Coulomb excitation 2023Ay02,1980Le24,2001To13

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Jun Chen and Ameenah R. Farhan	NDS 194,3 (2024)	8-Jan-2024

2023Ay02,2019Ay04: two separate experiments were performed at the ATLAS-ANL facility. Beam=^{76}Ge at 291, 304 and 317 MeV. Target=0.5 mg/cm^2 thick ^{208}Pb target with front layer of 6 μg/cm^2 aluminum, and backing of 40 μg/cm^2 carbon foil. Measured Eγ, Iγ, (^{76}Ge)γ-coin using GRETINA array with 28 Ge crystals in one experiment at 304-MeV beam energy, and 42 Ge crystals in the second experiment at 291- and 317-MeV beam energies, both in coincidence with scattered particles detected by using CHICO2 array of position-sensitive parallel plate avalanche counters. The measured γ-ray yields were analyzed using the semiclassical, coupled-channel, Coulomb excitation least-squares code 'GOSIA', constrained by certain known experimental level half-lives, γ-ray branching ratios and multipole mixing ratios for low-lying positive-parity levels. Deduced 81 E2, M1, E1 and E3 matrix elements, B(E2) B(M1), B(E1), B(E3), spectroscopic quadrupole moments for five excited states, and evidence for rigid triaxial deformation at low excitation energies in ^{76}Ge. Also deduced were magnitude of the quadrupole invariants $<Q^2>$, and expectation values of the quadrupole asymmetry parameters $<\cos(3\gamma)>$ for the members of the ground-state and the γ bands. Comparison with configuration interaction shell-model calculations and generalized triaxial rotor model.

1980Le24 (also 1980Le16): (^{16}O,^{16}O$'$),E=36-42 MeV, measured Eγ, B(E2), static Q (for first 2$^+$) by reorientation method. 1980Le16 use (α,α') also.

2001To13: target=1.7 mg/cm^2 thick ^{208}Pb, beam=^{76}Ge at 300 MeV from tandem accelerator at JAEA. Measured Eγ, Iγ, (^{76}Ge)γ-coin; deduced yields, B(E2) matrix elements for 12 transitions for low-lying levels up to first 6$^+$ at 2456 keV, and quadrupole moments for first 2$^+$, second 2$^+$ and first 4$^+$ states from diagonal elements. GOSIA analysis of yields data with input of some known parameters for low-lying levels.

Additional information 1.

Others:

2013Gu23: measurement of g factors by transient-field technique in Coulomb excitation using inverse kinematics at Yale tandem accelerator facility. Beam=^{76}Ge at 190, 200, 210 MeV. Targets: multilayer C or Mg in front, Gd or Fe in the middle, and Ta+Cu at the back. Total of four targets were used with thicknesses 0.42, 0.44, 0.45 mg/cm^2 for C; 0.5, 0.9 mg/cm^2 for Mg; 3.24, 3.34, 4.0 mg/cm^2 for Gd; 4.44 mg/cm^2 for Fe; 1.0, 1.1, 1.4 mg/cm^2 for Ta; and 3.51, 3.90, 4.49, 4.92, 5.40 mg/cm^2 for Cu. Measured gamma-ray spectra, (particle)γ coin, angular distributions, precession angles. Deduced g factors. Comparison with shell-model calculations.

2008AzZZ: measured B(E2) in Pb(^{76}Ge,^{76}Ge$'$) at 60 MeV/nucleon; GANIL facility.

2005Di05: measured B(E2) in ^{197}Au(^{76}Ge,^{76}Ge$'$) at 80-90 MeV; Eγ, Iγ, (particle)γ-coin data.

1999Le67 (also 1998Le42, 2000LeZZ thesis): ^{76}Ge beam at 50 MeV/nucleon on Pb target at GANIL, measured (particle)$\gamma(\theta)$ for transition from first 2$^+$ state to the ground state. Known B(E2) for first 2$^+$ state in ^{76}Ge used as reference for determining B(E2) values for ^{68}Ni and ^{72}Zn.

1987La20: (^{34}S,^{34}S$'$),E=75 MeV, g-factor (first 2$^+$ state) measured by perturbed $\gamma(\theta)$ using transient hyperfine fields.

1984Pa20: (^{28}Si,^{28}Si$'$),E=70 MeV; (^{16}O,^{16}O$'$),E=36 MeV; (^{12}C,^{12}C$'$),E=27 MeV: g-factor (first 2$^+$ state) measured by $\gamma(\theta$,H) using transient fields.

1982Ke01: (^{82}Kr,^{82}Kr$'$), (^{84}Kr,^{84}Kr$'$),E=115 MeV, excitation of the first 2$^+$ state in ^{82}Kr and ^{84}Kr.

1969Si15, 1972Gr37: (^{16}O,^{16}O$'$).

1969Si15, 1965Ro09, 1962St02, 1962Mc03, 1956Te26: (α,α').

1962Er05: (^{14}N,^{14}N$'$).

1960Wi18: (d,d$'$), (p,p$'$).

