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Covariance Matrices for Use in Criticality Safety Predictability Studies

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ABSTRACT

Criticality predictability applications require as input the best available information on fissile and other nuclides. In recent years important work has been performed in the analysis of neutron transmission and cross-section data for fissile nuclei in the resonance region by using the computer code SAMMY. The code uses Bayes method (a form of generalized least squares) for sequential analyses of several sets of experimental data. Values for Reich-Moore resonance parameters, their covariances, and the derivatives with respect to the adjusted parameters (data sensitivities) are obtained. In general, the parameter file contains several thousand values and the dimension of the covariance matrices is correspondingly large. These matrices are not reported in the current evaluated data files due to their large dimensions and to the inadequacy of the file formats. The present work has two goals: The first is to calculate the covariances of group-averaged cross sections from the covariance files generated by SAMMY, because these can be more readily utilized in criticality predictability calculations. The second goal is to propose a more practical interface between SAMMY and the evaluated files. Examples are given for ^{235}U in the popular 199- and 238-group structures, using the latest ORNL evaluation of the ^{235}U resonance parameters.

1. INTRODUCTION

As reported elsewhere,[1] neutron resonance parameters for ^{235}U have been obtained in the energy range 0 to 2250 eV by using the computer code SAMMY[2] for sequential Bayes analysis of several experimental data sets. SAMMY calculations also provide covariance matrices that define the relationships between all the fitting parameters: both physical parameters (e.g., resonance energies and widths) and experimental parameters (e.g., normalization and background corrections). Analysis of experimental data over a large energy range involves a large number of resonances since the average resonance spacing of ^{235}U at low energy is smaller than 0.5 eV. The SAMMY calculations were usually performed in several energy ranges, each of which covered from 50 to 200 eV. The exact energy limits depended on the number of data points in the range analyzed; the limitations are due only to computer space and time. Generally, an energy interval of 100 eV contains more than 200 resonances involving more than 1000 parameters. If all parameters in a 100- eV interval are varied, the number of elements in the output covariance matrix will be larger than 10^6. The variance and covariance formats in the current evaluated data files are not suitable for including this large covariance matrix; hence much of the information obtained from the SAMMY fitting procedure cannot be presented via the current evaluated data files. Inadequacies in the ENDF/B-6 format[3] for the covariance matrices have also been noted by Fröhner.[4] Nevertheless, resonance parameters have been included in the most important evaluated data files, thus it has become urgent to develop methodologies for using the information contained in the SAMMY covariance matrix as well. Section 2 of this report presents a more detailed discussion of this topic.

Two alternatives to the current (unused) method are also reported in this document. In the first alternative, described in Sect. 3, SAMMY is used to calculate average cross sections and corresponding covariance matrices directly from the parameter covariance matrix obtained from fitting the microscopic data. Results are presented for calculations in the energy range 0 to 50 eV, using 14 sets of microscopic data as input to SAMMY, and introducing realistic errors on the normalization coefficients and on the background correction parameters of the experimental data. Covariance matrices have been obtained for the lowest-energy groups of the 199-group structure of the VITAMIN-B6 library[5] and for the lowest-energy groups of the 238-group structure of the LAW library.[6] These covariance matrices of the averaged group cross sections could be used for sensitivity calculations in the thermal and low-energy ranges. They should be considered preliminary because further work is in progress in order to improve the accuracy of the calculations.

The second alternative is a revised plan for the interface between SAMMY output and ENDF/B-6 files, described in Sect 4. Concluding remarks are in Sect. 5.

2. GENERAL COMMENTS ON FORMATS AND METHODS

In the ENDF/B-6 format[3] the elements of the covariance matrices for the resonance parameters are given in two sections of file 32, MT=151. The first section contains the covariances between the parameters of small groups of resonances (short-range correlations). The second section contains the covariances between parameters of the same type pertaining to different resonances (long-range correlations). However, the distinction between short-range and long-range correlations is quite arbitrary because it depends strongly on the type of nucleus and on the nature of the parameters. Also, conversion from the SAMMY format to the ENDF/B-6 format is not straightforward. In any case, for most nuclei the file 32, MT = 151 will be very large. Furthermore, it is not now possible for cross-section processing codes such as NJOY[7] or AMPX[8] to use the rather complicated ENDF/B-6 format.

However, the SAMMY resonance parameter covariance files can be used directly for the calculation of the covariance matrix of the averaged group cross sections. The covariance matrix of the resonance parameters depends on the experimental data used as input into SAMMY. If the experimental cross sections or transmissions are assumed to be free of normalization errors and of other experimental errors (background errors, self-shielding correction errors, etc.), the covariance matrix of each set of experimental data is diagonal and contains only the statistical errors on the measured data points. In this case, the covariance matrix of the resonance parameters contains only the statistical errors on the resonance parameters and the correlations due to the formalism and method of calculation which are, in general, short-range correlations. This covariance matrix, which ignores the systematic uncertainties on the experimental data, is not realistic and will not generate the expected covariance matrix of the averaged group cross sections, which should contain the long-range correlations due to the systematic errors on the analyzed experimental data.

Another way of analyzing the data is to use normalization and background correction parameters as input for SAMMY, allowing these parameters to vary in the SAMMY runs. The covariance matrix of the input experimental data is still diagonal, with only the statistical errors on each experimental data point. The output parameter covariance matrix contains the correlations between the resonance parameters and the normalization and background correction parameters. When used in the calculation of the averaged group cross sections, this covariance matrix will generate a group cross section covariance matrix with the long-range correlations due to the systematic errors on the normalization coefficients and on the background parameters.

Usually, the experimental data are normalized and corrected by the authors of the measurements for the known experimental effects; some details on these corrections could be found in their publications. But the experimental database available for an evaluation is rarely consistent due to the use of different standards for the normalization, to errors in the experimental effect corrections, or to some unknown experimental problems. In addition, the adjustments of the normalization and of the background are functions of the neutron energy; these functions are not known, or not well known. For all these reasons, some of the

normalization and background coefficients obtained in SAMMY sequential runs could be very large, strongly correlated, and unrealistic. The corresponding experiments should be eliminated from the experimental database. Generally, a preliminary SAMMY fit of a large experimental database, with variation of normalizations and backgrounds, assists the analyst in selecting the data that should be kept for the final analysis. These selected data are those that need only small adjustments of the normalization and background — adjustments generally being performed prior to the final SAMMY fits. The covariance matrix obtained from the final fit does not contain the long-range correlations due to systematic errors of the experimental data. This method was used in the resonance parameter evaluations of ^{233}U , ^{235}U, ^{239}Pu and ^{241}Pu,[9–11] for which the covariance matrices were not reported in the evaluated data files.

3. THE ^{235}U COVARIANCE FILES

3.1. THE SAMMY FIT TO THE EXPERIMENTAL DATA

In the present study of the covariance file of the ^{235}U resonance parameters, the SAMMY fits were restarted, in the energy range 0 to 50 eV, on a selected set of experimental data, allowing variation of the normalization and background parameters and using the current evaluated resonance parameters[1] as input. This study should be considered as a test case for further consideration of the methodology for using the SAMMY covariance files in the evaluated data files.

The sequential SAMMY analysis was performed on the set of experimental data[12-20] described in Table 1. In the input to SAMMY, the normalization coefficients were settled at the value of 1 with prior uncertainty of 2% for the fission, capture, and absorption data, and 1% for the transmission data. The background consisted of two parts: one which was constant over all the energy range, and one which was linear in time-of-flight. The prior uncertainty on the background was 100%. The input value of the effective scattering radius R was 9.602 ± 0.050 fm.[1] Values of the normalization parameters and of the background corrections, subsequent to the fitting process, are given in Table 2. The output value of the effective scattering radius was 9.657 ± 0.045 fm. The normalization parameters are close to 1, generally within the error bars given by the authors of the experiments. The background corrections are also small for most data sets, but the error bars are of the same order of magnitude as the corrections, which means that in general the background corrections could not be accurately determined from the fit of the experimental data. It is likely that the "true" background corrections are not a smooth function of the neutron energy. In their publications, the authors of the experiments state that the corrections for experimental effects were performed or were negligible. Inaccurate corrections could have been performed or unknown experimental effects could remain in the published experimental data. According to N. M. Larson [21] and M. Moxon,[22] in the "ideal" analysis method, raw experimental data would be used as input to fitting codes that would be able to perform all the corrections. In practice this ideal method could hardly be used because, for most published experimental data, the raw data (particularly the counting rates for each time-of-flight

Table 1. Experimental data used as input for the SAMMY fits.

Data set number	Nature of the data	References	Sample thickness (atoms/barn)	Energy Range (eV)	Number of data points
1	Transmission	Harvey (1984) [12]	0.03269 [a]	0.4 -20.0	3900
2	Transmission	Harvey (1984) [12]	0.00233 [b]	4.0 -50.0	3006
3	Transmission	Harvey (1984) [12]	0.03269 [b]	4.0 -50.0	3006
4	Fission	Schrack (1988) [13]		0.015-20.0	3858
5	Fission	DeSaussure (1967) [14]		0.4 -50.0	2043
6	Capture	DeSaussure (1967) [14]		0.4 -50.0	2043
7	Fission	Perez (1973) [15]		8.0 -50.0	972
8	Capture	Perez (1973) [15]		8.0 -50.0	972
9	Fission	Gwin (1984) [16]		0.02 -20.0	1422
10	Transmission	Spencer (1987) [17]	0.00137	0.01 -1.00	1399
11	Fission	Wagemans (1988) [18]		0.002-1.00	210
12	Absorption	Gwin (1996) [16]		0.02 -4.00	1451
13	Fission	Gwin (1996) [19]		0.02 -4.00	1451
14	Fission	Weston (1984) [20]		14.0 -50.0	1002

a. Flight path length = 17.88 m b. Flight path length = 80.39 m

Table 2. Normalization coefficients and background correction parameters obtained from the SAMMY fits. The background corrections are given by the formula $a + b/E^{1/2}$; backgrounds are in barns for cross section and dimensionless for transmission. For the data set number, see Table 1.

Data set number	Normalization coefficient		Background correction			
			a		*b*	
	Value	Uncertainty	Value	Uncertainty	Value	Uncertainty
1	1.0099	0.0034	-0.00208	0.00029	0.0040	0.0004
2	1.0133	0.0089	-0.00905	0.00076	-0.0064	0.0022
3	1.0052	0.0033	0.00225	0.00045	0.0010	0.0017
4	1.0034	0.0024	-0.241	0.096	-0.172	0.220
5	1.0124	0.0020	0.188	0.069	-0.694	0.171
6	0.9921	0.0033	0.360	0.037	-1.494	0.084
7	0.9726	0.0048	-0.007	0.306	-1.783	1.401
8	1.0333	0.0067	-0.535	0.253	4.096	1.195
9	1.0083	0.0050	-0.326	0.191	-0.406	0.458
10	0.9964	0.0035	-0.00236	0.00327	0.0015	0.0033
11	0.9885	0.0068	-0.127	0.386	0.632	0.656
12	1.0090	0.0038	0.211	0.229	-1.401	0.427
13	1.0013	0.0050	0.027	0.266	-0.744	0.490
14	1.0022	0.0009	-0.182	0.205	-0.712	1.08

run) were not kept in the laboratory files. Only for a few recent experiments could one find the raw data.

Prior to the SAMMY analysis, the experimental data were checked against the currently accepted standard data. The total, scattering, fission and capture standard cross sections are given at 0.0253 eV.[23] The fission integral standard is also given in the energy range 0.0206 to 0.06239 eV and in the energy range 7.8 to 11.0 eV, with a quite small error.[23, 18] The results of the present SAMMY fits are compared with the standard data in Table 3.

Table 3. The standard cross-section values.

Energy (eV)	Type	Calculated	Standard [23]
0.0253	Fission	588.63 ± 0.74 b	584.25 ± 1.11 b
0.0253	Capture	99.26 ± 0.21 b	98.96 ± 0.74 b
0.0253	Scattering	15.43 ± 0.13 b	15.46 ± 1.06 b
0.0253	Total	703.32 ± 0.80 b	698.67 ± 2.00 b
0.0206-0.06239	Fission Integral	19.31 ± 0.03 b-eV	19.15 ± 0.08 b-eV
7.8 -11.0	Fission Integral	239.20 ± 0.64 b-eV	246.50 ± 1.04 b-eV

All the experimental data were normalized at 0.0253 eV on the standard values. Since in the SAMMY fits the normalization and the background parameters were adjustable, the cross sections calculated at 0.0253 eV with the resonance parameters should be slightly different from the standard values, unless the corrections at this energy are null or negligible. For the fission cross section, the values of the corrections, calculated by the parameters of Table 2, vary between 3 b and 5 b (depending on the experimental data set), which is on average 0.7% of the value of the cross section (i.e., much larger than the error on the standard value). However, the capture and the scattering cross sections calculated at 0.0253 eV are consistent with the standard values.

The standard value in the energy range from 7.8 to 11 eV is the one obtained by the ENDF/B-VI standard evaluation group,[23] but nothing was published concerning the manner in which this value was obtained. In most of the experimental fission data, normalization on the standard at 0.0253 eV results in a fission integral which is not consistent with the standard value in the 7.8- to 11-eV energy range; the standard value is probably overestimated in this energy range. Table 4 shows the values of the fission integral in the energy range 7.8 to 11.0 eV for some recent fission measurements normalized to the same value of 19.15 b-eV in the energy range 0.0206 to 0.06239 eV. The value calculated from the resonance parameters obtained in the present work is in agreement with the experimental data of Wagemans[18] and Schrack.[13] The discrepancies among the experimental data in the energy range 7.8 to 11.0 eV could be due to inaccurate or inadequate corrections, by the authors of the experiments, of the experimental effects.

These results are an illustration of the difficulties encountered when analyzing a large set of experimental data over a large energy range. Nevertheless, a large set of data and a large energy range are needed to obtain a realistic covariance matrix for the calculation of the correlation matrix of the average group cross sections. It is unlikely that a large set of experimental data would be consistent over a large energy range when compared with the standard data available at different energies. At least the cross sections calculated from the evaluated resonance parameters should reproduce the standard values at 0.0253 eV within the accuracy of the standard. The resonance parameters obtained in the present work do not reproduce with enough accuracy the standard values at 0.0253 eV, but the corresponding covariance matrix is nevertheless adequate for the calculation of the covariance matrix of the average cross sections.

Table 4. The fission integral (in units of b-eV) in the energy range 7.8 to 11.0 eV. The standard value is 246.50 ± 1.04 b-eV.

	Experimental	Deviation from standard	Calculated
Wagemans (1988) [16]	240.82	-2.4%	239.20
Schrack (1988) [11]	239.02	-3.1%	
Gwin (1984) [14]	248.02	+0.6%	
Gwin (1996) [17]	236.21	-4.6%	

3.2. AVERAGE CROSS SECTION AND UNCERTAINTIES

Flux-weighted group cross sections are defined in such a way that for a particular reaction (e.g., σ_x), the reaction rate within the group is conserved,

$$\bar{\sigma}_{xg}\,\phi_g = \int_{E_g}^{E_{g+1}} \sigma_x(E)\;\phi(E)\;dE \qquad (1)$$

and

$$\phi_g = \int_{E_g}^{E_{g+1}} \phi(E)\,dE \quad . \qquad (2)$$

Here ϕ_g is the energy-dependent neutron flux in the energy group g, and $\bar{\sigma}_{xg}$ is the flux-weighted group cross section. Since $\phi(E)$ is not known *a priori*, the Bondarenko narrow-resonance weighting scheme[24] is frequently used. In this approach $\phi(E)$ is defined as

$$\phi(E) = \frac{C(E)}{\sigma_0 + \sigma_t(E,T)} \quad , \tag{3}$$

where $C(E)$ is a smooth function of energy, σ_0 is the dilution and $\sigma_t(E,T)$ the energy and temperature-dependent total cross section. In the Bondarenko scheme the flux-weighted group cross section is therefore

$$\bar{\sigma}_{xg} = \frac{\int_{E_g}^{E_{g+1}} \sigma_x(E) \frac{C(E)}{\sigma_0 + \sigma_t(E,T)} dE}{\int_{E_g}^{E_{g+1}} \frac{C(E)}{\sigma_0 + \sigma_t(E,T)} dE} \quad . \tag{4}$$

The infinite dilution condition occurs when $\sigma_0 \gg \sigma_t(E,T)$, which leads to

$$\bar{\sigma}_{xg} = \frac{\int_{E_g}^{E_{g+1}} \sigma_x(E)\, C(E)\, dE}{\int_{E_g}^{E_{g+1}} C(E)\, dE} \quad . \tag{5}$$

In this work the group-averaged cross section calculated in SAMMY assumes the infinite-dilution condition for a flat flux, that is $C(E)$ = constant,

$$\bar{\sigma}_{xg} = \frac{\int_{E_g}^{E_{g+1}} \sigma_x(E)\, dE}{E_{g+1} - E_g} \quad . \tag{6}$$

To obtain the uncertainty in $\bar{\sigma}_{xg}$ with respect to a parameter p, one first generates an increment in $\bar{\sigma}_{xg}$ due to an increment in σ_x via

$$\delta\bar{\sigma}_{xg} = \frac{1}{E_{g+1} - E_g} \sum_j \int_{E_g}^{E_{g+1}} \frac{\partial \sigma_x(E)}{\partial p_j} \delta p_j \, dE \quad . \tag{7}$$

The variance on $\bar{\sigma}_{xg}$ is obtained by squaring this quantity and taking expectation values, which give

$$<(\delta\bar{\sigma}_{xg})^2> = \frac{1}{E_{g+1}-E_g}\sum_{ij}\int_{E_g}^{E_{g+1}}\int_{E_g}^{E_{g+1}}\frac{\partial\sigma_x(E)}{\partial p_i}\frac{\partial\sigma_x(E')}{\partial p_j}<\delta p_i\,\delta p_j>\,dE\,dE' \quad . \qquad (8)$$

By definition, the uncertainty in $\bar{\sigma}_{xg}$ is then given by the square root of Eq. (8).

The sensitivity matrix (derivatives with respect to the parameters) and the covariance matrix $<\delta p_i\ \delta p_j>$ are both calculated in SAMMY, along with the values for the group cross sections.

Note that SAMMY is not limited to the infinite dilution condition with flat flux. Although the more general formulations of Eqs. (1) and (4) are not yet implemented within SAMMY, plans are being made to accomplish this as soon as time and funding permit.

3.3. THE COVARIANCE MATRICES

The covariance matrix of the resonance and experimental parameters was obtained in the energy range 0 to 50 eV, corresponding to 488 adjusted parameters (445 resonance parameters, 42 experimental correction parameters, and the effective scattering R). The matrix has 488 diagonal elements (which are the variance of the parameters) and 118,828 symmetrical nondiagonal covariance elements. Small parts of the covariance matrix are shown in Tables 5 and 6. Table 5 shows the correlation coefficients between the resonance parameters at low energy. Table 6 shows the correlation coefficients between the experimental correction parameters. As expected, strong correlations are observed between the parameters of the same resonance and between the parameters of nearby resonances over energy ranges of several eV. Some correlations of 10 to 20% are also found beyond the energy range of 10 eV. For example, the energy of the resonance at 0.302 eV is correlated with the fission width of the second fission channel of the resonance at 18.49 eV. As is shown in Table 6, the correlations between the normalization factor and the background corrections of a given experiment could be as large as 90%. These strong correlations are not unexpected.

In general, the long-range correlations between resonance parameters are smaller than a few percent and could be neglected for practical purposes. It is likely that only about 20% of the correlation coefficients will need to be stored in the evaluated data files, which should help to build an interface between the SAMMY outputs and the evaluated data files. (See Sect. 4 for more on this topic.)

Table 5. A part of the SAMMY output correlation matrix showing the correlations between the parameters of the low-energy resonances. There are five parameters for each resonance in the following order: (1) resonance energy, (2) capture width, (3) neutron width, (4) first fission channel width, and (5) second fission channel width; parameters for resonance number N are labeled $5N$-4 through $5N$. The number of the parameter is given in the first column of the Table, the absolute and relative uncertainties on the parameter in column 2 and 3, and the correlation coefficients (×100) in the remaining columns. (Values for the resonance parameters are given in Appendix A.)

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	4.6545E-04	.002	100														
2	0.8939	.022	-6	100													
3	3.6718E-05	.008	25	51	100												
4	1.255	.010	41	-57	-5	100											
5	2.0350E-02	.092	15	-4	7	-1	100										
6	1.6199E-04	.000	2	-1	0	3	1	100									
7	0.3718	.010	1	1	-3	0	-1	2	100								
8	6.1601E-05	.007	2	3	50	0	1	2	-23	100							
9	0.2398	.024	-9	-1	-1	2	3	-16	-20	-10	100						
10	5.5672E-02	.069	23	-1	0	1	-3	39	-5	3	-3	100					
11	4.1068E-04	.000	7	0	1	2	-1	-3	-3	-1	-6	3	100				
12	0.6285	.016	0	3	0	-1	-1	1	3	0	-4	2	6	100			
13	1.6094E-04	.006	1	2	51	2	2	3	-1	57	-2	2	-17	9	100		
14	0.9287	.044	-26	1	-6	-3	4	6	3	-4	11	-30	-61	-16	8	100	
15	1.175	.013	21	-2	3	5	-2	-1	-3	1	-7	26	22	-22	8	-53	100
16	1.5426E-03	.000	-2	1	-1	0	1	3	0	-2	0	-3	10	1	-2	4	-5
17	2.177	.040	-1	1	0	-1	0	0	2	1	-1	-2	2	3	1	0	-2
18	1.0838E-03	.015	-5	1	19	0	2	2	-1	22	1	-8	4	1	24	7	-7
19	2.443	.059	-26	2	-5	-5	5	1	-1	-3	8	-32	-2	2	-2	29	-26
20	3.073	.019	15	-2	0	3	-3	0	0	-1	-3	21	-1	-2	1	-15	18
21	4.8203E-03	.001	7	0	-2	2	-1	0	-2	-3	1	-3	2	-1	-4	8	-8
22	4.292	.075	1	0	-1	0	0	0	1	-1	0	-1	1	1	-1	2	-3
23	1.4500E-04	.042	-10	1	5	-3	2	1	0	5	0	-3	2	1	8	2	-1
24	5.431	.092	-3	-1	0	-2	0	-1	0	-1	-1	3	4	0	-3	-4	2
25	8.324	.076	0	0	0	0	0	2	-1	-1	0	0	-3	0	2	2	1
26	7.7058E-03	.001	13	-1	2	3	-3	-2	2	2	-2	14	-2	0	3	-9	10
27	3.446	.070	-5	1	0	-1	2	1	0	-1	0	-8	2	1	-1	5	-6
28	5.1809E-03	.035	-20	2	5	-3	6	4	-4	6	4	-25	10	1	6	20	-22
29	9.069	.042	-29	2	-1	-7	5	0	-1	2	4	-20	0	1	1	13	-13
30	7.272	.054	6	0	-4	2	0	0	-2	-4	0	-2	0	0	-4	6	-4
31	2.0991E-03	.000	0	0	-2	1	1	1	-2	-2	1	-4	4	0	-2	5	-5
32	2.413	.056	0	0	0	0	0	0	1	0	-1	0	1	2	-1	0	-1
33	8.5402E-04	.021	13	-1	15	3	-2	-1	1	16	-4	16	-7	0	19	-15	16
34	0.3810	.096	-1	0	0	0	0	1	0	0	0	-1	1	0	1	1	-1
35	5.252	.025	6	-1	1	2	-2	-1	1	0	-2	10	-9	-1	3	-9	13

			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
17	2.177	.040	48	100													
18	1.0838E-03	.015	76	39	100												
19	2.443	.059	-24	-8	0	100											
20	3.073	.019	16	-34	24	-59	100										
21	4.8203E-03	.001	-9	0	-8	29	-26	100									
22	4.292	.075	1	0	-1	2	-2	-9	100								
23	1.4500E-04	.042	2	-2	0	-16	8	-46	22	100							

24	5.431	.092	5	-1	-5	-6	-1	14	-5	22	100							
25	8.324	.076	-12	-1	-2	5	-3	-6	-11	36	-30	100						
26	7.7058E-03	.001	2	-3	-1	-26	19	-9	-3	0	1	4	100					
27	3.446	.070	2	2	3	9	-7	2	-2	3	1	1	-19	100				
28	5.1809E-03	.035	6	3	4	31	-30	9	3	10	6	-3	-54	35	100			
29	9.069	.042	6	3	6	12	-7	-29	-1	28	7	0	-4	-1	12	100		
30	7.272	.054	-10	0	-4	18	-14	40	7	-15	-4	-2	-20	2	4	-31	100	
31	2.0991E-03	.000	2	0	2	10	-7	21	4	2	-4	14	-4	5	24	-11	54	
32	2.413	.056	2	1	0	-1	0	0	0	0	0	0	7	-14	-3	2	-3	
33	8.5402E-04	.021	-9	-1	4	-21	17	5	-1	-9	2	-2	-10	-3	-26	-52	29	
34	0.3810	.096	2	0	1	-2	1	2	1	3	0	2	5	-2	1	-15	14	
35	5.252	.025	-10	-1	0	-13	15	-2	0	-8	0	-7	-13	8	-20	-30	23	

			31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
32	2.413	.056	3	100													
33	8.5402E-04	.021	-17	10	100												
34	0.3810	.096	-23	-1	0	100											
35	5.252	.025	-24	-34	73	-7	100										

Table 6. Part of the SAMMY output correlation matrix showing the correlations between the normalization and the background correction parameters. There are three parameters for each experimental data set. The numbers 453, 454, 455 are for the normalization coefficient and the two background corrections coefficients of the second transmission experiment of Harvey, etc., in the same order as on Table 1. The absolute and relative errors on the parameters are given in column 2 and 3 of the Table. (Values for the correction parameters are given in Table 2.)

			451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466
452	4.1417E-04	.103	-77	100														
453	8.9375E-04	.001	-8	3	100													
454	7.6163E-04	.084	8	-4	-69	100												
455	2.2137E-03	.344	7	-2	-31	-37	100											
456	3.2990E-03	.003	3	0	27	-1	0	100										
457	4.5007E-04	.200	8	-9	-1	11	-9	2	100									
458	1.7023E-03	1.894	1	5	-3	-6	11	-4	-91	100								
459	2.4180E-03	.002	-4	-4	3	-2	-3	-1	-1	-1	100							
460	9.5674E-02	.397	-11	15	-1	0	-1	-5	-1	0	62	100						
461	0.2197	1.275	13	-18	1	1	1	7	7	-6	-77	-86	100					
462	2.0549E-03	.002	-7	-2	13	-12	-5	2	-8	3	25	16	-16	100				
463	6.8785E-02	.366	-7	13	-9	4	5	-7	-12	13	1	11	-8	-17	100			
464	0.1707	.246	10	-17	4	1	-4	8	18	-19	-1	-8	15	-8	-82	100		
465	3.3187E-03	.003	-15	8	39	-34	-17	0	-8	0	-13	-13	11	-16	-9	8	100	
466	3.7259E-02	.103	-3	4	-7	3	4	-1	-7	5	-3	-4	5	-7	-6	8	-11	100
467	8.4268E-02	.056	4	-6	-4	5	0	1	8	-5	2	3	-5	5	8	-10	-13	-81
468	4.7519E-03	.005	-3	0	5	-5	-2	1	-3	1	9	6	-6	19	0	-3	-6	-3
469	0.3060	46.51	0	0	-1	0	1	-1	-3	3	-1	0	0	-1	3	-2	0	-1
470	1.401	.786	0	0	0	1	0	0	2	-3	1	1	0	0	0	1	-1	0
471	6.6596E-03	.006	-7	4	20	-19	-7	0	-4	1	-6	-6	6	-9	-5	4	39	0
472	0.2535	.474	1	0	-1	0	1	0	-2	2	1	1	0	0	-1	1	-1	4
473	1.195	.292	-1	1	-1	1	-1	0	2	-2	-1	-1	1	-1	0	0	0	0

			467	468	469	470	471	472	473
467	8.4268E-02	.056	100						
468	4.7519E-03	.005	2	100					
469	0.3060	46.51	1	-9	100				
470	1.401	.786	0	-12	-90	100			
471	6.6596E-03	.006	-7	-3	0	0	100		
472	0.2535	.4741	-3	0	0	0	-4	100	
473	1.195	.292	1	0	0	0	-11	-93	100

The covariance matrix of the resonance parameter was used as input in SAMMY for calculation of the correlations among the 45 lowest energy groups of the 199-group cross sections of the VITAMIN-B6 library [5] and of the 140 lowest energy groups of the 238-group cross sections of the LAW library.[6] Correlation matrices were obtained for the fission, capture, scattering, and total cross sections. Energy boundaries of the averaged group cross sections are given in Tables 7 to 10 for the 199-group structure with the average cross sections and their uncertainties. Uncertainties are in general smaller than 1% because (1) a large experimental database was analyzed and (2) there is good consistency among the various sets of experimental data. Correlation coefficients of the 199- group structure are given in the Tables 11 to 14. All correlation coefficients are positive for the total, fission, capture, and scattering cross sections. The small energy ranges of the thermal region are fully correlated. Strong long-range correlations exist also between the thermal groups and the groups where the cross sections are small, and, in general, between the groups with small cross-section values. These strong correlations are due to the systematic errors on the normalization and background corrections of the experimental data.

Results for the 238-group structure are given in Appendix B of this paper.

Due to computer limitations, it is not currently possible to calculate the covariance matrix for all parameters in a single SAMMY run in the energy range from the thermal region to 2.25 keV (i.e., over the entire energy range where the resonance parameters are available). The results of the present calculations are suitable for sensitivity calculations relative to benchmarks in thermal spectrum. A similar procedure can be developed in the intermediate-energy region to generate sensitivity coefficients for the determination of criticality safety margins. However, the possibility of calculations over a wider energy range is limited by the size of the covariance matrices. Partial SAMMY runs could be carried out on overlapping energy ranges and a single covariance matrix could be obtained by mixing the partial covariance matrices. It is not certain, however, that so large a matrix could be used in SAMMY for the calculation of the covariance matrix of the group cross sections in the energy range up to 2.25 keV. The Nuclear Data Group (i.e., the authors) have plans to develop tools to circumvent these problems.

