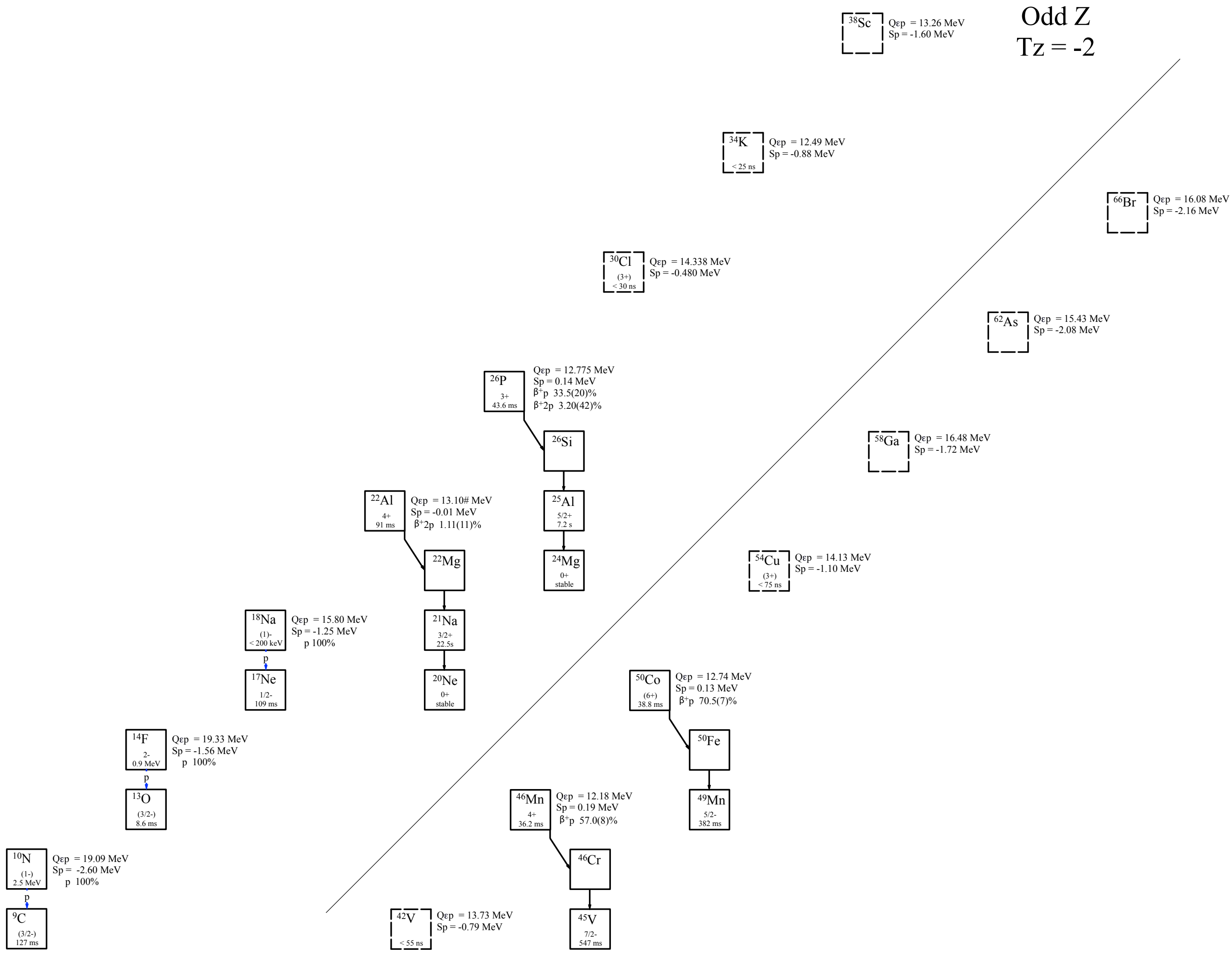

Fig. 1: Known experimental values for heavy particle emission of the odd-Z T_z= -2 nuclei.

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Table 1
Observed and predicted β-delayed particle emission from the odd Z, T_z = -2 nuclei. Unless otherwise stated, all Q-values values are taken from [2021Wa16] or deduced from values therein.

