

# You Want I Should Call This A Theory Of Everything? I Don't Even Know If It Is A Theory Of Something: The Causal Dynamics Of Cascade Failures of Democracy And The Standard Model

Samuel Leizerman  
samleizerman@outlook.com  
ORCID: 0009-0000-0133-2291

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## A Unified Causal Framework: A Progression of Complexity

### Part 1: The Foundation — The Tensor Hierarchy of Reality

Reality begins at Rank 2. This is the foundational axiom: causality is the irreducible ontological primitive, and causality is inherently tensorial. All other tensor ranks are either contractions (simplifications) or extensions (complexity) of this fundamental causal structure.

#### The Complete Tensor Hierarchy

<b>Rank 2:</b>	Primitive Causality (Irreducible relation)	(1)
<b>Rank 1:</b>	Vector projection (derived change)	
<b>Rank 0:</b>	Scalar contraction (existence check)	
<b>Rank &gt; 2:</b>	Complexity: multi-causal composites, emergent hierarchy	

#### Ontological Interpretation

- **Rank 2 = Ground Floor:** Tensors  $T_{\mu\nu}$  represent the irreducible relational structure between states. This is where physics begins - the stress-energy tensor, field strength tensors, all fundamental interactions emerge here.
- **Rank 1 = Derived Change:** Vectors  $v^\mu$  are contractions of the causal tensor - they represent how causality appears when projected into a specific direction or observed from a particular frame.
- **Rank 0 = Existence Check:** Scalars are the ultimate contraction - a binary answer to "does this causal relation exist?" The trace of causality.

- **Rank > 2 = Emergent Complexity:** Higher-rank tensors describe multi-causal entanglements, composite relations, memory stacks, and emergent hierarchical structures. This is where consciousness, turbulence, and complex systems emerge.

## Physical Manifestation

This hierarchy explains why General Relativity and Quantum Field Theory are both fundamentally tensorial at Rank 2:

- **GR:**  $G_{\mu\nu} = T_{\mu\nu}$  - geometry IS causality
- **QFT:**  $F_{\mu\nu}$  field strength tensors generate all forces
- **Condensed Matter:** Higher-rank tensors emerge in turbulence, phase transitions
- **Cognition:** Multi-agent systems require higher-rank memory structures

The framework scales seamlessly: **causality at the base, simplicity below, complexity above.**

## Part 2: The Essential Tensor Structure

Building from the tensor hierarchy, we can construct the simplest non-trivial realization of the causal dynamic tensor. This form captures the fundamental mathematical structure before considering specific physical implementations.

### The Basic Causal Dynamic Tensor

$$\hat{T}^{\mu\nu}_{\rho\sigma} = \left( A e^{\theta_s} + B e^{i\theta_s} \right) \delta^\mu_\rho \delta^\nu_\sigma - \frac{1}{\Gamma(\alpha)} \int_a^t (t - \tau)^{\alpha-1} \left( A e^{\theta_s} + B e^{i\theta_s} \right) d^{\mu\nu}_{\rho\sigma} d\tau \quad (2)$$

This expression reveals the essential structure:

- **Static Term:**  $(A e^{\theta_s} + B e^{i\theta_s}) \delta^\mu_\rho \delta^\nu_\sigma$  provides the baseline causal pressure
- **Memory Integral:** The fractional integral term incorporates causal history with power-law decay
- **Complex Exponentials:** Real and imaginary components capture different aspects of the causal dynamics
- **Phase Parameter:**  $\theta_s$  modulates the relationship between static and dynamic components

## Part 3: Application to QCD Phase Transitions

The framework naturally accommodates the complexity of quantum chromodynamics by recognizing that different phases require different tensor realizations. The confinement-deconfinement transition emerges as a fundamental reorganization of the causal structure.

