

IFIMAC

NEWSLETTER #4

CONDENSED MATTER PHYSICS CENTER

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The IFIMAC Newsletter is released twice a year, aimed at both IFIMAC members and anyone with an interest in the field of Condensed Matter Physics.

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Year-End Reflections at IFIMAC

As 2024 comes to an end, these last two months offer a remarkable snapshot of the achievements of IFIMAC's members across different career stages.

Starting with the youngest, IFIMAC's Day featured an engaging poster session where early-career researchers showcased the quality of their research. Their enthusiastic contributions created a dynamic environment for interactions, for which we express our deepest gratitude.

Moving up the career ladder, we celebrate the recognition earned by our mid-career researchers. Carlos Antón received the Young Researcher Award in Experimental Science from our University, highlighting his promising contributions. At an international level, Pablo Ares secured a prestigious ERC grant, reflecting the excellence and competitiveness of his research. Among our senior members, we are proud to highlight the Comunidad de Madrid award given to our esteemed colleague and Professor Francisco J. García Vidal. From here we recognize his vision and dedication in founding IFIMAC and leading it through years of excellence. Finally, at the pinnacle of this year's achievements, our "solid" Professor Fernando Flores, whose leadership and contributions have been key to shaping IFIMAC as a cradle of talent, has received the University's medal. Congratulations to all of them.

In these times of intense debate and evolving challenges, these accomplishments, along with those of many other IFIMAC researchers, remain at the heart of our shared mission and scientific pursuit.

I wish you all a joyful holiday season. May 2025 bring new opportunities for growth, collaboration and achievement.

Medalla de la Universidad Autónoma de Madrid, 2024

Fernando Flores Sintas, Emeritus Professor of Condensed Matter Physics, has been awarded the prestigious Medalla de la Universidad Autónoma de Madrid (UAM), the highest distinction granted by the institution. This honour recognises his outstanding scientific and academic career, including pioneering contributions to physics. He introduced the theoretical study of Scanning Tunneling Microscopy (STM) in UAM, a pioneer innovation that has positioned the university as a leader in this field.

Flores Sintas was instrumental in the establishment of the Condensed Matter Physics Center (IFIMAC). His contributions have earned him numerous esteemed accolades, including the Blas Cabrera National Research Award and the Medal of the Royal Spanish Society of Physics, solidifying his prominence in the realm of Condensed Matter Physics in Spain and beyond.



2024 Miguel Catalán Research Prize

Francisco José García-Vidal, or FJ as we like to call him, has been awarded the prestigious 2024 Miguel Catalán Research Prize. This recognition, granted by the Community of Madrid, celebrates his significant contributions to the fields of nanophotonics, plasmonics, and metamaterials. Over the past decade, García-Vidal has established himself as one of the most influential physicists in these cutting-edge areas. The award also highlights the collective work of the research group he founded at UAM in 1997. FJ is particularly noted for advancing the theoretical understanding of how light interacts with matter on the nanoscale, an achievement with broad implications across multiple scientific and technological fields.



NEWS - Pablo Ares García 2024

ERC Starting Grant



Pablo completed his Ph.D. at the UAM after working for more than 10 years at Nanotec, a company dedicated to the design, development, manufacture and commercialization of atomic force microscopes (AFM). In October 2017, he joined the University of Manchester as a postdoctoral researcher in the Department of Condensed Matter Physics and the National Graphene Institute. He was awarded a Marie Skłodowska-Curie Individual Fellowship and stayed there for 3 years. In 2020, he returned to the UAM as Assistant Professor & IFIMAC Junior Group Leader, where he continues as a Ramón y Cajal Fellow since March 2022, working on fundamental properties of 1D and 2D materials using and developing scanning probe techniques.

