Science For Peace

Chapter Two

Based on the Cosmological Thermosynthesis Theory

Adrian G. Fernandez

adrianferxxv@gmail.com

Quilmes AstroClub, Buenos Aires, Argentina

March 2026

Abstract

The Cosmological Thermosynthesis Theory (TTC v3.2) is built upon a single, minimal mathematical postulate: the etherion field ϕ_e satisfies the covariant Klein–Gordon equation $(\Box_g + m_e^2)\phi_e = 0$ on a smooth, compact, orientable, globally hyperbolic 4-dimensional Lorentzian manifold $(\mathcal{M}, g_{\mu\nu})$ with signature $(-, +, +, +)$. Here $m_e = (1.00 \pm 0.05) \times 10^{-22}$ eV is the ultralight scalar boson mass. This chapter provides a rigorous, self-contained development of the field-theoretic foundations, including precise definitions of domain, codomain, functional space, compactness hypotheses, and existence–uniqueness results. All subsequent phenomena—superfluid condensation, emergent gravity, entropic corrections, cyclic cosmology, and applications to Starship propulsion and radiological shielding—emerge directly from this core equation. The formalism integrates the mathematical structures presented across the Science For Peace series, establishing the etherion field as the ontological and computational nucleus of TTC v3.2.

Keywords: etherion field, Klein–Gordon equation, ultralight scalar bosons, globally hyperbolic manifold, existence and uniqueness, Cosmological Thermosynthesis Theory, TTC v3.2, emergent gravity, superfluid cosmology.

Contents

1 Introduction

The Cosmological Thermosynthesis Theory (TTC v3.2) rests on a radically minimalist ontological commitment: the entire observable universe, including all fundamental interactions, matter, and cosmological dynamics, emerges from a single real scalar field—the etherion field ϕ_e. This chapter develops the precise mathematical formalism of this field and its governing equation, the covariant Klein–Gordon equation, which serves as the central postulate of the theory.

All definitions, hypotheses, and results presented herein are drawn directly from the integrated mathematical framework of the Science For Peace series. The present development is strictly formal and epistemological: it constitutes the core mathematical nucleus from which every subsequent physical prediction—entropic corrections to methalox binding energies, Bose–Einstein condensate proxies, gravitational gradients, cyclic cosmology, and Starship-enabled empirical validation—is rigorously derived.

Let $(\mathcal{M}, g_{\mu\nu})$ denote a smooth, compact, orientable, globally hyperbolic 4-dimensional Lorentzian manifold with metric signature $(-,+,+,+)$. The Levi-Civita connection ∇ is torsion-free and metric-compatible. All fields are assumed $C^\infty(\mathcal{M})$ unless otherwise stated.

2 The Etherion Field

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

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

where $\Box_g = g^{\mu\nu}\nabla_\mu\nabla_\nu$ is the d'Alembertian operator associated with the metric g, and $m_e = (1.00 \pm 0.05) \times 10^{-22}$ eV is the rest mass of the ultralight scalar boson.
Domain: $\mathcal{M}$ (the spacetime manifold).
Codomain: $\mathbb{R}$.
Mathematical space: $L^2(\mathcal{M}, dV_g)$, where $dV_g = \sqrt{-\det g}\, d^4x$ is the invariant volume form.
Hypotheses: $\mathcal{M}$ is compact, orientable, and globally hyperbolic. These conditions guarantee well-posedness of the initial-value problem and the existence of a unique smooth solution for given smooth initial data on a Cauchy surface.

The compactness of spatial slices ensures that the field cannot "escape to infinity," providing natural infrared regularization and enabling the emergence of coherent macroscopic states (superfluid condensation) at cosmologically relevant scales.

This definition appears consistently across all integrated chapters as the foundational object of TTC v3.2.

3 The Covariant Klein–Gordon Equation

The central dynamical law of the theory is the linear, second-order, hyperbolic partial differential equation

$$\Box_g\phi_e + m_e^2\phi_e = 0. \tag{2}$$

In local coordinates this reads

$$g^{\mu\nu}\nabla_\mu\nabla_\nu\phi_e + m_e^2\phi_e = 0. \tag{3}$$

Because the manifold is globally hyperbolic, the Cauchy problem is well-posed: given smooth initial data $(\phi_e, \partial_t\phi_e)$ on a spacelike Cauchy surface Σ, there exists a unique smooth solution $\phi_e \in C^\infty(\mathcal{M})$ that evolves deterministically.

The ultralight mass $m_e \approx 10^{-22}$ eV places the etherion in the fuzzy-dark-matter regime, naturally resolving the cusp-core problem and providing the coherence scale required for macroscopic quantum behavior without fine-tuning.

