## $^{78}$Se(n,n′γ) 1977SiZT,1975SiZT,1986DoZW

History

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

1977SiZT, 1975SiZT: E=2.5 to 4.1 MeV, Iγ measured At 55°. Anti-Compton spectrometer used for γ-rays.
1986DoZW: E=fast, measured G.
Others:
1989Do14: measured σ(θ), multipole mixing, and excited-state half-lives.
1976La12: E(n)=8 MeV; deduced $\beta_2$=0.27 for the 614-keV, $2^+$ level.
1975Ef01, 1972Ko17, 1971Uh03, 1971Br18: measure σ for the population of 614- and 1308-kEV levels In (n,n′) reactions.
1980Ko17: $^{77}$Se(n,n) slow neutron scattering.
1996Ko41: (n,n′γ) E=fast; data analysis.
2000Za09, 1999Za07, 1999Za09, 1992Mu20, 1990Go13: (n,n′) E=1.5-5.0 MeV; data analysis.
The data In 1977SiZT and 1975SiZT agree well with those of 1986DoZW except for few cases.

### $^{78}$Se Levels

| E(level)† | Jπ‡ | $T_{1/2}$# | E(level)† | Jπ‡ | $T_{1/2}$# |
|---|---|---|---|---|---|
| 0.0 | $0^+$ | | 2838.8 *5* | $(2^+)$ | |
| 613.8 *3* | $2^+$ | | 2890.1 *6* | $5^-$ | |
| 1308.7 *3* | $2^+$ | | 2898.6 *6* | $2^+$ | |
| 1498.5 *6* | $0^+$ | | 2914.5 *11* | $4^+$ | 0.24 ps *+15−8* |
| 1502.6 *5* | $4^+$ | | 2950.4 *7* | $4^-$ | |
| 1758.7 *4* | $0^+$ | | 3005.4 *6* | $(1,2^+)$ | |
| 1853.9 *4* | $3^+$ | | 3090.3 *6* | $0^+$ | |
| 1996.0 *3* | $2^+$ | | 3133.3 *6* | $3^-$ | |
| 2190.5@ *7* | $4^+$ | | 3144.8 *5* | $2^+$ | |
| 2299.8 *5* | | | 3181.9 *5* | $(2)^+$ | |
| 2327.3 *3* | $2^+$ | 0.28 ps *+13 −8* | 3230.4? *6* | $(1^-,2,3)$ | |
| 2335.1 *11* | $0^+$ | | 3243.0 *5* | $2^+$ | |
| 2507.6 *4* | $3^-$ | | 3253.4 *6* | $(1,2)^+$ | |
| 2537.5 *5* | $2^+$ | 0.055 ps *7* | 3288.5 *6* | $1^-$ | |
| 2546.1@ *11* | $6^+$ | | 3386.1 *5* | $(2^+,5^-)$ | |
| 2647.7 *5* | $(1,2)^+$ | | 3440.1 *10* | $(1,2^+)$ | |
| 2682.1 *5* | $4^+$ | | 3603.9 *11* | | |
| 2719.3 *6* | | | 3632.2 *5* | | |
| 2736.3 *11* | $(5^+)$ | | 3686.9 *11* | $3^-$ | |
| 2754.4 *5* | $0^+$ | | | | |

† From least-squares fit to Eγ′s.
‡ From 'Adopted Levels'.
# From DSAM (1989Do14).
@ Reported by 1986DoZW only.

### γ($^{78}$Se)

| $E_\gamma$† | $I_\gamma$‡ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ |
|---|---|---|---|---|---|
| 320.3@ | | 2647.7 | $(1,2)^+$ | 2327.3 | $2^+$ |
| 331.2 *5* | 0.10 *1* | 2327.3 | $2^+$ | 1996.0 | $2^+$ |
| 351.1@ | 0.10 *2* | 1853.9 | $3^+$ | 1502.6 | $4^+$ |
| 354.7@ | 0.10 *3* | 2682.1 | $4^+$ | 2327.3 | $2^+$ |
| 382.5 *5* | 0.10 *1* | 2890.1 | $5^-$ | 2507.6 | $3^-$ |

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## $^{78}$Se(n,n′γ) 1977SiZT,1975SiZT,1986DoZW (continued)

