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Evaluated Nuclear Structure Data File

A Manual for Preparation of Data Sets

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Abstract

The structure and the format for the Evaluated Nuclear Structure Data FILE (ENSDF) is described. ENSDF is used to store nuclear structure properties of nuclides and the results of various experiments to derive those properties.

Contents

Chapter I

Introduction

This manual[1] describes the organization and structure of the Evaluated Nuclear Structure Data File (ENSDF). This computer-based file is maintained by the National Nuclear Data Center (NNDC) at Brookhaven National Laboratory for the international Nuclear Structure and Decay Data Network.[2]

For every mass number (presently, $A \leq 293$), the Evaluated Nuclear Structure Data File (ENSDF) contains evaluated structure information. For masses $A \geq 44$, this information is published in the *Nuclear Data Sheets*; for $A < 44$, ENSDF is based on compilations published in the journal *Nuclear Physics*. The information in ENSDF is updated by mass chain or by nuclide with a varying cycle time dependent on the availability of new information.

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[1] The format for ENSDF was first designed by W. B. Ewbank and M. R. Schmorak at the Nuclear Data Project, Oak Ridge National Laboratory, and was described in the Rept ORNL-5054/R1 (February 1978). The present report describes the current format and supersedes both the ORNL report and the reports BNL-NCS 51655 (March 1983) and BNL-NCS-51655-Rev.87 (April 1987) both by J. K. Tuli.

[2] Coordinated by the International Atomic Energy Agency, Vienna - see any issue of the *Nuclear Data Sheets* for list of evaluation data centers.

Chapter II

GENERAL ORGANIZATION AND STRUCTURE OF THE DATA FILE

A General Organization

The Evaluated Nuclear Structure Data File (ENSDF) is made up of a collection of 'data sets' which present one of the following kinds of information:

1. The summary information for a mass chain giving information, *e.g.*, evaluators' names and affiliations, cutoff date, evaluators' remarks, and publication details, *etc.*
2. The references used in all the data sets for the given mass number. This data set is based upon reference codes (key numbers) used in various data sets for a given mass number and is added to the file by the NNDC.
3. The adopted level and gamma-ray properties for each nuclide.
4. The evaluated results of a single type of experiment, *e.g.*, a radioactive decay or a nuclear reaction for a given nuclide.
5. The combined evaluated results of a number of experiments of the same kind, *e.g.*, (Heavy ion, xnγ), Coulomb excitation, *etc.* for a given nuclide.

The data sets in ENSDF are organized by their mass number. Within a mass number the data sets are of two kinds:

- Data sets which contain information pertaining to the complete mass chain. These data sets contain information of the type (1) and (2) given above.
- Data sets belonging to a given nuclide (Z-value).

Latter data sets, *i.e.* for a given nuclide (Z-value), consist of the following:

- A Comments data set which gives abstract information for the nuclide. This data set contains summary information as described in (1) above. This data set exists only if the nuclide was evaluated or updated beyond the whole mass chain was evaluated.
- Adopted data set (only one per Z-value) giving adopted properties of the levels and gamma rays seen in that nuclide.
- Data sets giving information of the type (4) or (5) above.

If there is more than one data set of type (4) or (5) for a given nuclide, then an adopted data set is *required* for that nuclide. If there is only one data set for a given nuclide and no gamma-rays have been seen, then that data set is assumed also to present the adopted properties for that nuclide. If, however, there is gamma information known for the nuclide then a separate Adopted Levels, Gammas data set must be given even if all the information comes from only one experiment (data set).

The general organization of ENSDF is shown schematically in Fig. II.1.

B Data Set Structure

A data set is composed of 80-character records. A data set has at least two records, the beginning (DSCID) and the endrecord. Data set structure is shown in Fig. II.2 and is described below:

A data set *must* begin with an **IDENTIFICATION** record and *must* end with an **END** record (a blank record). Between these two records, there can be as many additional records as are needed to describe fully the experimental or the evaluated information.

Immediately following the **IDENTIFICATION** record is a group of records which contain information about the entire data set (#1 and #2 in Fig. II.2). The **History (H)**, general **COMMENT (C)**, **NORMALIZATION (N)**, **Q-VALUE (Q)**, **PARENT (P)**, and **CROSS-REFERENCE (X)** records are of this type. Not all of these records are included in every data set. For example, **Q-VALUE (Q)** and **CROSS-REFERENCE (X)** records normally appear only in adopted data sets while the **PARENT (P)** record is given only in radioactive decay data sets.

The body of a data set (#3 and #4 in Fig. II.2) is composed of numeric data records which describe the measured or deduced properties of levels, γ rays, α particles, *etc.* These records are associated with the level which decays (for **GAMMA**, records) or the level which is populated (for **BETA**, **EC**, **ALPHA**, **PARTICLE**, or **DELAYED- PARTICLE** records). Thus, each **LEVEL** record is followed by a group of records describing β, ϵ, or (delayed-) particle decay into the level and γ-ray out of the level (#4 in Fig. II.2). The **LEVEL** records, and the corresponding radiation records, are placed in the data set in the order of increasing energy.

If a **GAMMA**, **ALPHA**, **EC**, **BETA**, or **(DELAYED-)PARTICLE** record properly belongs in a data set but cannot be associated with any particular level, then the record should be placed in the data set *before any* **LEVEL** records (#3 in fig. II.2).

The placement of **COMMENT** records is described in **III.B.5**.

C File Storage and Transmittal

The data sets sent to NNDC for inclusion in ENSDF can be in any order, as the file is currently maintained using a data base management system which rearranges various data sets in their predetermined order. Copies of the file are transmitted in the form of a sequential file via various mass media. Unless requested otherwise the data sets in the sequential file are arranged by mass numbers in increasing numerical order. For a given mass number the data sets are organized as given in Fig. II.1, ordering them from left to right. Decay data sets are placed under the daughter nuclide and are ordered by A, Z and then the excitation energy of the parent nuclide. The reaction data sets are given under the residual nuclide and ordered by the A, Z of the target

EVALUATED NUCLEAR STRUCTURE DATA FILE

Organization Chart

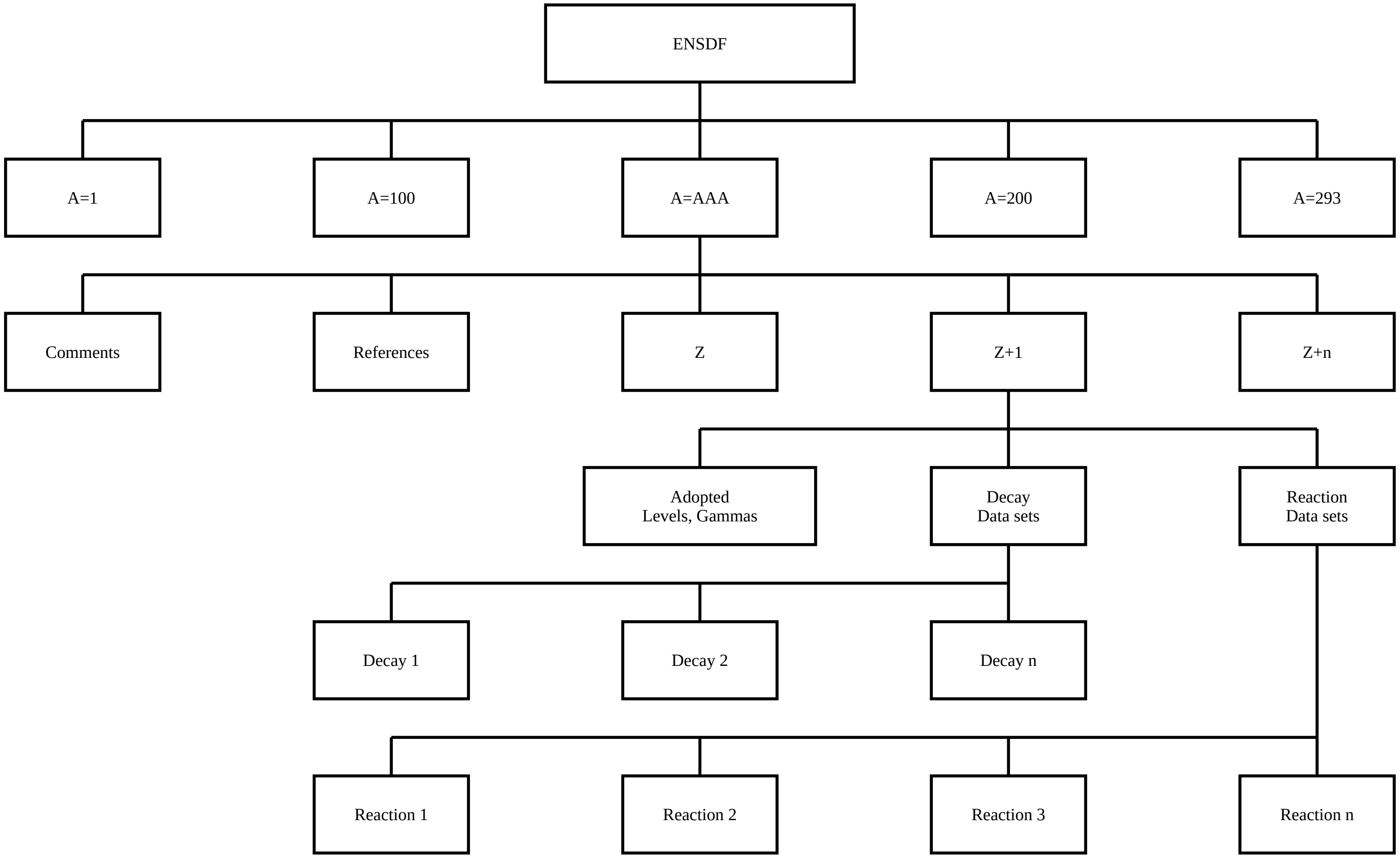

Figure II.1: ENSDF Organization

nuclide follwed by the A, Z of the incident particle and then by the energy of the incident particle. These are followed by other data sets, *e.g.*, Coulomb Excitation, (HI,XNG), etc.

Data Set Structure

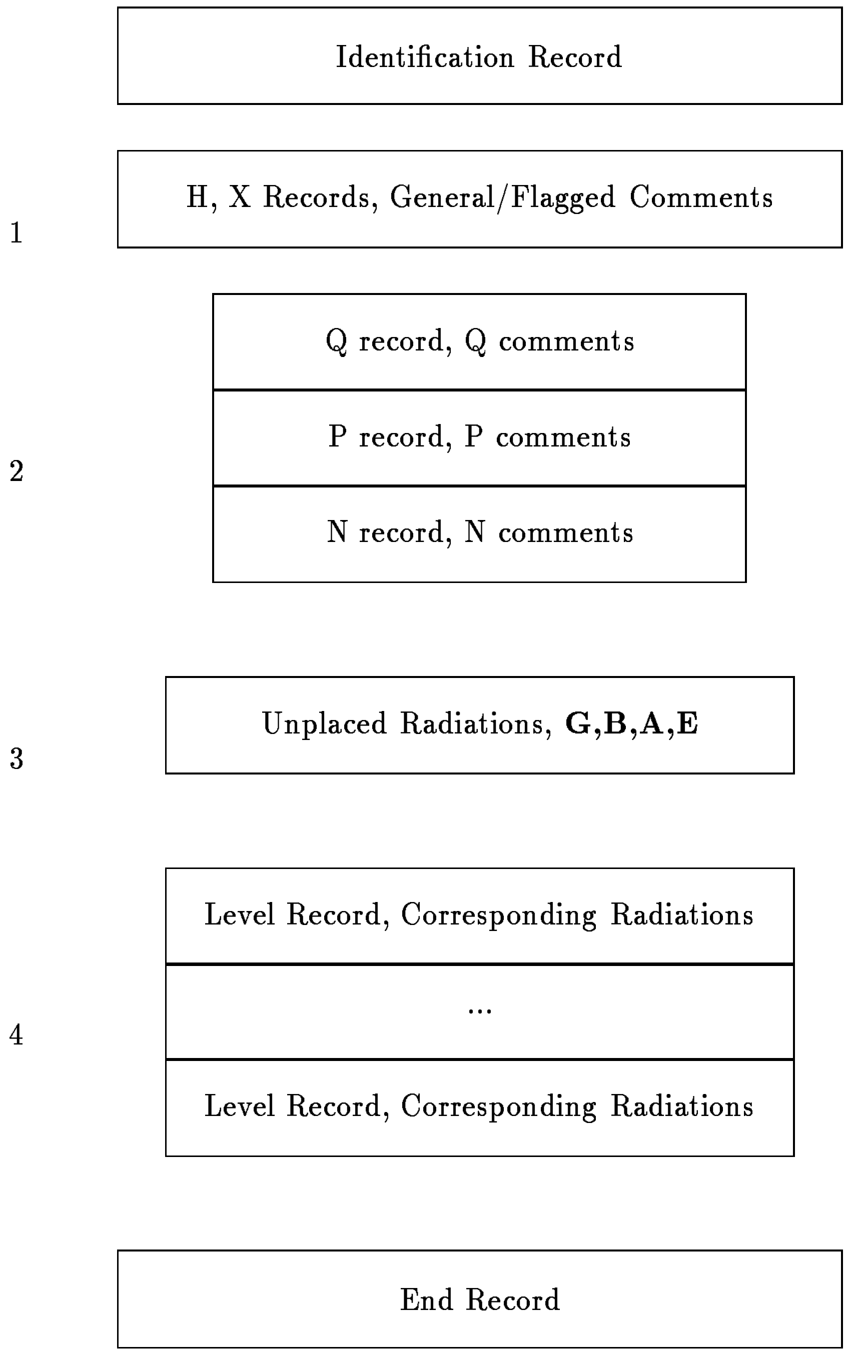

Fig. II.2

Chapter III

STANDARD ONE-CARD RECORD FORMATS

A Introduction

In most cases, all information for a record can be placed on a single 80-column (byte) card (record)[1]. A 'standard' format has been defined for each one-card record, such that the most commonly used quantities can be placed on a single card. The standard formats are described in this section for each record. If a needed quantity is not included in the standard format or if a value will not fit within the field defined for the value by the standard format, or if a record cannot be contained on a single card, then additional cards can be prepared as described in Chapter IV (for examples, see Appendix C and D). Note that many of the analysis programs may not process standard fields when placed on the continuation records.

B The Standard One-Card Record Formats

Record formats are given below in the same order in which they would normally be encountered in a data set. Conditions under which each record may appear or be required are given in parentheses. The format descriptions give the fields (in inclusive card-column numbers), the field names (the formal 'name' of the quantity that goes into the field), and a brief field description. Card columns not explicitly included in the fields are expected to be blank. A detailed description of each field can be found in the reference section noted. (Any numerical field left blank usually implies that the numerical information is lacking. Numbers will usually be assumed to be positive unless stated otherwise.) Numbers can be entered anywhere in the appropriate field (*i.e.*, there is no need to left-adjust or right-adjust, unless stated otherwise.)

[1]Throughput this manual an 80-byte record is referred to as a card of 80 columns. Column number refers to the byte number on the record, starting from the left.

1 The Identification Record

Required for all data sets.
Must precede all other records.

Field (Col.)	Name	Description	Reference
1-5	**NUCID**	Nuclide Identification	**V.1**
6-9		Must be blank	
10-39	**DSID**	Data set identification	**V.2**
40-65	**DSREF**	References to main supporting publications and analyses	**V.3**
66-74	**PUB**	Publication Information	**V.4**
75-80	**DATE**	The date (year/month) when the data set was placed in ENSDF (entered automatically by computer)	**V.5**

Note: In the rare case when DSID field is insufficient for dataset identification it may be continued on a second identification record with col 1-39 defined as above except that col. 6 will contain an alphanumeric character and columns 40-80 will be blank. If there is a continuation record, the DSID field on the first IDENTIFICATION record *must* end with a ',' (comma).

2 The History Record

The history records follow the Identification record and should appear in reverse-chronological order, most recent being the first

Field (Col.)	Name	Description	Reference
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**H**	Letter 'H' is required	
9		Must be blank	
10-80	**History**	Dataset history consisting of various field descriptors and their values in cols 10-80 continued on any number of continuation records. Field descriptor is followed by an '=' (without spaces before or after '=')and the value and a terminator '$' ('$' is not needed for the last field descriptor).	**V.25**

3 The Q-value Record

Required for adopted data sets.
If there is only one data set for the nuclide then the Q-value record should be given in that data set.
Must precede **L, G, B, E, A, DP** *records.*
If signs are not given, they will be assumed to be +.

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank	
7		Must be blank	
8	**Q**	Letter 'Q' is required	
9		Must be blank	
10-19	$\mathbf{Q}^-$	Total energy (keV) available for β^- decay of the ground state. ($\mathbf{Q}^- > \mathbf{0}$ if β^- decay is energetically possible. $\mathbf{Q}^- < 0$ represents the Q_ϵ energy of the Z+1 (Z = proton number) isobar.)	**V.10**
20-21	$\mathbf{DQ}^-$	Standard uncertainty in $\mathbf{Q}^-$	**V.11**
22-29	**SN**	Neutron separation energy in keV	**V.10**
30-31	**DSN**	Standard uncertainty in **SN**	**V.11**
32-39	**SP**	Proton separation energy in keV	**V.10**
40-41	**DSP**	Standard uncertainty in **SP**	**V.11**
42-49	**QA**	Total energy (keV) available for α decay of the ground state	**V.10**
50-55	**DQA**	Standard uncertainty in **QA**	**V.12**
56-80	**QREF**	Reference citation(s) for the Q-values	**V.3**

4 The Cross-Reference Record

Given only in adopted data sets.
Must precede **L, G, B, E, A, DP** *records.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank	
7		Must be blank	
8	**X**	Letter 'X' is required	
9	**DSSYM**	Any ASCII character that uniquely identifies the data set whose **DSID** is given in col. 10-39.	
10-39	**DSID**	*Must* exactly match one of the DSID's used	**V.2**
40-80		Blank	

NOTES:

1. In the *Nuclear Data Sheets* the DSID on the first 'X' record in the data set will be identified with character 'A' and second DSID with 'B' and so on irrespective of DSSYM on the X card. Only the first 14 DSID's on 'X' records are given different symbols. All the rest are given the symbol 'O' (for others). By merely reshuffling the X-records, evaluators can ascertain the DSID's that will be identified individually. This has no effect on the file and affects only the published output.

2. If the DSID for the data set is continued on to a second card, the DSID on XREF record must match the DSID on the the first card, including the terminating ',' which will be translated into ellipses in the cross-reference table in the output.

3. There must be a data set corresponding every given X-record.

5 The Comment Record

General Comments
Must precede all **L, G, B, E, A, DP** *records.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7	**C**	Letter 'C', 'D', or 'T' is required *See notes 3 - 5 below*	
8	**RTYPE**	Blank or record type of records to which the comment pertains	**V.6**
9	**PSYM**	Blank , or symbol for a (delayed-)particle, *e.g.*, N, P, *etc.*	
10-80	**CTEXT**	Text of the comment. [See ENSDF Translation Dictionary (Appendix F)]	**V.7**

NOTES:

1. The comment refers only to records of specified **RTYPE** given in that data set. The comment will normally appear only in the table for that **RTYPE** in the output. For example, if the comment is on levels ('L' in col. 8) it will appear only in the level properties table.

2. If col. 8 and 9 are blank then the comment refers to the whole data set. These general comments precede formatted level or the radiation records. See Appendix B for use of comment records in COMMENTS data set.

3. Letter 'T' in place of 'C' in col. 7 of a comment record indicates to the output programs that this record should be reproduced 'as is' and the blanks in the record should not be squeezed out.

4. Letter 'D' in place of 'C' in col. 7 of a comment record indicates to the output programs that this is a documentation record and can be ignored. This record will also be ignored by the various analysis programs.

5. Lower case letters 'c' and 't' in col. 7 of a comment record indicate to the output programs that CTEXT in these records should not be translated. These will appear as written in the *Nuclear Data Sheets.* In this mode one must write special characters directly, for example, '|g' for γ, '{+238}Pu' for ^{238}Pu. See Appendix A for list of special characters.

Record Comments

Must follow the record to which the comment pertains.

Field (Col.)	Name	Description	Reference
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7	**C**	Letter 'C' or 'D' is required *See notes 4 and 5 on General Comments*	
8	**RTYPE**	Record type being commented upon It can be blank for **Particle** records	**V.6**
9	**PSYM**	Blank , or symbol for a particle, *e.g.*, N, P, *etc.*	
10-80	**SYM$** or **SYM,SYM,...,$**	**SYM** = type of data being commented upon Specified **SYM**s must be followed by a '$' except as in note 1 below.	**V.8**
10-80	**CTEXT**	Text of comment follows the '$' On continuation comment records, **CTEXT** may start in col. 10, and **SYM** or **SYM**s are *not* repeated. [See ENSDF Translation Dictionary, Appendix F]	**V.7**

NOTES:

1. The old format, where **SYM** were specified in col. 10-19, will be accepted without the '$' delimiter as long as col. 19 is a blank. In this case comment text begins in col. 20.

2. Record comments placed following a record of the same **RTYPE** refer only to that one record. (For example, a comment record with 'CL' in cols. 7-8 and 'T$' in col. 10-11 placed following the level record for the second-excited state refers to the half-life of *only* the second-excited state.)

Footnote Comments

Must precede **L, G, B, E, A, DP** *records*

Field (Col.)	**Name**	**Description**	**Reference**
1-9		same as in ii (Record Comments)	
10-80	**SYM$** or **SYM,SYM,...,$** or **SYM(FLAG)$** or **SYM(FLAG),** **SYM(FLAG),...,$**	**SYM** = see note 1 below **FLAG** = any ASCII alphanumeric character or string of alphanumeric characters *Field must end with a '$'* *-See note 1 on Record comments for exception*	**V.8**
10-80	**CTEXT**	Text of comment follows '$' On continuation comment records **SYM** or **SYM(FLAG)** are *not* repeated. [See ENSDF Translation Dictionary (Appendix F)]	**V.7**

NOTES:

1. **SYM** can only be one of the following:
   - The fields defined in formated **L, G, B, E, A, DP** records.
   - BAND. This **SYM** *must* be accompanied with a **FLAG**. Note also that text following '$' delimiter, or in col. 20-80 in old format, will appear as the band label in some of the drawings. Any other information on that band should, therefore, be given on continuation records.

2. <u>Footnote without **FLAG**</u>
   - This refers to all records of the specified **RTYPE** in the data set.
   - The footnote will normally appear only in the table for that **RTYPE** in the output. For example, if the footnote is on levels ('L' in col. 8) it will appear only in the level properties table.
   - <u>Footnote with **FLAG**</u>
     - Only those records are footnoted for which footnote flags are given, see note 4 below.
     - Only those data values of data types specified by **SYM** which is associated with a given **FLAG** are footnoted.

3. Footnote **FLAG** must be either a single character placed in col. 77 of the formatted record or a string of characters assigned to a special data type called FLAG on the following continuation record.

   Examples of flags on a continuation record:

   152EU2 G FLAG=ABCD$
   156GD2 L FLAG=KMP$

4. No footnotes are allowed for records of **RTYPE**: **N**, **P**, or **Q**.

5. To change the standard label heading of a formated field, *e.g.*, S to C^2S for **L** records, **CTEXT** should have the form LABEL=name, where 'name' is the new label desired. The new label should be kept as short as possible. Note that **FLAG** can not be specified with relabeling; also any other comment on the relabelled field must appear on a different record.

   Examples of field relabel:

   156GD CL S$LABEL=C2S
   156GD CL S$LABEL=DSIGMA/DOMEGA (45 DEG)

6 The Parent Record

Required for all decay data sets.
Must precede **L, G, B, E, A, DP** *records.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Parent Nuclide identification	**V.1**
6		Must be blank	
7		Must be blank	
8	**P**	Letter 'P' is required	
9		Blank or an integer in case of multiple **P** records in the data set	
10-19	**E**	Energy of the decaying level in keV (0.0 for g.s.)	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-39	**J**	Spin and parity	**V.20**
40-49	**T**	Half-life; units *must* be given	**V.14**
50-55	**DT**	Standard uncertainty in **T**	**V.12**
56-64		Must be blank	
65-74	**QP**	Ground-state Q-value in keV (total energy available for $\underline{g.s. \rightarrow g.s.}$ transition); it will always be a positive number. Not needed for **IT** and **SF** decay.	**V.9**
75-76	**DQP**	Standard uncertainty in **QP**	**V.11**
77-80	**ION**	Ionization State (for Ionized Atom decay), blank otherwise	

NOTES:

1. More than one parent card is allowed in a data set. If the decay scheme is due to more than one parent then separate **P** records should be given for each parent level.

2. Currently, publication program allows maximum of two parent cards.

3. Parent information, *namely*, E, J, T, QP must be identical to their values given in its Adopted Levels data set.

7 The Normalization Record

Must precede **L, G, B, E, A, DP** *records.*
Required if an absolute normalization is possible;
used mainly with decay and (n, γ) reaction data sets.

