

# Even Z $T_z = +8$

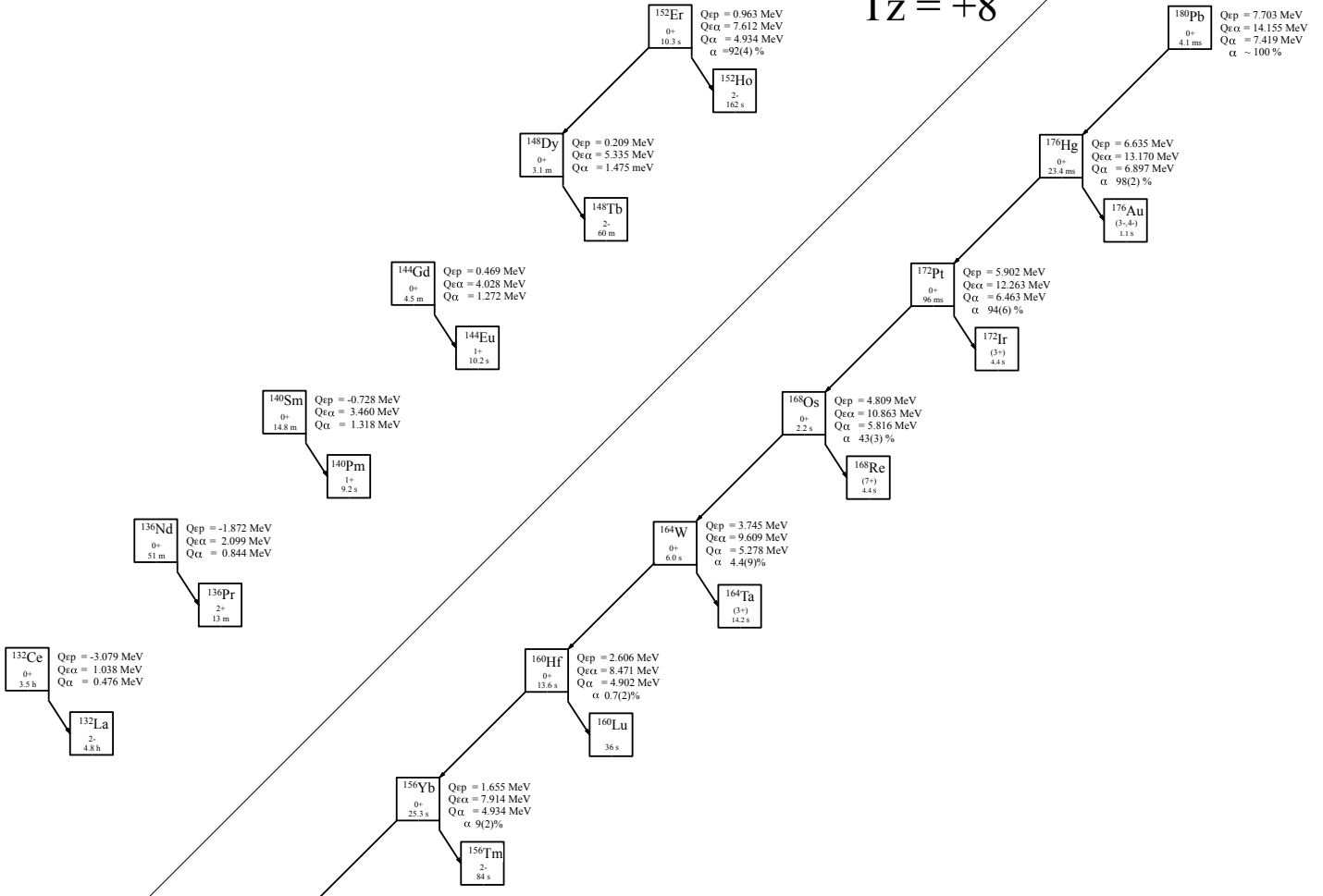


Fig. 1: Known experimental values for heavy particle emission of the even-Z  $T_z = +8$  nuclei.

