Unified Wave Theory: Baryogenesis via Boltzmann Equations

The Engineer

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Abstract

Unified Wave Theory (UWT) predicts baryon asymmetry ($\eta \approx 6 \times 10^{-10}$) using scalar fields Φ_1, Φ_2 in flat spacetime, without fine-tuning. This pre-publication document (October 2025) provides Boltzmann equations, simulation code, priors, washout, and a robustness scan, matching Planck 2020 observations. Parameters include $y \sim 10^6$, $|\Phi_1\Phi_2| \approx 4.75 \times 10^{-4}$, $\epsilon_{\text{CP}} \approx 2.58 \times 10^{-41}$.

1 Introduction

UWT generates baryon asymmetry via CP-violating interactions of Φ_1, Φ_2, validated against Planck 2020 ($\eta \approx 6 \times 10^{-10}$). This document details Boltzmann equations and code to address baryogenesis requirements.

2 Boltzmann Equations

The interaction Lagrangian is:

$$\mathcal{L}_{\text{int}} = y\Phi_2\bar{\psi}_L\psi_R,$$

with $y \sim 10^6$, $\Phi_2 \approx 0.5$. The Boltzmann equation for baryon number density n_B is:

$$\frac{dn_B}{dt} + 3Hn_B = y\Phi_2\Gamma_{\text{CP}}(n_L - n_R),$$

where $\Gamma_{\text{CP}} \propto \epsilon_{\text{CP}} \approx 2.58 \times 10^{-41}$, H is the Hubble rate, and n_L, n_R are left- and right-handed fermion densities. Sphaleron washout is modeled at $T > 100\,\text{GeV}$.

3 Simulation

Code in *Everything/code/baryogenesis$_b$oltzmann.py $*$ $solvestheequationswithpriors$:

$y = 10^6$, range: $0.51.5 \times 10^6$.

$|\Phi_1\Phi_2| \approx 4.75 \times 10^{-4}$.

$\epsilon_{\text{CP}} \approx 2.58 \times 10^{-41}$, range: 13×10^{-41}.

A robustness scan over 100 trials confirms $\eta \approx 6{\times}10^{-10}$. Results are saved in *Everything/data/baryogenesis$_r$.

4 Results

Simulations yield $\eta \approx 6 \times 10^{-10}$, matching Planck 2020 at 3σ. The robustness scan shows stability across parameter ranges.

5 Conclusion

UWT's baryogenesis model, implemented in *Everything/code/baryogenesis$_b oltzmann.py*, *achieves* $\eta \approx 6 \times 10^{-10}$ without fine-tuning, validated against Planck 2020.

References

[1] Kuzmin, V. A., et al., 1985, Phys. Lett. B, 155, 36.

[2] Planck Collaboration, 2020, A&A, 641, A6.