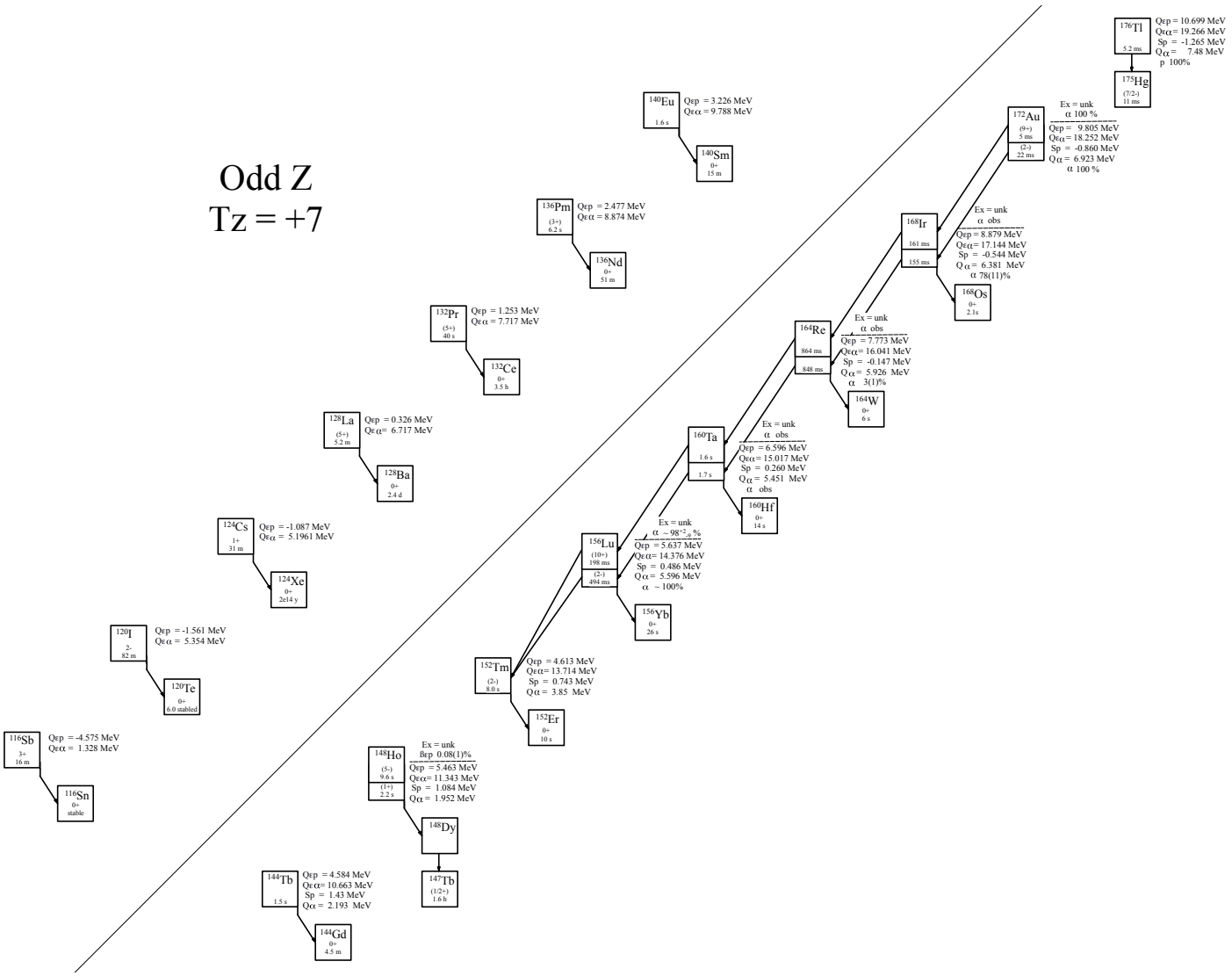

Fig. 1: Known experimental values for heavy particle emission of the odd-Z T_z= +7 nuclei.

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Table 1
Observed and predicted β-delayed particle emission from the odd-Z, T_z = +7 nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein. All J^π values are taken from ENSDF.

