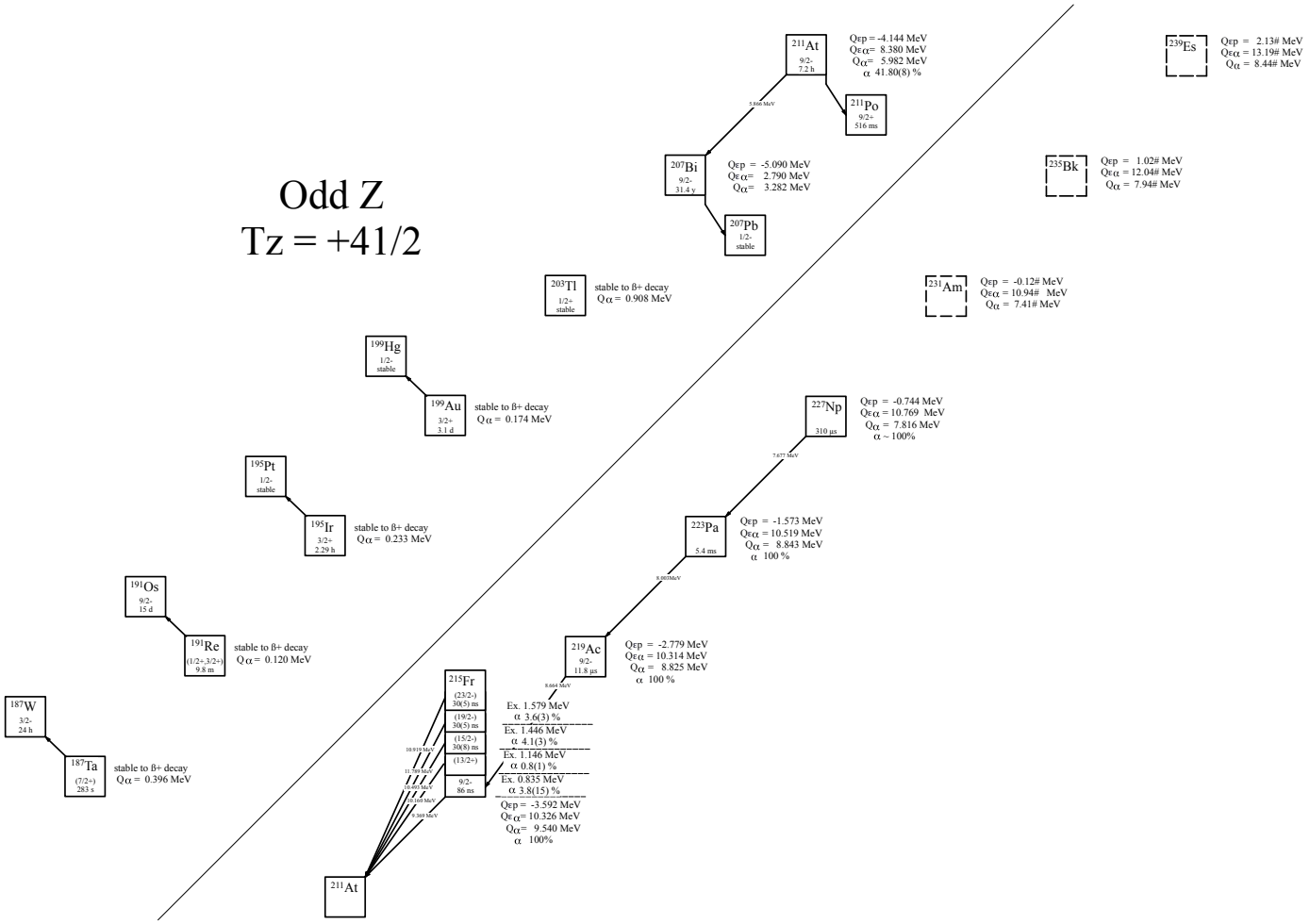

Fig. 1: Known experimental values for heavy particle emission of the odd-Z T_z= +41/2 nuclei.