Units of reduced matrix elements: eb$^{1/2}$ for E1, eb for E2, eb$^{3/2}$ for E3, and μ_N for M1. Quoted uncertainties include statistical and systematic, and those from cross-correlation effects.

Units of transition probabilities: e^{2}b for E1, e^{2}b^2 for E2, e^{2}b^3 for E3, and μ_N^2 for M1.

Spectroscopic quadrupole moments in eb units deduced by 2023Ay02 from E2 diagonal matrix elements obtained in the present work.

Coulomb excitation 2023Ay02,1980Le24,2001To13 (continued)

^{76}Ge Levels

Reduced matrix elements (M.E.), and reduced transition probabilities: B(E2), B(M1), B(E1) and B(E3); and B(E2)(W.u.), B(M1)(W.u.), B(E1)(W.u.) and B(E3)(W.u.) values are from Table III in 2023Ay02.

E(level)[#]	J^{π}[‡]	$T_{1/2}$[†]	Comments
0.0	0+		
562.93 *10*	2+	18.3 ps *2*	B(E2)↑=0.277 *2* Q=−0.18 *2* (2023Ay02) g=+0.32 *1* (2013Gu23) E2 M.E. (0,0+ → 563,2+)=+0.526 *2*. E2 diagonal M.E. (563,2+ → 563,2+)=−0.24 *2*. B(E2)↑: weighted average of 0.278 *3* (1980Le24,1980Le16), 0.272 *+5−4* (2001To13), 0.277 *2* (2019Ay04). B(E2)↑: others: 0.272 *25* (2008AzZZ), 0.292 *35* (2005Di05), 0.27 *2* (1972Sa27), 0.260 *5* (1969Si15), 0.263 *+32−21* (1962St02), 0.28 *4* (1962Er05), 0.29 *3* (1960Wi18), 0.23 *4* (1956Te26). Weighted average of all the available values gives B(E2)=0.273 *3*. 2001Ra27 evaluation lists B(E2)=0.268 *8* and corresponding half-life=18.6 ps *6*. β_2=0.267 (1980Le24). Q=−0.19 *6* or −0.03 *6* (1980Le16), −0.14 *4* (2001To13). Q: two values correspond to constructive and destructive interference, respectively, with the 1108, 2+ level. Others: Q=−0.15 *10* or −0.05 *10* (1972Gr37); −0.18 *14* or +0.05 *14* (1969Si15). g factor from transient−field technique in Coulomb excitation, average of +0.39 *3*, +0.32 *3*, +0.32 *1* and +0.31 *1* for three targets and three beam energies (2013Gu23), 0.334 *39* (1987La20), +0.419 *23* (1984Pa20). Method in 1987La20 and 1984Pa20: $\gamma(\theta$,H) using transient-field technique.
1108.5 *4*	2+	9.9 ps *9*	Q=+0.20 *+2−4* (2023Ay02) g=+0.39 *5* (2013Gu23) E2 M.E. (0,0+ → 1108,2+)=+0.089 *3*. E2 M.E. (563,2+ → 1108,2+)=+0.535 *+3−7*. M1 M.E. (563,2+ → 1108,2+)=+0.175 *+6−8*. E2 diagonal M.E. (1108,2+ → 1108,2+)=+0.26 *+2−5*. $T_{1/2}$: from B(E2)(from 2+,563)=0.064 *8* (2013Gu23), 0.0572 *+7−14* (2019Ay04), 0.074 *9* (1980Le24), 0.058 *7* (2001To13), weighted average=0.0576 *+12−14* giving $T_{1/2}$=10.2 ps *9*; B(E2)(from 0+,g.s.)=0.0065 *15* (2013Gu23), 0.0079 *6* (2019Ay04), 0.0085 *15* (1980Le24), 0.00475 *+150−175* (2001To13), weighted average=0.00752 *60* giving $T_{1/2}$=9.3 ps *+13−11*. g: average of +0.43 *33*, +0.29 *10*, +0.50 *32*, +0.36 *10* and +0.44 *7* for four targets and three beam energies (2013Gu23). Q=+0.28 *6* (2001To13). β_2=0.047 (1980Le24).
1410.1 *5*	4+	1.86 ps *4*	g=+0.24 *17* (2013Gu23) Q=−0.197 *+8−53* (2023Ay02) E2 M.E. (563,2+ → 1410,4+)=+0.795 *5*. E2 M.E. (1108,2+ → 1410,4+) =+0.09 *2*. E2 diagonal M.E. (1410,4+ → 1410,4+)=−0.26 *+1−7*. g: average of +0.11 *56*, +0.26 *18* and +0.12 *86* for three targets and three beam energies (2013Gu23). Q=−0.01 *5* (2001To13). $T_{1/2}$: from B(E2)(from 2+,563): 0.1264 *16* (2019Ay04), 0.131 *24* (1980Le24), 0.101 *11* (2001To13), weighted average=0.1259 *26*.
1539	3+	35 ps *7*	E2 M.E. (563,2+ → 1539,3+)=+0.082 *5*. M1 M.E. (563,2+ → 1539,3+)=+0.027 *3*. E2 M.E. (1108,2+ → 1539,3+)=+0.52 *+2−4*. M1 M.E. (1108,2+ → 1539,3+)=+0.10 *1*. E2 M.E. (1410,4+ → 1539,3+)=−0.44 *+8−5*. E2 diagonal M.E. (1539,3+ → 1539,3+)=+0.13 *+8−10*.