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide (Daughter/Product) identification	**V.1**
6		Must be blank	
7		Must be blank	
8	**N**	Letter 'N' is required	
9		Blank or an integer in case of multiple **P** records in the data set. It should correspond to the designator on the **P** record.	
10-19	**NR**	Multiplier for converting relative *photon* intensity (**RI** in the **GAMMA** record) to *photons* per 100 decays of the parent through the decay branch or to *photons* per 100 neutron captures in an (n,γ) reaction. *Required* if the absolute photon intensity can be calculated.	**V.9**
20-21	**DNR**	Standard uncertainty in **NR**	**V.11**
22-29	**NT**	Multiplier for converting relative *transition* intensity (including conversion electrons) [**TI** in the **GAMMA** record] to *transitions* per 100 decays of the parent through this decay branch or per 100 neutron captures in an (n, γ) reaction. *Required* if **TI** are given in the **GAMMA** record and the normalization is known.	**V.9**
30-31	**DNT**	standard uncertainty in **NT**	**V.11**
32-39	**BR**	Branching ratio multiplier for converting intensity per 100 decays through this decay branch to intensity per 100 decays of the parent nuclide. *Required if known.*	**V.9**
40-41	**DBR**	Standard uncertainty in **BR**	**V.11**
42-49	**NB**	Multiplier for converting relative β^- and ϵ intensities (**IB** in the **B-** record; **IB**, **IE**, **TI** in the **EC** record) to intensities per 100 decays through this decay branch. *Required if known.*	**V.9**

Field (Col.)	Name	Description	Reference
50-55	**DNB**	Standard uncertainty in **NB**	**V.11**
56-62	**NP**	Multiplier for converting per hundred delayed-transition intensities to per hundred decays of precursor	**V.9**
63-64	**DNP**	standard uncertainty in **NP**	**V.11**
65-80		Must be blank	

Note: Normally β^- and ϵ intensities are given as per 100 parent decays. One should remember that the multiplier for conversion to per 100 decays is NB×BR and, therefore, $NB = 1/BR$. Also, the uncertainties in I(β^-) will be calculated from addition of three quantities $\Delta(I(\beta^-))$, DBR and DNB in quadrature. Unless the uncertainties are precisely known it is recommended that NB be given without uncertainty. See **PN** record.

If more than one **P** records exist in the data set then there should be corresponding **N** records giving the respective branching ratios.

8 The Production Normalization Record

Must follow N record, if N record present.
It should be given when **G** *records with intensities are present.*

Field	Name	Description
1-5	**NUCID**	Nuclide (Daughter/Product) identification
6		Blank
7	**P**	Letter 'P' (for production) is required
8	**N**	Letter 'N' is required
9		Must be blank
10-19	**NR×BR**	Multiplier for converting relative *photon* intensity (**RI** in the **GAMMA** record) to *photons* per 100 decays of the parent. (Normally NR×BR). If left blank (NR DNR)×(BR DBR) from N record will be used for normalization.
20-21	**UNC**[1]	Standard uncertainty in **NR×BR**
22-29	**NT×BR**	Multiplier for converting relative *transition* intensity (including conversion electrons) [**TI** in the **GAMMA** record] to *transitions* per 100 decays of the parent. (Normally NT×BR) If left blank (NT DNT)×(BR DBR) from N record will be used for normalization.
30-31	**UNC**[1]	standard uncertainty in **NT×BR**
42-49	**NB×BR**	Multiplier for converting relative β^- and ϵ intensities (**IB** in the **B-** record; **IB**, **IE**, **TI** in the **EC** record) to intensities per 100 decays. If left blank **(NB DNB)×(BR DBR)** from N record will be used for normalization.
50-55	**UNC**[1]	Standard uncertainty in **(NB DNT)×(BR DBR)**
56-62	**NP**	Same as in 'N' record
63-64	**UNC**[1]	standard uncertainty in **NP**
77	**COM**	Blank or 'C' (for comment) If blank, comment associated with the intensity option will appear in the drawing in the *Nuclear Data Sheets.* If letter 'C' is given, the desired comment to appear in the drawing should be given on the continuation ('nPN') record(s), col. 10-80.

[1]If left blank no uncertainty will appear in the publication.

Field	Name	Description
78	**OPT**	Intensity Option. Option as to what intensity to display in the drawings in the *Nuclear Data Sheets*. The available options are given below (default option 3).

Option	Intensity displayed	Comment in drawing
1	TI or RI$(1+\alpha)$	Relative I$(\gamma + ce)$
2	TI$\times$NT or RI$\times$NR$\times(1+\alpha)$	I$(\gamma + ce)$ per 100 (mode) decays
3	TI$\times$NT$\times$BR or RI$\times$BR$\times$NR$\times(1+\alpha)$	I$(\gamma + ce)$ per 100 parent decays
4	RI$\times$NT$\times$BR	I(γ) per 100 parent decays
5	RI	Relative I(γ)
6	RI	Relative photon branching from each level
7	RI	% photon branching from each level

9 The Level Record

Optional, although a data set usually has at least one.

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**L**	Letter 'L' is required	
9		Must be blank	
10-19	**E**	Level energy in keV - *Must not be blank*	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-39	**J**	Spin and parity	**V.20**
40-49	**T**	Half-life of the level; units *must* be given. Mean-life expressed as the width of a level, in units of energy, may also be used	**V.14**
50-55	**DT**	Standard uncertainty in **T**	**V.12**
56-64	**L**	Angular momentum transfer in the reaction determining the data set. (Whether it is L_n, L_p, Δ**L**, *etc.*, is determined from the **DSID** field of the **IDENTIFICATION** record.)	**V.22**
65-74	**S**	Spectroscopic strength for this level as determined from the reaction in the **IDENTIFICATION** record. (Spectroscopic factor for particle-exchange reactions; β for inelastic scattering.) Note: If a quantity other than spectroscopic factor is given in this field, a footnote relabelling the field is required.	**V.21**
75-76	**DS**	Standard uncertainty in **S**	**V.11**
77	**C**	Comment **FLAG** used to refer to a particular comment record	**V.8**
78-79	**MS**	Metastable state is denoted by 'M ' or 'M1' for the first (lowest energy) isomer; 'M2', for the second isomer, *etc.* For Ionized Atom Decay field gives the atomic electron shell or subshell in which β^- particle is captured	**V.17**

Field (Col.)	**Name**	**Description**	**Reference**
80	**Q**	The character '?' denotes an uncertain or questionable level Letter 'S' denotes neutron, proton, alpha separation energy or a level expected but not observed	

10 The Beta (β^-) Record

Must follow the **LEVEL** *record for the level which is fed by the* β^-*.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**B**	Letter 'B' is required	
9		Must be blank	
10-19	**E**	Endpoint energy of the β^- in keV *Given only if measured*	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IB**	Intensity of the β^--decay branch[1]	**V.13**
30-31	**DIB**	Standard uncertainty in **IB**	**V.11**
42-49	**LOGFT**	The log *ft* for the β^- transition for uniqueness given in col. 78-79	**V.9**
50-55	**DFT**	Standard uncertainty in **LOGFT**	**V.12**
56-76		Must be blank	
77	**C**	Comment **FLAG** (Letter 'C' denotes coincidence with a following radiation. A '?' denotes probable coincidence with a following radiation.)	**V.8**
78-79	**UN**	Forbiddenness classification for the β^- decay, *e.g.*, '1U', '2U' for first-, second-unique forbidden. (A blank field signifies an allowed transition. Nonunique forbiddenness can be indicated in col 78, with col 79 blank)	**V.16**
80	**Q**	The character '?' denotes an uncertain or questionable β^- decay Letter 'S' denotes an expected or predicted transition	

[1]The intensity units are defined by the **NORMALIZATION** record.

11 The EC (or EC + β^+) Record

Must follow the **LEVEL** *record for the level being populated in the decay.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**E**	Letter 'E' is required	
9		Must be blank	
10-19	**E**	Energy for *electron capture* to the level Given only if measured or deduced from measured β^+ end-point energy	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IB**	Intensity of β^+-decay branch[1]	**V.13**
30-31	**DIB**	Standard uncertainty in **IB**	**V.11**
32-39	**IE**	Intensity of electron capture branch[1]	**V.13**
40-41	**DIE**	Standard uncertainty in **IE**	**V.11**
42-49	**LOGFT**	The log *ft* for $(\epsilon + \beta^+)$ transition for uniqueness given in col. 78-79	**V.9**
50-55	**DFT**	Standard uncertainty in **LOGFT**	**V.12**
65-74	**TI**	Total $(\epsilon + \beta^+)$ decay intensity[1]	**V.13**
75-76	**DTI**	Standard uncertainty in **TI**	**V.11**
77	**C**	Comment **FLAG** (Letter 'C' denotes coincidence with a following radiation. A '?' denotes probable coincidence with a following radiation.)	**V.8**
78-79	**UN**	Forbiddenness classification for ϵ, β^+ decay, *e.g.*, '1U', '2U'for first, second unique forbidden. (A blank signifies an allowed or a nonunique forbidden transition. Nonunique forbiddenness can be indicated in col 78, with col 79 blank)	**V.16**
80	**Q**	The character '?' denotes an uncertain or questionable ϵ, β^+ branch Letter 'S' denotes an expected or predicted transition	

[1]**IE**, **IB** and **TI** must be in the same units (see also **NB** in **NORMALIZATION** record).

12 The Alpha Record

Must follow the **LEVEL** *record for the level being populated in the decay.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank	
7		Must be blank	
8	**A**	Letter 'A' is required	
9		Must be blank	
10-19	**E**	Alpha energy in keV	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IA**	Intensity of α-decay branch in *percent* of the total α decay	**V.13**
30-31	**DIA**	Standard uncertainty in **IA**	**V.11**
32-39	**HF**	Hindrance factor for α decay	**V.9**
40-41	**DHF**	Standard uncertainty in **HF**	**V.11**
42-76		Must be blank	
77	**C**	Comment **FLAG** (Letter 'C' denotes coincidence with a following radiation. A '?' denotes probable coincidence with a following radiation.)	**V.8**
78-79		Must be blank	
80	**Q**	The character '?' denotes uncertain or questionable α branch Letter 'S' denotes an expected or predicted α branch	

13 The (Delayed-) Particle Record

Must follow the **LEVEL** *record for the level which is fed by the particle. Records for particles which are unassigned in a level scheme should precede the first level of the data set.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**D**	Blank for prompt-, Letter 'D' for delayed-particle emission	
9	**Particle**	The symbol for the (delayed) particle (N=neutron, P=proton, A=alpha particle) is required)	
10-19	**E**	Energy of the particle in keV	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**IP**	Intensity of (delayed) particles in *percent* of the total (delayed-) particle emissions	**V.13**
30-31	**DIP**	Standard uncertainty in **IP**	**V.11**
32-39	**EI**	Energy of the level in the 'intermediate' (mass=A+1 for n, p;A+4 for α) nuclide in case of delayed particle	**V.13**
40-49	**T**	Width of the transition in keV	**V.14**
50-55	**DT**	Uncertainty in **T**	**V.12**
56-64	**L**	Angular-momentum transfer of the emitted particle	**V.22**
65-76	Blank		
77	**C**	Comment **FLAG** used to refer to a particular comment record.	**V.8**
78	**COIN**	Letter 'C' denotes placement confirmed by coincidence. Symbol '?' denotes probable coincidence.	**V.15**
79		Blank	
80	**Q**	The character '?' denotes an uncertain placement of the transition in the level scheme Letter 'S' denotes an expected, but as yet unobserved, transition	

Notes:

1. The delayed-particle record will appear in a delayed-particle data set (*e.g.*, B-N DECAY, ECP DECAY, *etc.*) which should be given under the A-chaan for the final nuclide. For example, '95RB B-N DECAY' should be given as data set for ^{94}Sr.

2. The intensity units are defined by the **NORMALIZATION** record.

14 The Gamma Record

Must follow the **LEVEL** *record for the level from which the γ ray decays. Records for γ rays which are unassigned in a level scheme should precede the first level of the data set.*

Field (Col.)	**Name**	**Description**	**Reference**
1-5	**NUCID**	Nuclide identification	**V.1**
6		Blank Any alphanumeric character other than '1' for continuation records	
7		Must be blank	
8	**G**	Letter 'G' is required	
9		Must be blank	
10-19	**E**	Energy of the γ-ray in keV - *Must not be blank*	**V.18**
20-21	**DE**	Standard uncertainty in **E**	**V.11**
22-29	**RI**	Relative *photon* intensity[1]	**V.13**
30-31	**DRI**	Standard uncertainty in **RI**	**V.11**
32-41	**M**	Multipolarity of transition	**V.19**
42-49	**MR**	Mixing ratio, δ. (Sign must be shown explicitly if known. If no sign is given, it will be assumed to be unknown.)	**V.10**
50-55	**DMR**	Standard uncertainty in **MR**	**V.12**
56-62	**CC**	Total conversion coefficient	**V.9**
63-64	**DCC**	Standard uncertainty in **CC**	**V.11**
65-74	**TI**	Relative total transition intensity[1]	**V.13**
75-76	**DTI**	Standard uncertainty in **TI**	**V.11**
77	**C**	Comment **FLAG** used to refer to a particular comment record. The symbol '*' denotes a multiply-placed γ ray. The symbol '&' denotes a multiply-placed transition with intensity <u>not</u> divided. The symbol '@' denotes a multiply-placed transition with intensity suitably divided. The symbol '%' denotes that the intensity given as **RI** is the % branching in the Super Deformed Band.	**V.8**
78	**COIN**	Letter 'C' denotes placement confirmed by coincidence. Symbol '?' denotes questionable coincidence.	**V.15**

[1]The intensity units are defined by the **NORMALIZATION** record.

Field (Col.)	**Name**	**Description**	**Reference**
79		Blank	
80	**Q**	The character '?' denotes an uncertain placement of the transition in the level scheme Letter 'S' denotes an expected, but as yet unobserved, transition	

15 The Reference Record

Record can occur only in Reference data set.
The NNDC provides the Reference data set.

Field (Col.)	**Name**	**Description**	**Reference**
1-3	**MASS**	Mass Number	
4-7		Must be blank	
8	**R**	Letter 'R' is required	
9		Must be blank	
10-17	**KEYNUM**	Reference key number	**V.3**
18-80	**REFERENCE**	Abbreviated reference (from NSR file)	

16 The End Record

Required for all data sets.
Must be the last record in a data set.

Field (Col.)	**Description**
1-80	All columns are blank

C Summary

The following two pages summarize the standard one-card formats for all allowed record types.

SUMMARY of STANDARD ONE-CARD RECORD FORMAT

```
Col                         Record TYPE
No.   R  I  X  C/D      Q    N    P    L    G    B    E    A    Particle
--    --------------------------------------------------------------------
1-3   <-------------------------Mass------------------------------------>
4-5      <----------------------Element symbol-------------------------->
6        #     #        #    #    #    #    #    #    #    #    #
7             C/D
8     R        @        Q    N    P    L    G    B    E    A    D(delayed)
9        #                                                      P/N/A
10-39    ID ID
10-19key#     SYM       Q-  NR   <--------------E----------------------->
20-21                   DQ- DNR  <--------------DE---------------------->
20-80Ref      Com
22-39                             J     J
22-29                   SN  NT              RI   IB   IB   IA   IP
30-31                  DSN DNT             DRI  DIB  DIB  DIB  DIP
32-41                                       M
32-39                   SP  BR                        IE   HF   ED
40-41                  DSP DBR                       DIE  DHF
40-49                             T     T                       T
40-65   Ref
42-49                   QA  NB              MR  <-LOGFT->
50-55                  DQA DNB    DT    DT DMR  <--DFT-->
56-62                                       CC
56-64                                   L                        L
56-80                  QRef
63-64                                      DCC
65-74                             QP    S   TI         TI
66-74 PUB
75-76                            DQP   DS  DTI        DTI
75-80 Date
77                                      C    a    C    C     C    C
78-79                                  MS    C/?  UN   UN
80                                      Q    Q    Q    Q     Q    Q
```

\# Any ASCII Character
@ L,G,B,A,E,N,Q,P for record comments following the respective record
a * denotes multiply placed.
  @ denotes multiply placed, intensity sitably divided.
  & denotes multiply placed, undivided intensity given.
  % denotes that the intensity given is % branching in SD band

ENSDF Standard 80-character Formated Records

Record																
Record	1 5	6	7	8	9	0 9 (1)	0 1 (2)	2 9	0 1 (3)	2 9	0 1 (4)	2 9	0 5 (5)	6 0 2 (6)	3 4	5 0 4 (7) / 5 6 / 7 / 8 9 / 0 (8)
IDENT	NUCID	&	blank	<—DSID—>	DSREF	<—PUB—>	<—DATE—>									
XREF	NUCID	blank	X	!	<—DSID—>	blank										
REF	AAA	blank	R	bl	KEYNUMBER	REFERENCE										
HIST	NUCID	&	bl	H	bl	<—HTEXT—>										
Q-VALUE	NUCID	blank	Q	bl	Q-	DQE	SN	DSN	SP	DSP	QA	DQA	QREF			
G COMM	NUCID	&	†	#	bl	CTEXT										
F/R COMM	NUCID	&	†	#	‡	SYM(FLAG)	CTEXT									
PARENT	NUCID	blank	P	š	E	DE	<—J—>	<—T—>	DT	blank	QP	DQP	<—ION—>			
NORM	NUCID	blank	N	š	NR	DNR	NT	DNT	BR	DBR	NB	DNB	NP	DNP	blank	
P NORM	NUCID	&	P	N	š	NR*BR	UNC	NT*BR	UNC	blank	NB*BR	UNC	NP	DNP	blank	
LEVEL	NUCID	&	bl	L	bl	E	DE	<—J—>	<—T—>	DT	<—L—>	<—S—>	DS	F	MS	Q
BETA	NUCID	&	bl	B	bl	E	DE	IB	DIB	blank	LOGFT	DFT	blank	F	UN	Q
EC	NUCID	&	bl	E	bl	E	DE	IB	DIB	IE	DIE	LOGFT	DFT	blank	F	UN	Q
ALPHA	NUCID	&	bl	A	bl	E	DE	IA	DIA	HF	DHF	blank	F	bl	Q	
PART	NUCID	&	bl	¶	E	DE	IP	DIP	ED	<—T—>	DT	<—L—>	blank	F	C	bl	Q
GAMMA	NUCID	&	bl	G	bl	E	DE	RI	DRI	<—M—>	MR	DMR	CC	DCC	TI	DTI	F	C	bl	Q
	1 5	6	7	8	9	0 9 (1)	0 1 (2)	2 9	0 1 (3)	2 9	0 1 (4)	2 9	0 5 (5)	6 0 2 (6)	3 4	5 0 4 (7) / 5 6 / 7 / 8 9 / 0 (8)

Notes:

- blank — These fields must be blank.
- & — Primary record must have a blank or "1" in this field. Continuation records should have any printable ASCII character except for blank or "1" (one).
- ! — Unique alphanumeric character identifying the source data set.
- † — Allowed characters for this field are C, c, D, d, T, and t.
- # — Character identifying the record being commented on. Allowed characters for this field are N, P, Q, L, G, B, E, A, D, and blank.
- ‡ — Must be blank except for: 1) Particle code for a (delayed-)particle record. 2) Sequence number for normalization and parent records.
- š — Must be blank except when there are multiple parent records then this field should contain an integer relating the parent record to the related normalization record.
- ¶ — Byte 8 must either be blank for a prompt particle radiation or D for a delayed particle radiation. Byte 9 identifies the particle (N, P, D, or T).

Chapter IV

RECORDS CONTAINING MORE THAN ONE CARD

A Card Enumeration

Certain record types, namely, the **Identification**, **History**, **Parent**, **Normalization** records can have multiple occurrence of records with qualifications as indicated in the descriptions of these record types. For other record types if all the information cannot be contained on a single card, it is possible to use additional cards to describe the record fully. The first card of a record will have a blank in col. 6 and subsequent cards will have an ASCII character different from blank or 1 (usually running numbers: 2 to 9 or letters A to Z).

B Format for Continuation Cards

THE CONTINUATION RECORD

Must follow the record of the same **RTYPE**.

Field	Name	Description
1-5	**NUCID**	Nuclide identification
6		Any alphanumeric character other than 1. Note: 'S' is reserved for computer-produced records which will usually be suppressed in the *Nuclear Data Sheets*
7		Must be blank
8	**RTYPE**	Letter corresponding to the record type **L, B, E, G** or **H**
9		Must be blank
10-80	**Data**	$<quant><op><value>[<op><value>][<ref>]\$\ \ldots$

In the description of **Data** above the following abbreviations have been used:

< *quant* >: Standard symbol for a quantity as defined in **IV.C** below.
Notes: 1. Ratios of more than two quantities should be indicated by colons and not by slashes (*e.g.*, K:L1:L2:L3 and not K/L1/L2/L3).
2. See **V.24** for description of < *value* > when < *quant* >=XREF
3. See **V.25** for description of items for **H** record

< *op* >: =, <, >, <=,>=, EQ, AP, LT, LE, GT, GE
Note: For the last 6 operators blanks before and after them are required.

< *value* >: Numeric value with units as needed and optional uncertainty.
Uncertainty is as defined in Sections **V.11** and **V.12**.
Note: For ranges, uncertainties should not be included.
To specify a bounded range of values a second operator (note that =, EQ, AP are not valid) and value are required.
See examples below.

[...]: Optional.

< *ref* >: 8 character key numbers, **KEYNUM** (see **V.3**), separated by commas and enclosed within parentheses, *e.g.*, (1976TU01,1981BO01).

$: Delimiter (end of record is also a delimiter; thus '$' is not needed for the last item on a record)

Examples:

```
126TE  2 G  BE2W=25.3 7(1970LAZM)
126I   2 L  %EC+%B+=56.3 20 (1977JA04)$%B- EQ 43.7 20 (1977JA04)
126SN  S B  EAV=2030 60
126TE  2 L  G LE 0.19 GT 0.1 (1981SH15)$MOME2 AP -0.20$BE2=0.478 12
```

C Allowed Data Types on Continuation Records

Each record type is permitted to contain only a limited (but extendable) set of data types. For example, a **GAMMA** record is not allowed to contain information of data type **DTYPE** = **J** (nuclear spin), similarly a **LEVEL** record is not allowed to contain **LOGFT** information.

For **A** and **DP** records only FLAG in addition to the quantities on the formatted records, can be given on a continuation record. The allowed data types for **LEVEL**, **GAMMA**, **B-**, and **EC** records are described below.

1 The Level Record

Allowed data types **E**, **DE**, **J**, **T**, **DT**, **L**, **S**, **DS**, **C**, **MS**, **Q**, are described with the standard formats in Section **III.B.9**. Additional allowed data types are:

TYPE	Description
%EC,%B+,%EC+%B+,	Percent decay of the level by ϵ, β^+, $\epsilon + \beta^+$,
%B-,%IT,%SF,	β^-, isomeric transition, spontaneous fission,
%A,%P,%N,...;	α, proton, or neutron decay, ...
%B-N; %B-XN; ...	Percent delayed decay through n, xn emission,....
	Similarly, for other particle emissions, *e.g.*,
	p, xp, α, xα, *etc.*, following β-, β+, or ϵ decays.
	Note: Decay modes must be given on **'2 L'**
	card in adopted set and on an **'S L'**
	card in decay and (n,γ) data sets
ION	Ionization State (used in Ionized Atom Decay)
CONF	Nuclear configuration of the level
BE1, BE2, ...	Reduced electric transition probability (*upward*)
	given in units $e^2 \times (barns)^L$, where L = 1, 2, ...
	for the transition from the ground state to this level
B2, B3, ...	$2^L - pole$ (L=2,3,...) nuclear deformation
	parameter
FLAG	Additional footnote symbols
G	g-factor of the level
ISPIN	Isobaric spin
ISPINZ	Z-component of Isobaric Spin
MOME1, MOME2, ...	Electric moments: dipole, quadrupole, ...
MOMM1, MOMM2, ...	Magnetic moments: dipole, quadrupole, ...
WIDTH,WIDTHG,	Level width, Γ, Partial-γ , -γ0, -n, -p, -α widths,
WIDTHG0,WIDTHN,	$\Gamma(\gamma)$, $\Gamma(\gamma 0)$, Γ(n),
WIDTHP, WIDTHA	Γ(p), $\Gamma(\alpha)$, respectively
XREF	Cross-reference to other data sets for that nuclide, this is generally given only in the adopted set.

