## Adopted Levels, Gammas

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Ameenah R. Farhan, Balraj Singh | NDS 110,1917 (2009) | 30-Jun-2009 |

Q($\beta^-$)=955 *11*; S(n)=8721 *4*; S(p)=13159 *5*; Q($\alpha$)=−8530 *5* 2012Wa38
Note: Current evaluation has used the following Q record $ 955 10 *8719* 4 *13159* 5 −8530 *4* 2009AuZZ,2003Au03.
S(2n)=14792 *4*, s(2p)=24137 *4* (2009AuZZ).
Values in 2003Au03: Q($\alpha$)=−8580 *50*, s(2p)=24300 *80* (2003Au03); others same as in 2009AuZZ.
Other reaction: $^{238}$U(p,F), E=25 MeV, measured fission fragment mass distribution (1997Hu09).
Additional information 1.
Nuclear structure calculations: 2008Yo07 (high-spin levels, B(E2), shell model), 1992Er02, 1992Hs02.
Double $\beta$ decay calculation: 2001Ka15.

### $^{78}$Ge Levels

Cross Reference (XREF) Flags

| | | | |
|---|---|---|---|
| A | $^{78}$Ga $\beta^-$ decay (5.09 s) | D | Coulomb excitation |
| B | $^{79}$Ga $\beta^-$n decay (2.847 s) | E | $^{82}$Se(d,$^6$Li) |
| C | $^{76}$Ge(t,p) | F | $^{192}$Os($^{82}$Se,X$\gamma$) |

| E(level)[†] | J$^\pi$[‡] | T$_{1/2}$[#] | XREF | Comments |
|---|---|---|---|---|
| 0.0[@] | 0$^+$ | 88.0 min *10* | ABCDEF | %$\beta^-$=100<br>T$_{1/2}$: from 1965Kv01. Others: 88 min 2 (1965Fr04), 86 min 1 (1953Su04). |
| 619.36[@] *12* | 2$^+$ | 13.5 ps *24* | A CDEF | J$^\pi$: level is Coulomb excited from 0$^+$; L(t,p)=2.<br>T$_{1/2}$: weighted average of 15.9 ps *28* from $\beta\gamma\gamma$(t) in $\beta^-$ decay (1993Ch05) and 11.1 ps *7* from B(E2)↑=0.222 *14* (2005Pa23). |
| 1186.51 *12* | 2$^+$ | 12 ps *6* | A C E | J$^\pi$: L(t,p)=2. |
| 1546.6 *4* | 0$^+$ | 25 ps *11* | A C E | J$^\pi$: L(t,p)=0. |
| 1570.20[@] *19* | 4$^+$ | <3.5 ps | A C EF | J$^\pi$: L(t,p)=4. |
| 1644.58 *14* | (2,3,4$^+$) | 15 ps *6* | A | J$^\pi$: log *ft*=6.64 from (3$^+$); $\gamma$ to 2$^+$. |
| 1842.73 *22* | 2$^+$ | | A C | J$^\pi$: L(t,p)=2. |
| 2292 *3* | (4$^+$) | | C | J$^\pi$: L(t,p)=(4). |
| 2319.57 *20* | (2,3,4) | 43 ps *5* | A | J$^\pi$: log *ft*=6.26 from (3$^+$). |
| 2330 *3* | | | C | J$^\pi$: L(t,p)=(4,5) suggests (4$^+$,5$^-$), another L(t,p)=(0,4) suggests (0$^+$,4$^+$). The 2330 peak in (t,p) may contain contribution from 2319 level as well. |
| 2404? *5* | | | C | |
| 2438.71 *19* | (2$^+$) | <7 ps | A C | J$^\pi$: L(t,p)=2. |
| 2652 *3* | (5$^-$) | | C | J$^\pi$: L(t,p)=5. |
| 2665.63 *17* | (2,3,4$^+$) | 4.2 ps *25* | A | J$^\pi$: log *ft*=5.81 from (3$^+$); $\gamma$ to 2$^+$. |
| 2706.01 *19* | (2$^+$) | | A | J$^\pi$: log *ft*=6.29 from (3$^+$); $\gamma$ to 0$^+$. |
| 2748.2[@] *11* | (6$^+$) | | F | J$^\pi$: yrast population in ($^{82}$Se,X). |
| 2759 *10* | (3$^-$,4$^+$) | | C | J$^\pi$: L(t,p)=(3,4). |
| 2850 *10* | (5$^-$) | | C | J$^\pi$: L(t,p)=5. |
| 2857.14 *19* | (2,3,4$^+$) | | A | J$^\pi$: log *ft*=6.20 from (3$^+$); $\gamma$ to 2$^+$. |
| 2952.9 *3* | (4$^+$) | 9 ps *4* | A C | J$^\pi$: L(t,p)=4. |
| 3120.60 *20* | (2,3,4$^+$) | <2.8 ps | A | J$^\pi$: log *ft*=5.65 from (3$^+$); $\gamma$ to 2$^+$. |
| 3183 *10* | (2$^+$) | | C | J$^\pi$: L(t,p)=2. |
| 3236 *10* | (1$^-$&3$^-$) | | C | J$^\pi$: L(t,p)=1+3. |
| 3287 *10* | (6$^+$) | | C | J$^\pi$: L(t,p)=6. |
| 3350 *10* | (0$^+$) | | C | J$^\pi$: L(t,p)=0. |
| 3389.91 *22* | (2$^+$,3,4$^+$) | | A C | J$^\pi$: log *ft*=6.18 from (3$^+$); $\gamma$'s to 2$^+$ and (4$^+$). |
| 3615 *10* | (3$^-$) | | C | J$^\pi$: L(t,p)=3. |
| 3638 *10* | (2$^+$) | | C | J$^\pi$: L(t,p)=2. |
| 3667 *10* | 0$^+$ | | C | J$^\pi$: L(t,p)=0. |

