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REDUCED ELECTRIC-OCTUPOLE TRANSITION PROBABILITIES, $B(E3;0_1^+ \rightarrow 3_1^-)$, FOR EVEN–EVEN NUCLIDES THROUGHOUT THE PERIODIC TABLE

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Adopted values for the excitation energy, $E_x(3_1^-)$, of the first 3^- state of even–even nuclides are tabulated. Values of the reduced electric-octupole transition probability, $B(E3;0_1^+ \rightarrow 3_1^-)$, from the ground state to this state, as determined from Coulomb excitation, lifetime measurements, inelastic electron scattering, deformation parameters β_3 obtained from angular distributions of inelastically scattered nucleons and light ions, and other miscellaneous procedures are listed in separate tables. Adopted values for $B(E3;0_1^+ \rightarrow 3_1^-)$ are presented in the final table, together with the $E3$ transition strengths, in Weisskopf units, and the product $E_x(3_1^-) \times B(E3;0_1^+ \rightarrow 3_1^-)$, expressed as a percentage of the energy-weighted $E3$ sum-rule strength. An evaluation is made of the reliability of $B(E3;0_1^+ \rightarrow 3_1^-)$ values deduced from deformation parameters β_3. The literature has been covered to March 1988.

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CONTENTS

INTRODUCTION

It has been known for many years that low-lying collective octupole excitations occur in even–even nuclei throughout the periodic table, with $E3$ transition probabilities an order of magnitude larger than the single-particle estimate (see, for example, Ref. 1). Theoretical interpretation of the nature of these excitations, and of the systematics of their energies and strengths, has been attempted by various authors (for example, Lane and Pendlebury,[2] Bernstein,[3] Neergard and Vogel,[4,5] Bohr and Mottelson,[1] Scholten et al.,[6] Sheline,[7] Stringari,[8] Abbas et al.,[9] Kirson,[10] Engel and Iachello,[11,12] Cottle and Bromley,[13,14] Barfield et al.,[15] and Cottle and Kemper[16]). In order to facilitate such studies, it is desirable to have a compilation of all available experimental information on the systematics of $E3$ excitations.

Detailed compilations of reduced $E2$ transition probabilities $[B(E2;0_1^+ \rightarrow 2_1^+)]$ from the ground (0_1^+) to the first 2^+ state (2_1^+) of even–even nuclides were made by Stelson and Grodzins[17] in 1965 and more recently by Raman et al.[18] However, there appears to have been no similar compilation for $E3$ transitions. The present work assembles and evaluates available experimental information on $E_x(3_1^-)$, the excitation energy of the first 3^- state, and $B(E3;0_1^+ \rightarrow 3_1^-)$, the reduced $E3$ transition probability from the ground state to the first 3^- state, for even–even nuclides throughout the periodic table. The abbreviations $B(E3)\uparrow$ and $B(E2)\uparrow$ will sometimes be used for $B(E3;0_1^+ \rightarrow 3_1^-)$ and $B(E2;0_1^+ \rightarrow 2_1^+)$, respectively. Although it is well known that substantial fragmentation of the low-lying octupole strength occurs in some parts of the periodic table, the present considerations are restricted to the first 3^- state for the sake of definiteness and consistency. The experimental information available for $B(E3)\uparrow$ values is much less extensive, and generally less precise, than that available for $B(E2)\uparrow$ values. The literature has been covered to March 1988.

Excitations Energies of 3_1^- States

Before considering values of $B(E3)\uparrow$, it is necessary to identify the states involved. Table I is a compilation of all excitation energies $E_x(3_1^-)$ of 3_1^- states known to the present author. Most of the data have been taken from *Nuclear Data Sheets* and similar compilations. Values enclosed in square brackets are regarded as doubtful, either because there is significant doubt about the 3^- assignment or because it is possible that some lower-lying state may also have spin and parity 3^-; usually the "doubtful" assignation follows the original compiler.

Values of $E_x(3_1^-)$ listed in Table I are plotted in Figs. 1a, 2a, and 3a versus A, Z, and N, respectively (A is the mass number, Z is the atomic number, and N is the neutron number). For the sake of comparison corresponding plots of $E_x(2_1^+)$, the excitation energy of the first 2^+ state, are shown in Figs. 1b, 2b, and 3b, the data being obtained from the compilation of Raman et al.[18]

Strong shell-structure effects are evident for both $E_x(3_1^-)$ and $E_x(2_1^+)$. The plots of $E_x(2_1^+)$ show peaks at $Z = 8, 20, 28, 50$, and 82, with a strong suggestion of a peak at $Z = 40$, and at $N = 8, 20, 28, 50, 82$, and 126. The plots of $E_x(3_1^-)$ show peaks at $Z = 28, 50$, and 82 and at $N = 28, 50, 82$, and 126, with a suggestion of peaks at $Z = 12$ and at $N = 12$. It is striking that the $E_x(3_1^-)$ data show no peaks at the magic numbers 8 and 20. Also, the peaks in the $E_x(3_1^-)$ data are broader than those for the $E_x(2_1^+)$ data, with a smaller peak-to-background ratio. The $E_x(3_1^-)$ data show a depression at $A \cong 220$–230 which is not apparent in the $E_x(2_1^+)$ plots.

Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Various Experimental Procedures

Values of $B(E3)\uparrow$ have been determined using a variety of experimental procedures. These procedures are discussed briefly below, and in each case values obtained for $B(E3)\uparrow$ are tabulated.

The data were compiled from an overall survey of the literature, usually beginning for each nuclide by reference to *Nuclear Data Sheets* and similar compilations. With the exception of the deformation-parameter data of Section (d), an attempt was made to include all relevant published information.

(a) Coulomb Excitation

The determination of reduced electric transition probabilities by Coulomb excitation is model independent. However, there are some pitfalls which must be avoided if reliable results are to be obtained.

It is necessary for the valid application of Coulomb-excitation theory that data be obtained at bombarding energies sufficiently low that contributions from nuclear interactions are negligible. Ideally, the maximum safe bombarding energy should be determined by direct measurement for each experimental configuration.[19] The use of data obtained at unsafe bombarding energies can produce values of reduced electric transition probabilities which are substantially in error. For example, McGowan et al.[20] have suggested that the relatively large values of $B(E3)\uparrow$ obtained in the early work of Hansen and Nathan[21] (about three times as large as those of subsequent workers) are due to their use of unsafe bombarding energies.

There are numerous higher-order effects which contribute to the Coulomb excitation of a 3_1^- state; for example, the reorientation effect involving the static electric quadrupole moment of the state; interference effects due to virtual excitation of other states, including the states of the giant-dipole resonance; and multiple excitation via lower excited states, chiefly the 2_1^+ state. These and other higher-order processes are discussed in several excellent reviews (for example, Refs. 22, 23). Because the Coulomb excitation probability of the 3_1^- state is usually small, the precision with which $B(E3)\uparrow$ is determined is often limited by statistics, and corrections for higher-order effects are relatively unimportant. However, as experimenters strive for increasing accuracy such corrections become increasingly significant.

In general, awareness of experimental precautions and corrections needed to obtain reliable transition probabilities from Coulomb excitation has increased with time. Therefore, recently measured values tend to be more reliable than older results.

Values of $B(E3)\uparrow$ obtained from Coulomb excitation are presented in Table II.

(b) Lifetime Measurements

The determination of $B(E3)\uparrow$ values from measurements of nuclear lifetimes is model independent. A comprehensive review of the various techniques for lifetime measurement, together with the uncertainties inherent in each technique, has been given by Alexander and Forster.[24] A knowledge of the lifetime is not in itself

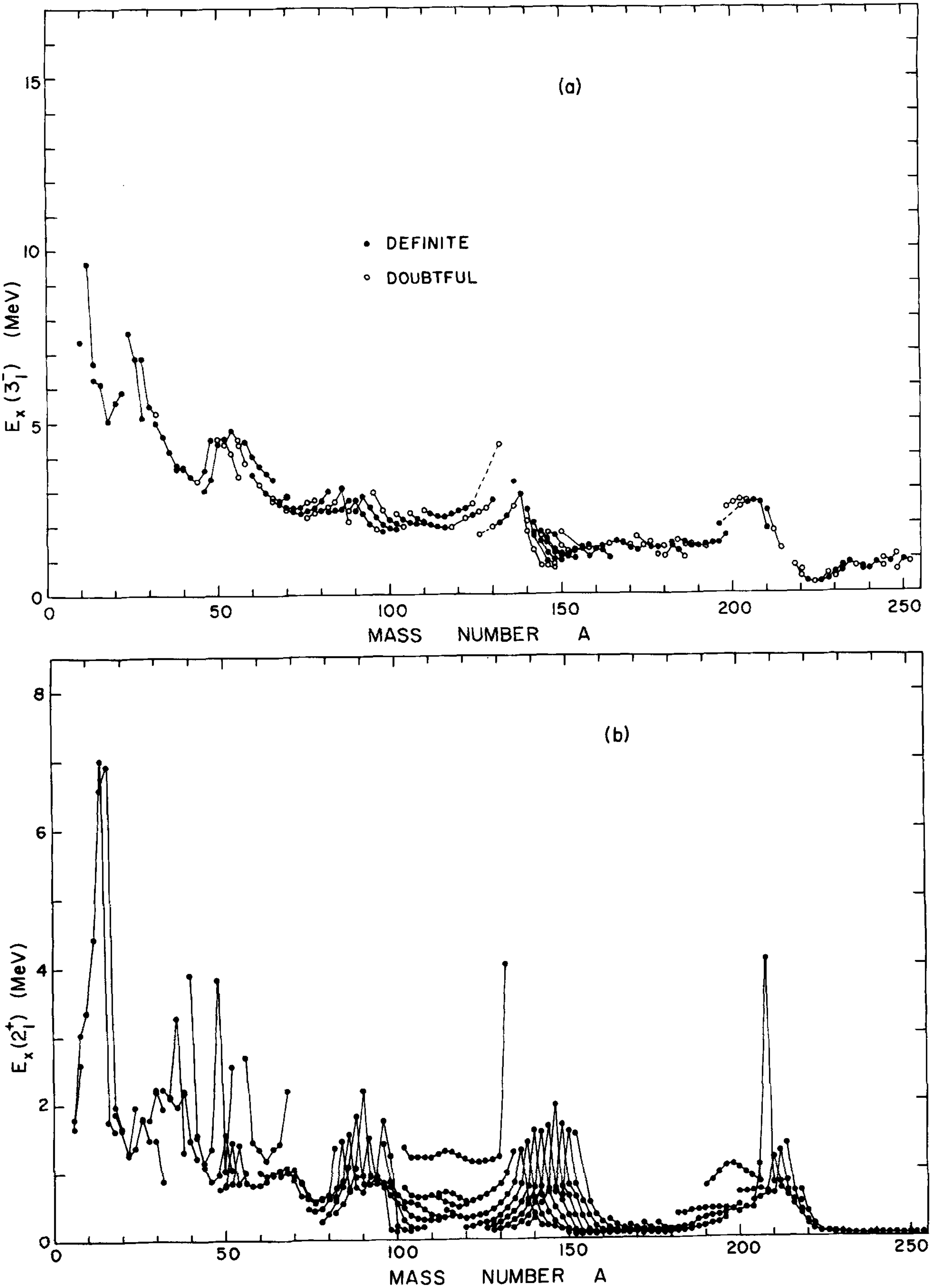

Figure 1. (a) Excitation energy, $E_x(3_1^-)$, of the first 3^- state in even–even nuclides as a function of mass number A (Table I). The open circles correspond to doubtful assignments. The lines connect isotopes. (b) Excitation energy $E_x(2_1^+)$, of the first 2^+ state in even–even nuclides as a function of mass number A. The data are taken from Ref. 18. The lines connect isotopes.

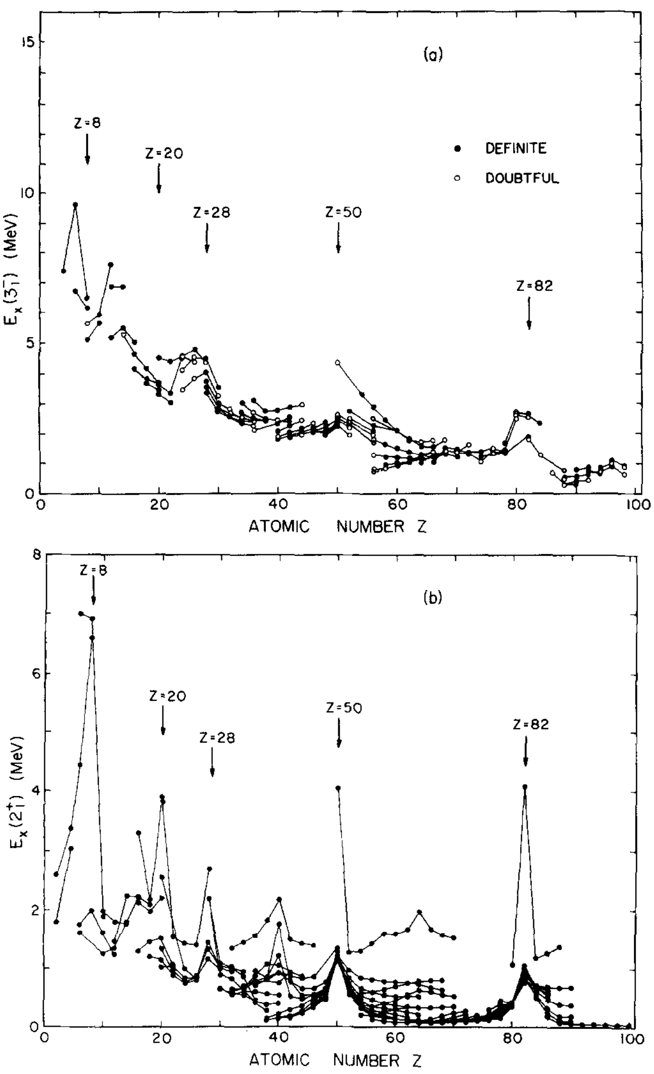

Figure 2. As for Fig. 1, but as a function of atomic number Z. The lines connect isotones.

sufficient to determine $B(E3)\uparrow$; it is also necessary to know the ground-state branching ratio, that is, the fraction of 3_1^- state decays which proceed by $E3$ radiation to the ground state. There are many nuclides for which the lifetime of the 3_1^- state is known but for which the ground-state branching ratio has not been determined. The $B(E3)\uparrow$ value is deduced using the formula

$$B(E3)\uparrow = 1.226 \times 10^{-8}/(E_\gamma^7 \tau_{E3})\ e^2b^3, \qquad (1)$$

where E_γ is the γ-ray energy in MeV, and τ_{E3} is the partial mean lifetime for $E3$ γ-ray emission to the ground state, in seconds (τ_{E3} is determined from the mean lifetime τ and the ground-state branching ratio).

