^{226}Ra(α,t) 1988Ma18

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Ictp-2014 Workshop Group	NDS 132, 257 (2016)	15-Jan-2016

1988Ma18 (also 1986MaYU thesis): E(α)=30 MeV. Target=radioactive ^{226}Ra of ≈40 μg/cm^2 thickness on carbon backing. Measured α spectra at θ=40°, 60°, and 70° using Enge split-pole magnetic spectrometer at McMaster accelerator facility. FWHM=14-16 keV. DWBA analysis. Deduced levels, J, π, bands.

The K^π=3/2$^-$ (g.s.) and K^π=3/2$^+$ (27 keV), and also the K^π=1/2$^-$ (354 keV) and K^π=1/2$^+$ (435 keV) opposite-parity nearly degenerate rotational bands had been previously interpreted by 1983Sh16 as due to the coupling of a single-particle Nilsson state with an octupole-deformed core. However, a comparison between experimental and theoretical (DWBA) spectroscopic factors in (α,t) could not confirm this interpretation. Moreover, the experimental spectroscopic factors agree better with values calculated assuming a pure prolate-deformed core, than with those which include an octupole deformation (1988Ma18).

Experimental absolute cross sections at 70° for members of 3/2[532], 3/2[651], 1/2[530] and 1/2[660] bands were compared (in 1986MaZU) with theoretical values calculated for reflection symmetric and reflection asymmetric cases with octupole deformations of 0.03 and 0.09. No clear picture seemed to have emerged about the static octupole deformation of ^{227}Ac. See Table III C.4 in 1986MaZU for details.

Cross sections in μb/sr (1986MaYU)

Level	dσ/dΩ (70°)	dσ/dΩ (40°)	dσ/dΩ (60°)
0	<2	<1	<1
27		<2	<2
30	4.7 7	2.5 30	3.7 20
46	<1	3.2 10	<1
74	7.6 10	7.1 10	9.2 10
84/85	2.5 10	4.5 10	3.3 10
110	11.6 10	16.1 20	12.0 10
127	31.5 20	24.4 20	31.2 30
148	2.5 7		
160		<1	<1
187	<3	5.4 10	<3
199	<2	2.7 20	1.5 20
211	50.2 30	68.9 30	72.6 40
226/228/225	8.6 20	8.8 20	8.0 20
250/247		2.7 10	<2
271	<2		<2
273		5.2 10	
305	2.4 9	6.1 20	1.1
316/314/319	13.7 20	18.6 30	15.3 50
330	18.1 20	15.4 20	14.8 20
336			10 14
347	5.8 30		
354/355	5.5 50	12.1 20	10.2 20
372	25.2 20	25.0 30	25.1 30
387	36.1 40	37.6 30	50.3 40
397/409/403	9.7 30	6.6 [I20	8.2
428	1.4 7	8 13	
438	10.1 10	16 9	14.5 30
469	2.9 10	3.2 10	2.6 10b
501	5.7 10	2.7 20	4.5 30b
509		<1	a
514	2.7 10	3.7 40	8.7 70b
526/529	13.4 20	28 6	20.5 80b
537	16.8 20	<2	25 11b
547/550		5.6 40	9.2 20b
563/562	4.4 9	4.6 20	5.4 30b
577		2.6 10	7.2 20b
590/594	10.8 10	15.0 20	21.9 20b
639	<2	<2	a
657	<1		a

698	<1	3.6 *10*	a
790	<1	3.1 *10*	a
864	<2	<1	a
875	<2	a	a
1069/1064	12.1 *10*	10.6 *40*b	15.2 *20*
1092/1089	26.9 *30*	12.8 *40*b	24.9 *30*

a: No σ value is available due to impurity
b: Peak on top of impurities, intensity quoted is upper limit