Table 7. The averaged capture cross sections and their uncertainties for the lowest 45 groups of the 199-group structure of the VITAMIN-B6 library. The energy boundaries of the groups are given in eV and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00050	1583.62	2.19118
(2)	.00050	.00200	581.447	.814407
(3)	.00200	.00500	332.593	.479974
(4)	.00500	.01000	217.260	.332767
(5)	.01000	.01450	160.512	.265833
(6)	.01450	.02100	126.564	.229096
(7)	.02100	.03000	99.1694	.201790
(8)	.03000	.04000	79.6855	.184531
(9)	.04000	.05000	67.0371	.175575
(10)	.05000	.07000	55.4726	.171735
(11)	.07000	.10000	44.5069	.178960
(12)	.10000	.12500	37.9880	.200970
(13)	.12500	.15000	34.9931	.235094
(14)	.15000	.18400	33.9773	.298876
(15)	.18400	.22500	36.2010	.432866
(16)	.22500	.27500	42.6642	.671274
(17)	.27500	.32500	41.2566	.722969
(18)	.32500	.36680	29.1536	.459712
(19)	.36680	.41399	20.2983	.253470
(20)	.41399	.50000	14.0817	.118298
(21)	.50000	.53158	11.2708	6.544099E-02
(22)	.53158	.62506	9.70383	4.212451E-02
(23)	.62506	.68256	8.48628	2.794191E-02
(24)	.68256	.80000	7.75934	2.375308E-02
(25)	.80000	.87643	7.55463	2.912808E-02
(26)	.87643	1.00000	8.73944	5.500305E-02
(27)	1.00000	1.04000	12.0877	.111810
(28)	1.04000	1.08000	16.3936	.180070
(29)	1.08000	1.12530	24.2145	.299789
(30)	1.12530	1.30000	20.2525	.222470
(31)	1.30000	1.44500	6.60897	8.043458E-02
(32)	1.44500	1.85540	3.84365	1.096020E-02
(33)	1.85540	2.38240	13.3112	8.596037E-02
(34)	2.38240	3.05900	3.56924	3.195349E-02
(35)	3.05900	3.92790	16.2886	.124316
(36)	3.92790	5.04350	21.0874	.123322
(37)	5.04350	6.47600	46.5651	.244552
(38)	6.47600	8.31530	16.2042	8.814033E-02
(39)	8.31530	10.67700	34.4581	.192407
(40)	10.67700	13.71000	67.3420	.253481
(41)	13.71000	17.60400	17.4441	8.699141E-02
(42)	17.60400	22.60300	43.7486	.193572
(43)	22.60300	29.02300	20.0091	.109174
(44)	29.02300	37.26600	34.8962	.157284
(45)	37.26600	47.85100	17.3388	8.418739E-02

Table 8. The averaged fission cross sections and their uncertainties for the lowest 45 groups of the 199-group structure of the VITAMIN-B6 library. The energy boundaries of the groups are given in eV and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00050	8075.54	9.11608
(2)	.00050	.00200	2969.21	3.36168
(3)	.00200	.00500	1709.79	1.94862
(4)	.00500	.01000	1141.43	1.31552
(5)	.01000	.01450	873.736	1.01936
(6)	.01450	.02100	717.665	.847229
(7)	.02100	.03000	588.783	.705119
(8)	.03000	.04000	490.821	.597177
(9)	.04000	.05000	421.928	.521487
(10)	.05000	.07000	353.390	.446704
(11)	.07000	.10000	281.797	.370619
(12)	.10000	.12500	233.332	.324493
(13)	.12500	.15000	205.484	.307308
(14)	.15000	.18400	185.640	.315612
(15)	.18400	.22500	176.956	.374306
(16)	.22500	.27500	188.501	.504730
(17)	.27500	.32500	189.707	.530874
(18)	.32500	.36680	154.626	.402967
(19)	.36680	.41399	122.344	.300739
(20)	.41399	.50000	94.5994	.204853
(21)	.50000	.53158	79.7989	.161258
(22)	.53158	.62506	70.2993	.139515
(23)	.62506	.68256	62.3491	.126187
(24)	.68256	.80000	57.1196	.122392
(25)	.80000	.87643	54.8610	.129892
(26)	.87643	1.00000	59.3632	.162353
(27)	1.00000	1.04000	72.3234	.230766
(28)	1.04000	1.08000	86.8187	.308667
(29)	1.08000	1.12530	107.078	.460306
(30)	1.12530	1.30000	59.9402	.253683
(31)	1.30000	1.44500	20.0025	8.460446E-02
(32)	1.44500	1.85540	14.5537	4.147414E-02
(33)	1.85540	2.38240	14.5606	7.563083E-02
(34)	2.38240	3.05900	13.8780	4.688665E-02
(35)	3.05900	3.92790	32.0537	.120415
(36)	3.92790	5.04350	5.82144	5.518072E-02
(37)	5.04350	6.47600	30.1274	.138791
(38)	6.47600	8.31530	13.2147	7.450271E-02
(39)	8.31530	10.67700	98.2584	.251004
(40)	10.67700	13.71000	46.9066	.160465
(41)	13.71000	17.60400	32.5538	8.382954E-02
(42)	17.60400	22.60300	64.9394	.168061
(43)	22.60300	29.02300	43.7285	.101293
(44)	29.02300	37.26600	57.2400	.137985
(45)	37.26600	47.85100	33.9546	7.902660E-02

Table 9. The averaged scattering cross sections and their uncertainties for the lowest 45 groups of the 199-group structure of the VITAMIN-B6 library. The energy boundaries of the groups are given in eV and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00050	15.7020	.124688
(2)	.00050	.00200	15.6946	.124660
(3)	.00200	.00500	15.6779	.124598
(4)	.00500	.01000	15.6491	.124491
(5)	.01000	.01450	15.6166	.124370
(6)	.01450	.02100	15.5816	.124239
(7)	.02100	.03000	15.5359	.124066
(8)	.03000	.04000	15.4837	.123869
(9)	.04000	.05000	15.4320	.123673
(10)	.05000	.07000	15.3595	.123397
(11)	.07000	.10000	15.2478	.122967
(12)	.10000	.12500	15.1342	.122526
(13)	.12500	.15000	15.0371	.122145
(14)	.15000	.18400	14.9281	.121713
(15)	.18400	.22500	14.8012	.121207
(16)	.22500	.27500	14.7052	.120842
(17)	.27500	.32500	14.7272	.120994
(18)	.32500	.36680	14.7294	.121049
(19)	.36680	.41399	14.6546	.120764
(20)	.41399	.50000	14.5116	.120194
(21)	.50000	.53158	14.3892	.119701
(22)	.53158	.62506	14.2693	.119216
(23)	.62506	.68256	14.1331	.118662
(24)	.68256	.80000	13.9849	.118057
(25)	.80000	.87643	13.8252	.117401
(26)	.87643	1.00000	13.6596	.116715
(27)	1.00000	1.04000	13.5277	.116161
(28)	1.04000	1.08000	13.4894	.115989
(29)	1.08000	1.12530	13.5447	.116193
(30)	1.12530	1.30000	13.8008	.117256
(31)	1.30000	1.44500	13.5185	.116094
(32)	1.44500	1.85540	13.1482	.114527
(33)	1.85540	2.38240	12.7957	.113006
(34)	2.38240	3.05900	12.2947	.110783
(35)	3.05900	3.92790	12.1251	.109954
(36)	3.92790	5.04350	11.6192	.107571
(37)	5.04350	6.47600	11.0828	.103960
(38)	6.47600	8.31530	11.0442	.104731
(39)	8.31530	10.67700	11.9938	.106412
(40)	10.67700	13.71000	12.2993	.105997
(41)	13.71000	17.60400	11.1625	.104823
(42)	17.60400	22.60300	12.5482	.106203
(43)	22.60300	29.02300	11.5800	.106049
(44)	29.02300	37.26600	12.1264	.104203
(45)	37.26600	47.85100	11.5146	.104681

Table 10. The averaged total cross sections and their uncertainties for the lowest 45 groups of the 199-group structure of the VITAMIN-B6 library. The energy boundaries of the groups are given in eV and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00050	9674.85	9.71998
(2)	.00050	.00200	3566.35	3.57440
(3)	.00200	.00500	2058.06	2.06606
(4)	.00500	.01000	1374.34	1.38967
(5)	.01000	.01450	1049.86	1.07260
(6)	.01450	.02100	859.810	.888598
(7)	.02100	.03000	703.488	.738349
(8)	.03000	.04000	585.990	.626631
(9)	.04000	.05000	504.397	.550419
(10)	.05000	.07000	424.222	.478001
(11)	.07000	.10000	341.552	.409852
(12)	.10000	.12500	286.454	.375924
(13)	.12500	.15000	255.514	.371633
(14)	.15000	.18400	234.545	.393963
(15)	.18400	.22500	227.958	.457712
(16)	.22500	.27500	245.870	.592743
(17)	.27500	.32500	245.691	.689774
(18)	.32500	.36680	198.509	.537804
(19)	.36680	.41399	157.296	.380508
(20)	.41399	.50000	123.193	.249250
(21)	.50000	.53158	105.459	.197026
(22)	.53158	.62506	94.2724	.174405
(23)	.62506	.68256	84.9684	.162046
(24)	.68256	.80000	78.8638	.159158
(25)	.80000	.87643	76.2409	.166572
(26)	.87643	1.00000	81.7622	.199911
(27)	1.00000	1.04000	97.9388	.280852
(28)	1.04000	1.08000	116.702	.382390
(29)	1.08000	1.12530	144.837	.579329
(30)	1.12530	1.30000	93.9934	.321456
(31)	1.30000	1.44500	40.1299	.137978
(32)	1.44500	1.85540	31.5456	.108788
(33)	1.85540	2.38240	40.6675	.127743
(34)	2.38240	3.05900	29.7419	.107718
(35)	3.05900	3.92790	60.4674	.168227
(36)	3.92790	5.04350	38.5281	.160651
(37)	5.04350	6.47600	87.7753	.260689
(38)	6.47600	8.31530	40.4631	.133205
(39)	8.31530	10.67700	144.710	.292082
(40)	10.67700	13.71000	126.548	.279780
(41)	13.71000	17.60400	61.1605	.139306
(42)	17.60400	22.60300	121.236	.242064
(43)	22.60300	29.02300	75.3176	.158385
(44)	29.02300	37.26600	104.263	.198930
(45)	37.26600	47.85100	62.8080	.137202

Table 11. The correlation matrix of the capture cross sections for the lowest 45 groups of the 199- group structure of the VITAMIN-B6 library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2.19118	100														
2	.814407	100	100													
3	.479974	100	100	100												
4	.332767	100	100	100	100											
5	.265833	100	100	100	100	100										
6	.229096	100	100	100	100	100	100									
7	.201790	99	99	99	100	100	100	100								
8	.184531	99	99	99	99	100	100	100	100							
9	.175575	99	99	99	99	100	100	100	100	100						
10	.171735	99	99	99	99	99	100	100	100	100	100					
11	.178960	98	98	98	99	99	99	100	100	100	100	100				
12	.200970	98	98	98	98	99	99	99	100	100	100	100	100			
13	.235094	97	97	98	98	98	99	99	99	99	100	100	100	100		
14	.298876	97	97	97	97	98	98	98	99	99	99	99	100	100	100	
15	.432866	95	95	95	95	96	96	96	97	97	97	98	98	99	99	100
16	.671274	90	90	90	91	91	91	92	92	92	93	93	94	95	96	98
17	.722969	88	88	89	89	89	89	90	90	90	90	91	91	92	93	95
18	.459712	92	92	92	92	92	93	93	93	93	93	93	93	93	93	93
19	.253470	94	94	94	94	95	95	95	95	95	95	95	95	95	94	93
20	.118298	95	95	96	96	96	96	97	97	97	97	96	96	96	95	93
21	6.544099E-02	96	96	96	96	97	97	97	97	97	97	97	96	96	95	92
22	4.212451E-02	95	95	95	96	96	96	96	96	96	96	96	95	94	93	91
23	2.794191E-02	90	90	90	90	90	91	91	91	90	90	89	89	88	86	84
24	2.375308E-02	72	72	72	73	73	73	73	72	72	72	71	70	69	68	65
25	2.912808E-02	45	45	45	45	45	45	45	45	44	44	43	42	41	40	38
26	5.500305E-02	24	24	24	24	24	24	24	24	24	23	22	21	21	20	18
27	.111810	16	16	16	16	16	16	16	16	16	15	15	14	13	12	11
28	.180070	13	13	13	13	13	13	13	13	13	13	12	12	11	10	10
29	.299789	11	11	11	11	11	11	11	12	11	11	11	10	10	9	8
30	.222470	13	13	13	13	13	13	12	12	12	11	10	10	9	8	8
31	8.043458E-02	8	8	8	7	7	7	7	6	6	6	6	6	5	5	5
32	1.096020E-02	24	24	24	24	24	24	24	23	23	22	21	20	19	18	17
33	8.596037E-02	7	7	6	6	6	6	6	6	6	6	6	5	5	5	5
34	3.195349E-02	8	8	8	8	8	8	7	7	7	7	7	6	6	6	6
35	.124316	8	8	8	8	8	8	8	8	7	7	7	7	7	7	6
36	.123322	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2
37	.244552	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2
38	8.814033E-02	4	4	4	4	4	4	4	4	3	3	3	3	3	2	2
39	.192407	5	5	5	5	5	5	5	4	4	4	4	3	3	3	2
40	.253481	5	5	5	5	5	5	5	5	4	4	4	4	3	3	3
41	8.699141E-02	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
42	.193572	4	4	4	4	4	4	4	4	4	4	4	3	3	3	2
43	.109174	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
44	.157284	4	4	4	4	4	4	4	4	4	4	3	3	3	2	2
45	8.418739E-02	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.671274	100														
17	.722969	98	100													
18	.459712	94	98	100												
19	.253470	92	95	99	100											
20	.118298	90	93	98	100	100										
21	6.544099E-02	89	91	96	99	100	100									
22	4.212451E-02	87	89	94	97	98	99	100								
23	2.794191E-02	80	82	87	90	92	95	98	100							
24	2.375308E-02	62	63	68	70	74	78	85	94	100						
25	2.912808E-02	36	37	40	42	46	52	61	76	94	100					
26	5.500305E-02	17	18	20	22	25	32	41	60	83	97	100				
27	.111810	10	11	12	14	18	24	33	52	76	93	99	100			
28	.180070	9	9	10	12	15	21	30	48	71	88	96	99	100		
29	.299789	8	8	8	10	13	18	26	42	63	79	87	92	97	100	
30	.222470	7	8	8	9	12	17	24	39	57	69	71	72	73	79	100
31	8.043458E-02	4	4	5	5	7	9	12	19	26	31	33	35	36	37	15
32	1.096020E-02	16	17	18	20	23	29	37	53	71	80	79	74	70	64	64
33	8.596037E-02	5	6	6	6	7	8	9	11	13	14	13	12	11	10	10
34	3.195349E-02	5	4	4	4	5	7	9	12	16	17	16	15	15	15	13
35	.124316	6	6	6	6	7	8	10	14	17	18	16	15	15	15	14
36	.123322	1	2	2	2	2	3	4	6	8	9	8	8	8	8	7
37	.244552	2	2	3	3	4	5	7	9	12	13	12	12	12	11	11
38	8.814033E-02	2	2	2	3	3	4	6	9	11	12	11	11	11	11	11
39	.192407	2	3	3	3	4	6	8	11	15	16	15	14	14	13	13
40	.253481	3	3	3	3	4	6	8	11	15	16	15	15	15	15	14
41	8.699141E-02	2	2	2	2	3	4	6	8	11	11	11	10	10	10	9
42	.193572	2	2	3	3	4	5	7	10	14	15	14	14	14	13	13
43	.109174	1	1	2	2	2	3	4	6	8	9	8	8	8	8	8
44	.157284	2	2	2	3	3	5	6	9	12	13	13	12	12	12	11
45	8.418739E-02	1	1	1	2	2	3	4	6	8	9	8	8	8	8	8

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
31	8.043458E-02	100														
32	1.096020E-02	54	100													
33	8.596037E-02	6	33	100												
34	3.195349E-02	9	28	10	100											
35	.124316	8	25	11	30	100										
36	.123322	3	11	7	6	12	100									
37	.244552	5	17	9	8	15	17	100								
38	8.814033E-02	5	16	9	9	16	15	26	100							
39	.192407	6	20	11	11	20	19	28	30	100						
40	.253481	5	20	13	10	22	23	34	30	43	100					
41	8.699141E-02	4	15	9	8	16	15	23	22	30	34	100				
42	.193572	5	19	12	10	21	21	32	29	41	48	34	100			
43	.109174	3	12	8	7	15	14	21	20	28	32	25	33	100		
44	.157284	4	17	11	8	19	19	29	26	38	45	31	43	31	100	
45	8.418739E-02	3	12	8	7	16	14	22	21	30	35	27	35	28	35	100

Table 12. The correlation matrix of the fission cross sections for the lowest 45 groups of the 199-group structure of the VITAMIN-B6 library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	9.11608	100														
2	3.36168	100	100													
3	1.94862	100	100	100												
4	1.31552	100	100	100	100											
5	1.01936	100	100	100	100	100										
6	.847229	100	100	100	100	100	100									
7	.705119	100	100	100	100	100	100	100								
8	.597177	100	100	100	100	100	100	100	100							
9	.521487	99	99	99	99	100	100	100	100	100						
10	.446704	99	99	99	99	99	99	99	100	100	100					
11	.370619	96	96	97	97	97	97	98	98	99	99	100				
12	.324493	92	92	92	92	93	93	94	95	96	97	99	100			
13	.307308	84	84	84	85	85	86	87	88	89	91	95	99	100		
14	.315612	71	71	71	72	72	73	74	76	77	80	85	92	97	100	
15	.374306	51	51	52	52	53	53	55	56	58	61	67	75	84	94	100
16	.504730	38	39	39	39	39	39	40	40	41	42	45	50	56	66	83
17	.530874	38	38	38	38	38	39	39	39	39	40	41	42	43	44	52
18	.402967	38	38	39	39	39	40	41	42	43	45	48	53	56	57	52
19	.300739	43	43	43	44	44	45	46	47	48	50	55	60	65	67	60
20	.204853	58	58	59	59	59	60	60	61	62	64	67	71	74	75	66
21	.161258	71	71	71	72	72	72	72	73	73	74	76	78	79	77	67
22	.139515	79	79	79	80	80	80	80	80	81	81	82	82	81	77	66
23	.126187	85	85	85	85	85	85	85	85	85	86	86	85	82	75	62
24	.122392	85	85	85	85	85	85	85	86	86	86	85	84	80	72	58
25	.129892	79	79	79	79	80	80	80	80	80	81	80	78	74	66	52
26	.162353	64	64	64	64	64	65	65	65	66	66	66	65	62	54	42
27	.230766	42	43	43	43	43	43	44	44	45	45	46	45	43	38	29
28	.308667	27	27	27	27	27	28	28	28	29	29	30	30	29	26	20
29	.460306	14	14	14	14	14	14	14	14	14	15	15	15	14	13	11
30	.253683	26	26	26	26	27	27	27	27	27	27	27	27	26	23	19
31	8.460446E-02	32	32	32	32	32	32	33	33	33	33	34	34	33	30	23
32	4.147414E-02	60	60	60	60	60	59	59	60	60	60	60	58	55	49	38
33	7.563083E-02	35	35	35	35	35	35	35	35	36	36	36	35	34	30	24
34	4.688665E-02	34	34	35	35	35	35	36	36	37	37	39	39	38	35	26
35	.120415	21	21	21	21	21	21	21	21	21	22	22	22	21	19	16
36	5.518072E-02	24	24	24	24	24	24	25	25	25	26	26	27	26	23	17
37	.138791	17	17	17	17	17	17	17	18	18	18	18	18	17	15	12
38	7.450271E-02	18	18	18	18	18	18	18	18	18	18	19	18	17	16	12
39	.251004	15	15	15	15	15	15	15	15	15	15	15	14	14	12	10
40	.160465	17	17	17	17	17	17	18	18	18	18	18	18	17	15	12
41	8.382954E-02	14	14	14	14	14	14	15	15	15	15	15	15	14	13	10
42	.168061	14	14	14	14	14	14	14	15	15	15	15	15	14	13	10
43	.101293	10	10	10	10	10	10	10	10	10	10	10	10	10	9	7
44	.137985	9	9	9	9	9	9	9	9	9	9	9	9	9	8	6
45	7.902660E-02	8	8	8	8	8	8	8	8	8	8	8	8	7	7	5

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.504730	100														
17	.530874	79	100													
18	.402967	47	76	100												
19	.300739	37	51	92	100											
20	.204853	40	39	78	95	100										
21	.161258	42	37	67	85	97	100									
22	.139515	44	36	59	76	92	98	100								
23	.126187	43	36	52	67	84	94	98	100							
24	.122392	41	35	46	58	75	87	94	98	100						
25	.129892	37	33	39	48	64	76	85	92	98	100					
26	.162353	30	28	31	36	49	60	69	78	87	95	100				
27	.230766	21	21	23	25	32	40	48	56	66	78	92	100			
28	.308667	14	15	17	17	21	26	31	37	44	55	73	93	100		
29	.460306	9	10	11	11	12	13	13	14	16	20	34	59	83	100	
30	.253683	14	14	16	17	21	23	25	26	26	24	22	22	29	49	100
31	8.460446E-02	15	13	18	21	28	33	37	41	44	46	43	32	17	1	18
32	4.147414E-02	26	24	31	37	46	52	55	56	53	47	37	28	23	19	25
33	7.563083E-02	17	16	19	23	28	32	34	35	34	31	25	19	15	11	16
34	4.688665E-02	16	18	22	23	26	29	32	34	35	34	30	23	18	12	17
35	.120415	13	14	14	14	16	18	20	21	21	21	20	17	15	12	15
36	5.518072E-02	11	12	14	14	16	18	19	21	21	21	18	15	12	9	12
37	.138791	9	10	10	10	12	14	15	16	16	16	14	12	10	8	10
38	7.450271E-02	9	9	10	11	13	16	17	18	18	17	15	12	10	9	11
39	.251004	9	9	9	9	11	13	14	15	16	15	15	13	12	11	12
40	.160465	10	10	10	10	11	13	15	16	16	16	14	12	11	9	11
41	8.382954E-02	8	9	8	8	9	11	12	13	13	13	12	11	10	9	10
42	.168061	8	9	8	8	10	11	13	13	14	14	13	12	11	10	11
43	.101293	6	6	6	6	7	8	9	9	9	9	8	7	7	6	7
44	.137985	5	5	5	5	7	8	9	9	10	10	9	9	8	8	8
45	7.902660E-02	5	5	4	5	6	7	8	8	8	7	7	6	6	6	6

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
31	8.460446E-02	100														
32	4.147414E-02	53	100													
33	7.563083E-02	25	50	100												
34	4.688665E-02	31	59	39	100											
35	.120415	15	24	18	30	100										
36	5.518072E-02	22	38	23	26	16	100									
37	.138791	10	17	13	15	13	14	100								
38	7.450271E-02	14	25	17	20	15	18	20	100							
39	.251004	7	12	9	11	15	8	16	19	100						
40	.160465	7	14	11	13	15	11	15	17	24	100					
41	8.382954E-02	9	17	12	15	15	13	15	18	22	21	100				
42	.168061	7	12	9	11	14	9	15	16	27	23	24	100			
43	.101293	6	11	8	9	11	8	11	14	19	17	22	22	100		
44	.137985	4	8	7	8	12	6	12	14	24	21	21	25	23	100	
45	7.902660E-02	5	10	7	8	10	7	10	14	18	17	20	21	25	25	100

Table 13. The correlation matrix of the scattering cross sections for the lowest 45 groups of the 199-group structure of the VITAMIN-B6 library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.124688	100														
2	.124660	100	100													
3	.124598	100	100	100												
4	.124491	100	100	100	100											
5	.124370	100	100	100	100	100										
6	.124239	100	100	100	100	100	100									
7	.124066	100	100	100	100	100	100	100								
8	.123869	100	100	100	100	100	100	100	100							
9	.123673	100	100	100	100	100	100	100	100	100						
10	.123397	100	100	100	100	100	100	100	100	100	100					
11	.122967	100	100	100	100	100	100	100	100	100	100	100				
12	.122526	100	100	100	100	100	100	100	100	100	100	100	100			
13	.122145	100	100	100	100	100	100	100	100	100	100	100	100	100		
14	.121713	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
15	.121207	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
16	.120842	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
17	.120994	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
18	.121049	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
19	.120764	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
20	.120194	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
21	.119701	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
22	.119216	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
23	.118662	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
24	.118057	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
25	.117401	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
26	.116715	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
27	.116161	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
28	.115989	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
29	.116193	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
30	.117256	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
31	.116094	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
32	.114527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
33	.113006	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
34	.110783	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
35	.109954	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
36	.107571	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
37	.103960	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
38	.104731	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
39	.106412	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
40	.105997	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
41	.104823	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
42	.106203	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
43	.106049	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
44	.104203	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
45	.104681	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.120842	100														
17	.120994	100	100													
18	.121049	100	100	100												
19	.120764	100	100	100	100											
20	.120194	100	100	100	100	100										
21	.119701	100	100	100	100	100	100									
22	.119216	100	100	100	100	100	100	100								
23	.118662	100	100	100	100	100	100	100	100							
24	.118057	100	100	100	100	100	100	100	100	100						
25	.117401	100	100	100	100	100	100	100	100	100	100					
26	.116715	100	100	100	100	100	100	100	100	100	100	100				
27	.116161	100	100	100	100	100	100	100	100	100	100	100	100			
28	.115989	100	100	100	100	100	100	100	100	100	100	100	100	100		
29	.116193	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
30	.117256	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
31	.116094	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
32	.114527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
33	.113006	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
34	.110783	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
35	.109954	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
36	.107571	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
37	.103960	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
38	.104731	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
39	.106412	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
40	.105997	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
41	.104823	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
42	.106203	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
43	.106049	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
44	.104203	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
45	.104681	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
31	.116094	100														
32	.114527	100	100													
33	.113006	100	100	100												
34	.110783	100	100	100	100											
35	.109954	100	100	100	100	100										
36	.107571	100	100	100	100	100	100									
37	.103960	100	100	100	100	100	100	100								
38	.104731	100	100	100	100	100	100	100	100							
39	.106412	100	100	100	100	100	100	100	100	100						
40	.105997	99	99	99	99	99	99	99	98	98	100					
41	.104823	100	100	100	100	100	100	100	100	100	99	100				
42	.106203	98	98	98	98	98	98	98	98	98	97	98	100			
43	.106049	100	100	100	100	100	100	100	100	100	99	100	98	100		
44	.104203	98	98	98	98	98	98	98	98	98	97	98	97	98	100	
45	.104681	100	100	100	100	100	100	100	100	100	99	100	98	100	98	100

Table 14. The correlation matrix of the total cross sections for the lowest 45 groups of the 199-group structure of the VITAMIN-B6 library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	9.71998	100														
2	3.57440	100	100													
3	2.06606	100	100	100												
4	1.38967	100	100	100	100											
5	1.07260	99	100	100	100	100										
6	.888598	99	99	100	100	100	100									
7	.738349	99	99	99	100	100	100	100								
8	.626631	98	98	99	99	99	100	100	100							
9	.550419	97	97	98	98	99	99	100	100	100						
10	.478001	95	96	96	97	98	98	99	99	100	100					
11	.409852	91	92	92	93	94	95	96	97	98	99	100				
12	.375924	84	85	86	87	88	90	91	93	94	96	99	100			
13	.371633	77	77	79	80	81	82	84	86	88	91	95	99	100		
14	.393963	66	67	68	70	71	72	74	77	79	83	89	94	98	100	
15	.457712	55	56	56	58	59	60	62	64	67	70	77	84	90	96	100
16	.592743	47	48	48	49	50	51	51	52	53	55	57	59	62	67	80
17	.689774	43	43	44	44	45	46	46	47	47	48	48	47	44	41	44
18	.537804	40	41	42	43	44	45	47	49	50	53	57	59	59	56	45
19	.380508	42	43	44	45	47	48	50	52	54	58	63	68	70	68	54
20	.249250	50	51	52	54	55	57	59	61	63	66	71	75	77	74	62
21	.197026	55	56	58	60	61	63	65	67	69	71	75	77	77	74	62
22	.174405	57	58	60	62	64	65	67	69	71	73	75	76	75	70	60
23	.162046	57	58	60	62	64	65	67	69	71	73	74	74	71	66	56
24	.159158	55	56	58	60	62	64	65	67	69	70	72	71	68	62	52
25	.166572	51	52	54	56	58	59	61	63	64	66	67	66	63	56	47
26	.199911	41	43	44	46	47	49	50	52	53	55	56	56	53	48	40
27	.280852	25	26	27	28	30	31	32	33	34	36	37	38	37	34	28
28	.382390	12	13	13	14	15	16	17	18	19	20	22	23	23	22	20
29	.579329	2	2	3	3	3	4	4	5	6	7	8	10	10	11	11
30	.321456	16	16	17	18	19	20	21	22	23	24	25	25	25	23	20
31	.137978	7	9	10	13	15	16	19	21	23	26	29	31	31	29	25
32	.108788	6	8	11	14	16	18	21	24	26	29	33	35	35	33	29
33	.127743	8	9	11	14	16	18	20	23	25	28	31	33	33	31	27
34	.107718	1	3	5	8	10	13	15	18	21	24	28	31	31	30	25
35	.168227	6	7	9	11	12	14	15	17	19	21	24	25	25	24	21
36	.160651	-1	0	2	4	5	7	9	11	13	15	18	20	20	19	16
37	.260689	1	2	3	4	5	6	7	8	9	10	12	13	14	13	11
38	.133205	-1	1	3	5	7	9	11	13	15	18	21	23	24	22	19
39	.292082	6	7	8	9	10	10	11	12	13	14	16	16	16	15	13
40	.279780	2	3	4	5	6	7	8	9	10	11	13	14	14	13	11
41	.139306	-4	-2	0	2	4	6	8	10	12	14	18	20	21	20	17
42	.242064	2	3	4	5	6	7	8	10	11	12	14	15	15	14	12
43	.158385	-5	-3	-2	0	2	4	5	7	9	11	14	16	17	16	14
44	.198930	-4	-3	-2	0	1	2	4	5	7	8	11	13	13	13	11
45	.137202	-7	-5	-4	-1	0	2	4	6	9	11	14	17	18	17	15

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.592743	100														
17	.689774	75	100													
18	.537804	39	76	100												
19	.380508	27	49	91	100											
20	.249250	29	33	74	93	100										
21	.197026	33	29	61	82	97	100									
22	.174405	36	28	52	72	90	98	100								
23	.162046	37	29	45	62	82	94	99	100							
24	.159158	37	30	40	55	75	88	95	99	100						
25	.166572	36	30	37	48	67	80	88	94	98	100					
26	.199911	31	28	32	39	54	66	74	81	88	95	100				
27	.280852	23	22	25	28	37	45	51	58	65	75	91	100			
28	.382390	17	17	19	20	24	28	32	36	42	51	71	92	100		
29	.579329	11	12	13	13	13	13	13	13	14	17	30	57	82	100	
30	.321456	18	17	19	22	27	31	32	33	32	29	23	17	20	42	100
31	.137978	18	16	22	30	43	52	58	62	64	62	54	39	27	14	32
32	.108788	22	19	25	34	50	62	69	73	74	70	58	42	31	20	36
33	.127743	21	19	24	31	44	54	60	64	64	61	52	38	28	19	32
34	.107718	19	17	23	31	46	57	64	69	70	67	56	40	29	19	34
35	.168227	18	17	20	24	34	41	46	48	49	47	41	32	25	18	27
36	.160651	12	12	15	20	29	36	41	44	45	44	37	27	21	15	24
37	.260689	9	8	10	13	19	23	26	28	29	28	24	19	16	12	18
38	.133205	15	14	17	24	35	45	50	54	55	52	44	32	24	17	29
39	.292082	11	10	11	14	20	25	28	29	30	29	26	21	18	14	19
40	.279780	9	9	11	13	18	22	25	27	28	27	24	20	17	14	19
41	.139306	14	13	16	21	32	40	46	49	51	49	41	31	24	17	27
42	.242064	10	9	11	14	20	24	27	29	30	29	26	21	18	14	20
43	.158385	12	11	13	18	28	35	40	43	44	42	35	26	20	15	24
44	.198930	10	9	11	14	22	27	31	34	34	33	29	22	18	14	21
45	.137202	12	11	14	20	30	39	44	48	49	46	39	28	22	16	26

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
31	.137978	100														
32	.108788	79	100													
33	.127743	66	83	100												
34	.107718	75	95	82	100											
35	.168227	50	62	56	62	100										
36	.160651	51	64	56	63	45	100									
37	.260689	32	40	36	39	32	36	100								
38	.133205	60	76	66	75	53	55	40	100							
39	.292082	29	36	34	36	31	32	33	37	100						
40	.279780	30	37	36	37	34	37	40	40	40	100					
41	.139306	57	72	63	72	52	54	40	63	40	43	100				
42	.242064	33	41	38	41	35	37	37	42	41	47	45	100			
43	.158385	50	63	55	63	45	47	36	56	36	41	58	43	100		
44	.198930	39	49	44	49	39	41	37	47	40	47	51	47	49	100	
45	.137202	56	71	62	71	50	51	37	61	37	42	64	45	61	54	100

4. REPORTING COVARIANCE MATRICES IN EVALUATED DATA FILES

At least two major issues must be addressed in introducing SAMMY parameter covariance information into ENDF and subsequently into the Data Processing Codes: formats and programming.

