

### Adopted Levels, Gammas

| Type            | Author          | History | Citation | Literature Cutoff Date |
|-----------------|-----------------|---------|----------|------------------------|
| Full Evaluation | Coral M. Baglin | ENSDF   |          | 15-Mar-2015            |

Q( $\beta^-$ )=-7686 28; S(n)=10690 30; S(p)=805 16; Q( $\alpha$ )=5014 14 [2012Wa38](#)

Identification: <sup>169</sup>Re is known as the  $\alpha$ -decay parent of <sup>165</sup>Ta and the  $\alpha$ -decay daughter of <sup>173</sup>Ir. See comment below for assignment of <sup>169</sup>Re (15.1 s) to an isomer.

Theory (partial list):

[2011Pr17](#): calculation of band structure and deformation using deformed Hartree-Fock and angular momentum projection theory.

Notation for quasiparticle orbits:

$\nu$  i<sub>13/2</sub>: A, B, C, D.

$\nu$  h<sub>9/2</sub>: E, F.

$\pi$  h<sub>11/2</sub>: E<sub>p</sub>, F<sub>p</sub>.

### <sup>169</sup>Re Levels

#### Cross Reference (XREF) Flags

- A** <sup>173</sup>Ir  $\alpha$  decay (9.3 s)
- B** <sup>173</sup>Ir  $\alpha$  decay (2.16 s)
- C** <sup>144</sup>Sm(<sup>28</sup>Si,p2n $\gamma$ )
- D** <sup>118</sup>Sn(<sup>55</sup>Mn,4n $\gamma$ )

| E(level) <sup>†</sup>      | J $\pi^{\ddagger}$                     | T <sub>1/2</sub> | XREF       | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|----------------------------------------|------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0 <sup>@</sup>           | (9/2 <sup>-</sup> )                    | 8.1 s 5          | <b>BCD</b> | $\% \epsilon + \% \beta^+ = 100.00$ 1; $\% \alpha < 0.01$<br>$\% \alpha$ : $\approx 0.01$ to $\approx 0.001$ ( <a href="#">1992Me10</a> ). Both $\alpha$ and $\epsilon + \beta^+$ decays were observed by <a href="#">1992Me10</a> .<br>$J^\pi$ : possible 9/2[514] bandhead, analogous to <sup>171</sup> Re; M1+E2 intraband 136 $\gamma$ from possible 11/2 <sup>-</sup> 136 level.<br>T <sub>1/2</sub> : weighted average of 6.6 s 9 from 4700 $\alpha$ (t) ( <a href="#">1992Me10</a> ) and 8.3 s 3 from 101 $\gamma$ (t) ( <a href="#">1992Me10</a> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 0.0+x                      | (1/2 <sup>+</sup> , 3/2 <sup>+</sup> ) | 15.1 s 15        | <b>A</b>   | $\% \alpha \approx 0.2$ ; $\% \epsilon + \% \beta^+ = ?$ ; $\% \text{IT} = ?$<br>E(level): level energy held fixed in least-squares adjustment; x=175 13 ( <a href="#">2012Au07</a> ).<br>Identification: three-particle channels for <sup>27</sup> Al and <sup>28</sup> Si bombardment of <sup>144</sup> Sm show activity in second reaction only ( <a href="#">1984Sc06</a> ); observation of same activity with Re compound nucleus ( <a href="#">1978Ca11</a> ) confirms formation from <sup>144</sup> Sm( <sup>28</sup> Si,p2n). Assignment to isomer based on systematics ( <a href="#">1984Sc06</a> ).<br>$\% \alpha$ : estimated from extrapolation of log T <sub>1/2</sub> ( $\alpha$ ) versus log Q( $\alpha$ ). Only $\alpha$ decay observed, but other decay modes apparently dominate.<br>$J^\pi$ : fed in $\alpha$ decay (HF=6 4) from a possible 3/2[402] or 5/2[402] bandhead state ( <a href="#">1992Sc16</a> ); parent state assigned (1/2 <sup>+</sup> , 3/2 <sup>+</sup> ) in <a href="#">2001Ko44</a> based on favored $\alpha$ decay from (1/2 <sup>+</sup> , 3/2 <sup>+</sup> ) <sup>177</sup> Au g.s..<br>T <sub>1/2</sub> : weighted average of 12.9 s 11 from 5050 $\alpha$ (t) in <a href="#">1984Sc06</a> and 16.3 s 8 from 5061 $\alpha$ (t) in <a href="#">1992Me10</a> (the unweighted average is 14.6 s 17). |
| 118.9 <sup>d</sup> 4       | (5/2 <sup>+</sup> )                    |                  | <b>D</b>   | $J^\pi$ : see comment on 5/2[402], $\alpha = +1/2$ band.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 136.40 <sup>&amp;</sup> 14 | (11/2 <sup>-</sup> )                   |                  | <b>BCD</b> | $J^\pi$ : $\alpha$ decay from (11/2 <sup>-</sup> ) <sup>173</sup> Ir state probably has HF=1.3 3. however, $\alpha$ decay parent state is suggested to be the 11/2[505] bandhead by <a href="#">1992Sc16</a> (not the 11/2 <sup>-</sup> 9/2[514] state assigned here).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 215.9 4                    | (3/2)                                  |                  | <b>CD</b>  | $J^\pi$ : stretched D 320 $\gamma$ from (5/2 <sup>-</sup> ) 536 level.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 271.4 <sup>e</sup> 4       | (7/2 <sup>+</sup> )                    |                  | <b>CD</b>  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 278.78 25                  | (7/2)                                  |                  | <b>D</b>   | $J^\pi$ : D 355 $\gamma$ from (9/2 <sup>-</sup> ) 634 in ( <sup>55</sup> Mn,4n $\gamma$ ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 382.69 <sup>@</sup> 15     | (13/2 <sup>-</sup> )                   |                  | <b>CD</b>  | $J^\pi$ : intraband D+Q 246 $\gamma$ to (11/2 <sup>-</sup> ) 136 and Q, $\Delta J=2$ 383 $\gamma$ to (9/2 <sup>-</sup> ) g.s..                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 447.8 3                    | (9/2 <sup>+</sup> )                    |                  | <b>D</b>   | $J^\pi$ : 176 $\gamma$ to (7/2 <sup>+</sup> ) 271; 329 $\gamma$ to (5/2 <sup>+</sup> ) 119 in ( <sup>55</sup> Mn,4n $\gamma$ ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

Continued on next page (footnotes at end of table)

**Adopted Levels, Gammas (continued)** $^{169}\text{Re}$  Levels (continued)

| E(level) <sup>†</sup>       | J <sup>π</sup> <sup>‡</sup> | XREF | Comments                                                                                                                                                                                                                  |
|-----------------------------|-----------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 535.98 <sup>#</sup> 25      | (5/2 <sup>-</sup> )         | CD   | XREF: C(320+X).<br>J <sup>π</sup> : band assignment.                                                                                                                                                                      |
| 622.44 <sup>&amp;</sup> 16  | (15/2 <sup>-</sup> )        | CD   | J <sup>π</sup> : intraband D+Q, ΔJ=1 240γ to (13/2 <sup>-</sup> ) 383; stretched Q intraband 486γ to (11/2 <sup>-</sup> ) 136.                                                                                            |
| 633.78 <sup>#</sup> 14      | (9/2 <sup>-</sup> )         | CD   | XREF: C(418+X).<br>J <sup>π</sup> : (D), ΔJ=(1) 497γ to (11/2 <sup>-</sup> ) 136; intraband 98γ to (5/2 <sup>-</sup> ) 536.<br>only the 98-keV branch was reported In ( $^{28}\text{Si}$ ,p2nγ).                          |
| 637.6 3                     | (11/2 <sup>+</sup> )        | D    | J <sup>π</sup> : 190γ to (9/2 <sup>+</sup> ) 448; 366γ to (7/2 <sup>+</sup> ) 271 In ( $^{55}\text{Mn}$ ,4nγ).                                                                                                            |
| 886.83 <sup>#</sup> 15      | (13/2 <sup>-</sup> )        | CD   | XREF: C(671+X).<br>J <sup>π</sup> : stretched Q 887γ to (9/2 <sup>-</sup> ) g.s..                                                                                                                                         |
| 898.0 3                     | (13/2 <sup>+</sup> )        | D    | J <sup>π</sup> : 260γ to (11/2 <sup>+</sup> ) 638, 450γ to (9/2 <sup>+</sup> ) 448 In ( $^{55}\text{Mn}$ ,4nγ).                                                                                                           |
| 940.01 <sup>@</sup> 18      | (17/2 <sup>-</sup> )        | CD   | J <sup>π</sup> : intraband stretched D 318γ to (15/2 <sup>-</sup> ) 622 and stretched Q 557γ to (13/2 <sup>-</sup> ) 383.                                                                                                 |
| 1121.7 3                    | (15/2 <sup>+</sup> )        | D    | J <sup>π</sup> : 224γ to (13/2 <sup>+</sup> ) 898; 484γ to (11/2 <sup>+</sup> ) 638 In ( $^{55}\text{Mn}$ ,4nγ).                                                                                                          |
| 1218.48 <sup>&amp;</sup> 19 | (19/2 <sup>-</sup> )        | CD   | J <sup>π</sup> : intraband D+Q 278γ to (17/2 <sup>-</sup> ) 940 and stretched Q 596γ to (15/2 <sup>-</sup> ) 622.                                                                                                         |
| 1275.61 <sup>#</sup> 20     | (17/2 <sup>-</sup> )        | CD   | XREF: C(1060+X).<br>J <sup>π</sup> : intraband stretched Q 389γ to (13/2 <sup>-</sup> ) 887.                                                                                                                              |
| 1342.92 <sup>b</sup> 19     | (15/2 <sup>+</sup> )        | CD   | J <sup>π</sup> : stretched Q or D, ΔJ=0 721γ to (15/2 <sup>-</sup> ) 622; 403γ to (17/2 <sup>-</sup> ) 940, 960γ to (13/2 <sup>-</sup> ) 383.                                                                             |
| 1431.878 <sup>a</sup> 22    | (17/2 <sup>+</sup> )        | CD   | J <sup>π</sup> : 310γ to (15/2 <sup>+</sup> ) 1122, 534γ to (13/2 <sup>+</sup> ) 898, intraband 88γ to (15/2 <sup>+</sup> ) 1343.                                                                                         |
| 1510.00 21                  |                             | D    | J <sup>π</sup> : 887γ to (15/2 <sup>-</sup> ) 622; 1127γ to (13/2 <sup>-</sup> ) 383.                                                                                                                                     |
| 1583.93 <sup>@</sup> 20     | (21/2 <sup>-</sup> )        | CD   | J <sup>π</sup> : intraband D+Q 365γ to (19/2 <sup>-</sup> ) 1218 and stretched Q 644γ to (17/2 <sup>-</sup> ) 940.                                                                                                        |
| 1623.37 <sup>b</sup> 18     | (17/2 <sup>+</sup> )        | CD   | J <sup>π</sup> : stretched D 281γ to (15/2 <sup>+</sup> ) 1343; intraband stretched D 405γ to (19/2 <sup>-</sup> ) 1218. differs from (19/2) proposed In ( $^{28}\text{Si}$ ,p2nγ).                                       |
| 1663.44 <sup>c</sup> 21     | 17/2 <sup>+</sup>           | D    | J <sup>π</sup> : 388γ to (17/2 <sup>-</sup> ) 1276; 1041γ to (15/2 <sup>-</sup> ) 622.                                                                                                                                    |
| 1764.8 <sup>#</sup> 3       | (21/2 <sup>-</sup> )        | CD   | XREF: C(1551+X).<br>J <sup>π</sup> : intraband stretched Q 489γ to (17/2 <sup>-</sup> ) 1276.                                                                                                                             |
| 1799.28 <sup>a</sup> 20     | (19/2 <sup>+</sup> )        | CD   | J <sup>π</sup> : intraband stretched D 176γ to (17/2 <sup>+</sup> ) 1623; 215γ to (21/2 <sup>-</sup> ) 1584; D 859γ to (17/2 <sup>-</sup> ) 940. differs from (21/2 <sup>+</sup> ) proposed In ( $^{28}\text{Si}$ ,p2nγ). |
| 1815.4 11                   |                             | C    | J <sup>π</sup> : 192γ to (17/2 <sup>+</sup> ) 1623; possible 107γ from (21/2) 1923..                                                                                                                                      |
| 1882.28 <sup>&amp;</sup> 22 | (23/2 <sup>-</sup> )        | CD   | J <sup>π</sup> : intraband stretched D 298γ to (21/2 <sup>-</sup> ) 1584; intraband stretched Q 664γ to (19/2 <sup>-</sup> ) 1218.                                                                                        |
| 1922.7 <sup>b</sup> 15      | (21/2 <sup>+</sup> )        | C    | J <sup>π</sup> : intraband D 123γ to (19/2 <sup>+</sup> ) 1799; differs from 23/2 proposed In ( $^{28}\text{Si}$ ,p2nγ).                                                                                                  |
| 1991.55 21                  | (21/2 <sup>+</sup> )        | D    | J <sup>π</sup> : 192γ to (19/2 <sup>+</sup> ) 1799; 368γ to (17/2 <sup>+</sup> ) 1623; 773γ to (19/2 <sup>-</sup> ) 1218.                                                                                                 |
| 2038.4 <sup>c</sup> 3       | (21/2 <sup>+</sup> )        | D    | J <sup>π</sup> : stretched Q intraband 375γ to (17/2 <sup>+</sup> ) 1663.                                                                                                                                                 |
| 2122.82 <sup>f</sup> 24     | (21/2 <sup>+</sup> )        | D    | J <sup>π</sup> : 324γ to (19/2 <sup>+</sup> ) 1799, 691γ to (17/2 <sup>+</sup> ) 1432 In ( $^{55}\text{Mn}$ ,4nγ).                                                                                                        |
| 2183.47 <sup>g</sup> 24     | (23/2 <sup>+</sup> )        | D    | J <sup>π</sup> : 192γ to (21/2 <sup>+</sup> ) 1992, 384γ to ((19/2 <sup>+</sup> ) 1799 In ( $^{55}\text{Mn}$ ,4nγ).                                                                                                       |
| 2257.71 <sup>@</sup> 23     | (25/2 <sup>-</sup> )        | CD   | J <sup>π</sup> : intraband stretched D 375γ to (23/2 <sup>-</sup> ) 1882; intraband stretched Q 674γ to (21/2 <sup>-</sup> ) 1584.                                                                                        |
| 2306.5 <sup>f</sup> 3       | (25/2 <sup>+</sup> )        | CD   | J <sup>π</sup> : intraband stretched D 123γ to (23/2 <sup>+</sup> ) 2183.                                                                                                                                                 |
| 2321.0 <sup>#</sup> 3       | (25/2 <sup>-</sup> )        | CD   | XREF: C(2104+X).<br>J <sup>π</sup> : intraband stretched Q 556γ to (21/2 <sup>-</sup> ) 1765.                                                                                                                             |
| 2462.1 <sup>g</sup> 4       | (27/2 <sup>+</sup> )        | CD   | XREF: C(2078).<br>J <sup>π</sup> : intraband stretched D 156γ to (25/2 <sup>+</sup> ) 2307.                                                                                                                               |
| 2486.78 <sup>&amp;</sup> 24 | (27/2 <sup>-</sup> )        | CD   |                                                                                                                                                                                                                           |
| 2498.0 <sup>c</sup> 3       | (25/2 <sup>+</sup> )        | D    |                                                                                                                                                                                                                           |
| 2509.4 3                    | (25/2 <sup>+</sup> )        | D    |                                                                                                                                                                                                                           |
| 2602.8 <sup>@</sup> 3       | (29/2 <sup>-</sup> )        | CD   |                                                                                                                                                                                                                           |
| 2657.6 <sup>f</sup> 4       | (29/2 <sup>+</sup> )        | CD   | XREF: C(2274).                                                                                                                                                                                                            |
| 2743.7 <sup>&amp;</sup> 3   | (31/2 <sup>-</sup> )        | CD   |                                                                                                                                                                                                                           |
| 2896.4 <sup>g</sup> 4       | (31/2 <sup>+</sup> )        | CD   | XREF: C(2513).                                                                                                                                                                                                            |
| 2903.5 <sup>#</sup> 3       | (29/2 <sup>-</sup> )        | CD   | XREF: C(2687+X).                                                                                                                                                                                                          |
| 2921.0 <sup>@</sup> 3       |                             | D    |                                                                                                                                                                                                                           |

