12/2024
    PI. AGRAIT DE LA PUENTE, MARIO NICOLAS

14. **EXCELENCIA PROFESORADO UNIVERSITARIO CATEDRÁTICO/A DE UNIVERSIDAD - FÍSICA DE LA MATERIA CONDENSADA**
    Reference. UAM2020-A472CU
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2021 31/12/2024
    PI. ALIEV KAZANSKI, FARKHAD

15. **EXCELENCIA PROFESORADO UNIVERSITARIO CATEDRÁTICO/A DE UNIVERSIDAD – QUÍMICA INORGÁNICA**
    Reference. UAM2020-A475CU
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2021 31/12/2024
    PI. ZAMORA ABANADES, FELIX JUAN

16. **EXCELENCIA PROFESORADO UNIVERSITARIO PROFESOR CONTRATADO DOCTOR - FÍSICA DE LA MATERIA CONDENSADA**
    Reference. 2020-PCD028
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2020 31/12/2024
    PI. AGRAIT DE LA PUENTE, MARIO NICOLAS

17. **EXCELENCIA PROFESORADO UNIVERSITARIO PROFESOR CONTRATADO DOCTOR - FÍSICA TEÓRICA DE LA MATERIA CONDENSADA**
    Reference. 2020-I3PCD024
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2020 31/12/2024
    PI. LEVY-YEYATI MIZRAHI, ALFREDO

18. **EXCELENCIA PROFESORADO UNIVERSITARIO PROFESOR CONTRATADO DOCTOR - QUÍMICA**
    Reference. 2020-I3PCD026
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2020 31/12/2024
    PI. PALACIOS CAÑAS, ALICIA

19. **EXCELENCIA PROFESORADO UNIVERSITARIO PROFESOR TITULAR DE UNIVERSIDAD – FÍSICA DE LA MATERIA CONDENSADA**
    Reference. UAM2020-A470TU
    Funding Institution: COMUNIDAD DE MADRID
    Period: 01/01/2020 31/12/2024
    PI. AGRAIT DE LA PUENTE, MARIO NICOLAS

20. **EXCELENCIA PROFESORADO UNIVERSITARIO PROFESOR/A CONTRATADO/A DOCTOR/A – FÍSICA DE LA MATERIA CONDENSADA**
Reference. 2020-PCD028
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2021 31/12/2023
PI. JAAFAR RUIZ-CASTELLANOS, MIRIAM

21. **EXCELENCIA PROFESORADO UNIVERSITARIO PROFESOR/A CONTRATADO/A DOCTOR/A – FÍSICA TEÓRICA DE LA MATERIA CONDENSADA**
Reference. 2020-I3PCD024
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2021 31/12/2024
PI. VALLE REBOUL, ELENA DEL

22. **EXCELENCIA PROFESORADO UNIVERSITARIO PROFESOR/A TITULAR DE UNIVERSIDAD – FÍSICA DE LA MATERIA CONDENSADA**
Reference. UAM2020-A470TU
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2021 31/12/2024
PI. OTERO MARTIN, ROBERTO

23. **INCUBA Y ACELERA UAM**
Reference. INCUBA Y ACELERA UAM
Funding Institution: AYUNTAMIENTO DE MADRID AREA DE GOBIERNO DE ECONOMIA
Y PARTICIPACION CIUDADANA
Period: 16/11/2022 15/11/2023
PI. ZAMORA ABANADES, FELIX JUAN

24. **MICROSCOPIO DE FUERZAS ATÓMICAS TECNOLÓGICO EN UHV PARA NANOCIRCUITOS ULTRA LIMPIOS.**
Reference. SI3/PJI/2021-00479
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2022 31/12/2023
PI. ARES GARCIA, PABLO

25. **NANOFOTÓNICA PARA COMPUTACIÓN CUÁNTICA**
Reference. Y2020/TCS-6545 (NanoQuCo-CM)
Grupo: QNanoLight Funding Institution: COMUNIDAD DE MADRID
Period: 01/07/2021 31/12/2024
PI. GARCIA VIDAL, FRANCISCO JOSE

26. **NUEVOS MATERIALES BIDIMENSIONALES: CARACTERIZACIÓN, PROPIEDADES Y APLICACIONES - G2-UAM**
Reference. S2018/NMT-4511
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2019 30/04/2023
PI. BRIHUEGA ALVAREZ, IVAN

27. **SOLUCIONES DEL NANOMAGNETISMO A LOS RETOS SOCIALES - 287**
Reference. S2018/NMT-4321
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2019 30/04/2023
PI. RAMOS RUIZ, MIGUEL ANGEL

28. **SOLUCIONES DEL NANOMAGNETISMO A LOS RETOS SOCIALES - LASUAM**
Reference. S2018/NMT-4321
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2019 30/04/2023
PI. MIRANDA SORIANO, RODOLFO

29. **SOLUCIONES DEL NANOMAGNETISMO A LOS RETOS SOCIALES - LBT-UAM**
Reference. S2018/NMT-4321
Funding Institution: COMUNIDAD DE MADRID
Period: 01/01/2019 30/04/2023
PI. SUDEROW RODRIGUEZ, HERMANN JESUS

Private Funding

1. **CONVENIO BANCO SANTANDER-UAM-IFIMAC**
Reference. SANTANDER UNIVERSIDADES
Funding Institution: BANCO DE SANTANDER CENTRAL HISPANO SA Period: 18/06/2016 31/12/2024
PI. GARCIA VIDAL, FRANCISCO JOSE

2. **DISTRIBUCIÓN CUÁNTICA DE CLAVES CON EMISORES DE FOTONES A TEMPERATURA AMBIENTE**
Funding Institution: FUNDACION BBVA
Period: 19/05/2023 19/05/2024
PI. ANTON SOLANAS, CARLOS

3. **DOTACION ADICIONAL JUNIOR LEADER LA CAIXA (CARLOS SANCHEZ MUÑOZ).**
Reference. JUNIOR LEADER 2020
Funding Institution: FUNDACION BANCARIA LA CAIXA
Period: 01/08/2020 31/07/2023
PI. SANCHEZ MUÑOZ, CARLOS

4. **DOTACION ADICIONAL JUNIOR LEADER LA CAIXA (DIEGO MARTÍN CANO).**
Reference. JUNIOR LEADER 2020
Funding Institution: FUNDACION BANCARIA LA CAIXA
Period: 01/09/2020 31/08/2023
PI. MARTIN CANO, DIEGO

5. **DOTACION ADICIONAL JUNIOR LEADER LA CAIXA (SALVATORE ASSENZA).**
Reference. JUNIOR LEADER 2020
Funding Institution: FUNDACION BANCARIA LA CAIXA
Period: 01/12/2020 30/11/2023
PI. ASSENZA, SALVATORE

6. **ESCUELA DE VERANO INSTITUTO NICOLAS CABRERA 2022**
Funding Institution: FUNDACION BBVA
Period: 21/03/2022 20/03/2023
PI. RAMOS RUIZ, MIGUEL ANGEL

7. **FUENTES ULTRABRILLANTES DE FOTONES EN CAVIDADES ABIERTAS (ULTRA-BRIGHT)**
Reference. ULTRA-BRIGHT
Funding Institution: FUNDACION RAMON ARECES
Period: 14/04/2023 14/04/2026
PI. ANTON SOLANAS, CARLOS

