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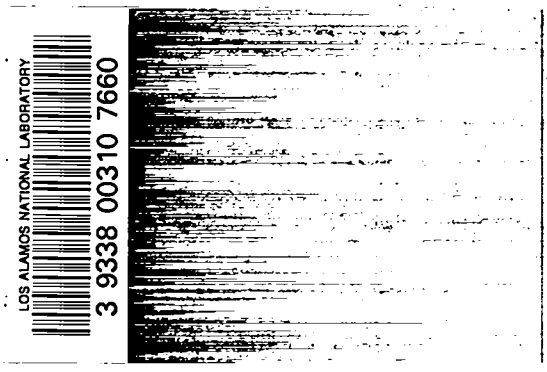

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Report written:
May 1952

Report distributed: JUL 2 9 1952

LA-1412

INELASTIC COLLISION CROSS SECTION OF NITROGEN FOR 14-Mev NEUTRONS

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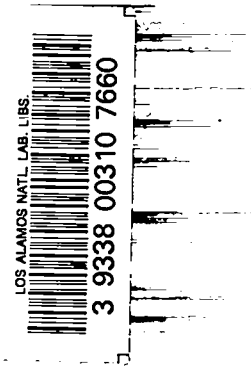

PHYSICS

INELASTIC COLLISION CROSS SECTION OF NITROGEN FOR 14-MEV NEUTRONS

The cross section for the inelastic scattering of 14-Mev neutrons by nitrogen has been previously reported in LA-1142. The experimental method employed was that of sphere scattering with threshold detectors as described in LA-740. For the nitrogen measurement, the $Cu^{63}(n,2n)$ threshold reaction was used. The present report gives the values obtained for σ_{in} of nitrogen using copper, aluminum, and U-238 threshold detectors, with thresholds at approximately 11.5, 2.6, and 1 Mev, respectively. A major improvement in the experimental method was the use of a spherical dewar to contain the liquid nitrogen instead of the spherical flask employed in the previous measurement.

The volume of the inner dewar flask was 12.8 liters (29.0 cm diameter). The center of the dewar was located 63 cm from the source. At the beginning of the run, a sample of the liquid nitrogen was analyzed (mass spectrometer) with the following results: 98.88% N_2, 0.98% O_2, 0.18% A, and a negligible amount of Ne. A similar analysis was made 24 hours later, and no perceptible change in the composition of the liquid nitrogen was observed. A double-walled test tube (intervening region evacuated) of 2.3 cm outer diameter was inserted into the liquid to provide for the placement of the detectors. The Cu and Al foils were placed at the center of the dewar and the transmissions measured. The details of the experimental method employed can be found in LA-740.

The U-238 detector was a small spiral fission chamber[1] (5/16 in. long by 3/8 in. diameter) constructed by J. C. Hoogterp. The ratio of U-238 to U-235 in the foil was 111,000. The fission chamber pulses were amplified by a Model 101 amplifier and fed into two scalers with bias settings adjusted so that on one scaler the background count due to alpha particles was 1/2% and on the other was 6% of the count due to neutron-induced fissions. Background counting rates were checked at frequent intervals during the run. With the fission chamber in place, it was observed that the end of the chamber got cold enough to cause the counter gas (argon) to liquefy. This difficulty was eliminated by inserting a small heater element into the test tube and pumping on the lower section of the test tube. Blowing of air into the test tube gave rise to microphonics because of the vibration of the counter assembly. Since the tubular neck of the counter was not long enough to permit placing of the U-238 detector at the center of the sphere, the position of the detector was 4 cm above the center of the sphere. Placement of the detector in an off-center position results in an error, difficult to estimate, in the measured transmission. This error is due to an incomplete compensation for the elastic scattering which the neutrons undergo in traversing the scatterer. It might be mentioned that the more forward the elastic scattering, the smaller will be the error involved.

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1. W. C. Bright, MDDC-91 or LA-420.

The data obtained for the various threshold detectors and the corresponding inelastic collision cross sections are tabulated below.

Detector	Threshold	Transmission	σ_{in} (barn)
Cu	11.5 Mev	0.699 ± 0.014	0.79 ± 0.05
Al	2.6 Mev	0.814 ± 0.016	0.46 ± 0.05
U-238	1 Mev	0.815 ± 0.010	0.43 ± 0.04

The value quoted for the U-238 detector measurement is the average of the data obtained at the biases mentioned previously, and the error indicated does not include any systematic error due to incomplete compensation of elastic scattering effects.