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Characterizing the Galactic Center gamma-ray Excess using differentiable probabilistic programming

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The Galactic Center gamma-ray Excess (GCE) is a puzzling excess of gamma-ray photons in the inner galaxy, broadly consistent with annihilating dark matter signals, but can also be explained by unresolved astrophysical point sources (PSs) such as millisecond pulsars. Non-Poissonian Template Fitting (NPTF) has been used to study its origin; however, it has proven susceptible to systematic biases, partially arising from degenerate morphologies between different emission components in the GCE region.

In this work, we introduce a novel approach to study the GCE using differentiable probabilistic programming, which enables us to probe spatially varying templates as well as hybrid templates for PS and diffuse components within a single inference framework. This method prepares us to more rigorously and systematically investigate the biases and uncertanties in non-poissonian analyses of the GCE.

Authors: Dr MISHRA-SHARMA, Siddharth (IAIFI, MIT, Harvard); SUN, Yitian (MIT); Prof. SLATYER, Tracy (MIT)

Presenter: SUN, Yitian (MIT)

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