^{139}La(α,4nγ):prompt 1988Ar07,1980Pi03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	P. K. Joshi, B. Singh, S. Singh, A. K. Jain	NDS 138, 1 (2016)	15-Oct-2016

1980Pi03: E=55 MeV. See ^{139}La(^{3}He,3nγ) for experimental details.
1988Ar07: E=47 MeV. Measured γ's, $\gamma\gamma$-coincidences, and $\gamma(\theta)$.
Other: 1981NaZJ.
All data are from 1988Ar07, except as noted. See also ^{140}Ce(p,2nγ).

^{139}Pr Levels

E(level)	J$^\pi$‡	Comments
0.0	5/2$^+$	
113.94 *5*	7/2$^+$	
405.12?† *8*	3/2$^+$	
822.00 *8*	11/2$^-$	
827.86 *10*	9/2$^+$	
851.90 *10*	11/2$^+$	
1024.04 *12*	9/2$^+$	
1124.04 *12*		
1369.20?† *20*	9/2$^-$,11/2$^-$	
1523.08 *11*	13/2$^-$	
1722.19 *10*	15/2$^-$	
1790.16?† *20*	(13/2)$^+$	
1833.72?† *15*	9/2$^-$,11/2$^-$	
1866.61 *14*	(15/2)$^+$	
1941.53 *11*	(17/2)$^-$	
2187.51 *12*	(19/2,15/2)$^-$	15/2, 19/2 from $\gamma(\theta)$. ≠15/2 since 246γ seen intensely in (α,4nγ) and feeding from high-spin levels.
2277.99 *14*	(15/2,19/2)$^-$	J$^\pi$: 15/2,19/2 from $\gamma(\theta)$.
2367.15 *13*	(21/2,17/2,13/2)$^-$	J$^\pi$: 21/2,17/2 from $\gamma(\theta)$ if J^π(2188)=19/2. ≠17/2 from yrast arguments.
2481.41 *16*	(21/2,17/2)	J$^\pi$: from $\gamma(\theta)$.
2741.41 *19*		
2761.14 *14*	(15/2,19/2)$^-$	J$^\pi$: 15/2,19/2 from $\gamma(\theta)$.
2821.25 *13*	(21/2,17/2,13/2)$^+$	J$^\pi$: 21/2,17/2 from $\gamma(\theta)$. 1988Ar07 suggest π=(−).
2985.65 *16*		
3021.51 *14*	(23/2,19/2,15/2)$^+$	J$^\pi$: 23/2,19/2 from $\gamma(\theta)$. ≠23/2 from yrast arguments. 1988Ar07 suggest π=(−).
3204.00 *15*		
3265.94 *15*	+#	
3483.93 *16*		
3579.72 *18*	#	
3627.48 *16*	#	
3697.86 *14*	#	
3972.54 *17*		
4052.65 *16*		
4100.60 *16*		
4377.40 *18*		
4536.60 *19*		
4862.60 *22*		

† Suggested by 1980Pi03.
‡ As proposed in 1988Ar07 based on $\gamma(\theta)$ data.
# 25/2,21/2,17/2,15/2 from $\gamma(\theta)$. ≠15/2 since (α,4nγ) unlikely to directly populate 15/2 at this excitation energy.

^{139}La(α,4nγ):prompt 1988Ar07,1980Pi03 (continued)

