SYES 1: Spain as Guest of Honor

The 'Guest of Honor' Symposia celebrate the European physics community in general and the cooperation of the respective learned societies in particular. Thereby, the German Physical Society aims to further collaborations between individual scientists, research groups and institutions.

This year's 'Guest of Honor' Symposium honors the numerous ties between Spanish and German physicists by highlighting five fields of common interests.

Time: Wednesday 13:30–16:15 Location: Audimax 2

Invited Talk SYES 1.1 Wed 13:30 Audimax 2
DFMC-GEFES — •Julia Herrero-Albillos — Dpto. Ciencia y Tecn. de Materiales y Fluidos, Universidad de Zaragoza and Instituto de Nanociencia y Materiales de Aragón (CSIC-UNIZAR). Zaragoza, Spain

I will shortly present DFMC-GEFES* activities with special emphasis on its role in Spanish and European physics.

*DFMC-GEFES: División de Física de la Materia Condensada de la Real Sociedad Española de Física (http://gefes-rsef.org)

Invited Talk SYES 1.2 Wed 13:40 Audimax 2
Towards Phononic Circuits based on Optomechanics — •Clivia M. Sotomayor Torres — Catalan Institute of Nanoscience and Nanotechnology ICN2, Campus UAB, 08193 Bellaterra, Spain

The optomechanical (OM) interaction using suspended nanobeams where overlapping confined mechanical and optical modes coexist is chosen to realise phononic circuit elements. Room temperature mechanical quality factors reached Q > 103. We demonstrated a coherent phonon emitter at 0.3 GHz via self-pulsing and up to 5 GHz via dynamical back-action. The nanobeam is coupled evanescently via a tapered fibre either directly to the OM cavity or to an integrated photonic waveguide. The non-linear interactions can be controlled to reach a chaotic regime and, with an external laser, the coherent phonon emission can be modulated. The physics of synchronisation, of nanobeams coupled to optical waveguides and the coupling to surface acoustic waves to excite and detect phononic signals have been studied and reproducible functionalities demonstrated. We report on the successful integration of circuit elements in a proof-of-concept phononics chip.

Work in collaboration with D. Navarro-Urrios, M. Colombano, G. Arregui, J. Maire, N. Capuj, A. Griol, A. Martinez, J. Ahopelto, T. Makkonen, A. Pitanti, S. Zanotto, B. Djafari-Rouhani, Y. Pennec, D. Mencarelli and L. Pierantoni , partners of the EU H2020 FET Open project PHENOMEN (713450) www.phenomen-project.eu and G. Madiot

Invited Talk SYES 1.3 Wed 14:10 Audimax 2
Adding magnetic functionalities to epitaxial graphene — •Rodolfo Miranda — IMDEA Nanociencia, Madrid, Spain — Universidad Autónoma Madrid, Madrid, Spain

The intrinsic magnetic properties of pristine graphene are negligible, but we show here that, by either adsorption of suitable molecules or intercalation of heavy or magnetic metal atoms, one can i) create long range magnetic order in hybrid graphene systems, ii) introduce a giant spin-orbit coupling into the π bands of graphene or iii) produce chiral magnetic domain walls stabilized and protected by graphene even at 300 K.

i)A monolayer of TCNQ molecules on graphene grown on Ru(0001) acquire charge and a magnetic moment. The TCNQ monolayer develops spatially extended, spin-split, electronic bands and a magnetically ordered ground-state as visualized by spin-polarized STS. The long range magnetic order is due to direct exchange interaction mediated by overlapping frontier orbitals of the molecules.

ii)Pb-intercalated Graphene grown on Ir(111) develops a giant (70-100 meV) spin-orbit coupling in the π bands of graphene, as detected by spin-ARPES. The system is a suitable candidate for the observation of Spin Hall Effect in graphene

iii)Finally, epitaxial graphene/Co(111)/Pt(111) stacks grown on MgO(111) exhibit enhanced Perpendicular Magnetic Anisotropy for Co layers up to 4 nm thick and generate left-handed Néel-type chiral Domain Walls stabilized by interfacial DMI interaction. The magnetic texture, protected by graphene is stable at 300 K in air.

5-Minute Break

Invited Talk SYES 1.4 Wed 14:45 Audimax 2
Bringing nanophotonics to the atomic scale — •Javier Aizpurua — Center for Materials Physics in San Sebastian (CSIC-UPV/EHU), Spain

A plasmonic nanogap is a superb configuration to explore the interplay between light and matter. Light scattered off, or emitted from a nanogap carries the information of the surrounding electromagnetic environment with it. In metallic nanocavities with ultrasmall gaps, electron currents across the gap at optical frequencies efficiently produce a strong nonlinear optical response. All these effects can be further controlled when a bias is applied across the gap, enabling the possibility of active control of light emitted from the cavity. This situation becomes even more appealing when a molecule is located in the gap of the plasmonic cavity or in its proximity, with the molecule playing an active role either in the electromagnetic coupling with the cavity, or even participating in processes of charge injection and transfer, which can be revealed through molecular electroluminescence. Here, we will address situations of light emission in electron tunneling configurations where atomic-scale resolution is achieved due to the presence of picocavities within the gap. The process of interaction between a molecular emitter and a tunneling cavity will be addressed both in the weak and strong coupling regimes, as revealed in light absorption and in emission. Strong coupling between a molecule and a plasmonic cavity shows great technological potential as it produces hybrid molecule-cavity polaritonic states which can be used for quantum information or in induced chemical reactivity.

Invited Talk SYES 1.5 Wed 15:15 Audimax 2
Hydrodynamics of collective cell migration in epithelial tissues — •Jaume Casademunt — University of Barcelona - UBICS, Barcelona, Spain

Collective migration of cohesive groups of cells is a hallmark of the tissue remodeling events that underlie embryonic morphogenesis, wound repair and cancer invasion. In this collective migration, supra-cellular properties such as collective polarization or force generation emerge and eventually control large- scale tissue organization. This suggests that a coarse-grained approach based on a hydrodynamic description of tissues as continuous active materials may shed some light into our understanding of large-scale tissue dynamics. Specifically, an appealing open question is to what extent the complex biological regulation at play can be encoded in a series of material parameters within a purely mechanical description. Here we present an overview of hydrodynamic modeling of cell tissues as active polar fluids, and discuss some examples where this approach has been instrumental to elucidate physical mechanisms behind collective cell behavior in epithelia: the occurrence of elastic-like waves, the wetting-dewetting transition in spreading cell monolayers, and the understanding of morphological instabilities of tissues.

Invited Talk SYES 1.6 Wed 15:45 Audimax 2
Understanding the physical variables driving mechanosensing — •Pere Roca-Cusachs — Institute for Bioengineering of Catalonia and University of Barcelona, Barcelona, Spain

Cell response to force regulates essential processes in health and disease. However, the fundamental mechanical variables that cells sense and respond to remain largely unknown. During this talk, I will discuss how this process of mechanosensing can be understood in physical terms, and used to predict cell response to both external force application, and passive mechanical properties such as Extracellular Matrix (ECM) rigidity.