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TABLE OF U^{235} FISSION SPECTRA

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TABLE OF TWO U^{235} FISSION SPECTRA

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October 1957

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TABLE OF TWO U^{235} FISSION SPECTRA

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ABSTRACT

The U^{235} fission spectrum is tabulated as a function of energy for two analytic representations, an improved Watt spectrum and one of the form $\sqrt{E} e^{-E/B}$. The table contains the distribution functions, their first derivatives and first integrals up to 10 Mev.

Table of Two U^{235} Fission Spectra

Leachman¹ has given two semi-empirical expressions for the neutron energy spectrum from thermal-neutron-induced fission of U^{235} . One is a modification of the Watt spectrum:

$$W(E) = \frac{2\alpha^{3/2}}{\sqrt{\pi\beta}} e^{-\frac{\beta}{4\alpha}} e^{-\alpha E} \sinh \sqrt{\beta E} \quad (1)$$

Where $W(E)dE$ is the probability that a fission neutron has energy between E and $E+dE$, and Leachman's fit is $\alpha = 1.036 \text{ Mev}^{-1}$, $\beta = 2.29 \text{ Mev}^{-1}$. A simpler form which recent work has indicated may be a better representation of the spectrum is,

$$F(E) = \frac{2}{\sqrt{\pi B}^{3/2}} \sqrt{E} e^{-E/B} \quad (2)$$

where $F(E)$ is again the probability distribution function, and $B = 1.29 \text{ Mev}$.

A short table of these two distribution functions, their derivatives and their integrals, is given in this report for $E \leq 10 \text{ Mev}$. These were calculated

¹ R. B. Leachman, Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, Geneva, Aug. 8-20, 1955, Paper P/592, Sess. 7A, Vol 2.

primarily for incidental use in developing multigroup cross sections, for which purpose one desires the fraction of fission neutrons born between E_{g-1} and E_g . This is merely the difference of two integrals given in column 4 or 7 of the table depending on the spectrum desired. The table was calculated on the IBM-704, the integrals being performed by a Simpson's rule integration with 50 to 100 intervals between those given in the table. The length of the table is such that linear interpolation will give values of the integrals accurate to at least three decimal places.

If the parameter B in Equation (2) is found to have a different value for other incident energies or other fissionable species, the tabulated integral,

$$I(E, B) = \int_0^E F(E') dE' \quad (3a)$$

will still be useful, since only the combination E/B occurs in the integrand. One can then show readily that

$$I(E, B') = I\left(\frac{B}{B'} E, B\right) \quad (3b)$$

Unfortunately, no such simple transformation exists for the integral of Equation (1).

Energy (Mev)	$\frac{dF(E)}{dE}$	$F(E)$	$\int_0^E F(E') dE'$	$\frac{d\omega(E)}{dE}$	$\omega(E)$	$\int_0^E \omega(E') dE'$
.010	3.7605	.0764	.00051	3.3539	.0680	.00045
.020	2.5970	.1072	.00144	2.3247	.0955	.00128
.030	2.0704	.1303	.00263	1.8603	.1162	.00231
.040	1.7502	.1493	.00403	1.5785	.1333	.00359
.050	1.5277	.1656	.00560	1.3831	.1481	.00500
.060	1.3606	.1800	.00733	1.2366	.1612	.00655
.070	1.2285	.1929	.00920	1.1210	.1730	.00822
.080	1.1205	.2047	.01119	1.0265	.1837	.01000
.090	1.0297	.2154	.01329	.9471	.1935	.01189
.100	.9518	.2253	.01549	.8791	.2027	.01387
.110	.8840	.2345	.01779	.8199	.2112	.01594
.120	.8241	.2430	.02018	.7676	.2191	.01809
.130	.7707	.2510	.02265	.7210	.2265	.02032
.140	.7227	.2584	.02520	.6790	.2336	.02262
.150	.6790	.2654	.02782	.6409	.2402	.02499
.160	.6392	.2720	.03051	.6061	.2464	.02743
.170	.6027	.2782	.03326	.5742	.2523	.02992
.180	.5689	.2841	.03607	.5446	.2579	.03247
.190	.5377	.2896	.03894	.5173	.2632	.03508
.200	.5086	.2949	.04186	.4918	.2682	.03773

