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SkyFACT: a novel analysis of Fermi diffuse gamma-ray data

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All models for Galactic diffuse gamma-ray emission share one property: They give formally a remarkably bad fit to the data. A large number of statistically significant residuals remain, making it very challenging to discriminate genuine features in the data from analysis artefacts. We present SkyFACT (Sky Factorization with Adaptive Constrained Templates) [1], a new approach for studying, modeling and decomposing diffuse gamma-ray emission. In contrast to previous approaches, we can account for fine-grained variations related to uncertainties in gas tracers and small scale variations in the cosmic-ray density, that are missed in predictions from cosmic-ray propagation codes, by introducing (and handling) $\sim 100,000$ nuisance parameters. We combine methods of image reconstruction and adaptive spatio-spectral template regression in one coherent hybrid approach. We apply the method to the gamma-ray emission from the inner Galaxy, as observed by the Fermi Large Area Telescope. We define a simple reference model that removes most of the residual emission from the inner Galaxy and characterize extended emission components: the Fermi bubbles, the Fermi Galactic center excess, and extended sources along the Galactic disk.

[1] E.Storm, C. Weniger and F. Calore, arXiv:1705.04065 [astro-ph.HE], Submitted to JCAP.

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