## $^{157}$Yb ε decay 1994Xu07,1996Xu03,2008VaZV

| Type | Author | History Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | N. Nica | NDS 132, 1 (2016) | 4-Dec-2015 |

Parent: $^{157}$Yb: E=0.0; $J^\pi=7/2^-$; $T_{1/2}$=38.6 s *10*; Q(ε)=5311 *28*; %ε+%$β^+$ decay=99.5

The scheme is from 1994Xu07, who produced the $^{157}$Yb by an $^{16}$O beam on $^{147}$Sm, with some added data from 1996Xu03 (same authors). γ placements are from γγ coincidence data.

With a Q value of 5300 keV, this decay scheme is clearly very incomplete since levels are only reported up to 834 keV.

I(ε+β+) values are given by 1994Xu07, but for two reasons they are not given here. First, the values of 1994Xu07 depend critically on assumptions concerning the γ-ray multipolarities. Second, the scheme is very incomplete since levels are only reported to 834 keV compared to a Q value of 5300 keV. Also, the strongest γ, at 23 keV, is not placed in this scheme.

The ratio of the intensities of the K x-rays and the 511 photons suggests a major share of the decays are to levels above 834 keV and even above 2000 keV. The largest single component of the K x ray intensity from internal conversion will come from the 69 γ and its maximum value will be ≈ 250 if it is an M1 transition. Therefore, the measured I(Kαx) = 1660 *150*, from which one can calculate that I(Kx) ≈ 2100, is primarily from ε decay. Since the I(511) = 821 *13* should correspond to 2 times the β+ decays (this assumes all of the β+ were stopped near the source), the measured capture to positron ratio is ≈ 5. For comparison, the theoretical capture to positron ratios are: to 0 keV level 0.35, to 835 level 0.65, to a 2000 level 2.0, and to a 3000 level 10. Therefore, most of the ε+β+ decays are to levels above 2000 keV, assuming that the I(Kαx) and I(511) are correct.

### $^{157}$Tm Levels

| E(level)† | $J^\pi$‡# | $T_{1/2}$ | Comments |
|---|---|---|---|
| 0.0@ | $1/2^+$ | | |
| 35.23 *11* | | 1.6 s | According to 2008VaZV this level is not populated directly by $^{157}$Yb ε decay (presumably because of nuclear structure arguments).<br>$J^\pi$: $(7/2^-)$ from (E2) γ from $(3/2^-)$ (2008VaZV).<br>$T_{1/2}$: Quoted by 2008VaZV from a 1999 report (with no given evidence this value looks questionable and it is not adopted); other value: > 40 ns from lack of observed coincidences in xγ(t) measurement (1996Xu03). |
| 69.51 *9* | | | |
| 105.78& *8* | | | $J^\pi$: (3/2+$(3/2^+)$ (1994Xu07,1996Xu03); π=− (2008VaZV). |
| 115.20 *20* | | | |
| 164.50@ *4* | | | $J^\pi$: $3/2^+$ (1994Xu07,1996Xu03); π=− (2008VaZV). |
| 206.78 *22* | | | |
| 231.08 *4* | | | $J^\pi$: $(3/2^+)$ from 2008VaZV. |
| 317.5 *3* | | | |
| 339.95 *8* | | | |
| 347.86& *9* | | | $J^\pi$: $(5/2^+)$ (1994Xu07,1996Xu03); π=+ (2008VaZV). |
| 353.86@ *6* | | | $J^\pi$: $5/2^+$ (1994Xu07,1996Xu03); π=− (2008VaZV). |
| 430.53 *11* | | | |
| 458.28 *8* | | | |
| 580.40& *12* | | | $J^\pi$: $(7/2^+)$ from 1994Xu07 and 1996Xu03. |
| 639.81@ *11* | | | $J^\pi$: $7/2^+$ from 1994Xu07 and 1996Xu03. |
| 656.87 *11* | | | |
| 787.74 *14* | | | |
| 834.70 *21* | | | |

† From least-squares fit to γ energies.

‡ From Adopted Levels, Gammas dataset.

