Coulomb excitation **1996Wu07,1984WuZX,1978Ba38**

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 177, 1 (2021)	3-Sep-2021

1996Wu07 (also 1984WuZX): (^{40}Ca,^{40}Ca′γ), (^{58}Ni,^{58}Ni′γ) E=155 MeV ^{40}Ca from Rochester tandem and E=190-235 MeV ^{58}Ni beams from both the Rochester and BNL tandems; γ rays were detected with Ge(Li) detectors. (^{136}Xe,^{136}Xe′γ) E=612-624 MeV ^{136}Xe beam from the SuperHILAC at LBL; scattered ^{136}Xe ions were detected with an array of rectangular silicon detectors and γ rays were detected with five NaI detectors. (^{208}Pb,^{208}Pb′γ) E=952-1053 MeV ^{208}Pb beams were from the SuperHILAC at BNL; γ rays were detected with six NaI detectors. Measured Eγ, γ yields, $\gamma\gamma$-coin. Deduced 37 matrix elements from 223 experimental γ-ray yields from 18 independent Coulomb excitation experiments. The analysis utilized two lifetimes, five branching ratios, one E2/M1 mixing ratio, and 12 additional γ-ray yields from three sets of Coulomb excitation data, all taken from earlier literature.

The level scheme is from 1996Wu07, 1984WuZX and 1977St26.

1984WuZX and 1996Wu07 are from the same group.

Others: 1995St02, 1995An15, 1995An26, 1995Re15, 1994La02, 1993Ta07, 1992Br03, 1991St04, 1988Fe08, 1986Gy04, 1986Bi13, 1986Ba19, 1984Mu19, 1984Fe08, 1983St01, 1983Ch35, 1982Le02, 1981St24, 1980Ka34, 1979Ha16, 1979Ha06, 1979DoZZ, 1978BaYK, 1977SpZY, 1977RoYQ, 1977Ro16, 1977Le15, 1977Jo05, 1976Ba35, 1976Ba23, 1974Ga31, 1973Gr06, 1972Sp03, 1972Do18, 1971NoZV, 1971Mi08, 1970Br26, 1969Va05, 1969Gl08, 1968Gl01, 1967Ka16, 1966Gr20, 1966Bo34, 1965Sp03, 1964Sp09, 1961Mc01, 1959Vi31, 1958Ba37, 1958Ba43, 1957Mc43, 1955St57, 1955Mc44, 1954He02.

Reactions:

(^{208}Pb,^{208}Pb′) E=3.3-4.8 MeV/nucleon: 1996Wu07.

(^{206}Pb,^{206}Pb′) E=952 MeV. 1984WuZX. See 1988Fe04 for investigating the feasibility of measuring hexadecapole moments in (^{208}Pb,^{208}Pb′).

(^{136}Xe,^{136}Xe′) E=620 MeV. 1996Wu07, 1984WuZX, 1977St26, 1977Le15.

(^{86}Kr,^{86}Kr′), (^{84}Kr,^{84}Kr′) E=340 MeV. 1977RoYQ.

(^{81}Br,^{81}Br′) E=190 MeV. 1979Ha06.

(^{63}Cu,^{63}Cu′) E=180 MeV. 1986Ba19.

(^{58}Ni,^{58}Ni′) E=196.2, 200.0, 220.0 MeV. 1996Wu07, 1984WuZX. E=160 MeV, 1991St04. E=180-210 MeV, 1992Br03. Others:1995An15, 1984Fe08, 1977SpZY.

(^{40}Ar,^{40}Ar′) E=149 MeV. 1977Jo05.

(^{40}Ca,^{40}Ca′) E=120 MeV. 1996Wu07, 1979Ha06.

(^{37}Cl,^{37}Cl′) E=115 MeV. 1991St04.

(^{34}S,^{34}S′) E=80 MeV: 1995An26, 1996St22, measured static fields.

(^{32}S,^{32}S′) E=80, 90, 100 MeV. 1986Bi13, 1982Le02, 1980Ka34, 1973Gr06. E=80 MeV, 1993Ta07.

