V. 7 A Study of the Low Energy Octupole Resonance

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Recently, the low energy octupole resonance (LEOR) at \( E_x \approx 30A^{-1/3} \) MeV corresponding to the 1 \( \hbar \omega \) giant resonance has been observed in many nuclei from \(^{40}\text{Ca}\) to \(^{208}\text{Pb}\) through the inelastic \( \alpha \)-scattering at \( E_\alpha = 96, 115 \) MeV.\(^1\) In an inelastic \( \alpha \)-scattering study\(^2\) on \( Zr \) and \( Ni \) isotopes at \( E_\alpha = 65 \) MeV, fine structures in the LEOR region have been observed for all the isotopes studied, and it has been found that these structures carry an intensity of about 25% of EWSR for LEOR in all the cases.

As for the giant quadrupole resonance, there is some evidence that via the inelastic \( \alpha \)-scattering it is not excited with an appreciable intensity at lower incident energies. The giant quadrupole resonance has not been observed in an inelastic \( \alpha \)-scattering study\(^3\) on s-d shell nuclei at \( E_\alpha = 96 \) MeV, whereas it has been observed in a similar study\(^4\) on s-d shell nuclei at \( E_\alpha = 120-173 \) MeV.

The aims of the present study are; 1) to see whether the LEOR in \( Zr \) and \( Ni \) isotopes observed through the inelastic \( \alpha \)-scattering at \( E_\alpha = 65 \) MeV are observed or not at a lower energy of \( E_\alpha = 50 \) MeV, and 2) to study the detailed structures of the LEOR, when observed.

After passing through a pair of high resolution magnetic analyzers, 50 MeV \( \alpha \)-particles from the CYRIC cyclotron bombarded a self-supporting metallic target located at the center of a 90-cm scattering chamber. The beam was stopped in a Faraday cup, which was 2.5 m down-stream of the scattering chamber and enclosed with concrete walls. Figure 1 shows the experimental arrangement. Inelastically scattered \( \alpha \)-particles were detected with a counter telescope consisting of three Si surface barrier detectors; a 250 \( \mu \)m \( \Delta E \) detector, a 2000 \( \mu \)m E detector and a 2000 \( \mu \)m veto detector. Conventional electronic devices were used for particle identification. Figure 2 shows a block diagram of the electronics, and Fig. 3 a particle identification spectrum. Figure 4 shows an \( \alpha \)-particle spectrum from the \(^{92}\text{Zr}\) target at a scattering angle of 30°. The overall energy resolution of the system was about 80 keV.

Differential cross sections for the inelastic scatterings of \( \alpha \)-particles to the lowest 2\(^+\) and 3\(^-\) states in \(^{92}\text{Zr}\) are shown in Fig. 5. In this figure are also shown DWBA curves, which reproduce satisfactorily the experimental angular distributions. A detailed analysis of the LEOR region of the measured spectra is in progress.

References


Fig. 1. A schematic diagram of the experimental arrangement.

Fig. 2. A block diagram of the electronics.

Fig. 3. A particle identification spectrum from Ni obtained at a lab angle of 25°.
Fig. 4. A spectrum of α-particles inelastically scattered from $^{92}\text{Sr}$ observed at a lab angle of 30°.

Fig. 5. Angular distributions for the inelastic scatterings of 50 MeV α-particles to the lowest 2+ and 3− states in $^{92}\text{Sr}$. Solid curves are results of DWBA calculations.