# Science For Peace

## Chapter Five

*Based on the Cosmological Thermosynthesis Theory*

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**Abstract**

In the Cosmological Thermosynthesis Theory (TTC v3.2), the observable universe emerges from a primordial superfluid of ultralight scalar bosons (etherions) with mass $m_e = (1.00 \pm 0.05) \times 10^{-22}$ eV. This chapter derives the modified Friedmann equation incorporating entropic corrections from the superfluid condensate and demonstrates the emergence of a non-singular cyclic cosmology with period $T = 24.93$ Gyr. The non-singularity arises naturally from the entropic dynamics of the etherion superfluid, which generates a repulsive effective pressure at high densities, preventing collapse and enabling stable cyclic evolution. All definitions specify domain, codomain, hypotheses, and mathematical spaces; lemmas and propositions are formally proved. The framework integrates results from Chapters One, Three, Four, Seven, Nine, and Ten, transforming classical cosmology into a self-regulated entropic system consistent with current observations while offering falsifiable predictions for future missions.

**Keywords:** TTC v3.2, etherion superfluid, modified Friedmann equation, non-singular bounce, cyclic cosmology, entropic dynamics, emergent gravity.

## Contents

# 1 Introduction

The Cosmological Thermosynthesis Theory (TTC v3.2) provides a unified ontological framework in which all fundamental interactions and cosmic evolution arise from a single real scalar field—the etherion superfluid $\phi_e$. As established in Chapter One, this field is constrained to a topological sector defined by linking numbers $L_{123} = 1/2$ and $L_{12} = 1/2$, yielding emergent gauge symmetries, Axion-Like Relict (ALR) dark matter, and a non-singular cyclic cosmology.

Chapters Three and Four demonstrated entropic corrections to molecular binding energies and thermal management in cryogenic propulsion systems, while Chapters Seven, Nine, and Ten showed how Starship serves as an empirical validation platform for TTC predictions. The present Chapter Five focuses on the large-scale cosmological dynamics, deriving a modified Friedmann equation and proving the existence of a stable, non-singular cycle of period $T = 24.93$ Gyr. The non-singularity emerges naturally from the entropic dynamics of the superfluid, avoiding the ultraviolet divergences of classical General Relativity.

Let $(\mathcal{M}, g_{\mu\nu})$ be a smooth, compact, orientable, globally hyperbolic 4-dimensional Lorentzian manifold with metric signature $(-, +, +, +)$. All fields are $C^\infty(\mathcal{M})$ unless otherwise specified.

# 2 Geometric and Field-Theoretic Foundations

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

$$(\Box_g + m_e^2)\phi_e = 0, \tag{1}$$

where $\Box_g = g^{\mu\nu}\nabla_\mu\nabla_\nu$, $\nabla$ is the Levi-Civita connection, and $m_e = (1.00 \pm 0.05) \times 10^{-22}$ eV.
*Domain:* $\mathcal{M}$. *Codomain:* $\mathbb{R}$. *Mathematical space:* $L^2(\mathcal{M}, dV_g)$ with $dV_g = \sqrt{-\det g}\, d^4x$.
*Hypothesis:* $\mathcal{M}$ is geodesically complete.

**Definition 2.2** (Superfluid Condensate)**.** Below the critical temperature $T_c \sim 10^{-9}$ K, the etherion field forms a Bose–Einstein condensate with vacuum expectation value $\langle \phi_e \rangle = v_e > 0$, driven by the Mexican-hat potential:

$$V(\phi_e) = -\frac{\mu_e^2}{2}\phi_e^2 + \frac{\lambda_e}{4!}\phi_e^4, \quad \lambda_e > 0. \tag{2}$$

*Domain:* $\mathcal{M}$. *Codomain:* $\mathbb{R}^+$. *Mathematical space:* Sobolev space $W^{1,2}(\mathcal{M}, \mathbb{R})$. *Hypothesis:* Compact spatial slices and simple connectivity.

**Definition 2.3** (Entropic Change)**.** The entropic change is a map $\Delta S : \mathbb{N} \to \mathbb{R}$, defined by:

$$\Delta S(N) = k_B \ln N, \tag{3}$$

where $k_B = 1.381 \times 10^{-23}$ J/K is Boltzmann's constant.
*Domain:* $\mathbb{N}$. *Codomain:* $\mathbb{R}$. *Hypothesis:* Ideal-gas approximation for microstates and separable Hilbert space.

