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Galactic CR sources: Insights from the diffuse emission, TeV halos, and the CR anisotropy (remote)

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We present two models of CR transport in the Galaxy. One with isotropic diffusion, and another one with anisotropic diffusion, where CRs are propagated in Galactic magnetic field models. In both models, CRs are injected at discrete transient sources in the disc. We calculate the corresponding diffuse Galactic gamma-ray emissions. We find that the emission at $> \sim 100$ 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 \sim GeV energies. We then discuss how many PeVatrons would be detectable in our simulations (hadronic and leptonic), and compare our predictions with LHAASO data. We show that this allows to place interesting constraints on the nature and properties of PeVatrons.

Moreover, 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. We also discuss the case of another type of extended sources, TeV halos, and show that some may lead to the appearance of spurious “mirage” gamma-ray sources with no counterparts.

Finally, we discuss the implications of the observed TeV-PeV cosmic-ray anisotropies, and present a new calculation of their expected angular power spectrum.

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