E1-Resonances in Neutron-Rich Nuclei

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The photoabsorption and electromagnetic (EM) E1 differential cross sections of for oxygen and calcium isotopes are calculated within the phonon damping model (PDM) [1] including the superfluid pairing correlations. Clear pygmy dipole resonances (PDR) are seen in the EM cross sections in ^{18,20,22,24}O and some very neutron-rich calciums (^{50,52}Ca). The present work demonstrates that the EM differential cross section is a better probe for the PDR as compared to the photoabsorption cross section because, in the former, the low-energy tail of giant dipole resonance (GDR) is enhanced. It also shows that, using low-energy beams at around 50 – 60 MeV/n, one can separate PDR peaks out of admixture with the GDR in the EM differential cross sections. An example for the energy-weighted sums (EWS) of pygmy dipole resonance's (PDR) strength is shown in Fig. 1 for oxygen isotopes, where the results of calculations within PDM are compared with the preliminary experimental systematic [2] and the prediction by the cluster model sum rule (CRS).

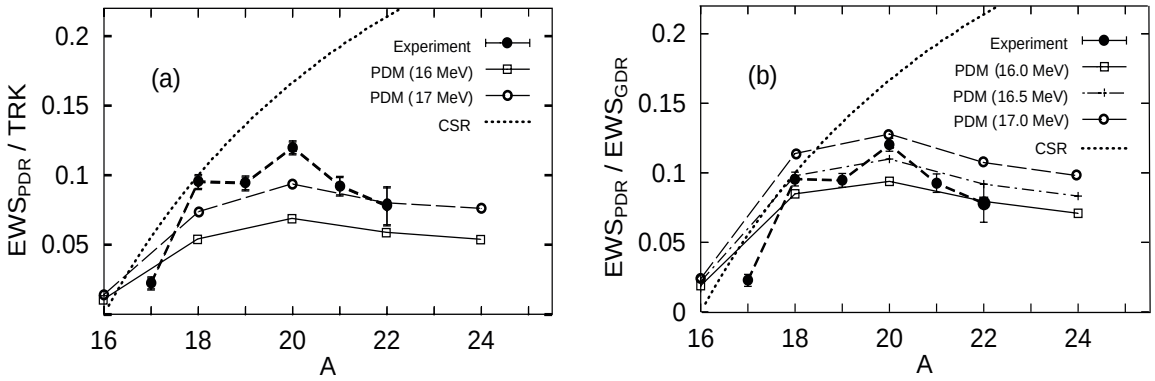

FIG. 1. EWS of PDR strength up to excitation energy $E_{\max}$ for oxygens. Results obtained within PDM with $E_{\max}$ = 16, 16.5, and 17 MeV are displayed as open boxes connected with solid line, crosses connected with dash-dotted line, and open circles connected with thin dashed line, respectively. The PDM results are shown in units of Thomas-Reich-Kuhn sum rule (TRK) in (a), and in units of the total GDR strength integrated up to 30 MeV in (b). Experimental data (in units of TRK), obtained with $E_{\max}$ = 15 MeV, are shown by full circles connected with thick dashed line. The dotted line is the prediction by CSR (in units of TRK).

[1] N. Dinh Dang and A. Arima, Phys. Rev. Lett. **80** (1998) 4145, Nucl. Phys. **A 636** (1998) 427.
[2] T. Aumann et al., GSI scientific report 1999 (GSI 2000-1, March 2000) 27.

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