Guidelines for Evaluators

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Source Datasets (Decay and Reaction)

A. Extraction of Data

1. In any experiment, the author's basic measured quantities should be quoted as given, unless these data can be converted, by applying known numerical factors, from the authors' units, to units used by convention in ENSDF. Examples would be converting mean-life to half-life, or BE2(sp) to BE2↑.

   Quote what was actually measured in an experiment and not what the author quotes, in cases where these are different.

   Example 1: A measurement of Iγ/ΣIβ might be quoted by an author as Iβ(gs), which, for the author's decay scheme should be equivalent to the absolute Iγ determination, but is not as fundamental a quantity. If the decay scheme is changed, the Iβ(gs) could change, whereas the absolute Iγ measurement would still be valid. **This distinction is an important one, and failure to make it is a particularly common source of confusion when normalization conditions are being stated.**

   Example 2: A measurement of Iγ±/Iγ might be quoted by an author as $I\beta^+/I\gamma$. The ratio should be expressed in terms of the annihilation radiation since $I\beta^+/I\gamma$ could imply that the positron spectrum was measured.

   Example 3: As discussed in the section on (γ,γ') below, the quantity usually measured is $gW(\theta)\Gamma(\gamma_0)^2/\Gamma$. An author may quote a deduced value of Γ based on their assumption or measurement of the branching ratio, $\Gamma(\gamma_0)/\Gamma$. If possible, the value of $gW(\theta)\Gamma(\gamma_0)^2/\Gamma$ that the authors measured should be "reconstructed" and given, since your adopted branching may differ from what the authors used. Note that the authors may also have used a different value of J in their analysis.

   Example 4: From angular distribution and angular correlation experiments, the resulting γ character can be determined only as D, Q, D+Q, etc., Authors sometimes convert these to (M1), (E1), etc. based just on their proposed level scheme. It is important to retain the D, Q etc., assignment in these source datasets. Note that for Jπ assignments, the argument mult=D is strong, whereas mult=(M1) is weak. Sometimes mult=D is sufficient as part of an argument and this is one reason why it is important to keep track of what was actually experimentally determined. If the source dataset also has measured halflives that allow mult=M2 to be ruled out from RUL, then the assignment Q=E2 can be made in that dataset.

2. Document any and all changes made in data quoted from an author. When correcting an author's value for a quantity, for example a misprint in Eγ, give the corrected value in the appropriate field and mention the uncorrected value in a comment. **Do not give the uncorrected value in the E field and rely on the comment to explain what the correct**

value is.

3. When extracting data from an author's paper, note any assumptions, standards, or constants that enter into derived values, and correct the values for any changes in the assumed quantities.

Example: An Iε/Iα decay branching ratio for a gs or ms state decay for one nuclide might depend on the value assumed for a daughter nuclide, or a conversion coefficient might be given relative to a standard value. Such data should be presented in such a way that the effect of changes in any of the assumed values is clearly displayed; thus, comments such as "Iε/Iα=X if Iε/Iα(α daughter)=Y", or α(K)=A if α(K)(standard)=B" would be appropriate.

4. Check the bibliography in each article against the reference list provided by BNL. This is a valuable cross-check to help ensure that references have not been overlooked. Also, authors will sometimes quote data received as private communications. These data should be tracked down if possible if they seem important.

5. Do not rely on an author to extract older data correctly. Even if an author collects such data in a table, the original article should be checked. This is especially important in view of point 3. above.

6. Be sure to distinguish between values measured by an author and those assumed by the author based on data from other works. Such distinctions should be noted.

Example 1: In a transfer reaction, an author might adopt L values for some levels based on known Jπ values or on L values determined by other authors, in order to determine σ(θ) as a function of L so that L values for other levels can be deduced.

Example 2: In determining Eγ or E(level) values, an author might adopt values from other works as internal calibration standards.

B. Manipulation and presentation of Data

1. Comments

There are several types of comment formats differing in how they appear in the presentation. All require a "C" in column 7.

a) No entry in column 8. These comments appear at the head of a dataset immediately following the ID record.

b) A record type (RTYPE) such as "L", "G", or "B" etc. in column 8, with no further modifier in column10.... These comments appear at the head of the respective level,

gamma, or beta etc. listing.

c) Same as b) but with a data type (SYM) modifier such as “E”, “RI”, “L”, etc. in column 10....

1) If entered at the head of a dataset, the comment appears as a footnote on the respective column headings in the data listing defined by the content of column 8.
2) If entered within a data listing the comment appears in the Comments column on the same line as the quantity being commented on.

d) Same as b) but with a flagged modifier in column 10..., such as “E(A)$, RI(A)$, L(A)$. By using a “FLAG=A” continuation record on a specific data entry within the data listing, a footnote symbol is attached to the entry and the corresponding comment appears as a footnote. An alternative to a continuation record is to put the flag symbol in column 77.

The use of the flagged comment format is recommended whenever the same comment applies to many data entries, especially if the comment is involved. This avoids having the Comments column filled with many appearances of the same comment

See the ENSDF manual for a more complete discussion of the formats for Comments.

Example 1: Comments on γγ(θ), γ (t), γ(θ), γ(θ,H,T) etc. in a given dataset should normally be given with the levels rather than with gammas since it is usually under the levels listing that one wants to see comments on the values of J, T½ , or μ, etc., deduced in that data set from measurements of these types. If the γγ(θ) or γ(θ) data also yield δ values, then in the gamma listing one can simply state “See the levels listing for details”. That said, with proper cross referencing either location is acceptable. Of course if just δ values are deduced, all the data should be given with the gamma listing.

Example 2: For reaction datasets, comments of the type 1. a) should include, for each keynumber, the bombarding energy and energy resolution where given by the authors or as estimated by the evaluator from the authors’ spectrum. Note that it is not recommended to put the bombarding energy on the ID record unless needed to distinguish otherwise identical dataset ID’s such as E=th and E=res for (n,γ). Other information, such as angular range for σ(θ) measurements might be included since, for example, small angles are often needed to establish L=0 transfers and the angular range studied might lead to a preference of one reference over another in cases of discrepancies. For grouped reactions, such as (HI,xnγ), the particle beam would need to be added, and for Coulomb Excitation the distinction between particle detection, (x,x’) and gamma detection, (x,x’γ) should be made. Except for even-even targets, Jπ(target) should be given. References listed as “Others:” do not need detailed information. For readability, it is recommended that each keynumber be given on a separate line rather than running them together across the page. The following are examples.

^{207}Pb(d,p),(pol d,p)

Jπ(target)=1/2-
2001Va04 E(d), E(pol d)=22 MeV, FWHM=5-6 keV
2006He21 E=22 MeV, FWHM=3 keV
Others: 1962Mu05, 1967Ba41, 1968Do04

Coulomb Excitation

1969Ba51 (x,x') x=α, E=17-19 MeV; x=^{16}O, E=69 MeV
1972Ha59 (x,x'γ) x=α E=15, 18 MeV

Example 3: For decay datasets, there should be a comment explaining which references have contributed to the scheme is being adopted. This comment could be of the type a) or b). In the latter case it should appear with the levels.

For the β listing, there should be a comment stating how the Iβ were obtained. This is usually "From an intensity balance at each level".

For the gamma listing, there should be comments stating how the normalization was obtained, and whose Eγ and Iγ data are being adopted. For Eγ and Iγ, comments of the type "From 1992Fe01" or "From 1992Fe01 except where noted otherwise", or "Weighted average of 1992Fe01, 1990Ka22, and 1975Gu03" will usually cover most cases. Sources for other properties, such as mults, should be specified.

2. Combining Datasets

It is sometimes convenient to combine two or more different reactions in a single dataset. This is useful when the reactions are similar in nature and where data in the reactions are sparse, or where one reaction is very complete with little information in the others. The following are two examples.

a) Inelastic scattering experiments, (p,p'), (d,d'), (α,α') etc. can sometimes be combined into a single dataset as (x,x'). If this is done, then of course it is important to specify in which reaction a property such as L or S was determined. The following example compresses 10 separate datasets into one . See the 2013 version of the A=152 mass chain for details of data presentation.

^{152}Sm(x,x')

x=n:
1985Fe04: E=2.47, 2.75 MeV, σ(θ); coupled channel analysis; levels 122, 366, 1086
x=e:
1988Ph01: E=251, 500 MeV, σ(E,θ): levels 122, 366, 707
x=p, pol p:
1993Pe01: E(pol p)=20.4 MeV, σ(θ), analyzing power; levels 0, 122, 366, 709, 963,
1989Ob02: E=24 MeV, FWHM=18 keV, σ(θ); levels 0, 122, 366, 707
x=d, pol d:
etc.

The notation for inelastic scattering, (x,x'), includes the case of elastic scattering, so there is usually no need for a separate (x,x) dataset. One exception is the case of resonance work, where information on resonances in the compound nucleus can be obtained and may be of importance (see F. below). Information on nuclear shapes and charge densities, etc., deduced from elastic scattering can be given, or referred to, in adopted levels without the need for an (x,x) source data set.

b) In a similar fashion to inelastic scattering in a), heavy ion in-beam reactions can sometimes be combined into a single dataset as (HI,xnγ). Since Iγ data from different in-beam reactions can be combined only via branching ratios, if there are several sets of fairly complete relative intensities, it is best to create separate datasets for those reactions. In this regard, note that one can relabel the TI column as Iγ, which allows for inclusion of two sets of relative Iγ values or of branching ratios, or one of each, within a single dataset.

3. Sources of data

The sources of data for all headings, for example E(level), Iγ , δ, L, S, T½ should be given, unless there is only one reference for the dataset. This single reference can be given with the ID record and/or a comment can be given stating “All data are from ...”. Keep in mind that all the data presented should be readily traceable to their source. When more than one keynumber is included on an ID record or in the heading comments, it is important to state from which keynumber the individual pieces of data are taken. If a reader wants to check an Eγ, an Iγ , or a δ, for example, that reader should be able to go directly to the relevant reference, or references.

4. Placement of gamma records

For consistency in presenting drawings (and for convenience in reading data bank listings) gammas should be placed in order of increasing energy following each level. This same order should be followed in the unplaced gammas listing. Note that Format check will warn you if gammas are out of order, but this is not considered a fatal error.

