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Detecting extended gamma-ray emission with the next generation Cherenkov telescopes

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Very high energy (VHE > 100 GeV) gamma rays coming from blazars can produce pairs when interacting with the Extragalactic Background Light (EBL), initiating an electromagnetic cascade. For a non-null Intergalactic Magnetic Field (IGMF), this cascade may result in an extended isotropic emission of photons around the source (halo), or in a broadening of the emission beam, depending on the IGMF intensity. The detection of these effects may lead to important constrains on both the IGMF intensity and the EBL density, quantities of great relevance in astrophysics and cosmology.
Since the gamma ray extended emission was proposed, several groups have tried unsuccessfully to observe it using different approaches [1-5]. The next generation of Cherenkov telescope systems, with an order of magnitude more sensitivity and better angular resolution, might be able to distinguish this effect.

Using a Monte Carlo program, we simulate electromagnetic cascades coming from a blazar at redshift z=0.14, which is in principle an ideal distance for potentially observing the effect [6]. We have previously reported a calculation for a monochromatic source [7]. In this work the spectrum of the gamma ray source 1ES 0229+200 (hard spectrum) is used as the input photon distribution, which is injected to space within a 6 degree cone to simulate a blazar jet scenario. We study the possible detection of this gamma ray flux considering a generic future Cherenkov telescope system whose sensitivity, effective collection area, and angular resolution are characterized by a simplified analytical model [8]. Combining the properties of this detector, we calculate the telescope system point spread function (PSF). We simulate the angular distribution of the gamma rays detected under two situations (null and non-null IGMF intensity) and convolve them with the PSF to simulate the observed angular photon distribution. Finally we develop a method for testing the statistical feasibility of detecting the extended gamma ray emission effect by comparing these two distributions.

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Collaboration

– not specified –

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