Photodisintegration of ^{6}Li (*).

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The photodisintegration of ^{6}Li has received in the past and recently particular consideration. Among many other problems, two have some special interest, *i.e.*, the measured value of the integrated photon absorption cross-section, which is, in the energy region considered up to now, rather lower than the theoretical predictions, and the possibility of interpreting the experimental results as consistent with a clustering of the six nucleons of ^{6}Li.

In order to have a better insight in the behaviour of the photon absorption cross-section, expecially at energies higher than 30 MeV, the photoneutron yield curve has been measured from 5 MeV up to 97 MeV using an improved thermalized neutron detector (1) which, with a particular disposition of BF_3 counters, assures a neutron detection efficency nearly constant for neutron energies up to 50 MeV. One mole of enriched ^{6}Li (99.3%) target has been used, and an over-all accuracy better than 0.5% in the yield points has been achieved as a result of several runs. Background has been measured and subtracted and all the necessary corrections have been apported to the measured points.

The yield curve, without any smoothing, has been analysed up to 30 MeV using the method proposed by COOK (2) and from 30 MeV up to 97 MeV simply with the aid of the Penfold and Leiss tables (3). In Fig. 1 are reported the cross-section obtained and the corresponding integrated cross-section. The presence of a structure below 20 MeV is evident and a comparison of the levels found in the present work with the results of other experiments is given in Table I.

Above 20 MeV the points in Fig. 1*b*) are only indicative and we took values averaged over energy which serve mainly to show the behaviour of the cross-section. One can see, however, that the cross-section keeps its value of $\sim$ 1.5 mb up to about 36 MeV, thereby decreasing

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(2) B. C. COOK: *Nucl. Instr. and Meth.*, **24**, 256 (1963).

(3) A. S. PENFOLD and J. E. LEISS: *Analysis of Photocross-sections*, University of Illinois, 1958. Unpublished.

rather slowly with an appreciable contribution to the integrated cross-section.

Our cross-section integrated up to 30 MeV is in rather good agreement with other measurements performed with the bremsstrahlung spectrum ([4-6]) while the result obtained using nearly monochromatic X-rays is about 40% lower ([7]).

The major part of the photonuclear reactions in ^{6}Li yield at least one neutron and the only important reactions not measured with our detector are the (γ, pd) and (γ, t) processes. These have been measured with different techniques ([5,8]) but the results quoted

