^{89}Y(n,n′γ)   1986Na18,1984Bu28

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 114, 1 (2013)	20-Oct-2012

1986Na18 (also 1983Na16): E=2.2-4.8 MeV. Measured Eγ, Iγ, excitation functions, γ(θ).

1984Bu28: E=0.5-4.2 MeV. Measured Eγ, Iγ, excitation functions. Levels (and transitions) are reported up to 3715 keV.

Others:

1974Di04: E=14.1 MeV. Measured prompt and delayed γ, σ. Four γ rays reported at 715.7, 909.1, 1311.0 and 1506.4.

1973Pe10: E<2 MeV. Measured cross section.

1973Ha68: measured Eγ.

1971Ru15: E=14.8 MeV. Measured cross section for isomer activation.

1968BuZY (also 1970BuZW, 1967Bu13): E=3.5-4.2 MeV. Measured Eγ, Iγ, γ(θ), excitation functions. Comparisons with theoretical cross sections. All 24 levels proposed up to 4020 were confirmed by 1986Na18, but J$^\pi$ assignments differ for many levels.

1969Ro13: E=2.75 MeV.

1966Ma10: E=3.25-4.0 MeV. Measured Eγ, Iγ, σ. 14 levels proposed up to 4210.

1963Sh02: E=0.78-3.36 MeV. Measured Eγ, Iγ, σ. Levels proposed at 908, 1510, 1750, 2220, 2530, 2610, 2840, 3050. Comparison of σ data with Hauser-Feshbach calculations.

^{89}Y Levels

E(level)	J$^{\pi}$[†]	T$_{1/2}$[†]	E(level)	J$^{\pi}$[†]	E(level)	J$^{\pi}$[†]
0	1/2$^-$		3343.4 6	13/2$^-$	4015.3 7	1/2$^+$
909.1 2	9/2$^+$	15.663 s	3410.8 5	(5/2$^+$)	4022.9 3	(3/2)$^-$
1507.3 2	3/2$^-$		3451.4 7	(7/2$^+$)	4105.0 6	(7/2$^+$)
1744.8 3	5/2$^-$		3503.6 5	(7/2$^-$)	4170.9 11	3/2$^-$,5/2$^-$
2222.5 3	5/2$^+$		3515.7 7	(3/2)$^-$	4188.1 6	5/2$^+$
2529.9 4	7/2$^+$		3557.4 5	(7/2$^-$)	4230.5[@] 13	(7/2)
2566.4 5	11/2$^+$		3621.2 7	(11/2)	4309.4 6	(7/2)$^-$
2622.1 5	9/2$^+$		3630.5 7	(11/2)$^+$	4334.3 13	
2871.8 4	(7/2)$^+$		3715.3 4	5/2$^+$	4354.9 11	
2881.3 6	(3/2)$^-$		3747.8 9	(9/2)$^+$	4408.4 8	(1/2,3/2,5/2)
2892.6 7	13/2$^+$		3752.9 5	(5/2$^+$)	4457.7 7	7/2$^-$,9/2$^-$
3067.7 4	3/2$^-$		3848.2 5	(3/2$^-$,5/2$^-$)	4476.3 13	(5/2$^+$)
3107.2 4	(5/2)$^-$		3862.3 5	(3/2,5/2)$^{-}$[#]	4529.5 17	5/2$^+$,7/2$^+$
3138.9 3	(5/2)$^-$		3976.9 7	(11/2)$^+$	4537.5 20	3/2$^-$,5/2$^-$
3247.5 5	(3/2,5/2)[‡]		3991.6 8	3/2$^-$		

[†] From Adopted Levels.

[‡] Excitation function supports 5/2.

[#] Excitation function suggests 7/2.

[@] From the observation of a weak γ ray at 3326.2 19 on the tail of 3321γ, 1986Na18 propose two levels near this energy, the second one, tentatively, at 4235.3 20.

γ(^{89}Y)

1986Na18 display excitation function and γ(θ) data for transitions from 2881 to 4309 levels. But values of A$_2$ and A$_4$ coefficients are not given.

