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LOS ALAMOS SCIENTIFIC LABORATORY

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INELASTIC COLLISION CROSS SECTIONS

of Be, B, C, N, Al, Fe, Cu, Cd, Au, Pb, Bi, and U

FOR 14 MEV NEUTRONS

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INELASTIC COLLISION CROSS SECTIONS FOR 14 MEV NEUTRONS

This report is an extension of LA-740 in that it contains cross sections for nitrogen, copper, and uranium in addition to the previously reported cross sections. The experimental method was that of sphere scattering with threshold detectors as described in LA-740. The threshold detectors used were copper, aluminum, and phosphorus with thresholds at approximately 11.5 Mev, 2.6 Mev, and 1.4 Mev respectively.

The nitrogen data were obtained by placing liquid nitrogen in a spherical flask of 11.5 inches diameter. The copper detector foils were dropped into a test tube extending down through the neck of the flask to the center of the sphere.

Some of the copper data were obtained by placing two copper hemispherical shells about the tritium target of the Los Alamos Cockcroft-Walton accelerator. The source strength was held as nearly constant as possible and was monitored by means of a proportional counter, counting the alpha-particles from the $T(d,n)\alpha$ reaction. This method of using a spherical shell around the source, rather than around the detector, was used for the copper detectors only and is described in LA-740. The copper cross sections using aluminum and phosphorus detectors were obtained by the method of placing

the spherical shell around the detector and monitoring the neutron flux with a similar detector on the other side of the source.

In obtaining the uranium data, threshold detectors were placed inside a spherical shell of outside diameter 4.06 inches and inside diameter 0.83 inches, containing 10.81 kilograms of normal uranium metal. The final results for uranium were obtained from eighteen irradiations each using copper and aluminum foils and six irradiations using phosphorus foils. The limits of error placed upon the cross section values were obtained by taking into account the accuracy with which the densities were known as well as the probable errors involved in making the transmission measurements.

The results obtained with copper foils should represent very closely σ_c, the cross section for formation of the compound nucleus. The experimental results are tabulated and also plotted against atomic weight. The curve represents the expression

$$\sigma_c = \pi R^2$$

where $$R = (2.5 \neq 1.1\, A^{1/3}) \times 10^{-13} \text{ cm.}$$

in which A is the atomic weight.

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The difference between measured cross sections, obtained with detectors having different activation thresholds, is indicative of the relative number of neutrons ejected from the compound nucleus with energies lying between the two thresholds.

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INELASTIC COLLISION CROSS SECTIONS, σ, OBTAINED WITH VARIOUS THRESHOLD DETECTORS

Element	Atomic Weight	Density gm/cc	Atoms per 10^{-22} cc	σ Cu detector barns	σ Al detector barns	σ P detector barns
Be	9.02	1.70 ± .01	11.4 ± .1	0.82 ± .03	0.16 ± .08	
B*	10.20	1.08 ± .06	6.4 ± .5	0.69 ± .10	0.24 ± .04	
C	12.01	1.45 ± .01	7.26 ± .02	0.85 ± .02		
N	14.01	0.79 ± .02	3.40 ± .08	0.78 ± .14		
Al	26.97	2.61 ± .02	5.83 ± .05	1.06 ± .05	0.62 ± .07	
Fe	55.85	7.88 ± .04	8.48 ± .05	1.45 ± .02	1.21 ± .03	0.78 ± .03
Cu	63.57	8.92 ± .02	8.45 ± .02	1.51 ± .06	1.32 ± .05	0.87 ± .06
Cd	112.41	8.61 ± .05	4.61 ± .03	1.89 ± .06	1.66 ± .07	1.14 ± .04
Au	197.2	19.1 ± .2	5.83 ± .06	2.51 ± .04	2.06 ± .09	1.47 ± .10
Pb	207.2	11.3 ± .1	3.28 ± .03	2.56 ± .05	2.29 ± .04	0.91 ± .06
Bi	209.0	9.74 ± .08	2.81 ± .03	2.56 ± .05	2.28 ± .08	1.03 ± .11
U	238.1	19.00 ± .07	4.81 ± .02	2.73 ± .04	2.16 ± .03	0.29 ± .08

