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**GAMMA-EMISSION DATA FOR THE CALCULATION
OF EXPOSURE RATES FROM NUCLEAR DEBRIS.
Volume I. Fission Products**

by
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ABSTRACT

Photon energies and photon abundances have been compiled and summarized for some fission-product and other radionuclides, using data reported in the literature up to June 1963. The data are presented in tabular form, listing photon energies and abundances for gamma rays, beta rays, and X rays emitted. A list of multipliers is also presented for converting activities of the radionuclides to infinite-plane exposure rates.

SUMMARY

The radiation exposure rate from fallout (per disintegration per unit area) depends upon the energies of the photons emitted by the fission-product radionuclides and induced activities and upon the number of photons of each energy emitted in one disintegration. This report is a compilation of the photon energies and abundances for fission products of uranium and plutonium as well as for a few isomers of uranium, neptunium and plutonium which are sometimes present in debris from nuclear weapons. A list of factors for converting radionuclide activities to infinite-plane exposure rate contributions is also presented.

PREFACE

This report was originally published as USNRDL Reviews and Lectures (R & L) No. 143. The R & L series reports are intended primarily for intralaboratory and limited outside distribution or reference. The appearance of this report in the more widely distributed Technical Reports series is in response to numerous outside requests. A second volume, presenting gamma-emission data on some induced radioactivities found in fallout is in preparation.

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INTRODUCTION

In order to predict exposure-dose rates from calculated fission-product activities, it is necessary to know the energies and abundances per disintegration of the gamma photons emitted by the radionuclides. In addition the exposure per unit of photon flux, as a function of energy, must be calculated for the situation of interest. This latter result can be expressed as the dose at a well-defined point (in a standard situation) that results from one disintegration of a specified nuclide. This value can be regarded as a multiplier for converting the activity of that nuclide in a mixture of fission products to the dose-rate contribution of the nuclide.

C. F. Miller's compilation¹ has done excellent service as a source of gamma photon energies and abundances for most of the more important fission product gamma emitters. However, in view of the large volume of published data on fission-product decay that has appeared since 1957, it is desirable to up-date and extend Miller's compilation. Many of Miller's gamma photon abundances are merely estimates based on fragmentary data. It is now possible to substitute fairly complete experimental data for some of these and to include others which Miller omitted for lack of information. In other cases, decays have been extensively re-studied and revision of the abundances reported by Miller is desirable.

A review has been made of the most important sources of this kind of information. Since gamma photon abundances are rarely measured directly or reported as such, it was generally necessary to deduce the abundances from reported relative gamma intensities, interpreted in conjunction with energy-level diagrams for the nuclei involved. The resulting collection of current best information on gamma energies, gamma-photon abundances, X-ray photons resulting from gamma conversion, beta energies, and beta particle abundances is presented in Appendix I of this report. The data pertain largely to fission products of uranium, but data also are included for certain isotopes of uranium, neptunium and plutonium that sometimes occur in weapon debris.

Miller also presented² a list of multipliers for converting activities into dose rates. These have been recalculated using the new gamma abundance data and an improved solution for exposure dose per unit of photon flux. The results are presented in Appendix II.

INFORMATION SOURCES

Experimental study of beta-decay processes is currently a very active field and the volume of publications on the subject is large. The Nuclear Data Sheets (NDS) published by National Academy of Sciences-National Research Council, including additions and revisions issued to date, formed the basic reference for this compilation. These sheets are prepared by a team of specialists and include a certain amount of critical commentary and evaluation in addition to the data itself.

Many other recently published papers which have not yet been incorporated into NDS were taken into consideration. The principal sources of such papers were Physical Review, Nuclear Physics, Physica, Arkiv for Fysik, Nuovo Cimento, Journal of Inorganic and Nuclear Chemistry, Soviet Journal of Experimental and Theoretical Physics, and Canadian Journal of Physics. It is believed that these journals account for the major portion of publication in this field.

Much of the material appears in report or thesis form in advance of formal publication in journals. Such sources have not been much utilized for this compilation, partly because they are not easily available and partly because the results presented are often tentative in nature.

Miller's estimates have been retained for a number of nuclides for which no new data were encountered. In many other instances, the changes which have been made on the basis of new data are relatively minor.

INTERPRETATION OF PUBLISHED DECAY DATA

Data on the gamma and X radiation accompanying beta decay are usually presented in the literature with a view toward establishing the energy level structure of the nuclides involved, rather than toward displaying photon energies and abundances as such. Consequently, it is usually necessary to deduce the photon abundances by interpretation of the decay data in conjunction with a logical decay scheme.

The decay schemes, which are usually provided along with the report of the data, are diagrammatic representations of the processes in which an unstable nuclide is transformed into one of greater stability by emitting a beta particle, with or without accompanying gamma and X radiation. The emission of a beta particle transforms the unstable nuclide into its daughter nuclide. Depending upon the energy of the emitted beta particle, the daughter nuclide may be in its ground state or in some excited level. In the former case no radiation is emitted, but in the latter case the daughter must de-excite to its ground state by making one or more transitions to lower energy levels. These transitions must be accompanied by the emission of radiation. In general, the radiation consists of one or more gamma photons of the appropriate energies, but an alternative process is the emission of a characteristic X ray, along with an accelerated extranuclear electron, in place of a gamma photon. This process is termed conversion of the gamma photon, and the probability of its occurrence is expressed by a conversion coefficient.

Not all nuclides decay along a single path. Many cases of branching arise, as, for example:

Here A_1 and B_1 are metastable isomers of two nuclides whose ground states are A_2 and B_2 . The arrows indicate possible modes of decay, which may or may not be accompanied by emission of gamma rays. A_1 , for instance, decays partly along each of three paths which may involve emission of three different sets of gamma rays. A definite value can be assigned to the percentage of all A_1 nuclides that

follows each path. In reporting photon abundances, it is necessary to specify the process for which the figure is applicable. The convention adopted here is: All possible decay paths for a nuclide are considered, and the gamma-photon abundances for each path are multiplied by the appropriate branching fraction and are summed. Further, the paths are considered to extend only to the next stable or metastable state. Thus, in the example, the gamma-photon abundance for A_1 includes all gamma rays accompanying the transitions $A_1 \rightarrow A_2$, $A_1 \rightarrow B_2$, and $A_1 \rightarrow B_1$. The radiation accompanying $A_2 \rightarrow B_2$ (as well as $A_2 \rightarrow B_1$) is assigned to A_2 , and that for $B_1 \rightarrow B_2$ is assigned to B_1 .

The data to be interpreted in conjunction with the decay scheme diagram usually consist of beta branching percentages, which indicate the proportion of parent nuclides that decays to the various levels in the daughter nuclide, along with relative gamma abundances corresponding to transitions in the daughter nuclide. Occasionally, absolute gamma photon abundances are supplied instead of relative values, and at other times the investigator may choose to report absolute or relative transition probabilities.

If the data source does not state absolute gamma-photon abundances explicitly, it is necessary to deduce the values by finding a means to normalize reported relative gamma abundances or transition probabilities to absolute photon abundances. If the decay scheme is relatively simple - involving only one or two beta transitions and not many more gamma transitions - the normalization can often be accomplished by inspection.

In more complicated cases, where a number of beta transitions and two or more gamma transitions branching from the same level occur, a general formula for absolute gamma abundances may be used, such as the one presented in Appendix IV. However, such formulas are rather cumbersome in application and it frequently happens that some of the parameters are missing and must be estimated. A more direct method, based on the following principles, is often useful.

Only one beta particle is emitted per disintegration, and the sum of the branching fractions for the beta transitions must equal one. These transitions can be regarded as populating the various energy levels in the daughter nucleus. The highest lying of the levels can be populated only by beta transitions, but the other levels can also receive some population by transitions from higher levels. The levels are then depopulated by transitions to lower levels in proportion to the transition probabilities. In the absence of conversion of gamma photons to X-ray photons, the number of transitions are simply proportional to the relative gamma abundances. If conversion occurs, the

relative gamma abundances must be multiplied by $(1+\alpha)$, where α is the conversion coefficient, in order to obtain relative transition probabilities. Thus, one can start with any level in the daughter nucleus and calculate the number of beta particles and transitions from upper levels which populate it. An equal number of transitions to lower levels must then take place. This number can be properly distributed among gamma photons and X-ray photons of various energies, from a knowledge of the conversion coefficients and of either the relative probabilities of transitions to lower levels or the relative gamma abundances corresponding to these transitions.

Some of the parameters required by the calculations just described are occasionally missing from the experimental data. When necessary, estimates have been made to arrive at the values presented in this report.

Although the conversion X rays emitted in fission-product decay usually contribute only a very small portion of the total radiation energy, they have been accounted for in this compilation wherever sufficient data were available. X-ray photon emission is not generally reported explicitly in the literature, but conversion coefficients (number of conversion electrons emitted divided by the number of gamma photons emitted) are frequently given. Some of these coefficients are the result of experimental measurements, while others are based on theoretical calculations. Experimental coefficients, if available, have been preferred to calculated values for this compilation. In general, conversion has not been assumed to occur unless the X ray has been observed and reported. In a few cases where other strong reasons existed for assuming conversion took place, the theoretical coefficients were used. For most fission products, conversion results in the emission of only K-series X rays in significant numbers. The tendency to emit L-, M- and N-series X rays increases with atomic number, and in a few cases (notably for the non-fission products U, Np, and Pu) these have been accounted for.

The K X-ray energies are taken from Nuclear Spectroscopy Tables,³ Table 7.2-3. These values are derived from experimental measurements and are 10 to 20 % lower than the K-electron binding energies. For the L-, M-, and N-series X rays such values are not available and the binding energies, taken from Siegbahn,⁴ have been used.

For this report, X-ray photon abundances have been calculated as if each conversion electron emitted were accompanied by emission of the corresponding X-ray photon. This is not actually the case, since an alternative to X-ray emission is the emission of an electron from a higher quantum level. The probability of this process, called Auger

electron emission, decreases with increasing atomic number and is expressed by a coefficient known as the fluorescent yield of the nuclide. The K X-ray photon abundances reported here might be improved somewhat by multiplying by the appropriate fluorescent yields, which range from 0.49 to 0.90 for fission products. However, the uncertainty in the conversion data was so large in many cases that the extra refinement in the calculations did not seem warranted. The effect of fluorescence on dose-rate calculations is negligible, in any case. In the case of the L-, M- and N-shells, fluorescent yields are not well known at all, and the corresponding X-ray photon abundances reported here should be regarded only as rough numbers.

A detailed example, showing the interpretation of the Nuclear Data Sheet scheme and data for some of the nuclides in the mass-75 decay chain, is presented in Appendix III. It illustrates many of the features of the calculations just described.

The accuracy of the data compiled and presented in this report varies widely. The methods used by the original investigators and the equipment available to them were highly diverse. Readers who require estimates of error in the data are referred to the original sources. Many of the reports discuss the accuracy of the measurements in some detail, while others give little information on this point. In view of this situation, no attempt has been made here to assign limits of error to the values reported.

In cases where conflicting data were encountered (and no reason was apparent for preferring one set of results to another), the values reported are those which result in the largest gamma-radiation energy for the nuclide. Since the data are intended for use in predicting hazard from exposure to gamma radiation, overestimation of the gamma abundances seemed preferable to underestimation.

CALCULATION OF THEORETICAL EXPOSURE-DOSE RATE MULTIPLIERS

The gamma abundances have been assembled primarily for the purpose of computing exposure-dose rates from local fallout. The contribution of each radioactive nuclide to the total dose rate depends on its spectrum of gamma energies and the photon abundances corresponding to each energy. In order to convert photon abundances to roentgens, it is necessary to resort to theoretical calculations of the attenuation of

gamma rays by matter. As is well known, this attenuation is found to be a function of photon energy. This problem has been extensively studied⁵⁻⁷ and the solution is understood in principle. Numerical calculations by machine methods have supplied so-called "build-up" factors⁸ which can be used to arrive at the proper conversion factors. These depend on the particular geometry of the situation of interest. For exposure-dose rates from fallout, it is usual to calculate the dose at a point 3 feet above a uniformly contaminated, infinite plane. Conversion factors for this situation, based on the build-up factors of Gates and Eisenhower,⁸ have been supplied by S. Rainey* and used in this report. The factors, calculated for 35 discrete photon energies ranging from 0.1 Mev to 5.0 Mev, have been fitted to the following expression:

$$D = (5.97E - 1.21E^2 + 0.201E^3 - 0.013E^4) \times 10^{-6}$$

D is the dose rate in roentgens per hour at a point 3 feet above an infinite plane uniformly contaminated with one emitter per square centimeter emitting one photon of energy E per second. This equation is useful for computer work, but for hand calculations the following alternative version is more convenient:

$0 < E < 0.2,$	$D = 5.32 \times 10^{-6}E$
$0.2 < E < 3.0,$	$D = (-0.130 + 5.77E - 0.643E^2) \times 10^{-6}$
$3.0 < E < 5.0$	$D = (3.05 + 2.78E) \times 10^{-6}$

The calculations on which these equations are based did not cover the range between zero and 0.1 Mev. The expressions given above assume a smooth extrapolation of the curve through the origin. A recent publication by Holme and Stewart⁹ suggests that this procedure may be grossly in error for energies below 0.075 Mev.

If nuclide n emits N_1 photons of energy E_1 per disintegration, N_2 photons of energy E_2 , etc., then a total dose-rate multiplier, D_n , for the nuclide can be defined:

$$D_n = D_1N_1 + D_2N_2 + \dots$$

If the activity, A_n , of the nuclide per square centimeter is known, the contribution of the nuclide to the dose rate is D_nA_n roentgens per hour.

*Of this laboratory, private communication, June 1963.

The dose-rate multipliers listed in Appendix II are presently regarded as tentative, since a re-examination of the method of calculation indicates that it may be subject to improvement, particularly in the region of low energies.

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APPENDIX I

SUMMARY OF PHOTON ENERGIES AND ABUNDANCES

Nuclides are arranged by ascending mass number, ordered by atomic number. Metastable-state decays are summarized separately, and these states and their ground states are distinguished by numbers (e.g., As 1 and As 2, respectively). The half-life of each nuclide is stated below its identification. The source or sources of the data are quoted at the beginning of each summary. The abbreviation NDS is used for the Nuclear Data Sheets compiled and published by National Academy of Sciences-National Research Council. Other literature abbreviations follow standard practice.

The data contained in the columns is indicated by the headings, as follows:

- E(G) - Gamma energy in Mev.
- N(G) - Corresponding number of photons per disintegration. This column is totalled.
- N(K) - Corresponding number of gammas converted to X-ray photons per disintegration. This column is totalled.
- N(G)E(G) - Product of columns 1 and 2. This column is totalled.
- E(B) - End-point beta-ray energy in Mev.
- N(B) - Corresponding number of beta particles per disintegration.

Following the columns the X-ray energy, E(K), is given. The product of this energy times the total of the N(K) column is given as PRODX. The following totals are then listed:

- PH - Total photons emitted per disintegration.
- HPH - Total photons emitted per disintegration with energies greater than 0.020 Mev.
- ED - Total photon energy per disintegration (Mev/dis).
- HED - Total photon energy per disintegration (Mev/dis) counting only photons greater than 0.020 Mev.

Energies and abundances are printed out only to the third decimal place, although the computer input often carried a fourth place. For this reason, the totals and products (which were machine calculated) are not always completely consistent with the printout. The discrepancies are not important.

SOURCE... T.T. THWAITES, PHYS. REV. 129, 1778 (1963).

72 ZN 30
46.50 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.051	0.018	0.	0.001	0.246	0.090
0.100	0.009	0.	0.001	0.295	0.910
0.143	0.910	0.	0.130		
0.192	0.073	0.	0.014		
TOTAL	1.010	0.	0.146		
E(K) = 0.009MEV			PRODX = 0.		
PH = 1.010			ED = 0.146MEV/D		
HPH = 1.010			MED = 0.146MEV/D		

SOURCE... NDS 59-1-25

72 GA 31
14.10 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.950	0.001	0.	0.001	0.660	0.170
2.508	0.170	0.	0.426	0.680	0.240
2.690	0.001	0.	0.003	0.959	0.350
3.340	0.000	0.	0.001	1.508	0.070
0.440	0.015	0.	0.007	1.940	0.070
0.812	0.023	0.	0.019	2.529	0.050
1.268	0.015	0.	0.019	3.166	0.050
1.598	0.055	0.	0.088		
1.860	0.058	0.	0.108		
2.490	0.099	0.	0.247		
0.620	0.000	0.	0.000		
1.320	0.001	0.	0.001		
2.201	0.300	0.	0.660		
0.115	0.000	0.	0.000		
0.786	0.032	0.	0.025		
1.680	0.016	0.	0.027		
1.920	0.001	0.	0.002		
0.601	0.069	0.	0.041		
1.231	0.012	0.	0.015		
1.340	0.000	0.	0.000		
0.630	0.188	0.	0.118		
0.730	0.000	0.	0.000		
1.465	0.039	0.	0.057		
0.835	0.857	0.	0.716		
1.710	0.002	0.	0.003		
0.894	0.009	0.	0.008		
0.690	0.002	0.	0.001		
2.150	0.001	0.	0.001		
2.849	0.004	0.	0.011		
TOTAL	1.971	0.	2.607		
E(K) = 0.010MEV			PRODX = 0.		
PH = 1.971			ED = 2.607MEV/D		
HPH = 1.971			MED = 2.607MEV/D		

SOURCE... NDS 59-1-37

73 GE1 32
0.53 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.054	0.090	0.423	0.005		
0.013	0.	0.504	0.		
TOTAL	0.090	0.927	0.005		
E(K)= 0.010MEV			PRODX= 0.009		
PH= 1.017			ED= 0.014MEV/D		
HPH= 0.090			HED= 0.005MEV/D		

SOURCE... NDS 59-1-37

73 GA 31
4.80 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.745	0.060	0.	0.045	0.400	0.070
0.295	0.970	0.	0.286	1.190	0.910
1.040	0.010	0.	0.010	1.480	0.020
TOTAL	1.040	0.	0.341		
E(K)= 0.010MEV			PRODX= 0.		
PH= 1.040			ED= 0.341MEV/D		
HPH= 1.040			HED= 0.341MEV/D		

SOURCE... C.F. MILLER, USNRDL-TR-160, (1957).

