Instituto Universitario de Ciencia de Materiales Nicolás Cabrera

Activity Report 2016

INSTITUTO NICOLÁS CABRERA

Campus Internacional excelencia UAM CSIC

UAM UNIVERSIDAD AUTÓNOMA DE MADRID

FACULTAD DE CIENCIAS

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Welcome

Dear reader:

This year's Summer School, entitled "The Physics of Biological Systems: From Biomolecular Nanomachines to Tissues and Organisms" was successfully organized by Raúl Guantes, David G. Míguez and Victor Muñoz. The speakers were again of top level and the FBBVA covered the event with several interviews. We all thank the organizers for their efforts and we all look forward to the next summer school, entitled "Quantum transport in Topological Materials" and organized by Eduardo Lee, Elsa Prada and Alfredo Levy Yeyati. Speakers have been confirmed and include some of the major players in the condensed matter approach to quantum technologies. The subject is thus very timely and promises to promote, again, the participation of members of the INC in a European excellence initiative.

We have also organized four colloquia and our students have benefitted from the interaction with the speakers. This years prize for Young researchers has been particularly difficult to choose. Among all the outstanding contributions, there were two publications in very high impact factor journals (Science and Nature Materials). This just shows that the overall level of our work increases. We thank all participants and their tutors for submitting their applications to this prize. We look forward to see soon again many papers and excellent students competing for this award, whatever the impact factor of the journal has been.

We start the New Year with the challenge to support excellence Science in our environment. This is not always easy, because not everybody understands that excellent Science is as an intrinsic quality of a modern University. The Institute contributes to support excellent Science through several activities. This year, we will organize again grants for undergraduates, prizes for PhD students, and we will continue disseminating our publications through our web page. As always, it is important that we remember to write the affiliation section of our papers, including all relevant information and in particular the INC. As a novelty, we will organize a new prize for the technical staff, dedicated to those who provide the service we need to make excellent Science, but who are not mentioned as co-authors. As mentioned in our code of conduct in research, being coauthor of a scientific paper implies three main conditions which include being capable to present in detail the personal contribution to the research and to discuss the main aspects of the research as a whole. Technicians are automatically excluded from many contributions presenting topical scientific results. Their work and, above all, their capacity to provide *service* to scientists, is however fundamental to make competitive publications.

Finally, I would like to acknowledge the FBBVA which generously supports the Summer School. This year, we have signed a new contract with FBBVA that guarantees funding of the next three Summer Schools. It is our duty to participate in these events and make them as successful as possible, by focusing on excellent Science.

Hermann Suderow

Director del INC

Nicolás Cabrera Summer School

The Nicolás Cabrera Summer School takes place since 1994, with the support of the program "Frontiers of science and technology" of the BBVA Foundation since 2002.

FBBVA made a press release that can be downloaded here.

The 2016 Summer School, entitled "The Physics of Biological Systems: From Biomolecar Nanomachines to Tissues and Organisms" was directed by Rául Guantes, David G. Miguez y Victor Muñoz, and took place from 10-15 July 2016 in Miraflores de la Sierra. The main objective of the school was to provide as complete a vision as possible of the most recent experimental advances in Biophysics as well as an integrative perspective on Physicists approximations to some of the most interesting open problems in Biology. To this end, the organizers invited a small group of excellent researchers who have developed their career working at the interface of both disciplines. Experts with knowledge in the fields ranging from the manipulation and study of individual molecules to the specialization of cells in tissues and organisms.

The School worked through the following themes:

- The Physics of Biomolecules and Molecular Complexes
- Physical principles of biological networks.
- Physics of tissues and organisms.

The school was held in the residence of the UAM "La Cristalera" as every year. In total, 25 students attended the school, mostly from different Spanish Universities and centers (UAM, National Center for Biotechnology, Carlos III University, University of Barcelona, IMDEA Nanociencia, Institute of Microelectronics, Andalusian Center for Developmental Biology), but also from Germany, the Netherlands, Pakistan, China, India, Iran and the United Kingdom. Among the students there were physicists as well as biologists, biotechnologists and engineers.

The lectures covered topical subjects. Lecturers were available throughout the school and students were able to enjoy a relaxed work climate to interact with them. Numerous informal discussions were held. As a result, new scientific relationships were established between participating groups.

Throughout the development of the school there was a very high participation of all attendees, including doctoral students, asking frequent questions to teachers during their classes. This interaction increased during the three poster sessions held on Mondays, Tuesdays and Thursdays afternoons after the presentations.

The evaluation of the participants, conducted through personal interviews, has been very positive and the success of the format of the guest classes (two 50-minute talks each) has been visible in the mood and comments of the students. Lecturers first made a pedagogical talk, explaining the basic fundamentals of his field of work, and then an advanced talk about the main novel results of their laboratories, many of them not yet published. This has enabled lively discussions around the most topical novelties, disclosed to the students during the Summer School.

Another successful initiative were the poster sessions, where the students attending the School presented their work and discussed it with peers and with the invited speakers. Among all the works presented, speakers choose one fro a prize for the best poster presented at the School.

