^{253}No α decay 2012He09,2006Lo12,2004He28

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. D. Nesaraja	NDS 195,718 (2024)	12-Oct-2023

Parent: ^{253}No: E=0.0; J$^{\pi}$=(9/2^{-}); T$_{1/2}$=94.0 s *12*; Q(α)=8415 *4*; %α decay=55 *3*

^{253}No-J$^{\pi}$: From Adopted Levels of ^{253}No in the ENSDF (2013Br09).

^{253}No-T$_{1/2}$: From weighted average of 100.0 s *55* (2018Ac08), 102 s *12* (2017Mi01), 93.6 s *12* (2009He23), 94 s *+11−9* (2009Qi04), 95 s *10* (1967Mi03), 105 s *20* (1967Gh01).

^{253}No-Q(α): From 2021Wa16.

^{253}No-%α decay: From Adopted Levels of ^{253}No in ENSDF database (2013Br09).

2012He09: ^{253}No was produced in ^{207}Pb(^{48}Ca,2n) reaction. The ^{48}Ca beam at E=218.4 MeV from the UNILAC accelerator at GSI bombarded a 98.9% enriched ^{207}Pb target. Evaporation residues were separated using the velocity filter SHIP. They were then implanted into a position-sensitive 16-strip PIPS detector at the focal plane The PIPS detector was used to measure α decay energy of the implanted nuclei and their daughter products. It was surrounded in backward hemisphere by a box of silicon detectors to stop α particles. Gamma rays were detected using a four crystal Ge-clover detector shielded with Cu, Cd, Pb (Expt.1), and VEGA-type detector without shielding (Expt.2) FWHM=1.7 keV (Expt.1) and FWHM=2.5 keV (Expt.2) for the 279.5 keV γ-rays. Measured Eγ, Iγ, E$_{\alpha}$, I$_{\alpha}$, $\alpha\gamma$ coin (Δt$\leq\pm$0.4 μs). Deduced level scheme, J^{π}, and simulated the sum energy (E$_{\alpha}$+E$_{ce}$) spectra as a function of the implantation depth of ^{253}No by GEANT4 code.

2004He28,2004He04,1997He29 (same group as 2012He09): ^{253}No produced in ^{207}Pb(^{48}Ca,2n) Residues separated by SHIP velocity filter and implanted into PIPS of GSI. Measured α, γ, $\gamma\gamma$ coin, $\alpha\gamma$ coin. Prompt and delayed spectra following α decay of ^{253}No.

2011Lo06: (The same group as 2006Lo12 at FLNR, JINR. However, 2011Lo06 did the measurements with increased efficiency of their detector system and revisited the decay scheme). ^{253}No was produced in ^{207}Pb(^{48}Ca,2n). The residues were separated by VASSILISSA recoil separator and implanted into the GABRIELA detection system at focal plane. The detectors consisted of 48x48 strip Double-Sided-Silicon strip Detector (DSSD), 32-strip silicon detector upstream and a Ge detector. The efficiency for γ ray detection was increased to 16.4% for 100-keV photon and 3.4% at 1332 keV. Measured α, γ, $\gamma\gamma$ coin, $\alpha\gamma$ coin, conversion electrons and α(ce) coin and prompt and delayed spectra following α decay of ^{253}No. Confirmed the work of 2006Lo12 and observed a new α-group to a (7/2^{-}) state at 669 keV.

2006Lo12 and 2006Po10: (Same group as 2011Lo06 but used the position sensitive 16-strip silicon detector.) ^{253}No was produced in ^{207}Pb(^{48}Ca,2n). The residues were separated by VASSILISSA recoil separator and implanted into GABRIELA detection system at FLNR, JINR. The detectors consisted of 16-strip silicon detectors at the focal plane, 4-strip silicon detectors upstream and the Ge detector. The source was mixed with ^{254}No which made it impossible to determine the absolute α decay branching ratios. Measured α, γ, $\gamma\gamma$ coin, $\alpha\gamma$ coin, conversion electrons and α(ce) coin. Prompt and delayed spectra following α decay of ^{253}No.

