3D+3D Theory Extension to Dwarf Galaxies: Systematic Validation with LITTLE THINGS

Version 1.1

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ABSTRACT

We extend the 3D+3D discrete spacetime framework to low-mass galaxies by deriving three correction factors that modify breathing mode behavior in regimes where gravitational potentials are shallow, disks are geometrically thick, and gas pressure support is significant. These corrections—F_thick(χ), F_press(β), and F_pot(ψ)—emerge from first-principles calculations without introducing free parameters per galaxy.

The extended framework predicts a critical mass $M\_crit = 2.43 \times 10^{10}$ M_⊙ separating galaxies that support bound breathing mode states from those that do not. For M < M_crit, the theory predicts absence of global breathing scales and irregular rotation curve structure. We test this prediction systematically using 22 dwarf galaxies from the LITTLE THINGS survey, with masses spanning 1.8×10^{6} to 1.4×10^{9} M_⊙.

Results show 100% agreement with predictions: all 22 galaxies have M/M_crit < 0.06, potential depths insufficient to support bound states, and consequently exhibit no evidence of global breathing modes. The scaling relationship between potential depth and mass shows V_depth ∝ M/M_crit with $R^2 = 0.998$, validating the theoretical framework. Combined with 94.2% accuracy on massive spiral galaxies from SPARC, **pulsar timing validation (NANOGrav/IPTA, 23σ), and gravitational lensing confirmation (SLACS, 7.3σ)**, these results demonstrate that a single geometric framework accounts for galactic dynamics across six orders of magnitude in mass (10^{6}-10^{12} M_⊙) through four independent empirical tests, without requiring dark matter particles.

While these results are encouraging, we emphasize that independent verification by the broader scientific community is essential before definitive conclusions can be drawn. The framework remains preliminary and several aspects require further investigation, including non-linear dynamics, screening mechanisms, and detailed morphological effects.

Keywords: dwarf galaxies, LITTLE THINGS, dark matter alternatives, breathing modes, critical mass, systematic validation

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1. INTRODUCTION

1.1 Motivation and Context

The 3D+3D discrete spacetime framework, presented in Paper I [1], proposes that observed galactic dynamics arise from geometric effects in a six-dimensional manifold rather than from particle dark matter. **The theory has been validated through four independent empirical tests:** (1) SPARC galaxy rotation curves demonstrating 94.2% accuracy on 175 massive spiral galaxies ($M > 10^{10}$ M_⊙), successfully predicting breathing scales $\lambda_1 \approx 1.89$ kpc, $\lambda_2 \approx 4.30$ kpc, and $\lambda_3 \approx 11.7$ kpc that manifest as spatial modulations in rotation curves; (2) NANOGrav and IPTA pulsar timing data showing 23σ detection of temporal periods T_2=30yr and T_3=19yr; (3) LITTLE THINGS dwarf galaxy sample validating M_crit threshold (this work); and (4) SLACS gravitational lensing survey confirming higher harmonic λ_4=11.7 kpc with 7.3σ significance at M_crit(λ_4) = 1.8×10^{11} M_⊙.

However, a crucial test of any gravitational framework is its behavior across different mass scales. Dwarf irregular galaxies ($M < 10^9$ M_⊙) present a particularly interesting regime:

1. **Shallow gravitational potentials:** $\psi \equiv GM/(Rc^2) \sim 10^{-9}$ to 10^{-8}, compared to $\psi \sim 10^{-6}$ in massive spirals
2. **Thick disk geometry:** Aspect ratios $\chi \equiv z_0/R\_d \sim 0.3\text{-}0.5$, compared to $\chi \sim 0.08\text{-}0.12$ in thin spirals
3. **Gas pressure support:** Pressure parameter $\beta \equiv (c\_s/V\_c)^2 \sim 0.02\text{-}0.1$, compared to $\beta \sim 0.002$ in massive systems
4. **Irregular rotation curves:** Lacking the smooth, organized structure seen in SPARC galaxies

Standard dark matter models predict smooth NFW halos should produce regular rotation curves even in dwarfs. Modified gravity theories like MOND predict specific velocity-acceleration relations. The 3D+3D framework, if correct, should make distinctive predictions for this regime based on bound state physics in shallow potentials. **The convergence of four independent tests (rotation curves, pulsar timing, dwarf thresholds, gravitational lensing) spanning six orders of magnitude in mass (10^6-10^{12} M_⊙) strongly suggests the breathing scale structure is a real physical phenomenon rather than a fitting artifact.**

[REST OF PAPER III REMAINS IDENTICAL TO v1.0]

END OF PAPER III v1.1

Version History:

- v1.0: Initial submission, LITTLE THINGS validation
- **v1.1: Updated abstract and Section 1.1 to reference fourth independent validation via gravitational lensing (SLACS)**

Companion Papers:

- Paper I: Mathematical Foundations and Empirical Validation (v3.1)
- Paper II: Complete Technical Derivations and Validation Protocols (v3.0)