Speakers list:

Jordi García Ojalvo (U Pompeu-Fabra, Barcelona, España)

James Briscoe (The Francis Crich Institute, London, UK)

Thomas Gregor (Princenton University, USA)

Alfonso Martínez-Arias (U of Cambridge, UK)

Pieter Rein ten Wolde (AMOLF, Amsterdam, Nederland)

Jané Kondev (BrandeisUniversity, USA)

Kirill Korolev (Boston University, USA)

Edo Kussell (New York University, USA)

Lingchong You (Duke University, USA)

José Onuchic (Rice University, USA)

William A. Eaton (National Institutes of Health, USA)

Devarajan Thirumalai (University of Texas Austin, USA)

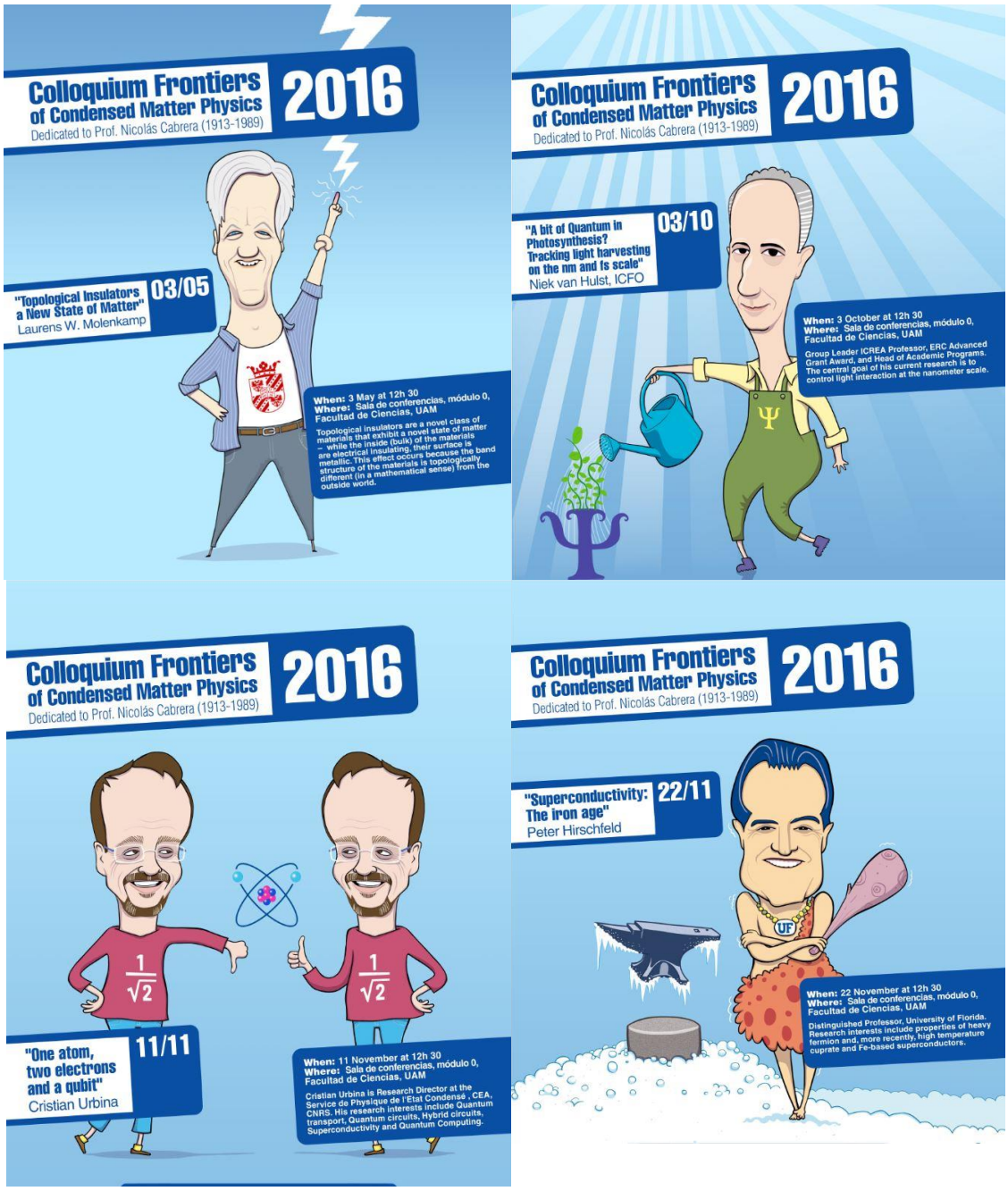
George Lorimer (University of Maryland, USA)

Yann Chemla (University of Maryland, USA)

Group photo at Miraflores de la Sierra.

Coloquia

During 2016 we continued with the colloquia “Frontiers in Condensed Matter Physics”, thanks to the collaboration of FBBVA. The colloquia are dedicated to the memory of Professor Nicolás Cabrera. This year, we received **Laurens W. Molenkamp** with the talk “*Topological Insulator a New State of Matter ”,* **Niek van Hulst** with the talk “*A bit of Quantum in Photosynthesis? Tracking Light-Harvesting on the nm & fs Scale,*” **Cristian Urbina** who spoke about “*An atom, a Cooper pair, a Qubi*” and **Peter Hirschfeld,** who explained “*Superconductivity, The Iron Age*”. UAM students and Young researchers value positively the colloquia, which will be continued during 2015.