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued) $^{169}\text{Re}$  Levels (continued)

| E(level) <sup>†</sup>     | J <sup>π</sup> <sup>‡</sup> | XREF | Comments                                                                                                                                                     |
|---------------------------|-----------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2923.8 <sup>@</sup> 3     | (33/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 3025.4 <sup>c</sup> 4     | (29/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 3083.8 <sup>h</sup> 3     | (27/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 3141.2 <sup>&amp;</sup> 3 | (35/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 3169.7 <sup>f</sup> 4     | (33/2 <sup>+</sup> )        | CD   | XREF: C(2787).                                                                                                                                               |
| 3344.3 <sup>h</sup> 3     | (31/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 3396.3 <sup>@</sup> 3     | (37/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 3458.4 <sup>#</sup> 4     | (33/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 3464.6 <sup>g</sup> 4     | (35/2 <sup>+</sup> )        | CD   | XREF: C(3081).                                                                                                                                               |
| 3608.1 <sup>c</sup> 4     | (33/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 3686.6 <sup>&amp;</sup> 3 | (39/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 3720.1 <sup>h</sup> 3     | 35/2 <sup>+</sup>           | D    |                                                                                                                                                              |
| 3792.1 <sup>f</sup> 4     | (37/2 <sup>+</sup> )        | CD   | XREF: C(3409).<br>E(level): differs In ( $^{28}\text{Si}$ ,p2n $\gamma$ ) because order of 623 $\gamma$ and 642 $\gamma$ cascade was reversed In that study. |
| 3942.6 <sup>#</sup> 4     | (37/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 3946.8 <sup>i</sup> 4     | (37/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4005.8 <sup>@</sup> 4     | (41/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 4106.5 <sup>g</sup> 4     | (39/2 <sup>+</sup> )        | CD   | XREF: C(3723+X).                                                                                                                                             |
| 4164.3 <sup>k</sup> 4     | (37/2 <sup>-</sup> )        | D    | J <sup>π</sup> : stretched Q 706 $\gamma$ to (33/2 <sup>-</sup> ) 3458 In ( $^{55}\text{Mn}$ ,4n $\gamma$ ).                                                 |
| 4219.7 <sup>h</sup> 3     | (39/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4238.0 <sup>c</sup> 5     | (37/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4297.5 7                  | (39/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4356.0 <sup>&amp;</sup> 4 | (43/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 4434.0 <sup>f</sup> 5     | (41/2 <sup>+</sup> )        | CD   | XREF: C(4050).                                                                                                                                               |
| 4452.1 <sup>#</sup> 5     | (41/2 <sup>-</sup> )        | CD   | XREF: C(4237+X).                                                                                                                                             |
| 4533.3 <sup>i</sup> 4     | (41/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4727.2 <sup>@</sup> 4     | (45/2 <sup>-</sup> )        | CD   |                                                                                                                                                              |
| 4728.2 <sup>g</sup> 5     | (43/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4745.9 <sup>k</sup> 4     | (41/2 <sup>-</sup> )        | D    |                                                                                                                                                              |
| 4798.5 <sup>j</sup> 4     | (43/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4836.8 <sup>h</sup> 4     | (43/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 4867.1 <sup>c</sup> 5     | (41/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5015.7 <sup>f</sup> 5     | (45/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5048.6 <sup>#</sup> 5     | (45/2 <sup>-</sup> )        | D    |                                                                                                                                                              |
| 5079.7 <sup>i</sup> 4     | (45/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5125.3 <sup>&amp;</sup> 4 | (47/2 <sup>-</sup> )        | D    |                                                                                                                                                              |
| 5298.6 <sup>g</sup> 5     | (47/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5377.5 <sup>k</sup> 5     | (45/2 <sup>-</sup> )        | D    |                                                                                                                                                              |
| 5389.1 <sup>j</sup> 4     | (47/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5426.3 <sup>c</sup> 5     | (45/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5537.6 <sup>@</sup> 4     | (49/2 <sup>-</sup> )        | D    |                                                                                                                                                              |
| 5545.7 <sup>h</sup> 5     | (47/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5595.0 <sup>f</sup> 5     | (49/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5726.8 <sup>#</sup> 6     | (49/2 <sup>-</sup> )        | D    |                                                                                                                                                              |
| 5732.4 <sup>i</sup> 4     | (49/2 <sup>+</sup> )        | D    |                                                                                                                                                              |
| 5912.0 <sup>g</sup> 5     | (51/2 <sup>+</sup> )        | D    |                                                                                                                                                              |

Continued on next page (footnotes at end of table)

**Adopted Levels, Gammas (continued)** $^{169}\text{Re}$  Levels (continued)

| E(level) <sup>†</sup>     | J <sup>π</sup> <sup>‡</sup> | XREF | E(level) <sup>†</sup>     | J <sup>π</sup> <sup>‡</sup> | XREF | E(level) <sup>†</sup>      | J <sup>π</sup> <sup>‡</sup> | XREF |
|---------------------------|-----------------------------|------|---------------------------|-----------------------------|------|----------------------------|-----------------------------|------|
| 5973.2 <sup>&amp;</sup> 4 | (51/2 <sup>-</sup> )        | D    | 7248.1 <sup>#</sup> 6     | (57/2 <sup>-</sup> )        | D    | 8554.1 <sup>h</sup> 6      | (63/2 <sup>+</sup> )        | D    |
| 6056.5 <sup>c</sup> 6     | (49/2 <sup>+</sup> )        | D    | 7312.9 <sup>@</sup> 4     | (57/2 <sup>-</sup> )        | D    | 8626.3 <sup>&amp;</sup> 11 | (63/2 <sup>-</sup> )        | D    |
| 6061.3 <sup>k</sup> 5     | (49/2 <sup>-</sup> )        | D    | 7398.3 <sup>i</sup> 5     | (57/2 <sup>+</sup> )        | D    | 8778.6 <sup>f</sup> 6      | (65/2 <sup>+</sup> )        | D    |
| 6105.3 <sup>j</sup> 4     | (51/2 <sup>+</sup> )        | D    | 7416.3 <sup>g</sup> 5     | (59/2 <sup>+</sup> )        | D    | 8861.5 <sup>l</sup> 8      |                             | D    |
| 6248.9 <sup>f</sup> 5     | (53/2 <sup>+</sup> )        | D    | 7494.3 <sup>c</sup> 8     | (57/2 <sup>+</sup> )        | D    | 8918.6 <sup>#</sup> 7      | (65/2 <sup>-</sup> )        | D    |
| 6315.3 <sup>h</sup> 5     | (51/2 <sup>+</sup> )        | D    | 7635.2 <sup>k</sup> 6     | (57/2 <sup>-</sup> )        | D    | 9137.5 <sup>c</sup> 11     | (65/2 <sup>+</sup> )        | D    |
| 6413.9 <sup>@</sup> 4     | (53/2 <sup>-</sup> )        | D    | 7755.9 <sup>&amp;</sup> 5 | (59/2 <sup>-</sup> )        | D    | 9295.7 <sup>g</sup> 8      | (67/2 <sup>+</sup> )        | D    |
| 6466.5 <sup>#</sup> 6     | (53/2 <sup>-</sup> )        | D    | 7785.3 <sup>h</sup> 6     | (59/2 <sup>+</sup> )        | D    | 9395.8 <sup>h</sup> 7      | (67/2 <sup>+</sup> )        | D    |
| 6516.4 <sup>i</sup> 5     | (53/2 <sup>+</sup> )        | D    | 7838.0 <sup>j</sup> 7     | (59/2 <sup>+</sup> )        | D    | 9741.5 <sup>l</sup> 9      |                             | D    |
| 6615.5 <sup>g</sup> 5     | (55/2 <sup>+</sup> )        | D    | 7843.6 <sup>f</sup> 5     | (61/2 <sup>+</sup> )        | D    | 9812.6 <sup>#</sup> 7      | (69/2 <sup>-</sup> )        | D    |
| 6743.0 <sup>c</sup> 6     | (53/2 <sup>+</sup> )        | D    | 8024.0 <sup>l</sup> 8     |                             | D    | 10307.0 <sup>h</sup> 8     | (71/2 <sup>+</sup> )        | D    |
| 6812.3 <sup>k</sup> 6     | (53/2 <sup>-</sup> )        | D    | 8062.1 <sup>#</sup> 7     | (61/2 <sup>-</sup> )        | D    | 10755.8 <sup>#</sup> 9     | (73/2 <sup>-</sup> )        | D    |
| 6869.4 <sup>&amp;</sup> 4 | (55/2 <sup>-</sup> )        | D    | 8185.6 <sup>@</sup> 5     | (61/2 <sup>-</sup> )        | D    | 11286.0 <sup>h</sup> 10    | (75/2 <sup>+</sup> )        | D    |
| 6945.0 <sup>j</sup> 5     | (55/2 <sup>+</sup> )        | D    | 8298.5 <sup>c</sup> 10    | (61/2 <sup>+</sup> )        | D    | 11764.8 <sup>#</sup> 10    | (77/2 <sup>-</sup> )        | D    |
| 6998.9 <sup>f</sup> 5     | (57/2 <sup>+</sup> )        | D    | 8311.5 <sup>g</sup> 5     | (63/2 <sup>+</sup> )        | D    |                            |                             |      |
| 7063.9 <sup>h</sup> 5     | (55/2 <sup>+</sup> )        | D    | 8316.3 <sup>i</sup> 7     | (61/2 <sup>+</sup> )        | D    |                            |                             |      |

<sup>†</sup> From least-squares fit to E<sub>γ</sub>, assigning 0.5 keV uncertainty to E<sub>γ</sub> data for which authors did not state an uncertainty.

<sup>‡</sup> From  $^{118}\text{Sn}(^{55}\text{Mn},4n\gamma)$ , based on transition multiplicities, deduced band structure, alignment, band crossing frequencies and comparison with neighboring odd-A Re isotopes, unless noted otherwise.

