## $^{167}$Er($^{209}$Bi,$^{209}$Bi′γ) 1997Ge07

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Balraj Singh and Jun Chen | NDS 191,1 (2023) | 22-Aug-2023 |

See another dataset for Coulomb excitation based on data primarily from $^{167}$Er($^{35}$Cl,$^{35}$Cl′γ) (1985Oh03) and $^{167}$Er($^{16}$O,$^{16}$O′γ) (1969Tv01), with selected data from several other works using α particles and protons.

1997Ge07: E($^{209}$Bi)=5.4 MeV/nucleon. Target=$^{167}$Er, 1.87 mg/cm$^2$ with 43.8 mg/cm$^2$ thick gold backing. Measured Eγ, Iγ, γγ-coin using 8π array with 20 Compton-suppressed HPGe detectors and 71-element BGO ball at the TASCC facility of the Chalk River Nuclear Laboratories. Comparison with cranked shell model with RPA and particle-vibration coupling. Deduced experimental Routhians, signature splitting energies, intrinsic moment ratios, B(M1)/B(E2) ratios for for the g.s. band, and identical bands. No B(E2) values deduced.

### $^{167}$Er Levels

| E(level)† | Jπ‡ | E(level)† | Jπ‡ | E(level)† | Jπ‡ | E(level)† | Jπ‡ |
|---|---|---|---|---|---|---|---|
| 0.0# | 7/2+ | 709.6e 14 | 11/2+ | 1393.9@ 12 | 25/2+ | 2322.2c 20 | 27/2− |
| 79.3@ 8 | 9/2+ | 772.5# 10 | 19/2+ | 1422.6f 11 | (21/2+) | 2327.0f 13 | (29/2+) |
| 178.0# 7 | 11/2+ | 813.2b 12 | 13/2− | 1495.9d 10 | 21/2+ | 2476.9@ 17 | 33/2+ |
| 209.0& 18 | 1/2− | 829.3d 9 | 13/2+ | 1553.4g 11 | (23/2+) | 2477.0d 13 | 29/2+ |
| 266.2a 18 | 3/2− | 954.9@ 10 | 21/2+ | 1698.6# 13 | 27/2+ | 2528.3g 14 | (31/2+) |
| 282.8& 16 | 5/2− | 956.6a 16 | 15/2− | 1712.0e 11 | 23/2+ | 2765.9e 16 | 31/2+ |
| 294.9@ 9 | 13/2+ | 965.6e 9 | 15/2+ | 1782.3a 19 | 23/2− | 2833.3a 24 | 31/2− |
| 346.8b 9 | 5/2− | 981.2c 13 | 15/2− | 1816.9& 22 | 25/2− | 2843& 3 | 33/2− |
| 414.4a 16 | 7/2− | 999.4& 18 | 17/2− | 1820.2c 18 | 23/2− | 2946.2# 18 | 35/2+ |
| 430.0c 11 | 7/2− | 1122.8d 9 | 17/2+ | 1836.9f 12 | (25/2+) | 3081.0d 17 | 33/2+ |
| 434.5# 9 | 15/2+ | 1167.2b 14 | 17/2− | 1901.9@ 13 | 29/2+ | 3118.9@ 20 | 37/2+ |
| 442.9& 13 | 9/2− | 1194.2# 11 | 23/2+ | 1948.0d 11 | 25/2+ | 3152.3g 18 | (35/2+) |
| 536.2b 9 | 9/2− | 1198.5g 11 | (19/2+) | 1994.7g 13 | (27/2+) | 3427& 3 | 37/2− |
| 587.4@ 9 | 17/2+ | 1299.0e 9 | 19/2+ | 2201.9e 12 | 27/2+ | 3756.0d 19 | 37/2+ |
| 646.3a 15 | 11/2− | 1336.8a 18 | 19/2− | 2283.2# 14 | 31/2+ | | |
| 664.1c 11 | 11/2− | 1370.2c 15 | 19/2− | 2285.3a 22 | 27/2− | | |
| 684.6& 16 | 13/2− | 1379.9& 19 | 21/2− | 2305.9& 24 | 29/2− | | |

† From a least-squares adjustment of Eγ, assuming Δ(Eγ)=1 keV.
‡ As given by 1997Ge07 based on band structures.
# Band(a): ν7/2[633],α=−1/2.
@ Band(A): ν7/2[633],α=+1/2.
& Band(B): ν1/2[521],α=+1/2.
a Band(b): ν1/2[521],α=−1/2.
b Band(C): ν5/2[512],α=+1/2.
c Band(c): ν5/2[512],α=−1/2.
d Band(D): 11/2+, γ-vibrational band,α=+1/2.
e Band(d): 11/2+, γ-vibrational band,α=−1/2.
f Band(E): Band based on (21/2+),α=+1/2.
g Band(e): Band based on (19/2+),α=−1/2.

