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THE GROUP CONSTANTS FOR THE keV CAPTURE OF STRUCTURAL MATERIALS Cr, Fe AND Ni

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Group Constants for the KeV Capture of Structural Materials Cr, Fe and Ni

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The effective capture cross sections of Cr, Fe and Ni are calculated in the energy range of 1.0 to 800 kev, and the group constants of ABBN type are given for the 70-group structure of JAERI-Fast Set. Using the various evaluated nuclear data, the uncertainties of these cross sections are investigated through comparisons of the group constants and analysis of the Doppler effects of stainless steel and natural iron samples. The uncertainties in the 1.15 kev resonance parameter of ^{56}Fe and in the smooth capture cross sections near the resonance energy are very large and have important influence in analysis of the Doppler coefficients. In the Doppler analysis, the results obtained with ENDF/B-III data are better than those with other data. The experimental values are well reproduced by raising the capture cross sections of iron in ENDF/B-III data by about 15% in the energy range of 1.0 to 800 kev.

構造材Cr，FeとNiのKeV領域での捕獲に対する群定数

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Cr，FeとNiの実効捕獲断面積が1～800KeVの範囲で計算され，ABBN型の群定数がJAFRI－Fast setの70群構造で与えられる。幾つかの評価済み核データを用いてこれらの断面積の不確かさが調査される。このことは群定数及びS.SとFe試料のドップラー実験解析に対する比較から検討される。^{56}Feの1.15KeVの共鳴パラメータとこのエネルギー附近での滑らかな捕獲断面積に対する不確かさは大変大きく，ドップラー係数に大きな影響を与えることが示される。ドップラー解析においてENDF／B－Ⅲを用いた結果は他の核データを用いた結果よりも良く，更に1～800KeVでENDF／B－ⅢデータのFeの捕獲断面積を約15％大きくすると実験値を非常によく再現することが分った。

Contents

1. Introduction

In a fast reactor, Cr, Fe and Ni are much contained as structural materials. The accuracies for capture cross sections of these materials will be very important for calculation of breeding ratio in a large fast breeder reactor. However, uncertainties in nuclear data for these materials are large at present. In recent analyses of critical assemblies, the reference value of cross section is often largely changed for good reproduction of integral quantity.[(1)-(3)] For example, the adjustments of group constants using least squares methods produced large deviation (40%) for iron capture cross sections.[(1)(2)]

For capture cross sections of structural materials in the energy range between 1 kev to 1 MeV, the required target accuracies are given to be ± 10% for stainless steel from consideration on breeding gain for large LMFBR systems.[(4)] Taking account of this target value, the variations given by the adjustments seem too large. Before adjusting the cross sections of Cr, Fe and Ni, therefore, the detailed investigation of the uncertainties and accuracies for them should be done.

In the present report, the comparisons among the various evaluated nuclear data for Cr, Fe and Ni are done. The effective capture cross sections are calculated from these data, and an intercomparison will be made also for the infinitely dilute cross sections and temperature coefficients of self-shielding factors. Furthermore, the accuracies of three resonance parameter sets (ENDF/B-II, -III and Story's[(5)] data) are investigated through the analysis of Doppler effects for stainless steel and natural iron samples.

2. Comparisons of Nuclear Data of Cr, Fe and Ni

The four evaluated nuclear data, ENDF/B-II, -III, Story's, and KEDAK data[6], are considered here. These data consist of the smooth and resonance cross sections, as usual. In Table 1 are shown the numbers of resonances classified as Doppler broadened and unbroadened resonances. The condition of the Doppler broadened resonance is $\theta_\lambda \lesssim 3.0$, where $\theta_\lambda = \Gamma_\lambda/\Delta$, Γ_λ the total width for resonance level λ, and Δ the Doppler width. The differences among these numbers of resonances are very remarkable. In both of the Story's and KEDAK data, the d-wave resonances of ^{56}Fe exist. The number of resonances of ^{56}Fe of ENDF/B-III is less than that of ENDF/B-II. The Doppler broadened resonances are almost for p-wave sharp resonance ($\ell = 1$). The Doppler broadened resonances in KEDAK data are a few and θ_λ-values are large except for the 1.15 kev resonance of ^{56}Fe. The other sharp resonances seem to be included in the smooth cross section. From this reason, the KEDAK data are not used in the present study. The remarkable difference among these resonance parameters will be attributed to the difficulties of measurement for sharp resonances and of the cross section fits.

In Figs. 1～6, the comparisons of the unbroadened capture cross sections and total cross sections for Cr, Fe and Ni are shown for the four nuclear data files. The Story's data did not contain the data of Cr at the time of this study. The ENDF/B-II and -III data for Cr are in good agreement, though the resonance parameters differ each other. In the iron cross sections, both the data of ENDF/B-III and of Story show very similar variations, while the unbroadened capture cross sections from ENDF/B-II and KEDAK data are larger than the two other data. The total cross sections of ENDF/B-II, -III and Story's data for Fe are in very good agreements except for those of KEDAK data. The total cross sections of Ni of all the files are very like each other, hence they seem to be based on the same measurement.

In Table 2, for the most important 1.15 kev resonance of ^{56}Fe are done the comparison of both the resonance parameters and infinite dilution cross sections. The differences for the neutron widths among these data are very large. Consequently, the tendency is similar also for the infinite dilution cross sections. The difference between ENDF/B-II and -III is about 2 in factor. This large discrepancies will importantly influence on the calculation of the Doppler effect of stainless steel and natural iron samples.

The effective capture cross sections for Cr, Fe and Ni were calculated under the narrow resonance approximation, assuming constant collision density on each energy group.[7] The shielding factors and infinite dilution cross sections for the 70-group structure of the JAERI-Fast set[8] were obtained for the four nuclear data files in the energy range from 800 to 1 kev. In Tables 3~10 the calculated results are given for the temperatures 300, 600, 900 and 2100 °K and σ_0= 0, 1, 10, 100, and 1000, where σ_0 is the sum of the total cross section of the other element per the atom under consideration.

In Figs. 7-9, the comparisons of the infinite dilution capture cross sections for Cr, Fe and Ni are done. The capture cross sections of Fe for ENDF/B-II data are considerably large as compared with those of ENDF/B-III and of Story's data in the energy range 20 to 100 kev. However, this tendency becomes reversely for the energy range near the important 1.15 kev resonance. The values of ENDF/B-III are larger than those of Story for the energy range below 100 kev which is main Doppler region for structural materials. The capture cross sections of Ni in ENDF/B-II data show large deviations from those of ENDF/B-III and of Story in the energy range from 8 to 18 kev.

Table 11 compares the temperature coefficients for self-shielding factors of Cr, Fe and Ni. They are especially shown for the important energy groups where the infinite dilution capture cross sections are large. The differences among these temperature coefficients especially stand out for the cross section of Fe and importantly influence on the Doppler effect for the structural materials.

3. Comparison of Doppler Coefficients Calculated from Three Nuclear Data with Experiments

The Doppler effects of natural iron and stainless steel (74% Fe, 18% Cr and 8% Ni) were measured in assemblies FCA V-1, V-2, VI-1, and VI-2 cores.(9)(10) These experiments showed that the Doppler effect due to structural materials was an important correction factor to small-sample Doppler experiments of higher isotopes such as ^{235}U, ^{238}U, or plutonium.(9) In anticipation of an important contribution to fast reactor safety, these Doppler experiments were analyzed using the JAERI-Fast set and various nuclear data files for the cross sections of Cr, Fe and Ni.(10)(11)(12) The Doppler coefficients were calculated by first-order perturbation theory with one and two dimensional diffusion equations using the group constants in Tables 3～10. The detailes of the calculated results will be seen in Refs. (10), (11) and (12), and the comparisons of the calculated results with the measured ones are reviewed in Figs. 10～15. The agreement between the measured and calculated values is rather poor, and the disagreement is especially remarkable for the FCA-VI-1 core. However, the experimental values for the assembly VI-1 do not monotonously increase according as temperature rising. Hence, it may be considered that this experiment includes some systematic errors. Among the three nuclear data, the results from ENDF/B-III data are better than those from the others, but the differences between the experiments and these values are about 20～35%.

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In Figs. 16 and 17 are shown the contribution to the Doppler coefficients from each energy group for the iron-sample and for the stainless steel - sample in the FCA-V-2 and -1, respectively. From these figures, it is found that the 1.15 kev resonance of ^{56}Fe contributes to the total Doppler effect of these samples by about 50 ~ 60% and that another important energy range is from 20 to 60 kev. For the stainless steel sample, the 1.62 kev resonance of ^{52}Cr is also important. The assemblies V-1 and -2 are physics mockup cores of JOYO (Experimental Fast Reactor) and have harder spectrum than the assemblies VI-1 and -2 which are physics mockup cores of the outer and inner core compositions of MONJU (Prototype Fast Reactor). This is shown in Fig. 18. In Fig. 19 are compared the contributions to the Doppler coefficients of iron sample from each energy group for three assemblies with the different spectra. In the assemblies VI-1 and -2, the contribution from the 1.15 kev resonance of ^{56}Fe to the total Doppler effect is larger than that in the V-2 core, by about 70%. However, it is very strange that the spectrum of the assembly VI-2 is softer than that of the VI-1 core but the Doppler effect in the assembly VI-2 is smaller than that in the assembly VI-1. In the energy region below 1.0 kev the cross sections of Fe is smooth. Therefore, the value of the relative flux at core center for the energy group including the 1.15 kev resonance have very important influence on the magnitude of the total Doppler effect.

On the other hand, the differences among the Doppler coefficients obtained from three nuclear data files are considerably large. The about ninety percent of the differences comes from the uncertainty in the resonance parameter of the 1.15 kev resonance of ^{56}Fe. This fact can be ascertained by seeing again the results listed in Tables 2 and 11.

To estimate clearly the uncertainty of Fe cross section, a more accurate calculation of the effective Doppler cross sections was made by using the integral transport code

PEACO-II[13] for the important energy range 1 to 1.29 kev.[10] This detailed calculation showed that the analytical method using the equivalence relation underestimated about 10% to the temperature coefficient of the effective cross sections. Thus, for good reproduction of the Doppler effects of the natural iron and stainless steel in the assemblies V-1, V-2 and VI-2 cores, an about 15% raise of σ_c for Fe in ENDF/B-III data will be required. In Figs. 10∼15, the results obtained by 25% raising of σ_c for Fe in ENDF/B-III data at the presently considered energy range are shown by a dotted line, and very good reproduction of the experiments will be seen except for the VI-1 core.

4. Conclusions

The group constants for capture cross sections of Cr, Fe and Ni were made with the 70-group structure of JAERI-Fast Set in the energy range from 1.0 to 800 kev. The uncertainties of these cross sections were investigated by intercomparison of the microscopic cross sections and of the effective cross sections calculated from the various evaluated nuclear data, respectively. Furthermore, the influences of the uncertainties on the Doppler effect were definitely shown through the analysis of the Doppler experiments for stainless-steel and natural iron samples measured in FCA-V-1, V-2, VI-1 and VI-2 cores.

The uncertainty for the important 1.15 kev resonance of ^{56}Fe is very large, and therefore the precise evaluation will be firstly demanded at any rate. Among the nuclear data used here, the results using ENDF/B-III data show better values than the results using the other data, for Doppler analysis. It was found that the experimental values were very well reproduced by raising the capture cross sections of iron for ENDF/B-III data by about 15% in the energy range from 1 to 800 kev.

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References

1. ROWLANDS, J.L., et al. : The Production and Performance of the Adjusted Cross Section - Set FGL 5., Inter. Sympo. Phys. Fast Reac. IAEA Tokyo (1973), paper A30.
2. KUROI, H., et al. : Adjusted Cross Section Library AGLI and Reliability of Analysis of Integral Data., ibid (1973), paper A33.
3. YOSHIDA, T., et al. : Proc. AESJ 1973 Topical Meeting on Fast Reactor Physics, paper A9 (in Japanese).
4. COWAN, C.L., et al. : Comparison of Two Sodium -Cooled 1000 MWe Fast Reactor Concepts, Section VI Nuclear Design, GEAP-5618 (1968).
5. STORY, J.S. : Private communication (1973).
6. WOLL, D. : Card Image Format of the Karlsruhe Evaluated Nuclear Data File, KFK-880 (1968).
7. ISHIGURO, Y. : JAERI-M-4660 (1971).
8. KATSURAGI, S., et al. : JAERI-1195 (1970) and JAERI-1199 (1970).
9. IIJIMA, T., et al. : Doppler Experiments in FCA, paper submitted to the 14th EACRP Meeting, Stockholm, June (1971).
10. ISHIGURO, Y., et al. : Measurements and Analysis of the Doppler Effect of Structural Materials, Inter. Sympo. Phys. Fast Reac. IAEA Tokyo (1973), paper B21.
11. ISHIGURO, Y. : Nucl. Sci. Eng., 49, 228, 1972.
12. TAKANO, H., et al. : Comparison of Effective Capture Cross Sections and Doppler Coefficients for Structural Materials Calculated by Three Evaluated Nuclear Data, paper submitted to on ad hoc working group meeting on the kev capture of the structural materials Ni, Fe, Cr., Karlsruhe, May (1973).
13. ISHIGURO, Y. : JAERI-M-5527 (1974).

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Table 1. Numbers of Doppler broadened and unbroadened resonances

Material		ℓ	Broadened resonance				Unbroadened resonance			
			ENDF/B-II	ENDF/B-III	KEDAK	STORY	ENDF/B-II	ENDF/B-III	KEDAK	STORY
Cr	50	0	1	1	0		14	37	5	
		1	12	12	0		2	8	0	
	52	0	0	0	0		6	14	14	
		1	25	35	18		8	24	26	
	53	0	0	0	0		15	15	1	
		1	10	10	0		0	0	0	
	54	0	0	0	0		6	14	3	
		1	8	8	0		2	5	0	
Fe	54	0	0	0	0	0	20	2	20	27
		1	18	2	12	19	12	0	12	7
	56	0	1	0	2	0	32	2	22	26
		1	35	12	8	23	60	0	17	14
		2	0	0	1	6	0	0	0	0
	57	0	0	0	0	1	3	3	2	23
		1	7	8	0	9	0	0	0	0
Ni	58	0	0	0	0	0	15	31	9	20
		1	9	17	0	13	8	19	0	0
	60	0	21	0	0	0	21	40	9	20
		1	0	25	0	11	29	24	0	0
	62	0	0	0	0	0	10	35	1	20
		1	2	6	0	0	6	29	0	0
	64	0	0	0	0	1	9	24	0	18
		1	3	12	0	0	8	12	0	0
	61	0				7				26
		1				3				1

TABLE 2. Comparison of the 1.15 keV resonance parameters and infinitely dilute capture cross section of ^{56}Fe

	E_λ (keV)	g_J	Γ_n (eV)	Γ_γ (eV)	σ_γ for 1.0 to 1.29 keV (barn)
ENDF/B-III	1.15	1.0	0.086	0.6	0.8891
ENDF/B-II	1.15	1.0	0.04	0.6	0.4446
STORY	1.154	1.0	0.0592	0.58	0.6290
KEDAK	1.15	1.0	0.04	0.6	0.4446
RIBON	1.16	1.0	0.05	0.45	0.5204

TABLE 3. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF FE OBTAINED FROM STORYS DATA

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	SHIELDING FACTORS $\sigma_0=0$	$\sigma_0=1$	$\sigma_0=10$	$\sigma_0=100$	$\sigma_0=1000$
20	100.0 - 77.3	0.00521	300.	0.5136	0.5218	0.6497	0.9048	0.9884
			600.	0.5196	0.5291	0.6617	0.9120	0.9894
			900.	0.5244	0.5350	0.6704	0.9163	0.9901
			2100.	0.5382	0.5513	0.6919	0.9254	0.9903
21	77.3 - 59.8	0.00427	300.	0.5645	0.5629	0.6689	0.9075	0.9881
			600.	0.5645	0.5629	0.6689	0.9075	0.9881
			900.	0.5645	0.5629	0.6689	0.9075	0.9881
			2100.	0.5645	0.5629	0.6689	0.9075	0.9881
22	59.8 - 46.5	0.00957	300.	0.5966	0.6303	0.7756	0.9470	0.9929
			600.	0.6363	0.6681	0.8024	0.9551	0.9941
			900.	0.6588	0.6894	0.8174	0.9596	0.9947
			2100.	0.7034	0.7314	0.8468	0.9681	0.9951
23	46.5 - 36.0	0.01041	300.	0.6435	0.6732	0.8090	0.9619	0.9957
			600.	0.6915	0.7193	0.8424	0.9704	0.9971
			900.	0.7185	0.7450	0.8602	0.9746	0.9977
			2100.	0.7700	0.7937	0.8921	0.9817	0.9986
24	36.0 - 27.8	0.01964	300.	0.5738	0.5902	0.6819	0.8762	0.9810
			600.	0.6112	0.6259	0.7063	0.8814	0.9816
			900.	0.6322	0.6457	0.7189	0.8839	0.9819
			2100.	0.6720	0.6827	0.7411	0.8880	0.9824
25	27.8 - 21.5	0.01956	300.	0.4155	0.4735	0.6522	0.8798	0.9835
			600.	0.4420	0.4985	0.6636	0.8813	0.9836
			900.	0.4577	0.5124	0.6691	0.8820	0.9837
			2100.	0.4890	0.5389	0.6785	0.8832	0.9838
26	21.5 - 16.6	0.00226	300.	0.8895	0.9096	0.9661	0.9945	0.9990
			600.	0.8991	0.9182	0.9702	0.9958	0.9996
			900.	0.9061	0.9244	0.9730	0.9965	0.9999
			2100.	0.9238	0.9397	0.9795	0.9978	1.0003
27	16.6 - 12.9	0.00438	300.	0.8252	0.8529	0.9394	0.9913	0.9997
			600.	0.8530	0.8776	0.9512	0.9925	1.0000
			900.	0.8683	0.8910	0.9574	0.9939	1.0001
			2100.	0.8969	0.9155	0.9681	0.9960	1.0004
28	12.9 - 10.0	0.00732	300.	0.8790	0.8950	0.9524	0.9929	1.0002
			600.	0.9088	0.9217	0.9658	0.9954	1.0005
			900.	0.9238	0.9349	0.9722	0.9966	1.0006
			2100.	0.9494	0.9573	0.9826	0.9984	1.0008

