



Fig. 1: Known experimental values for heavy particle emission of the even- Z $T_z = +25/2$ nuclei.

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Table 1

Observed and predicted β -delayed particle emission from the even- Z , $T_z = +25/2$ nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	Ex	J^π	$T_{1/2}$	Q_β	$Q_{\beta p}$	$Q_{\beta\alpha}$	Experimental
^{145}Nd		$7/2^-$	$>10^{17}$ y	stable	—	—	[1966Ka23]
^{149}Sm		$7/2^-$	$>2\times 10^{15}$ y	stable	—	—	[1970Gu14]
^{153}Gd		$3/2^-$	239.472(69) d	0.485(1)	-5.409(0)	0.757(2)	[1992Un01]
^{157}Dy		$3/2^-$	8.2(1) h	1.339(5)	-4.178(5)	1.518(5)	[1953Ha81]
^{161}Er		$3/2^-$	3.24(4) h	1.995(9)	-2.818(9)	3.138(9)	[1972Wo08]
^{165}Yb		$5/2^-$	9.8(5) m*	2.635(27)	-1.642(27)	4.476(27)	[1968Ta05, 1967Pa04]
^{169}Hf		$5/2^-$	3.26(5) m	3.366(28)	-0.426(28)	5.788(28)	[1970Ch17]
^{173}W		$5/2^-$	7.6(1) m	3.670(40)	0.386(37)	6.930(28)	[1991KuZn]
^{177}Os		$1/2^-$	3.1(2) m	4.310(30)	1.396(32)	8.015(32)	[1972Be89]
^{181}Pt		$1/2^-$	51(5) s	5.082(15)	2.686(21)	9.463(31)	[1966Si08]
^{185}Hg		$1/2^-$	49.1(10) s	5.674(14)	3.860(20)	10.854(15)	[2013Sa43]
^{185m}Hg	0.1037(5)**	$13/2^+$	21.6(15) s	5.778(14)	3.964(20)	10.958(15)	[2013Sa43, 1982Bo27]
^{189}Pb		$(3/2^-)$	39(8) s	6.772(16)	5.065(16)	11.589(14)	[2013Sa43, 2009Sa09]
^{189m}Pb	0.040(4)**	$(13/2^+)$	50(3) s	6.812(16)	5.105(16)	11.629(14)	[2013Sa43, 2009Sa09]
^{193}Po		$(3/2^-)$	420(40) ms	7.559(16)	6.938(16)	13.866(17)	[2013Sa43]
^{193m}Po	0.095(6)	$(13/2^+)$	240(10) ms	7.654(17)	7.033(17)	13.961(18)	[2013Sa43]
^{197}Rn		$(3/2^-)$	53^{+7}_{-5} ms	7.866(18)	7.690(17)	14.970(18)	[2013Sa43, 2008An05]
^{197m}Rn	0.194(10)	$(13/2^+)$	25^{+3}_{-2} ms	8.060(21)	7.884(20)	15.164(21)	[2013Sa43, 2008An05]
^{201}Ra		$(3/2^-)$	8^{+40}_{-4} ms	8.348(22)	8.648(21)	15.867(22)	[2014Ka23]
^{201m}Ra	0.260(30)	$(13/2^+)$	$1.6^{+7.7}_{-0.7}$ ms	8.608(37)	8.908(37)	16.127(37)	[2014Ka23, 2005Uu02]

* Weighted average of 9.0(5) m [1968Ta05] and 10.5(5) m [1967Pa04].