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**Table 1**

Observed and predicted  $\beta$ -delayed particle emission from the even- $Z$ ,  $T_z = +8$  nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	$J^\pi$	$T_{1/2}$	$Q_\epsilon$	$Q_{\epsilon p}$	$BR_{\beta p}$	$Q_{\epsilon 2p}$	$Q_{\epsilon \alpha}$	Experimental
<sup>132</sup> Ce	0 <sup>+</sup>	3.51(11) h	1.250(40)	-3.079(20)		-10.147(22)	1.038(21)	[1976Ge10]
<sup>136</sup> Nd	0 <sup>+</sup>	50.65(33) m	2.141(16)	-1.872(16)		-8.559(23)	2.099(38)	[1975Br16]
<sup>140</sup> Sm	0 <sup>+</sup>	14.82(10) m	2.756(27)	-0.728(30)		-6.905(16)	3.460(17)	[1972De23]
<sup>144</sup> Gd	0 <sup>+</sup>	4.47(6) m	3.860(30)	0.469(28)		-5.196(37)	4.028(37)	[1991Tu01]
<sup>148</sup> Dy	0 <sup>+</sup>	3.1(1) m	2.678(10)	0.209(9)		-5.320(11)	5.335(14)	[1975To03]
<sup>152</sup> Er	0 <sup>+</sup>	10.3(1) s	3.104(10)	0.963(9)		-3.972(12)	7.612(15)	[1982Bo04]
<sup>156</sup> Yb	0 <sup>+</sup>	25.3(5) s*	3.569(13)	1.655(11)		-3.204(12)	7.914(16)	[2011Es03, 1983Mi01, 1982To14, 1979Ho10, 1970To16]
<sup>160</sup> Hf	0 <sup>+</sup>	13.6(2) s	4.330(60)	2.606(20)		-1.813(27)	8.471(17)	[1995Hi12]
<sup>164</sup> W	0 <sup>+</sup>	6.0(3) s**	5.047(30)	3.745(27)		0.018(76)	9.609(58)	[[1979Ho10, 1975To05, 1973Ea01]
<sup>168</sup> Os	0 <sup>+</sup>	2.2(1)*** s	5.800(30)	4.809(21)		1.525(30)	10.863(30)	[1996Pa01, 1982En03]
<sup>172</sup> Pt	0 <sup>+</sup>	96(3) ms	6.270(30)	5.902(21)		3.219(15)	12.263(33)	[1996Pa01]
<sup>176</sup> Hg	0 <sup>+</sup>	21.3(8) ms <sup>@</sup>	6.740(30)	6.635(22)		4.423(16)	13.170(34)	[2009An20, 2004GoZZ, 2002Ro17, 1999To11, 1999Po09]
<sup>180</sup> Pb	0 <sup>+</sup>	4.1(3) ms	7.450(70)	7.703(31)		5.784(16)	14.155(35)	[2010Ra12]

\* Weighted average of 24(1) s [1970To16], 26.1(7) s [2011Es03], 25.8(10) s [1977Ha48], 26.0(5) s [1978AfZZ], 23.6(13) s [1983Mi01], and 23(1) s [1982To14].

\*\* Weighted average of 6.3(5) s [1973Ea01], 5.5(5) s [1975To05], 6.4(8) s [1979Ho10].

\*\*\* Weighted average of 2.2(1) s [1982En03], and 2.1(1) s [1996Pa01].

<sup>@</sup> Weighted average of 20(3) ms [2009An20], 22(1) ms [2004GoZZ], 20(2) ms [2002Ro17], 20(3) ms [1999To11], and 21(4) ms [1999Po09].

**Table 2**

Particle separation and emission from the even- $Z$ ,  $T_z = +8$  nuclei. Unless otherwise stated, all Q-values and separation energies are taken from [2021Wa16] or deduced from values therein.