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Coulomb excitation 2023Ay02,1980Le24,2001To13 (continued)

^{76}Ge Levels (continued)

E(level)[#]	Jπ[‡]	$T_{1/2}$[†]	Comments
			$T_{1/2}$: B(E2)(from 563, 2$^+$)=0.00134 +17−15 (2019Ay04), B(E2)(from 1410, 4$^+$)=0.022 +5−8 (2019Ay04).
1911.1 5	0$^+$	1.77 ps 8	$T_{1/2}$: B(E2)(from 563,2$^+$)=0.00128 +114−78 (2001To13), 0.00144 6 (2023Ay02), weighted average=0.0144 6.
2020.0	4$^+$	1.6 ps 4	Q=−0.18 +6−3 (2023Ay02) E2 M.E. (563,2$^+$ → 2020,4$^+$)=−0.220 +5−3. E2 M.E. (1108,2$^+$ → 2020,4$^+$)=+0.472 6. E2 M.E. (1410,4$^+$ → 2020,4$^+$)=+0.61 1. M1 M.E. (1410,4$^+$ → 2020,4$^+$)=+0.447 9. E2 M.E. (1539,3$^+$ → 2020,4$^+$)=+0.64 +3−7. M1 M.E. (1539,3$^+$ → 2020,4$^+$)=+0.26 1. E2 diagonal M.E. (2020,4$^+$ → 2020,4$^+$)=−0.24 +8−4. $T_{1/2}$: B(E2)(from 1108,2$^+$)=0.0446 +11−12 (2019Ay04), 0.0626 +47−43 (2001To13), unweighted average=0.536 90.
2456.0	6$^+$	0.59 ps +19−12	Q=−0.16 +6−3 (2023Ay02) E2 M.E. (1410,4$^+$ → 2454,6$^+$)=+1.11 +3−2. E2 M.E. (2020,4$^+$ → 2454,6$^+$)=+0.35 +5−3. E2 diagonal M.E. (2454,6$^+$ → 2454,6$^+$)=−0.23 +9−4. $T_{1/2}$: B(E2)(from 1410, 4$^+$)=0.137 +7−5 (2019Ay04), 0.084 4 (2001To13), unweighted average=0.111 27.
2487	5$^+$		E2 M.E. (1410,4$^+$ → 2487,5$^+$)=−0.08 +9−5. E2 M.E. (1540,3$^+$ → 2487,5$^+$)=+0.9 +4−6. E2 M.E. (2021,4$^+$ → 2487,5$^+$)=−0.9 +7−2. M1 M.E. (2021,4$^+$ → 2487,5$^+$)=−0.74 +18−6.
2504	2$^+$		E2 M.E. (0,0$^+$ → 2504,2$^+$)=+0.061 3. E2 M.E. (563,2$^+$ → 2504,2$^+$)=−0.126 +6−4. M1 M.E. (563,2$^+$ → 2504,2$^+$)=+0.11 +6−28. E2 M.E. (1108,2$^+$ → 2504,2$^+$)=+0.38 +1−2. M1 M.E. (1108,2$^+$ → 2504,2$^+$)=+0.31 +4−3. E2 M.E. (1539,3$^+$ → 2504,2$^+$)=+0.25 +2−4. M1 M.E. (1539,3$^+$ → 2504,2$^+$)=+0.33 +2−3. E2 M.E. (1911,0$^+$ → 2504,2$^+$)=+0.32 2. E2 diagonal M.E. (2504,2$^+$ → 2504,2$^+$)=−0.24 +2−16.
2692	3$^-$		E3 M.E. (0,0$^+$ → 2692,3$^-$)=+0.12 +2−4. E1 M.E. (563,2$^+$ → 2692,3$^-$)=+0.026 1. E1 M.E. (1108,2$^+$ → 2692,3$^-$)=+0.012 1. E1 M.E. (1410,4$^+$ → 2692,3$^-$)=+0.021 2. E2 diagonal M.E. (2692,3$^-$ → 2692,3$^-$)=+0.1 +18−15.
2733	4$^+$		E2 M.E. (563,2$^+$ → 2733,4$^+$)=−0.064 +6−7. E2 M.E. (1108,2$^+$ → 2733,4$^+$)=+0.60 +1−2. E2 M.E. (1410,4$^+$ → 2733,4$^+$)=+0.04 +2−3. M1 M.E. (1410,4$^+$ → 2733,4$^+$)=+0.9 +2−1. E2 M.E. (1539,3$^+$ → 2733,4$^+$)=+0.35 +4−7. M1 M.E. (1539,3$^+$ → 2733,4$^+$)=+0.69 +2−5. E2 diagonal M.E. (2733,4$^+$ → 2733,4$^+$)=+0.5 +1−2.
2767	2$^+$		E2 M.E. (0,0$^+$ → 2767,2$^+$)=+0.054 4. E2 M.E. (563,2$^+$ → 2767,2$^+$)=+0.022 +8−5. M1 M.E. (563,2$^+$ → 2767,2$^+$)=+0.2 +1−4. E2 M.E. (1108,2$^+$ → 2767,2$^+$)=−0.18 2. M1 M.E. (1108,2$^+$ → 2767,2$^+$)=+0.51 +10−5. E2 diagonal M.E. (2767,2$^+$ → 2767,2$^+$)=−0.12 +3−12.
2842	2$^+$		E2 M.E. (0,0$^+$ → 2842,2$^+$)=+0.010 +9−21. E2 M.E. (563,2$^+$ → 2842,2$^+$)=+0.016 +11−21.
2898	0$^+$		E2 M.E. (563,2$^+$ → 2898,0$^+$)=+0.002 +3−5. E2 M.E. (1108,2$^+$ → 2898,0$^+$)=−0.002 2.
3033	(6$^+$)		E2 M.E. (1410,4$^+$ → 3033,6$^+$)=−0.186 +30−5.

