^{48}Ti(p,nγ) 1973SaZF,1973SaYJ,1976Ri01

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1973SaZF,1973SaYJ: E=(p)=5.97, 6.48, 7.03 and 8.33 MeV proton beams were produced from the Michigan State University Cyclotron or from the Western Michigan University Tandem for measurements of excitation functions. Targets were 0.66 mg/cm^2 isotopically enriched ^{48}Ti foil. γ rays were detected with Ge(Li) detectors. Measured Eγ, Iγ, γγ-coin, γ(θ), γγ(t). Deduced levels, J, π, $T_{1/2}$, γ-ray multipolarities, mixing ratios. See also 1973SaYI and 1973SaYL for the report of the same γγ(t), 1972SaYR and 1972SaZX for the report of the same γγ-coin and γ(θ). The γ(θ) data (A_2 and A_4 values) from which mixing are deduced are not explicitly given in these references. See γγ-coin spectra in 1977Sa03.

1976Ri01: E=5.5, 6.0, 6.4, and 7.0 MeV proton beams were produced from the TUNL Cyclograaff facility. Targets were both 1 and 4 mg/cm^2 self-supporting ^{48}Ti (90% enriched). γ-rays were detected with Ge(Li) detectors. Measured Eγ, γ(θ), γ(lin pol). Deduced levels, J, π, γ-ray multipolarities and mixing ratios. 1976Ri01 also report data for 199γ(θ) from ^{34}S(^{16}O,pnγ).

1976BeXG: E=6.4 MeV proton beams was produced from the MSU cyclotron. Target was 1 mg/cm^2 metallic ^{48}Ti (99% enriched). Conversion electrons were detected with a on-line electron spectrometer, consisting of a short solenoidal magnet with anti-positron vanes and a Si(Li) detector; γ rays were detected with a Ge(Li) detector. Measured E(e), I(e), e-γ-coin. Deduced conversion coefficient and multipolarity for 1099γ. See also 1977Sa03.

1976Mo26: E=6.15 MeV proton beam was produced from the CN Van de Graaff generator of Laboratori Nazionali di Legnaro. Target was a 730 μg/cm^2 ^{48}Ti foil (>95% enriched). γ rays were detected Ge(Li) detectors. Measured Eγ, Iγ, γ(θ), γ(lin pol), γγ-coin. Deduced levels, J, π, γ-ray multipolarities, mixing ratios. 1976Mo26 also report measurements of ^{35}Cl(^{16}O,2pnγ) for γ(θ) and ^{27}Al(^{24}Mg,2pnγ) for γγ-coin and γ excitation functions.

1978Ta17: E=5.6 MeV proton beam was from the McMaster University tandem. Target was a $^{48}Ti_5Fe_{95}$ alloy. Measured γ(θ,H,t) with Ge(Li) detectors. Deduced g-factor for the 308 level using the time-integral perturbed angular distribution technique.

1963Ba22: E=5.5 MeV proton was produced from the Livermore 90-in variable-energy cyclotron. Measured Eγ, γ(t). Deduced $T_{1/2}$ for the 308 level.