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′$\gamma$) 1997Ge07 (continued)

### $\gamma(^{167}Er)$

Intensities of the most intense $\gamma$ rays as a function of spin for stopped nuclei within the $\nu 7/2[633],\alpha=+1/2$ band, with gate on a $\gamma$ ray from a certain spin in this band are listed under comments.

| $E_\gamma$ | $I_\gamma$ [†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Comments |
|---|---|---|---|---|---|---|
| 57 | | 266.2 | $3/2^-$ | 209.0 | $1/2^-$ | |
| 74 | | 282.8 | $5/2^-$ | 209.0 | $1/2^-$ | |
| 79 | | 79.3 | $9/2^+$ | 0.0 | $7/2^+$ | |
| 83 | | 430.0 | $7/2^-$ | 346.8 | $5/2^-$ | |
| 99 | | 178.0 | $11/2^+$ | 79.3 | $9/2^+$ | |
| 106 | | 536.2 | $9/2^-$ | 430.0 | $7/2^-$ | |
| 117 | | 294.9 | $13/2^+$ | 178.0 | $11/2^+$ | |
| 128 | | 664.1 | $11/2^-$ | 536.2 | $9/2^-$ | |
| 132 | | 414.4 | $7/2^-$ | 282.8 | $5/2^-$ | |
| 139 | | 434.5 | $15/2^+$ | 294.9 | $13/2^+$ | |
| 148[‡] | | 414.4 | $7/2^-$ | 266.2 | $3/2^-$ | |
| 148[‡] | | 442.9 | $9/2^-$ | 294.9 | $13/2^+$ | |
| 149 | | 813.2 | $13/2^-$ | 664.1 | $11/2^-$ | |
| 153 | | 587.4 | $17/2^+$ | 434.5 | $15/2^+$ | |
| 157 | | 1122.8 | $17/2^+$ | 965.6 | $15/2^+$ | |
| 158 | | 1994.7 | $(27/2^+)$ | 1836.9 | $(25/2^+)$ | |
| 160 | | 442.9 | $9/2^-$ | 282.8 | $5/2^-$ | |
| 168 | | 981.2 | $15/2^-$ | 813.2 | $13/2^-$ | |
| 178 | | 178.0 | $11/2^+$ | 0.0 | $7/2^+$ | |
| 182 | | 954.9 | $21/2^+$ | 772.5 | $19/2^+$ | |
| 185 | | 772.5 | $19/2^+$ | 587.4 | $17/2^+$ | |
| 186 | | 1167.2 | $17/2^-$ | 981.2 | $15/2^-$ | |
| 190 | | 536.2 | $9/2^-$ | 346.8 | $5/2^-$ | |
| 197 | | 1495.9 | $21/2^+$ | 1299.0 | $19/2^+$ | |
| 200 | | 1393.9 | $25/2^+$ | 1194.2 | $23/2^+$ | |
| 201 | | 2528.3 | $(31/2^+)$ | 2327.0 | $(29/2^+)$ | |
| 203 | | 646.3 | $11/2^-$ | 442.9 | $9/2^-$ | |
| 203 | | 1370.2 | $19/2^-$ | 1167.2 | $17/2^-$ | |
| 203 | | 1901.9 | $29/2^+$ | 1698.6 | $27/2^+$ | |
| 216 | | 294.9 | $13/2^+$ | 79.3 | $9/2^+$ | |
| 224 | | 1422.6 | $(21/2^+)$ | 1198.5 | $(19/2^+)$ | |
| 232 | | 646.3 | $11/2^-$ | 414.4 | $7/2^-$ | |
| 234 | | 664.1 | $11/2^-$ | 430.0 | $7/2^-$ | |
| 236 | | 1948.0 | $25/2^+$ | 1712.0 | $23/2^+$ | |
| 239 | | 1194.2 | $23/2^+$ | 954.9 | $21/2^+$ | |
| 242 | 9.4 *5* | 684.6 | $13/2^-$ | 442.9 | $9/2^-$ | |
| 256 | | 965.6 | $15/2^+$ | 709.6 | $11/2^+$ | |
| 257 | | 434.5 | $15/2^+$ | 178.0 | $11/2^+$ | |
| 272 | | 956.6 | $15/2^-$ | 684.6 | $13/2^-$ | |
| 275 | | 2477.0 | $29/2^+$ | 2201.9 | $27/2^+$ | |
| 277 | | 813.2 | $13/2^-$ | 536.2 | $9/2^-$ | |
| 284 | | 1836.9 | $(25/2^+)$ | 1553.4 | $(23/2^+)$ | |
| 293 | | 587.4 | $17/2^+$ | 294.9 | $13/2^+$ | I$\gamma$=38 *1* for most intense $\gamma$ for stopped nuclei with gate at 216$\gamma$ from $13/2^+$. |
| 294 | | 1122.8 | $17/2^+$ | 829.3 | $13/2^+$ | |
| 305 | | 1698.6 | $27/2^+$ | 1393.9 | $25/2^+$ | |
| 310 | | 956.6 | $15/2^-$ | 646.3 | $11/2^-$ | |
| 315 | | 999.4 | $17/2^-$ | 684.6 | $13/2^-$ | |
| 317 | | 981.2 | $15/2^-$ | 664.1 | $11/2^-$ | |
| 332 | | 2327.0 | $(29/2^+)$ | 1994.7 | $(27/2^+)$ | |

