The Finitude of Information: Proving the Absoluteness of Relativity and Quantics, and the Impossibility of Universal Synthesis

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Abstract

This paper presents a formal proof for the validity of General Relativity and Quantum Mechanics based on the "Axiom of Finite Information." We demonstrate that if the speed of information transfer were infinite, or if space-time were perfectly continuous, the universe would contain states of infinite information density, leading to logical singularities. Furthermore, we prove that because physical laws must be encoded within the universe itself, a "Theory of Everything" is precluded by G"odelian incompleteness, ensuring that a universal theory can never exist.

1 The Axiom of Finite Information

We define a physical system as a set of observable states. Let (S) be the Shannon information required to describe the state of a system S. We pose the **Finitude Constraint**:

$$\forall S \subset, \quad (S) < \infty \tag{1}$$

Any physical theory that allows $(S) \to \infty$ is non-physical and results in a "collapse" of causality.

2 Proof of Relativity: The Limit of c

Postulate 1: The speed of information passing is limited ($v \leq c$).

Proof. Assume the contrary: information can travel at infinite speed ($v = \infty$). If $v = \infty$, then every point in the universe is in instantaneous contact with every other point. For any volume element dV, the number of possible interactions (mutual information) becomes:

$$_{mutual}= \int \rho(\vec{r}) d\vec{r} \to \infty \tag{2}$$

where ρ is the density of interacting agents. If $v = \infty$, the entropy of any local coordinate becomes undefined because it must simultaneously account for the state of the entire infinite universe. To prevent an "Information Singularity" at every point in space-time, a universal speed limit (c) must exist. Thus, Relativity is a necessary consequence of information finitude. □

3 Proof of Quantics: The Discrete Nature

Postulate 2: Things are not contiguous (Space-time and Energy are quantized).

Proof. Assume the contrary: Reality is perfectly continuous (infinitely divisible). Consider a finite line segment of length L. If space is continuous, the segment contains an uncountable infinity of points $n \in [0, 1]$. To define the position of a single particle with absolute precision in a continuous manifold, one requires an infinite number of bits:

$$(position) = \lim_{\Delta x \to 0} \log_2 \left(\frac{L}{\Delta x} \right) = \infty \tag{3}$$

Since the universe cannot store infinite information in a finite volume (Bekenstein Bound), Δx cannot reach zero. There must be a minimum scale (L_{Planck}) and discrete energy levels (h). Therefore, Quantum Theory is definitely true because the alternative (continuity) requires infinite memory. □

4 The Non-Existence of a Universal Theory

The quest for a "Theory of Everything" (ToE) seeks a single Lagrangian $\mathcal{L}_{ToE}$ that describes all forces. We prove this is impossible.

[The Universal Incompleteness] No finite set of equations can describe the totality of the universe.

Proof. Any "Universal Theory" is a self-referential map. If the theory $\mathcal{T}$ resides within the universe , then must contain $(\mathcal{T})$. By G"odel's Incompleteness Theorem, a system of sufficient complexity cannot be both consistent and

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complete. If $\mathcal{T}$ tries to account for the "information cost" of its own calculation, it creates an infinite regress:

$$\mathcal{T}_{n+1} = \mathcal{T}_n + (\text{computation of } \mathcal{T}_n) \tag{4}$$

As $n \to \infty$, the complexity of the theory exceeds the capacity of the universe to hold it. Thus, there will never be a final universal theory; science will remain an asymptotical approach to a truth that cannot be finitely compressed. □

5 Conclusion

Relativity and Quantum Mechanics are not merely "models"; they are the logical guards against infinite information singularities. Relativity prevents spatial information overflow, and Quantics prevents resolution information overflow. Because the universe is a finite-information system, a complete "Universal Theory" is a mathematical impossibility.