

An Infrared Topological Approach to Baryon Structure

Friday, 9 October 2026 17:30 (30)

This report investigates the infrared structure of QCD through the lens of the Cho–Faddeev–Niemi decomposition and Faddeev–Niemi effective theory. We argue that gluon knots, as topological solitons characterized by the Hopf invariant, constitute the relevant infrared ground-state degrees of freedom of Yang–Mills fields. Within this framework, we present a unified mechanism for monopole condensation and center-vortex confinement. Crucially, we introduce a picture of baryons as quarks embedded in a gluon-knot background, where dual superconductivity naturally gives rise to the characteristic Y-shaped flux-tube geometry. We further delineate how the strong local color-magnetic fields drive chiral symmetry breaking through magnetic catalysis. The talk will also highlight the topological connection between the Hopf invariant, Yang–Mills vacua, and the axial anomaly, demonstrating that the topological current of gluon knots offers a viable carrier for the missing proton spin. Ultimately, we offer a cohesive, topology-driven perspective uniting confinement, chiral symmetry breaking, and baryon structure.

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Session Classification : Section 4