Momentum distribution of nucleons from the reaction $D(e,e'p)n$ at 1200 MeV in deuterium

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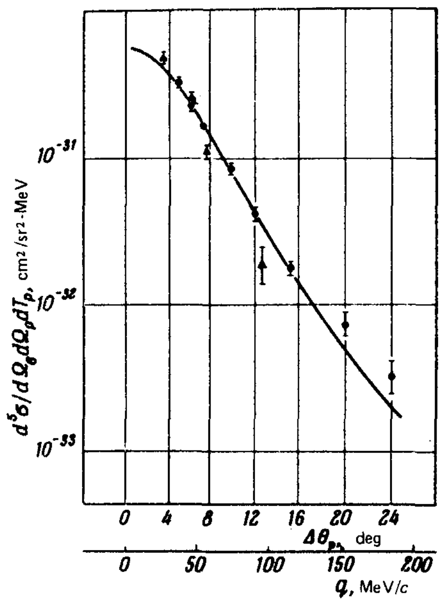
We measured the cross section of the reaction $D(e, e'p)n$ at 1200 MeV as a function of the proton emission angle at a constant proton momentum. Within the framework of the plane-wave impulse approximation, we determined the momentum distribution in the deuterium nucleus, and compared it with the Hulthen distribution.

We measured the angular distribution of the protons in the reaction $D(e,e'p)n$ at a momentum-transfer squared $-t=0.16$ $(\text{GeV}/c)^2$. The obtained experimental data agree with a calculation in which the Hulthen wave function is used for the S state of deuterium at proton momenta $q<150$ MeV/c inside the nucleus.

Measurement of the cross section of the reaction $D(e,e'p)n$ as a function of the angle of the emitted proton yields the momentum distribution of the proton in the deuterium nucleus.[1] It follows from the first experiment[2] at 350 MeV that the cross section of the reaction, at proton momenta inside the nucleus $q<100$ MeV/c, is adequately described in the plane-wave impulse approximation if a Hulthen function, with only the s-wave taken into account,[2] is used as the wave function of the deuteron. We have investigated the momentum distribution of the protons in the momentum range $q<185$ MeV/c, using the beam from the 1200-MeV linear electron accelerator of our Institute. The angular distribution of the protons in the reaction $D(e,e'p)n$ was measured at an electron registration angle 20°, and the momentum of the secondary protons was 407 MeV/c. The liquid deuterium target, with 50 mm diameter and with 2.47×10^{23} nuclei/cm^2, was placed on the rotation axis of two magnetic spectrometers[3] with solid angles 1.5 and 8.2 msr for electrons and protons, respectively.

The nine-channel registration system was similar to that described in[4]. The resolution in terms of the separation energy was 9 MeV (total width at half height). Calibration of the apparatus against hydrogen has shown that we can measure the absolute cross section with accuracy not worse than 10%. The measured angular distribution is shown in the figure (circles) together with the normalized data by Bounin[2] (triangle). The solid line shows the result of a calculation normalized by the χ^2 method to the experimental data. The difference between the absolute values of the calculated and experimental cross sections is 35%, and can be explained if



Angular distribution of the protons in the reaction $D(e,e'p)n$; ●—our data, ▲—data of Bounin.[6] The angles $\Delta\theta$ are relative to the kinematics of free scattering.

account is taken of the 18% radiative correction[5] and the possible systematic errors.

We used in the calculations the Hulthen wave-function parameters $\alpha=46$ MeV/c and $\beta=285$ MeV/c.

The agreement between our data and calculation, just as in the case of the $(p,2p)$ experiment at a proton energy 600 MeV,[6] confirms the applicability of the simple momentum approximation for $q<150$ MeV/c. At momenta $q>150$ MeV/c, the experimental points have a tendency to lie above the calculated curve, in analogy with the results observed in $(p,2p)$ scattering.

It was shown in[7] that in the case of $(p,2p)$ scattering allowance for double scattering and for the spin structure of the NN interaction amplitude makes it possible, when the Hulthen function is used, to describe adequately the experimental data on the $D(p,2p)n$ reaction up to momenta $q=300$ MeV/c. Allowance for the interaction in the final state in the calculation of the cross section of the reaction $D(e,e'p)n$ seems likewise to improve the agreement with experiment at $q<150$ MeV/c.

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