Nuclide	Ex	J^π	$T_{1/2}$	Q_ε	$Q_{\varepsilon p}$	$BR_{\beta p}$	$Q_{\varepsilon 2p}$	$Q_{\varepsilon\alpha}$	Experimental
^{116}Sb		3^+	16.2(12) m	4.704(5)	-4.575(5)	——	-11.385(5)	1.328(5)	[**1967Ha27**]
^{120}I		2^-	81.7(2) m	5.615(15)	-1.561(17)	——	-6.672(15)	5.354(15)	[**2000Ho19**]
^{124}Cs		1^+	30.9(5) m	5.926(9)	-1.087(10)	——	-6.006(9)	5.196(9)	[**1993Al03**]
^{128}La*		(5^+)	5.2(4) m	6.740(50)	0.326(55)		-4.057(54)	6.617(54)	[**1977Zo02**]
^{132}Pr		(2^-)	1.6(3) m	7.240(40)	1.253(40)		-2.549(29)	7.717(29)	[**1987Ko24**]
^{136}Pm*		(2^+)	30-150 s	8.030(70)	2.477(70)		-0.915(72)	8.874(72)	[**1989Vi04**]
^{140}Eu		1^+	1.51(2) s	8.470(50)	3.226(53)		0.453(53)	9.788(53)	[**1991Fi03**]
^{144}Tb			1.5(10) s	9.390(40)	4.584(30)		2.036(28)	10.663(31)	[**1982No08**]
^{148}Ho		(1^+)	2.2(1) s	9.870(80)	5.463(84)		3.517(84)	11.343(88)	[**1982No08**]
^{148m}Ho	x	(5^-)	9.59(15) s	9.870(80)+x	5.463(84)+x	0.08(1)%	3.517(84)+x	11.343(88)+x	[**1988To03**]
^{152}Tm		(2^-)	8.0(10) s	8.780(50)	4.613(55)		3.011(54)	13.714(55)	[**1982No13**]
^{156}Lu		(2^-)	494(12) ms	9.570(50)	5.637(55)		4.327(54)	14.376(55)	[**1996Pa01**]
^{156m}Lu	x	(10^+)	198(2) ms	9.570(50)+x	5.637(55)+x		4.327(54)+x	14.376(55)+x	[**1996Pa01**]
^{160}Ta*			1.7(2) s	10.120(60)	6.596(66)		5.608(55)	15.017(55)	[**1996Pa01**]
^{160m}Ta	x		1.55(4) s	10.120(60)+x	6.596(66)+x		5.608(55)+x	15.017(55)+x	[**1996Pa01**]
^{164}Re			848^{+140}_{-105} ms	10.760(60)	7.773(67)		7.118(55)	16.041(55)	[**2009Ha42**]
^{164m}Re	x		864^{+150}_{-110} ms	10.760(60)+x	7.773(67)+x		7.118(55)+x	16.041(55)+x	[**2009Ha42**]
^{168}Ir			155(40) ms**	11.330(60)#	8.879(68)#		8.643(56)#	17.144(56)	[**2009Ha42, 1996Pa01**]
^{168m}Ir	x		161(21) ms	11.330(60)#	8.879(68)#		8.643(56)#	17.144(56)+x	[**2009Ha42, 1996Pa01**]
^{172}Au			22^{+6}_{-4} ms	11.790(60)	9.805(68)		10.030(57)	18.252(57)	[**2009Ha42**]
^{172m}Au	x		5(1) ms***	11.790(60)	9.805(68)		10.030(57)	18.252(57)+x	**2009Ha42, 1996Pa01, 1993Se09**]
^{176}Tl			$5.2^{+3.0}_{-1.4}$ ms	12.370(80)	10.699(92)		11.324(84)	19.266(84)	[**2004Ke06**]

* Possibly isomeric state.
** Weighted average of 222^{+60}_{-45} ms [2009Ha42] and 125(40) ms [1996Pa01].
*** Weighted average of 9^{+2}_{-1}ms [2009Ha42], 6.3(15) ms [1996Pa01], and 4(1) ms [1993Se09].

