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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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