A Study of the Low Energy Octupole Resonance

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Recently, the low energy octupole resonance (LEOR) at $E_x \sim 30A^{-1/3}$ MeV corresponding to the 1 $\hbar\omega$ giant resonance has been observed in many nuclei from ^{40}Ca to ^{208}Pb through the inelastic α-scattering at E_α = 96, 115 MeV.$^{1)}$ In an inelastic α-scattering study$^{2)}$ on Zr and Ni isotopes at E_α = 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 α-scattering it is not excited with an appreciable intensity at lower incident energies. The giant quadrupole resonance has not been observed in an inelastic α-scattering study$^{3)}$ on s-d shell nuclei at E_α = 96 MeV, whereas it has been observed in a similar study$^{4)}$ on s-d shell nuclei at E_α = 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 α-scattering at E_α = 65 MeV are observed or not at a lower energy of E_α = 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 α-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 α-particles were detected with a counter telescope consisting of three Si surface barrier detectors; a 250 μm ΔE detector, a 2000 μm E detector and a 2000 μm veto detector. Conventional electronic devices were used for particle identifacation. Figure 2 shows a block diagram of the electronics, and Fig. 3 a particle identification spectrum. Figure 4 shows an α-particle spectrum from the ^{92}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 α-particles to the lowest 2^+ and 3^- states in ^{92}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

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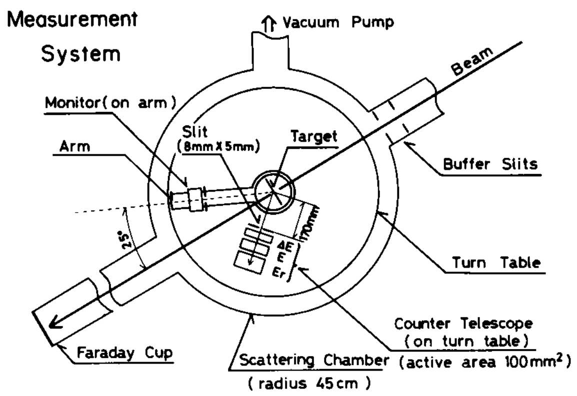

Fig. 1. A schematic diagram of the experimental arrangement.

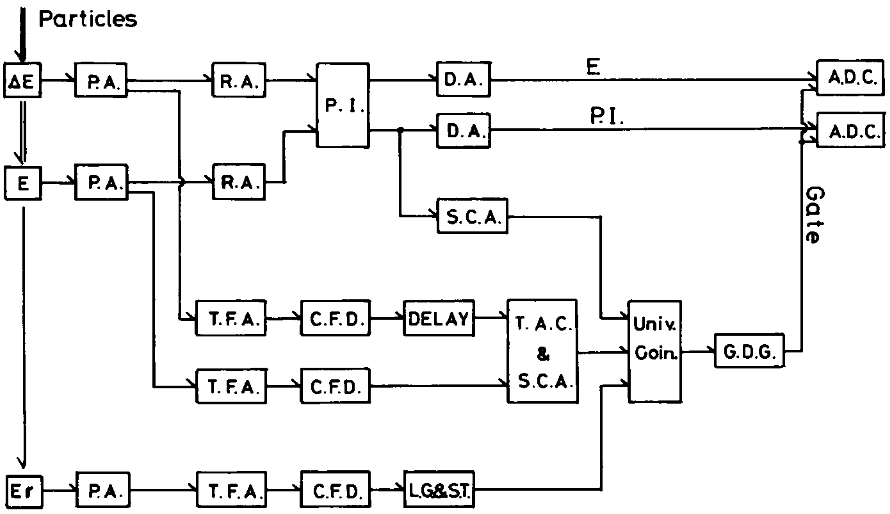

Fig. 2. A block diagram of the electronics.

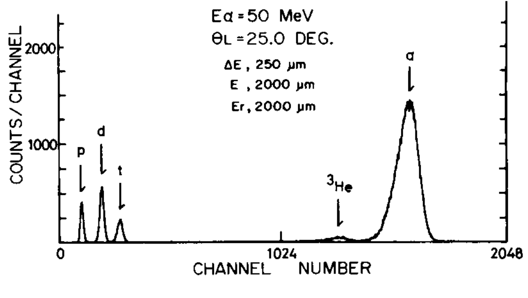

Fig. 3. A particle identification spectrum from Ni obtained at a lab angle of 25°.

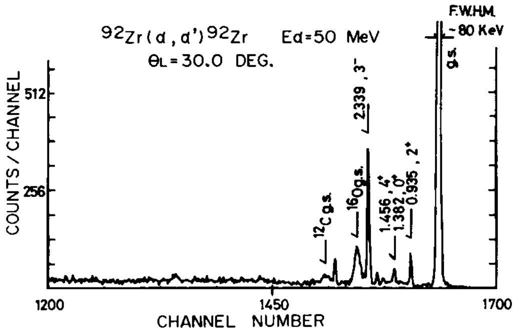

Fig. 4. A spectrum of α-particles inelastically scattered from ^{92}Zr observed at a lab angle of 30°.

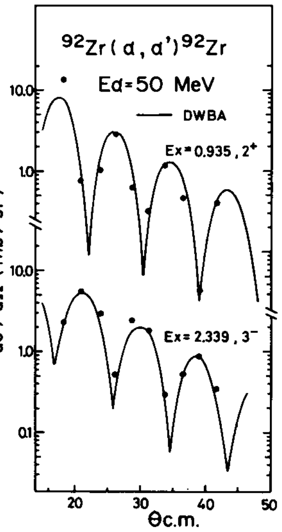

Fig. 5. Angular distributions for the inelastic scatterings of 50 MeV α-particles to the lowest 2^+ and 3^- states in ^{92}Zr. Solid curves are results of DWBA calculations.