What about the early spectral shape of GRB Ags?

Observations of gamma-ray bursts (GRBs), the universe’s most powerful cosmic explosions, have significantly advanced our understanding of high-energy astrophysical processes. Instruments such as ROTSE, TORTORA, Pi of the Sky, MASTER-net, and others have historically recorded single-band optical flux measurements of GRBs, typically starting as early as ~10 seconds after the gamma-ray trigger. However, the earliest measurements of the optical spectral shape have been made much later, usually on hour time-scales, and never starting less than a minute after the trigger, until now.

Our recent observations demonstrate that significant information about the early emission phase is missed without such early observations using simultaneous multiband instruments. Our telescope’s unique scientific capabilities enable us to study faster astrophysical transients, including GRBs and some of the most distant objects known. Since September 2020, we have been actively following up on GRB alerts, allowing us to capture crucial early data.

In this work, we report on two multiband observations of GRBs starting at 41 and 58 seconds after the trigger, which represent record-fast multiband observations of GRBs. These observations provide new insights into the early emission phase of GRBs, highlighting the importance of rapid-response, multiband observational strategies in capturing the full temporal and spectral evolution of these extraordinary events.

GRB201015A

The light curve above shows the light curve in the three optical bands and X-rays. All bands generally follow a power law ($\text{flux} \propto t^{-\beta}$). Our data show strong color evolution from red to blue, consistent with the destruction of cosmic dust by the strong UV emission from the explosion. The log slope of the optical spectrum changed (got less steep) by $+0.72 \pm 0.14$; during this time the X-ray log slope remained constant (dust strongly affects blue light but not X-rays). This is one of the first observation of this phenomenon, only possible with very early observations. See Komesh et al. 2023+ for details.

GRB230328B

This figure shows the GRB 230328B light curve in three different colors. This reveals a flare activity occurring between ~2,000 seconds and ~6,500 seconds. We reported our measurements via the GCN platform (see Komesh et al. 2023+). Currently, we are performing a thorough analysis of the data.

Observations

The two GRBs that we observed are known under names GRB201015A and GRB230328B. We started observing the latter at UT 2020 October 15, 22:51:11, 58 seconds after the Swift BAT trigger. The GRB230328B events was observed starting 41 after the trigger. The cameras used exposures of 7.5 s and 15 s in the first 60 and 1635 s and exposure of 30 s thereafter. The five sigma upper limit sensitivities are 17.7, 18.2, and 17.7 mag for green, red, and infrared filter images.

Conclusion

- We have observed GRB 201015A and GRB 230328B using green, red, and infrared filter bands. We thoroughly analyzing their temporal and spectral properties.
- Our observations of the early afterglow GRB201015A reveal the presence of a colour variation.
- We find that most of the optical spectral slope evolution, coupled with no change in the X-ray temporal slope, are consistent with a monotonic decay of extinction. This provides evidence for dust destruction.
- This work shows early multi-color observations of GRBs reveal unprecedented insight that is not possible to obtain with late-time observations. We plan to measure more GRBs and create a catalogue of spectral shape measurements covering a wide variety scenarios.

References