Contribution ID: **279** Type: **not specified**

The axial anomaly and topology in finite temperature QCD

Tuesday 30 August 2016 15:30 (30 minutes)

The magnitude of axial U(1) symmetry breaking is believed to affect the nature of phase transition in QCD with two light quark flavors. I review the recent studies on the fate of axial U(1) in finite temperature QCD using lattice techniques. Most of them investigate the eigenvalue spectrum of the fermion Dirac operator in QCD. The current understanding from majority of these studies is that the axial U(1) is not effectively restored near Tc, the chiral crossover transition temperature. Studying the eigenvalue spectrum also gives us rich insights on the nature and interactions between the topological objects in QCD. Specifically the near-zero eigenmodes are observed to persist even at 1.5 Tc, and are primarily responsible for U(1) breaking. The near-zero eigenmodes are localized unlike those in the bulk, with a mobility edge similar to a Mott-Anderson like system. The possible microscopic origins of the near-zero mode spectra in QCD would be discussed in detail. At 1.5 Tc, its origin can be traced back to the dilute instanton gas ensemble. Consequences of these findings for finite temperature QCD and axion cosmology would be further discussed in this talk.

Summary

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Session Classification: Section D

Track Classification: Section D: Deconfinement