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Correlated Dirac Eigenvalues and Axial Anomaly in Chiral Symmetric QCD

In this talk I will present the novel relations between the quark mass derivatives $[\partial^n \rho(\lambda, m_l)/\partial m_l^n]$ of the Dirac eigenvalue spectrum and the (n + 1)-point correlations among the eigenvalues. Using these relations we present lattice QCD results for $\partial^n \rho(\lambda, m_l)/\partial m_l^n$(n = 1; 2; 3) for ml corresponding to pion masses $m_\pi = 160 - 55\ MeV$, and at a temperature of about 1.6 times the chiral phase transition temperature. Calculations were carried out using (2+1) avors of highly improved staggered quarks with the physical value of strange quark mass, three lattice spacings a = 0.2, 0.08, 0.06 fm. We find that $\rho(\lambda \to 0, m_l)$ develops a peaked structure. This peaked structure arises due to non-Poisson correlations within the infrared part of the Dirac eigenvalue spectrum, becomes sharper as $a \to 0$, and its amplitude is proportional to m_l^2. We demonstrate that this $\rho(\lambda \to 0, m_l)$ is responsible for the manifestations of axial anomaly in two-point correlation functions of light scalar and pseudoscalar mesons. After continuum and chiral extrapolations we find that axial anomaly remains manifested in two-point correlation functions of scalar and pseudoscalar mesons in the chiral limit. This talk is based on our recent published paper [PRL 126 (2021) 082001].

Topics

Chiral Magnetic Effect

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