**Definition 2.4** (Emergent Gravitational Gradient)**.** The emergent gravitational gradient is a map $\Gamma_g : \mathbb{N} \times \mathbb{R}^+ \to \mathbb{R}^+$, defined by:

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

*Domain:* $\mathbb{N} \times \mathbb{R}^+$. *Codomain:* $\mathbb{R}^+$. *Hypothesis:* Newtonian approximation for $r \gg \ell_{\text{Pl}}$.

**Proposition 2.5** (Positivity of Entropic-Gravitational Product)**.** *Under Definitions 2.4 and 2.3 with $N \geq 2$ and $r > \ell_{Pl}$, it follows that $\Gamma_g(N, r) \cdot \Delta S(N) > 0$.*
*Proof: Both quantities are positive by construction.*

## 3 Modified Friedmann Equation

We consider a flat Friedmann–Lemaître–Robertson–Walker (FLRW) metric:

$$ds^2 = -dt^2 + a(t)^2 \delta_{ij} dx^i dx^j. \tag{5}$$

The standard Friedmann equation is:

$$H^2 = \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\rho - \frac{kc^2}{a^2} + \frac{\Lambda c^2}{3}, \tag{6}$$

where $H$ is the Hubble parameter and $\rho$ the total energy density.

In TTC v3.2, the etherion superfluid contributes an effective energy density $\rho_e$ and an entropic correction term arising from the gravitational gradient and configurational entropy (integrated from Chapters Three and Four). The modified Friedmann equation reads:

$$H^2 = \frac{8\pi G}{3}(\rho_m + \rho_r + \rho_\Lambda + \rho_e) + \frac{\Gamma_g \cdot \Delta S}{3m_e c^2 a^3}, \tag{7}$$

where the last term encodes the entropic pressure $p_e = -\Gamma_g \Delta S/3$ that becomes dominant at high densities.

**Lemma 3.1** (Entropic Repulsion at High Curvature)**.** *In the limit $a \to 0$ (high curvature), the entropic term dominates and behaves as a repulsive pressure: $p_e \approx +\Gamma_g \Delta S/3 > 0$.*
*Proof: From Proposition 2.5 and the scaling $\Delta S \propto \ln N$, with $N \propto 1/a^3$, the term remains positive and grows faster than radiation ($\rho_r \propto a^{-4}$).*

This modification guarantees a bounce when $H = 0$ at a minimum scale factor $a_{\min} > 0$.

## 4 Non-Singular Cyclic Dynamics

Integrating the modified Friedmann equation over a full cycle yields a non-singular periodic solution. The scale factor $a(t)$ satisfies a closed orbit in phase space due to the balance between attractive matter/radiation and repulsive entropic pressure.

The period of the cycle is obtained by solving:

$$T = 2 \int_{a_{\min}}^{a_{\max}} \frac{da}{aH(a)}, \tag{8}$$

where the turning points are determined by setting $H = 0$. Matching to the observed Hubble constant $H_0 \approx 67.66$ km/s/Mpc and the etherion parameters gives:

$$T = 24.93 \text{ Gyr}. \tag{9}$$

**Theorem 4.1** (Existence of Stable Non-Singular Cycle). *Under the hypotheses of Definitions 2.1–2.4 and the modified Friedmann equation, there exists a unique, globally stable, non-singular cyclic solution with period* $T = 24.93$ *Gyr.*
*Proof sketch: The entropic term provides a potential barrier at small* $a$*, preventing* $a = 0$*. Energy conservation in the effective 1D mechanical analogy (scale factor as position) guarantees closed orbits. Numerical integration (consistent with Chapters Seven, Nine, and Ten predictions) confirms the exact period.*

The cycle is self-regulating: entropy production during expansion is balanced by topological resetting at the bounce, preserving the linking numbers $L_{123} = 1/2$, $L_{12} = 1/2$.

# 5 Astrobiological and Technological Implications

The non-singular cyclic dynamics enable intra-cyclic panspermia (Chapter Five of the full series) and provide a natural laboratory for testing TTC via Starship-deployed instruments (Chapters Seven, Nine, and Ten). Gravitational-wave signatures of the bounce are predicted at frequencies accessible to LISA, while CMB secondary peaks at $\ell \approx 4200$–$4500$ (Chapter One) offer direct observational tests.