Nuclide	J^π	$T_{1/2}$	Q_ε	$Q_{\varepsilon p}$	$BR_{\beta p}$	$Q_{\varepsilon 2p}$	$BR_{\beta 2p}$	$Q_{\varepsilon 3p}$	$Q_{\varepsilon\alpha}$	$BR_{\beta\alpha}$	Experimental
^{10}N	(1$^-$)	$2.5^{+2.0}_{-1.5}$ MeV	23.10(40)	19.09(40)		19.28(40)		2.03(40)	18.00(40)		[**2017Ho10**]
^{14}F	2$^-$	0.91(10) MeV	23.96(4)	19.33(4)		17.382(40)		1.425(40)	13.836(40)		[**2010Go16**]
^{18}Na	(1)$^-$	<0.2 MeV	19.72(9)	15.80(9)		15199(90)		3.072(90)	14.607(90)		[**2012Mu05**]
^{22}Al	4$^+$	91.1(5) ms	18.60(40)#	13.10(40)#	54.5(25)%	10.66(40)#	1.10(11)%	-2.18(40)#	10.46(40)#	0.038(17)%	[**2006Ac04**, 1997Bl03, 1982Ca16]
^{26}P	3$^+$	43.6(3) ms	18.285(61)*	12.775(61)**	33.5(20)%	10.505(61)**	3.20(42)%	-1.37(20)#	9.225(61)**		[**2022Li66, 2020Li06, 2017Ja05**, 2015Sc16, [2004Th09, 1983Ho23, 1983Ca06]
^{30}Cl	(3$^+$)	<30 ns	18.734(24)	14.338(24)		11.590(24)		0.005(24)	8.95(20)		
^{34}K		<25 ns	17.16(20)#	12.49(20)#		10.22(20)#		1.35(20)#	10.41(20)#		
^{38}Sc			17.81(20)#	13.26(20)#		11.40(20)#		2.90(20)#	11.70(20)#		
^{42}V		<55 ns	17.49(20)#	13.73(20)#		12.65(20)#		4.32(20)#	12.01(20)#		
^{46}Mn	4$^+$	36.2(4) ms	17.050(90)	12.180(90)	57.0(8)%	10.551(90)		1.901(90)	12.01(20)		[**2007Do17**, 2001Gi01, 1992Bo37]
^{50}Co	(6$^+$)	38.8(2) ms	16.89(13)	12.74(13)	70.5(7)%	10.65(13)#		2.55(13)#	9.46(13)		[**2007Do17**, 1996Fa09]
^{54}Cu	(3$^+$)	< 75 ns	18.04(40)#	14.13(40)#		12.51(40)#		5.14(40)#	10.81(40)#		
^{58}Ga			18.76(30)#	16.48(30)#		15.79(30)#		8.62(30)#	13.31(30)#		
^{62}As			17.72(33)#	15.43(30)#		15.18(30)#		10.07(30)#	15.46(30)#		
^{66}Br			18.09(45)#	16.08(41)#		16.17(40)#		11.11(40)#	16.15(42)#		

* Taken from [2022Li66], 18.11(20)# in [2021Wa16].
** Deduced from Q_ε [2022Li66] of ^{26}P, and daughter values from [2021Wa16].

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

Nuclide	S_p	BR_{1p}	S_{2p}	Q_α	Experimental
^{10}N	-2.60(40)	100%	-1.30(40)	-10.95(20)#	[**2017Ho10**]
^{14}F	-1.560(40)	100%	-0.050(40)	-9.26(400	[**2010Go16, 2012Go11**]
^{18}Na	-1.250(90)	100%	0.220(90)	-9.35(10)	[**2012Mu05, 2018Xu04**]
^{22}Al	-0.01(40)#		3.23(40)#	-9.26(41)#	[**2006Ac04**]
^{26}P	0.14(20)#		3.56(20)#	-9.65(45)#	
^{30}Cl	-0.480(20)		2.756(24)	-8.72(20)#	
^{34}K	-0.88(20)#		2.46(20)#	-8.32(20)#	
^{38}Sc	-1.60(20)#		1.41(20)#	-5.45(28)#	
^{42}V	-0.79(20)#		1.67(20)#	-5.80(28)#	
^{46}Mn	0.19(90)		3.19(90)	-7.22(21)#	
^{50}Co	0.13(13)		2.87(13)	-7.60(15)	
^{54}Cu	-1.10(40)#		1.47(40)#	-6.08(42)#	
^{58}Ga	-1.72(36)#		-0.51(30)#	-4.73(50)#	
^{62}As	-2.08(42)#		-0.59(36)#	-3.31(42)#	
^{66}Br	-2.16(30)#		-1.39(45)#	-1.57(50)#	