Continued on next page (footnotes at end of table)

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′$\gamma$) 1997Ge07 (continued)

### $\gamma$($^{167}$Er) (continued)

| $E_\gamma$ | $I_\gamma$[†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Comments |
|---|---|---|---|---|---|---|
| 334 | | 1299.0 | $19/2^+$ | 965.6 | $15/2^+$ | |
| 338 | 87 *4* | 772.5 | $19/2^+$ | 434.5 | $15/2^+$ | |
| 338 | | 1336.8 | $19/2^-$ | 999.4 | $17/2^-$ | |
| 347 | | 346.8 | $5/2^-$ | 0.0 | $7/2^+$ | |
| 354 | 0.64 *6* | 1167.2 | $17/2^-$ | 813.2 | $13/2^-$ | |
| 355 | | 1553.4 | $(23/2^+)$ | 1198.5 | $(19/2^+)$ | |
| 358 | | 536.2 | $9/2^-$ | 178.0 | $11/2^+$ | |
| 359 | | 1553.4 | $(23/2^+)$ | 1194.2 | $23/2^+$ | |
| 368 | 100 | 954.9 | $21/2^+$ | 587.4 | $17/2^+$ | Iγ=86 *2* for most intense γ for stopped nuclei with gate at 293γ from $17/2^+$.<br>Iγ=100 for most intense γ for stopped nuclei with gate at 439γ from $25/2^+$. |
| 373 | | 1495.9 | $21/2^+$ | 1122.8 | $17/2^+$ | |
| 380 | 2.4 *1* | 1336.8 | $19/2^-$ | 956.6 | $15/2^-$ | |
| 380 | | 1379.9 | $21/2^-$ | 999.4 | $17/2^-$ | |
| 381 | | 2283.2 | $31/2^+$ | 1901.9 | $29/2^+$ | |
| 389 | 0.59 *5* | 1370.2 | $19/2^-$ | 981.2 | $15/2^-$ | |
| 402 | | 1782.3 | $23/2^-$ | 1379.9 | $21/2^-$ | |
| 413 | 4.6 *3* | 1712.0 | $23/2^+$ | 1299.0 | $19/2^+$ | |
| 414 | 3.2 *2* | 1836.9 | $(25/2^+)$ | 1422.6 | $(21/2^+)$ | |
| 422 | | 1194.2 | $23/2^+$ | 772.5 | $19/2^+$ | |
| 426 | | 1198.5 | $(19/2^+)$ | 772.5 | $19/2^+$ | |
| 437 | | 1816.9 | $25/2^-$ | 1379.9 | $21/2^-$ | |
| 439 | | 1393.9 | $25/2^+$ | 954.9 | $21/2^+$ | Iγ=100 for most intense γ for stopped nuclei with gate at 368γ from $21/2^+$.<br>Iγ=53 *2* for most intense γ for stopped nuclei with gate at 508γ from $29/2^+$. |
| 441 | 6.8 *3* | 1994.7 | $(27/2^+)$ | 1553.4 | $(23/2^+)$ | |
| 446 | | 1782.3 | $23/2^-$ | 1336.8 | $19/2^-$ | |
| 450 | | 1820.2 | $23/2^-$ | 1370.2 | $19/2^-$ | |
| 452 | 6.1 *3* | 1948.0 | $25/2^+$ | 1495.9 | $21/2^+$ | |
| 468[#] | | 1299.0 | $19/2^+$ | 829.3 | $13/2^+$ | Evaluators consider the placement of this transition from $19/2^+$ to $13/2^+$ as questionable, since implied mult=M3, which is highly unlikely. This γ ray is not included in the Adopted dataset. |
| 468 | | 1422.6 | $(21/2^+)$ | 954.9 | $21/2^+$ | |
| 489 | | 2305.9 | $29/2^-$ | 1816.9 | $25/2^-$ | |
| 490 | | 2201.9 | $27/2^+$ | 1712.0 | $23/2^+$ | |
| 490 | | 2327.0 | $(29/2^+)$ | 1836.9 | $(25/2^+)$ | |
| 502 | | 2322.2 | $27/2^-$ | 1820.2 | $23/2^-$ | |
| 503 | | 2285.3 | $27/2^-$ | 1782.3 | $23/2^-$ | |
| 504 | | 1698.6 | $27/2^+$ | 1194.2 | $23/2^+$ | |
| 508 | | 1901.9 | $29/2^+$ | 1393.9 | $25/2^+$ | Iγ=16 *1* for most intense γ for stopped nuclei with gate at 575γ from $33/2^+$. |
| 527 | | 1299.0 | $19/2^+$ | 772.5 | $19/2^+$ | |
| 529 | | 2477.0 | $29/2^+$ | 1948.0 | $25/2^+$ | |
| 531 | | 965.6 | $15/2^+$ | 434.5 | $15/2^+$ | |
| 534 | | 2528.3 | $(31/2^+)$ | 1994.7 | $(27/2^+)$ | |
| 535 | | 1122.8 | $17/2^+$ | 587.4 | $17/2^+$ | |
| 537 | | 2843 | $33/2^-$ | 2305.9 | $29/2^-$ | |
| 541 | | 1495.9 | $21/2^+$ | 954.9 | $21/2^+$ | |
| 548 | | 2833.3 | $31/2^-$ | 2285.3 | $27/2^-$ | |
| 564 | | 2765.9 | $31/2^+$ | 2201.9 | $27/2^+$ | |
| 575 | | 2476.9 | $33/2^+$ | 1901.9 | $29/2^+$ | Iγ=1.3 *2* for most intense γ for stopped nuclei with gate at 642γ from $37/2^+$. |
| 584 | | 3427 | $37/2^-$ | 2843 | $33/2^-$ | |

