^{231}Pa(pol d,t) 2013Ko11

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	17-Feb-2014

2013Ko11 (also 2012Ko37): E=22 MeV, 80% polarized deuteron beam from the Garching/Munich Tandem accelerator at the Maier-Leibnitz- Laboratory. Target=140 μg/cm^2 radioactive (28 KBq) ^{231}Pa. Measured triton spectra, $\sigma(\theta)$ using the Munich Q3D magnetic spectrometer and multiwire proportional chamber. Calibration done using known spectra from ^{234}U(d,t)^{233}U and ^{230}Th(d,t)^{229}Th reactions. FWHM=6.9 keV to 12.6 keV. Deduced levels, J, π, bands, configurations. DWBA analysis. In 2012Ko37, eleven excited states up to 199 keV were reported.

J^π(^{231}Pa g.s.)=3/2$^-$.

dσ/dΩ in μb/sr (2013Ko11)

Level	5°	10°	15°	20°	25°
0 1	10.3 8	27 2	67 5	51 4	59 4
28 1	8.1 7	23 2	55 4	46 3	51 4
48 1	7.1 6	20 2	50 4	37 3	44 3
66 1	25 2	64 13	174 16	155 13	172 25
69 2	4 1	12 12	33 9	34 7	29 22
104 1	7.1 7	20 2	73 6	78 6	78 6
112 1	1.3 3	3.6 5	13 2	20 2	16 2
146 1	1.4 2	4.9 4	15 1	17 1	17 1
157 1	2.9 3	8.6 7	24 2	23 2	27 2
170 1	8.5 7	25 2	111 8	162 12	152 11
199 1	3.4 4	9 1	22 4	42 6	45 4
202 1		20 4	18 5	13 3	
223 1	2.5 3	5.8 5	27 2	38 3	38 3
237 1	1.3 2	3.0 5	16 2	22 2	
247 1	3.3 4	7.7 8	32 3	41 3	41 3
259 1	2 2	3.5 4	16 2	20 2	23 2
284 1	2 2	2.8 2	11 1	15 1	16 1
297 1	1.6 2	2.7 4	10 1	13 1	18 1
312 1	1.8 3	5.2 6	21 2	25 2	26 2
322 1	4.2 5	14 1	37 3	31 3	38 3
341 1	2.1 3	8 1	21 3	16 2	17 2
350 1	5.7 5	8 2	32 8	27 4	34 4
357 1	3.1 6	2 2	8 8	16 4	24 4
373 1	4.1 4	14 1	49 4	58 4	69 5
401 1	3.6 5	8 2	27 4	34 3	37 5
409 1	2.0 4	8 2	20 3	15 2	20 4
423 1	1.9 2	5.1 5	14 1	11 1	11 1
437 1	1.1 2	2.3 3	8.2 8	15 1	21 2
455 1	2.3 3	4.8 5	18 2	14 2	20 3
465 1	1.5 3	4.7 5	17 2	30 3	33 3
488 1	20 2	33 2	60 5	76 6	94 7
497 1	11 3	8.5 9	29 3	20 2	25 2
506 1	3.0 4	4.5 5	16 2	19 2	21 2
518 1	3.4 4	9.9 8	31 3	44 3	46 3
532 1	10 1	8 1	41 9	23 4	37 5
538 1	9 1	23 2	37 9	50 5	55 6
559 1	119 9	215 15	387 29	443 33	576 44
580 1	10.0 9	13 1	48 4	40 3	46 4
594 1	13 1	18 1	30 3	38 3	49 4
605 1	6.0 6	14 1	39 3	33 3	39 3
618 1	13 1	34 2	68 5	83 6	83 6
634 1	277 20	475 34	772 58	949 71	1192 90
641 1	50 4	101 8	161 14	232 19	260 21
662 1	19 2	36 3	72 5	80 6	100 7
689 1		201 15	235 17	240 17	

