High-Energy Neutrinos from the Galactic Plane under Ontological Discipline

A Critical–Propositional Analysis of the IceCube Collaboration Paper
in the Light of the Theory of Objectivity

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2026

Abstract

The observation of high-energy neutrinos associated with the Galactic plane, reported by the *IceCube Collaboration* in *Science* (IceCube Collaboration, 2023a), constitutes a decisive milestone in contemporary astrophysics and in the consolidation of neutrino astronomy. This manuscript develops a critical–propositional reading of that study under *ontological discipline*, in the light of the *Theory of Objectivity* (TO), a modal–axiomatic ontology grounded in the Seven Absolute Truths (Cabannas and Silva, 2016, 2018, 2020, 2025).

We argue that there exist deep structural compatibilities between (i) the relational character of detection and event reconstruction in IceCube, (ii) the field-singularity of each event when treated as a phenomenic element, and (iii) the cumulative composition that links hadronic production, decay chains, and cosmological transport. We also identify relevant ontological tensions regarding the primordial status of spacetime and the derived (or non-derived) status of information in standard-model cosmology.

We maintain that TO does not aim to replace contemporary physics or cosmology; rather, it must function as the logical and ontological basis for any model coherent with a *possible universe*, given the modal necessity of its seven axioms. Finally, we propose that high-energy neutrinos can be interpreted as persistent phenomenic manifestations of plasmas described in TO's cosmological eras, thus operating as long-coherence information carriers.

Keywords

neutrinos; IceCube; Galactic plane; modal ontology; Theory of Objectivity; cosmology; information; inductor effects; testability.

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Chapter 1

Introduction

1.1 Motivation and scope

High-energy physics and observational astrophysics are currently experiencing a phase of *methodological unification* via multi-messenger astronomy. Neutrinos, by interacting only weakly, preserve information from dense and distant regions, crossing media that would be opaque to photons. The consequence is twofold: (i) a direct observational window onto hadronic processes and cosmic accelerators, and (ii) the possibility, by comparison with gamma rays and cosmic rays, of testing structural coherences in production and transport across scales.

The evidence for a diffuse component of high-energy neutrinos associated with the Galactic plane, reported by the *IceCube Collaboration* (IceCube Collaboration, 2023a), marks a transition: from neutrino astronomy dominated by extragalactic isotropic fluxes toward an observational capability that resolves (statistically, but robustly) a Galactic contribution. Technically, the result integrates directional reconstruction, spectral inference, statistical modeling, and morphological comparison against Galactic-plane templates.

However, any physical construction implicitly relies on ontological commitments. In the standard approach, spacetime, quantum fields, and fundamental parameters are often treated as primitive. The *Theory of Objectivity* (TO) argues that a possible universe requires explicit modal discipline: logically necessary axioms without which intelligibility collapses into ontological incoherence (Cabannas and Silva, 2018). This work applies that discipline to the IceCube result with three aims:

1. clarify compatibilities between observational structure and TO axioms;
2. make explicit tensions (or lacunae) in the standard ontological reading;

3. propose operational bridges for testability, including AI-assisted evaluation protocols.

1.2 Thesis, method, and organization

Our central thesis is that the IceCube result is *epistemically robust* and yet *ontologically incomplete* if treated solely within standard cosmology. “Incomplete” does not mean false; it means *undisciplined modally.* The method is a critical–propositional reading: we (i) present the experimental result with methodological detail, (ii) interpret it through TO’s ontological categories, and (iii) propose decision criteria and testability bridges.

The manuscript is organized into eleven main chapters and three appendices: (i) technical synthesis of IceCube, (ii) modal foundations of TO, (iii) compatibilities, (iv) tensions, (v) TO cosmology and plasmas, (vi) formalization of inductor effects, (vii) experimental dialogue and multi-messenger coherence, (viii) testability and AI-assisted evaluation, (ix) epistemological framing, (x) synthesis, and (xi) conclusion, followed by appendices on the 64–2048 structure, differential modeling, and a phenomenic correspondence table.

Chapter 2

IceCube: Technical and Methodological Synthesis

2.1 Detector architecture and detection principle

IceCube is a neutrino observatory deployed in approximately 1 km^3 of Antarctic ice, instrumented with thousands of digital optical modules. Detection occurs via Cherenkov light emitted by relativistic charged secondaries produced in neutrino–nucleus interactions in ice.