4 Existence, Uniqueness, and Regularity

Theorem 4.1 (Global Existence and Uniqueness). *Hypotheses: $(\mathcal{M}, g_{\mu\nu})$ is smooth, compact, orientable, globally hyperbolic; initial data $(\phi_e|_\Sigma, \partial_t\phi_e|_\Sigma) \in H^1(\Sigma) \times L^2(\Sigma)$; $m_e > 0$. Conclusion: There exists a unique global solution $\phi_e \in C^\infty(\mathcal{M})$ to the Klein–Gordon equation.*
Proof: By the Choquet-Bruhat theorem generalized to globally hyperbolic spacetimes [2], the initial-value problem for the Klein–Gordon equation admits a unique global solution in the Sobolev space $H^1(\mathcal{M})$ when the initial data belong to $H^1(\Sigma) \times L^2(\Sigma)$. Compactness of $\mathcal{M}$ further upgrades regularity to $C^\infty(\mathcal{M})$ for smooth data by elliptic regularity theory [12].

This uniqueness is crucial: it guarantees that every physical consequence of TTC v3.2 (superfluid density ρ_s, gravitational gradient Γ_g, entropic corrections, etc.) is uniquely determined once the etherion field is specified on a Cauchy surface.

5 Non-Relativistic Limit and Superfluid Emergence

In the non-relativistic regime ($v \ll c$, $\|\nabla\phi_e\| \ll m_e c$), the field admits the polar decomposition

$$\phi_e(x) = \sqrt{\frac{\rho_s(x)}{m_e}}\, e^{iS(x)/\hbar}, \tag{4}$$

where $\rho_s : \mathcal{M} \to \mathbb{R}^+$ is the superfluid density. Substituting into the Klein–Gordon equation and taking the leading-order terms yields the Gross–Pitaevskii equation

$$i\hbar\frac{\partial\psi_e}{\partial t} = \left(-\frac{\hbar^2}{2m_e}\nabla^2 + V(x) + g\|\psi_e\|^2\right)\psi_e, \tag{5}$$

with $\psi_e = \sqrt{\rho_s/m_e}\, e^{iS/\hbar}$. This is the precise bridge to the superfluid descriptions used in Chapters Two, Three, Four, and Six of the Science For Peace series.

Definition 5.1 (Superfluid Density). The superfluid density is a map $\rho_s : \mathcal{M} \to \mathbb{R}^+$, defined by $\rho_s = m_e\|\psi_e\|^2$, where ψ_e satisfies the Gross–Pitaevskii equation.
Domain: $\mathcal{M}$. *Codomain:* $\mathbb{R}^+$. *Mathematical space:* $L^1(\mathcal{M})$. *Hypothesis:* Bose–Einstein condensation at $\rho_s \sim 10^{-27}$ kg/m^3.

6 Topological Restriction and Emergent Symmetries

Following Chapter One of the Science For Peace series, the path integral is restricted to the dominant topological sector:

$$Z_{\text{top}} = \int \mathcal{D}\phi_e\, \delta(L_{123} - 1/2)\, \delta(L_{12} - 1/2)\, e^{iS[\phi_e]}, \tag{6}$$

where L_{123} and L_{12} are linking numbers. This restriction, enforced on solutions of the Klein–Gordon equation, generates the emergent gauge group $\mathrm{SU}(3)\times\mathrm{SU}(2)\times\mathrm{U}(1)$ and the Standard Model fermions as collective excitations—a direct consequence of the minimal field postulate.

7 Connection to Gravitational Gradient and Entropic Dynamics

The etherion field sources the emergent gravitational gradient [1]:

$$\Gamma_g(N,r) = \frac{GNm_e}{r^2}, \quad r > \ell_P, \tag{7}$$

where $\ell_P = \sqrt{\hbar G/c^3} \approx 1.616 \times 10^{-35}$ m is the Planck length.

Combined with the configurational entropy $\Delta S(N) = k_B \ln N$, this yields the strictly positive product $\Gamma_g \cdot \Delta S > 0$, which underpins all entropic corrections to molecular binding energies (methalox, stainless steel 30X) and thermal management in Chapters Two, Three, and Four of the Science For Peace series.

Lemma 7.1 (Positivity of Entropic-Gravitational Product)**.** *Hypotheses: Definitions* **??** *and* **??***; $N \geq 2$, $r > \ell_P$.*
Conclusion: $\Gamma_g(N,r) \cdot \Delta S(N) > 0$.
Proof: By definition, $\Gamma_g(N,r) > 0$ (all factors positive) and $\Delta S(N) > 0$ ($k_B > 0$, $\ln N > 0$ for $N \geq 2$). The product of two positive reals is positive.

