^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	S. Kumar(a), J. Chen(b) and F. G. Kondev	NDS 137, 1 (2016)	31-May-2016

Parent: ^{109}Rh: E=0.0; $J^\pi=7/2^+$; $T_{1/2}$=80.8 s *7*; Q(β^-)=2607 *4*; %β^- decay=100.0

^{109}Rh-J^π,$T_{1/2}$: From Adopted Levels of ^{109}Rh.

^{109}Rh-Q(β^-): From 2012Wa38.

1978Ka10: ^{109}Rh sources were produced by the (γ,p) reaction on 97.7% enriched metallic ^{110}Pd using bremsstrahlung from the electron linear accelerator of the Japan Atomic Energy Research Institute. Low-energy γ rays were detected with a 25 mm2×5 mm pure Ge detector (FWHM=500 eV at Eγ=133 keV) and high energy γ rays were detected with a 40 cm^3 coaxial Ge(Li) detector (FWHM=2.5 keV at Eγ=1333 keV);β rays were detected with a 2-cm-thick×5-cm dia. anthracene scintillator. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(t), Eβ, Iβ. Deduced decay scheme, J^π, γ- and β-branching ratios, half-lives, α.

1977Ba57: ^{109}Rh sources were produced by activating a sample of 50 mg ^{110}Pd metallic powder (96.98%) at the pulsed bremsstrahlung beam of the Giessen linear accelerator. γ rays were detected by a low energy photon Ge detector (FWHM=195 eV at 5.9 keV) or a Ge(Li) detector (FWHM=2.3 keV at 1333 keV). Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(t), E(x-ray), I(x-ray). Deduced decay scheme, J^π, γ- and β-ray branching ratios, half-lives, α.

1978Fr21: ^{109}Rh sources were produced by thermal-neutron induced fission of ^{239}Pu.γ rays were detected with two Ge(Li) detectors of 35 cm^3 active volume (FWHM=2.15 keV at 1333 keV). Measured Eγ, Iγ, $\gamma\gamma$-coin. Deduced decay scheme, J^π, γ-ray branching ratios.

2015Bu15: mass=109 nuclides up to ^{109}Mo were produced via U(p,f) reaction with E=30 MeV proton beam provided by the K-130 cyclotron at Jyvaskyla, incident on a 15 mg/cm^2 uranium target. Fission fragments were separated using the Ion-Guide Isotope Separator On-Line (IGISOL) method and deposited onto an aluminum catcher. β partcles were detected with a plastic scintillator and a pair of $LaBr_3$(Ce) detectors; γ rays were detected with two HPGe detectors. Measured Eγ, Iγ, Eβ, $\beta\gamma\gamma$(t). Deduced levels, half-lives, transition strengths.

1969WiZX: ^{109}Rh nuclides were produced from ^{252}Cf fissions. Measured $T_{1/2}$, Eγ, fission yields.

Others: 1975Fe12, 1971Ri02, 1959Pi49.

The decay scheme is proposed by 1977Ba57, 1978Fr21 and 1978Ka10. Discrepancies exist for the placements of some γ-ray transitions. Due to the use of high-resolution Ge detector, 1978Ka10 resolve the doublets (and even a triplet of 211.9+213.8+215.3) that can not be resolved in 1977Ba57 and 1978Fr21. The evaluators thus have adopted the decay scheme that proposed by 1978Ka10, as are the γ-energies, intensities, and coincidence relations.

1978Ka10 measured the α(K)exp for three low-energy gammas. The results indicate M1(+E2) for the gammas. To calculate total transition intensity, the evaluators have assumed an M1 multipolarity for the 50.6 and 59.0 gammas and ignored the conversion for other gammas (all over 100 keV in energy). Since nearly all the low-energy gammas must be M1 and/or E2, the conversion can be ignored for Eγ>200 keV when compared to the normalization uncertainty. For gammas in the 150-keV energy range the conversion increases the transition intensity by ≈15%.

The total average radiation energy released by ^{109}Rh is 2684 keV *232* (calculated by evaluators using the computer program radlst). This value agrees with Q(β^-)=2607 keV *4* (2012Wa38).

