

(HI,xn $\gamma$ ) 2004Sm02

| Type            | Author                | History | Citation             | Literature Cutoff Date |
|-----------------|-----------------------|---------|----------------------|------------------------|
| Full Evaluation | J. Katakura, Z. D. Wu |         | NDS 109, 1655 (2008) | 1-Apr-2008             |

Data set based on the XUNDL data set compiled by J. Roediger and B. Singh (McMaster), April 29, 2004.

Unless otherwise noted, the data are taken from [2004Sm02](#).

Includes (HI,xpyn $\gamma$ ).

**2004Sm02:**  $^{64}\text{Zn}(^{64}\text{Zn},2p2n\gamma)$ ; E=260 MeV; 750  $\mu\text{g}/\text{cm}^2$ ; measured  $E\gamma$ ,  $I\gamma$ ,  $\gamma\gamma$  coin,  $\gamma(\theta)$ , angular intensity ratios, particle- $\gamma$  coin; The gammasphere detector array of 101 Compton-suppressed Ge detectors and microball array of 95 CsI(Tl) scintillators for particle detection.

**1986Yi01:**  $^{54}\text{Fe}(^{74}\text{Se},2p2n\gamma)$  E=300 MeV; recoil separator, Ge; measured  $E\gamma$ ,  $\gamma\gamma$  coin,  $\gamma$ -residual-nucleus-coin.

**1986IsZR:**  $^{92}\text{Mo}(^{35}\text{Cl},p2n\gamma)$ ; Ge, charged-particle multiplicity filter; measured  $E\gamma$ ,  $\gamma\gamma$  coin,  $\gamma(\theta)$ , DSA.

**1995Ma96:**  $^{92}\text{Mo}(^{35}\text{Cl},p2n\gamma)$  E=145 MeV; Ge, charged-particle multiplicity filter; measured  $\gamma$ ,  $\gamma(\theta)$ , DSA.

$^{124}\text{Ce}$  Levels

Quasiparticle notations:

- A:  $\nu 5/2[402]$ ,  $\alpha=+1/2$ .
- B:  $\nu 5/2[402]$ ,  $\alpha=-1/2$ .
- C:  $\nu 3/2[411]$ ,  $\alpha=+1/2$ .
- D:  $\nu 3/2[411]$ ,  $\alpha=-1/2$ .
- E:  $\nu 7/2[523]$ ,  $\alpha=-1/2$ .
- F:  $\nu 7/2[523]$ ,  $\alpha=+1/2$ .
- G:  $\nu 5/2[532]$ ,  $\alpha=-1/2$ .
- H:  $\nu 5/2[532]$ ,  $\alpha=+1/2$ .
- a:  $\pi 1/2[420]$ ,  $\alpha=+1/2$ .
- b:  $\pi 1/2[420]$ ,  $\alpha=-1/2$ .
- c:  $\pi 5/2[413]$ ,  $\alpha=-1/2$ .
- d:  $\pi 5/2[413]$ ,  $\alpha=+1/2$ .
- e:  $\pi 3/2[541]$ ,  $\alpha=-1/2$ .
- f:  $\pi 3/2[541]$ ,  $\alpha=+1/2$ .
- g:  $\pi 1/2[550]$ ,  $\alpha=-1/2$ .
- h:  $\pi 1/2[550]$ ,  $\alpha=+1/2$ .

| E(level) <sup>†</sup>  | J $\pi$ &          | T <sub>1/2</sub>        | Comments   |
|------------------------|--------------------|-------------------------|--|
| 0.0 <sup>‡</sup>       | 0 <sup>+</sup>     | 6 s 2                   |  |
| 141.90 <sup>‡</sup> 20 | 2 <sup>+</sup>     | 0.88 <sup>a</sup> ns 19 |  |
| 447.8 <sup>‡</sup> 3   | 4 <sup>+</sup>     | 19 <sup>a</sup> ps 6    | T <sub>1/2</sub> : Upper limit because of insufficient correction of long-lived component. |
| 891.9 <sup>‡</sup> 4   | 6 <sup>+</sup>     |                         |  |
| 1450.7 <sup>‡</sup> 4  | 8 <sup>+</sup>     |                         |  |
| 1849.8 <sup>@</sup> 5  | (7 <sup>-</sup> )  |                         |  |
| 2100.9 <sup>‡</sup> 5  | 10 <sup>+</sup>    |                         |  |
| 2127.7 <sup>@</sup> 5  | (9 <sup>-</sup> )  |                         |  |
| 2183.9 <sup>#</sup> 5  | (8 <sup>+</sup> )  |                         |  |
| 2509.9 <sup>@</sup> 5  | (11 <sup>-</sup> ) |                         |  |
| 2600.6 <sup>#</sup> 5  | (10 <sup>+</sup> ) |                         |  |
| 2818.3 <sup>‡</sup> 5  | 12 <sup>+</sup>    |                         |  |
| 2984.1 <sup>@</sup> 5  | (13 <sup>-</sup> ) |                         |  |
| 3072.5 <sup>#</sup> 5  | (12 <sup>+</sup> ) |                         |  |

