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Surprising Variation of Gamma Rays from the Sun over the Solar Cycle Revealed with Fermi

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The steady-state gamma-ray emission from the Sun arises from interactions with Galactic cosmic rays and consists of two components: (1) a hadronic disk component and (2) a leptonic component peaking at the solar edge and extending into the heliosphere. Their flux is expected to vary with the 11-year solar cycle, peaking at solar minimum due to the higher cosmic-ray flux. However, no previous study has separately analyzed the temporal evolution of these components over multiple solar cycles.

This work focuses on investigating the flux variation of each component over 15 years of Fermi Large Area Telescope observations. We analyze their temporal evolution and compare the results with the sunspot number and Galactic cosmic-ray flux from AMS-02. We confirm that the disk component anticorrelates with solar activity and correlates with cosmic-ray protons, supporting the expected emission mechanism. The extended component also exhibits variability with the solar cycle, but its behavior suggests a more complex cosmic-ray transport and modulation in the inner heliosphere than previously assumed or hints at the presence of an additional, unknown gamma-ray or cosmic-ray source.

Collaboration(s)

Fermi-LAT Collaboration

Author: RAINO', Silvia (Dipartimento di Fisica, Università di Bari & INFN - Bari)

Co-authors: ORLANDO, Elena (Stanford University); GIGLIETTO, nicola (infn-bari)

Presenter: RAINO', Silvia (Dipartimento di Fisica, Università di Bari & INFN - Bari)

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