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Ultra-high Energy Inverse Compton Emission from Galactic Electron Accelerators

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With the High-Altitude Water Cherenkov Observatory (HAWC), the Large High Altitude Air Shower Observatory (LHAASO), and the future SWGO and CTA observatories, our view of the gamma-ray sky above 100 TeV energies will improve rapidly. It is generally held that emission at such high energies from astrophysical objects unambiguously demonstrates the presence of PeV protons or nuclei, due to the unavoidable Klein–Nishina suppression of inverse Compton (IC) emission from electrons. However, if the spectrum of accelerated electrons is hard enough in the Klein-Nishina regime, significant leptonic IC emission >100 TeV is possible. Such spectra occur as the result of equilibrium between particle injection and energy losses in IC cooling dominated environments. We show that the environmental requirements can naturally be met in spiral arms, and in particular in regions of enhanced star formation activity. These are also the natural locations for the most promising electron accelerators: powerful young pulsars. Regions with magnetic fields less than a few micro Gauss, for example associated to superbubbles, exhibit the required conditions irrespective of infrared or optical radiation fields due to the omnipresence of the cosmic microwave background. Our scenario suggests a population of hard ultra-high energy sources is likely to be revealed in future searches, and may also provide a natural explanation for the 100 TeV sources recently reported by HAWC.

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High energy astrophysics; Gamma-rays; Pulsars; Inverse Compton emission; Radiation dominated cooling; HAWC; Galactic

Collaboration

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Subcategory

Theoretical Results

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