TABLE 3. (CONTINUED)

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	$\sigma_0=0$	$\sigma_0=1$	$\sigma_0=10$	$\sigma_0=100$	$\sigma_0=1000$
29	10.00 - 7.73	0.01919	300.	0.8165	0.8287	0.8896	0.9753	0.9988
			600.	0.8289	0.8398	0.8952	0.9759	0.9989
			900.	0.8353	0.8456	0.8981	0.9764	0.9990
			2100.	0.8467	0.8556	0.9029	0.9773	0.9991
30	7.73 - 5.98	0.02272	300.	0.9081	0.9142	0.9459	0.9889	0.9999
			600.	0.9090	0.9150	0.9464	0.9891	1.0000
			900.	0.9094	0.9154	0.9467	0.9892	1.0000
			2100.	0.9102	0.9161	0.9471	0.9893	1.0000
31	5.98 - 4.65	0.00572	300.	0.9804	0.9824	0.9895	0.9955	0.9965
			600.	0.9811	0.9830	0.9899	0.9955	0.9965
			900.	0.9814	0.9833	0.9901	0.9955	0.9965
			2100.	0.9819	0.9837	0.9904	0.9956	0.9965
32	4.65 - 3.60	0.00849	300.	0.9107	0.9198	0.9583	0.9936	1.0003
			600.	0.9107	0.9198	0.9583	0.9936	1.0003
			900.	0.9107	0.9198	0.9583	0.9936	1.0003
			2100.	0.9107	0.9198	0.9583	0.9936	1.0003
33	3.60 - 2.78	0.00375	300.	0.9999	0.9998	0.9995	0.9992	0.9992
			600.	0.9999	0.9998	0.9995	0.9992	0.9992
			900.	0.9999	0.9998	0.9995	0.9992	0.9992
			2100.	0.9999	0.9998	0.9995	0.9992	0.9992
34	2.78 - 2.15	0.00522	300.	0.9912	0.9915	0.9943	0.9967	0.9971
			600.	0.9915	0.9922	0.9946	0.9968	0.9971
			900.	0.9919	0.9924	0.9948	0.9968	0.9971
			2100.	0.9924	0.9929	0.9950	0.9968	0.9971
35	2.15 - 1.66	0.00532	300.	1.0020	1.0022	1.0029	1.0036	1.0037
			600.	1.0020	1.0022	1.0029	1.0036	1.0037
			900.	1.0020	1.0022	1.0029	1.0036	1.0037
			2100.	1.0020	1.0022	1.0029	1.0036	1.0037
36	1.66 - 1.29	0.01344	300.	0.9928	0.9936	0.9972	1.0001	1.0015
			600.	0.9978	0.9982	0.9997	1.0009	1.0015
			900.	1.0004	1.0005	1.0010	1.0013	1.0016
			2100.	1.0051	1.0048	1.0033	1.0018	1.0016
37	1.29 - 1.00	0.62896	300.	0.2911	0.3056	0.4102	0.7534	0.9623
			600.	0.3256	0.3420	0.4571	0.7949	0.9704
			900.	0.3511	0.3686	0.4893	0.8186	0.9746
			2100.	0.4167	0.4363	0.5651	0.8642	0.9819

TABLE 4. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF NI OBTAINED FROM STORYS DATA

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	σ_0=0	σ_0=1	σ_0=10	σ_0=100	σ_0=1000
				SHIELDING FACTORS				
20	100.0 - 77.3	0.00305	300.	0.9191	0.9232	0.9518	0.9904	0.9990
			600.	0.9199	0.9240	0.9523	0.9906	0.9990
			900.	0.9204	0.9244	0.9525	0.9906	0.9991
			2100.	0.9210	0.9250	0.9529	0.9907	0.9991
21	77.3 - 59.8	0.00709	300.	0.7065	0.7162	0.7853	0.9387	0.9919
			600.	0.7065	0.7162	0.7853	0.9387	0.9919
			900.	0.7065	0.7162	0.7853	0.9387	0.9919
			2100.	0.7065	0.7162	0.7853	0.9387	0.9919
22	59.8 - 46.5	0.00180	300.	1.1246	1.1030	1.0406	1.0053	0.9999
			600.	1.1246	1.1030	1.0406	1.0053	0.9999
			900.	1.1246	1.1030	1.0406	1.0053	0.9999
			2100.	1.1246	1.1030	1.0406	1.0053	0.9999
23	46.5 - 36.0	0.02092	300.	0.6421	0.6617	0.7712	0.9445	0.9938
			600.	0.6723	0.6916	0.7967	0.9529	0.9950
			900.	0.6907	0.7097	0.8115	0.9575	0.9949
			2100.	0.7292	0.7473	0.8407	0.9657	0.9963
24	36.0 - 27.8	0.03134	300.	0.7429	0.7556	0.8288	0.9554	0.9945
			600.	0.7852	0.7969	0.8628	0.9668	0.9954
			900.	0.8102	0.8213	0.8820	0.9726	0.9964
			2100.	0.8608	0.8700	0.9184	0.9827	0.9979
25	27.8 - 21.5	0.01929	300.	0.8745	0.8822	0.9237	0.9835	0.9986
			600.	0.9224	0.9280	0.9562	0.9915	0.9998
			900.	0.9488	0.9530	0.9731	0.9956	1.0004
			2100.	0.9981	0.9993	1.0030	1.0022	1.0012
26	21.5 - 16.6	0.03486	300.	0.9358	0.9391	0.9586	0.9910	0.9989
			600.	0.9692	0.9714	0.9834	0.9983	1.0003
			900.	0.9881	0.9896	0.9969	1.0019	1.0009
			2100.	1.0244	1.0243	1.0219	1.0083	1.0018
27	16.6 - 12.9	0.16079	300.	0.9228	0.9244	0.9365	0.9754	0.9969
			600.	0.9376	0.9390	0.9494	0.9811	0.9978
			900.	0.9457	0.9470	0.9563	0.9839	0.9980
			2100.	0.9607	0.9617	0.9690	0.9890	0.9989
28	12.9 - 10.0	0.06169	300.	0.6871	0.6979	0.7661	0.9231	0.9907
			600.	0.6871	0.6979	0.7662	0.9232	0.9907
			900.	0.6872	0.6979	0.7662	0.9232	0.9907
			2100.	0.6872	0.6980	0.7662	0.9232	0.9907
			TABLE 4. (CONTINUED)					
29	10.00 - 7.73	0.01966	300.	0.9904	0.9914	0.9961	1.0007	1.0014
			600.	0.9922	0.9931	0.9971	1.0010	1.0016
			900.	0.9934	0.9942	0.9978	1.0011	1.0017
			2100.	0.9966	0.9971	0.9994	1.0004	1.0018
30	7.73 - 5.98	0.02862	300.	1.0067	1.0065	1.0053	1.0021	1.0014
			600.	1.0104	1.0100	1.0075	1.0024	1.0015
			900.	1.0124	1.0119	1.0086	1.0028	1.0015
			2100.	1.0158	1.0151	1.0107	1.0034	1.0016
31	5.98 - 4.65	0.02915	300.	0.9806	0.9815	0.9870	0.9941	0.9963
			600.	0.9842	0.9850	0.9895	0.9950	0.9964
			900.	0.9860	0.9867	0.9907	0.9955	0.9965
			2100.	0.9890	0.9896	0.9928	0.9961	0.9966
32	4.65 - 3.60	0.02842	300.	0.9897	0.9902	0.9930	0.9989	1.0009
			600.	0.9897	0.9902	0.9930	0.9989	1.0009
			900.	0.9897	0.9902	0.9930	0.9989	1.0009
			2100.	0.9897	0.9902	0.9930	0.9989	1.0009
33	3.60 - 2.78	0.02989	300.	0.9574	0.9595	0.9714	0.9921	0.9983
			600.	0.9578	0.9598	0.9715	0.9922	0.9983
			900.	0.9580	0.9600	0.9717	0.9923	0.9983
			2100.	0.9582	0.9602	0.9720	0.9924	0.9984
34	2.78 - 2.15	0.07354	300.	0.8245	0.8324	0.8803	0.9671	0.9921
			600.	0.8545	0.8614	0.9027	0.9737	0.9936
			900.	0.8719	0.8782	0.9152	0.9772	0.9943
			2100.	0.9058	0.9107	0.9388	0.9834	0.9954
35	2.15 - 1.66	0.01564	300.	1.0037	1.0037	1.0037	1.0037	1.0037
			600.	1.0037	1.0037	1.0037	1.0037	1.0037
			900.	1.0037	1.0037	1.0037	1.0037	1.0037
			2100.	1.0037	1.0037	1.0037	1.0037	1.0037
36	1.66 - 1.29	0.04394	300.	0.9293	0.9337	0.9552	0.9904	0.9991
			600.	0.9379	0.9413	0.9611	0.9920	0.9998
			900.	0.9433	0.9465	0.9648	0.9930	1.0001
			2100.	0.9549	0.9575	0.9724	0.9949	1.0006
37	1.29 - 1.00	0.01906	300.	0.9988	0.9989	0.9990	0.9991	0.9991
			600.	0.9988	0.9989	0.9990	0.9991	0.9991
			900.	0.9988	0.9989	0.9990	0.9991	0.9991
			2100.	0.9988	0.9989	0.9990	0.9991	0.9991

TABLE 5. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF CR OBTAINED FROM ENDF/B-II

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	SHIELDING FACTORS σ_0 =0	σ_0 =1	σ_0 =10	σ_0 =100	σ_0 =1000
			300.	0.9754	0.9826	0.9948	0.9991	0.9997
11	800.0 -630.0	0.00384	600.	0.9754	0.9826	0.9948	0.9991	0.9997
			900.	0.9754	0.9826	0.9948	0.9991	0.9997
			2100.	0.9754	0.9826	0.9948	0.9991	0.9997
			300.	1.0001	1.0001	1.0001	1.0001	1.0001
12	630.0 -500.0	0.00299	600.	1.0001	1.0001	1.0001	1.0001	1.0001
			900.	1.0001	1.0001	1.0001	1.0001	1.0001
			2100.	1.0001	1.0001	1.0001	1.0001	1.0001
			300.	0.9993	0.9995	1.0000	1.0002	1.0002
13	500.0 -400.0	0.00315	600.	0.9993	0.9995	1.0000	1.0002	1.0002
			900.	0.9993	0.9995	1.0000	1.0002	1.0002
			2100.	0.9993	0.9995	1.0000	1.0002	1.0002
			300.	1.0013	1.0012	1.0007	1.0002	1.0002
14	400.0 -310.0	0.00253	600.	1.0013	1.0012	1.0007	1.0002	1.0002
			900.	1.0013	1.0012	1.0007	1.0002	1.0002
			2100.	1.0013	1.0012	1.0007	1.0002	1.0002
			300.	0.7316	0.7524	0.8512	0.9680	0.9958
15	310.0 -250.0	0.00341	600.	0.7325	0.7534	0.8523	0.9685	0.9959
			900.	0.7333	0.7543	0.8532	0.9688	0.9955
			2100.	0.7362	0.7573	0.8563	0.9699	0.9959
			300.	0.7121	0.7309	0.8305	0.9615	0.9949
16	250.0 -200.0	0.00424	600.	0.7129	0.7318	0.8315	0.9620	0.9950
			900.	0.7136	0.7326	0.8325	0.9623	0.9951
			2100.	0.7160	0.7351	0.8352	0.9633	0.9950
			300.	0.8747	0.8856	0.9321	0.9851	0.9985
17	200.0 -150.0	0.00475	600.	0.8773	0.8882	0.9343	0.9860	0.9986
			900.	0.8791	0.8900	0.9360	0.9867	0.9987
			2100.	0.8839	0.8949	0.9407	0.9883	0.9990
			300.	0.7959	0.8289	0.9210	0.9862	0.9985
18	150.0 -120.0	0.00857	600.	0.8111	0.8421	0.9267	0.9870	0.9986
			900.	0.8191	0.8489	0.9295	0.9875	0.9986
			2100.	0.8334	0.8602	0.9338	0.9881	0.9987
			300.	0.8402	0.8586	0.9279	0.9863	0.9978
19	120.0 -100.0	0.00953	600.	0.8493	0.8668	0.9325	0.9872	0.9979
			900.	0.8537	0.8709	0.9346	0.9875	0.9980
			2100.	0.8611	0.8776	0.9381	0.9881	0.9980

TABLE 5. (CONTINUED)

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	σ_0 =0	σ_0 =1	σ_0 =10	σ_0 =100	σ_0 =1000
			300.	0.7512	0.7790	0.8741	0.9731	0.9970
20	100.0 - 77.3	0.01082	600.	0.7545	0.7817	0.8749	0.9732	0.9970
			900.	0.7562	0.7830	0.8753	0.9732	0.9970
			2100.	0.7591	0.7852	0.8760	0.9733	0.9970
			300.	0.9775	0.9817	0.9928	0.9984	0.9991
21	77.3 - 59.8	0.00763	600.	0.9777	0.9819	0.9929	0.9984	0.9992
			900.	0.9778	0.9820	0.9930	0.9985	0.9992
			2100.	0.9783	0.9825	0.9932	0.9985	0.9992
			300.	0.7864	0.8206	0.9104	0.9779	0.9966
22	59.8 - 46.5	0.02122	600.	0.8138	0.8471	0.9252	0.9803	0.9968
			900.	0.8290	0.8615	0.9326	0.9814	0.9970
			2100.	0.8580	0.8882	0.9452	0.9831	0.9972
			300.	0.8642	0.8965	0.9660	0.9960	1.0002
23	46.5 - 36.0	0.01606	600.	0.8657	0.8978	0.9666	0.9961	1.0002
			900.	0.8666	0.8986	0.9669	0.9962	1.0002
			2100.	0.8685	0.9002	0.9675	0.9962	1.0002
			300.	0.8596	0.8735	0.9224	0.9803	0.9976
24	36.0 - 27.8	0.03386	600.	0.8804	0.8925	0.9358	0.9852	0.9983
			900.	0.8925	0.9036	0.9435	0.9876	0.9986
			2100.	0.9172	0.9260	0.9587	0.9919	0.9991
			300.	0.7037	0.7311	0.8472	0.9706	0.9971
25	27.8 - 21.5	0.04566	600.	0.7234	0.7524	0.8681	0.9768	0.9981
			900.	0.7359	0.7656	0.8800	0.9798	0.9986
			2100.	0.7630	0.7936	0.9025	0.9850	0.9993
			300.	0.9732	0.9764	0.9886	0.9988	1.0008
26	21.5 - 16.6	0.02688	600.	0.9748	0.9777	0.9891	0.9989	1.0008
			900.	0.9757	0.9784	0.9893	0.9989	1.0008
			2100.	0.9770	0.9795	0.9897	0.9990	1.0008
			300.	0.9875	0.9897	0.9964	1.0002	1.0008
27	16.6 - 12.9	0.02765	600.	0.9887	0.9908	0.9969	1.0003	1.0008
			900.	0.9893	0.9913	0.9971	1.0003	1.0008
			2100.	0.9903	0.9921	0.9974	1.0004	1.0008
			300.	0.9926	0.9938	0.9978	1.0005	1.0010
28	12.9 - 10.0	0.03057	600.	0.9946	0.9956	0.9987	1.0007	1.0010
			900.	0.9957	0.9965	0.9991	1.0007	1.0010
			2100.	0.9975	0.9980	0.9997	1.0009	1.0011

TABLE 5. (CONTINUED)

			300.	0.9030	0.9079	0.9363	0.9852	1.0000
29	10.00 - 7.73	0.04828	600.	0.9030	0.9079	0.9363	0.9852	1.0000
			900.	0.9030	0.9079	0.9363	0.9852	1.0000
			2100.	0.9030	0.9079	0.9363	0.9852	1.0000
			300.	0.9916	0.9920	0.9946	0.9996	1.0012
30	7.73 - 5.98	0.08023	600.	0.9916	0.9920	0.9946	0.9996	1.0012
			900.	0.9916	0.9920	0.9946	0.9996	1.0012
			2100.	0.9916	0.9920	0.9946	0.9996	1.0012
			300.	0.9151	0.9170	0.9310	0.9726	0.9933
31	5.98 - 4.65	0.10601	600.	0.9151	0.9170	0.9310	0.9726	0.9933
			900.	0.9151	0.9170	0.9310	0.9726	0.9933
			2100.	0.9151	0.9170	0.9310	0.9726	0.9933
			300.	0.9860	0.9866	0.9903	0.9981	1.0008
32	4.65 - 3.60	0.06093	600.	0.9860	0.9866	0.9903	0.9981	1.0008
			900.	0.9860	0.9866	0.9903	0.9981	1.0008
			2100.	0.9860	0.9866	0.9903	0.9981	1.0008
			300.	0.9687	0.9705	0.9807	0.9951	0.9987
33	3.60 - 2.78	0.03330	600.	0.9687	0.9705	0.9807	0.9951	0.9987
			900.	0.9687	0.9705	0.9807	0.9951	0.9987
			2100.	0.9687	0.9705	0.9807	0.9951	0.9987
			300.	0.9909	0.9915	0.9942	0.9966	0.9971
34	2.78 - 2.15	0.02250	600.	0.9909	0.9915	0.9942	0.9966	0.9971
			900.	0.9909	0.9915	0.9942	0.9966	0.9971
			2100.	0.9909	0.9915	0.9942	0.9966	0.9971
			300.	1.0027	1.0028	1.0033	1.0036	1.0037
35	2.15 - 1.66	0.01922	600.	1.0027	1.0028	1.0033	1.0036	1.0037
			900.	1.0027	1.0028	1.0033	1.0036	1.0037
			2100.	1.0027	1.0028	1.0033	1.0036	1.0037
			300.	0.2698	0.2906	0.4287	0.7956	0.9732
36	1.66 - 1.29	0.42975	600.	0.3014	0.3252	0.4781	0.8339	0.9798
			900.	0.3247	0.3504	0.5113	0.8549	0.9831
			2100.	0.3850	0.4144	0.5872	0.8937	0.9887
			300.	0.9993	0.9993	0.9992	0.9991	0.9991
37	1.29 - 1.00	0.01908	600.	0.9993	0.9993	0.9992	0.9991	0.9991
			900.	0.9993	0.9993	0.9992	0.9991	0.9991
			2100.	0.9993	0.9993	0.9992	0.9991	0.9991

