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FISSION CROSS SECTION OF 25 FROM 30 KEV TO 3 MEV

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ABSTRACT

The fission cross section for isotope 23 has been measured for neutrons of energies from 30 Kev to 3 Mev by counting simultaneously the fissions from known 23 and 25 foils placed back to back in a monoenergetic neutron beam. The absolute values of the cross sections given depend on the values of $\sigma(25)$, and on the assumed half life of 1.46×10^5 years for 23.

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FISSION CROSS SECTION OF 23 FROM 30 KEV TO 3 MEV

The cross section for fission of isotope 23 has been determined for neutrons of energies from 30 Kev to 3 Mev. The technique used was that of other similar measurements which have been made here; namely, the fissions from foils of 23 and 25 placed back to back in a parallel-plate comparison chamber were counted simultaneously[1).]

The short electrostatic generator in W was used for neutron energies from 30 Kev to 500 Kev, and the long electrostatic generator was used for neutron energies between 500 Kev and 2 Mev. In both cases the Li(p,n) reaction with a thin Li target was used as the source of neutrons. The 2.5-Mev and 3.0-Mev points were taken with the D-D source in building Z, using a thick heavy-ice target and an accelerating voltage of 200 Kev.

The construction of the ionization chamber used in these measurements was somewhat different from that of the chambers used in previous measurements. While working with heavy 49 foils, it was shown that for pressures at which the alpha path length is long compared to the dimensions of the collecting volume, the ratio of the minimum fission pulse to the maximum alpha pulse becomes larger as the distance between the plate increases if the following requirements are fulfilled: (1) the product of the gas pressure and the perpendicular distance between the plates is kept constant; (2) the distance in the direction parallel to the foil from the outside edge of the foil to the outside edge of the collecting plate is equal to the plate

1) LA-150

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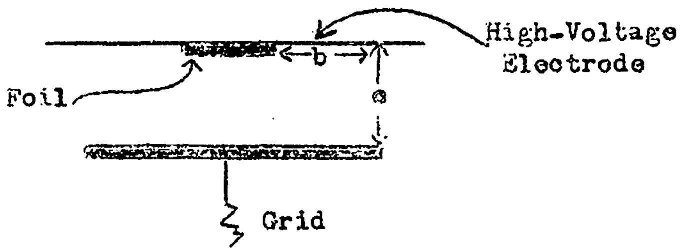
spacing (b = c).



Therefore the chamber used in these measurements was made quite deep; the distance between the plates, c, on either side of the high-voltage electrode was 1.5 cm.

It had also been found that the plateaus of the bias curves obtained with the heavy 49 foils shifted with time when tank argon was used as the collecting gas. When the argon was purified continuously by convection-current circulation over hot calcium, the bias curves remained unchanged indefinitely, tests having been made for 3 days at a time. In addition, the length of the plateau was roughly doubled. The collecting voltage necessary was also reduced; in these measurements 45 volts was sufficient.

The construction of the chamber made possible the use of a thinner piece of metal than usual to support the foils. In this case the foils were separated by .015 inches of aluminum and were centered with respect to each other by means of centered concentric circles scratched on both sides of the plate.

The 23 foil was electroplated by Cpl. Miller of Dodson's group. It was 1 3/16 inches in diameter, and contained 836 gammas of 23 and 173 gammas of 28, as determined by weighing and alpha counting, using a half life of 1.46×10^5 years[2]. The 25 foil, also 1 3/16 inches in diameter, was one which had been used in previous measurements and whose mass is accurately

2) Value from conversation with H. L. Anderson

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known. It contains 764 gammas of 25 and 241 gammas of 28, as determined by Chamberlain.

The fission cross section curve of 23 is given in Fig. 1. The $\sigma \cdot v$ curve for 23 is compared to that of 25 in Fig. 2, the 25 data having been taken from LA-150 and LA-140. The cross sections for fission of 25 and 28 used in correcting the observed counting rates and in obtaining the 23 cross section were taken from the curves given in LA-140 and LA-150. The errors indicated are in each case 1.5 times the statistical error of the point in question. The targets used on the short tank were ~5.5 Kev thick. The long tank points were obtained with a target ~25 Kev thick, with the exception of the 2-Mev point. In this case a 70-Kev target was used. The thickness of the targets was taken into account in the calculations, and in each case the cross section is given for the average neutron energy. In the geometry used, the maximum variation of neutron energy caused by the finite solid angle subtended by the foils was small compared to the variation introduced by the target thickness; hence it was not necessary to correct for this effect.