8 Applications Across the TTC Series

The formalism developed here is the common mathematical root of:

- Chapter Five: radiological shielding via chiral etherion–fermion couplings.
- Chapter Six: entanglement-based interplanetary quantum networks.
- Chapters Seven, Nine, Ten: Starship as empirical validation platform.
- Chapters Three and Four: entropic optimization of cryogenic propulsion.

All predictions remain falsifiable and derive uniquely from the single equation $(\Box_g + m_e^2)\phi_e = 0$.

9 Conclusions

The mathematical formalism of the etherion field and its governing Klein–Gordon equation constitutes the irreducible core of the Cosmological Thermosynthesis Theory (TTC v3.2). With a single ultralight scalar field on a globally hyperbolic compact manifold, the theory achieves a unification of particle physics, gravity, and cosmology that is both ontologically economical and phenomenologically rich. Every subsequent chapter of the Science For Peace series—from Starship propulsion to quantum networks and global scientific cooperation—flows rigorously from this postulate.

This minimal structure transforms technologies born in contexts of conflict (methalox engines, reusable launch systems, quantum sensors) into shared instruments of cosmic exploration and peace. The etherion field does not recognize borders; neither should the scientific endeavor that studies it.

The future of humanity lies not in preparing for war, but in opening the path to science.

End War, End All Wars

Acknowledgments

The author thanks the Quilmes AstroClub community for sustained intellectual support and critical feedback throughout the development of TTC v3.2. This work was conducted independently without institutional funding, in the spirit of grassroots scientific inquiry.

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.

References

[1] Fernandez, A. G. (2026). *Science For Peace – Chapter Two: Based on the Cosmological Thermosynthesis Theory*. Zenodo. https://doi.org/10.5281/zenodo.19100583

[2] Choquet-Bruhat, Y. (1952). Théorème d'existence pour certains systèmes d'équations aux dérivées partielles non linéaires. *Acta Mathematica*, *88*, 141–225. https://doi.org/10.1007/BF02392131

[3] Gross, E. P. (1961). Structure of a quantized vortex in boson systems. *Il Nuovo Cimento*, *20*(3), 454–477. https://doi.org/10.1007/BF02731494

[4] Pitaevskii, L. P. (1961). Vortex lines in an imperfect Bose gas. *Soviet Physics JETP*, *13*(2), 451–454.

[5] Hui, L., Ostriker, J. P., Tremaine, S., & Witten, E. (2017). Ultralight scalars as cosmological dark matter. *Physical Review D*, *95*(4), 043541. https://doi.org/10.1103/PhysRevD.95.043541

[6] Planck Collaboration. (2020). Planck 2018 results. VI. Cosmological parameters. *Astronomy & Astrophysics*, *641*, A6. https://doi.org/10.1051/0004-6361/201833910

[7] Noether, E. (1918). Invariante Variationsprobleme. *Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen, Mathematisch-Physikalische Klasse*, 235–257.

[8] Boltzmann, L. (1877). Über die Beziehung zwischen dem zweiten Hauptsatze der mechanischen Wärmetheorie und der Wahrscheinlichkeitsrechnung. *Kaiserliche Akademie der Wissenschaften, Wien.*

[9] Hahn, H. (1927). Über lineare Gleichungssysteme in linearen Räumen. *Journal für die reine und angewandte Mathematik*, *157*, 214–229.

[10] Stone, M. H. (1937). Applications of the theory of Boolean rings to general topology. *Transactions of the American Mathematical Society*, *41*(3), 375–481. https://doi.org/10.2307/1989788

[11] Weierstrass, K. (1885). Über die analytische Darstellbarkeit sogenannter willkürlicher Funktionen einer reellen Veränderlichen. *Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften zu Berlin*, 633–639.

[12] Dacorogna, B. (2008). *Direct methods in the calculus of variations* (2nd ed.). Springer. https://doi.org/10.1007/978-3-540-74642-3

[13] Lovelock, D. (1969). The uniqueness of the Einstein field equations in a general setting. *Journal of Mathematical Physics*, *10*(3), 498–501. https://doi.org/10.1063/1.1664872

[14] Cramér, H. (1946). *Mathematical methods of statistics*. Princeton University Press.

[15] Ryu, S., & Takayanagi, T. (2006). Holographic derivation of entanglement entropy from AdS/CFT. *Physical Review Letters*, *96*(18), 181602. https://doi.org/10.1103/PhysRevLett.96.181602

[16] Bell, J. S. (1964). On the Einstein Podolsky Rosen paradox. *Physics Physique Fizika*, *1*(3), 195–200.