STRUCTURE OF THE CROSS SECTION OF THE REACTION $Ca^{40}(\gamma, p)$

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It has become clear by now that the existing calculations of photodisintegration of magic nuclei, within the framework of the shell model with residual "particle-hole" interaction, do not describe all the characteristics of this process. This raises the question of further refinement of the theory. Naturally, this makes much more stringent the requirements with respect to the precision and completeness of the experimental data. For Ca^{40} this is connected first of all with the measurement of the photoproton spectra and of the structure of the cross section of the reaction $Ca^{40}(\gamma, p)$, which is dominant for this nucleus. The present investigation is devoted to the structure of the cross section of the $Ca^{40}(\gamma, p)$ reaction.

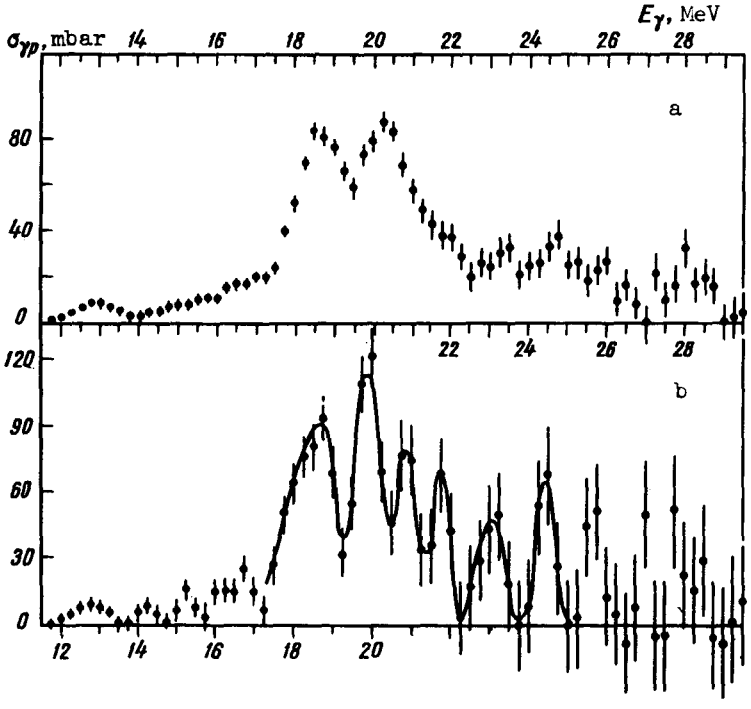

Fig. 1. Cross section of the reaction $Ca^{40}(\gamma, p)$ ($E_p \geq 2$ MeV) calculated by the Penfold-Leiss method with steps ΔE_γ = 1.0 MeV (a) and ΔE_γ = 0.5 MeV (b).

The measurements were made with the 35-MeV Moscow State University betatron. The photoprotons were registered by four surface-barrier silicon detectors with barrier depth 300 μ and with each detector having a surface area 2 cm^2. The method described in [1] was used to suppress the drift of the apparatus in time. Curves showing the yield of the $Ca^{40}(\gamma, p)$ were

obtained for two proton energy groups $E_p \geq 2$ MeV and $E_p \geq 7$ MeV. In both cases, the measurements were made in the $E_{\gamma_{max}}$ interval from 8.0 to 30.0 MeV, in steps of $\Delta E_{\gamma_{max}} = 0.250$ MeV. The statistical errors in the upper part of the yield curve were 0.17% and 0.330% in the cases $E_p \geq 2$ MeV and $E_p \geq 7$ MeV, respectively.

The cross sections of the indicated reactions were calculated by the Penfold-Leiss method in ΔE_γ steps of 1.0 and 0.5 MeV. The results of the calculations are shown in Figs. 1 and 2. In the case $E_p \geq 2$ MeV, the cross section curve has eight clearly pronounced maxima at $E_\gamma = 12.7 \pm 0.2$, 18.7 ± 0.2, 19.9 ± 0.2, 20.9 ± 0.2, 21.8 ± 0.2, 23.2 ± 0.3, 25.0 ± 0.5, and 28.0 ± 0.5. The maximum at $E_\gamma = 24.4$ MeV has a somewhat worse appearance. The integrated cross section up to 30 MeV is 510 ± 70 MeV-mb. The maxima at 18.7, 19.9, 24.0, and 27 MeV can be reliably separated also in the cross section of the high-energy proton group. The integrated cross section of the high-energy proton group up to 30 MeV is 240 ± 40 MeV-mb.

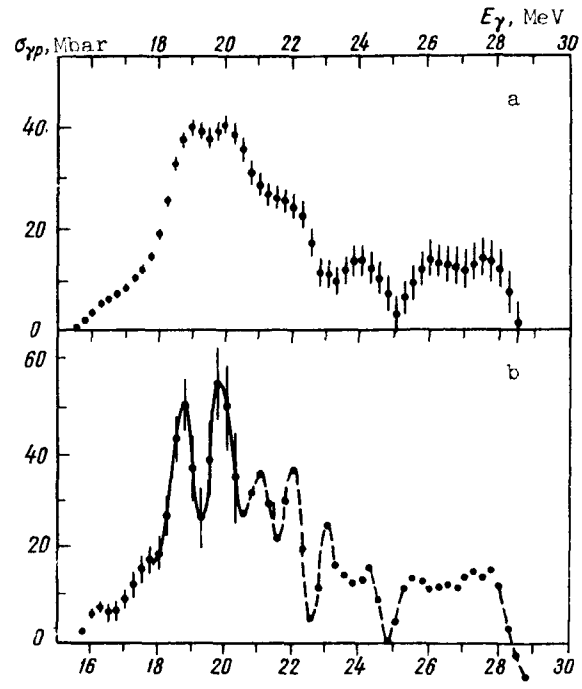

Fig. 2. Cross section of the reaction $Ca^{40}(\gamma, p)$ ($E_p \geq 7$ MeV) calculated by the Penfold-Leiss method with steps $\Delta E_\gamma = 1.0$ MeV (a) and $\Delta E_\gamma = 0.5$ MeV (b).

This is the first time that the structure of the cross section of the $Ca^{40}(\gamma, p)$ reaction has been obtained. The position of the maxima in the cross section of $Ca^{40}(\gamma, p)$, obtained in the present paper, is in good agreement with the position of the maxima of the cross section of the $Ca^{40}(\gamma, n)$ reaction [2].

[1] B. I. Goryachev, B. S. Ishkhanov, I. K. Kapitonov, Zh. M. Seliverstova, V. G. Shevchenko, and B. A. Yur'ev, YaF 4, 505 (1966), Soviet JNP 4, 359 (1967).

[2] B. I. Goryachev, B. S. Ishkhanov, V. G. Shevchenko, and B. A. Yur'ev, YaF 5, No. 5 (1967), in press.