^{40}Ar(p,nγ) 1979Be41,1971We09,1970Tw01

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 140, 1 (2017)	30-Sep-2015

1979Be41: E=5.75 MeV proton beam was produced from the Auckland tandem Van de Graaff accelerator. Gaseous argon target. γ-rays were detected by a Ge(Li) detector (FWHM=3 keV at 1.33 MeV). Measured Eγ, Iγ, DSA, γ(θ). Deduced levels, half-lives, J, mixing ratios, branching ratios. Comparisons with shell-model calculations.

1971We09 (also 1970Ba34): E=3.7-4.9 MeV proton beams were produced from the Frankfurt 7 MV Van de Graaff accelerator. Gaseous argon target. γ rays were detected with a Ge(Li) detector (FWHM=2.8 keV at 1.33 MeV). Measured Eγ, Iγ, γ(θ). Deduced levels, J, π, mixing ratios, branching ratios. Comparisons with shell-model calculations. 1971We09 and 1970Ba34 also measure lifetimes using DSAM in (α,nγ).

1970Tw01 (also 1969Tw01): E=3.2-5.2 MeV proton beams were produced from the University of Alberta Van de Graaff accelerator. Gaseous argon target. γ rays were detected with a Ge(Li) detector (FWHM=3.5 keV at 1.33 MeV and 4.5 keV at 2.62 MeV) and a NaI crystal. Measured Eγ, Iγ, γ(θ), γγ(θ), γ(pol). Deduced levels, J, π, γ-ray branching ratios, mixing ratios.

Others:

1977St29: E=8.30 MeV. Measured Eγ, Iγ, nγ-coin, γγ-coin, γγ(θ). Deduced levels, J, π, γ-ray branching ratios.

1973Da18: E=5.30-6.10 MeV. Measured Eγ, Iγ, γγ-coin, γ(θ), γγ(θ). Deduced levels, J, π, γ-ray branching ratios, mixing ratios. See most details from this study in (α,nγ).

1968Ma09: E=5 MeV. Measured lifetime of 1643 level.

1959Ly68, 1959Ho96: E=2.55, 2.878 MeV. Measured lifetime of 30-keV level (1959Ly68). Two γ rays reported at 29.4 and 771 (1959Ho96).

^{40}K Levels

E(level)†	Jπ@	$T_{1/2}$#	Comments
0	4^-		
29.4	3^-	3.88 ns *35*	$T_{1/2}$: from γ(t) in 1959Ly68.
800	2^-	222 fs *21*	
891	5^-	0.73 ps *14*	
1643	0^+&	0.340 μs *7*	Jπ: from 1977St29. $T_{1/2}$: from γγ(t) in 1968Ma09.
1959	2^+&	0.513 ps *28*	
2047	2^-	0.319 ps *21*	
2069	3^-	0.73 ps *+24−15*	
2104	1^-	0.58 ps *8*	
2261	3^+&	69 fs *11*	
2290	1^+&	94 fs *12*	
2291	3^-	155 fs *17*	Jπ: from Adopted Levels. Others: 3^-,4 (1979Be41), (3,4) (1971We09), 4(3) (1970Tw01,1969Tw01).
2397	4^-	<38 fs	Additional information 1.
2419	2^-	0.73 ps *11*	Additional information 2.
2543	7^+		Jπ: from Adopted Levels. E(level): very weakly populated in (p,nγ) (1973Da18).
2576	2^+	155 fs *11*	Jπ: from 1979Be41. Others: (2,4) (1973Da18), (2^+,4^+) In 1971We09.
2626	0^-	215 fs *38*	
2731	1	<28 fs	
2747	$(2,3)^-$	123 fs *25*	
2756	2^+	<24 fs	Jπ: from Adopted Levels. Jπ=$2,3^-$ (1979Be41).
2786.6	3^+	<38 fs	Jπ: from Adopted Levels. Jπ=2^-,3 (1979Be41).
2787.4	$(3,4)^-$	<28 fs	Jπ: from Adopted Levels. Jπ=3,4,5 (1979Be41).
2808	$(1,2)^-$	0.16 ps *4*	
2879	6^+		populated weakly In (p,nγ) (1973Da18); also reported by 1977St29. Jπ: from adopted level. Other: Jπ=4,6 (1973Da18).
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^{40}Ar(p,nγ) 1979Be41,1971We09,1970Tw01 (continued)

