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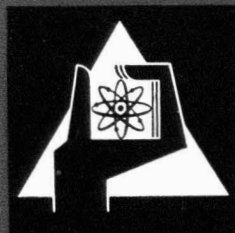
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The Infinite Dilute Resonance Integral of Thorium

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Letters to the Editors

The Infinite Dilute Resonance Integral of Thorium

Previous measurements of the infinite dilute resonance integral of thorium show wide discrepancies. Values between 67 barns¹ and 106 barns² have been reported. Therefore, and due to the importance of the resonance integral as a check for resonance parameters, a redetermination of this quantity was performed.

In the measurements the cadmium-ratio technique was used, comparing the activation of thin circular thorium and gold foils. To eliminate self-shielding effects, foils containing only 50 μg/cm² thorium were prepared by alloying thorium and aluminum. The gold foils were about 700 μg/cm² and therefore show some self-shielding; this was, however, corrected by using previous experimental results (see below). The irradiations were performed in the pool of the Munich research reactor at a core distance of about 20 cm, where the epithermal neutrons follow a 1/E spectrum. Bare and Cd-covered Au and Th foils (Cd thickness 1 mm) were irradiated simultaneously by placing them on a rotating Plexiglas turntable. Thus the average neutron flux was the same for all foils. The activity of the foils was counted with single-channel γ spectrometers using the Hg¹⁹⁰ 412-keV line in the case of gold and the 105-keV Pa²³³ line in the case of thorium.

The results of the measurements were evaluated by the well-known equation

$$\left(\frac{I}{\sigma_{eff}}\right)^{Th} = \left(\frac{I}{\sigma_{eff}}\right)^{Au} \frac{R_{cd}^{Au} - 1}{R_{cd}^{Th} - 1}$$

where

- I is the resonance integral
- σ_{eff} the effective thermal cross section.
- R_{cd} the cadmium ratio.

¹R. L. MACKLIN and H. S. POMERANCE, "Resonance Activation Integrals of U²³⁸ and Th²³²," *J. Nucl. Energy, Part A: Reactor Sci.* 2, 243-246 (1956).

²R. B. TATTERSALL, TNCC (UK)-53.

We found

$$R_{cd}^{Au} = 8.40 \pm 0.05$$

$$R_{cd}^{Th} = 10.80 \pm 0.05$$

and thus

$$\left(\frac{I}{\sigma_{eff}}\right)^{Th} = \left(\frac{I}{\sigma_{eff}}\right)^{Au} \cdot [0.7543 \pm 0.0066].$$

Using $I = 1461.8$ barn and $\sigma_{eff} = 99.3$ barn for gold foils³ and $\sigma_{eff} = 7.45 \pm 0.15$ barn for thorium⁴, we get

$$I^{Th} = 82.7 \pm 1.8 \text{ barn}$$

for the infinite dilute resonance integral of thorium under 1 mm cadmium. This value is in good agreement with that obtained by Johnston⁵. From the resonance parameters published in BNL - 325, one calculates 96 barn for this quantity (including a correction of 3.89 barn for unresolved s-resonances and 2.86 barn for the 1/v part).

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³M. BROSE, "Zur Messung und Berechnung der Resonanzabsorption von Neutronen in Goldfolien," *Nukleonik* (in print).

⁴E. HELLSTRAND and J. WEITMANN, "The Resonance Integral of Thorium Metal Rods," *Nucl. Sci. Eng.* 9, 507-518 (1961).

⁵F. J. JOHNSTON *et al.*, "The Thermal Neutron Absorption Cross-section of Th²³³ and the Resonance Integrals of Th²³², Th²³³ and Co⁵⁹," *J. Nucl. Energy, Part A: Reactor Sci.* 11, 95-100 (1960).

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