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A beyond-mean-field description for nuclear excitation spectra: applications of the subtracted second random-phase approximation

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 recent 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 applications to low–lying states and giant resonances will be shown: for instance, a systematic study on giant quadrupole resonances in medium-mass and heavy nuclei (centroids and widths) will be presented. In addition, a related topic will be discussed, namely the modification (enhancement) of the effective masses induced by the beyond-mean-field SSRPA effects.

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