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The Nambu–Jona-Lasinio model with quark anomalous magnetic moment

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Effective models to the quantum chromodynamics (QCD), like the Nambu–Jona-Lasinio (NJL) model, has been used to describe strong interaction for its simplicity. Regularization procedures can be applied to magnetized quark matter and describe the physics of peripheral heavy ion collisions and magnetars. The quark anomalous magnetic moment is a phenomena that has been calling attention in the last few years, mainly using NJL model, and could lead to the inverse magnetic catalysis phenomena. Some works found first-order phase transitions (1st PT) , even at zero temperature case. Here, we will that these 1st PT are artifacts of the improper regularization procedures. To do so, we explore the vacuum magnetic regularization (VMR) in two cases in respect to the subtraction of the divergences: the mass-dependent (MD) and mass-independent (MI). The MD case leads to a nonmassive minimum at the thermodynamical potential, inducing 1st PT. So, the MI agrees with the present predictions of the Lattice QCD, this case constrains the magnetic field to be smaller than the squared of the vacuum effective quark mass at the VMR scheme. The MI case also get the exactly expression of the one-loop Schwinger–Weisskopf effective Lagrangian adapted to the NJL model.

Authors: LUCIANO SONEGO FARIAS, RICARDO; Mr CARDOSO, Rafael (Universidade Federal de Santa Catarina); AVANCINI, Sidney (universidade federal de santa catarina); TAVARES, William (UERJ)

Presenter: Mr CARDOSO, Rafael (Universidade Federal de Santa Catarina)

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