713 *1*	38 *3*	70 *5*	140 *10*	158 *11*	190 *14*
735 *1*	9.0 *9*	17 *1*	39 *4*	43 *4*	42 *3*
747 *1*	36 *3*	65 *5*	106 *17*	144 *12*	179 *14*
755 *1*	6 *1*	12 *2*	56 *15*	32 *5*	36 *5*
772 *1*	24 *2*	33 *3*	65 *7*	68 *24*	98 *8*
795 *1*	5.1 *6*	13 *1*	28 *3*	28 *2*	30 *3*
807 *1*	12 *1*	24 *2*	53 *4*	60 *5*	66 *5*
828 *1*	13 *1*	28 *2*	67 *5*	75 *5*	84 *6*
865 *1*	10 *2*	24 *2*	80 *7*	84 *7*	84 *7*
873 *1*	14 *2*	24 *2*	59 *6*	64 *5*	78 *6*
887 *1*	7 *1*	30 *2*	159 *12*	193 *14*	167 *13*
906 *1*	7.2 *8*	28 *3*	35 *3*	29 *3*	
921 *1*	13 *1*	40 *3*	180 *13*	222 *16*	202 *15*
944 *1*	15 *1*	19 *2*	66 *5*	51 *4*	64 *5*
958 *1*	6 *2*	14 *1*	68 *6*	75 *6*	61 *5*
969 *1*	17 *2*	39 *3*	128 *10*	153 *11*	160 *12*
992 *1*	26 *2*	67 *5*	267 *20*	331 *24*	315 *23*
1012 *1*	12 *1*	19 *2*	17 *3*	23 *3*	33 *4*
1026 *1*	37 *4*	104 *9*	117 *9*	126 *10*	
1035 *1*	26 *3*	132 *11*	172 *13*	151 *12*	
1057 *1*	25 *2*	51 *4*	131 *10*	156 *11*	176 *13*
1092 *1*	26 *2*	62 *5*	116 *10*	214 *16*	219 *16*
1112 *1*	27 *2*	51 *4*	79 *6*	126 *9*	148 *11*
1129 *1*	14 *1*	33 *3*	84 *7*	98 *4*	105 *8*
1145 *1*	19 *2*	35 *3*	67 *6*	91 *7*	108 *8*
1163 *1*	10 *1*	22 *3*	40 *13*	56 *9*	50 *6*
1173 *1*	79 *6*	117 *21*	220 *57*	334 *25*	424 *31*
1195 *1*	35 *3*	64 *5*	109 *9*	142 *11*	170 *13*
1211 *1*	29 *3*	39 *7*	81 *9*	117 *17*	141 *13*
1218 *1*	13 *2*	35 *7*	67 *9*	70 *14*	79 *10*
1243 *1*	19 *2*	38 *3*	81 *7*	98 *8*	114 *9*
1256 *1*	9 *1*	18 *2*	35 *4*	40 *5*	47 *5*
1318 *1*	38 *6*	46 *3*	102 *8*	121 *9*	138 *10*
1336 *1*	27 *3*	53 *5*	105 *8*	125 *12*	160 *13*
1349 *1*	34 *1*	42 *8*	59 *5*	40 *6*	
1361 *1*	42 *3*	83 *6*	132 *12*	176 *13*	217 *16*

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dσ/dΩ in μb/sr (2013Ko11)

Level	30°	35°	40°	45°
0 *1*	54 *4*	56 *4*	43 *3*	30 *2*
28 *1*	45 *3*	49 *4*	40 *3*	25 *2*
48 *1*	42 *3*	41 *3*	36 *3*	23 *2*
66 *1*	160 *18*	85 *6*	126 *39*	82 *12*
69 *2*	23 *14*	31 *11*	25 *10*	
104 *1*	72 *6*	72 *5*	70 *5*	45 *4*
112 *1*	11 *1*	12 *1*	9 *1*	
146 *1*	17 *1*	15 *1*	17 *1*	11 *1*
157 *1*	25 *2*	22 *2*	22 *2*	12 *1*
170 *1*	131 *10*	134 *10*	127 *10*	90 *7*
199 *1*	35 *5*	48 *4*	37 *4*	34 *3*
202 *1*	19 *5*			
223 *1*	37 *3*	37 *3*	38 *3*	24 *2*
237 *1*	22 *2*	21 *2*	23 *2*	17 *2*
247 *1*	39 *3*	36 *3*	38 *3*	24 *2*
259 *1*	21 *2*	19 *2*	21 *2*	15 *1*
284 *1*	14 *1*	14 *1*	15 *1*	11 *1*
297 *1*	17 *1*	15 *1*	16 *1*	10 *1*
312 *1*	28 *2*	29 *2*	26 *2*	22 *2*
322 *1*	37 *3*	32 *3*	33 *3*	18 *2*
341 *1*	18 *2*	15 *2*	19 *2*	11 *1*
350 *1*	37 *4*	32 *3*	30 *4*	21 *2*
357 *1*	18 *3*	22 *2*	20 *4*	15 *2*

