Recent publications

Astrophysics

Novae explosions

Classical novae are thermonuclear explosions that repeatedly eject material into the interstellar medium. DFEN researchers Jordi Casanova and Jordi José, in collaboration with other researchers from UPC, Università di Pisa (Italy) and Stony Brook University (US) have led a study that unveiled the origin of the inhomogeneous distribution of chemical species in such explosions. Through pioneering 3-D hydrodynamic simulations, they have shown Kelvin-Helmholtz instabilities are responsible for the observed data. Their work has been published in Nature in Oct, 2011.

Data analysis

A dishy fit

No longer just a bean-based dish, FABADA is a program to efficiently explore the $\chi^2$ landscape produced when fitting a physical model to experimental data. Researchers from the GCM led by Luis C Pardo have created an algorithm that allows data fitting while avoiding getting stuck in local $\chi^2$ minima as it happens with standard algorithms. Once the algorithm reaches the best fit, it calculates the probability density function of all parameters. This allows knowing what is behind the data and performing a selection of the best physical model, if there are competing ones. Their work appeared in Physical Review E & Journal of Physics: Conference Series, 2011.

Nonlinear optics

Spherical geometries

Recent theoretical and experimental investigations have demonstrated the usefulness of circular geometries to tailor 2nd-order nonlinear optical effects. Jordi Martorell (UPC, ICFO) and colleagues from ICFO and Université Libre de Bruxelles (Belgium) have reviewed nonlinear optics research in such spherical geometries in a publication that appeared on the cover of Laser & Photonics Reviews on Nov, 2011.

Chemical physics

Glassy states

The glassy state is far from being completely understood. Lack of periodicity makes structure determination really hard, and thousands of atoms must be considered to yield realistic configurations. Starting from x-ray inelastic scattering measures on a metallic glass, Eloi Pineda and colleagues have measured the dispersion curve of acoustic phonons in the nanometer wavelength region. The behavior obtained is similar to that in other glasses. Their findings provide new evidence about the acoustic origin of the boson peak that characterizes disordered materials. These results appeared on the Journal of Chemical Physics on Sept, 2011, being one of the most downloaded items of the month.
Our people
Simone Capaccioli, physicist and DFEN visiting researcher

“What can we learn by squeezing a liquid? Any liquid, if cooled fast enough, can form a disordered solid called glass: isobaric cooling reduces the thermal energy of molecules and the volume available to their motions, which become jammed and dramatically slow down up to freeze at the glass transition. An isothermal compression is an alternative way to form a glass, using only densification. I joined the GCM to work with Josep Lluis Tamarit and Maria del Barrio. We developed a high pressure dielectric spectroscopy apparatus, able to get orientational molecular dynamics over a broad timescale range at different pressures and temperatures.”

Simone Capaccioli is currently a researcher at the Physics Dept of the Università di Pisa. He obtained his PhD in Materials Science from Politecnico of Milan. He was a post-doctoral researcher at the Polymer Max-Planck Institute (Mainz), the SOFT center (Roma La Sapienza) and the Naval Research Lab (Washington DC). He joined the DFEN in December 2010 as a visiting scientist granted by AGAUR.

Simone Pigolotti, biophysicist and DFEN Junior faculty

“I started my activity as a Ramon y Cajal fellow at the DONLL in May 2011. My research develops at the interface between physics and biology. In particular my interest is in the application of statistical physics techniques and nonlinear dynamics to biological problems. I have been working on a variety of different biological problems, the main ones being the individual-based description of biological populations and the understanding of the dynamics of small genetic circuits. Understanding the macroscopic features of a biological population from the interactions of single individuals is a problem which presents intriguing similarities to the understanding of macroscopic properties of materials from the interactions of single atoms, which is one of the main goals of statistical mechanics. In the field of systems biology, I have been trying to develop general techniques to analyze the dynamics of genetic circuits without having to rely on a detailed knowledge of the parameters characterizing the dynamics.”

Simone Pigolotti obtained his PhD in Sissa (Trieste, Italy). He worked at the Niels Bohr Institut in May 2011. My fellowship at the DONLL in May 2011.