** [2013Sa43].

Table 2

Particle separation, Q-values, and measured values for direct particle emission of the even-Z, $T_z = +25/2$ 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
^{145}Nd	7.970(2)	14.404(2)	1.574(1)		
^{149}Sm	7.559(6)	13.567(1)	1.871(1)		
^{153}Gd	7.283(1)	12.884(1)	1.828(1)		
^{157}Dy	6.623(6)	11.932(5)	1.033(5)		
^{161}Er	6.108(17)	10.612(9)	1.798(10)		
^{165}Yb	5.675(36)	9.706(27)	2.481(28)		
^{169}Hf	4.933(47)	8.705(28)	3.154(39)		
^{173}W	4.686(40)	7.874(40)	3.565(40)		
^{177}Os	4.183(32)	6.902(32)	4.346(32)		
^{181}Pt	3.693(26)	5.939(21)	5.150(5)	0.074(10)%	[1995Bi01, 1993BiZY, 1993Me13, 1992MeZW, 1966Si08]
^{185}Hg	3.154(26)	4.988(20)	5.773(4)	$\approx 6.04\%$	[2013Sa43, 1979Ha10, 1977Ij01, 1976GrZC, 1976GrZL, 1970Ha18, 1970Ma24, 1969Ha03, 1969NaZT, 1969NaZU, 1968De01, 1963Ka17, 1953Ra02]
^{185m}Hg	3.050(26)	4.884(20)	5.877(4)	$\approx 0.030\%$	[2013Sa43, 1979Ha10, 1976GrZC, 1976GrZL, 1970Ha18]
^{189}Pb	2.797(33)	4.303(19)	5.915(4)	$\leq 0.4\%$	[2013Sa43]
^{189m}Pb	2.757(33)	4.263(19)	5.955(4)	$\approx 0.4\%$	[2013Sa43, 1974Ho26, 1993An19, 1974JoZU, 1974Le02, 1973LiYK, 1972Ga27]
^{193}Po	2.080(33)	2.612(16)	7.094(4)	$\approx 100\%^*$	[2013Sa432002Va13, 1997Fo06, 1995Mo14, 1993Wa04, 1982LeZW, 1981Le23, 1977De32, 1977DeXF]
^{193m}Po	1.985(33)	2.517(17)	7.189(6)	$\approx 100\%^*$	[2013Sa432002Va13, 1997Fo06, 1995Mo14, 1993Wa04, 1982LeZW, 1981Le23, 1977De32, 1977DeXF, 1967Si09, 1965Si22]
^{197}Rn	1.865(34)	1.951(17)	7.411(7)	$\approx 100\%^*$	[2013Sa43, 2008An05, 1996En01, 1996MoZV, 1995LeZY, 1995Mo14, 1995NoZW]
^{197m}Rn	1.865(34)	1.951(17)	7.411(7)	$\approx 100\%^*$	[2013Sa43, 2008An05, 2005Uu02, 1997Pu01, 1996En01, 1995LeZY, 1995NoZW]
^{201}Ra	1.486(37)	1.081(22)	8.002(12)	100%	[2014Ka23]
^{201m}Ra	1.746(48)	1.341(37)	8.362(32)	100%	[2014Ka23, 2005Uu02]

* Based on short half-life.

Table 3

direct α emission from $^{181}\text{Pt}^*$, $J_i^\pi = 1/2^-$, $T_{1/2} = 51(5) \text{ s}^{**}$, $BR_\alpha = 0.074(10)\%$.

$E_\alpha(\text{c.m.})$	$E_\alpha(\text{lab})$	$I_\alpha(\text{rel})$	$I_\alpha(\text{abs})$	J_f^π	$E_{\text{daughter}}(^{177}\text{Os})$	coincident γ -rays	R_0 (fm)	HF
5.062(20)	4.95(20)	4%	0.0028(4)%		0.88(21)		1.5504(65)	14
5.150(5)	5.036(5)	100%	0.071(10)%	$1/2^-$	0.0	—	1.5504(65)	1.6(5)

* All values from [1995Bi01], except where noted.

** [1966Si08].

Table 4

direct α emission from $^{185}\text{Hg}^*$, $J_i^\pi = 1/2^-$, $T_{1/2} = 49.1(10) \text{ s}$, $BR_\alpha = \approx 6.04\%$.

$E_\alpha(\text{c.m.})$	$E_\alpha(\text{lab})$	$I_\alpha(\text{rel})$	$I_\alpha(\text{abs})$	J_f^π	$E_{\text{daughter}}(^{181}\text{Pt})$	coincident γ -rays	R_0 (fm)	HF
5.692(5)	5.569(5)	4%	$\approx 0.24\%$	$5/2^-$	0.094	0.079, 0.094	1.506(13)	11
5.778(5)	5.653(5)	100%	$\approx 5.8\%$	$1/2^-$	0.0	—		1.1

* All values from [2013Sa43].

Table 5
direct α emission from $^{185m}\text{Hg}^*$, $E_x = 103.7(5)$ keV, $J_i^\pi = 13/2^+$, $T_{1/2} = 21.6(15)$ s, $BR_\alpha \approx 0.030\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}(^{181}\text{Pt})$	coincident γ -rays	R_0 (fm)	HF
5.491(8)	5.372(8)	100%	$\approx 0.024\%$	(13/2 ⁺)	0.381	0.0228, 0.405, 0.094, 0.105, 0.119, 0.159	1.506(13)	≈ 7
5.528(10)	5.408(10)	25%	$\approx 0.006\%$	(11/2 ⁺)	0.343	0.056, 0.727, 0.079, 0.094, 0.1206, 0.1607	1.506(13)	≈ 40
5.550	5.430	<25%	<0.006%	(11/2 ⁺)	0.320	0.0228, 0.405, 0.044, 0.094, 0.119, 0.159	1.506(13)	>51

* All values from [2013Sa43], except where noted.