373 *1*	63 *5*	61 *5*	59 *4*	40 *3*
401 *1*	37 *7*	30 *5*	33 *3*	24 *2*
409 *1*	22 *7*	21 *5*	13 *2*	12 *2*
423 *1*	11 *1*	10 *1*	11 *1*	5.7 *8*
437 *1*	19 *1*	18 *2*	20 *2*	13 *1*
455 *1*	14 *2*	11 *2*	14 *2*	11 *3*
465 *1*	38 *3*	42 *4*	39 *4*	27 *4*
488 *1*	86 *7*	82 *6*	69 *5*	58 *5*
497 *1*	26 *2*	21 *2*	21 *2*	15 *2*
506 *1*	20 *2*	20 *2*	21 *2*	14 *2*
518 *1*	39 *4*	43 *3*	37 *3*	28 *2*
532 *1*	39 *4*	31 *3*	23 *4*	20 *2*
538 *1*	50 *5*	51 *5*	51 *5*	38 *3*
559 *1*	532 *41*	523 *38*	428 *31*	337 *25*
580 *1*	44 *3*	38 *3*	34 *3*	28 *2*
594 *1*	46 *3*	44 *3*	37 *3*	29 *2*
605 *1*	39 *3*	34 *3*	33 *3*	24 *2*
618 *1*	74 *5*	76 *6*	74 *5*	59 *4*
634 *1*	1109 *85*	1069 *78*	874 *64*	697 *53*
641 *1*	237 *19*	252 *20*	221 *18*	158 *13*
662 *1*	87 *6*	82 *6*	70 *5*	59 *4*
689 *1*	214 *16*	213 *16*	194 *14*	167 *12*
713 *1*	173 *13*	171 *12*	150 *11*	115 *8*
735 *1*	33 *3*	38 *3*	39 *3*	26 *3*
747 *1*	181 *14*	165 *14*	123 *18*	107 *9*
755 *1*		32 *7*	38 *16*	23 *4*
772 *1*	75 *7*	103 *7*	96 *7*	69 *5*
795 *1*	31 *2*	28 *2*	21 *1*	19 *2*
807 *1*	61 *5*	62 *5*	57 *4*	40 *3*
828 *1*	76 *6*	77 *6*	68 *5*	54 *4*
865 *1*	77 *6*	72 *6*	70 *5*	56 *4*
873 *1*	70 *5*	68 *5*	69 *6*	45 *4*
887 *1*	161 *12*	183 *14*	159 *12*	132 *10*
906 *1*	24 *2*	32 *3*	23 *2*	20 *2*
921 *1*	194 *15*	210 *16*	193 *14*	150 *11*
944 *1*	56 *4*	43 *3*	41 *3*	31 *3*
958 *1*	67 *5*	65 *5*	59 *5*	44 *4*
969 *1*	145 *11*	156 *11*	148 *11*	114 *8*
992 *1*	292 *22*	311 *23*	290 *21*	227 *17*
1012 *1*	24 *3*	25 *3*	24 *3*	17 *2*
1026 *1*	127 *10*	119 *9*	109 *9*	90 *7*
1035 *1*	138 *11*	159 *12*	145 *12*	109 *9*
1057 *1*	154 *11*	152 *11*	148 *11*	107 *8*
1092 *1*	199 *15*	204 *15*	165 *14*	160 *12*
1112 *1*	123 *9*	132 *10*	89 *7*	83 *6*
1129 *1*	98 *2*	110 *8*	99 *8*	
1145 *1*	90 *7*	95 *7*	89 *7*	62 *5*
1163 *1*	44 *4*	40 *6*	32 *4*	38 *8*
1173 *1*	363 *26*	384 *28*	367 *27*	260 *20*
1195 *1*	146 *11*	156 *12*	152 *11*	105 *8*
1211 *1*	99 *7*	106 *11*	91 *14*	58 *11*
1218 *1*	86 *8*	88 *10*	95 *14*	71 *10*
1243 *1*	93 *7*	104 *8*	102 *8*	70 *6*
1256 *1*	42 *4*	44 *4*	38 *4*	25 *3*
1318 *1*	116 *8*	124 *9*	106 *8*	84 *6*
1336 *1*	134 *10*	149 *11*	131 *10*	83 *9*
1349 *1*	41 *7*	44 *8*		42 *6*
1361 *1*	174 *13*	184 *15*	187 *14*	135 *10*

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^{231}Pa(pol d,t) 2013Ko11 (continued)

