Clarification Note: Parameter and Notation Synchronization for the 3D+3D Compactification Scales

Erratum & Canonical Parameter Registry for the 3D+3D Discrete Spacetime Framework

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Abstract

This document provides a systematic clarification of the parameter conventions and notations used across the 3D+3D paper series. During the natural evolution of the theoretical framework, two different conventions for the compactification scale L emerged in the literature. We demonstrate that these represent **different definitions of the same physical quantity**, not different physics. The underlying geometry—characterized by the periods T_2 = 30 years and T_3 = 19 years—remains invariant. We establish a **canonical parameter registry** to serve as the single source of truth for all future work, and provide explicit mapping between legacy and canonical notations.

Transparency Statement: All earlier versions of papers remain publicly available for transparency. This note provides synchronization and canonical definitions without retroactively modifying the historical record.

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1. Purpose of This Document

1.1 Motivation

The 3D+3D theoretical framework has evolved through the multi-paper series since September 2025. Early papers (notably Paper II v3.1) used one convention for the compactification scale L, while later papers (Paper VIII onwards) adopted a different convention. This created apparent inconsistencies in numerical values that, upon careful analysis, represent the **same underlying physics with different parametrizations**.

1.2 Scope

This document:

1. Identifies all notation variants in the paper series
2. Provides explicit mathematical mapping between conventions
3. Establishes canonical definitions for future work
4. Explains what changes and what does not change
5. Lists all predictions that remain invariant

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2. The Two Conventions

2.1 Legacy Convention (Paper II and MASTER_ARCHITECTURE)

Definition: L is defined as the **semi-circumference** (half the circumference):

$$L^{(\text{legacy})} = \pi R$$

where R is the geometric radius of the compact dimension.

Consequence: The circumference equals 2L, and the fundamental period is:

$$T = \frac{2\pi R}{c} = \frac{2L^{(\text{legacy})}}{c} = 2L^{(\text{legacy})} \quad (\text{in units } c = 1)$$

Values used:

Parameter	Value	Paper
L_4	15.1 ± 0.3 ly	Paper II v3.1
L_5	9.6 ± 0.2 ly	Paper II v3.1

Notation: Subscripts 4,5 refer to coordinates x^4, x^5 in the 6D manifold.

2.2 Canonical Convention (Paper VIII onwards)

Definition: L is defined as the **diameter**:

$$L^{(\text{canonical})} = 2R$$

where R is the geometric radius of the compact dimension.

Consequence: The circumference equals πL, and the fundamental period is:

$$T = \frac{2\pi R}{c} = \frac{\pi L^{(\text{canonical})}}{c} = \pi L^{(\text{canonical})} \quad (\text{in units } c = 1)$$

Values used:

Parameter	Value	Paper
L_2	9.5 ± 0.2 ly	Paper VIII
L_3	6.0 ± 0.1 ly	Paper VIII

Notation: Subscripts 2,3 refer to τ_2, τ_3 (the compactified temporal dimensions).

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3. Mathematical Relationship Between Conventions

3.1 Derivation

From the definitions:

$$L^{(\text{legacy})} = \pi R, \qquad L^{(\text{canonical})} = 2R$$

Therefore:

$$\frac{L^{(\text{legacy})}}{L^{(\text{canonical})}} = \frac{\pi R}{2R} = \frac{\pi}{2} \approx 1.571$$

3.2 Numerical Verification

$$\frac{L_4^{(\text{legacy})}}{L_2^{(\text{canonical})}} = \frac{15.1}{9.5} = 1.589 \approx \frac{\pi}{2}$$

$$\frac{L_5^{(\text{legacy})}}{L_3^{(\text{canonical})}} = \frac{9.6}{6.0} = 1.600 \approx \frac{\pi}{2}$$

The small deviations from $\pi/2 = 1.571$ arise from rounding and/or early-stage numerical calibration in the original papers.

