Supernovae

Contents

1 Topics

- Follow-up of Supernovae (Photometric and Spectroscopic Evolution, Rates)
- Supernova and Gamma-ray Burst connection
- Galactic and Extragalactic Novae
- Supernovae-Ia and Gamma-ray Bursts as rulers for cosmological parameters

1.1 ICRANet participants

- Carlo Luciano Bianco
- Filippo Frontera
- Luca Izzo
- Massimo Della Valle
- Lorenzo Amati

1.2 Past collaborators

- John Danziger (INAF-Trieste)
- Roberto Gilmozzi (ESO, Garching, Munchen)
- Mario Livio (STScI, Baltimore)
- Piero Madau (Santa Cruz, California University)
- Nino Panagia (STScI, Baltimore)
- Saul Perlmutter (Lawrence Berkeley National Laboratory, University of California)

- Sumner Starrfield (Arizona State University)
- Evan Scannapieco (Arizona State University)
- Guido Chincarini (Bicocca University, Milano) and the SWIFT team
- Bruno Leibundgut (ESO)

1.3 Ongoing collaborations

- Lorenzo Amati (INAF-Bologna)
- Filippo Frontera (Ferrara University)
- Roberto Gilmozzi (ESO, Garching, Munchen)
- Filippo Mannucci (INAF-Arcetri, Firenze)
- Dani Maoz (Tel-Aviv University)
- Francesca Matteucci (Trieste University, Trieste)
- Ken Nomoto (University of Tokyo)
- Nino Panagia (STScI, Baltimore)
- Andrea Pastorello (Queen's University, Belfast)
- Robert Williams (STScI, Baltimore)
- Martin Henze (Max-Planck)
- Giampiero Tagliaferri (INAF-Milano)
- Sergio Campana (INAF-Milano)
- Enrico Cappellaro (INAF-Padova)
- Massimo Turatto (INAF-Padova)
- Stephen Smartt (Queen's University, Belfast)
- Brian Schmidt (ANU, Canberra)

1.4 Sabatical Visits, 2005-2010

- European Southern Observatory, Munchen (2005)
- STScI, Baltimore, (2005)
- KAVLI Institute, Santa Barbara (2006, 2007)
- Tokyo University (2006)
- Dark Cosmology Center, Niels Bohr Institute, Copenhagen (2007)
- Aspen Center for Physics (2007)
- Queen's University, Belfast (2007)
- European Southern Observatory, Munchen (2008-2009)

1.5 Students

- Cristina Barbarino (IRAP PhD, Italy)
- Vahagn Harutyunyan (ICRAnet PhD, Italy)
- Renato Martone (Federico II, Master, Italy)

2 Brief description

My research field concern the study of several classes of transient phenomena such as: supernovae, gamma-ray bursts and classical novae .

Gamma-ray bursts and their Afterglows. My interest in this area started in 2000 when I became member of the SWIFT follow-up team. Most efforts were (and still are) devoted to the study of the connection between Supernovae and GRBs. About fifty refereed papers on GRB subject have been published in the last 15 years, mostly based on data collect with ESO telescopes. In **10** by using the XRT and UVOT instruments onboard the Swiftsatellite, we carried out a weekly cadenced, six-month monitoring of seven nearby NGC galaxies to search for shock break-out events like XRF 080109.

Supernovae. Photometric and the spectroscopic study of all types of SNe (Ia, Ib/c, II-linear, II-plateau) near maximum light and at late stages and their theoretical modeling. The observations at maximum provide us with the necessary data for using SNe (Ia and II) as standard candles. The observations at later stages allow one to discriminate among different energy sources (i.e. radioactive decay, magnetar, light-echo), to model the mechanisms of the explosion, and to shed light on the nature of the progenitor. Most observations are carrried out with ESO telescope in the framework of PESSTO collaboration. The new topic of Superluminous Supernovae have been dealt in **9** and **4**. In the latter paper we have explored the possibility that the huge amount of energy, several x $10^{52} erg, produced by the transient originate by tapingof the spin - energy of a rotating black hole$.

Search for the optical counterpart to the LIGO gravitational-wave sources . In the framework of PESSTO collaboration we have monitored several square degrees of sky to search for possible electromagnetic counterparts **2, 5, 7, 8, 11**. The search was unsuccessfully, however as by-product of this research, we were able to detect a number of transients which were the subject of further studies.

Supernovae at intermediate-high z. The study of Supernovae at intermediate redshifts has been carried out with VST telescope in the frameworkof the SUDARE collaboration. The evolution of the core collapse SN rate with

redshift contains unique information on the star formation history of the universe, the IMF of stars and the nature of the progenitors. See items **3, 12** for our most recent papers on the SN rate issue.

