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AN EVALUATION OF KERMA IN CARBON AND THE CARBON CROSS SECTIONS

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Current Address:
36 Hurst Road, East Molesey
Surrey, KT8 9AF ENGLAND

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U.S. DEPARTMENT OF COMMERCE
Barbara Hackman Franklin, Secretary

TECHNOLOGY ADMINISTRATION
Robert M. White, Under Secretary for Technology

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
John W. Lyons, Director

Introductory Statement

This work was completed in 1988, and was a major input to the Evaluated Nuclear Data File ENDF/B-VI for carbon. There is continuing interest in this work. Therefore it is being issued as an NIST Internal Report (NISTIR).

ABSTRACT

A preliminary simultaneous least squares fit to measurements of kerma in carbon, and carbon cross sections taken from the ENDF/B-V file was carried out. In this calculation the shapes of the total cross section and the various partial cross sections were rigid but their absolute values were allowed to float in the fit within the constraints of the ENDF/B-V uncertainties. The construction of the ENDF/B-V file imposed improbable shapes, particularly in the case of the $^{12}C(n,n'3\alpha)$ reaction, which were incompatible with direct measurements of kerma and of the reaction cross sections. Consequently a new evaluation of the cross section data became necessary. Since the available time was limited the new evaluation concentrated particularly on those aspects of the ENDF/B-V carbon file which would have most impact on kerma calculations. Following the new evaluation of cross sections new tables of kerma factors were produced. Finally, the simultaneous least squares fit to measurements of kerma and the new cross section file was repeated.

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1. INTRODUCTION

Recent measurements of kerma (mnemonic for kinetic energy released in matter) in carbon indicate that values of this quantity calculated on the basis of cross sections taken from the ENDF/B-V file (Ca80) are probably too high, particularly in the energy range from 15 to 20 MeV. Measurements of the inelastic scattering cross section to the first excited state of ^{12}C, and of the $^{12}C(n,n'3\alpha)$ cross section in this energy range which have appeared since the establishment of ENDF/B-V suggest that the former should be higher, and the latter lower.

A preliminary exercise is to perform a least squares fit to the available data for kerma and the cross sections in order to find best values for these parameters. The basis of the fitting procedure has been described elsewhere, (Ax86) and a brief description is given in Appendix 1.

The calculation is programmed on a SAGE computer in APL ("A Programming Language"), which is specially suitable for matrix manipulations and has many other advantages over the traditional FORTRAN-type languages.

2. PRELIMINARY EVALUATION BASED ON ENDF/B-V CROSS SECTION DATA

The initial problem is the definition of a suitable model, which must be capable of representing all cross sections and partial cross sections, and kerma and partial kerma analytically in terms of a limited number of parameters whose values can be changed in the fitting process.

A full representation of all the cross-section data in the ENDF/B-V files including the covariance files would introduce too many variables and the covariance matrix alone would occupy more than the available capacity of most computers. Moreover, the limited amount of information in the covariance files of ENDF/B-V is in a very condensed form, and is considered to grossly over-estimate the correlations between individual partial cross sections at different neutron energies whilst ignoring completely the important correlations between the partial cross sections at the same energy. This subject will be discussed in more detail in a later section.

This preliminary calculation has been carried out with a very simple model in which the cross sections are taken from ENDF/B-V and multiplied by various factors which are initially unity, but which are allowed to float in the least squares fit within the constraints of their uncertainties. Thus, the absolute values of the cross sections can change, but not their shapes as a function of energy, which is another way of saying that there is 100% correlation between cross sections at different energies. This procedure comes fairly close to representing the status of the ENDF/B-V covariance files.

The first six floating parameters in the fit are multiplying factors for the total, elastic, inelastic, $(n-\alpha)$, (n-p), and (n-d) reactions. The $(n,n'3\alpha)$ reaction is represented as the total cross section minus the sum of the remaining partial cross sections. There are ten floating parameters altogether, the remaining four being the multiplying factors applicable to the first Legendre coefficients in the angular distributions for the elastic scattering reaction, and the ENDF/B-V reactions MT51, MT52, and MT53, which represent inelastic scattering to the first three excited states of ^{12}C. These coefficients are known as f1 values. The only departure from ENDF/B-V at this stage is that f1 for ENDF/B-V reaction MT53 is applied to all reactions leading to higher excited states of ^{12}C, in order to introduce some variability into the mean kinetic energy imparted in the (n,n'3α) reaction.

Any measurement of a cross section, partial cross section, or total or partial kerma can then be entered into the system as an APL language function of these ten floating parameters, as seen in Appendix 2. Total carbon kerma is represented by fk, and fka and fk3a represent partial kerma for the (n,α) and (n,n'3α) reactions. Similarly, csa and cs3a are the cross sections for these reactions. feb3a is the average energy, imparted in the (n,n'3α) reaction. Representative definitions of some of these functions are given in Appendix 3.

These representations are not merely identifiers. They are executable APL functions, and when called, they evaluate the appropriate quantity using the current values of the variable parameters.

Appendix 2 shows author or source, date, measured function, measured value, uncertainty, fitted value, residual, and weighted residual, the sum of squares of which is χ^2.

Any number of derived functions of the fitted parameters can be calculated.

The data set may not be complete, but it probably gives a reasonable initial estimate of the eventual outcome. The calculation covers the energy range from 11 to 20 MeV. The total kerma at 14.1 MeV is reduced by 16% from the initial value. The (n,n'3α) cross section is reduced by between 10% and 17% over the range considered. This is achieved by reducing the total, elastic, (n,α), and (n,d) cross sections by 6, 5.5, 11, and 5.3% respectively, and increasing the inelastic by 7.9%. This latter increase is supported by inelastic angular distribution measurements which appeared after ENDF/B-V was established.

The fitted values of the floating parameters gp[1] through gp[10] can be used in conjunction with the ENDF/B-V cross section file to calculate, as derived functions, for any energy grid, both the total kerma and the partial kerma from the individual reactions. The value of χ^2 for 37 degrees of freedom is 46, which is not unreasonable.

Probably the main defect in the simple model described above is the rather improbable shape of the (n,n'3α) cross section derived as represented in ENDF/B-V and which cannot change appreciably using this simple model. There have been some important new measurements of carbon cross sections since the establishment of ENDF/B-V, and it is concluded that a re-evaluation of the carbon cross sections is necessary. It is also necessary to design a new model which will allow a more realistic shape to the cross section for the (n,n'3α) reaction which in turn requires a revised structure for the carbon cross section file.

3. EVALUATION OF CROSS SECTION DATA

3.1 Energy Range 5 MeV to 20 MeV

The intention is to re-evaluate the cross section data from 5 MeV to 20 MeV, and to extend the energy range up to 32 MeV. The ENDF/B-V file will be retained except where new data renders it obsolete, or where there is a need to change the structure. The structure and data sources for ENDF/B-V are shown in table 1. In this file the requirement that the sum of all the partial cross sections should equal the total cross section is met, approximately by designating a selected partial cross section as equal to the total cross section less the sum of the remaining partial cross sections. The approximation arises because the equality can only be exact if the total and elastic cross sections are quoted to seven significant figures in order to retain only two significant figures for the (n,γ) reaction.

From 5 MeV to the threshold of the $(n,n'3\alpha)$ reaction at 7.887 MeV the selected cross section is that of inelastic scatter to the first excited state of ^{12}C, and above this energy is that of the $(n,n'3\alpha)$ cross section. In both cases the selected partial cross sections are small, and consequently they finish up with undesirable shapes over at least part of the energy range. An example is the lone peak in the inelastic cross section[1] at 14.86 MeV. Of far more importance, however, is the shape of the $(n,n'3\alpha)$ cross section, which is not supported by now available measurements and which leads to kerma values considerably higher than the measured values.

The total and partial cross section values at a given energy form an over-determined set of which none is known exactly. The requirement that the total cross sections should equal the sum of the partial cross sections can therefore be met by a weighted least squares minimization procedure[2] to determine the partial cross sections, with the total cross section entered as their sum. In this way all the data carries its true weight, and the resulting correlation matrix more correctly describes correlations between the partial cross sections, and between them and the total. This information is needed to determine the uncertainties of calculated kerma values. ENDF/B-V does not mention correlations between partial cross sections, but nevertheless they exist in a distorted form due to the method used to obtain congruity. Correlations will be discussed in more detail later.

A consequence of this difference in procedure provokes the need to evaluate the cross sections for inelastic scatter and the $(n,n'3\alpha)$ reaction in their entirety.

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[1] Because all higher states are presumed to decay by the break-up reaction to 3 alpha particles, this term will, henceforth in this report refer only to inelastic scatter to the first excited state of ^{12}C unless otherwise stated.

[2] This procedure will be referred to henceforth as the <u>unification procedure</u>. It treats all partial cross sections equally. This is in contradistinction to the evaluation procedure used in ENDF/B-V where all but one of the partial cross sections were evaluated and the remaining cross section was determined by subtracting the evaluated partial cross sections from the total.

The sections of ENDF/B-V which will be retained are listed below. However, this does not mean that they will remain unchanged in the final evaluation because the cross section data will change in the unification procedure.

(1) All data below 5 MeV
(2) Elastic scattering cross sections below 8 MeV
(3) (n,p) cross sections
(4) (n,d) cross sections
(5) All angular distribution data
(6) (n,γ) cross sections.

Some of the above items are retained because there is no time available to review them. The (n,p) reaction cross section, and the angular distribution data for elastic and inelastic scattering would benefit from consideration of new measurements.

Of the Legendre coefficients given in file 4 of ENDF/B-V, only the first quoted, f1, is important to kerma calculations. A review of f1 for elastic scattering and for inelastic scattering to the first three excited states of ^{12}C in isolation would tend to be misleading and might produce unacceptable angular distributions.

3.2 Energy Range 20 MeV to 32 MeV

In this energy range the total cross section and those for elastic and inelastic scatter and for the $(n,n'3\alpha)$ reaction are evaluated to 32 MeV, and plausible assumptions are made which enable the cross sections for the (n,α), (n,p), and (n,d) reactions to be extended to 32 MeV. However, over this energy range numerous other reactions become energetically possible for which little cross section data is available. Possible reactions below 32 MeV are listed in table 2.

3.3 Total Cross Section. 5 MeV to 32 MeV

The experimental data obtained in several experimental determinations of the carbon total cross section were obtained from the Brookhaven Data Center. Of particular interest were the data sets for experiments done since ENDF/V-B was issued. Three data sets fell into this category. They are:

1. Cierjacks et al. from Karlsruhe (Ci78)
2. Auchampaugh from Los Alamos (Au79)
3. Kellie et al. from NBS (Ke79).

In addition the earlier work from NBS by (Sc67) was examined. Other recent measurements were found to have inadequate resolution.

To make a point by point comparison of the different experimental results it was decided to reduce all data to a common energy grid. The ENDF/B-V energy grid was chosen. This grid has the virtue that the energy values used are such that linear interpolation of the cross section between any two successive points will not induce an interpolation error greater than 1%.

The spacing of data points in energy varied greatly. The Karlsruhe data had the finest energy grid, having on average ten data values between each set of ENDF/B-V energy values. At the other extreme the NBS data had as few as one data value for every 3 ENDF/B-V values.

The large amount of data in the Karlsruhe and Los Alamos data was combined into sets with the same energy grid as ENDF/B-V by linear least squares fitting. The experimental data points lying between two ENDF/B-V points were fitted and values defined by this fit were calculated for each ENDF/B-V end point. This produced two values of calculated cross sections with associated uncertainties for each ENDF/B-V energy grid point; one value determined by the set with lower energies, and the other by the set with higher energies. The weighted mean of these two calculated values was then taken as the "experimental" value associated with the ENDF/B-V energy grid point. An estimated uncertainty of 1.5% was added to the uncertainties of these weighted means to cover uncertainties which would not be expected to be reduced in the fitting procedure.

For the NBS data a simple linear interpolation between experimental data points was used to define the values associated with the ENDF/B-V energy grid point.

The values obtained using the procedure described were then plotted and compared visually. It could be seen that the Karlsruhe data set was clearly superior in resolution to the other three sets of data.

Any technique that would combine the data sets would produce a data set with lower resolution than the Karlsruhe data. A procedure was developed to preserve the resolution of the Karlsruhe data and yet take advantage of any additional information the other data sets might provide.

The point by point ratios of the Los Alamos and NBS data to the Karlsruhe data were taken. If the data sets differed only in resolution and statistical precision then the ratio values have an average value of a reduced χ^2 of unity. The unweighted and weighted means of the ratio was calculated for each set of data together with its standard deviation and the standard error of the mean.

The results of this procedure are shown in table 3. Ratio tests were made over the energy ranges 5 to 8 MeV, 8 to 10 MeV, 10 to 14.8 MeV and 14.8 to 20 MeV. Similar tests were made to compare the Ci78 data with the ENDF/B-V file. As would be expected the ratios tend to be high at the energies of cross section peaks and lower in valleys, due to the superior resolution of the Ci78 data.

The results show that the normalization of the Ci78 data is not contested by the alternatives, and in view of their better resolution and accuracy, these data reduced to the ENDF/B-V energy grid are accepted for this evaluation. The total cross sections and uncertainties are shown in table 4, and compared with the ENDF/B-V version in figure 1.

3.4 Elastic Scattering 5 MeV to 32 MeV

Elastic scattering cross sections are invariably obtained by integration of measured angular distributions of scattered neutrons. The amount of detail in the reporting of results varies considerably. In some cases only the angular distributions themselves are given. In others, Legendre coefficients and/or integrated cross sections are given as well as, or instead of, angular distributions. Similarly, there is considerable variation in the amount of information available on the uncertainties. In some cases relative uncertainties are given for each angle together with an overall normalization uncertainty which is quoted individually for each incident neutron energy. Sometimes only relative uncertainties or only total uncertainties are quoted and it is necessary to guess the normalization uncertainty. None of the authors considered provided any information regarding the degree of correlation between the normalization uncertainties for different neutron energies.

For each measurement energy by each author varying degrees of Legendre polynomial fitting were performed to test for stability, meaning that the addition of one extra coefficient does not produce a significantly different cross section. Also, the fitted coefficients were used to test for negative cross sections at zero and 180 degrees. Measurements which failed either of these tests were rejected. The degree of agreement with the authors' own integrated cross sections varied with the degree of detail in the uncertainty statements. For the evaluation the authors integrated cross sections are adopted if provided. Failing that, the authors fitted Legendre coefficients are used if provided. Otherwise, integrations as described above are used.

For evaluation purposes the energy range from 5 MeV to 32 MeV is divided into suitable sections, each section being evaluated separately using a method based on that described by Ha70. For each section the main, or most prolific author is selected, being the author covering the largest section of the range with measurements at the most energies. These data are then interpolated at any energy at which another author or other authors have made measurements. In some cases the second most prolific author is interpolated as well. Each author is regarded as having a bias factor which is initially unity with an uncertainty equal to the authors normalization uncertainty. If the latter varies with neutron energy an average is used. A weighted least squares fit is then performed in which the floating parameters are the cross section at each neutron energy and the author bias factors. This is a non-linear least squares problem and therefore it is necessary to choose starter values for the unknown parameters, which are usually the main author's values for the cross sections and unity for the authors' bias factors. The output consists of the best values for the cross sections at each energy at which there is a measurement available, and the best values of the author bias factors. At interpolated energies the cross sections are weighted averages of two or more measurements, and at other energies they are the main author's measurements divided by his bias factor. Some consideration has to be given to the input covariance matrix. Consideration of the cross section shapes as a function of neutron energy for different authors and the same energy range tend to suggest that the normalization uncertainties are not very strongly correlated. These correlations are certainly unknown, and under these circumstances it is considered more accurate to ignore them than to guess them. Input covariance matrices for these fits therefore have no non-zero off-diagonal elements, and are constructed from the total uncertainties of the cross sections.

Output covariance matrices for the cross sections and author bias factors are generated. These will be discussed later in section 4.1

3.4.1 Energy Range 5-7.936 MeV

Over this energy range the cross sections of ENDF/B-V are adopted. The region was very carefully evaluated for ENDF/B-V and there are no new measurements to be considered. The covariance files of ENDF/B-V give the total uncertainty of 2.29% at each energy. 100% correlation is given within the three energy ranges 5-6 MeV, 6-7 MeV, and 7-8 MeV with approximately 24% correlation between the three ranges. However, it was found when operating the unification procedure described in section 3.1 that these total uncertainties were too small and produced undesirable aberrations in the total and other partial cross sections and abnormal distributions of residuals in the unification fits. The elastic scatter data were therefore down-weighted by increasing the uncertainties to 5% and discarding the correlations. The justification for this procedure is as follows.

In section 3.1 it was observed that the ENDF/B-V definition of the cross sections for inelastic scattering and the (n,n'3α) reaction as the total cross section less the sum of the remaining partial cross sections over two different energy ranges led to undesirable features in the shapes of these cross sections. At a meeting with Dr. F. G. Perey and Dr. C. Y. Fu at Oak Ridge National Laboratory in October 1986 these problems were discussed, and it was concluded that it was wrong to define a small cross section as effectively the difference between two large ones, and that less disturbance would occur if the elastic cross section was defined as the total less the remainder. Since this would be equivalent to giving zero weight to the evaluated elastic scattering cross section data the downweighting described above does not seem unreasonable.

3.4.2 Energy Range 8.04 to 8.69 MeV

The available measurements are those of Ve73, Ha75, Pe69, and Pe71 where the measurements of the main author, Pe71, are interpolated at the energies of the other authors for the least squares calculation designated FIT1. The output author bias factors are 0.985 ± 0.071, 0.994 ± 0.060, 1.068 ± 0.071, and 1.029 ± 0.063 for Ve73, Ha75, Pe69, and Pe71, respectively. The value of χ^2 is 53.6 for 8 degrees of freedom so the agreement cannot be regarded as good. Consequently external rather than internal uncertainties are propagated.

3.4.3 Energy Range 8.98 to 11.96 MeV

The available measurements are those of Ve73, Ha75, Gl76, and Sa81, where the main author Gl76 is interpolated at the energies of the other authors for the calculation designated FIT2. The output author bias factors are 1.012 ± 0.098, 1.009 ± 0.064, 0.985 ± 0.062, and 1.008 ± 0.140 in the above order, respectively. Again, the agreement is poor, with a χ^2 value of 94 for 8 degrees of freedom. External uncertainties are propagated.

3.4.4 Energy Range 12 to 14.43 MeV

The available measurements are those of Ha75, Gl76, Ba85, and Bo68, where the author Gl76 is interpolated at the energies of Ha75 and Ba85, and Bo68 is interpolated at these energies and those of Gl76. The calculation is designated FIT3 and the author bias factors become 0.968 ± 0.019, 1.017 ± 0.019, 1.008 ± 0.036, and 0.990 ± 0.027 for the authors Ha75, Gl76, Ba85, and Bo68, respectively. The value of χ^2 is 34.1 for 9 degrees of freedom. As before, external uncertainties are propagated.

3.4.5 Energy Range 14.43 to 16 MeV

The available measurements are those of Ha75, Gu81, Ar71, Gl76, and Bo68 where the authors Gl76 and Bo68 are interpolated at the energies of the others. The calculation is referenced FIT4 and the author bias factors become, in the order listed above, 0.952 ± 0.029, 0.952 ± 0.034, 0.873 ± 0.045, 1.034 ± 0.022, and 0.986 ± 0.029. The value of χ^2 is 12.9 for 6 degrees of freedom, and external uncertainties are propagated.

3.4.6 Energy Range 16 to 26 MeV

The available measurements are those of Ba85, Me84, De70, and Bo68, where the author Bo68 is interpolated at the energies of the others. The calculation is referenced FIT5 and the author bias factors, in the order listed above, are respectively, 1.000 ± 0.045, 1.002 ± 0.024, 1.009 ± 0.026, and 0.901 ± 0.022. The value of χ^2 is 28.2 for 7 degrees of freedom, so external uncertainties are propagated. Unfortunately, the data of Bo68 are available only in graphical form. Nevertheless it is possible to read the cross section data to approximately ± 2.5% accuracy, and a further uncertainty of ± 10% was added. Although the data looks highly correlated between different energies the shapes of the cross sections as a function of neutron energy of Bo68 and Me84 are quite different and therefore both set of data are regarded as uncorrelated at different energies.

3.4.7 Energy Range 26 to 32 MeV

This range is covered by interpolating a straight line between the 26 MeV cross section of Me84 and the 40 MeV cross section of Wi86.

The Wi86 data are given as angular distributions covering the angular range to 95° (CM), beyond which angle the differential cross section was too low to measure. In order to obtain an integrated cross section it was assumed that the differential cross section continued to fall at the same rate per 10 degree interval. The integration was obtained both trapezoidally and by Legendre polynomial fitting, with similar results. The latter is preferred because it also produces an f1 value (for kerma calculations) which does not look out of place with regard to the values in the energy range 20-26 MeV. Thirteen Legendre coefficients were required.

The input data for the elastic cross section evaluation are shown in table 5a, and the evaluated data in table 5b. The I following a reference signifies an interpolated value. The fit references in the first column refer to the least-squares calculation described in section 3.4 above. The B following author references indicate that the authors measured value has been divided by the appropriate bias factor. The unified (see section 4) elastic cross section is compared with the evaluated and ENDF/B-V versions in figure 2.

3.5 Inelastic Scatter to the 4.439 MeV Level of ^{12}C.

The evaluation of this cross section follows in general the procedures described in the previous section. The ENDF/B-V file does not contain an independent evaluation of this cross section in the energy range from the threshold at 4.812 MeV to the threshold of the (n,n'3α) reaction at 7.887 MeV, it being equated to the total cross section minus the sum of the elastic and the (n,γ) cross sections.

3.5.1 Energy Range 5.0 to 6.5 MeV

For this evaluation, from 5.0 to 5.306 MeV, the values were taken from the γ-ray production data of Mo72. In using this data it is assumed that the measurement made at 125° can also be used to obtain the total γ-ray production cross section since this angle is a zero of the second Legendre polynomial, and the fourth Legendre polynomial coefficient is assumed to be negligible (see La75). From 5.32 to 6.5 MeV the data of Pe71 are used.

3.5.2 Energy Range 6.508 to 8.69 MeV

The available measurements are those of Ha75, Mc72, Pe71, Pe69, Ve73, and Mo72, where the latter was interpolated at the energies of the other authors for input to the least squares calculation designated FIT6. The author bias factors listed in the above order are 0.987 ± 0.055, 0.932 ± 0.078, 0.950 ± 0.056, 0.953 ± 0.058, 1.046 ± 0.061, and 0.975 ± 0.056. External uncertainties are quoted because the value of χ^2 is 140 for 29 degrees of freedom.

3.5.3 Energy Range 8.69 to 19.09 MeV

The available measurements are those of Ha75, Ad80, Gu81, Ba85, Ve73, Sa81, Gl76, and Mo72. For the least squares calculation designated FIT7 both Gl76 and Mo72 were interpolated at the energies of the other authors and Mo72 was interpolated at the energies of Gl76. As in the previous fits of this type the residuals are high compared with the uncertainties, and a high value of χ^2 (635 for 49 degrees of freedom) is obtained. Consequently external uncertainties are propagated. The author bias factors, in the order of the references listed above are 0.953 ± 0.050, 1.056 ± 0.123, 1.008 ± 0.238, 1.019 ± 0.153, 0.914 ± 0.061, 0.996 ± 0.229, 1.027 ± 0.056, and 0.894 ± 0.048, respectively.

3.5.4 Energy Range 20.8 to 35 MeV

The angular distribution measurements of Me84 are used for the range 20.8 to 26 MeV. The fitted Legendre coefficients are to be found in table 3 of the thesis. The extension to 35 MeV is achieved by using the deformed optical model calculation, in the absence of reported measurements, in this energy range. Over the energy range 20 to 25 MeV the optical model calculations are in good agreement with cross sections calculated from the Legendre coefficients in the overlap region 20 to 25 MeV. Similar optical model calculations are available for the elastic cross sections, but the agreement with the measured cross sections calculated from the Legendre coefficients was not so good in the overlap region. Consequently the 40 MeV measurement of Wi86 was preferred. Use of the optical model calculation for 30 MeV would lead to an increase in the elastic scattering cross section varying between zero and about 50 mb over the energy range from 26 to 32 MeV. The effect of this alternative on the calculation of kerma will be considered later.

The input data for the evaluation of the inelastic scattering to the first excited state of ^{12}C are shown in table 6a, and the evaluated data in table 6b. In the reference column the letters B and I have the same significance as before. The letter O distinguishes the optical model calculations from measured values. The unified inelastic scattering cross section is compared with the evaluated and ENDF/B-V versions in figure 3.

3.6 The $^{12}C(n,\alpha_0)^9Be$ Reaction to the Ground State of ^9Be

Most of the data contributing to the ENDF/B-V evaluation of this reaction is based on the reciprocity theorem as applied to cross section measurements of the inverse reaction $^9Be(\alpha,n)^{12}C$. In their description of the evaluation Lachkar (La75) considered, in addition to the references listed in table 1, the $^{12}C(n,\alpha_0)^9Be$ measurements of Br68, Al63, Ki69, Ch64, Ko67, Sa71, and Hu66, as well as the $^9Be(\alpha,n)^{12}C$ measurements of Ri57, De70, and Ni62. The references for $^9Be(\alpha,n)^{12}C$ measurements do not usually contain reciprocity calculations for the inverse reaction so it has not been possible to locate all of the data. The data for Re60 and Ob72 are available in graphical form in Ob72. Those of De70 and Ni62 have not been located, but reciprocity calculations of Va70 were reported in Ge76, and are quoted without uncertainties in Di87.

3.6.1 Energy Range from Threshold to 11.04 MeV

Some new $^{12}C(n,\alpha_0)^9Be$ measurements at PTB (Di87) have become available, although as yet only in graphical form, but it is possible to extract[3] the data to an accuracy of ± 0.6 mb. In this energy range the data of Re60 and Ob72 are also available graphically. The Di87 data are in general, lower than those of the other authors, but not catastrophically so. As reported in La75, the data of Da63 are approximately a factor of two lower, and have not been included. The data of Ge76 are taken from Di87. Following the procedure adopted for the elastic cross section, the PTB data up to 10.03 MeV have been interpolated at the energies of the other three authors for the least squares fit designated FIT8 from which the author bias factors emerge as 1.043 ± 0.098, 1.165 ± 0.126, 1.003 ± 0.112, and 0.982 ± 0.080 for the authors Re60, Ob72, Ge76, and Di87, respectively. In view of the large disparity in values and uncertainties the author bias factor starter values were entered as 1 ± 0.2, 1 ± 0.2, 1 ± 0.2, and 1 ± 0.05, respectively. The value of χ^2 is 96.9 for 31 degrees of freedom, and as for the previous two reactions, external uncertainties are propagated. The Di87 data above 10.03 MeV are not used because they exhibit a sharp rise which is attributed to the on-set of the $(n,n'3\alpha)$ reaction. Consequently the energy range from 10.03 to 11.04 MeV is satisfied by the Re60 and the Ob72 data divided by their appropriate author bias factors. From the threshold to 7.34 MeV the ENDF/B-V evaluation is used with uncertainties of ± 20%.

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[3] Subsequent comparison of the extracted data with revised values in Kl87 showed agreement of the order of 1%.

3.6.2 Energy Range 11.3 to 14.5 MeV

The only data available from 11.333 to 13.6 MeV are those of Ve68, which are in harmony with those of Ob72 at 11.04 MeV, and with the average of the three measurements at 14.1 MeV. This energy range is therefore covered by the data of Ve68.

The cross section at 14.1 MeV is derived from a weighted least squares fit to the data of Ki69, Ha84, and Gr55 (FIT9). The cross section at this point emerges as 75.3 ± 11.5 mb with a value of 0.072 for χ^2 indicating good agreement within the rather large quoted uncertainties.

At 14.5 MeV the data of Ch64 is used, and at 14.0 MeV, that of Al63.

3.6.3 Energy Range 15.6 to 21.46 MeV

This energy range is spanned by the data of Sa71 to 18.65 MeV at which energy they are overlapped by those of St76 which extend to 21.7 MeV.

In La75 the data of Sa71 and De63 were not accepted because they were approximately a factor of two lower than those of Br68, Hu66, and Ni62 in the overlapping range 15 to 17 MeV. It has not been possible to locate the (n,α) data of De63 and Ni62, but Sa71 is supported by St76 at the overlap energy of 18.65 MeV. The range 15.8 to 18.65 MeV is therefore covered by a least squares calculation (FIT10) comprising the data of St76, Br68, Hu66, and Sa71 with Sa71 interpolated at the energies of the other authors. The data of Hu66 is renormalized to the cross section at 14.1 MeV obtained in 3.6.2 above. A χ^2 value of 4.45 is obtained with 4 degrees of freedom, so the external and internal uncertainties are not significantly different. Sa71 data at other energies are included, divided by the appropriate bias factor. The bias factors are 0.857 ± 0.176, 1.106 ± 0.170, 1.081 ± 0.176, and 0.850 ± 0.146 for St76, Br68, Hu66, and Sa71, respectively. The energy range from 18.92 to 21.46 MeV is covered by the data of St76 divided by the appropriate bias factor.

3.6.4 Energy Range 22-32 MeV

To cover this energy range an exponential tail was added. The exponent (5.640 MeV^{-1}) was obtained by fitting an exponential curve to the evaluated data from 16 to 21.46 MeV. Twenty-five percent uncertainty is attributed to the extension. This exponential curve appears to give a reasonable approximation to the (n,α_0) cross section even down to 12 MeV.

The input data selected for the evaluation of the $^{12}C(n,\alpha_0)^9Be$ reaction is listed in table 7a, and the evaluated data in table 7b. The latter is compared with the unified and ENDF/B-V versions in figure 4.

3.7 The $^{12}C(n,n'3\alpha)$ Reaction

The cross section for this reaction was not evaluated in ENDF/B-V. From its threshold at 7.887 MeV to 20 MeV the cross section is determined as the total cross section less the sum of all remaining partial cross section. All inelastic scattering reactions to states higher than the 4.439 MeV level in ^{12}C are deemed to contribute to the (n,n'3α) reaction (as discussed in La75) and they are represented in ENDF/B-V as reactions MT52 through MT68. Of these the first four represent inelastic scattering to the 7.563, 9.638, 10.3, and 10.84 MeV states of ^{12}C and the remainder represent scattering to pseudo-states at 0.5 MeV intervals up to 17.25 MeV. In addition the reaction $^{12}C(n,\alpha)^{9}Be^* \rightarrow 2\alpha + n$, represented in ENDF/B-V by reaction MT91, contributes 10-12% to the (n,n'3α) reaction cross section. The sum of the reactions MT52 to MT68 and MT91 is normalized to the total (n,n'3α) cross section determined as described above.

In this evaluation the $^{12}C(n,n'3\alpha)$ reaction cross section is evaluated from available measured values. The reactions MT52 to MT68 and MT91 are, replaced by MT52-MT73 and MT91 as evaluated later in section 5, and the sum of the partial cross sections is normalized to the new unified total $^{12}C(n,n'3\alpha)$ reaction cross section.

3.7.1 Evaluation of the $^{12}C(n,n'3\alpha)$ Cross Section

The available data are those of Fr55, Br84, Va58, Co76, Gr69, Fa71, An84, and An86. The An84 measurements spanning the energy range 11-35 MeV are studies of kinematically complete events in nuclear emulsions exposed in a white spectrum of neutrons. The results were subsequently revised downwards significantly by several corrections by Br84, the most important of which was the subtraction of three-pronged events produced by reactions other than (n,n'3α) which become significant above 16 MeV. Similar measurements using monoenergetic neutrons were reported in An76. The data set as a whole shows wide variations in the value of the cross section and no single set of data can be used for the interpolation technique used for the previous partial cross sections. Least squares fitting of the data to an arbitrary shape can be dangerous because it involves addition of information which does not really exist, namely the shape, and it invariably leads to output uncertainties which are much too low. However, in this case there appears to be no viable alternative. Consequently, a quadratic has been fitted to the data of Fr55, Fa71, Va58, Co76, An86, Gr69, and Br84 over the energy range from 11 to 20 MeV.

The data of An84 as corrected above 15 MeV in Br84 were included. The An84 data at 14 and 15 MeV are disproportionately high, and at 11-13 MeV considerably lower than the fitted curve, and have not been included. Likewise, the data of St76 is not included because it is an average 40% low and shows wild fluctuations. Also Ha84 at 14 MeV is excluded being considerably lower than all the other measurements in the neighborhood of 14 MeV.

The fitted curve for (11 < E < 20 MeV) is

$$\sigma = (-\ 0.7537) + (0.1062\ E) - (0.002674\ E^2)\ b \quad . \qquad \text{(FIT11)}$$

A second quadratic was fitted to the data of Br84 from 20 MeV to 35 MeV. Giving for (21 < E < 35 MeV)

$$\sigma = (-\ 0.5165) - (0.01215\ E) + (0.0000899\ E^2)\ b \quad . \qquad \text{(FIT12)}$$

The two curves join smoothly at 0.301 b (20 MeV) for the first, and 0.301 b (21 MeV) for the second. From threshold to 10.5 MeV the sum of the reactions MT91 and MT52 is used, with a very small contribution from reaction MT53.

The uncertainties derived from FIT11 and FIT12 are, as expected, too small. More realistic uncertainties attributed to the evaluated curve are 20% for E < 12 MeV, 15% for (12 < E < 20 MeV) and 20% for 20 < E < 35 MeV. It should be emphasized that if the $(n,n'3\alpha)$ reaction cross section evaluation were either significantly lower or higher it would cause problems with the unification procedure described in the following section over the energy range 12 - 20 MeV.

The consideration of inelastic scattering to the higher excited states of ^{12}C will be described in section 5. The input data for the $(n,n'3\alpha)$ reaction are listed in table 8a and the evaluated data in table 8b. The latter are compared with the unified and ENDF/B-V versions in figure 5.

3.8 The $^{12}C(n,p)^{12}B$ Reaction Cross Section

The ENDF/B-V evaluation is based on the data of Ri68, which are supported by that of Kr57 up to 16 MeV, but the latter are considerably higher above that energy. There are no new measurements. The Ri68 extends to 21.56 MeV and is therefore used for this evaluation. The energy range from 21.56 MeV to 32 MeV is covered, as in the (n,α_0) reaction, by adding an exponential tail which is derived by fitting an exponential curve to the Ri68 data from 18.5 to 21.56 MeV. The exponent is 2.992 MeV^{-1}. The uncertainties are estimated for (20 < E < 32 MeV) as ± 30%. The evaluated data for the $^{12}C(n,p)^{12}B$ cross section appear in table 9. The unified cross section is shown in figure 6.

3.9 The $^{12}C(n,d)^{11}B$ Reaction Cross Section

The ENDF/B-V evaluation is based on the reciprocity theorem applied to the Am57 measurements of the $^{11}B(d,n)^{12}C$ reaction. The (n,d) reaction to excited states of ^{11}B, and the $^{12}C(n,np)$ cross sections were considered to be small and were ignored. There appear to be no new measurements. For this evaluation, the (n,d) reaction to excited states of ^{11}B is ignored, but it is discussed in section 8. The (n,np) reaction is considered in section 3.12. The extension of the ENDF/B-V file to 32 MeV is achieved by adding an exponential tail derived by fitting an exponential curve to the data from 19 to 20 MeV. The exponent is 3.881 MeV^{-1}. The estimates of uncertainty are the same as in section 3.8 above. The evaluated data for the $^{12}C(n,d)^{11}B$ cross section appear in table 10. The unified cross section is shown in figure 6.

3.10 The $^{12}C(n,\gamma)^{13}C$ Reaction Cross Section

This cross section is taken directly from ENDF/B-V. Since this cross section is constant from 16 to 20 MeV it is assumed to remain constant (at 0.21 b) to 32 MeV with an uncertainty of ± 10%.

3.11 The $^{12}C(n,2n)^{11}C$ Reaction

This reaction has a threshold at 20.296 MeV. The data of An81 which are quoted with an uncertainty of 10% are used for this evaluation. The measurements of We81 which extend to 26 MeV and are quoted to 14%, are in reasonable agreement. Both sets of data are based on neutron activation to produce ^{11}C and therefore do not include contributions from other reactions in which two neutrons are emitted. The cross sections for the $^{12}C(n,2n)^{11}C$ reaction are presented in table 11.

3.12 Other Charged Particle Reactions With Thresholds Below 26.4 MeV

A further six charged particle reactions have thresholds below 26.4 MeV, for which little experimental evidence is available. However, it is possible to make rough estimates of the probable shapes of these cross sections as a function of neutron energy and approximate estimates of their size. The reactions concerned are $^{12}C(n,np)^{11}B$, $^{12}C(n,t)^{10}B$, $^{12}C(n,^{3}He)^{10}Be$, $^{12}C(n,^{6}Li)^{7}Li$, $^{12}C(n,d\alpha)^{7}Li$, and $^{12}C(n,p\alpha)^{8}Li$. Of the reaction products ^{6}Li, ^{7}Li, ^{10}B, and ^{11}B are stable. ^{8}Li decays by β emission to $^{8}Be \rightarrow 2\alpha$ with a half-life of 0.84 s. ^{10}Be is effectively stable since it has a half-life of 2.5×10^{6} y. The Q-values and the threshold energies of the reactions are given in table 2.

3.12.1 Shape Information

The shapes of the cross sections for the reactions $^{12}C(n,\alpha_0)^{9}Be$, $^{12}C(n,p)^{12}B$, and $^{12}C(n,d)^{11}B$ have certain characteristics in common. Coulomb barrier considerations prevent the cross sections from rising significantly until the Coulomb threshold is reached. The difference between the Coulomb threshold and the energetic threshold has been assessed in Ca80 as 0.1 zZ where z is the atomic number of the lighter emitted particle and Z is the atomic number of the residual nucleus after particle emission. When three or more charged particles are emitted an averaging process is used. Each reaction cross section exhibits a peak at 3 or 4 MeV above the threshold and then reduces more or less exponentially. The exponents given in sections 3.6, 3.8, and 3.9 for the (n,α_0), (n,p), and (n,d) reactions appear to lie on a straight line as a function of the mass of the emitted particle. Whilst there is no theoretical basis for this relationship, in the absence of better information it has been used to estimate the cross section shapes for other reactions.

3.12.2 Normalization Information

A limited amount of information is available from the work of Su83 which presents double differential angular dependent energy spectra ($mb \cdot sr^{-1} \cdot MeV^{-1}$) for protons, deuterons, tritons, ^{3}He, and α-particles for neutron energies of 27.4, 39.7, and 60.9 MeV. Double integrals were performed trapezoidally to provide both charged particle production cross sections and charged particle kerma for the particles and neutron energies above. Firstly, the spectra were integrated at each angle and neutron energy to give $mb \cdot sr^{-1}$ and $mb \cdot MeV \cdot sr^{-1}$. It was assumed that the spectra terminated at the highest particle energy listed, and that the intensity at zero energy was equal to the intensity at the first listed energy. Secondly, the results of the first integration were integrated over the range 0 to 180°. Here it was assumed that the intensity at zero degrees was equal to that at the first listed angle, and that the intensity fell to zero at 180° or at the first measurement angle at which no measurements were recorded. The results of these integrations are shown in table 12. It is the measurements at 27.4 MeV that are of particular interest for this evaluation, since they provide almost the only information on the reactions discussed in this section.

Compared with this evaluation the cross section of 431 mb for the total production of α-particles appears to be very low. From tables 7 and 8 the total cross section for α-particle production ($3 \times \sigma_{n,n'3\alpha} + \sigma_{n,\alpha}$) is 760 excluding any allowance for the $^{12}C(n,p\alpha)^{8}Li$, $^{12}C(n,d\alpha)^{7}Li$, and $^{12}C(n,t\alpha)^{6}Li$ reactions. After making a modest allowance for these reactions it would be necessary to reduce $\sigma_{n,n'3\alpha}$ by between 110 mb and 140 mb, in order to produce agreement with the integrals of Su83. Such a low value would be in disagreement with the evaluation in table 8. Furthermore, in order to maintain unification with the total cross section, a further 110 mb - 140 mb would have to be re-allocated to the other partial cross sections, of which the majority would be taken by the elastic cross section, thereby producing disagreement with the value from table 5b based on Me84 and Wi86. Nevertheless, the cross sections for the production of p, d, t, and ^{3}He can be used as a guide to the probable strengths of the reactions discussed in this section.

Other evidence considered is the deficiency in the sum of the cross sections for the reactions already evaluated, relative to the total cross section over the energy range from 17.3 MeV to 26.4 MeV.

3.12.3 The $^{12}C(n,np)^{11}B$ Reaction

Since there are no measurements available for this reaction, the cross section is assumed to be similar in shape to that of the $^{12}C(n,d)^{11}B$ reaction, with a threshold of 17.3 MeV, a Coulomb threshold of 17.8 MeV, a peak value of 35 mb at 20.9 MeV, and a "decay exponent" of 3.881 MeV^{-1}. The peak value was initailly chosen as equal to that of the (n,d) reaction, and then halved after considering the cross-section deficiency at that energy. In retrospect it might have been better to retain the initial value in order to take up more of the Su83 proton production at 27.4 MeV.

3.12.4 The $^{12}C(n,t)^{10}B$ Reaction

The cross section for this reaction has a threshold at 20.522 MeV, a Coulomb threshold at 21.02 MeV, and it is allocated a peak value of 12 mb at 23.8 and an exponent of 3.881 MeV^{-1}. The shape was normalized to the single measurement, 8.6 ± 2.4 mb at 22.5 MeV, of Qa78. It absorbs 6 mb at 27.4 MeV which is most of the Su83 cross section for charged particle production at this energy. The exponent was derived by interpolation as described in Section 3.12.1.

3.12.5 The $^{12}C(n,^{3}He)^{10}Be$ Reaction

This reaction has a threshold at 21.102 MeV. Since no ^{3}He particles were observed by Su83 at 27.4 MeV this reaction is presumed to have a negligible cross section.

3.12.6 The $^{12}C(n,d\alpha)^{7}Li$ Reaction

This reaction has a threshold at 24.281 MeV, an estimated Coulomb threshold at 25.0 MeV, and is allocated a peak value of 28 mb at 27.3 MeV. The exponent 4.76 MeV^{-1} is a compromise between the values for α-particles and deuterons. The cross section at 27.4 MeV is 27.8 mb giving a total cross section at this energy for the production of deuterons of 35.9 mb in comparison with the Su83 value of 34.7 mb.

3.12.7 The $^{12}C(n,p\alpha)^{8}Li$ Reaction

This reaction has a threshold of 24.489 MeV, an estimated Coulomb threshold at 25.2 MeV, and is allocated a peak value of 38 mb at 27.5 MeV. With an exponent of 3.9 MeV^{-1} the cross section at 27.4 MeV is 37.1 mb, giving a total cross section for the production of protons at 27.4 MeV of 45.9 mb in comparison with the Su83 value of 51.9 mb.

3.12.8 The $^{12}C(n,^{6}Li)^{7}Li$ Reaction

All the partial cross sections considered in the previous sections have been evaluated without reference to the discrepancy between the total cross section and the aggregate of the partial cross sections. For this reaction, and for the seventeen additional reactions considered in the following sections, this is not possible. The discrepancy is the only evidence available for the determination of the magnitudes of the individual reaction cross sections.

Based on the shape information of section 3.12.1 the cross section for the $^{12}C(n,^{6}Li)^{7}Li$ reaction has a threshold at 22.683 MeV, a Coulomb threshold at 23.6 MeV, a peak value at 26.3 MeV. In the following section a cross section σ_{spare} is defined as the sum of the remaining partial cross sections which become energetically possible between 26.4 MeV and 32 MeV. The individual cross sections are then unfolded from the unified σ_{spare}. The magnitude of σ_{spare} is determined by reference to the discrepancy between the total cross sections and the sum of the partial cross sections. For the unfolding technique to be viable it is necessary that the discrepancy should be approximately zero at 26.4 MeV. This condition is met by allocating to the $^{12}C(n,^{6}Li)^{7}Li$ cross section a peak value of 100 mb. Although this value seems inordinately high there does not seem to be any alternative. The consequences of ignoring this reaction completely will be discussed at a later stage.

Evaluated cross sections for the reactions discussed in section 3.12 are presented in table 13.

3.12.9 Other Reactions Which Become Energetically Possible Below 32 MeV

Reference to table 2 shows a further seventeen reactions which are energetically possible below 32 MeV. There is no experimental evidence regarding their cross sections. For the purposes of the unification procedure described in the next section a cross section σ_{spare} is defined as the sum of these cross sections and its magnitude is derived by smoothing the discrepancy between the total cross section and the sum of all remaining cross sections. In a later section σ_{spare} is unfolded to give cross section curves for the individual reactions. The values adopted for σ_{spare} are shown in table 14.

4. THE UNIFICATION PROCEDURE

This is the procedure by which the requirement that the total cross section is equal to the sum of all the partial cross sections is met. It consists of a least squares fit to the over determined set of evaluated cross sections consisting of the total cross section and all the partial cross sections.

4.1 Correlations Between the Uncertainties of the Data

In the process of evaluating the cross sections for elastic scattering, inelastic scattering, the (n,α_0) reaction and the $(n,n'3\alpha)$ reaction it was observed that measurements by different authors had quite different shapes as a function of energy, leading to the conclusion that errors in measurements at different energies are uncorrelated. In the cases of the scattering reactions this implies that the normalization uncertainties given for each energy, although in many cases equal, are at most only weakly correlated. No author has made any comment on this degree of correlation. Hence there is no evidence of correlations of the type given in ENDF/B-V file 33.

