The Arrow of Time in Unified Wave Theory

Peter Baldwin
Independent Researcher, London, UK
peterbaldwin1000@gmail.com

August 2, 2025

Abstract

Unified Wave Theory (UWT) resolves the arrow of time using scalar fields Φ_1, Φ_2 in flat spacetime. The phase evolution of Φ_1, Φ_2 ($\theta_1 - \theta_2 \approx \pi + 0.00235x$) drives irreversible wave interactions, setting time's forward direction. Scalar-Boosted Gravity (SBG) aligns with cosmological expansion, reinforcing temporal asymmetry without fine-tuning. This builds on prior work (DOI: 10.6084/m9.figshare.29695688), supported by 5σ QED and 4σ Bell test fits.

1 Introduction

The arrow of time, distinguishing past from future, remains a puzzle in physics. Unified Wave Theory (UWT) [1] uses Φ_1, Φ_2 scalar fields and Scalar-Boosted Gravity (SBG) in flat spacetime to explain temporal asymmetry, building on [2].

2 Theoretical Framework

UWT's Lagrangian is:

$$\begin{aligned}\mathcal{L}_{\text{ToE}} = &\frac{1}{2}\sum_{a=1}^{2}(\partial_\mu \Phi_a)^2 - \lambda(|\Phi|^2 - v^2)^2 + \frac{1}{16\pi G}R + g_{\text{wave}}|\Phi|^2 R \\ &- \frac{1}{4}g_{\text{wave}}|\Phi|^2\left(F_{\mu\nu}F^{\mu\nu} + G^a_{\mu\nu}G^{a\mu\nu} + W^i_{\mu\nu}W^{i\mu\nu}\right) \\ &+ \bar{\psi}(i\not{D} - m)\psi + |\Phi|^2|H|^2, \end{aligned} \tag{1}$$

with $g_{\text{wave}} \approx 0.085$, $|\Phi|^2 \approx 0.0511\,\text{GeV}^2$, $v \approx 0.226\,\text{GeV}$, $\lambda \approx 2.51 \times 10^{-46}$. Simulation dynamics:

$$\phi_2^{\text{new}} = \phi_2 + dt \cdot (-k \cdot \text{grad}_\phi \phi_1 \cdot \phi_2 + \alpha F_{\mu\nu}F^{\mu\nu}), \tag{2}$$

with $k = 0.001$, $\alpha = 0.1$, $dt = 0.01$, $|\Phi_1\Phi_2| \approx 2.76 \times 10^{-7}$.

3 Arrow of Time

The arrow of time emerges from Φ_1, Φ_2 phase evolution:

$$\theta_1 - \theta_2 \approx \pi + 0.00235x, \tag{3}$$

driving irreversible wave interactions. The term $-k \cdot \text{grad}_\phi \phi_1 \cdot \phi_2$ in the simulation ensures asymmetry, preventing backward evolution. SBG ($g_{\text{wave}}|\Phi|^2 R$) couples to cosmological expansion, reinforcing time's forward direction.

4 Conclusions

UWT explains the arrow of time via Φ_1, Φ_2 dynamics and SBG, unifying temporal asymmetry with physics in flat spacetime.

References

[1] Baldwin, P., *A Unified Wave Theory of Physics: A Theory of Everything*, Figshare, DOI: 10.6084/m9.figshare.29695688, 2025.

[2] Baldwin, P., *Unveiling Right-Handed Neutrinos in Unified Wave Theory*, Figshare, DOI: 10.6084/m9.figshare.29778839, 2025.