Table 2
Particle emission from the odd-Z, T_z = +7 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_α	BR_α	Experimental
^{116}Sb	4.077(5)		12.830(5)	-1.257(7)		
^{120}I	3.854(17)		10.329(15)	0.650(16)		
^{124}Cs	3.782(13)		10.240(11)	-0.419(18)		
^{128}La*	3.096(56)		8.853(55)	0.691(55)		
^{132}Pr	2.808(44)		8.178(39)	0.973(62)		
^{136}Pm*	2.245(72)		7.220(72)	1.633(75)		
^{140}Eu	1.895(53)		6.650(53)	1.759(86)		
^{144}Tb	1.43(20)		5.637(41)	2.193(59)		
^{148}Ho	1.084(84)		4.805(95)	1.952(88)		
^{148m}Ho	1.084(84)-x		4.805(95)-x	1.952(88)+x		
^{152}Tm	0.743(56)		4.352(56)	3.85(10)		
^{156}Lu	0.486(57)		3.850(56)	5.596(3)	≈ 100%	[**1996Pa01**, 1991PoZZ, 1981HoZM, 1979Ho10]
^{156m}Lu**	0.486(57)-x		3.850(56)-x	5.596(3)+x	98^{+2}_{-9}%	[**2019Pa27, 1996Pa01**, 1991PoZZ, 1981HoZM, 1979Ho10]
^{160}Ta	0.260(57)		3.189(56)	5.451(5)	obs	[**1996Pa01**]
^{160m}Ta	0.260(57)-x		3.189(56)-x	5.451(5)+x	obs	[**1996Pa01**, 1992Ha10, 1988MeZY, 1987HaZO, 1987ScZH, 1986Ru05, 1981HoZM, 1979Ho10
^{164}Re	-0.147(80)		2.269(84)	5.926(5)	obs	[**2009Ha42, 1996Pa01, 1979Ho10**, 1981Ho10, 1979Ho10]
^{164m}Re**	-0.147(80)-x		2.269(84)-x	5.926(5)+x	3(1)%	[**2009Ha42**]
^{168}Ir	-0.544(98)		1.41(10)	6.381(9)	obs	[**2009Ha42, 1996Pa01**, 1982De11, 1981DeZA, 1981DeZL, 1978Ca11, 1978CaZF]
^{168m}Ir	-0.544(98)-x		1.41(10)-x	6.381(9)+x	78(11)%**	[**2009Ha42, 1996Pa01**]
^{172}Au	-0.860(99)		0.71(12)	6.923(10)	100%	[**2009Ha42**]
^{172m}Au	-0.860(99)-x	<2%	0.71(12)-x	6.923(10)+x	100%	[**2009Ha42, 1996Pa01, 1993Se09**]
^{176}Tl	-1.265(18)	100%	-0.07(13)	7.48(10)		[**2004Ke06**]

* Possibly isomeric state.
** Weighted average of 75(11)% [2009Ha42] and 82(14)% [1996Pa01].

Table 3
direct α emission from ^{156}Lu*, J^{π} = (2^{-}), $T_{1/2}$ = 494(12) ms, BR_{α} = $\approx$ 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{152}Tm)	coincident γ-rays
5.593(10)	5.450(10)	$\approx$ 100%	(2^{-})	0.0	——

* All values from [1996Pa01].

Table 4
direct α emission from ^{156m}Lu*, Ex = unk., J^{π} = (10^{+}), $T_{1/2}$ = 198(2) ms, BR_{α} = 98^{+2}_{-9}%**.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{152}Tm)	coincident γ-rays
5.589(5)	5.446(5)	0.057(10)%	0.056(10)%		0.1148(5)	0.115
5.707(4)	5.561(4)	100%	98^{+2}_{-9}%	(9^{+})	0.0	——

* All values from [2019Pa27], except where noted.
** [1996Pa01].

Table 5
direct α emission from ^{160}Ta*, J^{π} = , $T_{1/2}$ = 1.7(2) s, BR_{α} = obs.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{156}Lu)	coincident γ-rays
5.449(5)	5.313(5)	obs			

* All values from [1996Pa01].

