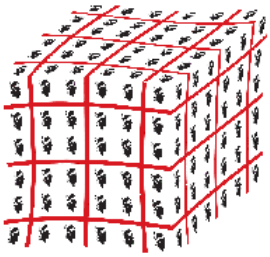

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Wilson Fermions, Random Matrix Theory and the Aoki Phase

Monday, 14 June 2010 14:50 (20 minutes)

The QCD partition function for the Wilson Dirac operator, D_W, at finite lattice spacing a can be expressed in terms of a chiral Lagrangian as a systematic expansion in the mass, the momentum and a^2. Starting from this chiral Lagrangian we obtain an analytical expression for the spectral density of $\gamma_5 D_W$ in the microscopic domain (also known as the $]epsilon$-domain). It is shown that the γ_5-Hermiticity of the Dirac operator necessarily leads to the sign of the coefficient of the a^2 term that allows an Aoki phase. The transition to the Aoki phase is explained in detail, and the interplay of topological charge and finite a is discussed. Finally, we formulate a random matrix theory for the Wilson Dirac operator in the sector of topological charge ν. It is shown by an explicit calculation that this random matrix theory reproduces the a^2-dependence of the chiral Lagrangian in the microscopic domain and that the sign the a^2-term is directly related to the γ_5-hermiticity of D_W.

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