Multi-reference energy density functional calculations for odd mass nuclei

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Résumé

For many years, the nuclear energy density functional (EDF) method, based on a representation of the nuclear energy by a functional depending on one-body densities, has been extensively used for the description of atomic nuclei. Already on its rst level, the single-reference EDF (SR-EDF) realization, often called self-consistent mean eld or Hartree-Fock Bogoliubov (HFB), it gives a very satisfactory description of many low-energy properties such as masses, radii, intrinsic deformations, or rotational bands for nuclei throughout the entire chart of nuclides. But despite its many successes, the SR-EDF approach faces a number of limitations that require to go "beyond the mean eld". One possibility to proceed is to restore symmetries broken on the SR-EDF level and to mix congurations that dier in one or several collective degrees of freedom in the framework of the generator coordinate method (GCM). In this way, selection rules for electromagnetic transitions are restored and correlations that originate from uctuations in shape degrees of freedom or the mixing of competing minima in the deformation energy landscape are taken into account. It is only at this stage, called multi-reference EDF (MR-EDF), that the EDF method shows its full and remarkable capacities for the analysis of low energy nuclear structure. Several groups have constructed numerical codes along these lines for both relativistic and non-relativistic EDFs. The current standard is the angular-momentum and particle-number projected mixing of time-reversal invariant axial HFB vacua, and rst applications using triaxial states have been published recently. All of these have in common that the model space is limited to collective states in even-even nuclei. We will present rst results of our ongoing developments to project and mix cranked triaxial quasiparticle states in odd-even nuclei. This extension is necessary to treat odd-even and even-even nuclei on the same footing and should lead us to a better understanding of a broad range of phenomena in nuclear structure, in particular, the coupling between individual single-particle states and collective degrees of freedom. As example, we will discuss preliminary results about 49Cr obtained using a regularizable Skyrme EDF.

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