However, the least squares fitting process used for FIT1 to FIT10 produces correlation matrices between the uncertainties of the fitted cross section values at each neutron energy involved in the fit, and the various author bias factors. The evaluated cross section tables contain fitted cross sections intermingled on the energy scale with authors measurements divided by their appropriate bias factors.The correlations can only be preserved in a full covariance matrix. The unification procedure is carried out at each energy of the ENDF/B-V energy grid for the total cross section, and each partial cross section is interpolated at each of these energies. In order to preserve the correlations described it would be necessary to carry out the unification simultaneously at least over the energy range of a singe FIT. The input correlation matrix would be enormous. The output correlation matrix would be almost as large, and would probably never be used.

It was decided, therefore, that since these correlations are relatively unimportant, and in fact non-existent except within the energy range of a particular fit to a particular partial cross section, that correlations between uncertainties at different energies should be ignored.

The unification procedure can then be carried out separately at each energy. It is necessary to do so at all energies of the ENDF/B-V grid in order to ensure that linear interpolation is valid for all output files.

On the other hand, each operation of the unification procedure produces a correlation matrix for the uncertainties of the total and all the partial cross sections. The correlations cannot be ignored. They are important to the calculation of derived functions of the cross sections, such as kerma, or the response of a neutron detector. Fortunately this information can be preserved with reasonable accuracy in a fairly compact form. Although unification produces of the order of 500 such correlation matrices, they do not change very much except when the threshold of a new reaction is reached. The unification procedure described in the following sections is therefore separated into various energy bands within which the number of partial cross sections remains the same.

4.2 Smoothing of Evaluated Cross Section Files

In most evaluations the evaluated data are smoothed. Fluctuations in data are smoothed out either by fitting a curve or by eye-line drawing. For example, the higher energy parts of the evaluations of the (n,α_0), (n,p) and (n,d) reactions would look better if replaced by their respective exponentials. The reason for such artificial smoothing is obscure, because no new information has been contributed. In the present evaluation, although the correlations have been dropped, the total uncertainties from the fits have been preserved, and would be lost if artificial smoothing were to be applied at this stage. Moreover, the curves could become unsmoothed again during the unification procedure. If artificial smoothing is applied after the unification procedure, the sum of the partial cross sections would cease to be equal to the total cross section. Consequently the cross section shapes will remain jagged in this evaluation.

4.3 Energy Range from 5 to 6.174 MeV

In this energy range the data set consists only of the total cross section and the partial cross sections for the reactions (n,γ), elastic scattering and inelastic scattering. The floating parameters are the partial cross sections. Values for these are interpolated from the evaluated files of section 3, and the total cross section is entered as the sum of the partial cross sections. Output tables from the procedure list, for each energy, the input cross sections and their uncertainties, the output cross sections and their uncertainties, the fractional changes in the cross sections, and the ratio of the change to the uncertainty. A study of these ratios provides insight into the consistency of the data. For example, ideally they should be equally distributed between positive and negative, and equally distributed between reactions. The absolute values should be less than unity in 68% of the cases, and so on.

Some larger ratios might be expected to appear near sharp resonances, indicating slight differences in energy scale or in energy resolution, for example, between the total and elastic scattering cross sections. Larger ratios would appear at peaks and valleys if the resolution of partial cross sections is inferior to that of the total cross section. These would tend to distort the normality of the distribution.

The procedure also calculates a quantity called the discrepancy, which is the total cross section less the sum of the partial cross sections. The unification procedure dissipates this discrepancy among the total and partial cross sections according to their variances. In this energy range there are 42 ENDF/B-V energies, and therefore 42 least squares fits, which produce an average value of χ^2 of 0.49 for one degree of freedom. Only five cross sections changed by more than their uncertainty, and two by more than twice that amount. All were elastic, in the region of the peaks in the total and the elastic cross sections at 5.371 MeV, where the peaks were displaced by about 1 keV. Unified cross sections from 5 to 6.174 MeV are shown in table 15a, and an average correlation matrix in table 15b, which shows 50% correlation between elastic and inelastic cross sections.

4.4 Energy Range from 6.2 to 7.888 MeV

In this energy range, which includes also a contribution from the $^{12}C(n,\alpha_0)$ reaction, there are 82 ENDF/B-V energies. The 82 least squares fits produce an average value of χ^2 of 1.11 for 1 degree of freedom. The discrepancies are commensurate with their uncertainties. One total cross section and thirteen elastic cross sections change by more than their uncertainty, four of which change by more than twice that amount. All are associated with total cross section peaks at 6.295, 6.36, and 6.658 MeV; reflecting the superior resolution of the total cross section data. The unification procedure reduces the uncertainties of all the cross sections. For example the uncertainty in the elastic cross section is reduced from 5 to 2% in this energy range and in the previous one. Unified cross sections from 6.2 to 7.888 MeV are shown in table 16a, with an average correlation matrix in table 16b.

4.5 Energy Range from 7.89 to 10 MeV

In this energy range, which also includes a contribution from the $^{12}C(n,n'3\alpha)$ reaction, there are 95 energy points. Twenty-six cross sections (all elastic) change by more than their uncertainty, but none more than twice that amount. Most of these changes are associated with improvement of the resolution of the peak in the elastic cross section at 8.101 MeV and the subsequent valley at 8.92 MeV. The average value of χ^2 over this energy range is 1.0 for one degree of freedom. As an illustration of the effect of the unification procedure, the peak total cross section at 8.101 MeV is 1919.40 mb, and the interpolated evaluated partial cross sections for the (n,γ), elastic scattering, inelastic scattering, (n,α_0), and $(n,n'3\alpha)$ reactions are 0.11 mb, 1240.54 mb, 442.49 mb, 110.21 mb, and 0.30 mb, respectively. The discrepancy is 125.66 mb, which is disposed of by decreasing the total cross section by 15.57 mb and increasing the partial cross sections by 0.00 mb,[4] 91.32 mb, 15.87 mb, 2.89 mb, and 0.01 mb, respectively. The elastic cross section takes up most of the discrepancy because it has the greatest uncertainty in absolute terms.

Unified cross sections from 7.89 to 10 MeV are shown in table 17a, with an average correlation matrix of partial cross sections in table 17b.

4.6 Energy Range from 10.05 to 14.5 MeV

Agreement between the total cross section and the sum of the partial cross section is generally poor in this energy range, which comprises 84 ENDF/B-V energy points. The average value of χ^2 is 2.25. Thirty-eight cross sections change by more than their uncertainty, of which 26 are elastic cross sections and the remainder are distributed between the total, inelastic, (n,α_0), and $(n,n'3\alpha)$ cross sections. The discrepancies are caused by the conflict between the elastic scattering measurements of Gl76 and Ha75. Compared with the unified elastic cross section shape the measurements of Ha75 appear to be low at 11 and 12 MeV whilst those of Gl76 appear to be too low at 10.69 MeV and too high at 13.94 MeV. These observations indicate that there is little

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[4] There is an increase in the (n,γ) cross section which is insignificant to two decimal places.

correlation between measurements at different energies by the same author. The maximum value of χ^2, 14.8 at 12.1 MeV, suggests under-estimation of error by a factor approaching 4 at this energy. Unified cross sections from 10.05 to 14.5 MeV are shown in table 18a, with an average correlation matrix in table 18b.

4.7 Energy Range from 14.55 to 15.25 MeV

This range comprises 25 ENDF/B-V energies and also includes a contribution from the $^{12}C(n,p)^{12}B$ reaction. The average value of χ^2 is 1.0, and no cross section is changed by more than its uncertainty. Unified cross sections from 14.55 to 15.25 MeV are shown in table 19a, with an average correlation matrix in table 19b.

4.8 Energy Range from 15.45 to 17.3 MeV

This range comprises 23 ENDF/B-V energies and also includes a contribution from the $^{12}C(n,d)^{11}B$ reaction. As in section 4.7, the sum of the partial cross sections follows reasonably closely the total cross section. No cross sections are changed significantly by the unification procedure, which gives an average of 0.38 for the 23 values of χ^2. As usual, the uncertainties of the output cross sections are reduced, those with the larger absolute uncertainties benefitting the most.

In this energy range the uncertainty of the elastic cross section is reduced from 5% to 3.4%, and that of the $^{12}C(n,n'3\alpha)$ reaction is reduced from 15% to 12%. Unified cross sections from 15.45 to 17.3 MeV are shown in table 20a, with an average correlation matrix in table 20b.

4.9 Energy Range from 17.3 to 20.5 MeV

This energy range comprises 29 energies, and includes a contribution from the $^{12}C(n,np)^{11}B$ reaction. The ENDF/B-V energy grid terminates at 20 MeV. Above this energy, cross sections are evaluated at 0.1 MeV intervals. This is another region in which the sum of the partial cross sections follows closely the total cross section. No cross sections are changed significantly in the unification procedure. The average of the 29 values of χ^2 is 0.10. Unified cross sections from 17.3 to 20.5 MeV are shown in table 21a, with an average correlation matrix in table 21b.

4.10 Energy Range from 20.6 to 23.6 MeV

This energy range covers 31 energies, and it includes contributions from the $^{12}C(n,2n)^{11}C$ and $^{12}C(n,t)^{10}B$ reactions, which have similar threshold energies. Over most of this energy range the sum of partial cross sections is deficient, the discrepancy rising from zero at 21 MeV to about 170 mb at 26.4 MeV. At this energy 136 mb is transferred to the elastic cross section, which thus rises slightly more than its uncertainty of 15%. The fall in the elastic cross section observed by Me84 and Bo68 is thus over-ridden by the unification procedure. The other partial cross sections are also raised, but less significantly. The average of the 31 values of χ^2 is 0.45 but values above 23.2 MeV are between 1 and 1.5.

Unified cross sections from 20.6 to 23.6 MeV are shown in table 22a, with an average correlation matrix in table 22b.

4.11 Energy Range from 23.7 to 24.6 MeV

This energy range has 10 energies, and witnesses the onset of the $^{12}C(n,^{6}Li)^{7}Li$ reaction. The discrepancy is still of the order of 110-160 mb and the elastic cross section is still raised above the level of the observations of Me84 and Bo68, although the situation is alleviated by the relatively large contribution of the lithium production reaction. If the latter were omitted the other cross sections would have to rise even more. The average value of χ^2 is 0.98.

Unified cross sections from 23.7 to 24.6 MeV are shown in table 23a, with an average correlation matrix in table 23b.

4.12 Energy Range from 24.7 to 26.3 MeV

Two more reactions contribute to this energy range which comprises 17 energies. They are the $^{12}C(n,d\alpha)^{7}Li$ and $^{12}C(n,p\alpha)^{8}Li$ reactions. The discrepancy falls from 120 mb to zero over this energy range. These values are less than the relevant uncertainties, so that no individual cross section changes by more than its uncertainty. The average value of χ^2 is 0.25. However, it should be remembered that the $^{12}C(n,^{6}Li)^{7}Li$ cross section was not evaluated independently, but was chosen to bring the discrepancy close to zero at 26.3 MeV. Consequently the value of χ^2 has no real meaning.

Unified cross sections for 24.7 to 26.3 MeV are shown in table 24a, with an average correlation matrix in table 24b.

4.13 Energy Range from 26.4 to 32 MeV

This is the energy range in which the cross section σ_{spare} represents the sum of the cross sections of the final 17 reactions in table 2. Since σ_{spare} is a smoothed version of the difference between the total cross section and the sum of the evaluated partial cross sections the discrepancies in this energy range are simply a reflection of the "noise" in the total cross section, all partial cross sections being smooth. The operation of the unification procedure therefore only disperses this noise amongst the evaluated partial cross sections according to their variances. χ^2 in this situation is a meaningless quantity. Unified cross sections from 26.4 to 32 MeV are shown in tables 25a and 26a, with an average correlation matrices in tables 25b and 26b.

5. UNFOLDING THE COMPONENTS OF THE $^{12}C(n,n'3\alpha)$ CROSS SECTION

The components of the $^{12}C(n,n'3\alpha)$ reaction were discussed in La75 from which most of the carbon cross section data for ENDF/B-V was taken. From a study of the products of neutron reactions on carbon La75 concluded that:

(1) the $(n,n'3\alpha)$ reaction proceeds through sequential processes involving intermediate nuclei in particle-unstable states, and that no evidence has been reported for the simultaneous break-up of the carbon nucleus below 20 MeV.

(2) the low value of the separation energy for secondary particle emission is the main reason why only the 4.439 MeV γ-ray is produced by inelastic scattering. It was deduced that the largest contribution to the (n,n'3α) reaction comes from inelastic scattering with the ^{12}C nucleus excited above the 7.653 MeV level. The remaining small amount comes from the $^{12}C(n,\alpha)^{9}Be^{*}$ reaction with the ^{9}Be nucleus excited to the 2.4 MeV level which breaks up into n + 2α.

(3) the spectrum of emitted neutrons is therefore assumed to consist of a sum of Gaussian distributions associated with the excited states of ^{12}C, plus an evaporation spectrum due to the $^{12}C(n,\alpha)^{9}Be^{*}$ reaction.

Table 15 of La75 shows the total $^{12}C(n,n'3\alpha)$ cross section evaluated as the total cross section less the sum of the remaining partial cross sections, and this total is subdivided into contributions from the $^{12}C(n,\alpha)^{9}Be^{*}$ reaction, and from inelastic scattering to excited states of ^{12}C at 7.653, 9.638, 10.3, 10.84, 11.83, 12.71, and 13.35 MeV.

ENDF/B-V retained the total (n,n'3α) cross section of La75, but changed considerably the way that it was subdivided into the various contributing components. The share allocated to the $^{12}C(n,\alpha)^{9}Be^{*}$ reaction above 10 MeV is a straight 10% of the total, a large reduction on the La75 allocation (a factor of 4.5 at 12 MeV). Allocations for inelastic scattering to the excited states of ^{12}C at 7.653, 9.638, 10.3, and 10.84 MeV became corresponding larger, they peaked at lower energies, and reduced more rapidly with increasing neutron energies.

Instead of the excited states at 11.83, 12.71, and 13.85 MeV, a series of 23 pseudo-states were introduced at 0.5 MeV intervals starting at 11.25 MeV and terminating at 17.75 MeV. These 23 inelastic scattering cross sections were allocated characteristic shapes as a function of neutron energy above the individual threshold energies, and given amplitudes such that the sum of the contributing reactions equaled the total $^{12}C(n,n'3\alpha)$ reaction cross section. The departures from table 17 of La75 do not appear to be documented anywhere.

The cross sections for inelastic scattering to the 7.65 MeV and all higher states (ENDF/B-V reactions MT52-MT68) all have the same general shape, rising to a peak a few MeV above threshold, and becoming exponential a few MeV above the peak. For this evaluation the same general shape is assumed, but modified in the light of the new measurements now available.

Cross sections for inelastic scattering to the 7.655 and 9.84 MeV levels of ^{12}C (reactions MT52 and MT53) are derived from the measurements of Ba85, Gu81, Me84, and O187. Exponential shapes were fitted to the available data at neutron energies greater than 7.65 MeV above the reaction thresholds, yielding exponents of 7.874 MeV^{-1} and 9.285 MeV^{-1}, respectively. At lower energies smooth curves were drawn which exhibited peaks 4-5 MeV above the thresholds.

For the 10.8 MeV, 11.8 MeV, 12.7 MeV, 13.35 MeV, and 14.08 MeV levels of ^{12}C (MT54-MT58) only the data of Me84 are available, at neutron energies of 22 MeV and 24 MeV. In view of the large uncertainties of the data, and the wide spread of apparent exponents, it was assumed that these five cross sections would exhibit the exponential shape in this energy region, and that the exponent would be the same for all five reactions. Accordingly, a least squares calculation was used to determine the common exponent (3.587 MeV^{-1}), and individual amplitudes for each reaction. It was further assumed that the cross sections would peak at about 4 MeV above the thresholds.

Following ENDF/B-V, pseudo states were introduced at 1 MeV intervals with thresholds from 15.08 MeV to 29.08 MeV with similar cross section shapes. These are designated as reactions MT59-MT73.

In the absence of any information for the $^{12}C(n,\alpha)^{9}Be^{*}$ reaction (MT91) the cross section was evaluated as the difference between the unified $^{12}C(n,n'3\alpha)$ cross section and the sum of the cross sections for MT52-MT73. The amplitudes of the cross sections for the latter were then adjusted arbitrarily in order to produce a plausible shape for the cross section of MT91. The somewhat jagged shape of the latter is simply a reflection of the noise in the total cross section which is introduced into the $^{12}C(n,n'3\alpha)$ cross section by the unification procedure.

Evidence for the existance of high level states in ^{12}C is summarized in Aj85, where 37 such states are identified below 28 MeV. The cross sections derived here, which appear in Table 27, are necessarily rather speculative. Their purpose in the context of kerma calculations is to provide a basis for the estimation of kinetic energy transfer in the $^{12}C(n,n'3\alpha)$ reaction.

6. UNFOLDING THE COMPONENTS OF σ_{spare}

It is necessary to allocate cross section values to the 17 components of σ_{spare}, which represent the last 17 reactions listed in table 2, in order to determine a reasonable estimate of the average energy transfer per event for these reactions. In order to do this it is necessary to make some assumptions. It is assumed that these cross sections have the same general shape characteristics as those for the reactions discussed in section 3.12. Thus it is possible to calculate Q-values, reaction thresholds, Coulomb thresholds, positions of cross section peaks on the energy scale, and "decay" exponents. Armed with this information it is a simple matter to generate, by trial and error, a set of cross sections which follow the general shape characteristics, and which can then be normalized to the total unified σ_{spare}. The results of this exercise is shown in table 28.

It is important to realize that these cross sections are highly speculative, because apart from the uncertainty of the unfolding process, the value of the total unified σ_{spare} is dependent on the validity of all previously evaluated partial cross sections. Many of these are themselves highly speculative, and furthermore small errors in the large cross sections, such as the total, the elastic, and the $(n,n'3\alpha)$ have a profound effect on these results.

The total cross sections for the production of p, d, t, ^{3}He and α-particles at 32 MeV can be calculated by summing the contributions from all of the reactions involved, and are 88 mb, 41 mb, 56 mb, 10 mb, and 751 mb, respectively. Those for p and d are in reasonable agreement with values from table 12 interpolated at 32 MeV, but those for the heavier particles are considerably higher than the interpolated values.

7. ANGULAR DISTRIBUTIONS

Angular distributions of secondary neutrons produced by elastic and inelastic scattering are expressed in terms of coefficients derived from the fitting of Legendre polynomials to experimental data. In ENDF/B-V format the coefficients are expressed in terms of parameters f, which represent the Legendre coefficients normalized so that $f_o = 1$. Thus, $f_i = (P(i)\ell_o)/(P(o)\ell_i)$. In Ca80 it was shown that, for the purposes of kerma calculations, only f_1 is required. For the calculation of mean energy transfer per event, $\bar{E}$, only the average energy of the scattered neutrons is required, not their angular distribution. Hence, in their expressions for $\bar{E}$ the terms containing other f factors cancel out. Time did not permit a new evaluation of f factors based on all the scattering data considered in the cross section evaluation. An evaluation of f_1 in isolation would serve no useful purpose because it might well lead to unacceptable angular distributions. It was therefore decided that, for the purposes of the present calculations of kerma, the ENDF/B-V values should be adopted. However, since the ENDF/B-V covariance files give no information regarding the uncertainties of f_1 it was necessary to allocate uncertainties based on those obtained in Legendre polynomial fitting processes mentioned in section 3.4. ENDF/B-V provides f values only for inelastic scattering to the first three excited states of ^{12}C, scattering to higher states and pseudo-states being assumed to be isotropic. There remains the problem of extending the ENDF/B-V data to 32 MeV.

For elastic scattering a survey of results from the Legendre polynomial fitting processes indicated an uncertainty of 5% for f_1 values up to 20 MeV. Uncertainties for individual results were in general much smaller, but the scatter of values from different authors suggested that 5% would be reasonable. The Legendre coefficients relating to the measurements of Me84 and Wi86 demonstrated clearly that f_1 for elastic scattering continues to rise over the range from 20 to 32 MeV. The f_1 file was extended through values obtained from the Legendre coefficients of Me84 and Wi86, with uncertainties of 2%. For inelastic scattering to the 4.439 MeV level of ^{12}C also, the f_1 values continue to rise. The curve was extended by means of a straight line from the 20 MeV point through the values based on Legendre coefficients of Me84, representing an increase of about 15% at 32 MeV. The f_1 curve shows structure up to about 15 MeV and has many negative values and values close to zero, so relative uncertainties are rather meaningless. Uncertainties of ± 0.03 were used for energies up to 15 MeV, and above that energy, where the scatter of individual values is greater, the uncertainty was increased to ± 0.06. For inelastic scatter to the 7.563 MeV and 9.638 MeV levels of ^{12}C the f_1 values were assumed to remain constant at their 20 MeV values.

8. CALCULATIONS OF MEAN KINETIC ENERGY TRANSFER AND KERMA

For calculations of $\bar{E}$, the average amount of energy transferred to kinetic energy of charged particles in each reaction, the non-relativistic equations of Ca80 are used. These equations are stated to be accurate to 1% for neutron energies up to 30 MeV incident upon target nuclei up to mass 55, and must therefore be accurate to better than 1% for 32 MeV neutrons incident upon carbon. Natural carbon consists of 99.892% ^{12}C and 1.108% ^{13}C. For most cross section measurements pure natural carbon is used unless isotopic ^{13}C is specifically stated. However, in the application of the equations to determine

$\bar{E}$, for the determination of Q-values and threshold energies in table 2, and in the subsequent discussions of charged particle reactions, it is assumed that natural carbon is ^{12}C.

Examples of thresholds of similar reactions in ^{13}C are (n,α) 4.198 MeV, (n,t) 13.385 MeV, (n,p) 13.636 MeV, (n,d) 14.887 MeV, and (n,2n) 5.330 MeV. Experiments in which charged particles are detected would presumably record charged particle reactions from ^{13}C as well as from ^{12}C, but wrong $\bar{E}$ values would be attributed to them. Measurements of $^{12}C(n,2n)$ by activation would not record $^{13}C(n,2n)$, but would record $^{13}C(n,3n)$ with a threshold of 25.5 MeV.

Thresholds of some possible mechanisms for the $^{13}C(n,2n3\alpha)$ break-up reaction are

$$n + {}^{13}C \rightarrow ({}^{8}Be \rightarrow 2\alpha) + {}^{6}He^{*(1.8\ MeV)} \rightarrow 2n + \alpha \quad 14.162\ MeV$$

$$n + {}^{13}C \rightarrow 2n + 3\alpha \quad 13.169\ MeV$$

$$n + {}^{13}C \rightarrow 2n + {}^{12}C^{*(7.653\ MeV)} \rightarrow 3\alpha \quad 13.577\ MeV$$

$$n + {}^{13}C \rightarrow n + \alpha + {}^{9}Be^{*(2.429\ MeV)} \rightarrow n + 2\alpha \quad 14.091\ MeV$$

Such possibilities have been ignored in this evaluation because of the low abundance of ^{13}C.

The product of cross section in units of mb, and $\bar{E}$ in units of MeV, produces kerma factors in units of mb·MeV·atom^{-1}. Conversion to the SI unit Gy·m^2 is achieved by multiplication by the factor 8.04044 x 10^{-19}, which is the product of the three factors atoms per kg of ^{12}C(6.0221367 ÷ 12) x 10^{26}, J·MeV^{-1} (1.60217733 x 10^{-13}), and m^2·mb^{-1} (10^{-31}).

In calculating $\bar{E}$ it is assumed that all final nuclei are at ground-state levels. Cases where final states are above the level at which charged particle emission becomes possible are catered for by the introduction of the appropriate multi-body reactions. However, intermediate states are possible which are above the ground state but below the level for charged particle emission, and which decay by γ-ray emission which does not contribute to the kerma factor. Ca80 took the view that if these intermediate states are energetically possible they will occur to some extent. Where cross section data was not available, they used a simple algorithm, called "energy averaging," which assumed that the probability of excitation of the intermediate levels increases linearly from zero at the Coulomb threshold to free (equally probable) excitation at 2 MeV above the threshold. This energy averaging procedure is not used in this evaluation, but a rough estimate is made of the consequences of including it. Energy-averaging would have a noticeable effect in the calculation of $\bar{E}$ if applied to the intermediate (i.e., above ground state and below charged particle emission level) states of ^{11}C, ^{12}B, ^{11}B, ^{10}B, ^{8}Li, and ^{7}Li. At 19 MeV there would be a reduction of 4.8% in total kerma, principally due to the (n,d) and (n,np) reactions. At 28 MeV the reduction would be 2.45% of total kerma mainly due to the (n,d), (n,np), (n,dα), and (n,2n) reactions. At 32 MeV the reduction would be about 1.4%. Uncertainties due to these effects are not included in the uncertainties quoted for kerma factors, the latter being derived only from propagation of the uncertainties in cross sections and f_1 values. The unification procedure, which contributes the information that the sum of the partial cross sections is equal to the total cross section, has a reducing effect on the uncertainties of the cross sections, and the negative correlation between pairs of partial cross sections further reduces the uncertainties in the kerma factors.

Kerma factors, partial kerma factors, and uncertainties, in units of $fGy \cdot m^2$ are presented in tables 30 through 41.

9. SIMULTANEOUS FIT TO CARBON CROSS SECTIONS AND KERMA

The kerma factors presented in tables 30 through 41 are calculated from unified cross sections and calculated $\bar{E}$ values only. Measured kerma values were not considered. It is therefore of interest to repeat the simultaneous evaluation of cross sections and kerma described in section 2 and Appendices 1 through 3. The problem of finding a model with sufficient simplicity and flexibility remains, so it is necessary to retain the same model with all its faults, because no better one has been devised. The assumption of rigidity for all cross section shapes is less true now than at the beginning, and as before, the cross section for the (n,n'3α) reaction cannot float independently without disturbing the equality between the total cross sections and the sum of the partial cross sections. The input data set needs editing because it is necessary to delete all cross section measurements which were used in the cross section evaluation, leaving only kerma and partial-kerma measurements, $\bar{E}$ measurements, and measurements of the total α-particle production between 14 and 15 MeV. The kerma measurement of Mc87 was also deleted following criticism of the interpretation of this experiment by Go87. The input data and fitted values for this calculation are shown in table 42. The fitted values demonstrate that the unified cross sections are much more in harmony with the available measurements of kerma than are the ENDF/B-V cross sections. This is demonstrated by the low value of χ^2 which is 14 for 29 degrees of freedom. The total, elastic, (n,p), and (n,d) cross sections are reduced by only 0.3%, 0.1%, 0.3%, and 0.5%, respectively. The inelastic and (n,α) cross sections rise by 3.1% and 1.3%, respectively.

Kerma factors calculated from the simultaneous fit are presented in table 43. They are approximately 4% lower than those of tables 30 through 41. Uncertainties for the values in table 43 are not quoted because they are unrealistically small, being a by-product of the over-simplified model which assumes that all cross section data are exact apart from the errors in the normalizing factors. Nevertheless, the fitting exercise demonstrates clearly the improved agreement between measured and calculated kerma factors.

Total kerma factors from the simultaneous fit are compared with those in tables 30 through 41, and with calculations by other authors in figure 7. Partial kerma factors appear in figures 8 through 12.

10. DISCUSSION

The evaluated data for the partial cross sections form a consistent set, the sum of which is equal to the total cross section. If any partial cross section is reduced substantially, for example the cross sections which yield high kerma in the energy range from 20 MeV to 32 MeV, the defect would have to be rectified by increasing other partial cross sections. The weighting would ensure that most of this defect would be allocated to the elastic scattering reaction. The unified elastic scattering cross section is already raised substantially above the evaluated curve of table 5b, and above the Me84 optical model calculations, and to cause it to be raised further would contradict the available evidence. The controversial $^{12}C(n,^{6}Li)^{7}Li$ reaction, with its 100 mb peak cross section, is a case in point. If the reaction is eliminated, another home has to be found for this 100 mb at 26 MeV. There appears to be nowhere for it to go without conflicting with the available evidence upon which the evaluated cross sections are based.

The calculated kerma factors are lower than those of Ca80 above 13 MeV as a result of the reduction in the $(n,n'3\alpha)$ cross section from the ENDF/B-V curve and the redistribution of the components of this reaction. From 20 MeV to 32 MeV the calculated values of Br83, Dy82, Be81, and We79 are 15% to 25% lower. It is not easy to see how the present kerma factors could be reduced by such large amounts. Significant re-arrangement of the values of partial cross sections would conflict with available evidence.

Kerma calculations based on ENDF/B-V shapes for the MT52-MT73 would be about 10% higher above 20 MeV, and therefore even more in disagreement with the other authors in figure 7. The new shape is compared with the ENDF/B-V shape in figure 13 where all available data is shown for inelastic scattering to the 7.65 MeV, 9.63 MeV, 10.8 MeV, 11.8 MeV, 12.7 MeV, 13.55 MeV, and 14.08 MeV states of ^{12}C. In order to display these on a single graph, they are plotted on a horizontal scale of $E_n - E_{th}$, and normalized to a scale of arbitrary units by least squares fitting. The decay exponent is 7.71 MeV. Figure 14 is similar to figure 13, but only the top five of the above states are included, and the decay exponent is 3.71 MeV.

The tabulated kerma factors could be reduced by perhaps 5% to 2% over the energy range from 19 MeV to 32 MeV by taking into consideration the energy-averaging procedure described in section 8, but this would be insufficient agreement with the other authors in figure 7.

11. CONCLUSIONS

The parts of the carbon cross section file which have been evaluated are a considerable improvement on the ENDF/B-V version, partly as a result of the inclusion of modern data and partly as a result of the unification procedure used to dissipate more fairly the discrepancies between total and partial cross sections. In addition important correlations between partial cross sections are provided. Aspects which should receive high priority in any further work would be the evaluation of angular distributions and the inclusion of new data such as the scattering measurements from PTB and revised values from the TUNL University group. To facilitate ease of access, the data should be transformed into ENDF/B-V format. Calculated values of kerma could possibly be reduced by as much as 5% above 20 MeV, but not enough to create agreement with some of the other calculations.

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Appendix 1. Comments on the Least Squares Fitting Procedure

The linear model is[1]

$$y = Ab + \epsilon \quad ,$$

where
- y is a specified n-element observation vector,
- A is a specified n by p design matrix containing the differentials of each measurement with respect to the parameters to be fitted,
- b is a p element regression vector to be determined, (the solution),
- ϵ is an unknown n-element noise vector with zero mean and covariance Z,
- n is the total number of measurements, and p is the number of unknown parameters to be determined, leading to n-p degrees of freedom.

The solution satisfies the normal equations

$$A^T Z^{-1} Ab = A^T Z^{-1} y \quad ,$$

where Z is the covariance matrix of the input data. In the construction of the covariance matrix it is assumed that all uncertainties in the measurements are estimated at the one standard deviation (68% confidence) level.

The solution, which can be obtained by matrix inversion of the covariance matrix, Z, is

$$b = (A^T Z^{-1} A)^{-1} A^T Z^{-1} y \quad ,$$

with residual vector

$$r = y - Ab \quad ,$$

and covariance matrix

$$V = (A^T Z^{-1} A)^{-1} \quad .$$

The statistical parameter χ^2 is given by

$$\chi^2 = r^T Z^{-1} r \quad .$$

Although in theory Z will be positive semi-definite, it will not necessarily be positive-definite. Occasions can occur when the solution cannot be obtained by straightforward matrix inversion of Z, because wrong results can be obtained if the matrix is near-singular. It is always safer to use the method of Cholesky factorization to solve the equations. The procedure is to derive a weight matrix W such that $W^T W = Z^{-1}$. Then if $A' = WA$ and $y' = Wy$ the solution is identical to that of the model $y' = A'b + f$, where f has zero mean and only diagonal variance.

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The solution is then given by

$$b = (A')^{-1} y' \quad , \quad \text{where } (A')^{-1} \text{ is the pseudo-inverse of } A'$$

with (weighted) residual vector

$$r' = y' - A'b \quad ,$$

and covariance matrix

$$V = [(A')^T A']^{-1} \quad .$$

The statistical parameter χ is given by

$$\chi^2 = (r')^T r' \quad .$$

The residual vector r can be obtained from

$$r = W^{-1} r' \quad ,$$

but it is better to save time by using the expression for r given above.

The Cholesky method is safer, and therefore less vulnerable to criticism, and it also uses considerably less computer time and space when large matrices are involved. FORTRAN[2] and APL[3] algorithms are available for this operation.

The uncertainties in the fitted parameters are derived from the diagonal elements of V. These are normally referred to as internal uncertainties which are derived from the statistical uncertainties of the measurements. To obtain what are normally referred to as external uncertainties, which also take into account the goodness of fit, it is necessary to multiply V by $\chi^2/(n-p)$, where n is the number of observations, and p is the number of unknown parameters to be fitted.

In order to linearize the problem it is necessary to guess starter values GP for the p unknown parameters to be determined. Each measurement Y is expressed as a function f(GP), and the observation vector y consists of the differences Y-f(GP). The solution b is a vector of small corrections to the GP, with covariance V. The calculation is then iterated by restarting with the corrected GP until b becomes zero or negligible.

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[2]S. L. Hammarling, E.M.R. Long, D. W. Martin, NPL Report DITC 33183 (1983).

[3]C. Bastian, "An APL Workspace of Interactive Multi-parametric Evaluation," CBNM Report GE/R/LI/142/84 (1984).

Appendix 2. Input Data and Fitted Values

Author	Measured Quantity	Measured Value	Uncertainty	Fitted Value	Residual	Weighted Residual
ENDF/B-V	gp[1]	1.000	.040	.941	.059	1.485
ENDF/B-V	gp[2]	1.000	.080	.945	.056	.694
ENDF/B-V	gp[3]	1.000	.150	1.079	-.079	-.524
ENDF/B-V	gp[4]	1.000	.250	.890	.110	.438
ENDF/B-V	gp[5]	1.000	.050	1.000	-.000	-.002
ENDF/B-V	gp[6]	1.000	.150	.947	.054	.357
ENDF/B-V	gp[7]	1.000	.150	1.162	-.162	-1.078
ENDF/B-V	gp[8]	1.000	.250	1.045	-.045	-.180
ENDF/B-V	gp[9]	1.000	.250	1.005	-.005	-.018
ENDF/B-V	gp[10]	1.000	.250	1.060	-.060	-.239
De84	fk 14.1*	1.780	.110	1.832	-.052	-.474
Mc87	fk 14.6	1.800	.160	2.018	-.218	-1.361
De85	fk 15	2.100	.160	2.209	-.109	-.679
Bu85	fk 15	2.350	.210	2.209	.141	.673
Bu85	fk 17	2.460	.240	2.734	-.274	-1.142
De86	fk 17.8	2.920	.220	2.927	-.007	-.031
De85	fk 17.9	2.970	.300	2.965	.005	.016
De86	fk 19.8	3.550	.280	3.131	.419	1.496
Ha84	csa 14.1*	72.0	9.0	72.3	- .30	-.038
Br84	cs3a 16	350.0	34.0	352.9	- 2.9	-.085
Br84	cs3a 17	292.0	22.2	322.7	-30.7	-1.384
Br84	cs3a 18	315.0	23.3	316.9	-01.9	-.082
Br84	cs3a 19	319.0	22.3	285.2	33.8	1.515
Br84	cs3a 20	283.0	16.7	269.9	13.1	.783
Va58	cs3a 14	176.0	82.0	196.0	-20.0	-.244
An83	cs3a 14	301.0	89.0	196.0	105.0	1.179
Fa71	cs3a 14	190.0	20.0	196.0	-06.0	-.302
Fr55	cs3a 14.1	230.0	50.0	200.3	29.7	.595
Gr69	cs3a 14.1	190.0	20.0	200.3	-10.3	-.514
Co76	cs3a 14.2	202.0	30.0	204.5	-02.5	-.085
An86	cs3a 11.915	176.8	24.6	148.8	28.0	1.138
An86	cs3a 12.895	167.1	15.9	143.9	23.2	1.459
An86	cs3a 14	201.5	16.0	196.0	05.5	.341
An86	cs3a 14.8	227.6	13.3	238.2	-10.6	-.795
An86	cs3a 17	272.0	17.0	322.7	-50.7	-2.983
An86	cs3a 19	300.0	14.2	285.2	14.8	1.045
Ho76	csta 14.4	654.0	92.0	730.3	-76.3	-.829
Fa78	csta 14.8	900.0	70.0	786.0	114.1	1.629
Kn86	csta 14.8	894.0	60.0	786.0	108.1	1.801
Ho76	csta 14.9	744.0	60.0	799.7	-55.7	-.927
Ha84	fka 14.1*	.490	.060	.488	.002	.028
Ha84	fk3a 14.1	.560	.080	.749	-.189	-2.361
An84	feb3a 10.91	3.010	1.260	2.237	.773	.614
An84	feb3a 12.93	4.020	1.110	3.718	.303	.273
An84	feb3a 14.95	5.630	1.130	5.277	.354	.313
An84	feb3a 16.87	5.940	1.210	6.491	-.551	-.456
2 An84	feb3a 18.94	7.690	1.190	8.150	-.460	-.386

*Kerma values are in fGy·m. Cross section values are in mb. $\bar{E}$ values are in MeV.

Appendix 3. Description of Functions Used in the Tables

gp[1]	Multiplying factor for carbon total cross section.
gp[2]	Multiplying factor for carbon elastic scattering.
gp[3]	Multiplying factor for inelastic scattering to the first excited state.
gp[4]	Multiplying factor for the (n,α) reaction.
gp[5]	Multiplying factor for the (n,p) reaction.
gp[6]	Multiplying factor for the (n,d) reaction.
gp[7]	Multiplying factor for f_1 for elastic scattering.
gp[8]	Multiplying factor for f_1 for inelastic scattering.
gp[9]	Multiplying factor for f_1 for ENDF/B-V reaction MT52.
gp[10]	Multiplying factor for f_1 for ENDF/B-V reaction MT53.
fk	Total kerma. The succeeding argument specifies the neutron energy.
fka	Partial kerma from the (n,α) reaction.
fk3a	Partial kerma from the (n,n'3α) reaction.
csa	Partial cross section for the (n,α) reaction. = gp[4] x $\sigma_{n,\alpha}$
cstot	Total cross section = gp[1] x σ_{tot}
cs3a	Partial cross section for the (n,n'3α) reaction. = (gp[1] x σ_{tot}) - (gp[2] x σ_{el}) - (gp[3] x $\sigma_{nn'g}$) - - (gp[4] x $\sigma_{n,\alpha}$) - (gp[5] x $\sigma_{n,p}$) - (gp[6] x $\sigma_{n,d}$)
csta	Cross section for total α production. Equal to csa plus 3xcs3a.
feb3a	$\bar{E}$ = kinetic energy transfer for (n,n'3α) reaction calculated using gp[7] through gp[10].

Several tens of such functions are used in the definition of total kerma. Only those listed in the input table are defined here. As an example of their use, the first element of the observation vector y is 1-gp[1]. The eleventh element is 1.78-(fk 14.1).

Table 1

ENDF/B-V File Structure and Sources of Data

Reaction Energy Range (MeV)	Total (1)	Elastic (2)	Inelastic First state (2)	n,α (107)	n,n′3α	n,p (103)	n,d (104)	n,γ (3)
10^{-8}-4.81	Elastic + n,γ	R matrix analysis						1/V to 1 MeV based on thermal value
4.81-6.32	Sc67	Ga72	Total-n,γ - elastic				Derived from (d,n) reaction data of Am57	Derived from γ,n cross section data of Co57
6.32-7.887	Ci69	Ve73	Total-n,γ - elastic - n,α	Da63 Ve68				
7.887-8	Pe72	Pe72	Same references as elastic plus γ-ray data of Mo72	Re60	The sum of reactions 52-91 normalised to the total - the sum of all other partial cross sections			
8-8.796		Ha75		Gr55		Ri68		
8.796-14		Ve73		Ob72 Va70				
14 - 20		Bo68						

Table 2

Reactions with Thresholds Below 32 MeV

Reaction		Threshold	Q MeV
$^{12}C(n,\alpha)$	^{9}Be	6.181	5.702
$^{12}C(n,n\alpha)$	^{8}Be	7.986	7.367
$^{12}C(n,^{5}He)$	^{8}Be	8.954	8.260
$^{12}C(n,p)$	^{12}B	13.646	12.588
$^{12}C(n,d)$	^{11}B	14.887	13.733
$^{12}C(n,np)$	^{11}B	17.298	15.957
$^{12}C(n,2n)$	^{11}C	20.296	18.722
$^{12}C(n,t)$	^{10}B	20.522	18.931
$^{12}C(n,^{3}He)$	^{10}Be	21.105	19.468
$^{12}C(n,^{6}Li)$	^{7}Li	22.683	20.924
$^{12}C(n,\alpha d)$	^{7}Li	24.281	22.398
$^{12}C(n,\alpha p)$	^{8}Li	24.489	22.590
$^{12}C(n,\alpha t)$	^{6}Li	25.357	23.391
$^{12}C(n,dt)2\alpha$		26.955	24.865
$^{12}C(n,dt)$	^{8}Be	27.055	24.957
$^{12}C(n,pd)$	^{10}Be	27.060	24.962
$^{12}C(n,nd)$	^{10}B	27.306	25.189
$^{12}C(n,^{6}He)$	^{7}Be	27.422	25.296
$^{12}C(n,pt)$	^{9}Be	27.661	25.516
$^{12}C(n,2n)\alpha$	^{7}Be	28.475	26.267
$^{12}C(n,2p)$	^{11}Be	28.927	26.684
$^{12}C(n,^{3}He)\alpha$	^{6}He	29.142	26.882
$^{12}C(n,npt)2\alpha$		29.366	27.089
$^{12}C(n,npt)$	^{8}Be	29.466	27.181
$^{12}C(n,n2p)$	^{10}Be	29.472	27.187
$^{12}C(n,nt)$	^{9}B	29.666	27.366
$^{12}C(n,2np)$	^{10}B	29.717	27.413
$^{12}C(n,^{3}He)2\alpha 2n$		30.195	27.853
$^{12}C(n,\alpha pt)$	^{5}He	30.335	27.983

Table 3.

