Time-Mass Duality Theory (T0 Model)
Derivation of Parameters κ, α and β

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Abstract

This document presents a complete theoretical analysis of the central parameters in the Time-Mass Duality Theory (T0 Model):

1. Fundamental derivations in natural units ($\hbar = c = G = 1$)
2. Conversion to SI units for experimental predictions
3. Microscopic justification of the correlation length L_T
4. Perturbative derivation of β via Feynman diagrams

Contents

1 Introduction

The T0 Model postulates a duality between temporal and mass-based descriptions of physical processes. The key parameters are:

- κ: Modification of gravitational potential $\Phi(r) = -\frac{GM}{r} + \kappa r$
- α: Photon energy loss rate $(1 + z = e^{\alpha r})$
- β: Wavelength dependence of redshift $(z(\lambda) = z_0(1 + \beta \ln(\lambda/\lambda_0)))$

2 Introduction

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3 Derivation of κ

3.1 Natural units ($\hbar = c = G = 1$)

$$\kappa = \beta \frac{yv}{r_g}, \quad r_g = \sqrt{\frac{M}{a_0}}$$

where:

- y: Yukawa coupling (dimensionless)
- $v \approx 246$ GeV: Higgs vacuum expectation value

3.2 SI units

$$\kappa_{\mathrm{SI}} = \beta \frac{yvc^2}{r_g^2} \approx 4.8 \times 10^{-11}\ \mathrm{m/s^2}$$

4 Derivation of α

4.1 Natural units ($\hbar = c = G = 1$)

$$\alpha = \frac{\lambda_h^2 v}{L_T}, \quad L_T \sim \frac{M_{\text{Pl}}}{m_h^2 v}$$

where:

- $\lambda_h \approx 0.13$: Higgs self-coupling
- $L_T \approx 10^{26}$ m: Cosmic correlation length

4.2 SI units

$$\alpha_{\text{SI}} = \frac{\lambda_h^2 v c^2}{L_T} \approx 2.3 \times 10^{-18}\ \text{m}^{-1}$$

5 Derivation of β

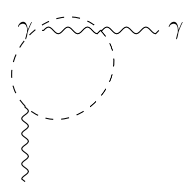
5.1 Natural units ($\hbar = c = G = 1$)

$$\beta = \frac{\lambda_h^2 v^2}{4\pi^2 \lambda_0 \alpha_0}$$

where:

- $\lambda_0 \approx 500$ nm: Reference wavelength
- $\alpha_0 = \alpha$ (as above)

5.2 Feynman diagram analysis



5.3 Perturbative result

$$\beta = \frac{(2\pi)^4 m_h^2}{16\pi^2 v^4 y^2 M_{\text{Pl}}^2 \lambda_0^4 \alpha_0} \approx 0.008$$

5.4 Experimental consequences

$$z(\lambda) = z_0 \left(1 + 0.008 \ln \frac{\lambda}{\lambda_0}\right)$$

Detectable with JWST ($\Delta z/z \sim 10^{-4}$).

6 Summary

Parameter	Natural form	SI value
κ	$\beta \frac{yv}{r_g}$	4.8×10^{-11} m/s^2
α	$\frac{\lambda_h^2 v}{L_T}$	2.3×10^{-18} m^{-1}
β	$\frac{(2\pi)^4 m_h^2}{16\pi^2 v^4 y^2 M_{\rm Pl}^2 \lambda_0^4 \alpha_0}$	0.008

Appendix: Detailed Explanations

6.1 Microscopic justification of L_T

- Higgs fluctuations:

$$\langle \delta\Phi(x)\delta\Phi(0)\rangle \sim \frac{m_h}{16\pi^2 M_{\rm Pl}} e^{-m_h|x|}$$

- Microscopic scale:

$$L_h = \frac{1}{m_h} \approx 1.58 \times 10^{-9} \text{ m}$$

- Cosmic scale:

$$L_T \sim \frac{M_{\rm Pl}}{m_h^2 v} \approx 6.3 \times 10^{27} \text{ m}$$

6.2 Dimensional analysis

In natural units ($\hbar = c = G = 1$):

- $[m_h] = [v] = E = L^{-1}$
- $[M_{\rm Pl}] = E = L^{-1}$
- $[\alpha] = L^{-1}$, $[\kappa] = L^{-2}$
- $[\beta] = 1$ (dimensionless)