$\gamma(^{139}Pr)$

E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	α[a]	Comments
60.2 *1*	1.8 *1*	2821.25	(21/2,17/2,13/2)$^+$	2761.14	(15/2,19/2)$^-$			A_2=−0.03 *9*; A_4=−0.05 *14*
113.94‡ *5*	100	113.94	7/2$^+$	0.0	5/2$^+$	(M1+E2)	1.11 *22*	A_2=−0.05 *3*; A_4=+0.02 *3* α(K)=0.79 *4*; α(L)=0.25 *15*; α(M)=0.06 *4* α(N)=0.012 *8*; α(O)=0.0018 *10*; α(P)=5.1×10^{-5} *8*
128.0 *1*	1.5 *2*	4100.60		3972.54		D		A_2=−0.29 *8*; A_4=+0.09 *14*
179.64‡ *5*	46 *3*	2367.15	(21/2,17/2,13/2)$^-$	2187.51	(19/2,15/2)$^-$	D&		A_2=−0.34 *3*; A_4=+0.02 *4*
x182.5[b] *1*	@							
182.5[b] *1*	@	3204.00		3021.51	(23/2,19/2,15/2)$^+$			
199.1# *1*	14 *4*	1722.19	15/2$^-$	1523.08	13/2$^-$	D+Q		A_2=−0.28 *6*; A_4=+0.15 *7*
200.3 *1*	35 *5*	3021.51	(23/2,19/2,15/2)$^+$	2821.25	(21/2,17/2,13/2)$^+$	D+Q		A_2=−0.26 *12*; A_4=−0.19 *14*
214.0 *1*		3697.86		3483.93				I_γ: weak.
219.32‡ *5*	117 *7*	1941.53	(17/2)$^-$	1722.19	15/2$^-$	D		A_2=−0.28 *3*; A_4=+0.03 *4*
244.5[b] *1*	@	3265.94	$^+$	3021.51	(23/2,19/2,15/2)$^+$			
245.95‡ *5*	59 *4*	2187.51	(19/2,15/2)$^-$	1941.53	(17/2)$^-$	D&		A_2=−0.44 *4*; A_4=+0.03 *4* Mult.: discrepant with M1+E2, δ=−0.07 *5* from $\gamma(\theta)$ and α(K)exp in (^{3}He,3nγ).
260.0 *1*	WEAK	2741.41		2481.41	(21/2,17/2)			
280.0 *1*	20.1 *16*	3483.93		3204.00		D		A_2=−0.23 *2*; A_4=+0.04 *3*
293.9 *1*	3.4 *2*	2481.41	(21/2,17/2)	2187.51	(19/2,15/2)$^-$	D&		A_2=−0.35 *7*; A_4=−0.03 *7*
326.0 *1*	12.3 *8*	4862.60		4536.60		D		A_2=−0.31 *3*; A_4=−0.01 *4*
336.51‡ *10*	35 *2*	2277.99	(15/2,19/2)$^-$	1941.53	(17/2)$^-$	D&		A_2=−0.41 *3*; A_4=+0.01 *4*
345.0 *1*	3.6 *3*	3972.54		3627.48		D+Q		A_2=−0.49 *7*; A_4=+0.07 *9*
354.8 *1*	1.5 *1*	4052.65		3697.86		D+Q		A_2=−0.29 *9*; A_4=+0.31 *11*
382.8 *1*	1.3 *1*	3204.00		2821.25	(21/2,17/2,13/2)$^+$			
402.8 *1*	13.9 *14*	4100.60		3697.86				A_2=+0.28 *7*; A_4=−0.08 *8*
405.12‡[c] *8*		405.12?	3/2$^+$	0.0	5/2$^+$			I_γ: 2.0 *4* (1980Pi03).
418.5# *1*	6.4 *5*	1941.53	(17/2)$^-$	1523.08	13/2$^-$			
x425.6 *1*								I_γ: weak γ ray. Coin with 114γ, 199γ, 219γ, 701γ, 708γ, and 900γ but not placed by 1988Ar07.
436.0 *1*	19.0 *12*	4536.60		4100.60		D+Q		A_2=−0.46 *3*; A_4=+0.04 *4*
444.6 *1*	16.6 *11*	3265.94	$^+$	2821.25	(21/2,17/2,13/2)$^+$			A_2=+0.23 *3*; A_4=−0.05 *4*
454.1 *1*	7.1 *1*	2821.25	(21/2,17/2,13/2)$^+$	2367.15	(21/2,17/2,13/2)$^-$	Q		A_2=+0.20 *2*; A_4=+0.01 *3* Mult.: ΔJ=0 or 2.
543.3 *1*	30 *2*	2821.25	(21/2,17/2,13/2)$^+$	2277.99	(15/2,19/2)$^-$	D&		A_2=−0.34 *3*; A_4=+0.04 *4*
547.2‡[c] *2*		1369.20?	9/2$^-$,11/2$^-$	822.00	11/2$^-$			I_γ: 1.6 *3* (1980Pi03).
558.2 *1*	8.7 *6*	3579.72		3021.51	(23/2,19/2,15/2)$^+$	D+Q		A_2=−0.61 *4*; A_4=+0.06 *5*
605.9 *1*	6.4 *5*	3627.48		3021.51	(23/2,19/2,15/2)$^+$	D+Q		A_2=−0.68 *9*; A_4=+0.05 *13*
618.5 *1*	4.8 *4*	2985.65		2367.15	(21/2,17/2,13/2)$^-$			A_2=+0.23 *9*; A_4=+0.05 *12*