^{40}K Levels (continued)

E(level)[†]	J$^{\pi}$[@]	Comments
4384.0 *3*	0$^+$	T=2 E(level),J$^{\pi}$: from 1977St29.

† From 1979Be41, unless otherwise noted.
‡ Rounded-off value from 1973Da18.
# From 1979Be41 using DSAM, unless otherwise noted. The uncertainties are purely statistical for values from 1979Be41 and a 15% systematic uncertainty due to slowing-down estimated in the evaluation of 1978En02 are added where used in Adopted Levels.
@ Above 30-keV level, the assignments are from γ(θ) data of 1979Be41 1971We09 and 1970Tw01.
& Positive parity from γ(pol) in 1970Tw01 and 1969Tw01.

γ(^{40}K)

E$_i$(level)	J$_i^{\pi}$	E$_{\gamma}$[†]	I$_{\gamma}$[‡]	E$_f$	J$_f^{\pi}$	Mult.[a]	δ[a]	Comments
29.4	3$^-$	29.4 *10*	100	0	4$^-$			E$_{\gamma}$: from 1959Ho96.
800	2$^-$	770	100	29.4	3$^-$	D(+Q)	0.00 *1*	Mult.,δ: from 1970Tw01. Other: 0.00 *3* (1971We09). A$_2$=−0.09 *1*, A$_4$=0.00 *1* (1970Tw01), A$_2$=−0.06 *1*, A$_4$=0.00 *1* (1971We09).
891	5$^-$	891	100	0	4$^-$	D+Q	+0.11 *5*	Mult.,δ: from 1971We09. A$_2$=−0.10 *1*, A$_4$=0.00 *1* (1971We09).
1643	0$^+$	843	18 *2*	800	2$^-$			Additional information 3.
		1613	82 *2*	29.4	3$^-$	[E3]		Additional information 4.
1959	2$^+$	1159	83 *2*	800	2$^-$	E1(+M2)	0.00 *5*	Additional information 5. Mult.: polarity from γ(pol) in 1969Tw01. δ: other: 0.00 *2* (1970Tw01), 0.00 *3* (1971We09). A$_2$=+0.33 *1*, A$_4$=+0.01 *1* (1979Be41), A$_2$=+0.29 *1*, A$_4$=0.00 *1* (1971We09), A$_2$=+0.40 *1*, A$_4$=0.00 *1*, POL=−0.76 *21* (1969Tw01).
		1929	17 *2*	29.4	3$^-$	D+Q	+0.11 *3*	Additional information 6. δ: other: +0.10 *4* (1970Tw01), +0.10 *5* (1971We09). A$_2$=−0.21 *1*, A$_4$=−0.01 *1* (1979Be41), A$_2$=−0.19 *2*, A$_4$=+0.01 *1* (1971We09), A$_2$=−0.23 *1*, A$_4$=0.00 *2* (1970Tw01).
2047	2$^-$	1247	40 *1*	800	2$^-$	D(+Q)	+0.05 *8*	Additional information 7. δ: or +0.66 *41*. Others: +0.13 *9* (1970Tw01), +0.10 *+5−10* (1971We09). A$_2$=+0.47 *3*, A$_4$=+0.03 *2* (1979Be41), A$_2$=+0.41 *15*, A$_4$=−0.04 *2* (1971We09), A$_2$=+0.48 *7*, A$_4$=+0.07 *7* (1970Tw01).
		2017	30 *1*	29.4	3$^-$	D(+Q)	0.00 *2*	Additional information 8. δ: or +0.09 *4*, −5.7. Others: +0.01 *2* (1970Tw01), +0.05 *3* or −9.0 *20* (1971We09). A$_2$=−0.12 *2*, A$_4$=−0.04 *2* (1979Be41), A$_2$=−0.11 *1*, A$_4$=+0.01 *1* (1971We09), A$_2$=−0.12 *1*, A$_4$=−0.01 *1* (1970Tw01).
		2047	30 *1*	0	4$^-$	Q		Additional information 9. A$_2$=+0.16 *3*, A$_4$=0.00 *4* (1970Tw01), A$_2$=+0.03 *1*, A$_4$=+0.02 *1* (1971We09).
2069	3$^-$	1178	3 *1*	891	5$^-$	Q		I$_{\gamma}$: from 1979Be41. Other: 6 *2* (1971We09). A$_2$=−0.18 *7*, A$_4$=0.00 *5* (1971We09). Note that sign of A$_2$ in 1971We09 seems in error since it is expected to be positive for a ΔJ=2 transition.