Scientific Results

Publications

1. Ackermann, N; Zazunov, A; Park, S; Egger, R; Yeyati, AL . (2023) . Dynamical parity selection in superconducting weak links. **PHYSICAL REVIEW B**, 107 (21) 214515.DOI: 10.1103/PhysRevB.107.214515
2. Aguado, R; Cervera-Lierta, A; Correia, A; de Franceschi, S; Diez Muiño, R; Garcia Ripoll, JJ; Levi-Yeyati, A; Platero, G; Roche, S; Sanchez-Portal, D. (2023). When matter and information merge into "Quantum". **COMMUNICATIONS PHYSICS**, 6 (1) 266. DOI: 10.1038/s42005-023-01391-x
3. Aguirre, J; Guantes, R. (2023). Virus-host protein co-expression networks reveal temporal organization and strategies of viral infection. **ISCIENCE**, 26 (12) 108475. DOI: 10.1016/j.isci.2023.108475
4. Aldave, DA; Lopez-Polin, G; Moreno, C; Zamora, F; Ares, P; Gómez-Herrero, J. (2023). All-Dry Deterministic Transfer of Thin Gold Nanowires for Electrical Connectivity. **ADVANCED ELECTRONIC MATERIALS**, 9 (7) 2300107. DOI: 10.1002/aelm.202300107
5. Alvarado, M; Burset, P; Yeyati, AL. (2023). Intrinsic nonmagnetic ϕ Josephson junctions in twisted bilayer graphene. **PHYSICAL REVIEW RESEARCH**, 5 (3) L032033. DOI: 10.1103/PhysRevResearch.5.L032033
6. Ascenzi, D; Erdmann, E; Bolognesi, P; Avaldi, L; Castrovilli, MC; Thissen, R; Romanzin, C; Alcaraz, C; Rabadan, I; Mendez, L; Díaz-Tendero, S; Cartoni, A. (2023). HO+ and OH reactivity furan: experimental low energy absolute cross sections for modeling radiation damage. **PHYSICAL CHEMISTRY CHEMICAL PHYSICS,** 25 (36) 24643 - 24656. DOI: 10.1039/d3cp02772d
7. Ballestad TM; Cortijo A; Vozmediano MAH; Qaiumzadeh A. (2023). Unconventional thermoelectric transport in tilted Weyl semimetals. **PHYSICAL REVIEW B**, 107 (1) 014410. DOI: 10.1103/PhysRevB.107.014410
8. Barreiro-Lage, D; Chiarinelli, J; Bolognesi, P; Richter, R; Zettergren, H; Stockett, MH; Diaz-Tendero, S; Avaldi, L. (2023). Photofragmentation specificity of photoionized cyclic amino acids (diketopiperazines) as precursors of peptide building blocks. **PHYSICAL CHEMISTRY CHEMICAL PHYSICS**, 25 (23) 15635 - 15646. DOI: 10.1039/d3cp00608e
9. Barzaga, R; García-Hernández, DA; Díaz-Tendero, S; Sadjadi, S; Manchado, A; Alcami, M. (2023). On the Presence of Metallofullerenes in Fullerene-rich Circumstellar Envelope. **ASTROPHYSICAL JOURNAL**, 942 (1) 5. DOI: 10.3847/1538-4357/aca529
10. Barzaga, R; García-Hernández, DA; Diaz-Tendero, S; Sadjadi, S; Manchado, A; Alcami, M; Gómez-Muñoz, MA; Huertas-Roldán, T. (2023). Infrared Spectral Fingerprint of Neutral and Charged Endo- and Exohedral Metallofullerenes. **ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES** 269 (1) 26. DOI: 10.3847/1538-4365/acfd99
11. Ben-Asher, A; Fernández-Domínguez, AI; Feist, J. (2023). Non-Hermitian Anharmonicity Induces Single-Photon Emission. **PHYSICAL REVIEW LETTERS**, 130 (24) 243601. DOI: 10.1103/PhysRevLett.130.243601
12. Bernabeu J; Cortijo A. (2023). Bounds on phonon-mediated hydrodynamic transport in a type-I Weyl semimetal. **PHYSICAL REVIEW B**, 107 (23) 235141. DOI: 10.1103/PhysRevB.107.235141
13. Boll, D.I.R.; Martini, L.; Palacios, A.; Fojón, O.A. (2023). Two-color polarization control of angularly resolved attosecond time delays. **PHYSICAL REVIEW A**, 107 (4) 043113. DOI: 10.1103/PhysRevA.107.043113
14. Borràs, VJ; González-Vázquez, J; Argenti, L; Martín, F. (2023). Attosecond photoionization delays in the vicinity of molecular Feshbach resonances. **SCIENCE ADVANCES**, 9 (15) eade3855. DOI: 10.1126/sciadv.ade3855
15. Bosch, AM; Assenza, S. (2023). Interplay of Hydropathy and Heterogeneous Diffusion in the Molecular Transport within Lamellar Lipid Mesophases. **PHARMACEUTICS**, 15 (2) 573. DOI: 10.3390/pharmaceutics15020573
16. Burzurí, E; Martínez-Pérez, MJ; Martí-Gastaldo, C; Evangelisti, M; Mañas-Valero, S; Coronado, E; Martínez, JI; Galan-Mascaros, JR; Luis, F. (2023). A quantum spin liquid candidate isolated in a two-dimensional CoRh bimetallic oxalate network. **CHEMICAL SCIENCE**, 14 (14) 3899 - 3906. DOI: 10.1039/d2sc06407c
17. Calderón, AS; Cantero, M; Pérez, U; Ortega-González, P; San Martín, C; de Pablo, PJ; Silván, MM; Hernando-Pérez, M. (2023). Surface characterization of alkane viral anchoring films prepared by titanate-assisted organosilanization. **COLLOIDS AND SURFACES B-BIOINTERFACES**, 222 113136. DOI: 10.1016/j.colsurfb.2023.113136
18. Calegari, F.; Martín, F. (2023). Open questions in attochemistry. **COMMUNICATIONS CHEMISTRY**, 6 (1) 184. DOI: 10.1038/s42004-023-00989-0
19. Cano, BM; Ferreiros, Y; Pantaleón, PA; Dai, J; Tallarida, M; Figueroa, AI; Marinova, V; García-Díez, K; Mugarza, A; Valenzuela, SO; Miranda, R; Camarero, J; Guinea, F; Silva-Guillén, JA; Valbuena, M. (2023). Experimental Demonstration of a Magnetically Induced Warping Transition in a Topological Insulator Mediated by Rare-Earth Surface Dopants. **NANO LETTERS**, 23 (13) 6249 - 6258. DOI: 10.1021/acs.nanolett.3c00587
20. Cantero, M; Cvirkaite-Krupovic, V; Krupovic, M; de Pablo, PJ. (2023). Mechanical tomography of an archaeal lemon-shaped virus reveals membrane-like fluidity of the capsid and liquid nucleoprotein cargo. **PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA**, 120 (42) e2307717120. DOI: 10.1073/pnas.2307717120
21. Cárdenas, G; Lucia-Tamudo, J; Mateo-delaFuente, H; Palmisano, VF; Anguita-Ortiz, N; Ruano, L; Pérez-Barcia, A; Díaz-Tendero, S; Mandado, M; Nogueira, JJ. (2023). MoBioTools: A toolkit to setup quantum mechanics/molecular mechanics calculations. **JOURNAL OF COMPUTATIONAL CHEMISTRY**, 44 (4) 516 - 533. DOI: 10.1002/jcc.27018

22. Carracedo-Cosme, J; Romero-Muñiz, C; Pou, P; Pérez, R. (2023). Molecular Identification from AFM Images Using the IUPAC Nomenclature and Attribute Multimodal Recurrent Neural Networks. **ACS APPLIED MATERIALS & INTERFACES**, 15 (18) 22692 - 22704. DOI: 10.1021/acsami.3c01550

23. Caruso, T; De Luca, O; Melfi, N; Policicchio, A; Pisarra, M; Godbert, N; Aiello, I; Giorno, E; Pacile, D; Moras, P; Martin, F; Rudolf, P; Agostino, RG; Papagno, M. (2023). Nearly-freestanding supramolecular assembly with tunable structural properties. **SCIENTIFIC REPORTS**, 13 (1) 2068. DOI: 10.1038/s41598-023-28865-w

24. Caso, D; Tuero, P; Garcia, J; Guslienko, KY; Aliev, FG. (2023). Dynamics and Reversible Control of the Bloch-Point Vortex Domain Wall in Short Cylindrical Magnetic Nanowires. **PHYSICAL REVIEW APPLIED**, 19 (6) 064030. DOI: 10.1103/PhysRevApplied.19.064030

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National and International congresses: invited lectures