<sup>#</sup> Band(A): 1/2[541] band (2002Zh42). Decoupled sequence with initial alignment of 3 $\hbar$ ; delayed AB crossing At  $\hbar\omega=0.27$  MeV; second crossing At  $\hbar\omega=0.43$  MeV occurs At lower frequency than expected for CD alignment and alignment gain May result instead from mixing with another band. level-spacings consistent with trends In known 1/2[541] bands In heavier odd-A Re isotopes.

<sup>@</sup> Band(B): 9/2[514],  $\alpha=+1/2$  band (2002Zh42). Initial alignment $\approx 1.5\hbar$ ; lower than cranked shell model prediction of 2.6 $\hbar$ , possibly indicating mixing with K=11/2 orbital. first band crossing At  $\hbar\omega=0.23$  MeV matches prediction for AB alignment. Observed B(M1)/B(E2) ratios and alignments consistent with calculated values for  $\pi$  9/2[514] band. second crossing near 0.44 MeV associated with CD alignment.

<sup>&</sup> Band(b): 9/2[514],  $\alpha=-1/2$  band (2002Zh42). See comment on signature partner band.

<sup>a</sup> Band(C):  $\alpha=+1/2$ , 3 quasiparticle band (2002Zh42). Configuration= $(\pi$  9/2[514]) $\otimes(\nu$  i<sub>13/2</sub>)( $\nu$  f<sub>7/2</sub> or h<sub>9/2</sub>) (2002Zh43). strongly feeds g.s. band via D transitions, possibly suggesting opposite parity (2013Ha02).

<sup>b</sup> Band(c):  $\alpha=-1/2$ , 3 quasiparticle band (2002Zh42). Configuration= $(\pi$  9/2[514]) $\otimes(\nu$  i<sub>13/2</sub>)( $\nu$  f<sub>7/2</sub> or h<sub>9/2</sub>). See comment on signature partner band.

<sup>c</sup> Band(D):  $\pi$  1/2[660] band. Decoupled band; initial alignment of 6  $\hbar$  is somewhat low for a 3-quasiparticle structure but consistent with  $\pi$  1/2[660]; band crossing observed near  $\hbar\omega=0.30$  MeV (possibly delayed AB alignment).

<sup>d</sup> Band(E):  $\pi$  5/2[402] band,  $\alpha=+1/2$ . Strongly-coupled structure with almost zero initial alignment, suggests  $\pi$  5/2[402] or  $\pi$  7/2[402] and observed B(M1)/B(E2) ratios clearly favor the former.

<sup>e</sup> Band(e):  $\pi$  5/2[402] band,  $\alpha=-1/2$ . See comment on signature partner band.

<sup>f</sup> Band(F):  $\pi$  h<sub>11/2</sub>  $\nu$  AE band,  $\alpha=+1/2$ . Strongly-coupled structure. Energy and initial alignment $\approx 10\hbar$  suggests a 3-quasiparticle structure. Band crossing At  $\hbar\omega=0.30$  MeV is near predicted BC crossing (AB is blocked) and is consistent with its observation In the  $\pi$ h<sub>11/2</sub> $\nu$ i<sub>13/2</sub> band In  $^{170}\text{Re}$  At 0.29 MeV. Observed B(M1)/B(E2) ratios consistent with those predicted for assigned configuration, where E is  $\pi=-$  orbital closest to the Fermi surface, and with absence of CD alignment At high frequency. J<sup>π</sup> assignments are based on data from ( $^{55}\text{Mn},4n\gamma$ ); J values proposed by authors In ( $^{28}\text{Si},p2n\gamma$ ) are one unit lower than adopted here.

<sup>g</sup> Band(f):  $\pi$  h<sub>11/2</sub>  $\nu$  AE band,  $\alpha=-1/2$ . See comment on signature partner band.

<sup>h</sup> Band(G):  $\pi$  h<sub>9/2</sub>  $\nu$  AE band,  $\alpha=-1/2$ . Decoupled sequence. lowest level feeds J=25/2 and 27/2 states. Initial alignment 2-3  $\hbar$

Continued on next page (footnotes at end of table)

---

**Adopted Levels, Gammas (continued)**

---

 $^{169}\text{Re}$  Levels (continued)

larger than that of  $\pi h_{11/2} \nu$  AE band; crossing At 0.37 MeV, between expectations for BC and CD alignments. larger deformation driven by  $\pi h_{9/2}$  May delay BC crossing.

<sup>i</sup> Band(H):  $\pi h_{11/2} \nu$  AF band,  $\alpha=+1/2$ . Strongly-coupled band feeding g.s. band. observed B(M1)/B(E2) ratios agree with those predicted for the suggested configuration.

<sup>j</sup> Band(h):  $\pi h_{11/2} \nu$  AF band,  $\alpha=-1/2$ . See comment on signature partner band.

<sup>k</sup> Band(I): band fragment (1). Decoupled sequence feeding  $1/2[541]$  band via stretched Q transitions, suggesting  $\pi=-$ . excitation energy suggests  $3^-$  or 5-quasiparticle configuration. initial alignment  $\approx 13\hbar$ . decoupled character suggests involvement of  $\pi 1/2[411]$ ,  $\pi 1/2[541]$  or  $\pi 1/2[660]$ ; J rules out assignment As  $1/2[541]$  signature partner, and  $1/2[660]$  has already been assigned elsewhere, so authors tentatively assign the  $\pi 1/2[411]$  ? AEBC configuration.

<sup>l</sup> Band(J): band fragment (2). Feeds into  $1/2[541]$  band.

Adopted Levels, Gammas (continued)

$\gamma(^{169}\text{Re})$

| $E_i(\text{level})$ | $J_i^\pi$            | $E_\gamma^a$ | $I_\gamma^a$ | $E_f$    | $J_f^\pi$            | Mult.&    | $\delta^\ddagger$ | $\alpha^\dagger$ | Comments                                                                                                                                     |
|---------------------|----------------------|--------------|--------------|----------|----------------------|-----------|-------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 136.40              | (11/2 <sup>-</sup> ) | 136.4 2      | 100          | 0.0      | (9/2 <sup>-</sup> )  | M1+E2     | 0.71 7            | 1.83 5           | $E_\gamma$ , Mult., $\delta$ : from <sup>173</sup> Ir $\alpha$ decay (2.16 s).                                                               |
| 271.4               | (7/2 <sup>+</sup> )  | 152.5 2      | 100          | 118.9    | (5/2 <sup>+</sup> )  |           |                   |                  |                                                                                                                                              |
| 382.69              | (13/2 <sup>-</sup> ) | 246.3 2      | 100          | 136.40   | (11/2 <sup>-</sup> ) | (M1(+E2)) |                   | 0.28 13          |                                                                                                                                              |
|                     |                      | 382.7 2      | 13 2         | 0.0      | (9/2 <sup>-</sup> )  | (E2)      |                   | 0.0439           | $I_\gamma$ : from ( <sup>28</sup> Si,p2n $\gamma$ ). other: $\approx$ 24 from ( <sup>55</sup> Mn,4n $\gamma$ ).                              |
| 447.8               | (9/2 <sup>+</sup> )  | 176.3 2      | 100 10       | 271.4    | (7/2 <sup>+</sup> )  |           |                   |                  |                                                                                                                                              |
|                     |                      | 328.9 2      | 17.6 22      | 118.9    | (5/2 <sup>+</sup> )  |           |                   |                  |                                                                                                                                              |
| 535.98              | (5/2 <sup>-</sup> )  | 320.1 2      | 100          | 215.9    | (3/2)                | D         |                   |                  |                                                                                                                                              |
| 622.44              | (15/2 <sup>-</sup> ) | 239.8 2      | 100          | 382.69   | (13/2 <sup>-</sup> ) | (M1(+E2)) |                   | 0.31 14          |                                                                                                                                              |
|                     |                      | 486.0 2      | 67 5         | 136.40   | (11/2 <sup>-</sup> ) | (E2)      |                   | 0.0235           | $I_\gamma$ : other $I_\gamma$ : 86 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                   |
| 633.78              | (9/2 <sup>-</sup> )  | 97.8 2       | 51 7         | 535.98   | (5/2 <sup>-</sup> )  | [E2]      |                   | 4.51 8           | Mult.: consistent with D based on angular distribution ratio In ( <sup>55</sup> Mn,4n $\gamma$ ) but level scheme requires $\Delta J=2$ .    |
|                     |                      | 355.0 2      | 24 3         | 278.78   | (7/2)                | D         |                   |                  |                                                                                                                                              |
|                     |                      | 497.4 2      | 100 14       | 136.40   | (11/2 <sup>-</sup> ) | (D)       |                   |                  |                                                                                                                                              |
|                     |                      | 633.8 2      | 29 3         | 0.0      | (9/2 <sup>-</sup> )  |           |                   |                  |                                                                                                                                              |
| 637.6               | (11/2 <sup>+</sup> ) | 189.9 2      | 100 11       | 447.8    | (9/2 <sup>+</sup> )  |           |                   |                  |                                                                                                                                              |
|                     |                      | 366.2 2      | 42 4         | 271.4    | (7/2 <sup>+</sup> )  |           |                   |                  |                                                                                                                                              |
| 886.83              | (13/2 <sup>-</sup> ) | 253.1 2      | 100 6        | 633.78   | (9/2 <sup>-</sup> )  | (E2)      |                   | 0.1484           | Mult.: from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                               |
|                     |                      | 886.8 2      | 9.4 12       | 0.0      | (9/2 <sup>-</sup> )  | Q         |                   |                  |                                                                                                                                              |
| 898.0               | (13/2 <sup>+</sup> ) | 260.4 2      | 100 9        | 637.6    | (11/2 <sup>+</sup> ) |           |                   |                  |                                                                                                                                              |
|                     |                      | 450.1 2      | 62 6         | 447.8    | (9/2 <sup>+</sup> )  |           |                   |                  |                                                                                                                                              |
| 940.01              | (17/2 <sup>-</sup> ) | 317.6 2      | 100 6        | 622.44   | (15/2 <sup>-</sup> ) | (M1)      |                   | 0.204            |                                                                                                                                              |
|                     |                      | 557.3 2      | 60 6         | 382.69   | (13/2 <sup>-</sup> ) | (E2)      |                   | 0.01680          |                                                                                                                                              |
| 1121.7              | (15/2 <sup>+</sup> ) | 223.7 2      | 100 8        | 898.0    | (13/2 <sup>+</sup> ) |           |                   |                  |                                                                                                                                              |
|                     |                      | 484.1 2      | 61 5         | 637.6    | (11/2 <sup>+</sup> ) |           |                   |                  |                                                                                                                                              |
| 1218.48             | (19/2 <sup>-</sup> ) | 278.4 2      | 65 4         | 940.01   | (17/2 <sup>-</sup> ) | (M1(+E2)) |                   | 0.20 9           | other $I_\gamma$ : 58 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                |
|                     |                      | 596.0 2      | 100 7        | 622.44   | (15/2 <sup>-</sup> ) | (E2)      |                   | 0.01435          |                                                                                                                                              |
| 1275.61             | (17/2 <sup>-</sup> ) | 388.8# 2     | 100@         | 886.83   | (13/2 <sup>-</sup> ) | (E2)      |                   | 0.0420           | Mult.: Q from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                             |
| 1342.92             | (15/2 <sup>+</sup> ) | 403.0        |              | 940.01   | (17/2 <sup>-</sup> ) |           |                   |                  | $E_\gamma$ : from ( <sup>28</sup> Si,p2n $\gamma$ ); absent In ( <sup>55</sup> Mn,4n $\gamma$ ).                                             |
|                     |                      | 720.5 2      | 100 7        | 622.44   | (15/2 <sup>-</sup> ) |           |                   |                  | Mult.: interpreted by 2013Ha02 As $\Delta J=0$ , $\Delta\pi=\text{yes}$ transition.                                                          |
|                     |                      | 960.2 2      | 39 4         | 382.69   | (13/2 <sup>-</sup> ) | (E1)      |                   | 0.00201          |                                                                                                                                              |
| 1431.878            | (17/2 <sup>+</sup> ) | 88           |              | 1342.92  | (15/2 <sup>+</sup> ) |           |                   |                  | $E_\gamma$ : from ( <sup>28</sup> Si,p2n $\gamma$ ); $\gamma$ absent In ( <sup>55</sup> Mn,4n $\gamma$ ).                                    |
|                     |                      | 310.2 2      | 100 10       | 1121.7   | (15/2 <sup>+</sup> ) |           |                   |                  | absent In ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                                 |
|                     |                      | 533.9 2      | 86 8         | 898.0    | (13/2 <sup>+</sup> ) |           |                   |                  | absent In ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                                 |
| 1510.00             |                      | 887.6 2      | 100 33       | 622.44   | (15/2 <sup>-</sup> ) |           |                   |                  |                                                                                                                                              |
|                     |                      | 1127.3 5     | <100         | 382.69   | (13/2 <sup>-</sup> ) |           |                   |                  |                                                                                                                                              |
| 1583.93             | (21/2 <sup>-</sup> ) | 365.4 2      | 91 7         | 1218.48  | (19/2 <sup>-</sup> ) | (M1(+E2)) |                   | 0.09 5           |                                                                                                                                              |
|                     |                      | 643.9 2      | 100 9        | 940.01   | (17/2 <sup>-</sup> ) | (E2)      |                   | 0.01202          |                                                                                                                                              |
| 1623.37             | (17/2 <sup>+</sup> ) | 113.4 2      | 4.2 8        | 1510.00  |                      |           |                   |                  | from ( <sup>55</sup> Mn,4n $\gamma$ ) only.                                                                                                  |
|                     |                      | 191.4 2      | 50 8         | 1431.878 | (17/2 <sup>+</sup> ) |           |                   |                  | other $E_\gamma(I_\gamma)$ : 192.3 (233 70) from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                          |
|                     |                      | 280.5 2      | 92 8         | 1342.92  | (15/2 <sup>+</sup> ) | (M1)      |                   | 0.286            | other $I_\gamma$ : 126 37 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                            |
|                     |                      |              |              |          |                      |           |                   |                  | Mult.: D from ( <sup>55</sup> Mn,4n $\gamma$ ); however, DCO and anisotropy In ( <sup>28</sup> Si,p2n $\gamma$ ) are consistent with Q also. |
|                     |                      | 404.9 2      | 100 8        | 1218.48  | (19/2 <sup>-</sup> ) | (E1)      |                   | 0.01175          | other $I_\gamma$ : 100 30 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                            |
|                     |                      |              |              |          |                      |           |                   |                  | Mult.: D from ( <sup>55</sup> Mn,4n $\gamma$ ); $\Delta\pi=\text{yes}$ from level scheme.                                                    |