(^{28}Si,^{28}Si′) E=60 MeV: 1995An26, 1996St22, measured static fields.

(^{16}O,^{16}O′) E=33-75 MeV: 1995An26, 1996St22, 1995Re15, 1988Fe08, 1986Gy04, 1984Fe08, 1983Ch35, 1979Ha16, 1978Ba38, 1972Sp03, 1974Ga31, 1973Gr06, 1970Br26, 1971Mi08, 1969Gl08, 1972Do18, 1968Gl01, 1967Ka16, 1966Gr20, 1966Bo34.

(^{12}C,^{12}C′) E=41-50 MeV (1986Gy04,1988Fe08).

(α,α′) E=3-17 MeV. 1989Li05, 1988Fe08, 1986Gy04, 1984Mu19, 1978Ba38, 1977Ro16, 1970Br26, 1954He02.

(p,p′) E=2.5-6.0 MeV. 1984Mu19, 1971Mi08, 1969Gl08, 1965Sp03, 1964Sp09, 1961Mc01, 1959Vi31, 1958Ba43, 1958Ba37, 1957Mc43, 1955St57, 1955Mc44.

g factor measurements: 1982Le02, 1979Ha06, 1974Ga31, 1972Do18, 1967Ka16, 1965Sp03.

Q measurements: 1986Gy04, 1983Ch35, 1978Ba38, 1973Gr06, 1969Gl08, 1968Gl01.

$T_{1/2}$ measurements by Doppler-shift methods: 1977Jo05, 1977St26, 1971NoZV.

^{194}Pt Levels

B(E2) values are deduced from quoted matrix elements: (matrix element)^2/(2J$_i$+1).

Deduced deformation parameters β_2=−0.15, β_4=−0.08 (1988Fe08).

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Coulomb excitation **1996Wu07,1984WuZX,1978Ba38 (continued)**

