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Compton-induced cascade γ-rays in the radio galaxy NGC 1275

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Among the active galactic nuclei (AGNi), blazars are the brightest emitters of high- (HE, $E \geq 100\,\mathrm{MeV}$) to very-high-energy (VHE, $E \geq 100\,\mathrm{GeV}$) γ-rays from their jets. Radio galaxies, being the misaligned parent population of the blazar class, were historically not observed at these frequencies. However, there is a growing number of radio galaxies detected in HE–VHE γ-rays in recent years. In this work, we leverage and refine a Monte-Carlo photon and electron-positron ($e^{\pm}$) tracking code in the AGN environment of the radio galaxy NGC 1275. In the code, we consider the isotropic broad emission line and Shakura-Sunyaev (SS) accretion disk radiation fields, with mild magnetic fields in the AGN environment. We find that cascade γ-rays from the inverse-Compton scattering by relativistic $e^{\pm}$ pairs of these external radiation fields can explain the \emph{Fermi} Large Area Telescope's (LAT) observation of the radio galaxy NGC 1275. We present a set of parameters obtained from the code and fit the source's spectral energy distribution during the flaring events recorded in December 2022 and January 2023.

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