# In comments: from 1994Xu07 and 1996Xu03 and based on the suggestion that these levels form bands. Same J values are retrieved by 2008VaZV (mentioned as deduced from γ-ray multipolarities from measured ICC; however no evidence is shown) while parities are only partially in agreement with 1994Xu07 and 1996Xu03 (which makes their band assignments more

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## $^{157}$Yb ε decay 1994Xu07,1996Xu03,2008VaZV (continued)

### $^{157}$Tm Levels (continued)

hypothetical). As there is not enough evidence, neither the $J^\pi$ values nor the band assignments have been adopted.
[@] Band(A): Possibly $K^\pi=1/2^+$ band.
[&] Band(B): Possibly $K^\pi=3/2^+$ band.

### γ($^{157}$Tm)

Iγ normalization: with the scheme and internal-conversion coefficients given by 1994Xu07, the $I_\gamma$ normalization is ≈ 0.17. For a more complete scheme, this factor could be much smaller.
Unplaced γ's are from 1994StZZ.

| $E_\gamma$[†] | $I_\gamma$[†‡a] | $E_i$(level) | $E_f$ | $J^\pi_f$ | Comments |
|---|---|---|---|---|---|
| [x]23.39[@&] *16* | 253 *13* | | | | |
| [x]26.05[@&] *17* | 60 *6* | | | | |
| 35.2[#] *2* | 6 *2* | 35.23 | 0.0 | 1/2+ | |
| [x]44.02[@&] *25* | 51 *11* | | | | |
| 69.52 *9* | 33 *2* | 69.51 | 0.0 | 1/2+ | |
| 101.0[#] *2* | 16 *3* | 206.78 | 105.78 | | |
| 105.7 *1* | 38 *5* | 105.78 | 0.0 | 1/2+ | $I_\gamma$: Values disagree; 35 *2* (1994StZZ) and 41 *2* (1994Xu07). |
| 115.2[#&] *2* | 50 *20* | 115.20 | 0.0 | 1/2+ | |
| 116.78 *14* | 3.2 *10* | 347.86 | 231.08 | | |
| 129.26 *12* | 28.5 *14* | 164.50 | 35.23 | | Mult.: According to 2008VaZV this is an E2 transitions (presumably based on ICC measurement). |
| [x]133.02[@] *16* | 7 *2* | | | | |
| [x]156.82[@] *10* | 6 *1* | | | | |
| 164.49 *4* | 62.7 *17* | 164.50 | 0.0 | 1/2+ | Mult.: According to 2008VaZV this is an E1 transitions (presumably based on ICC measurement). |
| 189.33 *6* | 29 *3* | 353.86 | 164.50 | | $I_\gamma$: Values disagree; 30 *2* (1994StZZ) and 23 *4* (1994Xu07). |
| [x]196.47[@] *10* | 4 *2* | | | | |
| 202.3[#&] *2* | 23 *5* | 317.5 | 115.20 | | |
| [x]206.23[@] *16* | 4 *2* | | | | |
| 227.31 *10* | 16 *2* | 458.28 | 231.08 | | |
| 231.10 *4* | 100 *3* | 231.08 | 0.0 | 1/2+ | |
| [x]239.10[@] *27* | 7 *2* | | | | |
| 242.05 *5* | 102 *4* | 347.86 | 105.78 | | |
| [x]248.07[@] *12* | 8 *2* | | | | |
| [x]249.91[@] *11* | 12 *2* | | | | |
| [x]258.32[@] *7* | 20 *2* | | | | |
| [x]273.1[@] *1* | 9 *2* | | | | |
| [x]280.7[@] *1* | 47 *3* | | | | |
| 285.93 *10* | 12.4 *9* | 639.81 | 353.86 | | |
| 339.95 *8* | 62 *10* | 339.95 | 0.0 | 1/2+ | $I_\gamma$: Values disagree; 33 *6* (1994StZZ) and 65 *2* (1994Xu07). |
| [x]341.86[@] *11* | 50 *4* | | | | |
| 348.36 *25* | 24 *4* | 347.86 | 0.0 | 1/2+ | $E_\gamma$: Values disagree; 338.47 *9* (1994StZZ) and 347.8 *2* (1994Xu07). |
| 353.90 *9* | 44 *7* | 353.86 | 0.0 | 1/2+ | $I_\gamma$: Values disagree; 55 *3* (1994StZZ) and 39 *2* (1994Xu07). |
| [x]357.70[@] *10* | 39 *4* | | | | |
| 361.02 *8* | 45 *11* | 430.53 | 69.51 | | $I_\gamma$: Values disagree; 67 *4* (1994StZZ) and 40 *2* (1994Xu07). |
| [x]385.93[@] *10* | 11 *5* | | | | |
| [x]388.10[@] *16* | 7 *4* | | | | |

