

Even Z
 $T_z = +9$

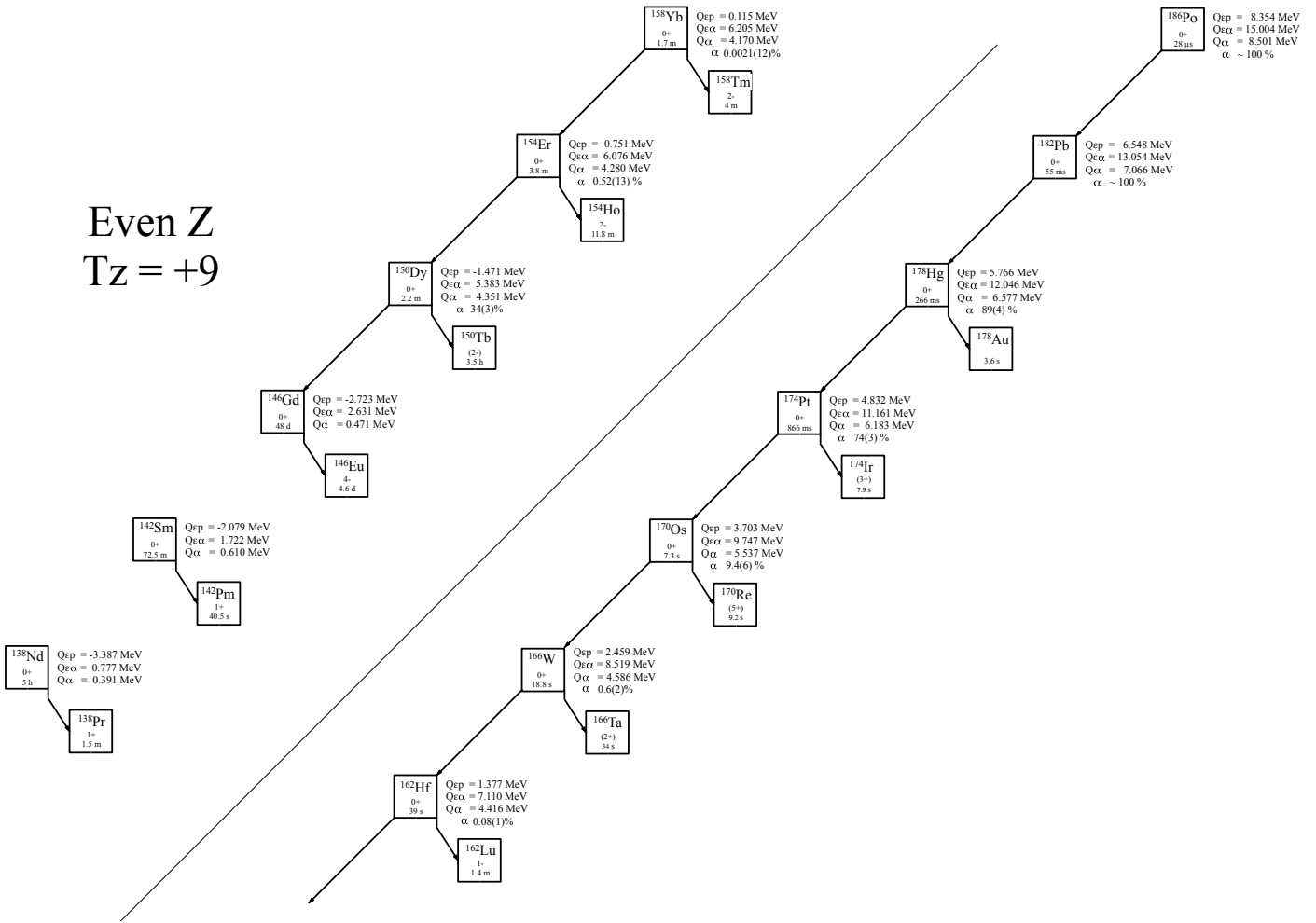


Fig. 1: Known experimental values for heavy particle emission of the even-Z $T_z = +9$ nuclei.

