^{223}Fr α decay (22.00 min) 2001Li44,1955Ad10,1956Pe27

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh et al. ,	NDS 175, 1 (2021)	19-May-2021

Parent: ^{223}Fr: E=0.0; J$^{\pi}$=3/2$^{(-)}$; T$_{1/2}$=22.00 min *7*; Q(α)=5561.4 *28*; %α decay=0.023 *10*

^{223}Fr-J$^{\pi}$,T$_{1/2}$: From ^{223}Fr Adopted Levels in the ENSDF database (May 2001 update). No new data for J^{π} and T$_{1/2}$ since this update.

^{223}Fr-Q(α): From 2021Wa16.

^{223}Fr-%α decay: %α=0.023 *10* (summed α branches from 2001Li44, with uncertainties from upper and lower limits) from decay of ^{223}Fr. 2001Li44 give %α=0.02 *1* in level-scheme Fig. 8. Others: 0.006% (1955Ad10,1956Pe27), ≈0.004% (1953Hy83).

2001Li44 (also 2002Sh19): recoil-collected source from ^{227}Ac α decay. Measured Eα, Iα, Eγ, Iγ, $\alpha\gamma$-coin. FWHM=17 keV for α spectrum. Deduced levels, J^{π}, configurations, shell-model interpretation.

Others: 1956Pe27, 1955Ad10, 1953Hy83; measured Eα, Iα.

DDEP evaluation: see 2011BeZW.

^{219}At Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$	Comments
0	(9/2$^-$)	56 s *4*	T$_{1/2}$: from the Adopted Levels. Proposed configuration=$\pi h^3_{9/2}\otimes\nu g^{-2}_{9/2}$.
58.9 *2*	(7/2$^-$)		Proposed configuration=$\pi(h^2_{9/2}f_{7/2})\otimes\nu g^{-2}_{9/2}$.
150.9 *2*	(5/2$^-$)#		
174 *5*	(3/2$^-$)#		E(level): deduced by evaluators from Eα=5291 *4*, and Q(α)=5561.4 *28* from 2021Wa16. Other: 2001Li44 listed ≈174.
296.2 *4*	(3/2$^-$)#		

† From Eγ values, except where noted.

‡ As assigned by 2001Li44 (also 2002Sh19) based on multipolarity assignments to gamma-ray transitions, and shell-model configurations in comparison with level structures of ^{215}At and ^{217}At.

Configuration may involve parts of seniority three protons, $h^3_{9/2}$ and $h^2_{9/2}f_{7/2}$, as in ^{215,217}At. For 174 and 296 levels, (3/2$^-$) is also supported by low hindrance factors (<3) from 3/2$^{(-)}$ parent state.

α radiations

Eα†	E(level)	Iα†#	HF‡	Comments
5172 *5*	296.2	4 *2*	2.3 *16*	Measured Iα=39 *15*. Hindrance factor ≈2 (2001Li44).
5291 *4*	174	30 *13*	1.5 *9*	Measured Iα=250 *30*. Hindrance factor=2 *1* (2001Li44).
5314 *4*	150.9	26 *13*	2.3 *16*	Eα: other: 5340 *80* (1956Pe27,1955Ad10). Measured Iα=220 *30*. Hindrance factor=3.0 *15* (2001Li44).
5403 *3*	58.9	22 *9*	8 *5*	Measured Iα=182 *30*. Hindrance factor=10 *4* (2001Li44).
5462 *3*	0	17 *8*	22 *15*	Measured Iα=137 *25*. Hindrance factor=30 *15* (2001Li44).

† From 2001Li44. Intensities listed here are per 100 decays of ^{223}Fr, whereas 2001Li44 give these as per 10^{-6} β particles. Normalization factor for converting relative α intensities to per decay of ^{223}Fr decay was 2.7×10^{-7} *11*, deduced from intensity measurement of 50.1γ in ^{223}Ra from ^{223}Fr β^- decay and its evaluated absolute intensity taken from 1996FiZY (Table of Isotopes). Note that the normalization factor was quoted as 2.4×10^{-7} *10* in Table II of 2001Li44, and 2.7×10^{-7} *11* in the text, the latter being consistent with the values in column #3 of this table.

‡ Deduced with r$_0$=1.54541 *13* deduced from unweighted average of r$_0$=1.54864 *16* for ^{218}Po and r$_0$=1.542177 *86* for ^{220}Rn; values of r$_0$ taken from 2020Si16. 2001Li44 deduced hindrance factors using a classical formula relating T$_{1/2}$ and Q value.

For absolute intensity per 100 decays, multiply by 0.00023 *10*.

$\gamma(^{219}$At)

Iγ normalization, I(γ+ce) normalization: Intensities listed here are per 100 decays of ^{223}Fr.

E$_\gamma$ [†]	I$_\gamma$ [†#]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult. [‡]	δ	α [@]	I$_{(\gamma+ce)}$ [#]	Comments
(23 *5*)		174	(3/2$^-$)	150.9	(5/2$^-$)				70×10^{-4} *30*	Existence of this transition implied from observation of weak 150.9γ in coincidence with 5172α, and required by intensity balance arguments. I$_{(\gamma+ce)}$: From Iα.
58.9 *2*	8×10^{-4} *3*	58.9	(7/2$^-$)	0	(9/2$^-$)	M1		10.87 *19*		α(L)exp=7.2 *35* (2001Li44) α(L)=8.27 *15*; α(M)=1.96 *4*; α(N)=0.508 *9*; α(O)=0.1088 *19*; α(P)=0.0150 *3* Mult.: δ(E2/M1)<0.2 from α(L)exp, but pure M1 from intensity balance obtained from Iα and I(γ+ce). α(L)exp: from I(L-x rays)/Iγ(58.9)=130 *30*/68 *20*, and fluorescence yield ω=0.3.
145.3 *3*	2×10^{-4} *1*	296.2	(3/2$^-$)	150.9	(5/2$^-$)	(M1(+E2))	<0.9	3.6 *6*		α(exp)=5 *2* (2001Li44) α(K)=2.69 *69*; α(L)=0.69 *9*; α(M)=0.17 *3* α(N)=0.044 *7*; α(O)=0.0092 *13*; α(P)=0.00116 *7* α(exp): deduced by 2001Li44 from Iγ(145)/Iγ(151)=0.5 *2* in (5172α)γ-coin data and mult=E2 for 150.9γ. δ: from α(exp); consistent with intensity balance argument.
150.9 *2*	56×10^{-4} *5*	150.9	(5/2$^-$)	0	(9/2$^-$)	E2		1.417		α(K)exp=0.22 *11* (2001Li44); α(L)exp=1.4 *6* (2001Li44) α(K)=0.287; α(L)=0.836; α(M)=0.224; α(N)=0.0578; α(O)=0.01138; α(P)=0.001171 δ(E2/M1)>8.0 from α(K)exp and >2.5 from α(L)exp. Both values are consistent with intensity balance argument; however assigned J^π values require E2. α(K)exp: from I(K-x rays)/Iγ(150.9)=50 *22*/252 *25*, and fluorescence yield ω=1. α(L)exp: from I(L-x rays)/Iγ(150.9)=98 *30*/252 *25*, and fluorescence yield ω=0.3.

† From 2001Li44. Intensities listed here are per 100 decays of ^{223}Fr, whereas 2001Li44 give these as per 10^{-6} β particles.

‡ From conversion coefficients deduced from x-ray and γ-ray intensities, and also from intensity balance arguments (2001Li44).

\# Absolute intensity per 100 decays.

@ 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.

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