Adopted Levels, Gammas

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	30-Nov-2021

Q(β^-)=5177 *6*; S(n)=4916 *3*; S(p)=13109 *4*; Q(α)=−6547 *3* 2021Wa16
S(2n)=11968.9 *22*, S(2p)=24688 *3* (2021Wa16).

Identification and production of ^{89}Kr isotope by 1940Ha10 and 1943Ha09 in neutron bombardment of uranium. Later studies of decay of ^{89}Kr: 1950Di01, 1951Ko10, 1965Pa14, 1969Ca03, 1970Fi04, 1972Eh02, 1972Po13, 1973He01, and several others.
Additional information 1.

Hyperfine structure, rms charge radii, isotope shifts: 1995Ke04.

Mass measurement: 2006De36 (ISOLTRAP, Penning-trap method at ISOLDE- CERN facility).

Theoretical calculations: consult NSR database at www.nndc.bnl.gov/nsr/ or additional document records in this dataset for five primary references, three for structure and two for half-life and β^-n decay mode of ^{89}Kr.

^{89}Kr Levels

Cross Reference (XREF) Flags

- A ^{89}Br β^- decay (4.357 s)
- B ^{90}Br β^-n decay (1.911 s)
- C ^{252}Cf SF decay

E(level)‡	Jπ†	$T_{1/2}$	XREF	Comments
0.0	3/2(+)	3.15 min *4*	ABC	%β^-=100 μ=−0.330 *3* (1995Ke04,2019StZV) Q=+0.166 *2* (1995Ke04,2016St14,2021StZZ) RMS charge radius: $(<r^2>)^{1/2}$=4.2289 fm *54* (2004An14 evaluation; and 2008 update available at http://cdfe.sinp.msu.ru). $\Delta<r^2>(^{86}Kr-^{89}Kr)$=0.379 fm^2 *71* (1995Ke04). Jπ: collinear fast LASER beam spectroscopy (1995Ke04). Parity from systematics. μ,Q: collinear fast LASER spectroscopy (1995Ke04). Note that original value of Q=+0.16 *2* has been re-evaluated to +0.166 *2* in 2016St14 and 2021StZZ evaluations with reference to re-evaluated Q=+0.259 *3* for ^{83}Kr g.s. by 2018Py01. $T_{1/2}$: weighted average of 2.97 min *7* (1972Eh02), 3.07 min *8* (1970Fi04), 3.178 min *23* (1969Ca03), and 3.11 min *6* (1965Pa14). Others: 3.18 min (1951Ko10,1951Ko50), 2.6 min *1* (1950Di01), 2.5 min (1943Ha09).
28.59[b] *3*	(5/2+)	21.7 ns *13*	ABC	Jπ: from systematics of nuclides in this mass region, 3/2+ and 5/2+ are expected at low excitations. $T_{1/2}$: weighted average of 22.0 ns *13* (SF decay) and 21 ns *2* (^{89}Br β^- decay).
411.42 *3*			AB	
982.07[b] *4*	(9/2+)		A C	Jπ: ΔJ=2, Q γ to (5/2+).
991.36 *4*			AB	
1026.58 *3*			AB	
1097.835 *25*			AB	
1379.85 *3*			A	
1482.94 *3*			A	
1536.37 *4*			A	
1772.5 *5*	(11/2−)		C	Jπ: spin from ΔJ=1, dipole γ from $\gamma\gamma(\theta)$ in ^{252}Cf SF decay, parity from similarity of level structure with ^{91}Sr (2008Hw03). Evaluator notes a level at 2077.5, (11/2−) in ^{91}Sr Adopted Levels in the ENSDF database (Sept 2013 update), decaying by ΔJ=1, dipole γ to (9/2+).
1833.92 *8*			A	
1887.63 *5*			A	

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Adopted Levels, Gammas (continued)

^{89}Kr Levels (continued)