4.1. FORMATS

As addressed earlier in this document, it will be necessary to modify the existing ENDF formats in order for the evaluated files to contain the large amount of information needed for covariance matrices. As early as 1994, CSEWG discussions were held concerning methods of compact storage. Froehner[4] suggested (and the authors completely agree) that such methods should store uncertainties plus correlation matrix, since in that form the covariance matrix is far more understandable. One of us, N. M. Larson,[25] proposed a specific format in a letter to the chairman of the CSEWG formats committee; action was never taken on adopting that (or any other) format for this purpose.

Essentially the format proposed (and still advocated) is the following:

1. Number the parameters via some specific scheme (presumably, sequentially as they appear in File 2 of the ENDF file). Let n be the total number of parameters.

2. Include the uncertainties in a file whose formats are identical to that of the parameters themselves.

3. Map correlation coefficients c to an integer scheme M via some well-defined method. The one used in examples hereafter is the following:

   (a) If $-0.04 \le c \le 0.04$, set $M = 0$.
   (b) If $c > 0.04$, set $M = 50 \times (1 + c) - 1$; round to the nearest integer. (Thus $c = 1$ implies $M = 99$; C = 0.5 implies $M = 74$.)
   (c) If $c < -0.04$, set $M = 50 \times (1 + c) + 1$; round to integer. (Thus $c = -1$ implies $M = 1$; $c = -0.5$ implies $M = 24$.)

Table 15 shows this mapping for a few values of the correlation coefficient.

4. Store the lower triangular half of the $n \times n$ correlation matrix C_{ij} in an ENDF file . The first entry of a row is the row number I, the second the initial column number j, and the following entries are the (M-style) correlation of parameter I with parameters j through k (where k is the lesser of $I - 1$ and $j + m - 1$, and m is the maximum number of such correlations that can fit on the line). If all entries on a line are zero, the line can be omitted.

Table 15. Map from correlation coefficient c to integer M.

c	M	c	M
-1.0	1	1.	99
-0.9	6	0.9	94
-0.8	11	0.8	89
-0.7	16	0.7	84
-0.6	21	0.6	79
-0.5	26	0.5	74
-0.4	31	0.4	69
-0.3	36	0.3	64

Table 16 gives an example of what this "ENDF" format might look like, for a small portion of the ^{235}U covariance matrix, compared with the actual output from the SAMMY run for that same portion of the covariance matrix given in Table 5. In this example, n (the number of parameters) is 35 and m (the number which can fit on one line) is 26.

Table 16. The correlation matrix from Table 5, in the format proposed for ENDF.

```
 2    1 47
 3    1 6174
 4    1 692248
 5    1 56  52
 8    3 74      39
 9    1 46        434145
10    1 60        6848
11    1 52              48
12    9 48  52
13    3 74        77    4253
14    1 38  47    51    5436204353
15    1 59    51        476160395224
16   11 53      48
17   16 72
18    1 48  58        59  4751  6152478768
19    1 37  484851      5235      63373946
20    1 56                59      435756346021
21    1 52                        534646  476337
22   21 46
23    1 45  51        51        52          43532759
24   11 51        51  4848  564860
25   16 44    51  47456636
26    1 55                55      4654      385846      51
27    1 48                47      5147      5347          41
28    1 40  51  5151  52513853  51583951    643653  5451  2466
```

```
29    1 36    4751       5140       554451  52554736  6352
29   28 54
30    1 51  48                   48514846  485844685243    41
30   29 35
31   10 48       5148       544759    48554851604576
32   26 5244
33    1 55  56         56  5647  58435746  51405751  46    45
33   28 3825634253
34   26 51    435539
35    1 52                 5346    465546    4456    47  474453
35   28 41366039338547
```

4.2. PROGRAMMING

Techniques for propagating uncertainties from resonance (or other) parameters to derived quantities (e.g., integral quantities) are well understood. Let F represent a derived quantity (e.g., a group cross section) and P represent the resonance parameters. Because F is a well-defined function of the parameters, derivatives of F with respect to P can be found. (More will be said on this subject later.) Small increments in the parameters then lead to a small increment in F via:

$$\delta F_i = \sum_k \frac{\partial F_i}{\partial P_k} \delta P_k \quad , \tag{9}$$

where the subscript i suggests that a family of functions may be involved. The covariance matrix is then given by

$$\langle \delta F_i \delta F_j \rangle = \sum_{k,n} \frac{\partial F_i}{\partial P_k} \langle \delta P_k \delta P_n \rangle \frac{\partial F_j}{\partial P_n} \tag{10}$$

or

$$C_{ij} = \sum_{k,n} \frac{\partial F_i}{\partial P_k} V_{kn} \frac{\partial F_j}{\partial P_n} \quad , \tag{11}$$

where C represents the covariance matrix for the functions F, and V the covariance matrix for the parameters P.

This method of "propagating uncertainties" is used within SAMMY, e.g. for calculating uncertainties on various integral quantities (group cross sections, resonance integrals, Westcott's g-factor, etc.).

Likely the most serious difficulty to be overcome in the processing codes is the necessity of computing derivatives with respect to the resonance parameters. Ideally, these derivatives are already calculated analytically and are readily available to the programmer for use in the above equations, in which case there is no problem. In most cases it is expected that they do not yet exist. Several options are available for generating these derivatives:

1. Analytical derivatives can be explicitly added to the code. Though this is the ideal solution, it is not always practical in terms of man-hours needed to derive the appropriate formulae, to write the coding, and to debug.

2. Special tools can be used to generate the derivative program. Though the authors have no personal experience with these codes, it is our understanding that programs exist which can take existing FORTRAN coding and generate new FORTRAN coding that calculates the derivative of the original (GRESS code).[26]

3. Numerical derivatives can be generated. This method may be the fastest way to develop the appropriate coding. One of us (N. M. Larson), however, has a personal bias against numerical derivatives, as experience has shown that these have a tendency to be unstable or ill-defined; far greater care must be taken at run time to ensure the accuracy of the results than is the case for analytical derivatives. This places the burden on the user, rather than on the developer, and consquently this method is more error-prone. Further, such errors tend to be "invisible" in the sense that they do not cause runs to abort, but merely give erroneous answers.

5. CONCLUSIONS

The ^{235}U covariance matrix of the resonance parameters and the experimental data parameters have been obtained from a SAMMY sequential analysis of an experimental database containing 14 sets of microscopic experimental results of neutron transmission, fission, capture and absorption cross sections, in the energy range from the thermal region to 50 eV. A complete report of this analysis will be published later.[1] This covariance matrix has been used in SAMMY to generate the covariance matrix of the averaged group cross sections corresponding to the 199-group structure of the VITAMIN-B6 library and to the 238-group structure of the LAW library, for the low energy groups.

A proposal has been reiterated for revising ENDF/B formats to allow concise reporting of uncertainties and correlation matrices. Work is continuing to ensure that the proposed format is adequate for most needs; additional efforts to incorporate this information into data-processing codes is also needed.

Further work, not described in this report but directly relevant for criticality predictability applications, concerns the following: (1) including in the SAMMY fits integral experiment results such as Maxwellian-averaged cross sections, Wescott g-factors, resonance integrals, K1

data, etc., in conjunction with the microscopic data; and (2) calculating off-diagonal elements of the microscopic experimental data in the SAMMY input from predetermined values of the errors on the normalization coefficients and on the experimental background corrections. This procedure would improve the calculation of the systematic errors on the resonance parameters and on the averaged group cross sections.

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APPENDIX A. VALUES FOR RESONANCE PARAMETERS AND DATA-CORRECTION PARAMETERS

In this appendix part of the SAMMY output "LPT" file is reproduced. A number between brackets is the "variable number" for that parameter; these numbers are used as row and line numbers for the parameter covariance matrix (see Table 5). Parameters labeled as "unused" at the end of this output are those data-correction parameters that do not apply to the data set which has just been analyzed.

Table A.1. Values of resonance parameters

*****NEW VALUES FOR RESONANCE PARAMETERS

SPIN GROUP NUMBER 1 WITH SPIN= 3.0, ABUNDANCE= 1.0000, AND G*ABNDNC= .4375

"true" radius =	9.0000E+00	9.0000E+00	9.0000E+00
effective radius =	9.6566E+00	9.6566E+00	9.6566E+00
ENERGY	GAMMA-GAMMA	GAMMA-CHANNEL 1	GAMMA-CHANNEL 2	GAMMA-CHANNEL 3
		L=0 SPIN= 3.0	L=0 SPIN= 0.0	L=0 SPIN= 0.0
(EV)	(MILLI-EV)	(MILLI-EV)	(MILLI-EV)	(MILLI-EV)
3.01247E-01(1)	4.0422E+01(2)	4.7777E-03(3)	1.2256E+02(4)	2.2049E-01(5)
2.03586E+00(6)	3.7310E+01(7)	9.1821E-03(8)	-1.0168E+01(9)	8.0360E-01(10)
3.14379E+00(11)	3.8108E+01(12)	2.5643E-02(13)	-2.1236E+01(14)	8.7458E+01(15)
6.18423E+00(16)	5.4780E+01(17)	7.0752E-02(18)	-4.1715E+01(19)	1.6535E+02(20)
7.65320E+00(21)	5.7182E+01(22)	3.4280E-03(23)	5.9150E+01(24)	1.0897E+02(25)
8.88961E+00(26)	4.9288E+01(27)	1.4995E-01(28)	-2.1569E+02(29)	1.3539E+02(30)
9.71692E+00(31)	4.2720E+01(32)	3.9741E-02(33)	-3.9670E+00(34)	-2.1020E+02(35)
1.06755E+01(36)	4.3265E+01(37)	7.8384E-03(38)	-6.0123E+00(39)	-2.7282E+02(40)
1.23899E+01(41)	4.0715E+01(42)	1.1807E+00(43)	3.1681E+01(44)	-1.4976E+00(45)
1.35865E+01(46)	3.0188E+01(47)	7.6442E-02(48)	-4.5179E+00(49)	-3.5134E+02(50)
1.39886E+01(51)	2.4060E+01(52)	4.5595E-01(53)	-3.6133E+02(54)	1.5494E+02(55)
1.45507E+01(56)	4.1068E+01(57)	1.2546E-01(58)	7.7379E+00(59)	1.2476E+01(60)
1.80099E+01(61)	4.0071E+01(62)	2.5194E-01(63)	1.0581E-03(64)	-1.4724E+02(65)
1.84630E+01(66)	4.2638E+01(67)	1.7636E-02(68)	-1.9501E+03(69)	-2.3996E+01(70)
1.93125E+01(71)	5.1653E+01(72)	4.3240E-01(73)	7.3389E-04(74)	3.8600E+01(75)
2.35937E+01(76)	4.2162E+01(77)	8.8020E-01(78)	1.5043E+02(79)	-8.0653E+01(80)
2.42253E+01(81)	5.6093E+01(82)	3.3757E-01(83)	-3.5518E-02(84)	-5.1404E+01(85)
2.55441E+01(86)	2.2607E+01(87)	1.3672E+00(88)	-2.8896E+02(89)	3.5702E+02(90)
2.64376E+01(91)	4.0091E+01(92)	3.6120E-01(93)	-2.1233E+02(94)	1.9674E+02(95)
2.71607E+01(96)	3.3366E+01(97)	5.2082E-02(98)	-7.1250E-01(99)	-4.0397E+01(100)
2.83718E+01(101)	4.6693E+01(102)	2.1683E-01(103)	7.6573E+00(104)	1.1995E+02(105)
3.05930E+01(106)	4.6251E+01(107)	2.2651E-01(108)	-1.3876E+01(109)	7.7417E+01(110)
3.21180E+01(111)	3.7089E+01(112)	6.3631E-01(113)	-1.2301E+01(114)	1.2940E+01(115)
3.46123E+01(116)	4.2837E+01(117)	6.3207E-01(118)	2.6186E+01(119)	2.9956E+02(120)
3.48728E+01(121)	4.1909E+01(122)	1.4502E+00(123)	-6.3631E+01(124)	2.8979E+01(125)
3.51817E+01(126)	4.9533E+01(127)	2.9845E+00(128)	-8.0424E+01(129)	2.5126E+00(130)
3.91221E+01(131)	4.5009E+01(132)	4.8590E-02(133)	-3.8590E+00(134)	7.3848E+00(135)
3.98894E+01(136)	4.2078E+01(137)	3.7583E-01(138)	4.1545E+00(139)	-1.8377E+02(140)
4.15448E+01(141)	4.2598E+01(142)	5.6713E-01(143)	-3.1057E+01(144)	1.9725E+02(145)
4.18658E+01(146)	3.6784E+01(147)	1.3290E+00(148)	-1.3768E+01(149)	-5.5019E-01(150)
4.33847E+01(151)	3.8213E+01(152)	7.0660E-01(153)	-7.0567E+00(154)	-1.1308E+01(155)
4.49286E+01(156)	3.4796E+01(157)	8.3738E-01(158)	9.0567E+01(159)	-4.0635E+02(160)
4.83216E+01(161)	3.4453E+01(162)	1.0087E+00(163)	1.7346E+02(164)	-6.2837E-01(165)
4.87730E+01(166)	4.0703E+01(167)	8.6056E-01(168)	1.0689E+00(169)	-7.0828E+01(170)

SPIN GROUP NUMBER 2 WITH SPIN= 4.0, ABUNDANCE= 1.0000, AND G*ABNDNC= .5625

	"true" radius =	9.0000E+00	9.0000E+00	9.0000E+00
	effective radius =	9.6566E+00	9.6566E+00	9.6566E+00
ENERGY	GAMMA-GAMMA	GAMMA-CHANNEL 1	GAMMA-CHANNEL 2	GAMMA-CHANNEL 3
		L=0 SPIN= 4.0	L=0 SPIN= 0.0	L=0 SPIN= 0.0
(EV)	(MILLI-EV)	(MILLI-EV)	(MILLI-EV)	(MILLI-EV)
1.13144E+00(171)	3.3116E+01(172)	1.4071E-02(173)	9.5958E-02(174)	1.2615E+02(175)
1.30280E+00(176)	4.8552E+01(177)	2.1250E-04(178)	-1.7833E-01(179)	1.9991E+01(180)
2.75873E+00(181)	3.3231E+01(182)	5.5706E-04(183)	1.2667E+02(184)	-1.5142E-01(185)
3.61081E+00(186)	3.6980E+01(187)	4.3707E-02(188)	-5.5868E+01(189)	-5.3620E+00(190)
4.84996E+00(191)	3.6981E+01(192)	5.2372E-02(193)	-1.3988E-01(194)	-4.3449E+00(195)
5.44291E+00(196)	4.6797E+01(197)	2.2554E-02(198)	-2.8549E+02(199)	-1.8490E+02(200)
6.38882E+00(201)	3.9238E+01(202)	2.3432E-01(203)	7.2454E-01(204)	1.0944E+01(205)
7.08052E+00(206)	3.8535E+01(207)	1.1317E-01(208)	4.6689E+00(209)	-2.9437E+01(210)
8.76270E+00(211)	3.4175E+01(212)	9.0314E-01(213)	8.4365E+01(214)	-1.6143E+01(215)
9.27159E+00(216)	3.7749E+01(217)	1.1250E-01(218)	3.6222E+01(219)	3.4055E+01(220)
1.01614E+01(221)	3.6374E+01(222)	4.7002E-02(223)	4.0144E-04(224)	-6.0526E+01(225)
1.16653E+01(226)	3.9206E+01(227)	5.0006E-01(228)	1.8071E+00(229)	4.0444E+00(230)
1.23879E+01(231)	5.4491E+01(232)	1.9707E-01(233)	3.2824E+00(234)	7.7275E+01(235)
1.28430E+01(236)	3.6170E+01(237)	6.2209E-02(238)	2.5030E+00(239)	1.2519E+02(240)
1.32575E+01(241)	2.6498E+01(242)	6.3617E-02(243)	-6.2706E+01(244)	1.4629E+02(245)
1.40137E+01(246)	3.8841E+01(247)	3.2409E-03(248)	-5.2798E+01(249)	1.0331E+02(250)
1.54108E+01(251)	4.2292E+01(252)	2.1069E-01(253)	-2.7114E+01(254)	2.7562E+01(255)
1.60867E+01(256)	3.7197E+01(257)	3.2766E-01(258)	9.1211E+00(259)	1.5131E+01(260)
1.66391E+01(261)	3.5275E+01(262)	2.3454E-01(263)	5.3468E+00(264)	1.0734E+02(265)
1.80601E+01(266)	3.2237E+01(267)	1.2319E-01(268)	1.7549E+00(269)	-1.2292E+02(270)
1.90042E+01(271)	3.1133E+01(272)	7.0643E-02(273)	-9.8174E-03(274)	1.1329E+01(275)
1.92902E+01(276)	3.9091E+01(277)	2.3874E+00(278)	-1.8589E+01(279)	6.2860E+01(280)
2.01847E+01(281)	4.3468E+01(282)	5.0177E-02(283)	-5.3222E+01(284)	-1.3596E+01(285)
2.06451E+01(286)	3.5072E+01(287)	1.4407E-01(288)	-6.2082E-02(289)	-3.7134E+01(290)
2.10635E+01(291)	4.1468E+01(292)	1.2767E+00(293)	-3.0718E+01(294)	-3.4786E+00(295)
2.29296E+01(296)	3.8576E+01(297)	3.9422E-01(298)	-5.4438E+01(299)	1.1708E+00(300)
2.34132E+01(301)	3.6885E+01(302)	6.4553E-01(303)	-5.1074E-02(304)	1.0071E+01(305)
2.64559E+01(306)	3.7054E+01(307)	2.9443E-01(308)	-1.7378E+02(309)	-1.0810E+01(310)
2.77582E+01(311)	4.3528E+01(312)	4.7923E-01(313)	-1.1809E+02(314)	-1.8383E+00(315)
2.83883E+01(316)	3.5498E+01(317)	5.4921E-03(318)	4.1234E+02(319)	-1.0909E+01(320)
2.87855E+01(321)	4.6120E+01(322)	3.5966E-02(323)	2.1316E+02(324)	-8.3125E+00(325)
2.96488E+01(326)	3.5116E+01(327)	1.4844E-01(328)	9.0774E-02(329)	2.4183E+01(330)
3.08703E+01(331)	3.7289E+01(332)	4.6515E-01(333)	1.9554E+00(334)	2.1821E+01(335)
3.20291E+01(336)	3.2231E+01(337)	1.1365E+00(338)	1.0233E-01(339)	9.8004E+01(340)
3.32010E+01(341)	3.9608E+01(342)	3.5427E-02(343)	5.8260E+01(344)	5.0727E+02(345)
3.35156E+01(346)	3.5329E+01(347)	1.5428E+00(348)	-2.9684E+01(349)	5.9450E-01(350)
3.43559E+01(351)	3.6412E+01(352)	1.6861E+00(353)	1.5660E-01(354)	3.3155E+01(355)
3.51117E+01(356)	1.9660E+01(357)	1.4390E+00(358)	2.1706E+02(359)	-6.7990E-02(360)
3.54811E+01(361)	3.6822E+01(362)	1.4193E-03(363)	-1.5129E+00(364)	1.9096E+01(365)
3.60260E+01(366)	2.8700E+01(367)	5.6702E-02(368)	-4.5117E+02(369)	1.5892E+01(370)
3.72599E+01(371)	2.9622E+01(372)	5.3253E-03(373)	3.2500E+02(374)	4.7292E+00(375)
3.83290E+01(376)	3.1264E+01(377)	2.9041E-01(378)	-1.5076E+02(379)	-1.3922E+02(380)
3.94004E+01(381)	3.6701E+01(382)	2.1423E+00(383)	-1.9703E+01(384)	4.5625E+01(385)
4.04527E+01(386)	3.6181E+01(387)	2.9000E-01(388)	-3.9635E+00(389)	1.8335E+02(390)
4.13067E+01(391)	4.4612E+01(392)	2.5649E-01(393)	-1.2032E+02(394)	-9.1329E+01(395)
4.22041E+01(396)	4.1035E+01(397)	2.5963E-01(398)	-4.9904E+01(399)	-5.8183E-01(400)
4.27053E+01(401)	3.5640E+01(402)	2.3303E-01(403)	3.6671E+00(404)	-8.4773E-02(405)
4.38402E+01(406)	3.8452E+01(407)	2.0134E-03(408)	1.0498E+02(409)	2.9136E+02(410)
4.39410E+01(411)	3.1836E+01(412)	3.9415E-01(413)	1.6322E+02(414)	1.2546E+00(415)
4.46023E+01(416)	3.9570E+01(417)	6.4164E-01(418)	-1.1719E+02(419)	4.4824E-01(420)

4.58023E+01(421)	3.1521E+01(422)	1.4461E-01(423)	5.7243E+01(424)	-1.2207E+00(425)
4.67189E+01(426)	2.9274E+01(427)	4.5755E-01(428)	1.3956E+02(429)	5.0438E-01(430)
4.70272E+01(431)	4.0743E+01(432)	8.4555E-01(433)	-1.2563E+02(434)	1.6616E-01(435)
4.79507E+01(436)	4.9793E+01(437)	7.6465E-01(438)	7.4306E-02(439)	5.3153E+01(440)
4.94375E+01(441)	3.8447E+01(442)	8.4900E-01(443)	1.3691E+01(444)	-4.0619E-01(445)

EFFECTIVE RADIUS	"TRUE" RADIUS	SPIN GROUP NUMBERS FOR THESE RADII
9.657 (446)	9.000	1 2

RADIUS	TEMPERATURE	THICKNESS	DELTA-L	DELTA-T-GAUS	DELTA-T-EXP
9.6020E+00	3.0678E+02	0.0000E+00	4.6000E-02	-2.4000E-02	0.0000E+00

NORMALIZATION	BCKG(CONST)	BCKG/SQRT(E)
1.0022E+00(447)	-1.8233E-01(448)	-7.1161E-01(449)

UNUSED PARAMETERS ARE --

norm1	back1	bacb1	norm2
1.0099E+00(450)	-2.0819E-03(451)	4.0242E-03(452)	1.0133E+00(453)
back2	bacb2	norm3	back3
-9.0494E-03(454)	-6.4434E-03(455)	1.0052E+00(456)	2.2541E-03(457)
bacb3	norm4	back4	bacb4
8.9855E-04(458)	1.0034E+00(459)	-2.4087E-01(460)	-1.7237E-01(461)
norm5	back5	bacb5	norm6
1.0124E+00(462)	1.8795E-01(463)	-6.9401E-01(464)	9.9207E-01(465)
back6	bacb6	norm7	back7
3.6025E-01(466)	-1.4938E+00(467)	9.7257E-01(468)	-6.5796E-03(469)
bacb7	norm8	back8	bacb8
-1.7826E+00(470)	1.0333E+00(471)	-5.3461E-01(472)	4.0966E+00(473)
norm9	back9	bacb9	nor10
1.0083E+00(474)	-3.2623E-01(475)	-4.0601E-01(476)	9.9644E-01(477)
bac10	bab10	nor11	bac11
-2.3566E-03(478)	1.5090E-03(479)	9.8850E-01(480)	-1.2691E-01(481)
bab11	nor12	bac12	bab12
6.3217E-01(482)	1.0090E+00(483)	2.1131E-01(484)	-1.4013E+00(485)
nor13	bac13	bab13	
1.0013E+00(486)	2.7052E-02(487)	-7.4361E-01(488)	

APPENDIX B. VALUES FOR 238-GROUP STRUCTURE

Tables in this appendix give cross-section values and correlation matrices, as generated by SAMMY, for the lowest 140 groups of the 238-group structure of the LAW library. Capture values and correlation matrix are given in Tables B.1 and B.2 respectively, fission in B.3 and B.4, scattering in B.5 and B.6, and total in B.7 and B.8.

Energy boundaries of the groups (number sequentially in column 1) are given in the second and third columns of the "values" tables, along with the averaged cross sections (column 4) and their uncertainties (column 5). The group number and the uncertainties are repeated in the first two columns of the correlation matrix tables. The remainder of the correlation table shows the correlation matrix elements, multiplied by 100 for ease of display; only the lower half of the symmetric correlation matrix is shown.

Elements of the correlation matrices are related to the covariance matrix elements via

$$C_{ij} = \frac{V_{ij}}{\sigma_i \sigma_j} ,$$

where C represents the correlation coefficient, V the covariance matrix element, and σ the uncertainty. That is, σ is given by

$$\sigma_i = \sqrt{V_{ii}} .$$

Table B.1. The averaged capture cross sections and their uncertainties for the lowest 140 groups of the 238-group structure of the LAW library. The energy boundaries of the groups are given in eV, and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00010	3232.31	4.46458
(2)	.00010	.00050	1212.66	1.67967
(3)	.00050	.00075	786.785	1.09443
(4)	.00075	.00100	662.255	.924093
(5)	.00100	.00120	588.909	.824098
(6)	.00120	.00150	531.015	.745447
(7)	.00150	.00200	465.647	.657054
(8)	.00200	.00250	408.828	.580718
(9)	.00250	.00300	368.278	.526674
(10)	.00300	.00400	325.107	.469755
(11)	.00400	.00500	284.119	.416479
(12)	.00500	.00750	238.321	.358490
(13)	.00750	.01000	196.199	.307058
(14)	.01000	.02530	130.620	.233861
(15)	.02530	.03000	93.4073	.196341
(16)	.03000	.04000	79.6855	.184531
(17)	.04000	.05000	67.0371	.175575
(18)	.05000	.06000	58.5330	.171877
(19)	.06000	.07000	52.4121	.171601
(20)	.07000	.08000	47.8102	.173887
(21)	.08000	.09000	44.2529	.178315
(22)	.09000	.10000	41.4576	.184701
(23)	.10000	.12500	37.9880	.200970
(24)	.12500	.15000	34.9931	.235094
(25)	.15000	.17500	33.9229	.286460
(26)	.17500	.20000	34.6016	.361717
(27)	.20000	.22500	37.0544	.468570
(28)	.22500	.25000	40.9375	.606405
(29)	.25000	.27500	44.3909	.738223
(30)	.27500	.30000	43.9607	.774949
(31)	.30000	.32500	38.5526	.673628
(32)	.32500	.35000	31.3034	.510306
(33)	.35000	.37500	25.0963	.365000
(34)	.37500	.40000	20.5852	.259850
(35)	.40000	.45000	16.3126	.164321
(36)	.45000	.50000	12.9482	9.549844E-02
(37)	.50000	.55000	10.9944	6.102349E-02
(38)	.55000	.60000	9.73336	4.229973E-02
(39)	.60000	.62500	9.04511	3.366989E-02
(40)	.62500	.65000	8.68232	2.977380E-02
(41)	.65000	.70000	8.24888	2.592691E-02
(42)	.70000	.75000	7.82688	2.355667E-02
(43)	.75000	.80000	7.57806	2.406198E-02
(44)	.80000	.85000	7.51779	2.748504E-02
(45)	.85000	.90000	7.70758	3.457414E-02
(46)	.90000	.92500	8.07889	4.322324E-02

(47)	.92500	.95000	8.51159	5.168804E-02
(48)	.95000	.97500	9.15330	6.325241E-02
(49)	.97500	1.00000	10.0988	7.937113E-02
(50)	1.00000	1.01000	10.9977	9.425114E-02
(51)	1.01000	1.02000	11.6461	.104799
(52)	1.02000	1.03000	12.4069	.117066
(53)	1.03000	1.04000	13.3001	.131362
(54)	1.04000	1.05000	14.3482	.148037
(55)	1.05000	1.06000	15.5750	.167457
(56)	1.06000	1.07000	17.0030	.189961
(57)	1.07000	1.08000	18.6483	.215771
(58)	1.08000	1.09000	20.5117	.244829
(59)	1.09000	1.10000	22.5643	.276556
(60)	1.10000	1.11000	24.7287	.309528
(61)	1.11000	1.12000	26.8611	.341208
(62)	1.12000	1.13000	28.7451	.367989
(63)	1.13000	1.14000	30.1178	.385876
(64)	1.14000	1.15000	30.7369	.391824
(65)	1.15000	1.17500	29.5434	.369572
(66)	1.17500	1.20000	24.8051	.304164
(67)	1.20000	1.22500	19.3083	.232113
(68)	1.22500	1.25000	15.0377	.175677
(69)	1.25000	1.30000	11.5001	.115561
(70)	1.30000	1.35000	8.41195	.155884
(71)	1.35000	1.40000	6.13958	6.055508E-02
(72)	1.40000	1.45000	5.09180	2.914848E-02
(73)	1.45000	1.50000	4.48815	1.910383E-02
(74)	1.50000	1.59000	3.98867	1.294695E-02
(75)	1.59000	1.68000	3.63529	9.311538E-03
(76)	1.68000	1.77000	3.53517	8.579859E-03
(77)	1.77000	1.86000	3.82446	1.189662E-02
(78)	1.86000	1.94000	5.38322	2.761996E-02
(79)	1.94000	2.00000	13.8606	.108239
(80)	2.00000	2.12000	39.5868	.326910
(81)	2.12000	2.21000	5.28879	2.990400E-02
(82)	2.21000	2.30000	3.19437	1.084124E-02
(83)	2.30000	2.38000	2.66790	7.125177E-03
(84)	2.38000	2.47000	2.47489	7.048409E-03
(85)	2.47000	2.57000	2.44407	9.694340E-03
(86)	2.57000	2.67000	2.67551	1.965083E-02
(87)	2.67000	2.77000	3.70614	5.234624E-02
(88)	2.77000	2.87000	4.17049	7.687142E-02
(89)	2.87000	2.97000	3.86392	3.560673E-02
(90)	2.97000	3.00000	4.68346	4.530987E-02
(91)	3.00000	3.05000	6.07224	7.027439E-02
(92)	3.05000	3.15000	13.0431	.194774
(93)	3.15000	3.50000	9.35857	8.978999E-02
(94)	3.50000	3.73000	37.0331	.358937
(95)	3.73000	4.00000	4.89534	3.113598E-02
(96)	4.00000	4.75000	3.30814	1.089710E-02
(97)	4.75000	5.00000	82.2444	.540704

(98)	5.00000	5.40000	3.84009	3.991290E-02
(99)	5.40000	6.00000	4.33498	5.640122E-02
(100)	6.00000	6.25000	19.0154	.264730
(101)	6.25000	6.50000	237.694	1.31675
(102)	6.50000	6.75000	16.0934	8.773205E-02
(103)	6.75000	7.00000	11.3859	6.023109E-02
(104)	7.00000	7.15000	98.9505	.836844
(105)	7.15000	8.10000	5.78417	3.178312E-02
(106)	8.10000	9.10000	62.1263	.388458
(107)	9.10000	10.00000	16.5357	.171311
(108)	10.00000	11.50000	6.92530	5.807920E-02
(109)	11.50000	11.90000	202.718	.958867
(110)	11.90000	12.90000	112.899	.534730
(111)	12.90000	13.75000	6.84037	8.336930E-02
(112)	13.75000	14.40000	6.49606	.114821
(113)	14.40000	15.10000	15.5582	.146933
(114)	15.10000	16.00000	18.4103	.160275
(115)	16.00000	17.00000	34.5113	.227580
(116)	17.00000	18.50000	7.81085	9.732078E-02
(117)	18.50000	19.00000	14.8079	.317119
(118)	19.00000	20.00000	110.267	.662415
(119)	20.00000	21.00000	23.3589	.148102
(120)	21.00000	22.50000	44.6806	.269266
(121)	22.50000	25.00000	38.1863	.214218
(122)	25.00000	27.50000	5.55291	8.563800E-02
(123)	27.50000	30.00000	10.8366	.126181
(124)	30.00000	31.25000	21.1827	.183941
(125)	31.25000	31.75000	3.82774	2.966190E-02
(126)	31.75000	33.25000	29.9827	.254005
(127)	33.25000	33.75000	115.234	.779229
(128)	33.75000	34.60000	72.5925	.502946
(129)	34.60000	35.50000	90.3256	.803890
(130)	35.50000	37.00000	3.82504	4.525134E-02
(131)	37.00000	38.00000	1.26434	1.717420E-02
(132)	38.00000	39.10000	4.14123	8.782174E-02
(133)	39.10000	39.60000	83.9121	.767155
(134)	39.60000	41.00000	7.32850	.111655
(135)	41.00000	42.40000	37.6878	.284550
(136)	42.40000	44.00000	22.3037	.176387
(137)	44.00000	45.20000	10.0921	.177939
(138)	45.20000	47.00000	8.59069	.127253
(139)	47.00000	48.30000	21.0330	.251802
(140)	48.30000	49.20000	18.4884	.285031

