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Electric dipole strength and dipole polarizability in 48Ca within a fully self−consistent second random−phase approximation

The Second Random Phase Approximation (SRPA) is a natural extension of Random Phase Approximation obtained by introducing more general excitation operators where two particle-two hole configurations, in addition to the one particle-one hole ones, are considered. Only in the last years, large-scale SRPA calculations, without usually employed approximations have been performed [1,2].

The SRPA model corrected by a subtraction procedure [2] designed to cure double counting, instabilities, and ultraviolet divergences, is employed for the first time to analyze the dipole strength and polarizability in 48Ca [3]. All the terms of the residual interaction are included, leading to a fully self-consistent scheme. Results are illustrated with two Skyrme parametrizations, SGII and SLy4 and compared with the experimental data recently obtained at RCNP-Osaka, employing the (p,p') reaction at forward angle [4].

The results obtained with the SGII interaction are particularly satisfactory. In this case, the low−lying strength below the neutron threshold is extremely well reproduced and the giant dipole resonance is described in a very satisfactory way especially in its spreading and fragmentation. Spreading and fragmentation are produced in a natural way within such a theoretical model by the coupling of 1 particle−1 hole and 2 particle−2 hole configurations. Owing to this feature, we may provide for the electric polarizability as a function of the excitation energy a curve with a similar slope around the centroid energy of the giant resonance compared to the corresponding experimental results.

This represents a considerable improvement with respect to previous theoretical predictions obtained with the random−phase approximation or with several ab−initio models. In such cases, the spreading width of the excitation cannot be reproduced and the polarizability as a function of the excitation energy displays a stiff increase around the predicted centroid energy of the giant resonance.

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Primary author: GAMBACURTA, Danilo (ELI-NP)

Presenter: GAMBACURTA, Danilo (ELI-NP)

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