



**Fig. 1:** Known experimental values for heavy particle emission of the even-Z  $T_z = +15/2$  nuclei.

Last updated 12/8/22

**Table 1**

Observed and predicted  $\beta$ -delayed particle emission from the even- $Z$ ,  $T_z = +15/2$  nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein.  $J^{\pi}$  values for  $^{123}\text{Xe}$ ,  $^{127}\text{Ba}$ ,  $^{131}\text{Ce}$ ,  $^{135}\text{Md}$ ,  $^{139}\text{Sm}$ ,  $^{143}\text{Gd}$ ,  $^{147}\text{Dy}$ ,  $^{151}\text{Er}$  are taken from ENSDF

Nuclide	$J^{\pi}$	$T_{1/2}$	$Q_{\epsilon}$	$Q_{\epsilon p}$	$\text{BR}_{\beta p}$	$Q_{\epsilon 2p}$	$Q_{\epsilon \alpha}$	Experimental
$^{123}\text{Xe}$	$1/2^+$	2.040(9) h	2.694(10)	-2.224(10)	—	-10.227(10)	1.802(12)	[2021Ze01]
$^{127}\text{Ba}$	$1/2^+$	12.7(4) m	3.422(13)	-0.961(11)	—	-8.560(11)	2.700(12)	[1976Be11]
$^{131}\text{Ce}$	$7/2^+$	10.5(6) m	4.060(40)	0.259(33)	—	-6.787(33)	4.107(33)	[1966No05]
$^{135}\text{Nd}$	$9/2^-$	12.4(6) m	4.722(22)	1.330(28)	—	-5.297(34)	5.131(34)	[1975Wi11]
$^{139}\text{Sm}$	$1/2^+$	2.57(10) m	5.121(17)	2.348(16)	—	-3.756(14)	6.131(16)	[1982De06]
$^{143}\text{Gd}$	$(1/2^+)$	39(2) s	6.01(20)	3.46(20)	—	-2.29(20)	6.85(20)	[1978Fi02]
$^{147}\text{Dy}$	$(1/2^+)$	67(7) s	6.547(12)	4.601(10)	$\approx 0.05\%$	-0.782(9)	7.620(14)	[1984To07, 1988WiZN]
$^{151}\text{Er}$	$(7/2^-)$	23.8(20) s*	5.356(18)	3.754(17)	—	-1.356(17)	10.051(18)	[1988Ba02, 1970To16]
$^{155}\text{Yb}$	$(7/2^-)$	1.79(2) s**	6.123(19)	4.813(17)	—	-0.068(17)	10.695(19)	[1991To08, 1996Pa01]
$^{159}\text{Hf}$	$(7/2^-)$	5.2(1) s	6.860(40)	5.868(19)	—	1.279(33)	11.348(20)	[1996Pa01]
$^{163}\text{W}$	$7/2^-$	2.7(1) s***	7.630(70)	6.971(59)	—	3.076(65)	12.375(70)	[2010Sc02, 1979Ho10, 1973Ea01]
$^{167}\text{Os}$	$(7/2^-)$	839(5) ms	8.340(90)	8.100(81)	—	4.771(82)	13.611(89)#	[2010Sc02]
$^{171}\text{Pt}$	$(7/2^-)$	43(3) ms	8.950(90)	9.170(82)	—	6.365(82)	14.943(90)	[1996Pa01]
$^{175}\text{Hg}$	$(7/2^-)$	10.2(4) ms@	9.430(90)	10.059(82)	—	7.721(82)	16.018(90)	[2017Ba46, 2002Ro17]
$^{179}\text{Pb}$	$(9/2^-)$	2.7(2) ms	10.320(90)	11.078(82)	—	9.019(82)	17.030(90)	[2017Ba46]

\* Weighted average of 23(2) s [1970To16] and 24.6(20)s [1988Ba02].

\*\* Weighted average of 1.75(5) s [1991To08] and 1.80(2) s [1996Pa01].

\*\*\* Weighted average of 2.6(1) s [2010Sc02], 3.0(2) s [1979Ho10] and 2.5(3) s [1973Ea01].

@ Weighted average of 9.6(4) ms [2017Ba46], and 10.8(4) ms [2002Ro17].

**Table 2**

Particle separation and emission from the even- $Z$ ,  $T_z = +15/2$  nuclei. Unless otherwise stated, all Q-values and separation energies values are taken from [2021Wa16] or deduced from values therein.