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Table 1

Observed and predicted β -delayed particle emission from the even- Z , $T_z = +9$ nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein. J^π values for ^{138}Nd , ^{142}Sm , and ^{146}Gd are taken from ENSDF.

Nuclide	J^π	$T_{1/2}$	Q_ε	$Q_{\varepsilon p}$	$Q_{\varepsilon\alpha}$	$\text{BR}_{\beta F}$	Experimental
^{138}Nd	0^+	5.04(9) h	1.112(15)	-3.387(12)	0.777(23)		[1970Ho25]
^{142}Sm	0^+	72.49(5) m	2.160(24)	-2.079(3)	1.722(10)		[1966Ma15]
^{146}Gd	0^+	48.27(10) d	1.032(7)	-2.723(4)	2.631(24)		[1970Ch09]
^{150}Dy	0^+	2.17(2) m	1.796(8)	-1.471(5)	5.383(7)		[1973Bi06]
^{154}Er	0^+	3.75(12) m	2.034(9)	-0.751(6)	6.076(9)		[1974PeZS]
^{158}Yb	0^+	1.65(20) m	2.694(26)	0.115(28)	6.205(11)		[1977Ha48]
^{162}Hf	0^+	39.8(4) s	3.660(80)	1.377(17)	7.110(27)		[1995Hi12]
^{166}W	0^+	18.8(4) s	4.210(30)	2.459(30)	8.519(76)		[1989Hi04]
^{170}Os	0^+	7.3(2) s*	4.978(15)	3.703(18)	9.747(30)		[2004GoZZ, 1995Hi02, 1982En03]
^{174}Pt	0^+	866(5) ms**	5.468(15)	4.832(18)	11.161(15)		[2014Pe02, 2004GoZZ, 1996Pa01, 1982En03]
^{178}Hg	0^+	266(3) ms***	5.988(15)	5.766(18)	12.046(16)		[2002Ro17, 2000Ko01]
^{182}Pb	0^+	55(5) ms	6.503(17)	6.548(20)	13.054(16)		[1999To11]
^{186}Po	0^+	28^{+16}_{-6} μs	7.247(25)	8.354(24)	15.004(22)		[2013An13]

* Weighted average of 7.2(2) s [2004GoZZ], 7.9(3) s [1995Hi02], and 7.1(2) s [1982En03].