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^{40}Ar(p,nγ) 1979Be41,1971We09,1970Tw01 (continued)

γ(^{40}K) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[a]	δ[a]	Comments
2069	3⁻	1269	6 *2*	800	2⁻	D+Q	−0.20 *10*	I_γ: from 1979Be41. Others: 10 *1* (1970Tw01), 8 *2* (1971We09). δ: from 1970Tw01. Other:−0.05 *15* (1971We09). A_2=−0.69 *10*, A_4=+0.09 *12* (1970Tw01), A_2=−0.26 *10*, A_4=+0.05 *3* (1971We09).
		2039	50 *3*	29.4	3⁻	D+Q	+0.27 *10*	I_γ: from 1979Be41. Others: 55 *2* (1970Tw01), 46 *8* (1971We09). δ: from 1970Tw01. Other: +0.25 *15* (1971We09). A_2=+0.61 *4*, A_4=−0.01 *5* (1970Tw01), A_2=+0.51 *10*, A_4=−0.05 *2* (1971We09).
		2069	41 *5*	0	4⁻	D+Q	−0.07 *5*	I_γ: from 1979Be41. Others: 35 *1* (1970Tw01), 40 *8* (1971We09). δ: from 1970Tw01. Other: −0.07 *10* (1971We09). A_2=−0.03 *4*, A_4=+0.01 *5* (1970Tw01), A_2=0.00 *7*, A_4=0.00 *5* (1971We09).
2104	1⁻	1304	30 *2*	800	2⁻	D+Q	+0.30 *6*	Additional information 10. δ: from 1970Tw01. Others: +1.0 *5* (1971We09); +0.05, −0.53, −1, −4.3 (1979Be41). A_2=−0.22 *2*, A_4=0.00 *3* (1979Be41), A_2=−0.12 *1*, A_4=0.00 *1* (1970Tw01), A_2=−0.17 *5*, A_4=−0.02 *1* (1971We09).
		2074	70 *2*	29.4	3⁻	Q		Additional information 11. A_2=+0.01 *2*, A_4=+0.01 *2* (1970Tw01), A_2=0.00 *5*, A_4=0.00 *5* (1971We09).
2261	3⁺	2231	81 *2*	29.4	3⁻	E1(+M2)	+0.01 *9*	Additional information 12. Mult.: polarity from γ(pol) in 1970Tw01. δ: others: +0.02 *5* (1970Tw01), 0.00 *10* (1971We09). A_2=+0.44 *3*, A_4=−0.03 *2* (1979Be41), A_2=+0.40 *3*, A_4=−0.07 *2* (1971We09), A_2=+0.41 *1*, A_4=−0.01 *1*, POL=−0.57 *30* (1970Tw01).
