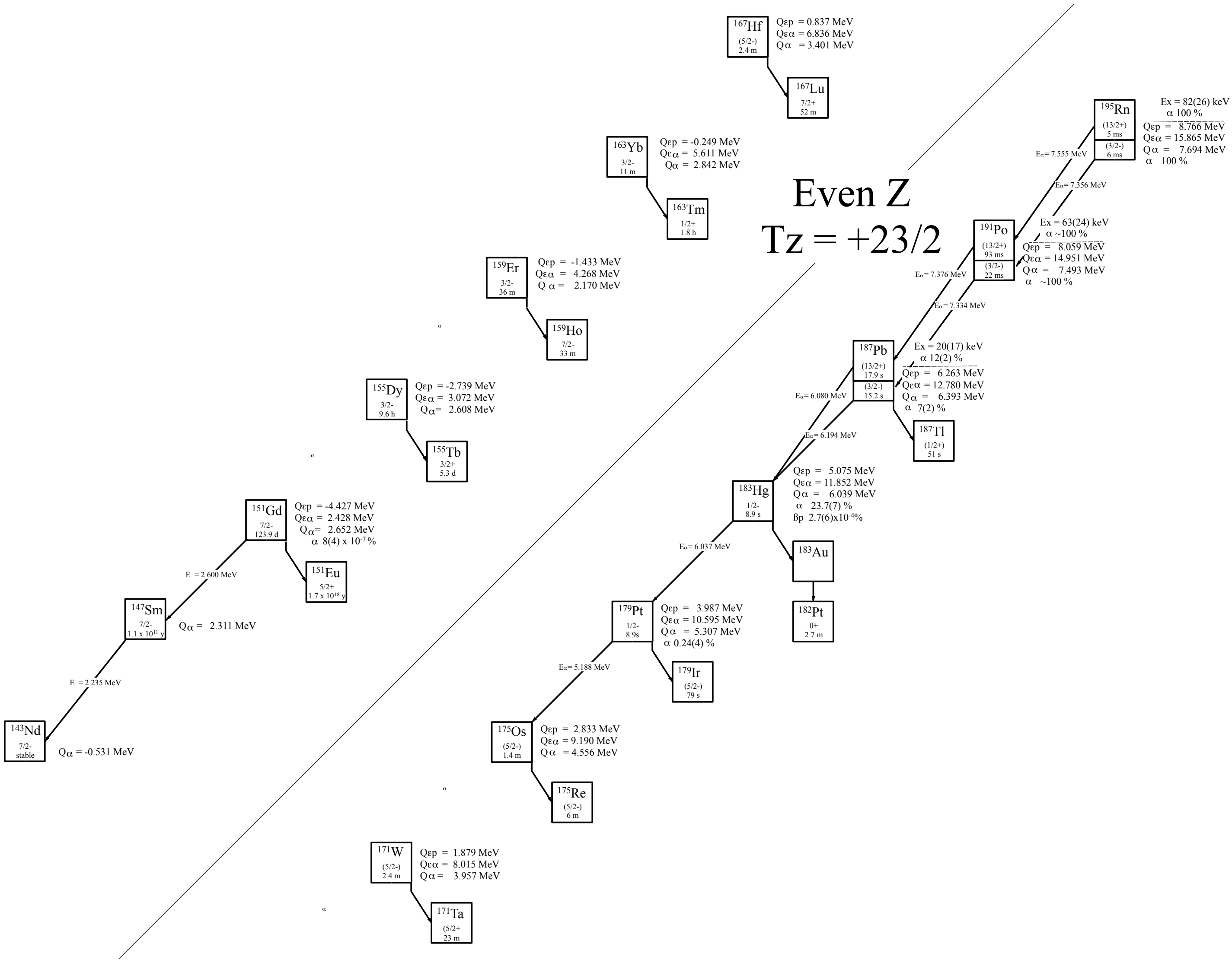

Fig. 1: Known experimental values for heavy particle emission of the even-Z T_z= +23/2 nuclei.

