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RADIATIVE CAPTURE CROSS-SECTIONS FOR FAST NEUTRONS IN In, Re AND Ta

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Using a liquid scintillation detector to record capture events and the time-of-flight technique to measure neutron energies, the radiative capture cross-sections were measured for a number of elements in the neutron energy range from 30 to 170 keV.

As neutron source the authors used the $T(p,n)He^3$ reaction on the target of a pulsed accelerator with a maximum proton energy of 1.2 MeV. The dimensions of the detector were 0.5 x 0.5 x 0.5 m. The cross-section measurements were done with a resolving time of 30 ns and a path length of 1.5 m.

The way in which the cross-section varied as a function of neutron energy was determined in relation to the capture cross-section in In, as given in reference [1]. If the same value for the capture cross-section in In is also used in order to assign an absolute value to the cross-sections, good agreement is found with the data presented in reference [1]. However, there is a considerable difference in the absolute value of the cross-sections obtained in reference [1] and those obtained by the activation method [2] [3] [4], and also the results presented in reference [5], despite the fact that there is good agreement between all these papers as to the way in which the cross-sections vary.

It is interesting to note that the reference cross-section used in most activation measurements and in reference [5] was the fission cross-section σ_f or the absorption cross-section $(\sigma_f + \sigma_c)$ for U^{235}, whereas in reference [1] absolute values were assigned on the basis of the absorption cross-sections obtained by the absolute method of transmission in a spherical geometry.

The authors of reference [1] mention that for verification purposes they assigned values on the basis of U^{235} and this resulted in the cross-section being increased by 5%. However, owing to the difficulties caused by the background of the natural radioactivity from U^{235}, the initial method was preferred. Consequently we thought it important to endeavour to measure the absolute value of the cross-section in In, using as reference the $(\sigma_f + \sigma_c)$ cross-section for U^{235}. Fig. 1 gives the cross-section in In, measured with reference to $(\sigma_f + \sigma_c)$ for U^{235}. The value of σ_f was taken from reference [6] (recommended curve) and that of σ_c was calculated using the α values published in reference [7]. A correction for the average path of a neutron in the sample was made by the method described in reference [8]. No correction was made for resonance self-shielding.

A correction for the detector's different recording efficiency for captures in U and In was made by the same means as in references [1] and [5]. The average ratio of the capture cross-sections in In obtained in this work to those reported in reference [1] is 1.67 ± 0.03. The corresponding figure obtained by comparing references [5] and [1] is 1.61 ± 0.05. Figs. 2 and 3 show the capture cross-sections for Re and Ta, obtained by means of the new value for the cross-section in In.

Figure Captions

Fig. 1 Neutron energy dependence of the radiative capture cross-section in indium

● - this work

Fig. 2 Neutron energy dependence of the radiative capture cross-section in rhenium

● - this work

Fig. 3 Neutron energy dependence of the radiative capture cross-section in tantalum