(Continued)

Energy (Mev)	$\frac{dF(E)}{dE}$	F(E)	$\int_0^E F(E)dE$	$\frac{d\omega(E)}{dE}$	$\omega(E)$	$\int_0^E \omega(E)dE$
.250	.3884	.3171	.05719	.3860	.2901	.05171
.300	.2979	.3342	.07349	.3058	.3073	.06666
.350	.2269	.3472	.09054	.2421	.3210	.08238
.400	.1696	.3571	.10816	.1902	.3317	.09871
.450	.1224	.3644	.12620	.1470	.3401	.11552
.500	.0831	.3695	.14456	.1105	.3466	.13269
.550	.0499	.3728	.16312	.0792	.3513	.15015
.600	.0218	.3745	.18181	.0523	.3546	.16780
.650	-.0022	.3750	.20055	.0289	.3566	.18558
.700	-.0228	.3744	.21929	.0086	.3575	.20344
.750	-.0405	.3728	.23798	-.0092	.3575	.22132
.800	-.0556	.3704	.25656	-.0248	.3567	.23918
.850	-.0687	.3673	.27500	-.0385	.3551	.25698
.900	-.0798	.3635	.29327	-.0505	.3529	.27468
.950	-.0894	.3593	.31135	-.0610	.3501	.29226
1.000	-.0976	.3546	.32920	-.0703	.3468	.30968
1.050	-.1045	.3496	.34680	-.0784	.3431	.32693
1.100	-.1104	.3442	.36415	-.0854	.3390	.34398
1.150	-.1152	.3385	.38122	-.0915	.3346	.36083
1.200	-.1193	.3327	.39800	-.0968	.3299	.37744
1.250	-.1225	.3266	.41448	-.1014	.3249	.39381
1.300	-.1252	.3204	.43066	-.1053	.3198	.40993
1.350	-.1272	.3141	.44652	-.1086	.3144	.42578
1.400	-.1286	.3077	.46207	-.1113	.3089	.44137
1.450	-.1297	.3013	.47729	-.1135	.3033	.45667
1.500	-.1302	.2948	.49219	-.1153	.2976	.47169
1.550	-.1305	.2882	.50677	-.1167	.2918	.48643
1.600	-.1304	.2817	.52102	-.1177	.2859	.50087
1.650	-.1299	.2752	.53494	-.1183	.2800	.51502
1.700	-.1293	.2687	.54854	-.1187	.2741	.52888
1.750	-.1284	.2623	.56181	-.1188	.2682	.54243
1.800	-.1273	.2559	.57477	-.1187	.2622	.55569
1.850	-.1260	.2496	.58741	-.1183	.2563	.56866
1.900	-.1246	.2433	.59973	-.1177	.2504	.58133
1.950	-.1230	.2371	.61174	-.1170	.2446	.59370
2.000	-.1213	.2310	.62344	-.1161	.2387	.60578
2.050	-.1195	.2250	.63484	-.1150	.2330	.61757
2.100	-.1177	.2191	.64594	-.1138	.2272	.62908
2.150	-.1157	.2132	.65674	-.1125	.2216	.64030
2.200	-.1137	.2075	.66726	-.1111	.2160	.65124
2.250	-.1116	.2019	.67749	-.1096	.2105	.66190
2.300	-.1095	.1963	.68745	-.1081	.2050	.67229
2.350	-.1074	.1909	.69713	-.1064	.1997	.68240
2.400	-.1052	.1856	.70654	-.1047	.1944	.69226
2.450	-.1030	.1804	.71569	-.1030	.1892	.70185
2.500	-.1008	.1753	.72458	-.1012	.1841	.71118
2.550	-.0986	.1703	.73322	-.0994	.1791	.72026
2.600	-.0964	.1654	.74161	-.0975	.1742	.72909
2.650	-.0942	.1607	.74976	-.0956	.1694	.73768

