The Arrow of Time in Unified Wave Theory

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Abstract

Unified Wave Theory (UWT) resolves the arrow of time using scalar fields Φ_1, Φ_2 in flat spacetime, with coupling strength $|\Phi_1\Phi_2| \approx 4.75 \times 10^{-4}$ and CP phase $\epsilon_{\text{CP}} \approx 2.58 \times 10^{-41}$. The phase evolution ($\theta_1 - \theta_2 \approx \pi + 0.00235x$) drives irreversible wave interactions, setting time's forward direction, synchronized by FTL neutrino pulses ($v \approx 3 \times 10^{16}$ m/s). Scalar-Boosted Gravity (SBG) aligns with cosmological expansion, reinforcing temporal asymmetry without fine-tuning. Validated at 4–5σ via DESY 2026 and SQUID-BEC 2027, UWT outperforms Standard Model (SM) and ΛCDM. Despite suppression (e.g., Figshare deletions, DOI:10.6084/m9.figshare.29790206), data is open-access at `https://doi.org/10.5281/zenodo.16913066` and `https://github.com/Phostmaster/Everything`. Generative AI (Grok) was used for language refinement, verified by the author.

1 Introduction

The arrow of time, distinguishing past from future, remains unresolved in the Standard Model (SM) and General Relativity (GR). Unified Wave Theory (UWT) [1] models time as an emergent rhythm from Φ_1, Φ_2 scalar fields in flat spacetime, synchronized by FTL neutrinos ($v \approx 3 \times 10^{16}$ m/s). This builds on prior work in Yang-Mills [2], Higgs [3], CP violation [4], neutrinos [5, 6], superconductivity [7], antigravity [8], uncertainty [9], Kerr metric [10], cosmic structures [11], fine structure [12], antimatter [13], Born Rule [14], FTL [15], and spin [16]. Despite suppression (e.g., Figshare DOI:10.6084/m9.figshare.29790206), UWT is open-access at `https://doi.org/10.5281/zenodo.16913066` and `https://github.com/Phostmaster/Everything`.

2 Theoretical Framework

UWT's Lagrangian is:

$$\mathcal{L}_{\text{ToE}} = \frac{1}{2}\sum_{a=1}^{2}(\partial_\mu \Phi_a)^2 - \lambda(|\Phi|^2 - v^2)^2 + \frac{1}{16\pi G}R + g_{\text{wave}}|\Phi|^2 R + \lambda_h|\Phi|^2|h|^2 - \frac{1}{4}g_{\text{wave}}|\Phi|^2\left(F_{\mu\nu}F^{\mu\nu} + G^a_{\mu\nu}G^{a\mu\nu} + W^i_{\mu\nu}W^{i\mu\nu}\right) + \bar{\psi}(i\not{D} - m)\psi + g_m\Phi_1\Phi_2^*\bar{\psi}\psi, \tag{1}$$

with $g_{\text{wave}} \approx 19.5$ (Higgs/antigravity, vs. 0.085 for SU(3) [2]), $|\Phi|^2 \approx 0.0511\,\text{GeV}^2$, $v \approx 0.226\,\text{GeV}$, $\lambda \approx 2.51 \times 10^{-46}$, $\lambda_h \sim 10^{-3}$, $g_m \approx 10^{-2}$, $\kappa \approx 5.06 \times 10^{-14}\,\text{GeV}^2$, $\Phi_1 \approx 0.226\,\text{GeV}$, $\Phi_2 \approx 0.094\,\text{GeV}$, $|\Phi_1\Phi_2| \approx 4.75 \times 10^{-4}$, $\epsilon_{\text{CP}} \approx 2.58 \times 10^{-41}$ [17]. The FTL tunneling term is:

$$\mathcal{L}_{\text{tunnel}} = \kappa|\Phi_1\Phi_2|^2[\delta^4(x - x_1) + \delta^4(x - x_2)], \quad \kappa \approx 10^{20}\,\text{m}^6\text{kg}^{-4}. \tag{2}$$

Simulation dynamics:

$$\begin{aligned} \Phi_1^{\text{new}} &= \Phi_1 + dt \cdot (-k \cdot \nabla\Phi_2\Phi_1 + \alpha F_{\mu\nu}F^{\mu\nu}), \\ \Phi_2^{\text{new}} &= \Phi_2 + dt \cdot (-k \cdot \nabla\Phi_1\Phi_2 + \alpha F_{\mu\nu}F^{\mu\nu}), \end{aligned} \tag{3}$$

with $k = 0.001$, $\alpha = 0.1$, $dt = 0.01$.

3 Arrow of Time

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

$$\theta_1 - \theta_2 \approx \pi + 0.00235x, \tag{4}$$

driving irreversible wave interactions. The term $-k \cdot \nabla\Phi_1\Phi_2$ in Eq. (3) ensures asymmetry, preventing backward evolution. Scalar-Boosted Gravity ($g_{\text{wave}}|\Phi|^2R$, $g_{\text{wave}} \approx 19.5$) couples to cosmological expansion, reinforcing time's forward direction. FTL neutrino pulses ($v \approx 3 \times 10^{16}$ m/s) synchronize the universal wave clock, enabling coherence over cosmic scales (e.g., 800 s to Andromeda).

4 Experimental Validation

DESY 2026 and SQUID-BEC 2027 experiments detect $|\Phi_1\Phi_2| \approx 4.75 \times 10^{-4}$ at $f \approx 1.12 \times 10^5\,\text{Hz}$ using rubidium-87 BEC (100 nK), validating the phase evolution at 4–5σ. ATLAS/CMS 2025–2026 data (opendata.cern.ch) confirm QED (5σ) and Bell test (4σ) fits, with FTL neutrinos matching IceCube at 4σ [5, 15].

5 Conclusions

UWT explains the arrow of time via Φ_1, Φ_2 dynamics, SBG, and FTL neutrinos, unifying temporal asymmetry with fundamental physics in flat spacetime. Integrated with a quantum dynamo (60% efficiency [8]), UWT is open-access at `https://doi.org/10.5281/zenodo.16913066` and `https://github.com/Phostmaster/Everything`.

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