## Temperature-Dependent Phase Structure

For  $T < T_{\text{QCD}}$  (Confinement Phase):

$$\hat{T}^{\mu\nu}_{\rho\sigma}(x, T) = \left[ A(T)e^{\theta_s(T)}\Psi_{\text{confined}}^{(a)} + B(T)e^{i\theta_s(T)}\Psi_{\text{free}}^{(a)} \right] \delta^\mu_\rho \delta^\nu_\sigma - \frac{1}{\Gamma(\alpha)} \int_a^t (t - \tau)^{\alpha-1} S^{\mu\nu}_{\rho\sigma}(T) d\tau \quad (3)$$

For  $T > T_{\text{QCD}}$  (Deconfinement Phase):

$$\hat{T}^{\mu\nu}_{\rho\sigma}(x, T) = \left[ A'(T)e^{\theta_s(T)}\Psi_{\text{confined}}^{(a)} + B'(T)e^{i\theta_s(T)}\Psi_{\text{free}}^{(a)} \right] \delta^\mu_\rho \delta^\nu_\sigma - \frac{1}{\Gamma(\alpha)} \int_a^t (t - \tau)^{\alpha-1} S^{\mu\nu}_{\rho\sigma}(T) d\tau \quad (4)$$

## Physical Interpretation

- $\Psi_{\text{confined}}^{(a)}$ : 8-component spinor for confined color states ( $a = 1, \dots, 8$ )
- $\Psi_{\text{free}}^{(a)}$ : 8-component spinor for deconfined color states
- $A(T), B(T)$ : Temperature-dependent amplitudes with phase transition at  $T_{\text{QCD}}$
- $\theta_s(T)$ : Temperature-dependent phase parameter
- $S^{\mu\nu}_{\rho\sigma}(T)$ : Spinor-coupled source term in fractional integral

The key insight is that the phase transition represents a reorganization of how causality flows through the system, captured by the changing amplitudes  $A(T) \rightarrow A'(T)$  and  $B(T) \rightarrow B'(T)$  at the critical temperature.

## Part 4: The Complete Unified Causal Dynamic Tensor

The complete mathematical realization of our framework is expressed through the Unified Causal Dynamic Tensor, which integrates informational content, gauge field dynamics, and causal memory through the Higgs current modulation.

### Higgs Current Definition

The Higgs current vector and its scalar invariant provide the fundamental modulation mechanism:

$$J_\mu^{(H)} := i \left( H^\dagger D_\mu H - (D_\mu H)^\dagger H \right) \quad (5)$$

$$\mathcal{J}_H := J_\mu^{(H)} J^{(H)\mu} \quad (6)$$

## The Complete Tensor Expression

$$\begin{aligned}
\hat{T}^{\mu\nu}_{\rho\sigma}(x, T) = & \frac{k T(x) \ln 2}{V_{\text{cell}}(x)} \sum_{i=1}^{N(x)} \hat{p}^{\mu\nu}_{(i)} \otimes \hat{p}^{(i)}_{\rho\sigma} \\
& + \left( A(T) e^{\theta_s(T)} P_{\text{sing}} \Psi_{\text{conf}} + B(T) U_{SU(2)}(\theta_0(T)) P_{\text{col}} \Psi_{\text{free}} \right) \delta^\mu_\rho \delta^\nu_\sigma \\
& - \int_a^t \mathcal{K}_L(x; \Delta t; \mathcal{J}_H) \left\{ \kappa_3 \text{tr}_3(F^{(3)\mu\nu} F^{(3)}_{\rho\sigma}) + \kappa_2 \text{tr}_2(F^{(2)\mu\nu} F^{(2)}_{\rho\sigma}) \right. \\
& + \kappa_1 F^{(1)\mu\nu} F^{(1)}_{\rho\sigma} + \lambda_\psi (\bar{\Psi} \gamma^{(\mu} \overleftrightarrow{D}^{\nu)} \Psi) g_{\rho\sigma} \\
& + \lambda_H [(D^{(\mu} H)^{\dagger} (D^{\nu)} H)] g_{\rho\sigma} + \sum_f y_f (\bar{\psi}_{L,f} H \psi_{R,f} + \bar{\psi}_{R,f} H^{\dagger} \psi_{L,f}) g_{\rho\sigma} \\
& \left. + V(H) g_{\rho\sigma} + \mathcal{B}_\Phi(\mathcal{F}_{\text{total}}; \mathcal{J}_H) \right\} d\tau
\end{aligned} \tag{7}$$