The 30-Kev point was obtained by setting the proton energy so near the threshold of the reaction that neutrons were produced only about half the time, as the energy of the proton beam fluctuated above and then below the threshold. Since the foils were not completely covered by the neutron beam with the above "tickling" technique, this point was taken at two distances from the target to check on the uniformity of the foils. No significant evidence for nonuniformity was found. The value of the ratio of the observed counting rates at this energy with this technique is changed markedly by

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relatively small changes in proton energy above threshold; hence this point may be in error by more than the statistics involved. However, it is felt that it is good at least to 10 per cent. Of course, any future change in the accepted value of the 25 fission cross section for these energies will necessarily change the 23 cross section given here. It is also evident that a change in the present value of the half life of 23 would result in a change in the cross section of 23.

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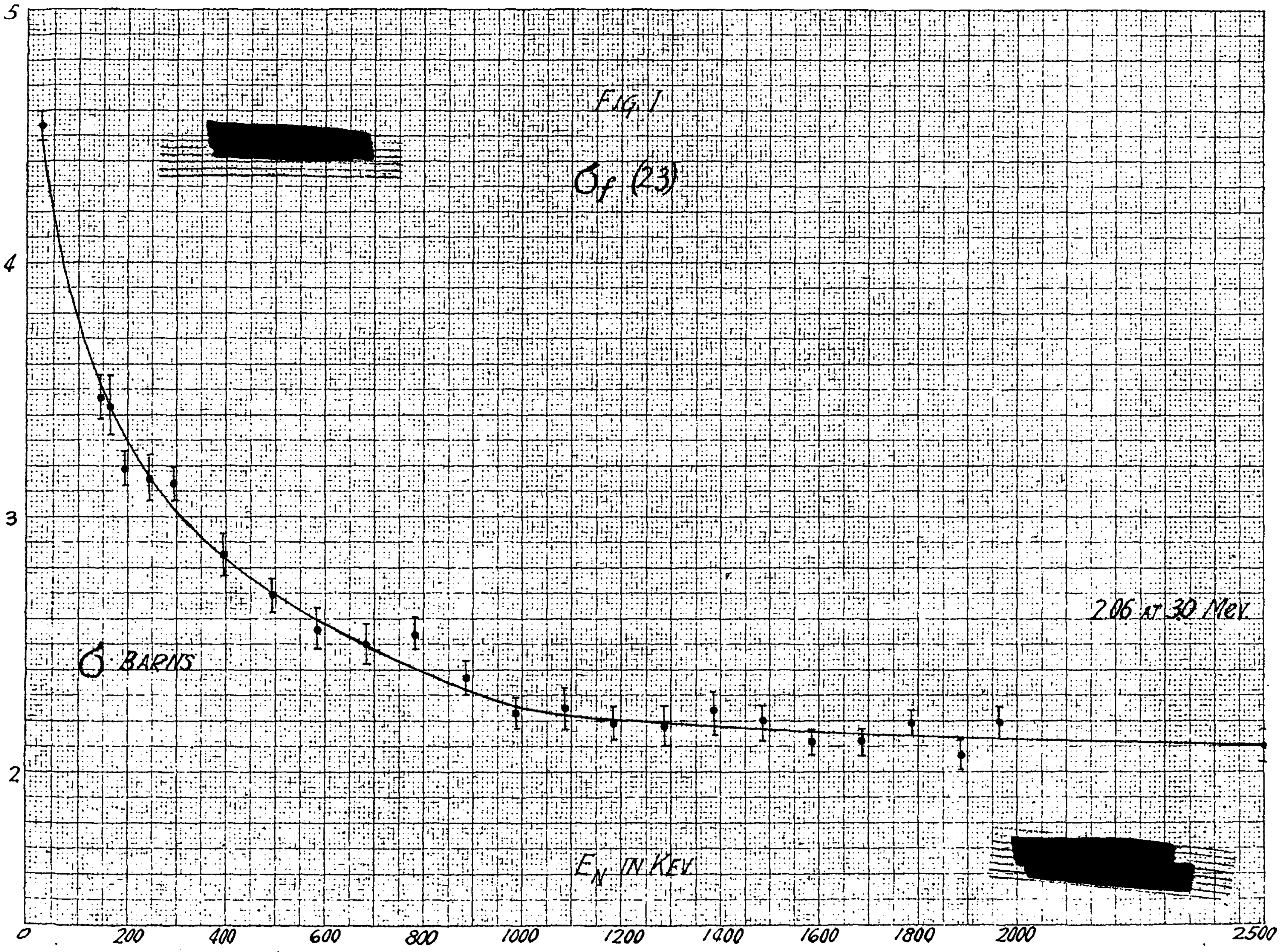