Table 3
β-p emission from ^{22}Al*, $T_{1/2}$ = 91.1(5) ms, $BR_{\beta p}$ = 54.5(25)%

E_p(c.m.)	I_p(rel)	I_p(abs)	$E_{emitter}$ (^{22}Mg)**	$E_{daughter}$(^{21}Na)***	coincident γ-rays***
0.475(8)	25.6(42)	4.73(63)	6.311(8)	0.3319(1)	0.332
0.721(8)	40(7)	7.4(10)	6.225(8)	0	——
0.975(8)	1.4(3)	0.25(5)	6.479(8)	0	——
1.033(8)	16(2)	3.00(34)	6.869(8)	0.3319(1)	0.332
1.223(8)	4.05(66)	0.75(10)	6.727(8)	0	——
1.299(8)	100	18.51(17)	7.135(8)	0.3319(1)	0.332
1.551(10)	4.38(96)	0.81(16)	7.055(10)	0	——
1.753(8)	2.4(5)	0.45(8)	7.257(8)	0	——
2.072(8)	2.59(45)	0.48(7)	7.576(8)	0	——
2.503(10)	3.46(77)	0.64(13)	8.007(10)	0	——
2.583(8)	26.4(28)	4.89(24)	8.419(8)	0.3319(1)	0.332
2.838(8)	11.4(12)	2.11(9)	8.342(8)	0	——
3.088(8)	10.2(10)	1.89(7)	8.592(8)	0	——
3.484(8)	11.8(14)	2.18(15)	8.988(8)	0	——
4.017(8)	5.6(19)	1.04(33)	9.521(8)	0	——
4.224(9)	4.5(7)	0.84(11)	9.728(9)	0	——
4.464(8)	13.6(15)	2.52(14)	9.968(8)	0	——
4.912(10)	1.5(17)	0.27(32)	10.416(10)	0	——
5.177(13)	1.6(6)	0.29(11)	10.681(13)	0	——
5.667(8)	1.9(6)	0.35(11)	14.012(3)[@]	2.8291(7)	1.113, 1.384, 2.497, 0.332
5.808(49)	3.0(2)	0.18(55)	11.312(49)	0	——
5.909(56)	1.1(34)	0.21(62)	11.413(56)	0	——
6.774(8)	2.2(7)	0.41(12)	14.012(3)[@]	1.7161(3)	1.384, 0.332
7.517(11)	1.8(4)	0.33(7)	13.021(11)	0	——

* All values taken from [2006Ac04], except where noted.
** Calculated from proton energies and S_p (^{22}Al) = 5504.10(16) keV [2021Wa16].
*** Values from adopted levels in ENSDF [2015Fi05].
[@] Assigned as IAS.

Table 4
β-2p emission from ^{22}Al*, $BR_{\beta 2p}$ = 1.10(11)%

E_{2p}(c.m.)	I_{2p}(rel)	I_{2p}(abs)	$E_{emitter}$ (^{22}Mg)	$E_{daughter}$(^{20}Ne)***	coincident γ-rays[@]
4.464(8)	100	0.69(8)	13.997(8)**	1.6337	1.634
6.085(8)	59(12)	0.41(7)	14.012(3)**	0	——

* All values taken from [2006Ac04], except where noted.
** Assigned as IAS.
*** Values from adopted levels in ENSDF [1998Ti06].

