Contribution ID: **151** Type: **Talk**

Probing Galactic cosmic rays with $gamma$-ray observations of giant molecular clouds

Monday 19 July 2021 18:12 (12 minutes)

High-energy γ rays originating from interactions of cosmic rays (CRs) with the interstellar medium (ISM) carry direct information about the spatial and spectral distribution of these relativistic particles. Observations of Fermi-LAT of the diffuse gas show enhanced emission in the region around 4 kpc from the Galactic center. Analyses of the diffuse emission however are performed on a large spatial scale, usually of several kpc^2. Giant Molecular clouds instead are a unique tool, which can be used as 'barometers'to infer the cosmic-ray density point by point, in distant and small regions of the Galaxy. Their enhanced density ($n_H > 100$ cm^{-3}), compared to the diffuse gas, allows us to derive the CR energy density on scales comparable to the size of the clouds (10–100 pc). We report here the results of the analyses of Fermi-LAT Pass8 data, obtained in the direction of molecular clouds located in the entire galactic disk from 0.1 kpc to 12 kpc from the Galactic Center (GC). The CR densities measured at the locations of these clouds have a high degree of fluctuation and are not always compatible with the values derived from the diffuse gas. That can be explained if the cosmic-ray density gradient, inferred from the diffuse gamma-ray emission, is the result of the presence of recently accelerated cosmic-rays.

Keywords

Cosmic Rays; Giant Molecular Clouds; Gamma-rays; Fermi-LAT

Collaboration

other Collaboration

Subcategory

Experimental Results

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Session Classification: Discussion

Track Classification: Scientific Field: GAD | Gamma Ray Direct