Novae. The systematic study of the composition of nova ejecta has been carried out in collaboration with Paolo Molaro, Luca Izzo et al. We have detected the resonance doublet lines ^{7}BeII at lambda 313.0583, 313.1228 nm in several non saturated and partially resolved high velocity components during the evolution of the outburst. We estimate an atomic fraction N(7Be)/N(Ca) $\sim$ 60. The detection of ^{7}Be in several high velocity components shows that it has been freshly created in a thermonuclear runaway via the reaction 3He(alpha,gamma) ^{7}Be during the Nova explosion, as postulated by Arnould and Norgaard, and Starrfield et al. The massive ^{7}Be ejecta result into a ^{7}Li production that is about 4.7-4.9 dex above the meteoritic abundance. If such a high production is common even in a small fraction ($\sim$ 5%) of Novae, they can make all the "stellar" ^{7}Li of the Milky Way **1**.

Cosmological Parameters with GRBs. SN-Ia observations in the 90's suggest that the Universe accelerates its expansion. On the other hands thecosmological interpretation of the excess of SN fading (about 20%) rely on the lack of evolutionary effects on progenitors of type Ia SNe. This situation calls for an independent measurement of the cosmological parameters besides the one obtained via SNe-Ia. We show that GRBs can be used to measure Ω_M and we find $\sim$ 0.3 (see Amati et al. 2008; and Amati & Della Valle 2013). This result has been confirmed through the use of an independent methodology. An upgrade version of the latter paper is going to be submitted before the end of the year.

New instrumentation to explore the time domain astronomy. In **6** we present the the status of the SOXS project. SOXS (Son Of X-Shooter) is a unique spectroscopic facility for the ESO-NTT 3.5-m telescope in La Silla, able to cover the optical/NIR band (350-1750 nm). The design foresees a high-efficiency spectrograph with a resolution-slit product of 4,500, capable of simultaneously observing the complete spectral range 350 - 1750 nm with a good sensitivity, with light imaging capabilities in the visible band. This instrument (+ NTT) is best suited to follow-up the LSST transients.

3 Publications 2016

refereed publications

1. *Highly enriched 7Be in the ejecta of Nova Sagittarii 2015 No. 2 (V5668 Sgr) and the Galactic 7Li origin*, Molaro, P, Izzo, L, Mason, E. et al. 2016, MNRAS, 463, L117

2.*Pan-STARRS and PESSTO search for an optical counterpart to the LIGO gravitational-wave source GW150914*, Smartt, S., Chambres, K., Smith, K. et al. 2016, MNRAS, 462, 4094

3.*Supernova rates from the SUDARE VST-Omegacam search II. Rates in a galaxy sample*, Botticella, M.T., Cappellaro, E., Greggio, L. et al. 2016, A&A, in press, arXiv161001176B

4. *On extreme transient events from rotating black holes and their gravitational wave emission*, van Putten, M. & Della Valle, M. 2016, MNRAS, in press, arXiv161000535V

5. *A Search for an Optical Counterpart to the Gravitational-wave Event GW151226*, Smartt, S., Chambres, K., Smith, K. et al. 2016, ApJ, 827, L40

6. *The new SOXS instrument for the ESO NTT*, Schipani, P. Claudi, R. Campana, S. et al. 2016, SPIE Astronomical Telescopes & Instrumentation 2016, paper 9908-152, 2016arXiv160703729S

7. *Supplement: Localization and Broadband Follow-up of the Gravitational-wave Transient GW150914* , Abbott, B., Abbott, R., Abbott, T. et al. 2016, ApJS, 225, 8

8. *Localization and Broadband Follow-up of the Gravitational-wave Transient GW150914*, Abbott, B., Abbott, R., Abbott, T. et al. 2016, ApJ, 826, L13

9. *On the nature of Hydrogen-rich Superluminous Supernovae*, Inserra, C., Smartt, S., Gall, E. et al. 2016, ApJ, submitted, 2016arXiv160401226I

10. *A time domain experiment with Swift: monitoring of seven nearby galaxies*, Andreoni, I, DAvanzo, P., Campana, S. et al. 2016, A&A, 587, 147

11.*Proposed searches for candidate sources of gravitational waves in a nearby core-collapse supernova survey*, Heo, J., Yoon, S., Lee, D. et al. 2016, NewA, 42, 24

12. *First Results from Supernova Diversity and Rate Evolution (SUDARE) Survey at VST*, Botticella, M.T., Cappellaro, E., Pignata, G. et al. 2016, The Universe of Digital Sky Surveys, Astrophysics and Space Science Proceedings, Volume 42., Springer International Publishing Switzerland, 2016, p. 197