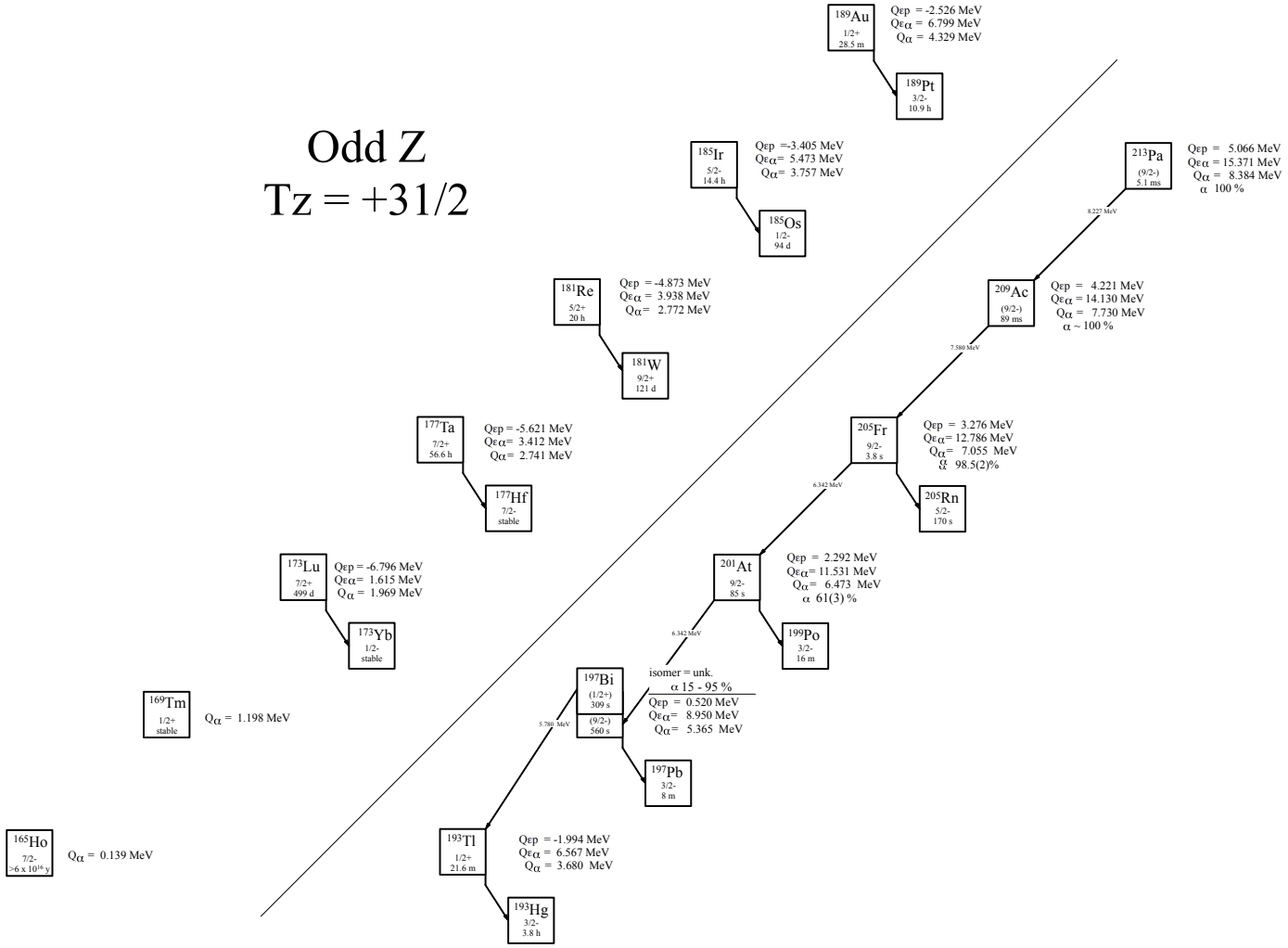

Fig. 1: Known experimental values for heavy particle emission of the odd-Z T_z= +31/2 nuclei.