### γ($^{78}$Se) (continued)

| $E_\gamma$[†] | $I_\gamma$[‡] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[#] | δ[#] | Comments |
|---|---|---|---|---|---|---|---|---|
| 449.5 *5* | 0.10 *1* | 1758.7 | $0^+$ | 1308.7 | $2^+$ | | | |
| 497.5[@] | 0.10 *2* | 1996.0 | $2^+$ | 1498.5 | $0^+$ | | | |
| 544.9 *5* | 1.8 *2* | 1853.9 | $3^+$ | 1308.7 | $2^+$ | D+Q | +0.42 *4* | $A_2$=+0.27 *5*, $A_4$=+0.08 *4* (1989Do14). |
| 613.8 *5* | 100 | 613.8 | $2^+$ | 0.0 | $0^+$ | | | |
| 686.3[@] | | 2682.1 | $4^+$ | 1996.0 | $2^+$ | | | |
| 687.5[@] | 1.5 *3* | 1996.0 | $2^+$ | 1308.7 | $2^+$ | | | |
| 688.2[@] | | 2190.5 | $4^+$ | 1502.6 | $4^+$ | | | |
| 695.0 *5* | 15.2 *3* | 1308.7 | $2^+$ | 613.8 | $2^+$ | | | |
| 757.1[@] | 0.10 *2* | 2754.4 | $0^+$ | 1996.0 | $2^+$ | | | |
| 793.6[@] | 0.10 *2* | 2647.7 | $(1,2)^+$ | 1853.9 | $3^+$ | | | |
| 828.1[@] | 0.4 *1* | 2682.1 | $4^+$ | 1853.9 | $3^+$ | | | |
| 842.7[@] | 0.7 *2* | 2838.8 | $(2^+)$ | 1996.0 | $2^+$ | | | |
| 881.7[@] | | 2190.5 | $4^+$ | 1308.7 | $2^+$ | | | |
| 884.7 *5* | | 1498.5 | $0^+$ | 613.8 | $2^+$ | | | |
| 888.9 | | 1502.6 | $4^+$ | 613.8 | $2^+$ | | | |
| 1005 *1* | 0.7 *1* | 2507.6 | $3^-$ | 1502.6 | $4^+$ | | | |
| 1018.6 *5* | 0.4 *1* | 2327.3 | $2^+$ | 1308.7 | $2^+$ | | | |
| 1043.5[@] | 0.3 *1* | 2546.1 | $6^+$ | 1502.6 | $4^+$ | | | |
| 1079.5 *5* | 0.3 *1* | 2838.8 | $(2^+)$ | 1758.7 | $0^+$ | | | |
| 1096.5 *5* | | 2950.4 | $4^-$ | 1853.9 | $3^+$ | | | |
| 1145.0 *5* | 2.7 *1* | 1758.7 | $0^+$ | 613.8 | $2^+$ | | | |
| 1199.1 *5* | 1.6 *2* | 2507.6 | $3^-$ | 1308.7 | $2^+$ | D+Q | +0.09 *5* | $A_2$=−0.12 *7*, $A_4$=+0.009 *5* (1989Do14). |
| 1229.2 *5* | 0.3 *1* | 2537.5 | $2^+$ | 1308.7 | $2^+$ | | | |
| 1233.7[@] | 0.6 *2* | 2736.3 | $(5^+)$ | 1502.6 | $4^+$ | | | |
| 1240.3 *5* | 4.5 *3* | 1853.9 | $3^+$ | 613.8 | $2^+$ | | | |
| 1293.2 *10* | | 3288.5 | $1^-$ | 1996.0 | $2^+$ | | | |
| 1308.8 *5* | 11.4 *1* | 1308.7 | $2^+$ | 0.0 | $0^+$ | (Q) | | $A_2$=+0.27 *6*, $A_4$=+0.009 *7* (1989Do14). |
| 1339.1 *5* | 0.7 *1* | 2647.7 | $(1,2)^+$ | 1308.7 | $2^+$ | | | |
| 1373.5[@] | 0.3 *1* | 2682.1 | $4^+$ | 1308.7 | $2^+$ | | | |
| 1382.2 *5* | 1.4 *3* | 1996.0 | $2^+$ | 613.8 | $2^+$ | | | |
| 1387.5 *5* | 0.3 *1* | 2890.1 | $5^-$ | 1502.6 | $4^+$ | | | |
| 1410.6 *5* | | 2719.3 | | 1308.7 | $2^+$ | | | |
| 1411.9[@] | 0.4 *1* | 2914.5 | $4^+$ | 1502.6 | $4^+$ | | | |
| 1444.5[@] | 0.3 *1* | 2754.4 | $0^+$ | 1308.7 | $2^+$ | | | |
| 1530.6 *5* | 0.3 *1* | 2838.8 | $(2^+)$ | 1308.7 | $2^+$ | | | |
| 1576.4[@] | 0.20 | 2190.5 | $4^+$ | 613.8 | $2^+$ | | | |
| 1642.1 *5* | | 3144.8 | $2^+$ | 1502.6 | $4^+$ | | | |
| 1713.4 *5* | 2.5 *3* | 2327.3 | $2^+$ | 613.8 | $2^+$ | D+Q | | $A_2$=+0.14 *10*, $A_4$=+0.03 *2* (1989Do14).<br>δ: +3.3 *+17−11* or −0.1 *1* (1988DoZS). |
| 1721.3[@] | 0.6 *2* | 2335.1 | $0^+$ | 613.8 | $2^+$ | | | |
| 1732[&] *1* | | 3230.4? | $(1^-,2,3)$ | 1498.5 | $0^+$ | | | |
| 1778.3 *5* | | 3632.2 | | 1853.9 | $3^+$ | | | |
| 1836.1 *5* | | 3144.8 | $2^+$ | 1308.7 | $2^+$ | | | |
| 1873.5 *5* | | 3632.2 | | 1758.7 | $0^+$ | | | |
| 1893.5 *5* | 0.8 *1* | 2507.6 | $3^-$ | 613.8 | $2^+$ | | | |
| 1923.3 *5* | 1.2 *1* | 2537.5 | $2^+$ | 613.8 | $2^+$ | | | |
| 1995.5 *5* | 2.6 *1* | 1996.0 | $2^+$ | 0.0 | $0^+$ | | | |
| 2068.3[@] | 0.10 *3* | 2682.1 | $4^+$ | 613.8 | $2^+$ | | | |
| 2141.2 *5* | 0.10 *3* | 2754.4 | $0^+$ | 613.8 | $2^+$ | | | |
| 2284.8 *5* | 0.6 *1* | 2898.6 | $2^+$ | 613.8 | $2^+$ | | | |
| 2299.8 *5* | | 2299.8 | | 0.0 | $0^+$ | | | $I_\gamma$: 0.5 *2* for E(n)=3.9 MeV, a weak γ ray for |

