

GRBs and their afterglows at VHEs

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Recently, the observational study of gamma-ray bursts (GRBs) in the very-high-energy (VHE) regime has advanced with several long-awaited detections with MAGIC and H.E.S.S. telescope systems. Currently, the list of GRBs with robustly measured VHE emissions contains GRB 180720B, GRB 190114C, and GRB 190829A. Three more bursts were reported as source candidates by the MAGIC Collaboration. This candidate list includes a short GRB, which was detected with low significance (GRB 160821B), and a very distant GRB 201216C (from $z=1.1$), which was detected with high significance ($>5\sigma$). Although in the latter case the analysis has still a preliminary status. Detection of GRB afterglows in the VHE regime allows obtaining essential information on particle acceleration by relativistic shock waves. This makes GRB afterglows to be important sources for high-energy astrophysics and their studies have an exceptionally broad scope. However, the extragalactic origin of GRB implies a severe constrain for their observational study in the VHE domain. Namely, attenuation of multi TeV photons by extragalactic background light (EBL) becomes significant at cosmological distances. The EBL absorption hardens the detection of GRBs and deforms their TeV spectrum, which makes nearly impossible any reliably determination of the intrinsic gamma-ray spectrum. The fortunate proximity of one of the detected GRBs (GRB 190829A occurred at $z\sim 0.08$) allowed an unexpectedly long signal detection, up to 56 hours after the trigger, and accurate spectral determination in a broad energy interval, spanning between 0.18 and 3.3 TeV. The obtained temporal and spectral properties of the VHE emission appeared to be remarkably similar to those seen in the X-ray band with Swift-XRT. Comparison to other detected GRB afterglow shows that SEDs and lightcurves obtained from GRBs share much in common, which disfavors the chances for GRB 190829A being an exceptional event. This suggests a need for a revision of the theoretical scenarios used to predict the broadband emission from GRB afterglows.

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