1997He29: α decay chain ^{257}Rf$\rightarrow^{253}$No was studied at the UNILAC accelerator at GSI, Germany. The evaporation residue (ER) from the ^{208}Pb(^{50}Ti,n) were separated in the SHIP velocity fiter and then passed through a TOF system and finally implanted into a position sensitive 16-strip silicon wafer. Measured Eα, $\alpha\alpha$ correlations and excitation functions, and half-lives. There may be some indication that the ^{253}No α decay involves the decay of two isomers. Possibly the 8063 α are correlated with the α's from 3.9 s ^{257}Rf, however no final conclusion was made.

Fm K-x rays (keV) (measured by 2012He09)

115.3 *2*	K$_{\alpha2}$
121.1 *2*	K$_{\alpha1}$
136.4 *2*	K$_{\beta1}$
140.6 *2*	K$_{\beta2}$

^{253}No α decay 2012He09,2006Lo12,2004He28 (continued)

^{249}Fm Levels

E(level)†	Jπ‡	$T_{1/2}$	Comments
0.0#	(7/2+)	2.05 min *25*	$T_{1/2}$: From Adopted Levels. Configuration=7/2[624].
58.20# *17*	(9/2+)		
129.2# *3*	(11/2+)		
140? *20*			E(level): Calculated by the evaluator from Eα in 1997He29. May consist of unresolved doublet as observed by 1997He29.
209.30 *20*	(5/2+)		Configuration=5/2[622].
248 *17*			E(level): Calculated by the evaluator from Eα in 1997He29.
279.80 *16*	(9/2−)		Configuration=9/2[734].
669.5 *4*	(7/2−)		Configuration=7/2[743].

† From least-squares fit to Eγ data except as noted.
‡ From Adopted Levels.
# Band(A): 7/2[624].

α radiations

Eα	E(level)	Iα#	HF‡	Comments
7619 *15*	669.5	0.24 *6*	24 *7*	Eα: Weighted average of 7620 *15* (2012He09) and 7615 *4* (2011Lo06). Iα: Estimated by evaluator from intensity balance. 2012He09 gives Iα= 0.25 *6*.
8007 *4*	279.80	95.2 *52*	1.47 *12*	Eα: Weighted average of 8004 *10* (2012He09) and 8007 *4* (2011Lo06). Others: 8011 *93* (1997He29), 8003 *5* (2006Lo12), 8004 *5* (2004He28). Iα: Estimated by the evaluator from 100−(Summed α branches to g.s., 209.30, and 669.5 -keV levels). 2012He09 gives Iα= 95.8 *1*.
8038 *17*	248			Eα: From 1997He29.
8078 *10*	209.30	3.9 *5*	62 *9*	Eα: Weighted average of 8075 *15* (2012He09) and 8080 *10* (2011Lo06). Others: 8063 *74* (1997He29), 8070 *10* (2006Lo12). Iα: Estimated by evaluator from intensity balance. 2012He09 gives Iα= 4.2 *6*.
8144 *20*	140?			Eα: Observed by 1997He29 who noted that it may consist of an unresolved doublet.
8150† *20*	129.2			Eα: From 2006Lo12.
8220† *20*	58.20			Eα: From 2006Lo12.
8280† *20*	0.0			Eα: From 2006Lo12.

† Broad distribution of alpha particles was observed by 2012He09. The shape analysis of the measured α spectra was compared to GEANT simulations that lead to evidence for weak α decay branches of ^{253}No into g.s. of ^{249}Fm or the ground-state rotational band. In the simulations, by GEANT4 code, (E_{α}+E_{ce}) and a total of 0.7% α decay branch to the g.s. rotational band were considered.
‡ The nuclear radius parameter r_0(^{249}Fm)=1.4730 *54* is deduced from interpolation (or unweighted average) of radius parameters of the adjacent even-even nuclides.
# For absolute intensity per 100 decays, multiply by 0.55 *3*.