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## Adopted Levels, Gammas (continued)

### $^{78}$Ge Levels (continued)

| E(level)† | Jπ‡ | XREF | Comments |
|---|---|---|---|
| 3687.73 *17* | (4+) | A C | XREF: C(3707).<br>Jπ: L(t,p)=4. |
| 3714.2@ *15* | (8+) | F | Jπ: yrast population in ($^{82}$Se,X). |
| 3797 *10* | (3−) | C | Jπ: L(t,p)=3. |
| 3816 *10* | (2+) | C | Jπ: L(t,p)=2. |
| 3898 *10* | 0+ | C | Jπ: L(t,p)=0. |
| 3965 *10* | (2+) | C | Jπ: L(t,p)=2. |
| 4015 *10* | (0+) | C | Jπ: L(t,p)=0. |
| 4036 *10* | (5−) | C | Jπ: L(t,p)=5. |
| 4070 *10* | (2+) | C | Jπ: L(t,p)=2. |
| 4083.7 *5* | (2,3,4+) | A | Jπ: log *ft*=5.64 from (3+); γ to 2+. |
| 4115 *10* | (1−) | C | Jπ: L(t,p)=1. |
| 4134 *10* | (2+) | C | Jπ: L(t,p)=2. |
| 4270.08 *23* | (2,3,4+) | A C | XREF: C(4259).<br>Jπ: log *ft*=5.76 from (3+); γ to 2+. |
| 4279.4 *4* | (2,3,4+) | A | Jπ: log *ft*=5.81 from (3+); γ to 2+. |
| 4305 *10* | | C | |
| 4335 *10* | | C | |
| 4378 *10* | | C | |
| 4745 *10* | | C | |
| 4816 *10* | | C | |
| 5078.2 *10* | (2,3,4+) | A | Jπ: log *ft*=5.68 from (3+); γ to 2+. |
| 5191 *10* | | C | |
| 5324 *10* | | C | |

† From least squares fit to Eγ′s.
‡ From L transfer in (t,p) except as noted. The evaluators consider all assignments as tentative for levels above 1843 since there seem disagreements between the (t,p) data of 1978Ar12 and 1987Ma21. Moreover, L(t,p)>2 distribution patterns are generally not characteristic of a unique L value.
# From βγγ(t) fast timing technique in β− decay (1993Ch05), except as noted.
@ Band(A): yrast structure.