Two broad classes of event topologies are relevant: *tracks* (muon-dominated) and *cascades* (hadronic/electromagnetic showers). The Galactic-plane analysis typically relies on samples with good angular resolution, because spatial association with the plane depends on directional reconstruction.

2.2 Directional reconstruction and inference

Directional reconstruction estimates the arrival direction by maximum likelihood. Let $\vec{n}$ be the direction and t_i the time registered at module i. A standard formulation models photon-arrival times under an optical/geometry hypothesis:

$$\mathcal{L}(\vec{n}) = \prod_{i=1}^{N} P\big(t_i \mid \vec{n}, \theta\big), \tag{2.1}$$

where θ aggregates propagation parameters in ice (scattering, absorption, anisotropies, calibration). Maximizing $\mathcal{L}$ yields $\hat{\vec{n}}$. Uncertainties are estimated by local curvature of $\ln \mathcal{L}$, bootstrapping, or simulation-based calibration.

2.3 Spectral analysis and component separation

Diffuse astrophysical fluxes are commonly approximated by a power law:

$$\Phi(E) = \Phi_0 \left(\frac{E}{E_0} \right)^{-\gamma}, \tag{2.2}$$

with $\gamma \sim 2$–3 depending on population and energy regime. Separating an extragalactic isotropic component from a Galactic-plane component is performed via joint fitting of spatial and spectral templates. This is ontologically significant: it assumes that statistical "components" correspond to discernible physical realities—i.e., that boundaries in inference can be interpreted as boundaries in nature.

2.4 Test statistic and significance

IceCube reports evidence for emission from the Galactic plane with significance around 4.5σ (IceCube Collaboration, 2023a). The analysis uses a likelihood-ratio test:

$$TS = -2 \ln \left(\frac{\mathcal{L}_0}{\mathcal{L}_1} \right), \tag{2.3}$$

where $\mathcal{L}_0$ is the null hypothesis (no Galactic component) and $\mathcal{L}_1$ includes a Galactic component. The observed TS is compared to distributions obtained via scrambling or simulation to derive a p-value and its sigma-equivalent.

2.5 Hadronic origin and multi-messenger coherence

The standard physical interpretation links Galactic neutrinos to hadronic interactions of cosmic rays with gas and dust in the interstellar medium, producing pions and, through decay chains, neutrinos. Schematically:

$$p + p \to \pi^{\pm} + X, \tag{2.4}$$

$$\pi^{\pm} \to \mu^{\pm} + \nu_{\mu}, \tag{2.5}$$

$$\mu^{\pm} \to e^{\pm} + \nu_e + \nu_{\mu}. \tag{2.6}$$

Gamma rays may arise from correlated channels (e.g., $\pi^0 \to \gamma\gamma$), so morphological comparison with gamma maps is an independent coherence check.

2.6 Public data and reproducibility

The study is accompanied by a public data release with DOI (IceCube Collaboration, 2023b). Public availability strengthens inferential auditability: the community can reproduce significance maps, spectral fits, and systematically test alternative assumptions.

Chapter 3

Modal Foundations of the Theory of Objectivity

3.1 The Seven Absolute Truths as axioms of possibility

TO proposes seven fundamental propositions presented as modal necessities, without which no existential universe can be logically intelligible (Cabannas and Silva, 2018). For the present analysis, four axes are central:

- **Nothingness as primitive essence** (Axiom 1): origin is not a physical "something," but an eternal logical basis;
- **Field singularity** (Axiom 2): every element possesses a field (aura) that makes it unique;
- **Boundary and observation** (Axioms 4 and 5): distinction requires a boundary; full existence requires observation by at least two others;
- **Composition and transcendence** (Axioms 6 and 7): every element is composed of prior elements; no universe exists without substance transcendent to its quantum.

3.2 Ontological discipline and the status of physical primitives

Standard physics often treats spacetime and dynamical laws as given. Ontological discipline asks: *what is the logical status of these objects?* Primitive? Emergent? Derived from a relational grammar? TO asserts that spacetime and laws must be emergent from a prior logical structure, otherwise circularity arises: the universe is used to justify the universe.

3.3 The Perfect Logical Sphere and the 64–2048 structure

TO describes a minimal structure (Perfect Logical Sphere) with 64 straight logical parts on the maximal circumference and 2048 on the total surface (Cabannas and Silva, 2020). This segmentation is treated as a *logical minimum* necessary for relational closure. The relation

$$2048 = 64 \times 32 \tag{3.1}$$

is interpreted as a completeness rule: the surface subdivisions encode layered relational constraints derived from the axioms.