Continued on next page (footnotes at end of table)

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′$\gamma$) 1997Ge07 (continued)

### $\gamma(^{167}Er)$ (continued)

| $E_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | $E_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ |
|---|---|---|---|---|---|---|---|---|---|
| 585 | 2283.2 | $31/2^+$ | 1698.6 | $27/2^+$ | 723 | 1495.9 | $21/2^+$ | 772.5 | $19/2^+$ |
| 599 | 1553.4 | $(23/2^+)$ | 954.9 | $21/2^+$ | 749 | 829.3 | $13/2^+$ | 79.3 | $9/2^+$ |
| 604 | 3081.0 | $33/2^+$ | 2477.0 | $29/2^+$ | 754 | 1948.0 | $25/2^+$ | 1194.2 | $23/2^+$ |
| 611 | 1198.5 | $(19/2^+)$ | 587.4 | $17/2^+$ | 757 | 1712.0 | $23/2^+$ | 954.9 | $21/2^+$ |
| 624 | 3152.3 | $(35/2^+)$ | 2528.3 | $(31/2^+)$ | 788 | 965.6 | $15/2^+$ | 178.0 | $11/2^+$ |
| 642 | 3118.9 | $37/2^+$ | 2476.9 | $33/2^+$ | 808 | 2201.9 | $27/2^+$ | 1393.9 | $25/2^+$ |
| 650 | 1422.6 | $(21/2^+)$ | 772.5 | $19/2^+$ | 828 | 1122.8 | $17/2^+$ | 294.9 | $13/2^+$ |
| 651 | 829.3 | $13/2^+$ | 178.0 | $11/2^+$ | 835 | 1422.6 | $(21/2^+)$ | 587.4 | $17/2^+$ |
| 663 | 2946.2 | $35/2^+$ | 2283.2 | $31/2^+$ | 865 | 1299.0 | $19/2^+$ | 434.5 | $15/2^+$ |
| 671 | 965.6 | $15/2^+$ | 294.9 | $13/2^+$ | 882 | 1836.9 | $(25/2^+)$ | 954.9 | $21/2^+$ |
| 675 | 3756.0 | $37/2^+$ | 3081.0 | $33/2^+$ | 909 | 1495.9 | $21/2^+$ | 587.4 | $17/2^+$ |
| 688 | 1122.8 | $17/2^+$ | 434.5 | $15/2^+$ | 993 | 1948.0 | $25/2^+$ | 954.9 | $21/2^+$ |
| 712 | 1299.0 | $19/2^+$ | 587.4 | $17/2^+$ | | | | | |

† Relative to 100 for 368$\gamma$ from $21/2^+$ level in $\nu 7/2[633]$ band, only for the strongest $\gamma$ in each band.
‡ Multiply placed.
# Placement of transition in the level scheme is uncertain.