^{48}V Levels

E(level)[†]	Jπ[‡]	$T_{1/2}$	Comments
0.0	4^+		
308.31 *8*	2^+	7.12 ns *4*	g=+0.14 *5* (1978Ta17) Jπ: spin=2 from γ(θ) in 1973SaZF. $T_{1/2}$: from 308.3γ(t) (1973SaZF). Other: 7.21 ns *28* from 1963Ba22. g-factor: measured by 1978Ta17 from integral perturbed angular correlation using $T_{1/2}$=7.09 ns *4*, taken by 1978Ta17 from weighted average of data from 1967Au02, 1963Ba22, 1971Bo13, and 1973SaZF.
420.77 *10*	1^+	<1 ns	Jπ: spin=1 from γ(θ) in 1973SaZF. $T_{1/2}$: from 1973SaYL based on 112.5γ(t) following closely 98.0γ(t) and 210.4γ(t) and lower limit (1 ns) of halflife measurement in 1973SaYL.
427.89 *8*	5^+		Jπ: 3^+,4^+,5^+ from γ(θ,pol) in 1976Ri01 and 5 from γ(θ) in 1973SaZF.
518.74[#] *10*	1^-	2.72 ns *6*	Jπ: spin=1 from γ(θ,pol) in 1976Ri01 and γ(θ) in 1973SaZF. $T_{1/2}$: from 98.0γ(t) and 210.4γ(t) (1973SaZF).
613.36 *8*	4^+		Jπ: spin=4 from γ(θ) in 1973SaZF and 3^-,4^+,5^- from γ(θ,pol) in 1976Ri01.
627.25 *14*	6^+		Jπ: spin=6 from γ(θ) in 1973SaZF.
745.06[#] *10*	2^-		Jπ: spin=2 from γ(θ) (1973SaZF) and γ(θ,pol) (1976Ri01).
764.99 *8*	3^+		Jπ: spin=3 from γ(θ) in 1973SaZF; 2^-,3 from γ(θ,pol) in 1976Ri01.
1055.85[#] *13*	3^-		Jπ: spin=3 from γ(θ) in 1973SaZF; 2^+,3^- from γ(θ,pol) in 1976Ri01.
1099.20[@] *17*	4^-		Jπ: from γ(θ,pol) in 1976Mo26. Spin=4 from γ(θ) in 1973SaZF.
1264.56 *17*	5^+		Jπ: spin=5 from γ(θ) in 1973SaZF; 3,4^-,5 from γ(θ,pol) in 1976Ri01.
1521.43 *11*	2^+		Jπ: spin=2 from γ(θ) in 1973SaZF.
1557.61[#] *16*	4^-		Jπ: spin=4 from γ(θ) in 1973SaZF; 2^+,4 from γ(θ,pol) in 1976Ri01.
1685.5[@] *3*	$5^{(-)}$		
1780.99 *14*	3^+		Jπ: spin=3 from γ(θ) in 1973SaZF.

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^{48}Ti(p,nγ) 1973SaZF,1973SaYJ,1976Ri01 (continued)

^{48}V Levels (continued)

E(level)†	Jπ‡	E(level)†	E(level)†	E(level)†
1998.49 *18*	2⁻,3⁻	2333.1 *6*	2579.1 *12*	2915.2 *18*
2096.9 *3*		2372.7 *6*	2586.6 *12*	2969.2 *18*
2118.5 *5*		2391.2 *7*	2604.7 *14*	3022.6 *20*
2179.5 *5*		2408.2 *7*	2607.4 *14*	3048.7 *20*
2258.1 *9*		2458.2 *12*	2715.7 *15*	3200.5? *25*
2289.0 *10*		2471.8 *12*	2793.0 *16*	
2321.7 *12*		2574.8 *10*	2823.1? *12*	

† From a least-squares fit to γ-ray energies for levels below 2 MeV and from 1973SaYJ above 2 MeV deduced by authors from their Eγ data which however are not porvided in 1973SaYJ.

‡ From Adopted Levels. Supporting arguments from γ(θ), γ(lin pol) and ce data in this dataset are given under comments where available.

Band(A): $K^\pi=1^-$ rotational band (1977Sa03).

@ Band(B): $K^\pi=4^-$ rotational band (1977Sa03,1976Mo26).

γ(^{48}V)