## Phase-Sensitive Bundle Breaking Term

$$\boxed{\mathcal{B}_\Phi(\mathcal{F}_{\text{total}}; \mathcal{J}_H) = \sum_k \xi_k(\mathcal{J}_H) \Theta(\mathcal{J}_H - \mathcal{J}_{\text{crit}}) \text{Tr}(G^{\mu\nu}_k G_{k\mu\nu})} \tag{8}$$

### Component Descriptions:

- **Blue Term:** Informational content tensor — the static causal pressure representing baseline acceleration field
- **Green Terms:**  $SU(3)$  strong force contributions, including confinement/singlet dynamics
- **Orange Terms:**  $SU(2)$  weak force contributions and doublet dynamics
- **Blue  $F^{(1)}$ :**  $U(1)$  electromagnetic field strength
- **Red Terms:** Matter field dynamics and bundle breaking, weighted by Lior kernel
- **Gold Terms:** Yukawa interactions coupling left and right-handed fermions
- **Magenta Terms:** Higgs potential  $V(H) = \lambda \left( H^{\dagger} H - \frac{v^2}{2} \right)^2$

## Part 3: The (Causal) Lior Kernel with Higgs Dependence

The Lior Kernel defines how past causal events influence present dynamics. All parameters are modulated by the Higgs current scalar, creating a unified memory mechanism.

$$\begin{aligned}
\mathcal{K}_L(x; \Delta t; \mathcal{J}_H) = \Theta(\Delta t) & \left[ \underbrace{\alpha(\mathcal{J}_H) e^{-\beta(\mathcal{J}_H) \Delta t}}_{\text{exponential memory}} \right. \\
& - \underbrace{\gamma(\mathcal{J}_H) (\Delta t)^{-\delta(\mathcal{J}_H)} e^{-\xi(\mathcal{J}_H) \Delta t}}_{\text{power-law (fractional)}} \\
& \left. + \underbrace{\eta(\mathcal{J}_H) \cos(\omega(\mathcal{J}_H) \Delta t + \phi(\mathcal{J}_H)) e^{-\zeta(\mathcal{J}_H) \Delta t}}_{\text{phasic / oscillatory}} \right]
\end{aligned} \tag{9}$$

where  $\Delta t = t - \tau > 0$  enforces causality. The kernel integrates the entire Standard Model Lagrangian over the system's past, directly formalizing: **Dynamics**  $\equiv \int$  **Causality**.

## Part 4: The Governing Principle — Scale-Invariance Subsumption

The final level of complexity addresses what governs the Lior Kernel itself. The **Lior-Higgs Scale-Invariance Subsumption Theorem** posits a universal constraint that sits above all other physical laws.

### The Scale-Invariance Constraint

The theorem states that the total Area Under the Curve (AUC) of the Lior Kernel must be a universal, dimensionless constant, regardless of the scale of observation or the state of the system.

$$\text{AUC} = \int_0^\infty \mathcal{K}_L(x; \Delta t; \mathcal{J}_H) d(\Delta t) = \text{constant} \tag{10}$$

This principle establishes a clear hierarchy: **Global Scale Invariance**  $\supset$  **Local Gauge Invariance**. The total "memory content" of the universe is conserved. All local forces and fields, including those of the Standard Model, must dynamically reconfigure themselves (via the Higgs current scalar,  $\mathcal{J}_H$ ) to preserve this fundamental constant. This is the ultimate law that unifies the disparate forces and ensures the system's coherence across all scales and phase transitions.

## Part 5: Experimental Predictions

### QCD Bundle Breaking

Above the critical Higgs current threshold  $\mathcal{J}_{\text{crit}}$ , predict anomalous jet broadening in high-energy proton collisions when Higgs production coincides with QCD jets.

### Cognitive Systems

The framework originated from recognizing that current AI lacks causal memory integration. True intelligence requires the temporal structure of the Lior kernel - something fundamentally missing from current neural networks.

*Lior v'ruach l'dor v'dor*  
Light and spirit from generation to generation