IFIMAC Researcher Pablo Ares has been awarded an ERC Starting Grant 2024, one of 494 grants awarded by the European Research Council to early-stage researchers (out of 3474 proposals submitted). Pablo's research project, Heat2Defects, aims to investigate the effect of atomic-level defects in two-dimensional materials, such as graphene, on heat transport. Graphene, known for its outstanding properties, including a remarkable thermal conductivity, has attracted considerable attention for its potential applications in electronics, energy systems and thermal management. However, the presence of atomic-level defects can significantly alter the heat transport properties of these materials, making it essential to understand their effects in detail.

In this project, Pablo and his team will first investigate the influence of individual defects, including the absence of an atom (vacancies), on the way heat is conducted through the material. These atomic-level imperfections can cause perturbations in the regular atomic structure of the material, potentially leading to new, unexpected thermal behaviours. To carry out this research, the team will develop novel experimental tools to study heat transport at the nanoscopic scale, allowing precise measurements of thermal transport in the presence of these defects.

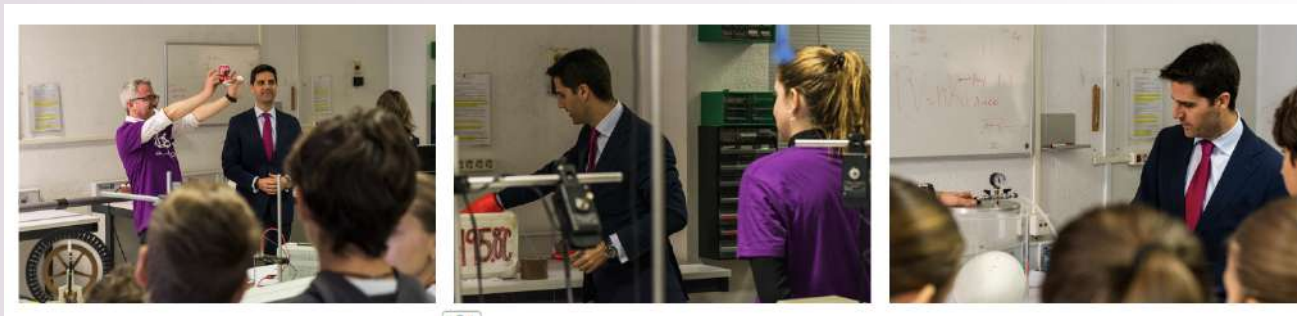
With this fundamental understanding, Pablo aims to use the knowledge gained to develop new types of thermal devices. By strategically introducing specific atomic defects into 2D materials, his team will locally tune the thermal properties of these materials for advanced technological applications. Such devices could be crucial in improving the efficiency of electronics, developing thermal management solutions, such as improved cooling systems.

The Heat2Defects project represents a cutting-edge approach to materials science, combining atomic-scale physics with practical applications in thermal engineering, and promises to open up exciting new possibilities for the use of two-dimensional materials in a range of novel applications. This project is an exceptional opportunity to continue to grow as a scientist, to train new young researchers and to build a larger network of collaborators to achieve higher goals.

See the interview
with Pablo about his
ERC StG project.



Emilio Viciano Duro, the Education, Science, and Universities Councilor of the Community of Madrid, along with Ana Ramírez, Deputy Regional Minister of Universities; Marina Villegas, Director General of Research and Innovation; and Federico Morán, Director of Madri+d, visited our CryoPresionLab workshop during Science and Innovation Week 2024. They were accompanied by a group of third-year ESO students from IES Gran Capitán.



Héctor González, Edwin Herrera, Paula Obladen, Jaime Rumeu, José David Bermúdez, and Teresa García, researchers from IFIMAC and the Department of Condensed Matter Physics at the Autonomous University of Madrid (UAM), designed this workshop for secondary school students. Participants explored low-temperature physics, learning about magnetic levitation with superconductors, state changes, and gas dynamics using dry ice. They studied how extreme cold affects semiconductor optoelectronic properties.

Activities included using a vacuum cannon to launch a table tennis ball near the speed of sound, experimenting with liquid nitrogen to explore state changes and pressure effects, and investigating fluid dynamics and rocket propulsion. Students also examined ideal gas behavior through balloon experiments, linking gas volume, pressure, and temperature.

