QPT 2019

Enshi, China

Contribution ID: **81** Type: **not specified**

Meson masses in external magnetic fields from Lattice QCD

Summary

We will present the first study in full QCD on meson temporal correlation functions in the presence of external magnetic fields at zero temperature. The simulations of (2+1)-flavor QCD were performed on 32^3x96 lattices using the Highly Improved Staggered Quarks (HISQ) action with m_π around 230 MeV. The strength of magnetic fields is up to 3 GeV^2.

We found that the masses of neutral pseudo-scalars, e.g. neutral pion and kaon, monotonically decrease as the magnetic field grows and then saturate at a nonzero value. It is observed that heavier neutral pseudo-scalars are less affected by magnetic fields. While the masses of charged pion and kaon show a non-monotonic behavior in magnetic field, which is different from all the previous studies from quenched QCD. In the case of small magnetic field ($0 \leq |eB| \leq 0.3$ GeV^2) the mass of charged pseudo-scalar grows with magnetic field and can be well described by the Lowest Landau Level approximation, while for eB larger than 0.3 GeV^2 the mass starts to decrease.

We will discuss the possible connection between eB dependences of mesons in pseudo-scalar channels and the decreasing behavior of pseudo-critical temperature in magnetic field. We will also discuss the possibility of superconductivity of QCD induced by strong magnetic field through the study on eB dependence of meson masses in the vector channel.

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