74 ZN 30
4.50 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.700	1.000	0.	0.700	1.800	1.000
TOTAL	1.000	0.	0.700		
E(K)= 0.009MEV			PRODX= 0.		
PH= 1.000			ED= 0.700MEV/D		
HPH= 1.000			HED= 0.700MEV/D		

SOURCE... C.YTHIER ET AL.; PHYSICA 25: 694 (1959).

74 GA 31
7.80 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.495	0.098	0.	0.049	1.100	0.110
0.600	1.401	0.	0.841	1.840	0.040
0.865	0.119	0.	0.103	2.050	0.030
1.020	0.098	0.	0.100	2.270	0.100
1.100	0.077	0.	0.085	2.650	0.690
1.200	0.105	0.	0.126	4.300	0.030
1.310	0.028	0.	0.037		
1.450	0.094	0.	0.136		
1.720	0.077	0.	0.132		
1.840	0.036	0.	0.066		
1.960	0.094	0.	0.184		
2.350	0.701	0.	1.647		
2.550	0.035	0.	0.089		
2.720	0.049	0.	0.133		
2.950	0.042	0.	0.124		
3.170	0.022	0.	0.070		
3.330	0.024	0.	0.080		
3.610	0.015	0.	0.054		
TOTAL	3.115	0.	4.056		

E(K)= 0.010MEV
PH= 3.115
HPH= 3.115

PRODX= 0.
ED= 4.056MEV/D
HED= 4.056MEV/D

SOURCE... NDS 59-1-42

75 GE1 32
49.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.139	0.333	0.667	0.046		
TOTAL	0.333	0.667	0.046		

E(K)= 0.010MEV
PH= 1.000
HPH= 0.333

PRODX= 0.007
ED= 0.053MEV/D
HED= 0.046MEV/D

SOURCE... NDS 59-1-42

75 GE2 32
82.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.066	0.003	0.002	0.000	0.550	0.004
0.199	0.014	0.000	0.003	0.720	0.003
0.264	0.110	0.002	0.029	0.920	0.114
0.427	0.003	0.	0.001	0.980	0.014
0.477	0.003	0.	0.001	1.190	0.865
0.628	0.001	0.	0.001		
TOTAL	0.134	0.004	0.035		

E(K)= 0.011MEV
PH= 0.138
HPH= 0.134

PRODX= 0.000
ED= 0.035MEV/D
HED= 0.035MEV/D

SOURCE... NDS 59-5-36

76 AS 33
26.50 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.112	0.003	0.	0.006	0.300	0.006
1.454	0.002	0.	0.003	0.310	0.130
2.656	0.000	0.	0.001	0.550	0.009
2.097	0.006	0.	0.013	1.200	0.066
1.438	0.005	0.	0.007	1.750	0.036
0.869	0.001	0.	0.001	2.410	0.306
2.420	0.	0.	0.	2.970	0.564
1.860	0.000	0.	0.000		
1.200	0.009	0.	0.011		
1.789	0.003	0.	0.005		
1.229	0.010	0.	0.012		
0.560	0.054	0.	0.030		
1.216	0.043	0.	0.052		
0.657	0.063	0.	0.041		
0.559	0.392	0.	0.219		
0.760	0.004	0.	0.003		
1.400	0.001	0.	0.001		
1.530	0.001	0.	0.002		
1.630	0.000	0.	0.000		
TOTAL	0.597	0.	0.409		

E(K) = 0.011 MEV
 PH = 0.597
 HPH = 0.597

PRODX = 0.
 ED = 0.409 MEV/D
 MED = 0.409 MEV/D

SOURCE... NDS 59-3-40

77 GE1 32
54.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.159	0.190	0.170	0.030	2.700	0.180
0.215	0.180	0.	0.039	2.900	0.460
TOTAL	0.370	0.170	0.069		

E(K) = 0.011 MEV
 PH = 0.540
 HPH = 0.370

PRODX = 0.002
 ED = 0.071 MEV/D
 MED = 0.069 MEV/D

SOURCE... NOS 59-3-40

77 GE2 32
11.30 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.320	0.007	0.	0.016	0.380	0.030
1.960	0.024	0.	0.047	0.760	0.150
1.740	0.004	0.	0.007	1.200	0.110
0.920	0.058	0.	0.053	1.300	0.040
2.020	0.024	0.	0.048	1.560	0.240
1.500	0.011	0.	0.016	2.120	0.290
1.370	0.037	0.	0.051	2.270	0.140
0.800	0.108	0.	0.086		
1.080	0.072	0.	0.078		
1.190	0.037	0.	0.044		
0.709	0.108	0.	0.077		
0.563	0.180	0.	0.101		
0.632	0.108	0.	0.068		
0.416	0.252	0.	0.105		
0.368	0.158	0.	0.058		
0.153	0.	0.	0.		
0.210	0.355	0.	0.075		
0.265	0.262	0.	0.069		
0.215	0.504	0.	0.108		
TOTAL	2.309	0.	1.109		

E(K) = 0.011MEV
 PH = 2.309
 HPH = 2.309

PRODX = 0.
 ED = 1.109MEV/D
 HED = 1.109MEV/D

77

 SOURCE... H. LANGEVIN, J. PHYS. RAD. 16, 238 (1955).
 F. RASETTI AND F.C. BOOTH, PHYS. REV. 91, 1192 (1953).
 NOS 59-3-41
 C.F. MILLER, USNRDL-TR-160, (1957).
77 AS 33
38.70 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.086	0.003	0.000	0.000	0.160	0.028
0.159	0.002	0.002	0.000	0.438	0.001
0.245	0.023	0.002	0.006	0.438	0.027
0.525	0.007	0.	0.004	0.684	0.944
TOTAL	0.035	0.004	0.010		

E(K) = 0.011MEV
 PH = 0.039
 HPH = 0.035

PRODX = 0.000
 ED = 0.010MEV/D
 HED = 0.010MEV/D

SOURCE... C.F. MILLER, USNRDL-TR-160, (1957).

78 GE 32
2.10 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.450	0.990	0.010	0.445	0.900	1.000
TOTAL	0.990	0.010	0.445		

E(K) = 0.011MEV
 PH = 1.000
 HPH = 0.990

PRODX = 0.000
 ED = 0.446MEV/D
 HED = 0.445MEV/D

SOURCE... NDS 59-5-50

78 AS1 33
6.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	0.500	1.000	0.	0.500		
		1.000	0.	0.500		
	E(K)= 0.011MEV			PRODX= 0.		
	PH= 1.000			ED= 0.500MEV/D		
	HPH= 1.000			HED= 0.500MEV/D		

SOURCE... NDS 59-5-50 (DATA REFERENCED 58V05 ONLY)

78 AS2 33
91.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.615	0.420	0.	0.258	1.420	0.022
	0.695	0.155	0.	0.108	1.490	0.021
	0.830	0.079	0.	0.066	1.600	0.140
	0.990	0.025	0.	0.025	1.860	0.062
	1.100	0.029	0.	0.032	2.960	0.097
	1.210	0.042	0.	0.051	3.650	0.190
	1.310	0.108	0.	0.141	4.270	0.470
	1.490	0.021	0.	0.031		
	1.700	0.017	0.	0.029		
	1.820	0.014	0.	0.025		
	1.940	0.015	0.	0.029		
	2.050	0.010	0.	0.020		
	2.240	0.010	0.	0.022		
	2.650	0.014	0.	0.037		
TOTAL		0.959	0.	0.875		
	E(K)= 0.011MEV			PRODX= 0.		
	PH= 0.959			ED= 0.875MEV/D		
	HPH= 0.959			HED= 0.875MEV/D		

SOURCE... NDS 59-2-47

79 SE1 34
3.89 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	0.096	0.090	0.910	0.009		
		0.090	0.910	0.009		
	E(K)= 0.011MEV			PRODX= 0.010		
	PH= 1.000			ED= 0.019MEV/D		
	HPH= 0.090			HED= 0.009MEV/D		

SOURCE... NDS 59-1-64

81 SE1 34
57.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	0.103	0.104	0.896	0.011		
		0.104	0.896	0.011		
	E(K)= 0.011MEV			PRODX= 0.010		
	PH= 1.000			ED= 0.021MEV/D		
	HPH= 0.104			HED= 0.011MEV/D		

SOURCE... NDS 59-1-67

82 BR 35
35.90 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.554	0.727	0.	0.403	0.444	1.000
0.619	0.454	0.	0.281		
0.692	0.309	0.	0.216		
0.777	0.909	0.	0.706		
0.827	0.273	0.	0.226		
1.044	0.318	0.	0.332		
1.317	0.309	0.	0.407		
1.475	0.182	0.	0.268		
TOTAL	3.481	0.	2.839		

E(K) = 0.013MEV
PH = 3.481
HPH = 3.481

PRODX = 0.
ED = 2.839MEV/D
HED = 2.839MEV/D

SOURCE... NDS 59-1-77

83 SE1 34
69.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.023	0.028	0.	0.058	1.500	0.100
1.010	0.071	0.	0.072	3.400	0.900
0.850	0.014	0.	0.009		
0.350	0.009	0.	0.003		
TOTAL	0.123	0.	0.142		

E(K) = 0.012MEV
PH = 0.123
HPH = 0.123

PRODX = 0.
ED = 0.142MEV/D
HED = 0.142MEV/D

SOURCE... R.G. COCHRAN AND W.W. PRATT, PHYS. REV. 113, 852 (1959).

83 SE2 34
25.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.225	0.607	0.	0.137	0.450	0.130
0.358	0.953	0.	0.341	1.000	0.830
0.524	0.823	0.	0.431	1.700	0.040
0.712	0.347	0.	0.247		
0.833	0.563	0.	0.469		
1.058	0.217	0.	0.229		
1.309	0.347	0.	0.454		
1.880	0.217	0.	0.407		
2.294	0.130	0.	0.298		
TOTAL	4.203	0.	3.014		

E(K) = 0.012MEV
PH = 4.203
HPH = 4.203

PRODX = 0.
ED = 3.014MEV/D
HED = 3.014MEV/D

SOURCE... NDS 59-1-77

83 BR 35
2.40 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.046	0.160	0.040	0.007	0.910	0.200
0.032	1.000	0.	0.032	0.960	0.800
0.009	1.000	0.	0.009		
TOTAL	2.160	0.040	0.048		
E(K)= 0.013MEV			PRODX= 0.001		
PH= 2.200			ED= 0.049MEV/D		
MPH= 1.160			HED= 0.039MEV/D		

SOURCE... NDS 59-1-77

83 KR1 36
114.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.032	1.000	0.	0.032		
0.009	1.000	0.	0.009		
TOTAL	2.000	0.	0.041		
E(K)= 0.013MEV			PRODX= 0.		
PH= 2.000			ED= 0.041MEV/D		
MPH= 1.000			HED= 0.032MEV/D		

SOURCE... NDS 5-2-5 (DEC. 1962)

84 BR 35
32.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
3.280	0.024	0.	0.079	0.500	0.030
3.930	0.104	0.	0.410	0.830	0.190
3.030	0.030	0.	0.091	0.980	0.020
2.050	0.158	0.	0.325	1.390	0.140
0.270	0.005	0.	0.001	1.810	0.015
1.570	0.010	0.	0.015	2.800	0.150
1.210	0.032	0.	0.039	3.830	0.140
2.820	0.019	0.	0.053	4.680	0.320
2.470	0.078	0.	0.194		
2.170	0.016	0.	0.035		
0.610	0.024	0.	0.014		
1.900	0.150	0.	0.285		
0.430	0.022	0.	0.009		
1.010	0.087	0.	0.088		
0.740	0.016	0.	0.012		
0.520	0.024	0.	0.012		
0.879	0.417	0.	0.366		
0.810	0.062	0.	0.051		
0.350	0.010	0.	0.004		
1.740	0.020	0.	0.035		
1.470	0.017	0.	0.025		
0.470	0.009	0.	0.004		
TOTAL	1.335	0.	2.148		
E(K)= 0.013MEV			PRODX= 0.		
PH= 1.335			ED= 2.148MEV/D		
MPH= 1.335			HED= 2.148MEV/D		

SOURCE... NDS 60-3-35

85 KR1 36
4.40 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.305	0.135	0.055	0.041	0.824	0.810
0.149	0.778	0.032	0.116		
TOTAL	0.913	0.087	0.157		
E(K)= 0.014MEV			PRODX= 0.001		
PH= 1.000			ED= 0.159MEV/D		
HPH= 0.913			HED= 0.157MEV/D		

SOURCE... NDS 60-3-35

85 KR2 36
10.60 Y

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.514	0.010	0.	0.005	0.150	0.007
TOTAL	0.010	0.	0.005	0.672	0.990
E(K)= 0.014MEV			PRODX= 0.		
PH= 0.010			ED= 0.005MEV/D		
HPH= 0.010			HED= 0.005MEV/D		

SOURCE... NDS 60-3-45

86 RB1 37
1.04 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.550	1.000	0.	0.560		
TOTAL	1.000	0.	0.560		
E(K)= 0.014MEV			PRODX= 0.		
PH= 1.000			ED= 0.560MEV/D		
HPH= 1.000			HED= 0.560MEV/D		

SOURCE... NDS 60-3-45

86 RB2 37
18.70 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.084	0.090	0.	0.098	0.696	0.090
TOTAL	0.090	0.	0.098	1.777	0.910
E(K)= 0.014MEV			PRODX= 0.		
PH= 0.090			ED= 0.098MEV/D		
HPH= 0.090			HED= 0.098MEV/D		

SOURCE... NDS 60-3-56

87 KR 36
78.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.403	0.524	0.	0.211	1.250	0.250
0.447	0.100	0.	0.084	3.300	0.100
2.050	0.031	0.	0.064	3.800	0.650
2.570	0.220	0.	0.565		
TOTAL	0.875	0.	0.925		

E(K) = 0.014MEV
 PH = 0.875
 HPH = 0.875

PRODX = 0.
 ED = 0.925MEV/D
 HED = 0.925MEV/D

SOURCE... NDS 60-3-67

88 KR 36
2.80 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.028	0.	0.	0.	0.520	0.700
0.165	0.070	0.	0.012	0.900	0.100
0.191	0.350	0.	0.067	2.700	0.200
0.360	0.049	0.	0.018		
0.445	0.227	0.	0.192		
1.190	0.035	0.	0.042		
1.550	0.140	0.	0.217		
2.190	0.175	0.	0.383		
2.400	0.350	0.	0.840		
TOTAL	1.396	0.	1.770		

E(K) = 0.014MEV
 PH = 1.396
 HPH = 1.396

PRODX = 0.
 ED = 1.770MEV/D
 HED = 1.770MEV/D

SOURCE... NDS 60-3-67

88 RB 37
18.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.908	0.145	0.	0.132	2.500	0.140
1.390	0.014	0.	0.019	3.400	0.040
1.450	0.230	0.	0.425	5.200	0.760
2.110	0.010	0.	0.021	-0.	0.060
2.680	0.025	0.	0.067		
3.010	0.003	0.	0.010		
3.240	0.003	0.	0.010		
3.520	0.002	0.	0.009		
3.680	0.001	0.	0.003		
4.870	0.003	0.	0.016		
TOTAL	0.437	0.	0.712		

E(K) = 0.014MEV
 PH = 0.437
 HPH = 0.437

PRODX = 0.
 ED = 0.712MEV/D
 HED = 0.712MEV/D

SOURCE... M.A. WAHLGREN AND W.W. MEINKE, J. INORG. NUCL. CHEM. 24, 1527 (1962).

89 KR 36
3.20 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.215	0.310	0.	0.067		
0.275	0.130	0.	0.049		
0.430	0.130	0.	0.056		
0.510	0.190	0.	0.097		
0.595	0.390	0.	0.232		
0.730	0.150	0.	0.109		
0.880	0.230	0.	0.202		
1.120	0.190	0.	0.213		
1.320	0.130	0.	0.172		
1.520	0.270	0.	0.410		
1.670	0.120	0.	0.200		
1.720	0.051	0.	0.116		
2.050	0.100	0.	0.205		
2.230	0.054	0.	0.120		
2.350	0.099	0.	0.233		
2.620	0.031	0.	0.081		
2.720	0.022	0.	0.059		
2.950	0.071	0.	0.202		
3.020	0.035	0.	0.105		
3.180	0.043	0.	0.137		
3.380	0.060	0.	0.203		
3.560	0.043	0.	0.153		
3.720	0.043	0.	0.160		
3.920	0.037	0.	0.144		
4.050	0.014	0.	0.057		
4.160	0.010	0.	0.042		
4.310	0.010	0.	0.043		
4.580	0.005	0.	0.023		
TOTAL	2.978	0.	3.890		
E(K) = 0.014 MEV			PROD = 0.		
D4 = 2.978			ED = 3.890 MEV/D		
WD4 = 2.978			WED = 3.890 MEV/D		

SOURCE... NDS 67-7-72

89 RB 37
15.40 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.463	0.150	0.	0.099	0.400	0.020
1.050	0.750	0.	0.787	0.670	0.280
1.260	0.530	0.	0.668	1.170	0.030
1.550	0.040	0.	0.062	1.330	0.020
2.200	0.140	0.	0.308	1.610	0.530
2.590	0.130	0.	0.337	2.870	0.050
2.750	0.030	0.	0.082	3.920	0.070
3.530	0.020	0.	0.071		
TOTAL	1.790	0.	2.415		
E(K) = 0.014 MEV			PROD = 0.		
D4 = 1.790			ED = 2.415 MEV/D		
WD4 = 1.790			WED = 2.415 MEV/D		

SOURCE... M.A. WAHLGREN AND W.W. MEINKE, J. INORG. NUCL. CHEM. 24, 1527 (1962).