		2261	19 *2*	0	4⁻	D(+Q)	−0.05 *6*	Additional information 13. δ: others: −0.04 *6* (1970Tw01), 0.00 *5* (1971We09). A_2=−0.05 *3*, A_4=−0.04 *3* (1979Be41), A_2=−0.09 *2*, A_4=0.00 *1* (1971We09), A_2=−0.10 *2*, A_4=+0.02 *3* (1970Tw01).
2290	1⁺	331	4 *2*	1959	2⁺			
		647	60 *2*	1643	0⁺	D		I_γ: Others: 65 *2* (1970Tw01), 63 *4* (1971We09). A_2=−0.10 *1*, A_4=+0.05 *2* (1979Be41), A_2=−0.12 *3*, A_4=0.00 *5* (1971We09), A_2=−0.15 *3*, A_4=+0.06 *4* (1970Tw01).
		1490	36 *3*	800	2⁻	D+Q	+0.14	I_γ: Others: 35 *2* (1970Tw01), 37 *4* (1971We09). δ: others: >+0.3 (1970Tw01), +0.15 *15* or <−3.0 (1971We09), −0.02 *5* (1973Da18). A_2=−0.05 *2*, A_4=−0.01 *2* (1979Be41), A_2=−0.01 *1*, A_4=0.00 *1* (1973Da18), A_2=−0.04 *3*, A_4=+0.10 *1* (1971We09), A_2=−0.09 *3*, A_4=−0.01 *5* (1970Tw01).
2291	3⁻	1400	16 *2*	891	5⁻			A_2=+0.13 *11*, A_4=−0.11 *12* (1973Da18).
		2291	84 *2*	0	4⁻	D+Q	−0.8 *+3−5*	δ: for J=3. Others: −1.0 *3* (1970Tw01,1971We09), −0.6 *+1−8* (1973Da18). A_2=+0.50 *3*, A_4=−0.07 *4* (1979Be41), A_2=+0.39 *4*, A_4=−0.03 *4* (1973Da18), A_2=+0.41 *5*, A_4=−0.10 *2* (1971We09), A_2=+0.55 *4*, A_4=−0.04 *5* (1970Tw01).
2397	4⁻	2367	71 *2*	29.4	3⁻	D+Q	+0.25 *4*	δ: other: +0.27 *6* (1973Da18). A_2=+0.21 *3*, A_4=−0.07 *3* (1979Be41), A_2=+0.14 *4*, A_4=+0.07 *4* (1973Da18).
		2397	29 *2*	0	4⁻	D+Q	−0.32 *12*	δ: +2.4 *5* (1973Da18). A_2=+0.19 *5*, A_4=−0.08 *6* (1979Be41), A_2=+0.08 *4*, A_4=−0.23 *4* (1973Da18).

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^{40}Ar(p,nγ) 1979Be41,1971We09,1970Tw01 (continued)

