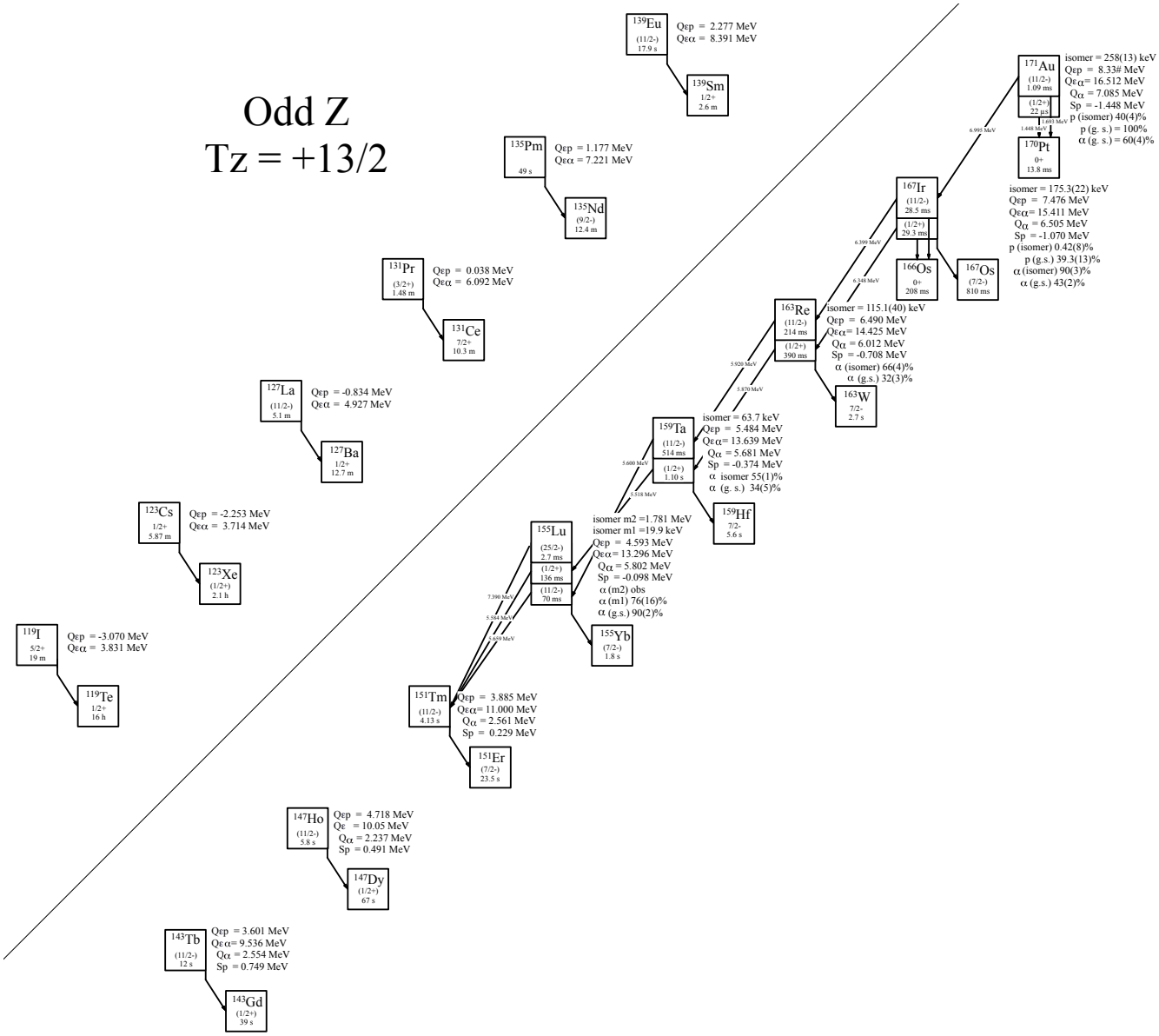

Fig. 1: Known experimental values for heavy particle emission of the odd-Z T_z= +13/2 nuclei.

