

^{229}Th IT decay [2024EI03](#),[2024Ti04](#),[2024Zh44](#)

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	F. G. Kondev, J. K. Tuli and E. Browne		NDS 208,397 (2026)	23-Oct-2025

Parent: ^{229}Th : $E=8355734\times 10^{-9}$ *11*; $J^\pi=3/2^+$; $T_{1/2}=7.0\ \mu\text{s}$ *10*; %IT decay=100

^{229}Th -%IT decay: %IT=100. α and β -decay branches were searched for $^{229\text{m}}\text{Th}^{2+,3+}$ in [2016We07](#), but were not observed.

[2024EI03](#): $^{229\text{m}}\text{Th}$ was produced in a vacuum-ultraviolet (VUV) laser excitation of three ^{229}Th -doped:LiSrAlF₆ crystals with doping concentrations of $5\times 10^{16}\ \text{cm}^{-3}$, $5\times 10^{15}\ \text{cm}^{-3}$ and $1\times 10^{16}\ \text{cm}^{-3}$. The laser delivered 30 pulses per second with a typical VUV pulse energy of $\sim 1\ \mu\text{J}$ /pulse and a beam diameter of $\sim 2\ \text{mm}$. The crystal under study was held in a vacuum chamber consisting of a crystal mount, two VUV-sensitive photomultiplier tubes (PMTs) (Hamamatsu R6835/R6836), and a pneumatic shutter system to protect the PMTs from direct exposure to the VUV laser. Measured: E_γ and $\gamma(t)$. Deduced: $T_{1/2}$.

[2024Ti04](#): $^{229\text{m}}\text{Th}$ was produced in a VUV laser excitation of a ^{229}Th -doped:CaF₂ crystal with a doping concentration of up to $5\times 10^{18}\ \text{cm}^{-3}$. The laser operated at a repetition rate of 30 Hz, with a pulse duration of 10 ns and mean pulse energy of $\approx 15\ \mu\text{J}$ and beam diameter of $\sim 3\ \text{mm}$. The crystal was held in a vacuum chamber and a spherical mirror was used to collect the crystal fluorescence over a large solid angle. The fluorescence is then directed to a Cs-I PMT tube by two dielectric mirrors. Measured: E_γ and $\gamma(t)$. Deduced: $T_{1/2}$.

[2024Zh44](#): The isomeric state of $^{229\text{m}}\text{Th}$ was produced in laser excitation using a single line of a VUV comb of ^{229}Th -doped:CaF₂ crystal with a doping concentration of up to $5\times 10^{18}\ \text{cm}^{-3}$. Low energy photons were measured by performing VUV spectroscopy. Measured: E_γ , $\gamma(t)$. Deduced: $T_{1/2}$, quadrupole moment.

Others (**experimental**): [2025Zi04](#), [2025Be28](#), [2025Sc06](#), [2025On01](#), [2025Hi02](#), [2025Pi03](#), [2024Hi06](#), [2024Ya11](#), [2023Kr02](#), [2020Si22](#), [2019Ma63](#), [2019Se13](#), [2019Sh38](#), [2019Ya18](#), [2019Ve05](#), [2018Sa48](#), [2018St09](#), [2018St11](#), [2018Th02](#), [2018Th02](#), [2017Se01](#), [2017Vo08](#), [2016St16](#), [2016We07](#), [2015Je01](#), [2012Zh51](#), [2010BeZZ](#), [2010Sa02](#), [2009In01](#), [2009Ki14](#), [2007Be16](#), [2005Ga63](#), [2005Gu15](#), [2005Ka58](#), [2003Mi02](#), [2001Br20](#), [1999KoZR](#), [1994He08](#), [1990Bu17](#), [1990Re03](#), [1976Kr03](#), [1971KrZL](#).