Table 6
direct α emission from $^{189}\text{Pb}^*$, $J_i^\pi = (3/2^-)$, $T_{1/2} = 39(8)$ s**, $BR_\alpha \leq 0.4\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}(^{185}\text{Hg})$	coincident γ -rays	R_0 (fm)	HF
5.740(6)	5.619(6)	11%	$\leq 0.04\%$		0.1739	0.026, 0.148, 0.174	1.4904(44)	≥ 1.6
5.889(5)	5.764(5)	100%	$\leq 0.36\%$	(3/2 ⁻)	0.026	0.026	1.4904(44)	≥ 4.3

* All values from [2013Sa43], except where noted.

** [2009Sa09].

Table 7
direct α emission from $^{189m}\text{Pb}^*$, $E_x = 40(4)$ keV, $J_i^\pi =$, $T_{1/2} = 50(3)$ s**, $BR_\alpha \approx 0.4\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}(^{185}\text{Hg})$	coincident γ -rays	R_0 (fm)	HF
5.851(5)	5.727(5)	$\approx 0.4\%$	(13/2 ⁺)	0.1037	0.0124, 0.0260, 0.0653	1.4904(44)	≈ 3.3

* All values from [2013Sa43], except where noted.

** [2009Sa09].

Table 8
direct α emission from $^{193}\text{Po}^*$, $J_i^\pi = (3/2^-)$, $T_{1/2} = 420(40)$ ms, $BR_\alpha \approx 100\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}(^{189}\text{Pb})$	coincident γ -rays	R_0 (fm)	HF
6.556(20)	6.420(20)**	0.7(3)%	0.7(3)%***	(3/2 ⁻)	0.539(20)	0.539	1.5125(26)	$3.5^{+3.3}_{-1.4}$
7.095(4)	6.948(4)	100.0(25)%	99.3(25)%***	(3/2 ⁻)	0.0	—	1.5125(26)	2.37(27)

* All values from [2013Sa43], except where noted.

** [2013Sa43, 2002Va13].

*** [2003Va13].

Table 9
direct α emission from $^{193m}\text{Po}^*$, $E_x = 95(6)$ keV, $J_i^\pi = (13/2^+)$, $T_{1/2} = 240(10)$ ms, $BR_\alpha \approx 100\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}(^{189}\text{Pb})$	coincident γ -rays	R_0 (fm)	HF
6.510(15)	6.375(15)**	0.8(3)%	0.8(3)%***	(13/2 ⁺)	0.677(15)	0.637	1.5125(26)	$2.0^{+1.4}_{-0.7}$
7.152(4)	7.004(4)	100.0(35)%	99.2(35)%***	(13/2 ⁺)	0.040(4)	—	1.5125(26)	3.20(28)

* All values from [2013Sa43], except where noted.

** [2013Sa43, 2002Va13].

*** [2003Va13].

Table 10
direct α emission from $^{197}\text{Rn}^*$, $J_i^\pi = (3/2^-)$, $T_{1/2} = 53^{+7}_{-5}$ ms**, $BR_\alpha \approx 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}(^{193}\text{Po})$	coincident γ -rays	R_0 (fm)	HF
7.410(7)	7.260(7)	100%	(3/2 ⁻)	0.0	—	1.5653(89)	$1.8^{+0.5}_{-0.4}$

* All values from [2013Sa43], except where noted.

** [2008An05].

Table 11

direct α emission from $^{197m}\text{Rn}^*$, $E_x = 194(10)$ keV, $J_i^\pi = (13/2^+)$, $T_{1/2} = 25^{+3}_{-2}$ ms**, $BR_\alpha = \approx 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$J_f^\pi E_{daughter} (^{193}\text{Po})$	coincident γ -rays	R_0 (fm)	HF
7.509(8)	7.357(8)	100%	(13/2 ⁺)	0.095(6)	—	1.5653(89)	3.8 ^{+1.0} _{-0.9}

* All values from [2013Sa43], except where noted.

** [2008An05].

Table 12

direct α emission from $^{201}\text{Ra}^*$, $J_i^\pi = (3/2^-)$, $T_{1/2} = 8^{+40}_{-4}$ ms, $BR_\alpha = \approx 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter} (^{197}\text{Rn})$	coincident γ -rays	R_0 (fm)	HF
8.001(12)	7.842(12)	100%	(3/2 ⁻)	0.0	—	1.590(18)	7 ⁺³³ ₋₃

* All values from [2014Ka23].

Table 13

direct α emission from $^{201m}\text{Ra}^*$, $E_x = 260(30)$ keV, $J_i^\pi = (13/2^+)$, $T_{1/2} = 1.6^{+7.7}_{-0.7}$ ms, $BR_\alpha = 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter} (^{197}\text{Rn})$	coincident γ -rays	R_0 (fm)	HF
8.066(20)	7.905(20)	100%	(13/2 ⁺)	0.194(10)	—	1.590(18)	2.1 ^{+10.0} _{-1.3}

* All values from [2005Uu02].

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