2 The Gamma Record

Allowed data types, **E**, **DE**, **RI**, **DRI**, **M**, **MR**, **DMR**, **CC**, **DCC**, **TI**, **DTI**, **C**, **COIN**, **Q**, are described with the standard formats in Section **III.B.14**. Additional allowed data types are:

DTYPE	**Description**
BE1, BE2, ...	Reduced electric transition probability (*downward*) given in units of $e^2 \times (barns)^L$, where L = 1, 2, ...
BE1W, BE2W, ...	Reduced electric transition probability (*downward*) given in single-particle (Weisskopf) units
BM1,BM2, ...	Reduced magnetic transition probability (*downward*) given in units of $\mu_N^2 \times (barns)^{L-1}$, where L = 1, 2, ...
BM1W,BM2W, ...	Reduced magnetic transition probability (*downward*) given in single-particle (Weisskopf) units
CE	Total conversion electron intensity
CEK,CEL,...	Conversion-electron (ce) intensity for K, L, ...
CEL1,...	L_1, ... conversion
ECC	Measured total conversion coefficient
EKC, ELC, EL1C, ...	Measured K-, L-, L_1-,... conversion coefficient
FL	Final level energy. It must be either *identical* to a level energy in the data set optionally followed by a '?' (latter expresses uncertain placement) or a '?' (if the final level is not known)
FLAG	Additional footnote symbols
KC,LC,L1C, ...	Theoretical K-, L-, L_1-,... conversion coefficient
K:L,M:L,L1:L2, ...	Conversion-electron intensity ratios
K:T,L:T,...	Ratio of K, L, ... ce-intensity to total (γ + ce) intensity

3 The Beta (β^-) Record

Allowed data types **E**, **DE**, **IB**, **DIB**, **LOGFT**, **DFT**, **C**, **UN**, **Q**, are described with the standard formats in Section **III.B.10**. Additional allowed data types are:

DTYPE	Description
EAV	Average energy of the β^- spectrum
FLAG	Additional footnote symbols (Note: 'C' and '?' may not be used - see III.B.10 for their special meaning)

4 The EC Record

Allowed data types, **E**, **DE**, **IB**, **DIB**, **IE**, **DIE**, **LOGFT**, **DFT**, **TI**, **DTI**, **C**, **UN**, **Q**, are described with the standard formats in Section **III.B.11**. Additional allowed data types are:

DTYPE	Description
EAV	Average energy of the β^+ spectrum
CK,CL,CM, ...,CL+	Calculated fraction of decay by electron capture from the **K**, **L**, **M**, ..., **L+M+**... shells
ECK,ECL,ECM, ..., ECL+	Measured fraction of decay by electron capture from the **K**, **L**, **M**, ..., **L+M+**... shells
CK/T,CL/T, ...	Ratio of K, L, ... ϵ-intensity to total ϵ intensity
FLAG	Additional footnote symbols (Note: 'C' and '?' may not be used - see III.B.11 for their special meaning)

Chapter V

DETAILED FIELD DESCRIPTIONS

1 NUCID

The standard nuclide identification consists of two parts - mass number in cols. (1-3), right justified and element name (or $Z - 100$ for $Z > 109$) in (col. 4-5), left justified. The nuclide identification must be contained *within* the field defined for it (cols. 1-5). The nuclide identification *must* be included on every card of a data set except the **END** record. Comments and reference data sets pertaining to the whole A-(mass) chain evaluation contain only the A-value in the **NUCID** field.

2 DSID

Data Set **ID** for an ENSDF data set serves as a unique, computer recognizable identification for the data set. There can *not* be two data sets with identical DSID and NUCID. In the rare circumstance two data sets with same DSID for a given NUCID can be accomodated by ending DSID with a colon (:) and following it with a unique identifier which will then be different for the various data sets with that DSID.

The following rules for DSID should be strictly observed for ENSDF entries. Single blanks have meaning and should be used according to the formats below. In the description below the *optional fields are given in italics.* General categories are given in upper and lower cases and further defined. DSID <u>must</u> be confined to the 30 spaces allowed. The field may, however, be continued on to the DSID field on the second ID record as explained in Chapter III in which case the DSID on the first record <u>must</u> end with a ','.

GENERAL ID'S

REFERENCES
COMMENTS (see Appendix B for format for this data set)
ADOPTED LEVELS
ADOPTED LEVELS, GAMMAS

DECAY DATA SET ID'S

Parent Mode Decay (*Half-life*)

Parent should be the parent nuclide symbol, *e.g.*, 52CR
For SF decay more than one parent can be given separated by commas
For Ionized Atom Decay parent nuclide symbol is followed by ionization state in square brackets, *e.g.*, 187RE[+75]

Mode may be one of **B+**, **B-**, **EC**, **IT**, **A**, **P**, **B-N**, **ECP**, **SF**, , ...
List of decay modes may be expanded.

Half-life can be of the form **T** defined in **V.14.1**

MUONIC ATOM

REACTION DATA SET ID'S

Target(Reaction), (*Reaction*), *Target*(*Reaction*) *E=Energy Qualifier*
COULOMB EXCITATION
(HI,XNG)

Target should be the target (nuclide or element) symbol

Reaction should be given as *(in,out)*, *e.g.*, (**N**,**P**)
in is the incident particle, *out* are the outgoing particles

Energy may be one of the following
NUM, *NUM* Units (for definition of NUM see **V.9.**)
NUM-NUM Units
TH (for thermal)
RES (for resonance)

Qualifier may be one of the following
RES
IAR
IAS

EXAMPLES:

187RE B- DECAY	187OS IT DECAY (231 US)
187RE[+75] B- DECAY	187AU P DECAY:?
190PT A DECAY (6E11 Y)	95RB B-N DECAY
186OS(N,G) E=THERMAL	186W(N,G) E=TH: SECONDARY
RE(N,N'):TOF	238U(N,FG) E=TH
186W(N,G) E=RES: AVG	189OS(P,T) E=19 MEV
187OS(D,D') E=12, 17 MEV	185RE(A,2NG) E=23-42.8 MEV
187RE(D,2NG), 187RE(P,NG)	44CA(P,G) E=856, 906 KEV IAR
PB(238U,FXG)	PB(238U,XG)

3 DSREF, KEYNUM, QREF

The **DSREF** and **QREF** fields may include up to three key numbers (**KEYNUM**) each of which refers to a particular publication. Additional key numbers may be placed in **COMMENT** records. *Key numbers must be left-justified and separated by commas with no blanks between the comma and the reference.* A reference key number must be of the form **YYYYAABB** where **YYYY** is a four digit integer, **AA** are two alphabetic characters and **BB** is either a two digit integer or consists of two alphabetic characters. Examples: **1981TU01**, **1981TUXY**, *etc.*

4 PUB

Publication information generally consists of the year of the **A**-chain publication denoted by two digit year indicator followed by three-character code **NDS** for Nuclear Data Sheets and two-letter code **NP** for Nuclear Physics-A. This may optionally be followed by a comma and other updating information, *e.g.*, the initials of the person modifying the data set after its publication. Example: **78NDS,TWB** or **81NDS**.

5 DATE

This field is of the form **YYYYMM** where **YYYY** and **MM** are four and two digit integers, respectively, within the following ranges:
$YY \geq 1900$ and $01 \leq MM \leq 12$

6 RTYPE

RTYPE is a two-letter code in col. 8-9 that gives a name to the **RECORD** type. Note that col. 9 is blank for most of the RTYPE

RTYPE	Description
blank	May be **IDENTIFICATION**, general **COMMENT**, or **END** record
H	**HISTORY** record
N	**NORMALIZATION** record
	Production Normalization record has 'P' in col 7.
P	**PARENT** record
Q	**Q-VALUE** record
L	**LEVEL** record
G	**GAMMA** record
B	**BETA** (β^-)record

E	**EC** (for $\epsilon, \beta^+ or \epsilon + \beta^+$) record
A	**ALPHA** record
R	**REFERENCE** record
X	**CROSS-REFERENCE** record
DP	**DELAYED PARTICLE** record, or **PARTICLE** (col.8=blank) record Particle symbol (*e.g.*, 'P' for proton) is given in col. 9.

7 CTEXT

This field consists of free text. The various expressions used in **CTEXT** can be translated via dictionary lookup. The translation dictionary is given in Appendix F. The unit expression used in translation is the string of characters between adjacent 'delimiters'. The characters presently used as 'delimiters' are:

b(blank) ,(comma) .b(period followed by a blank) ; : ( ) - =
+ < > / and $

In some cases the dictionary lookup programs look beyond the next delimiter for proper translation.

8 SYM(FLAG)

The **SYM(FLAG)** field (with **FLAG** given) is valid only for records with **RTYPE**: **L**, **G**, **B**, **E**, **A**, **DP**. However, **SYM** (without **FLAG**) may additionally be used for record types **N**, **P**, and **Q**.
FLAG can be a string of characters *optionally* separated by commas. Any character other than a comma and parentheses can be used as a **FLAG** symbol. For **B** and **E** records 'C' can not be used for a **FLAG** as 'C' in column 77 of **B**, **E**, and **A** records denotes coincidence. Similarly '*', '@', '%', and '&' for **G** records are reserved with special meaning (**III.B.14**). See notes on **SYM** and **FLAG** under description of **COMMENT** record. **FLAG** can be used only with **SYM**s which are valid data types on a formated card or with BAND. In fact, for BAND **FLAG** *must* be given.

Allowed symbols to be used as **SYM** for various **RTYPE** are currently limited to the fields allowed on the formatted records.

9 BR,CC,HF,LOGFT,NB,NP,NR,NT,QP

These fields consist of either a blank or a single unsigned number (NUM) in one of the following forms:

1. An integer (*e.g.*, 345)
2. A real number (*e.g.*, 345.23)
3. An integer followed by an integer exponent (*e.g.*, 345E-4, 4E+5)
4. A real number followed by an integer exponent (*e.g.*, 345.E-4)

Note: It is desirable to write a number as '0.345' rather than '.345'.

10 MR,Q-,QA,SN,SP

These fields have the same form as the quantities in **V.9.** above with the difference that they are allowed to have signature (positive or negative).

11 DBR,DCC,DE,DHF,DIA,DIB,DIE,DIP,DNB

Includes DNR,DNP,DNT,DQP,DQ-,DS,DSP,DTI

These two character fields, represent uncertainty in the 'standard' form in the given quantity. The 'standard' numeric uncertainty denotes an uncertainty in the last significant figure(s), for example, NR=0.873, DNR=11 represent a normalization factor of 0.873 ± 0.011, similarly QP=2.3E6, DQP=10 stand for a Q-value of $(2.3 \pm 1.0) \times 10^6$ (see also General Policies given in Appendix H). The non-numeric uncertainty, e.g, $<, >, or \geq$, *etc.* is denoted by expressions LT, GT, and GE, *etc.* The allowed forms for these fields are summarized below:

1. Blank
2. An integer < 99, preferably < 25, (left or right justified)
3. One of the following expressions:
   LT, GT, LE, GE, AP, CA, SY
   for $<, >, \leq, \geq, \approx$, calculated, and from systematics, respectively.

12 DFT,DMR,DT,DNB,DQA

These fields allow for the specification of 'standard' asymmetric uncertainty. For example, T=4.2 S, DT=+8-10, represent a half-life=$4.2^{+0.8}_{-1}$ s, similarly MR=-3, DMR=+1-4 represent mixing ratio=-3^{+1}_{-4} meaning a range from -7 to -2. (Note: asymmetric uncertainties add algebraically.) When the $+/-$ construction is missing from this field, the digits or the expressions given in this field represent either the numeric 'standard' symmetric or the non-numeric uncertainty as described in **V.11** above.

To summarize this field, there are two cases:

1. Symmetric uncertainty - the field consists of an integer number or an expression of the type described in **V.11** above.
2. Asymmetric uncertainty - the field is of the form $+x-y$, where x and y are integers.

13 IA, IB, IE, IP, RI, TI

The following numbers/expressions are valid for these fields:

1. NUM (number as defined in **V.9** above)
2. (NUM)

Note: Parentheses denote that the number given has been deduced (not directly measured) or taken from other experiment(s).

14 T

The field for half-life **T** must have one of the following forms:

1. NUM-Blank-Units (*i.e.*, number as defined in **V.9** above followed by a blank and its units)
   Valid symbols for units are: Y, D, H, M, S, MS, US, NS, PS, FS, AS, EV, KEV, and MEV, for year, day, hour, minute, second(s), 10^{-3} s, 10^{-6} s, 10^{-9} s, 10^{-12} s, 10^{-15} s, 10^{-18} s, eV, 10^3 eV, and 10^6 eV, respectively.
2. Word 'STABLE'

Note: A question mark following half-life denotes that the assignment to that level is not certain. A comment should be given to explain the exact meaning intended.

15 COIN

This one character field can either be blank or have character 'C' or '?'. The character 'C' denotes coincidence while '?' denotes questionable coincidence.

16 UN

This two character field can either be blank for allowed transitions or have an integer between 1 and 9 indicating order of forbiddeness followed by a blank for 'non-unique' or a 'U' for unique transition.

17 MS

This two character field can either be blank or have character 'M' followed by a blank or a digit between 1 and 9.

18 E

An energy field, **E**, can have only one of the following forms:

1. NUM (as defined in **V.9** above)
2. NUM+A or A+NUM, where A=X, Y, Z, U, V, W, A, B,...used in this order; *i.e.*, for the first occurrence an 'X' is used, for its second occurrence a 'Y' is used, and so on.
3. SN+NUM, SP+NUM. Resonance energies should be given in center-of-mass system, as far as possible.
4. A (as defined in 2. above)

   Note: Parentheses are allowed for this field. They denote that the number given has been deduced (not directly measured) or taken from other experiment(s). Explanation as to what is intended should be given.

19 M

The multipolarity field can be one of the following:

1. Mult

2. Mult+Mult
3. Mult,Mult
4. NOT Mult

MULT

Where Mult $=E_L$ or $M_{L'}$
(where L, L' are single digits - $L \geq 0, L' \geq 1$)
$M_{L'} + E_L$ or
$E_L + M_{L'}$ or
D or Q

Note: Parentheses in the multipolarity field denote that the assignment is probable and not definite. Square brackets indicate assumed or derived assignment.

20 J

The spin-parity field can have only one of the following forms:

1. JPI (it can be J, π , or Jπ)
2. JPI OR JPI (',' (comma) can be used in place of 'OR')
3. JPI AND JPI ('&' (ampersand) can be used in place of 'AND')
4. OP JPI (where OP is AP, LE, or GE)
   Note: This will be interpreted as π=PI and J is OP J
   Example: $\leq 5+$ means $\pi = +$ and $J \leq 5$
5. NOT JPI
6. JPI TO JPI (':' (colon) can be used in place of 'TO')
   Note: If parity is given in the range it will be interpreted as follows:
   (a) J to $J'PI$ means $J \leq J \leq J'$ and $\pi = PI$
   (b) JPI to $J'PI'$ means JPI,J=J+1 $PI = \pm, \ldots, J = J' - 1PI = \pm, J'PI'$
   (c) JPI to J' means $JPI, J = J + 1PI = \pm, \ldots, J = J' - 1PI = \pm$, $J'PI = \pm$

Examples:

(a) 3 to 6- means $J\pi = 3-, 4-, 5-, 6-$

(b) 3+ to 6- means $J\pi = 3+, 4\pm, 5\pm, 6-$

(c) 3+ to 6 means $J\pi = 3+, 4\pm, 5\pm, 6\pm$

7. NATURAL/UNNATURAL

8. A or A+JPI (where A is one of the characters, J, K, L, M, N, O, P,...)

In the above J=N or $N/2$ (N is a positive integer or zero)
PI(π)=+ or -
JPI=J or PI or J followed by PI

Note:

1. Parentheses in the J^π field indicate that the parenthesised value(s) is (are) based upon weak arguments. See 'Bases for Spin and Parity Assignments' in Appendix H. Note that JPI=(3,4)- is interpreted as J=(3) or (4) and π=-.

2. As far as possible do not give more than three JPI values.

3. The ranges such as 3- to 5+ are better written as 3-,4,5+.

4. Square brackets around J^π value indicate assumed value.

21 S

This field may contain no more than three S-values, in the form of NUM defined in **V.9**, separated by a '+' or a comma, for corresponding L-values given in the L-field (col. 65-74). Parentheses are allowed and will be interpreted to mean probable values.

22 L

This field may contain no more than three integer numbers optionally preceded by LE or GE and separated by a '+' or a comma. Parentheses are allowed and will be interpreted to mean probable values. Square brackets indicate assumed or derived values.

For certain reactions the L value may be accompanied by its electric or magnetic character in the form similar to multipolarity (**V.19**).

23 ION

This field is either blank or a signed integer, left justified, denoting order of ionization of the atom, *e.g.*, +75. It is used in Ionized Atom Decay data sets.

24 Cross Reference

The cross referencing of a record (currently allowed only for the 'L' record in an ADOPTED data set) is done through specification on the continuation record and it takes the following forms:

1. NUCID 2 L XREF=ABC$
   Above record indicates that the adopted level (specified by preceding 'L' record) has been seen in data sets 'A', 'B', and 'C' and that the corresponding levels are unambiguous.

2. NUCID 2 L XREF=A(E1)B(E2)C(E3)$
   This record indicates that the adopted level is the same as the E1 level in data set 'A', the E2 level in data set 'B', *etc.*

3. NUCID 2 L XREF=A(E1,E2)B(E3)$
   This record indicates that the adopted level is either the E1 or the E2 level in data set 'A', the E3 level in data set 'B'.

4. NUCID 2 L XREF=A(*E1)B(E2)$
   This record indicates that a level with energy E1 in data set 'A' is associated with more than one adopted level. An '*' must appear on all occurrences of a multiply assigned level. Alternatively, the notation A(*) may be used if the energy is apparent.

5. NUCID 2 L XREF=+$
   This record indicates that the adopted level has been seen in all data sets.

6. NUCID 2 L XREF=-(AB)$
   This record indicates that the adopted level has been seen in all data sets except the data sets 'A' and 'B'.

Note: The symbols A, B, C relating to specific data sets must be defined through Cross-Reference records (see **III.B.4**).

25 History record

1. In all individual data sets in ENSDF (excepting the REFERENCE and COMMENTS data sets) the following information will be presented (the information is required, unless indicated optional) on an **H** record every time changes are made to the data set (see **III.B.2** for description of **H** record):

TYP	Type of change/evaluation (required)
AUT	Author's name (the person who makes or is responsible for the change not necessarily the evaluator of the data set) (required)
DAT	Date of change (optional, if cutoff date given)
CUT	Literature cutoff date (optional when changes do not involve fresh evaluation)
CIT	Citation (optional, if not published)
COM	Comments (optional)

2. Current list of evaluation types (can be expanded) are

FUL	Complete revision of the nuclide based on all information to the cutoff date indicated. Cutoff date required
FMT	Some format changes done
ERR	Errata (Fix error(s) in the dataset, should be accompanied with COM)
MOD	Modified dataset for partial update of nuclide. Kind of modification done should be indicated as comment. Cutoff date is optional.
UPD	Update due to scan of new literature. Cutoff date is required.
EXP	Experimental (not evaluated) data set.

   There can be only one type specification per history record given.

3. Date and Cutoff date must be given as DD-MMM-YYYY (e.g., 31-MAY-1996)

4. Citation (optional) gives the reference where the evaluation is published. CIT=ENSDF means included in ENSDF but not published.

5. Comments (optional) may give general remarks about evaluation/update.

6. The fields can be in any order on an 'H' record.

Note that history records indicate various revisions. These are wiped out at the next FULL evaluation.

For FULL evaluation NNDC will introduce 'H' records based on the COMMENTS data set.

Examples:

```
156DY H  TYP=MOD$AUT=B. Singh$DAT=31-DEC-1995$
156DY2H  COM=Updated SDB data only$
156DY H  TYP=UPD$AUT=R. Helmer$CUT=15-DEC-1994$
156DY2H  COM=Updated data set since last full evaluation$
156DY H  TYP=FMT$AUT=J. Tuli$DAT=1-DEC-1994$COM=FIXED T1/2$
156DY H  TYP=FUL$AUT=R. Helmer$CUT=01-May-1991$
156DY2H  CIT=NDS 65, 65 (1992)$
```

Appendix A

Character Set

The base character set is the standard 7-bit ASCII character set up to octal 173. Characters with octal values of 173 and greater are used as control characters. An alternate character set consists primarily of the Greek alphabet and some special symbols. The backslash character (octal 134) is interpreted as a backspace command. An alternate character in the input file consists of two characters, a control character and the standard character equivalent of the alternate character. All available alternate characters and their standard equivalents are given in the table on the follwing page.

There are four control characters, | (octal 176), ˜ (octal 176), { (octal 173), and } (octal 175). The vertical bar and the tilda are used to shift the next character into the first and second alternate character sets, respectively. The entire string of characters may also be modified from their standard form. In this case the string to be modified is enclosed by the open and close brace control characters. The character immediately following the open brace is interpreted as a control character. The available control character values and their meanings are given below. The modified character strings may be nested. The control characters may be in either upper or lower case.

Examples

|*g*	will be displayed as	γ
{B{+238}Pu}	will be displayed as	**^{238}Pu**

String Control Characters

|	first alternate character
˜	second alternate character
+	superscript
−	subscript (Note: + and − are mutually exclusive)
I	italic
B	bold
U	underline

Note: The symbol ˆ (caret) may be used before a character or a word to preserve its case, *e.g.*, ˆA for A (and not a).

Alternate Character sets

Standard	1st alt.	2nd alt.	Standard	1st alt.	2nd alt.
!	©_	!	N	N	N
"		"	O	O	Ö
#	§	⊗	P	Π	P
$	e	$	Q	Θ	Õ
%	√	%	R	P	R
&	≡	&	S	Σ	S
'	°	Å	T	T	T
(	←	(	U	ϒ	Ü
)	→	)	V	∇	V
*	×	·	W	Ω	W
+	±	+	X	Ξ	X
,	½	,	Y	Ψ	Y
–	∓	–	Z	Z	Z
.	∝	.	[	{	[
/	÷	/	]	}	]
0	(	0	^	↑	^
1	)	1	_	↓	_
2	[	2	‘	′	‘
3	]	3	a	α	ä
4	⟨	4	b	β	b
5	⟩	5	c	η	c
6	√	6	d	δ	d
7	∫	7	e	ε	é
8	∏	8	f	φ	f
9	∑	9	g	γ	g
:	†	:	h	χ	ħ
;	‡	;	i	ι	i
<	≤	<	j	∈	j
=	≠	=	k	κ	k
>	≥	>	l	λ	ƛ
?	≈	?	m	μ	m
@	∞	•	n	ν	n
A	A	Ä	o	ο	ö
B	B	B	p	π	p
C	H	C	q	θ	õ
D	Δ	D	r	ρ	r
E	E	É	s	σ	s
F	Φ	F	t	τ	t
G	Γ	G	u	υ	ü
H	X	H	v	?	v
I	I	I	w	ω	w
J	~	J	x	ξ	x
K	K	K	y	ψ	y
L	Λ	L	z	ζ	z
M	M	M			

Appendix B

Format For Comments Data Set

This data set consists only of general comment records (defined in III.B(4)). The format of the comment records is similar to general comments in other data sets except that the NUCID field will contain only the mass number, AAA, and that a SYM field is required as in a flagged comment. As in the flagged comments, the SYM field will either occupy columns 10 to 19 with column 19 being blank or the SYM will be followed by a '$'. Continuation records for a given comment are allowed with the additional feature that a new line will be started if the continuation character in column 6 is a '#' and that a new paragraph will be started if the character is a '@'. This feature is intended to facilitate the entry of information into the COMM comments.

