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MEASUREMENT OF THE NEUTRON-INDUCED
FISSION CROSS SECTION OF ^{241}Am RELATIVE TO ^{235}U
FROM 0.001 TO 30 MeV

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MEASUREMENT OF THE NEUTRON-INDUCED FISSION CROSS SECTION OF ^{241}Am
RELATIVE TO ^{235}U FROM 0.001 to 30 MeV

ABSTRACT

The work described in this report represents a continuation of the fission cross-section ratio measurements in progress at the Lawrence Livermore Laboratory. We provide our preliminary results for the $^{241}\text{Am}/^{235}\text{U}$ fission cross-section ratio from 0.2 to 30 MeV. Upper limits on this ratio are given over broad energy bands from 0.001 to 0.2 MeV. Using the threshold cross-section method, we obtained the value 1.616 ± 0.042 for the cross-section ratio in the interval 1.75 to 4.00 MeV.

PRELIMINARY RESULTS

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We measured the fission cross section of ^{241}Am relative to the fission cross section of ^{235}U using ionization fission chambers at the Lawrence Livermore Laboratory's 100-MeV electron linear accelerator. The time-of-flight technique was used to measure the cross-section ratio as a function of neutron energy over the energy range 0.001 to 30 MeV. Using the threshold method,^{1,2} we obtained the value 1.616 ± 0.042 for the cross-section ratio in the interval 1.75 to 4.00 MeV.

We conducted the measurement at the 15.7-m time-of-flight station. Each of the three ^{241}Am fission chambers contained about 1 mg of fissionable material. Further details of our experimental setup and procedures are available.^{1,2}

Figure 1 shows and Table 1 lists our preliminary data for the $^{241}\text{Am}/^{235}\text{U}$ ratio from 0.2 to 30 MeV. The line shown in the figure was obtained using files of evaluated fission cross sections from ENDF/B-IV.³ Below 0.2 MeV, the correction for no-beam backgrounds due to alpha pileup in the ^{241}Am fission chambers became large. However, it was possible to determine upper limits for the cross-section ratio using three standard deviations above the background subtraction as a measure of our sensitivity in a given energy range. Table 2 gives these upper limits over broad energy bands from 0.001 to 0.2 MeV. These limits should *not* be interpreted as values for the cross-section ratio.

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Fig. 1. Ratio of the ^{241}Am to ^{235}U fission cross sections in the energy range 0.2 to 30 MeV. Our preliminary work is given by $\bullet$. The statistical error bars, representing one standard deviation, are shown for each point. The line denotes the $^{241}\text{Am}/^{235}\text{U}$ ratio obtained using the ENDF/B-IV evaluated fission cross-section files.

The Cross Section Evaluation Working Group (CSEWG), responsible for the upcoming ENDF/B-V evaluations, requested this brief report. We plan a more complete and formal presentation of this measurement.

Table 1. Fission cross-section ratio of ^{241}Am to ^{235}U from 0.2 to 30 MeV.

Neutron energy (MeV)	Ratio	Statistical uncertainty ^a (%)	Neutron energy (MeV)	Ratio	Statistical uncertainty ^a (%)
0.2189	0.018	38	1.788	1.545	1.2
0.2438	0.018	31	1.930	1.542	1.2
0.2732	0.023	23	2.069	1.573	1.5
0.3084	0.031	15	2.200	1.533	1.5
0.3507	0.037	12	2.345	1.605	1.6
0.3885	0.044	12	2.504	1.583	1.6
0.4172	0.049	11	2.679	1.596	1.8
0.4492	0.0666	8.5	2.874	1.581	1.9
0.4850	0.0825	6.4	3.092	1.602	1.9
0.5200	0.0930	6.8	3.334	1.643	2.0
0.5530	0.1284	5.2	3.607	1.699	2.0
0.5894	0.1469	4.6	3.915	1.722	2.0
0.6294	0.1985	3.8	4.263	1.788	2.0
0.6660	0.2649	3.6	4.661	1.795	2.1
0.6976	0.3305	3.1	5.117	1.834	2.0
0.7315	0.3858	2.7	5.644	1.799	1.9
0.7679	0.5320	2.3	6.148	1.594	2.2
0.8072	0.6386	2.0	6.601	1.480	2.1
0.8495	0.7677	1.9	7.107	1.475	2.0
0.8952	0.8845	1.6	7.674	1.429	2.0
0.9447	0.9783	1.5	8.311	1.536	2.1
0.9985	1.108	1.4	9.032	1.544	2.3
1.057	1.218	1.3	9.851	1.537	2.6
1.121	1.395	1.2	10.79	1.547	2.9
1.191	1.483	1.2	11.87	1.475	3.3
1.267	1.563	1.1	13.11	1.334	3.6
1.351	1.574	1.1	14.57	1.285	4.0
1.444	1.526	1.1	16.29	1.343	4.5
1.546	1.571	1.1	18.34	1.256	5.2
1.660	1.579	1.2	20.80	1.254	6.0
			23.80	1.270	7.1
			27.50	1.455	7.6

^aThis indicates a counting error expressed as one standard deviation. Total errors may be estimated by combining the normalization error of 2.6% and the estimated overall systematic error of 2% with the counting errors in the table.

Table 2. Upper limits on the fission cross-section
ratio of ^{241}Am to ^{235}U from 0.001 to 0.2 MeV.

Neutron energy range (MeV)	Ratio ^a
0.001 to 0.005	$\leq$ 0.162
0.005 to 0.010	$\leq$ 0.147
0.010 to 0.025	$\leq$ 0.074
0.025 to 0.050	$\leq$ 0.059
0.050 to 0.100	$\leq$ 0.029
0.100 to 0.150	$\leq$ 0.023
0.150 to 0.200	$\leq$ 0.020

^aThese are upper limits (99.9% confidence level) and should *not* be interpreted as values for the cross-section ratio.

REFERENCES

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2. J. W. Behrens and G. W. Carlson, "Measurements of Neutron-Induced Fission Cross-Section Ratios Involving Isotopes of Uranium and Plutonium," in *Proc. of NEANDC/NEACRP Specialists Meeting on the Fast Neutron Fission Cross Sections of U-233, U-235, U-238, and Pu-239, Argonne National Laboratory, June 28-30, 1976*, Argonne National Laboratory, Ill., Rept. ANL-76-90 (1976), p. 47.
3. Evaluated Nuclear Data File/Format B - Version IV. This evaluation originates at the Brookhaven National Laboratory, Upton, New York.

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