Others (**theoretical, the list is incomplete; see also references therein**): [2025Pe15](#), [2025Ca16](#), [2025Mo19](#), [2024Ka39](#), [2024Wa58](#), [2024Xu15](#), [2024Zh42](#), [2024Zh49](#), [2023Qi04](#), [2023Li49](#), [2023Ka33](#), [2022Wa29](#), [2022Ki13](#), [2022Dz01](#), [2021Wa37](#), [2021Tk01](#), [2021Po12](#), [2021Mi03](#), [2020Vi10](#), [2020Tk02](#), [2020Tk01](#), [2020Ni02](#), [2020Dz03](#), [2020Bi05](#), [2020Tk01](#), [2019Tk01](#), [2019Mi05](#), [2019Bo13](#), [2018Tk01](#), [2018Ka04](#), [2018Bi05](#), [2017Bi04](#), [2017Is17](#), [2017Ka09](#), [2017Mi07](#), [2016Tk02](#), [2016Tk01](#), [2015Ka42](#), [2012Li56](#), [2011Tk01](#), [2010Po09](#), [2009Li21](#), [2009Be53](#), [2008Ha32](#), [2007Ka59](#), [2006Ka19](#), [2006IzZZ](#), [2005Ka60](#), [2001SaZL](#), [2001Ka03](#), [2000Tk02](#), [2000Ko53](#), [1999Tk03](#), [1999Ka47](#), [1998Dy01](#), [1997Va16](#), [1996Ty01](#), [1996Tk01](#), [1996Dy01](#), [1992Tk03](#), [1992Tk02](#).

 ^{229}Th Levels

E(level)	J^π	$T_{1/2}$	Comments
0.0	$5/2^+$	7907 y <i>24</i>	% α =100
8355734×10^{-9} <i>11</i>	$3/2^+$	7.0 μs <i>10</i>	%IT=100
E(level): From $\lambda=148.38218\ \text{nm}$ <i>19</i> , weighted average of $148.38210\ \text{nm}$ <i>50</i> (2024Ti04 , laser excitation of Th^{4+} :CaF ₂) and $148.38219\ \text{nm}$ <i>20</i> , determined from $148.38219\ \text{nm}$ <i>4</i> (stat) <i>20</i> (syst) (2024EI03 , laser excitation of Th^{4+} :LiSrAlF ₆). Others: [direct: photon detection]: $8.355733554021\ \text{eV}$ <i>8</i> (stat) in 2024Zh44 (laser excitation of a vacuum ultraviolet (VUV) comb of Th:CaF ₂) from $\omega=2020407384335\ \text{kHz}$ <i>2</i> (stat); Others (2025Hi02 , same group): at $150\ \text{K}$ <i>1</i> : $8.355733554021\ \text{eV}$ <i>8</i> (stat) from $\omega=2020407384335\ \text{kHz}$ <i>2</i> (stat); at $229\ \text{K}$ <i>1</i> : $8.355733552329\ \text{eV}$ <i>12</i> (stat) from $\omega=2020407383926\ \text{kHz}$ <i>3</i> (stat); at $293\ \text{K}$ <i>1</i> : $8.355733550811\ \text{eV}$ <i>8</i> (stat) from $\omega=2020407383559\ \text{kHz}$ <i>2</i> (stat). $8.352\ \text{eV}$ <i>6</i> from $\lambda=148.45\ \text{nm}$ <i>11</i> , weighted average of $148.491\ \text{nm}$ <i>19</i> (stat) <i>150</i> (syst) (CaF ₂) and $148.402\ \text{nm}$ <i>86</i> (stat) <i>150</i> (syst) (LiSrAlF ₆) in 2025Pi03 ($^{229\text{m}}\text{Th}$ produced in ^{229}Ac β^- decay), $8.367\ \text{eV}$ <i>12</i> from $\lambda=148.18\ \text{nm}$ <i>4</i> (stat) <i>20</i> (syst) in 2024Hi06 ($^{229\text{m}}\text{Th}$ produced in X-rays irradiation), $8.337\ \text{eV}$ <i>23</i> from $\lambda=148.71\ \text{nm}$ <i>6</i> (stat) <i>41</i> (syst) (MgF ₂ and CaF ₂) in 2023Kr02 ($^{229\text{m}}\text{Th}$ produced in ^{229}Ac β^- decay), $8.355735\ \text{eV}$ <i>6</i> from $\omega=2020407.8\ \text{GHz}$ <i>15</i> in 2025Sc06 (resonant fluorescence of ^{229}Th :CaF ₂ crystal); no observation between $7.5\ \text{eV}$ and $10\ \text{eV}$ in 2018St09 and between $7.3\ \text{eV}$ and $8.8\ \text{eV}$ in 2015Je01 ; [direct: ce detection]: $8.28\ \text{eV}$ <i>3</i> (stat) <i>1</i> (syst) in 2019Se13 ($^{229\text{m}}\text{Th}$ produced in			