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(HL,xny) **2004Sm02** (continued)

$^{124}\text{Ce}$  Levels (continued)

| E(level) <sup>†</sup> | J <sup>π&amp;</sup> | E(level) <sup>†</sup> | J <sup>π&amp;</sup> | E(level) <sup>†</sup>  | J <sup>π&amp;</sup> | E(level) <sup>†</sup>   | J <sup>π&amp;</sup> |
|-----------------------|---------------------|-----------------------|---------------------|------------------------|---------------------|-------------------------|---------------------|
| 3544.0 <sup>@</sup> 6 | (15 <sup>-</sup> )  | 4916.7 <sup>@</sup> 6 | (19 <sup>-</sup> )  | 6788.2 <sup>‡</sup> 7  | (22 <sup>+</sup> )  | 9334.7 <sup>#</sup> 19  | (28 <sup>+</sup> )  |
| 3544.6 <sup>‡</sup> 5 | 14 <sup>+</sup>     | 4997.6 <sup>‡</sup> 6 | 18 <sup>+</sup>     | 7304.7 <sup>#</sup> 12 | (24 <sup>+</sup> )  | 9733.7 <sup>@</sup> 16  | (29 <sup>-</sup> )  |
| 3592.8 <sup>#</sup> 5 | (14 <sup>+</sup> )  | 5584.5 <sup>#</sup> 6 | (20 <sup>+</sup> )  | 7577.6 <sup>@</sup> 7  | (25 <sup>-</sup> )  | 10177.2 <sup>‡</sup> 19 | (28 <sup>+</sup> )  |
| 4182.9 <sup>#</sup> 6 | (16 <sup>+</sup> )  | 5724.2 <sup>@</sup> 7 | (21 <sup>-</sup> )  | 7818.2 <sup>‡</sup> 12 | (24 <sup>+</sup> )  | 10483.7 <sup>#</sup> 21 | (30 <sup>+</sup> )  |
| 4189.3 <sup>@</sup> 6 | (17 <sup>-</sup> )  | 5848.2 <sup>‡</sup> 7 | 20 <sup>+</sup>     | 8284.7 <sup>#</sup> 16 | (26 <sup>+</sup> )  | 10921.7 <sup>@</sup> 19 | (31 <sup>-</sup> )  |
| 4239.2 <sup>‡</sup> 6 | 16 <sup>+</sup>     | 6402.7 <sup>#</sup> 7 | (22 <sup>+</sup> )  | 8620.7 <sup>@</sup> 13 | (27 <sup>-</sup> )  | 11502.2 <sup>‡</sup> 21 | (30 <sup>+</sup> )  |
| 4846.2 <sup>#</sup> 6 | (18 <sup>+</sup> )  | 6611.2 <sup>@</sup> 7 | (23 <sup>-</sup> )  | 8947.2 <sup>‡</sup> 16 | (26 <sup>+</sup> )  | 11734.7 <sup>#</sup> 24 | (32 <sup>+</sup> )  |

<sup>†</sup> From least-squares fit to E<sub>γ</sub>'s (by compilers).

<sup>‡</sup> Band(A): g.s. band. Quasiparticle vacuum at low spins; possible EF neutron alignment at higher spins.

<sup>#</sup> Band(B): K<sup>π</sup>=2<sup>+</sup>; πfg (?). At higher spins possible alignment of νEF and/or πeh.

<sup>@</sup> Band(C): K<sup>π</sup>=3<sup>-</sup>; π3/2[541]⊗π3/2[422]. At higher spins possible alignment of νEF and/or πfg.

& These are those reported by 2004Sm02 and based on the listed γ multiplicities and the usual considerations of band structure.

