FENOMEN

NEWSLETTER OF THE DEPARTMENT OF PHYSICS AND NUCLEAR ENGINEERING

Conferences & workshops

Organization

* *Nuclear Astrophysics Opportunities at the Underground Laboratory in Canfranc*, EUETIB-UPC, Feb. 2009
* *Vth European Summer School on "Experimental Nuclear Astrophysics"*, Santa Tecla (Sicily) , Italy, Sep. 2009
* *VIII Latin American Symp. on Nuclear Physics & Applications*, Santiago, Chile, Dec. 2009

Invited Talks & Courses

* "Novae & X-ray bursts", *1st Lebanese Astrophysics Meeting: From Stars to Galaxies*, American Univ. of Beirut, Lebanon, Apr. 2009
* Course on "Stellar remnants: white dwarfs & neutron stars", Inst. Nuclear Fussion, UPM, Madrid, May 2009
* "Hydrodynamic simulations of type I X-ray bursts: metalliciity effects", *Defining the Neutron Star Crust: X-ray Bursts, Superbursts and Giant Flares*, Santa Fe (NM), USA, May 2009
* "Hydrodynamic models of classical novae & type I X-ray bursts", *Tours Symp. on Nuclear Physics and Astrophysics VII*, Kobe, Japan, Nov. 2009

Selected publications in 2009 (GAA-DFEN)

A new *Smoothed Particle Hydrodynamics* (SPH) code

A new axisymmetric SPH code with self-gravity has been developed by the GAA researchers D. García-Senz, A. Relaño, R. Cabezón & E. Bravo. The work has been published in the *Monthly Notices of the Royal Astronomical Society*, in January 2009.

Simulations of ballistic jets in binary systems

An international group of researchers, with participation of A. Riera (GAA), has published an analytic, ballistic model and a 3-D gas-dynamical simulation of a bipolar outflow from a stellar source (related with Herbig-Haro jets and bipolar planetary nebulae) in *The Astrophysical Journal* (December 2009).

Laboratory measurements of γ-ray emitters in nova explosions

The simultaneous measurement of the $^{18}F(p,p')^{18}F$ and $^{18}F(p,\alpha)^{15}O$ reaction rates has led to new implications for the level structure of ^{19}Ne, and for ^{18}F production in classical nova outbursts. The work, published in *Physical Review C* (May 2009), has been performed by an international team, with participation of J. José (GAA).

Optical flares in gamma-ray bursts

G. Sala (GAA) and co-workers have determined for the first time the spectral energy distribution of the optical flare before the rising afterglow of a gamma-ray burst. The work was published in *The Astrophysical Journal*, in March 2009.

Spectroscopy of HH 223

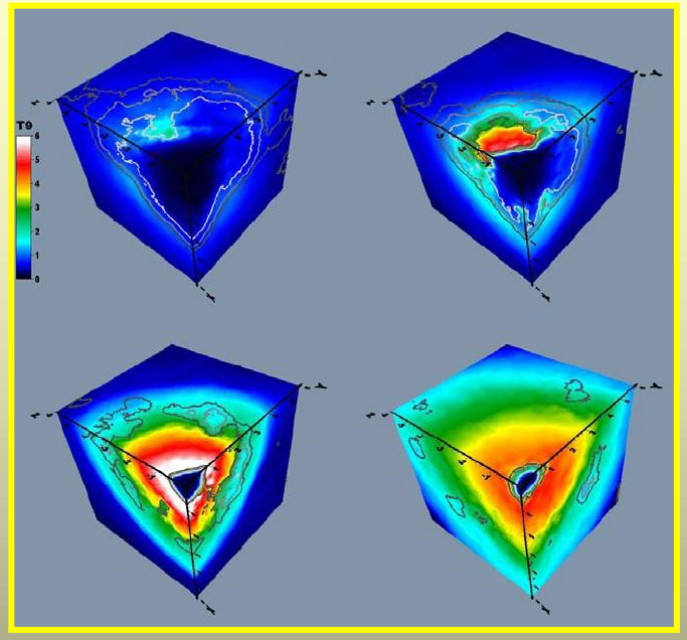
A detailed spectroscopic analysis of the physical conditions and kinematics along the Herbig-Haro object HH 223 has been performed by a team of researchers, including A. Riera (GAA). The work was published in *Astronomy & Astrophysics*, in May 2009.

X-ray observations of a pre-nova

A persistent X-ray emission during the quiescent time prior to the optical outburst of the nova V2491 Cyg has been reported by a group of scientists, including G. Sala (GAA). The work was published in *Astronomy & Astrophysics*, in April 2009.

Detonations in type Ia supernovae

A new model for type Ia supernova explosions, based in the role of pulsating reverse detonations, has been developed by a team led by the GAA scientists E. Bravo, D. García-Senz, & R. Cabezón. The work has been published in two papers in *The Astrophysical Journal* (April 2009), describing both the igntion of the detonation and the propagation up to the homologous expansion.



