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The Infinite Dilute Resonance Integral of Thorium

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Letters to the Editors

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Previous measurements of the infinite dilute resonance integral of thorium show wide discrepancies. Values between 67 barns[1] and 106 barns[2] 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 $\mu g/cm^2$ thorium were prepared by alloying thorium and aluminum. The gold foils were about 700 $\mu g/cm^2$ 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 Hg^{198} 412-keV line in the case of gold and the 105-keV Pa^{233} 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.

[1]R. L. MACKLIN and H. S. POMERANCE, "Resonance Activation Integrals of U^{238} and Th^{232}," *J. Nucl. Energy, Part A: Reactor Sci.* **2**, 243-246 (1956).

[2]R. 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

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

Using $I = 1461.8$ barn and $\sigma_{eff} = 99.3$ barn for gold foils[3] and $\sigma_{eff} = 7.45 \pm 0.15$ barn for thorium[4], 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 Johnston[5]. 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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[3]M. BROSE, "Zur Messung und Berechnung der Resonanzabsorption von Neutronen in Goldfolien," *Nukleonik* (in print).

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

[5]F. J. JOHNSTON *et al.*, "The Thermal Neutron Absorption Cross-section of Th^{233} and the Resonance Integrals of Th^{232}, Th^{233} and Co^{59}," *J. Nucl. Energy, Part A: Reactor Sci.* **11**, 95-100 (1960).