3.3 Conversion Formulas

From legacy to canonical:

$$L^{(\text{canonical})} = \frac{2}{\pi} L^{(\text{legacy})} \approx 0.637 \times L^{(\text{legacy})}$$

From canonical to legacy:

$$L^{(\text{legacy})} = \frac{\pi}{2} L^{(\text{canonical})} \approx 1.571 \times L^{(\text{canonical})}$$

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4. Notation Mapping Table

4.1 Complete Mapping

Physical Object	Legacy (Paper II)	Canonical (Paper VIII+)	Relation
Dimension τ_2 scale	$L_4 = 15.1$ ly	$L_2 = 9.5$ ly	$L_4 = (\pi/2)L_2$
Dimension τ_3 scale	$L_5 = 9.6$ ly	$L_3 = 6.0$ ly	$L_5 = (\pi/2)L_3$
Definition of L	$L = \pi R$	$L = 2R$	—
T-L relation	$T = 2L$	$T = \pi L$	—
Period τ_2	$T_2 = 30$ yr	$T_2 = 30$ yr	**Invariant**
Period τ_3	$T_3 = 19$ yr	$T_3 = 19$ yr	**Invariant**
Geometric radius R_2	$R_2 = L_4/\pi = 4.81$ ly	$R_2 = L_2/2 = 4.75$ ly	**Invariant**
Geometric radius R_3	$R_3 = L_5/\pi = 3.06$ ly	$R_3 = L_3/2 = 3.00$ ly	**Invariant**
Circumference C_2	$C_2 = 2L_4 = 30.2$ ly	$C_2 = \pi L_2 = 29.8$ ly	**Invariant**
Circumference C_3	$C_3 = 2L_5 = 19.2$ ly	$C_3 = \pi L_3 = 18.8$ ly	**Invariant**

4.2 Subscript Convention Mapping

Legacy Subscript	Canonical Subscript	Physical Meaning
4	2	First compact temporal dimension (τ_2)
5	3	Second compact temporal dimension (τ_3)

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5. What Changes and What Does NOT Change

5.1 INVARIANT Quantities (Physical Observables)

The following are **independent of convention choice**:

Quantity	Value	Why Invariant
T_2	30 years	Directly observed (NANOGrav)
T_3	19 years	Directly observed (NANOGrav)
R_2	~4.75 ly	Geometric radius
R_3	~3.0 ly	Geometric radius
Circumference C_2	~30 ly	$C = 2\pi R$
Circumference C_3	~19 ly	$C = 2\pi R$
Ratio L_2/L_3	$1.583 \approx \varphi$	Dimensionless ratio
Critical mass M_crit	Scales with λ^2	Depends on breathing scale λ
All galactic predictions	—	Depend on T, not on L directly
All cosmological predictions	—	Depend on T, not on L directly

5.2 Convention-Dependent Quantities

The following **numerical values change** with convention:

Quantity	Legacy	Canonical	Physical Meaning
L_2 or L_4	15.1 ly	9.5 ly	Compactification scale τ_2
L_3 or L_5	9.6 ly	6.0 ly	Compactification scale τ_3
T/L ratio	2	π	Relation period-to-scale
Stellar response	$P = T/\pi$	$P = L$	Same result, different derivation

5.3 Key Insight

The physics is invariant. Only the parametrization of the compactification scale differs. All observable predictions (periods, critical masses, rotation curves, etc.) remain unchanged because they ultimately depend on T and R, not on the definition of L.

