Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 157, 1 (2019)	15-Apr-2019

Q(β^-)=1038.06 *30*; S(n)=9333.4 *9*; S(p)=7949.2 *4*; Q(α)=−9887.7 *8* 2017Wa10
S(2n)=20889.0 *11*, S(2p)=19298 *5* (2017Wa10).

Other measurements:
Isotopic assignment and natural abundance: 1949-Hess: Phys. Rev. 76, 1717; 1949-Leland, Phys. Rev. 76, 1722.
1979Da07: ^{48}Ti(^{16}O,^{12}Cpnγ), E^{16}O=120 MeV. Measured (^{12}C)γ-coin using Ge(Li) at θ=−90°, and Si telescope at θ=+15°. Deduced yields.
Mass measurements: 2017Ka53, 1994Wa17, 1972De39.
1998Co14: measured hyperfine structure measurements for g.s. using Crossed beam laser spectroscopy technique, deduced isotope shift.
Theory references: consult the NSR database (www.nndc.bnl.gov/nsr/) for 26 primary references dealing with various aspects of nuclear structure.

^{50}V Levels

Cross Reference (XREF) Flags

A	^{47}Ti(α,pγ)	G	^{50}Ti(p,n),(p,nγ)	M	^{51}V(d,t)
B	^{48}Ti(t,nγ)	H	^{50}Ti(^{3}He,t)	N	^{51}V(^{3}He,α)
C	^{48}Ti(^{3}He,p),(^{3}He,pγ)	I	^{50}V(p,p′)	O	^{52}Cr(p,^{3}He)
D	^{48}Ti(α,npγ)	J	^{50}V(d,d′)	P	^{52}Cr(d,α)
E	^{49}Ti(p,γ):resonances	K	Coulomb excitation		
F	^{49}Ti(^{3}He,d)	L	^{51}V(p,d)		

E(level)[†]	J$^\pi$[#]	T$_{1/2}$[‡]	XREF	Comments
0.0	6$^+$	2.65×10^{17} y *+16−18*	ABCDEFGHIJKLMNOP	%ε+%β^+=99.3 *7*; %β^-=0.7 *7* μ=+3.3456889 *14* (1981Lu04,2014StZZ) Q=+0.21 *4* (1982Bl03,1979Er04,2016St14) J$^\pi$: spin from hyperfine structure in paramagnetic resonance (1952Ba63,1953Ki41); parity from L(^{3}He,d)=L(d,t)=3; also L(d,α)=L(p,^{3}He)=6 from 0$^+$. T$_{1/2}$: from T$_{1/2}$(ε)=2.67×10^{17} y *+16−18* (68% confidence interval) and T$_{1/2}$(β^-)>1.9×10^{19} y (90% confidence interval) in 2019La09. Others: T$_{1/2}$(ε)=2.29 ×10^{17} y *25* from 123 net counts for the 1588 keV γ transition of the ^{50}Ti daughter nuclide taking into account detection efficiency and natural abundance of ^{50}V and T$_{1/2}$(β^-)>1.7×10^{18} y (2011Do08); T$_{1/2}$(ε)=1.71×10^{17} y *26* and T(β^-)=8.2×10^{17} y *+131−31* (1989Si07, this value was an average of 2.05×10^{17} y *49* measured by 1989Si07, their previous value of 1.2×10^{17} y *+8−4* in 1985Si02, and 1.5×10^{17} y *3* by 1984Al10). T$_{1/2}$(β^-) was measured by 1989Si07 as 8.2×10^{17} y *+131−31*, based on analysis of intensity of 783γ (from 783,2$^+$ level in ^{50}Cr), in a complex γ spectrum, contributed by several activities near 772-790 keV range, whereas 1984Al10 measured T$_{1/2}$(β^-)>4.3×10^{17} y from non-observation of 783γ in ^{50}Cr. Total half-life implied from the ε and β^- partial half-lives in 1989Si07 was 1.42×10^{17} y *23*, in disagreement with >2.0×10^{17} y from 2011Do08. Theoretical nuclear matrix elements (NMEs) and partial half-lives calculated by 2014Ha33

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)[†]	J$^{\pi}$[#]	T$_{1/2}$[‡]	XREF	Comments
				using shell model. Additional information 1. μ: NMR (1981Lu04) using ^{2}H and ^{1}H standards. Others: 1954Wa37, 1953Ki41, 1952Ba63. Q: value from 1982Bl03 (NMR; deduced from measured Q(^{50}V)/(Q(^{51}V); also 1981Bl14); sign from 1979Er04 (atomic-beam laser double resonance detection). Evaluated by 2008Py02 and 2016St14. Others: 0.21 *4* (1981Lu04,NMR) using ^{51}V standard; 1981Ta12 (NMR technique); 1979Sk06 (NMR method, deduced quadrupole interaction, and Knight shift). No polarization correction included. %ε+%β^+: from >98.6%, deduced from T$_{1/2}$($\varepsilon+\beta^+$)=2.67×10^{17} y *+16−18* (68% confidence interval) and T$_{1/2}$(β^-)>1.9×10^{19} y (90% confidence interval) in 2019La09. Others: ε>92.9 measured by 2011Do08 from observation of no β^- activity through the non-observation of 783γ in ^{50}Cr; %ε=83 *11* from 1989Si07 is in disagreement.
226.21 *24*	5$^+$	<3.7 ps	ABCDEFGHIJKLMNOP	B(E2)↑=0.0118 *10* J$^{\pi}$: M1(+E2) 226.3g to 6$^+$; L(p,^{3}He)=L(d,α)=4 from 0$^+$. B(E2) from Coulomb excitation. T$_{1/2}$: other: <11 ps from DSAM in (p,nγ).
320.30 *24*	4$^+$	54 ps *+19−14*	AB DEFGhIJKLMNOP	XREF: h(340). J$^{\pi}$: spin=4 from $\gamma(\theta)$ in (α,npγ); L(p,^{3}He)=4 from 0$^+$. T$_{1/2}$: from B(E2)↑=0.0031 *5* in Coulomb excitation and Adopted γ branching ratio. Other: <320 ps (DSAM in (p,nγ).
355.8 *4*	3$^+$	<3 ns	ABCDEFGhIJ LMNOP	XREF: B(347)E(347)h(340)O(362). J$^{\pi}$: L(d,α)=2 from 0$^+$; L(p,^{3}He)=2+4 from 0$^+$; 35.1γ to 4$^+$ can only have mult=D; 129γ to 5$^+$. T$_{1/2}$: from DSAM in (p,nγ).
388.8 *4*	2$^+$		A CD FGHI LMNOP	XREF: H(400). J$^{\pi}$: L(p,^{3}He)=2 from 0$^+$; L(^{3}He,d)=1+3 from 7/2$^-$; M1 943.3γ from 1$^+$.
836.4 *5*	5$^+$	38 fs *14*	A D FGhIJ LMNOP	XREF: h(880). J$^{\pi}$: M1 516.1γ to 4$^+$ and 836γ to 6$^+$; L(^{3}He,d)=1+3 from 7/2$^-$; L(p,^{3}He)=L(d,α)=4 from 0$^+$. T$_{1/2}$: weighted average of 76 fs *28* in (p,nγ) and 33 fs *10* in (α,pγ).
909.8 *4*	(7)$^+$	43 fs *8*	A cD fGhij lmnOP	XREF: h(880). J$^{\pi}$: M1+E2 909.7γ to 6$^+$; L(p,^{3}He)=L(d,α)=6 from 0$^+$; M1+E2 814.6γ from (8)$^+$. T$_{1/2}$: other: 0.08 ps *+8−4* from DSAM in (α,pnγ).
910.1 *4*	4$^+$	70 fs *9*	A cD fGhij lmn	XREF: h(880). J$^{\pi}$: M1+E2 683.9γ to 5$^+$; spin=4 from $\gamma(\theta)$ in (p,nγ). T$_{1/2}$: weighted average of 76 fs *9* in (p,nγ) and 60 fs *12* in (α,pγ).
1301.7 *5*	2$^+$	46 fs *8*	A CD FGHI LMNOP	XREF: H(1270)L(1290). J$^{\pi}$: M1+E2 912.8γ to 2$^+$; spin=2 from $\gamma(\theta)$ in (p,nγ); L(p,^{3}He)=2 from 0$^+$. T$_{1/2}$: weighted average of 52 fs *11* in (p,nγ) and 43 fs *8* in (α,pγ).
1332.2 *6*	1$^+$	17 fs *6*	A C FG I LMNOP	J$^{\pi}$: L(^{3}He,p)=L(p,^{3}He)=0+2 from 0$^+$; spin=1 from $\gamma(\theta)$ in (p,nγ). T$_{1/2}$: from DSAM in (p,nγ). Other: <10 fs from DSAM in (α,pγ).
1402.0 *4*	3$^+$	>0.8 ps	A CD FGHI M OP	J$^{\pi}$: L(^{3}He,p)=2 from 0$^+$; spin=3 from $\gamma(\theta)$ in (p,nγ); 1013.4γ M1(+E2) to 2$^+$; 1081.6γ and 493γ to 4$^+$ $\gamma(\theta)$ and polarization measurements in (p,nγ) and γ to a level with J^{π}=1$^+$,2$^+$,3$^+$.
1495.5 *5*	1$^+$	45 fs *7*	A C FG M OP	J$^{\pi}$: L(^{3}He,p)=L(d,α)=0+2 from 0$^+$; spin=1 from $\gamma(\theta)$ in (p,nγ); 1106.7γ M1+E2 to 2$^+$. T$_{1/2}$: weighted average of 51 fs *7* in (p,nγ) and 38 fs *8* in (α,pγ).
1518.5 *5*	2$^+$	148 fs *22*	A C FG I MNOP	J$^{\pi}$: L(^{3}He,p)=L(d,α)=2 from 0$^+$; spin=2 from $\gamma(\theta)$ in (p,nγ);

