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Tensor Moments of ^{5}Li from the Sequential Decay in the Reaction $^{6}Li(p,d)^{5}\vec{Li}(\alpha)p$ at E_p = 10 MeV

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Recently resonating group calculations for the A = 7 system have been performed by Hofmann et al.[1] for excitation energies below 12 MeV using for ^{7}Be the fragmentations $^{4}He + {}^{3}He$, ^{6}Li + p, ^{5}Li + d, ^{6}Be + n and allowing for low-lying excited states of the fragments. The calculations were extended to higher energies covering also the energy of this experiment[2]. Among the different possibilities to investigate the ^{7}Be system we chose the $^{6}Li(p,d)^{5}Li(\alpha)p$ sequential decay break-up reaction via the ground state of ^{5}Li. Tensor moments of ^{5}Li produced in the first reaction step are measured through the angular distribution of the second step and can be compared with predictions from the resonating group calculations.

The kinematically complete experiment was performed by using a 10 MeV proton beam from the Köln FN Tandem Van de Graaff accelerator and by measuring coincidences between particles from detectors on either side of the beam. The detector defining the reaction plane of the first step was mounted at $\Theta_d = 60^0$, $\Phi_d = 0^0$. In addition five detectors were arranged in and out of this plane between $\Theta_\alpha = 42^0$ and 65.3^0 (with Φ_α from 168.3^0 to 180^0). Since all particles in the exit channel were charged, the coincidence events appeared on six different kinematical curves. The events from the desired d - α coincidences were discriminated against the interfering coincident reactions and accidental background by using a time-of-flight difference method[3,4]. Figures 1 and 2 show two typical spectra of these events as a function of the relative energy between the α and p serving as a measure of the excitation energy of ^{5}Li.

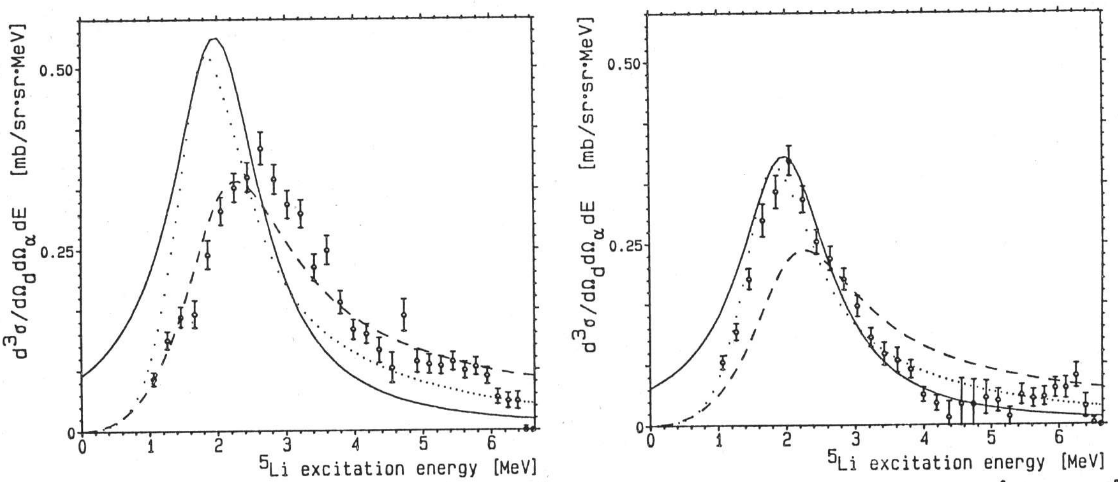

FIG.1: Proj. spect. for Θ_α=42.1° Φ_α=180°

FIG.2: Proj. spect. for Θ_α=54.3° Φ_α=173.8°

FIGURES 1 and 2: Typical spectra of $^{6}Li(p,d)^{5}\vec{Li}(\alpha)p$ at E_p = 10 MeV displaying differential cross section as a functon of the ^{5}Li excitation energy. Curves show the theoretical results (solid: Breit - Wigner, dotted: Micklinghoff, dashed: Heiss).

Since the shape of the ^5Li peak is asymmetric a description using a standard Breit - Wigner distribution is not satisfactory (Figs. 1 and 2 solid curve). However, two different approaches by Micklinghoff[5] and Heiss[6] describing the shape by asymmetric enhancement factors also were only partly successful as shown by a comparison of Figs. 1 and 2.

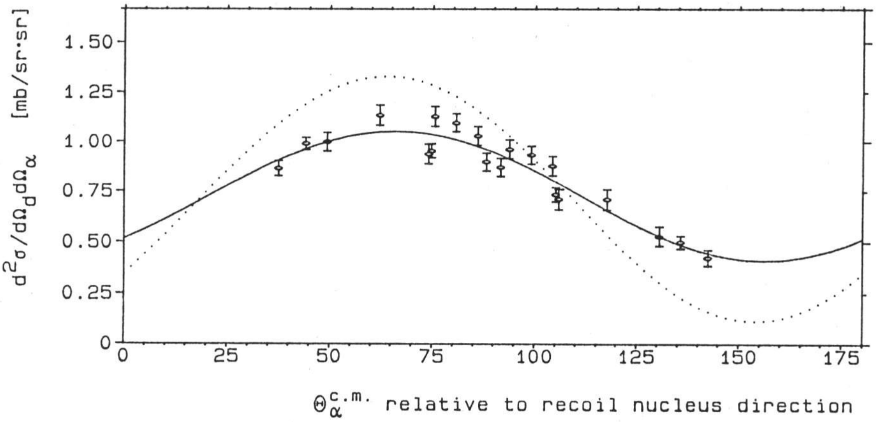

FIGURE 3: Angular distribution of the ^5Li breakup cross section at $\Phi_\alpha = 0^o$
Solid line : fit to the experimental data.
Dotted line: Theoretical results by Hofmann et al.[2].

From the measured angular distributions of the cross section which had been integrated over the ^5Li peak in the spectra the tensor moments of even rank (0 and 2) were obtained by a fit with a spherical harmonics expansion according to eq. (4) in ref. 7), calculated for the $J^\pi = 3/2^-$ ground state of ^5Li.

Figure 3 shows this cross section as a function of the c.m. angle of the α - particle relative to the ^5Li recoil direction. The Φ dependence of the data points was eliminated by using the fitted tensor moments allowing a simultaneous display of all data points within a single plot (Fig. 3). The solid curve is the result of the tensor moment fit. Table I gives the resulting tensor moments normalized according to the Madison convention. Also shown in Fig. 3 is an angular distribution at $\Phi_\alpha = 0^o$ from preliminary tensor moments obtained with a set of S-matrix elements from resonating group calculations by Hofmann et al[2].

In addition it is intended to obtain polarization transfer coefficients for this reaction by using a polarized incident beam.

Table I. Tensor moments of ^5Li from fit to the data

Re T_{00}	10.18	± 1.64
Re T_{20}	0.078	± 0.026
Re T_{21}	0.046	± 0.016
Re T_{22}	0.013	± 0.032

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