^{194}Pt Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
0.0	0^+		
328.49 *8*	2^+	41.7 ps *4*	B(E2)↑=1.649 *15* B(E2)↑: weighted average of 1.46 *+12−4* (1996Wu07), 1.661 *11* (1986Gy04), 1.46 *8* (1984WuZX), 1.620 *15* (1978Ba38), 1.68 *3* (1977Ro16), 1.87 *9* (1971Mi08), 1.64 *4* (1969Gl08), 1.9 *2* (1961Mc01). $T_{1/2}$: from B(E2)=1.649 *15*. From recoil distance method, $T_{1/2}$= 45.0 ps *24* (1977Jo05, (^{40}Ar,^{40}Ar′γ)), 50.5 ps *22* (1971NoZV). g factor=+0.296 *22* (transient field integral perturbed angular correlations, 1991St04), 0.203 *6* (1982Le02, transient field technique), 0.349 *31* (1974Ga31, IMPAC), 0.32 *3* (1972Do18, recoil in vacuum), 0.32 *4* (1967Ka16, IPAC), 0.33 *15* (1965Sp03, IPAC). Value given by 1982Le02 (also 1987Be08) is much lower as compared to other values from Coulomb excitation and from IPAC technique in ^{194}Ir β^- decay (see Adopted Levels). See 1983St01 for a possible explanation of this low value. Others: 1979Ha06 (g-factor ratio of ^{196}Pt/^{194}Pt); 1992Br03 report a value of +0.295 *10* from weighted average of several literature values for the first 2^+ levels in both ^{194}Pt and ^{196}Pt, which is used for normalization of other g-factors. Q=+0.48 *14* (1986Gy04), 0.13 *17* (1983Ch35), 0.63 *6* (1978Ba38), +0.77 *50* (1973Gr06), 0.64 *16* or 0.87 *18* (1969Gl08,1968Gl01). 1983Ch35 and 1978Ba38 are from the same group. E2 matrix element=(+)1.208 *+49−17* (1996Wu07). Static E2 matrix element=+0.54 *+8−6* (1996Wu07).
622.01 *8*	2^+	35 ps *4*	$T_{1/2}$: from ce-γ(t) in ^{194}Ir β^- decay (1972Be53). Other: 42 ps *3* from B(E2)(from g.s.)=0.0080 *4* and adopted %I(γ+ce)=11.15 *15* for 622.0γ. B(E2)(from g.s.)=0.0080 *4*. Weighted average of 0.0079 *2* (1996Wu07), 0.0079 *4* (1984WuZX) and 0.0081 *4* (1978Ba38). Others: 0.0070 *10* (1977St26), 0.0094 *15* (1977Ro16), 0.011 *2* (1970Br26), 0.0087 *20* (1961Mc01). B(E2)(from 328.5, 2^+)=0.437 *16*. Weighted average of 0.460 *+9−11* (1996Wu07), 0.423 *15* (1978Ba38) and 0.456 *17* (1984WuZX). Others: 0.58 *7* (1977St26), 0.23 *5* (1961Mc01). g factor=+0.281 *55*, from transient field integral perturbed angular correlations, normalized using g(622)/g(328)=0.952 *183* and g(328)=0.295 *10* (1992Br03). E2 matrix element=+0.0888 *12* (1996Wu07). E2 matrix element (from 328,2^+)=(+)1.517 *+11−18* (1996Wu07). E2 matrix element (from 811,4^+)=+0.25 *+14−6* (1996Wu07). Static E2 matrix element=−0.40 *+12−5* (1996Wu07). M1 matrix element (622,2^+ to 328,2^+)=+0.028 *+13−5* (1996Wu07).
811.39 *11*	4^+	3.7 ps *2*	$T_{1/2}$: from Doppler-shift recoil-distance method (1977Jo05). Others: 4.8 ps *14* (Doppler-shift attenuation method, 1977St26); 4.7 ps *2* from B(E2)(from 328.5). B(E2)(from 328.5, 2^+)=0.78 *3* Weighted average of 0.749 *+16−10* (1996Wu07), 0.92 *9* (1988Fe08), 0.81 *4* (1978Ba38), 0.75 *2* (1984WuZX), 0.85 *5* (1977St26), 0.86 *13* (1971Mi08). B(E2)(from 622,2^+)=0.0069 *+100−29* (1996Wu07). B(E4)=0.05 *4* (1988Fe08). g factor=+0.279 *31*, from transient field integral perturbed angular correlations, normalized using g(811)/g(328)=0.946 *102* and g(328)=0.295 *10* (1992Br03). E2 matrix element=(+)1.935 *+21−13* (1996Wu07). Static E2 matrix element=+1.00 *+12−24* (1996Wu07).
922.64 *11*	3^+		
1229.50 *10*	4^+	3.8 ps *6*	$T_{1/2}$: from Doppler-shift attenuation method (1977St26). Other: 1.53 ps *+7−9* from B(E2)(from 622.0, 2^+) (1996Wu07) and adopted %I(γ+ce)=81.0 *12* for 607.5γ; this value disagrees with measured $T_{1/2}$ from DSAM. B(E2)(from 328.5, 2^+)=0.0097 *10* (1996Wu07), 0.0097 *15* (1984WuZX). Other: 0.018 *9* (1978Ba38). B(E2)(from 622.0, 2^+)=0.64 *+3−2* (1996Wu07), 0.63 *5* (1984WuZX). Others: 1.2 *5* (1978Ba38), 0.50 *21* (1977St26). B(E2)(from 811.4, 4^+)=0.25 *2* (1996Wu07), 0.25 *6* (1984WuZX). Other: 0.87 *31* (1978Ba38). B(E4)(from g.s.)=0.017 *6* (1978Ba38). E2 matrix element (from 328,2^+)=+0.220 *9* (1996Wu07). E2 matrix element (from 811,4^+)=+1.51 *+6−5* (1996Wu07). E2 matrix element (from 1412,6^+)=+0.16 *+6−16* (1996Wu07).

