Paper XXXVII: Mathematical Notation and Symbol Glossary for 3D+3D Theory

A Complete Reference Guide to the Mathematical Language of Six-Dimensional Spacetime

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Abstract

This document provides a comprehensive glossary of all mathematical symbols, conventions, and notation used throughout the 3D+3D discrete spacetime theory papers (I-XXXVI). We organize symbols by category: coordinates and indices, metric components, fundamental constants, Q-field quantities, characteristic scales, coupling parameters, operators, and cosmological quantities. Each entry includes the symbol, name, definition, units, typical values, and the paper where it first appears. This reference is intended to make the theory accessible to researchers from diverse backgrounds and to ensure consistent notation across all publications.

Keywords: notation, glossary, mathematical symbols, reference guide, 3D+3D theory

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1. Coordinates and Indices

1.1 Spacetime Coordinates

Symbol	Name	Definition	Range	Paper
X^A	6D coordinates	Full spacetime position	A = 0,1,2,3,4,5	I
x^μ	4D coordinates	Observable spacetime	μ = 0,1,2,3	I
t	Cosmic time	Observable time coordinate	(-∞, +∞)	I
x, y, z	Spatial coordinates	Observable space	(-∞, +∞)	I
τ_2	Second time	First compactified temporal dimension	[0, $2\pi L_4$]	I
τ_3	Third time	Second compactified temporal dimension	[0, $2\pi L_5$]	I
r	Radial coordinate	Distance from galactic center	[0, ∞)	II
θ, φ	Angular coordinates	Spherical angles	[0,π], [0,2π)	II

1.2 Index Conventions

Symbol	Name	Range	Usage
A, B, C, ...	6D indices	0, 1, 2, 3, 4, 5	Full spacetime tensors
μ, ν, ρ, σ, ...	4D spacetime indices	0, 1, 2, 3	Observable spacetime
i, j, k, ...	3D spatial indices	1, 2, 3	Spatial tensors
I, J, K, ...	Internal indices	4, 5	Compact dimensions
a, b, c, ...	Internal (alternative)	4, 5	Compact space tensors

Symbol	Name	Range	Usage
α, β, ...	Spinor indices	1, 2, 3, 4	Dirac spinors

1.3 Coordinate Shorthand

Symbol	Meaning	Explicit Form
d^6x	6D volume element	dt dx dy dz $d\tau_2$ $d\tau_3$
d^4x	4D volume element	dt dx dy dz
$d^2\tau$	Internal volume element	$d\tau_2$ $d\tau_3$
d^3x	Spatial volume element	dx dy dz

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2. Metric and Geometry

2.1 Metric Tensors

Symbol	Name	Definition	Signature	Paper
g_AB	6D metric	Full spacetime metric	(−,+,+,+,−,−)	I
g_μν	4D metric	Observable spacetime metric	(−,+,+,+)	I
γ_IJ	Internal metric	Metric on T^2	(−,−)	I
η_AB	6D Minkowski	Flat 6D metric	(−,+,+,+,−,−)	I
η_μν	4D Minkowski	Flat 4D metric	(−,+,+,+)	I
g_μν^(ind)	Induced metric	Metric on brane	(−,+,+,+)	XXII
h_AB	Metric perturbation	g_AB = ḡ_AB + h_AB	—	II

2.2 Metric Ansatz

The general 6D metric in the 3D+3D framework:

$$g_{AB} = \begin{pmatrix} g_{\mu\nu} + A^I_\mu A^J_\nu \gamma_{IJ} & A^I_\mu \gamma_{IJ} \\ A^J_\nu \gamma_{IJ} & \gamma_{IJ} \end{pmatrix}$$

