The Quark-Gluon Mixed Condensate $g\langle\bar{q}\sigma_{\mu\nu}G_{\mu\nu}q\rangle$ in quenched Lattice QCD

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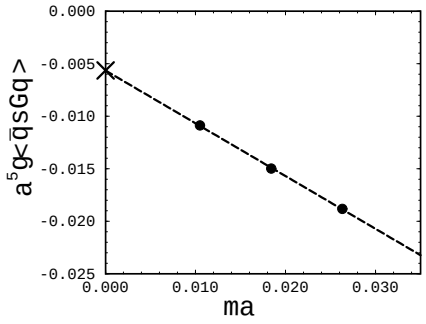
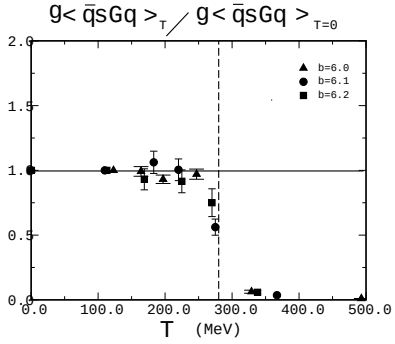
We study the quark-gluon mixed condensate $g\langle\bar{q}\sigma_{\mu\nu}G_{\mu\nu}q\rangle$, using the $\mathrm{SU}(3)_c$ lattice QCD with the Kogut-Susskind fermion at the quenched level. The mixed condensate plays an important role in various quark hadron physics, especially in the baryon sector such as the N-Δ splitting. In addition, thermal effects of the mixed condensate is interesting to investigate, because this condensate is another chiral order parameter.

We first analyze at zero temperature. We generate 100 gauge configurations on the 16^4 lattice with $\beta = 6.0$, and perform the measurement of the mixed condensate at 16 points in each gauge configuration for each current quark mass of $m_q = 21, 36, 52$ MeV. Using the 1600 data for each m_q, we find the ratio between the mixed condensate and the quark condensate, $m_0^2 \equiv g\langle\bar{q}\sigma_{\mu\nu}G_{\mu\nu}q\rangle/\langle\bar{q}q\rangle \simeq 2.5$ GeV^2 at the lattice scale of $1/a \simeq 2$ GeV in the chiral limit [1]. This large value of the mixed condensate suggests its importance in the operator product expansions in QCD. Secondly, we perform the lattice QCD calculation at finite temperature[2, 3]. We observe the clear behaviors as chiral order parameters for the mixed condensate as well as the quark condensate. The detailed study of the chiral phase structure near the critical temperature using these condensates is in progress now.



The mixed condensate plotted against the quark mass at zero temperature. The dashed line denotes the best linear extrapolations, the cross symbol the value in the chiral limit.



The thermal effects on the mixed condensate plotted against the temperature. The vertical dashed line denotes the critical temperature $T_c \simeq 280$MeV at the quenched level.

Acknowledgements

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References

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