5. Significant digits

When converting values from one set of "units" to another, for example, halflife to mean-life, or renormalizing Iγ values, enough digits should be retained so that the inverse operation will reproduce the original values. Note that in some cases this will result in more digits being quoted in the converted value than in the original value. Another way of stating this principle is that the fractional uncertainty in the original value should be preserved (to the same number of significant digits) in the converted value. This procedure is especially important when dealing with quantities determined with fairly high precision.

Example 1: From BE2=0.384 *4* one should report T½=7.27 ps *8*, not 7.3 ps *1*, and from τ=32 ps 1, one should report T½=22.2 ps *7*, not 22 ps *1*.

Example 2: Note that it is not always necessary to renormalize data, for example to renormalize an authors data to give Iγ=100 for the strongest transition. Such renormalizations may be useful when averaging two or more sets of values, but consider a case where there is just one set of values and where the authors do not assign Iγ =100 to any of the transitions. Assume that they have assigned Iγ=90 *3* to the strongest transition. A renormalization to 100 gives Iγ=100.0 *33* and creates a problem with the roundoff. Choosing Iγ=100 *3* or 100 *4* both slightly change the authors fractional uncertainty. If these data are then used in adopted gammas, there will be an additional renormalization involved in getting branching ratios and a probable further change from the original fractional uncertainties. It is advisable to keep renormalizations to a minimum.

6. Data roundoff

a) Our present suggested upper limit for rounding off uncertainties is “25". There are cases where this cutoff should be increased.

Example 1: When two or more values are being averaged, and the uncertainties are comparable, with some just above the cutoff of “25", then it is recommended to take the average before rounding off the values with uncertainties >25. Consider two values of a quantity reported as 3.20 *25* and 3.52 *26*. A weighted average gives 3.35 *18*. If the second values is rounded off to 3.5 *4* before taking the average, one gets 3.32 *19*. The two averages are consistent, but the first gives a better representation of the relative weights.

b) **Example 2:** When the fractional uncertainty is large, retaining uncertainties *>25* may be justified. A value of 5.8 *27* for some quantity should be kept rather than rounding off to 6 *3*.

c) **Example 3**: When the uncertainty on a value gives a lower limit close to zero, a roundoff may by misleading. A value for some quantity of 3.2 *27* does not overlap zero, whereas a rounded-off value of 3 *3* allows for the quantity to be zero.

7. Multiplets

a) In a reaction spectrum, unless a complex peak is resolved in a given experiment, just one "level" entry should be made. For example, in the case of a peak suspected, on the basis of work from other experiments, of being made up of two levels with J =a and J =b, respectively, a single level with "J =a and b" in the J field should be introduced. The inclusion in this data set of two levels would involve making an explicit assumption that is not necessary. The probable level association can be adequately explained in a comment.

When stating that a peak is a multiplet, the basis for this claim should be given. In this connection it is important to distinguish between experimental arguments such as "peak is broad", and theoretical arguments such as "C^2S is too large for a single level on the basis of shell model expectations".

b) In a gamma spectrum, a multiply placed transition seen as a single peak in the spectrum should appear in the output as one transition with multiple placements. Do not “resolve” such peaks by introducing additional transitions with energies taken from the level scheme.

When stating that a gamma transition is a multiplet, the basis for this claim should be given. For example, the gamma peak might be broad, coincidence data might suggest that a peak is a multiplet or a comparison of Iγ branching with other transitions from the same level as determined in other datasets might suggest a multiplet.

Note: If the intensity of a gamma multiplet cannot be divided among the several placements, then the full intensity, with uncertainty, should be given for each placement, along with a "&" in column 77. Do not enter the intensities as limits in source data sets (the converse is true in adopted gammas, where multiply-placed Iγ values should be entered as upper limits. See Note under **E. 2.** in **GUIDELINES FOR ADOPTED LEVELS.**

If the intensity of the multiplet can be divided, for example on the basis of γγ or from branching ratios in other datasets, then a "@" should be entered in column 77. Appropriate comments, such as “From γγ” and “From Iγ (γ_1)/Iγ (γ_2) in β- decay", should be given, and a "@" should be entered in column 77.

The entries “&” and “@” will automatically generate footnotes explaining that the transitions are multiply placed and that the intensities are not divided (for "&"), or are suitably divided (for "@").

c) A multipolarity determined for a multiplet will not necessarily be correct for each, or perhaps even any, member of the multiplet. For example, depending on the relative strengths of the components, the I(γ) and I(cek) for a doublet consisting of an El and Ml component could yield mult=E2. The mult deduced for the doublet should be given in a comment, but should not be entered in the mult field of the individual components, unless additional information is available that justifies the assignments.

Note: In a case where the I(γ) but not the I(cek) (or vice-versa) is resolved, and the multipolarity of one component of a doublet is known from other sources, it may be possible to deduce the multipolarity for the other component.

8. (γ,γ') experiments

The most common type of measurement in these experiments is scattering, which, for the case of photons scattered elastically from a thin target, yields the quantity $gW(\theta)\Gamma(\gamma_0)^2/\Gamma$. This is what most authors quote. Here, $g=(2J+1)/(2J_0+1)$, with J=γ-resonance level spin, J_0=gs spin, and W is the usual angular correlation function (See note 1). In this type of experiment. the quantity $gW\Gamma(\gamma_0)^2/\Gamma$, or just $\Gamma(\gamma_0)^2/\Gamma$, if J and W are known, should be given. If the branching

$\Gamma(\gamma_0)/\Gamma = I\gamma(\gamma_0)/\Sigma(I(\gamma+ce)$ is known, the level width (or T½) should be deduced. **The branching used should be the adopted value**.

> **Note 1:** Measurements are usually done at 127° where W=1 for all dipole transitions. independent of J_0, J. or Ji. ($P_2(\theta)=0$ at this angle). For mixed transitions, W depends on the mixing ratio and on the J's.
>
> **Note 2:** Occasionally, self-absorption experiments are performed. These can yield the quantity $gW\Gamma(\gamma_0)/\Gamma$.
>
> **Note 3:** The quantity quantity $gW\Gamma(\gamma_0)^2/\Gamma$, with g and W taken out if known, can be given in the "S" field on the level record, with the field suitably relabelled (see G. 1. below). This procedure is convenient since it eliminates considerable typing work at the input stage. If given in units of milli-electron volts, be sure that the heading translates as "meV" and not "MeV".
>
> **Note 4:** If the branching, $\Gamma(\gamma_0)/\Gamma$, is measured, it can be given in the RI field for the relevant γ or as a comment on the corresponding level.
>
> **Note 5:** For inelastic scattering, the term $(\Gamma_0)^2$ in the numerator should be replaced by $\Gamma(\gamma_0)\Gamma(\gamma i)$, where (γi) refers to the deexciting transition to excited level "i". To extract the level width (or T½), in addition to the gs branching, the branching $I\gamma(\gamma\, i)/\Sigma(I(\gamma+ce)$ would be needed.

9. BEλ and βλ

In Coulomb excitation and (e,e'), where electromagnetic excitation probabilities can be determined, the quantities BE2, BE3, etc. , should be quoted on continuation level records. Data quoted as matrix elements should be converted to BE2 etc. The fact that a matrix element had been determined could be added as a comment. Note that $BE\lambda = (2Jo+I)^{-1} |<ME\lambda>|^2$, where $<ME\lambda>$ is the matrix element and J_0 is the target spin.

> **Note 1:** All BEλ data should be given with the levels. If an author gives BEλ (down) data with the gammas, these should be converted to BEλ(up) and given with the corresponding level. The appropriate place for BEλ (down) data is in adopted gammas where we give such values in single-particle units based on adopted T½, branching, etc., data.
>
> **Note 2:** It is not necessary to give T½ deduced from BE2 in the source dataset, but if done, then adopted values for Eγ, branching, etc. should be used. It is often more convenient to collect all T½ values in adopted levels in which case one can state "From BE2=... in Coulomb Excitation" for the value from that dataset.

In inelastic reactions other than those governed by the electromagnetic interaction, the appropriate interaction strengths to quote are the deformation parameters, βλ or βλR. Authors sometimes convert the deformation parameters to BEλ , but this is a model-dependent procedure

and, unless the authors quote only BEλ, the deformation parameters are what should be entered into ENSDF.

10. Isomeric decay and delayed gammas

When a level with a measurable lifetime has been produced and studied as a separate source, then an isomeric decay dataset for that parent level should be prepared. When delayed gammas are seen in an in-beam experiment, creating an isomeric decay dataset is sometimes a convenient way of presenting the delayed data, as discussed in b) below.

a) When in-beam experiments give data on prompt transitions and also on delayed transitions from, say level X, one way of presenting the data is to create two datasets, one labelled with the modifier "prompt gammas" and the other with the modifier "delayed gammas" where the data for decay of level X can be presented. For cases where there is more than one level whose delayed deexcitation has been observed, a separate "delayed gammas" dataset can be prepared for each such level. See the following comment.

b) An alternate mode of presentation for delayed gammas is to create an isomeric decay dataset for level X . This alternative is especially recommended if there is more than one source of data. In this case a single IT data set which combines the results from all the relevant reactions is preferable to creating several delayed-gammas data sets for the same level X from the several reactions.

Note: In cases where only a few pieces of data are presented from the delayed spectrum it may not be worthwhile to create a separate delayed or isomeric decay dataset. In such cases, mult or T½ etc.information can be included with the prompt data with appropriate comments. For example. "Mult: From α=... from an intensity balance in a delayed spectrum"

11. β^-, $\varepsilon+\beta^+$: Energies, Feedings and Logft

a) Measurements of E(β) or E(ε) should be given in comments rather than in the energy field. All of our programs deduce these energies based on the Q value and the level energies.

Note: If a new accurate measurement of E(β) or E(ε) appears in the literature and that value has not yet been included in the latest mass adjustment, then it should be compared with the input values in the mass adjustment. If it is of comparable accuracy, an attempt should be made to see if it alters significantly the value from the mass adjustment. If so, an updated Q value can be adopted. In this regard, correspondence with the atomic mass center is advised.

The β^- and $\varepsilon+\beta^+$ feedings usually come from intensity balances at each level, and the logft's are then calculated based on these feedings. Some special cases should be noted.

b) For transitions that are expected to be non-negligible, such as those for allowed or first-forbidden transitions, when the feedings are consistent with zero, the logft should be expressed as a lower limit.

Example 1: For a feeding of 3% *3*, the logft should be calculated for a feeding of 6% and expressed as a lower limit.