Last updated 3/22/23

Table 1
Observed and predicted β-delayed particle emission from the odd-Z, T_z = +13/2 nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein. $J^{|pi}$ values for ^{119}I, ^{123}Cs, ^{127}La, ^{131}Pr, ^{135}Pm, ^{139}Eu, ^{143}Tb, ^{147}Ho, ^{151}Tm are taken from ENSDF

Nuclide	Ex	J^π	$T_{1/2}$	Q$_\varepsilon$	$Q_{\varepsilon p}$	BR$_{\beta p}$	Q$_{\varepsilon 2p}$	$Q_{\varepsilon\alpha}$	Experimental
^{119}I		$5/2^+$	19.0(2) m*	3.405(23)	-3.070(22)	——	-7.958(22)	3.831(22)	[**1968Se05, 1969La33**]
^{123}Cs		$1/2^+$	5.87(5) m	4.205(15)	-2.253(13)	——	-7.078(29)	3.714(14)	[**1993Al03**]
^{127}La		$(11/2^-)$	5.1(1) m	4.922(28)	-0.834(28)	——	-5.275(26)	4.927(28)	[**1992Ic02**]
^{131}Pr		$(3/2^+)$	1.48(2) m	5.410(60)	0.038(54)		-3.818(48)	6.092(48)	[**1983AkZZ**]
^{135}Pm			49(3) s	6.150(90)	1.177(85)		-2.222(85)	7.221(89)	[**1989Ko07**]
^{139}Eu		$(11/2^-)$	17.9(6) s	6.982(17)	2.227(18)		-0.392(18)	8.391(23)	[**1986De35**]
^{143}Tb		$(11/2^-)$	12(1) s	7.81(21)	3.601(59)		0.937(52)	9.536(52)	[**1986Re11**]
^{147}Ho		$(11/2^-)$	5.8(4) s	8.439(10)	4.718(45)		2.592(20)	10.05(20)	[**1982No08**]
^{151}Tm		$(11/2^-)$	4.13(11) s	7.495(25)	3.885(16)		2.344(21)	11.000(21)	[**1988Ba02**]
^{155}Lu		$(11/2^-)$	70(1) ms	7.958(25)	4.593(16)		3.344(21)	13.296(25)	[**1996Pa01**]
^{155m1}Lu	0.199(62)	$(1/2^+)$	136(9) ms	7.978(25)	4.613(16)		3.364(21)	13.316(25)	**1996Pa01, 1997Da07**]
^{155m2}Lu	1.781(2)	$(25/2^-)$	2.71(3) ms	9.739(25)	6.374(16)		5.125(21)	15.097(25)	**1996Pa01**]
^{159}Ta		$(1/2^+)$	1.10(10) s	8.413(26)	5.484(17)		4.403(23)	13.639(26)	**1996Pa01**]
^{159m}Ta	0.0637(52)	$(11/2^-)$	514(9) ms**	8.477(26)	5.548(18)		4.467(24)	13.703(26)	**1997Da07, 1996Pa01**]
^{163}Re		$(1/2^+)$	390(72) ms	8.910(60)	6.490(64)		5.736(30)	14.425(25)	[**1997Da07**]
^{163m}Re	0.1151(40)	$(11/2^-)$	214(5) ms	9.025(60)	6.605(64)		5.851(30)	14.540(25)	[**1997Da07**]
^{167}Ir		$(1/2^+)$	29.3(6) ms	9.430(80)	7.476(88)		7.211(32)	15.411(61)	[**2005Sc22**]
^{167m}Ir	0.1753(22)	$(11/2^-)$	28.5(6) ms***	9.650(80)	7.651(88)		7.386(32)	15.586(61)	[**2005Sc22, 2004Ke06, 1997Da07**]
^{171}Au		$(1/2^+)$	22^{+3}_{-2} μs	9.900(80)#	8.33(10)#		8.583(33)#	16.512(84)	[**2004Ke06**]
^{171m}Au	0.258(13)	$(11/2^-)$	1.09(3) ms	10.158(81)#	8.59(10)#		8.5841(35)#	16.770(85	[**2004Ke06**]

* Weighted average of 19.3(2) m [1968Se05] and 18.2(3) m [1969La33].
** Weighted average of 500(11) ms [1997Da07], and 544(16) ms [1996Pa01].
*** Weighted average of 30.0(6) ms [1997Da07], 25.7(8) ms [2004Ke06], and 28.7(33) ms [2005Sc22].

Table 2
Particle emission from the odd-Z, T_z = +13/2 nuclei. Unless otherwise stated, all Q-values and separation energies are taken from [2021Wa16] or deduced from values therein.