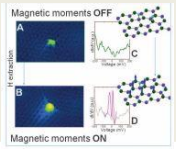


Science at INC

The articles of the INC members can be found on the Institute's website. We mention below some publications that we have highlighted:

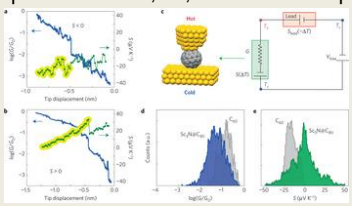
Atomic-scale control of graphene magnetism by using hydrogen atoms, H. Gonzalez Herrero, JM Gómez Rodríguez, P. Mallet, M. Moaied, JJ Palacios, C. Salgado, MM Ugeda, JY. Veuillen, F. Yndurain, I. Brihuega, Science **352**, 437, (2016).

Isolated hydrogen atoms absorbed on graphene are predicted to induce magnetic moments. Here we demonstrate that the adsorption of a single hydrogen atom on graphene induces a magnetic moment characterized by a similar to 20-millielectron volt spin-split state at the Fermi energy. Our scanning tunneling microscopy (STM) experiments, complemented by first-principles calculations, show that such a spin-polarized state is essentially localized on the carbon sublattice opposite to the one where the hydrogen atom is chemisorbed.



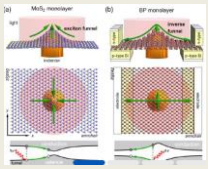
Molecular design and control of fullerene-based bi-thermoelectric materials, L. Rincón García, A.K. Ismael, C. Evangeli, I. Grace, G. Rubio-Bollinger, K. Porfyrakis, N. Agraït, C.J. Lambert, Nature Materials, **15**, 289, (2016).

Molecular junctions are a versatile test bed for investigating nanoscale thermoelectricity and contribute to the design of new cost-effective environmentally friendly organic thermoelectric materials11. It was suggested that transport resonances associated with discrete molecular levels could play a key role in thermoelectric performance12, 13, but no direct experimental evidence has been reported.



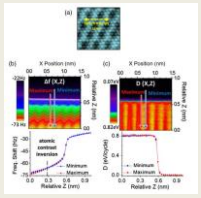
Inverse Funnel Effect of Excitons in Strained Black Phosphorus, P. San José, V. Parente, F. Guinea, R. Roldan, E. Prada, Physical Review X, **6**, 031046, (2016).

We study the effects of strain on the properties and dynamics of Wannier excitons in monolayer (phosphorene) and few-layer black phosphorus (BP), a promising two-dimensional material for optoelectronic applications due to its high mobility, mechanical strength, and strain-tunable direct band gap. We compare the results to the case of molybdenum disulphide (MoS2) monolayers. pushed away from said regions



Atomic-Scale Variations of the Mechanical Response of 2D Materials Detected by Noncontact Atomic Force Microscopy, B. de la Torre, M. Ellner, P. Pou, N. Nicoara, R. Pérez y J.M. Gómez-Rodríguez, Physical Review Letters **116**, 245502, (2016).

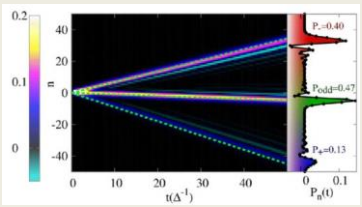
We show that noncontact atomic force microscopy (AFM) is sensitive to the local stiffness in the atomic-scale limit on weakly coupled 2D materials, as graphene on metals. Our large amplitude AFM topography and dissipation images under ultrahigh vacuum and low temperature resolve the atomic and moiré patterns in graphene on Pt(111), despite its extremely low geometric corrugation



Physical Review Letters
moving physics forward

Andreev Bound States Formation and Quasiparticle Trapping in Quench Dynamics Revealed by Time-Dependent Counting Statistics, R. Seoane Souto, A. Martín-Rodero, A. Levy Yeyati, Physical Review Letters 117, 267701, (2016).

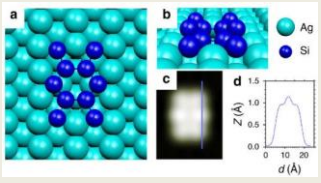
We analyze the quantum quench dynamics in the formation of a phase-biased superconducting nanojunction. We find that in the absence of an external relaxation mechanism and for very general conditions the system gets trapped in a metastable state, corresponding to a nonequilibrium population of the Andreev bound states.



Physical Review Letters
moving physics forward

Unveiling the pentagonal nature of perfectly aligned single-and double-strand Si Nao-ribbons on Ag(110), J.I. Cerdá, J. Slawinska, G. Le Lay, A. C. Marele, J.M. Gómez-Rodríguez, M. E. Dávila, Nature Communications, **7**, 13076m (2016).

