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Low-Enrichment Uranium-Metal Exponential Experiments

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A study of low average enrichment, uranium-metal exponential columns has been performed at the Los Alamos Scientific Laboratory. The source reactor, materials, equipment, and procedures were essentially the same as used in the earlier natural-uranium experiment.¹

Unreflected 21-in.-diam uranium cylinders of 6.53 and 9.12% ²³⁵U enrichment were investigated during the Summer of 1966.² These efforts were extensions of work reported in 1965 on a 4.29%-enriched column.³ The enriched col-

umns were formed by interleaving natural-uranium plates, machined from cast stock, with uranium plates enriched to an average of 93.29% ²³⁵U, which were machined from rolled stock. The overall column density, allowing for stacking voids, was estimated to be 18.70 ± 0.05 g/cm³.

Those results that are considered best values are tabulated on the preceding page.

Interpolation of a buckling vs percent-enrichment curve obtained from the above data by a quadratic, least-squares analysis implies a ²³⁵U enrichment of (5.26 ± 0.11) % for infinite critical mass. Backscattering perturbations in the enriched assemblies were not as pronounced as in the natural-uranium system¹ and were ignored.

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¹C. G. CHEZEM, "A Uranium Metal Exponential Experiment," *Nucl. Sci. Eng.*, **8**, 652 (1960).

²R. G. STEINKE, "Spectral Indices of 6.53% and 9.12% ²³⁵U Enriched Uranium Metal Exponential Experiments," Los Alamos Scientific Laboratory Report (to be published).

³R. G. STEINKE, "Spectral Indices of a 4.29% ²³⁵U Enriched Uranium Metal Exponential Column," LA-3406-MS, Los Alamos Scientific Laboratory (September 1965).

TABLE I

| Average Enrichment % | Length of Column (in.) | Method of Observation | Buckling (cm ⁻²) | $\frac{\bar{\sigma}_f(^{235}\text{U})}{\bar{\sigma}_f(^{238}\text{U})}$ | $\frac{\bar{\sigma}_f(^{237}\text{Np})}{\bar{\sigma}_f(^{238}\text{U})}$ | $\frac{\bar{\sigma}_f(^{239}\text{Pu})}{\bar{\sigma}_f(^{238}\text{U})}$ |
|----------------------|------------------------|--|------------------------------|---|--|--|
| 9.12 | 25.28 | Foil Activation (<i>i</i>) | 0.0054 ± 0.0002 | 27 ± 1 | | |
| 6.53 | 32.72 | Foil Activation (<i>i</i>) | 0.0022 ± 0.0004 | 39 ± 2 | | |
| 4.29 | 31.4 | Foil Activation (<i>j</i>) Fission chambers | -0.0018 ± 0.0003 | 57 ± 6 60.1 ± 3.0 | 10.7 ± 0.5 11.3 ± 0.5 | 1.14 ± 0.06 |
| (0.72) | Chezem ¹ | Chezem ¹ | -0.0119 ± 0.0005 | 239 ± 7 | 16.0 ± 0.1 ^a | 250 ± 16) |

^aCorrects an arithmetic error in Table VI of Chezem.¹