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The QCD critical end point driven by an external magnetic field in asymmetric quark matter

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Presently the study of the phase diagram of QCD is the subject of both theoretical and experimental studies under extreme conditions of density and temperature. In particular, it is expected that the phenomenon of deconfinement occurs in relativistic heavy-ion collisions and in the interior of compact stars, two very different scenarios when isospin asymmetry is considered. While in heavy ion collisions the proton fraction is presently not smaller than ~ 0.4, much smaller proton fractions are expected in the interior of neutron stars.

Also the understanding of the effect of an external magnetic field on the structure of the QCD phase diagram is very important once extremely strong magnetic fields are relevant for compact objects like magnetars and are expected to affect measurements in heavy ion collisions at very high energies or the behavior of the first phases of the universe.

Another degree of freedom that must be considered when discussing the QCD phase diagram is strangeness. In the interior of a neutron star it is expected that strangeness is present either in the form of hyperons, of a kaon condensate or of a core of deconfined quark matter. Beta–equilibrium is energetically favored and the Fermi pressure of neutrons is reduced if strangeness degrees of freedom are generated through the action of the weak interaction. On the other hand, the strong force governs heavy ion collisions.

In this presentation the location of the critical end point (CEP) in the QCD phase diagram is discussed under different scenarios. The effect of strangeness, isospin/charge asymmetry and an external magnetic field is investigated. The discussion is performed within the 2+1 flavor Nambu-Jona-Lasinio mode with Polyakov loop (PNJL). It is shown that isospin asymmetry shifts the CEP to larger baryonic chemical potentials and smaller temperatures. At large asymmetries the CEP disappears. However, a strong enough magnetic field drives the system into a first order phase transition.

[1] "Phase transition and critical end point driven by an external magnetic field in asymmetric quark matter"
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