## (HI,xnγ) 1997Be65,1979Zo02,1979Pa13

| Type | Author | History Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | C. D. Nesaraja | NDS 115, 1 (2014) | 31-Jul-2013 |

$^{60}$Ni($^{12}$C,2pnγ): 1997Be65: E=48, 56, 60 MeV; Eγ, Iγ, γ yield functions, γγ coin, $T_{1/2}$ by recoil-distance Doppler shift (RDDS) method.

$^{56}$Fe($^{16}$O,2pnγ): 1997Vy01: E=65 MeV; carried out improvements in the level mixing spectroscopy (LEMS) method of measuring quadrupole moments. These authors quote for the 398 keV $J^\pi=9/2^+$ level Q=2.4 *5*; however, the provenance of this value is not clear from this paper, and a more detailed analysis of data is being done.

$^{55}$Mn($^{16}$O,npγ): 1979Zo02: E=44 MeV; Eγ, γγ coincidences, Iγ, γ(θ), γ-ray linear polarization and $T_{1/2}$ by recoil distance. 1979Zo02: E=40-51 MeV; γ-ray yield functions. 1979Pa13: E=47.5 MeV; Eγ, γγ coincidences, Iγ and γ(θ) 1979Pa13: E=42.5 MeV; γ(θ). 1979Pa13: E=37.5-50 MeV; γ-ray yield functions.

$^{64}$Zn($^{7}$Li,npγ), 1982Pa03: E=15-18 MeV; γ(θ), γ ray yield functions and $T_{1/2}$ by DSAM.

1995Fe15: theoretical calculations of $^{69}$Ge properties based on the interacting boson model (IBM), the interacting boson-fermion model (IBFM) and the interacting boson-fermion-fermion model (IBFFM).

### $^{69}$Ge Levels

| E(level)[†] | $J^\pi$[b] | $T_{1/2}$ | Comments |
|---|---|---|---|
| 0 | $5/2^-$ | | |
| 86.78 *2* | $1/2^-$ | | |
| 373.96 *4* | $3/2^-$ | | |
| 397.96 *3* | $9/2^+$ | | |
| 812.17 *3* | $5/2^+$ | | |
| 862.05 *9* | $7/2^-$ | | |
| 1195.72 *5* | $5/2^-$ | 0.97[#] ps *21* | |
| 1350.64 *5* | $11/2^+$[&] | 0.59[#] ps *7* | $T_{1/2}$: corrected for feeding from above. Others:≤0.7 ps (1979Zo02), 1.1 ps *2* (1997Be65).<br>$J^\pi$: $11/2^+$ from γ(θ) of 953γ and linear-polarization data (1979Zo02); same $J^\pi$ assigned by 1982Pa03 and 1979Pa13 based on γ(θ) and yield data. |
| 1407.20 *4* | $13/2^+$[&] | 1.59[@] ps *7* | $T_{1/2}$: other: 1.7 ps *+7−4* (1982Pa03).<br>$J^\pi$: $13/2^+$ from γ(θ) of 1009γ and linear-polarization data (1979Zo02); same $J^\pi$ assigned by 1982Pa03 and 1979Pa13 based on γ(θ) and yield data. |
| 1430.14 *9* | $9/2^-$[&] | 0.61 ps *19* | $T_{1/2}$: weighted average of 1.0 ps *3* (1997Be65) and 0.52 ps *14* (1982Pa03).<br>$J^\pi$: $9/2^{(-)}$ from γ(θ) and yield ratio (1982Pa03); $9/2^-$ (1997Be65). |
| 1465.8 *15* | $9/2^+$[&] | | $J^\pi$: $9/2^+$ (1997Be65). |
| 1591.09 *21* | $7/2^+$ | 0.55[#] ps *+28−14* | $J^\pi$: 7/2 from γ(θ) (1982Pa03); $7/2^+$ (1997Be65). |
| 1920.41 *10* | $9/2^-$[&] | | $J^\pi$: $9/2^-$ (1997Be65). |
| 2018.15 *6* | $13/2^+$[&] | 1.46 ps *24* | $T_{1/2}$: weighted average of 1.11 ps *35* (1997Be65), 1.66 ps *42* (1979Zo02), and 1.87 ps *49* (1982Pa03).<br>$J^\pi$: $13/2^{(+)}$ from γ(θ) and yield ratio (1982Pa03); 13/2 from γ(θ) (1979Zo02); $13/2^+$ (1997Be65). |
| 2248.20 *11* | $11/2^-$ | | $J^\pi$: $11/2^-$; J=9/2, 11/2 possible from side feeding excitation function (1997Be65). |
| 2483.27[a] *7* | $15/2^+$[&] | 0.62 ps *21* | $T_{1/2}$: from 1997Be65; other: 1.3 ps *+6−3* (1982Pa03).<br>$J^\pi$: $15/2^+$ (1997Be65). |
| 2730.07 *11* | $13/2^-$[&] | | $J^\pi$: $13/2^-$ (1997Be65). |
| 2755.11 *7* | $17/2^+$[&] | 0.6[#] ps *1* | $J^\pi$: $17/2^{(+)}$ from γ(θ) and yield ratio (1982Pa03,1979Pa13). Reinvestigation of γ(θ) of 1348γ allowing for Doppler shift gave J=17/2 (1980Zo03). This resolves the discrepancy between 1979Pa13 and 1979Zo02 for the J of this level; $17/2^+$ (1997Be65).<br>$T_{1/2}$: others: 0.2 ps *1* by RDDS (1997Be65),≤0.5 ps by recoil distance (1979Zo02). |
| 2834.14 *9* | $13/2^-$[&] | | $J^\pi$: $13/2^-$ (1997Be65). |
| 3075.80 *8* | $15/2^-$[&] | 0.46[@] ps *24* | $J^\pi$: 15/2 from γ(θ) (1979Pa13); $15/2^-$ (1997Be65). |

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**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13 (continued)**

