FENÒMEN

NEWSLETTER OF THE DEPARTMENT OF PHYSICS AND NUCLEAR ENGINEERING

NEWS

2006 FEN POSTDOCTORAL FELLOWSHIPS

The Research Commission of the Department has granted financial support for two postdoctoral fellows. The recipients of the fellowships are Drs. Anuj Parikh (Yale University, USA) and Sandip Kar (Jadavpur University, India). Dr. Parikh will work at the Astronomy and Astrophysics group on classical novae and X-ray bursts. Dr. Kar will model brain activity in the research group of Nonlinear Dynamics, Nonlinear Optics and Lasers.

OPEN POSITIONS

- PhD fellowship on dynamics of semiconductor laser (cristina.masoller@upc.edu)
- PhD fellowship to work in simulations of condensed systems (elvira.guardia@upc.edu)
- PhD fellowships on nuclear security (Càtedra Argos, www.seguridadnuclear.upc.edu)
- PhD fellowship on brain dynamics (jordi.g.ojalvo@upc.edu)

RECENT EVENTS

- Annual meeting of the EMLG/JMLG group, "Liquid systems under extreme conditions" (Sept. 3-7, 2006). Web: congress.cimne.upc.es/emlg06
- Workshop "Noise in Life 2006" (June 15-17, 2006). Web: www-fen.upc.es/donll/nil06

Recent publications

Photonics

Generating light from disorder

A new study has demonstrated theoretically the possibility of generating radiation via second-order nonlinear processes in disordered media. So far, it was believed that second-order processes were only efficient in ordered materials such as crystals, or in materials with periodically structured refraction index. This work, performed by Xavier Vidal and Jordi Martorell, was published in *Physical Review Letters* on July 7 2006.

Astrophysics

Nucleosynthesis in stars

An international collaboration, with the participation of Eduardo Bravo, has discovered a new nucleosynthesis process, the nu-p process, which operates via neutrino-produced neutrons in proton-rich ejecta of supernovae and produces elements beyond Ge. The work has been published in *Physical Review Letters* on April 10, 2006.

Condensed Matter

Confining water in nanochannels

Molecular dynamics simulations of liquid water confined in graphite nanochannels have shown the existence of two stable phases, at low and high densities. These results agree with scanning tunneling microscope experiments. The work was performed by Jordi Martí, Elvira Guàrdia and co-workers, and was published on March 7, 2006 in the *Journal of Chemical Physics*.

Astrophysics

Radioisotope production in novae

The measurement of a nuclear resonance in ^{26g}Al(p,g) performed at the TRIUMF nuclear facility in Vancouver (Canada) has shed new light on the production of ^{26g}Al in nova outbursts. The work, with the participation of Jordi José, was published in *Physical Review Letters* on June 30, 2006.

Photonics

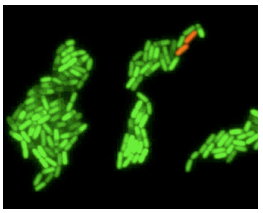
Subdiffractive light

A theoretical and numerical study has shown that light beams can propagate sub-diffractively in an array of fibers whose propagation constant is periodically modulated along the propagation direction. The research has been done by Kestutis Staliunas and Cristina Masoller, and will be published in *Optics Express*.

Gene Regulation

An excitable genetic circuit

A combination of experimental and theoretical analysis has unveiled for the first time a natural gene regulation circuit that exhibits excitable dynamics. Such dynamics, typically found for instance in the electrical activity of neurons, has been observed in the stress response of the bacterium *B. subtilis*. The study, performed by J. Garcia-Ojalvo and co-workers, appeared in *Nature* on March 23, 2006.