E(level)‡	XREF	E(level)‡	XREF	E(level)‡	XREF	E(level)‡	XREF
1894.59@ 7	A	2373.72 7	A	4114.72 7	A	4403.0# 4	A
1957.19 9	A	2426.36 14	A	4165.88 10	A	4510.5# 4	A
2038.86 5	A	2468.2a 10	A	4185.66# 18	A	4516.00& 18	A
2062.77 6	A	2648.2 6	C	4232.47# 8	A	4530.3@ 3	A
2104.43 6	A	2735.40 21	A	4238.45 22	A	4610.7a 4	A
2108.15 6	A	2976.49 11	A	4248.8 3	A	4673.1a 4	A
2146.99 6	A	3215.0b 6	C	4288.85 23	A	4707.3# 4	A
2216.67 7	A	3318.4 3	A	4319.1# 3	A		
2278.5b 5	C	3753.92 10	A	4375.3b 6	C		
2298.48& 8	A	3992.16 11	A	4381.70 7	A		

† Spin assignments for only two levels are given above the first excited state. log *ft* values (in ^{89}Br β^- decay) from (3/2$^-$,5/2$^-$) suggest J≤7/2 for most states.

‡ From least-squares fit to Eγ data.

If the deexciting transition feeds the 28.6 level, E(level) should be increased by 28.6 keV.

@ If the deexciting transition feeds the g.s., E(level) should be decreased by 28.6 keV.

& According to 1981Ho17, the g.s. transition feeds the g.s. or the 28.6 level, but another connecting transition supports this level energy.

a Mismatch in energy sums/differences for transitions (1487.25γ, 1697.0γ, 1915.23γ) connected with this level produces a large uncertainty. Either the 1915.23γ or the 1487.25γ may be too high in energy by ≈2.5 keV, the former is true if 1697.0γ is correctly placed from 4165.9 level.

b Band(A): Band based on (5/2$^+$). Possible configuration=$\nu 2d_{5/2}\otimes$(^{90}Kr core states).

γ(^{89}Kr)

E_i(level)	J_i^π	E_γ†	I_γ	E_f	J_f^π	Mult.	δ	α@	Comments
28.59	(5/2$^+$)	28.51 *10*	100	0.0	3/2$^{(+)}$	[M1+E2]	<0.24	6.9 *22*	B(M1)(W.u.)=0.006 *2* δ: from RUL(E2)=300.
411.42		382.87 *5*	18.2 *9*	28.59	(5/2$^+$)				
		411.49 *4*	100 *6*	0.0	3/2$^{(+)}$				
982.07	(9/2$^+$)	953.53 *4*	100	28.59	(5/2$^+$)	Q			
991.36		580.03 *4*	28.3 *17*	411.42					
		962.70 *4*	100 *4*	28.59	(5/2$^+$)				
		991.35 *15*	22 *4*	0.0	3/2$^{(+)}$				E_γ: from ^{90}Br β^-n. Eγ=991.5 *3* in ^{89}Br β^-.
1026.58		997.93 *4*	100 *3*	28.59	(5/2$^+$)				
		1026.46 *4*	42.3 *14*	0.0	3/2$^{(+)}$				
1097.835		1069.24 *7*	3.6 *2*	28.59	(5/2$^+$)				
		1097.82 *3*	100 *3*	0.0	3/2$^{(+)}$				
1379.85		282.1 *2*	2.9 *9*	1097.835					
		353.08 *5*	5.1 *11*	1026.58					
		397.94 *5*	4.4 *3*	982.07	(9/2$^+$)				
		1351.31 *5*	100 *6*	28.59	(5/2$^+$)				
		1379.80 *4*	63 *4*	0.0	3/2$^{(+)}$				
1482.94		385.11 *5*	15.0 *9*	1097.835					
		456.3 *2*	3.1 *9*	1026.58					
		1454.22 *7*	56 *3*	28.59	(5/2$^+$)				
		1483.00 *4*	100 *6*	0.0	3/2$^{(+)}$				