Table B.2. The correlation matrix of the capture cross sections for the lowest 140 groups of the 238-group structure of the LAW library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	4.46458	100														
2	1.67967	100	100													
3	1.09443	100	100	100												
4	.924093	100	100	100	100											
5	.824098	100	100	100	100	100										
6	.745447	100	100	100	100	100	100									
7	.657054	100	100	100	100	100	100	100								
8	.580718	100	100	100	100	100	100	100	100							
9	.526674	100	100	100	100	100	100	100	100	100						
10	.469755	100	100	100	100	100	100	100	100	100	100					
11	.416479	100	100	100	100	100	100	100	100	100	100	100				
12	.358490	100	100	100	100	100	100	100	100	100	100	100	100			
13	.307058	100	100	100	100	100	100	100	100	100	100	100	100	100		
14	.233861	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
15	.196341	99	99	99	99	99	99	99	99	99	99	99	100	100	100	100
16	.184531	99	99	99	99	99	99	99	99	99	99	99	99	99	100	100
17	.175575	99	99	99	99	99	99	99	99	99	99	99	99	99	100	100
18	.171877	99	99	99	99	99	99	99	99	99	99	99	99	99	100	100
19	.171601	98	98	98	98	98	99	99	99	99	99	99	99	99	100	100
20	.173887	98	98	98	98	98	98	98	98	98	99	99	99	99	99	100
21	.178315	98	98	98	98	98	98	98	98	98	98	98	99	99	99	100
22	.184701	98	98	98	98	98	98	98	98	98	98	98	98	99	99	100
23	.200970	98	98	98	98	98	98	98	98	98	98	98	98	98	99	99
24	.235094	97	97	97	97	97	97	97	97	98	98	98	98	98	99	99
25	.286460	97	97	97	97	97	97	97	97	97	97	97	97	97	98	98
26	.361717	96	96	96	96	96	96	96	96	96	96	96	96	96	97	98
27	.468570	94	94	94	94	94	94	94	94	94	94	94	95	95	95	96
28	.606405	91	91	92	92	92	92	92	92	92	92	92	92	92	93	93
29	.738223	89	89	89	89	89	89	89	89	89	89	89	89	89	90	90
30	.774949	88	88	88	88	88	88	88	88	88	88	88	88	88	89	89
31	.673628	89	89	89	89	89	89	89	89	89	89	89	89	90	90	90
32	.510306	91	91	91	91	91	91	91	91	91	91	91	91	92	92	92
33	.365000	93	93	93	93	93	93	93	93	93	93	93	93	93	94	94
34	.259850	94	94	94	94	94	94	94	94	94	94	94	94	94	95	95
35	.164321	95	95	95	95	95	95	95	95	95	95	95	95	95	96	96
36	9.549844E-02	96	96	96	96	96	96	96	96	96	96	96	96	96	97	97
37	6.102349E-02	96	96	96	96	96	96	96	96	96	96	96	96	97	97	97
38	4.229973E-02	95	95	95	95	95	95	95	95	95	95	95	96	96	96	96
39	3.366989E-02	94	94	94	94	94	94	94	94	94	94	94	94	94	94	95
40	2.977380E-02	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
41	2.592691E-02	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87
42	2.355667E-02	76	76	76	76	76	77	77	77	77	77	77	77	77	77	77
43	2.406198E-02	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
44	2.748504E-02	48	48	48	48	48	48	48	48	48	48	48	49	49	49	48
45	3.457414E-02	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
46	4.322324E-02	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
47	5.168804E-02	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
48	6.325241E-02	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
49	7.937113E-02	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
50	9.425114E-02	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
51	.104799	16	16	16	16	16	16	16	16	16	16	16	16	16	17	16
52	.117066	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
53	.131362	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
54	.148037	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
55	.167457	13	13	13	13	13	13	13	13	13	13	13	13	14	14	14
56	.189961	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
57	.215771	12	12	12	12	12	12	12	12	12	12	12	12	12	13	13
58	.244829	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

59	.276556	11	11	11	11	11	11	11	11	11	11	11	11	11	12	12
60	.309528	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
61	.341208	10	10	10	10	10	10	10	10	10	11	11	11	11	11	11
62	.367989	10	10	10	10	10	10	10	10	10	10	10	10	11	11	11
63	.385876	10	10	10	10	10	10	10	10	10	10	10	10	11	11	11
64	.391824	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
65	.369572	12	12	12	12	12	12	12	12	12	12	11	11	11	11	11
66	.304164	13	13	13	13	13	13	13	13	13	13	13	13	13	12	12
67	.232113	14	14	14	14	14	14	14	14	14	14	14	13	13	13	12
68	.175677	14	14	14	14	14	14	14	14	14	14	14	14	13	13	12
69	.115561	12	12	12	12	12	12	12	12	12	12	12	12	12	11	11
70	.155884	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
71	6.055508E-02	11	11	11	11	11	11	11	11	11	11	11	10	10	10	9
72	2.914848E-02	18	18	18	18	18	18	18	18	18	18	17	17	17	17	16
73	1.910383E-02	22	22	22	22	22	22	22	22	22	22	22	21	21	21	20
74	1.294695E-02	25	25	25	25	25	25	25	25	25	25	25	25	25	24	24
75	9.311538E-03	27	27	27	27	27	27	27	27	27	27	27	27	27	26	26
76	8.579859E-03	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
77	1.189662E-02	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
78	2.761996E-02	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
79	.108239	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
80	.326910	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
81	2.990400E-02	6	6	6	6	6	6	6	6	6	6	6	6	6	7	7
82	1.084124E-02	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
83	7.125177E-03	16	16	16	16	16	16	16	16	16	16	16	16	16	16	15
84	7.048409E-03	16	16	16	16	16	16	16	16	16	16	16	16	16	15	15
85	9.694340E-03	13	13	13	13	13	13	13	13	13	13	13	13	13	12	12
86	1.965083E-02	9	9	9	9	9	9	9	9	9	9	9	9	9	8	8
87	5.234624E-02	7	7	7	7	7	7	7	7	7	7	7	7	6	6	5
88	7.687142E-02	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4
89	3.560673E-02	8	8	8	8	8	8	8	8	8	8	8	8	7	7	
90	4.530987E-02	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
91	7.027439E-02	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
92	.194774	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
93	8.978999E-02	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
94	.358937	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
95	3.113598E-02	8	8	8	8	8	8	8	8	8	8	8	8	7	7	7
96	1.089710E-02	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
97	.540704	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
98	3.991290E-02	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
99	5.640122E-02	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
100	.264730	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
101	1.31675	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
102	8.773205E-02	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
103	6.023109E-02	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4
104	.836844	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
105	3.178312E-02	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
106	.388458	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
107	.171311	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
108	5.807920E-02	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
109	.958867	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
110	.534730	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
111	8.336930E-02	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
112	.114821	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
113	.146933	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
114	.160275	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
115	.227580	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
116	9.732078E-02	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
117	.317119	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
118	.662415	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
119	.148102	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
120	.269266	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
121	.214218	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
122	8.563800E-02	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
123	.126181	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

124	.183941	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
125	2.966190E-02	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
126	.254005	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
127	.779229	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
128	.502946	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
129	.803890	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
130	4.525134E-02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
131	1.717420E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132	8.782174E-02	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
133	.767155	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
134	.111655	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
135	.284550	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
136	.176387	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
137	.177939	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
138	.127253	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
139	.251802	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
140	.285031	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.184531	100														
17	.175575	100	100													
18	.171877	100	100	100												
19	.171601	100	100	100	100											
20	.173887	100	100	100	100	100										
21	.178315	100	100	100	100	100	100									
22	.184701	100	100	100	100	100	100	100								
23	.200970	100	100	100	100	100	100	100	100							
24	.235094	99	99	100	100	100	100	100	100	100						
25	.286460	99	99	99	99	99	99	100	100	100	100					
26	.361717	98	98	98	98	99	99	99	99	99	100	100				
27	.468570	96	96	97	97	97	97	97	98	98	99	100	100			
28	.606405	93	94	94	94	94	95	95	96	96	97	98	99	100		
29	.738223	91	91	91	91	92	92	92	93	94	95	96	98	99	100	
30	.774949	89	89	90	90	90	90	91	91	92	93	94	96	98	99	100
31	.673628	90	91	91	91	91	91	91	91	92	92	93	94	96	98	99
32	.510306	92	93	93	93	93	93	93	93	93	93	93	93	94	95	97
33	.365000	94	94	94	94	94	94	94	94	94	94	93	93	93	93	95
34	.259850	95	95	95	95	95	95	95	95	95	94	93	92	92	92	94
35	.164321	96	96	96	96	96	96	96	96	95	95	94	92	91	90	92
36	9.549844E-02	97	97	97	97	97	97	97	96	96	95	94	92	90	89	90
37	6.102349E-02	97	97	97	97	97	97	97	96	96	95	93	92	89	88	89
38	4.229973E-02	96	96	96	96	96	96	96	95	94	93	92	90	88	86	87
39	3.366989E-02	95	94	94	94	94	94	93	93	92	91	90	88	85	84	85
40	2.977380E-02	92	92	92	92	92	91	91	91	90	89	87	85	83	81	82
41	2.592691E-02	87	87	87	87	86	86	86	85	84	83	82	80	78	76	77
42	2.355667E-02	77	76	76	76	76	75	75	74	73	72	71	69	67	66	66
43	2.406198E-02	63	62	62	62	61	61	61	60	59	58	57	55	54	52	53
44	2.748504E-02	48	48	47	47	47	46	46	45	44	43	42	41	40	39	39
45	3.457414E-02	36	35	35	35	34	34	34	33	32	31	30	29	28	28	28
46	4.322324E-02	29	28	28	27	27	27	26	26	25	24	23	22	22	21	22
47	5.168804E-02	25	24	24	24	23	23	23	22	21	20	20	19	18	18	18
48	6.325241E-02	21	21	21	20	20	20	19	19	18	17	17	16	15	15	15
49	7.937113E-02	19	18	18	18	18	17	17	16	16	15	14	13	13	13	13
50	9.425114E-02	17	17	17	16	16	16	15	15	14	13	13	12	12	11	12
51	.104799	16	16	16	16	15	15	15	14	14	13	12	11	11	11	11
52	.117066	16	15	15	15	15	14	14	14	13	12	12	11	10	10	10
53	.131362	15	15	15	14	14	14	13	13	12	12	11	10	10	10	10
54	.148037	14	14	14	14	13	13	13	12	12	11	11	10	9	9	9
55	.167457	14	14	13	13	13	13	12	12	11	11	10	10	9	9	9
56	.189961	13	13	13	13	12	12	12	12	11	10	10	9	9	8	9
57	.215771	13	13	12	12	12	12	12	11	11	10	9	9	8	8	8
58	.244829	12	12	12	12	12	11	11	11	10	10	9	9	8	8	8
59	.276556	12	12	12	11	11	11	11	10	10	9	9	8	8	8	8
60	.309528	11	11	11	11	11	11	11	10	10	9	9	8	8	7	7
61	.341208	11	11	11	11	11	10	10	10	9	9	8	8	8	7	7

62	.367989	11	11	11	10	10	10	10	10	9	9	8	8	7	7	7
63	.385876	11	11	10	10	10	10	10	9	9	9	8	8	7	7	7
64	.391824	11	10	10	10	10	10	10	9	9	8	8	8	7	7	7
65	.369572	11	11	10	10	10	10	9	9	9	8	8	7	7	7	7
66	.304164	11	11	11	10	10	10	9	9	8	8	7	7	7	7	7
67	.232113	12	11	11	10	10	10	9	9	8	8	7	7	7	7	7
68	.175677	12	11	11	10	10	10	9	9	8	8	7	7	7	7	7
69	.115561	10	10	10	9	9	9	8	8	7	7	7	6	6	6	7
70	.155884	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
71	6.055508E-02	9	9	9	8	8	8	8	8	7	7	6	6	6	6	6
72	2.914848E-02	16	15	15	14	14	14	14	13	12	12	11	11	10	10	10
73	1.910383E-02	20	19	19	18	18	18	17	17	16	15	14	14	13	13	13
74	1.294695E-02	23	23	22	22	21	21	21	20	19	18	17	17	16	16	16
75	9.311538E-03	26	25	25	24	24	23	23	22	21	21	20	19	18	18	18
76	8.579859E-03	24	23	23	23	22	22	21	21	20	19	19	18	17	17	17
77	1.189662E-02	16	16	16	15	15	15	15	14	14	13	13	12	12	11	11
78	2.761996E-02	8	8	8	8	8	8	8	8	7	7	6	6	6	6	6
79	.108239	5	5	5	5	5	5	5	4	4	4	4	3	3	4	4
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81	2.990400E-02	7	7	7	7	6	6	6	6	6	6	5	5	5	4	4
82	1.084124E-02	12	12	12	11	11	11	11	11	10	10	9	9	8	8	8
83	7.125177E-03	15	15	15	15	14	14	14	14	13	13	12	12	11	11	11
84	7.048409E-03	15	15	14	14	14	14	13	13	13	12	12	11	11	10	10
85	9.694340E-03	12	11	11	11	11	10	10	10	10	9	9	9	8	8	8
86	1.965083E-02	8	7	7	7	7	6	6	6	6	6	6	5	5	5	4
87	5.234624E-02	5	5	5	5	4	4	4	4	4	4	4	4	4	3	3
88	7.687142E-02	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3
89	3.560673E-02	7	7	7	7	7	7	7	6	6	6	6	6	6	5	5
90	4.530987E-02	7	7	6	6	6	6	6	6	6	6	6	6	5	5	4
91	7.027439E-02	6	6	6	6	6	6	6	5	5	5	5	5	5	4	4
92	.194774	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4
93	8.978999E-02	6	6	6	6	6	6	6	5	5	5	5	5	4	4	5
94	.358937	6	6	6	6	6	5	5	5	5	5	5	5	5	5	5
95	3.113598E-02	7	7	7	6	6	6	6	6	6	5	5	5	5	5	5
96	1.089710E-02	7	6	6	6	6	6	6	6	6	5	5	5	5	5	4
97	.540704	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
98	3.991290E-02	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2
99	5.640122E-02	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2
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102	8.773205E-02	3	3	2	2	2	2	2	2	2	2	1	1	1	1	2
103	6.023109E-02	4	4	4	4	3	3	3	3	3	3	3	3	3	2	2
104	.836844	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
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106	.388458	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2
107	.171311	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1
108	5.807920E-02	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1
109	.958867	3	3	3	2	2	2	2	2	2	2	2	2	1	1	2
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111	8.336930E-02	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
112	.114821	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
113	.146933	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
114	.160275	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
115	.227580	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1
116	9.732078E-02	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
117	.317119	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
118	.662415	4	3	3	3	3	3	3	3	3	2	2	2	2	2	2
119	.148102	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
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121	.214218	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
123	.126181	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
124	.183941	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
125	2.966190E-02	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
126	.254005	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
127	.779229	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1

128	.502946	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
129	.803890	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1
130	4.525134E-02	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
133	.767155	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
134	.111655	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
135	.284550	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
136	.176387	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
137	.177939	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
138	.127253	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
139	.251802	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
140	.285031	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
31	.673628	100														
32	.510306	99	100													
33	.365000	98	100	100												
34	.259850	97	99	100	100											
35	.164321	95	98	99	100	100										
36	9.549844E-02	94	97	98	99	100	100									
37	6.102349E-02	92	95	97	98	99	100	100								
38	4.229973E-02	90	93	95	97	98	99	100	100							
39	3.366989E-02	88	91	93	94	95	97	98	100	100						
40	2.977380E-02	85	88	90	92	93	95	97	99	100	100					
41	2.592691E-02	80	83	85	86	88	90	92	96	98	99	100				
42	2.355667E-02	69	71	73	75	76	79	83	88	92	95	98	100			
43	2.406198E-02	55	57	59	60	62	65	70	76	82	86	92	98	100		
44	2.748504E-02	41	43	44	46	47	51	56	64	70	76	83	93	98	100	
45	3.457414E-02	29	31	32	33	35	39	44	52	60	66	75	86	95	99	100
46	4.322324E-02	23	24	25	26	28	32	37	45	53	60	69	82	92	97	100
47	5.168804E-02	19	20	21	22	24	28	33	42	50	56	66	80	90	96	99
48	6.325241E-02	16	17	18	19	21	24	30	39	47	53	63	77	88	95	98
49	7.937113E-02	14	15	15	16	18	22	28	36	44	51	61	75	86	94	97
50	9.425114E-02	12	13	14	15	17	20	26	34	43	49	59	73	85	93	97
51	.104799	12	13	13	14	16	20	25	33	42	48	58	72	84	92	96
52	.117066	11	12	13	14	15	19	24	33	41	47	57	72	83	91	95
53	.131362	11	11	12	13	15	18	24	32	40	46	56	70	82	90	95
54	.148037	10	11	11	12	14	18	23	31	39	45	55	69	81	89	94
55	.167457	10	10	11	12	14	17	22	30	38	44	54	68	80	88	92
56	.189961	9	10	11	11	13	16	22	29	37	43	53	67	78	86	91
57	.215771	9	9	10	11	12	16	21	29	36	42	52	65	76	84	89
58	.244829	8	9	10	10	12	15	20	28	35	41	50	63	74	82	87
59	.276556	8	9	9	10	12	15	20	27	34	39	49	61	72	80	84
60	.309528	8	8	9	10	11	14	19	26	33	38	47	59	69	77	81
61	.341208	7	8	8	9	11	14	18	25	31	37	45	57	67	74	78
62	.367989	7	8	8	9	10	13	17	24	30	35	43	54	64	71	75
63	.385876	7	7	8	9	10	13	17	23	29	34	42	52	62	68	72
64	.391824	7	7	8	8	10	12	16	22	28	33	41	51	60	65	69
65	.369572	7	7	8	8	9	12	16	22	28	33	40	50	58	64	66
66	.304164	7	7	8	8	9	12	16	22	28	33	41	51	59	64	66
67	.232113	7	8	8	8	10	12	17	23	29	34	42	52	60	64	66
68	.175677	7	8	8	9	10	12	17	23	29	33	41	51	58	63	64
69	.115561	7	7	8	8	9	11	14	19	24	28	33	41	47	50	50
70	.155884	2	3	3	3	4	4	5	7	9	10	12	15	17	19	20
71	6.055508E-02	6	7	7	7	8	10	13	17	20	23	28	34	39	42	43
72	2.914848E-02	11	12	12	13	14	17	21	28	34	38	46	56	63	67	69
73	1.910383E-02	14	15	16	16	18	21	26	34	41	46	55	66	75	79	81
74	1.294695E-02	17	18	19	20	21	25	30	38	46	51	60	72	81	85	87
75	9.311538E-03	19	20	21	22	24	27	33	40	48	53	62	73	81	85	86
76	8.579859E-03	18	19	20	20	22	25	30	36	42	47	54	63	70	72	73
77	1.189662E-02	12	13	13	14	15	17	20	25	29	32	36	42	46	47	47
78	2.761996E-02	6	7	7	8	8	9	11	14	16	17	20	23	25	26	25
79	.108239	4	5	5	5	5	6	7	9	10	11	13	15	16	16	16
80	.326910	5	5	5	5	5	5	6	7	7	8	8	9	9	9	9
81	2.990400E-02	5	5	6	6	6	7	9	11	12	14	15	18	19	19	19
82	1.084124E-02	8	9	9	10	11	12	14	17	20	22	25	28	30	30	30

83	7.125177E-03	11	11	12	12	13	15	18	21	24	27	30	34	37	37	36
84	7.048409E-03	10	10	11	11	12	14	16	20	23	25	28	32	34	34	33
85	9.694340E-03	7	7	8	8	9	10	12	15	17	18	21	24	25	25	25
86	1.965083E-02	4	4	4	4	5	6	7	8	10	11	13	14	15	15	15
87	5.234624E-02	2	2	2	2	2	3	4	5	6	7	8	10	10	11	10
88	7.687142E-02	2	2	2	2	2	3	4	5	6	7	8	10	11	11	11
89	3.560673E-02	4	4	4	4	5	6	7	9	11	12	14	16	17	18	17
90	4.530987E-02	4	4	4	5	5	6	8	9	11	12	14	16	17	17	17
91	7.027439E-02	4	4	4	4	5	6	7	8	10	11	12	14	15	15	15
92	.194774	4	4	4	4	4	5	6	7	8	9	10	12	12	13	12
93	8.978999E-02	5	5	5	6	6	7	8	9	11	12	13	15	16	16	15
94	.358937	5	4	4	4	5	5	6	8	9	10	11	12	13	13	13
95	3.113598E-02	5	5	5	5	5	6	7	9	11	12	13	15	15	15	15
96	1.089710E-02	4	4	4	4	5	6	7	9	11	12	14	16	17	17	17
97	.540704	1	2	2	2	2	2	3	4	4	5	6	7	7	7	7
98	3.991290E-02	2	2	2	2	2	3	4	5	7	7	9	10	11	11	11
99	5.640122E-02	2	2	2	2	3	4	5	6	7	8	10	11	12	12	11
100	.264730	2	2	2	2	2	3	4	5	6	6	7	8	9	9	8
101	1.31675	2	2	2	2	3	3	4	5	6	7	8	10	10	11	11
102	8.773205E-02	2	2	2	2	2	3	4	5	6	6	7	9	9	10	9
103	6.023109E-02	2	2	2	2	2	3	4	5	7	7	9	10	11	11	10
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105	3.178312E-02	2	2	2	2	3	4	5	6	8	9	10	12	12	12	12
106	.388458	2	3	3	3	3	4	5	7	8	9	11	13	14	14	14
107	.171311	1	2	2	2	2	3	3	4	5	6	7	8	8	9	8
108	5.807920E-02	1	1	1	1	2	2	3	4	4	5	6	7	7	7	7
109	.958867	2	2	2	2	2	3	4	5	6	6	7	9	10	10	10
110	.534730	3	3	3	3	4	4	6	7	9	10	11	13	15	15	15
111	8.336930E-02	1	1	1	1	1	2	2	3	4	4	5	6	6	6	6
112	.114821	1	1	1	1	1	2	2	3	3	4	4	5	5	5	5
113	.146933	1	1	1	1	1	2	2	3	3	4	4	5	5	6	5
114	.160275	1	1	1	1	1	2	2	3	4	4	5	6	6	6	6
115	.227580	1	1	2	2	2	2	3	4	5	5	6	7	8	8	8
116	9.732078E-02	1	1	1	1	1	2	2	3	3	4	4	5	5	5	5
117	.317119	0	0	0	1	1	1	1	1	2	2	2	3	3	3	3
118	.662415	2	2	2	3	3	4	5	6	7	8	10	11	12	13	12
119	.148102	1	1	1	1	2	2	2	3	4	4	5	6	7	7	7
120	.269266	2	2	2	2	2	3	4	5	6	6	7	9	10	10	10
121	.214218	1	2	2	2	2	2	3	4	5	6	7	8	9	9	9
122	8.563800E-02	0	1	1	1	1	1	1	2	2	2	3	3	3	3	3
123	.126181	1	1	1	1	1	1	1	2	2	2	3	3	4	4	4
124	.183941	1	1	1	1	1	1	2	3	3	3	4	5	5	5	5
125	2.966190E-02	1	1	1	1	1	2	2	3	4	4	5	5	6	6	6
126	.254005	1	1	1	1	1	2	2	3	4	4	5	6	7	7	7
127	.779229	1	1	2	2	2	2	3	4	5	5	6	7	8	8	8
128	.502946	1	1	1	2	2	2	3	4	5	5	6	7	8	8	8
129	.803890	1	1	2	2	2	2	3	4	5	5	6	8	8	8	8
130	4.525134E-02	0	1	1	1	1	1	1	2	2	3	3	4	4	4	3
131	1.717420E-02	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
133	.767155	1	1	1	1	1	2	2	3	4	4	5	6	7	7	7
134	.111655	0	0	0	0	0	1	1	1	1	2	2	2	2	2	2
135	.284550	1	1	1	1	1	2	2	3	3	4	5	5	6	6	6
136	.176387	1	1	1	1	1	1	1	2	2	3	3	4	4	4	4
137	.177939	0	0	0	0	0	1	1	1	2	2	2	2	2	2	2
138	.127253	0	1	1	1	1	1	1	1	2	2	2	3	3	3	3
139	.251802	1	1	1	1	1	1	1	2	2	3	3	4	4	4	4
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46	4.322324E-02	100														
47	5.168804E-02	100	100													
48	6.325241E-02	100	100	100												
49	7.937113E-02	99	100	100	100											
50	9.425114E-02	98	99	100	100	100										
51	.104799	98	99	99	100	100	100									

52	.117066	97	98	99	100	100	100	100								
53	.131362	97	98	98	99	100	100	100	100							
54	.148037	96	97	98	99	99	100	100	100	100						
55	.167457	95	96	97	98	99	99	99	100	100	100					
56	.189961	93	94	96	97	98	98	99	99	100	100	100				
57	.215771	91	93	94	96	97	97	98	99	99	100	100	100			
58	.244829	89	91	92	94	95	96	97	97	98	99	99	100	100		
59	.276556	87	88	90	92	93	94	95	96	97	98	98	99	100	100	
60	.309528	84	86	87	89	91	92	93	94	95	96	97	98	99	100	100
61	.341208	81	82	84	86	87	88	90	91	92	93	95	96	98	99	100
62	.367989	77	79	80	82	84	85	86	87	89	90	92	94	95	97	99
63	.385876	74	75	77	79	80	81	82	84	85	87	88	90	92	94	96
64	.391824	71	72	73	75	76	77	78	79	81	82	84	86	88	91	93
65	.369572	68	68	69	70	71	71	72	73	74	75	76	78	80	83	86
66	.304164	66	66	66	65	65	65	65	65	65	66	66	67	68	70	73
67	.232113	66	65	64	63	62	61	61	60	60	59	59	59	59	60	61
68	.175677	63	62	61	59	57	57	56	55	53	52	51	51	50	50	51
69	.115561	49	49	47	46	45	44	43	42	41	40	39	39	38	38	39
70	.155884	20	21	22	22	23	24	24	25	26	26	27	28	28	29	29
71	6.055508E-02	43	43	43	43	43	43	43	43	43	44	44	44	44	44	44
72	2.914848E-02	69	68	68	67	66	66	66	65	65	64	64	63	62	61	60
73	1.910383E-02	81	80	79	78	77	77	76	75	74	73	72	71	70	69	67
74	1.294695E-02	86	86	84	83	82	81	81	80	79	77	76	75	73	72	70
75	9.311538E-03	85	84	83	81	80	79	79	78	77	75	74	72	71	69	67
76	8.579859E-03	72	71	70	68	67	66	66	65	64	63	61	60	59	57	55
77	1.189662E-02	46	46	45	44	43	42	42	41	40	40	39	38	37	35	34
78	2.761996E-02	25	24	24	23	22	22	22	21	21	20	20	19	18	18	17
79	.108239	15	15	15	14	14	13	13	13	13	12	12	11	11	10	10
80	.326910	8	8	8	8	8	8	8	8	8	8	8	8	8	7	7
81	2.990400E-02	18	17	17	16	16	16	15	15	15	14	14	13	13	12	12
82	1.084124E-02	29	28	27	27	26	26	25	25	24	24	23	23	22	21	21
83	7.125177E-03	35	34	34	33	32	32	31	31	31	30	30	29	28	28	27
84	7.048409E-03	33	32	31	30	30	30	29	29	29	28	28	28	27	27	26
85	9.694340E-03	24	24	23	23	22	22	22	22	22	22	21	21	21	21	20
86	1.965083E-02	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
87	5.234624E-02	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
88	7.687142E-02	11	11	10	10	10	10	10	10	10	10	10	10	10	10	10
89	3.560673E-02	17	17	16	16	16	16	16	16	16	16	15	15	15	15	15
90	4.530987E-02	16	16	15	15	15	15	15	15	15	14	14	14	14	14	14
91	7.027439E-02	14	14	14	13	13	13	13	13	13	13	13	13	12	12	12
92	.194774	12	12	11	11	11	11	11	11	11	11	11	11	11	11	11
93	8.978999E-02	15	15	14	14	14	14	13	13	13	13	13	13	13	12	12
94	.358937	12	12	12	12	12	12	11	11	11	11	11	11	11	11	11
95	3.113598E-02	14	14	14	13	13	13	13	13	13	13	13	13	12	12	12
96	1.089710E-02	16	16	15	15	15	15	15	15	14	14	14	14	14	14	14
97	.540704	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
98	3.991290E-02	10	10	10	10	9	9	9	9	9	9	9	9	9	8	8
99	5.640122E-02	11	11	10	10	10	10	10	9	9	9	9	9	9	9	9
100	.264730	8	8	7	7	7	7	7	7	7	7	7	7	6	6	6
101	1.31675	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
102	8.773205E-02	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8
103	6.023109E-02	10	10	10	10	9	9	9	9	9	9	9	9	10	10	10
104	.836844	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
105	3.178312E-02	11	11	11	11	10	10	10	10	10	10	10	10	10	10	10
106	.388458	13	13	13	13	13	13	13	13	12	12	12	12	12	12	12
107	.171311	8	8	8	8	8	8	7	7	7	7	7	7	7	7	7
108	5.807920E-02	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6
109	.958867	10	10	9	9	9	9	9	9	9	9	9	9	9	9	9
110	.534730	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14
111	8.336930E-02	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5
112	.114821	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4
113	.146933	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
114	.160275	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
115	.227580	8	8	8	8	7	7	7	7	7	7	7	7	7	7	7
116	9.732078E-02	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4