TABLE 6. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF FE OBTAINED FROM ENDF/B-II

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	SHIELDING FACTORS σ_0=0	σ_0=1	σ_0=10	σ_0=100	σ_0=1000
			300.	0.9367	0.9513	0.9807	0.9969	0.9994
11	800.0 -630.0	0.00502	600.	0.9368	0.9513	0.9807	0.9969	0.9994
			900.	0.9368	0.9514	0.9808	0.9969	0.9994
			2100.	0.9370	0.9516	0.9809	0.9969	0.9994
			300.	0.9138	0.9277	0.9693	0.9951	0.9994
12	630.0 -500.0	0.00507	600.	0.9139	0.9279	0.9697	0.9952	0.9993
			900.	0.9141	0.9282	0.9699	0.9953	0.9992
			2100.	0.9147	0.9291	0.9708	0.9956	0.9992
			300.	0.9715	0.9578	0.9723	0.9948	0.9993
13	500.0 -400.0	0.00502	600.	0.9719	0.9582	0.9726	0.9949	0.9994
			900.	0.9722	0.9586	0.9729	0.9950	0.9995
			2100.	0.9732	0.9597	0.9737	0.9952	0.9995
			300.	0.9554	0.9626	0.9821	0.9969	0.9997
14	400.0 -310.0	0.00499	600.	0.9556	0.9629	0.9827	0.9971	0.9998
			900.	0.9558	0.9633	0.9832	0.9972	0.9998
			2100.	0.9564	0.9644	0.9846	0.9976	0.9997
			300.	0.9693	0.9752	0.9900	0.9983	0.9996
15	310.0 -250.0	0.00563	600.	0.9693	0.9752	0.9900	0.9982	0.9996
			900.	0.9693	0.9752	0.9900	0.9982	0.9996
			2100.	0.9694	0.9752	0.9900	0.9982	0.9996
			300.	1.0076	0.9853	0.9853	0.9968	0.9992
16	250.0 -200.0	0.00624	600.	1.0076	0.9853	0.9853	0.9968	0.9992
			900.	1.0076	0.9853	0.9853	0.9968	0.9992
			2100.	1.0076	0.9853	0.9853	0.9968	0.9992
			300.	0.9627	0.9460	0.9658	0.9938	0.9996
17	200.0 -150.0	0.00569	600.	0.9627	0.9460	0.9658	0.9938	0.9996
			900.	0.9628	0.9460	0.9658	0.9938	0.9996
			2100.	0.9628	0.9460	0.9658	0.9938	0.9996
			300.	0.7559	0.7556	0.8657	0.9737	0.9970
18	150.0 -120.0	0.00659	600.	0.7559	0.7556	0.8657	0.9737	0.9970
			900.	0.7559	0.7556	0.8657	0.9737	0.9970
			2100.	0.7559	0.7556	0.8657	0.9737	0.9970
			300.	0.9068	0.9330	0.9802	0.9969	0.9990
19	120.0 -100.0	0.01521	600.	0.9068	0.9330	0.9802	0.9969	0.9990
			900.	0.9068	0.9330	0.9802	0.9969	0.9990
			2100.	0.9068	0.9330	0.9802	0.9969	0.9990

TABLE 6. (CONTINUED)

			300.	0.8973	0.9249	0.9652	0.9920	0.9991
20	100.0 - 77.3	0.01880	600.	0.8973	0.9249	0.9652	0.9920	0.9991
			900.	0.8973	0.9249	0.9652	0.9920	0.9991
			2100.	0.8973	0.9249	0.9652	0.9920	0.9991
			300.	0.8987	0.9036	0.9317	0.9808	0.9971
21	77.3 - 59.8	0.01721	600.	0.8987	0.9036	0.9317	0.9808	0.9971
			900.	0.8987	0.9036	0.9317	0.9808	0.9971
			2100.	0.8987	0.9036	0.9317	0.9808	0.9971
			300.	0.8420	0.8574	0.9216	0.9846	0.9974
22	59.8 - 46.5	0.02515	600.	0.8603	0.8751	0.9342	0.9876	0.9979
			900.	0.8709	0.8852	0.9409	0.9891	0.9981
			2100.	0.8919	0.9048	0.9532	0.9916	0.9984
			300.	0.8750	0.8872	0.9397	0.9897	0.9995
23	46.5 - 36.0	0.02472	600.	0.8962	0.9071	0.9522	0.9923	0.9998
			900.	0.9073	0.9174	0.9582	0.9934	0.9999
			2100.	0.9270	0.9355	0.9684	0.9954	1.0001
			300.	0.8159	0.8220	0.8573	0.9420	0.9911
24	36.0 - 27.8	0.02492	600.	0.8276	0.8329	0.8638	0.9432	0.9913
			900.	0.8337	0.8386	0.8670	0.9438	0.9913
			2100.	0.8446	0.8485	0.8724	0.9446	0.9914
			300.	0.6030	0.6636	0.7947	0.9284	0.9903
25	27.8 - 21.5	0.03168	600.	0.6169	0.6811	0.8032	0.9295	0.9904
			900.	0.6260	0.6915	0.8075	0.9300	0.9905
			2100.	0.6467	0.7128	0.8146	0.9308	0.9906
			300.	0.9898	0.9927	0.9985	1.0006	1.0010
26	21.5 - 16.6	0.01488	600.	0.9909	0.9936	0.9989	1.0007	1.0010
			900.	0.9915	0.9941	0.9990	1.0007	1.0010
			2100.	0.9926	0.9950	0.9993	1.0008	1.0010
			300.	0.9385	0.9489	0.9797	0.9976	1.0003
27	16.6 - 12.9	0.01919	600.	0.9459	0.9555	0.9829	0.9982	1.0004
			900.	0.9501	0.9592	0.9847	0.9985	1.0005
			2100.	0.9585	0.9665	0.9880	0.9990	1.0006
			300.	0.9476	0.9556	0.9815	0.9981	1.0007
28	12.9 - 10.0	0.02212	600.	0.9598	0.9664	0.9867	0.9989	1.0008
			900.	0.9661	0.9719	0.9892	0.9993	1.0009
			2100.	0.9771	0.9812	0.9933	1.0000	1.0010

TABLE 6. (CONTINUED)

			300.	0.7672	0.7850	0.8695	0.9733	0.9984
29	10.00 - 7.73	0.05817	600.	0.7720	0.7896	0.8727	0.9740	0.9986
			900.	0.7753	0.7928	0.8747	0.9744	0.9987
			2100.	0.7830	0.7999	0.8768	0.9752	0.9989
			300.	0.9554	0.9591	0.9764	0.9962	1.0008
30	7.73 - 5.98	0.06439	600.	0.9558	0.9595	0.9765	0.9962	1.0008
			900.	0.9560	0.9596	0.9766	0.9963	1.0008
			2100.	0.9563	0.9599	0.9767	0.9963	1.0008
			300.	0.9784	0.9810	0.9897	0.9955	0.9965
31	5.98 - 4.65	0.02787	600.	0.9786	0.9812	0.9898	0.9956	0.9965
			900.	0.9787	0.9812	0.9898	0.9956	0.9965
			2100.	0.9789	0.9814	0.9899	0.9956	0.9965
			300.	0.9528	0.9582	0.9797	0.9976	1.0008
32	4.65 - 3.60	0.01991	600.	0.9528	0.9582	0.9797	0.9976	1.0008
			900.	0.9528	0.9582	0.9797	0.9976	1.0008
			2100.	0.9528	0.9582	0.9797	0.9976	1.0008
			300.	1.0156	1.0133	1.0055	1.0001	0.9993
33	3.60 - 2.78	0.00699	600.	1.0156	1.0133	1.0055	1.0001	0.9993
			900.	1.0156	1.0133	1.0055	1.0001	0.9993
			2100.	1.0156	1.0133	1.0055	1.0001	0.9993
			300.	0.9512	0.9566	0.9773	0.9934	0.9968
34	2.78 - 2.15	0.00958	600.	0.9599	0.9643	0.9812	0.9943	0.9969
			900.	0.9642	0.9682	0.9832	0.9948	0.9969
			2100.	0.9716	0.9747	0.9864	0.9954	0.9970
			300.	1.0022	1.0023	1.0030	1.0036	1.0037
35	2.15 - 1.66	0.00500	600.	1.0022	1.0023	1.0030	1.0036	1.0037
			900.	1.0022	1.0023	1.0030	1.0036	1.0037
			2100.	1.0022	1.0023	1.0030	1.0036	1.0037
			300.	0.9814	0.9835	0.9922	0.9992	1.0014
36	1.66 - 1.29	0.01355	600.	0.9896	0.9908	0.9960	1.0003	1.0015
			900.	0.9937	0.9946	0.9980	1.0007	1.0015
			2100.	1.0010	1.0011	1.0014	1.0015	1.0016
			300.	0.3320	0.3504	0.4757	0.8132	0.9737
37	1.29 - 1.00	0.44457	600.	0.3710	0.3914	0.5260	0.8474	0.9794
			900.	0.3991	0.4207	0.5594	0.8663	0.9823
			2100.	0.4693	0.4927	0.6347	0.9017	0.9873

TABLE 7. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF NI OBTAINED FROM ENDF/B-II

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	SHIELDING FACTORS σ_0=0	σ_0=1	σ_0=10	σ_0=100	σ_0=1000
			300.	0.9768	0.9809	0.9921	0.9986	0.9996
11	800.0 -630.0	0.00740	600.	0.9768	0.9809	0.9921	0.9986	0.9996
			900.	0.9768	0.9809	0.9921	0.9986	0.9996
			2100.	0.9768	0.9809	0.9921	0.9986	0.9996
			300.	0.9987	0.9989	0.9996	1.0000	1.0001
12	630.0 -500.0	0.00642	600.	0.9987	0.9989	0.9996	1.0000	1.0001
			900.	0.9987	0.9989	0.9996	1.0000	1.0001
			2100.	0.9987	0.9989	0.9996	1.0000	1.0001
			300.	0.9980	0.9983	0.9993	1.0001	1.0002
13	500.0 -400.0	0.00621	600.	0.9980	0.9983	0.9993	1.0001	1.0002
			900.	0.9980	0.9983	0.9993	1.0001	1.0002
			2100.	0.9980	0.9983	0.9993	1.0001	1.0002
			300.	0.9990	0.9992	0.9997	1.0001	1.0001
14	400.0 -310.0	0.00630	600.	0.9990	0.9992	0.9997	1.0001	1.0001
			900.	0.9990	0.9992	0.9997	1.0001	1.0001
			2100.	0.9990	0.9992	0.9997	1.0001	1.0001
			300.	1.0051	1.0030	0.9990	0.9993	0.9996
15	310.0 -250.0	0.00846	600.	1.0051	1.0030	0.9990	0.9993	0.9996
			900.	1.0052	1.0030	0.9990	0.9993	0.9996
			2100.	1.0052	1.0030	0.9991	0.9993	0.9996
			300.	1.0224	1.0163	1.0034	0.9996	0.9993
16	250.0 -200.0	0.00954	600.	1.0224	1.0164	1.0034	0.9996	0.9994
			900.	1.0225	1.0164	1.0035	0.9996	0.9994
			2100.	1.0226	1.0166	1.0036	0.9997	0.9995
			300.	0.9750	0.9746	0.9823	0.9964	0.9999
17	200.0 -150.0	0.01239	600.	0.9751	0.9747	0.9823	0.9964	0.9999
			900.	0.9751	0.9747	0.9824	0.9964	0.9999
			2100.	0.9753	0.9750	0.9827	0.9966	0.9999
			300.	0.9114	0.9195	0.9550	0.9913	0.9989
18	150.0 -120.0	0.01617	600.	0.9116	0.9197	0.9551	0.9914	0.9989
			900.	0.9117	0.9198	0.9552	0.9914	0.9989
			2100.	0.9121	0.9202	0.9555	0.9914	0.9990
			300.	0.9254	0.9226	0.9395	0.9841	0.9975
19	120.0 -100.0	0.01530	600.	0.9254	0.9226	0.9395	0.9841	0.9975
			900.	0.9254	0.9226	0.9395	0.9841	0.9975
			2100.	0.9254	0.9226	0.9395	0.9841	0.9975

TABLE 7 (CONTINUED)

			300.	0.9625	0.9665	0.9824	0.9969	0.9998
20	100.0 - 77.3	0.01602	600.	0.9625	0.9665	0.9824	0.9969	0.9998
			900.	0.9625	0.9665	0.9824	0.9969	0.9998
			2100.	0.9625	0.9665	0.9824	0.9969	0.9998
			300.	0.8928	0.9041	0.9414	0.9849	0.9976
21	77.3 - 59.8	0.02097	600.	0.8929	0.9042	0.9414	0.9849	0.9976
			900.	0.8930	0.9043	0.9415	0.9849	0.9976
			2100.	0.8931	0.9043	0.9415	0.9849	0.9976
			300.	0.7068	0.7297	0.8254	0.9560	0.9941
22	59.8 - 46.5	0.02422	600.	0.7228	0.7464	0.8426	0.9633	0.9951
			900.	0.7327	0.7567	0.8531	0.9673	0.9950
			2100.	0.7542	0.7791	0.8748	0.9745	0.9963
			300.	0.7723	0.7841	0.8524	0.9642	0.9960
23	46.5 - 36.0	0.02482	600.	0.7884	0.8004	0.8675	0.9696	0.9969
			900.	0.7980	0.8100	0.8759	0.9723	0.9973
			2100.	0.8176	0.8294	0.8918	0.9769	0.9979
			300.	0.7382	0.7492	0.8156	0.9468	0.9932
24	36.0 - 27.8	0.04688	600.	0.7661	0.7768	0.8404	0.9569	0.9947
			900.	0.7834	0.7939	0.8551	0.9622	0.9954
			2100.	0.8207	0.8304	0.8849	0.9719	0.9964
			300.	0.8501	0.8583	0.9044	0.9776	0.9979
25	27.8 - 21.5	0.03824	600.	0.8785	0.8859	0.9262	0.9842	0.9989
			900.	0.8948	0.9017	0.9380	0.9874	0.9994
			2100.	0.9265	0.9320	0.9595	0.9927	1.0001
			300.	0.8823	0.8850	0.9042	0.9620	0.9951
26	21.5 - 16.6	0.05876	600.	0.8923	0.8950	0.9135	0.9674	0.9961
			900.	0.8994	0.9021	0.9202	0.9710	0.9967
			2100.	0.9177	0.9202	0.9368	0.9791	0.9980
			300.	1.0370	1.0370	1.0363	1.0237	1.0051
27	16.6 - 12.9	0.23628	600.	1.0490	1.0488	1.0465	1.0280	1.0057
			900.	1.0552	1.0549	1.0518	1.0301	1.0060
			2100.	1.0662	1.0657	1.0610	1.0336	1.0065
			300.	0.9518	0.9536	0.9648	0.9896	0.9996
28	12.9 - 10.0	0.17417	600.	0.9518	0.9536	0.9648	0.9896	0.9996
			900.	0.9518	0.9536	0.9648	0.9896	0.9996
			2100.	0.9518	0.9536	0.9648	0.9896	0.9996

TABLE 7. (CONTINUED)

			300.	0.9796	0.9813	0.9898	0.9995	1.0014
29	10.00 - 7.73	0.06726	600.	0.9808	0.9825	0.9906	0.9998	1.0016
			900.	0.9816	0.9833	0.9911	0.9999	1.0016
			2100.	0.9837	0.9852	0.9924	1.0002	1.0017
			300.	0.9829	0.9846	0.9921	0.9995	1.0012
30	7.73 - 5.98	0.02020	600.	0.9877	0.9890	0.9948	1.0002	1.0012
			900.	0.9899	0.9911	0.9962	1.0005	1.0013
			2100.	0.9937	0.9946	0.9983	1.0010	1.0013
			300.	0.9710	0.9723	0.9801	0.9925	0.9961
31	5.98 - 4.65	0.03579	600.	0.9742	0.9755	0.9824	0.9932	0.9962
			900.	0.9758	0.9770	0.9835	0.9935	0.9962
			2100.	0.9785	0.9795	0.9853	0.9940	0.9963
			300.	0.9797	0.9805	0.9855	0.9965	1.0006
32	4.65 - 3.60	0.03511	600.	0.9797	0.9805	0.9855	0.9965	1.0006
			900.	0.9797	0.9805	0.9855	0.9965	1.0006
			2100.	0.9797	0.9805	0.9855	0.9965	1.0006
			300.	0.9942	0.9944	0.9959	0.9983	0.9991
33	3.60 - 2.78	0.02281	600.	0.9942	0.9944	0.9959	0.9983	0.9991
			900.	0.9942	0.9944	0.9959	0.9983	0.9991
			2100.	0.9942	0.9944	0.9959	0.9983	0.9991
			300.	0.8317	0.8386	0.8820	0.9662	0.9926
34	2.78 - 2.15	0.07505	600.	0.8638	0.8698	0.9063	0.9736	0.9940
			900.	0.8814	0.8868	0.9192	0.9774	0.9946
			2100.	0.9139	0.9180	0.9423	0.9837	0.9955
			300.	1.0037	1.0037	1.0037	1.0037	1.0037
35	2.15 - 1.66	0.02000	600.	1.0037	1.0037	1.0037	1.0037	1.0037
			900.	1.0037	1.0037	1.0037	1.0037	1.0037
			2100.	1.0037	1.0037	1.0037	1.0037	1.0037
			300.	0.9994	0.9995	1.0000	1.0012	1.0016
36	1.66 - 1.29	0.02410	600.	0.9995	0.9996	1.0003	1.0013	1.0016
			900.	0.9997	0.9998	1.0004	1.0013	1.0016
			2100.	1.0000	1.0000	1.0006	1.0014	1.0016
			300.	0.9990	0.9990	0.9990	0.9991	0.9991
37	1.29 - 1.00	0.02346	600.	0.9990	0.9990	0.9990	0.9991	0.9991
			900.	0.9990	0.9990	0.9990	0.9991	0.9991
			2100.	0.9990	0.9990	0.9990	0.9991	0.9991

