Deformation Dependence of the Cross Section of $^{7}\vec{Li}$ induced Reactions.

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The first experiments with the aligned $^{7}\vec{Li}$ beam from the Heidelberg EN Tandem have already shown, that the scattering cross section is sensitive to the orientation of the deformed projectile with respect to the beam axis.[1)]

The reaction cross section was next examined. For experimental reasons ^{51}V was used as a target and the reaction cross section determined from γ-ray yields and the known decay schemes of the residual nuclei. A second set of data was obtained by fitting elastic scattering angular distributions with an optical model and calculating then from the model total reaction cross sections.[2)] Both sets of data are compatible (Fig. 1).

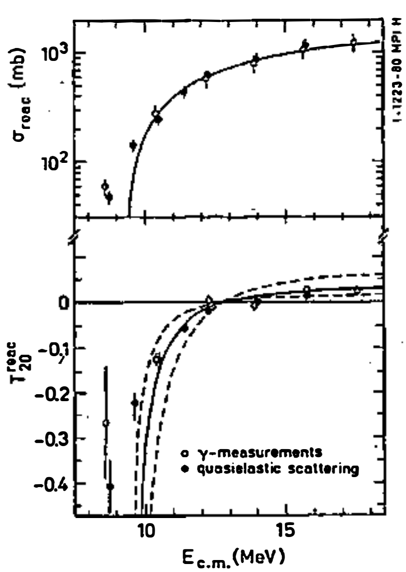

Fig. 1. Reaction Cross Section (top) and Analyzing Power T_{20} (bottom) for $^{7}Li+^{51}V$.

The relevant quantity measured in these experiments is:

$$t_{20}\cdot T_{20} = \Delta\sigma/\sigma = (\sigma_{\alpha\ell}-\sigma)/\sigma$$

where t_{20} is the alignement of the beam (monitored throughout the experiment), $\sigma_{\alpha\ell}$ the cross section with the aligned beam, σ the unaligned cross section and T_{20} the analyzing power of the reaction.

In a classical picture, the change of overlapp between target and projectile due to the change of alignement can be represented by the change of the radius of closest approach.[3)] Starting from the expression $\sigma = \pi b^2$ and assuming that :

- the radius of the aligned ^{7}Li is
  $R = R_0(1+\beta Y_{20}(\phi))$
- the projectile moves on Coulomb trajectories, and
- the alignement axis stays fixed during collision

we can calculate σ and T_{20}.

The curve for β =-0.12 is drawn through the data points of Fig. 1, while dashed lines correspond to β =-0.06 and β=-0.24. Although the classical model cannot describe tunneling and misses the low energy points, it is clear that the deformation of ^{7}Li is responsible for the observed effects.

As a further step, the angular distributions of light particles emitted during the reaction were measured at E_{lab}=12 and 20 MeV. Although the evaluation of the data is not yet complete, some interresting features already emerge. The distribution of T_{20} for tritons (Fig. 2) shows the qualitative behaviour expected from a direct reaction on the basis of the classical model : it is positive at forward an - gles where large impact parameters contribute and negative at the back. Similar behaviour is observed with the α-particles.

On the other hand the proton spectrum starts at an energy corresponding to the p2n-threshold and it has the shape normally associated with evaporation from a compound nucleus. We should then expect a distribution of T_{20} symmetric around 90^{o}. The assymmetry displayed in fig. 2 indicates that the protons are emmitted from a non-equilibrated system. This has to be taken into account during the theoretical interpretation of the data.

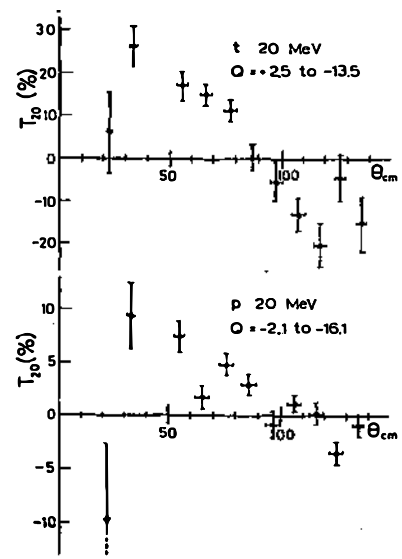

Fig. 2. Analyzing Power for tritons (top) and protons (bottom) from $^{7}Li+^{51}V$. For each angle the energy spectra were integrated within the indicated Q-value intervals.

References :

1) W. Dreves et. al., Phys. Lett., 78B (1978) 36
2) K.-H. Moebius et. al., Fifth Intern. Symp. on Polarization Phenomena in Nuclear Physics, Santa Fé, U.S.A., 1980
3) E. Steffens, ibid.

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