

**<sup>164</sup>Gd IT decay (0.580 μs) 2017Yo01,2017Pa25**

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen <sup>#</sup>		NDS 147, 1 (2018)	30-Nov-2017

Parent: <sup>164</sup>Gd: E=1095.5 11; J<sup>π</sup>=(4<sup>-</sup>); T<sub>1/2</sub>=0.580 μs 23; %IT decay=100.0

<sup>164</sup>Gd-%IT decay: %IT=100 is assumed.

Reaction: <sup>9</sup>Be(<sup>238</sup>U,F),E=345 MeV/nucleon.

**2017Yo01:** <sup>164</sup>Gd formed by in-flight fission of 345 MeV/nucleon <sup>238</sup>U beam with a 3.96 to 4.93 mm thick <sup>9</sup>Be target at RIBF-RIKEN facility. Fission fragments were separated and identified in the BigRIPS spectrometer by the measurement of energy loss ΔE, time-of-flight and magnetic rigidity. Two parallel-plate avalanche counters (PPACs) were used to track the position of implanted ions. The γ rays were detected by four Clover HPGe detectors. Measured E<sub>γ</sub>, I<sub>γ</sub>, (<sup>164</sup>Gd ions)γ-coin, delayed γ-radiation, and half-life of an isomer, within a time window of ≈100 ns to 30 μs. Comparison with theoretical calculations using deformed Hartree-Fock with angular momentum projection model, and projection shell model.

**2017Pa25:** <sup>164</sup>Gd isomer populated in <sup>9</sup>Be(<sup>238</sup>U,F),E=345 MeV/nucleon reaction at RIBF, RIKEN facility using the BigRIPS and ZeroDegree spectrometers for separation and identification of in-flight fission fragments. Delayed gamma rays were detected using EURICA (Euroball-RIKEN Cluster) array, consisting of 84 HPGe crystals. Measured half-life of the 1096, (4<sup>-</sup>) isomer by γ(t) method.

<sup>164</sup>Gd Levels

E(level) <sup>†</sup>	J <sup>π</sup> <sup>‡</sup>	T <sub>1/2</sub>	Comments
0.0	0 <sup>+</sup>		
73 1	2 <sup>+</sup>		
241.2 11	4 <sup>+</sup>		
1035.1 11	(3 <sup>+</sup> )		J <sup>π</sup> : theoretical calculations predict configuration=νf <sub>5/2</sub> ⊗ν1/2[521] (2017Yo01).
1095.5 11	(4 <sup>-</sup> )	0.580 μs 23	Proposed configuration=ν7/2[633]⊗ν1/2[521],K <sup>π</sup> =4 <sup>-</sup> from comparison with deformed Hartree-Fock with angular momentum projection model, and projection shell model. Theoretical calculations for this level reported by 2017Yo01 and 2017Pa25. T <sub>1/2</sub> : from 2017Yo01, based on likelihood fitting of time spectrum between the <sup>164</sup> Gd beam implantation and subsequent summed γ-ray spectrum. Other: 0.530 μs 100 (2017Pa25). Weighted average of the two values is 0.577 μs 23, very close to that in 2017Yo01.

<sup>†</sup> Deduced by evaluators from E<sub>γ</sub> values.

<sup>‡</sup> As assigned by 2017Yo01 and 2017Pa25, based on systematic trend of even-even nuclei for the 2<sup>+</sup> and 4<sup>+</sup> states, and Hartree-Fock calculations for the 3<sup>+</sup> and 4<sup>-</sup> states.

γ(<sup>164</sup>Gd)

I<sub>γ</sub> normalization: Deduced by evaluators from I<sub>γ</sub>+ce(854.1γ+961.9γ)=100. Using intensity data for 854.1 and 961.9 gamma rays from 2017Pa25, γ-normalization factor=0.57 13.

E <sub>γ</sub> <sup>†</sup>	I <sub>γ</sub> <sup>‡&amp;</sup>	E <sub>i</sub> (level)	J <sub>i</sub> <sup>π</sup>	E <sub>f</sub>	J <sub>f</sub> <sup>π</sup>	Mult.#	α <sup>@</sup>	Comments
60.2	14 3	1095.5	(4 <sup>-</sup> )	1035.1	(3 <sup>+</sup> )	[E1]	1.124 22	E <sub>γ</sub> : from 2017Yo01, 0.3 keV uncertainty assumed by evaluators for least-squares fit. This γ was not seen by 2017Pa25, but included in the decay scheme with E <sub>γ</sub> =61 1. I <sub>γ</sub> =16 6, from intensity balance (2017Pa25). Reduced E1 hindrance factor f <sub>v</sub> =2.37×10 <sup>6</sup> 10 (2017Yo01), where ν=ΔK-λ.
73 1	19 4	73	2 <sup>+</sup>	0.0	0 <sup>+</sup>	(E2)	8.71 19	E <sub>γ</sub> =72.0 (2017Yo01). I <sub>γ</sub> =27 14 (2017Pa25).
168.4 4	71 5	241.2	4 <sup>+</sup>	73	2 <sup>+</sup>	(E2)	0.400 7	E <sub>γ</sub> =168.0 (2017Yo01). I <sub>γ</sub> =100 28 (2017Pa25).

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$^{164}\text{Gd}$  IT decay (0.580  $\mu\text{s}$ ) 2017Yo01,2017Pa25 (continued) $\gamma(^{164}\text{Gd})$  (continued)

$E_\gamma$ <sup>†</sup>	$I_\gamma$ <sup>‡</sup> &	$E_i(\text{level})$	$J_i^\pi$	$E_f$	$J_f^\pi$	Mult. #	$a$ <sup>@</sup>	Comments
794 <sup>a</sup>		1035.1	(3 <sup>+</sup> )	241.2	4 <sup>+</sup>			$E_\gamma$ : tentative $\gamma$ from 2017Pa25 only, very weak line as shown in authors' spectral Fig. 6.
854.7 5	100 11	1095.5	(4 <sup>-</sup> )	241.2	4 <sup>+</sup>	[E1]	0.00154	$E_\gamma=854.1$ (2017Yo01). $I_\gamma=97\ 34$ (2017Pa25). Reduced E1 hindrance factor $f_v=1.28\times 10^3\ 3$ (2017Yo01), where $v=\Delta K-\lambda$ . Other $f_v=65$ (2017Pa25).
961.9 4	37 7	1035.1	(3 <sup>+</sup> )	73	2 <sup>+</sup>	[M1]	0.0050	$E_\gamma=961.9$ (2017Yo01). $I_\gamma=79\ 17$ (2017Pa25).

<sup>†</sup> From 2017Pa25, unless otherwise stated. Values from 2017Yo01 are given under comments.

<sup>‡</sup> From 2017Yo01. Values from 2017Pa25 are given under comments.

# As assigned by 2017Yo01 from transition intensity balances for the lowest energy transitions, also guided by  $\Delta J^\pi$ .

@ Additional information 1.

& For absolute intensity per 100 decays, multiply by 0.73 7.

<sup>a</sup> Placement of transition in the level scheme is uncertain.

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