γ(^{40}K) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[a]	δ[a]	Comments
2419	2⁻	1619	79 *2*	800	2⁻	D+Q		I_γ: other: 90 *3* (1970Tw01). δ: −0.03 *13* or +2.2 *7*. Others: +0.07 *5* or +1.8 *2* (1973Da18), +0.05 *10* or +2.0 *6* (1970Tw01). A_2=+0.32 *3*, A_4=−0.01 *2* (1979Be41), A_2=+0.39 *1*, A_4=−0.03 *1* (1973Da18), A_2=+0.34 *3*, A_4=+0.01 *4* (1970Tw01).
		2389	15 *2*	29.4	3⁻	D+Q	−0.8 *5*	I_γ: other: 5 *3* (1970Tw01). δ: from 1973Da18. Other: −0.25 or −2.6 (1979Be41). A_2=+0.22 *3*, A_4=+0.03 *3* (1979Be41), A_2=+0.31 *3*, A_4=−0.01 *3* (1973Da18).
		2419	6 *1*	0	4⁻	Q(+O)	+0.17 *28*	I_γ: other: 5 *3* (1970Tw01). δ: other: 0.00 *+15−30* (1973Da18). A_2=+0.06 *6*, A_4=−0.13 *7* (1979Be41), A_2=+0.13 *6*, A_4=+0.05 *6* (1973Da18).
2543	7⁺	1652[#]	88[#] *2*	891	5⁻			δ: +1.0 *+2−4* for J=5, 0.00 *13* for J=7 (1973Da18). A_2=+0.41 *6*, A_4=−0.17 *7* for J=5, A_2=+0.10, A_4=+0.01 *9* for J=7 (1973Da18).
		2542[#]	12[#] *2*	0	4⁻	[E3]		
2576	2⁺	2546	100	29.4	3⁻	D(+Q)		δ: +0.03 *+7−4* or −7.6 *+13−20*. Others: +0.08 *3* (1970Tw01); 0.00 *3* (1973Da18). For J=4, δ=+0.06 *2* (1970Tw01); +0.09 *4* (1973Da18). A_2=−0.13 *1*, A_4=−0.01 *1* (1979Be41), A_2=−0.13 *2*, A_4=+0.02 *1* (1973Da18), A_2=−0.21 *3*, A_4=+0.06 *4* (1970Tw01).
2626	0⁻	522	69 *2*	2104	1⁻	D		A_2=−0.01 *4*, A_4=+0.03 *4* (1979Be41).
		1826	31 *2*	800	2⁻	Q		A_2=−0.09 *14*, A_4=+0.21 *16* (1979Be41).
2731	1	772[@b]		1959	2⁺			
		1088	94 *4*	1643	0⁺	D		I_γ: other: 73 *9* (1977St29). See comment for 772γ. A_2=−0.13 *4*, A_4=−0.03 *5* (1979Be41), A_2=−0.33 *2*, A_4=−0.01 *2* (1973Da18).
		1931	6 *4*	800	2⁻			I_γ: other: 4 *3* (1977St29).
2747	(2,3)⁻	678	<3	2069	3⁻			
		788	4 *1*	1959	2⁺			
		2717	63 *3*	29.4	3⁻	D+Q		δ: 0.0 *1* for J=2, −0.19 *14* or −3.4+13-29 for J=3. Other: −1.2 *+8−5* for J=2, −0.09 *+18−9* for J=3, +0.36 *7* for J=4 (1973Da18). A_2=+0.30 *3*, A_4=−0.01 *4* (1979Be41), A_2=+0.33 *4*, A_4=+0.07 *4* (1973Da18).
		2747	33 *3*	0	4⁻	D+Q		δ: −0.87 *+5−16* for J=2, −0.18+11-18 for J=3. Other: −0.09 *+12−8* for J=2, −0.27 *8* or −2.8 *+5−8* for J=3, −0.27 *+15−9* for J=4 (1973Da18). A_2=+0.12 *5*, A_4=+0.02 *5* (1979Be41), A_2=+0.16 *13*, A_4=+0.07 *13* (1973Da18).
2756	2⁺	1956	66 *2*	800	2⁻	D+Q		δ: +0.19 *+19−26* or −2.1 *+13−7* (1979Be41). Other: −0.02 *7* or −1.7 *+5−3* for J=2 (1973Da18). For J=3, δ=+0.45 *11* (1979Be41), +0.36 *5* (1973Da18). A_2=+0.38 *4*, A_4=+0.01 *4* (1979Be41), A_2=+0.34 *2*, A_4=+0.01 *2* (1973Da18).
		2726	34 *2*	29.4	3⁻	D+Q		δ: 0.00 *12* or −4.7 *+20−144* (1979Be41). Other: 0.00 *3* (1973Da18). For J=3, δ=−0.47 *+9−23* or +5.1 *+63−24* (1979Be41); −0.52 *+8−12* (1973Da18). A_2=−0.02 *3*, A_4=−0.11 *4* (1979Be41), A_2=−0.10 *2*, A_4=−0.02 *2* (1973Da18).
2786.6	3⁺	828	22 *3*	1959	2⁺	D+Q	−0.09 *7*	δ: from 1973Da18. A_2=−0.44 *9*, A_4=−0.11 *9* (1973Da18).
		2756	78 *3*	29.4	3⁻	D+Q		δ: +0.03 *14* or +1.1 *4* (1979Be41). Other: +0.09 *11*