**Adopted Levels, Gammas (continued)**

$\gamma(^{169}\text{Re})$  (continued)

| $E_i(\text{level})$ | $J_i^\pi$            | $E_\gamma^a$                             | $I_\gamma^a$                         | $E_f$                                    | $J_f^\pi$                                                                                    | Mult. &         | $\alpha^\dagger$  | Comments                                                                                                                                                                                                      |
|---------------------|----------------------|------------------------------------------|--------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------|-----------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1623.37             | (17/2 <sup>+</sup> ) | 683.4 2<br>1000.9 2                      | 53 5<br>48 3                         | 940.01<br>622.44                         | (17/2 <sup>-</sup> )<br>(15/2 <sup>-</sup> )                                                 | (E1)            | 0.00186           | from ( <sup>55</sup> Mn,4n $\gamma$ ) only.<br>Mult.: D from ( <sup>55</sup> Mn,4n $\gamma$ ); $\Delta\pi$ =yes from level scheme.                                                                            |
| 1663.44             | 17/2 <sup>+</sup>    | 387.8 2<br>1041.0 2                      | 25 6<br>100 13                       | 1275.61<br>622.44                        | (17/2 <sup>-</sup> )<br>(15/2 <sup>-</sup> )                                                 |                 |                   |                                                                                                                                                                                                               |
| 1764.8              | (21/2 <sup>-</sup> ) | 489.2 2                                  | 100                                  | 1275.61                                  | (17/2 <sup>-</sup> )                                                                         | (E2)            | 0.0231            |                                                                                                                                                                                                               |
| 1799.28             | (19/2 <sup>+</sup> ) | 175.9 2<br>215.3 2<br>367.5 2<br>859.3 2 | 100 12<br>4.0 8<br>6.4 12<br>14.8 12 | 1623.37<br>1583.93<br>1431.878<br>940.01 | (17/2 <sup>+</sup> )<br>(21/2 <sup>-</sup> )<br>(17/2 <sup>+</sup> )<br>(17/2 <sup>-</sup> ) | (M1)<br><br>D   | 1.038             | other $E_\gamma$ (I $\gamma$ ): 368.3 (56 17) In ( <sup>28</sup> Si,p2n $\gamma$ ).<br>Mult.: level scheme requires $\Delta\pi$ =yes.                                                                         |
| 1815.4              |                      | 192.0                                    | 100                                  | 1623.37                                  | (17/2 <sup>+</sup> )                                                                         |                 |                   |                                                                                                                                                                                                               |
| 1882.28             | (23/2 <sup>-</sup> ) | 298.3 2<br>663.8 2                       | 51 3<br>100 7                        | 1583.93<br>1218.48                       | (21/2 <sup>-</sup> )<br>(19/2 <sup>-</sup> )                                                 | (M1)<br>(E2)    | 0.242<br>0.01122  |                                                                                                                                                                                                               |
| 1922.7              | (21/2 <sup>+</sup> ) | 107.0<br>122.8                           |                                      | 1815.4<br>1799.28                        | <br>(19/2 <sup>+</sup> )                                                                     | <br>(M1)        | <br>2.87          | $E_\gamma$ : placement from ( <sup>28</sup> Si,p2n $\gamma$ ), weak $\gamma$ , not confirmed In ( <sup>55</sup> Mn,4n $\gamma$ ).<br>$E_\gamma$ , I $\gamma$ , Mult.: from ( <sup>28</sup> Si,p2n $\gamma$ ). |
| 1991.55             | (21/2 <sup>+</sup> ) | 192.3 2<br>368.2 2<br>773.0 2            | 100 21<br>21 3<br>2.9 7              | 1799.28<br>1623.37<br>1218.48            | (19/2 <sup>+</sup> )<br>(17/2 <sup>+</sup> )<br>(19/2 <sup>-</sup> )                         | <br><br>(E2)    | <br><br>0.0465    |                                                                                                                                                                                                               |
| 2038.4              | (21/2 <sup>+</sup> ) | 374.9 2                                  | 100                                  | 1663.44                                  | 17/2 <sup>+</sup>                                                                            |                 |                   |                                                                                                                                                                                                               |
| 2122.82             | (21/2 <sup>+</sup> ) | 323.6 2<br>690.9 2                       | 76 10<br>100 14                      | 1799.28<br>1431.878                      | (19/2 <sup>+</sup> )<br>(17/2 <sup>+</sup> )                                                 |                 |                   |                                                                                                                                                                                                               |
| 2183.47             | (23/2 <sup>+</sup> ) | (61)<br>191.9 2<br>384.2 2               |                                      | 2122.82<br>1991.55<br>1799.28            | (21/2 <sup>+</sup> )<br>(21/2 <sup>+</sup> )<br>(19/2 <sup>+</sup> )                         |                 |                   |                                                                                                                                                                                                               |
| 2257.71             | (25/2 <sup>-</sup> ) | 375.4 2<br>673.8 2                       | 90 7<br>100 7                        | 1882.28<br>1583.93                       | (23/2 <sup>-</sup> )<br>(21/2 <sup>-</sup> )                                                 | (M1)<br>(E2)    | 0.1304<br>0.01086 |                                                                                                                                                                                                               |
| 2306.5              | (25/2 <sup>+</sup> ) | 123.0 2                                  | 100                                  | 2183.47                                  | (23/2 <sup>+</sup> )                                                                         | (M1)            | 2.86              |                                                                                                                                                                                                               |
| 2321.0              | (25/2 <sup>-</sup> ) | 556.3 2                                  | 100                                  | 1764.8                                   | (21/2 <sup>-</sup> )                                                                         | (E2)            | 0.01688           | other $E_\gamma$ : 554.8 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                                                                              |
| 2462.1              | (27/2 <sup>+</sup> ) | 155.6 2                                  | 100                                  | 2306.5                                   | (25/2 <sup>+</sup> )                                                                         | (M1)            | 1.466             |                                                                                                                                                                                                               |
| 2486.78             | (27/2 <sup>-</sup> ) | 229.1 2<br>604.5 2                       | 72 4<br>100 7                        | 2257.71<br>1882.28                       | (25/2 <sup>-</sup> )<br>(23/2 <sup>-</sup> )                                                 | (M1)<br>(E2)    | 0.498<br>0.01389  |                                                                                                                                                                                                               |
| 2498.0              | (25/2 <sup>+</sup> ) | 459.6 2                                  | 100                                  | 2038.4                                   | (21/2 <sup>+</sup> )                                                                         | (E2)            | 0.0270            |                                                                                                                                                                                                               |
| 2509.4              | (25/2 <sup>+</sup> ) | 471.0 2                                  | 100                                  | 2038.4                                   | (21/2 <sup>+</sup> )                                                                         |                 |                   |                                                                                                                                                                                                               |
| 2602.8              | (29/2 <sup>-</sup> ) | 116.0 2<br>345.0 2                       | 100 5<br>14 4                        | 2486.78<br>2257.71                       | (27/2 <sup>-</sup> )<br>(25/2 <sup>-</sup> )                                                 | (M1)            | 3.38              | other I $\gamma$ : $\leq 33$ from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                                                                          |
| 2657.6              | (29/2 <sup>+</sup> ) | 195.5 2<br>351.2 2                       | 100 11<br>18.9 16                    | 2462.1<br>2306.5                         | (27/2 <sup>+</sup> )<br>(25/2 <sup>+</sup> )                                                 | (M1+E2)<br>(E2) | 0.56 22<br>0.0557 | Mult.: Q intraband $\gamma$ from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                                                                           |
| 2743.7              | (31/2 <sup>-</sup> ) | 140.9 2<br>257.0 <sup>#</sup>            | 100<br>$\leq 11$ @                   | 2602.8<br>2486.78                        | (29/2 <sup>-</sup> )<br>(27/2 <sup>-</sup> )                                                 | (M1)            | 1.94              | $\gamma$ absent In ( <sup>55</sup> Mn,4n $\gamma$ ).                                                                                                                                                          |
| 2896.4              | (31/2 <sup>+</sup> ) | 238.7 2<br>434.3 2                       | 100 14<br>21.9 24                    | 2657.6<br>2462.1                         | (29/2 <sup>+</sup> )<br>(27/2 <sup>+</sup> )                                                 | (M1)<br>(E2)    | 0.445<br>0.0313   | Mult.: from ( <sup>28</sup> Si,p2n $\gamma$ ).<br>Mult.: from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                                              |

Adopted Levels, Gammas (continued)

$\gamma(^{169}\text{Re})$  (continued)