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     Angle-integrated cross sections (mb) E(n)=4.5 MeV (1986Na18)
     Eγ        σ        Eγ        σ        Eγ        σ
-----------------------------------------------------------
    341.9     3  1     1800.8    10  2     2712.1    12  2
    715.2    35  3     1812.5     7  2     2721.4    12  2
    777.0     4  1     1882.5     4  1     2806.7    13  2
    916.1     7  1     1962.8    51  5     2838.7    14  2
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955.0	8 2	1983.5	6 1	2844.2	7 1
1313.2	87 7	1996.2	31 3	2881.2	79 8
1361.8	6 1	2008.3	20 2	3067.6	65 5
1492.7	10 2	2050.1	21 3	3107.5	66 5
1507.2	357 31	2086.7	14 2	3139.2	61 5
1559.8	8 2	2103.5	27 4	3196.3	3 1
1599.8	5 1	2278.6	12 3	3516.2	42 5
1620.8	88 7	2340.8	6 1	3861.8	7 2
1631.6	9 1	2355.1	19 4	3991.5	51 7
1657.3	26 3	2501.4	33 5	4170.8	38 6
1713.0	35 3	2515.3	15 2		
1740.2	38 7	2542.3	46 5		
1744.7	239 18	2648.3	13 2		
1792.8	5 1	2680.9	13 2		

The cross sections are also available for transitions at
E(n)=4.2, 3.7 and 3.4 MeV (table ii in 1986Na18)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.	δ[#]	Comments
909.1	$9/2^+$	909.0 3	100	0	$1/2^-$	M4+E5		Mult.: from Adopted Gammas.
1507.3	$3/2^-$	1507.2 3	100	0	$1/2^-$			δ(Q/D)=−0.05 to −0.2 or +2.0 to +2.8 (1967Bu13).
1744.8	$5/2^-$	1744.7 3	100	0	$1/2^-$			
2222.5	$5/2^+$	715.2 3	31.5 6	1507.3	$3/2^-$			
		1313.2 3	68.5 6	909.1	$9/2^+$			
2529.9	$7/2^+$	1620.8 3	100	909.1	$9/2^+$			
2566.4	$11/2^+$	1657.3 4	100	909.1	$9/2^+$			
2622.1	$9/2^+$	1115.0[@] 7	9	1507.3	$3/2^-$	[E3]		E_γ,I_γ: from 1984Bu28 only. This transition is considered suspect (evaluator) since it is not confirmed by 1986Na18 and in ^{89}Zr ε decay where such a transition should have been detected.
		1713.0 4	91	909.1	$9/2^+$			I_γ: from 1984Bu28.
2871.8	$(7/2)^+$	1962.8 4	100	909.1	$9/2^+$			
2881.3	$(3/2)^-$	2881.2 6	100	0	$1/2^-$			
2892.6	$13/2^+$	1983.5 6	100	909.1	$9/2^+$			
3067.7	$3/2^-$	1559.8 5	9.6 7	1507.3	$3/2^-$			
		3067.6 6	90.4 7	0	$1/2^-$	D+Q	+0.05	
3107.2	$(5/2)^-$	1361.8 9	9.1 7	1744.8	$5/2^-$	D+Q	+0.6	
		1599.8 4	8.4 8	1507.3	$3/2^-$	D+Q	−0.25	
		3107.5 6	82.5 11	0	$1/2^-$			
3138.9	$(5/2)^-$	916.1 5	9.4 8	2222.5	$5/2^+$			I_γ(916)/I_γ(3139)=0.047 (1984Bu28), 0.12 (1986Na18) are discrepant.
		1631.6 4	12.7 6	1507.3	$3/2^-$			
		3139.2 6	77.9 9	0	$1/2^-$			
3247.5	$(3/2,5/2)$	1740.2 5	93.1 18	1507.3	$3/2^-$	D+Q	−0.24	
		3247.5 9	6.9 18	0	$1/2^-$			
3343.4	$13/2^-$	777.0 4	100	2566.4	$11/2^+$			
3410.8	$(5/2^+)$	2501.4 5	100	909.1	$9/2^+$			
3451.4	$(7/2^+)$	2542.3 6	100	909.1	$9/2^+$	D+Q	−0.03	
3503.6	$(7/2^-)$	364.7 5	5.9 9	3138.9	$(5/2)^-$			
		1996.2 5	94.1 9	1507.3	$3/2^-$			
3515.7	$(3/2)^-$	1770.0 10		1744.8	$5/2^-$			E_γ: from 1984Bu28 only.
		3516.2 8		0	$1/2^-$	D+Q	−0.65 +15−30	
3557.4	$(7/2^-)$	1812.5 9	12.4 18	1744.8	$5/2^-$			
		2050.1 8	49.8 16	1507.3	$3/2^-$			
		2648.3 6	37.8 15	909.1	$9/2^+$	D+Q	−0.08	

