RADIATIVE CAPTURE

MULTIPOLE STRENGTH DISTRIBUTIONS IN ^{16}O ABOVE THE DIPOLE RESONANCE REGION

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The giant electric dipole resonance has been extensively studied for several decades using the photonuclear reaction, where the enhanced coupling of dipole photons to the collective motion of neutrons and protons offers a clear signal of the nuclear dynamics. Electric resonances with multipolarity $l > 1$ are predicted[1] to occur at higher energies, but are generally more difficult to distinguish[2,3] experimentally. The present investigation is an attempt to use radiative capture of polarized protons to search for high multipolarity strength in ^{16}O in the energy range above the GDR. This work extends our previously reported[4] measurements to a broader range of excitation in ^{16}O.

The angular distributions of cross sections and analyzing powers for the reaction ^{15}N$(\vec{p},\gamma_0)^{16}$O have been measured at excitation energies of 28.2, 41.8, 45.0, and 48.1 MeV, to supplement our previous data at 31.1, 35.0 and 39.0 MeV. Data were collected in eight angular steps from 23° to 155°.

Gamma-rays were detected in a pair of large NaI spectrometers located on either side of the beam at a target-to-detector spacing of about 91 cm. Both spectrometers were actively shielded to reject background cosmic rays. The beam was pulsed at a frequency of about 16 MHz, and differences in time-of-flight were used to distinguish gamma-rays from the background of direct neutron groups produced in the target. The overall TOF resolution was 800 psec. Attenuation of slow neutrons was accomplished by placing boron around the lead shield of the detector.

The target consisted of a gas cell of 2.7 cm length pressurized to approximately 3 atm with ^{15}N gas enriched to 99%, and operated at room temperature. The gas cell contained beam entrance and exit windows of havar with a total thickness of 12.5 μm.

Analysis of the data at 35.0 and 39.0 MeV demonstrated[5] that the E1 and E2 cross sections could be determined with good precision. The data further revealed the presence of E3 strength at a level near 0.5% of the total cross section. The additional data are now being analyzed, and will allow a determination of the distributions of E1, E2 and E3 strengths over the region extending from 28 to 48 MeV in ^{16}O.

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