### γ($^{78}$Ge)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$† | $I_\gamma$† | $E_f$ | $J_f^\pi$ | Mult. | Comments |
|---|---|---|---|---|---|---|---|
| 619.36 | 2+ | 619.40 *16* | 100 | 0.0 | 0+ | [E2] | B(E2)(W.u.)=23 *4* |
| 1186.51 | 2+ | 567.06 *16* | 91 *5* | 619.36 | 2+ | [E2] | B(E2)(W.u.)=19 *11* |
| | | 1186.42 *16* | 100 *5* | 0.0 | 0+ | [E2] | B(E2)(W.u.)=0.53 *24* |
| 1546.6 | 0+ | 927.2 *3* | 100 | 619.36 | 2+ | | |
| 1570.20 | 4+ | 950.77 *17* | 100 | 619.36 | 2+ | [E2] | B(E2)(W.u.)>11 |
| 1644.58 | (2,3,4+) | 458.00 *15* | 47 *3* | 1186.51 | 2+ | | |
| | | 1025.11 *17* | 100 *6* | 619.36 | 2+ | | |
| 1842.73 | 2+ | 1223.36 *18* | 100 | 619.36 | 2+ | | |
| 2319.57 | (2,3,4) | 674.86 *17* | 100 | 1644.58 | (2,3,4+) | | |
| 2438.71 | (2+) | 891.3 *16* | 12 *7* | 1546.6 | 0+ | | |
| | | 1251.96 *20* | 65 *8* | 1186.51 | 2+ | | |
| | | 1819.59 *21* | 100 *16* | 619.36 | 2+ | | |
| 2665.63 | (2,3,4+) | 345.76 *26* | 63 *9* | 2319.57 | (2,3,4) | | |
| | | 1021.2 *4* | 15 *4* | 1644.58 | (2,3,4+) | | |
| | | 1479.13 *18* | 100 *7* | 1186.51 | 2+ | | |
| | | 2046.32 *25* | 67 *7* | 619.36 | 2+ | | |
| 2706.01 | (2+) | 862.8 *15* | 25 *11* | 1842.73 | 2+ | | |
| | | 1061.9 *4* | 20 *6* | 1644.58 | (2,3,4+) | | |

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## Adopted Levels, Gammas (continued)

