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TABLE OF THE DIFFUSION CONSTANT K

Work done by:

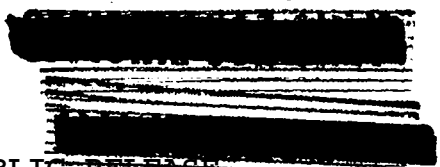
Group T-2

Report written by:

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TABLE OF THE DIFFUSION CONSTANT k

In one-velocity neutron diffusion theory the quantity k appears in the expression for the asymptotic neutron density of a given medium. It is a function of the parameter f of the medium, which is defined by $f = \frac{\sigma_f(\nu-1) - \sigma_c}{\sigma_a}$. This function has the following forms:

$$\text{For } -1 \leq f \leq 0, \quad \frac{1}{1+f} = \frac{\text{arc tanh } k}{k}$$

$$\text{For } 0 \leq f \leq \infty, \quad \frac{1}{1+f} = \frac{\text{arc tan } k}{k}$$

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TABLE OF k

f	k	Δk	f	k	Δk
-1.00	1.000000	-.000000	-.50	.957504	-.003933
-.99	1.000000	-.000000	-.49	.953571	-.004158
-.98	1.000000	-.000000	-.48	.949413	-.004389
-.97	1.000000	-.000000	-.47	.945024	-.004626
-.96	1.000000	-.000000	-.46	.940398	-.004869
-.95	1.000000	-.000000	-.45	.935529	-.005117
-.94	1.000000	-.000000	-.44	.930412	-.005371
-.93	1.000000	-.000000	-.43	.925041	-.005633
-.92	1.000000	-.000000	-.42	.919408	-.005900
-.91	1.000000	-.000000	-.41	.913508	-.006176
-.90	1.000000	-.000000	-.40	.907332	-.006457
-.89	1.000000	-.000000	-.39	.900875	-.006747
-.88	1.000000	-.000000	-.38	.894128	-.007045
-.87	1.000000	-.000001	-.37	.887083	-.007351
-.86	.999999	-.000002	-.36	.879732	-.007667
-.85	.999997	-.000004	-.35	.872065	-.007992
-.84	.999993	-.000009	-.34	.864073	-.008327
-.83	.999984	-.000014	-.33	.855746	-.008674
-.82	.999970	-.000024	-.32	.847072	-.009033
-.81	.999946	-.000037	-.31	.838039	-.009404
-.80	.999909	-.000055	-.30	.828635	-.009789
-.79	.999854	-.000080	-.29	.818846	-.010190
-.78	.999774	-.000110	-.28	.808656	-.010606
-.77	.999664	-.000147	-.27	.798050	-.011040
-.76	.999517	-.000191	-.26	.787010	-.011494
-.75	.999326	-.000245	-.25	.775516	-.011968
-.74	.999081	-.000305	-.24	.763548	-.012468
-.73	.998776	-.000374	-.23	.751080	-.012991
-.72	.998402	-.000451	-.22	.738089	-.013546
-.71	.997951	-.000537	-.21	.724543	-.014131
-.70	.997414	-.000631	-.20	.710412	-.014754
-.69	.996783	-.000733	-.19	.695658	-.015417
-.68	.996050	-.000842	-.18	.680241	-.016128
-.67	.995208	-.000960	-.17	.664113	-.016893
-.66	.994248	-.001084	-.16	.647220	-.017719
-.65	.993164	-.001217	-.15	.629501	-.018617
-.64	.991947	-.001356	-.14	.610884	-.019603
-.63	.990591	-.001501	-.13	.591281	-.020690
-.62	.989090	-.001654	-.12	.570591	-.021899
-.61	.987436	-.001812	-.11	.548692	-.023262
-.60	.985624	-.001977	-.10	.525430	-.024815
-.59	.983647	-.002148	-.09	.500615	-.026613
-.58	.981499	-.002324	-.08	.474002	-.028732
-.57	.979175	-.002506	-.07	.445270	-.031294
-.56	.976669	-.002693	-.06	.413976	-.034491
-.55	.973976	-.002887	-.05	.379485	-.038656
-.54	.971089	-.003085	-.04	.340829	-.044448
-.53	.968004	-.003289	-.03	.296381	-.053398
-.52	.964715	-.003498	-.02	.242983	-.070472
-.51	.961217	-.003713	-.01	.171511	-.171511
-.50	.957504		-.00	.000000	

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TABLE OF k CON'T.

