Role of the effective interaction on Bohr Hamiltonian calculations

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The Bohr-Hamiltonian (BH) method [1,2], based on microscopic Hartree-Fock-Bogoliubov calculations, is the tool of choice to perform systematic calculations of the properties of low-energy states along the nuclear chart with a good degree of accuracy [3]. A first systematic study [4] shows that, despite the cranking approximation used to calculate the mass parameters, the BH is able to reproduce the energy of the first 2^+ for more than 500 nuclei with an accuracy of ≈ 20 %.

Although the effective nucleon-nucleon (NN) interaction is not explicitly included in the expressions of the generalised BH, it explicitly contributes to the determination of the deformation landscape as well as the single particle shell structure. In Ref.[5], a limited study on krypton isotopes has shown that a small adjustment of the spin orbit term can lead to remarkable differences in the observed energies and electromagnetic transitions of low-energy collective states.

In recent years, several groups have worked to further improve the Gogny interactions, and since Gogny's original work in the 1980s, great advances have been made to improve on well-known shortcomings of the original force. For example, the D1M [6] interaction has been adapted to include the so-called zero point energy arising from coupling to collective vibrations, while the D3G3M [7] has been adapted to further improve the infinite matter properties of the D1M. It is therefore important to study the performance of these new interactions on the energy spectra obtained by the BH method.

In this talk, I will present the results of the BH using a variety of Gogny interactions to perform a sensitivity study of the role of the different terms on the position of the low energy states. In particular, I will discuss how the inclusion of additional beyond mean field corrections can affect the calculations.

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