



Fig. 1: Known experimental values for heavy particle emission of the even-Z $T_z = +19$ nuclei.

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Table 1

Observed and predicted β -delayed particle emission from the even- Z , $T_z = +19$ nuclei. Unless otherwise stated, all Q -values are taken from [2021Wa16] or deduced from values therein.

Nuclide	Ex.	J^π	$T_{1/2}$	Q_ϵ	$Q_{\epsilon p}$	$Q_{\epsilon\alpha}$	Experimental
$^{182}\text{Hf}^*$		0^+	$8.90(9) \times 10^6$ y	-4.28(20)#	—	—	[2004Vo16]
^{186}W		0^+	stable	-3.900(60)	—	—	
^{190}Os		0^+	stable	-3.125(5)	—	—	
^{194}Pt		0^+	stable	-2.228(1)	—	—	
^{198}Hg		0^+	stable	-1.374(1)	—	—	
^{202}Pb		0^+	$5.25(28) \times 10^4$ y	0.040(4)	-5.567(4)	1.215(4)	[1981Na15]
^{206}Po		0^+	8.8(1) d	1.840(9)	-1.707(4)	5.367(4)	[1956Jo34]
^{210}Rn		0^+	144(6) m	2.367(9)	-0.528(5)	7.999(9)	[1971Go35]
^{214}Ra		0^+	2.47(2) s**	1.051(10)	-1.500(6)	9.640(9)	[2009MuZV, 2006Ku26]
^{214m}Ra	1.865(30)	8^+	68.6(20) μs	2.916(10)	0.365(6)	11.505(9)	[2006Ku26]
^{218}Th		0^+	117(5) ns***	1.520(60)	-0.812(13)	10.900(14)	[1982Ch29, 1973Ha32, 1973No09]
^{222}U		0^+	4.7(7) μs	2.21(10)	0.044(53)	10.997(78)	[2015Kh09]
^{226}Pu		0^+		2.81(23)#	0.97(20)#	11.14(22)#	

* 100% β^- emitter.

** Weighted average of 2.485(25) s [2009MuZV] and 2.46(3) s [2006Ku26].

*** Weighted average of 125(5) ns [1982Ch29], 122(8) ns [1973Ha32] and 96(7) ns [1973No09].

Table 2

Particle separation, Q -values, and measured values for direct particle emission of the even- Z , $T_z = +19$ 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
^{182}Hf	8.54(13)	15.91(30)#	1.203(9)		
^{186}W	8.403(14)	15.587(40)	1.116(6)		
^{190}Os	8.018(8)	14.618(3)	1.376(1)		
^{194}Pt	7.513(1)	13.456(2)	1.523(0)		
^{198}Hg	7.104(0)	12.888(1)	1.381(1)		
^{202}Pb	6.049(15)	11.015(4)	2.589(4)		
^{206}Po	4.412(6)	7.657(4)	5.327(1)	5.2(4)%	[1971Go35, 1970Ra14, 1968Go11, 1970AfZZ, 1967Le08, 1967Ti04, 1961Fo05, 1956Bu12, 1955Mo68, 1951Ka37, 1947Te01]
^{210}Rn	4.010(7)	6.713(4)	6.159(2)	96(1)%	[1971Go35, 1955Mo68, 1955Mo69, 1952Mo23]
^{214}Ra	3.642(7)	5.826(6)	7.273(3)	$\approx 100\%$	[2006Ku26, 2015Kh09, 2009MuZV, 2000He17, 1974Ho27, 1968Lo15, 1961Gr42]
^{214m}Ra	1.777(7)	3.961(6)	9.138(3)	0.09(7)%	[2006Ku26]
^{218}Th	3.625(15)	5.503(13)	9.849(9)	100%	[1973No09, 2018Br13, 2015Kh09, 1982Ch29, 1973Ha32, 1973Hi06]
^{222}U	3.391(79)	4.995(54)	9.416(8)*	100%	[2023Lu04, 2015Kh09, 1983Hi12]
^{226}Pu	3.28(22)#	4.69(20)#	8.93(22)#		

* From α decay of ^{222}U . 9.481(51) MeV in [2021Wa16].