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)[†]	J$^{\pi}$[#]	T$_{1/2}$[‡]	XREF	Comments
				M1+E2 1129.9γ to 2$^+$. T$_{1/2}$: weighted average of 190 fs *35* in (p,nγ) (1974Ri13) and 139 fs *14* in (α,pγ). Other: 58 fs *16* from DSA of 1130γ and 69 fs *14* from DSA of 1163γ in 1974Ri02 from (p,nγ) are in disagreement.
1562.1 *4*	2$^+$	0.7 ps *+4−2*	A C G I NOP	J$^{\pi}$: spin=2 from $\gamma(\theta)$ in (p,nγ); 1173.2γ M1(+E2) to 2$^+$. But L(^{3}He,α)=0 from 7/2$^-$ gives 3$^+$,4$^+$. T$_{1/2}$: others: from DSAM in (p,nγ): >0.38 ps (1974Ri13), 3.7 ps *33* from DSA of 1172γ and 0.16 ps *12* from DSA of 1206γ (1974Ri02).
1677.4 *4*	3$^+$	>0.32 ps	A CD FG M OP	J$^{\pi}$: L(p,^{3}He)=2+4 and L(d,α)=2 from 0$^+$; T$_{1/2}$: other: >0.34 ps from DSAM in (p,nγ).
1700.3 *11*	(3$^+$,4$^+$,5$^+$)	0.35 ps *10*	A c f i mn p	XREF: c(1703)i(1701)m(1701)n(1715). J$^{\pi}$: L(^{3}He,p)=4 for a level at 1703 *6*.
1703.1 *21*	(3$^+$,4$^+$,5$^+$)		c fG i mn p	XREF: c(1703)i(1701)m(1701)n(1715). J$^{\pi}$: L(^{3}He,p)=4 for a level at 1703 *6*.
1719.3 *15*	(1$^+$,2,3,4$^+$)		c G ij mn	XREF: c(1729)i(1724)j(1725)m(1724)n(1715). J$^{\pi}$: 1331γ to 2$^+$ and 1363γ to 3$^+$.
1724.5 *4*	(8)$^+$	0.14 ps *6*	A D ij	XREF: D(1724.5)i(1724)j(1725). J$^{\pi}$: ΔJ=2, E2 1724.5γ to 6$^+$; γ excitation in (α,npγ). T$_{1/2}$: other: 0.37 ps +42-14 from DSAM in (α,pnγ).
1725.3 *21*	(3$^+$,4,5,6$^+$)		cD G ij mn	XREF: c(1729)D(1724.0)i(1724)j(1725)m(1724)n(1715). J$^{\pi}$: 1405γ to 4$^+$ and possible 1499γ to 5$^+$.
1752.5 *7*	3$^+$,4$^+$,5$^+$	>1.3 ps	A fg Ij lMn P	XREF: M(1753)P(1759). J$^{\pi}$: 1397γ to 3$^+$ and 1526γ to 5$^+$; L(d,α)=4 from 0$^+$.
1761.6 *8*	(4$^+$,5$^+$)	<5 fs	A fg ij lmn p	XREF: m(1761)p(1766). J$^{\pi}$: 851γ to 4$^+$ and 1762γ to 6$^+$; L(d,α)=4 for a level at 1766 *8* could be for 1761.5+1762.2.
1762.4 *11*	(3$^+$,4$^+$,5$^+$)		D fg ij lmn p	XREF: m(1761)p(1766). J$^{\pi}$: L(d,α)=4 for a level at 1766 *8* could be for 1761.5+1762.2.
1812.8 *15*	(2,3)$^+$	>2.9 ps	A FG MNOP	J$^{\pi}$: L(p,^{3}He)=L(d,α)=2 from 0$^+$; possible γ to 4$^+$.
1881.4 *11*	(4$^+$,5$^+$,6$^+$)	15 fs *8*	A I M	J$^{\pi}$: 1045γ possible (M1) to 5$^+$.
1936 *5*	(0 to 5)$^+$		C G I MNOP	E(level): weighted average of 1934 *8* from (^{3}He,d), 1936 *5* from (p,n), 1937 *7* from (p,p′) and 1935 *6* from (d,α). J$^{\pi}$: L(^{3}He,α)=L(p,d)=L(d,t)=3 from 7/2$^-$; L(d,α)=(4,0) from 0$^+$.
1955 *4*	1$^+$		C FG I LMNOP	XREF: F(?)L(1970). E(level): weighted average of 1953 *5* from (p,n), 1957 *7* from (p,p′) and 1956 *4* from (d,α). J$^{\pi}$: L(p,^{3}He)=0+2 from 0$^+$. Also L(d,t)=L(p,d)=L(^{3}He,α)=3. L(^{3}He,d)=0 giving 3$^-$,4$^-$ is inconsistent, but level in this reaction is uncertain.
1984?	(0 to 7)$^+$		N	J$^{\pi}$: L(^{3}He,α)=3 from 7/2$^-$.
2038 *4*	3$^+$,4$^+$,5$^+$		C FG I MNOP	E(level): weighted average of 2037 *8* from (^{3}He,p), 2038 *10* from (^{3}He,d), 2037 *5* from (p,n), 2038 *7* from (p,p′) and 2038 *4* from (d,α). J$^{\pi}$: L(p,^{3}He)=4 from 0$^+$; also L(d,α)=(4) from 0$^+$. But 3$^-$,4$^-$ from L(^{3}He,d)=0 is inconsistent. Note that level in (^{3}He,d) is not seen in one of the (^{3}He,d) studies.
2111 *4*	3$^+$,4$^+$,5$^+$		C F IJ MNOP	E(level): weighted average of 2103 *10* from (^{3}He,p), 2109 *10* from (^{3}He,d), 2112 *6* from (p,p′), 2112 *6* from (d,d′), and 2112 *4* from (d,α). J$^{\pi}$: L(p,^{3}He)=4 from 0$^+$; L(d,t)=3+1 from 7/2$^-$.
2132 *7*	3$^+$,4$^+$,5$^+$		C F I LMNO	E(level): weighted average of 2131 *8* from (^{3}He,p), 2132 *10* from (^{3}He,d), 2133 *7* from (p,p′). Other: 2130 *20* (p,d). J$^{\pi}$: L(^{3}He,p)=4 from 0$^+$; L(^{3}He,d)=L(^{3}He,α)=1 from 7/2$^-$.