Lifetimes, branching ratios, and deduced values of $B(E3)\uparrow$ are given in Table III. No corrections have been made for internal conversion because the correction is in each case much less than 1%, which is insignificant compared to the experimental uncertainties in the lifetime determinations; the one exception occurs in the case of ^{182}W, where a substantial proportion of the 3_1^- state decays occur via internal conversion to states other than the ground state.

(c) Inelastic Electron Scattering

The determination of reduced electric transition probabilities from inelastic electron scattering is model

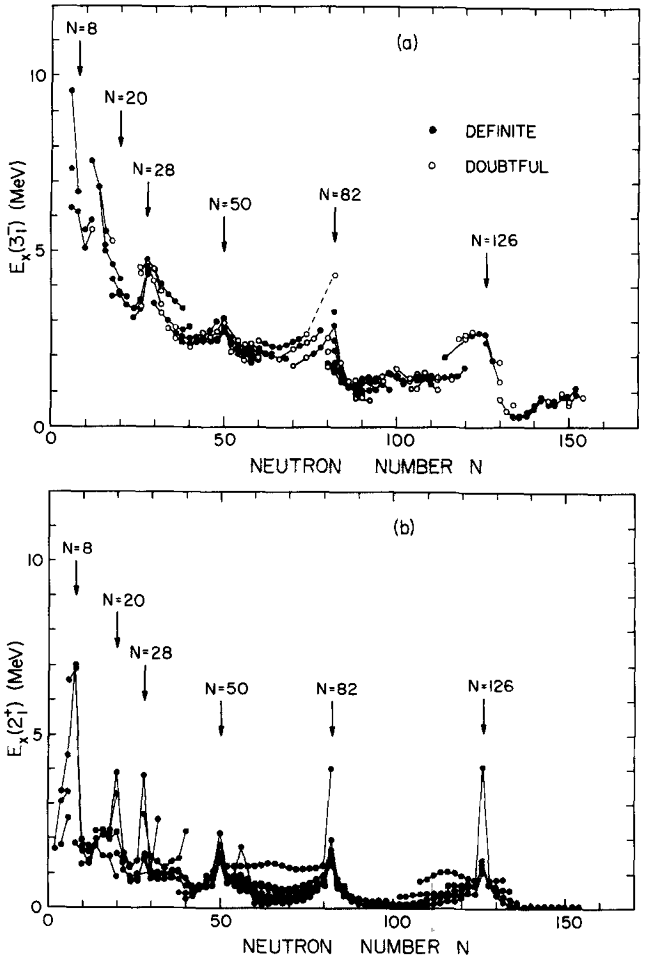

Figure 3. As for Fig. 1, but as a function of neutron number N. The lines connect isotopes.

dependent to varying degrees depending on the experimental conditions and the methods of analysis. Some recent work is claimed to be model independent (for example, Refs. 25, 26). In recent years there has been a great improvement in the quality of available electron beams and in the resolution of electron spectrometers. Methods of analysis have also become more sophisticated.[27] Therefore, more recently obtained results tend to be more reliable. A brief but useful discussion of the application of inelastic electron scattering to the determination of electric transition strengths has been given by Alexander and Forster.[24]

Values of $B(E3)\uparrow$ determined from inelastic electron scattering are listed in Table IV, together with the bombarding energies and values of momentum transfer used.

(d) Deformation Parameters Determined from Inelastic Scattering of Nucleons and Light Ions

Values of $B(E3)\uparrow$ are frequently deduced from deformation parameters, β_3, determined by analyzing the angular distributions of inelastically scattered nuclear particles (that is, protons, neutrons, deuterons, ^{3}He, ^{4}He, etc.). Such analyses may be performed using a variety of procedures, for example, distorted-wave Born approximation and coupled-channel calculations, usually assuming some particular nuclear model. The $B(E3)\uparrow$ value is then deduced using the formula

$$B(E3)\uparrow = (3/4\pi)^2\,(ZeR^3)^2\beta_3^2, \qquad (2)$$

where R is the nuclear radius. This formula (derived, for example, in Ref. 28) assumes a collective model of the nucleus and a uniform charge distribution with sharp cutoff at radius R. It is usually assumed that $R = r_0A^{1/3}$. If, as is most frequently done, it is further assumed that $r_0 = 1.20$ fm, then

$$B(E3)\uparrow = 1.702 \times 10^{-7}(ZA\beta_3)^2\ \mathrm{e^2b^3}. \qquad (3)$$

Clearly, this procedure is highly model dependent and is subject to large variations among various authors in the choice of such things as method of angular-distribution analysis, optical-model parameters, and nuclear radius. It must be regarded as less reliable than the traditional methods of Coulomb excitation and lifetime measurement.

Nevertheless, there are many nuclei for which the only available information on $B(E3)\uparrow$ is that obtained from β_3. It would presumably be possible to improve the reliability of available $B(E3)\uparrow$ values obtained in this way by carefully reanalyzing each experiment using a consistent approach and the best available reaction theory. However, the work involved would be prohibitive. It is therefore desirable to assess the reliability of $B(E3)\uparrow$ values obtained from the simple global procedure of taking each author's published value of β_3 at its face value and applying expression (3). A preliminary analysis indicated that β_3 values obtained from inelastic proton scattering, [β_3(p)], gave $B(E3)\uparrow$ values in substantial agreement with those determined from more traditional methods. Values obtained for other projectiles were significantly smaller than those for protons, as has been noted previously (for example, Refs. 29, 30). A more complete evaluation is described below. However, it seems clear that in determining $B(E3)\uparrow$ from β_3 values, data from (p, p′) angular distributions give reasonably reliable results and are preferable to those from other, heavier projectiles.

Table V is a compilation of β_3 values determined from inelastic scattering of protons, and of other projectiles where no (p, p′) data were available. It is not claimed that the compilation covers all available data, but it should be adequately representative. Values of β_3 enclosed in square brackets correspond to cases where authors give deformation lengths ($\delta_3 = \beta_3R$) only; they have been calculated assuming $R = 1.20A^{1/3}$ fm. No errors are assigned to individual values of β_3 and $B(E3)\uparrow$ because most authors do not quote uncertainties in their results; in any case, it is difficult to assess the effects of model dependence. Values of $B(E3)\uparrow$ have been calculated from β_3 using expression (3), that is, assuming $r_0 = 1.20$ fm; those who prefer some other value of r_0 can easily do their own arithmetic.

(e) Miscellaneous Procedures

Table VI presents values of $B(E3)\uparrow$ determined from procedures other than those described above. Most entries are derived from the measurement of (d, d′) cross sections at a particular angle (usually 90° or 125°). It is assumed that there is a linear relationship between the (d, d′) cross section for the 3_1^- state and the $B(E3)\uparrow$ value. The constants of proportionality are determined semiempirically from nuclei with known values of $B(E3)\uparrow$ (usually determined from Coulomb excitation). For most of these results the authors do not assign uncertainties; their reliability will be discussed below.

Adopted Values of $B(E3;0_1^+ \rightarrow 3_1^-)$

In deciding the best available values of $B(E3)\uparrow$, results obtained from model-independent procedures (Coulomb excitation; lifetime measurement; and, to a lesser degree, inelastic electron scattering) have been given greatest weight, except where there is good reason to believe that the experimental or analytical technique used in a particular experiment was flawed. It was recognized that recent data are more likely to be reliable than older data, because of improved experimental facilities (for example, improved quality of electron beams for (e, e′) studies), increased awareness of potential experimental problems (for example, the necessity of safe bombarding energies in Coulomb excitation) or more sophisticated analysis procedures (due, for example, to increased computing power). Results published in refereed journals were given priority over those reported in laboratory progress reports, private communications, etc.

In all of this there is an inevitable element of subjectivity. However, all the information used is presented in Tables I to VI, so those who disagree with the present selection of "adopted values" can readily perform their own evaluations.

Adopted values of $B(E3)\uparrow$ are presented in Table VII. Also given are single-particle strengths, in Weisskopf units (W.u.) and the product $E_x(3_1^-) \times B(E3)\uparrow$, expressed as a percentage of the energy-weighted sum-rule (EWSR) strength.

The single-particle strength $|M(E3)|^2$ has been evaluated using the expression

$$|M(E3)|^2 = 2.404 \times 10^6 B(E3)\uparrow/A^2 \text{ W.u.}, \qquad (4)$$

where $B(E3)\uparrow$ is in units of e^2b^3 (Ref. 24). This expression is based on the assumption that $r_0 = 1.20$ fm. Since expression (3) also uses $r_0 = 1.20$ fm, the combination of expressions (3) and (4) gives

$$|M(E3)|^2 = 0.409 Z^2 \beta_3^2 \text{ W.u.} \qquad (5)$$

independent of choice of nuclear radius.

The EWSR, obtained from relations (6-177) of Ref. 1 and (14.67) of Ref. 28, is given by

$$S(E3) = \sum_n E_x(3_n^-) \times B(E3;0_1^+ \rightarrow 3_n^-)$$

$$= 63e^2(\hbar^2/8\pi m)ZR^4, \qquad (6)$$

where m is the nucleon mass. Assuming $R = 1.20A^{1/3}$ fm, one obtains

$$S(E3) = 0.217 Z A^{4/3} \text{ keV } e^2b^3. \qquad (7)$$

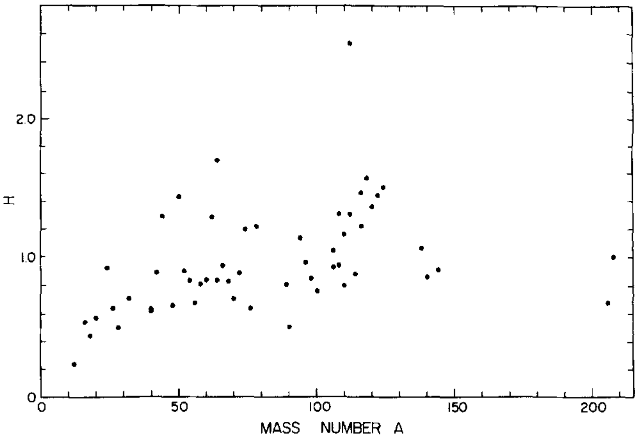

Figure 4. Plot of the ratio H as a function of mass number A, where H = [mean value of $B(E3;0_1^+ \rightarrow 3_1^-)$ determined from β_3(p) (Table V)]/[adopted value of $B(E3;0_1^+ \rightarrow 3_1^-)$ (Table VII)].

The final column of Table VII gives the quantity $E_x(3_1^-) \times B(E3)\uparrow$ as a percentage of $S(E3)$.

In order to assess the reliability of those adopted values of $B(E3)\uparrow$ obtained from model-dependent analysis involving deformation parameters β_3, and to assign uncertainties to the values, the following procedure was used. For all nuclides whose adopted value was obtained from Coulomb excitation, lifetime measurement, or inelastic electron scattering (or some combination thereof), and for which deformation parameters from inelastic proton scattering [β_3(p)] were available (Table V), the ratio H was calculated, where H = [unweighted mean value of $B(E3)\uparrow$ from β_3(p) (Table V)]/[adopted value of $B(E3)\uparrow$ (Table VII)]. The quantity H is plotted as a function of A in Fig. 4. Considering all values of A, the unweighted mean value of H is 0.97. For $A > 20$, the mean value, for 51 nuclides, is 1.01 with a standard deviation of 0.36. Thus, it seems that no correction factor need be applied to $B(E3)\uparrow$ values determined from β_3(p) assuming $r_0 = 1.20$ fm, and that the uncertainties are approximately one-third of the values; accordingly, the uncertainties assigned to these adopted values in Table VII are 33.3%. A similar analysis for cases where the adopted value of $B(E3)\uparrow$ is determined from β_3 values other than β_3(p) showed that the following correction factors should be applied: 1.38 for neutrons, 1.40 for deuterons, 1.51 for ^{4}He, and 2.13 for ^{3}He projectiles, with an uncertainty of 50% in the values so obtained. The corresponding adopted values of Table VII have been obtained following this prescription.

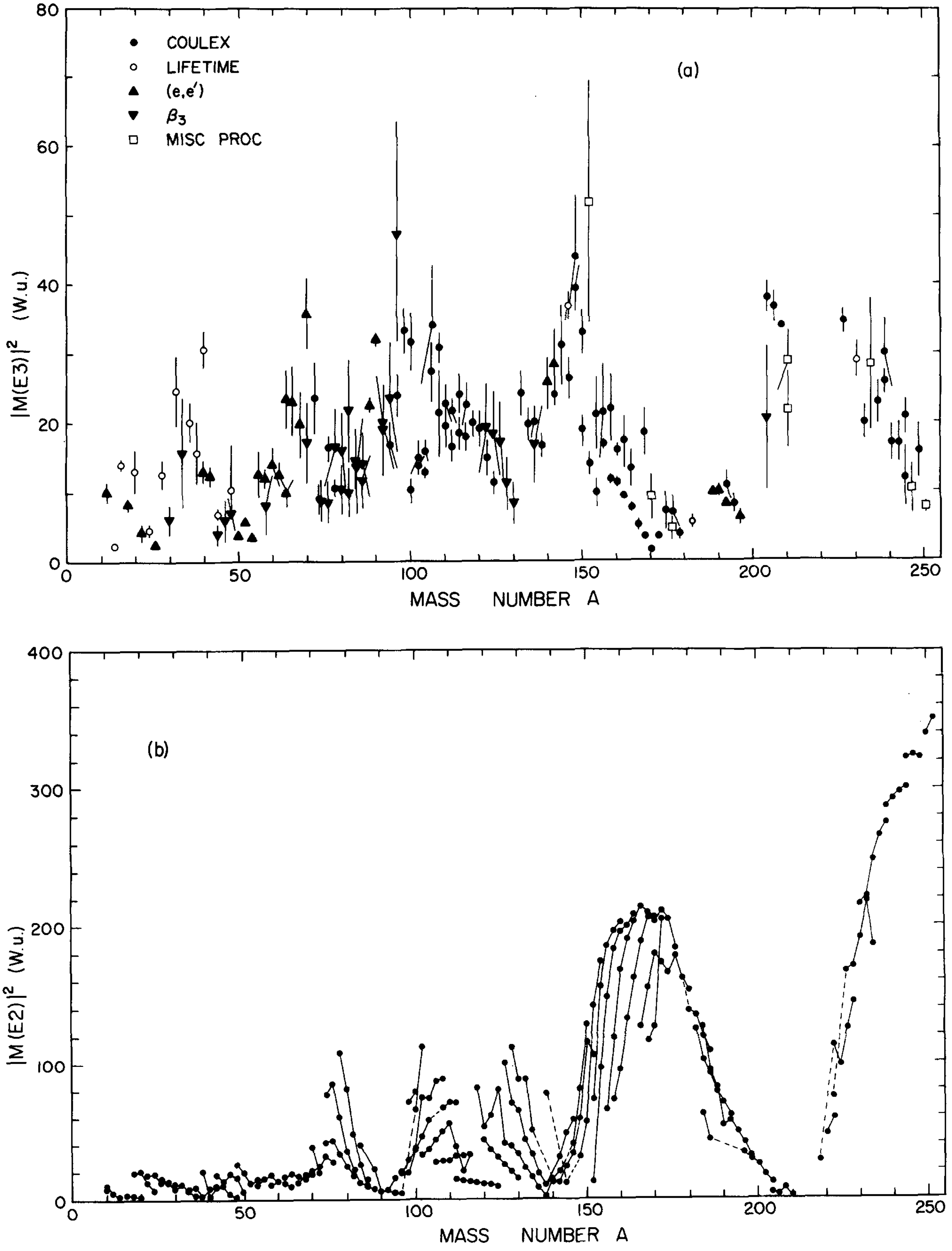

Figure 5. (a) Single-particle strength $|M(E3)|^2$ as a function of mass number A for $0_1^+ \rightarrow 3_1^-$ transitions (column 6 of Table VII). (b) Single-particle strength $|M(E2)|^2$ as a function of mass number A for $0_1^+ \rightarrow 2_1^+$ transitions (given by $[\beta_2/\beta_{2(\mathrm{sp})}]^2$ of Ref. 18).