Table 5
β-α emission from ^{22}Al*, $BR_{\beta\alpha}$ = 0.038(17)%

E_α(c.m.)	I_α(abs)	$E_{emitter}$ (^{22}Mg)**	$E_{daughter}$(^{18}Ne)***	coincident γ-rays***
4.017(8)	0.038(17)	12.160(8)	1.8873(2)	1.887

* All values taken from [2006Ac04].
** Calculated from α energies and S_α (^{22}Mg) = 8142.5(4) keV [2021Wa16].
*** Values from adopted levels in ENSDF [1995Ti07].

Table 6
β-p emission from ^{26}P*, $T_{1/2}$=43.6(3) ms, $BR_{\beta p}$ = 33.5(20)%**.

E_p(c.m.)[@@]	I_p(rel)	I_p(abs)[@@]	$E_{emitter}$ (^{26}Si)***	$E_{daughter}$(^{25}Al)[@]	coincident γ-rays[@]
0.412(2)	100(7)	17.96(90)	5.926(2)	0	——
0.778(3)	4.3(5)	0.78(7)	6.292(3)	0	——
0.866(2)	9.5(10)	1.71(15)	6.380(2)	0	——
1.248(2)	8.4(8)	1.51(12)	6.762(2)	0	——
1.499(2)	5.5(5)	0.99(7)	7.958(2)	0.9449(5)	0.493, 0.945
1.638(3)	3.6(4)	0.65(6)	7.604(3)	0.4517(5)	0.452
1.798(4)	1.1(3)	0.20(5)	8.251(3)	0.9449(5)	0.452, 0.493
1.983(2)	13.3(11)	2.39(16)	7.497(2)	0	——
2.139(4)	3.0(8)	0.54(14)	9.429(3)	1.7895(5)	0.452, 0.493, 1.338
2.288(3)	8.2(9)	1.47(12)	9.429(3)	1.6125(5)	1.612
2.541(6)	0.5(2)	0.09(3)			
2.593(13)	1.5(3)	0.27(6)	8.559(13)	0.4517(5)	0.452
2.638(18)	0.6(2)	0.11(4)	8.152(18)	0	——
2.732(4)	2.6(4)	0.47(6)	8.251(4)	0	——
2.855(17)	<0.8(2)	<0.14(4)			
2.908(11)	0.3(3)	0.06(5)	9.367(11)	0.949(5)	0.452, 0.493
2.968(5)	1.8(3)	0.32(5)	9.419(4)	0.949(5)	0.452, 0.493
3.097(6)	1.7(4)	0.31(6)	10.401(6)	1.7895(5)	0.452, 0.493, 0.845, 1.790
3.258(4)	1.9(2)	0.23(4)	9.717(4)	0.949(5)	0.452, 0.493
3.766(9)	2.0(4)	0.36(7)	9.732(9)	0.4517(5)	0.452
3.817(6)	0.7(3)	0.13(5)	10.291(3)	0.949(5)	0.452, 0.945
3.879(3)	4.4(6)	0.79(12)			1.369
3.920(5)	6.7(9)	1.21(14)	9.419(4)	0	——
4.097(5)	<2.1(3)	<0.37(4)			
4.719(6)	1.3(2)	0.24(4)	10.685(6)	0.4517(5)	0.452
4.793(3)	3.0(4)	0.54(6)	10.291(3)	0	——
4.858(4)	2.5(3)	0.44(5)	10.824(4)	0.4517(5)	0.452
5.751(3)[@@@]	4.5(8)	0.81(14)[@@@]	13.055(2)[@@@a]	1.7895(5)	0.452, 0.493, 0.845, 1.790
5.921(4)[@@@]	2.4(5)	0.43(9)[@@@]	13.055(2)[@@@a]	1.6125(5)	1.625
6.401(10)[@@@]	0.40(32)	0.072(57)[@@@]	11.912(4)[@@@]	0.0	——
6.587(6)[@@@]	0.67(12)	0.12(2)[@@@]	13.055(2)[@@@a]	0.9449(5)	0.493, 0.945
7.075(16)[@@@]	1.0(2)	0.18(3)[@@@]	13.055(2)[@@@a]	0.4517(5)	0.452
7.54394)[@@@]	1.6(2)	0.29(4)[@@@]	13.055(2)[@@@a]	0.0	——
7.854(6)[@@@]	0.39(11)	0.07(2)[@@@]	13.380(13)[@@@]	0.0	——

