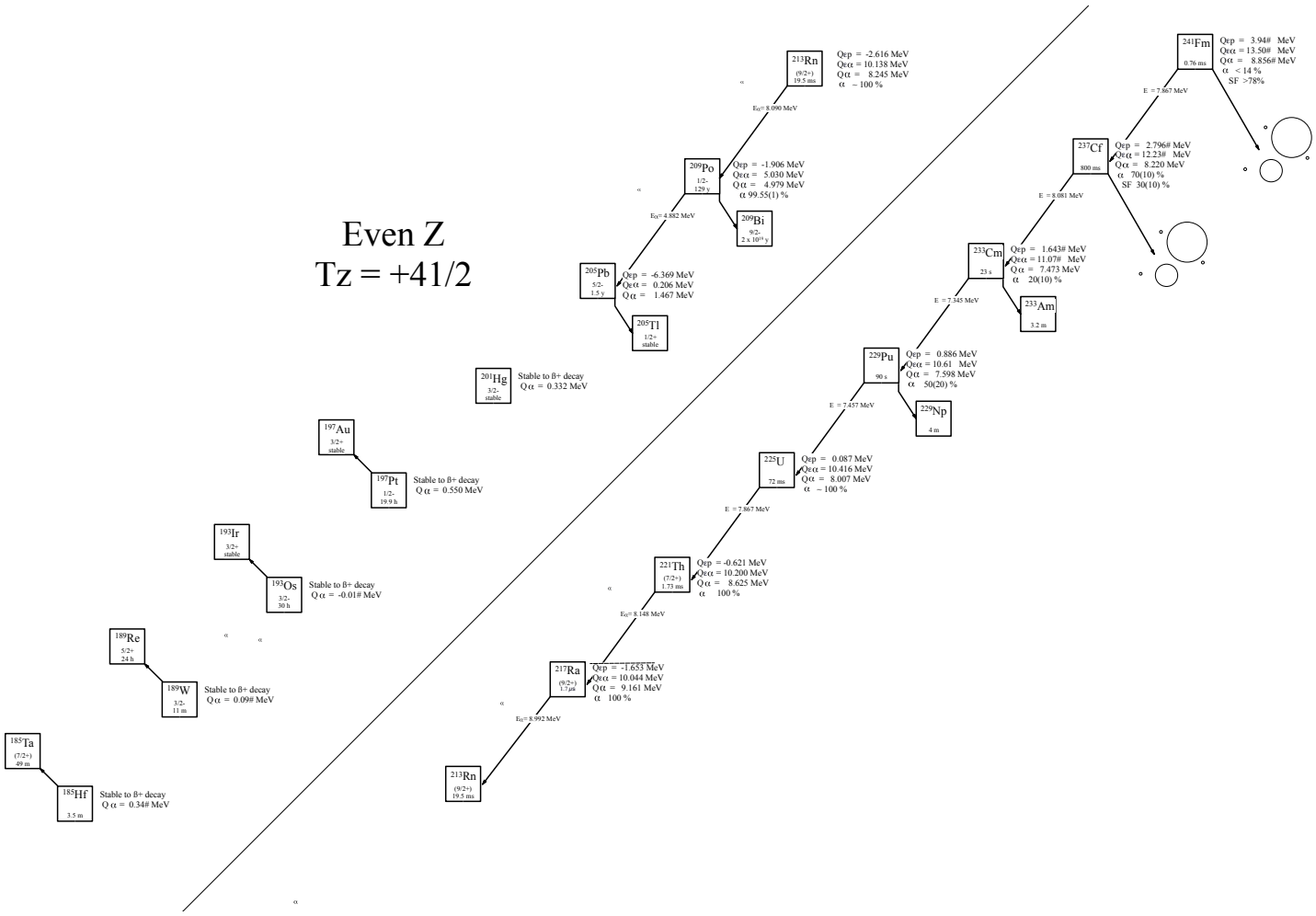

Fig. 1: Known experimental values for heavy particle emission of the even-Z T_z= +41/2 nuclei.

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Table 1
Observed and predicted β-delayed particle emission from the even-Z, T_z = +41/2 nuclei. J^π values for ^{185}Hf, ^{189}W, ^{193}Os, ^{197}Pt, ^{201}Hg, and ^{205}Pb are taken from ENSDF. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein.