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^{40}Ar(p,nγ) 1979Be41,1971We09,1970Tw01 (continued)

γ(^{40}K) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[a]	δ[a]	Comments
								(1973Da18). For J=2, δ=−0.81 *34* (1979Be41). A_2=+0.43 *2*, A_4=−0.06 *2* (1979Be41), A_2=+0.43 *2*, A_4=0.00 *2* (1973Da18).
2787.4	(3,4)$^-$	496	40 *8*	2291	3$^-$			
		1896	19 *8*	891	5$^-$			
		2786	41 *8*	0	4$^-$	D+Q		δ: >+0.09 or <+19 for J=3, <−0.81 or >+4.9 for J=4, −0.19+19-34 or −1.8 *4* for J=5. A_2=−0.58 *13*, A_4=−0.11 *4* (1979Be41).
2808	(1,2)$^-$	2008[#]	100[#]	800	2$^-$			δ: −0.09 to −2.14 for J=1; −0.27 *5* or +5.7 *+24−14* for J=2 (1973Da18). A_2=+0.07 *2*, A_4=+0.02 *2* (1973Da18).
2879	6$^+$	336[#]	62[#] *4*	2543	7$^+$			δ<0.10 (1973Da18).
		1987[#]	38[#] *4*	891	5$^-$	D(+Q)	−0.09 *9*	δ: from 1973Da18. Other: 0.0 *2* for J=4 (1973Da18). A_2=−0.05 *14*, A_4=−0.06 *15* (1973Da18).
3147	1	1503[#]	33[#] *5*	1643	0$^+$	D		Mult.: from 1973Da18. A_2=−0.37 *9*, A_4=−0.19 *10* (1973Da18).
		2347[#]	67[#] *5*	800	2$^-$	D+Q	+0.1 *2*	δ: from 1973Da18. A_2=−0.04 *3*, A_4=−0.08 *3* (1973Da18).
4384.0	0$^+$	1653	24[&] *3*	2731	1			(1653γ)(1087γ)(θ): A_2=+0.42 *19* (1977St29).
		2094	76[&] *3*	2290	1$^+$			(2094γ)(646γ)(θ): A_2=+0.42 *10* (1977St29).