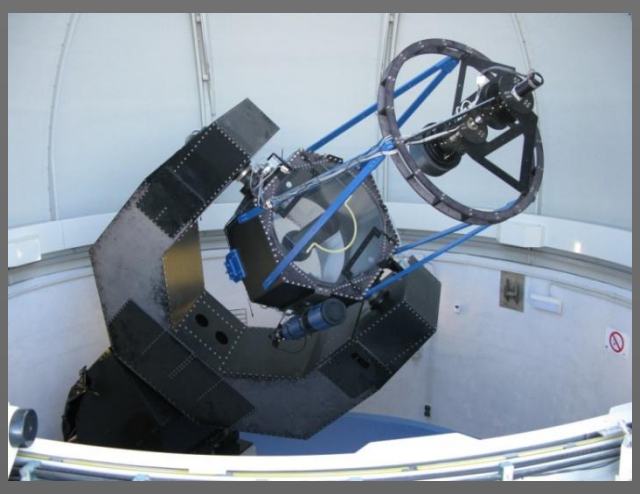
Nucleosynthesis in X-ray bursts

The impact of nuclear uncertainties in reaction Q-values on the nucleosynthesis accompanying type I X-ray bursts has been discussed in a paper published in *Physical Review C*, in April 2009, by J. José, F. Moreno (GAA) and co-workers.

Observational astronomy

Nova explosions in Andromeda

The new Joan Oró telescope, located in the Montsec Astronomical Observatory in the Catalan Pyrenees, has begun to produce its first results. With an 80 cm mirror and the support and control elements that allow a complete robotic operation, the observatory run by the *Institut d'Estudis Espacials de Catalunya* is the most advanced in Catalonia. One of the first scientific projects run during the comissioning phase is the monitoring of classical novae explosions in the neighboring Andromeda galaxy (M31), lead by Gloria Sala (GAA) and involving UPC (Jordi José, Jordi, Casanova & Simon Campbell from the GAA) and CSIC researchers.



The first nova discovered from the Montsec observatory was detected on 2009 June 30, and provided the first scientific results from the observatory to be published (*The Astronomer's Telegram* #2105). The monitoring of novae in M31 provides the elements for population studies and is a part of an international collaboration, involving spectroscopy with larger telescopes and X-ray observations with XMM-Newton and Chandra satellites, lead by the *Max-Planck-Institut für extraterrestrische Physik*.

PhD thesis defended in 2009 (GAA-DFEN)

Type Ia supernovae

Alina Hirschmann

Type Ia supernovae are one of the most violent events known in the Universe, and yet, until this very day, we do not know the mechanism that triggers these explosions. However, the era of high energy astronomy is at its peak of research since we now have the necessary technology. My PhD thesis was centered on trying to provide theoretical diagnostic tools in the γ-ray emission range to unveil an option of analysis for these objects.

I worked on my Phd thesis at GAA. During my last years of research, I had the opportunity to teach at the DFEN. At present, besides teaching at the University, I am in charge of the Public Outreach Area at the *Institut de Ciències de l'Espai* (CSIC), a fast growing area to attract young generations into the scientific fields.

Alina Hirschmann obtained her BsC degree in Physics and Astronomy from Florida Institute of Technology. In Barcelona, she obtained her PhD degree with a thesis on 'Gamma-ray emission from type Ia supernovae', under the supervision of Drs. Eduardo Bravo and Jordi Isern (ICE-CSIC).

Type I X-ray bursts

Fermín Moreno

Type I X-ray bursts (XRBs) are thermonuclear explosions occurring in the surface of accreting neutron stars. The aim of my thesis was, first to study the effects of nuclear reaction-rate uncertainties on the nucleosynthesis produced during an XRB, and second to determine the physical properties and the nucleosynthesis associated to this phenomenon through hydrodynamic simulations.

During my PhD thesis, I had to combine research with my current job outside the UPC, which became a hectic way of living. Hopefully, I was lucky to do my thesis in the GAA group, first at the IEEC building, and later in the historical EUETIB building, sharing in both places my office with excellent people who made me feel warmly welcome.

Fermín Moreno obtained his PhD from the Universitat Politècnica de Catalunya in 2009, with the thesis entitled "Accretion onto neutron stars: hydrodynamics and nucleosynthesis", advised by Dr. Jordi José. He is currently collaborating with J. José and other colleagues in the field of XRBs.

News

* J. José (GAA) has been appointed by NuPECC (Nuclear Physics European Collaboration Committee) as a member of the Committee responsible for developing a new *Long Range Plan* for nuclear physics in Europe, that relates to the next ten-fifteen years.

* The GAA (DFA-DFEN) has been granted by the *Generalitat de Catalunya* in 2009 as a Consolidated Research Group –*Grup de recerca consolidat* (PI: E. García-Berro, DFA)

* The GAA (DFA-DFEN) is leading the *ESF EuroGENESIS project* entitled "Physics of compact objects: explosive nucleosynthesis and evolution", with participation of research groups from Austria, Belgium, Canada, Croatia, Germany, Greece, Spain, and USA (PI: J. José, DFEN).

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