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3.52 High Precision Measurement of the Analyzing Powers iT_{11}, T_{20}, T_{21} and T_{22} of the Reaction $^3He(d,p)^4He$ between 1.0 and 13.0 MeV

M. Bittcher, V. König, P.A. Schmelzbach, Ch. Forstner,
W. Grüebler, B. Vuaridel, D. Singy and J. Ulbricht

Institute for Medium Energy Physics, Swiss Federal Institute of Technology,
CH-8093 Zürich, Switzerland

The investigation of the polarization observables of the $^3He(d,p)^4He$ reaction is of particular interest for several reasons. It is a very suitable reaction for polarimeters measuring the tensor polarization of polarized deuterons induced by scattering or nuclear reactions. The known smooth behaviour of the vector and tensor analyzing powers as a function of energy over a wide energy range, and the large values of the different analyzing powers make it a nearly ideal analyzing reaction. Moreover, the high Q-value of 18.4 MeV allows relatively simple detection of the emitted protons, and facilitates dicrimination from other proton producing reactions[1]. These characteristics make the $^3He(\vec{d},p)^4He$ reaction popular for use in medium energy experiments also as e.g. in π-d and e-d elastic scattering[2,3].

Precision polarization data for the $^3He(d,p)^4He$ reaction also reveal important information concerning structure of the five nucleon systems, its resonant behaviour and the subclustering of this system.

Finally high precision results for the tensor analyzing powers can be used for a more accurate determination of the D- to S-state normalization of the deuteron wave function by the extrapolation of the data to the exchange pole.

While older comprehensive measurements of the analyzing powers are lacking the necessary precision[4], more recent results are restricted to certain angular or energy regions. Therefore we have measured the differential cross section, the vector analyzing power iT_{11} and the tensor analyzing powers T_{20}, T_{21} and T_{22} to a high precision. Measurements were carried out between 1.0 and 13.0 MeV in energy steps of between 1.0 and 2.0 MeV. Angular distribution at these energies were measured in steps of 5° between θ_{cm}=10° and 166°. The statistical errors are typically 0.005, the absolute calibration has a accuracy of between 1 and 2 %. A sample of the present data (analyzing power T_{22}) is shown in Fig. 1. The statistical errors are smaller than the dots. Similar data have been obtained for the other components.

These results are complemented by similar measurements in LANL between 12.0 and 17 MeV[5]. This body of data will be used to map out the behaviour of the analyzing powers over the investigated angular and energy range in order to determine the analyzing characteristics for a thick ^3He target and for extented solid angles. This analysis is in progress.

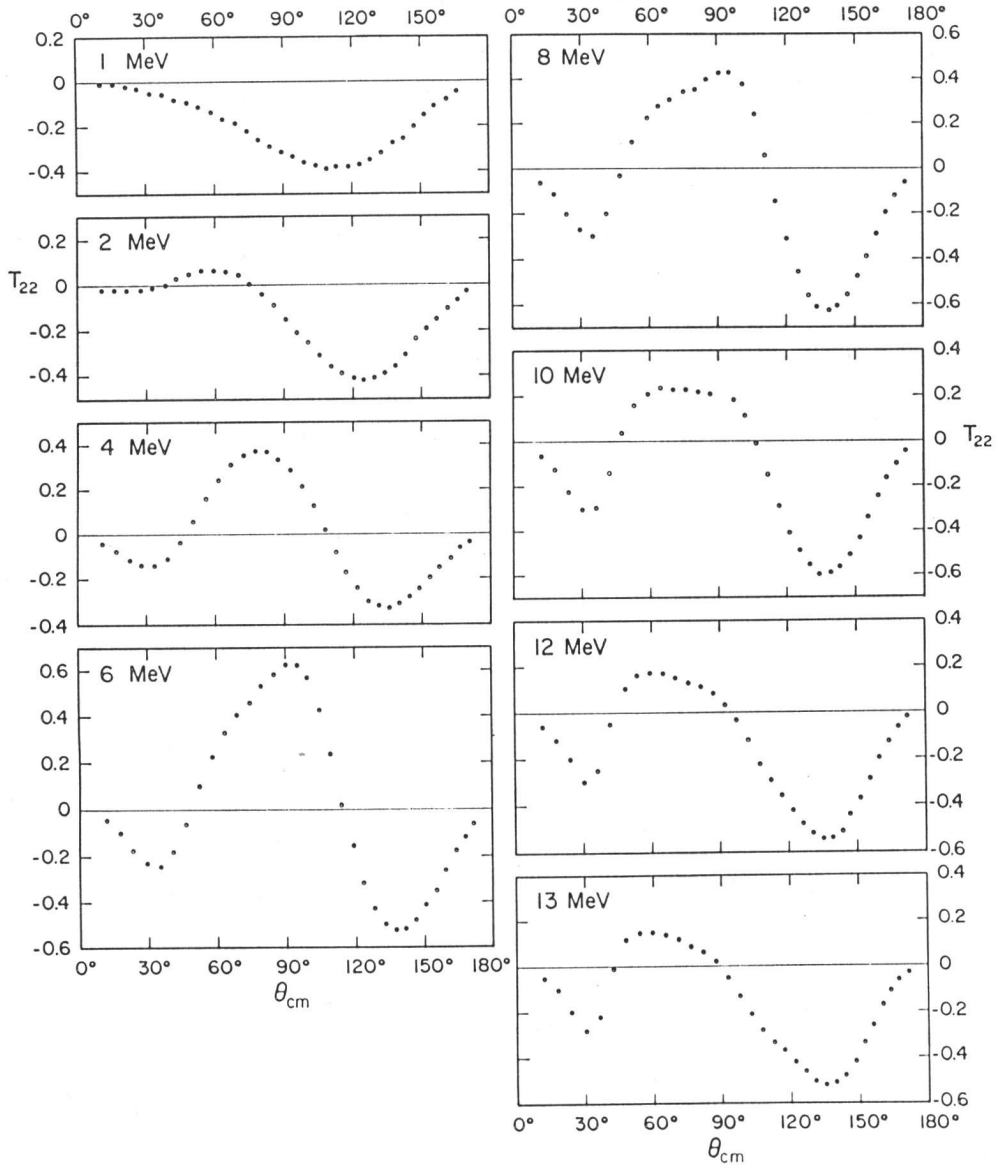

Fig. 1. The analyzing power T_{22} of the $^{3}He(d,p)^{4}He$ reaction between 1.0 and 13.0 MeV.

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