SÉMINAIRE du PÔLE THÉORIE

LABORATOIRE DE
PHYSIQUE DES DEUX INFINIS
IRÈNE JOLIOT-CURIE
Pôle de Physique Théorique
Bat. 100, F-91405 ORSAY CEDEX

Lars Zurek
CEA DAM DIF

Densities and dense matrices

In the first part of the seminar, I will discuss nuclear energy density functionals, which successfully reproduce properties of nuclei across almost the entire nuclear chart. However, nearly all available functionals are phenomenological in nature, which makes it unclear how to best improve them. We incorporate parameter-free pion exchanges as described by chiral effective field theory into Skyrme energy density functionals and we find significant improvements for the description of nuclear binding energies. The description of nuclear charge densities is however clearly worsened by the new functional terms. We study this behavior and argue that this phenomenon occurs because of the finite range of the attractive pion exchanges.

The second part of the seminar will focus on the ab initio approach to nuclear structure. It allows us to describe atomic nuclei with controlled and systematically improvable approximations. Applying it to nuclei that are at the same time both heavy and open-shell is largely impossible with current many-body techniques. This is due to the computational cost of handling huge dense tensors. We demonstrate in the case of Bogoliubov many-body perturbation theory how this hurdle can be tackled by applying dimensionality reduction techniques based on the singular value decomposition. By using modern linear algebra algorithms and avoiding the construction of large many-body tensors in the first place, we are able to extend the reach of the method to nuclei where standard approaches would be too expensive to run.

Thursday 11 Dec. 2025 – 14:00

IJCLab, Bât. 100, A201