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Polarization effects at finite temperature and magnetic field

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Understanding the impact of strong magnetic fields on QCD dynamics is important for an accurate description of non-central heavy-ion collisions and neutron stars. Lattice simulations found that a finite magnetic field affects the chiral dynamics of QCD in a non-trivial way. At low temperatures, the magnitude of chiral condensate increases with the magnetic field, the phenomenon known as the magnetic catalysis (MC). At finite temperature, the magnetic field leads to a faster melting of the condensate and thus the chiral transition temperature decreases with the magnetic field. This phenomenon is called the inverse magnetic catalysis (IMC). Lattice simulations suggest that IMC may be related to a competition between different effects in the magnetized QCD medium. The role of various interactions can be explored with the aid of effective models which makes them important tools, complementary to LQCD. While most chiral models are able to capture MC, they predict the opposite trend from LQCD calculations on the magnetic field dependence of the chiral transition temperature. In this talk we discuss the screening of a four-quark interaction by the ring diagram and its back-reaction on the quark gap equation in an effective chiral quark model. In consequence, a medium-dependent coupling is derived. This naturally reduces the chiral transition temperature in a class of chiral models and generates the inverse magnetic catalysis at finite temperatures and magnetic fields. These results provide a coherent description of inverse magnetic catalysis anchored to a reliable field-theoretical basis. We also demonstrate the important role of confining forces, via the Polyakov loop, in a positive feedback mechanism which reinforces the inverse magnetic catalysis. The contribution is based on the following works: arXiv:2107.05521, arXiv:2109.04439.

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