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Coulomb excitation 2023Ay02,1980Le24,2001To13 (continued)

^{76}Ge Levels (continued)

E(level)[#]	J^{π}[‡]	Comments
		E2 M.E. (2021,4$^+$ → 3033,6$^+$)=+0.49 *3*.
		E2 M.E. (2454,6$^+$ → 3033,6$^+$)=+1.2 *+2−1*.
		E2 M.E. (2487,5$^+$ → 3033,6$^+$)=−0.74 *+10−8*.
		E2 diagonal M.E. (3033,6$^+$ → 3033,6$^+$)=+1.3 *2*.
3130	2$^+$	E2 M.E. (0,0$^+$ → 3130,2$^+$)=+0.023 *6*.
		E2 M.E. (563,2$^+$ → 3130,2$^+$)=−0.048 *+2−7*.
		M1 M.E. (563,2$^+$ → 3130,2$^+$)=+1.08 *+16−6*.
		E2 M.E. (1108,2$^+$ → 3130,2$^+$)=+0.036 *+11−7*.
		E2 diagonal M.E. (3130,2$^+$ → 3130,2$^+$)=−0.2 *+3−2*.
3163	(4)$^+$	E2 M.E. (563,2$^+$ → 3163,4$^+$)=+0.47 *+7−2*.
		E2 M.E. (1108,2$^+$ → 3163,4$^+$)=+0.25 *+2−5*.
		E2 M.E. (1410,4$^+$ → 3163,4$^+$)=+0.21 *1*.
		M1 M.E. (1410,4$^+$ → 3163,4$^+$)=+0.21 *2*.
		E2 diagonal M.E. (3163,4$^+$ → 3163,4$^+$)=+0.8 *2*.
3544	8$^+$	E2 M.E. (2454,6$^+$ → 3544,8$^+$)=+1.25 *+7−10*.
		E2 M.E. (3033,6$^+$ → 3544,8$^+$)=−0.3 *+2−3*.
4130	8$^+$	E2 M.E. (3033,6$^+$ → 4130,8$^+$)=+0.5 *+4−3*.

[†] From B(E2) (2023Ay02,1980Le24,2001To13) and photon branching ratios from the Adopted Gammas. For levels above 1109, see B(E2) values with γ transitions from respective levels.
[‡] From Adopted Levels.
[#] From least-squares fit to Eγ values.

γ(^{76}Ge)

B(M1) and B(E2) under comments are from 2023Ay02, unless specified otherwise. B(E2) quoted from 2001To13 have been deduced by evaluators from the E2 matrix elements listed in authors′ Table 1.

E_i(level)	J^{π}_i	E_γ	I_γ[†]	E_f	J^{π}_f	Mult.[‡]	δ[‡]	Comments
562.93	2$^+$	562.93 *10*	100	0.0	0$^+$	E2		B(E2)↓=0.0556 *6* (1980Le24); B(E2)↓=0.0545 *8* (2001To13) B(E2)↓=0.0553 *4* B(E2)(W.u.)=28.9 *2* E2 matrix element=+0.522 *4* (2001To13).
1108.5	2$^+$	545.5 *5*	100	562.93	2$^+$	E2+M1	+2.4 *2*	B(E2)↓=0.074 *9* (1980Le24); B(E2)↓=0.058 *7* (2001To13) B(E2)↓=0.0573 *+6−15*; B(M1)↓=0.0061 *+4−6* B(E2)(W.u.)=29.9 *+3−8*; B(M1)(W.u.)=0.0034 *+2−3* β_{22}=0.218 (1980Le24). E2 matrix element=+0.54 *3* (2001To13).
		1108.5 *5*	75 *4*	0.0	0$^+$	E2		B(E2)↓=0.0016 *1* B(E2)(W.u.)=0.83 *6* I_γ: from 1980Le24. Iγ=71 *4* in Adopted Gammas. B(E2)↓: others: 0.0017 *3* (1980Le24) and 0.00095 *+30−25* (2001To13). E2 matrix element=+0.069 *10* (2001To13).
1410.1	4$^+$	(302[#])		1108.5	2$^+$	[E2]		B(E2)↓=0.0009 *4* B(E2)(W.u.)=0.5 *2* B(E2)↓=0.00134 *+26−23* (2001To13) E2 matrix element=−0.11 *1* (2001To13). I_γ: 0.011 *3* deduced by evaluators from B(E2) ratios in 2001To13.