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Table 1
Observed and predicted β-delayed particle emission from the odd-Z, T_z = +41/2 nuclei. J^π values for ^{187}Ta, ^{191}Re, ^{195}Ir, ^{199}Au, ^{203}Tl and ^{207}Bi and taken from ENSDF. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	Ex.	J^π	$T_{1/2}$	Q$_\varepsilon$	$Q_{\varepsilon p}$	$Q_{\varepsilon\alpha}$	Experimental
^{187}Ta		$(7/2^+)$	283(10) s	-3.90(21)#	——	——	[**2022Mu10**]
^{191}Re		$(1/2^+, 3/2^+)$	9.8(5) m	-3.170(40)	——	——	[**1953At24**]
^{195}Ir		$3/2^+$	2.29(17) h	-2.180(60)	——	——	[**2013Bi14**]
^{199}Au		$3/2^+$	3.129(11) d	-1.705(2)	——	——	[**1969La34**]
^{203}Tl		$1/2^+$	stable	-0.492(1)	——	——	
^{207}Bi		$9/2^-$	31.35(4) y	2.397(2.1)	-5.090(2)	2.790(3)	[**2002Un02**]
^{211}At		$9/2^-$	7.214(7) h	0.785(2.5)	-4.144(2)	8.380(3)	[**1961Ap01**]
^{215}Fr		$9/2^-$	86(5) ns	1.487(9)	-3.592(8)	10.326(7)	[**1984De16**]
^{215m1}Fr	0.835	$(13/2^+)$		2.322(9)	-2.727(8)	11.161(7)	[**1984Sc25**]
^{215m2}Fr	1.146	$(15/2^-)$	30(8) ns	2.633(9)	-2.446(8)	11.472(7)	[**1984De16**]
^{215m3}Fr	1.446	$(19/2^-)$	30(5) ns	2.933(9)	-2.146(8)	11.772(7)	[**1984De16**]
^{215m4}Fr	1.579	$(23/2^-)$	30(5) ns	3.066(9)	-2.013(8)	11.905(7)	[**1982GoZU**]
^{219}Ac		$9/2^-$	11.8(15) μs	2.180(50)	-2.779(52)	10.314(52)	[**1989Mi17**]
^{223}Pa			5.4(4) ms*	2.950(80)	-1.573(76)	10.519(76)	[**2019Mi08, 1999Ho28, 1995AnZY, 1970Bo13**]
^{227}Np			510(60) ms	3.530(80)	-0.744(78)	10.769(77)	[**1990Ni05**]
^{231}Am				4.10(30)#	-0.12(31)#	10.94(30)#	
^{235}Bk				4.76(41)#	1.02(43)#	12.04(40)#	
^{239}Es				5.43(32)#	2.13(39)#	13.19(33)#	

* Weighted average of 7(1) ms [2019Mi08], 4.9(5) ms [1999Ho28], 5(1) ms [1995AnZY] and 6.5(10) ms [1970Bo13].

