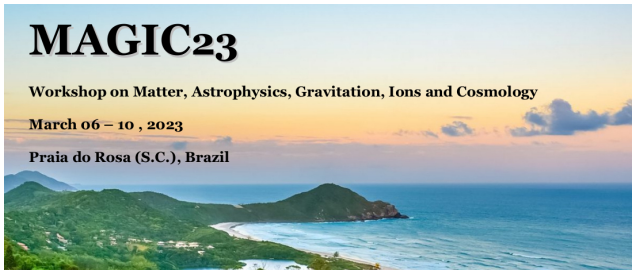

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The Physics and Astrophysics of GRBs

The observations of Ic supernovae (Ic/SNe) occurring after the prompt emission of long gamma-ray bursts (GRBs) are addressed within the binary-driven hypernova (BdHN) model. Here, the GRBs originate from a binary composed of a ~ 10M_⊠ carbon-oxygen (CO) star and a companion neutron star (NS). We assume these same progenitors originate from the Ic/SN. The binary evolution depends strongly on the binary period, P_bin. The trigger, given by the CO core collapse, for P_bin of up to a few hours leads to an Ic/SN with a fast-spinning NS (νNS) at its center. For Pbin ~ 4–5 min, BdHN I occur with 37 energies 10^52–10^54 erg, a contribution by the black hole (BH) created by the NS companion collapse, originating the Mev/GeV radiations. The ~ 1 millisecond νNS originates, by synchrotron radiation,the X-ray afterglow. For P_bin ~ 10 min, BdHN II occurs with energies of 10^50–10^52 erg. For P_bin ~ hours, BdHN III occurs with energies below 10^50 erg. The 1–1000 ms νNS, in all BdHNe, originates from the X-ray afterglow by synchrotron emission. The SN Ic follows an independent evolution, becoming observable by the nickel decay after the GRB prompt emission. We report 24 Ic/SNe associated with BdHNe, their optical peak luminosity and their time of occurrence are similar and independent of the associated GRBs. We give four examples of BdHNe and their associated hypernovae. We approach, for the first time, new physical processes in BdHNe; we identify seven episodes and their signatures in their spectra.

Author: RUFFINI, Remo (ICRANet)

Presenter: RUFFINI, Remo (ICRANet)

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