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The quark anomalous magnetic moment in the Nambu–Jona-Lasinio model

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The quark anomalous magnetic moment (AMM) of quarks is generated by a dynamical chiral symmetry breaking for massive quarks. In this way, the recent literature has applied the quark AMM on the magnetized Quantum Chromodynamics (QCD) phase diagram in order to predict different physical phenomena. In particular, the effect of the inverse magnetic catalysis, i.e., the decrease of the quark condensate as a function of the magnetic field close to the pseudocritical temperature, has been connected in effective models with the inclusion of quark AMM. In this work we study the magnetized two-flavor Nambu–Jona-Lasinio (NJL) model with the quark AMM introduced by the Pauli term. Using regularization schemes that do not separate vacuum contributions from the magnetic field, some works have found first-order phase transitions at zero temperature. Taking the vacuum magnetic regularization scheme, based on magnetic field independent regularization, we are able to show that these transitions are regularization artifacts arising from mass-dependent terms in the potential. Constraining the magnetic field to be smaller than the squared of the effective quark mass, we obtain a mass-independent terms in the potential and the usual result of the Schwinger–Weisskopf one-loop effective Lagrangian, which has already been addressed to the problem of the quark AMM in the NJL model.

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