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DIFFERENTIAL $D(d,n)He^3$ CROSS SECTION FOR 10 MEV DEUTERONS

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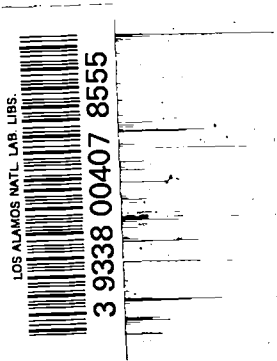
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DIFFERENTIAL D(d,n)He³ CROSS SECTION FOR 10 MEV DEUTERONS

A B S T R A C T

In the center of mass system the differential cross section for production of He³ particles from the reaction D(d,n)He³ by 10.2 Mev deuterons has been found to be approximately independent of angle from 0.70° - 130°. The total cross section as determined by extrapolation of the data is $0.04 \times 10^{-24} \text{ cm}^2$.



DIFFERENTIAL $D(d,n)He^3$ CROSS SECTION FOR 10 MEV DEUTERONS

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The angular dependence of the yield of He^3 from the $D(d,n)He^3$ reaction has been determined for 10.2 Mev deuterons from the Los Alamos cyclotron. The experiment consisted of bombarding the thin gas target with high energy deuterons and observing the number of He^3 particles per micro coulomb which were emitted into a known solid angle in a given direction.

Deuterium gas, at about atmospheric pressure, was contained in the gas target by three mica windows: beam entrance and exit windows, and an exit window on the side tube for the He^3 particles. The beam, focused at the center of a two foot diameter chamber 15 feet from the cyclotron, (1) was of the order of $5\mu a$ over one square inch. This was diaphragmed by a hole, approximately $1/4$ inch in diameter, in a gold sheet in front of the gas target.

Three gas targets were used, with side tubes making different angles with the direction of the beam so that, in the laboratory system, all angles to the beam between 20° and 42° could be covered. These targets were so designed that the proportional counter could not see any material (except the deuterium gas) which was being bombarded by the beam. Through a Wilson seal the proportional counter could be rotated to any angle in the horizontal plane. The deuterium current from the exit window was caught in a 9 inch long Faraday cage, and monitored with an electronic

current integrator.

The Faraday cage could be lifted out of the way so that the beam from the target, being collimated by two slits, could pass between the poles of an energy analyzing magnet (2). The value of the deuteron energy, determined by magnetic deflection, was 10.2 Mev. It remained constant to about two percent during the experiment. The spread of energy in the beam through the target was less than five percent.

The He³ particles were slowed down by calculated thicknesses of mica and aluminum foils so that their ranges ended in the proportional counter. This made it possible to distinguish between the He³ particles and the protons, tritons and recoil deuterons which are also produced by the deuteron beam.

The distribution of He³ pulses from the proportional counter, after being amplified by a fast pre-amplifier and amplifier system, was analyzed by a Los Alamos 10 channel amplitude discriminator (3). The resulting plots of pulses per amplitude interval against amplitude gave, in general, a peak well resolved from background. An estimate of background correction was obtained by substituting hydrogen for deuterium in the gas target. The number of counts contained in the He³ peak, corrected for background (<10%), gave the He³ counts obtained for a given run from which, using the integrated current, one calculated differential cross sections.

Figure 1 shows the results as cross section per unit solid angle in the center of mass system, plotted as a function of the angle in the center of mass system. These data indicate that the differential cross section is essentially independent of angle in this region. The apparent decrease