117	.317119	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2
118	.662415	12	12	12	12	12	12	12	12	12	12	12	12	11	11	11
119	.148102	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
120	.269266	10	10	9	9	9	9	9	9	9	9	9	9	9	9	9
121	.214218	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8
122	8.563800E-02	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
123	.126181	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3
124	.183941	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
125	2.966190E-02	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
126	.254005	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
127	.779229	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
128	.502946	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
129	.803890	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
130	4.525134E-02	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
133	.767155	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6
134	.111655	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
135	.284550	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5
136	.176387	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
137	.177939	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
138	.127253	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
139	.251802	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
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		61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
61	.341208	100														
62	.367989	100	100													
63	.385876	98	99	100												
64	.391824	96	98	99	100											
65	.369572	89	92	95	98	100										
66	.304164	76	80	84	89	96	100									
67	.232113	64	67	72	77	88	97	100								
68	.175677	53	56	60	66	78	91	98	100							
69	.115561	40	42	46	51	60	72	78	85	100						
70	.155884	28	27	24	21	13	0	-12	-22	-12	100					
71	6.055508E-02	43	42	41	39	35	26	18	9	9	89	100				
72	2.914848E-02	60	59	58	57	55	52	48	42	37	70	93	100			
73	1.910383E-02	66	65	64	64	64	63	61	57	49	56	83	98	100		
74	1.294695E-02	68	67	66	65	66	67	67	63	54	45	73	92	98	100	
75	9.311538E-03	65	64	63	62	63	65	65	63	53	36	62	84	92	97	100
76	8.579859E-03	54	52	51	51	51	53	54	53	45	27	48	69	78	86	95
77	1.189662E-02	33	32	31	31	31	33	34	34	29	16	30	45	53	63	77
78	2.761996E-02	16	15	15	15	15	16	17	18	16	8	16	26	32	41	58
79	.108239	9	9	8	8	8	9	10	11	10	4	10	17	22	29	44
80	.326910	7	7	7	7	7	7	6	6	5	2	5	8	10	13	18
81	2.990400E-02	11	11	10	10	11	12	13	13	12	6	12	20	26	34	50
82	1.084124E-02	20	19	19	19	19	19	20	20	18	9	19	29	36	46	63
83	7.125177E-03	26	25	25	24	24	24	25	24	21	11	22	34	42	51	66
84	7.048409E-03	26	25	24	24	24	23	23	22	19	11	20	31	38	46	57
85	9.694340E-03	20	20	19	19	18	18	17	15	13	9	15	23	28	34	42
86	1.965083E-02	13	13	13	13	12	11	10	9	7	6	10	14	17	21	27
87	5.234624E-02	10	10	10	9	9	8	7	6	5	4	7	10	12	15	19
88	7.687142E-02	10	10	10	9	9	8	7	6	5	4	7	10	13	15	19
89	3.560673E-02	15	15	14	14	13	12	11	10	9	7	11	16	20	25	30
90	4.530987E-02	13	13	13	13	12	11	11	10	9	6	10	15	19	23	28
91	7.027439E-02	12	12	11	11	11	10	10	9	8	5	9	14	17	20	25
92	.194774	10	10	10	10	10	9	8	8	7	4	8	12	14	17	20
93	8.978999E-02	12	12	12	11	11	11	10	10	8	5	9	14	17	21	25
94	.358937	11	11	11	11	11	10	10	9	7	4	7	11	14	16	19
95	3.113598E-02	12	12	12	12	12	11	11	10	8	5	9	13	16	20	23
96	1.089710E-02	14	14	14	14	14	13	12	11	10	7	12	17	20	23	27
97	.540704	7	7	7	7	6	6	6	6	5	2	4	6	7	8	10
98	3.991290E-02	8	8	8	8	7	7	7	7	6	4	7	10	12	15	18
99	5.640122E-02	9	9	8	8	8	8	7	7	6	4	7	11	13	16	19
100	.264730	6	6	6	6	6	5	5	5	4	2	4	7	9	11	14
101	1.31675	9	9	9	9	9	8	8	8	6	2	5	8	10	12	14

102	8.773205E-02	8	8	8	8	8	8	8	7	6	4	7	10	11	13	15
103	6.023109E-02	10	10	10	10	10	9	8	7	6	4	7	10	12	14	16
104	.836844	8	8	8	8	8	7	7	6	5	2	5	7	9	10	11
105	3.178312E-02	10	10	10	10	10	9	8	8	6	3	6	10	13	16	19
106	.388458	12	12	12	12	12	11	10	10	8	3	7	11	14	17	20
107	.171311	7	7	7	7	7	6	6	6	5	2	4	7	9	10	12
108	5.807920E-02	6	6	5	5	5	5	5	4	4	1	3	6	7	9	10
109	.958867	9	9	9	9	9	8	8	7	6	2	4	8	9	11	13
110	.534730	14	13	13	13	13	12	12	11	9	3	7	12	15	17	20
111	8.336930E-02	5	4	4	4	4	4	4	4	3	1	3	5	6	8	9
112	.114821	4	4	4	4	3	3	3	3	3	1	2	4	5	7	8
113	.146933	5	5	5	5	4	4	4	4	3	1	3	4	6	7	8
114	.160275	6	6	5	5	5	5	5	4	4	1	3	5	6	8	9
115	.227580	7	7	7	7	7	6	6	6	5	1	3	6	8	9	11
116	9.732078E-02	4	4	4	4	4	4	4	4	3	1	3	4	5	7	8
117	.317119	2	2	2	2	2	2	2	2	1	0	1	2	3	3	4
118	.662415	11	11	11	11	11	10	10	9	8	2	6	10	12	15	17
119	.148102	6	6	5	5	5	5	5	5	4	1	3	5	7	8	9
120	.269266	9	9	9	9	8	8	8	7	6	2	5	8	10	11	13
121	.214218	8	8	8	8	8	7	7	6	5	2	4	7	9	11	12
122	8.563800E-02	2	2	2	2	2	2	2	2	2	0	1	2	3	4	5
123	.126181	3	3	3	3	3	3	3	3	2	1	2	3	4	5	6
124	.183941	5	5	4	4	4	4	4	4	3	1	2	4	5	6	7
125	2.966190E-02	5	5	5	5	5	5	5	4	4	1	3	5	6	7	9
126	.254005	6	6	6	6	6	5	5	5	4	1	3	5	6	8	9
127	.779229	8	7	7	7	7	7	7	6	5	2	4	7	8	10	11
128	.502946	8	8	8	8	7	7	6	6	5	2	4	6	8	9	11
129	.803890	7	7	7	7	7	7	6	6	5	2	4	7	8	10	11
130	4.525134E-02	3	3	3	3	3	3	2	2	2	0	1	3	4	5	6
131	1.717420E-02	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3
132	8.782174E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
133	.767155	6	6	6	6	6	6	5	5	4	1	3	5	7	8	9
134	.111655	2	2	2	2	1	1	1	1	1	0	1	1	2	3	4
135	.284550	5	5	5	5	5	5	5	4	4	1	3	5	6	7	8
136	.176387	4	4	4	4	3	3	3	3	2	1	2	3	4	5	6
137	.177939	2	2	2	2	2	2	2	2	1	0	1	2	3	3	4
138	.127253	2	2	2	2	2	2	2	2	1	0	1	2	3	3	4
139	.251802	4	4	4	4	3	3	3	3	3	1	2	3	4	5	6
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		76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
76	8.579859E-03	100														
77	1.189662E-02	93	100													
78	2.761996E-02	79	96	100												
79	.108239	65	84	94	100											
80	.326910	24	28	30	40	100										
81	2.990400E-02	71	86	85	65	37	100									
82	1.084124E-02	82	93	89	70	32	96	100								
83	7.125177E-03	81	85	77	61	26	81	94	100							
84	7.048409E-03	67	67	57	43	18	59	78	94	100						
85	9.694340E-03	48	46	36	27	10	38	58	81	96	100					
86	1.965083E-02	31	28	21	15	4	23	42	66	85	96	100				
87	5.234624E-02	22	21	15	9	2	18	33	53	71	83	91	100			
88	7.687142E-02	22	21	16	9	1	19	32	49	64	72	76	90	100		
89	3.560673E-02	34	29	21	13	4	23	43	67	82	86	78	73	78	100	
90	4.530987E-02	30	25	17	10	5	19	36	54	63	59	46	37	37	84	100
91	7.027439E-02	26	22	14	8	5	16	31	46	52	46	32	25	25	75	99
92	.194774	22	18	11	7	4	12	25	38	43	38	26	21	23	67	91
93	8.978999E-02	26	20	13	8	7	13	27	42	47	40	24	10	11	59	79
94	.358937	19	16	10	7	6	11	17	22	22	17	9	5	6	12	12
95	3.113598E-02	24	19	12	8	8	12	21	29	30	24	14	7	6	15	14
96	1.089710E-02	28	23	15	10	7	16	25	31	30	22	12	8	8	17	20
97	.540704	9	7	5	4	5	4	7	9	9	7	4	2	2	5	6
98	3.991290E-02	18	15	10	6	3	10	16	19	17	12	5	2	3	9	10
99	5.640122E-02	20	16	10	6	4	10	17	22	22	16	9	5	6	11	11

100	.264730	14	11	7	5	4	6	12	17	17	13	8	5	5	8	7
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102	8.773205E-02	15	11	7	5	6	7	11	15	14	10	5	2	2	7	8
103	6.023109E-02	17	13	8	6	7	8	14	19	19	15	9	7	6	11	11
104	.836844	11	8	5	4	6	5	8	11	11	8	5	3	3	6	7
105	3.178312E-02	19	15	9	6	7	9	16	21	21	16	10	6	6	11	12
106	.388458	20	15	9	7	9	9	15	20	20	15	9	5	5	11	12
107	.171311	12	9	6	4	5	6	9	12	12	9	5	3	3	7	7
108	5.807920E-02	10	8	5	4	4	5	9	11	11	8	5	3	3	6	7
109	.958867	13	10	6	5	7	6	10	12	12	9	5	3	3	7	8
110	.534730	20	15	10	7	10	9	15	20	19	14	8	4	4	10	12
111	8.336930E-02	9	7	5	3	3	5	8	10	10	7	4	2	2	6	7
112	.114821	9	7	4	3	3	4	7	9	9	7	4	3	2	5	5
113	.146933	8	6	4	3	4	4	6	8	8	6	3	2	2	5	5
114	.160275	9	7	5	3	4	4	7	9	9	7	4	2	2	5	6
115	.227580	11	9	5	4	6	5	9	11	11	8	5	3	3	6	7
116	9.732078E-02	8	6	4	3	4	4	6	9	9	7	4	2	2	5	6
117	.317119	4	3	2	2	2	2	3	5	5	4	2	1	1	3	3
118	.662415	17	13	8	6	9	8	13	17	16	12	7	4	4	9	10
119	.148102	10	7	5	4	5	4	8	10	10	8	4	3	3	6	6
120	.269266	13	10	6	5	7	6	10	13	12	9	5	3	3	7	8
121	.214218	12	10	6	5	7	6	10	12	12	9	5	3	3	7	8
122	8.563800E-02	6	5	3	2	2	3	5	7	7	5	3	2	2	4	4
123	.126181	6	5	3	2	3	3	5	7	6	5	2	1	1	4	5
124	.183941	7	6	4	3	4	4	6	8	7	6	3	2	2	4	5
125	2.966190E-02	9	7	4	3	4	4	7	10	10	7	4	3	3	5	6
126	.254005	9	7	4	3	5	4	7	9	9	6	3	2	2	5	6
127	.779229	11	8	5	4	6	5	8	10	10	7	4	2	2	6	7
128	.502946	11	8	5	4	6	5	8	11	11	8	5	3	3	6	7
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130	4.525134E-02	7	6	3	3	3	3	6	8	9	7	4	3	2	5	5
131	1.717420E-02	4	3	2	1	2	2	4	6	7	5	3	2	2	4	4
132	8.782174E-02	2	2	1	1	1	1	2	4	4	3	2	1	1	3	3
133	.767155	9	7	5	3	5	4	7	9	9	6	3	2	2	5	6
134	.111655	4	3	2	1	2	2	4	5	5	4	2	1	1	3	4
135	.284550	8	7	4	3	5	4	7	9	8	6	3	2	2	5	6
136	.176387	6	5	3	2	3	3	5	6	6	5	3	1	1	4	4
137	.177939	4	4	2	2	2	2	4	5	5	4	2	1	1	3	3
138	.127253	5	4	2	2	3	2	4	6	6	5	3	2	2	3	4
139	.251802	6	5	3	2	3	3	5	6	6	4	2	1	1	3	4
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		91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
91	7.027439E-02	100														
92	.194774	94	100													
93	8.978999E-02	80	83	100												
94	.358937	10	4	25	100											
95	3.113598E-02	11	8	34	73	100										
96	1.089710E-02	18	12	25	26	41	100									
97	.540704	5	5	7	9	9	21	100								
98	3.991290E-02	9	6	9	4	13	57	7	100							
99	5.640122E-02	9	6	9	6	15	48	5	88	100						
100	.264730	6	5	7	6	11	24	6	10	50	100					
101	1.31675	8	7	10	12	13	13	15	5	9	11	100				
102	8.773205E-02	7	6	8	8	10	19	9	8	13	31	36	100			
103	6.023109E-02	10	8	11	11	14	23	10	12	17	22	21	44	100		
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105	3.178312E-02	10	9	13	12	17	23	11	12	15	14	16	27	60	44	100
106	.388458	11	9	13	15	17	19	17	8	10	9	25	15	21	18	35
107	.171311	7	6	8	9	10	12	9	6	7	7	13	10	12	10	16
108	5.807920E-02	6	5	7	7	9	11	7	6	7	6	10	8	10	8	14
109	.958867	7	7	9	12	12	12	14	5	7	7	22	12	15	15	16
110	.534730	11	10	14	17	18	18	19	7	10	11	29	17	21	22	24
111	8.336930E-02	6	5	7	6	9	10	6	6	7	6	8	7	10	7	12
112	.114821	5	4	6	6	7	9	5	5	6	5	7	6	8	6	10

113	.146933	5	4	6	7	8	8	7	4	5	5	10	7	9	8	10
114	.160275	6	5	7	8	9	10	8	5	6	6	12	8	11	9	12
115	.227580	7	6	8	10	11	11	11	5	7	7	16	10	13	12	15
116	9.732078E-02	5	5	6	7	8	9	7	5	6	5	10	8	10	8	11
117	.317119	3	3	4	4	4	5	4	2	3	3	5	4	5	4	6
118	.662415	10	9	12	15	16	16	17	6	9	9	25	15	19	19	21
119	.148102	6	5	7	8	10	10	9	5	6	6	12	9	12	10	13
120	.269266	8	7	10	12	12	12	13	5	7	7	21	12	15	15	17
121	.214218	7	7	10	11	12	12	12	5	7	7	19	11	14	14	16
122	8.563800E-02	4	3	5	5	6	7	5	5	6	4	7	6	8	6	9
123	.126181	4	4	5	6	7	7	6	4	5	4	9	6	8	7	9
124	.183941	5	4	6	7	8	7	7	3	5	5	11	7	9	9	10
125	2.966190E-02	6	5	7	8	9	10	8	4	6	6	12	8	11	9	12
126	.254005	6	5	7	8	9	9	9	4	5	6	14	8	11	11	12
127	.779229	6	6	8	10	10	10	11	4	6	6	17	10	12	13	13
128	.502946	7	6	8	10	11	10	11	4	6	6	17	10	13	13	14
129	.803890	7	6	8	9	10	10	11	4	6	6	17	9	12	12	14
130	4.525134E-02	5	4	6	7	8	8	6	5	6	5	9	7	9	8	10
131	1.717420E-02	4	3	5	5	6	7	4	5	6	4	6	5	8	5	9
132	8.782174E-02	2	2	3	3	4	5	2	3	4	3	4	4	5	4	6
133	.767155	6	5	7	8	9	8	9	4	5	5	14	8	10	11	12
134	.111655	3	3	4	4	5	5	4	3	4	4	6	5	6	5	7
135	.284550	5	5	7	8	8	8	8	3	5	5	13	7	10	10	11
136	.176387	4	3	5	6	6	6	6	3	4	4	9	6	8	7	9
137	.177939	3	3	4	4	5	5	4	3	4	3	7	5	6	5	7
138	.127253	3	3	4	5	6	6	5	3	4	4	7	5	7	6	8
139	.251802	4	3	5	6	6	6	6	3	4	4	9	5	7	7	8
140	.285031	3	3	4	4	5	4	5	2	3	3	7	4	6	6	6

		106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
106	.388458	100														
107	.171311	19	100													
108	5.807920E-02	14	12	100												
109	.958867	26	13	14	100											
110	.534730	36	19	18	30	100										
111	8.336930E-02	12	9	8	8	17	100									
112	.114821	10	7	8	7	11	21	100								
113	.146933	13	8	7	10	15	7	11	100							
114	.160275	15	9	8	12	17	8	7	10	100						
115	.227580	20	11	9	16	24	9	8	9	15	100					
116	9.732078E-02	13	8	7	10	15	8	7	7	8	11	100				
117	.317119	7	4	4	6	8	4	3	4	5	5	8	100			
118	.662415	32	17	13	26	37	12	10	13	16	21	16	1	100		
119	.148102	16	10	8	13	19	8	7	8	9	12	10	6	17	100	
120	.269266	25	13	10	21	30	10	8	10	12	17	11	6	26	32	100
121	.214218	24	13	10	19	28	10	9	10	12	16	11	6	24	14	21
122	8.563800E-02	10	7	6	7	11	8	7	6	7	8	7	4	10	8	9
123	.126181	12	8	6	9	14	7	6	6	7	9	7	3	13	9	12
124	.183941	14	8	6	11	17	7	6	6	8	10	7	4	15	9	12
125	2.966190E-02	16	9	8	12	19	9	7	8	9	12	9	4	16	11	13
126	.254005	18	10	8	15	21	8	6	8	9	12	8	5	19	11	15
127	.779229	21	11	8	18	25	8	7	9	10	14	9	5	22	11	18
128	.502946	22	12	9	18	26	8	7	9	11	15	10	5	23	12	18
129	.803890	21	12	9	18	25	8	7	9	10	14	9	5	22	12	18
130	4.525134E-02	13	8	7	10	15	9	8	7	8	10	8	4	13	9	11
131	1.717420E-02	9	7	7	6	10	9	8	6	7	8	8	3	10	8	8
132	8.782174E-02	6	5	5	4	6	6	5	4	4	5	5	2	6	5	5
133	.767155	18	10	7	15	21	7	6	7	9	12	8	4	19	10	15
134	.111655	9	6	5	6	10	6	6	5	6	7	6	3	9	7	8
135	.284550	17	9	7	13	20	7	6	7	9	11	8	4	17	10	14
136	.176387	12	7	6	10	15	6	5	6	7	9	6	3	13	8	10
137	.177939	9	6	5	7	11	6	5	5	5	7	5	3	10	6	8
138	.127253	10	6	5	8	12	6	5	5	6	7	6	3	11	7	9
139	.251802	12	7	5	9	14	6	5	5	6	8	6	3	12	7	10
140	.285031	9	5	4	7	11	5	4	4	5	7	5	3	10	6	8

		121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
121	.214218	100														
122	8.563800E-02	11	100													
123	.126181	11	14	100												
124	.183941	12	7	8	100											
125	2.966190E-02	13	11	9	17	100										
126	.254005	15	7	8	10	37	100									
127	.779229	17	7	9	10	14	14	100								
128	.502946	18	8	10	11	14	14	16	100							
129	.803890	17	8	9	11	14	14	17	17	100						
130	4.525134E-02	12	10	8	8	13	8	9	14	39	100					
131	1.717420E-02	9	11	9	7	13	7	6	9	17	34	100				
132	8.782174E-02	6	7	6	5	8	5	4	5	5	9	60	100			
133	.767155	14	7	8	9	10	11	13	13	13	9	12	7	100		
134	.111655	8	7	7	6	9	7	6	7	7	9	14	8	11	100	
135	.284550	14	7	8	9	11	11	12	13	12	9	9	6	10	9	100
136	.176387	11	7	7	7	9	8	9	9	9	8	7	5	8	6	10
137	.177939	8	6	6	6	8	6	7	7	7	7	8	5	6	6	7
138	.127253	9	7	7	6	9	7	8	8	8	8	8	6	7	7	7
139	.251802	10	6	6	7	8	8	9	9	9	7	7	5	8	5	8
140	.285031	8	5	5	5	7	6	7	7	7	6	6	4	6	5	6

		136	137	138	139	140
136	.176387	100				
137	.177939	10	100			
138	.127253	7	8	100		
139	.251802	6	5	12	100	
140	.285031	6	4	6	9	100

Table B.3. The averaged fission cross sections and their uncertainties for the lowest 140 groups of the 238-group structure of the LAW library. The energy boundaries of the groups are given in eV, and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00010	16480.8	18.5963
(2)	.00010	.00050	6184.34	6.98302
(3)	.00050	.00075	4014.00	4.53713
(4)	.00075	.00100	3379.87	3.82326
(5)	.00100	.00120	3006.67	3.40342
(6)	.00120	.00150	2712.38	3.07259
(7)	.00150	.00200	2380.59	2.69995
(8)	.00200	.00250	2092.88	2.37721
(9)	.00250	.00300	1888.24	2.14798
(10)	.00300	.00400	1671.51	1.90561
(11)	.00400	.00500	1467.29	1.67769
(12)	.00500	.00750	1242.57	1.42767
(13)	.00750	.01000	1040.29	1.20339
(14)	.01000	.02530	735.920	.867325
(15)	.02530	.03000	560.873	.674359
(16)	.03000	.04000	490.821	.597177
(17)	.04000	.05000	421.928	.521487
(18)	.05000	.06000	372.293	.467251
(19)	.06000	.07000	334.487	.426304
(20)	.07000	.08000	304.613	.394414
(21)	.08000	.09000	280.392	.369163
(22)	.09000	.10000	260.387	.349096
(23)	.10000	.12500	233.332	.324493
(24)	.12500	.15000	205.484	.307308
(25)	.15000	.17500	187.659	.311966
(26)	.17500	.20000	178.165	.340564
(27)	.20000	.22500	176.855	.394405
(28)	.22500	.25000	183.442	.471920
(29)	.25000	.27500	193.560	.556849
(30)	.27500	.30000	196.046	.578301
(31)	.30000	.32500	183.368	.507905
(32)	.32500	.35000	161.849	.428355
(33)	.35000	.37500	140.756	.363199
(34)	.37500	.40000	123.644	.306456
(35)	.40000	.45000	105.357	.241523
(36)	.45000	.50000	88.9838	.187267
(37)	.50000	.55000	78.1750	.157152
(38)	.55000	.60000	70.5269	.139923
(39)	.60000	.62500	66.1056	.131773
(40)	.62500	.65000	63.6890	.128000
(41)	.65000	.70000	60.7118	.124244
(42)	.70000	.75000	57.6832	.122065
(43)	.75000	.80000	55.7023	.123078
(44)	.80000	.85000	54.8124	.127737
(45)	.85000	.90000	55.2469	.137284
(46)	.90000	.92500	56.6758	.148893

(47)	.92500	.95000	58.4451	.159901
(48)	.95000	.97500	61.0659	.174443
(49)	.97500	1.00000	64.8361	.193893
(50)	1.00000	1.01000	68.3133	.211444
(51)	1.01000	1.02000	70.7464	.223565
(52)	1.02000	1.03000	73.5300	.237546
(53)	1.03000	1.04000	76.7039	.253811
(54)	1.04000	1.05000	80.3045	.272905
(55)	1.05000	1.06000	84.3560	.295513
(56)	1.06000	1.07000	88.8570	.322434
(57)	1.07000	1.08000	93.7573	.354468
(58)	1.08000	1.09000	98.9250	.392126
(59)	1.09000	1.10000	104.102	.435067
(60)	1.10000	1.11000	108.861	.481292
(61)	1.11000	1.12000	112.581	.526388
(62)	1.12000	1.13000	114.501	.563542
(63)	1.13000	1.14000	113.882	.585136
(64)	1.14000	1.15000	110.264	.585714
(65)	1.15000	1.17500	96.9214	.528190
(66)	1.17500	1.20000	72.1460	.404452
(67)	1.20000	1.22500	50.6693	.301015
(68)	1.22500	1.25000	36.3258	.266552
(69)	1.25000	1.30000	25.7888	.164916
(70)	1.30000	1.35000	22.7469	.163340
(71)	1.35000	1.40000	19.5050	8.034505E-02
(72)	1.40000	1.45000	17.4375	5.555828E-02
(73)	1.45000	1.50000	16.2846	4.661075E-02
(74)	1.50000	1.59000	15.3101	4.262234E-02
(75)	1.59000	1.68000	14.4648	4.128490E-02
(76)	1.68000	1.77000	13.8523	4.128777E-02
(77)	1.77000	1.86000	13.4379	4.278388E-02
(78)	1.86000	1.94000	13.4916	4.936779E-02
(79)	1.94000	2.00000	15.7053	8.816497E-02
(80)	2.00000	2.12000	22.1858	.229782
(81)	2.12000	2.21000	11.9067	5.020069E-02
(82)	2.21000	2.30000	11.0080	4.119657E-02
(83)	2.30000	2.38000	10.5165	4.007490E-02
(84)	2.38000	2.47000	10.0487	4.130887E-02
(85)	2.47000	2.57000	9.43132	4.515185E-02
(86)	2.57000	2.67000	8.27215	5.142265E-02
(87)	2.67000	2.77000	7.54267	4.435929E-02
(88)	2.77000	2.87000	15.5652	.102690
(89)	2.87000	2.97000	20.3928	7.485531E-02
(90)	2.97000	3.00000	23.5603	8.560026E-02
(91)	3.00000	3.05000	27.8529	.103628
(92)	3.05000	3.15000	45.5982	.220052
(93)	3.15000	3.50000	26.4081	.102412
(94)	3.50000	3.73000	58.4540	.340425
(95)	3.73000	4.00000	4.10850	4.235528E-02
(96)	4.00000	4.75000	3.82010	3.120693E-02
(97)	4.75000	5.00000	12.6862	.196341

(98)	5.00000	5.40000	8.42215	5.505267E-02
(99)	5.40000	6.00000	16.2308	6.675505E-02
(100)	6.00000	6.25000	38.2899	.292287
(101)	6.25000	6.50000	84.6147	.648270
(102)	6.50000	6.75000	7.41503	6.998867E-02
(103)	6.75000	7.00000	9.75708	6.772120E-02
(104)	7.00000	7.15000	82.9563	.653770
(105)	7.15000	8.10000	5.31627	3.918570E-02
(106)	8.10000	9.10000	175.155	.534681
(107)	9.10000	10.00000	49.7539	.204406
(108)	10.00000	11.50000	16.6151	6.685724E-02
(109)	11.50000	11.90000	39.0272	.390133
(110)	11.90000	12.90000	94.3579	.414579
(111)	12.90000	13.75000	28.4137	.103340
(112)	13.75000	14.40000	71.2747	.224548
(113)	14.40000	15.10000	19.2280	.128357
(114)	15.10000	16.00000	22.6449	.144299
(115)	16.00000	17.00000	39.5254	.183982
(116)	17.00000	18.50000	25.9471	.117144
(117)	18.50000	19.00000	32.6639	.231700
(118)	19.00000	20.00000	193.501	.665766
(119)	20.00000	21.00000	25.9947	.143214
(120)	21.00000	22.50000	35.9230	.188824
(121)	22.50000	25.00000	51.8210	.176196
(122)	25.00000	27.50000	42.4648	.130418
(123)	27.50000	30.00000	20.9800	.103166
(124)	30.00000	31.25000	17.8979	.133543
(125)	31.25000	31.75000	4.36443	5.831678E-02
(126)	31.75000	33.25000	46.0001	.264303
(127)	33.25000	33.75000	89.8353	.556980
(128)	33.75000	34.60000	84.0198	.424234
(129)	34.60000	35.50000	239.882	.888071
(130)	35.50000	37.00000	24.5157	9.135285E-02
(131)	37.00000	38.00000	10.7054	5.342505E-02
(132)	38.00000	39.10000	17.3895	9.598414E-02
(133)	39.10000	39.60000	142.323	.750038
(134)	39.60000	41.00000	26.3789	.121599
(135)	41.00000	42.40000	42.4017	.209174
(136)	42.40000	44.00000	22.8107	.141342
(137)	44.00000	45.20000	48.4771	.223800
(138)	45.20000	47.00000	27.2174	.158575
(139)	47.00000	48.30000	40.3910	.252002
(140)	48.30000	49.20000	43.6513	.284682

Table B.4. The correlation matrix of the fission cross sections for the lowest 140 groups of the 238-group structure of the LAW library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	18.5963	100														
2	6.98302	100	100													
3	4.53713	100	100	100												
4	3.82326	100	100	100	100											
5	3.40342	100	100	100	100	100										
6	3.07259	100	100	100	100	100	100									
7	2.69995	100	100	100	100	100	100	100								
8	2.37721	100	100	100	100	100	100	100	100							
9	2.14798	100	100	100	100	100	100	100	100	100						
10	1.90561	100	100	100	100	100	100	100	100	100	100					
11	1.67769	100	100	100	100	100	100	100	100	100	100	100				
12	1.42767	100	100	100	100	100	100	100	100	100	100	100	100			
13	1.20339	100	100	100	100	100	100	100	100	100	100	100	100	100		
14	.867325	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
15	.674359	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
16	.597177	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
17	.521487	99	99	99	99	99	99	99	99	99	99	99	99	100	100	100
18	.467251	99	99	99	99	99	99	99	99	99	99	99	99	99	99	100
19	.426304	98	98	98	98	98	98	98	98	98	98	98	99	99	99	99
20	.394414	97	97	98	98	98	98	98	98	98	98	98	98	98	98	99
21	.369163	96	96	96	96	96	96	97	97	97	97	97	97	97	97	98
22	.349096	95	95	95	95	95	95	95	95	95	95	95	95	96	96	97
23	.324493	92	92	92	92	92	92	92	92	92	92	92	92	92	93	94
24	.307308	84	84	84	84	84	84	84	84	84	84	85	85	85	86	87
25	.311966	73	73	73	73	73	73	73	73	73	73	74	74	74	75	77
26	.340564	60	60	60	60	60	60	60	60	60	60	60	60	61	62	64
27	.394405	48	48	48	48	48	48	48	48	48	48	48	48	48	49	51
28	.471920	39	40	40	40	40	40	40	40	40	40	40	40	40	41	42
29	.556849	36	36	36	36	36	36	36	36	36	36	36	36	36	37	37
30	.578301	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37
31	.507905	38	38	38	38	38	38	38	38	38	38	38	38	38	39	39
32	.428355	38	38	38	38	38	38	38	38	38	38	38	38	39	39	40
33	.363199	39	39	39	39	39	39	39	39	39	39	39	39	40	41	42
34	.306456	42	43	43	43	43	43	43	43	43	43	43	43	43	44	45
35	.241523	51	51	51	51	51	51	51	51	51	51	51	51	52	52	53
36	.187267	63	63	63	63	63	63	63	63	63	63	63	63	63	64	65
37	.157152	73	73	73	73	73	73	73	73	73	73	73	73	73	73	74
38	.139923	79	79	79	79	79	79	79	79	79	79	79	79	80	80	80
39	.131773	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
40	.128000	84	84	84	84	84	84	84	84	84	84	84	84	84	84	85
41	.124244	85	85	85	85	85	85	85	85	85	85	85	85	85	86	86
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23	.324493	95	96	96	97	98	99	100	100							
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138	.158575	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
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31	.507905	100														
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33	.363199	76	95	100												
34	.306456	64	88	98	100											
35	.241523	53	78	92	98	100										
36	.187267	46	68	83	91	97	100									
37	.157152	42	60	74	83	92	98	100								
38	.139923	40	55	67	76	86	95	99	100							
39	.131773	39	51	62	71	81	91	97	100	100						
40	.128000	38	49	59	68	78	89	96	99	100	100					
41	.124244	38	47	56	64	74	86	93	97	99	100	100				
42	.122065	37	44	51	58	69	81	89	95	97	98	99	100			
43	.123078	36	41	47	54	64	76	85	91	94	96	98	99	100		
44	.127737	34	38	43	49	58	70	79	86	90	92	95	98	99	100	
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46	.148893	30	33	35	39	47	58	67	75	79	82	86	90	94	97	99
47	.159901	29	31	33	36	43	53	62	70	75	78	82	87	91	95	98
48	.174443	27	29	30	33	39	49	57	65	69	72	77	82	87	91	96
49	.193893	25	26	27	30	35	43	51	58	63	66	70	76	81	86	92
50	.211444	23	24	25	27	32	39	46	53	58	60	65	70	76	82	88
51	.223565	22	23	24	25	30	37	43	50	54	57	61	66	72	78	84
52	.237546	21	22	22	24	27	34	40	46	50	53	57	62	68	74	81
53	.253811	19	20	21	22	25	31	37	42	46	49	52	58	63	69	76
54	.272905	18	19	19	20	23	28	33	38	41	44	47	52	58	64	71
55	.295513	17	17	17	18	20	25	29	33	36	39	42	46	51	57	64
56	.322434	15	16	16	16	18	21	25	29	31	33	36	40	44	50	57
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62	.563542	10	10	10	10	10	10	10	10	9	9	8	7	7	7	8
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66	.404452	14	15	15	16	18	21	24	26	28	28	29	30	30	29	27
67	.301015	12	13	14	14	16	19	22	25	26	27	28	30	31	32	32
68	.266552	7	8	9	10	11	13	14	15	15	15	16	17	18	18	19
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70	.163340	9	10	11	13	15	18	21	23	25	25	27	28	30	31	31
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72	5.555828E-02	19	22	25	28	33	39	43	46	48	49	50	51	51	51	50
73	4.661075E-02	22	26	29	32	38	44	48	51	52	53	53	53	52	50	48
74	4.262234E-02	24	28	31	35	41	47	51	54	54	54	54	53	51	48	44
75	4.128490E-02	25	29	33	36	42	48	52	55	55	55	54	52	50	46	41
76	4.128777E-02	26	30	33	36	42	48	52	55	55	55	54	52	50	46	41
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79	8.816497E-02	13	16	19	21	25	29	31	33	33	33	33	32	31	29	27
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81	5.020069E-02	21	23	24	26	29	33	36	38	39	39	39	39	37	35	32
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83	4.007490E-02	26	29	30	31	34	39	43	46	47	48	48	48	46	44	41
84	4.130887E-02	24	27	29	30	33	37	41	43	45	45	46	46	45	43	40
85	4.515185E-02	21	24	25	26	29	32	36	38	39	40	40	40	40	38	36
86	5.142265E-02	15	17	19	20	21	24	26	28	29	30	30	30	30	30	29
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88	.102690	9	10	10	10	11	12	13	14	15	16	16	17	17	17	16
89	7.485531E-02	13	15	14	14	15	17	18	20	21	21	22	22	22	22	21
90	8.560026E-02	13	14	14	14	15	16	18	19	20	20	21	22	22	21	21
91	.103628	11	13	13	13	14	16	17	19	19	20	20	21	21	20	20
92	.220052	10	10	11	12	13	15	16	17	18	18	18	18	18	17	16
93	.102412	15	16	16	16	18	20	22	24	24	25	25	25	25	24	23
94	.340425	8	8	7	7	7	7	8	9	9	9	10	10	10	10	11
95	4.235528E-02	14	15	15	15	15	17	18	20	21	21	22	22	22	22	21
96	3.120693E-02	20	22	21	21	21	23	26	28	30	30	31	32	32	31	30
97	.196341	5	5	5	5	6	6	7	8	8	8	8	8	8	8	8
98	5.505267E-02	16	17	17	18	20	22	25	26	27	27	27	27	26	25	23
99	6.675505E-02	9	10	10	10	10	11	12	13	14	14	15	15	15	15	15
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107	.204406	6	6	6	6	7	9	10	10	10	11	11	11	10	10	10
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122	.130418	4	3	3	4	4	5	6	6	6	6	6	6	6	6	5
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130	9.135285E-02	4	4	4	5	6	7	8	9	9	9	9	9	8	7	7
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132	9.598414E-02	2	2	2	2	3	3	3	4	4	4	4	4	4	4	3
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138	.158575	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
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46	.148893	100														
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48	.174443	98	99	100												