Mentoring programme , academic year 2024/2025

This academic year, we are delighted to welcome 41 mentees to our mentoring programme. We look forward to supporting these talented young women as they navigate their academic paths and make important career decisions. The programme kicked off on 20 September with an inspiring talk by Eulalia Pérez Sedeño on "Gender bias in teachers and research"(CSIC).



María de Maeztu Accreditation, IFIMAC receives Medals.

On 5 September, a special ceremony was held at the CaixaForum Madrid to celebrate the accreditation of Severo Ochoa and María de Maeztu centers. Presided over by the Minister of Science, Innovation and Universities, Diana Morant, the ceremony recognised excellence in research. Francisco J. García Vidal and Rubén Pérez, the former and current directors of IFIMAC, received medals in recognition of the institute's second (2018) and third (2023) accreditations.



IFIMAC Day, 2024

At this year's IFIMAC Day, Juan Carlos Cuevas shared his groundbreaking research on heat transfer at the nanoscale and explored its potential to drive advances in nanotechnology. In addition, Celia Polop gave an insightful presentation on the innovative energy materials being developed at our centre, highlighting their role in shaping sustainable energy solutions and cutting-edge applications.

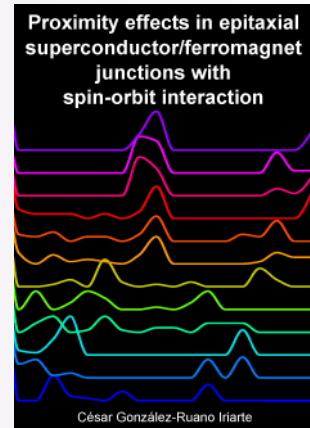
The afternoon featured a thought-provoking round table on knowledge transfer, titled *Could We Do More at IFIMAC?*, led by Félix Zamora. After lunch, the event continued with a poster session, providing an excellent platform for young researchers to share their work and networking.

Watch on  YouTube

AWARDS

IEEE Magnetics Society, 2023

César González-Ruano Iriarte was awarded in the third edition of the Prize for the Best Doctoral Thesis for his thesis entitled "Proximity effects in epitaxial superconductor/ferromagnet junctions with spin-orbit interaction" of the "Magnetism, Magnetic Materials and their Applications" of 2023, by the Spanish Section of the IEEE Magnetics Society.



UAM Young Scientist Award 2023

Carlos Antón Solanas has been awarded the UAM Young Scientist Award in the Experimental Sciences category. Carlos currently forms part of the SemicUAM group at the UAM, and this award highlights his contributions to the field of quantum light-matter interactions.

Carlos joined IFIMAC in 2022 and has since built up a research line on single photon emitters and cavity-coupled light sources. He has also been awarded with BBVA Leonardo Fellowship and the Ramon Areces Grant (Ayudas a la Investigación en Ciencias de la Vida y de la Materia)

ERC Starting Grant, 2024

Pablo Ares García has been awarded an ERC Starting Grant 2024, one of 494 grants awarded by the European Research Council to early-stage researchers (out of 3474 proposals submitted). Pablo's research project, HeaT2Defects, aims to investigate the effect of atomic-level defects in two-dimensional materials, such as graphene, on heat transport. **See page 3 for more details**

Juan de la Cierva, 2023

Jae Hwan Jeong has been awarded a Juan de la Cierva fellowship. This grant is designed to support young researchers who hold a PhD, enabling them to further their postdoctoral research at Spanish R&D centers. The award is part of a broader initiative to foster the development of scientific talent by providing these researchers with the opportunity to gain valuable experience and contribute to the advancement of research in Spain.