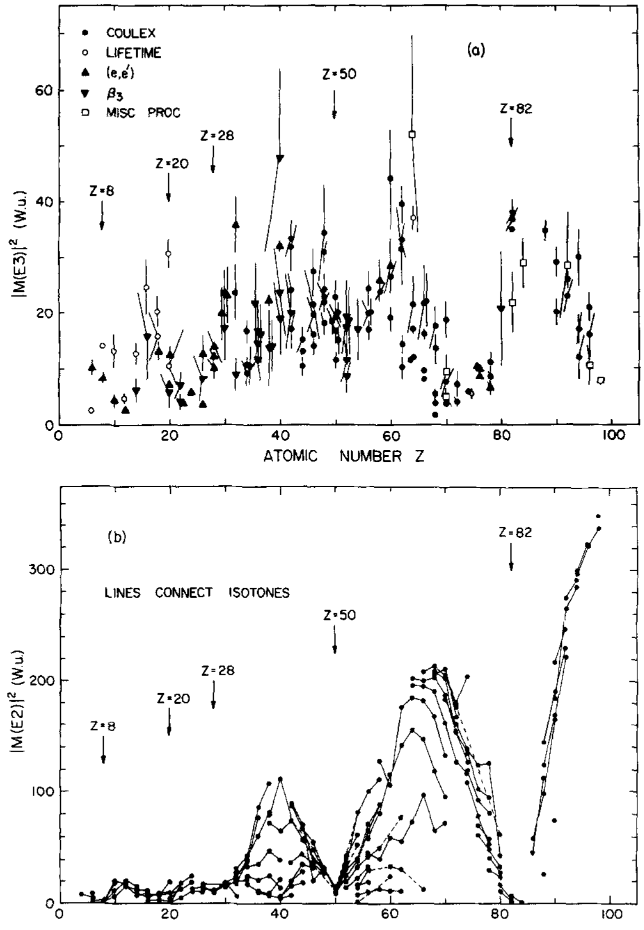

Figure 6. As for Fig. 5, but as a function of atomic number Z.

There are six adopted values obtained from (d, d′) scattering at specific angles and energies [(d, d′)(θ)(E)]. For ^{152}Gd, ^{170}Yb, ^{176}Yb, and ^{234}U, it was possible to allow for such things as the possibility that the data originally used for normalization might have been subsequently superseded, by comparing results obtained for other nuclides in the same experiments with results obtained from "traditional" techniques, and determining appropriate correction factors. An uncertainty of 33.3% has been assigned to the adopted values so obtained, based upon the scatter in correction factors. This procedure was not possible for ^{246}Cm and ^{250}Cf because no values for other nuclides were available for comparison. The uncertainty assigned to the adopted value of ^{246}Cm is 33.3%, the same as the uncertainty deduced for ^{152}Gd, ^{170}Yb, ^{176}Yb, and ^{234}U. The uncertainty quoted for ^{250}Cf is that assigned by the original authors.

The adopted values of $|M(E3)|^2$ are plotted as functions of A, Z, and N in Figs. 5, 6, and 7, respectively. Also shown, for the sake of comparison, are corresponding plots of $|M(E2)|^2$ for 0_1^+ to 2_1^+ transitions, obtained using the compilation of Raman et al.[18] All the $E3$ transitions are stronger than 1 W.u., and the strongest range up to about 40 W.u. There are suggestions of structure in the $|M(E3)|^2$ plots. However, any shell effects which may be present are certainly less prominent than in the corresponding plots of $E_x(3_1^-)$ in Figs. 1, 2, and 3. On the other hand, the plots of $|M(E2)|^2$ show pronounced minima at the magic numbers 50, 82, and 126.

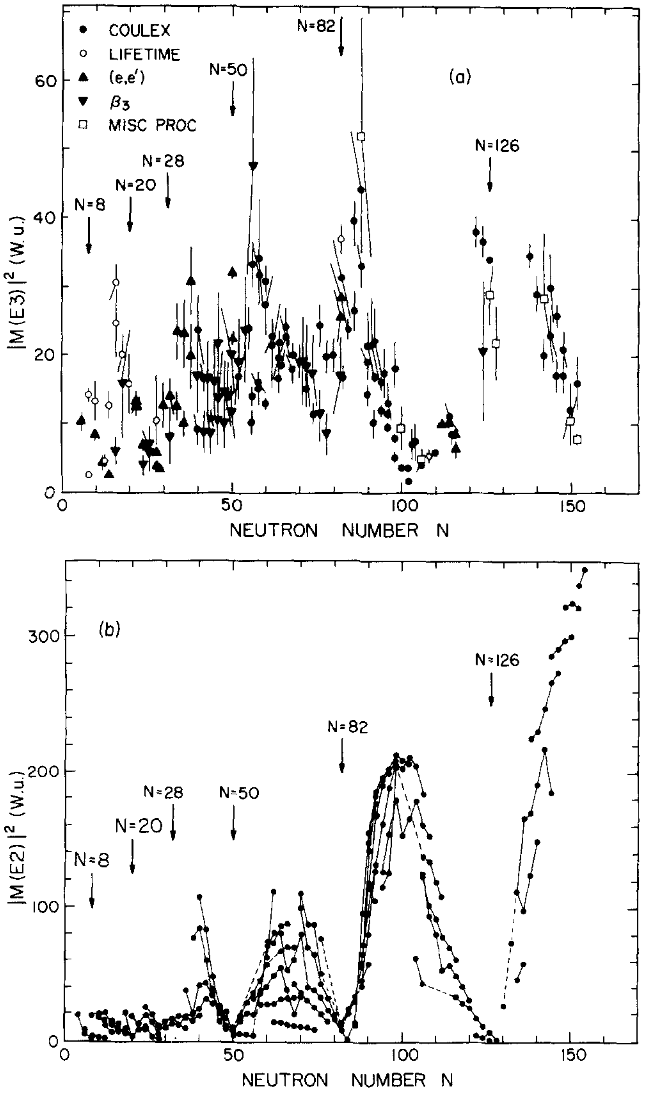

Figure 7. As for Fig. 5, but as a function of neutron number N.

TABLE A

Levels of Accuracy for Adopted Values of $B(E2)\uparrow$ (Table I of Ref. 18) and $B(E3)\uparrow$ (Table VII of Present Work)

Accuracy (%)	Number of nuclides $B(E2)\uparrow$	$B(E3)\uparrow$ (traditional methods)	$B(E3)\uparrow$ (all methods)
<2	51	1	1
≥2–<5	83	2	5
≥5–<10	72	25	30
≥10–<25	57	54	70
≥25	18	8	47
Total	281	90	153

Data Base

Measurements of $B(E3)\uparrow$ are fewer, and generally less precise, than those of $B(E2)\uparrow$, largely because the 3_1^- state is almost always at a substantially higher excitation energy than the 2_1^+ state. It is of interest to compare the data base of the present work with that of the $B(E2)\uparrow$ compilation of Raman et al.[18] The number of data available on $B(E2)\uparrow$ is sufficiently great that Raman et al. were able to restrict their adopted values to data obtained by "traditional methods," that is, Coulomb excitation, lifetime measurements, and resonance fluorescence. They listed 1605 $B(E2)\uparrow$ values from traditional measurements; the number of $B(E3)\uparrow$ values from traditional measurements covered in the present work is 151. The lower precision of the $B(E3)\uparrow$ data is demonstrated in Table A. A summary of the experimental methods used in determining $B(E3)\uparrow$ values is given in Table B.

TABLE B

Methods Employed in Obtaining the Measured Values of $B(E3)\uparrow$ Listed in Tables I to VI

Method	Number of measurements
Coulomb excitation	136
Lifetime measurements	15
Inelastic electron scattering	70
Deformation parameter β_3	249
Inelastic deuteron scattering	30
Others	4
Total	504

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EXPLANATION OF TABLES

TABLE I. Excitation Energies of 3_1^- States in Even–Even Nuclides

Throughout this table the italicized numbers refer to the uncertainties in the last digits of the quoted values.

Nuclide	The even Z, even N nuclide studied
Z	Atomic number of nuclide
N	Neutron number of nuclide
$E_x(3_1^-)$	Excitation energy of the first 3^- state in keV. Entries enclosed in square brackets correspond to doubtful assignments.
References	References for the energy values, keyed to the list following Table VII

TABLE II. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Coulomb Excitation

Throughout this table, the italicized numbers refer to the uncertainties in the last digits of the quoted values.

Nuclide	The even Z, even N nuclide studied
Projectile	The bombarding projectile(s) used
Detection	The radiation detected: γ rays (γ), particles (part)
$B(E3;0_1^+ \rightarrow 3_1^-)$	Reduced electric-octupole transition rate, in units of e^2b^3
References	References keyed to the list following Table VII
ϵ	Where appropriate, the value assumed by the compiler for the branching ratio of decay of the 3_1^- state to the 2_1^+ state

TABLE III. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Lifetime Measurements

Throughout this table, the italicized numbers refer to the uncertainties in the last digits of the quoted values.

Nuclide	The even Z, even N nuclide studied
τ	The mean lifetime of the state
Value	The value of τ, in seconds
Method	Method used for lifetime determination (Ref. 24)
DBLA	Doppler-broadened lineshape analysis
DC	Delayed coincidence
DSAM	Doppler-shift attenuation method
RC	Radiative capture
RDM	Recoil-distance method
RF	Resonance fluorescence
References	References for the lifetime values, keyed to the list following Table VII
GSB	Ground-state branching ratio (the fraction of 3_1^- state decays which proceed via $E3$ radiation to the ground state)
Value	Value of GSB in %
References	References for GSB values, keyed to the list following Table VII

EXPLANATION OF TABLES continued

$\mathrm{B(E3;0_1^+ \to 3_1^-)}$	Reduced electric-octupole transition rate, in units of e^2b^3 $B(E3;0_1^+ \to 3_1^-) = 1.226 \times 10^{-8}/(E_\gamma^7 \tau_{E3})$ [Eq. (1)], where E_γ is the γ-ray energy, in MeV, and τ_{E3} is the mean lifetime for $E3$ γ-ray emission to the ground state, in seconds (τ_{E3} is determined from τ and GSB)

TABLE IV. Values of $B(E3;0_1^+ \to 3_1^-)$ Determined from Inelastic Electron Scattering

Throughout this table, the italicized numbers refer to the uncertainties in the last digits of the quoted values.

Nuclide	The even Z, even N nuclide studied
E	Electron bombarding energies used, in MeV
q	Momentum transfers used, in fm^{-1}
$\mathrm{B(E3;0_1^+ \to 3_1^-)}$	Reduced electric-octupole transition rate, in e^2b^3
References	References keyed to the list following Table VII

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \to 3_1^-)$

All data are from proton scattering unless indicated otherwise.

Nuclide	The even Z, even N nuclide studied
References	References for the β_3 values, keyed to the list following Table VII
E	Projectile energy, in MeV
δ_3	Deformation length deduced in the experiment, in fm ($\delta_3 = \beta_3 R$, where R is the nuclear radius)
β_3	Deformation parameter deduced in the experiment (values in square brackets are calculated from δ_3 assuming $R = 1.20A^{1/3}$ fm)
$\mathrm{B(E3;0_1^+ \to 3_1^-)}$	Reduced electric-octupole transition rate, in e^2b^3 $B(E3;0_1^+ \to 3_1^-) = 1.702 \times 10^{-7}(ZA\beta_3)^2\ e^2b^3$ [Eq. (3)]
Mean B(E3)↑	Unweighted mean value of $B(E3;0_1^+ \to 3_1^-)$ for each nuclide, in e^2b^3
Projectile	Specification of the projectile when it is not a proton

TABLE VI. Values of $B(E3;0_1^+ \to 3_1^-)$ Determined from Miscellaneous Procedures

Where appropriate in this table, the italicized numbers refer to the uncertainties in the last digits of the quoted values.

Nuclide	The even Z, even N nuclide studied
References	References keyed to the list following Table VII

EXPLANATION OF TABLES continued

$B(E3;0_1^+ \rightarrow 3_1^-)$	Reduced electric-octupole transition rate, in e^2b^3
Method	Method employed in the measurement
(d, d′)(θ)(E)	Semiempirical relationship between $B(E3;0_1^+ \rightarrow 3_1^-)$ value and cross section for (d, d′) at angle θ° and bombarding energy E, in MeV
^{181}Ta(p, 2nγ)^{180}W	Analysis of γ decay in ^{181}Ta(p, 2nγ)^{180}W
γ	Model-dependent analysis of γ-ray transitions
(t, t′), (d, d′), (p, p′)	From cross section in (t, t′), (d, d′), and (p, p′) relative to ^{208}Pb, assuming $B(E3;0_1^+ \rightarrow 3_1^-) = 0.611 \pm 0.009\ e^2b^3$ for ^{208}Pb

TABLE VII. Adopted Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ and Related Quantities

Throughout this table, the italicized numbers refer to the uncertainties in the last digits of the quoted values.