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Adopted Levels, Gammas (continued)

γ(^{89}Kr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.
1536.37		554.37 *5*	5.39 *24*	982.07	(9/2$^+$)	
		1507.70 *4*	100 *5*	28.59	(5/2$^+$)	
1772.5	(11/2$^-$)	790.0		982.07	(9/2$^+$)	D
1833.92		807.33 *8*	100	1026.58		
1887.63		789.76 *5*	100 *6*	1097.835		
		896.37 *10*	34 *3*	991.36		
1894.59		1865.98[‡] *6*	100	28.59	(5/2$^+$)	
1957.19		1928.44 *13*	100 *6*	28.59	(5/2$^+$)	
		1957.22 *15*	87 *8*	0.0	3/2$^{(+)}$	
2038.86		1012.25 *4*	100	1026.58		
2062.77		1036.13 *7*	65 *3*	1026.58		
		1080.61 *8*	53 *3*	982.07	(9/2$^+$)	
		2034.49 *13*	100 *7*	28.59	(5/2$^+$)	
2104.43		621.56 *5*	38.1 *17*	1482.94		
		1122.08 *10*	100 *8*	982.07	(9/2$^+$)	
2108.15		2108.16 *6*	100	0.0	3/2$^{(+)}$	
2146.99		2118.40 *6*	100	28.59	(5/2$^+$)	
2216.67		1190.11 *8*	39 *3*	1026.58		
		2216.60 *12*	100 *9*	0.0	3/2$^{(+)}$	
2278.5		1296.0		982.07	(9/2$^+$)	
2298.48		2298.47[‡] *8*	100	0.0	3/2$^{(+)}$	
2373.72		1391.64 *7*	60 *3*	982.07	(9/2$^+$)	
		2345.33 *10*	100 *8*	28.59	(5/2$^+$)	
2426.36		1399.77 *13*	100	1026.58		
2468.2		1487.25[#] *20*	100	982.07	(9/2$^+$)	
2648.2		875.7		1772.5	(11/2$^-$)	
2735.40		1355.54 *20*	100	1379.85		
2976.49		1994.40 *10*	100	982.07	(9/2$^+$)	
3215.0		936.5		2278.5		
3318.4		1782 *6*	≈100	1536.37		
		3289.8 *3*	100 *13*	28.59	(5/2$^+$)	
3753.92		1606.93 *10*	100 *5*	2146.99		
		1919.96 *12*	59 *5*	1833.92		
3992.16		1693.71 *12*	15.1 *17*	2298.48		
		2894.20 *15*	100 *8*	1097.835		
4114.72		1741.34 *12*	11.3 *10*	2373.72		
		2006.72 *13*	27.7 *16*	2108.15		
		2075.61 *13*	14.3 *13*	2038.86		
		2578.03 *16*	46 *5*	1536.37		
		3017.0 *7*	10 *3*	1097.835		
		3132.30 *15*	15.7 *13*	982.07	(9/2$^+$)	
		4086.3 *3*	100 *10*	28.59	(5/2$^+$)	
4165.88		1697.00[&] *17*	3.0[&] *5*	2468.2		
		2208.59 *12*	8.8 *8*	1957.19		
		2785.8 *2*	5.6 *8*	1379.85		
		3174.6 *2*	11.7 *8*	991.36		
		4166.3 *3*	100 *8*	0.0	3/2$^{(+)}$	
4185.66		2228.42 *20*	30 *3*	1957.19		
		4185.6[‡] *3*	100 *10*	0.0	3/2$^{(+)}$	
4232.47		1858.73 *5*	100 *3*	2373.72		
		4232.5[‡] *4*	24 *3*	0.0	3/2$^{(+)}$	
4238.45		4209.9 *3*	76 *7*	28.59	(5/2$^+$)	
		4238.2 *3*	100 *10*	0.0	3/2$^{(+)}$	
4248.8		3837.3 *3*	100	411.42		