Last updated on 9/27/2023

Table 1
Observed and predicted β-delayed particle emission from the odd-Z, T_z = +31/2 nuclei. J^π values for ^{165}Ho, ^{169}Tm, ^{173}Lu, ^{177}Ta, ^{181}Re, ^{185}Ir, ^{189}Au, and ^{193}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
^{165}Ho		$7/2^-$	$>6\times10^{16}$ y	-1.286(1)	——	——	[**1956Po16**]
^{169}Tm		$1/2^+$	stable	-0.354(1)	——	——	
^{173}Lu		$7/2^+$	499(5) d	0.670(2)	-6.796(6)	1.615(2)	[**1962Bo12**]
^{177}Ta		$7/2^+$	56.56(6) h	1.166(3)	-5.621(3)	3.412(3)	[**1961We11**]
^{181}Re		$5/2^+$	19.9(7) h	1.717(13)	-4.873(13)	3.938(13)	[**1968Sc27**]
^{185}Ir		$5/2^-$	14.4(1) h	2.470(28)	-3.405(28)	5.473(28)	[**1982Al34**]
^{189}Au		$1/2^+$	28.5(3) m*	2.887(22)	-2.526(22)	6.799(20)	[**1970Fi16, 1966Fo13**]
^{193}Tl		$1/2^+$	21.6(6) m**	3.585(17)	-1.994(17)	6.567(12)	[**1961An03, 1974Va23**]
^{197}Bi		$(9/2^-)$	560(30) s	5.058(10)	0.520(15)	8.950(18)	[**1991Va09**]
^{197m}Bi	x	$(1/2^+)$	309(33) s	5.058(10)+x	0.520(15)+x	8.950(18)+x	[**1985Co06**]
^{201}At		$9/2^-$	85(2) s***	5.732(10)	2.292(24)	11.531(9)	[**1996Ta18, 1975BaYJ, 1974Ho27**]
^{205}Fr		$9/2^-$	3.80(3) s	6.400(9)	3.276(24)	12.786(9)	[**2005De01**]
^{209}Ac		$(9/2^-)$	89^{+12}_{-9} ms@	6.990(60)	4.221(57)	14.130(56)	[**1996Ta18, 1975BaYJ, 1974Ho27**]
^{213}Pa		$(9/2^-)$	$5.1^{+3.3}_{-1.2}$ ms@@	7.530(60)	5.066(61)	15.371(57)	[**2020Au04, 1995Ni05**]

* Weighted average of 28.3(5) m [1970Fi16] and 28.7(4) m [1966Fo13].
** Weighted average of 22.6(10) m [1961An03] and 21.0(8) m [1974Va23].
*** Weighted average of 83(2) s [1996Ta18], 87(3) s [1975BaYJ] and 88(5) s [1974Ho27].
@ Weighted average of 98(20) ms [2014Ya19], 82^{+18}_{-13} ms [1996Ik01] and 91^{+21}_{-14} ms [1996Ik01].
@@ Weighted average of $4.9^{+5.9}_{-1.8}$ ms [2020Au04] and $5.3^{+4.0}_{-1.6}$ ms [1995Ni05].

Table 2
Particle separation, Q-values, and measured values for direct particle emission of the odd-Z, T_z = +31/2 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
^{165}Ho	6.219(1)	14.880(4)	0.139(1)		
^{169}Tm	5.574(1)	13.573(5)	1.198(1)		
^{173}Lu	4.915(2)	12.249(2)	1.969(2)		
^{177}Ta	4.427(3)#	11.127(3)	2.741(3)		
^{181}Re	4.170(13)	10.738(13)	2.772(13)		
^{185}Ir	3.372(28)	9.104(29)	3.757(31)		
^{189}Au	3.050(21)	8.611(34)	4.329(34)	$<3\times10^{-5}$%	
^{193}Tl	2.755(17)	8.257(8)	3.680(21)		
^{197}Bi	1.628(11)	6.110(14)	5.365(11)		
^{197m}Bi	1.628(11)-x	6.110(14)-x	5.365(11)+x	15-95 %	[**1985Co06**, 1984Co13, 1974Le02, 1972Ga27, 1970Ta14]
^{201}At	1.137(11)	4.570(13)	6.473(2)	61(3)%*	[**1998Bo14, 1996Ta18, 1974Ho27**, 2015We13, 2005De01 2004DeZV, 1986Wo03, 1975BaYJ, 1970DaZM, 1970HoZT, 1967Tr06]
^{205}Fr	0.629(11)	3.725(13)	7.055(2)	98.5(2)%	[**2010De04, 2005De01, 1981Ri04, 1967Va20**, 2015Ma63, 2012Ja01, 2004DeZV, 1974Ho27, 1964Gr02, 1961Gr42]
^{209}Ac	0.172(57)	2.884(59)	7.730(55)	$\approx$ 100%**	[**2000He17, 1994Le05, 1968Va04**, 2014Ya19, 1996Ik01]
^{213}Pa	-0.254(58)	2.067(78)	8.384(12)	100%**	[**2020Au04, 1995Ni05**, 2000He17, 1996An21, 1995NiZR, 1995NiZS]