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Coulomb excitation 2023Ay02,1980Le24,2001To13 (continued)

$\gamma(^{76}Ge)$ (continued)

E_i(level)	J_i^π	E_γ	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
1410.1	4^+	847.2 *5*	100	562.93	2^+	[E2]		B(E2)↓=0.0702 *9* B(E2)(W.u.)=36.7 *5* B(E2)↓=0.073 *13* (1980Le24); B(E2)↓=0.056 *6* (2001To13) E2 matrix element=+0.71 *4* (2001To13). β_{42}=0.216 (1980Le24).
1539	3^+	(129[@])		1410.1	4^+	[E2+M1]		B(E2)↓=0.028 *+10−6* B(E2)(W.u.)=15 *+5−3*
		431		1108.5	2^+	E2+M1	+1.86 *+17−11*	B(E2)↓=0.039 *+3−6*; B(M1)↓=0.0014 *3* B(E2)(W.u.)=20 *+2−3*; B(M1)(W.u.)=0.0008 *2*
		976		562.93	2^+	E2+M1	+2.61 *20*	B(E2)↓=0.0010 *1*; B(M1)↓=0.00010 *2* B(E2)(W.u.)=0.50 *6*; B(M1)(W.u.)=0.00006 *1*
1911.1	0^+	(803[#])		1108.5	2^+	[E2]		B(E2)↓=0.056 *+15−3* B(E2)(W.u.)=29 *+8−1* I_γ: <19 deduced by evaluators from B(E2) ratios in 2001To13. E2 matrix element=+0.06 *2* (2001To13).
		1348.2 *5*	100	562.93	2^+	[E2]		B(E2)↓=0.0072 *3* B(E2)(W.u.)=3.8 *+1−2* B(E2)↓=0.0064 *+57−39* (2001To13); B(E2)↓<0.017 (1980Le24) γ masked by contaminants. E2 matrix element=−0.08 *3* (2001To13),
2020.0	4^+	481		1539	3^+	E2+M1		B(E2)↓=0.046 *+4−10*; B(M1)↓=0.0075 *6* B(E2)(W.u.)=24 *+2−5*; B(M1)(W.u.)=0.0042 *3*
		(610[#])		1410.1	4^+			B(E2)↓=0.041 *1*; B(M1)↓=0.0222 *9* B(E2)(W.u.)=21.6 *7*; B(M1)(W.u.)=0.0124 *5* B(E2)↓=0.00111 *+77−57* (2001To13) I_γ: <0.65 deduced by evaluators from B(E2) ratios in 2001To13. E2 matrix element=−0.10 *3* (2001To13).
		911.5	100	1108.5	2^+	[E2]		B(E2)↓=0.0248 *6* B(E2)(W.u.)=13.0 *3* B(E2)↓=0.0348 *+26−24* (2001To13) E2 matrix element=+0.56 *2* (2001To13).
		(1457[#])		562.93	2^+	[E2]		B(E2)↓=0.0054 *2* B(E2)(W.u.)=2.81 *+13−8* B(E2)↓=0.00111 *+49−40* (2001To13) I_γ: 33 *+19−13* deduced by evaluators from B(E2) ratios in 2001To13. E2 matrix element=+0.10 *2* (2001To13).
2456.0	6^+	(436[#])		2020.0	4^+	[E2]		B(E2)↓=0.0094 *+27−16* B(E2)(W.u.)=4.9 *+14−9* E2 matrix element=+0.21 *4* (2001To13).
		1045.9		1410.1	4^+	[E2]		B(E2)↓=0.095 *+5−3* B(E2)(W.u.)=50 *+3−2* B(E2)↓=0.0582 *27* (2001To13) E2 matrix element=+0.87 *2* (2001To13).
2487	5^+	467		2020.0	4^+	E2+M1		B(E2)↓=0.07 *+12−3*; B(M1)↓=0.050 *+24−8* B(E2)(W.u.)=39 *+60−17*; B(M1)(W.u.)=0.028 *+14−5*
		948		1539	3^+	E2		B(E2)↓=0.07 *+8−7* B(E2)(W.u.)=39 *+42−34*
		(1077[@])		1410.1	4^+	[E2+M1]		B(E2)↓=0.0006 *+21−6* B(E2)(W.u.)=0.3 *+11−3*

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Coulomb excitation 2023Ay02,1980Le24,2001To13 (continued)

γ(^{76}Ge) (continued)