| $E_i(\text{level})$ | $J_i^\pi$            | $E_\gamma^a$ | $I_\gamma^a$ | $E_f$   | $J_f^\pi$            | Mult. &   | $\alpha^\dagger$ | Comments                                                                                                                                            |
|---------------------|----------------------|--------------|--------------|---------|----------------------|-----------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 2903.5              | (29/2 <sup>-</sup> ) | 582.5 2      | 100          | 2321.0  | (25/2 <sup>-</sup> ) | (E2)      | 0.01514          |                                                                                                                                                     |
| 2921.0              |                      | 663.3 2      | 100          | 2257.71 | (25/2 <sup>-</sup> ) |           |                  |                                                                                                                                                     |
| 2923.8              | (33/2 <sup>-</sup> ) | 180.2 2      | 100 6        | 2743.7  | (31/2 <sup>-</sup> ) | (M1)      | 0.970            |                                                                                                                                                     |
|                     |                      | 321.0 2      | 11.4 26      | 2602.8  | (29/2 <sup>-</sup> ) | (E2)      | 0.0722           |                                                                                                                                                     |
| 3025.4              | (29/2 <sup>+</sup> ) | 516.0 2      | 73 9         | 2509.4  | (25/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |
|                     |                      | 527.5 2      | 100 9        | 2498.0  | (25/2 <sup>+</sup> ) | (E2)      | 0.0192           |                                                                                                                                                     |
| 3083.8              | (27/2 <sup>+</sup> ) | 574.4 5      |              | 2509.4  | (25/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |
|                     |                      | 585.7 5      |              | 2498.0  | (25/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |
|                     |                      | 597.0 5      |              | 2486.78 | (27/2 <sup>-</sup> ) |           |                  |                                                                                                                                                     |
|                     |                      | 762.9 5      |              | 2321.0  | (25/2 <sup>-</sup> ) |           |                  |                                                                                                                                                     |
| 3141.2              | (35/2 <sup>-</sup> ) | 217.4 2      | 100 5        | 2923.8  | (33/2 <sup>-</sup> ) | (M1)      | 0.575            |                                                                                                                                                     |
|                     |                      | 397.5 2      | 16.2 15      | 2743.7  | (31/2 <sup>-</sup> ) | (E2)      | 0.0396           | other I $\gamma$ : 33 10 from ( <sup>28</sup> Si,p2n $\gamma$ ).<br>Mult.: Q from ( <sup>28</sup> Si,p2n $\gamma$ ); $\Delta\pi$ from level scheme. |
| 3169.7              | (33/2 <sup>+</sup> ) | 273.3 2      | 100 5        | 2896.4  | (31/2 <sup>+</sup> ) | (M1)      | 0.307            |                                                                                                                                                     |
|                     |                      | 512.0 2      | 25.3 21      | 2657.6  | (29/2 <sup>+</sup> ) | (E2)      | 0.0206           |                                                                                                                                                     |
| 3344.3              | (31/2 <sup>+</sup> ) | 260.5 2      | 100 13       | 3083.8  | (27/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |
|                     |                      | 423.3 5      | <20          | 2921.0  |                      |           |                  |                                                                                                                                                     |
|                     |                      | 440.8 2      | 20 7         | 2903.5  | (29/2 <sup>-</sup> ) |           |                  |                                                                                                                                                     |
| 3396.3              | (37/2 <sup>-</sup> ) | 255.2 2      | 100 5        | 3141.2  | (35/2 <sup>-</sup> ) | (M1(+E2)) | 0.26 12          |                                                                                                                                                     |
|                     |                      | 472.5 2      | 23.7 26      | 2923.8  | (33/2 <sup>-</sup> ) | (E2)      | 0.0252           |                                                                                                                                                     |
| 3458.4              | (33/2 <sup>-</sup> ) | 554.9 2      | 100          | 2903.5  | (29/2 <sup>-</sup> ) | (E2)      | 0.01698          | other I $\gamma$ : 556.8 from ( <sup>28</sup> Si,p2n $\gamma$ ).<br>Mult.: Q intraband $\gamma$ from ( <sup>28</sup> Si,p2n $\gamma$ ).             |
| 3464.6              | (35/2 <sup>+</sup> ) | 294.8 2      | 100 12       | 3169.7  | (33/2 <sup>+</sup> ) | (M1)      | 0.250            |                                                                                                                                                     |
|                     |                      | 568.3 2      | 49 5         | 2896.4  | (31/2 <sup>+</sup> ) | (E2)      | 0.01604          | other I $\gamma$ : 37 6 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                     |
| 3608.1              | (33/2 <sup>+</sup> ) | 582.7 2      | 100          | 3025.4  | (29/2 <sup>+</sup> ) | (E2)      | 0.01513          |                                                                                                                                                     |
| 3686.6              | (39/2 <sup>-</sup> ) | 290.4 2      | 100 8        | 3396.3  | (37/2 <sup>-</sup> ) | (M1)      | 0.260            |                                                                                                                                                     |
|                     |                      | 545.4 2      | 29.2 17      | 3141.2  | (35/2 <sup>-</sup> ) | (E2)      | 0.01769          |                                                                                                                                                     |
| 3720.1              | 35/2 <sup>+</sup>    | 375.8 2      | 100          | 3344.3  | (31/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |
| 3792.1              | (37/2 <sup>+</sup> ) | 327.6 2      | 100 15       | 3464.6  | (35/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |
|                     |                      | 622.5 2      | 61 5         | 3169.7  | (33/2 <sup>+</sup> ) | (E2)      | 0.01298          | other I(623 $\gamma$ ):I(328 $\gamma$ )=35 11:100 30 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                        |
| 3942.6              | (37/2 <sup>-</sup> ) | 484.2 2      | 100          | 3458.4  | (33/2 <sup>-</sup> ) | (E2)      | 0.0237           |                                                                                                                                                     |
| 3946.8              | (37/2 <sup>+</sup> ) | 805.6 2      | 100          | 3141.2  | (35/2 <sup>-</sup> ) |           |                  |                                                                                                                                                     |
| 4005.8              | (41/2 <sup>-</sup> ) | 319.1 2      | 100 4        | 3686.6  | (39/2 <sup>-</sup> ) | (M1)      | 0.202            |                                                                                                                                                     |
|                     |                      | 609.5 2      | 56 4         | 3396.3  | (37/2 <sup>-</sup> ) | (E2)      | 0.01363          | other I $\gamma$ : 35 10 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                    |
| 4106.5              | (39/2 <sup>+</sup> ) | 314.4 2      | 100 9        | 3792.1  | (37/2 <sup>+</sup> ) | (M1)      | 0.210            | Mult.: from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                                      |
|                     |                      | 641.8 2      | 67 5         | 3464.6  | (35/2 <sup>+</sup> ) |           |                  | other I $\gamma$ : 60 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                                                       |
| 4164.3              | (37/2 <sup>-</sup> ) | 705.9 2      | 100          | 3458.4  | (33/2 <sup>-</sup> ) | (E2)      | 0.00979          | Mult.: stretched Q from ( <sup>55</sup> Mn,4n $\gamma$ ); $\Delta\pi$ from level scheme.                                                            |
| 4219.7              | (39/2 <sup>+</sup> ) | 499.7 2      | 100 11       | 3720.1  | 35/2 <sup>+</sup>    |           |                  |                                                                                                                                                     |
|                     |                      | 823.4 2      | 21 5         | 3396.3  | (37/2 <sup>-</sup> ) |           |                  |                                                                                                                                                     |
| 4238.0              | (37/2 <sup>+</sup> ) | 629.9 2      | 100          | 3608.1  | (33/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |
| 4356.0              | (43/2 <sup>-</sup> ) | 350.3 2      | 100 6        | 4005.8  | (41/2 <sup>-</sup> ) | (M1)      | 0.1568           |                                                                                                                                                     |
|                     |                      | 669.4 2      | 44 3         | 3686.6  | (39/2 <sup>-</sup> ) | (E2)      | 0.01102          |                                                                                                                                                     |
| 4434.0              | (41/2 <sup>+</sup> ) | 327.5 2      | 100 11       | 4106.5  | (39/2 <sup>+</sup> ) |           |                  |                                                                                                                                                     |

**Adopted Levels, Gammas (continued)**

$\gamma(^{169}\text{Re})$  (continued)

| $E_i(\text{level})$ | $J_i^\pi$            | $E_\gamma^a$ | $I_\gamma^a$ | $E_f$                       | $J_f^\pi$ | Mult. & | $\alpha^\dagger$ | Comments                                                                                                               |
|---------------------|----------------------|--------------|--------------|-----------------------------|-----------|---------|------------------|------------------------------------------------------------------------------------------------------------------------|
| 4434.0              | (41/2 <sup>+</sup> ) | 641.9 2      | 74 9         | 3792.1 (37/2 <sup>+</sup> ) |           |         |                  | other I(642 $\gamma$ ):I(328 $\gamma$ )=100 30:17 5 from ( <sup>28</sup> Si,p2n $\gamma$ ).                            |
| 4452.1              | (41/2 <sup>-</sup> ) | 509.5 2      | 100          | 3942.6 (37/2 <sup>-</sup> ) | (E2)      | 0.0209  |                  | other E $\gamma$ : 509.0 In ( <sup>28</sup> Si,p2n $\gamma$ ).                                                         |
| 4533.3              | (41/2 <sup>+</sup> ) | 586.4 2      | 19 3         | 3946.8 (37/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 846.7 2      | 100 11       | 3686.6 (39/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
| 4727.2              | (45/2 <sup>-</sup> ) | 371.2 2      | 100 10       | 4356.0 (43/2 <sup>-</sup> ) | (M1+E2)   | 0.09 5  |                  |                                                                                                                        |
|                     |                      | 721.4 2      | 92 6         | 4005.8 (41/2 <sup>-</sup> ) |           |         |                  | other E $\gamma$ : 722.0 from ( <sup>28</sup> Si,p2n $\gamma$ ).                                                       |
| 4728.2              | (43/2 <sup>+</sup> ) | 294.2 2      | 100 13       | 4434.0 (41/2 <sup>+</sup> ) | [M1]      | 0.251   |                  |                                                                                                                        |
|                     |                      | 621.7 2      | 75 6         | 4106.5 (39/2 <sup>+</sup> ) | [E2]      | 0.01302 |                  |                                                                                                                        |
| 4745.9              | (41/2 <sup>-</sup> ) | 581.6 2      | 100 13       | 4164.3 (37/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 803.3 2      | 38 13        | 3942.6 (37/2 <sup>-</sup> ) | (E2)      | 0.00742 |                  | Mult.: Q from ( <sup>55</sup> Mn,4n $\gamma$ ); $\Delta\pi$ from level scheme.                                         |
| 4798.5              | (43/2 <sup>+</sup> ) | 265.2 2      | 100 11       | 4533.3 (41/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 501.0 5      | <8.1         | 4297.5 (39/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 4836.8              | (43/2 <sup>+</sup> ) | 617.1 2      | 100          | 4219.7 (39/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 4867.1              | (41/2 <sup>+</sup> ) | 629.1 2      | 100          | 4238.0 (37/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5015.7              | (45/2 <sup>+</sup> ) | 287.5 2      | 100 11       | 4728.2 (43/2 <sup>+</sup> ) | (M1)      | 0.267   |                  | E $\gamma$ : presumed to be the 287.0 $\gamma$ known In ( <sup>28</sup> Si,p2n $\gamma$ ), but unplaced In that study. |
|                     |                      | 581.6 2      | 83 11        | 4434.0 (41/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5048.6              | (45/2 <sup>-</sup> ) | 596.5 2      | 100          | 4452.1 (41/2 <sup>-</sup> ) | (E2)      | 0.01432 |                  |                                                                                                                        |
| 5079.7              | (45/2 <sup>+</sup> ) | 281.2 2      | 100 8        | 4798.5 (43/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 546.4 2      | 17.5 25      | 4533.3 (41/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5125.3              | (47/2 <sup>-</sup> ) | 398.0 2      | 100 8        | 4727.2 (45/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 769.2 2      | 83 5         | 4356.0 (43/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
| 5298.6              | (47/2 <sup>+</sup> ) | 282.9 2      | 100 13       | 5015.7 (45/2 <sup>+</sup> ) | (M1)      | 0.279   |                  |                                                                                                                        |
|                     |                      | 570.5 2      | 93 8         | 4728.2 (43/2 <sup>+</sup> ) | (E2)      | 0.01590 |                  |                                                                                                                        |
| 5377.5              | (45/2 <sup>-</sup> ) | 631.6 2      | 100          | 4745.9 (41/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
| 5389.1              | (47/2 <sup>+</sup> ) | 309.4 2      | 100 7        | 5079.7 (45/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 590.6 2      | 38 3         | 4798.5 (43/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5426.3              | (45/2 <sup>+</sup> ) | 559.2 2      | 100          | 4867.1 (41/2 <sup>+</sup> ) | (E2)      | 0.01667 |                  |                                                                                                                        |
| 5537.6              | (49/2 <sup>-</sup> ) | 412.3 2      | 90 10        | 5125.3 (47/2 <sup>-</sup> ) | (M1+E2)   | 0.07 4  |                  |                                                                                                                        |
|                     |                      | 810.4 2      | 100 7        | 4727.2 (45/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
| 5545.7              | (47/2 <sup>+</sup> ) | 708.9 2      | 100          | 4836.8 (43/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5595.0              | (49/2 <sup>+</sup> ) | 296.4 2      | 100 9        | 5298.6 (47/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 579.3 2      | 58 7         | 5015.7 (45/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5726.8              | (49/2 <sup>-</sup> ) | 678.2 2      | 100          | 5048.6 (45/2 <sup>-</sup> ) | (E2)      | 0.01070 |                  |                                                                                                                        |
| 5732.4              | (49/2 <sup>+</sup> ) | 343.2 2      | 100 5        | 5389.1 (47/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 652.7 2      | 65 5         | 5079.7 (45/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5912.0              | (51/2 <sup>+</sup> ) | 317.0 2      | 100 12       | 5595.0 (49/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 613.4 2      | 64 8         | 5298.6 (47/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 5973.2              | (51/2 <sup>-</sup> ) | 435.7 2      | 86 14        | 5537.6 (49/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
|                     |                      | 847.9 2      | 100 14       | 5125.3 (47/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
| 6056.5              | (49/2 <sup>+</sup> ) | 630.2 2      | 100          | 5426.3 (45/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |
| 6061.3              | (49/2 <sup>-</sup> ) | 683.8 2      | 100          | 5377.5 (45/2 <sup>-</sup> ) |           |         |                  |                                                                                                                        |
| 6105.3              | (51/2 <sup>+</sup> ) | 372.9 2      | 100 7        | 5732.4 (49/2 <sup>+</sup> ) |           |         |                  |                                                                                                                        |