^{230}Pa Levels

E(level)†	Jπ#	Comments
0@ 1	2⁻	
28@ 1	(3⁻)	
48& 1	(2⁻)	
66@ 1	(4⁻)	
69& 2	(3⁻)	
104& 1	(4⁻)	
112@ 1	(5⁻)	
146& 1	(5⁻)	
157a 1	(3⁻)	
170@ 1	(6⁻)	
199a 1	(4⁻)	In 2012Ko37, this level was considered as possible 6⁻ member of configuration=π1/2[530]-ν5/2[633], K^{π}=2⁻.
202b 1	(0⁻)	
223 1		
237b 1	(2⁻)	
247a 1	(5⁻)	
259c 1	(1⁻)	
284c 1	(2⁻)	
297b 1	(1⁻)	
312‡a 1	(6⁻)	
312‡c 1	(3⁻)	
322b 1	(4⁻)	
341d 1	(1⁻)	
350c 1	(4⁻)	
357b 1	(3⁻)	
373d 1	(2⁻)	
401c 1	(5⁻)	
409 1		
423d 1	(3⁻)	
437 1		
455b 1	(6⁻)	
465‡b 1	(5⁻)	
465‡c 1	(6⁻)	
488‡d 1	(4⁻)	
488‡e 1	(0⁺)	
497 1		
506 1		
518e 1	(2⁺)	
532 1		
538 1		
559e 1	(1⁺)	
580 1		
594e 1	(4⁺)	
605 1		
618e 1	(3⁺)	
634 1		
641 1		
662 1		
689f 1	(1⁺)	

Continued on next page (footnotes at end of table)

^{231}Pa(pol d,t) 2013Ko11 (continued)

^{230}Pa Levels (continued)

E(level)†	Jπ#	E(level)†	Jπ#	E(level)†	Jπ#	E(level)†
713[f] *1*	(2+)	887[i] *1*	(2+)	1035[j] *1*	(3+)	1218 *1*
735[g] *1*	(2+)	906[h] *1*	(2+)	1057 *1*		1243 *1*
747[f] *1*	(3+)	921[i] *1*	(3+)	1092[j] *1*	(4+)	1256 *1*
755 *1*		944 *1*		1112[h] *1*	(5+)	1318 *1*
772[g] *1*	(3+)	958[h] *1*	(3+)	1129 *1*		1336 *1*
795[f] *1*	(4+)	969[i] *1*	(4+)	1145 *1*		1349 *1*
807 *1*		992 *1*		1163[j] *1*	(5+)	1361 *1*
828[g] *1*	(4+)	1012 *1*		1173 *1*		
865 *1*		1026‡[h] *1*	(4+)	1195 *1*		
873[h] *1*	(1+)	1026‡[i] *1*	(5+)	1211[h] *1*	(6+)	

† Uncertainty is approximately 1 keV, determined from both the statistical uncertainty in the peak position and the uncertainty in the calibration polynomial.

‡ 312, 465, 488 and 1026 are interpreted as doublets from analysis of measured cross sections and comparison with theoretical values for assigned configurations.

From fingerprint method (2013Ko11).

@ Band(A): $K^\pi=2^-$, $\pi1/2[530]+\nu3/2[631]$. While configuration=$\pi1/2[530]+\nu3/2[631]$, p=2^- is more probable, $\pi1/2[530]-\nu5/2[633]$, $K^\pi=2^-$ cannot be ruled out.

& Band(B): $K^\pi=2^-$, $\pi1/2[530]-\nu5/2[633]$. While configuration=$\pi1/2[530]-\nu5/2[633]$, p=2^- is more probable, $\pi1/2[530]+\nu3/2[631]$, $K^\pi=2^-$ cannot be ruled out.

[a] Band(C): $K^\pi=3^-$, $\pi1/2[530]+\nu5/2[633]$.

[b] Band(D): $K^\pi=0^-$, $\pi1/2[530]-\nu1/2[631]$.

[c] Band(E): $K^\pi=1^-$, $\pi1/2[530]-\nu3/2[631]$.

[d] Band(F): $K^\pi=1^-$, $\pi1/2[530]+\nu1/2[631]$.

[e] Band(G): $K^\pi=0^+$, $\pi1/2[530]-\nu1/2[501]$.

[f] Band(H): $K^\pi=1^+$, $\pi1/2[530]+\nu1/2[501]$.

