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Time dependence of AGN pair echo, and halo emission as a probe of weak extragalactic magnetic fields

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Gamma-rays with energy exceeding 100 GeV emitted by extragalactic sources initiate cascades in the intergalactic medium. The angular and temporal distribution of the cascade photons that arrive at the Earth depend on the strength and configuration of extragalactic magnetic fields in the line of sight. For weak enough fields, extended emission around the source (halo) is expected to be detectable, and the characteristics (angular size, energy dependence, and shape) of this emission are a sensitive probe of EGMF strength and correlation length. We model the expected spectra and angular profiles of blazars, and misaligned active galactic nuclei (radio-galaxies) in a wide range of parameter space of the extra-galactic magnetic field strength and correlation length, which is unconstrained by existing measurements. Our calculations focus on the time dependence of such halo emission, which is being discussed for the first time in this work. We present the competitive bounds on/measurement of the extragalactic magnetic field strength and correlation length that are implied by the absence/detection of such, extended emission, in stacked searches of GeV halo emission by blazars, and radio-galaxies.

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