## A neural simulation-based inference approach to the Galactic Center $\gamma$ -ray excess

Siddharth Mishra-Sharma<sup>1,\*</sup> and Kyle Cranmer<sup>1,2,†</sup>

<sup>1</sup>Center for Cosmology and Particle Physics, Department of Physics, New York University, New York, NY 10003, USA <sup>2</sup>Center for Data Science, New York University, 60 Fifth Ave, New York, NY 10011, USA (Dated: March 26, 2021)

Abstract will go here.

- I. INTRODUCTION
- II. ANALYSIS PIPELINE
- III. TEST ON SIMULATED DATA
- IV. RESULTS ON FERMI DATA
- V. SUSCEPTIBILITY TO MISMODELING
  - A. Foreground mismodeling
    - B. Signal mismodeling
    - C. Signal injection test

## VI. SYSTEMATIC VARIATIONS ON ANALYSIS

## VII. CONCLUSIONS

## ACKNOWLEDGMENTS

We thank...for helpful conversations. KC is partially supported by NSF awards ACI-1450310, OAC-1836650, and OAC-1841471, the NSF grant PHY-1505463, and the Moore-Sloan Data Science Environment at NYU. SM is supported by the NSF CAREER grant PHY-1554858, NSF grants PHY-1620727 and PHY-1915409, and the Simons Foundation. This work made use of the NYU IT High Performance Computing resources, services, and staff expertise. This research has made use of NASA's Astrophysics Data System. This research made use of the astropy [1, 2], IPython [3], Jupyter [4], matplotlib [5], mlflow, NPTFit, NumPy [6], PyTorch, PyTorch Geometric, PyTorch Lightning, seaborn [7], pandas [8], sbi, scikit-learn, SciPy [9], and tqdm [10] software packages.

Appendix A: Variations on analysis

<sup>\*</sup> sm8383@nyu.edu; ORCID: 0000-0001-9088-7845

<sup>†</sup> kyle.cranmer@nyu.edu; ORCID: 0000-0002-5769-7094]

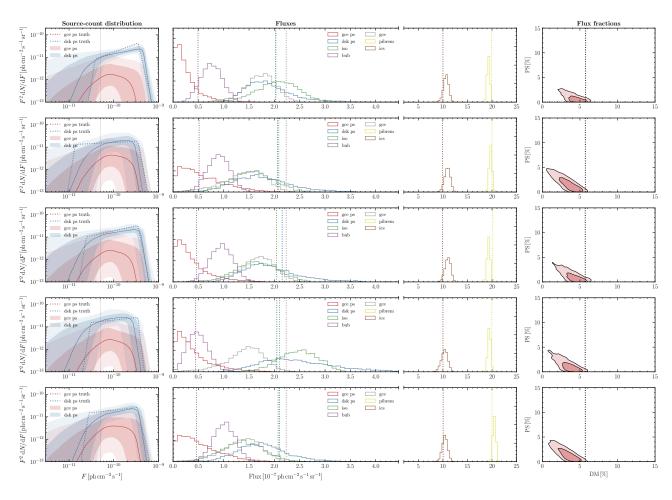


FIG. 1. Results on simulated data where the GCE consists of purely PS-like emission.

- A. M. Price-Whelan et al., Astron. J. 156, 123 (2018), arXiv:1801.02634.
- [2] T. P. Robitaille *et al.* (Astropy), Astron. Astrophys. **558**, A33 (2013), arXiv:1307.6212 [astro-ph.IM].
- [3] F. Perez and B. E. Granger, Computing in Science and Engineering 9, 21 (2007).
- [4] T. Kluyver et al., in ELPUB (2016).
- [5] J. D. Hunter, Computing In Science & Engineering 9, 90
- [6] S. van der Walt, S. C. Colbert, and G. Varoquaux,

- Computing in Science and Engineering 13, 22 (2011), arXiv:1102.1523 [cs.MS].
- [7] M. Waskom et al., "mwaskom/seaborn: v0.8.1 (september 2017)," (2017).
- [8] W. McKinney, in Proceedings of the 9th Python in Science Conference, edited by S. van der Walt and J. Millman (2010) pp. 51 56.
- [9] P. Virtanen et al., Nature Methods (2020), https://doi.org/10.1038/s41592-019-0686-2.
- [10] C. O. da Costa-Luis, JOSS 4, 1277 (2019).

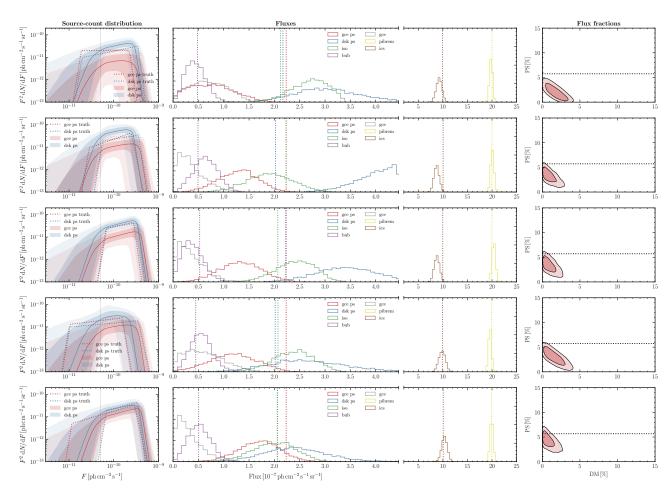


FIG. 2. Results on simulated data where the GCE consists of purely DM-like emission.

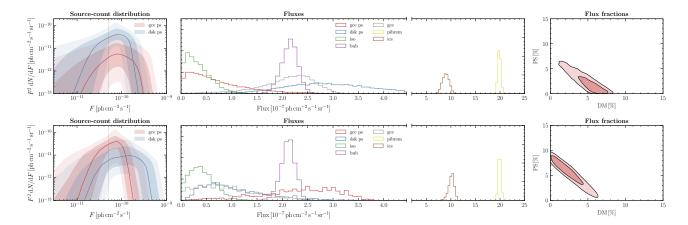


FIG. 3. Fiducial results on data.

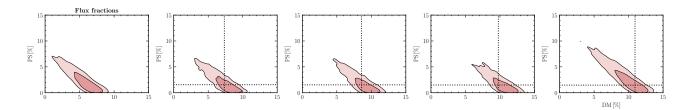


FIG. 4. Signal injection on data.