SYM	Meaning
TITLE	Title of evaluation. Required if the evaluation spans several masses.
AUTH	Authors, a list of authors from the institution given in the following INST comment. A letter or number in parenthesis following an authors last name will signal a permanent address which is different from the institution. (See PERM)
INST	Institution, name and address of the authors' institution. INST comment must follow the appropriate AUTH comment. The # continuation character is used so the address does not run together into one line. More than one set of AUTH and INST comments can be given if more than one institution is involved.
ABST	Abstract, should be terse and to the point. Additonal details should be given under COMM comments.
CUT	Cutoff data and associated comments.
COMM	General comments on techniques used in the evaluation or on other information common to many of the isotopes.
ACKN	Acknowledgments.
PERM(a)	Permanent address of an author. The letter or number 'a' within the parenthesis corresponds to the letter

	or number within the parenthesis which follows the authors last name in the AUTH comment.
FUND	Funding, an acknowledgment of funding which will result in a footnote being added to the title.
CIT	Citation. To be added by the NDS production staff so that the publication can be correctly cited by persons using a retrieval of the A chain. The authors may leave it out.

```
                              EXAMPLE of a COMMENTS data set
                              ------------------------------
156       COMMENTS
156   C  TITL$  Nuclear Data Sheets for A=156
156   C  AUTH$R. G. Helmer
156   C  INST$Idaho National Engineering Laboratory
156  #C       EG&G Idaho, Inc.
156  #C       Idaho Falls, Idaho 83415 USA
156   C  ABST$The experimental results from the various reaction and decay
156  2C  studies leading to nuclides in the A=156 mass chain, and ALPHA decays
156  3C  from it, have been reviewed. These data are summarized and presented,
156  4C  together with adopted levels schemes and properties.
156   C  CUT$Data available prior to May 1991 have been evaluated.
156   C  ACKN$The evaluator wishes to thank C. W. Reich, the reviewer, and the
156  2C  editors for many helpful discussions.
156   C  FUND$Research sponsored by the U. S. Department of Energy.
156   C  CIT$R. G. Helmer, NDS 65, 65 (1992)
156   C  COMM$General Comments: In this evaluation, the following expression
156  2C  was used to define the rotational-band parameters a and B:
156   C  E(J)=E{-0} + a[J(J+1)-K{+2}] + B[J(J+1)-K{+2}]{+2}.
156   C  with the following terms sometimes added for K=1 and 2 bands
156   C  + (-1){+J+1}a{-2}J(J+1) for K=1
156   C  and
156   C  + (-1){+J}a{-4}(J-1)J(J+1)(J+2) for K=2.
156   C  In the determination of the values of these parameters, the energy
156  2C  spacings of only the lowest levels, and minimum number of levels, were
156  3C  used.
156   C  The ENSDF file (the computer data base from which these Data Sheets
156  3C  are produced), contains some information that is not printed in these
156  4C  Data Sheets. This includes the theoretical internal-conversion
156  6C  coefficients for each shell, where the values are significant, for
156  8C  each |g for which a multipolarity is given in the Data Sheets. Also, a
156  9C  short comment is made about the experimental methods for each
156  BC  reference.  This information would be available if a copy of the ENSDF
156  DC  file were obtained.
```

Output for above COMMENTS data set is shown on the following page

Nuclear Data Sheets 65, 65 (1992)

Nuclear Data Sheets for A = 156*

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(Received June 24, 1991; Revised August 20, 1991)

Abstract: The experimental results from the various reaction and decay studies leading to nuclides in the A=156 mass chain, and α decays from it, have been reviewed. These data are summarized and presented, together with adopted levels schemes and properties.

Cutoff Date: Data available prior to May 1991 have been evaluated.

General Policies and Organization of Material: See the January issue of Nuclear Data Sheets.

Acknowledgments: The evaluator wishes to thank C. W. Reich, the reviewer, and the editors for many helpful discussions.

General Comments: In this evaluation, the following expression was used to define the rotational–band parameters A and B:

$E(J)=E_0 + A[J(J+1)-K^2] + B[J(J+1)-K^2]^2$.

with the following terms sometimes added for K=1 and 2 bands

$+ (-1)^{J+1}A_2J(J+1)$ for K=1

and

$+ (-1)^J A_4(J-1)J(J+1)(J+2)$ for K=2.

In the determination of the values of these parameters, the energy spacings of only the lowest levels, and minimum number of levels, were used.

The ENSDF file (the computer data base from which these Data Sheets are produced), contains some information that is not printed in these Data Sheets. This includes the theoretical internal–conversion coefficients for each shell, where the values are significant, for each γ for which a multipolarity is given in the Data Sheets. Also, a short comment is made about the experimental methods for each reference. This information would be available if a copy of the ENSDF file were obtained.

* Research sponsored by the U. S. Department of Energy.

0090–3752/92 $35.00

Appendix C

Example of an adopted data set

Example of an ADOPTED LEVELS, GAMMAS data set

```
162TB    ADOPTED LEVELS, GAMMAS                                  99NDS    199909
162TB  H TYP=FUL$AUT=R. G. Helmer and C. W. Reich$CIT=NDS 87, 317 (1999)$
162TB2 H CUT=1-Jan-1999$
162TB  Q  2506     36 6284   36 7457   36 -895   85    1995AU04
162TB C  Data are from 162GD B- decay (1982Ge07,1970Ch02) and 163DY(T,A)
162TB2C  reaction (1989BuZW,1988BuZP).
162TB CL E         Other levels up to 1600 keV are indicated by the 163DY(T,A)
162TB2CL spectrum in 1988BuZP.
162TB CL J         For the levels reported from the 163DY(T,A) reaction, the
162TB2CL JPI values are based on L=2 transfers and intensity patterns
162TB3CL within bands that indicate pickup of a 3/2[411] proton.
162TB CL BAND(A)   KPI = 1- band.
162TB2CL CONF=((P,3/2(411))(N,5/2(523))).
162TB@CL ^A=9.78
162TB DL           Levels: 1- (0), 2- (39), 3- (97), 4- (176), 5- (267).
162TB CL BAND(B)   KPI = 4- band.
162TB2CL CONF=((P,3/2(411))(N,5/2(523))).
162TB@CL ^A AP 10
162TB CL BAND(C)   Bandhead of KPI = 1+ band.
162TB2CL CONF=((P,7/2(523))(N,5/2(523)))
162TB  XY162GD B- DECAY
162TB  XZ163DY(T,A)
162TB PN                                                                     6
162TB  L   0          1-               7.60 M   15                          A
162TB2 L %B-=100 $ XREF=+
162TB CL T         Unweighted average of 7.43 MIN 4 (1965Sc24) and 7.76 MIN 10
162TB2CL (1977Ka08). Others: 7.48 M 3 (1965Sc24), 8.0 M 5 (1966Fu08),
162TB3CL 7.75 M 31 (1966Sc24), 7.5 M 10 (1967Gu03), and 7.6 M 2 (1968Ka10).
162TB4CL See 1951Bu25, 1960Wi10, and 1962Ta12 for half-life measurements
162TB5CL related to nuclide identification.
162TB CL J         Configuration is assigned as
```

```
162TB2CL CONF=((P,3/2(411))(N,5/2(523))) based on the ground-state
162TB3CL assignments of CONF=(P,3/2(411)) for 161TB and
162TB4CL CONF=(N,5/2(523)) for 161GD and 163DY.
162TB CL J         LOGFT=4.95 of the B- transition to the 2- level at 1148 keV
162TB2CL in 162DY indicates an allowed-unhindered B transition, which
162TB3CL must be CONF=(N,5/2(523)) to CONF=(P,7/2(523)). This confirms
162TB4CL the configuration assignment to this ground state as well as
162TB5CL helping establish the configuration assignment to the 1148-keV
162TB6CL level in 162DY as CONF=((P,3/2(411))(P,7/2(523))). See 162DY
162TB6CL Adopted Levels and 1995Be02 for further discussion.
162TB  L  39.10    9  2-                                                   A
162TB2 L XREF=+
162TB CL J         From M1 component in G to 1- ground state, expected energy
162TB2CL spacing in rotational band, and (T,A) reaction results.
162TB  G  39.0     2  100       M1+(E2)
162TB CG M         From intensity balance at 39 level in 162GD B- decay,
162TB2CG transition is primarily M1 (1970Ch02); x/G intensity ratio and
162TB3CG ^L x-ray energy are consistent with this.
162TB  L   97      1  3-                                                   A
162TB2 L XREF=Z
162TB  L  176      1  4-                                                   A
162TB2 L XREF=Z
162TB  L  216      1  4-                                                   B
162TB2 L XREF=Z
162TB CL J         Configuration is assigned as that of the ground state,
162TB2CL namely, (PI 3/2[411])(NU 5/2[523]) recoupled. The systematics
162TB3CL of 1998Ja07 suggest a "theoretical" Gallagher-Moszkowski splitting
162TB4CL of 82 keV compared to the observed 216 keV, if this assignment
162TB5CL is correct.
162TB  L  267      2  5-                                                   A
162TB2 L XREF=Z
162TB  L  310      1  5-                                                   B
162TB2 L XREF=Z
162TB  L 341.41    9 (0-,1)
162TB2 L XREF=Y
162TB CL J         From LOGFT=5.9 in B- decay from 0+ 162GD.
162TB  G 302.30    15  58    9
162TB  G 341.42    10 100    9
162TB  L 442.11    8  1+                                                   C
162TB2 L XREF=Y
162TB CL J         From allowed-unhindered (LOGFT=4.4) B- transition from the
162TB2CL 162GD ground state (0+). This also uniquely establishes the
162TB3CL configuration of this level as CONF=((N,5/2(523))(P,7/2(523))).
162TB  G 403.00    8   85    4
162TB  G 442.12    8  100
```

Output for above data set is shown in the follwing pages

Adopted Levels, Gammas

Q(β⁻)=2506 *36*; S(n)=6284 *36*; S(p)=7457 *36*; Q(α)=−895 *85* 1995Au04.
Data are from ^{162}Gd β⁻ decay (1982Ge07,1970Ch02) and ^{163}Dy(t,α) reaction (1989BuZW,1988BuZP).

^{162}Tb Levels

Cross Reference (XREF) Flags

A ^{162}Gd β⁻ Decay
B ^{163}Dy(t,α)

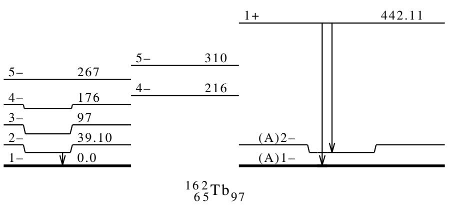
E(level)[†]	Jπ[‡]	XREF	$T_{1/2}$	Comments
0.0[§]	1−	AB	7.60 min *15*	%β⁻=100. $T_{1/2}$: Unweighted average of 7.43 min *4* (1965Sc24) and 7.76 min *10* (1977Ka08). Others: 7.48 min *3* (1965Sc24), 8.0 min *5* (1966Fu08), 7.75 min *31* (1966Sc24), 7.5 min *10* (1967Gu03), and 7.6 min *2* (1968Ka10). See 1951Bu25, 1960Wi10, and 1962Ta12 for half-life measurements related to nuclide identification. Jπ: Configuration is assigned as configuration=((π 3/2[411])(ν 5/2[523])) based on the ground-state assignments of configuration=(π 3/2[411]) for ^{161}Tb and configuration=(ν 5/2[523]) for ^{161}Gd and ^{163}Dy. Jπ: log *ft*=4.95 of the β⁻ transition to the 2− level at 1148 keV in ^{162}Dy indicates an allowed-unhindered β transition, which must be configuration=(ν 5/2[523]) to configuration=(π 7/2[523]). This confirms the configuration assignment to this ground state as well as helping establish the configuration assignment to the 1148-keV level in ^{162}Dy as configuration=((π 3/2[411])(π 7/2[523])). See ^{162}Dy Adopted Levels and 1995Be02 for further discussion.
39.10[§] *9*	2−	AB		Jπ: From M1 component in γ to 1− ground state, expected energy spacing in rotational band, and (t,α) reaction results.
97[§] *1*	3−	B		
176[§] *1*	4−	B		
216[#] *1*	4−	B		Jπ: Configuration is assigned as that of the ground state, namely, (π 3/2[411])(ν 5/2[523]) recoupled. The systematics of 1998Ja07 suggest a "theoretical" Gallagher-Moszkowski splitting of 82 keV compared to the observed 216 keV, if this assignment is correct.
267[§] *2*	5−	B		
310[#] *1*	5−	B		
341.41 *9*	(0−,1)	A		Jπ: From log *ft*=5.9 in β⁻ decay from 0+ ^{162}Gd.
442.11[@] *8*	1+	A		Jπ: From allowed-unhindered (log *ft*=4.4) β⁻ transition from the ^{162}Gd ground state (0+). This also uniquely establishes the configuration of this level as configuration=((ν 5/2[523])(π 7/2[523])).

† Other levels up to 1600 keV are indicated by the ^{163}Dy(t,α) spectrum in 1988BuZP.
‡ For the levels reported from the ^{163}Dy(t,α) reaction, the Jπ values are based on L=2 transfers and intensity patterns within bands that indicate pickup of a 3/2[411] proton.
§ (A): Kπ=1− band. Configuration=((π 3/2[411])(ν 5/2[523])). A=9.78.
\# (B): Kπ=4− band. Configuration=((π 3/2[411])(ν 5/2[523])). A≈10.
@ (C): Bandhead of Kπ=1+ band. Configuration=((π 7/2[523])(ν 5/2[523])).

γ(^{162}Tb)

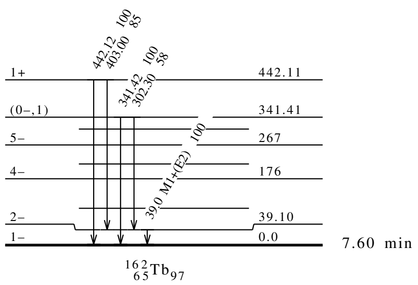
E(level)	Eγ	Iγ	Mult.	Comments
39.10	39.0 *2*	100	M1+(E2)	Mult.: From intensity balance at 39 level in ^{162}Gd β⁻ decay, transition is primarily M1 (1970Ch02); x/γ intensity ratio and L x-ray energy are consistent with this.
341.41	302.30 *15*	58 *9*		
	341.42 *10*	100 *9*		
442.11	403.00 *8*	85 *4*		
	442.12 *8*	100		

Adopted Levels, Gammas (continued)



Level Scheme

Intensities: relative photon branching from each level



Appendix D

Example of a decay data set

Example of a DECAY data set

```
162TB    162GD B- DECAY                1982GE07,1970CH02        99NDS    199909
162TB  H TYP=FUL$AUT=R. G. Helmer and C. W. Reich$CIT=NDS 87, 317 (1999)$
162TB2 H CUT=1-Jan-1999$
162TB C  162GD has been produced by double-neutron capture in enriched 160GD
162TB2C  with radiochemistry (1967Wa05,1970Ch02) and from spontaneous fission
162TB3C  of 252CF with radiochemistry (1982Ge07). Measurements include
162TB4C  G singles and GG, GX, and GB coincidences.
162TB CL          Decay scheme is from 1982Ge07, and is similar to those of
162TB2CL 1970Ch02 and 1967Wa05.
162TB CL          The consistency of the scheme is supported
162TB2CL by the fact that the sum of the energies of the radiations is
162TB3CL 1395 keV 56 which agrees with the Q value of 1400 100.
162TB CL E        From least-squares fit to G energies.
162TB CL J        From 162TB Adopted Levels. Rotational band and Nilsson
162TB CG          Data are from 1982Ge07, unless otherwise noted. Others:
162TB2CG 1970Ch02, 1967Wa05.
162TB CB E        From 1970Ch02.
162TB CB IB       From evaluators' assumption that 100% of the decays
162TB2CB depopulate the levels at 341 and 442 keV (that is, no B-
162TB3CB feeding of the ground state and 39 level) and no G feeding of
162TB4CB the 341-keV level. From LOGFT GE 5.9 for 0+ to 1- ground state
162TB5CB (1973Ra10), IB-(0) LE 13% and from LOGF1T GE 8.5 for 0+ to 2- at
162TB6CB 39 keV (1973Ra10), IB-(39) LE 0.15%.
162TB2CL configuration assignments are given there.
162TB D  Experimental methods:
162TB D  1967Wa05: 162GD from double-neutron capture in enriched (94%) 160GD
162TB2D       with radiochemistry.  G's measured with NAI(TL) detectors.
162TB D  1970Ch02: 162GD from double-neutron capture in enriched (94.8%) 160GD
162TB2D       with radiochemistry.  G's measured with Ge and Si(Li) detectors
162TB3D       and B's with Si(Li) detector.  GX and GB coincidences measured.
162TB D  1982Ge07: 162GD from 252CF spontaneous fission with radiochemistry.
```

```
162TB2D      G's measured with Ge detector.
162GD  P   0          0+                 8.4 M    2               14E2     1
162TB  N   0.51    2           1.0       1.0
162TB CN NR        Based on evaluators' assumption that 100% of the decays
162TB2CN depopulate the levels at 341 and 442 keV.
162TB PN                                                                     3
162TB  L   0          1-                 7.60 M   15
162TB CL T         From 162TB Adopted Levels and based on 7.43 M 4 (1965Sc24)
162TB2CL and 7.76 M 10 (1977Ka08).
162TB  L  39.10    9  2-
162TB  G  39.0     2   10    2  M1+(E2)                  8     2             C
162TBS G LC=6 2$ MC=1.4 3
162TB CG E         Average of 39.1 2 (1982Ge07) and 38.8 2 (1970Ch02).
162TB CG RI        Average of 9 2 (1982Ge07) and 14 3 (1970Ch02).
162TB CG M,CC      CC value deduced by evaluators from intensity balance at 39
162TB2CG level for current decay scheme; added G's feeding 39 level will
162TB3CG increase CC value. From CC(M1)=5.58 and CC(E2)=135, G is
162TB4CG primarily M1 with some E2 probable. Measured x/G intensity
162TB5CG ratio and L x-ray energy are consistent with this (1970Ch02).
162TB  L 341.41    9 (0-,1)
162TB  B              4.5  5             5.9    2
162TBS B EAV=362 14
162TB  G 302.30    15   3.1  5
162TB  G 341.42    10   5.3  5
162TB  L 442.11    8  1+
162TB  B  10E2     1   95.5  5           4.4    2                           C
162TBS B EAV=322 40
162TB  G 403.00    8   85    4  [E1]                 0.008                   C
162TBS G KC=0.0069$ LC=0.0010$ MC=0.0002
162TB  G 442.12    8  100       [E1]                 0.007                   C
162TBS G KC=0.0056$ LC=0.00076$ MC=0.0002
```

Output for above data set is shown in the follwing pages

^{162}Gd β^- Decay 1982Ge07,1970Ch02

Parent ^{162}Gd: E=0; Jπ=0+; $T_{1/2}$=8.4 min 2; Q(g.s.)=14×10^2 *1*; %β^- decay=100.
^{162}Gd has been produced by double–neutron capture in enriched ^{160}Gd with radiochemistry (1967Wa05,1970Ch02) and from spontaneous fission of ^{252}Cf with radiochemistry (1982Ge07). Measurements include γ singles and γγ, γX, and γβ coincidences.

^{162}Tb Levels

Decay scheme is from 1982Ge07, and is similar to those of 1970Ch02 and 1967Wa05.
The consistency of the scheme is supported by the fact that the sum of the energies of the radiations is 1395 keV 56 which agrees with the Q value of 1400 *100*.

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0	1−	7.60 min *15*	$T_{1/2}$: From ^{162}Tb Adopted Levels and based on 7.43 min *4* (1965Sc24) and 7.76 min *10* (1977Ka08).
39.10 *9*	2−		
341.41 *9*	(0−,1)		
442.11 *8*	1+		

† From least–squares fit to γ energies.
‡ From ^{162}Tb Adopted Levels. Rotational band and Nilsson.

β^- radiations

Eβ$^-$†	E(level)	Iβ$^-$‡§	Log *ft*	Comments
1000 *100*	442.11	95.5 *5*	4.4 *2*	av Eβ=322 *40*.
(1060 *100*)	341.41	4.5 *5*	5.9 *2*	av Eβ=362 *14*.

† From 1970Ch02.
‡ From evaluators' assumption that 100% of the decays depopulate the levels at 341 and 442 keV (that is, no β^- feeding of the ground state and 39 level) and no γ feeding of the 341–keV level. From log *ft*≥5.9 for 0+ to 1− ground state (1973Ra10), Iβ$^-$(0)≤13% and from log f^1t≥8.5 for 0+ to 2− at 39 keV (1973Ra10), Iβ$^-$(39)≤0.15%. configuration assignments are given there.
§ For β^- intensity per 100 decays, multiply by 1.0.

γ(^{162}Tb)

Data are from 1982Ge07, unless otherwise noted. Others: 1970Ch02, 1967Wa05.
Iγ normalization: Based on evaluators' assumption that 100% of the decays depopulate the levels at 341 and 442 keV.

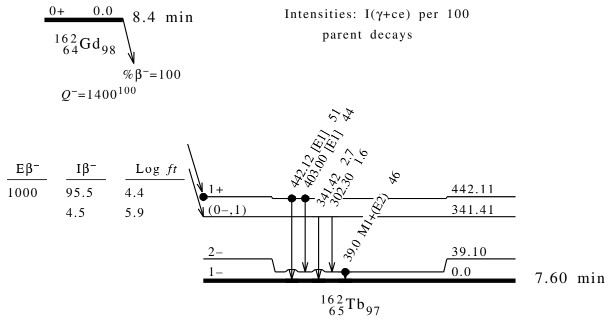
Eγ	E(level)	Iγ†	Mult.	α	Comments
39.0 *2*	39.10	10 *2*	M1+(E2)	8 *2*	α(L)=6 *2*; α(M)=1.4 *3*. Eγ: Average of 39.1 *2* (1982Ge07) and 38.8 *2* (1970Ch02). Iγ: Average of 9 *2* (1982Ge07) and 14 *3* (1970Ch02). Mult.,α: α value deduced by evaluators from intensity balance at 39 level for current decay scheme; added γ's feeding 39 level will increase α value. From α(M1)=5.58 and α(E2)=135, γ is primarily M1 with some E2 probable. Measured x/γ intensity ratio and L x–ray energy are consistent with this (1970Ch02).
302.30 *15*	341.41	3.1 *5*			
341.42 *10*	341.41	5.3 *5*			
403.00 *8*	442.11	85 *4*	[E1]	0.008	α(K)=0.0069; α(L)=0.0010; α(M)=0.0002.
442.12 *8*	442.11	100	[E1]	0.007	α(K)=0.0056; α(L)=0.00076; α(M)=0.0002.

† For absolute intensity per 100 decays, multiply by 0.51 *2*.

^{162}Gd β^- Decay 1982Ge07,1970Ch02 (continued)

Decay Scheme

Intensities: I(γ+ce) per 100 parent decays



Appendix E

ENSDF coding for Ionized Atom decay

Decay Data Set

1. ID record
   The ionization state of the atom would be in square brackets following the nuclide symbol in the DSID field.

2. Parent record

   - Energy field: level energy of the parent nucleus
   - Half-life field: half-life for the decay of the ionized itom
   - Q-value field: nuclear ground-state to ground-state value
   - New field (77-80): ionization state

3. Level records

   - Energy field: level energy of the daughter nucleus
   - MS field: atomic electron shell or subshell in which the emitted beta-particle is captured.
   - A new quantity, "ION", giving the ionization state would be required on an "S L" record following the level record.

4. Daughter Adopted Levels, Gammas
   The adopted levels would be cross-referenced to the observed states in the ionized atom decay dataset.

5. Parent Adopted Levels, Gammas
   The half-life and decay branching of the ionized atom decay would be given as comments (analagous to the current practice for half-lifes which differ due to chemical effects). This should be regarded as an interim solution; after more experience is gained, methods of giving this data on level continuation records should be derived.