Simplified form (A^I_μ = 0):

$$g_{AB} = \begin{pmatrix} g_{\mu\nu} & 0 \\ 0 & \gamma_{IJ} \end{pmatrix}$$

2.3 Curvature Quantities

Symbol	Name	Definition	Paper
R_6	6D Ricci scalar	g^{AB} R_AB	I
R_4	4D Ricci scalar	g^{μν} R_μν	I
R_2	Internal Ricci scalar	γ^{IJ} R_IJ (= 0 for flat T^2)	I
R_ABCD	6D Riemann tensor	Full curvature tensor	I
R_AB	6D Ricci tensor	R^C_ACB	I
G_AB	6D Einstein tensor	R_AB - ½ g_AB R_6	I
K_μν	Extrinsic curvature	Brane embedding curvature	XXII

2.4 Geometric Objects

Symbol	Name	Definition	Paper
Γ^A_BC	Christoffel symbols	½ g^{AD}(∂_B g_CD + ∂_C g_BD - ∂_D g_BC)	I
√(-g_6)	6D volume factor	√	det(g_AB)
√(-g_4)	4D volume factor	√	det(g_μν)
V_int	Internal volume	∫ $d^2\tau$ √	γ

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3. Fundamental Constants

3.1 Natural Constants

Symbol	Name	Value	Units	Paper
c	Speed of light	2.998×10^{8}	m/s	I
$\hbar$	Reduced Planck constant	1.055×10^{-34}	J·s	I
G_N	Newton's constant	6.674×10^{-11}	$m^3/(kg \cdot s^2)$	I
k_B	Boltzmann constant	1.381×10^{-23}	J/K	VII

3.2 Planck Units

Symbol	Name	Definition	Value	Paper
M_P	Planck mass	√($\hbar$c/G_N)	2.176×10^{-8} kg	I
M_Pl	Reduced Planck mass	M_P/√(8π)	2.435×10^{18} GeV	I
l_P	Planck length	√($\hbar$G_N/c^3)	1.616×10^{-35} m	I
t_P	Planck time	√($\hbar$G_N/c^5)	5.391×10^{-44} s	I
E_P	Planck energy	√($\hbar c^5$/G_N)	1.956×10^{9} J	I

3.3 6D Constants

Symbol	Name	Definition	Value	Paper
M_6	6D Planck mass	(M_Pl²/V_int)^{1/4}	~3 × 10¹⁵ GeV	I
G_6	6D Newton constant	1/(M_6⁴)	—	I
κ_6	6D gravitational coupling	8πG_6 = 8π/M_6⁴	—	I

3.4 Standard Model Constants

Symbol	Name	Value	Paper
v	Higgs VEV	246 GeV	XXXV
m_H	Higgs mass	125.1 GeV	XXXV
g	SU(2)_L coupling	0.652	XXXVI
g'	U(1)_Y coupling	0.357	XXXVI
g_s	SU(3)_c coupling	1.22 (at m_Z)	XXXVI
y_t	Top Yukawa	0.99	XXXVI
α	Fine structure constant	1/137.036	XXXVI
α_s	Strong coupling	0.118 (at m_Z)	XXXVI

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4. Q-Field Quantities

4.1 Q-Field Definitions

Symbol	Name	Definition	Units	Paper
Q_2	First Q-field	Modulus of τ_2 dimension	M_Pl	II
Q_3	Second Q-field	Modulus of τ_3 dimension	M_Pl	II
Q	Combined Q-field	$\sqrt{(Q_2^2 + Q_3^2)}$	M_Pl	II
$\bar{Q}_2$, $\bar{Q}_3$	Background values	⟨Q_i⟩ in equilibrium	M_Pl	II
δQ_i	Q-field perturbation	Q_i - $\bar{Q}$_i	M_Pl	II

4.2 Q-Field Parameters

Symbol	Name	Definition	Value	Paper
m_2	Q_2 mass	$2\pi/T_2$	~7 × 10⁻²⁴ eV	II
m_3	Q_3 mass	$2\pi/T_3$	~1.1 × 10⁻²³ eV	II
T_2	Q_2 oscillation period	$2\pi R_2/c$	30 years	XI