^{109}Pd Levels

E(level)†	J^π†	$T_{1/2}$‡	Comments
0	$5/2^+$	13.59 h *12*	$T_{1/2}$: from Adopted Levels.
113.4000 *14*	$1/2^+$	380 ns *50*	$T_{1/2}$: from (178.0γ)(113.4γ)(t) measurements by 1978Ka10.
245.0807 *16*	$(7/2)^-$	1.528 ns *56*	
266.3424 *15*	$1/2^+$		
276.289 *3*	$7/2^+$	11.3 ps *34*	
291.4339 *16*	$3/2^+$	136.5 ps *23*	
325.2836 *16*	$3/2^+$	39.6 ps *35*	
326.8689 *22*	$5/2^+$	0.832 ns *27*	
426.140 *3*	$7/2^+$	73.6 ps *42*	
491.589 *3*	$3/2^+$	62.9 ps *42*	
540.6753 *19*	$5/2^+$	29.3 ps *43*	
597.1 *5*	$(9/2)^+$		

Continued on next page (footnotes at end of table)

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21 (continued)

^{109}Pd Levels (continued)

E(level)[†]
667.3?
981.755 *10*
1317.23 *19*

[†] From Adopted Levels.
[‡] From 2015Bu15 using the delayed coincidence $\beta\gamma\gamma$(t), unless otherwise noted. The same values are adopted in Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(1290 *4*)	1317.23	0.22 *7*	6.36 *14*	av Eβ=472.8 *18*
(2010 *4*)	597.1	0.16 *7*	7.26 *19*	av Eβ=793.8 *19*
(2066 *4*)	540.6753	9.7 *10*	5.53 *5*	av Eβ=819.5 *19*
(2115 *4*)	491.589	2.2 *3*	6.21 *6*	av Eβ=842.0 *19*
(2181 *4*)	426.140	8.3 *11*	5.69 *6*	av Eβ=872.1 *19*
(2280 *4*)	326.8689	67 *7*	4.86 *5*	av Eβ=917.8 *19* E(decay): Eβ=2250 *50*.
(2331 *4*)	276.289	1.1 *3*	6.69 *12*	av Eβ=941.2 *19*
(2607 *4*)	0	13 *8*	5.8 *3*	av Eβ=1069.4 *19*

[†] Deduced from I(γ+ce) intensity balances. g.s. feeding is from $\Sigma(\beta^-+\gamma+ce)$ to g.s.=100%.
[‡] Absolute intensity per 100 decays.

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21 (continued)

$\gamma(^{109}Pd)$

Iγ normalization: weighted average of 0.52 *6*, derived from the g.s. β^- feeding of 16% *10*, based on Iβ(total)/I(326.83γ) measured in 1978Ka10 and by assuming the $\Sigma(\beta^-+\gamma+ce)$ to g.s.=100% and 0.57 *9*, derived from the fraction of 3.42% *50* per ^{252}Cf fission for 326.83γ in 1969WiZX and the cumulative yield of 5.96% *24* for ^{109}Rh produced in ^{252}Cf fissions from the JEFF library.

1969WiZX report photons per 100 ^{252}Cf fissions for four γ rays at 151.4, 177.92, 215.1 and 326.8 keV, with values of 0.124 *22*, 0.675 *16*, 0.102 *2* and 3.42 *50*, respectively.