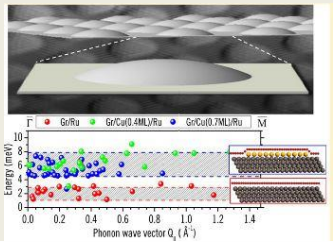
Carbon and silicon pentagonal low-dimensional structures attract a great interest as they may lead to new exotic phenomena such as topologically protected phases or increased spin–orbit effects. However, no pure pentagonal phase has yet been realized for any of them.



nature COMMUNICATIONS

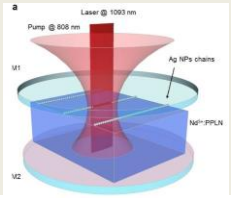
Observation of Localized Vibrational Modes of Graphene Nanodomes by Inelastic Atom Scattering, D. Maccariello, A. Al Taleb, F. Calleja, A.L. Vázquez de Parga, P. Perna, J. Camarero, E,. Gnecco, D. Farías, R. Miranda, Nano Letters **16**, (1), 2, (2016).

Inelastic helium atom scattering (HAS) is suitable to determine low-energy (few meV) vibrations spatially localized on structures in the nanometer range. This is illustrated for the nanodomes that appear often on graphene (Gr) epitaxially grown on single crystal metal surfaces.



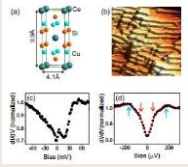
Plasmon-Assisted Nd^{3+} -Based Solid-State Nanolaser, P. Molina, E. Yraola, M. O. Ramírez, C. Tserkezis, J.L. Plaza, J. Aizpurua, J. Abravo-Abad, L. E. Bausá, Nano Letters **16**,895, (2016).

Solid-state lasers constitute essential tools in a variety of scientific and technological areas, being available in many different designs. However, although nanolasing has been successfully achieved for dyes and semiconductor gain media associated with plasmonic structures, the operation of solid-state lasers beyond the diffraction limit has not been reported yet.



Superconducting gap and vortex lattice of the heavy-fermion compound $CeCu_2Si_2$, M. Enayat, Z. Sun, A. Maldonado, H. Suderow, S. Seiro, C. Geibel, S. Wirth, F. Steglich, P. Wahl, Physical Review B **93**, 045123, (2016).

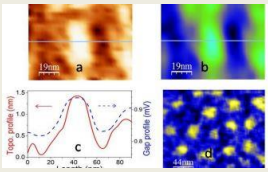
The order parameter and pairing mechanism for superconductivity in heavy-fermion compounds are still poorly understood. Scanning tunneling microscopy and spectroscopy at ultralow temperatures can yield important information about the superconducting order parameter and the gap structure. Here, we study the first heavyfermion superconductor, CeCu2Si2. Our data show the superconducting gap which is not fully formed and exhibits features that point to a multigap order parameter.



Fermionic scenario for the destruction of superconductivity in ultrathin MoC films evidenced by STM measurements, P. Szabó, T. Samuely, V. Hasková, J. Kacmarcik, M. Zemlicka, M. Grajcar, J.G. Rodrigo, P. Samuely, Physical Review B **93**, 014505, (2016).

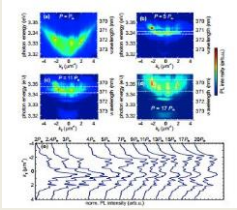
We use sub-Kelvin scanning tunneling spectroscopy to investigate the suppression of superconductivity in homogeneously disordered ultrathin MoC films. We observe that the superconducting state remains spatially homogeneous even on the films of 3-nm thickness. The vortex imaging suggests the global phase coherence in our films

Physical Review B
condensed matter and materials physics



Cavity polariton condensate in a disordered environment, M. Thunert, A. Janot, H. Franke, C. Sturm, T. Michalsky, M.D. Martín, L. Viña, B. Rosenow, M. Grundmann, R. Schmidt-Grund, Physical Review B **93**, 064203, (2016).

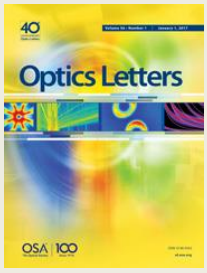
We report on the influence of disorder on an exciton-polariton condensate in a ZnO-based bulk planar microcavity and compare experimental results with a theoretical model for a nonequilibrium condensate. Experimentally, we detect intensity fluctuations within the far-field emission pattern even at high condensate densities, which indicates a significant impact of disorder.

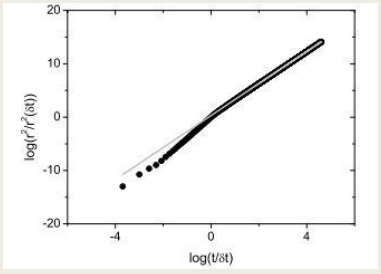


Physical Review B
condensed matter and materials physics

Dynamics of small particle in a fluctuating random light field, M.I. Marques, Optics Letters **41**, 796, (2016).

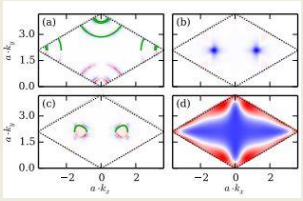
The dynamics of an electric dipole in a light field consisting of electromagnetic plane waves with polarizations randomly distributed and fluctuating phases is theoretically analyzed. The expression for the optical random-force fluctuations is derived and found to be proportional to the scattering cross section and to the square of the intensity divided by the frequency of the electromagnetic field.





