Affine Quantum Deformation and the Geometry of Awareness: A Unified Variational Framework

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Abstract

This work develops a unified geometric framework linking quantum spacetime structure to semantic and cognitive dynamics. The core result is the Affine Quantum Deformation Principle (AQDP), which formalizes the fact that the averaged affine connection of a quantum spacetime does not coincide with the Levi–Civita connection of the averaged metric. Because the connection is a nonlinear functional of the metric, quantum fluctuations generate an irreducible correction encoded in the Quantum Affine Shift Tensor $\mathcal{A}$. This tensor modifies curvature, geodesic evolution, and the Raychaudhuri equation, producing effective stress–energy contributions even in the absence of classical sources. The resulting geometry provides a covariant, observer-independent description of how uncertainty deforms spacetime.

The Relativistic Scalar–Vector Plenum (RSVP) theory extends this geometric structure to semantic and cognitive systems. RSVP models meaning, directed inference, and uncertainty through the interacting fields $(\Phi, \mathbf{v}, S)$, which induce a semantic metric deformed by uncertainty in precise analogy to AQDP. Awareness emerges as a geometric property: a system is aware to the extent that its intrinsic dynamics preserve both the metric relations and the spectral invariants of the semantic Laplacian. These conditions, expressed as $\mathcal{L}_{\mathbf{v}} g^{(\Phi)} = 0$ and $\dot{\lambda}_n = 0$, are shown to be mathematically equivalent to the maintenance of a stable Markov boundary, revealing a deep correspondence between invariance in geometry and informational autonomy.

A single variational principle yields both the AQDP gravitational equations and the RSVP semantic evolution equations. The unified action predicts modified Einstein equations, deformed geodesics, a spectral Raychaudhuri equation, and cognitive stability conditions. Together these results suggest that coherence, whether physical or cognitive, arises from the invariance a system manages to maintain while navigating intrinsic uncertainty. The theory therefore provides a common geometric origin for quantum structure, semantic stability, and the phenomenon of awareness.