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In this paper we present some preliminary results on the study of the reaction

(1) $$\gamma + {}^3\mathrm{He} \rightarrow p + d$$

with linearly polarized gamma rays.

We have measured the asymmetry parameter at 90° in the CMS and at gamma ray energies between 180 and 300 MeV. The measured value are indicated in Table I and in Fig. 1a.

TABLE I

E_γ (MeV)	A/90° CMS
170 - 190	-0.41 ± 0.10
190 - 210	-0.40 ± 0.06
210 - 230	-0.35 ± 0.05
230 - 250	-0.28 ± 0.05
250 - 270	-0.31 ± 0.07
270 - 290	-0.28 ± 0.07

Experimentally measured values of the asymmetry parameter.

The hypothesis that the reaction is dominated by an electric dipole transition implies that the asymmetry is equal to minus one and is clearly inconsistent with our data.

The cross section for the two body photodisintegration of ^{3}He has been calculated with different models. Most models reproduce very well the cross section at low energy. No model pretends to be valid at high energy around and above the pion threshold.

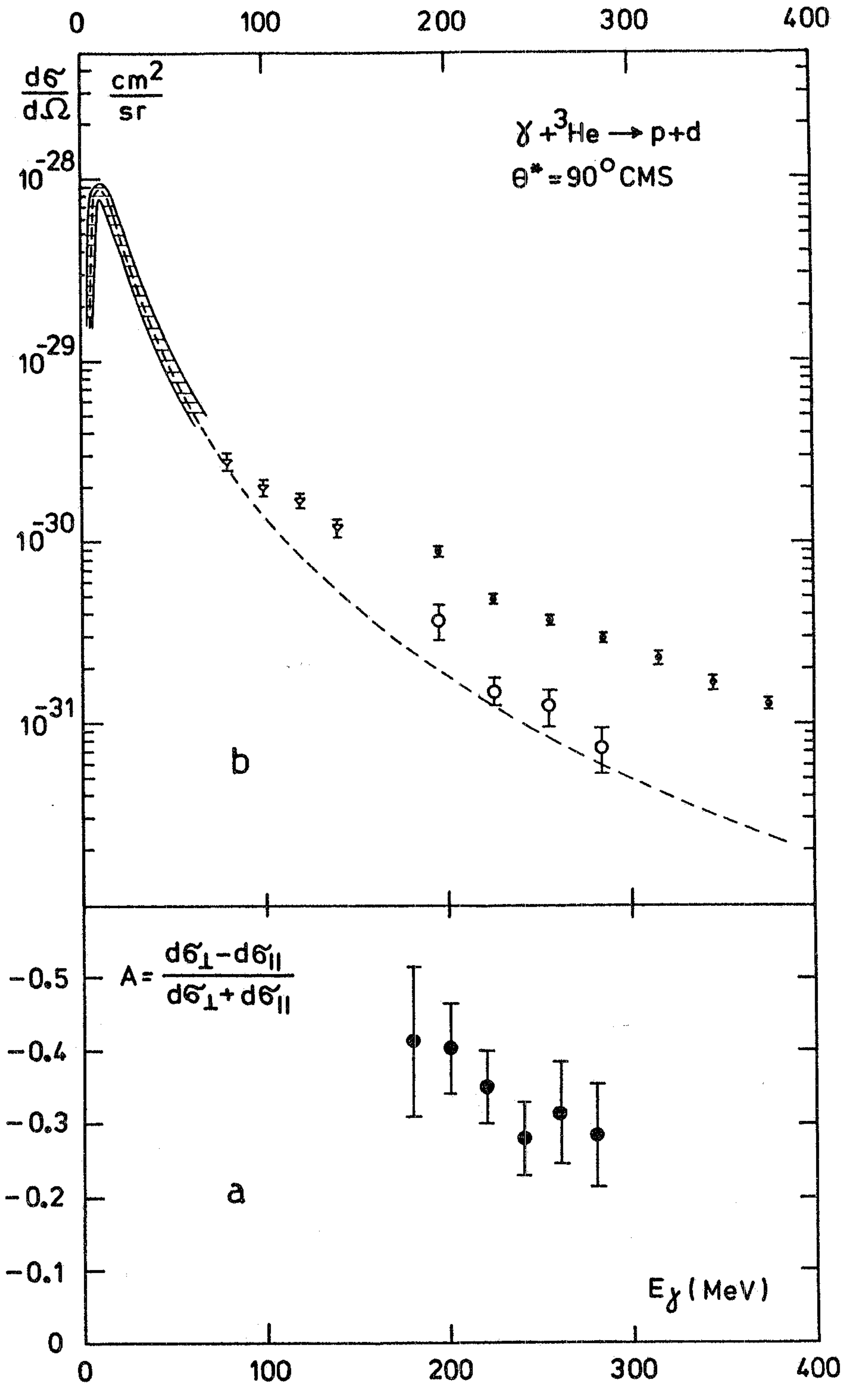

FIG. 1 - (a) The asymmetry parameter A from Table I. (b) Comparison of the experimental results of various authors with the Gunn and Irving theoretical calculations with μ^{-1} = = 2.6 fm (dashed line). The experimental values of the differential cross section at 90° CMS have been taken from Fig. 9 of Ref. (2). The dashed zone represents an artist's view of the low energy data. The open circle (o) indicate the electric dipole experimental cross section calculated from our measurements of the asymmetry A as explained in the text.