E$_\gamma$ [†]	I$_\gamma$ [‡b]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult. [@]	δ [@a]	α [&]	Comments
25.1[c]	0.06 *5*	291.4339	3/2$^+$	266.3424	1/2$^+$	[M1+E2]	≤0.9	21	%Iγ=0.03 *3*, using the calculated normalization. E$_\gamma$: this γ was not observed in the singles spectra but was inferred from $\gamma\gamma$-coincidence measurements (1978Ka10). Mult.: measurements by 1978Ka10 indicate the 25.1γ may be M1 (+0-50% E2).
35.34 *10*	2.4 *3*	326.8689	5/2$^+$	291.4339	3/2$^+$	M1		7.65 *13*	α(K)=6.64 *11*; α(L)=0.830 *14*; α(M)=0.156 *3* α(N)=0.0262 *5* %Iγ=1.30 *19*, using the calculated normalization. E$_\gamma$: 35.34 *10* (1978Ka10). I$_\gamma$: others: 2.8 *10* (1978Fr21), 0.7 *2* (1977Ba57). Mult.: α(K)exp=9 *5* (1978Ka10).
50.6[c] *3*	0.06 *2*	326.8689	5/2$^+$	276.289	7/2$^+$	[M1]		2.68 *6*	α(K)=2.32 *6*; α(L)=0.289 *7*; α(M)=0.0545 *13* α(N)=0.00914 *21* %Iγ=0.032 *12*, using the calculated normalization. E$_\gamma$: from 1978Ka10 only.
59.0[c] *3*	0.06 *2*	325.2836	3/2$^+$	266.3424	1/2$^+$	[M1]		1.71 *4*	α(K)=1.49 *3*; α(L)=0.185 *4*; α(M)=0.0348 *8* α(N)=0.00585 *12* %Iγ=0.032 *12*, using the calculated normalization. E$_\gamma$: from 1978Ka10 only.
81.78 *5*	1.3 *1*	326.8689	5/2$^+$	245.0807	(7/2)$^-$	E1(+M2)	0.3 *+2−3*	0.9 *10*	α(K)=0.8 *8*; α(L)=0.13 *15*; α(M)=0.02 *3* α(N)=0.004 *5* %Iγ=0.70 *9*, using the calculated normalization. E$_\gamma$: 81.78 *5* (1978Ka10). I$_\gamma$: others: 1.3 *1* (1978Fr21), 1.1 *2* (1977Ba57). Mult.: α(K)exp=0.7 *6* (1978Ka10). δ: the authors report M1(+E2) with δ=0.3 *+21−3* which is not compatible with change in parity between the two levels.
[x]98.2 *5*	0.19 *2*								%Iγ=0.103 *15*, using the calculated normalization. E$_\gamma$,I$_\gamma$: observed only by 1978Fr21 and placed from the E=426.1 keV 7/2$^+$ level. A 98.258γ de-excites a 9/2$^-$ level at E=287.25 in Adopted Levels.
113.401 *2*	10.5 *6*	113.4000	1/2$^+$	0	5/2$^+$	E2		0.891	α(K)=0.704 *10*; α(L)=0.1527 *22*; α(M)=0.0294 *5* α(N)=0.00463 *7* %Iγ=5.7 *6*, using the calculated normalization.

$^{109}_{46}Pd_{63}$-3

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21 (continued)

