^{138}Nd ε decay 1981AbZV

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 146, 1 (2017)	30-Sep-2017

Parent: ^{138}Nd: E=0.0; J$^{\pi}$=0^{+}; T$_{1/2}$=5.04 h *9*; Q(ε)=1116 *16*; %ε+%β^{+} decay=100.0

^{138}Nd-T$_{1/2}$: From Adopted Levels of ^{138}Nd.

^{138}Nd-Q(ε): From 2017Wa10.

1981AbZV: Source of ^{138}Nd was produced by bombarding a 2 g metallic Gd target with a E=660 MeV proton beam from the Synchro-cyclotron at JINR. Ions were separated and selected with an electromagnetic separator and implanted into aluminum substrate or mylar foil. γ rays were detected with Ge(Li) detectors (FWHM=0.6 keV for ^{57}Co line, 2.2 keV for ^{60}Co line); conversion electrons were detected with Si(Li) detectors (FWHM=2.2 keV at 500 keV). Measured Eγ, Iγ, E(ce), I(ce), $\beta\gamma$-coin. Deduced levels, J, π, γ and β branching ratios, conversion coefficients, γ-ray multipolarities. See also 1971Af05, 1974Bu03, 1974BaZU, 1987BaZC from the same group at JINR.

Others: 1966Gr15, 1970Ho28, 1971JuZU, 1980ZhZZ.

Decay scheme is from 1981AbZV.

The total average radiation energy released by ^{138}Nd ε decay is 1111 keV *19* (calculated by evaluator using the computer program RADLST). This value agrees well with Q(ε)=1116 keV *16* (2017Wa10) and shows the completeness of the decay scheme.

^{138}Pr Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$‡	E(level)†	J$^{\pi}$‡	E(level)†	J$^{\pi}$‡
0.0	1^{+}	1.45 min *5*	326.96 *6*	0^{+},1^{+},2^{+}	623.6 *11*	(1)$^{+}$
194.22 *5*	0^{+},1^{+},2^{+}		389.6 *4*	(0,1,2)$^{+}$	673.9 *7*	(1)$^{+}$
199.52 *4*	0^{+},1^{+},2^{+}		505.9 *4*	(1)$^{+}$	718.0? *7*	(0^{-},1^{-},2^{-})
325.73 *4*	1^{+}		541.11 *5*	0^{+},1^{+}		

† From a least-squares fit to γ-ray energies.
‡ From Adopted Levels.

ε,β^{+} radiations

$\beta^{+}\leq$2.5%, $\varepsilon/\beta^{+}\geq$40, Q($\varepsilon$)<1750 keV (1974BaZU).

E(decay)	E(level)	Iε†‡	Log *ft*	Comments
(398# *16*)	718.0?	0.030 *12*	7.7 *2*	εK=0.8240 *15*; εL=0.1364 *11*; εM+=0.0396 *4*
(442 *16*)	673.9	0.060 *18*	7.5 *2*	εK=0.8270 *12*; εL=0.1342 *9*; εM+=0.0388 *3*
(492# *16*)	623.6	0.024 *9*	8.0 *2*	εK=0.8297 *9*; εL=0.1322 *7*; εM+=0.03813 *23*
(575 *16*)	541.11	0.85 *16*	6.6 *1*	εK=0.8330 *7*; εL=0.1297 *5*; εM+=0.03730 *16*
(610# *16*)	505.9	0.14 *3*	7.4 *1*	εK=0.8341 *6*; εL=0.1289 *5*; εM+=0.03702 *14*
(726 *16*)	389.6	<0.04	>8.1	εK=0.8370 *4*; εL=0.1267 *3*; εM+=0.03630 *10* Iε: sum of Iε to levels 389.5 and 326.96.
(789 *16*)	326.96	<0.1	>7.8	εK=0.8381 *4*; εL=0.12585 *24*; εM+=0.03601 *8*
(790 *16*)	325.73	2.9 *5*	6.3 *1*	εK=0.8382 *4*; εL=0.12584 *24*; εM+=0.03601 *8*
(916 *16*)	199.52	<0.09	>8.0	εK=0.8400 *3*; εL=0.12447 *17*; εM+=0.03555 *6*
(922 *16*)	194.22	<0.07	>8.1	εK=0.8400 *3*; εL=0.12442 *17*; εM+=0.03553 *6*
(1116 *16*)	0.0	95.9 *7*	5.12 *2*	εK=0.8420 *2*; εL=0.1230 *2*; εM+=0.03505 *4*

† From γ-ray intensity balance at each level.
‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

^{138}Nd ε decay 1981AbZV (continued)

$\gamma(^{138}Pr)$

Iγ normalization: From the adopted I(789γ)=2.4 *4* per 100 decays of 1.45-min ^{138}Pr and I(γ)/I(789γ) in Nd-Pr source in equilibrium.

Eγ, Iγ, α(K)exp, α(L)exp from 1981AbZV, unless otherwise noted.