1. A. Palacios. **54th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP).** June 5-9, 2023. Washington (USA)
2. Mechanics of defective 2D Materials. C. Gómez-Navarro. **2nd Annual Conference on Global Nanotechnology (Nano Series 2023)**. June 19-21, 2023; Madrid (Spain)
3. Superconducting quantum dots: from Andreev transport to Andreev qubits. A. Levy. **Bariloche Workshop on Condensed Matter Physics**.18-20 December 2023. Bariloche (Argentina)
4. OPERA - Development of operando techniques and multiscale modelling to face the zero-excess solid-state battery challenge. C. Polop. **BATTERY 2030+ Annual Conference 2023.** May 9-10, 2023. Uppsala (Sweden)
5. Desarrollo de fotocatalizadores híbridos con control de espín para la producción de H2 por hidrólisis de agua. J. de Miguel**. 8° Congreso de Investigación 2023 celebrado en la Universidad Nacional Autónoma de Honduras en el Valle de Sula (UNAH-VS).** Dec 4-7 2023. Honduras.
6. Magnon transport and topological magnetic textures in rare-earth magnetic insulators. S. Velez.**68th Conference on Magnetism and Magnetic Materials.** 30 October – 3 November 2023. Dallas (USA)
7. Two-dimensional materials for nonlinear and quantum photonics" C. Antón. **Conferencia Española de Nanofotónica (CEN).** 12-14.06.2023. Zaragoza (Spain). https://tinyurl.com/ywk5ukf
8. Electrical and thermal transport in atomic contacts and molecular junctions N. Agrait. **Electronic Transport in Molecular Quantum Conductors**. 26-29 June 2023. Wiezmann Institute, Rehovot (Israel).
9. Manuel I. Marqués. **DINAMO 2023**, 11-16 June 2023, Lofoten Islands, Norway.
10. G. Vilhena. **European Nanomanipulation Workshop**. 15-17 May 2023. Kraków (Poland)
11. Exploiting the quantum nature of magnons via spin fluctuations. Akashdeep Kamra, **Fluctuation and Nonlinearities 2023**. February 27th to March 2nd 2023, Kloster Irsee (Germany)
12. Piezoelectricity and Ferroelectricity in hexagonal boron nitride. P. Ares. **GEFES Meeting**. February 01-03, 2023. Salamanca (Spain)
13. Rotating vesicles to mimic cell motion. L. R. Arriaga. **GEFES2023**. 1-3 February 2023. Salamanca (Spain)
14. E. Lee. **Hybrid Quantum Technologies Workshop**. 3-6 April 2023. Vienna (Austria)
15. Controlling the emisión or rare earth ions by plasmonic chains: spatial coherence and subwavelength waveguiding**.** J. Fernandez-Martínez, M.O Ramírez, S. Carretero-Palacios, P. Molina, J. Bravo-Abad, N.J. van Hoof, J. Gómez-Rivas and L.E. Bausá. **20th International Conference on Luminescence (ICL'2023)**. (27 August- 1 September,2023. Paris (France)
16. H. Suderow. **IIp-Natal WE-Hereaeus workshop on new frontiers in emergent materials**. (23/10 to 27/10, Natal, Brazil)
17. Non-equilibrium spin accumulation and magnetoconductance in chiral systems from density functional & group theory. J.J. Palacios. **International Workshop on Superconductivity and Magnetism in Two Dimensional Films and Heterostructures**. 30 August - 1 September 2023. Bath (United Kingdom)
18. Nonreciprocal Magnon Transport and Hanle Effect in Hematite. Akashdeep Kamra. **8th International Conference on Superconductivity and Magnetism**, May 4th - 11th, 2023. Fethiye (Turkey)
19. Low-temperature thermal properties of ultrastable glasses: depletion (or not) of two-level systems with increasing stability. M.A. Ramos. **9th International Discussion Meeting on Relaxations in Complex Systems**. 12–18 August 2023. Chiba (Japan)
20. Low-temperature thermal properties of ultrastable glasses. M.A. Ramos. **26th IUPAC International Conference on Chemical Thermodynamics**. 30 July – 4 August 2023. Osaka (Japan)
21. Quantum photonics: from near-optimal sources to emergent platforms. C. Antón. **International Conference on Physics of Light-Matter Coupling in Nanostructures 2023.** 11-16.04.2023. Medellin (Colombia).
22. "Single-photon sources based in semiconductor quantum dots and in two-dimensional materials" C. Antón. **Int. Conf. on Modulated Semiconductor Structures (MSS-21)**. 9-14.07.2023. Grenoble (France). https://tinyurl.com/4hcj4ubf
23. A. Palacios. **XXXIII International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC)**. July 25 – August 1, 2023. Ottawa, Ontario (Canada)
24. Ultrafast site-selective spectroscopy for observing chemical bond changes. A. Picón. **22nd International Symposium on Correlation, Polarization and Ionization in Atomic and Molecular Collisions (COPIAMC),** August 2 to 5 (2023). York University (Toronto, Canada)
25. Controlling the saptial coherence and subwavelength waveguiding of rare earth quantum emitters by plasmonic nanostructures. L.E. Bausá. **9th International Symposium on Optical Materials (IS-OM'9)** June 26-30, 2023. Tarragona (Spain)

26. A. Palacios. **International Symposium on Ultrafast Intense Laser Science**. October 1-6, 2023. (Sitges, Sapain)

27. A numerical approach for laser-driven electron dynamics in solids. A. Picón. **International Workshop on Control of Ultrafast (Attosecond and Strong Field) Processes Using Structured Light.** July 2 to 14 (2023). Max Planck Institute for the Physics of Complex Systems (Germany)

28. H. Suderow. **International Workshop on Superconductivity and Magnetism in Two Dimensional Films and Heterostructures**, 30 August -1 September 2023, Bath (UK)

29. Interactions and dynamics in Andreev nanowires. A. Levy**. InstituteQ workshop on fundamentals for quantum technology**. Aalto University, 5-6 July 2023. Helsinki (Finland)

30. Group-theoretic approach to chirality induced spin selectivity in molecular junctions. J.J. Palacios. **Joint CMD 30 - FisMat 2023 conference**. 4th September – 8th September 2023. Politecnico di Milano (Italy)

31. "Temporal and spatio-temporal metamaterials." P. A. Huidobro. **XII meeting of the Condensed matter division (GEFES) of the Spanish Royal Socity of Physics.** 01–03 February 2023.Salamanca (Spain)

32. Magnonics and topological electronics with magnetic insulators. S. Velez. **MAT-SUS Spring 2023, Materials for Quantum Technology Symposium**. Spain, 6-10 March 2023.Valencia (Spain)

33. Ferroelectricity in hexagonal boron nitride. P. Ares. **Multifrequency AFM Conference**. June 14-16, 2023; Madrid (Spain)

34. Inverse Design for quantum nanophotonics: antibunched light and qubit entanglement. A.I. Fernández. **Nanophotonics Out of Equilibrium**. 25-29 June 2023. Telluride (USA)

35. Ferroelectricity in hexagonal boron nitride. P. Ares. **NanoSpain Conf**. April 25-28, 2023. Tarragona (Spain)

36. Inverse Design for quantum nanophotonics: qubit entanglement and Bell state preparation. A.I. Fernández**. NOP2023**. 6-8 September 2023. Lecce (Italy)

37. Advanced concepts in Solid-State Li-ion Batteries. C. Polop. **1st NPU-UAM Symposium on Advanced Materials (NUSAM 2023).** September 17-20, 2023. Xi An, China.

38. Quantum nanophotonics: antibunched light and molecular entanglement. A.I. Fernández. **PIERS 2023**. 3-6 July 2023. Prague (Czech Republic)

39. Inverse Design for quantum nanophotonics: antibunched light and qubit entanglement. A.I. Fernández. **PhotOptics 2023**, Lisbon, 16-18 February 2023. Lisbon (Portugal)

40. Inverse Design for quantum nanophotonics: antibunched light and qubit entanglement. A.I. Fernández. **PhotonicsNorth 2023**. 12-15 June 2023. Montreal (Canada)

41. E. Lee. **Quantum Matter 2023.** 23-25 May 2023. Madrid (Spain)

42. Mapping between Quantum & Nano-Photonics. J. Feist. **Quantum Nanophotonics 2023**, 16/03/2023 Benasque (Spain)

43. Mapping between Quantum & Nano-Photonics. J. Feist. **SCOM 2023**, 21/06/2023 San Diego (USA)

44. Spin-phonon coupling in ordered magnets: origin and consequences. Akashdeep Kamra. **Spring Meeting of the German Physical Society (DPG) 2023**. March 26th - 31st. Dresden (Germany)

