History Туре Author Literature Cutoff Date Citation Full Evaluation Janos Timar and Zoltan Elekes, Balraj Singh NDS 121, 143 (2014) 31-May-2014

 $Q(\beta^{-}) = -7460 SY; S(n) = 11510 40; S(p) = 1530 40; Q(\alpha) = 1560 40$ 2012Wa38

Estimated uncertainty=200 for $Q(\beta^{-})$ (2012Wa38).

S(2n)=21370 200 (syst), S(2p)=6460 40, Q(\varepsilon p)=1560 60 (2012Wa38).

1977Bo02: ¹²⁹Pr produced and identified in ¹⁰²Pd, ¹⁰⁶Cd(³²S,X) reactions followed by half-life measurement. Later decay studies: 1996Gi08.

A

в

Additional information 1.

¹²⁹Pr Levels

Cross Reference (XREF) Flags

 129 Nd ε decay:mixed

 94 Mo(40 Ca,3p2n γ)

E(level)	$\mathrm{J}^{\pi}^{\dagger}$	T _{1/2}	XREF	Comments
0.0 ^{<i>a</i>}	(3/2 ⁺)	30 s 4	AB	$\%\varepsilon + \%\beta^+ = 100$ E(level): tentatively assigned as g.s. by the evaluators. T _{1/2} : weighted average of 24 s 5 (1977Bo02) and 32 s 3 (1996Gi08).
91.10 ^{&} 10	$(5/2^+)$		AB	,
241.82 ^a 16	$(7/2^+)$		AB	
327.3 4	$(5/2^+, 7/2^+)$		Α	
382.57 [‡] 24	(11/2 ⁻)		A	E(level): proposed by 1997Gi07 to be an isomer but no half-life data available in the literature, 2012Au07 suggest 1 ms from systematics
418.43 ^{&} 23	$(9/2^+)$		AB	
437.7 4			Α	
452.7 3	$(1/2^+, 3/2^+)$		Α	
462.1 4			Α	
471.21 24	$(7/2^+, 9/2^+)$		Α	
497.3 [#] 4	(9/2+)	≈60 ns	AB	$T_{1/2}$: from $\gamma\gamma(t)$ (1990JaZU) in high-spin studies, not clear whether the value listed by the authors is the mean lifetime or half-life. It is assay as half-life here.
516.83 18	$(7/2^{-})$		Α	
569.3 4	(*)		Α	
580.3 4	$(^{+})$		Α	
620.0 [‡] 23	$(15/2^{-})$		В	
632.44 ^a 25	$(11/2^+)$		AB	
682.3 [@] 4	$(11/2^+)$		AB	
724.5 <i>4</i>	$(7/2^+, 9/2^+, 11/2^+)$		Α	
728.87 20	(9/2 ⁻)		Α	
889.2 [#] 15	$(13/2^+)$		В	
900.9 ^{&} 12	$(13/2^+)$		В	
975.00 10	(10)=)		A	
986.10 14	$(5/2^+, 7/2^+)$		A	
$1035.0^{\ddagger} 21$	$(19/2^{-})$		В	
1118 0 [@] 16	$(15/2^+)$		R	
1147.0^{a} 13	$(15/2^+)$		B	
1368 6 [#] 17	$(17/2^+)$		R	
1402 0 1/	(17/2)		D	
1492.9 ~ <i>1</i> 6	$(17/2^{+})$		В	

₂: from $\gamma\gamma$ (t) (1990JaZU) in high-spin studies, not clear whether the value listed by the authors is the mean lifetime or half-life. It is assumed as half-life here.

Adopted Levels, Gammas (continued)

¹²⁹Pr Levels (continued)