E_i(level)	J_i^π	E_γ	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
2504	2+	(593[@])	1911.1	0+	[E2]		B(E2)↓=0.021 *2* B(E2)(W.u.)=11 *1*
		965	1539	3+	E2+M1		B(E2)↓=0.013 *+2−4*; B(M1)↓=0.022 *+3−4* B(E2)(W.u.)=7 *+1−2*; B(M1)(W.u.)=0.012 *+1−2* E_γ: rounded value from 2017Mu03.
		1396	1108.5	2+	E2+M1		B(E2)↓=0.028 *+2−3*; B(M1)↓=0.019 *+5−4* B(E2)(W.u.)=15 *+1−2*; B(M1)(W.u.)=0.011 *+3−2*
		(1941[@])	562.93	2+	[E2+M1]		B(E2)↓=0.0032 *+3−2*; B(M1)↓=0.0024 *+34−24* B(E2)(W.u.)=1.7 *+2−1*; B(M1)(W.u.)=0.0013 *+19−13*
		2504	0.0	0+	E2		B(E2)↓=0.00074 *7* B(E2)(W.u.)=0.39 *4*
2692	3−	1282	1410.1	4+	E1		B(E1)↓=0.00006 *1* B(E1)(W.u.)=0.0052 *10*
		1584	1108.5	2+	E1		B(E1)↓=0.000022 *+2−3* B(E1)(W.u.)=0.0019 *+2−3* E_γ: rounded value from 2017Mu03.
		2129	562.93	2+	E1		B(E1)↓=0.000100 *+8−7* B(E1)(W.u.)=0.0086 *+7−6*
		(2692[@])	0.0	0+	[E3]		B(E3)↓=0.0021 *+7−14* B(E3)(W.u.)=6 *+2−4*
2733	4+	1194	1539	3+	E2+M1		B(E2)↓=0.013 *+4−6*; B(M1)↓=0.053 *+3−8* B(E2)(W.u.)=7 *+2−3*; B(M1)(W.u.)=0.030 *+2−4*
		(1323[@])	1410.1	4+	[E2+M1]		B(E2)↓=0.0002 *2*; B(M1)↓=0.09 *+4−2* B(E2)(W.u.)=0.09 *+12−9*; B(M1)(W.u.)=0.05 *+2−1*
		1625	1108.5	2+	E2		B(E2)↓=0.040 *2* B(E2)(W.u.)=21 *1*
		(2170[@])	562.93	2+	[E2]		B(E2)↓=0.00045 *+8−10* B(E2)(W.u.)=0.24 *+4−5*
2767	2+	(1659[@])	1108.5	2+	[E2+M1]		B(E2)↓=0.007 *1*; B(M1)↓=0.05 *+2−1* B(E2)(W.u.)=3.4 *7*; B(M1)(W.u.)=0.03 *1*
		2204	562.93	2+	E2+M1	−0.09 *2*	B(E2)↓=0.00009 *+7−4*; B(M1)↓=0.008 *+10−8* B(E2)(W.u.)=0.05 *+3−2*; B(M1)(W.u.)=0.005 *+6−5*
		2767	0.0	0+	E2		B(E2)↓=0.00058 *9* B(E2)(W.u.)=0.31 *5*
2842	2+	1734	1108.5	2+	E2+M1	+0.01 *+3−2*	
		2279	562.93	2+	E2+M1		B(E2)↓=0.00005 *+10−5* B(E2)(W.u.)=0.027 *+50−27* E_γ: rounded value from 2017Mu03.
		(2842[@])	0.0	0+	[E2]		B(E2)↓=0.00002 *+5−2* B(E2)(W.u.)=0.01 *+3−1*
2898	0+	1789	1108.5	2+	E2		B(E2)↓=0.000004 *+12−4* B(E2)(W.u.)=0.0021 *+63−21* E_γ: rounded value from 2017Mu03.
		2335	562.93	2+	E2		B(E2)↓=0.000004 *+21−4* B(E2)(W.u.)=0.002 *+11−2*
3033	(6+)	547	2487	5+	[E2+M1]		B(E2)↓=0.042 *+11−9* B(E2)(W.u.)=22 *+6−5*
		580	2456.0	6+	(M1+E2)	+1 *4*	B(E2)↓=0.11 *+4−2* B(E2)(W.u.)=58 *+19−10* E_γ: rounded value from 2013To05.
		1013	2020.0	4+	[E2]		B(E2)↓=0.019 *2* B(E2)(W.u.)=10 *1*
		1623	1410.1	4+	[E2]		B(E2)↓=0.0027 *+9−1* B(E2)(W.u.)=1.39 *+45−8*

Continued on next page (footnotes at end of table)

Coulomb excitation 2023Ay02,1980Le24,2001To13 (continued)

$\gamma(^{76}Ge)$ (continued)