90 KR 36
33.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.125	0.670	0.	0.084		
0.240	0.070	0.	0.017		
0.540	0.670	0.	0.362		
1.100	0.670	0.	0.737		
1.540	0.280	0.	0.431		
1.780	0.120	0.	0.214		
TOTAL	2.480	0.	1.844		

E(K) = 0.014 MEV
PH = 2.480
HPH = 2.480

PRODX = 0.
ED = 1.844 MEV/D
HED = 1.844 MEV/D

SOURCE... NDS 60-5-70

91 SR 38
9.70 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.645	0.150	0.	0.097	0.610	0.070
0.748	0.270	0.	0.202	1.090	0.330
0.930	0.030	0.	0.028	1.360	0.290
1.025	0.300	0.	0.307	2.030	0.040
1.413	0.150	0.	0.212	2.670	0.270
TOTAL	0.900	0.	0.846		

E(K) = 0.015 MEV
PH = 0.900
HPH = 0.900

PRODX = 0.
ED = 0.846 MEV/D
HED = 0.846 MEV/D

SOURCE... NDS 60-5-70

91 Y1 39
50.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.551	0.956	0.044	0.527		
TOTAL	0.956	0.044	0.527		

E(K) = 0.015 MEV
PH = 1.000
HPH = 0.956

PRODX = 0.001
ED = 0.527 MEV/D
HED = 0.527 MEV/D

SOURCE... NDS 60-5-70

91 Y2 39
58.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.208	0.003	0.	0.004	0.330	0.003
TOTAL	0.003	0.	0.004	1.540	0.997

E(K) = 0.016 MEV
PH = 0.003
HPH = 0.003

PRODX = 0.
ED = 0.004 MEV/D
HED = 0.004 MEV/D

SOURCE... NDS 60-5-90

92 SR 38
2.70 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.230	0.035	0.	0.008	0.545	0.900
0.440	0.041	0.	0.018	1.500	0.100
1.370	0.900	0.	1.233		
TOTAL	0.976	0.	1.259		

$E(K) = 0.015 \text{ MEV}$
 $PH = 0.976$
 $HPH = 0.976$

$PRODX = 0.$
 $ED = 1.259 \text{ MEV/D}$
 $HED = 1.259 \text{ MEV/D}$

SOURCE... M.E. BUNKER ET AL.: PHYS. REV. 127: 844 (1962).

92 Y 39
3.53 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.448	0.023	0.	0.010	2.150	0.015
0.490	0.004	0.	0.002	2.260	0.023
0.560	0.026	0.	0.015	2.710	0.031
0.840	0.011	0.	0.009	1.320	0.062
0.904	0.008	0.	0.007	1.590	0.003
0.932	0.137	0.	0.128	1.810	0.008
1.120	0.002	0.	0.003		
1.395	0.047	0.	0.066		
1.830	0.004	0.	0.007		
2.060	0.000	0.	0.001		
TOTAL	0.263	0.	0.247		

$E(K) = 0.016 \text{ MEV}$
 $PH = 0.263$
 $HPH = 0.263$

$PRODX = 0.$
 $ED = 0.247 \text{ MEV/D}$
 $HED = 0.247 \text{ MEV/D}$

SOURCE... C.F. MILLER: USNRDL-TR-160: (1957).

93 SR 38
8.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.200	1.000	0.	0.200	4.600	0.100
TOTAL	1.000	0.	0.200		

$E(K) = 0.015 \text{ MEV}$
 $PH = 1.000$
 $HPH = 1.000$

$PRODX = 0.$
 $ED = 0.200 \text{ MEV/D}$
 $HED = 0.200 \text{ MEV/D}$

SOURCE... NOS 60-5-91

93 Y 39
10.10 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.430	0.000	0.	0.001	0.450	0.001
2.180	0.001	0.	0.002	0.710	0.018
2.180	0.003	0.	0.006	1.470	0.009
1.900	0.018	0.	0.034	1.950	0.030
1.420	0.007	0.	0.010	2.620	0.039
1.150	0.002	0.	0.003	2.890	0.900
0.490	0.000	0.	0.000		
0.035	0.023	0.	0.022		
0.665	0.007	0.	0.005		
0.267	0.064	0.001	0.017		
0.380	0.000	0.	0.000		
1.200	0.001	0.	0.002		
1.620	0.001	0.	0.001		
TOTAL	0.128	0.001	0.103		

E(K)= 0.016MEV
PH= 0.130
HPH= 0.128

PRODX= 0.000
ED= 0.103MEV/D
HED= 0.103MEV/D

SOURCE... NOS 60-5-92

93 NB1 41
3.70 Y

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.029	1.000	0.	0.029		
TOTAL	1.000	0.	0.029		

E(K)= 0.017MEV
PH= 1.000
HPH= 1.000

PRODX= 0.
ED= 0.029MEV/D
HED= 0.029MEV/D

SOURCE... J.D. KNIGHT, D.C. HOFFMAN, B.J. DROPSKY AND D.L. FRASCO,
J. INORG. NUCL. CHEM. 10, 197 (1959).

94 Y 39
20.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.560	0.060	0.	0.034		
0.920	0.430	0.	0.396		
1.130	0.050	0.	0.056		
1.650	0.024	0.	0.040		
1.900	0.016	0.	0.030		
2.130	0.024	0.	0.051		
2.570	0.015	0.	0.039		
2.840	0.007	0.	0.020		
3.060	0.013	0.	0.040		
3.530	0.011	0.	0.039		
TOTAL	0.650	0.	0.744		

E(K)= 0.016MEV
PH= 0.650
HPH= 0.650

PRODX= 0.
ED= 0.744MEV/D
HED= 0.744MEV/D

SOURCE... NOS 60-5-119

95 ZR 40
65.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.726	0.550	0.000	0.399	0.360	0.430
0.760	0.430	0.001	0.327	0.396	0.550
0.235	0.020	0.	0.005	0.855	0.020
				1.130	0.004
TOTAL	1.000	0.001	0.731		
E(K)= 0.017MEV			PROD= 0.000		
PH= 1.001			ED= 0.731MEV/D		
HPH= 1.000			HED= 0.731MEV/D		

SOURCE... NOS 60-5-120

95 NB1 41
90.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.235	1.000	0.	0.235		
TOTAL	1.000	0.	0.235		
E(K)= 0.017MEV			PROD= 0.		
PH= 1.000			ED= 0.235MEV/D		
HPH= 1.000			HED= 0.235MEV/D		

SOURCE... NOS 60-5-120

95 NB2 41
35.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.768	0.990	0.	0.760	0.160	0.990
TOTAL	0.990	0.	0.760	0.930	0.010
E(K)= 0.018MEV			PROD= 0.		
PH= 0.990			ED= 0.760MEV/D		
HPH= 0.990			HED= 0.760MEV/D		

SOURCE... NOS 60-3-33

96 NB 41
23.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.216	0.033	0.	0.007	0.370	0.080
0.238	0.034	0.	0.008	0.700	0.920
0.451	0.310	0.	0.140		
0.560	0.370	0.	0.207		
0.725	0.050	0.	0.036		
0.770	1.000	0.	0.770		
0.804	0.170	0.	0.137		
0.840	0.260	0.	0.218		
1.078	0.320	0.	0.345		
1.187	0.340	0.	0.404		
TOTAL	2.887	0.	2.272		
E(K)= 0.018MEV			PROD= 0.		
PH= 2.887			ED= 2.272MEV/D		
HPH= 2.887			HED= 2.272MEV/D		

SOURCE... NOS 60-6-43

97 ZR 40
17.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.020	0.010	0.	0.010	0.760	0.025
1.150	0.020	0.	0.023	1.910	0.030
1.720	0.005	0.	0.009	2.490	0.945
1.770	0.005	0.	0.009		
TOTAL	0.040	0.	0.051		

E(K)= 0.017MEV
PH= 0.040
HPH= 0.040

PRODX= 0.
ED= 0.051MEV/D
HED= 0.051MEV/D

SOURCE... NOS 60-6-43

97 NB1 41
1.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.750	0.986	0.014	0.739		
TOTAL	0.986	0.014	0.739		

E(K)= 0.017MEV
PH= 1.000
HPH= 0.986

PRODX= 0.000
ED= 0.740MEV/D
HED= 0.739MEV/D

SOURCE... NOS 60-6-43

97 NB2 41
73.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.020	0.010	0.	0.010	0.930	0.010
0.665	0.990	0.	0.658	1.267	0.990
TOTAL	1.000	0.	0.669		

E(K)= 0.018MEV
PH= 1.000
HPH= 1.000

PRODX= 0.
ED= 0.669MEV/D
HED= 0.669MEV/D

SOURCE... NOS 61-1-49

99 MO 42
66.50 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.950	0.	0.	0.	0.450	0.140
0.740	0.100	0.	0.074	0.870	0.010
0.780	0.040	0.	0.031	1.230	0.850
0.372	0.010	0.	0.004		
0.181	0.037	0.003	0.007		
0.140	0.068	0.006	0.010		
TOTAL	0.255	0.009	0.125		

E(K)= 0.019MEV
PH= 0.264
HPH= 0.255

PRODX= 0.000
ED= 0.125MEV/D
HED= 0.125MEV/D

SOURCE... NDS 61-1-49

99 TC1 43
6.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.142	0.004	0.	0.001		
0.002	0.986	0.	0.002		
0.140	0.900	0.086	0.126		
	1.890	0.086	0.129		
TOTAL			PROD= 0.002		
E(K)= 0.019MEV			ED= 0.130MEV/D		
PH= 1.976			HED= 0.127MEV/D		
HPH= 0.904					

SOURCE... NDS 61-1-63

100 TC 43
16.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.538	1.000	0.	0.538	2.200	-0.
0.600	1.000	0.	0.600	2.900	-0.
				3.370	1.000
TOTAL	2.000	0.	1.138		
E(K)= 0.023MEV			PROD= 0.		
PH= 2.000			ED= 1.138MEV/D		
HPH= 2.000			HED= 1.138MEV/D		

SOURCE... NDS 61-2-26

101 MO 42
14.60 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.080	0.030	0.	0.002	0.600	0.030
0.191	0.190	0.060	0.036	0.700	0.380
0.193	0.020	0.	0.004	0.800	0.130
0.300	0.070	0.	0.021	1.200	0.110
0.400	0.020	0.	0.008	1.600	0.250
0.510	0.160	0.	0.082	2.230	0.100
0.590	0.210	0.	0.124		
0.704	0.120	0.	0.084		
0.840	0.010	0.	0.008		
0.890	0.150	0.	0.133		
0.950	0.020	0.	0.019		
1.024	0.250	0.	0.256		
1.180	0.110	0.	0.130		
1.140	0.010	0.	0.011		
1.280	0.030	0.	0.038		
1.380	0.090	0.	0.124		
1.460	0.010	0.	0.015		
1.560	0.110	0.	0.172		
1.660	0.030	0.	0.050		
2.080	0.160	0.	0.333		
TOTAL	1.800	0.060	1.651		
E(K)= 0.019MEV			PROD= 0.001		
PH= 1.860			ED= 1.652MEV/D		
HPH= 1.800			HED= 1.651MEV/D		

SOURCE... NDS 61-2-26

101 TC 43
14.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.939	0.002	0.	0.002	1.070	0.080
0.385	0.016	0.	0.006	1.320	0.900
0.846	0.003	0.	0.003		
0.720	0.011	0.	0.008		
0.635	0.009	0.	0.006		
0.545	0.076	0.	0.041		
0.235	0.007	0.	0.002		
0.410	0.004	0.	0.002		
0.307	0.910	0.	0.279		
TOTAL	1.038	0.	0.349		

E(K)= 0.020MEV
PH= 1.038
HPH= 1.038

PRODX= 0.
ED= 0.349MEV/D
HED= 0.349MEV/D

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

102 TC1 43
4.50 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.100	1.000	0.	1.100	3.700	1.000
TOTAL	1.000	0.	1.100		

E(K)= 0.020MEV
PH= 1.000
HPH= 1.000

PRODX= 0.
ED= 1.100MEV/D
HED= 1.100MEV/D

SOURCE... NDS 61-3-62

103 RU 44
39.70 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.610	0.065	0.	0.040	0.100	0.070
0.555	0.005	0.	0.003	0.212	0.890
0.498	0.880	0.005	0.438	0.710	0.030
0.440	0.005	0.	0.002		
0.053	0.007	0.008	0.000		
TOTAL	0.952	0.013	0.483		

E(K)= 0.021MEV
PH= 0.975
HPH= 0.975

PRODX= 0.000
ED= 0.483MEV/D
HED= 0.483MEV/D

SOURCE... NDS 61-3-62

103 RH1 45
57.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.040	0.024	0.976	0.001		
TOTAL	0.024	0.976	0.001		

E(K)= 0.021MEV
PH= 1.000
HPH= 1.000

PRODX= 0.020
ED= 0.021MEV/D
HED= 0.021MEV/D

SOURCE... NDS 61-4-4

104 RH1 45
4.40 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.051	0.370	0.329	0.019	1.240	0.001
0.077	0.020	0.358	0.002		
0.096	0.020	0.	0.002		
TOTAL	0.410	0.687	0.022		
E(K)= 0.022MEV			PRODX= 0.015		
PH= 1.097			ED= 0.037MEV/D		
HPH= 1.097			HED= 0.037MEV/D		

SOURCE... NDS 61-4-4

104 RH2 45
42.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.556	0.990	0.	0.550	0.640	0.001
1.240	0.010	0.	0.012	1.880	0.018
TOTAL	1.000	0.	0.563	2.440	0.980
E(K)= 0.022MEV			PRODX= 0.		
PH= 1.000			ED= 0.563MEV/D		
HPH= 1.000			HED= 0.563MEV/D		

28

SOURCE... R.A. RICCI, S. MONARO AND R. VAN LIESHOUT, NUCL. PHYS. 16, 339 (1960).

105 RU 44
4.40 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.130	0.011	0.044	0.001	0.520	0.040
0.210	0.050	0.	0.010	0.770	0.020
0.260	0.065	0.	0.017	1.115	0.400
0.317	0.130	0.	0.041	1.180	0.500
0.400	0.070	0.	0.028	1.220	0.050
0.475	0.210	0.	0.100		
0.670	0.175	0.	0.117		
0.725	0.500	0.	0.362		
0.870	0.040	0.	0.035		
0.970	0.025	0.	0.024		
TOTAL	1.276	0.044	0.737		
E(K)= 0.021MEV			PRODX= 0.001		
PH= 1.320			ED= 0.737MEV/D		
HPH= 1.32			HED= 0.737MEV/D		

SOURCE... NDS 61-4-15

105 RH1 45
38.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.129	0.476	0.524	0.061		
TOTAL	0.476	0.524	0.061		
E(K)= 0.021MEV			PRODX= 0.011		
PH= 1.000			ED= 0.072MEV/D		
HPH= 1.000			HED= 0.072MEV/D		

SOURCE... NDS 61-4-15

105 RM2 45
36.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.322	0.097	0.003	0.031	0.250	0.100
				0.560	0.900
TOTAL	0.097	0.003	0.031		
E(K)= 0.022MEV			PROD= 0.000		
PH= 0.100			ED= 0.031MEV/D		
HPH= 0.100			MED= 0.031MEV/D		

SOURCE... O.J. SEGAERT AND J.L. DEMUYNCK, NUCL. PHYS. 16, 492 (1960).

106 RM1 45
2.20 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.220	0.121	0.	0.027	0.790	0.400
0.407	0.121	0.	0.049	0.950	0.380
0.450	0.212	0.	0.095	1.180	0.110
0.512	0.606	0.	0.310	1.620	0.100
0.620	0.200	0.	0.124		
0.735	0.285	0.	0.209		
0.820	0.242	0.	0.198		
0.950	0.021	0.	0.020		
1.055	0.176	0.	0.186		
1.140	0.085	0.	0.097		
1.225	0.115	0.	0.141		
1.560	0.127	0.	0.198		
1.740	0.012	0.	0.021		
1.860	0.012	0.	0.023		
2.120	0.006	0.	0.013		
2.280	0.003	0.	0.007		
TOTAL	2.344	0.	1.719		
E(K)= 0.022MEV			PROD= 0.		
PH= 2.344			ED= 1.719MEV/D		
HPH= 2.344			MED= 1.719MEV/D		

SOURCE... S.Y. AMBIYE AND R.P. SHARMA, NUCL. PHYS. 29, 657 (1962).

106 RM2 45
30.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.513	0.315	0.	0.162	3.550	0.672
0.624	0.139	0.	0.087	3.050	0.125
0.860	0.005	0.	0.004	2.390	0.170
1.060	0.019	0.	0.020	2.000	0.020
1.140	0.006	0.	0.007		
TOTAL	0.484	0.	0.280		
E(K)= 0.022MEV			PROD= 0.		
PH= 0.484			ED= 0.280MEV/D		
HPH= 0.484			MED= 0.280MEV/D		

SOURCE... W.R. PIERSON, H.C. GRIFFIN AND C.D. CORYELL, PHYS. REV. 127, 1708 (1962).