Orbital Magnetic susceptibility of graphene and MoSe, A. Gutiérrez-Rubio, T. Stauber, G. Gómez-Santos, R. Asgari, F. Guinea, Physical Review B **93**, 085133, (2016).

We calculate the orbital magnetic susceptibility χ_{orb} for an 8-band tight-binding model of gapless and gapped graphene using Green's functions. Analogously, we study χ_{orb} for a **MoS_2** 12-band model. For both materials, we unravel the character of the processes involved in the magnetic response by looking at the contribution at each point of the Brillouin zone



Physical Review B
condensed matter and materials physics

Dynamic bonding of metallic nanocontacts: Insights from experiments and atomistic simulations, M.A. Fernández, C. Sabater, W. Dednam, J.J. Palacios, M.R. Calvo, C. Untiedt, M.J. Caturla, Physical Review B **93**, 085437, (2016).

The conductance across an atomically narrow metallic contact can be measured by using scanning tunneling microscopy. In certain situations, a jump in the conductance is observed right at the point of contact between the tip and the surface, which is known as “jump to contact” (JC). Such behavior provides a way to explore, at a fundamental level, how bonding between metallic atoms occurs dynamically

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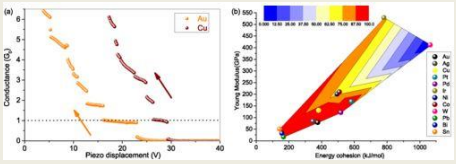
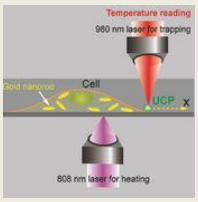


Thermal Scanning at the Cellular level by an Optically Trapped Upconverting Fluorescent Particle, P. Rodríguez-Sevilla, Y. Zhang, P. Haro-Gonzáles, F. Sanz-Rodríguez, F. Jaque, J. García Solé, X. Liu, D. Jaque, Advanced Materials **20**, 2421, (2016)

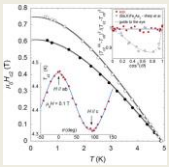
Photothermal treatment of cancer cells consists in a controlled heating above their physiological temperature (37 °C) by means of an external light source. Therapeutic effects of such heating arise from the activation of different biological, physical, and chemical phenomena that could result in permanent or temporal modifications at the cellular level.[1]



ADVANCED MATERIALS

Single-gap superconductivity in beta-Bi2pd, J. Kacmarcik, Z. Pribulová, T. Samuely, P. Szabó, V. Cambel, J. Soltys, E. Herrera, H. Suderow, A. Correa-Orellana, D. Prabhakaran, P. Samuely, Physical Review b **93**, 144502, (2016).

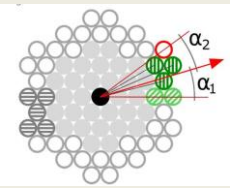
The *B*-Bi_2 Pd compound has been proposed as another example of a multigap superconductor [Imai et al., J. Phys. Soc. Jpn. 81, 113708 (2012)]. Here, we report on measurements of several important physical quantities capable of showing a presence of multiple energy gaps on our superconducting single crystals of β-Bi_2 Pd with the critical temperature



Physical Review B
condensed matter and materials physics

Collective effects of torsion in FtsZ filaments, P. González de Prado Salas, P. Tarazona, Physical Review E **93**, 04207, (2016)

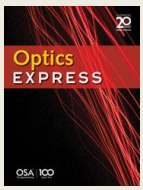
We study a one-dimensional interacting electronic liquid coupled to a 1D array of classical magnetic moments and to a superconductor. We show that at low energy and temperature the magnetic moments and the electrons become strongly entangled and that a magnetic spiral structure emerges.

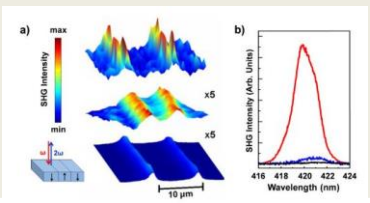


PHYSICAL REVIEW E
covering statistical, nonlinear, biological, and soft matter physics

Plasmonic enhancement of second harmonic generation from nonlinear RbTiOpO4 crystal by aggregates of silver nanostructures, L. Sánchez-García, C. Tserkezis, M. O. Ramírez, P. Molina, J.J. Carvajal, M. Aguiló, F. Díaz, J. Aizpurua, L.E. Bausá, Optics Express **24**, 8491, (2016).

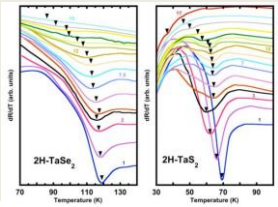
We demonstrate a 60–fold enhancement of the second harmonic generation (SHG) response at the nanoscale in a hybrid metal-dielectric system. By using complex silver nanostructures photochemically deposited on the polar surface of a ferroelectric crystal, we tune the plasmonic resonances from the visible to the near-infrared (NIR) spectral region, matching either the SH or the fundamental frequency.