$^{69}$Ge Levels (continued)

| E(level)[†] | Jπ[b] | $T_{1/2}$ | Comments |
|---|---|---|---|
| | | | $T_{1/2}$: others: 1.5 ps *+12−4* (1982Pa03),≤0.7 ps by recoil distance (1979Zo02). |
| 3157.29 *8* | 17/2+& | 1.0@ ps *3* | $T_{1/2}$: other:≥1.7 ps (1982Pa03).<br>Jπ: 17/2+ from γ(θ) and yield ratio (1979Pa13); 17/2+ (1997Be65). |
| 3395.93 *13* | 15/2−& | | Jπ: 15/2− (1997Be65). |
| 3605.10 *12* | 17/2−& | 2.1@ ps *7* | Jπ: 17/2− (1997Be65). |
| 3666.83 *9* | 17/2−& | | Jπ: 17/2− (1997Be65). |
| 3749.15 *7* | 19/2−& | 6.5‡ ps *6* | $T_{1/2}$: other: 2.4 ps *5* (1997Be65).<br>Jπ: 19/2 from γ(θ) (1979Pa13); π=− from linear polarization (1979Zo02); 19/2− (1997Be65). |
| 3963.91 *10* | | | |
| 4067.90 *8* | 19/2−& | | Jπ: 19/2(−) from γ(θ) and yield (1979Pa13); 19/2− (1997Be65). |
| 4267.13 *9* | 21/2− | 3.1 ps *3* | $T_{1/2}$: Weighted average of 3.5 ps *5* (1997Be65) and 2.9 ps *3* (1979Zo02).<br>Jπ: 21/2 from γ(θ) and yield; π=− from RUL (1979Pa13). |
| 4305.74 *15* | 21/2(+) | 0.6@ ps *3* | J=21/2 from side feeding excitation function; π=(+) from systematics (1997Be65). |
| 4493.5 *3* | | | |
| 4566.39 *13* | | | |
| 4594.29 *9* | 23/2− | 13.6‡ ps *4* | $T_{1/2}$: other: 12.1 ps *10* (1997Be65).<br>Jπ: (23/2) from γ(θ) and yield (1979Pa13); 23/2− most likely from systematics (1997Be65). |
| 4714.78 *12* | | | |
| 4837.10 *23* | | | |
| 5006.2 *4* | (25/2−) | | Jπ: 25/2(−) from γ(θ) and yield (1979Pa13). |
| 5089.9 *3* | | | |
| 5467? | | | |
| 5593.06 *14* | 23/2− | | Jπ: from side feeding excitation functions and γ decay characteristics (1997Be65). |
| 5737.84 *12* | | | |
| 5802? | | | |
| 5834.79 *13* | 27/2− | 3.5@ ps *6* | Jπ: yield ratio suggests J>25/2; γ(θ) of 1242γ to 23/2 *4595* level shows it to be quadrupole; hence J=27/2. J=27/2− from side feeding excitation function and systematics (1997Be65). |
| 5841.7 *5* | | | |
| 5897.97 *25* | (25/2+) | <0.3@ ps | Jπ: most likely from systematics (1997Be65). |
| 6041.87 *14* | | | |
| 6086.86 *15* | | | |
| 6291.75 *14* | (25/2+) | | Jπ: most likely from systematics (1997Be65). |
| 6504.2 *8* | | | |
| 6548.49 *14* | (25/2+) | | Jπ: most likely from systematics (1997Be65). |
| 6591.1 *6* | | | |
| 6839.57 *12* | 25/2(−) | 1.5@ ps *4* | Jπ: from side feeding excitation function and γ decay characteristics (1997Be65). |
| 7147.59 *14* | 29/2(+) | | Jπ: most likely from systematics (1997Be65). |
| 7405.5 *4* | | | |
| 7412.4 *4* | | | |
| 7578.58 *24* | 29/2(−) | 3.5@ ps *21* | Jπ: from side feeding excitation function and γ ray characteristics (1997Be65). |
| 7780.22 *16* | 31/2(−) | 0.21@ ps *14* | Jπ: J=31/2 from side feeding excitation function; π from systematics (1997Be65). |
| 7903.60 *17* | 33/2(+) | 0.8@ ps *4* | Jπ: J=33/2 from side feeding excitation function; π from systematics (1997Be65). |
| 8708.9 *3* | (33/2−) | | Jπ: most likely from systematics (1997Be65). |
| 9012.33 *19* | (35/2−) | | Jπ: most likely from systematics (1997Be65). |
| 9182.31 *20* | (37/2+) | | Jπ: most likely from systematics (1997Be65). |

[†] From least-squares fit to Eγ data.

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**(HI,xn$\gamma$) 1997Be65,1979Zo02,1979Pa13 (continued)**

$^{69}$Ge Levels (continued)

‡ From 1979Zo02 using recoil-distance method.
# From 1982Pa03 using DSAM; assuming a side feeding of 0.1 ps.
@ From 1997Be65 using RDDS.
& The spin unambiguously determined from the side feeding excitation function is consistent with results of $\gamma(\theta)$ (1997Be65).
a Level doublet proposed by 1975Eb05 based on $^{66}$Zn($\alpha$,n$\gamma$) data (1975Eb05) and HI data (1979Zo02) according to which 1133$\gamma$ depopulates the 2483.2 level and the 1076$\gamma$ originates from the 2483.6 level and a change in the intensity ratio of these two $\gamma$-rays with bombarding energy is observed. 1979Pa13 measured a constant ratio for these two $\gamma$-rays and suggested contamination by a 1076$\gamma$ from $^{68}$Ge as a possible reason for the results of 1975Eb05 and 1979Zo02. 1982Pa03 confirm the results of 1979Pa13 and assign only one level at 2483 with a $J^{\pi}=15/2^{+}$.
b From Adopted Levels; supporting arguments from this data set are indicated in comments.

## (HI,xnγ) 1997Be65,1979Zo02,1979Pa13 (continued)

### γ($^{69}$Ge)

γ placement from 1982Pa03, 1979Pa13 and 1979Zo02.
γγ coincidences from 1979Zo02.

