^{140}Ce(p,2nγ):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=20 MeV. See ^{139}La(^{3}He,3nγ) for experimental details.
1988Ar07: E=25 MeV. See ^{139}La(α,4nγ) for experimental details.
All data are from 1988Ar07, except as noted.

^{139}Pr Levels

E(level)	J$^\pi$[†]	$T_{1/2}$	Comments
0.0	5/2$^+$		
113.93 *5*	7/2$^+$		
405.12 *7*	3/2$^+$		
589.42 *7*	(3/2,5/2)$^+$		
822.01 *7*	11/2$^-$	45.5 ns *9*	g=+1.20 *9* (1979Ke07) $T_{1/2}$: from 1979Ke07 (E=20 MeV. 708γ(t); ≈10 $T_{1/2}$'s). Other: 44 ns *4* from analysis of 708γ(θ,H,t), ≈3 $T_{1/2}$'s. g: from 708γ(θ,H,t).
827.81 *10*	9/2$^+$		
851.83 *9*	11/2$^+$		
917.12? *22*	3/2$^+$		
1024.22 *13*	9/2$^+$		
1369.71 *11*	9/2$^-$		
1523.13 *10*	13/2$^-$		
1584.23 *22*			
1624.51 *11*	(11/2,9/2)$^-$		
1722.22 *10*	15/2$^-$		
1790.12 *23*			
1833.83 *14*	(11/2,9/2)$^-$		
1866.5 *4*	(9/2,13/2)$^+$		
1926.93 *11*	(9/2,13/2)$^-$		
1941.4? *3*			See comment on 1089γ.
1941.56 *10*	17/2$^-$		
2029.63 *14*			
2187.56 *14*	(19/2,15/2)$^-$		
2278.16 *14*	(19/2,15/2)$^-$		
2367.26 *25*	(21/2,17/2)$^-$		
2456.13 *17*			
2700.53 *24*			

[†] As proposed in 1988Ar07 based on $\gamma(\theta)$ data for prompt γ rays. See Adopted Levels for recommended assignments.

γ(^{139}Pr)

A 97.8 *1* γ with Iγ=1.8 *2* placed from 1722 level in 1988Ar07 is omitted here since 1980Pi03 identified a 98γ as a contaminant from ^{140}Pr in (^{3}He,3nγ); and also not seen in any other study.

E$_\gamma$	I$_\gamma$	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.[†]	α[e]	Comments
92.9 *3*	≈1.1[‡]	1926.93	(9/2,13/2)$^-$	1833.83	(11/2,9/2)$^-$	[M1+E2]	2.2 *6*	
113.94[#] *5*	100	113.93	7/2$^+$	0.0	5/2$^+$	(M1+E2)	1.11 *22*	A_2=−0.030 *3*; A_4=−0.030 *5*
179.7[@] *2*	2.0 *3*	2367.26	(21/2,17/2)$^-$	2187.56	(19/2,15/2)$^-$			
184.3 *1*	6.7 *4*	589.42	(3/2,5/2)$^+$	405.12	3/2$^+$	(M1)	0.233	A_2=−0.14 *5*; A_4=−0.06 *8*

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^{140}Ce(p,2nγ):prompt 1988Ar07,1980Pi03 (continued)

γ(^{139}Pr) (continued)