<sup>a</sup> From DSA of E<sub>γ</sub> (1995Ma96).

γ( $^{124}\text{Ce}$ )

R: angular intensity ratio at angles near 90° and 40°; 1.3 for ΔJ=2, Q and 0.7 for ΔJ=1, D.

| E <sub>γ</sub> | I <sub>γ</sub> | E <sub>i</sub> (level) | J <sub>i</sub> <sup>π</sup> | E <sub>f</sub> | J <sub>f</sub> <sup>π</sup> | Mult. <sup>†</sup> | Comments  |
|----------------|----------------|------------------------|-----------------------------|----------------|-----------------------------|--------------------|---|
| 141.9 2        | 100 2          | 141.90                 | 2 <sup>+</sup>              | 0.0            | 0 <sup>+</sup>              | E2                 | R=1.15 2  |
| 277.8 2        | 1.9 6          | 2127.7                 | (9 <sup>-</sup> )           | 1849.8         | (7 <sup>-</sup> )           |                    |   |
| 305.9 2        | 59 1           | 447.8                  | 4 <sup>+</sup>              | 141.90         | 2 <sup>+</sup>              | E2                 | R=1.24 2  |
| 382.5 2        | 7.7 3          | 2509.9                 | (11 <sup>-</sup> )          | 2127.7         | (9 <sup>-</sup> )           | Q                  | R=1.52 6  |
| 408.7 2        | 3.2 2          | 2509.9                 | (11 <sup>-</sup> )          | 2100.9         | 10 <sup>+</sup>             | D                  | R=0.75 4  |
| 416.6 2        | 4 1            | 2600.6                 | (10 <sup>+</sup> )          | 2183.9         | (8 <sup>+</sup> )           |                    |   |
| 444.1 2        | 57 1           | 891.9                  | 6 <sup>+</sup>              | 447.8          | 4 <sup>+</sup>              | Q                  | R=1.28 3  |
| 472.3 2        | 4 1            | 3072.5                 | (12 <sup>+</sup> )          | 2600.6         | (10 <sup>+</sup> )          | Q                  | R=1.6 1   |
| 474.2 2        | 8.7 6          | 2984.1                 | (13 <sup>-</sup> )          | 2509.9         | (11 <sup>-</sup> )          | Q                  | R=1.41 2  |
| 520.3 2        | 5.8 4          | 3592.8                 | (14 <sup>+</sup> )          | 3072.5         | (12 <sup>+</sup> )          |                    |   |
| 558.9 2        | 50 5           | 1450.7                 | 8 <sup>+</sup>              | 891.9          | 6 <sup>+</sup>              | Q                  | R=1.56 4  |
| 559.9 2        | 6 1            | 3544.0                 | (15 <sup>-</sup> )          | 2984.1         | (13 <sup>-</sup> )          | Q                  | R=1.46 3  |
| 590.1 2        | 3.3 8          | 4182.9                 | (16 <sup>+</sup> )          | 3592.8         | (14 <sup>+</sup> )          | Q                  | R=1.6 2   |
| 645.3 2        | 3.3 6          | 4189.3                 | (17 <sup>-</sup> )          | 3544.0         | (15 <sup>-</sup> )          | Q                  | R=1.32 6  |
| 649.6 2        | 33 1           | 2100.9                 | 10 <sup>+</sup>             | 1450.7         | 8 <sup>+</sup>              | Q                  | R=1.47 7  |
|                |                |                        |                             |                |                             |                    | E <sub>γ</sub> : Level-energy difference=650.3. |
| 663.3 2        | 2.7 7          | 4846.2                 | (18 <sup>+</sup> )          | 4182.9         | (16 <sup>+</sup> )          | Q                  | R=1.6 1   |
| 677.4 2        | 5.8 3          | 2127.7                 | (9 <sup>-</sup> )           | 1450.7         | 8 <sup>+</sup>              | D                  | R=0.82 3  |
| 694.6 2        | 11 1           | 4239.2                 | 16 <sup>+</sup>             | 3544.6         | 14 <sup>+</sup>             | Q                  | R=1.26 4  |
| 717.4 2        | 21 1           | 2818.3                 | 12 <sup>+</sup>             | 2100.9         | 10 <sup>+</sup>             | Q                  | R=1.34 8  |
| 726.3 2        | 15 1           | 3544.6                 | 14 <sup>+</sup>             | 2818.3         | 12 <sup>+</sup>             | Q                  | R=1.39 8  |
| 727.4 2        | 2.0 4          | 4916.7                 | (19 <sup>-</sup> )          | 4189.3         | (17 <sup>-</sup> )          | Q                  | R=1.32 5  |
| 738.3 2        | 1.6 4          | 5584.5                 | (20 <sup>+</sup> )          | 4846.2         | (18 <sup>+</sup> )          | Q                  | R=1.6 1   |
| 758.3 2        | 8 1            | 4997.6                 | 18 <sup>+</sup>             | 4239.2         | 16 <sup>+</sup>             | Q                  | R=1.41 6  |
| 807.5 2        | 1.3 2          | 5724.2                 | (21 <sup>-</sup> )          | 4916.7         | (19 <sup>-</sup> )          |                    |   |
| 818.2 2        | 1.3 4          | 6402.7                 | (22 <sup>+</sup> )          | 5584.5         | (20 <sup>+</sup> )          |                    |   |
| 850.6 2        | 3.7 2          | 5848.2                 | 20 <sup>+</sup>             | 4997.6         | 18 <sup>+</sup>             | Q                  | R=1.34 7  |
| 887.0 2        | 0.5 1          | 6611.2                 | (23 <sup>-</sup> )          | 5724.2         | (21 <sup>-</sup> )          |                    |   |