Nuclide	S$_p$	BR$_p$	S$_{2p}$	Q$_\alpha$	BR$_\alpha$	Experimental
^{119}I	3.376(28)		9.716(23)	0.801(27)		
^{123}Cs	2.978(16)		9.376(13)	0.309(25)		
^{127}La	2.515(29)		8.384(27)	0.723(29)		
^{131}Pr	2.167(55)		7.555(52)	1.171(54)		
^{135}Pm	1.705(84)		6.703(84)	1.813(95)		
^{139}Eu	1.189(18)		5.903(19)	2.239(84)		
^{143}Tb	0.749(58)		5.071(53)	2.554(53)		
^{147}Ho	0.491(8)		3.94(11)	2.237(51)		
^{151}Tm	0.229(9)		3.704(23)	2.561(20)		
^{155}Lu	-0.098(8)		3.150(23)	5.802(2)	90(2)%	[**2016Ca42, 1997Da01, 1996Pa01, 1979Ho10**, 2018Pa37, 1998DiZY, 1993Li34, 1993ToZX,1991To09, 1990AbZW, 1989Ho12, 1989HoZX, 1984Gr14, 1981HoZM]
^{155m1}Lu	-0.078(10)		3.130(23)	5.822(6)	76(16)%	[**2016Ca42, 1997Da07, 1996Pa01, 1991To09**]
^{155m2}Lu	1.683(12)		1.369(23)	7.583(6)	obs	[**1996Pa01**, 2016Ca42, 1993Li34 1981HoZM]
^{159}Ta	-0.374(9)		2.578(23)	5.681(6)	34(5)%	**1997Da07, 1996Pa01**]
^{159m}Ta	-0.438(10)		2.514(24)	5.745(8)	55(1)%	**1997Da07, 1996Pa01**, 2002Ro17, 1979Ho10]
^{163}Re	-0.708(6)		1.802(31)	6.012(8)	32(3)%	[**1997Da07**]
^{163m}Re	-0.823(7)		1.687(31)	6.127(9)	66(4)%	[**1997Da07**, 1996Pa01, 1979Ho10]
^{167}Ir	-1.070(4)	39.3(13)%	0.991(30)	6.505(3)	43(2)%	[**2005Sc22, 1997Da07**, 2001Ke05, 1996Pa01, 1995DaZX, 1981Ho10]
^{167m}Ir	-1.185(6)	0.42(8)%	0.876(30)	6.620(5)	90(3)%	**2005Sc22, 2004Ke06, 1997Da07**, 1995DaZX,1981Ho10]
^{171}Au	-1.448(10)	100%	0.047(31)	7.085(11)		[**2004Ke06, 1999Po09**, 2003Bb21]
^{171m}Au	-1.706(16)	40(4)%*	-0.211(34)	7.343(17)	60(4)%*	[**2004Ke06, 1999Po09, 1997Da07**, 2003Bb21, 1995DaZX]

* Weighted average from [2004Ke06] BR$_p$ = 34(4)% and [1997Da07]. BR$_p$ = 46(4) %.

Table 3
direct α emission from ^{155}Lu, J^{π} = (11/2$^-$), $T_{1/2}$ = 70(1) ms*, BR_{α} = 90(2)%**.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{151}Tm)	coincident γ-rays		
5.809(5)	5.659(5)***	90(2)%**	(11/2$^-$)	0.0	——	1.5533(22)	1.38(9)

* [1996Pa01]
** [1997Da07]
*** Weighted average of 5.661(5) MeV [2016Ca42], 5661(4) MeV [1997Da07], 5.655(5) [1996Pa01], and 5.656(6) MeV [1979Ho10].

Table 4
direct α emission from ^{155m1}Lu, Ex = 19.9(62) keV*, J^{π} = (1/2$^+$), $T_{1/2}$ = 136(9) ms**, BR_{α} = 76(16)%*.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{151}Tm)	coincident γ-rays		
5.732(4)	5.584(4)***	76(16)%**	(1/2$^+$)	0.096(9)$^{@}$		1.5533(22)	$1.6^{+0.6}_{-0.4}$

* [1997Da07]
** [1996Pa01]
*** Weighted average of 5.586(5) MeV [2016Ca42], 5.586(4) MeV [1997Da07], 5.584(5) [1996Pa01], and 5.579(5) MeV [1991To09].
$^{@}$ Deduced from isomer energy, and α energies of ground state and isomer.

Table 5
direct α emission from ^{155m2}Lu*, Ex = 1.781(2) MeV, J^{π} = (25/2$^-$), $T_{1/2}$ = 2.71(3) ms, BR_{α} = obs.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{151}Tm)	coincident γ-rays	
7.586(5)	7.390(5)	(11/2$^-$)	(11/2$^-$)	0.0?	——	1.5533(22)

* All values from [1996Pa01].

Table 6
direct α emission from ^{159}Ta, J^{π} = , $T_{1/2}$ = 1.10(10) s*, BR_{α} = 34(5) %**.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{155m}Lu)	coincident γ-rays
5.660(4)	5.518(4)***	34(5) %	19.9(62)		

* [1996Pa01].
** [1997Da07].
*** Weighted average of 5.519(4) MeV [1997Da07] and 5.516(5) MeV [1996Pa01].

