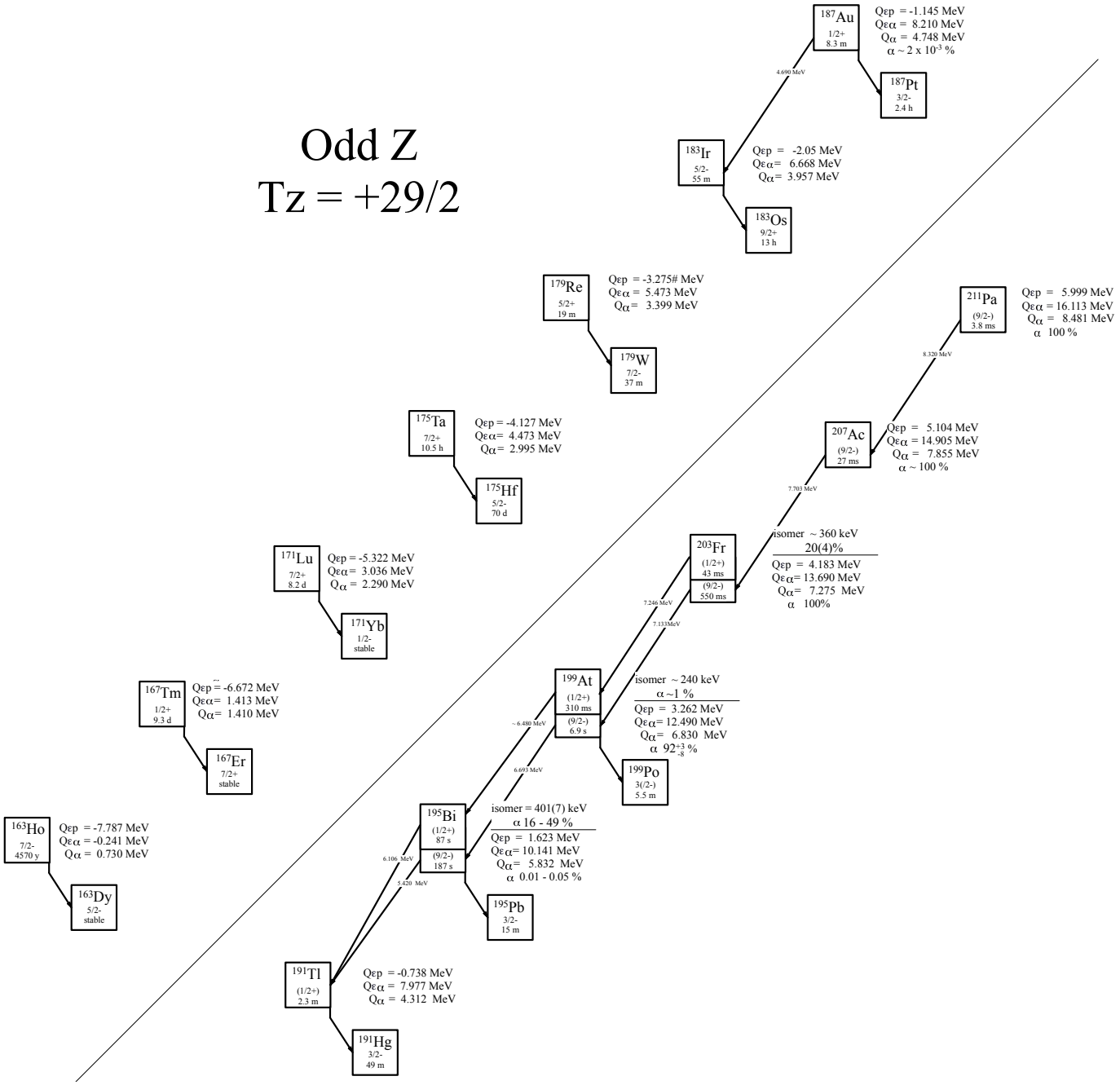

Fig. 1: Known experimental values for heavy particle emission of the odd-Z T_z= +29/2 nuclei.