45. Cavity-mediated modification of materials: Fundamentals & pitfalls. J. Feist. **Topological phases and strong correlations in many-body systems and light-matter hybrids**, 08/11/2023 Cambridge (USA)

46. H. Suderow.**Topology, spin-orbit interactions and superconductivity in strongly correlated quantum materials under extreme conditions**. (10-12 October 23 Grenoble)

47. Understanding CISS from group theory/first principles. J.J. Palacios. **Workshop on Electronic Transport in Molecular Quantum Conductors**. June 26-29, 2023. Weizmann Institute of Science (Israel)

48. H. Suderow. **Workshop Magnetic Fields in Materials Research** (May 22-24, 2023, Wrocław, (Poland)

49. Resolving electron dynamics in graphene with x-ray spectroscopy. A. Picón. **12th Ringberg Meeting on Science with FELs**, February 5 to 8 (2023). Ringberg Castle in Bavaria (Germany)

50. Polarizations in hexagonal boron nitride: Piezoelectricity and Ferroelectricity. P. Ares. **2D Transition Metal Dichalcogenides (2D TMDs).** June 19-21, 2023; Cambridge (UK)

51. Mechanics of defective 2D MoS2. C. Gómez-Navarro. **2D Transition Metal Dichalcogenides (2D TMDs)**. June 26-29, 2023; Cambridge (UK)

52. Advanced Atomic Force Microscopy: a tool for Nanoscience and Nanotechnology. P. Ares. **Series of invited lectures of the 3DScavengers Nanotechnology on Surfaces and Plasma group**. May 08, 2023, Sevilla (Spain)

53. SOLIMEC - Enhancing the mechanical stability of interfaces in solid-state Li-ion batteries for energy-intensive applications. C. Polop. **Workshop BATTERY2030+ & M-ERA.NET - Connecting European battery projects**. April 4, 2023. Online.

54. Poms, Pirates, and Polycycles. N. Agrait. **30 Years of Advances in Quantum Nanoscience.** 16th June 2023, Delft (Netherlands)

Organization of congresses

1. **2nd Annual Conference on Global Nanotechnology** (June 19-21, 2023 Madrid). Organizers: Elanva Conferences & Exhibitions, Andrés Castellanos and Carmen Munuera (from ICMM-CSIC), Pablo Ares (from IFIMAC-UAM): Local Organizing Commitee.
2. **CECAM School on "Ultrafast phenomena in Chemistry: Laser-matter interactions at the femto- and attosecond time scales"** (May 22-26, 2023. Zaragoza). Organizers: Alicia Palacios and Wojciech Gawelda.
3. **COST-CECAM School on "New Computational Methods for Attosecond Molecular Processes"** (May 29 to June 2, 2023. Zaragoza). Organizers: Alicia Palacios and Fernando Martín.
4. **B06 Experimental and Computational Advances in Biomolecular Electronics" within the conference "2023 MRS Fall Meeting & Exhibit"** (Nov26th-Dec 1st 2023) Boston (USA). Organizers: Juan Artés Vivancos, Anant Anantram, Joshua Hihath, Linda Angela Zotti.
5. **XXXIII International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC)** (July 25 to August 1, 2023 Ontario). General Committee: A. Picón.
6. **International Conference of Excited States on Transition Elements -ESTE 2023.** (Setiembre 3-8, 2023. Świeradów Zdrój, Polonia-). International committee: L. E. Bausá.
7. **International meeting on superconducting quantum materials and nanodevices** (17 to 21 April 2023, Montenegro) Organizers: Predrag Miranovic (chair), University of Montenegro, Jovan Mirkovic (co-chair), University of Montenegro, Milorad Milosevic (co-chair), UAntwerp, Belgium Anna Böhmer, University Bochum, Szabolcs Csonka, Budapest University, Francesco Tafuri, UniNaples, Italy, Hermann Suderow UAM Madrid, Spain.
8. **Focus topic "Spin Transport & Magnetization Dynamics in Metal Based Systems" for the APS** (March 5th - 10th, 2023, Las Vegas, USA). Co-organizer: Akashdeep Kamra.
9. **Minicolloquium entitled "Charge transport in molecules and biosystems at different scales: going beyond traditional electronics" within the conference "CMD30-FisMat 2023".** 4th-8th of September 2023. Milan (Italy). Organizers: Linda Angela Zotti, Edmund Leary and Eleonora Alfinito
10. **Nanospain 2023,** April 25-28. Tarragona (Spain). Organizers: Phantoms Foundation and Manuel I. Marqués.
11. **1st NPU-UAM Symposium on Advanced Materials (NUSAM 2023).** (September 17-20, 2023. Xi An, China) Program Committee: Laura R. Arriaga
12. **9th International Symposium on Optical Materials** (26-24 junio 2023. Tarragona, Spain). General Committee: L. E. Bausá.
13. **Quantum Matter 2023.** 23-25 May 2023. Madrid (Spain). Local organizing committee: A. Levy.
14. **1st Spanish Soft Matter 1 ½ Day**. (29 – 31 October 2023, Benasque). Organizers: Juan L. Aragonés, Laura R. Arriaga, Alberto Fernandez-Nieves, Miguel Ruiz-Garcia
15. **Spanish Conference on Nanophotonics (Conferencia Española de Nanofotónica CEN 2023** (12-14 junio 2023. Zaragoza, Spain). General Committee: L. E. Bausá.
16. **Symposium 13: Domain walls, skyrmions and spin-orbit related phenomena. Joint European Magnetic Symposia 2023 (JEMS).** (27 August - 1 September 2023. Madrid, Spain) Organizers: Saül Vélez, João Sampaio and Gianfranco Durin.
17. **Waves in Time varying Media workshop** (3–5 May 2023, New York). Organizers: Emanuele Galiffi, Paloma A Huidobro, Riccardo Sapienza and Andrea Alu.
18. **Young researchers online workshop on Topology and Superconductivity in Strongly Correlated f-electron Materials** (27 February to 01 March 2023) Online. Organizers: Brison, Jean Pascal (France), Custers, Jeroen (Chair, Czech Republic), Dunsiger, Sarah (Canada), Flint, Rebecca (USA), Pagliuso, Pascoal (Brazil), Paschen, Silke (Austria), Ronning, Filip (USA), Suderow, Hermann (Spain)

Sponsorships

Fuerzas y Túnel FyT2023 conference (Zamora, July 3-5) organized by Guilherme de Vilhena (UAM-IFIMAC), Manuela Garnica (IMDEA-Nanoscience), Miriam Jaafar (UAM-IFIMAC) and Pablo Merino (ICMM-CSIC): https://aseva.es/conferences/fuerzas-y-tunel-2023/

MRS Fall 2023 Symposium "SB06—Experimental and Computational Advances in Biomolecular Electronics" (Boston, November 26 – December 1) organized by Materials Research Society: https://www.mrs.org/meetings-events/fall-meetings-exhibits/2023-mrs-fall-meeting

QUANTUMatter2023 (Madrid, May 23-25) organized by Fundación Phanthoms. https://www.quantum-conf.eu/2023/about.php#about

Spanish Conference on Nanophotonics – Conferencia Española de Nanofotónica (CEN) (Zaragoza, June 23-25) organized by L. Martin-Moreno (INMA) and S. Gutierrez (INMA): https://www.benasque.org/2023cen/

The TopoPhoto23 workshop (Madrid, Ma y31– June 2) organized by Paloma A. Huidobro (IFIMAC-UAM), Alejandro González Tudela (Instituto de Física Fundamental-CSIC), Diego Porras (Instituto de Física Fundamental-CSIC), Alberto Amo (Laboratoire PhLAM CNRS – Université de Lille) and Aitzol García-Etxarri (Donostia International Physics Center): https://eventos.uam.es/88595/detail/topological-photonics-2023.html

1st Spanish Soft Matter 1 ½ Day (Benasque, October 29-31) organized by J. Aragones (IFIMAC- UAM), L. Arriaga (IFIMAC- UAM), A. Fernandez-Nieves (UB - ICREA) and M. Ruiz-Garcia (UCM) : https://www.benasque.org/2023ssm/

11st edition of the GEFES awards for the best doctoral thesis in condensed Matter Physics: https://gefes-rsef.org/xi-edicion-premios-de-tesis-gefes-2023/