Example 2: For a feeding of -5% *7*, the logft should be calculated for a feeding of 2% and expressed as a lower limit.

c) When $\Delta J>2$, one expects logft$\geq$13. For such transitions any feeding that gives logft$\leq$ 13 should be set to zero with an appropriate comment since such feedings imply an error in the decay scheme. An exception to this policy of omitting "unphysical" branches occurs when the initial or final J is in question and it is not clear whether it is the J or the feeding that is in error. In such a case, the feeding should be shown with a "?", and the problem pointed out in a comment.

d) The summed feeding to two or more levels connected by γ transitions whose TI's are not known, or known only as a limit, can sometimes be determined even though the feeding cannot be divided among the levels. Such combined feedings should be given in a comment.

12. Normalization

The normalization condition should always be given. Be sure to account for all relevant normalization factors.

Note 1: If the normalization condition involves a measured quantity for which no uncertainty is quoted by the authors, for example, I(β^- gs)=30%, then the resulting NR should be given as approximate. If NR is given with no uncertainty, note that GTOL will generate level feedings, and MEDLIST will generate absolute intensities, that reflect only the uncertainties in the relative intensities. In the example given, if ΔI(β -) is assigned, the uncertainty can be explicitly added to the I(β -) in the listing, with an appropriate comment, or imply referred to in the normalization statement, for example "NR:...The evaluator has assigned an uncertainty of x% to the intensity of the gs β- branch in order to get an overall uncertainty for NR". The former approach is recommended. Note that when the gs branch has a small intensity, say a few percent, then even a large assigned uncertainty can result in a rather precise NR as calculated from TI(gs)=100-Iβ^-(gs).

Note 2: In a case where the Iγ in the RI field already include all the uncertainty appropriate for absolute intensities, such as when an author determines and quotes absolute values (including absolute uncertainties), then the NR and BR should introduce no additional uncertainty, that is, they should be given on the "N" record with no uncertainty (there is no requirement that the uncertainty in BR as given in adopted levels be carried over to the "N" record in a decay data set, although the value itself of course

must be the same).

13. Parent records

In the parent record, the fields where data are known should be filled in, and the data should be the same as in the adopted dataset for the parent. Comments on "P" record data, such as sources, are not needed unless the evaluator is modifying them or unless otherwise relevant to properties of the daughter. The appropriate place for comments on any of the quantities appearing on the "P" record is in the adopted data set for the parent nuclide.

14. Alpha Decay

a) If the energies of the daughter levels being fed are not known, the E(level)=O+X style should be used rather than listing the alphas as unplaced. With this procedure, relative level energies can be presented in the daughter-nucleus mass chain. Alternatively, a systematics level energy can be given (see C. c) below). Note that there is no such thing as an unplaced alpha, unless one is referring to an alpha whose parent assignment is uncertain.

b) The calibration standards used by an author should be checked for possible newer values and E(α)'s corrected accordingly. The evaluation by Rytz, 1991Ry01, is still a useful starting point for checking calibration standards.

c) Hindrance factors should be given where possible. See XXXX for a description of the procedure to follow to get the radius parameters needed for the hindrance factor calculations.

15. Halflives

For decay datasets, the adopted T½ should be entered for all levels. Values measured in an individual dataset should be given in a comment along with the method and the source.

Note: Footnotes on the T½ column can be used to cut down on repetition of the method/source requirement. For example, a footnote on the T½ column stating "T½ values given as comments are from γγ(t) (reference) except where noted otherwise", would be appropriate.

16. Miscellaneous

a) The symbol "/" should not be used when proportionality of more than two values is being expressed. The expression K/L/M is mathematically equivalent to KM/L, even though few readers would interpret it that way. Use ":" instead, thus K:L:M.

b) Do not replace numerical values with large uncertainties by approximate values.

Example: An "isomer" energy of 230 *300* allows for the possibility that the isomer may lie below the "ground state" (by 70 keV). If the energy is replaced by ≈230,the possibility of an isomer-ground state energy inversion will not be considered by most readers.

c) Try to resolve discrepancies. If they cannot be resolved, then at least state this fact.

Example: If δ=+0.38 *4*, say, is adopted for a certain transition, based on solid evidence, and a value δ=+1.2 *3* has been determined in one of the source data sets, then, if the reason for the discrepancy cannot be determined, the evaluator should at least comment on the discrepancy. This can be done with a comment in the source data set, where it could be pointed out that the value differs from the adopted value, or with a comment in adopted γ's, where the discrepant value could be mentioned. If the discrepancy is not pointed out, the reader might think that the discrepant value had been overlooked and might thus question the adopted value. If there were several such "discrepant" values in a certain data set, a general comment rather than a comment on each case could be given.

d) Use the word "uncertainty" rather than "error" to refer to what we call the standard deviation in a measured quantity. The word "error" should be reserved for mistakes, such as in the sentence "The authors apparently made an error when they ...".

e) Note that TI is translated as I(γ +ce), not I($\varepsilon+\beta^+$) even though the fields have the same name in ENSDF. When I($\varepsilon+\beta^+$) is what is meant, it must be spelled out.

f) A level designated as an isomer in one data set should be treated as an isomer in all data sets, that is, columns 78 and/or 79 should be filled in.

g) It is not necessary to comment on correction factors for a quantity when such correction factors are negligible relative to the uncertainty quoted for the quantity. For example, μ=+3.8 *5* does not require a comment stating "The diamagnetic correction has not been applied".

h) Do not use "CA" in the uncertainty field when a numeric uncertainty can be calculated.

Example: If Iγ is calculated from I(γ +ce) and α, the uncertainty in Iγ from the uncertainties in TI and α, not "CA", should be put in the uncertainty field.

i) When calculating or correcting quantities that depend on other properties, for example calculating a conversion coefficient which depend on Eγ and δ, calculating T½ from BE2 which depends on Eγ, branching, δ, and α, or calculating Γ from $\Gamma(\gamma_0)^2/\Gamma$ which depends on the gs γ branching ratio, adopted values of all relevant quantities should be used.

Example 1: For datasets with γ data, when α values are given, they should correspond to the adopted Eγ and δ values, even though Eγ and δ values may have been measured in that dataset. A comment on the heading of the α column should be given stating this fact. Alternately, this policy could be stated in a general statement in the Comments dataset at

the head of the mass chain.

Example 2: In a dataset in which BE2 has been measured, if T½ is deduced from that BE2 value it should be done using the adopted values for Eγ, γ branching, etc. Note, however, as mentioned in **Note 2** under **BEλ and βλ** above, that it is not necessary to convert BE2 to T½. in the source dataset.

j) When working with data in any dataset, a comparison with data in other datasets should be made.

Note 1: A γ might be multiply placed in dataset A but resolved in dataset B. The branchings from B can sometimes be used to divide intensities in A. This should be done whenever possible.

Note 2: It is recommended that Eγ and E(level) data in each dataset be checked against values for the same quantity obtained in other datasets. This cross checking will sometimes show that such data in one dataset are shifted relative to those in other datasets. In such a case a comment should be made pointing this out, and the shift should be taken into account in making level associations in adopted levels, and in arriving at adopted energies.

k) Measurements of $P_k\omega_k$ (=I(K x ray)) should be given. They can be entered on a continuation "E" record. These quantities are of direct interest to some researchers and of course they provide a direct measurement of the K x rays, either for branches to individual levels, or an average for the whole decay scheme, depending on the case. When possible, the $P_k\omega_k$ should be compared with the I(K x ray) as calculated by MEDLIST.

l) If numerical data are quoted in comments, the uncertainty should be included unless the value is being used only as a label, thus "T1/2: From BE2=0.240 *6*", or "μ : From g=1.62 *3* in (α,2nγ)". This is not to imply that the actual numerical value is needed in all cross references, but only that if quoted, the uncertainty should be included.

m) When changing the sign of a mixing ratio which has an asymmetric uncertainty, note that δ = A +a-b becomes δ = -A +b-a.

n) The ground state should be included in all data sets of the type (X,X'), that is, inelastic scattering.

o) It is recommended that cross sections, analyzing-power, and angular- distribution coefficients not be given explicitly. It is sufficient simply to mention that such measurements were made, in the context of justifying any conclusions based on such data. The conclusions themselves, of course, should be given.

Note: If an evaluator feels that the angular distribution coefficients do need to be given, then they should be given in the form A_2, A_4, not A_2/A_0 A_4/A_0. That is, we define the angular distribution function as $W(\theta)=1+A_2P_2(\cos\theta)+...$, not as $A_0+A_2P_2(\cos\theta)+...$

p) Separate data sets for experiments in which no specific level information is given, can be included at the evaluator's discretion if an experiment yields some useful information. Such a data set would consist only of comments. The following are examples:

^{208}Pb(e,F)

1976Dr01, 1977Ke11 E=28-44 MeV
1976Tu03 E=38-50 MeV
1976Dr01, 1977Ke11 determine level density parameters and fission barrier =27.6 MeV *5*. 1976Tu03 determine the fission barrier=23.6 MeV *15*

^{154}Sm(α,^{6}He) 1974BoZF,1974BoZN

E=50 MeV. Measured σ(^{6}He,θ)

^{68}Zn from ^{67}Zn(n,α)

For studies of the 67Zn(n,α) reaction and the parameters of the the resonances in the compound nuclide 68Zn, see 1978An01, 84Em01, and 1985Gl04.

q) In some cases the information contained in a data set could be included directly in adopted levels without the need for a separate dataset, for example where T½ for a single excited state was determined; however, unless a dataset is created for such a reaction, there is no convenient way to search and retrieve that reaction and thus to indicate to the reader that such a reaction was studied. If a reaction was studied but no "useful" information is available, then it would be appropriate to simply list the reaction under "Other reactions" in a comment in adopted levels.

C. Systematics

Use should be made of systematics whenever possible, the extent to which they can be applied in any given case being determined by how reliable they are for the mass region under consideration.. The evaluator is usually in a better position to know how and when to apply systematics of a given quantity than the typical reader who is generally looking at just one, or perhaps a few, mass chains at a time.

Note: The network evaluators already make extensive use of systematics. The strong arguments for J assignments which rely on logft's, the strong arguments for multipolarities which rely on RUL, and extrapolations from the measured data in the mass adjustment (which are in fact called systematics values) are perhaps the prime examples.