Table 3

direct α emission from ^{206}Po , $J^\pi = 0^+$, $T_{1/2} = 8.8(1)$ d*, $BR_\alpha = 5.2(4)\%$ ***.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{\text{daughter}}(^{202}\text{Pb})$	coincident γ -rays	R_0 (fm)]	HF
5.327(2)	5.223(2)**	5.2(4)%***	0^+	0.0	—	1.4547(10)	1.05(8)

* [1956Jo14].

** Weighted average of 5.224(2) MeV [1968Go11] and 5.222(3) MeV [1970Ra14].

*** From [1971Go35]. [1967Le08] reports 5.45% with no error bar.

Table 4
direct α emission from ^{210}Rn , $J^\pi = 0^+$, $T_{1/2} = 144(6)$ m*, $BR_\alpha = 96(1)\%^{**}$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{\text{daughter}}(^{206}\text{Po})$	coincident γ -rays	R_0 (fm)]	HF
5.455(3)	5.351(3)*	$5.6(3) \times 10^{-3}\%$	$5.4(3) \times 10^{-3}\%$	0^+	0.700(4)	0.700	1.4568(22)	6.7(4)
6.155(3)	6.038(3)	100%	96(1)%	0^+	0.0	—	1.4568(22)	0.97(2)

* [1971Go35].
** [1955Mo68].

Table 5
direct α emission from $^{214}\text{Ra}^*$, $J^\pi = 0^+$, $T_{1/2} = 2.47(2)$ s**, $BR_\alpha = \approx 100\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{\text{daughter}}(^{210}\text{Rn})$	coincident γ -rays	R_0 (fm)]	HF
6.629(5)	6.505(5)	0.16(3)%	0.16(3)%	2^+	0.6439	0.6439	1.4557(12)	$2.6^{+0.6}_{-0.4}$
7.271(4)	7.135(4)	100%	99.84(3)%	0^+	0.0	—	1.4557(12)	0.997(8)

* All values from [2006Ku26], except where noted.
** Weighted average of 2.485(25) s [2009MuZV] and 2.46(3) s [2006Ku26].

Table 6
direct α emission from $^{214m}\text{Ra}^*$, Ex. = 1.865.2 keV, $J^\pi = 8^+$, $T_{1/2} = 68.6(20)$ μs , $BR_\alpha = 0.09(7)\%$.

E_α (c.m.)	E_α (lab)	I_α (rel)	I_α (abs)	J_f^π	$E_{\text{daughter}}(^{210}\text{Rn})$	coincident γ -rays	R_0 (fm)]	HF
7.429(30)	7.290(30)	6.6(33)%	$5.4(46) \times 10^{-3}\%$	8^+	1.710(30)	0.2031, 0.6439, 0.8178	1.4557(12)	14(12)
≈ 8.509	$\approx 8.350^{**}$	0.18(3)%	0.16(3)%	2^+	0.6439	0.6439	1.4557(12)	$> 6 \times 10^3$
9.120(30)	8.950(30)	100%	91(6)%	0^+	0.0	—	1.4557(12)	$8^{+30}_{-4} \times 10^3$

* All values from [2006Ku26], except where noted.
** tentatively assigned [2006Ku26].

Table 7
direct α emission from ^{218}Th , $J^\pi = 0^+$, $T_{1/2} = 117(5)$ ns*, $BR_\alpha = 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{\text{daughter}}(^{214}\text{Ra})$	coincident γ -rays	R_0 (fm)]	HF
9.846(10)	9.665(10)**	100%	0^+	0.0	—	1.5487(30)	0.95(4)

* Weighted average of 125(5) ns [1982Ch29], 122(8) ns [1973Ha32] and 96(7) ns [1973No09].
** [1973No09].

Table 8
direct α emission from ^{222}U , $J^\pi = 0^+$, $T_{1/2} = 4.7(7)$ μs^* , $BR_\alpha = 100\%$.

E_α (c.m.)	E_α (lab)	I_α (abs)	J_f^π	$E_{\text{daughter}}(^{218}\text{Th})$	coincident γ -rays	R_0 (fm)]	HF
9.416(8)	9.246(8)**	100%	0^+	0.0	—	1.529(15)	0.70(10)

* [2015Kh09].
** [2023Lu04].

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