Nuclide	$S_p$	$S_{2p}$	$Q_{\alpha}$	$\text{BR}_{\alpha}$	Experimental
$^{123}\text{Xe}$	6.458(11)	11.283(28)	-0.491(12)	—	
$^{127}\text{Ba}$	5.756(15)	10.197(11)	0.005(15)	—	
$^{131}\text{Ce}$	5.370(42)	9.226(34)	0.685(35)	—	
$^{135}\text{Nd}$	4.975(28)	8.373(25)	1.070(38)	—	
$^{139}\text{Sm}$	4.755(16)	7.374(16)	1.408(22)	—	
$^{143}\text{Gd}$	4.211(203)	6.88(20)	1.72(20)	—	
$^{147}\text{Dy}$	3.721(46)	5.847(22)	1.61(20)	—	
$^{151}\text{Er}$	3.609(22)	5.150(19)	3.505(19)	—	
$^{155}\text{Yb}$	3.364(22)	4.614(19)	5.339(2)	90(5)%	[1996Pa01, 1991To08, 1979Ho10, 1977Ha48, 1992Al18, 1992AlZM, 1992AlZY, 1990KaZM, 1990Po13, 1989KaYU, 1988KaZK, 1987KaZI, 1982Bo04, 1981HoZM, 1980Da09, 1978AfZZ, 1973BoXL, 1973BoXW, 1964Ma45]
$^{159}\text{Hf}$	2.929(23)	4.011(20)	5.225(3)	12(1)%	[1996Pa01, 1992Ha10, 1979Ho10, 1983Fa03, 1996HiZX, 1981HoZM, 1978Ca11, 1973To02, 1973ToZU, 1972ToZC, 1996HiZX, 1996HiZX, 1972ToZL]
$^{163}\text{W}$	2.416(86)	3.171(63)	5.519(5)*	14(2)%**	[2010Sc02, 1996Pa01, 1979Ho10, 1975To01, 1973Ea01, 1978Ca11, 1982De11, 1981DeZA, 1981DeZL, 1981HoZM, 1973Ea011975To05, 1972EaZU]
$^{167}\text{Os}$	1.95(12)#	2.215(85)#	5.978(5)***	58(7)%@	[2010Sc22, 1996Pa01, 1982En03, 1981Ho10, 2009Od02, 1978Ca11, 1978ReZZ, 1977Ca13]
$^{171}\text{Pt}$	1.57(13)	1.322(85)	6.607(3)	$\approx 100\%$ @@	[1996Pa01, 1981De22, 1981Ho10, 2010Sc02, 2006Jo04, 2005Jo18, 2003Ba32, 2002Ro17, 1997Uu01, 1993ToZY, 1982En03, 1981DeZB]
$^{175}\text{Hg}$	1.20(13)	0.61(10)	7.008(4)@@@	$\approx 100\%$ @@	[2017Ba46, 2002Ro17, 1997Uu01, 1996Pa01, 1984ScZQ, 1983Sc24]
$^{179}\text{Pb}$	0.62(13)	-0.25(12)	7.516(4) <sup>a</sup>	$\approx 100\%$ @@	[2017Ba46, 2010An01]

\* Deduced from  $\alpha$  energy, 5.520(60) in [2021Wa16].

\*\* Weighted average of 15(2)% [2010Sc22], and 13(2)% [1996Pa01].

\*\*\* Deduced from  $\alpha$  energy, 5.985(56)# in [2021Wa16].

@ Weighted average of 58(12)% [1981Ho10], 76(10)% [1982En03], and 49(7)% [1996Pa01].

@@ Inferred from half-life.

@@@ Deduced from  $\alpha$  energy, 7.072(5) in [2021Wa16].

<sup>a</sup> Deduced from  $\alpha$  energy, 7.596(5) in [2021Wa16].

**Table 3**  
direct  $\alpha$  emission from  $^{155}\text{Yb}$ ,  $T_{1/2} = 1.79(2)$  s\*,  $BR_{\alpha} = 90(5)\%$ \*\*.

$E_{\alpha}$ (c.m.)	$E_{\alpha}$ (lab)	$I_{\alpha}$ (abs)***	$E_{daughter}(^{151}\text{Er})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
5.341(4)	5.203(4)**	90(5)%**	0.0	—	1.5767(66)	1.79 $^{+0.26}_{-0.24}$

\* Weighted average of 1.75(5) s [1991To08] and 1.80(2) s [1996Pa01].

\*\* [1991To08].

\*\*\* Weighted average of 5.202 MeV [1991To08], 5.206(5) MeV [1979Ho10], and 5.202(10) MeV [1977Ha48] (adjusted to 5.203(10) MeV in [1991Ry01]).

**Table 4**  
direct  $\alpha$  emission from  $^{159}\text{Hf}$ ,  $T_{1/2} = 5.2(1)$  s\*,  $BR_{\alpha} = 12(1)\%$ \*\*.