E_γ	I_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
							Mult.: M1 or E2 from α(exp)′s in 29.7-min ε decay. D from γ(θ).
199.1[@&] 1	9.7 6	1722.22	15/2$^-$	1523.13	13/2$^-$	D	A_2=−0.32 11; A_4=−0.09 12
219.32[#&] 5	19.1 12	1941.56	17/2$^-$	1722.22	15/2$^-$	D	A_2=−0.25 3; A_4=+0.03 3
246.0[@] 1	6.8 4	2187.56	(19/2,15/2)$^-$	1941.56	17/2$^-$	D	A_2=−0.39 8; A_4=−0.03 12
254.8 1	8.0 5	1624.51	(11/2,9/2)$^-$	1369.71	9/2$^-$	D+Q	A_2=−0.08 2; A_4=−0.05 2
302.6 2	≈0.6[‡a]	1926.93	(9/2,13/2)$^-$	1624.51	(11/2,9/2)$^-$		
336.6 1	4.3 3	2278.16	(19/2,15/2)$^-$	1941.56	17/2$^-$	D	A_2=−0.35 3; A_4=−0.05 4
(403.75 8)	≈3[‡]	1926.93	(9/2,13/2)$^-$	1523.13	13/2$^-$		Expected from 5.5-h ε decay but probably masked by 405γ doublet.
405.12[g#] 8	33[gb] 2	405.12	3/2$^+$	0.0	5/2$^+$	D+Q[c]	A_2=−0.11 2; A_4=+0.03 3
405.12[g#] 8	33[gb] 2	2029.63		1624.51	(11/2,9/2)$^-$	D+Q[c]	A_2=−0.11 2; A_4=+0.03 3
418.5 1	5.7 9	1941.56	17/2$^-$	1523.13	13/2$^-$		
475.5 1	12.7 8	589.42	(3/2,5/2)$^+$	113.93	7/2$^+$		A_2=+0.01 1; A_4=+0.01 2
[x]512.0[fh] 2	a						
512.0[fh] 2	a	917.12?	3/2$^+$	405.12	3/2$^+$		
547.7[@] 1	9.4 6	1369.71	9/2$^-$	822.01	11/2$^-$	D	A_2=−0.35 1; A_4=+0.07 3
589.4 1	6.0 4	589.42	(3/2,5/2)$^+$	0.0	5/2$^+$		A_2=−0.13 3; A_4=+0.09 4
[x]600.5[f@] 2	a						
600.5[f@] 2	a	1624.51	(11/2,9/2)$^-$	1024.22	9/2$^+$		
622.3 1	7.8 5	2456.13		1833.83	(11/2,9/2)$^-$	D	A_2=−0.05 4; A_4=+0.01 6
670.9 2	2.3 1	2700.53		2029.63		D	A_2=−0.19 15; A_4=+0.08 19
[x]698.3							Coin with 114γ, 219γ, and 910γ but not placed by 1988Ar07.
701.12[#] 10	15.9 12	1523.13	13/2$^-$	822.01	11/2$^-$	D+Q	A_2=−0.87 13; A_4=+0.10 20
708.06[#] 6	75 5	822.01	11/2$^-$	113.93	7/2$^+$	M2+E3	Mult.: from Adopted Gammas. γ(θ) is isotropic.
732.4 2	3.2 6	1584.23		851.83	11/2$^+$		
737.96[#] 8	59 4	851.83	11/2$^+$	113.93	7/2$^+$	Q	A_2=+0.18 2; A_4=−0.04 3
796.6 3	1.9 4	1624.51	(11/2,9/2)$^-$	827.81	9/2$^+$		
802.5 2	5.1 4	1624.51	(11/2,9/2)$^-$	822.01	11/2$^-$		A_2=−0.20 7; A_4=−0.02 13 Mult.: E2 in table I of 1988Ar07 is inconsistent with negative A_2 value.
809.5 1	12.7[d] 8	1833.83	(11/2,9/2)$^-$	1024.22	9/2$^+$	D	A_2=+0.13 4; A_4=+0.09 6
822.0[@] 2	5.7 5	822.01	11/2$^-$	0.0	5/2$^+$	E3	A_2=−0.03 1; A_4=−0.03 2 Mult.: from Adopted Gammas.
827.8[@] 1	37 3	827.81	9/2$^+$	0.0	5/2$^+$	Q	A_2=+0.11 2; A_4=−0.01 3
[x]852.0[fh] 3	a						
852.0[fh] 3	a	851.83	11/2$^+$	0.0	5/2$^+$	[M3]	E_γ: highly unlikely transition.
900.16[#] 8	34 2	1722.22	15/2$^-$	822.01	11/2$^-$	(Q)	A_2=+0.02 1; A_4=−0.08 1
910.1[@] 2	17.6 10	1024.22	9/2$^+$	113.93	7/2$^+$	D+Q	A_2=−0.21 1; A_4=+0.10 1 I_γ: 1988Ar07 give 17.6 1; probable typographical error since no ΔIγ<6%.
917.1[h] 3	2.4 2	917.12?	3/2$^+$	0.0	5/2$^+$	D+Q	A_2=−0.19 4; A_4=+0.15 6
[x]962.3[f#] 2	a						
962.3[f#] 2	a	1790.12		827.81	9/2$^+$		
982.3 2	7.2[d] 4	1833.83	(11/2,9/2)$^-$	851.83	11/2$^+$	D	A_2=+0.14 8; A_4=+0.08 11
[x]1014.7[f@] 3	a						A_2=−0.38 4; A_4=+0.07 4
1014.7[f@] 3	a	1866.5	(9/2,13/2)$^+$	851.83	11/2$^+$	D	A_2=−0.38 4; A_4=+0.07 4

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^{140}Ce(p,2nγ):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
1075.2 *2*	4.7 *3*	1926.93	$(9/2,13/2)^-$	851.83	$11/2^+$	D	A_2=−0.15 *5*; A_4=−0.05 *7*
1089.0[h] *3*	2.7 *2*	1941.4?		851.83	$11/2^+$		Placed from 1941.5, $(17/2)^-$ by 1988Ar07. Alternate placement suggested by evaluators based on (^{3}He,3nγ) where no 1089γ was observed to deexcite 1941.5, $(17/2)^-$.
1105.2 *3*	2.2 *2*	1926.93	$(9/2,13/2)^-$	822.01	$11/2^-$	D+Q	A_2=−0.59 *10*; A_4=+0.18 *12*
1369.7[h] *2*	4.8 *4*	1369.71	$9/2^-$	0.0	$5/2^+$		A_2=−0.68 *7*; A_4=+0.09 *10* E_γ: existence of this transition is considered as questionable by the evaluators since with the given intensity it should have been seen in other studies. This γ is omitted in the Adopted Levels, Gammas dataset. Other explanation may be that this γ defined another level as suggested in the previous evaluation 2001Bu16.