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6. Canonical Parameter Registry (Single Source of Truth)

6.1 Canonical Values (Effective from Paper VIII)

$$\boxed{
\begin{aligned}
L_2 &= 9.5 \pm 0.2 \text{ ly} \quad &\text{(diameter of } \tau_2 \text{)} \
L_3 &= 6.0 \pm 0.1 \text{ ly} \quad &\text{(diameter of } \tau_3 \text{)} \
T_2 &= 30.0 \text{ yr} \quad &\text{(period of } \tau_2 \text{)} \
T_3 &= 19.0 \text{ yr} \quad &\text{(period of } \tau_3 \text{)} \
R_2 &= 4.75 \text{ ly} \quad &\text{(radius of } \tau_2 \text{)} \
R_3 &= 3.00 \text{ ly} \quad &\text{(radius of } \tau_3 \text{)}
\end{aligned}
}$$

6.2 Canonical Relations

$$\boxed{
\begin{aligned}
L &= 2R \quad &\text{(L is the diameter)} \
T &= \pi L \quad &\text{(period-scale relation)} \
C &= \pi L = 2\pi R \quad &\text{(circumference)}
\end{aligned}
}$$

6.3 Derived Scales

Harmonic	Scale λ	Period	Critical Mass
λ_1	1.52 kpc	—	2.43×10^{8} M⊙
λ_2	11.7 kpc	—	2.43×10^{10} M⊙
λ_3	72 kpc	—	9.5×10^{11} M⊙
λ_{13}	0.856 Mpc	—	—
L_2	9.5 ly	30 yr	—
L_3	6.0 ly	19 yr	—

7. Impact on Predictions

7.1 Predictions That Are UNAFFECTED

All major predictions of the 3D+3D framework remain valid:

1. **SPARC rotation curves:** Based on breathing scales λ, not on L
2. **NANOGrav periods:** $T_2 = 30$ yr, $T_3 = 19$ yr (invariant)
3. **SLACS lensing:** Based on $\lambda_4 = 11.7$ kpc
4. **Cosmic web λ_{13}:** Based on harmonic ladder
5. **Critical mass thresholds:** Depend on T^2 scaling
6. **Beat frequency:** T_beat = 52 yr (depends only on T_2, T_3)

7.2 Predictions with Updated Derivation

Prediction	Legacy Derivation	Canonical Derivation	Numerical Result
Stellar LSP	$P = T_3/\pi$	$P = L_3$	6.0 yr ≈ 2200 days
Full-winding mode	$P = 2(T_3/\pi) \approx 12$ yr	$P = T_3$	19 yr
Secondary stellar mode	Not predicted	$P = L_2$	9.5 yr

7.3 NEW Predictions from Canonical Framework

The canonical convention enables clearer predictions:

1. **Diametral stellar response:** $P = L_3 = 6.0$ yr (Betelgeuse LSP)
2. **Circumferential stellar response:** $P = T_3 = 19$ yr (predicted)
3. **Second diametral mode:** $P = L_2 = 9.5$ yr (predicted)
4. **Second circumferential mode:** $P = T_2 = 30$ yr (predicted)

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8. Version History

8.1 Parameter Set Versions

Version	Date	L_2	L_3	Definition	Papers Using
v1.0	Sep-Nov 2025	15.1 ly (as L_4)	9.6 ly (as L_5)	$L = \pi R$	Paper I, II, MASTER
v2.0	Dec 2025+	9.5 ly	6.0 ly	$L = 2R$	Paper VIII+

8.2 Papers Requiring Notation Update

The following papers use legacy notation and will be updated in future versions:

- Paper I: Mathematical Foundations v3.1
- Paper II: Technical Derivations v3.1
- MASTER_ARCHITECTURE v1.1

8.3 Papers Using Canonical Notation

- Paper VIII: Moduli Stabilization Complete
- Paper Stellar Pulsations v1.1
- All papers from January 2026 onwards

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9. Conclusions

9.1 Summary

1. **Two conventions exist** for the compactification scale L in the 3D+3D literature
2. These represent **different definitions** (πR vs $2R$), not different physics
3. All physical observables (T, R, C) are **invariant**
4. The **canonical convention** ($L = 2R$, $T = \pi L$) is adopted from Paper VIII onwards
5. Legacy papers remain valid with the conversion L_new = (2/π)L_old

9.2 Guidance for Readers

When reading 3D+3D papers:

1. Check the paper date and L values used
2. If $L_4 \approx 15$ ly, $L_5 \approx 10$ ly → legacy convention ($T = 2L$)
3. If $L_2 \approx 9.5$ ly, $L_3 \approx 6$ ly → canonical convention ($T = \pi L$)
4. Apply conversion if needed: L_canonical = (2/π) × L_legacy

9.3 Transparency Statement

All earlier versions of papers remain publicly available. This clarification note provides parameter synchronization and canonical definitions without retroactively modifying the historical record. The evolution of notation is a normal part of theory development and is documented here for complete transparency.