I(Kα_1 x ray+Kα_2 x ray Pr)=2350 *250*; I(Kβ_1' x ray Pr)=380 *40*; I(Kβ_2' x ray Pr)=80 *15*, normalized to 100 for the 789γ in 1.45-min ^{138}Pr decay (Nd-Pr source in equilibrium) (1981AbZV).

E$_\gamma$	I$_\gamma$[@c]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[&]	δ[‡b]	α[†]	Comments
62.6 *4*	1.2 *4*	389.6	(0,1,2)$^+$	326.96	0$^+$,1$^+$,2$^+$	M1+E2	0.37 *9*	5.8 *4*	α(K)=4.22 *10*; α(L)=1.3 *3*; α(M)=0.28 *7* α(N)=0.061 *15*; α(O)=0.0089 *21*; α(P)=0.000313 *10* Mult.: α(K)exp=4.0 *18*, α(L)exp=0.64 *29* (1981AbZV).
116.3 *2*	3.6 *4*	505.9	(1)$^+$	389.6	(0,1,2)$^+$	M1+E2	0.22 *3*	0.861 *14*	α(K)=0.720 *11*; α(L)=0.111 *4*; α(M)=0.0236 *9* α(N)=0.00525 *19*; α(O)=0.00083 *3*; α(P)=5.45×10^{-5} *9* Mult.: α(K)exp=0.82 *17*, α(L)exp=0.084 *22* (1981AbZV).
126.14 *5*	4.6 *6*	325.73	1$^+$	199.52	0$^+$,1$^+$,2$^+$	M1+E2	0.87 *10*	0.782 *19*	α(K)=0.585 *9*; α(L)=0.154 *11*; α(M)=0.0339 *24* α(N)=0.0074 *6*; α(O)=0.00109 *7*; α(P)=3.92×10^{-5} *9* Mult.: α(K)exp=0.65 *15*, α(L)exp=0.078 *20* (1981AbZV). Additional information 3.
127.33[#d]		326.96	0$^+$,1$^+$,2$^+$	199.52	0$^+$,1$^+$,2$^+$	M1+E2[a]		0.78 *13*	α(K)=0.572 *18*; α(L)=0.16 *9*; α(M)=0.035 *20* α(N)=0.008 *5*; α(O)=0.0011 *6*; α(P)=3.7×10^{-5} *6*
131.59[#d]		325.73	1$^+$	194.22	0$^+$,1$^+$,2$^+$				
132.73 *5*	7.3 *9*	326.96	0$^+$,1$^+$,2$^+$	194.22	0$^+$,1$^+$,2$^+$	M1+E2	0.33 *7*	0.600 *12*	α(K)=0.496 *7*; α(L)=0.081 *6*; α(M)=0.0174 *13* α(N)=0.0039 *3*; α(O)=0.00060 *4*; α(P)=3.70×10^{-5} *7* Mult.: α(K)exp=0.50 *11*, α(L)exp=0.084 *21* (1981AbZV). Additional information 5.
151.77[#d]		541.11	0$^+$,1$^+$	389.6	(0,1,2)$^+$				
168 *1*	0.6 *2*	673.9	(1)$^+$	505.9	(1)$^+$	M1+E2[a]		0.322 *23*	α(K)=0.252 *8*; α(L)=0.055 *21*; α(M)=0.012 *5* α(N)=0.0026 *10*; α(O)=0.00040 *13*; α(P)=1.7×10^{-5} *3*
178.5 *10*	1.2 *4*	718.0?	(0$^-$,1$^-$,2$^-$)	541.11	0$^+$,1$^+$	(E1)		0.0513 *11*	α(K)=0.0439 *10*;

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^{138}Nd ε decay 1981AbZV (continued)

γ(^{138}Pr) (continued)