107 RU 44

4.60 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.195	0.143	0.	0.028	1.850	0.040
0.370	0.060	0.	0.022	2.100	0.110
0.480	0.	0.	0.	2.200	0.040
0.860	0.070	0.	0.060	2.600	0.060
0.930	0.040	0.	0.037	3.000	0.050
1.030	0.040	0.	0.041	3.200	0.740
1.290	0.040	0.	0.052		
TOTAL	0.393	0.	0.240		

E(K) = 0.021MEV
 PH = 0.393
 HPH = 0.393

PRODX = 0.
 ED = 0.240MEV/D
 HED = 0.240MEV/D

SOURCE... W.R. PIERSON, H.C. GRIFFIN AND C.D. CORYELL, PHYS. REV. 127, 1708 (1962)

107 RH2 45

22.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.115	0.005	0.	0.001	0.830	0.070
0.285	0.025	0.	0.007	0.930	0.020
0.307	0.730	0.	0.224	1.100	0.080
0.365	0.015	0.	0.005	1.200	0.710
0.390	0.107	0.	0.042	1.510	0.170
0.470	0.010	0.	0.005		
0.570	0.018	0.	0.010		
0.675	0.027	0.	0.018		
TOTAL	0.937	0.	0.312		

E(K) = 0.022MEV
 PH = 0.937
 HPH = 0.937

PRODX = 0.
 ED = 0.312MEV/D
 HED = 0.312MEV/D

SOURCE... W.R. PIERSON, H.C. GRIFFIN AND C.D. CORYELL, PHYS. REV. 127, 1708 (1962)

108 RU 44

4.30 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.165	0.280	0.	0.046	1.150	0.280
				1.320	0.720
TOTAL	0.280	0.	0.046		

E(K) = 0.021MEV
 PH = 0.280
 HPH = 0.280

PRODX = 0.
 ED = 0.046MEV/D
 HED = 0.046MEV/D

SOURCE... W.R. PIERSON, H.C. GRIFFIN AND C.D. CORYELL, PHYS. REV. 127, 1708 (1962)

108 RM 45
18.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.430	0.430	0.	0.185	3.500	0.220
0.510	0.100	0.	0.051	3.600	0.050
0.620	0.220	0.	0.136	4.100	0.170
1.520	0.051	0.	0.078	4.500	0.510
TOTAL	0.801	0.	0.450		

E(K)= 0.022MEV
PH= 0.801
HPH= 0.801

PRODX= 0.
ED= 0.450MEV/D
HED= 0.450MEV/D

SOURCE... NDS 60-2-47

109 RM1 45
50.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.110	1.000	0.	0.110		
TOTAL	1.000	0.	0.110		

E(K)= 0.021MEV
PH= 1.000
HPH= 1.000

PRODX= 0.
ED= 0.110MEV/D
HED= 0.110MEV/D

SOURCE... NDS 60-2-47

109 PD1 46
4.70 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.180	0.625	0.375	0.112		
TOTAL	0.625	0.375	0.112		

E(K)= 0.022MEV
PH= 1.000
HPH= 1.000

PRODX= 0.008
ED= 0.121MEV/D
HED= 0.121MEV/D

SOURCE... NDS 60-2-47

109 PD2 46
14.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.088	0.100	0.900	0.009	1.025	1.000
TOTAL	0.100	0.900	0.009		

E(K)= 0.023MEV
PH= 1.000
HPH= 1.000

PRODX= 0.020
ED= 0.029MEV/D
HED= 0.029MEV/D

SOURCE... NDS 60-2-47

109 AG1 47
39.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.088	0.046	0.436	0.004		
TOTAL	0.046	0.436	0.004		

E(K)= 0.023MEV
PH= 0.482
HPH= 0.482

PRODX= 0.010
ED= 0.014MEV/D
HED= 0.014MEV/D

SOURCE... S.F. ECCLES, PHYSICA 28, 251 (1962).

111 PD1 46
5.50 H

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	0.170	0.300	0.380	0.051		
		0.300	0.380	0.051		
	E(K)= 0.022MEV			PROD= 0.008		
	PH= 0.680			ED= 0.059MEV/D		
	HPH= 0.680			HED= 0.059MEV/D		

SOURCE... S.F. ECCLES, PHYSICA 28, 251 (1962).

111 PD2 46
23.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.067	0.036	0.	0.002		
	0.108	0.007	0.	0.001		
	0.129	0.011	0.	0.001		
	0.148	0.019	0.	0.003		
	0.293	0.009	0.	0.003		
	0.367	0.011	0.	0.004		
	0.395	0.046	0.	0.018		
	0.435	0.019	0.	0.008		
	0.479	0.010	0.	0.005		
	0.523	0.015	0.	0.008		
	0.584	0.027	0.	0.016		
	0.650	0.033	0.	0.021		
	0.727	0.017	0.	0.012		
	0.828	0.011	0.	0.009		
	0.865	0.004	0.	0.004		
	0.963	0.002	0.	0.002		
	1.030	0.004	0.	0.004		
	1.140	0.009	0.	0.010		
	1.220	0.003	0.	0.004		
	1.315	0.003	0.	0.004		
	1.400	0.004	0.	0.005		
	1.600	0.001	0.	0.002		
	1.690	0.008	0.	0.014		
	1.780	0.004	0.	0.006		
	1.990	0.003	0.	0.007		
TOTAL		0.317	0.	0.175		
	E(K)= 0.023MEV			PROD= 0.		
	PH= 0.317			ED= 0.175MEV/D		
	HPH= 0.317			HED= 0.175MEV/D		

SOURCE... NDS 60-2-79

111 AG1 47
74.00 S

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	0.065	1.000	0.	0.065		
		1.000	0.	0.065		
	E(K)= 0.023MEV			PROD= 0.		
	PH= 1.000			ED= 0.065MEV/D		
	HPH= 1.000			HED= 0.065MEV/D		

SOURCE... NDS 60-2-79

111 AG2 47
7.60 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.247	0.011	0.001	0.003	0.690	0.062
0.342	0.060	0.001	0.021	0.790	0.011
0.095	0.001	0.	0.000	1.050	0.927
TOTAL	0.072	0.002	0.023		

E(K)= 0.024MEV
 PH= 0.074
 MPH= 0.074

PRODX= 0.000
 ED= 0.023MEV/D
 HED= 0.023MEV/D

SOURCE... NDS 60-2-89

112 PD 46
21.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.018	0.200	0.800	0.004	0.280	1.000
TOTAL	0.200	0.800	0.004		

E(K)= 0.023MEV
 PH= 1.000
 MPH= 0.800

PRODX= 0.018
 ED= 0.022MEV/D
 HED= 0.018MEV/D

SOURCE... NDS 60-2-90

112 AG 47
3.20 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.950	0.001	0.	0.002	0.460	2.570
3.280	0.000	0.	0.001	0.750	2.630
3.100	0.000	0.	0.001	0.920	2.730
1.810	0.008	0.	0.014	1.220	3.420
2.830	0.006	0.	0.017	1.340	4.040
2.240	0.008	0.	0.018	1.500	0.018
1.490	0.012	0.	0.018	1.610	0.020
2.710	0.004	0.	0.011	1.780	0.044
2.110	0.032	0.	0.068	2.010	0.053
2.540	0.010	0.	0.025	2.200	0.006
1.930	0.008	0.	0.015	2.570	0.016
1.810	0.008	0.	0.014	2.630	0.009
1.090	0.012	0.	0.013	2.730	0.028
1.620	0.032	0.	0.052	3.420	0.180
0.980	0.012	0.	0.012	4.040	0.560
1.400	0.053	0.	0.074		
1.210	0.006	0.	0.007		
0.855	0.016	0.	0.014		
0.785	0.009	0.	0.007		
1.310	0.014	0.	0.018		
0.690	0.045	0.	0.031		
0.615	0.400	0.	0.246		
TOTAL	0.696	0.	0.679		

E(K)= 0.024MEV
 PH= 0.696
 MPH= 0.696

PRODX= 0.
 ED= 0.679MEV/D
 HED= 0.679MEV/D

SOURCE... NOS 60-3-104

115 CD1 48
43.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.485	0.003	0.	0.001	0.200	0.003
1.300	0.010	0.	0.013	0.335	0.010
0.935	0.023	0.	0.022	0.687	0.020
				1.630	0.967
TOTAL	0.036	0.	0.036		
E(K)= 0.025MEV			PRODX= 0.		
PH= 0.036			ED= 0.036MEV/D		
HPH= 0.036			HED= 0.036MEV/D		

SOURCE... NOS 60-3-104

115 CD2 48
53.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.523	0.240	0.	0.126	0.590	0.244
0.260	0.002	0.	0.001	0.630	0.126
0.033	0.002	0.	0.000	0.850	0.009
0.490	0.122	0.	0.060	1.110	0.621
0.230	0.006	0.	0.001		
0.260	0.017	0.	0.004		
TOTAL	0.389	0.	0.192		
E(K)= 0.025MEV			PRODX= 0.		
PH= 0.389			ED= 0.192MEV/D		
HPH= 0.389			HED= 0.192MEV/D		

SOURCE... NOS 60-3-104

115 IN1 49
4.51 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.335	0.516	0.361	0.173	0.840	0.055
TOTAL	0.516	0.361	0.173		
E(K)= 0.025MEV			PRODX= 0.009		
PH= 0.877			ED= 0.182MEV/D		
HPH= 0.877			HED= 0.182MEV/D		

SOURCE... NOS 60-3-117

116 AG 47
2.50 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.700	1.000	0.	0.700	5.000	1.000
0.517	1.000	0.	0.517		
TOTAL	2.000	0.	1.217		
E(K)= 0.024MEV			PRODX= 0.		
PH= 2.000			ED= 1.217MEV/D		
HPH= 2.000			HED= 1.217MEV/D		

SOURCE... C.F. MILLER, USNDPDL-TR-160, (1957).

117 CD1 48
3.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.281	0.570	0.280	0.160	-0.	-0.
0.430	0.120	0.030	0.052		
0.440	0.140	0.010	0.118		
1.270	0.700	0.	0.889		
1.550	0.150	0.	0.232		
TOTAL	1.680	0.320	1.451		
E(K) = 0.024MEV			PROD = 0.008		
PH = 2.000			ED = 1.458MEV/D		
HPH = 2.000			HED = 1.458MEV/D		

SOURCE... NDS 60-3-131

117 IN1 49
2.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.710	0.087	0.113	0.027	0.950	0.040
0.822	0.020	0.	0.016	1.620	0.230
0.622	0.020	0.	0.012	1.770	0.530
0.161	0.221	0.029	0.036		
TOTAL	0.348	0.142	0.091		
E(K) = 0.025MEV			PROD = 0.004		
PH = 0.490			ED = 0.095MEV/D		
HPH = 0.490			HED = 0.095MEV/D		

SOURCE... NDS 60-3-131

117 IN2 49
45.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.565	1.000	0.	0.565	0.740	1.000
0.161	0.885	0.115	0.142		
TOTAL	1.885	0.115	0.707		
E(K) = 0.026MEV			PROD = 0.003		
PH = 2.000			ED = 0.710MEV/D		
HPH = 2.000			HED = 0.710MEV/D		

SOURCE... NDS 60-3-131

117 SN1 50
4.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.161	0.885	0.115	0.142		
0.159	0.310	0.690	0.049		
TOTAL	1.195	0.805	0.192		
E(K) = 0.026MEV			PROD = 0.021		
PH = 2.000			ED = 0.213MEV/D		
HPH = 2.000			HED = 0.213MEV/D		

SOURCE... NOS 60-3-140

118 IN2 49
5.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.220	0.200	0.	0.244	3.300	0.200
				4.500	0.800
TOTAL	0.200	0.	0.244		
E(K) = 0.026MEV			PROD = 0.		
PH = 0.200			ED = 0.244MEV/D		
HPH = 0.200			HED = 0.244MEV/D		

SOURCE... C.E. GLEIT AND C.D. CORYELL; PHYS. REV. 124, 1914 (1961).

119 IN1 49
18.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.300	0.023	0.017	0.007	2.700	0.400
0.907	0.050	0.	0.045	2.700	0.500
				1.800	0.050
TOTAL	0.073	0.017	0.052		
E(K) = 0.026MEV			PROD = 0.000		
PH = 0.090			ED = 0.053MEV/D		
HPH = 0.090			HED = 0.053MEV/D		

SOURCE... C.E. GLEIT AND C.D. CORYELL; PHYS. REV. 124, 1914 (1961).

119 IN2 49
2.00 "

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.796	0.950	0.	0.756	1.600	1.000
0.731	0.050	0.	0.037		
0.024	0.050	0.	0.001		
TOTAL	1.050	0.	0.794		
E(K) = 0.026MEV			PROD = 0.		
PH = 1.050			ED = 0.794MEV/D		
HPH = 1.050			HED = 0.794MEV/D		

SOURCE... C.E. GLEIT AND C.D. CORYELL; PHYS. REV. 124, 1914 (1961).

119 SN1 50
245.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.024	0.120	0.880	0.003		
			0.003		
TOTAL	0.120	0.880	0.003		
E(K) = 0.026MEV			PROD = 0.023		
PH = 1.000			ED = 0.026MEV/D		
HPH = 1.000			HED = 0.026MEV/D		

SOURCE... C.F. MILLER, USNRDL-TR-160, (1957).

120 CD 48
12.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(P) (MEV)	N(B)
	0.500	1.000	0.	0.500	1.900	1.000
TOTAL		1.000	0.	0.500		
E(K)= 0.025MEV				PRODX= 0.		
PH= 1.000				ED= 0.500MEV/D		
HPH= 1.000				HED= 0.500MEV/D		

SOURCE... NDS 60-4-74

121 IN2 49
30.00 S

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(P) (MEV)	N(B)
	0.940	1.000	0.	0.940	2.900	1.000
TOTAL		1.000	0.	0.940		
E(K)= 0.026MEV				PRODX= 0.		
PH= 1.000				ED= 0.940MEV/D		
HPH= 1.000				HED= 0.940MEV/D		

SOURCE... E.DEP MATEOSIAN AND M.L. SFHGALE, PHYS. REV. 125, 1615 (1962).

122 SR1 51
3.50 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(P) (MEV)	N(B)
	0.075	0.244	0.756	0.018		
	0.051	0.532	0.468	0.032		
TOTAL		0.776	1.224	0.051		
E(K)= 0.027MEV				PRODX= 0.033		
PH= 2.070				ED= 0.084MEV/D		
HPH= 2.000				HED= 0.084MEV/D		

SOURCE... NDS 60-4-85

122 SR2 51
2.80 D

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(P) (MEV)	N(B)
	0.564	0.664	0.003	0.374	0.740	0.040
	0.586	0.033	0.	0.002	1.400	0.629
	1.258	0.001	0.	0.001	1.970	0.330
TOTAL		0.668	0.003	0.377		
E(K)= 0.028MEV				PRODX= 0.000		
PH= 0.671				ED= 0.378MEV/D		
HPH= 0.671				HED= 0.378MEV/D		

SOURCE... NDS 60-6-23

123 IN2 49
10.00 S

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(P) (MEV)	N(B)
	1.100	1.000	0.	1.100	3.300	1.000
TOTAL		1.000	0.	1.100		
E(K)= 0.026MEV				PRODX= 0.		
PH= 1.000				ED= 1.100MEV/D		
HPH= 1.000				HED= 1.100MEV/D		

SOURCE... NDS 60-6-63

123 SN1 50
125.00 0

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.080	0.020	0.	0.022	0.340	0.020
				1.420	0.980
TOTAL	0.020	0.	0.022		
E(K)= 0.027MEV		PRODX= 0.			
PM= 0.020		ED= 0.022MEV/D			
HPM= 0.020		HED= 0.022MEV/D			

SOURCE... NDS 60-6-63

123 SN2 50
41.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.160	0.885	0.115	0.142	1.260	1.000
	0.985	0.115	0.142		
TOTAL			0.003		
E(K)= 0.027MEV		PRODX= 0.003			
PM= 1.000		ED= 0.145MEV/D			
HPM= 1.000		HED= 0.145MEV/D			

SOURCE... NDS 60-6-76

124 SB2 51
60.00 0

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.603	0.976	0.001	0.589	0.051	0.020
0.645	0.072	0.000	0.046	0.225	0.110
0.714	0.037	0.000	0.026	0.621	0.510
0.722	0.105	0.000	0.076	0.954	0.050
0.970	0.020	0.	0.019	1.016	0.015
1.050	0.020	0.	0.021	1.590	0.050
1.298	0.012	0.	0.016	2.313	0.230
1.320	0.020	0.	0.026		
1.366	0.030	0.	0.041		
1.450	0.020	0.	0.029		
1.500	0.010	0.	0.015		
1.540	0.006	0.	0.009		
1.690	0.480	0.000	0.811		
1.900	0.004	0.	0.008		
2.090	0.063	0.	0.132		
2.260	0.006	0.	0.014		
TOTAL	1.880	0.002	1.877		
E(K)= 0.028MEV		PRODX= 0.000			
PM= 1.982		ED= 1.877MEV/D			
HPM= 1.882		HED= 1.877MEV/D			

SOURCE... NDS 60-6-91

125 SN1 50
9.7C M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.126	0.997	0.	0.325	0.650	0.022
0.640	0.003	0.	0.002	2.040	0.978
1.070	0.003	0.	0.003		
1.190	0.019	0.	0.026		
TOTAL	1.022	0.	0.356		

