^{156}Dy 2ε decay 2011Be18,2011El05

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich	NDS 113, 2537 (2012)	1-Mar-2012

Parent: ^{156}Dy: E=0; $J^{\pi}=0^+$; $T_{1/2}\geq 1.8\times10^{14}$ y; Q(2ε)=2005.95 *10*; %2ε decay=?

^{156}Dy-$T_{1/2}$: Nuclide nominally stable. The listed value is the smallest one given by 2011Be18 and is for the transition to the 2^+, 89 keV level in ^{156}Gd. For a discussion of decay modes of the ^{156}Dy g.s., see the ^{156}Dy Adopted Levels.

^{156}Dy-Q(2ε): From 2011El05. 2011AuZZ list 2012 *6*.

Additional information 1.

Papers report the results of a search for the double-"beta" decay of ^{156}Dy. These studies obtain only upper limits for the intensities of the branches to the various ^{156}Gd levels.

2011Be18: Search for double β decay of ^{156}Dy, using an ultra-low background HPGe detector (volume≈244 cm^3) located deep underground in the Gran Sasso National Laboratory. Detector passively shielded by a shield consisting of low-radioactivity Pb, Cu and borated polyethylene. Sample consisted of high-purity (99.98%) Dy_2O_3 of mass 322 g. Sample counted for≈2512 h. Radioactive contaminants in the sample and their associated γ's were identified. Inspection of regions of the γ-ray spectrum where ^{156}Gd γ's were expected to be present revealed no statistically significant peaks. These data provide only lower limits for the half-lives of possible 2β processes leading to ^{156}Gd.

2011El05: Used Penning-trap mass spectrometry to determine the ^{156}Dy-^{156}Gd mass difference. Together with this difference, and using theoretical electron wave functions and double-hole binding energies, authors calculate possible resonance-enhancement in the neutrinoless double electron capture in ^{156}Dy. They identify four excited states in ^{156}Gd as candidates for resonance enhancement and list computed enhancement factors.

^{156}Gd Levels

Listed $T_{1/2}$ values are measured ones only and represent lower limits (at the 90% confidence level) for the transition from the ^{156}Dy g.s. 2011Be18 also list values for various resonant processes in double β decay, but these are not listed here. Numerous studies present calculated $T_{1/2}$ values for double-β-decay, based on various assumptions. Some of the more recent of these include: 2010Ra06; 2009Ra26; 2011Kr07; and 2002Hi09. These values are not listed here. See these papers for them. These calculated $T_{1/2}$ values are generally several orders of magnitude greater than the presently measured lower limits.

E(level)[†]	J^{π}[#]	Comments
0	0^+	$T_{1/2}(\varepsilon\beta^+(2\nu+0\nu))$ to this level $\geq 1.9\times10^{16}$ y.
89.0	2^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(\varepsilon\beta^+(2\nu+0\nu))\geq 1.9\times10^{16}$ y; $T_{1/2}(2\varepsilon,2\nu)\geq 1.8\times10^{14}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 1.5\times10^{14}$ y.
1049.5	0^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 7.1\times10^{16}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 6.4\times10^{16}$ y.
1129.4	2^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 1.4\times10^{16}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 1.4\times10^{16}$ y.
1154.1	2^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 4.7\times10^{15}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 4.1\times10^{15}$ y.
1168.2	0^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 8.9\times10^{15}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 8.0\times10^{15}$ y.
1715.2	0^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 3.0\times10^{16}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 2.8\times10^{16}$ y.
1771.1	2^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 1.0\times10^{16}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 8.9\times10^{15}$ y.
1827.8	2^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 1.9\times10^{16}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 1.9\times10^{16}$ y.
1851.2	0^+	For the transition to this level, the following $T_{1/2}$ values are reported: $T_{1/2}(2\varepsilon,2\nu)\geq 1.5\times10^{15}$ y; $T_{1/2}(2\varepsilon,0\nu)\geq 1.5\times10^{15}$ y.
1914.8[‡]	2^+	Proposed as a candidate for resonance-enhanced double β decay by 2011Be18, but not by 2011El05.
1946.4[‡]	1^-	Calculated enhancement factor for 0ν 2ε decay = 4.1×10^6 (2011El05).

Continued on next page (footnotes at end of table)

^{156}Dy 2ε decay 2011Be18,2011El05 (continued)

^{156}Gd Levels (continued)

E(level)†	J$^{\pi}$#	Comments
1952.3‡	0$^-$	Calculated enhancement factor for 0ν 2ε decay = 1.7×10^6 (2011El05).
1988.5‡	0$^+$	Calculated enhancement factor for 0ν 2ε decay = 2.5×10^6 (2011El05).
2003.8‡	2$^+$	Calculated enhancement factor for 0ν 2ε decay = 7.7×10^8 (2011El05).

† Nominal values, from the adopted values. Only those levels expected to be populated in the double-β decay of ^{156}Dy are given.
‡ Level proposed as a candidate for resonance-enhanced neutrinoless double-electron capture decay.
# From the adopted values.

γ(^{156}Gd)

E$_\gamma$†	E$_i$(level)	J$_i^{\pi}$	E$_f$	J$_f^{\pi}$	Comments
89.0	89.0	2$^+$	0	0$^+$	
472.7	1715.2	0$^+$			The final state implied by this γ is not listed among the candidate levels given in 2011Be18.
697.0	1851.2	0$^+$	1154.1	2$^+$	
960.5	1049.5	0$^+$	89.0	2$^+$	
1040.5	1129.4	2$^+$	89.0	2$^+$	
1079.2	1168.2	0$^+$	89.0	2$^+$	
1154.1	1154.1	2$^+$	0	0$^+$	
1682.2	1771.1	2$^+$	89.0	2$^+$	
1738.9	1827.8	2$^+$	89.0	2$^+$	

† Nominal value, from the adopted values, to indicate the region of the γ spectrum studied to identify the presence of the searched-for 2β transition.

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Decay Scheme