Examples:

187Re

```
187OS    187RE[+75] B- DECAY           96BO37
187OS C  BOUND STATE B- DECAY OF BARE 187RE (75+ CHARGE STATE)
187OS C  96BO37 (ALSO 97NO07,97KL06,97WE08): DECAY OF FULLY IONIZED 187RE
187OS2C  NUCLEI CIRCULATING IN A STORAGE RING. ...............
187OS C  T1/2 OF 187RE ION (75+ CHARGE STATE)=32.9 Y 20
187RE  P  0            5/2+              32.9 Y 20            2.663     19+75
187OS  N                        1.0
187OS  L  0            1/2-                                                K
187OSS L ION=+75
187OS  B                WEAK                11  AP                         1U?
187OS  L  9.75         3/2-                                                K
187OSS L ION=+75
187OS  B                100              7.87  3
187OS  G  9.75                                                               S
187OS  L  0            1/2-                                                L1
187OSS L ION=+75
187OS  B                                                                     ?

187RE    ADOPTED LEVELS, GAMMAS
187RE CL BAND(A)$5/2[402]?
187RE  L        0.0   5/2+             4.35E10 Y 13                        A
187RE2 L %B-=100$%A LT 0.0001
187RE CL $%B-({+187}Re{++75})=100; T1/2({+187}Re{++75})=32.9 20 Y

187OS    ADOPTED LEVELS, GAMMAS
187OS CL BAND(A)$1/2[501] BAND
187OS CL BAND(B)$3/2[512] BAND
187OS  XA187RE B- DECAY
187OS  XB187IR EC DECAY
187OS  XC186OS(N,G) E=THERMAL
187OS  XD187RE(D,2NG), 187RE(P,NG)
187OS  XECOULOMB EXCITATION
187OS  XF189OS(P,T)
187OS  XG186OS(D,P)
187OS  XH187OS(D,D')
187OS  XI188OS(D,T),(T,A)
187OS  XJ187RE[+75] B- DECAY
187OS  L        0.0   1/2-             STABLE                              A
187OSX L XREF=ABCDEFGHIJ
187OS  L     9.746 24 3/2-              2.38 NS 18                         B
187OSX L XREF=BCDFJ
```

163Dy

```
163HO C  BOUND STATE B- DECAY OF {+163}Dy{+66+} ION
163HO C  92JU01: T1/2 MEASURED BY STORING BARE 163DY 66+ IONS IN A HEAVY-ION
163HO2C  STORAGE RING. .......................
163HO C  T1/2({+163}Dy{+66+})=47 +5-4 D
163DY  P  0+Y           5/2-              47 D   +5-4           -2.565    14+66
163HO  N                         1.0
163HO  L  0             7/2-                                                  K
163HOS L ION=+66
163HO  B                 100

163DY    ADOPTED LEVELS, GAMMAS
163DY  L 0.0          5/2-              STABLE
163DY CL $%B-({+163}Dy{+66+})=100; T1/2({+163}Dy{+66+})=47 +5-4 D
163HO  XA163HO IT DECAY (1.09 S)
163HO  XB163ER EC DECAY
163HO  XC162DY(P,P) IAR
163HO  XD162DY(3HE,D),(A,T)
163HO  XE163DY(D,2NG),(P,NG)
163HO  XG164ER(POL T,A)
163HO  XI165HO(P,T)
163HO  XJ163DY[+66] B- DECAY
163HO CL BAND(A)   7/2(523).  A=11.12, B=-0.313 EV
163HO  L 0.0          7/2-              4570 Y    25
163HO2 L %EC=100
163HO3 L FLAG=A$XREF=-(C)
```

Appendix F

ENSDF Dictionary - Translation into true-type character set

```
ENSDF          Translation          ENSDF           TRANSLATION
-----          -----------          -----           -----------
"A"             "A"                 (UP)             (|^)
%12C            %{+12}C             *                \|*\
%14C            %{+14}C             **(J+1/2)        {+(J+|,)}
%2B-            %2|b{+-}            **-1             {+-1}
%A              %|a                 **-3             {+-3}
%B+A            %|b{++}|a           **-4             {+-4}
%B+N            %|b{++}n            **1/2            {+1/2}
%B+P            %|b{++}p            **1/3            {+1/3}
%B+_            %|b{++}             **2              {+2}
%B-2N           %|b{+-}2n           **3              {+3}
%B-N            %|b{+-}n            **L              {+L}
%B-P            %|b{+-}p            *A**(1/3)        |*|A{+1/3}
%B-_            %|b{+-}             *DS/DW           d|s/d|W
%BEC            %|b{++}|e           *E               |*E
%E0             %E0                 *EG              E|g
%E2             %E2                 *EKC             |a(K)exp
%EC             %|e                 *G*WIDTHG0**2    g|G{+2}\{-|g0}
%ECA            %|e|a               *G2              g{-2}
%ECF            %|eF                *IB-             |*I|b{+-}
%ECK            %|ek                *IE              |*I|e
%ECP            %|ep                *Q               |*Q
%EWSR           %EWSR               *R               R
%G              %|g                 *RI              I|g
%I              %I                  *SIGMA           |*|s
%IB             %I|b                *SUMOF           |S
%IG             %I|g                *T1/2            |*T{-1/2}
%IT             %IT                 *TAU             |t
%M1             %M1                 *WIDTH           |G
%N              %n                  *WIDTHP          |G{-p}
%P              %p                  2B-              2|b{+-}
%RI             %I|g                2J               2J
%SF             %SF                 2N*SIGMA         2N|s
(A)             (|a)                4PI              4|p
(B)             (|b)                4PIB             4|p|b
(COUL.)         (Coul.)             4PIBG            4|p|b|g
(CV)            (CV)                4PIG             4|p|g
(DOWN)          (|_)                A DECAY          |a decay
(H,T)           (H,T)               A DECAYS         |a decays
(IT)            (IT)                A SYST           |a syst
(T)             (t)                 A'               |a'
(THETA,H)       (|q,H)              A(THETA)         A(|q)
(THETA,H,T,T)   (|q,H,t,T)          A**1/3           A{+1/3}
(THETA,T,H)     (|q,T,H)            A**2/3           A{+2/3}
```

<table>
<tr><th>ENSDF</th><th>TRANSLATION</th><th>ENSDF</th><th>TRANSLATION</th></tr>
<tr><td>-----</td><td>-----------</td><td>-----</td><td>-----------</td></tr>
<tr><td>A-DECAY</td><td>|a-decay</td><td>B(E4</td><td>B(E4</td></tr>
<tr><td>A-N</td><td>A-N</td><td>B(IS</td><td>|b(IS</td></tr>
<tr><td>A-SYST</td><td>|a-syst</td><td>B(J</td><td>B(J</td></tr>
<tr><td>A0</td><td>A{-0}</td><td>B*R</td><td>|bR</td></tr>
<tr><td>A1</td><td>A{-1}</td><td>B*RHO</td><td>B|*|r</td></tr>
<tr><td>A11</td><td>A{-11}</td><td>B+</td><td>|b{++}</td></tr>
<tr><td>A2</td><td>A{-2}</td><td>B-2N</td><td>|b{+-}2n</td></tr>
<tr><td>A2/A0</td><td>A{-2}/A{-0}</td><td>B-N</td><td>|b{+-}n</td></tr>
<tr><td>A22</td><td>A{-22}</td><td>B-VIBRATIONAL</td><td>|b-vibrational</td></tr>
<tr><td>A2P2</td><td>A{-2}P{-2}</td><td>B-_</td><td>|b{+-}</td></tr>
<tr><td>A3</td><td>A{-3}</td><td>B/A</td><td>B/A</td></tr>
<tr><td>A4</td><td>A{-4}</td><td>B0</td><td>|b{-0}</td></tr>
<tr><td>A44</td><td>A{-44}</td><td>B00</td><td>|b{-00}</td></tr>
<tr><td>A5</td><td>A{-5}</td><td>B02</td><td>|b{-02}</td></tr>
<tr><td>A6</td><td>A{-6}</td><td>B03</td><td>|b{-03}</td></tr>
<tr><td>A7</td><td>A{-7}</td><td>B04</td><td>|b{-04}</td></tr>
<tr><td>A=</td><td>A=</td><td>B1</td><td>|b{-1}</td></tr>
<tr><td>AA</td><td>|a|a</td><td>B12</td><td>|b{-12}</td></tr>
<tr><td>AA0</td><td>Aa{-0}</td><td>B2</td><td>|b{-2}</td></tr>
<tr><td>AAS</td><td>AAS</td><td>B2*R</td><td>|b{-2}R</td></tr>
<tr><td>AB</td><td>AB</td><td>B20</td><td>|b{-20}</td></tr>
<tr><td>ACE</td><td>(|a)(ce)</td><td>B22</td><td>|b{-22}</td></tr>
<tr><td>AG</td><td>|a|g</td><td>B24</td><td>|b{-24}</td></tr>
<tr><td>AJ</td><td>AJ</td><td>B3</td><td>|b{-3}</td></tr>
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<tr><td>ALPHAS</td><td>|a's</td><td>B5</td><td>|b{-5}</td></tr>
<tr><td>AP</td><td>|?</td><td>B5*R</td><td>|b{-5}R</td></tr>
<tr><td>APRIL</td><td>April</td><td>B6</td><td>|b{-6}</td></tr>
<tr><td>AUGER</td><td>Auger</td><td>B6*R</td><td>|b{-6}R</td></tr>
<tr><td>AUGUST</td><td>August</td><td>B7</td><td>|b{-7}</td></tr>
<tr><td>AVRSQ</td><td>{ <r{+2}>}</td><td>B=</td><td>B=</td></tr>
<tr><td>AXK</td><td>(|a)(K x ray)</td><td>BA</td><td>|b|a</td></tr>
<tr><td>AY</td><td>Ay</td><td>BAVRSQ</td><td>{ <|b{+2}>{+1/2}}</td></tr>
<tr><td>B</td><td>|b</td><td>BB</td><td>|b|b</td></tr>
<tr><td>B(E0</td><td>B(E0</td><td>BC</td><td>|bc</td></tr>
<tr><td>B(E1</td><td>B(E1</td><td>BCE</td><td>|bce</td></tr>
<tr><td>B(E2</td><td>B(E2</td><td>BCS</td><td>BCS</td></tr>
<tr><td>B(E3</td><td>B(E3</td><td>BE(L)</td><td>BE(L)</td></tr>
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ENSDF	TRANSLATION
BE-	|be{+-}
BE0	B(E0)
BE0W	B(E0)(W.u.)
BE1	B(E1)
BE1UP	B(E1)|^
BE1W	B(E1)(W.u.)
BE2	B(E2)
BE2DWN	B(E2)|_
BE2UP	B(E2)|^
BE2W	B(E2)(W.u.)
BE3	B(E3)
BE3UP	B(E3)|^
BE3W	B(E3)(W.u.)
BE3WUP	B(E3)(W.u.)|^
BE4	B(E4)
BE4UP	B(E4)|^
BE4W	B(E4)(W.u.)
BE5	B(E5)
BE5W	B(E5)(W.u.)
BE6	B(E6)
BE6UP	B(E6)|^
BE6W	B(E6)(W.u.)
BE7	B(E7)
BE7W	B(E7)(W.u.)
BE8	B(E8)
BEC DECAY	|b{++}|e Decay
BEL	B(EL)
BELW	B(EL)(W.u.)
BERKELEY	Berkeley
BESSEL	Bessel
BETA	|b
BETA*R	|bR
BETAS	|b's
BETHE	Bethe
BF3	BF{-3}
BG	|b|g
BGG	|b|g|g
BGN	|b|gn
BGO	BGO
BGT	|b(GT)
BIEDENHARN	Biedenharn
BJ**2	BJ{+2}
BL	|b{-L}
BL**2	|b{-L}{+2}
BL*R	|b{-L}R
BL*R*A**(1/3)	|b{-L}RA{+1/3}
BLAIR	Blair
BM(L)	BM(L)
BM1	B(M1)
BM1UP	B(M1)|^
BM1W	B(M1)(W.u.)
BM2	B(M2)
BM2UP	B(M2)|^
BM2W	B(M2)(W.u.)
BM3	B(M3)
BM3W	B(M3)(W.u.)
BM4	B(M4)
BM4W	B(M4)(W.u.)
BM5W	B(M5)(W.u.)
BM8UP	B(M8)|^
BML	B(ML)
BMLW	B(ML)(W.u.)
BN	|bn
BOHR	Bohr
BORN	Born
BP	|bp
BR	Branching
BREIT	Breit
BRINK	Brink
Be	Be
C	C
C.M.	c.m.
C12G	{+12}C|g
C2S	C{+2}S
CA(OH)	Ca(OH)
CC	|a
CCBA	CCBA
CCC	CCC
CE	ce
CEB	ce|b
CEG	ce|g
CEK	ce(K)
CEL	ce(L)
CEL1	ce(L1)
CEL12	ce(L12)
CEL2	ce(L2)

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<tr><td>-----</td><td>-----------</td><td>-----</td><td>-----------</td></tr>
<tr><td>CEL23</td><td>ce(L23)</td><td>CURIE</td><td>Curie</td></tr>
<tr><td>CEL3</td><td>ce(L3)</td><td>Cm</td><td>Cm</td></tr>
<tr><td>CEM</td><td>ce(M)</td><td>D)</td><td>D)</td></tr>
<tr><td>CEM1</td><td>ce(M1)</td><td>D+(Q)</td><td>D+(Q)</td></tr>
<tr><td>CEM2</td><td>ce(M2)</td><td>D+Q</td><td>D+Q</td></tr>
<tr><td>CEM23</td><td>ce(M23)</td><td>D3HE</td><td>d{+3}He</td></tr>
<tr><td>CEM3</td><td>ce(M3)</td><td>DA</td><td>|DA</td></tr>
<tr><td>CEM4</td><td>ce(M4)</td><td>DA2</td><td>|DA{-2}</td></tr>
<tr><td>CEM45</td><td>ce(M45)</td><td>DA4</td><td>|DA{-4}</td></tr>
<tr><td>CEM5</td><td>ce(M5)</td><td>DAVRSQ</td><td>{ |D<r{+2}>}</td></tr>
<tr><td>CEN</td><td>ce(N)</td><td>DAVRSQ4</td><td>{ |D<r{+4}>}</td></tr>
<tr><td>CEN1</td><td>ce(N1)</td><td>DAVRSQ6</td><td>{ |D<r{+6}>}</td></tr>
<tr><td>CEN2</td><td>ce(N2)</td><td>DAVYDOV</td><td>Davydov</td></tr>
<tr><td>CEN3</td><td>ce(N3)</td><td>DBR</td><td>branching uncertainty</td></tr>
<tr><td>CEN4</td><td>ce(N4)</td><td>DCC</td><td>|D|a</td></tr>
<tr><td>CEN45</td><td>ce(N45)</td><td>DCO</td><td>DCO</td></tr>
<tr><td>CEN5</td><td>ce(N5)</td><td>DCOQ</td><td>DCOQ</td></tr>
<tr><td>CEO</td><td>ce(O)</td><td>DE</td><td>|DE</td></tr>
<tr><td>CEO+CEP</td><td>ce(O)+ce(P)</td><td>DE/DX</td><td>dE/dx</td></tr>
<tr><td>CEO1</td><td>ce(O1)</td><td>DECEMBER</td><td>December</td></tr>
<tr><td>CERENKOV</td><td>Cerenkov</td><td>DEG</td><td>\|'</td></tr>
<tr><td>CERN</td><td>CERN</td><td>DELTA</td><td>|D\</td></tr>
<tr><td>CHI</td><td>|h</td><td>DFT</td><td>|D(log ft)</td></tr>
<tr><td>CHI**2</td><td>|h{+2}</td><td>DG</td><td>d|g</td></tr>
<tr><td>CK</td><td>|eK</td><td>DHF</td><td>|D(HF)</td></tr>
<tr><td>CL</td><td>|eL</td><td>DIA</td><td>|DI|a</td></tr>
<tr><td>CLEBSCH</td><td>Clebsch</td><td>DIB</td><td>|DI|b</td></tr>
<tr><td>CM</td><td>|eM</td><td>DIE</td><td>|DI|e</td></tr>
<tr><td>CM2</td><td>cm{+2}</td><td>DISPIN</td><td>|DT</td></tr>
<tr><td>CM3</td><td>cm{+3}</td><td>DJ</td><td>|DJ</td></tr>
<tr><td>CN</td><td>|eN</td><td>DJPI</td><td>|DJ|p</td></tr>
<tr><td>CO</td><td>Co</td><td>DK</td><td>|DK</td></tr>
<tr><td>COMPTON</td><td>Compton</td><td>DL</td><td>|DL</td></tr>
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<tr><td>CORIOLIS</td><td>Coriolis</td><td>DNB</td><td>|D(|b-normalization)</td></tr>
<tr><td>COS2TH</td><td>cos{+2}|q</td><td>DNR</td><td>|D(|g-normalization)</td></tr>
<tr><td>COSTER</td><td>Coster</td><td>DNT</td><td>|D(|g+ce-normalization)</td></tr>
<tr><td>COUL</td><td>Coul</td><td>DOMEGA</td><td>d|W</td></tr>
<tr><td>COULOMB</td><td>Coulomb</td><td>DOPPLER</td><td>Doppler</td></tr>
<tr><td>CP</td><td>CP</td><td>DPAC</td><td>DPAC</td></tr>
<tr><td>CRC</td><td>CRC</td><td>DPAD</td><td>DPAD</td></tr>
<tr><td>CSI</td><td>CsI</td><td>DPI</td><td>|D|p</td></tr>
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<tr><td>DQ+</td><td>|DQ(|e)</td></tr>
<tr><td>DQ-</td><td>|DQ(|b{+-})</td></tr>
<tr><td>DQA</td><td>|DQ(|a)</td></tr>
<tr><td>DRI</td><td>|DI|g</td></tr>
<tr><td>DS</td><td>|DS</td></tr>
<tr><td>DS/DW</td><td>d|s/d|W</td></tr>
<tr><td>DSA</td><td>DSA</td></tr>
<tr><td>DSAM</td><td>DSAM</td></tr>
<tr><td>DSIGMA</td><td>d|s</td></tr>
<tr><td>DSN</td><td>|DS(n)</td></tr>
<tr><td>DSP</td><td>|DS(p)</td></tr>
<tr><td>DT</td><td>|DT{-1/2}</td></tr>
<tr><td>DT1/2</td><td>|DT{-1/2}</td></tr>
<tr><td>DTI</td><td>|DI(|g+ce)</td></tr>
<tr><td>DUBNA</td><td>Dubna</td></tr>
<tr><td>DWBA</td><td>DWBA</td></tr>
<tr><td>DWIA</td><td>DWIA</td></tr>
<tr><td>DWUCK</td><td>DWUCK</td></tr>
<tr><td>E</td><td>E</td></tr>
<tr><td>E'(THETA)</td><td>e'(|q)</td></tr>
<tr><td>E(A)</td><td>E(|a)</td></tr>
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<tr><td>E(E)</td><td>E(e)</td></tr>
<tr><td>E(N)</td><td>E(n)</td></tr>
<tr><td>E(P)</td><td>E(p)</td></tr>
<tr><td>E(P1)</td><td>E(p{-1})</td></tr>
<tr><td>E(P2)</td><td>E(p{-2})</td></tr>
<tr><td>E(T)</td><td>E(t)</td></tr>
<tr><td>E**1/2</td><td>E{+1/2}</td></tr>
<tr><td>E**2</td><td>E{+2}</td></tr>
<tr><td>E+</td><td>e{++}</td></tr>
<tr><td>E+-</td><td>e{+|+}</td></tr>
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<tr><td>E1</td><td>E1</td></tr>
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<tr><td>EBE2UP</td><td>|eB(E2)|^</td></tr>
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<tr><td>ENGE</td><td>Enge</td></tr>
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<tr><td>EPR</td><td>EPR</td></tr>
<tr><td>EPSILON</td><td>|e</td></tr>
<tr><td>EPSILONB</td><td>|eB</td></tr>
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<tr><td>EV</td><td>eV</td></tr>
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<tr><td>E{</td><td>E{</td></tr>
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<tr><td>F-K</td><td>F-K</td></tr>
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<tr><td>FESHBACH</td><td>Feshbach</td></tr>
<tr><td>FG</td><td>(fragment)|g</td></tr>
<tr><td>FM</td><td>fm</td></tr>
<tr><td>FM**-1</td><td>fm{+-1}</td></tr>
<tr><td>FM**2</td><td>fm{+2}</td></tr>
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<tr><td>FM-1</td><td>fm{+-1}</td></tr>
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<tr><td>FWHM</td><td>FWHM</td></tr>
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<tr><td>G*WIDTHG0</td><td>g|G{-|g0}</td></tr>
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<tr><td>GA</td><td>|?></td></tr>
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<tr><td>GAUSSIAN</td><td>Gaussian</td></tr>
<tr><td>GB</td><td>|g|b</td></tr>
<tr><td>GB-</td><td>|g|b{+-}</td></tr>
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<tr><td>GE</td><td>|></td></tr>
<tr><td>GE(LI)</td><td>Ge(Li)</td></tr>
<tr><td>GE-</td><td>|ge{+-}</td></tr>
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<tr><td>GEIGER-MULLER</td><td>Geiger-Muller</td></tr>
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<tr><td>GEV</td><td>GeV</td></tr>
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ENSDF	TRANSLATION	ENSDF	TRANSLATION
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GP(T)	|gp(t)	IMPAC	IMPAC
GQR	GQR	IN(	In(
GS	g.s.	INFNT	|@
GSI	GSI	IPAC	IPAC
GT	>	IS D	is D
GT1/2	gT{-1/2}	ISOLDE	ISOLDE
GTOL	GTOL	ISPIN	T
GWIDTHOWIDTHG	g|G{-0}|G|g	ISPINZ	T{-z}
GX	|gX	IT BRANCHING	IT branching
G_	|g	IT DECAY	IT decay
H(	H(	IT DECAYS	IT decays
H**2	h{+2}	IT TRANSITION	IT transition
H,	H,	IT-	IT-
H=	H=	IT=	IT=
HAGER	Hager	IX	I(x ray)
HARTREE	Hartree	J	J
HAUSER	Hauser	J**2	J{+2}
HERA	HERA	J0	J{-0}
HF	HF	J1	J{-1}
HI	HI	J2	J{-2}
HOMEGA	h\\|'|w	JANUARY	January
HP	HP	JF	J{-f}
HPGE	HPGE	JI	J{-i}
I	I	JKP	JK|p
I.E.	{Ii.e.}	JMAX	Jmax
IA	I|a	JMIN	Jmin
IAR	IAR	JOSEF	JOSEF
IAS	IAS	JPI	J|p
IB	I|b	JULIE	JULIE
IB+	I|b{++}	JULY	July
IB-	I|b{+-}	JUNE	June
IBA	IBA	K	K
IBM	IBM	K/L+M	K/L+M
IBS	IBS	K/LM	K/LM
ICC	|a	K/T	ce(K)/(|g+ce)
ICE	Ice	KAPPA	|k
ICE(K)	Ice(K)	KC	|a(K)
ICE(N)	Ice(N)	KELSON	Kelson
IE	I|e	KEV	keV
IEC	I|e	KEVIN	Kelvin
IG	I|g	KG	kG
IG*EG	I|gE|g	KL1L1	KL{-1}L{-1}
IGISOL	IGISOL	KL1L2	KL{-1}L{-2}

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ENSDF          TRANSLATION          ENSDF          TRANSLATION
-----          -----------          -----          -----------
KL1L3           KL{-1}L{-3}         LARMOR          Larmor
KL1M1           KL{-1}M{-1}         LASER           LASER
KL1M2           KL{-1}M{-2}         LBL             LBL
KL1M3           KL{-1}M{-3}         LC              |a(L)
KL2L2           KL{-2}L{-2}         LE              |<
KL2L3           KL{-2}L{-3}         LEGENDRE        Legendre
KL2M1           KL{-2}M{-1}         LI              Li
KL2M3           KL{-2}M{-3}         LITHERLAND      Litherland
KL2M4           KL{-2}M{-4}         LM              LM
KL3L3           KL{-3}L{-3}         LMN             LMN
KL3LM1          KL{-3}LM{-1}        LN              L(n)
KL3M2           KL{-3}M{-2}         LOGF1T          log| {If{+1}t}
KL3M3           KL{-3}M{-3}         LOGF1UT         log| {If{+1u}t}
KL3N            KL{-3}N             LOGF2UT         log| {If{+2u}t}
KLL             KLL                 LOGF3UT         log| {If{+3u}t}
KLM             KLM                 LOGFT           log| {Ift}
KM2M3           KM{-2}M{-3}         LOHENGRIN       LOHENGRIN
KM2N2           KM{-2}N{-2}         LORENTZIAN      Lorentzian
KM3M3           KM{-3}M{-3}         LP              L(p)
KNIGHT          Knight              LT              <
KOE             kOe                 M               M
KPI             K|p                 M+/T            ce(M+)/(|g+ce)
KRANE           Krane               M+=             M+=
KRONIG          Kronig              M-SHELL         M-shell
KUO-BROWN       Kuo-Brown           M-SUBSHELL      M-subshell
KURIE           Kurie               M/CE            M/total ce
KXY             KXY                 M/T             ce(M)/(|g+ce)
L               L                   M1              M1
L+/T            ce(L+)/(|g+ce)      M12             M12
L/T             ce(L)/(|g+ce)       M1C             |a(M1)
L1              L1                  M2              M2
L12             L12                 M23             M23
L12C            |a(L12)             M2C             |a(M2)
L1C             |a(L1)              M3              M3
L2              L2                  M3C             |a(M3)
L23             L23                 M4              M4
L23C            |a(L23)             M45             M45
L2C             |a(L2)              M4C             |a(M4)
L3              L3                  M5              M5
L3C             |a(L3)              M5C             |a(M5)
LA              |?<                 M6              M6
LAMBDA          |l                  M8              M8
LAMPF           LAMPF               MARCH           March
```

