

<sup>140</sup>Pr ε decay 1982Ad02

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 154, 1 (2018)	20-Nov-2018

Parent: <sup>140</sup>Pr: E=0.0; J<sup>π</sup>=1<sup>+</sup>; T<sub>1/2</sub>=3.39 min I; Q(ε)=3388 6; %ε+%β<sup>+</sup> decay=100.0

<sup>140</sup>Pr-E,J<sup>π</sup>,T<sub>1/2</sub>: from <sup>140</sup>Pr Adopted Levels.

<sup>140</sup>Pr-Q(ε): from 2017Wa10.

Measured: γ (1982Ad02,1970Ja10,1970Ka18,1968Ab17), ce (1982Ad02,1984Ju01,1969Hi03,1968Ab17), γγ, γγ(θ) (1964Hi03), β<sup>+</sup> (1968Ab17); γ<sup>±</sup> (1989Fo03).

<sup>140</sup>Ce Levels

E(level) <sup>†</sup>	J <sup>π</sup> <sup>‡</sup>	T <sub>1/2</sub>
0.0	0 <sup>+</sup>	stable
1596.15 18	2 <sup>+</sup>	
1903.1 5	0 <sup>+</sup>	
2347.9 4	2 <sup>+</sup>	
2521.4 4	2 <sup>+</sup>	
2547.14 18	1 <sup>+</sup>	
2899.7 4	2 <sup>+</sup>	
3016.8 5	0 <sup>+</sup>	
3119.0 15	2 <sup>+</sup>	
3320.0 20	2 <sup>+</sup>	

<sup>†</sup> From fit of γ's to levels.

<sup>‡</sup> Same as in Adopted Levels.

ε,β<sup>+</sup> radiations

ce(K)(1903γ)/β<sup>+</sup>=0.00152 3, ce(K+L+M)(1597γ)/β<sup>+</sup>=9.9×10<sup>-6</sup> 12 (1968Ab17); β<sup>+</sup>/I(1597γ)=102.5 75 (1982Ad02). Others: 102.5 100 (1970Ja10), 105.5 30 (1968Ab17), 160 25 (1969Hi03).

εK(exp)/β<sup>+</sup>=0.729 30 (1977Ca12). Others: 0.74 3 (1970Bi02), 0.90 8 (1972Ev01), 0.897 (1960Br29).

E(decay)	E(level)	Iβ <sup>+</sup> <sup>†</sup>	Iε <sup>†</sup>	Log ft	I(ε+β <sup>+</sup> ) <sup>†</sup>	Comments
(68 6)	3320.0		5×10 <sup>-5</sup> 4	6.4 4	5×10 <sup>-5</sup> 4	εK=0.53 8; εL=0.36 6; εM+=0.117 21
(269 6)	3119.0		0.00083 12	6.87 7	0.00083 12	εK=0.8122 12; εL=0.1454 9; εM+=0.0424 3
(371 6)	3016.8		0.0064 12	6.30 9	0.0064 12	εK=0.8247 6; εL=0.1360 4; εM+=0.03927 13
(488 6)	2899.7		0.00032 12	7.86 17	0.00032 12	εK=0.8319 3; εL=0.13064 21; εM+=0.03746 7
(841 6)	2547.14		0.00014 7	8.72 22	0.00014 7	εK=0.84079 9; εL=0.12397 7; εM+=0.03524 3
(867 6)	2521.4		0.038 5	6.31 6	0.038 5	εK=0.8411; εL=0.12371 6; εM+=0.03515 2
(1040 6)	2347.9		0.039 5	6.47 6	0.039 5	εK=0.8430; εL=0.12230 4; εM+=0.03468 2
(1485 6)	1903.1	0.00096 16	0.26 4	5.96 7	0.26 4	av Eβ=218.3 27; εK=0.8427 2; εL=0.11978 5; εM+=0.03386 2
(1792 6)	1596.15	0.0067 8	0.26 3	6.12 5	0.27 3	av Eβ=352.7 27; εK=0.8257 6; εL=0.1164 1; εM+=0.03288 3
3388 6	0.0	51.0 3	48.4 3	4.419 4	99.39 6	av Eβ=1067.1 28; εK=0.4136 17; εL=0.05727 23; εM+=0.01613 7

<sup>†</sup> Absolute intensity per 100 decays.

<sup>140</sup>Pr ε decay **1982Ad02** (continued)

γ(<sup>140</sup>Ce)

I<sub>γ</sub> normalization: ΣI(γ+ce)(g.s.)+I(ε+β<sup>+</sup>)(g.s.)=100% with I(γ<sup>±</sup>)/I(1596γ)=205 15.