f	k	Δk	f	k	Δk
.00	.000000	.173897	.50	1.451104	.018675
.01	.173897	.073005	.51	1.469779	.018606
.02	.246902	.056680	.52	1.488385	.018538
.03	.303582	.048333	.53	1.506923	.018474
.04	.351915	.043064	.54	1.525397	.018411
.05	.394979	.039364	.55	1.543808	.018351
.06	.434343	.036594	.56	1.562159	.018293
.07	.470937	.034427	.57	1.580452	.018237
.08	.505364	.032675	.58	1.598689	.018183
.09	.538039	.031226	.59	1.616872	.018131
.10	.569265	.030003	.60	1.635003	.018080
.11	.599268	.028956	.61	1.653083	.018031
.12	.628224	.028048	.62	1.671114	.017984
.13	.656272	.027252	.63	1.689098	.017938
.14	.683524	.026547	.64	1.707036	.017893
.15	.710071	.025920	.65	1.724929	.017851
.16	.735991	.025355	.66	1.742780	.017809
.17	.761346	.024847	.67	1.760589	.017769
.18	.786193	.024384	.68	1.778358	.017729
.19	.810577	.023963	.69	1.796087	.017692
.20	.834540	.023577	.70	1.813779	.017654
.21	.858117	.023222	.71	1.831433	.017619
.22	.881339	.022894	.72	1.849052	.017584
.23	.904233	.022592	.73	1.866636	.017550
.24	.926825	.022310	.74	1.884186	.017517
.25	.949135	.022048	.75	1.901703	.017486
.26	.971183	.021803	.76	1.919189	.017454
.27	.992986	.021575	.77	1.936643	.017424
.28	1.014561	.021361	.78	1.954067	.017395
.29	1.035922	.021160	.79	1.971462	.017366
.30	1.057082	.020971	.80	1.988828	.017338
.31	1.078053	.020792	.81	2.006166	.017311
.32	1.098845	.020624	.82	2.023477	.017284
.33	1.119469	.020465	.83	2.040761	.017259
.34	1.139934	.020314	.84	2.058020	.017233
.35	1.160248	.020171	.85	2.075253	.017209
.36	1.180419	.020036	.86	2.092462	.017185
.37	1.200455	.019907	.87	2.109647	.017162
.38	1.220362	.019784	.88	2.126809	.017139
.39	1.240146	.019667	.89	2.143948	.017117
.40	1.259813	.019557	.90	2.161065	.017096
.41	1.279370	.019449	.91	2.178161	.017074
.42	1.298819	.019349	.92	2.195235	.017053
.43	1.318168	.019251	.93	2.212288	.017033
.44	1.337419	.019158	.94	2.229321	.017014
.45	1.356577	.019069	.95	2.246335	.016994
.46	1.375646	.018984	.96	2.263329	.016976
.47	1.394630	.018902	.97	2.280305	.016957
.48	1.413532	.018824	.98	2.297262	.016939
.49	1.432356	.018748	.99	2.314201	.016921
.50	1.451104		1.00	2.331122	

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TABLE OF k CON'T.

