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PHOTOPRODUCTION MEASUREMENTS OF π^+ NEAR THRESHOLD ON ^{3}He AND ^{2}H

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The two-and three-nucleon systems offer the ground for a significant study of nuclear structures generated by the nucleon-nucleon interaction. We present here a contribution to the knowledge of these systems, based on the fact that charged pion photoproduction at threshold is a weak probe measuring the spin-flip form factor of the nuclear target. We have thus measured [1,2] the cross-sections for reactions :

$$\gamma + {}^3\mathrm{He} \rightarrow {}^3\mathrm{H} + \pi^+, \qquad (1)$$

$$\gamma + {}^2\mathrm{H} \rightarrow n + n + \pi^+, \qquad (2)$$

relatively to the elementary one :

$$\gamma + p \rightarrow n + \pi^+, \qquad (3)$$

at energies ranging from 1 to 5 MeV above threshold.

From these data, we extract the ratio of the slopes of the cross sections at threshold for reactions (1) and (3) :

$$\frac{a(^3\mathrm{He})}{a(q)} = \lim(q = 0)\ \frac{\sigma(^3\mathrm{He})\ k/qs}{\sigma(p)\ k.q} = 0.62 \pm 0.02.$$

As for reaction (2), because of the three-body final state, the cross section has a more complicated shape, but it can nevertheless be characterized by one number playing a role equivalent to the slope a(A), and which was measured with a ± 2.5 % accuracy.

In order to extract from the data a form factor, it was necessary to estimate correctly the modification to a plane wave calculation due to the pion rescattering. Using a multiple scattering expansion[3], we found a small effect (-1 %) for reaction (1) and a larger one (+ 10 %) for reaction (2). By applying the correction to the data on reaction (1), we obtain

$$|F(Q^2)|^2 = 0.52 \pm 0.02. \qquad (4)$$

This is 20 % lower than the form factor squared extracted from the magnetic electron scattering on ^{3}He and ^{3}H. Calculations based on realistic wave functions yield form factors in general agreement

with the experimental one (4). These calculations corrected by the effect of the nucleon fermi-motion should result in a slightly lower threshold cross section improving the overall agreement with the experiment.

The cross section for reaction (2) has been computed[5] including the effect of the fermi motion of the nucleon, but with less scruting concerning the 2N wave functions. Once corrected for the pion multiple scattering, they fall 10 % above the measured cross section. The cross section for the threshold electrodisintegration :

$$e + d \rightarrow e' + n + p$$

(which measures the spin flip transition form factor). When computed in impulse approximation is about 20 % lower than the measured one.

Thus we observe in the case of the two- and three-nucleon targets that their spin-flip form factor as measured by threshold photoproduction is 11-15 % lower than the one measured by magnetic electron scattering, and agrees better with impulse approximation calculations. It indicates the following trend :

- pion photoproduction measures essentially the one-body spin flip form factor ;
- magnetic electron scattering is more sensitive to many-body corrections.

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