Chiral Condensates at Small Chemical Potential

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Lattice QCD provides us a useful tool to understand non-perturbative aspects of QCD. Numerical simulations of lattice QCD are very successful for zero chemical potential simulations. As the fermionic determinant at finite chemical potential ($\mu \neq 0$) is complex on the lattice, numerical simulations are very difficult. In stead of simulating a finite chemical potential system on the lattice directly, we use a Taylor expansion technique to obtain interesting physical information from simulations at $\mu = 0$. The idea is that we obtain the Taylor coefficients directory in simulations at $\mu = 0$, by measuring the derivatives of the relevant observables. The method is especially useful at small chemical potential. In Ref.[1] the derivatives of meson masses with respect to μ are studied. Here we further study the derivatives of $<\bar{\psi}\psi>$ to understand the chiral symmetry restoration at finite temperature and finite density. Preliminary results are found in Ref.[2] and comparable results from Nombu-Jona-Lasinio Model are given in Ref.[3] Figure 1 shows the second derivative of $<\bar{\psi}\psi>$ at $m_q = 0.025$. The derivative is negative and the response to μ is large at T_c. This result is consistent with a picture that T_c tends to decrease with increasing μ.

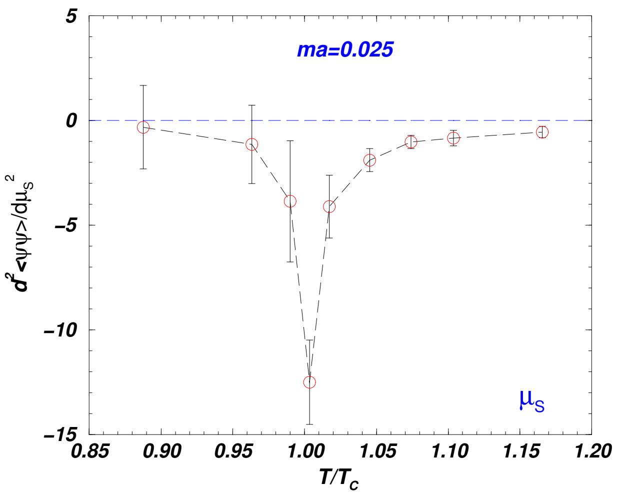

Figure 1: The second derivative of $<\bar{\psi}\psi>$ with respect to μ at $m_q = 0.025$.

References

[1] QCD-TARO Collaboration: S. Choe et. al., Phys. Rev. **D65** (2002) 054501
[2] QCD-TARO Collaboration: S. Choe et. al., Nucl. Phys. Proc.Suppl. **106** (2002) 462
[3] O.Miyamura, S.Choe, Y.Liu, T.Takaishi, A.Nakamura, hep-lat/0204013