



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

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Table 1

Observed and predicted β -delayed particle emission from the even- Z , $T_z = +13$ nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	J^π	$T_{1/2}$	Q_ϵ	$Q_{\epsilon p}$	$Q_{\epsilon\alpha}$	Experimental
^{142}Ce	0^+	stable	-4.509(6)	—	—	
^{146}Nd	0^+	stable	-4.256(30)	—	—	
^{150}Sm	0^+	stable	-3.454(20)	—	—	
^{154}Gd	0^+	stable	-1.968(2)	—	—	
^{158}Dy	0^+	stable	-0.963(3)	—	—	
^{162}Er	0^+	stable	-0.294(3)	—	—	
^{166}Yb	0^+	56.7(1) h	0.293(14)	-4.361(7)	2.022(8)	[1970Ka13]
^{170}Hf	0^+	15.82(15) h	1.050(30)	-3.167(28)	3.208(30)	[1970Ch17]
^{174}W	0^+	33.9(5) m*	1.510(40)	-2.104(40)	4.654(33)	[1990Me12, 1985Sz03, 1964Sa22]
^{178}Os	0^+	5.0(4) m	2.110(30)	-1.131(31)	5.772(31)	[1972Be89]
^{182}Pt	0^+	2.2(1) m	2.883(25)	0.093(29)	7.060(31)	[1972Fi12]
^{186}Hg	0^+	1.41(8) m**	3.176(24)	0.860(28)	8.088(24)	[1970Ha18, 1969Ha03]
^{190}Pb	0^+	71(1) s	3.950(14)	1.921(34)	8.873(24)	[1996Ri12]
^{194}Po	0^+	392(4) ms	5.018(14)	3.936(17)	10.937(15)	[1993Wa04]
^{198}Rn	0^+	65(2) ms***	5.478(14)	4.874(17)	12.368(14)	[1999Ta03, 1995Bi17]
^{202}Ra	0^+	$3.8^{+1.3}_{-0.8}$ ms	5.973(16)	5.893(18)	13.359(16)	[2014Ka23]

* Weighted average of 35.3(5) m [1990Me12], 33.2(9) m [1985Sz03] and 29(1) m [1964Sa22].

** Weighted average of 1.42(10) m [1970Ha18], and 1.38(13) m [1969Ha03].

*** Weighted average of 66^{+3}_2 ms [1999Ta03] and 63(2) ms [1995Bi17].

Table 2

Particle separation, Q-values, and measured values for direct particle emission of the even- Z , $T_z = +13$ 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
^{142}Ce	8.892(5)	15.843(8)	1.304(2)		
^{146}Nd	8.589(7)	15.072(3)	1.182(2)		
^{150}Sm	8.276(2)	14.221(2)	1.450(1)		
^{154}Gd	7.628(1)	13.521(1)	0.920(1)		
^{158}Dy	6.932(2)	12.450(2)	0.874(2)		
^{162}Er	6.427(2)	11.240(1)	1.648(2)		
^{166}Yb	5.953(7)	10.229(7)	2.316(7)		
^{170}Hf	5.460(28)	9.252(28)	2.915(29)		
^{174}W	5.120(40)	8.403(37)	3.602(40)		
^{178}Os	4.564(31)	7.481(31)	4.258(31)		
^{182}Pt	3.994(14)	6.390(20)	4.951(5)	0.038(2)%	[1995Bi01, 1966Si08, 1963Gr08]
^{186}Hg	3.970(12)	5.785(19)	5.204(10)	0.016(5)%	[1970Ha18, 1996Ri12, 1993ToZY, 1969Ha03, 1969NaZT, 1969NaZU]
^{190}Pb	3.089(15)	4.796(14)	5.698(5)	0.24(7)%*	[1996Ri12, 1992Wa14, 1984To09, 1974Ho26, 1996Bi17, 1992WaZV, 1989De18, 1981El03, 1977De32, 1974Ho26, 1974JoZU, 1973LiYK, 1972Ga27]
^{194}Po	2.409(15)	3.031(14.)	6.987(3)	93(7)%	[1994Wa13, 1993Wa04, 1985Va03, 2014Ka23, 2005Uu02, 1993WaZO, 1989De18, 1982LeZN, 1981Le23, 1977De32, 1967Si09, 1967Tr04, 1967Tr06]
^{198}Rn	2.164(16)	2.340(14)	7.349(4)	$\approx 100\%^{**}$	[1995Bi17, 2014Ka23, 1999Ta03, 1996En02, 1995BiZY, 1993Wa02, 1984Ca32]
^{202}Ra	1.803(18)	1.503(16)	7.880(7)	100%*	[2014Ka23, 2005Uu02, 1996Le09]

* Weighted average of 0.37(12)% [1992Wa14], 0.22(7)% [1984To09] and 0.21(7)% [1974Ho26].

