

Intergalactic electromagnetic cascade echo from GRB 190114C

Wednesday, 1 September 2021 17:45 (15)

Primary very high energy (VHE, $E > 100$ GeV) gamma-rays from distant (redshift $z > 0.1$) extragalactic gamma-ray sources are partially absorbed on extragalactic background light (EBL) photons by means of the pair production process $\gamma\gamma \rightarrow e^+e^-$ with the subsequent formation of intergalactic electromagnetic cascades through inverse Compton scattering of secondary electrons (mostly on cosmic microwave background (CMB) photons). These electrons get deflected in the extragalactic magnetic field (EGMF); therefore, the parameters of the observable gamma-ray flux are sensitive to the EGMF strength and structure. The weakest EGMF (magnetic field strength $B < 100$ aG) could, in principle, be probed through the observation of gamma-ray bursts with imaging atmospheric Cherenkov telescopes (IACTs) and space gamma-ray telescopes such as Fermi-LAT. The gamma-ray burst GRB 190114C was detected with the MAGIC IACTs in the 200 GeV – 1 TeV energy range, for the first time allowing us to estimate the observable intensity of cascade gamma-rays robustly. In this work we present detailed calculations of the observable cascade signal for various assumptions about the strength of the EGMF. We perform an analysis of the publicly available dataset of the Fermi-LAT telescope and derive upper limits on the intensity of the intergalactic pair echo. We show that the sensitivity of Fermi-LAT is not sufficient to obtain any constraints on the EGMF parameters. However, next-generation space gamma-ray observatories would be able to detect pair echoes from GRBs similar to GRB 190114C for the EGMF strength below 1-10 aG.

Reference to paper (DOI or arXiv)

doi: 10.1103/PhysRevD.102.123017 arxiv: <https://arxiv.org/abs/2002.06918>

Your gender (free text)

Primary author(s) : DZHATDOEV, Timur (Moscow State University); PODLESNYI, Egor (Moscow State University); VAIMAN, Igor (Moscow State University)

Presenter(s) : DZHATDOEV, Timur (Moscow State University)

Session Classification : Discussion Panel HE astrophys. & CRs/Multi-messenger astronomy 2

Track Classification : High Energy Astrophysics, Cosmic Rays and Multimessenger Astronomy