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A new self-consistent model for the VHE Galactic gamma-ray and neutrino emissions

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In this work, we present the first example of a self-consistent 3D modeling of the VHE (>100TeV) cosmic ray (CR) distribution in our Galaxy, by injecting CRs at individual discrete transient sources in the Galactic disc, and propagating them from first principles by integrating their trajectories in models of the Galactic magnetic field. We then calculate the resulting VHE secondary gamma-rays and neutrinos from these CR distributions. Our model predicts in a self-consistent way the number of visible point gamma-ray sources, extended gamma-ray sources and the diffuse gamma-ray emission from our Galaxy. We find that the VHE diffuse Galactic gamma-ray emission is very clumpy at >˜ 400 TeV, as observed by AS-gamma and LHAASO experiments. We then compare our predictions for the number of detectable hadronic and leptonic gamma-ray sources to the existing gamma-ray data from LHAASO. We show how comparing our new model predictions to such observations allows to constrain important unknown astrophysical parameters, such as the rate of PeVatrons in our Galaxy.

References:
Giacinti, Koldobskiy & Semikoz, In prep. (2025)
Giacinti & Semikoz, “Model of Cosmic Ray Propagation in the Milky Way at the Knee” (2023), arXiv:2305.10251

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