FENÒMEN

NEWSLETTER OF THE DEPARTMENT OF PHYSICS AND NUCLEAR ENGINEERING

NEWS

2008 POSTDOCTORAL FELLOWSHIPS

Funding is available for two postdoctoral positions in all areas of physics research. The positions will be co-financed by the Department and by the host research group. The application deadline is June 15th, and a decision will be made by June 30th. The starting date should be between October 2008 and April 2009. Interested candidates should contact a research group of the Department within their area of expertise. A list of research groups can be found at http://www.fen.upc.edu

UPCOMING EVENT

The Summer Session Program of the International Space University will take place at the Vertex Building of the UPC from June 30 to August 28, 2008. Jordi José is the UPC representative at the Local Organizing Committee.

RESEARCH SUPPORT ACTIONS

The Research Commission of the FEN Department has approved a set of actions to financially support the activities of its researchers. These actions include start-up funds for new researchers arriving in the Department, financial support for applying to international projects, mobility grants for young researchers, and funds for invited researchers. For more information, contact the Research Vicechair (jordi.jose@upc.edu) or the Research Coordinator (jordi.g.ojalvo@upc.edu).

Recent publications

Photonics

Photonic crystals change colors

Second-harmonic generation is a nonlinear optical process leading to changes in the wavelength of light. In regular photonic crystals, the process requires careful tuning in order to accomplish phase matching. Researchers from the DONLL group have shown that in crystals with random spatial modulation, at micro-nanometric scale, of the 2nd-order nonlinear susceptibility, phase matching can occur for different processes simultaneously. The study was published in *Optics Express* on November 26, 2007.

Molecular Dynamics

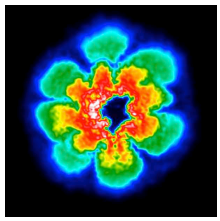
The structure of a superionic conductor

Before melting, solid AgI exhibits a superionic phase, which has a liquid-like ionic conductivity because of the diffusive motion of the silver ions through the sublattice formed by the iodides. Molecular dynamics simulations carried out by V. Bitrián and J. Trullàs using a polarizable ionic model have reproduced the structure factor of molten AgI as measured by neutron diffraction experiments, as well as the averaged spatial distribution of the cations in the superionic phase derived from experimental data analysis. This work has been published in the *Journal of Physical Chemistry B* on February 14, 2008.

Astrophysics

The death of a white dwarf

The process of delayed detonation of a white dwarf has been analyzed for the first time in three dimensions thanks to a smoothed-particle-hydrodynamics numerical code developed by Eduard Bravo and Domingo García-Senz. The study was highlighted in the cover of the *Astronomy&Astrophysics* journal in February 2008.



Complex systems

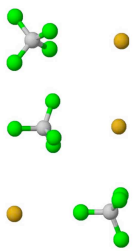
How networks reach the infinite

Statistical physics teaches us that no true singularities (such as phase transitions) can occur in systems composed of a finite number of elements. Therefore, the notion of thermodynamic limit (in which the number of elements tends to infinity) has become a fundamental concept in science. In a paper published in *Physical Review Letters* on April 8, 2008, Claudio Castellano and Romualdo Pastor-Satorras report their discovery of several routes towards the thermodynamic limit in complex scale-free networks.

Condensed Matter - Materials

The nature of plastic crystals

Carbon tetrachloride (CCl_4) is a molecular liquid that, when cooled, transforms into a rotator-phase crystal, in which molecules rotate fairly freely about their equilibrium lattice positions. In order to understand the similarities and differences between the two phases, researchers from the Group of Characterization of Materials have used a Monte Carlo method and Molecular Dynamics simulations to analyze neutron diffraction data of this system. Their results show that while the positional short-range order is similar, the orientational short-range order changes between the two phases. The study was published in the *Physical Review B* on October 11, 2007.