3.4 Minimal relational formalism: boundary, observation, full existence

To dialogue with conventional scientific language (without replacing TO's native formalism), consider a minimal relational model. Let E be a set of elements and $R \subseteq E \times E$ a set of constitutive relations. Axiom 4 imposes that if $a \neq b$, then there exists a boundary $F(a, b)$. Axiom 5 imposes that full existence of a requires at least two distinct observers b, c such that $(b, a) \in R$ and $(c, a) \in R$.

A minimal criterion is:

$$\mathrm{Full}(a) \Rightarrow \exists b \neq c : \ (b, a) \in R \ \wedge \ (c, a) \in R. \tag{3.2}$$

This operator Full is ontological (not merely instrumental), although instrumental detection is a phenomenic realization of relational observation.

Chapter 4

Ontological Compatibilities between IceCube and TO

4.1 Relational observation: from quantum measurement to ontology

The intuition that observation and reality are inseparable appears in Heisenberg (1958). TO elevates this to necessity: without double observation, there is no full existence. IceCube is a distributed relational network: no single module defines an event; event identity emerges from coherence among multiple registrations (times, amplitudes, geometry). Thus, the neutrino event is not a "point" by itself, but a reconstructed *configuration* under rules and boundaries: selection boundaries, noise boundaries, template boundaries, energy boundaries. The reconstruction algorithm can be read as a boundary-operator.

4.2 Field singularity: the event as a phenomenic element

Axiom 2 requires singularity of field. In neutrino physics, each event has an energy proxy, direction, uncertainty, and topology signature. Phenomenically, this can be read as an event-level *effective field*—an informational identity derived from relational coherence.

4.3 Cumulative composition: causal chains and strata of memory

Galactic neutrino production is cumulative: it depends on acceleration sources, cosmic-ray propagation, gas density, magnetic fields, and interaction processes. This realizes Axiom 6 (composition by prior elements) as a stratified causal chain. Under TO, each stratum preserves information; neutrinos preserve a portion of that memory due to weak interaction.

4.4 Infinity and definability: energy domain and extrapolation

Axiom 3 treats infinity as a logical non-element required for definability. Operationally, astrophysics uses extrapolations (power laws), integrals over wide energy ranges, and asymptotic regimes. These operations presuppose a stabilizing "domain" that makes limits and comparisons meaningful. TO supplies an ontological reading for this condition of definability.

Chapter 5

Ontological Tensions: Spacetime and Information

5.1 Spacetime as primordial: a modal critique

General relativity treats spacetime as a dynamical geometric entity, but its existence is typically assumed. Einstein (1920) discusses the physical character of space, yet does not provide a modal deduction of spacetime's necessity. TO proposes that spacetime is emergent from prior logical relations; thus standard ontology remains incomplete by not making explicit a pre-physical logical substrate.

This tension appears in how "origins" are framed: many cosmological models attempt to explain initial conditions within an already-existing spacetime, which can be seen as ontological circularity.

5.2 Information: from derived quantity to transcendent substance

Contemporary readings frequently treat information as derivative (entropy, state-counting). TO elevates information to transcendent substance (Axiom 7), interpreted as knowledge produced in atomic relations and equivalent to radiation. This thesis reinterprets neutrinos as privileged carriers: messengers of information with long persistence and low degradation.

5.3 Decision criteria: when is ontological discipline required?

We propose three operational criteria:

1. **Circularity criterion**: if a model uses structures of the universe to justify those same structures, modal discipline is required;
2. **Relational invariance criterion**: if observables arise from correlation networks, ontology must reflect relational primacy;
3. **Informational persistence criterion**: if a messenger preserves information with minimal interaction, it is a candidate phenomenic form of transcendent substance.

Chapter 6

TO Cosmological Eras and the Plasma Hypothesis

6.1 Overview of eras

TO describes a cosmology in eras: Antagonistic Era, Logical-Rails Era, Plasma eras (primary, secondary, tertiary), Centrifugal Era, and subsequent emergences (Cabannas and Silva, 2018). What matters here is the transition from a primitive logical basis to regimes of coherence capable of sustaining persistent phenomenic elements.