Patent applications

1. **A computer implemented method for identifying a organic molecule from atomic force microscopy images by generating a 2D colored rgb structural representation of said molecule in the form of a ball-and-stick depiction.**
   Rubén Pérez Pérez, Jaime Carracedo Cosme.
   Application number: PCT/ES2023/070275
   Date of application: 28/04/2023
   UAM
2. **A computer implemented method for identifying a molecule from atomic force microscopy images and generating the name of said molecule according to the IUPAC nomenclature.**
   Rubén Pérez Pérez, Jaime Carracedo Cosme
   Application number: : PCT/ES2023/070276
   Date of application: 28/04/2023
   UAM
3. **Nanoreactors for the synthesis of porous crystalline materials.**
   Félix Zamora, David Rodriguez
   Application number: EP18179325.8. PCT/EP2019/066526.
   Countries: China (201980054690X); USA (17/255,121); UE (EP19736609.9); Hong-Kong (62022046474.2); Japan (2020-571441)
   Date of application: 22/11/2023
   UAM

Awards



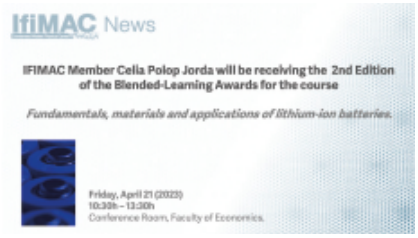
Carlos Antón Solanas has been awarded with a **Beca Leonardo 2023**. The Leonardo Scholarships for Researchers in Physics support the work of researchers who, being in intermediate stages of their career, are characterized by a high and innovative scientific production. In this call dedicated exclusively to Physics, a total of 7 have been awarded out of 67 received. Carlos will be working on his project **"Quantum key distribution with single-photon sources at room temperature"** aiming at developing solid-state single-photon sources (defects in hexagonal boron nitride) capable of generating single-photons efficiently and with high purity, and using them in free-space quantum key distribution protocols.¡



Cristina Gómez-Navarro has been awarded with the best talk in Nanomechanics and Optomechanics at **Nano Series 2023**.



Eva Osuna Bris has been awarded with the best talk in the Early Career Researchers (ECR) session at **Nano Series 2023**.



Celia Polop Jorda has been awarded with the 2nd Edition of the **BLA Awards** (Blended-Learning Awards) for their course from the CIVIS Forum Area – Climate, environment and energy: **"Fundamentals, materials and applications of lithium-ion batteries"**

In this course they delve into the physical and chemical fundamentals of lithium-ion batteries with the analysis of the key aspects for their applications in renewable energy storage technology.



4

TRAINING AND OUTREACH ACTIVITIES

Master and Doctorate Programmes
IFIMAC´s Master Fellowships
Research Awards for Physics Students
Outreach

IfiMAC
Condensed Matter Physics Center

Master and Doctorate Programmes

IFIMAC members are actively involved in the **Master Programmes**:

- Máster Universitario en Física de la Materia Condensada y de los Sistemas Biológicos.
- Máster Universitario en Química Teórica y Modelización Computacional.
- Máster Universitario en Materiales Avanzados, Nanotecnología y Fotónica.
- Máster Universitario en Química Aplicada.

And in the **Doctorate programmes**:

- Física de la Materia Condensada, Nanociencia y Biofísica.
- Programa de Doctorado en Materiales Avanzados y Nanotecnología.
- Química Teórica y Modelización Computacional.
- Química Aplicada.

IFIMAC's Master Fellowships

IFIMAC has offered 10 grants for the best students starting the **Masters of Condensed Matter Physics** within UAM.

2022/2023 course: five Master grants awarded.

De la Peña Ruiz, Sebastián (Máster en Física de la Materia Condensada y de los Sistemas Biológicos , NANOFÍSICA)
TFM Supervisor: Juan Carlos Cuevas

Diez Silva, Pablo (Máster en Física de la Materia Condensada y de los Sistemas Biológicos, NANOFÍSICA)
TFM Supervisor: Linda Angela Zotti

Fernandez Écija, Laura (Máster en Nuevos Alimentos)
TFM Supervisor: Félix Zmora Abanades

Molina Hernández, Javier (Máster en Física de la Materia Condensada y de los Sistemas Biológicos, BIOFÍSICA)
TFM Supervisor: David Miguez Gómez

Tuero Álvarez, Pablo (Máster en Física de la Materia Condensada y de los Sistemas Biológicos, NANOFÍSICA)
TFM Supervisor: Farkhad Aliev

Viña Bausá, Beatriz María (Máster en Máster en Física de la Materia Condensada y de los Sistemas Biológicos, NANOFÍSICA)
TFM Supervisor: Iván Brihuega

2023/2024 course: five Master grants awarded.

Castro Luaces, Javier (Máster en Física de la Materia Condensada y de los Sistemas Biológicos, NANOFÍSICA)
TFM Supervisor: Merino, Jaime and Bravo, Jorge

Gallego de Roa, Álvaro (Máster Erasmus Mundus en Química Teórica y Modelización Computacional)
TFM Supervisor: Díaz-Tendero, Sergio

Ronquillo Tutiven, Joan Javier (Máster en Física de la Materia Condensada y de los Sistemas Biológicos , NANOFÍSICA)
TFM Supervisor: Cuevas Rodriguez, Juan Carlos and Vilhena, Guilherme.

Torrico García-Viso, Lucía (Máster en Química Aplicada)
TFM Supervisor: Zamora, Félix

Verde Ruiz, Miguel (Máster en Física de la Materia Condensada y de los Sistemas Biológicos, NANOFÍSICA)
TFM Supervisor: Feist, Johannes

Research Awards for Physics Students

The Condensed Matter Physics Center provides two of the six awards called by The Nicolás Cabrera Institute. The candidates awarded by IFIMAC in the 2023 edition are Abel Rosado Peinado and Carlos Sánchez Cruz.



Outreach

NEW IFIMAC Newsletter

The IFIMAC Newsletter is a platform for sharing our activities, it strengthens the identity of our organization, and provides regular updates on our achievements to the broader scientific community. This strategic communication approach enhances collaboration and cohesion among our team members. It also contributes to the dissemination of IFIMAC's accomplishments, fostering connections and knowledge exchange with the wider scientific community.





Science outreach activities

International Day of Women and Girls in Science

On 11 February, IFIMAC organised a science fair consisting of a series of workshops to celebrate the International Day of Women and Girls in Science in a central location in Madrid (La Corrala, UAM). This event brought together more than 200 participants and provided them with a unique opportunity to explore soft and hard matter and optics. The overall aim of the event was to stimulate curiosity and interest in science among the general public. In addition, these activities make visible the scientific activities of women working at IFIMAC and highlight the careers of pioneering women in the history of science.



During this science fair, participants explored the behaviour of soft matter, including liquids and gels, through hands-on experimental engagements and learned about the practical applications of advances in the field. At the same time, participants explored the metamorphosis of matter from one state to another under the guidance of IFIMAC members specialising in 'hard matter'. The optics workshop allowed a hands-on exploration of light, spectrally dissecting it to reveal its myriad colours and demonstrating the properties of light using everyday objects such as olive oil or gummy bears.

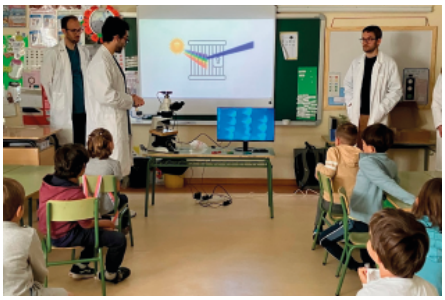
In addition to the science fair in La Corrala, members of the Condensed Matter Physics Center participated in the celebration of the International Day of Women and Girls in Science by giving a series of talks at various primary and secondary schools in the Comunidad de Madrid:

- **Linda Zotti** and **Paloma Cerezo** gave a talk "Simulaciones de sistemas biológicos y la carrera en física" at Colegio Altair (Madrid) on February 9th .
- **María Dolores Martín** gave a talk at CEIP Fuente Santa (Colmenar Viejo) on February 10th.
- **Nerea Alcázar** gave a talk at IES Francisco de Goya (Madrid) on February 13rd.
- **Eva Osuna Bris** and **Beatriz Viña Bausá** gave a talk "Charla-taller sobre física de la materia condensada y nuestra experiencia como jóvenes investigadoras en esta área" at IES Severo Ochoa (Alcobendas) on February 17th.
- **Celia González** gave a talk "La ciencia también es cosa nuestra" at IES Leonardo Da Vinci (Majadahonda) on February 6th, at IES Gran Capitán (Madrid) February 7th and at CEIP Gustavo Adolfo Bécquer (Madrid) February 9th and 14th.

