INELASTIC PROTON SCATTERING AT INTERMEDIATE ENERGIES TO GIANT RESONANCES

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The study of giant resonances (GR) populated in (p,p') reactions at E_p = 115 Mev on Si and ^{92}Zr targets reported earlier[1] has been completed. The measurements covered the angular ranges between 10^o to 34^o for Si and 14^o to 30^o for ^{92}Zr in 2^o steps. The scattered particles were detected using intrinsic germanium detectors in a telescope configuration. The resolution was 200 keV. Collective model DWBA calculations have been performed for both the low-lying states as well as the GR region in Si and ^{92}Zr. The proton optical model parameters used in these calculations are listed in Table I.

The experimental angular distribution data for Si and the DWBA predictions for the various multipoles are shown in Fig. 1. It is found that this region is well described by contributions from L=1,2,3 and 4 multipoles. Similar analyses performed for ^{92}Zr are shown in Fig. 2. In this case, in addition to L=1,2 and 4 multipoles, an L=0 contribution is also required to explain the data. The percentage energy-weighted sum rule (EWSR) strengths determined from collective model calculations are given in Table II.

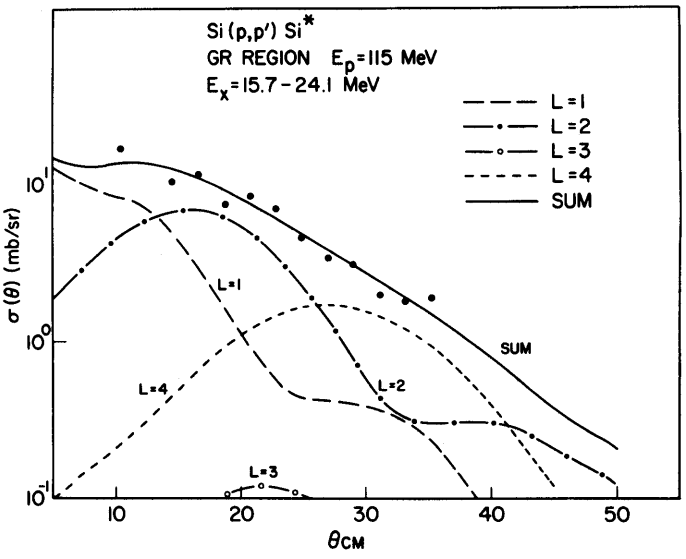

Figure 1. Differential cross section angular distribution for the GR excited in the region Ex=15.7-24.1 MeV. The respective contributions due to L=1,2,3 and 4 as well as their sum are shown.

The following conclusions emerge from the present work:

1) As expected, the GR region is dominated by the Giant Quadrupole Resonance (GQR). The EWSR strengths extracted are generally in good accord with those

Table I. Proton optical potential parameters

A	V_R	a_R	r_R	W_I	a_I	r_I	V_{so}	W_{so}	a_{so}	r_{so}
^{28}Si	-22.75	0.749	1.265	-6.00	0.644	1.409	-3.43	1.38	0.588	0.972
^{92}Zr	-26.80	0.716	1.24	-8.85	0.643	1.35	-3.30	+1.51	0.594	1.052

Units are MeV and fm.