Nuclide	The even Z, even N nuclide studied
$E_x(3_1^-)$	Excitation energy of first 3^- state in keV (Table I)
$B(E3;0_1^+ \rightarrow 3_1^-)$	Adopted value of reduced electric-octupole transition rate, in e^2b^3
Procedure	The experimental procedure used in obtaining the data upon which the adopted value of $B(E3;0_1^+ \rightarrow 3_1^-)$ is based
Coulex	Coulomb excitation (Table II)
τ	Lifetime measurement using RDM (recoil-distance method), DSAM (Doppler-shift attenuation method), RC (radiative capture), or DC (delayed coincidence) (Table III)
(e, e′)	Inelastic electron scattering (Table IV)
β_3(x)	Deformation parameters β_3 determined from the inelastic scattering of particles (Table V)
(d, d′)(θ)	Semiempirical relationship between $B(E3;0_1^+ \rightarrow 3_1^-)$ value and cross section for (d, d′) at angle θ° (Table VI)
γ	Model-dependent analysis of γ-ray transitions (Table VI)
(t, t′), (d, d′), (p, p′)	From cross section in (t, t′), (d, d′), and (p, p′) relative to ^{208}Pb (Table VI)
References	References keyed to the list following Table VII
$\lvert M(E3)\rvert^2$	$E3$ transition strength in Weisskopf units W.u. $\lvert M(E3)\rvert^2 = 2.404 \times 10^6 B(E3;0_1^+ \rightarrow 3_1^-)/A^2$ W.u. where $B(E3;0_1^+ \rightarrow 3_1^-)$ is in units of e^2b^3 [Eq. (4)].
EWSR	$E_x(3_1^-) \times B(E3;0_1^+ \rightarrow 3_1^-)$ expressed as a percentage of $S(E3)$, the energy-weighted sum-rule strength $S(E3) = 0.217ZA^{4/3}$ keV e^2b^3 [Eq. (7)]

TABLE I. Excitation Energies of 3_1^- States in Even–Even Nuclides

See page 66 for Explanation of Tables

Nuclide	Z	N	$E_x(3_1^-)$ (keV)	References
^{6}Be	4	2	27000	Aj84
^{10}Be	4	6	7371 *1*	Aj84
^{12}C	6	6	9641 *5*	Aj85
^{14}C	6	8	6728.2 *13*	Aj86a
^{14}O	8	6	6272 *10*	Aj86a
^{16}O	8	8	6129.893 *40*	Aj86
^{18}O	8	10	5097.78 *54*	Aj87
^{20}O	8	12	[5614 *3*]	Aj87
^{20}Ne	10	10	5621.4 *17*	Aj87
^{22}Ne	10	12	5909.9 *18*	En78
^{24}Mg	12	12	7616.2 *5*	En78
^{26}Mg	12	14	6877.7 *9*	En78
^{28}Mg	12	16	5171.8 *4*	En78
^{28}Si	14	14	6878.6 *3*	En78
^{30}Si	14	16	5487.5 *4*	En78
^{32}Si	14	18	[5288.8 *8*]	En78
^{32}S	16	16	5006.2 *3*	En78
^{34}S	16	18	4622.7 *4*	En78
^{36}S	16	20	4192.5 *7*	En78
^{36}Ar	18	18	4178.33 *11*	En78
^{38}Ar	18	20	3810.04 *7*	En78
^{40}Ar	18	22	3680.8 *2*	En78
^{38}Ca	20	18	3695 *5*	En78
^{40}Ca	20	20	3736.9 *2*	En78
^{42}Ca	20	22	3446.4 *8*	En78
^{44}Ca	20	24	3307.86 *7*	En78
^{46}Ca	20	26	3614.0 *9*	Al86
^{48}Ca	20	28	4506.90 *8*	Al85a
^{46}Ti	22	24	3058.54 *6*	Al86
^{48}Ti	22	26	3358.823 *16*	Al85a
^{50}Ti	22	28	4410.5	Al84
^{50}Cr	24	26	[4546.2 *12*]	Al84
^{52}Cr	24	28	4563	Be78
^{54}Cr	24	30	[4129.2 *30*]	Go87
^{56}Cr	24	32	[3451 *15*]	Ju87
^{52}Fe	26	26	[4398.3]	Be78
^{54}Fe	26	28	4782.0 *6*	Go87
^{56}Fe	26	30	[4510.0 *4*]	Au77,Ju87
^{58}Fe	26	32	[3845]	Pe84c
^{56}Ni	28	28	[4392 *3*]	Ju87
^{58}Ni	28	30	4475.3 *8*	Pe84c
^{60}Ni	28	32	4039.67 *15*	An86
^{62}Ni	28	34	3757.0 *5*	Ha79c
^{64}Ni	28	36	3560 *7*	Ha79b
^{66}Ni	28	38	3364 *10*	Wa83
^{60}Zn	30	30	3504.4 *12*	An86
^{62}Zn	30	32	[3216]	Ha79c
^{64}Zn	30	34	2998.60 *21*	Ha79b
^{66}Zn	30	36	[2827.0 *3*]	Wa83
^{68}Zn	30	38	2750.72 *9*	Ke81
^{70}Zn	30	40	2859.2 *2*	Bh87
^{66}Ge	32	34	[2798.6 *7*]	Wa83
^{68}Ge	32	36	2649.20 *11*	Ke81
^{70}Ge	32	38	2561.4 *1*	Bh87
^{72}Ge	32	40	2514.92 *3*	Ke80
^{74}Ge	32	42	2536.31 *2*	Si87
^{76}Ge	32	44	[2691.10 *16*]	Si84
^{78}Ge	32	46	[2744 *5*]	Ma78a
^{70}Se	34	36	[2519.2 *4*]	Bh87
^{72}Se	34	38	2405.73 *21*	Ke80
^{74}Se	34	40	2349.62 *12*	Si87
^{76}Se	34	42	2429.09 *2*	Si84
^{78}Se	34	44	2507.61 *11*	Si81a
^{80}Se	34	46	2717.4 *6*	Si82
^{82}Se	34	48	3009.8 *15*	Mü87
^{76}Kr	36	40	[2257.8 *3*]	Si84
^{78}Kr	36	42	[2399.02 *5*]	Si81a
^{80}Kr	36	44	2439.03 *25*	Si82
^{82}Kr	36	46	[2547.75 *5*]	Mü87
^{84}Kr	36	48	[2699.82 *15*]	Mü79
^{86}Kr	36	50	3099.28 *18*	Te78
^{88}Kr	36	52	[2115 *10*]	Bu76a
^{82}Sr	38	44	2401.98 *10*	Mü87
^{84}Sr	38	46	2447.92 *15*	Mü79
^{86}Sr	38	48	2482.02 *9*	Te78
^{88}Sr	38	50	2734.197 *41*	Wi87
^{88}Zr	40	48	[2456.0 *6*]	Bu76a
^{90}Zr	40	50	2749.9 *5*	Ko75a

TABLE I. Excitation Energies of 3_1^- States in Even–Even Nuclides
See page 66 for Explanation of Tables

Nuclide	Z	N	$E_x(3_1^-)$ (keV)	References
^{92}Zr	40	52	2339.72 *7*	Lu80
^{94}Zr	40	54	2057.64 *10*	Mü85
^{96}Zr	40	56	[1897.12 *16*]	Mü82
^{98}Zr	40	58	1806.02 *18*	Mü83
^{90}Mo	42	48	2437 *10*	Ko75a
^{92}Mo	42	50	2849.70 *8*	Lu80
^{94}Mo	42	52	2533.9 *3*	Mü85
^{96}Mo	42	54	2234.51 *6*	Mü82
^{98}Mo	42	56	2017.51 *7*	Mü83
^{100}Mo	42	58	1908.1 *3*	Ko74
^{102}Mo	42	60	1881 *5*	Ge82
^{94}Ru	44	50	[2965 *6*]	Mü85
^{98}Ru	44	54	[2435 *10*]	Mü83
^{100}Ru	44	56	2166.0 *5*	La80
^{102}Ru	44	58	2043.91 *20*	Ge82
^{104}Ru	44	60	[1970.4 *1*]	Bl84
^{102}Pd	46	56	[2341.7]	Lu86
^{104}Pd	46	58	2192.8	Lu86
^{106}Pd	46	60	2083.86 *5*	Fr88
^{108}Pd	46	62	2046.65 *14*	Ha82
^{110}Pd	46	64	[2037.68 *18*]	Ge83
^{106}Cd	48	58	[2370.5 *5*]	Ha80
^{108}Cd	48	60	2202.29 *19*	Ha82
^{110}Cd	48	62	2078.843 *12*	Ge83
^{112}Cd	48	64	2005.1 *5*	Pe80
^{114}Cd	48	66	1957.70 *6*	Bl82
^{116}Cd	48	68	1921.5 *10*	Bl81
^{110}Sn	50	60	[2459]	Ge83
^{112}Sn	50	62	2354.7 *4*	Pe80,Jo81
^{114}Sn	50	64	2274.7 *4*	Bl82
^{116}Sn	50	66	2266.09 *2*	Bl81
^{118}Sn	50	68	2324.75 *3*	Ra88
^{120}Sn	50	70	2401.03 *19*	Ra88
^{122}Sn	50	72	2492.73 *5*	Ra88
^{124}Sn	50	74	[2614.2 *3*]	Ta84
^{132}Sn	50	82	[4351.3]	Bj86
^{118}Te	52	66	[1944.37 *25*]	Ta87
^{122}Te	52	70	[2200 *1*]	Ki86
^{124}Te	52	72	2293.725 *4*	Ta84
^{126}Te	52	74	[2386.09 *12*]	Ta82
^{128}Te	52	76	[2494.17 *17*]	Ki83,De80
^{130}Te	52	78	2730 *10*	Ma75
^{136}Xe	54	82	3275.23 *13*	Bu87
^{126}Ba	56	70	[1743]	Sc86
^{130}Ba	56	74	[1948 *5*]	Bu85a
^{132}Ba	56	76	2070 *5*	Bu85a
^{134}Ba	56	78	2251 *5*	Bu85a
^{136}Ba	56	80	[2532.46 *7*]	Bu87
^{138}Ba	56	82	2880.98 *14*	Pe82,Bu85a
^{140}Ba	56	84	[1802.74 *12*]	Pe87a
^{142}Ba	56	86	[1292.2 *3*]	Pe84
^{144}Ba	56	88	[838.4]	Sc80
^{146}Ba	56	90	[820.8 *1*]	Pe84a
^{148}Ba	56	92	[775.0]	Hi86
^{140}Ce	58	82	2464.05 *6*	Pe87a
^{142}Ce	58	84	1652.6 *4*	Pe84
^{144}Ce	58	86	1242.1	Mi82
^{146}Ce	58	88	960.75 *8*	Pe84a
^{148}Ce	58	90	[841.35 *6*]	Pe84b
^{140}Nd	60	80	[2124.0]	Pe87a
^{142}Nd	60	82	2084.4 *7*	Pe84,Ra68
^{144}Nd	60	84	1510.53 *6*	Tu79
^{146}Nd	60	86	1189.6 *7*	Pe84a
^{148}Nd	60	88	999.3 *2*	Pe84b
^{150}Nd	60	90	934.6 *8*	Ma86
^{142}Sm	62	80	1784.1 *3*	Pe84
^{144}Sm	62	82	1810.1 *5*	Tu79
^{146}Sm	62	84	1380.2 *2*	Pe84a
^{148}Sm	62	86	1161.53 *5*	Pe84b
^{150}Sm	62	88	1071.40 *6*	Ma86
^{152}Sm	62	90	1041.180 *7*	Ba80
^{154}Sm	62	92	1012.62 *12*	He87
^{144}Gd	64	80	[1702.3]	Tu79
^{146}Gd	64	82	1579.3 *1*	Pe84a
^{148}Gd	64	84	1273.479 *20*	Pe84b
^{150}Gd	64	86	1134.35 *15*	Ma86
^{152}Gd	64	88	1123.189 *5*	Ba80
^{154}Gd	64	90	1251.75 *4*	He87
^{156}Gd	64	92	1276.105 *16*	He86
^{158}Gd	64	94	1041.587 *26*	Le80
^{160}Gd	64	96	[1289.7 *4*]	Le85
^{146}Dy	66	80	[1782.9 *4*]	Pe84a
^{148}Dy	66	82	1688.4 *1*	To88
^{150}Dy	66	84	[1395.0]	Ma86

TABLE I. Excitation Energies of 3_1^- States in Even–Even Nuclides

See page 66 for Explanation of Tables

Nuclide	Z	N	$E_x(3_1^-)$ (keV)	References
^{152}Dy	66	86	[1227.8 *3*]	Ba80
^{154}Dy	66	88	1208.01 *12*	He87
^{156}Dy	66	90	1368.90 *13*	He86
^{158}Dy	66	92	1397.17 *6*	Le80
^{160}Dy	66	94	1286.695 *24*	Le85
^{162}Dy	66	96	1210.24 *4*	He85
^{164}Dy	66	98	1039.31 *10*	Sh86
^{150}Er	68	82	[1786.4]	Ma86
^{156}Er	68	88	[1303.53 *11*]	He86
^{158}Er	68	90	[1341.95 *8*]	Le80
^{162}Er	68	94	1356.77 *8*	He85
^{164}Er	68	96	[1434.0 *1*]	Sh86
^{166}Er	68	98	1513.7 *2*	Ig87
^{168}Er	68	100	1431.461 *5*	Sh88
^{170}Er	68	102	1304.4 *4*	Sc75,McG78
^{168}Yb	70	98	1479.71 *14*	Sh88
^{170}Yb	70	100	[1398 *5*]	Ch87
^{172}Yb	70	102	1221.750 *19*	Go87a
^{174}Yb	70	104	[1381.98 *2*]	Br84
^{176}Yb	70	106	[1491]	Bu67a
^{172}Hf	72	100	[1639.67 *9*]	Go87a
^{176}Hf	72	104	1313.3 *2*	Ho76
^{178}Hf	72	106	1322.459 *4*	Ha86
^{180}Hf	72	108	[1374.43 *3*]	Br87
^{178}W	74	104	[1120.72 *12*]	Br88
^{180}W	74	106	[1082.366 *10*]	Br87
^{182}W	74	108	1373.86 *4*	Sc75a
^{184}W	74	110	1221.292 *25*	Ma77
^{186}W	74	112	[1045.06 *19*]	Sc74
^{182}Os	76	106	1471.5 *3*	Fi88
^{184}Os	76	108	[1543.94 *13*]	Ma77
^{186}Os	76	110	1480.10	Ya75a,Sp78a
^{188}Os	76	112	[1413.83 *9*]	Si81
^{190}Os	76	114	1387.01 *3*	Le82
^{192}Os	76	116	[1341.130 *16*]	Sh83
^{186}Pt	78	108	[1407.9 *2*]	Sc74
^{188}Pt	78	110	1350.31 *4*	Si81
^{190}Pt	78	112	1353.3 *3*	Le82
^{192}Pt	78	114	1377.995 *25*	Sh83,Ei85
^{194}Pt	78	116	1432.52 *6*	Ha77
^{196}Pt	78	118	1447.027 *6*	Ci79
^{198}Pt	78	120	1680.8	Ya83
^{198}Hg	80	118	[2486 *3*]	Au83,Ba81
^{200}Hg	80	120	[2609 *3*]	Sc87a
^{202}Hg	80	122	[2709 *3*]	Sc87b
^{204}Hg	80	124	[2679 *4*]	Sc87
^{196}Pb	82	114	1991.8	Du87
^{202}Pb	82	120	[2517.29 *8*]	Sc87b
^{204}Pb	82	122	2618 *2*	Sc87,Ba81
^{206}Pb	82	124	2647.9 *2*	We79
^{208}Pb	82	126	2614.551 *13*	Ma86a
^{210}Pb	82	128	1870 *7*	Ha81
^{212}Pb	82	130	[1820 *10*]	Ma79a
^{210}Po	84	126	2386.8 *2*	Ha81
^{214}Po	84	130	[1274.77 *2*]	To77
^{220}Rn	86	134	[663.03 *10*]	Ma86b
^{218}Ra	88	130	[794]	El87b
^{220}Ra	88	132	[473.8 *3*]	Ma86b
^{222}Ra	88	134	317.27 *9*	El87
^{224}Ra	88	136	[290.36 *4*]	Ma86b
^{226}Ra	88	138	321.54 *6*	El87a
^{228}Ra	88	140	[537.49 *4*]	Ma86b
^{224}Th	90	134	[306.0 *5*]	Ma86b
^{226}Th	90	136	307.5 *2*	El87a
^{228}Th	90	138	396.082 *4*	Ma86b
^{230}Th	90	140	571.70 *13*	El83
^{232}Th	90	142	774.4 *2*	Sc82
^{230}U	92	138	[421.2 *6*]	El83
^{232}U	92	140	628.968 *9*	Sc82
^{234}U	92	142	849.3 *3*	El83a
^{236}U	92	144	[744.2 *5*]	Sc82
^{238}U	92	146	731.9 *2*	Sh83a
^{238}Pu	94	144	661.43 *10*	Sh83a
^{240}Pu	94	146	648.89 *4*	Sh84
^{242}Pu	94	148	832.3 *2*	Sh85
^{244}Pu	94	150	[708 *4*]	Sh86a
^{244}Cm	96	148	[970 *4*]	Sh86a
^{246}Cm	96	150	876.43 *2*	Sc81
^{248}Cm	96	152	1094 *2*	Sc81
^{248}Cf	98	150	[630 *1*]	Sc81
^{250}Cf	98	152	905.90 *5*	Sc81
^{252}Cf	98	154	[867.51 *7*]	Sc81