| $E_\gamma$[†] | $I_\gamma$[a] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α[l] | Iγ[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 86.78[‡] *2* | | 86.78 | 1/2⁻ | 0 | 5/2⁻ | | | | | |
| 148.4 *1* | 0.2 *1* | 4714.78 | | 4566.39 | | | | | | |
| 241.7 *3* | 0.9 *2* | 3075.80 | 15/2⁻ | 2834.14 | 13/2⁻ | | | | | |
| 271.7 *2* | 0.5 *2* | 2755.11 | 17/2⁺ | 2483.27 | 15/2⁺ | | | | | |
| 287.18[‡] *3* | | 373.96 | 3/2⁻ | 86.78 | 1/2⁻ | | | | | |
| 288.3 *3* | 0.5 *3* | 4594.29 | 23/2⁻ | 4305.74 | 21/2(+) | | | | | |
| 291.1 *1* | 0.3 *2* | 6839.57 | 25/2(−) | 6548.49 | (25/2⁺) | | | | | |
| 303.2 *1* | | 4267.13 | 21/2⁻ | 3963.91 | | | | | | |
| 318.8 *1* | 0.8 *4* | 4067.90 | 19/2⁻ | 3749.15 | 19/2⁻ | | | | | |
| 327.17[#] *5* | 11.6 *6* | 4594.29 | 23/2⁻ | 4267.13 | 21/2⁻ | M1+E2[e] | −0.11[f] *4* | 0.00384 *8* | 8.4 *4* | ce(K)/(γ+ce)=0.00341 *7*; ce(L)/(γ+ce)=0.000355 *8*; ce(M)/(γ+ce)=5.30×10$^{-5}$ *12*<br>ce(N)/(γ+ce)=3.47×10$^{-6}$ *7*<br>α(K)=0.00343 *7*; α(L)=0.000356 *8*; α(M)=5.32×10$^{-5}$ *12*<br>α(N)=3.48×10$^{-6}$ *7*<br>δ: Other: −0.02 *3* (1979Zo02). |
| 397.96[#] *3* | 100 *1* | 397.96 | 9/2⁺ | 0 | 5/2⁻ | | | | 100.0 *20* | |
| 400.9 *2* | 0.9 *4* | 4067.90 | 19/2⁻ | 3666.83 | 17/2⁻ | | | | | |
| 402.2 *3* | 1.3 *6* | 3157.29 | 17/2⁺ | 2755.11 | 17/2⁺ | | | | | |
| 447.6 *1* | 0.6 *3* | 4714.78 | | 4267.13 | 21/2⁻ | | | | | |
| 465.0 *3* | 0.2 *1* | 2483.27 | 15/2⁺ | 2018.15 | 13/2⁺ | | | | | |
| 481.7 *3* | 0.1 *1* | 2730.07 | 13/2⁻ | 2248.20 | 11/2⁻ | | | | | |
| 518.60[#] *5* | 15.5 *7* | 4267.13 | 21/2⁻ | 3749.15 | 19/2⁻ | M1+E2[e] | +0.08[f] *1* | 1.29×10$^{-3}$ | 12.9 *6* | ce(K)/(γ+ce)=0.001149 *17*; ce(L)/(γ+ce)=0.0001182 *17*; ce(M)/(γ+ce)=1.765×10$^{-5}$ *25*<br>ce(N)/(γ+ce)=1.161×10$^{-6}$ *17*<br>α(K)=0.001150 *17*; α(L)=0.0001183 *17*; α(M)=1.768×10$^{-5}$ *25*<br>α(N)=1.162×10$^{-6}$ *17*<br>Eγ: This transition is not included in the least-squares fit for the excitation energies since the energy fit is poor. The least-squares fit gives Eγ=518.39 *4*.<br>δ: Other: +0.17 *2* (1979Zo02). |
| 526.3 *1* | 4.6 *3* | 4594.29 | 23/2⁻ | 4067.90 | 19/2⁻ | E2 | | 0.00201 | | α(K)=0.00179 *3*; α(L)=0.000188 *3*; |

**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13 (continued)**

γ($^{69}$Ge) (continued)

| $E_\gamma$ [†] | $I_\gamma$ [a] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α [l] | Iγ [b] | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | α(M)=2.80×10$^{-5}$ *4*<br>α(N)=1.79×10$^{-6}$ *3*<br>Mult.: Q from γ(θ) (1979Pa13); E2 from RUL. |
| 529.3 *2* | 1.0 *5* | 3605.10 | 17/2$^-$ | 3075.80 | 15/2$^-$ | | | | | |
| 547.9 *2* | 0.2 *1* | 6839.57 | 25/2$^{(-)}$ | 6291.75 | (25/2$^+$) | | | | | |
| 568.1 *2* | 0.3 *1* | 1430.14 | 9/2$^-$ | 862.05 | 7/2$^-$ | | | | | |
| 591.0 *2* | 0.7 *2* | 3666.83 | 17/2$^-$ | 3075.80 | 15/2$^-$ | | | | | |
| 591.86[#] *6* | 4.9 *5* | 3749.15 | 19/2$^-$ | 3157.29 | 17/2$^+$ | (E1(+M2))[d] | −0.01[f] *2* | 4.68×10$^{-4}$ | 6.4 *4* | ce(K)/(γ+ce)=0.000419 *6*;<br>ce(L)/(γ+ce)=4.26×10$^{-5}$ *7*;<br>ce(M)/(γ+ce)=6.36×10$^{-6}$ *10*<br>ce(N)/(γ+ce)=4.14×10$^{-7}$ *6*<br>α(K)=0.000419 *6*; α(L)=4.27×10$^{-5}$ *7*;<br>α(M)=6.36×10$^{-6}$ *10*<br>α(N)=4.14×10$^{-7}$ *6*<br>δ: Other: −0.05 *2* (1979Zo02). |
| 610.8 *1* | 0.8 *4* | 2018.15 | 13/2$^+$ | 1407.20 | 13/2$^+$ | | | | | |
| 662.0 *3* | 6.4 *3* | 4267.13 | 21/2$^-$ | 3605.10 | 17/2$^-$ | | | | | |
| 662.5[j&] *5* | 6[k] | 6504.2 | | 5841.7 | | | | | | |
| 667.56 *6* | 12.0 *10* | 2018.15 | 13/2$^+$ | 1350.64 | 11/2$^+$ | M1+E2[e] | +0.45 *4* | 7.76×10$^{-4}$ *13* | 13.13 *11* | ce(K)/(γ+ce)=0.000693 *12*;<br>ce(L)/(γ+ce)=7.12×10$^{-5}$ *12*;<br>ce(M)/(γ+ce)=1.063×10$^{-5}$ *18*<br>ce(N)/(γ+ce)=6.97×10$^{-7}$ *12*<br>α(K)=0.000694 *12*; α(L)=7.12×10$^{-5}$ *12*;<br>α(M)=1.064×10$^{-5}$ *18*<br>α(N)=6.98×10$^{-7}$ *12*<br>δ: weighted average of +0.51 *5* (1979Zo02), +0.45 *10* (1979Pa13), and +0.39 *5* (1982Pa03). |
| 671.9 *2* | 0.5 *3* | 4067.90 | 19/2$^-$ | 3395.93 | 15/2$^-$ | | | | | |
| 673.37[#] *5* | 6.6 *5* | 3749.15 | 19/2$^-$ | 3075.80 | 15/2$^-$ | E2 | | 9.78×10$^{-4}$ | 7.8 *5* | ce(K)/(γ+ce)=0.000872 *13*;<br>ce(L)/(γ+ce)=9.06×10$^{-5}$ *13*;<br>ce(M)/(γ+ce)=1.351×10$^{-5}$ *19*<br>ce(N)/(γ+ce)=8.71×10$^{-7}$ *13*<br>α(K)=0.000873 *13*; α(L)=9.07×10$^{-5}$ *13*;<br>α(M)=1.352×10$^{-5}$ *19*<br>α(N)=8.72×10$^{-7}$ *13*<br>Mult.: Q from γ(θ) (1979Pa13); E2 from RUL. |
| 674.0 *3* | 3.1 *2* | 3157.29 | 17/2$^+$ | 2483.27 | 15/2$^+$ | | | | | |
| 737.0 *3* | 0.3 *1* | 2755.11 | 17/2$^+$ | 2018.15 | 13/2$^+$ | | | | | |