Table 7
direct α emission from ^{159m}Ta*, Ex = 63.7(52) keV, J^{π} = , $T_{1/2}$ = 514(9) ms**, BR_{α} = 55(1) %.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{155}Lu)	coincident γ-rays
5.746(3)	5.600(3)	55(1)%	0.0	——	

* All values from [1997Da07], except where noted.
** Weighted average of 500(11) ms [1997Da07], and 544(16) ms [1996Pa01].

Table 8
direct α emission from ^{163}Re*, J^{π} = , $T_{1/2}$ = 390(72) ms, BR_{α} = 32(3) %.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{159}Ta)	coincident γ-rays
6.018(4)	5.870(4)	32(30)%	0.0	——	

* All values from [1997Da07].

Table 9
direct α emission from ^{163m}Re*, Ex = 115.1(40) keV, J^π = , $T_{1/2}$ = 214(5) ms, BR_α = 66(4)%.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{159m}Tm)	coincident γ-rays
6.069(3)	5.920(3)	66(4)%	0.0637(52)		

* All values from [1997Da07].

Table 10
direct p emission from ^{167}Ir*, J^π = , $T_{1/2}$ = 29.3(6) ms, BR_p = 39.3(13)%.

E_p(c.m.)	E_p(lab)	I_p(abs)	$E_{daughter}$(^{166}Os)	coincident γ-rays
1.068(6)	1.062(6)	39.3(13)%	0.0	——

* All values from [2015Sc22], except where noted.

Table 11
direct α emission from ^{167}Ir*, J^π = , $T_{1/2}$ = 29.3(6) ms , BR_α = 43(2)%.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{163}Re)	coincident γ-rays
6.504(3)	6.348(3)	43(2)%	0.0	——	

* All values from [2005Sc22].

Table 12
direct p emission from ^{167m}Ir*, Ex = 175.3(22) keV, J^π = , $T_{1/2}$ = 28.5(6) ms**, BR_p = 0.42(8)%.

E_p(c.m.)	E_p(lab)	I_p(abs)	$E_{daughter}$(^{166}Os)	coincident γ-rays
1.251(7)	1.243(7)***	0.42(8)%	0.0	——

* All values from [2005Sa22], except where noted.
** Weighted average of 30.0(6) [1997Da07], 25.7(8) ms [2004Ke06], and 28.7(33) ms [2005Sc22].
** Weighted average of 1.238(7) MeV [1997Da07], and 1.248)7) MeV [2005Sc22].

Table 13
direct α emission from ^{167m}Ir, Ex = 175.3(22) keV*, J^π = , $T_{1/2}$ = 28.5(6) ms**, BR_α = 90(3) %***.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{163m}Re)	coincident γ-rays
6.556(3)	6.399(3)***	90(3)%	0.1151(40)		

* [1997Da07].
** Weighted average of 30.0(6) ms [1997Da07], 25.7(8) ms [2004Ke06], and 28.7(33) ms [2005Sc22].
*** [2005Sc22].
*** Weighted average of 6.410(3) MeV [1997Da07] and 6.394(2) MeV [2004Ke06].

Table 14
direct p emission from ^{171}Au*, J^π = , $T_{1/2} = 22^{+3}_{-2}$ μs, BR_p = 100%.

E_p(c.m.)	E_p(lab)	I_p(abs)	$E_{daughter}$(^{170}Pt)	coincident γ-rays
1.448(12)	1.439(12)	100%	0.0	——

* All values from [2004Ke06], except where noted.
** Weighted average of 1.437(12) MeV [2004Ke06] and 1.444(17) MeV [1999Po09].

Table 15
direct p emission from ^{171m}Au, Ex = 258(13) keV*, J^{π} = , $T_{1/2}$ = 1.09(3) ms*, BR_p = 40(4)%**.

E_p(c.m.)	E_p(lab)	I_p(abs)	$E_{daughter}$(^{170}Pt)	coincident γ-rays
1.703(6)	1.693(6)***	40(4)%	0.0	——

* [2004Ke06].
** Weighted average of 34(4)% [2004Ke06], and 46(4)% [1997Da07].
*** Weighted average of 1.694(6) MeV [2004Ke06], and 1.692(6) MeV [1999Po09, 1997Da07].

Table 16
direct α emission from ^{171m}Au*, Ex = 258(13) keV, J^{π} = , $T_{1/2}$ = 1.09(3) ms,BR_{α} = 60(4)%**.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_f	$E_{daughter}$(^{167m}Ir)	coincident γ-rays
7.162(4)	6.995(4)	60(4)%	0.1753(22)		

* [2004Ke06].
** Weighted average from [2004Ke06] BR_{α} = 66(4)% and [1997Da07]. BR_{α} = 54(4) %.

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