TABLE II. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Coulomb Excitation
See page 66 for Explanation of Tables

Nuclide	Projectile	Detection	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	References	ϵ
^{70}Ge	^{16}O	γ	0.04 *3*	Le80a	
^{72}Ge	^{16}O	γ	0.051 *11*	Le80a	
^{74}Se	^{16}O	γ	0.021 *5*	Ba74	
^{76}Se	^{16}O	γ	0.040 *5*	Ba74	
^{78}Se	^{16}O	γ	0.027 *3*	Ba74	
^{80}Se	^{16}O	γ	0.009 *2*	Ba74	
^{94}Mo	^{4}He,^{16}O	γ	0.062 *12*	Ba72b	
^{96}Mo	^{4}He,^{16}O	γ	0.092 *12*	Ba72b	
^{98}Mo	^{4}He,^{16}O	γ	0.133 *13*	Ba72b	
^{100}Mo	^{4}He,^{16}O	γ	0.132 *17*	Ba72b	
^{100}Ru	^{16}O	γ	0.0432 *71*	La80	
^{102}Ru	^{16}O	γ	0.0654 *97*	La80	
^{104}Ru	^{16}O	γ	0.0579 *35*	La80	
^{102}Pd	^{16}O	γ	0.060 *6*	Lu86	
^{104}Pd	^{16}O	γ	0.072 *7*	Lu86	
^{106}Pd	^{16}O	γ	0.128 *20*	Ro69,Ha80	0.92
^{108}Pd	^{16}O	γ	0.104 *30*	Ro69,Ha82	0.89
^{110}Pd	^{16}O	γ	0.098 *16*	Ro69,De73	0.88
^{106}Cd	^{16}O	part	0.16 *4*	Fe85	
^{108}Cd	^{16}O	part	0.150 *10*	Fe85	
^{110}Cd	^{4}He	γ,part	0.63 *32*	Ha63	
	^{16}O	γ	0.119 *24*	McG65,Ge83	0.86
	^{16}O	part	0.115 *13*	Fe85	
^{112}Cd	^{4}He	γ,part	0.37 *18*	Ha63	
	^{16}O	γ	0.129 *25*	McG65,Pe80	0.82
	^{16}O	γ	0.192 *33*	Jo78,Pe80	0.82
	^{16}O	part	0.114 *9*	Fe85	

TABLE II. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Coulomb Excitation
See page 66 for Explanation of Tables

Nuclide	Projectile	Detection	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	References	ϵ
^{114}Cd	^{4}He	γ,part	0.40 *20*	Ha63	
	^{16}O	γ	0.118 *23*	McG65,Bl82	0.76
	^{16}O	γ	0.265 *68*	Jo78,Bl82	0.76
	^{16}O	part	0.131 *15*	Fe85	
^{116}Cd	^{16}O	γ	0.102 *21*	McG65,De73	0.73
	^{16}O	part	0.100 *11*	Fe85	
^{112}Sn	^{16}O	γ	0.087 *12*	Jo81	
^{114}Sn	^{4}He	γ,part	0.49 *25*	Ha63	
	^{14}N	γ	0.16 *7*	Al64	
	^{16}O	γ	0.100 *12*	Jo81	
^{116}Sn	^{4}He	γ,part	0.57 *30*	Ha63	
	^{14}N	γ,part	0.22 *9*	Al64	
	^{16}O	γ	0.127 *17*	Jo81	
^{118}Sn	^{14}N	γ	0.17 *7*	Al64	
	^{16}O	γ	0.097 *14*	Jo81	
	^{12}C	part	0.122 *6*	Sp88	
^{120}Sn	^{14}N	γ	0.13 *6*	Al64	
	^{16}O	γ	0.090 *17*	Jo81	
	^{12}C	part	0.131 *10*	Sp88	
^{122}Sn	^{4}He	γ,part	0.66 *27*	Ha63	
	^{14}N	γ,part	0.21 *8*	Al64	
	^{16}O	γ	0.110 *17*	Jo81	
	^{12}C	part	0.087 *6*	Sp88	
^{124}Sn	^{4}He	γ,part	0.60 *24*	Ha63	
	^{14}N	γ,part	0.20 *8*	Al64	
	^{16}O	γ	0.073 *10*	Jo81	
^{132}Ba	^{12}C	part	0.176 *22*	Bu85	
^{134}Ba	^{12}C	part	0.148 *18*	Bu85	
^{136}Ba	^{12}C	part	0.155 *18*	Bu85	
^{138}Ba	^{12}C	part	0.133 *13*	Bu85	
^{140}Ce	^{4}He	γ,part	0.76 *38*	Ha63	
^{142}Ce	^{4}He	γ,part	1.13 *60*	Ha63	
	^{4}He,^{12}C,^{16}O	part	0.202 *13*	Ve88	

TABLE II. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Coulomb Excitation
See page 66 for Explanation of Tables

Nuclide	Projectile	Detection	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	References	ϵ
^{142}Nd	^{4}He	γ,part	0.44 *22*	Ha63	
^{144}Nd	^{4}He	γ,part	0.26 *13*	Ha63	
^{146}Nd	^{4}He	γ,part	0.41 *20*	Ha63	
	^{16}O	γ	0.21 *4*	Bu67	
	^{4}He	part	0.26 *3*	Ch70	
^{148}Nd	^{4}He	γ,part	0.41 *21*	Ha63	
	^{16}O	γ	0.13 *4*	Bu67	
	^{4}He	part	0.40 *8*	Ah88	
^{150}Nd	^{4}He	γ,part	0.30 *15*	Ha63	
	^{4}He	part	0.175 *20*	Wo77	
	^{4}He	part	0.18 *3*	Ah88	
^{144}Sm	^{4}He	γ	0.27 *5*	Bu87	
^{148}Sm	^{16}O	γ	0.23 *13*	Se66	
	^{16}O	γ	0.37 *3*	Ke68	
	^{4}He	part	0.35 *4*	Ve68	
^{150}Sm	^{4}He	γ,part	0.25 *12*	Ha63	
	^{16}O	γ	0.36 *10*	Se66	
	^{16}O	γ	0.31 *3*	Ke68	
	^{4}He	part	0.32 *5*	Ve68	
^{152}Sm	^{4}He	γ,part	0.30 *15*	Ha63	
	^{16}O	γ,part	0.15 *5*	Se66	
	^{16}O	γ,part	0.14 *3*	Ke68	
	^{4}He	part	0.12 *3*	Ve68	
	^{4}He	part	0.135 *19*	Wo77	
^{154}Sm	^{4}He	γ,part	0.15 *8*	Ha63	
	^{16}O	γ,part	0.11 *3*	Ke68	
	^{4}He	part	0.09 *2*	Ve68	
^{154}Gd	^{4}He	part	0.21 *5*	Wo77	
^{156}Gd	^{4}He	part	0.16 *4*	Ro77a	
	^{4}He	γ	0.171 *7*	McG81	
^{158}Gd	^{4}He	γ	0.124 *7*	McG81	
^{160}Gd	^{4}He	part	0.127 *14*	Ro77a	
	^{4}He	γ	0.118 *7*	McG81	
^{156}Dy	^{4}He	part	0.22 *7*	Ro82	

TABLE II. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Coulomb Excitation
See page 66 for Explanation of Tables

Nuclide	Projectile	Detection	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	References	ϵ
^{158}Dy	^{4}He	part	0.23 *5*	Ro82	
^{160}Dy	^{16}O	γ,part	0.119	Oe74	
	^{4}He	γ	0.171 *10*	McG81	
^{162}Dy	^{16}O	γ,part	0.103	Oe74	
	^{4}He	γ	0.104 *7*	McG81	
^{164}Dy	^{16}O	γ,part	0.047	Oe74	
	^{4}He	γ	0.088 *6*	McG81	
^{162}Er	^{4}He	part	0.19 *4*	Ro82	
^{164}Er	^{4}He	part	0.15 *3*	Ro82	
^{166}Er	^{4}He	γ	0.061 *10*	McG78	
^{168}Er	^{4}He	γ	0.043 *6*	McG78	
^{170}Er	^{4}He	γ	0.020 *3*	McG78	
^{168}Yb	^{4}He	part	0.22 *4*	Ro82	
^{172}Yb	^{16}O	γ,part	0.048 *19*	Ri79	
	^{4}He	γ	0.045 *3*	Cr81	
^{174}Yb	^{16}O	γ,part	0.093 *33*	Ri79	
^{176}Hf	^{4}He	part	0.093 *29*	Ro77a	
^{178}Hf	^{4}He	part	0.053 *10*	Ro77a	
^{184}W			0.082 *6*	Mi76	
^{192}Pt	^{4}He	part	0.17 *3*	Ro77	
^{194}Pt	^{4}He	part	0.14 *3*	Ro77	
	^{4}He	part	0.111 *9*	Ba78a	
^{204}Pb	^{4}He,^{12}C,^{16}O	part	0.66 *4*	Sp78	
^{206}Pb	^{4}He,^{16}O	γ	0.66 *7*	Gr71a	
	^{4}He,^{16}O	γ	0.50 *3*	Ha72	
	^{4}He,^{12}C,^{16}O	part	0.65 *4*	Sp78	
^{208}Pb	^{4}He,^{16}O	part	0.58 *4*	Ba69	
	^{4}He,^{16}O	γ	0.60 *7*	Gr71a	
	^{4}He,^{16}O	γ	0.54 *3*	Ha72	
	^{4}He,^{16}O	part	0.665 *35*	Jo77	
	^{12}C,^{16}O	part	0.611 *12*	Sp83	

TABLE II. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Coulomb Excitation

See page 66 for Explanation of Tables

Nuclide	Projectile	Detection	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	References	ϵ
^{226}Ra			0.74 *4*	Le82a,El87a	
^{230}Th	^{4}He	part	0.64 *6*	McG74	
^{232}Th	^{4}He	part	0.45 *5*	McG74	
^{234}U	^{4}He	part	$\leq$0.59 *7*	McG74	
^{236}U	^{4}He	part	0.53 *7*	McG74	
^{238}U	^{4}He	part	0.64 *6*	McG74	
	^{4}He,^{16}O	γ,part	0.59 *5*	Al81	
^{238}Pu	^{4}He	part	0.71 *12*	McG74	
^{240}Pu	^{4}He	part	0.41 *6*	McG74	
^{242}Pu	^{4}He	part	0.42 *7*	McG74	
^{244}Pu	^{4}He	part	0.30 *10*	McG74	
^{244}Cm	^{4}He	part	0.52 *7*	McG74	
^{248}Cm	^{4}He	part	0.41 *10*	McG74,Sc81	

TABLE III. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Lifetime Measurements

See page 66 for Explanation of Tables

Nuclide	τ			GSB		$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)
	Value (sec)	Method	References	Value (%)	References	
^{14}C	96 *11* x10^{-12}	RDM	Al68,Ko81	96.4 *12*	Al66,Be68a,Aj86a	0.000197 *24*
^{16}O	25 *2* x10^{-12}	RDM	Al65	100	Aj86	0.00155 *12*
^{20}Ne	24 *5* x10^{-13}	RC	To71	7.6 *10*	Aj87,Ha71a	0.0022 *5*
^{24}Mg	1.70 *30* x10^{-12}	DSAM	En78	23 *2*	Le73	0.00112 *22*
^{28}Si	26 *4* x10^{-13}	DSAM	En78	64 *2*	Me75	0.00414 *65*
^{32}S	550 *100* x10^{-15}	DSAM	En78	3.7 *3*	Ol70,Ve76	0.0105 *21*
^{36}Ar	33 *4* x10^{-13}	RDM	Co76,No76	6.5 *4*	En78	0.0109 *15*
^{38}Ar	80 *20* x10^{-15}	DSAM	En78	0.072 *8*	En78	0.0095 *26*
^{40}Ca	59 *5* x10^{-12}	DC	Ta72	100	En78	0.0204 *17*
^{48}Ca	8.8 $^{55}_{28}$ x10^{-12}	DSAM	Be70b	27 *2*	Be70b	0.0100 $^{63}_{32}$
^{88}Sr	5.1 $^{65}_{22}$ x10^{-13}	RF	Ka72	0.7 *1*	Wi87	0.15 $^{19}_{6}$
^{106}Pd	0.7 *3* x10^{-12}	DBLA	Ro69	0.32 *8*	Fr88	0.32 *15*
^{146}Gd	1.53 *9* x10^{-9}	DC	Kl78,Kl82	100	Kl78a	0.328 *18*
^{182}W	112 *15* x10^{-12}	DC	He72	0.65 *5*	Fi88	0.077 *12*
^{208}Pb	47 *15* x10^{-12}	DC	We62	100	Ma86a	0.31 *10*

TABLE IV. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Inelastic Electron Scattering
See page 66 for Explanation of Tables

