PHOTONEUTRONS FROM Li^6 *AND* Co^{59}

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We have made a study of the cross sections for photoneutron reactions in the nuclei Li^6 and Co^{59}, at the synchrotron of the A. F. Ioffe Physico-technical Institute of the Academy of Sciences. The neutrons were moderated and counted in BF_3 counters.

In the curve showing the variation of the photoneutron reaction cross section with γ-ray energy for Li^6 (Fig. 1, solid line histogram), a number of broad peaks are observed. The results obtained by us confirm the existence of a broad resonance in the energy region 7—17 MeV, a significant drop in the cross section at energies of about 17—19 MeV, and also of a rise in the cross section in the region above 19 MeV. For comparison we have shown in the same figure the results of the recently published work of Costa et al,[1] (dashed line histogram). According to our data, at energies above 19 MeV at least two peaks are observed: in the regions 20—24 and 26—30 MeV. The cross section falls to small values only at energies near 50 MeV.

The integrated cross section for the energy region studied up to $E_\gamma = 60$ MeV is 53.0 ± 0.8 MeV-mb. If we take into account the contribution of reactions not counted in this experiment, $Li^6(\gamma, t)He^3$ and $Li^6(\gamma, pd)H^3$ (30—35 MeV-mb), then the experimental total cross section for absorption of γ rays by the Li^6 nucleus does not exceed the minimum value predicted by the sum rule for dipole transitions (90 MeV-mb).

Evaluation of the cross section σ_{-1} gives the value

$$\sigma_{-1} = \int \sigma(E_\gamma) E_\gamma^{-1} dE_\gamma = 4{,}2 \text{ mb},$$

which agrees well with the sum rule predictions. The rms radius of the nuclear charge distribution in Li^6, calculated on the basis of the value of σ_{-1} obtained by us, is 1.9×10^{-13} cm, which quite sat-

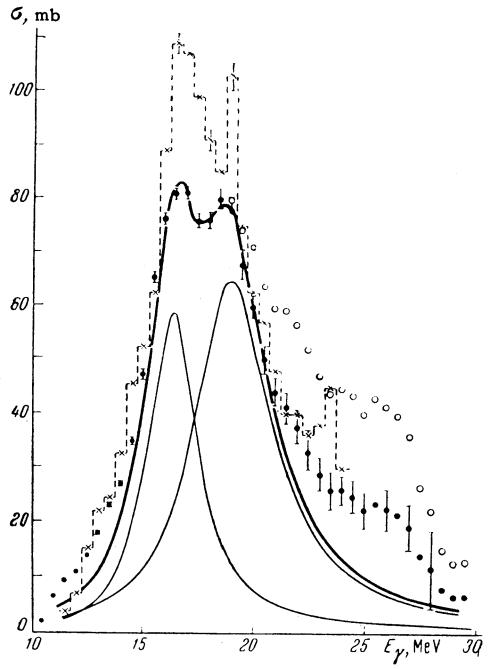

FIG. 2. Variation of photoneutron cross section with γ-ray energy for Co^{59}. Statistical errors are indicated. The light circles show the behavior of the cross section before correction is made for the multiplicity of neutrons.

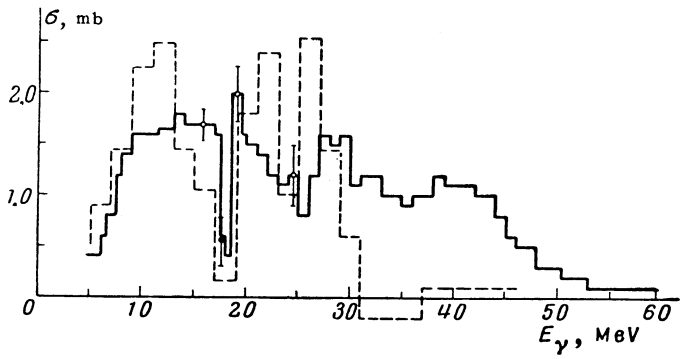

FIG. 1. Variation of photoneutron cross section with γ-ray energy for Li^6. The statistical errors are indicated.

isfactorily agrees with the results of electron scattering experiments.

The value

$$\sigma_{-2} = \int \sigma(E_\gamma) E_\gamma^{-2} dE_\gamma = 270 \text{ MeV}^{-1}\text{-}\mu\text{b}$$

is six times larger than the value predicted by theory, and approximately two times larger than the value found by Gorbunov et al.[2] for He^4. This indicates a high polarizability of the Li^6 nucleus and the inadequacy of the theoretical calculations of Levinger[3] for light nuclei.

The excitation function for photoneutron reactions in the Co^{59} nucleus is shown in Fig. 2 (dark points). For comparison we have shown by the dashed line the data of Flournoy et al.[4] A distinct splitting of the giant resonance into two peaks is observed. The parameters of the splitting, obtained from the theoretical curve (solid dark line) which consists of two superposed Lorentz curves, are in satisfactory agreement with the predictions of the hydrodynamical model of Okamoto and Danos. The integrated cross section for photoneutron reactions is

$$\int_0^{29\text{ MeV}} \sigma(E_\gamma)\, dE_\gamma = 701\,(\pm 13\%)\text{ MeV-mb}$$

The total error of the measurements is shown.

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[3] J. S. Levinger, Phys. Rev. **107**, 554 (1957).

[4] Flournoy, Tickle, and Whitehead, Phys. Rev. **120**, 1424 (1960).

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