Nuclide	$S_p$	$S_{2p}$	$Q_\alpha$	$BR_\alpha$	Experimental
<sup>132</sup> Ce	5.988(35)	9.790(20)	0.476(20)		
<sup>136</sup> Nd	5.552(17)	8.944(24)	0.844(24)		
<sup>140</sup> Sm	5.244(18)	8.017(17)	1.318(17)		
<sup>144</sup> Gd	4.807(30)	7.356(28)	1.272(31)		
<sup>148</sup> Dy	4.406(12)	6.352(10)	1.475(29)		
<sup>152</sup> Er	4.166(12)	5.769(10)	4.934(2)	92(4)%*	[1982Bo04, 1982De11, 1987To02, 1979Ho10, 1982Ba75, 1982To14, 1981HoZM, 1977Ha48, 1970To16]
<sup>156</sup> Yb	3.929(14)	5.239(11)	4.810(4)	9(2)%	[1996Pa01, 1983Mi01, 1982To14, 1979Ho10, 1978AfZZ, 1977Ha48, 1979To16, 2011Es03, 1970ToZS, 1970ToZU]
<sup>160</sup> Hf	3.519(39)	4.507(12)	4.902(3)	0.7(2)%	[1995Hi12, 1992Ha10, 1996Pa01, 1996HiZX, 1979Ho10, 1973To02, 1970ToZU, 1970ToZY]
<sup>164</sup> W	2.990(39)	3.645(13)	5.278(2)	4.4(9)%**	[1996Pa01, 1979Ho10, 1975To05, 1973Ea01, 1994TeZZ, 1982De11, 1981DeZA, 1976ToZP, 1974Sc35, 1972EaZU]
<sup>168</sup> Os	2.450(41)#	2.685(14)	5.816(3)	43(3)%***	[2004GoZZ, 1996Pa01, 1995Hi02, 1984Sc06, 1982De11, 1982En03, 1978Ca11, 1978Sc26, 1977Ca23]
<sup>172</sup> Pt	1.984(40)#	1.759(14)	6.463(4)	94(6)%	[2004GoZZ, 1996Pa01, 1981De22, 2002Ro17, 1993ToZY, 1984ScZQ, 1982En03]
<sup>176</sup> Hg	1.670(40)#	1.045(15)	6.897(6)	98(2)%	[2004GoZZ, 1999Po09, 2010Ju02, 2009An02, 2002Ro17, 1999To11, 1998Mu25, 1996Pa01, 1993ToZY, 1990SeZW, 1984ScZQ, 1983Sc24]
<sup>180</sup> Pb	0.960(41)	0.204(16)	7.419(5)	$\approx 100\%$ <sup>@</sup>	[2010Ra12, 2009An20, 2010Ju02, 1999To11, 1998ToZW, 1996To08]

\* Weighted average of 93(4)% [1979Ho10] and 90(4)% , 94(4)% [1987To01].

\*\* Weighted average of 5(1)% [1996Pa01] and 2.6(17)% [1979Ho10].

\*\*\* Weighted average of 36(4)% [2004GoZZ], 40(3)% [1996Pa01], and 49(3)% [1982En03].

<sup>@</sup> Deduced from short half-life.

**Table 3**  
direct  $\alpha$  emission from  $^{152}\text{Er}$ ,  $J^\pi = 0^+$ ,  $T_{1/2} = 10.3(1) \text{ s}^*$ ,  $BR_\alpha = 92(4)\%^{**}$ .

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{148}\text{Dy})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
4.935(2)	4.805(2)***	92(4)%**	$0^+$	0.0	—	1.5668(28)	1.00(5)

\* [1982Bo04].

\*\* Weighted average of 93(4)% [1979Ho10] and 90(4)% , 94(4)% [1987To01].

\*\*\* Weighted average of 4.799(3) MeV [1982Bo04] (adjusted to 4.805(3) in [1991Ry02]), 4.804(2) MeV [1982De11], and 4.808(5) MeV [1979Ho10].

**Table 4**  
direct  $\alpha$  emission from  $^{156}\text{Yb}^*$ ,  $J^\pi = 0^+$ ,  $T_{1/2} = 25.3(5) \text{ s}^{**}$ ,  $BR_\alpha = 9(2)\%^{***}$ .

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{152}\text{Er})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
4.810(4)	4.687(4)	9(2)%	$0^+$	0.0	—	1.592(15)	$1.09^{+0.34}_{-0.22}$

\* All values from [1996Pa01], except where noted.

\*\* Weighted average of 24(1) s [1970To16], 26.1(7) s [2011Es03], 25.8(10) s [1977Ha48], 26.0(5) s [1978AfZZ], 23.6(13) s [1983Mi01], and 23(1) s [1982To14].

\*\*\* [1983Mi01].