Continued on next page (footnotes at end of table)

**(HI,xn $\gamma$ ) 2004Sm02 (continued)** $\gamma(^{124}\text{Ce})$  (continued)

| $E_\gamma$ | $I_\gamma$ | $E_i(\text{level})$ | $J_i^\pi$          | $E_f$    | $J_f^\pi$          | Mult. <sup>†</sup> | Comments |
|------------|------------|---------------------|--------------------|----------|--------------------|--------------------|----------|
| 902 1      |            | 7304.7              | (24 <sup>+</sup> ) | 6402.7   | (22 <sup>+</sup> ) |                    |          |
| 940.0 2    | 2.2 1      | 6788.2              | (22 <sup>+</sup> ) | 5848.2   | 20 <sup>+</sup>    |                    |          |
| 956 1      |            | 1849.8              | (7 <sup>-</sup> )  | 891.9    | 6 <sup>+</sup>     |                    |          |
| 966.4 2    | 0.26 9     | 7577.6              | (25 <sup>-</sup> ) | 6611.2   | (23 <sup>-</sup> ) |                    |          |
| 971.2 2    | 3.5 3      | 3072.5              | (12 <sup>+</sup> ) | 2100.9   | 10 <sup>+</sup>    | Q                  | R=1.36 8 |
| 980 1      | 0.8 2      | 8284.7              | (26 <sup>+</sup> ) | 7304.7   | (24 <sup>+</sup> ) |                    |          |
| 1030 1     | 1.5 4      | 7818.2              | (24 <sup>+</sup> ) | 6788.2   | (22 <sup>+</sup> ) |                    |          |
| 1043 1     | 0.15 5     | 8620.7              | (27 <sup>-</sup> ) | 7577.6   | (25 <sup>-</sup> ) |                    |          |
| 1050 1     | 0.7 2      | 9334.7              | (28 <sup>+</sup> ) | 8284.7   | (26 <sup>+</sup> ) |                    |          |
| 1113 1     | 0.10 5     | 9733.7              | (29 <sup>-</sup> ) | 8620.7   | (27 <sup>-</sup> ) |                    |          |
| 1129 1     | 0.6 2      | 8947.2              | (26 <sup>+</sup> ) | 7818.2   | (24 <sup>+</sup> ) |                    |          |
| 1149 1     | 0.5 3      | 10483.7?            | (30 <sup>+</sup> ) | 9334.7   | (28 <sup>+</sup> ) |                    |          |
| 1150.3 2   | 0.27 2     | 2600.6              | (10 <sup>+</sup> ) | 1450.7   | 8 <sup>+</sup>     | Q                  | R=1.4 3  |
| 1188 1     | 0.1 1      | 10921.7?            | (31 <sup>-</sup> ) | 9733.7   | (29 <sup>-</sup> ) |                    |          |
| 1230 1     | 0.5 2      | 10177.2             | (28 <sup>+</sup> ) | 8947.2   | (26 <sup>+</sup> ) |                    |          |
| 1251 1     | 0.2 1      | 11734.7?            | (32 <sup>+</sup> ) | 10483.7? | (30 <sup>+</sup> ) |                    |          |
| 1291 1     | 0.2 1      | 2183.9              | (8 <sup>+</sup> )  | 891.9    | 6 <sup>+</sup>     |                    |          |
| 1325 1     | 0.3 2      | 11502.2?            | (30 <sup>+</sup> ) | 10177.2  | (28 <sup>+</sup> ) |                    |          |