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)†	Jπ#	T1/2‡	XREF	Comments
2162 *5*	3⁻,4⁻		C F I MNOP	E(level): weighted average of 2168 *10* from (^{3}He,p), 2157 *10* from (^{3}He,d), 2162 *6* from (p,p′), and 2162 *5* from (d,α). Jπ: L(^{3}He,α)=L(^{3}He,d)=0 from 7/2⁻.
2313.3 *23*	2⁺,3⁺,4⁺,5⁺		D F IJ MNOP	Jπ: L(^{3}He,d)=1 from 7/2⁻. L(p,^{3}He)=(4),(6) from 0⁺ gives (3⁺,4⁺,5⁺,6⁺,7⁺).
2344 *5*	3⁺,4⁺,5⁺		C F IJ LMN P	E(level): weighted average of 2350 *8* from (^{3}He,p), 2342 *10* from (^{3}He,d), 2344 *7* from (p,p′), 2341 *6* from (d,d′), 2340 *20* from (p,d), and 2345 *5* from (d,α). Jπ: L(^{3}He,p)=4 from 0⁺; also L(d,t)=1(+3) from 7/2⁻.
2398 *8*	(2 to 5)⁺		F I MN P	E(level): weighted average of 2394 *10* from (^{3}He,d), 2399 *8* from (p,p′), and 2400 *10* from (d,α). Jπ: L(d,t)=1+(3) from 7/2⁻. 3⁻,4⁻ from L(^{3}He,α)=0 is inconsistent, but there is some uncertainty about level in (^{3}He,α).
2424 *4*	3⁻,4⁻		F ij MnOP	E(level): weighted average of 2427 *10* from (^{3}He,d) and 2424 *4* from (d,α). Jπ: L(d,t)=L(^{3}He,d)=0 from 7/2⁻; also L(p,^{3}He)=L(d,α)=3.
2425 *8*	1⁺		C ij n	E(level): from (^{3}He,p). Other: 2414 *10* from Eγ. Jπ: L(^{3}He,p)=0+2 from 0⁺.
2455 *5*	3⁺,4⁺,5⁺		C F I MN P	E(level): weighted average of 2453 *10* from (^{3}He,p), 2454 *10* from (^{3}He,d), 2456 *7* from (p,p′), and 2455 *5* from (d,α). Jπ: L(d,α)=4 from 0⁺; also L(^{3}He,d)=1 and L(d,t)=3 from 7/2⁻. 3⁻,4⁻ from L(^{3}He,α)=0 is inconsistent, but L(^{3}He,α)=3 is also suggested in one of the (^{3}He,α) studies.
2478.2 *7*	(9)⁺	0.24 ps *+28−14*	D	Jπ: ΔJ=1, M1+E2 753.7γ to (8)⁺. T1/2: from DSAM in (α,npγ).
2482 *6*	(0 to 7)⁺		C f IJ Mn P	XREF: P(2489). E(level): weighted average of 2478 *10* from (^{3}He,p), 2481 *6* from (p,p′), 2481 *6* from (d,d′), and 2489 *8* from (d,α). Jπ: L(^{3}He,d)=L(d,t)=3 from 7/2⁻.
2495 *7*	(0 to 7)⁺		f I Mn P	XREF: P(2499). E(level): weighted average of 2492 *7* from (p,p′) and 2499 *8* from (d,α). Jπ: L(d,t)=3+(0) from 7/2⁻.
2511 *5*	3⁻,4⁻		C I lMNOP	XREF: l(2530). E(level): weighted average of 2513 *10* from (^{3}He,p), 2512 *6* from (p,p′), and 2510 *5* from (d,α). Jπ: L(d,t)=L(^{3}He,α)=0 from 7/2⁻.
2532 *10*	1⁺		C i O	E(level): from (^{3}He,p). Jπ: L(p,^{3}He)=0+2 from 0⁺; also L(^{3}He,p)=2 from 0⁺.
2533 *5*	3⁻,4⁻		F i lMN P	XREF: l(2530). E(level): weighted average of 2532 *10* from (^{3}He,p) and 2534 *5* from (d,α). Jπ: L(^{3}He,d)=0 from 7/2⁻; also L(d,t)=L(^{3}He,α)=2 from 7/2⁻ and L(d,α)=3,5 from 0⁺.
2597 *5*	3⁻,4⁻		F I MNOP	E(level): weighted average of 2595 *10* from (^{3}He,d), 2600 *7* from (p,p′), and 2596 *5* from (d,α). Jπ: L(d,t)=L^{3}He,α)=0 from 7/2⁻.
2652 *8*	(2 to 5)⁺		F I lMN P	XREF: l(2690). E(level): weighted average of 2657 *10* from (^{3}He,d), 2655 *9* from (p,p′), and 2647 *8* from (d,α). Jπ: L(^{3}He,d)=L(^{3}He,α)=1 and L(d,t)=3+1 from 7/2⁻.
2736 *5*	(3,4,5)⁺		C I lMNOP	XREF: l(2690). E(level): weighted average of 2735 *12* from (^{3}He,p), 2738 *8* from (p,p′), and 2735 *5* from (d,α).

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)†	Jπ#	XREF	Comments
			Jπ: L(d,α)=4,(6) from 0+; also L(d,t)=3 from 7/2−. But L(3He,α)=2 from 7/2− is inconsistent.
2762 *6*	(5,6,7)+	I MN P	E(level): weighted average of 2763 *6* from (p,p′) and 2760 *10* from (d,α). Jπ: L(d,α)=6,(4) from 0+; also L(d,t)=3 from 7/2−. But L(3He,α)=0 from 7/2− is inconsistent.
2791 *5*	1+,2+,3+	C I MnOP	XREF: n(2802). E(level): weighted average of 2782 *10* from (3He,p), 2792 *7* from (p,p′), and 2792 *5* from (d,α). Jπ: L(p,3He)=L(d,α)=2 from 0+; also L(d,t)=L(3He,α)=3 from 7/2−.
2816 *8*	1+	C F I Mn P	XREF: n(2802). E(level): weighted average of 2816 *8* from (3He,p), 2815 *10* from (3He,d), 2815 *10* from (p,p′), and 2818 *8* from (d,α). Jπ: L(3He,p)=0+2 from 0+; also L(d,α)=2; L(3He,d)=1; L(d,t)=(3+1). 1481 and 1509 γs placed from 2816 state in (3He,pγ), but 1493 and 1499 γs from 1725 and 1811 states, respectively, in (p,nγ).
2828 *6*		I M	E(level): from (p,p′).
2842	(5+,6+,7+)	D I M P	E(level): from Eγ. 2850 *8* from weighted average of 2849 *8* from (p,p′) and 2850 *8* from (d,α). Jπ: L(d,α)=(6) from 0+; also L(d,t)=(3) from 7/2−.
2877 *8*	3−,4−	C MNOP	E(level): weighted average of 2876 *10* from (3He,p), and 2878 *8* from (d,α). Jπ: L(3He,α)=0 and L(d,t)=0+2 from 7/2−; also L(d,α)=3 from 0+.
2893?	(1 to 6)−	N	Jπ: L(3He,α)=2 from 7/2−.
2928 *5*	(0 to 7)+	C F I MNOP	E(level): weighted average of 2922 *10* from (3He,p), 2935 *10* from (3He,d), 2931 *8* from (p,p′), and 2923 *10* from (d,α). Jπ: L(d,t)=3; also L(3He,d)=3 for a possible level in that reaction. 3−,4− from L(3He,α)=0 is inconsistent but level population is not certain. (2−) from L(p,3He)=(1+3); (3 to 7)(+) from L(d,α)=(4,6) are also inconsistent, but all these L values are tentative.
2957 *9*	(1 to 6)−	I MN	E(level): weighted average of 2958 *9* from (p,p′) and 2955 *10* from (d,α). Jπ: L(3He,α)=2 from 7/2−. L(d,α)=(4) from 0+ is inconsistent.
2966 *9*	(3 to 5)+	F I M P	XREF: P(2955). E(level): weighted average of 2967 *10* from (3He,d) and 2965 *9* from (p,p′). Jπ: L(3He,d)=1 and L(d,α)=(4) from 0+.
2991 *6*	1+	C F I MNOP	E(level): weighted average of 2989 *10* from (3He,p), 2995 *10* from (3He,d), 2992 *9* from (p,p′), and 2990 *6* from (d,α). Jπ: L(p,3He)=0+2 and L(d,α)=L(3He,p)=2 from 0+; also L(3He,d)=1 and L(d,t)=3 from 7/2−.
3014 *8*	(3 to 7)+	C I MNOP	E(level): weighted average of 3022 *15* from (3He,p), 3011 *8* from (p,p′), and 3014 *10* from (d,α). Jπ: L(d,t)=L(3He,α)=3 from 7/2-and L(d,α)=(4,6) from 0+. But L(p,3He)=(2,3) gives (1+,2,3,4−).
3096 *8*	(2 to 5)+	C F I LM op	XREF: F(3101)p(3098). E(level): weighted average of 3090 *10* from (3He,p), 3101 *15* from (3He,d), and 3099 *8* from (p,p′). Jπ: L(3He,d)=1 from 7/2−; also L(p,d)=3 from 7/2−.
3111 *8*	(1 to 6)−	I MNop	XREF: p(3098). E(level): from (p,p′). Jπ: L(3He,α)=2 from 7/2−.
3139 *8*	3+	C F I MN P	E(level): weighted average of 3140 *8* from (3He,p), 3142 *10* from (3He,d), 3142 *8* from (p,p′), and 3136 *6* from (d,α). Jπ: L(3He,p)=2+4 and L(d,α)=2 from 0+; also L(3He,d)=1 from 7/2−.
3169 *8*	1+,2+,3+	C F I MN	XREF: F(?). E(level): weighted average of 3171 *15* from (3He,p) and 3169 *8* from (p,p′). Jπ: L(3He,p)=2 from 0+. But L(3He,α)=0 from 7/2− is inconsistent. Note that this level is seen only in one of the (3He,α) studies.

