Contribution ID: **72** Type: **poster**

Constraints on the intergalactic magnetic field strength from gamma-ray observations of GRB 221009A

TeV gamma-ray sources can be used to constrain the Intergalactic Magnetic Fields (IGMF), which provides an important clue on the origin of the seed field in early university. TeV photons from very-high-energy (VHE) transient sources such as Gamma-ray burst (GRB) are absorbed on Extragalactic Background Light (EBL), and then create eˆ+eˆ- pairs that will radiate delayed, secondary GeV photons by interacting with Cosmic Microwave Background (CMB) photons. Characteristics of the observable cascade gamma-ray signal are sensitive to the strength and structure of the IGMF. There has been a debate on whether GRB 190114C, the first GRB with bright TeV photons, can constrain the IGMF. Recently, LHAASO detected the brightest-of-all-time GRB 221009A, which has much larger energy in TeV band and the spectrum extends to energy above 10 TeV, providing an unprecedented chance to studying the cascade emission. By comparing it with the flux limit obtained from Fermi-LAT observations, we infer a limit of > 10ˆ{-18.5} Guass for IGMF. For the 397 GeV photon arrived at 0.4 day after GBM trigger time, we find that the probability that it results from the cascade process is only 0.8%.

Summary

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