CEIP Aldredo Di Stefano (Madrid)

Workshop "Invisible Forces" with 4-5 year olds on April 12nd. During the engaging workshop at CEIP Alfredo Di Stefano members of IFIMAC collaborated with five classrooms to explore natural forces. The session served as an introduction for students, covering topics such as magnetism, electricity, and surface tension.





CEIP Príncipe de Asturias (Madrid)

Worshop "What is colour?". IFIMAC´s Photonic Nanomaterials and Devices Lab explored light and how we can see different colours with six year old students at the CEIP Principe de Asturias on April 17th.

Workshops at Instituto de Libre Enseñanza (ILE)

We are delighted to share with you the recent success of our joint workshops with the Instituto de Libre Enseñanza of the Fundación Giner. Held in Madrid on 15 April and 13 May, these engaging workshops were specifically designed to stimulate young children's curiosity and interest in science through a fun and interactive approach. Eva Osuna, a PhD student at IFIMAC, explored the state of matter through fun experiments in her workshop "Let's change matter by sublimating, vaporizing, crystallizing". Celia González, also a PhD student at IFIMAC, explored how density works in her workshop "Do you float or sink? The mystery of density".



European Researchers Night

IFIMAC researchers participated in the European Researchers Night 2023 with the organisation of two activities that took place in the Plaza Mayor UAM:

- Making an electric battery using everyday materials. We explored how the stored chemical energy of our battery was transformed into electrical energy by lighting up a small LED.
- Build a car that can move under a spotlight that simulates the sun. In addition, participants also got a glimpse of the latest advances in photovoltaic energy through a light concentrator demonstration.



Science and Innovation Week 2023

IFIMAC participated in the XXIII Madrid Science and Innovation Week with 3 activities in the Community of Madrid through the Fundación para el Conocimiento madri+d.

8 de noviembre de 2023: Ciencia y palomitas – Introducción a los materiales 2D

In this activity, the students watched our video "How to Create a One Atom Thick Material and Why They Are Revolutionary". After some popcorn and a few questions, Pablo Ares García, Yolanda Manzanares Negro and Beatriz Viña Bausá helped the students to exfoliate graphite to obtain monolayers, which they observed under the microscope. They went home with their own sample and new knowledge about 2D materials!



17 November 2023: Science and Popcorn – Introduction to light

In this activity, the students watched our video "Seriously, what exactly is light?". After some popcorn and a few questions, Carlos Antón Solanas and Carlos Sánchez Muñoz showed the students how light behaves and how its properties can help us discover the nature of things.



17 November 2023: Lab in your mobile

In this activity, we explored the world around us using the PhyPhox app on our mobiles. Paloma Arroyo Huidobro, Alejandro Caballero Domínguez, Amalia Coro, Jaime Echave-Sustaeta Osuna, Diego Martín Cano, Miguel Ángel Martínez García and Ferry Prins showed a series of experiments to learn about the different sensors in our smartphone and how it can be used as a small laboratory.



IFIMAC on Media

International Day of Women and Girls in Science at RTVE

During the celebration of the Physics Fair at La Corrala for the International Day of Women and Girls in Science, we had RTVE recording. It was in the news, along with other activities carried out by other centres that day.

More information: *https://x.com/ifimacuam/status/1625059267177861121?s=20*

Carlos Antón Solanas got a Leonardo Grant

Carlos is one of seven 2023 recipients in the field of physics. The Leonardo Fellowships for Researchers in Physics recognise the excellence of mid-career researchers who have made significant contributions to the field. His project, entitled 'Quantum Key Distribution with Single-Photon Sources at Room Temperature', focuses on the development of solid-state single-photon sources using defects in hexagonal boron nitride. The aim of the project is to create efficient and highly pure single-photon sources that can be used in free-space quantum key distribution protocols.

Interview at ABC: *https://www.abc.es/ciencia/carlos-anton-solanas-fisico-podremos-enviar-mensajes-20230510185826-nt.html?ref=https%3A%2F%2Fwww.abc.es%2Fciencia%2Fcarlos-anton-solanas-fisico-podremos-enviar-mensajes-20230510185826-nt.html*

IFIMAC YouTube Channel

NEW IFIMAC Colloquium

We invited colloquium speakers to participate in an interview with four IFIMAC PhD students. This is an excellent opportunity for our doctoral students to learn from renowned experts in their field. It is also a great way to showcase the work of these outstanding researchers and share their insights with a wider audience. By making the interviews available on the IFIMAC YouTube channel, we are providing a valuable resource for anyone interested in the work being done in their respective fields. The personal insights and career advice shared by the speakers can also be incredibly inspiring and helpful to students and early career researchers. Overall, this is an excellent initiative that will benefit not only students but also the wider research community.

Interviews:

Olivier Dauchot: *https://www.youtube.com/watch?v=DMuVAj85CdQ*

Serge Haroche: *https://www.youtube.com/watch?v=JKV_AC9KibI*

Andreas J. Heinrich: *https://youtu.be/J_DUm39FfTU*

Allan MacDonald: *https://www.youtube.com/watch?v=FMsEnVl_wR0*

Jascha Repp: *https://www.youtube.com/watch?v=VhoE9zuf4SQ*

Roser Valentí: *https://www.youtube.com/watch?v=AMcu7B-P714*

NEW Nobel Prizes 2023

To celebrate the 2023 Nobel Prizes in Chemistry and Physics, two explanatory videos were made explaining the relevance of their research and the work that led to these prizes.

Celebrating Nobel Prize in Physics: *https://www.youtube.com/watch?v=6EmR2Toz7jc*

In this video, Alicia Palacios tells us more about the science behind the 2023 Nobel Prize in Physics awarded to Anne L'Huillier, Ferenc Krausz and Pierre Agostini, "for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter".

Celebrating Nobel Prize in Chemistry: *https://www.youtube.com/watch?v=U1hVXnquESQ*

In this video, Ferry Prins tells us more about the science behind the 2023 Nobel Prize in Chemistry awarded to Moungi G. Bawendi, Louis E. Brus and Alexey Ekimov, "for the discovery and synthesis of quantum dots".

Quantum Fracture

Since 2017, we have kept a fruitful collaboration with the Quantum Fracture YouTube channel (*https://www.youtube.com/user/QuantumFracture*), devoted to scientific outreach in spanish and english. Since then, we have generated 8 videos:

- The first video, **La física de lo complejo**, provided a general perspective on the field of condensed matter physics, as well as the research performed at IFIMAC. A team of 7 IFIMAC researchers were involved in its realization. ***Views***: 725, 365
- The following videos dealt with different topics of intense research activity worldwide, in which IFIMAC researchers play an important role. They were coordinated by 1-2 IFIMAC researchers each, who offered their particular vision on the topic in question. The titles of the videos were:
  - **El cristal que se alimenta de entropía. *Views:*** 1,041,391
  - **Cómo el microscopio más potente del mundo acabó en España. *Views:*** 2,208,822
  - **El quinto estado de la materia: superfluidos y superconductores. *Views:*** 643,939
  - **El material cuántico que se enfría al sol. *Views:*** 546,521
  - **Ya, en serio, ¿qué es la luz? *Views:*** 2,731,879

In 2023, thanks to the support from Fundación Española para la Ciencia y la Tecnología (FECYT), IFIMAC has continued its collaboration with the Quantum Fracture YouTube channel with the production of three videos that showcase the contribution of female scientist to the world class research performed at IFIMAC.

NEW - Cómo Crear un Material de 1 Atómo de Grosor (y por qué son revolucionarios) ***Views:*** 535,476

In this video, we explored materials that are just one atom thick. We showed how they can be obtained and combined, the techniques involved and how they have been developed in recent years. We also discuss the applications that these extraordinary materials will have in the near future. This video is an introduction to the scientific and technological revolution in two-dimensional materials.

