Institut de Recherche sur les lois Fondamentales de l'Univers

Département de Physique Nucléaire

Séminaire ESNT-DPhN

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Bât 703, room 135 DPhN CEA Saclay, Orme des Merisiers

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Recent results using the EDF derived from the quark-meson coupling model

Dense nuclear matter would ideally be described within calculations approaches based on quantum chromodynamics (QCD) theory and quark and gluons degrees of freedom. However, this turns out to be limited to few nucleon systems.
For the many-body treatment of heavier nuclei, the *ab initio* approaches based on realistic nucleon-nucleon (NN) interaction are intensively developed to reach extended regions of nuclei but their numerically complexity limits their applications to light and medium-mass nuclei, up to now.
The nuclear properties can be widely described over the chart of nuclei by phenomenological models based on effective Nucleon-Nucleon interactions. These models are globally interpreted within the methods of the energy density functional (EDF) theory.

This seminar will explain how the EDF can be derived from the quark-meson coupling (QMC) model with a reduced number of parameters [1,2].
The talk will highlight recent results obtained on the ground state properties of finite nuclei using the QMC model [2,3].
Moreover, through the QMC approach, connecting relativistic mean fields and quark structure of hadronic nuclear matter, the origins of phenomena encountered in low energy nuclear physics can be directly explained. As main examples, we can underline the saturation effects of many-body nuclear interactions, and the characteristics of the spin-orbit interaction arising naturally [1].

[1] *Finite Nuclei in the Quark-Meson Coupling Model,*
J. R. Stone, P. A. M. Guichon, P. G. Reinhard, and A. W. Thomas, Phys. Rev. Lett. **116**, 092501 (2016).
[2] *Quark–Meson-Coupling (QMC) model for finite nuclei, nuclear matter and beyond,*
P.A.M. Guichon, J.R. Stone, and A.W. Thomas, Progress in Particle and Nuclear Physics **100** 262 (2018).
[3] *Tensor and pairing interactions within the quark-meson coupling energy-density functional,*
K. L. Martinez, A. W. Thomas, P. A. M. Guichon, and J. R. Stone, Phys. Rev. C **102**, 034304 (2020).

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