Symbol	Name	Definition	Value	Paper
T_3	Q_3 oscillation period	$2\pi R_3/c$	19 years	XI
ω_2	Q_2 angular frequency	$2\pi/T_2 = m_2$ ($\hbar$=1)	—	XI
ω_3	Q_3 angular frequency	$2\pi/T_3 = m_3$ ($\hbar$=1)	—	XI

4.3 Q-Field Amplitudes

Symbol	Name	Typical Value	Paper
A_2	Q_2 amplitude	~10^{-10} M_Pl	II
A_3	Q_3 amplitude	~10^{-10} M_Pl	II
	Q	_max	Maximum total amplitude

4.4 Q-Field Lagrangian Terms

$$\mathcal{L}_Q = -\frac{1}{2}(\partial_\mu Q_2)^2 - \frac{1}{2}m_2^2 Q_2^2 - \frac{1}{2}(\partial_\mu Q_3)^2 - \frac{1}{2}m_3^2 Q_3^2 - V_{int}(Q_2, Q_3)$$

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5. Characteristic Scales

5.1 Compactification Radii

Symbol	Name	Definition	Value	Paper
R_2	τ_2 compactification radius	$L_4/(2\pi)$	~1.4 ly	I
R_3	τ_3 compactification radius	$L_5/(2\pi)$	~3.7 ly	I
L_4	τ_2 circumference	$2\pi R_2$	~9 ly	I
L_5	τ_3 circumference	$2\pi R_3$	~23 ly	I

5.2 Characteristic Wavelengths

Symbol	Name	Definition	Value	Paper
λ_2	First characteristic scale	$c \times T_2 = 2\pi R_2$	**4.30 kpc**	II
λ_3	Second characteristic scale	$c \times T_3 = 2\pi R_3$	**11.7 kpc**	II
λ_n	n-th harmonic scale	$\lambda_2 \times \varphi^{n-2}$	—	V

5.3 Harmonic Scale Ladder

The characteristic scales follow a **golden ratio progression**:

$$\lambda_n = \lambda_2 \times \varphi^{n-2}$$

n	Scale	Value	Astrophysical Correspondence
1	λ_1	2.66 kpc	Inner galaxy
2	λ_2	4.30 kpc	**Fundamental scale**
3	λ_3	6.96 kpc	Disk scale
4	λ_4	11.3 kpc	Outer disk
5	λ_5	18.2 kpc	Halo transition
6	λ_6	29.5 kpc	MW halo
7	λ_7	47.7 kpc	Local Group
8	λ_8	77.2 kpc	Satellite distribution

5.4 Critical Scales

Symbol	Name	Definition	Value	Paper
r_c	Core radius	Transition to Q-dominated	~λ_2	IV
r_V	Vainshtein radius	Screening activation	(G_N M/Λ^3)^{1/3}	XXVI
M_crit	Critical mass	Dark matter threshold	1.8 × 10^{11} M_$\odot$	XXXI

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6. Coupling Parameters

6.1 Q-Matter Coupling

Symbol	Name	Definition	Value	Paper
β_2	Q_2-matter coupling	$\partial \ln(m)/\partial Q_2$	3.2 ± 0.8	IV
β_3	Q_3-matter coupling	$\partial \ln(m)/\partial Q_3$	3.2 ± 0.8	IV
α_2	Brane tension coefficient	$\partial^2\sigma/\partial Q_2^2$	~O(1)	XXVII
α_3	Brane tension coefficient	$\partial^2\sigma/\partial Q_3^2$	~O(1)	XXVII

6.2 Q-Higgs Coupling

Symbol	Name	Definition	Value	Paper
ξ	Q-Higgs portal coupling	Coefficient of Q^2	H	²
ξ_crit	Critical coupling	Minimum for first-order PT	0.26	XXXVI

