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Solar disk gamma-rays emission via synthetic magnetic turbulence canopy from photosphere to low corona

Gamma-ray emission in the GeV-TeV range from the solar disk (observed by Fermi-LAT and HAWC) is likely to arise from collisions of galactic cosmic rays (GCRs) with solar atmospheric plasma. We model the photo-/chromospheric magnetic field with a static, laminar structure of open field lines in the chromosphere increasingly braiding near the solar surface, with a typical scale height of 0.01 solar radii. The height-dependent increase in magnetic turbulence strength is modulated by an exponential scalar function. Employing 3D test-particle numerical simulations (with PLUTO code) and empirical models for hadronic inelastic collisions, we investigate how such distorted magnetic field lines affect the gamma-rays flux by injecting GeV-TeV protons into both laminar and turbulent regions, as a function of the turbulence strength.
Our findings show that the turbulent magnetic structures can account for the gamma-ray spectrum observed by Fermi-LAT/HAWC, in producing a nearly power law dependence on energy. A rebrightening between approximately 30 and 100 GeV (following a yet unexplained ˜ 30 GeV spectral dip), suggests an enhanced confinement within the turbulent photo-/chromospheric layer by a strong turbulence.

Collaboration(s)

Authors: FRASCHETTI, Federico (Center for Astrophysics | Harvard & Smithsonian); Dr PUZZONI, Eleonora; GIACALONE, Joe (University of Arizona); KOTA, Jozsef (University of Arizona)

Presenter: FRASCHETTI, Federico (Center for Astrophysics | Harvard & Smithsonian)

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