† From $\gamma(\theta)$ and α(exp) values from 1971Bu22 (see ε decay data).
‡ From branching ratios in 5.5-h ε decay and Iγ(1075γ+1105γ).
# From 1980Pi03.
@ Weighted average of results from (p,2nγ) and (α,4nγ) (1988Ar07).
& Possible multiplet from discrepancy in branching ratio with adopted value.
[a] Member of unresolved doublet; therefore, no Iγ given by 1988Ar07.
[b] From $\gamma\gamma$-coin there are two 405.2γ's. Iγ≈30 if corrected for possible presence of 403γ observed in 5.5-h ε decay.
[c] D+Q for the doublet.
[d] Branching ratios from 1980Pi03 discrepant. Iγ(809γ)/Iγ(982γ)=3.3 *6* (1980Pi03), 1.76 *15* (1988Ar07).
[e] 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.
[f] Multiply placed.
[g] Multiply placed with undivided intensity.
[h] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

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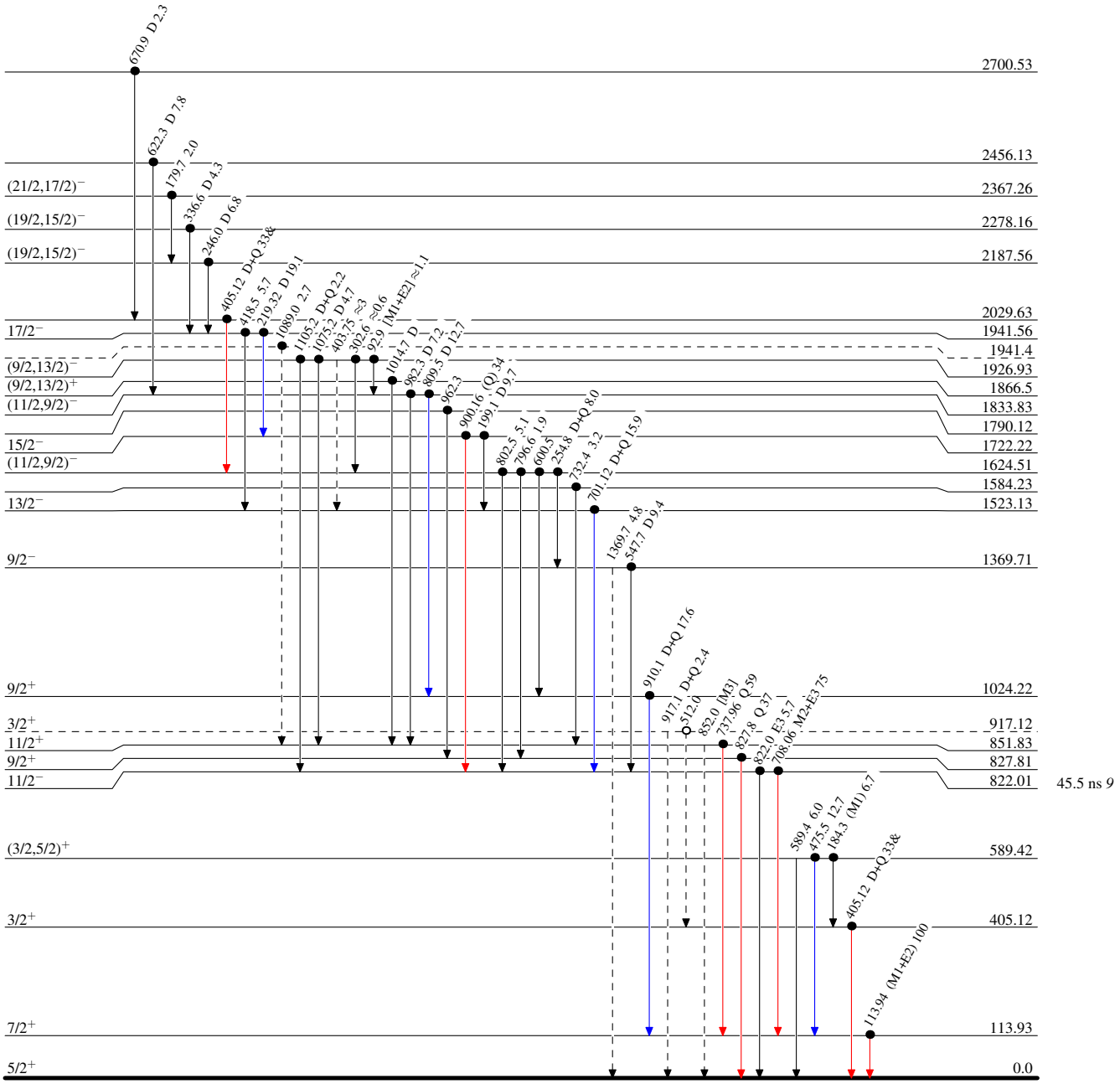
Level Scheme

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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
Coincidence (Uncertain)



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