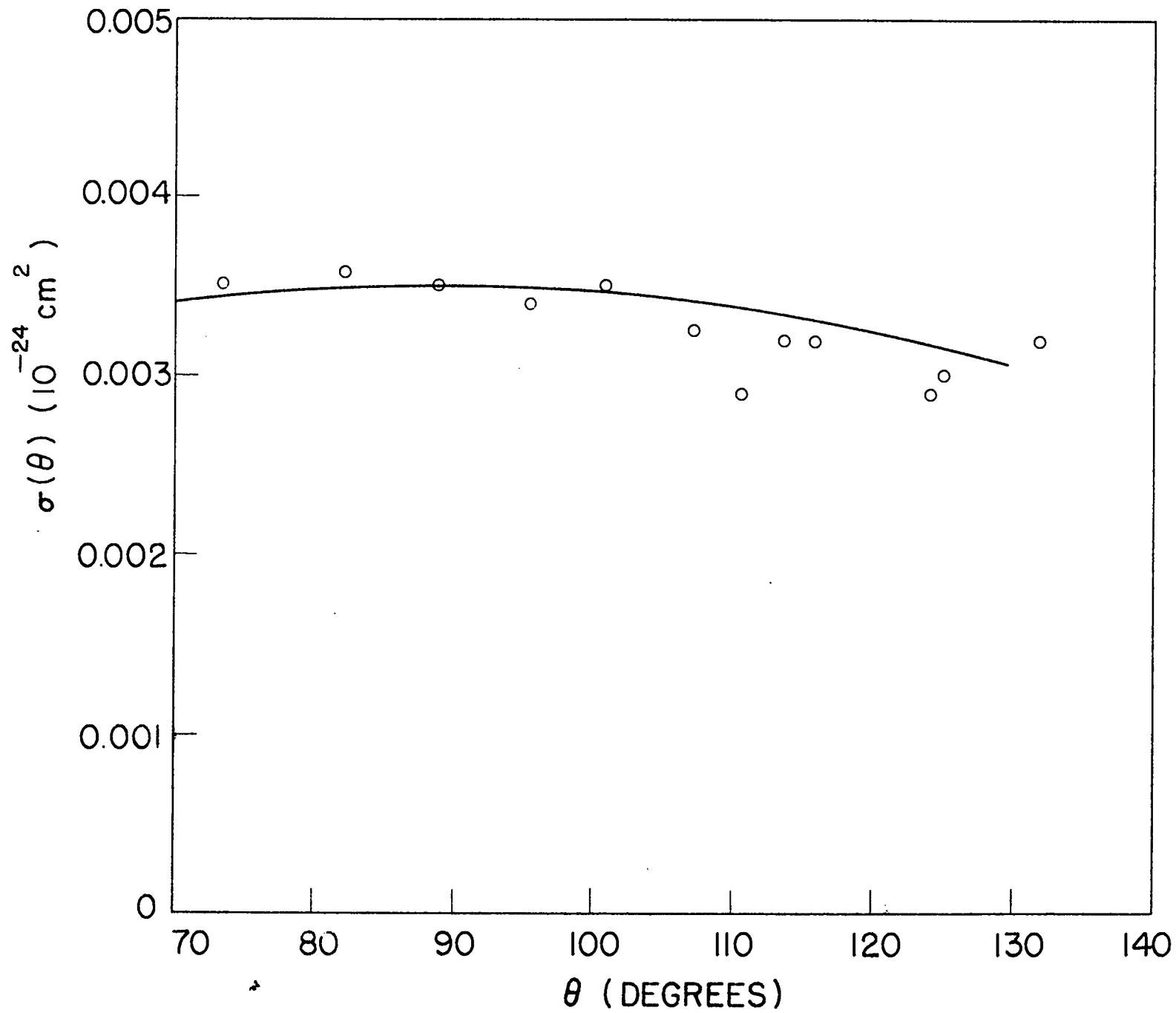
in differential cross section with increasing angle is being investigated further. This differs from the results for bombardment energies below 2 Mev, where the differential cross section increases in this angular region as $B(1+A \cos^2 \theta)$, in which θ is the angle in the center of mass system between the incident beam and the emitted He^3 particles, and A is an increasing function of energy up to 2 Mev (4).

The total cross section at 10.2 Mev, as determined by extrapolation of the curve of Figure 1, is $.04 \times 10^{-24} \text{ cm}^2$. This is lower than the total cross section at low energies, in which region the cross section is an increasing function of energy.

References:

- (1) L. S. Lavatelli, L. A. D. C. - 128.
- (2) E. C. Creutz and R. R. Wilson, Rev. Sci. Inst. 17, 385 (1946).
- (3) Ten Channel Discriminator to be reported by M. Sands and E. Dexter.
- (4) W. E. Bennett, C. E. Mandeville and H. T. Richards, Phys. Rev. 69, 418 (1946).

Fig. 1 Cross section per unit solid angle in the center of mass system for production of He^3 by the $\text{D}(\text{d},\text{n})\text{He}^3$ reaction as a function of angle between the beam direction and the direction of the emitted He^3 particles.



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