NEW - Virus, ADN y Vesículas: ¿Qué hace un Físico Estudiando Esto? ***Views:*** 281.953

This video explores three topics in Biophysics where IFIMAC researchers are involved: AFM studies on viruses, mechancical properties of nuecleic acids and lipid vesicles as model to study cellular processes.

NEW - Cómo se Fabrica un Bit Cuántico | Átomos Artificiales. ***Views:*** 1.029.632

Carlos Antón Solanas recipient of a 2023 Ramón Areces Grant

Carlos is the recipient of a 2023 Ramón Areces Grant for his project "Ultrabright Sources of Photons in Open Cavities". The project aims to develop an ultrabright source of single photons that can operate at both ambient and cryogenic temperatures.

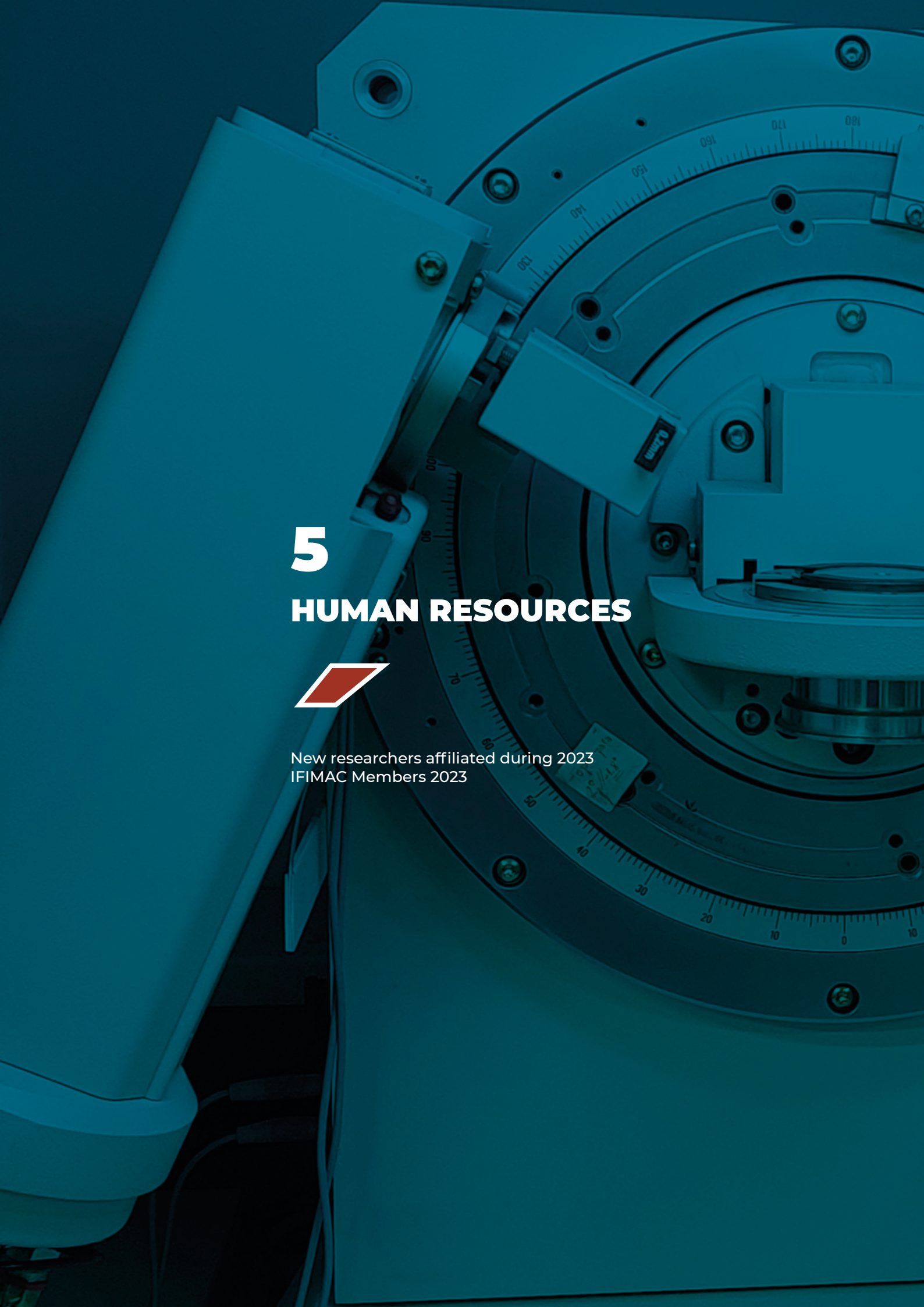
Interview: *https://www.youtube.com/watch?v=4n8vgk1AYBM*

IFIMAC Social Media

During 2023, two campaigns have been launched on X with the hashtags:

#CondensedMatterPioneers and *#IFIMACFacts*

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5
HUMAN RESOURCES

New researchers affiliated during 2023
IFIMAC Members 2023

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Condensed Matter Physics Center

New researchers affiliated during 2023

New members proposed by IFIMAC Researchers



NEW - Héctor González Herrero (Ramón y Cajal Fellow)

Héctor González Herrero's research has been focused on the synthesis and study of low dimensional materials (specially 2D materials) and their properties by means of Scanning Tunneling Microscopy (STM) and non-contact Atomic Force Microscopy (nc-AFM). Héctor obtained his PhD at the Univ. Autonoma of Madrid in 2017. Thereupon he became a postdoctoral researcher at UPOL, Czech Republic, where he focused on on-surface synthesis of 1D polymers. Afterwards, he moved to Aalto university in Helsinki, where he worked on the synthesis and characterization of transition metal dichalcogenides. Then, he obtained a Global Individual Marie Sklodowska-Curie Fellowship to work on "Tuning electronic properties in twisted 2D transition metal dichalcogenides heterostructures" at Monash University in Melbourne. In 2023 he incorporated to IFIMAC with a "Ramón y Cajal Fellowship".



NEW - Antonio Javier Martínez Galera (Ramón y Cajal Fellow)

Antonio Javier Martínez Galera obtained his PhD degree in July 2012, receiving the extraordinary PhD prize awarded by the Universidad Autónoma de Madrid, as well as, the prize for the best experimental thesis in Solid State Physics defended in 2012, awarded by the Grupo Especializado de Física del Estado Sólido (GEFES) of the Real Sociedad Española de Física (RSEF). Subsequently, he received a Marie Skłodowska-Curie postdoctoral mobility grant to join the group of Prof. Thomas Michely, pioneer and world leader in graphene growth on metal surfaces, at the University of Cologne. After that, he received a grant from the Spanish Juan de la Cierva incorporation program and returned to UAM in 2016. In 2020, he obtained an Assistant Professor position, and more recently a grant from the Ramón y Cajal program, becoming IFIMAC member. His main research lines are: 1) Growth, functionalization, and characterization of 2D Materials, 2) Study and tuning of the interaction between molecular adsorbates and 2D materials, 3) Growth and nanomanipulation of ordered arrays of nanoparticles, 4) Atomic-scale study of heterogeneous catalysis processes on metal nanoparticles.



NEW - Antonio Picón Álvarez (Associate Profesor)

Antonio Picón's area of expertise is theoretical modelling of ultrafast phenomena. Antonio obtained his PhD at the Univ. Autonoma of Barcelona in 2008. Then he moved to University of Colorado, JILA, as a Fulbright fellow to work in the area of strong-field and attosecond physics. In 2012 he moved to Argonne National Laboratory, first as postdoc and then was promoted to senior researcher. There he worked in the field of ultrafast x-ray science and started to be involved with experiments carried out at X-ray Free Electron Lasers (XFELs) facilities. In 2018 he incorporated in the Department of Chemistry as a Talento fellow of CM and is associate professor (contratado doctor) since 2023. He is recently working in the field of attosecond science in 2D materials.