Adopted Levels, Gammas (continued)

| $\gamma(^{169}\text{Re})$ (continued) |                      |                      |              |        |                      |         |                  |
|---------------------------------------|----------------------|----------------------|--------------|--------|----------------------|---------|------------------|
| $E_i(\text{level})$                   | $J_i^\pi$            | $E_\gamma^a$         | $I_\gamma^a$ | $E_f$  | $J_f^\pi$            | Mult. & | $\alpha^\dagger$ |
| 6105.3                                | (51/2 <sup>+</sup> ) | 716.2 2              | 73 7         | 5389.1 | (47/2 <sup>+</sup> ) |         |                  |
| 6248.9                                | (53/2 <sup>+</sup> ) | 337.0 2              | 100 9        | 5912.0 | (51/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 653.9 2              | 56 4         | 5595.0 | (49/2 <sup>+</sup> ) |         |                  |
| 6315.3                                | (51/2 <sup>+</sup> ) | 769.6 2              | 100          | 5545.7 | (47/2 <sup>+</sup> ) |         |                  |
| 6413.9                                | (53/2 <sup>-</sup> ) | 440.7 2              | 88 13        | 5973.2 | (51/2 <sup>-</sup> ) |         |                  |
|                                       |                      | 876.3 2              | 100 13       | 5537.6 | (49/2 <sup>-</sup> ) |         |                  |
| 6466.5                                | (53/2 <sup>-</sup> ) | 739.7 2              | 100          | 5726.8 | (49/2 <sup>-</sup> ) |         |                  |
| 6516.4                                | (53/2 <sup>+</sup> ) | 411.1 2              | 100 10       | 6105.3 | (51/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 784.1 2              | 100 10       | 5732.4 | (49/2 <sup>+</sup> ) |         |                  |
| 6615.5                                | (55/2 <sup>+</sup> ) | 366.6 2              | 100 8        | 6248.9 | (53/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 703.5 2              | 54 5         | 5912.0 | (51/2 <sup>+</sup> ) |         |                  |
| 6743.0                                | (53/2 <sup>+</sup> ) | 686.5 2              | 100          | 6056.5 | (49/2 <sup>+</sup> ) |         |                  |
| 6812.3                                | (53/2 <sup>-</sup> ) | 751.0 2              | 100          | 6061.3 | (49/2 <sup>-</sup> ) |         |                  |
| 6869.4                                | (55/2 <sup>-</sup> ) | 455.4 2              | 57 5         | 6413.9 | (53/2 <sup>-</sup> ) |         |                  |
|                                       |                      | 896.4 2              | 100 10       | 5973.2 | (51/2 <sup>-</sup> ) |         |                  |
| 6945.0                                | (55/2 <sup>+</sup> ) | 428.6 2              | 100 13       | 6516.4 | (53/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 839.7 2              | 100 13       | 6105.3 | (51/2 <sup>+</sup> ) |         |                  |
| 6998.9                                | (57/2 <sup>+</sup> ) | 383.4 2              | 100 7        | 6615.5 | (55/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 749.9 2              | 64 4         | 6248.9 | (53/2 <sup>+</sup> ) |         |                  |
| 7063.9                                | (55/2 <sup>+</sup> ) | 748.6 2              | 100          | 6315.3 | (51/2 <sup>+</sup> ) |         |                  |
| 7248.1                                | (57/2 <sup>-</sup> ) | 781.6 2              | 100          | 6466.5 | (53/2 <sup>-</sup> ) | (E2)    | 0.00786          |
| 7312.9                                | (57/2 <sup>-</sup> ) | 443.4 2              | 63 13        | 6869.4 | (55/2 <sup>-</sup> ) |         |                  |
|                                       |                      | 898.9 2              | 100 13       | 6413.9 | (53/2 <sup>-</sup> ) |         |                  |
| 7398.3                                | (57/2 <sup>+</sup> ) | 453.4 2              | 100 20       | 6945.0 | (55/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 881.8 2              | 100 20       | 6516.4 | (53/2 <sup>+</sup> ) |         |                  |
| 7416.3                                | (59/2 <sup>+</sup> ) | 417.5 2              | 100 6        | 6998.9 | (57/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 800.8 2              | 76 6         | 6615.5 | (55/2 <sup>+</sup> ) |         |                  |
| 7494.3                                | (57/2 <sup>+</sup> ) | 751.3 5              | 100          | 6743.0 | (53/2 <sup>+</sup> ) |         |                  |
| 7635.2                                | (57/2 <sup>-</sup> ) | 822.9 2              | 100          | 6812.3 | (53/2 <sup>-</sup> ) |         |                  |
| 7755.9                                | (59/2 <sup>-</sup> ) | 443.0 2              | 36 7         | 7312.9 | (57/2 <sup>-</sup> ) |         |                  |
|                                       |                      | 886.5 2              | 100 7        | 6869.4 | (55/2 <sup>-</sup> ) |         |                  |
| 7785.3                                | (59/2 <sup>+</sup> ) | 721.4 2              | 100          | 7063.9 | (55/2 <sup>+</sup> ) |         |                  |
| 7838.0?                               | (59/2 <sup>+</sup> ) | 893.0 <sup>b</sup> 5 | 100          | 6945.0 | (55/2 <sup>+</sup> ) |         |                  |
| 7843.6                                | (61/2 <sup>+</sup> ) | 427.3 2              | 100 8        | 7416.3 | (59/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 844.8 2              | 77 8         | 6998.9 | (57/2 <sup>+</sup> ) |         |                  |
| 8024.0                                |                      | 775.9 5              | 100          | 7248.1 | (57/2 <sup>-</sup> ) |         |                  |
| 8062.1                                | (61/2 <sup>-</sup> ) | 814.0 2              | 100          | 7248.1 | (57/2 <sup>-</sup> ) | (E2)    | 0.00721          |
| 8185.6                                | (61/2 <sup>-</sup> ) | 429.7 2              | 75 13        | 7755.9 | (59/2 <sup>-</sup> ) |         |                  |
|                                       |                      | 872.8 2              | 100 13       | 7312.9 | (57/2 <sup>-</sup> ) |         |                  |
| 8298.5                                | (61/2 <sup>+</sup> ) | 804.2 5              | 100          | 7494.3 | (57/2 <sup>+</sup> ) |         |                  |
| 8311.5                                | (63/2 <sup>+</sup> ) | 467.9 2              | 60 20        | 7843.6 | (61/2 <sup>+</sup> ) |         |                  |
|                                       |                      | 895.2 2              | 100 10       | 7416.3 | (59/2 <sup>+</sup> ) |         |                  |
| 8316.3?                               | (61/2 <sup>+</sup> ) | 918.0 <sup>b</sup> 5 | 100          | 7398.3 | (57/2 <sup>+</sup> ) |         |                  |

**Adopted Levels, Gammas (continued)**

$\gamma(^{169}\text{Re})$  (continued)

| $E_i(\text{level})$ | $J_i^\pi$            | $E_\gamma^a$         | $I_\gamma^a$ | $E_f$  | $J_f^\pi$            | $E_i(\text{level})$ | $J_i^\pi$            | $E_\gamma^a$ | $I_\gamma^a$ | $E_f$   | $J_f^\pi$            |
|---------------------|----------------------|----------------------|--------------|--------|----------------------|---------------------|----------------------|--------------|--------------|---------|----------------------|
| 8554.1              | (63/2 <sup>+</sup> ) | 768.8 2              | 100          | 7785.3 | (59/2 <sup>+</sup> ) | 9295.7              | (67/2 <sup>+</sup> ) | 984.1 5      | 100          | 8311.5  | (63/2 <sup>+</sup> ) |
| 8626.3              | (63/2 <sup>-</sup> ) | 870.4                | 100          | 7755.9 | (59/2 <sup>-</sup> ) | 9395.8              | (67/2 <sup>+</sup> ) | 841.7 2      | 100          | 8554.1  | (63/2 <sup>+</sup> ) |
| 8778.6              | (65/2 <sup>+</sup> ) | 467.0 2              | 71 29        | 8311.5 | (63/2 <sup>+</sup> ) | 9741.5              |                      | 880.0 5      | 100          | 8861.5  |                      |
|                     |                      | 934.9 2              | 100 14       | 7843.6 | (61/2 <sup>+</sup> ) | 9812.6              | (69/2 <sup>-</sup> ) | 894.0 2      | 100          | 8918.6  | (65/2 <sup>-</sup> ) |
| 8861.5              |                      | 799.3 5              |              | 8062.1 | (61/2 <sup>-</sup> ) | 10307.0             | (71/2 <sup>+</sup> ) | 911.1 5      | 100          | 9395.8  | (67/2 <sup>+</sup> ) |
|                     |                      | 837.5 5              |              | 8024.0 |                      | 10755.8             | (73/2 <sup>-</sup> ) | 943.2 5      | 100          | 9812.6  | (69/2 <sup>-</sup> ) |
| 8918.6              | (65/2 <sup>-</sup> ) | 856.5 2              | 100          | 8062.1 | (61/2 <sup>-</sup> ) | 11286.0             | (75/2 <sup>+</sup> ) | 979.0 5      | 100          | 10307.0 | (71/2 <sup>+</sup> ) |
| 9137.5?             | (65/2 <sup>+</sup> ) | 839.0 <sup>b</sup> 5 | 100          | 8298.5 | (61/2 <sup>+</sup> ) | 11764.8             | (77/2 <sup>-</sup> ) | 1009.0 5     | 100          | 10755.8 | (73/2 <sup>-</sup> ) |

<sup>†</sup> Additional information 1.

<sup>‡</sup> If No value given it was assumed  $\delta=1.00$  for E2/M1,  $\delta=1.00$  for E3/M2 and  $\delta=0.10$  for any other mixed multiplicities.

# From <sup>144</sup>Sm(<sup>28</sup>Si,p2n $\gamma$ ). Authors report that uncertainties range from 0.1 to 0.5 keV. the evaluator assigns 0.5 keV uncertainty to all these data for the purpose of calculating level energies.

@ From <sup>144</sup>Sm(<sup>28</sup>Si,p2n $\gamma$ ), assigning  $\Delta I_\gamma=30\%$  In cases where authors did not state branching ratio (authors report  $\Delta I_\gamma=5\%$  to 30%).

& From <sup>144</sup>Sm(<sup>28</sup>Si,p2n $\gamma$ ), except As noted;  $\Delta J$  based on measured DCO ratios and  $\gamma$  anisotropy,  $\Delta\pi=(\text{No})$  assigned by evaluator for intraband transitions.

<sup>a</sup> From <sup>118</sup>Sn(<sup>55</sup>Mn,4n $\gamma$ ), except As noted.

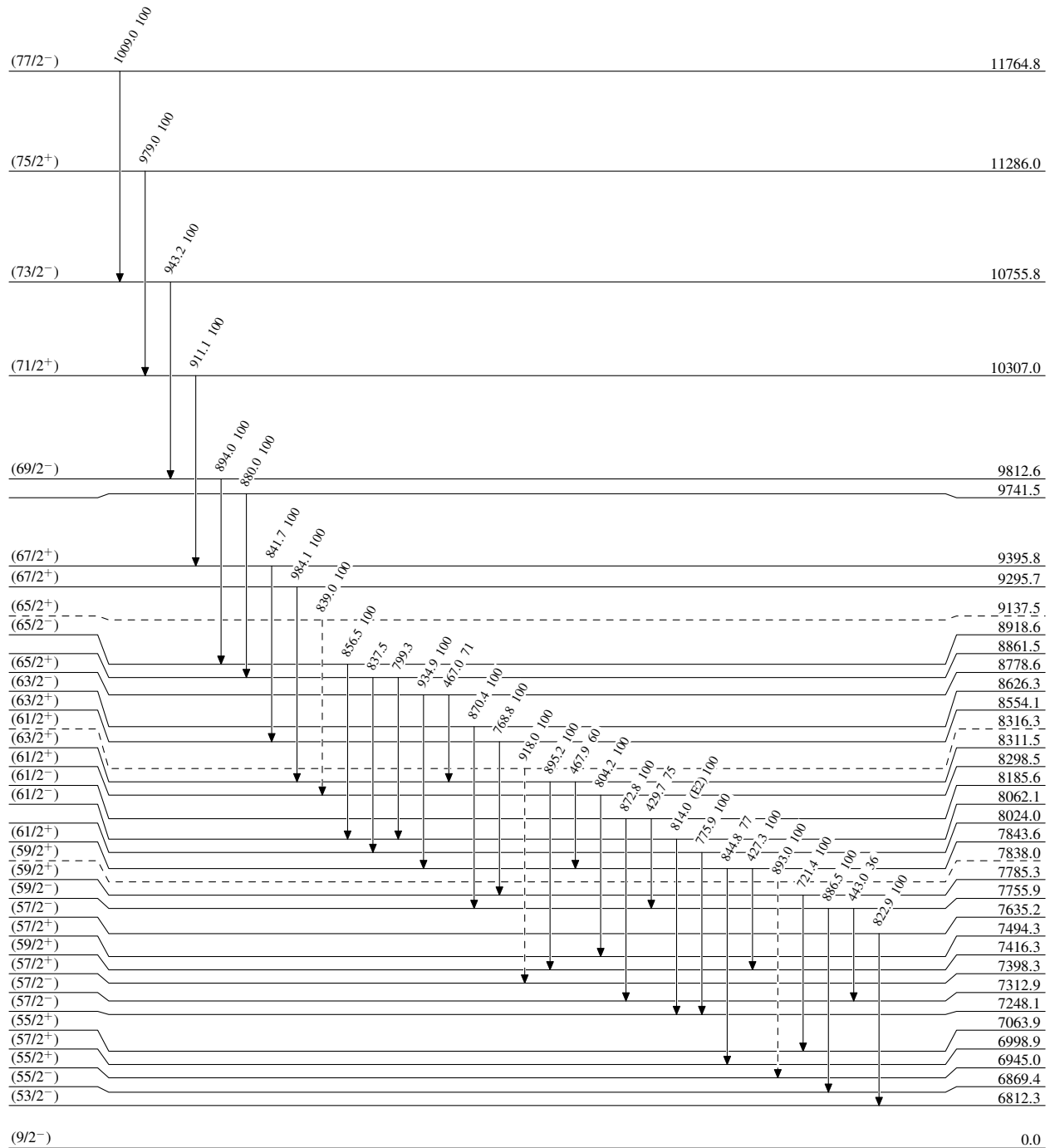
<sup>b</sup> Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Legend