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Adopted Levels, Gammas (continued)

$\gamma(^{89}Kr)$ (continued)

E_i(level)	E_γ [†]	I_γ	E_f	J^π_f
4288.85	3877.0 *8*	36 *12*	411.42	
	4260.5 *4*	78 *8*	28.59	$(5/2^+)$
	4288.6 *3*	100 *10*	0.0	$3/2^{(+)}$
4319.1	4319.0[‡] *3*	100	0.0	$3/2^{(+)}$
4375.3	1160.3		3215.0	
4381.70	1064.0 *10*	10 *5*	3318.4	
	1915.23[#] *8*	31.1 *15*	2468.2	
	2165.04 *12*	31 *3*	2216.67	
	2234.81 *15*	20 *2*	2146.99	
	2318.79 *13*	22 *2*	2062.77	
	3001.60 *13*	38 *3*	1379.85	
	3400.0 *8*	15 *5*	982.07	$(9/2^+)$
4381.70	4353.6 *3*	100 *9*	28.59	$(5/2^+)$
4403.0	4402.9[‡] *4*	100	0.0	$3/2^{(+)}$
4510.5	4510.4[‡] *4*	100	0.0	$3/2^{(+)}$
4516.00	3489.1 *2*	74 *8*	1026.58	
	4516.9[‡] *4*	100 *10*	0.0	$3/2^{(+)}$
4530.3	4501.6[‡] *3*	100	28.59	$(5/2^+)$
4610.7	2503.16[a] *15*	100 *9*	2108.15	
	4610.5[‡] *4*	100 *11*	0.0	$3/2^{(+)}$
4673.1	1697.00[&a] *17*	45[&] *7*	2976.49	
	4672.9[‡] *4*	100 *12*	0.0	$3/2^{(+)}$
4707.3	4678.6[‡] *4*	100	28.59	$(5/2^+)$

[†] From ^{89}Br β^- decay, unless indicated otherwise.
[‡] Transition feeds the g.s. or the 28.6 level.
[#] Energy may be too high by ≈2.5 keV, see comment for 2468 level.
[@] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[&] Multiply placed with undivided intensity.
[a] Placement of transition in the level scheme is uncertain.

