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Microquasars as the main Galactic PeVatrons

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Recently, LHAASO published its measurement of the Galactic diffuse gamma-ray emission in the $\mathrm{TeV} - \mathrm{PeV}$ range, which seemed to be 2 to 3 times higher than theoretical expectations. To explain the apparent discrepancy, an important contribution from a population of unresolved pulsars or important spatial variations in the cosmic-ray density have been proposed. We show through a robust data-driven approach based on the ATNF and LHAASO catalogs that the contribution of unresolved pulsars can hardly reach 50% around $30\,\mathrm{TeV}$ and is smaller than 25% of the flux of LHAASO at $100\,\mathrm{TeV}$ [1]. On the other hand, we find that forecasting a small number of ~ 10 microquasars acting as powerful PeVatrons [2] leads to a self-consistent description of our Galaxy at very-high-energy. In this scenario, the cosmic-ray spectrum and the LHAASO data in the $\mathrm{TeV} - \mathrm{PeV}$ range are well-fitted owing to the important fluctuations in the cosmic-ray density induced by the small number of sources, while the number of detectable microquasars above $100\,\mathrm{TeV}$ remains consistent with the latest LHAASO detections. We conclude that our findings support the picture in which the high-energy end of the Galactic cosmic-ray spectrum is dominantly, if not entirely, contributed by a small subset of very powerful microquasars.

[1] S. Kaci, G. Giacinti, D. Semikoz, ApJ. Lett. 975, L6 (2024).
[2] S. Kaci, G. Giacinti, J-S. Wang (2025). To be submitted very soon.

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