

Measurements of the optical spectral shape of early GRB emission from NUTTeLA-TAO

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Instruments such as the ROTSE, TORTORA, Pi of the Sky, MASTER-net, and others have recorded single-band optical flux measurements of gamma-ray bursts starting as early as ~ 10 seconds after gamma-ray trigger. The earliest measurements of optical spectral shape have been made only much later, typically on hour time scales, never starting less than a minute after trigger, until now. We designed and built a unique instrument, the Burst Simultaneous Three-channel Imager, mounted on the 700 mm aperture Nazarbayev University Transient Telescope at Assy-Turgen Astrophysical Observatory (NUTTeLA-TAO), to make these measurements. The system can point and track any celestial target above 15° altitude in ≤ 8 s, responding automatically to Swift and other real-time GRB alerts, with time resolution down to ~ 0.1 seconds. We observed GRB 201015A and GRB 200925B starting only 58 and 129 seconds, respectively, after the BAT trigger, measuring in three Sloan filter bands, g' , r' , and i' . We find that the majority of the optical spectral slope evolution is consistent with a monotonic decay of extinction, evidence of dust destruction. I also present the observations of GRB 230328B and GRB 231111A, which started 41 seconds after the trigger. Our work shows that significant information about the early emission phase is being missed without such early observations with simultaneous multi-band instruments.

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