γ(^{249}Fm)

Iγ normalization: From I(γ+ce)=99.3 for all gammas from 209, 279 and 669 levels, allowing for 0.7% relative α feeding to g.s. or ground-state band. It is considered approximate due to unplaced 75.0γ and other uncertain features of the decay scheme.

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^{253}No α decay 2012He09,2006Lo12,2004He28 (continued)

γ(^{249}Fm) (continued)

E_γ	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	α[‡]	Comments
58.3 *2*	1.3 *3*	58.20	(9/2$^+$)	0.0	(7/2$^+$)	(M1)	50.6 *9*	α(L)=37.8 *7*; α(M)=9.36 *16* α(N)=2.62 *5*; α(O)=0.691 *12*; α(P)=0.1342 *23*; α(Q)=0.00758 *13* E_γ,I_γ: From 2012He09. E(58γ) was also seen in 2011Lo06 (shown in Fig.4 in 2011Lo06). Mult.: From 2012He09 who notes that for M1 transition, the expected I(γ+ce)(58.3γ)/I(γ+ce)(221.5γ)=1. The experimental ratio is 0.73 *25* for M1, 4.1 *15* for E2, 0.022 *10* for E1; thus M1 (or M1 with small E2 admixture) for 58.3γ is most probable. It is noted by the evaluator that if 58.3γ is pure M1, Iγ should be 2.1, deduced from γ intensity balance at 58.2 level: I(γ+ce)(58.3γ)=I(γ+ce)(221.5γ)=109.2 units. If Iγ=1.3 *3* is correct, then 58.3γ may be M1+E2 with δ ≈ 0.35.
(71)		129.2	(11/2$^+$)	58.20	(9/2$^+$)			E_γ: Expected by 2006Lo12 based on the 150γ in coincident with ≈55$^-$ and ≈70−keV electrons and the presence of a structure at 100 keV in the electron single spectrum.
^{x}75.0 *2*	1.3 *3*							E_γ: 75γ in coincidence with α events ranging from 8050-8100 keV.
129.2 *4*	1.0 *2*	129.2	(11/2$^+$)	0.0	(7/2$^+$)	E2	8.19 *16*	α(L)=5.88 *12*; α(M)=1.690 *34* α(N)=0.481 *10*; α(O)=0.1216 *24*; α(P)=0.0195 *4*; α(Q)=9.24×10^{-5} *17* E_γ,I_γ: From 2012He09. Mult.: From α(LMN+)exp=4.0 *18* (2006Lo12),.
150.6 *3*	18 *1*	279.80	(9/2$^-$)	129.2	(11/2$^+$)	E1	0.2151 *32*	α(K)=0.1594 *23*; α(L)=0.0416 *6*; α(M)=0.01035 *15* α(N)=0.00287 *4*; α(O)=0.000734 *11*; α(P)=0.0001266 *19*; α(Q)=4.54×10^{-6} *7* E_γ: weighted average of 150.4 *2* (2012He09) and 151.2 *4* (2011Lo06). I_γ: From 2012He09. Mult.: From α(LMN+)exp=0.11 *3* (2006Lo12), α(K)exp<0.98 (2004He28), α(L)exp<0.3 (2004He28), α(LMN+)exp=0.11 *2* (2011Lo06).
209.3 *2*	1.1 *1*	209.30	(5/2$^+$)	0.0	(7/2$^+$)	M1	5.61 *8*	α(K)=4.35 *6*; α(L)=0.945 *13*; α(M)=0.2335 *33* α(N)=0.0652 *9*; α(O)=0.01722 *25*; α(P)=0.00334 *5*; α(Q)=0.0001866 *27* E_γ: weighted average of 209.3 *2* (2012He09) and 209.5 *5* (2011Lo06). I_γ: From 2012He09. Mult.: From α(LMN+)exp=2.8 *22* (2006Lo12), α(K)exp=4.4 *12* (2012He09), α(K)exp=4.9 *19* (2012He09) α(LMN+)exp=3.42 *87* (2011Lo06).
221.7 *2*	100	279.80	(9/2$^-$)	58.20	(9/2$^+$)	E1	0.0916 *13*	α(K)=0.0698 *10*; α(L)=0.01631 *23*;

