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The impact of model realism on interpretations of the Galactic Center Excess

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The Galactic Center Excess (GCE) in GeV gamma rays has been debated for over a decade, with the possibility that it might be due to dark matter annihilation or undetected point sources such as millisecond pulsars. We investigate how the gamma-ray emission model used in Galactic center analyses affects the interpretation of the GCE's nature in terms of these two competing hypotheses using a set of gamma-ray emission models with increasing complexity. When different models lead to different conclusions, a general gap between the model space and reality may influence our findings. In this talk, we report the results of our study, showing that convolutional DeepEnsemble Networks can robustly detect the background components and the GCE in all gamma-ray emission model iterations. In addition, the predicted emission associated with the background components is consistent with the outcome of a traditional likelihood analysis. However, the reconstructed composition of the GCE is model-dependent. It is likely biased by the presence of a reality gap. We assess the severity of such a gap for each model instance using the One-Class Deep Support Vector Data Description method, and we show that it persists across all iterations. Our study casts doubt on the validity of previous conclusions regarding the GCE and dark matter and underscores the urgent need to account for the reality gap and consider previously overlooked ''out of domain"-uncertainties in future interpretations.

Submitted on behalf of a Collaboration?

No

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