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Constraints on the pair injection of pulsar halos: Implications from the Galactic diffuse multi-TeV gamma-ray emission

Diffuse gamma-ray emission (DGE) has been discovered over the Galactic disk in the energy range from sub-GeV to sub-PeV. While it is believed to be dominated by the pionic emission of cosmic ray hadrons via interactions with interstellar medium, unresolved gamma-ray sources may also be potential contributors. TeV gamma-ray halos around middle-aged pulsars have been proposed as such sources. Their contribution to DGE, however, highly depends on the injection rate of electrons and the injection spectral shape, which are not well determined based on current observations. The measured fluxes of DGE can thus provide constraints on the injection of the pulsar halo population in turn. We estimate the contribution of pulsar halos to DGE based on the Australia Telescope National Facility pulsar samples with taking into account the off-beam pulsars. The recent measurement on DGE by Tibet ASγ and an early measurement by Multiple Institution Los Alamos Gamma Ray Observatory (MILAGRO) are used to constrain the pair injection parameters of the pulsar halo population. Our result may be used to distinguish different models for pulsar halos.

Summary

Primary authors: YAN , Kai (Nanjing University); LIU, Ruoyu (Nanjing University)

Presenter: YAN , Kai (Nanjing University)