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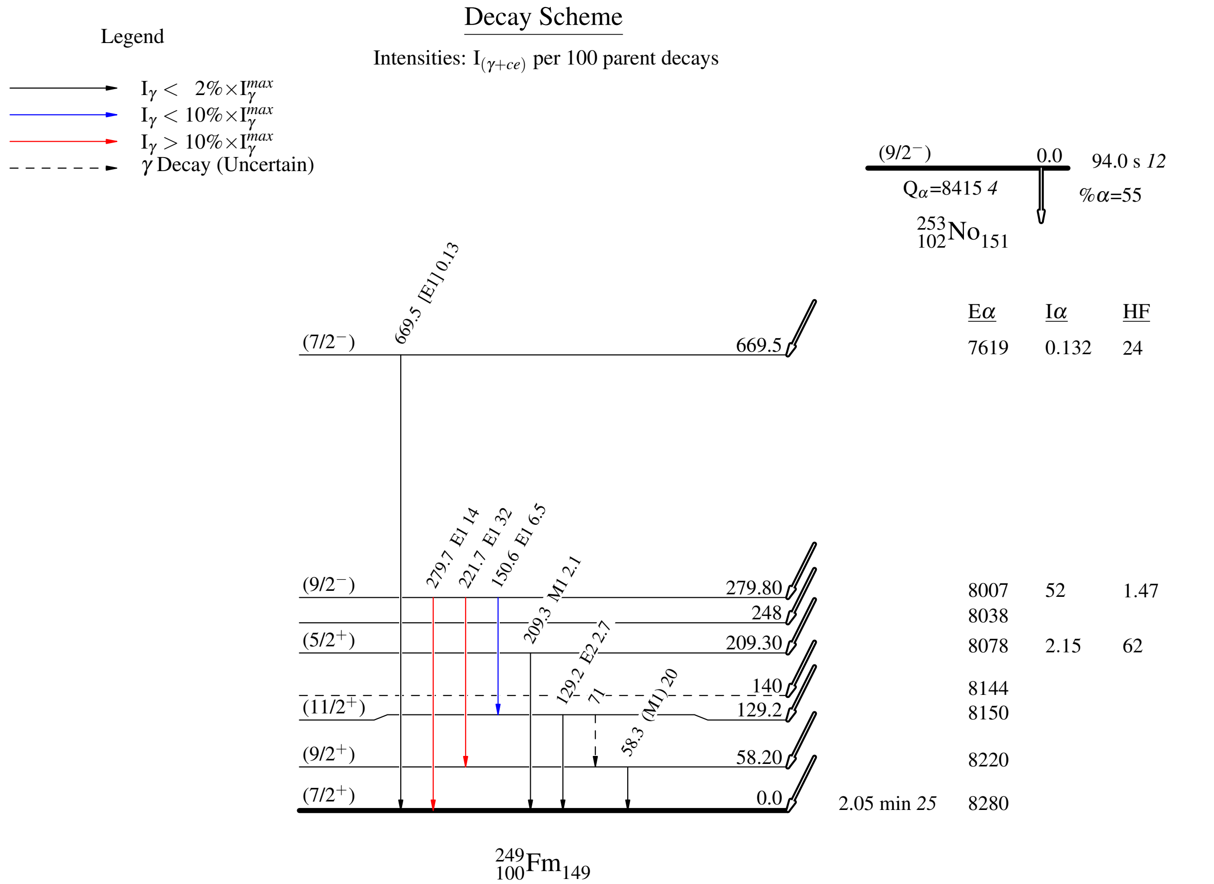
^{253}No α decay 2012He09,2006Lo12,2004He28 (continued)