E_i(level)	J^π_i	E_γ	E_f	J^π_f	Mult.‡	Comments
3130	2^+	2022	1108.5	2^+		B(E2)↓=0.0003 *+2−1* B(E2)(W.u.)=0.14 *+8−5*
		(2567@)	562.93	2^+		B(E2)↓=0.00045 *+4−14*; B(M1)↓=0.23 *+7−3* B(E2)(W.u.)=0.24 *+2−7*; B(M1)(W.u.)=0.13 *+4−1*
		3130	0.0	0^+		B(E2)↓=0.00011 *6* B(E2)(W.u.)=0.06 *3* E_γ: rounded value from 2017Mu03.
3163	$(4)^+$	1753	1410.1	4^+	E2+M1	B(E2)↓=0.0049 *5*; B(M1)↓=0.0049 *9* B(E2)(W.u.)=2.6 *3*; B(M1)(W.u.)=0.0027 *5*
		(2055@)	1108.5	2^+	[E2]	B(E2)↓=0.007 *+1−3* B(E2)(W.u.)=3.5 *+6−14*
		(2600@)	562.93	2^+	[E2]	B(E2)↓=0.025 *+7−2* B(E2)(W.u.)=12.8 *+38−10*
3544	8^+	(511@)	3033	(6^+)	[E2]	B(E2)↓=0.0053 *+94−53* B(E2)(W.u.)=2.8 *+49−28*
		1090	2456.0	6^+	[E2]	B(E2)↓=0.09 *+1−2* B(E2)(W.u.)=48 *+5−8*
4130	8^+	1097	3033	(6^+)	[E2]	B(E2)↓=0.015 *+33−12* B(E2)(W.u.)=7.8 *+173−63*

† Photon branching ratios from Adopted Gammas, unless otherwise stated.

‡ From Adopted Gammas.

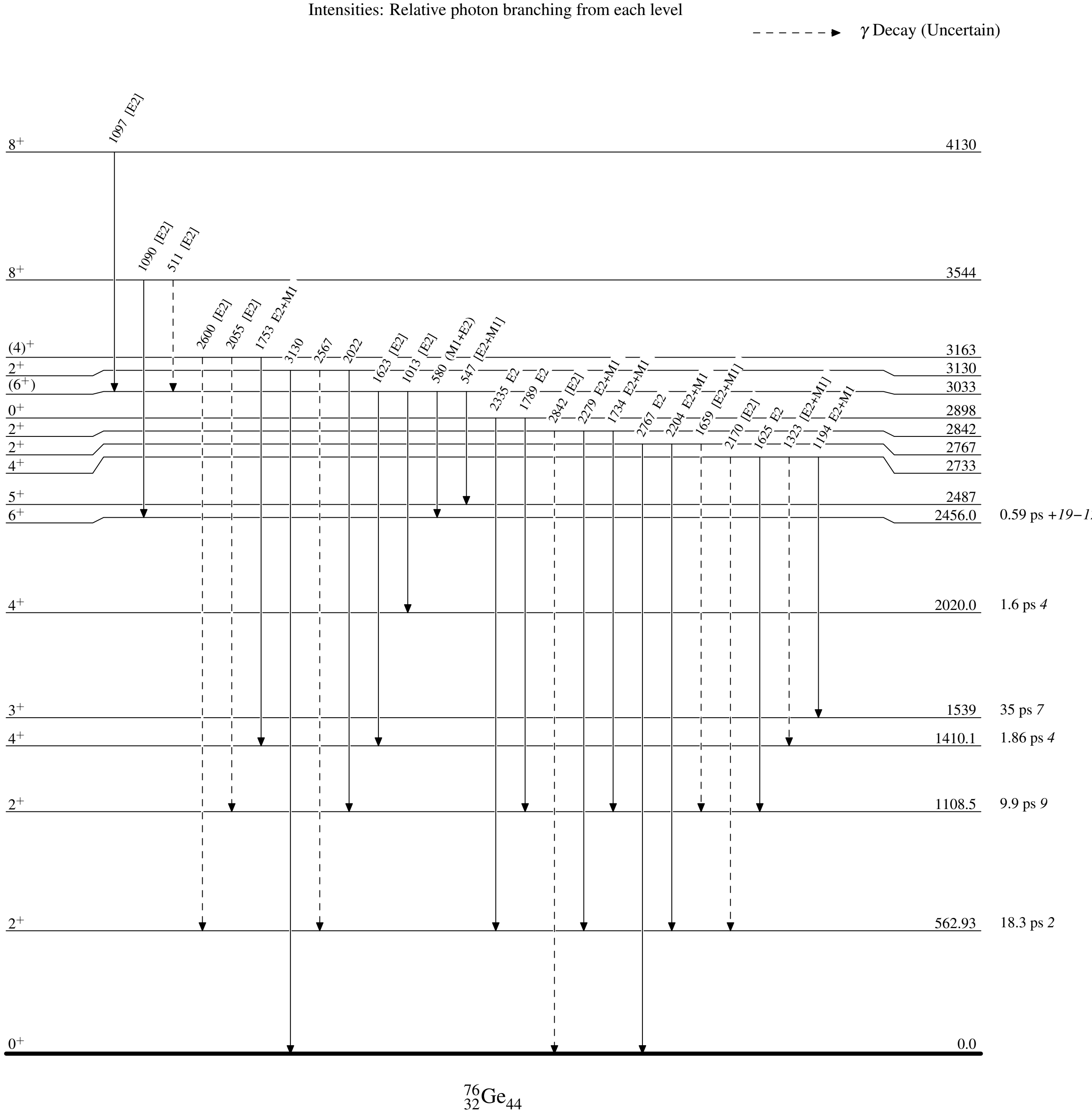
\# Transition included from listed E2 matrix element in Table 1 of 2001To13. This γ is not reported in authors′ gamma-ray spectral Fig. 1, or in any other study. From listed B(E2) values, this transition is expected to have low branching. It is not given in the Adopted Levels, Gammas dataset.