E_i(level)	J_i^π	E_γ†	I_γ†	E_f	J_f^π	Mult.‡	δ#	Comments
308.31	2⁺	308.3 *1*	100	0.0	4⁺	E2		Mult.: Q from γ(θ) in 1973SaZF; M2 ruled out by RUL.
420.77	1⁺	112.5 *1*	100	308.31	2⁺	M1+E2	−0.08 *6*	Mult.: D+Q from γ(θ) in 1973SaZF; E1+M2 is ruled out by RUL for measured δ(Q/D) in 1973SaZF. δ: from −0.14<δ<−0.02 in 1973SaZF.
427.89	5⁺	427.9 *1*	100	0.0	4⁺	M1+E2	−0.135 *15*	δ: from −0.15<δ<−0.12 in 1973SaZF. Others: −0.13 *8* for J^π(428)=5⁺, +0.31 *15* or +7 *5* for 3⁺, <−1.2 for 4⁺ (1976Ri01). A_2=−0.46 *2*, A_4=−0.06 3, POL=−0.20 *10* (1976Ri01).
518.74	1⁻	98.0 *1*	38 *2*	420.77	1⁺	D(+Q)	+0.15 *23*	δ: from −0.08<δ<+0.37 in 1973SaZF.
		210.4 *1*	62 *2*	308.31	2⁺	D+Q	+0.04 *3*	δ: from +0.01<δ<+0.07 in 1973SaZF. A_2=−0.02 *2*, A_4=0.00 3, POL=0.00 *3* (1976Ri01).
613.36	4⁺	185.5 *1*	11 *2*	427.89	5⁺	D(+Q)	+0.025 *45*	δ: from −0.08<δ<+0.37 in 1973SaZF.
		613.4 *1*	89 *2*	0.0	4⁺	M1+E2	−0.19 *2*	δ: from −0.21<δ<−0.17 in 1973SaZF. Others: −0.28 *5* for J^π(613)=4⁺, −0.21 *6* or −2.5 *10* for 3⁻, , +0.27 *5* for 5⁻ (1976Ri01). A_2=+0.16 *2*, A_4=+0.01 2, POL=+0.56 *6* (1976Ri01).
627.25	6⁺	199.3 *2*	37 *5*	427.89	5⁺	D(+Q)	−0.10 *13*	δ: from −0.23<δ<+0.03 in 1973SaZF.
		627.3 *2*	63 *5*	0.0	4⁺	Q		
745.06	2⁻	226.3 *1*	92 *1*	518.74	1⁻	D+Q	−0.07 *1*	δ: from −0.08<δ<−0.06 in 1973SaZF. Others: δ(E2/M1)=−0.14 *12* or δ(M2/E1)=−2.1 *6* from γ(θ,pol) in 1976Ri01. A_2=−0.27 *2*, A_4=+0.01 3, POL=−0.18 *4* (1976Ri01).
		324.2 *1*	3.1 *3*	420.77	1⁺	D(+Q)	−0.03 *19*	δ: from −0.21<δ<+0.16 in 1973SaZF.
		436.8 *1*	4.9 *4*	308.31	2⁺	D(+Q)	−0.04 *18*	δ: from −0.21<δ<+0.14 in 1973SaZF.
764.99	3⁺	151.7 *2*	3.3 *3*	613.36	4⁺			
		456.7 *1*	55 *2*	308.31	2⁺	D+Q	−0.02 *1*	δ: from −0.03<δ<−0.01 in 1973SaZF. Others: 0.00 *5* for 3⁺, −3.4 *10* for 3⁻, <−0.58 for 2⁻ (1976Ri01). A_2=−0.29 *1*, A_4=−0.01 2, POL=−0.25 *5* (1976Ri01).
		764.9 *1*	45 *2*	0.0	4⁺	D(+Q)	−0.025 *25*	δ: from −0.03<δ<−0.01 in 1973SaZF.
1055.85	3⁻	310.8 *1*	92 *3*	745.06	2⁻	M1(+E2)	−0.05 *9*	Mult.: M1+E2 for J(1056)=3⁻ or E1+M2 for 2⁺ from γ(θ,pol) in 1976Ri01, with the former consistent

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^{48}Ti(p,nγ) 1973SaZF,1973SaYJ,1976Ri01 (continued)