Nuclide	J^π	$T_{1/2}$	Q_ε	$Q_{\varepsilon p}$	$Q_{\varepsilon\alpha}$	Experimental
^{185}Hf*		3.5(6) m	-4.36(31)#	——	——	[**1993Yu01**]
^{189}W*	$(3/2^-)$	11.7(5) m	-3.85(28)#	——	——	[**1997Ya03**]
^{193}Os*	$3/2^-$	29.830(18) h	-3.160(40)	——	——	[**2012Kr05**]
^{197}Pt*	$1/2^-$	19.8915(19) h	-2.156(20)	——	——	[**1992An13**]
^{201}Hg	$3/2^-$	stable	-1.262(3)	——	——	
^{205}Pb	$5/2^-$	1.51(4) y	0.051(1)	-6.369(1)	0.206(3)	[**1978Pe08**]
^{209}Po	$1/2^-$	128.7(3) y	1.893(2)	-1.906(1)	5.030(2)	[**2007Co07**, 2015Po03, 2014Co16]
^{213}Rn	$(9/2^+)$	19.5(1) ms	0.884(6)	-2.616(3)	10.138(4)	[**2000He17**]
^{217}Ra	$(9/2^+)$	1.7(1) μs**	1.575(9)	-1.653(9)	10.044(9)	[**2019Ya04, 2019Mi08, 1990AnZU, 1970Va13**]
^{221}Th	$(7/2^+)$	1.73(3) ms***	2.410(60)	-0.621(11)	10.200(10)	[**2001Ku07, 1993AnZS, 1970To07**]
^{225}U		72(4) ms[@]	3.020(80)	0.087(14)	10.416(58)	[**2019Mi08, 2001Ku07, 2000He17**]
^{229}Pu		90(10) s	3.59(12)	0.886(62)	10.61(10)	[**2002CaZU**]
^{233}Cm		23^{+13}_{-6} s	4.01(14)#	1.643(83)#	11.07(13)#	[**2010Kh06**]
^{237}Cf		0.8(2) s	4.73(25)#	2.796(99)#	12.23(15)#	[**2010Kh06**]
^{241}Fm		0.73(6) ms	5.33(38)#	3.94(30)#	13.50(38)#	[**2008Kh10**]

* 100% β^- emitter.
** Weighted average of 1.4(4) μs [2019Ya04], 2.5(2) μs [2019Mi08], 1.7(1) μs [1990AnZU] and 1.6(2) μs [1970Va13].
*** Weighted average of 1.73(3) ms [2001Ku07], 1.9(1) ms [1993AnZS] and 1.68(6) ms [1970To07].
[@] Weighted average of 63(7) ms [2019Mi08], 84(4) ms [2001Ku07] and 59^{+5}_{-2} ms [2000He17].

Table 2
Particle separation, Q-values, and measured values for direct particle emission of the even-Z, T_z = +41/2 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	BR_{SF}	Experimental
^{185}Hf	9.31(21)#	17.90(41)#	0.34(31)#			
^{189}W	9.19(28)#	17.39(28)#	0.09(21)#			
^{193}Os	9.095(71)	16.796(42)	-0.01(20)#			
^{197}Pt	8.273(38)	15.486(56)	0.550(2)			
^{201}Hg	7.711(27)	14.852(2)	0.332(1)			
^{205}Pb	6.713	13.079(1)	1.467(1)			
^{209}Po	4.785(2)	8.492(1)	4.979(1)	99.55(1)%		[**1996Sc24, 1989Ma05, 1966Ha29**, 1969Go23, 1953AsZZ, 1951Ka03, 1951Ka37]
^{213}Rn	4.357(4)	7.841(3)	8.245(3)	$\approx$ 100%		[**2001Ku07, 2000He17**, 2021Hu19, 2019Mi08, 2005Li17, 1970TaZS, 1970Va13, 1970VaZZ, 1966Ro12, 1961Gr43]
^{217}Ra	4.370(8)	7.519(9)	9.161(6)	100%		[**1970To07, 1970Va13**, 2021Hu19, 2019Ya04, 2019Mi08, 1970VaZZ,1969ToXX, 1961Gr43]
^{221}Th	4.093(10)	7.032(10)	8.625(4)	100%		[**2020Pa44, 2021Hu19**, 2019Mi08, 2019Ya04, 2015Li17, 2014Lo10, 2003Ni10, 2001Ku07, 2000He17, 1993AnZS, 1990An19, 1990AnZQ, 1990AnZU, 1970To07, 1970Va13, 1970VaZZ, 1969MaZT]
^{225}U	3.779(12)	6.591(13)	8.007(6)	$\approx$ 100%		[**2001Ku07, 2000He17**, 2019Mi08, 2003Ni10, 1994AnZY, 1994Ye08, 1993AnZS, 1992To02, 1992ToZV, 1990YeZY, 1989An13, 1989HeZK, 1989HeZZ, 1988AnZS]
^{229}Pu	3.72(12)#	6.228(61)	7.590(20)**	50(20)%	<7%*	[**2010Kh06**, 2002CaZU, 2002CaZZ, 1994An02, 1994AnZX, 1994AnZY, 1994Ye08]
^{233}Cm	3.42(31)#	5.593(84)#	7.473(20)***	20(10)%		[**2010Kh06**, 2002CaCU, 2002CaZZ]
^{237}Cf	2.89(37)#	4.65(14)#	8.220(54)	70(10)%	30(10)%	[**2010Kh06**]
^{241}Fm	2.29(47)#	3.56(32)#	8.856(32)#	<14%*	>78%	[**2008Kh10**]