Nuclide	E (MeV)	q (fm^{-1})	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	References
^{12}C	100–200	0.5–1.4	0.00075 *10*	Cr67a
	600–800	0.5–3.4	0.000475 *120*	Cr66,Gu78
^{16}O	33–60	0.3–0.5	0.00130 *65*	St68a
	38–60	0.3–0.5	0.00149 *7*	Mi75
^{18}O	93,106	0.5–0.9	0.00112 *11*	Gr71
^{22}Ne	60–110	0.5–1.0	0.00087 *25*	Ma79
^{24}Mg	$\leq$59	0.3–0.5	0.00160 *31*	Ti69
	$\leq$120	0.5–0.9	0.00136 *22*	Jo74
	90–280	0.9–2.1	0.000562	Za84a
^{26}Mg	56–110	0.5–1.05	0.00075 *13*	Le74
^{28}Si	238	1.0–2.6	0.00387 *75*	Ye83
^{32}S	120,150,180		0.0050 *5*	Lo64
	250,500	0.7–2.5	0.0139 *38*	Li74,Gu78
^{36}Ar	65–116	0.54–0.96	0.01130 *47*	Fi77
^{40}Ar	65–116	0.54–0.96	0.00875 *102*	Fi77
^{40}Ca	183		0.01724 *69*	He56
	120–220	0.6–1.4	0.00998 *106*	Bl63
	41–60	0.32–0.57	0.0211 *30*	Ei69
	183,250	0.5–2.2	0.0180 *7*	It70
	250	0.5–2.0	0.0166 *17*	He71
	60–121	0.57–0.99	0.01487 *66*	Ha73
^{42}Ca	298	0.8–2.3	0.00910 *91*	He71
^{44}Ca	298	0.8–2.6	0.00560 *56*	He71
^{48}Ca	41–60	0.32–0.57	0.0065 *10*	Ei69
^{50}Ti	198,299	0.8–2.4	0.00391 *16*	He71
^{52}Cr	150,180	0.7–1.4	0.00652 *34*	Be64
^{54}Fe	150		0.00439 *28*	Be62
^{56}Fe	150		0.01037 *96*	Be62
	60.2	0.4–0.6	0.0166 *42*	Pe70a
^{58}Ni	183	0.7–1.4	0.0195 *27*	Cr61
	55–65	0.43–0.52	0.01860 *52*	Du67
	150,225	0.95–1.30	0.01302 *78*	Af70

TABLE IV. Values of $B(E3;0_1^+ \to 3_1^-)$ Determined from Inelastic Electron Scattering

See page 66 for Explanation of Tables

Nuclide	E (MeV)	q (fm^{-1})	$B(E3;0_1^+ \to 3_1^-)$ (e^2b^3)	References
^{60}Ni	183		0.0249 *40*	Cr61
	54–60	0.41–0.53	0.02810 *64*	Du67
	183,250	0.5–1.6	0.0165 *25*	To69
	150,225	0.96–1.40	0.01391 *83*	Af70
^{62}Ni	56–60	0.31–0.57	0.02010 *54*	Du67
^{64}Ni	150,225	0.8–1.5	0.0170 *14*	Af70
^{64}Zn	54–112	0.3–1.1	0.0401 *68*	Ne76
^{66}Zn	54–112	0.3–1.1	0.0424 *89*	Ne76
^{68}Zn	54–112	0.3–1.1	0.0381 *83*	Ne76
^{70}Ge	84–120	0.65–1.14	0.073 *10*	Kl75
^{72}Ge	84–120	0.63–1.14	0.080 *15*	Kl75
^{88}Sr	183		0.0930 *84*	He56
	65,70	0.37–0.65	0.0806 *30*	Pe68
	45–121	0.40–0.99	0.0620 *40*	Fi74
^{90}Zr	58–60	0.33–0.58	0.108 *3*	Be70a
^{108}Pd	72,115,121	0.3–1.15	0.113 *15*	Ar78
^{114}Cd	68,112	0.47–1.09	0.0854 *85*	Gi76
^{116}Sn	150	0.6–1.0	0.121 *15*	Ba67
	55–60	0.3–0.6	0.074	Cu69
	39–110	0.36–1.0	0.163 *13*	Li76
^{118}Sn	55–60	0.3–0.6	0.112	Cu69
^{120}Sn	150	0.6–1.0	0.113 *14*	Ba67
	55–60	0.3–0.6	0.103	Cu69
^{124}Sn	150	0.6–1.0	0.076 *11*	Ba67
^{140}Ce	50,60	$\leq$0.6	0.21 *3*	Pi70
^{142}Nd	60	0.34–0.58	0.239 *42*	Ma71
^{188}Os	200,500	0.6–3.2	0.147 *8*	Bo88
^{190}Os	200,500	0.6–3.2	0.154 *13*	Bo88
^{192}Os	150–364	0.6–2.9	0.130 *34*	Re84
	200,500	0.6–3.2	0.131 *9*	Bo88

TABLE IV. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Inelastic Electron Scattering

See page 66 for Explanation of Tables

Nuclide	E(MeV)	q(fm^{-1})	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	References
^{194}Pt	200,500	0.6–3.2	0.157 *13*	Bo88
^{196}Pt	200,500	0.6–3.2	0.103 *18*	Bo88
^{206}Pb	28–73	0.3–0.6	0.64 *4*	Zi68
^{208}Pb	183		0.57 *21*	Cr61
	28–73	0.25–0.65	0.72 *4*	Zi68
	183,248		0.77 *9*	Na71
	124,167	0.48–1.54	0.624 *40*	Fr72
			0.69 *5*	Ro74
	52-335,502	0.55–3.4	0.612 *13*	Go80

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \rightarrow 3_1^-)$

See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Mean $B(E3)\uparrow$ (e^2b^3)	Projectile (if not p)
^{12}C	Fr65	40		0.44	0.000171		
	Ha66a	155		0.57	0.000286		
	Sa67	46		0.41	0.000148		
	Bu77	45		0.45	0.000178		
	Bu77	155		0.41	0.000148		
	Bl78	800	1.02	[0.37]	0.000121		
	In79	185	0.90	[0.33]	0.000096		
	Bl81a	800	1.21	[0.44]	0.000171		
	Le83	30–40		0.35	0.000108		
	Jo86	200$^{\#}$		0.40	0.000148		
	Jo86	398$^{\#}$		0.36	0.000114		
	Jo86	597$^{\#}$		0.36	0.000114		
	Jo86	698$^{\#}$		0.34	0.000102	0.000147	
^{14}C	Ce75	17		0.28	0.000094	0.000094	d
	Pe84d	35		0.40	0.000192	0.000192	^{4}He
^{16}O	Cr67	17.5		0.79	0.00174		
	Am84	135		0.37	0.00038	0.00106	
^{18}O	Es74,Es75	24.5$^{\#}$		0.39	0.00054		
	Gr80	24		0.35	0.00043	0.00049	
^{20}Ne	Sw76a	24.5		0.43	0.00126	0.00126	
^{24}Mg	Cr67	17.5		0.29	0.00119		
	Zw78	40		0.25	0.00086	0.00103	
^{26}Mg	Bl82a	800	0.56	[0.158]	0.00041		
	Sc85	15–38		0.18	0.00054	0.00048	
^{28}Si	To78	51.9		0.32	0.00267		
	Za84	26.3		0.24	0.00150	0.00209	
^{30}Si	To78	51.9		0.275	0.00227	0.00227	
^{32}S	Cr67	17.5		0.41	0.0075		
	Sw76	30.3$^{\#}$		0.41	0.0075	0.0075	
^{34}S	Al86a	22,26		0.33	0.0055	0.0055	n
^{36}Ar	Me69	18		0.31	0.0069	0.0069	d
^{40}Ar	Le85a	30,35		0.26	0.0060		
	Bl88	800		0.244	0.00525	0.0056	

$^{\#}$: polarized beam

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \rightarrow 3_1^-)$
See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Mean $B(E3)\uparrow$ (e^2b^3)	Projectile (if not p)
^{40}Ca	Ya64	55		0.33	0.0118		
	Gr65a	17		0.36	0.0141		
	Gr72	25,40	1.36	[0.331]	0.0120		
	Ad80	800	1.39	[0.339]	0.0125	0.0126	
^{42}Ca	Ba68a	22.9		0.26	0.0081	0.0081	
^{44}Ca	Ba68a	22.9		0.23	0.0070	0.0070	
^{46}Ca	Be65	10		0.16	0.0037	0.0037	d
^{48}Ca	Te69	12		0.25	0.0098		
	Gr72a	40	0.81	[0.186]	0.0054		
	Ad80	800	0.87	[0.200]	0.0063		
	Fu88	65	0.76	[0.174]	0.0048	0.0066	
^{46}Ti	Pe68a	17.5	0.70	[0.163]	0.00462		
	Lu69a	14.4	0.67	[0.156]	0.00424		
	Fu87	65#	0.423	[0.099]	0.00171	0.00352	
^{48}Ti	Lu69a	14.4	0.82	[0.188]	0.0067	0.0067	
^{50}Ti	Fu64	17.5		0.17	0.00594		
	Gr65	18.2		0.17	0.00594		
	Lu69a	14.4	0.78	[0.177]	0.00642		
	Pr70	40	0.69	[0.156]	0.00502		
	Fu85	65	0.66	[0.149]	0.00460	0.00558	
^{52}Cr	Fu64	17.5		0.16	0.0068		
	Pe69	17.5	0.72	[0.160]	0.0068		
	Pr70	40	0.65	[0.145]	0.0056		
	Fu85	65	0.61	[0.136]	0.0049	0.0060	
^{54}Fe	St64	40		0.0787	0.0021		
	Gr65	17.9		0.13	0.0056		
	Fr67	40#		0.13	0.0056		
	Ma70	49		0.069	0.0016		
	Ad80	800#	0.47	[0.104]	0.0036		
	Fu85a	65	0.46	[0.102]	0.0035	0.0037	
^{56}Fe	Pe69	17.5		0.198	0.0141		
	Ma71a	49		0.154	0.0085	0.0113	
^{58}Fe	Jo70	11.8		0.20	0.0155	0.0155	d
	Fl67	22	0.48	[0.103]	0.0041	0.0041	^{3}He
	Br70	44	0.37	[0.080]	0.0025	0.0025	^{4}He

: polarized beam

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \rightarrow 3_1^-)$

See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Mean $B(E3)\uparrow$ (e^2b^3)	Projectile (if not p)
^{58}Ni	Ec66	19		0.19	0.016		
	Ja67	17.8		0.16	0.0115	0.0137	
^{60}Ni	Ec66	19		0.21	0.021		
	Ja67	17.8		0.17	0.0139	0.0174	
^{62}Ni	Ec66	19		0.22	0.0248		
	Be69	12		0.23	0.0271	0.0260	
^{64}Ni	Be69	12		0.23	0.029	0.029	
^{64}Zn	Jo68	26		0.24	0.036		
	Le68	50		0.235	0.035		
	Pe70	11		0.19	0.023		
	Ta73	30		0.248	0.039		
	Th77	15#		0.218	0.030		
	Ja87	22		0.250	0.039	0.0337	
^{66}Zn	Le68	50		0.25	0.042		
	Ya69	55		0.26	0.045		
	Pe70	11		0.19	0.024		
	Ta73	30		0.256	0.044		
	Ja87	22		0.255	0.043	0.0396	
^{68}Zn	Le68	50		0.217	0.033		
	Pe70	11		0.17	0.020		
	Ta73	30		0.202	0.029		
	Ja87a	22		0.250	0.044	0.0315	
^{70}Zn	Le68	50		0.216	0.035		
	Ja87a	22		0.220	0.036	0.0355	
^{70}Ge	Pe70	11		0.22	0.041		
	Ro86	22		0.270	0.062	0.0515	
^{72}Ge	Cu70	14.5		0.23	0.048		
	Pe70	11		0.20	0.036		
	Ro86	22		0.240	0.052	0.0453	
^{74}Ge	Cu70	14.5		0.13	0.016		
	Pe70	11		0.15	0.021		
	Ro86	22		0.160	0.024	0.0203	
^{76}Ge	Pe70	11		0.14	0.020		
	Cu70	14.5		0.14	0.020		
	Ro86	22		0.150	0.023	0.0210	

: polarized beam

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \rightarrow 3_1^-)$
See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Mean B(E3)↑ (e^2b^3)	Projectile (if not p)
^{74}Se	Og86	64.8	0.77	[0.153]	0.0252	0.0252	
^{76}Se	Ma79	51.9		0.164	0.0305		
	Og86	64.8	0.69	[0.136]	0.0209	0.0257	
^{78}Se	Ma79	51.9		0.179	0.0383		
	Og86	64.8	0.70	[0.137]	0.0223	0.0303	
^{80}Se	Ma79	51.9		0.167	0.0351		
	Og86	64.8	0.66	[0.128]	0.0206	0.0279	
^{82}Se	Ma79	51.9		0.161	0.0343		
	Og86	64.8	0.68	[0.131]	0.0227	0.0285	
^{78}Kr	Ma78	51.9			0.0422	0.0422	
^{80}Kr	Ma78	51.9			0.0429	0.0429	
^{82}Kr	Ma78	51.9			0.0607	0.0607	
^{84}Kr	Ar74	12.0		0.157	0.0383		
	Ma78	51.9			0.0464	0.0423	
^{86}Kr	Ar74	12.0		0.145	0.0343		
	Ma78	51.9			0.0381	0.0362	
^{84}Sr	Re73	12		0.129	0.029	0.029	d
^{86}Sr	Ra72	12		0.153	0.043	0.043	
^{88}Sr	St67a	19		0.20	0.076		
	Pi69	20.2		0.17	0.055	0.0655	
^{90}Zr	Gr66	18.8		0.16	0.056		
	Di68	12.7		0.17	0.064		
	Wh72	61		0.14	0.043		
	Sw76b	30*		0.13	0.037		
	Sw79	40*		0.157	0.054		
	Ba83	800*		0.165	0.060		
	Bu83	25	1.02	[0.190]	0.079		
	Fu85	65	0.79	[0.147]	0.048	0.0551	
^{92}Zr	St66	19.4		0.18	0.075		
	Sw76b	30*		0.17	0.0665		
	Sw79	40*		0.157	0.057		
	Ba83	800*		0.190	0.083		
	Ka84	104*	0.819	[0.151]	0.052	0.0668	