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^{227}Ac Levels

E(level)[†]	J^π[‡]	[(2J+1)/2]S[#]	Comments
0[a]	$3/2^-$	0.012 *3*	
27[&b]	$3/2^+$	<0.017	
30[&a]	$5/2^-$	<0.051	
46[b]	$5/2^+$	0.009 *4*	
74[a]	$7/2^-$	0.087 *7*	
85[b]	$7/2^+$	0.033 *6*	
110[b]	$9/2^+$	0.12 *1*	
127[a]	$9/2^-$	0.76 *7*	Theoretical [(2J+1)/2]S=0.939 (symmetric), 0.336 (asymmetric).
148 *5*			
187[b]	$11/2^+$	0.14 *3*	
199[a]	$11/2^-$	0.06 *2*	
211[b]	$13/2^+$	2.1 *1*	Theoretical [(2J+1)/2]S=1.55 (symmetric), 0.70 (asymmetric).
227 *2*			
249[@] *2*			
271[&a]	$13/2^-$	<0.076	
273[&c]	$(5/2^-)$	<0.067	
305[d]	$(5/2^+)$	0.017 *7*	
316[c] *2*	$(7/2^-)$	0.18 *2*	Theoretical [(2J+1)/2]S=0.0216 (symmetric), 0.095 (asymmetric).
330[e]	$3/2^-$	0.20 *3*	Theoretical [(2J+1)/2]S=0.111 (symmetric), 0.159 (asymmetric).
342[d] *5*	$(7/2^+)$	0.06 *2*	
355[e]	$1/2^-$	0.12 *4*	Theoretical [(2J+1)/2]S=0.0146 (symmetric), 0.043 (asymmetric).
372[c] *2*	$(9/2^-)$	0.73 *4*	Theoretical [(2J+1)/2]S=0.667 (symmetric), 0.381 (asymmetric).
387[e]	$7/2^-$	0.51 *3*	Theoretical [(2J+1)/2]S=0.51 (symmetric), 0.20 (asymmetric).
403[d] *5*	$(9/2^+)$	0.08 *1*	
428[f]	$5/2^+$	<0.02	E(level): unresolved peak, 426 in Table ii of 1988Ma14.
435[&f]	$1/2^+$	<0.20	Theoretical [(2J+1)/2]S=0.0002 (symmetric), 0.060 (asymmetric).
438[&e]	$5/2^-$	<0.14	
469[f]	$9/2^+$	0.032 *5*	
501			
515			
528[d] *3*	$(13/2^+)$	0.58 *9*	Theoretical [(2J+1)/2]S=0.288 (symmetric), 0.202 (asymmetric).
537[f]	$3/2^+$	0.12 *3*	5/2[642] Nilsson assignment in Adopted Levels.
549 *3*			
563			
577[@e]	$9/2^-$	0.11 *5*	Theoretical [(2J+1)/2]S=0.165 (symmetric), 0.135 (asymmetric).
593[f] *2*	$(13/2^+)$	0.53 *9*	Theoretical [(2J+1)/2]S=0.419 (symmetric), 0.028 (asymmetric). E(level): 591 in Table II of 1988Ma18.
639			
657[f]	$7/2^+$	<0.011	E(level): unresolved peak, 656 in Table ii of 1988Ma14.
698			

Continued on next page (footnotes at end of table)

^{226}Ra(α,t) 1988Ma18 (continued)

^{227}Ac Levels (continued)

E(level)†
790
864
875
1068 *2*
1091 *2*

† Energies were obtained by fixing known levels in the deuteron spectrum within ±1 keV. 1988Ma18 also state that uncertainties are <2 keV for well-resolved peaks but are greater for weak or poorly resolved peaks. Levels listed with energy uncertainties were newly proposed by 1988Ma18.

‡ From 1988Ma18 based on comparison of experimental and theoretical cross sections for band members (fingerprint method). See also Adopted Levels for assignments of octupole parity doublet bands.

S=(2J+1)N[dσ/dΩ (exp)/dσ/dΩ(DWBA)]; where N=104. 1988Ma18 also define it as $(\Sigma a_\Omega C_{JL\Omega} U_\Omega)^2$, summed over Ω states; $C_{JL\Omega}$ are the spherical amplitudes of the Nilsson states NΩ, a_Ω are the mixing amplitudes, and U_Ω are pairing factors. Here J=spin of the state, L=orbital angular momentum transfer. See also 1988Le13 for an interpretation of the data using a different normalization factor.

@ Observed only at θ=40° and 60°.

& Unresolved doublets: 27 and 30 keV with a mean energy of 30 keV 271 and 273 keV with a mean energy of 272 keV; 437 and 438 keV with a mean energy of 438 keV. Mean energies are from Table I in 1988Ma18.

[a] Band(A): π3/2[532] band. Comparison of theoretical and experimental spectroscopic factors for 127,9/2$^-$ level supports reflection symmetric interpretation over the reflection asymmetric. For other band members, with small spectroscopic factors, no definite conclusions can be made.

[b] Band(B): π3/2[651] band. Comparison of theoretical and experimental spectroscopic factors for 211,13/2$^+$ level supports reflection symmetric interpretation over the reflection asymmetric. For other band members, with small spectroscopic factors, no definite conclusions can be made.

[c] Band(C): π5/2[523] band. Comparison of theoretical and experimental spectroscopic factors for 373,9/2$^-$ level supports reflection symmetric interpretation over the reflection asymmetric, while for 316,7/2$^-$ member, reflection asymmetric character is favored. For other band members, with small spectroscopic factors, no definite conclusions can be made.

[d] Band(D): π5/2[642] band. Comparison of theoretical and experimental spectroscopic factors for 527,13/2$^+$ level somewhat favors reflection symmetric interpretation over the reflection asymmetric. For other band members, with small spectroscopic factors, no definite conclusions can be made.