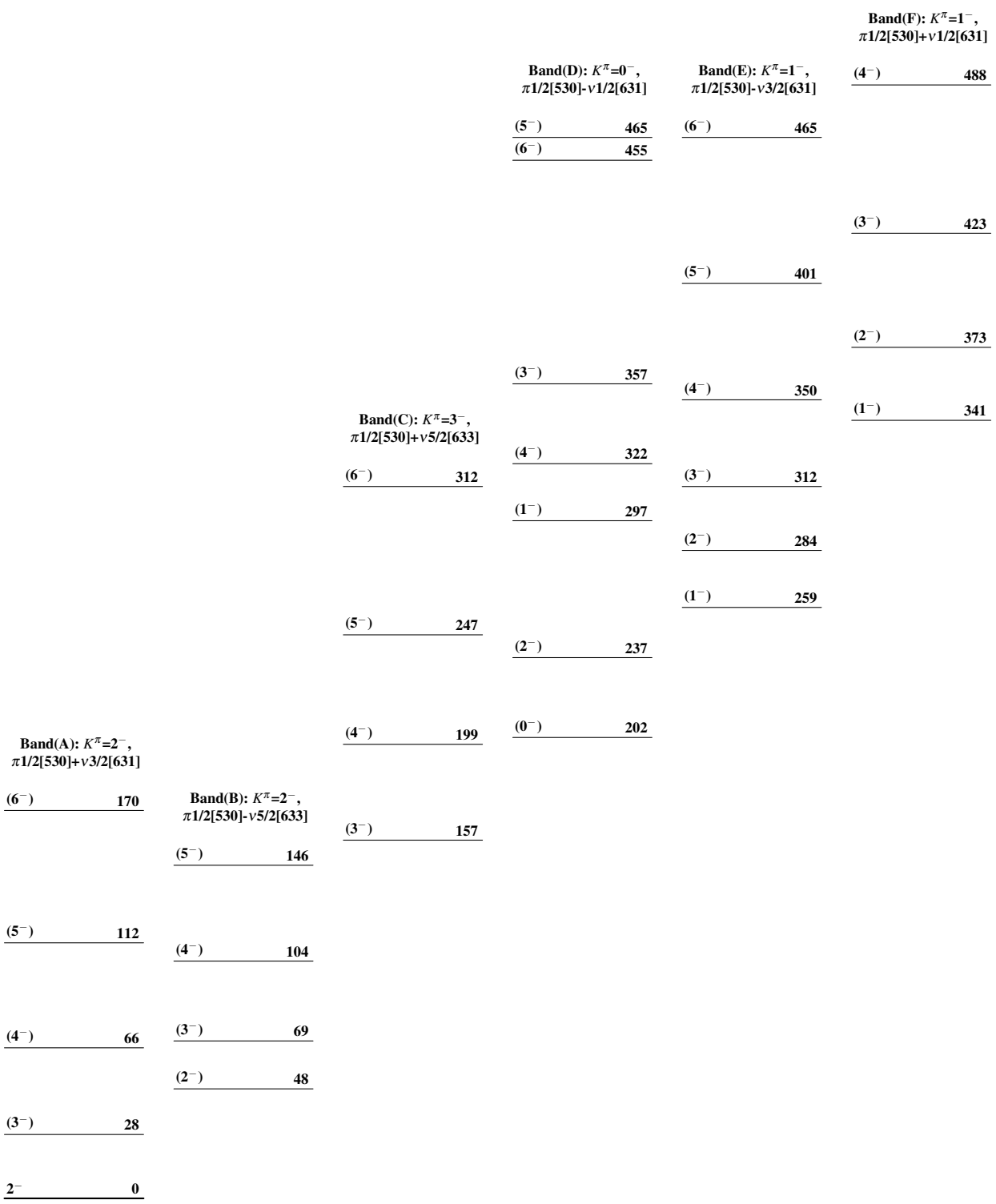
[g] Band(I): $K^\pi=2^+$, $\pi1/2[530]+\nu3/2[501]$.

[h] Band(J): $K^\pi=1^+$, $\pi1/2[530]-\nu3/2[501]$.

[i] Band(K): $K^\pi=2^+$, $\pi1/2[530]-\nu5/2[503]$.

[j] Band(L): $K^\pi=3^+$, $\pi1/2[530]+\nu5/2[503]$.

^{231}Pa(pol d,t) 2013Ko11



$^{230}_{91}Pa_{139}$

^{231}Pa(pol d,t) 2013Ko11 (continued)