6.2 The Antagonistic Era and the status of Nothingness

In the Antagonistic Era, "Nothingness" is not absence but a primitive mathematical essence (Axiom 1). This shifts the "before the universe" question: it is not a physical state but an eternal logical condition. Therefore genesis is deducible as relational transition, not as an event in pre-existing spacetime.

6.3 Logical rails as relational directionality

The Logical-Rails Era introduces directionality: an organization of boundaries and relations that allows regularities to emerge. In conventional language, one may think of a breaking of relational degeneracy in which certain relational trajectories become preferred due to coherence and stability.

6.4 Primary, secondary, and tertiary plasmas

In plasma regimes, TO describes states of organization and memory. The present hypothesis is phenomenic: neutrinos can be interpreted as persistent manifestations (or traces) of the tertiary plasma, because they preserve information across long distances and interact minimally with matter.

6.5 Propositional consequences for Galactic neutrinos

If neutrinos are carriers of persistent structural memory, then: (i) Galactic morphology should imprint detectable statistical signatures, (ii) coherence regimes may manifest as spectral changes or fine anisotropies, (iii) correlation with gamma-ray maps is not merely astrophysical but also an indicator of stable phenomenic boundaries.

Chapter 7

Inductor Effects: Formalization, Dynamics, and Galactic Application

7.1 Operational definitions

TO describes inductor effects as relational mechanisms derived from axiomatic combinations. For dialogue with scientific language, we define effective quantities:

- $F(t)$: boundary density (effective distinctions per structural unit);
- $N_{\mathrm{rel}}(t)$: number of effective observational relations;
- $C(t)$: structural coherence (effective measure of relational stability);
- $\mathcal{M}(t)$: cumulative memory (effective weight of prior compositions);
- $I(t)$: informational flux (effective amount of preserved and transmissible information).

7.2 Expansive Inductor Effect (Axioms 4 and 5)

A minimal compatible form is:

$$\frac{dF}{dt} = k_1 \, N_{\mathrm{rel}}(t), \tag{7.1}$$

with $k_1 > 0$ an effective expansive-induction constant. Interpretation: increasing relations increases boundaries, multiplying distinctions and expanding the state space.

7.2.1 Astrophysical reading

The Galaxy contains multiple accelerators and interaction media. Increasing effective relations (sources, gas, magnetic fields, turbulence) increases interaction boundaries and thus the diversity of neutrino production channels.

7.3 Reductive Inductor Effect (Axioms 4, 5, and 6)

A minimal form is:

$$\frac{dC}{dt} = -k_2\,(C - C_*) + k_3\,\mathcal{M}(t), \tag{7.2}$$

where $k_2 > 0$ and C_* is an equilibrium coherence; $\mathcal{M}(t)$ is cumulative memory coupled to coherence. The term $-k_2(C - C_*)$ reduces deviations and induces convergence; the term $k_3\mathcal{M}(t)$ preserves inherited stability.

7.3.1 Quasi-stationary solution

If $\mathcal{M}(t) \approx \mathcal{M}_0$ over an interval, then $C(t)$ converges to:

$$C_\infty = C_* + \frac{k_3}{k_2}\mathcal{M}_0. \tag{7.3}$$

This formalizes the qualitative thesis: greater cumulative memory implies greater final coherence.

7.4 Inductor effects and neutrino energy

We propose a heuristic relation:

$$I(E) \propto C(E)\,\Phi(E), \tag{7.4}$$

where $I(E)$ measures information carried by neutrinos of energy E and $\Phi(E)$ is the flux. Since $\Phi(E)$ decreases with E while $C(E)$ may vary due to channel selection and coherence, the product can exhibit maxima or regime changes. This suggests searching for spectral breaks associated with coherence transitions.

7.5 Application to the Galactic plane: phenomenic boundary

The Galactic plane is a boundary of density, gas, dust, fields, and sources. Under TO, boundaries are not mere geometric cuts; they are ontological conditions of distinction. Thus, an excess aligned with the plane suggests that physical and methodological boundaries coincide in coherence regimes.

Chapter 8

Dialogue with Experimental Evidence: Nonlocality, CMB, Gravitational Waves

8.1 Nonlocality and relational geometry

Violations of Bell inequalities and quantum nonlocality (Aspect, Dalibard, and Roger, 1982) suggest that relational structure is more fundamental than classical locality. TO reads such results as compatible with deep relational geometries and the constitutive role of boundaries.

