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Spectral Analysis of the Fermion Propagator in Minkowski Space

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Content

This research focuses on determining the analytic structure of the quark propagator in Minkowski space by employing a novel method that solves the Dyson-Schwinger Equations (DSEs) for the spectral density function $\sigma(\kappa)$. The objective is to investigate the theoretical link between the violation of positivity in the propagator and color confinement in Quantum Chromodynamics (QCD), a feature currently hindered by Minkowski-space singularities. The project first extends this spectral DSE analysis to Quantum Electrodynamics (QED) to test if positivity violation is a sufficient condition for confinement in an unconfined theory. The work involves calculation and numerical implementation of the DSE kernel, including enhanced corrections to the fermion-gauge-boson vertex (using the Ball-Chiu and Kızılersü-Reenders-Pennington bases), resulting in an iterative algorithm to find the spectral density functio. This framework will be used to search for positivity violation in the calculated one-loop spectral function, contributing to the understanding of nonperturbative quantum field dynamics.

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