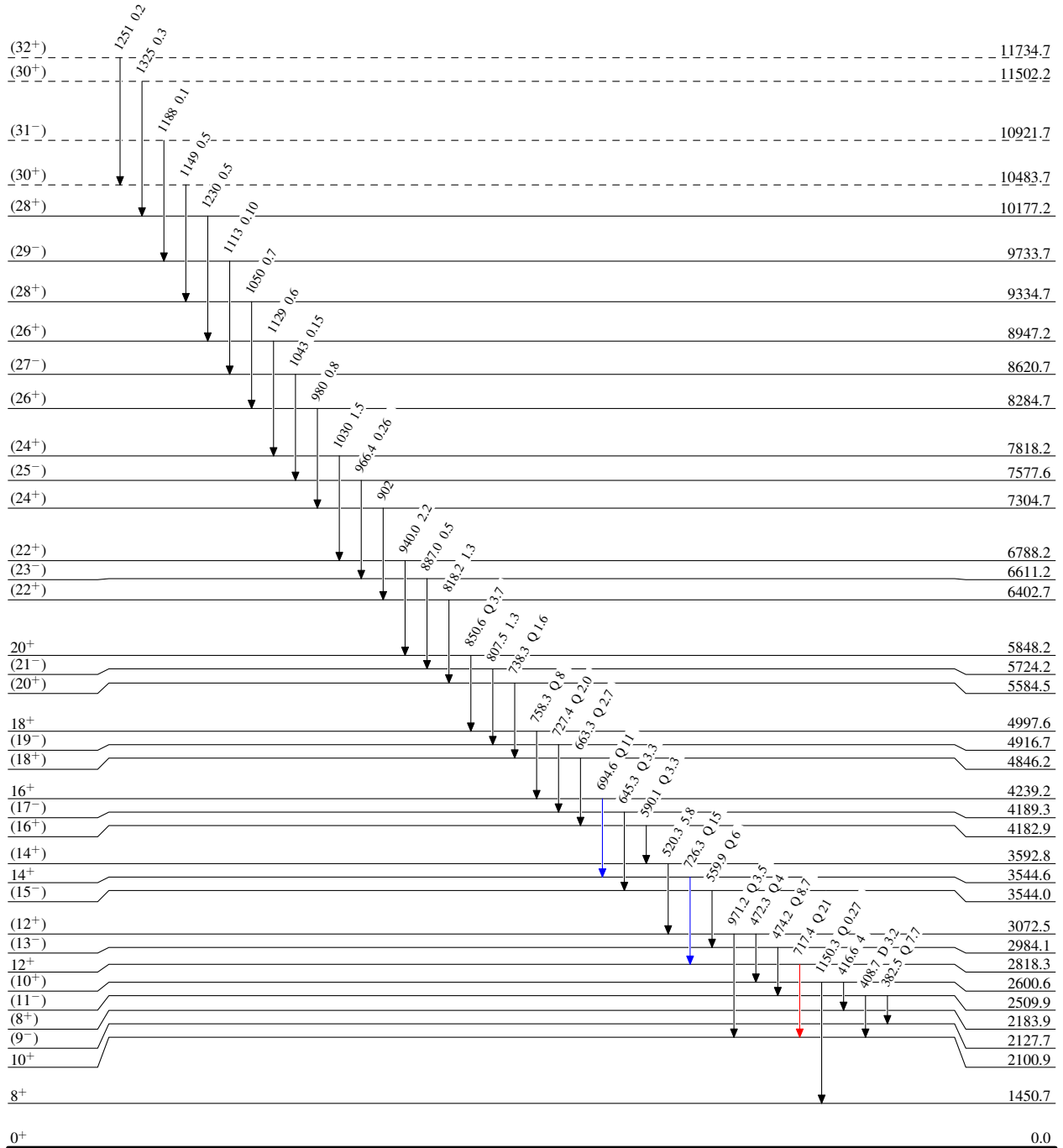
<sup>†</sup> These are those reported by 2004Sm02. These are based on angular intensity ratios and band structure considerations. When the life time is given, angular intensity ratios and RUL are used.