** Weighted average of 930(30) ms [2014Pe02], 857(5) ms [2004GoZZ], 890(20) ms [1996Pa01], and 900(10) ms [1982En03].

*** Weighted average of 269(3) ms [2002Ro17] and 262(4) ms [2000Ko01].

Table 2

Particle separation, Q-values, and measured values for direct particle emission of the even- Z , $T_z = +9$ nuclei. Unless otherwise stated, all S and Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	S_p	S_{2p}	Q_α	BR_α	Experimental
^{138}Nd	6.104(14)	10.087(12)	0.391(23)		
^{142}Sm	5.748(14)	9.303(4)	0.610(12)		
^{146}Gd	5.383(5)	8.698(4)	0.471(4)		
^{150}Dy	5.110(5)	7.618(4)	4.351(2)	34(3)%*	[1974To07, 1973Bi06, 1973BoXL, 1968Go32] 1981HoZM, 1977Ha48, 1974ToZN, 1974ToZQ, 1974PeZS, 1970Ma23, 1968Go13, 1964Ma19, 1960To05]
^{154}Er	4.882(7)	7.065(6)	4.280(3)	0.52(13)%**	[1974To07, 1974PeZS, 1973BoXL, 1968Go13, 1988KaZK, 1982Bo04, 1978AtZZ, 1978VrZY, 1975ToZT, 1974ToZN, 1975ToZT, 1970Ma23, 1963Ma18]
^{158}Yb	4.589(29)	6.376(26)	4.170(7)	0.0021(12)%	[1992Ha10, 1977Ha48, 1979Ho10, 1976Gi15]
^{162}Hf	3.895(29)	5.583(11)	4.416(5)	0.008(1)%	[1995Hi12, 1992Ha10, 1983To01, 1982Sc15] 1992HeZV]
^{166}W	3.329(17)	4.647(18)	4.856(4)	0.6(2)%	[1979Ho10, 1975To05, 1987ScZL, 1984ScZQ, 1981HoZM, 1976ToZP]
^{170}Os	2.805(15)	3.611(16)	5.537(3)	9.4(6)%***	[2004GoZZ, 1996Pa01, 1995Hi02, 1982De11 1982En03, 2002Ro17, 1984Sc06, 1981DeZA, 1981DeZL, 1978Sc26, 1972To06, 1972ToZC, 1972ToZL, 1972ToZW]
^{174}Pt	2.338(15)	2.652(16)	6.183(3)	74(3)%	[2004GoZZ, 2004Go38, 1996Pa01, 1979Ha10, 2002Ro17, 1982En03, 1981DeZB, 1973Ga08 1966Si08]
^{178}Hg	2.059(15)	1.959(17)	6.577(3)	89(4)%	[2012Ve04, 2004GoZZ, 2000Ko01, 1979Ha10 2019Ma08, 2009An20, 2003An13, 2002Ro17, 1999To11, 1996Pa01, 1991Se01, 1976HaYQ, 1976HoZD, 1971Ha03]
^{182}Pb	1.315(15)	1.152(17)	7.066(6)	$\approx 100\%$ @	[2000Je09, 1999To11, 1987To09, 1986Ke05, 2013An13, 1988ToZV, 1988ToZW, 1984SeZQ, 1982HeZM]
^{186}Po	0.952(83)	-0.575(22)	8.501(14)	100% [@]	[2013An13, 2005AnZY]

* Weighted average of 31(3)% and 36(3)% [1974To07].

** Weighted average of 0.59(16)% and 0.47(13)% [1974To07].

*** Weighted average of 10(3)% [2004GoZZ], 8.6(5)% [1996Pa01], 992)% [1995Hi02], and 12(1)% [1982En03].

@ Inferred from Half-life.

Table 3direct α emission from ^{150}Dy , $J^\pi = 0^+$, $T_{1/2} = 7.17(2)$ m*, $BR_\alpha = 34(3)\%$ **.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{146}Gd)	coincident γ -rays	R_0 (fm)	HF
4.348(3)	4.232(3)	34(3)%**	0^+	0.0	—	1.5648(57)	1.0

* [1973Bi06].

** Weighted average of 31(3)% and 36(3)% [1974To07].

Table 4direct α emission from ^{154}Er , $J^\pi = 0^+$, $T_{1/2} = 3.75(12)$ m*, $BR_\alpha = 0.52(13)\%$ **.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{150}Dy)	coincident γ -rays	R_0 (fm)	HF
4.279(5)	4.168(5)***	5.2(13)%**	0^+	0.0	—	1.556(18)	1.0

* [1974PeZS].

** Weighted average of 5.9(16)% and 4.7(13)% [1974To07].

*** Reported as 4.166(5) MeV [1968Go13] (adjusted to 4.168(5) MeV in [1999Ry01]).

Table 5direct α emission from ^{158}Yb , $J^\pi = 0^+$, $T_{1/2} = 1.65(20)$ m*, $BR_\alpha = 0.0021(12)\%$ **.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{154}Er)	coincident γ -rays	R_0 (fm)	HF
4.171(10)	4.065(10)***	0.0021(12)%**	0^+	0.0	—	1.523(51)	1.0

* [1977Ha48].

** [1992Ha10].

*** weighted average of 4.059(12) MeV [1992Ha10] and 4.069 MeV [1977Ha48].

Table 6direct α emission from ^{162}Hf *, $J^\pi = 0^+$, $T_{1/2} = 39.8(4)$ s, $BR_\alpha = 0.008(1)\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{158}Yb)	coincident γ -rays	R_0 (fm)	HF
4.417(9)	4.308(9)**	0.008(1)%	0^+	0.0	—	1.583(10)	1.0

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

** Weighted average of 4.307(10) MeV [1995Hi12], 4.305(9) MeV [1992Ha10], 4.311(10) MeV [1983To01], and 4.308(10) MeV [1982Sc15].