E(level)	$J^{\pi \dagger}$	XREF	Comments
1595.0 [‡] 21	$(23/2^{-})$	В	
1636.9 [@] 17	$(19/2^+)$	В	
1744.0 ^a 16	$(19/2^+)$	В	
1922.2 [#] 18	$(21/2^+)$	В	
2153.0 <mark>&</mark> 22	$(21/2^+)$	В	
2225.0 [@] 19	$(23/2^+)$	В	
2267.0 [‡] 22	$(27/2^{-})$	В	
2311.0 ^{<i>a</i>} 19	$(23/2^+)$	В	a possible 1297γ to $11/2^{-}$ band is not shown.
2546.3 [#] 19	$(25/2^+)$	В	
2585.0 ^{&} 23	$(25/2^+)$	В	
2759.0 ^{<i>a</i>} 21	$(27/2^+)$	В	a possible 1185γ to $11/2^-$ band is not shown.
2884.6 [@] 20	$(27/2^+)$	В	
3020.0 [‡] 24	$(31/2^{-})$	В	
3076.0 ^{&} 25	$(29/2^+)$	В	
3238.4 [#] 20	$(29/2^+)$	В	
3311.0 ^{<i>a</i>} 22	$(31/2^+)$	В	a possible 1065γ to $11/2^{-}$ band is not shown.
3611.6 [@] 22	$(31/2^+)$	В	
3695 ^{&} 3	$(33/2^+)$	В	
3830 [‡] <i>3</i>	$(35/2^{-})$	В	
3998.0 ^{<i>a</i>} 24	$(35/2^+)$	В	a possible 999 γ to $11/2^-$ band is not shown.
4013.4 [#] 23	$(33/2^+)$	В	
4457 ^{&} 3	$(37/2^+)$	В	
4701 [‡] 3	$(39/2^{-})$	В	
4821 ^{<i>a</i>} 3	$(39/2^+)$	В	
5348 X 3	$(41/2^+)$	В	
5654 [‡] 3	$(43/2^{-})$	В	
5771 ^{<i>a</i>} 3	$(43/2^+)$	В	
6349 ^{&} 4	$(45/2^+)$	В	
6704 [‡] 3	$(47/2^{-})$	В	
7466 ^{&} 4	$(49/2^+)$	В	
7858 [‡] 4	$(51/2^{-})$	В	

[†] From systematics of decoupled $h_{11/2}$ proton band in neighboring odd Pr nuclei. All assignments are considered as tentative, including that for the ground state, since no supporting experimental data are available for the assignment of multipolarities. For levels populated in high-spin studies, ascending order of spins with excitation energy is assumed based on yrast pattern of population.

^{\ddagger} Band(A): $\pi h_{11/2}$ band. Possible Nilsson configuration=3/2[541] (1993We05).

[#] Band(B): $\pi g_{9/2}$, $\alpha = +1/2$.

[@] Band(b): $\pi g_{9/2}$, $\alpha = -1/2$.

& Band(C): $\pi 3/2[411], \alpha = +1/2$. The $\pi 3/2[411]$ configuration is probably from a mixture of $d_{5/2}$ and $g_{7/2}$ proton orbitals. Band from 1998SmZX.

^{*a*} Band(c): $\pi 3/2[411], \alpha = -1/2$. See comment for $\alpha = +1/2$ partner.

