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Intergalactic electromagnetic cascades from extreme TeV blazars

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Extreme TeV blazars (ETB) are active galactic nuclei that have intrinsic spectral energy distribution (SED) peaked at an energy E>1 TeV. ETB, defined solely by very high energy (VHE, E>100 GeV) gamma-ray properties, have much in common with extreme highly peaked BL Lac objects (EHBL) [1], defined by broadband (in particular, X-ray) properties. Indeed, some blazars such as 1ES 0229+200 and 1ES 0347−121 may be classified as both ETB and EHBL. Compared to well-known nearby blazars such as Mkn 501 and Mkn 421, ETB, as a rule, reveal hard observable spectra and weak, slow variability in the high energy (HE, E>100 MeV) and VHE spectral bands. These peculiar properties of ETBs allow for a possibility that a significant part of observable gamma-rays were in fact produced not inside the source, but as the result of electromagnetic cascade development in the intergalactic medium, where the extragalactic background light (EBL) and cosmic microwave background (CMB) dominate over intrinsic photon fields of the source, and the extragalactic magnetic field (EGMF) dominates over intrinsic magnetic fields. We discuss this "intergalactic cascade hypothesis"for ETBs in details and show that: 1) The "absorption-only model"that accounts for only the $\gamma\gamma \rightarrow e^+e^-$ pair production process and adiabatic losses and neglects secondary (cascade) flux faces significant difficulties; 2) All contemporary observations may be qualitatively accomodated in the framework of the "electromagnetic cascade model"that includes inverse Compton (IC) cascade flux;
3) The "basic hadronic cascade model"which assumes that all observable HE and VHE gamma-rays were produced in the intergalactic medium by primary ultra-high energy (UHE) cosmic rays (CR), is disfavoured due to a combination of source-intrinsic effects (such as the broadening of the primary CR beam in magnetic fields around the source) and the angular broadening of the observable gamma-ray image due to deflection of primary protons in filaments of the large scale structure.
A description of our calculations and discussion of our results is available in [2-4].
References
1. G. Bonnoli et al., MNRAS, 451, 611 (2015)
2. T.A. Dzhatdoev et al., A&A, 603, A59 (2017)
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Are you presenting on behalf of collaborations or institutions?

no

Primary author: DZHATDOEV, Timur (SINP MSU Moscow)

Presenter: DZHATDOEV, Timur (SINP MSU Moscow)

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