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Séminaire de Physique Nucléaire Théorique

Dense matter properties within the chiral confining model

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The properties of dense matter remain one of the most pursued topic of nuclear physics. Understanding them provides valuable insights into the fundamental interactions, and mainly QCD, which desribes the strong interaction. These conditions are also at the heart of many astrophysical phenomena such as neutron stars (NS), supernovae and the early universe. Although QCD is well established, understanding the state of matter at high densities-low temperatures is not straightforward ; on one hand the strong interaction, unlike other interactions, is non-perturbative at these "low" energy regimes (< 1GeV.fm-3), rendering the mathematical tools usually employed, such as perturbative approaches ineffective here. On the other hand we often rely on numerical approaches to problems in physics, in that case these are known as numerical lattice calculations, they work fine for finite temperatures, but encounter a problem at finite densities known as the sign problem. The consequence of this is that today, we have no theory in the regime of low temperature and high density that allows us to make experimental predictions, and this strongly motivates relying on effective modeling.

In this talk, I will present a theoretical framework for the study of nuclear matter, known as the chiral confining model, that is anchored in two central phenomena in nuclear physics : chiral symmetry breaking and confinement. This model will be used within the relativistic Hartree-Fock (RHF) approach where chiral symmetry is represented by a scalar potential and the effect of confinement through the nucleon response.

The predictions of this model will be discussed along with various improvements progressively added on top of the model.

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