<u>E<sub>γ</sub><sup>†</sup></u>	<u>I<sub>γ</sub><sup>#c</sup></u>	<u>E<sub>i</sub>(level)</u>	<u>J<sub>i</sub><sup>π</sup></u>	<u>E<sub>f</sub></u>	<u>J<sub>f</sub><sup>π</sup></u>	<u>Mult. @&amp;</u>	<u>δ<sup>b</sup></u>	<u>α<sup>a</sup></u>	<u>I<sub>(γ+ce)</sub><sup>#c</sup></u>	<u>Comments</u>
306.9 5	30 3	1903.1	0 <sup>+</sup>	1596.15	2 <sup>+</sup>	E2		0.0454		α(K)=0.0365 6; α(L)=0.00697 11; α(M)=0.001498 23 α(N)=0.000327 5; α(O)=4.98×10 <sup>-5</sup> 8; α(P)=2.42×10 <sup>-6</sup> 4 Mult.: α(K)exp=0.024 6; K/L=5.5 13, γγ(θ) (1964Hi03).
751.8 5	6.4 6	2347.9	2 <sup>+</sup>	1596.15	2 <sup>+</sup>	M1+E2		0.0048 10		α(K)=0.0041 9; α(L)=0.00055 9; α(M)=0.000114 18 α(N)=2.5×10 <sup>-5</sup> 4; α(O)=4.1×10 <sup>-6</sup> 7; α(P)=3.0×10 <sup>-7</sup> 7 Mult.: α(K)exp=0.0063 9;
925.3 5	5.2 5	2521.4	2 <sup>+</sup>	1596.15	2 <sup>+</sup>	E2+M1		0.0029 6		α(K)=0.0025 5; α(L)=0.00033 6; α(M)=6.9×10 <sup>-5</sup> 12 α(N)=1.5×10 <sup>-5</sup> 3; α(O)=2.5×10 <sup>-6</sup> 5; α(P)=1.9×10 <sup>-7</sup> 4 Mult.: α(K)exp=0.0044 6.
(950.987 26)	0.24 14	2547.14	1 <sup>+</sup>	1596.15	2 <sup>+</sup>	M1(+E2)	+0.01 7	0.00327		α(K)=0.00282 4; α(L)=0.000361 5; α(M)=7.52×10 <sup>-5</sup> 11 α(N)=1.669×10 <sup>-5</sup> 24; α(O)=2.72×10 <sup>-6</sup> 4; α(P)=2.12×10 <sup>-7</sup> 3 γ from Adopted Levels, Gammas. I <sub>γ</sub> : from I <sub>γ</sub> (2547.5γ) and relative branching ratio from Adopted Levels, Gammas. γ from Adopted Levels, Gammas. I <sub>γ</sub> : from I <sub>γ</sub> (2899.61γ) and relative branching ratio from Adopted Levels, Gammas.
(1303.5 4)	0.025 13	2899.7	2 <sup>+</sup>	1596.15	2 <sup>+</sup>					
1420.7 5	1.3 2	3016.8	0 <sup>+</sup>	1596.15	2 <sup>+</sup>	E2		1.03×10 <sup>-3</sup>		α(K)=0.000846 12; α(L)=0.0001089 16; α(M)=2.27×10 <sup>-5</sup> 4 α(N)=5.02×10 <sup>-6</sup> 7; α(O)=8.13×10 <sup>-7</sup> 12; α(P)=6.15×10 <sup>-8</sup> 9; α(IPF)=5.17×10 <sup>-5</sup> 8 Mult.: α(K)exp≤0.00053.
1596.1 2	100	1596.15	2 <sup>+</sup>	0.0	0 <sup>+</sup>	E2		8.98×10 <sup>-4</sup>		α(K)=0.000676 10; α(L)=8.63×10 <sup>-5</sup> 12; α(M)=1.79×10 <sup>-5</sup> 3 α(N)=3.97×10 <sup>-6</sup> 6; α(O)=6.45×10 <sup>-7</sup> 9; α(P)=4.92×10 <sup>-8</sup> 7; α(IPF)=0.0001128 16 Mult.: K/L=4.9 16 and γγ(θ) (1964Hi03).
1903.5		1903.1	0 <sup>+</sup>	0.0	0 <sup>+</sup>	E0			21 4	Mult.: α(K)exp>172 (I <sub>γ</sub> ≤0.1, ce(K)=17.2 4) (1982Ad02), K/L=5.55 15 (1968Ab17).