6.3 Q-SM Couplings (Dimension-5 and -6)

Symbol	Name	Operator	Strength	Paper
c_S	Scalar Q-fermion	(c_S/M_P) Q $\bar{\psi}\psi$	~O(1)	XXXVI
c_P	Pseudoscalar Q-fermion	(c_P/M_P) Q $\bar{\psi}\gamma^5\psi$	~O(1)	XXXVI
c_F	Q-gauge (EM)	(c_F/M_P²) Q² F²	~O(1)	XXXVI
c_W	Q-gauge (SU(2))	(c_W/M_P²) Q² W²	~O(1)	XXXVI
c_g	Q-gluon	(c_g/M_P²) Q² G²	~O(1)	XXXVI

6.4 Gravitational Coupling

Symbol	Name	Definition	Paper
G_eff	Effective Newton constant	G_N × S(r)	II
κ	Einstein coupling	8πG_N = 1/M_Pl²	I

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7. Screening and Potential

7.1 Screening Function

Symbol	Name	Definition	Paper
S(r)	Screening function	G_eff(r)/G_N	II
$S_2(r)$	Q_2 screening	$1 + \beta_2^2 Q_2^2(r)/M_{Pl}^2$	IV
$S_3(r)$	Q_3 screening	$1 + \beta_3^2 Q_3^2(r)/M_{Pl}^2$	IV

Full screening function:

$$S(r) = 1 + \beta_2^2 \left(\frac{Q_2(r)}{M_{Pl}}\right)^2 + \beta_3^2 \left(\frac{Q_3(r)}{M_{Pl}}\right)^2$$

7.2 Q-Field Profiles

Radial profile (sourced by mass M):

$$Q_2(r) = \frac{\beta_2 G_N M}{r}\left(1 - e^{-r/\lambda_2}\right)$$

$$Q_3(r) = \frac{\beta_3 G_N M}{r}\left(1 - e^{-r/\lambda_3}\right)$$

7.3 Effective Potential

Symbol	Name	Definition	Paper
Φ_N	Newtonian potential	-G_N M/r	II
Φ_eff	Effective potential	Φ_N × S(r)	II
Φ_Q	Q-field potential	Φ_eff - Φ_N	IV
V_5(r)	Fifth force potential	-α₅ G_N m₁m₂ e^{-r/λ}/r	XXXVI

7.4 Vainshtein Mechanism

Symbol	Name	Definition	Paper
r_V	Vainshtein radius	(G_N M/Λ³)^{1/3}	XXVI
Λ	Strong coupling scale	(M_Pl m_Q²)^{1/3}	XXVI
α_5	Fifth force strength	c_S²/(4π)	XXXVI

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8. Kaluza-Klein Spectrum

8.1 KK Mode Indices

Symbol	Name	Range	Paper
n_2	τ_2 mode number	0, ±1, ±2, ...	XXII
n_3	τ_3 mode number	0, ±1, ±2, ...	XXII
(n_2, n_3)	KK mode label	Integer pairs	XXII

8.2 KK Mass Formula

$$M^2_{n_2,n_3} = \frac{n_2^2}{R_2^2} + \frac{n_3^2}{R_3^2}$$

8.3 Special Modes

Mode	(n_2, n_3)	Mass	Interpretation
Zero mode	(0, 0)	0	4D graviton

Mode	(n_2, n_3)	Mass	Interpretation
First tower	(1, 0)	$1/R_2$	Q_2-like excitation
Second tower	(0, 1)	$1/R_3$	Q_3-like excitation
Mixed	(1, 1)	$\sqrt{(1/R_2^2 + 1/R_3^2)}$	Combined excitation

8.4 KK Coupling

Symbol	Name	Definition	Paper
g_{n2,n3}	KK mode coupling	1/M_P × (overlap integral)	XXII

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9. Cosmological Quantities

9.1 Background Cosmology

Symbol	Name	Definition	Value	Paper
H	Hubble parameter	ȧ/a	H_0 = 67.4 km/s/Mpc	XVI
H_0	Hubble constant today	$H(t_0)$	67.4 km/s/Mpc	XVI
a(t)	Scale factor	Expansion of universe	1 today	XVI
z	Redshift	a_0/a - 1	—	XVI
ρ_c	Critical density	$3H^2/(8\pi G\_N)$	—	XVI