Table 2
Particle separation, Q-values, and measured values for direct particle emission of the odd-Z, T_z = +41/2 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
^{187}Ta	7.760(76)	17.51(31)#	0.396(98)		
^{191}Re	7.271(37)	16.97(20)#	0.120(57)		
^{195}Ir	6.546(2)	16.039(39)	0.233(10)		
^{199}Au	6.479(2)	15.408(20)	0.174(1)		
^{203}Tl	5.705(1)	13.939(3)	0.908(1)		
^{207}Bi	3.558(2)	10.812(2)	3.282(2)		
^{211}At	2.983(2)	7.967(2)	5.982(1)	41.80(8)%*	[**1985La17, 1978Ya04, 1975Ja04, 1969Go23**, 2009Vi09, 2003HaZT, 2001Ch66, 2000ChZU, 2000OgZU, 1977YaZG, 1970AfZZ, 1968GuZX, 1963Uh01, 1961Ap01, 1955Mo68, 1953AsZZ, 1953Ho49, 1953Hy83, 1951Ne02, 1940Co01, 1940Co02]
^{215}Fr	2.651(11)	7.680(8)	9.540(7)	100%	[**1984Sc25, 1984De16**, 2019Mi08, 1982GoZU, 1982SaZO, 1974Ni02, 1973HaVQ, 1973HaZO, 1973HiYZ, 1972No06, 1971HyZX, 1970VaZZ]
^{215m1}Fr	1.816(11)	6.845(8)	10.375(7)	3.8(15)%	[**1984Sc25**]
^{215m2}Fr	1.505(11)	6.534(8)	10.686(7)	0.8(1)%	[**1984Sc25, 1984De16**]
^{215m3}Fr	1.205(11)	6.234(8)	10.986(7)	4.1(3)%	[**1984Sc25, 1984De16**, 1982GoZU]
^{215m4}Fr	1.072(11)	6.101(8)	11.119(7)	3.6(3)%	[**1984Sc25, 1984De16**, 1982GoZU, 1982SaZO]
^{219}Ac	2.365(52)	7.323(52)	8.825(10)**	100%	[**1989Mi17**, 2019Mi08, 1989MiZK, 1989MiZZ, 1988MiZJ, 1970Bo13, 1970VaZZ]
^{223}Pa	2.154(76)	6.771(94)	8.343(8)***	100%	[**1995AnZY, 1970Bo13**, 2019Mi08, 1999Ho28, 1993AnZS, 1970VaZZ]
^{227}Np	2.039(78)	6.36(11)	7.816(14)	$\approx$ 100%@	[**1990Ni05**, 1994AnZY, 1994Ye08, 1993AnZS, 1990An19, 1990AnZQ, 1990YeZY]
^{231}Am	1.81(30)#	5.97(32)#	7.41(31)#		
^{235}Bk	1.24(40)#	5.09(42)#	7.94(50)#		
^{239}Es	0.94(42)#	4.16(38)#	8.44(50)#		

* Weighted average of 41.94(16)% [1985La17], 41.74(10)% [1978Ya04] and 41.8(2)% [1969Go23].
** Deduced from α decay. 8.826(51) MeV in [2021Wa16].
*** Deduced from α decay. 8.343(55) MeV in [2021Wa16].
@ No other decay observed.

Table 3
direct α emission from ^{211}At, J^{π} = (9/2$^-$), $T_{1/2}$ = 7.214(7) h*, BR_{α} = 41.80(8)%**.

E_{α}(c.m.)	E_{α}(lab)***	I_{α}(rel)	I_{α}(abs)	J_f^{π}@	$E_{daughter}$(^{207}Bi)@	coincident γ-rays@	R_0 (fm)	HF
5.240(2)	5.141(2)	0.0023(8)%	0.00097(33)%	7/2$^-$	0.7247(1)	0.7427	1.4216(13)	33^{+17}_{-8}
5.311(2)	5.210(2)	0.0086(19)%	0.0036(8)%	11/2$^-$	0.6698(1)	0.6698	1.4216(13)	18^{+5}_{-3}
5.979(2)	5.866(2)	100%	41.80(8)%**	9/2$^-$	0.0	——	1.4216(13)	1.52(6)

* [1961Ap01].
** Weighted average of 41.94(16)% [1985La17], 41.74(10)% [1978Ya04] and 41.8(2)% [1969Go23].
*** [1969Go23].
@ [1975Ja04].

Table 4
direct α emission from ^{215}Fr*, J^{π} = (9/2$^-$), $T_{1/2}$ = 86(5) ns, BR_{α} = 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J_f^{π}	$E_{daughter}$(^{211}At)	coincident γ-rays	R_0 (fm)	HF
9.547(10)	9.369(10)	100%	9/2$^-$	0.0	——	1.5387(31)	1.03(10)

* All values from [1984De16].

