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Small-Scale Magnetic Fields are Critical to Shaping Solar Gamma-Ray Emission

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The Sun emits gamma rays ranging from several hundred MeV to 1 TeV through hadronic cosmic ray interactions with the solar atmosphere. A critical factor influencing this phenomenon is the reflection of cosmic rays by solar magnetic fields in the photosphere and the upper convection zone. In this talk, I will present a simplified solar magnetic flux tube structure that combines network elements and granular sheets, which serve as sites for gamma-ray emissions from hadronic cosmic-ray showers. Our findings reveal a gamma-ray spectrum, including the spectral index and overall magnitude, that aligns well with Fermi-LAT data at 1-200 GeV and HAWC at 1 TeV. I propose that solar gamma-ray observations offer a novel means to probe small-scale magnetic fields in the quiet Sun.

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