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′γ) 1997Ge07

Level Scheme

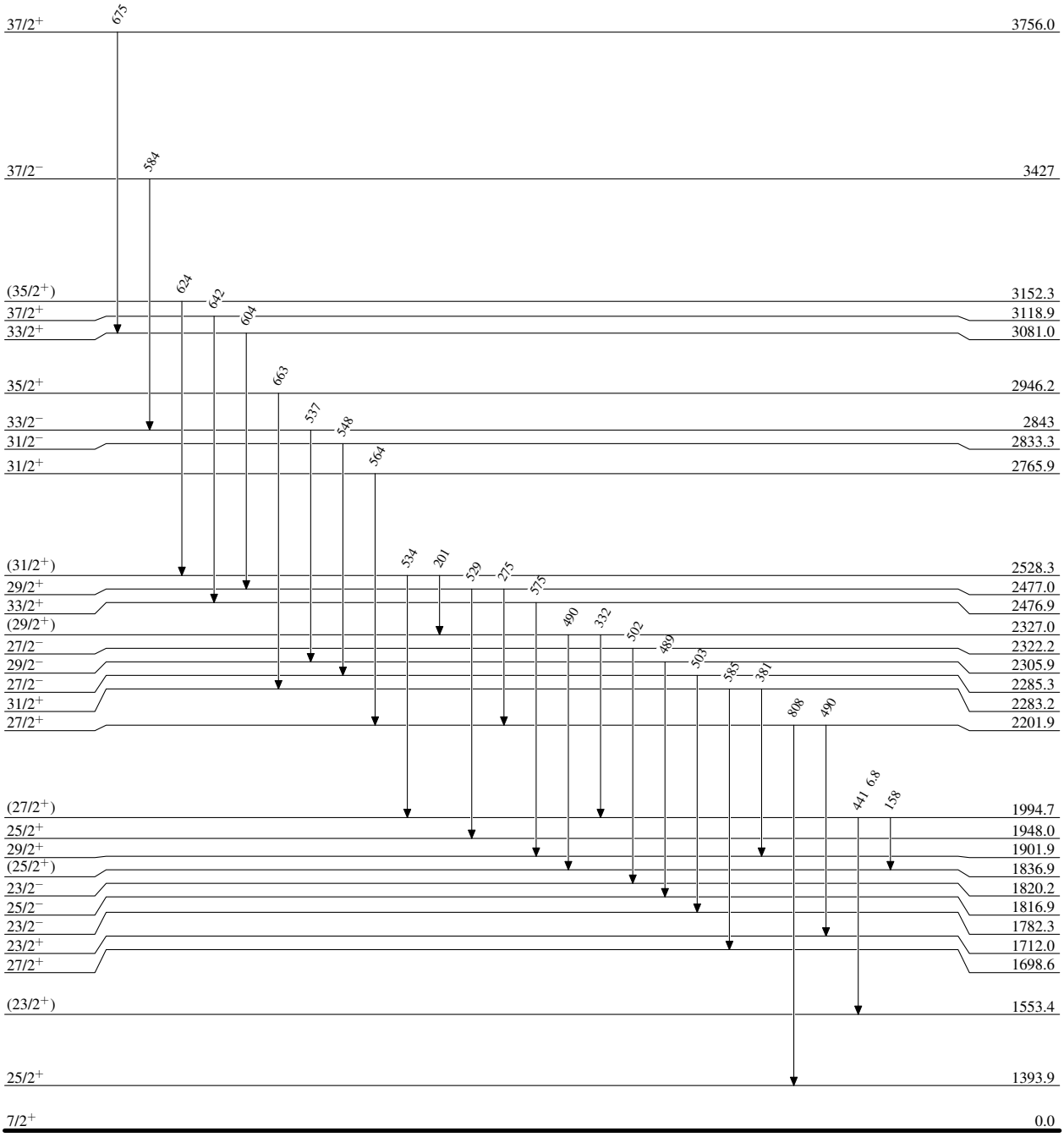
Intensities: Relative $I_\gamma$

Legend

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

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

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



