Excitations of correlated nucleons within the second random-phase approximation

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Résumé

The second random-phase approximation (SRPA) is an extension of the standard random-phase
approximation (RPA) where two particle-two hole (2p2h) configurations are included together with the RPA one particle-one hole (1p1h) configurations. This beyond mean-field model allows for reliable quantitative predictions to describe the widths and the fragmentation of excited states, due to the coupling between 1p1h and 2p2h elementary configurations.
I will present the formal developments and the practical applications that we have realized in
the last years. One important achievement was the development of a substantial implementation of the SRPA model, based on a subtraction procedure. This subtraction method was tailored to cure double-counting problems encountered when effective interactions are used in beyond mean-field models, within energy-density functional theories. At the same time, this procedure cures all the instabilities and divergences present in the standard SRPA and produces renormalized single-particle excitation energies. The subtracted
SRPA (SSRPA) provides a well-defined theoretical framework for quantitative predictions on
nuclear excitation spectra.
Several recent applications will be shown, for instance, a systematic study on collective axial compression modes in medium-mass and heavy nuclei. A related topic will be discussed, namely the modification (enhancement) of the effective masses induced by beyond-meanfield SSRPA effects. Low-lying compression excitations will also be described and a link with the incompressibility modulus of asymmetric nuclear matter will be illustrated. Finally, beyond-mean-field effects on the symmetry energy of infinite matter and its density dependence will be deduced from the low-energy dipole response of the nucleus 68Ni.

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