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# Correlated Dirac eigenvalues around the transition temperature on $N_\tau = 8$ lattices

Dirac Eigenvalue spectrum $\rho$ and its derivatives with respect to quark mass are useful quantities to study the microscopic origin of the chiral symmetry breaking in QCD. It has been proposed in Ref.[1] that the n-th order derivative of Dirac eigenvalue spectrum with respect to quark mass $\partial^n \rho/\partial m^n$ is connected to the (n+1)-point correlation function among Dirac eigenvalues, which can be computed directly on the lattice. By investigating on the 1st, 2nd and 3rd derivatives of Dirac eigenvalue spectrum it is found $\rho \propto m^2$ at $T = 205$ MeV. In this talk we extend the computation done in Ref.[1] to lower temperatures, i.e. 10 temperature values from 137 MeV to 166 MeV on $N_\tau = 8$ lattices using Highly Improved Staggered Quarks/Tree-level Improved Symanzik (HISQ/tree) action. We will discuss the temperature and quark mass dependences of the 1st and 2nd order quark mass derivatives of $\rho$ at $T \in (137, 166)$ MeV. We found that $\partial\rho/\partial m/m$ is no longer equal to $\partial^2\rho/\partial m^2$ as that at $T = 205$ MeV, and $\partial^2\rho/\partial m^2$ even becomes negative at certain low temperatures.Furthermore, in order to study the magnetic equation of state we also discuss the possibility to get rid of the UV-divergent contribution in the chiral condensate by putting a UV-cutoff in the Dirac eigenvalue spectrum.

[1] H. T. Ding, S. T. Li, S. Mukherjee, A. Tomiya, X. D. Wang and Y. Zhang, Phys. Rev. Lett.126 (2021) no.8, 082001 doi:10.1103/PhysRevLett.126.082001 [arXiv:2010.14836 [hep-lat]].

## Topics

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