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)†	Jπ#	$T_{1/2}$‡	XREF	Comments
3202 *8*	$3^-,4^-$		C F I LMNOP	XREF: F(3200?). E(level): weighted average of 3202 *8* from (p,p′), 3210 *20* from (p,d), and 3200 *8* from (d,α). Jπ: L(p,d)=L(^{3}He,α)=0 from 7/2$^-$. L(d,α)=(2) from 0^+ is inconsistent. Possible 1690γ to 2^+ disfavors 4^-.
3219 *6*	1^+		C F MNOP	XREF: C(3216)F(3223?). E(level): from weighted average of 3216 *8* from (^{3}He,p) and 3220 *6* from (d,α). Other: 3230 *10* from Eγ. Jπ: L(^{3}He,p)=L(p,^{3}He)=0+2. However, $J^\pi=0^+$ is suggested from possible assignment of this level as IAS to 11680, 0^+ in ^{50}Cr.
3269 *8*	$3^+,4^+,5^+$		C F I M	E(level): weighted average of 3262 *10* from (^{3}He,d) and 3274 *8* from (p,p′). Jπ: L(^{3}He,p)=4 from 0^+; also L(^{3}He,d)=1 and L(^{3}He,α)=3 from 7/2$^-$.
3293 *7*	$3^+,4^+,5^+$		C F I Mno	XREF: n(3307)o(3296). E(level): weighted average of 3292 *15* from (^{3}He,p), 3285 *10* from (^{3}He,d), and 3297 *7* from (p,p′). Jπ: L(p,^{3}He)=4 from 0^+; also L(^{3}He,d)=1 from 7/2$^-$.
3311 *7*			F I Mno	XREF: n(3307)o(3296). E(level): weighted average of 3310 *10* from (^{3}He,d) and 3312 *7* from (p,p′).
3402 *15*	$(0 \text{ to } 7)^+$		C L	E(level): from (^{3}He,p). Jπ: L(p,d)=3 from 7/2$^-$.
3431 *8*	$(2 \text{ to } 5)^+$		F I	E(level): weighted average of 3429 *10* from (^{3}He,d) and 3433 *8* from (p,p′). Jπ: L(^{3}He,d)=1 from 7/2$^-$.
3462 *5*	1^+		C I L NO	E(level): 3479 *8* from weighted average of 3466 *15* from (^{3}He,p), 3482 *8* from (p,p′), and 3480 *20* from (p,d). Jπ: L(^{3}He,p)=L(p,^{3}He)=0+2. However, $J^\pi=0^+$ is suggested from possible assignment of this level as IAS to 11680, 0^+ in ^{50}Cr.
3520?	$(1 \text{ to } 6)^-$		N	Jπ: L(^{3}He,α)=2 from 7/2$^-$.
3537 *10*	$(2 \text{ to } 5)^+$		c F o	XREF: c(3536)o(3546). Jπ: L(^{3}He,d)=1 from 7/2$^-$.
3542	$(1 \text{ to } 6)^-$		c N	XREF: c(3536). Jπ: L(^{3}He,α)=2 from 7/2$^-$.
3555 *7*	$(0,1)^+$		C I No	XREF: o(3546). E(level): 3565 *9* from weighted average of 3562 *15* from (^{3}He,p) and 3566 *9* from (p,p′). Jπ: L(^{3}He,p)=0(+2) from 0^+. But L(^{3}He,α)=2 from 7/2$^-$ is inconsistent. There may be two separate levels near this energy.
3606 *8*	(0 to 7)		C F NO	E(level): from (^{3}He,d). Jπ: 1 to 6, π=− from L(^{3}He,d)=2; 0 to 7, π=+ from L(^{3}He,α)=3. There may be two separate levels near this energy.
3668 *5*	$2^+,3^+$		C F I o	XREF: o(3684). E(level): weighted average of 3658 *15* from (^{3}He,p), 3658 *10* from (^{3}He,d), and 3671 *5* from (p,p′). Jπ: L(^{3}He,p)=2 from 0^+; L(^{3}He,d)=1 from 7/2$^-$.
3700 *5*	$(2 \text{ to } 5)^+$		c F I l No	XREF: c(3705)l(3700)o(3684). E(level): weighted average of 3701 *10* from (^{3}He,d) and 3700 *5*. Jπ: L(^{3}He,d)=1 and L(^{3}He,α) from 7/2$^-$.
3721 *5*	1^+		c F I l NO	XREF: c(3705)l(3700)N(3710). E(level): weighted average of 3717 *10* from (^{3}He,d) and 3722 *5* from (p,p′). Jπ: L(p,^{3}He)=0+2 from 0^+; also L(^{3}He,d)=3 from 7/2$^-$.
3729.3 *9*	(10^+)	28 fs *+56−28*	D I	Jπ: ΔJ=2, D 1251.1γ to $(9)^+$.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)[†]	Jπ[#]	$T_{1/2}$[‡]	XREF	Comments
				$T_{1/2}$: from DSAM in (α,npγ).
3749 *5*	$(1^+,3^-,4^-)$		I NO	E(level): from (p,p′). Jπ: L(^{3}He,α)=0 from 7/2$^-$ gives $3^-,4^-$, but L(p,^{3}He)=0+2 from 0^+ gives 1^+. Possible two levels near this energy.
3769? *15*	1^+		C O	E(level): from (^{3}He,p). Jπ: L(p,^{3}He)=0+2 from 0^+.
3796 *10*	3^+		C F No	E(level): weighted average of 3792 *15* from (^{3}He,p) and 3798 *10* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0^+; L(p,^{3}He)=4 from 0^+.
3811 *10*	$3^+,4^+,5^+$		F No	E(level): from (^{3}He,d). Jπ: L(^{3}He,d)=1 from 7/2$^-$; L(p,^{3}He)=4 from 0^+.
3846? *10*	$1^+,2^+,3^+$		C F No	XREF: o(3853). E(level): weighted average of 3858 *15* from (^{3}He,p) and 3840 *10* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0^+.
3878 *10*	$(2\text{ to }5)^+$		F no	XREF: n(3890)o(3853). Jπ: L(^{3}He,d)=1 from 7/2$^-$.
3914 *10*	$(2\text{ to }5)^+$		F n	XREF: n(3890). Jπ: L(^{3}He,d)=1 from 7/2$^-$.
3940 *10*	(1 to 4)		C F n	XREF: n(3950). E(level): weighted average of 3943 *15* from (^{3}He,p) and 3938 *10* from (^{3}He,d). Jπ: $1^+,2^+,3^+$ from L(^{3}He,p)=2; $3^-,4^-$ from L(^{3}He,d)=0. Possible two levels near this energy.
3963 *10*	$(2\text{ to }5)^+$		F n	XREF: n(3950). Jπ: L(^{3}He,d)=1.
4040?	$(1\text{ to }6)^-$		N	Jπ: L(^{3}He,α)=2 from 7/2$^-$.
4073 *10*	$(2\text{ to }5)^+$		C F N	E(level): weighted average of 4067 *15* from (^{3}He,p) and 4075 *10* from (^{3}He,d). Jπ: L(^{3}He,d)=1 from 7/2$^-$; also L(^{3}He,α)=3 from 7/2$^-$.
4095?			N	
4120 *10*	$(0\text{ to }7)^+$		C F N	E(level): weighted average of 4130 *15* from (^{3}He,p) and 4116 *10* from (^{3}He,d). Jπ: L(^{3}He,α)=3 from 7/2$^-$.
4146 *10*	$2^+,3^+$		C F N	E(level): weighted average of 4148 *15* from (^{3}He,p) and 4145 *10* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0^+; L(^{3}He,d)=1 from 7/2$^-$.
4195? *10*			F	
4213? *10*			F n	XREF: n(4240).
4234? *10*			F n	XREF: n(4240).
4262 *10*	$2^+,3^+$		C F N	XREF: N(4270). E(level): 4266 *10* from weighted average of 4252 *15* from (^{3}He,p) and 4272 *10* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0^+; L(^{3}He,α)=1 from 7/2$^-$.
4292.2 *10*	(11^+)	0.24 ps *7*	D	Jπ: ΔJ=1, D(+Q) 562.9γ to (10^+). $T_{1/2}$: from DSAM in (α,npγ).
4294? *10*			F	E(level),Jπ: unresolved structure, L(^{3}He,d)=1 suggests $(2\text{ to }5)^+$.
4334 *15*	$(1\text{ to }6)^-$		C N	XREF: N(4340). Jπ: L(^{3}He,α)=2 from 7/2$^-$.
4361 *10*	$(2\text{ to }5)^+$		F N	XREF: N(4380). Jπ: L(^{3}He,α)=1 from 7/2$^-$.
4396 *10*	$(2\text{ to }5)^+$		F N	Jπ: L(^{3}He,d)=1 from 7/2$^-$.
4430 *10*	$(2\text{ to }5)^+$		F N	E(level): from (^{3}He,d). Jπ: L(^{3}He,d)=1 and L(^{3}He,α)=3 from 7/2$^-$.
4431 *15*	1^+		C	Jπ: L(^{3}He,p)=0+2 from 0^+.

