

Chiral anomaly, neutral pion lifetime and axion-photon coupling

Saturday, 10 October 2026 17:45 (15)

The chiral anomaly underlies many processes, including the two-photon decay of the neutral pion and the axion-photon coupling, and fixes their leading-order contributions to a constant independent of QCD dynamics. However, traditional lattice QCD methods compute the complete amplitude, making percent-level precision demanding. We show that, by applying the anomalous Ward identity (AWI), the anomalous contribution can be isolated directly, leaving only a finite-quark-mass correction that lattice QCD evaluates reliably. Employing this strategy, we present the first lattice determination of the neutral pion lifetime with isospin-breaking effects, and determine the axion-photon coupling to 1.8% precision, furnishing a first-principles benchmark and reconciling the discrepancies among published ChPT determinations.

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Session Classification : Section 9