FENOMEN

NEWSLETTER OF THE DEPARTMENT OF PHYSICS AND NUCLEAR ENGINEERING

NEWS

2009 FEN POSTDOCTORAL FELLOWSHIP AWARDED

The Research Commission of the Department has awarded financial support for a postdoctoral fellowship. The recipient of the grant this year is Dr. Alistar Ottochian, who will join the Group of Characterization of Materials to study relaxation processes in complex liquids.

OPEN POSITIONS

- PhD fellowship in meteorology (marta.alarcon@upc.edu)
- PhD fellowship in nonlinear and stochastic dynamics (jordi.g.ojalvo@upc.edu)

VISITING SCHOLARS

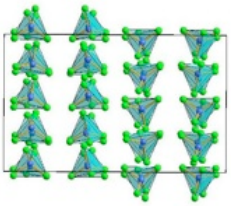
- Alain Barrat (ISI, Turin, Italy)
- Marvin Girardeau, Univ. Arizona, USA
- Yurii E. Lozovik, Institute of Spectroscopy, Troitsk, Russia
- Arturo Martí, Univ. de la República, Uruguay
- Marco Masia, Univ. di Sassari, Italy
- Mario Natiello, Lund Univ., Sweden
- Reynald Pain, Univ. Paris, France
- Géza Ódor, Hungarian Academy of Sciences, Hungary.
- Gordon Pipa and Raúl Vicente, Max Planck Institute, Frankfurt, Germany
- Osvaldo Rosso, Newcastle Univ., Australia
- Ekkehard Ullner, Aberdeen Univ., UK
- Alessandro Villa, Univ. Joseph Fourier, Grenoble, France
- Evgenii Volkov, Lebedev Physical Institute, Moscow, Russia
- Joachim Wuttke, Jülich Forschungszentrum, Munich, Germany

Recent publications

Materials Science

Fast-moving glass

Windows are made of liquid silica, where molecules are moving so slowly that they seem to be solid to our eyes. Astonishingly enough, molecules in glasses also perform some kind of fast motion, whose microscopic origin is not known. A generally accepted explanation is that some molecules are sitting in "holes" where the density is lower than the average, and thus move faster than most molecules. Experiments by the Group of Characterization of Materials have now shown that this "hole" theory may not be universal. Their results were published in *Physical Review Letters* in Aug 2009.



Meteorology

Emissions model

Photochemical simulations provide essential information for understanding pollution processes and making policy decisions, with the goal of improving air quality. Sara Ortega and Marta Alarcón, together with UPC and UB colleagues, have developed a new emissions model, MNEQA, to be applied to the specific case of tropospheric ozone pollutants. Their work was published in *Atmospheric Environment* on April 2009.

Photonics

Anomalous dispersion

Light propagation in photonic crystals at the high energy range is known to display surprising behaviors, such as an anomalous group velocity. Muriel Botey, Jordi Martorell and co-workers have observed that this leads to an enhancement of second-harmonic generation of light in the presence of nonlinearities. The work was published in *Optics Express* in July 2009.

Chemical physics

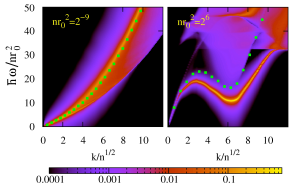
Polarizable salts

Molten copper and silver halides, which exhibit fast ionic conduction before melting, present some structural properties different than molten alkali halides, because of the anionic polarizability. V. Bitrián, O. Alcaraz and J. Trullàs have derived the fluctuation-dissipation theorem for the static dielectric response function of systems of ions with inducible point dipoles, and have shown that this function is determined by spatial correlations of both charge and dipole-moment density fluctuations. This work was published in the *Journal of Chemical Physics* in June 2009.

Quantum Liquids

Excitation spectrum of dipolar gases

In the recent years, cold gases with long-range interactions have attracted much interest. Such gases are highly impurity-free, can be cooled to form Bose-Einstein condensates, and their shape is highly controllable. Grigory Astrakharchik and colleagues have studied the excitation spectrum of two-dimensional gas with repulsive



dipolar interactions at zero temperature. As the density is increased, the excitation spectrum ceases being monotonous and a "roton" minimum is formed. The work was published in *Physical Review Letters* in March 20, 2009.

Our postdocs

Erell Bonnot, materials scientist

"I joined the Group of Characterization of Materials to investigate the barocaloric effect associated with the martensitic phase transition in Ni-Mn-In magnetic shape-memory alloys, by means of high-pressure dilatometer.