Our postdocs

Maria Dolores Ruiz, materials scientist

"I joined the group of characterization of materials four months ago and the experience has been excellent. I was warmly welcomed, and I felt as an active part of the group from the very beginning. My research project concerns the study of the microscopic dynamics of molecular liquids such as halogenoethane derivatives by means of inelastic neutron scattering and computer simulations. Some thermodynamic properties of these compounds have been studied in detail during the past years by members of the FEN Department, and some anomalies in the heat capacity (among others) have been reported. The purpose of the inelastic neutron scattering experiments is to try to find a microscopic explanation for such anomalies and their correlation with the system dynamics. The experiments will be performed at the Institut Laue-Langevin, the most intense neutron source in the world."

Maria Dolores Ruiz obtained her PhD in physics from the Institute Laue-Langevin (France) in 2007, and arrived in Barcelona in December of the same year, financed in part by funds from the Department.

Gregory E. Astrakharchik, theoretical physicist

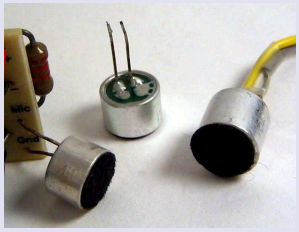
"Properties of gases cooled to ultralow temperatures might be strikingly different from properties of systems at normal temperatures. Quantum phenomena such as superfluidity (2003 Nobel Prize), superconductivity, Bose-Einstein condensation (1995 Nobel Prize) might happen. The goal of our group – led by J. Boronat and J. Casulleras – is to use quantum Monte Carlo methods to provide quantitative predictions for experiments with quantum gases and solids. Some very hot and controversial topics are addressed, such as existence of a supersolid, i.e. a solid that remains superfluid."

Gregory Astrakharchik obtained his PhD in physics from University of Trento (Italy) in 2004, and is in Barcelona from 2005. He is currently a postdoctoral fellow within the Juan de la Cierva program. He was one of the organizers of international conference on Recent Progress in Many Body Theories held in UPC in July, 2007 and is one of the editors of the book of proceedings (to appear in 2008).

Physical technologies

The sound of electrets

An electret is a dielectric material that has a quasi-permanent electric charge distribution. It generates internal and external electric fields that can be used to power electronic devices such as microphones. Electret microphones can now rival capacitor microphones in most respects, and can even have the long-term stability



and ultra-flat response required of a measuring microphone. However, improvements in the materials and charging processes used in electret technology are necessary in order to obtain electric fields high and stable enough for special applications. The Dielectric Physics Laboratory (DILAB) research group has collaborated with CESVA, a leader manufacturer of sonometers, in the development of a charging device for high-quality electret microphones.

FUNDING

- "Dynamics of the disordered and glassy phases in halogenic molecular compounds", Agencia Española de Coordinación Internacional (J. Ll. Tamarit).
- "Spanish Network of Multiple Sclerosis", Instituto de Salud Carlos III (Jordi Garcia-Ojalvo).

VISITING SCHOLARS

- Prof. Tiago Buckup (Univ. Marburg, Germany).
- Prof. Alan Calder (State Univ. of New York at Stony Brook, USA).
- Dr. S. Capaccioli (Univ. of Pisa, Italy).
- Prof. D. Gauthier (Duke Univ., USA).
- Dr. Miguel Angel Gonzalez (Institute Laue-Langevin, France).
- Dr. Attila Imre (KFKI Atomic Energy Institute, Hungary).
- Dr. Alexander Krivchikov (Verkin Inst. for Low Temperature Physics, Ukraine)
- Dr. Daniel Laria (Univ. Buenos Aires, Argentina).
- Prof. John C. Lattanzio (Monash University, Australia).
- Prof. Stefano Longhi (Politecnico di Milano, Italy).
- Dr. Victor Mazur (Academy of Refrigeration, Ukraine).
- Dr. Giulio Monaco (European Synchrotron Radiation Facility, France).
- Dr. Ph. Negrier (CNRS-Universite Bordeaux I, France)
- Dr. Javier Rodríguez (Univ. de Buenos Aires, Argentina).
- Prof. Gürol Süel (Southwestern Medical Center, USA).
- Prof. Evgenii Volkov (Lebedev Physical Institute, Russia).
- Prof. Robert Zillich (Johannes Kepler Universität, Austria).

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