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)†	Jπ#	XREF	Comments
4480	(1 to 6)$^-$	N	Jπ: L(^{3}He,α)=2.
4501 *10*	(1 to 6)$^-$	C F N	E(level): weighted average of 4507 *15* from (^{3}He,p) and 4498 *10* from (^{3}He,d). Jπ: L(^{3}He,α)=2 from 7/2$^-$.
4541 *10*		C F	E(level): from (^{3}He,d).
4570 *10*	3$^-$,4$^-$	C F N	E(level): weighted average of 4569 *15* from (^{3}He,p) and 4570 *10* from (^{3}He,d). Jπ: L(^{3}He,α)=0 from 7/2$^-$.
4599 *10*	(2,3)$^+$	C F N	XREF: N(4610). E(level): weighted average of 4602 *15* from (^{3}He,p) and 4597 *10* from (^{3}He,d). Jπ: L(^{3}He,α)=1 from 7/2$^-$; L(^{3}He,p)=(2) from 0$^+$.
4653 *10*	(2 to 5)$^+$	C F	E(level): from (^{3}He,d). Jπ: L(^{3}He,d)=1 from 7/2$^-$.
4704 *15*	(1 to 6)$^-$	C N	XREF: N(4670). E(level): from (^{3}He,p). Jπ: L(^{3}He,α)=2 from 7/2$^-$.
4722 *15*	1$^+$	C	Jπ: from L(^{3}He,p)=0+2 from 0$^+$.
4774 *15*	(1 to 6)	F N	E(level): from (^{3}He,d). Jπ: 2 to 5, π=+ from L(^{3}He,d)=1; 1 to 6, π=− from L(^{3}He,α)=2. Possible two levels near this energy.
4815 *10*	(0)$^+$	C H L nO	T=3 XREF: L(4800)n(4816). E(level): weighted average of 4816 *15* from (^{3}He,p), 4800 *20* from (p,d), and 4806 *6* from (p,^{3}He). Jπ: L(^{3}He,p)=0 from 0$^+$; L(p,d)=L(^{3}He,α)=3 from 7/2$^-$; IAS of ^{50}Ti g.s., 0$^+$.
4833 *15*	(2 to 5)$^+$	F n	XREF: n(4816). Jπ: L(^{3}He,d)=1 from 7/2$^-$.
4864 *15*		C N	XREF: N(4880).
4904 *15*	1$^+$,2$^+$,3$^+$	C F N	XREF: N(4910). E(level): weighted average of 4909 *15* from (^{3}He,p) and 4898 *15* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0$^+$.
4935 *15*	1$^+$,2$^+$,3$^+$	C F	E(level): weighted average of 4943 *15* from (^{3}He,p) and 4928 *15* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0$^+$.
5026 *15*		C F	E(level): weighted average of 5034 *15* from (^{3}He,p) and 5018 *15* from (^{3}He,d).
5060 *15*	(2 to 5)$^+$	C F N	E(level): weighted average of 5062 *15* from (^{3}He,p) and 5058 *15* from (^{3}He,d). Jπ: L(^{3}He,α)=1 from 7/2$^-$.
5107 *15*	(2 to 5)$^+$	C F N	E(level): weighted average of 5123 *15* from (^{3}He,p) and 5090 *15* from (^{3}He,d). Jπ: L(^{3}He,d)=1 from 7/2$^-$.
5172 *15*	1$^+$	C	Jπ: L(^{3}He,p)=0+2 from 0$^+$.
5264 *15*		C	
5288 *15*		C	
5320 *15*		C F	E(level): weighted average of 5313 *15* from (^{3}He,p) and 5326 *15* from (^{3}He,d).
5352 *15*		C	
5405 *15*		C F	E(level): weighted average of 5401 *15* from (^{3}He,p) and 5409 *15* from (^{3}He,d).
5440	(2 to 5)$^+$	N	Jπ: L(^{3}He,α)=1 from 7/2$^-$.
5491 *15*	1$^+$	C N	XREF: N(5480). Jπ: L(^{3}He,p)=0+2 from 0$^+$.
5543 *15*	1$^+$,2$^+$,3$^+$	C F	E(level): weighted average of 5554 *15* from (^{3}He,p) and 5531 *15* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0$^+$.
5664 *19*		C F	E(level): weighted average of 5682 *15* from (^{3}He,p) and 5645 *15* from (^{3}He,d).
5753 *15*	1$^+$	C F	E(level): weighted average of 5750 *15* from (^{3}He,p) and 5755 *15* from (^{3}He,d). Jπ: L(^{3}He,p)=0+2 from 0$^+$.
5782 *15*	1$^+$,2$^+$,3$^+$	C F	E(level): weighted average of 5778 *15* from (^{3}He,p) and 5786 *15* from (^{3}He,d). Jπ: L(^{3}He,p)=2 from 0$^+$.
5829 *15*		C F	E(level): weighted average of 5838 *15* from (^{3}He,p) and 5820 *15* from (^{3}He,d).
5871 *15*		C	
5896 *15*		C F	E(level): weighted average of 5899 *15* from (^{3}He,p) and 5893 *15* from (^{3}He,d).

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)[†]	J$^{\pi}$[#]	XREF	Comments
5948 *15*	$2^+,3^+$	C F	E(level): weighted average of 5945 *15* from (^{3}He,p) and 5951 *15* from (^{3}He,d). J$^{\pi}$: L(^{3}He,p)=2 from 0^+; L(^{3}He,d)=1 from $7/2^-$.
6080 *15*		C	
6124 *15*		C	
6179 *15*	$(1^+,2^+,3^+)$	C	J$^{\pi}$: L(^{3}He,p)=(2) from 0^+.
6222 *15*		C	
6267 *15*	$(1^+,2^+,3^+)$	C	J$^{\pi}$: L(^{3}He,p)=(2) from 0^+.
6341 *15*		C	
6390 *15*	$(2)^+$	C L N	E(level): weighted average of 6395 *15* from (^{3}He,p) and 6380 *20* from (p,d). J$^{\pi}$: L(p,d)=3; possible IAS of 1555, 2^+ in ^{50}Ti favors 2^+.
6464 *15*		C	
6558 *15*		C	
6601 *15*		C	
6652 *15*		C	
6685 *15*		C	
6744 *15*		C	
6804 *15*		C	
6833 *15*		C	
6883 *15*		C	
6929 *15*		C	
6969 *15*		C	
6989 *15*		C	
7092 *15*		C	
7106 *15*		C	
7173 *15*		C	
7206 *15*		C	
7321 *15*		C	
7386 *15*		C	
7442 *15*		C	
7520 *20*	$(4)^+$	L N	E(level): from (p,d). J$^{\pi}$: L(^{3}He,α)=3 from $7/2^-$; possible IAS of 2670, 4^+ in ^{50}Ti favors 4^+.
8050 *20*	$(6)^+$	L N	XREF: N(8066). E(level): from (p,d). J$^{\pi}$: L(^{3}He,α)=3; possible IAS of 3200, 6^+ in ^{50}Ti favors 6^+.
8.59×10^3 *3*	$(0)^+$	C	J$^{\pi}$: L(^{3}He,p)=0; possible IAS of 3868, 0^+ in ^{50}Ti.
8768		E	
8812.1 *11*		E	
8814.3 *11*		E	
8840.0 *11*		E	
8842.2 *11*		E	
8847.7 *11*		E	
8854.6 *11*		E	
8864.4 *11*		E	
8869.8 *11*		E	
8875.7 *11*		E	
8878.9 *11*		E	
8883.3 *11*		E	
8889.7 *11*		E	
8893.3 *11*		E	
8894.6 *11*		E	
8896.4 *11*		E	
8899.2 *11*		E	
8904.0 *11*		E	
8906.5 *11*		E	
8908.3 *11*		E	
8911.2 *11*		E	