TABLE 8. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF CR OBTAINED FROM ENDF/B-III

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	SHIELDING FACTORS $\sigma_0=0$	$\sigma_0=1$	$\sigma_0=10$	$\sigma_0=100$	$\sigma_0=1000$
			300.	1.0253	1.0139	1.0020	0.9999	0.9998
11	800.0 -630.0	0.00402	600.	1.0254	1.0140	1.0020	0.9999	0.9998
			900.	1.0254	1.0140	1.0020	0.9999	0.9998
			2100.	1.0255	1.0142	1.0021	0.9999	0.9997
			300.	0.9355	0.9428	0.9719	0.9953	0.9994
12	630.0 -500.0	0.00383	600.	0.9360	0.9434	0.9725	0.9954	0.9993
			900.	0.9364	0.9439	0.9729	0.9955	0.9994
			2100.	0.9378	0.9454	0.9741	0.9958	0.9995
			300.	1.0052	0.9997	0.9964	0.9993	1.0000
13	500.0 -400.0	0.00386	600.	1.0054	0.9999	0.9965	0.9993	1.0000
			900.	1.0055	1.0000	0.9965	0.9993	1.0001
			2100.	1.0061	1.0006	0.9968	0.9994	1.0001
			300.	0.8396	0.8632	0.9339	0.9884	0.9988
14	400.0 -310.0	0.00396	600.	0.8398	0.8636	0.9344	0.9886	0.9988
			900.	0.8400	0.8639	0.9349	0.9887	0.9987
			2100.	0.8408	0.8650	0.9363	0.9891	0.9986
			300.	0.6813	0.7061	0.8339	0.9665	0.9957
15	310.0 -250.0	0.00371	600.	0.6819	0.7068	0.8349	0.9669	0.9958
			900.	0.6824	0.7075	0.8357	0.9672	0.9954
			2100.	0.6844	0.7099	0.8386	0.9682	0.9958
			300.	0.6955	0.7109	0.8229	0.9613	0.9949
16	250.0 -200.0	0.00425	600.	0.6961	0.7117	0.8240	0.9617	0.9950
			900.	0.6967	0.7124	0.8249	0.9621	0.9951
			2100.	0.6987	0.7147	0.8277	0.9631	0.9950
			300.	0.8590	0.8734	0.9287	0.9850	0.9985
17	200.0 -150.0	0.00475	600.	0.8616	0.8760	0.9310	0.9859	0.9986
			900.	0.8634	0.8778	0.9327	0.9866	0.9987
			2100.	0.8680	0.8826	0.9375	0.9882	0.9990
			300.	0.6652	0.7122	0.8472	0.9681	0.9961
18	150.0 -120.0	0.00857	600.	0.6663	0.7135	0.8490	0.9687	0.9962
			900.	0.6668	0.7143	0.8500	0.9691	0.9963
			2100.	0.6680	0.7159	0.8523	0.9703	0.9965
			300.	0.8198	0.8432	0.9245	0.9862	0.9978
19	120.0 -100.0	0.00953	600.	0.8295	0.8521	0.9292	0.9870	0.9979
			900.	0.8343	0.8565	0.9315	0.9874	0.9980
			2100.	0.8424	0.8637	0.9351	0.9880	0.9980

TABLE 8. (CONTINUED)

			300.	0.7168	0.7582	0.8697	0.9729	0.9970
20	100.0 - 77.3	0.01082	600.	0.7207	0.7614	0.8706	0.9730	0.9970
			900.	0.7227	0.7630	0.8711	0.9731	0.9970
			2100.	0.7263	0.7657	0.8718	0.9732	0.9970
			300.	0.9721	0.9784	0.9924	0.9984	0.9991
21	77.3 - 59.8	0.00763	600.	0.9723	0.9786	0.9925	0.9984	0.9992
			900.	0.9725	0.9788	0.9926	0.9985	0.9992
			2100.	0.9730	0.9792	0.9928	0.9985	0.9992
			300.	0.6955	0.7417	0.8579	0.9654	0.9951
22	59.8 - 46.5	0.02122	600.	0.7152	0.7629	0.8732	0.9691	0.9956
			900.	0.7274	0.7758	0.8820	0.9712	0.9958
			2100.	0.7540	0.8032	0.9001	0.9750	0.9960
			300.	0.8204	0.8744	0.9639	0.9960	1.0002
23	46.5 - 36.0	0.01607	600.	0.8221	0.8758	0.9645	0.9960	1.0002
			900.	0.8232	0.8767	0.9649	0.9961	1.0002
			2100.	0.8254	0.8785	0.9656	0.9962	1.0002
			300.	0.8453	0.8640	0.9203	0.9802	0.9976
24	36.0 - 27.8	0.03386	600.	0.8678	0.8843	0.9339	0.9851	0.9983
			900.	0.8811	0.8961	0.9417	0.9876	0.9986
			2100.	0.9083	0.9200	0.9572	0.9919	0.9991
			300.	0.6789	0.7122	0.8419	0.9705	0.9971
25	27.8 - 21.5	0.04567	600.	0.6968	0.7324	0.8632	0.9766	0.9981
			900.	0.7083	0.7451	0.8752	0.9797	0.9986
			2100.	0.7338	0.7726	0.8982	0.9849	0.9993
			300.	0.9702	0.9742	0.9881	0.9988	1.0008
26	21.5 - 16.6	0.02689	600.	0.9722	0.9758	0.9886	0.9989	1.0008
			900.	0.9732	0.9765	0.9888	0.9989	1.0008
			2100.	0.9749	0.9778	0.9892	0.9990	1.0008
			300.	0.9853	0.9882	0.9962	1.0002	1.0008
27	16.6 - 12.9	0.02765	600.	0.9867	0.9894	0.9967	1.0003	1.0008
			900.	0.9873	0.9900	0.9969	1.0003	1.0008
			2100.	0.9885	0.9909	0.9973	1.0004	1.0008
			300.	0.9882	0.9901	0.9963	1.0003	1.0010
28	12.9 - 10.0	0.03103	600.	0.9905	0.9921	0.9972	1.0005	1.0010
			900.	0.9917	0.9931	0.9976	1.0005	1.0010
			2100.	0.9937	0.9948	0.9984	1.0007	1.0010

TABLE 8. (CONTINUED)

			300.	0.8992	0.9045	0.9347	0.9851	1.0000
29	10.00 - 7.73	0.04829	600.	0.8992	0.9045	0.9347	0.9851	1.0000
			900.	0.8993	0.9045	0.9347	0.9851	1.0000
			2100.	0.8993	0.9045	0.9347	0.9851	1.0000
			300.	0.9912	0.9917	0.9945	0.9996	1.0012
30	7.73 - 5.98	0.08024	600.	0.9912	0.9917	0.9945	0.9996	1.0012
			900.	0.9912	0.9917	0.9945	0.9996	1.0012
			2100.	0.9912	0.9917	0.9945	0.9996	1.0012
			300.	0.9137	0.9157	0.9301	0.9725	0.9933
31	5.98 - 4.65	0.10620	600.	0.9137	0.9157	0.9301	0.9725	0.9933
			900.	0.9137	0.9157	0.9301	0.9725	0.9933
			2100.	0.9137	0.9157	0.9301	0.9725	0.9933
			300.	0.9855	0.9862	0.9901	0.9981	1.0008
32	4.65 - 3.60	0.06094	600.	0.9855	0.9862	0.9901	0.9981	1.0008
			900.	0.9855	0.9862	0.9901	0.9981	1.0008
			2100.	0.9855	0.9862	0.9901	0.9981	1.0008
			300.	0.9672	0.9693	0.9802	0.9950	0.9987
33	3.60 - 2.78	0.03331	600.	0.9672	0.9693	0.9802	0.9950	0.9987
			900.	0.9672	0.9693	0.9802	0.9950	0.9987
			2100.	0.9672	0.9693	0.9802	0.9950	0.9987
			300.	0.9904	0.9911	0.9940	0.9966	0.9971
34	2.78 - 2.15	0.02251	600.	0.9904	0.9911	0.9940	0.9966	0.9971
			900.	0.9904	0.9911	0.9940	0.9966	0.9971
			2100.	0.9904	0.9911	0.9940	0.9966	0.9971
			300.	1.0025	1.0027	1.0033	1.0036	1.0037
35	2.15 - 1.66	0.01924	600.	1.0025	1.0027	1.0033	1.0036	1.0037
			900.	1.0025	1.0027	1.0033	1.0036	1.0037
			2100.	1.0025	1.0027	1.0033	1.0036	1.0037
			300.	0.2543	0.2764	0.4203	0.7946	0.9732
36	1.66 - 1.29	0.42977	600.	0.2835	0.3089	0.4691	0.8330	0.9798
			900.	0.3054	0.3328	0.5019	0.8541	0.9831
			2100.	0.3625	0.3943	0.5777	0.8931	0.9887
			300.	0.9993	0.9993	0.9992	0.9991	0.9991
37	1.29 - 1.00	0.01910	600.	0.9993	0.9993	0.9992	0.9991	0.9991
			900.	0.9993	0.9993	0.9992	0.9991	0.9991
			2100.	0.9993	0.9993	0.9992	0.9991	0.9991

TABLE 9. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF FE OBTAINED FROM ENDF/B-III

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	SHIELDING FACTORS σ_0=0	σ_0=1	σ_0=10	σ_0=100	σ_0=1000
11	800.0 -630.0	0.00505	300.	1.0038	1.0031	1.0011	1.0000	0.9998
			600.	1.0038	1.0031	1.0011	1.0000	0.9998
			900.	1.0038	1.0031	1.0011	1.0000	0.9998
			2100.	1.0038	1.0031	1.0011	1.0000	0.9998
12	630.0 -500.0	0.00507	300.	1.0014	1.0011	1.0005	1.0001	1.0001
			600.	1.0014	1.0011	1.0005	1.0001	1.0001
			900.	1.0014	1.0011	1.0005	1.0001	1.0001
			2100.	1.0014	1.0011	1.0005	1.0001	1.0001
13	500.0 -400.0	0.00492	300.	1.0009	1.0008	1.0005	1.0002	1.0002
			600.	1.0009	1.0008	1.0005	1.0002	1.0002
			900.	1.0009	1.0008	1.0005	1.0002	1.0002
			2100.	1.0009	1.0008	1.0005	1.0002	1.0002
14	400.0 -310.0	0.00501	300.	1.0006	1.0006	1.0005	1.0002	1.0002
			600.	1.0006	1.0006	1.0005	1.0002	1.0002
			900.	1.0006	1.0006	1.0005	1.0002	1.0002
			2100.	1.0006	1.0006	1.0005	1.0002	1.0002
15	310.0 -250.0	0.00569	300.	0.9957	0.9966	0.9988	0.9996	0.9997
			600.	0.9957	0.9966	0.9988	0.9996	0.9997
			900.	0.9957	0.9966	0.9988	0.9996	0.9997
			2100.	0.9957	0.9966	0.9988	0.9996	0.9997
16	250.0 -200.0	0.00657	300.	1.0005	1.0004	1.0000	0.9996	0.9995
			600.	1.0005	1.0004	1.0000	0.9996	0.9995
			900.	1.0005	1.0004	1.0000	0.9996	0.9995
			2100.	1.0005	1.0004	1.0000	0.9996	0.9995
17	200.0 -150.0	0.00552	300.	0.9969	0.9972	0.9986	1.0001	1.0003
			600.	0.9969	0.9972	0.9986	1.0001	1.0003
			900.	0.9969	0.9972	0.9986	1.0001	1.0003
			2100.	0.9969	0.9972	0.9986	1.0001	1.0003
18	150.0 -120.0	0.00537	300.	1.0022	1.0021	1.0012	1.0002	1.0000
			600.	1.0022	1.0021	1.0012	1.0002	1.0000
			900.	1.0022	1.0021	1.0012	1.0002	1.0000
			2100.	1.0022	1.0021	1.0012	1.0002	1.0000
19	120.0 -100.0	0.00716	300.	0.9791	0.9819	0.9916	0.9981	0.9991
			600.	0.9791	0.9819	0.9916	0.9981	0.9991
			900.	0.9791	0.9819	0.9916	0.9981	0.9991
			2100.	0.9791	0.9819	0.9916	0.9981	0.9991

TABLE 9. (CONTINUED)

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	σ_0=0	σ_0=1	σ_0=10	σ_0=100	σ_0=1000
20	100.0 - 77.3	0.00901	300.	1.0001	1.0001	1.0001	1.0001	1.0001
			600.	1.0001	1.0001	1.0001	1.0001	1.0001
			900.	1.0001	1.0001	1.0001	1.0001	1.0001
			2100.	1.0001	1.0001	1.0001	1.0001	1.0001
21	77.3 - 59.8	0.00852	300.	1.0057	1.0046	1.0008	0.9993	0.9994
			600.	1.0057	1.0046	1.0008	0.9993	0.9994
			900.	1.0057	1.0046	1.0008	0.9993	0.9994
			2100.	1.0057	1.0046	1.0008	0.9993	0.9994
22	59.8 - 46.5	0.00942	300.	0.6590	0.6968	0.8461	0.9731	0.9964
			600.	0.7065	0.7415	0.8737	0.9786	0.9970
			900.	0.7317	0.7648	0.8872	0.9811	0.9973
			2100.	0.7769	0.8059	0.9097	0.9851	0.9978
23	46.5 - 36.0	0.01085	300.	0.6573	0.6913	0.8354	0.9711	0.9973
			600.	0.7102	0.7414	0.8677	0.9778	0.9982
			900.	0.7387	0.7680	0.8838	0.9810	0.9985
			2100.	0.7905	0.8156	0.9109	0.9860	0.9991
24	36.0 - 27.8	0.02242	300.	0.5791	0.5953	0.6858	0.8781	0.9813
			600.	0.6148	0.6294	0.7092	0.8831	0.9820
			900.	0.6349	0.6483	0.7214	0.8855	0.9822
			2100.	0.6729	0.6838	0.7429	0.8894	0.9827
25	27.8 - 21.5	0.01801	300.	0.4650	0.5211	0.7026	0.9085	0.9883
			600.	0.4956	0.5505	0.7176	0.9107	0.9885
			900.	0.5143	0.5676	0.7253	0.9117	0.9887
			2100.	0.5531	0.6012	0.7383	0.9134	0.9888
26	21.5 - 16.6	0.00255	300.	0.9631	0.9735	0.9929	0.9981	1.0007
			600.	0.9749	0.9824	0.9958	0.9993	1.0008
			900.	0.9822	0.9879	0.9971	0.9998	1.0009
			2100.	0.9975	0.9990	1.0005	1.0006	1.0009
27	16.6 - 12.9	0.00470	300.	0.8353	0.8664	0.9505	0.9935	0.9999
			600.	0.8600	0.8879	0.9599	0.9944	1.0002
			900.	0.8738	0.8996	0.9648	0.9954	1.0003
			2100.	0.8994	0.9210	0.9734	0.9970	1.0005
28	12.9 - 10.0	0.00781	300.	0.8818	0.8994	0.9572	0.9939	1.0003
			600.	0.9096	0.9239	0.9690	0.9961	1.0006
			900.	0.9237	0.9363	0.9747	0.9971	1.0007
			2100.	0.9482	0.9574	0.9839	0.9987	1.0008

TABLE 9. (CONTINUED)