E(K) = 0.027MEV
PH = 1.022
HGH = 1.022

PROD = 0.
ED = 0.356MEV/D
HED = 0.356MEV/D

SOURCE... NDS 60-6-91

125 SN2 50
9.40 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.230	0.	0.	0.	0.230	-0.
0.342	0.004	0.	0.001	0.370	0.021
0.465	0.005	0.	0.002	0.470	0.015
0.811	0.010	0.	0.008	0.930	0.001
0.904	0.009	0.	0.008	1.300	0.013
1.068	0.036	0.	0.038	2.330	0.950
1.410	0.001	0.	0.001		
1.970	0.012	0.	0.024		
TOTAL	0.077	0.	0.083		

E(K) = 0.027MEV
PH = 0.077
HGH = 0.077

PROD = 0.
ED = 0.083MEV/D
HED = 0.083MEV/D

SOURCE... NDS 60-6-91

125 SB 51
2.00 Y

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.035	0.064	0.700	0.002	0.090	0.019
0.110	0.	0.210	0.	0.105	0.007
0.109	0.040	0.	0.004	0.118	0.060
0.125	0.	0.	0.	0.124	0.307
0.171	0.003	0.	0.001	0.233	0.010
0.176	0.068	0.011	0.012	0.295	0.404
0.203	0.002	0.	0.000	0.437	0.058
0.206	0.003	0.	0.001	0.612	0.134
0.255	0.015	0.	0.004		
0.290	0.015	0.	0.004		
0.319	0.008	0.	0.003		
0.379	0.012	0.	0.005		
0.427	0.310	0.	0.132		
0.462	0.100	0.	0.046		
0.598	0.190	0.	0.114		
0.604	0.052	0.	0.031		
0.633	0.110	0.	0.070		
0.652	0.007	0.	0.005		
0.668	0.016	0.	0.011		
TOTAL	1.015	0.921	0.444		

E(K) = 0.028MEV
PH = 1.936
HGH = 1.936

PROD = 0.026
ED = 0.470MEV/D
HED = 0.470MEV/D

SOURCE... NDS 60 5-91

125 TE1 52
58.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.035	0.081	0.919	0.003		
0.110	0.006	0.994	0.001		
TOTAL	0.087	1.913	0.004		
E(K)= 0.028MEV			PRODX= 0.054		
PH= 2.000			ED= 0.057MEV/D		
HPH= 2.000			HED= 0.057MEV/D		

SOURCE... NDS 60-6-104

126 SB2 51
12.50 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.415	1.000	0.	0.415	1.900	1.000
0.695	1.000	0.	0.695		
0.665	1.000	0.	0.665		
TOTAL	3.000	0.	1.775		
E(K)= 0.028MEV			PRODX= 0.		
PH= 3.000			ED= 1.775MEV/D		
HPH= 3.000			HED= 1.775MEV/D		

SOURCE... C.F. MILLER, USNRDL-TR-167, (1957).

127 SN 50
2.60 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.500	1.000	0.	0.500	3.000	1.000
TOTAL	1.000	0.	0.500		
E(K)= 0.027MEV			PRODX= 0.		
PH= 1.000			ED= 0.500MEV/D		
HPH= 1.000			HED= 0.500MEV/D		

SOURCE... NDS 61-1-72

127 SB 51
91.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.060	0.040	0.	0.002	0.800	0.350
0.248	0.140	0.	0.035	0.860	0.100
0.310	0.060	0.	0.019	1.110	0.350
0.463	0.540	0.	0.250	1.500	0.200
0.772	0.240	0.	0.185		
TOTAL	1.020	0.	0.491		
E(K)= 0.028MEV			PRODX= 0.		
PH= 1.020			ED= 0.491MEV/D		
HPH= 1.020			HED= 0.491MEV/D		

SOURCE... NOS 61-1-72

127 TE1 52
105.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.089	0.985	0.	0.087	0.054	0.000
0.059	0.015	0.	0.001		
0.665	0.000	0.	0.000		
TOTAL	1.000	0.	0.088		

E(K) = 0.029 MEV
 PH = 1.000
 HPH = 1.000
 PRODX = 0.
 ED = 0.088 MEV/D
 HED = 0.088 MEV/D

SOURCE... NOS 61-1-72

127 TE2 52
9.30 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.412	0.008	0.	0.003	0.270	0.010
0.767	0.001	0.	0.000	0.695	0.990
0.215	0.000	0.	0.000		
0.059	0.001	0.002	0.000		
0.203	0.000	0.	0.000		
0.145	0.	0.	0.		
TOTAL	0.012	0.002	0.004		

E(K) = 0.020 MEV
 PH = 0.014
 HPH = 0.014
 PRODX = 0.000
 ED = 0.004 MEV/D
 HED = 0.004 MEV/D

SOURCE... P. DEL MARMOLE AND J. COLLARD, NUCL. PHYS. 36, 109 (1962).

128 SN 50
57.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.044	0.070	0.126	0.003	0.730	-0.
0.072	0.181	0.094	0.013	0.800	-0.
0.497	0.500	0.	0.297		
0.570	0.216	0.	0.123		
TOTAL	1.065	0.210	0.436		

E(K) = 0.027 MEV
 PH = 1.275
 HPH = 1.275
 PRODX = 0.006
 ED = 0.442 MEV/D
 HED = 0.442 MEV/D

SOURCE... P. DEL MARMOLE AND J. COLLARD, NUCL. PHYS. 36, 109 (1962).

128 SB1 51
11.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.320	0.810	0.	0.259	2.450	0.850
0.754	1.960	0.	1.478	-0.	0.150
1.074	0.040	0.	0.043		
TOTAL	2.810	0.	1.780		

E(K) = 0.028 MEV
 PH = 2.810
 HPH = 2.810
 PRODX = 0.
 ED = 1.780 MEV/D
 HED = 1.780 MEV/D

SOURCE... NDS 61-1-93

128 I 53
25.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.445	0.172	0.	0.077	1.130	0.020
0.750	0.002	0.	0.001	1.670	0.155
0.540	0.017	0.	0.009	2.120	0.760
0.990	0.003	0.	0.003		
TOTAL	0.194	0.	0.090		

E(K)= 0.030MEV
 PH= 0.194
 MPH= 0.194
 PRODX= 0.
 ED= 0.090MEV/D
 MED= 0.090MEV/D

SOURCE... C.F. MILLER, USNRDL-TR-160, (1957).

129 SB 51
4.60 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.165	0.580	0.170	0.096	1.250	0.250
0.308	0.550	0.	0.169	1.560	0.550
0.534	1.000	0.	0.534	1.870	0.200
0.788	0.250	0.	0.197		
TOTAL	2.380	0.170	0.996		

E(K)= 0.029MEV
 PH= 2.550
 MPH= 2.550
 PRODX= 0.005
 ED= 1.001MEV/D
 MED= 1.001MEV/D

SOURCE... NDS 61-1-96

129 TE1 52
37.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.106	0.050	0.950	0.005		
TOTAL	0.050	0.950	0.005		

E(K)= 0.028MEV
 PH= 1.000
 MPH= 1.000
 PRODX= 0.027
 ED= 0.032MEV/D
 MED= 0.032MEV/D

SOURCE... W.E. GRAVES AND A.C.G. MITCHELL, PHYS. REV. 101, 701 (1956).

129 TE2 52
72.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.120	0.104	0.	0.116	0.290	-0.
0.720	0.037	0.	0.027	0.690	0.037
0.210	0.	0.	0.	0.989	0.154
0.475	0.154	0.	0.073	1.453	0.705
0.027	0.963	0.	0.026		
TOTAL	1.258	0.	0.242		

E(K)= 0.029MEV
 PH= 1.258
 MPH= 1.258
 PRODX= 0.
 ED= 0.242MEV/D
 MED= 0.242MEV/D

SOURCE... NOS 61-1-96

129 XE1 54
8.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.196	0.083	0.917	0.016		
0.040	0.118	0.882	0.005		
TOTAL	0.201	1.799	0.021		
E(K) = 0.030MEV			PRODX = 0.055		
PH = 2.000			ED = 0.076MEV/D		
HPH = 2.000			HED = 0.076MEV/D		

SOURCE... NOS 59-3-52

130 1 53
12.50 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.150	0.255	0.	0.293	0.600	0.470
0.410	0.205	0.003	0.084	1.020	0.530
0.740	0.536	0.002	0.397	1.760	0.002
0.660	0.606	0.002	0.400		
0.530	0.636	0.004	0.337		
TOTAL	2.238	0.011	1.511		
E(K) = 0.030MEV			PRODX = 0.000		
PH = 2.249			ED = 1.511MEV/D		
HPH = 2.249			HED = 1.511MEV/D		

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

131 SB 51
23.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.600	1.000	0.	0.600	3.000	1.000
TOTAL	1.000	0.	0.600		
E(K) = 0.028MEV			PRODX = 0.		
PH = 1.000			ED = 0.600MEV/D		
HPH = 1.000			HED = 0.600MEV/D		

SOURCE... NDS 61-2-48

131 TE1 52
30.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.240	0.006	0.	0.013	0.215	0.036
0.240	0.030	0.	0.007	0.420	0.430
2.000	0.040	0.	0.080	0.570	0.310
1.220	0.170	0.	0.207	2.457	0.038
1.080	0.050	0.	0.054		
0.080	0.040	0.083	0.003		
1.920	0.020	0.	0.038		
0.100	0.080	0.098	0.008		
0.200	0.080	0.	0.016		
1.140	0.285	0.	0.325		
0.335	0.160	0.	0.054		
1.620	0.030	0.	0.049		
0.840	0.400	0.001	0.336		
0.920	0.050	0.	0.046		
0.780	0.800	0.001	0.624		
0.182	0.	0.190	0.		
TOTAL	2.241	0.372	1.861		

E(K)= 0.029MEV
 PH= 2.613
 HPH= 2.613

PRODX= 0.011
 ED= 1.872MEV/D
 HED= 1.872MEV/D

SOURCE... NDS 61-2-48

131 TE2 52
24.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.130	0.100	0.	0.113	1.150	0.100
0.985	0.	0.	0.	1.360	0.050
0.920	0.050	0.	0.046	1.680	0.250
0.600	0.050	0.	0.030	2.140	0.600
0.454	0.200	0.	0.091		
0.145	0.800	0.208	0.116		
TOTAL	1.200	0.208	0.396		

E(K)= 0.029MEV
 PH= 1.408
 HPH= 1.408

PRODX= 0.006
 ED= 0.402MEV/D
 HED= 0.402MEV/D

SOURCE... NDS 61-2-49

131 I 53
8.05 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.724	0.028	0.	0.020	0.250	0.028
0.538	0.091	0.	0.058	0.330	0.091
0.177	0.	0.	0.	0.606	0.875
0.364	0.810	0.015	0.295	0.810	0.007
0.284	0.055	0.003	0.016		
0.136	0.010	0.	0.002		
0.210	0.010	0.	0.002		
0.164	0.007	0.	0.001		
0.050	0.063	0.109	0.005		
TOTAL	1.074	0.127	0.399		

E(K) = 0.030MEV
PH = 1.2^1
HPH = 1.201

PRODX = 0.004
ED = 0.403MEV/D
HED = 0.403MEV/D

SOURCE... NDS 61-2-49

131 Xe1 54
12.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.164	0.033	0.967	0.005		
TOTAL	0.033	0.967	0.005		

E(K) = 0.030MEV
PH = 1.000
HPH = 1.000

PRODX = 0.029
ED = 0.035MEV/D
HED = 0.035MEV/D

SOURCE... NDS 61-2-69

132 TE 52
78.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.233	0.935	0.065	0.218	0.220	1.000
0.052	0.160	0.840	0.008		
TOTAL	1.095	0.905	0.226		

E(K) = 0.029MEV
PH = 2.000
HPH = 2.000

PRODX = 0.026
ED = 0.253MEV/D
HED = 0.253MEV/D

SOURCE... NDS 61-2-69

132 I 53
2.30 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.240	0.013	0.	0.003	0.800	0.210
0.375	0.046	0.	0.017	1.040	0.150
0.460	0.022	0.	0.010	1.220	0.120
0.523	0.190	0.	0.099	1.490	0.120
0.624	0.052	0.	0.032	1.610	0.210
0.647	0.090	0.	0.058	2.140	0.180
0.650	0.170	0.	0.110	2.280	0.
0.670	0.990	0.	0.663	2.920	0.000
0.720	0.065	0.	0.047		
0.775	0.820	0.	0.635		
0.950	0.190	0.	0.180		
1.142	0.045	0.	0.051		
1.300	0.031	0.	0.040		
1.400	0.083	0.	0.116		
1.450	0.014	0.	0.020		
1.500	0.018	0.	0.027		
1.650	0.007	0.	0.012		
1.750	0.004	0.	0.007		
1.910	0.009	0.	0.017		
1.990	0.010	0.	0.020		
2.070	0.007	0.	0.014		
2.180	0.002	0.	0.004		
2.350	0.001	0.	0.003		
2.420	0.001	0.	0.004		
2.540	0.001	0.	0.002		
2.630	0.000	0.	0.001		
2.800	0.000	0.	0.000		
TOTAL	2.882	0.	2.197		

E(K) = 0.030MEV
 PH = 2.882
 MPH = 2.882

PRODX = 0.
 ED = 2.197MEV/D
 HED = 2.197MEV/D

SOURCE... NDS 61-2-86

133 TE1 52
52.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.334	0.041	0.089	0.014	1.300	0.700
0.309	0.207	0.	0.064	2.400	0.170
0.387	0.057	0.	0.022		
0.432	0.500	0.	0.216		
0.468	0.220	0.	0.103		
0.557	0.350	0.	0.195		
0.632	0.180	0.	0.114		
0.698	0.240	0.	0.168		
0.754	0.850	0.	0.641		
0.910	0.570	0.	0.519		
0.973	0.100	0.	0.097		
TOTAL	3.315	0.089	2.152		

E(K) = 0.028MEV
 PH = 3.404
 MPH = 3.404

PRODX = 0.002
 ED = 2.154MEV/D
 HED = 2.154MEV/D

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

133 TE2 52
2.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.800	1.000	0.	0.800	1.300	0.700
1.100	0.700	0.	0.770	2.400	0.300
TOTAL	1.700	0.	1.570		
E(K) = 0.029MEV			PRODX = 0.		
PH = 1.700			ED = 1.570MEV/D		
HPH = 1.700			HED = 1.570MEV/D		

SOURCE... C.F. MILLER; USNRDL-TP-160; (1957).

133 I 53
20.80 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.430	0.980	0.	0.519	0.490	0.070
0.850	0.050	0.	0.042	1.340	0.930
1.380	0.020	0.	0.028		
TOTAL	1.050	0.	0.589		
E(K) = 0.030MEV			PRODX = 0.		
PH = 1.050			ED = 0.589MEV/D		
HPH = 1.050			HED = 0.589MEV/D		

SOURCE... NDS 61-2-84

133 XE1 54
2.30 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.233	0.184	0.816	0.043		
TOTAL	0.184	0.816	0.043		
E(K) = 0.030MEV			PRODX = 0.025		
PH = 1.000			ED = 0.068MEV/D		
HPH = 1.000			HED = 0.068MEV/D		

SOURCE... NDS 61-2-84

133 XE2 54
5.27 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.380	0.	0.	0.	0.046	0.000
0.302	0.000	0.	0.000	0.268	0.001
0.160	0.001	0.	0.000	0.347	0.990
0.079	0.008	0.	0.001		
0.081	0.410	0.590	0.033		
TOTAL	0.419	0.590	0.034		
E(K) = 0.032MEV			PRODX = 0.019		
PH = 1.009			ED = 0.053MEV/D		
HPH = 1.009			HED = 0.053MEV/D		

SOURCE... C.F. MILLER: USNRDL-TR-160, (1957).