(HL,xn $\gamma$ ) 2004Sm02

Level Scheme  
Intensities: Relative I $\gamma$

Legend

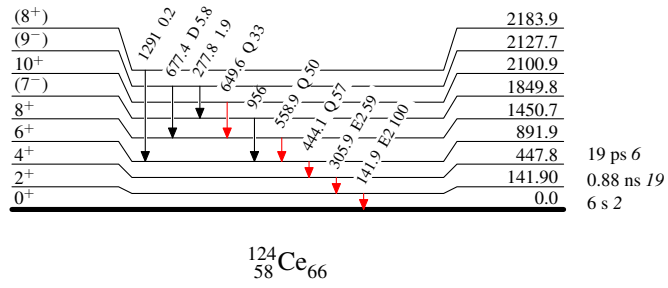
- I $\gamma$  < 2%  $\times$  I $\gamma$ <sup>max</sup>
- I $\gamma$  < 10%  $\times$  I $\gamma$ <sup>max</sup>
- I $\gamma$  > 10%  $\times$  I $\gamma$ <sup>max</sup>

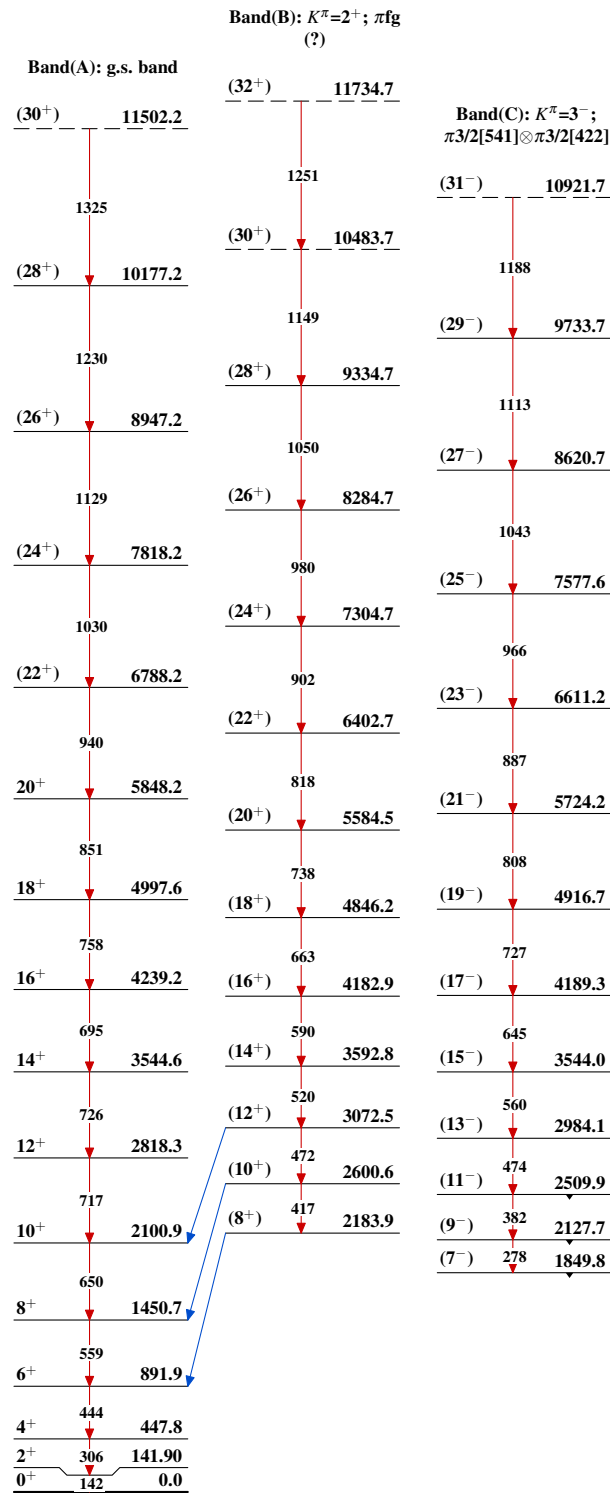


(HI,xn $\gamma$ ) 2004Sm02Level Scheme (continued)Intensities: Relative  $I_\gamma$ 

## Legend

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



**(HI,xn $\gamma$ ) 2004Sm02** $^{124}_{58}\text{Ce}_{66}$