Continued on next page (footnotes at end of table)

## $^{78}$Se(n,n′γ) 1977SiZT,1975SiZT,1986DoZW (continued)

### γ($^{78}$Se) (continued)

| $E_\gamma$ [†] | $I_\gamma$ [‡] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Comments |
|---|---|---|---|---|---|---|
| | | | | | | the spectrum. $I_\gamma$: 0.5 *2* for E(n)=3.9 MeV, a weak γ ray for the spectrum for E(n)=4.1 MeV. |
| 2327.3 *5* | 0.10 *2* | 2327.3 | $2^+$ | 0.0 | $0^+$ | |
| 2391.6 *5* | | 3005.4 | $(1,2^+)$ | 613.8 | $2^+$ | |
| 2476.5 *5* | | 3090.3 | $0^+$ | 613.8 | $2^+$ | |
| 2519.5 *5* | | 3133.3 | $3^-$ | 613.8 | $2^+$ | |
| 2616.3[&] *5* | | 3230.4? | $(1^-,2,3)$ | 613.8 | $2^+$ | |
| 2629.1 *5* | | 3243.0 | $2^+$ | 613.8 | $2^+$ | |
| 2639.5 *5* | | 3253.4 | $(1,2)^+$ | 613.8 | $2^+$ | |
| 2674.5 *5* | | 3288.5 | $1^-$ | 613.8 | $2^+$ | |
| 2772.0 *5* | | 3386.1 | $(2^+,5^-)$ | 613.8 | $2^+$ | |
| 2990 *1* | | 3603.9 | | 613.8 | $2^+$ | |
| 3073 *1* | | 3686.9 | $3^-$ | 613.8 | $2^+$ | |
| 3181.8 *5* | | 3181.9 | $(2)^+$ | 0.0 | $0^+$ | |
| 3243 *1* | | 3243.0 | $2^+$ | 0.0 | $0^+$ | |
| 3253[&] *1* | | 3253.4 | $(1,2)^+$ | 0.0 | $0^+$ | |
| 3387 *1* | | 3386.1 | $(2^+,5^-)$ | 0.0 | $0^+$ | |
| 3440 *1* | | 3440.1 | $(1,2^+)$ | 0.0 | $0^+$ | |
| 3632 *1* | | 3632.2 | | 0.0 | $0^+$ | |

[†] From 1977SiZT and 1975SiZT. Iγ is given for 4.1 MeV neutron energy. Iγ values have been renormalized with respect to that of 613.8-keV γ taken As 100.
[‡] From 1986DoZW. Other: 1977SiZT.
[#] From angular correlation measurements In 1989Do14.
[@] From 1986DoZW.
[&] Placement of transition in the level scheme is uncertain.