134 TE 52
42.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	1.500	1.000	0.	1.500	0.300	1.000
TOTAL		1.000	0.	1.500		
	E(K)= 0.292MEV			PROD= 0.		
	PH= 1.000			ED= 1.500MEV/D		
	HPH= 1.000			HED= 1.500MEV/D		

SOURCE... NDS 61-2-97

134 I 53
53.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.140	0.030	0.	0.004	0.500	0.065
	0.180	0.	0.	0.	1.050	0.010
	0.210	0.044	0.	0.009	1.250	0.230
	0.270	0.	0.	0.	1.490	0.150
	0.320	0.	0.	0.	1.680	0.075
	0.390	0.070	0.	0.027	1.810	0.095
	0.410	0.005	0.	0.002	2.210	0.120
	0.430	0.030	0.	0.013	2.410	0.250
	0.510	0.010	0.	0.005		
	0.540	0.080	0.	0.043		
	0.610	0.180	0.	0.110		
	0.690	0.070	0.	0.048		
	0.750	0.010	0.	0.007		
	0.770	0.060	0.	0.046		
	0.848	0.950	0.	0.806		
	0.860	0.045	0.	0.039		
	0.890	0.055	0.	0.049		
	0.890	0.650	0.	0.572		
	0.960	0.020	0.	0.019		
	1.000	0.045	0.	0.045		
	1.070	0.030	0.	0.032		
	1.070	0.150	0.	0.160		
	1.150	0.095	0.	0.109		
	1.280	0.016	0.	0.020		
	1.340	0.017	0.	0.023		
	1.460	0.035	0.	0.051		
	1.490	0.010	0.	0.015		
	1.620	0.050	0.	0.081		
	1.790	0.050	0.	0.089		
TOTAL		2.807	0.	2.433		
	E(K)= 0.030MEV			PROD= 0.		
	PH= 2.807			ED= 2.433MEV/D		
	HPH= 2.807			HED= 2.433MEV/D		

SOURCE... NDS 61-2-97

134 CS1 55
2.90 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.127	0.682	0.310	0.087	0.550	0.010
0.137	0.008	0.	0.001		
0.010	0.	0.992	0.		
TOTAL	0.690	1.302	0.088		
E(K)= 0.033MEV			PRODX= 0.043		
PH= 1.992			ED= 0.131MEV/D		
HPH= 1.992			HED= 0.131MEV/D		

SOURCE... NDS 61-2-97

134 CS2 55
2.20 Y

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.365	0.050	0.	0.068	0.086	0.270
0.802	0.105	0.	0.084	0.282	0.025
0.569	0.115	0.	0.065	0.410	0.090
1.038	0.050	0.	0.052	0.658	0.610
0.475	0.040	0.	0.019	0.892	0.015
1.570	0.001	0.	0.002	1.453	0.002
0.060	0.005	0.	0.005		
0.797	0.725	0.	0.578		
1.168	0.025	0.	0.029		
0.563	0.140	0.	0.079		
0.605	0.974	0.006	0.589		
TOTAL	2.230	0.006	1.570		
E(K)= 0.033MEV			PRODX= 0.000		
PH= 2.236			ED= 1.570MEV/D		
HPH= 2.236			HED= 1.570MEV/D		

SOURCE... NDS 61-2-113, NDS 61-2-116

135 53
6.70 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.420	0.144	0.	0.060	0.470	0.035
0.533	0.277	0.	0.148	1.000	0.040
0.620	0.416	0.	0.258	1.400	0.250
0.700	0.194	0.	0.136		
0.851	0.116	0.	0.099		
1.040	0.198	0.	0.206		
1.140	0.532	0.	0.606		
1.270	0.554	0.	0.704		
1.470	0.198	0.	0.291		
1.690	0.256	0.	0.433		
1.800	0.183	0.	0.329		
TOTAL	3.068	0.	3.270		
E(K)= 0.030MEV			PRODX= 0.		
PH= 3.068			ED= 3.270MEV/D		
HPH= 3.068			HED= 3.270MEV/D		

SOURCE... NOS 61-2-113

135 XE1 5A
15.30

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	0.528	0.830	0.170	0.438		
		0.830	0.170	0.438		
	E(K)= 0.030MEV			PROD= 0.005		
	PH= 1.000			ED= 0.443MEV/D		
	HPH= 1.000			HED= 0.443MEV/D		

SOURCE... NOS 61-2-113

135 XE2 5A
9.20 H

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	0.604	0.030	0.	0.018	0.550	0.030
	0.360	0.001	0.	0.000	0.910	0.970
	0.250	0.970	0.052	0.242		
		1.001	0.052	0.261		
	E(K)= 0.032MEV			PROD= 0.002		
	PH= 1.053			ED= 0.263MEV/D		
	HPH= 1.053			HED= 0.263MEV/D		

SOURCE... NOS 61-2-122

136 I 53
83.00 S

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
TOTAL	1.000	0.060	0.	0.060	2.730	0.060
	2.400	0.120	0.	0.288	4.160	0.050
	0.710	0.030	0.	0.021	4.370	0.240
	2.250	0.070	0.	0.157	5.600	0.150
	3.200	0.050	0.	0.160	7.000	0.060
	1.910	0.050	0.	0.095		
	0.390	0.190	0.	0.074		
	1.720	0.020	0.	0.034		
	2.840	0.080	0.	0.227		
	1.550	0.040	0.	0.062		
	0.200	0.120	0.	0.024		
	2.630	0.110	0.	0.289		
	1.320	0.950	0.	1.254		
		1.890	0.	2.747		
	E(K)= 0.030MEV			PROD= 0.		
	PH= 1.890			ED= 2.747MEV/D		
	HPH= 1.890			HED= 2.747MEV/D		

SOURCE... NDS 61-2-122

136 CS 55
13.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.337	0.590	0.	0.199	0.341	0.926
0.152	0.190	0.	0.029	0.657	0.074
0.270	0.220	0.	0.059		
1.255	0.210	0.	0.264		
1.065	0.840	0.	0.895		
0.830	1.000	0.	0.830		
0.170	0.230	0.	0.039		
0.200	0.030	0.	0.006		
TOTAL	3.310	0.	2.320		

E(K) = 0.033MEV
 PH = 3.310
 MPH = 3.310
 PRODX = 0.
 ED = 2.320MEV/D
 MED = 2.320MEV/D

SOURCE... NDS 61-2-130

137 BA1 56
2.60 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.662	0.910	0.090	0.602		
TOTAL	0.910	0.090	0.602		

E(K) = 0.033MEV
 PH = 1.000
 MPH = 1.000
 PRODX = 0.003
 ED = 0.605MEV/D
 MED = 0.605MEV/D

SOURCE... NDS 61-3-77

138 XE 54
17.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.420	1.000	0.	0.420	2.400	1.000
0.510	0.200	0.	0.102		
1.780	0.200	0.	0.356		
TOTAL	1.400	0.	0.878		

E(K) = 0.032MEV
 PH = 1.400
 MPH = 1.400
 PRODX = 0.
 ED = 0.878MEV/D
 MED = 0.878MEV/D

SOURCE... NOS 61-3-77

138 CS 55
32.20 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
3.340	0.005	0.	0.017	1.490	0.015
2.630	0.090	0.	0.237	2.200	0.100
0.193	0.008	0.	0.002	2.390	0.360
1.010	0.250	0.	0.252	2.530	0.050
0.550	0.080	0.	0.044	2.620	0.160
0.229	0.016	0.	0.004	2.940	0.120
0.139	0.020	0.	0.003	3.400	0.210
0.870	0.040	0.	0.035		
0.411	0.030	0.	0.012		
2.210	0.180	0.	0.398		
0.463	0.230	0.	0.106		
1.426	0.730	0.	1.041		
TOTAL	1.679	0.	2.150		

E(K) = 0.033MEV
PH = 1.679
HPH = 1.679

PRODX = 0.
ED = 2.150MEV/D
HED = 2.150MEV/D

SOURCE... M.A. WAHLGREN AND W.W. MEINKE, J. INORG. NUCL. CHEM. 24, 1527 (1962).

139 XE 54
41.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.170	0.200	0.	0.034		
0.220	0.490	0.	0.108		
0.295	0.260	0.	0.077		
0.395	0.100	0.	0.039		
TOTAL	1.050	0.	0.258		

E(K) = 0.032MEV
PH = 1.050
HPH = 1.050

PRODX = 0.
ED = 0.258MEV/D
HED = 0.258MEV/D

SOURCE... NOS 61-3-86

139 CS 55
9.50 M

M.A. WAHLGREN AND W.W. MEINKE, J. INORG. NUCL. CHEM. 24, 1527 (1962).

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.280	0.160	0.	0.205	2.700	0.160
0.630	0.040	0.	0.025	3.400	0.040
TOTAL	0.200	0.	0.230	4.000	0.800

E(K) = 0.033MEV
PH = 0.200
HPH = 0.200

PRODX = 0.
ED = 0.230MEV/D
HED = 0.230MEV/D

SOURCE... NDS 61-3-86

139 BA 56
83.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.340	0.000	0.	0.000	0.830	0.000
1.430	0.003	0.	0.004	0.910	0.003
1.260	0.000	0.	0.001	1.090	0.000
1.090	0.000	0.	0.000	2.170	0.280
0.166	0.233	0.047	0.039	2.340	0.720
TOTAL	0.237	0.047	0.044		

E(K)= 0.034MEV
PH= 0.284
HPH= 0.284

PRODX= 0.002
ED= 0.045MEV/D
MED= 0.045MEV/D

SOURCE... M.A. WAHLGREN AND W.W. MEINKE, J. INORG. NUCL. CHEM. 24, 1527 (1962).

140 CS 55
66.00 S

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.610	1.000	0.	0.610		
TOTAL	1.000	0.	0.610		

E(K)= 0.033MEV
PH= 1.000
HPH= 1.000

PRODX= 0.
ED= 0.610MEV/D
MED= 0.610MEV/D

SOURCE... NDS 59-1-83

140 BA 56
12.80 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.537	0.250	0.002	0.134	0.500	0.250
0.430	0.045	0.	0.019	0.600	0.100
0.306	0.033	0.001	0.010	0.900	0.050
0.162	0.073	0.004	0.012	1.000	0.600
0.030	1.050	0.150	0.031		
TOTAL	1.451	0.157	0.207		

E(K)= 0.034MEV
PH= 1.608
HPH= 1.608

PRODX= 0.005
ED= 0.212MEV/D
MED= 0.212MEV/D

SOURCE... NDS 59-1-83

140 LA 57
40.20 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.597	1.000	0.001	1.597	0.420	0.160
0.329	0.224	0.011	0.074	0.830	0.120
0.431	0.040	0.	0.017	1.100	0.260
0.486	0.432	0.004	0.210	1.380	0.450
0.752	0.034	0.	0.026	1.710	0.100
0.815	0.280	0.002	0.228	2.200	0.070
0.868	0.050	0.	0.043		
0.926	0.110	0.	0.102		
2.343	0.008	0.	0.019		
2.550	0.050	0.	0.127		
3.000	0.001	0.	0.003		
TOTAL	2.229	0.018	2.446		

E(K) = 0.035MEV
 PH = 2.247
 HPH = 2.247

PRODX = 0.001
 ED = 2.447MEV/D
 HED = 2.447MEV/D

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

141 BA 56
18.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.700	1.000	0.	0.700	2.800	1.000
TOTAL	1.000	0.	0.700		

E(K) = 0.034MEV
 PH = 1.000
 HPH = 1.000

PRODX = 0.
 ED = 0.700MEV/D
 HED = 0.700MEV/D

SOURCE... NDS 61-4-29

141 LA 57
3.80 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.370	0.020	0.	0.027	2.510	0.950
TOTAL	0.020	0.	0.027	0.910	0.050

E(K) = 0.035MEV
 PH = 0.020
 HPH = 0.020

PRODX = 0.
 ED = 0.027MEV/D
 HED = 0.027MEV/D

SOURCE... NDS 61-4-29

141 CE 58
33.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.145	0.519	0.157	0.075	0.435	0.700
TOTAL	0.519	0.157	0.075	0.580	0.300

E(K) = 0.037MEV
 PH = 0.676
 HPH = 0.676

PRODX = 0.006
 ED = 0.081MEV/D
 HED = 0.081MEV/D

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

142 BA 56
10.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	1.000	1.000	0.	1.000	1.000	1.000
TOTAL		1.000	0.	1.000		
	E(K) = 0.034MEV			PRODX = 0.		
	PH = 1.000			ED = 1.000MEV/D		
	HPH = 1.000			HED = 1.000MEV/D		

SOURCE... R.P. SCHUMAN; E.H. TURK AND R.L. HEATH; PHYS. REV. 115; 185 (1959).

142 LA 57
1.40 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.540	0.550	0.	0.352	4.400	-0.
	0.900	0.120	0.	0.108		
	1.055	0.060	0.	0.063		
	1.540	0.040	0.	0.062		
	1.750	0.025	0.	0.044		
	1.920	0.060	0.	0.115		
	2.080	0.030	0.	0.062		
	2.400	0.110	0.	0.264		
	2.615	0.030	0.	0.079		
	3.000	0.040	0.	0.120		
	3.300	0.007	0.	0.023		
	3.650	0.012	0.	0.044		
TOTAL		1.084	0.	1.336		
	E(K) = 0.035MEV			PRODX = 0.		
	PH = 1.084			ED = 1.336MEV/D		
	HPH = 1.084			HED = 1.336MEV/D		

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

143 LA 57
18.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	1.200	1.000	0.	1.200	2.300	1.000
TOTAL		1.000	0.	1.200		
	E(K) = 0.035MEV			PRODX = 0.		
	PH = 1.000			ED = 1.200MEV/D		
	HPH = 1.000			HED = 1.200MEV/D		

SOURCE... G.N. RAO AND H.S. HANS: NUCL. PHYS. 41: 511 (1963).

143 CE 58
33.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.056	0.243	1.557	0.014	0.300	0.060
0.293	0.935	0.065	0.274	0.542	0.050
0.230	0.062	0.007	0.014	0.730	0.050
0.341	0.055	0.	0.022	1.100	0.400
0.488	0.058	0.	0.028	1.400	0.370
0.665	0.130	0.	0.086		
0.718	0.160	0.	0.115		
0.970	0.017	0.	0.015		
1.087	0.013	0.	0.014		
TOTAL	1.683	1.629	0.583		

E(K)= 0.035MEV
PH= 3.312
HPH= 3.312

PRODX= 0.058
ED= 0.640MEV/D
HED= 0.640MEV/D

SOURCE... J.S. GEIGER ET AL.: NUCL. PHYS. 28: 387 (1961).

144 CE 58
285.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.133	0.100	0.072	0.013	0.320	0.760
0.053	0.001	0.010	0.000	0.240	0.045
0.034	0.012	0.	0.000	0.186	0.195
0.100	0.001	0.	0.000		
0.041	0.013	0.	0.001		
0.080	0.025	0.030	0.002		
0.059	0.012	0.	0.001		
TOTAL	0.164	0.112	0.017		

E(K)= 0.037MEV
PH= 0.276
HPH= 0.276

PRODX= 0.004
ED= 0.021MEV/D
HED= 0.021MEV/D

SOURCE... NDS 59-1-106

144 PR 59
17.30 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.180	0.008	0.	0.017	0.800	0.010
0.691	0.015	0.	0.010	2.290	0.013
1.490	0.002	0.	0.003	2.980	0.977
TOTAL	0.025	0.	0.031		

E(K)= 0.038MEV
PH= 0.025
HPH= 0.025

PRODX= 0.
ED= 0.031MEV/D
HED= 0.031MEV/D

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

145 CE 58
3.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.700	1.000	0.	0.700	2.000	1.000
TOTAL		1.000	0.	0.700		
	E(K)= 0.037MEV			PRODX= 0.		
	PH= 1.000			ED= 0.700MEV/D		
	MPH= 1.000			HED= 0.700MEV/D		

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

145 PR 59
5.98 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.800	1.000	0.	0.800	1.000	1.000
TOTAL		1.000	0.	0.800		
	E(K)= 0.038MEV			PRODX= 0.		
	PH= 1.000			ED= 0.800MEV/D		
	MPH= 1.000			HED= 0.800MEV/D		

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

146 CE 58
13.90 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.050	0.010	0.040	0.000	0.660	0.090
	0.110	0.090	0.090	0.010	0.700	0.680
	0.142	0.200	0.100	0.028	0.880	0.230
	0.210	0.160	0.	0.034		
	0.220	0.070	0.	0.015		
	0.250	0.020	0.	0.005		
	0.270	0.050	0.	0.013		
	0.320	0.470	0.	0.150		
TOTAL		1.070	0.230	0.257		
	E(K)= 0.037MEV			PRODX= 0.008		
	PH= 1.300			ED= 0.265MEV/D		
	MPH= 1.300			HED= 0.265MEV/D		

SOURCE... NDS 59-1-125

146 PR 59
24.40 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	1.490	0.330	0.	0.492	3.700	0.560
	0.750	0.460	0.	0.345	2.300	0.440
	0.460	1.000	0.	0.460		
TOTAL		1.790	0.	1.297		
	E(K)= 0.038MEV			PRODX= 0.		
	PH= 1.790			ED= 1.297MEV/D		
	MPH= 1.790			HED= 1.297MEV/D		

SOURCE... NDS 59-1-133

147 ND 60
11.10 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.532	0.168	0.002	0.089	0.212	0.030
0.441	0.019	0.	0.008	0.368	0.200
0.120	0.006	0.005	0.001	0.810	0.770
0.688	0.010	0.	0.007		
0.600	0.003	0.	0.002		
0.277	0.014	0.001	0.004		
0.197	0.003	0.	0.001		
0.400	0.016	0.	0.006		
0.321	0.032	0.001	0.010		
0.091	0.280	0.504	0.025		
TOTAL	0.551	0.513	0.154		

E(K) = 0.040MEV
 PH = 1.064
 HPH = 1.064

PRODX = 0.020
 ED = 0.174MEV/D
 HED = 0.174MEV/D

SOURCE... C.F. SCHWERTFEGER, E.G. FUNK, JR. AND J.W. MIHELICH,
PHYS. REV. 125, 1641 (1962).148 PM 61
5.40 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.551	0.359	0.003	0.198	1.900	0.090
0.910	0.284	0.	0.258	1.020	0.720
1.460	0.436	0.	0.637	2.460	0.220
TOTAL	1.079	0.003	1.093		

E(K) = 0.041MEV
 PH = 1.082
 HPH = 1.082

PRODX = 0.000
 ED = 1.093MEV/D
 HED = 1.093MEV/D

SOURCE... NDS 5-2-16

149 ND 60
2.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.029	0.	0.011	0.	0.950	0.160
0.096	0.	0.040	0.	1.100	0.430
0.112	0.024	0.086	0.003	1.500	0.310
0.114	0.144	0.286	0.016		
0.124	0.017	0.043	0.002		
0.188	0.021	0.009	0.004		
0.198	0.019	0.006	0.004		
0.210	0.327	0.083	0.069		
0.226	0.014	0.006	0.003		
0.240	0.267	0.043	0.064		
0.266	0.089	0.011	0.024		
TOTAL	0.924	0.623	0.189		

E(K) = 0.040MEV
 PH = 1.546
 HPH = 1.546

PRODX = 0.025
 ED = 0.214MEV/D
 HED = 0.214MEV/D

SOURCE... NDS 5-2-16

149 PM 61
53.00 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.286	0.017	0.003	0.005	0.190	0.002
				0.240	0.001
				0.470	0.001
				0.784	0.030
				1.071	0.970
TOTAL	0.017	0.003	0.005		
E(K)= 0.041MEV			PRODX= 0.000		
PH= 0.020			ED= 0.005MEV/D		
HPH= 0.020			HED= 0.005MEV/D		

SOURCE... NDS 59-2-56

150 PM 61
2.70 H

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
2.757	0.090	0.	0.247	2.000	0.800
1.930	0.020	0.	0.039	3.000	0.200
1.680	0.070	0.	0.118		
0.820	0.190	0.	0.156		
1.330	0.200	0.	0.266		
0.510	0.100	0.	0.051		
1.170	0.200	0.	0.234		
0.820	0.190	0.	0.156		
0.400	0.200	0.	0.080		
0.340	0.800	0.	0.272		
0.570	0.020	0.	0.011		
0.700	0.050	0.	0.035		
TOTAL	2.130	0.	1.665		
E(K)= 0.041MEV			PRODX= 0.		
PH= 2.130			ED= 1.665MEV/D		
HPH= 2.130			HED= 1.665MEV/D		

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

151 NO 60
13.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.085	0.090	0.160	0.008	1.930	1.000
0.109	0.120	0.130	0.013		
0.110	0.120	0.130	0.013		
0.117	0.120	0.130	0.014		
0.421	0.250	0.	0.105		
0.720	0.500	0.	0.360		
1.140	0.500	0.	0.570		
TOTAL	1.700	0.550	1.083		
E(K)= 0.040MEV			PRODX= 0.022		
PH= 2.250			ED= 1.105MEV/D		
HPH= 2.250			HED= 1.105MEV/D		

SOURCE... D.G.BURKE, M.E.LAW AND M.W.JOHNS,
CAN. J. PHYS. 41, 57 (1963).