* Not observed.
** Deduced from α decay. 7.598(60) MeV in [2021Wa16].
*** Deduced from α decay. 7.473(54) MeV in [2021Wa16].

Table 3
direct α emission from ^{209}Po, J^{π} = 1/2$^-$,$T_{1/2}$ = 128.7(3) y*, BR_{α} = 99.55(1)%**.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J_f^{π}[@@]	$E_{daughter}$(^{205}Pb)[@@]	coincident γ-rays[@@]	R_0 (fm)	HF
4.190(15)	4.110(15)	5.7(42) $\times$ 10^{-4}%***	5.6(42) $\times$ 10^{-4}%		0.787(15)		1.41923(39)	$1.1^{+3.3}_{-0.6}$
4.394(15)	4.310(15)	1.5(4) $\times$ 10^{-4}%***	1.5(4) $\times$ 10^{-4}%	3/2$^-$	0.576(4)[@@]	0.2605, 0.2628 , 0.3134, 0.5739, 0.5763	1.41923(39)	160^{+60}_{-40}
4.707(5)	4.617(5)	0.56(1)%	0.551(6)%**	3/2$^-$	0.263[@@]	0.2605, 0.2628	1.41923(39)	6.33(9)
4.977(2)	4.882(2)[@]	100%	98.56 (1)%**	5/2$^-$, 1/2$^-$	0.0, 0.0023[@@]		1.41923(39)	1.536(21)

* [2007Co07].
** [1996Sc24].
*** [1966Ha29].
[@] α energy is a weighted average of 4.877(5) MeV [1966Ha29] and 4.883(2) MeV [1989Ma05]. This peak is an unresolved transition that feeds both the 5/2$^-$ ground state and a low-lying state 1/2$^-$ at 2.3 keV [1996Sc24]. Due to the change in respective spins and the low HF (treating it as one transition), it appears that the majority of the α transitions frred the 2.3 keV state.
[@@] [2020Ko17].

Table 4
direct α emission from ^{213}Rn, J^{π} = (9/2$^+$),$T_{1/2}$ = 19.5(1) ms*, BR_{α} = $\approx$ 100%.

E_{α}(c.m.)	E_{α}(lab)**	I_{α}(rel)*	I_{α}(abs)	J_f^{π}***	$E_{daughter}$(^{209}Po)***	coincident γ-rays***	R_0 (fm)	HF
7.393(4)	7.254(4)	1.1(1)%	1.1(1)%	3/2$^-$	0.854	0.854	1.4842(25)	22(2)
7.700(4)	7.555(4)	0.68(7)%	0.67(7)%	5/2$^-$	0.545	0.545	1.4842(25)	350^{+50}_{-40}
8.245(3)	8.090(3)	100%	98.2(2)%	1/2$^-$	0.0	——	1.4842(25)	96(5)

* [2000He17].
** [2001Ku07].
*** [2015Ch30].