$\gamma(^{109}Pd)$ (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@a]	α[&]	Comments
[x]114.0 *2*	<1								E_γ: 113.35 *5* (1978Ka10). I_γ: others: 10.0 *7* (1978Fr21), 12.0 *11* (1977Ba57). Mult.: α(K)exp=0.7 *2* (1977Ba57). %Iγ=0.3 *3*, using the calculated normalization. E_γ,I_γ: observed only by 1977Ba57 and placed from the E=540.7 keV $5/2^+$ level.
149.854 *3*	1.1 *1*	426.140	$7/2^+$	276.289	$7/2^+$				%Iγ=0.59 *8*, using the calculated normalization. E_γ: 149.82 *7* (1978Ka10). E_γ: placed by 1977Ba57 from a level at E=263.1 keV that is not in Adopted Levels. I_γ: others: 1.1 *1* (1978Fr21), 1.1 *3* (1977Ba57).
152.942 *1*	1.2 *1*	266.3424	$1/2^+$	113.4000	$1/2^+$	M1		0.1170	α(K)=0.1018 *15*; α(L)=0.01242 *18*; α(M)=0.00234 *4* α(N)=0.000393 *6* %Iγ=0.65 *8*, using the calculated normalization. E_γ: 152.91 *7* (1978Ka10). E_γ: placed by 1977Ba57 and 1978Fr21 from a level at E=694 keV that is not in Adopted Levels. I_γ: others: 1.0 *1* (1978Fr21), 1.3 *3* (1977Ba57).
166.306 *8*	0.10 *5*	491.589	$3/2^+$	325.2836	$3/2^+$				%Iγ=0.05 *3*, using the calculated normalization. E_γ: 166.3 *5* (1978Ka10).
178.034 *1*	14.1 *7*	291.4339	$3/2^+$	113.4000	$1/2^+$	M1		0.0776	α(K)=0.0676 *10*; α(L)=0.00820 *12*; α(M)=0.001543 *22* α(N)=0.000260 *4* %Iγ=7.6 *8*, using the calculated normalization. E_γ: 178.03 *5* (1978Ka10). I_γ: others: 12.1 *8* (1978Fr21), 14.7 *8* (1977Ba57).
200.153 *4*	0.9 *1*	491.589	$3/2^+$	291.4339	$3/2^+$	M1		0.0567	α(K)=0.0494 *7*; α(L)=0.00598 *9*; α(M)=0.001125 *16* α(N)=0.000189 *3* %Iγ=0.49 *7*, using the calculated normalization. E_γ: 200.13 *7* (1978Ka10). I_γ: others: 0.83 *7* (1978Fr21), 0.9 *2* (1977Ba57).
211.884 *3*	1.2 *2*	325.2836	$3/2^+$	113.4000	$1/2^+$	M1(+E2)	0.3 *+2−3*	0.053 *6*	α(K)=0.046 *5*; α(L)=0.0058 *9*; α(M)=0.00108 *17* α(N)=0.00018 *3* %Iγ=0.65 *13*, using the calculated normalization. E_γ: 211.88 *10* (1978Ka10).
213.806 *4*	1.0 *2*	540.6753	$5/2^+$	326.8689	$5/2^+$				%Iγ=0.54 *12*, using the calculated normalization. E_γ: 213.81 *10* (1978Ka10). E_γ: placed by 1977Ba57 and 1978Fr21 from the 326.7-keV level. I_γ: others: 0.97 *9* (1978Fr21), 4.4 *14* (1977Ba57).
215.390 *2*	3.2 *2*	540.6753	$5/2^+$	325.2836	$3/2^+$	M1		0.0467	α(K)=0.0407 *6*; α(L)=0.00492 *7*; α(M)=0.000924 *13* α(N)=0.0001557 *22* %Iγ=1.73 *20*, using the calculated normalization. E_γ: 215.28 *7* (1978Ka10). I_γ: others: 2.9 *2* (1978Fr21), 4.5 *14* (1977Ba57).
245.080 *2*	2.4 *2*	245.0807	$(7/2)^-$	0	$5/2^+$	E1		0.01200	α(K)=0.01050 *15*; α(L)=0.001233 *18*; α(M)=0.000230 *4*

$^{109}_{46}Pd_{63}$-4

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21 (continued)

$\gamma(^{109}Pd)$ (continued)