151 PM 61
28.4 HR

E(G) MEV	N(G)	N(K)	N(L)	N(G)E(G)	E(B) MEV	N(B)
0.0257	0.	0.	0.030	0.	1.20	0.11
0.0351	0.	0.	0.007	0.	1.13	0.13
0.0649	0.	0.094	0.022	0.	1.63	0.12
0.0658	0.	0.056	0.012	0.	0.85	0.44
0.0697	0.	0.020	0.004	0.	0.75	0.11
0.0762	0.	0.007	0.006	0.	0.425	0.09
0.1000	0.	0.039	0.008	0.		
0.1048	0.	0.025	0.006	0.		
0.1432	0.008	0.	0.	0.0011		
0.1522	0.004	0.	0.	0.0006		
0.1562	0.	0.0006	0.	0.		
0.1632	0.024	0.0051	0.001	0.0039		
0.1680	0.110	0.0056	0.001	0.0185		
0.1768	0.052	0.0092	0.002	0.0092		
0.2018	0.013	0.	0.	0.0026		
0.2090	0.018	0.0030	0.	0.0038		
0.2324	0.014	0.0012	0.	0.0033		
0.2365	0.014	0.0004	0.	0.0033		
0.2401	0.030	0.0005	0.	0.0072		
0.2752	0.063	0.0010	0.	0.0173		
0.3240	0.009	0.	0.	0.0029		
0.3401	0.210	0.0019	0.	0.0714		
0.3449	0.015	0.	0.	0.0052		
0.3529	0.005	0.	0.	0.0018		
0.4394	0.009	0.	0.	0.0040		
0.4445	0.033	0.0016	0.	0.0147		
0.6370	0.012	0.	0.	0.0076		
0.6700	0.012	0.	0.	0.0080		
0.7170	0.035	0.	0.	0.0251		
0.7350	0.008	0.	0.	0.0059		
0.7520	0.001	0.	0.	0.0008		
0.7720	0.001	0.	0.	0.0005		
0.9500	0.001	0.	0.	0.0006		
TOTAL	0.701	0.2711	0.099	0.2193		

E(K)=0.0410 N(K)E(K)=0.0111
E(L)=0.0077 N(L)E(L)=0.0008

PM=1.0711 ED=0.2318
MPH=0.9721 MED=0.2310

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

152 PM 61
6.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.120	1.000	0.	0.120	3.200	1.000
0.500	1.000	0.	0.500		
TOTAL	2.000	0.	0.620		

E(K)= 0.041MEV
PH= 2.000
HPH= 2.000

PRODX= 0.
ED= 0.620MEV/D
HED= 0.620MEV/D

SOURCE... NDS 59-4-78

152 EU1 63
9.30 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
1.390	0.010	0.	0.014	0.210	0.000
0.963	0.090	0.	0.087	0.560	0.016
0.841	0.110	0.	0.093	1.260	0.000
0.563	0.240	0.	0.135	1.550	0.020
0.122	0.132	0.	0.016	1.870	0.740
1.320	0.010	0.	0.013		
0.975	0.005	0.	0.005		
0.344	0.026	0.	0.009		
TOTAL	0.623	0.	0.371		

E(K)= 0.044MEV
PH= 0.623
HPH= 0.623

PRODX= 0.
ED= 0.371MEV/D
HED= 0.371MEV/D

SOURCE... NDS 59-4-77

152 EU2 63
13.00 Y

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.344	0.252	0.008	0.087	0.220	0.020
0.411	0.020	0.000	0.008	0.360	0.027
0.778	0.120	0.000	0.093	0.710	0.120
0.692	0.002	0.	0.001	1.040	0.018
1.100	0.025	0.	0.027	1.470	0.075
1.240	0.020	0.	0.025		
0.122	0.387	0.232	0.047		
0.245	0.075	0.005	0.018		
1.085	0.120	0.000	0.130		
0.964	0.150	0.000	0.144		
0.866	0.040	0.000	0.034		
1.112	0.130	0.000	0.144		
0.443	0.050	0.000	0.022		
1.411	0.250	0.000	0.352		
1.210	0.020	0.	0.024		
TOTAL	1.659	0.248	1.159		

E(K)= 0.044MEV
PH= 1.907
HPH= 1.907

PRODX= 0.011
ED= 1.170MEV/D
HED= 1.170MEV/D

SOURCE... K. KOTAJIMA, NUCL. PHYS. 39: 89 (1962).

153 PM 61
5.50 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.125	0.750	0.	0.094	1.650	1.000
0.180	0.250	0.	0.045		
TOTAL	1.000	0.	0.139		
E(K) = 0.041 MEV			PRODX = 0.		
PH = 1.000			ED = 0.139 MEV/D		
HPH = 1.000			HED = 0.139 MEV/D		

SOURCE... NDS 59-3-55

153 SM 62
47.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.590	0.000	0.	0.000	0.130	0.001
0.540	0.001	0.008	0.000	0.640	0.380
0.191	0.	0.	0.	0.698	0.400
0.107	0.	0.	0.	0.803	0.220
0.173	0.003	0.013	0.001		
0.070	0.029	0.114	0.002		
0.084	0.006	0.	0.000		
0.097	0.014	0.	0.001		
0.103	0.143	0.162	0.015		
TOTAL	0.195	0.297	0.020		
E(K) = 0.045 MEV			PRODX = 0.013		
PH = 0.492			ED = 0.032 MEV/D		
HPH = 0.492			HED = 0.032 MEV/D		

SOURCE... NDS 59-3-63

154 EU 63
16.00 Y

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.693	0.050	0.001	0.035	0.250	0.290
1.600	0.021	0.	0.034	0.570	0.350
0.725	0.206	0.001	0.150	0.830	0.200
0.591	0.062	0.	0.037	0.970	0.030
1.280	0.345	0.	0.442	1.600	0.030
1.006	0.145	0.	0.146	1.850	0.100
0.758	0.086	0.	0.065		
0.998	0.114	0.	0.114		
0.875	0.172	0.001	0.150		
0.248	0.062	0.	0.015		
0.123	0.189	0.094	0.023		
TOTAL	1.452	0.097	1.210		
E(K) = 0.044 MEV			PRODX = 0.004		
PH = 1.549			ED = 1.214 MEV/D		
HPH = 1.549			HED = 1.214 MEV/D		

SOURCE... NDS 59-3-74

155 SM 62
24.00 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.246	0.060	0.	0.015	1.500	0.070
0.141	0.010	0.002	0.001	1.650	0.930
0.105	0.940	0.254	0.099		
TOTAL	1.010	0.256	0.115		
E(K)= 0.042MEV			PRODX= 0.011		
PH= 1.266			ED= 0.126MEV/D		
HPH= 1.266			HED= 0.126MEV/D		

SOURCE... NDS 59-3-75

155 EU 63
1.70 Y

R.N. SURBA RAO; NUOVO CIMENTO 16, 283 (1960).

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.060	0.013	0.	0.001	0.150	0.300
0.087	0.268	0.132	0.023	0.160	0.400
0.105	0.170	0.049	0.018	0.190	0.100
TOTAL	0.451	0.181	0.042	0.250	0.200
E(K)= 0.044MEV			PRODX= 0.008		
PH= 0.632			ED= 0.050MEV/D		
HPH= 0.632			HED= 0.050MEV/D		

SOURCE... G.T. EWAN; R.L. GRAHAM AND J.S. GEIGER; NUCL. PHYS. 29, 153 (1962).

156 EU 63
15.40 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.089	0.084	0.183	0.007	2.430	0.330
0.199	0.007	0.	0.001	1.195	0.140
0.600	0.015	0.	0.009	0.485	0.360
0.646	0.065	0.001	0.042	0.350	00.000
0.720	0.056	0.	0.040		
0.812	0.092	0.006	0.075		
0.867	0.001	0.	0.001		
0.861	0.003	0.	0.003		
1.065	0.061	0.	0.065		
1.153	0.057	0.	0.066		
1.154	0.056	0.	0.065		
1.231	0.092	0.	0.113		
1.242	0.061	0.	0.076		
1.366	0.001	0.	0.001		
1.877	0.002	0.	0.004		
1.937	0.002	0.	0.004		
1.966	0.005	0.	0.010		
2.026	0.003	0.	0.006		
2.098	0.004	0.	0.008		
2.184	0.006	0.	0.013		
TOTAL	0.673	0.190	0.609		
E(K)= 0.044MEV			PRODX= 0.008		
PH= 0.863			ED= 0.618MEV/D		
HPH= 0.863			HED= 0.618MEV/D		

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

157 EU 63
15.40 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.200	0.830	0.170	0.166	1.000	0.750
	0.600	0.750	0.	0.450	1.600	0.250
TOTAL		1.580	0.170	0.616		
	E(K)= 0.044MEV		PRODX= 0.007			
	PH= 1.750		ED= 0.623MEV/D			
	MPH= 1.750		MED= 0.623MEV/D			

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

158 SM 62
15.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.500	1.000	0.	0.500	1.000	1.000
TOTAL		1.000	0.	0.500		
	E(K)= 0.042MEV		PRODX= 0.			
	PH= 1.000		ED= 0.500MEV/D			
	MPH= 1.000		MED= 0.500MEV/D			

SOURCE... C.F. MILLER; USNRDL-TR-160; (1957).

158 EU 63
1.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.400	1.000	0.	0.400	2.600	1.000
	0.800	1.000	0.	0.800		
TOTAL		2.000	0.	1.200		
	E(K)= 0.044MEV		PRODX= 0.			
	PH= 2.000		ED= 1.200MEV/D			
	MPH= 2.000		MED= 1.200MEV/D			

SOURCE... NDS 59-5-68

159 GD 64
18.00 M

	E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
	0.362	0.192	0.001	0.070	0.590	0.200
	0.305	0.001	0.	0.000	0.890	0.060
	0.225	0.005	0.000	0.001	0.948	0.740
	0.137	0.	0.	0.		
	0.079	0.	0.	0.		
	0.058	0.	0.	0.		
TOTAL		0.199	0.002	0.071		
	E(K)= 0.045MEV		PRODX= 0.000			
	PH= 0.201		ED= 0.071MEV/D			
	MPH= 0.201		MED= 0.071MEV/D			

SOURCE... NDS 59-5-76

160 TB 65
73.00 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(S) (MEV)	N(S)
0.087	0.072	0.017	0.006	0.300	0.120
0.197	0.012	0.002	0.002	0.460	0.190
0.215	0.013	0.001	0.003	0.560	0.380
0.298	0.084	0.	0.025	0.760	0.110
0.393	0.005	0.	0.002	0.860	0.200
0.682	0.003	0.	0.002	1.710	0.004
0.764	0.007	0.	0.005		
0.879	0.114	0.	0.100		
0.962	0.036	0.	0.035		
0.966	0.084	0.	0.081		
0.985	0.003	0.	0.003		
1.070	0.004	0.	0.004		
1.080	0.006	0.	0.006		
1.112	0.006	0.	0.007		
1.179	0.054	0.	0.064		
1.200	0.008	0.	0.010		
1.272	0.029	0.	0.037		
1.314	0.008	0.	0.011		
TOTAL	0.548	0.020	0.403		

$\Sigma(K) = 0.047\text{MEV}$
 $\text{PH} = 0.568$
 $\text{HPH} = 0.568$

$\text{PRODX} = 0.001$
 $\text{ED} = 0.404\text{MEV/D}$
 $\text{HED} = 0.404\text{MEV/D}$

SOURCE... NDS 59-5-98

161 GO 64
3.70 M

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(S) (MEV)	N(S)
0.531	0.015	0.	0.008	1.440	0.040
0.273	0.011	0.	0.003	1.540	0.050
0.106	0.010	0.	0.001	1.600	0.910
0.482	0.019	0.	0.009		
0.165	0.041	0.004	0.007		
0.361	0.590	0.011	0.213		
0.284	0.072	0.003	0.021		
0.102	0.183	0.040	0.019		
0.315	0.215	0.021	0.068		
0.259	0.016	0.036	0.004		
0.181	0.021	0.005	0.004		
0.134	0.	0.	0.		
0.078	0.011	0.056	0.001		
TOTAL	1.204	0.177	0.357		

$\Sigma(K) = 0.045\text{MEV}$
 $\text{PH} = 1.381$
 $\text{HPH} = 1.381$

$\text{PRODX} = 0.008$
 $\text{ED} = 0.365\text{MEV/D}$
 $\text{HED} = 0.365\text{MEV/D}$

SOURCE... P. GREGGORS HANSEN; O. NATHAN; O.B. NIELSON AND R.K. SHELIN;
 NUCL. PHYS. 6: 530 (1958).

161 T9 65
 6.90 D

E(G) (MEV)	N(G)	N(K)	N(G)E(G) (MEV/D)	E(B) (MEV)	N(B)
0.057	0.040	0.260	0.002	0.460	0.320
0.074	0.072	0.034	0.005	0.525	0.590
0.049	0.290	0.	0.014	0.610	0.090
0.026	0.240	0.	0.006		
TOTAL	0.642	0.294	0.028		
E(K) = 0.047MEV			PROD = 0.014		
PM = 0.936			ED = 0.042MEV/D		
HPM = 0.936			HED = 0.042MEV/D		

SOURCE... J.O. RASMUSSEN, F.L. CANAVAN AND J.M. HOLLANDER,
PHYS. REV. 107, 141 (1957).

237 U 92
6.75 DA

E(G) MEV	N(G)	N(K)	N(L1)	N(L2)	N(L3)	N(M)	N(N)	N(G)E(G)	E(B) MEV	N(B)
0.060	0.360	-----	0.075	0.149	0.047	0.085	0.021	0.021	0.248	0.960
0.065	0.023	-----	0.003	0.003	0.003	-----	0.001	0.001		
0.165	0.036	0.005	0.002	0.013	0.006	0.005	0.006	0.006		
0.208	0.240	0.620	0.108	0.014	0.001	0.022	0.050	0.050		
0.234	-----	0.001	-----	---						
0.267	-----	0.005	0.002	-----						
0.332	0.014	-----	---				0.005	0.005		
0.335	0.002	-----	---				0.001	0.001		
0.368	-----	---								
0.371	-----	---								
TOTAL	0.675	0.631	0.190	0.179	0.057	0.112	0.084			

E(K)=0.103	N(K)E(K)=0.065
E(L1)=0.022	N(L1)E(L1)=0.004
E(L2)=0.022	N(L2)E(L2)=0.004
E(L3)=0.018	N(L3)E(L3)=0.001
E(M)=0.006	N(M)E(M)=0.001
PH=1.845	ED=0.159 MEV/D
HPH=1.677	HED=0.158 MEV/D

SOURCE... J. BORGGREEN, O.B. NIELSEN AND H. MORDBY,
NUCL. PHYS. 29, 515 (1962).

238 NP 93
2.1 DA

E(G) MEV	N(G)	N(K)	N(L1+L2)	N(L3)	N(M)	N(N)	N(G)E(G)	E(B) MEV	N(B)
0.044	-----	-----	0.145	0.106	0.175	0.036	-----	1.240	0.580
1.010	-----	-----	0.019	0.009	0.010	0.002	-----	0.260	0.420
0.885	0.009	-----	---				0.008		
0.925	0.025	-----	---				0.023		
0.986	0.241	0.003	0.001	-----	-----	-	0.238		
1.030	0.174	0.002	0.001	-----	-----		0.180		
TOTAL	0.449	0.005	0.166	0.115	0.185	0.038	0.449		

E(K)=0.106	N(K)E(K)=0.001
E(L1+L2) (AVG)=0.022	N(L1+L2)E(L1+L2)=0.004
E(L3)=0.018	N(L3)E(L3)= 0.002
E(M)=0.006	N(M)E(M)=0.001
E(N)=0.002	N(N)E(N)=0.0001
PH=0.986	ED=0.456 MEV/D
HPH=0.619	HED=0.452 MEV/D

SOURCE... C.F. MILLER, USNRDL-TR-160, (1957).

