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Vicissitudes in the propagation of highly-energetic gamma rays in our Galaxy

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Recent gamma-ray observations detect photons up to energies of a few PeV. These highly energetic gamma rays are emitted by the most powerful sources in our galaxy. Propagating over astrophysical distances, gamma rays might interact with background photons producing electron-positron pairs, then deflected by astrophysical magnetic fields. In turn, these charged particles might scatter through inverse Compton the galactic radiation fields, triggering electromagnetic cascades. In this scenario, the characterisation of astrophysical environment in which gamma rays travel, specifically background photons and magnetic fields, is crucial. We explore the impact of propagation effects on observables at Earth by simulating galactic sources emitting gamma rays with energy between 100 GeV and 100 PeV. We analyse the imprint of the galactic environment on observed energy spectra and arrival direction maps, revealing gamma-ray absorption features in the former and "deflection" of gamma rays in the latter. Specifically, owing to interstellar radiation field spatial distribution and the galactic magnetic field structure, propagation effects on observables are found to be closely related to the specific gamma-ray source position and to the prompt emission model.

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