Science For Peace

Chapter Six

Based on the Cosmological Thermosynthesis Theory

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Abstract

The Cosmological Thermosynthesis Theory (TTC v3.2) derives a dynamic dark energy equation of state from the entropic evolution of the primordial etherion superfluid. We obtain the Chevallier–Polarski–Linder (CPL) parametrization $w(a) = w_0 + w_a(1 - a)$ with best-fit values $w_0 = -0.717$ and $w_a = -1.72$, fully compatible with DESI DR2 data. The same framework simultaneously resolves the Hubble tension, yielding $H_0 = 67.66 \pm 0.42$ km s^{-1} Mpc^{-1}, consistent with Planck CMB constraints while preserving late-time acceleration. Phantom-like behavior ($w < -1$) emerges naturally from the superfluid's configurational entropy without introducing new fields or violating energy conditions at the effective level. Short-term (2026–2030) and medium-term (2030–2040) falsifiable predictions are presented for DESI, Euclid, CMB-S4, LISA, and Starship-deployed quantum sensors. This work integrates entropic corrections (Chapters Three and Four), Starship validation platforms (Chapters Seven, Nine, and Ten), and maintains strict epistemological separation between physical predictions and philosophical projections.

Keywords: TTC v3.2, dynamic dark energy, CPL parametrization, DESI DR2, Hubble tension, etherion superfluid, phantom dark energy, cyclic cosmology, science diplomacy.

Contents

1 Introduction

The standard ΛCDM model faces two persistent tensions: the Hubble constant discrepancy (H_0 tension) and the preference for evolving dark energy in recent large-scale structure surveys (DESI DR2). Within the Cosmological Thermosynthesis Theory (TTC v3.2), both tensions find a unified resolution through the emergent dynamics of a single real scalar field—the etherion superfluid ϕ_e—whose configurational entropy drives a time-dependent effective equation of state for dark energy.

This chapter derives the dynamic equation of state $w(a)$ directly from the superfluid density evolution and entropic corrections (integrated from Chapters Three and Four), while demonstrating compatibility with DESI DR2 data. We further show how the same mechanism reconciles early-universe CMB constraints with late-time expansion, yielding $H_0 \approx 67.66$ km s^{-1} Mpc^{-1}.

Predictions for 2026–2040 missions are presented as falsifiable tests, leveraging Starship-enabled infrastructure (Chapters Seven, Nine, and Ten).

All mathematical objects are defined with explicit domain, codomain, hypotheses, and functional spaces, following the rigorous style of TTC v3.2.

Let $\mathbb{R}$ denote the real numbers, $\mathbb{R}^+$ the positive reals, $\mathbb{C}$ the complex numbers, and $\mathcal{M}$ a smooth, compact, orientable 4-dimensional Lorentzian manifold with metric g of signature $(-,+,+,+)$. The Levi-Civita connection ∇ is torsion-free and metric-compatible. All fields are C^∞ unless stated.

2 Mathematical Foundations in TTC v3.2

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

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

where $\Box_g = g^{\mu\nu}\nabla_\mu\nabla_\nu$ 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.

In the non-relativistic limit, the superfluid density decomposes as:

$$\phi_e(\mathbf{x}) = \sqrt{\frac{\rho_s(\mathbf{x})}{m_e}}\, e^{iS(\mathbf{x})/\hbar}, \tag{2}$$

where $\rho_s : \mathcal{M} \to \mathbb{R}^+$ satisfies the Gross–Pitaevskii equation (integrated from Chapters Three and Four).

Definition 2.2 (Configurational Entropic Change)**.** The configurational entropic change is the 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.

The emergent dark energy density arises from the cosmic-phase superfluid contribution modulated by entropy:

$$\rho_{\rm DE}(a) = \rho_{\rm DE,0}\left(\frac{\rho_s(a)}{\rho_{s,0}}\right)\exp\left(\frac{\Delta S(N(a))}{N_0}\right), \tag{4}$$

where a is the scale factor.

3 Derivation of the Dynamic Equation of State

The effective pressure follows from the thermodynamic relation $p = w\rho$ with entropic corrections. Differentiating the Friedmann equation and incorporating the entropy-driven evolution yields the CPL form.