γ(^{249}Fm) (continued)

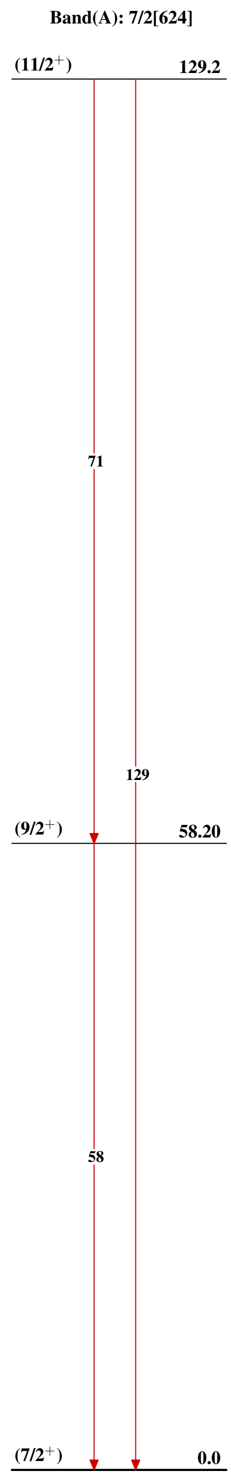
E_γ	I_γ[#]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[†]	α[‡]	Comments
								α(M)=0.00404 *6* α(N)=0.001119 *16*; α(O)=0.000289 *4*; α(P)=5.14×10^{-5} *7*; α(Q)=2.054×10^{-6} *29* E_γ: weighted average of 221.5 *2* (2012He09) and 221.8 *2* (2011Lo06). I_γ: From 2012He09. Mult.: From α(LMN+)exp=0.04 *1* (2006Lo12), α(K)exp<0.17 (2004He28), α(L)exp<0.05 (2004He28), α(LMN+)exp=0.023 *4* (2011Lo06).
279.7 *2*	44 *1*	279.80	(9/2$^-$)	0.0	(7/2$^+$)	E1	0.0556 *8*	α(K)=0.0429 *6*; α(L)=0.00953 *13*; α(M)=0.002349 *33* α(N)=0.000652 *9*; α(O)=0.0001687 *24*; α(P)=3.05×10^{-5} *4*; α(Q)=1.294×10^{-6} *18* E_γ: weighted average of 279.5 *2* (2012He09) and 279.8 *2* (2011Lo06). I_γ: From 2012He09. Mult.: α(LMN+)exp=0.08 *2* (2006Lo12), α(K)exp=0.12 *3* (2006Lo12), α(K)exp<0.35 (2004He28), α(L)exp<0.1 (2004He28), α(K)exp=0.145 *22* (2011Lo06), α(LMN+)=0.076 *12* (2011Lo06).
669.5 *4*	0.43 *11*	669.5	(7/2$^-$)	0.0	(7/2$^+$)	[E1]	0.01023 *14*	α(K)=0.00814 *11*; α(L)=0.001571 *22*; α(M)=0.000382 *5* α(N)=0.0001059 *15*; α(O)=2.77×10^{-5} *4*; α(P)=5.22×10^{-6} *7*; α(Q)=2.64×10^{-7} *4* E_γ: From 2012He09.

† From the experimental internal conversion data. The numerical values of the conversion coefficients data from 2006Lo12 listed in the comments were read from Figure 6 of 2006Lo12.
‡ Additional information 1.
# For absolute intensity per 100 decays, multiply by 0.30.
x γ ray not placed in level scheme.

^{253}No α decay 2012He09,2006Lo12,2004He28



^{253}No α decay 2012He09,2006Lo12,2004He28



$^{249}_{100}Fm_{149}$