$^{69}_{32}Ge_{37}$-5

**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13 (continued)**

γ($^{69}$Ge) (continued)

| $E_\gamma$ [†] | $I_\gamma$ [a] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α [l] | Iγ [b] | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 739.0 *2* | 7.6 *5* | 7578.58 | 29/2$^{(-)}$ | 6839.57 | 25/2$^{(-)}$ | | | | | |
| 739.1[&] *3* | 5[k] | 5006.2 | (25/2$^-$) | 4267.13 | 21/2$^-$ | Q[d] | | | | |
| 752.7 *1* | 1.0 *4* | 6839.57 | 25/2$^{(-)}$ | 6086.86 | | | | | | |
| 756.0 *1* | 5.1 *6* | 7903.60 | 33/2$^{(+)}$ | 7147.59 | 29/2$^{(+)}$ | | | | | |
| 756.3[&] *5* | 3[k] | 6591.1 | | 5834.79 | 27/2$^-$ | D+Q[d] | | | | δ: −0.15 *5* if it is a 25/2 to 27/2 transition; +0.17 *4* if it is a 29/2 to 27/2 transition (1979Pa13). |
| 771.0 *3* | 0.4 *3* | 3605.10 | 17/2$^-$ | 2834.14 | 13/2$^-$ | | | | | |
| 778.92[@] *20* | | 1591.09 | 7/2$^+$ | 812.17 | 5/2$^+$ | M1+E2[h] | +0.43[i] *4* | 5.44×10$^{-4}$ *9* | | α(K)=0.000487 *8*; α(L)=4.98×10$^{-5}$ *8*; α(M)=7.44×10$^{-6}$ *12*<br>α(N)=4.89×10$^{-7}$ *8* |
| 795[m] | | 5802? | | 5006.2 | (25/2$^-$) | | | | | $E_\gamma$: Uncertain gamma shown in level scheme in Fig.1 (1979Pa13). |
| 797.7 *1* | 2.5 *8* | 6839.57 | 25/2$^{(-)}$ | 6041.87 | | | | | | |
| 809.7 *3* | 0.5 *3* | 2730.07 | 13/2$^-$ | 1920.41 | 9/2$^-$ | | | | | |
| 812.16[‡] *3* | | 812.17 | 5/2$^+$ | 0 | 5/2$^-$ | | | | | |
| 816.1 *3* | 0.3 *2* | 2834.14 | 13/2$^-$ | 2018.15 | 13/2$^+$ | | | | | |
| 817.3 *2* | 2.6 *8* | 4566.39 | | 3749.15 | 19/2$^-$ | | | | | |
| 821.75[‡] *3* | | 1195.72 | 5/2$^-$ | 373.96 | 3/2$^-$ | | | | | |
| 832.6 *1* | 0.6 *2* | 3666.83 | 17/2$^-$ | 2834.14 | 13/2$^-$ | | | | | |
| 845.2 *1* | 6.5 *4* | 4594.29 | 23/2$^-$ | 3749.15 | 19/2$^-$ | E2 | | 5.34×10$^{-4}$ | | α(K)=0.000477 *7*; α(L)=4.92×10$^{-5}$ *7*; α(M)=7.34×10$^{-6}$ *11*<br>α(N)=4.77×10$^{-7}$ *7*<br>Mult.: Q from γ(θ) (1979Pa13); E2 from RUL. |
| 855.8 *1* | 0.9 *4* | 7147.59 | 29/2$^{(+)}$ | 6291.75 | (25/2$^+$) | | | | | |
| 862.0 *1* | 4.4 *2* | 862.05 | 7/2$^-$ | 0 | 5/2$^-$ | | | | | |
| 872[m] | | 5467? | | 4594.29 | 23/2$^-$ | | | | | $E_\gamma$: Uncertain gamma shown in level scheme in Fig.1 (1979Pa13). |
| 874.9 *2* | 4.2 *2* | 3605.10 | 17/2$^-$ | 2730.07 | 13/2$^-$ | | | | | |
| 910.7 *2* | 0.5 *3* | 4067.90 | 19/2$^-$ | 3157.29 | 17/2$^+$ | | | | | |
| 952.69 *5* | 23.5 *10* | 1350.64 | 11/2$^+$ | 397.96 | 9/2$^+$ | M1+E2[c] | +0.74 *5* | 3.62×10$^{-4}$ *6* | | α(K)=0.000324 *5*; α(L)=3.31×10$^{-5}$ *5*; α(M)=4.93×10$^{-6}$ *8*<br>α(N)=3.24×10$^{-7}$ *5*<br>δ: weighted average of +0.79 *+10−18* (1979Zo02), +0.65 *12* (1979Pa13), and +0.76 *6* (1982Pa03). |
| 966.0 *3* | 0.6 *3* | 4714.78 | | 3749.15 | 19/2$^-$ | | | | | |
| 992.0 *2* | 0.4 *2* | 4067.90 | 19/2$^-$ | 3075.80 | 15/2$^-$ | | | | | |
| 994.04[#] *3* | 20.4 *11* | 3749.15 | 19/2$^-$ | 2755.11 | 17/2$^+$ | E1+M2[c] | −0.03[f] *2* | 1.55×10$^{-4}$ *2* | 20.2 *7* | ce(K)/(γ+ce)=0.0001388 *21*; ce(L)/(γ+ce)=1.407×10$^{-5}$ *22*; ce(M)/(γ+ce)=2.10×10$^{-6}$ *4*<br>ce(N)/(γ+ce)=1.376×10$^{-7}$ *21* |