```
ENSDF         TRANSLATION            ENSDF         TRANSLATION
-----         -----------            -----         -----------
MB             mb                    N4C            |a(N4)
MB/SR          mb/sr                 N5             N5
MC             |a(M)                 N5C            |a(N5)
MC+            |a(M+..)              N6C            |a(N6)
MEDLIST        MEDLIST               N<             N<
MEV            MeV                   N=             N=
MEV**-4        MeV{E4-4}             NAI            NaI
MG/CM2         mg/cm{+2}             NB             I|b normalization
MHZ            MHZ                   NB/SR          nb/sr
MILLI-EV       meV                   NBS            NBS
MIT            MIT                   NC             |a(N)
ML             M+L                   NC+            |a(N+..)
MNO            M+N+O                 NC2S           NC{+2}S
MOME2          Q                     NDS            Nuclear Data Sheets
MOME3          Octupole mom(el)      NE             |=
MOMM1          |m                    NE213          NE213
MOMM3          Octupole mom(mag)     NG             n|g
MOMM5          2{+5} mom(mag)        NGG            n|g|g
MOMM7          2{+7} mom(mag)        NILSSON        Nilsson
MOSSBAUER      Mossbauer             NMR            NMR
MOSZKOWSKI     Moszkowski            NOTE:          Note:
MR             |d                    NOVEMBER       November
MR**2          |d{+2}                NP             Particle normalization
MS             ms                    NQR            NQR
MU             |m                    NR             I|g normalization
MU-            |m{+-}                NS*SIGMA       NS|s
N*SIGMA        N|*|s                 NT             I(|g+ce) normalization
N+/T           ce(N+)/(|g+ce)        NU             |n
N-SHELL        N-shell               NX             NX
N-SUBSHELL     N-subshell            Ne             Ne
N-Z            N-Z                   O              O
N/T            ce(N)/(|g+ce)         O/Q            O/Q
N1             N1                    O/T            ce(O)/(|g+ce)
N12            N12                   O1             O1
N123           N123                  O123           O123
N1C            |a(N1)                O1C            |a(O1)
N2             N2                    O2             O2
N23            N23                   O2C            |a(O2)
N2C            |a(N2)                O3             O3
N3             N3                    O3C            |a(O3)
N3C            |a(N3)                O4C            |a(O4)
N4             N4                    OCTOBER        October
N45            N45                   ODD-A          odd-A
```

ENSDF	TRANSLATION	ENSDF	TRANSLATION
-----	-----------	-----	-----------
OMEGA	|w	QA	Q(|a)
OMEGA**2*TAU	|w{+2}|t	QDD	QDD
OMEGA*T	|w|t	QDDM	QDDM
ORNL	ORNL	QDMDQ	QDMDQ
OSIRIS	OSIRIS	QMG	QMG
P DECAY	p decay	QP	Q(g.s.)
P(THETA)	p(|q)	QQSP	QQSP
P+/T	ce(P+)/(|g+ce)	QS	Q{-s}
P-WIDTH	p-width	QSD	QSD
P0	P{-0}	R	R
P1	P1	R(DCO)	R(DCO)
P1/2	p1/2	R**2	r{+2}
P1C	|a(P1)	R**4	r{+4}
P2NG	p2n|g	R**6	r{+6}
PAC	PAC	R0	r{-0}
PAD	PAD	RDDS	RDDS
PALPHA	p|a	RDM	RDM
PG	p|g	RHO	|r
PGG	p|g|g	RHO**2	|r{+2}
PHI	|F	RI	I|g
PHI(P1)	|F(p{-1})	RITZ	Ritz
PHI(P2)	|F(p{-2})	ROSE	Rose
PI	|p	RPA	RPA
PI-	|p{+-}	RUL	RUL
PIB	|p|b	RUTHERFORD	Rutherford
PIBG	|p|b|g	RYTZ	Rytz
PIG	|p|g	S VALUE	S value
PN	P{-n}	S VALUES	S values
PNG	pn|g	S'	S'
PRI	|DI|g(%)	S(2N)	S(2n)
PSI	|Y	S(2P)	S(2p)
PWBA	PWBA	S(CE)	s(ce)
PWIA	PWIA	S-1	s{+-1}
Q	Q	S-FACTOR	S-factor
Q(	Q(	S-FACTORS	S-factors
Q+0	Q+0	S-VALUE	S-value
Q+_	Q(|e)	S-VALUES	S-values
Q-	Q(|b{+-})	S-WAVE	s-wave
Q/D	Q/D	S/	S/
Q22	Q{-22}	S=	S=
Q2D	Q2D	SA	S(|a)
Q2DM	Q2DM	SAXON	Saxon
Q3D	Q3D	SCHMIDT	Schmidt

```
ENSDF          TRANSLATION
-----          -----------
SD              SD
SDB             SDB
SE(LI)          Se(Li)
SELTZER         Seltzer
SEPTEMBER       September
SF              SF
SI(LI)          Si(Li)
SIGMA           |s
SIGMA(0)        |s{-0}
SIGMA*DE        |s|*|DE
SIGMAG          |s{-|g}
SIGMAN          |s{-n}
SIGMANU         |s|n
SIGNA           |s(n|a)
SIGNG           |s(n|g)
SILI            Si(Li)
SIO             SiO
SLIV-BAND       Sliv-Band
SN              S(n)
SOREQ           SOREQ
SP              S(p)
STEFFEN         Steffen
STOCKHOLM       Stockholm
SUMOF           |S\
SY              syst
Sn              Sn
T               T{-1/2}
T)              t)
T,              t,
T/              T/
T1/2            T{-1/2}
T20             T20
T21             T21
T22             T22
TAU             |t
TDPAD           TDPAD
TELLER          Teller
TEMP            T
TG              t|g
TH              th
THETA           |q
THETA**2        |q{+2}
THETA1          |q{-1}

ENSDF          TRANSLATION
-----          -----------
THETA2          |q{-2}
THETAA          |q|a
THETAA**2       |q|a{+2}
THETAG          |q|g
THETAP1**2      |q{-p1}{+2}
THETAP2**2      |q{-p2}{+2}
TI              I(|g+ce)
TOF             tof
TPAD            TPAD
TRISTAN         TRISTAN
TRIUMPH         TRIUMPH
Ti              Ti
U               U
U2A2            U{-2}A{-2}
UB              |mb
UB*MEV          |mb|*MeV
UB/SR           |mb/sr
UG              |mg
UG/CM           |mg/cm
UK              UK
UNISOR          UNISOR
UNIV            Univ
UNIVERSITY      University
US              |ms
USA             USA
USSR            USSR
V               V
VAP             VAP
W               W
W(THETA)*G*WIDTH w(|q)g|G{-|g0}
W.U.            W.u.
WEISSKOPF       Weisskopf
WIDTH           |G
WIDTH**2        |G{+2}
WIDTHA          |G|a
WIDTHA0         |G{-|a0}
WIDTHA1         |G{-|a1}
WIDTHA2         |G{-|a2}
WIDTHA3         |G{-|a3}
WIDTHA4         |G{-|a4}
WIDTHG          |G{-|g}
WIDTHG0         |G{-|g0}
WIDTHG0**2      |G{+2}\{-|g0}
```

