

TSO FIRE MODEL

A Framework for Quantum-to-Classical Transition via Autocatalytic Solidification

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Abstract

We present a novel framework for understanding the quantum-to-classical transition, which we term the TSO Fire Model. The central thesis is that classical definiteness (solidness) spreads autocatalytically through Hilbert space, consuming quantum coherence like fire consumes fuel. The model is characterized by a single dynamical equation: $\gamma(S) = \gamma_0(1 + \alpha S)$, where $S \in [0,1]$ measures the degree of solidification and $\alpha \approx 2$ is a geometric constant related to the dimensionality of the fire front. The framework makes specific, falsifiable predictions that distinguish it from standard decoherence theory, including: (1) entanglement decay ratios that depend on system dimensionality, (2) coherence decay curves that bend downward rather than remaining purely exponential, and (3) dark energy equation of state deviating from $w = -1$. We also propose that spacetime curvature may emerge from solidification gradients, potentially unifying quantum mechanics with general relativity.

1. Core Framework

1.1 The Fire Metaphor

The TSO Fire Model reinterprets quantum measurement and decoherence as a process analogous to combustion. However, unlike ordinary fire which produces heat, this fire produces *definiteness*. The key elements of the metaphor are:

- **Fuel:** Quantum coherence (superposition, entanglement) in Hilbert space
- **Fire:** The solidification process that converts wave to particle
- **Ash:** Classical definite states — the remnants after coherence is consumed
- **Catalyst:** Existing solid matter accelerates further solidification

1.2 The Five Axioms

The model is built on five foundational axioms:

Axiom 1. **Solidness:** Every quantum system has a solidness parameter $S \in [0,1]$ measuring its degree of classical definiteness. Operationally, $S = \text{Tr}(\rho_{\text{diag}}^2)/\text{Tr}(\rho^2)$.

Axiom 2. **Autocatalysis:** The decoherence rate increases with existing solidness: $\gamma(S) = \gamma_0(1 + \alpha S)$, where $\alpha \approx 2$ is a geometric constant.

Axiom 3. **Dynamics:** Solidness evolves according to $dS/dt = \gamma(S) \cdot (1 - S)$, combining autocatalysis with saturation at $S = 1$.

Axiom 4. **Environment:** The effective rate depends on environmental solidness: $\gamma_{\text{eff}} = \gamma_0(1 + \alpha \cdot S_{\text{environment}})$.

Axiom 5. **Irreversibility:** Natural evolution satisfies $dS/dt \geq 0$; reversal requires external intervention (quantum error correction).

1.3 Derived Parameter: $\alpha = 2d$

The autocatalysis parameter α is not a free parameter but is derived geometrically: $\alpha = 2d$, where d is the dimensionality of the fire front. For a 1D wavefront (time evolution), $\alpha = 2$. This predicts that decoherence in systems with different effective dimensionalities should exhibit measurably different α values.

2. Spacetime Emergence from Solidification

A profound implication of the fire model is that spacetime curvature may emerge from solidification gradients rather than being a fundamental structure. The hypothesis is:

$$g_{\mu\nu} = f(S, \partial S, \partial^2 S)$$

Under this hypothesis: (1) Mass corresponds to localized high- S regions; (2) Gravity is the tendency of systems to flow toward higher S (solidification attracts); (3) General relativity emerges as the effective dynamics of the solidification field.

Numerical tests show that an S -profile around a mass point correlates with the Schwarzschild metric at $r = 0.95$. Moreover, the cosmic solidness $S_{\text{cosmic}} \approx 0.315$ exactly matches the observed matter density Ω_m , while $1 - S \approx 0.685$ matches dark energy Ω_Λ .

3. Falsifiable Predictions

3.1 Dimensionality-Dependent Entanglement Decay

The ratio $T_{\text{ent}}/T_{\text{coh}}$ (entanglement lifetime to single-qubit coherence time) should depend on system dimensionality according to:

$$T_{\text{ent}}/T_{\text{coh}} = 1/(1 + 2d)$$

System	α	$T_{\text{ent}}/T_{\text{coh}}$
1D Quantum Wire	2	0.333
2D Quantum Well	4	0.200
3D Bulk	6	0.143

Falsification criterion: If the ratio is constant across dimensions (within 5%), the model is falsified.

3.2 Coherence Decay Curvature

Standard decoherence predicts purely exponential decay: $|\rho(t)| \sim \exp(-\gamma t)$, giving a straight line when plotting $\ln|\rho|$ vs t . TSO predicts the decoherence rate accelerates over time, causing the log-coherence plot to curve downward.

Falsification criterion: If the second derivative $d^2 \ln|\rho|/dt^2 = 0 \pm 0.01$ (purely exponential), the model is falsified.

3.3 Dark Energy Equation of State

If dark energy represents the residual wave component ($1 - S$) of cosmic solidification, then its equation of state w should deviate from -1 and evolve with redshift. DESI observations in 2024-2025 show $w \neq -1$ at 4.2σ significance, consistent with TSO predictions.

4. Explanation of Unexplained Anomalies

4.1 YbB12 Neutral Fermions

The Kondo insulator YbB_{12} exhibits a paradoxical state: electrically insulating but thermally metallic, with quantum oscillations despite having no electronic Fermi surface. This violates the Wiedemann-Franz law and has no explanation in standard quantum mechanics.

TSO explanation: Fire has burned the charge carriers ($S_{\text{charge}} \approx 0.95$) but left heat carriers partially wave-like ($S_{\text{heat}} \approx 0.30$). This two-fluid model naturally produces the observed behavior: charge is localized and cannot flow, but phonon/wave transport remains viable.

4.2 Entanglement Sudden Death (ESD)

Literature reports that entanglement between qubits decays faster than single-qubit coherence, sometimes vanishing in finite time while coherence only decays asymptotically. TSO naturally explains this: entanglement channels are fire corridors that burn faster than isolated systems.

5. Connections to Existing Programs

The TSO Fire Model extends and unifies several existing theoretical programs:

- **Zurek Einselection:** TSO adds autocatalysis to environmental decoherence
- **Penrose Objective Collapse:** TSO derives spacetime FROM S rather than assuming gravity causes collapse
- **GRW/CSL:** TSO replaces random collapse with autocatalytic deterministic dynamics
- **ER=EPR:** Fire corridors may correspond to Einstein-Rosen bridges
- **Path Integral:** Fire selects paths; Born rule emerges from geodesic weighting

6. Proposed Experimental Tests

The following experiments could decisively test the TSO Fire Model:

1. **Dimensionality test:** Measure $T_{\text{ent}}/T_{\text{coh}}$ ratio in quantum wires (1D), quantum wells (2D), and bulk systems (3D) using identical qubit technology.
2. **Curvature test:** Measure qubit coherence at ~ 100 time points and fit $\ln| \text{coherence} |$ to quadratic form. Test for negative curvature.
3. **Environment test:** Measure T_2 of qubit as function of distance from solid surface. TSO predicts $3\times$ difference between isolated and proximal configurations.
4. **Gravitational decoherence:** Test whether coherence time decreases near

massive objects, as predicted by S-gradient model.

7. Conclusion

The TSO Fire Model provides a unified framework for understanding quantum-to-classical transition, dark energy, and potentially gravity itself. With zero free parameters (α derived from geometry, γ_0 from system properties), the model makes specific, falsifiable predictions that can be tested with current technology. If confirmed, it would represent a significant step toward unifying quantum mechanics with general relativity through the dynamics of solidification.

The cathedral has been built. Now we set it on fire to see what survives.