Scattering of 29.2-Mev He^3 Nuclei by Deuterons

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Differential cross sections for He^3 particles elastically scattered from deuterium are presented for angles from 10° to 40° (lab). Cross sections obtained previously for the same process are also shown, and there is good general agreement between the two sets of results.

A FOCUSED beam of He^3 nuclei of an energy of about 29 Mev and an intensity of 5-10 μa is now available externally from the Nuffield 60-inch cyclotron of the University of Birmingham.[1] This beam has been used to study the interactions of He^3 with a number of nuclei in the scattering camera described by Gibson, Prowse, and Rotblat.[2] In this note we present results obtained for the elastic scattering of He^3 by deuterons; these confirm earlier observations made by one of us[3] using an unfocused external beam from the same cyclotron and a solid deuterated paraffin wax target in a small nuclear plate camera. The process has also been studied by Allred, Armstrong, Hudson, Potter, Robinson, Rosen, and Stovall,[4] using He^3 as a target for a beam of 10.2-Mev deuterons.

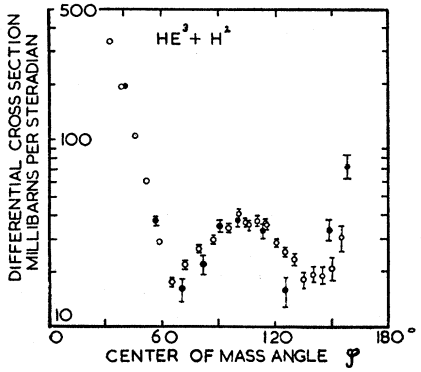

FIG. 1. Differential cross section for scattering of 29.2-Mev He^3 nuclei by deuterons. Open circles, present results; filled circles, Sweetman, 1955.

The scattering chamber was filled with deuterium gas at 27-cm pressure and the beam charge collected in the Faraday cup was 0.95 microcoulomb. Particles leaving the target volume were recorded in Ilford C2 nuclear research emulsions. The beam energy was estimated, from the range of the elastically scattered He^3 tracks observed at many angles, to be 29.2±0.3 Mev.

Clearly resolved groups of elastically scattered He^3 particles and of recoil deuterons were observed at all angles up to 40° (lab) and differential cross sections were calculated from the numbers per unit area at intervals of 2.5°. The results are shown in Fig. 1, which also includes values from the work of Sweetman[3] in which absolute cross sections were obtained by comparison with the intensity of elastic scattering from a gold target exposed simultaneously. The two sets of results are seen to be in good general agreement.

The angular distribution of the (He^3, H^2) scattering is remarkably similar to that observed for the same process at lower energy and to that obtained for the (He^4, H^2) scattering at the same relative velocity.[5]

The inelastic process $He^3(d,p)He^4$ was observed at a number of angles. The cross sections were of the order of 5 mb sterad^{-1} (center-of-mass system) but could not be measured accurately.

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[1] Fremlin, Hardy, and Shaylor (to be published).

[2] Gibson, Prowse, and Rotblat, Proc. Roy. Soc. (London) A243, 237 (1957).

[3] D. R. Sweetman, Ph.D. thesis, University of Birmingham, October, 1955 (unpublished).

[4] Allred, Armstrong, Hudson, Potter, Robinson, Rosen, and Stovall, Phys. Rev. 88, 425 (1952).

[5] Freemantle, Grotdal, Gibson, McKeague, Prowse, and Rotblat, Phil. Mag. 45, 1090 (1954).