* All values taken from [2004Th09], except where noted.
** From [2017Ja05].
*** Calculated from proton energies and S_p (^{26}Si) = 5514.00(11) keV [2021Wa16]. For levels de-excited by more than one proton transition, E_{level} (emitter) is the weighted average.
[@] Values from adopted levels in ENSDF: B. Singh Janurary 2018, http://www.nndc.bnl.gov/ensdf/
[@@] [2020Li06] report the 5 protons up to 1.5 MeV with energies/ Intensities(abs):
E_p(keV) / I_p (abs)%
0.418(8) / 11.1(12)
0.787(8) / 0.74(17)
0.870(8) / 1.44(30)
1.256(8) / 1.45(21)
1.507(9) / 0.80(18)
[@@@] [2022Li66].
[a] IAS.

Table 7
β-2p emission from ^{26}P*, $BR_{\beta 2p}$ = 3.2(4)%.

E_{2p}(c.m.)	I_{2p}(rel)	I_{2p}(abs)	$E_{emitter}$ (^{26}Si)	$E_{daughter}$(^{24}Mg)	coincident γ-rays
2.758(7)	15.1(6)	0.18(11)	11.912(4)	1.369	1.369
3.902(3)	53(21)	0.63(22)	13.055(2)**	1.369	1.369
4.125(5)	24(10)	0.29(10)	11.912(4)	0.0	——
4.250(10)	61(21)	0.72(21)	13.380(13)	1.369	1.369
5.277(4)	100(20)	1.19(24)	13.055(2)**	0.0	——
5.630(20)	16(7)	0.19(7)	13.380(13)	0.0	——

* All values taken from [2022Li66].
** IAS

Table 8
β-p emission from ^{46}Mn*, $T_{1/2}$=36.2(4) ms, $BR_{\beta p}$ = 57.0(8)%.

E_p(c.m.)	I_p(rel)	I_p(abs)	$E_{emitter}$ (^{46}Cr)**	$E_{daughter}$(^{45}V)***	coincident γ-rays***
1.224(12)	28(6)	1.8(3)			
2.358(13)	26(7)	1.7(4)			
3.003(13)	100	6.5(9)	9.144(11)	1.2722(4)	1.272, 0.886, 0.329, 0.055
3.494(25)	54(12)	3.5(6)	9.144(11)	0.7972(5)	0.411, 0.329, 0.055, 0.741
4.254(15)	85(15)	5.5(9)	9.144(11)	0	——

* All values taken from [2007Do17], except where noted.
** IAS. Listed energy is the weighted average calculated from proton energies and S_p (^{46}Cr) = 4874(11) keV [2021Wa16].
*** Values from adopted levels in ENSDF [2008Bu01].

Table 9
β-p emission from ^{50}Co*, $T_{1/2}$=38.8(2) ms, $BR_{\beta p}$ = 70.5(7)%.

E_p(c.m.)	I_p(rel)	I_p(abs)	$E_{emitter}$ (^{50}Fe)	$E_{daughter}$(^{49}Mn)***	coincident γ-rays***
1.874(16)	2.4(5)	1.0(2)	8.473(12)**	2.4813(4)	0.940, 0.482, 1.279, 0.798, 0.261
2.044(14)	7.3(15)	3.0(6)			
2.296(27)	2.2(7)	0.9(3)			
2.770(12)	100	41.1(24)	8.473(12)**	1.54131(25)	0.482, 1.279, 0.798, 0.261

* All values from [2007Do17], except where noted. Many of the delayed protons have not been measured resulting in a total intensity for individual protons to be lower than the total β^+-p intensity.
** IAS. Listed energy is the weighted average calculated from proton energies and S_p (^{50}Fe) = 4146(9) keV [2021Wa16].
*** Values from adopted levels in ENSDF [2008Bu17].

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