Nicolás Cabrera Institute (INC) Young Researchers 2024

Congratulations to the following students who have won research awards:

Marcos Jiménez Larroy, Daniel Ruano Medina, Marcos Puerto Matías, Lara Suárez García, Juan Manuel González Monges, Alejandro Cabanelas Serrano, Andrea Herrero Otermin, Bruno Pérez Gómez, Adolfo Menéndez Rua, Daniel Santiso Herrero & Raquel Calvo Marín.

OUTREACH

Europeans Researchers Night 2024

IFIMAC contributed to the event with its activity, "Cryolaboratory – Exploring the Wonders of Extreme Cold," which was led by a dedicated team of researchers and students: Edwin Herrera, Héctor González, Pablo García, José A. Moreno, Óscar Bou, Paula Obladen, José David Bermúdez, Miguel Águeda, and Jaime Rumeu.

The attendees observed how objects transformed when exposed to liquid nitrogen. The activity demonstrated the principles of flash freezing and provided insights into the states of matter. Participants investigated also how cryogenics has revolutionized transport through superconducting magnetic levitation and examined the properties of dry ice, observing its sublimation process.



XXIV Madrid Science and Innovation Week

IFIMAC hosted two workshops for the public:

"La Buena Onda": The workshop, led by Elena del Valle, Arianna Barreto, and Sofía Quiñonez, introduced participants to the physics of light and sound through the use of musical instruments, water, strings, ropes, and other materials. This approach enabled the creation of waves, which in turn facilitated an understanding of how waves behave in different media and provided insights into the world around them.

"CrioPresiónLab: Exploring the Power of Extreme Cold and Pressure Changes" with Héctor González, Edwin Herrera, Paula Obladen, Jaime Rumeu, José David Bermúdez and Teresa García was designed for high school students. The participants observed the effects of low temperatures, conducted experiments with superconductors, and observed changes in states of matter and gas dynamics with the use of dry ice and liquid nitrogen. Additionally, they employed a vacuum cannon to accelerate a table tennis ball to a velocity approaching that of sound.



"Cuéntame 11F" - Interview with Upasana Das

In the episode of Cuéntame 11F, Upasana Das offers insights into the field of nanoscale energy transport. As a doctoral candidate at IFIMAC, Upasana concentrates her research efforts on the transport of charges within nanostructured materials, with a particular focus on the impact of nanoscale disorder on the dynamics of energy charges.



Watch on  YouTube

OUTREACH

Project - Cultural Transfer Grant 2024 from UAM

We recently held a series of condensed matter physics workshops with fifth and sixth-grade students at CEIP Príncipe de Asturias in Cantoblanco, supported by the 2024 Cultural Transfer Grant from UAM. The initiative, titled **"Exploring Condensed Matter Physics from Príncipe de Asturias School: Science Workshops with IFIMAC"**, aimed to enhance our outreach efforts and establish a new connection with the primary education community in the Community of Madrid (CAM).

This pilot program at CEIP Príncipe de Asturias featured five engaging workshops: 1. The Scientific Method, a Great Ally!, 2. What is Matter Made Of? 3. Laws of Motion, 4. Where Does Color Come From?, and 5. Science Gives You Wings.

We are grateful to the team for their dedication in carrying out this project: Diego Martín Cano (PI), Fabrice Leardini, Linda Angela Zotti, Sofía Usandizaga García, Carlos Roldán Piñero, Antonio Miguel Bosch Fernández, Miguel Ángel Martínez García, Antonio. I. Fernández Domínguez, Salvatore Assenza, Ferry Prins, Amalia Coro González, Antonella Cutrupi, Upasana Das, Enrique Arevalo Rodríguez, Emma Fierro López, Emma López Ortín, Juan Rodríguez Lorente & Pablo Vaquer De Nieves.



IDEO school visits IFIMAC

We received a visit from the IDEO school. Isabel Guillamón and Edwin Herrera welcomed first year Bachillerato students to introduce them to the fascinating world of atoms and Scanning Tunneling Microscopy (STM). The students learned about the evolution of research in the field, explored semiconductors through a series of experiments, and visited several laboratories in the Condensed Matter Physics Department at IFIMAC. Researchers Hector González, Beatriz Viña, José David Bermúdez, Diego Expósito, Pablo García, Roberto Carrasco, José Antonio Moreno and Óscar Bou shared their research experiences in this field and explained more details about their projects.