Total Cross Section Ratios of Various Data Sets to Ci78

Ref.	Energy Range (MeV)	Unweighted mean ratio	Standard deviation	Standard error of mean
Au79	5- 8	0.9848	0.0630	0.0056
Au79	8- 9.92	0.9817	0.0205	0.0022
Au79	10-13.82	0.9871	0.0134	0.0015
La75	5- 8	1.0017	0.0494	0.0044
La75	8-10	1.0016	0.0158	0.0017
Sc67	5- 8	1.0023	0.0633	0.0056
Sc67	8- 9.92	1.0071	0.0273	0.0029
Sc67	10-14.812	1.0143	0.0285	0.0030
ENDF/B-V	5- 8	1.0063	0.0411	0.0036
ENDF/B-V	8-10	0.9987	0.0155	0.0010
ENDF/B-V	10-14.812	0.9844	0.0138	0.0014
ENDF/B-V	15-20	1.0023	0.0218	0.0026

Table 4

Total Cross Sections Reduced to ENDF/B-V Energy Grid

E_n MeV	mb	Δmb	E_n MeV	mb	Δmb
5.000	1178.400	20.496	6.240	1416.300	24.470
5.001	1193.000	17.895	6.250	1482.200	23.914
5.030	1174.400	18.774	6.285	2410.800	37.807
5.053	1170.300	18.440	6.295	2736.200	46.010
5.100	1148.200	18.166	6.303	2623.700	44.941
5.120	1138.800	18.360	6.310	2394.900	40.465
5.150	1132.300	18.045	6.320	1941.500	32.660
5.180	1121.100	18.083	6.330	1701.300	28.798
5.200	1103.600	17.833	6.340	1511.200	25.862
5.230	1094.800	17.239	6.350	1479.700	25.404
5.280	1061.600	16.876	6.360	1640.400	27.712
5.300	1056.000	17.163	6.370	1420.700	23.486
5.330	1041.600	17.493	6.390	1174.100	19.922
5.335	1077.400	21.326	6.400	1157.200	20.603
5.340	1013.400	17.957	6.410	1122.700	20.193
5.360	1572.800	26.160	6.420	1093.600	19.923
5.362	1853.100	33.647	6.430	1107.900	19.965
5.370	2023.200	35.829	6.440	1079.800	19.559
5.371	1996.800	37.007	6.450	1079.000	18.531
5.378	1771.800	32.569	6.470	1056.100	17.660
5.380	1685.100	29.735	6.490	1056.300	17.645
5.390	1460.500	24.863	6.510	1043.400	17.125
5.400	1322.300	22.803	6.540	991.800	16.631
5.410	1258.200	21.933	6.553	913.320	17.376
5.420	1226.200	21.408	6.560	863.340	17.197
5.430	1197.600	21.027	6.570	772.930	15.443
5.440	1192.700	19.965	6.580	732.310	14.779
5.460	1145.800	18.282	6.590	746.190	15.059
5.500	1118.900	17.535	6.600	735.500	13.852
5.550	1100.100	17.760	6.620	775.900	13.710
5.553	1111.100	18.003	6.640	749.720	13.531
5.600	1087.800	17.037	6.658	939.870	16.904
5.650	1078.400	16.883	6.665	855.590	17.982
5.700	1067.400	16.490	6.670	842.130	17.205
5.800	1079.800	16.556	6.680	840.890	15.226
5.900	1078.300	16.540	6.700	838.770	13.761
6.000	1095.900	16.924	6.750	817.920	13.042
6.050	1102.000	17.842	6.810	800.940	12.529
6.053	1106.300	17.548	6.920	771.600	12.046
6.125	1132.400	17.663	7.000	745.790	11.868
6.160	1162.600	18.879	7.053	749.840	12.142
6.174	1190.500	21.109	7.100	749.050	12.257
6.180	1196.100	20.435	7.140	768.240	12.627
6.200	1222.500	20.596	7.180	794.810	13.336
6.210	1271.000	22.265	7.200	843.690	14.650
6.220	1285.500	22.551	7.220	874.250	16.141
6.230	1334.200	23.168	7.225	884.730	15.864

Table 4 (Continued)

E_n MeV	mb	Δmb	E_n MeV	mb	Δmb
7.250	972.010	16.303	8.166	1666.000	26.571
7.270	1061.500	18.289	8.200	1507.700	24.147
7.280	1130.900	18.071	8.210	1453.600	25.103
7.340	1639.700	25.538	8.218	1435.900	23.595
7.350	1758.500	29.804	8.240	1382.400	21.791
7.360	1753.900	29.666	8.280	1286.400	20.523
7.370	1811.000	28.946	8.296	1252.600	23.131
7.400	1778.100	28.105	8.296	1250.900	18.765
7.420	1766.800	27.528	8.320	1228.800	20.309
7.470	1750.200	26.919	8.330	1206.600	19.054
7.529	1749.700	27.231	8.391	1140.900	18.113
7.542	1727.700	28.642	8.400	1131.700	18.861
7.553	1718.200	27.121	8.426	1133.500	18.417
7.594	1696.300	26.501	8.448	1116.200	19.188
7.620	1693.400	26.631	8.450	1096.600	18.476
7.650	1713.500	27.170	8.480	1109.600	18.026
7.667	1774.100	28.872	8.500	1085.800	19.673
7.680	1799.900	29.247	8.500	1075.200	16.130
7.698	1926.000	31.955	8.520	1082.800	17.545
7.700	1930.500	31.584	8.553	1064.300	16.848
7.725	2238.900	35.323	8.600	1077.900	17.366
7.745	2441.200	39.845	8.611	1078.200	17.248
7.750	2398.900	39.181	8.664	1061.800	16.713
7.770	2280.500	36.257	8.700	1066.100	17.494
7.789	2141.600	34.071	8.708	1059.800	17.242
7.810	2051.800	33.131	8.750	1057.000	16.995
7.819	2061.300	32.420	8.768	1063.200	17.316
7.860	2007.000	31.209	8.800	1067.000	17.052
7.887	1975.100	32.153	8.833	1068.700	17.387
7.888	1950.400	29.324	8.850	1067.700	17.328
7.897	1949.300	30.967	8.885	1089.200	17.293
7.930	1916.700	30.542	8.920	1074.800	17.360
7.936	1891.700	29.399	8.940	1094.800	17.530
8.000	1843.300	28.682	8.980	1117.300	17.860
8.005	1857.600	32.804	9.000	1122.100	19.234
8.010	1813.200	33.742	9.005	1143.700	20.063
8.014	1858.400	29.883	9.020	1142.800	19.557
8.044	1850.500	29.570	9.030	1155.900	19.781
8.053	1898.300	30.441	9.045	1160.500	19.996
8.079	1907.700	31.241	9.053	1186.300	20.468
8.080	1892.800	28.395	9.067	1183.400	19.973
8.100	1901.400	31.756	9.080	1215.100	19.025
8.101	1919.400	29.568	9.149	1286.800	20.075
8.105	1905.100	35.143	9.163	1308.200	21.493
8.109	1876.700	32.208	9.180	1301.600	20.658
8.120	1860.900	30.957	9.219	1329.000	20.850
8.131	1824.600	31.032	9.250	1324.100	21.411
8.138	1809.200	29.519	9.254	1340.600	21.318
8.160	1717.700	28.033	9.300	1319.900	20.923

Table 4 (Continued)

E_n MeV	mb	Δmb	E_n MeV	mb	Δmb
9.310	1321.100	20.856	10.940	1417.200	21.842
9.360	1293.100	20.100	11.000	1424.500	22.201
9.400	1267.600	19.723	11.004	1415.400	22.285
9.450	1252.300	19.426	11.053	1429.200	22.071
9.500	1237.400	19.447	11.096	1416.600	22.387
9.522	1238.900	19.738	11.100	1422.700	22.097
9.553	1224.300	19.946	11.166	1417.800	22.029
9.560	1231.700	20.060	11.170	1418.300	21.957
9.590	1224.700	19.873	11.250	1408.200	21.569
9.600	1222.300	19.888	11.300	1405.400	21.466
9.630	1229.500	19.920	11.400	1396.500	21.237
9.640	1241.100	19.843	11.500	1361.100	20.796
9.678	1237.100	19.971	11.553	1349.800	20.538
9.680	1237.400	22.597	11.700	1330.900	20.261
9.692	1237.800	21.123	11.750	1350.200	21.380
9.700	1248.800	20.473	11.751	1342.800	21.099
9.726	1237.100	20.066	11.800	1346.300	20.951
9.740	1256.600	21.344	11.828	1359.700	20.971
9.750	1232.600	19.509	11.900	1399.500	21.674
9.800	1242.900	19.502	11.909	1391.600	23.334
9.821	1231.700	20.495	11.917	1408.000	21.726
9.830	1233.000	19.771	12.000	1446.100	22.122
9.868	1208.000	19.003	12.050	1482.500	23.393
9.900	1188.700	19.112	12.053	1492.500	23.658
9.917	1190.800	20.287	12.088	1498.000	23.611
9.921	1177.500	18.410	12.100	1503.500	23.078
10.000	1173.400	18.294	12.196	1434.800	21.987
10.003	1163.800	18.592	12.224	1414.500	22.254
10.050	1161.800	18.582	12.250	1400.800	21.744
10.053	1150.900	17.777	12.300	1364.100	20.845
10.170	1137.200	17.383	12.400	1348.100	20.511
10.250	1125.800	17.373	12.500	1336.700	20.430
10.300	1117.400	17.282	12.553	1347.300	20.786
10.372	1136.200	17.665	12.599	1350.100	20.643
10.400	1144.100	17.964	12.700	1363.500	20.861
10.448	1163.900	18.234	12.738	1356.700	20.935
10.478	1181.500	18.851	12.800	1379.500	21.050
10.500	1198.600	19.884	12.900	1397.800	21.269
10.506	1198.900	19.516	12.990	1408.500	21.688
10.536	1218.900	19.573	13.000	1409.700	21.998
10.550	1216.300	20.688	13.053	1406.000	21.651
10.553	1232.900	19.346	13.100	1406.200	21.937
10.620	1274.100	19.550	13.120	1405.900	21.468
10.690	1311.800	20.385	13.250	1387.800	21.177
10.700	1312.100	20.647	13.280	1367.600	21.641
10.750	1352.000	20.860	13.300	1375.600	20.900
10.800	1378.800	21.392	13.500	1387.600	21.057
10.830	1392.200	21.464	13.540	1397.200	21.957
10.900	1415.000	21.757	13.553	1395.800	22.097

Table 4 (Continued)

E_n MeV	mb	Δmb	E_n MeV	mb	Δmb
13.587	1396.000	21.551	16.256	1472.500	22.268
13.646	1367.700	21.025	16.440	1446.400	22.067
13.700	1360.600	20.971	16.443	1441.600	22.226
13.748	1344.300	20.642	16.532	1431.800	22.055
13.822	1303.000	20.247	16.553	1429.100	21.855
13.830	1307.200	20.009	16.695	1408.600	21.389
13.965	1297.200	19.805	16.820	1404.500	21.600
14.000	1302.700	20.210	16.824	1400.800	21.428
14.053	1307.500	19.938	16.974	1391.100	21.177
14.182	1310.500	19.963	17.053	1398.400	21.666
14.250	1316.700	20.080	17.074	1403.800	21.890
14.364	1299.000	19.838	17.138	1386.100	21.115
14.419	1294.000	19.847	17.300	1406.400	21.554
14.500	1315.100	20.166	17.301	1405.100	21.475
14.553	1342.500	20.943	17.467	1399.100	21.287
14.566	1341.500	20.696	17.553	1407.400	21.615
14.653	1374.700	21.084	17.616	1413.800	21.756
14.694	1387.100	21.414	17.687	1413.700	22.292
14.750	1395.400	21.685	17.900	1427.000	22.305
14.767	1393.400	21.865	17.901	1430.600	22.098
14.807	1407.000	22.145	18.000	1439.300	22.094
14.812	1411.200	22.982	18.053	1452.500	22.642
14.837	1406.700	22.153	18.087	1443.900	22.389
14.863	1402.700	22.130	18.158	1468.300	22.451
14.888	1397.700	22.969	18.273	1465.100	22.248
14.892	1407.300	22.568	18.460	1454.400	22.118
14.906	1408.600	24.443	18.553	1468.100	22.501
14.909	1406.800	22.473	18.632	1481.600	22.794
14.927	1397.900	22.188	18.700	1485.900	22.719
14.954	1401.400	22.574	18.833	1482.200	22.506
14.962	1401.800	22.264	19.030	1482.200	22.699
14.996	1421.500	22.985	19.034	1497.200	24.076
15.000	1406.600	23.551	19.053	1497.100	23.065
15.006	1409.400	22.365	19.185	1506.700	22.925
15.045	1417.900	22.454	19.346	1526.500	23.193
15.053	1423.100	22.573	19.511	1548.700	23.691
15.093	1427.400	21.728	19.553	1554.500	23.958
15.248	1440.200	22.000	19.660	1557.300	24.303
15.250	1439.700	21.888	19.661	1563.200	24.074
15.448	1457.200	22.133	19.794	1539.000	23.519
15.477	1458.600	22.481	19.892	1533.700	23.508
15.553	1466.900	22.256	20.000	1531.400	23.758
15.731	1490.500	22.514	20.100	1517.800	23.290
15.966	1509.300	22.903	20.200	1519.600	23.320
15.970	1521.200	25.125	20.300	1500.100	23.049
15.990	1511.300	24.320	20.400	1486.200	22.858
16.000	1519.400	23.712	20.500	1483.600	22.822
16.053	1504.800	23.485	20.600	1466.400	22.575
16.068	1506.000	22.912	20.700	1454.100	22.411

Table 4 (Continued)

E_n MeV	mb	Δmb	E_n MeV	mb	Δmb
20.800	1445.900	22.301	25.700	1423.100	23.512
20.900	1456.900	22.457	25.800	1402.500	23.242
21.000	1460.900	22.547	25.900	1400.400	23.300
21.100	1458.000	22.510	26.000	1420.100	23.655
21.200	1450.800	22.406	26.100	1389.600	23.246
21.300	1463.500	22.620	26.200	1391.100	23.363
21.400	1455.200	22.516	26.300	1411.100	23.710
21.500	1448.200	22.426	26.400	1413.100	23.820
21.600	1453.200	22.522	26.500	1397.200	23.715
21.700	1450.100	22.478	26.600	1402.200	23.777
21.800	1435.000	22.273	26.700	1401.600	23.894
21.900	1428.500	22.200	26.800	1398.000	23.965
22.000	1422.700	22.124	26.900	1390.500	23.898
22.100	1413.300	22.001	27.000	1395.300	23.932
22.200	1434.800	22.330	27.100	1392.600	24.003
22.300	1415.300	22.084	27.200	1415.700	24.396
22.400	1425.800	22.243	27.300	1402.800	24.317
22.500	1425.000	22.263	27.400	1384.400	24.175
22.600	1422.700	22.260	27.500	1411.800	24.752
22.700	1432.600	22.436	27.600	1384.400	24.465
22.800	1432.900	22.452	27.700	1374.200	24.256
22.900	1432.500	22.478	27.800	1390.500	24.657
23.000	1437.100	22.555	27.900	1368.100	26.563
23.100	1436.100	22.582	28.000	1390.500	25.272
23.200	1447.100	22.781	28.100	1358.400	24.455
23.300	1442.100	22.730	28.200	1384.500	24.893
23.400	1457.500	23.005	28.300	1375.300	24.861
23.500	1441.400	22.776	28.400	1359.100	24.917
23.600	1455.400	23.005	28.500	1375.900	25.082
23.700	1446.400	22.917	28.600	1368.900	25.103
23.800	1445.900	22.935	28.700	1372.900	25.176
23.900	1442.100	22.906	28.800	1377.200	25.428
24.000	1450.300	23.052	28.900	1332.500	25.015
24.100	1430.200	22.796	29.000	1355.500	25.335
24.200	1417.400	22.687	29.100	1342.900	25.240
24.300	1444.200	23.123	29.200	1367.300	25.621
24.400	1422.900	22.809	29.300	1336.600	25.364
24.500	1438.400	23.092	29.400	1355.800	25.704
24.600	1423.800	22.949	29.500	1332.400	25.609
24.700	1427.000	23.068	29.600	1350.300	25.881
24.800	1414.200	22.901	29.700	1331.900	25.764
24.900	1430.500	23.154	29.800	1299.700	25.266
25.000	1423.300	23.134	29.900	1351.200	26.186
25.100	1407.900	22.989	30.000	1342.600	26.370
25.200	1403.500	22.940	30.100	1338.500	26.301
25.300	1424.400	23.271	30.200	1316.700	25.932
25.400	1394.400	22.902	30.300	1318.100	26.129
25.500	1412.000	23.204	30.400	1327.300	26.289
25.600	1405.200	23.158	30.500	1297.500	26.083

Table 4 (Continued)

E_n MeV	mb	Δmb
30.600	1328.500	26.554
30.700	1338.800	26.983
30.800	1323.400	26.669
30.900	1358.100	27.253
31.000	1319.200	26.789
31.100	1311.500	26.960
31.200	1325.600	27.017
31.300	1309.800	26.961
31.400	1281.400	27.030
31.500	1281.000	27.069
31.600	1346.800	27.887
31.700	1317.500	27.637
31.800	1326.300	27.885
31.900	1290.800	27.813
32.000	1316.600	34.922

Table 5a

Input Data for Evaluation of Cross Section for Elastic Scattering

Ref	E_n MeV	σ_e mb	$\Delta\sigma_e$	Ref	E_n MeV	σ_e mb	$\Delta\sigma_e$
Ha75	8.0000	1433.30	46.13	Ha75	14.0000	788.77	25.66
Pe71 I	8.0000	1371.20	99.95	Gl76 I	14.0000	911.91	51.78
Pe72	8.0400	1202.80	91.41	Bo68 I	14.0000	835.82	86.93
Pe71 I	8.0400	1336.80	97.32	Ba85	14.2000	872.10	65.90
Ve73	8.2000	1000.00	53.81	Gl76 I	14.2000	900.60	46.22
Pe71 I	8.2000	1114.00	81.01	Bo68 I	14.2000	838.31	87.17
Pe72	8.5000	838.57	60.38	Gl76	14.4300	887.60	41.10
Ha75	8.5000	723.26	24.55	Bo68 I	14.4300	841.17	87.44
Pe71 I	8.5000	791.70	58.26	Ha75	14.5000	716.06	42.51
Pe69	8.5600	802.63	56.99	Ar71	14.5000	714.95	79.20
Pe71 I	8.5600	788.00	58.39	Gl76 I	14.5000	895.30	42.76
Ha75	9.0000	700.00	23.07	Bo68 I	14.5000	842.94	87.61
Ve73	9.0000	710.00	39.41	Gu81	14.7000	830.00	84.34
Gl76 I	9.0000	670.56	18.11	Gl76 I	14.7000	917.30	47.88
Ha75	9.5000	657.85	21.29	Bo68 I	14.7000	854.19	88.69
Gl76 I	9.5000	665.77	17.31	Gl76	14.9300	942.60	54.30
Ha75	10.0000	674.06	22.36	Bo68 I	14.9300	867.14	89.94
Gl76 I	10.0000	635.56	16.88	De70	17.2700	884.00	36.45
Ha75	10.5000	708.44	23.64	Bo68 I	17.2700	778.93	80.95
Gl76 I	10.5000	647.46	16.44	Ba85	18.2000	897.20	75.80
Ha75	11.0000	775.57	25.22	Bo68 I	18.2000	808.43	82.98
Gl76 I	11.0000	846.88	26.31	De70	18.2500	899.00	37.07
Ha75	11.5000	841.82	27.42	Bo68 I	18.2500	812.42	83.37
Gl76 I	11.5000	810.78	21.75	De70	19.8800	1044.00	43.05
Sa81	11.6500	853.01	70.83	Bo68 I	19.8800	927.06	94.57
Gl76 I	11.6500	819.73	21.78	Me84	20.8000	902.45	54.15
Ha75	12.0000	820.87	26.80	Bo68 I	20.8000	868.74	88.86
Gl76 I	12.0000	908.44	27.71	Me84	22.0000	867.41	52.04
Ha75	12.5000	823.62	26.86	Bo68 I	22.0000	803.94	82.54
Gl76 I	12.5000	825.32	25.61	Me84	24.0000	919.03	55.14
Ha75	13.0000	946.84	30.93	Bo68 I	24.0000	740.52	76.38
Gl76 I	13.0000	971.70	35.94	Me84	26.0000	887.46	53.25
Ha75	13.5000	891.13	28.88	Wi86	40.0000	703.00	29.28
Gl76 I	13.5000	941.70	45.32				

Table 5b

Evaluated Data for Cross Section for Elastic Scattering

Ref	E_n MeV	σ_e mb	$\Delta\sigma_e$	Ref	E_n MeV	σ_e mb	$\Delta\sigma_e$
ENDF/B-V	5.0000	1158.30	57.92	ENDF/B-V	6.2850	2141.40	107.07
ENDF/B-V	5.0007	1157.90	57.90	ENDF/B-V	6.2950	2232.50	111.63
ENDF/B-V	5.0300	1144.80	57.24	ENDF/B-V	6.3030	2125.10	106.26
ENDF/B-V	5.0530	1136.70	56.84	ENDF/B-V	6.3100	1834.00	91.70
ENDF/B-V	5.1000	1120.10	56.01	ENDF/B-V	6.3200	1559.90	78.00
ENDF/B-V	5.1200	1112.50	55.63	ENDF/B-V	6.3300	1379.00	68.95
ENDF/B-V	5.1500	1094.10	54.71	ENDF/B-V	6.3400	1248.00	62.40
ENDF/B-V	5.1800	1074.60	53.73	ENDF/B-V	6.3500	1158.20	57.91
ENDF/B-V	5.2000	1058.00	52.90	ENDF/B-V	6.3600	1075.60	53.78
ENDF/B-V	5.2300	1035.00	51.75	ENDF/B-V	6.3700	1001.30	50.07
ENDF/B-V	5.2800	993.97	49.70	ENDF/B-V	6.3900	912.64	45.63
ENDF/B-V	5.3000	973.97	48.70	ENDF/B-V	6.4000	862.44	43.12
ENDF/B-V	5.3300	962.97	48.15	ENDF/B-V	6.4100	826.94	41.35
ENDF/B-V	5.3350	974.47	48.72	ENDF/B-V	6.4200	810.94	40.55
ENDF/B-V	5.3400	1036.00	51.80	ENDF/B-V	6.4300	820.64	41.03
ENDF/B-V	5.3600	1503.80	75.19	ENDF/B-V	6.4400	826.93	41.35
ENDF/B-V	5.3620	1551.60	77.58	ENDF/B-V	6.4500	837.94	41.90
ENDF/B-V	5.3700	1692.10	84.61	ENDF/B-V	6.4700	852.50	42.63
ENDF/B-V	5.3710	1710.10	85.51	ENDF/B-V	6.4900	838.05	41.90
ENDF/B-V	5.3780	1550.80	77.54	ENDF/B-V	6.5100	773.61	38.68
ENDF/B-V	5.3800	1517.70	75.89	ENDF/B-V	6.5400	634.44	31.72
ENDF/B-V	5.3900	1354.20	67.71	ENDF/B-V	6.5530	582.22	29.11
ENDF/B-V	5.4000	1242.40	62.12	ENDF/B-V	6.5600	554.10	27.71
ENDF/B-V	5.4100	1150.60	57.53	ENDF/B-V	6.5700	520.59	26.03
ENDF/B-V	5.4200	1108.80	55.44	ENDF/B-V	6.5800	501.27	25.06
ENDF/B-V	5.4300	1079.50	53.98	ENDF/B-V	6.5900	496.94	24.85
ENDF/B-V	5.4400	1048.30	52.42	ENDF/B-V	6.6000	522.61	26.13
ENDF/B-V	5.4600	1015.80	50.79	ENDF/B-V	6.6200	606.44	30.32
ENDF/B-V	5.5000	990.97	49.55	ENDF/B-V	6.6400	681.94	34.10
ENDF/B-V	5.5500	980.96	49.05	ENDF/B-V	6.6575	718.94	35.95
ENDF/B-V	5.5530	980.12	49.01	ENDF/B-V	6.6650	711.94	35.60
ENDF/B-V	5.6000	966.96	48.35	ENDF/B-V	6.6700	698.94	34.95
ENDF/B-V	5.6500	947.96	47.40	ENDF/B-V	6.6800	670.56	33.53
ENDF/B-V	5.7000	925.96	46.30	ENDF/B-V	6.7000	643.80	32.19
ENDF/B-V	5.8000	901.96	45.10	ENDF/B-V	6.7500	637.76	31.89
ENDF/B-V	5.9000	895.46	44.77	ENDF/B-V	6.8100	626.76	31.34
ENDF/B-V	6.0000	886.95	44.35	ENDF/B-V	6.9200	595.60	29.78
ENDF/B-V	6.0500	885.95	44.30	ENDF/B-V	7.0000	568.92	28.45
ENDF/B-V	6.0530	886.35	44.32	ENDF/B-V	7.0530	568.39	28.42
ENDF/B-V	6.1250	895.95	44.80	ENDF/B-V	7.1000	567.92	28.40
ENDF/B-V	6.1600	912.22	45.61	ENDF/B-V	7.1400	581.92	29.10
ENDF/B-V	6.1800	945.08	47.25	ENDF/B-V	7.1800	617.92	30.90
ENDF/B-V	6.2000	1012.90	50.65	ENDF/B-V	7.2000	644.42	32.22
ENDF/B-V	6.2100	1043.00	52.15	ENDF/B-V	7.2200	682.91	34.15
ENDF/B-V	6.2200	1083.00	54.15	ENDF/B-V	7.2250	691.33	34.57
ENDF/B-V	6.2300	1152.90	57.65	ENDF/B-V	7.2500	773.41	38.67
ENDF/B-V	6.2400	1243.00	62.15	ENDF/B-V	7.2700	864.59	43.23
ENDF/B-V	6.2500	1423.00	71.15	ENDF/B-V	7.2800	936.58	46.83

Table 5b (Continued)

Ref	E_n MeV	σ_e mb	$\Delta\sigma_e$	Ref	E_n MeV	σ_e mb	$\Delta\sigma_e$
ENDF/B-V	7.3400	1366.70	68.34	G176 B	9.9700	649.65	40.88
ENDF/B-V	7.3500	1416.60	70.83	Fit2	10.0000	654.71	43.26
ENDF/B-V	7.3600	1431.60	71.58	G176 B	10.2200	611.28	38.35
ENDF/B-V	7.3700	1448.60	72.43	Fit2	10.5000	676.29	45.13
ENDF/B-V	7.4000	1435.30	71.77	G176 B	10.6900	688.21	43.53
ENDF/B-V	7.4200	1424.70	71.24	G176 B	10.9600	872.83	56.50
ENDF/B-V	7.4700	1408.20	70.41	Fit2	11.0000	776.56	51.47
ENDF/B-V	7.5287	1406.90	70.35	G176 B	11.1700	802.90	51.34
ENDF/B-V	7.5417	1405.30	70.27	Fit2	11.5000	831.92	54.96
ENDF/B-V	7.5530	1402.40	70.12	Fit2	11.6500	832.38	61.88
ENDF/B-V	7.5937	1392.00	69.60	G176 B	11.7400	837.41	53.19
ENDF/B-V	7.6200	1377.50	68.88	G176 B	11.9600	929.16	59.83
ENDF/B-V	7.6500	1396.60	69.83	Fit3	12.0000	853.63	33.71
ENDF/B-V	7.6674	1442.70	72.14	G176 B	12.4900	808.16	32.54
ENDF/B-V	7.6800	1469.20	73.46	Fit3	12.5000	843.22	33.05
ENDF/B-V	7.6977	1533.10	76.66	G176 B	12.9500	958.29	39.44
ENDF/B-V	7.7000	1541.30	77.07	Fit3	13.0000	974.61	38.55
ENDF/B-V	7.7250	1718.40	85.92	Fit3	13.5000	920.40	36.18
ENDF/B-V	7.7450	1900.30	95.02	G176 B	13.9400	899.89	42.72
ENDF/B-V	7.7500	1917.00	95.85	Fit3	14.0000	817.99	32.33
ENDF/B-V	7.7700	1790.60	89.53	Fit3	14.2000	863.56	48.25
ENDF/B-V	7.7887	1692.50	84.63	Fit3	14.4300	858.34	52.33
ENDF/B-V	7.8100	1590.90	79.55	Bo68 B	14.4796	854.03	44.01
ENDF/B-V	7.8191	1568.70	78.44	Fit4	14.5000	836.84	36.01
ENDF/B-V	7.8600	1491.70	74.59	Fit4	14.7000	872.70	40.29
ENDF/B-V	7.8870	1465.40	73.27	Fit4	14.9300	891.92	42.03
ENDF/B-V	7.8884	1464.10	73.21	Bo68 B	15.1223	917.63	46.32
ENDF/B-V	7.8971	1451.60	72.58	Bo68 B	15.3909	970.63	48.28
ENDF/B-V	7.9300	1411.50	70.58	Bo68 B	15.5827	981.22	48.68
ENDF/B-V	7.9361	1408.30	70.42	Bo68 B	15.7746	979.71	48.62
Fit1	8.0000	1438.57	86.99	Bo68 B	16.0048	1009.29	51.89
Pe71 B	8.0100	1323.23	86.95	Bo68 B	16.1966	967.85	50.33
Fit1	8.0400	1233.36	90.77	Bo68 B	16.3981	946.31	49.52
Pe71 B	8.1100	1241.62	81.29	Bo68 B	16.5420	921.45	48.60
Fit1	8.2000	1067.87	77.68	Bo68 B	16.7338	901.56	47.86
Pe71 B	8.2000	1082.29	70.95	Bo68 B	16.8777	898.25	47.74
Pe71 B	8.3100	893.81	58.39	Bo68 B	17.0887	888.31	47.38
Pe71 B	8.4100	827.75	54.80	Bo68 B	17.2326	888.31	47.38
Fit1	8.5000	747.24	46.60	Fit5	17.2700	874.91	87.49
Pe71 B	8.5100	762.66	50.75	Bo68 B	17.3381	822.26	82.23
Fit1	8.5600	753.93	52.03	Bo68 B	17.8177	863.79	86.38
Pe71 B	8.6100	768.49	51.97	Fit5	18.2000	897.63	89.76
Pe71 B	8.6900	768.49	53.73	Fit5	18.2500	892.78	89.28
G176 B	8.9700	670.96	42.45	Bo68 B	18.3645	912.24	91.22
Fit2	9.0000	688.70	45.29	Bo68 B	18.7962	941.66	94.17
G176 B	9.2000	744.54	46.83	Bo68 B	19.1607	988.38	98.84
Fit2	9.5000	659.41	42.60	Bo68 B	19.3909	1022.99	102.30
G176 B	9.5600	661.93	41.55	Bo68 B	19.5156	1028.18	102.82

Table 5b (Continued)

Ref	E_n MeV	σ_e mb	$\Delta\sigma_e$
Bo68 B	19.6211	1026.45	102.65
Bo68 B	19.8225	1031.64	103.16
Fit5	19.8800	1033.71	103.37
Bo68 B	20.0432	1022.99	153.45
Bo68 B	20.5036	978.00	146.70
Fit5	20.8000	911.70	136.76
Bo68 B	20.8106	964.16	144.62
Bo68 B	21.5300	912.24	136.84
Fit5	22.0000	868.18	130.23
Bo68 B	22.0288	891.48	133.72
Bo68 B	22.3933	872.44	130.87
Bo68 B	22.8345	855.14	128.27
Bo68 B	23.1319	856.87	128.53
Bo68 B	23.5252	837.83	125.67
Fit5	24.0000	900.63	135.09
Bo68 B	24.0000	822.26	123.34
Me84 B	26.0000	885.51	132.83
Wi86 B	40.0000	717.37	107.61

Table 6a

Input Data for Evaluation of Cross Section for Inelastic Scattering

Ref	E_n MeV	σ_{in} mb	$\Delta\sigma_{in}$	Ref	E_n MeV	σ_{in} mb	$\Delta\sigma_{in}$
Pe71	5.3200	116.00	20.88	Pe71	7.7000	321.00	25.68
Pe71	5.4200	130.00	16.90	Mo72 I	7.7000	283.41	29.75
Pe71	5.5200	128.00	14.08	Pe71	7.8100	383.00	30.64
Pe71	5.6200	131.00	13.10	Mo72 I	7.8100	323.03	34.06
Pe71	5.7200	153.00	15.30	Pe71	7.9100	354.00	28.32
Pe71	5.8000	168.00	15.12	Mo72 I	7.9100	313.25	32.81
Pe71	5.9300	204.00	18.36	Ha75	8.0000	378.31	13.02
Pe71	6.0200	230.00	20.70	Mo72 I	8.0000	347.73	36.50
Pe71	6.1200	243.00	21.87	Pe71	8.0100	406.00	32.48
Pe71	6.2100	254.00	22.86	Mo72 I	8.0100	354.22	37.19
Pe71	6.2600	290.00	23.20	Pe69	8.0400	409.02	29.45
Pe71	6.3100	333.00	26.64	Mo72 I	8.0400	369.53	38.55
Pe71	6.3600	338.00	27.04	Pe71	8.1100	476.00	38.08
Pe71	6.4100	264.00	21.12	Mo72 I	8.1100	412.98	43.11
Pe71	6.4600	251.00	20.08	Pe71	8.2000	428.00	34.24
Pe71	6.5200	261.00	20.88	Ve68	8.2000	497.80	21.66
Mo72 I	6.5200	217.21	22.82	Mo72 I	8.2000	446.65	46.53
Pe71	6.5700	254.00	20.32	Pe71	8.3100	304.00	24.32
Mo72 I	6.5700	224.05	23.44	Mo72 I	8.3100	307.63	32.73
Pe71	6.6200	200.00	16.00	Pe71	8.4100	236.00	18.88
Mo72 I	6.6200	214.85	22.44	Mo72 I	8.4100	281.34	30.27
Pe71	6.7200	167.00	13.36	Ha75	8.5000	242.93	9.14
Mo72 I	6.7200	165.57	17.66	Pe69	8.5000	248.01	18.60
Pe71	6.8200	157.00	12.56	Mo72 I	8.5000	263.73	28.08
Mo72 I	6.8200	144.06	15.53	Pe71	8.5100	230.00	18.40
Pe71	6.9200	153.00	12.24	Mo72 I	8.5100	261.58	27.82
Mo72 I	6.9200	156.27	16.85	Pe69	8.5600	245.08	17.40
Pe71	7.0300	161.00	12.88	Mo72 I	8.5600	293.34	31.34
Pe69	7.0300	166.60	12.16	Pe71	8.6100	230.00	18.40
Mo72 I	7.0300	166.42	17.73	Mo72 I	8.6100	275.48	29.66
Pe71	7.1300	166.00	13.28	Pe71	8.6900	226.00	18.08
Mo72 I	7.1300	182.33	19.46	Mo72 I	8.6900	255.38	27.74
Pe71	7.2300	200.00	16.00	Gl76	8.9700	334.00	9.10
Mo72 I	7.2300	210.75	22.47	Mo72 I	8.9700	254.90	27.72
Pe71	7.3300	286.00	22.88	Ha75	9.0000	273.90	9.51
Mo72 I	7.3300	288.62	30.13	Ve73	9.0000	277.77	10.55
Pe71	7.4000	317.00	25.36	Gl76 I	9.0000	330.48	8.95
Mo72 I	7.4000	346.42	36.06	Mo72 I	9.0000	259.18	28.15
Mc72	7.4800	327.83	33.07	Gl76	9.2000	307.00	8.00
Mo72 I	7.4800	344.70	35.74	Mo72 I	9.2000	258.79	28.71
Pe71	7.5000	312.00	24.96	Ha75	9.5000	279.83	10.21
Mo72 I	7.5000	341.16	35.47	Gl76 I	9.5000	342.33	9.24
Pe69	7.5400	302.40	21.77	Mo72 I	9.5000	264.45	29.50
Mo72 I	7.5400	334.31	34.83	Gl76	9.5600	349.40	9.50
Pe71	7.6000	274.00	21.92	Mo72 I	9.5600	289.34	31.52
Pe69	7.6000	273.47	22.70	Ad80	9.8000	354.72	23.04
Mo72 I	7.6000	321.58	33.56	Gl76 I	9.8000	325.81	9.08

Table 6a (Continued)

Ref	E_n MeV	σ_{in} mb	$\Delta\sigma_{in}$	Ref	E_n MeV	σ_{in} mb	$\Delta\sigma_{in}$
Mo72 I	9.8000	327.12	36.27	Gl76 I	12.5000	215.52	5.85
Gl76	9.9700	309.10	8.80	Mo72 I	12.5000	216.91	22.61
Mo72 I	9.9700	316.52	34.98	Gl76	12.9500	252.30	9.70
Ha75	10.0000	345.01	11.96	Mo72 I	12.9500	213.17	22.42
Gl76 I	10.0000	307.66	8.64	Ha75	13.0000	218.76	8.78
Mo72 I	10.0000	295.34	32.51	Gl76 I	13.0000	252.33	7.88
Gl76	10.2200	297.10	7.50	Mo72 I	13.0000	212.90	22.41
Mo72 I	10.2200	293.22	29.71	Ha75	13.5000	207.75	8.50
Ha75	10.5000	331.19	11.04	Gl76 I	13.5000	252.63	8.37
Gl76 I	10.5000	339.93	8.67	Mo72 I	13.5000	190.98	20.43
Mo72 I	10.5000	282.32	28.65	Gl76	13.9400	252.90	15.20
Gl76	10.6900	369.00	9.10	Mo72 I	13.9400	182.59	19.72
Mo72 I	10.6900	285.35	28.99	Ha75	14.0000	184.63	7.37
Gl76	10.9600	365.20	10.50	Gl76 I	14.0000	247.77	8.76
Mo72 I	10.9600	300.67	30.58	Mo72 I	14.0000	181.92	19.67
Ha75	11.0000	342.31	11.17	Ba85	14.2000	214.40	19.09
Gl76 I	11.0000	356.53	10.24	Gl76 I	14.2000	230.67	8.49
Mo72 I	11.0000	302.95	30.81	Mo72 I	14.2000	178.49	19.39
Gl76	11.1700	319.70	8.40	Gl76	14.4300	211.00	9.50
Mo72 I	11.1700	301.89	30.74	Mo72 I	14.4300	173.50	18.98
Ha75	11.5000	259.84	8.87	Ha75	14.5000	146.39	7.93
Gl76 I	11.5000	293.18	7.86	Gl76 I	14.5000	205.34	7.76
Mo72 I	11.5000	281.36	28.77	Mo72 I	14.5000	171.98	18.85
Sa81	11.6500	275.58	35.49	Gu81	14.7000	199.21	41.87
Gl76 I	11.6500	281.13	7.60	Gl76 I	14.7000	189.18	6.51
Mo72 I	11.6500	269.24	27.59	Mo72 I	14.7000	165.74	18.29
Gl76	11.7400	273.90	7.40	Gl76	14.9300	170.60	9.80
Mo72 I	11.7400	260.15	26.70	Mo72 I	14.9300	156.73	17.46
Gl76	11.9600	264.80	8.30	Ba85	18.2000	121.80	11.62
Mo72 I	11.9600	237.93	24.54	Mo72 I	18.2000	93.06	12.61
Ha75	12.0000	238.39	9.46	Me84	20.8000	96.33	9.63
Gl76 I	12.0000	261.02	7.64	Me84	22.0000	81.15	8.12
Mo72 I	12.0000	233.89	24.15	Me84	24.0000	78.51	7.85
Gl76	12.4900	214.70	6.60	Me84	26.0000	62.48	6.25
Mo72 I	12.4900	217.13	22.63	Me84 O	30.0000	53.30	8.00
Ha75	12.5000	218.74	8.27	Me84 O	35.0000	41.70	6.30

Table 6b

Evaluated Cross Section for Inelastic Scattering

Ref	E_n MeV	σ_{in} mb	$\Delta\sigma_{in}$	Ref	E_n MeV	σ_{in} mb	$\Delta\sigma_{in}$
Mo72	4.8574	13.29	2.11	Fit6	8.0100	384.48	29.92
Mo72	4.9084	31.50	3.97	Fit6	8.0400	414.41	27.21
Mo72	4.9576	67.17	7.55	Fit6	8.1100	446.85	34.12
Mo72	5.0075	62.69	7.01	Fit6	8.2000	464.72	28.47
Mo72	5.0583	56.61	6.50	Fit6	8.3100	317.60	25.64
Mo72	5.1070	60.14	6.88	Fit6	8.4100	265.01	22.02
Mo72	5.1565	75.29	8.37	Fit6	8.5000	253.50	15.38
Mo72	5.2067	90.20	9.89	Fit6	8.5100	254.73	20.59
Mo72	5.2576	99.56	10.80	Fit6	8.5600	260.03	16.78
Mo72	5.3064	102.06	11.16	Fit6	8.6100	258.65	21.52
Pe71	5.3200	116.00	20.88	Fit6	8.6900	247.70	20.91
Pe71	5.4200	130.00	16.90	Fit7	8.9700	324.61	21.28
Pe71	5.5200	128.00	14.08	Fit7	9.0000	306.31	17.40
Pe71	5.6200	131.00	13.10	Fit7	9.2000	300.97	18.02
Pe71	5.7200	153.00	15.30	Fit7	9.5000	321.36	19.02
Pe71	5.8000	168.00	15.12	Fit7	9.5600	341.67	22.34
Pe71	5.9300	204.00	18.36	Fit7	9.8000	320.58	20.57
Pe71	6.0200	230.00	20.70	Fit7	9.9700	306.05	21.87
Pe71	6.1200	243.00	21.87	Fit7	10.0000	323.23	19.49
Pe71	6.2100	254.00	22.86	Fit7	10.2200	295.13	17.17
Pe71	6.2600	290.00	23.20	Fit7	10.5000	332.60	17.50
Pe71	6.3100	333.00	26.64	Fit7	10.6900	360.71	20.14
Pe71	6.3600	338.00	27.04	Fit7	10.9600	348.78	23.56
Pe71	6.4100	264.00	21.12	Fit7	11.0000	355.26	19.62
Mo72 B	6.5079	220.44	23.18	Fit7	11.1700	316.60	19.05
Mo72 B	6.5553	229.80	24.09	Fit7	11.5000	283.45	16.01
Mo72 B	6.6073	229.96	23.94	Fit7	11.6500	277.55	16.65
Mo72 B	6.6598	190.50	20.14	Fit7	11.7400	271.89	17.35
Mo72 B	6.7089	173.00	18.43	Fit7	11.9600	261.39	18.60
Mo72 B	6.7586	158.91	17.05	Fit7	12.0000	254.62	16.50
Mo72 B	6.8088	146.09	15.76	Fit7	12.4900	213.18	13.69
Mo72 B	6.8595	153.77	16.53	Fit7	12.5000	215.35	12.85
Mo72 B	6.9065	162.37	17.54	Fit7	12.9500	245.21	19.18
Fit6	6.9200	160.68	13.35	Fit7	13.0000	239.12	16.71
Fit6	7.0300	172.94	11.55	Fit7	13.5000	229.26	17.04
Fit6	7.1300	180.70	14.71	Fit7	13.9400	233.06	21.49
Fit6	7.2300	213.41	17.32	Fit7	14.0000	210.24	16.11
Fit6	7.3300	297.89	22.74	Fit7	14.2000	215.34	19.84
Fit6	7.4000	346.94	26.22	Fit7	14.4300	202.60	20.95
Fit6	7.4800	352.04	27.88	Fit7	14.5000	183.17	16.69
Fit6	7.5000	341.76	25.70	Fit7	14.7000	184.61	16.66
Fit6	7.5400	322.89	21.36	Fit7	14.9300	168.15	13.32
Fit6	7.6000	305.52	21.94	Mo72 B	15.0950	167.97	18.84
Fit6	7.7000	306.53	23.85	Mo72 B	15.5960	150.17	17.50
Fit6	7.8100	355.45	28.05	Mo72 B	16.0920	136.55	16.39
Fit6	7.9100	338.00	26.10	Mo72 B	16.5800	114.39	14.45
Fit6	8.0000	379.26	22.41	Mo72 B	17.0740	116.68	14.93

Table 6b (Continued)

Ref	E_n MeV	σ_{in} mb	$\Delta\sigma_{in}$
Mo72 B	17.5730	122.06	15.52
Mo72 B	18.0760	100.25	13.60
Fit7	18.2000	113.36	24.27
Mo72 B	18.5820	115.62	15.60
Mo72 B	19.0900	83.39	13.07
Me84	20.8000	96.33	9.63
Me84	22.0000	81.15	8.12
Me84	24.0000	78.51	7.85
Me84	26.0000	62.48	6.25
Me72 O	30.0000	53.30	8.00
Me72 O	35.0000	41.70	6.30

Table 7a

Input Data for Evaluation of the $^{12}C(n,\alpha_0)^9Be$ Cross Section

Ref	E_n MeV	σ_{n,α_0} mb	$\Delta\sigma_{n,\alpha_0}$	Ref	E_n MeV	σ_{n,α_0} mb	$\Delta\sigma_{n,\alpha_0}$
Re60	7.5900	48.36	4.87	Di87 I	9.7400	200.90	12.77
Di87 I	7.5900	76.40	4.36	Ob72	9.8300	176.12	18.14
Re60	7.6600	75.82	7.63	Ge76	9.8300	164.00	16.40
Di87 I	7.6600	97.20	5.52	Di87 I	9.8300	166.40	10.44
Re60	7.8700	167.16	16.82	Re60	9.8800	198.81	20.00
Di87 I	7.8700	123.14	6.88	Di87 I	9.8800	156.73	9.32
Ge76	8.0000	156.00	15.60	Ob72	9.9300	187.46	19.31
Di87 I	8.0000	122.53	8.17	Di87 I	9.9300	149.43	15.49
Re60	8.1100	161.19	16.22	Re60	10.0000	187.46	18.86
Di87 I	8.1100	98.38	6.39	Di87 I	10.0000	156.14	7.43
Re60	8.2700	101.49	10.21	Ob72	10.0300	182.69	18.82
Di87 I	8.2700	75.02	4.45	Di87 I	10.0300	149.20	8.41
Re60	8.4800	85.97	8.65	Re60	10.1400	164.78	16.58
Di87 I	8.4800	65.24	3.70	Ob72	10.1500	145.67	15.00
Re60	8.6400	90.15	9.07	Ob72	10.2500	145.07	14.94
Ge76	8.6400	50.40	5.04	Re60	10.2800	141.49	14.23
Di87 I	8.6400	57.62	3.88	Ob72	10.3200	131.34	13.53
Re60	8.8100	107.46	10.81	Re60	10.3800	140.90	14.17
Di87 I	8.8100	78.57	5.81	Ob72	10.4300	126.57	13.04
Re60	8.9400	139.70	14.05	Ob72	10.5500	109.25	11.25
Di87 I	8.9400	170.74	9.54	Ob72	10.6100	105.07	10.82
Ge76	8.9900	202.00	20.20	Ob72	10.6900	102.69	10.58
Di87 I	8.9900	197.62	10.42	Ob72	10.8700	96.72	9.96
Re60	9.1200	223.88	22.52	Ob72	11.0400	82.39	8.49
Di87 I	9.1200	265.71	15.81	Ve68	11.3000	81.00	12.15
Re60	9.1800	264.48	26.61	Ve68	12.1000	103.00	15.45
Ob72	9.1800	278.81	28.72	Ve68	12.8000	93.00	13.95
Di87 I	9.1800	253.48	17.17	Ve68	13.6000	72.00	10.80
Ge76	9.2200	305.00	30.50	Br68	13.9000	79.00	20.00
Di87 I	9.2200	277.67	14.10	Al63	14.0000	62.00	15.00
Re60	9.3100	296.72	29.85	Ki69	14.1000	76.00	11.00
Di87 I	9.3100	267.90	13.65	Gr55	14.1000	80.00	20.00
Ob72	9.3500	318.81	32.84	Ha84	14.1000	72.00	9.00
Di87 I	9.3500	255.46	13.65	Ch64	14.5000	69.00	14.72
Ge76	9.4100	265.00	26.50	Br68	15.6000	77.00	20.00
Di87 I	9.4100	253.23	15.03	Sa71 I	15.6000	38.53	3.89
Re60	9.4200	282.39	28.41	Hu66	16.0000	46.10	16.00
Di87 I	9.4200	252.86	16.57	Sa71 I	16.0000	28.62	2.97
Ob72	9.4800	272.84	28.10	Hu66	17.0000	50.80	18.00
Di87 I	9.4800	220.53	13.84	Sa71 I	17.0000	35.38	3.06
Re60	9.5700	232.84	23.42	St76	18.6500	14.50	3.60
Di87 I	9.5700	176.73	10.98	Sa71 I	18.6500	16.90	1.74
Ob72	9.6800	208.36	21.46	St76	18.9200	19.20	4.00
Di87 I	9.6800	146.29	15.42	St76	19.1200	18.20	3.60
Re60	9.7200	186.87	18.80	St76	19.2000	19.60	4.90
Di87 I	9.7200	208.57	15.16	St76	19.4600	22.00	5.70
Re60	9.7400	192.24	19.34	St76	19.7200	30.70	9.50