IFIMAC Members

Researchers

Surname and name	Professional category	Department	Research line/s
Agrait de la Puente, Nicolás	Catedrático de Universidad	FMC	NP
Aliev Kazanski, Farkhad	Catedrático de Universidad	FMC	AM
Álvarez Alonso, Jesús	Titular de Universidad	FMC	NP AM
Álvarez Carrera, José Vicente	Contratado Doctor	FMC	FPSM,NP
Antón Solanas, Carlos	Atracción de Talento	FM	AM, NQO
Aragonés Gómez, Juan Luis	Investigador RyC	FTMC	SCMB
Ares García, Pablo	Investigador RyC	FTMC	AM, NP
Arroyo Huidobro, Paloma	Investigadora RyC	FTMC	NQO
Assenza, Salvatore	La Caixa Junior Leader	FTMC	SCMB
Bausá López, Luisa E.	Catedrática de Universidad	FM	AM, NQO
Bravo Abad, Jorge	Titular de Universidad	FTMC	NQO
Brihuega Álvarez, Iván	Titular de Universidad	FMC	AM,NP
Burset Atienza, Pablo	Research Fellow CM-Talento	FTMC	NP, AM
Burzurí Linares, Enrique	Investigador RyC	FMC	NP, AM
Camarero de Diego, Julio	Titular de Universidad	FMC	NP AM
Cinacchi, Giorgio	Contratado Doctor	FTMC	SCMB,AM
Cortijo, Alberto	Investigador RyC	FMC	FPSM
Cuevas Rodríguez, Juan	Titular de Universidad	FTMC	NP,NQO
de Pablo Gómez, Pedro José	Titular de Universidad	FMC	SCMB,NP
Delgado Buscalioni, Rafael	Titular de Universidad	FTMC	SCMB
Díaz-Tendero Victoria, Sergio	Titular de Universidad	Q	FPSM
Farías Tejerina, Daniel	Catedrático de Universidad	FMC	NP
Feist, Johannes	Contratado Doctor	FTMC	NQO
Fernández Domínguez, Antonio I.	Contratado Doctor	FTMC	NQO
Flores Sintas, Fernando	Profesor Emérito	FTMC	NP,FPSM
García González, Pablo	Titular de Universidad	FTMC	FPSM,NQO
García Michel, Enrique	Catedrático de Universidad	FMC	AM,NP
García Mochales, Pedro	Contratado Doctor	FMC	FPSM
García Vidal, Francisco J.	Catedrático de Universidad	FTMC	NQO
Gómez Herrero, Julio	Catedrático de Universidad	FMC	NP,AM
Gómez Santos, Guillermo	Titular de Universidad	FMC	FPSM
Gómez-Navarro González, Cristina	Titular de Universidad	FMC	AM,NP
González Herrero, Héctor	Investigador RyC	FMC	AM,NP
Guantes Navacerrada, Raúl	Contratado Doctor	FMC	SCMB

Guillamón Gómez, Isabel	Titular de Universidad	FMC	AM
Hernando Pérez, Mercedes	Investigadora RyC	FM	SCMB
Jaafar Ruiz-Castellanos, Miriam	Contratado doctor	FMC	AM NP
Kamra, Akashdeep	Joven Investigador IFIMAC	FTMC	AM, NP
Lazic, Snezana	Contratado Doctor	FM	NP
Lee, Eduardo Jian Hua	Contratado Doctor	IFIMAC	NP, AM
Levy Yeyati, Alfredo	Catedrático de Universidad	FTMC	NP,AM
López Vázquez de Parga, Amadeo	Catedrático de Universidad	FMC	NP
Marchetti, Francesca María	Titular de Universidad	FTMC	NQO
Marqués Ponce, Manuel	Titular de Universidad	FM	NQO
Martín Cano, Diego	Investigador RyC	FTMC	NQO
Martín Fernández, María	Titular de Universidad	FM	NQO
Martín García, Fernando	Catedrático	Q	NP, FPSM
Martínez Galera, Antonio	Ayudante Doctor	FM	AM,NP
Merino Troncoso, Jaime	Titular de Universidad	FTMC	AM
Miguel Llorente, Juan José	Titular de Universidad	FMC	AM,NP
Míguez Gómez , David	Contratado Doctor	FMC	SCMB
Miranda Soriano, Rodolfo	Catedrático de Universidad	FMC	NP,AM
Monreal Vélez, Rosa	Profesora Emérita	FTMC	NP,NQO
Moreno Soriano, Esteban	Titular de Universidad	FTMC	NQO
Mori Sánchez, Paula	Contratado doctor	Q	FPSM
Ortega Mateo, José	Catedrático de Universidad	FTMC	AM,SCMB,NP,FPSM
Otero Martín, Roberto	Titular de Universidad	FTMC	AM, NP
Palacios Burgos, Juan José	Catedrático de Universidad	FMC	NP,FPSM
Palacios Cañas, Alicia	Titular de Universidad	Q	FPSM
Pérez Pérez, Rubén	Catedrático de Universidad	FTMC	NP,FPSM
Picón Álvarez, Antonio	Contratado doctor	Q	NP,FPSM
Platero Prats, Ana Eva	Investigadora RyC	QI	AM
Polop Jordá, Celia	Titular de Universidad	FTMC	AM, NP
Porto Ortega, Juan Antonio	Contratado Doctor	FTMC	NQO
Pou Bell, Pablo	Titular de Universidad	FTMC	FPSM,NP
Prins, Ferry	Investigador RyC	FMC	NQO
Ramírez Herrero, Mariola	Contratado Doctor	FM	AM, NQO
Ramos Ruiz, Miguel Ángel	Catedrático de Universidad	FMC	AM,SCMB
Rodrigo Rodríguez, José	Titular de Universidad	FMC	AM
Rodríguez Arriaga, Laura	Investigadora RyC	FTMC	SCMB
Rubio Bollinger, Gabino	Catedrático de Universidad	FMC	NP AM
Sánchez Muñoz, Carlos	La Caixa Junior Leader	FTMC	NQO
Sánchez Rodrigo, Rafael	Contratado doctor	FTMC	NP
Segovia Cabrero, Pilar	Titular de Universidad	FMC	AM,NP

Seijo Loché, Luis	Catedrático de Universidad	Q	FPSM
Soler Torroja, Jose María	Catedrático de Universidad	FMC	FPSM
Suderow Rodríguez, Hermann	Titular de Universidad	FMC	AM,NP
Tarazona Lafarga, Pedro	Catedrático de Universidad	FTMC	SCMB
Tejedor de Paz, Carlos	Profesor Emérito	FTMC	NQO
Valle Reboul, Elena del	Contratado Doctor	FTMC	NQO, NP
Van Der Meulen, Herko	Titular de Universidad	FM	AM, NQO
Velasco Caravaca, Enrique	Titular de Universidad	FTMC	SCMB
Velez Centoral, Saül	Atracción de Talento	FMC	AM, NP
Vieira Díaz, Sebastián	Profesor Emérito	FMC	AM
Vilhena, Guilherme	Atracción de Talento	FTMC	AM, NP
Viña Liste, Luis	Catedrático de Universidad	FM	NQO
Yndurain Muñoz, Félix	Profesor Emérito	FMC	FPSM
Zamora Abanades, Félix	Catedrático de Universidad	QI	AM
Zotti, Linda Ángela	Ayudante doctor	FTMC	NP, FPSM

Acronyms

Departments

FMC: Física de la Materia Condensada
FTMC: Física Teórica de la Materia Condensada
FM: Física de Materiales
QI: Química Inorgánica
Q: Química

Research Lines

NP: Nanophysics
AM: Advanced Materials
SCMB: Soft Condensed Matter and Biophysics
FPSM: First-principles Simulations and Modeling
NQO: Nano and Quantum Optics

Staff

Surname and name	Profesional category
Bilan, Stefan	IT and High-Performance Computing Infrastructure
Bafunyembaka Batundi, Heri	Laboratory Technician
Conde Angulo, Almudena	Project Manager
Fallaque Najar, Joel	IT and High-Performance Computing Infrastructure
Márques Gallego, Patricia	Outreach
Nevado Rodríguez, Jesús	Laboratory Technician
Souto Pérez, Beatriz	Project Manager Assistant



6
BUDGET

IfiMAC
Condensed Matter Physics Center

GASTOS			INGRESOS	
Previsión de gastos de personal, gastos corrientes de funcionamiento y equipamiento e inversiones	a) Gastos de personal	**530,039.83**	**Estimación de ingresos por actividad propia**	**864,542.88**
	b) gastos corrientes de funcionamiento	**217,789.57**		
	c) equipamiento e inversiones	**63,000.00**		
TOTAL GASTOS (€)		**810,829.40**	**864,542.88**	

IFIMAC



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