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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.

Primary author: GRASSO, Marcella (IPN Orsay) Presenter: GRASSO, Marcella (IPN Orsay)

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