* Weighted average of 59(3)% [1998Bo14] and 71(7)% [1974Ho27].
** Based on short half-life.

Table 3
direct α emission from ^{197m}Bi*, Ex. = unk., $J_i^\pi = (1/2^+)$, $T_{1/2}$ = 309(33) s, BR_α = 15-95 %.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{193}Tl)	coincident γ-rays	R_0 (fm)	HF
5.900(5)	5.780(5)	15-95 %	$(1/2^+)$	0.0	——	1.4900(31)	0.071-0.45

* All values taken from [2015Ya13].

Table 4
direct α emission from ^{201}At, $J_i^\pi = 9/2^-$, $T_{1/2}$ = 85(2) s*, BR_α = 61(3)%**.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{197}Bi)	coincident γ-rays	R_0 (fm)	HF
6.471(1)	6.342(1)***	61(3)%**	(9/2$^-$)	0.0	——	1.4955(33)	1.39(13)

* Weighted average of 83(2) s [1996Ta18], 87(3) s [1975BaYJ] and 88(5) s [1974Ho27].
** Weighted average of 59(3)% [1998Bo14] and 71(7)% [1974Ho27].
*** [1996Ta18].

Table 5
direct α emission from ^{205}Fr, $J_i^\pi = 9/2^-$, $T_{1/2}$ = 3.80(3) s*, BR_α = 98.5(2)%**.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{201}At)	coincident γ-rays	R_0 (fm)	HF
7.054(3)	6.342(3)***	98.5(2)%**	(9/2$^-$)	0.0	——	1.5157(28)	1.64(11)

* [2005De01].
** [2010De04].
*** Weighted average of 6.916(5) MeV [2005De01], 6.917(5) MeV [1981Ri04] and 6.917(5) MeV [1967Va20].

Table 6
direct α emission from ^{209}Ac, $J_i^\pi = (9/2^-)$, $T_{1/2} = 89^{+12}_{-9}$ ms*, $BR_\alpha \approx 100\%$.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{205}Fr)	coincident γ-rays	R_0 (fm)	HF
7.728(7)	7.580(7)**	$\approx$ 100%	(9/2$^-$)	0.0	——	1.5050(73)	1.1(3)

* Weighted average of 98(20) ms [2014Ya19], 82^{+18}_{-13} ms [1996Ik01] and 91^{+21}_{-14} ms [1996Ik01].
** Weighted average of 7.577(10) MeV [2000He17], 7.581(15) MeV [1994Le05] and 7.585(15) MeV [1968Va04],

Table 7
direct α emission from ^{213}Pa, $J_i^\pi = (9/2^-)$, $T_{1/2} = 5.1^{+3.3}_{-1.2}$ ms*, BR_α = 100%.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{209}Ac)	coincident γ-rays	R_0 (fm)	HF
8.384(15)	8.227(15)**	100%	(9/2$^-$)	0.0	——	1.516(14)	$1.6^{+1.2}_{-0.7}$

* Weighted average of $4.9^{+5.9}_{-1.8}$ ms [2020Au04] and $5.3^{+4.0}_{-1.6}$ ms [1995Ni05].
** Weighted average of 8.210(20) MeV [2020Au04] and 8.236(15) MeV [1995Ni05],

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