E_γ [†]	I_γ [‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [@]	δ [@a]	α [&]	Comments
									α(N)=3.85×10^{-5} *6* %Iγ=1.30 *16*, using the calculated normalization. E_γ: 245.03 *7* (1978Ka10). I_γ: others: 2.1 *2* (1978Fr21), 2.5 *3* (1977Ba57).
249.238 *11*	10.8 *6*	540.6753	5/2$^+$	291.4339	3/2$^+$	M1		0.0319	α(K)=0.0278 *4*; α(L)=0.00334 *5*; α(M)=0.000628 *9* α(N)=0.0001058 *15* %Iγ=5.8 *7*, using the calculated normalization. E_γ: 249.16 *5* (1978Ka10). I_γ: others: 9.1 *6* (1978Fr21), 11.3 *11* (1977Ba57).
264.378 *11*	0.7 *2*	540.6753	5/2$^+$	276.289	7/2$^+$				%Iγ=0.38 *12*, using the calculated normalization. E_γ: 264.33 *10* (1978Ka10). E_γ: 1977Ba57 place a transition of Eγ=263.1 *2* from a level at E=263.1 keV level that is not in Adopted Levels. I_γ: others: 0.59 *7* (1978Fr21), 0.9 *2* (1977Ba57).
266.346 *3*	0.5 *1*	266.3424	1/2$^+$	0	5/2$^+$	E2		0.0441	α(K)=0.0375 *6*; α(L)=0.00541 *8*; α(M)=0.001025 *15* α(N)=0.0001674 *24* %Iγ=0.27 *6*, using the calculated normalization. E_γ: 266.26 *10* (1978Ka10). E_γ: placed by 1978Fr21 from a level at E=806.8 keV that is not in Adopted Levels. I_γ: others: 0.48 *7* (1978Fr21), 0.9 *2* (1977Ba57).
274.328 *7*	0.2 *1*	540.6753	5/2$^+$	266.3424	1/2$^+$				%Iγ=0.11 *6*, using the calculated normalization. E_γ: 274.21 *10* (1978Ka10).
276.296 *5*	4.0 *3*	276.289	7/2$^+$	0	5/2$^+$	M1+E2	0.5 *3*	0.027 *3*	α(K)=0.0237 *23*; α(L)=0.0030 *5*; α(M)=0.00056 *8* α(N)=9.4×10^{-5} *13* %Iγ=2.2 *3*, using the calculated normalization. E_γ: 276.26 *7* (1978Ka10). E_γ: placed by 1977Ba57 from a level at E=389.7 keV that is not in Adopted Levels. I_γ: others: 3.9 *3* (1978Fr21), 4.3 *6* (1977Ba57).
291.430 *4*	13.9 *8*	291.4339	3/2$^+$	0	5/2$^+$	M1+E2	0.6 *4*	0.024 *3*	α(K)=0.0210 *22*; α(L)=0.0027 *4*; α(M)=0.00050 *8* α(N)=8.4×10^{-5} *12* %Iγ=7.5 *8*, using the calculated normalization. E_γ: 291.36 *7* (1978Ka10). I_γ: others: 13.2 *9* (1978Fr21), 12.8 *14* (1977Ba57).
295.597 *3*	0.6 *1*	540.6753	5/2$^+$	245.0807	(7/2)$^-$				%Iγ=0.32 *7*, using the calculated normalization. E_γ: 295.54 *10* (1978Ka10). I_γ: others: 0.60 *7* (1978Fr21), 0.9 *2* (1977Ba57).
[x]298.0 *5*	0.05 *3*								%Iγ=0.027 *17*, using the calculated normalization. E_γ,I_γ: observed only by 1978Fr21 and placed from a level at E=624.7 keV. A 298.197γ de-excites a 1/2$^+$ level at E=623.48 in Adopted Levels.
320 *1*	0.10 *5*	597.1	(9/2)$^+$	276.289	7/2$^+$				%Iγ=0.05 *3*, using the calculated normalization.

$^{109}_{46}Pd_{63}$-5

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21 (continued)

