

Loop Ontology of Quarks: Geometric Closure and the Stability of Matter

Abstract

We present an ontological interpretation of quarks as irreducible Planck-scale loops, deriving matter stability from geometric closure rather than abstract gauge assignments. From the axiom “Something Is, Nothing Isn’t,” persistence requires closure; the Planck scale constitutes the indivisible boundary of such closure. We propose that quarks correspond to fundamental loop units at this boundary, whose interactions reflect strict geometric constraints. One loop yields a confined excitation, two loops collapse due to anisotropic stress, and three loops form the minimal circular symmetry required for sustainable field extension. This geometry explains baryon triplets, the instability of diquarks, and the transience of multi-quark states. The framework reproduces empirical features of quantum chromodynamics (QCD)—confinement, hadron spectra, resonance decay—while grounding them in ontological necessity.

1. Ontological Axiom and Planck Closure

- Axiom: “Something Is, Nothing Isn’t.” - Consequence: Non-being is prohibited; persistence demands closure. - Minimal closure is the loop, an indivisible structure at the Planck boundary ($\sim 10^{-35}$ m). - Planck loops represent the irreducible substrates of physical being. Thus, quarks are interpreted not as “point particles” but as Planck-scale closures capable of anchoring extended excitations.

2. Loop Configurations and Stability Criteria

Stability is determined by loop geometry and field continuity: 2.1 Single Quark: A solitary loop is self-contained but produces no extended symmetry. Field projection remains bound; no free quark states are observable. 2.2 Two Quarks: Partial closure generates an elongated, anisotropic loop. Stress accumulates at symmetry axes, leading to collapse. Explains absence of stable diquark states in isolation. 2.3 Three Quarks: Minimal rotational symmetry arises at three loops. Circular closure sustains a stable outward field. Constitutes the basis of baryons (protons, neutrons). 2.4 Four and Five Quarks: Over-saturation introduces excess potential energy. States are metastable; observed as tetraquarks and pentaquarks. Natural decay channel is relaxation into three-loop baryons. 2.5 Six Quarks: Geometry favors bifurcation into two stable triplets. Consistent with dibaryon correlations and nuclear binding.

3. Ontological Interpretation of QCD Phenomena

This framework reproduces essential features of QCD without invoking arbitrary “color” rules: 1. Confinement: Single-loop states cannot extend fields; quarks are unobservable in isolation. 2. Baryon Triplets: Three-loop closure is the minimal stable configuration. 3. Mesons: Quark–antiquark pairs are unstable partial closures; short-lived and prone to decay. 4. Multi-quark Resonances: Higher-loop saturations manifest transiently, consistent with observed hadronic spectra.

4. Geometric Dynamics

- Stress Principle: Anisotropic fields collapse under asymmetry (two-loop systems). - Circular Symmetry Principle: Stable fields require ≥ 3 loops for isotropic closure. - Over-saturation Principle: Additional loops store energy as tension; metastable but not fundamental.

5. Implications

- Explains why three quarks, not two, form the basis of stable matter. - Provides ontological grounding for confinement, beyond gauge-field postulates. - Predicts resonance patterns as necessary consequences of geometry. - Suggests that matter stability is a manifestation of loop closure at multiple scales.

6. Conclusion

Quarks, reinterpreted as minimal Planck loops, reveal stability criteria grounded in closure and geometry. The prohibition of non-being ensures that all persistence is loop-based. A single loop is self-confined, two loops collapse, and three loops achieve minimal circular symmetry—yielding the stable baryons that form the foundation of matter. Larger combinations express metastability and decay. This Loop Ontology of Quarks (LOQ) unifies confinement, baryon structure, and resonance behavior under a single ontological framework.

References

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