1. The gross beta decay T½(β-) and T½(ε+β+) estimates from, for example K. Takahashi, et

al., *Beta-Decay Half-lives Calculated on the Gross Theory*, *Atomic Data and Nuclear Data Tables* 12, 101 (1973) (1973Ta30), can be used to estimate β^- or $\varepsilon+\beta^+$ branching fractions. These halflife estimates are considered to be reliable to better than a factor of about 3; thus, while an estimate of % β^- ≈50, and thus branching for the alternate modes ≈50%, is perhaps of marginal usefulness, an estimate of % β^- ≈0.1 can be used to assign the alternate mode(s) as essentially 100% with a high degree of confidence.

Example: ^{106}Te has been observed to decay by a single α group to the gs of ^{102}Sn. T½=70 us 17 for this α branch. Decay via an $\varepsilon+\beta^+$ branch is also allowed but has not been observed so the $(\varepsilon+\beta^+)/\alpha$ branching is not known experimentally. From the graphs in 1973Ta30 one gets T½$(\varepsilon+\beta^+)$>0.1 s which leads to %$(\varepsilon+\beta^+)$<0.09. It is thus reasonable to adopt %α=100.

2. Systematics of alpha-decay hindrance factors can be used to deduce a variety of quantities depending on what is known about the decay branch. These quantities include Jπ and configurations, total alpha branching and branchings of individual groups, and the excitation energy of the level fed in the daughter nucleus. Each evaluator (or center) responsible for a mass region in which alpha decay occurs is encouraged to build up such a set of systematics. See M. R. Schmorak, *Systematics of Nuclear Level Properties in the Lead Region*, Nuclear Data Sheets 31, 283 (1980), and M. R. Schmorak, *α- Decay Hindrance Factors*, in the ENSDF procedures manual for a further discussion of these and other types of systematics.

   Example 1: For α-decay of an even-even parent, for which the gs branch is defined as having a hindrance factor HF=1, systematics for α decay to the first 2+ state leads to HF>1. For the case discussed in the **Example** in a) above, given E(2+)=1472 for ^{102}Sn, one gets %α<2×10^{-6} for a possible α branch to this state. It is thus safe to assign I(α)=100% to the observed α group.

   Example 2: Prior to 2002, for ^{110}Xe α decay, only Eα had been measured. From systematics of r_0 values, a partial T½ for α decay of ^{110}Xe is estimated to be T½(α)=0.06 s *+10-3*. From 1973Ta30 (see a) above) one estimates T½(β^+)=0.5 s +5-3. From these partial T½ values one gets %α=87 *+10-32* and %$(\varepsilon+\beta^+)$=13 *+32-10* and thus T½(^{110}Xe)=0.054 s *+84-28* (see 1998Ak04).

   Measured values for these quantities for ^{110}Xe from 2002 reported in the 2012 version of the Nuclear Data Sheets are T½=93 ms *3* and %α=87 *+10-32*. These measurements indicate the reliability of the interim values adopted based on systematics.

   Example 3: For ^{172}Os, measured values for %α were, prior to 2004, 1.0 *2* and 0.2 with no uncertainty. The smaller value gave an r_0 inconsistent with the value expected from systematics and consequently the larger value was adopted. In 2004 %α was remeasured as 1.4 3, confirming the interim choice adopted on the basis of r_0 systematics.

3. In cases where a certain pair of shell-model or Nilsson-model orbitals gives rise to the

appearance of isomeric states over a reasonably large mass range, the reduced transition probabilities for the isomeric transitions usually fall within a narrow range of values. Such values can be used to estimate properties for the "same" transition where one piece of information, such as T1/2, IT branching, or Eγ , is missing.

4. In cases where a ground-state β- or ε branch is not known and there is no other way to determine the intensity normalization for the γ's, if the change in Jπ is known, the systematic logft values can sometimes be invoked. Moreover, it might be possible to build up local systematics of logft values for similar transitions, that is, transitions involving the same configurations that give a more restrictive range of logft values..

Example 1: For the $\varepsilon+\beta^+$ decay of ^{152}Ho, the intensity of the gs transition has not been measured. The transition is 2^- to 0^+, which from $\log f^{1u}t>8.5$ gives $I(\varepsilon+\beta+)<15\%$, and thus $\Sigma I(\gamma+ce)>85\%$, or 92% *8*; however, there are three similar transitions in nearby nuclides with $\log f^{1u}t$ values ranging from 8.8 to 9.9. If one uses a lower limit of 8.8, one gets an expected gs branch of <7%. which gives a normalization condition $\Sigma I(\gamma+ce)>93\%$, or 96% *4*. The representation of the limit value as a value with an uncertainty is done here just for the purpose of getting a value for the normalization. A normalization given as a limit is of course essentially useless.

D. Uncertainties

1. Experimental uncertainties should be included whenever given by an author.

Note: If an author gives a general statement, you should state this and then also state how you interpret that statement. For example, an author might state that uncertainties in the Eγ values are 0.1 for the strong transitions increasing to 0.5 for the weak one. After looking at the range of Iγ values listed, and perhaps the spectrum if given, a comment such as "The authors state that the uncertainties in Eγ are 0.1 for strong transitions increasing to 0.5 for weak transitions. The evaluator has assigned 0.1 to transitions with Iγ >10, 0.3 to transitions with Iγ=5 to 10, and 0.5 to transitions with Iγ<5" would be appropriate. Of course an evaluator could choose to make finer divisions if he/she wished.

2. When experimental data are quoted without uncertainties, the evaluator should state explicitly that no uncertainties are given by the authors. In general, the evaluator should not take on the responsibility of adding them; however, an attempt should be made to contact the authors to see if uncertainties can be provided. If a paper is relatively recent, authors will usually respond to such requests. Some exceptions are given in the notes below.

In the case of datasets with γ's, keep in mind that GTOL assigns an uncertainty of 1 KeV to Eγ when no uncertainty is given on an Eγ entry, so even for an input dataset with no uncertainties on Eγ, the GTOL output will contain uncertainties on the output E(level) values. In such cases these uncertainties should be deleted, the energies should be

rounded off appropriately, and a footnote added that states something like "No uncertainties are available for the Eγ input. The E(level) values are from a least-squares fit to the Eγ data with the assumption that the uncertainties are the same for all the Eγ values".

Note 1: The intensity normalization of a decay scheme may sometimes involve a measurement quoted with no uncertainty. If that quantity is a β or ε feeding, it might be possible to invoke systematics to estimate a reasonable value for the quantity, as discussed above.

3. The weighted average program, GTOL, and all other analysis programs that calculate uncertainties when individual values with uncertainties are combined, treat the individual uncertainties as statistical in nature. When the uncertainties are known to have a significant systematic component, say due to a calibration uncertainty, the output from the above programs should be modified as necessary. In such cases the adopted uncertainty should be no smaller than the smallest of the input uncertainties.

   In particular, no result obtained from a weighted or unweighted average program or by any other method should be quoted with an uncertainty smaller than the uncertainty(ies) in the calibration standard(s) used to determine the input values.

4. All uncertainties in extracted data should be accounted for, either explicitly or in comments. In addition to the uncertainties quoted in tables, authors occasionally state in a comment that additional uncertainties should be added to get absolute values. These should be taken into consideration.

   Note 1: In the case of energies, authors sometimes quote their values relative to some standard, or a set of standards. In such cases the evaluator should check to see if those standards have changed, and if so, and if possible, the authors' values should be revised to reflect the change in the standards.

   In cases where the authors state that an addition x keV should be added in quadrature to the uncertainties quoted in their table, it is recommended that this fact be included just as a comment in the source dataset and not added explicitly to the values in the table; however, if a value from this dataset is to be used in adopted levels, either by itself or as one value in a weighted average, then the additional uncertainty should be included.

   Note 2: In the case of Iγ values, authors sometimes state that in addition to the values in their table, an additional x% should be added in quadrature to account for uncertainty in the efficiency calibration. This type of correction, which is independent of Eγ or Iγ, can best be incorporated in NR. Since transitions close in energy might be expected to have a common correction factor, intensity ratios can sometimes be deduced that are independent of x. The alternative approach to including x, namely including the x% explicitly in each Iγ not only entails more work at the input stage, but rules out the possibility of obtaining the more precise ratios, or at least requires "uncorrecting" the

relevant Iγ values. As for the Eγ case discussed in **Note 1**, if a value from this dataset is used in Adopted Gammas, the additional uncertainty should be included.

5. **Uncertainty in the internal conversion coefficients:** When BRICC is run on a dataset, no uncertainty is generated in the case of pure multipolarities; that is, the DCC field is blank, and no uncertainty should be added by the evaluator. All the analysis programs that involve α will assign an appropriate uncertainty to the theoretical values as part of the calculation. For mixed mults, BRICC generates an uncertainty corresponding to the mults and MR. The analysis programs do not add any additional uncertainty.

   Note 1: When a mult is determined by an experimental α value, that value is what should appear in the CC and DCC fields. Once mult and MR are determined and BRICC is rerun, the output α value might be slightly different due to roundoff. In such cases be sure to correct back to the input value.

   Note 2: When doing a calculation "by hand" that involves the internal conversion coefficient for a pure mult, the uncertainty in α should be included..

   > **Example 1:** When normalizing a decay scheme in which a single γ transition feeds the ground state so that Iγ(1+α)=100, the only uncertainty in the absolute intensity of Iγ will be from the uncertainty in α.
   >
   > **Example 2:** When deducing T½ from a measured value of BE2 α enters through the factor 1+α, and its uncertainty should be taken into account.

6. Uncertainties larger than 25 should, in general, be rounded off, and where feasible, data should be quoted in units such that this convention can be applied. For example, a measured value of T½=250 ps 50 could be given as 0.25 ns 5.

   Note 1: Quantities for which standard units are used should always be quoted in those units. For example, Eγ, Eα, and E(level) are always quoted in keV, so E(level)=2560 *250* should not be expressed as 2.56 MeV *25*, but rather as 2.56E+3 *25*. Note that ENSDF does not have standard units for level widths, even though these have units of energy. A convenient unit for Giant resonance widths is often MeV, and for level widths from (γ,γ') is often meV.

   Note 2: In general, the "25" roundoff recommendation applies to final values. Larger uncertainties should be kept for quantities appearing in intermediate steps in a calculation to avoid possible roundoff errors.

   > **Example:** in a weighted average it might be advisable to keep larger uncertainties for the individual values and just round off the average value itself.

E. Resonances

The following is the revised policy statement for inclusion of resonance data adopted by the USNDP at the US-DDP meeting in November, 2010

1. **Charged-particle resonances**.

