**PRIN Meeting on Gamma Ray Bursts**

**10-11 April 2014**

**University of Ferrara**

**Department of Physics and Earth Sciences**

**Meeting Room 412**

**ABSTRACTS**

1. **Lorenzo Amati**, INAF, IASF Bologna

Title

**Testing the reliability of the Ep,i - Eiso correlation**

Abstract

The Ep,i - Eiso correlation of GRBs is one of the most intriguing and debated evidences in the files, because of its relevant implications for GRB physics, sub-classes and cosmology. The impact ofselection and instrumental effects has been investigated by several groups, coming to different conclusions. I review the work done by the Ferrara-Bologna Unit in order to shade light on this issue, which also included important discussions with Prof. Piran and Prof. Kulkarni visiting UNIFE in the last year. I will also discuss prospects of future GRB observations In particular I will present the activities of the Ferrara - Bologna unit aimed at evaluating the expected impact of already planned missions with capabilities for GRB science and developing the science case, requirements, concept design and expected performances for next generation GRB missions in view of future opportunities (ESA, collaboration with Brazil).

2. **Joao Braga**, INPE, San José dos Campos, Brazil

Title: **The MIRAX Mission and the Brazilian Space Astronomy Program**

Abstract

The Monitor e Imageador de Raios X (MIRAX) is an X-ray astronomy satellite mission being developed at the National Institute for Space Research (INPE) in Brazil. In its currently proposed configuration, under revision, MIRAX will contain a set of hard X-ray imagers that will carry our a deep, wide-field monitoring of a very large sample of X-ray transients. MIRAX will be capable of contributing to crucial aspects of Time Domain Astrophysics by making high cadence spectral observations of a variety of astrophysical objects. In this talk I will review the scientific objectives of MIRAX and describe its main characteristics. I will also present an overview of the Brazilian activities and projects in space astronomy.

3. **Sergio Campana**, INAF, Osservatorio Astronomico di Brera, Merate

Title: **GRB precursors: a view to the central engine**

Abstract

One of the most elusive features of gamma-ray bursts (GRBs) is the sporadic emission prior to the main prompt event observed in at least ~15% of cases. These precursors have spectral and temporal properties similar to the main prompt emission, and smaller, but comparable, energetics. They are separated from the main event by a quiescent time that may be extremely long, and, in some cases, more than one precursor has been observed in the same burst. Precursors are still a puzzle: despite many attempts, none of the proposed models can account for all the observed features. Based on the complete sample of bright long GRBs observed by Swift (BAT6), we propose a new scenario for which precursors are explained by assuming that the central GRB engine is a newly born magnetar. In this model the precursor and the prompt emission arise from accretion of matter onto the surface of the magnetar. The accretion process can be halted by the centrifugal drag exerted by the rotating magnetosphere onto the infalling matter, allowing for multiple precursors and very long quiescent times. Application of the same idea to the monster GRB 130427A and to giant flares in the X-ray afterglow will also be presented.

4. **Maria Felicia De Laurentis**, Università Napoli

Title: **Probing GRBs progenitor mass by GW**

Abstract

We analyze a sample of 115 long gamma ray bursts in view of searching for the related emission of gravitational waves. Considering an un-modeled gravitational-wave burst, we suppose that the emission of gravitational waves comes out from an extreme stellar collapse where a neutron star or a black hole is the remnant of the gamma ray bursts progenitor. We make the assumption that energy realised by the progenitor during the collapse is partially converted in GW, namely EGW = kEiso, where k is a scaling factor. We take the extreme case in which k = 1 as the starting point to define the upper limits for the masses of the progenitors. From these upper limits we are able to define the possible amplitude of detection of gravitational waves. Finally, we verify how much percentage of the gamma ray burst Eiso is compatible with the binding energy of the collapsed object. Results seem reliable since the order of magnitude of gamma ray burst Eiso is compatible with the binding energy of the collapsed object. Furthermore, using a sample of short gamma ray bursts, we outline here the possibility to associate short Gamma Ray Bursts as electromagnetic counterpart of coalescing binary systems.

5. **Massimo Della Valle**, INAF, Osservatorio Astronomico di Capodimonte, Napoli

Title: **Supernovae vs. GRBs rates**

Abstract

In my talk, I'll provide an updated census of SN-GRBs associations and their frequency of occurrence.