Continued on next page (footnotes at end of table)

^{89}Y(n,n'γ)   **1986Na18,1984Bu28 (continued)**

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

E_i(level)	J_i^π	E_γ†	I_γ‡	E_f	J_f^π	Mult.	δ#	Comments
3621.2	(11/2)	2712.1 6	100	909.1	9/2$^+$	D+Q	+0.10	Additional information 1.
3630.5	(11/2)$^+$	2721.4 6	100	909.1	9/2$^+$	D+Q	+0.19	
3715.3	5/2$^+$	843.6 5	14.7 11	2871.8	(7/2)$^+$			
		1492.7 4	38.0 19	2222.5	5/2$^+$	D+Q	−0.15	
		2806.7 8	47.3 23	909.1	9/2$^+$			
3747.8	(9/2)$^+$	2838.7 8	100	909.1	9/2$^+$	D+Q	+0.40	
3752.9	(5/2$^+$)	341.9 5	8.2 8	3410.8	(5/2$^+$)			
		2008.3 6	68.1 18	1744.8	5/2$^-$			
		2844.2 8	23.7 17	909.1	9/2$^+$			
3848.2	(3/2$^-$,5/2$^-$)	2103.5 5	84.9 12	1744.8	5/2$^-$	D+Q	+1.80	
		2340.8 6	15.1 12	1507.3	3/2$^-$	D+Q	−0.50	
3862.3	(3/2,5/2)$^-$	2355.1 5	76.3 18	1507.3	3/2$^-$			
		3861.8 9	23.7 18	0	1/2$^-$			
3976.9	(11/2)$^+$	1447.0 5	100	2529.9	7/2$^+$			
3991.6	3/2$^-$	3991.5 8	100	0	1/2$^-$	D+Q	−0.90	
4015.3	1/2$^+$	1792.8 7	43 4	2222.5	5/2$^+$			
		4015.4 15	57 4	0	1/2$^-$			
4022.9	(3/2)$^-$	955.0 3	16.5 8	3067.7	3/2$^-$	D+Q	−0.10	
		1800.8 4	20.9 10	2222.5	5/2$^+$	D+Q	−1.25	
		2278.6 7	22.3 12	1744.8	5/2$^-$			
		2515.3 6	28.8 12	1507.3	3/2$^-$	D+Q	−0.80	
		4022.9 15	11.5 11	0	1/2$^-$			
4105.0	(7/2$^+$)	1574.9 7	41.8 26	2529.9	7/2$^+$			
		1882.5 8	32.6 25	2222.5	5/2$^+$	D+Q	+0.28	
		3196.3 12	25.6 22	909.1	9/2$^+$	D+Q	−0.15	I_γ: based on Iγ=26 in figure 2 of 1986Na18. In table I, authors value of 22.5 22 seems a misprint.
4170.9	3/2$^-$,5/2$^-$	4170.8 11	100	0	1/2$^-$			
4188.1	5/2$^+$	2680.9 7	83.9 18	1507.3	3/2$^-$			
		3278.7 9	16.1 18	909.1	9/2$^+$			
4230.5	(7/2)	3321.4 12	100	909.1	9/2$^+$			
4309.4	(7/2)$^-$	2086.7 7	88.4 12	2222.5	5/2$^+$			
		3400.5 9	11.6 12	909.1	9/2$^+$			
4334.3		3425.1 12	100	909.1	9/2$^+$			
4354.9		3445.7 10	100	909.1	9/2$^+$			
4408.4	(1/2,3/2,5/2)	2901.0 10	40 5	1507.3	3/2$^-$			
		4408.2 13	60 5	0	1/2$^-$			
4457.7	7/2$^-$,9/2$^-$	1927.8 6	100	2529.9	7/2$^+$			
4476.3	(5/2$^+$)	2253.8 12	100	2222.5	5/2$^+$			
4529.5	5/2$^+$,7/2$^+$	3620.3 16	100	909.1	9/2$^+$			
4537.5	3/2$^-$,5/2$^-$	4537.4 20	100	0	1/2$^-$			