			300.	0.7774	0.7929	0.8690	0.9714	0.9984
29	10.00 - 7.73	0.02789	600.	0.7865	0.8011	0.8729	0.9718	0.9985
			900.	0.7913	0.8053	0.8750	0.9722	0.9986
			2100.	0.7999	0.8128	0.8785	0.9729	0.9986
			300.	0.9059	0.9122	0.9450	0.9889	0.9999
30	7.73 - 5.98	0.02919	600.	0.9065	0.9128	0.9454	0.9890	1.0000
			900.	0.9068	0.9131	0.9456	0.9891	1.0000
			2100.	0.9074	0.9136	0.9459	0.9892	1.0000
			300.	0.9762	0.9787	0.9878	0.9952	0.9964
31	5.98 - 4.65	0.00758	600.	0.9767	0.9791	0.9881	0.9952	0.9964
			900.	0.9769	0.9791	0.9883	0.9952	0.9964
			2100.	0.9772	0.9796	0.9885	0.9953	0.9964
			300.	0.9176	0.9263	0.9623	0.9944	1.0004
32	4.65 - 3.60	0.00964	600.	0.9176	0.9263	0.9623	0.9944	1.0004
			900.	0.9176	0.9263	0.9623	0.9944	1.0004
			2100.	0.9176	0.9263	0.9623	0.9944	1.0004
			300.	0.9998	0.9997	0.9994	0.9992	0.9992
33	3.60 - 2.78	0.00453	600.	0.9998	0.9997	0.9994	0.9992	0.9992
			900.	0.9998	0.9997	0.9994	0.9992	0.9992
			2100.	0.9998	0.9997	0.9994	0.9992	0.9992
			300.	0.9911	0.9918	0.9943	0.9967	0.9971
34	2.78 - 2.15	0.00609	600.	0.9914	0.9921	0.9946	0.9968	0.9971
			900.	0.9918	0.9924	0.9948	0.9968	0.9971
			2100.	0.9923	0.9928	0.9950	0.9968	0.9971
			300.	1.0021	1.0023	1.0030	1.0036	1.0037
35	2.15 - 1.66	0.00605	600.	1.0021	1.0023	1.0030	1.0036	1.0037
			900.	1.0021	1.0023	1.0030	1.0036	1.0037
			2100.	1.0021	1.0023	1.0030	1.0036	1.0037
			300.	0.9952	0.9958	0.9984	1.0000	1.0014
36	1.66 - 1.29	0.01469	600.	0.9994	0.9996	1.0005	1.0008	1.0015
			900.	1.0017	1.0017	1.0016	1.0012	1.0016
			2100.	1.0060	1.0056	1.0038	1.0018	1.0016
			300.	0.2818	0.2939	0.3821	0.7052	0.9503
37	1.29 - 1.00	0.88910	600.	0.3125	0.3265	0.4256	0.7524	0.9613
			900.	0.3363	0.3515	0.4570	0.7806	0.9670
			2100.	0.4007	0.4182	0.5350	0.8371	0.9772

TABLE 10. CAPTURE CROSS SECTION AND SHIELDING FACTOR OF NI OBTAINED FROM ENDF/B-III

JAERI GROUP NO.	ENERGY RANGE (KEV)	$\sigma_\gamma(\infty)$	T (°K)	SHIELDING FACTORS $\sigma_0=0$	$\sigma_0=1$	$\sigma_0=10$	$\sigma_0=100$	$\sigma_0=1000$
			300.	1.6795	1.5589	1.2217	1.0317	1.0031
11	800.0 -630.0	0.00283	600.	1.6795	1.5589	1.2217	1.0317	1.0031
			900.	1.6795	1.5589	1.2217	1.0317	1.0031
			2100.	1.6795	1.5589	1.2217	1.0317	1.0031
			300.	0.9845	0.9863	0.9937	0.9990	0.9999
12	630.0 -500.0	0.00764	600.	0.9845	0.9864	0.9937	0.9991	1.0000
			900.	0.9846	0.9864	0.9938	0.9991	0.9999
			2100.	0.9847	0.9866	0.9939	0.9991	0.9999
			300.	1.0112	1.0046	0.9993	0.9999	1.0001
13	500.0 -400.0	0.00783	600.	1.0114	1.0048	0.9995	0.9999	1.0001
			900.	1.0115	1.0050	0.9996	0.9999	1.0000
			2100.	1.0120	1.0055	0.9999	1.0000	1.0001
			300.	1.0105	1.0030	0.9977	0.9996	1.0001
14	400.0 -310.0	0.00796	600.	1.0105	1.0030	0.9977	0.9996	1.0001
			900.	1.0105	1.0030	0.9977	0.9996	1.0001
			2100.	1.0105	1.0030	0.9977	0.9996	1.0001
			300.	1.0587	1.0269	1.0030	0.9998	0.9996
15	310.0 -250.0	0.00892	600.	1.0589	1.0270	1.0030	0.9998	0.9996
			900.	1.0590	1.0271	1.0030	0.9998	0.9996
			2100.	1.0595	1.0275	1.0031	0.9998	0.9997
			300.	1.0428	1.0262	1.0042	0.9996	0.9993
16	250.0 -200.0	0.00955	600.	1.0428	1.0262	1.0042	0.9997	0.9994
			900.	1.0428	1.0262	1.0043	0.9997	0.9994
			2100.	1.0430	1.0264	1.0044	0.9997	0.9995
			300.	0.9780	0.9744	0.9813	0.9963	0.9999
17	200.0 -150.0	0.01239	600.	0.9781	0.9745	0.9814	0.9963	0.9999
			900.	0.9781	0.9746	0.9814	0.9964	0.9999
			2100.	0.9783	0.9747	0.9817	0.9965	0.9999
			300.	0.9023	0.9119	0.9528	0.9912	0.9989
18	150.0 -120.0	0.01617	600.	0.9024	0.9120	0.9529	0.9913	0.9989
			900.	0.9025	0.9122	0.9530	0.9913	0.9989
			2100.	0.9029	0.9126	0.9533	0.9914	0.9990
			300.	0.9368	0.9247	0.9377	0.9840	0.9975
19	120.0 -100.0	0.01530	600.	0.9368	0.9247	0.9377	0.9840	0.9975
			900.	0.9368	0.9247	0.9377	0.9840	0.9975
			2100.	0.9368	0.9247	0.9377	0.9840	0.9975

TABLE 10. (CONTINUED)

			300.	0.9579	0.9629	0.9816	0.9969	0.9998
20	100.0 - 77.3	0.01602	600.	0.9579	0.9629	0.9816	0.9969	0.9998
			900.	0.9579	0.9629	0.9816	0.9969	0.9998
			2100.	0.9579	0.9629	0.9816	0.9969	0.9998
			300.	0.8775	0.8948	0.9395	0.9848	0.9976
21	77.3 - 59.8	0.02098	600.	0.8776	0.8949	0.9395	0.9848	0.9976
			900.	0.8777	0.8950	0.9396	0.9848	0.9976
			2100.	0.8777	0.8951	0.9396	0.9848	0.9976
			300.	0.6795	0.7108	0.8199	0.9557	0.9941
22	59.8 - 46.5	0.02422	600.	0.6946	0.7269	0.8372	0.9630	0.9951
			900.	0.7039	0.7369	0.8478	0.9670	0.9950
			2100.	0.7239	0.7585	0.8697	0.9743	0.9963
			300.	0.7613	0.7743	0.8480	0.9640	0.9960
23	46.5 - 36.0	0.02482	600.	0.7772	0.7904	0.8632	0.9694	0.9969
			900.	0.7868	0.8001	0.8718	0.9721	0.9973
			2100.	0.8064	0.8196	0.8879	0.9767	0.9979
			300.	0.7283	0.7402	0.8111	0.9464	0.9932
24	36.0 - 27.8	0.04689	600.	0.7563	0.7680	0.8362	0.9566	0.9947
			900.	0.7738	0.7853	0.8512	0.9620	0.9954
			2100.	0.8117	0.8224	0.8814	0.9717	0.9964
			300.	0.8455	0.8542	0.9026	0.9775	0.9979
25	27.8 - 21.5	0.03616	600.	0.8762	0.8841	0.9262	0.9845	0.9990
			900.	0.8940	0.9013	0.9390	0.9879	0.9995
			2100.	0.9288	0.9346	0.9623	0.9936	1.0002
			300.	0.8669	0.8701	0.8921	0.9576	0.9945
26	21.5 - 16.6	0.05370	600.	0.8779	0.8810	0.9024	0.9635	0.9956
			900.	0.8857	0.8888	0.9098	0.9675	0.9963
			2100.	0.9059	0.9088	0.9281	0.9764	0.9977
			300.	0.9431	0.9445	0.9546	0.9848	0.9987
27	16.6 - 12.9	0.17149	600.	0.9598	0.9609	0.9689	0.9908	0.9994
			900.	0.9685	0.9695	0.9762	0.9937	0.9999
			2100.	0.9840	0.9847	0.9891	0.9986	1.0006
			300.	0.8677	0.8727	0.9041	0.9709	0.9972
28	12.9 - 10.0	0.06676	600.	0.8677	0.8727	0.9041	0.9709	0.9972
			900.	0.8677	0.8727	0.9041	0.9709	0.9972
			2100.	0.8677	0.8727	0.9041	0.9709	0.9972

TABLE 10. (CONTINUED)

			300.	0.9641	0.9669	0.9811	0.9978	1.0008
29	10.00 - 7.73	0.02893	600.	0.9669	0.9697	0.9831	0.9983	1.0012
			900.	0.9690	0.9717	0.9844	0.9986	1.0013
			2100.	0.9740	0.9764	0.9875	0.9993	1.0016
			300.	0.9814	0.9833	0.9917	0.9995	1.0012
30	7.73 - 5.98	0.02020	600.	0.9864	0.9879	0.9945	1.0002	1.0012
			900.	0.9888	0.9902	0.9959	1.0005	1.0013
			2100.	0.9929	0.9939	0.9981	1.0010	1.0013
			300.	0.9698	0.9712	0.9797	0.9924	0.9961
31	5.98 - 4.65	0.03580	600.	0.9732	0.9745	0.9820	0.9932	0.9962
			900.	0.9748	0.9761	0.9831	0.9935	0.9962
			2100.	0.9776	0.9787	0.9849	0.9940	0.9963
			300.	0.9790	0.9799	0.9851	0.9965	1.0006
32	4.65 - 3.60	0.03512	600.	0.9790	0.9799	0.9851	0.9965	1.0006
			900.	0.9790	0.9799	0.9851	0.9965	1.0006
			2100.	0.9790	0.9799	0.9851	0.9965	1.0006
			300.	0.9939	0.9942	0.9958	0.9983	0.9991
33	3.60 - 2.78	0.02282	600.	0.9939	0.9942	0.9958	0.9983	0.9991
			900.	0.9939	0.9942	0.9958	0.9983	0.9991
			2100.	0.9939	0.9942	0.9958	0.9983	0.9991
			300.	0.8257	0.8331	0.8791	0.9660	0.9926
34	2.78 - 2.15	0.07506	600.	0.8586	0.8650	0.9039	0.9735	0.9940
			900.	0.8767	0.8825	0.9171	0.9772	0.9946
			2100.	0.9103	0.9147	0.9407	0.9836	0.9955
			300.	1.0037	1.0037	1.0037	1.0037	1.0037
35	2.15 - 1.66	0.02002	600.	1.0037	1.0037	1.0037	1.0037	1.0037
			900.	1.0037	1.0037	1.0037	1.0037	1.0037
			2100.	1.0037	1.0037	1.0037	1.0037	1.0037
			300.	0.9993	0.9994	1.0000	1.0012	1.0016
36	1.66 - 1.29	0.02411	600.	0.9994	0.9995	1.0002	1.0013	1.0016
			900.	0.9996	0.9997	1.0004	1.0013	1.0016
			2100.	0.9999	1.0000	1.0005	1.0014	1.0016
			300.	0.9990	0.9990	0.9990	0.9991	0.9991
37	1.29 - 1.00	0.02348	600.	0.9990	0.9990	0.9990	0.9991	0.9991
			900.	0.9990	0.9990	0.9990	0.9991	0.9991
			2100.	0.9990	0.9990	0.9990	0.9991	0.9991

Table 11. Comparison of temperature coefficients for self-shielding factors of Cr, Fe and Ni, $\sigma_0 = 10$ (b)

Material	JAERI Group No.	Nuclear data	$((f_c(T) - f_c(T-300)) / T-300) \times 10^4$		
			T=600	T=900	T=2100
Cr	25	ENDF/B-II	0.697	0.547	0.307
		ENDF/B-III	0.710	0.555	0.299
	36	ENDF/B-II	1.65	1.38	0.881
		ENDF/B-III	1.63	1.36	0.874
Fe	24	Story	0.813	0.617	0.329
		ENDF/B-II	0.217	0.162	0.084
		ENDF/B-III	0.780	0.593	0.317
	37	Story	1.56	1.32	0.861
		ENDF/B-II	1.68	1.40	0.883
		ENDF/B-III	1.45	1.25	0.849
Ni	27	Story	0.430	0.330	0.181
		ENDF/B-II	0.340	0.258	0.137
		ENDF/B-III	0.477	0.360	0.192
	34	Story	0.747	0.582	0.325
		ENDF/B-II	0.810	0.620	0.335
		ENDF/B-III	0.827	0.633	0.342