Interviews with the speakers and their colloquium talk can be found in our YouTube channel.



The
IFIMAC
Colloquium brings
together leading
experts from different
areas of research in
condensed matter
physics.



Mircea Dincă, Oct 11th:
"From electrically Conductive
MOFs to sustainable batteries"



Javier García de Abajo, Dec 17th:
"Quantum nanophotonic
with free electrons"

In the first half of 2024, we organized five colloquia covering a range of exciting topics within the field of condensed matter physics. These talks featured leading experts who shared their latest research and insights:

Maia Vergniory, Donostia International Physics Center, Spain.
Topology Is Everywhere. 16th February, 2024.

Susana Huelga, Institute of Theoretical Physics and IQST, Universität Ulm, Germany.
Coherent Effects in Biological Processes: A Case Study in the Dynamics and Response of Open Quantum Systems. 13th March, 2024.

Florian Marquardt, Max Planck Institute for the Science of Light, Erlangen, Germany.
Better Quantum Technologies via Machine Learning. 19th April, 2024.

Vahid Sandoghdar, Max Planck Institute for the Science of Light & Max-Planck-Zentrum für Physik und Medizin, Erlangen, Germany.
On single photons and single molecules: from nano-quantum optics to nanobiophotonics. 10th May, 2024.

Ludovic Berthier, Director of research at CNRS, Laboratoire Charles Coulomb, Université de Montpellier, Physics, France.
Is Glass a State of Matter? 31st May, 2024

Interviews with the speakers were conducted by Beatriz María Viña Bausá, Anna Luisa Römling, Diego Fernández de la Pradilla Viso, José Antonio Moreno.

PARTICIPATION IN EVENTS

The XXXIX RSEF Physics Biennial. 15 - 19 July, San Sebastian (ES). Linda A. Zotti and Salvatore Assenza organized the symposium "Molecular Biophysics". Hector González Herrero (Ifimac), Daniel Martín Jiménez (ICMAB) y Ana Pérez Rodríguez (Universidad de Salamanca) organized the symposium "Scanning probe microscopies: a tool to understand and fabricate materials for future electronics". Pablo Palacios (UPM), Celia Polop (UAM), & Ferry Prins (UAM) organized the symposium "Energy transition: materials, technologies and sustainability".

XXXI International Summer School Nicolás Cabrera "Energy Storage Systems to face the Climate Challenge: Sustainable development of Li ion batteries". 2-6 September 2024. Organized by Carmen Morant & Celia Polop. (Link)

Sino-Spanish Symposium on Advanced Materials for Nanotechnology and Optoelectronics. 1-5 October, La Cristalera, Madrid (ES). Organizing committee: Daniel Jaque García, Miguel Manso, Félix Zamora, Rubén Pérez, José Alemán, Miguel Ángel Ramos & Celia Polop. (Link)

2nd Spanish Soft Matter 1 1/2 days. 3 - 6 November, Benasque, Spain. Organized by J. L. Aragonés (IFIMAC-UAM), L. Rodríguez Arriaga (IFIMAC-UAM), A. Fernandez- Nieves (UB-ICREA) and M. Ruiz-García (UCM). (Link)

Nicolás Cabrera Institute (INC) Young Researchers Meeting. 13 December 2024. Organized by Jaime Merino, Patricia Haro and Edwin Herrera. (Link)

Congratulations to the following students who have won research awards:

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UPCOMING EVENTS

GEFES 2025 - January 29 - 31 Oviedo, Spain. At the Palacio de Exposiciones y Congresos. This biennial gathering promises to be a valuable platform for sharing ideas and exploring the latest developments in the field. (Link)