† From 1986Na18. 1984Bu28 report energies for levels up to 3715 level but are less precise than in 1986Na18.
‡ Branching ratios from 1986Na18, unless indicated otherwise.
From $\gamma(\theta)$ (1986Na18). In case of double value result, only the lower δ value is quoted (and adopted) by 1986Na18.
@ Placement of transition in the level scheme is uncertain.
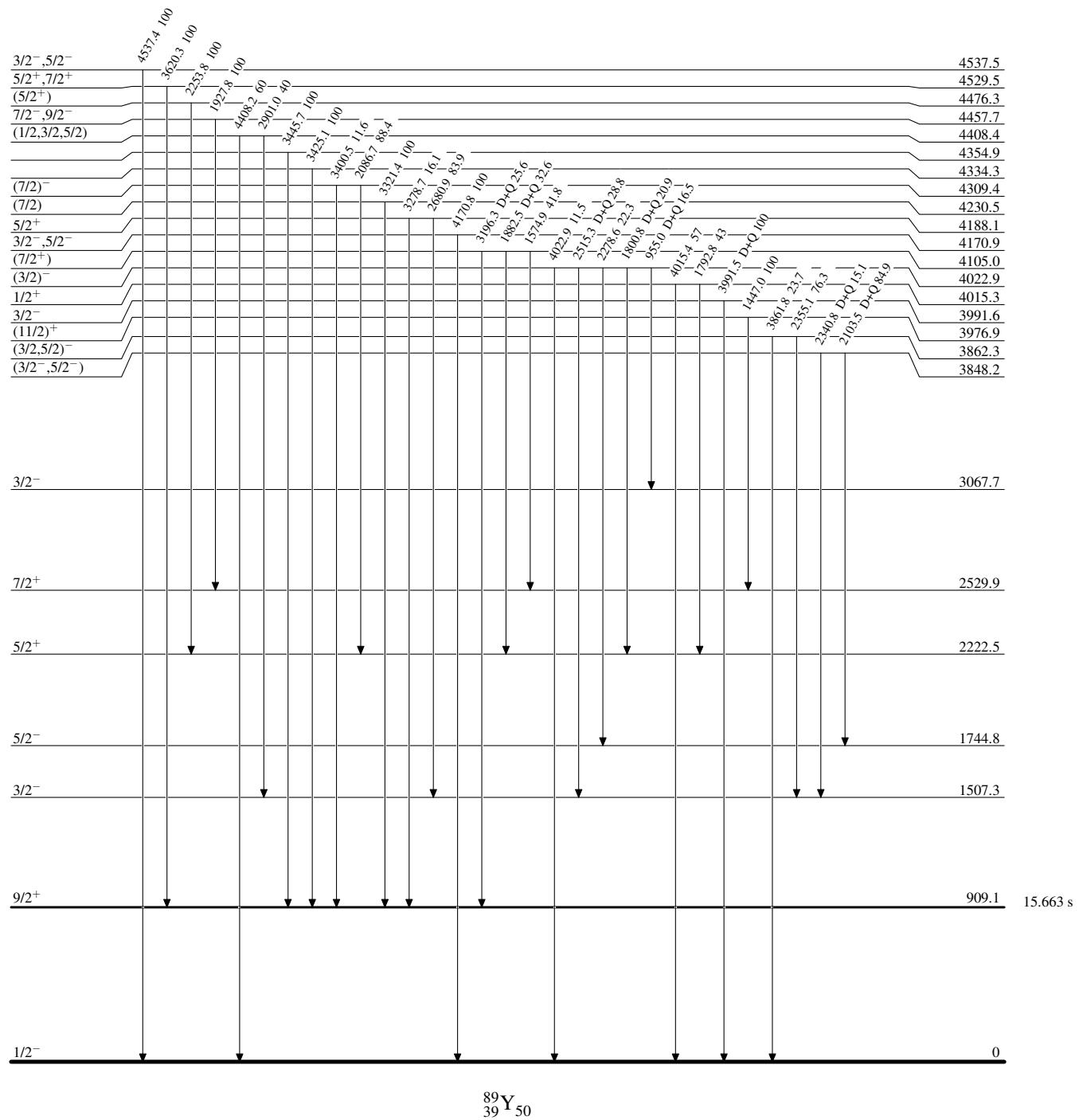
^{89}Y(n,n'γ)   1986Na18,1984Bu28