$^{69}_{32}Ge_{37}$-6

**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13 (continued)**

γ($^{69}$Ge) (continued)

| $E_\gamma$ † | $I_\gamma$ [a] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α [l] | Iγ [b] | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | α(K)=0.0001389 *21*; α(L)=1.407×10$^{-5}$ *22*; α(M)=2.10×10$^{-6}$ *4*<br>α(N)=1.377×10$^{-7}$ *21*<br>δ: Other: −0.04 *5* (1979Zo02). |
| 1009.23 *2* | 58.1 *25* | 1407.20 | 13/2$^+$ | 397.96 | 9/2$^+$ | E2 [c] | | 3.46×10$^{-4}$ | | α(K)=0.000309 *5*; α(L)=3.17×10$^{-5}$ *5*; α(M)=4.73×10$^{-6}$ *7*<br>α(N)=3.09×10$^{-7}$ *5*<br>δ: δ(O/Q)=0.00 *1* (1979Zo02), +0.01 *1*(1982Pa03). |
| 1057.9 *2* | 0.9 *2* | 3075.80 | 15/2$^-$ | 2018.15 | 13/2$^+$ | | | | | |
| 1058.2 *3* | 0.8 *3* | 1920.41 | 9/2$^-$ | 862.05 | 7/2$^-$ | | | | | |
| 1067.8 [@] *15* | | 1465.8 | 9/2$^+$ | 397.96 | 9/2$^+$ | (M1+E2) [g] | −1.3 [i] *2* | 2.92×10$^{-4}$ *5* | | α(K)=0.000261 *5*; α(L)=2.66×10$^{-5}$ *5*; α(M)=3.97×10$^{-6}$ *7*<br>α(N)=2.61×10$^{-7}$ *5* |
| 1076.27 *17* | 5.4 *3* | 2483.27 | 15/2$^+$ | 1407.20 | 13/2$^+$ | M1+E2 [h] | +0.44 *6* | 2.72×10$^{-4}$ | 5.0 *13* | ce(K)/(γ+ce)=0.000243 *4*; ce(L)/(γ+ce)=2.48×10$^{-5}$ *4*; ce(M)/(γ+ce)=3.70×10$^{-6}$ *6*<br>ce(N)/(γ+ce)=2.44×10$^{-7}$ *4*<br>α(K)=0.000243 *4*; α(L)=2.48×10$^{-5}$ *4*; α(M)=3.70×10$^{-6}$ *6*<br>α(N)=2.44×10$^{-7}$ *4*<br>δ: weighted average of +0.35 *15* (1979Pa13), and +0.46 *6* (1982Pa03).<br>δ: Other: −0.05 *2* (1979Zo02). |
| 1101.7 *1* | 1.5 *5* | 6839.57 | 25/2$^{(-)}$ | 5737.84 | | | | | | |
| 1121.9 *2* | 1.2 *2* | 3605.10 | 17/2$^-$ | 2483.27 | 15/2$^+$ | D(+Q) [d] | −0.1 [f] *1* | | | |
| 1130.3 *1* | 0.3 *1* | 8708.9 | (33/2$^-$) | 7578.58 | 29/2$^{(-)}$ | | | | | |
| 1132.59 *8* | 3.9 *2* | 2483.27 | 15/2$^+$ | 1350.64 | 11/2$^+$ | E2 | | 2.67×10$^{-4}$ | 4.6 *10* | ce(K)/(γ+ce)=0.000237 *4*; ce(L)/(γ+ce)=2.42×10$^{-5}$ *4*; ce(M)/(γ+ce)=3.62×10$^{-6}$ *5*<br>ce(N)/(γ+ce)=2.37×10$^{-7}$ *4*; α(IPF)/$T_{1/2}$=2.01×10$^{-6}$ *3*<br>α(K)=0.000237 *4*; α(L)=2.43×10$^{-5}$ *4*; α(M)=3.62×10$^{-6}$ *5*<br>α(N)=2.37×10$^{-7}$ *4*; α(IPF)=2.01×10$^{-6}$ *3*<br>Mult.: Q from γ(θ) (1982Pa03); π from RUL.<br>δ: δ(O/Q)=0.03 *7* (1979Zo02). |
| 1139.16 *8* | 8.5 *4* | 3157.29 | 17/2$^+$ | 2018.15 | 13/2$^+$ | (E2) [g] | | 2.64×10$^{-4}$ | 9.8 *14* | ce(K)/(γ+ce)=0.000234 *4*; ce(L)/(γ+ce)=2.39×10$^{-5}$ *4*; ce(M)/(γ+ce)=3.57×10$^{-6}$ *5* |





$^{69}_{32}Ge_{37}$-7

**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13 (continued)**

γ($^{69}$Ge) (continued)

| $E_\gamma$[†] | $I_\gamma$[a] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α[l] | Iγ[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | ce(N)/(γ+ce)=2.34×10$^{-7}$ *4*; α(IPF)/$T_{1/2}$=2.38×10$^{-6}$ *4*<br>α(K)=0.000234 *4*; α(L)=2.39×10$^{-5}$ *4*; α(M)=3.57×10$^{-6}$ *5*<br>α(N)=2.34×10$^{-7}$ *4*; α(IPF)=2.38×10$^{-6}$ *4*<br>$I_\gamma$: not corrected for angular distribution (1979Zo02). |
| 1143.5 *1* | 1.3 *7* | 5737.84 | | 4594.29 | 23/2$^-$ | | | | | |
| 1147.7 *1* | 0.8 *4* | 3395.93 | 15/2$^-$ | 2248.20 | 11/2$^-$ | | | | | |
| 1171.5 *3* | 1.3 *7* | 5737.84 | | 4566.39 | | | | | | |
| 1183.6 *1* | 0.7 *2* | 3666.83 | 17/2$^-$ | 2483.27 | 15/2$^+$ | | | | | |
| 1204.8 *3* | 0.5 *4* | 6041.87 | | 4837.10 | | | | | | |
| 1232.1 *1* | 1.6 *4* | 9012.33 | (35/2$^-$) | 7780.22 | 31/2$^{(-)}$ | | | | | |
| 1240.5 *1* | 9.8 *9* | 5834.79 | 27/2$^-$ | 4594.29 | 23/2$^-$ | Q[d] | | | | |
| 1246.5 *1* | 5.3 *3* | 6839.57 | 25/2$^{(-)}$ | 5593.06 | 23/2$^-$ | | | | | |
| 1247.4[&] *5* | | 5841.7 | | 4594.29 | 23/2$^-$ | | | | | δ: +0.03 *3* for J(5842)=23/2, 0.00 *3* for J(5842)=19/2 (1979Pa13). |
| 1249.8 *3* | 0.2 *1* | 7147.59 | 29/2$^{(+)}$ | 5897.97 | (25/2$^+$) | | | | | |
| 1278.7 *1* | 0.4 *2* | 9182.31 | (37/2$^+$) | 7903.60 | 33/2$^{(+)}$ | | | | | |
| 1299.9 *1* | 4.9 *3* | 2730.07 | 13/2$^-$ | 1430.14 | 9/2$^-$ | | | | | |
| 1312.7 *1* | 2.0 *10* | 4067.90 | 19/2$^-$ | 2755.11 | 17/2$^+$ | (E1(+M2))[d] | −0.02[f] *4* | 2.17×10$^{-4}$ | | α(K)=8.34×10$^{-5}$ *15*; α(L)=8.43×10$^{-6}$ *15*; α(M)=1.257×10$^{-6}$ *22*<br>α(N)=8.27×10$^{-8}$ *15*; α(IPF)=0.0001235 *18* |
| 1312.8 *1* | 5.6 *3* | 7147.59 | 29/2$^{(+)}$ | 5834.79 | 27/2$^-$ | | | | | |
| 1325.9 *2* | 8.0 *10* | 5593.06 | 23/2$^-$ | 4267.13 | 21/2$^-$ | D+Q[d] | −0.25[f] *5* | | | |
| 1340.7 *3* | 2.0 *10* | 5089.9 | | 3749.15 | 19/2$^-$ | | | | | |
| 1347.92 *12* | 35.3 *17* | 2755.11 | 17/2$^+$ | 1407.20 | 13/2$^+$ | E2[c] | | 2.21×10$^{-4}$ | 43.5 *34* | ce(K)/(γ+ce)=0.0001625 *23*; ce(L)/(γ+ce)=1.655×10$^{-5}$ *24*; ce(M)/(γ+ce)=2.47×10$^{-6}$ *4*<br>ce(N)/(γ+ce)=1.622×10$^{-7}$ *23*; α(IPF)/$T_{1/2}$=3.95×10$^{-5}$ *6*<br>α(K)=0.0001626 *23*; α(L)=1.655×10$^{-5}$ *24*; α(M)=2.47×10$^{-6}$ *4*<br>α(N)=1.622×10$^{-7}$ *23*; α(IPF)=3.95×10$^{-5}$ *6*<br>δ: δ(O/Q)=0.00 *2* (1982Pa03). |
| 1386.1 *1* | 1.5 *3* | 2248.20 | 11/2$^-$ | 862.05 | 7/2$^-$ | | | | | |
| 1426.8 *3* | 0.4 *2* | 2834.14 | 13/2$^-$ | 1407.20 | 13/2$^+$ | | | | | |
| 1430.1 *1* | 8.2 *4* | 1430.14 | 9/2$^-$ | 0 | 5/2$^-$ | E2 | [i] | 2.23×10$^{-4}$ | | α(K)=0.0001438 *21*; α(L)=1.462×10$^{-5}$ *21*; α(M)=2.18×10$^{-6}$ *3*<br>α(N)=1.434×10$^{-7}$ *20*; α(IPF)=6.20×10$^{-5}$ *9*<br>δ: δ(O/Q)=+0.01 *3*.<br>Mult.: Q+O from γ(θ) (1982Pa03); π from RUL. |