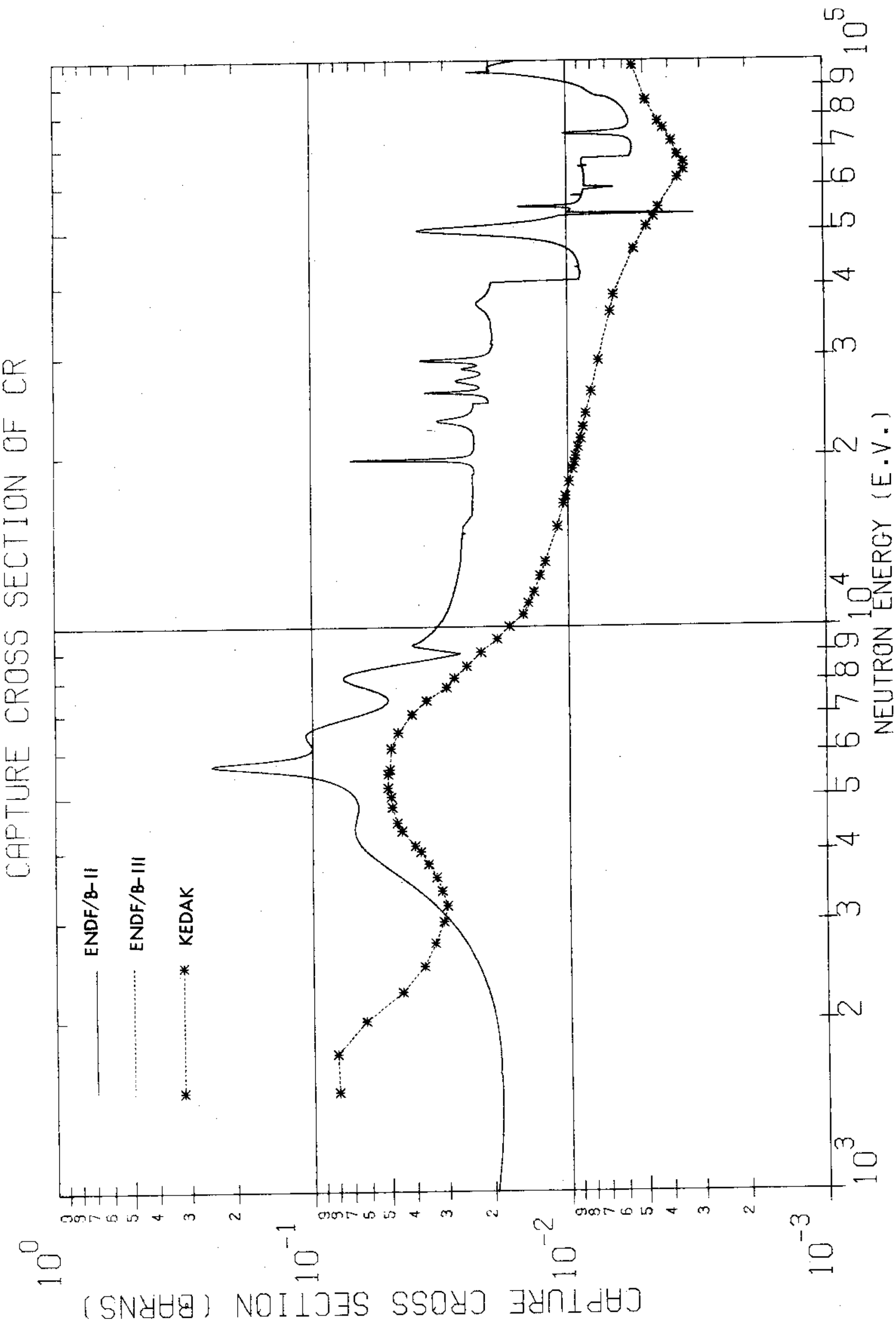

Fig. 1. Capture cross sections of Cr from various nuclear data

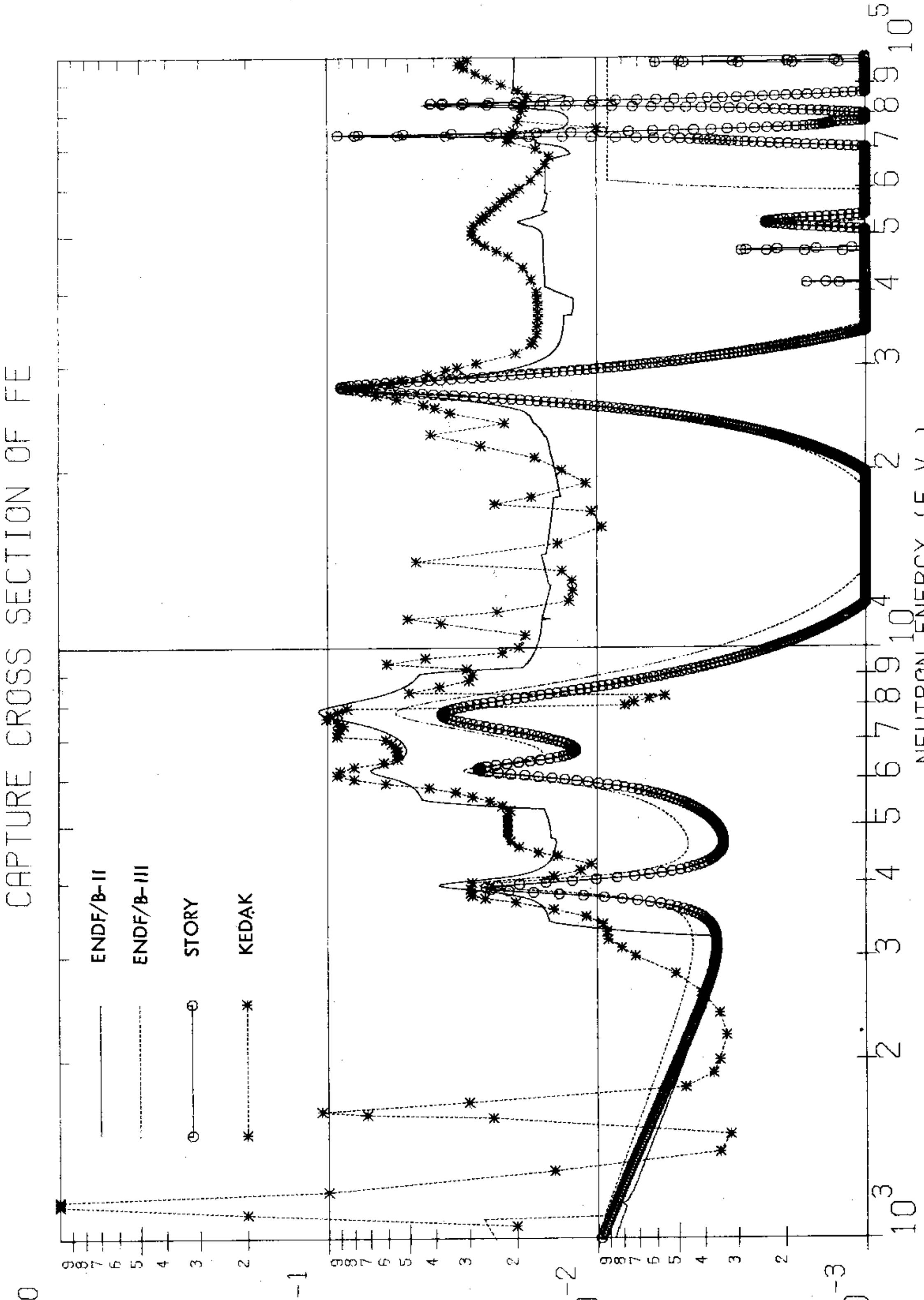

Fig. 2. Capture cross sections of Fe from various nuclear data

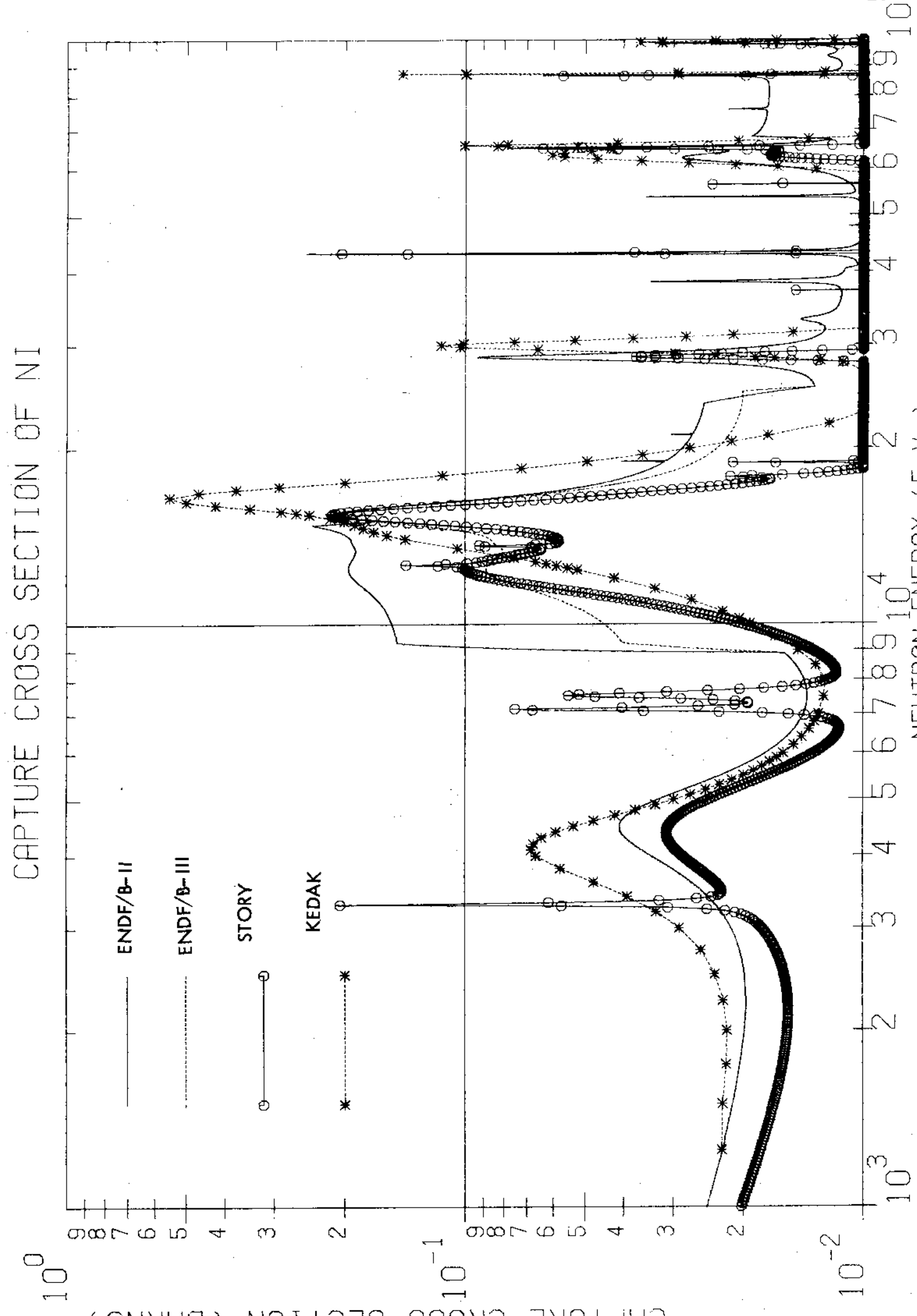

Fig. 3. Capture cross sections of Ni from various nuclear data

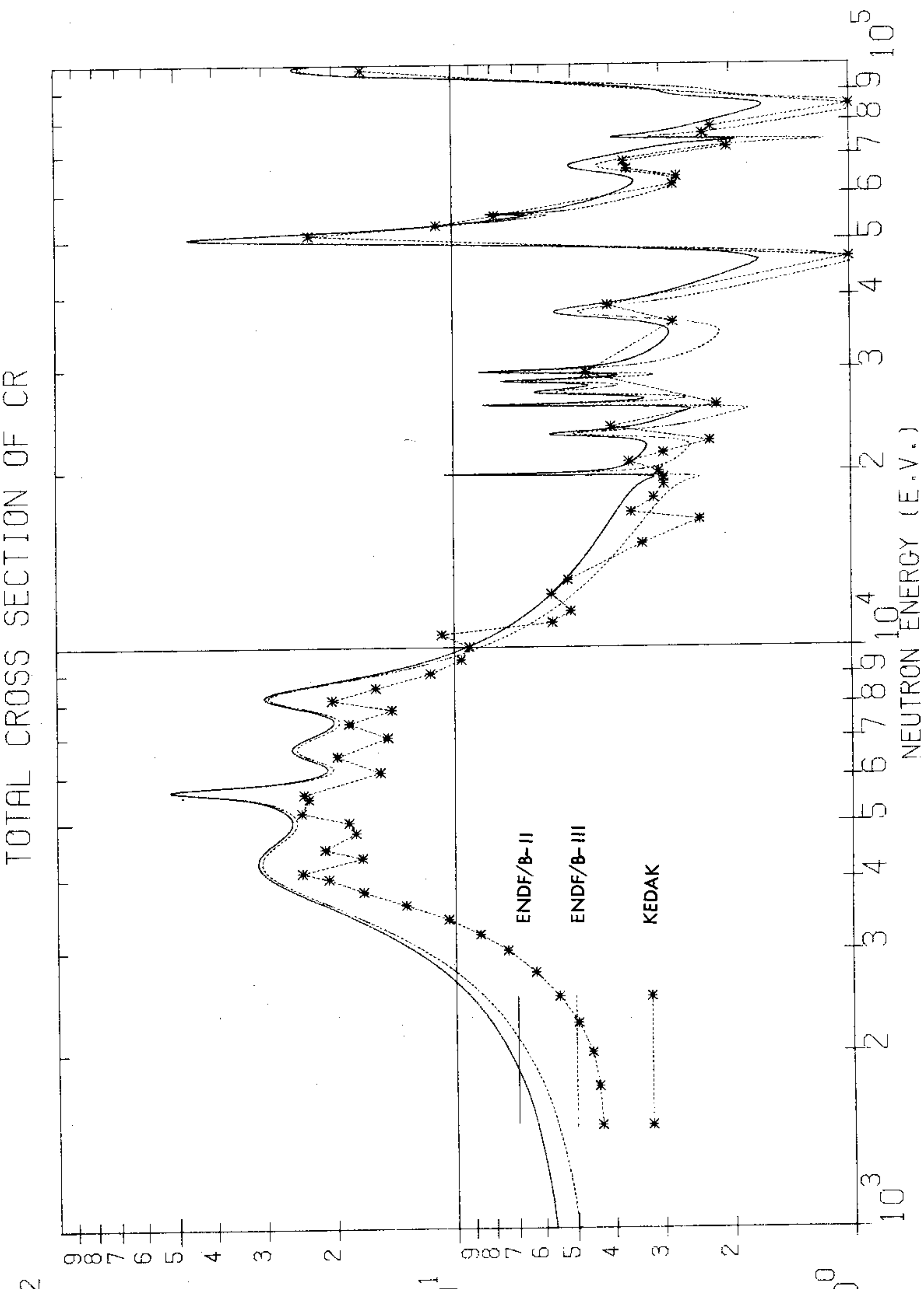

Fig. 4. Total cross sections of Cr from various nuclear data

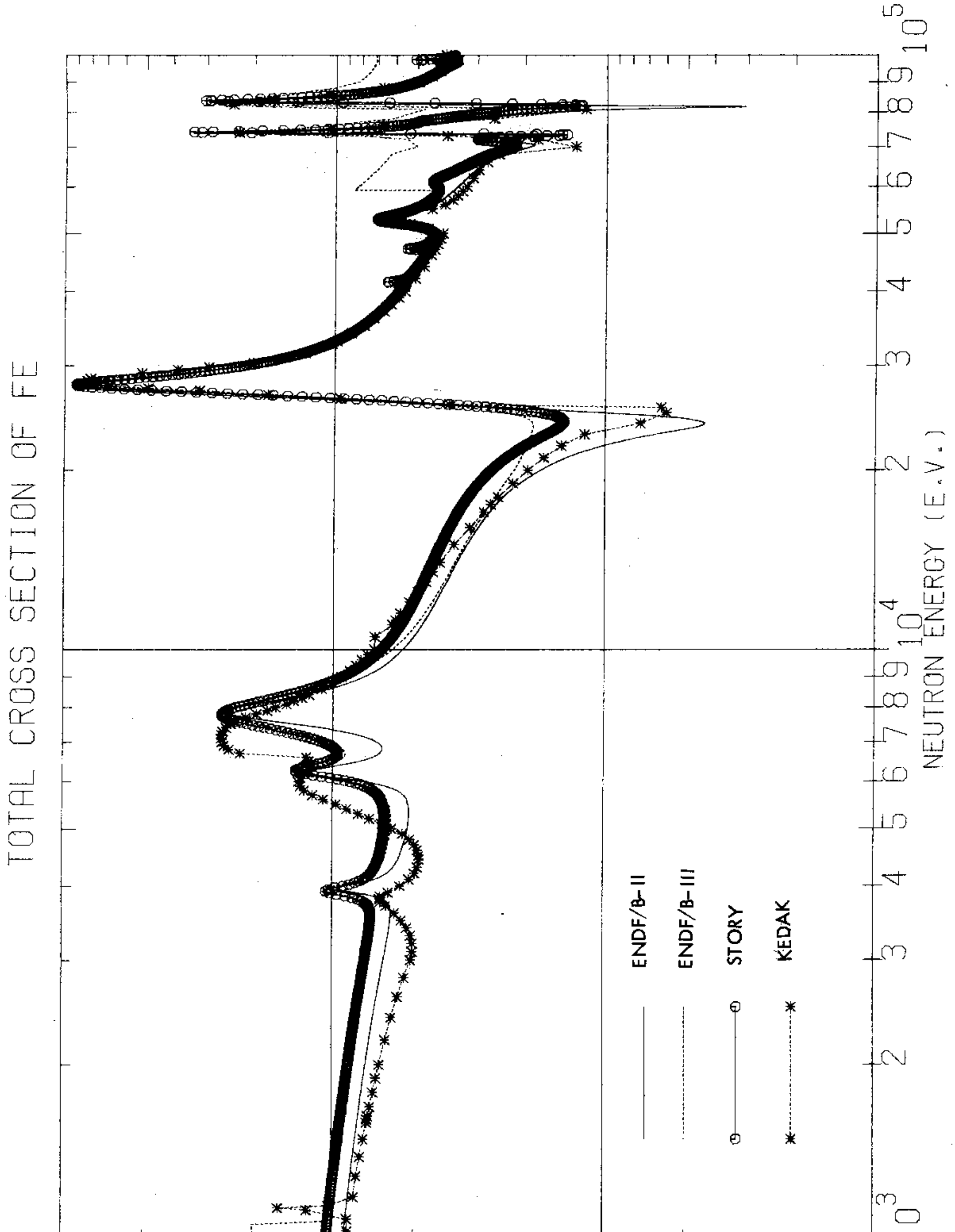

Fig. 5. Total cross sections of Fe from various nuclear data

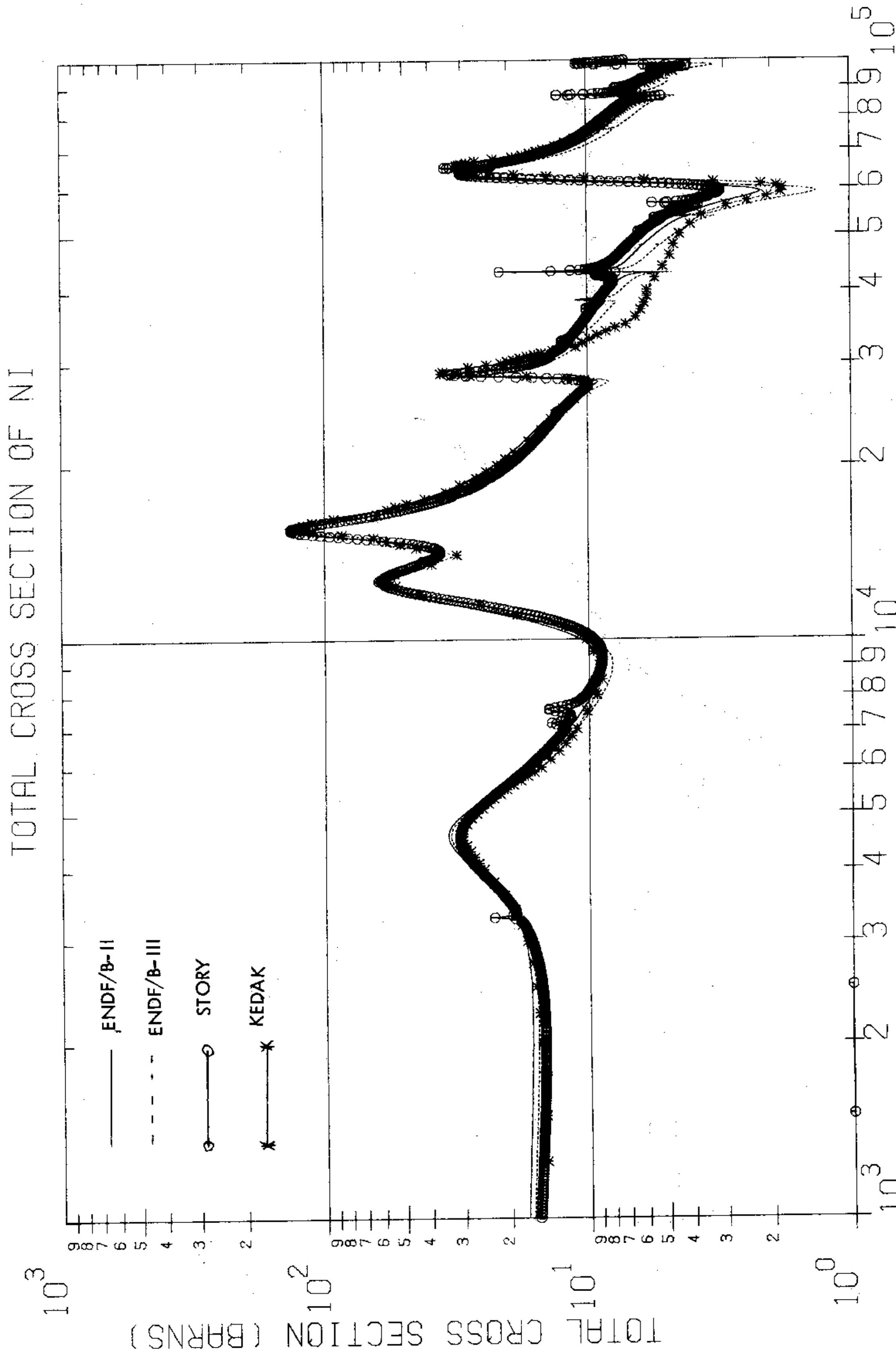

Fig. 6. Total cross sections of Ni from various nuclear data

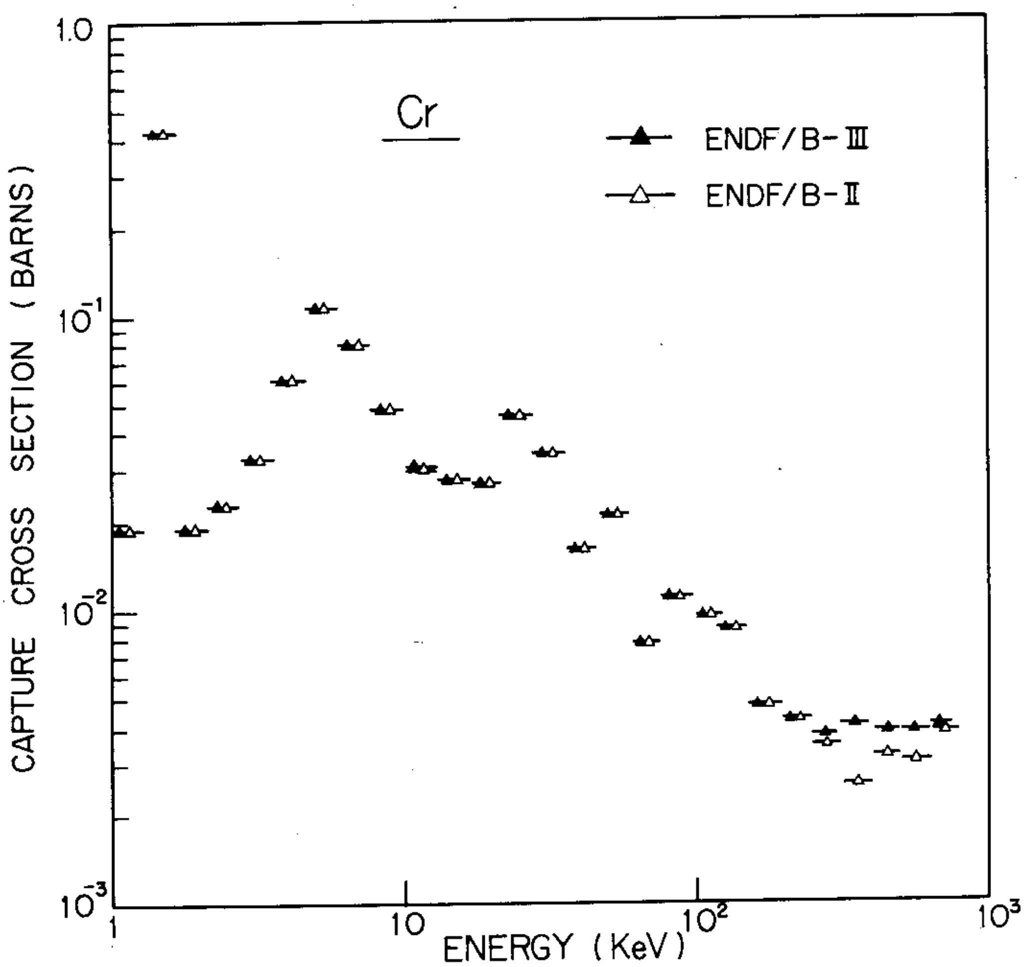

Fig. 7. Comparison of infinitely dilute capture cross sections of Cr