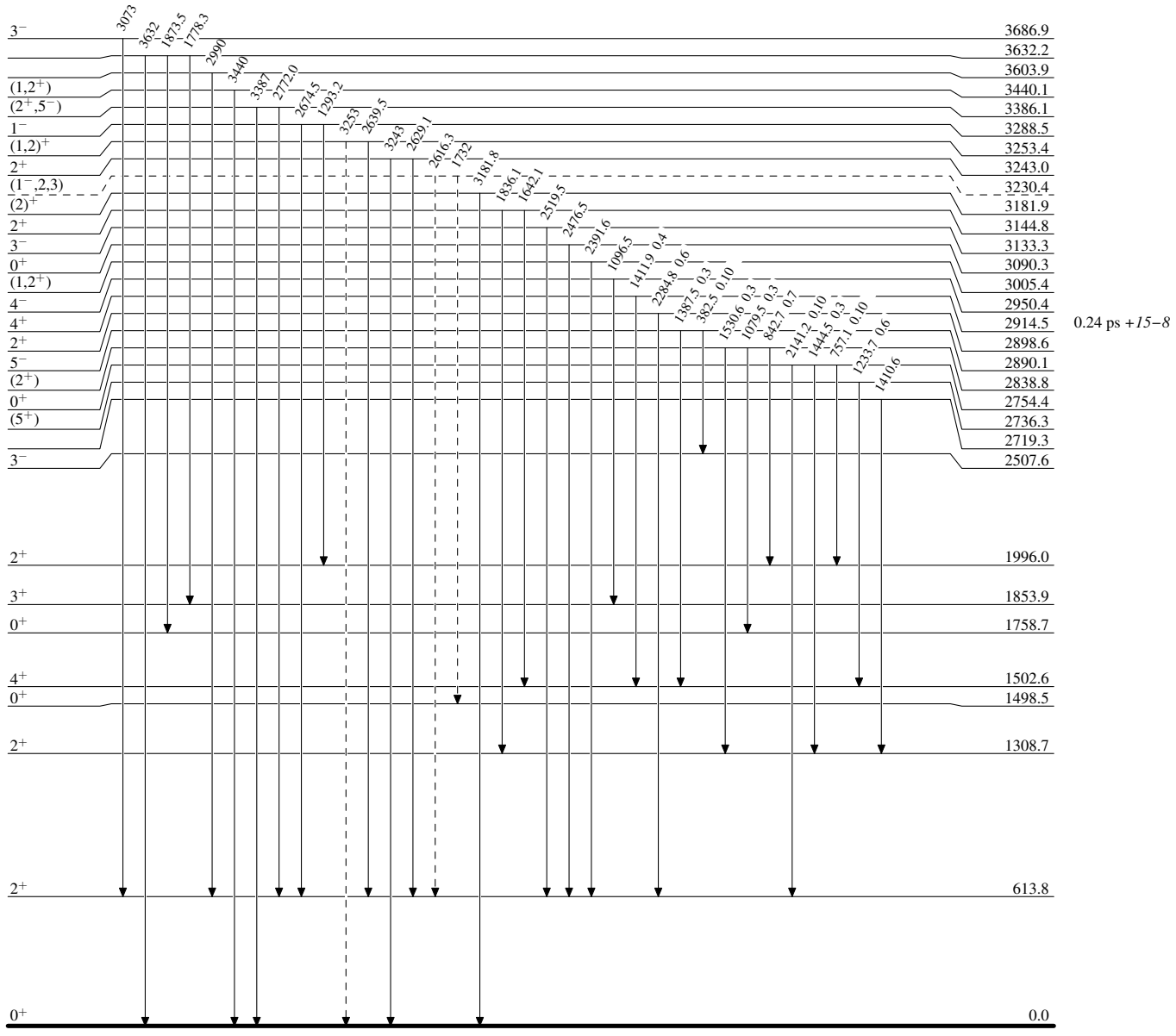
## $^{78}$Se(n,n′γ) 1977SiZT,1975SiZT,1986DoZW

