Differential Cross Section of Elastic and Inelastic $P^{15}N$ Scattering in the Optical Limit of Diffraction Theory

E. Ibraeva[1], **N. Burtebaev**[1], **M. Zhusupov**[2]

[1]Institute of Nuclear Physics, Almaty, Kazakhstan

[2]Al-Farabi Kazakh National University, Almaty, Kazakhstan

At intermediate energies (from hundreds of MeV to tens of GeV), the process of pA-scattering the most adequate is described by Glauber's diffraction theory. The input parameters of the theory are the wave function (WF) of the target nucleus and the elementary nucleon-nucleon amplitude. Glauber's theory is attractive because it allows you to split the structural (depending on WF of the target nucleus) and dynamic (depending on the operator of multiple scattering) components of the scattering amplitude. Calculating the DCS in the optical limit (OL) (when only single collisions are taken into account in the operator of multiple scattering), we can allow for the contributions to the cross section of scattering by nucleons at different shells of nucleus. As shown in previous studies [1, 2], this approximation adequately describes the DCS only in the front angles.

We calculated the DCS of ^{15}N-scattering in the OL approximation at energies 0.2, 0.6 and 1.0 GeV. We used the WF ^{15}N in the shell model with $(1s)^4(1)^{11}$ configuration in the ground state ($J^{\pi} = 1/2^-$) and with $(1s)^4(1)^{10}(2s)^1$ and $(1s)^4(1)^{10}(1d)^1$ configurations in the excited states (($J^{\pi} = 5/2^+$, $1/2^+$, $3/2^+$) [3].

Having calculated the dependence of DCS from collisions on nucleons from different shells for elastic ^{15}N-scattering we showed that the contribution from protons scattering on 1s-shell nucleons in the region of front angles is smaller by order than the scattering on 1-shell nucleons. Physically this is explained by the fact that the larger impulse (more than for 1-shell nucleons) is required for scattering on internal 1s-shell nucleons, and the larger the transmitted momentum the greater the scattering angle. Accounting the interference from scattering on nucleons from different shells leads to smoothing minima in the DCS.

References

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