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Probing into emission mechanisms of GRBs using time-resolved spectra and polarization studies

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The emission processes responsible for the prompt emission of gamma-ray bursts (GRBs) are still an open question. Besides temporal and spectral properties, hard X-ray/ gamma-ray polarization measurement is thought to be a powerful tool for probing the radiation mechanisms of GRBs since the emission mechanisms invoked to explain prompt emission are associated with unique polarization signatures. Therefore, a detailed time-resolved spectro-polarimetric investigation of the prompt emission could provide insights into this long debatable problem. This work presents the timing, spectral, and polarimetric analysis of the prompt emission of bright bursts (specifically GRB 190530A) observed using the Cadmium Zinc Telluride Imager (CZTI) on-board *AstroSat* and *Fermi* gamma-ray space telescope to provide insight into the prompt emission radiation mechanisms. By performing a detailed time-resolved spectro-polarimetric study of these GRBs, we could pin down their elusive prompt emission mechanisms.

In the case of multi-pulsed GRB 190530A, the time-integrated spectrum shows conclusive proof of two breaks due to peak energy and a second lower energy break. Time-integrated (55.43 +/- 21.30 %) as well as time-resolved polarization measurements made by the CZT-Imager onboard *AstroSat*, show a hint of a high degree of polarization. The presence of a hint of the high degree of polarization and the values of low energy spectral index (α) do not run over the synchrotron limit for the first two pulses, supporting the synchrotron origin in an ordered magnetic field. However, during the third pulse, α exceeds the synchrotron line of death in a few bins, and a thermal signature along with the synchrotron component in the time-resolved spectra is observed. Furthermore, we also report the earliest optical observations constraining afterglow polarization using the MASTER ($P < 1.3$ %) and the redshift measurement ($z = 0.9386$) obtained with the 10.4m GTC telescopes.

Track

GRBs

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