$^{69}_{32}Ge_{37}$-8

**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13 (continued)**

γ($^{69}$Ge) (continued)

| $E_\gamma$ [†] | $I_\gamma$ [a] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | δ | α [l] | Iγ [b] | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 1480.6 *1* | 0.5 *3* | 3963.91 | | 2483.27 | 15/2$^+$ | | | | | |
| 1483.4 *1* | 2.3 *2* | 2834.14 | 13/2$^-$ | 1350.64 | 11/2$^+$ | | | | | |
| 1492.5 *3* | | 6086.86 | | 4594.29 | 23/2$^-$ | | | | | |
| 1507.5 *3* | | 7405.5 | | 5897.97 | (25/2$^+$) | | | | | |
| 1550.6 *2* | 1.1 *2* | 4305.74 | 21/2$^{(+)}$ | 2755.11 | 17/2$^+$ | | | | | |
| 1592.4 *3* | 0.5 *2* | 5897.97 | (25/2$^+$) | 4305.74 | 21/2$^{(+)}$ | | | | | |
| 1620.23[#] *7* | 4.6 *5* | 2018.15 | 13/2$^+$ | 397.96 | 9/2$^+$ | | | | 4.6 *6* | Not reported by 1979Pa13.<br>$I_\gamma$: angular distribution correction is for a pure E2 transition. |
| 1668.62 *24* | 10.6 *5* | 3075.80 | 15/2$^-$ | 1407.20 | 13/2$^+$ | (E1(+M2))[d] | −0.01[f] *4* | $4.50\times10^{-4}$ | 10.4 *9* | ce(K)/(γ+ce)=$5.60\times10^{-5}$ *9*;<br>ce(L)/(γ+ce)=$5.64\times10^{-6}$ *9*;<br>ce(M)/(γ+ce)=$8.42\times10^{-7}$ *13*<br>ce(N)/(γ+ce)=$5.55\times10^{-8}$ *9*; α(IPF)/$T_{1/2}$=0.000387 *6*<br>α(K)=$5.60\times10^{-5}$ *9*; α(L)=$5.65\times10^{-6}$ *9*;<br>α(M)=$8.42\times10^{-7}$ *13*<br>α(N)=$5.55\times10^{-8}$ *9*; α(IPF)=0.000387 *6*<br>δ: Other: δ(O/Q)=−0.13 *2* (1979Zo02), −0.01 *6*(1982Pa03). |
| 1697.4 *2* | 0.5 *2* | 6291.75 | (25/2$^+$) | 4594.29 | 23/2$^-$ | | | | | |
| 1738.4 *3* | 0.1 *1* | 4493.5 | | 2755.11 | 17/2$^+$ | | | | | |
| 1774.7 *2* | 0.3 *2* | 6041.87 | | 4267.13 | 21/2$^-$ | | | | | |
| 1819.3 *3* | | 7412.4 | | 5593.06 | 23/2$^-$ | | | | | |
| 1920.4 *1* | 0.6 *2* | 1920.41 | 9/2$^-$ | 0 | 5/2$^-$ | | | | | |
| 1945.4 *1* | 2.8 *7* | 7780.22 | 31/2$^{(-)}$ | 5834.79 | 27/2$^-$ | | | | | |
| 1954.2 *3* | 1.0 *3* | 6548.49 | (25/2$^+$) | 4594.29 | 23/2$^-$ | | | | | |
| 1985.9 *3* | | 6291.75 | (25/2$^+$) | 4305.74 | 21/2$^{(+)}$ | | | | | |
| 2082.0 *3* | 0.5 *2* | 4837.10 | | 2755.11 | 17/2$^+$ | | | | | |
| 2242.8 *3* | | 6548.49 | (25/2$^+$) | 4305.74 | 21/2$^{(+)}$ | | | | | |
| 2341.6 *3* | 0.1 *1* | 3749.15 | 19/2$^-$ | 1407.20 | 13/2$^+$ | | | | | |

[†] From 1997Be65, except as noted otherwise. Values quoted to two decimal digits are the weighted average of Eγ's from 1979Zo02 and 1982Pa03, except as noted otherwise.
[‡] From Adopted Gammas.
[#] From 1979Zo02.
[@] From 1982Pa03.
[&] From 1979Pa13.
[a] From 1997Be65.