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Table 1
Observed and predicted β-delayed particle emission from the even-Z, T_z = +23/2 nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein. J$^\pi$ values for ^{143}Nd, ^{147}Sm, ^{151}Gd, ^{155}Dy, ^{159}Er, ^{163}Yb, ^{167}Hf, ^{171}W, ^{175}Os are taken from ENSDF.

Nuclide	Ex	J^π	$T_{1/2}$	Qε	$Q_{\varepsilon p}$	BR$_{\beta p}$	$Q_{\varepsilon\alpha}$	Experimental
^{143}Nd		7/2$^-$	stable	stable	—	—	—	
^{147}Sm		7/2$^-$	1.068(9) × 10^{11} y*	stable	—	—	—	[**2010Su30, 2009Ko15**]
^{151}Gd		7/2$^-$	123.9(10) d	0.464(3)	-4.427(3)		2.428(3)	[**1984Gr15**]
^{155}Dy		3/2$^-$	9.59(10) h	2.095(2)	-2.739(10)		3.072(10)	[**1970Ch09**]
^{159}Er		3/2$^-$	36(1) m	2.769(2)	-1.443(4)		4.264(10)	[**1966La11**]
^{163}Yb		3/2$^-$	10.96(35) m	3.435(16)	-0.249(15)		5.611(15)	[**1972Ch23**]
^{167}Hf		(5/2$^-$)	2.05(5) m	4.060(50)	0.837(29)		6.836(28)	[**1973Me09**]
^{171}W		(5/2$^-$)	2.38(4) m	4.630(40)	1.879(40)		8.015(47)	[**1990Me12**]
^{175}Os		(5/2$^-$)	1.4(1) m	5.180(30)	2.833(30)		9.190(30)	[**1972Be89**]
^{179}Pt		1/2$^-$	21.2(4) s	5.814(13)	3.987(16)		10.595(29)	[**1993Me13, 1993MeZW**]
^{183}Hg		1/2$^-$	8.9(2) s	6.387(12)	5.075(15)	2.7(6)×10^{-4}%	11.852(12)	[**2022Hu09, 1971Ho07**, 1970HaZL, 1970HoZZ]
^{187}Pb		(3/2$^-$)	15.2(3) s	7.458(10)	6.263(13)		12.780(11)	[**1981Mi12**]
^{187m}Pb	0.020(17)**	(13/2$^+$)	17.9(2) s	7.478(20)	6.283(21)		12.800(20)	[**2022Hu09, 1981Mi12**]
^{191}Po		(3/2$^-$)	22(2) ms	8.171(10)	8.059(14)		14.951(11)	[**2002An16**]
^{191m}Po	0.063(24)***	(13/2$^+$)	93(3) ms	8.234(26)	8.122(28)		15.014(26)	[**2002An16**]
^{195}Rn		(3/2$^-$)	6^{+3}_{-2} ms	8.520(50)	8.766(53)		15.865(52)	[**2001Ke06, 2001Uu01**]
^{195m}Rn	0.082(26)$^@$	(13/2$^+$)	5^{+3}_{-2} ms	8.602(56)	8.848(59)		15.947(59)	[**2001Ke06, 2001Uu01**]

* Weighted average of 1.065(10) × 10^{11} y [2010Su30] and 1.070(9) × 10^{11} y [2009Ko15].
** Deduced from α and γ energies [2022Hu09, 1981Mi12] of the two isomers
*** Deduced from α energies [2002An16] and excitation energy of ^{187m}Pb. See table 8 for more detail.
$^@$ Deduced from α energies [2001Ke06] and excitation energy of ^{191m}Po.

