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Cross-Section Asymmetry in Helium-3 Disintegration by Linearly Polarized Photons in the Energy Range from 90 to 350 MeV

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The photodisintegration of few-nucleon systems is an important means of studying fundamental problems of nuclear and elementary-particle physics. During recent years a great deal of experimental and theoretical results has been obtained [1-3]. These results have demonstrated the necessity of considering, in addition to single-nucleon currents, meson exchange currents (MEC) and isobar configurations (IC) in nuclei for the description of the electromagnetic field interaction with very light nuclei. Simultaneously, these results have shown the problems concerning nuclear wave functions at small distances, D-state contributions, wave-function quark components, the role of three-nucleon forces, off-mass-shell effects, final-state interaction effects, relativistic corrections, excitation of multiquark states (dibaryons, tribaryons), etc.

To solve these problems unambiguously, it is insufficient to have the data on differential and total cross sections only. An important information on the mechanism of the photodisintegration of light nuclei and their structure can be extracted from polarization experiments using polarized photon beams, polarized targets, and from recoil-nucleon polarization measurements.

In the $\gamma^3\text{He} - \text{pd}$ reaction the cross-section asymmetry

$$\Sigma = (d\sigma'' - d\sigma^\perp) / (d\sigma'' + d\sigma^\perp) \quad (1)$$

has been studied with linearly-polarized photon beams at Frascati [4] in the energy range between 180 and 280 MeV for the c.m. proton emission angle 90° , and at Kharkov [5] at energies from 100 to 250 MeV for an emission angle of 110° , as well in the angular range $45^\circ - 140^\circ$ for 200 MeV photons.

Here we report the measurements of the cross-section asymmetry Σ in the $\gamma^3\text{He} - \text{pd}$ reaction using the linearly-polarized photon beam of the Kharkov 2 GeV electron linac in the energy range from 90 to 350 MeV at c.m. angles 60° , 90° , 110° and 135° . Some preliminary results obtained earlier in [5] are also revised.

The experimental equipment except a low-temperature ^3He target was identical to that used previously to study the processes of pion photoproduction on nucleons and deuteron disintegration by linearly polarized photons [6,7]. It included electron and photon beam formation and control systems, goniometers with diamond single crystals and detecting apparatus.

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