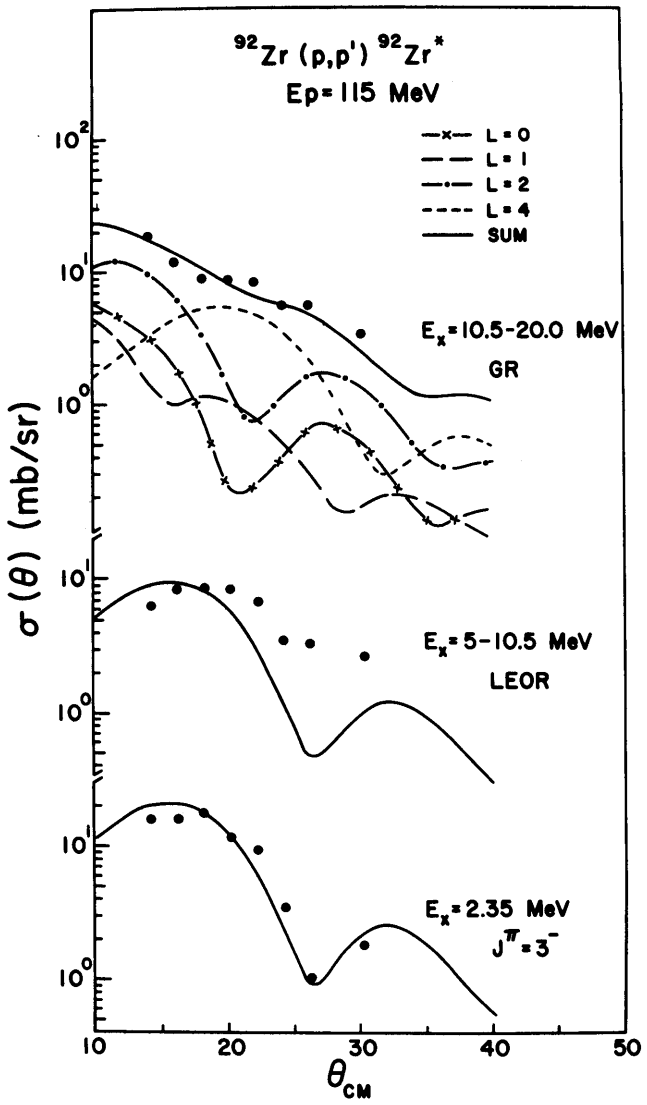

Figure 2. Measured angular distributions for the low-lying level at $E_x \simeq 2.35$ MeV, low energy octupole resonance (LEOR) between $E_x \simeq 5$-10.5 MeV, and GR between $E_x \simeq 10.5$-20 MeV compared with DWBA calculations.

obtained using other projectiles.[2,3]

2) The Giant Dipole Resonance (GDR) cross sections calculated using both the phenomenological isovector potential and microscopic optical potential agree reasonably well with each other. It is found that the GDR contribution (with 50% and 100% strengths for Si and ^{92}Zr) to the total GR cross sections is relatively small.

3) The present work has indicated the presence of measurable L=4 strength in the GR region consistent with other experimental data[2,4] and theoretical calculations.[5]

A detailed report of the present work has been prepared for publication.

1) P.P. Singh, S. Kailas, D.L. Friesel, P. Schwandt, C.C. Foster, J. Wiggins, A.D. Bacher, A. Van der Woude, and A.G. Drentje, IUCF Annual Report (1979).

2) K. Van der Borg, Thesis (1979), KVI, Groningen, the Netherlands.

3) D.H. Youngblood, et al., Phys. Rev. C13, 994 (1976).

4) P. Martin, et al., Nucl. Phys. A315, 291 (1979).

5) S. Krewald and J. Speth, Phys. Lett. 52B, 295 (1974).

Table II. Deformation parameters and energy-weighted sum rule strengths

A	E_x (MeV)	J^π	$(\beta R)_{opt}$ [a] (fm)	S_u [b] (%)	
^{28}Si	1.78	2^+	1.70	16.6	±5.7
	GR (15.7-24.1)	2^+	0.83	44.0	±1.0
	4.62	4^+	0.49	1.0	±0.3
	GR	4^+	0.69	8.4	±1.0
	6.89	3^-	1.02	11.0	±4.0
	GR	3^-	0.31	3.0	±0.9
	4.98	0^+	0.35	4.0	±2.0
^{92}Zr	2.35	3^-	0.96	10.7	±3.6
	LEOR [c] (5-10.5)	3^-	0.66	16.3	±4.9
	GR (10.5-20)	2^+	0.59	49.9	±1.3
	GR	0^+	0.53	99.8	±9.9
	GR	4^+	0.61	16.7	±0.4

a) Product of β and radius R obtained from DWBA analysis.

b) Percent EWSR using uniform mass distribution. Errors quoted are obtained from fitting the measurements with DWBA calculations.

c) Low energy octupole resonance.