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PROTON RADIATIVE CAPTURE BY DEUTERIUM AT MEDIUM ENERGIES

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In an attempt to learn more about reaction mechanisms for (p,γ) at medium energies, we have designed and executed an experiment investigating $^2H(p,\gamma)^3He$ in the proton energy range of 100-200 MeV. Eight point angular distributions, at angles ranging from 17° to 150° in the lab, have been obtained for the differential cross section and analyzing power at energies of 100, 150, and 200 MeV.

In order to obtain good event definition and reduce background, the emitted ^3He and γ were detected in coincidence. The recoil particles were detected using a plastic scintillator range telescope. The high energy photons were detected using lead glass Cerenkov detectors whose solid angles were defined with lead collimators. In order to obtain high efficiency, simultaneous measurements were made at eight angles ranging from θ_γ=17° to 150° in the lab. This was done by using an array of eight independent photon detectors and a plastic scintillator range telescope covering an extended angular range (2.5°-16°). The range telescope was segmented to reduce the rate in each of its elements and also to provide a measure of the angle at which the detected particle was emitted.

Production runs were made using CD_2 targets. The deuterium and carbon content of the targets was monitored continuously using a plastic scintillator - NaI telescope. Background checks were made repeatedly using CH_2 targets. We generally found the background everywhere to be less than 5%.

The high efficiency and effectiveness of the apparatus has yielded data of high statistical quality. Although the data analysis is still in its preliminary stages, we should be able to extract analyzing powers with uncertainties of ±0.02, or less, at all energies and angles. We should be able to extract differential cross sections with absolute uncertainties less than 15%. The experiment has made it clear that with only a few minor modifications to the apparatus and with a little more time spent investigating systematic effects, we should be able to make absolute measurements of the cross section to better than ~5%.

The small relative uncertainties in the extracted analyzing powers and cross sections will permit a more significant study of the energy dependence of these quantities. We hope that the existence of these measurements will eventually lead to an increase in our understanding of mechanisms for radiative capture at intermediate energies.