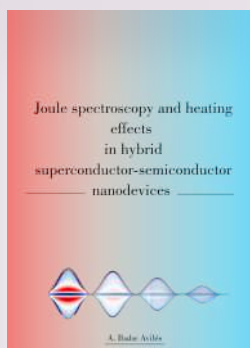
Workshop: "European Workshop on Battery Interfaces: High-Resolution Techniques and Multiscale Modelling"- April 3-4, Universidad de Córdoba, Spain
Scientific committee: Elixabete Ayerbe, Qiong Cai, Daniel Rettenwander, Peter Siffalovic, Gustavo de Miguel, Rafael Trócoli Jiménez. (Link)

Fuerzas y Túnel 2025 - July 8 - 11 Oviedo, Spain. This conference is a biennial event that brings together the national and international scientific community to discuss the latest developments in scanning probe microscopy (SPM). Scientific committee: Jonathan Rodríguez Fernández (UNIOVI), Eider Berganza Eguiarte (ICMM-CSIC), Mercedes Hernando Pérez (IFIMAC-UAM), Bruno de la Torre Cerdeño (CINN; CSIC-UNIOVI-PA), Dimas G. de Oteyza (CINN; CSIC-UNIOVI-PA). (Link)

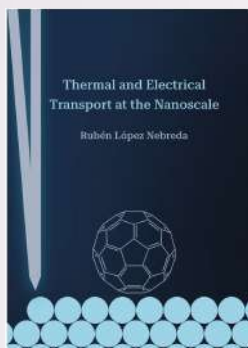
MAGNONICS2025 conference - July 28th - August 1st, Mallorca, Spain. This conference brings together researchers from academia, industry and national laboratories working in magnonics to exchange ideas and form collaborations. (Link)

International Conference on Low Temperature Physics - August 7 - 13. 15 January 2025 deadline for the two awards Lounasmaa and IUPAP young scientist. Follow LT30 on the social networks (X, BlueSky and In). (Link)

Recent PhD theses



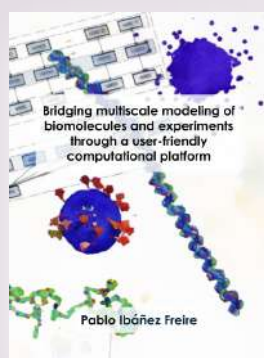
Ángel Ibabe Avilés
28 June 2024



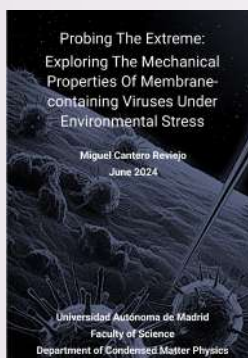
Rubén López Nebreda
12 July 2024



Maª Jesús Rodríguez Espinosa
19 July 2024



Pablo Ibañez Freire
20 September 2024



Miguel Cantero Reviejo
18 October 2024

**NEW
ARRIVALS**

PhD students

Guzmán Orero Gámez. Advisor: Saül Vélez Centoral.
Joan Ronquillo Tutiven. Advisors: Rafael Delgado Buscalioni and Manuel Marqués Ponce.
Juan V. Vidal Martínez-Pons. Advisor: Carlos Antón Solanas.
Miguel Verde. Advisor: Paloma Arroyo Huidobro.
Pablo Díez Silva. Advisors: Rafael Delgado Buscalioni and Manuel Marqués Ponce.
Pablo Hernández Martín. Advisor: Celia Polop Jordá.
Pablo Vaquer de Nieves. Advisors: Carlos Antón Solanas and Ferry Prins.
Teresa Espinosa González. Advisor: Laura Rodríguez Arriaga.

Postdoctoral researchers

Simon Solari. Supervisor: Ferry Prins.
Thomas Allard. Supervisor: Paloma Arroyo Huidobro.