γ(^{48}V) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[#]	Comments
								with γ(θ) in 1973SaZF. δ: from 1976Ri01. Other: δ(M2/E1)<−0.58 for J(1056)=2$^+$ (1976Ri01). A_2=−0.22 *2*, A_4=+0.03 2, POL=−0.60 *10* (1976Ri01).
1055.85	3$^-$	537.2 *2*	8 *3*	518.74	1$^-$	Q		
1099.20	4$^-$	1099.3 *2*	100	0.0	4$^+$	E1(+M2)	≤0.052	Mult.,δ: from α(K)exp=4.0×10^{-5} *6* (1977Sa03). Others: δ(M2/E1)=−0.015 *155* from γ(θ,pol) in 1976Mo26; −0.1 *3* for J^π(1099)=4$^-$, +0.33 *13* for 5$^+$, −2.0 to −0.3 for 3$^+$ from γ(θ,pol) in 1976Ri01. A_2=+0.40 *2*, A_4=−0.01 *2*, POL=−0.32 *18* (1976Mo26). A_2=+0.39 *6*, A_4=+0.02 9, POL=+0.69 *10* (1976Ri01).
1264.56	5$^+$	637.3 *2*	25 *4*	627.25	6$^+$			
		651.2 *2*	75 *4*	613.36	4$^+$	D+Q	−0.15 *12*	δ: from −0.26<δ<−0.03 in 1973SaZF. Others: −0.32 *14* for J^π(1265)=5$^+$, −0.05 *5* or 3 to 12 for 3$^+$, >0.7 for 4$^-$, −4 *2* for 5$^-$ (1976Ri01). A_2=−0.53 *9*, A_4=+0.15 9, POL=−0.24 *9* (1976Ri01).
1521.43	2$^+$	756.4 *1*	20 *2*	764.99	3$^+$	D(+Q)	+0.06 *8*	δ: from −0.02<δ<+0.13 in 1973SaZF.
		1101.0 *2*	35 *4*	420.77	1$^+$	D(+Q)	−0.01 *4*	δ: from −0.05<δ<+0.03 in 1973SaZF.
		1212.9 *2*	45 *4*	308.31	2$^+$	D+Q	+0.21 *7*	δ: from +0.14<δ<+0.28 in 1973SaZF.
1557.61	4$^-$	501.8 *1*	78 *4*	1055.85	3$^-$	D+Q	−0.09 *3*	δ: from −0.11<δ<−0.06 in 1973SaZF. Others: −0.23 *17* for J^π(1558)=4$^-$, −1.8 *5* for 4$^+$, 0.3 to 1.7 for 2$^+$ (1976Ri01). A_2=−0.71 *5*, A_4=+0.15 6, POL=−0.18 *16* (1976Ri01).
		812.2 *3*	22 *4*	745.06	2$^-$	Q		
1685.5	5$^{(-)}$	586.3 *2*	100	1099.20	4$^-$			
1780.99	3$^+$	1167.8 *2*	42 *5*	613.36	4$^+$	D(+Q)	−0.07 *14*	δ: from −0.20<δ<+0.07 in 1973SaZF.
		1472.5 *2*	43 *5*	308.31	2$^+$	D(+Q)	−0.03 *10*	δ: from −0.12<δ<+0.07 in 1973SaZF.
		1780.9 *3*	15 *3*	0.0	4$^+$			
1998.49	2$^-$,3$^-$	899.4 *2*		1099.20	4$^-$			
		1253.3 *2*		745.06	2$^-$			

[†] From 1973SaZF. Intensities values are for photon branching from each level.
[‡] From γ(θ) in 1973SaZF and/or γ(θ,pol) in 1976Ri01, unless otherwise noted.
[#] Deduced by the evaluator from the range of δ values given in 1973SaZF (as given under comments), unless otherwise noted. Values from γ(θ,pol) in 1976Ri01 are given under comments.

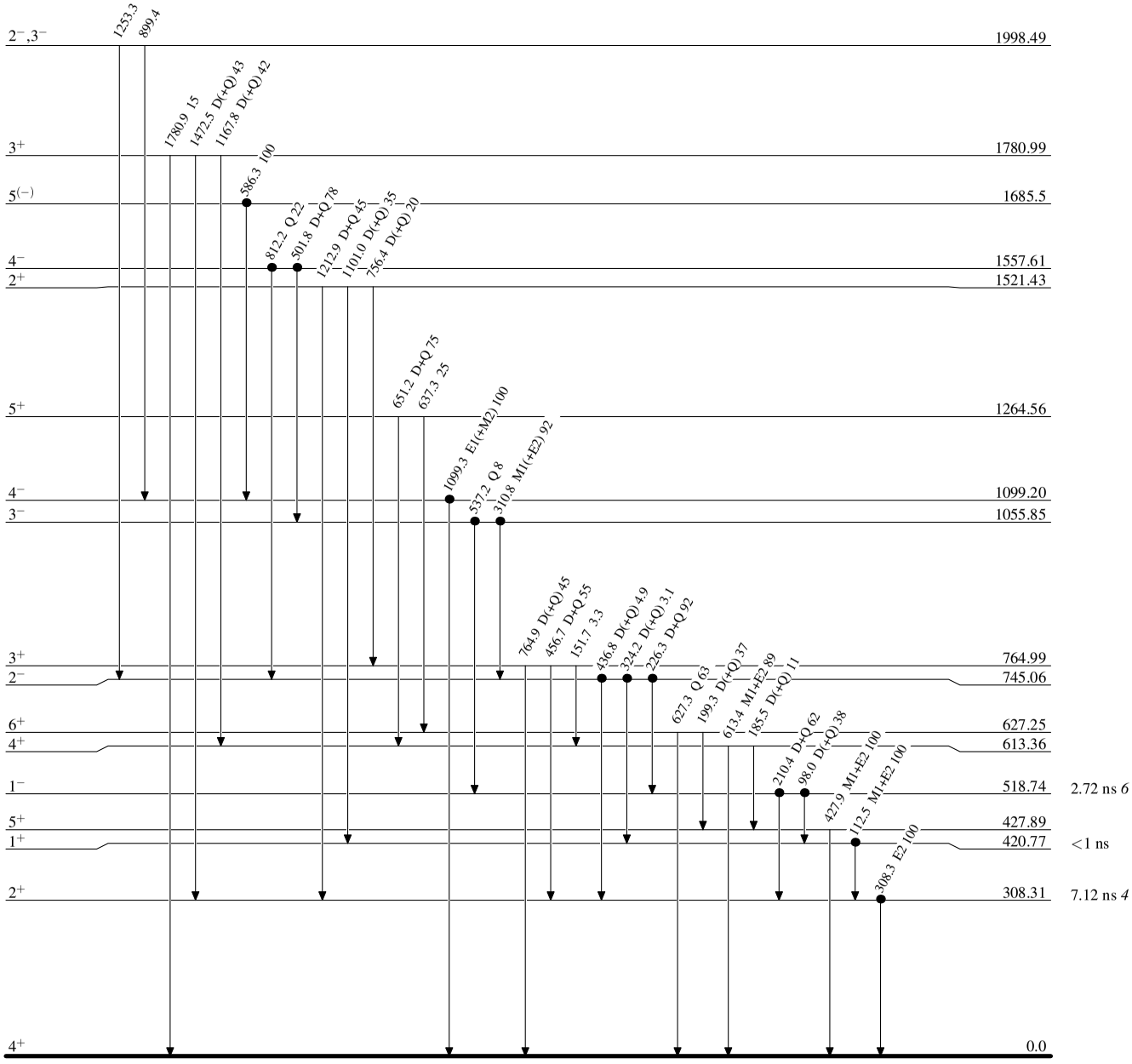
^{48}Ti(p,nγ) 1973SaZF,1973SaYJ,1976Ri01