```
ENSDF          TRANSLATION
-----          -----------
WIDTHG1         |G{-|g1}
WIDTHN          |G{-n}
WIDTHN0         |G{-n0}
WIDTHP          |G{-p}
WIDTHP'         |G{-p'}
WIDTHP0         |G{-p0}
WIDTHP1         |G{-p1}
WIDTHP2         |G{-p2}
WIGNER          Wigner
WINTHER         Winther
X(              X(
X-RAY           x-ray
X-RAYS          x-rays
XG              X|g
XK              K| x ray
XKA             K|a| x ray
XKA1            K|a{-1}| x ray
XKA2            K|a{-2}| x ray
XKB             K|b| x ray
XKB1            K|b{-1} x ray
XKB13           K|b{-13} x ray
XKB1P           K|b{-1}'| x ray
XKB2            K|b{-2} x ray
XKB2P           K|b{-2}'| x ray
XKB3            K|b{-3} x ray
XKB4            K|b{-4} x ray
XKB5            K|b{-5} x ray
XKB5I           K|b{-5}\{+I} x ray
XKB5II          K|b{-5}\{+II} x ray
XKG             (K| x ray)|g
XKO2            K-O{-2} x ray
XKO23           K-O{-23} x ray
XKO3            K-O{-3} x ray
XL              L| x ray
XL1             L{-1} x ray
XL2             L{-2} x ray
XL3             L{-3} x ray
XLA             L{-|a} x ray
XLA1            L|a{-1}| x ray
XLA2            L|a{-2}| x ray
XLB             L{-|b} x ray
XLB1            L|b{-1}| x ray
XLB10           L|b{-10}| x ray
XLB15           L|b{-15}| x ray
XLB2            L|b{-2}| x ray
XLB215          L|b{-215}| x ray
XLB3            L|b{-3}| x ray
XLB4            L|b{-4}| x ray
XLB5            L|b{-5}| x ray
XLB6            L|b{-6}| x ray
XLB9            L|b{-9}| x ray
XLC             L{-|c} x ray
XLG             L{-|g} x ray
XLG1            L|g{-1}| x ray
XLG2            L|g{-2}| x ray
XLG3            L|g{-3}| x ray
XLG4            L|g{-4}| x ray
XLG5            L|g{-5}| x ray
XLG6            L|g{-6}| x ray
XLL             L{-{Sl}} x ray
XM              M x ray
XPYNG           xpyn|g
XX              XX
YTTRIUM         Y
Z               Z
Z>N             Z>N
[E2]            [E2]
[RI             [I|g
a0              a{-0}
|D              |D
```

Appendix G

ENSDF Dictionary - ordered by output

ENSDF Dictionary – ordered by output

Translation	ENSDF
(α)(ce)	ACE
(β)	(B)
$(\theta$,H,t,T)	(THETA,H,T,T)
$(\theta$,H)	(THETA,H)
$(\theta$,T,H)	(THETA,T,H)
2J	2J
2Nσ	2N*SIGMA
2^5 mom(mag)	MOMM5
2^7 mom(mag)	MOMM7
$2\beta^-$	2B–
4π	4PI
$4\pi\beta\gamma$	4PIBG
$4\pi\beta$	4PIB
$4\pi\gamma$	4PIG
<	LT
>	GT
A(θ)	A(THETA)
A–N	A–N
A=	A=
AAS	AAS
AB	AB
AJ	AJ
Aa_0	AA0
Alaga	ALAGA
April	APRIL
Auger	AUGER
August	AUGUST
Ay	AY
$A^{1/3}$	A**1/3
$A^{2/3}$	A**2/3
A_0	A0
A_{11}	A11
A_1	A1
A_{22}	A22
A_2/A_0	A2/A0
A_2	A2
A_2P_2	A2P2
A_3	A3
A_{44}	A44
A_4	A4
A_5	A5
A_6	A6
A_7	A7
B(E0	B(E0
B(E0)	BE0
B(E0)(W.u.)	BE0W
B(E1	B(E1
B(E1)(W.u.)	BE1W
B(E1)$\uparrow$	BE1UP
B(E1)	BE1
B(E2	B(E2
B(E2)	BE2
B(E2)$\uparrow$	BE2UP
B(E2)$\downarrow$	BE2DWN
B(E2)(W.u.)	BE2W
B(E3	B(E3
B(E3)$\uparrow$	BE3UP
B(E3)(W.u.)$\uparrow$	BE3WUP
B(E3)	BE3
B(E3)(W.u.)	BE3W
B(E4	B(E4
B(E4)$\uparrow$	BE4UP
B(E4)(W.u.)	BE4W
B(E4)	BE4
B(E5)	BE5
B(E5)(W.u.)	BE5W
B(E6)(W.u.)	BE6W
B(E6)$\uparrow$	BE6UP
B(E6)	BE6
B(E7)(W.u.)	BE7W
B(E7)	BE7
B(E8)	BE8
B(EL)(W.u.)	BELW
B(EL)	BEL
B(J	B(J
B(M1)	BM1
B(M1)$\uparrow$	BM1UP
B(M1)(W.u.)	BM1W
B(M2)	BM2
B(M2)$\uparrow$	BM2UP
B(M2)(W.u.)	BM2W
B(M3)(W.u.)	BM3W
B(M3)	BM3
B(M4)	BM4
B(M4)(W.u.)	BM4W
B(M5)(W.u.)	BM5W
B(M8)$\uparrow$	BM8UP
B(ML)	BML

ENSDF Dictionary – ordered by output

Translation	ENSDF	Translation	ENSDF
B(ML)(W.u.)	BMLW	DCO	DCO
B/A	B/A	DCOQ	DCOQ
B=	B=	DPAC	DPAC
BCS	BCS	DPAD	DPAD
BE(L)	BE(L)	DSA	DSA
BF_3	BF3	DSAM	DSAM
BGO	BGO	DWBA	DWBA
BJ^2	BJ**2	DWIA	DWIA
BM(L)	BM(L)	DWUCK	DWUCK
Be	Be	Davydov	DAVYDOV
Berkeley	BERKELEY	December	DECEMBER
Bessel	BESSEL	Doppler	DOPPLER
Bethe	BETHE	Dubna	DUBNA
Biedenharn	BIEDENHARN	E	E
Blair	BLAIR	E(ce)	ECE
Bohr	BOHR	E(d)	ED
Born	BORN	E(d)	E(D)
Branching	BR	E(e)	E(E)
Breit	BREIT	E(n)	E(N)
Brink	BRINK	E(n)	EN
B_4C	B4C	E(p)	EP
B×ρ	B*RHO	E(p)	E(P)
C	C	$E(p_2)$	E(P2)
CCBA	CCBA	$E(p_1)$	E(P1)
CCC	CCC	E(t)	ET
CERN	CERN	E(t)	E(T)
CP	CP	E(α)	E(A)
CRC	CRC	E–E	E–E
Ca(OH)	CA(OH)	E/ΔE	E/DE
Cerenkov	CERENKOV	E0	E0
Clebsch	CLEBSCH	E1	E1
Cm	Cm	E10	E10
Co	CO	E2	E2
Compton	COMPTON	E3	E3
Coriolis	CORIOLIS	E4	E4
Coster	COSTER	E5	E5
Coul	COUL	E6	E6
Coulomb	COULOMB	E7	E7
CsI	CSI	E8	E8
Curie	CURIE	E9	E9
C^2S	C2S	EL	EL
D)	D)	ENDF/B–V	ENDF/B–V
D+(Q)	D+(Q)	ENDF/B	ENDF/B_
D+Q	D+Q	ENDOR	ENDOR

ENSDF Dictionary – ordered by output

Translation	ENSDF
EPR	EPR
ESR	ESR
EWSR	EWSR
Ee	EE
Enge	ENGE
E	E
$E^{1/2}$	E**1/2
E^2	E**2
EΔE	EDE
Eα	EA
Eβ	EB
Eβ	EB_
Eβ^-	EB–
Eε	EEC
Eγ	*EG
Eγ	EG
Eγ^3	EG**3
Eγ^5	EG**5
F+B	F+B
F–K	F–K
F/B	F/B
FWHM	FWHM
February	FEBRUARY
Fermi	FERMI
Feshbach	FESHBACH
Fock	FOCK
Fourier	FOURIER
G–M	G–M
GDR	GDR
GM	GM
GMR	GMR
GQR	GQR
GSI	GSI
GTOL	GTOL
Gallagher	GALLAGHER
Gamow	GAMOW
Garvey	GARVEY
Gaussian	GAUSSIAN
Ge(Li)	GE(LI)
Ge(Li)	GELI
GeV	GEV
Geiger–Muller	GEIGER–MULLER
Geiger	GEIGER
H(	H(
H,	H,
H=	H=
HERA	HERA
HF	HF
HI	HI
HP	HP
HPGE	HPGE
Hager	HAGER
Hartree	HARTREE
Hauser	HAUSER
I	I
I(x ray)	IX
I(γ+ce)	TI
I(γ+ce) normalization	NT
IAR	IAR
IAS	IAS
IBA	IBA
IBM	IBM
IBS	IBS
IGISOL	IGISOL
IMPAC	IMPAC
IPAC	IPAC
ISOLDE	ISOLDE
IT branching	IT BRANCHING
IT decay	IT DECAY
IT decays	IT DECAYS
IT=	IT=
Ice	ICE
Ice(K)	ICE(K)
Ice(N)	ICE(N)
In(	IN(
Iα	IA
Iβ	IB
Iβ normalization	NB
Iβ^-	IB–
Iβ^+	IB+
Iε	IE
Iε	IEC
Iγ	IG
Iγ	*RI
Iγ	RI
Iγ normalization	NR
IγEγ	IG*EG
J	J

ENSDF Dictionary – ordered by output

Translation	ENSDF	Translation	ENSDF
$JK\pi$	JKP	Kelvin	KEVIN
JOSEF	JOSEF	Knight	KNIGHT
JULIE	JULIE	Krane	KRANE
January	JANUARY	Kronig	KRONIG
Jmax	JMAX	Kuo–Brown	KUO–BROWN
Jmin	JMIN	Kurie	KURIE
July	JULY	K x ray	XK
June	JUNE	$K\alpha_2$ x ray	XKA2
J^2	J**2	$K\alpha_1$ x ray	XKA1
J_0	J0	$K\alpha$ x ray	XKA
J_1	J1	$K\beta_2$ x ray	XKB2
J_2	J2	$K\beta_2'$ x ray	XKB2P
J_f	JF	$K\beta_4$ x ray	XKB4
J_i	JI	$K\beta_3$ x ray	XKB3
$J\pi$	JPI	$K\beta_1$ x ray	XKB1
K	K	$K\beta_1'$ x ray	XKB1P
$K–O_2$ x ray	XKO2	$K\beta_5^{I}$ x	XKB5I
$K–O_3$ x ray	XKO3	$K\beta_5^{II}$ x	XKB5II
$K–O_{23}$ x ray	XKO23	$K\beta_{13}$ x ray	XKB13
K/L+M	K/L+M	$K\beta_5$ x ray	XKB5
K/LM	K/LM	$K\beta$ x ray	XKB
KLL	KLL	$K\pi$	KPI
KLM	KLM	L	L
KL_1L_1	KL1L1	L(n)	LN
KL_1M_2	KL1M2	L(p)	LP
KL_1L_3	KL1L3	L1	L1
KL_1M_3	KL1M3	L12	L12
KL_1M_1	KL1M1	L2	L2
KL_1L_2	KL1L2	L23	L23
KL_2M_1	KL2M1	L3	L3
KL_2L_2	KL2L2	LAMPF	LAMPF
KL_2L_3	KL2L3	LASER	LASER
KL_2M_3	KL2M3	LBL	LBL
KL_2M_4	KL2M4	LM	LM
KL_3L_3	KL3L3	LMN	LMN
KL_3LM_1	KL3LM1	LOHENGRIN	LOHENGRIN
KL_3N	KL3N	Larmor	LARMOR
KL_3M_3	KL3M3	Legendre	LEGENDRE
KL_3M_2	KL3M2	Li	LI
KM_2M_3	KM2M3	Litherland	LITHERLAND
KM_2N_2	KM2N2	Lorentzian	LORENTZIAN
KM_3M_3	KM3M3	L_1 x ray	XL1
KXY	KXY	L_2 x ray	XL2
Kelson	KELSON	L_3 x ray	XL3

ENSDF Dictionary – ordered by output

Translation	ENSDF
L_1 x ray	XLL
L_α x ray	XLA
L_β x ray	XLB
L_η x ray	XLC
L_γ x ray	XLG
L x ray	XL
$L\alpha_1$ x ray	XLA1
$L\alpha_2$ x ray	XLA2
$L\beta_3$ x ray	XLB3
$L\beta_4$ x ray	XLB4
$L\beta_1$ x ray	XLB1
$L\beta_5$ x ray	XLB5
$L\beta_2$ x ray	XLB2
$L\beta_{215}$ x ra	XLB215
$L\beta_9$ x ray	XLB9
$L\beta_{15}$ x ray	XLB15
$L\beta_6$ x ray	XLB6
$L\beta_{10}$ x ray	XLB10
$L\gamma_3$ x ray	XLG3
$L\gamma_4$ x ray	XLG4
$L\gamma_6$ x ray	XLG6
$L\gamma_5$ x ray	XLG5
$L\gamma_2$ x ray	XLG2
$L\gamma_1$ x ray	XLG1
M	M
M x ray	XM
M+=	M+=
M+L	ML
M+N+O	MNO
M–shell	M–SHELL
M–subshell	M–SUBSHELL
M/total ce	M/CE
M1	M1
M12	M12
M2	M2
M23	M23
M3	M3
M4	M4
M45	M45
M5	M5
M6	M6
M8	M8
MEDLIST	MEDLIST
MHZ	MHZ

Translation	ENSDF
MIT	MIT
March	MARCH
MeV	MEV
MeV^{-4}	MEV**–4
Mossbauer	MOSSBAUER
Moszkowski	MOSZKOWSKI
N–Z	N–Z
N–shell	N–SHELL
N–subshell	N–SUBSHELL
N1	N1
N12	N12
N123	N123
N2	N2
N23	N23
N3	N3
N4	N4
N45	N45
N5	N5
N<	N<
N=	N=
NBS	NBS
NC^2S	NC2S
NE213	NE213
NMR	NMR
NQR	NQR
$NS\sigma$	NS*SIGMA
NX	NX
NaI	NAI
Ne	Ne
Nilsson	NILSSON
Note:	NOTE:
November	NOVEMBER
Nuclear Data Sheets	NDS
$N\times\sigma$	N*SIGMA
O	O
O/Q	O/Q
O1	O1
O123	O123
O2	O2
O3	O3
ORNL	ORNL
OSIRIS	OSIRIS
October	OCTOBER
Octupole mom(mag)	MOMM3

ENSDF Dictionary – ordered by output

Translation	ENSDF
Octupole mom(el)	MOME3
P1	P1
PAC	PAC
PAD	PAD
PWBA	PWBA
PWIA	PWIA
Particle normalization	NP
P_0	P0
P_n	PN
Q	MOME2
Q	Q
Q(	Q(
Q(g.s.)	QP
Q(α)	QA
Q(β^-)	Q–
Q(ε)	Q+_
Q+O	Q+O
Q/D	Q/D
Q2D	Q2D
Q2DM	Q2DM
Q3D	Q3D
QDD	QDD
QDDM	QDDM
QDMDQ	QDMDQ
QMG	QMG
QQSP	QQSP
QSD	QSD
Q_{22}	Q22
Q_s	QS
R	*R
R	R
R(DCO)	R(DCO)
RDDS	RDDS
RDM	RDM
RPA	RPA
RUL	RUL
Ritz	RITZ
Rose	ROSE
Rutherford	RUTHERFORD
Rytz	RYTZ
S values	S VALUES
S value	S VALUE
S'	S'
S(2n)	S(2N)
S(2p)	S(2P)
S(n)	SN
S(p)	SP
S(α)	SA
S–factors	S–FACTORS
S–factor	S–FACTOR
S–value	S–VALUE
S–values	S–VALUES
S/	S/
S=	S=
SD	SD
SDB	SDB
SF	SF
SOREQ	SOREQ
Saxon	SAXON
Schmidt	SCHMIDT
Se(Li)	SE(LI)
Seltzer	SELTZER
September	SEPTEMBER
Si(Li)	SI(LI)
Si(Li)	SILI
SiO	SIO
Sliv–Band	SLIV–BAND
Sn	Sn
Steffen	STEFFEN
Stockholm	STOCKHOLM
T	TEMP
T	ISPIN
T/	T/
T20	T20
T21	T21
T22	T22
TDPAD	TDPAD
TPAD	TPAD
TRISTAN	TRISTAN
TRIUMPH	TRIUMPH
Teller	TELLER
Ti	Ti
$T_{1/2}$	T1/2
$T_{1/2}$	T
T_z	ISPINZ
U	U
UK	UK
UNISOR	UNISOR

ENSDF Dictionary – ordered by output

Translation	ENSDF
USA	USA
USSR	USSR
Univ	UNIV
University	UNIVERSITY
U_2A_2	U2A2
V	V
VAP	VAP
W	W
W.u.	W.U.
Weisskopf	WEISSKOPF
Wigner	WIGNER
Winther	WINTHER
X(	X(
XX	XX
Xγ	XG
Y	YTTRIUM
Z	Z
Z>N	Z>N
[E2]	[E2]
[Iγ	[RI
°	DEG
×	*
av Eβ	EAV
a_0	a0
branching uncertainty	DBR
c.m.	C.M.
ce	CE
ce(K)/(γ+ce)	K/T
ce(K)	CEK
ce(L)/(γ+ce)	L/T
ce(L)	CEL
ce(L+)/(γ+ce)	L+/T
ce(L1)	CEL1
ce(L12)	CEL12
ce(L23)	CEL23
ce(L2)	CEL2
ce(L3)	CEL3
ce(M)/(γ+ce)	M/T
ce(M)	CEM
ce(M+)/(γ+ce)	M+/T
ce(M1)	CEM1
ce(M2)	CEM2
ce(M23)	CEM23
ce(M3)	CEM3
ce(M45)	CEM45
ce(M4)	CEM4
ce(M5)	CEM5
ce(N)/(γ+ce)	N/T
ce(N)	CEN
ce(N+)/(γ+ce)	N+/T
ce(N1)	CEN1
ce(N2)	CEN2
ce(N3)	CEN3
ce(N45)	CEN45
ce(N4)	CEN4
ce(N5)	CEN5
ce(O)	CEO
ce(O)/(γ+ce)	O/T
ce(O)+ce(P)	CEO+CEP
ce(O1)	CEO1
ce(P+)/(γ+ce)	P+/T
ceβ	CEB
ceγ	CEG
cm^2	CM2
cm^3	CM3
configuration=	CONF=
configuration	CONF
$cos^2θ$	COS2TH
dE/dx	DE/DX
d^3He	D3HE
dΩ	DOMEGA
dγ	DG
dσ	DSIGMA
dσ/dΩ	DS/DW
dσ/dΩ	*DS/DW
e'(θ)	E'(THETA)
eV	EV
even–A	EVEN–A
ex.	EX.
e^+	E+
$e^\pm$	E+–
fm	FM
fm^{-1}	FM–1
fm^{-1}	FM**–1
fm^2	FM**2
fm^4	FM**4
g factor	G FACTOR
g factors	G FACTORS

ENSDF Dictionary – ordered by output

Translation	ENSDF	Translation	ENSDF
g(2+	G(2+	p1/2	P1/2
g–factors	G–FACTORS	p2nγ	P2NG
g–factor	G–FACTOR	pnγ	PNG
g.s.	GS	pα	PALPHA
g=	G=	pγ	PG
gT	G*T	p$\gamma\gamma$	PGG
g$T_{1/2}$	GT1/2	r^2	R**2
gWΓ_0^2	G*W*WIDTHG0**2	r^4	R**4
gw$\Gamma_{\gamma 0}$	G*W*WIDTHG0	r^6	R**6
$g_1\Gamma$	G1*WIDTH	r_0	R0
g_1	G1	s(ce)	S(CE)
$g_2\Gamma$	G2*WIDTH	s–wave	S–WAVE
g_2	*G2	syst	SY
g_2	G2	s^{-1}	S–1
g_A^2	GA2	t)	T)
gΓ	G*WIDTH	t,	T,
g$\Gamma^2_{\gamma 0}$	*G*WIDTHG0**2	th	TH
g$\Gamma^2_{\gamma 0}$	G*WIDTHG0**2	tof	TOF
gΓ_n	G*WIDTHN	tγ	TG
g$\Gamma_{\gamma 0}$	G*WIDTHG0	w(θ)g$\Gamma_{\gamma 0}$	W(THETA)*G*WID
g$\Gamma_0\Gamma\gamma$	GWIDTH0WIDTHG	x–ray	X–RAY
$\hbar\omega$	HOMEGA	x–rays	X–RAYS
h^2	H**2	xpynγ	XPYNG
is D	IS D	$<r^2>$	AVRSQ
kG	KG	$<\beta^2>^{1/2}$	BAVRSQ
kOe	KOE	$\Delta<r^4>$	DAVRSQ4
keV	KEV	$\Delta<r^2>$	DAVRSQ
log $f^{1u}t$	LOGF1UT	$\Delta<r^6>$	DAVRSQ6
log $f^{3u}t$	LOGF3UT	$^{(J+½)}$	**(J+1/2)
log $f^{2u}t$	LOGF2UT	$^{-1}$	**–1
log $f^{1}t$	LOGF1T	$^{-3}$	**–3
log ft	LOGFT	$^{-4}$	**–4
mb	MB	$^{1/2}$	**1/2
mb/sr	MB/SR	$^{1/3}$	**1/3
meV	MILLI–EV	$^{12}C\gamma$	C12G
mg/cm^2	MG/CM2	^{2}	**2
ms	MS	^{3}	**3
nb/sr	NB/SR	^{L}	**L
nγ	NG	*e.g.*	E.G.
n$\gamma\gamma$	NGG	*i.e.*	I.E.
odd–A	ODD–A	$\times$E	*E
p decay	P DECAY	$\times I\beta^-$	*IB–
p(θ)	P(THETA)	$\times I\varepsilon$	*IE
p–width	P–WIDTH	$\times$Q	*Q

ENSDF Dictionary – ordered by output

Translation	ENSDF	Translation	ENSDF
$\times T_{1/2}$	*T1/2	Φ	PHI
$\times A^{1/3}$	*A**(1/3)	$\Phi(p_2)$	PHI(P2)
$\times\sigma$	*SIGMA	$\Phi(p_1)$	PHI(P1)
$\leq$	LE	Γ	*WIDTH
$\neq$	NE	Γ	WIDTH
$\geq$	GE	$\Gamma^2_{\gamma 0}$	WIDTHG0**2
$\approx$	AP	Γ^2	WIDTH**2
$\approx<$	LA	Γ_n	WIDTHN
$\approx>$	GA	Γ_{n0}	WIDTHN0
∞	INFNT	Γ_{p0}	WIDTHP0
Δ	Δ	Γ_{p1}	WIDTHP1
Δ(HF)	DHF	Γ_p	*WIDTHP
Δ(log ft)	DFT	$\Gamma_{p'}$	WIDTHP'
$\Delta(\beta$–normalization	DNB	Γ_{p2}	WIDTHP2
$\Delta(\gamma$–normalization	DNR	Γ_p	WIDTHP
$\Delta(\gamma$+ce–normalization	DNT	$\Gamma_{\alpha 4}$	WIDTHA4
ΔA	DA	$\Gamma_{\alpha 1}$	WIDTHA1
ΔA_2	DA2	Γ_γ	WIDTHG
ΔA_4	DA4	$\Gamma_{\gamma 1}$	WIDTHG1
ΔE	DE	$\Gamma_{\alpha 2}$	WIDTHA2
$\Delta I(\gamma$+ce)	DTI	$\Gamma_{\alpha 0}$	WIDTHA0
$\Delta I\alpha$	DIA	$\Gamma_{\gamma 0}$	WIDTHG0
$\Delta I\beta$	DIB	$\Gamma_{\alpha 3}$	WIDTHA3
$\Delta I\varepsilon$	DIE	$\Gamma\alpha$	WIDTHA
$\Delta I\gamma$	DRI	Σ	*SUMOF
$\Delta I\gamma(\%)$	PRI	Σ	SUMOF
ΔJ	DJ	Ψ	PSI
$\Delta J\pi$	DJPI	α	ICC
ΔK	DK	α	ALPHA
ΔL	DL	α	CC
ΔN	DN	α decay	A DECAY
$\Delta Q(\varepsilon)$	DQ+	α decays	A DECAYS
$\Delta Q(\beta^-)$	DQ–	α syst	A SYST
$\Delta Q(\alpha)$	DQA	α'	A'
ΔS	DS	α's	ALPHAS
ΔS(n)	DSN	α(K)exp	*EKC
ΔS(p)	DSP	α(K)exp	EKC
ΔT	DISPIN	α(K)	KC
$\Delta T_{1/2}$	DT	α(L)exp	ELC
$\Delta T_{1/2}$	DT1/2	α(L)	LC
Δ	DELTA	α(L12)exp	EL12C
$\Delta\alpha$	DCC	α(L12)	L12C
$\Delta\delta$	DMR	α(L1)exp	EL1C
$\Delta\pi$	DPI	α(L1)	L1C

ENSDF Dictionary – ordered by output

Translation	ENSDF	Translation	ENSDF
α(L2)	L2C	α_3	ALPHA3
α(L23)exp	EL23C	$\alpha\alpha$	AA
α(L23)	L23C	$\alpha\gamma$	AG
α(L2)exp	EL2C	β	BETA
α(L3)exp	EL3C	β	B
α(L3)	L3C	β's	BETAS
α(M)exp	EMC	β(GT)	BGT
α(M)	MC	β(IS	B(IS
α(M+..)	MC+	β–vibrational	B–VIBRATIONAL
α(M1)	M1C	βR	B*R
α(M1)exp	EM1C	βR	BETA*R
α(M2)	M2C	βc	BC
α(M2)exp	EM2C	βce	BCE
α(M3)	M3C	βe^-	BE–
α(M3)exp	EM3C	βn	BN
α(M4)	M4C	βp	BP
α(M4)exp	EM4C	β^+	B+
α(M5)	M5C	$\beta^+\varepsilon$ Decay	BEC DECAY
α(M5)exp	EM5C	β^-2n	B–2N
α(N)exp	ENC	β^-	B–_
α(N)	NC	β^-n	B–N
α(N+..)	NC+	β_0	B0
α(N1)exp	EN1C	β_{04}	B04
α(N1)	N1C	β_{03}	B03
α(N2)exp	EN2C	β_{02}	B02
α(N2)	N2C	β_{00}	B00
α(N23)exp	EN23C	β_{12}	B12
α(N3)	N3C	β_1	B1
α(N3)exp	EN3C	β_{20}	B20
α(N4)exp	EN4C	β_{24}	B24
α(N4)	N4C	β_{22}	B22
α(N5)	N5C	β_2R	B2*R
α(N6)	N6C	β_2	B2
α(O1)	O1C	β_3	B3
α(O2)	O2C	β_3R	B3*R
α(O3)	O3C	β_{30}	B30
α(O4)	O4C	β_4	B4
α(P1)	P1C	β_{42}	B42
α(exp)	ECC	β_4R	B4*R
α–decay	A–DECAY	β_5	B5
α–syst	A–SYST	β_5R	B5*R
α_0	ALPHA0	β_6	B6
α_1	ALPHA1	β_6R	B6*R
α_2	ALPHA2	β_7	B7

ENSDF Dictionary – ordered by output

Translation	ENSDF	Translation	ENSDF
β_L	BL	γγτ	GGT
$\beta_L RA^{1/3}$	BL*R*A**(1/3)	γγγ	GGG
$\beta_L{}^2$	BL**2	χ	CHI
$\beta_L R$	BL*R	χ^2	CHI**2
βα	BA	∈M(exp)	ECM
ββ	BB	∈N(exp)	ECN
βγ	BG	κ	KAPPA
βγn	BGN	λ	LAMBDA
βγγ	BGG	μ	MOMM1
δ	MR	μ	MU
δ^2	MR**2	μb	UB
ε	EPSILON	μb/sr	UB/SR
ε	EC	μb×MeV	UB*MEV
ε2p	EC2P	μg	UG
εB	EPSILONB	μg/cm	UG/CM
εB(E2)↑	EBE2UP	μs	US
εB(E3)↑	EBE3UP	μ^-	MU–
εK	CK	ν	NU
εK(exp)	ECK	π	PI
εL	CL	π^-	PI–
εL(exp)	ECL	πβ	PIB
εL1(exp)	ECL1	πβγ	PIBG
εL2(exp)	ECL2	πγ	PIG
εL3(exp)	ECL3	θ	THETA
εM	CM	θ^2	THETA**2
εN	CN	θ_1	THETA1
εp	ECP	θ_2	THETA2
εα	ECA	$\theta_{p1}{}^2$	THETAP1**2
γ	GAMMA	$\theta_{p2}{}^2$	THETAP2**2
γ	G_	θα	THETAA
γ/α	G/A	$\theta\alpha^2$	THETAA**2
γX	GX	θγ	THETAG
γce	GCE	ρ	RHO
γe^-	GE–	ρ^2	RHO**2
γn	GN	σ	SIGMA
γp	GP	σ(nγ)	SIGNG
γp'	GP'	σ(nα)	SIGNA
γp(t)	GP(T)	σ_0	SIGMA(0)
$\gamma^{\pm}$	G+–	σ_n	SIGMAN
γ_0	G0	σ_γ	SIGMAG
γβ	GB	σ×ΔE	SIGMA*DE
$\gamma\beta^-$	GB–	σν	SIGMANU
γγ	GG	τ	*TAU
γγn	GGN	τ	TAU

ENSDF Dictionary – ordered by output

Translation	ENSDF
ω	OMEGA
$\omega^2\tau$	OMEGA**2*TAU
$\omega\tau$	OMEGA*T

Appendix H

ENSDF Policies

The Nuclear Data Sheets are prepared from the Evaluated Nuclear Structure Data File (ENSDF), a computer file maintained by the National Nuclear Data Center on behalf of the International Network for Nuclear Structure and Decay Data Evaluations. See page iii for a list of the members of this network and their evaluation responsibilities. The presentation of material in the Nuclear Data Sheets reflects the organization of ENSDF, which is a collection of "data sets". For each nuclear species, these data sets present the following types of information:

- The adopted properties of the nucleus.
- The evaluated results of a single type of experiment, such as a radioactive decay, a single nuclear reaction, or the combined results of a number of similar types of experiments, such as (HI,xnγ) reactions. The data given in ENSDF are primarily derived from experimental information.

The gener al policies and conventions followed in the preparation of these data sets and in the presentation of material in the Nuclear Data Sheets (NDS) are discussed below.

General

The following policies apply to the adoption or presentation of data. Deviations from these policies will be noted by the evaluator.

1. The excitation energies of levels connected by γ transitions are from a least−squares fit to the adopted γ energies.
2. Dominant decay branches (*i.e.*, for the decay of ground states and isomeric states) are rounded off to 100 when the competing branches total less than approximately 0.001%. When only one branch has been observed and no estimate can be made for expected competing branches, the observed branch is given as ≤100 and the competing branch(es) as "%branching=?".
3. Total internal−conversion coefficients (α) for each transition are theoretical values corresponding to the listed radiation character (*i.e.*, multipolarity) and mixing ratio (δ). For a transition of mixed character (two or more multipolarities) and unknown mixing ratio, α is the average of the possible extremes and the uncertainty overlaps the full range of values.

   In all calculations by the evaluator involving internal−conversion coefficients, a 3% uncertainty is assumed for the theoretical coefficients.
4. The cross reference flags (XREF), defined in the Adopted Levels table are given for each adopted level. When a level in an individual reaction or decay data set may correspond to more than one adopted level, the flag for that data set is given in lower case. In case of ambiguity, the energy from a particular data set is given as a comment.

Adopted Levels, Gammas data set

The Adopted Levels and γ radiations tables in the NDS are generated from an Adopted Levels, Gammas data set in ENSDF. This data set represents the best values for the level and γ properties as determined by the evaluator on the basis of all the available information.

The following information is included in an Adopted Levels, Gammas data set.

For the nuclide:

1. **Q(β⁻):** β⁻ decay energy [always presented as Q(β⁻)=M(A,Z)−M(A,Z+1)] and α decay energy [Q(α)] for the ground state.
2. **S(n) and S(p):** Neutron and proton separation energies.
3. **XREF:** Cross−reference symbol assignments for the various experimental data sets.

For each level:

1. **E(lev):** Excitation energy (relative to the ground state).
2. **J^{π}:** Spin and parity with arguments supporting the assignment.
3. **$T_{1/2}$ or Γ:** Half−life or total width in center of mass.
4. **Decay branching** for the ground state and isomers (an isomer is defined as a nuclear level with $T_{1/2}$≥0.1 s or one for which a separate decay data set is given in ENSDF).
5. **Q,μ:** Static electric and magnetic moments.
6. **XREF Flags** to indicate in which reaction and/or decay data sets the level is seen.
7. **Configuration assignments** (*e.g.*, Nilsson orbitals in deformed nuclei, shell−model assignments in spherical nuclei).
8. **Band assignments** and possibly band parameters (*e.g.*, rotational bands in deformed regions).
9. Isomer and isotope shifts (usually only a literature reference is given).
10. Charge distribution of ground states (usually only a literature reference is given).
11. Deformation parameters.
12. **B(E2)↑,B(M1)↑,..:** Electric or magnetic excitation probabilities when the level half−life or the ground−state branching is not known.

For γ−ray and E0 transitions:

1. **Placement** in level scheme.
2. **Eγ:** Measured γ−ray or E0 transition energy.
3. **Iγ:** Relative photon intensity from each level.
4. **Mult,δ:** Electric or magnetic multipole character, the mixing ratio, and nuclear penetration parameter.
5. **CC:** Total internal−conversion coefficient (when significant).
6. **B(EL)(W.u),B(M1)(W.u),..:** Reduced transition probabilities in Weisskopf units.

Reaction and decay data sets

These data sets include information about different types of experiments and may include data sets for β decay, α decay, isomeric transition (IT) decay, Coulomb excitation, charged–particle reactions [such as (d,p) and (t,p)], heavy–ion reactions [such as (^{40}Ar,xnγ)], (γ,γ'), and mesonic atoms.

The following policies apply to the presentation of data in reaction and decay data sets. Any deviation from these policies will be noted by the evaluator.

1. The J^{π} values in the decay data sets and reaction data sets with gammas are taken from the associated Adopted Levels, Gammas data set. For other reaction data sets the J^{π} values are from the reaction data. The J^{π} value to the capture state in thermal –neutron capture is assigned assuming s–wave capture.
2. The character of a γ ray and its mixing ratio are from the associated Adopted γ radiation table.
3. The term "absolute intensity" has the same meaning as the term "emission probability", and the term "relative intensity" is equivalent to "relative emission probability" or "relative emission rate." The former are given as intensities per 100 decays.
4. Beta and electron–capture intensities are per 100 decays of the parent and are usually deduced from γ intensity imbalance for the levels fed. The separation of $I(\varepsilon+\beta^+)$ into $I(\varepsilon)$ and $I(\beta^+)$ is based on theoretical ε/β^+ ratios. The log *ft* values for nonunique transitions are calculated as for allowed transitions.
5. Particle transition intensities (other than β's) are per 100 particle decays. The total particle branching is given both in the drawings and in the tables.
6. Tabular γ–ray intensities are relative values. The normalization factor to convert them to absolute intensities [photons per 100 decays of the parent for decay data sets, or photons per 100 neutron captures for (n,γ) data sets, *etc.*] is given in a footnote.
7. Radiations from the decay of neutron or proton resonances are not presented. The energies and other level properties for bound levels deduced from resonance experiments are included. Primary as well as secondary γ's following thermal–neutron capture are generally included.
8. BEλ, BMλ for the excitation of levels are generally given.
9. Up to three references that make major contributions to the information in a specific data set are given in the data set heading. These major references also appear in the drawings.

Organization of material

Within each A chain, information is presented by nuclides which are arranged in order of increasing Z. There is an index for each evaluation which is followed by an isobaric diagram. A table of properties for the ground state and isomeric levels for all nuclides of the A chain is given following or with the isobaric diagram.

For each nuclide, ^{A}Z, the arrangement of material and conventions for inclusion in tables are described below.

1. Adopted levels in ^{A}Z – All adopted level properties are shown for each level, together with explanatory comments.
2. Adopted γ radiations in ^{A}Z.
3. Band structure is shown where known.
4. Levels and radiations in ^{A}Z from radioactive decays – Decays are ordered by increasing A, Z, and excitation energy of the parent.
   a. Table of levels deduced from the decay.
   b. Tables of radiations observed in the decay.
   c. Decay Scheme
5. Levels and γ rays in ^{A}Z from nuclear reactions – Reactions are ordered by increasing A, Z of the target, then by increasing A, Z of the incident nucleus. A heading is given for each reaction.
   a. Table of levels deduced from the reaction.
   b. Table of γ rays observed in the reaction, if any.
   c. Level Scheme, if γ rays were observed and placed.

A reference "Theory 1967Xy01" indicates theoretical predictions computed by the authors of 1967Xy01. A reference "Theory" alone indicates a determination by the evaluator of theoretical predictions described below.

Internal Conversion Coefficients

Theoretical conversion coefficients are obtained by spline interpolation (1968Ha53) from tables of Hager and Seltzer (1968Ha53) for the K–, $L_{1...3}$–, $M_{1...5}$–shells and of Dragoun, Plajner, and Schmutzler (1971Dr11) for the (N+O+...)–shells. For the $N_{1...5}$–subshells, values are obtained by graphical interpolation from tables of Dragoun, Pauli, and Schmutzler (1969Dr09). For K–, $L_{1...3}$–shells, conversion coefficients for transitions outside the E_γ, Λ, or Z ranges of Hager and Seltzer are obtained as follows: for $E_\gamma \le 6000$ keV and for Z=3,6,10 and $14 \le Z \le 30$ interpolation from tables of Band, *et al.* (1976Ba63); for $E_\gamma > 2600$ keV, by graphical interpolation from tables of Trusov (1972Tr09). For E0 transitions, K/L_1 and L_1/L_2 ratios are obtained by graphical interpolation from tables of Hager and Seltzer (1969Ha61).

Angular Distribution and Correlation Coefficients

The coefficients required for analysis of directional correlation, polarization correlation, directional distribution, and polarization distribution data are obtained as described by Steffen (1971St47, 1971St48). In particular, we adopt the phase convention for the mixing ratio, δ, defined by Krane and Steffen (1970Kr03). Particle parameters required for the analysis of correlation and distribution data involving conversion electrons are obtained by graphical interpolation from tables of Hager and Seltzer (1968Ha54). The expression for the deorientation coefficient required to account for intermediate unobserved mixed radiations is given by Anicin (1972An20).*

A tabulation of gamma–gamma directional–correlation coefficients is given by Taylor, *et al.* (1971Ta32). These authors use the Steffen phase convention.

Penetration Parameters

Penetration parameters required for the analysis of internal conversion data and angular correlation or distribution data involving electrons are obtained by graphical interpolation from tables of Hager and Seltzer (1969Ha61).

Internal Pair Conversion Coefficients

Theoretical internal pair conversion coefficients for Λ=E1, M1, E2 are obtained by graphical interpolation in Z, E from tables of Lombard, *et al.* (1968Lo16).

* As pointed out by these authors, most earlier references which discuss this coefficient define it incorrectly.

β–Decay Rate Probabilities

Log *ft* values, capture–to–positron ratios, and electron–capture ratios for allowed, first–forbidden unique, and second–forbidden unique transitions are obtained as described by Gove and Martin (1971Go40). This reference also contains a tabulation of log *ft* values and total capture–to–positron ratios for allowed and first–forbidden unique transitions.

Atomic Processes

X–ray fluorescence yields are obtained from Bambynek, *et al.* (1972Bb16) for $Z \le 92$ and from Ahmad (1979Ah01) for Z>92.

Electron binding energies for Z<84 are taken from Bearden and Burr (1967Be73) and from Porter and Freedman (1978Po08) for Z>84.

α–Decay Hindrance Factors

The α–hindrance factors (the ratio of the measured partial half–life for α–emission to the theoretical half–life) are obtained from the spin–independent equations of Preston (1947Pr17). The nuclear radius for each even–even nucleus is determined by defining, for the g.s. to g.s. α–transition, the hindrance factor (HF)≡1. For odd–A and odd–odd nuclei, the radius parameters are chosen to be the average of the radii for the adjacent even–even nuclei (1998Ak04). In cases where only one adjacent even–even radius is known, the extrapolated/interpolated value for the unknown radius is used in the calculation. A survey of the dependence of α–hindrance factors on asymptotic quantum numbers and the variation of α–hindrance factors within rotational bands is given for A>=229 in 1972El21.