Table 7a (Continued)

Ref	E_n MeV	σ_{n,α_0} mb	$\Delta\sigma_{n,\alpha_0}$
St76	19.9000	25.00	10.80
St76	19.9800	35.20	8.40
St76	20.1400	40.90	7.40
St76	20.2300	29.80	9.20
St76	20.4800	24.60	9.10
St76	20.7300	18.90	6.60
St76	20.9800	21.20	6.10
St76	21.2200	23.30	7.00
St76	21.4600	31.00	10.90

Table 7b

Evaluated Cross Section for the Reaction $^{12}C(n,\alpha_0)^9Be$

Ref	E_n MeV	σ_{n,α_0} mb	$\Delta\sigma_{n,\alpha_0}$	Ref	E_n MeV	σ_{n,α_0} mb	$\Delta\sigma_{n,\alpha_0}$
ENDF/B-V	.0000	.00	.00	Ve69	11.3000	81.00	12.15
ENDF/B-V	6.1737	.00	.00	Ve69	12.1000	103.00	15.45
ENDF/B-V	6.3400	1.00	.20	Ve69	12.8000	93.00	13.95
ENDF/B-V	7.1800	1.00	.20	Ve69	13.6000	72.00	10.80
ENDF/B-V	7.2800	6.00	1.20	Br68	13.9000	79.00	20.00
ENDF/B-V	7.3400	11.00	2.20	Al63	14.0000	62.00	15.00
Fit8	7.5900	62.86	7.77	Fit9	14.1000	75.25	11.52
Fit8	7.6600	89.20	10.82	Ch64	14.5000	69.00	14.72
Fit8	7.8700	130.91	15.62	Sa81 B	14.8000	51.77	7.26
Fit8	8.0000	131.60	16.93	Sa81 B	15.1600	49.66	6.06
Fit8	8.1100	108.26	13.82	Sa81 B	15.3800	50.09	6.97
Fit8	8.2700	80.07	9.80	Sa81 B	15.5700	46.73	5.37
Fit8	8.4800	69.15	8.30	Fit10	15.6000	46.78	8.81
Fit8	8.6400	58.96	7.19	Sa81 B	15.7600	37.86	4.28
Fit8	8.8100	85.65	11.50	Sa81 B	15.8800	39.64	5.21
Fit8	8.9400	160.18	19.25	Fit10	16.0000	34.15	6.58
Fit8	8.9900	201.25	23.50	Sa81 B	16.0100	33.18	3.77
Fit8	9.1200	250.55	30.88	Sa81 B	16.0700	35.96	5.21
Fit8	9.1800	252.18	30.34	Sa81 B	16.1300	41.34	6.32
Fit8	9.2200	286.61	32.92	Sa81 B	16.1900	30.39	4.89
Fit8	9.3100	274.98	31.58	Sa81 B	16.2500	34.21	4.85
Fit8	9.3500	262.72	30.78	Sa81 B	16.3100	28.33	2.99
Fit8	9.4100	259.44	31.84	Sa81 B	16.3700	32.27	4.17
Fit8	9.4200	261.11	33.27	Sa81 B	16.4300	41.73	5.21
Fit8	9.4800	226.96	28.49	Sa81 B	16.4800	35.49	3.70
Fit8	9.5700	188.52	23.50	Sa81 B	16.5300	35.70	4.02
Fit8	9.6800	161.49	25.21	Sa81 B	16.6000	38.85	4.29
Fit8	9.7200	198.29	26.55	Sa81 B	16.7200	40.87	4.98
Fit8	9.7400	197.86	24.96	Sa81 B	16.8300	39.60	4.06
Fit8	9.8300	163.59	19.32	Sa81 B	16.9500	42.08	4.19
Fit8	9.8800	165.67	20.27	Fit10	17.0000	41.86	7.78
Fit8	9.9300	156.28	24.32	Sa81 B	17.0100	41.53	4.23
Fit8	10.0000	162.05	18.12	Sa81 B	17.1000	44.14	4.26
Fit8	10.0300	152.97	18.34	Sa81 B	17.2100	45.82	5.66
Re60 B	10.1400	157.95	15.89	Sa81 B	17.4100	39.44	5.55
Ob72 B	10.1500	124.99	12.87	Sa81 B	17.6000	32.32	4.55
Ob72 B	10.2500	124.48	12.82	Sa81 B	17.8000	29.52	5.34
Re60 B	10.2800	135.63	13.65	Sa81 B	18.0000	28.66	4.18
Ob72 B	10.3200	112.70	11.61	Sa81 B	18.3600	19.12	2.53
Re60 B	10.3800	135.06	13.59	Sa81 B	18.6000	19.32	2.52
Ob72 B	10.4300	108.60	11.19	Fit10	18.6500	19.31	3.60
Ob72 B	10.5500	93.74	9.66	Sa81 B	18.8000	21.55	3.15
Ob72 B	10.6100	90.16	9.29	St76 B	18.9200	22.39	4.66
Ob72 B	10.6900	88.11	9.07	St76 B	19.1200	21.22	4.20
Ob72 B	10.8700	82.98	8.55	St76 B	19.2000	22.86	5.71
Ob72 B	11.0400	70.69	7.28	St76 B	19.4600	25.66	6.65

Table 7b (Continued)

Ref	E_n MeV	σ_{n,α_0} mb	$\Delta\sigma_{n,\alpha_0}$
St76 B	19.7200	35.80	11.08
St76 B	19.9000	29.15	12.59
St76 B	19.9800	41.05	9.80
St76 B	20.1400	47.70	8.63
St76 B	20.2300	34.75	10.73
St76 B	20.4800	28.69	10.61
St76 B	20.7300	22.04	7.70
St76 B	20.9800	24.72	7.11
St76 B	21.2200	27.17	8.16
St76 B	21.4600	36.15	12.71
Exp	22.0000	17.08	4.27
Exp	24.0000	12.07	3.02
Exp	26.0000	8.53	2.13
Exp	28.0000	6.03	1.51
Exp	30.0000	4.27	1.07
Exp	32.0000	3.02	.75

Table 8a

Input Data for the Evaluation of the $^{12}C(n,n'3\alpha)$ Reaction

Ref	E_n MeV	σ mb	$\Delta\sigma$
ENDF/B-V	8.2960	.58	.12
ENDF/B-V	9.5000	21.29	4.26
ENDF/B-V	10.0000	30.00	6.00
ENDF/B-V	10.5000	57.00	11.40
An86	11.9150	177.00	25.00
An86	12.8950	167.00	16.00
Fr55	12.9000	190.00	50.00
Fa71	14.0000	190.00	20.00
Va58	14.0000	173.80	85.00
An86	14.0000	202.00	16.00
Fr55	14.1000	230.00	50.00
Co76	14.2000	202.20	30.00
Gr69	14.2000	190.00	20.00
An86	14.8000	228.00	13.00
Va58	15.0000	198.70	85.00
Fr55	15.5000	316.00	73.00
Br84	16.0000	350.00	97.00
Va58	16.0000	324.20	85.00
Br84	17.0000	292.00	76.00
Va58	17.0000	344.10	130.60
An86	17.0000	272.00	17.00
Br84	18.0000	315.00	74.00
Va58	18.0000	349.70	120.00
Fr55	18.8000	283.00	59.00
Br84	19.0000	319.00	70.00
Va58	19.0000	274.50	105.00
An86	19.0000	300.00	14.00
Br84	20.0000	289.00	59.00
Br84	21.0000	290.00	59.00
Br84	22.0000	322.00	62.00
Br84	23.0000	292.00	57.00
Br84	24.0000	299.00	56.00
Br84	25.0000	252.00	50.00
Br84	26.0000	294.00	57.00
Br84	27.0000	248.00	57.00
Br84	28.0000	233.00	60.00
Br84	29.0000	223.00	63.00
Br84	30.0000	179.00	60.00
Br84	31.0000	255.00	56.00
Br84	32.0000	218.00	66.00
Br84	33.0000	225.00	71.00
Br84	34.0000	242.00	73.00
Br84	35.0000	186.00	62.00

Table 8b

Evaluated Cross Section for the $^{12}C(n,n'3\alpha)$ Reaction

Ref	E_n MeV	σ mb	$\Delta\sigma$
ENDF/B-V	.0000	.00	.00
ENDF/B-V	7.8850	.00	.00
ENDF/B-V	8.2960	.58	.12
ENDF/B-V	9.5000	21.29	4.26
ENDF/B-V	10.0000	30.00	6.00
ENDF/B-V	10.5000	57.00	11.40
Fit11	11.0000	91.25	18.25
Fit11	11.5000	114.28	22.86
Fit11	12.0000	135.97	20.40
Fit11	12.5000	156.33	23.45
Fit11	13.0000	175.35	26.30
Fit11	13.5000	193.03	28.95
Fit11	14.0000	209.37	31.41
Fit11	14.5000	224.38	33.66
Fit11	15.0000	238.05	35.71
Fit11	15.5000	250.38	37.56
Fit11	16.0000	261.38	39.21
Fit11	16.5000	271.04	40.66
Fit11	17.0000	279.36	41.90
Fit11	17.5000	286.34	42.95
Fit11	18.0000	291.99	43.80
Fit11	18.5000	296.30	44.45
Fit11	19.0000	299.28	44.89
Fit11	19.5000	300.91	45.14
Fit11	20.0000	301.21	45.18
Fit12	21.0000	300.99	60.20
Fit12	22.0000	292.71	58.54
Fit12	23.0000	284.60	56.92
Fit12	24.0000	276.68	55.34
Fit12	25.0000	268.93	53.79
Fit12	26.0000	261.36	52.27
Fit12	27.0000	253.97	50.79
Fit12	28.0000	246.77	49.35
Fit12	29.0000	239.74	47.95
Fit12	30.0000	232.89	46.58
Fit12	31.0000	226.22	45.24
Fit12	32.0000	219.73	43.95

Table 9

Evaluated Data for the $^{12}C(n,p)^{12}B$ Reaction

Ref	E_n MeV	σ mb	$\Delta\sigma$
ENDF/B-V	14.5000	.00	.00
ENDF/B-V	15.0000	1.00	.20
ENDF/B-V	15.4770	4.00	.80
ENDF/B-V	15.9660	8.00	1.60
ENDF/B-V	16.4430	11.00	2.20
ENDF/B-V	16.9740	13.00	2.60
ENDF/B-V	17.4670	16.00	3.20
ENDF/B-V	17.9010	19.00	3.80
ENDF/B-V	18.4600	19.00	3.80
ENDF/B-V	19.0340	18.00	3.60
ENDF/B-V	19.5110	15.00	3.00
ENDF/B-V	20.0000	13.00	2.60
Exp	22.0000	6.63	1.33
Exp	24.0000	3.40	.68
Exp	26.0000	1.75	.35
Exp	28.0000	.90	.18
Exp	30.0000	.46	.09
Exp	32.0000	.24	.05

Table 10

Evaluated Data for the $^{12}C(n,d)^{11}B$ Reaction

Ref	E_n MeV	σ mb	$\Delta\sigma$
ENDF/B-V	15.2500	.00	.00
ENDF/B-V	15.4770	2.00	.40
ENDF/B-V	15.9660	20.00	4.00
ENDF/B-V	16.4430	30.00	6.00
ENDF/B-V	16.9740	40.00	8.00
ENDF/B-V	17.4670	50.00	10.00
ENDF/B-V	17.9010	60.00	12.00
ENDF/B-V	18.4600	70.00	14.00
ENDF/B-V	19.0340	68.00	13.60
ENDF/B-V	19.5110	60.00	12.00
Exp	20.0000	53.00	10.60
Exp	22.0000	31.64	6.33
Exp	24.0000	18.90	3.78
Exp	26.0000	11.29	2.26
Exp	28.0000	6.74	1.35
Exp	30.0000	4.03	.81
Exp	32.0000	2.40	.48

Table 11

Evaluated Data for the $^{12}C(n,2n)^{11}C$ Reaction

Ref	E_n MeV	σ mb	$\Delta\sigma$
An81	22.8	3.0	0.3
An81	23.9	6.3	0.6
An81	25.0	11.4	1.0
An81	26.0	13.9	1.3
An81	26.7	16.3	1.5
An81	28.0	20.7	1.9
An81	29.7	22.9	2.3
An81	30.4	25.8	2.3
An81	31.3	27.0	2.4
An81	32.6	24.2	2.4
An81	33.6	27.0	2.7

Table 12

Integrals of Double Differential Charged Particle Production Data (Su83)

E_n MeV	Cross Sections mb					
	p	d	t	^{3}He	α	sum
27.4	51.93	34.73	6.46	-	430.72	523.84
39.7	91.79	65.97	21.63	5.91	322.75	512.14
60.7	121.97	75.48	26.33	10.10	266.15	500.03

E_n MeV	Kerma $fGy \cdot m^2$					
	p	d	t	^{3}He	α	sum
27.4	0.233	0.224	0.022	-	1.943	2.422
39.7	0.633	0.633	0.107	0.050	1.603	3.026
60.7	1.727	1.233	0.261	0.109	1.349	4.679

Table 13

Evaluated Cross Sections for the Reactions Discussed in Section 3.12

$^{12}C(n,np)^{11}B$

E_n MeV	mb
17.301	0
17.888	1.0
18.377	10.0
18.854	15.0
19.385	20.0
19.878	25.0
20.311	30.0
20.871	35.0
21.445	34.0
21.922	30.0
22.411	26.5
24.411	15.82
26.411	9.45
28.411	5.65
30.411	3.37
32.411	2.01

Uncertainties 30%

$^{12}C(n,t)^{10}B$

E_n MeV	mb
20.522	0
21.0	0.2
22.5	8.6
23.0	11.0
23.8	12.2
24.0	12.0
26.0	8.0
27.0	6.5
28.0	5.3
29.0	5.4
30.0	3.4
31.0	2.8
32.0	2.4

Uncertainties 30%

$^{12}C(n,d\alpha)^{7}Li$

E_n MeV	mb
24.28	0
24.70	0.9
25.0	1.5
26.0	16.0
27.0	25.7
27.2	27.54
27.3	27.93
27.4	27.80
28.0	27.0
29.0	22.0
30.0	18.0
32.0	12.0

Uncertainties 30%

$^{12}C(n,p\alpha)^{8}Li$

E_n MeV	mb
24.5	0
25.1	0.3
25.2	2.07
27.0	34.0
27.5	38.0
28.0	36.0
29.0	28.0
30.0	21.5
31.0	16.6
32.0	12.9

Uncertainties 30%

$^{12}C(n,^{6}Li)^{7}Li$

E_n MeV	mb
23.3	0
23.7	6.8
24.0	14
26.0	100
26.5	100
30.0	62
31.0	54
32.0	48

Uncertainties 25%

Table 14

Blanket Cross Sections for the Remaining 17 Reactions in Table 2 (σ_{spare})

E_n MeV	mb
26.3	0
26.4	1
26.6	2
27.0	7
27.1	8.5
27.2	10.5
27.7	18.0
28.0	24.0
29.0	45.0
32.0	117.0

Table 15a

Unified Cross Sections and Uncertainties (mb)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$
5.000	1183.158	19.337	.029	.004	1120.308	20.259	62.821	6.853
5.001	1195.430	17.107	.029	.004	1132.466	18.207	62.935	6.860
5.030	1177.322	17.850	.029	.004	1117.640	18.744	59.652	6.372
5.053	1172.529	17.550	.029	.004	1115.529	18.463	56.970	6.372
5.100	1151.167	17.291	.030	.004	1091.899	18.279	59.238	6.590
5.120	1142.467	17.448	.030	.004	1078.841	18.508	63.596	6.889
5.150	1135.682	17.154	.031	.004	1063.017	18.567	72.634	7.923
5.180	1124.659	17.160	.031	.004	1043.176	18.786	81.452	8.565
5.200	1107.829	16.925	.031	.004	1020.789	18.879	87.008	9.376
5.230	1098.157	16.384	.032	.004	1004.746	18.553	93.380	9.730
5.280	1064.891	16.015	.032	.005	965.431	18.466	99.428	10.321
5.300	1058.087	16.230	.033	.005	957.165	18.768	100.890	10.677
5.330	1045.566	16.575	.033	.005	932.920	22.868	112.613	17.993
5.335	1079.582	19.737	.033	.005	963.081	24.405	116.468	17.428
5.340	1027.137	17.062	.033	.005	921.685	22.682	105.419	16.863
5.360	1578.277	24.761	.033	.005	1458.550	28.161	119.694	15.149
5.362	1825.566	30.960	.033	.005	1697.984	33.358	127.548	15.023
5.370	1992.353	33.067	.033	.005	1864.097	35.226	128.222	14.556
5.371	1971.627	34.040	.033	.005	1844.485	36.096	127.108	14.514
5.378	1757.693	30.103	.033	.005	1630.761	32.378	126.899	14.247
5.380	1679.555	27.750	.033	.005	1553.816	30.300	125.705	14.203
5.390	1462.731	23.401	.034	.005	1337.656	26.488	125.041	14.215
5.400	1327.647	21.477	.034	.005	1202.716	24.973	124.898	14.594
5.410	1260.705	20.586	.034	.005	1133.367	24.456	127.304	15.286
5.420	1227.717	20.082	.034	.005	1098.628	24.474	129.055	16.256
5.430	1199.040	19.695	.034	.005	1070.013	23.621	128.992	15.197
5.440	1190.950	18.745	.034	.005	1060.363	22.423	130.552	14.242
5.460	1145.717	17.264	.034	.005	1016.440	20.600	129.243	12.803
5.500	1118.953	16.589	.035	.005	990.546	19.895	128.372	12.456
5.550	1101.177	16.755	.036	.005	972.744	19.696	128.398	11.813
5.553	1110.879	16.956	.036	.005	981.756	19.793	129.088	11.696
5.600	1088.805	16.120	.036	.005	958.867	19.138	129.901	11.686
5.650	1079.166	15.960	.037	.005	941.923	19.025	137.207	11.764
5.700	1068.152	15.605	.037	.005	920.034	19.461	148.080	13.211
5.800	1078.741	15.636	.039	.005	909.819	20.077	168.883	14.423
5.900	1079.683	15.628	.040	.006	885.323	20.698	194.321	15.569
6.000	1097.581	15.968	.041	.006	875.404	21.997	222.136	17.519
6.050	1104.150	16.735	.042	.006	872.694	22.550	231.414	17.801
6.053	1107.979	16.492	.042	.006	875.640	22.394	232.297	17.745
6.125	1133.209	16.642	.045	.006	890.746	23.612	242.418	19.592
6.160	1162.293	17.654	.046	.007	914.013	23.555	248.234	18.540
6.174	1189.434	19.196	.047	.007	938.844	23.896	250.543	18.555

Table 15b

Average Correlation Matrix for Total and Partial Cross Sections from 5 to 6.174 MeV

σ_t	1.000		
σ_e	.796	1.000	
σ_{in}	.088	-.509	1.000

Table 16a

Unified Cross Sections and Uncertainties (mb)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$
6.1800	1196.018	18.995	.047	.007	945.518	24.678	250.416	19.037	.038	.008
6.2000	1227.807	19.295	.048	.007	980.810	25.840	246.791	20.310	.158	.032
6.2100	1274.483	20.736	.048	.007	1023.889	27.219	250.328	21.202	.218	.044
6.2200	1293.173	21.035	.049	.007	1038.760	27.102	254.086	20.363	.278	.056
6.2300	1345.103	21.677	.049	.007	1085.405	27.556	259.311	20.025	.338	.068
6.2400	1428.825	22.930	.049	.007	1162.203	28.727	266.174	20.231	.399	.080
6.2500	1503.159	22.769	.050	.007	1237.474	29.522	265.177	21.049	.459	.092
6.2850	2415.353	35.741	.051	.007	2104.881	41.072	309.752	22.939	.669	.134
6.2950	2710.692	42.679	.051	.007	2382.642	47.192	327.269	23.908	.730	.146
6.3030	2598.989	41.563	.052	.007	2263.234	46.462	334.925	24.883	.778	.156
6.3100	2360.339	37.258	.052	.007	2011.488	42.836	347.980	25.746	.820	.164
6.3200	1935.126	30.348	.052	.007	1596.250	36.673	337.943	24.580	.880	.176
6.3300	1703.125	26.810	.053	.007	1368.536	33.479	333.597	23.915	.940	.188
6.3400	1520.692	24.143	.053	.008	1192.743	31.312	326.896	23.715	.999	.200
6.3500	1481.987	23.584	.053	.008	1146.317	30.762	334.616	23.998	1.000	.198
6.3600	1600.922	25.173	.054	.008	1224.280	31.423	375.586	24.687	1.002	.195
6.3700	1406.454	21.656	.054	.008	1066.038	28.303	339.361	22.791	1.001	.193
6.3900	1178.541	18.541	.055	.008	889.340	24.914	288.146	20.183	1.000	.189
6.4000	1154.890	18.939	.055	.008	872.560	24.432	281.274	19.472	1.000	.186
6.4100	1117.816	18.517	.056	.008	847.417	23.863	269.343	19.195	1.000	.184
6.4200	1090.072	18.260	.056	.008	825.554	23.549	263.461	19.024	1.000	.182
6.4300	1102.980	18.318	.056	.008	841.423	23.635	260.500	19.010	1.000	.180
6.4400	1079.625	18.020	.057	.008	827.714	23.549	250.854	19.034	1.000	.178
6.4500	1079.838	17.234	.057	.008	833.657	23.301	245.124	19.119	1.000	.176
6.4700	1060.285	16.563	.058	.008	828.121	23.297	231.106	19.484	1.000	.172
6.4900	1057.663	16.539	.059	.008	830.365	23.513	226.239	19.993	1.000	.168
6.5100	1037.360	16.008	.059	.008	804.425	23.089	231.875	20.293	1.001	.165
6.5400	972.187	15.320	.060	.009	705.793	21.258	265.332	19.541	1.002	.160
6.5530	895.675	15.780	.061	.009	631.747	20.751	262.866	19.560	1.001	.158
6.5600	849.167	15.564	.061	.009	590.884	20.181	257.221	19.284	1.001	.157
6.5700	769.464	14.140	.062	.009	530.436	19.138	237.967	18.630	1.000	.155
6.5800	732.294	13.577	.062	.009	501.316	18.607	229.916	18.288	1.000	.154
6.5900	743.225	13.784	.062	.009	505.012	18.569	237.151	18.291	1.000	.153
6.6000	737.918	12.895	.063	.009	514.008	18.932	222.848	18.504	1.000	.151
6.6200	781.930	12.891	.063	.009	576.943	19.951	203.925	18.735	.999	.149
6.6400	763.901	12.821	.064	.009	591.897	20.190	170.941	18.282	.998	.147
6.6580	935.894	15.641	.065	.009	736.919	21.252	197.910	18.014	1.000	.146
6.6650	863.108	16.449	.065	.009	682.477	21.367	179.567	17.704	1.000	.145
6.6700	849.118	15.804	.065	.009	670.107	20.837	177.947	17.389	1.000	.145
6.6800	842.789	14.158	.066	.009	661.352	19.664	180.371	16.821	1.000	.144
6.7000	836.624	12.901	.066	.009	655.544	18.704	180.013	16.291	1.000	.143
6.7500	815.874	12.266	.068	.010	649.995	17.765	164.811	15.214	1.000	.142
6.8100	797.901	11.799	.070	.010	645.774	16.924	151.056	14.255	1.000	.143
6.9200	769.893	11.301	.074	.010	606.035	15.395	162.783	12.331	1.000	.151
7.0000	744.972	11.057	.077	.011	573.618	13.981	170.277	10.201	1.000	.163
7.0530	749.068	11.282	.079	.011	572.617	14.248	175.372	10.466	1.000	.173

Table 16a (Continued)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$
7.1000	748.824	11.400	.081	.011	569.136	14.922	178.607	11.624	1.000	.182
7.1400	768.072	11.762	.083	.012	582.812	15.870	184.177	12.891	1.000	.191
7.1800	797.674	12.404	.085	.012	602.546	16.244	194.044	12.663	.999	.200
7.2000	844.627	13.536	.086	.012	639.885	17.432	202.656	13.544	2.000	.289
7.2200	877.618	14.847	.087	.012	667.835	19.047	206.700	14.971	2.997	.495
7.2250	887.890	14.664	.087	.012	676.327	19.213	208.230	15.367	3.246	.551
7.2500	976.749	15.201	.088	.012	746.745	19.918	225.429	15.387	4.487	.842
7.2700	1069.018	17.014	.089	.013	822.589	21.546	240.865	15.812	5.474	1.080
7.2800	1138.707	16.992	.090	.013	884.156	22.086	248.496	16.357	5.966	1.200
7.3400	1644.538	24.059	.092	.013	1332.063	30.127	301.418	20.773	10.964	2.199
7.3500	1756.149	27.643	.093	.013	1429.881	32.510	313.089	20.366	13.086	2.144
7.3600	1755.517	27.570	.093	.013	1422.189	32.506	318.095	20.387	15.140	2.136
7.3700	1808.552	27.034	.094	.013	1463.925	32.411	327.297	20.906	17.237	2.175
7.4000	1781.396	26.379	.095	.013	1413.809	33.939	344.074	24.822	23.418	2.544
7.4200	1770.795	25.850	.096	.014	1397.950	32.546	345.200	22.830	27.548	2.941
7.4700	1755.586	25.345	.098	.014	1371.349	33.297	346.306	24.741	37.833	4.204
7.5290	1754.002	25.535	.101	.014	1378.189	31.054	325.774	19.812	49.938	5.891
7.5420	1734.654	26.695	.101	.014	1363.449	32.150	318.603	20.378	52.501	6.277
7.5530	1725.268	25.433	.102	.014	1355.155	30.873	315.253	19.393	54.758	6.615
7.5940	1704.122	24.915	.102	.014	1338.046	31.078	302.372	20.325	63.601	7.587
7.6200	1701.060	24.989	.103	.015	1326.267	30.830	301.179	19.764	73.511	7.642
7.6500	1722.517	25.477	.104	.015	1337.039	31.411	301.108	19.393	84.266	9.729
7.6670	1782.403	26.982	.104	.015	1390.871	33.033	301.893	20.105	89.535	10.605
7.6800	1808.523	27.356	.104	.015	1414.798	33.709	301.564	20.981	92.057	10.455
7.6980	1927.406	29.719	.105	.015	1525.012	36.194	305.747	22.691	96.543	10.363
7.7000	1932.411	29.443	.105	.015	1529.921	36.147	305.445	22.940	96.941	10.360
7.7250	2225.306	32.850	.105	.015	1798.830	38.494	323.042	21.639	103.329	10.495
7.7450	2425.897	36.918	.106	.015	1987.321	42.007	331.247	21.603	107.223	10.800
7.7500	2392.678	36.432	.106	.015	1954.238	41.730	330.768	21.725	107.566	10.899
7.7700	2275.103	33.792	.106	.015	1823.509	39.932	339.897	22.695	111.590	11.379
7.7890	2143.098	31.824	.107	.015	1683.256	39.075	345.157	24.300	114.579	11.948
7.8100	2053.589	30.884	.107	.015	1580.589	39.345	354.165	26.700	118.727	12.715
7.8190	2058.984	30.242	.107	.015	1582.253	38.412	355.435	25.535	121.188	13.075
7.8600	2001.733	29.056	.108	.015	1521.782	36.480	349.681	22.491	130.162	14.879
7.8870	1969.841	29.752	.109	.015	1492.710	36.877	344.928	22.960	132.094	14.431
7.8880	1948.754	27.466	.109	.015	1474.355	35.516	342.874	23.013	131.416	14.361

Table 16b

Average Correlation Matrix for Total and Partial Cross Sections from 6.18 to 7.888 MeV

σ_t	1.000			
σ_e	.650	1.000		
σ_{in}	.159	-.619	1.000	
σ_{n,α_0}	.014	-.067	-.010	1.000

Table 17a

Unified Cross Sections and Uncertainties (mb)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$
7.8970	1945.661	28.742	.109	.012	1471.590	35.481	342.263	22.119	131.683	12.706	.017	.003
7.9300	1912.868	28.259	.110	.013	1431.960	33.966	348.965	20.184	131.770	11.365	.064	.013
7.9360	1891.429	27.322	.110	.013	1409.857	32.884	350.088	19.030	131.302	11.415	.072	.014
8.0000	1852.836	27.367	.111	.015	1350.850	36.450	373.440	21.787	128.273	16.666	.162	.032
8.0050	1863.753	29.426	.111	.015	1354.527	34.301	379.979	18.514	128.965	15.731	.170	.034
8.0100	1816.378	31.656	.111	.015	1305.265	41.361	381.976	27.964	128.849	15.277	.176	.035
8.0140	1854.915	28.079	.111	.015	1333.984	37.082	391.147	24.977	129.490	14.664	.182	.036
8.0440	1842.955	28.100	.112	.015	1297.226	36.889	421.978	24.766	123.415	11.481	.224	.045
8.0530	1882.716	28.435	.112	.015	1330.608	35.159	429.367	22.187	122.392	10.924	.237	.047
8.0790	1885.117	28.201	.112	.014	1322.834	33.412	444.274	21.416	117.623	10.892	.274	.055
8.0800	1875.975	26.062	.112	.014	1314.692	32.199	443.718	21.542	117.176	10.931	.275	.055
8.1000	1885.986	29.401	.112	.014	1317.221	38.084	455.520	27.625	112.829	12.517	.303	.061
8.1010	1903.830	27.675	.112	.014	1331.855	37.431	458.455	27.902	113.102	12.599	.305	.061
8.1050	1888.476	32.374	.113	.014	1318.290	41.243	458.094	29.718	111.669	13.076	.311	.062
8.1090	1867.368	30.265	.113	.014	1299.989	41.676	456.866	31.570	110.085	13.602	.317	.063
8.1200	1850.106	28.869	.113	.013	1281.963	38.488	459.308	28.500	108.391	12.825	.332	.066
8.1310	1813.811	28.451	.113	.013	1247.996	35.745	459.183	25.286	106.172	11.924	.347	.069
8.1380	1798.554	27.011	.113	.013	1233.018	33.704	460.118	23.593	104.949	11.389	.357	.071
8.1600	1714.947	25.487	.113	.013	1156.190	30.892	458.459	20.721	99.797	9.874	.388	.078
8.1660	1669.777	24.426	.113	.012	1115.971	30.330	455.401	20.724	97.895	9.519	.397	.079
8.2000	1516.868	23.188	.113	.012	972.993	34.294	451.970	26.890	91.347	8.145	.444	.089
8.2100	1471.072	23.637	.113	.012	949.032	32.130	432.615	24.360	88.854	7.976	.458	.092
8.2180	1452.793	22.195	.114	.012	941.779	30.097	423.106	22.707	87.325	7.941	.469	.094
8.2400	1400.096	20.236	.114	.012	920.992	26.323	395.748	19.112	82.741	8.285	.501	.100
8.2800	1299.571	19.075	.114	.011	877.111	25.397	344.968	18.820	76.820	9.205	.557	.111
8.2960	1264.108	21.437	.114	.011	860.717	28.108	325.581	21.046	77.116	8.567	.579	.116
8.2960	1258.940	17.828	.114	.011	856.641	26.385	324.596	20.997	77.009	8.554	.580	.116
8.3200	1234.152	19.176	.114	.012	850.978	27.228	305.372	21.479	76.695	7.660	.993	.142
8.3300	1213.415	17.926	.114	.012	837.386	24.999	298.825	19.463	75.924	7.324	1.164	.165
8.3910	1146.788	17.022	.115	.013	802.598	23.039	268.807	17.338	73.054	6.287	2.214	.353
8.4000	1137.013	17.803	.115	.013	797.515	24.526	264.307	18.719	72.709	6.310	2.367	.383
8.4260	1135.642	17.273	.115	.013	800.184	23.142	260.848	17.186	71.680	6.607	2.815	.471
8.4480	1118.448	17.356	.116	.014	785.663	20.796	258.957	13.604	70.529	7.085	3.184	.545

Table 17a (Continued)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$
8.4500	1101.742	16.778	.116	.014	771.544	20.283	256.937	13.287	69.921	7.151	3.224	.554
8.4800	1107.128	16.515	.116	.015	776.258	20.138	257.328	12.377	69.678	8.157	3.748	.658
8.5000	1084.095	18.275	.116	.015	757.154	22.666	254.594	14.644	68.149	7.270	4.083	.726
8.5000	1074.973	15.340	.116	.015	749.136	20.959	253.706	14.693	67.926	7.245	4.089	.728
8.5200	1083.451	16.376	.116	.016	757.194	21.572	255.193	15.786	66.516	6.422	4.432	.798
8.5530	1066.469	15.896	.116	.016	739.463	20.561	257.632	14.088	64.264	5.546	4.994	.913
8.6000	1079.607	16.276	.116	.014	755.182	21.832	257.189	16.414	61.318	5.741	5.803	1.078
8.6110	1079.567	16.481	.116	.014	756.381	24.618	256.442	19.797	60.636	6.045	5.993	1.117
8.6640	1065.360	15.603	.115	.013	748.053	20.510	248.078	14.836	62.223	6.324	6.890	1.304
8.7000	1068.357	16.698	.115	.012	745.187	24.257	247.442	18.948	68.099	6.141	7.514	1.430
8.7080	1062.748	16.439	.115	.012	737.156	23.756	248.676	18.453	69.165	6.259	7.637	1.457
8.7500	1061.547	15.987	.114	.012	718.225	21.879	259.601	16.033	75.259	7.765	8.349	1.606
8.7680	1067.810	16.140	.114	.011	716.053	21.500	265.113	15.246	77.872	8.692	8.658	1.670
8.8000	1072.059	15.753	.114	.011	706.817	20.844	273.892	14.290	82.043	10.506	9.194	1.782
8.8330	1076.418	15.852	.113	.012	689.035	20.209	281.289	13.968	96.256	9.771	9.725	1.898
8.8500	1077.227	15.771	.113	.012	677.261	20.084	284.405	14.087	105.460	9.640	9.987	1.958
8.8850	1097.630	15.835	.113	.012	668.342	20.929	293.979	14.955	124.604	11.652	10.592	2.082
8.9200	1086.375	16.127	.113	.013	638.260	23.032	298.562	16.517	138.318	15.331	11.123	2.204
8.9400	1103.940	16.426	.112	.013	637.694	24.743	305.479	17.688	149.151	17.780	11.503	2.276
8.9800	1130.922	16.339	.112	.014	632.936	22.090	308.474	14.378	177.304	17.293	12.095	2.416
9.0000	1132.571	18.090	.112	.015	630.646	27.185	297.737	16.558	191.561	20.139	12.514	2.488
9.0050	1153.122	18.712	.112	.015	644.425	26.838	299.432	16.161	196.524	19.519	12.628	2.505
9.0200	1154.568	18.118	.112	.015	642.490	25.165	298.127	15.020	201.008	18.023	12.832	2.558
9.0300	1167.811	18.174	.112	.016	650.463	24.439	298.624	14.342	205.612	17.460	13.000	2.593
9.0450	1174.661	18.177	.111	.015	653.701	23.659	298.082	13.461	209.551	17.320	13.215	2.645
9.0530	1197.671	18.460	.111	.015	669.241	23.509	299.833	13.073	215.080	17.593	13.407	2.673
9.0670	1196.918	18.031	.111	.015	668.426	23.161	298.746	12.519	216.042	18.513	13.593	2.723
9.0800	1223.542	17.333	.110	.014	685.629	23.066	300.416	12.198	223.500	19.687	13.886	2.768
9.1490	1288.876	18.337	.108	.013	723.345	24.509	301.298	13.547	248.919	19.467	15.206	3.011
9.1630	1307.386	19.611	.108	.012	736.752	26.129	302.364	14.377	252.660	20.883	15.501	3.059
9.1800	1302.464	19.327	.107	.012	735.318	29.204	300.961	15.666	250.313	25.937	15.766	3.122
9.2190	1330.726	19.584	.106	.011	731.505	30.341	301.113	16.259	281.590	27.214	16.413	3.259
9.2500	1325.768	19.628	.105	.011	724.629	26.670	303.507	14.706	280.578	21.685	16.948	3.367
9.2540	1339.432	19.512	.105	.011	733.317	26.331	305.195	14.552	283.735	21.241	17.079	3.379
9.3000	1319.608	19.090	.104	.010	716.951	25.432	307.885	13.097	276.810	23.572	17.858	3.542

Table 17a (Continued)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$
9.3100	1320.120	19.133	.103	.010	715.890	25.769	308.838	12.935	277.239	25.191	18.049	3.577
9.3600	1292.928	18.226	.102	.010	699.562	23.645	311.914	12.664	262.462	21.884	18.888	3.751
9.4000	1269.952	18.041	.101	.011	681.438	24.231	313.368	13.440	255.568	22.503	19.478	3.892
9.4500	1252.887	17.871	.099	.012	671.543	24.703	317.552	15.255	243.289	19.645	20.404	4.067
9.3100	1320.120	19.133	.103	.010	715.890	25.769	308.838	12.935	277.239	25.191	18.049	3.577
9.3600	1292.928	18.226	.102	.010	699.562	23.645	311.914	12.664	262.462	21.884	18.888	3.751
9.4000	1269.952	18.041	.101	.011	681.438	24.231	313.368	13.440	255.568	22.503	19.478	3.892
9.4500	1252.887	17.871	.099	.012	671.543	24.703	317.552	15.255	243.289	19.645	20.404	4.067
9.5000	1235.341	18.219	.098	.013	669.291	27.376	323.325	17.875	221.239	20.771	21.389	4.245
9.5220	1235.070	17.633	.097	.013	669.774	21.964	330.889	13.743	212.473	16.948	21.837	4.062
9.5530	1223.483	18.338	.096	.013	664.452	25.296	340.105	18.269	196.585	18.231	22.244	3.848
9.5600	1230.021	18.708	.096	.013	669.132	27.594	343.746	20.453	194.651	19.539	22.396	3.807
9.5900	1222.035	18.350	.096	.012	671.099	25.715	341.652	18.227	186.240	18.266	22.948	3.646
9.6000	1219.305	18.266	.096	.012	671.499	24.944	340.863	17.535	183.717	17.139	23.131	3.602
9.6300	1222.979	18.065	.095	.011	680.146	23.503	340.220	15.800	178.760	16.189	23.758	3.506
9.6400	1231.778	17.968	.095	.011	687.522	23.308	340.999	15.353	179.144	16.749	24.018	3.486
9.6780	1226.385	18.132	.094	.010	685.617	23.689	337.490	14.408	178.465	21.180	24.719	3.467
9.6800	1224.202	20.045	.094	.010	684.364	24.162	337.080	14.433	177.926	21.612	24.738	3.469
9.6920	1226.259	18.657	.094	.010	682.990	22.500	335.992	14.253	182.233	17.484	24.950	3.481
9.7000	1236.504	18.128	.094	.010	685.419	22.019	336.129	14.254	189.727	16.653	25.134	3.494
9.7260	1231.012	17.881	.093	.010	670.350	22.012	330.865	14.758	204.285	17.914	25.419	3.566
9.7400	1246.208	19.035	.093	.010	676.281	23.001	331.991	15.381	212.071	21.180	25.772	3.622
9.7500	1226.687	17.589	.093	.009	669.538	22.265	329.429	15.695	201.772	19.376	25.855	3.666
9.8000	1229.860	17.468	.092	.009	684.552	21.829	335.083	18.166	183.074	14.366	27.060	3.966
9.8210	1217.960	18.197	.092	.009	683.734	22.188	329.613	16.617	177.074	16.170	27.447	4.126
9.8300	1219.307	17.744	.092	.009	686.276	22.343	328.607	16.021	176.673	17.419	27.659	4.197
9.8680	1199.051	17.122	.091	.009	678.725	21.809	320.440	14.196	171.580	14.963	28.215	4.532
9.9000	1182.579	17.342	.090	.010	671.848	22.447	316.011	14.492	165.974	14.631	28.656	4.847
9.9170	1183.512	18.420	.090	.010	674.155	24.076	315.341	15.376	164.927	17.181	28.999	5.022
9.9210	1173.293	17.044	.090	.010	667.501	24.191	313.691	15.647	163.067	18.403	28.944	5.068
10.0000	1173.024	17.225	.089	.012	656.811	26.159	323.661	18.195	162.424	17.078	30.040	5.963

Table 17b

Average Correlation Matrix for Total and Partial Cross Sections
from 7.89 to 10 MeV

σ_t	1.00				
σ_e	.56	1.00			
σ_{in}	.15	-.48	1.00		
σ_{n,α_0}	.13	-.37	-.11	1.00	
$\sigma_{n,n'3\alpha}$	.02	-.04	-.01	-.02	1.00

Table 18a

Unified Cross Sections and Uncertainties (mb)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$
10.0500	1162.214	16.962	.088	.012	643.408	22.484	316.555	14.622	153.592	14.392	48.571	7.399
10.0530	1152.910	16.306	.088	.012	636.847	22.000	314.961	14.426	152.600	14.028	48.413	7.331
10.1700	1130.728	15.737	.085	.010	642.036	20.183	305.704	13.144	127.300	10.250	55.602	9.191
10.2500	1121.741	15.993	.084	.009	634.335	21.752	302.349	14.482	126.688	12.277	58.285	8.667
10.3000	1117.797	15.519	.083	.008	628.639	19.283	305.601	12.467	124.057	8.721	59.417	8.244
10.3720	1140.166	15.892	.081	.008	635.038	20.105	313.542	11.736	130.285	11.354	61.220	10.698
10.4000	1147.172	16.241	.081	.009	643.276	20.728	317.657	12.201	123.652	9.069	62.506	12.204
10.4480	1163.715	16.762	.080	.009	664.996	22.059	325.763	13.856	106.420	9.408	66.456	10.100
10.4780	1180.074	17.465	.079	.010	678.159	23.113	330.710	15.311	102.896	7.650	68.229	9.522
10.5000	1195.755	18.472	.078	.010	690.947	24.493	334.808	16.543	100.316	7.242	69.605	9.608
10.5060	1196.075	18.104	.078	.010	690.849	23.956	335.625	16.039	99.591	7.289	69.932	9.692
10.5360	1212.586	17.784	.078	.011	701.722	22.496	341.485	13.946	96.702	8.480	72.599	10.544
10.5500	1209.792	18.443	.078	.011	698.239	22.432	342.956	13.274	95.160	9.437	73.360	11.147
10.5530	1223.936	17.434	.077	.011	708.508	21.814	345.013	13.133	95.583	8.988	74.756	11.274
10.6200	1258.679	17.431	.076	.009	725.472	21.464	358.562	13.460	92.616	8.054	81.953	12.723
10.6900	1298.055	18.879	.075	.008	750.892	25.797	374.129	18.690	90.831	8.946	82.128	10.818
10.7000	1298.163	18.987	.075	.008	752.644	25.263	372.593	18.041	90.232	8.468	82.620	10.879
10.7500	1332.993	18.711	.074	.008	786.195	23.245	369.977	15.472	88.353	6.620	88.394	12.530
10.8000	1359.896	19.044	.073	.007	812.805	23.397	365.544	14.479	86.618	6.247	94.855	15.588
10.8300	1374.910	19.150	.073	.007	832.637	23.496	363.658	14.734	85.934	6.872	92.608	13.760
10.9000	1405.287	20.004	.071	.008	873.351	26.179	358.738	17.735	81.866	7.095	91.260	12.151
10.9400	1412.292	20.473	.071	.008	887.418	28.759	354.588	20.495	78.275	5.828	91.940	13.570
11.0000	1408.568	20.753	.070	.009	862.183	29.198	367.706	18.627	74.716	5.893	103.893	17.717
11.0040	1399.866	20.760	.069	.009	856.231	28.769	365.841	18.202	74.427	5.989	103.297	17.368
11.0530	1402.722	19.784	.069	.009	866.894	24.291	355.035	14.088	73.827	6.876	106.897	14.017
11.0960	1389.646	19.750	.068	.009	863.634	23.350	343.573	13.149	75.035	6.228	107.336	13.157
11.1000	1395.240	19.576	.068	.009	868.601	23.340	343.248	13.219	75.276	6.209	108.047	13.195
11.1660	1401.779	20.530	.068	.008	885.302	28.311	328.933	17.711	77.296	6.936	110.180	16.511
11.1700	1402.939	20.532	.067	.007	886.877	28.742	328.154	18.125	77.443	7.036	110.397	16.835
11.2500	1390.142	19.654	.067	.007	875.540	25.460	317.227	14.321	82.832	9.734	114.476	15.463
11.3000	1386.552	19.338	.066	.007	873.098	24.343	310.616	12.680	87.038	11.778	115.734	14.351
11.4000	1383.383	19.533	.065	.007	872.830	26.667	298.084	12.218	87.146	10.588	125.258	20.236
11.5000	1356.445	19.661	.064	.008	864.422	27.943	286.210	15.496	87.554	9.778	118.196	15.779