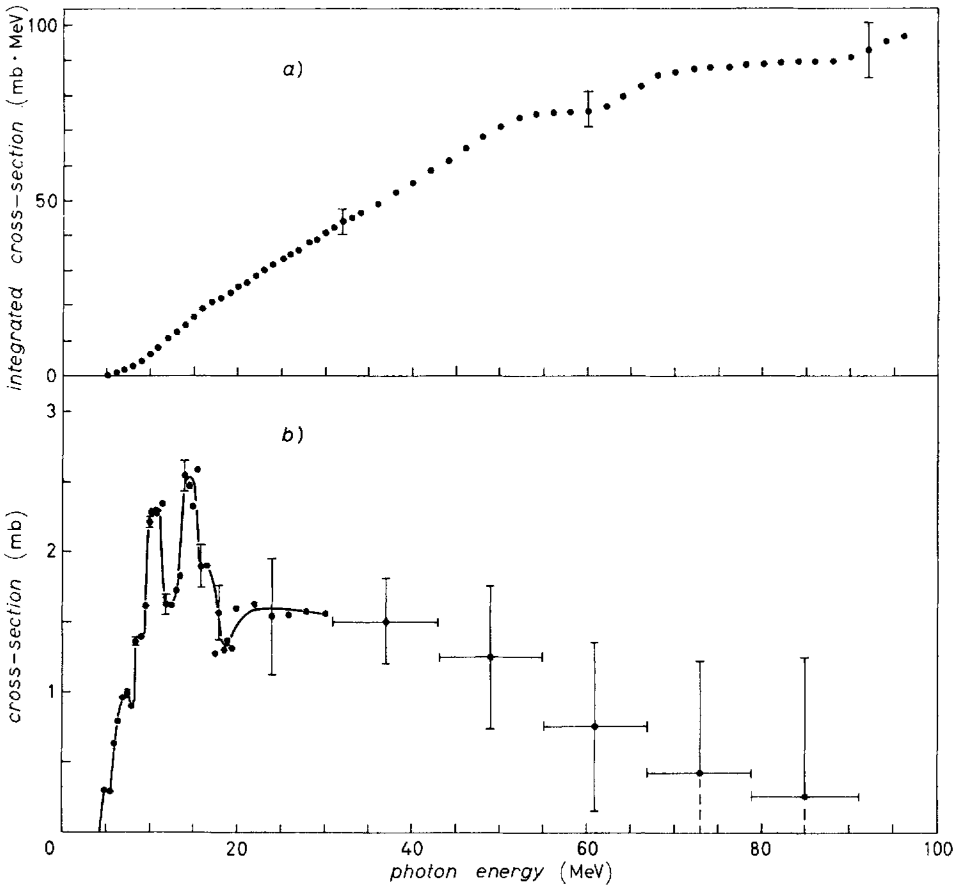

Fig. 1. – a) $\int_{4.7\,\text{MeV}}^{96\,\text{MeV}} \sigma(E)\,dE$; b) $\sigma(\gamma,\text{tn})$.

([4]) E. HAYWARD and T. STOVALL: *Nucl. Phys.*, **69**, 241 (1965).

([5]) E. B. BAZANOV, A. P. KOMAR, A. V. KULIKOV and E. D. MAKHNOWSKY: *Nucl. Phys.*, **68**, 191 (1965).

([6]) S. COSTA, S. FERRONI, V. WATAGHIN and R. MALVANO: *Phys. Lett.*, **4**, 308 (1963).

([7]) B. L. BERMAN, R. L. BRAMBLETT, J. T. CALDWELL, R. R. HARVEY and S. C. FULTZ: *Phys. Rev. Lett.*, **15**, 727 (1965).

([8]) G. MANUZIO, R. MALVANO, G. RICCO and M. SANZONE: *Nuovo Cimento*, **40 B**, 300 (1965).

are in striking disagreement. However, adding together the contributions of the two reactions obtained from the experimental cross-sections, one reaches a pratically coincident result, namely ~ 35 mb·MeV. This figure is affected by a considerable uncertainty and in the case of ref. (8) might be somewhat underestimated. Nevertheless if we add these 35 mb·MeV to our cross-section integrated up to 97 MeV ((95 ± 8) mb·MeV), and if we neglect the neutron multiplicity (which surely affects our results above 30 MeV) we can estimate an upper limit of the integrated photon absorption cross-section, namely (130 ± 20) mb·MeV which can be compared with the 126 mb·MeV calculated with the sum rule with 50% exchange force.

TABLE I.

Present work	From ref. (4)	From ref. (9)	From ref. (10)	From ref. (11)
5 (?)	—	—	—	—
7 $\pm$ 0.3	7	—	—	—
9 $\pm$ 0.3	9	9.3 ± 0.1	9.5	9.3
11 $\pm$ 0.4	11	11.1 ± 0.2	11.2	—
—	13.2	13.1 ± 0.3	—	—
14.5 ± 0.5	14.5	14.8 ± 0.3	—	—
16.3 (?)	16.3	—	—	—
—	—	17.5 ± 0.4	18.3	—

The bremsstrahlung-weighted cross-section σ_{-1}, calculated from our results, is (3.8 ± 0.3) mb; this value gives a r.m.s. charge radius, $\bar{R}_c$, of (1.8 ± 0.1) fermi. If we add the contribution from the (γ, t) reaction taken from ref. (5), we get $\sigma_{-1} = (5.1 \pm 0.8)$ mb and consequently $\bar{R}_c = (2.0 \pm 0.15)$ fermi. Is not easy to evaluate the contribution to the σ_{-1} of the (γ, pd) and (γ, t) processes using the data of ref. (11) but it must be recognized that the $\sigma(\gamma, t)$ as measured in ref. (5) increases considerably the σ_{-1} value because the peak of this reaction is located at only 21 MeV and reaches the very high value of ~ 8 mb.

For what concerns a cluster interpretation of the photon absorption cross-section in ^{6}Li (6,7,12), the problem deserves, in our opinion, further consideration. The absence of a pronounced valley at 19 MeV in the cross-section and its behaviour above 20 MeV weakens some of the evidence in favour of an α-d cluster, but the new measurements on (γ, pd) and (γ, t) processes (8), the more recent value of the ^{6}Li r.m.s. charge radius (13)—2.4 fermi—, the results from electrodisintegration (13) and from elastic electron scattering (14) indicate that the problem needs further investigation.

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