### γ($^{78}$Ge) (continued)

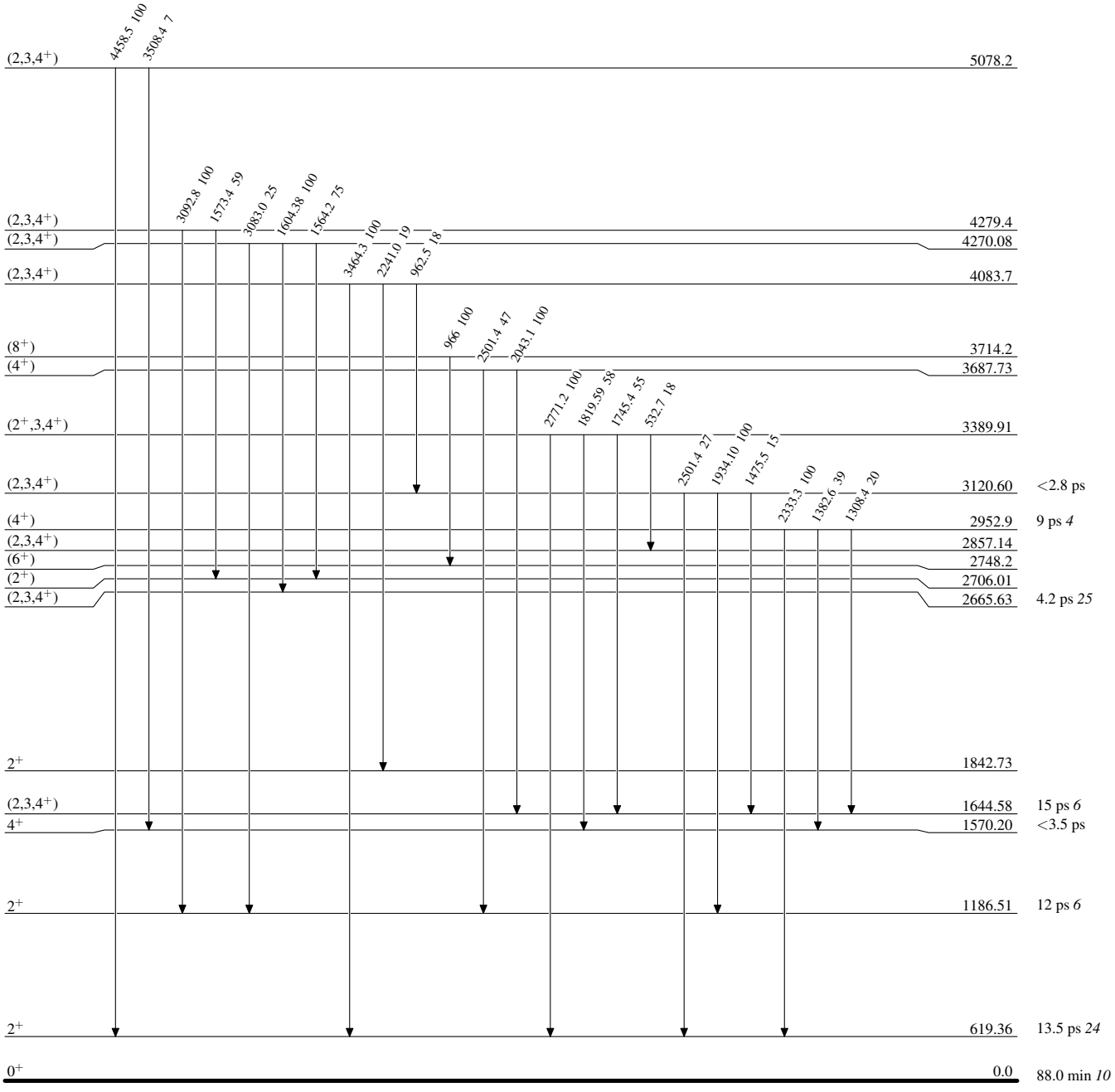
| $E_i$(level) | $J_i^\pi$ | $E_\gamma$ † | $I_\gamma$ † | $E_f$ | $J_f^\pi$ |
|---|---|---|---|---|---|
| 2706.01 | (2$^+$) | 1519.32 *24* | 47 *7* | 1186.51 | 2$^+$ |
| | | 2706.2 *4* | 100 *11* | 0.0 | 0$^+$ |
| 2748.2 | (6$^+$) | 1178‡ | 100‡ | 1570.20 | 4$^+$ |
| 2857.14 | (2,3,4$^+$) | 1212.41 *24* | 100 *13* | 1644.58 | (2,3,4$^+$) |
| | | 1670.67 *23* | 83 *10* | 1186.51 | 2$^+$ |
| | | 2237.9 *4* | 63 *13* | 619.36 | 2$^+$ |
| 2952.9 | (4$^+$) | 1308.4 *3* | 20 *10* | 1644.58 | (2,3,4$^+$) |
| | | 1382.6 *9* | 39 *35* | 1570.20 | 4$^+$ |
| | | 2333.3 *4* | 100 *17* | 619.36 | 2$^+$ |
| 3120.60 | (2,3,4$^+$) | 1475.5 *4* | 15 *6* | 1644.58 | (2,3,4$^+$) |
| | | 1934.10 *21* | 100 *7* | 1186.51 | 2$^+$ |
| | | 2501.4 *3* | 27 *5* | 619.36 | 2$^+$ |
| 3389.91 | (2$^+$,3,4$^+$) | 532.7 *4* | 18 *5* | 2857.14 | (2,3,4$^+$) |