			Adopt	ed Levels	, Gammas (co	ontinued)		
				<u>)</u>	v(¹²⁹ Pr)			
E _i (level)	${ m J}^{\pi}_i$	E_{γ}^{\dagger}	I_{γ}^{\dagger}	E_f	${ m J}_f^\pi$	Mult. [‡]	α &	Comments
91.10 241.82	$(5/2^+)$ $(7/2^+)$	91.1 <i>1</i> 150.8 2 241 8 3	100 100 <i>12</i> 24 7	0.0 91.10	$(3/2^+)$ $(5/2^+)$ $(3/2^+)$			
327.3 382.57	(5/2 ⁺ ,7/2 ⁺) (11/2 ⁻)	236.2 <i>3</i> 140.9 <i>4</i>	100 100 <i>33</i>	91.10 241.82	$(5/2^{+})$ $(5/2^{+})$ $(7/2^{+})$	[M2]	3.64 7	$\alpha(K)=2.90 5; \alpha(L)=0.583$ $11; \alpha(M)=0.1283 23$ $\alpha(N)=0.0287 6;$ $\alpha(O)=0.00454 9:$
		291.6 4	89 <i>33</i>	91.10	(5/2+)	[E3]	0.220	$\alpha(P)=0.000298 \ 6$ $\alpha(K)=0.1437 \ 22;$ $\alpha(L)=0.0598 \ 10;$ $\alpha(M)=0.01355 \ 21$ $\alpha(N)=0.00295 \ 5;$ $\alpha(O)=0.000423 \ 7;$ $\alpha(P)=9.55\times10^{-6} \ 14$
418.43	(9/2 ⁺)	176.6 <i>3</i> 327.2 <i>3</i>	100 <i>17</i> 83 <i>17</i>	241.82 91.10	$(7/2^+)$ $(5/2^+)$			
437.7 452.7 462.1	(1/2+,3/2+)	346.6 ^{<i>a</i>} 3 452.7 3 371.0 3	100 ^{a#} 100 100	91.10 0.0 91.10	(5/2 ⁺) (3/2 ⁺) (5/2 ⁺)			
471.21	$(7/2^+, 9/2^+)$	229.5 <i>3</i> 380.0 <i>3</i>	46 <i>15</i> 100 <i>23</i>	241.82 91.10	$(7/2^+)$ $(5/2^+)$			
497.3 516.83	(9/2 ⁺) (7/2 ⁻)	255.5 <i>3</i> 134.0 <i>4</i>	100 100 <i>15</i>	241.82 382.57	$(7/2^+)$ $(11/2^-)$	[E2]	0.752 14	α (K)=0.502 9; α (L)=0.195 4; α (M)=0.0437 9 α (N)=0.00948 18; α (O)=0.00135 3; α (D)=2.70×10 ⁻⁵ 5
569.3 580.3 620.0 632.44 682.3 724.5	$(^{+})$ $(^{+})$ $(15/2^{-})$ $(11/2^{+})$ $(11/2^{+})$ $(7/2^{+},9/2^{+},11/2^{+})$	275.0 <i>I</i> 116.6 ^{<i>a</i>} 2 127.6 2 238 214.0 <i>I</i> 391.0 5 185.0 <i>I</i> 482.7 3	$ \begin{array}{r} 17 \ 6 \\ 100^{a} \\ 100 \\ <83 \\ 100 \ 33 \\ 100 \\ 100 \\ 100 \end{array} $	241.82 452.7 452.7 382.57 418.43 241.82 497.3 241.82	$\begin{array}{c} (7/2^+) \\ (1/2^+, 3/2^+) \\ (1/2^+, 3/2^+) \\ (11/2^-) \\ (9/2^+) \\ (7/2^+) \\ (9/2^+) \\ (7/2^+) \end{array}$	(E2)	0.1064	<i>a</i> (r)-2.79×10 5
728.87	(9/2 ⁻)	212.0 <i>1</i> 346.6 ^{<i>a</i>} <i>3</i>	<33 100 ^{<i>a</i>#} 20	516.83 382.57	$(7/2^{-})$ $(11/2^{-})$			
889.2	(13/2+)	487.0 5 208	100	241.82 682.3	$(7/2^+)$ $(11/2^+)$			
900.9	(13/2+)	394 268 483		497.3 632.44 418.43	$(9/2^+)$ $(11/2^+)$ $(9/2^+)$			
975.00		882.0 [@] 1 975.0 1	48 8 100 <i>16</i>	91.10	$(5/2^+)$ $(3/2^+)$			
986.10	$(5/2^+, 7/2^+)$	895.0 1	100 10	91.10	$(5/2^+)$			
1035.0	$(19/2^{-})$	415	100	620.0	$(15/2^{-})$	(E2)	0.0190	
1118.9	$(15/2^+)$	230 438		889.2 682 3	$(13/2^+)$ $(11/2^+)$			
1147.0	$(15/2^+)$	246		900.9	$(13/2^+)$			
1368.6	(17/2 ⁺)	514 250 479		632.44 1118.9 889.2	$(11/2^+)$ $(15/2^+)$ $(13/2^+)$			
1492.9	$(17/2^+)$	592		900.9	$(13/2^+)$			

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

$\gamma(^{129}\text{Pr})$ (continued)