Senior researchers

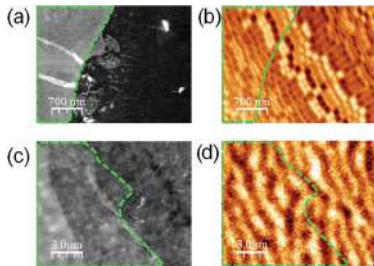
Guillermo López-Polín Peña. Ramón y Cajal Fellow.

Technical support

Julián Olivares Fernández y Rosa M. Collado - laboratory.

RESEARCH HIGHLIGHTS

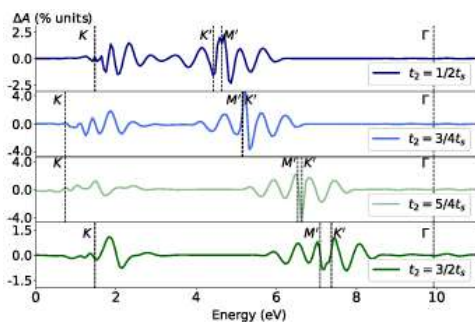
Magnetic Field Screening of 2D Materials Revealed by Magnetic Force Microscopy



Using Magnetic Force Microscopy, a team led by Guillermo López-Polín, Pablo Ares and ICM researchers shows that 2D materials like graphene provide minimal magnetic field screening ($\sim 0.5\%$ per layer), while graphene oxide and MoS_2 show negligible effects. These properties make 2D materials ideal for protecting nanostructures in data storage and spintronics.

doi.org/10.1002/aelm.202400607

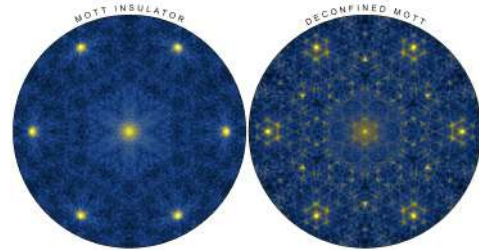
Topological phase transitions via attosecond x-ray absorption spectroscopy



A numerical study led by Antonio Picón reveals that attosecond x-ray absorption spectroscopy can capture topological phase transitions in Chern insulators. Using ultrafast IR pump and x-ray probe pulses, laser-induced spectra reveal signatures tied to the system's Berry structure, advancing topological material studies.

doi.org/10.1088/1361-6633/ad889f

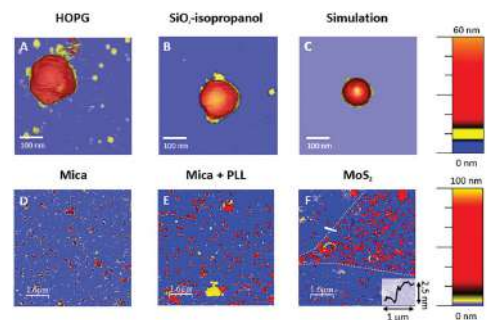
Electron delocalization in a 2D Mott insulator



A team led by Amadeo Lopez Vazquez de Parga have observed a quantum Kondo lattice in a 2D Mott insulator on a metallic substrate below 11K. This discovery reveals how delocalized Mott electrons interact with substrate conduction electrons, forming a shared Fermi surface and introducing new system periodicity.

doi.org/10.1038/s41467-024-54747-4

Broad Adaptability of Coronavirus Adhesion Revealed from the Complementary Surface Affinity of Membrane and Spikes



A collaboration between Rafael Delgado Buscalioni and Pedro J. de Pablo reveals the virus adhesion adaptability of transmissible gastroenteritis coronavirus (TGEV). Atomic force microscopy shows deformation of 20-50% depending on surface interactions. Modeling highlights complementary adsorption affinities of the envelope and spikes, influencing adhesion energy.

doi.org/10.1002/advs.202404186

and
more

**For the following newsletter we would love to hear from you:
outreach.ifimac@uam.es**

**We invite you to fill in the
intranet form for any news
related to your research**

Composition Committee:

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Alexander Kuvshinov

Gregorio Martínez García

Fernando

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