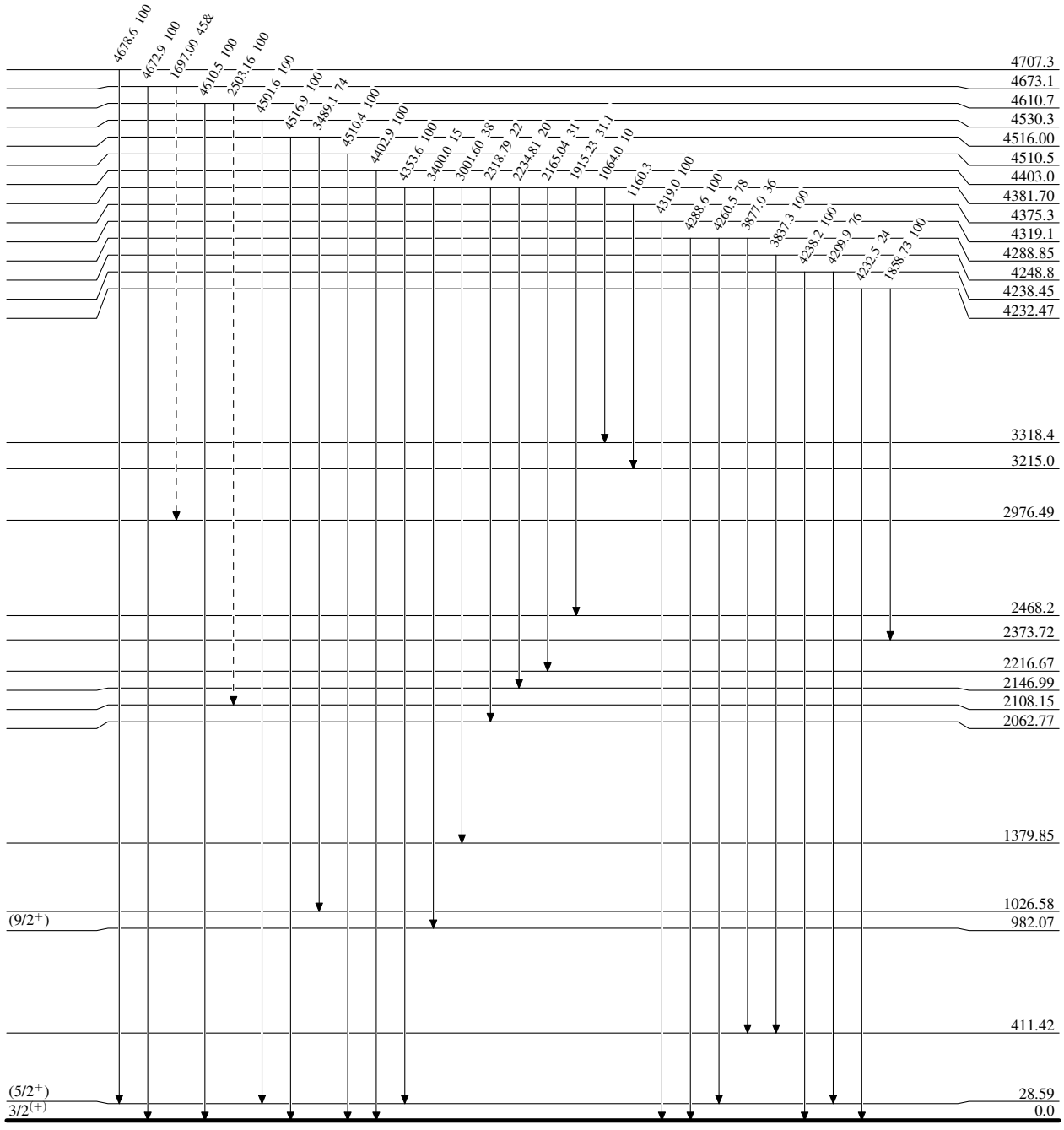
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given

– – – – – – ► γ Decay (Uncertain)

