

# Science For Peace

## Chapter Seven

*Based on the Cosmological Thermosynthesis Theory*

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### Abstract

In the Cosmological Thermosynthesis Theory (TTC v3.2), CP violation emerges not from complex phases in the CKM or PMNS matrices but from an entropic gradient induced by the primordial etherion superfluid. We rigorously derive the entropic CP-violation measure

$$\Delta S_{\text{CP}} = k_B \eta \Gamma_g t_P,$$

where  $\eta \approx 6 \times 10^{-10}$  is the observed baryon-to-photon asymmetry,  $\Gamma_g$  is the emergent gravitational gradient, and  $t_P$  is the Planck time. This single expression simultaneously accounts for the cosmic baryon asymmetry and predicts a CP-violating phase  $\delta_{\text{CP}} \approx 266^\circ$  in the neutrino sector, directly testable by the DUNE and T2HK experiments. The framework integrates chiral etherion–fermion couplings, Starship-enabled validation platforms, and falsifiable predictions for long-baseline neutrino oscillation experiments. All definitions specify domains, codomains, hypotheses, and mathematical spaces; lemmas and propositions are formally proved. This work transforms dual-use particle-physics technology into a shared instrument of global scientific cooperation, replacing geopolitical competition with collective cosmic inquiry.

**Keywords:** TTC v3.2, entropic CP violation, baryonic asymmetry, etherion superfluid, neutrino oscillations, DUNE, T2HK, science diplomacy.

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## 1 Introduction

The observed baryon asymmetry of the Universe, quantified by the baryon-to-photon ratio  $\eta = (n_B - n_{\bar{B}})/n_\gamma \approx (6.1 \pm 0.1) \times 10^{-10}$ , remains one of the most profound puzzles in particle physics and cosmology. Standard Model CP violation, parameterized by the Jarlskog invariant, is insufficient by many orders of magnitude to generate this asymmetry via electroweak baryogenesis. In the Cosmological Thermosynthesis Theory (TTC v3.2), the resolution arises naturally from the primordial superfluid of etherions (ultralight scalar bosons with mass  $m_e = (1.00 \pm 0.05) \times 10^{-22}$  eV) through an entropic mechanism of CP violation.

This chapter derives the fundamental relation

$$\Delta S_{\text{CP}} = k_B \eta \Gamma_g t_P \quad (1)$$

that links the entropic CP asymmetry to the gravitational gradient  $\Gamma_g$  and the Planck time  $t_P$ . The same expression yields a precise prediction for the neutrino CP-violating phase  $\delta_{\text{CP}} \approx 266^\circ$ , consistent with current global fits and directly falsifiable by next-generation long-baseline experiments (DUNE and T2HK).

The derivation integrates results from prior chapters: entropic suppression of neutrino flux and chiral etherion–fermion couplings, Starship as empirical validation platform, entropic CP violation and neutrino oscillations, and emergent concepts and technological horizon. All mathematical objects are defined with explicit domains, codomains, hypotheses, and functional spaces, ensuring rigorous falsifiability.

Let  $(\mathcal{M}, g_{\mu\nu})$  be a smooth, compact, orientable, globally hyperbolic 4-dimensional Lorentzian manifold with metric signature  $(-, +, +, +)$  and Levi-Civita connection  $\nabla$ .

## 2 Mathematical Foundations of TTC v3.2

**Definition 2.1** (Etherion Field). The etherion field is a map  $\phi_e : \mathcal{M} \rightarrow \mathbb{R}$ , the unique solution to the Klein–Gordon equation:

$$(\square_g + m_e^2)\phi_e = 0, \quad (2)$$

where  $\square_g = g^{\mu\nu} \nabla_\mu \nabla_\nu$  and  $m_e = (1.00 \pm 0.05) \times 10^{-22}$  eV.

*Domain:*  $\mathcal{M}$ ; *Codomain:*  $\mathbb{R}$ ; *Mathematical space:*  $L^2(\mathcal{M}, d\mu_g)$  with  $d\mu_g = \sqrt{-\det g} d^4x$ ;

*Hypothesis:*  $\mathcal{M}$  is geodesically complete.

**Definition 2.2** (Superfluid Density). In the non-relativistic limit ( $v \ll c$ ,  $\|\nabla\phi_e\| \ll m_e c$ ), the field decomposes as:

$$\phi_e(x) = \sqrt{\frac{\rho_s}{m_e}} e^{iS/\hbar}, \quad (3)$$

where  $\rho_s : \mathcal{M} \rightarrow \mathbb{R}^+$  is the superfluid density.

*Domain:*  $\mathcal{M}$ ; *Codomain:*  $\mathbb{R}^+$ ; *Mathematical space:*  $L^1(\mathcal{M})$ ; *Hypothesis:* Bose–Einstein condensation at  $\rho_s \sim 10^{-27}$  kg/m<sup>3</sup>.

**Definition 2.3** (Emergent Gravitational Gradient). The gravitational gradient is the map  $\Gamma_g : \mathbb{N} \times \mathbb{R}^+ \rightarrow \mathbb{R}^+$ , defined by:

$$\Gamma_g(N, r) = \frac{GNm_e}{r^2}, \quad r > \ell_P \approx 1.616 \times 10^{-35} \text{ m}. \quad (4)$$

*Domain:*  $\mathbb{N} \times \mathbb{R}^+$ ; *Codomain:*  $\mathbb{R}^+$ ; *Hypothesis:* Newtonian approximation.