Table 18a (Continued)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$
11.5530	1345.112	18.903	.064	.009	851.431	25.354	282.942	11.598	88.990	9.474	121.685	17.749
11.7000	1330.068	18.587	.063	.007	838.478	24.600	274.706	11.800	92.196	9.643	124.626	16.472
11.7500	1348.095	20.062	.063	.006	853.483	28.964	272.681	15.973	93.853	10.048	128.015	19.053
11.7510	1341.652	19.822	.063	.006	848.604	28.837	272.070	15.902	93.671	10.055	127.244	19.116
11.8000	1347.447	19.441	.062	.006	857.822	27.912	268.544	13.194	94.452	10.483	126.566	22.828
11.8280	1360.817	19.261	.062	.006	870.066	26.276	267.275	12.416	95.213	10.763	128.201	20.197
11.9000	1399.340	20.016	.062	.007	904.848	26.782	264.322	13.864	97.549	11.707	132.560	15.711
11.9090	1393.305	21.406	.062	.007	900.796	27.796	263.132	14.362	97.288	11.852	132.027	15.532
11.9170	1407.716	20.225	.062	.007	912.681	27.632	263.582	14.827	98.058	11.974	133.334	15.443
12.0000	1426.375	19.842	.061	.008	899.424	24.909	265.596	15.579	107.709	13.091	153.585	18.698
12.0500	1446.538	20.233	.061	.008	909.918	23.052	264.950	14.105	115.450	13.784	156.158	15.274
12.0530	1452.958	20.374	.061	.008	913.429	22.994	265.595	14.025	116.684	13.829	157.188	15.129
12.0880	1452.746	20.053	.062	.008	910.313	21.905	262.548	13.093	121.473	14.311	158.350	14.079
12.1000	1457.012	19.654	.062	.008	911.021	21.514	261.902	12.789	123.835	14.467	160.192	14.048
12.1960	1404.335	18.851	.063	.007	871.893	19.876	246.111	10.910	113.059	12.781	173.209	18.457
12.2240	1385.872	18.760	.063	.006	864.989	19.375	242.579	10.539	110.924	12.300	167.318	17.078
12.2500	1374.276	18.225	.063	.006	861.185	18.951	239.879	10.291	109.626	11.871	163.524	15.565
12.3000	1346.702	17.569	.063	.006	848.523	18.785	233.700	10.146	105.655	11.182	158.760	14.416
12.4000	1335.232	18.148	.064	.007	839.267	21.407	224.892	11.170	102.192	10.345	168.816	19.564
12.5000	1331.804	18.241	.065	.009	856.034	22.640	217.291	12.321	98.545	10.089	159.868	15.463
12.5530	1343.608	18.294	.066	.009	864.223	21.799	220.012	11.147	97.479	10.235	161.827	17.247
12.5990	1349.402	18.283	.067	.008	869.750	21.514	222.117	10.543	96.066	10.557	161.402	20.180
12.7000	1368.301	17.909	.069	.007	887.257	19.835	227.261	10.695	92.797	11.603	160.918	15.747
12.7380	1366.118	18.171	.070	.007	889.525	20.474	228.147	11.340	90.372	12.185	158.004	16.911
12.8000	1386.692	18.881	.071	.007	906.746	22.834	232.308	12.934	89.841	13.338	157.725	21.385
12.9000	1407.277	19.223	.073	.008	919.477	24.850	235.762	16.064	87.215	11.900	164.750	16.948
12.9900	1421.367	19.469	.074	.010	943.633	24.278	235.049	13.340	84.737	10.668	157.874	21.547
13.0000	1420.339	20.182	.075	.010	941.945	27.637	232.983	15.928	85.183	10.597	160.154	23.138
13.0530	1418.486	19.447	.076	.010	936.844	24.628	232.045	14.328	83.625	9.915	165.897	18.748
13.1000	1419.512	19.297	.078	.009	936.018	23.025	231.885	13.163	82.569	9.402	168.962	17.300
13.1200	1418.717	18.890	.079	.009	935.640	22.509	231.804	12.746	82.133	9.212	169.061	17.594
13.2500	1402.309	18.409	.084	.008	924.903	20.803	229.583	11.460	78.788	8.436	168.951	18.724
13.2800	1387.555	18.584	.085	.009	914.509	20.612	227.416	11.545	77.284	8.374	168.261	17.598
13.3000	1391.909	18.117	.085	.009	915.617	20.564	227.633	11.684	77.152	8.361	171.421	17.405
13.5000	1392.731	19.142	.093	.012	905.259	25.256	225.898	16.040	73.557	9.434	187.924	18.699

Table 18a (Continued)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$
13.5400	1400.928	19.649	.095	.013	910.058	24.490	227.718	14.805	72.795	9.833	190.263	19.869
13.5530	1399.789	19.736	.095	.013	909.445	24.326	227.826	14.461	72.384	9.976	190.039	20.621
13.5870	1399.494	19.406	.097	.012	909.474	23.955	228.467	13.704	71.492	10.380	189.964	22.909
13.6460	1377.816	18.637	.100	.011	895.627	22.054	226.390	12.832	70.945	9.425	184.754	20.221
13.7000	1373.184	18.430	.102	.010	889.148	21.502	225.785	12.831	71.578	9.565	186.571	18.540
13.7480	1358.664	18.483	.105	.010	880.897	22.565	224.593	13.526	71.162	10.943	181.907	20.399
13.8220	1320.336	18.659	.108	.011	860.077	25.484	220.701	15.546	67.583	14.422	171.868	23.245
13.8300	1323.548	18.476	.109	.011	859.759	25.619	220.764	15.793	67.507	14.833	175.410	22.684
13.9650	1309.120	17.986	.115	.015	841.380	22.687	217.410	13.560	63.572	11.610	186.643	21.904
14.0000	1302.220	18.743	.117	.016	819.219	25.905	210.550	15.377	62.264	14.411	210.071	25.530
14.0530	1310.272	17.829	.119	.016	824.989	21.468	210.425	12.396	68.417	9.119	206.322	20.493
14.1820	1316.260	18.833	.124	.013	831.474	30.033	210.142	17.274	72.626	9.517	201.894	25.706
14.2500	1323.221	18.660	.127	.013	837.274	27.148	208.338	15.449	71.576	8.944	205.906	22.564
14.3640	1306.353	18.542	.132	.014	830.249	27.900	201.484	15.318	69.076	10.287	205.411	24.096
14.4190	1299.421	18.924	.134	.016	824.355	32.551	197.724	19.032	68.295	11.767	208.913	26.808
14.5000	1314.773	18.622	.138	.018	837.885	26.229	183.393	15.825	69.174	14.129	224.183	21.175

Table 18b

Average Correlation Matrix for Total and Partial Cross Sections from 10.05 to 14.5 MeV

σ_t	1.00				
σ_e	.502	1.000			
σ_{in}	.149	-.342	1.000		
σ_{n,α_0}	.108	-.229	-.070	1.000	
$\sigma_{n,n'3\alpha}$	.197	-.412	-.126	-.093	1.000

Table 19a

Unified Cross Sections and Uncertainties (mb)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\Delta\sigma_{n,p}$
14.5530	1338.477	18.849	.140	.019	853.815	22.960	185.109	12.548	67.318	11.787	231.989	22.395	.106	.021
14.5660	1338.136	18.674	.141	.018	854.635	22.562	184.863	12.034	66.265	11.248	232.101	23.029	.132	.026
14.6530	1367.813	19.048	.145	.016	880.103	24.294	187.024	12.837	61.233	7.996	239.002	22.388	.306	.061
14.6940	1380.217	19.642	.147	.015	894.571	26.834	188.488	15.422	58.597	6.947	238.026	21.697	.388	.078
14.7500	1385.795	19.560	.150	.015	898.894	24.847	184.672	12.877	55.516	6.475	246.063	22.989	.500	.100
14.7670	1383.946	19.681	.151	.015	897.388	24.399	182.866	12.043	54.546	6.604	248.460	23.902	.534	.107
14.8070	1395.148	19.978	.153	.015	902.104	23.971	179.796	10.609	52.958	7.053	259.524	25.405	.614	.123
14.8120	1397.517	20.529	.153	.016	903.982	23.922	179.574	10.492	52.981	6.957	260.203	25.157	.624	.125
14.8370	1393.855	19.739	.154	.016	907.502	23.622	177.637	10.169	52.677	6.486	255.209	23.369	.674	.135
14.8630	1390.770	19.699	.155	.017	911.291	24.073	175.686	10.358	52.305	6.037	250.606	22.133	.727	.145
14.8880	1387.014	20.452	.157	.017	913.414	25.222	173.740	11.017	51.910	5.647	247.017	21.720	.776	.155
14.8920	1395.195	20.207	.157	.018	919.057	25.340	173.984	11.158	51.984	5.589	249.228	21.704	.785	.157
14.9060	1395.539	21.711	.157	.018	921.278	26.598	173.041	11.742	51.793	5.397	248.457	22.049	.813	.162
14.9090	1395.914	20.331	.158	.018	921.899	26.328	172.857	11.868	51.757	5.357	248.425	22.040	.819	.164
14.9270	1389.850	20.340	.158	.019	919.813	27.585	171.188	12.774	51.462	5.141	246.374	22.930	.854	.171
14.9540	1392.508	20.474	.160	.020	919.324	26.781	170.512	11.425	51.286	4.877	250.318	24.164	.909	.182
14.9620	1393.105	20.205	.160	.020	918.773	26.409	170.367	11.079	51.230	4.815	251.650	24.546	.925	.185
14.9960	1409.905	20.788	.162	.021	923.016	25.691	170.723	10.755	51.099	4.653	263.913	26.586	.993	.198
15.0000	1397.585	21.234	.162	.022	917.514	25.736	170.064	10.846	50.950	4.645	257.894	26.937	1.001	.200
15.0060	1400.535	20.287	.162	.022	919.473	25.302	170.313	11.011	50.945	4.636	258.603	26.248	1.038	.198
15.0450	1407.731	20.156	.164	.023	928.532	25.017	171.829	13.231	50.783	4.709	255.139	23.746	1.284	.196
15.0530	1412.175	20.264	.164	.022	932.107	25.305	172.490	13.864	50.773	4.751	255.308	23.392	1.334	.199
15.0930	1419.071	19.991	.166	.021	941.634	27.719	174.083	17.536	50.510	5.089	251.092	22.621	1.586	.224
15.2480	1433.090	19.903	.171	.017	958.852	25.477	165.468	13.598	50.136	4.562	255.899	24.005	2.562	.427
15.2500	1432.770	19.807	.171	.017	958.988	25.406	165.334	13.556	50.135	4.558	255.567	23.861	2.575	.430

Table 19b

Average Correlation Matrix for Total and Partial Cross Sections from 14.553 to 15.25 MeV

σ_t	1.000					
σ_e	.414	1.000				
σ_{in}	.120	-.220	1.000			
σ_{n,α_0}	.058	-.103	-.031	1.000		
$\sigma_{n,n'3\alpha}$	.323	-.571	-.168	-.083	1.000	
$\sigma_{n,p}$	.002	-.003	-.001	.000	-.002	1.000

Table 20a

Unified Cross Sections and Uncertainties (mb)

E_n MeV	σ_t	$\Delta\sigma_t$	σ_c	$\Delta\sigma_c$	σ_e	$\Delta\sigma_e$	σ_{in}	$\Delta\sigma_{in}$	$\sigma_{n,\alpha}$	$\Delta\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\Delta\sigma_{n,p}$	$\sigma_{n,d}$	$\Delta\sigma_{n,d}$
15.4480	1453.018	20.201	.179	.022	985.389	27.009	156.990	13.102	49.088	4.852	255.805	24.791	3.822	.751	1.746	.349
15.4770	1453.763	20.215	.180	.023	986.729	25.559	156.293	13.538	48.557	4.362	255.998	22.998	4.006	.800	2.002	.400
15.5530	1462.833	20.591	.182	.025	993.932	29.315	153.820	15.465	47.230	4.912	258.241	25.879	4.626	.720	4.802	.707
15.7310	1481.828	20.557	.188	.019	1006.304	27.600	149.579	13.088	39.729	3.842	268.512	24.328	6.092	.916	11.424	2.085
15.9660	1503.540	21.246	.195	.024	1025.482	30.650	141.866	12.714	35.972	4.925	271.820	27.857	8.028	1.599	20.176	3.991
15.9700	1512.825	23.045	.195	.025	1031.277	31.534	142.171	12.802	35.867	5.087	274.964	28.492	8.059	1.586	20.293	3.959
15.9900	1506.027	22.695	.196	.026	1028.493	33.806	140.976	13.236	34.931	6.023	272.627	31.059	8.172	1.523	20.633	3.805
16.0000	1513.930	22.316	.196	.026	1033.797	35.029	140.910	13.473	34.568	6.551	275.375	32.452	8.236	1.494	20.849	3.734
16.0530	1498.182	21.505	.197	.027	1018.909	29.213	140.378	14.645	35.351	3.878	272.811	26.063	8.570	1.368	21.967	3.443
16.0680	1498.574	20.910	.198	.026	1016.653	27.980	140.658	15.001	36.225	5.022	273.871	24.873	8.667	1.343	22.302	3.390
16.2560	1465.033	20.404	.201	.020	983.689	27.769	131.238	11.640	33.913	4.363	279.817	25.602	9.857	1.477	26.317	3.960
16.4400	1440.952	20.324	.205	.024	955.088	28.160	122.178	11.098	40.684	4.225	281.427	26.909	11.035	2.185	30.335	5.929
16.4430	1436.576	20.406	.205	.025	952.690	27.853	121.921	11.131	40.270	3.967	280.074	26.604	11.049	2.198	30.366	5.966
16.5320	1426.198	20.543	.207	.029	946.869	30.088	118.550	12.817	35.964	3.904	281.248	26.187	11.376	1.881	31.984	5.152
16.5530	1423.964	20.463	.207	.028	942.947	30.991	117.624	13.346	36.834	3.044	282.557	27.773	11.450	1.825	32.344	5.021
16.6950	1404.505	19.711	.208	.022	919.498	27.533	116.127	11.357	40.597	4.034	281.137	24.679	11.975	1.690	34.964	4.915
16.8200	1400.974	19.970	.208	.021	908.543	27.354	116.314	10.208	39.824	3.712	286.270	28.105	12.449	1.952	37.367	5.908
16.8240	1397.835	19.822	.208	.021	907.328	27.404	116.214	10.208	39.769	3.841	284.450	27.871	12.460	1.965	37.406	5.951
16.9740	1389.994	19.627	.209	.026	896.525	27.048	116.584	11.969	42.016	4.310	281.485	27.873	13.017	2.597	40.158	7.919
17.0530	1396.423	20.123	.209	.028	896.788	29.189	117.443	13.874	42.815	3.000	283.863	27.102	13.502	2.241	41.803	6.858
17.0740	1401.279	20.403	.209	.027	899.274	30.145	117.850	14.468	43.443	3.259	284.606	26.395	13.633	2.170	42.264	6.651
17.1380	1386.475	19.439	.208	.024	887.268	26.709	117.222	12.771	44.712	3.397	279.777	25.757	13.994	2.034	43.293	6.248
17.3000	1397.786	19.518	.206	.021	870.776	24.869	121.270	10.531	43.242	3.979	299.652	24.216	15.081	2.290	47.559	7.075

Table 20b

Average Correlation Matrix for Total and Partial Cross Sections from 15.448 to 17.3 MeV

σ_t	1.000							
σ_c	.000	1.000						
σ_e	.397	.000	1.000					
σ_{in}	.098	.000	-.221	1.000				
σ_{n,α_0}	.031	.000	-.070	-.017	1.000			
$\sigma_{n,n'3\alpha}$	.283	.000	-.634	-.155	-.050	1.000		
$\sigma_{n,p}$	.012	.000	-.027	-.007	-.002	-.020	1.000	
$\sigma_{n,d}$	.033	.000	-.073	-.018	-.006	-.055	-.003	1.000

Table 21a

Unified Cross Sections (mb)

E MeV	σ_t	σ_c	σ_e	σ_{in}	$\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\sigma_{n,d}$	$\sigma_{n,np}$
17.3010	1402.917	.206	885.223	120.220	43.064	292.126	15.032	47.045	.00
17.4670	1396.497	.205	873.313	122.280	37.458	296.446	16.059	50.574	.16
17.5530	1404.788	.204	880.400	123.190	34.206	297.302	16.656	52.586	.25
17.6160	1411.090	.203	887.324	121.548	32.213	298.313	17.096	54.087	.31
17.6870	1411.154	.202	889.699	118.285	31.220	298.048	17.584	55.691	.43
17.9000	1424.712	.199	905.965	108.820	29.192	299.616	19.059	60.639	1.22
17.9010	1428.188	.199	908.648	108.846	29.196	300.277	19.071	60.711	1.24
18.0000	1436.929	.197	917.541	104.485	28.745	301.312	19.070	62.513	3.07
18.0530	1449.562	.197	929.470	102.323	27.344	303.479	19.083	63.621	4.05
18.0870	1441.627	.196	923.358	102.375	26.419	301.487	19.065	64.055	4.67
18.1580	1465.661	.196	935.750	111.156	24.534	303.492	19.076	65.471	5.99
18.2730	1463.116	.196	928.923	115.844	21.458	302.161	19.058	67.367	8.11
18.4600	1454.164	.195	922.820	115.059	19.206	296.908	19.007	70.094	10.88
18.5530	1467.612	.195	933.333	115.699	19.288	298.525	18.852	69.863	11.86
18.6320	1480.648	.195	946.338	112.875	19.333	300.727	18.726	69.754	12.70
18.7000	1484.851	.196	952.869	108.587	20.081	301.537	18.610	69.552	13.42
18.8330	1481.603	.196	956.940	99.935	21.798	300.643	18.366	68.923	14.80
19.0300	1482.226	.197	971.156	87.185	21.749	299.273	18.006	68.005	16.66
19.0340	1496.544	.197	982.840	87.142	21.748	301.670	18.015	68.209	16.72
19.0530	1496.541	.197	984.553	85.919	21.635	301.568	17.894	67.874	16.90
19.1850	1506.401	.200	997.643	84.201	22.568	301.034	17.057	65.565	18.13
19.3460	1526.441	.203	1017.372	85.343	24.433	300.630	16.039	62.785	19.64
19.5110	1548.324	.206	1035.068	86.675	27.684	302.284	15.006	60.096	21.31
19.5530	1553.922	.207	1038.200	87.041	29.354	302.996	14.837	59.541	21.75
19.6600	1556.761	.208	1037.082	87.833	33.553	302.868	14.398	57.989	22.83
19.6610	1562.423	.208	1041.642	87.901	33.636	303.744	14.398	58.032	22.86
19.7940	1539.361	.209	1023.968	88.629	32.980	299.757	13.838	55.867	24.11
19.8920	1534.181	.210	1022.950	89.345	29.314	299.372	13.435	54.442	25.11
20.0000	1531.908	.211	1008.122	90.163	41.797	299.374	12.994	52.899	26.35
20.1000	1518.993	.211	991.235	90.897	45.946	298.739	12.674	51.811	27.48
20.2000	1520.089	.211	997.166	91.737	39.021	300.101	12.360	50.816	28.68
20.3000	1500.749	.211	983.887	92.478	32.983	299.603	12.041	49.734	29.81
20.4000	1486.922	.211	972.557	93.228	30.549	299.268	11.722	48.661	30.73
20.5000	1483.957	.211	970.789	94.026	28.119	300.128	11.406	47.628	31.65

Table 21a (Continued)

Unified Uncertainties (mb)

E MeV	$\Delta\sigma_t$	$\Delta\sigma_c$	$\Delta\sigma_e$	$\Delta\sigma_{in}$	$\Delta\sigma_{n,\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,p}$	$\Delta\sigma_{n,d}$	$\Delta\sigma_{n,np}$
17.3010	20.97	.04	43.92	15.02	5.60	38.44	3.00	9.29	.00
17.4670	20.78	.04	43.90	15.20	5.24	38.56	3.20	9.95	.05
17.5530	21.09	.04	44.22	15.30	4.79	38.75	3.32	10.34	.07
17.6160	21.23	.04	44.39	15.17	4.61	38.87	3.40	10.63	.09
17.6870	21.73	.04	44.69	14.91	4.89	39.02	3.50	10.95	.13
17.9000	21.76	.04	45.14	14.13	4.76	39.42	3.80	11.91	.37
17.9010	21.57	.04	45.09	14.13	4.75	39.42	3.80	11.92	.37
18.0000	21.58	.04	45.26	13.77	4.18	39.61	3.80	12.26	.92
18.0530	22.09	.04	45.49	13.57	3.94	39.70	3.80	12.45	1.21
18.0870	21.86	.04	45.64	14.41	3.78	39.76	3.80	12.57	1.40
18.1580	21.93	.04	47.06	20.26	3.46	39.96	3.80	12.82	1.79
18.2730	21.75	.04	47.64	22.09	2.93	40.13	3.80	13.23	2.43
18.4600	21.64	.04	47.19	18.10	2.53	40.40	3.80	13.88	3.26
18.5530	22.00	.04	47.00	16.07	2.52	40.50	3.77	13.82	3.55
18.6320	22.28	.04	47.04	15.20	3.21	40.58	3.74	13.77	3.80
18.7000	22.21	.04	47.06	14.87	3.45	40.65	3.71	13.72	4.01
18.8330	22.02	.04	47.10	14.23	3.56	40.81	3.67	13.63	4.43
19.0300	22.22	.04	47.43	13.28	4.41	41.09	3.60	13.50	4.99
19.0340	23.51	.04	47.82	13.26	4.40	41.12	3.60	13.50	5.00
19.0530	22.57	.04	47.54	13.16	4.35	41.12	3.57	13.44	5.06
19.1850	22.45	.04	47.69	12.80	5.42	41.27	3.41	13.01	5.43
19.3460	22.72	.04	48.01	12.48	6.23	41.48	3.21	12.48	5.88
19.5110	23.20	.04	48.33	12.16	7.50	41.61	3.00	11.94	6.37
19.5530	23.45	.04	48.46	12.08	8.21	41.62	2.97	11.82	6.50
19.6600	23.77	.04	48.72	11.86	10.02	41.64	2.88	11.52	6.83
19.6610	23.56	.04	48.65	11.86	10.04	41.63	2.88	11.51	6.83
19.7940	23.04	.04	48.69	11.60	11.64	41.66	2.77	11.14	7.23
19.8920	23.06	.04	49.17	11.41	12.46	41.88	2.69	10.86	7.53
20.0000	23.46	.04	51.07	11.21	9.63	43.10	2.60	10.57	7.91
20.1000	31.92	.04	56.00	11.02	8.91	44.75	2.54	10.37	8.26
20.2000	31.95	.04	57.00	10.82	10.01	46.04	2.47	10.15	8.60
20.3000	31.57	.04	57.76	10.62	10.67	47.30	2.41	9.94	8.95
20.4000	31.30	.04	58.46	10.42	10.63	48.54	2.35	9.73	9.22
20.5000	31.24	.04	59.23	10.22	10.36	49.77	2.28	9.52	9.49

Table 21b

Average Correlation Matrix of Total and Partial Cross Sections
from 17.301 to 20.5 MeV

σ_t	1.00								
σ_c	.00	1.00							
σ_e	.39	.00	1.00						
σ_{in}	.03	.00	-.22	1.00					
$\sigma_{n,\alpha}$	.01	.00	-.10	-.01	1.00				
$\sigma_{n,n'3\alpha}$	.09	.00	-.78	-.06	-.02	1.00			
$\sigma_{n,p}$	.01	.00	-.05	.00	.00	-.01	1.00		
$\sigma_{n,d}$	.02	.00	-.19	-.01	-.01	-.05	.00	1.00	
$\sigma_{n,np}$	.01	.00	-.07	.00	.00	-.01	.00	.00	1.00

Table 22a

Unified Cross Sections (mb)

E MeV	σ_t	σ_c	σ_e	σ_{in}	$\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\sigma_{n,d}$	$\sigma_{n,np}$	$\sigma_{n,2n}$	$\sigma_{n,t}$
20.6000	1466.490	.211	954.572	94.810	25.490	300.815	11.089	46.584	32.57	.32	.03
20.7000	1453.690	.211	942.295	95.617	22.866	302.359	10.772	45.559	33.51	.42	.08
20.8000	1444.906	.211	930.905	96.429	22.850	304.397	10.456	44.537	34.47	.53	.12
20.9000	1457.295	.211	949.392	95.032	23.844	299.628	10.132	43.358	34.91	.64	.16
21.0000	1460.797	.211	952.599	93.813	24.933	301.371	9.815	42.327	34.79	.74	.20
21.1000	1457.648	.211	950.425	92.569	25.969	301.453	9.498	41.276	34.64	.85	.76
21.2000	1450.368	.211	944.786	91.311	26.997	300.924	9.179	40.213	34.47	.95	1.32
21.3000	1462.249	.211	953.269	90.111	30.283	302.994	8.863	39.193	34.39	1.06	1.88
21.4000	1454.022	.211	944.510	88.838	34.067	301.925	8.545	38.117	34.20	1.17	2.44
21.5000	1446.904	.211	939.418	87.580	34.933	301.537	8.226	37.053	33.67	1.27	3.00
21.6000	1450.988	.211	947.232	86.381	31.456	303.914	7.910	36.028	32.92	1.38	3.56
21.7000	1447.278	.211	948.446	85.157	27.906	305.249	7.592	34.984	32.13	1.48	4.12
21.8000	1432.114	.211	940.167	83.894	24.307	304.791	7.273	33.913	31.28	1.59	4.69
21.9000	1425.145	.211	938.629	82.658	20.730	305.685	6.955	32.859	30.47	1.69	5.25
22.0000	1418.837	.211	937.516	81.423	17.153	306.720	6.637	31.804	29.76	1.80	5.81
22.1000	1410.741	.211	936.378	81.202	16.876	301.242	6.473	31.108	28.93	1.95	6.37
22.2000	1430.887	.211	953.832	81.156	16.647	304.876	6.314	30.516	28.30	2.10	6.94
22.3000	1411.966	.211	938.842	80.989	16.386	302.251	6.151	29.855	27.53	2.25	7.50
22.4000	1421.607	.211	947.554	80.912	16.148	304.226	5.990	29.241	26.86	2.40	8.07
22.5000	1420.550	.211	947.494	80.797	15.899	304.224	5.829	28.606	26.31	2.55	8.63
22.6000	1418.063	.211	946.295	80.677	15.650	304.004	5.667	27.969	25.77	2.70	9.12
22.7000	1427.139	.211	954.662	80.594	15.408	305.681	5.506	27.348	25.27	2.85	9.61
22.8000	1427.106	.211	955.482	80.483	15.160	305.876	5.345	26.713	24.74	3.00	10.09
22.9000	1426.577	.211	956.393	80.358	14.908	305.372	5.183	26.071	24.20	3.30	10.58
23.0000	1430.870	.211	961.634	80.242	14.659	305.336	5.021	25.433	23.66	3.60	11.07
23.1000	1429.845	.211	962.731	80.110	14.406	304.501	4.860	24.789	23.12	3.90	11.22
23.2000	1439.931	.211	972.266	80.029	14.163	306.214	4.698	24.163	22.60	4.20	11.38
23.3000	1434.806	.211	968.797	79.906	13.911	305.826	4.537	23.521	22.06	4.50	11.54
23.4000	1448.868	.211	981.220	79.845	13.671	308.584	4.376	22.899	21.56	4.80	11.70
23.5000	1433.304	.211	969.088	79.689	13.413	306.500	4.213	22.245	20.99	5.10	11.85
23.6000	1446.912	.211	984.177	79.570	13.161	306.280	4.052	21.603	20.45	5.40	12.01

Table 22a (Continued)

Unified Uncertainties (mb)

E MeV	$\Delta\sigma_t$	$\Delta\sigma_c$	$\Delta\sigma_e$	$\Delta\sigma_{in}$	$\Delta\sigma_{n,\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,p}$	$\Delta\sigma_{n,d}$	$\Delta\sigma_{n,np}$	$\Delta\sigma_{n,2n}$	$\Delta\sigma_{n,t}$
20.6000	30.88	.04	59.66	10.02	9.20	50.89	2.22	9.30	9.75	.04	.01
20.7000	30.63	.04	60.12	9.82	8.04	51.98	2.16	9.09	10.02	.06	.02
20.8000	30.46	.04	60.65	9.61	7.52	53.03	2.09	8.88	10.29	.07	.04
20.9000	30.72	.04	62.19	9.49	7.29	54.57	2.03	8.67	10.46	.09	.05
21.0000	30.82	.04	63.02	9.36	7.19	55.71	1.97	8.45	10.41	.10	.06
21.1000	30.76	.04	62.81	9.24	7.63	55.53	1.90	8.24	10.36	.11	.23
21.2000	30.61	.04	62.56	9.11	8.07	55.33	1.84	8.03	10.31	.13	.40
21.3000	30.87	.04	62.56	8.99	9.66	55.15	1.77	7.81	10.25	.14	.56
21.4000	30.71	.04	62.48	8.86	11.54	54.97	1.71	7.60	10.20	.16	.73
21.5000	30.57	.04	62.26	8.73	12.05	54.78	1.65	7.39	10.04	.17	.90
21.6000	30.68	.04	61.84	8.61	10.50	54.57	1.58	7.17	9.79	.18	1.07
21.7000	30.60	.04	61.38	8.48	8.94	54.35	1.52	6.96	9.54	.20	1.24
21.8000	30.30	.04	60.87	8.36	7.39	54.12	1.46	6.75	9.29	.21	1.40
21.9000	30.18	.04	60.44	8.23	5.83	53.90	1.39	6.54	9.04	.23	1.57
22.0000	30.06	.04	60.05	8.10	4.27	53.68	1.33	6.32	8.82	.24	1.74
22.1000	29.91	.04	60.14	8.09	4.21	53.73	1.30	6.20	8.60	.25	1.91
22.2000	30.33	.04	60.09	8.08	4.14	53.56	1.27	6.07	8.39	.26	2.08
22.3000	29.97	.04	59.76	8.06	4.08	53.38	1.23	5.94	8.18	.26	2.24
22.4000	30.17	.04	59.64	8.05	4.02	53.21	1.20	5.81	7.96	.27	2.41
22.5000	30.17	.04	59.46	8.04	3.96	53.05	1.17	5.69	7.80	.28	2.58
22.6000	30.14	.04	59.28	8.02	3.89	52.89	1.14	5.56	7.64	.29	2.72
22.7000	30.35	.04	59.18	8.01	3.83	52.73	1.10	5.43	7.48	.29	2.87
22.8000	30.36	.04	59.01	8.00	3.77	52.57	1.07	5.31	7.32	.30	3.01
22.9000	30.37	.04	58.89	7.98	3.71	52.44	1.04	5.18	7.16	.33	3.16
23.0000	30.46	.04	58.81	7.97	3.64	52.32	1.01	5.05	7.00	.36	3.30
23.1000	30.47	.04	58.71	7.96	3.58	52.20	.97	4.92	6.84	.38	3.34
23.2000	30.71	.04	58.63	7.95	3.52	52.05	.94	4.80	6.68	.41	3.39
23.3000	30.62	.04	58.42	7.93	3.46	51.88	.91	4.67	6.52	.44	3.43
23.4000	30.94	.04	58.35	7.92	3.39	51.72	.88	4.54	6.36	.46	3.48
23.5000	30.63	.04	58.06	7.91	3.33	51.55	.84	4.42	6.20	.49	3.52
23.6000	30.93	.04	58.18	7.89	3.27	51.50	.81	4.29	6.04	.52	3.57

Table 22b

Average Correlation Matrix of Total and Partial Cross Sections from 20.6 to 23.6 MeV

σ_t	1.00										
σ_c	.00	1.00									
σ_e	.42	.00	1.00								
σ_{in}	.01	.00	-.11	1.00							
$\sigma_{n,\alpha}$	.01	.00	-.08	.00	1.00						
$\sigma_{n,n'3\alpha}$	.09	.00	-.83	-.02	-.02	1.00					
$\sigma_{n,p}$	.00	.00	-.02	.00	.00	.00	1.00				
$\sigma_{n,d}$	.01	.00	-.09	.00	.00	-.02	.00	1.00			
$\sigma_{n,np}$	.01	.00	-.11	.00	.00	-.02	.00	.00	1.00		
$\sigma_{n,n2n}$	.00	.00	.00	.00	.00	.00	.00	.00	.00	1.00	
$\sigma_{n,t}$	.00	.00	-.02	.00	.00	-.01	.00	.00	.00	.00	1.00

Table 23a

Unified Cross Sections (mb)

E MeV	σ_t	σ_c	σ_e	σ_{in}	$\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\sigma_{n,d}$	$\sigma_{n,np}$	$\sigma_{n,2n}$	$\sigma_{n,t}$	$\sigma_{n,6Li}$
23.7000	1439.472	.211	976.975	79.344	12.892	300.722	3.889	20.932	19.85	5.70	12.14	6.82
23.8000	1439.784	.211	979.723	79.160	12.631	297.272	3.726	20.274	19.27	6.00	12.28	9.23
23.9000	1436.921	.211	979.846	78.969	12.370	293.534	3.564	19.617	18.70	6.30	12.17	11.64
24.0000	1445.418	.211	989.323	78.814	12.114	291.555	3.402	18.969	18.14	6.77	12.06	14.06
24.1000	1422.037	.211	953.121	78.216	11.966	301.265	3.321	18.634	17.69	7.23	11.90	18.47
24.2000	1410.263	.211	942.631	77.348	11.779	297.480	3.238	18.236	17.12	7.70	11.69	22.84
24.3000	1435.733	.211	963.015	76.598	11.609	299.742	3.156	17.865	16.60	8.16	11.50	27.28
24.4000	1415.999	.211	945.824	75.709	11.419	294.748	3.073	17.463	16.02	8.62	11.28	31.63
24.5000	1430.869	.211	957.224	74.925	11.244	295.247	2.990	17.085	15.68	9.09	11.08	36.09
24.6000	1417.398	.211	944.964	74.058	11.058	291.310	2.907	16.689	15.34	9.55	10.87	40.45

Unified Uncertainties (mb)

E MeV	$\Delta\sigma_t$	$\Delta\sigma_c$	$\Delta\sigma_e$	$\Delta\sigma_{in}$	$\Delta\sigma_{n,\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,p}$	$\Delta\sigma_{n,d}$	$\Delta\sigma_{n,np}$	$\Delta\sigma_{n,2n}$	$\Delta\sigma_{n,t}$	$\Delta\sigma_{n,6Li}$
23.7000	30.80	.04	58.21	7.88	3.20	51.49	.78	4.16	5.88	.55	3.61	1.70
23.8000	30.82	.04	58.29	7.87	3.14	51.47	.75	4.03	5.72	.57	3.66	2.30
23.9000	30.78	.04	58.34	7.85	3.08	51.45	.71	3.91	5.56	.60	3.63	2.90
24.0000	30.98	.04	58.47	7.84	3.02	51.43	.68	3.78	5.40	.64	3.60	3.50
24.1000	30.51	.04	57.25	7.76	2.97	50.69	.66	3.70	5.24	.67	3.54	4.57
24.2000	30.32	.04	57.17	7.68	2.93	50.60	.65	3.63	5.08	.71	3.48	5.65
24.3000	30.87	.04	57.38	7.60	2.88	50.51	.63	3.55	4.93	.75	3.42	6.72
24.4000	30.46	.04	57.24	7.52	2.84	50.42	.61	3.48	4.77	.78	3.36	7.79
24.5000	30.80	.04	57.40	7.44	2.80	50.33	.60	3.40	4.66	.82	3.30	8.86
24.6000	30.57	.04	57.36	7.36	2.75	50.23	.58	3.32	4.57	.86	3.24	9.93

Table 23b

Average Correlation Matrix of Total and Partial Cross Sections from 23.7 to 24.6 MeV

σ_t	1.00											
σ_c	.00	1.00										
σ_e	.44	.00	1.00									
σ_{in}	.01	.00	-.11	1.00								
$\sigma_{n,\alpha}$	.00	.00	-.04	.00	1.00							
$\sigma_{n,n'3\alpha}$	.09	.00	-.82	-.02	-.01	1.00						
$\sigma_{n,p}$	.00	.00	-.01	.00	.00	.00	1.00					
$\sigma_{n,d}$	.01	.00	-.05	.00	.00	-.01	.00	1.00				
$\sigma_{n,np}$	.01	.00	-.07	.00	.00	-.02	.00	.00	1.00			
$\sigma_{n,2n}$	.00	.00	-.01	.00	.00	.00	.00	.00	.00	1.00		
$\sigma_{n,d\alpha}$	.01	.00	-.05	.00	.00	-.01	.00	.00	.00	.00	1.00	
$\sigma_{n,p\alpha}$	.01	.00	-.07	.00	.00	-.02	.00	.00	.00	.00	.00	1.00

Table 24a

Unified Cross Sections (mb)

E MeV	σ_t	σ_c	σ_e	σ_{in}	$\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\sigma_{n,d}$	$\sigma_{n,np}$	$\sigma_{n,2n}$	$\sigma_{n,t}$	$\sigma_{n,^6Li}$	$\sigma_{n,d\alpha^7Li}$	$\sigma_{n,p\alpha^8Li}$
24.7000	1420.736	.211	945.876	73.239	10.878	289.870	2.825	16.303	15.01	10.01	10.66	44.87	.88	.10
24.8000	1408.945	.211	934.724	72.381	10.693	286.259	2.742	15.910	14.67	10.48	10.45	49.19	1.08	.15
24.9000	1424.637	.211	946.528	71.598	10.518	286.822	2.659	15.532	14.36	10.94	10.26	53.72	1.29	.20
25.0000	1418.114	.211	939.734	70.757	10.336	284.067	2.576	15.143	14.02	11.41	10.05	58.06	1.50	.25
25.1000	1403.860	.211	925.561	69.897	10.151	280.097	2.494	14.750	13.68	11.65	9.84	62.27	2.95	.30
25.2000	1400.094	.211	918.704	69.061	9.969	277.465	2.411	14.363	13.35	11.90	9.63	66.55	4.41	2.08
25.3000	1420.320	.211	931.940	68.282	9.795	278.287	2.328	13.985	13.04	12.16	9.43	71.15	5.86	3.85
25.4000	1392.229	.211	904.670	67.393	9.607	272.286	2.245	13.590	12.69	12.40	9.22	74.98	7.31	5.63
25.5000	1409.356	.211	915.292	66.607	9.432	272.679	2.163	13.211	12.38	12.65	9.02	79.53	8.77	7.41
25.6000	1403.278	.211	906.462	65.772	9.250	269.869	2.080	12.825	12.05	12.90	8.81	83.64	10.22	9.18
25.7000	1420.689	.211	917.306	64.986	9.075	270.279	1.998	12.446	11.74	13.15	8.62	88.23	11.68	10.97
25.8000	1401.466	.211	897.476	64.127	8.891	265.782	1.915	12.057	11.40	13.40	8.41	91.95	13.12	12.73
25.9000	1399.836	.211	892.386	63.305	8.712	263.693	1.833	11.674	11.08	13.65	8.20	96.03	14.56	14.50
26.0000	1418.999	.211	904.683	62.522	8.537	264.331	1.750	11.296	10.77	13.90	8.01	100.68	16.03	16.29
26.1000	1389.888	.211	879.112	62.239	8.406	259.820	1.707	11.061	10.44	14.24	7.85	99.82	16.96	18.03
26.2000	1391.326	.211	879.067	62.012	8.282	259.262	1.665	10.834	10.12	14.59	7.70	99.86	17.93	19.80
26.3000	1410.415	.211	893.766	61.819	8.160	260.966	1.623	10.611	9.81	14.93	7.55	100.42	18.93	21.61

Table 24a (Continued)

Unified Uncertainties (mb)

E MeV	$\Delta\sigma_t$	$\Delta\sigma_c$	$\Delta\sigma_e$	$\Delta\sigma_{in}$	$\Delta\sigma_{n,\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,p}$	$\Delta\sigma_{n,d}$	$\Delta\sigma_{n,np}$	$\Delta\sigma_{n,2n}$	$\Delta\sigma_{n,t}$	$\Delta\sigma_{n,^6Li}$	$\Delta\sigma_{n,d\alpha^7Li}$	$\Delta\sigma_{n,p\alpha^8Li}$
24.7000	30.69	.04	57.46	7.28	2.71	50.14	.56	3.25	4.47	.89	3.18	10.99	.26	.03
24.8000	30.46	.04	57.45	7.20	2.66	50.05	.55	3.17	4.38	.93	3.12	12.06	.33	.05
24.9000	30.79	.04	57.65	7.12	2.62	49.96	.53	3.09	4.28	.96	3.06	13.12	.39	.07
25.0000	30.71	.04	57.72	7.04	2.58	49.86	.52	3.02	4.19	1.00	3.00	14.18	.45	.08
25.1000	30.47	.04	57.74	6.96	2.53	49.77	.50	2.94	4.09	1.03	2.94	15.24	.89	.10
25.2000	30.40	.04	57.85	6.88	2.49	49.68	.48	2.87	4.00	1.06	2.88	16.29	1.32	.63
25.3000	30.83	.04	58.16	6.80	2.44	49.59	.47	2.79	3.90	1.09	2.82	17.35	1.76	1.16
25.4000	30.30	.04	58.13	6.72	2.40	49.49	.45	2.71	3.81	1.12	2.76	18.40	2.19	1.70
25.5000	30.68	.04	58.46	6.64	2.35	49.40	.43	2.64	3.71	1.15	2.70	19.45	2.63	2.23
25.6000	30.59	.04	58.63	6.56	2.31	49.31	.42	2.56	3.62	1.18	2.64	20.49	3.06	2.76
25.7000	31.01	.04	59.00	6.48	2.27	49.22	.40	2.49	3.52	1.21	2.58	21.54	3.49	3.29
25.8000	30.63	.04	59.10	6.40	2.22	49.12	.38	2.41	3.43	1.24	2.52	22.57	3.93	3.82
25.9000	30.66	.04	59.37	6.32	2.18	49.03	.37	2.33	3.34	1.27	2.46	23.61	4.36	4.35
26.0000	31.10	.04	59.80	6.24	2.13	48.94	.35	2.26	3.24	1.30	2.40	24.64	4.80	4.88
26.1000	30.52	.04	59.53	6.29	2.10	48.81	.34	2.21	3.15	1.33	2.36	24.64	5.09	5.41
26.2000	30.62	.04	59.52	6.33	2.07	48.68	.33	2.17	3.05	1.36	2.31	24.64	5.38	5.94
26.3000	31.04	.04	59.62	6.37	2.04	48.56	.32	2.12	2.96	1.39	2.27	24.64	5.67	6.47

Table 24b

Average Correlation Matrix of Total and Partial Cross Sections
from 24.7 to 26.3 MeV

σ_t	1.00													
σ_c	.00	1.00												
σ_e	.44	.00	1.00											
σ_{in}	.01	.00	-.09	1.00										
$\sigma_{n,\alpha}$	.00	.00	-.03	.00	1.00									
$\sigma_{n,n'3\alpha}$	.09	.00	-.78	-.02	-.01	1.00								
$\sigma_{n,p}$	.00	.00	-.01	.00	.00	.00	1.00							
$\sigma_{n,d}$	.00	.00	-.04	.00	.00	-.01	.00	1.00						
$\sigma_{n,np}$	.01	.00	-.05	.00	.00	-.01	.00	.00	1.00					
$\sigma_{n,n2n}$	.00	.00	-.02	.00	.00	.00	.00	.00	.00	1.00				
$\sigma_{n,t}$	.00	.00	-.04	.00	.00	-.01	.00	.00	.00	.00	1.00			
$\sigma_{n,^6Li}$	.03	.00	-.26	-.01	.00	-.05	.00	.00	.00	.00	.00	1.00		
$\sigma_{n,d\alpha}$	.00	.00	-.04	.00	.00	-.01	.00	.00	.00	.00	.00	.00	1.00	
$\sigma_{n,p\alpha}$	.00	.00	-.03	.00	.00	-.01	.00	.00	.00	.00	.00	.00	.00	1.00

Table 25a

Unified Cross Sections (mb)