In the source dataset the following quantities should be given as determined in that dataset:

a) Excitation energies in absolute values and not, for example, as S(p)+E(p).

b) Measured resonance energies in a comment record or in a re-labeled field. The coordinate system, lab or center of mass should be stated.

c) J, π, L

d) Total widths or T½

e) Partial widths in comment records or in re-labeled fields

f) Resonance strength in a comment record or in a re-labeled field.

g) Cross sections in comment records

h) Reaction Q value in a comment record.

i) Eγ

j) Iγ or branching ratios

k) Gamma-ray multipolarities, mixing ratios, coefficients for angular distribution, angular correlation, polarization, etc.,

2. **Neutron resonances:**
Average resonance neutron capture data should be given. Inclusion of other neutron resonance data is optional.

F. L Transfers

1. A brief comment on the method used for obtaining the L values should be given. It is important to distinguish between, for example, L values deduced from a DWBA analysis, and L values based on a comparison of σ(θ) with shapes for levels with known Jπ.

2. Parentheses should be used to denote questionable or uncertain values. Square brackets

can be used to indicate an assumed value, such as a value adopted by an experimenter (or by an evaluator) on the basis of known $\Delta J\pi$, or a value taken from other work. L values put in square brackets might be assignments assumed for the purpose of extracting S, or might denote values assumed in order to determine empirical angular distribution shapes for known levels so that L values for other levels can be determined.

Note: The L values should always be quoted as given by the author. The evaluator can then use his/her judgement as to their reliability when incorporating them into $J\pi$ assignments. For example, an author's L=2 which in the evaluator's judgement should be L=(2), should appear as L=2 in the source data set, but as L=(2) if used as a $J\pi$ argument. In such a case a comment is needed explaining that the evaluator feels that the L assignment is tentative. A comment of this type is best given as a footnote or comment in the source dataset rather than in Adopted Levels.

G. Spectroscopic Factors

1. The exact label for the quantity given should be defined by using the "LABEL=name" format described in the manual; thus, "LABEL=C^2S".

2. It is recommended that an explicit definition of S be given if there is any ambiguity about what is meant; thus "S is defined by $d\sigma/d\Omega$ (exp)=$NSd\sigma/d\Omega$ (DWBA) with N=..."

3. The method for obtaining the scale of S should be given. It is important to distinguish between absolute and relative values; thus, a comment such as "From DWBA", which implies that the values are "absolute" , or "From DWBA normalized to 3.0 for the 1430 level" for relative S values, should be given.

4. The shell-model (or other) orbital involved in the transfer should be specified if needed for the extraction of S.

   Note: This can usually be done with a general comment such as "L= l, 2, and 3, are assumed to be $p_{3/2}$, $d_{5/2}$, and $f_{5/2}$ except where noted otherwise". An alternative method is to fill in the J field for the relevant levels along with a comment such as "J : Value assumed by the authors for the extraction of S". The former approach is preferred when practical.

5. In cases where the J given by an author differs from the evaluator's adopted value, the S value, which may thus be incorrect, should not be entered in the S field but given only in a comment. The reason for recommending that the incorrect value be given at all, is that a knowledgeable reader can perhaps estimate from the value calculated for the incorrect orbital what the value for the correct orbital will be.

H. Spins and parities

1. **For decay data sets and reaction datasets with γ's**,
Jπ values from adopted levels should be given. The introductory section in the *Nuclear Data Sheets* publication states that this is our policy so there is no need to comment on it in individual cases. J and/or π values determined in such experiments should be given in comments. This is especially important if such values are used as part of the Jπ argument.

Example 1: Comments such as "γγ(θ) consistent with J=7/2, not consistent with J=5/2, or 9/2", "J=1 from γ(θ)", "Fed by primary γ from the J=1/2+ capturing state" are appropriate.

Example 2: If quoting values given by the authors, some justification is needed. For example, "From xxxxx based on γ(θ) and proposed band structure".

2. **For reaction data sets without γ or Jπ information**.
It is recommended that Jπ values, whether from adopted levels or from some other dataset, not be given, unless they are important in explaining some other aspect of the experiment. Some examples are given below.

Example 1: In a dataset where J has not been determined but where the J values used to extract C^2S factors are needed, it might be convenient to give the J values used to extract those factors in the J field rather than in a comment.

Example 2: In a dataset where J has not been determined but where the J values used to extract widths (via the factor g) are needed, it might be convenient to give the J values used to extract those factors in the J field rather than in a comment.

Example 3: In a dataset where Jπ has not been determined but where band structure has been proposed, it is usual to give Jπ in the J field in order to show that band structure.

3. **For reactions darasets without γ data but with Jπ informarion**.
The deduced Jπ values should be given in the J field along with a comment stating how they were determined.

Note 1: Jπ values that come directly from L values, such as J=L± ½ for single-particle transfer on an even-even nucleus, or L=J in (p,t) on an even-even target, are redundant, and should not be given. In such cases the L value is sufficient.

4 Arguments used in the Jπ assignments in adopted levels must be documented in the source data sets. The following are just a few examples.

	Jπ	Argument
a)	3/2-	L(d,p)=l gives 1/2-, 3/2-. 392γ to 5/2- is Ml

b) 1- Av. Res. (n,γ) gives 0-, 1-. γ to 0+

c) 3+ El γ to 2-. γγ(θ) consistent with J=3, not with J=1 or 2.

d) (5/2)+ L=2, C^2S in (d,p)

In a), the (d,p) data set should contain the L value referred to, with any explanation deemed necessary to justify or explain it. The adopted gammas data set should contain the justification for the Ml assignment to the 392γ .

In b), the Av. Res. (n,γ) data set should contain the value deduced in that data set, given in a comment.

In c), enough details on the γγ(θ) experiment should be given in the source data set to justify the conclusion. Briefly, this section should mention the assumptions, that is, what J's for other levels and what δ 's for relevant gammas in the cascade were adopted, and should clearly state which values of J are allowed and which are ruled out. In the above example, it is only necessary to state that γγ (θ) is consistent with J=3, and rules out J=l and 2. Note that unless J=1 and 2 are specifically ruled out, consistency with J=3 by itself adds nothing to the argument and one would be left with the assignment Jπ=1+,2+,3+.

In d), the (d,p) data set should contain the L and C^2S values for the level in question, along with a comment justifying the basis for the C^2S argument. For example, "$d_{3/2}$ strength exhausted by known 3/2+ levels. C^2S for the L=2, E=...level suggests $d_{5/2}$". Note that if C^2S were sufficiently large, the argument for ruling out J=3/2 might be considered strong, giving Jπ=5/2+.

I. Transition intensities

1. Iγ data should be given as relative values rather than as branching ratios whenever possible. If both relative Iγ and independently determined branching ratio values are available, both should be given. The branching ratios can be given in a re-labeled TI field.

   Note: If the TI field is already being used for I(γ+ce) data, then the branching ratios can be put in comments.

2. For reaction γ's, the projectile energy and the angle at which the quoted intensities were measured should be specified in footnotes on the column headings, unless such information is obvious from the keywords given in general comments.

   Note: Relative Iγ values measured under different experimental conditions, such as at a different bombarding energy or angle, should not be combined in the RI field except where an Iγ from level "X" can be deduced from its branching relative to other transitions from level "X".

3. Gamma intensities reported as upper limits are important data measurements and should be included. A comment to the effect that the transition was not seen could be included. An Iγ given by an author as "weak" should be so noted in a comment.

   Note 1: It is important to distinguish between the cases where Iγ is not given because it is weak and where it is not given because it is obscured by an impurity (and thus could be strong).

   Note 2: A value quoted by an author as <A±ΔA should be entered in the RI field as <A+ΔA along with a comment giving <A±ΔA .

4. Unless being used as a re-labeled field, the TI field should be used only if I(γ+ce), rather than Iγ, is the quantity measured or deduced. Two common cases where this occurs are where TI is deduced from intensity-balance arguments, or where TI is deduced by summing measured I(ce), such as for an E0 transition or for a low-energy highly converted transition.

   Note: When both Iγ and I(γ+ce) are known, then of course one should calculated α and deduce the mult. When TI is known but no Iγ is available, then if α is known, the corresponding Iγ should be calculated and entered into the Iγ field. The uncertainty given for this deduced Iγ should include that in both TI and α. A comment should then be given stating that the Iγ comes from TI and α.

   Note 1: An Iγ deduced from TI and α may be given in the RI field even when a direct measurement of Iγ is available if the evaluator concludes that the deduced value is more reliable and/or if of higher precision, than the measured value.

   Note 2: When TI, rather than Iγ, is the basic measured or deduced quantity, then the K/T etc., format on the continuation record should be used. K/T, for example, operates directly on TI to generate the cek intensity (via MEDLIST) and the resulting x ray intensities. Note that BRICC outputs K/T etc. if the TI field has an entry, so this caution applies only if the SG record is generated “by hand”. This format avoids including some uncertainties twice, since Iγ, if calculated from TI and α, will already have an uncertainty combined from these two quantities so that I(ceK), if calculated from Iγ and α(K) would double count a portion of the uncertainty.

5. Do not put TI values in the RI field, even if a comment is included to explain what is being done, and even if all the entries are TI values. It is especially important to avoid mixing RI and TI in the same field.

6. The RI (or TI) field should be left blank for a transition which deexcites an isomeric state in the daughter nucleus whose T1/2 value is such that the intensity is time-dependent. A comment should be included giving the % feeding of the isomer, and a comment is also needed explaining why the intensity is missing.

7. I(x ray) and I(γ±) data should be given as comments. It is recommended that they be given in the form I(x ray)/Iγi, where i is the transition to which the γ's are normalized. This procedure avoids the necessity of changing the comments if the Iγ are renormalized. It is recommended that the program MEDLIST be run to compare the measured x ray and Iγ intensities with those calculated on the basis of the adopted decay scheme. If the I(x ray))/Iγ or I(γ±)/Iγ measurements are needed to get the decay scheme normalization, note that MEDLIST can be used in an iterative fashion to deduce NR.

8. Internal conversion intensities are not needed and it is recommended that they not be given except in the following cases.
a) I(ce) ratios measured to a precision of better than about 3% should be included. At this level of precision it is useful to compare such values to the theoretical values.

b) Where no Iγ is given, or where the I(ce) are more precise, the I(ce) values should be quoted.

c) I(ce) are needed for E0 transitions, and should also be given for anomalously converted transitions.