49	.193893	95	98	99	100											
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51	.223565	89	93	96	99	100	100									
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56	.322434	63	68	74	81	86	89	92	95	98	99	100				
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61	.526388	16	19	24	31	38	42	48	53	60	67	75	82	89	95	99
62	.563542	9	12	16	21	27	31	36	42	48	55	63	72	80	88	94
63	.585136	5	7	9	13	18	21	25	30	36	43	51	59	69	78	86
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65	.528190	11	9	8	7	7	7	8	10	12	15	20	25	33	41	51
66	.404452	25	23	20	16	13	12	10	8	7	6	5	6	8	12	18
67	.301015	31	30	28	25	23	21	18	16	13	10	7	4	2	1	1
68	.266552	20	21	21	21	21	20	20	19	18	16	14	11	8	5	1
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70	.163340	31	30	29	27	24	23	20	18	15	12	9	5	2	-1	-3
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72	5.555828E-02	49	47	45	42	39	37	35	32	29	26	22	18	14	10	7
73	4.661075E-02	46	44	41	39	36	35	33	31	29	27	24	21	18	15	13
74	4.262234E-02	41	38	36	33	31	30	29	28	26	25	24	22	20	19	17
75	4.128490E-02	37	35	32	29	27	26	25	25	24	23	22	21	21	20	19
76	4.128777E-02	36	33	30	28	26	25	24	23	22	22	21	21	20	20	20
77	4.278388E-02	36	33	30	27	25	24	23	22	21	20	20	19	19	19	19
78	4.936779E-02	34	31	28	25	23	22	21	20	19	18	18	17	17	16	16
79	8.816497E-02	25	23	21	19	18	17	16	15	14	13	12	11	11	10	10
80	.229782	15	14	13	12	11	11	10	10	9	9	8	7	7	6	6
81	5.020069E-02	30	28	26	24	22	21	20	19	18	17	16	15	14	13	13
82	4.119657E-02	36	34	31	28	26	25	24	23	22	20	19	18	17	16	15
83	4.007490E-02	38	35	33	30	28	26	25	24	22	21	20	18	17	16	15
84	4.130887E-02	37	35	32	30	28	26	25	24	22	21	19	18	16	15	14
85	4.515185E-02	34	32	30	28	26	25	23	22	21	19	18	16	14	13	12
86	5.142265E-02	27	26	25	23	22	21	20	19	17	16	14	13	11	10	8
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91	.103628	19	19	18	17	16	15	15	14	13	12	12	11	10	9	8
92	.220052	16	15	14	14	13	13	12	12	11	11	10	10	9	8	8
93	.102412	22	21	20	18	18	17	16	16	15	14	13	13	12	11	10
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95	4.235528E-02	20	19	19	18	17	16	16	15	15	14	13	12	11	10	9
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97	.196341	7	7	7	7	6	6	6	6	6	5	5	5	5	4	4
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112	.224548	7	7	7	7	7	7	6	6	6	6	6	6	6	6	5
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122	.130418	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4
123	.103166	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3
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129	.888071	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
130	9.135285E-02	6	5	5	4	4	4	4	4	3	3	3	3	3	3	3
131	5.342505E-02	5	5	4	4	4	4	4	3	3	3	3	3	3	3	3
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135	.209174	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
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137	.223800	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
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139	.252002	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
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61	.526388	100														
62	.563542	98	100													
63	.585136	93	98	100												
64	.585714	84	92	98	100											
65	.528190	62	74	85	93	100										
66	.404452	27	38	51	65	86	100									
67	.301015	3	9	17	28	52	85	100								
68	.266552	-1	-3	-2	1	14	46	84	100							
69	.164916	4	1	-1	-2	3	19	42	58	100						
70	.163340	-3	-2	2	7	18	26	13	-20	-12	100					
71	8.034505E-02	0	0	3	7	18	33	34	20	-10	39	100				
72	5.555828E-02	5	4	6	9	18	30	30	16	12	41	90	100			
73	4.661075E-02	11	10	10	12	17	24	25	16	23	40	76	95	100		
74	4.262234E-02	16	15	14	14	15	18	20	17	27	34	60	85	97	100	
75	4.128490E-02	19	18	17	16	15	15	17	17	27	28	48	74	90	98	100
76	4.128777E-02	19	19	18	17	16	14	15	16	26	24	42	68	84	95	99
77	4.278388E-02	18	18	18	17	16	14	15	16	24	22	39	62	79	90	96
78	4.936779E-02	16	16	16	16	15	14	14	14	21	19	34	54	69	79	86
79	8.816497E-02	9	9	10	10	11	11	11	9	12	13	22	33	41	48	53
80	.229782	5	5	5	6	7	8	8	6	7	8	12	16	19	19	20
81	5.020069E-02	12	11	11	11	11	12	14	13	19	17	31	44	53	56	55
82	4.119657E-02	14	14	13	13	14	14	16	15	22	20	37	54	66	72	73
83	4.007490E-02	14	14	13	13	14	15	16	16	22	21	39	57	69	75	78
84	4.130887E-02	13	12	12	12	13	15	16	15	21	21	39	56	67	74	76
85	4.515185E-02	11	10	10	10	11	14	15	14	19	20	37	53	62	67	70
86	5.142265E-02	7	6	6	6	8	11	13	11	16	18	33	44	51	54	56
87	4.435929E-02	6	5	5	6	7	10	11	9	11	13	23	32	38	42	44
88	.102690	5	5	5	5	6	8	8	6	7	9	15	21	25	27	28
89	7.485531E-02	8	7	7	8	9	10	9	7	9	9	16	23	28	31	32
90	8.560026E-02	8	7	7	8	9	10	10	7	9	10	17	24	28	31	32
91	.103628	7	7	7	7	8	10	10	7	9	10	17	23	27	29	30
92	.220052	7	7	7	7	8	9	8	6	6	7	11	15	17	18	18
93	.102412	10	10	10	10	11	12	11	8	10	10	16	22	26	28	29
94	.340425	8	7	7	7	7	8	6	4	4	5	7	8	9	9	9
95	4.235528E-02	8	7	6	6	7	10	12	11	14	14	26	36	40	42	42
96	3.120693E-02	10	9	9	9	9	12	14	13	19	20	37	52	60	63	63

97	.196341	4	4	3	3	4	4	4	4	4	5	8	11	12	12	12
98	5.505267E-02	9	9	9	9	9	10	11	10	14	14	26	37	44	47	47
99	6.675505E-02	7	6	6	6	6	8	8	7	10	11	19	26	29	30	30
100	.292287	4	4	4	4	5	5	5	3	3	4	6	8	9	9	10
101	.648270	5	5	5	6	6	5	4	3	2	1	2	3	3	4	5
102	6.998867E-02	7	7	7	6	7	7	8	7	10	10	19	26	30	31	31
103	6.772120E-02	5	5	5	5	6	8	8	6	7	7	13	17	19	20	21
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105	3.918570E-02	9	9	9	9	10	10	11	10	13	11	21	30	36	40	41
106	.534681	9	9	9	9	9	8	7	4	4	3	5	7	7	8	8
107	.204406	6	6	6	6	6	6	5	4	4	3	6	8	9	10	10
108	6.685724E-02	6	6	6	6	6	6	6	6	8	7	13	18	22	23	24
109	.390133	3	4	4	4	4	4	3	2	2	1	2	3	4	4	4
110	.414579	7	7	7	7	8	7	6	4	3	3	4	6	7	7	8
111	.103340	6	6	6	6	6	6	5	5	5	4	9	12	14	16	16
112	.224548	5	5	5	5	5	4	4	3	3	3	5	7	8	9	9
113	.128357	4	4	4	4	4	4	3	3	4	3	6	8	10	10	11
114	.144299	4	4	4	4	4	4	4	3	3	3	5	7	8	8	8
115	.183982	5	5	5	5	5	4	4	3	3	2	4	5	6	7	7
116	.117144	5	5	5	5	5	4	4	4	4	4	7	10	11	12	12
117	.231700	3	3	3	3	3	2	2	2	2	1	3	4	4	5	5
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119	.143214	4	4	4	4	4	4	4	3	3	2	5	6	7	8	8
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121	.176196	5	5	4	4	4	4	4	3	3	2	4	6	6	7	7
122	.130418	4	4	4	4	3	3	3	2	3	2	4	6	7	8	8
123	.103166	3	3	3	3	3	3	3	2	3	2	5	7	8	9	9
124	.133543	2	2	2	2	2	2	2	2	2	1	2	3	4	5	5
125	5.831678E-02	2	2	2	2	2	2	2	2	2	1	3	5	6	8	8
126	.264303	3	3	3	3	3	3	3	2	2	1	2	3	3	4	4
127	.556980	3	3	3	3	3	3	2	2	1	1	1	2	2	2	2
128	.424234	3	3	3	3	4	3	3	2	1	1	1	2	2	2	3
129	.888071	5	5	5	5	5	4	4	2	2	1	2	2	2	2	2
130	9.135285E-02	3	3	3	3	3	3	3	3	4	3	7	11	13	14	14
131	5.342505E-02	2	2	2	2	2	2	3	3	5	5	10	14	16	17	17
132	9.598414E-02	2	2	2	2	1	1	2	2	3	2	4	6	7	8	8
133	.750038	3	3	3	3	3	3	2	2	1	1	2	2	2	2	2
134	.121599	2	2	2	2	2	2	2	2	2	2	4	5	6	7	7
135	.209174	3	3	3	3	3	2	2	2	2	1	2	3	4	4	4
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137	.223800	2	2	2	2	2	2	2	1	1	1	2	2	3	3	3
138	.158575	2	2	2	2	2	1	1	1	1	1	1	2	2	2	3
139	.252002	2	2	2	2	2	2	2	1	2	1	2	3	4	4	4
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		76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
76	4.128777E-02	100														
77	4.278388E-02	99	100													
78	4.936779E-02	91	96	100												
79	8.816497E-02	58	67	83	100											
80	.229782	21	24	37	71	100										
81	5.020069E-02	52	45	35	30	53	100									
82	4.119657E-02	71	65	51	29	34	93	100								
83	4.007490E-02	76	72	58	31	26	85	98	100							
84	4.130887E-02	76	73	61	33	21	76	93	98	100						
85	4.515185E-02	70	68	60	33	16	64	84	92	97	100					
86	5.142265E-02	57	57	52	31	12	48	67	77	86	95	100				
87	4.435929E-02	45	44	38	20	11	46	56	58	54	45	30	100			
88	.102690	29	28	25	13	7	29	37	39	40	36	22	44	100		
89	7.485531E-02	32	30	25	13	9	31	35	33	29	23	19	47	46	100	
90	8.560026E-02	32	31	26	14	9	30	35	34	29	22	15	63	31	89	100
91	.103628	30	30	26	16	8	26	32	33	31	26	20	61	29	73	94
92	.220052	18	18	17	12	7	15	18	19	20	19	18	18	12	29	46
93	.102412	29	28	25	17	11	25	29	29	28	26	22	18	13	33	40
94	.340425	9	8	8	6	5	8	9	9	9	8	6	6	5	6	6

95	4.235528E-02	41	40	36	24	13	35	41	43	43	42	40	29	16	12	12
96	3.120693E-02	61	58	49	28	16	53	61	60	56	50	41	37	18	26	21
97	.196341	12	11	10	7	5	10	12	11	11	10	8	6	4	6	6
98	5.505267E-02	46	43	37	22	12	38	44	44	42	37	29	20	13	21	19
99	6.675505E-02	29	28	25	16	9	25	29	30	30	27	24	21	12	15	14
100	.292287	10	10	9	7	4	8	9	10	9	9	7	9	5	7	7
101	.648270	5	5	5	4	3	5	5	5	4	4	2	3	2	4	4
102	6.998867E-02	29	28	24	15	9	25	28	28	27	24	20	13	8	12	12
103	6.772120E-02	21	21	20	14	7	20	23	24	24	23	20	18	10	12	12
104	.653770	4	4	4	4	3	4	4	4	4	4	3	3	2	4	4
105	3.918570E-02	41	39	35	22	12	34	40	40	39	36	31	26	14	19	18
106	.534681	8	8	8	6	4	7	8	8	7	7	5	6	4	7	7
107	.204406	10	10	9	6	4	8	10	10	9	8	6	5	4	6	6
108	6.685724E-02	24	23	20	13	7	20	23	24	23	21	18	14	8	11	11
109	.390133	5	5	5	4	2	4	5	5	5	4	3	4	2	4	4
110	.414579	9	9	8	6	4	8	9	9	9	8	6	6	4	6	7
111	.103340	16	16	14	9	5	14	17	17	16	15	13	9	6	8	8
112	.224548	9	8	7	5	3	7	8	8	8	7	6	5	3	6	6
113	.128357	11	10	9	6	3	9	10	10	10	9	8	6	4	5	5
114	.144299	8	8	7	5	3	8	9	9	8	7	6	5	3	5	5
115	.183982	7	7	7	5	3	7	8	8	7	7	6	5	3	5	5
116	.117144	12	11	10	6	4	10	12	12	11	10	9	7	4	6	6
117	.231700	5	4	4	2	2	4	5	4	4	3	2	3	2	3	3
118	.665766	7	7	7	5	3	6	7	7	6	6	4	4	3	6	6
119	.143214	8	8	8	6	3	7	8	9	8	8	7	6	3	5	6
120	.188824	9	8	8	5	3	8	9	9	8	7	6	5	3	5	5
121	.176196	7	7	6	5	3	6	7	7	7	6	5	4	3	5	5
122	.130418	8	8	7	4	2	7	7	8	7	7	6	4	3	4	4
123	.103166	9	9	8	5	3	8	9	9	8	8	6	5	3	5	5
124	.133543	5	5	4	3	2	4	5	5	5	4	4	3	2	3	3
125	5.831678E-02	9	8	7	5	2	8	9	9	9	8	7	4	3	4	4
126	.264303	4	4	4	3	2	4	5	5	4	4	3	2	2	3	3
127	.556980	2	2	2	2	2	2	2	1	1	1	0	0	0	2	2
128	.424234	3	3	3	3	2	3	3	3	3	3	3	3	2	3	3
129	.888071	2	2	2	2	2	2	2	2	2	2	2	3	2	3	3
130	9.135285E-02	14	13	12	8	3	10	12	13	12	12	10	8	4	6	6
131	5.342505E-02	17	16	14	9	3	14	17	17	17	16	14	11	5	7	7
132	9.598414E-02	8	8	7	4	2	7	8	8	8	8	7	5	3	4	4
133	.750038	2	2	2	2	2	2	2	2	2	1	1	1	1	2	2
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135	.209174	4	4	3	3	2	3	3	3	3	3	2	2	1	3	3
136	.141342	5	5	4	3	2	4	5	5	5	5	4	3	2	3	3
137	.223800	3	3	3	2	1	3	3	3	3	3	3	2	1	2	2
138	.158575	3	3	3	2	1	2	3	3	3	3	3	2	1	2	2
139	.252002	4	4	3	2	2	4	4	4	4	3	3	2	1	3	3
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		91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
91	.103628	100														
92	.220052	65	100													
93	.102412	48	70	100												
94	.340425	6	5	19	100											
95	4.235528E-02	15	14	25	31	100										
96	3.120693E-02	18	15	27	8	64	100									
97	.196341	5	5	7	3	10	23	100								
98	5.505267E-02	17	12	20	5	31	58	16	100							
99	6.675505E-02	13	9	16	5	25	41	5	69	100						
100	.292287	6	5	8	5	10	13	4	9	35	100					
101	.648270	4	5	6	5	6	2	3	4	9	9	100				
102	6.998867E-02	11	9	16	5	21	30	7	21	17	28	35	100			
103	6.772120E-02	12	8	15	7	21	29	8	24	18	13	11	51	100		
104	.653770	4	4	6	5	4	5	3	5	4	2	4	12	51	100	
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106	.534681	8	8	10	9	6	6	4	7	8	6	11	8	10	9	19
107	.204406	6	6	9	6	7	8	4	8	8	6	6	7	7	6	11

108	6.685724E-02	11	8	13	6	19	23	6	19	15	7	6	14	12	5	23
109	.390133	4	4	5	4	5	4	3	5	5	4	5	5	6	4	8
110	.414579	7	7	10	8	8	7	4	8	8	6	9	9	9	8	14
111	.103340	9	8	11	6	14	16	5	15	12	7	6	12	11	5	18
112	.224548	6	6	7	5	6	8	3	8	7	5	5	6	7	5	9
113	.128357	6	5	7	4	9	10	4	10	8	4	4	9	9	4	13
114	.144299	5	5	7	5	8	9	4	8	7	5	5	9	8	5	12
115	.183982	5	5	7	5	7	7	4	7	7	5	6	8	8	5	11
116	.117144	7	6	9	5	10	12	4	10	9	5	5	9	9	5	13
117	.231700	3	3	4	3	4	4	2	3	3	3	3	4	5	3	6
118	.665766	6	6	8	8	5	5	3	5	6	6	9	7	8	8	9
119	.143214	6	5	7	5	9	9	4	8	8	5	5	9	10	5	13
120	.188824	5	5	7	5	7	8	3	7	6	4	6	8	7	5	10
121	.176196	5	5	7	5	7	7	3	7	6	5	6	8	8	5	11
122	.130418	4	4	6	4	6	7	3	7	6	4	4	7	6	4	10
123	.103166	5	4	7	4	7	9	3	8	7	4	4	8	8	4	12
124	.133543	3	3	4	3	5	5	2	5	5	3	3	6	6	3	9
125	5.831678E-02	4	3	5	2	8	10	3	10	7	3	2	8	7	2	13
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127	.556980	2	3	4	3	1	0	1	1	2	2	4	3	3	4	4
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129	.888071	4	4	5	5	2	1	2	3	4	4	6	5	6	6	6
130	9.135285E-02	6	4	6	3	10	12	3	10	7	3	3	9	9	3	13
131	5.342505E-02	7	4	7	2	14	18	4	15	10	3	2	12	10	2	18
132	9.598414E-02	4	3	5	3	8	9	3	8	7	3	2	8	7	3	11
133	.750038	2	3	4	4	2	1	1	2	2	3	4	3	4	4	4
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139	.252002	3	3	4	3	4	4	2	4	3	2	3	5	5	3	7
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		106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
106	.534681	100														
107	.204406	11	100													
108	6.685724E-02	8	11	100												
109	.390133	9	6	12	100											
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115	.183982	11	8	8	5	10	8	8	8	12	100					
116	.117144	10	7	10	5	9	10	8	8	8	11	100				
117	.231700	6	4	4	3	5	4	5	4	4	5	10	100			
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121	.176196	13	8	8	5	11	9	9	8	8	9	9	5	12	10	10
122	.130418	10	6	8	4	8	9	8	7	7	8	9	4	9	9	7
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124	.133543	6	4	6	3	6	6	5	5	6	6	6	3	6	6	6
125	5.831678E-02	3	4	8	3	4	7	3	6	6	5	6	3	3	7	5
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130	9.135285E-02	6	5	8	3	7	9	5	7	6	6	8	3	6	8	6
131	5.342505E-02	4	5	11	3	5	10	5	8	7	6	8	3	4	9	6
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133	.750038	10	5	4	4	8	4	5	4	4	5	5	3	9	5	6
134	.121599	6	5	7	3	6	7	5	6	6	6	7	3	6	7	6
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137	.223800	7	4	5	3	6	5	5	4	4	5	5	3	6	5	5
138	.158575	6	4	4	2	5	5	4	4	4	4	5	2	6	5	5
139	.252002	6	4	5	3	6	5	4	4	4	5	5	3	6	5	5
140	.284682	5	3	2	2	4	3	3	2	3	3	3	2	5	4	3

		121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
121	.176196	100														
122	.130418	12	100													
123	.103166	10	12	100												
124	.133543	8	8	9	100											
125	5.831678E-02	7	9	10	8	100										
126	.264303	8	7	8	6	39	100									
127	.556980	6	5	4	3	1	4	100								
128	.424234	8	7	7	5	8	6	6	100							
129	.888071	10	8	8	6	4	7	7	7	100						
130	9.135285E-02	9	10	9	7	7	6	1	7	-2	100					
131	5.342505E-02	9	11	12	9	15	6	1	6	2	25	100				
132	9.598414E-02	8	9	10	7	10	6	3	4	4	11	29	100			
133	.750038	7	6	5	4	3	5	5	6	7	5	6	9	100		
134	.121599	8	9	9	7	9	6	4	5	5	12	14	10	5	100	
135	.209174	8	8	7	6	6	6	4	6	6	7	8	7	5	9	100
136	.141342	8	8	9	7	8	6	4	5	5	10	11	9	5	9	9
137	.223800	7	8	7	5	6	5	4	5	6	8	9	7	4	7	6
138	.158575	7	7	7	5	6	5	3	5	5	7	8	7	4	7	6
139	.252002	7	7	7	6	7	5	4	5	5	8	9	7	4	7	6
140	.284682	5	5	4	3	2	4	3	4	4	4	4	4	3	5	5

		136	137	138	139	140
136	.141342	100				
137	.223800	8	100			
138	.158575	7	6	100		
139	.252002	7	6	2	100	
140	.284682	4	4	4	0	100

Table B.5. The averaged scattering cross sections and their uncertainties for the lowest 140 groups of the 238-group structure of the LAW library. The energy boundaries of the groups are given in eV and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00010	15.7036	.124694
(2)	.00010	.00050	15.7017	.124687
(3)	.00050	.00075	15.6993	.124678
(4)	.00075	.00100	15.6974	.124671
(5)	.00100	.00120	15.6957	.124664
(6)	.00120	.00150	15.6938	.124657
(7)	.00150	.00200	15.6908	.124646
(8)	.00200	.00250	15.6871	.124632
(9)	.00250	.00300	15.6834	.124619
(10)	.00300	.00400	15.6778	.124598
(11)	.00400	.00500	15.6705	.124571
(12)	.00500	.00750	15.6579	.124524
(13)	.00750	.01000	15.6403	.124458
(14)	.01000	.02530	15.5828	.124243
(15)	.02530	.03000	15.5236	.124020
(16)	.03000	.04000	15.4837	.123869
(17)	.04000	.05000	15.4320	.123673
(18)	.05000	.06000	15.3830	.123486
(19)	.06000	.07000	15.3361	.123307
(20)	.07000	.08000	15.2910	.123134
(21)	.08000	.09000	15.2474	.122966
(22)	.09000	.10000	15.2052	.122802
(23)	.10000	.12500	15.1342	.122526
(24)	.12500	.15000	15.0371	.122145
(25)	.15000	.17500	14.9443	.121777
(26)	.17500	.20000	14.8559	.121425
(27)	.20000	.22500	14.7761	.121107
(28)	.22500	.25000	14.7161	.120875
(29)	.25000	.27500	14.6943	.120809
(30)	.27500	.30000	14.7139	.120924
(31)	.30000	.32500	14.7405	.121066
(32)	.32500	.35000	14.7390	.121083
(33)	.35000	.37500	14.7081	.120972
(34)	.37500	.40000	14.6611	.120790
(35)	.40000	.45000	14.5805	.120470
(36)	.45000	.50000	14.4730	.120039
(37)	.50000	.55000	14.3710	.119628
(38)	.55000	.60000	14.2750	.119239
(39)	.60000	.62500	14.2061	.118959
(40)	.62500	.65000	14.1615	.118778
(41)	.65000	.70000	14.0964	.118513
(42)	.70000	.75000	14.0117	.118167
(43)	.75000	.80000	13.9289	.117828
(44)	.80000	.85000	13.8469	.117491
(45)	.85000	.90000	13.7648	.117152
(46)	.90000	.92500	13.7026	.116895

(47)	.92500	.95000	13.6608	.116721
(48)	.95000	.97500	13.6188	.116546
(49)	.97500	1.00000	13.5774	.116372
(50)	1.00000	1.01000	13.5494	.116254
(51)	1.01000	1.02000	13.5342	.116189
(52)	1.02000	1.03000	13.5201	.116128
(53)	1.03000	1.04000	13.5073	.116073
(54)	1.04000	1.05000	13.4967	.116026
(55)	1.05000	1.06000	13.4889	.115990
(56)	1.06000	1.07000	13.4851	.115970
(57)	1.07000	1.08000	13.4868	.115972
(58)	1.08000	1.09000	13.4957	.116003
(59)	1.09000	1.10000	13.5139	.116071
(60)	1.10000	1.11000	13.5431	.116186
(61)	1.11000	1.12000	13.5844	.116352
(62)	1.12000	1.13000	13.6373	.116569
(63)	1.13000	1.14000	13.6986	.116825
(64)	1.14000	1.15000	13.7625	.117094
(65)	1.15000	1.17500	13.8548	.117487
(66)	1.17500	1.20000	13.9120	.117735
(67)	1.20000	1.22500	13.8858	.117626
(68)	1.22500	1.25000	13.8203	.117352
(69)	1.25000	1.30000	13.7079	.116882
(70)	1.30000	1.35000	13.5982	.116434
(71)	1.35000	1.40000	13.5130	.116070
(72)	1.40000	1.45000	13.4322	.115731
(73)	1.45000	1.50000	13.3599	.115427
(74)	1.50000	1.59000	13.2692	.115045
(75)	1.59000	1.68000	13.1624	.114591
(76)	1.68000	1.77000	13.0607	.114155
(77)	1.77000	1.86000	12.9562	.113702
(78)	1.86000	1.94000	12.8380	.113182
(79)	1.94000	2.00000	12.6803	.112460
(80)	2.00000	2.12000	12.9200	.113542
(81)	2.12000	2.21000	12.8564	.113295
(82)	2.21000	2.30000	12.7373	.112771
(83)	2.30000	2.38000	12.6505	.112388
(84)	2.38000	2.47000	12.5721	.112040
(85)	2.47000	2.57000	12.4924	.111682
(86)	2.57000	2.67000	12.4001	.111259
(87)	2.67000	2.77000	12.2865	.110747
(88)	2.77000	2.87000	12.1870	.110289
(89)	2.87000	2.97000	12.1173	.109983
(90)	2.97000	3.00000	12.0484	.109683
(91)	3.00000	3.05000	11.9974	.109446
(92)	3.05000	3.15000	11.9801	.109314
(93)	3.15000	3.50000	12.0585	.109702
(94)	3.50000	3.73000	12.1838	.110116
(95)	3.73000	4.00000	12.1781	.110255
(96)	4.00000	4.75000	11.5622	.107424
(97)	4.75000	5.00000	11.6564	.107384

(98)	5.00000	5.40000	11.4260	.106782
(99)	5.40000	6.00000	10.8819	.104207
(100)	6.00000	6.25000	10.0159	9.990100E-02
(101)	6.25000	6.50000	12.4851	.106423
(102)	6.50000	6.75000	12.2876	.110760
(103)	6.75000	7.00000	10.9647	.104544
(104)	7.00000	7.15000	11.4032	.105527
(105)	7.15000	8.10000	10.9326	.104381
(106)	8.10000	9.10000	11.5601	.100660
(107)	9.10000	10.00000	12.4569	.111321
(108)	10.00000	11.50000	10.5325	.102434
(109)	11.50000	11.90000	12.8343	.105857
(110)	11.90000	12.90000	14.4054	.118460
(111)	12.90000	13.75000	11.7983	.108352
(112)	13.75000	14.40000	11.6118	.107150
(113)	14.40000	15.10000	11.6053	.106977
(114)	15.10000	16.00000	10.7330	.102818
(115)	16.00000	17.00000	11.3736	.105431
(116)	17.00000	18.50000	9.97506	9.949439E-02
(117)	18.50000	19.00000	7.91294	8.799483E-02
(118)	19.00000	20.00000	17.3775	.138409
(119)	20.00000	21.00000	10.6213	.101896
(120)	21.00000	22.50000	14.0443	.114459
(121)	22.50000	25.00000	11.7843	.105856
(122)	25.00000	27.50000	11.4739	.106481
(123)	27.50000	30.00000	11.0097	.104299
(124)	30.00000	31.25000	10.0444	9.903515E-02
(125)	31.25000	31.75000	8.98685	9.467514E-02
(126)	31.75000	33.25000	10.2945	9.829318E-02
(127)	33.25000	33.75000	13.5139	.113007
(128)	33.75000	34.60000	11.6381	.101546
(129)	34.60000	35.50000	17.0133	.176684
(130)	35.50000	37.00000	14.6673	.120691
(131)	37.00000	38.00000	11.6747	.107621
(132)	38.00000	39.10000	10.3305	.101093
(133)	39.10000	39.60000	14.7172	.115702
(134)	39.60000	41.00000	12.2672	.110237
(135)	41.00000	42.40000	12.1966	.108222
(136)	42.40000	44.00000	11.5845	.106143
(137)	44.00000	45.20000	11.4996	.106379
(138)	45.20000	47.00000	10.4612	.101247
(139)	47.00000	48.30000	10.8632	.102701
(140)	48.30000	49.20000	11.2384	.104820

