Patricelli Barbara

Position: Ph.D. student

Period covered: October 2006 – October 2009

I Scientific Work

- Neutron Stars

I've collaborated to the development of a theoretical model describing nuclear matter in bulk: I've considered systems composed by a plasma of degenerate electrons, protons and neutrons, with values of mass number A ranging from the ones typical of nuclei to the ones typical of NSs (from few units up to 10^{57}). I have developed a numerical code for the integration of all the equilibrium equations, taking into account gravitational, weak and electromagnetic interactions and I have obtained a very significant result: a universal charge to mass ratio.

I have investigated the possibility of having electric fields of the order of the critical field of Sauter-Heisenberg-Euler-Schwinger for electron-positron pair production in massive nuclear cores; I've also analysed how the shape and the intensity of this electric field changes by assuming different density profile for protons. Now I'm extending the model to systems composed by non degenerate fermions.

I've studied the Crust of Neutron Stars; in particular, by using a general relativistic treatment I calculated the mass and the thickness of this physical region for different sets of initial conditions. I also investigated a possible correlation between the properties of the Crust and the baryonic material left by Gamma Ray Bursts (GRBs) progenitors during their collapse, within the framework of the Fireshell Model.

- Gamma Ray Bursts

I'm analysing GRB 080319B: I'm studying the light curve and the spectrum of this burst and trying to interpret them within the Fireshell Model. From the analysis of the prompt emission of this source, characterized by a very high emitted isotropic energy (~10^{54} ergs) and by an anomalously bright optical emission, it results that the assumption of thermal spectrum of photons in the comoving frame, which is a characteristic of the Fireshell Model, can be just an approximation in such extreme conditions. In particular, thanks to the high energetics of this burst, it was possible to analyse also spectra more resolved in time and this revealed small discrepancies between the theoretical predicted spectrum and the observed one. Therefore, I've investigated the possibility of having a different spectral energy distributions of photons in the comoving frame. As a first analysis I have introduced a ``modified" thermal spectrum, whose low energy slope depends on an index α. In particular, I have obtained all the equations involved in the problem by considering this new spectral energy distribution and I've implemented them in the numerical code

simulating the emission observed from GRBs. The best fit of the observational data (spectrum and light curve) was obtained by assuming a ``modified'' thermal spectrum with α=-1.8. The same result was obtained also for another very energetic burst: GRB 050904, characterized by z=6.29.

II Conferences and educational activities

Conferences and Other External Scientific Work

- The Sun, the Stars, the Universe and General Relativity, Fortaleza (Brazil), May 26 - 29, 2009
- Sixth Italian-Sino Workshop on Relativistic Astrophysics, Pescara (Italy), June 29 - July 1
- Twelfth Marcel Grossmann Meeting, Paris (France), July 12 - 18, 2009
- The Shocking Universe: Gamma Ray Bursts and High Energy shock phenomena, San Servolo Island - Venezia (Italy), September 14 - 18, 2009
- First Galileo - Xu Guangqi meeting, Shangai (China), October 26-30, 2009