$E_{\alpha}$ (c.m.)	$E_{\alpha}$ (lab)	$I_{\alpha}$ (abs)***	$E_{daughter}(^{155}\text{Yb})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
5.226(5)	5.094(5)***	12(1)%**	0.0	—	1.5552(96)	0.96 $^{+0.21}_{-0.19}$

\* [1996Pa01].

\*\* [1979Ho10].

\*\*\* Weighted average of 5.095(5) MeV [1979Ho10] (adjusted to 5.094(10) MeV in [1991Ry01]), 5.088(6) MeV [1992Ha10], and 5.098(5) MeV [1996Pa01].

**Table 5**  
direct  $\alpha$  emission from  $^{163}\text{W}$ ,  $T_{1/2} = 2.7(1)$  s\*,  $BR_{\alpha} = 14(2)\%$ \*\*.

$E_{\alpha}$ (c.m.)	$E_{\alpha}$ (lab)	$I_{\alpha}$ (abs)***	$E_{daughter}(^{159}\text{Hf})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
5.519(5)	5.383(5)***	14(2)%**	0.0	—	1.568(13)	1.5 $^{+0.5}_{-0.4}$

\* Weighted average of 2.6(1) s [2010Sc02], 3.0(2) s [1979Ho10] and 2.5(3) s [1973Ea01]

\*\* Weighted average of 15(2)% [2010Sc22], and 13(2)% [1996Pa01].

\*\*\* Weighted average of 5.385(5) MeV [1973Ea01], 5.383(6) MeV [2010Sc02], 5.383(6) MeV [1996Pa01] and 5.384(5) MeV [1979Ho10] (adjusted to 5.382(5) MeV in [1991Ry01]).

**Table 6**  
direct  $\alpha$  emission from  $^{167}\text{Os}$ ,  $T_{1/2} = 839(5)$  ms\*,  $BR_{\alpha} = 58(7)\%$ \*\*.

$E_{\alpha}$ (c.m.)	$E_{\alpha}$ (lab)	$I_{\alpha}$ (abs)***	$E_{daughter}(^{163}\text{W})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
5.978(5)	5.835(5)***	58(7)%**	0.0	—	1.5653(46)	1.30 $^{+0.23}_{-0.19}$

\* [2010Sc02].

\*\* Weighted average of 58(12)% [1981Ho10], 76(10)% [1982En03], and 49(7)% [1996Pa01].

\*\*\* [1996Pa01].

**Table 7**  
direct  $\alpha$  emission from  $^{171}\text{Pt}$ ,  $T_{1/2} = 43(3)$  ms\*,  $BR_{\alpha} \approx 100\%$ \*\*.

$E_{\alpha}$ (c.m.)	$E_{\alpha}$ (lab)	$I_{\alpha}$ (abs)***	$E_{daughter}(^{167}\text{Os})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
6.607(4)	6.453(4)***	$\approx 100\%$ **	0.0	—	1.5607(30)	1.34(13)

\* [1996Pa01].

\*\* Inferred from half-life.

\*\*\* Weighted average of 6.453(4) MeV [1981De22] and 6.448(5) MeV [1981Ho10], (adjusted to 6452(5) MeV in [1991Ry01]).

**Table 8**direct  $\alpha$  emission from  $^{175}\text{Hg}$ ,  $T_{1/2} = 10.2(4)$  ms\*,  $BR_{\alpha} = \approx 100\%^{**}$ .

$E_{\alpha}$ (c.m.)	$E_{\alpha}$ (lab)	$I_{\alpha}$ (abs) $^{***}$	$E_{daughter}$ ( $^{171}\text{Pt}$ )	coincident $\gamma$ -rays	$R_0$ (fm)	HF
7.008(4)	6.848(4) $^{***}$	$\approx 100\%^{**}$	0.0	—	1.5469(98)	1.02 $^{+0.22}_{-0.19}$

\* Weighted average of 9.6(4) ms [2017Ba46], and 10.8(4) ms [2002Ro17].

\*\* Inferred from half-life.

\*\*\* [2017Ba46].

**Table 9**direct  $\alpha$  emission from  $^{179}\text{Pb}$ \*,  $T_{1/2} = 2.7(2)$  ms,  $BR_{\alpha} = \approx 100\%^{**}$ .

$E_{\alpha}$ (c.m.)	$E_{\alpha}$ (lab)	$I_{\alpha}$ (abs) $^{***}$	$E_{daughter}$ ( $^{175}\text{Hg}$ )	coincident $\gamma$ -rays	$R_0$ (fm)	HF
7.516(4)	7.348(5)	$\approx 100\%^{**}$	0.0	—	1.532(20)	1.6 $^{+0.8}_{-0.5}$

\* All values from [2017Ba46].

\*\* Inferred from half-life.

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