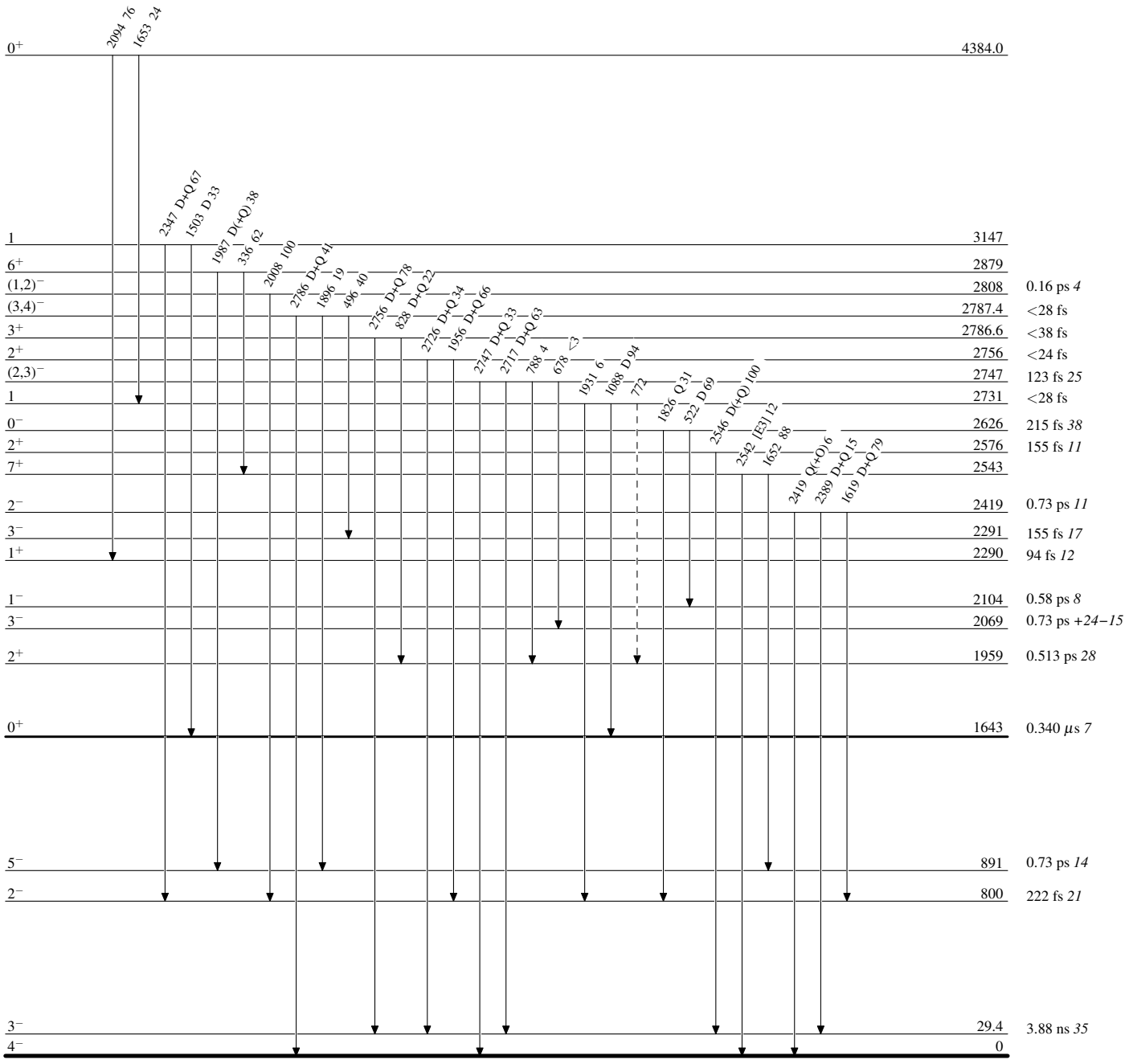
[†] From level-energy differences.
[‡] From weighted average of values from 1979Be41, 1970Tw01 and 1971We09 if available for transitions from levels up to 2261 and from 1979Be41 after that, unless otherwise noted.
[#] From 1973Da18. The energies are rounded values. The precise γ-ray energies and branching ratios given by 1973Da18 are most likely from their (α,nγ) experiment.
[@] Reported only by 1977St29 with Iγ=23 *8*. With this large intensity, this γ ray should have been seen in the high-resolution (n,γ) experiment where only one γ ray at 770.3053 is reported. Thus this γ ray is considered as suspect by the evaluator.
[&] From 1977St29.
[a] From 1979Be41 based on measured γ(θ), unless otherwise noted.
[b] Placement of transition in the level scheme is uncertain.