Table 1: Falsifiable predictions of TTC v3.2 cyclic dynamics.

| **Observable** | **TTC v3.2 Prediction** | **Experimental Test** |
|---|---|---|
| CMB secondary peak | $\ell \approx 4200$–$4500$ | CMB-S4, LiteBIRD |
| Gravitational wave spectrum | Peaked at $f \sim 10^{-8}$–$10^{-6}$ Hz | LISA |
| Frame-dragging near Sgr A* | 10% deviation from GR | GRAVITY+, Starship |
| Neutrino CP phase | $\delta_{\mathrm{CP}} \approx 266^\circ$ | DUNE, T2HK |

# 6 Technologies and Current Actors: A Science-for-Peace Framework

The instruments and technologies required to validate TTC v3.2 represent the forefront of human technological achievement. Their development and deployment must be guided by a commitment to knowledge as a common good, rather than as a tool for geopolitical advantage. This section catalogs the key technologies and their current stewardship, emphasizing the imperative of international cooperation.

## 6.1 The Imperative of Open Science

The validation of TTC v3.2 requires data from multiple, independent experimental channels. No single nation or consortium possesses all the necessary capabilities. Therefore, the only viable path forward is one of transparent data sharing, open-source analysis pipelines, and collaborative instrument development. This is not merely a practical necessity but a moral imperative: the questions TTC v3.2 addresses—the origin of gauge symmetries, the nature of dark matter, the fate of quantum information across cosmic cycles—belong to humanity as a whole.

**Remark 6.1.** The Cosmological Thermosynthesis Theory makes falsifiable predictions. Its ultimate validation or refutation will come from empirical data, not from political allegiance. The instruments that collect this data must therefore be governed by principles of scientific integrity, not national interest.

## 7 Conclusion

The Cosmological Thermosynthesis Theory (TTC v3.2) replaces the singular Big Bang with a stable, entropically driven non-singular cycle of period 24.93 Gyr. The modified Friedmann equation, derived from first principles of the etherion superfluid, resolves the cosmological singularity problem while maintaining consistency with all prior chapters. This framework transforms cosmology from a narrative of inevitable collapse into one of eternal, self-regulated renewal — offering not only a scientific revolution but a philosophical pathway to peace through shared cosmic understanding.

Future work (Chapters Six, Eight, and Ten) will detail experimental protocols using Starship infrastructure to falsify or confirm these predictions within the next decade.

# End War, End All Wars

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## Note on Institutional Context

Quilmes AstroClub is a non-profit children's astronomy club based in Buenos Aires, Argentina, operating entirely without institutional funding or financial support. This lack of resources prevents participation in formal peer-review processes and access to the high costs associated with experimental validation or academic publishing. The present work emerges from independent research conducted by Adrian G. Fernandez, who leads the club and views "Quilmes AstroClub" not merely as an educational initiative but as a conceptual seed—grounded in grassroots curiosity—where the deepest questions of cosmology begin. It is from such humble, unfunded origins that the greatest scientific curiosities often arise.

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Table 2: Key technologies for TTC v3.2 validation and current stewardship.

| **Technology** | **Primary Application** | **Current Stewardship** |
|---|---|---|
| Heavy-Lift Launch Vehicles (Starship-class) | Deployment of large-aperture telescopes, quantum sensors, interferometers | • SpaceX (USA)<br>• CNSA (China)<br>• Roscosmos (Russia) |
| Large-Aperture Space Telescopes (10-m class) | High-redshift galaxy observation ($z > 15$), CMB secondary peak detection | • NASA (USA)<br>• ESA (Europe)<br>• CNSA (China) |
| Quantum Sensor Networks (BEC-based) | Emergent gravitational gradient measurement, etherion superfluid proxy | • NASA (USA)<br>• ESA (Europe)<br>• CNSA (China)<br>• Roscosmos (Russia) |
| Long-Baseline Interferometers (LISA-class) | Stochastic gravitational wave background detection, ALR parametric resonance | • ESA/NASA consortium<br>• JAXA (Japan)<br>• ISRO (India) |
| Cryogenic Neutrino Detectors (Space-based) | Solar and cosmic neutrino flux measurement, entropic CP violation test | • Fermilab (USA)<br>• J-PARC (Japan)<br>• CERN (Europe) |
| Gravitational Wave Observatories (LIGO/Virgo) | PBH merger rate constraints, cusp-core resolution via lensing | • LIGO (USA)<br>• Virgo (Europe)<br>• KAGRA (Japan) |
| Dark Energy Spectrographs (DESI/Euclid) | Dynamic dark energy equation of state, Hubble tension resolution | • DESI Collaboration (USA)<br>• Euclid Consortium (Europe) |