

Paper XIV: Gamma-Ray Emission from the Galactic Center in the 3D+3D Framework

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Overview

This repository contains the complete analysis code and documentation for Paper XIV of the 3D+3D discrete spacetime theory series. We investigate whether the gamma-ray excess observed from the Galactic Center by the Fermi Large Area Telescope (Totani 2025) can be explained within the 3D+3D geometric framework as an alternative to WIMP dark matter annihilation.

Key Results

Test	WIMP	3D+3D	Interpretation
Radial profile	$r = 0.990$	$r = 0.990$	Statistically equivalent
Spectral shape	$\chi^2/\text{dof} = 32.1$	$\chi^2/\text{dof} = 5.3$	3D+3D fits data better
Dwarf galaxies	Exceeds limits	Below limits	Non-detection favors 3D+3D
Free parameters	2	0	3D+3D more parsimonious

Repository Contents

Main Document

- [Paper_XIV_Gamma_Ray_3D3D_Academic_v1_0.md](#) - Complete academic paper

Analysis Code

- [paper_xiv_complete_analysis.py](#) - Fully reproducible Python script
 - Radial profile computation
 - Spectral analysis
 - Dwarf spheroidal predictions
 - Figure generation

Figures

- [figure1_radial_profile.png](#) - Radial intensity profile comparison
- [figure2_spectral_comparison.png](#) - Energy spectrum comparison
- [figure3_dwarf_comparison.png](#) - Dwarf galaxy flux predictions

Numerical Results

- `numerical_results.json` - Machine-readable analysis output

Reproducing the Analysis

Requirements

```
Python >= 3.8
numpy >= 1.20
scipy >= 1.7
matplotlib >= 3.4
```

Installation

```
bash

pip install numpy scipy matplotlib
```

Running the Analysis

```
bash

python paper_xiv_complete_analysis.py --output-dir ./results
```

This will generate all figures and save numerical results to the specified directory.

Theory Parameters

The analysis uses parameters fixed by previous SPARC galaxy rotation curve calibration (Paper IV):

Parameter	Value	Origin
λ_2	4.30 kpc	Inner compactification scale
λ_3	11.7 kpc	Outer compactification scale
λ_3/λ_2	$2.72 \approx e$	Eigenvalue ratio

No additional parameters are introduced for the gamma-ray analysis.

Observational Data Sources

- Galactic Center excess:** Totani (2025), JCAP 2025(11):080
- Dwarf spheroidal limits:** Fermi-LAT Collaboration (2024), Phys. Rev. D 109:063024
- SPARC rotation curves:** Lelli et al. (2016), AJ 152:157

Citation

If you use this code or results, please cite:

```
bibtex
```

```
@article{Calzighetti2025_PaperXIV,  
  author = {Calzighetti, Simone and Lucy},  
  title = {Gamma-Ray Emission from the Galactic Center in the 3D+3D Framework},  
  year = {2025},  
  doi = {10.5281/zenodo.XXXXXXXX}  
}
```

Related Papers

- Paper I: Mathematical Foundations
- Paper II: Technical Derivations
- Paper IV: SPARC Rotation Curve Analysis
- Paper V: Cosmic Web Statistics
- Paper VI: Gravitational Lensing

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