E_γ	I_γ[@c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	δ[‡b]	α[†]	Comments
									α(L)=0.00592 *13*; α(M)=0.00124 *3* α(N)=0.000275 *6*; α(O)=4.31×10^{-5} *9*; α(P)=2.80×10^{-6} *6* Mult.: α(K)exp=0.06 *3* (1981AbZV).
190.3[#d]		389.6	(0,1,2)$^+$	199.52	0$^+$,1$^+$,2$^+$				
194.21 *5*	10.6 *6*	194.22	0$^+$,1$^+$,2$^+$	0.0	1$^+$	M1		0.202	α(K)=0.1721 *25*; α(L)=0.0235 *4*; α(M)=0.00494 *7* α(N)=0.001105 *16*; α(O)=0.0001780 *25*; α(P)=1.316×10^{-5} *19* Mult.: α(K)exp=0.154 *22*, α(L)exp=0.021 *4* (1981AbZV). Additional information 1.
195.8[#d]		389.6	(0,1,2)$^+$	194.22	0$^+$,1$^+$,2$^+$				
199.50 *5*	22.9 *12*	199.52	0$^+$,1$^+$,2$^+$	0.0	1$^+$	M1+E2	0.29 *8*	0.188	α(K)=0.1586 *24*; α(L)=0.0230 *8*; α(M)=0.00487 *18* α(N)=0.00109 *4*; α(O)=0.000173 *5*; α(P)=1.195×10^{-5} *23* Mult.: α(K)exp=0.125 *20*, α(L)exp=0.021 *5* (1981AbZV). Additional information 2.
214.13 *6*	3.0 *8*	541.11	0$^+$,1$^+$	326.96	0$^+$,1$^+$,2$^+$	M1(+E2)		0.153 *3*	α(K)=0.123 *9*; α(L)=0.023 *6*; α(M)=0.0050 *13* α(N)=0.0011 *3*; α(O)=0.00017 *4*; α(P)=8.6×10^{-6} *16* Mult.: α(K)exp=0.21 *9* (1981AbZV). Additional information 6.
215.31 *6*	12.0 *13*	541.11	0$^+$,1$^+$	325.73	1$^+$	M1+E2	0.47 *13*	0.1516	α(K)=0.1269 *23*; α(L)=0.0195 *9*; α(M)=0.00416 *21* α(N)=0.00092 *5*; α(O)=0.000145 *6*; α(P)=9.4×10^{-6} *3* Mult.: α(K)exp=0.096 *22* (1981AbZV). Additional information 7.
[x]233.0[#]									
234 *1*	0.9 *3*	623.6	(1)$^+$	389.6	(0,1,2)$^+$	M1+E2[a]		0.117 *5*	α(K)=0.095 *9*; α(L)=0.017 *3*; α(M)=0.0037 *8* α(N)=0.00082 *16*; α(O)=0.000125 *19*; α(P)=6.7×10^{-6} *13*
284.3 *7*	1.6 *5*	673.9	(1)$^+$	389.6	(0,1,2)$^+$	M1+E2		0.066 *7*	α(K)=0.055 *8*; α(L)=0.0090 *8*; α(M)=0.00194 *19* α(N)=0.00043 *4*;

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^{138}Nd ε decay 1981AbZV (continued)

γ(^{138}Pr) (continued)

E_γ	I_γ [@c]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[&]	δ[‡b]	α[†]	Comments
									α(O)=6.7×10^{-5} *4*; α(P)=3.9×10^{-6} *9* Mult.: α(K)exp=0.056 *28* (1981AbZV).
325.76 *5*	122 *3*	325.73	1$^+$	0.0	1$^+$	M1+E2	0.44 *11*	0.0487 *11*	α(K)=0.0413 *10*; α(L)=0.00584 *9*; α(M)=0.001233 *19* α(N)=0.000275 *4*; α(O)=4.39×10^{-5} *7*; α(P)=3.09×10^{-6} *10* Mult.: α(K)exp=0.039 *4*, α(L)exp=0.0054 *9* (1981AbZV). Additional information 4.
326.9 *6*	1.0 *3*	326.96	0$^+$,1$^+$,2$^+$	0.0	1$^+$				
341.65 *5*	17.2 *17*	541.11	0$^+$,1$^+$	199.52	0$^+$,1$^+$,2$^+$	M1+E2		0.039 *6*	α(K)=0.033 *6*; α(L)=0.00511 *8*; α(M)=0.001089 *21* α(N)=0.000242 *4*; α(O)=3.79×10^{-5} *11*; α(P)=2.4×10^{-6} *6* Mult.: α(K)exp=0.034 *8*, α(L)exp=0.0072 *20* (1981AbZV).
389.5[#d]		718.0?	(0$^-$,1$^-$,2$^-$)	326.96	0$^+$,1$^+$,2$^+$				
541.0 *3*	1.7 *5*	541.11	0$^+$,1$^+$	0.0	1$^+$	M1		0.01385	α(K)=0.01187 *17*; α(L)=0.001566 *22*; α(M)=0.000329 *5* α(N)=7.35×10^{-5} *11*; α(O)=1.188×10^{-5} *17*; α(P)=8.93×10^{-7} *13* Mult.: α(K)exp=0.024 *12* (1981AbZV). Additional information 8.

[†] Additional information 9.
[‡] 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.
[#] New transitions from 1987BaZC. Placed in level scheme by evaluator based on energy differences.
[@] From 1981AbZV, normalized to 100 for the 789γ in 1.45-min ^{138}Pr decay (Nd-Pr source in equilibrium).
[&] From 1981AbZV based on ce data, unless otherwise noted. The same assignments were adopted in Adopted Gammas.
[a] From 1987BaZC. I(ce) are normalized to α(K)exp(789γ in Pr decay)=0.00297 (E2, theory). The same assignments were adopted in Adopted Gammas.
[b] From 1987BaZC, based on L-subshell ratios. The same values are adopted in Adopted Gammas.
[c] For absolute intensity per 100 decays, multiply by 0.024 *4*.
[d] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{138}Nd ε decay 1981AbZV

Decay Scheme

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