** Based on short half-life.

Table 3direct α emission from $^{182}\text{Pt}^*$, $J_i^\pi = 0^+$, $T_{1/2} = 2.2(1)$ m^{**}, $BR_\alpha = 0.038(2)\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}(^{178}\text{Os})$	coincident γ -rays	R_0 (fm)	HF
4.952(5)	4.843(5)	0.038(2)%	0^+	0.0	—	1.5539(68)	1.0

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

** [1972Fi12].

Table 4direct α emission from $^{186}\text{Hg}^*$, $J_i^\pi = 0^+$, $T_{1/2} = 1.41(8)$ m^{**}, $BR_\alpha = 0.016(5)\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{daughter}(^{182}\text{Pt})$	coincident γ -rays	R_0 (fm)	HF
5.208(15)	5.094(15)	0.038(2)%	0^+	0.0	—	1.500(17)	1.0

* All values from [1970Ha18], except where noted.

** Weighted average of 35.3(5) m [1990Me12], 33.2(9) m [1985Sz03] and 29(1) m [1964Sa22].

Table 5direct α emission from $^{190}\text{Pb}^*$, $J_i^\pi = 0^+$, $T_{1/2} = 71(1)$ s, $BR_\alpha = 0.24(7)\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}(^{186}\text{Hg})^{***}$	coincident γ -rays ^{****}	R_0 (fm)	HF
5.169(12)	5.060(12)	0.014(6)%	$3.3(17) \times 10^{-5}\%$	0^+	0.5225(7)	—	1.4923(55)	23_{-9}^{+26}
5.297(5)	5.185(5)	0.084(15)%	$2.0(7) \times 10^{-4}\%$	2^+	0.4053	0.4053	1.4923(55)	18_{-5}^{+10}
5.697(5)	5.577(5)	100%	0.24(7)%	0^+	0.0	—	1.4923(55)	1.0

* All values from [1996Ri12], except where noted.

** Weighted average of 0.37(12)% [1992Wa14], 0.22(7)% [1984To09] and 0.21(7)% [1974Ho26].

**** [2022Ba26].

Table 6direct α emission from ^{194}Po , $J_i^\pi = 0^+$, $T_{1/2} = 392(4)$ ms^{*}, $BR_\alpha = 93(7)\%$ ^{*}.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}(^{190}\text{Pb})^{***}$	coincident γ -rays ^{****}	R_0 (fm)	HF
6.321(7)	6.191(7) ^{**}	0.24%	0.22% ^{****}	0^+	0.677(7)	—	1.724(13)	1.06
6.988(3)	6.844 (3) [@]	100.00%	93% ^{****}	0^+	0.0	—	1.724(13)	1.0

* [1993Wa04].

** [1985Va03].

*** [1994Wa13].

[@] Values from [1991Ry01], based on weighted average of 6.847(10) MeV [1967Si09], 6.845(7) MeV (adjusted to 6.847(7) MeV) [1967Tr06], 6.840(5) MeV [1977De32] and 6.846(5) MeV [1985Va03].**Table 7**direct α emission from ^{198}Rn , $J_i^\pi = 0^+$, $T_{1/2} = 65(2)$ ms^{**}, $BR_\alpha = \approx 100\%$ ^{*}.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{daughter}(^{194}\text{Po})^{***}$	coincident γ -rays ^{****}	R_0 (fm)	HF
7.035(8)	6.893(8)	0.07(2)%	0.07(2)%	2^+	0.3193(1) ^{****}	0.319	1.7622(23)	110_{-30}^{+50}
7.354(5)	7.205(5)	100%	99.93(2)%	0^+	0.0	—	1.7622(23)	1.0

* All values from [1995Bi17], except where noted.

** Weighted average of 66_{-2}^{+3} ms [1999Ta03] and 63(2) ms [1995Bi17].

*** [2021Ch50].

Table 8direct α emission from $^{202}\text{Ra}^*$; $J_f^\pi = 0^+$, $T_{1/2} = 3.8^{+1.3}_{-0.8}$ ms, $BR_\alpha = 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{\text{daughter}}(^{198}\text{Rn})$	coincident γ -rays	R_0 (fm)	HF
7.878(7)	7.722(7)	100%	0^+	0.0	—	1.794(23)	1.0

* All values from [2014Ka23]

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