$^{69}_{32}Ge_{37}$-9

$\gamma(^{69}Ge)$ (continued)

[b] From 1979Zo02.
[c] From $\gamma(\theta)$ and linear polarization (1979Zo02).
[d] From $\gamma(\theta)$ (1979Pa13) and $J^{\pi}$ of initial and final levels.
[e] From $\gamma(\theta)$ (1979Pa13) and RUL.
[f] From $\gamma(\theta)$ (1979Pa13).
[g] From $\gamma(\theta)$ (1982Pa03) and $J^{\pi}$ of initial and final levels.
[h] From $\gamma(\theta)$ (1982Pa03) and RUL.
[i] From $\gamma(\theta)$ (1982Pa03).
[j] Doublet.
[k] Relative intensity at E=47.5 MeV and $\theta(\gamma)$=90°. No uncertainties are given (1979Pa13).
[l] Additional information 1.
[m] Placement of transition in the level scheme is uncertain.





$^{69}_{32}Ge_{37}$-10

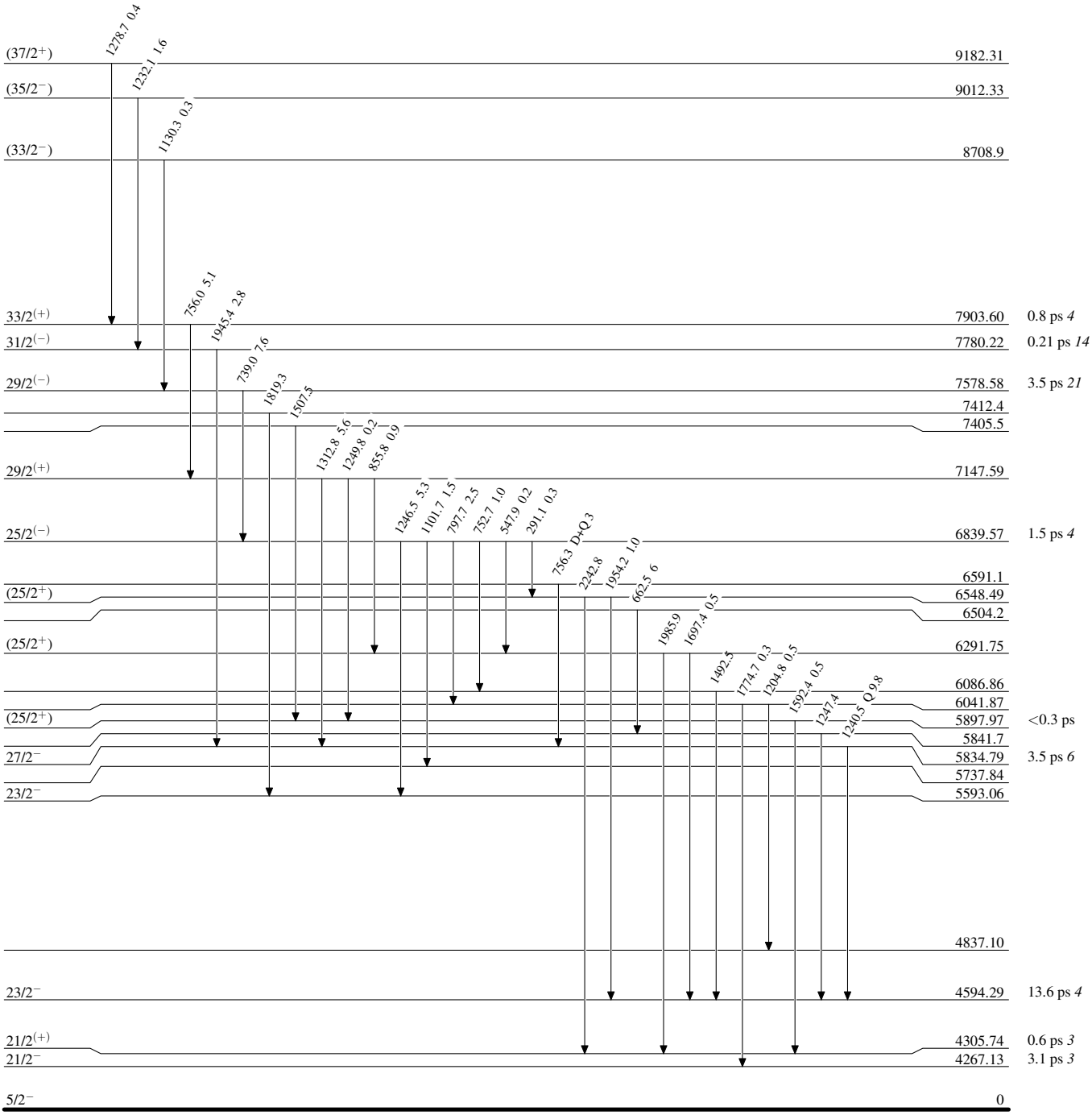
**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13**