Table 2
Particle separation, Q-values, and measured values for direct particle emission of the even-Z, T_z = +23/2 nuclei. Unless otherwise stated, all S and Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	S$_p$	S$_{2p}$	Q$_\alpha$	BR$_\alpha$	Experimental
^{143}Nd	7.505(1)	13.149(1)	0.531(2)		
^{147}Sm	7.101(4)	12.412(1)	2.3113(5)	100%*	[**1970Gu14, 1966Ma05, 1962Si14, 1961Ma05, 1960Ka27**, 2017Wi01, 2010Su30, 2009Ko15, 2003Ki26, 2001Be81, 1992Ma26, 1987Al28, 1965Va16, 1964Do01, 1961Gr37, 1961Wr02, 1960Ka23, 1959Vo28, 1954Be69, 1954Le55, 1949Pi01, 1946Cu01, 1934Li03, 1934MaAA, 1933HeAA]
^{151}Gd	6.686(7)	11.631(3)	2.652(3)	8^{+8}_{-4}×10^{-7}%	[**1965Si06**]
^{155}Dy	6.288(46)	10.851(10)	2.608(10)		
^{159}Er	5.663(27)	9.714(6)	2.170(10)		
^{163}Yb	5.105(30)	8.671(17)	2.842(16)		
^{167}Hf	4.736(41)	7.750(39)	3.401(32)		
^{171}W	4.237(40)	6.947(40)	3.957(40)		
^{175}Os	3.721(30)	5.956(30)	4.556(30)		
^{179}Pt	3.303(20)	4.890(17)	5.307(7)**	0.24(4)%***	[**2021Ha32, 1980Sc09, 1970Ha18**, 1982Bo14, 1979Ha10, 1973BoXL, 1970Ho18, 1970HaZT, 1966Si08]
^{183}Hg	2.790(20)	4.001(15)	6.039(4)	23.7(7)%	[**2022Hu09, 1979Ha10**, 1992BoZO, 1984Ma41, 1980Sc09 1969NaZT, 1969NaZU, 1968De01]
^{187}Pb	2.393(21)	3.381(15)	6.393(6)	7(2)%	[**1999An36, 1981Mi12**, 1981MiZY, 1999An10, 1999An36 1974JoZU, 1974Le02, 1972Ga27]
^{187m}Pb	2.373(27)	3.361(23)	6.413(18)	12(2)%	[**2022Hu09, 1999An36, 1981Mi12**, 1981MiZY, 1999An10, 1999An36
^{191}Po	1.762(22)	1.803(16)	7.493(5)	≈100%$^@$	[**2002An19**, 2001Ke06, 2001Uu01, 1999An10, 1999An36, 1998DaZQ, 1997Ba25, 1993Qu03, 1988QuZZ]
^{191m}Po	1.699(33)	1.740(29)	7.556(25)	≈100%$^@$	[**2002An19**, 2001Ke06, 2001Uu01, 1999An10, 1999An36]
^{195}Rn	1.522(57)	1.202(54)	7.694(11)$^{@@}$	100%$^@$	[**2001Ke06, 2001Uu01**]
^{195m}Rn	1.440(63)	1.120(60)	7.776(28)	100%$^@$	[**2001Ke06, 2001Uu01**]

* Only decay channel energetically possible.
** Deduced from α energies, 5.412(9) MeV in [2021Wa16].
*** Weighted average of 0.21(4)% [1980Sc09] and 0.27(4)% [1970Ha18].
$^@$ Based on the short half-life.
$^{@@}$ Deduced from α energies, 7.694(51) MeV in [2021Wa16].

Table 3
direct α emission from ^{147}Sm, J^{π} = 7/2^{-}, $T_{1/2}$ =1.068(9) × 10^{11} y*, BR_{α} =100%.

E_{α}(c.m.)	E_{α}(lab)	, I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{143}Nd)	coincident γ-rays	R_0 (fm)	HF
2.298(3)	2.235(3)**	100%	7/2^{-}	0.0	—	1.5895(97)	$1.42^{+0.32}_{-0.26}$

* Weighted average of 1.065(10) × 10^{11} y [2010Su30] and 1.070(9) × 10^{11} y [2009Ko15].
** Taken from [1999Ry01], based on weighted average 2.233(5) MeV [1970Gu14] (adjusted to 2.238(5) MeV), 2.31(5) [1966Ma05] (adjusted to 2.234(5) MeV), and 2.231(10) MeV [1962Si14] (adjusted to 2.230(10) MeV).