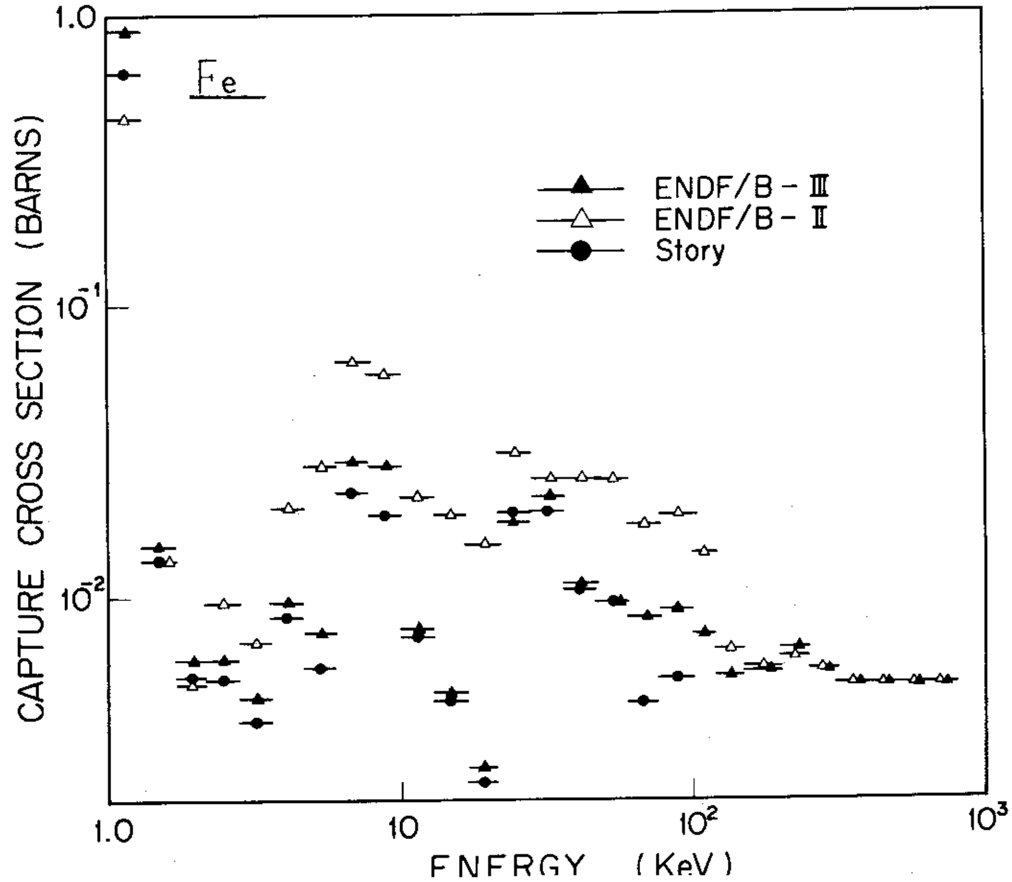

Fig. 8. Comparison of infinitely dilute capture cross sections of Fe

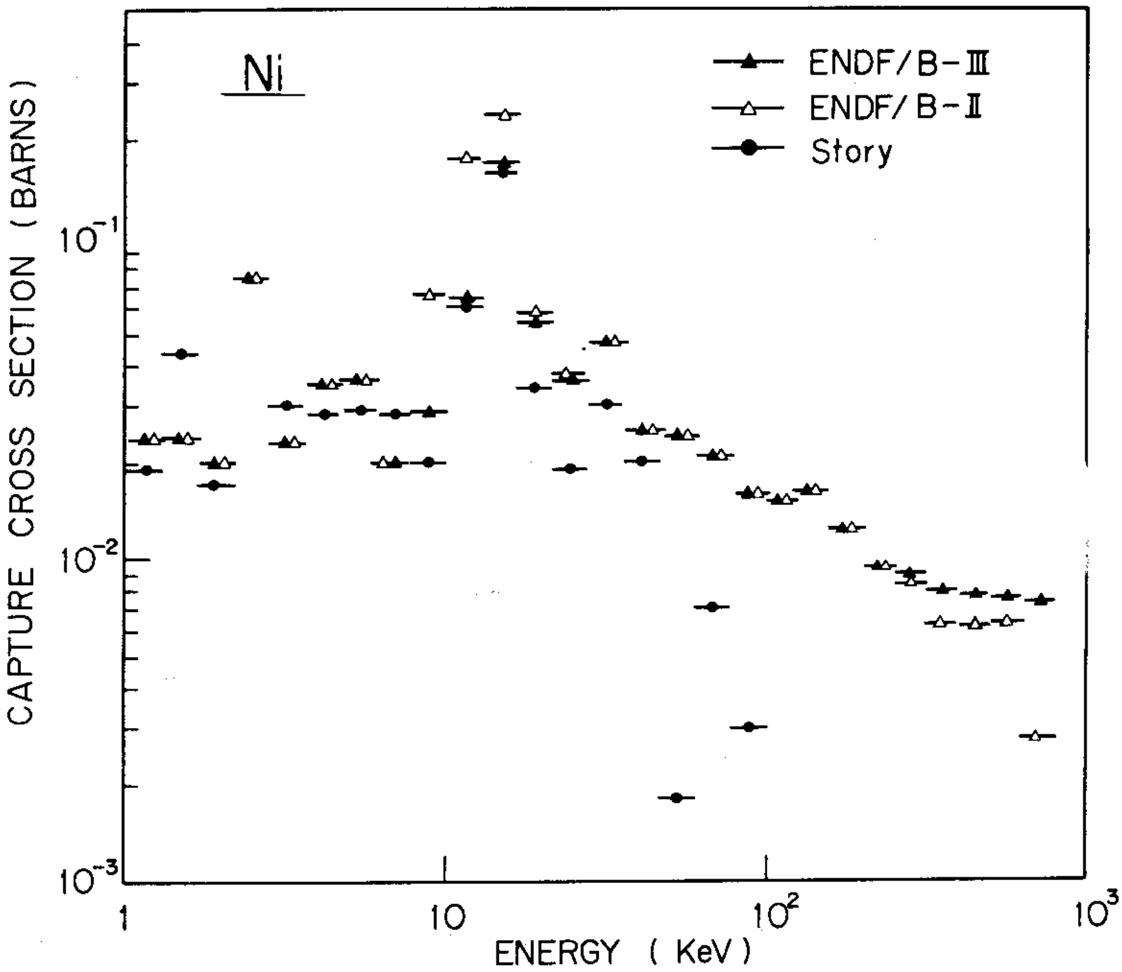

Fig. 9. Comparison of infinitely dilute capture cross sections of Ni

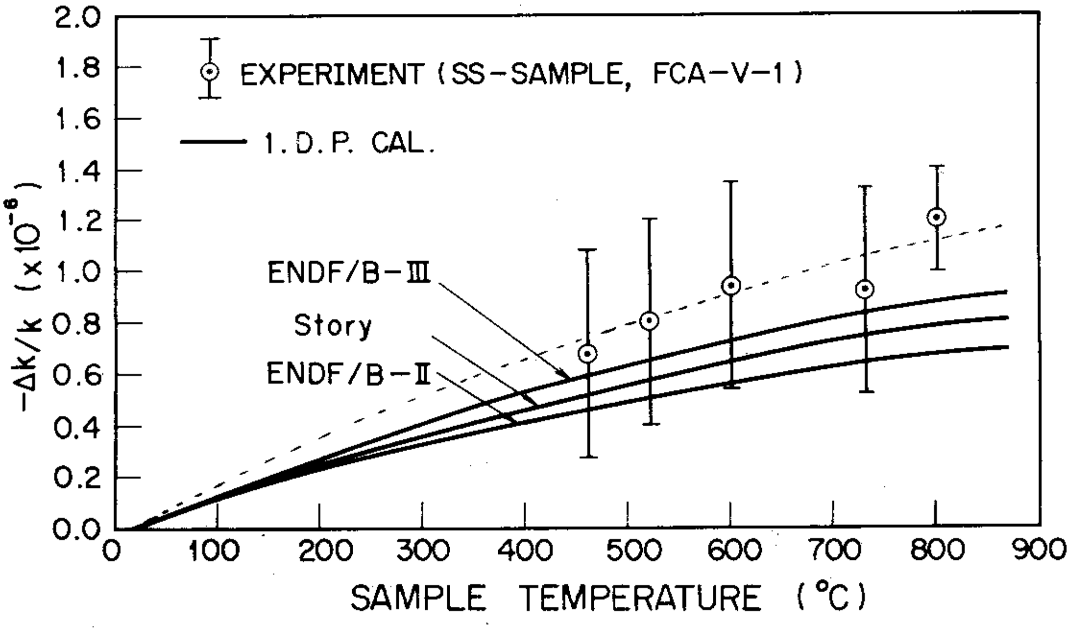

Fig. 10. Comparison of calculated Doppler coefficients with the experimental results --- FCA-V-1 core, S.S. sample

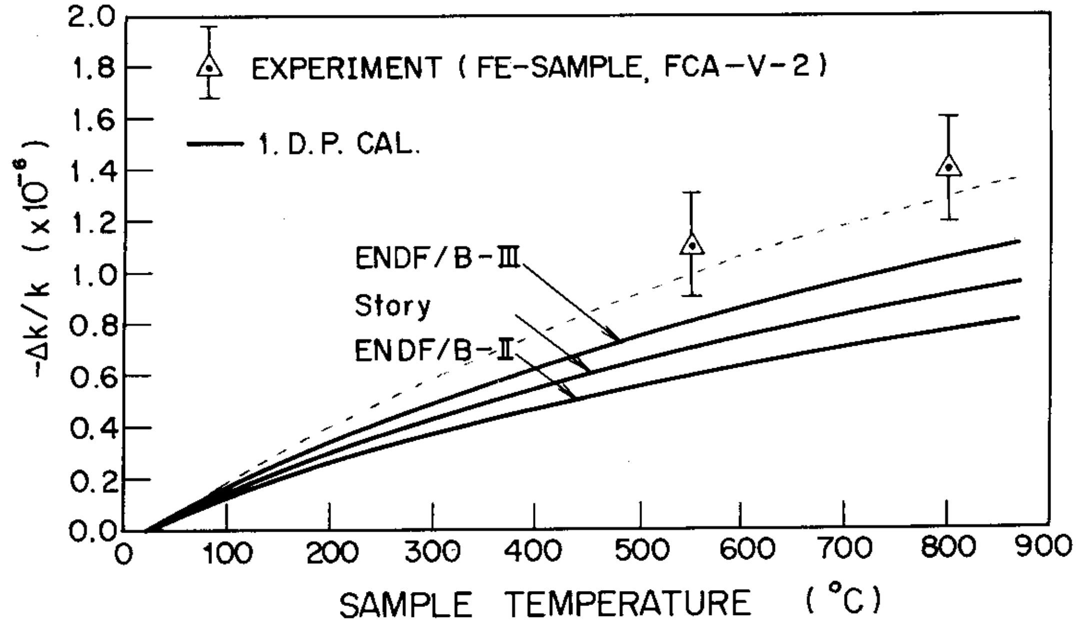

Fig. 11. Comparison of calculated Doppler coefficients with the experimental results --- FCA-V-2 core, Fe sample

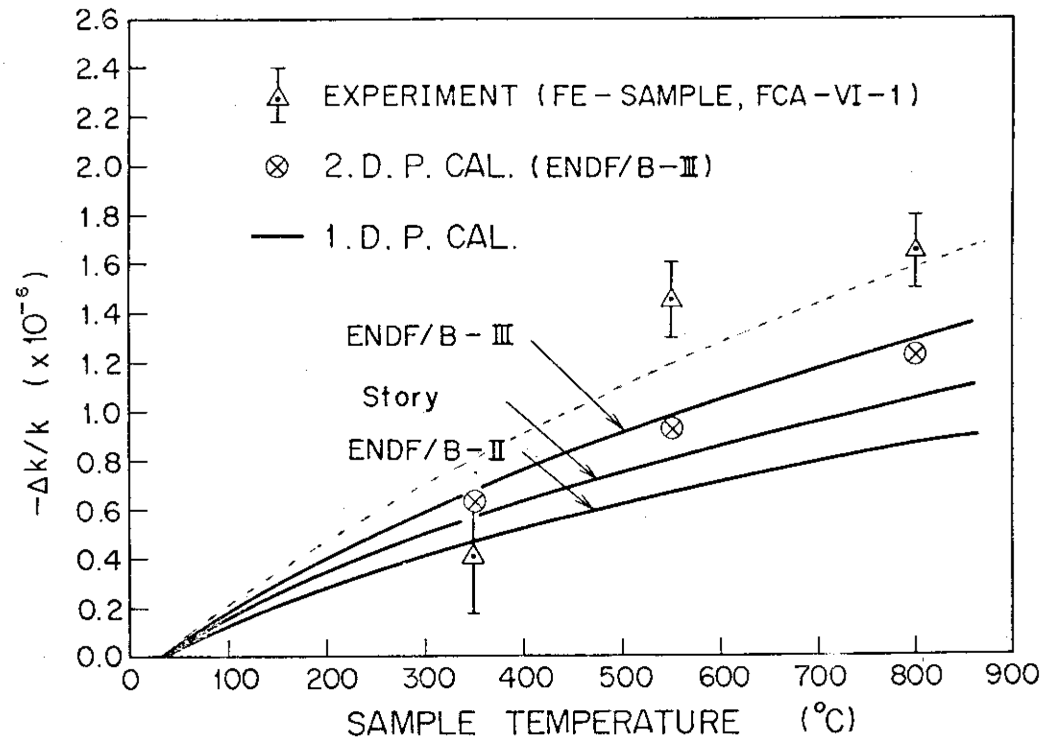

Fig. 12. Comparison of calculated Doppler coefficients with the experimental results --- FCA-VI-1 core, Fe sample