9.2 Density Parameters

Symbol	Name	Definition	Value (3D+3D)	Paper
Ω_b	Baryon density	ρ_b/ρ_c	0.049	XVI
Ω_r	Radiation density	ρ_r/ρ_c	~10^{-4}	XVI
Ω_Q	Q-field density	ρ_Q/ρ_c	**Replaces Ω_DM**	XVI
Ω_Λ	Dark energy	ρ_Λ/ρ_c	0.69 (geometric)	XVI
Ω_tot	Total density	Σ Ω_i	1.00	XVI

9.3 Power Spectrum

Symbol	Name	Definition	Paper
P(k)	Matter power spectrum	⟨	δ_k
$\Delta^2(k)$	Dimensionless spectrum	$k^3P(k)/(2\pi^2)$	V
ξ(r)	Correlation function	FT of P(k)	V

Symbol	Name	Definition	Paper
σ_8	Amplitude at 8 Mpc/h	—	XVI

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10. Phase Transition Parameters

10.1 Effective Potential

Symbol	Name	Definition	Paper
V_eff(φ,T)	Effective potential	V_0 + V_CW + V_T + V_daisy	XXXVI
V_0	Tree-level potential	$-\mu^2\varphi^2/2 + \lambda\varphi^4/4$	XXXVI
V_CW	Coleman-Weinberg	1-loop zero-T correction	XXXVI
V_T	Thermal potential	Finite-T correction	XXXVI
V_daisy	Daisy resummation	Ring diagram correction	XXXVI

10.2 Critical Parameters

Symbol	Name	Definition	Value (SM+Q)	Paper
T_c	Critical temperature	V_eff(φ_c) = V_eff(0)	142 GeV	XXXVI
φ_c	Critical VEV	Higgs VEV at T_c	156 GeV	XXXVI
φ_c/T_c	Transition strength	Sphaleron suppression	**1.1**	XXXVI
T_n	Nucleation temperature	$\Gamma \times H^{-4} \sim 1$	135 GeV	XXXVI

10.3 Transition Dynamics

Symbol	Name	Definition	Value	Paper
α	Transition strength	ΔV/ρ_rad	0.05	XXXVI
β/H	Inverse duration	T_c d(S_3/T)/dT	~300	XXXVI
v_w	Wall velocity	Bubble expansion speed	0.4-0.6	XXXVI
S_3	Bounce action	O(3) Euclidean action	—	XXXVI

10.4 Gravitational Waves

Symbol	Name	Definition	Value	Paper
Ω_GW	GW density	ρ_GW/ρ_c	$\sim 10^{-12}$	XXXVI
f_peak	Peak frequency	—	~2 mHz	XXXVI
h	GW strain	Characteristic amplitude	—	XXIV

11. Observational Quantities

11.1 Rotation Curves

Symbol	Name	Definition	Units	Paper
v_c(r)	Circular velocity	√(r × dΦ/dr)	km/s	IV
v_bar	Baryonic velocity	From visible mass	km/s	IV
v_3D3D	Q-field contribution	√(v_c² - v_bar²)	km/s	IV
v_∞	Asymptotic velocity	v_c(r → ∞)	km/s	IV

Key prediction:

$$v_{3D3D} = \sqrt{\frac{\beta^2 G_N M}{2\lambda}} \approx 90 \text{ km/s (universal)}$$

11.2 Gravitational Lensing

Symbol	Name	Definition	Paper
Σ_crit	Critical surface density	c²D_s/(4πG D_d D_{ds})	XXXII
κ	Convergence	Σ/Σ_crit	XXXII
γ	Shear	Tidal distortion	XXXII
θ_E	Einstein radius	√(4GM D_{ds}/(c² D_d D_s))	XXXII

11.3 Pulsar Timing

Symbol	Name	Definition	Paper
TOA	Time of arrival	Pulse arrival time	XI
Δt	Timing residual	Observed - predicted TOA	XI
P	Pulsar period	Rotation period	XI
Ṗ	Period derivative	Spin-down rate	XI