E_i (level)	\mathbf{J}_i^{π}	E_{γ}^{\dagger}	I_{γ}^{\dagger}	\mathbf{E}_{f}	J_f^π	Mult. [‡]	α &
1595.0	$(23/2^{-})$	560	100	1035.0	$(19/2^{-})$	(E2)	0.0083 4
1636.9	$(19/2^+)$	268		1368.6	$(17/2^+)$		
		518		1118.9	$(15/2^+)$		
1744.0	$(19/2^+)$	597		1147.0	$(15/2^+)$		
1922.2	$(21/2^+)$	285		1636.9	$(19/2^+)$		
	. , ,	554		1368.6	$(17/2^+)$		
2153.0	$(21/2^+)$	1118		1035.0	$(19/2^{-})$		
2225.0	$(23/2^+)$	303		1922.2	$(21/2^+)$		
		588		1636.9	$(19/2^+)$		
2267.0	$(27/2^{-})$	672	100	1595.0	$(23/2^{-})$		
2311.0	$(23/2^+)$	567		1744.0	$(19/2^+)$		
2546.3	$(25/2^+)$	321		2225.0	$(23/2^+)$		
		624		1922.2	$(21/2^+)$		
2585.0	$(25/2^+)$	432		2153.0	$(21/2^+)$		
		990		1595.0	$(23/2^{-})$		
2759.0	$(27/2^+)$	448		2311.0	$(23/2^+)$		
2884.6	$(27/2^+)$	338		2546.3	$(25/2^+)$		
		660		2225.0	$(23/2^+)$		
3020.0	$(31/2^{-})$	753	100	2267.0	$(27/2^{-})$		
3076.0	$(29/2^+)$	491		2585.0	$(25/2^+)$		
3238.4	$(29/2^+)$	354		2884.6	$(27/2^+)$		
		692		2546.3	$(25/2^+)$		
3311.0	$(31/2^+)$	552		2759.0	$(27/2^+)$		
3611.6	$(31/2^+)$	727		2884.6	$(27/2^+)$		
3695	$(33/2^+)$	619		3076.0	$(29/2^+)$		
3830	$(35/2^{-})$	810		3020.0	$(31/2^{-})$		
3998.0	$(35/2^+)$	687		3311.0	$(31/2^+)$		
4013.4	$(33/2^+)$	775		3238.4	$(29/2^+)$		
4457	$(37/2^+)$	762		3695	$(33/2^+)$		
4701	$(39/2^{-})$	871		3830	$(35/2^{-})$		
4821	$(39/2^+)$	823		3998.0	$(35/2^+)$		
5348	$(41/2^+)$	891		4457	$(37/2^+)$		
5654	$(43/2^{-})$	953		4701	$(39/2^{-})$		
5771	$(43/2^+)$	950		4821	$(39/2^+)$		
6349	$(45/2^+)$	1001 ⁰		5348	$(41/2^+)$		
6704	$(47/2^{-})$	1050		5654	$(43/2^{-})$		
7466	$(49/2^+)$	1117 <mark>b</mark>		6349	$(45/2^+)$		
7858	$(51/2^{-})$	1154		6704	$(47/2^{-})$		

[†] When same level is populated in both datasets, $E\gamma$ values are from ¹²⁹Pr ε decay, and $I\gamma$ values are averages from the two datasets.

[‡] From $\gamma(\theta)$ in (⁴⁰Ca,3p2n γ).

[#] 346.6 γ is a doublet with separate intensities quoted in 1997Gi07 but the authors did not specify these intensities with levels. The evaluators have arbitrarily assigned higher intensity to the decay of the low-lying level.

[@] Poor fit, level-energy difference=883.9.

& 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.

^{*a*} Multiply placed with intensity suitably divided.

^b Placement of transition in the level scheme is uncertain.

	Adopted Levels, Gammas Legend	Legend		
	<u>Level Scheme</u> Intensities: Relative photon branching from each level $\gamma \Gamma$	Decay (Uncertain)		
51/2 ⁻)	57 	7858_		
9/2+)		7466_		
7/2-)		6704		
5/2+)	↓ ⁽³ 8)	6349		
$-3/2^+$)		5771		
3/2-)		5654		
1/2+)		5348		
9 /2 ⁺)		4821		
9/2-)		4701		
7/2+)		4457		
$\frac{3/2^+}{5/2^+}$		4013.4		
/2 ⁻)		3830		
/2+)	\	3695		
$\frac{12^+}{12^+}$		$-\frac{3611.6}{2211.0}$		
$\frac{12}{2^+}$		3238.4		
/2+)	\mathbb{N}	3076.0		
$\frac{(2^{-})}{(2^{+})}$				
$\frac{12}{1/2^+}$		$-\frac{2884.6}{2759.0}$		
/2+)				
$\frac{1}{2^{+}}$	\└──── ★ │ <u></u> ││││ [★] │ <i>⊗</i> -∅ [*] ∠ 、			
$\frac{12^{-1}}{(2^{-1})}$		-2311.0		
/2+)	\↓			
/2 ⁺)		2153.0		
$\frac{(2^+)}{(2^+)}$		1922.2		
$\frac{12^{+}}{(2^{+})}$		-1744.0		
/2-)		1595.0		
//2+)		1492.9		
$\frac{1}{2^+}$		1368.6		
N(2+)		1147.0		
$5/2^+$				
$\frac{5/2^+}{5/2^+}$ $\frac{5/2^-}{9/2^-}$		1035.0		

¹²⁹₅₉Pr₇₀

Level Scheme (continued)

Intensities: Relative photon branching from each level @ Multiply placed: intensity suitably divided



¹²⁹₅₉Pr₇₀

Level Scheme (continued)

Intensities: Relative photon branching from each level @ Multiply placed: intensity suitably divided



¹²⁹₅₉Pr₇₀



¹²⁹₅₉Pr₇₀