6. **Simone Dichiara**, UNIFE, Department of Physics and Earth Sciences

Title: **A search for pulsations in short GRB to constrain their progenitors**

Abstract:

We searched for periodic and quasi-periodic signals in the prompt emission of a sample of 44 bright events detected with Fermi/GBM, Swift/BAT, and CGRO/BATSE. The aim was to look for the observational signature of quasi-periodic jet precession, which is expected from black hole (BH)–neutron star (NS) mergers, but not from double NS mergers. Thus, this kind of search holds the key to identifying the progenitor systems of short GRBs and, in the interim before gravitational wave detectors become on-lines, represents the only direct way to constrain the progenitors. We tailored our search to the nature of the expected signal by properly stretching the observed light curves by an increasing factor with time, after calibrating the technique with synthetic curves. None of our GRBs showed evidence for periodic or quasi-periodic signals. In particular, for the seven unambiguously short GRBs with the best signal-to-noise ratios, we obtained significant upper limits to the amplitude of the possible oscillations. This result suggests that BH–NS systems do not dominate the population of short GRB progenitors, as described by the kinematic model of Stone et al. (2013)

7. **Ruben Farinelli**, ISDC, Department of Astronomy, Université de Genève, Versoix, Switzerland

Title: **An up-scattering spectral formation model for the prompt emission of Gamma-Ray Bursts.**

**2. Implementation**

Abstract

Recently, it has been proposed a new model for explaining the prompt emission spectra of Gamma Ray Bursts. The main feature of the model is that the GRB spectra up to the peak energy in the EF(E) diagram originate from the Comptonization of a thermal bath of photons at few keV off a hot electron corona which moves outwardly at subrelativistic velocity. I will present a detailed mathematic treatment of the radiative transfer problem under these physical conditions, and the way how it was built GRBCOMP, the new XSPEC model which was successufully tested on a sample of GRBs. The analytical results are also compared with Montecarlo simulations in order to show the differences arising between approximate and exact treatment of the photon-electron interaction process.

8**. Filippo Frontera**, University of Ferrara, Department of Physics and Earth Sciences, and INAF-IASF, Bologna

Title: **Test results of spectral models of GRB prompt emission**

Abstract

We will present test results of spectral models of the GRB prompt emission that have recently been proposed. In particular, we test the photospheric model proposed by Ryde and Pe’er (2009), the addition of a blackbody emission to the Band function in the cases in which this function does not fit the data, and the Comptonization model developed by Titarchuk et al. (2012). The test of these models was performed by using the broad–band (2–2000 keV) time–resolved prompt emission spectra of a sample of Gamma-Ray Bursts (GRBs) detected with both the Wide Field Cameras (WFCs) aboard the BeppoSAX satellite and the BATSE experiment aboard CGRO. The peculiarity of this energy band is that the extension down to 2 keV is not covered by most missions devoted to GRBs, inclusive of the still operational missions, Swift and Fermi.

9. **Cristiano Guidorzi**, University of Ferrara, Department of Physics and Earth Sciences

Title: **Developments in GRB time variability**

Abstract

Time variability in GRB light curves keeps a wealth of information about the inner engine activity, which still needs to be deciphered into physics: e.g., what mechanism and where the prompt emission is produced, what kind of progenitor and physical process (e.g. hyperaccreting BH? Newborn magnetar?). I discuss recent developments we have been pursuing through different lines of research to tackle the problem of characterizing GRB variability, which is notoriously hampered by the limited duration and aperiodic nature of the signal.

10. **Eliana Palazzi**, INAF-IASF, Bologna

Title: **Evidence for an early-type post-starburst galaxy hosting the long GRB 050219A**

Abstract

We present a multi-band search for the host galaxy of the long dark GRB 050219A within the enhanced Swift/XRT error circle. In addition, we used spectroscopic observations acquired with VLT/X-shooter to determine the redshift and star-formation rate of its putative host galaxy and compared the results with its optical/IR spectral energy distribution. Surprisingly, this host is a 3 Gyr-old early-type galaxy at z = 0.2115 characterised by an unprecedentedly low specific star-formation rate. GRB 050219A is the first long burst discovered in an early-type post-starburst galaxy. This is further evidence that GRBs can explode in all kind of galaxies, with the only requirement being an episode of star-formation.

11**. Ester Piedipalumbo**, Università di Napoli

Title: **Cosmological scenarios and the GRBs high redshift Hubble diagram**

Abstract

The understanding of the accelerated expansion of the Universe poses one of the most fundamental questions in physics and cosmology today. Whether or not the acceleration is driven by some form of dark energy, and in the absence of a well-based theory to interpret the proposed to solve this problem, both in the context of General Relativity and alternative theories of gravity. Actually, a further possibility to investigate the nature of dark energy lies in measuring the dark energy equation of state (EOS), and its time (or redshift) dependence at high accuracy. However, since the EOS is not directly accessible to measurement, reconstruction methods are needed to extract it reliably from observations. We present results concerning different models of dark energy, described through several parametrizations of the EOS, and based on high-redshift Hubble diagram, consisting in the Union2 Type Ia Supernovae (SNIa) data set and the Hubble diagram constructed from some Gamma Ray Bursts (GRBs) luminosity distance indicators. It turns out that the dark energy equation of state is evolving for all the parametrizations that we considered.We compare these results with the ones obtained by means of a cosmographic approach performed on the same astronomical datasets, showing that the latter ones are sufficient to test and compare the new parametrizations. Implications on modified gravity theories are discussed.