12. Mathematical Operators

12.1 Differential Operators

Symbol	Name	Definition
∂_μ	Partial derivative	∂/∂x^μ
∇_A	Covariant derivative (6D)	∂_A + Γ connection
∇_μ	Covariant derivative (4D)	∂_μ + Γ connection
□	d'Alembertian (4D)	g^{μν}∇_μ∇_ν
□_6	d'Alembertian (6D)	g^{AB}∇_A∇_B
∇²	Laplacian (3D)	∂²/∂x² + ∂²/∂y² + ∂²/∂z²
Δ	Laplace-Beltrami	Generalized Laplacian

12.2 Tensor Operations

Symbol	Name	Definition
A_{(μν)}	Symmetrization	(A_μν + A_νμ)/2
A_{[μν]}	Antisymmetrization	(A_μν - A_νμ)/2
A^μ_μ	Trace	g^{μν} A_μν
δ^μ_ν	Kronecker delta	1 if μ=ν, 0 otherwise
ε_{μνρσ}	Levi-Civita (4D)	Totally antisymmetric
ε_{ABCDEF}	Levi-Civita (6D)	Totally antisymmetric

12.3 Special Functions

Symbol	Name	Definition	Paper
J_B(x²)	Bosonic thermal integral	∫ y² ln(1-e^{-√(y²+x²)}) dy	XXXVI
J_F(x²)	Fermionic thermal integral	∫ y² ln(1+e^{-√(y²+x²)}) dy	XXXVI
Y_n(x)	Bessel function 2nd kind	Standard definition	IV
J_n(x)	Bessel function 1st kind	Standard definition	IV
K_n(x)	Modified Bessel	Exponentially decaying	IV

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13. Greek Letter Summary

Letter	Lowercase	Primary Usage in 3D+3D
Alpha	α	Transition strength, coupling coefficients

Letter	Lowercase	Primary Usage in 3D+3D
Beta	β	Q-matter coupling, transition rate
Gamma	γ	Internal metric, Lorentz factor
Delta	δ	Perturbation, variation
Epsilon	ε	Small parameter, Levi-Civita
Eta	η	Minkowski metric, baryon asymmetry
Theta	θ	Angular coordinate, QCD θ-term
Kappa	κ	Gravitational coupling, convergence
Lambda	λ	Characteristic scale, cosmological constant
Mu	μ	4D index, mass parameter
Nu	ν	4D index, frequency
Xi	ξ	Q-Higgs coupling
Pi	π	Self-energy, 3.14159...
Rho	ρ	Density, 4D index
Sigma	σ	Brane tension, surface density
Tau	τ	Internal time coordinates
Phi	φ	Potential, Higgs field, golden ratio
Chi	χ	Moduli deformation
Psi	ψ	Fermion field, wavefunction
Omega	ω	Density parameter, angular frequency

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14. Latin Letter Summary

Letter	Primary Usage in 3D+3D
A, B, C	6D indices
a	Scale factor, internal index
c	Speed of light, coefficients
G	Newton's constant, gluon field
g	Metric, gauge coupling
H	Hubble parameter, Higgs, Hamiltonian
h	Metric perturbation, Planck constant
L	Lagrangian, circumference
M	Mass
m	Mass (particle), mode number

Letter	Primary Usage in 3D+3D
n	Mode number, number density
P	Power spectrum, pressure
Q	Q-field
R	Ricci scalar, radius
r	Radial coordinate
S	Action, screening function
T	Temperature, period
t	Time
V	Potential, volume
v	Velocity

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15. Numerical Constants

15.1 Mathematical Constants

Symbol	Name	Value	Usage
π	Pi	3.14159265...	Circular geometry
e	Euler's number	2.71828182...	Exponentials
φ	Golden ratio	(1+√5)/2 = 1.6180339...	Scale ladder
γ_E	Euler-Mascheroni	0.5772156...	Thermal functions