Level Scheme

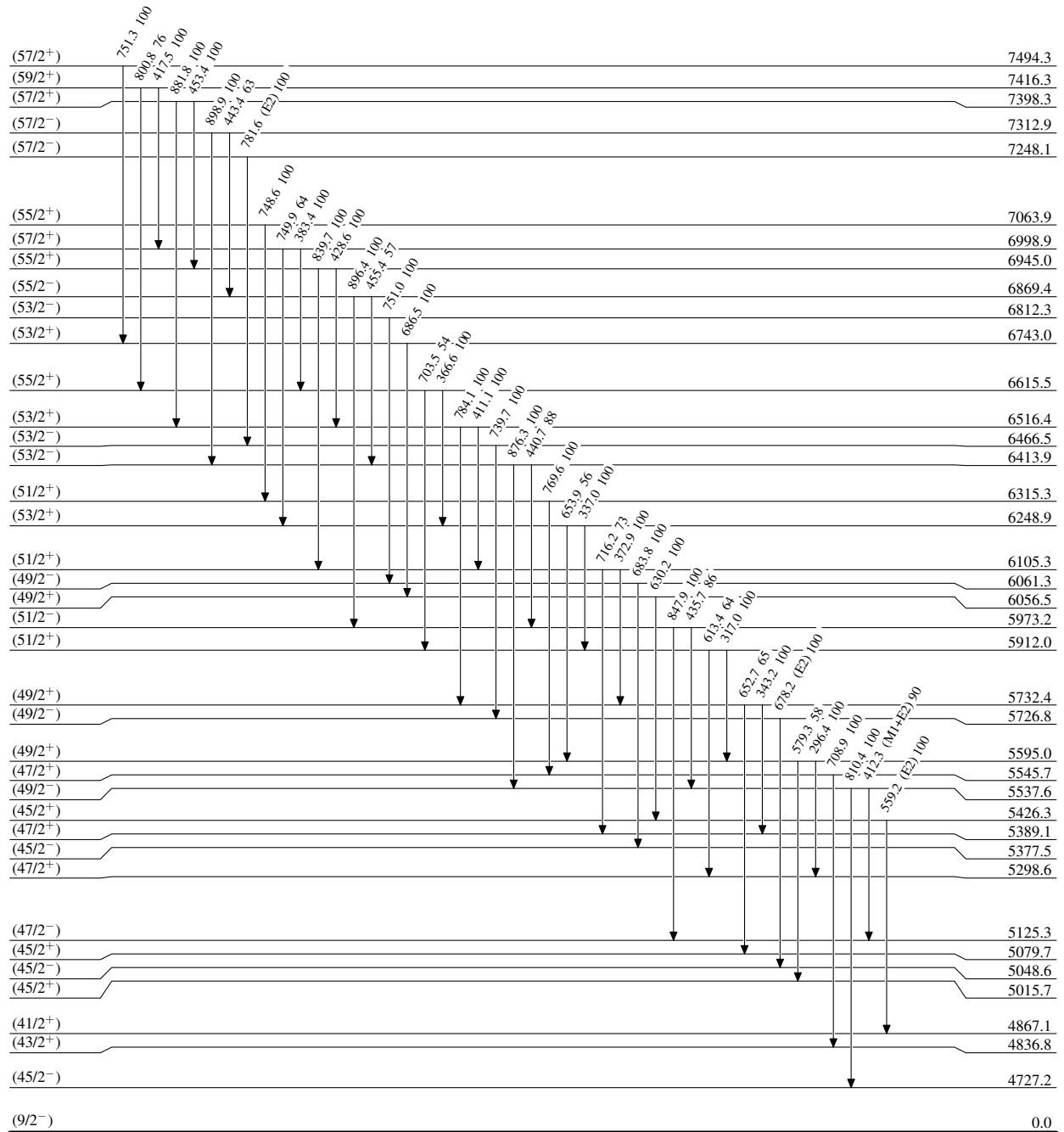
Intensities: Relative photon branching from each level

-----►  $\gamma$  Decay (Uncertain)

Adopted Levels, Gammas

## Level Scheme (continued)

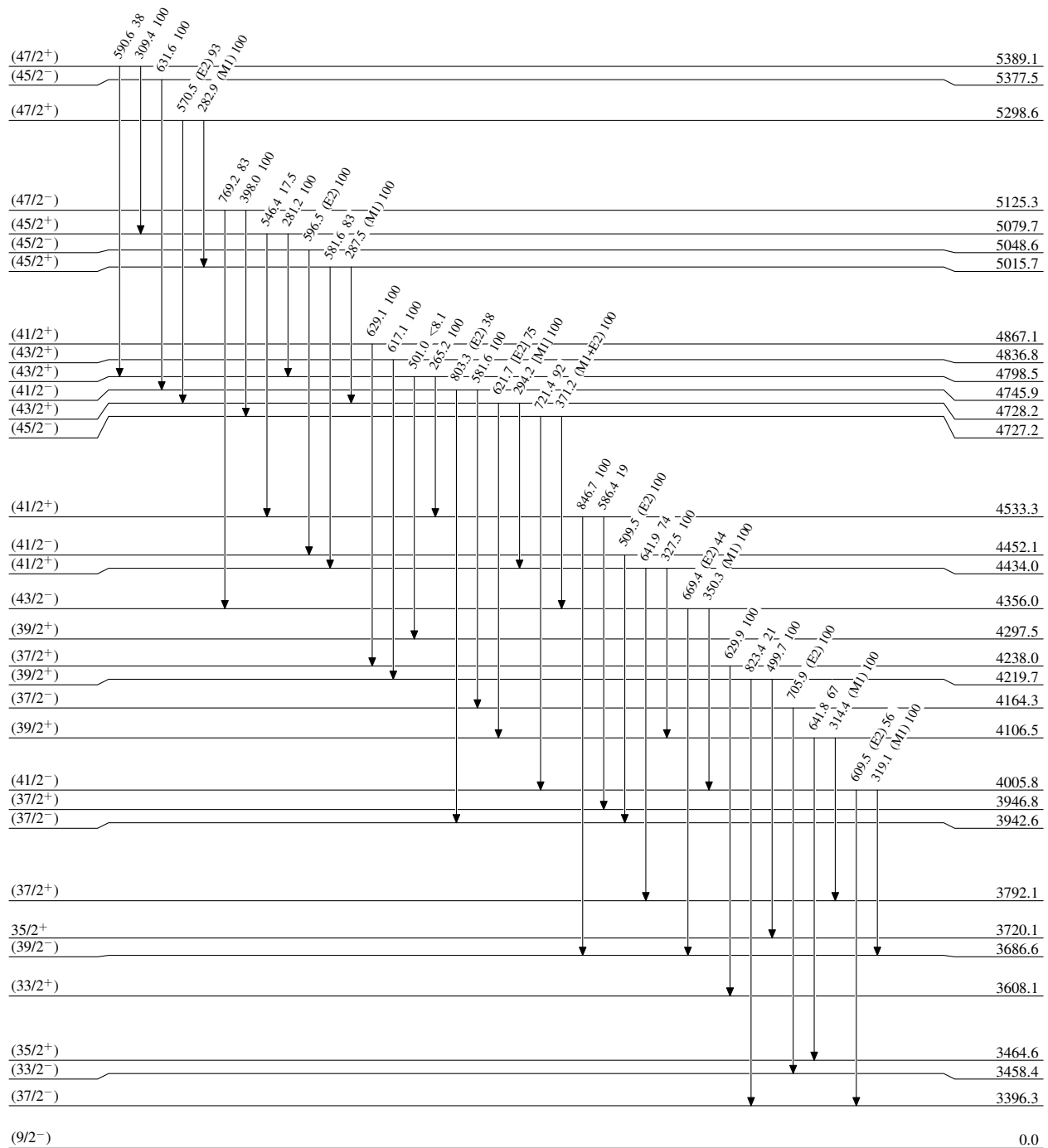
Intensities: Relative photon branching from each level



8.1 s 5

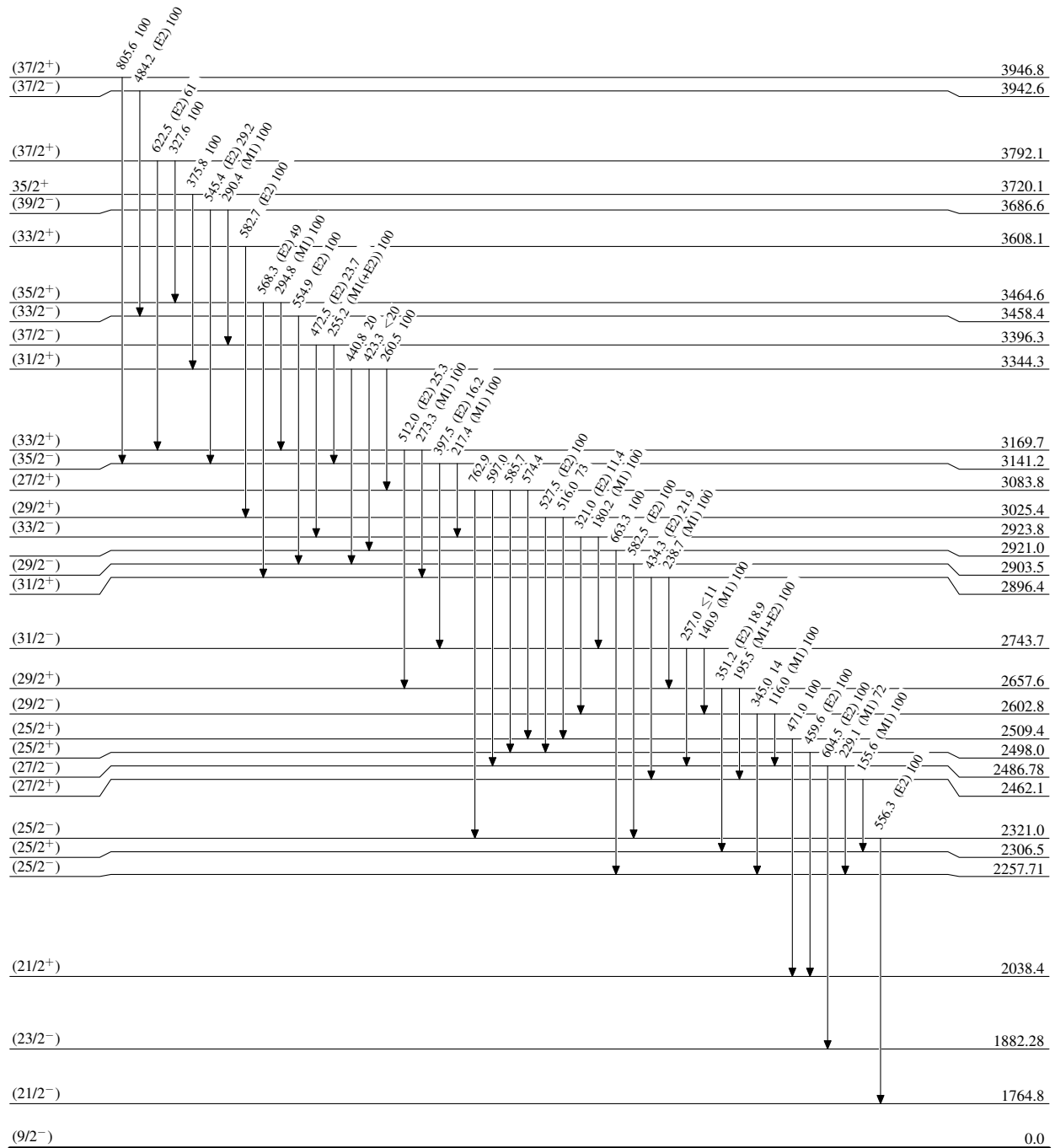
**Adopted Levels, Gammas****Level Scheme (continued)**