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## $^{157}$Yb ε decay 1994Xu07,1996Xu03,2008VaZV (continued)

### γ($^{157}$Tm) (continued)

| $E_\gamma$[†] | $I_\gamma$[†‡a] | $E_i$(level) | $E_f$ | $J^\pi_f$ | Comments |
|---|---|---|---|---|---|
| [x]395.25[@] *16* | 14 *2* | | | | |
| [x]405.84[@] *18* | 10 *3* | | | | |
| 430.5[#] *2* | 8 *4* | 430.53 | 0.0 | $1/2^+$ | |
| 447.79 *11* | 16 *3* | 787.74 | 339.95 | | |
| 458.15 *11* | 14 *4* | 458.28 | 0.0 | $1/2^+$ | $I_\gamma$: Values disagree; 18 *2* (1994StZZ) and 10 *2* (1994Xu07). |
| 474.62 *9* | 19 *4* | 580.40 | 105.78 | | $I_\gamma$: Values disagree; 17 *3* (1994StZZ) and 26 *5* (1994Xu07). |
| 475.4[#] *2* | 10 *2* | 639.81 | 164.50 | | |
| [x]480.98[@] *17* | 10 *2* | | | | |
| 492.37 *10* | 16.4 *18* | 656.87 | 164.50 | | |
| [x]525.13[@] *13* | 12 *3* | | | | |
| [x]535.13[@] *13* | 17 *3* | | | | |
| 670.2[#] *2* | 21 *2* | 834.70 | 164.50 | | |

[†] Weighted average of values of 1994Xu07 and 1994StZZ; significant discrepancies are noted; other: 1991StZZ. Somewhat different values are given in 1996Xu03 (same authors as 1994Xu07), but the origin of values is not given.
[‡] $I(X_{K\alpha})$=1660 *150* and I(511)=821 *13* (1994StZZ).
[#] γ reported only by 1994Xu07.
[@] γ reported only by 1994StZZ.
[&] γ not confirmed by 2008VaZV.
[a] For absolute intensity per 100 decays, multiply by 0.09 *8*.
[x] γ ray not placed in level scheme.

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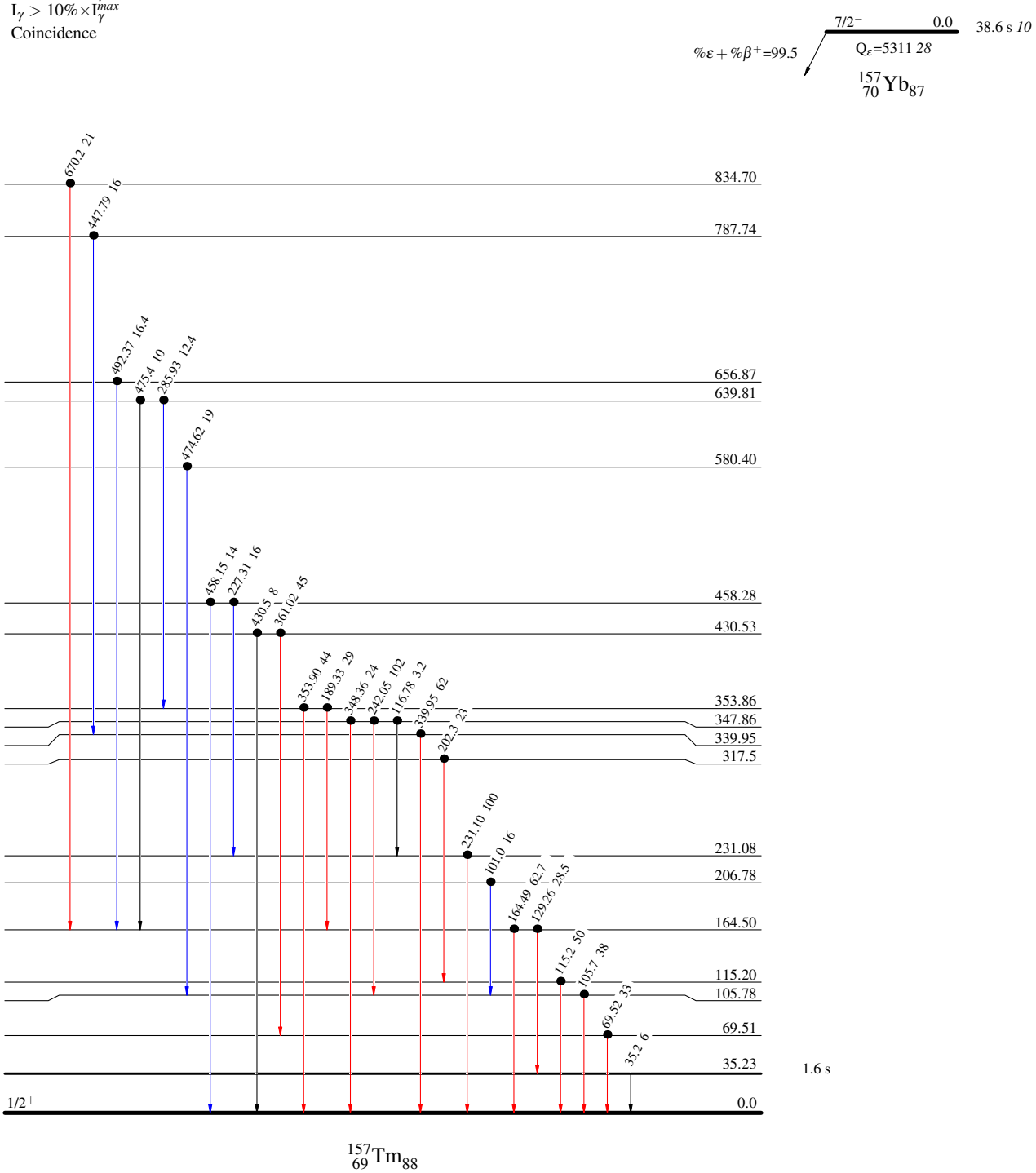
### Decay Scheme