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)

Level Scheme

Intensities: Relative $I_\gamma$




$^{78}_{34}Se_{44}$

## $^{78}$Se(n,n′γ) 1977SiZT,1975SiZT,1986DoZW

Level Scheme (continued)

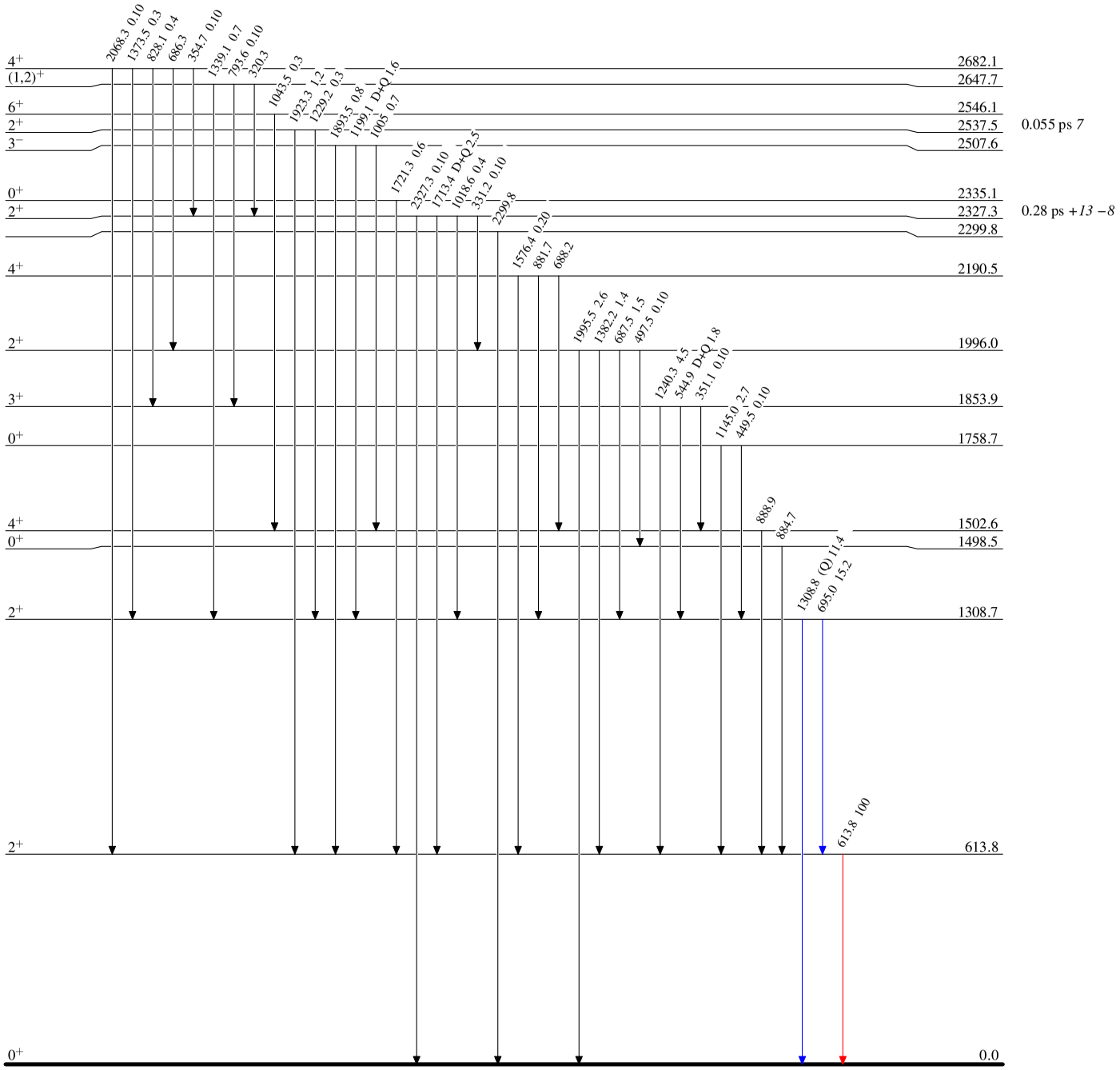
Intensities: Relative $I_\gamma$

Legend

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

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

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




$^{78}_{34}Se_{44}$