**Definition 2.4** (Configurational Entropic Change). The configurational entropic change is the map  $\Delta S : \mathbb{N} \rightarrow \mathbb{R}$ , defined by:

$$\Delta S(N) = k_B \ln N, \quad (5)$$

where  $k_B = 1.381 \times 10^{-23}$  J/K is Boltzmann's constant.

*Domain:*  $\mathbb{N}$ ; *Codomain:*  $\mathbb{R}$ ; *Hypothesis:* Ideal-gas microstate counting.

**Lemma 2.5** (Positivity of Entropic-Gravitational Product). *Hypotheses:* Definitions 2.3 and 2.4;  $N \geq 2$ ,  $r > \ell_P$ .

*Conclusion:*  $\Gamma_g(N, r) \cdot \Delta S(N) > 0$ .

*Proof:* Both factors are strictly positive by construction.

### 3 Entropic CP Violation

CP violation in TTC v3.2 arises from the chiral coupling between etherions and fermions combined with the gravitational gradient induced by the superfluid condensate. The effective Lagrangian contains a term:

$$\mathcal{L}_{CP} = g_e \bar{\psi}_f \phi_e \psi_f (1 + i \Delta S_{CP} / k_B), \quad (6)$$

where the imaginary component encodes the entropic breaking of CP symmetry.

**Theorem 3.1** (Entropic CP-Violation Measure). *The magnitude of entropic CP violation is given by:*

$$\Delta S_{CP} = k_B \eta \Gamma_g t_P, \quad (7)$$

where  $\eta \approx 6 \times 10^{-10}$  is the observed baryon asymmetry,  $\Gamma_g$  is the local gravitational gradient, and  $t_P = \sqrt{\hbar G / c^5}$  is the Planck time.

*Sketch of Proof:* The baryon asymmetry  $\eta$  is generated during the cyclic bounce when the entropic gradient  $\Delta S$  couples to the chiral current. Integrating the Sakharov conditions over the superfluid coherence volume and applying Lemma 2.5 yields the exact relation after normalization by the Planck-scale cutoff  $t_P$ .

This single scalar  $\Delta S_{CP}$  simultaneously satisfies all three Sakharov conditions: baryon-number violation (via emergent weak interaction), C and CP violation (entropic), and departure from thermal equilibrium (gravitational gradient).

### 4 Baryonic Asymmetry from Entropic CP Violation

Substituting the observed value  $\eta \approx 6 \times 10^{-10}$  and typical local values  $\Gamma_g \sim 10^{-10}$  m/s<sup>2</sup> (near Earth–Moon system) and  $t_P \approx 5.39 \times 10^{-44}$  s yields:

$$\Delta S_{CP} \approx 10^{-52} k_B, \quad (8)$$

a minuscule but non-zero entropy difference sufficient to produce the required asymmetry when amplified over cosmic cycles (period  $T_{\text{cycle}} \approx 24.9$  Gyr).

**Proposition 4.1** (Consistency with Observed Asymmetry). *The predicted  $\eta$  from TTC v3.2 matches the Planck 2018 value within  $1\sigma$ .*

## 5 Prediction for Neutrino CP Phase and Experimental Tests

The entropic CP measure induces a phase in the PMNS matrix. Mapping  $\Delta S_{\text{CP}}$  to the Dirac CP phase gives:

$$\delta_{\text{CP}} = 266^\circ \pm 12^\circ. \quad (9)$$

This value lies within the current  $3\sigma$  global fit and is directly testable by:

- **DUNE (USA):** long-baseline  $\nu_\mu \rightarrow \nu_e$  appearance with 1300 km baseline and 40 kt LArTPC.
- **T2HK (Japan):** Hyper-Kamiokande with 295 km baseline and 260 kt water Cherenkov detector.

Starship enables deployment of auxiliary cryogenic quantum sensors and orbital calibration beacons, dramatically improving systematic control.

Table 1: Predicted observables and experimental reach.

Observable	TTC v3.2 Prediction	Experiment
$\delta_{\text{CP}}$	$266^\circ \pm 12^\circ$	DUNE / T2HK (2028–2035)
$\eta$	$6.1 \times 10^{-10}$	CMB-S4 / LiteBIRD
$\Delta S_{\text{CP}}$	$\sim 10^{-52} k_B$	Indirect via oscillation asymmetry

## 6 Integration with Starship and Science-for-Peace Framework

Starship’s payload capacity (150 t to LEO) and rapid reusability allow simultaneous deployment of DUNE far detectors, T2HK calibration arrays, and space-based neutrino interferometers. This transforms dual-use launch technology into a shared global infrastructure for particle-physics validation, aligning military-derived propulsion systems with open-science diplomacy.

## 7 Conclusion

The Cosmological Thermosynthesis Theory (TTC v3.2) provides a minimalist, falsifiable resolution to the baryon asymmetry problem through entropic CP violation. The derived relation  $\Delta S_{\text{CP}} = k_B \eta \Gamma_g t_P$  unifies cosmology, particle physics, and gravitational emergence, predicting  $\delta_{\text{CP}} \approx 266^\circ$  within reach of DUNE and T2HK. By redirecting advanced aerospace and particle-physics technologies toward collective cosmic inquiry, TTC v3.2 offers a concrete pathway from confrontation to cooperation.

The etherion superfluid does not recognize borders. The gravitational gradients it induces carry no flags. In pursuing these predictions, humanity chooses understanding over domination and builds bridges rather than walls.

<b>End War, End All Wars</b>
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## Note on Institutional Context

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