Intensities: Relative photon branching from each level



**Adopted Levels, Gammas****Level Scheme (continued)**

Intensities: Relative photon branching from each level

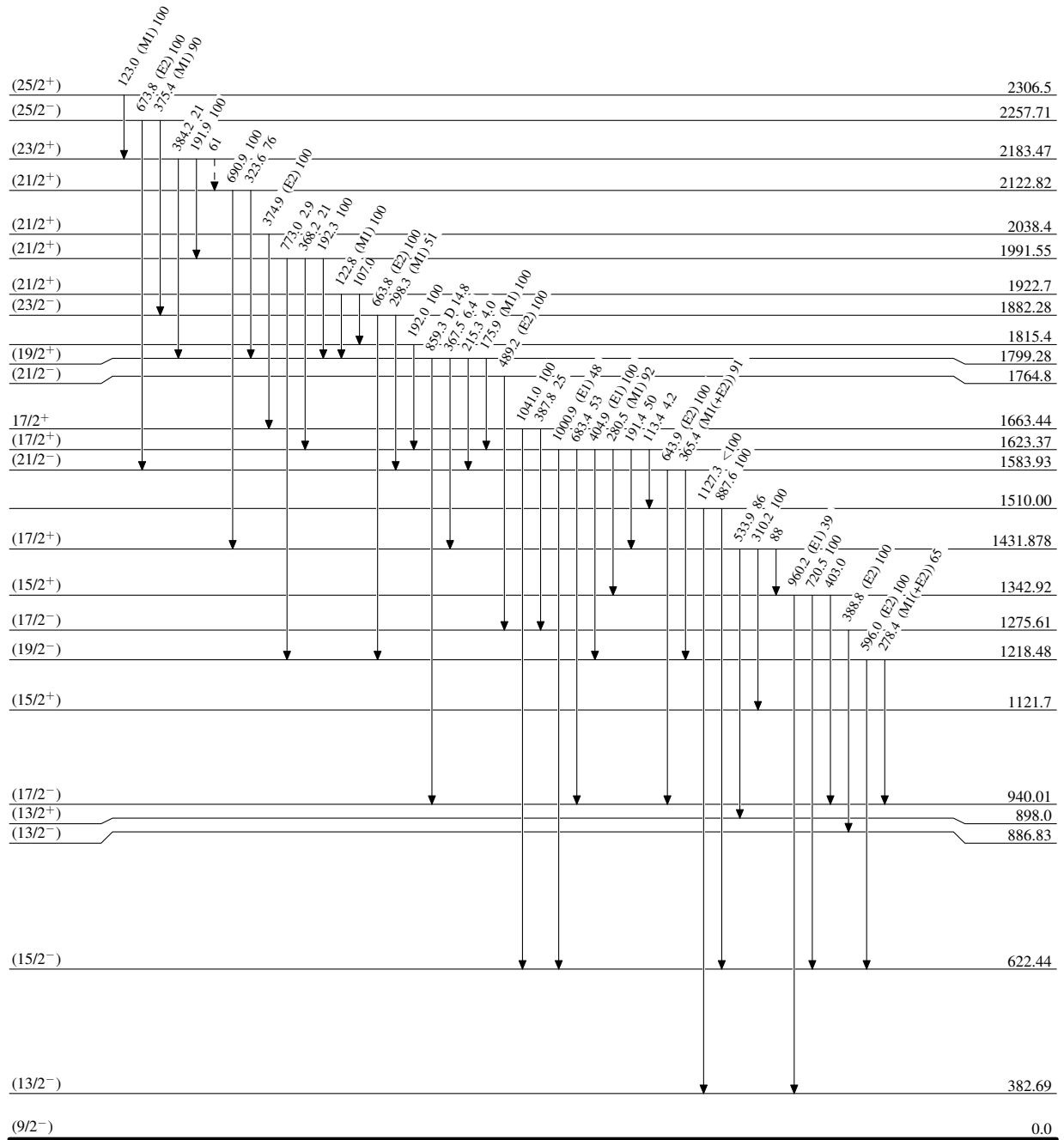


**Adopted Levels, Gammas**

Legend

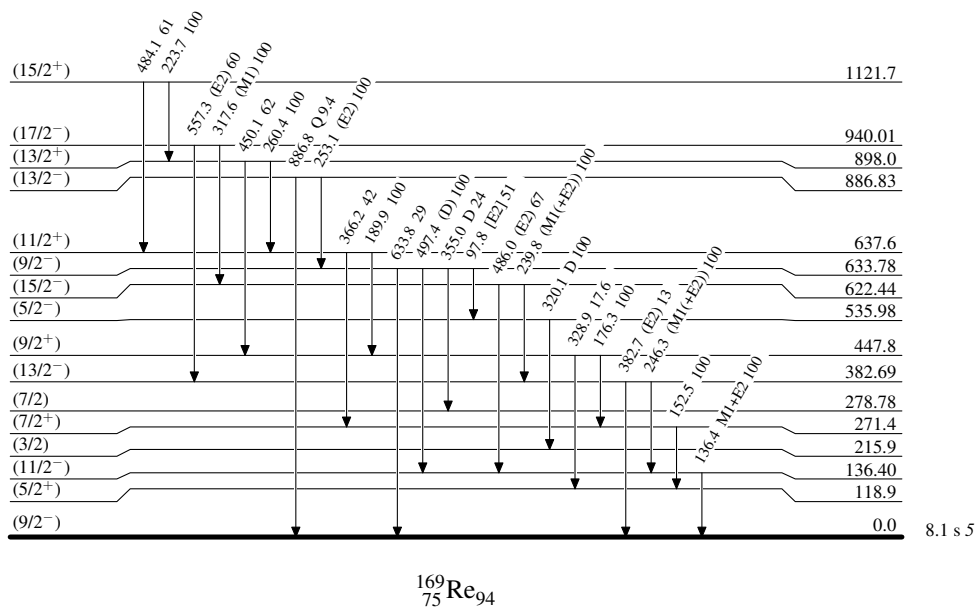
**Level Scheme (continued)**

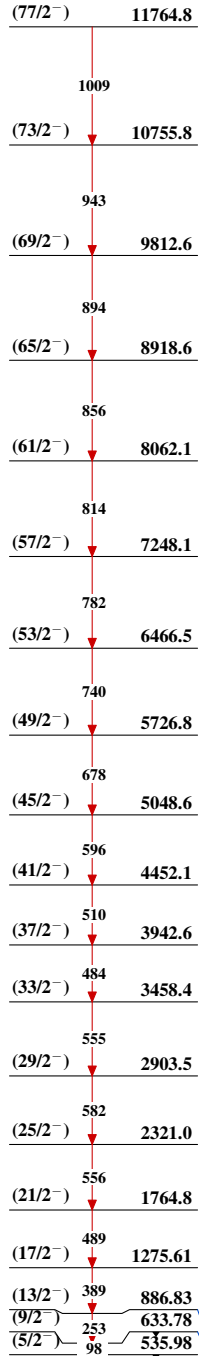
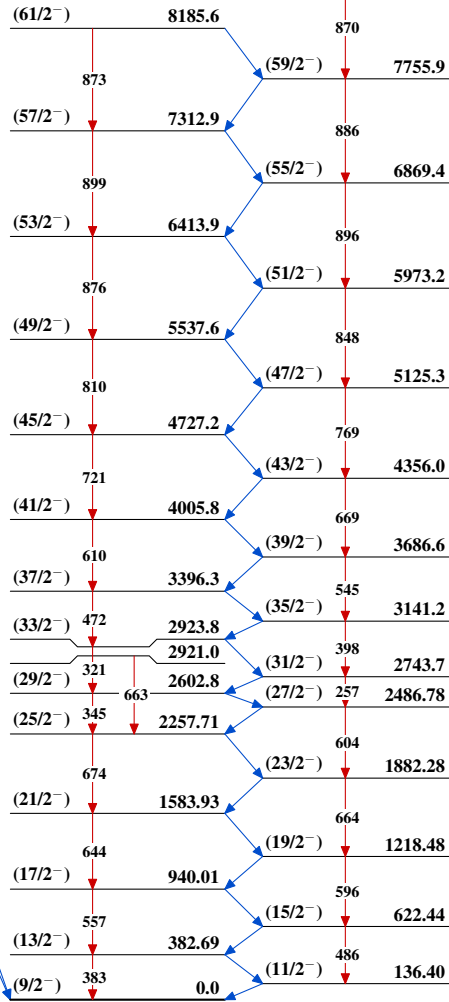
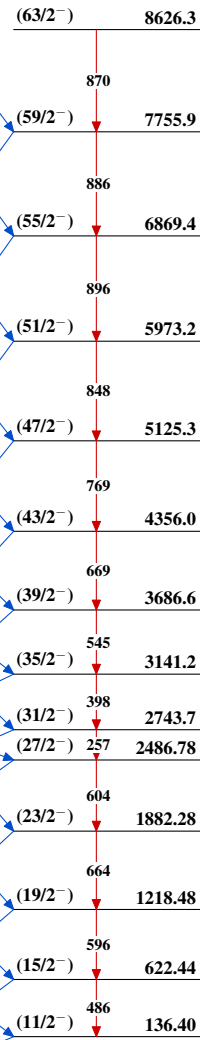
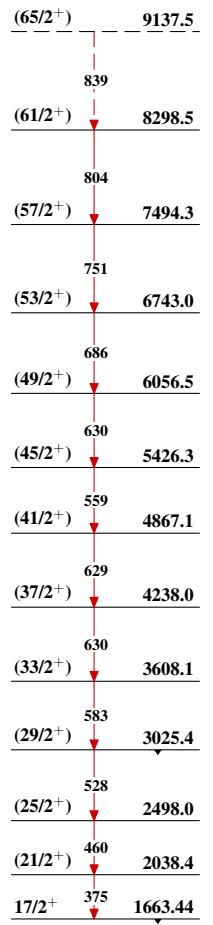
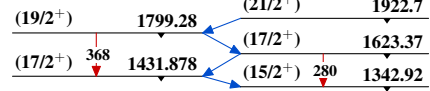
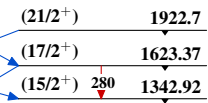
Intensities: Relative photon branching from each level

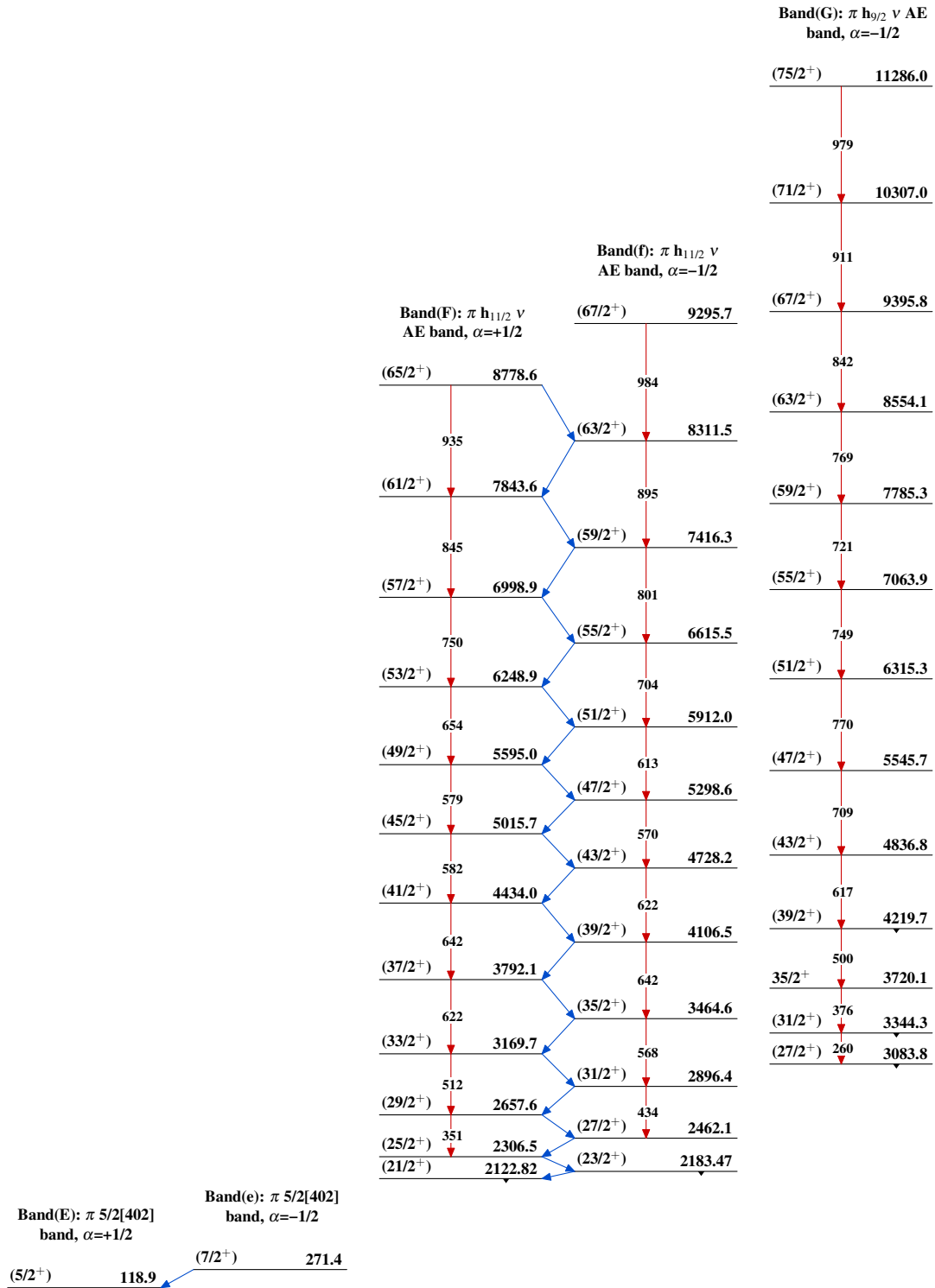
-----►  $\gamma$  Decay (Uncertain)

**Adopted Levels, Gammas****Level Scheme (continued)**

Intensities: Relative photon branching from each level



Adopted Levels, Gammas**Band(A): 1/2[541] band  
(2002Zh42)****Band(B): 9/2[514],  
 $\alpha=+1/2$  band (2002Zh42)****Band(b): 9/2[514],  
 $\alpha=-1/2$  band (2002Zh42)****Band(D):  $\pi$  1/2[660]  
band****Band(C):  $\alpha=+1/2$ , 3  
quasiparticle band  
(2002Zh42)****Band(c):  $\alpha=-1/2$ , 3  
quasiparticle band  
(2002Zh42)**

Adopted Levels, Gammas (continued)

Adopted Levels, Gammas (continued)