Level Scheme

Intensities: % photon branching from each level
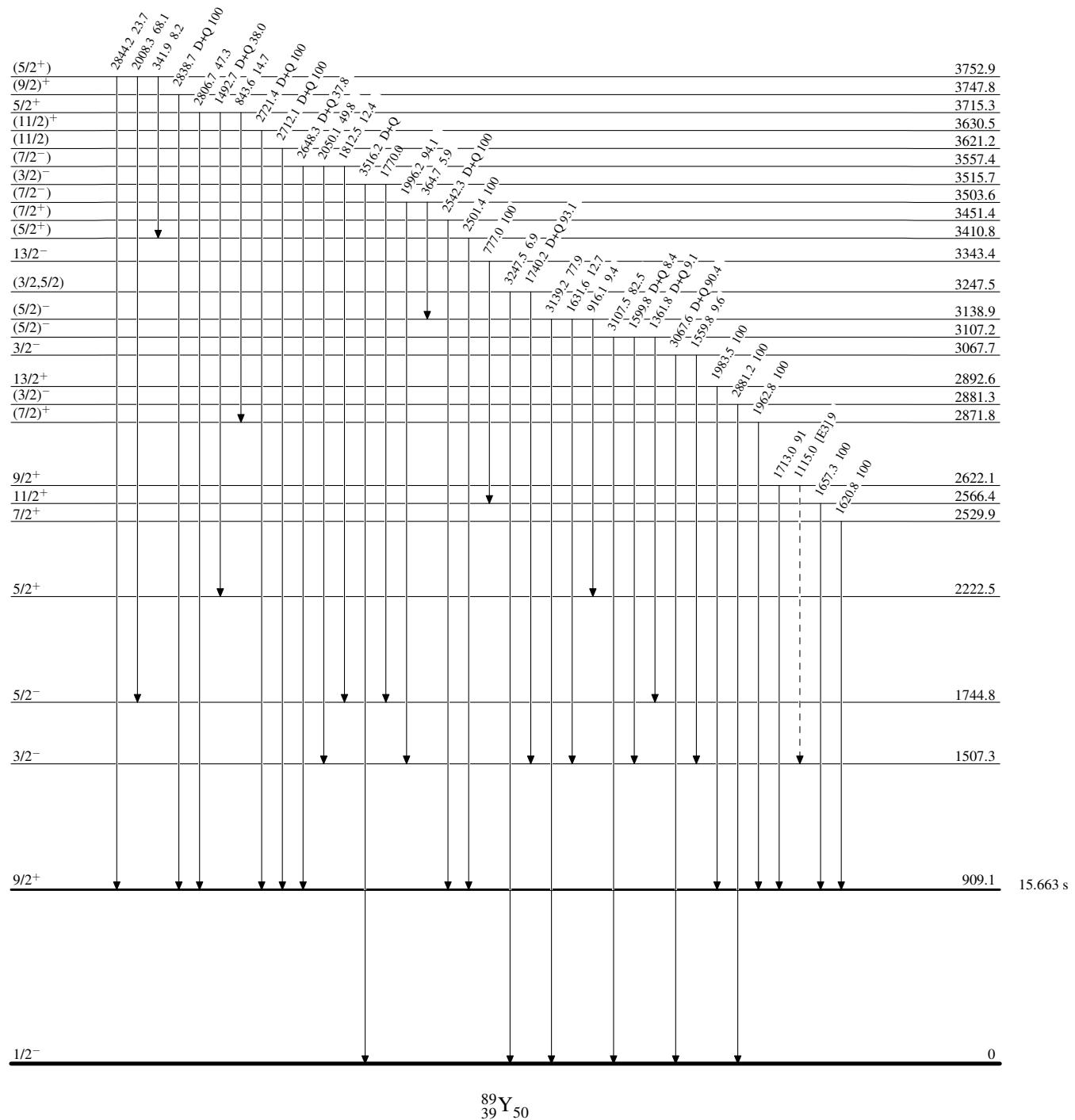
$^{89}\text{Y}(n,n'\gamma)$ **1986Na18,1984Bu28**   Legend

Level Scheme (continued)

Intensities: % photon branching from each level

- - - - - ► γ Decay (Uncertain)

$^{89}_{39}\text{Y}_{50}$

<p align="center">^{89}Y(n,n'γ)   1986Na18,1984Bu28</p>

<p align="center">Level Scheme (continued)</p>

<p align="center">Intensities: % photon branching from each level</p>

<p align="center">$^{89}_{39}$Y$_{50}$</p>

^{89}Y(n,n'γ)   1986Na18,1984Bu28