<sup>140</sup>Pr ε decay **1982Ad02** (continued)

γ(<sup>140</sup>Ce) (continued)

<u>E<sub>γ</sub><sup>†</sup></u>	<u>I<sub>γ</sub><sup>‡c</sup></u>	<u>E<sub>i</sub>(level)</u>	<u>J<sub>i</sub><sup>π</sup></u>	<u>E<sub>f</sub></u>	<u>J<sub>f</sub><sup>π</sup></u>	<u>Mult. @&amp;</u>	<u>α<sup>a</sup></u>	<u>I<sub>(γ+ce)</sub><sup>#c</sup></u>	<u>Comments</u>
2347.8 5	1.45 15	2347.9	2 <sup>+</sup>	0.0	0 <sup>+</sup>	E2	8.45×10 <sup>-4</sup>		Others: K/L=7.40 34, M/L=0.24 3 (1962Ba57), K/L=6.20 14 (1964Hi03); ce(K)(1903γ)/β <sup>+</sup> =0.00152 3 (1968Ab17). α(K)=0.000333 5; α(L)=4.15×10 <sup>-5</sup> 6; α(M)=8.60×10 <sup>-6</sup> 12 α(N)=1.91×10 <sup>-6</sup> 3; α(O)=3.11×10 <sup>-7</sup> 5; α(P)=2.42×10 <sup>-8</sup> 4; α(IPF)=0.000460 7 Mult.: α(K)exp=0.00051 13.
2521.4 5	2.6 3	2521.4	2 <sup>+</sup>	0.0	0 <sup>+</sup>	E2	8.81×10 <sup>-4</sup>		α(K)=0.000293 5; α(L)=3.65×10 <sup>-5</sup> 6; α(M)=7.55×10 <sup>-6</sup> 11 α(N)=1.676×10 <sup>-6</sup> 24; α(O)=2.73×10 <sup>-7</sup> 4; α(P)=2.13×10 <sup>-8</sup> 3; α(IPF)=0.000542 8 Mult.: α(K)exp=0.0004 1.
2547.5 7	0.047 23	2547.14	1 <sup>+</sup>	0.0	0 <sup>+</sup>	M1	9.62×10 <sup>-4</sup>		α(K)=0.000318 5; α(L)=3.97×10 <sup>-5</sup> 6; α(M)=8.24×10 <sup>-6</sup> 12 α(N)=1.83×10 <sup>-6</sup> 3; α(O)=2.99×10 <sup>-7</sup> 5; α(P)=2.36×10 <sup>-8</sup> 4; α(IPF)=0.000593 9
2900 1	0.04 2	2899.7	2 <sup>+</sup>	0.0	0 <sup>+</sup>	E2	9.79×10 <sup>-4</sup>		α(K)=0.000230 4; α(L)=2.84×10 <sup>-5</sup> 4; α(M)=5.88×10 <sup>-6</sup> 9 α(N)=1.305×10 <sup>-6</sup> 19; α(O)=2.13×10 <sup>-7</sup> 3; α(P)=1.668×10 <sup>-8</sup> 24; α(IPF)=0.000714 10
3016.3 12		3016.8	0 <sup>+</sup>	0.0	0 <sup>+</sup>	E0		0.00029 42	I <sub>(γ+ce)</sub> : pairing conversion is neglected. Mult.: α(K)exp≥0.03. ce(K)=0.35 15 (if ce(K)(1597γ)=100).
3119.0 15	0.17 2	3119.0	2 <sup>+</sup>	0.0	0 <sup>+</sup>	(E2)	1.04×10 <sup>-3</sup>		α(K)=0.000203 3; α(L)=2.50×10 <sup>-5</sup> 4; α(M)=5.17×10 <sup>-6</sup> 8 α(N)=1.149×10 <sup>-6</sup> 17; α(O)=1.87×10 <sup>-7</sup> 3; α(P)=1.471×10 <sup>-8</sup> 21; α(IPF)=0.000808 12
3320 2	0.011 8	3320.0	2 <sup>+</sup>	0.0	0 <sup>+</sup>	(E2)	1.10×10 <sup>-3</sup>		α(K)=0.000182 3; α(L)=2.24×10 <sup>-5</sup> 4; α(M)=4.64×10 <sup>-6</sup> 7 α(N)=1.030×10 <sup>-6</sup> 15; α(O)=1.680×10 <sup>-7</sup> 24; α(P)=1.322×10 <sup>-8</sup> 19; α(IPF)=0.000892 13

<sup>†</sup> From 1982Ad02.

<sup>‡</sup> E<sub>γ</sub>(I<sub>γ</sub>): 109.0 (≈7), 174 (≤0.5) from 1968Ab17, 618.2 (≤0.14), 867.8 (≤0.2), 936 (≤0.2), 950.7 (≤0.2), 1630.5 (≤0.08), 2533 (≤0.03) were not observed in 1982Ad02.

<sup>#</sup> I(ce) were normalized to I<sub>γ</sub>(1596γ)=100 (1982Ad02).

<sup>@</sup> α(K)exp were normalized to α(K)(1597γ)=0.000696 for E2.

<sup>&</sup> From adopted γ's.

<sup>a</sup> Additional information 1.

<sup>b</sup> If no value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.

<sup>c</sup> For absolute intensity per 100 decays, multiply by 0.0049 4.

**$^{140}\text{Pr}$   $\epsilon$  decay 1982Ad02**

Decay Scheme

Intensities: Relative  $I_\gamma$

Legend

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

