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Cascade gamma rays as a probe of the high-energy universe: general constraints, hints, and implications
KOHTA MURASE, Inst for Advanced Study

Very-high-energy (VHE) and ultra-high-energy (UHE) gamma rays from extragalactic sources experience electromagnetic cascades during their propagation in intergalactic space. Recent observations by Fermi and Cherenkov telescopes allow us to get more insight into VHE and UHE gamma-ray emitters. The latest Fermi data on the diffuse gamma-ray background have provided us with powerful constraints on potential cosmic-ray sources and annihilating/decaying dark matter, as well as a possible hint of the cascades. The relevance of the cascades is also motivated by some extreme blazars seen in the VHE range, and understanding such VHE gamma-ray sources is relevant to constrain intergalactic magnetic fields in voids and identify extragalactic cosmic-ray sources.