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)†	XREF
8914.9 *11*	E
8918.0 *11*	E
8921.1 *11*	E
8923.0 *11*	E
8925.8 *11*	E
8933.7 *11*	E
8937.8 *11*	E
8941.8 *11*	E
8949.9 *11*	E
8957.7 *11*	E
8959.4 *11*	E
8964.2 *11*	E
8966.1 *11*	E
8968.1 *11*	E
8972.9 *11*	E
8976.3 *11*	E
8987.3 *11*	E
8990.1 *11*	E
8992.7 *11*	E
8996.4 *11*	E
9004.1 *11*	E
9011.6 *11*	E
9014.4 *11*	E
9016.6 *11*	E
9017.7 *11*	E
9021.6 *11*	E
9025.0 *11*	E
9026.6 *11*	E
9029.3 *11*	E
9031.9 *11*	E
9034.6 *11*	E
9037.9 *11*	E
9039.3 *11*	E
9042.5 *11*	E
9045.8 *11*	E
9050.9 *11*	E
9053.1 *11*	E
9056.9 *11*	E
9061.9 *11*	E
9065.0 *11*	E
9069.6 *11*	E
9072.6 *11*	E
9076.2 *11*	E
9081.3 *11*	E
9084.3 *11*	E
9087.2 *11*	E
9088.5 *11*	E
9092.2 *11*	E
9097.5 *11*	E
9100.4 *11*	E
9104.5 *11*	E
9107.2 *11*	E
9109.8 *11*	E
9112.4 *11*	E
9115	C
9115.6 *11*	E
9118.8 *11*	E

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

E(level)†	Jπ#	XREF	Comments
9125.6 *11*		E	
9127.8 *11*		E	
9131.4 *11*		E	
9133.6 *11*		E	
9141.0 *11*		E	
9145.3 *11*		E	
9148.1 *11*		E	
9150.8 *11*		E	
9154.4 *11*		E	
9157.5 *11*		E	
9162.3 *11*		E	
9163.6 *11*		E	
9164		C	
9165.9 *11*		E	
9167.8 *11*		E	
9173.8 *11*		E	
9175.4 *11*		E	
9178.4 *11*		E	
9179.7 *11*		E	
9182.3 *11*		E	
9188.3 *11*		E	
9191.7 *11*		E	
9196.8 *11*		E	
9198.6 *11*		E	
9203.2 *11*		E	
9206.6 *11*		E	
9255		E	
9270 *20*	$(3)^-$	L N	E(level): from (p,d). Jπ: L(^{3}He,α)=0; possible IAS of 4410, 3^- in ^{50}Ti.
9304		E	
9451		E	
9499		E	
9529		E	
9548		E	
9646		E	
9743		E	
9841		E	
10036		E	
10133		E	
10.24×10^3 *2*	$(1\text{ to }6)^{(-)}$	L	Jπ: L(p,d)=(2).
10280		E	
10387		E	
10475		E	
10572		E	
10.64×10^3 *2*	$(1\text{ to }6)^{(-)}$	L	Jπ: L(p,d)=(2).
10669		E	
10767		E	
10830		E	
10.90×10^3 *2*	$3^-,4^-$	L	Jπ: L(p,d)=0.
10928		E	
11222		E	
11.27×10^3 *2*	$(3)^-$	L	Jπ: L(p,d)=(2); possible IAS of 6400, $(3)^-$ in ^{50}Ti.
11.44×10^3 *2*	$(1\text{ to }6)^{(-)}$	L	Jπ: L(p,d)=(2).
12.57×10^3 *2*	(2^+)	L	Jπ: possible IAS of 7667, 2^+ in ^{50}Ti.

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Adopted Levels, Gammas (continued)

^{50}V Levels (continued)

† From a least-squares fit to γ-ray energies for level connected by γ transitions, and from particle-transfer experiments for others, unless otherwise noted.

‡ From DSAM in (α,pγ), except as noted.

In ^{48}Ti(^{3}He,p), ^{52}Cr(p,^{3}He) and ^{52}Cr(d,α) reactions, where J^{π}(target g.s.)=0^{+}, implied $J^{\pi}=0^{+},1^{+}$ for L=0; $1^{+},2^{+},3^{+}$ for L=2; 1^{+} for L=0+2; $2^{-},3^{-},4^{-}$ for L=3; 2^{-} for L=1+3; $3^{+},4^{+},5^{+}$ for L=4; 3^{+} for L=2+4; $4^{-},5^{-},6^{-}$ for L=5; 4^{-} for L=3+5; $5^{+},6^{+},7^{+}$ for L=6; In ^{49}Ti(^{3}He,d), ^{51}V(p,d), ^{51}V(d,t) and ^{51}V(^{3}He,α) where J^{π}(target g.s.)=$7/2^{-}$, implied $J^{\pi}=3^{-},4^{-}$ for L=0 or 0+2; 2 to 5, π=+ for L=1 or 1+3; 1 to 6, π=− for L=2; 0 to 7.

Adopted Levels, Gammas (continued)

$\gamma(^{50}V)$

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.	δ	α ‡	Comments
226.21	5^+	226.3 *3*	100	0.0	6^+	M1(+E2)	+0.07 *+14−7*	0.0029 *5*	α(K)=0.0026 *5*; α(L)=0.00024 *5*; α(M)=3.1×10^{-5} *6* α(N)=1.6×10^{-6} *3* E_γ: weighted average of 226.2 *6* from (α,pγ), 226.2 *5* from (α,npγ), and 226.3 *3* from (p,n). Other: 225 *3* from Coulomb excitation. Mult.: D(+Q) from $\gamma(\theta)$ in (α,npγ). M1 is suggested from RUL, however E2 component is required from Coulomb excitation.
320.30	4^+	94.2 *3*	100.0 *2*	226.21	5^+	(M1)		0.0259 *5*	B(M1)(W.u.)=0.47 *+17−13* α(K)=0.0234 *4*; α(L)=0.00221 *4*; α(M)=0.000289 *5* α(N)=1.471×10^{-5} *24* E_γ: weighted average of 94.0 *5* from (α,npγ) and 94.3 *3* from (p,n). Mult.: D(+Q) with δ=+0.08 *+28−8* from $\gamma(\theta)$ in (α,npγ), D from RUL; magnetic character from $\Delta\pi$=no.
		320.2 *3*	1.5 *2*	0.0	6^+	(E2)		0.00449	B(E2)(W.u.)=4.1 *+22−15* α(K)=0.00406 *6*; α(L)=0.000376 *6*; α(M)=4.91×10^{-5} *7* α(N)=2.48×10^{-6} *4* E_γ: weighted average of 320.6 *8* from (α,pγ) and 320.2 *3* from (p,n). Other: 320 *3* from Coulomb excitation. I_γ: other: 7.7 *19* in (α,npγ) discrepant. Mult.: D,E2 from comparison to RUL; E2 component from Coulomb excitation. ΔJ,$\Delta\pi$=2,no from the decay scheme.
355.8	3^+	35.5 *3*	100.0 *2*	320.30	4^+	(M1)		0.375 *11*	α(K)=0.338 *10*; α(L)=0.0326 *10*; α(M)=0.00427 *12* α(N)=0.000213 *6* Mult.: D from RUL; $\Delta\pi$=no from L(d,α)=2.
		129 *1*	0.7 *2*	226.21	5^+	(E2)		0.140 *5*	α(K)=0.127 *5*; α(L)=0.0122 *5*; α(M)=0.00158 *6* α(N)=7.5×10^{-5} *3* RUL suggests D,E2; $\Delta\pi$=no and ΔJ>1 from L(d,α)=2.
388.8	2^+	33.1 *3*	100	355.8	3^+	[M1]		0.458 *14*	α(K)=0.413 *13*; α(L)=0.0399 *12*; α(M)=0.00521 *16* α(N)=0.000260 *8*
836.4	5^+	516.1 *4*	59 *24*	320.30	4^+	M1			B(M1)(W.u.)=1.6 *+19−9* Mult.: δ(E2/M1)=−0.08 *40* from $\gamma(\theta$,pol) in (p,nγ) and RUL.
		836 *1*	100 *24*	0.0	6^+	(M1)			B(M1)(W.u.)=0.6 *+6−3* Mult.: M2 and E2 ruled out by RUL; $\Delta\pi$=no from level scheme.
909.8	$(7)^+$	909.7 *5*	100	0.0	6^+	M1+E2	−0.21 *+10−16*		B(M1)(W.u.)=0.65 *+18−15*; B(E2)(W.u.)=8×10^1 *+21−6* E_γ: weighted average of 909.9 *5* from (α,npγ) and 909 *1* from (p,nγ). Mult.,δ: D+Q from $\gamma(\theta)$ in (α,npγ) and M2 ruled out by RUL.
910.1	4^+	683.9 *3*	100	226.21	5^+	M1+E2	+0.21 *+30−10*		B(M1)(W.u.)=0.94 *+18−25*; B(E2)(W.u.)=2.1×10^2 *+96−16* E_γ: weighted average of 684.0 *5* from (α,npγ) and 683.8 *3* from (p,nγ). Mult.: D+Q from $\gamma(\theta)$ in (α,pnγ) and M1(+E2) from $\gamma(\theta)$ and linear polarization in (p,nγ). δ: from (α,pnγ). Other: +0.01 *9* from (p,nγ).
1301.7	2^+	912.8 *3*	100 *7*	388.8	2^+	M1+E2	−0.12 *5*		B(M1)(W.u.)=0.43 *+13−9*; B(E2)(W.u.)=18 *+27−13* Mult.,δ: from $\gamma(\theta$,pol) in (p,nγ) and RUL.