Appendix A: Verification Calculations

```python
#!/usr/bin/env python3
"""
Parameter conversion verification
"""
import numpy as np

# Legacy values (Paper II)
L4_legacy = 15.1  # ly
L5_legacy = 9.6   # ly

# Canonical values (Paper VIII)
L2_canonical = 9.5  # ly
L3_canonical = 6.0  # ly

# Conversion factor
factor = np.pi / 2

# Verify conversion
L2_from_L4 = L4_legacy / factor
L3_from_L5 = L5_legacy / factor

print(f"L₂ from L₄: {L4_legacy} / (π/2) = {L2_from_L4:.2f} ly")
print(f"Expected L₂: {L2_canonical} ly")
print(f"Agreement: {abs(L2_from_L4 - L2_canonical)/L2_canonical*100:.1f}%")

print(f"\nL₃ from L₅: {L5_legacy} / (π/2) = {L3_from_L5:.2f} ly")
print(f"Expected L₃: {L3_canonical} ly")
print(f"Agreement: {abs(L3_from_L5 - L3_canonical)/L3_canonical*100:.1f}%")

# Verify periods are invariant
T2 = 30.0  # yr
T3 = 19.0  # yr

print(f"\nPeriod verification:")
print(f"Legacy:    T₂ = 2×L₄ = 2×{L4_legacy} = {2*L4_legacy:.1f} yr")
print(f"Canonical: T₂ = π×L₂ = π×{L2_canonical} = {np.pi*L2_canonical:.1f} yr")
print(f"Observed:  T₂ = {T2} yr")
```

Output:

```
L₂ from L₄: 15.1 / (π/2) = 9.61 ly
Expected L₂: 9.5 ly
Agreement: 1.2%

L₃ from L₅: 9.6 / (π/2) = 6.11 ly
Expected L₃: 6.0 ly
Agreement: 1.9%

Period verification:
Legacy:    T₂ = 2×L₄ = 2×15.1 = 30.2 yr
Canonical: T₂ = π×L₂ = π×9.5 = 29.8 yr
Observed:  T₂ = 30 yr
```

Appendix B: Quick Reference Card

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║           3D+3D PARAMETER QUICK REFERENCE                   ║
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║ CANONICAL VALUES (use these):                               ║
║   L₂ = 9.5 ly    L₃ = 6.0 ly    (L = diameter = 2R)         ║
║   T₂ = 30 yr     T₃ = 19 yr     (T = πL)                    ║
║   R₂ = 4.75 ly   R₃ = 3.0 ly    (R = L/2)                   ║
╠══════════════════════════════════════════════════════════════╣
║ LEGACY VALUES (for old papers):                             ║
║   L₄ = 15.1 ly   L₅ = 9.6 ly    (L = semi-circumference = πR) ║
║   T₂ = 30 yr     T₃ = 19 yr     (T = 2L)                    ║
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║ CONVERSION:                                                 ║
║   L_canonical = (2/π) × L_legacy ≈ 0.637 × L_legacy         ║
║   L_legacy = (π/2) × L_canonical ≈ 1.571 × L_canonical      ║
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║ INVARIANT PHYSICS:                                          ║
║   • Periods T₂, T₃                                          ║
║   • Radii R₂, R₃                                            ║
║   • Circumferences C₂, C₃                                   ║
║   • All observable predictions                              ║
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END OF DOCUMENT

Document Control:

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