Electromagnetic Transition Rates

The Weisskopf single–particle estimates for the half–lives of electric and magnetic multipole radiation of energy E_γ are (1952Bl97)

$$T_{1/2W}(EL)=0.190\left(\frac{L}{L+1}\right)\left(\frac{3+L}{3}\right)^2\frac{[(2L+1)!!]^2}{A^{2L/3}}\left(\frac{164.44}{E_\gamma\ (\mathrm{MeV})}\right)^{2L+1}\times 10^{-21}\ \mathrm{s}$$

$$T_{1/2W}(ML)=3.255\ A^{2/3}\ T_{1/2W}(EL)$$

for a nuclear radius of $1.2A^{1/3}\times10^{-13}$ cm.

Unweighted and Weighted Averages

If $x_1\pm\Delta x_1$, $x_2\pm\Delta x_2$, $...x_n\pm\Delta x_n$ are n independent measurements of a given quantity, Δx_i being the uncertainty in x_i, then the weighted average of these measurements is $\bar{x}\pm\Delta\bar{x}$, where

$$\bar{x} = W\Sigma x_i/(\Delta x_i)^2,$$
$$W = 1/\Sigma(\Delta x_i)^{-2},$$

and $\Delta\bar{x}$ is the larger of

$$(W)^{1/2}$$
$$\text{and } [W\Sigma(\Delta x_i)^{-2}(\bar{x}-x_i)^2/(n-1)]^{1/2}.$$

The unweighted average of these same measurements is given by $\bar{x}\pm\Delta\bar{x}$, where

$$\bar{x} = \Sigma x_i/n,$$
$$\Delta\bar{x} = [\Sigma(\bar{x}-x_i)^2/n(n-1)]^{1/2}.$$

PROPOSITIONS ON WHICH STRONG ARGUMENTS ARE BASED

Ground States

1. The ground state of an even−even nucleus has $J^{\pi} = 0^{+}$.
2. Spin determinations by such techniques as atomic−beam resonance, paramagnetic resonance, electron−spin resonance, and optical spectroscopy give correct values.

Gamma Transitions

3. The agreement of the measured value of a single conversion coefficient with the theoretical value for a multipolarity which is well separated from the value for any other multipolarity determines the transition multipolarity.
4. In all other cases if there is no other evidence for multipolarity, agreement of two or more measured conversion coefficients or ratios with theoretical values is necessary in order to establish the multipolarities of a transition and its mixing ratio.
5. Since an E0 transition can proceed only by conversion or pair production, pure E0 is ruled out if photons are observed.
6. Recommended upper limits for γ−ray strengths ($\Gamma_{\gamma}/\Gamma_{w}$, Γ_{w}−Weisskopf estimate) for various A values are given below.

Character*	$\Gamma_{\gamma}/\Gamma_{w}$(Upper Limit) A=6−44[a§]	A=45−150[b,c]	A>150[d]
E1 (IV)	0.3[#]	0.01	0.01
E2 (IS)[e]	100	300	1000
E3	100	100	100
E4	100	100[†]	
M1 (IV)	10	3	2
M2 (IV)	3	1	1
M3 (IV)	10	10	10
M4		30	10

* 'IV' and 'IS' stand for isovector and isoscalar
† $\Gamma_{\gamma}/\Gamma_{w}$(Upper Limit)=30 for A=90−150
$\Gamma_{\gamma}/\Gamma_{w}$(Upper Limit)=0.1 for A=21−44
§ $\Gamma_{\gamma}/\Gamma_{w}$(Upper Limit)=0.003 for E1 (IS), 10 for E2 (IV), 0.03 for M1 (IS), 0.1 for M2 (IS)
a From 1979En05
b From 1979En04
c From 1981En06
d Deduced from **ENSDF** by M. J. Martin
e In super−deformed bands the E2 transitions can have $\Gamma_{\gamma}/\Gamma_{w}>1000$.

Beta Transitions§

7. If log *ft* < 5.9, the transition is allowed: ΔJ=0 or 1, Δπ=no (no change in parity). Superallowed (ΔT=0) $0^{+}\rightarrow0^{+}$ transitions have log *ft* in the range 3.48 to 3.50. Isospin forbidden (ΔT=1) $0^{+}\rightarrow0^{+}$ transitions have log *ft*>6.4. If 3.6<log *ft*<6.4, the transition is not $0^{+}\rightarrow0^{+}$.
8. If log $f^{1u}t$<8.5 (log *f't* < 7.4), ΔJ=0,1; Δπ=yes or no.
9. If log *ft*<11.0, ΔJ=0,1; Δπ=yes or no or ΔJ=2, Δπ=yes.
10. If log *ft*<12.8, ΔJ=0,1,2; Δπ=yes or no.
11. If log $f^{1u}t\geq8.5$ (log $f't \geq 7.4$) and if the Fermi plot has the curvature corresponding to a shape factor (p^2+q^2), then the transition is first−forbidden unique (ΔJ=2, Δπ=yes).

See "β−Decay Rate Probabilities" on page vii.
Note that log $f^{1u}t$=log f't+1.079.

Note: For nuclei at, or very near to, closed shells values may be smaller. For example, in the mass region around Z=82, the upper limit of 5.9 given in #7 above could be 5.1.

§ See 1973Ra10

γγ Directional Correlation

$$W(\theta) = \sum_{k-even} A_k P_k (\cos\theta)$$

12. If a gamma−gamma directional−correlation experiment yields $A_2 \approx +0.36$ and $A_4 \approx +1.1$, then the spin sequence is $0 \rightarrow 2 \rightarrow 0$.
13. Results of γγ(θ) are strong evidence for excluding spin sequences for which the theoretical A_2 or A_4 falls well outside the experimental range.

βγ Directional Correlation

$$W(\theta) = \sum_{k-even} A_k(\beta)A_k(\gamma)P_k(\cos\theta)$$

14. If $|A_2(\beta)|\geq0.1 (A_4=0)$, the transition is not allowed. The converse is not true.
15. If $A_4(\beta)\neq0$. the transition is neither allowed nor first forbidden.
16. If $A_4(\beta)=0$, the transition is allowed or first forbidden.

βγ Polarization Correlation

$$P(\theta) = \frac{\sum_{k-odd} A_k(\beta)A_k(\gamma)P_k(\cos\theta)}{W(\theta)}$$

17. In allowed transitions,

β^-	$A_1(\beta)<0$ if $J_i=J_f$
β^+	$A_1(\beta)>0$ if $J_i=J_f$
β^-	$A_1(\beta)\geq0$ if $J_i=J_f+1$
	$A_1(\beta)<0$ if $J_i=J_f-1$
β^+	$A_1(\beta)\leq0$ if $J_i=J_f+1$
	$A_1(\beta)>0$ if $J_i=J_f-1$

18. If $A_3(\beta)\neq0$, the β−transition is not allowed. The converse is not always true.

γ Angular Distribution

19. In the angular distribution of gamma rays from deexcitation of states populated in high−spin reactions (for a typical value of σ/J=0.3, where σ is the magnetic substate population parmeter):

a. If $A_2\approx+0.3$ and $A_4\approx-0.1$, the transition is generally ΔJ=2 (stretched quadrupole). (The same A_2 and A_4 values are possible for ΔJ=0, D+Q transitions also, but such transitions are less common. A_4=0 for ΔJ=0, dipole transition).
b. If $A_2\approx-0.2$ and $A_4\approx0$, the transition is generally ΔJ=1 (stretched dipole).
c. If $A_4>0$ ($A_2\approx+0.5$ to −0.8), the transition is ΔJ=1, D+Q.

γ DCO Ratio

In the angular correlation (DCO) of gamma rays from deexcitation of states populated in high−spin reactions (for a typical value of σ/J=0.3, where σ is the magnetic substate population parmeter):

20. For ΔJ=2, stretched quadrupole as a gating transition:

a. R(DCO) ≈ 1.0, the transition is generally ΔJ=2 (stretched quadrupole). (The same value is possible for ΔJ=0, dipole but such transitions are less common).
b. If R(DCO) ≈0.5, the transition is generally ΔJ=1 (stretched dipole).
c. If R(DCO) differs significantly from ≈0.5 or ≈1.0, the transition is ΔJ=1 (or 0), D+Q.

PROPOSITIONS ON WHICH STRONG ARGUMENTS ARE BASED continued

γ **DCO Ratio** continued

21. For $\Delta J=1$, stretched dipole as a gating transition:
a. If R(DCO) ≈ 2.0, the transition is generally $\Delta J=2$ (stretched quadrupole). (The same value is possible for $\Delta J=0$, dipole transitions, but such transitions are less common).
b. If R(DCO) ≈ 1.0, the transition is generally $\Delta J=1$ (stretched dipole).
c. If R(DCO) differs significantly from ≈ 2.0 or ≈ 1.0, the transition is $\Delta J=1$ (or 0), D+Q.

Reactions

22. Low–energy Coulomb excitation is predominantly E2 excitation.
23. Coulomb excitation determines J^{π} if the excitation probability agrees with the calculated values of Alder (60Al23).
24. The spin of the compound nuclear state resulting from thermal–neutron capture is equal to the spin of the target nucleus plus or minus 1/2.
25. Primary γ's from neutron capture are E1, M1, E2, or M1+E2.
26. If the angular distribution in a single–nucleon transfer reaction can be fitted with a unique L value, the spin of the final state J_f is related to the spin of the inital state J_i by

$$\vec{J}_f = \vec{J}_i + \vec{L} + \vec{\tfrac{1}{2}}$$

with parity change if L is odd.
27. If the vector analyzing power for a single–nucleon transfer reaction shows a clear preference between J=L+1/2 and J=L−1/2 and if the L value is known, then the J value is determined.
28. Generally for the states populated in high–spin reactions, spins increase with increasing excitation energy. This is a result of the fact that these reactions tend to populate yrast or near yrast states.
29. If the angular distribution can be fitted with a unique L–value the J^{π} of the final state is related to the J^{π} of the initial state by $\vec{J}_f = \vec{J}_i + \vec{L}$, $\pi_f\pi_i=(-1)^L$, for the following cases
   a. A strong group observed in (p,t), (t,p), and (^{3}He,n) reactions (strong groups are assumed to result from two identical nucleons transferred in a relative s state)
   b. A strong group observed in the α–particle transfer reaction (^{6}Li,d).
   c. (e,e') and (α,α') inelastic scattering.
30. In reactions with $J^{\pi}=0^+$ target, projectle, and ejectile, if the yield of a group at 0° or 180° is
   a. non–zero, the parity of the final state is $(-1)^{J_f}$
   b. zero at several uncorrelated energies, the parity of the final state is $(-1)^{J_f+1}$

31. In reactions with a polarized $J^{\pi}=1$ projectile in the m=0 substate, with $J^{\pi}=0^+$ ejectile and target, if the yield of a group at 0° or 180° is
   a. non–zero, the parity of the final state is $(-1)^{J_f+1}$
   b. zero at several uncorrelated energies, the parity of the final state is $(-1)^{J_f}$

Regions of Strong Nuclear Deformation

The systematic occurrence of rotational–band structure in the strongly deformed nuclides can be a considerable help in making Jπ assignments, since one can also use the level energy as one of the considerations. This frequently makes it possible to assign a Jπ value to a level with confidence from data which, absent such structure, might yield an ambiguous assignment.

32. Level–energy considerations. If the couplings among the states are not too strong, the energies of the lower members of a band can be expressed by the relatively simple relation (see, *e.g.*, 1971Bu16 and references therein):

$$E(J,K)=AX+BX^2+CX^3+\ldots$$
$$+(-1)^{J+K}\prod_{i=1-K}^{K}(J+i)\{A_{2K}+B_{2K}X+\ldots\} \qquad (1)$$

where $X=J(J+1)-K^2$

The **inertial parameter**, A, exhibits a systematic behavior in the various regions of strongly deformed nuclei, which can be helpful in assigning levels to rotational bands. In some instances (*e.g.*, strong Coriolis coupling) where the A values depart significantly from systematic trends, this observation can itself be useful, since it can help establish the presence of such effects and, hence, provide evidence for the relevant nucleonic configurations.

For the case of K=1/2 bands, the **decoupling parameter**, a, which is characteristic for each such band, is given by the ratio A_1/A in (1). Establishing a value for the decoupling parameter of a proposed band can be useful in assigning a nucleonic configuration to it – and *vice–versa*.

33. Allowed–unhindered beta transitions. In this region, beta transitions having logft values <5.0 are classified as "allowed unhindered" (*au*). Such transitions take place between one–quasiparticle orbitals having the same asymptotic quantum numbers. In the "rare–earth" region ($90 \le N \le 112$, $60 <\approx Z <\approx 76$), four such orbital pairs are known: [532], near the beginning of this region; [523], near the middle of this region; [514], above the middle of this region; and, at the high end, [505]. Observation of an *au* transition is definitive evidence for the presence of the particular pair of orbitals.

34. Coulomb excitation. If a sequence of levels having "rotational–like" energy spacings is found to be excited with enhanced probabilities, this is evidence that this sequence (at least below the first "backbend") forms the ground–state rotational band for the nuclide involved. If the E2 transition probabilities involved are large (tens of Weisskopf units or larger) and comparable to each other, then this is definitive evidence for both a band structure and the sequence of Jπ values, assuming one of the spins is known.

35. Alpha decay. Observation of a "favored" α transition (HF <4) indicates that the two states involved have the same nucleonic configuration. If a sequence of levels having "rotational–like" energy spacings is associated with the level fed by this favored transition and these levels have HF's that vary according to the established trend within rotational bands (1972El21), then this sequence can be considered to form a rotational band whose nucleonic configuration is the same as that of the alpha–decaying state. If the Jπ value of this latter state and its configuration are known, then the corresponding quantities can be considered to be known for the band in the daughter nuclide or *vice versa*.

36. Single–nucleon–transfer reactions (light–ion–induced). For a single–nucleon transfer reaction induced by light ions (^{4}He and lighter), the characteristic pattern of cross sections among rotational–band members ("fingerprint") can be used to assign a set of levels as specific Jπ members of a band based on a particular Nilsson configuration, if the fingerprint agrees well with that predicted by the Nilsson–model wavefunctions and is distinct from those expected for other configurations in the mass region. (This method is even stronger if angular distributions giving unique L values, or vector analyzing powers, support the assignments for one or more of the levels.)

PROPOSITIONS ON WHICH STRONG ARGUMENTS ARE BASED continued

High–spin states

In the decay of high–spin states, commonly produced in heavy–ion induced compound nuclear reactions or in highly excited nuclides created as products of nuclear fission or in Coulomb excitation, the multipolarities of the deexciting γ transitions and the relative spins and parities of the levels are generally determined from angular distributions, angular correlations (DCO ratios), linear polarizations and internal–conversion coefficients. In addition, relative energy–level spacings and the increase of γ intensity with decreasing excitation energy are important clues.

37. For a well–deformed nucleus when a regular sequence of ΔJ=2 (stretched quadrupole) transitions is observed at high spins as a cascade, the sequence may be assigned to a common band with E2 multipolarity for all the transitions in the cascade. A similar but somewhat weaker argument holds for less deformed nuclei where a common sequence of levels is connected by a regular sequence of ΔJ=2 (stretched quadrupole) transitions in a cascade.

38. For near–spherical nuclei, when a regular sequence of ΔJ=1 (stretched dipole) transitions is observed at high spins as a cascade, then the sequence may be assigned to a common band with (M1) multipolarity for all the transitions in the cascade. (Cascades of ΔJ=1, E1 transitions occur in rare cases of nuclides which show alternating–parity bands or reflection asymmetry.)

39. In the absence of angular distribution/correlation data, a regular sequence of transitions in a cascade may be assigned to a common structure or a band if (a) the low–lying levels of this structure have well established spin and parity assignments and (b) there is good evidence that, at higher energies and spins, the band has not changed in its internal structure due to band crossings or other perturbations.

Alpha Decay

40. The hindrance factor for an α transition from the ground state of an even–even nucleus to the ground state of the daughter nucleus is 1.0 by definition. For odd–A and odd–odd nuclei, hindrance factors ≤4 identify favored α transitions, and these connect states having the same spin, parity and configuration.

41. For α–decay between two states, one of which has J=0, the parity change is given by $\Delta\pi=(-1)^{\Delta J}$.

PROPOSITIONS ON WHICH WEAK ARGUMENTS ARE BASED

1. In cases where gammas of one multipolarity "cluster" in one time region in the half–life vs. energy plot, as is true for M4's, other γ's whose half–lives fall in this cluster may be assigned the corresponding multipolarity.

2. In cases where a cluster of two multipolarities, *e.g.* M1 and E2 occupies one time region, a new gamma of which the half–life falls in this region may be assigned one of the two multipolarities or a mixture of the two.

3. Whenever ΔJ≥2, an appreciable part of the gamma transition proceeds by the lowest possible multipole order.

This statement is based on the scarcity of counter–examples and the observation that few E2 γ's are as slow as M3's, few M2's as slow as E3's, *etc.*

4. The spin and parity of a parent state may be inferred from the measured properties of its assumed isobaric analog resonance, and *vice versa*.

5. Low–lying states of odd–A nuclei have shell–model spins and parities, except in the regions where deformations appear. This argument is much stronger when supported by expected cross–section strengths (C^2S) in single–nucleon transfer reactions.

It is recognized that some shell–model predictions are stronger than others. For example, the shell model would mildly deny that the ground–state J^π of the 39th proton be $3/2^-$, but emphatically deny its being $3/2^+$. However, we have not included this distinction here and consider all shell–model arguments to be weak.

6a. For low–lying states of odd–odd spherical nuclei, the Nordheim rules (1950No10):

$$J = j_p + j_n,\ \text{if } j_p=l_p \pm 1/2 \text{ and } j_n = l_n \pm 1/2;$$
$$J = |j_p-j_n|,\ \text{if } j_p = l_p \pm 1/2 \text{ and } j_n=l_n \mp 1/2.$$

may be helpful in obtaining the ground–state spins and parities, if there is supporting evidence.

6b. For excited states of strongly deformed odd–odd nuclei, the Gallagher–Moszkowski rules (1958Ga27) may be helpful in deducing the relative positions of the two two–quasiparticle states formed by the two different couplings of the quasiparticle constituents, if there is supporting evidence. Here, the state corresponding to the parallel alignment (Σ=1) of the projections (=1/2) of the intrinsic spins of the two odd particles is expected to lie lower than that produced by the antiparallel (Σ=0) alignment. This can be particularly useful in establishing the ground state Jπ values and nucleonic configurations for odd–odd nuclei.

(In the strongly deformed even–even nuclei, the opposite is expected to obtain, i.e., the Σ=0 coupling should lie lower than that with Σ=1. In these nuclei, however, the experimental situation is less clear since the two–quasiparticle excitations occur at or above the pairing gap, where the level densities are high and couplings to vibrational excitations can affect the two two–quasiparticle states differently.)

7. Statements similar to 5 and 6 based on other models.

8. Statements based on interpolation or extrapolation of regional trends, such as shown in 1971Bu16, 1972El21, 1977Ch27, 1990Ja11 and 1998Ja07 for the rare–earth and heavy–mass regions.

9. All statements connected with the nonobservation of expected transitions.

10. Rules extracted in the survey by 1972El21 for unfavored α transitions can be used to deduce the configuration of the parent or the daughter level, if the configuration of the other is known.

11. For magnetic moments, the extreme rarity of pure single–particle states and observation of large deviations from free–nucleon g–factors in nuclei means that comparison between the experiment and the 'Schmidt Limit' estimates (based on such pure states) is not a sound basis for spin or parity assignment. The magnetic moments or g–factors, however, can give supporting evidence for assignments where predictions for possible alternatives, using g–factors based on local systematics of measured moments, differ widely.

For excited states, the 'collective' aspects of the state frequently make substantial contribution to the magnetic moment. The correct g–factor for this contribution is a matter of detailed theory and any assignment based on assumed g(collective)=Z/A must be viewed with caution.

CONVENTIONS USED IN NUCLEAR DATA SHEETS

Units

Energies	keV
Cross Sections	barns
Magnetic dipole moments	nuclear magnetons (μ_N)
Electric quadrupole moments	barns
B(EL)	e^2b^L
B(ML)	$\mu_N^2 b^{L-1}$

Uncertainties ("Errors") The uncertainty in any number is given one space after the number itself:

4.623 *3*	means 4.623 ±0.003
4.6 h *12*	means 4.6 ±1.2 h
5.4×10^3 *2*	means 5400 ±200
4.2 +*8*−*10*	means $4.2^{+0.8}_{-1.0}$
−4.2 +*8*−*10*	means $-(4.2\ +10-8)=-4.2^{+0.8}_{-1.0}$

? Question Mark given after a quantity often indicates doubt as to the existence or the value of the quantity. For example, a "?" given after the $T_{1/2}$ value indicates that the assignment of that half−life to the associated level is not certain.

( ) Parentheses have the following interpretation for different quantities in the tabular data:

Quantity	Meaning of parentheses
J^π	J^π based upon weak arguments. See SUMMARY OF BASES FOR SPIN AND PARITY ASSIGNMENTS.
L transfer or Mult.	Possible value but not definitely established experimentally.
Other	Value deduced (*i.e.*, is not directly measured) or taken from other sources.

Examples:

$J^\pi=(1/2,3/2)^-$

Weak arguments limit the spin to 1/2 or 3/2. Strong arguments indicate negative parity.

$J^\pi=4^{(+)}$

Strong arguments show the spin is 4; weak arguments suggest positive parity.

L=(3)

L value tentatively established as 3.

Mult.=(M1)

Radiation character tentatively established as M1.

Mult.=M1(+E2)

Radiation character includes E2 with a mixing ratio, |δ|, that may be >0.

[ ] Brackets

$7/2^-$[514] Nilsson asymptotic quantum numbers, $K^\pi[N\ n_z\ \Lambda]$

Assumed quantity, *e.g.*, [M1+E2]

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Nuclear Data Sheets Symbols and Abbreviations

A	mass number*, A=Z+N
A_2, A_4	coefficients of Legendre polynomials in angular-correlation or angular-distribution measurement
av	average
B(EL), B(ML)	reduced EL, ML transition probability in $e^2\times(\text{barn})^L$, $\mu_N^2\times(\text{barn})^{L-1}$
calc, CA	calculated, calculation
CCBA	coupled-channel Born approximation
ce	conversion electron
chem	chemical separation
circ	circular
c.m.	center of mass
coef	coefficient
coin	coincidence
Coul. ex.	Coulomb excitation
CP	circular polarization
cryst	crystal-diffraction spectrometer
C^2S, C^2S'	one-nucleon spectroscopic strength for pickup, stripping reactions
d	day
D	dipole
DSA	Doppler shift attenuation
DWBA	distorted-wave Born approximation
DWIA	distorted-wave impulse approximation
E	energy
E(ε)	energy of electron-capture transition (endpoint of γ-continuum + K-electron separation energy of daughter)
E1, E2, EL	electric dipole, quadrupole, 2^L-pole
excit	excitation function
expt	experiment, experimental
F	fission
F-K	Fermi-Kurie (plot)
FWHM	energy resolution, full width at half maximum
g	gyromagnetic ratio*
GDR	giant dipole resonance
GQR	giant quadrupole resonance
g.s.	ground state
h	hour
H	magnetic field
HF	hindrance factor
hfs	hyperfine structure
HI	heavy ion
I	intensity
IAR	isobaric analog resonance
IAS	isobaric analog state
IBS	internal bremsstrahlung spectrum
IMPAC	ion implantation perturbed angular correlation technique
inel	inelastic
ion chem	chemical separation by ion exchange
IT	isomeric transition
J	total angular momentum quantum number*
K	projection of nuclear angular momentum J on nuclear symmetry axis
K, L, M	K-, L-, M-shell internal conversion
K/L	K-, L-conversion electron ratio
L	(1)orbital angular momentum quantum number*, (2)multipolarity
L(n), L(p)	L-transfer in neutron, proton transfer reaction
min	minute
M+	M+N+O+...
M1, M2, ML	magnetic dipole, quadrupole, 2^L-pole
mag spect	magnetic spectrometer
max	maximum
Moss	Mossbauer effect
ms	(1)mass spectrometer, (2)millisecond
mult	multipolarity/character
N	neutron number*, N=A-Z
NMR, NQR	nuclear magnetic, quadrupole resonance
norm	normalization
PAC	perturbed angular correlation
pc	proportional counter
p,γ(θ)	angular distribution of γ-rays with respect to a proton beam
p,γ(t)	time distribution of photons with respect to a pulsed proton beam
pol	polarized, polarization
priv comm	private communication
PWBA	plane-wave Born approximation
Q	(1)reaction energy*, (2)disintegration energy*, (3)quadrupole moment*, in units of barns, (4)quadrupole
Q(ε)	total disintegration energy in ε decay
Q(β−)	total disintegration energy in β− decay
Q(α)	total disintegration energy in α decay, E(α) + E(recoil)
R	$r_oA^{1/3}$, nuclear radius*
RDM	recoil distance measurement
RUL	recommended upper limit for γ-ray strength
rel	relative
res	resonance
s	second
S	spectroscopic factor
S'	$[(2J_f+1)/(2J_i+1)]S$
S(n) or S_n, S(p) or S_p	energy necessary to separate a neutron, proton from nucleus
scatt	scattering
scin	scintillation counter
semi	semiconductor detector
SF	spontaneous fission
spall	spallation
sr	steradian
syst, SY	systematics
t	triton
T	(1)isobaric spin, (2)temperature
Tz	Z-Component of isobaric spin, (N-Z)/2
$T_{1/2}$	half-life*
th	thermal
thresh	threshold
tof	time-of-flight measurement
vib	vibrational
W.u.	Weisskopf single-particle transition speed
y	year
Z	atomic number*, Z=A-N
α	total γ-ray internal conversion coefficient N(ce)/N(γ)*
α(K), α(L)	γ-ray internal conversion coefficient for electrons ejected from the K-, L-shell
αγ, βγ, γγ	coincidences of α's and γs, β's and γs, γs and γs
αγ(θ,H,t), βγ(θ,H,t), γγ(θ,H,t)	αγ-, βγ-, γγ-coincidences as function of angle, magnetic field, time
β_2, β_3, βL	quadrupole, octupole, 2^L-pole nuclear deformation parameter
βγ(pol), γγ(pol)	polarization correlation of γs in coincidence with β's,γs
Γ, Γ(γ), Γ(n)	level width*, partial width for γ-, n-emission
γ(θ,H,T)	γ-intensity as function of angle, magnetic field, temperature
$\gamma^\pm$	annihilation radiation
δ	ratio of reduced matrix elements of (L+1)- to L-pole radiation with sign convention of Krane and Steffen, Phys.Rev. C2, 724 (1970)
ε	electron capture
εK, εL, εM	electron capture from K-, L-, M-shell
ε(γ)B(E2), ε(ce)B(E2)	partial B(E2) for photon, conversion electron detection
θ	indicates angular dependence
λ	(1)projection of particle angular momentum on nuclear symmetry axis, (2)radiation type, e.g., M1, M2...
μ	magnetic moment of particle*, given in nuclear magnetons (μ_n)
ν	neutron shell-model configuration
π	parity, proton shell-model configuration
σ	cross section*
Σ(γγ)	coincidence summing of γ-rays
ω(K), ω(L)	K, average-L fluorescence yield
%α	percent α branching from level
%β−	percent β− branching from level
%β+	percent β+ branching from level
%ε	percent ε branching from level
%IT	percent (γ+ce) branching from level
%SF	percent spontaneous fission from level
$\langle r^2\rangle$	root-mean-square of nuclear radius

Prefixes*

T	tera	$(=10^{12})$	m	milli	$(=10^{-3})$
G	giga	$(=10^{9})$	μ	micro	$(=10^{-6})$
M	mega	$(=10^{6})$	n	nano	$(=10^{-9})$
k	kilo	$(=10^{3})$	p	pico	$(=10^{-12})$
c	centi	$(=10^{-2})$	f	femto	$(=10^{-15})$
			a	atto	$(=10^{-18})$

Symbols for Particles and Quanta*

n	neutron	π	pion
p	proton	μ	muon
d	deuteron	e	electron
t	triton	ν	neutrino
α	α-particle	γ	photon

* Recommended by Commission on Symbols, Units, and Nomenclature of International Union of Pure and Applied Physics