quality of fits to the data (see Fig. 2). The %EWSR strengths obtained are given in Table I. Some L=0 strength is indicated in the results for ^{92}Zr and ^{120}Sn, but none is required for ^{208}Pb. On the other hand, we have determined that the inclusion of 50% L=0 in the case of ^{208}Pb does not drastically alter the quality of the fits. It appears that the angular range covered in the present work is not sufficient to allow a reliable extraction of the GMR strength. The L=4 strengths determined from the present work are consistent with those found in Refs. 4 and 8.

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GIANT MULTIPOLE RESONANCES IN THE (^{3}He,t) REACTION AT 200 MEV

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Charge exchange reactions at intermediate energy are particularly interesting because of their selective excitation of isovector giant multipole resonances.[1-3] As a result they provide information complementary to that of inelastic hadron scattering, which populates predominantly isoscalar resonances.

This investigation of the (^{3}He,t) reaction was undertaken to exploit that complementarity by studying the excitation of the giant dipole resonance (GDR) and by looking for higher multipolarity resonances. Because the GDR has been studied extensively in photonuclear reactions, it provides a good calibration point to verify our understanding of hadronic excitation of giant resonances. Since the isoscalar giant quadrupole resonance (GQR) is strongly excited in inelastic hadron scattering, the elusive isovector GQR should be seen in the isovector (^{3}He,t) reaction if it is compact.

The detection of energetic tritons is difficult because of their long range and high magnetic rigidity. A stack of 3 high-purity germanium diodes was used to detect and identify the tritons. Two of these were specially fabricated with thin ion-implanted electrodes on both sides for use in transmission. The first Ge detector was 10 mm thick and provided an excellent measurement of the differential energy loss for particle identification. The remaining two detectors were each 15 mm thick. A plastic scintillator was used as an active collimator to veto slit-scattered events.

The energy resolution of the system was limited to about 400 keV by kinematic energy spread over the ±0.5° aperture of the collimator. The data rate was limited by the high counting rates for every particle type except tritons. The question of matching the gains of the three detectors was investigated during the experiments. It was found that the most sensitive test of gain matching is the lack of discontinuity in a continuum spectrum at an energy corresponding to the detector boundary. This appears to be more sensitive than the more common technique of minimizing the width of a peak. The procedure of injecting a constant-charge pulse into each preamp input was not adequate for gain matching. Further measurements have shown that the gain matching problem does not arise from variations in charge collection efficiency. It may be due to differences in contact resistances between the preamp and the active volume of germanium.

This work has concentrated on ^{40}Ca, the heaviest T=0 target available. A typical spectrum from the $^{40}Ca(^{3}He,t)^{40}Sc$ reaction at 14° is shown in Fig. 1. The broad peak at about 12 MeV appears to be the analog of the GDR in ^{40}Ca.[2] The inset in this figure shows the GDR in ^{40}Ca as seen in photonuclear experiments[4] and shifted by the ^{40}Ca-^{40}Sc Coulomb energy difference. An arrow is also drawn in this figure at an excitation energy in ^{40}Sc corresponding to 120 $A^{-1/3}$ MeV in ^{40}Ca. This is approximately the energy region in which the evidence has been reported suggesting an isovector GQR in other nuclei.[5,6] No evidence for a compact structure is seen at this angle.

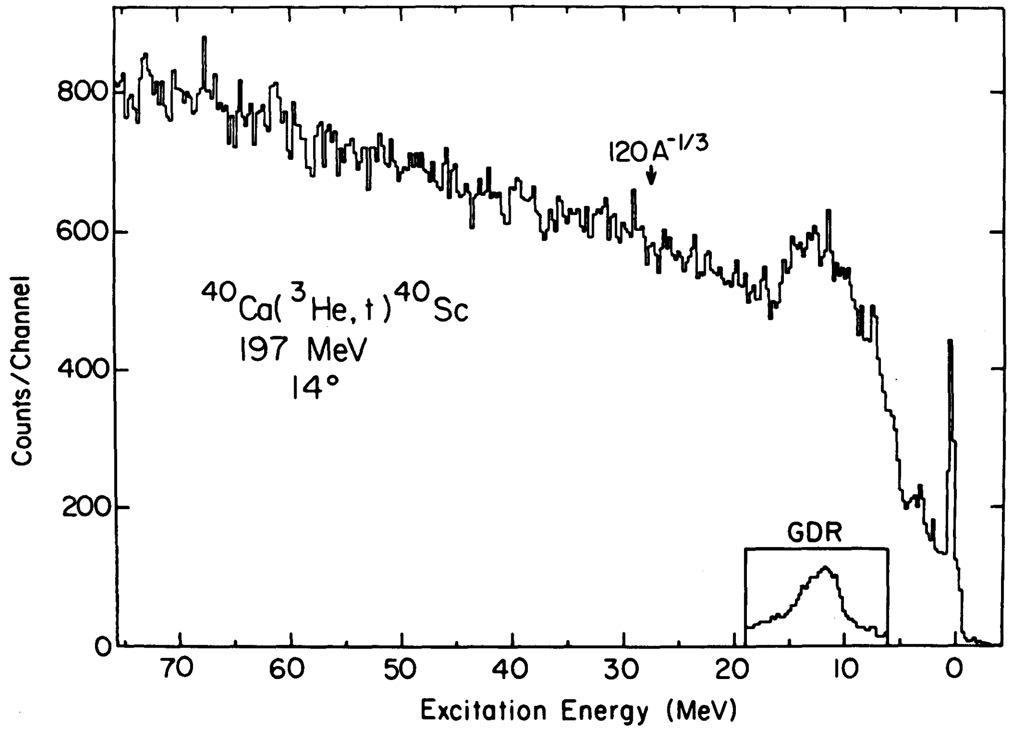

Figure 1. $^{40}Ca(^{3}He,t)$ spectrum at a laboratory energy and angle of 197 MeV and 14°. The inset is adapted from Ref. 4.

