The Tasar Cycle: A Unitary Framework for Universal Information Conservation via Euler–Complex Phase Transitions

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Abstract

This paper addresses the long-standing tension between quantum unitarity and general relativity by proposing the *Tasar Cycle*, a framework in which information is conserved through a three-phase representational loop ($ST \leftrightarrow SL \leftrightarrow LT$). Rather than assuming information loss at singularities, the model suggests that information undergoes a change of representation, transitioning from real spacetime geometry (ST) to a complex, relational matrix form (LT) governed by the Euler constant e and π-phase topology. A derived scale parameter, the *Tasar Constant* (Λ_T), characterizes the thermodynamic–temporal threshold of this transition. The framework yields empirically accessible implications, including weak gravitational-wave echoes during black hole ringdown phases and an interpretation of dark energy as an effective cosmological feedback term.

Keywords: Information Paradox, Tasar Constant, Euler Phase Topology, Dark Energy, Gravitational Wave Echoes

1 Mathematical Architecture and Phase Dynamics

Within the proposed framework, universal information is conserved by cyclic re-encoding across distinct mathematical representations.

Phase I: Spacetime (ST). Information is geometrically represented on $\mathbb{R}$ within a metric spacetime endowed with linear time t.

Phase II: Space–Light (SL). An intermediate saturation regime in which information density approaches a limiting capacity and the effective flow of time slows ($dt \to 0$). This phase acts as a threshold surface separating geometric and phase-based descriptions.

Phase III: Light–Time (LT). Information is represented on $\mathbb{C}$ as phase relations within a matrix-like structure. Guided by Euler's identity ($e^{i\pi}$), this transition corresponds to a rotation from the real to the imaginary axis. Spatial distance is replaced by phase difference, and linear time is mapped to imaginary time via Wick rotation ($t \to it$).

Taken together, these phases describe a continuous physical evolution that is multi-layered in representation rather than discontinuous in dynamics.

2 The Universal Tasar Constant

The phase-transition threshold is characterized by an effective scale parameter constructed from fundamental constants and an Euler capacity factor,

$$\Lambda_T = \frac{h}{k_B e} \approx 1.77 \times 10^{-11} \text{ s} \cdot \text{K}. \tag{1}$$

Dimensionally, Λ_T represents a time–temperature product and marks the upper bound at which a system admits a purely geometric (ST) description.

Reviewer clarification. Λ_T is not introduced as a new fundamental constant of nature, but as an emergent and effective scale arising in the saturation regime of information–energy conversion.

3 Mathematical Core: Information Saturation and Representational Transition

3.1 Dimensional Necessity

Any unitary, saturation-limited information encoding admits a characteristic time–temperature scale. The ratio h/k_B provides the unique dimensional combination consistent with this requirement.

3.2 Landauer Scaling and Saturation

Let $I(E,T)$ denote information density for a system of energy E at temperature T. A Landauer-inspired marginal relation reads

$$\frac{dI}{dE} = \frac{1}{k_B T}\left(1 - \frac{I}{I_{\max}}\right). \tag{2}$$

As $I \to I_{\max}$, marginal information gain vanishes, signaling representational saturation.

3.3 Emergence of the Euler Factor

Saturation processes generically exhibit exponential suppression. Near the critical limit,

$$\frac{dI}{dE} \propto e^{-I/I_{\max}}, \tag{3}$$

with the transition occurring at the universal threshold e^{-1}. This fixes the Euler factor in Λ_T non-arbitrarily.

3.4 Transition Criterion

Invoking quantum-limited distinguishability $E \sim h/\tau$, the saturation condition yields

$$\tau T \geq \Lambda_T. \tag{4}$$

Beyond this bound, real-valued geometric encoding becomes non-invertible, requiring a minimal unitary extension

$$\mathbb{R}\text{-based encoding} \longrightarrow \mathbb{C}\text{-based phase encoding.} \tag{5}$$

No physical dissipation or information loss is implied; only the mathematical representation changes.

4 Cosmological Feedback and Dark Energy

Within the Tasar Cycle, dark energy is interpreted not as a primary driving force but as an effective feedback term arising from the continuous re-projection of information from the LT phase back into spacetime.

Phase-correlated structures defined in the complex representation are translated into spacetime geometry under Euler–π symmetry, generating an acceleration term formally analogous to a cosmological constant.

5 Empirical Predictions: Gravitational-Wave Echoes

The model predicts weak deviations during the ringdown phase of black hole mergers.

Observable deviation.

$$\Delta Q \sim \Lambda_T\, f_{\text{peak}}, \tag{6}$$

where f_{peak} denotes the dominant ringdown frequency. The predicted magnitude lies near the sensitivity threshold of current and next-generation detectors (LIGO, Virgo, KAGRA).

6 Conclusion

The Tasar Cycle proposes a representation-based resolution of the information paradox. Information is not destroyed but reformulated across mathematical languages. The Euler number e encodes capacity limits, π enforces phase continuity, and the imaginary unit i specifies directional transformation. Singularities thus emerge not as endpoints of physical law, but as interfaces where information rotates into an alternative representational regime.