Some recent models tend to include only the transitions indicated in Fig. 2[1]. The lower E1 transition is the dominant one,

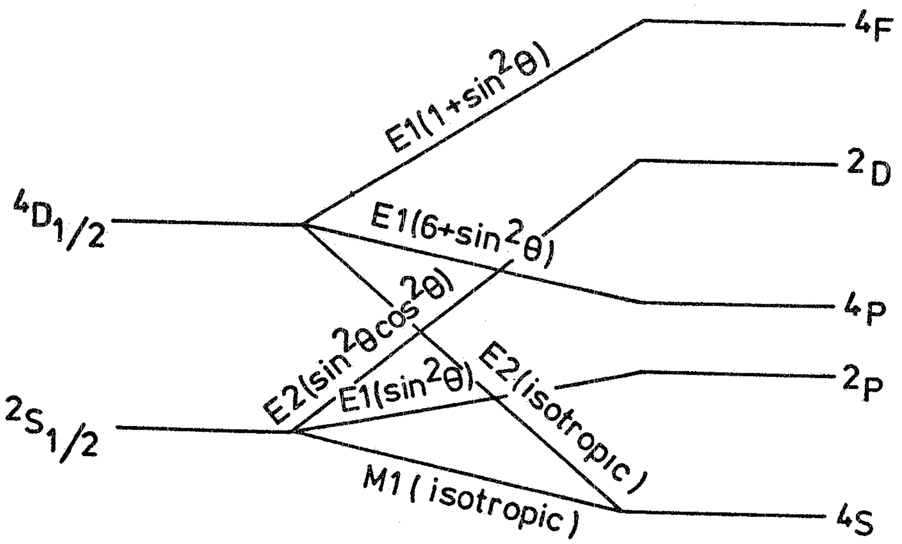

FIG. 2 - The lower order electromagnetic transitions contributing to our process with an indication of their respective contributions to the angular distributions of the reaction products.

while the M1 and E2 transitions from an $S_{1/2}$ state are the other more relevant contributions. There is no interference between E1 and M1 because they lead to final states with different spin. At 90° in the CMS E2 does not contribute. Under this hypothesis the asymmetry parameter, defined in the usual way, is given by:

$$A = \frac{d\sigma_{\perp} - d\sigma_{\parallel}}{d\sigma_{\perp} + d\sigma_{\parallel}} = - \frac{b_e}{a_m + b_e} = - \frac{1}{1 + \frac{a_m}{b_e}}$$

where:

- $d\sigma_{\parallel}$ is the differential cross section at 90° in the CMS measured in the plane of linear polarization of the gamma ray beam;
- $d\sigma_{\perp}$ is the differential cross section at 90° in the CMS measured in the plane perpendicular to the plane of polarization of the gamma ray beam;
- b_e is the contribution to the cross section from the E1 transition;
- a_m is the contribution to the cross section from the M1 transition.

It is clear from this formula that the asymmetry parameter A gives directly, under our simple assumptions, the partial contribution of the electric dipole transition to the cross section. In this way we can calculate an experimental electric dipole cross section by multiplying the asymmetry parameter obtained in this experiment and the cross sections measured in Ref. (2). The result of this operation is indicated in Fig. 1b.

It is interesting to note that the electric dipole experimental cross sections are in reasonable agreement with previous theoretical calculations in which only electric dipole transitions have been taken into account.

To perform our measurement we have used the partially polarized gamma ray beam produced by the coherent bremsstrahlung of electrons in a diamond crystal[3] and the liquid Helium target described in Ref. (4). The detection apparatus consisted of a NaI(Tl) crystal and two thin plastic scintillators in the deuteron channel. The proton telescope had four plastic scintillators and aluminium absorbers. Bidimensional analysis of the pulses in the NaI crystal and the plastic scintillator in front of it permitted identification and counting of the deuterons emitted in coincidence with a proton on the other side of the target.

The data have been collected in two separated runs with a different inclination of the crystal axes with respect to the beam line and therefore a different gamma ray spectrum. The points taken in the two runs were statistically consistent and have been combined to produce Table I.

It is a pleasure to thank Prof. G. Bologna for invaluable help in the calculation of the polarization of the coherent bremsstrahlung beam. Mr. C. Carocci contributed, with physical insight, intelligence and personal sacrifice to the experiment.

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