@ γ not reported, but required from listed M.E. and transition probability in 2023Ay02.

Coulomb excitation 2023Ay02,1980Le24,2001To13

Level Scheme

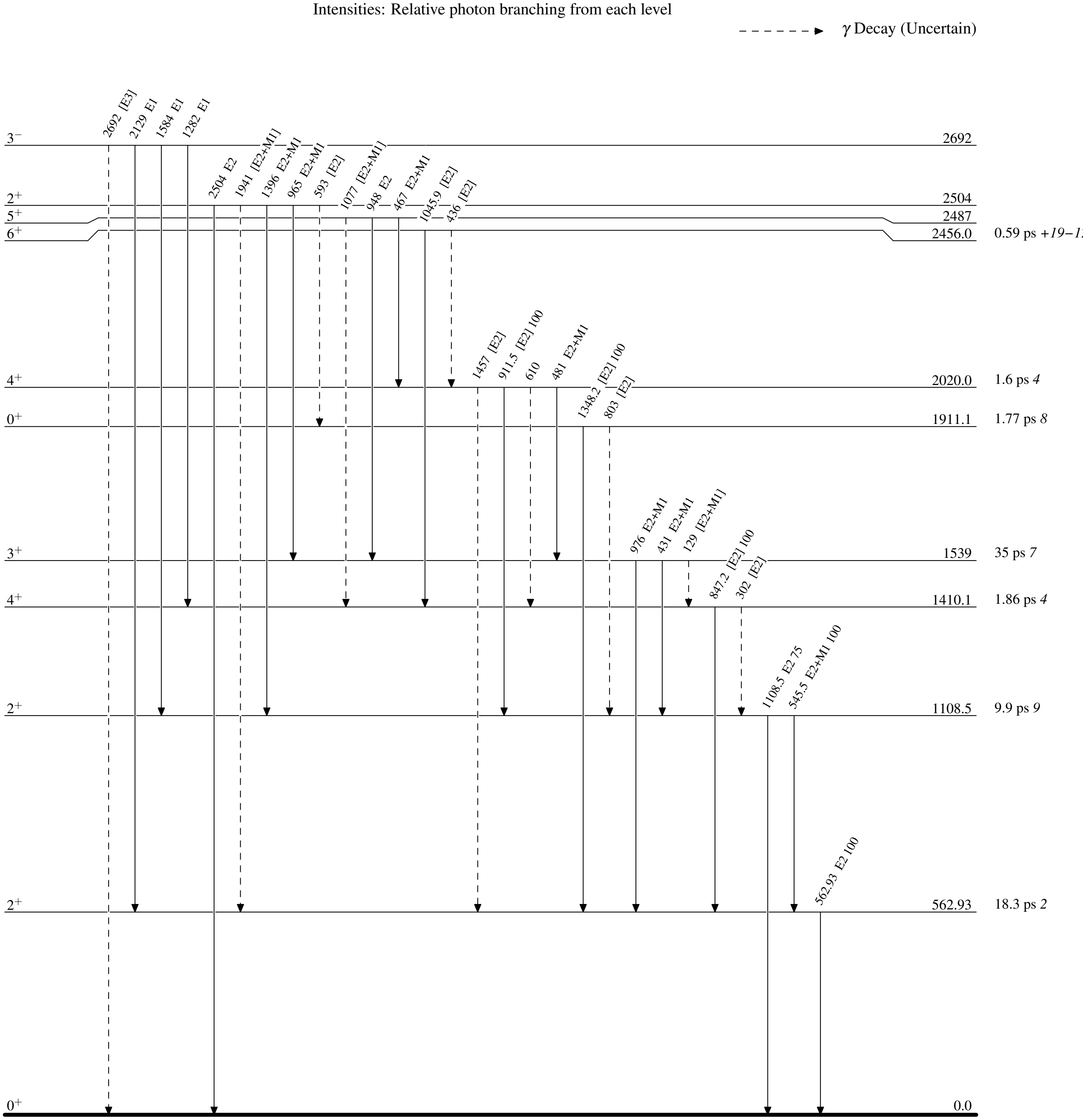
Intensities: Relative photon branching from each level



Coulomb excitation 2023Ay02,1980Le24,2001To13

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{76}_{32}Ge_{44}$