Legend

Level Scheme

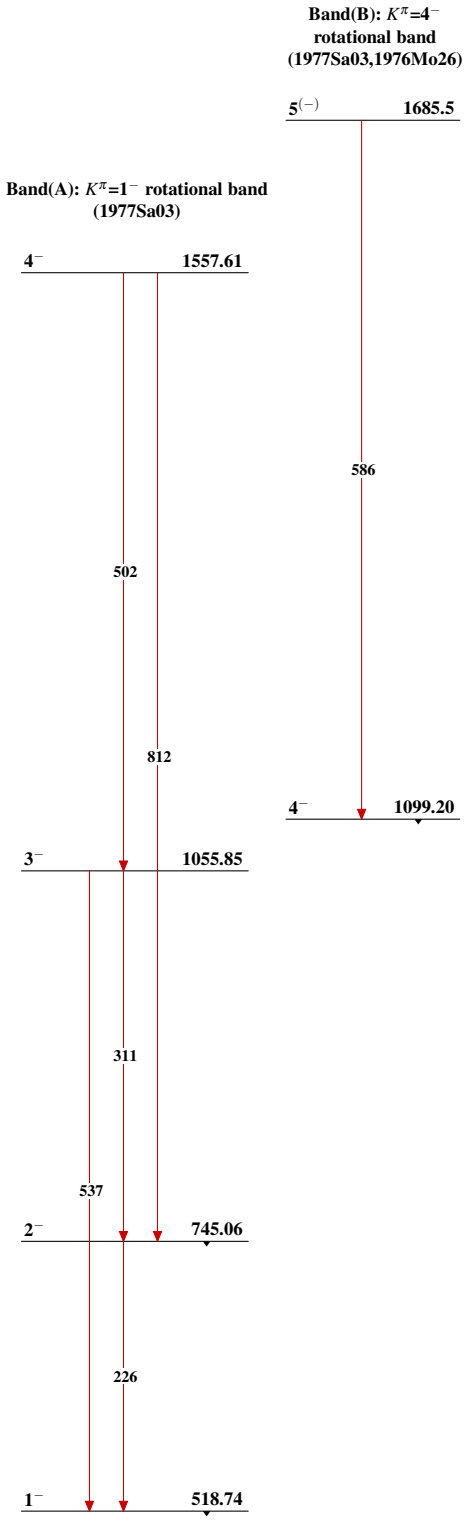
Intensities: % photon branching from each level

● Coincidence



$^{48}_{23}V_{25}$

^{48}Ti(p,nγ) 1973SaZF,1973SaYJ,1976Ri01



$^{48}_{23}V_{25}$