Table B.6. The correlation matrix of the scattering cross sections for the lowest 140 groups of the 238-group structure of the LAW library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.124694	100														
2	.124687	100	100													
3	.124678	100	100	100												
4	.124671	100	100	100	100											
5	.124664	100	100	100	100	100										
6	.124657	100	100	100	100	100	100									
7	.124646	100	100	100	100	100	100	100								
8	.124632	100	100	100	100	100	100	100	100							
9	.124619	100	100	100	100	100	100	100	100	100						
10	.124598	100	100	100	100	100	100	100	100	100	100					
11	.124571	100	100	100	100	100	100	100	100	100	100	100				
12	.124524	100	100	100	100	100	100	100	100	100	100	100	100			
13	.124458	100	100	100	100	100	100	100	100	100	100	100	100	100		
14	.124243	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
15	.124020	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
16	.123869	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
17	.123673	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
18	.123486	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
19	.123307	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
20	.123134	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
21	.122966	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
22	.122802	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
23	.122526	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
24	.122145	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
25	.121777	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
26	.121425	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
27	.121107	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
28	.120875	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
29	.120809	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
30	.120924	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
31	.121066	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
32	.121083	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
33	.120972	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
34	.120790	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
35	.120470	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
36	.120039	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
37	.119628	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
38	.119239	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
39	.118959	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
40	.118778	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
41	.118513	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
42	.118167	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
43	.117828	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
44	.117491	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
45	.117152	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
46	.116895	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
47	.116721	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
48	.116546	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
49	.116372	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
50	.116254	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
51	.116189	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
52	.116128	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
53	.116073	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
54	.116026	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
55	.115990	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
56	.115970	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
57	.115972	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
58	.116003	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

59	.116071	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
60	.116186	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
61	.116352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
62	.116569	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
63	.116825	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
64	.117094	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
65	.117487	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
66	.117735	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
67	.117626	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
68	.117352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
69	.116882	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
70	.116434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
71	.116070	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
72	.115731	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
73	.115427	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
74	.115045	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
75	.114591	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
76	.114155	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
77	.113702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
78	.113182	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
79	.112460	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
80	.113542	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
81	.113295	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
82	.112771	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
83	.112388	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
84	.112040	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
85	.111682	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
86	.111259	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
87	.110747	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
88	.110289	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
89	.109983	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
90	.109683	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
91	.109446	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
92	.109314	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
93	.109702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
94	.110116	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95	.110255	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
96	.107424	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
97	.107384	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
98	.106782	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
99	.104207	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	9.990100E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
101	.106423	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
102	.110760	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
103	.104544	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
104	.105527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
105	.104381	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
106	.100660	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
107	.111321	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
108	.102434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
109	.105857	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
110	.118460	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
111	.108352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
112	.107150	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
113	.106977	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
114	.102818	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
115	.105431	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
116	9.949439E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
117	8.799483E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
118	.138409	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
119	.101896	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
120	.114459	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
121	.105856	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
122	.106481	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
123	.104299	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

124	9.903515E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
125	9.467514E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
126	9.829318E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
127	.113007	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
128	.101546	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
129	.176684	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
130	.120691	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
131	.107621	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
132	.101093	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
133	.115702	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
134	.110237	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
135	.108222	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
136	.106143	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
137	.106379	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
138	.101247	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
139	.102701	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
140	.104820	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.123869	100														
17	.123673	100	100													
18	.123486	100	100	100												
19	.123307	100	100	100	100											
20	.123134	100	100	100	100	100										
21	.122966	100	100	100	100	100	100									
22	.122802	100	100	100	100	100	100	100								
23	.122526	100	100	100	100	100	100	100	100							
24	.122145	100	100	100	100	100	100	100	100	100						
25	.121777	100	100	100	100	100	100	100	100	100	100					
26	.121425	100	100	100	100	100	100	100	100	100	100	100				
27	.121107	100	100	100	100	100	100	100	100	100	100	100	100			
28	.120875	100	100	100	100	100	100	100	100	100	100	100	100	100		
29	.120809	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
30	.120924	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
31	.121066	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
32	.121083	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
33	.120972	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
34	.120790	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
35	.120470	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
36	.120039	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
37	.119628	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
38	.119239	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
39	.118959	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
40	.118778	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
41	.118513	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
42	.118167	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
43	.117828	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
44	.117491	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
45	.117152	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
46	.116895	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
47	.116721	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
48	.116546	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
49	.116372	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
50	.116254	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
51	.116189	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
52	.116128	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
53	.116073	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
54	.116026	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
55	.115990	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
56	.115970	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
57	.115972	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
58	.116003	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
59	.116071	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
60	.116186	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
61	.116352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

62	.116569	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
63	.116825	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
64	.117094	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
65	.117487	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
66	.117735	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
67	.117626	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
68	.117352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
69	.116882	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
70	.116434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
71	.116070	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
72	.115731	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
73	.115427	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
74	.115045	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
75	.114591	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
76	.114155	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
77	.113702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
78	.113182	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
79	.112460	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
80	.113542	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
81	.113295	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
82	.112771	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
83	.112388	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
84	.112040	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
85	.111682	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
86	.111259	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
87	.110747	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
88	.110289	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
89	.109983	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
90	.109683	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
91	.109446	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
92	.109314	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
93	.109702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
94	.110116	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95	.110255	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
96	.107424	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
97	.107384	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
98	.106782	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
99	.104207	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	9.990100E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
101	.106423	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
102	.110760	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
103	.104544	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
104	.105527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
105	.104381	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
106	.100660	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
107	.111321	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
108	.102434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
109	.105857	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
110	.118460	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
111	.108352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
112	.107150	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
113	.106977	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
114	.102818	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
115	.105431	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
116	9.949439E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
117	8.799483E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
118	.138409	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
119	.101896	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
120	.114459	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
121	.105856	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
122	.106481	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
123	.104299	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
124	9.903515E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
125	9.467514E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
126	9.829318E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

127	.113007	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
128	.101546	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
129	.176684	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
130	.120691	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
131	.107621	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
132	.101093	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
133	.115702	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
134	.110237	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
135	.108222	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
136	.106143	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
137	.106379	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
138	.101247	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
139	.102701	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
140	.104820	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
31	.121066	100														
32	.121083	100	100													
33	.120972	100	100	100												
34	.120790	100	100	100	100											
35	.120470	100	100	100	100	100										
36	.120039	100	100	100	100	100	100									
37	.119628	100	100	100	100	100	100	100								
38	.119239	100	100	100	100	100	100	100	100							
39	.118959	100	100	100	100	100	100	100	100	100						
40	.118778	100	100	100	100	100	100	100	100	100	100					
41	.118513	100	100	100	100	100	100	100	100	100	100	100				
42	.118167	100	100	100	100	100	100	100	100	100	100	100	100			
43	.117828	100	100	100	100	100	100	100	100	100	100	100	100	100		
44	.117491	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
45	.117152	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
46	.116895	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
47	.116721	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
48	.116546	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
49	.116372	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
50	.116254	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
51	.116189	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
52	.116128	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
53	.116073	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
54	.116026	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
55	.115990	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
56	.115970	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
57	.115972	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
58	.116003	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
59	.116071	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
60	.116186	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
61	.116352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
62	.116569	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
63	.116825	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
64	.117094	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
65	.117487	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
66	.117735	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
67	.117626	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
68	.117352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
69	.116882	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
70	.116434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
71	.116070	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
72	.115731	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
73	.115427	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
74	.115045	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
75	.114591	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
76	.114155	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
77	.113702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
78	.113182	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
79	.112460	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

80	.113542	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
81	.113295	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
82	.112771	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
83	.112388	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
84	.112040	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
85	.111682	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
86	.111259	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
87	.110747	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
88	.110289	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
89	.109983	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
90	.109683	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
91	.109446	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
92	.109314	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
93	.109702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
94	.110116	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95	.110255	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
96	.107424	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
97	.107384	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
98	.106782	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
99	.104207	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	9.990100E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
101	.106423	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
102	.110760	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
103	.104544	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
104	.105527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
105	.104381	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
106	.100660	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
107	.111321	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
108	.102434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
109	.105857	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
110	.118460	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
111	.108352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
112	.107150	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
113	.106977	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
114	.102818	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
115	.105431	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
116	9.949439E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
117	8.799483E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
118	.138409	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
119	.101896	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
120	.114459	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
121	.105856	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
122	.106481	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
123	.104299	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
124	9.903515E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
125	9.467514E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
126	9.829318E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
127	.113007	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
128	.101546	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
129	.176684	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
130	.120691	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
131	.107621	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
132	.101093	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
133	.115702	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
134	.110237	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
135	.108222	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
136	.106143	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
137	.106379	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
138	.101247	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
139	.102701	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
140	.104820	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

		46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
46	.116895	100														
47	.116721	100	100													

48	.116546	100	100	100												
49	.116372	100	100	100	100											
50	.116254	100	100	100	100	100										
51	.116189	100	100	100	100	100	100									
52	.116128	100	100	100	100	100	100	100								
53	.116073	100	100	100	100	100	100	100	100							
54	.116026	100	100	100	100	100	100	100	100	100						
55	.115990	100	100	100	100	100	100	100	100	100	100					
56	.115970	100	100	100	100	100	100	100	100	100	100	100				
57	.115972	100	100	100	100	100	100	100	100	100	100	100	100			
58	.116003	100	100	100	100	100	100	100	100	100	100	100	100	100		
59	.116071	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
60	.116186	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
61	.116352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
62	.116569	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
63	.116825	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
64	.117094	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
65	.117487	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
66	.117735	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
67	.117626	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
68	.117352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
69	.116882	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
70	.116434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
71	.116070	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
72	.115731	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
73	.115427	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
74	.115045	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
75	.114591	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
76	.114155	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
77	.113702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
78	.113182	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
79	.112460	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
80	.113542	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
81	.113295	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
82	.112771	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
83	.112388	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
84	.112040	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
85	.111682	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
86	.111259	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
87	.110747	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
88	.110289	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
89	.109983	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
90	.109683	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
91	.109446	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
92	.109314	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
93	.109702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
94	.110116	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95	.110255	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
96	.107424	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
97	.107384	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
98	.106782	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
99	.104207	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	9.990100E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
101	.106423	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
102	.110760	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
103	.104544	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
104	.105527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
105	.104381	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
106	.100660	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
107	.111321	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
108	.102434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
109	.105857	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
110	.118460	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
111	.108352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
112	.107150	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

113	.106977	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
114	.102818	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
115	.105431	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
116	9.949439E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
117	8.799483E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
118	.138409	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
119	.101896	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
120	.114459	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
121	.105856	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
122	.106481	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
123	.104299	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
124	9.903515E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
125	9.467514E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
126	9.829318E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
127	.113007	81	81	81	80	80	80	80	80	80	80	80	80	80	80	80
128	.101546	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
129	.176684	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
130	.120691	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
131	.107621	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
132	.101093	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
133	.115702	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
134	.110237	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
135	.108222	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
136	.106143	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
137	.106379	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
138	.101247	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
139	.102701	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
140	.104820	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

		61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
61	.116352	100														
62	.116569	100	100													
63	.116825	100	100	100												
64	.117094	100	100	100	100											
65	.117487	100	100	100	100	100										
66	.117735	100	100	100	100	100	100									
67	.117626	100	100	100	100	100	100	100								
68	.117352	100	100	100	100	100	100	100	100							
69	.116882	100	100	100	100	100	100	100	100	100						
70	.116434	100	100	100	100	100	100	100	100	100	100					
71	.116070	100	100	100	100	100	100	100	100	100	100	100				
72	.115731	100	100	100	100	100	100	100	100	100	100	100	100			
73	.115427	100	100	100	100	100	100	100	100	100	100	100	100	100		
74	.115045	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
75	.114591	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
76	.114155	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
77	.113702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
78	.113182	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
79	.112460	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
80	.113542	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
81	.113295	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
82	.112771	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
83	.112388	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
84	.112040	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
85	.111682	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
86	.111259	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
87	.110747	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
88	.110289	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
89	.109983	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
90	.109683	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
91	.109446	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
92	.109314	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
93	.109702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
94	.110116	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95	.110255	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

96	.107424	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
97	.107384	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
98	.106782	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
99	.104207	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	9.990100E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
101	.106423	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
102	.110760	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
103	.104544	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
104	.105527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
105	.104381	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
106	.100660	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
107	.111321	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
108	.102434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
109	.105857	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
110	.118460	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
111	.108352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
112	.107150	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
113	.106977	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
114	.102818	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
115	.105431	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
116	9.949439E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
117	8.799483E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
118	.138409	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
119	.101896	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
120	.114459	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
121	.105856	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
122	.106481	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
123	.104299	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
124	9.903515E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
125	9.467514E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
126	9.829318E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
127	.113007	80	80	80	81	81	81	81	81	81	81	81	81	81	81	81
128	.101546	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
129	.176684	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
130	.120691	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
131	.107621	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
132	.101093	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
133	.115702	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
134	.110237	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
135	.108222	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
136	.106143	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
137	.106379	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
138	.101247	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
139	.102701	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
140	.104820	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

		76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
76	.114155	100														
77	.113702	100	100													
78	.113182	100	100	100												
79	.112460	100	100	100	100											
80	.113542	100	100	100	100	100										
81	.113295	100	100	100	100	100	100									
82	.112771	100	100	100	100	100	100	100								
83	.112388	100	100	100	100	100	100	100	100							
84	.112040	100	100	100	100	100	100	100	100	100						
85	.111682	100	100	100	100	100	100	100	100	100	100					
86	.111259	100	100	100	100	100	100	100	100	100	100	100				
87	.110747	100	100	100	100	100	100	100	100	100	100	100	100			
88	.110289	100	100	100	100	100	100	100	100	100	100	100	100	100		
89	.109983	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
90	.109683	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
91	.109446	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
92	.109314	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
93	.109702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

94	.110116	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95	.110255	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
96	.107424	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
97	.107384	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
98	.106782	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
99	.104207	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	9.990100E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
101	.106423	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
102	.110760	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
103	.104544	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
104	.105527	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
105	.104381	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
106	.100660	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
107	.111321	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
108	.102434	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
109	.105857	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
110	.118460	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
111	.108352	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
112	.107150	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
113	.106977	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
114	.102818	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
115	.105431	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
116	9.949439E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
117	8.799483E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
118	.138409	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
119	.101896	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
120	.114459	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
121	.105856	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
122	.106481	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
123	.104299	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
124	9.903515E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
125	9.467514E-02	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
126	9.829318E-02	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
127	.113007	81	81	80	80	81	81	81	80	80	80	80	80	80	80	80
128	.101546	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
129	.176684	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
130	.120691	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
131	.107621	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
132	.101093	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
133	.115702	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
134	.110237	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
135	.108222	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
136	.106143	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
137	.106379	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
138	.101247	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
139	.102701	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
140	.104820	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

		91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
91	.109446	100														
92	.109314	100	100													
93	.109702	100	100	100												
94	.110116	100	100	100	100											
95	.110255	100	100	100	100	100										
96	.107424	100	100	100	100	100	100									
97	.107384	100	100	100	100	100	100	100								
98	.106782	100	100	100	100	100	100	100	100							
99	.104207	100	100	100	100	100	100	100	100	100						
100	9.990100E-02	100	100	100	100	100	100	100	100	100	100					
101	.106423	99	99	99	99	99	99	99	99	99	98	100				
102	.110760	100	100	100	100	100	100	100	100	100	100	99	100			
103	.104544	100	100	100	100	100	100	100	100	100	100	99	100	100		
104	.105527	100	100	100	100	100	100	100	100	100	100	99	100	100	100	
105	.104381	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
106	.100660	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99

107	.111321	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
108	.102434	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
109	.105857	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
110	.118460	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
111	.108352	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
112	.107150	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
113	.106977	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
114	.102818	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
115	.105431	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
116	9.949439E-02	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
117	8.799483E-02	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99
118	.138409	80	80	80	80	80	80	80	80	79	79	80	80	80	80	80
119	.101896	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
120	.114459	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
121	.105856	100	100	100	100	100	100	100	100	100	99	99	100	100	100	100
122	.106481	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
123	.104299	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
124	9.903515E-02	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
125	9.467514E-02	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
126	9.829318E-02	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99
127	.113007	80	80	80	80	80	80	81	80	80	80	80	81	80	81	80
128	.101546	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
129	.176684	61	61	61	61	61	61	61	61	60	60	60	61	61	61	61
130	.120691	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99
131	.107621	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
132	.101093	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
133	.115702	86	86	86	86	86	86	86	86	86	85	85	86	86	86	86
134	.110237	100	100	100	100	100	100	100	100	100	99	99	100	100	100	100
135	.108222	97	97	97	97	97	97	97	97	97	96	96	97	97	97	97
136	.106143	100	100	100	100	100	100	100	100	100	99	99	100	100	100	100
137	.106379	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
138	.101247	100	100	100	100	100	100	100	100	100	100	99	100	100	100	100
139	.102701	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99
140	.104820	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99

		106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
106	.100660	100														
107	.111321	100	100													
108	.102434	99	100	100												
109	.105857	95	95	95	100											
110	.118460	90	90	90	87	100										
111	.108352	99	100	100	96	91	100									
112	.107150	99	100	100	95	91	100	100								
113	.106977	99	100	100	95	91	100	100	100							
114	.102818	99	100	100	95	90	100	100	100	100						
115	.105431	99	100	100	95	90	100	100	100	100	100					
116	9.949439E-02	99	100	100	95	90	100	100	100	100	100	100				
117	8.799483E-02	98	99	99	94	89	99	99	99	99	99	99	100			
118	.138409	80	80	79	77	73	80	80	80	80	80	80	82	100		
119	.101896	99	100	100	95	90	100	100	100	100	100	100	98	80	100	
120	.114459	98	98	98	95	89	98	98	98	98	98	98	97	80	97	100
121	.105856	99	100	100	95	90	100	100	100	100	100	100	98	80	99	98
122	.106481	99	100	100	95	90	100	100	100	100	100	100	99	80	100	98
123	.104299	99	100	100	95	90	100	100	100	100	100	100	99	80	100	98
124	9.903515E-02	99	100	100	95	90	100	100	100	100	100	100	99	80	100	98
125	9.467514E-02	99	100	100	95	90	100	100	100	100	100	100	99	79	100	98
126	9.829318E-02	99	99	99	95	90	99	99	99	99	99	99	98	79	99	98
127	.113007	80	81	80	78	74	81	81	81	80	81	80	79	66	80	80
128	.101546	89	89	89	86	81	89	89	89	89	89	89	88	73	89	88
129	.176684	61	61	60	59	56	61	61	61	60	61	60	59	51	60	61
130	.120691	99	99	99	95	90	99	99	99	99	99	99	98	80	99	98
131	.107621	99	100	100	95	90	100	100	100	100	100	100	99	80	100	98
132	.101093	99	100	100	95	90	100	100	100	100	100	100	99	80	100	98
133	.115702	86	86	86	83	79	86	86	86	86	86	86	84	70	86	85
134	.110237	99	100	100	95	90	100	100	100	100	100	100	99	80	99	98

135	.108222	96	97	97	93	88	97	97	97	97	97	97	95	78	96	95
136	.106143	99	100	100	95	90	100	100	100	100	100	100	99	80	99	98
137	.106379	99	100	100	95	90	100	100	100	100	100	100	99	80	100	98
138	.101247	99	100	100	95	90	100	100	100	100	100	100	99	80	100	98
139	.102701	99	99	99	95	90	99	99	99	99	99	99	98	80	99	98
140	.104820	99	99	99	95	90	99	99	99	99	99	99	98	80	99	98

		121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
121	.105856	100														
122	.106481	100	100													
123	.104299	100	100	100												
124	9.903515E-02	100	100	100	100											
125	9.467514E-02	99	100	100	100	100										
126	9.829318E-02	99	99	99	99	99	100									
127	.113007	81	81	80	80	80	79	100								
128	.101546	89	89	89	89	89	88	75	100							
129	.176684	61	60	60	60	59	59	50	60	100						
130	.120691	99	99	99	99	99	98	81	90	66	100					
131	.107621	100	100	100	100	100	99	81	90	63	100	100				
132	.101093	100	100	100	100	100	99	81	89	62	100	100	100			
133	.115702	86	86	86	86	85	85	71	78	54	86	85	84	100		
134	.110237	99	100	100	100	99	99	81	89	61	99	100	99	88	100	
135	.108222	97	97	97	97	96	96	79	87	59	96	97	96	84	96	100
136	.106143	99	100	100	100	99	99	81	89	61	99	100	99	86	99	97
137	.106379	100	100	100	100	100	99	81	89	61	99	100	100	86	100	97
138	.101247	100	100	100	100	100	99	81	89	61	99	100	100	86	100	97
139	.102701	99	99	99	99	99	98	80	89	61	99	99	99	86	99	96
140	.104820	99	99	99	99	99	98	80	89	61	99	99	99	86	99	96

		136	137	138	139	140
136	.106143	100				
137	.106379	100	100			
138	.101247	100	100	100		
139	.102701	99	99	99	100	
140	.104820	99	99	99	99	100

Table B.7. The averaged total cross sections and their uncertainties for the lowest 140 groups of the 238-group structure of the LAW library. The energy boundaries of the groups are given in eV, and the cross sections in barns.

	E-min	E-max	theory	uncertainty
(1)	.00001	.00010	19728.9	19.8470
(2)	.00010	.00050	7412.70	7.44156
(3)	.00050	.00075	4816.48	4.82942
(4)	.00075	.00100	4057.83	4.06719
(5)	.00100	.00120	3611.28	3.61897
(6)	.00120	.00150	3259.09	3.26581
(7)	.00150	.00200	2861.92	2.86806
(8)	.00200	.00250	2517.39	2.52360
(9)	.00250	.00300	2272.20	2.27894
(10)	.00300	.00400	2012.29	2.02023
(11)	.00400	.00500	1767.08	1.77689
(12)	.00500	.00750	1496.55	1.50971
(13)	.00750	.01000	1252.12	1.26974
(14)	.01000	.02530	882.123	.910199
(15)	.02530	.03000	669.804	.706162
(16)	.03000	.04000	585.990	.626631
(17)	.04000	.05000	504.397	.550419
(18)	.05000	.06000	446.209	.497451
(19)	.06000	.07000	402.235	.458823
(20)	.07000	.08000	367.714	.429980
(21)	.08000	.09000	339.892	.408344
(22)	.09000	.10000	317.050	.392370
(23)	.10000	.12500	286.454	.375924
(24)	.12500	.15000	255.514	.371633
(25)	.15000	.17500	236.526	.388536
(26)	.17500	.20000	227.622	.424627
(27)	.20000	.22500	228.685	.477084
(28)	.22500	.25000	239.095	.551753
(29)	.25000	.27500	252.645	.663294
(30)	.27500	.30000	254.721	.733755
(31)	.30000	.32500	236.661	.680048
(32)	.32500	.35000	207.892	.576550
(33)	.35000	.37500	180.560	.475008
(34)	.37500	.40000	158.890	.388404
(35)	.40000	.45000	136.250	.296860
(36)	.45000	.50000	116.405	.227177
(37)	.50000	.55000	103.540	.192573
(38)	.55000	.60000	94.5352	.174753
(39)	.60000	.62500	89.3568	.167001
(40)	.62500	.65000	86.5328	.163612
(41)	.65000	.70000	83.0571	.160412
(42)	.70000	.75000	79.5218	.158777
(43)	.75000	.80000	77.2093	.159988
(44)	.80000	.85000	76.1771	.164505
(45)	.85000	.90000	76.7193	.173789
(46)	.90000	.92500	78.4573	.185511

(47)	.92500	.95000	80.6175	.197101
(48)	.95000	.97500	83.8380	.213084
(49)	.97500	1.00000	88.5123	.235532
(50)	1.00000	1.01000	92.8604	.256652
(51)	1.01000	1.02000	95.9267	.271663
(52)	1.02000	1.03000	99.4569	.289315
(53)	1.03000	1.04000	103.511	.310208
(54)	1.04000	1.05000	108.149	.335086
(55)	1.05000	1.06000	113.420	.364837
(56)	1.06000	1.07000	119.345	.400437
(57)	1.07000	1.08000	125.892	.442774
(58)	1.08000	1.09000	132.932	.492254
(59)	1.09000	1.10000	140.180	.548093
(60)	1.10000	1.11000	147.133	.607340
(61)	1.11000	1.12000	153.026	.664040
(62)	1.12000	1.13000	156.884	.709452
(63)	1.13000	1.14000	157.698	.734328
(64)	1.14000	1.15000	154.763	.732866
(65)	1.15000	1.17500	140.320	.661175
(66)	1.17500	1.20000	110.863	.515795
(67)	1.20000	1.22500	83.8634	.374708
(68)	1.22500	1.25000	65.1838	.282812
(69)	1.25000	1.30000	50.9968	.210409
(70)	1.30000	1.35000	44.7571	.196498
(71)	1.35000	1.40000	39.1576	.142638
(72)	1.40000	1.45000	35.9614	.116896
(73)	1.45000	1.50000	34.1326	.111479
(74)	1.50000	1.59000	32.5680	.109598
(75)	1.59000	1.68000	31.2625	.108947
(76)	1.68000	1.77000	30.4482	.108662
(77)	1.77000	1.86000	30.2186	.108625
(78)	1.86000	1.94000	31.7128	.110395
(79)	1.94000	2.00000	42.2462	.142038
(80)	2.00000	2.12000	74.6926	.320004
(81)	2.12000	2.21000	30.0519	.111768
(82)	2.21000	2.30000	26.9397	.108019
(83)	2.30000	2.38000	25.8349	.107216
(84)	2.38000	2.47000	25.0957	.106951
(85)	2.47000	2.57000	24.3677	.107360
(86)	2.57000	2.67000	23.3478	.109746
(87)	2.67000	2.77000	23.5353	.116711
(88)	2.77000	2.87000	31.9227	.127408
(89)	2.87000	2.97000	36.3740	.124919
(90)	2.97000	3.00000	40.2922	.127170
(91)	3.00000	3.05000	45.9225	.137398
(92)	3.05000	3.15000	70.6214	.245032
(93)	3.15000	3.50000	47.8251	.128337
(94)	3.50000	3.73000	107.671	.464192
(95)	3.73000	4.00000	21.1819	.109250
(96)	4.00000	4.75000	18.6905	.104886
(97)	4.75000	5.00000	106.587	.550075

(98)	5.00000	5.40000	23.6883	.107636
(99)	5.40000	6.00000	31.4477	.109173
(100)	6.00000	6.25000	67.3211	.200099
(101)	6.25000	6.50000	334.794	1.33831
(102)	6.50000	6.75000	35.7961	.122385
(103)	6.75000	7.00000	32.1078	.116819
(104)	7.00000	7.15000	193.310	.979426
(105)	7.15000	8.10000	22.0331	.105918
(106)	8.10000	9.10000	248.842	.600984
(107)	9.10000	10.00000	78.7465	.232088
(108)	10.00000	11.50000	34.0729	.111068
(109)	11.50000	11.90000	254.579	.982869
(110)	11.90000	12.90000	221.662	.592110
(111)	12.90000	13.75000	47.0523	.130579
(112)	13.75000	14.40000	89.3826	.245490
(113)	14.40000	15.10000	46.3915	.174841
(114)	15.10000	16.00000	51.7882	.186410
(115)	16.00000	17.00000	85.4104	.266867
(116)	17.00000	18.50000	43.7330	.150414
(117)	18.50000	19.00000	55.3847	.390805
(118)	19.00000	20.00000	321.145	.864709
(119)	20.00000	21.00000	59.9749	.171382
(120)	21.00000	22.50000	94.6480	.323953
(121)	22.50000	25.00000	101.792	.250712
(122)	25.00000	27.50000	59.4917	.165380
(123)	27.50000	30.00000	42.8263	.161342
(124)	30.00000	31.25000	49.1250	.211146
(125)	31.25000	31.75000	17.1790	.113994
(126)	31.75000	33.25000	86.2774	.309351
(127)	33.25000	33.75000	218.583	.880314
(128)	33.75000	34.60000	168.250	.585340
(129)	34.60000	35.50000	347.221	.966520
(130)	35.50000	37.00000	43.0081	.147318
(131)	37.00000	38.00000	23.6444	.113579
(132)	38.00000	39.10000	31.8613	.132748
(133)	39.10000	39.60000	240.952	.960592
(134)	39.60000	41.00000	45.9746	.136425
(135)	41.00000	42.40000	92.2861	.308195
(136)	42.40000	44.00000	56.6990	.211372
(137)	44.00000	45.20000	70.0688	.259038
(138)	45.20000	47.00000	46.2692	.206901
(139)	47.00000	48.30000	72.2872	.323867
(140)	48.30000	49.20000	73.3781	.342301

Table B.8. The correlation matrix of the total cross sections for the lowest 140 groups of the 238- group structure of the LAW library. The absolute errors are given in column 2 of the table, and the correlation coefficients (×100) follow.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	19.8470	100														
2	7.44156	100	100													
3	4.82942	100	100	100												
4	4.06719	100	100	100	100											
5	3.61897	100	100	100	100	100										
6	3.26581	100	100	100	100	100	100									
7	2.86806	100	100	100	100	100	100	100								
8	2.52360	100	100	100	100	100	100	100	100							
9	2.27894	100	100	100	100	100	100	100	100	100						
10	2.02023	100	100	100	100	100	100	100	100	100	100					
11	1.77689	100	100	100	100	100	100	100	100	100	100	100				
12	1.50971	100	100	100	100	100	100	100	100	100	100	100	100			
13	1.26974	100	100	100	100	100	100	100	100	100	100	100	100	100		
14	.910199	99	99	99	99	99	99	99	100	100	100	100	100	100	100	
15	.706162	98	98	99	99	99	99	99	99	99	99	99	99	100	100	100
16	.626631	98	98	98	98	98	98	98	98	98	99	99	99	99	100	100
17	.550419	97	97	97	97	97	97	97	98	98	98	98	98	99	99	100
18	.497451	95	96	96	96	96	96	96	96	97	97	97	97	98	98	99
19	.458823	94	94	95	95	95	95	95	95	95	96	96	96	97	98	99
20	.429980	92	93	93	93	93	93	94	94	94	94	94	95	95	96	98
21	.408344	91	91	91	91	91	92	92	92	92	92	93	93	94	95	96
22	.392370	89	89	89	89	89	90	90	90	90	90	91	91	92	93	95
23	.375924	84	85	85	85	85	85	85	86	86	86	86	87	88	89	91
24	.371633	76	77	77	77	77	78	78	78	78	79	79	79	80	82	85
25	.388536	68	68	68	68	69	69	69	69	69	70	70	71	72	74	76
26	.424627	59	59	60	60	60	60	60	61	61	61	61	62	63	65	68
27	.477084	52	53	53	53	53	53	54	54	54	54	55	55	56	58	60
28	.551753	48	48	49	49	49	49	49	49	49	50	50	50	51	52	54
29	.663294	44	44	45	45	45	45	45	45	45	45	45	46	46	47	48
30	.733755	42	42	42	42	42	42	43	43	43	43	43	43	44	44	45
31	.680048	41	41	42	42	42	42	42	42	42	42	43	43	43	45	46
32	.576550	40	40	41	41	41	41	41	41	41	42	42	42	43	45	47
33	.475008	40	40	40	41	41	41	41	41	41	42	42	42	43	45	48
34	.388404	41	42	42	42	42	42	43	43	43	43	44	44	45	47	50
35	.296860	46	46	46	47	47	47	47	47	48	48	48	49	50	52	55
36	.227177	51	52	52	53	53	53	53	54	54	54	55	56	57	59	62
37	.192573	55	56	56	56	57	57	57	58	58	58	59	60	61	63	66
38	.174753	56	57	58	58	58	59	59	59	60	60	61	62	63	65	68
39	.167001	57	57	58	58	59	59	59	60	60	60	61	62	63	65	68
40	.163612	56	57	58	58	58	59	59	59	60	60	61	62	63	65	68
41	.160412	56	57	57	58	58	58	59	59	59	60	60	61	62	65	67
42	.158777	55	55	56	56	57	57	57	58	58	59	59	60	61	64	66
43	.159988	53	54	55	55	55	55	56	56	57	57	58	59	60	62	65
44	.164505	51	52	52	53	53	53	54	54	54	55	56	56	57	60	62
45	.173789	48	49	49	50	50	50	51	51	51	52	52	53	54	57	59
46	.185511	45	46	46	46	47	47	47	48	48	48	49	50	51	53	55
47	.197101	42	43	43	43	44	44	44	44	45	45	46	46	47	50	52
48	.213084	38	39	39	40	40	40	40	41	41	41	42	42	43	45	48
49	.235532	33	34	34	35	35	35	35	36	36	36	37	37	38	40	42
50	.256652	29	30	30	30	31	31	31	31	32	32	32	33	34	35	37
51	.271663	27	27	27	28	28	28	28	28	29	29	29	30	31	32	34
52	.289315	24	24	25	25	25	25	25	25	26	26	26	27	27	29	31
53	.310208	21	21	21	22	22	22	22	22	22	23	23	23	24	26	27
54	.335086	17	18	18	18	18	18	19	19	19	19	19	20	20	22	23
55	.364837	14	14	15	15	15	15	15	15	15	16	16	16	17	18	19
56	.400437	11	11	11	11	11	11	11	12	12	12	12	13	13	14	15
57	.442774	7	8	8	8	8	8	8	8	8	9	9	9	9	10	12
58	.492254	4	5	5	5	5	5	5	5	5	5	6	6	6	7	8

