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1.48 Analyzing powers for the deuteron stripping reaction $^{12}C(\vec{d},p)$ leading to bound and unbound states in the residual nucleus ^{13}C

M. Godlewski[+], L. Jarczyk[+], J. Lang, J. Liechti, R. Müller, P.A. Schmelzbach, J. Smyrski, A. Strzalkowski[+] and H. Witala[+]

Institut für Mittelenergiephysik, Eidg. Technische Hochschule, CH-8093 Zürich, Switzerland
[+]Institute of Physics, Jagellonian University, 30059 Cracow, Poland

Recently, the tensor analyzing powers, T_{2q}, for the deuteron break-up reaction in the Coulomb field of Au nuclei were measured at an energy of 12 MeV[1]. In order to overcome the problems with the exact finite range approach, Dar's and local momentum approximations were used for calculations in the DWBA formalism. Attempts to reproduce the experimental results by this method led to drastic discrepancies. An extension to the case of deuteron stripping to unbound states of the residual nucleus could shed some light on possible sources of the observed disagreement. A ^{12}C target is especially favourable for such studies, since the first unbound state of the residual ^{13}C nucleus at an excitation energy of 6.864 MeV has the same spin and parity, $5/2^+$, as the preceding bound state at 3.854 MeV. In this way it is possible to compare directly reactions with one and two unbound nucleons in the exit channel, corresponding to the same angular momentum transfer in the reaction.

The experiment was performed using the polarized deuteron source at the tandem Van de Graaff accelerator of the ETH Zürich[2]. A 12 MeV deuteron beam with a vector or tensor polarization of t_{10} = -0.57/0 or t_{20} = +0.6/-0.6, respectively, was used in the experiment. The vector and tensor beam polarization was determined using elastic scattering on ^{12}C and $^3He(d,p)^4He$ as monitor reaction, respectively. For the determination of the different analyzing power components, T_{kq}, the axis of the beam spin alignment was appropriately rotated by means of a Wien filter and the asymmetries for two beam polarization states were determined. The beam polarization was changed every 50 s. ΔE-E counter telescopes allowed to record protons and deuterons separately. The energy resolution of the detection system was around 36 keV, sufficient to resolve protons from reactions leading to the first seven excited states of the residual ^{13}C nuclei. Angular distributions for cross sections and analyzing powers were measured from 15° to 165° in the lab. system, generally in 5° steps. The absolute value of the cross sections was normalized by comparison with elastic scattering on C.

In Fig. 1 and Fig. 2 measured cross sections and analyzing powers, respectively, are shown for the most interesting reactions leading to the third excited state (bound, 3.854 MeV, $5/2^+$) and the fourth excited state (unbound, 6.864 MeV, $5/2^+$). A theoretical analysis of these experimental data is in progress. It is obvious, that the analyzing powers for the two levels are completely different, although the two states have a similar structure[3].

References

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2) W. Grüebler et al., Nucl. Instr. Meth. 212 (1983) 1
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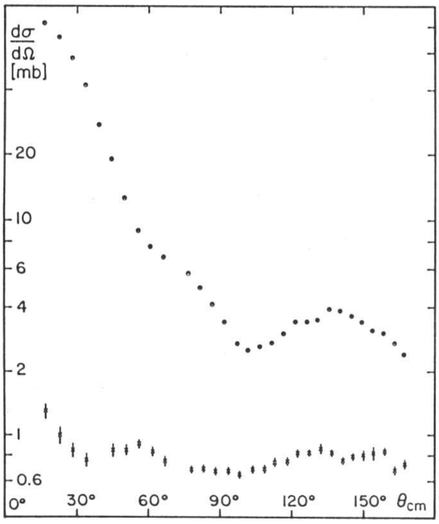

Fig. 1.
Angular distribution for the reaction $^{12}C(d,p)^{13}C$ leading to the third (points; statistical errors are generally smaller than the dot size) and fourth (crosses with error bars) excited state of ^{13}C.

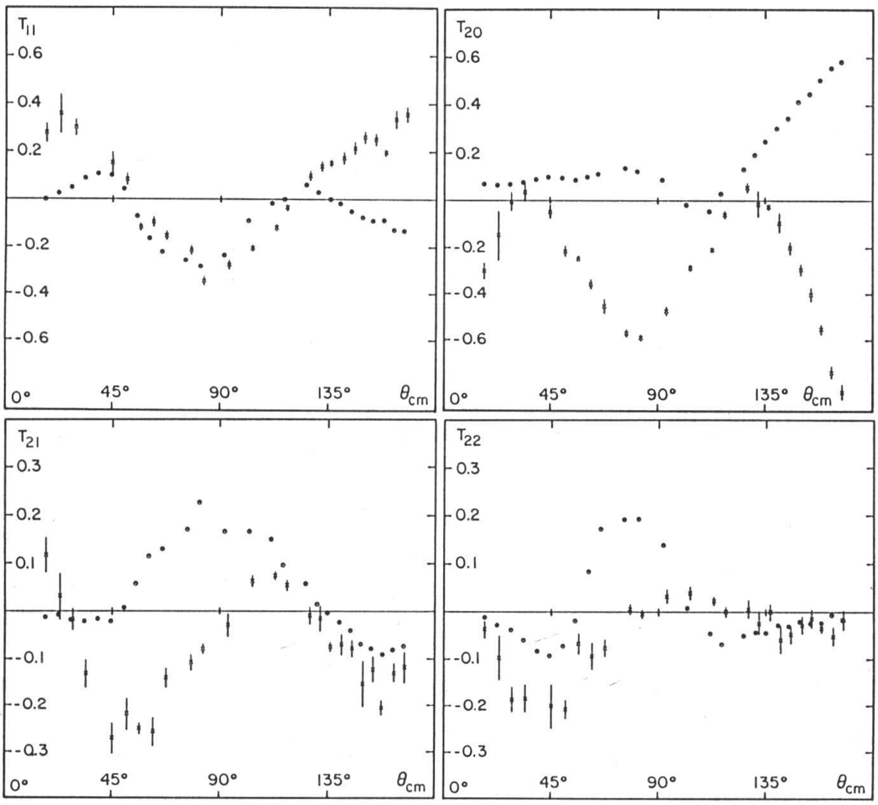

Fig. 2. Analyzing powers for the reaction $^{12}C(\vec{d},p)^{13}C$ leading to the third and fourth level in ^{13}C (same symbols as in fig. 1).