Inconsistent Treatment in ENSDF of Mult. and Jπ from (HI,xnγ)

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Does this mean our current rules are inadequate?

or

Have we not remembered/understood what the rules are?

(Assumption: consistency is **good!)**

From Evaluators' Guidelines for Mult.:

1. $\gamma(\theta)$ data determine only the L component of the gamma character (*i.e.*, mult=D, D+Q *etc*.). Further assumptions are needed to establish the change in π, and should be stated when D is converted to M1, or D+Q to M1+E2, *etc*.. In particular, Q=E2 should not be considered an "obvious" conclusion. If $T_{1/2}$ is known, RUL can sometimes be invoked to eliminate some possibilities, particularly Q=M2, and D+Q=E1+M2 when δ is known. If known values of Jπ are used to establish any part of the character of a gamma, that part should be placed in parentheses. Remember that one of the implied uses of a non-parenthesized multipolarity is as a strong argument to assign Jπ values, so one must avoid circularity.

2. If any multipolarity =D, D+Q, *etc.,* can be assigned as M1, M1+E2, *etc*., only by the use of level scheme arguments, the designation mult=D should be retained in the source data set unless the complete designation (mult=(M1)) is needed to determine α. The mult=(M1) assignment can be adopted when choosing the multipolarity for the adopted γ's section. The main advantage in following this procedure (other than that such assumptions should be made <u>only when necessary</u>), is that a transition known to have mult=D (strong argument) may be more useful in defining a Jπ value than having only the parenthesized mult=(M1) (weak assignment). When such an argument is used, the reference for the multipolarity should be to the source data set, and not to the adopted γ's if the adopted value is (M1).

Angular Distributions

Typical values of A_2, A_4 for θ relative to beam direction if $\sigma/J=0.3$
(B. Singh, McMaster University)

ΔJ	Multipolarity	Sign of A_2	Sign of A_4	Typical A_2	Typical A_4
2	Q	+	-	+0.3	-0.1
1	D	-		-0.2	0.0
1	Q	-	+	-0.1	+0.2
1	D+Q	+ or -	+	+0.5 to -0.8	0.0 to +0.2
0	D	+		+0.35	0.0
0	Q	-	-	-0.25	-0.25
0	D+Q	+ or -	-	+0.35 to -0.25	0.0 to -0.25

DCO Ratios

Typical DCO values for θ_1=37°, θ_2=79°, σ/J=0.3 (B. Singh, McMaster U.)

ΔJ_γ^{gate}, Mult	ΔJ_γ	Mult	Typical DCO
2, Q	2	Q	1.0
2, Q	1	D	0.56
2, Q	1	D+Q	0.2 to 1.3
2, Q	0	D	1.0
2, Q	0	D+Q	0.6 to 1.0
1, D	2	Q	1/0.56
1, D	1	D	1.0
1, D	0	D	1/0.56

(Heavy Ion,xnypγ) Strong Rules

37. For a well-deformed nucleus when a regular sequence of $\Delta J=2$ (stretched Q) transitions is observed at high spins as a cascade, the sequence may be assigned to a common band with E2 multipolarity for all transitions in the cascade.

38. For near-spherical nuclei, if a cascade of $\Delta J=1$ transitions is observed at high spin with regular energy progression, those transitions may be assigned as (M1) transitions within a common band. <u>Exception</u>: in rare cases, nuclei can have alternating parity bands (reflection asymmetry); for these, $\Delta J=1$, $\Delta\pi$=yes cascades occur.

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

Authors are not subject to these rules/guidelines so we cannot simply adopt whatever they adopt.

For example:

For us to assign a multipolarity, something must have been measured.

For us, similarity to bands in nearby nuclei, in-band ΔJ=1 to ΔJ=2 transition rate ratio, alignment, *etc*., arguments are **weak** ones.

In the deformed region, authors may have definite Jπ assignments to all observed levels in 20 or more bands, yet we may not even have a definite argument for the g.s. spin.

So …

Do we need to add new rules (if so, what?) or simply abide by the ones we already have?