59	.548093	2	2	3	3	3	3	3	3	3	3	3	3	4	4	5
60	.607340	1	1	1	1	1	1	1	1	2	2	2	2	2	3	4
61	.664040	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3
62	.709452	2	2	2	2	2	2	2	2	2	2	2	3	3	3	4
63	.734328	4	4	4	4	4	4	4	4	5	5	5	5	5	5	6
64	.732866	7	7	7	8	8	8	8	8	8	8	8	8	8	9	9
65	.661175	14	14	14	14	14	14	14	14	14	14	15	15	15	16	16
66	.515795	19	19	19	20	20	20	20	20	20	20	20	21	21	22	23
67	.374708	17	18	18	18	18	18	18	19	19	19	19	20	20	21	23
68	.282812	11	11	11	12	12	12	12	12	12	13	13	14	14	16	17
69	.210409	7	7	7	8	8	8	8	9	9	9	10	10	11	13	15
70	.196498	6	6	7	7	7	8	8	8	8	9	9	10	11	13	15
71	.142638	6	7	7	8	8	8	9	9	9	10	11	11	13	15	18
72	.116896	5	6	7	8	8	8	9	9	10	10	11	12	14	17	21
73	.111479	5	6	7	7	8	8	9	9	10	10	11	12	14	17	21
74	.109598	5	6	7	8	8	8	9	9	10	11	11	13	14	18	21
75	.108947	6	7	8	8	8	9	9	10	10	11	12	13	14	18	22
76	.108662	6	7	8	8	9	9	9	10	11	11	12	13	15	18	22
77	.108625	6	7	7	8	8	9	9	10	10	11	12	13	14	18	21
78	.110395	4	5	6	6	7	7	7	8	8	9	10	11	12	16	20
79	.142038	0	0	1	1	2	2	2	3	3	3	4	5	6	9	12
80	.320004	9	10	10	10	10	11	11	11	11	11	12	12	13	14	15
81	.111768	2	3	4	4	5	5	5	6	6	7	8	9	10	14	18
82	.108019	3	4	5	6	6	6	7	7	8	9	9	11	12	16	19
83	.107216	3	4	5	6	6	6	7	7	8	9	9	11	12	16	19
84	.106951	3	4	4	5	5	6	6	7	7	8	9	10	11	15	19
85	.107360	1	2	3	4	4	4	5	5	6	6	7	8	10	13	17
86	.109746	-2	-1	0	1	1	1	2	2	3	3	4	5	7	10	14
87	.116711	-3	-2	-1	-1	0	0	1	1	2	2	3	4	5	9	12
88	.127408	2	3	3	4	4	4	5	5	5	6	7	8	9	12	15
89	.124919	0	1	2	2	2	3	3	3	4	5	5	6	8	11	14
90	.127170	-1	0	1	1	2	2	2	3	3	4	4	6	7	10	13
91	.137398	0	0	1	1	2	2	2	3	3	4	4	5	6	9	12
92	.245032	8	9	9	9	9	9	10	10	10	10	11	11	12	13	15
93	.128337	5	6	6	7	7	7	8	8	9	9	10	11	12	15	18
94	.464192	5	5	5	5	6	6	6	6	6	6	6	7	7	8	9
95	.109250	-6	-5	-4	-4	-4	-3	-3	-2	-2	-1	0	1	2	6	10
96	.104886	-5	-4	-3	-3	-3	-2	-2	-1	-1	0	1	2	4	7	11
97	.550075	1	1	1	2	2	2	2	2	2	2	2	3	3	4	4
98	.107636	-2	-1	0	0	0	1	1	2	2	3	4	5	6	10	14
99	.109173	-7	-6	-6	-5	-5	-5	-4	-4	-3	-2	-2	0	1	5	8
100	.200099	2	2	3	3	3	3	4	4	4	5	5	6	6	8	10
101	1.33831	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
102	.122385	-3	-2	-1	-1	0	0	0	1	1	2	3	4	5	8	11
103	.116819	-5	-4	-3	-3	-3	-2	-2	-1	-1	0	0	1	3	6	10
104	.979426	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4
105	.105918	-4	-3	-2	-2	-2	-1	-1	0	0	1	2	3	4	8	12
106	.600984	7	7	7	7	7	7	7	8	8	8	8	8	8	9	10
107	.232088	1	2	2	2	3	3	3	3	3	4	4	5	5	7	9
108	.111068	-5	-4	-3	-3	-3	-2	-2	-1	-1	0	1	2	3	7	10
109	.982869	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2
110	.592110	4	4	4	5	5	5	5	5	5	5	5	5	6	6	7
111	.130579	-3	-2	-1	-1	-1	0	0	0	1	1	2	3	4	7	10
112	.245490	0	0	1	1	1	1	2	2	2	2	3	3	4	5	7
113	.174841	-4	-3	-3	-2	-2	-2	-2	-1	-1	-1	0	1	2	4	6
114	.186410	-4	-3	-3	-2	-2	-2	-2	-1	-1	-1	0	0	1	3	5
115	.266867	-3	-2	-2	-2	-1	-1	-1	-1	-1	0	0	0	1	2	4
116	.150414	-2	-1	-1	0	0	0	0	1	1	2	2	3	4	6	9
117	.390805	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	1	2
118	.864709	5	5	5	5	5	5	5	5	5	6	6	6	6	6	7
119	.171382	-3	-2	-2	-2	-1	-1	-1	-1	0	0	1	1	2	4	7
120	.323953	-2	-1	-1	-1	-1	-1	-1	0	0	0	0	1	1	2	3
121	.250712	-2	-2	-1	-1	-1	-1	-1	0	0	0	0	1	1	3	5
122	.165380	-4	-4	-3	-3	-3	-3	-2	-2	-2	-1	-1	0	1	4	6
123	.161342	-7	-7	-6	-6	-6	-6	-5	-5	-5	-4	-4	-3	-2	1	3

124	.211146	-5	-5	-4	-4	-4	-4	-4	-3	-3	-3	-2	-2	-1	1	3
125	.113994	-8	-7	-6	-6	-6	-5	-5	-4	-4	-3	-2	-1	0	3	7
126	.309351	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	0	0	0	2	3
127	.880314	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2
128	.585340	-1	0	0	0	0	0	0	0	0	0	0	1	1	2	2
129	.966520	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	1
130	.147318	-6	-6	-5	-5	-4	-4	-4	-3	-3	-3	-2	-1	0	3	5
131	.113579	-10	-9	-9	-8	-8	-7	-7	-6	-6	-5	-5	-4	-2	1	5
132	.132748	-7	-6	-6	-5	-5	-5	-4	-4	-3	-3	-2	-1	0	3	6
133	.960592	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
134	.136425	-7	-6	-6	-5	-5	-5	-5	-4	-4	-3	-3	-2	0	2	5
135	.308195	-4	-3	-3	-3	-3	-3	-2	-2	-2	-2	-2	-1	-1	1	2
136	.211372	-6	-5	-5	-5	-4	-4	-4	-4	-3	-3	-3	-2	-1	0	2
137	.259038	-4	-4	-4	-3	-3	-3	-3	-3	-2	-2	-2	-1	-1	1	2
138	.206901	-4	-4	-3	-3	-3	-3	-2	-2	-2	-2	-1	-1	0	2	4
139	.323867	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	-2	-2	-1	0	1
140	.342301	-3	-3	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	0	1	2

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16	.626631	100														
17	.550419	100	100													
18	.497451	100	100	100												
19	.458823	99	100	100	100											
20	.429980	98	99	100	100	100										
21	.408344	97	98	99	99	100	100									
22	.392370	96	97	98	99	99	100	100								
23	.375924	93	94	96	97	98	99	100	100							
24	.371633	86	88	90	92	94	95	97	99	100						
25	.388536	78	81	83	85	88	90	92	95	99	100					
26	.424627	70	72	75	77	80	82	85	89	95	98	100				
27	.477084	62	64	66	69	71	74	76	81	87	92	97	100			
28	.551753	55	56	58	59	61	63	64	67	72	77	84	94	100		
29	.663294	48	49	49	49	50	50	50	50	51	53	59	72	90	100	
30	.733755	45	45	45	45	45	45	44	43	41	39	40	49	69	91	100
31	.680048	46	47	48	49	49	49	49	48	46	42	39	40	49	69	90
32	.576550	48	49	51	53	54	55	56	57	56	53	47	41	37	45	68
33	.475008	49	51	53	55	57	59	61	63	64	62	56	45	32	29	47
34	.388404	52	54	56	58	61	63	65	67	69	68	62	50	32	21	33
35	.296860	57	59	61	64	66	68	70	72	74	73	67	55	36	19	24
36	.227177	63	65	68	69	71	73	74	76	77	75	70	59	40	21	20
37	.192573	67	69	71	73	74	75	76	77	77	74	68	59	43	25	21
38	.174753	69	71	72	74	75	76	76	76	75	71	66	57	44	28	23
39	.167001	69	71	72	74	74	75	75	75	73	69	63	55	44	30	24
40	.163612	69	71	72	73	74	75	75	74	72	68	62	54	43	30	25
41	.160412	69	70	72	73	73	74	74	73	70	66	60	52	43	31	26
42	.158777	68	69	70	71	72	72	72	71	68	63	57	50	42	32	27
43	.159988	66	68	69	70	70	70	70	69	66	61	55	48	41	32	28
44	.164505	64	65	66	67	68	68	68	67	64	58	52	46	39	32	28
45	.173789	60	62	63	64	64	64	64	63	60	55	49	43	37	31	28
46	.185511	57	58	59	60	60	61	61	60	57	52	46	40	35	30	27
47	.197101	53	54	56	56	57	57	57	56	54	49	44	38	33	28	27
48	.213084	49	50	51	52	53	53	53	52	50	46	41	36	31	27	25
49	.235532	43	44	45	46	47	47	47	47	45	42	37	33	28	25	24
50	.256652	38	40	41	41	42	43	43	43	41	38	34	30	26	23	23
51	.271663	35	36	37	38	39	39	40	40	38	36	32	28	25	22	22
52	.289315	32	33	34	35	36	36	36	37	35	33	30	26	23	21	21
53	.310208	28	29	30	31	32	32	33	33	32	30	28	25	22	19	19
54	.335086	24	25	26	27	28	29	29	29	29	27	25	22	20	18	18
55	.364837	20	21	22	23	24	24	25	25	25	24	22	20	18	17	17
56	.400437	16	17	18	19	20	20	21	21	22	21	20	18	16	15	15
57	.442774	12	13	14	15	16	16	17	17	18	18	17	16	15	14	14
58	.492254	9	10	10	11	12	12	13	14	14	15	14	14	13	12	13
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77	.108625	61	57	52	47	43	41	38	36	33	31	28	26	23	21	20
78	.110395	60	56	52	46	43	40	38	35	33	30	27	25	22	20	19
79	.142038	48	45	42	39	36	34	32	30	28	25	23	20	18	16	14
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81	.111768	59	55	51	46	43	40	38	36	33	30	28	25	22	20	18
82	.108019	60	57	52	47	43	41	39	36	33	31	28	25	23	21	19
83	.107216	61	57	53	48	44	41	39	36	33	30	28	25	23	20	19
84	.106951	61	57	53	48	44	41	39	36	33	30	28	25	22	20	18
85	.107360	60	56	52	47	43	41	38	36	33	30	27	25	22	20	18
86	.109746	58	55	51	46	42	40	38	35	32	30	27	24	22	19	17
87	.116711	54	51	47	43	39	37	35	33	30	28	25	23	21	18	17
88	.127408	51	48	45	41	37	35	33	31	29	26	24	22	20	18	16
89	.124919	52	49	46	41	38	36	34	31	29	27	24	22	20	18	16
90	.127170	52	49	45	41	38	36	34	31	29	27	24	22	19	17	16
91	.137398	49	46	43	39	36	34	32	30	28	26	23	21	19	17	15
92	.245032	32	30	28	26	24	23	22	21	20	18	17	16	14	13	12
93	.128337	54	51	47	43	40	38	36	34	31	29	26	24	22	20	18
94	.464192	19	18	17	17	16	15	15	14	14	13	13	12	11	11	10
95	.109250	56	53	49	45	41	39	37	34	32	29	27	24	22	19	18
96	.104886	58	54	50	46	42	40	37	35	32	29	27	24	22	20	18
97	.550075	13	13	12	11	11	10	10	10	9	9	8	8	7	7	6
98	.107636	57	53	49	45	41	39	36	34	31	29	27	24	22	20	18
99	.109173	55	52	48	44	40	38	36	34	31	29	26	24	21	19	17
100	.200099	34	33	30	28	26	25	23	22	20	19	17	16	14	13	12
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102	.122385	51	48	44	40	37	35	33	31	29	26	24	22	20	18	16
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117	.390805	14	13	12	11	10	10	9	9	8	8	7	6	6	5	5
118	.864709	11	11	10	10	10	10	10	10	10	10	9	9	9	9	8
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120	.323953	19	18	17	16	15	15	14	14	13	12	12	11	10	10	9
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122	.165380	36	34	32	29	26	25	23	22	20	19	17	16	15	13	12
123	.161342	35	33	30	27	25	24	22	21	20	18	17	15	14	13	12
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125	.113994	49	46	42	38	35	33	31	29	26	24	22	20	18	16	15
126	.309351	19	18	17	15	14	13	13	12	11	11	10	9	9	8	8
127	.880314	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5
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130	.147318	40	38	35	31	28	27	25	23	22	20	18	17	15	14	13
131	.113579	50	47	43	39	35	33	31	29	27	25	23	21	19	17	16
132	.132748	43	40	37	33	30	29	27	25	23	21	19	18	16	15	13
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135	.308195	19	18	17	15	14	13	13	12	11	11	10	9	9	8	8
136	.211372	27	25	23	21	19	18	17	16	15	14	13	12	11	10	9
137	.259038	22	21	19	17	16	15	14	13	13	12	11	10	9	8	8
138	.206901	28	26	24	22	20	19	18	17	16	14	13	12	11	10	9
139	.323867	17	16	15	14	13	12	12	11	10	10	9	8	8	7	7
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61	.664040	100														
62	.709452	98	100													
63	.734328	93	98	100												
64	.732866	83	92	98	100											
65	.661175	58	71	83	93	100										
66	.515795	19	31	46	62	86	100									
67	.374708	-5	3	13	28	56	88	100								
68	.282812	-7	-6	-3	5	25	60	88	100							
69	.210409	2	1	2	4	14	30	44	55	100						
70	.196498	10	9	8	8	10	15	21	27	39	100					
71	.142638	9	8	8	9	14	23	34	46	35	67	100				
72	.116896	11	10	10	11	17	27	38	47	52	59	91	100			
73	.111479	15	13	13	13	17	25	35	44	55	56	84	98	100		
74	.109598	17	16	15	15	17	23	32	41	54	55	78	95	99	100	
75	.108947	19	17	17	16	18	22	30	39	52	54	75	93	98	100	100
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77	.108625	18	18	17	17	18	21	28	37	50	53	73	91	96	98	99
78	.110395	17	16	16	16	17	21	28	37	49	52	71	88	93	95	97
79	.142038	12	11	11	11	13	18	24	31	39	41	56	68	70	71	72
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81	.111768	17	16	15	15	17	21	29	37	49	52	71	87	91	92	92
82	.108019	17	16	16	16	18	22	29	38	50	53	73	90	94	96	96
83	.107216	17	16	16	16	18	22	29	37	50	54	73	90	95	97	97
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85	.107360	16	15	15	15	17	21	29	37	50	53	73	89	94	95	96
86	.109746	15	14	14	14	16	21	28	37	49	52	71	87	91	92	93
87	.116711	15	14	14	14	15	20	27	35	46	49	67	82	86	87	87
88	.127408	14	14	13	13	15	19	25	32	43	45	62	75	79	80	80
89	.124919	15	14	14	14	16	19	26	33	43	46	63	77	81	82	83
90	.127170	14	13	13	13	15	19	25	32	42	45	62	76	79	81	81
91	.137398	13	12	12	12	14	18	24	31	40	42	58	70	73	74	75
92	.245032	11	11	10	10	11	13	17	20	25	25	34	42	43	44	44
93	.128337	16	15	15	15	17	21	27	34	43	46	62	76	79	80	81
94	.464192	10	9	9	9	9	9	11	12	14	14	19	23	23	23	23
95	.109250	16	15	14	14	16	20	28	37	49	52	71	87	91	93	93

96	.104886	16	15	15	15	16	21	28	37	50	53	73	90	94	96	96
97	.550075	6	6	5	5	5	6	8	9	11	11	16	19	20	20	20
98	.107636	17	16	15	15	16	20	28	36	49	52	71	87	92	93	94
99	.109173	16	15	14	14	15	20	27	36	48	51	71	86	90	92	92
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106	.600984	10	9	9	9	9	9	9	10	11	11	14	17	18	18	18
107	.232088	11	10	10	10	10	12	15	19	24	25	34	42	44	45	45
108	.111068	16	15	15	15	16	20	26	35	46	50	68	84	88	89	90
109	.982869	6	6	5	5	5	5	6	6	7	7	9	11	11	11	11
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111	.130579	14	14	13	14	15	18	24	30	40	43	59	72	76	77	77
112	.245490	10	9	9	9	10	11	14	17	22	24	32	40	42	42	42
113	.174841	11	11	11	11	11	13	18	23	30	32	44	54	57	58	58
114	.186410	11	10	10	10	11	13	16	21	28	30	41	50	53	54	54
115	.266867	9	9	9	8	9	10	12	16	20	21	29	35	37	37	38
116	.150414	13	12	12	12	12	15	19	25	33	35	49	60	63	64	64
117	.390805	5	4	4	4	4	5	7	9	12	13	18	23	24	24	24
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120	.323953	9	8	8	8	8	9	11	14	17	17	24	29	31	31	31
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122	.165380	12	11	11	11	11	14	18	23	31	33	46	56	59	60	61
123	.161342	11	11	10	10	11	13	17	23	31	33	45	56	59	60	60
124	.211146	9	9	9	8	9	11	14	18	24	26	35	43	45	46	46
125	.113994	14	13	13	13	15	18	24	32	43	46	63	78	82	83	84
126	.309351	7	7	7	7	7	8	10	13	16	17	23	29	30	30	31
127	.880314	5	5	5	5	4	4	5	6	7	6	9	11	11	11	11
128	.585340	6	6	5	5	5	6	7	8	9	9	13	16	16	16	16
129	.966520	6	5	5	5	5	5	5	6	6	6	8	10	10	10	10
130	.147318	12	12	11	11	12	15	19	26	35	38	52	64	67	68	69
131	.113579	14	14	13	13	14	18	24	32	44	47	65	80	84	86	86
132	.132748	12	12	12	12	13	15	21	27	37	40	55	68	72	73	73
133	.960592	4	4	4	4	4	4	4	5	6	6	8	10	10	10	10
134	.136425	13	12	12	12	13	15	21	27	37	40	54	67	71	72	72
135	.308195	7	7	7	7	7	8	10	13	17	18	25	30	32	32	32
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137	.259038	7	7	7	7	7	9	11	14	19	21	29	35	37	38	38
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139	.323867	6	6	6	6	6	7	9	12	15	16	23	28	29	30	30
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76	.108662	100														
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78	.110395	97	99	100												
79	.142038	73	75	83	100											
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81	.111768	92	91	90	74	31	100									
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83	.107216	97	96	93	71	35	96	100	100							
84	.106951	97	96	93	70	35	95	99	100	100						
85	.107360	96	95	93	69	35	93	98	99	100	100					
86	.109746	93	92	90	68	34	89	94	95	97	98	100				
87	.116711	87	87	85	65	31	85	87	87	87	87	88	100			
88	.127408	80	80	78	61	29	77	80	80	81	81	79	73	100		
89	.124919	83	82	80	62	30	80	82	82	81	79	78	77	77	100	
90	.127170	81	81	78	60	30	79	81	81	80	78	75	77	66	94	100
91	.137398	75	75	73	56	29	72	75	75	75	74	71	70	59	81	95
92	.245032	44	43	43	35	19	42	43	43	43	44	43	38	39	33	40
93	.128337	81	80	78	61	32	78	81	81	80	79	77	73	68	71	66

94	.464192	23	23	23	19	12	22	23	23	23	23	23	21	20	20	20
95	.109250	93	93	91	70	33	90	93	93	93	93	91	86	79	80	78
96	.104886	96	95	93	71	34	93	96	96	96	94	92	88	80	83	80
97	.550075	20	19	19	15	10	19	19	19	19	19	19	18	17	17	17
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99	.109173	92	92	89	69	33	89	92	92	92	91	89	85	77	80	78
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103	.116819	85	85	83	64	31	83	85	86	85	85	83	78	72	74	72
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111	.130579	77	77	75	59	29	75	78	78	78	77	75	71	66	68	66
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113	.174841	58	58	56	44	22	56	58	58	58	57	56	53	49	51	49
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115	.266867	37	37	36	29	16	36	37	37	37	37	36	34	32	33	32
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117	.390805	24	24	23	18	9	24	24	24	24	24	23	22	20	21	21
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119	.171382	57	57	55	43	22	55	57	57	57	57	55	52	48	50	49
120	.323953	31	31	30	24	15	30	31	31	31	31	30	28	26	27	26
121	.250712	40	40	39	31	17	39	40	40	40	40	39	37	34	35	34
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123	.161342	60	60	59	45	22	58	60	60	60	60	58	56	51	53	51
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125	.113994	84	84	81	62	30	81	84	84	84	83	81	77	70	73	71
126	.309351	31	30	30	23	13	30	31	31	31	30	30	28	26	27	26
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131	.113579	86	86	83	64	30	83	86	86	86	85	83	79	72	75	73
132	.132748	73	73	71	55	26	71	73	73	73	72	70	67	61	64	62
133	.960592	10	10	10	8	6	10	10	10	10	10	10	9	9	9	9
134	.136425	72	72	70	54	26	70	72	72	72	71	69	66	60	63	61
135	.308195	32	32	31	24	14	31	32	32	32	32	31	30	27	28	27
136	.211372	46	46	45	35	18	45	46	47	46	46	45	43	39	41	40
137	.259038	38	38	37	28	14	37	38	38	38	37	36	35	32	33	32
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139	.323867	30	30	29	22	12	29	30	30	30	30	29	28	25	26	25
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91	.137398	100														
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93	.128337	59	51	100												
94	.464192	21	14	22	100											
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96	.104886	73	44	80	24	96	100									
97	.550075	16	11	18	10	20	20	100								
98	.107636	73	43	79	23	92	95	21	100							
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101	1.33831	8	7	9	9	8	8	14	9	9	13	100				
102	.122385	65	39	71	22	82	85	20	84	83	48	16	100			
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104	.979426	10	8	11	8	11	11	10	12	12	10	13	13	10	100	
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107	.232088	36	23	40	15	44	45	14	45	45	29	12	42	42	11	45
108	.111068	70	42	77	23	89	91	19	89	89	51	9	80	82	12	90
109	.982869	10	8	11	9	11	11	15	11	12	10	20	13	11	13	11
110	.592110	16	12	18	14	18	18	19	19	19	16	25	20	18	17	19
111	.130579	61	37	67	21	77	79	18	77	77	45	9	70	72	11	78
112	.245490	34	22	38	14	42	43	12	43	43	29	9	40	40	9	43
113	.174841	46	28	50	17	57	59	15	58	58	35	10	53	54	10	59
114	.186410	42	26	47	16	53	55	15	54	53	32	10	49	50	10	54
115	.266867	30	19	33	14	37	38	15	38	38	24	14	36	35	11	38
116	.150414	50	30	55	18	63	65	15	63	63	37	9	58	59	10	64
117	.390805	19	12	21	7	24	25	6	24	24	14	4	22	22	4	24
118	.864709	11	9	12	11	11	11	14	12	12	12	21	13	11	14	12
119	.171382	45	27	49	16	57	58	14	57	57	34	9	52	53	10	58
120	.323953	25	16	28	13	31	31	16	31	31	20	19	30	29	13	31
121	.250712	32	20	35	15	40	41	16	40	40	25	16	38	37	13	41
122	.165380	47	28	52	17	60	61	13	60	60	34	8	54	55	9	61
123	.161342	47	28	51	17	60	62	14	60	60	34	9	55	56	10	62
124	.211146	36	22	40	14	46	47	13	46	46	26	10	42	43	9	47
125	.113994	65	38	71	21	83	86	16	83	82	45	7	74	76	10	85
126	.309351	24	15	27	11	31	31	11	31	30	18	11	29	28	9	31
127	.880314	9	7	10	8	11	11	10	11	11	8	14	12	10	9	11
128	.585340	14	9	15	9	17	17	11	17	17	12	14	17	16	10	17
129	.966520	9	7	11	8	10	10	10	10	11	9	15	11	10	10	11
130	.147318	53	31	58	18	68	70	14	68	67	37	7	61	62	9	69
131	.113579	67	39	72	21	85	88	17	85	84	46	7	76	78	10	87
132	.132748	57	33	62	18	73	75	14	72	72	39	6	65	67	9	74
133	.960592	8	6	10	7	10	10	8	10	10	8	11	10	10	7	10
134	.136425	56	33	61	19	72	73	15	71	71	39	8	64	66	10	73
135	.308195	25	16	28	11	32	33	11	32	32	19	11	30	30	9	33
136	.211372	36	22	40	14	46	47	12	46	46	26	8	42	43	9	47
137	.259038	30	18	33	11	38	38	9	37	37	21	6	34	35	7	38
138	.206901	37	22	40	13	47	48	11	46	46	26	7	42	43	7	48
139	.323867	24	14	26	9	30	30	8	29	29	17	7	27	28	6	30
140	.342301	22	13	24	9	28	29	8	28	28	16	6	26	26	6	29

		106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
106	.600984	100														
107	.232088	17	100													
108	.111068	18	45	100												
109	.982869	20	13	12	100											
110	.592110	28	19	19	26	100										
111	.130579	18	40	76	12	19	100									
112	.245490	17	26	43	10	16	40	100								
113	.174841	16	31	57	12	18	50	30	100							
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115	.266867	18	24	38	16	22	34	22	28	26	100					
116	.150414	17	33	62	11	18	55	33	42	39	30	100				
117	.390805	6	13	24	5	7	20	14	16	15	11	20	100			
118	.864709	26	15	13	21	29	13	13	13	13	17	13	-4	100		
119	.171382	15	30	56	11	17	50	30	38	36	27	41	14	12	100	
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123	.161342	16	31	59	11	18	52	30	40	38	28	44	16	13	40	25
124	.211146	14	25	46	12	18	40	24	32	30	24	34	13	13	32	22
125	.113994	15	40	81	10	16	70	38	53	49	35	58	22	10	53	29
126	.309351	15	18	30	12	17	27	17	22	21	18	24	9	14	22	18
127	.880314	15	10	11	15	20	11	9	11	11	13	10	4	16	10	16
128	.585340	16	13	17	15	20	16	12	14	14	15	14	6	17	14	18
129	.966520	20	12	11	16	22	11	11	11	11	14	11	4	20	10	17
130	.147318	15	34	67	10	16	59	33	45	42	30	49	18	11	45	26
131	.113579	16	41	83	10	17	73	40	55	51	36	60	22	11	55	30
132	.132748	14	35	71	9	15	62	35	47	44	31	52	19	10	47	26
133	.960592	13	9	11	12	16	10	8	9	10	11	10	4	14	9	13
134	.136425	16	36	71	11	17	62	36	48	44	32	52	20	12	48	27

135	.308195	14	19	32	13	18	29	18	24	23	20	25	10	14	24	19
136	.211372	13	25	46	11	16	41	24	32	30	24	35	13	12	32	21
137	.259038	11	20	37	8	12	33	21	26	25	19	29	11	10	27	16
138	.206901	12	24	46	9	14	41	24	31	29	22	34	13	10	32	19
139	.323867	11	17	30	8	12	27	17	21	20	16	23	9	10	22	15
140	.342301	10	16	28	7	11	25	16	20	19	15	22	8	9	20	14

		121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
121	.250712	100														
122	.165380	33	100													
123	.161342	32	45	100												
124	.211146	27	34	34	100											
125	.113994	38	58	58	46	100										
126	.309351	21	24	24	20	28	100									
127	.880314	15	10	11	11	10	11	100								
128	.585340	18	15	15	14	16	13	13	100							
129	.966520	17	12	12	11	10	13	13	14	100						
130	.147318	34	49	49	37	65	26	10	15	20	100					
131	.113579	39	60	60	45	82	31	11	17	12	71	100				
132	.132748	34	52	52	39	70	26	10	14	10	59	73	100			
133	.960592	13	10	10	9	9	9	10	10	12	10	10	7	100		
134	.136425	36	53	52	40	69	27	11	16	12	59	72	62	12	100	
135	.308195	23	26	26	22	31	17	11	14	12	28	32	29	10	30	100
136	.211372	27	36	35	28	45	20	10	13	11	39	47	41	9	42	23
137	.259038	22	30	29	23	37	16	8	11	9	33	38	34	8	35	18
138	.206901	25	35	34	27	45	19	9	12	10	38	47	41	8	41	21
139	.323867	19	25	24	19	29	14	8	10	9	26	31	27	7	28	16
140	.342301	18	23	22	18	27	13	7	9	8	24	28	25	7	26	15

		136	137	138	139	140
136	.211372	100				
137	.259038	22	100			
138	.206901	28	23	100		
139	.323867	20	17	9	100	
140	.342301	18	15	20	9	100

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