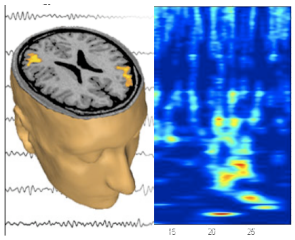
Funding

Physics applied to art

The European Synchrotron Radiation Source (ESRF) in Grenoble has awarded Trinitat Pradell a Long Term Project entitled "Influences between European regions in the transition from Gothic to Renaissance: SR analysis of submillimetric complex mixtures of compound". The project is a collaboration with the MNAC (Museu Nacional d'Art de Catalunya), and the line BM-01 of ESRF-Grenoble. The aim of the project is to scientifically prove the relations between painters and painting schools during the transition from Gothic to Renaissance periods in Catalonia in the XV century, through the analysis of paint materials.

Understanding the brain

Within the last call of the New and Emerging Science and Technology (NEST) activity of the 6th Framework Programme, the European Commission has awarded a STREP project to the research group of Nonlinear Dynamics, Nonlinear Optics and Lasers, under the title "GABA: Global Approach to Brain Activity". The aim of the project is to determine the role that brain synchronization plays in the emergence of the cooperative activity underlying cognitive states. The project will also study the effects of synchrony disruption in the appearance of certain neurological disorders such as Alzheimer's disease and epilepsy.



The project, coordinated by Jordi Garcia Ojalvo, is a collaboration between neurophysiologists, mathematicians, and physicists, and will include researchers from Spain, France, Italy, Germany and Finland.

Watching a supernova

The group of Astronomy and Astrophysics participates in the ESA project "Type I supernovae". The goal of the project is to monitor a supernova explosion with the gamma-ray space observatory INTEGRAL, with the aim of detecting radioactive elements emitted during the explosion. Supernovae explosions detectable with INTEGRAL occur with an approximate periodicity of 2-5 years. The FEN researchers involved are Alina Hirschmann, Eduardo Bravo and Domingo García.

Novel laser devices

The Air Force Office of Scientific Research (AFOSR) of the United States will fund the project "Nonlinear dynamics of novel types of semiconductor lasers", whose goal is the study of the nonlinear light-matter interactions in new types of semiconductor lasers, such as quantum-dot lasers and vertical cavity surface emitting lasers (VCSELs). The project is coordinated by Cristina Masoller.

Other recently funded projects

- "Supercritical Fluids as Environmentally Friendly Medium for Processing and Destruction of Organic Materials", NATO project (J.L. Tamarit)
- "Anharmonicity in the Orientational Glass and Orientationally Disordered phases", Institute Laue-Langevin, Grenoble (L.C. Pardo)
- "Dynamics of rotational motions of Orientationally Disordered Phases", Laboratoire Léon Brillouin, Saclay, Paris (J.L. Tamarit)
- "Effect of dipole concentration in fragile character of glassy phases of freon compounds", Forschungsneutronenquelle Heinz Maier-Leibnitz, Munich (L.C. Pardo)

VISITING SCHOLARS

- Dr. Ekkehard Ullner is staying from Oct. 2006 to Sept. 2007 at the group of Nonlinear Dynamics, Nonlinear Optics and Lasers, as a Feodor Lynen fellow of the Alexander von Humboldt foundation.
- Dr. Javier Rodríguez, from the University of Buenos Aires (Argentina) is visiting the group of Simulations in Condensed Matter from Sept. to Nov. 2006.
- Dr. Alexei Zaikin (Potsdam University) visited the group of Nonlinear Dynamics, Nonlinear Optics and Lasers in Sept.-Oct. 2006, within the HPC-Europa program of the Barcelona Supercomputing Center.

GRUPS CONSOLIDATS

In its latest call, the Generalitat de Catalunya recognized the following Grups de Recerca Consolidats of the Department:

- Grup de Recerca en la Transmutació de Residus Radioactius (G. Cortés)
- Grup d'Astronomia i Astrofísica (Resp. FEN D. García)
- Làsers i Propietats Elèctriques i Òptiques dels Materials (J. G. Ojalvo)
- Grup de simulació per ordinador en matèria condensada (E. Guàrdia)
- Dosimetria i radiofísica mèdica (X. Ortega)
- Grup de Transicions de Fase, Polimorfisme i Dinàmica de la Metaestabilitat (J.L. Tamarit)

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