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# Time-resolved spectro-polarimetric analysis of extremely bright GRB 230307A: Evidence of evolution from photospheric to synchrotron dominated emission

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The radiation mechanisms powering Gamma-ray bursts (GRBs) and their physical processes remain one of the unresolved questions in high-energy astrophysics. Spectro-polarimetric observations of exceptionally bright GRBs provide a powerful diagnostic tool to address these challenges. GRB 230307A, the second-brightest long-duration GRB ever detected, exhibits a rare association with a Kilonova, offering a unique and rare probe into the emission processes of GRBs originating from compact object mergers. We present a comprehensive time-averaged and time-resolved spectro-polarimetric analysis of GRB 230307A using joint observations from the AstroSat Cadmium Zinc Telluride Imager (CZTI), the Fermi Gamma-ray Burst Monitor (GBM), and Konus-Wind. Results. Spectral analysis reveals a temporal evolution in the low-energy photon index, ⊠, transitioning from a hard to a softer state over the burst duration. Time-averaged polarimetric measurements yield a low polarization fraction (< 12.7 %), whereas time-resolved polarization analysis unveils a marked increase in polarization fractions (> 49 %) in the later stages of the emission episode. This spectro-polarimetric evolution suggests a transition in the dominant radiative mechanism: the initial phase, characterized by thermal-dominated photospheric emission (unpolarized or weakly polarized), gives way to a regime dominated by non-thermal synchrotron emission (highly polarized). This transition provides critical evidence for the evolving influence of magnetic fields in shaping the GRB emission process and jet dynamics.

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