E MeV	σ_t	σ_c	σ_e	σ_{in}	$\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\sigma_{n,d}$	$\sigma_{n,np}$	$\sigma_{n,2n}$	$\sigma_{n,t}$	$\sigma_{n,^6Li}$	$\sigma_{n,d\alpha^7Li}$	$\sigma_{n,p\alpha^8Li}$	σ_{spare}
26.4000	1412.366	.211	893.310	61.592	8.036	260.336	1.580	10.383	9.49	15.27	7.40	100.45	19.91	23.39	1.00
26.5000	1397.234	.211	878.915	61.331	7.908	257.578	1.537	10.152	9.28	15.61	7.25	99.98	20.85	25.13	1.50
26.6000	1401.979	.211	882.109	61.112	7.784	257.508	1.495	9.926	9.09	15.96	7.10	98.93	21.83	26.92	2.00
26.7000	1401.404	.211	880.444	60.882	7.659	256.697	1.453	9.698	8.90	16.30	6.95	97.72	22.80	28.69	3.00
26.8000	1397.971	.211	876.393	60.645	7.533	255.526	1.410	9.470	8.71	16.64	6.80	96.42	23.76	30.46	4.00
26.9000	1390.866	.211	868.434	60.398	7.407	253.768	1.367	9.241	8.52	16.98	6.65	94.99	24.71	32.19	6.00
27.0000	1395.443	.211	871.077	60.179	7.283	253.610	1.325	9.015	8.33	17.32	6.50	93.92	25.69	33.99	7.00
27.1000	1392.847	.211	868.120	59.944	7.157	252.627	1.282	8.787	8.14	17.65	6.38	92.67	26.60	34.77	8.50
27.2000	1414.829	.211	885.313	59.764	7.036	254.657	1.240	8.562	7.96	18.00	6.26	92.04	27.60	35.70	10.50
27.3000	1402.511	.211	874.662	59.510	6.909	252.522	1.198	8.333	7.76	18.33	6.14	90.54	27.95	36.43	12.00
27.4000	1384.919	.211	860.024	59.243	6.782	249.803	1.155	8.104	7.57	18.67	6.02	88.95	27.76	37.14	13.50
27.5000	1410.897	.211	881.899	59.078	6.661	252.503	1.113	7.880	7.39	19.01	5.90	88.41	27.73	38.11	15.01
27.6000	1384.720	.211	861.051	58.793	6.533	248.876	1.070	7.649	7.19	19.35	5.78	86.65	27.51	37.56	16.50
27.7000	1374.874	.211	853.886	58.546	6.407	247.279	1.027	7.421	7.00	19.68	5.66	85.30	27.36	37.12	17.99
27.8000	1390.275	.211	867.516	58.360	6.284	248.740	.985	7.195	6.81	20.02	5.54	84.50	27.28	36.83	20.00
27.9000	1368.937	.211	850.255	58.082	6.157	245.668	.942	6.966	6.62	20.36	5.42	82.88	27.08	36.31	21.99
28.0000	1390.036	.211	868.711	57.912	6.035	247.820	.900	6.741	6.43	20.70	5.30	82.18	27.03	36.05	24.01
28.1000	1359.397	.211	843.903	57.610	5.943	243.681	.878	6.603	6.24	20.83	5.31	80.60	26.44	35.09	26.07
28.2000	1384.079	.211	865.735	57.452	5.858	246.325	.856	6.470	6.05	20.96	5.32	80.16	26.02	34.44	28.21
28.3000	1375.213	.211	859.272	57.206	5.769	244.858	.834	6.334	5.86	21.09	5.33	79.03	25.51	33.61	30.30
28.4000	1359.697	.211	847.179	56.941	5.679	242.585	.812	6.197	5.67	21.22	5.34	77.78	24.97	32.74	32.38
28.5000	1375.513	.211	861.519	56.762	5.593	244.120	.790	6.063	5.55	21.35	5.35	77.14	24.52	32.03	34.52
28.6000	1368.742	.211	856.753	56.521	5.504	242.904	.768	5.927	5.43	21.48	5.36	76.05	24.01	31.21	36.61
28.7000	1372.400	.211	860.818	56.310	5.417	242.952	.746	5.792	5.32	21.61	5.37	75.17	23.52	30.44	38.73
28.8000	1376.330	.211	865.120	56.099	5.329	243.030	.724	5.657	5.21	21.74	5.38	74.28	23.04	29.66	40.85
28.9000	1333.801	.211	830.012	55.753	5.237	237.506	.702	5.519	5.09	21.86	5.39	72.58	22.44	28.71	42.81
29.0000	1355.506	.211	849.394	55.595	5.151	239.726	.680	5.385	4.97	21.99	5.40	72.00	22.00	28.00	45.00
29.1000	1343.445	.211	839.814	55.335	5.062	237.859	.658	5.249	4.86	22.12	5.20	70.84	21.58	27.32	47.35
29.2000	1366.437	.211	860.015	55.183	4.976	240.190	.636	5.115	4.74	22.26	5.00	70.25	21.23	26.75	49.88

Table 25a (Continued)

Unified Uncertainties (mb)

E MeV	$\Delta\sigma_t$	$\Delta\sigma_c$	$\Delta\sigma_e$	$\Delta\sigma_{in}$	$\Delta\sigma_{n,\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,p}$	$\Delta\sigma_{n,d}$	$\Delta\sigma_{n,np}$	$\Delta\sigma_{n,2n}$	$\Delta\sigma_{n,t}$	$\Delta\sigma_{n,^6Li}$	$\Delta\sigma_{n,d\alpha^7Li}$	$\Delta\sigma_{n,p\alpha^8Li}$	$\Delta\sigma_{spare}$
26.4000	31.14	.04	59.61	6.42	2.01	48.43	.32	2.08	2.86	1.41	2.22	24.64	5.96	7.00	.20
26.5000	30.92	.04	59.49	6.46	1.98	48.30	.31	2.03	2.80	1.44	2.18	24.64	6.25	7.53	.30
26.6000	31.00	.04	59.41	6.50	1.95	48.17	.30	1.99	2.74	1.47	2.13	24.35	6.54	8.06	.40
26.7000	31.08	.04	59.33	6.55	1.91	48.04	.29	1.94	2.68	1.50	2.09	24.06	6.83	8.59	.60
26.8000	31.09	.04	59.24	6.59	1.88	47.91	.28	1.89	2.63	1.53	2.04	23.78	7.12	9.12	.80
26.9000	30.97	.04	59.10	6.64	1.85	47.78	.27	1.85	2.57	1.56	2.00	23.49	7.41	9.65	1.20
27.0000	31.04	.04	59.03	6.68	1.82	47.66	.27	1.80	2.51	1.59	1.95	23.20	7.70	10.18	1.40
27.1000	31.06	.04	58.93	6.72	1.79	47.53	.26	1.76	2.45	1.62	1.91	22.91	7.97	10.41	1.70
27.2000	31.55	.04	59.00	6.77	1.76	47.41	.25	1.71	2.40	1.65	1.88	22.62	8.25	10.65	2.10
27.3000	31.37	.04	58.81	6.81	1.73	47.28	.24	1.67	2.34	1.69	1.84	22.33	8.37	10.89	2.40
27.4000	31.10	.04	58.58	6.85	1.70	47.15	.23	1.62	2.28	1.72	1.81	22.04	8.33	11.13	2.70
27.5000	31.75	.04	58.69	6.90	1.66	47.03	.22	1.58	2.22	1.75	1.77	21.75	8.29	11.37	3.00
27.6000	31.30	.04	58.35	6.94	1.63	46.90	.21	1.53	2.17	1.78	1.73	21.46	8.25	11.25	3.30
27.7000	31.06	.04	58.09	6.98	1.60	46.76	.21	1.48	2.11	1.81	1.70	21.17	8.21	11.13	3.60
27.8000	31.48	.04	58.08	7.03	1.57	46.64	.20	1.44	2.05	1.84	1.66	20.88	8.17	11.01	4.00
27.9000	32.66	.04	58.38	7.07	1.54	46.52	.19	1.39	1.99	1.87	1.63	20.59	8.13	10.89	4.40
28.0000	31.92	.04	57.93	7.12	1.51	46.39	.18	1.35	1.94	1.90	1.59	20.29	8.09	10.77	4.80
28.1000	31.05	.04	57.43	7.16	1.49	46.25	.18	1.32	1.88	1.92	1.59	20.05	7.94	10.53	5.22
28.2000	31.59	.04	57.48	7.20	1.46	46.13	.17	1.29	1.82	1.95	1.60	19.81	7.79	10.29	5.64
28.3000	31.48	.04	57.28	7.25	1.44	46.01	.17	1.27	1.76	1.97	1.60	19.56	7.64	10.06	6.06
28.4000	31.37	.04	57.08	7.29	1.42	45.88	.16	1.24	1.71	1.99	1.60	19.32	7.49	9.82	6.47
28.5000	31.64	.04	57.03	7.33	1.40	45.76	.16	1.21	1.67	2.02	1.61	19.08	7.34	9.58	6.89
28.6000	31.59	.04	56.86	7.38	1.38	45.63	.15	1.19	1.63	2.04	1.61	18.83	7.19	9.34	7.31
28.7000	31.67	.04	56.75	7.42	1.35	45.51	.15	1.16	1.60	2.06	1.61	18.59	7.04	9.10	7.73
28.8000	31.89	.04	56.70	7.46	1.33	45.39	.14	1.13	1.56	2.09	1.61	18.34	6.89	8.86	8.15
28.9000	31.20	.04	56.29	7.51	1.31	45.25	.14	1.10	1.53	2.11	1.62	18.10	6.74	8.62	8.56
29.0000	31.62	.04	56.32	7.55	1.29	45.13	.14	1.08	1.49	2.14	1.62	17.86	6.59	8.39	8.98
29.1000	31.44	.04	56.14	7.60	1.27	45.01	.13	1.05	1.46	2.16	1.56	17.61	6.47	8.20	9.46
29.2000	31.93	.04	56.22	7.64	1.24	44.89	.13	1.02	1.42	2.18	1.50	17.37	6.35	8.01	9.94

Table 25b

Average Correlation Matrix of Total and Partial Cross Sections
from 26.4 to 29.2 MeV

σ_t	1.00														
σ_c	.00	1.00													
σ_e	.46	.00	1.00												
σ_{in}	.01	.00	-.10	1.00											
$\sigma_{n,\alpha}$	.00	.00	-.02	.00	1.00										
$\sigma_{n,n'3\alpha}$	.08	.00	-.73	-.02	.00	1.00									
$\sigma_{n,p}$	.00	.00	.00	.00	.00	.00	1.00								
$\sigma_{n,d}$	.00	.00	-.02	.00	.00	.00	.00	1.00							
$\sigma_{n,np}$	.00	.00	-.03	.00	.00	-.01	.00	.00	1.00						
$\sigma_{n,n2n}$	.00	.00	-.03	.00	.00	.00	.00	.00	.00	1.00					
$\sigma_{n,t}$	.00	.00	-.02	.00	.00	.00	.00	.00	.00	.00	1.00				
$\sigma_{n,^6Li}$	.03	.00	-.30	-.01	.00	-.05	.00	.00	.00	.00	.00	1.00			
$\sigma_{n,d\alpha}$	.01	.00	-.10	.00	.00	-.02	.00	.00	.00	.00	.00	-.01	1.00		
$\sigma_{n,p2}$	.02	.00	-.13	.00	.00	-.02	.00	.00	.00	.00	.00	-.01	.00	1.00	
σ_{spare}	.01	.00	-.06	.00	.00	-.01	.00	.00	.00	.00	.00	.00	.00	.00	1.00

Table 26a

Unified Cross Sections (mb)

E MeV	σ_t	σ_c	σ_e	σ_{in}	$\sigma_{n,\alpha}$	$\sigma_{n,n'3\alpha}$	$\sigma_{n,p}$	$\sigma_{n,d}$	$\sigma_{n,np}$	$\sigma_{n,2n}$	$\sigma_{n,t}$	$\sigma_{n,^6Li}$	$\sigma_{n,d\alpha^7Li}$	$\sigma_{n,p\alpha^8Li}$	σ_{spare}
29.3000	1337.250	.211	835.872	54.870	4.885	236.280	.614	4.978	4.63	22.38	4.80	68.82	20.78	26.01	52.13
29.4000	1355.316	.211	851.902	54.704	4.798	238.011	.592	4.843	4.51	22.51	4.60	68.13	20.42	25.43	54.65
29.5000	1333.049	.211	833.627	54.410	4.709	234.940	.570	4.707	4.40	22.64	4.40	66.83	19.98	24.72	56.92
29.6000	1349.871	.211	848.609	54.242	4.622	236.511	.548	4.572	4.28	22.77	4.20	66.11	19.61	24.12	59.46
29.7000	1332.348	.211	834.363	53.962	4.532	234.014	.526	4.436	4.17	22.90	4.00	64.89	19.19	23.43	61.74
29.8000	1301.701	.211	808.692	53.636	4.442	229.948	.504	4.300	4.05	23.30	3.80	63.50	18.74	22.71	63.88
29.9000	1350.376	.211	850.568	53.577	4.357	235.216	.482	4.166	3.94	23.73	3.60	63.19	18.42	22.18	66.73
30.0000	1342.145	.211	843.987	53.326	4.268	233.786	.460	4.030	3.82	24.15	3.40	62.10	18.01	21.52	69.08
30.1000	1338.208	.211	840.459	53.085	4.206	232.798	.449	3.949	3.71	24.56	3.34	61.26	17.71	21.02	71.45
30.2000	1317.539	.211	822.678	52.786	4.142	229.863	.438	3.867	3.59	24.97	3.28	60.22	17.38	20.49	73.63
30.3000	1318.806	.211	823.583	52.563	4.080	229.488	.427	3.785	3.48	25.38	3.22	59.45	17.08	20.01	76.05
30.4000	1327.433	.211	830.758	52.364	4.018	229.964	.416	3.704	3.36	25.80	3.16	58.77	16.80	19.54	78.57
30.5000	1299.184	.211	806.727	52.042	3.954	226.204	.405	3.622	3.29	25.93	3.10	57.67	16.46	19.00	80.58
30.6000	1328.402	.211	831.637	51.913	3.894	229.075	.394	3.541	3.22	26.07	3.04	57.22	16.20	18.56	83.43
30.7000	1338.011	.211	839.843	51.718	3.832	229.675	.383	3.460	3.16	26.20	2.98	56.54	15.92	18.09	86.01
30.8000	1323.429	.211	827.451	51.442	3.769	227.501	.372	3.378	3.09	26.33	2.92	55.60	15.60	17.58	88.19
30.9000	1355.954	.211	855.156	51.322	3.708	230.705	.361	3.297	3.02	26.48	2.86	55.15	15.34	17.14	91.21
31.0000	1319.306	.211	823.990	50.974	3.644	226.026	.350	3.215	2.95	26.60	2.80	53.98	15.00	16.60	92.97
31.1000	1311.993	.211	817.497	50.722	3.581	224.673	.339	3.133	2.89	26.73	2.75	53.32	14.69	16.22	95.24
31.2000	1325.202	.211	828.455	50.536	3.519	225.641	.328	3.052	2.82	26.87	2.70	52.86	14.41	15.87	97.94
31.3000	1310.266	.211	815.489	50.260	3.456	223.432	.317	2.970	2.75	27.00	2.65	52.13	14.09	15.48	100.03
31.4000	1283.428	.211	792.722	49.948	3.393	219.939	.306	2.888	2.68	26.77	2.60	51.29	13.77	15.08	101.82
31.5000	1282.975	.211	792.374	49.719	3.331	219.413	.295	2.807	2.61	26.56	2.55	50.71	13.47	14.72	104.21
31.6000	1344.712	.211	844.778	49.686	3.271	225.810	.284	2.727	2.55	26.36	2.50	50.68	13.23	14.41	108.21
31.7000	1317.164	.211	821.428	49.372	3.207	222.253	.273	2.645	2.48	26.14	2.45	49.85	12.90	14.02	109.94
31.8000	1325.321	.211	828.353	49.170	3.145	222.662	.262	2.563	2.41	25.93	2.40	49.33	12.61	13.65	112.62
31.9000	1291.920	.211	800.088	48.839	3.082	218.488	.251	2.481	2.34	25.70	2.35	48.46	12.29	13.25	114.09
32.0000	1315.853	.211	820.360	48.685	3.020	220.630	.240	2.400	2.28	25.50	2.30	48.07	12.01	12.91	117.25

Table 26a (Continued)

Unified Uncertainties (mb)

E MeV	$\Delta\sigma_t$	$\Delta\sigma_c$	$\Delta\sigma_e$	$\Delta\sigma_{in}$	$\Delta\sigma_{n,\alpha}$	$\Delta\sigma_{n,n'3\alpha}$	$\Delta\sigma_{n,p}$	$\Delta\sigma_{n,d}$	$\Delta\sigma_{n,np}$	$\Delta\sigma_{n,2n}$	$\Delta\sigma_{n,t}$	$\Delta\sigma_{n,^6Li}$	$\Delta\sigma_{n,d\alpha^7Li}$	$\Delta\sigma_{n,p\alpha^8Li}$	$\Delta\sigma_{spare}$
29.3000	31.47	.04	55.93	7.68	1.22	44.77	.12	1.00	1.39	2.21	1.44	17.12	6.23	7.82	10.41
29.4000	31.88	.04	55.99	7.73	1.20	44.65	.12	.97	1.35	2.23	1.38	16.88	6.11	7.63	10.89
29.5000	31.61	.04	55.78	7.77	1.18	44.53	.11	.94	1.32	2.25	1.32	16.63	6.00	7.44	11.36
29.6000	31.96	.04	55.83	7.81	1.16	44.41	.11	.91	1.28	2.28	1.26	16.39	5.88	7.25	11.84
29.7000	31.71	.04	55.64	7.86	1.13	44.29	.10	.89	1.25	2.30	1.20	16.14	5.76	7.06	12.31
29.8000	31.08	.04	55.29	7.90	1.11	44.16	.10	.86	1.21	2.30	1.14	15.90	5.64	6.87	12.79
29.9000	32.18	.04	55.66	7.94	1.09	44.05	.09	.83	1.18	2.30	1.08	15.65	5.52	6.68	13.26
30.0000	32.24	.04	55.61	7.99	1.07	43.93	.09	.81	1.14	2.30	1.02	15.41	5.40	6.49	13.73
30.1000	32.15	.04	55.51	7.95	1.05	43.81	.09	.79	1.11	2.30	1.00	15.21	5.31	6.34	14.21
30.2000	31.70	.04	55.26	7.92	1.04	43.69	.09	.77	1.07	2.30	.98	15.01	5.22	6.19	14.68
30.3000	31.85	.04	55.26	7.89	1.02	43.57	.08	.76	1.04	2.30	.97	14.82	5.13	6.04	15.15
30.4000	32.04	.04	55.29	7.85	1.01	43.46	.08	.74	1.00	2.30	.95	14.62	5.04	5.90	15.62
30.5000	31.64	.04	55.07	7.82	.99	43.34	.08	.72	.98	2.31	.93	14.42	4.95	5.75	16.09
30.6000	32.24	.04	55.28	7.78	.97	43.22	.08	.71	.96	2.32	.91	14.22	4.86	5.60	16.56
30.7000	32.64	.04	55.40	7.75	.96	43.11	.08	.69	.94	2.33	.89	14.03	4.77	5.45	17.03
30.8000	32.28	.04	55.21	7.72	.94	42.99	.07	.68	.92	2.34	.88	13.83	4.68	5.30	17.50
30.9000	32.99	.04	55.48	7.68	.93	42.88	.07	.66	.90	2.36	.86	13.63	4.59	5.15	17.97
31.0000	32.33	.04	55.17	7.65	.91	42.76	.07	.64	.88	2.37	.84	13.44	4.50	5.00	18.43
31.1000	32.39	.04	55.18	7.61	.90	42.64	.07	.63	.86	2.38	.83	13.29	4.41	4.89	18.90
31.2000	32.54	.04	55.23	7.58	.88	42.53	.07	.61	.84	2.39	.81	13.14	4.32	4.78	19.36
31.3000	32.37	.04	55.15	7.55	.86	42.41	.06	.59	.82	2.40	.80	12.99	4.23	4.67	19.83
31.4000	32.19	.04	55.06	7.51	.85	42.30	.06	.58	.80	2.40	.78	12.84	4.14	4.56	20.29
31.5000	32.21	.04	55.07	7.48	.83	42.19	.06	.56	.78	2.40	.77	12.70	4.05	4.45	20.75
31.6000	33.34	.04	55.55	7.45	.82	42.08	.06	.55	.76	2.40	.75	12.55	3.96	4.34	21.22
31.7000	32.92	.04	55.38	7.41	.80	41.96	.06	.53	.74	2.40	.74	12.40	3.87	4.23	21.68
31.8000	33.17	.04	55.49	7.38	.79	41.85	.05	.51	.72	2.40	.72	12.25	3.78	4.12	22.14
31.9000	32.84	.04	55.36	7.34	.77	41.74	.05	.50	.70	2.40	.71	12.10	3.69	4.01	22.60
32.0000	38.40	.04	57.87	7.31	.76	41.68	.05	.48	.68	2.40	.69	11.96	3.60	3.90	23.06

Table 26b

Average Correlation Matrix of Total and Partial Cross Sections from 29.3 to 32 MeV

σ_t	1.00														
σ_c	.00	1.00													
σ_e	.50	.00	1.00												
σ_{in}	.01	.00	-.11	1.00											
$\sigma_{n,\alpha}$	.00	.00	-.01	.00	1.00										
$\sigma_{n,n'3\alpha}$	.09	.00	-.70	-.02	.00	1.00									
$\sigma_{n,p}$	.00	.00	.00	.00	.00	.00	1.00								
$\sigma_{n,d}$	.00	.00	-.01	.00	.00	.00	.00	1.00							
$\sigma_{n,np}$	.00	.00	-.01	.00	.00	.00	.00	.00	1.00						
$\sigma_{n,n2n}$	.00	.00	-.03	.00	.00	-.01	.00	.00	.00	1.00					
$\sigma_{n,t}$	.00	.00	-.01	.00	.00	.00	.00	.00	.00	.00	1.00				
$\sigma_{n,^6Li}$	.03	.00	-.21	-.01	.00	-.04	.00	.00	.00	.00	.00	1.00			
$\sigma_{n,d\alpha}$	.01	.00	-.07	.00	.00	-.01	.00	.00	.00	.00	.00	.00	1.00		
$\sigma_{n,p\alpha}$	.01	.00	-.08	.00	.00	-.01	.00	.00	.00	.00	.00	.00	.00	1.00	
σ_{spare}	.03	.00	-.25	-.01	.00	-.04	.00	.00	.00	.00	.00	-.01	.00	.00	1.00

Table 27

Normalized Components of the $^{12}C(n,n'3\alpha)$ Reaction

E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)
	M91	MT52	7.653 MeV	MT53	9.638 MeV	MT54	10.8 MeV
7.89	.00	8.30	.00	10.45	.00	11.71	.00
8.00	.16	8.50	3.20	10.50	1.00	12.00	3.46
8.50	.88	9.00	7.00	11.00	10.00	12.50	8.71
9.00	5.51	9.50	11.40	11.50	20.00	13.00	13.34
9.50	9.99	10.00	15.50	12.00	30.00	13.50	16.92
10.00	14.54	10.50	19.00	12.50	39.00	14.00	19.48
10.50	49.61	11.00	23.60	13.00	47.50	14.50	22.22
11.00	70.29	11.50	28.00	13.50	60.00	15.00	23.73
11.50	70.20	12.00	28.80	14.00	65.00	15.50	24.05
12.00	91.33	12.50	28.40	14.50	73.00	16.00	24.01
12.50	83.76	13.00	26.60	15.00	77.00	16.50	22.49
13.00	70.45	13.50	23.40	15.50	76.00	17.00	20.37
13.50	80.58	14.00	20.00	16.00	75.00	17.50	18.21
14.00	89.55	14.50	16.50	16.50	72.00	18.00	16.03
14.50	83.87	15.00	14.00	17.00	69.00	18.50	13.84
15.00	100.68	15.50	12.20	17.50	63.50	19.00	11.74
15.50	89.08	16.00	10.80	18.00	59.00	19.50	9.94
16.00	98.99	16.50	9.76	18.50	54.00	20.00	8.32
16.50	97.45	17.00	9.16	19.00	49.00	20.50	6.97
17.00	86.94	17.50	8.59	19.50	45.00	21.00	5.92
17.50	94.29	18.00	8.06	20.00	42.00	21.50	5.00
18.00	86.34	18.50	7.57	20.50	38.02	22.00	4.25
18.50	76.15	19.00	7.10	21.00	36.03	22.50	3.69
19.00	66.22	19.50	6.66	21.50	34.14	23.00	3.21
19.50	62.16	20.00	6.25	22.00	32.35	23.50	2.80
20.00	48.77	20.50	5.87	22.50	30.65	24.00	2.43
20.50	45.03	21.00	5.51	23.00	29.05	24.50	2.12
21.00	38.53	21.50	5.17	23.50	27.53	25.00	1.84
21.50	33.86	22.00	4.85	24.00	26.08	25.50	1.60
22.00	35.73	22.50	4.55	24.50	24.71	26.00	1.39
22.50	32.13	23.00	4.27	25.00	23.42	26.50	1.21
23.00	34.78	23.50	4.01	25.50	22.19	27.00	1.05
23.50	37.62	24.00	3.76	26.00	21.03	27.50	.92
24.00	27.68	24.50	3.53	26.50	19.93	28.00	.80
24.50	34.43	25.00	3.31	27.00	18.88	28.50	.69
25.00	29.99	25.50	3.11	27.50	17.89	29.00	.60
25.50	21.63	26.00	2.92	28.00	16.95	29.50	.52
26.00	19.61	26.50	2.74	28.50	16.06	30.00	.46
26.50	16.35	27.00	2.57	29.00	15.22	30.50	.40
27.00	17.66	27.50	2.41	29.50	14.42	31.00	.35
27.50	19.98	28.00	2.26	30.00	13.67	31.50	.30
28.00	19.18	28.50	2.13	30.50	12.95	32.00	.26
28.50	18.74	29.00	1.99	31.00	12.27		
29.00	16.86	29.50	1.87	31.50	11.63		
29.50	15.24	30.00	1.76	32.00	11.02		
30.00	15.35	30.50	1.65				
30.50	11.13	31.00	1.55				
31.00	11.18	31.50	1.45				
31.50	7.90	32.00	1.36				
32.00	8.52						

Table 27 (Continued)

E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)
MT55	11.8 MeV	MT56	12.7 MeV	MT57	13.35 MeV	MT58	14.08 MeV
12.79	.00	13.77	.00	14.47	.00	15.26	.00
13.00	2.26	14.00	4.73	14.50	.00	15.50	1.69
13.50	7.02	14.50	13.66	15.00	3.69	16.00	4.82
14.00	11.31	15.00	21.67	15.50	6.91	16.50	7.63
14.50	14.70	15.50	27.96	16.00	9.58	17.00	9.83
15.00	17.12	16.00	32.45	16.50	11.49	17.50	11.40
15.50	19.40	16.50	36.84	17.00	12.88	18.00	12.95
16.00	21.29	17.00	40.11	17.50	14.91	18.50	14.08
16.50	21.44	17.50	40.46	18.00	14.92	19.00	14.21
17.00	21.63	18.00	40.70	18.50	15.36	19.50	14.28
17.50	20.49	18.50	38.43	19.00	14.91	20.00	13.48
18.00	18.57	19.00	34.82	19.50	13.55	20.50	12.21
18.50	16.67	19.50	31.22	20.00	12.28	21.00	10.95
19.00	14.69	20.00	27.50	20.50	10.83	21.50	9.64
19.50	12.76	20.50	23.84	21.00	9.53	22.00	8.36
20.00	10.81	21.00	20.21	21.50	8.07	22.50	7.09
20.50	9.18	21.50	17.15	22.00	6.88	23.00	6.01
21.00	7.69	22.00	14.36	22.50	5.78	23.50	5.04
21.50	6.43	22.50	12.02	23.00	4.82	24.00	4.21
22.00	5.45	23.00	10.19	23.50	4.06	24.50	3.57
22.50	4.62	23.50	8.64	24.00	3.48	25.00	3.03
23.00	3.90	24.00	7.29	24.50	2.89	25.50	2.56
23.50	3.39	24.50	6.35	25.00	2.51	26.00	2.22
24.00	2.95	25.00	5.52	25.50	2.18	26.50	1.94
24.50	2.57	25.50	4.80	26.00	1.90	27.00	1.68
25.00	2.23	26.00	4.18	26.50	1.65	27.50	1.46
25.50	1.94	26.50	3.63	27.00	1.44	28.00	1.27
26.00	1.69	27.00	3.16	27.50	1.25	28.50	1.11
26.50	1.47	27.50	2.75	28.00	1.09	29.00	.96
27.00	1.28	28.00	2.39	28.50	.95	29.50	.84
27.50	1.11	28.50	2.08	29.00	.82	30.00	.73
28.00	.97	29.00	1.81	29.50	.72	30.50	.63
28.50	.84	29.50	1.57	30.00	.62	31.00	.55
29.00	.73	30.00	1.37	30.50	.54	31.50	.48
29.50	.64	30.50	1.19	31.00	.47	32.00	.42
30.00	.55	31.00	1.04	31.50	.41		
30.50	.48	31.50	.90	32.00	.36		
31.00	.42	32.00	.78				
31.50	.36						
32.00	.32						

Table 27 (Continued)

E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)
MT59	15.08 MeV	MT60	16.08 MeV	MT61	17.08 MeV	MT62	18.08 MeV
16.35	.00	17.43	.00	18.52	.00	19.60	.00
16.50	4.52	17.50	1.73	19.00	10.51	20.00	8.59
17.00	17.36	18.00	12.55	19.50	20.43	20.50	18.27
17.50	29.10	18.50	22.65	20.00	28.77	21.00	26.59
18.00	38.55	19.00	30.97	20.50	34.81	21.50	32.78
18.50	45.26	19.50	36.86	21.00	39.19	22.00	37.25
19.00	50.00	20.00	41.13	21.50	41.89	22.50	40.11
19.50	52.71	20.50	43.66	22.00	43.18	23.00	41.56
20.00	53.61	21.00	44.74	22.50	42.74	23.50	41.40
20.50	52.51	21.50	44.04	23.00	41.15	24.00	40.03
21.00	50.26	22.00	42.24	23.50	39.05	24.50	38.06
21.50	47.40	22.50	39.99	24.00	36.34	25.00	35.54
22.00	43.75	23.00	37.08	24.50	32.92	25.50	32.34
22.50	39.30	23.50	33.45	25.00	29.12	26.00	28.72
23.00	34.45	24.00	29.46	25.50	25.06	26.50	24.83
23.50	29.51	24.50	25.25	26.00	21.39	27.00	21.21
24.00	25.09	25.00	21.53	26.50	18.01	27.50	17.90
24.50	21.05	25.50	18.08	27.00	15.02	28.00	14.95
25.00	17.57	26.00	15.07	27.50	12.64	28.50	12.56
25.50	14.86	26.50	12.71	28.00	10.81	29.00	10.71
26.00	12.66	27.00	10.88	28.50	9.02	29.50	8.98
26.50	10.62	27.50	9.06	29.00	7.80	30.00	7.71
27.00	9.23	28.00	7.88	29.50	6.78	30.50	6.70
27.50	8.03	28.50	6.85	30.00	5.90	31.00	5.83
28.00	6.99	29.00	5.96	30.50	5.13	31.50	5.07
28.50	6.08	29.50	5.19	31.00	4.46	32.00	4.41
29.00	5.29	30.00	4.51	31.50	3.88		
29.50	4.60	30.50	3.92	32.00	3.38		
30.00	4.00	31.00	3.41				
30.50	3.48	31.50	2.97				
31.00	3.03	32.00	2.58				
31.50	2.63						
32.00	2.29						

Table 27 (Continued)

E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)	E_n	σ(mb)
MT63	19.08 MeV	MT64	20.08 MeV	MT65	21.08 MeV	MT66	22.08 MeV
20.68	.00	21.77	.00	22.85	.00	23.94	.00
21.00	6.70	22.00	3.73	23.00	2.44	24.00	1.08
21.50	16.13	22.50	10.80	23.50	9.58	24.50	8.30
22.00	24.42	23.00	17.13	24.00	16.11	25.00	15.04
22.50	30.75	23.50	22.10	24.50	21.38	25.50	20.61
23.00	35.30	24.00	25.65	25.00	25.12	26.00	24.54
23.50	38.32	24.50	28.08	25.50	27.76	26.50	27.40
24.00	39.92	25.00	29.43	26.00	29.28	27.00	29.09
24.50	40.04	25.50	29.73	26.50	29.79	27.50	29.83
25.00	38.87	26.00	28.99	27.00	29.18	28.00	29.37
25.50	37.04	26.50	27.69	27.50	27.93	28.50	28.17
26.00	34.70	27.00	26.03	28.00	26.35	29.00	26.67
26.50	31.73	27.50	23.91	28.50	24.32	29.50	24.74
27.00	28.28	28.00	21.40	29.00	21.86	30.00	22.32
27.50	24.57	28.50	18.68	29.50	19.17	30.50	19.67
28.00	21.01	29.00	15.98	30.00	16.41	31.00	16.86
28.50	17.78	29.50	13.56	30.50	13.96	31.50	14.38
29.00	14.87	30.00	11.36	31.00	11.71	32.00	12.08
29.50	12.46	30.50	9.50	31.50	9.78		
30.00	10.60	31.00	8.06	32.00	8.27		
30.50	8.94	31.50	6.83				
31.00	7.61	32.00	5.77				
31.50	6.62						
32.00	5.76						
MT67	23.08 MeV	MT68	24.08 MeV	MT69	25.08 MeV	MT70	26.08 MeV
25.02	.00	26.10	.00	27.19	.00	28.27	.00
25.50	7.19	26.50	6.08	27.50	4.90	28.50	3.67
26.00	14.04	27.00	12.99	28.00	11.89	29.00	10.73
26.50	19.80	27.50	18.95	28.50	18.04	29.50	17.08
27.00	23.98	28.00	23.38	29.00	22.75	30.00	22.07
27.50	27.01	28.50	26.58	29.50	26.12	30.50	25.62
28.00	28.88	29.00	28.64	30.00	28.37	31.00	28.07
28.50	29.77	29.50	29.68	30.50	29.56	31.50	29.43
29.00	29.48	30.00	29.58	31.00	29.66	32.00	29.73
29.50	28.39	30.50	28.60	31.50	28.81		
30.00	26.94	31.00	27.20	32.00	27.45		
30.50	25.08	31.50	25.40				
31.00	22.73	32.00	23.12				
31.50	20.10						
32.00	17.30						
MT71	27.08 MeV	MT72	28.08 MeV	MT73	29.08 MeV		
29.36	.00	30.44	.00	31.52	.00		
29.50	2.37	30.50	1.01	32.00	7.14		
30.00	9.51	31.00	8.23				
30.50	16.06	31.50	14.99				
31.00	21.34	32.00	20.57				
31.50	25.09						
32.00	27.74						

Table 28

Cross Sections Unfolded from the Cross Section σ_{spare} in Tables 25a and 26a

$^{12}C(n,t\alpha)^{6}Li$

E_n MeV	mb
26.300	.000
26.500	1.500
27.000	7.000
27.500	15.008
28.000	15.529
28.500	13.896
29.000	11.742
29.500	10.976
30.000	9.885
30.500	7.877
31.000	7.348
31.500	6.795
32.000	6.262

$^{12}C(n,pd)^{10}Be$

E_n MeV	mb
27.660	.000
28.000	3.577
28.500	5.155
29.000	6.439
29.500	8.293
30.000	9.240
30.500	9.180
31.000	8.143
31.500	7.170
32.000	6.222

$^{12}C(n,pt)^{9}Be$

E_n MeV	mb
28.280	.000
29.000	3.509
29.500	4.599
30.000	7.091
30.500	7.934
31.000	9.597
31.500	8.592
32.000	7.667

$^{12}C(n,dt)2\alpha$

E_n MeV	mb
27.600	.000
28.000	2.452
28.500	5.828
29.000	6.768
29.500	8.903
30.000	9.344
30.500	8.878
31.000	8.259
31.500	7.565
32.000	6.924

$^{12}C(n,nd)^{10}B$

E_n MeV	mb
27.810	.000
28.500	3.810
29.000	5.514
29.500	7.562
30.000	8.488
30.500	9.067
31.000	8.744
31.500	7.841
32.000	7.005

$^{12}C(n,2n\alpha)^{7}Be$

E_n MeV	mb
29.280	.000
29.500	1.220
30.000	3.223
30.500	4.722
31.000	6.689
31.500	8.691
32.000	9.835

$^{12}C(n,dt)^{8}Be$

E_n MeV	mb
27.650	.000
28.000	2.452
28.500	5.828
29.000	6.768
29.500	8.903
30.000	9.344
30.500	9.124
31.000	8.337
31.500	7.545
32.000	6.824

$^{12}C(n,^{6}He)^{7}Be$

E_n MeV	mb
28.220	.000
29.000	4.261
29.500	6.464
30.000	7.843
30.500	8.689
31.000	9.093
31.500	8.335
32.000	7.607

$^{12}C(n,2p)^{11}Be$

E_n MeV	mb
29.280	.000
30.000	2.041
30.500	3.495
31.000	5.429
31.500	7.308
32.000	9.233

Table 28 (Continued)

$^{12}C(n,He)^{6}He$

E_n MeV	mb
29.530	.000
30.000	.430
30.500	2.267
31.000	4.265
31.500	6.321
32.000	8.430

$^{12}C(n,nt)^{9}B$

E_n MeV	mb
29.800	.000
30.000	.430
30.500	1.889
31.000	3.490
31.500	5.135
32.000	6.924

$^{12}C(n,npt)2\alpha$

E_n MeV	mb
29.940	.000
30.500	1.795
31.000	3.684
31.500	5.530
32.000	7.627

$^{12}C(n,2np)^{10}B$

E_n MeV	mb
29.870	.000
30.500	.944
31.000	2.327
31.500	3.753
32.000	5.419

$^{12}C(n,npt)^{8}Be$

E_n MeV	mb
29.700	.000
30.000	.860
30.500	2.361
31.000	3.684
31.500	5.728
32.000	7.627

$^{12}C(n,2n\ ^{3}He)2\alpha$

E_n MeV	mb
31.220	.000
32.000	1.806

$^{12}C(n,n2p)^{10}Be$

E_n MeV	mb
29.800	.000
30.000	.860
30.500	2.361
31.000	3.684
31.500	5.728
32.000	7.627

$^{12}C(n,pt\alpha)^{5}He$

E_n MeV	mb
30.900	.000
31.000	.194
31.500	2.173
32.000	4.215

Table 29. Extension to 32 MeV of ENDF/B-V Files for fl

E_n MeV	Elastic Scatter	Inelastic Scatter		
		MT51 4.439 MeV	MT52 7.653 MeV	MT53 9.638 MeV
20	0.730 ± 0.037	0.490 ± 0.060	0.233 ± 0.060	0.231 ± 0.046
20.8	0.789 ± 0.016			
22	0.804 ± 0.016			
24	0.814 ± 0.016			
26	0.833 ± 0.017			
32	0.867 ± 0.017	0.541 ± 0.060	0.233 ± 0.060	0.231 ± 0.046

Table 30

Kerma Factors and Uncertainties (fGy•m²)

E_n MeV	K_e	K_{in}	K_t	ΔK_t
5.0000	.486	.019	.504	.012
5.0010	.491	.019	.510	.011
5.0300	.489	.018	.507	.011
5.0530	.491	.017	.508	.011
5.1000	.486	.018	.505	.011
5.1200	.483	.020	.503	.011
5.1500	.480	.023	.503	.011
5.1800	.475	.026	.501	.011
5.2000	.467	.028	.495	.011
5.2300	.463	.030	.493	.010
5.2800	.446	.033	.479	.010
5.3000	.442	.033	.475	.010
5.3300	.390	.037	.427	.011
5.3350	.395	.039	.434	.013
5.3400	.371	.035	.406	.012
5.3600	.557	.040	.597	.020
5.3620	.648	.043	.691	.023
5.3700	.714	.043	.757	.025
5.3710	.707	.042	.749	.025
5.3780	.626	.042	.669	.022
5.3800	.597	.042	.639	.021
5.3900	.540	.042	.581	.017
5.4000	.508	.042	.550	.015
5.4100	.501	.043	.543	.014
5.4200	.507	.043	.550	.013
5.4300	.499	.043	.542	.013
5.4400	.500	.044	.544	.012
5.4600	.490	.043	.533	.011
5.5000	.490	.043	.533	.011
5.5500	.492	.043	.535	.011
5.5530	.497	.043	.540	.011
5.6000	.492	.043	.535	.011
5.6500	.490	.046	.536	.010
5.7000	.486	.051	.536	.010
5.8000	.495	.060	.555	.010
5.9000	.495	.073	.568	.010
6.0000	.503	.086	.589	.011
6.0500	.508	.091	.600	.011
6.0530	.511	.092	.602	.011
6.1250	.536	.096	.632	.011
6.1600	.561	.097	.659	.012
6.1740	.581	.098	.679	.013

Table 31

Kerma Factors and Uncertainties (fGy•m²)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	K_t	ΔK_t
6.1800	.587	.098	.000	.685	.013
6.2000	.616	.096	.000	.713	.013
6.2100	.647	.097	.000	.745	.014
6.2200	.660	.099	.000	.759	.014
6.2300	.694	.101	.000	.795	.015
6.2400	.745	.104	.000	.849	.016
6.2500	.795	.108	.000	.903	.016
6.2850	1.257	.143	.000	1.400	.025
6.2950	1.382	.154	.000	1.536	.030
6.3030	1.282	.158	.000	1.440	.030
6.3100	1.115	.164	.000	1.280	.027
6.3200	.858	.160	.000	1.018	.022
6.3300	.712	.158	.000	.870	.020
6.3400	.600	.154	.001	.755	.018
6.3500	.557	.158	.001	.715	.018
6.3600	.573	.176	.001	.750	.020
6.3700	.499	.159	.001	.659	.018
6.3900	.417	.134	.001	.551	.015
6.4000	.409	.131	.001	.540	.015
6.4100	.397	.125	.001	.522	.015
6.4200	.387	.121	.001	.509	.014
6.4300	.394	.119	.001	.515	.015
6.4400	.388	.115	.001	.504	.014
6.4500	.391	.112	.001	.503	.014
6.4700	.377	.106	.001	.482	.014
6.4900	.354	.103	.001	.456	.015
6.5100	.331	.101	.001	.436	.015
6.5400	.291	.108	.001	.410	.014
6.5530	.266	.110	.001	.385	.013
6.5600	.259	.109	.001	.375	.012
6.5700	.245	.105	.001	.352	.011
6.5800	.243	.104	.001	.348	.010
6.5900	.256	.107	.001	.366	.010
6.6000	.273	.105	.001	.377	.009
6.6200	.324	.101	.001	.421	.009
6.6400	.340	.092	.001	.423	.009
6.6580	.432	.095	.001	.529	.011
6.6650	.403	.091	.001	.492	.011
6.6700	.398	.090	.001	.487	.011
6.6800	.397	.091	.001	.488	.010
6.7000	.397	.089	.001	.488	.010
6.7500	.401	.082	.001	.485	.009
6.8100	.405	.076	.001	.483	.009
6.9200	.388	.085	.001	.473	.009
7.0000	.366	.090	.001	.458	.009
7.0530	.360	.094	.001	.455	.009
7.1000	.345	.095	.001	.441	.009
7.1400	.334	.097	.001	.432	.010

Table 31 (Continued)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	K_t	ΔK_t
7.1800	.316	.103	.001	.420	.012
7.2000	.313	.108	.002	.423	.013
7.2200	.302	.111	.004	.417	.015
7.2250	.300	.112	.004	.417	.015
7.2500	.297	.125	.006	.428	.018
7.2700	.297	.135	.007	.440	.021
7.2800	.303	.141	.008	.452	.023
7.3400	.405	.177	.014	.597	.038
7.3500	.439	.186	.017	.641	.040
7.3600	.474	.188	.020	.682	.038
7.3700	.527	.194	.023	.744	.038
7.4000	.621	.204	.032	.858	.032
7.4200	.689	.206	.038	.934	.029
7.4700	.779	.212	.054	1.046	.026
7.5290	.828	.210	.073	1.112	.025
7.5420	.827	.206	.078	1.113	.025
7.5530	.828	.206	.082	1.117	.025
7.5940	.840	.201	.097	1.141	.024
7.6200	.843	.202	.113	1.160	.024
7.6500	.858	.203	.132	1.195	.025
7.6670	.897	.204	.141	1.244	.027
7.6800	.914	.203	.146	1.266	.027
7.6980	.986	.207	.155	1.349	.029
7.7000	.989	.206	.156	1.353	.029
7.7250	1.162	.215	.168	1.544	.033
7.7450	1.278	.216	.176	1.670	.037
7.7500	1.252	.214	.177	1.644	.036
7.7700	1.151	.216	.186	1.552	.035
7.7890	1.027	.219	.192	1.438	.034
7.8100	.905	.226	.201	1.333	.035
7.8190	.880	.229	.206	1.316	.036
7.8600	.757	.234	.226	1.216	.040
7.8870	.732	.237	.232	1.200	.040
7.8880	.722	.235	.231	1.188	.039