The barocaloric effect is the analogue, in pressure, of the magnetocaloric effect that has received considerable attention in the recent years owing to its potential use for environmentally friendly refrigeration. It is defined as the isothermal change of entropy or the adiabatic change of temperature that takes place when an external pressure is applied in a given material. This work, done together with Josep Lluís Tamarit and Maria del Barrio, is a collaboration with Lluís Mañosa from the University of Barcelona."

Erell Bonnot obtained her PhD in physics from the Universitat de Barcelona in 2008 within the MULTIMAT network. She joined the department in December of 2008 and is currently funded by a postdoctoral grant of the UPC.

Simon Campbell, astrophysicist

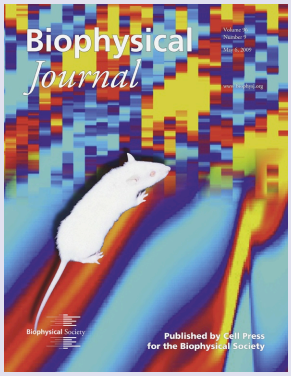
"My field of research involves the evolution and nucleosynthesis of low-mass stars. To do this I use computer codes that include the necessary physics to follow their entire lifetimes. In particular I focus on the evolution of ancient stars, that formed soon after the Big Bang. These stars were the first to synthesise and release heavy elements into the universe. This material then went into the formation of other stars, planets - and lifeforms such as us! I also occasionally do some observations of stars using optical telescopes. I am lucky to be sharing an office with two catalan colleagues, Dr. Gloria Sala and Jordi Casanova, in the historical EUETIB building. I will be working with Dr. Jordi Jose and other colleagues of the DFEN-DFA Astronomy and Astrophysics Group (GAA) for another two years."

Simon Campbell obtained his PhD at Monash Univeristy (Australia). His thesis won the Best Australian Astronomy PhD Thesis prize in 2007. Before moving to Barcelona he held a postdoc position at the Institute of Astronomy and Astrophysics, at the Academia Sinica (ASIAA) in Taiwan.

Side Note

Noisy rhythm generation

In higher organisms, circadian rhythms are generated by a multicellular genetic clock that is entrained very efficiently to the 24 hour light-dark cycle. While most studies so far have been done assuming that the



clock is entrained by a perfectly periodic driving by light, Jordi García-Ojalvo and colleagues from the Univ. Barcelona have discovered that the circadian rhythm shows a resonance-like phenomenon as a function of the noise intensity. The work was published in the *Biophysical Journal* in May 2009, and was awarded the journal cover here shown.

NEW MEC RESEARCH PROJECTS

The Ministerio de Ciencia e Innovación (MEC) has granted these projects to FEN:

- "Estudio del componente aerobiológico del material particulado atmosférico en Cataluña y Canarias" (M. Alarcón)
- "Nonlinear and stochastic dynamics in physical and biophysical systems" (J García-Ojalvo)
- "Preparación y estudio de las propiedades físicas bajo confinamiento micro y nanométrico" (D.O. López)
- "Dos retos para la evolucion estelar moderna: progenitores de supernova y estrellas AGB" (E. García-Berro)
- "Dynamic properties in liquid phases: molten salts, ionic solutions and molecular liquids" (E. Guàrdia)

GRUPS CONSOLIDATS

The Generalitat de Catalunya has recognized these Grups de Recerca Consolidats at FEN:

- Grup de transicions de fase, polimorfismes i dinàmica de la metaestabilitat (J.Ll.Tamarit)
- Propietats dinàmiques i no lineals de materials i sistemes fotònics, elèctrics i biològics (J. Garcia-Ojalvo)
- Grup de recerca en la transmutació de residus radiactius (GRETER, G. Cortés)
- Nuclear engineering research group (J. Dies)
- Modelització i simulació discreta de sistemes biològics (D. López)
- Grup d'astronomia i astrofísica (E. García-Berro)
- Grup de simulació per ordinador en matèria condensada (E.Guàrdia)

The following Grup de Recerca Emergent has also been recognized:

- Grup de caracterització física de materials mesogens i de memòria de forma (J. Salud)

PHD THESES

- Juanjo Fernández. Advisors: Ramon Vilaseca and Josep Ll. Font. June 11, 2009.
- Alina Hirschmann. FEN advisor: Eduard Bravo. July 3, 2009.
- Muriel Botey. Advisor: Jordi Martorell, July 24, 2009.

Edited by

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