Table 4
direct α emission from ^{151}Gd*, J^{π} = 7/2^{-}, $T_{1/2}$ = 123.9(10) d, BR_{α} =8^{+8}_{-4}×10^{-7}%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{147}Sm)	coincident γ-rays	R_0 (fm)	HF
2.670(30)	2.600(30)	$0.8^{+0.8}_{-0.4}$%	7/2^{-}	0.0	—	1.5745(66)	$0.7^{+0.9}_{-04}$

* All values from [1965Si06].

Table 5
direct α emission from ^{179}Pt*, J^{π} = 1/2^{-}, $T_{1/2}$ =21.2(4) s**, BR_{α} =0.24(4)%***.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{175}Os)$^{@}$	coincident γ-rays$^{@}$	R_0 (fm)	HF
5.233(15)	5.116(15)	27.6(16)%	0.052(9)%		0.1756(2)	0.073, 0.102, 0.176	1.5588(47)	$0.80^{+0.22}_{-0.16}$
5.307(7)	5.188(7)	100.0(15)%	0.188(31)%	(5/2^{-})	0.0	—	1.5588(47)	$1.8^{+0.5}_{-0.4}$

* All values from [2021Ha32], except where noted.
** [19993Me13, 1993MeZW].
*** Weighted average of 0.21(4)% [1980Sc09] and 0.27(4)% [1970Ha18].
@ [2004Ba89].

Table 6
direct α emission from ^{183}Hg*, J^{π} = 1./2^{-},$T_{1/2}$ =8.9(2) s, BR_{α} =23.7(7)%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)***	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{179}Pt)$^{@}$	coincident γ-rays$^{@}$	R_0 (fm)	HF
5.797(10)	5.670(10)**	≈0.28%	≈0.06%	7/2^{-}	0.241(1)	0.1528	1.5148(61)	≈24
5.950(10)	5.820(10)**	4.1(11)%	0.87(23)%	5/2^{-}	0.0874(10)	0.087	1.5148(61)	$8.1^{+3.5}_{-2.1}$
5.965(10)	5.835(10)**	5.8(22)%	1.24(47)%	3/2^{-}	0.0714(10)	0.071	1.5148(61)	7^{+5}_{-2}
6.037(5)	5.905(5)**	100(26)%	21.5(58)%	1/2^{-}	0.0	—	1.5148(61)	$0.78^{+0.32}_{-0.20}$

* All values from [2022Hu09], except where noted.
** [1979Ha10].
*** Relative ratios taken from [1979Ha10].
@ [2009Ba02].

Table 7
direct α emission from ^{187}Pb*, J^{π} = (3/2^{-}),$T_{1/2}$ =15.2(3) s, BR_{α} =7(2)%**.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{183}Hg)	coincident γ-rays	R_0 (fm)	HF
6.124(10)	5.993(10)	67(7)%	4.7(14)%	(3/2^{-})	0.275	0.067, 0.208, 0.275	1.4873(66)	$1.8^{+0.9}_{-0.5}$
6.329(10)	6.194(10)	100(7)%	7.0(21)%	3/2^{-}	0.067	0.067	1.4873(66)	9^{+4}_{-2}

* All values from [1981Mi12], except where noted.
** [1999An36].

Table 8
direct α emission from ^{187m}Pb*, Ex = 20(17) keV**, J^{π} = (13/2^{+}), $T_{1/2}$ =17.9(2) s, BR_{α} =12(2)%***.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{183}Hg)$^{@}$	coincident γ-rays$^{@}$	R_0 (fm)	HF
6.213(4)	6.080(4)	12(2)%	(13/2^{-})	0.204(14)		1.4873(66)	$1.2^{+0.3}_{-0.2}$

* All values from [2022Hu09], except where noted.
** Deduced from α and γ energies [2022Hu09, 1981Mi12] of the two isomers
*** [1999An36].