B* 82 per cent B^{10}, 18 per cent B^{11}

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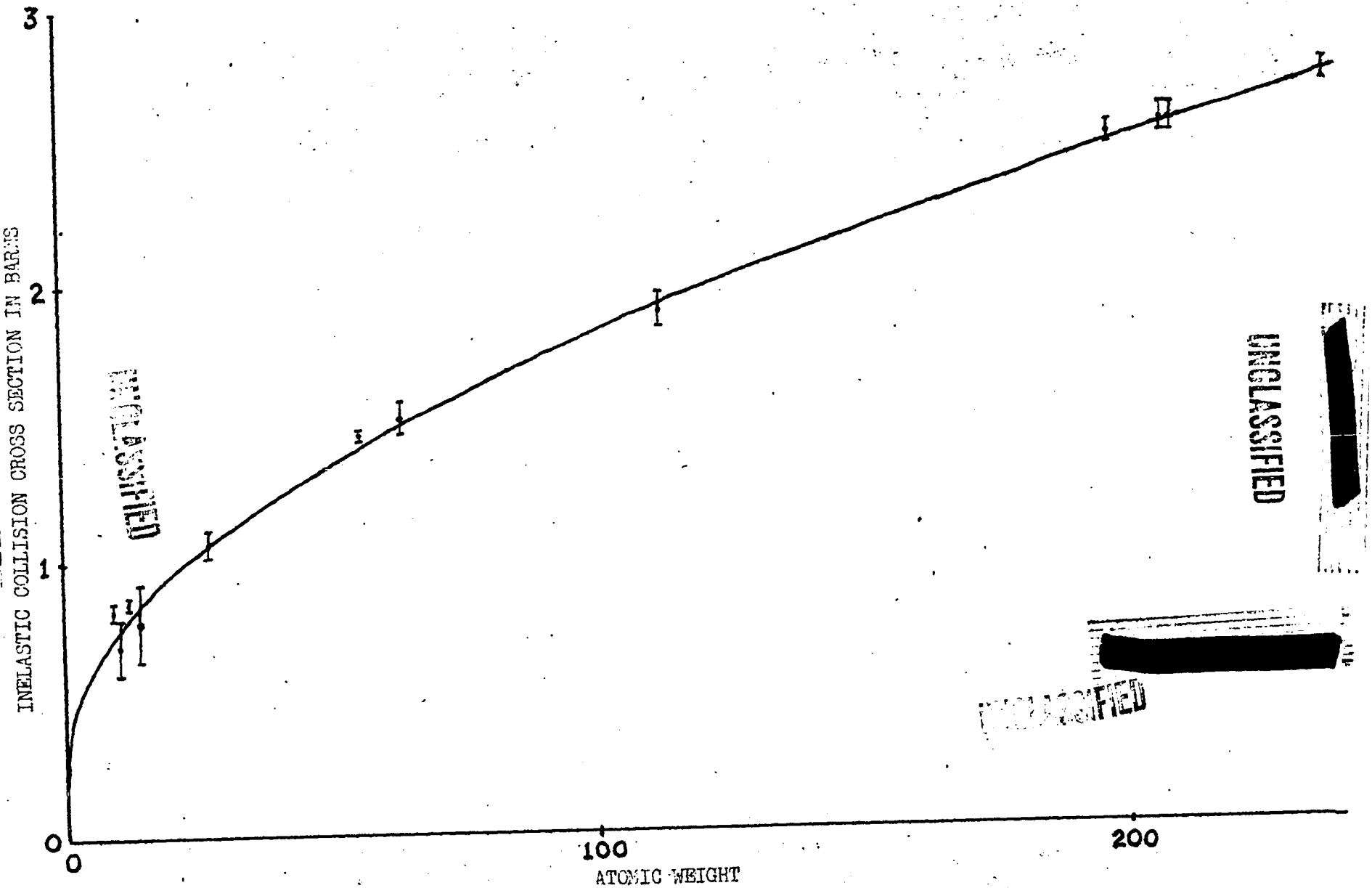

INELASTIC COLLISION CROSS SECTIONS FOR 14 MEV NEUTRONS OBTAINED WITH COPPER DETECTORS

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