$^{50}_{23}V_{27}$-13

Adopted Levels, Gammas (continued)

$\gamma(^{50}V)$ (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.	δ	Comments
1301.7	2^+	946 *2*	43 *6*	355.8	3^+	(M1(+E2))	+0.09 *9*	B(M1)(W.u.)=0.17 *+7−5* Mult.,δ: D(+Q) from $\gamma(\theta)$ in (p,nγ) and $\Delta\pi$=no from level scheme.
1332.2	1^+	943.4 *4*	100	388.8	2^+	M1		B(M1)(W.u.)=1.5 *+9−4* Mult.: from $\gamma(\theta$,pol) in (p,nγ) and RUL.
1402.0	3^+	493 *1*	21 *7*	910.1	4^+			
		1013.4 *3*	100 *5*	388.8	2^+	M1(+E2)	0.00 *20*	Mult.,δ: from $\gamma(\theta$,pol) in (p,nγ).
		1045.5 *5*	28 *12*	355.8	3^+			
		1081.6 *5*	24 *9*	320.30	4^+			
1495.5	1^+	1106.7 *3*	100 *6*	388.8	2^+	M1+E2	−0.58 *3*	B(M1)(W.u.)=0.24 *+7−5*; B(E2)(W.u.)=1.5×10^2 *+6−4* Mult.,δ: from $\gamma(\theta$,pol) in (p,nγ) and RUL.
		1140 *1*	14 *6*	355.8	3^+	[E2]		B(E2)(W.u.)=7×10^1 *+5−4*
1518.5	2^+	1129.9 *4*	100 *2*	388.8	2^+	M1+E2	+0.06 *1*	B(M1)(W.u.)=0.086 *+19−14*; B(E2)(W.u.)=0.57 *+38−24* Mult.,δ: from $\gamma(\theta$,pol) in (p,nγ) and RUL.
		1162.6 *4*	20 *4*	355.8	3^+	(M1+E2)		Mult.: D+Q with δ=−0.017 to +0.36 or ≤−1.7 from $\gamma(\theta)$ in (p,nγ); $\Delta\pi$=no from level scheme.
1562.1	2^+	1173.2 *3*	96 *8*	388.8	2^+	M1(+E2)	0.00 *20*	B(M1)(W.u.)=0.0095 *+50−42* Mult.: from parallel $\gamma(\theta)$ and polarization measurements in (p,nγ) and decay scheme.
		1206.4 *3*	100 *8*	355.8	3^+	M1+E2		Mult.: from $\gamma(\theta$,pol) in (p,nγ) with δ=+0.01 *16* or −7.1 *+20−40* (1974Ri13); −1.37 to −0.32 (1974To10).
1677.4	3^+	275.3 *5*	41 *11*	1402.0	3^+			
		375.5 *4*	100 *16*	1301.7	2^+			
		1288.6 *5*	45 *16*	388.8	2^+			
		1321.7 *3*	41 *16*	355.8	3^+			
1700.3	$(3^+,4^+,5^+)$	1380		320.30	4^+			E_γ: from (α,pnγ) only.
1703.1	$(3^+,4^+,5^+)$	793 *2*		910.1	4^+			
1719.3	$(1^+,2,3,4^+)$	1331 *2*	100 *20*	388.8	2^+			
		1363 *2*	79 *20*	355.8	3^+			
1724.5	$(8)^+$	814.6 *5*	100.0 *14*	909.8	$(7)^+$	M1+E2	−0.17 *+14−15*	B(M1)(W.u.)=0.18 *+15−7*; B(E2)(W.u.)=19 *+91−18* E_γ,I_γ: from (α,npγ). Mult.,δ: D+Q from $\gamma(\theta)$ in (α,npγ); M2 ruled out by RUL.
		1724.5 *5*	55.2 *14*	0.0	6^+	E2		B(E2)(W.u.)=9 *+7−3* E_γ,I_γ: from (α,npγ). Mult.: Q from $\gamma(\theta)$ in (α,npγ) and M2 ruled out by RUL.
1725.3	$(3^+,4,5,6^+)$	1405 *2*	10 *6*	320.30	4^+			
		1499# *2*	100 *6*	226.21	5^+			E_γ: 1481, 1509 γ rays placed with 2816 state in (^{3}He,pγ) and 1493, 1499 γs placed with 1725 and 1811 states, respectively, in (p,nγ).
1752.5	$3^+,4^+,5^+$	1397		355.8	3^+			E_γ: from (α,pγ) only.
		1432		320.30	4^+			E_γ: from (α,pγ) only.
		1526		226.21	5^+			E_γ: from (α,pγ) only.
1761.6	$(4^+,5^+)$	851		910.1	4^+			E_γ: from (α,pγ) only.
		1762		0.0	6^+			E_γ: from (α,pγ) only.
1762.4	$(3^+,4^+,5^+)$	926		836.4	5^+			E_γ: from (α,npγ) only.

$^{50}_{23}V_{27}$-14

Adopted Levels, Gammas (continued)

$\gamma(^{50}V)$ (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.	δ	Comments
1812.8	$(2,3)^+$	509#		1301.7	2^+			E_γ: from (α,npγ) only.
		1424 *2*	84 *44*	388.8	2^+			
		1457 *2*	100 *44*	355.8	3^+			
		1493# *2*	<220	320.30	4^+			E_γ: 1481, 1509 γs placed from 2816 state in (^{3}He,pγ) and 1493, 1499 γs placed from 1725 and 1811 states, respectively, in (p,nγ).
1881.4	$(4^+,5^+,6^+)$	1045	100	836.4	5^+	(M1)		B(M1)(W.u.)=1.3 *+15−5* E_γ: from (α,npγ) only. Mult.: M1 is required by RUL if 1045γ is the only branch or Iγ>35%.
2313.3	$2^+,3^+,4^+,5^+$	588		1725.3	$(3^+,4,5,6^+)$			E_γ: from (α,npγ) only.
2425	1^+	2025# *10*	100	388.8	2^+			E_γ: from (^{3}He,pγ) only.
2478.2	$(9)^+$	753.7 *5*	100	1724.5	$(8)^+$	M1+E2	−0.13 *+9−5*	B(M1)(W.u.)=0.21 *+30−12*; B(E2)(W.u.)=15 *+52−14* E_γ: from (α,npγ). Mult.,δ: D+Q from $\gamma(\theta)$ in (α,npγ); M2 ruled out by RUL.
2816	1^+	1481# *10*	67	1332.2	1^+			E_γ,I_γ: from (^{3}He,pγ) only.
		1509# *10*	100	1301.7	2^+			E_γ,I_γ: from (^{3}He,pγ) only.
2842	$(5^+,6^+,7^+)$	1932#		909.8	$(7)^+$			E_γ: from (α,npγ) only.
3202	$3^-,4^-$	1690# *10*	100	1518.5	2^+			E_γ: from (^{3}He,pγ).
3219	1^+	1735# *10*	100	1495.5	1^+			E_γ: from (^{3}He,pγ) only.
3462	1^+	1945 *10*	83	1518.5	2^+			E_γ,I_γ: from (^{3}He,pγ) only.
		1970 *10*	100	1495.5	1^+			E_γ,I_γ: from (^{3}He,pγ) only.
		2155 *10*	100	1301.7	2^+			E_γ,I_γ: from (^{3}He,pγ) only.
		3074 *10*	50	388.8	2^+			E_γ,I_γ: from (^{3}He,pγ) only.
3555	$(0,1)^+$	2063 *10*	100	1495.5	1^+			E_γ,I_γ: from (^{3}He,pγ) only.
		2220 *10*	100	1332.2	1^+			E_γ,I_γ: from (^{3}He,pγ) only.
3729.3	(10^+)	1251.1 *5*	100	2478.2	$(9)^+$	D		E_γ: from (α,npγ). Mult.: δ(Q/D)=0.00 *+7−4* from $\gamma(\theta)$ in (α,npγ).
4262	$2^+,3^+$	2743 *10*	100	1518.5	2^+			E_γ: from (^{3}He,pγ) only.
4292.2	(11^+)	562.9 *5*	100	3729.3	(10^+)	D(+Q)	−0.06 *+6−1*	E_γ: from (α,npγ). Mult.,δ: D(+Q) from $\gamma(\theta)$ in (α,npγ); RUL suggests D.
4815	$(0)^+$	3483 *10*	100	1332.2	1^+			E_γ: from (^{3}He,pγ) only.
8.59×10^3	$(0)^+$	7097 *25*	100	1495.5	1^+			E_γ: from (^{3}He,pγ) only.