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Table 1
Observed and predicted β-delayed particle emission from the odd-Z, T_z = +29/2 nuclei. J^π values for ^{163}Ho, ^{167}Tm, ^{171}Lu, ^{175}Ta, ^{179}Re, ^{183}Ir, and ^{191}Tl are 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_ε	$Q_{\varepsilon p}$	$Q_{\varepsilon\alpha}$	Experimental
^{163}Ho		$7/2^-$	4570(50) y	0.003	-7.787(2)	-0.241(1)	[**1983Ba32**]
^{167}Tm		$1/2^+$	9.25(2) d	0.746(1)	-6.762(1)	1.413(1)	[**1970Ka23**]
^{171}Lu		$7/2^+$	8.22(3) d	1.478(2)	-5.322(2)	3.036(2)	[**1970Ka23**]
^{175}Ta		$7/2^+$	10.5(2) h	2.073(28)	-4.127(28)	4.473(28)	[**1963Sa14**]
^{179}Re		$5/2^+$	19.5(1) m	2.711(27)	-3.275(58)#	5.473(25)	[**1975Me20**]
^{183}Ir		$5/2^-$	55(7) m	3.460(50)	-2.05(11)	6.668(29)	[**1961Di04**]
^{187}Au		$1/2^+$	8.3(3) m*	3.657(27)	-1.145(28)	8.210(55)	[**1983Ga01, 1979Be51**]
^{191}Tl		$(1/2^+)$		4.309(23)	-0.738(8)	7.977(25)	
^{195}Bi		$(9/2^-)$	187(5) s	5.712(7)	1.623(15)	10.141(23)	[**1985Co06**]
^{195m}Bi	0.401(7)	$(1/2^+)$	87(1) s	6.113(10)	2.024(17)	10.542(24)	[**1985Co06**]
^{199}At		$(9/2^-)$	6.92(13) s	6.415(8)	3.262(28)	12.490(7)	[**2013Ja06**]
^{199m}At	≈ 0.240	$(1/2^+)$	0.31(8) s	≈6.655(8)	≈3.502(28)	≈12.710(7)	[**2013Ja06**]
^{203}Fr		$(9/2^-)$	550(7) ms**	7.060(9)	4.183(28)	13.690(8)	[**2013Ja06, 2005De01, 2005Uu02, 1980Ew03**]
^{203m}Fr	≈ 0.360	$(1/2^+)$	43(4) ms	≈7.420(9)	≈4.543(28)	≈14.050(8)	[**2013Ja06**]
^{207}Ac		$(9/2^-)$	27^{+11}_{-6} ms	7.630(80)	5.104(63)	14.905(57)	[**1998Es02**]
^{211}Pa		$(9/2^-)$	$3.8^{+4.6}_{-1.4}$ ms	8.18(11)	5.999(93)	16.113(91)	[**2020Au04**]

* Weighted average of 8.4(3) m [1983Ga01] and 8.0(4) m [1979Be51].
** Weighted average of 550(10) ms [2013Ja06], 560(15) ms [2005De01], 530(20) ms [2005Uu02], and 550(20) ms [1980Ew03].

Table 2
Particle separation, Q-values, and measured values for direct particle emission of the odd-Z, T_z = +29/2 nuclei. Unless otherwise stated, all S and Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	S_p	S_{2p}	Q_α	BR_α	Experimental
^{163}Ho	5.486	13.494(1)	0.730(1)		
^{167}Tm	4.908(1)	12.223(1)	1.410(1)		
^{171}Lu	4.354(2)	11.132(2)	2.290(2)		
^{175}Ta	3.853(28)	10.106(28)	2.995(28)		
^{179}Re	3.466(29)	9.448(25)	3.399(37)		
^{183}Ir	2.882(33)	8.263(28)	3.957(35)		
^{187}Au	2.453(31)	7.271(36)	4.748(30)	$\approx 2 \times 10^{-3}$%*	[**1968Si01**]
^{191}Tl	2.201(18)	7.279(21)	4.321(24)		
^{195}Bi	1.107(18)	5.126(9)	5.832(5)	0.01 - 0.05%	[**1985Co06**, 1993An19, 1990AnZR, 1989AnZF, 1978Va21, 1974Le02, 1973LiYK, 1972Ga27, 1970Ta14, 1967Es05]
^{195m}Bi	0.706(19)	4.725(11)	6.233(9)	16 - 49%	[**1985Co06**, 1993An19, 1978Va21, 1974Le02, 1973LiYK, 1972Ga27, 1970Ta14, 1967Es05]
^{199}At	0.639(18)	3.714(10)	6.830(1)***	92^{+3}_{-8}%	[**2013Ja06, 1996Ta18, 1980Ew03**, 2015We13, 2015We16, 1986Wo03, 1975BaYJ, 1967Tr04, 1967Tr06]
^{199m}At	≈0.399(18)	≈3.474(10)	≈7.017(1)	≈ 1%	[**2013Ja06**]
^{203}Fr	0.138(19)	2.912(10)	7.275(4)	≈ 100%**	[**2013Ja06, 2005De01, 2005Uu02, 1980Ew03, 1967Va20** 2015We13, 2004DeZV, 1994Le05]
^{203m}Fr	≈-0.222(19)	≈2.552(10)	≈7.635(4)	20(4) %	[**2013Ja06**, 2005Uu02]
^{207}Ac	-0.292(59)#	2.122(57)#	7.855(18)@	≈ 100%	[**1998Es02, 1994Le05**, 1998LuZV]
^{211}Pa	-0.704(72)	1.371(89)	8.481(41)	100 %	[**2020Au04**, 2006Ku07]

* Value estimated by setting HF =1 (see table 3).
** Based on short half-life.
*** Deduced from α energy, 6.777(1) in [2021Wa16].
@ Deduced from α energy, 7.845(56)# in [2021Wa16].

Table 3
direct α emission from ^{187}Au*, $J_i^\pi = 1/2^+$, $T_{1/2}$ = 8.3(3)s**, $BR_\alpha = \approx 2 \times 10^{-3}$%***.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{183}Ir)	coincident γ-rays	R_0 (fm)	HF
4.793(20)	4.690(20)	$\approx 2 \times 10^{-3}$%***	$(1/2^+)$				

* All values from [1968Si08], except where noted.
** weighted average of 8.4(3) m [1983Ga01] and 8.0(4) m [1979Be51].
*** Value estimated by setting HF =1.