Intensities: Relative $I_\gamma$

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- Coincidence



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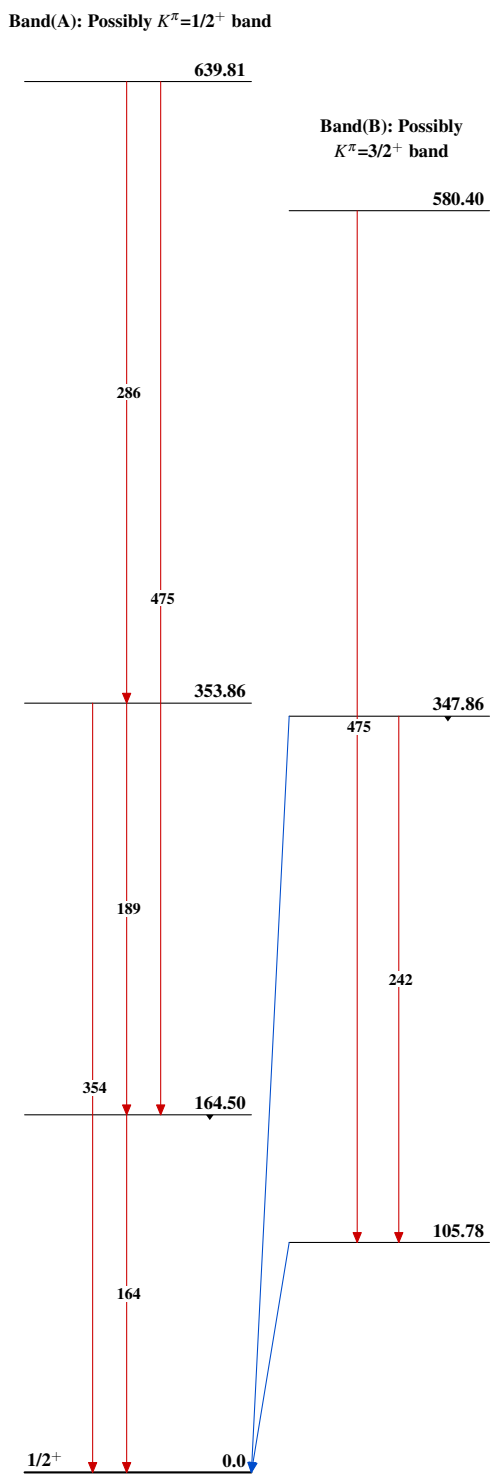


$^{157}_{69}Tm_{88}$