12. **Silvia Piranomonte**, INAF, OAR, Monteporzio Catone (govedi’)

Title: **GRB afterglows and hosts studies with VLT/X-Shooter and other instruments**

Abstract

In this talk I will show the state of the art of our work on GRB afterglows and their hosts with the instrument X-Shooter. I will start with the work on GRB hosts we are collecting from the X-Shooter slit observations inside the Italian-French X-shooter GRB host galaxies program which started at the end of 2009 and which allowed us to collect the spectra of about 20 GRB host galaxies in the 300-2400nm range from a redshift of about z=0.1 to z=3.5. Considering that Gamma Ray Bursts (GRB) are supposed to explode in faint star forming galaxies they represent a very powerful way to investigate these kind of galaxies which seemed to be the bulk of galaxies at high redshift and to obtain a better estimate of the star formation density value. Currently observational estimates could underpredict ther real value of cosmic star formation density, because of their inability to observe this population of galaxies. We are using these spectra to retrieve information on the host metallicities, star formation rates and extinctions in order to better examine these kind of galaxies. Furthermore, we analyzed the X-shooter optical/IR spectra of GRB120327A. Its absorbing gas is constituted by at least three components, ~100-200 pc away from the GRB explosion site. The metallicity is ~-1 and molecular hydrogen has been detected in its host galaxy, which appears to be particularly massive if compared to canonical GRB hosts. Then we conducted an extensive campaign to follow up SN 2013dx, associated with GRB130702A with VLT/FORS2 and TNG/DOLoRes. The light curves and spectra match quite well that of SN 1998bw, and we deduced a progenitor mass, a 56Ni mass and a kinetic energy ~15-20% smaller than that of SN 1998bw.

13. **Piero Rosati**

Title: **Cosmological constraints over the next decade**

Abstract

14. **Disha Sawant**, UNIFE and University of Nice

Title: **Cosmology with GRBs**

Abstract

Given their huge isotropic–equivalent radiated energies, up to more than 10^54 Erg s−1 and their redshift distribution extending up to more than z = 8, Gamma Ray Bursts (GRB) are in principle, the powerful tools for measuring the geometry and expansion rate of the Universe. However, they are not standard candles given that their luminosities span several orders of magnitude, even when considering possible collimation angles. In the recent years, several attempts to exploit the correlation between the photon energy at which the νFν spectrum peaks (peak energy) and the radiated energy (or luminosity) for ”standardizing” GRBs and using them as tools, complementary to other probes like SN Ia, BAO and the CMB, for estimating cosmological parameters have been made. These studies show that, already with the present data set of GRBs can provide a significant and independent confirmation of ΩM <1 (and around ∼0.25) for a flat ΛCDM universe and that the measurements expected from present and next GRB experiments (Swift, Fermi/GBM, SVOM, UFFO) will allow us to constrain ΩM, ΩΛ and in particular, to get clues on dark energy properties and evolution.

15. **Lev Titarchuk**, University of Ferrara

Title: **An upscattering spectral formation model for the prompt emission of Gamma-Ray Bursts.**

**1. Theory**

Abstract

We propose a model for the spectral formation of Gamma Ray Burst (GRB) prompt emission, where the phenomenological Band's function is usually applied to describe the GRB prompt emission.We suggest that the GRB prompt emission is mainly a result of two up-scattering processes. The first process is the Comptonization of relatively cold soft photons of the star off electrons of a hot shell of plasma of temperature T\_e of the order of 10^9 K that moves sub-relativistically with the bulk velocity V\_b substantially less than the speed of light c. In this phase, the Comptonization parameter $Y$ is high and the interaction between a blackbody-like soft seed photon population and hot electrons leads to formation of a saturated Comptonization spectrum modified by the sub-relativistic bulk outflow. The second process is an up-scattering of the previously Comptonized spectrum by the plasma outflow once it becomes relativistic. This process gives rise to the high-energy power-law component above the peak in the EF(E)-diagram where F(E) is the energy flux. The latter process can be described by a convolution of the Comptonized spectrum with a broken-power-law Green function. Possible physical scenarios for this second up-scattering process are discussed. In the framework of our model, we give an interpretation of the Amati relation between the intrinsic spectral peak photon energy and radiated energy or luminosity, and we propose a possible explanation of the GRB temporal variability. We also discuss our GRB model in context of other GRB models where an Inverse-Compton scattering of hot cocoon radiation by a relativistic jet is suggested.