A Strong Limit on the Very-High-Energy Emission from GRB 150323A

Last Updated Wednesday, 09 May 2018 03:57

The Swift-BAT lightcurve for GRB 150323A. For details, see Figure 1 below.  

Reference:  
A.U. Abeysekara et al. (The VERITAS Collaboration), Astrophysical Journal 857: 33, 2018

Full text version  
ArXiv: ArXiv:1803.01266  
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To date, no gamma ray burst (GRB) has been detected either at VHE energies (> 100 GeV) by imaging atmospheric Cherenkov telescopes (IACTs), or at energies above 10 TeV by air-shower detectors. GRBs remain elusive but potentially exciting targets for VHE detectors and have the highest observation priorities for a source in the VERITAS field of view, barring any safety constraints. GRBs are thought to be powered by ultra-relativistic jets associated with the birth of a compact object. The bulk of the radiation from a GRB is typically received over several seconds (which is why prompt follow up observations are critical), peaking at energies of a few 100 keV. More long-lived afterglow emissions have been observed across the entire electromagnetic spectrum from radio to GeV gamma rays. The few bursts that have been detected by the Fermi-Large Area Telescope (LAT) show a hard photon spectral index without any high energy spectral break or cut off. This indicates that there could be emission above 100
GeV, and IACTs with their large effective areas could potentially detect the afterglow emission. The detection of TeV emission from a nearby, bright burst could provide a relatively clean probe of the GRB environment and early blast wave evolution.

This article reports VERITAS observations of the GRB 150323A at a redshift of 0.593, first reported by the Swift Burst Alert Telescope (BAT) instrument. The VERITAS observations began only about two minutes after the prompt emission peaked at BAT energies. No statistically significant VHE gamma ray flux was detected by VERITAS above 140 GeV, and a flux upper limit of approximately 1% of the prompt fluence was determined for a 40-minute observation window. VERITAS has detected VHE emission from blazars out to a redshift of ~1. The proximity of GRB 150323A limits the attenuation by the extragalactic background light to ~50% in the energy range of 100 to 200 GeV. The non-detection of GRB 150323A at VHE energies thus allows us to place interesting constraints on the GRB environment. We conclude that GRB150323A had an intrinsically very weak high-energy afterglow, or that theGeV spectrum had a cut-off around 100 GeV. If the GRB exploded into the stellar wind of a massive progenitor, the VHE non-detection constrains the wind density parameter to be consistent with a standard Wolf–Rayet progenitor. Alternatively, the GRB environment could be a low-density medium such as the interstellar medium (ISM), in which case the VHE emission from the blast wave would be weak. We conclude that the ISM cannot be ruled out as the environment of GRB 150323A.

FITS files: N/A

Figures from paper (click to get full size image):
Figure 1: The Swift-BAT lightcurve for GRB 150323A, showing both the precursor and the main emission period. The different coloured plots correspond to various energy bands observed by BAT as indicated in each subplot. Taken from the batgrbproduct analysis page: http://gcn.gsfc.nasa.gov/notices/635887/BA/.