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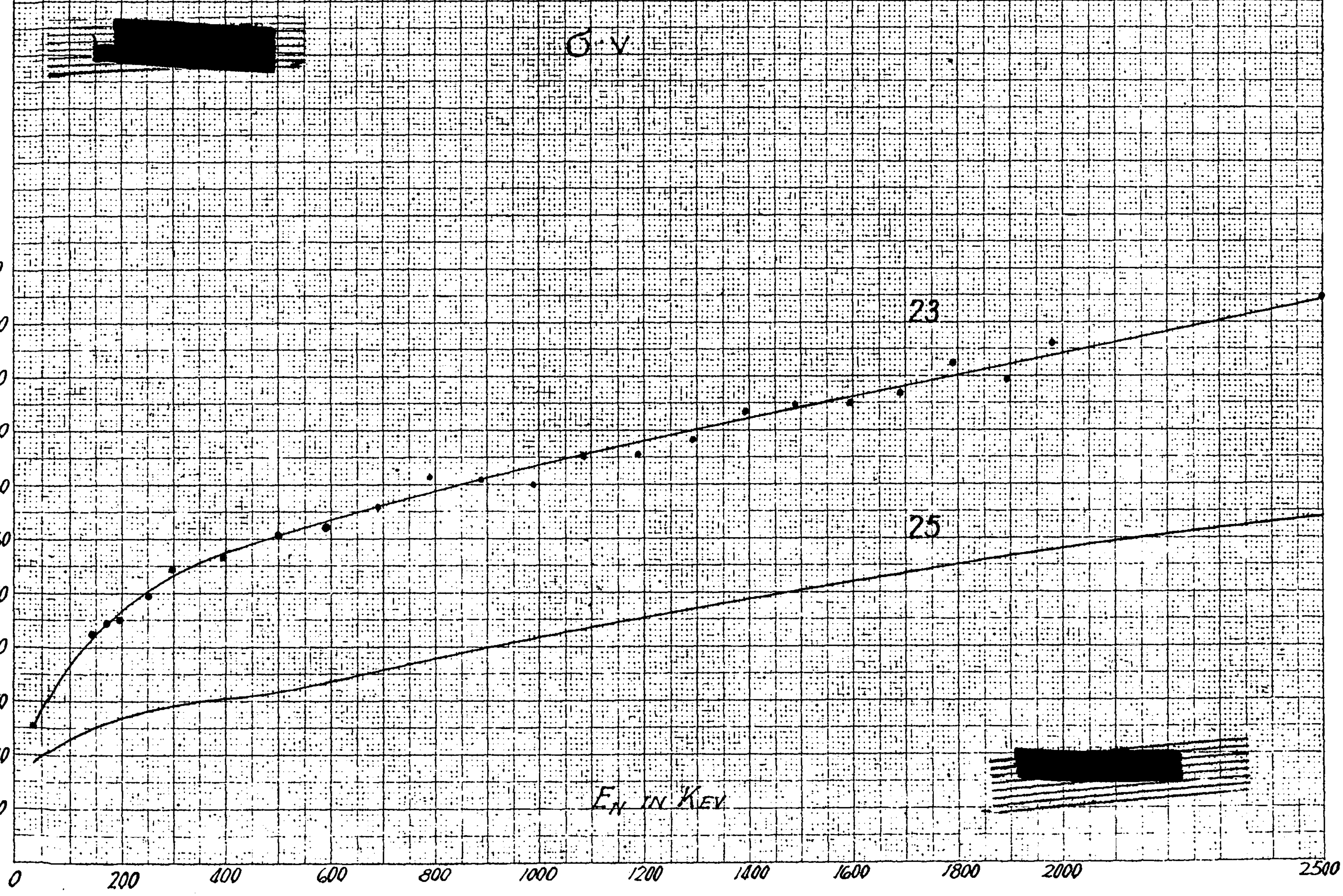
FIG. 2



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