A NEW MEAN-FIELD APPROACH FOR EXOTIC NUCLEI

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The macroscopic-microscopic method of description of the nuclear masses and, more generally, the nuclear deformation energies using Strutinsky-type approaches, plays a very important role in the large scale nuclear energy calculations. They help programming new important experiments, in particular on the exotic nuclei and the experiments testing new nuclear properties (such as for instance new symmetries and/or exotic decay modes). They also help in the more 'classical' applications of the nuclear structure theory such as fission, fission-fusion barrier calculations and many related subjects. This particular method is among the best as far as the stability with respect to extrapolations to new exotic, so far experimentally unknown nuclear ranges is concerned - probably the best. On the other hand this method suffers from the fact that the more profound microscopic mechanisms which can be modelled with the help of the realistic two-body interactions and the formalism of e.g. Hartree-Fock approach are mocked up by a simple parametrised version of the spin-orbit interaction. Moreover, it is well known from the recent shell-model studies [1] that the explicit presence of the tensor interactions in the microscopic nuclear structure calculations deserves much more attention as compared to the past efforts that can be found in the literature.

In this work we report on our efforts of combining the most desirable elements of the so far developped *distinct* microscopic techniques in an attempt to introduce simultaneously more stability with respect to extrapolations into the unknown 'corners' of the Periodic Table as well as stronger presence of the microscopic mechanisms whose functioning has been established so far, first of all in the Hartree-Fock method literature [2]. We use the fact that the central potential parametrised with the help of the deformed Woods-Saxon form does perform in a very stable manner when extrapolating into the distant areas of the Periodic Table. On the other hand we replace the totally phenomenological spin orbit term by the *density dependent* form inspired by the Hartree-Fock formalism. We also introduce the one-body density dependent terms that are obtained from the Skyrme-Hartree-Fock considerations, notably containing the tensor force contributions [3]. All the new terms appear in our new formulation of the mean-field model Hamiltonian whose adjustable constants are fitted to the newest experimental data on the single particle levels in doubly magic nuclei. The method used is self-consistent in that the diagonalisations are repeated to obtain the auto-reproduction of the stable single-particle spectra.

The results of the parameter fit procedures as well as the test of stability of the new approach in terms of extrapolation from one area of the Periodic Table to another are presented in some detail.

References

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