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TOTAL CROSS SECTION OF THE REACTION He^4 (γ, pn)H^2

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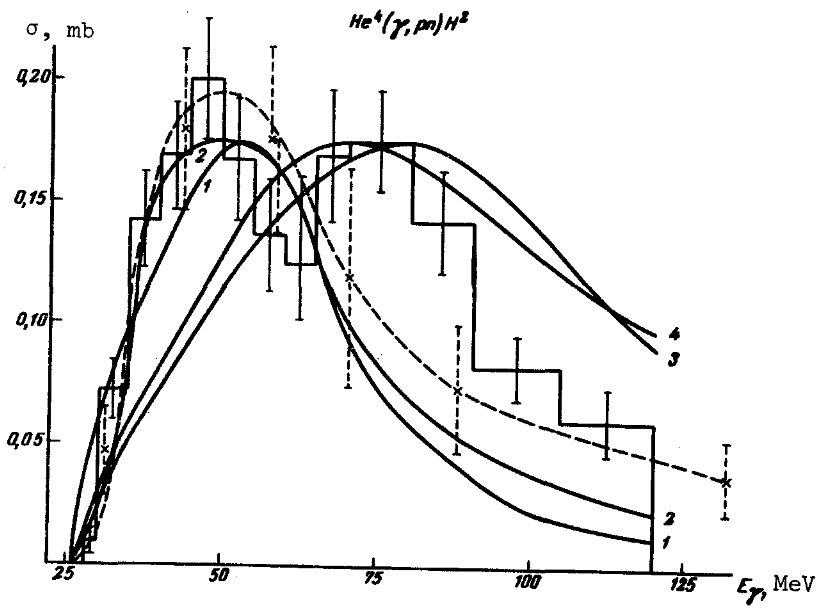
Investigation of the reaction He^4(γ, pn)H^2 yields information on the structure of the ground state of the He^4 nucleus, on the quantum absorption mechanism, and on the correlation of the nucleons in the nucleus.

However, there are few experimental investigations of this reaction [1 - 3]. It was investigated in greatest detail by Gorbunov et al. [3] but at relatively low statistics. We started a study of the reaction with the aid of a diffusion chamber operating in a magnetic field of approximate intensity 15 kOe, using a linear electron accelerator with maximum γ-quantum energy 120 MeV. In the present paper we discuss only the total cross section of the reaction, obtained on the basis of much larger statistics than in [3].

The figure shows the dependence of the total cross section on the γ-quantum energy. Our results are represented by the histogram, and Gorbunov's data by the dashed curve. The figure shows also a comparison with the theory (solid curves). Curve 1 was calculated by Dzhibuti et al. [4], who considered the reaction He^4(γ, pn)H^2 on the basis of the mechanisms of pair absorption of the γ quanta, and took explicit account of the Majorana exchange



Total cross section of the reaction He^4(γ, pn)H^2 vs. gamma-quantum energy. Histogram - our results; dahsed curve - data of Gorbunov et al. [3]; solid curves - results of theoretical calculations [4, 5].

currents. Curves 2, 3, and 4, were calculated by Kopaleishvili et al. [5] they are normalized at a cross section value of approximately 0.17 mb, i.e., the absolute values of the cross sections up to maxima for these curves are reduced respectively by three, three, and four times. In this paper we calculated the total cross sections by using different nucleon-nucleon interaction potentials and the corresponding wave functions in curve 2. A velocity-dependent potential was used to calculate while curves 3 and 4 were calculated with a potential with a repulsion core. The correlation function was taken into account for curve 3.

As seen from the figure, our data point to certain new singularities in the behavior of the total cross section as a function of the γ-quantum energy:

1. The maximum of the curve is quite broad.

2. The curve reveals two peaks. The maximum of the first is located near 50 MeV and that of the second near 75 MeV. The cross sections at the maxima are 0.2 and 0.17 mb. From a comparison of our data with the results of other authors we see that the experimental curve given by Gorbunov et al. is in good agreement with the first peak. None of the theoretical curves describes the structure revealed by our experiments in the dependence of the toal reaction cross section of the γ-quantum energy. The theoretical curves 2, 3 and 4 differ from our data on the absolute magnitudes of the cross sections at the maxima.

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SCATTERING OF X-RAYS BY HYDROGEN ATOMS

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Recently Gavrila [1] obtained an expression for the elastic scattering of light by hydrogen in the dipole approximation. Zon, Manakov, and Rappoport [2] obtained independently more general formulas in the dipole approximation for the scattering with transitions between arbitrary shells of the atom without ionization. In the present paper we obtain formulas for the scattering of photons by hydrogen atoms at the frequency ω, including frequencies on the order of the average electric momentum in the atom $\eta = m\alpha Z$ ($\hbar = c = 1$).

We consider arbitrary transitions between the shells of the atom, including ionization. For simplicity we confine ourselves to the nonrelativistic region $\omega \ll m$.

The Compton effect on the bound electron is described by the diagrams in the figure, where the shaded blocks represent the interaction with the Coulomb field that does not change the energy but changes the momentum in the line. The energy-momentum conversation law is