Continued on next page (footnotes at end of table)

^{229}Th IT decay [2024El03](#),[2024Ti04](#),[2024Zh44](#) (continued) ^{229}Th Levels (continued)

<u>E(level)</u>	<u>J^π[†]</u>	<u>$T_{1/2}$[†]</u>	<u>Comments</u>
			^{233}U α decay), 8.6 eV 2 (stat) 1 (syst) in 2025On01 ($^{229\text{m}}\text{Th}$ produced in ^{233}U α decay), between 6.3 eV and 18.3 eV in 2016We07 ($^{229\text{m}}\text{Th}$ produced in ^{233}U α decay); [indirect: microcalorimetry]: 8.10 eV 17 in 2020Si22 ($^{229\text{m}}\text{Th}$ produced in ^{233}U α decay), 8.30 eV 92 in 2019Ya18 ($^{229\text{m}}\text{Th}$ produced in ^{233}U α decay), between 2.5 eV and 8.9 eV in 2019Ma63 , 7.8 eV 5 (2010BeZZ), 7.6 eV 5 (2007Be16); [indirect: Ge and Si detectors]: <15 eV (2010Sa02), between 3 eV and 7 eV (2009In01), 5.5 eV 10 (2005Gu15), 3.5 eV 10 (1994He08), -1 eV 4 (1990Re03), <5 eV (1990Bu17), <100 eV (1976Kr03 , 1971KrZL); no observation between 2.3 eV and 6.3 eV in 2005Ga63 . $T_{1/2}$: From ce(t) in 2017Se01 ; others: 7.9 μs [2025On01 , ce(t)], 10 μs 8 [2019Sh38 , ce(t)], all values are for a neutral $^{229\text{m}}\text{Th}$ atom. Others: [Th-doped:CaF₂]: 437 s 10 [2024Ti04 , γ (t)], 447 s 16 (stat) 20 (syst) [2024Hi06 , γ (t)], 444.3 s 28 [2024Zh44 , γ (t)], 428 s 13 at T=100 K, 428 s 6 at T=150 K and 164 s 6 at T=297 K [2025Sc06 , γ (t)]; [Th-doped:LiSrAlF₆]: 397.5 s 20 [2025Te04 , γ (t)], 299 s 49 [2025Te04 ,growth(t)], 394 s 9 (stat) 14 (syst) [2024El03 , γ (t)]; [$^{229\text{m}}\text{Th}$ -implanted:MgF ₂]: 670 s 102 [2023Kr02 , γ (t)]; [$^{229\text{m}}\text{Th}^{3+}$ -trapped: vacuum]: 1400 s +600–300 (2024Ya11); [$^{229\text{m}}\text{Th}^{2+}$ -implanted: MCP detector]: >60 s [2016We07 , ce(t)]; similar limit is quoted in 2018Th02 , based on the storage time of the ions in the trap; Others: 6 h 1 [2012Zh51 , γ (t)], 1–3 min [2009In01 , α (t)], <2 h [2009Ki14 , α (t)], <3 m or >60 h [2005Ka58 , γ (t) for HNO ₃] 14 h 3 [2003Mi02 , 4.83–5.08 α (t)], <6 h or >20 d [2001Br20 , γ (t)], 20–400 min [1999KoZR , γ (t)]. Q: Q(3/2 ⁺ ,iso)/Q(5/2 ⁺ ,gs)=0.57003 1 (2024Zh44), Q(3/2 ⁺ ,iso)/Q(5/2 ⁺ ,gs)=0.555 19 (2018Th02) and 0.569 7 [using B(iso)=1288 MHz 10 (2024Ya11) and B(g)=2265 MHz 9 (2011Ca17)]; Q ₀ (3/2 ⁺ ,iso)/Q ₀ (5/2 ⁺ ,gs)=1.01791 2 (2025Be28). μ : μ (3/2 ⁺ ,iso)/ μ (5/2 ⁺ ,gs)=−1.045 14 for Th ³⁺ using A(iso)=−267 MHz 3 (2024Ya11) and A(g)=153.3 MHz 12 (2011Ca17), μ (3/2 ⁺ ,iso)/ μ (5/2 ⁺ ,gs)=−1.04 15 for Th ²⁺ using A(iso)/A(g)=−1.73 25 (2018Th02). $\delta\langle r^2 \rangle(^{229\text{m}}\text{Th}, ^{229}\text{Th})=0.0105 \text{ fm}^2$ 13 (2018Sa48 , for Th ²⁺), 0.0097 fm ² 26 (2024Ya11 , for Th ³⁺), 0.012 fm ² 2 (2018Th02 , for Th ²⁺). Frequency ratio $\nu(^{229\text{m}}\text{Th})/\nu(^{87}\text{Sr})=4.707072615078$ 5 (2024Zh44 , in CaF ₂ crystal at T=150 K 1).