Strong enhancement of superconductivity at high pressures within the charge-density-wave states of 2H-TaS2 and 2H-TaSe2,C.C. Freitas, P. Rodière, M.R. Osorio, E. Navarro-Moratalla, N.M. Nemes, V.G. Tissen, L. Cario, E. Coronado, M. García-Hernández, S. Vieira, M. Núñez-Regueiro, H. Suderow, Physical Review B **93**, 184512, (2016).

We present measurements of the superconducting and charge-density-wave (CDW) critical temperatures (T_c and T_{cdw}) as a function of pressure in the transition metal dichalchogenides 2H−$TaSe_2$ Resistance and susceptibility measurements show that T_c increases from temperatures below 1 K up to 8.5 K at 9.5 GPa in 2H−TaS2 and 8.2 K at 23 GPa in 2H−TaSe2

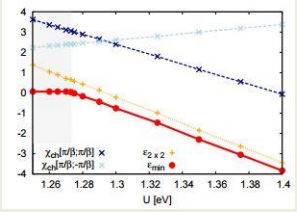


Physical Review B
condensed matter and materials physics

Parquet decomposition calculations of the electronic self-energy, O. Gunnarsson, T. Schäfer, J.P.F. LeBlanc, J. Merino, G. Sangiovanni, G. Rohringer, A. Toschi, Physical Review B **93**, 245102, (2016).

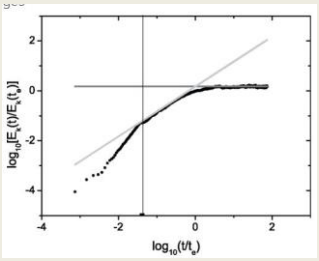
The parquet decomposition of the self-energy into classes of diagrams, those associated with specific scattering processes, can be exploited for different scopes. In this work, the parquet decomposition is used to unravel the underlying physics of nonperturbative numerical calculations.

Physical Review B
condensed matter and materials physics



Crossover from superdiffusive to diffusive dynamics in fluctuating light fields, M. I. Marques, Physical Review A **93**, 068315, (2016)

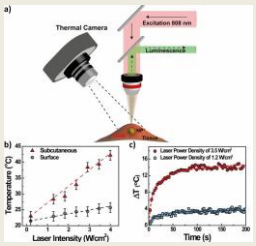
The expressions for the optical drag force, the equilibrium kinetic energy, and the diffusion constant of an electric dipole in a light field consisting of electromagnetic plane waves with polarizations randomly distributed and fluctuating phases are obtained. The drag force is proportional to the extinction cross section of the dipole and to the intensity.



PHYSICAL REVIEW A
covering atomic, molecular, and optical physics and quantum information

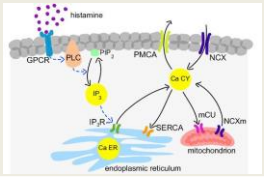
LaF3 core/shell nanoparticles for subcutaneous heating and thermal sensing in the second biological window, E.C. Ximendes, U. Rocha, K.U. Jumar, C. Jacinto, D. Jaque, Applied Physics Letters **108**, 253103, (2016).

We report on Ytterbium and Neodymium codoped LaF3 core/shell nanoparticles capable of simultaneous heating and thermal sensing under single beam infrared laser excitation. Efficient light-to-heat conversion is produced at the Neodymium highly doped shell due to non-radiative de-excitations. Thermal sensing is provided by the temperature dependent Nd3+ → Yb3+ energy transfer processes taking place at the core/shell interface.



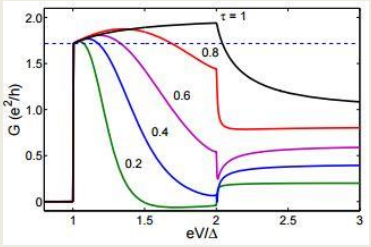
Cellular interrogation: Exploiting Cell-to-Cell variability to discriminate regulatory mechanisms in oscillatory signaling, J. Estrada, N. Andrew, D. Gibson, F. Chang, F. Gnada, J. Gunaward, PloS Computational Biology **12**, e1004945, (2016).

The molecular complexity within a cell may be seen as an evolutionary response to the external complexity of the cell's environment. This suggests that the external environment may be harnessed to interrogate the cell's internal molecular architecture. Cells, however, are not only nonlinear and non-stationary, but also exhibit heterogeneous responses within a clonal, isogenic population. In effect, each cell undertakes its own experiment



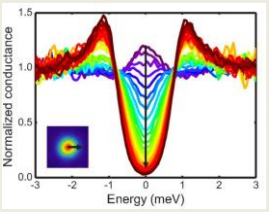
Low-energy theory of transport in Majorana wire junctions, A. Zazunov, R. Egger, A. Levy Yeyati, Physical Review B **94**, 014502, (2016).

We formulate and apply a low-energy transport theory for hybrid quantum devices containing junctions of topological superconductor (TS) wires and conventional normal (N) or superconducting (S) leads. We model TS wires as spinless p-wave superconductors and derive their boundary Keldysh Green's function, capturing both the Majorana end state and continuum quasiparticle excitations in a unified manner. We also specify this Green's function for a finite-length TS wire.