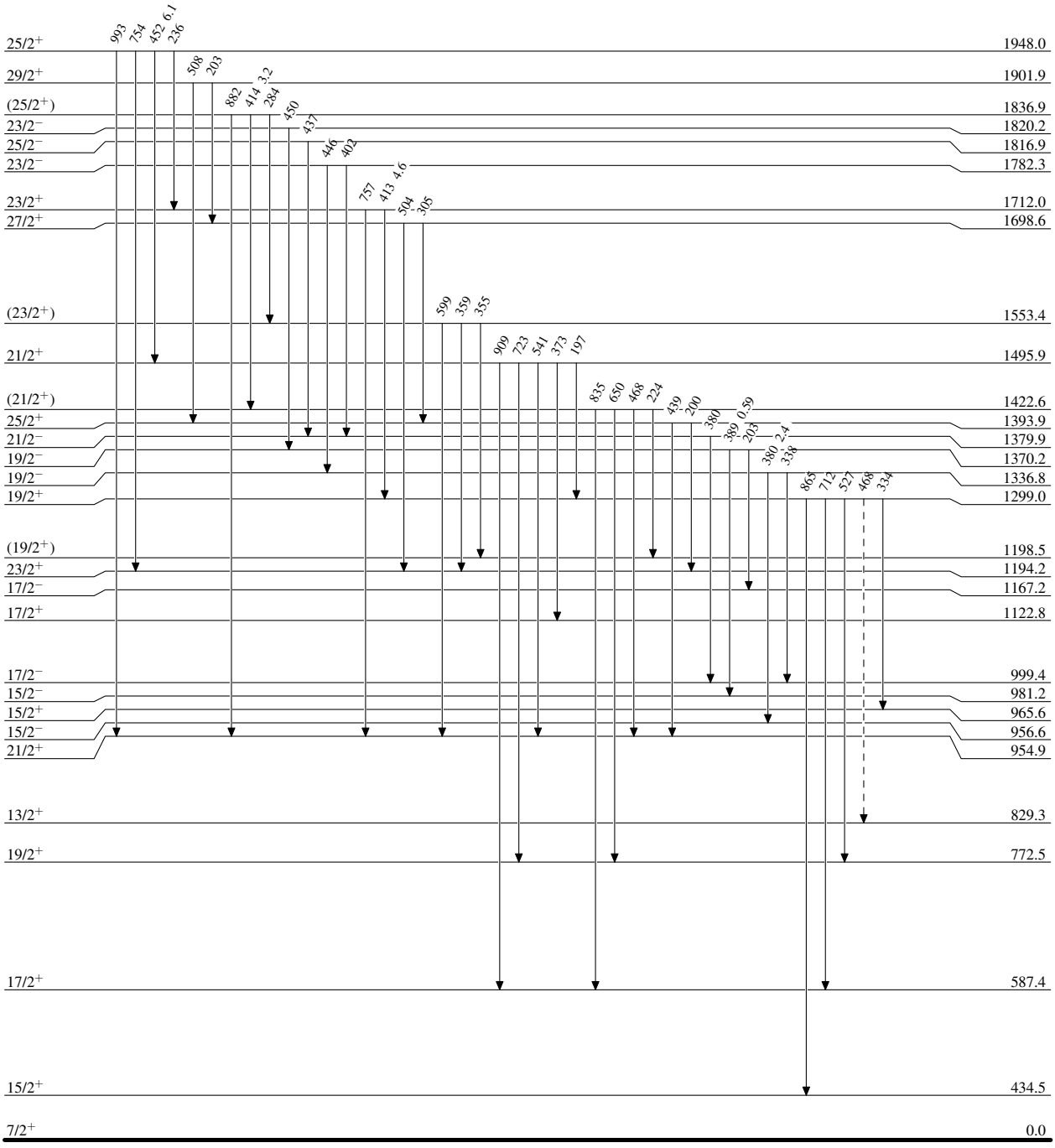

$^{167}_{68}Er_{99}$

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′γ) 1997Ge07

### Level Scheme (continued)

Intensities: Relative $I_\gamma$

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



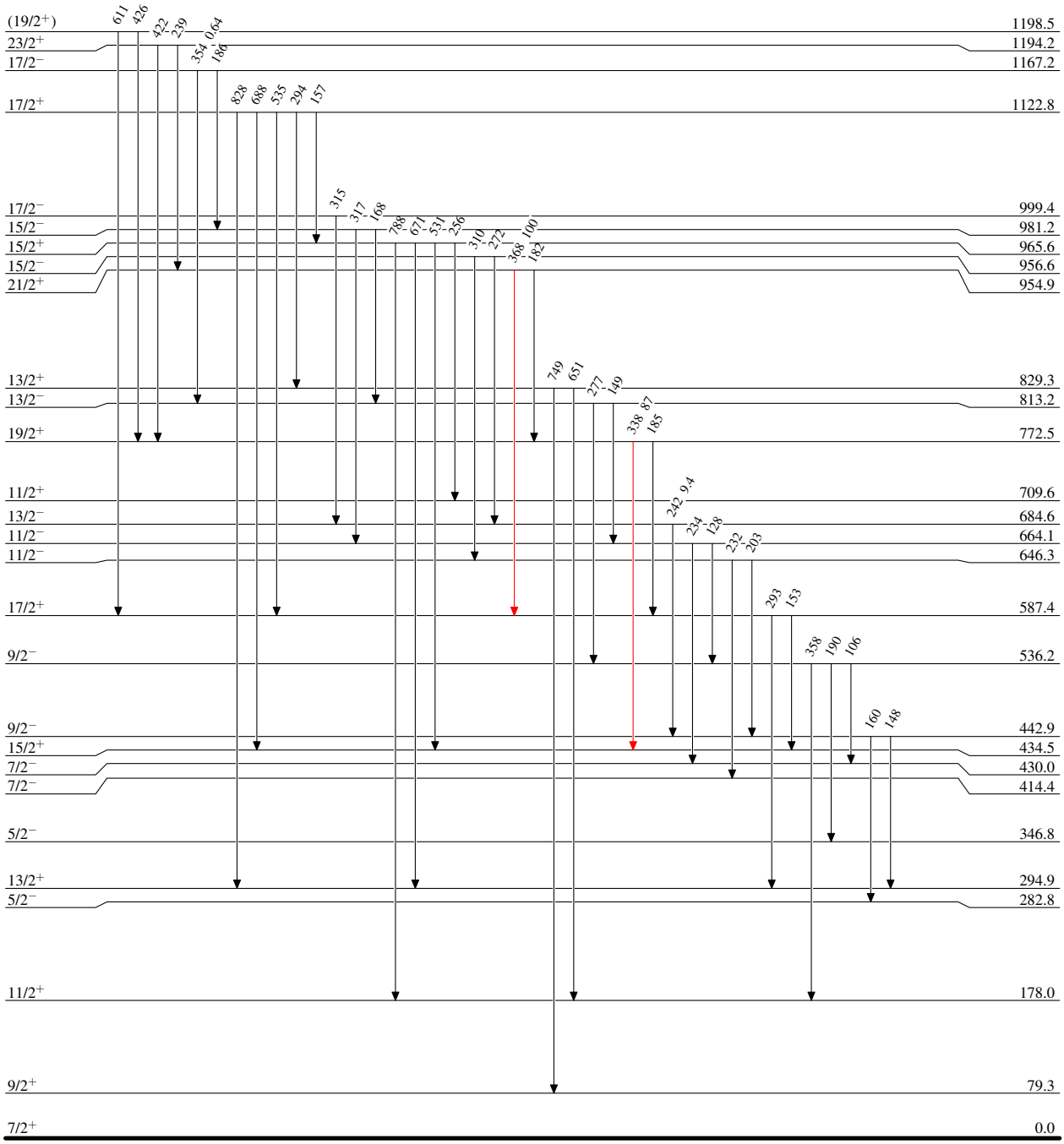

$^{167}_{68}Er_{99}$

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′γ) 1997Ge07

