

# Study of the Cosmic Rays and Interstellar Medium in local HI Clouds using Fermi-LAT Gamma-Ray Observations

Thursday 5 December 2019 15:35 (20 minutes)

An accurate estimate of the interstellar gas density distribution is crucial to understanding the interstellar medium (ISM) and Galactic cosmic rays (CRs). However, a significant amount of gas not traced properly by standard radio line surveys (“dark gas”) has been preventing accurate measurement of the total neutral gas column density and CR intensity. To overcome this difficulty, we performed a detailed study of the ISM and CRs in the mid-latitude region of the third quadrant. We used the *Fermi*-LAT data in the 0.1-25.6 GeV range and other interstellar gas tracers such as the HI4PI survey and the *Planck* dust model. Even though this region was analyzed in an early publication of the *Fermi*-LAT collaboration using six months of data, the analysis was significantly improved using eight years of *Fermi*-LAT data with the aid of newly available gas tracers and with the northern and southern regions treated separately. We used  $\gamma$ -rays as a robust tracer of the ISM gas and obtained the integrated  $\gamma$ -ray emissivities above 100 MeV as  $(1.58 \pm 0.04) \times 10^{-26}$  photons  $\text{s}^{-1} \text{sr}^{-1} \text{H-atom}^{-1}$  and  $(1.59 \pm 0.02) \times 10^{-26}$  photons  $\text{s}^{-1} \text{sr}^{-1} \text{H-atom}^{-1}$  in the northern and southern regions, respectively, supporting the existence of a uniform CR intensity in the vicinity of the solar system. Our emissivity agrees with the calculation using the model based on the directly measured CR proton spectrum. However, we caution that the uncertainty of the  $\gamma$ -ray emissivity model is still at the 20% level. In this contribution, we will present the details of the data analysis, results, and implications of CRs and ISM in the local environment.

**Authors:** MIZUNO, Tsunefumi (Hiroshima University); ON BEHALF OF THE FERMI-LAT COLLABORATION

**Presenter:** MIZUNO, Tsunefumi (Hiroshima University)

**Session Classification:** Parallel

**Track Classification:** Cosmic rays