Table 7direct α emission from ^{166}W , $J^\pi = 0^+$, $T_{1/2} = 18.8(4)$ s*, $BR_\alpha = 0.6(2)\%$ **.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{162}Hf)	coincident γ -rays	R_0 (fm)	HF
4.865(5)	4.739(5)**	0.6(2)%**	0^+	0.0	—	1.660(23)	1.0

* [1989Hi04].

** [1979Ho10].

*** [1975To05].

Table 8direct α emission from ^{170}Os , $J^\pi = 0^+$, $T_{1/2} = 7.3(2)$ s*, $BR_\alpha = 9.4(6)\%$ **.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{166}W)	coincident γ -rays	R_0 (fm)	HF
5.539(4)	5.409(4)***	9.4(6)%**	0^+	0.0	—	1.5615(43)	1.0

* Weighted average of 7.2(2) s [2004GoZZ], 7.9(3) s [1995Hi02], and 7.1(2) s [1982En03].

** Weighted average of 10(3)% [2004GoZZ], 8.6(5)% [1996Pa01], 992% [1995Hi02], and 12(1)% [1982En03].

*** Weighted average of 5.410(5) MeV [2004GoZZ], 5.411(4) MeV [1982De11], and 5.405(5) MeV [1982En03].

Table 9
direct α emission from $^{174}\text{Pt}^*$, $J^\pi = 0^+$, $T_{1/2} = 866(5)$ ms**, $BR_\alpha = 74(3)\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}$ (^{170}Os)	coincident γ -rays	R_0 (fm)	HF
5.898(5)	5.762(5)	<1%	<0.7%	2 ⁺	0.287	0.2867	1.5553(31)	>6.6
6.182(5)	6.040(5)***	100%	73(1)%	0 ⁺	0.0	—	1.5553(31)	1.0

* All values from [2004GoZZ], except where noted.

** Weighted average of 930(30) ms [2014Pe02], 857(5) ms [2004GoZZ], 890(20 ms [1996Pa01], and 900(10) ms [1982En03],

*** [2004GoZZ] and [2004Go38].

Table 10
direct α emission from ^{178}Hg , $J^\pi = 0^+$, $T_{1/2} = 266(3)$ ms*, $BR_\alpha = 89(4)\%$ **.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{174}Pt)	coincident γ -rays	R_0 (fm)	HF
6.577(3)	6.429(3)***	89(4)%**	0 ⁺	0.0	—	1.5422(27)	1.0

* Weighted average of 269(3) ms [2002Ro17] and 262(4) ms [2000Ko01].

** [2012Ve04].

*** Weighted average of 6.429(5) MeV [2004GoZZ], 6.429(4) MeV [2000Ko01] and 6.430(6) MeV [1979Ha10].

Table 11
direct α emission from ^{182}Pb , $J^\pi = 0^+$, $T_{1/2} = 55(5)$ ms*, $BR_\alpha = \approx 100\%$ **.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{178}Hg)	coincident γ -rays	R_0 (fm)	HF
7.066(10)	6.910(10)***	$\approx 100\%$ **	0 ⁺	0.0	—	1.5163(61)	1.0

* [1999To11].

** Inferred from half-life.

*** Weighted average of 6.911(10) MeV [2000Je09], 6.895(10) MeV [1999To11], 6.919(15) MeV [1987To09] and 6.921(10) MeV [1986Ke05].

Table 12
direct α emission from $^{186}\text{Po}^*$, $J^\pi = 0^+$, $T_{1/2} = 28_{-6}^{+16}$ μs , $BR_\alpha = 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}$ (^{182}Pb)	coincident γ -rays	R_0 (fm)	HF
8.503(15)	8.320(15)	100%	0 ⁺	0.0	—	1.487(43)	1.0

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