Field dependence of the vortex core size probed by scanning tunneling microscopy, A. Fente, E. Herrera, I. Guillamón, H. Suderow, S. Mañas-Valero, M. Galbiati, E. Coronado, V.G. Kogan, Physical Review B **94**, 014517, (2016).

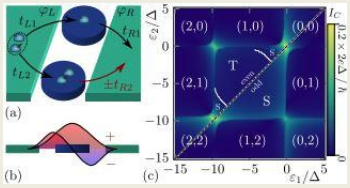
We study the spatial distribution of the density of states (DOS) at zero bias N(r) in the mixed state of single and multigap superconductors. We provide an analytic expression for N(r) based on deGennes' relationship between DOS and the order parameter that reproduces well scanning tunneling microscopy (STM) data in several superconducting materials. In the single gap superconductor β−Bi2Pd, we find that N(r) is governed by a length scale ξH=√ϕ0/2πH, which decreases in rising fields..



Physical Review B
condensed matter and materials physics

Signature of nonlocal Cooper-Pair transport and of a single-triplet transition in the critical current of a double-quantum-dot josephson junction, B. Probst, F. Dominguez, A. Schroer, A. Levy Yeyati, P. Recher, Physical Review B **94**, 155445, (2016).

We study the critical Josephson current flowing through a double quantum dot weakly coupled to two superconducting leads. We use analytical as well as numerical methods to investigate this setup in the limit of small and large bandwidth leads in all possible charging states, where we account for on-site interactions exactly. Our results provide clear signatures of nonlocal spin-entangled pairs, which support interpretations of recent experiments [Deacon, R. S. et al., Nat. Commun.



Physical Review B
condensed matter and materials physics

Shot noise in magnetic tunneling structures with two-level quantum dot , T. Szczepanski, V.K. Dugaev, J. Barmas, I. Martinez, J.P. Cascales, J.Y.Hong, M.T. Lin, F. G. Aliev, Physical Review B **94**, 235429, (2016).

We analyze shot noise in a magnetic tunnel junction with a two-level quantum dot attached to the magnetic electrodes. The considerations are limited to the case when some transport channels are suppressed at low temperatures. Coupling of the two dot's levels to the electrodes are assumed to be generally different and also spin dependent. To calculate the shot noise we apply the approach based on the full counting statistics. The approach is used to account for experimental data obtained in magnetic tunnel junctions with organic barriers

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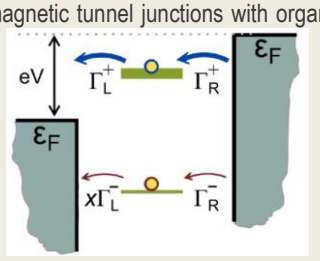

Physical Review B
condensed matter and materials physics

Young Researchers Meeting

The young researchers meeting 2016 was held in December in Miraflores de la Sierra with the participation of doctoral students of the INC in the residence La Cristalera. During the meeting the "Young researchers prize in materials science" award was presented, which this year, by decision of the jury, was granted ex aequo to Hector González Herrero for his work "Atomic-scale control of graphene magnetism by using hydrogen atoms" In collaboration with INC members José M. Gómez Rodriguez, Juan José Palacios, Felix Yndurain and Ivan Brihuega, and published in Science 352, 6284 (2016); and Laura Rincón García for her work Molecular Design and control of fullerene-based Bi-thermoelectric materials, carried out in collaboration with members of the INC Gabino Rubio-Bollinger and Nicolás Agraït and published in Nature Materials 15, 289, (2016). The jury, appointed by the Board of the INC and composed by professors Mrs. Luisa Bausa, Mr. Enrique García-Michel and Mr. Pedro Tarazona, met on November 30, 2016 to propose, among the participants and based on the rules of the prize, the winning candidates. The jury unanimously took its decision, after carefully analyzing the documentation submitted by the applicants, and took into account the quality of the work, the scientific prestige of the journals in which they have been published, and the fact that the candidates are the First signatories.

The jury expressed the excellent quality of the publications works presented by the applicants.

The lecturers, Héctor Gonzalez Herrero and Laura Rincón García, with the prizes awarded during the day.

During the meeting, the following conferences were also presented, and a poster session was organized that was very lively:

- *"Modifications of molecular structure and reactions under strong light-matter couplingr"* Javier Galego, (Departamento de Física Teórica de la Materia Condensada).

- *"Isolation of highly stable Antimonene under ambient conditions".* Pablo Ares (Departamento de Física de la Materia Condensada.

- *"Tunable plasmonic resonance of gallium nanoparticles by thermal oxidation at low temperatures"*, Sergio Catalán-Gómez (Departamento de Física Aplicada).

- *"Enhancement of the optical properties of* Yb^{3+} *doped* $RbTiOpO_4$ *by Ag aggregates"*, Laura Sánchez-García, (Departamento de Física de Materiales).

- *"Vortices in twp-effective-band, stoichiometric hight* $T_cCaKFe_4As_4$ *superconductor"*, Antón Fente (Departamento de Física de la Materia Condensada).

- *"Optical torques on upconverting particles for intracellular microtheometry",* Paloma Rodríguez-Sevilla , (Departamento de Física de Materiales).

- *"Order from Entropy",* Miguel González Pinto, (Departamento de Física Teórica de la Materia Condensada).