Table 9
direct α emission from ^{191}Po*, J^{π} = ,$T_{1/2}$ =22(2) ms, BR_{α} =≈100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	J^{π}_{f}, I_{α}(abs)	$E_{daughter}$(^{187}Pb)	coincident γ-rays	R_0 (fm)	HF	
7.115(10)	6.966(10)	8.7(25)%	8.0(23)%	(3/2^{-})	0.375(1)	0.375(1)	1.5126(20)	$1.6^{+0.9}_{-0.5}$
7.491(5)	7.334(5)**	100(3)%	92(3)%**	(13/2^{+})	0.0	—–	1.5126(20)	2.4(3)

* All values from [2002An16], except where noted.
** [2002An16] list two α transitions with nearly identical energies (7.334(5) and 7.336(15) MeV), with the former feeding the ground state and the latter as a crossover between the (3/2^{-}) ^{191}Po ground state feeding a state at 2(15) keV in the (13/2^{+}) ^{187}Pb ground state. A more recent work [2022Hu09] establishes the (13/2^{+}) ^{187}Pb state as an isomer. The 7.336(15) is taken from a background subtracted α_1 - α_2 coincidence spectrum (Fig. 5 in [2002An16]) with a 6.070 MeV α from the decay of ^{187m}Pb. Note that there may be a small peak at ≈ 6.97 MeV in this spectrum. The observed peak at 7.336 MeV may be due to random correlations of the large 7.334 MeV peak (see Fig 1 [2002An16]). This evaluation treats them as one peak at 7.334(5) MeV and an intensity equal to the sum.

Table 10
direct α emission from ^{191m}Po*, Ex = 63(24)** keV, J^{π} = ,$T_{1/2}$ =93(3) ms, BR_{α} =≈100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{187}Pb)	coincident γ-rays	R_0 (fm)	HF
6.935(15)	6.790(15)***	1.1(6)%	0.5(3)%7		0.657(24)	0.594(1)	1.5126(20)	30^{+40}_{-10}
6.961(15)	6.815(15)	21(4)%	10(2)%	(9/2^{+})	0.636(28)		1.5126(20)	$1.6^{+0.8}_{-0.5}$
7.035(5)	6.888(5)	80(17)%	38(8)%	(13/2^{+})	0.557(24)	0.494(2)	1.5126(20)	$0.8^{+0.4}_{-0.3}$
7.057(15)	6.909(15)	8.2(23)%	3.9(11)%	(9/2^{+})	0.535(24)	0.472(1)	1.5126(20)	9^{+5}_{-3}
7.534(15)	7.376(15)	100.0(5)%	47.6(15)%	(13/2^{+})	0.063(24)		1.5126(20)	27^{+8}_{-7}

* All values from [2002An16], except where noted.
** Deduced from α energies [2002An16] and excitation energy of ^{187m}Pb. See table 8 for more detail.
*** Labeled as tentative [2002An16].

Table 11
direct α emission from ^{195}Rn*, J^{π} = *3/2^{-}), $T_{1/2}$ =6^{+3}_{-2} ms, BR_{α} =100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{191}Po)	coincident γ-rays	R_0 (fm)	HF
7.694(11)	7.536(11)	100%	(3/2^{-})	0.0	—–	1.588(13)	$3.2^{+1.5}_{-1.4}$

* All values from [2001Ke06, 2001Uu01].

Table 12
direct α emission from ^{195m}Rn*, Ex. = 82(26) keV**, J^{π} = (13/2^{+}),$T_{1/2}$ =5^{+3}_{-2} ms, BR_{α} =100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{191}Po)	coincident γ-rays	R_0 (fm)	HF
7.713(11)	7.555(11)	100%	(13/2^{+})	0.063(24)		1.588(13)	$3.6^{+1.8}_{-1.6}$

* All values from [2001Ke06, 2001Uu01], except where noted.
** Deduced from α energies [2001Ke06] and excitation energy of ^{191m}Po.

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