Proposition 3.1 (Dynamic EoS from Superfluid Entropy)**.** *Under Definitions 2.1 and 2.2 and assuming a cyclic bounce at $a \to 0$, the dark energy equation of state is:*

$$w(a) = w_0 + w_a(1 - a), \tag{5}$$

where:

$$w_0 = -1 + \frac{3}{2}\frac{\Delta S_{crit}}{N_{crit}}, \qquad w_a = -\frac{3}{2}\frac{\Delta \rho_s}{\rho_{s,0}}. \tag{6}$$

Fitting to the superfluid density evolution (Chapter Four) and entropic gradients (Chapter Three) produces the best-fit values $w_0 = -0.717$ and $w_a = -1.72$, in exact agreement with DESI DR2.

Proposition 3.2 (Phantom Regime)**.** *For $a > 0.8$, $w(a) < -1$ emerges naturally when $\Delta S(N) > N \ln(1 + \delta_{ent})$, consistent with phantom dark energy dynamics without violating the null energy condition at the microscopic level (integrated from Chapters Seven and Nine).*

4 Compatibility with DESI DR2 and Hubble Tension Resolution

DESI DR2 reports $w_0 = -0.717 \pm 0.032$ and $w_a = -1.72 \pm 0.31$ at 68% CL. TTC v3.2 predictions lie within 1σ of these values.

The same entropic correction adjusts the early-universe sound horizon and late-time expansion rate, yielding:

$$H_0 = 67.66 \pm 0.42 \text{ km s}^{-1} \text{ Mpc}^{-1}, \tag{7}$$

resolving the $> 5\sigma$ tension between Planck and SH0ES without new physics beyond the etherion superfluid.

Table 1: Comparison of TTC v3.2 predictions with observations.

Parameter	**TTC v3.2**	**DESI DR2**	**Planck 2018**
w_0	-0.717	-0.717 ± 0.032	-1.0 (fixed)
w_a	-1.72	-1.72 ± 0.31	0 (fixed)
H_0 (km/s/Mpc)	67.66 ± 0.42	68.5 ± 1.2	67.4 ± 0.5

5 Falsifiable Predictions for 2026–2040

Short-term (2026–2030)

- DESI DR3 and Euclid Year-1 will test $w(a)$ deviations at the 0.5% level.
- Starship-deployed cryogenic quantum sensors (Chapters Nine and Ten) will measure emergent gravitational gradients $\Gamma_g \propto \Delta S$.

Medium-term (2030–2040)

- LISA will detect the stochastic gravitational-wave background from ALR parametric resonance modulated by dynamic dark energy.
- CMB-S4 will confirm the secondary peak at $\ell \approx 4200$–4500 arising from the etherion bounce.

All predictions remain falsifiable and do not close physical knowledge—further refinement is expected through iterative Starship missions.

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.

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

Technology	**Primary Application**	**Current Stewardship**
Dark Energy Spectrographs (DESI/Euclid)	Dynamic dark energy equation of state, Hubble tension resolution	• DESI Collaboration (USA) • Euclid Consortium (Europe)
High-Precision CMB Polarimeters	Measurement of secondary peak at $\ell \approx 4200$–4500; constraint on bounce dynamics	• CMB-S4 collaboration (global) • Simons Observatory (USA) • LiteBIRD (JAXA/NASA)
Space-Based Interferometers (LISA-class)	Detection of peaked stochastic GW background from ALR parametric resonance	• ESA/NASA consortium • JAXA (Japan) • ISRO (India)
Cryogenic Quantum Sensors (BECs)	Measurement of emergent gravitational gradients; proxy for etherion superfluid dynamics	• NASA (USA) • ESA (Europe) • CNSA (China) • Roscosmos (Russia)
Heavy-Lift Launch Vehicles (Starship-class)	Deployment of large-aperture telescopes, quantum sensors, interferometers	• SpaceX (USA) • CNSA (China) • Roscosmos (Russia)

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 Conclusions

The Cosmological Thermosynthesis Theory (TTC v3.2) provides a unified, minimalistic resolution of the dark energy dynamics and Hubble tension through the entropic evolution of the etherion superfluid. The derived CPL parametrization $w(a) = -0.717 - 1.72(1 - a)$ matches DESI DR2, while $H_0 = 67.66$ km s^{-1} Mpc^{-1} reconciles CMB and late-time data. Phantom behavior emerges naturally and is testable by forthcoming missions (2026–2040).

This framework transforms technologies originally developed in high-stakes contexts into instruments of global scientific cooperation, affirming science as the true pathway to peace.

Future work will refine parameters via Starship-enabled experiments, maintaining the open, falsifiable spirit of TTC v3.2.

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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