An angular distribution has been measured from 4° to 40° for the ^{40}Ca(^{3}He,t)^{40}Sc reaction, as well as for the elastic scattering. An elastic scattering angular distribution is shown in Fig. 2 along with an optical model fit. The optical potential parameters are V_0=70.45 MeV, r_0=1.356 fm and a=0.833 fm for the real well and W_0=18.78 MeV, r_{i0}=1.61 fm and a_i=0.653 fm for the volume imaginary well. The angular distribution for the GDR structure is shown in Fig. 3 along with a DWBA calculation. The GDR coupling strength was determined using the Satchler prescription.[2,7] The calculation reproduces the trend and magnitude of the data, but a predicted minimum near 7° is not observed experimentally. A similar effect was seen in earlier work at 130 MeV.[2] It is not yet clear whether this difference represents limitations in the reaction model or the presence of another state.

More limited (^{3}He,t) angular distributions were measured on ^{12}C and ^{208}Pb targets and some spectra were measured for ^{24}Mg and ^{28}Si targets. Analogs of the GDR were seen on the T=0 targets as well as analogs of $1\hbar\omega$ stretched states. Further analysis of this data is in progress.

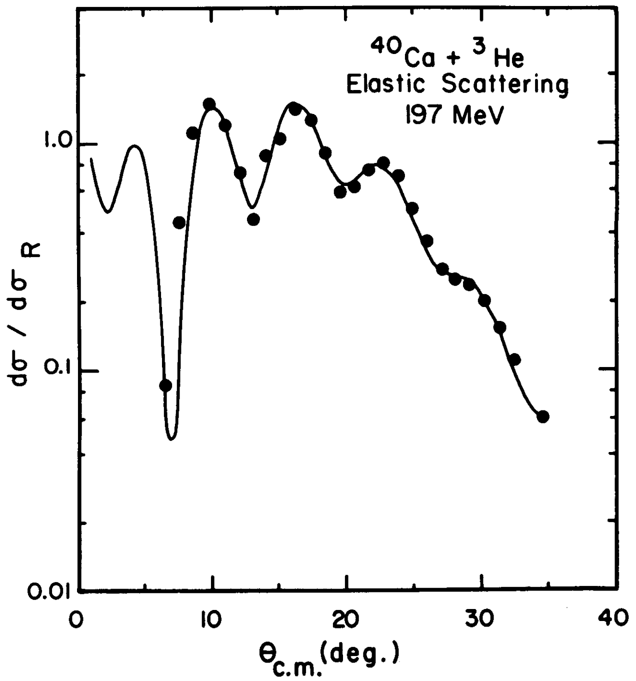

Figure 2. An angular distribution of the ratio of the elastic scattering cross section to the Rutherford value for ^{3}He projectiles on ^{40}Ca. The smooth line represents an optical model calculation which is described in the text.

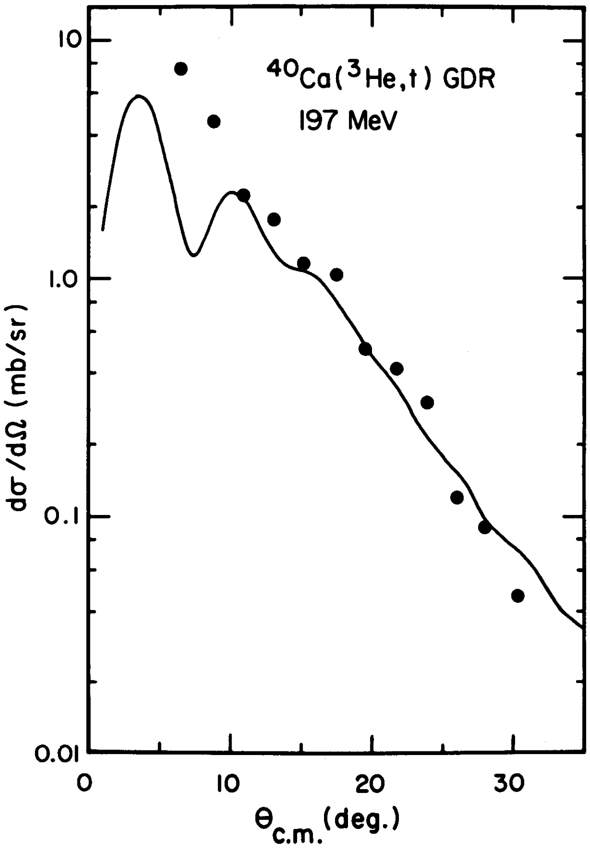

Figure 3. An angular distribution of the giant dipole resonance peak in the ^{40}Ca(^{3}He,t)^{40}Sc reaction. The smooth line represents a distorted-wave Born-approximation calculation which is discussed in the text.

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