A Microscopic Study of the Giant Dipole Resonance γ−Absorption Cross Section in Hot Rotating Nuclei

B. K. Agrawal[a], A. Ansari[a], and P. Ring
[a] Institute of Physics, Bhubaneswar 751 005, India

An attempt has been made to study the γ-absorption cross section for the giant dipole resonances (GDR) in hot rotating nuclei in the framework of linear response theory along with a microscopic approach to incorporate corrections due to thermal fluctuations of the nuclear quadrupole shapes. The latter approach is based on the static path approximation to the grand canonical partition function. In the present illustrative application, we have employed a deformed harmonic oscillator Hamiltonian. The calculations have been done for a fictitious nucleus with the magic numbers of the oscillator $N = Z = 70$. We find that the width of the GDR cross section increases with increasing temperature and angular momentum. The results are compared with those obtained by the Landau prescription and it is found that the latter overestimates the effect of thermal fluctuations somewhat.

Magnetic Dipole Response in Rare Earth Nuclei

R.R. Hilton, W. Höhenberger, and P. Ring

Experimental observations have established the existence of sizable B(M1) strength lying in the 5-10 MeV region in certain rare earth nuclei. They reveal an M1 distribution having a two peak structure ostensibly independent of the nucleus. These observations, together with the unexpected splitting of the B(M1) strength observed, have excited lively interest. Highly contrasting interpretations of these states have arisen which may be associated with a variety of inherent features of these calculations. The character of these states is studied within a self-consistent Random Phase Approximation using Skyrme forces. These investigations shed light on the nature of these states, the mechanism generating the double hump structure, and whether they are evidence of new giant resonances in heavy deformed nuclei.

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Are There New Elementary Modes of Excitation to be Found in Heavy Nuclei?

R.R. Hilton

The presence of $K = 1^+$ states lying in the region 2-4 and 5-10 MeV having substantial B(M1) strength has now been firmly established for nuclei in the rare earth region. Evidence for states lying above 20 MeV has also recently been secured. The physical character of such states, is a topic which is currently the subject of much controversy, with a considerable body of literature devoted to its study to date. Results are presented of an extensive investigation of these states using both collective model and microscopic descriptions within the framework of a Quasi Particle Random Phase Approximation employing Skyrme forces. This later study still represents the only fully self-consistent QRPA investigation of these states using realistic forces yet undertaken. We address the following questions:

a) To what extent do the experimental observations obtained for the group of states in the 2-4 MeV region support any given collective picture?
b) Do we understand the mechanism responsible for the splitting of the B(M1) strength observed for the 1^+ states found in the 5-10 MeV region? Do they indicate the presence of new giant resonances?
c) Has the Giant Angle Dipole a high energy counterpart?
d) What might we learn about nuclear matter from a study of 1^+ states in exotic nuclei.

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