[e] Band(E): π1/2[530] band. Comparison of theoretical and experimental spectroscopic factors for 387,7/2$^-$ level supports reflection symmetric interpretation over the reflection asymmetric, while for 355,1/2$^-$ member, reflection asymmetric character is somewhat favored. For 330,3/2$^-$, and 577,9/2$^-$ members, both interpretations seem valid. For other band members, with small spectroscopic factors, no definite conclusions can be made.

[f] Band(F): π1/2[660] band. Comparison of theoretical and experimental spectroscopic factors for 593,13/2$^+$ level supports reflection symmetric interpretation over the reflection asymmetric, while for 435,1/2$^+$ member, reflection asymmetric character is somewhat favored. For other band members, with small spectroscopic factors, no definite conclusions can be made.

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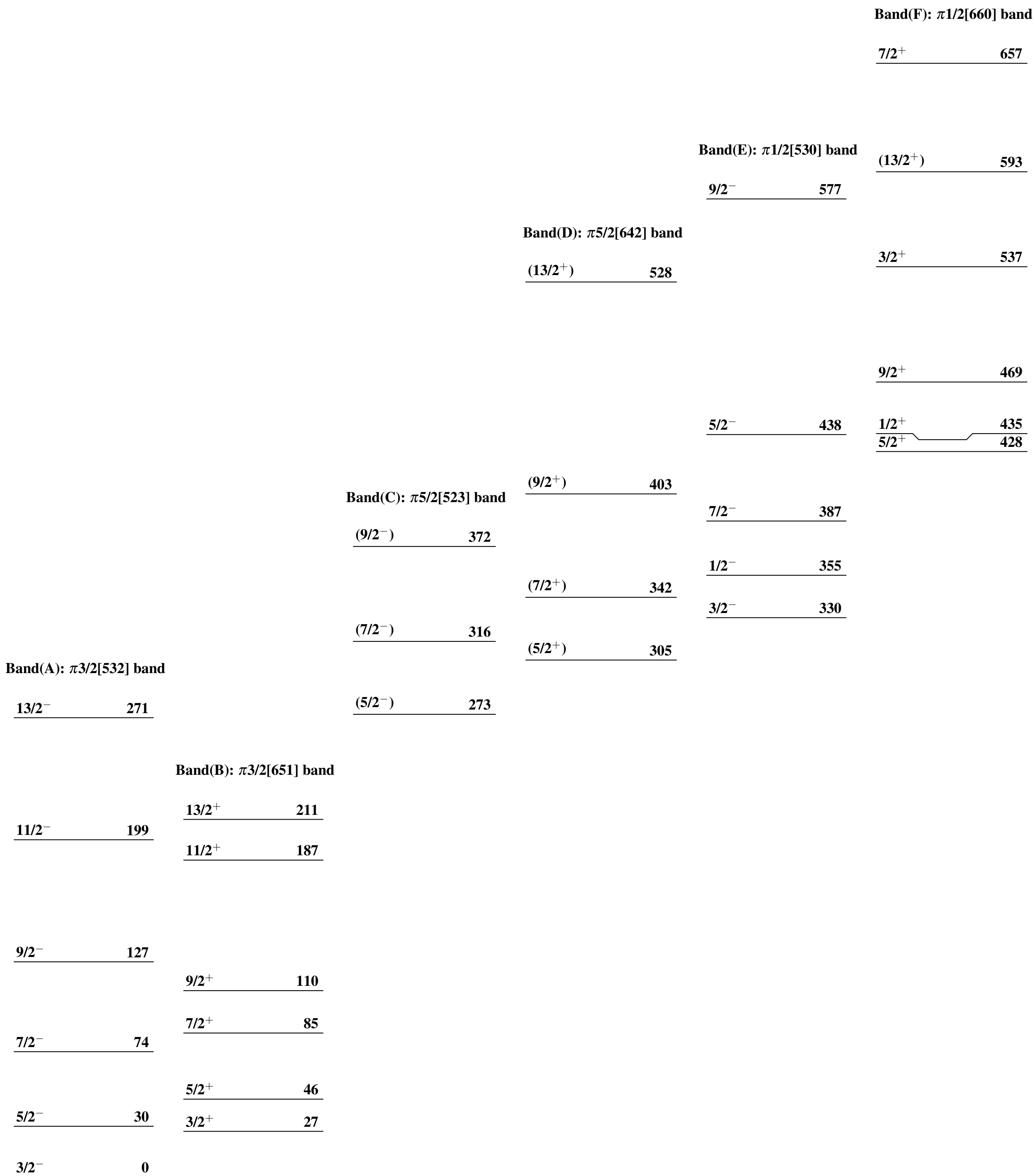

$^{227}_{89}Ac_{138}$