| | | 1745.4 *4* | 55 *13* | 1644.58 | (2,3,4$^+$) |
| | | 1819.59 *21* | 58 *24* | 1570.20 | 4$^+$ |
| | | 2771.2 *6* | 100 *24* | 619.36 | 2$^+$ |
| 3687.73 | (4$^+$) | 2043.1 *1* | 100 *18* | 1644.58 | (2,3,4$^+$) |
| | | 2501.4 *3* | 47 *24* | 1186.51 | 2$^+$ |
| 3714.2 | (8$^+$) | 966‡ | 100‡ | 2748.2 | (6$^+$) |
| 4083.7 | (2,3,4$^+$) | 962.5 *15* | 18 *9* | 3120.60 | (2,3,4$^+$) |
| | | 2241.0 *6* | 19 *5* | 1842.73 | 2$^+$ |
| | | 3464.3 *8* | 100 *12* | 619.36 | 2$^+$ |
| 4270.08 | (2,3,4$^+$) | 1564.2 *3* | 75 *12* | 2706.01 | (2$^+$) |
| | | 1604.38 *23* | 100 *14* | 2665.63 | (2,3,4$^+$) |
| | | 3083.0 *15* | 25 *15* | 1186.51 | 2$^+$ |
| 4279.4 | (2,3,4$^+$) | 1573.4 *3* | 59 *11* | 2706.01 | (2$^+$) |
| | | 3092.8 *7* | 100 *17* | 1186.51 | 2$^+$ |
| 5078.2 | (2,3,4$^+$) | 3508.4 *16* | 7 *5* | 1570.20 | 4$^+$ |
| | | 4458.5 *12* | 100 *18* | 619.36 | 2$^+$ |