**Table 5**  
direct  $\alpha$  emission from  $^{160}\text{Hf}^*$ ,  $J^\pi = 0^+$ ,  $T_{1/2} = 13.6(2) \text{ s}$ ,  $BR_\alpha = 0.7(2)\%$ .

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{156}\text{Yb})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
4.902(6)	4.779(6)**	0.7(2)%	$0^+$	0.0	—	1.549(19)	$1.0^{+0.4}_{-0.2}$

\* All values from [1995Hi12], except where noted.

\*\* [1992Ha10]

**Table 6**  
direct  $\alpha$  emission from  $^{164}\text{W}$ ,  $J^\pi = 0^+$ ,  $T_{1/2} = 6.0(3) \text{ s}^*$ ,  $BR_\alpha = 4.4(9)\%^{**}$ .

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{160}\text{Hf})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
5.278(3)	5.140(3)***	4.4(9)%	$0^+$	0.0	—	1.576(15)	$0.8^{+0.3}_{-0.2}$

\* Weighted average of 6.3(5) s [1973Ea01], 5.5(5) s [1975To05], 6.4(8) s [1979Ho10].

\*\* Weighted average of 5(1)% [1996Pa01] and 2.6(17)% [1979Ho10].

\*\*\* Weighted average of 5.148(6) MeV [1996Pa01], 5.153(5) MeV [1973Ea01], 5.146(5) MeV [1975To05], and 5.148(5) MeV [1979Ho10].

**Table 7**  
direct  $\alpha$  emission from  $^{168}\text{Os}$ ,  $J^\pi = 0^+$ ,  $T_{1/2} = 2.2(1) \text{ s}^*$ ,  $BR_\alpha = 43(3)\%^{**}$ .

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{164}\text{W})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
5.817(3)	5.678(3)***	43(4)%	$0^+$	0.0	—	1.5627(48)	1.03(11)

\* Weighted average of 2.2(1) s [1982En03], and 2.1(1) s [1996Pa01].

\*\* Weighted average of 36(4)% [2004GoZZ], 40(3)% [1996Pa01], and 49(3)% [1982En03].

\*\*\* Weighted average of 5.674(8) MeV [1995Hi02], 5.662(8) MeV [1984Sc06], and 5.680(3) MeV [1982De11].

**Table 8**direct  $\alpha$  emission from  $^{172}\text{Pt}$ ,  $J^\pi = 0^+$ ,  $T_{1/2} = 96(3)$  ms\*,  $BR_\alpha = 94(6)\%$ \*\*.

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{168}\text{Os})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
6.466(3)	6.315(3)***	43(4)%	$0^+$	0.0	—	1.5583(40)	0.99(7)

\* [1996Pa01].

\*\* [2004GoZZ].

\*\*\* Weighted average of 6.317(5) MeV [2004GoZZ], and 6.314(4) MeV [1982De11].

**Table 9**direct  $\alpha$  emission from  $^{176}\text{Hg}$ ,  $J^\pi = 0^+$ ,  $T_{1/2} = 21.3(8)$  ms\*,  $BR_\alpha = 98(2)\%$ \*\*.

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{172}\text{Pt})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
6.906(5)	6.749(5)***	98(2)%	$0^+$	0.0	—	1.5446(30)	1.02(4)

\* Weighted average of 20(3) ms [2009An20], 22(1) ms [2004GoZZ], 20(2) ms [2002Ro17], 20(3) ms [1999To11], and 21(4) ms [1999Po09].

\*\* [2004GoZZ].

\*\*\* Weighted average of 6.755(5) MeV [2004GoZZ], and 6.740(6) MeV [1999Po09].

**Table 10**direct  $\alpha$  emission from  $^{180}\text{Pb}$ \*,  $J^\pi = 0^+$ ,  $T_{1/2} = 4.1(3)$  ms,  $BR_\alpha = \approx 100\%$ .

$E_\alpha$ (c.m.)	$E_\alpha$ (lab)	$I_\alpha$ (abs)	$J_f^\pi$	$E_{daughter}(^{176}\text{Hg})$	coincident $\gamma$ -rays	$R_0$ (fm)	HF
7.419(7)	7.254(7)	$\approx 100\%$	$0^+$	0.0	—	1.5194(46)	0.98(7)

\* All values from [2010Ra12].

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