$^{139}_{59}Pr_{80}$-2

^{139}La(α,4nγ):prompt 1988Ar07,1980Pi03 (continued)

$\gamma(^{139}Pr)$ (continued)

E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
[x]633.6[b] *1*	@						
633.6[b] *1*	@	2821.25	(21/2,17/2,13/2)$^+$	2187.51	(19/2,15/2)$^-$		
701.12[‡] *10*	10.4 *14*	1523.08	13/2$^-$	822.00	11/2$^-$	D+Q	A_2=−0.91 *8*; A_4=+0.11 *10*
708.06 *6*	164 *10*	822.00	11/2$^-$	113.94	7/2$^+$	M2	A_2=−0.03 *3*; A_4=+0.03 *4* Mult.: from adopted gammas.
737.96[‡] *8*	28 *2*	851.90	11/2$^+$	113.94	7/2$^+$	(Q)	A_2=+0.15 *4*; A_4=−0.02 *5* Mult.: discrepant with E2+M3, δ=+0.20 *4* from $\gamma(\theta)$, α(K)exp, and conversion electron ratios in 5.5-h ε decay.
786.7 *1*	13.5 *9*	4052.65		3265.94	$^+$	D+Q	A_2=−0.26 *5*; A_4=−0.10 *5*
809.5[‡][c] *2*		1833.72?	9/2$^-$,11/2$^-$	1024.04	9/2$^+$		I_γ: 1.4 *3* (1980Pi03).
819.7 *1*	25 *2*	2761.14	(15/2,19/2)$^-$	1941.53	(17/2)$^-$	D[&]	A_2=−0.26 *6*; A_4=+0.01 *7*
822.0[#] *2*	6.7 *6*	822.00	11/2$^-$	0.0	5/2$^+$	E3	A_2=−0.03 *5*; A_4=+0.04 *6* Mult.: from adopted gammas.
827.86[‡] *10*	6.8 *5*	827.86	9/2$^+$	0.0	5/2$^+$		A_2=+0.04 *7*; A_4=+0.07 *8*
879.9[#][c] *1*		2821.25	(21/2,17/2,13/2)$^+$	1941.53	(17/2)$^-$		I_γ: weak.
900.16[‡] *8*	161 *10*	1722.19	15/2$^-$	822.00	11/2$^-$		A_2=+0.23 *3*; A_4=−0.07 *6* A_2=+0.23 *3*; A_4=−0.07 *6*
910.1 *1*	1.8 *12*	1024.04	9/2$^+$	113.94	7/2$^+$		
962.3[‡][c] *2*		1790.16?	(13/2)$^+$	827.86	9/2$^+$		I_γ: 3.8 *6* (1980Pi03).
982.0[‡][c] *2*		1833.72?	9/2$^-$,11/2$^-$	851.90	11/2$^+$		I_γ: 1.2 *3* (1980Pi03).
1010.1 *1*	@	1124.04		113.94	7/2$^+$		
1014.7[#] *1*	@	1866.61	(15/2)$^+$	851.90	11/2$^+$		
1173.4 *1*		4377.40		3204.00			I_γ: weak.
1330.7 *1*	23.2 *15*	3697.86		2367.15	(21/2,17/2,13/2)$^-$		A_2=+0.19 *3*; A_4=−0.03 *4*

[†] From $\gamma(\theta)$ and α(exp) values of 1971Bu22 (see ε decay data).
[‡] From 1980Pi03.
[#] Weighted average of results from (p,2nγ) and (α,4nγ) (1988Ar07).
[@] Member of unresolved doublet; therefore, no Iγ given by 1988Ar07.
[&] Stretched.
[a] 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.
[b] Multiply placed.
[c] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