^{40}Ar(p,nγ) 1979Be41,1971We09,1970Tw01 Legend

Level Scheme

Intensities: % photon branching from each level

- - - - - - ► γ Decay (Uncertain)

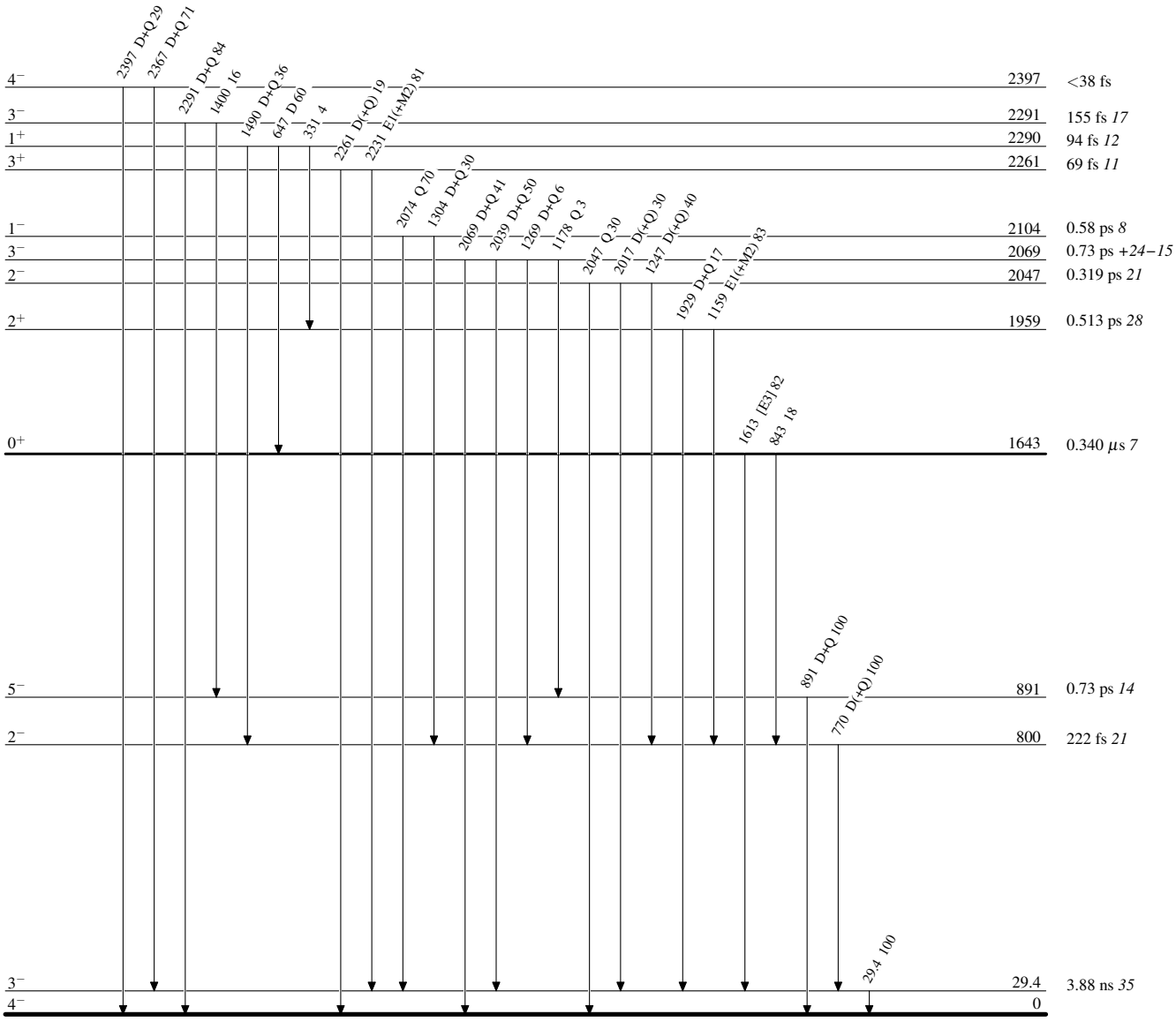


$^{40}_{19}K_{21}$

^{40}Ar(p,nγ) 1979Be41,1971We09,1970Tw01

Level Scheme (continued)

Intensities: % photon branching from each level



$^{40}_{19}K_{21}$