8.2 CMB anisotropies: traces of initial induction

CMB anisotropies measured by Planck (Aghanim et al., 2020) provide a record of the primordial universe. Under ontological discipline, these anisotropies can be read as traces of early geometric induction and stabilized boundaries.

8.3 Gravitational waves and coherence perturbations

Direct detection of gravitational waves (Abbott et al., 2016) provides a channel to read spacetime perturbations. If spacetime is emergent, such waves can be interpreted as perturbations in structural coherence of inductor fields (ontological reading), without denying the effective relativistic description.

8.4 Galactic neutrinos and gamma-ray maps

Since neutrinos and gamma rays may share hadronic origins, morphological coherence reinforces production in the interstellar medium. Under TO, this coherence is also an indicator of stable boundaries.

Chapter 9

Testability and AI-Assisted Evaluation

9.1 PASS/HOLD criteria and auditability

TO proposes that hypotheses be evaluated by modal consistency criteria and operational bridges (Cabannas and Silva, 2025). A minimal Bayesian form:

$$PASS \iff P(D|H) > P(D|\neg H), \tag{9.1}$$

where D are data and H is an operationalized ontological hypothesis. The criterion structures the relation between ontology and data; it does not replace standard tests.

9.2 Operational bridges for the IceCube case

We propose three bridges:

1. **Relational bridge**: quantify detection dependence on network structure (sensor redundancy, multiplicity, time coherence) and correlate with Axiom 5;
2. **Boundary bridge**: map Galactic templates as boundaries and quantify sensitivity of TS to boundary variations (plane thickness, masks, priors);
3. **Informational bridge**: estimate a proxy for preserved information as a function of energy and direction and search for coherence regimes $C(E)$.

9.3 Reproducible protocols

Public data (IceCube Collaboration, 2023b) enables pipeline audit and comparison of methodological choices. Ontological discipline recommends dual audit: technical (reproduction) and ontological (primitives and emergent alternatives).

Chapter 10

Paradigmatic Discussion and Epistemological Framing

10.1 Kuhn and the status of ontological discipline

Kuhn (1962) describes paradigm changes as shifts in disciplinary matrices. TO does not propose a new experimental datum; it proposes an ontological framework organizing what counts as a coherent model.

10.2 Comparisons with cosmology and foundations

Classical and modern works discuss cosmological limits and foundations (Hawking, 1988; Penrose, 2004; Weinberg, 1993). Ontological discipline does not deny these contributions; it imposes a criterion: any model must be compatible with axioms of possibility (TO), or justify why not.

10.3 IceCube as a maturity test for multi-messenger inference

IceCube is exemplary because: (i) it relies on robust statistical inference, (ii) it dialogues with Galactic morphology and gamma maps, and (iii) it is reproducible via public data. Therefore it is an ideal case to test whether ontological discipline can generate additional, non-redundant hypotheses and decision criteria.

Chapter 11

Conclusion

The evidence for high-energy neutrinos from the Galactic plane (IceCube Collaboration, 2023a) confirms the technical and methodological robustness of contemporary astrophysics. Under ontological discipline, the result exhibits compatibilities with TO axioms: relational observation (Axiom 5), field singularity (Axiom 2), and cumulative composition (Axiom 6). At the same time, it exposes tensions: the implicit acceptance of spacetime as primordial and the reduction of information to a derived physical quantity.

The Theory of Objectivity does not seek to replace contemporary physics. It proposes the logical, ontological, and scientific basis required for such models to be coherent with a possible universe, given the modal necessity of its axioms (Cabannas and Silva, 2025). Finally, we propose that neutrinos can be interpreted as persistent phenomenic manifestations of plasmas described in TO cosmology—a hypothesis operationalizable via testability bridges and reproducible audits.

Appendix A

Appendix A — The 64–2048 Structure: Minimal Sequence and Completeness Arguments

A.1 Operational derivation sketch

This appendix provides an operational sketch in conventional mathematical language, without replacing TO's native formalism. The goal is to clarify why a minimal, logical, perfect spherical structure requires at least 64 straight parts on the maximal circumference and 2048 on the total surface (Cabannas and Silva, 2020).

A.2 Minimal segmentation and stability

Let a maximal circumference be segmented into C parts, defining minimal boundaries. If C is too small, boundaries are too coarse to support complete relational closure. TO posits $C = 64$ as the logical minimum compatible with distinction, double relational observation, and non-collapse into degenerate symmetries.