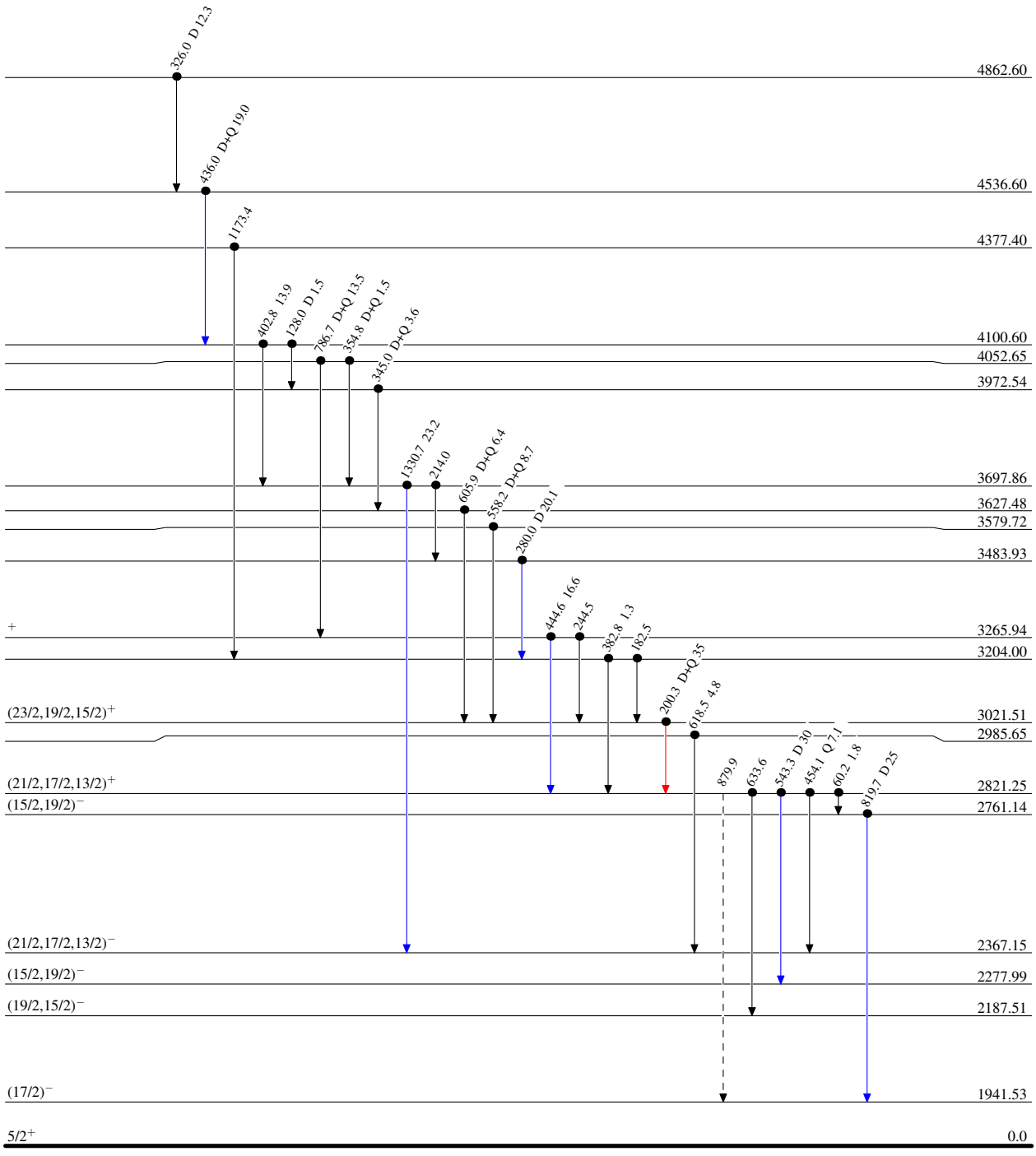
$^{139}_{59}Pr_{80}$-3

^{139}La(α,4nγ):prompt 1988Ar07,1980Pi03

Level Scheme

Intensities: Relative I_γ

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence