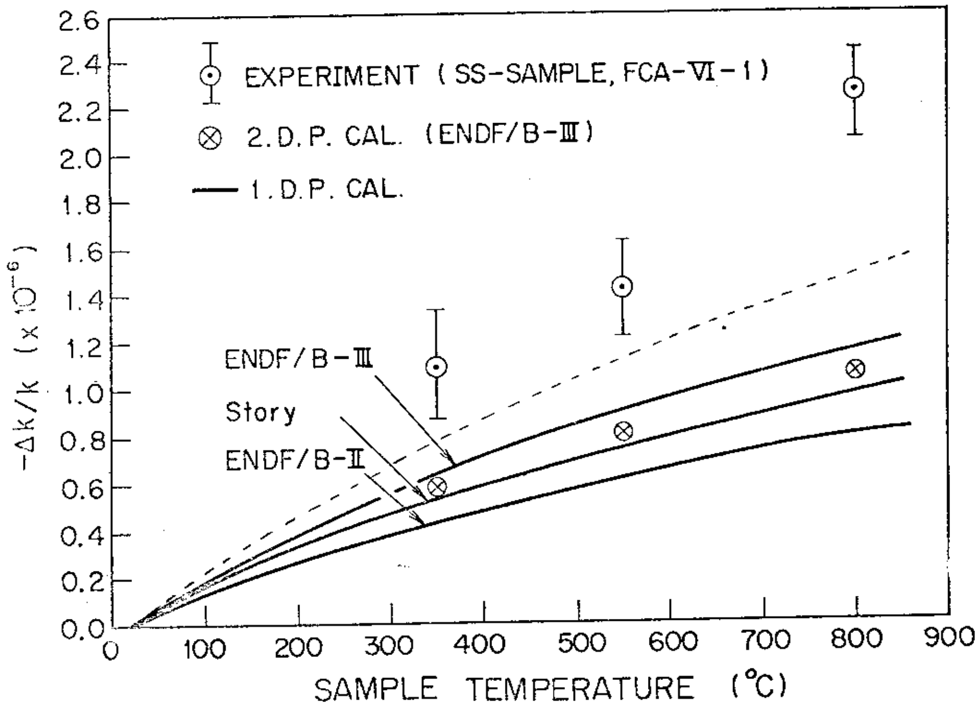

Fig. 13. Comparison of calculated Doppler coefficients with the experimental results --- FCA-VI-1 core, S.S. sample

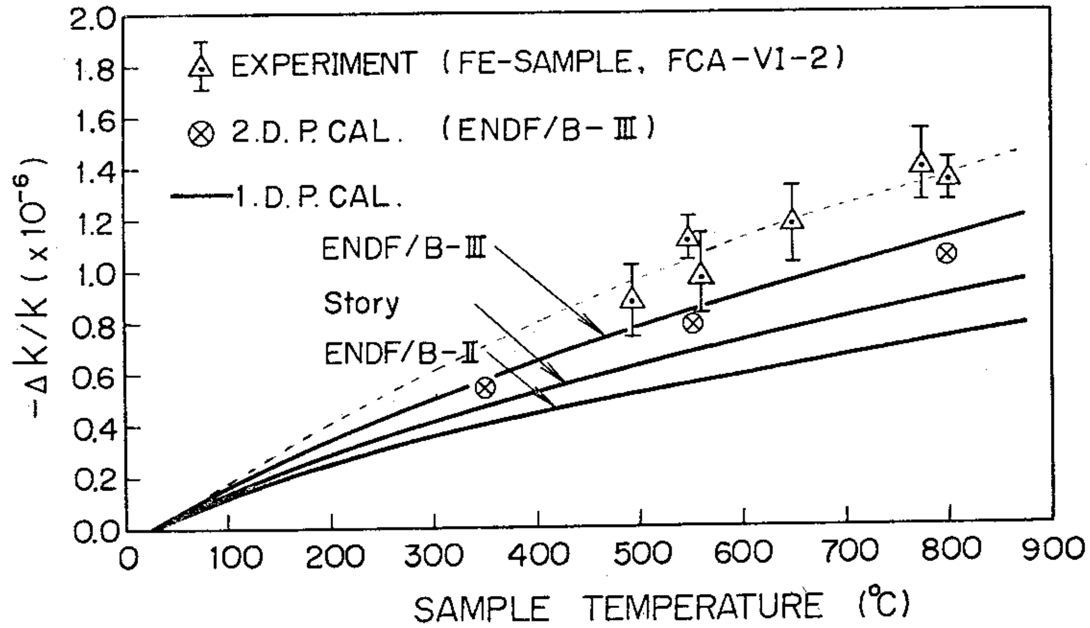

Fig. 14. Comparison of calculated Doppler coefficients with the experimental results --- FCA-VI-2 core, Fe sample

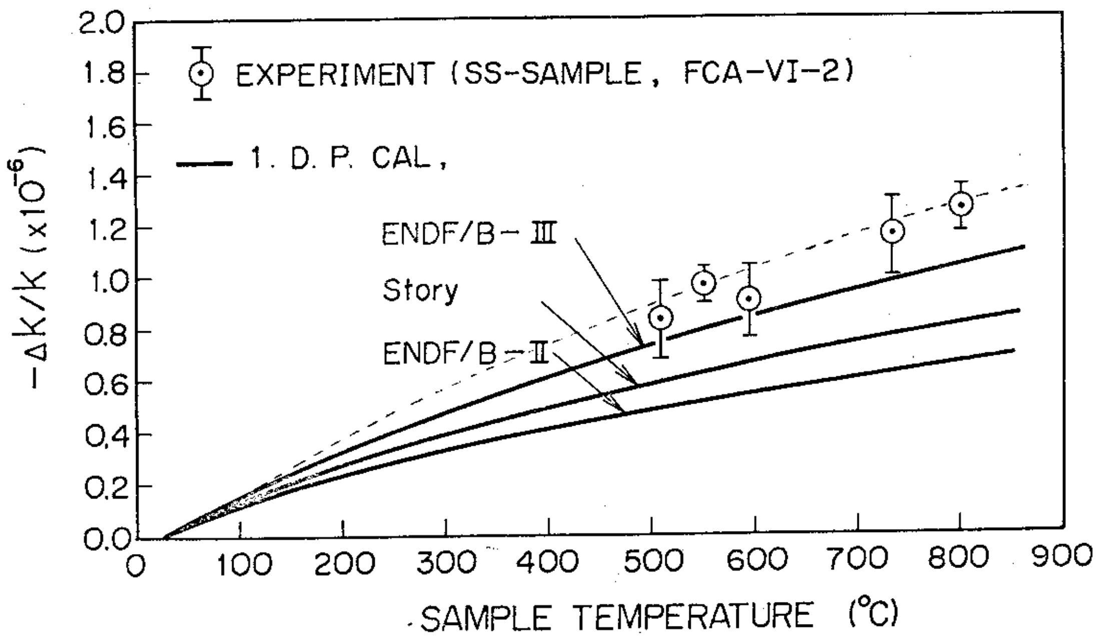

Fig. 15. Comparison of calculated Doppler coefficients with the experimental results --- FCA-VI-2 core, S.S. sample

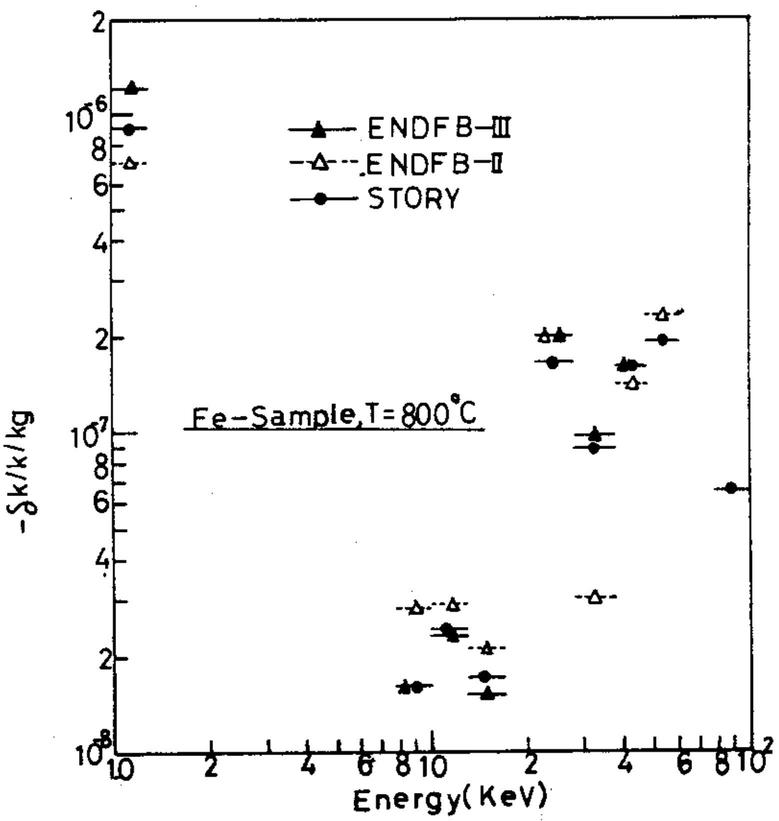

Fig. 16. Contribution to Doppler coefficient from each energy group calculated by one dimensional simple perturbation code with 70 group structure.

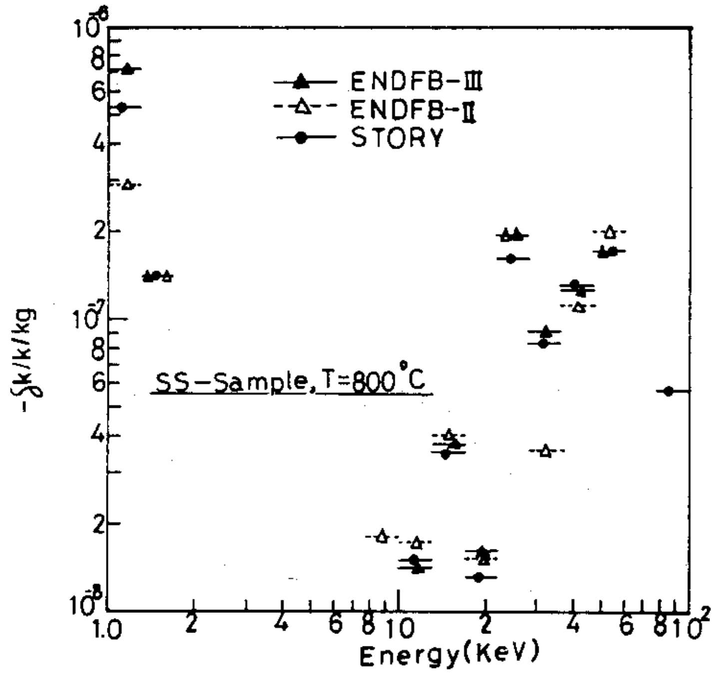

Fig. 17. Contribution to Doppler coefficient from each energy group calculated by one dimensional simple perturbation code with 70 group structure

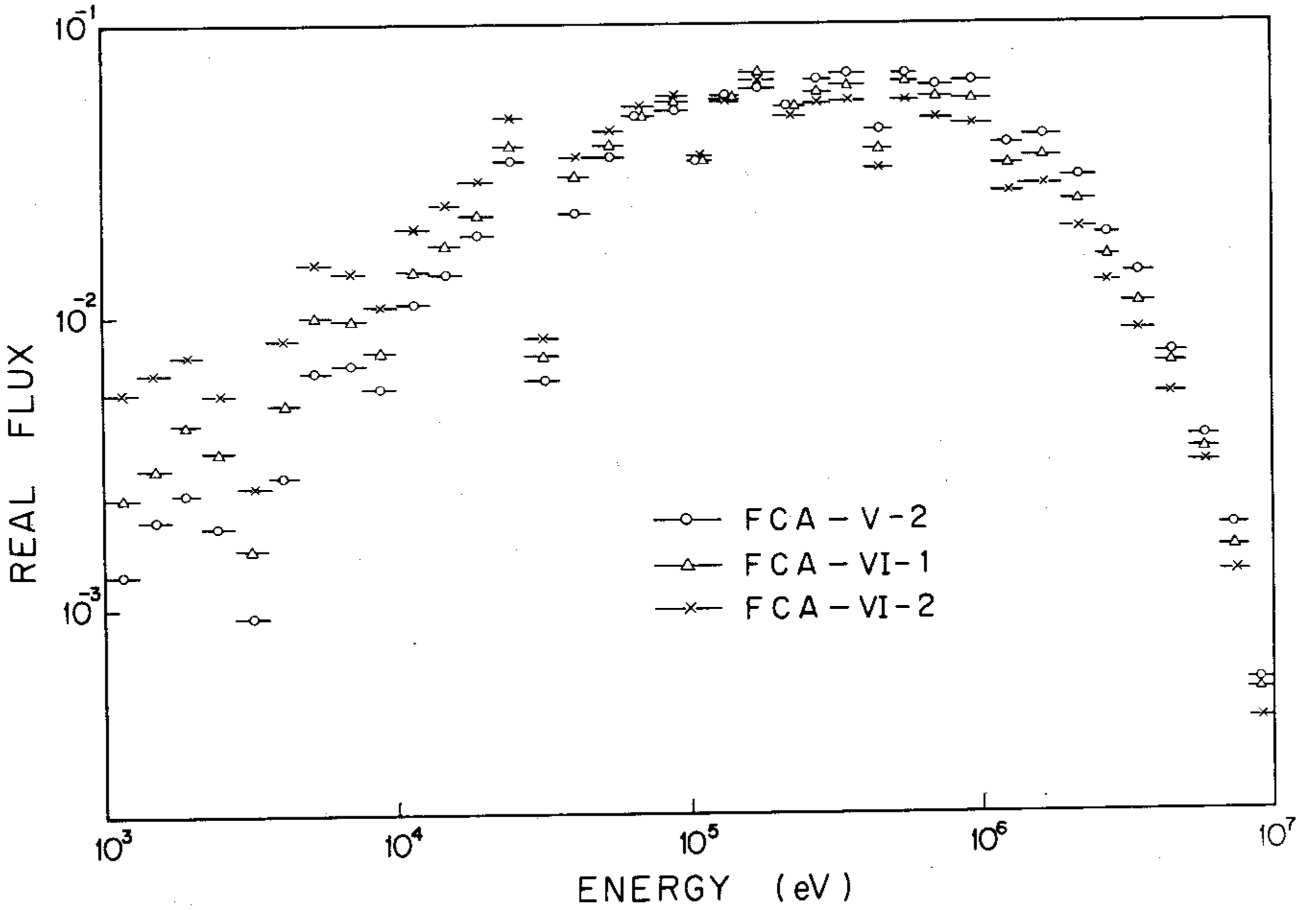

Fig. 18. Comparison of relative flux at core center

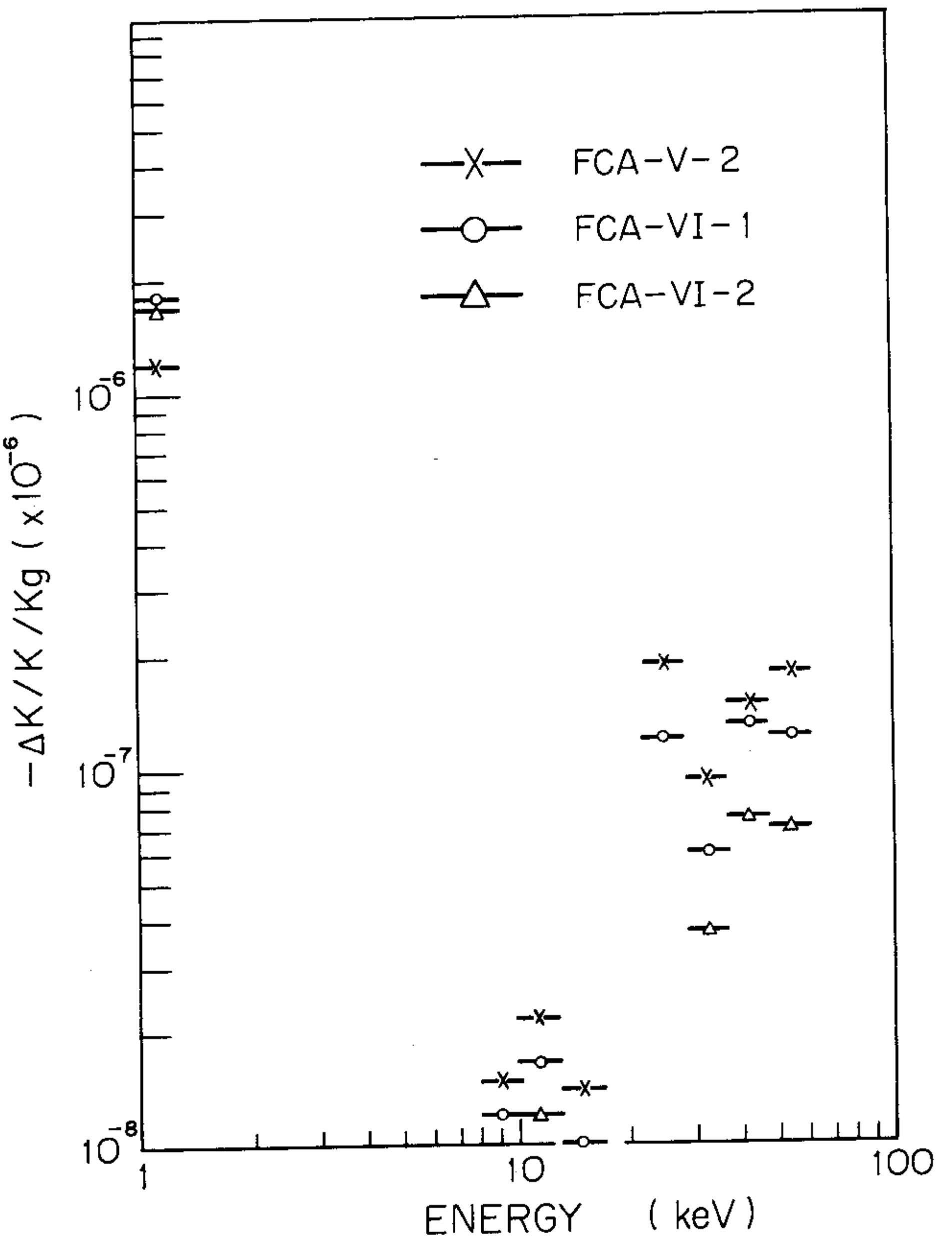

Fig. 19. Comparison of contribution to Doppler effect from each energy group influenced by variations in core spectrum.