$\gamma(^{109}Pd)$ (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@a]	α[&]	Comments
325.284 *4*	2.7 *5*	325.2836	3/2$^+$	0	5/2$^+$	M1(+E2)	0.5 *+3−5*	0.0174 *14*	E_γ: from 1978Ka10. A 320.164γ de-excites a 3/2$^+$ level at E=433.56 in Adopted Levels. α(K)=0.0151 *11*; α(L)=0.00187 *20*; α(M)=0.00035 *4* α(N)=5.9×10^{-5} *6* %Iγ=1.5 *3*, using the calculated normalization.
326.868 *4*	100	326.8689	5/2$^+$	0	5/2$^+$	E2(+M1)		0.019 *4*	E_γ: 325.43 *20* (1978Ka10). α(K)=0.016 *3*; α(L)=0.0021 *5*; α(M)=0.00040 *10* α(N)=6.7×10^{-5} *15* %Iγ=54 *5*, using the calculated normalization.
[x]338.2 *4*	0.19 *2*								E_γ: 326.450 *10* (1979Bo26) and 326.83 *5* (1978Ka10). %Iγ=0.103 *15*, using the calculated normalization.
[x]361.8 *5*	0.24 *4*								E_γ: not observed in 1978Ka10. Placed by 1977Ba57 from a level at E=338 keV and by 1978Fr21 from a level at E=765.2 keV, with both levels not in Adopted Levels. I_γ: weighted average of 0.18 *2* (1978Fr21) and 0.3 *1* (1977Ba57). %Iγ=0.130 *25*, using the calculated normalization.
378.191 *5*	2.3 *2*	491.589	3/2$^+$	113.4000	1/2$^+$	E2		0.01395	E_γ,I_γ: observed only by 1978Fr21 and placed from a level at E=361.8 keV that is not in Adopted Levels. α(K)=0.01200 *17*; α(L)=0.001598 *23*; α(M)=0.000302 *5* α(N)=4.98×10^{-5} *7* %Iγ=1.24 *16*, using the calculated normalization.
389.8[c] *3*	0.10 *5*	667.3?		276.289	7/2$^+$				E_γ: 378.05 *7* (1978Ka10). I_γ: others: 1.7 *2* (1978Fr21), 1.9 *3* (1977Ba57). %Iγ=0.05 *3*, using the calculated normalization.
[x]420.8 *5*	0.05 *3*								E_γ: weighted average of 391 *1* (1978Ka10) and 389.7 *2* (1977Ba57). 1977Ba57 place this γ ray from a E=389.7 keV level. I_γ: others: 0.8 *2* (1977Ba57). %Iγ=0.027 *17*, using the calculated normalization.
426.135 *4*	14.3 *13*	426.140	7/2$^+$	0	5/2$^+$	M1		0.00822	E_γ,I_γ: observed only by 1978Fr21 and placed from a level at E=712.2 keV. A level at 712 is in Adopted Levels and observed in (d,t). α(K)=0.00719 *10*; α(L)=0.000849 *12*; α(M)=0.0001593 *23* α(N)=2.69×10^{-5} *4* %Iγ=7.7 *10*, using the calculated normalization.
427.3[c] *9*	<0.5	540.6753	5/2$^+$	113.4000	1/2$^+$				E_γ: 426.14 *7* (1978Ka10). I_γ: others: 15.2 *11* (1978Fr21), 14.0 *14* (1977Ba57). %Iγ=0.14 *14*, using the calculated normalization.
[x]474.5 *5*	0.10 *5*								E_γ: from 1978Ka10. %Iγ=0.05 *3*, using the calculated normalization.
[x]489.0 *5*	0.03 *3*								E_γ,I_γ: observed only by 1978Fr21. %Iγ=0.016 *17*, using the calculated normalization. E_γ,I_γ: observed only by 1978Fr21 and placed from a level at E=765.2 keV that is not in Adopted Levels.

$^{109}_{46}Pd_{63}$-6

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21 (continued)

$\gamma(^{109}Pd)$ (continued)