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Coulomb excitation 1996Wu07,1984WuZX,1978Ba38 (continued)

^{194}Pt Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
			E2 matrix element (from 622,2$^+$)=(+)1.784 *+45−29* (1996Wu07). Static E2 matrix element=−0.07 *14* (1996Wu07). M1 matrix element (1229,4$^+$ to 811,4$^+$)=+0.19 *+3−6* (1996Wu07).
1267.21 *13*	0$^+$	6.1 ps *14*	$T_{1/2}$: from B(E2)(from 622.0, 2$^+$)=0.011 *+3−2* and adopted branching ratio %I(γ+ce)=66.9 *4* for 645.2γ. B(E2)(from 328.5, 2$^+$)=0.00098 *+27−37* (1996Wu07), 0.0009 *5* (1984WuZX). B(E2)(from 622.0, 2$^+$)=0.011 *+3−2* (1996Wu07), 0.011 *6* (1984WuZX). E2 matrix element (from 328,2$^+$)=0.070 *+9−15* (1996Wu07). E2 matrix element (from 611,2$^+$)=(+)0.231 *+30−21* (1996Wu07).
1373.79 *15*	(5$^-$)		
1411.95 *13*	6$^+$	1.6 ps *5*	$T_{1/2}$: from Doppler-shift attenuation method (1977St26). Other: 1.11 ps *+3−8* from B(E2)(from 811.0, 4$^+$)=0.93 *+7−2* (1996Wu07). Other B(E2)(from 811.0, 4$^+$)=0.93 *9* (1984WuZX); 0.46 *12* (1977St26) is discrepant. E2 matrix element=(+)2.90 *+10−4* (1996Wu07). Static E2 matrix element=+0.28 *+12−27* (1996Wu07).
1421.97 *11*	(3,4)$^+$		Level excited in (^{136}Xe,^{136}Xe′γ) only (1984WuZX).
1432.8 *8*	3$^-$	0.110 ns *+10−9*	$T_{1/2}$: from B(E3) and adopted %I(γ+ce)=1.93 *4* for 1432γ from Adopted Gammas. B(E3)=0.120 *8*, weighted average of 0.125 *8* (1989Li05), 0.111 *9* (1978Ba38), 0.14 *3* (1977Ro16).
1547.30 *10*	0$^+$	0.175 ps *+14−11*	$T_{1/2}$: from B(E2)(from 328.5, 2$^+$)=0.0191 *+11−13* and adopted %I(γ+ce)=79.5 *4* for 1218.8γ in Adopted Gammas. B(E2)(from 328.5, 2$^+$)=0.0191 *+11−13* (1996Wu07), 0.019 *7* (1984WuZX). B(E2)(from 622.0, 2$^+$)=0.0185 *+13−11* (1996Wu07), 0.019 *6* (1984WuZX). E2 matrix element (from 328,2$^+$)=+0.309 *+9−10* (1996Wu07). E2 matrix element (from 611,2$^+$)=(+)0.304 *+11−9* (1996Wu07).
1925.92 *12*	(6$^+$)	1.3 ps *2*	$T_{1/2}$: from Doppler-shift attenuation method (1977St26). γ branchings deduced from $T_{1/2}$ and B(E2) values. See Adopted Gammas for these values. B(E2)(from 811.0, 4$^+$)=0.0056 *+9−8* (1996Wu07), 0.0056 *16* (1984WuZX). B(E2)(from 1229.5, 4$^+$)=0.48 *+6−3* (1996Wu07), 0.48 *9* (1984WuZX). $T_{1/2}$=1.3 ps *2* gives B(E2)=0.40 *9* (1977St26), assuming that 696γ is the main deexciting transition from the 1926 level. B(E2)(from 1411.9, 6$^+$)=0.10 *+2−4* (1996Wu07), 0.10 *6* (1984WuZX). E2 matrix element (from 811,4$^+$)=0.224 *+17−19* (1996Wu07). E2 matrix element (from 1412,6$^+$)=+1.14 *+11−24* (1996Wu07). E2 matrix element (from 1229,4$^+$)=(+)2.09 *+11−7* (1996Wu07). Static E2 matrix element=+0.41 *+26−22* (1996Wu07).
2099.66 *16*	(8)$^+$	1.1 ps *3*	$T_{1/2}$: from Doppler-shift attenuation method (1977St26). Other: 0.65 ps *+7−4* from B(E2)(from 1411.9, 6$^+$)=0.73 *+5−7*. B(E2)(from 1411.9, 6$^+$)=0.73 *+5−7* (1996Wu07), 0.79 *15* (1984WuZX). $T_{1/2}$=1.1 ps *3* gives B(E2)=0.47 *14* (1977St26). E2 matrix element=(+)3.08 *+10−16* (1996Wu07). Static E2 matrix element=[−0.10,0.43] (1996Wu07).
2689.3 *1*	(8$^+$)	0.61 ps *+9−11*	$T_{1/2}$: from B(E2)=0.46 *+10−6*. B(E2)(from 1925.9, 6$^+$)=0.46 *+10−6* (1996Wu07), 0.45 *11* (1984WuZX). E2 matrix element (from 1926,6$^+$)=(+)2.44 *+28−15* (1996Wu07).
2848.7 *11*	(10$^+$)	1.05 ps *+30−22*	E(level): level seen in (^{136}Xe,^{136}Xe′) only (1984WuZX,1996Wu07). $T_{1/2}$: from B(E2)(from 2099,8$^+$)=0.28 *+7−6* (1996Wu07). E2 matrix element=2.20 *+25−27* (1996Wu07).
2916.7 *11*	(10$^+$)	0.54 ps *+26−12*	$T_{1/2}$: from B(E2)(from 2099,8$^+$)=0.35 *+9−11* (1996Wu07). E(level): level seen in (^{136}Xe,^{136}Xe′) only (1984WuZX,1996Wu07). E2 matrix element=2.43 *+32−41* (1996Wu07).

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

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Coulomb excitation 1996Wu07,1984WuZX,1978Ba38 (continued)

^{194}Pt Levels (continued)

‡ From the Adopted Levels.
# When available, values from direct measurements such as delayed coincidence method, Doppler-shift attenuation methods, etc. are generally adopted here. Values deduced from B(E2) values are found to be different in several cases.

$\gamma(^{194}Pt)$

E_γ †	E_i(level)	J_i^π	E_f	J_f^π	Comments
293.5 *1*	622.01	2^+	328.49	2^+	
300.6 *1*	922.64	3^+	622.01	2^+	γ from 1977St26.
328.5 *1*	328.49	2^+	0.0	0^+	
418.1 *1*	1229.50	4^+	811.39	4^+	Iγ(418)/Iγ(608)=0.13 *2* (1984WuZX).
482.9 *1*	811.39	4^+	328.49	2^+	
499.3 *1*	1421.97	$(3,4)^+$	922.64	3^+	
514.0 *1*	1925.92	(6^+)	1411.95	6^+	
562.4 *1*	1373.79	(5^-)	811.39	4^+	
600.6 *1*	1411.95	6^+	811.39	4^+	
607.5 *1*	1229.50	4^+	622.01	2^+	
622.0 *1*	622.01	2^+	0.0	0^+	
645.2 *1*	1267.21	0^+	622.01	2^+	
687.7 *1*	2099.66	$(8)^+$	1411.95	6^+	
696.4 *1*	1925.92	(6^+)	1229.50	4^+	Iγ(0°)/Iγ(90°)=1.35 (1977St26) consistent with mult=Q.
749 *1*	2848.7	(10^+)	2099.66	$(8)^+$	
763.4‡ *1*	2689.3	(8^+)	1925.92	(6^+)	Second possible placement with a 10^+ level at 2862 (1984WuZX), but is less likely as discussed by 1996Wu07.
811 *1*	1432.8	3^-	622.01	2^+	
817 *1*	2916.7	(10^+)	2099.66	$(8)^+$	
901.0 *1*	1229.50	4^+	328.49	2^+	
925.3 *1*	1547.30	0^+	622.01	2^+	
938.7	1267.21	0^+	328.49	2^+	
1093.5 *1*	1421.97	$(3,4)^+$	328.49	2^+	
1104 *1*	1432.8	3^-	328.49	2^+	
1114.5 *1*	1925.92	(6^+)	811.39	4^+	
1218.8 *1*	1547.30	0^+	328.49	2^+	
1432	1432.8	3^-	0.0	0^+	