9. For transitions whose intensity is given as an upper limit, the intensity, I<A should be converted to I=1/2A ± 1/2A for the purpose of calculating quantities that require the intensity of this transition, such as normalization factors, β^- and ε+β+ feedings, or branchings.

Note 1 : In a situation where Iβ-(gs) is determined to be <6%, and the evaluator has no further information to suggest, for example, that this value should be closer to 0 than to 6, the intensity should be expressed as 3% 3 for the purpose of obtaining the gamma intensity normalization. That is, one should set sum TI(gs)=97 3 and explain what is being done. This procedure is preferable to any of the alternatives, namely setting TI(gs)=l00, or TI(gs)>97. There is no justification for adopting the first alternative, and adopting the second alternative leads to lower limits being given for all the intensities. See the following note.

Note 2: The usefulness of the procedure described in **Note 1** depends of course on the value of the limit itself. If I(β-) is known only to be <50%, then perhaps it is not worthwhile normalizing the decay scheme, although setting sum TI(gs)=75% *25* is still perhaps better than doing nothing. If no normalization is adopted in this case, a comment could be given stating what the normalization factor would be for the extreme cases, namely for I β^- =0, and Iβ^- =50. The intensity of the gs β- group should still be given as a limit in the β- listing.

Note 3: Iγ values given as limits should be converted to 1/2Iγ± 1/2Iγ for the purpose of obtaining β- and/or ε feedings from intensity imbalances. GTOL treats limits in this fashion. This procedure may lead to some feedings with rather large uncertainties, but that correctly reflects the state of knowledge of the decay scheme..

10. For transitions whose placements are uncertain, that is, transitions with a "?" in column 80, Iγ should be handled in the same manner as for transitions given as limits discussed above. That is, Iγ=A ± ΔA should be taken as Iγ = ΔIγ = 1/2(A+ΔA). GTOL treats limits in this fashion.

J. Multipolarities, mixing ratios, conversion coefficients

1. For decay datasets, the multipolarity and δ entries (and thus α) should be adopted values. The inclusion of such data is mandatory. See also 9. below.

2. In reaction data sets, multipolarity, δ and α should be included only if needed or if measured.

3. In any data set in which multipolarity, δ, or α are determined, the bases for such determinations should be stated. The sources of mult data used by the evaluator, such as γ(θ), α_k(exp), should be specified. In the case of α_k(exp), the normalization used to put relative Iγ and I(ce_k) values on the same scale should be given. Normalizations used by authors may need to be revised if newer values for the standards they used become available. Multipolarity assignments from ce data should be those of the evaluator based on the output from BRICC. Multipolarities deduced by the authors (or by the evaluator) on the basis of γ(θ) to be "stretched" should be so noted. Comments such as "ΔJ=1 from γ(θ)", or "Stretched Q from γ(θ)" etc. are recommended.

4 Angular correlation or angular distribution data determine only the L component of the gamma character, thus mult=D, D+Q, etc. Further assumptions are needed to establish the change in π. These assumptions should be stated when D is converted to M1, or D+Q to M1+E2, etc. and it is recommended that this step be taken only in adopted gammas and only if needed. See the guidelines for Adopted Gammas for further discussion. If the polarization of a transition has been measured, then of course Δπ can be determined and mult= M1, E1, etc., as determined by the authors should be given.

Note 1: If T½ is known, RUL can sometimes be invoked to rule out a higher-L component, for example Q=M2, or D+Q=E1+M2 when δ is known. It is recommended that this step be taken only in adopted levels and not in the source dataset, unless needed for other purposes in that dataset. This policy is designed to preserve what was measured, or deduced from that measurement alone.

5. The entries in the mult, δ and α fields should be mutually consistent. In particular, the following guidelines should be followed.

a) If a single multipolarity is adopted, the MR field should be blank. If only an upper limit on δ is available, there are two options.

i) Give the dominant component in the M field, with corresponding α, and give

the δ limit in a comment.

ii) Give both components in the M field and give the δ limit in the MR field. In this case, α should be the value corresponding to 1/2 δ(max) with an uncertainty chosen to overlap the δ=0 to δ=δ(max) range.

Note: Option i) is recommended when, in the evaluator's judgement, the admixed component is likely to be smaller than the experimental limit; thus, for E2+M3 with δ<0.5, it is unlikely that an M3 component would compete so strongly with an E2, so mult should probably be entered as E2, with a comment stating "δ(M3/E2) < 0.5". Since E2 and M1 can compete strongly, MI+E2 with δ <0.5 should probably be retained as a mixed multipolarity entry.

b) Same as a) but with a lower limit on δ. In this case consistency with known Jπ values in the level scheme needs to be considered. Thus if mult=M1+E2 with δ>1.5 is deduced, but placement in the level scheme requires ΔJ=2, option i should be chosen. That is, mult should be adopted as E2 with the δ limit given in a comment.

c) If two multipolarities are given but no δ is known, the corresponding α value should be the value calculated as in 7. a) below.

d) If the mult field contains more than two multipolarities, for example, E1+M2+E3 or E0+MI+E2, the relevant mixing ratios should be given on continuation records, and CC should be calculated by hand. In the first case, BRICC will ignore the third component and if there is an entry in the MR field, BRICC will assume that quantity is the M2/E1 admixture. In all cases where there are more than two components in the mult field, the α will need to be calculated by hand.

e) If δ overlaps zero or infinity, the corresponding multipolarity component should be in parentheses.

6. The mixing ratio notation, MI+x%E2, occasionally used by authors should be converted to δ. In doing so be sure to use the constraint that the percentage of the two values must equal 100. Thus, M1 + 10±8% E2 gives δ^2=10/90 + 18/82 - 2/98 = 0.33 *+14-19*

7. The notation mult=M1,E2 is not the same as mult=M1+E2. The notation M1,E2 describes the case where the data are consistent with pure M1, pure E2, or a mixture. The notation M1+E2 describes the case where the data rule out pure M1 or pure E2. The designation M1(+E2) is an intermediate case where the experimental data overlap the M1 theory value but not the E2 theory value.

8 If αk, etc., data, or conclusions from such data, are given, the bases for the values used should be given. If from relative I(ce) and Iγ, the basis for the normalization of the relative scales should be stated. Be sure that the mult for any transition used in calibration is independently established.

9. In cases where Iγ is known and internal conversion is significant but the multipolarity is not known (apart from level scheme considerations), and TI is otherwise unobtainable and needed, the following procedures can be followed.

a) If ΔJ and Δπ are known, one can enter mult=[M1], [E1,M2], etc. , in the mult field and choose α accordingly. For mult=[MI,E2], for example, one should enter α =1/2[α(M1) + α (E2)] and Δα =|α - (M1)| = |α - (E2)|.

b) If ΔJ and/or Δπ are not known, one can still follow the procedure described in a) and set, for example, mult=[D,E2] (or mult=[E1,M1,E2]). Mult=M2 or higher are assumed here to be less probable, but of course could be included.

The usefulness of either a) or b) depends of course on the range of values for the quantity 1+α for the assumed multipolarities.

Note 1: If ΔJ=l, Δπ =no, then mult=[MI,E2] rather than mult=[M1] or mult=[E2] should be adopted*, unless there are good arguments for believing that one of the two possible multipole components dominates. α for mult= M1+E2 is always "correct", although it may have a large uncertainty, whereas (M1), for example, may lead to misleading conclusions. The possible large uncertainty in α when δ is not known, correctly reflects the state of knowledge concerning the total intensities.

* excluding the transitions J=0 to J=1 or 1/2 to 1/2 where E2 would be forbidden

Note 2: The use of the mult=[ ] convention in source datasets should be restricted to cases where the internal conversion is significant for the purpose at hand.

10. The experimental αk, etc., as well as ce ratios, that are used to determine multipolarities should be given. Note that values measured with a precision of better than about 3% as well as values for transitions within about 2 keV of the binding energy can be very useful in checking the validity of the BRICC code.

11. Note the distinction between ( ) and [ ] for multipolarities. These are discussed in the introductory material to the *Nuclear Data Sheets*. Parentheses are used when there are some experimental data, but the data are not conclusive. The square brackets are used to denote a value deduced solely from level scheme considerations.

Note: For the case where mult=D+Q is determined from angular correlation or angular distribution data, and the level scheme is used to assign M1+E2 rather than E1+M2, then the mult should be in parentheses, that is, mult=(M1+E2), with a comment stating something like "Mult: D+Q from γ(θ) in ... Δπ =no from the level scheme". Square brackets are not appropriate for this case, since the level scheme argument forms only part of the assignment.

11. Do not show α as a lower limit. This would result in TI=Iγ(l+α) appearing incorrectly as an indefinite quantity. This situation can arise for transitions that have an E0 component.

The basic data are usually a measured I(ce_k) and an upper limit on Iγ, say <X, which lead to α_k > I(ce_k)/X whixh leads to α >Y. TI=Iγ(1+α) then becomes <X(1+>Y). The recommended procedure for obtaining TI will depend on the relative magnitude of I(ce) and the Iγ limit. For I(ce)>>X, one should give TI=I(ce) + ½X with an uncertainty calculated in the usual way.. For X>>I(ce), TI<[X+I(ce)] is an appropriate choice. For the intermediate case, the first alternative is recommended

Note: For a transition adopted as pure E0, then of course TI=I(ce) and there will be no entry in the RI field.

12. Angular correlation and angular distribution data usually give two solutions for δ. Unless one of these solutions can be ruled out, both should be given in a comment and no entry should be given in the MR field.

Note: If neither solution overlaps zero or infinity, then the mult can be assigned as, say, D+Q; otherwise mult should be given as D,Q.

K. Gyromagnetic ratios, electric and magnetic moments

1. Values of the magnetic dipole moment, μ, and electric quadrupole moment, Q, should be taken from the evaluation 2011StZZ and entered directly into adopted levels. There is no need to repeat these values in source datasets. This includes, in the case of μ, the g factor from which it may have been deduced. Values of μ or Q that appear in the literature after the cutoff for values in 2011StZZ should be added.

Note 1: If the method of determining μ depends on T½, and if the value adopted by the evaluator differs from that used in 2011StZZ, then a correction should be made if possible. If the value cannot be readily corrected, then a comment should be included giving the T½ used in the evaluation.

Note 2: For new data, if the values are of comparable precision to those listed in 2011StZZ, it is recommended that the evaluator contact the author of 2011StZZ to see if intermediate recommendations are available.