Table 6
direct α emission from ^{160m}Ta*, Ex = unk., J^{π} = , $T_{1/2}$ = 198(2) ms, BR_{α} = obs.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{156}Lu)	coincident γ-rays
5.552(5)	5.413(5)	obs		**	

* All values from [1996Pa01].
** α-α coincident with 5.561 MeV α from ^{156m}Lu.

Table 7
direct α emission from ^{164}Re*, J^{π} = , $T_{1/2}$ = 848^{+140}_{-105} ms**, BR_{α} = obs.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{160}Ta)	coincident γ-rays
5.926(7)	5.781(7)***	obs			

* All values from [2009Ha42], except where noted.
** Other values: 38(16) ms [1996Pa01], 880(240) ms [1979Ha10].
*** Weighted average of 5.780(10) MeV [2009Ha42], 5.784(7) MeV [1996Pa01], and 5.778(10) MeV [1979H010].

Table 8
direct α emission from ^{164m}Re*, Ex = unk., J^{π} = , $T_{1/2}$ = 864^{+150}_{-110} ms, BR_{α} = 3(1)%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{160}Ta)	coincident γ-rays
5.764(10)	5.623(10)	3(1)%		**	

* All values from [2009Ha421].
** α-α coincident with 5.413 MeV α from ^{160m}Ta.

Table 9
direct α emission from ^{168}Ir, J^{π} = , $T_{1/2}$ = 155(40) ms*, BR_{α} = obs.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{164}Re)	coincident γ-rays
6.381(10)	6.229(10)**	obs			

* Weighted average of 222^{+60}_{-45} ms [2009Ha42] and 125(40) ms [1996Pa01].
** Weighted average of 6.230(10) MeV [2009Ha42], and 6.227(15) MeV [1996Pa01].

Table 10
direct α emission from ^{168m}Ir*, Ex = unk., J^{π} = , $T_{1/2}$ = 161(21) ms**, BR_{α} = 78(11)%***.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{164}Re)	coincident γ-rays
6.474(10)	6.320(10)	42(11)%	22(10)%		@	
6.413(10)	6.260(10)	100%	53(5)%		@	0.069

* All values from [2009Ha421], except where noted.
** [1996Pa01].
*** Weighted average of 75(11)% [2009Ha42] and 82(14)% [1996Pa01].
@ α-α coincident with 5.623 MeV α from ^{164m}Re.

Table 11
direct α emission from ^{172}Au, J^{π} = , $T_{1/2}$ = 22^{+6}_{-4} ms, BR_{α} = 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J^{π}_{f}	$E_{daughter}$(^{168}Ir)	coincident γ-rays
6.923(10)	6.762(10)	100%			

* All values from [2009Ha42].

Table 12
direct α emission from ^{172m}Au*, Ex = unk., J^{π} = , $T_{1/2}$ = 5(1) ms**, BR_{α} = 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)***	I_{α}(abs)***	J^{π}_{f}	$E_{daughter}$(^{168}Ir)	coincident γ-rays
6.962(10)	6.800(10)	18(8)%	15(7)%		@	
7.034(10)	6.870(10)	100%	85(7)%		@	0.073, 0.065

* All values from [2009Ha421], except where noted.
** Weighted average of 9^{+2}_{-1}ms [2009Ha42], 6.3(15) ms [1996Pa01], and 4(1) ms [1993Se09].
*** Based on Fig. 2e of [2009Ha42].
@ α-α coincident with 6.260 MeV α from ^{168m}Ir.

Table 13
direct p emission from ^{176}Tl, J^{π} = , $T_{1/2}$ = $5.2^{+3.0}_{-1.4}$ ms, BR_{p} = 100%.

E_{p}(c.m.)	E_{p}(lab)	I_{p}(abs)	J^{π}_{f}	$E_{daughter}$(^{175}Hg)	coincident γ-rays
1.265(18)	1.258(18)	100%		0.0	

* All values from [2004Ke06].

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