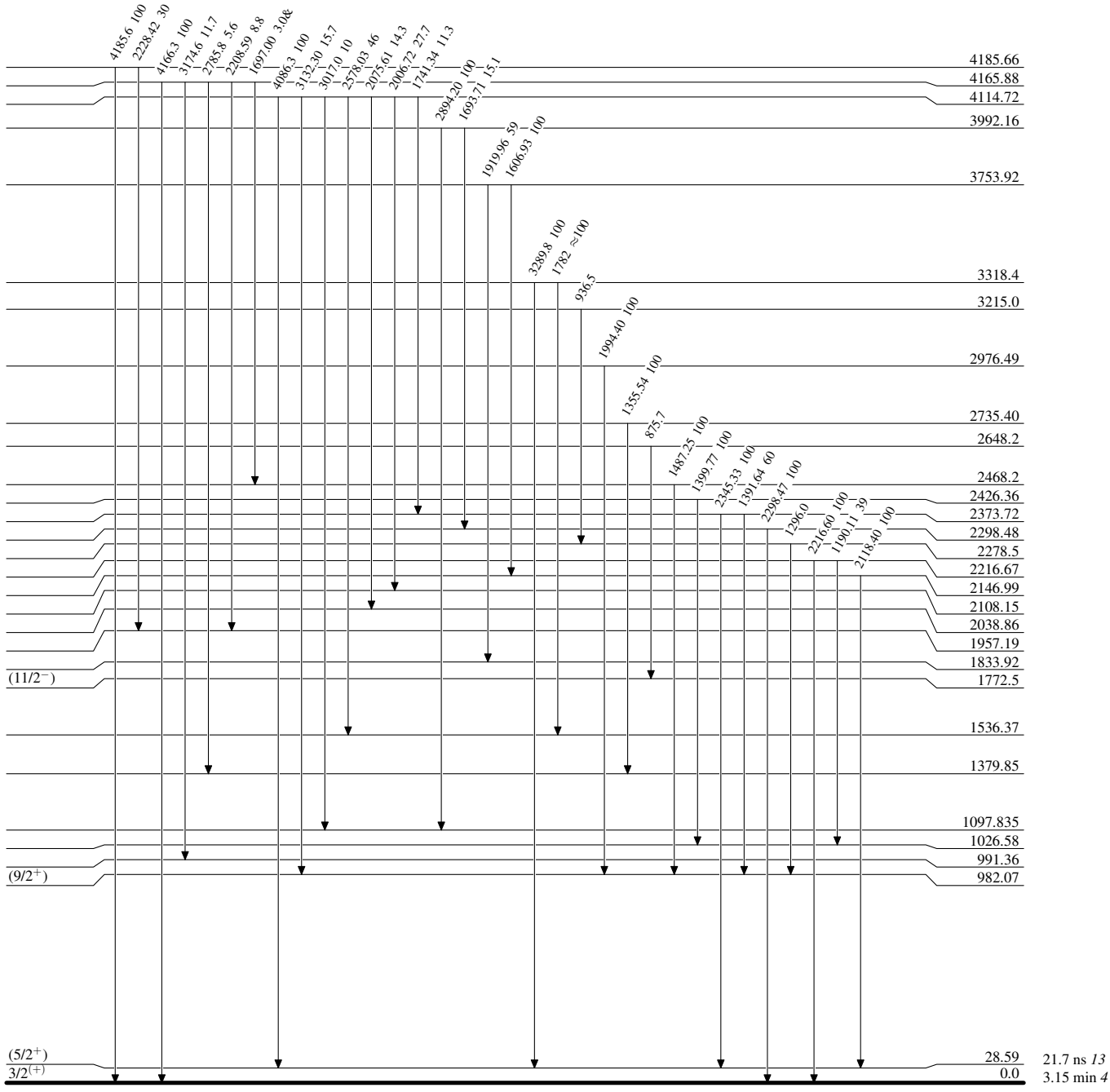


$^{89}_{36}Kr_{53}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given

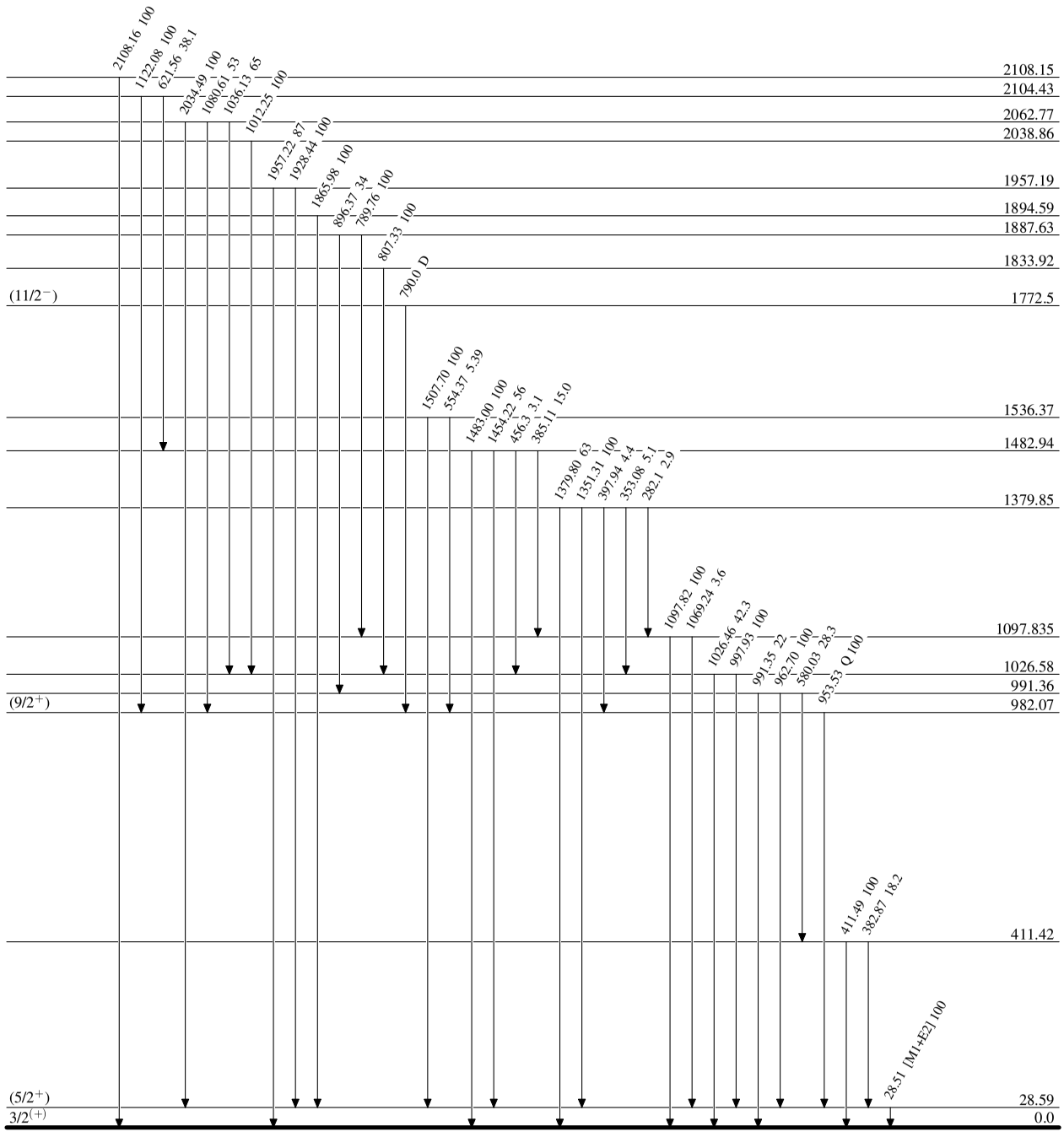


$^{89}_{36}Kr_{53}$

Adopted Levels, Gammas

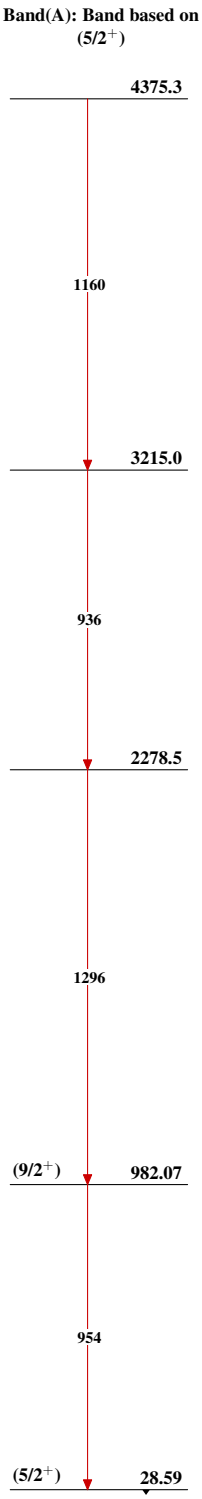
Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given



$^{89}_{36}Kr_{53}$

Adopted Levels, Gammas



$^{89}_{36}Kr_{53}$