2. g-factor data should be given in the appropriate source data sets with the corresponding value of μ, based on the adopted g factor, given in adopted levels. These values should be corrected, where necessary, for your adopted T1/2. When corrected, a comment such as "g: For T1/2=... The authors report g=... for T1/2=... ". A comment is also needed stating whether or not the diamagnetic and Knight-shift corrections have been applied (if the data are accurate enough to be affected by these corrections). This comment should be given both in the source data sets and in adopted levels.

Adopted Levels Datasets

A. General Guidelines

1. All distinct levels that are observed in any of the individual data sets, and that the evaluator feels are firmly established, should be included in adopted levels. Uncertain levels, that is, levels shown with a "?" in one or more of the individual data sets, can be included or not included at the evaluators discretion. Neutron and proton separation energies should not be included. Isobaric analog states (resonances) should be included.

   Note 1: To avoid the introduction of "extraneous" levels, the calibration and general trend of energies compared with adopted values should be checked for each data set. Systematic shifts of energies in one or more data sets should be corrected for when the energies from such data sets are used in obtaining the adopted value. This procedure will help avoid the incorrect association of a level in one reaction with a level in another reaction based only on the energy difference and will help to ensure that the energy adopted for a level seen in only one reaction is as correct as possible.

   Note 2: When levels from two (or more) reactions lie close in energy (that is, the values agree within the uncertainties) and the evaluator chooses to adopt both (or all) levels, the justification for assuming that the levels are distinct should be given, unless obvious from XREF or from other adopted level properties. Consider the following cases.

   a) E=5000 *10*, J =3/2+ and E=5010 *10*, J =5/2+ are known from reactions, and E=5005.3 *2* is known from a gamma reaction; however, it is not known to which of the two reaction levels this level corresponds and there is no evidence to suggest that it is a separate distinct level. The reaction levels should be adopted, with a comment on each stating that the more accurate value of 5005.32 *2* probably corresponds to one of the two adopted levels. Note that there is no unambiguous way to include the accurate energy as an adopted energy. The evaluator should not adopt three levels, unless there is definite evidence that the gamma-deduced level is distinct from the others.

   b) E-596.7 *5* with J =0+,1,2 and E-597.1 *3* with J =l+,2,3 are known to be different levels, and l(p,d)=2, leading to J =l-,2-,3- with E=598 *2* is also known. Unless there is evidence to suggest that the (p,d) level is distinct, only two levels should be adopted, with a comment on each stating that J =l-,2-,3- from l(p,d)=2, for one or both of the levels.

2. Make use of the XREF entries to avoid unnecessary comments

   Example 1: A comment such as "seen only in (d,p)" is not needed since XREF should already convey that information. An exception could arise, however, if the evaluator wishes to emphasize some doubt about the level.

Example 2: XREF can convey the "one level corresponds to many levels" situation so that comments that repeat only this information are not needed. Note, however, that comments such as "L(d,p)=l for E=3450", given for two or more adopted levels to which the (d,p) level could correspond, are still needed.

3. Important comments on level properties which appear in source data sets should be repeated in the adopted levels data sets. Comments such as "doublet", "possible contaminant", "not resolved from X", if important in a source data set, are usually just as important in adopted levels.

4. If the evaluator adopts a Q value, say Q-, that is different from the value given in the most recent mass adjustment, the mass adjustment value should be given in a comment for comparison. If the mass links are not too complicated, it may be possible to adjust the other entries on the Q record to reflect the change in the Q- value. If such is the case, and if the change in Q- is significant, that is, considerably outside the limits given by the mass adjustment, then giving the adjusted S(n), S(p), and Q(α) values would be a valuable contribution. Whether this is done or not, however, is left to the discretion of the evaluator.

   Note: In cases where it is not feasible to attempt a readjustment, a comparison between the mass adjustment value and the adopted value at least allows the reader to judge qualitatively what the effect on the other Q values may be.

5. BE2 and T½ should not both be given as adopted properties of a level. These are equivalent pieces of data (if all quantities needed to convert from one to the other are known), and our policy is to give T½ (See **note 1:** for an exception). The best BE2 value will then, by definition, be that deduced from the adopted T½ value and the adopted γ properties. We do not give this value explicitly.

   Note 1: BE2 should be given if T½ is not known and cannot be deduced from BE2, for example if the γ branching is not known.

   Note 2: If T½ and BE2 are both determined for a given level but the γ branching is not known independently, then T½ and BE2 can be combined to deduce the branching. T½ would be given and the deduced branchings would appear in adopted gammas.

6. When giving the source of a datum, include the name of the dataset. The data sources are much easier to locate with this information. The method and keynumber are optional except for adopted T½ values where the method should be given.

   Example 1: A T½ value extracted from BE2 should be stated as such, thus “T½: From BE2 in Coul. Ex.”.

B. Excitation energies

The introductory section to the Nuclear Data Sheets includes the statement "The excitation energies for levels connected by gamma transitions are taken from a least-squares fit to the adopted gamma energies". exceptions to this should be noted, but otherwise no comment is needed.

Other excitation energies are based on best values from all available reactions". For any adopted levels section for which this statement is appropriate, no further comment is needed. In cases where this statement may not be appropriate, then the evaluator should add a comment explaining the source for the excitation energies.

Uncertainties should be included where available. See **Uncertainties**, section **D** under **Decay and Reaction Datasets** above.

C. Spins and parities

1. Assignments should be based on the fewest and best arguments. There are two main advantages to this "fewest and best" approach. First, the Jπ arguments are easier to read and to follow when redundancy is eliminated. Second, alternate unneeded arguments can then be used to build up systematics.

   Example: Consider the assignment of 1+ to a level based on the arguments "M1 γ to 0+. Logft=4.4 from 0+". Either argument by itself is sufficient. If the multipolarity argument alone is used, the logft value is then "freed up" and can be added to the base of values from which the logft arguments are derived, thus helping to build up confidence in the application of such systematics to cases where other strong arguments are not available.

   Note: The above refers to strong arguments. For levels where only weak arguments are available, then the more arguments that can be given, the better the assignment becomes; however, remember that no combination of weak arguments constitutes a strong argument.

2. "Direct" measurements of J (atomic beam, etc.) should be referenced directly and the method should be stated, thus "atomic beam", "NMR". In many cases the reference 1976Fu06 is still a useful source. Note that these methods give J only. A separate argument is needed for π .

3. Arguments should be detailed enough to convince the ENSDF user that the assignments are reliable and also to allow the reader to judge what the consequences would be if new data were to become available. See also 4. below.

   Example 1: The argument "From (α,xn)" is not of much use. Statements such as "Excit.

in (α,xnγ)", and/or "γ(θ) in (α,xnγ)" are needed. See 5. below.

Example 2: Consider an argument for the assignment Jπ=2-,3- expressed as "L(d,p)=l gives 0- to 3-. γ to 4-". If the γ transition were to be subsequently determined as M1, it would follow immediately that Jπ would then be 3-. If the argument had been given only as a general statement such as "From L value in (d,p) and γ feeding", the consequences of the new piece of evidence would not be so transparent.

4. Gamma-decay arguments should be specific; thus "Ml γ to 2+", "γ 's to 3/2+,5/2+", etc. The gamma energy is optional, thus "326γ to 2+ is Ml", etc. and is of most use in complex level schemes where the level referred to as being fed may not be obvious. The vague statement "Jπ is based on γ-decay modes" is not of much use to the reader. Note that Jπ values and γ-ray multipolarities referred to in these comments should be adopted values; thus "Ml γ to (3/2+)", "(E2) γ to (4)-".

   Note: Include target/parent Jπ when the target is not even-even. For example, "logft=5.4 from 1/2+", or "L(p,t)=2 from 9/2+".

4. For arguments that are common to several levels, there are two approaches that avoid writing the same full argument for each relevant level.

   a) The argument can be written as a flagged footnote with the flag attached to the relevant levels. This approach improves readability and at the same time saves evaluators' input time. For example, the footnote could state "From (α,xnγ) based on excit. and γ(θ)", or "Member of band X based on energy fit and inertial parameter". The Jπ assignment would then be flagged with the appropriate footnote symbol.

   b) The argument can be put as a footnote on the Jπ heading itself. For example, such a footnote could state "Assignments from (α,nγ) are based on excit and γ(θ). Assignments from (d,p) are based on L values and analyzing power". Then for the relevant level one need state only "From (α,nγ)" or "From (d,p)". This option is particularly useful in cases where the argument is long.

5. Jπ arguments for two or more levels can be linked if they are interconnected in such a way that giving separate arguments for each level could be awkward, or could give the appearance of circularity.

   Example 1: Consider the the β- decay of a parent level with known Jπ=7- to a daughter level A followed by a γ cascade with known multipolarities from level A to levels B and C, specifically, 7-(β-)A(Ml)B(El)C(E2)2+. The argument "Logft=5.1 from 7- and the Ml-El-E2 γ cascade to 2+ uniquely establishes Jπ(A)=6-, Jπ(B)=5-, and Jπ(C)=4+". This argument can be given for one of the relevant levels, say C, and then for the others, one can simply say "Jπ: See C level".

6. An L=0 component in a particle transfer reaction in which S=0 can be assumed, leads to $\Delta J=0$, $\Delta\pi$ =no even if other L components are present. The same is true of an E0 component in a gamma transition.

7. $J\pi$ arguments for the ground state of an even-even nucleus are not needed.

8. Maintain consistency between source data and conclusions. For example, L(p,t)=2 (S=0 assumed) from an even-even target gives $J =2+$, not (2)+ or 2(+). That is, if the L value is considered to be a strong argument for J, then it is also a strong argument for π . Similarly, if the argument is not considered strong for J, then it should not be considered strong for π; thus, L(p,t)=(2) gives $J =(2+)$.

   Note: A reaction such as (α,d), with a measured L value, can of course be used as a strong argument for π, namely, $\pi=(-)^L$, even though J is determined only as J=L-l, L, or L+l.

9. Expressions such as "preferred", or 'consistent with" are not strong arguments. Avoid these expressions since they leave open the question of whether other alternative J values have been ruled out. These expressions are of course valid for weak arguments.

10. Configurations should be given, but note that "Conf=3/2[521]" is not a valid argument for $J\pi$. All that this argument accomplishes is to shift the burden of proof from establishing $J\pi=3/2-$ to establishing conf=3/2[521]. The configuration is usually deduced from $J\pi$, not vice-versa, although of course sometimes the reverse is true, and sometimes the same argument for $J\pi$ can be used to assign the configuration*.