- *"Insights to understand superconductivity in valence-disproportionated systems" Invite Talk,* Paula Giraldo-Gallo National High Magnetic Field Laboratory, Tallahassee, FL, USA).

Seminars and stays

During 2016, we celebrated the following seminars:

Friday, June 17, 2016, **“"Patterning Functional Nanostructures by Focused Beams Induced by Processing"”,** Rosa Córdoba Castillo (Instituto de ciencia de Materiales de Aragón (ICMA), CSIC-Universidad de Zaragoza).

Thursday, June 23, 2016, **“Quantum oscillations studies in the ferromagnetic superconductor UCoGe and in the hidden order state of URu2Si2”,** Gaël Bastien, Univ. Greoble Alpes, INAC-SPSMS, F-38000 Grenoble, France

Friday, November 30, 2016**, “Upper critical field and pairing mechanism in ferromagnetic superonductor UCoGe”,** Belium Wu, Univ. Grenoble Alpes, CEA, INAC, SPSMS, Grenoble, France.

Wednesday, December 13, 2016, **Controlling magnetization dynamics in heterostructures with first-order phase transitions**, Juan Gabriel Ramirez, Departamento de Física, Universidad de los Andes

Awards for research work carried out by physics students

The Institute Nicolás Cabrera, and the Departments of Condensed Matter Physics, Theoretical Physics of Condensed Matter and Materials Physics, in order to attract physics students to the research groups and to disseminate the scientific work of the members of the Institute, awarded four prizes for physics students, who carried out a research work. The students worked with members of the Institute. They learned the work we develop in our research, and presented their work during the Young Researchers Meeting. Some of these students are already working in the Institute's laboratories. The students who won the award have been:

- Alvarado Herrero, Miguel: “Andreev bound states coupled to a mechanical mode: A theoretical model”
- Robledo Moreno, Javier: “Spin waves in low dimensional systems”.
- López Pastor, Victor J.: “First principle simulations of gravity-like interactions induced by radiation ".
- Expósito Gascueña, Diego: “Design and construction of a RT-UHV STM chamber: Measuring the low reactivity of graphene”.

Publications

E. Yraola, L. Sanchez García, C. Tserkezis, et al:
Polarization-selective enhancement of Nd3+ photoluminescence assisted by linear chains of silver nanoparticles.
Journal of Luminescence **169**, 569, (2016).

A. Kaminska, A. Kozanecki, M.O. Ramirez, et al:
Spectroscopic study of radiative intra-configurational 4f -> 4f transitions in Yb3+doped materials using high hydrostatic pressure.
Journal of Luminiscence **169**, 507, (2016).

D. Maccariello, A. Al Taleb, F. Calleja, et al:
Observation of localized Vibrational Modes of Graphene Nanodomes by Inelastic Atom Scattering
Nano Letters **16**, 2, (2016).

E.C. Ximendes, U. Rocha, C. Jacinto, et al:
Self-monitored photothermal nanoparticles based on core-shell engineering.
Nanoscale **8**, 3057, (2016).

G. Anemone, E. Climent-Pascual, H.k, Yu, et al:
Quality of graphene on sapphire: long-range order from helium diffraction versus lattice defects from Raman spectroscopy
RSC Advances **6**, 21235, (2016)

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Quantum interference in a Cooper pair splitter: The three sites model.
Physical E-Low Dimensional Systems & Nanostructures **75**,322, (2016).

Y. Martinez-Raton, M. Gonzalez-Pinto, E. Velasco:
Biaxial nematic phase stability and demixing behaviour in monolayers of rod-plate mixtures.
Physical Chemistry Chemical Physics **18**, 24569, (2016).

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Tunable nanocrystalline CoFe2O4 isotropic powders obtained by co-precipitation and ultrafast ball milling for permanent magnet applications.
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Negative dissipation gradients in hysteretic materials
Nanoscale **8**, 16989, (2016).

A. Martin Recio, C. Romero Muñiz, P. Pou, et al:
Purely substitutional nitrogen on graphene/Pt(111) unveiled by STM and first principles calculations.
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Fermionic scenario for the destruction of superconductivity in ultrathin MoC films evidenced by STM measurements.
Physical Review B **93**, 014505, (2016).

M. Enayat, Z. Sun, A. Maldonado, et al:
Superconducting gap and vortex lattice of the heavy fermion compound CeCu2Si2.
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P. Molina, E. Yraola, M.O Ramirez, et al:
Plasmon-Assisted Nd3+Based Solid-State Nanolaser.
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L. Rincón-García, A.K. Ismael, C. Evangeli, et al*:*
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Physical Chemistry Chemical Physics **18**, 4547, (2016).

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S. Gutierrez-Rubio T. Stauber, G. Gomez-Santos, et al:
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We thank:
Antón Fente Hernández, Edwin Herrera and Jose Benito Llorens for their work in taking videos.

Mariola Ramírez and Jorge Bravo for the organization of the young researchers meeting

To the La Cristalera personnel, directed by Ana Martínez

The design of the announcements of the colloquia is made by Pablo Matera and Eduardo Ramos.
Eugenio Hernández Barcala is charged of our web page.