Legend

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

Level Scheme

Intensities: Relative $I_\gamma$



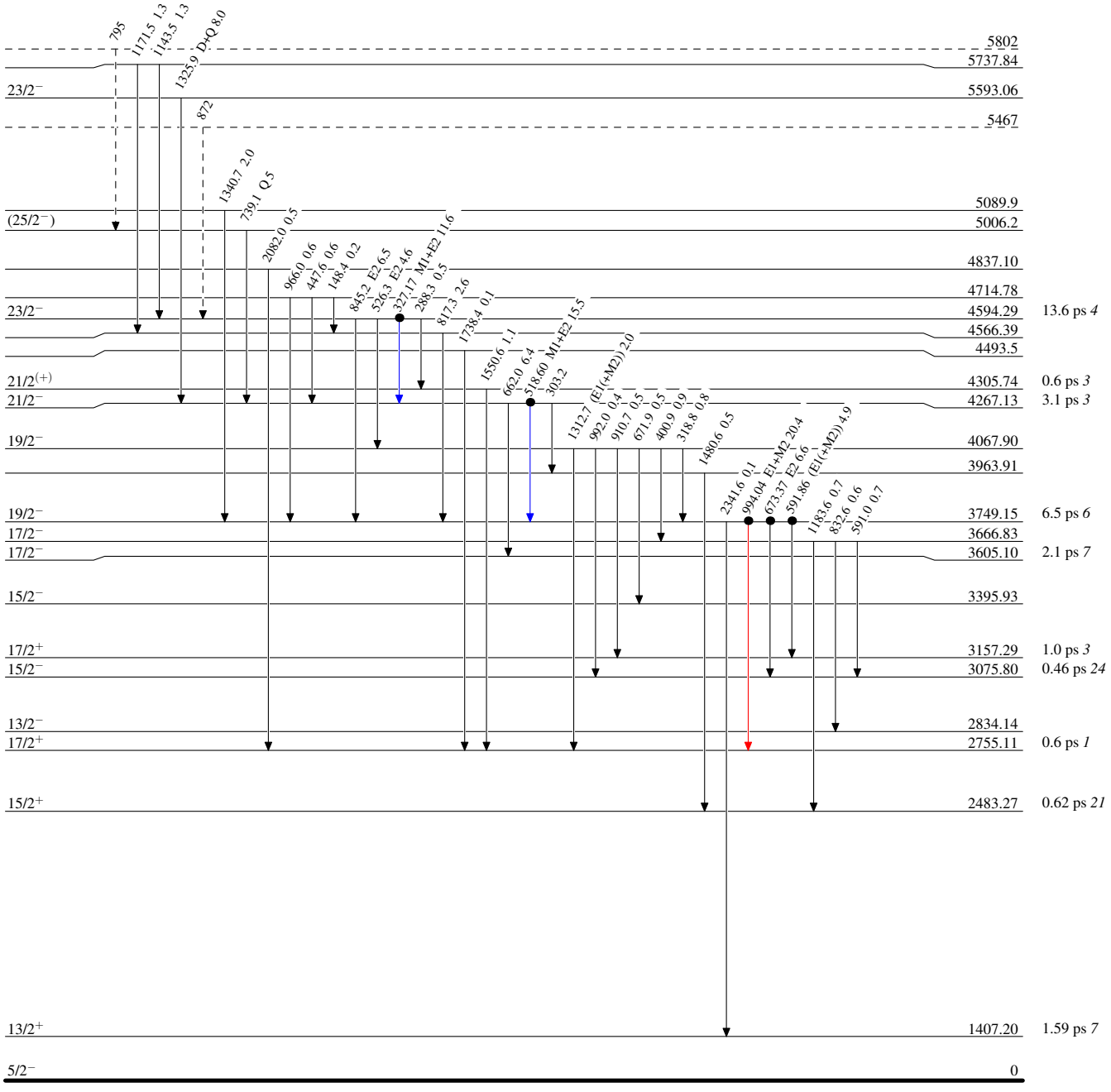

$^{69}_{32}Ge_{37}$

**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13**

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)
- Coincidence



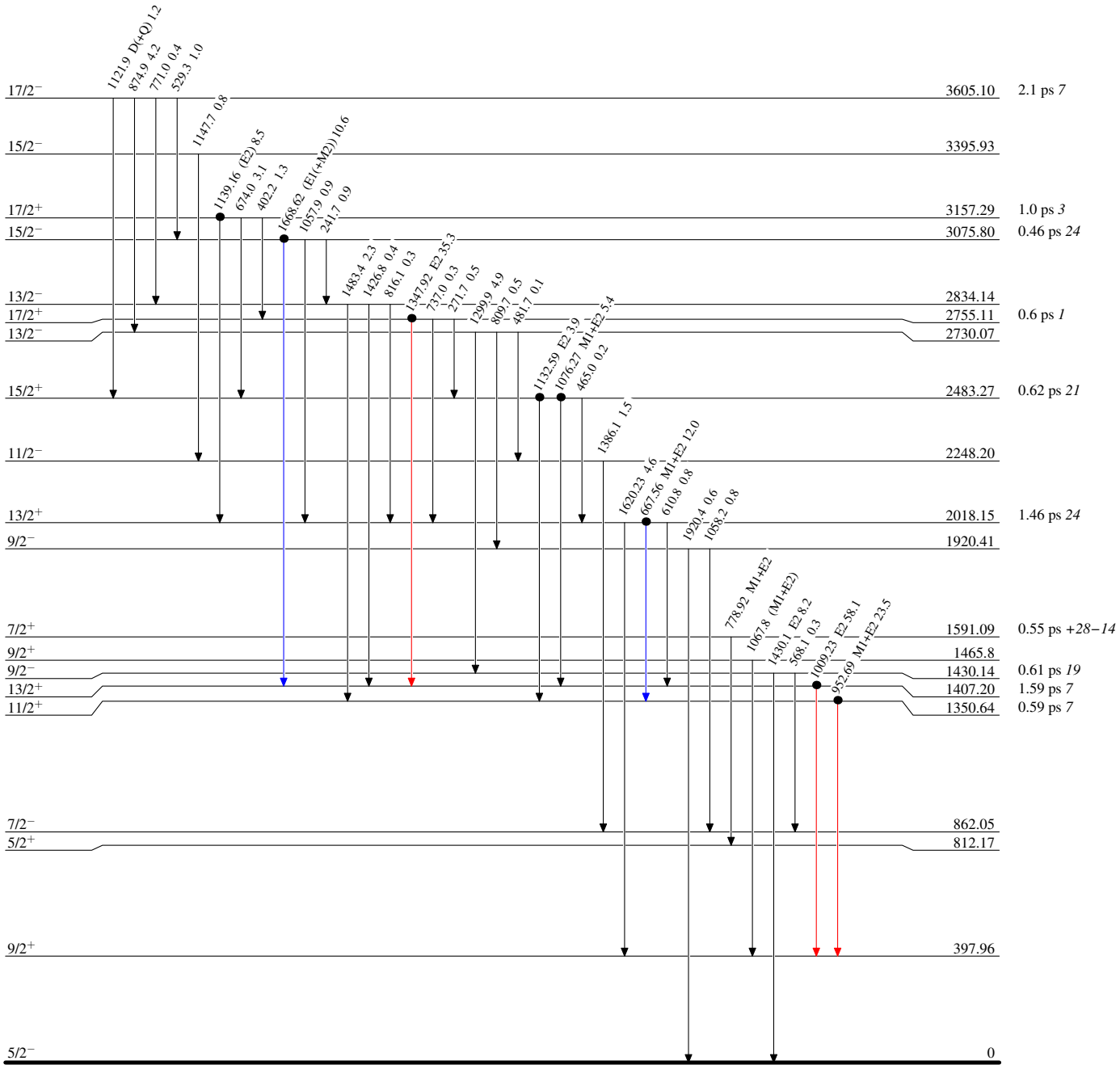

$^{69}_{32}Ge_{37}$

**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13**

## Level Scheme (continued)

Intensities: Relative $I_\gamma$

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




$^{69}_{32}Ge_{37}$

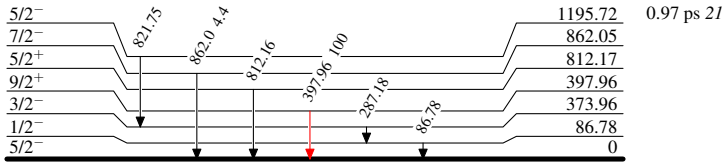
**(HI,xnγ) 1997Be65,1979Zo02,1979Pa13**

Level Scheme (continued)

Intensities: Relative $I_\gamma$

Legend

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




$^{69}_{32}Ge_{37}$