    * A measured value of μ will sometimes determine both $J\pi$ and the configuration.

    Note: The determination of L and analyzing power in a transfer reaction might give $J\pi=1/2^-$, and it might be reasonable to assign this level as a $p_{1/2}$ orbital, but the $J\pi$ argument should be "From L and analyzing power in (d,p)", not "From conf=$p_{1/2}$". The configuration should be treated as a separate data type from $J\pi$ and put on a continuation record. Comments on "Conf" should also normally be treated separately from comments on $J\pi$.

    Note 2: In the deformed regions, the cross sections and cross section ratios, for example in (d,p) and (d,t), can often determine directly the combination $J\pi$K[ ], rather than just $J\pi$, for example, 5/2-3/2[521] , rather than just $J\pi =5/2-$ by itself. In such cases, the configuration should be included in the $J\pi$ argument.

11. Do not use multiply placed transitions in $J\pi$ arguments unless the connection with the level in question is definite.

    Note: A multipolarity determined for a multiplet will not necessarily be the correct multipolarity for each member of the multiplet. See B. 7. c) under **Source Datasets**

above. If part of the multiplet is definitely established as being connected with the level in question, then the Jπ of the level so connected can be used as a Jπ argument in the usual way, that is "γ to 3/2+" for example.

12. When the Jπ choices are limited to three or fewer, it is recommended that they be spelled out rather than given as a range; thus Jπ=5/2-,7/2-,9/2- rather than Jπ=5/2- to 7/2-. There is less chance of values being misinterpreted when they are written out completely.

    Note: In many cases, the extra space required (which is the only good argument for quoting J values as a range) is not significant.

13. RUL is an argument for multipolarity, not for Jπ.

14. For an unresolved doublet whose components have Jπ established, the Jπ entry should be of the form, for example, "Jπ=5/2+ and 7/2-", or Jπ=5/2+&7/2-. Do not use the form "Jπ=5/2+,7/2-", which indicates a single level with two possible assignments

D. Halflives

1. All comparably precise T½ values should be summarized here along with the source datasets from which they come. Details of the measurements are not needed since that information should appear in the source datasets.

3. All values should be given at the 1σ level. Authors measuring halflives sometimes quote uncertainties as 2σ or 3σ. These uncertainties need to be divided by 2 and by 3, respectively, before averaging with the other values.

E. Other Level Properties

1. When branching modes are given, for example "%IT=", the bases for the values can be given here or in the source data sets. There is no need to repeat the arguments, but they must appear in one place or the other. Also, all possible modes of decay should be accounted for, unless the reason for omitting a mode is obvious.
   Note: In a case, for example, where one has "%ε+% β+=99.0 *1*; %IT=1.0 *1*" but β- is also energetically allowed, there should be a comment explaining why the β- branch is considered negligible; thus, for example, "%β- is negligible since the only available decay branch has Δ J=2, Δπ =yes, for which, from $\log f^{1u} t > 8.5$, one derives % β-<1×10^{-4}". An experimentally determined limit of this magnitude should, of course, be included explicitly in the branching statement. For more obviously negligible branches such as for a case where the only available branch has ΔJ=4, one can state simply "ΔJ=4 for possible β- branch so % β- is negligible".

2. BEλ values should be included in adopted levels in cases where the T1/2 is not independently known and cannot be calculated from the BEλ

3, Sources of data should be stated unless obvious, that is, unless there is only one keynumber associated with the dataset. General comments are usually sufficient; thus, "From X unless noted otherwise" or "Weighted average of values from A, B, and C".

Adopted Gammas Datasets

A. General Guidelines

1. For gamma records, all available first-card data should be included. Continuation-record data generated from the conversion coefficient program are not needed and are removed at the NDS production state. They do not have to be removed “by hand”.

2. Discrepant data should not be adopted. The data chosen for adopted levels should be self consistent.

Example 1: If a gamma multipolarity disagrees with the adopted ΔJπ, and the Jπ are considered well established, the discrepant multipolarity should not be adopted, and the discrepancy should be pointed out in a comment. It is recommended that a flagged comment be used so that a footnote symbol will appear in the mult field.

B. Transition energies

1. Sources for all data should be stated. This can usually be done with a general statement.

Example 1: Except where noted otherwise, the Eγ quoted to tenths of keV are from β-decay. The Eγ quoted to the nearest keV are from reaction data.

Example 2: Except where noted otherwise, Eγ from levels below 6570 are weighted averages of data from (α,xnγ) and (HI,xnγ). Eγ for higher levels are from (^{48}Ca,xnγ).

C. Transition intensities

1. Sources for all data should be stated. This can usually be done with a general statement. See examples under **B. Eγ** above.

2. As stated in the introductory section to the Nuclear Data Sheets, the Iγ should be given as relative photon branching from each level. Any deviation from this policy, such as

quoting branching ratios in %, should be stated. The strongest photon branch should be set to 100 except in the following cases.

a) The strongest transition is an unresolved multiplet.

b) The strongest transition is given as an upper limit.

Note 1: An uncertainty should be included in the normalization value of 100 if there is an uncertainty given for the original intensity, unless there is only one transition deexciting the level, in which case the uncertainty has no meaning and should not be given.

Note 2: Iγ for a multiply-placed transitions where the intensity has not been divided should be given as a limit, thus Iγ<A+ΔA for a multiplet with Iγ =A±ΔA), and the value Iγ =A±ΔA should be given in a comment.

3 For a transition which has no measured Iγ , or for which just a limit is known, TI should be given, if available,. The most common case would be for an E0 transition or for a low-energy transition for which I(ce) but no Iγ or α is available. TI should be given on the same scale as the other Iγ values from that level.

D. Multipolarities, mixing ratios, conversion coefficients

3. Sources for all data should be stated and all assignments justified.

Example: When a mult is based on measurements that yield only D, Q, D+Q etc.,, such as γ(θ) or γγ(θ), and M1+E2 rather than El+M2 is adopted, the basis for this choice must be stated.

6. See J. 5. in **Guidelines for Source Datasets** for requirements on consistency among the mult, δ, and α entries. α is not needed for transitions with mixed multipolarity and unknown δ, even though such values may have been used in a source data set.

7. The relation between BE2 and T½ allows δ (and/or α) to be deduced in cases where BE2 and T½ are independently known, and the ground-state branching is known. Conversely, the ground-state branching could be deduced if all the other quantities were known.

8. γ(θ) and γγ(θ) lead, in general, to two solutions for δ. Both should be accounted for. In particular, if it is not known which is correct, then both should be put in a comment. Do not put one value in the MR field and the alternate value in a comment.

9. In addition to the use of square brackets as discussed in **J. 9.** under **Guidelines for Source Datasets** above, this convention is also useful in cases where the mult has not been measured and α is negligible but you wish to show the mult because you are giving,

for example, a reduced transition probability. In this case, assigning mult=[E2] is preferable to stating “BE2W=xxx if mult=E2".

Note: Do not assign mult=[ ] simplv because the mult can be deduced from the level scheme or simply because this convention may have been used in a source dataset.

10. When making the assumption that, for example, mult=D is probably E1, the E1 should be put in parens.

Note: This step should not be taken unless necessary. An assignment of mult=D is strong, whereas that of mult=(E1) is weak, and for a Jπ assignment the fact that a transition is known to be D may be of more use than assuming it might be E1. One case where assigning D as (E1) might be necessary would be where I(γ+ce) is needed and α is significant.

E. Reduced Transition Probabilities

1. Reduced transition probabilities should be given whenever possible. For mixed transitions, values for each multipole component should be given.

Note 1: When δ is consistent with zero or infinity, the reduced transition probability for only the dominant component is required. The limit for the other component is optional and could be given in certain cases. Thus, BE2(W.u.)<1000 is not of much interest, but BE2(W.u.)<l0^{-3} might be significant.

Note 2: In cases where mult has not been established but where all other needed data are available, it is recommended that values also be given when the probable γ character can be determined from the level scheme as ΔJ=l, Δπ =yes; ΔJ=2, Δπ =no, or J≥3, that is, cases where significant mixing is not expected. In such cases mult can be entered as [E1], [E2] or [E3], [M3] etc.,respectively

Note 3: When one or more of the relevant pieces of information needed to calculate reduced transition probabilities is missing, the calculation should be carried out if reasonable assumptions can be made that will fill in the gaps.

Example: If a level has one or more branches with small gamma fractions but unknown mult, and if any reasonable mult, say D or E2 would lead to the total branching also being relatively small, such branches should be estimated so that reduced transition probabilities for the stronger transitions can be calculated.

2. When only limit is available for one of the relevant pieces of data, special care must be taken in presenting the result..

Example: For a transition with mult=Ml+E2 and δ<0.l, for example, while BE2(W.u.) can be given only as an upper limit, it is not correct to give BM1(W.u.) as a lower limit since an upper bound occurs for δ=0. In a case like this, the BM1(W.u.) should be given as an average of the values corresponding to δ=0 and δ=0.l with an uncertainty chosen to overlap the two values.

3, For a transition whose total intensity is known only as an upper limit, then provided that this intensity limit is not the dominant branching mode, it is recommended that the branching for this transition be treated as 1/2TI ± 1/2TI for the purpose of calculating the reduced transition probabilities for the other transitions.

4. When T½ is given as an upper limit, the resulting lower limits on the reduced transition probabilities be given. These should be compared with RUL. When T½ is a lower limit, the resulting upper limits on the reduced transition probabilities are usually not very interesting, except perhaps as noted in **E. 1. Note 1**: above.

5. The reduced transition probability for a transition for which the corresponding Coulomb excitation probability has been determined (BE2 being the most common case) can be deduced directly from this measurement and the appropriate single particle value. This procedure should be followed when the level T1/2 has been adopted from a measured BE2 (in order to avoid including the uncertainty in the BE2 twice), or where BE2 is known but branchings and/or mixing ratios are not known so that T1/2 for the corresponding level cannot be calculated.

6. In cases where Eγ is poorly known and α is large, note that the factor $E\gamma^{2L+l}$ x (l+α) appearing in the formula for the reduced transition probabilities may exhibit a smaller range of values than the factors $E\gamma^{2L+l}$ and (l+α) taken separately. The correlation in Eγ and α should always be taken into account in calculating uncertainties for BEλ(W.u.) and BMλ(W.u.).

7 BEλ(W.u.) and BMλ(W.u.) are not needed for mixed multipolarities where δ is not known; however, if an evaluator chooses to give them, they should be given as upper limits.