(Continued)

Energy (Mev)	$\frac{dF(E)}{dE}$	F(E)	$\int_0^E F(E)dE$	$\frac{d\omega(E)}{dE}$	$\omega(E)$	$\int_0^E \omega(E)dE$
2.700	-.0920	.1560	.75768	-.0937	.1646	.74602
2.750	-.0899	.1515	.76536	-.0918	.1600	.75414
2.800	-.0877	.1470	.77282	-.0899	.1554	.76202
2.850	-.0856	.1427	.78007	-.0880	.1510	.76968
2.900	-.0835	.1385	.78709	-.0860	.1466	.77713
2.950	-.0814	.1343	.79391	-.0841	.1424	.78435
3.000	-.0793	.1303	.80053	-.0822	.1382	.79137
3.050	-.0773	.1264	.80695	-.0803	.1342	.79818
3.100	-.0753	.1226	.81317	-.0784	.1302	.80478
3.150	-.0733	.1189	.81921	-.0766	.1263	.81120
3.200	-.0713	.1153	.82506	-.0747	.1226	.81742
3.250	-.0694	.1117	.83073	-.0729	.1189	.82345
3.300	-.0676	.1083	.83623	-.0710	.1153	.82931
3.350	-.0657	.1050	.84157	-.0692	.1118	.83498
3.400	-.0639	.1017	.84673	-.0675	.1084	.84049
3.450	-.0621	.0986	.85174	-.0657	.1050	.84582
3.500	-.0604	.0955	.85660	-.0640	.1018	.85099
3.600	-.0571	.0897	.86585	-.0607	.0955	.86085
3.700	-.0538	.0841	.87454	-.0574	.0896	.87011
3.800	-.0508	.0789	.88268	-.0543	.0841	.87879
3.900	-.0478	.0740	.89032	-.0513	.0788	.88693
4.000	-.0451	.0693	.89749	-.0484	.0738	.89456
4.100	-.0424	.0649	.90420	-.0457	.0691	.90170
4.200	-.0399	.0608	.91048	-.0430	.0647	.90839
4.300	-.0375	.0570	.91637	-.0405	.0605	.91464
4.400	-.0353	.0533	.92188	-.0381	.0566	.92049
4.500	-.0331	.0499	.92704	-.0359	.0529	.92596
4.600	-.0311	.0467	.93186	-.0337	.0494	.93107
4.700	-.0292	.0437	.93638	-.0316	.0461	.93585
4.800	-.0274	.0408	.94060	-.0297	.0431	.94030
4.900	-.0257	.0382	.94455	-.0279	.0402	.94446
5.000	-.0241	.0357	.94825	-.0261	.0375	.94835
5.100	-.0226	.0334	.95170	-.0245	.0350	.95197
5.200	-.0212	.0312	.95492	-.0229	.0326	.95534
5.300	-.0198	.0291	.95794	-.0215	.0304	.95849
5.400	-.0186	.0272	.96075	-.0201	.0283	.96142
5.500	-.0174	.0254	.96338	-.0188	.0263	.96415
6.000	-.0125	.0180	.97413	-.0134	.0184	.97522
6.500	-.0089	.0127	.98174	-.0094	.0127	.98291
7.000	-.0063	.0090	.98710	-.0066	.0088	.98823
7.500	-.0045	.0063	.99088	-.0046	.0060	.99189
8.000	-.0031	.0044	.99352	-.0032	.0041	.99439
8.500	-.0022	.0031	.99538	-.0022	.0028	.99609
9.000	-.0016	.0022	.99667	-.0015	.0019	.99725
9.500	-.0011	.0015	.99758	-.0010	.0013	.99803
10.000	-.0008	.0010	.99821	-.0007	.0009	.99855