Table 4
direct α emission from ^{195}Bi*, $J_i^\pi = (9/2^-)$, $T_{1/2}$ = 187(5) s, BR_α = 0.01 - 0.05%.

E_α(c.m.)	E_α(lab)	I_α(rel)	I_α(abs)	J_f^π	$E_{daughter}$(^{191}Tl)	coincident γ-rays	R_0 (fm)	HF
5.534(5)	5.420(5)	100%	0.9 - 4.5 $\times 10^{-4}$%	$(9/2^-)$	0.299		1.475(14)	1.0 - 5.2
5.833(5)	5.713(5)	10(1)%	0.9 - 4.5 $\times 10^{-5}$%	$(1/2^+)$	0.0	——	1.475(14)	290 - 1400

* All values from [1985Co06].

Table 5
direct α emission from ^{195m}Bi*, Ex. = 401(7) keV, $J_i^\pi = (1/2^+)$, $T_{1/2}$ = 87(1) s, BR_α = 16 - 49%.

E_α(c.m.)	E_α(lab)	I_α(rel)	I_α(abs)	J_f^π	$E_{daughter}$(^{191}Tl)	coincident γ-rays	R_0 (fm)	HF
5.893(5)	5.772(5)	0.16(2)%	0.036 - 0.078 %	$(9/2^-)$	0.341	0.341	1.475(14)	15 - 45
6.234(5)	6.106(5)	100%	16 -49 %	$(1/2^+)$	0.0	——	1.475(14)	0.73 - 2.2

* All values from [1985Co06].

Table 6
direct α emission from ^{199}At, $J_i^\pi = (9/2^-)$, $T_{1/2}$ = 6.92(13) s*, $BR_\alpha = 92^{+3}_{-8}$%**.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{195}Bi)	coincident γ-rays	R_0 (fm)	HF
6.830(1)	6.693(1)***	92^{+3}_{-8}%**	$(9/2^-)$	0.0	——	1.5084(56)	2.2(3)

* [2013Ja06].
** [1980Ew03].
*** [1996Ta18].

Table 7
direct α emission from ^{199m}At*, Ex. = $\approx$ 240 keV, $J_i^\pi = (1/2^+)$, $T_{1/2}$ = 0.31(8) s, $BR_\alpha = \approx 1$%.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{195}Bi)	coincident γ-rays	R_0 (fm)	HF
$\approx$ 6.613	$\approx$ 6.480	$\approx$ 1%	$(1/2^+)$	0.401(7)		1.5084(56)	$\approx$ 1.6

* All values from [2013Ja06].

Table 8
direct α emission from ^{203}Fr, $J_i^\pi = (9/2^-)$, $T_{1/2}$ = 550(7) ms*, $BR_\alpha = \approx 100$ %.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{199}At)	coincident γ-rays	R_0 (fm)	HF
7.274(3)	7.133(3)**	$\approx$ 100%	$(9/2^-)$	0.0	——	1.5178(95)	$1.3^{+0.3}_{-0.2}$

* Weighted average of 550(10) ms [2013Ja06], 560(15) ms [2005De01], 530(20) ms [2005Uu02], and 550(20) ms [1980Ew03].
** Weighted average of 7.130(6) MeV [2013Ja06], 7.132(5) MeV [2005De01], 7.130(6) MeV [2005Uu02], and 7.130(5) MeV [1967Va20].

Table 9
direct α emission from ^{203m}Fr*, Ex. = $\approx$ 360 keV, $J_i^\pi = (1/2^+)$, $T_{1/2}$ = 43(4) ms, BR_α = 20(4) %.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{199}At)	coincident γ-rays	R_0 (fm)	HF
7.395(5)	7.246(5)	20(4) %	$(1/2^+)$	$\approx$ 0.240		1.5178(95)	$1.3^{+0.6}_{-0.4}$

* All values from [2013Ja06].

Table 10
direct α emission from ^{207}Ac, $J_i^\pi = (9/2^-)$, $T_{1/2} = 27^{+11}_{-6}$ ms*, $BR_\alpha = \approx 100$ %.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}(^{203}Fr)$	coincident γ-rays	R_0 (fm)	HF
7.855(18)	7.703(18)**	$\approx$ 100%	$(9/2^-)$	0.0	——	1.542(11)	$1.7^{+0.8}_{-0.6}$

* [1998Es02].
** Weighted average of 7.693(25) MeV [1998Es02] and 7.712(25) meV [1994Le05].

Table 11
direct α emission from ^{211}Pa*, $J_i^\pi = (9/2^-)$, $T_{1/2} = 3.8^{+4.6}_{-1.4}$ ms, $BR_\alpha = 100$ %.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}(^{207}Ac)$	coincident γ-rays	R_0 (fm)	HF
8.481(40)	8.320(40)	100%	$(9/2^-)$	0.0	——	1.508(27)	$1.7^{+2.3}_{-1.2}$

* All values from [2020Au04].

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