MULTI-REFERENCE ENERGY DENSITY FUNCTIONAL CALCULATIONS FOR NUCLEAR SPECTROSCOPY - PERSPECTIVES AND PROSPECTS

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Recent progresses in high-performance computing made it possible to push "beyond-mean-field calculations" for nuclear spectroscopy behind many of their past limitations. This presentation will report on the ongoing development of a fully microscopic approach that aims at the mixing of angular-momentum and particle-number projected time-reversal-invariance-breaking triaxial HFB states within a generator coordinate method (GCM). Projection restores the selection rules for electromagnetic transitions that are crucial for the detailed interpretation of experimental data, and the GCM turns out to be necessary for a meaningful analysis of coexisting structures in a given nucleus. A new type of effective Skyrme interaction is used in order to carry out such calculations without formal ambiguities.

The breaking of intrinsic time-reversal invariance adds new degrees of freedom to this kind of approach that were completely absent in most earlier applications. In particular, it provides the means to model the coupling of single-particle states to collective motion. Examples to be addressed are the description of spectroscopic properties of odd nuclei, and the role of non-collective degrees of freedom for the description of low-lying states in even-even nuclei.

While first results obtained clearly show the potential of this kind of many-body method for the detailed description of spectroscopic properties, there remain open problems related to the set-up and phenomenological adjustment of a predictive effective interaction that can be safely used in such calculations. Some of the presently followed routes towards a solution will be briefly addressed.