239 U 92
23.5 MI

E(G) MEV	N(G)	N(K)	N(L)	N(G)E(G)	E(B) MEV	N(B)
0.074	0.830	-----	0.170	0.062	1.210	1.000
E(L)=0.022		N(L)E(L)=0.004				
PH=1.000		ED=0.066 MEV/D				
MPH=1.000		MED=0.066 MEV/D				

SOURCE... C.F. MILLER, USNRDL-TR-160, (1957).
R.D. CONNOR AND I.L. FAIRWEATHER,
PRO. PHYS. SOC. (LONDON) 74, 161 (1959).

239 NP 93
56.0 HR

E(G) MEV	N(G)	N(K)	N(L+M)	N(G)E(G)	E(B) MEV	N(B)
0.045	0.001	-----	0.046	-----	0.713	0.065
0.049	0.001	-----	0.079	-----	0.654	0.040
0.057	0.001	-----	0.213	-----	0.437	0.480
0.061	0.059	-----	0.002	0.004	0.393	0.135
0.068	0.002	-----	0.136	-----	0.332	0.280
0.106	0.314	-----	0.072	0.033		
0.182	0.005	-----	0.001	0.001		
0.210	0.029	0.080	0.026	0.006		
0.226	0.001	0.002	-----	-----		
0.228	0.083	0.187	0.055	0.019		
0.255	0.022	0.002	-----	0.006		
0.273	0.008	0.012	0.003	0.002		
0.278	0.133	0.178	0.047	0.037		
0.286	0.012	0.025	0.010	0.003		
0.316	0.004	-----	-----	0.001		
0.335	0.021	0.001	-----	0.007		
TOTAL	0.696	0.487	0.690	0.119		
E(K)=0.106		N(K)E(K)=0.052				
E(L)=0.022		N(L)E(L)=0.015				
PH=1.873		ED=0.187 MEV/D				
MPH=1.873		MED=0.187 MEV/D				

SOURCE... M.E. BUNKER, ET AL.,
PHYS. REV. 116, 143 (1959).

240 U 92
14.1 HR

E(G) MEV	N(G)	N(L)	N(G)E(G)	E(B) MEV	N(B)
0.044	0.063	0.188	0.003	0.320 .360	0.250 0.750

E(L)=0.022 N(L)E(L)=0.004

PH=0.250 ED=0.007MEV/D
HPH=0.250 HED=0.007 MEV/D

SOURCE... M.E. BUNKER, B.J. DROPSKY, J.D. KNIGHT, J.W. STARNER 240 NP 93
AND B. WARREN, PHYS. REV. 116, 143 (1959). 7.3 MI

E(G) MEV	N(G)	N(K)	E(G)N(G)	E(B) MEV	N(B)
0.260	0.019	0.001	0.005	2.180	0.520
0.304	0.009	-----	0.003	1.600	0.310
0.554	0.214	0.002	0.119	1.300	0.100
0.597	0.126	0.001	0.075	0.650	0.070
0.758	0.013	-----	0.010		
0.816	0.016	-----	0.013		
0.820	0.003	-----	0.002		
0.898	0.012	-----	0.011		
0.936	0.003	-----	0.003		
0.942	0.019	-----	0.018		
1.490	0.015	-----	0.022		
1.530	0.019	-----	0.029		
1.620	0.007	-----	0.011		
TOTAL	0.475	0.004	0.321		

E(K)=0.106 N(K)E(K)=0.0004

PH=0.479 ED=0.322MEV/D
HPH=0.479 HED=0.322MEV/D

APPENDIX II

EXPOSURE-DOSE RATE MULTIPLIERS

The following list gives an exposure-dose rate multiplier for each nuclide contained in Appendix I. The point of exposure is assumed to be 3 feet above an infinite plane uniformly contaminated with the nuclide in question. The units of the multiplier are roentgens-sec-cm²-hr⁻¹-disintegration⁻¹. The multiplier will convert nuclide activities in disintegrations per second per square centimeter to exposure-dose rates in roentgens per hour. The figure in parentheses indicates the number of zeros between the decimal point and the first significant figure; i.e., (6)840 is to be read 0.00000840 or 0.840×10^{-6} .

<u>Nuclide</u>	<u>Multiplier</u>	<u>Nuclide</u>	<u>Multiplier</u>
Zn 72	(6)840	Y (2) 91	(7)173
Ga 72	(4)117	Sr 92	(5)588
Ga 73	(5)189	Y 92	(5)122
Ge (1) 73	(7)779	Sr 93	(5)114
Zn 74	(5)365	Y 93	(6)488
Ga 74	(4)180	Nb (1) 93	(6)166
Ge (1) 75	(6)303	Y 94	(5)348
Ge (2) 75	(6)199	Zr 95	(5)378
As 76	(5)210	Nb (1) 95	(5)133
Ge (1) 77	(6)404	Nb (2) 95	(5)391
Ge (2) 77	(5)574	Nb 96	(4)115
As 77	(7)553	Zr 97	(6)238
Ge 78	(5)243	Nb (1) 97	(5)382
As (1) 78	(5)271	Nb (2) 97	(5)350
As (2) 78	(5)428	Mo 99	(6)658
Se (1) 79	(6)104	Tc (1) 99	(6)745
Se (1) 81	(6)115	Tc 100	(5)607
Br 82	(4)143	Mo 101	(5)792
Se (1) 83	(6)666	Tc 101	(5)193
Se (2) 83	(4)149	Tc (1) 102	(5)535
Br 83	(6)277	Ru 103	(5)261
Kr (1) 83	(6)232	Rh (1) 103	(6)122
Br 84	(5)917	Rh (1) 104	(6)215
Kr (1) 85	(6)909	Rh (2) 104	(5)300
Kr (2) 85	(7)277	Ru 105	(5)388
Rb (1) 86	(5)299	Rh (1) 105	(6)417
Rb (2) 86	(6)475	Rh (2) 105	(6)175
Kr 87	(5)410	Rh (1) 106	(5)868
Kr 88	(5)768	Rh (2) 106	(5)148
Rb 88	(5)312	Ru 107	(5)122
Kr 89	(4)169	Rh (2) 107	(5)174
Rb 89	(4)110	Ru 108	(6)265
Kr 90	(5)899	Rh 108	(5)236
Sr 91	(5)418	Rh (1) 109	(6)637
Y (1) 91	(5)282	Pd (1) 109	(6)691

<u>Nuclide</u>	<u>Multiplier</u>	<u>Nuclide</u>	<u>Multiplier</u>
Pd (2) 109	(6)169	Te (1) 127	(6)514
Ag (1) 109	(7)805	Te (2) 127	(7)234
Pd (1) 111	(6)340	Sn 128	(5)239
Pd (2) 111	(6)890	Sb (1) 128	(5)928
Ag (1) 111	(6)377	I 128	(6)490
Ag (2) 111	(6)131	Sb 129	(5)540
Pd 112	(6)125	Te (1) 129	(6)183
Ag 112	(5)324	Te (2) 129	(5)125
Cd (1) 115	(6)177	Xe (1) 129	(6)430
Cd (2) 115	(5)104	I 130	(5)784
In (1) 115	(5)102	Sb 131	(5)318
Ag 116	(5)643	Te (1) 131	(5)930
Cd (1) 117	(5)708	Te (2) 131	(5)213
In (1) 117	(6)525	I 131	(5)221
In (2) 117	(5)385	Xe (1) 131	(6)198
Sn (1) 117	(5)122	Te 132	(5)144
In (2) 118	(5)116	I 132	(4)112
In (1) 119	(6)269	Te (1) 133	(4)112
In (2) 119	(5)407	Te (2) 133	(5)784
Sn (1) 119	(6)147	I 133	(5)314
Cd 120	(5)271	Xe (1) 133	(6)384
In (2) 121	(5)469	Xe (2) 133	(6)306
Sb (1) 122	(6)484	Te 134	(5)684
Sb (2) 122	(5)202	I 134	(4)122
In (2) 123	(5)535	Cs (1) 134	(6)754
Sn (1) 123	(6)105	Cs (2) 134	(5)813
Sn (2) 123	(6)832	I 135	(4)156
Sb (2) 124	(5)896	Xe (1) 135	(5)239
Sn (1) 125	(5)196	Xe (2) 135	(5)149
Sn (2) 125	(6)398	I 136	(4)121
Sb 125	(5)254	Cs 136	(4)117
Te (1) 125	(6)327	Ba (1) 137	(5)318
Sb (2) 126	(5)939	Xe 138	(5)441
Sn 127	(5)271	Cs 138	(5)979
Sb 127	(5)263	Xe 139	(5)146
		Cs 139	(5)110

<u>Nuclide</u>	<u>Multiplier</u>	<u>Nuclide</u>	<u>Multiplier</u>
Ba 139	(6)255	Eu (1) 152	(5)192
Cs 140	(5)323	Eu (2) 152	(5)580
Ba 140	(5)116	Pm 153	(6)804
La 140	(4)114	Sm 153	(6)186
Ba 141	(5)365	Eu 154	(5)601
La 141	(6)127	Sm 155	(6)726
Ce 141	(6)467	Eu 155	(6)289
Ba 142	(5)495	Eu 156	(5)302
La 142	(5)601	Eu 157	(5)338
La 143	(5)574	Sm 158	(5)271
Ce 143	(5)350	Eu 158	(5)630
Ce 144	(6)123	Gd 159	(6)395
Pr 144	(6)140	Tb 160	(5)202
Ce 145	(5)365	Gd 161	(5)203
Pr 145	(5)409	Tb 161	(6)243
Ce 146	(5)150	U 237	(6)845
Pr 146	(5)653	Np 238	(5)227
Nd 147	(6)960	U 239	(6)327
Pm 148	(5)528	Np 239	(6)966
Nd 149	(5)122	U 240	(7)333
Pm 149	(7)280	Np 240	(5)165
Pm 150	(5)808		
Nd 151	(5)560		
Pm 151	(5)129		
Pm 152	(5)340		

APPENDIX III

SAMPLE CALCULATIONS BASED ON THE NDS DATA FOR MASS-75 CHAIN

Figure 1 shows the decay scheme for mass-75 nuclides as diagrammed in NDS 59-1-42. The diagram shows (1) the decay of 49-second Ge^{75} to 82-minute Ge^{75} , (2) the decay of 82-minute Ge^{75} to stable As^{75} , (3) the decay of 120-day Se^{75} to As^{75} by electron capture, and (4) the decay of 1.6-hour Br^{75} to Se^{75} by electron capture and positron emission. The data from which the diagram was constructed are given in the data sheets which accompany it in NDS.

There is only one transition involved (the 0.139-Mev transition) in the decay of 49-second Ge^{75} to 82-minute Ge^{75} , and each 49-second Ge^{75} decay must make this transition. However, the emission of a 0.139-Mev gamma photon does not accompany every decay, since the transition has a conversion coefficient of about 2, as shown on data sheet 59-1-45. This means that two X rays are emitted for every gamma photon emitted, so that the number of 0.139-Mev gamma photons per disintegration is 0.333 and the number of X-ray photons is 0.667. The X-ray photons have all been counted as K X-rays in this report, for simplicity and since the effect on dose-rate calculations is negligible, although the data sheet indicates that about one-fourth of the X-ray photons arise from L or M transitions. Also, the Auger electron emission is neglected, which would reduce the abundance of K X-ray photons somewhat. The energy of an X ray depends upon the atom emitting it, which is Ge in this case. Note that a metastable isomer may decay directly to the next element in the chain rather than by making the isomeric transition, and in this case any X rays arising from conversion would be characteristic of the new element.

The gamma photons observed in the decay of 82-minute Ge^{75} to As^{75} , as reported by two different investigators, are listed in NDS data sheet 59-1-41 as follows:

Fig. 1 Decay Scheme for Mass-95 Chain

<u>Investigator No. 1</u>		<u>Investigator No. 2</u>	
<u>Energy</u> <u>(Mev)</u>	<u>Relative</u> <u>Abundance</u>	<u>Energy</u> <u>(Mev)</u>	<u>Relative</u> <u>Abundance</u>
0.066	22	0.066	25
0.199	120	0.199	127
0.264	1000	0.265	1000
0.427	25	0.420	26
0.477	23	0.470	26
0.628	18	0.620	13

Note that the two sets of data show minor disagreements, not only in relative abundances but in the values of the energy. In such cases, NDS shows on the diagram the value which best fits the scheme, sometimes choosing an intermediate value when the reported values show wide differences.

In the case under consideration, NDS does not give absolute gamma-photon abundances. However, with the aid of the diagram, it is fairly simple to convert the relative abundances to absolute values. First, any conversion of the gammas should be noted. As it happens, the NDS data sheet for this decay carries no information on this point. A check of the data sheet for Se^{75} ground-state decay (NDS 59-1-49), which involves many of the same transitions, discloses appreciable conversion of the 0.066 gamma and slight conversion of the 0.199 and 0.264 gammas. The conversion coefficients, α , are:

<u>Energy</u>	<u>α</u>
0.066	0.4
0.199	0.03
0.264	0.02

Actually, NDS reports three widely separated values for the coefficient for the 0.264 gamma. We have selected the intermediate value. The conversion coefficients, α , are simply the ratio of converted photons to unconverted photons.

From the diagram it is clear that the highest excited level in As^{75} is depopulated by two gammas - the 0.628 and the 0.427. The relative abundance ratio is about 1 to 2 and neither ray is converted. Hence, 1 out of 3 or 33 % of the atoms in this level de-excite by emitting a 0.628 gamma and 67 % emit the 0.427. Since 0.41 % of the ground-

state Ge^{75} decays feed this level, we find $0.0041 \times 0.33 = 0.001$ gamma photons of 0.628 Mev emitted per disintegration. A similar calculation yields 0.003 gammas of 0.427 Mev per disintegration.

Actually, it is generally better to normalize on the basis of a more abundant ray when possible. In the case under consideration, we note that the second level in As^{75} is fed exclusively (in this decay) by the 0.92 beta ray (11.4 % of the Ge^{75} decays), and the level is depopulated by the 0.265 and 0.066 gammas. The relative abundances of these two rays are about 1000 and 25, respectively, and both are converted. The relative gamma abundances do not accurately represent the relative transition probabilities, since the two transitions are converted to different extents. Each relative abundance must be multiplied by the factor $(1+\alpha)$ to convert it to a relative transition probability

$$\begin{aligned} 25 \times (1+0.4) &= 35 \\ 1000 \times (1 + 0.02) &= 1020 \end{aligned}$$

Hence, about 3 % of the atoms decaying to this level de-excite by the 0.066 transition while 97 % make the 0.265 transition. These figures, along with the 11.4 % abundance figure for feeding the level, yield the absolute numbers of each transition per disintegration. These numbers are then distributed between gamma photons and X-ray photons according to the values of α .

For more complicated decay schemes, the calculation may become considerably more cumbersome, but the principle remains the same; i.e., the number feeding a level must equal the number depopulating it. Needless to say, both beta branching percentages and relative abundances of the gamma rays are required for the calculation, although very weak rays can frequently be neglected. Failure to account for conversion can sometimes strongly affect the results. It should be emphasized that the whole normalization procedure depends upon the availability of a logical decay scheme for the nuclei involved. The mass-chain 75 examples just discussed are fairly typical of the kind of calculations required to obtain gamma photon abundances from the beta decay information in the literature. The Nuclear Data Sheets currently being published (the compilation is continuously revised and updated) often include absolute transition probabilities marked on the decay-scheme diagram, as is the case in Figure 1. However, many of the older sheets give only relative gamma abundances.

APPENDIX IV

GENERAL SOLUTION FOR CONVERTING RELATIVE GAMMA ABUNDANCES TO ABSOLUTE PHOTON ABUNDANCES

The figure at the left is a generalized decay scheme. The $b_1, b_2 \dots$ are beta branching fractions and the g 's are the relative abundances of the gamma photons corresponding to transitions indicated by the vertical arrows. Let α_{nm} be the conversion coefficients for these transitions. We wish to find the absolute photon abundances (number of photons per disintegration) γ_{nm} of the gammas.

Consider any level i . The population arriving at this level is:

$$b_i + \sum_{k=1}^{i-1} \gamma_{ki} (1 + \alpha_{ki})$$

where the ki include all gammas starting from higher levels and ending on i . The population leaving level i is:

$$\sum_{l=1+i}^n \gamma_{il} (1 + \alpha_{il})$$

where n includes all levels lower than i .

Since the two populations must be equal:

$$\sum_{\ell=1}^n \gamma_{i\ell} (1+\alpha_{i\ell}) = b_i + \sum_{k=1}^{i-1} \gamma_{ki} (1+\alpha_{ki})$$

Since the g 's are relative abundances, we may substitute $\gamma_{i1} = cg_{i1}$ in this equation:

$$\sum_{\ell=1}^n cg_{i\ell} (1+\alpha_{i\ell}) = b_i + \sum_{k=1}^{i-1} cg_{ki} (1+\alpha_{ki})$$

But notice that for the highest-lying level, the summation term on the right vanishes:

$$\sum_{\ell=1}^n cg_{1\ell} (1+\alpha_{1\ell}) = b_1$$

and

$$c = \frac{b_1}{\sum_{\ell=1}^n g_{1\ell} (1+\alpha_{1\ell})}$$

The normalizing factor, c , will convert any of the relative abundances to absolute photon abundances, and it can be directly determined from the beta and gamma data for the highest-lying level in the daughter nucleus. If these rays are relatively weak, however, the experimental values of the relative abundances are likely to be uncertain. In such a case, the value of c determined by this method is best regarded as an estimate for calculating the gamma feed to a lower level which emits a more intense gamma ray. A better value of c can then be determined from the beta and gamma data on the lower level.

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Abundance
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