A.3 Surface unfolding

The unfolding to $2048 = 64 \times 32$ can be read as a layered completeness rule: each equatorial logical segment unfolds into 32 minimal surface relations, ensuring relational coverage of the whole.

Appendix B

Appendix B — Modeling Inductor Effects: Differential Forms and Regimes

B.1 Minimal system

We gather the main equations as a system:

$$\frac{dF}{dt} = k_1 N_{\text{rel}}(t), \tag{B.1}$$

$$\frac{dC}{dt} = -k_2(C - C_*) + k_3\mathcal{M}(t). \tag{B.2}$$

If N_{rel} and $\mathcal{M}$ are approximately constant in a regime, analytic solutions follow. In particular, $C(t)$ converges to:

$$C_\infty = C_* + \frac{k_3}{k_2}\mathcal{M}. \tag{B.3}$$

Appendix C

Appendix C — Phenomenic Table

Table C.1: Phenomenic table: propositional correspondences between neutrino properties and TO categories.

Neutrino property	**Physical description**	**Ontological reading (TO)**
Low interaction	Small cross section; traverses dense matter	Informational persistence; candidate phenomenic carrier of transcendent substance (Axiom 7)
Directionality	In track events, good angular reconstruction	Realization of boundaries and relational observation (Axioms 4 and 5)
High energy	TeV–PeV; linked to cosmic accelerators	Expansive induction regimes and coherence selection (inductor effects)
Cumulative origin	Hadronic chains and decays	Composition by prior elements and accumulated memory (Axiom 6)
Morphological correlation	Concentration along Galactic plane	Stable phenomenic boundary; emergent structural coherence

References

Bibliography

IceCube Collaboration. 2023a. "Observation of High-Energy Neutrinos from the Galactic Plane." *Science* 380(6652): 1338–1343. doi:10.1126/science.adc9818.

IceCube Collaboration. 2023b. "Observation of high-energy neutrinos from the Galactic plane — Public data release." Dataset. doi:10.21234/8v5d-rn16.

Aspect, Alain, Jean Dalibard, and Gérard Roger. 1982. "Experimental Test of Bell's Inequalities Using Time-Varying Analyzers." *Physical Review Letters* 49: 1804–1807. doi:10.1103/PhysRevLett.49.1804.

Aghanim, N., et al. (Planck Collaboration). 2020. "Planck 2018 results. VI. Cosmological parameters." *Astronomy & Astrophysics* 641: A6. doi:10.1051/0004-6361/201833910.

Abbott, B. P., et al. (LIGO Scientific Collaboration and Virgo Collaboration). 2016. "Observation of Gravitational Waves from a Binary Black Hole Merger." *Physical Review Letters* 116: 061102. doi:10.1103/PhysRevLett.116.061102.

Einstein, Albert. 1920. *Relativity: The Special and the General Theory.* London: Methuen.

Heisenberg, Werner. 1958. *Physics and Philosophy: The Revolution in Modern Science.* New York: Harper.

Hawking, Stephen. 1988. *A Brief History of Time.* New York: Bantam.

Kuhn, Thomas. 1962. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Penrose, Roger. 2004. *The Road to Reality.* London: Jonathan Cape.

Weinberg, Steven. 1993. *The First Three Minutes.* New York: Basic Books.

Cabannas, Vidamor, and Denivaldo Silva. 2016. *Theory of Objectivity: third theory of the origin of the universe, alternative to the Big Bang Theory and Creationism.* Zenodo. doi:10.5281/zenodo.17306198.

Cabannas, Vidamor, and Denivaldo Silva. 2018. *THEORY OF OBJECTIVITY: Third theory of the origin of the universe, alternative to the Big Bang Theory and Creationism*. Zenodo. doi:10.5281/zenodo.17012791.

Cabannas, Vidamor, and Denivaldo Silva. 2020. *THE PERFECT SPHERE (Comment No. 9 to the Theory of Objectivity)*. Zenodo. doi:10.5281/zenodo.17013728.

Cabannas, Vidamor, and Denivaldo Silva. 2025. *Theory of Objectivity: Logical, Ontological and Scientific Foundations for a New Physics and Cosmology (Dialogue with Artificial Intelligences)*. Zenodo. doi:10.5281/zenodo.17295496.