f	k	Δk	f	k	Δk
1.00	2.331122	.016905	1.50	3.161009	.016363
1.01	2.348027	.016887	1.51	3.177372	.016356
1.02	2.364914	.016871	1.52	3.193728	.016350
1.03	2.381785	.016855	1.53	3.210078	.016343
1.04	2.398640	.016839	1.54	3.226421	.016337
1.05	2.415479	.016824	1.55	3.242758	.016330
1.06	2.432303	.016808	1.56	3.259088	.016325
1.07	2.449111	.016794	1.57	3.275413	.016318
1.08	2.465905	.016779	1.58	3.291731	.016312
1.09	2.482684	.016765	1.59	3.308043	.016306
1.10	2.499449	.016751	1.60	3.324349	.016301
1.11	2.516200	.016738	1.61	3.340650	.016294
1.12	2.532938	.016724	1.62	3.356944	.016289
1.13	2.549662	.016711	1.63	3.373233	.016284
1.14	2.566373	.016698	1.64	3.389517	.016278
1.15	2.583071	.016686	1.65	3.405795	.016272
1.16	2.599757	.016673	1.66	3.422067	.016267
1.17	2.616430	.016661	1.67	3.438334	.016262
1.18	2.633091	.016650	1.68	3.454596	.016257
1.19	2.649741	.016637	1.69	3.470853	.016251
1.20	2.666378	.016626	1.70	3.487104	.016247
1.21	2.683004	.016615	1.71	3.503351	.016241
1.22	2.699619	.016604	1.72	3.519592	.016237
1.23	2.716223	.016593	1.73	3.535829	.016231
1.24	2.732816	.016583	1.74	3.552060	.016227
1.25	2.749399	.016572	1.75	3.568287	.016223
1.26	2.765971	.016562	1.76	3.584510	.016217
1.27	2.782533	.016552	1.77	3.600727	.016213
1.28	2.799085	.016542	1.78	3.616940	.016209
1.29	2.815627	.016532	1.79	3.633149	.016204
1.30	2.832159	.016523	1.80	3.649353	.016200
1.31	2.848682	.016514	1.81	3.665553	.016195
1.32	2.865196	.016505	1.82	3.681748	.016191
1.33	2.881700	.016495	1.83	3.697939	.016187
1.34	2.898195	.016487	1.84	3.714126	.016183
1.35	2.914682	.016477	1.85	3.730309	.016178
1.36	2.931159	.016469	1.86	3.746487	.016175
1.37	2.947628	.016461	1.87	3.762662	.016170
1.38	2.964089	.016453	1.88	3.778832	.016167
1.39	2.980542	.016444	1.89	3.794999	.016162
1.40	2.996986	.016436	1.90	3.811161	.016159
1.41	3.013422	.016428	1.91	3.827320	.016155
1.42	3.029850	.016421	1.92	3.843475	.016151
1.43	3.046271	.016413	1.93	3.859626	.016148
1.44	3.062684	.016406	1.94	3.875774	.016143
1.45	3.079090	.016398	1.95	3.891917	.016141
1.46	3.095488	.016391	1.96	3.908058	.016136
1.47	3.111879	.016383	1.97	3.924194	.016133
1.48	3.128262	.016377	1.98	3.940327	.016130
1.49	3.144639	.016370	1.99	3.956457	.016126
1.50	3.161009		2.00	3.972583	

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TABLE OF k CON'T.

f	k	k	f	k	k
2.00	3.972583	.161082	4.00	7.160161	
2.10	4.133665	.160781	4.10	7.318484	.158323
2.20	4.294446	.160512	4.20	7.476755	.158271
2.30	4.454958	.160273	4.30	7.634976	.158221
2.40	4.615231	.160057	4.40	7.793150	.158174
2.50	4.775288	.159862	4.50	7.951280	.158130
2.60	4.935150	.159687	4.60	8.109369	.158089
2.70	5.094837	.159528	4.70	8.267419	.158050
2.80	5.254365	.159382	4.80	8.425432	.158013
2.90	5.413747	.159249	4.90	8.583411	.157979
3.00	5.572996	.159128	5.00	8.741357	.157946
3.10	5.732124	.159017	5.50	9.530653	.789296
3.20	5.891141	.158914	6.00	10.319348	.788695
3.30	6.050055	.158820	6.50	11.107573	.788225
3.40	6.208875	.158732	7.00	11.895420	.787847
3.50	6.367607	.158651	7.50	12.682962	.787542
3.60	6.526258	.158576	8.00	13.470251	.787289
3.70	6.684834	.158506	8.50	14.257331	.787080
3.80	6.843340	.158441	9.00	15.044233	.786902
3.90	7.001781	.158380	9.50	15.830985	.786752
4.00	7.160161		10.00	16.617608	.786623

Expansions:

- (1) Six decimal accuracy,
- $-1.00 < f < -.70$
- ,

$$1 - k = 2 \cdot \exp \frac{-2}{1+f} \cdot \left(1 + \frac{2-f}{1+f} \exp \frac{2}{1+f} + \dots \right).$$

- (2) Six decimal accuracy,
- $-.15 < f < .15$
- ,

$$k = \sqrt{|3f|} \left(1 + .4f - .068571f^2 + .016f^3 + .002464f^4 + \dots \right).$$

- (3) Four decimal accuracy,
- $8 < f < \infty$
- ,

$$\frac{1}{k} = \frac{.6366198}{1+f} + \frac{.258012}{(1+f)^2} + \frac{.20914}{(1+f)^3} + \frac{.17704}{(1+f)^4} + \frac{.15570}{(1+f)^5} + \dots$$

Derivatives:

$$(4) \quad \frac{dk}{df} = \frac{k(1+k^2)}{(1+f)(k^2+f)}, \quad 0 < f < \infty; \quad = -\frac{k(1-k^2)}{(1+f)(k^2+f)}, \quad -1 < f < 0.$$

$$(5) \quad \frac{d^2k}{df^2} = -\frac{2fk(1+k^2)}{(1+f)(k^2+f)^2}, \quad 0 < f < \infty; \quad = \frac{2fk(1-k^2)}{(1+f)(k^2+f)^2}, \quad -1 < f < 0.$$

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