Investigation of the Isovector Giant Quadrupole Resonance in ^{208}Pb and ^{90}Zr by Coulomb inelastic scattering

Robert L. Varner
Physics Division, Oak Ridge National Laboratory, *
Oak Ridge, Tennessee 37831 USA

Reliable, systematic data on the strength distribution for the isovector giant quadrupole resonance (IVGQR) are notably missing from the existing information on electric giant resonances. Evidence for an IVGQR has been reported from (e,e') experiments on medium-mass and heavy nuclei. These data are subject to substantial systematic uncertainty because of very large backgrounds and possible contributions from a variety of other modes not differentiated by the experiments. A few more specific and sensitive experiments involving (n,γ) and (γ,n) reactions are available, along with one example of (HI, HI'γ). These latter experiments seem to confirm the basic results of the (e,e') analyses, but carry little detailed information about the distribution of ΔT=1 E2 strength. On the other hand, studies employing the $(\pi^{\pm}, \pi^{0})$ reaction, which should excite isovector states strongly, show no evidence of IVGQR strength at all.

Systematic analysis of resonance and continuum excitation by intermediate-energy heavy ions indicates that heavy-ion scattering in the bombarding energy range from 100 to 200 MeV/nucleon should be an excellent tool for studying the IVGQR. The systematics predict that (^{36}Ar,^{36}Ar') at 150 MeV/nucleon will excite the IVGQR in ^{208}Pb with a peak to continuum ratio of better than 1:1, which is substantially better than that of most of the data on which the systematics for the isoscalar GQR are based. The IVGQR cross-sections are large, so that experiments can be done in reasonable times, even for low beam intensities. Heavy-ion scattering excites the IVGQR almost exclusively by Coulomb excitation. Coulomb excitation cross sections for high-lying strength decrease rapidly with increasing multipolarity, providing a powerful filter against the broad structures with L$>$ 2 which probably occupy the same energy region as the IVGQR. Since the cross-section for target Coulomb excitation scales as Z^2 of the projectile, comparison of spectra obtained with two probes of significantly different Z can be used to isolate Coulomb-excited strength. These considerations imply that data acquired with two probes of different Z should provide enough information to unequivocally identify the IVGQR, and to reveal details of the strength distribution.

We will report on recent results of our search for IVGQR in ^{208}Pb and ^{90}Zr, using the inelastic scattering of 150 MeV/nucleon ^{36}Ar and ^{17}O at the NSCL.

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