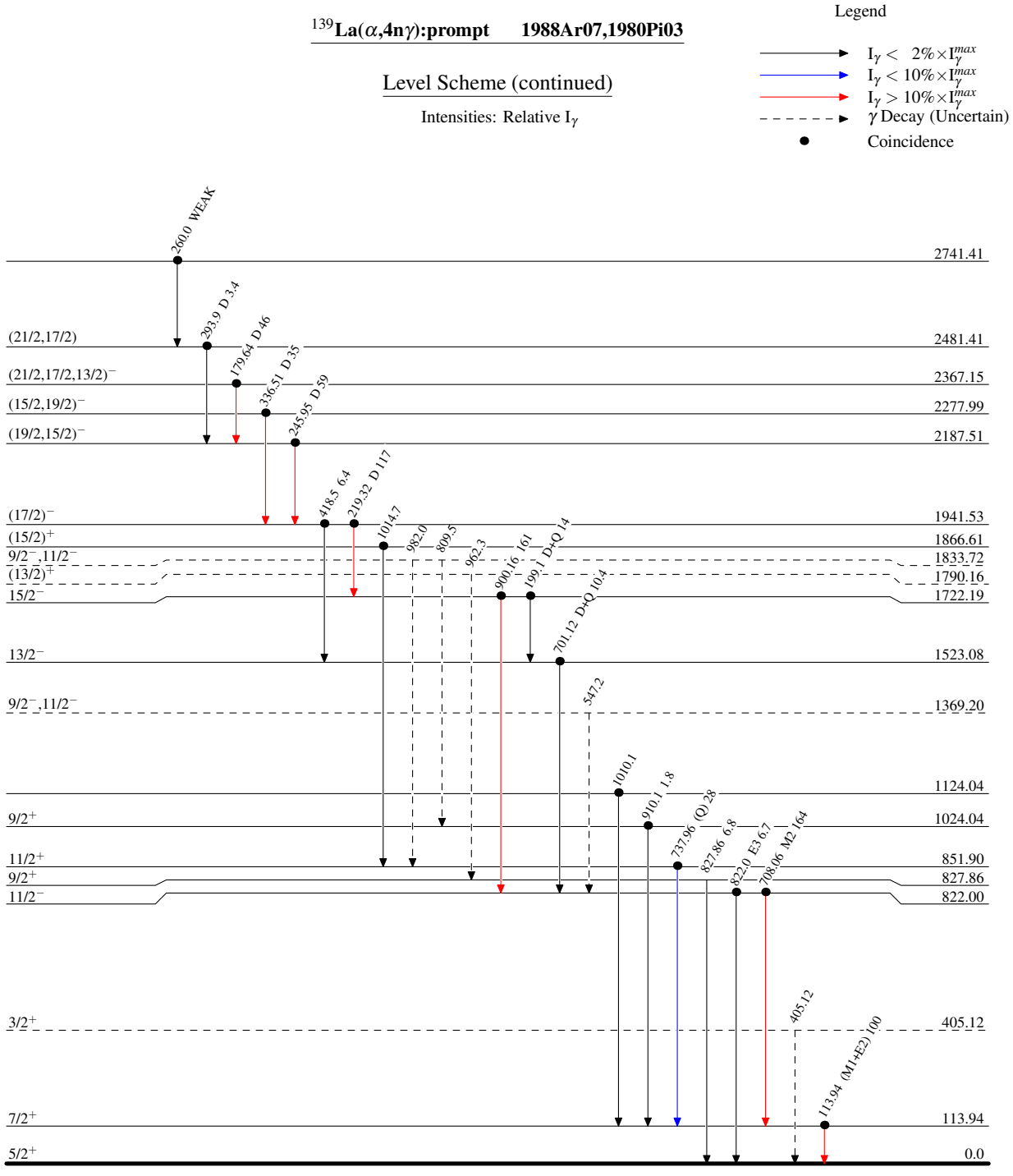


$^{139}_{59}Pr_{80}$

^{139}La(α,4nγ):prompt 1988Ar07,1980Pi03

Level Scheme (continued)

Intensities: Relative I_γ



$^{139}_{59}Pr_{80}$