† From $^{78}$Ga $\beta^-$ decay unless otherwise stated.
‡ From $^{192}$Os($^{82}$Se,Xγ) only.

## Adopted Levels, Gammas

### Level Scheme

Intensities: Relative photon branching from each level

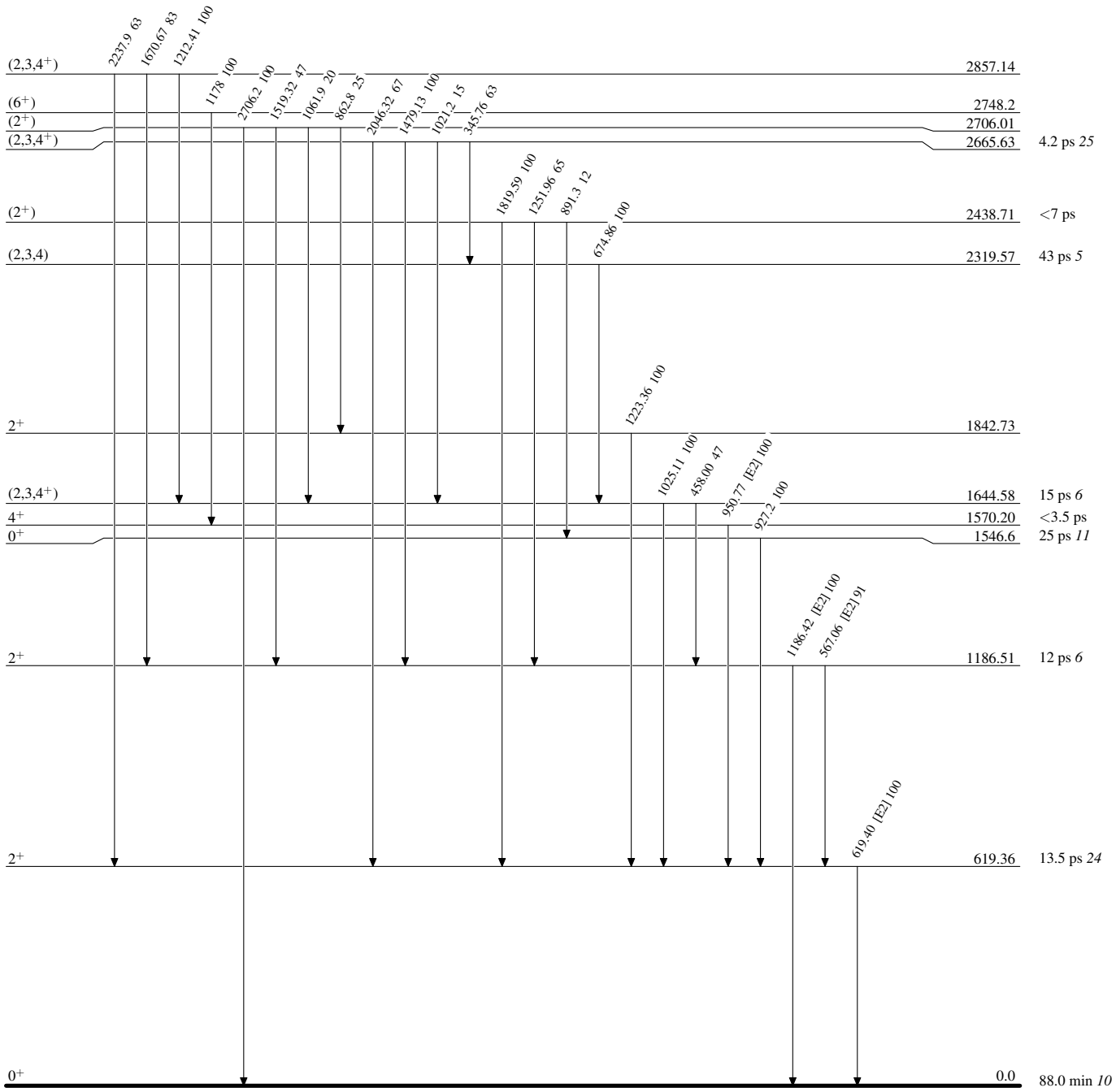



$^{78}_{32}Ge_{46}$

## Adopted Levels, Gammas

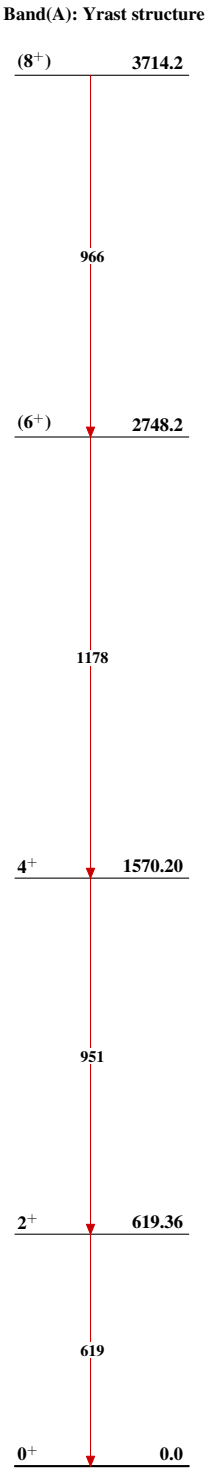
### Level Scheme (continued)

Intensities: Relative photon branching from each level




$^{78}_{32}Ge_{46}$

## Adopted Levels, Gammas




$^{78}_{32}Ge_{46}$