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* : polarized beam

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \to 3_1^-)$

See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \to 3_1^-)$ (e^2b^3)	Mean $B(E3)\uparrow$ (e^2b^3)	Projectile (if not p)
^{94}Zr	St66	19.4		0.20	0.096		
	Di68	12.7		0.18	0.078	0.087	
^{96}Zr	St67	19.4		0.27	0.183	0.183	
^{92}Mo	Lu71	15		0.174	0.0768		
	Bu75	12.5		0.175	0.0778		
	Sw76b	30#		0.15	0.0571	0.0706	
^{94}Mo	Lu71	15		0.163	0.070		
	Bu75	12.5		0.165	0.072		
	Fr87	25.6		0.162	0.0695	0.0705	
^{96}Mo	Lu71	15		0.185	0.0946		
	Bu75	12.5		0.182	0.0920		
	Fr87	25.6		0.167	0.0771	0.0879	
^{98}Mo	Lu71	15		0.195	0.109		
	Aw72	14.7		0.20	0.115		
	Bu75	12.5		0.199	0.114	0.113	
^{100}Mo	Lu71	15		0.210	0.132		
	Aw72	14.7		0.17	0.087		
	Bu75	12.5		0.180	0.097		
	Fr87	25.6		0.166	0.083	0.100	
^{100}Ru	Vo76	104			0.044	0.044	^{4}He
^{102}Ru	Re77	12		0.14	0.065	0.065	d
^{104}Ru	Re77	12		0.13	0.056	0.056	d
^{104}Pd	Si80			0.13	0.066	0.066	^{4}He
^{106}Pd	Ro66	12–13		0.15	0.091		
	Ko75	51.9		0.19	0.146	0.119	
^{108}Pd	Ro66	12–13		0.14	0.082		
	Ko75	51.9		0.165	0.114	0.098	
^{110}Pd	Ro69a	13		0.134	0.078		
	Ko75	51.9		0.135	0.079	0.0785	
^{106}Cd	Lu69	14		0.194	0.166	0.166	
^{108}Cd	Lu69	14		0.207	0.196	0.196	

: polarized beam

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \rightarrow 3_1^-)$
See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Mean $B(E3)\uparrow$ (e^2b^3)	Projectile (if not p)
^{110}Cd	Ma68	16		0.175	0.145		
	Lu69	14		0.168	0.134		
	Ko69	55		0.16	0.121	0.133	
^{112}Cd	Ma68	16		0.164	0.189		
	St68	13		0.15	0.111		
	Lu69	14		0.173	0.147	0.149	
^{114}Cd	Sa64	12.2		0.136	0.094		
	Ma68	16		0.160	0.130		
	St68	13		0.13	0.086		
	Lu69	14		0.164	0.137		
	Ko69	55		0.16	0.130	0.115	
^{116}Cd	Ma68	16		0.149	0.117		
	Lu69	14		0.160	0.135		
	Ko69	55		0.16	0.135		
	De72	12		0.139	0.102	0.122	
^{112}Sn	Ma68	16		0.203	0.220	0.220	
^{114}Sn	Br70	44	0.62	[0.106]	0.062	0.062	^{4}He
^{116}Sn	Ya68	55		0.18	0.185		
	Ma68	16		0.185	0.196		
	Be70	24.5		0.188	0.202		
	Ab87	16$^{\#}$	0.978	[0.167]	0.159	0.186	
^{118}Sn	Ma68	16		0.168	0.167		
	Be70	24.5		0.174	0.179	0.173	
^{120}Sn	Ja67	17.8		0.14	0.120		
	Fu68	30		0.17	0.177		
	Ma68	16		0.159	0.155		
	Be70	24.5		0.161	0.159		
	Ab87	16$^{\#}$	0.892	[0.151]	0.139	0.150	
^{122}Sn	Ma68	16		0.152	0.146		
	Be70	24.5		0.149	0.140	0.143	
^{124}Sn	Ma68	16		0.133	0.116		
	Be70	24.5		0.138	0.124		
	Ab87	16$^{\#}$	0.706	[0.118]	0.091	0.110	
^{122}Te	Ma75	51.9		0.132	0.119	0.119	
^{124}Te	Ra70	12		0.13	0.119		
	Ma75	51.9		0.128	0.116	0.118	

$^{\#}$: polarized beam

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \rightarrow 3_1^-)$

See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Mean $B(E3)\uparrow$ (e^2b^3)	Projectile (if not p)
^{126}Te	Ma68	16		0.131	0.125		
	Ma75	51.9		0.118	0.102	0.114	
^{128}Te	Ma68	16		0.110	0.091		
	Ma75	51.9		0.091	0.062	0.077	
^{130}Te	Ma68	16		0.100	0.078		
	Ma75	51.9		0.073	0.041	0.060	
^{136}Xe	Se72	14.0		0.119	0.130	0.130	
^{132}Ba	Bu85a	20		0.07	0.046	0.046	^{4}He
^{134}Ba	Bu85a	20		0.08	0.061	0.061	^{4}He
^{136}Ba	Bu85a	20		0.07	0.048	0.048	^{4}He
^{138}Ba	La74	30		0.118	0.141	0.141	
^{140}Ce	Sh77	30	0.79	[0.127]	0.181	0.181	
^{142}Nd	Mo78	115			0.146	0.146	^{4}He
^{146}Nd	Ch70	12	0.874	[0.139]	0.252	0.252	d
^{148}Nd	Ba78b	70.4		0.098	0.129	0.129	^{12}C
^{150}Nd	Ba78b	70.4		0.070	0.067	0.067	^{12}C
^{144}Sm	Ba71	30	0.82	[0.130]	0.229		
	La74	30	0.87	[0.139]	0.262	0.245	
^{168}Er	Go86	36			0.046	0.046	^{4}He
^{172}Yb	Go87b	36			0.016	0.016	^{4}He
^{192}Pt	Ba78	24		0.070	0.187	0.187	^{4}He
^{204}Hg	Ba81	27		0.073	0.241	0.241	^{4}He
^{204}Pb	Bj67	12.4	0.436	[0.059]	0.166	0.166	d
	Al67	42		0.114	0.617		^{4}He
	Gi76a	104		0.088	0.367		^{4}He
	Ba81	27		0.092	0.403	0.462	^{4}He
^{206}Pb	Va67	24.5		0.0813	0.321		
	Fi83	35		0.108	0.565	0.443	

: polarized beam

TABLE V. Deformation Parameters β_3 Determined from Angular Distributions of Inelastically Scattered Nucleons and Light Ions, together with Deduced Values of $B(E3;0_1^+ \rightarrow 3_1^-)$

See page 66 for Explanation of Tables

Nuclide	References	E (MeV)	δ_3 (fm)	β_3	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Mean $B(E3)\uparrow$ (e^2b^3)	Projectile (if not p)
^{208}Pb	Fr65	40		0.11	0.598		
	Sc66	40		0.11	0.598		
	Fu68	31		0.13	0.836		
	Co74a	156	0.77	[0.108]	0.577		
	Wa75,Le66	54		0.108	0.577		
	Wa75	35	0.85	[0.120]	0.712		
	In76	185	0.71–0.84	[0.109]	0.588		
	Sc77	24.5		0.108	0.577		
	Sc77	61.2		0.103	0.525		
	Bl78	800	0.75	[0.106]	0.556		
	Ad80a	135		0.100	0.495		
	Ga82	800	0.825	[0.106]	0.665		
	Fu85	65	0.83	[0.117]	0.677		
	Be86	334	0.83	[0.117]	0.677		
	Ka87	80	0.70	[0.099]	0.485		
	Ka87	98	0.75	[0.106]	0.556		
	Ka87	120	0.65	[0.092]	0.419		
	McD87	200	0.75	[0.106]	0.556		
	McD87	400	0.80	[0.113]	0.631	0.595	

[#] : polarized beam

TABLE VI. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Miscellaneous Procedures

See page 66 for Explanation of Tables

Nuclide	References	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Method	Comments
^{148}Sm	Ve68	0.31	(d,d')(90)(12)	
^{150}Sm	Ve68	0.29	(d,d')(90)(12)	
^{152}Sm	Ve68	0.14	(d,d')(90)(12)	
^{154}Sm	Ve68	0.077	(d,d')(90)(12)	
^{152}Gd	Bl67	0.320	(d,d')(90)(12)	
^{154}Gd	Bl67	0.163	(d,d')(90)(12)	
^{156}Gd	Bl67	0.116	(d,d')(90)(12)	
^{158}Gd	Bl67	0.069	(d,d')(90)(12)	
^{160}Gd	Bl67	0.073	(d,d')(90)(12)	
^{156}Dy	Gr68	0.194	(d,d')(90)(12)	Ro82 renormalization gives $B(E3)\uparrow=0.26$ e^2b^3
^{158}Dy	Gr68	0.164	(d,d')(90)(12)	Ro82 renormalization gives $B(E3)\uparrow=0.22$ e^2b^3
^{160}Dy	Gr68	0.123	(d,d')(90)(12)	
^{162}Dy	Gr68	0.094	(d,d')(90)(12)	
^{164}Dy	Gr68	0.065	(d,d')(90)(12)	
^{162}Er	Tj68	0.133	(d,d')(90)(12)	Ro82 renormalization gives $B(E3)\uparrow=0.17$ e^2b^3
^{164}Er	Tj68	0.094	(d,d')(90)(12)	Ro82 renormalization gives $B(E3)\uparrow=0.11$ e^2b^3
^{166}Er	Tj68	0.071	(d,d')(90)(12)	
^{168}Er	Tj68	0.038	(d,d')(90)(12)	
^{170}Er	Tj68	0.013	(d,d')(90)(12)	
^{168}Yb	Bu67a	0.077	(d,d')(90)(12)	Ro82 renormalization gives $B(E3)\uparrow=0.20$ e^2b^3
^{170}Yb	Bu67a	0.049	(d,d')(90)(12)	
^{172}Yb	Bu67a	0.026	(d,d')(90)(12)	
^{174}Yb	Bu67a	0.041	(d,d')(90)(12)	
^{176}Yb	Bu67a	0.027	(d,d')(90)(12)	

TABLE VI. Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ Determined from Miscellaneous Procedures

See page 66 for Explanation of Tables

Nuclide	References	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Method	Comments
^{180}W	Ko71	0.24	^{181}Ta(p,2nγ)^{180}W	
^{182}W	Gu71	0.078 *12*	γ	
^{210}Pb	El71	0.40 *10*	(t,t′)	
^{210}Po	El73	0.53 *8*	(t,t′),(d,d′),(p,p′)	
^{232}Th	El72	0.65 *6*	(d,d′)(90,125)(16)	
^{234}U	Bo73	0.65 *4*	(d,d′)(90,125)(16)	
^{236}U	Bo73	0.69 *8*	(d,d′)(90,125)(16)	
^{242}Pu	El72	0.71 *9*	(d,d′)(90,125)(16)	
^{246}Cm	Ya75	0.266	(d,d′)(90)(15)	
^{250}Cf	Ah80a	0.202 *20*	(d,d′)(90,125,140)(15)	

TABLE VII. Adopted Values of $B(E3;0_1^+ \to 3_1^-)$ and Related Quantities

See page 66 for Explanation of Tables

Nuclide	$E_x(3_1^-)$ (keV)	$B(E3;0_1^+ \to 3_1^-)$ (e^2b^3)	Procedure	References	$\lvert M(E3)\rvert^2$ (W.u.)	EWSR (%)
^{12}C	9641	0.000610 *85*	(e,e')	Cr66,Cr67a,Gu78	10.2 *14*	16.5 *23*
^{14}C	6728	0.000197 *24*	τ(RDM)	Al68,Ko81	2.4 *3*	3.0 *4*
^{16}O	6130	0.00150 *7*	τ(RDM),(e,e')	Al65,Mi75	14.1 *7*	13.1 *6*
^{18}O	5098	0.00112 *11*	(e,e')	Gr71	8.3 *9*	7.0 *7*
^{20}Ne	5621	0.0022 *5*	τ(RC)	To71,Aj87,Ha71a	13.2 *30*	10.5 *24*
^{22}Ne	5910	0.00087 *25*	(e,e')	Ma79	4.3 *12*	3.8 *11*
^{24}Mg	7616	0.00112 *22*	τ(DSAM)	En78,Le73	4.7 *9*	4.8 *9*
^{26}Mg	6878	0.00075 *13*	(e,e')	Le74	2.7 *5*	2.6 *4*
^{28}Si	6879	0.00414 *65*	τ(DSAM)	En78,Me75	12.7 *20*	11.0 *17*
^{30}Si	5488	0.00227 *76*	β_3(p)	To78	6.1 *21*	4.4 *15*
^{32}S	5006	0.0105 *21*	τ(DSAM)	En78,Ol70,Ve76	24.7 *50*	14.9 *30*
^{34}S	4623	0.0076 *38*	β_3(n)	Al86a	15.8 *79*	9.2 *46*
^{36}Ar	4178	0.0109 *15*	τ(RDM)	Co76,No76,En78	20.2 *28*	9.8 *14*
^{38}Ar	3810	0.0095 *26*	τ(DSAM)	En78	15.8 *44*	7.3 *20*
^{40}Ar	3681	0.0087 *10*	(e,e')	Fi77	13.1 *16*	6.0 *7*
^{40}Ca	3737	0.0204 *17*	τ(DC)	Ta72,En78	30.7 *26*	12.9 *11*
^{42}Ca	3446	0.0091 *10*	(e,e')	He71	12.4 *14*	5.0 *5*
^{44}Ca	3308	0.0056 *6*	(e,e')	He71	7.0 *8*	2.8 *3*
^{46}Ca	3614	0.0052 *26*	β_3(d)	Be65	5.9 *30*	2.6 *13*
^{48}Ca	4507	0.0083 *20*	τ(DSAM),(e,e')	Be70b,Ei69	8.7 *21*	4.9 *12*
^{46}Ti	3058	0.0035 *12*	β_3(p)	Pe68a,Lu69a,Fu87	4.0 *14*	1.4 *5*
^{48}Ti	3359	0.0067 *23*	β_3(p)	Lu69a	7.0 *24*	2.7 *9*
^{50}Ti	4410	0.00391 *16*	(e,e')	He71	3.8 *2*	1.96 *8*
^{52}Cr	4563	0.00652 *34*	(e,e')	Be64	5.8 *3*	2.95 *15*
^{54}Fe	4782	0.00439 *28*	(e,e')	Be62	3.6 *3*	1.82 *11*
^{56}Fe	4510	0.0166 *42*	(e,e')	Pe70a	12.7 *32*	6.2 *16*
^{58}Fe	3845	0.0114 *57*	β_3(d,^{3}He,^{4}He)	Jo70,Fl67,Br70	8.2 *41*	3.5 *18*
^{58}Ni	4475	0.0170 *20*	(e,e')	Cr61,Du67,Af70	12.1 *15*	5.6 *7*
^{60}Ni	4040	0.0208 *40*	(e,e')	Cr61,Du67,To69,Af70	13.9 *27*	5.9 *11*
^{62}Ni	3757	0.0201 *30*	(e,e')	Du67	12.6 *19*	5.1 *8*
^{64}Ni	3560	0.0170 *30*	(e,e')	Af70	10.0 *18*	3.9 *7*
^{64}Zn	2999	0.040 *7*	(e,e')	Ne76	23.5 *42*	7.2 *13*
^{66}Zn	2827	0.042 *9*	(e,e')	Ne76	23.2 *50*	6.8 *15*
^{68}Zn	2751	0.038 *9*	(e,e')	Ne76	19.8 *47*	5.8 *14*
^{70}Zn	2859	0.035 *12*	β_3(p)	Le68,Ja87a	17 *6*	5.3 *18*