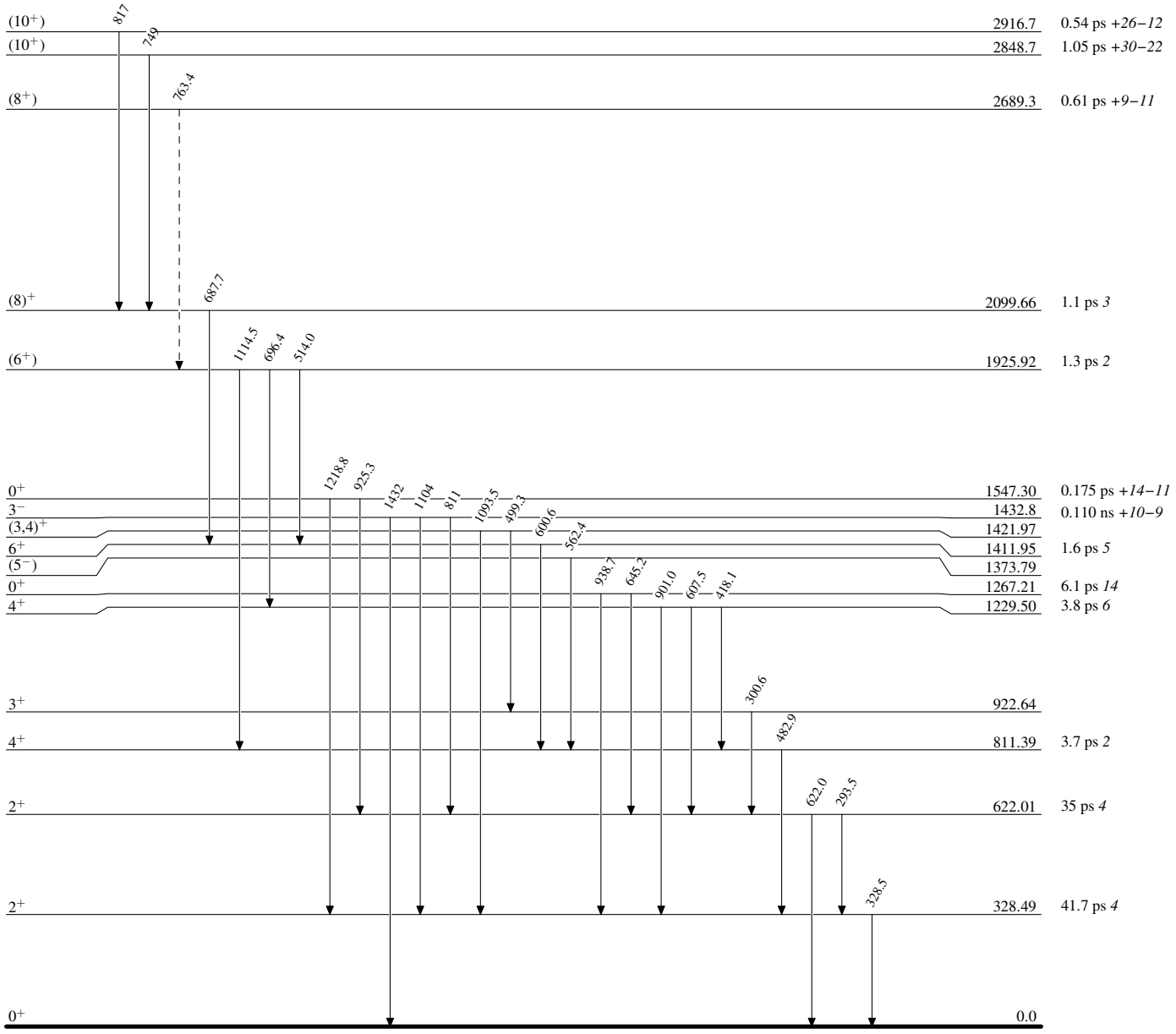
† From thesis by 1984WuZX, unless otherwise stated.
‡ Placement of transition in the level scheme is uncertain.

Legend

Coulomb excitation 1996Wu07,1984WuZX,1978Ba38

Level Scheme

γ Decay (Uncertain)



$^{194}_{78}Pt_{116}$