### Level Scheme (continued)

Intensities: Relative $I_\gamma$

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

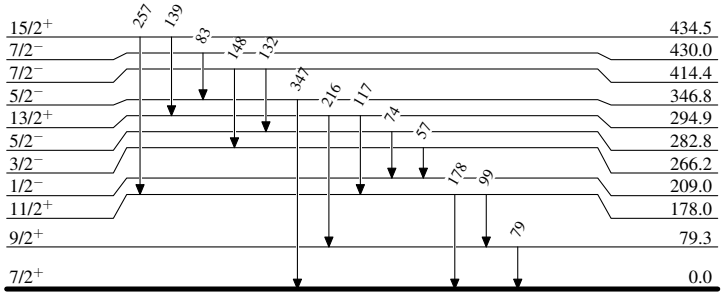



$^{167}_{68}Er_{99}$

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′$\gamma$) 1997Ge07

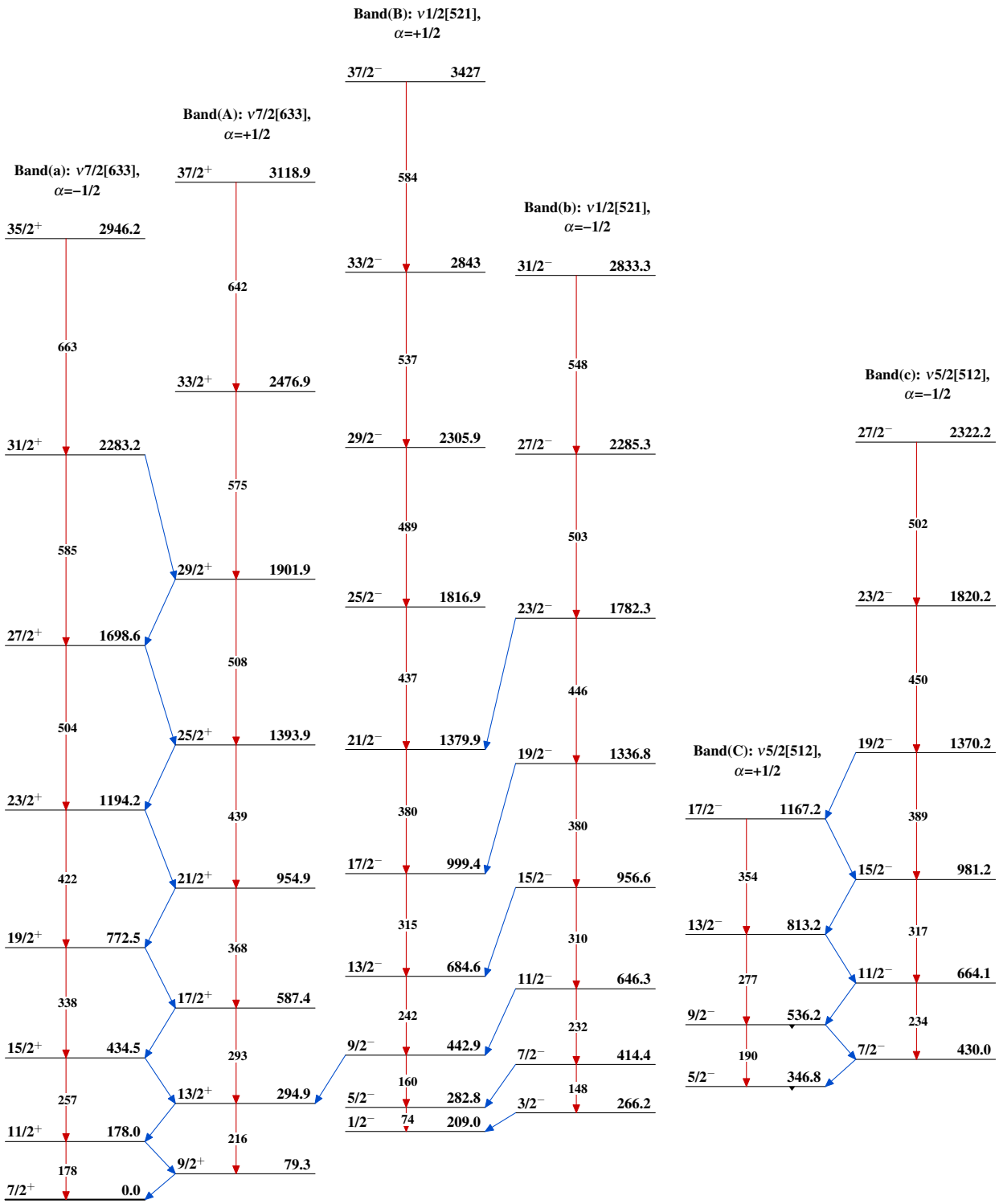
Level Scheme (continued)