Table 32

Kerma Factors and Uncertainties (fGy•m^2)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	K_t	ΔK_t
7.8970	.718	.237	.232	.000	1.186	.039
7.9300	.686	.246	.236	.000	1.167	.038
7.9360	.673	.246	.236	.000	1.155	.038
8.0000	.621	.271	.237	.000	1.129	.042
8.0050	.618	.276	.239	.000	1.133	.042
8.0100	.591	.278	.239	.000	1.108	.042
8.0140	.599	.285	.241	.000	1.125	.041
8.0440	.553	.302	.232	.000	1.088	.040
8.0530	.558	.307	.231	.000	1.096	.041
8.0790	.528	.313	.225	.000	1.065	.042
8.0800	.524	.312	.224	.000	1.060	.042
8.1000	.504	.319	.218	.000	1.038	.045
8.1010	.509	.322	.218	.000	1.045	.045
8.1050	.499	.321	.216	.000	1.032	.046
8.1090	.488	.319	.213	.000	1.017	.046
8.1200	.471	.318	.211	.000	.997	.045
8.1310	.447	.315	.207	.000	.968	.044
8.1380	.435	.314	.206	.000	.953	.043
8.1600	.393	.308	.197	.000	.897	.041
8.1660	.377	.304	.194	.000	.875	.040
8.2000	.317	.298	.183	.000	.798	.036
8.2100	.310	.278	.179	.000	.774	.035
8.2180	.309	.272	.177	.000	.763	.035
8.2400	.304	.255	.169	.000	.732	.034
8.2800	.312	.222	.159	.000	.696	.033
8.2960	.318	.209	.161	.000	.690	.032
8.2960	.318	.209	.161	.000	.690	.031
8.3200	.332	.196	.161	.000	.691	.030
8.3300	.334	.192	.160	.001	.688	.029
8.3910	.355	.172	.158	.001	.688	.026
8.4000	.358	.169	.158	.002	.687	.026
8.4260	.373	.167	.157	.002	.700	.025
8.4480	.378	.166	.156	.002	.702	.025
8.4500	.372	.165	.155	.002	.694	.025
8.4800	.396	.165	.156	.003	.719	.025
8.5000	.400	.163	.153	.003	.719	.024
8.5000	.400	.163	.153	.003	.719	.023
8.5200	.407	.163	.151	.003	.724	.023
8.5530	.409	.165	.147	.004	.725	.021
8.6000	.435	.165	.143	.004	.747	.022
8.6110	.439	.165	.142	.004	.750	.022
8.6640	.454	.161	.148	.005	.768	.022
8.7000	.465	.161	.164	.006	.796	.021
8.7080	.463	.162	.167	.006	.799	.021
8.7500	.463	.173	.184	.007	.827	.023
8.7680	.466	.180	.192	.007	.845	.024
8.8000	.469	.191	.204	.007	.872	.027
8.8330	.467	.199	.242	.008	.918	.026

Table 32 (Continued)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	K_t	ΔK_t
8.8500	.463	.204	.267	.008	.945	.025
8.8850	.467	.213	.319	.008	1.010	.028
8.9200	.455	.216	.358	.009	1.044	.035
8.9400	.460	.222	.388	.009	1.086	.039
8.9800	.467	.231	.467	.010	1.178	.039
9.0000	.470	.226	.508	.010	1.216	.044
9.0050	.479	.228	.522	.010	1.241	.043
9.0200	.475	.226	.536	.010	1.250	.041
9.0300	.479	.227	.550	.011	1.268	.040
9.0450	.479	.226	.563	.011	1.281	.041
9.0530	.488	.227	.580	.011	1.308	.041
9.0670	.485	.225	.585	.011	1.309	.043
9.0800	.495	.226	.607	.011	1.343	.046
9.1490	.507	.227	.690	.013	1.439	.047
9.1630	.513	.229	.703	.013	1.460	.051
9.1800	.509	.227	.700	.013	1.451	.061
9.2190	.497	.226	.796	.014	1.536	.065
9.2500	.486	.227	.800	.014	1.531	.054
9.2540	.491	.229	.810	.015	1.547	.053
9.3000	.469	.231	.801	.015	1.518	.060
9.3100	.466	.232	.804	.017	1.521	.064
9.3600	.445	.234	.772	.018	1.470	.057
9.4000	.424	.234	.760	.019	1.439	.059
9.4500	.407	.237	.733	.020	1.399	.053
9.5000	.395	.240	.676	.022	1.334	.057
9.5220	.393	.243	.653	.022	1.313	.049
9.5530	.387	.247	.609	.023	1.268	.052
9.5600	.389	.250	.604	.023	1.267	.055
9.5900	.388	.244	.582	.024	1.240	.053
9.6000	.387	.240	.576	.024	1.231	.050
9.6300	.389	.238	.565	.025	1.220	.049
9.6400	.392	.239	.567	.026	1.225	.051
9.6780	.388	.235	.571	.027	1.219	.063
9.6800	.387	.235	.569	.027	1.216	.064
9.6920	.385	.231	.585	.027	1.228	.054
9.7000	.385	.230	.610	.027	1.253	.052
9.7260	.374	.222	.661	.028	1.287	.055
9.7400	.376	.223	.689	.029	1.317	.064
9.7500	.372	.219	.657	.029	1.278	.059
9.8000	.375	.216	.603	.031	1.228	.047
9.8210	.372	.211	.586	.031	1.203	.052
9.8300	.373	.210	.586	.032	1.202	.056
9.8680	.365	.201	.575	.033	1.174	.050
9.9000	.358	.195	.560	.034	1.147	.049
9.9170	.358	.193	.559	.034	1.144	.056
9.9210	.354	.191	.553	.034	1.133	.059
10.0000	.340	.187	.561	.037	1.127	.057

Table 33

Kerma Factors and Uncertainties (fGy•m²)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	K_t	ΔK_t
10.0500	.336	.193	.537	.062	1.128	.050
10.0530	.333	.192	.534	.062	1.121	.049
10.1700	.343	.203	.457	.077	1.083	.040
10.2500	.344	.213	.463	.085	1.108	.046
10.3000	.344	.223	.459	.089	1.118	.037
10.3720	.352	.242	.489	.096	1.182	.045
10.4000	.359	.250	.467	.099	1.178	.040
10.4480	.374	.264	.406	.108	1.156	.041
10.4780	.383	.273	.395	.113	1.169	.038
10.5000	.392	.280	.387	.117	1.181	.038
10.5060	.392	.281	.385	.118	1.180	.038
10.5360	.395	.285	.376	.124	1.185	.041
10.5500	.392	.286	.371	.126	1.180	.044
10.5530	.398	.288	.373	.129	1.192	.043
10.6200	.402	.297	.366	.146	1.216	.043
10.6900	.409	.308	.364	.151	1.237	.046
10.7000	.409	.306	.363	.152	1.235	.045
10.7500	.423	.303	.359	.166	1.255	.043
10.8000	.432	.298	.355	.181	1.271	.045
10.8300	.440	.295	.354	.179	1.273	.046
10.9000	.453	.287	.342	.181	1.270	.048
10.9400	.456	.282	.330	.185	1.259	.047
11.0000	.436	.292	.318	.213	1.264	.051
11.0040	.434	.290	.317	.212	1.258	.051
11.0530	.446	.282	.318	.222	1.272	.050
11.0960	.449	.274	.325	.225	1.277	.048
11.1000	.452	.274	.327	.227	1.283	.048
11.1660	.470	.263	.340	.235	1.310	.053
11.1700	.471	.263	.340	.236	1.313	.053
11.2500	.476	.253	.370	.249	1.350	.058
11.3000	.481	.248	.392	.255	1.378	.063
11.4000	.494	.238	.399	.281	1.415	.065
11.5000	.503	.228	.408	.271	1.412	.060
11.5530	.500	.225	.419	.283	1.429	.061
11.7000	.506	.218	.445	.302	1.472	.061
11.7500	.519	.216	.456	.315	1.508	.065
11.7510	.516	.215	.456	.313	1.502	.065
11.8000	.526	.212	.463	.316	1.520	.071
11.8280	.536	.212	.469	.323	1.541	.069
11.9000	.565	.209	.486	.340	1.602	.070
11.9090	.563	.208	.486	.340	1.598	.071
11.9170	.571	.208	.490	.344	1.615	.071
12.0000	.571	.208	.545	.405	1.732	.077
12.0500	.584	.212	.589	.415	1.803	.078
12.0530	.587	.212	.596	.418	1.816	.078
12.0880	.589	.213	.624	.424	1.853	.080
12.1000	.591	.214	.637	.430	1.874	.080
12.1960	.577	.211	.590	.473	1.851	.077

Table 33 (Continued)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	K_t	ΔK_t
12.2240	.576	.210	.582	.459	1.826	.074
12.2500	.576	.210	.577	.451	1.814	.072
12.3000	.574	.208	.561	.441	1.784	.069
12.4000	.579	.208	.550	.476	1.814	.072
12.5000	.603	.207	.539	.458	1.808	.068
12.5530	.602	.212	.537	.467	1.819	.071
12.5990	.600	.216	.533	.468	1.818	.075
12.7000	.599	.224	.522	.473	1.819	.077
12.7380	.595	.226	.511	.466	1.800	.080
12.8000	.598	.232	.513	.469	1.814	.088
12.9000	.592	.239	.505	.496	1.835	.083
12.9900	.594	.244	.497	.481	1.816	.086
13.0000	.592	.243	.500	.489	1.822	.088
13.0530	.592	.244	.494	.511	1.841	.081
13.1000	.595	.245	.491	.526	1.857	.078
13.1200	.596	.246	.490	.528	1.859	.078
13.2500	.599	.248	.478	.540	1.865	.078
13.2800	.595	.247	.471	.541	1.852	.077
13.3000	.597	.248	.471	.553	1.868	.077
13.5000	.604	.252	.461	.627	1.944	.084
13.5400	.606	.253	.459	.639	1.958	.087
13.5530	.605	.253	.457	.639	1.956	.089
13.5870	.604	.254	.453	.643	1.955	.093
13.6460	.592	.253	.453	.631	1.930	.087
13.7000	.586	.253	.460	.643	1.942	.086
13.7480	.578	.251	.460	.632	1.922	.093
13.8220	.562	.246	.441	.606	1.856	.109
13.8300	.561	.246	.441	.619	1.869	.110
13.9650	.543	.243	.422	.676	1.887	.099
14.0000	.528	.236	.415	.766	1.946	.114
14.0530	.535	.236	.459	.758	1.988	.091
14.1820	.547	.236	.495	.754	2.031	.105
14.2500	.556	.233	.492	.775	2.055	.097
14.3640	.559	.225	.481	.783	2.047	.105
14.4190	.558	.220	.479	.801	2.057	.117
14.5000	.573	.203	.489	.867	2.132	.115

Table 34

Kerma Factors and Uncertainties (fGy•m²)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	K_t	ΔK_t
14.5530	.580	.204	.479	.906	.000	2.170	.108
14.5660	.579	.204	.472	.909	.000	2.165	.108
14.6530	.590	.205	.441	.950	.001	2.187	.101
14.6940	.596	.206	.424	.952	.001	2.181	.098
14.7500	.595	.202	.404	.994	.001	2.196	.102
14.7670	.592	.200	.398	1.006	.001	2.198	.105
14.8070	.592	.197	.388	1.058	.001	2.236	.111
14.8120	.593	.197	.388	1.061	.001	2.241	.110
14.8370	.593	.194	.387	1.045	.001	2.221	.105
14.8630	.593	.192	.385	1.030	.001	2.203	.102
14.8880	.593	.190	.383	1.020	.001	2.188	.100
14.8920	.596	.190	.384	1.029	.001	2.202	.100
14.9060	.596	.189	.383	1.028	.002	2.199	.102
14.9090	.596	.188	.383	1.029	.002	2.199	.101
14.9270	.594	.186	.382	1.023	.002	2.187	.103
14.9540	.591	.186	.382	1.044	.002	2.204	.107
14.9620	.590	.186	.381	1.050	.002	2.210	.108
14.9960	.590	.186	.382	1.107	.002	2.267	.116
15.0000	.586	.185	.381	1.083	.002	2.237	.117
15.0060	.587	.185	.381	1.086	.002	2.242	.114
15.0450	.592	.185	.382	1.075	.003	2.240	.107
15.0530	.595	.185	.382	1.077	.003	2.244	.107
15.0930	.600	.185	.381	1.063	.003	2.238	.105
15.2480	.610	.178	.385	1.097	.005	2.278	.111
15.2500	.610	.178	.385	1.096	.006	2.277	.110

Table 35

Kerma Factors and Uncertainties (fGy•m^2)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	$K_{n,d}$	K_t	ΔK_t
15.4480	.624	.170	.385	1.117	.009	.002	2.308	.131
15.4770	.625	.169	.382	1.121	.009	.003	2.310	.123
15.5530	.628	.166	.374	1.141	.011	.007	2.329	.137
15.7310	.634	.161	.320	1.213	.015	.018	2.364	.132
15.9660	.642	.153	.297	1.265	.022	.036	2.416	.152
15.9700	.646	.153	.296	1.280	.022	.037	2.435	.155
15.9900	.644	.152	.289	1.272	.022	.037	2.418	.168
16.0000	.647	.152	.286	1.286	.023	.038	2.433	.176
16.0530	.638	.150	.294	1.281	.024	.041	2.430	.144
16.0680	.636	.150	.302	1.288	.024	.042	2.445	.142
16.2560	.616	.141	.288	1.339	.029	.053	2.467	.144
16.4400	.598	.131	.351	1.376	.034	.066	2.557	.152
16.4430	.597	.131	.348	1.370	.034	.066	2.546	.150
16.5320	.593	.126	.313	1.391	.036	.072	2.533	.150
16.5530	.591	.125	.321	1.400	.037	.073	2.549	.156
16.6950	.576	.124	.359	1.413	.040	.083	2.595	.145
16.8200	.569	.124	.356	1.456	.042	.093	2.640	.161
16.8240	.568	.124	.356	1.447	.042	.093	2.630	.160
16.9740	.561	.124	.381	1.451	.046	.105	2.668	.164
17.0530	.561	.124	.391	1.477	.048	.112	2.714	.159
17.0740	.563	.125	.397	1.485	.049	.114	2.733	.157
17.1380	.555	.124	.411	1.473	.051	.119	2.733	.155
17.3000	.544	.127	.403	1.610	.057	.136	2.879	.151

Table 36

Kerma Factors and Uncertainties (fGy•m^2)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	$K_{n,d}$	$K_{n,np}$	K_t	ΔK_t
17.301	.553	.127	.402	1.570	.057	.135	.000	2.844	.200
17.467	.545	.128	.354	1.629	.063	.152	.000	2.872	.205
17.553	.549	.129	.326	1.652	.066	.162	.000	2.885	.208
17.616	.553	.127	.309	1.669	.069	.169	.000	2.897	.210
17.687	.554	.123	.301	1.680	.072	.177	.000	2.909	.213
17.900	.563	.113	.286	1.726	.081	.203	.002	2.975	.220
17.901	.565	.113	.286	1.730	.081	.203	.002	2.981	.220
18.000	.570	.108	.284	1.753	.083	.214	.004	3.017	.223
18.053	.577	.106	.272	1.774	.084	.221	.005	3.039	.225
18.087	.573	.106	.263	1.768	.084	.224	.006	3.024	.225
18.158	.580	.115	.246	1.790	.085	.233	.008	3.058	.227
18.273	.575	.121	.217	1.799	.087	.246	.012	3.058	.230
18.460	.570	.119	.197	1.795	.090	.266	.017	3.054	.236
18.553	.575	.120	.199	1.820	.090	.271	.019	3.094	.239
18.632	.583	.118	.201	1.848	.091	.275	.020	3.136	.242
18.700	.586	.113	.210	1.866	.091	.278	.022	3.166	.245
18.833	.587	.104	.230	1.885	.092	.283	.025	3.206	.250
19.030	.595	.091	.233	1.911	.093	.290	.030	3.243	.258
19.034	.602	.091	.233	1.927	.093	.291	.030	3.267	.258
19.053	.603	.090	.232	1.930	.093	.290	.030	3.269	.259
19.185	.612	.088	.245	1.950	.090	.287	.034	3.306	.265
19.346	.626	.089	.268	1.975	.087	.283	.038	3.366	.272
19.511	.639	.090	.307	2.013	.084	.279	.043	3.455	.280
19.553	.641	.091	.327	2.022	.083	.279	.044	3.487	.283
19.660	.641	.092	.377	2.036	.082	.276	.047	3.551	.291
19.661	.644	.092	.378	2.043	.082	.277	.047	3.562	.292
19.794	.634	.092	.374	2.037	.080	.272	.051	3.542	.301
19.892	.634	.093	.334	2.050	.079	.270	.055	3.516	.309
20.000	.626	.094	.481	2.067	.077	.267	.059	3.671	.305
20.100	.602	.095	.532	2.081	.077	.265	.063	3.714	.312
20.200	.591	.096	.455	2.109	.076	.264	.067	3.658	.325
20.300	.569	.098	.387	2.123	.075	.263	.071	3.585	.338
20.400	.549	.099	.361	2.139	.074	.261	.074	3.556	.348
20.500	.534	.100	.335	2.163	.073	.259	.078	3.541	.357

Table 37

Kerma Factors and Uncertainties (fGy•m²)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	$K_{n,d}$	$K_{n,np}$	$K_{n,2n}$	$K_{n,t}$	K_t	ΔK_t
20.600	.511	.101	.305	2.181	.071	.257	.082	.000	.000	3.509	.364
20.700	.490	.103	.276	2.206	.070	.255	.085	.000	.000	3.486	.370
20.800	.470	.104	.277	2.241	.069	.253	.089	.001	.000	3.504	.379
20.900	.479	.103	.291	2.225	.068	.250	.092	.001	.000	3.509	.392
21.000	.480	.102	.307	2.257	.066	.247	.093	.001	.000	3.554	.403
21.100	.478	.101	.322	2.275	.065	.245	.095	.001	.001	3.582	.406
21.200	.475	.100	.336	2.288	.064	.241	.096	.001	.002	3.603	.409
21.300	.478	.099	.380	2.320	.062	.238	.097	.001	.004	3.680	.416
21.400	.473	.098	.430	2.329	.061	.235	.098	.001	.005	3.730	.424
21.500	.470	.097	.444	2.342	.059	.231	.098	.002	.006	3.749	.428
21.600	.473	.096	.402	2.378	.057	.228	.097	.002	.008	3.741	.424
21.700	.473	.095	.359	2.406	.056	.224	.097	.002	.009	3.720	.420
21.800	.468	.094	.315	2.422	.054	.220	.095	.002	.011	3.681	.418
21.900	.466	.093	.270	2.453	.052	.216	.094	.002	.013	3.659	.416
22.000	.465	.092	.225	2.484	.050	.211	.094	.002	.014	3.637	.416
22.100	.465	.092	.223	2.457	.050	.209	.092	.002	.016	3.606	.419
22.200	.475	.092	.221	2.503	.049	.208	.092	.003	.018	3.660	.421
22.300	.468	.092	.219	2.498	.048	.206	.090	.003	.020	3.644	.422
22.400	.474	.092	.217	2.531	.047	.204	.089	.003	.022	3.680	.424
22.500	.474	.093	.215	2.547	.046	.202	.089	.003	.025	3.694	.425
22.600	.475	.093	.213	2.563	.046	.199	.088	.004	.027	3.707	.427
22.700	.480	.093	.211	2.595	.045	.197	.088	.004	.029	3.741	.428
22.800	.481	.093	.208	2.615	.044	.195	.087	.004	.031	3.759	.430
22.900	.482	.093	.206	2.632	.043	.192	.086	.004	.034	3.773	.432
23.000	.486	.093	.204	2.656	.042	.190	.085	.005	.036	3.797	.435
23.100	.487	.094	.202	2.669	.041	.187	.084	.005	.038	3.807	.438
23.200	.493	.094	.199	3.706	.040	.184	.083	.006	.039	3.844	.440
23.300	.492	.094	.197	3.723	.039	.181	.082	.006	.041	3.855	.442
23.400	.499	.094	.195	3.769	.038	.178	.082	.007	.042	3.903	.444
23.500	.494	.094	.192	3.772	.037	.175	.080	.007	.044	3.895	.446
23.600	.502	.094	.189	3.781	.036	.171	.079	.008	.045	3.906	.448

Table 38

Kerma Factors and Uncertainties (fGy•m^2)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	$K_{n,d}$	$K_{n,np}$	$K_{n,2n}$	$K_{n,t}$	$K_{n,^6Li}$	K_t	ΔK_t
23.700	.499	.095	.187	2.741	.035	.168	.078	.008	.047	.015	3.872	.450
23.800	.502	.095	.184	2.721	.034	.164	.076	.009	.048	.021	3.853	.452
23.900	.502	.095	.181	2.697	.032	.160	.075	.009	.049	.028	3.829	.453
24.000	.508	.095	.178	2.693	.031	.157	.074	.010	.049	.035	3.830	.455
24.100	.489	.094	.177	2.808	.031	.155	.073	.011	.049	.047	3.934	.453
24.200	.483	.094	.175	2.797	.030	.153	.071	.012	.050	.060	3.925	.456
24.300	.493	.093	.174	2.843	.030	.152	.070	.012	.050	.074	3.990	.460
24.400	.484	.092	.172	2.820	.029	.150	.068	.013	.050	.088	3.966	.463
24.500	.489	.092	.170	2.849	.029	.148	.067	.014	.050	.104	4.011	.466
24.600	.482	.091	.168	2.826	.028	.146	.066	.015	.050	.120	3.991	.468

Table 39

Kerma Factors and Uncertainties (fGy•m²)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	$K_{n,d}$	$K_{n,np}$	$K_{n,2n}$	$K_{n,t}$	$K_{n,^6Li}$	$K_{n,d\alpha}$	$K_{n,p\alpha}$	K_t	ΔK_t
24.700	.482	.090	.166	2.827	.028	.144	.066	.016	.049	.136	.002	.000	4.005	.470
24.800	.476	.090	.164	2.806	.027	.142	.065	.016	.049	.153	.002	.000	3.990	.472
24.900	.481	.089	.162	2.826	.026	.139	.064	.017	.049	.172	.003	.000	4.030	.473
25.000	.477	.088	.160	2.814	.026	.137	.063	.018	.049	.190	.003	.000	4.026	.475
25.100	.469	.087	.158	2.789	.025	.135	.062	.019	.049	.209	.006	.001	4.009	.477
25.200	.465	.087	.156	2.778	.024	.132	.062	.019	.049	.229	.010	.004	4.015	.479
25.300	.471	.086	.154	2.801	.024	.130	.061	.020	.048	.250	.014	.008	4.067	.481
25.400	.456	.085	.152	2.756	.023	.127	.060	.020	.048	.270	.018	.013	4.028	.482
25.500	.461	.084	.150	2.775	.022	.125	.059	.021	.048	.293	.022	.017	4.077	.485
25.600	.456	.084	.148	2.762	.022	.122	.058	.021	.047	.314	.026	.022	4.083	.487
25.700	.461	.083	.146	2.782	.021	.120	.057	.022	.047	.339	.031	.027	4.135	.489
25.800	.450	.082	.144	2.751	.020	.117	.056	.022	.046	.360	.036	.033	4.118	.492
25.900	.446	.081	.141	2.746	.020	.114	.055	.023	.046	.384	.041	.039	4.136	.494
26.000	.452	.080	.139	2.768	.019	.111	.054	.024	.046	.411	.046	.045	4.195	.497
26.100	.439	.080	.138	2.733	.019	.110	.052	.024	.045	.415	.050	.051	4.158	.498
26.200	.439	.080	.136	2.746	.018	.109	.051	.025	.045	.424	.055	.057	4.186	.500
26.300	.447	.080	.135	2.783	.018	.107	.050	.026	.045	.434	.059	.064	4.249	.503

Table 40

Kerma Factors and Uncertainties (fGy•m^2)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	$K_{n,d}$	$K_{n,np}$	$K_{n,2n}$	$K_{n,t}$	$K_{n,^6Li}$	$K_{n,d\alpha}$	$K_{n,p\alpha}$	K_{spare}	K_t	ΔK_t
26.400	.447	.080	.134	2.796	.018	.106	.049	.027	.044	.442	.064	.072	.002	4.280	.506
26.500	.439	.080	.132	2.785	.017	.104	.048	.027	.044	.448	.069	.079	.004	4.278	.508
26.600	.441	.080	.131	2.803	.017	.103	.048	.028	.044	.451	.074	.087	.005	4.311	.510
26.700	.440	.080	.129	2.813	.016	.101	.047	.029	.043	.454	.079	.095	.008	4.335	.513
26.800	.438	.080	.128	2.819	.016	.099	.046	.030	.043	.455	.084	.103	.011	4.353	.515
26.900	.434	.080	.126	2.818	.016	.098	.046	.030	.043	.456	.089	.112	.017	4.365	.517
27.000	.436	.080	.125	2.835	.015	.096	.045	.031	.042	.459	.095	.121	.020	4.400	.519
27.100	.434	.080	.123	2.841	.015	.094	.045	.032	.042	.460	.101	.126	.025	4.418	.521
27.200	.443	.079	.122	2.882	.015	.093	.044	.033	.042	.464	.107	.132	.032	4.487	.523
27.300	.438	.079	.120	2.882	.014	.091	.043	.034	.041	.464	.110	.138	.038	4.492	.526
27.400	.430	.079	.118	2.875	.014	.089	.042	.035	.041	.463	.112	.144	.044	4.485	.529
27.500	.441	.079	.117	2.930	.013	.087	.042	.035	.041	.467	.114	.150	.050	4.566	.533
27.600	.431	.079	.115	2.906	.013	.085	.041	.036	.040	.465	.115	.151	.056	4.533	.534
27.700	.427	.079	.113	2.905	.012	.083	.040	.037	.040	.465	.117	.153	.060	4.531	.536
27.800	.434	.079	.112	2.940	.012	.081	.039	.038	.040	.467	.118	.154	.066	4.580	.538
27.900	.425	.079	.110	2.921	.012	.079	.039	.039	.039	.465	.120	.155	.071	4.554	.540
28.000	.434	.079	.108	2.965	.011	.077	.038	.040	.039	.468	.122	.157	.077	4.614	.542
28.100	.422	.079	.107	2.931	.011	.076	.037	.040	.039	.465	.121	.155	.084	4.567	.543
28.200	.432	.078	.106	2.979	.011	.075	.036	.041	.040	.469	.121	.155	.091	4.634	.545
28.300	.429	.078	.105	2.979	.011	.074	.035	.041	.040	.469	.121	.154	.098	4.634	.547
28.400	.423	.078	.104	2.974	.010	.073	.034	.042	.041	.468	.120	.153	.104	4.624	.550
28.500	.430	.078	.103	3.016	.010	.072	.034	.042	.041	.470	.120	.152	.112	4.679	.552
28.600	.427	.078	.101	3.018	.010	.071	.033	.043	.042	.469	.120	.151	.119	4.683	.554
28.700	.429	.078	.100	3.037	.010	.070	.033	.043	.042	.470	.119	.150	.128	4.708	.556
28.800	.431	.078	.099	3.056	.009	.069	.033	.044	.043	.470	.119	.148	.136	4.733	.558
28.900	.413	.077	.098	3.004	.009	.067	.032	.044	.043	.465	.117	.146	.144	4.661	.560
29.000	.423	.077	.096	3.050	.009	.066	.032	.045	.044	.467	.117	.144	.154	4.724	.561
29.100	.418	.077	.095	3.041	.009	.065	.031	.045	.043	.466	.116	.143	.164	4.712	.563
29.200	.428	.077	.094	3.086	.008	.064	.031	.046	.041	.467	.116	.142	.176	4.775	.564

Table 41

Kerma Factors and Uncertainties ($fGy \cdot m^2$)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,n'3\alpha}$	$K_{n,p}$	$K_{n,d}$	$K_{n,np}$	$K_{n,2n}$	$K_{n,t}$	$K_{n,^6Li}$	$K_{n,d\alpha}$	$K_{n,p\alpha}$	K_{spare}	K_t	ΔK_t
29.300	.415	.077	.093	3.050	.008	.062	.030	.046	.040	.463	.115	.140	.186	4.728	.568
29.400	.423	.077	.091	3.091	.008	.061	.029	.047	.039	.464	.115	.139	.197	4.782	.570
20.500	.414	.077	.090	3.074	.008	.060	.029	.047	.037	.461	.114	.137	.207	4.755	.573
29.600	.421	.076	.089	3.114	.008	.058	.028	.048	.036	.461	.114	.136	.219	4.808	.575
29.700	.414	.076	.087	3.101	.007	.057	.028	.048	.035	.458	.113	.134	.230	4.788	.577
29.800	.401	.076	.086	3.066	.007	.056	.027	.049	.033	.453	.112	.132	.241	4.738	.579
29.900	.421	.076	.085	3.156	.007	.054	.027	.050	.032	.456	.111	.130	.253	4.858	.581
30.000	.417	.076	.083	3.157	.006	.053	.026	.052	.030	.453	.110	.128	.264	4.855	.583
30.100	.415	.076	.083	3.157	.006	.052	.025	.053	.030	.452	.110	.127	.272	4.857	.584
30.200	.406	.076	.082	3.130	.006	.051	.025	.054	.030	.449	.109	.125	.281	4.823	.585
30.300	.406	.075	.081	3.138	.006	.050	.024	.055	.029	.448	.109	.124	.291	4.837	.586
30.400	.409	.075	.080	3.158	.006	.050	.023	.056	.029	.448	.108	.123	.301	4.867	.587
30.500	.397	.075	.079	3.124	.006	.049	.023	.057	.029	.444	.107	.121	.310	4.821	.588
30.600	.409	.075	.078	3.184	.006	.048	.023	.057	.029	.445	.107	.120	.323	4.903	.591
30.700	.413	.075	.077	3.213	.006	.047	.022	.058	.028	.444	.106	.118	.334	4.941	.593
30.800	.406	.074	.076	3.202	.005	.046	.022	.059	.028	.441	.105	.118	.345	4.927	.595
30.900	.419	.074	.075	3.267	.005	.046	.022	.059	.028	.442	.105	.115	.359	5.016	.597
31.000	.404	.074	.074	3.221	.005	.045	.021	.060	.027	.437	.104	.112	.368	4.952	.599
31.100	.400	.074	.073	3.216	.005	.044	.021	.060	.027	.436	.103	.111	.378	4.948	.600
31.200	.405	.074	.072	3.244	.005	.043	.021	.061	.027	.437	.102	.110	.390	4.989	.601
31.300	.398	.074	.071	3.226	.005	.042	.020	.062	.026	.435	.101	.108	.400	4.968	.602
31.400	.387	.073	.070	3.189	.005	.041	.020	.061	.026	.432	.100	.107	.409	4.920	.603
31.500	.386	.073	.069	3.196	.004	.040	.020	.061	.026	.431	.099	.105	.420	4.931	.605
31.600	.411	.073	.068	3.309	.004	.039	.019	.061	.025	.435	.098	.103	.439	5.086	.607
31.700	.399	.073	.067	3.278	.004	.038	.019	.061	.025	.432	.097	.101	.452	5.047	.609
31.800	.402	.073	.066	3.305	.004	.037	.018	.061	.025	.431	.095	.101	.462	5.080	.612
31.900	.388	.072	.065	3.263	.004	.036	.018	.060	.025	.428	.094	.099	.471	5.023	.614
32.000	.397	.072	.064	3.316	.004	.035	.018	.060	.024	.428	.093	.099	.488	5.096	.616

Table 42

Table of Input Data and Fitted Values for Simultaneous Fit

Reference	Measured Quantity	Measured Value	Uncertainty	Fitted Value	Residual	Weighted Residual
This work	gp[1]	1.000	.015	.997	.003	.211
This work	gp[2]	1.000	.039	.999	.001	.036
This work	gp[3]	1.000	.076	1.031	-.031	-.409
This work	gp[4]	1.000	.130	1.013	-.013	-.097
This work	gp[5]	1.000	.190	.997	.003	.015
This work	gp[6]	1.000	.190	.995	.005	.025
This work	gp[7]	1.000	.050	1.024	-.024	-.474
This work	gp[8]	1.000	.150	1.013	-.013	-.089
This work	gp[9]	1.000	.250	1.008	-.008	-.033
This work	gp[10]	1.000	.250	1.029	-.029	-.115
De84	1 fk 14.1	1.780	.110	1.958	-.178	-1.616
De85	3 fk 15	2.100	.160	2.184	-.084	-.523
Bu85	3 fk 15	2.350	.210	2.184	.166	.792
Bu85	4 fk 17	2.460	.240	2.622	-.162	-.677
De86	5 fk 17.8	2.920	.220	2.877	.043	.197
De85	6 fk 17.9	2.970	.300	2.907	.063	.210
De86	7 fk 19.8	3.550	.280	3.408	.142	.508
Ho76	csta 14.4	654.0	92.0	662.550	-8.540	-.093
Fa78	csta 14.8	900.0	70.0	798.446	101.554	1.451
Kn86	csta 14.8	894.0	60.0	798.446	95.554	1.593
Ho76	csta 14.9	744.0	60.0	771.419	-27.423	-.457
Ha84	fka 14.1	.490	.060	.478	.012	.198
Ha84	fk3a 14.1	.560	.080	.718	-.157	-1.969
An84	feb3a 10.91	3.010	1.260	2.471	.539	.428
An84	feb3a 12.93	4.020	1.110	3.760	.260	.234
An84	feb3a 14.95	5.630	1.130	5.179	.451	.399
An84	feb3a 16.87	5.940	1.210	6.349	-.409	-.338
An84	feb3a 18.94	7.690	1.190	7.870	-.180	-.151

Table 43

Kerma Factors from Simultaneous Fit (fGy•m²)

E_n MeV	K_e	K_{in}	$K_{n,\alpha}$	$K_{n,p}$	$K_{n,d}$	$K_{n,np}$	$K_{n,n'3\alpha}$	K_t
11.800	.510	.220	.469	.000	.000	.000	.284	1.484
12.000	.554	.216	.552	.000	.000	.000	.371	1.693
12.200	.561	.216	.596	.000	.000	.000	.437	1.811
12.400	.564	.214	.557	.000	.000	.000	.444	1.779
12.600	.584	.223	.539	.000	.000	.000	.436	1.781
12.800	.580	.241	.519	.000	.000	.000	.435	1.774
13.000	.571	.249	.506	.000	.000	.000	.453	1.780
13.200	.578	.254	.489	.000	.000	.000	.499	1.820
13.400	.581	.256	.472	.000	.000	.000	.553	1.862
13.600	.581	.262	.459	.000	.000	.000	.602	1.904
13.800	.547	.256	.452	.000	.000	.000	.575	1.830
14.000	.508	.244	.421	.000	.000	.000	.728	1.900
14.200	.530	.241	.500	.000	.000	.000	.720	1.991
14.400	.538	.227	.485	.000	.000	.000	.756	2.007
14.600	.562	.210	.466	.000	.000	.000	.886	2.125
14.800	.569	.203	.394	.001	.000	.000	1.010	2.177
15.000	.561	.191	.386	.002	.000	.000	1.044	2.184
15.200	.581	.189	.388	.005	.000	.000	1.047	2.210
15.400	.594	.178	.389	.008	.000	.000	1.079	2.248
15.600	.601	.171	.365	.012	.010	.000	1.121	2.280
15.800	.607	.164	.317	.017	.023	.000	1.190	2.319
16.000	.616	.157	.290	.023	.038	.000	1.248	2.371
16.200	.592	.149	.296	.028	.050	.000	1.286	2.399
16.400	.572	.137	.341	.033	.063	.000	1.329	2.476
16.600	.556	.129	.338	.037	.076	.000	1.368	2.505
16.800	.541	.127	.361	.042	.091	.000	1.412	2.574
17.000	.532	.127	.389	.047	.106	.000	1.421	2.622
17.200	.522	.129	.413	.053	.125	.000	1.486	2.727
17.400	.519	.131	.378	.060	.144	.000	1.564	2.796
17.600	.522	.130	.317	.068	.166	.000	1.624	2.828
17.800	.528	.120	.297	.077	.190	.001	1.665	2.877
18.000	.538	.110	.288	.083	.213	.003	1.714	2.948
18.200	.545	.119	.238	.086	.237	.007	1.751	2.982
18.400	.538	.122	.206	.089	.259	.010	1.753	2.976
18.600	.545	.121	.203	.091	.272	.013	1.792	3.036
18.800	.551	.108	.228	.092	.280	.015	1.836	3.111
19.000	.556	.094	.236	.093	.287	.018	1.865	3.149
19.200	.575	.089	.250	.090	.286	.020	1.909	3.219
19.400	.590	.091	.284	.086	.281	.023	1.943	3.297
19.600	.600	.093	.353	.082	.276	.025	1.980	3.409
19.800	.593	.094	.376	.080	.271	.028	1.990	3.432
20.000	.585	.096	.486	.077	.265	.031	2.016	3.558