15.2 Key 3D+3D Numbers

Quantity	Value	Significance
λ_2	**4.30 kpc**	Fundamental galactic scale
λ_3	**11.7 kpc**	Second galactic scale
T_2	**30 years**	First oscillation period
T_3	**19 years**	Second oscillation period
T_2/T_3	**30/19 ≈ 1.579**	Near-golden ratio
v_3D3D	**90 km/s**	Universal velocity scale
M_crit	**1.8×10^{11} M_⊙**	Dark matter threshold
β	**3.2 ± 0.8**	Matter coupling
ξ	**0.3-0.5**	Q-Higgs coupling

15.3 Ratio Relationships

Ratio	Value	Origin
λ_3/λ_2	$2.72 \approx \varphi^2$	Golden ratio squared
T_2/T_3	$1.579 \approx \varphi$	Near golden ratio
R_3/R_2	φ	By construction
λ_{n+1}/λ_n	φ	Harmonic ladder

Appendix A: Unit Conversions

A.1 Length

Unit	In meters	In kpc
1 kpc	3.086×10^{19} m	1
1 Mpc	3.086×10^{22} m	1000
1 ly	9.461×10^{15} m	3.066×10^{-4}
1 AU	1.496×10^{11} m	4.848×10^{-9}

A.2 Mass

Unit	In kg	In $M_\odot$
1 $M_\odot$	1.989×10^{30} kg	1
1 GeV/c^2	1.783×10^{-27} kg	8.96×10^{-58}
1 M_{Pl}	2.176×10^{-8} kg	1.09×10^{-38}

A.3 Time

Unit	In seconds	In years
1 year	3.156×10^7 s	1
1 Hubble time	4.55×10^{17} s	1.44×10^{10}

A.4 Energy

Unit	In Joules	In eV
1 eV	1.602×10^{-19} J	1
1 GeV	1.602×10^{-10} J	10^9

Appendix B: Signature Conventions

B.1 The 6D Signature

The 3D+3D theory uses:

$$\eta_{AB} = \text{diag}(-1, +1, +1, +1, -1, -1)$$

Index assignment:

- 0: t (observable time) → −
- 1: x (space) → +
- 2: y (space) → +
- 3: z (space) → +
- 4: τ_2 (compact time) → −
- 5: τ_3 (compact time) → −

B.2 Why Multiple Time Dimensions?

The (−,−) signature for internal dimensions ensures:

1. **Q-fields have standard kinetic terms** (positive kinetic energy)
2. **Compactification projects out ghosts** (Paper XXII)
3. **4D physics remains causal** (observable sector unchanged)

Appendix C: Quick Reference Card

Essential Formulas

Screening function:

$$S(r) = 1 + \beta_2^2 \frac{Q_2^2}{M_{Pl}^2} + \beta_3^2 \frac{Q_3^2}{M_{Pl}^2}$$

Q-field profile:

$$Q_i(r) = \frac{\beta_i G_N M}{r}\left(1 - e^{-r/\lambda_i}\right)$$

Rotation curve:

$$v_c^2(r) = v_{bar}^2(r) + v_{3D3D}^2(r)$$

Universal velocity:

$$v_{3D3D} = \sqrt{\frac{\beta^2 G_N M}{2\lambda}} \approx 90\ \mathrm{km/s}$$

Scale ladder:

$$\lambda_n = \lambda_2 \times \varphi^{n-2}$$

Period ratio:

$$\frac{T_2}{T_3} = \frac{30}{19} \approx 1.579 \approx \varphi$$

Key Parameters (Copy-Paste Ready)

λ₂ = 4.30 kpc
λ₃ = 11.7 kpc
T₂ = 30 years
T₃ = 19 years
β = 3.2 ± 0.8
ξ = 0.3-0.5
v_3D3D = 90 km/s
M_crit = 1.8 × 10¹¹ M_⊙
φ = 1.618034

— End of Paper XXXVII —

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This glossary is intended as a living document and will be updated as the theory develops.

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