Intensities: Relative $I_\gamma$



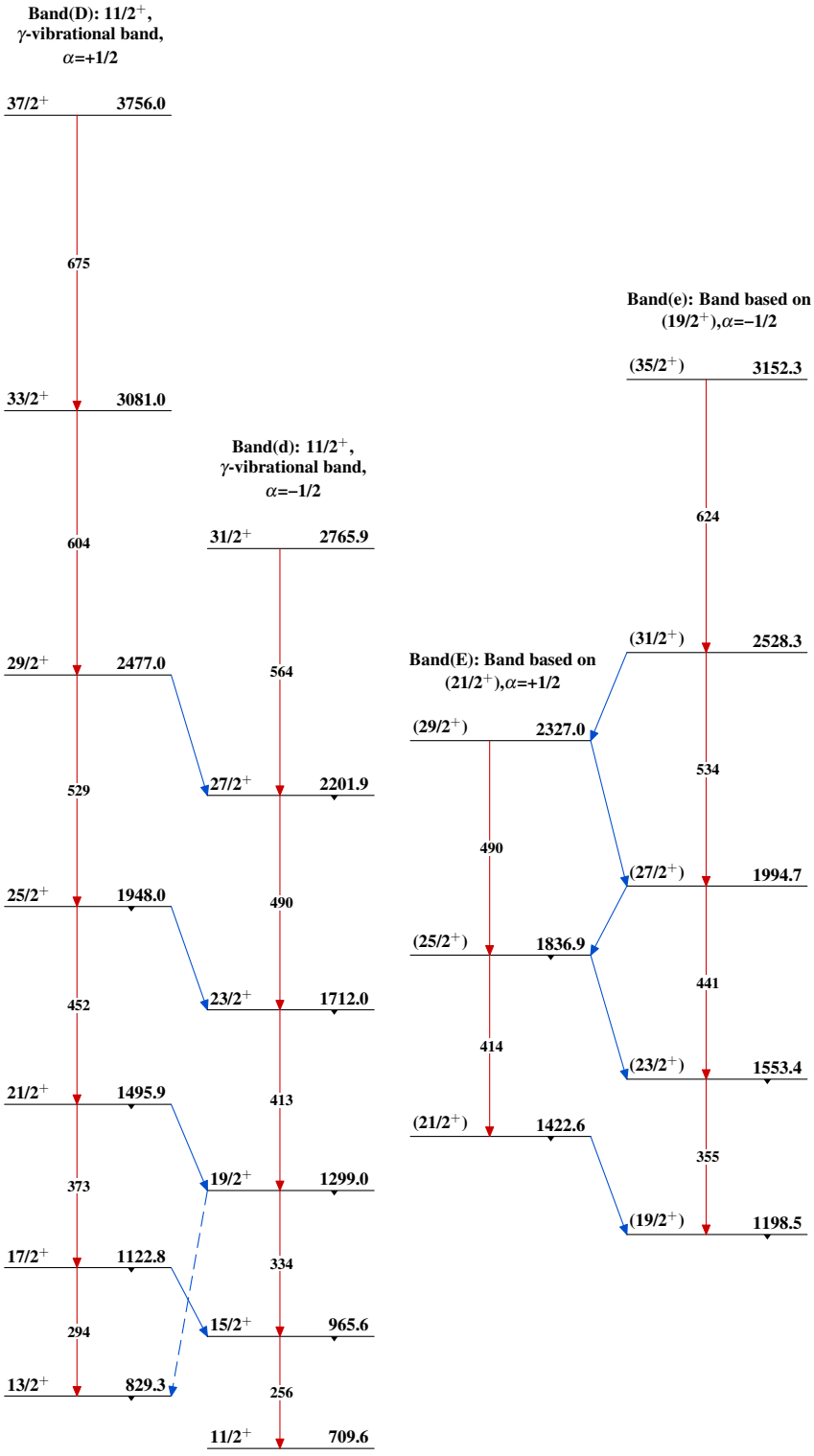

$^{167}_{68}Er_{99}$

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′γ) 1997Ge07




$^{167}_{68}Er_{99}$

## $^{167}$Er($^{209}$Bi,$^{209}$Bi′γ) 1997Ge07 (continued)




$^{167}_{68}Er_{99}$