E_γ [†]	I_γ [‡b]	E_i(level)	J_i^π	E_f	J_f^π	Comments
491.575 *10*	0.7 *1*	491.589	3/2$^+$	0	5/2$^+$	%Iγ=0.38 *7*, using the calculated normalization. E_γ: 491.7 *2* (1978Ka10). I_γ: others: 0.95 *8* (1978Fr21), 0.7 *2* (1977Ba57).
[x]515.0 *5*	<0.03					%Iγ=0.008 *9*, using the calculated normalization. E_γ,I_γ: observed only by 1978Fr21. A 515.128γ de-excites a J^π=3/2$^+$,5/2$^+$ at E=791.43 in Adopted Levels.
540.697 *10*	0.9 *1*	540.6753	5/2$^+$	0	5/2$^+$	%Iγ=0.49 *7*, using the calculated normalization. E_γ: 540.7 *2* (1978Ka10). I_γ: others: 2.4 *2* (1978Fr21), 1.4 *3* (1977Ba57).
555.614[#] *13*	0.06[#] *3*	981.755		426.140	7/2$^+$	%Iγ=0.032 *17*, using the calculated normalization. I_γ: normalized to Iγ(690.3γ)=0.2 *1* based on Iγ(555.614γ)/Iγ(630.3γ)=32 *4*/100 *7* in Adopted Gammas.
[x]586.1 *2*	0.7 *3*					%Iγ=0.38 *17*, using the calculated normalization. E_γ,I_γ: observed only by 1977Ba57 and placed from a level at E=975.2 keV that is not in Adopted Levels. A 585.908γ de-excites a 5/2$^+$ level at E=911.25 in Adopted Levels.
597.3 *5*	0.2 *1*	597.1	(9/2)$^+$	0	5/2$^+$	%Iγ=0.11 *6*, using the calculated normalization. E_γ: 597.3 *5* (1978Ka10).
[x]617.9 *10*	0.2 *1*					%Iγ=0.11 *6*, using the calculated normalization. E_γ,I_γ: from 1978Ka10.
654.892[#] *16*	0.07[#] *4*	981.755		326.8689	5/2$^+$	%Iγ=0.038 *22*, using the calculated normalization. I_γ: normalized to Iγ(690.3γ)=0.2 *1* based on Iγ(654.892γ)/Iγ(630.3γ)=37 *4*/100 *7* in Adopted Gammas.
690.30[c] *3*	0.2 *1*	981.755		291.4339	3/2$^+$	%Iγ=0.11 *6*, using the calculated normalization. E_γ: 690.6 *5* from weighted average of 692 *2* (1978Ka10) and 690.5 *5* (1978Fr21). I_γ: others: 0.23 *1* (1978Fr21).
705.43[#] *5*	0.03[#] *2*	981.755		276.289	7/2$^+$	%Iγ=0.016 *11*, using the calculated normalization. I_γ: normalized to Iγ(690.3γ)=0.2 *1* based on Iγ(705.43γ)/Iγ(630.3γ)=17 *3*/100 *7* in Adopted Gammas.
[x]777.9 *5*	0.30 *15*					%Iγ=0.16 *9*, using the calculated normalization. E_γ,I_γ: observed only by 1978Fr21.
[x]975.2 *2*	1.0 *3*					%Iγ=0.54 *17*, using the calculated normalization. E_γ,I_γ: observed only by 1978Fr21 and placed from a level at E=975.2 keV that is not in Adopted Levels.
1041.7 *5*	0.20 *5*	1317.23		276.289	7/2$^+$	%Iγ=0.11 *3*, using the calculated normalization. E_γ: 1041.7 *5* (1978Ka10).
[x]1072.4 *2*	0.10 *5*					%Iγ=0.05 *3*, using the calculated normalization. E_γ: from 1977Ba57, placed from a level at E=1612.8 keV that is not in Adopted Levels. 1072 *1* from 1978Ka10. I_γ: others: 0.4 *2* (1977Ba57).
1317.1 *2*	0.2 *1*	1317.23		0	5/2$^+$	%Iγ=0.11 *6*, using the calculated normalization. E_γ: 1317.1 *2* (1978Ka10). E_γ: weighted average of 1318 *1* (1978Ka10) and 1317.1 *2* (1977Ba57). 1977Ba57 place this γ ray from a level at E=1857.8 keV. I_γ: others: 0.4 *2* (1977Ba57).

$^{109}_{46}Pd_{63}$-7

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21 (continued)

$\gamma(^{109}Pd)$ (continued)

E_γ †	I_γ ‡ b	E_i(level)	Comments
x1612.8 2	0.9 3		%Iγ=0.49 17, using the calculated normalization. E_γ,I_γ: observed only by 1977Ba57 and placed from a level at E=1612.8 keV that is not in Adopted Levels.

† From Adopted Gammas, unless otherwise noted. Values from this dataset are given in comments. Unplaced γ rays are from this dataset.
‡ From 1978Ka10, unless otherwise noted. Iγ are normalized to Iγ(326.8)=100. Iγ from 1977Ba57 and 1978Fr21 are in comments.
# Not observed in this dataset and data are taken from Adopted Gammas. Iγ is normalized to absolute value of the strongest transition from each level in this dataset based on relative intensities in Adopted Gammas.
@ From Adopted Gammas, unless otherwise noted. ce data in this dataset are from α(K)exp based on Iγ/K x ray ratio in coincidence spectra (1978Ka10, 1977Ba57).
& Additional information 1.
a 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.
b For absolute intensity per 100 decays, multiply by 0.54 5.
c Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

$^{109}_{46}Pd_{63}$-8

^{109}Rh β^- decay 1978Ka10,1977Ba57,1978Fr21

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays