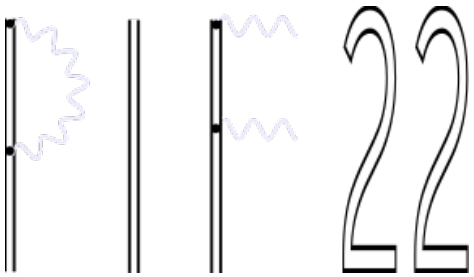

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The role of the chiral anomaly in polarized DIS

Friday 2 September 2022 10:00 (25 minutes)

I'll discuss the role of the triangle anomaly in polarized deep inelastic scattering (DIS) employing a worldline formalism. I'll demonstrate that the structure function $g_1(x_B, Q^2)$ measured in polarized DIS, as well as its first moment which defines the proton's helicity $\Sigma(Q^2)$, is dominated by the chiral anomaly in both Bjorken ($Q^2 \to \infty$) and Regge ($x_B \to 0$) asymptotics. I'll show that in both asymptotics the structure function is identically controlled by the triangle anomaly, which has an infrared pole in the forward scattering limit. The cancellation of this pole involves a subtle interplay of perturbative and nonperturbative physics that is deeply related to the $U_A(1)$ problem in QCD.

In the worldline formulation of quantum field theory, the triangle anomaly arises from the imaginary part of the worldline effective action. I'll show explicitly how a Wess-Zumino-Witten term coupling the topological charge density to a primordial isosinglet $\bar{\eta}$ arises in this framework. I'll demonstrate the fundamental role played by this contribution both in topological mass generation of the η' and in the cancellation of the infrared pole arising from the triangle anomaly in the proton's helicity $\Sigma(Q^2)$. I will introduce an axion-like effective action for g_1 at small x_B that follows from the cancellation of the infrared pole in the matrix element of the anomaly. It describes the interplay between gluon saturation and the topology of the QCD vacuum. In this context I'll outline the role of "over-the-barrier" sphaleron-like transitions in spin diffusion at small x_B. Such topological transitions can be measured in polarized DIS at a future Electron-Ion Collider.

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