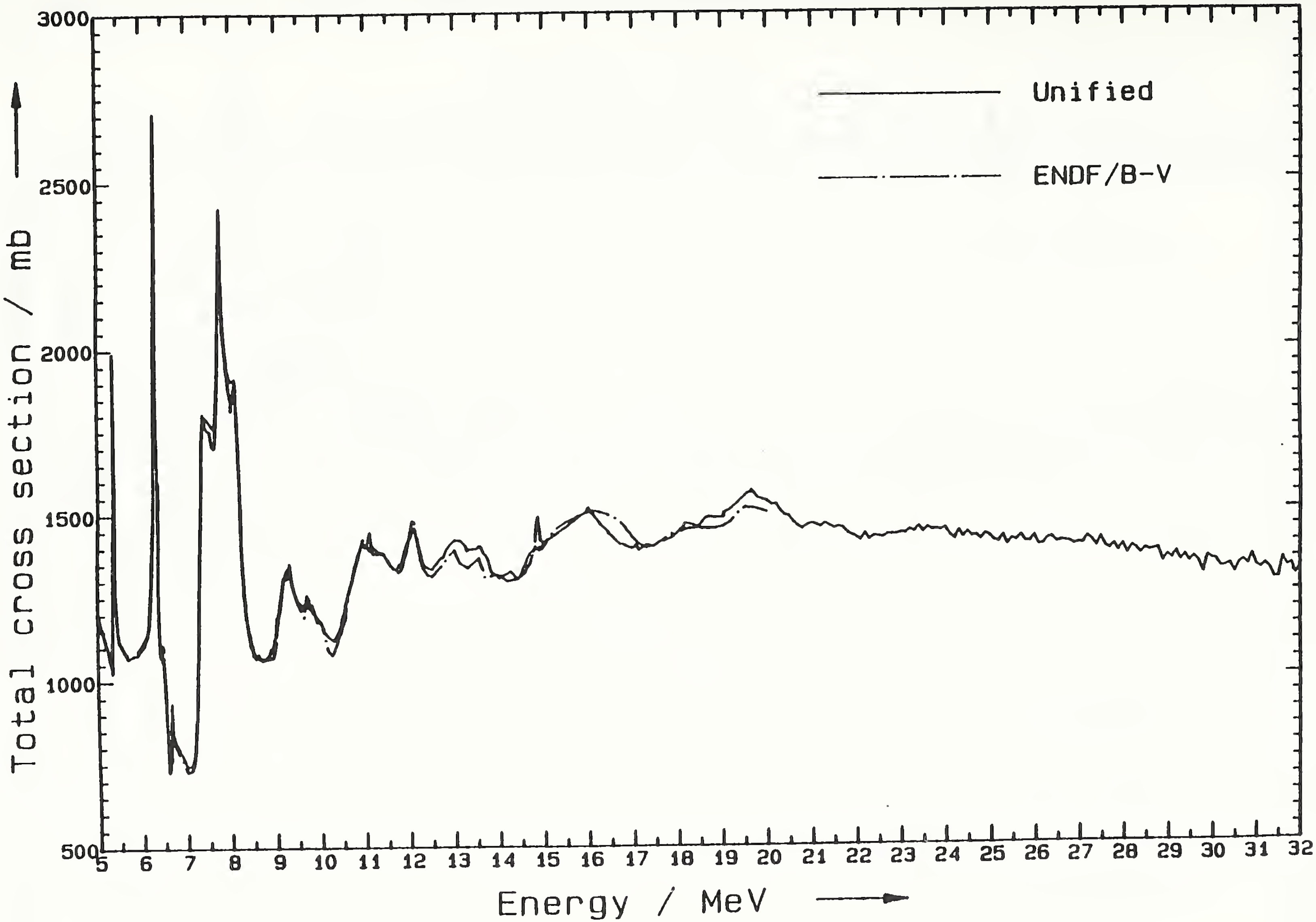

Fig. 1. Carbon total cross sections

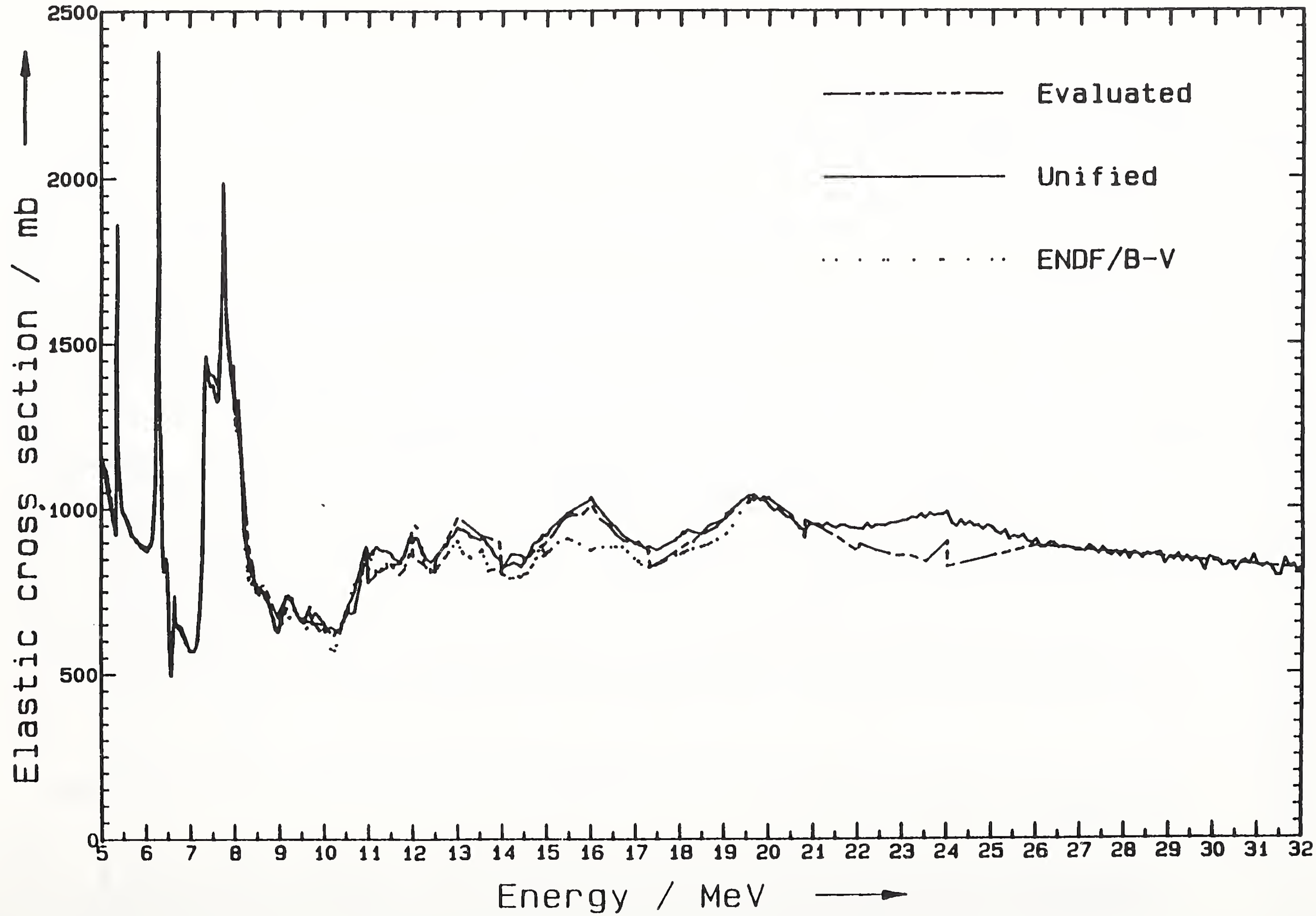

Fig. 2. Cross sections for carbon elastic scattering

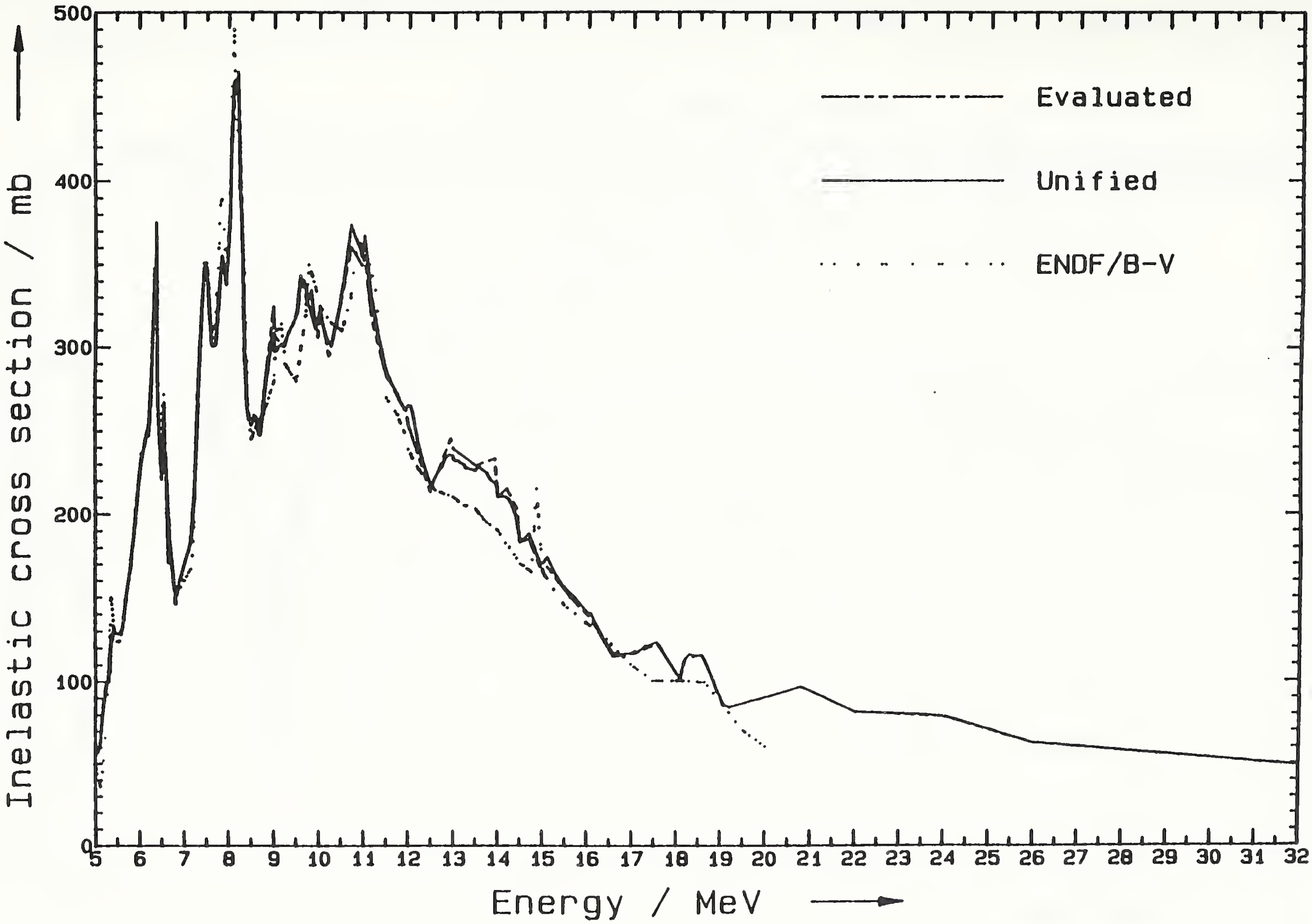

Fig. 3. Cross sections for inelastic scattering to 4.43 MeV state of ^{12}C

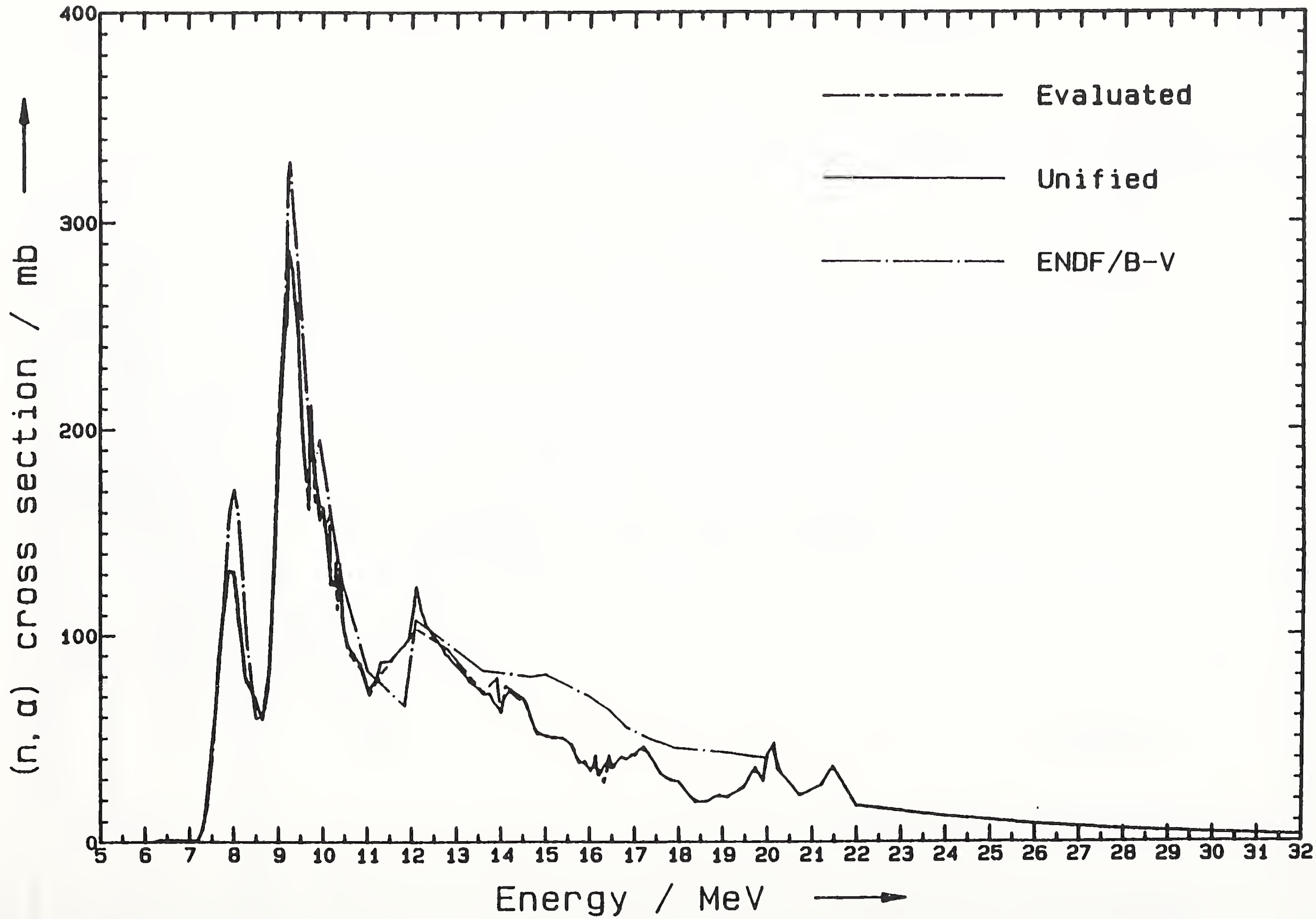

Fig. 4. Cross section for $^{12}C(n,\alpha_0)^{9}Be$ reaction

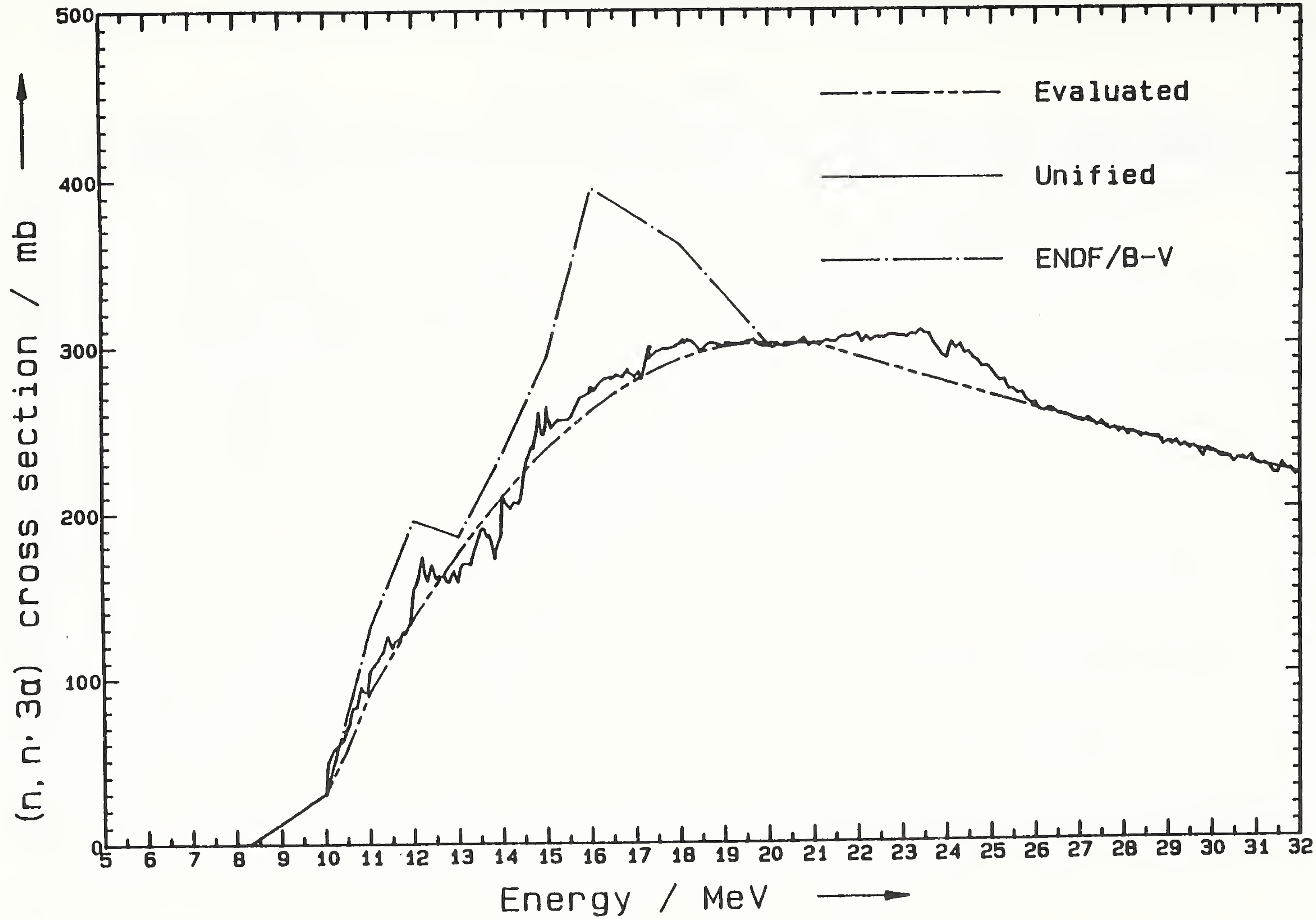

Fig. 5. Cross section for $^{12}C(n,n'3\alpha)$ reaction

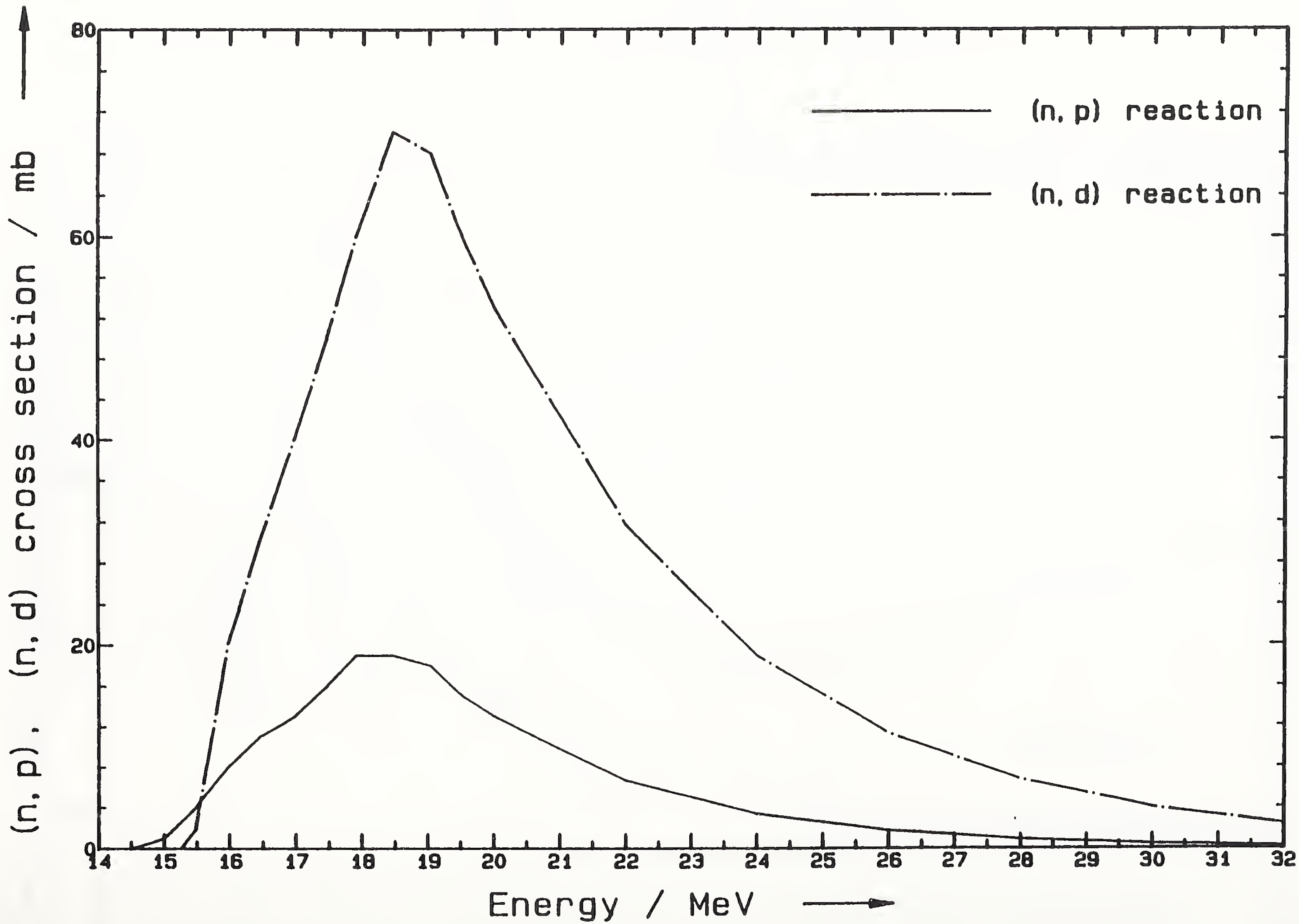

Fig. 6. Cross section for $^{12}C(n,p)^{12}B$ and $^{12}C(n,d)^{11}B$ reactions

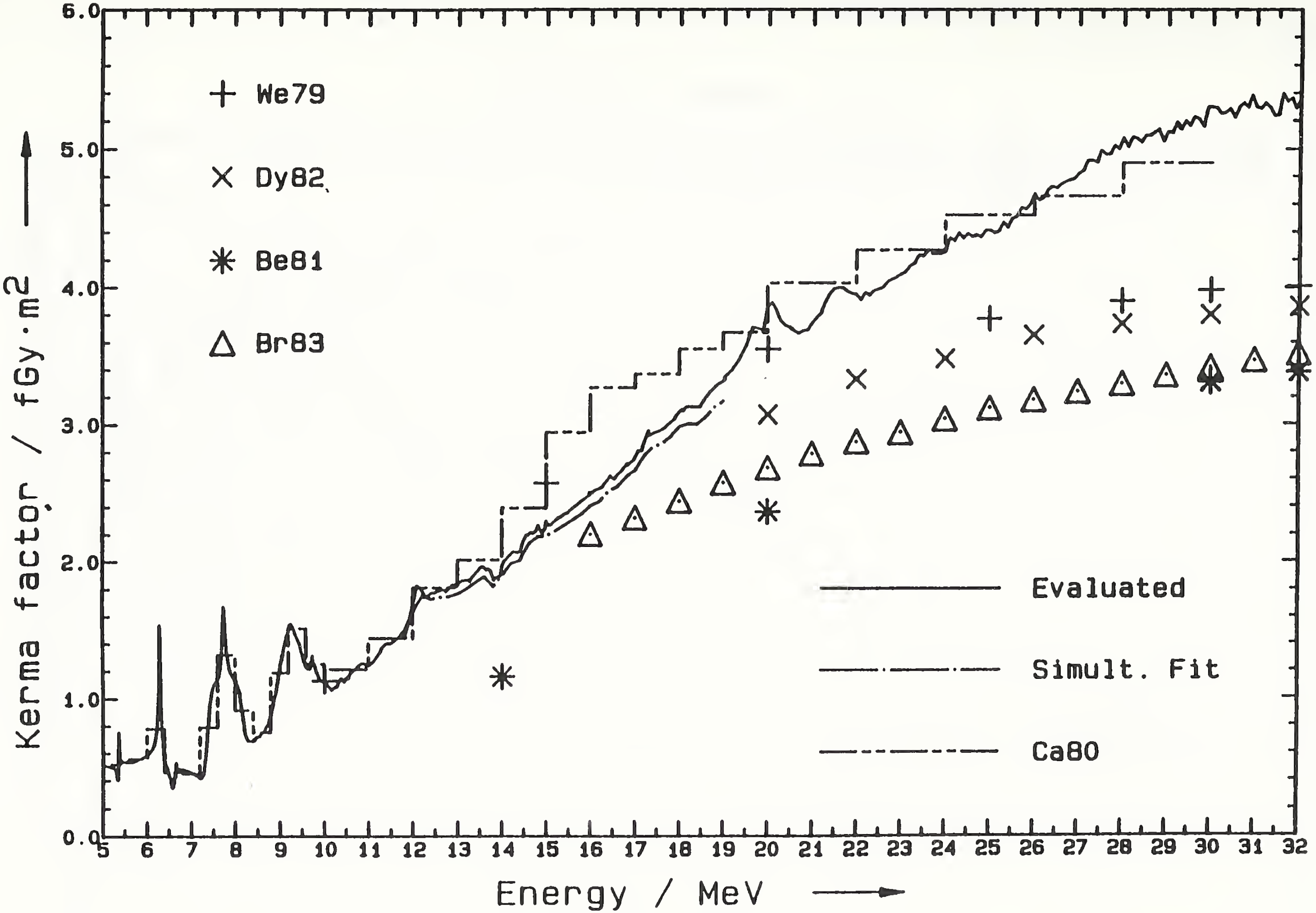

Fig. 7. Carbon total kerma factors, fGy·m^2

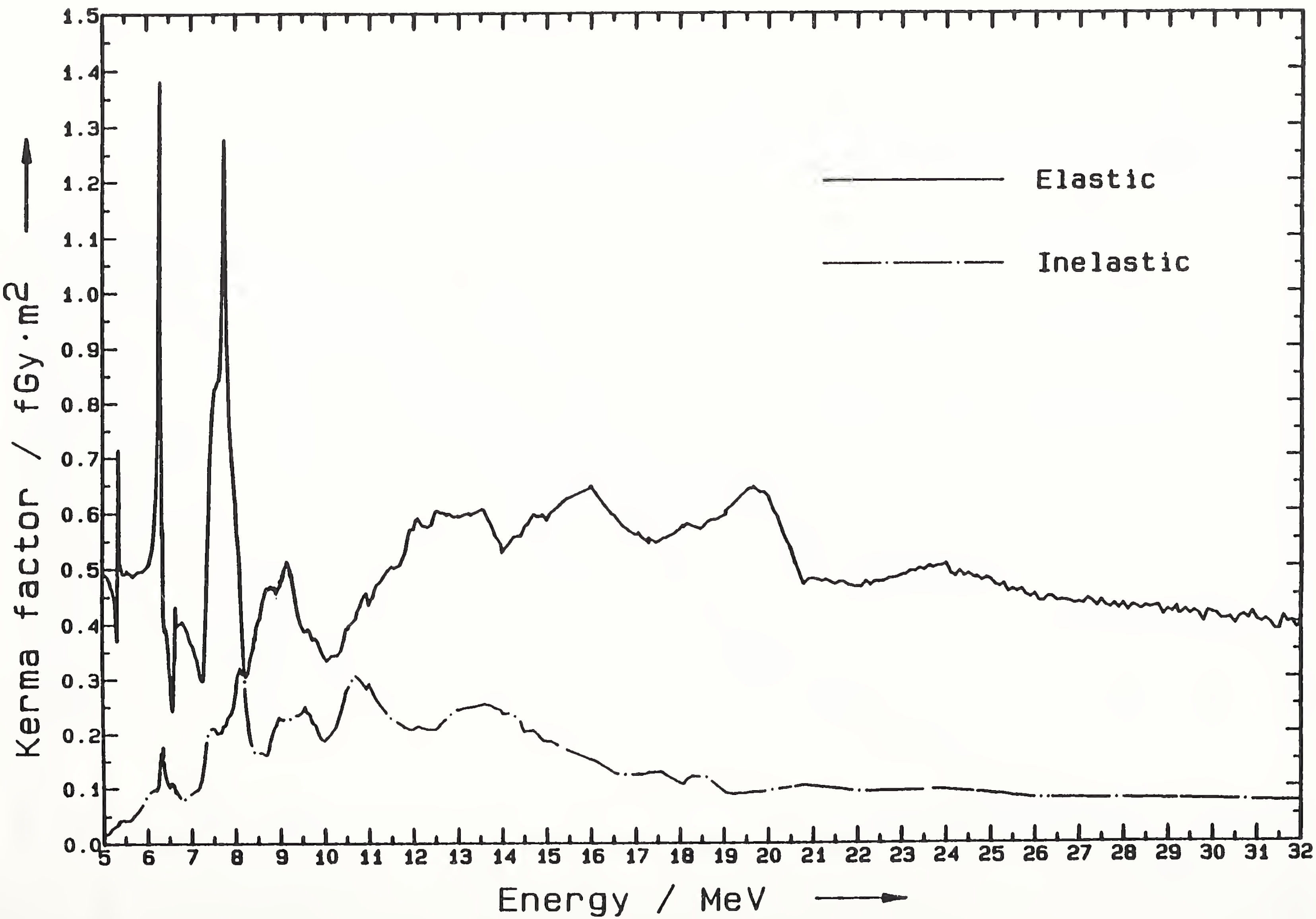

Fig. 8. Kerma from carbon elastic and inelastic scattering $fGy \cdot m^2$

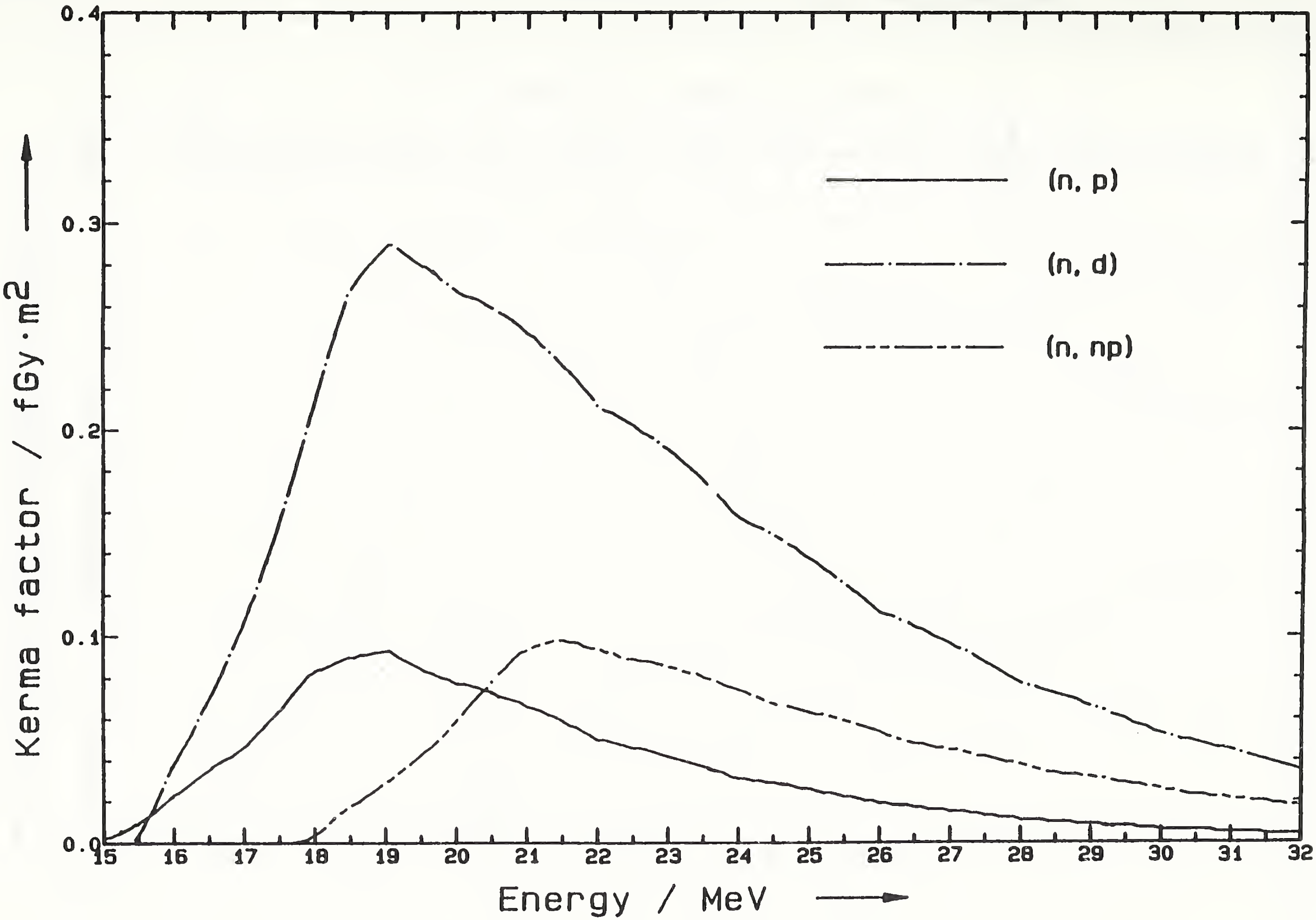

Fig. 9. Kerma from $^{12}C(n,p)^{12}B$, $^{12}C(n,d)^{11}B$, and $^{12}C(n,np)^{11}B$ reactions

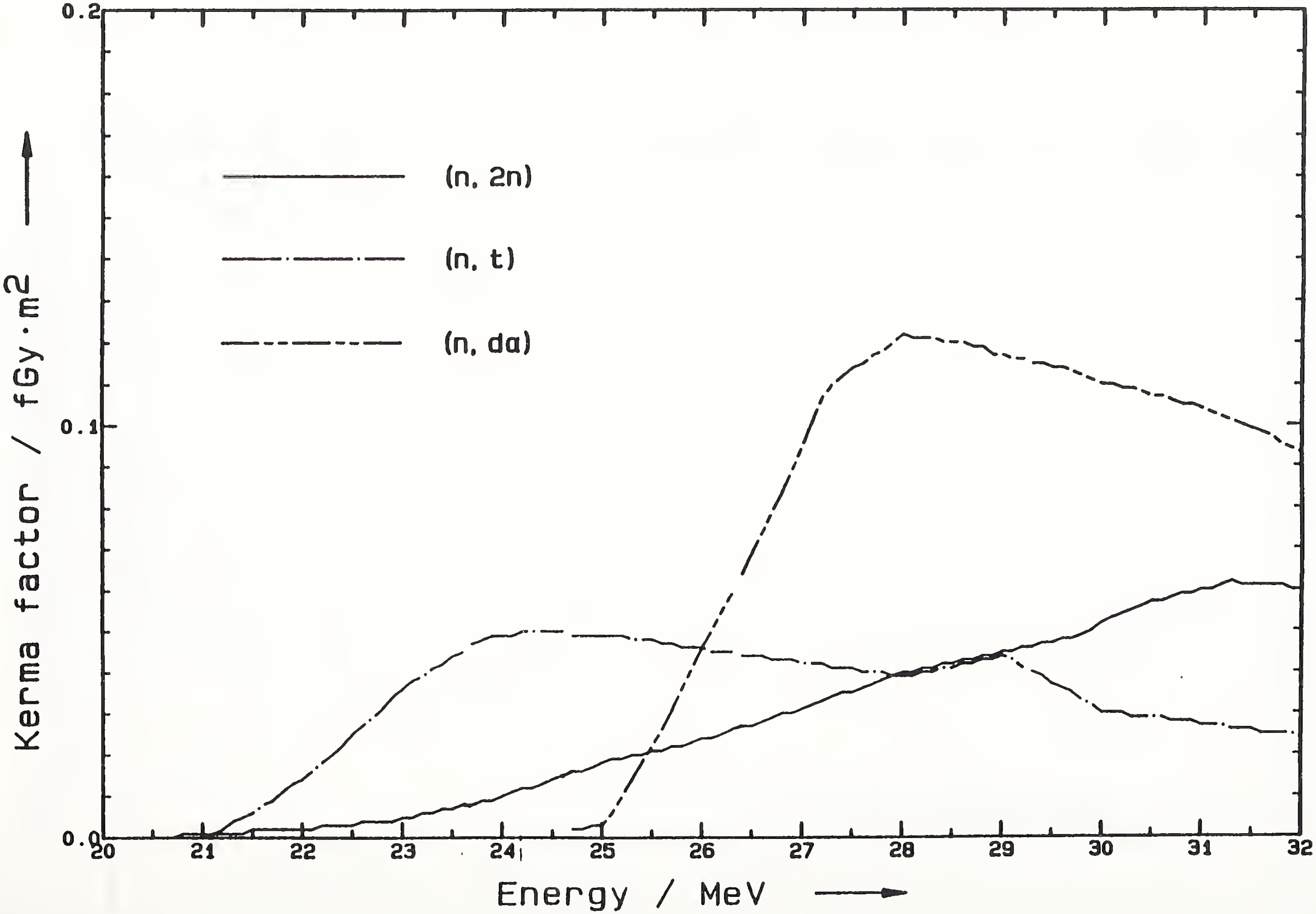

Fig. 10. Kerma from $^{12}C(n,2n)^{11}C$, $^{12}C(n,t)^{10}B$, and $^{12}C(n,d\alpha)^{7}Li$ reactions

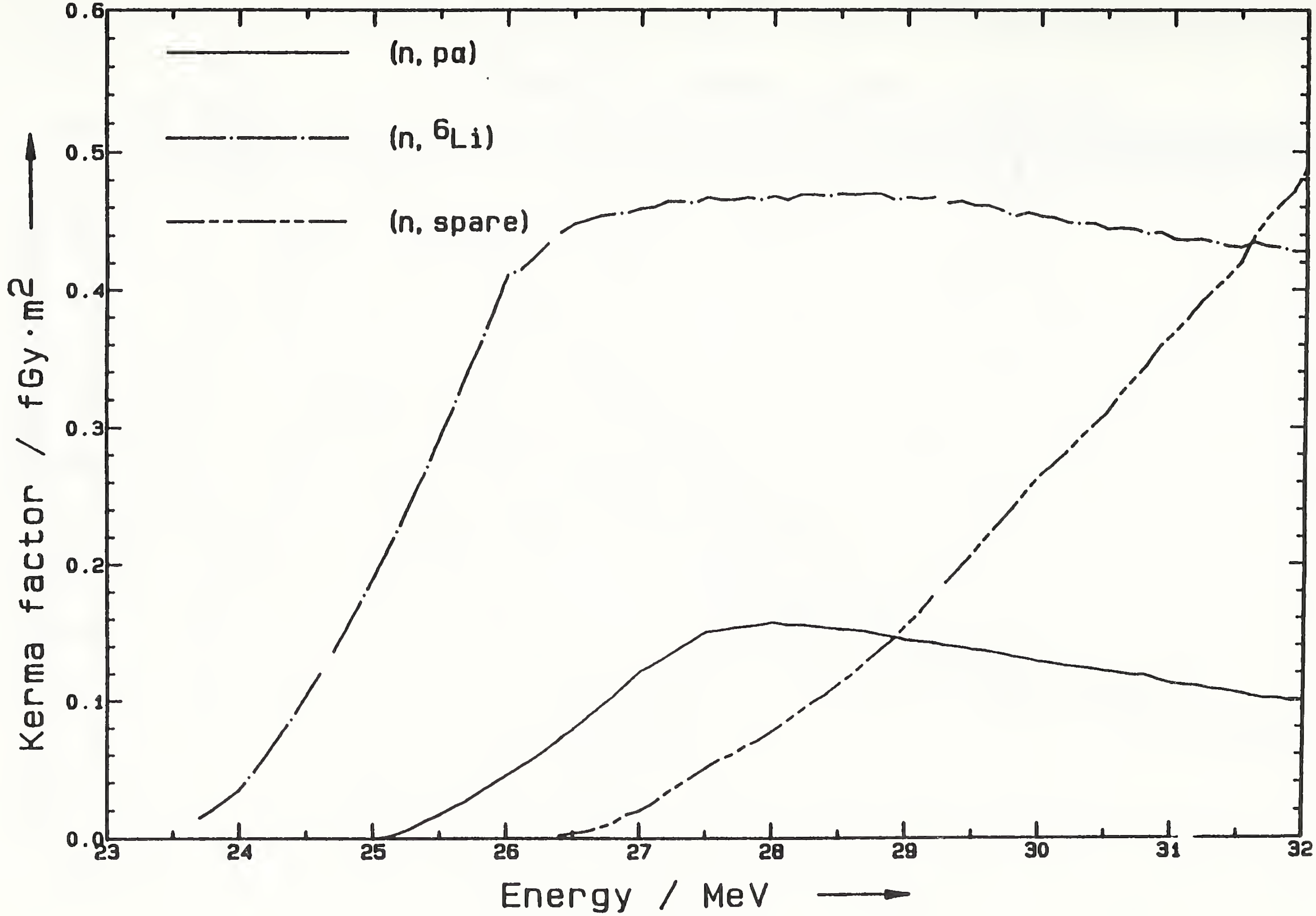

Fig. 11. Kerma from $^{12}C(n,^{6}Li)^{7}Li$, $^{12}C(n,p\alpha)^{8}Li$ reactions, and from the reactions contribution to σ_{spare}

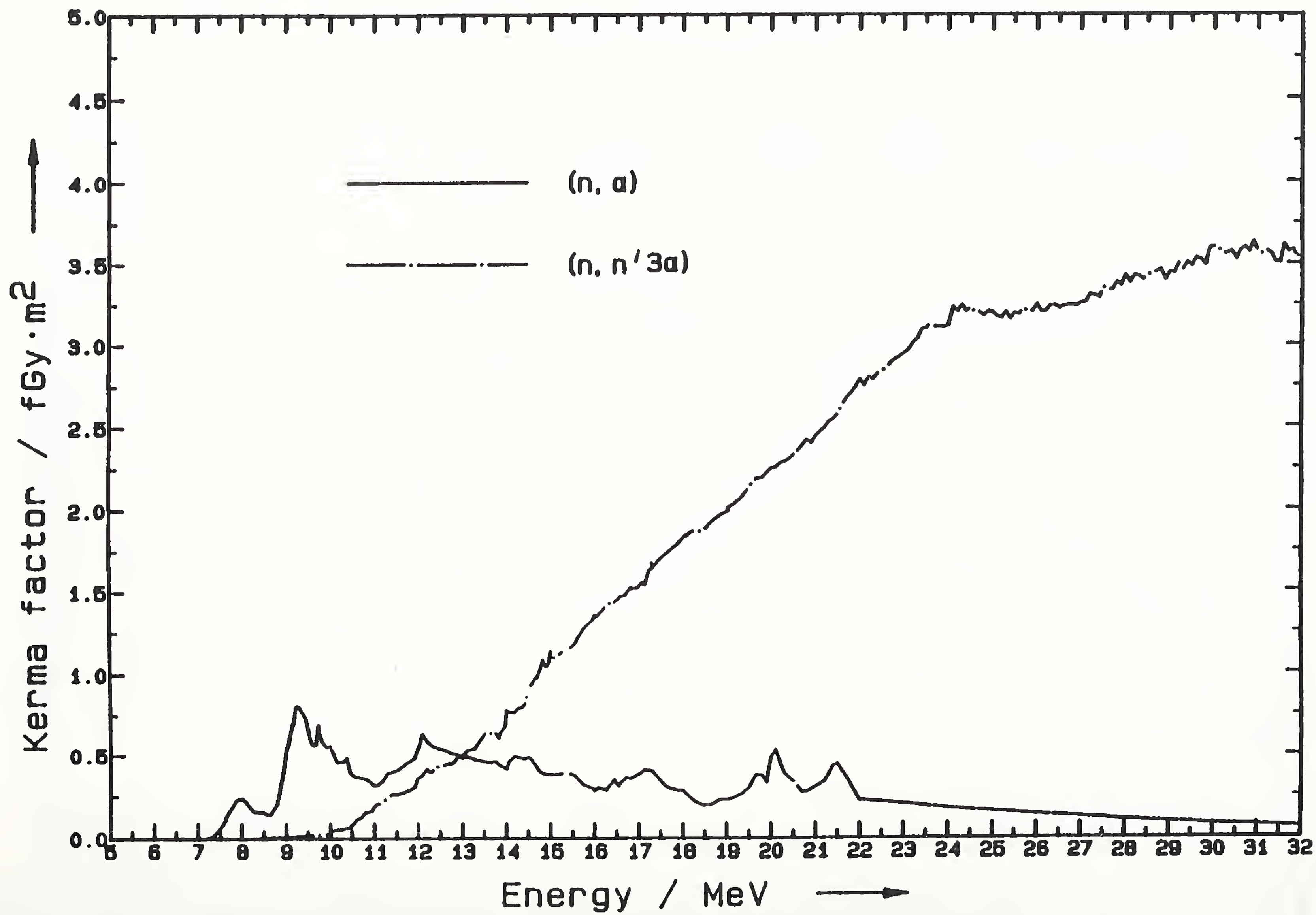

Fig. 12. Kerma from $^{12}C(n,\alpha_0)^9Be$ and $^{12}C(n,n'3\alpha)$ reactions

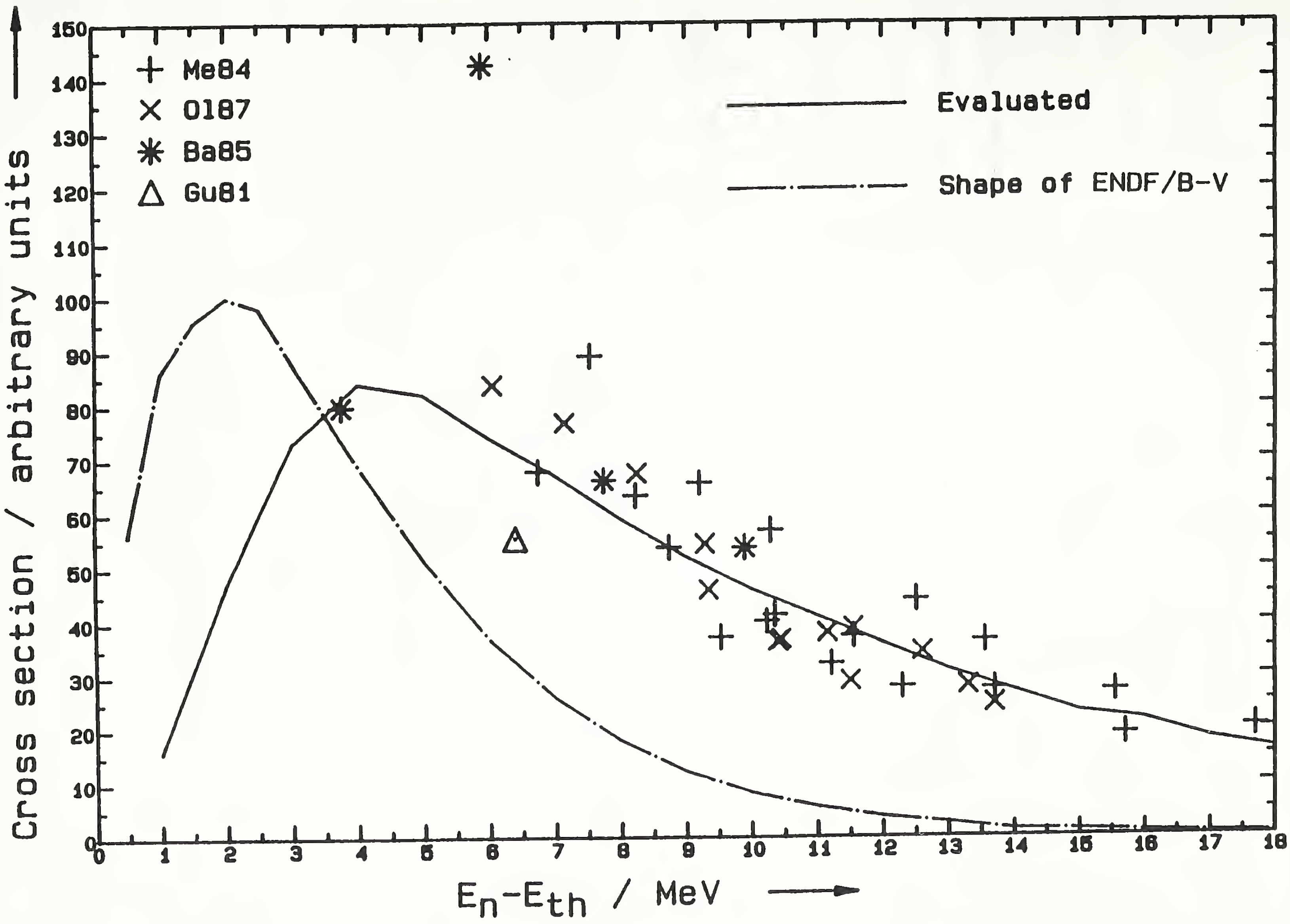

Fig. 13. Shapes of cross sections for inelastic scattering to higher excited states of ^{12}C

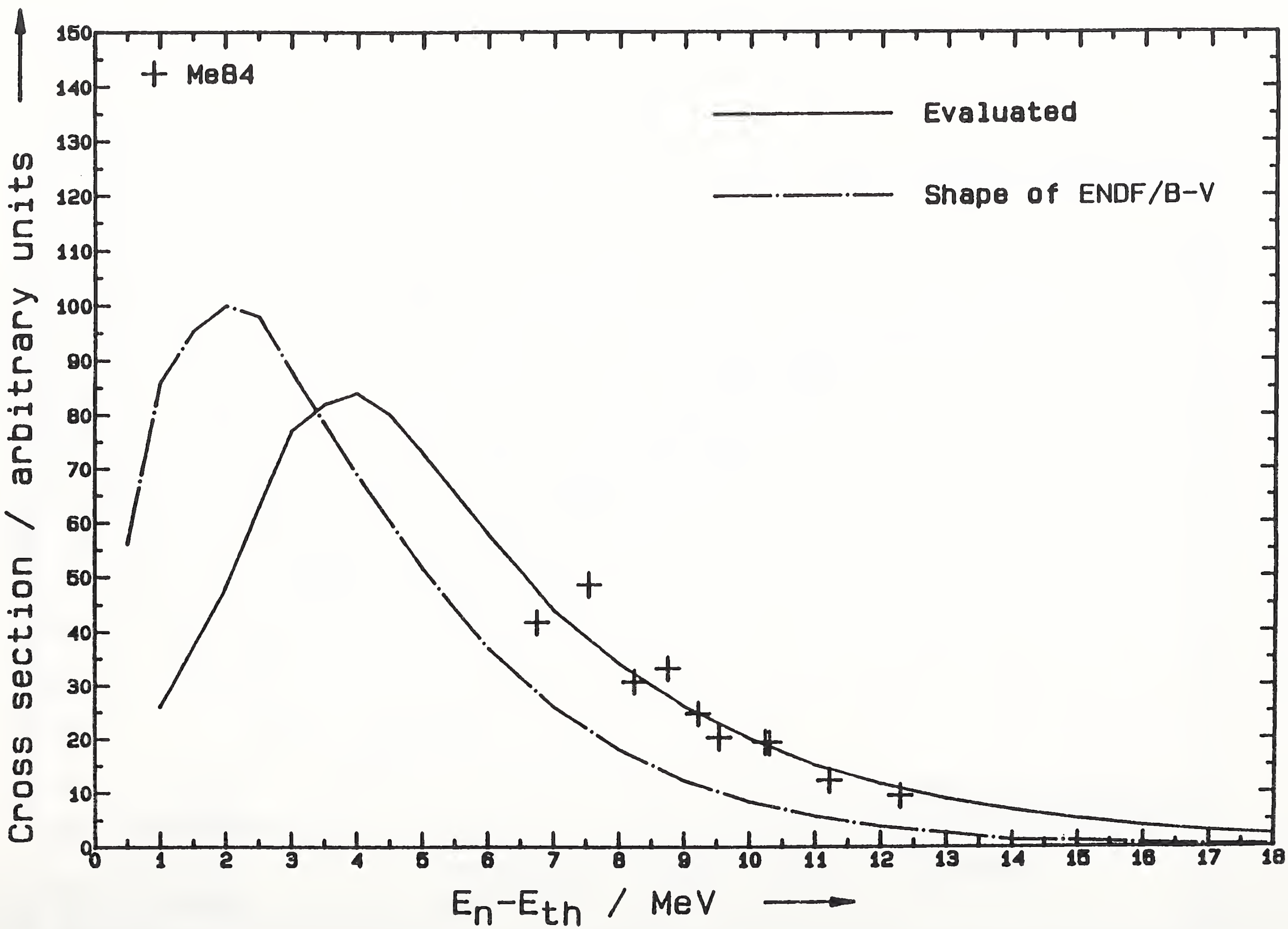

Fig. 14. Shapes of cross sections for inelastic scattering to pseudo-states of ^{12}C

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Edward Axton

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11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.)

A preliminary simultaneous least squares fit to measurements of kerma in carbon, and carbon cross sections taken from the ENDF/B-V file was carried out. In this calculation the shapes of the total cross section and the various partial cross sections were rigid but their absolute values were allowed to float in the fit within the constraints of the ENDF/B-V uncertainties. The construction of the ENDF/B-V file imposed improbable shapes, particularly in the case of the $^{12}C(n,n'3\alpha)$ reaction, which were incompatible with direct measurements of kerma and of the reaction cross sections. Consequently a new evaluation of the cross section data became necessary. Since the available time was limited the new evaluation concentrated particularly on those aspects of the ENDF/B-V carbon file which would have most impact on kerma calculations. Following the new evaluation of cross sections new tables of kerma factors were produced. Finally, the simultaneous least squares fit to measurements of kerma and the new cross section file was repeated.

12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)

carbon; evaluated data; Evaluated Nuclear Data File; kerma; least squares analysis; neutron cross sections

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