

^{151}Eu α decay (4.6×10^{18} y) 2014Ca13

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	N. Nica and B. Singh		NDS 181,1 (2022)	9-Mar-2022

Parent: ^{151}Eu : $E=0.0$; $J^\pi=5/2^+$; $T_{1/2}=4.6 \times 10^{18}$ y 12; $Q(\alpha)=1964.0$ 11; $\% \alpha$ decay=100

^{151}Eu - J^π : From Adopted Levels of ^{151}Eu in the ENSDF database.

^{151}Eu - $T_{1/2}$: From a total of 37.6 75 ^{151}Eu α decay events determined from an unbinned, extended likelihood fit to the α energy spectrum and the isotopic composition of ^{151}Eu (47.6 7%) precisely measured using high resolution inductively coupled plasma-mass spectrometry (2014Ca13). Others: $\geq 3.7 \times 10^{18}$ y for decay to first excited state in ^{147}Pm at 68% confidence level (2012Da16), $\geq 2.4 \times 10^{16}$ y (2007Be72); $\geq 6.0 \times 10^{17}$ y (2007Be48). ENSDF database for ^{151}Eu decay gives $\geq 1.7 \times 10^{18}$ y.

^{151}Eu - $\Delta T_{1/2}$: 2014Ca13 give $T_{1/2}=4.62 \times 10^{18}$ y 95 (stat) 68 (syst); evaluator has compounded uncertainties in quadrature. Statistical uncertainty results from the choice of the fitting interval and the choice of the response function.

^{151}Eu - $Q(\alpha)$: From 2021Wa16, 2014Ca13 measured $Q(\alpha)=1948.9$ keV 69 (stat) 51 (syst).

^{151}Eu - $\% \alpha$ decay: $\% \alpha$ branch is not measured, but from the work of 2014Ca13 and 2007Be48 ^{151}Eu does decay by α -decay mode. Here 100% α decay is assumed since β decay modes are blocked by the energetics of ^{151}Eu , ^{151}Sm and ^{151}Gd .

2014Ca13: measurement of half-life and $Q(\alpha)$ of ^{151}Eu decay. $\text{Li}_6\text{Eu}(\text{BO}_3)_3$ crystal used as a scintillating bolometer. Total crystal weight of 6.15 g. The $\text{Li}_6\text{Eu}(\text{BO}_3)_3$ crystal was operated in a dilution $^3\text{He}/^4\text{He}$ refrigerator in the Gran Sasso underground laboratory of the INFN. Measured E_α , I_α with FWHM=67 keV 7; deduced $T_{1/2}$ and $Q(\alpha)$ value. The β and γ events were rejected by performing a selection on the heat-to-light ratio of the detector. Measured $Q(\alpha)=1948.9$ 69 (stat) 51 (syst) (2014Ca13). Systematic uncertainty from a combination of the fitting interval and the response function used for fitting.

2012Da16: search for α -decay of ^{151}Eu to the first excited state in ^{147}Pm . Measurement of half-life for ^{151}Eu α decay. The decay of high purity europium oxide with natural isotopic abundance (^{151}Eu : 47.81 % 6 and ^{153}Eu : 52.19 % 6) was measured at the HADES underground laboratory with 303 g of Eu_2O_3 in a polyethylene bag directly placed on a ultra-low background HPGe detector and the γ spectrum measured in the range of 10-670 keV for over 2232.8 h. In addition the background spectrum was also measured for 1654.7 h. Deduced partial $T_{1/2}$ for α decay.

 ^{147}Pm Levels

E(level)	J^π [†]	$T_{1/2}$	Comments
0.0	$7/2^+$	2.6234 y 4	$T_{1/2}$: from the Adopted Levels.
91.1?	$5/2^+$		Level not observed in ^{151}Eu decay (2012Da16).

[†] From the Adopted Levels.

 α radiations

E_α	E(level)	HF [†]	Comments
1897.3 84	0.0	33 10	E_α : measured $Q(\alpha)=1948.9$ keV 69 (stat) 51 (syst) by 2014Ca13 as total α energy (i.e. in c.m. system). It is assumed that this α feeds the ground state of ^{147}Pm . Note that $Q(\alpha)=1964.0$ 11 from 2021Wa16 suggests $E_\alpha=1912.0$ 11. Measured $E_\alpha=1897.3$ 84 in 2014Ca13 agrees with evaluated E_α in 2021Wa16 within 2σ . HF: assuming 100% α branch for the g.s. to g.s. transition. Value of 33 10 suggests hindered α transition.

[†] Radius parameter $r_0=1.580$ 10 for ^{147}Pm was used, based on interpolation of $r_0=1.586$ 12 for ^{144}Nd daughter and $r_0=1.5741$ 45 for ^{148}Sm taken from 2020Si16.

¹⁵¹Eu α decay (4.6×10¹⁸ y) 2014Ca13 (continued)

γ(¹⁴⁷Pm)

<u>E_γ</u>	<u>E_i(level)</u>	<u>J_i^π</u>	<u>E_f</u>	<u>J_f^π</u>	<u>Comments</u>
91.1 [†]	91.1?	5/2 ⁺	0.0	7/2 ⁺	E _γ : no γ-ray peak was observed in 2012Da16. The measured energy spectrum was fitted within the energy range 88-95 keV to set the limit for partial T _{1/2} for α decay of ¹⁵¹ Eu to the first excited level.

[†] Placement of transition in the level scheme is uncertain.

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Legend

Decay Scheme

-----> γ Decay (Uncertain)