TABLE VII. Adopted Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ and Related Quantities

See page 66 for Explanation of Tables

Nuclide	$E_x(3_1^-)$ (keV)	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Procedure	References	$\lvert M(E3)\rvert^2$ (W.u.)	EWSR (%)
^{70}Ge	2561	0.073 *10*	(e,e′)	Kl75	35.8 *50*	9.3 *13*
^{72}Ge	2514	0.051 *11*	Coulex	Le80a	23.7 *51*	6.2 *13*
^{74}Ge	2536	0.020 *7*	β_3(p)	Cu70,Pe70,Ro86	8.8 *30*	2.4 *8*
^{76}Ge	2691	0.021 *7*	β_3(p)	Cu70,Pe70,Ro86	8.7 *30*	2.5 *8*
^{74}Se	2350	0.021 *5*	Coulex	Ba74	9.2 *22*	2.2 *5*
^{76}Se	2429	0.040 *5*	Coulex	Ba74	16.6 *21*	4.1 *5*
^{78}Se	2508	0.027 *3*	Coulex	Ba74	10.7 *12*	2.8 *3*
^{80}Se	2717	0.028 *9*	β_3(p)	Ma79,Og86	10.5 *35*	3.0 *9*
^{82}Se	3010	0.028 *10*	β_3(p)	Ma79,Og86	10.0 *34*	3.2 *11*
^{78}Kr	2399	0.042 *14*	β_3(p)	Ma78	17 *6*	3.9 *10*
^{80}Kr	2439	0.043 *15*	β_3(p)	Ma78	16 *5*	3.9 *13*
^{82}Kr	2548	0.061 *21*	β_3(p)	Ma78	22 *7*	5.6 *18*
^{84}Kr	2700	0.042 *15*	β_3(p)	Ar74,Ma78	14.4 *48*	4.0 *13*
^{86}Kr	3099	0.036 *12*	β_3(p)	Ar74,Ma78	11.7 *39*	3.8 *13*
^{84}Sr	2448	0.040 *21*	β_3(d)	Re73	14 *7*	3.2 *16*
^{86}Sr	2482	0.043 *15*	β_3(p)	Ra72	14.0 *47*	3.4 *11*
^{88}Sr	2734	0.0726 *30*	(e,e′)	Pe68,Fi74	22.5 *9*	6.1 *3*
^{90}Zr	2750	0.108 *3*	(e,e′)	Be70a	32.1 *9*	8 .5 *2*
^{92}Zr	2340	0.067 *22*	β_3(p)	St66,Sw79,Ba83,Ka84,Sw76b	19 *6*	4.4 *15*
^{94}Zr	2058	0.087 *29*	β_3(p)	St66,Di68	24 *8*	4.8 *16*
^{96}Zr	1897	0.18 *6*	β_3(p)	St67	48 *16*	9.1 *30*
^{92}Mo	2850	0.070 *24*	β_3(p)	Lu71,Bu75,Sw76b	20 *7*	5.3 *18*
^{94}Mo	2534	0.062 *12*	Coulex	Ba72b	16.9 *33*	4.0 *8*
^{96}Mo	2235	0.092 *12*	Coulex	Ba72b	24.0 *31*	5.1 *7*
^{98}Mo	2018	0.133 *13*	Coulex	Ba72b	33.3 *33*	6.5 *6*
^{100}Mo	1908	0.132 *17*	Coulex	Ba72b	31.7 *41*	6.0 *8*
^{100}Ru	2166	0.043 *7*	Coulex	La80	10.3 *17*	2.10 *34*
^{102}Ru	2044	0.065 *10*	Coulex	La80	15.0 *23*	2.92 *44*
^{104}Ru	1970	0.0579 *35*	Coulex	La80	12.9 *8*	2.41 *14*
^{102}Pd	2342	0.060 *6*	Coulex	Lu86	13.9 *14*	2.96 *29*
^{104}Pd	2193	0.072 *7*	Coulex	Lu86	16.0 *16*	3.24 *31*
^{106}Pd	2084	0.128 *20*	Coulex	Ro69,Ha80	27.4 *43*	5.3 *8*
^{108}Pd	2047	0.104 *30*	Coulex	Ro69,Ha82	21 *6*	4.1 *11*
^{110}Pd	2038	0.098 *16*	Coulex	Ro69,De73	19.5 *32*	3.8 *6*
^{106}Cd	2371	0.16 *4*	Coulex	Fe85	34 *9*	7.3 *18*
^{108}Cd	2202	0.150 *10*	Coulex	Fe85	30.9 *21*	6.18 *41*
^{110}Cd	2079	0.115 *13*	Coulex	Fe85	22.8 *26*	4.36 *49*
^{112}Cd	2005	0.114 *9*	Coulex	Fe85	21.8 *18*	4.07 *32*
^{114}Cd	1958	0.131 *15*	Coulex	Fe85	24.2 *28*	4.5 *5*
^{116}Cd	1922	0.100 *11*	Coulex	Fe85	17.9 *20*	3.27 *36*

TABLE VII. Adopted Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ and Related Quantities

See page 66 for Explanation of Tables

Nuclide	$E_x(3_1^-)$ (keV)	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Procedure	References	$\lvert M(E3)\rvert^2$ (W.u.)	EWSR (%)
^{112}Sn	2355	0.087 *12*	Coulex	Jo81	16.7 *23*	3.50 *48*
^{114}Sn	2275	0.100 *12*	Coulex	Jo81	18.5 *23*	3.80 *46*
^{116}Sn	2266	0.127 *17*	Coulex	Jo81	22.7 *31*	4.7 *6*
^{118}Sn	2325	0.115 *10*	Coulex	Jo81,Sp88	19.9 *18*	6.7 *6*
^{120}Sn	2401	0.115 *15*	Coulex	Jo81,Sp88	19.2 *25*	4.3 *6*
^{122}Sn	2493	0.092 *10*	Coulex	Jo81,Sp88	14.9 *25*	3.50 *38*
^{124}Sn	2614	0.073 *10*	Coulex	Jo81	11.4 *16*	2.85 *39*
^{122}Te	2200	0.119 *40*	β_3(p)	Ma75	19 *7*	3.8 *13*
^{124}Te	2294	0.118 *40*	β_3(p)	Ra70,Ma75	18 *6*	3.9 *14*
^{126}Te	2386	0.114 *38*	β_3(p)	Ma68,Ma75	17 *6*	3.8 *13*
^{128}Te	2494	0.077 *26*	β_3(p)	Ma68,Ma75	11.3 *38*	2.6 *9*
^{130}Te	2730	0.060 *20*	β_3(p)	Ma68,Ma75	8.5 *29*	2.2 *7*
^{136}Xe	3275	0.130 *43*	β_3(p)	Se72	17 *6*	5.2 *17*
^{132}Ba	2070	0.176 *22*	Coulex	Bu85	24.3 *31*	4.5 *6*
^{134}Ba	2251	0.148 *18*	Coulex	Bu85	19.8 *24*	4.00 *47*
^{136}Ba	2532	0.155 *18*	Coulex	Bu85	20.1 *24*	4.6 *5*
^{138}Ba	2881	0.133 *13*	Coulex	Bu85	16.8 *17*	4.43 *43*
^{140}Ce	2464	0.21 *3*	(e,e′)	Pi70	25.8 *37*	5 .7 *8*
^{142}Ce	1653	0.202 *13*	Coulex	Ve88	24.0 *16*	3.59 *23*
^{142}Nd	2084	0.239 *42*	(e,e′)	Ma71	29 *5*	5. 2 *9*
^{146}Nd	1190	0.235 *25*	Coulex	Bu67,Ch70	26.4 *29*	2.80 *30*
^{148}Nd	999	0.40 *8*	Coulex	Ah88	44 *9*	3.9 *8*
^{150}Nd	934	0.177 *20*	Coulex	Wo77,Ah88	18.9 *22*	1.60 *18*
^{144}Sm	1810	0.27 *5*	Coulex	Bu87	31 *6*	4.8 *9*
^{148}Sm	1162	0.36 *3*	Coulex	Ke68,Ve68	39 *3*	4.0 *3*
^{150}Sm	1071	0.31 *3*	Coulex	Ke68,Ve68	33 *3*	3.1 *3*
^{152}Sm	1041	0.136 *15*	Coulex	Se66,Ke68,Ve68,Wo77	14.2 *16*	1.30 *14*
^{154}Sm	1013	0.10 *2*	Coulex	Ke68,Ve68	10 *2*	0.9 *2*
^{146}Gd	1579	0.328 *18*	τ(DC)	Kl78a	37.0 *21*	4.86 *27*
^{152}Gd	1123	0.50 *17*	(d,d′)(90)	Bl67	52 *17*	5.0 *17*
^{154}Gd	1252	0.21 *5*	Coulex	Wo77	21 *5*	2.3 *6*
^{156}Gd	1276	0.171 *7*	Coulex	McG81	16.9 *7*	1.87 *8*
^{158}Gd	1042	0.124 *7*	Coulex	McG81	11.9 *7*	1.09 *6*
^{160}Gd	1290	0.121 *7*	Coulex	Ro77a,McG81	11.4 *7*	1.30 *7*
^{156}Dy	1369	0.22 *7*	Coulex	Ro82	22 *7*	2.5 *8*
^{158}Dy	1397	0.23 *5*	Coulex	Ro82	22 *5*	2.6 *6*
^{160}Dy	1287	0.171 *10*	Coulex	McG81	16.1 *9*	1.77 *10*
^{162}Dy	1210	0.104 *7*	Coulex	McG81	9.5 *6*	1.00 *7*
^{164}Dy	1039	0.088 *6*	Coulex	McG81	7.9 *6*	0.71 *5*
^{162}Er	1357	0.19 *4*	Coulex	Ro82	17 *4*	2.0 *4*
^{164}Er	1434	0.15 *3*	Coulex	Ro82	13.4 *27*	1.63 *32*
^{166}Er	1514	0.061 *10*	Coulex	McG78	5.3 *9*	0.69 *11*
^{168}Er	1431	0.043 *6*	Coulex	McG78	3.7 *5*	0.45 *6*
^{170}Er	1304	0.020 *3*	Coulex	McG78	1.7 *3*	0.19 *3*

TABLE VII. Adopted Values of $B(E3;0_1^+ \rightarrow 3_1^-)$ and Related Quantities

See page 66 for Explanation of Tables

Nuclide	$E_x(3_1^-)$ (keV)	$B(E3;0_1^+ \rightarrow 3_1^-)$ (e^2b^3)	Procedure	References	$\lvert M(E3)\rvert^2$ (W.u.)	EWSR (%)
^{168}Yb	1480	0.22 *4*	Coulex	Ro82	19 *4*	2.3 *4*
^{170}Yb	1398	0.112 *37*	(d,d')(90)	Bu67a	9.3 *31*	1.10 *36*
^{172}Yb	1222	0.045 *3*	Coulex	Cr81	3.7 *3*	0.38 *3*
^{174}Yb	1382	0.093 *33*	Coulex	Ri79	7.4 *27*	0.87 *31*
^{176}Yb	1491	0.062 *21*	(d,d')(90)	Bu67a	4.8 *16*	0.62 *21*
^{176}Hf	1313	0.093 *29*	Coulex	Ro77a	7.2 *23*	0.79 *25*
^{178}Hf	1322	0.053 *10*	Coulex	Ro77a	4.0 *8*	0.45 *9*
^{182}W	1374	0.077 *12*	τ(DC)	He72,Fi88	5.6 *9*	0.63 *10*
^{184}W	1221	0.082 *6*	Coulex	Mi76	5.8 *5*	0.60 *4*
^{188}Os	1414	0.147 *8*	(e,e')	Bo88	10.0 *6*	1.17 *6*
^{190}Os	1387	0.154 *13*	(e,e')	Bo88	10.3 *9*	1.19 *10*
^{192}Os	1341	0.131 *9*	(e,e')	Bo88	8.5 *6*	0.96 *7*
^{192}Pt	1378	0.17 *3*	Coulex	Ro77	11.1 *20*	1.25 *22*
^{194}Pt	1433	0.131 *20*	Coulex,(e,e')	Ro77,Ba78a,Bo88	8.4 *13*	0.97 *15*
^{196}Pt	1447	0.103 *18*	(e,e')	Bo88	6.4 *12*	0.77 *14*
^{204}Hg	2679	0.36 *18*	$\beta_3(^4\mathrm{He})$	Ba81	21 *11*	4.6 *23*
^{204}Pb	2618	0.66 *4*	Coulex	Sp78	38.1 *23*	8.1 *5*
^{206}Pb	2648	0.65 *4*	Coulex	Sp78	36.8 *23*	8.0 *5*
^{208}Pb	2615	0.611 *9*	Coulex,(e,e')	Sp83,Go80	34.0 *5*	7.29 *11*
^{210}Pb	1871	0.40 *10*	(t,t')	El71	22 *6*	3.4 *8*
^{210}Po	2387	0.53 *8*	(p,p'),(d,d'),(t,t')	El73	28.9 *44*	5.6 *8*
^{226}Ra	322	0.74 *4*	Coulex	Le82a,El87a	34.8 *19*	0.91 *5*
^{230}Th	572	0.64 *6*	Coulex	McG74	29.1 *27*	1.33 *12*
^{232}Th	774	0.45 *5*	Coulex	McG74	20.1 *23*	1.25 *14*
^{234}U	849	0.50 *18*	(d,d')(90,125)	Bo73	29 *10*	1.5 *5*
^{236}U	744	0.53 *7*	Coulex	McG74	22.9 *31*	1.36 *18*
^{238}U	732	0.61 *4*	Coulex	McG74,Al81	25.9 *17*	1.52 *10*
^{238}Pu	661	0.71 *12*	Coulex	McG74	30 *5*	1.56 *26*
^{240}Pu	649	0.41 *6*	Coulex	McG74	17.1 *26*	0.88 *13*
^{242}Pu	832	0.42 *7*	Coulex	McG74	17.2 *29*	1.14 *19*
^{244}Pu	708	0.30 *10*	Coulex	McG74	12.1 *41*	0.68 *23*
^{244}Cm	970	0.52 *7*	Coulex	McG74	21.0 *27*	1.59 *21*
^{246}Cm	876	0.27 *9*	(d,d')(90)	Ya75	10.6 *36*	0.74 *25*
^{248}Cm	1094	0.41 *10*	Coulex	McG74,Sc81	16.0 *39*	1.38 *34*
^{250}Cf	906	0.202 *20*	(d,d')(90,125,140)	Ah80a	7.8 *8*	0.55 *5*

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