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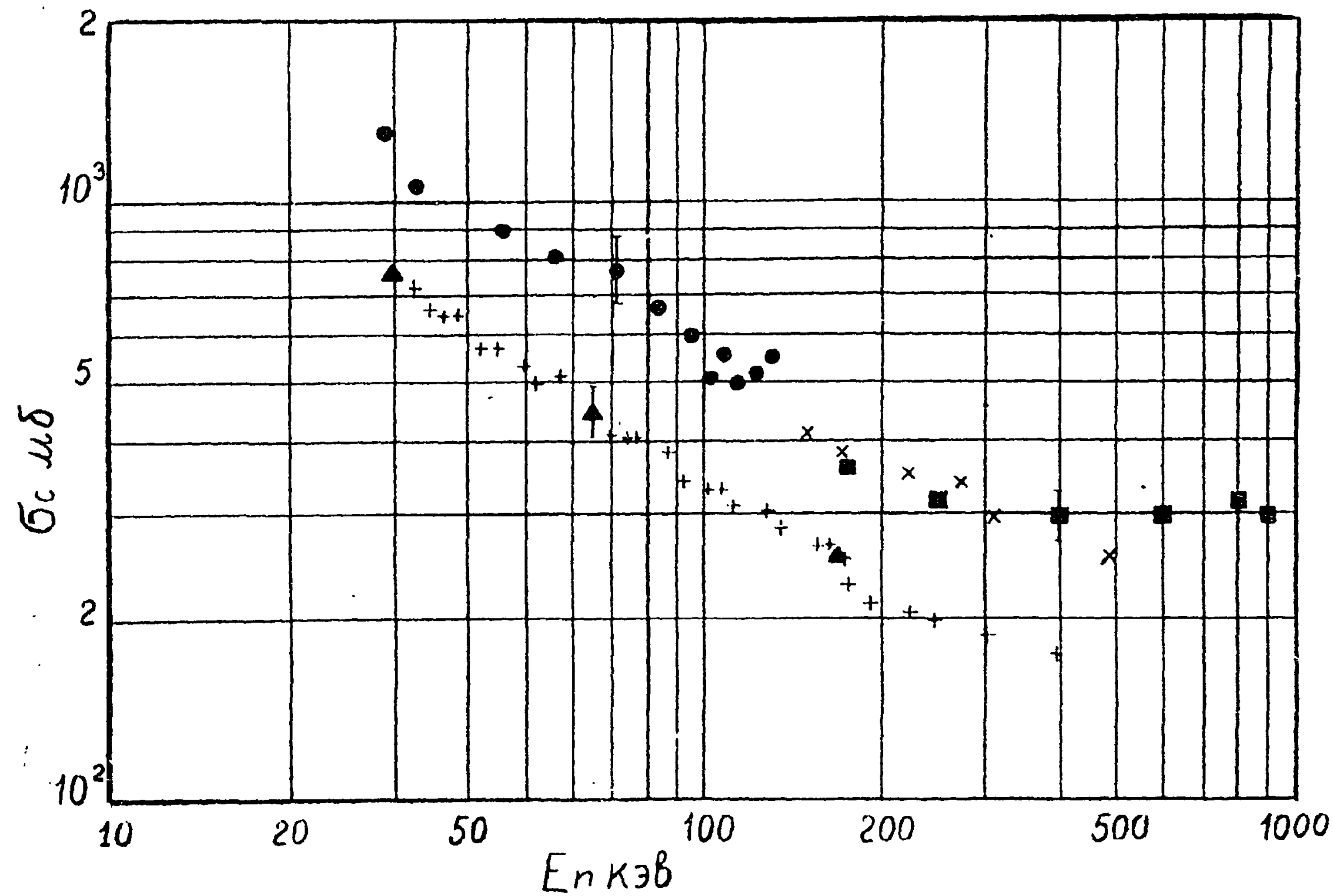
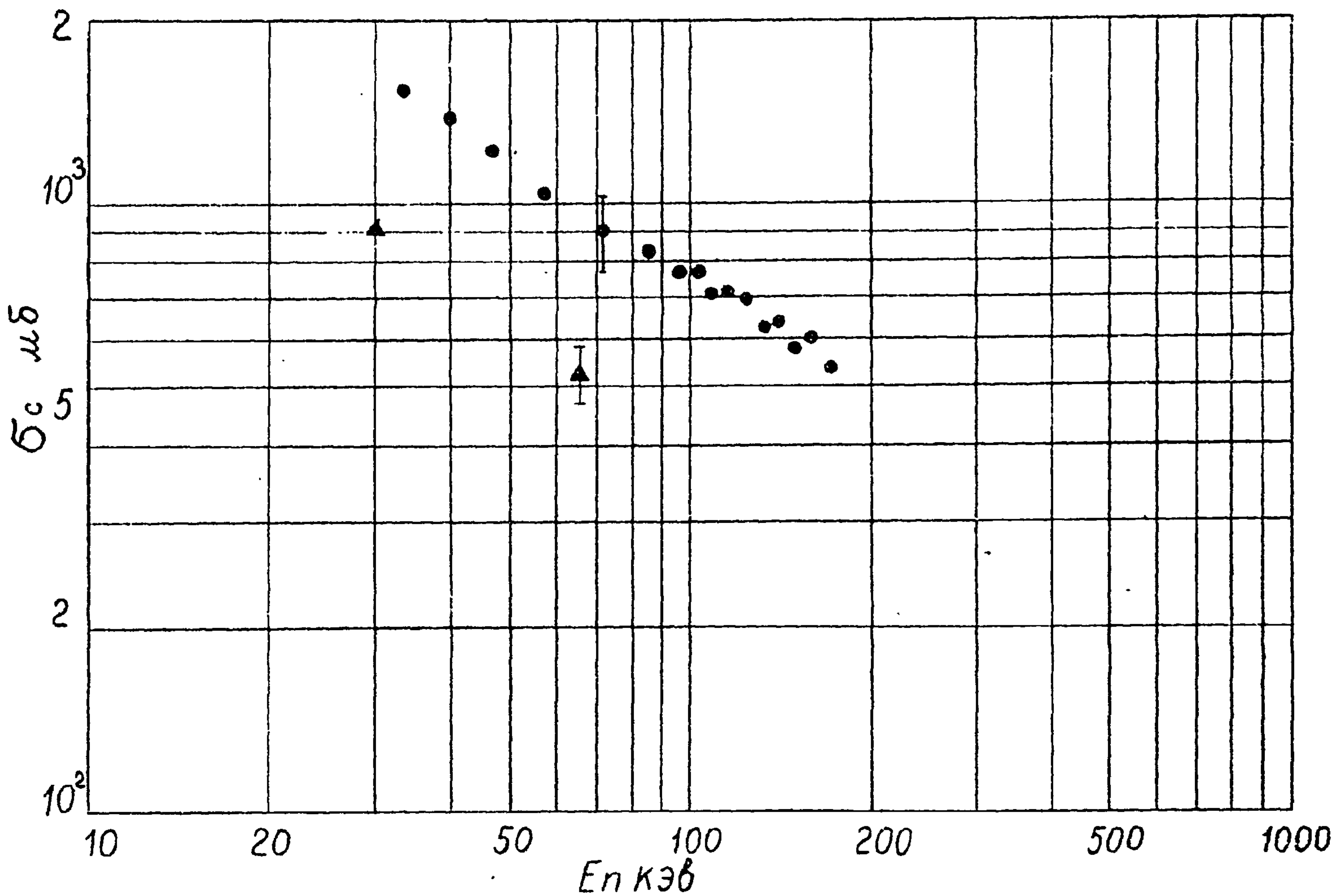
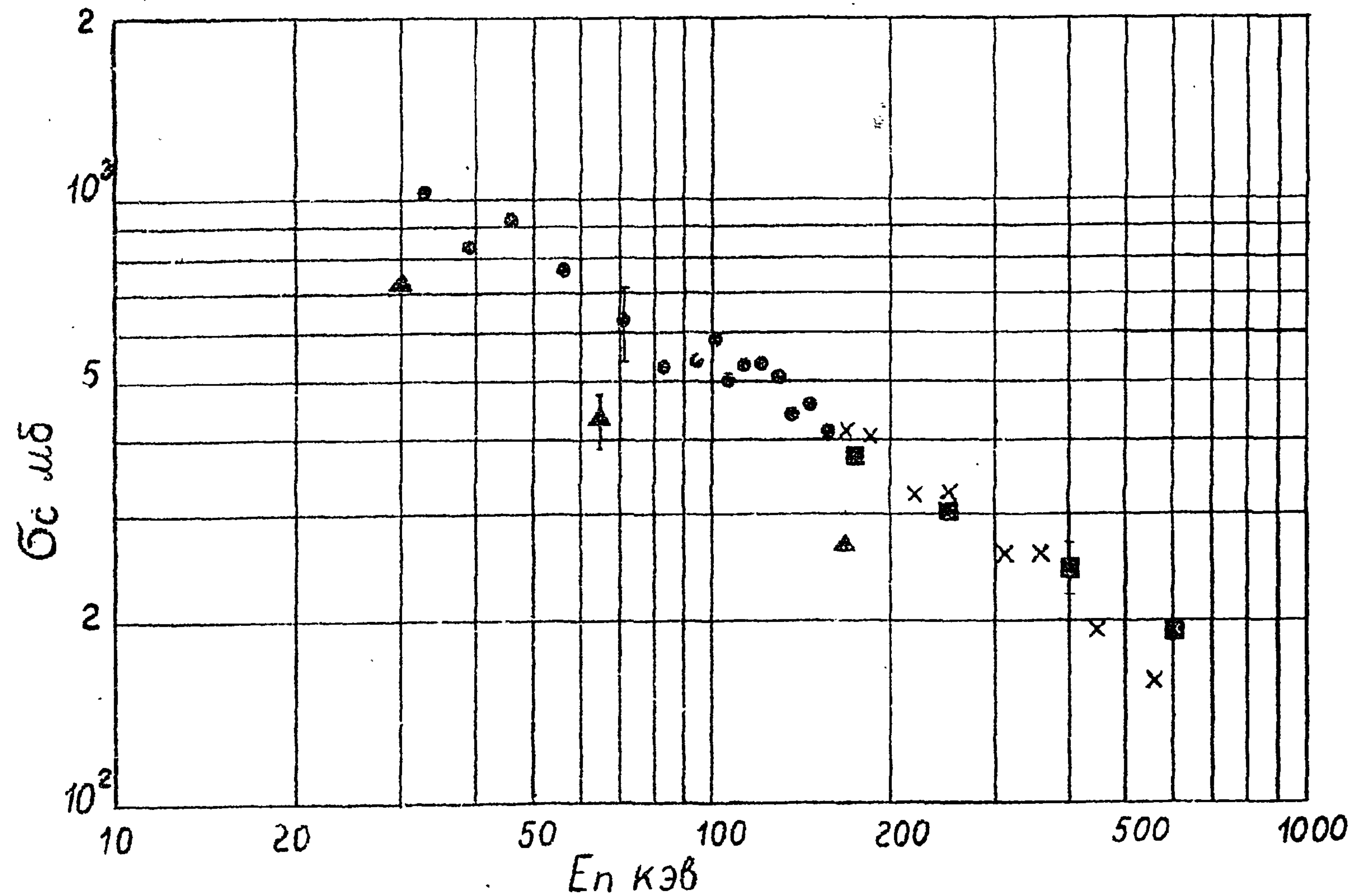


Фиг. 1. Зависимость сечения радиационного захвата в индии от энергии нейтронов.
• – настоящая работа; ▲+ – Gibbons [1]; x – Cox [4]; ■ – Diven [5].



Фиг. 2. Зависимость сечения радиационного захвата в рении от энергии нейтронов.
● - настоящая работа; ▲ - Macklin [9].



Фиг. 3. Зависимость сечения радиационного захвата нейтронов в тантале от энергии нейтронов. ● – настоящая работа; ▲ – Gibbons [I]; × – Cox [4]; ■ – Diven [5].