Table 5
direct α emission from ^{215m1}Fr*, Ex. = 0.835 MeV, J^{π} = (13/2$^+$), $T_{1/2}$ = , BR_{α} = 3.8(15)%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J_f^{π}	$E_{daughter}$(^{211}At)	coincident γ-rays	R_0 (fm)	HF
10.353(30)	10.160(30)	100%	9/2$^-$	0.0	——	1.5387(31)	

* All values from [1984Sc25].

Table 6
direct α emission from ^{215m2}Fr*, Ex. = 1.146 MeV*, J^{π} = (15/2$^-$), $T_{1/2}$ = 30(8) ns*, BR_{α} = 0.8(1)%**.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J_f^{π}	$E_{daughter}$(^{211}At)	coincident γ-rays	R_0 (fm)	HF
10.692(20)	10.493(20)	100%	9/2$^-$	0.0	——	1.5387(31)	$9^{+4}_{-3} \times 10^3$

* [1984De16].
** [1984Sc25].

Table 7
direct α emission from ^{215m3}Fr, Ex. = 1.446 MeV*, J^{π} = (19/2$^-$), $T_{1/2}$ = 30(5) ns, BR_{α} = 4.1(3)%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J_f^{π}	$E_{daughter}$(^{211}At)	coincident γ-rays	R_0 (fm)	HF
10.994(15)	10.789(15)	100%	9/2$^-$	0.0	——	1.5387(31)	$5.8(12) \times 10^3$

* [1984De16].
** [1984Sc25].

Table 8
direct α emission from ^{215m4}Fr, Ex. = 1.579 MeV*, J^{π} = (23/2$^-$), $T_{1/2}$ = 30(5), BR_{α} = 3.6(3)%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J_f^{π}	$E_{daughter}$(^{211}At)	coincident γ-rays	R_0 (fm)	HF
11.126(15	10.919(15)	100%	9/2$^-$	0.0	——	1.5387(31)	$1.12(23) \times 10^4$

* [1984De16].
** [1984Sc25].

Table 9
direct α emission from ^{219}Ac*, J^{π} = (9/2$^-$), $T_{1/2}$ = 11.8(15) μs, BR_{α} = 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{215}Fr)	coincident γ-rays	R_0 (fm)	HF
8.825(10)	8.664(10)**	100%	9/2$^-$	0.0	——	1.5853(28)	1.79(27)

* All values from [1989Mi17], except where noted.
** From [1989Mi17], which has the highest statistics. [1970Bo13] report one peak at 8.665(10) MeV. [2019Mi17] report 2 peaks at 8.520(40) and 9.160(40) MeV. However, no spectra is shown, or relative ratios where reported.

Table 10
direct α emission from ^{223}Pa, $T_{1/2}$ = 5.4(4) ms*, BR_{α} = 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{219}Ac)	coincident γ-rays	R_0 (fm)	HF
8.149(8)	8.003(8)**	100(5)%	57(3)%$^{@}$		0.194(11)		1.5543(24)	2.3(3)
8.343(8)	8.193(8)***	75(7)%	43(3)%$^{@}$	9/2$^-$	0.0	——	1.5543(24)	11.3(14)

* Weighted average of 7(1) ms [2019Mi08], 4.9(5) ms [1999Ho28], 5(1) ms [1995AnZY] and 6.5(10) ms [1970Bo13].
** Weighted average of 8.000(15) MeV [1995AnZY] and 8.005(10) MeV [1970Bo13].
*** Weighted average of 8.190(15) MeV [1995AnZY] and 8.195(10) MeV [1970Bo13].
$^{@}$ [1995AnZY].

Table 11
direct α emission from ^{227}Np*, $T_{1/2}$ = 510(60) ms, BR_{α} = $\approx$ 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{223}Pa)	coincident γ-rays	R_0 (fm)	HF
7.787(20)	7.650(20)	$\approx$33%	$\approx$25%**		0.028(20)		1.510(23)	$\approx$2.7
7.815(20)	7.677(20)	100%	$\approx$75%**		0.0	——	1.510(23)	$\approx$1.1

* All values from [1990Ni05].
** Estimated by evaluator based on Fig. 2 in [1990Ni05].

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