



FENOMEN

NEWSLETTER OF THE DEPARTMENT OF PHYSICS AND NUCLEAR ENGINEERING

NEWS

EVENTS

- The 14th International Workshop on Physical Characterization of Pharmaceutical Solids is being organized by Josep Lluís Tamarit (GCM) together with academic colleagues and pharmaceutical companies, with Assa International. The meeting will take place at UPC on June 25-28, 2012.
- The VII Jornada de Recerca del DFEN was celebrated on Feb 10, 2012 in Barcelona.
- The 1st Europhotonics Spring School took place March 25-31, 2012, in Castelldefels, with the participation of DONLL members Ramon Vilaseca and Kestutis Staliunas.

LECTURES AND COURSES

- C. Cabrillo (CSIC): "A novel numerically efficient real space theory of scattering" (Dec 19, 2011).
- S. Pilati (ICTP, Trieste): "Quantum many-body physics with ultracold gases" (Jan 19, 2012).
- D. Hufnagl (Univ. Linz): "Stability and excitations of dipolar quantum gases" (Feb 28, 2012).
- D. Gauthier (Duke Univ.): "Dynamics of autonomous Boolean networks" (March 22, 2012).
- W. Krolkowski (Australian National Univ.): "How to trap particles with laser beams" (March 27, 2012).

PHD FELLOWSHIPS

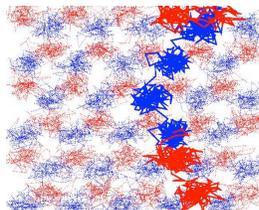
- Three PhD positions on climate networks, neurodynamics, and laser networks are available at DONLL. The grants are funded by two Marie Curie actions. For more information, contact cristina.masoller@upc.edu or jordi.g.ojalvo@upc.edu

Recent publications

Condensed Matter

Solids that flow

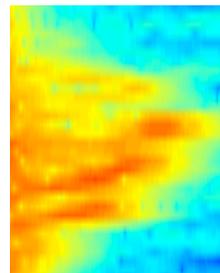
Supersolidity is an intriguing state of matter in which the spatial order defining a solid phase does not destroy completely the superfluidity, characteristic of Bose liquids at very low temperatures. Recent torsional oscillator experiments show the presence of a fraction of non-classical rotational inertia in solid ^4He , a smoking gun signature of supersolidity. In a recent work published in *Physical Review Letters*, Riccardo Rota and Jordi Boronat (SIMCON) have determined, using quantum Monte Carlo methods, the onset temperature for Bose-Einstein condensation when a small fraction of vacancies is present in the system. These temperatures are in agreement with experimental observations.



Nonlinear Optics

Quantum control

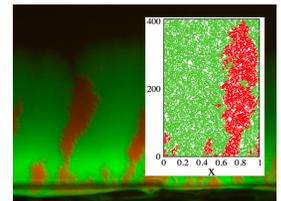
Recent advances in high-intensity ultrashort laser pulses with phase stability have paved the way for controlling attosecond time-scale dynamics of electrons. In a recent Rapid Communication to *Physical Review A*, published in December 2011, Carles Serfat (DONLL) presents a novel scheme for quantum coherent control in high-order harmonics and attosecond pulse generation based on shaping the driving laser through the addition of static electric fields at each spot of the interaction region.



Population Genetics

Mutations that flow

We currently have a good understanding of how genetic mutations spread in a stationary environment. Much less is known about what can happen in a fluid environment, for example in bacterial populations living in the ocean. Together with an international team, Simone Pigolotti (DONLL) is investigating new phenomena that arise in such situation. Their results show that, while on solid surfaces the range expansion is determined by the selective advantage of the different mutant species, the effect of fluid flows can alter dramatically the scenario and cause coexistence of less fit species.



The model proposed and the consequent theoretical analysis has been published in *Physical Review Letters* in March 2012.

Materials Science

Being cool under pressure

Most materials warm up when subject to increasing hydrostatic pressure under adiabatic conditions, and cool down when the pressure is released, in what is known as the standard barocaloric effect. Much less common is the inverse effect: materials that cool down when under pressure and heat up when pressure is released. Maria Barrio and Josep-Lluís Tamarit (GCM), in collaboration with researchers from the UB, India and Germany, have reported an inverse barocaloric effect in the compound La-Fe-Co-Si, a promising candidate for magnetic refrigeration through its magnetocaloric effect. These results were published in *Nature Communications* in December 2011.