[†] From Adopted Levels, unless otherwise stated.

<u>$\gamma(^{229}\text{Th})$</u>								<u>Comments</u>
<u>E_γ</u>	<u>I_γ</u>	<u>$E_i(\text{level})$</u>	<u>J_i^π</u>	<u>E_f</u>	<u>J_f^π</u>	<u>Mult.</u>	<u>α[†]</u>	
8355734×10 ^{−9} 11	100	8355734×10 ^{−9}	3/2 ⁺	0.0	5/2 ⁺	[M1]	1.6×10 ⁹ 3	E_γ : From $\lambda=148.38218 \text{ nm}$ 19, weighted average of 148.38210 nm 50 (2024Ti04 , Th ⁴⁺ :CaF ₂) and 148.38219 nm 20, determined from 148.38219 nm (4,stat) (20,syst) (2024El03 , Th ⁴⁺ :LiSrAlF ₆). Others: 8.355733554021 eV 8 (stat) in 2024Zh44 (laser excitation of a vacuum ultraviolet (VUV) comb of Th:CaF ₂) from $\omega=2020407384335 \text{ kHz}$ 2 (stat); Others (2025Hi02 , same group): at 150 K 1: 8.355733554021 eV 8 (stat) from $\omega=2020407384335 \text{ kHz}$ 2 (stat); at 229 K 1: 8.355733552329 eV 12 (stat) from $\omega=2020407383926 \text{ kHz}$ 3 (stat); at 293 K 1: 8.355733550811 eV 8 (stat) from $\omega=2020407383559 \text{ kHz}$ 2 (stat). 8.352 eV 6 from $\lambda=148.45 \text{ nm}$ 11, weighted average of 148.491 nm 19 (stat) 150 (syst) (CaF ₂) and 148.402 nm 86 (stat) 150 (syst) (LiSrAlF ₆)

Continued on next page (footnotes at end of table)

^{229}Th IT decay [2024El03](#),[2024Ti04](#),[2024Zh44](#) (continued)

$\gamma(^{229}\text{Th})$ (continued)

<u>E_γ</u>	<u>$E_i(\text{level})$</u>	<u>Comments</u>
		in 2025Pi03 ($^{229\text{m}}\text{Th}$ produced in ^{229}Ac β^- decay), 8.367 eV 12 from $\lambda=148.18$ nm 4 (stat) 20 (syst) in 2024Hi06 ($^{229\text{m}}\text{Th}$ produced in X-rays irradiation), 8.337 eV 23 from $\lambda=148.71$ nm 6 (stat) 41 (syst) (MgF_2 and CaF_2) in 2023Kr02 ($^{229\text{m}}\text{Th}$ produced in ^{229}Ac β^- decay), 8.355735 eV 6 from $\omega=2020407.8$ GHz 15 in 2025Sc06 (resonant fluorescence of $^{229}\text{Th}:\text{CaF}_2$ crystal).
		α : From $B(\text{M}1)=0.0033$ W.u. 5 for a similar $\nu 3/2[631] \rightarrow \nu 5/2[633]$ transition in ^{233}U (2020Si28), $T_{1/2}=7.0$ μs 10 and $E_\gamma=0.008355734$ keV 11. Others (theoretical): 0.96×10^9 or 1.6×10^9 (2020Tk01), 0.987×10^9 (2024Ka39).

[†] Total theoretical internal conversion coefficients, calculated using the BrIcc code ([2008Ki07](#)) with “Frozen Orbitals” approximation based on γ -ray energies, assigned multiplicities, and mixing ratios, unless otherwise specified.

^{229}Th IT decay [2024El03](#),[2024Ti04](#),[2024Zh44](#)