† From (p,nγ), except as noted.

‡ 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.

Placement of transition in the level scheme is uncertain.

$^{50}_{23}V_{27}$-15

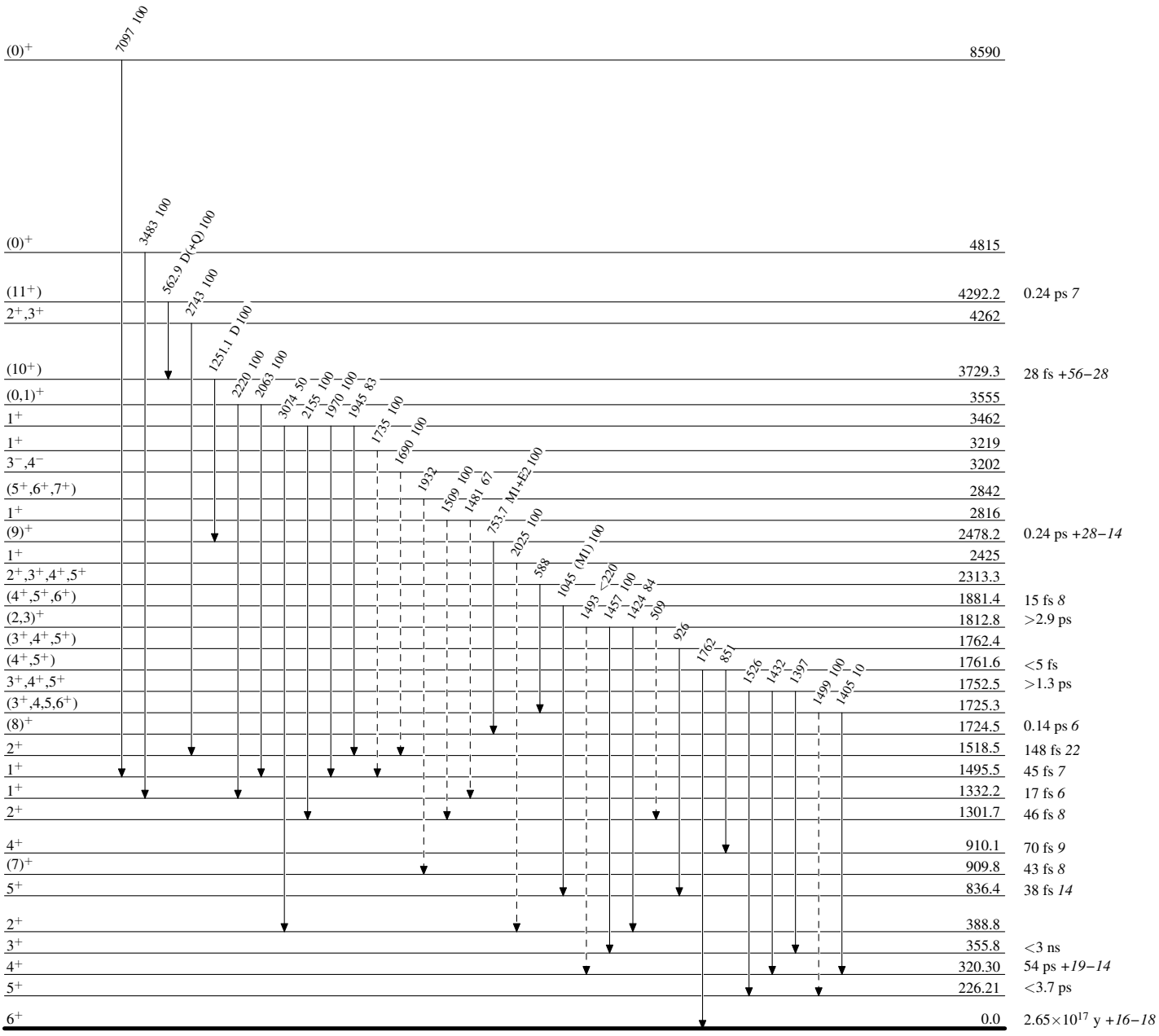
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

– – – – – – ► γ Decay (Uncertain)

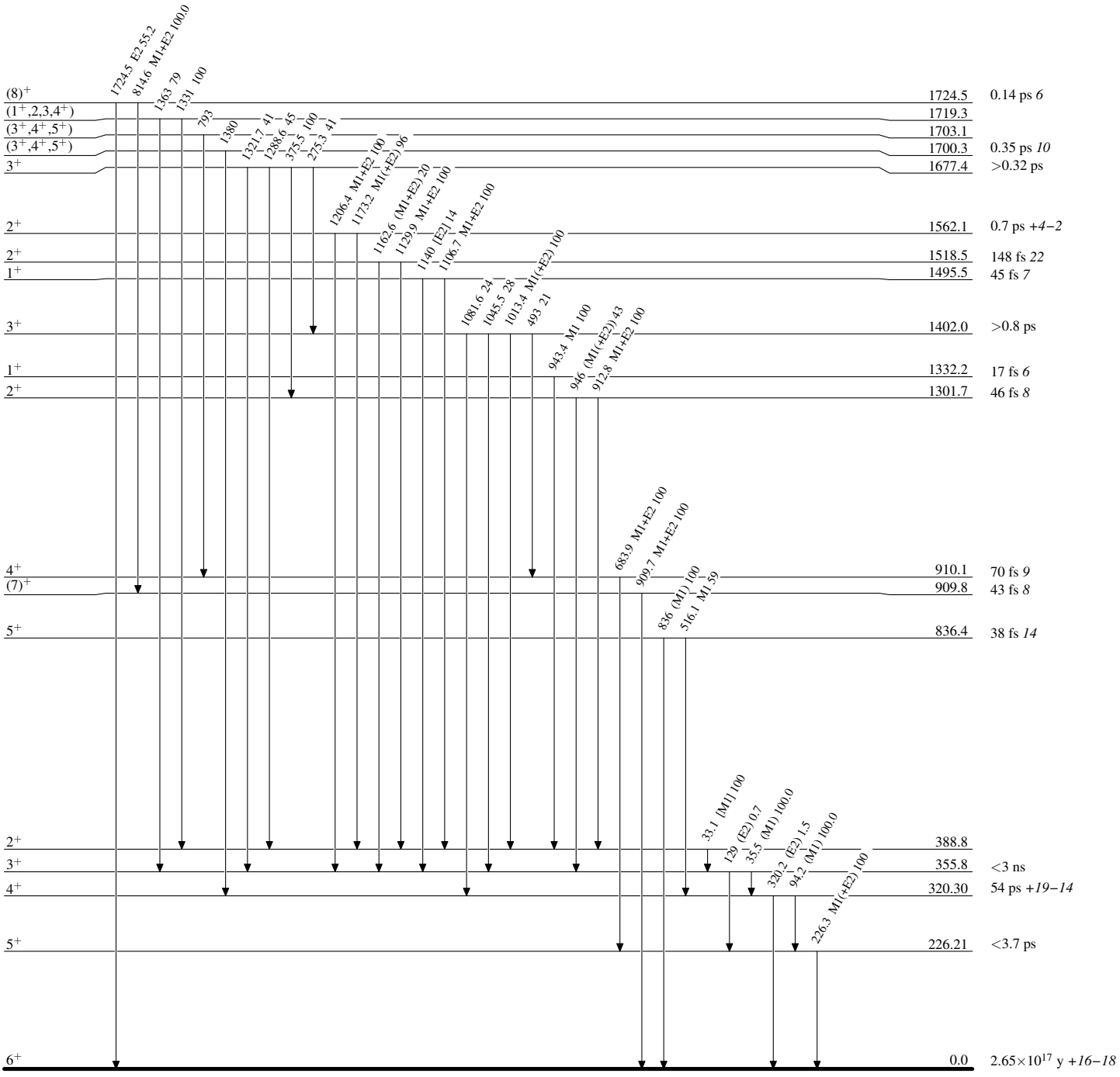


$^{50}_{23}V_{27}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{50}_{23}V_{27}$