Our people

Ivana Bešlić, condensed-matter



physicist

“Up to now the study of physical systems at zero temperature using quantum Monte Carlo methods has been the subject of my scientific work. The existence of the small mixed helium clusters, pure spin-polarised tritium, and small mixed spin-polarised tritium clusters has been investigated. The ground state energy as well as the structure properties of those systems have been determined in my previous investigations. Hydrogen and its isotopes deuterium and tritium offer one of the most interesting systems in the regime of ultralow temperature, where quantum effects become macroscopic. I joined the group of Prof. Jordi Boronat to perform simulations to obtain the missing equation of state for spin-polarised deuterium in the limit of absolute zero temperature. In the future I would like to broaden my investigations in the field of the dilute Fermi gases in the universal regime, and in the behavior of helium clusters on graphene.”

Ivana Bešlić joined DFEN in October 2011 as a postdoctoral researcher granted by Croatian Science Foundation. She is employed at the Faculty of Science of the University of Split (Croatia).

Elena Abad Adán, biophysicist



“When I finished my degree in Physics I had a strong curiosity in different disciplines such as economics; I even took a banking

management course. Some time later, fate brought me to a neurophysiology laboratory at Hospital Clínic in Barcelona, and suddenly I was involved in a PhD doing research in cell membrane calcium channels in isolated cell models, working with patch-clamp and fluorescence biotechniques. After the PhD I continued doing experimental studies in cell physiology, in particular on the role of microtubules in ischaemic cell injury in myocardium. All the experimental experience I gained in those years was really exciting for me. Recently I had the opportunity to join the research group of Prof. Jordi García-Ojalvo, to work on the development of mathematical models, together with experimental collaborators headed by Dr. Pablo Villoslada, devoted to understand the dynamics of the cellular response to interferon beta (IFN β), a common therapy for Multiple Sclerosis, and the dynamics of immune cell populations upon cytokine signaling”

Elena Abad Adán obtained her PhD from the Faculty of Medicine (University of Barcelona) in January 2009. She has joined DFEN, funded by the Red Española de Esclerosis Múltiple (REEM).

Carles Calero, computational physi-



cist

“I joined the SIMCON group to work with Elvira Guàrdia and Jordi Martí in October 2011. My current research focuses on the study of the structural and dynamical properties of water at nonpolar interfaces, which is key to understand one of the main (but not fundamental) interactions that governs biological processes at the nanoscale: the hydrophobic interaction. The hydrophobic effect plays an important role

in phenomena as diverse as protein folding, lipid aggregation, or chemical self-assembly of macroscopic objects. In spite of the ubiquity of water and its importance in many phenomena (life!), the anomalous properties of water still puzzle scientists. To advance in their comprehension, we employ computer simulations using both phenomenological expressions and quantum mechanical computed values for the force between atoms. Such methods allow a rigorous and precise description of the structure and dynamics of water molecules at interfaces.”

Carles Calero obtained his PhD in New York (USA). He worked at the Institut de Ciència de Materials de Barcelona before joining DFEN.

Side note

How to win a Mini

Many interesting problems in game theory can be directly studied with the tools of statistical physics. Simone Pigolotti (DONLL), together with international



colleagues, calculated the optimal bid distribution for the lowest unique bid problem, a kind of auction popular on internet websites, in which participants bid for things as diverse as tablets and cars. By comparing the theory with a large dataset of online auction, Pigolotti and co-workers observed a regime in which players are adapted, and another in which they are not and can thus be exploited. The research has been published in February 2012 in **Physical Review Letters**.

PHD THESES

- Marina Pérez Ferragut. Advisor: Francesc Reventós (November 30, 2011)
- Elisabet Mas de les Valls Ortiz. Advisor: Lluís Batet (December 1, 2011)
- Jordi Fradera. Advisors: Lluís Batet i Luis Sedano (January 25, 2012)
- Riccardo Rota. Advisor: Jordi Boronat (December 20, 2011)

- Jordi Orrit Prat. Advisor: Juan Belana (March 7, 2012)

RECOGNITIONS

- The chapter “Thermal-Hydraulic Analysis in Support of Plant Operation”, published by Francesc Reventós in the InTech book “Nuclear Power - System Simulations and Operation”, has been recognized by the publisher for its impressive readership results, quantified in terms of the number of down-

loads. The top downloads are from USA, India, Spain, China and Japan.

Edited by

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