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Cosmic-ray propagation in the Galaxy: Insights from the diffuse emission and TeV halos

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Gamma-ray observations provide important information on cosmic-ray (CR) propagation in our Galaxy.
First, we present a new model of CR propagation in the Milky Way, where CRs are injected at discrete transient sources in the disc. We then calculate the corresponding diffuse Galactic gamma-ray emission. We find that the diffuse gamma-ray emission at >˜ 100 TeV is very clumpy, and does not correlate with the gas density along the line of sight. It is substantially different from the relatively smoother emission detected by Fermi at ˜ GeV energies. We also discuss how many (hadronic) PeVatrons would be detectable in our simulations, and compare our predictions with LHAASO data. We show that this allows to place interesting constraints on CR transport in the Galaxy.
Second, we discuss detected TeV halos. We show that current gamma-ray measurements place interesting constraints on the turbulent magnetic fields around these pulsars, and we examine the implications for CR transport. Also, we suggest that extended gamma-ray sources of a hadronic origin should exist in the data. We show that such a source may exist in the AS-gamma data at 398-1000 TeV. Observations of this new type of sources could be used to constrain the Galactic magnetic field geometry.

Summary

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