Table 5
direct α emission from ^{217}Ra, J^{π} = (9/2$^+$), $T_{1/2}$ = 1.7(1) μs*, BR_{α} = 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(abs)	J_f^{π}	$E_{daughter}$(^{213}Rn)	coincident γ-rays	R_0 (fm)	HF
9.161(6)	8.992(6)**	100%	(9/2$^+$)	0.0	——	1.5544(25)	1.86(16)

* Weighted average of 1.4(4) μs [2019Ya04], 2.5(2) μs [2019Mi08], 1.7(1) μs [1990AnZU] and 1.6(2) μs [1970Va13].
** Weighted average of 8.990(8) MeV [1970To07] and 8.995(10) MeV [1970Va13].

Table 6
direct α emission from ^{221}Th*, J^{π} = (7/2$^+$),$T_{1/2}$ = 1.73(3) ms**, BR_{α} = 100%.

E_{α}(c.m.)	E_{α}(lab)	I_{α}(rel)	I_{α}(abs)	J_f^{π}	$E_{daughter}$(^{217}Ra)	coincident γ-rays	R_0 (fm)	HF
7.878(3)	7.735(3)	7.8(3)%	4.7(2)%	(7/2$^+$)	0.753	0.177, 0.227, 0.331, 0.526, 0.576, 0.753	1.5811(30)	4.9(4)
8.098(8)	7.951(8)	0.23(5)%	0.14(3)%	(13/2$^+$)	0.540	0.540	1.5811(30)	740^{+230}_{-160}
8.298(3)	8.148(3)	100(1)%	60.3(7)%	(11/2$^+$)	0.331	0.177, 0.331	1.5811(30)	7.1(5)
8.399(3)	8.247(3)	2.5(2)%	1.5(1)%	(7/2,9/2)$^-$	0.227	0.227	1.5811(30)	560(60)
8.564(16)***	8.409(16)***	12%***		0.063			1.5811(30)	370
8.627(3)	8.471(3)	55.4(9)%	33.4(4)%	(9/2$^+$)	0.0	——	1.5811(30)	106(7)

* All values from [2020Pa44], except where noted.
** Weighted average of 1.73(3) ms [2001Ku07], 1.9(1) ms [1993AnZS] and 1.68(6) ms [1970To07].
*** Tentatively assigned by [2021Hu19], with the comment "the small peak at 8409 keV may stem from the internal conversion effect." In addition, [1990An19] reports peaks at 8.265(10) MeV (I_{α} = 4) and 8.375(10) MeV (I_{α} = 11), with no spectra are shown in this work. No levels at 63, 98, or 210 keV have been observed in ^{208}Pb(^{13}C,4nγ) [1983Lo16] or ^{208}Pb(^{12}C,3nγ) [1991Dr08, 1984Ro20, 1984Su10] reactions (as detailed in [2018Ko01]).

Table 7
direct α emission from ^{225}U, $T_{1/2}$ = 72(4) ms*, $BR_\alpha = \approx 100\%$.

E_α(c.m.)	E_α(lab)**	I_α(rel)***	I_α(abs)	J_f^π	$E_{daughter}$(^{221}Th)	coincident γ-rays	R_0 (fm)	HF
7.762(12)	7.624(12)	9(4)%	5(2)%	$(11/2^+)^@$	0.2509(3)$^@$	0.2509$^@$	1.5454(32)	8^{+6}_{-3}
7.970(12)	7.828(12)	64(5)%	37(5)%		0.040(21)		1.5454(32)	$4.9^{+1.4}_{-1.2}$
8.010(6)	7.867(6)	100(7)%	58(4)%	$(7/2^+)$	0.0	——	1.5454(32)	4.2(5)

* Weighted average of 63(7) ms [2019Mi08], 84(4) ms [2001Ku07] and 59^{+5}_{-2} ms [2000He17].
** Weighted average of values from [2001Ku07] and [2000He17].
*** [2000He17].
$^@$ [2007Ja05].

Table 8
direct α emission from ^{229}Pu*, $T_{1/2}$ = 90(10) s**, BR_α = 50(20)%.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{225}U)	coincident γ-rays	R_0 (fm)	HF
7.590(20)	7.457(20)	50(20)%		0.0	——	1.509(24)	22^{+25}_{-13}

* All values from [2010Kh06], except where noted.
** [2002CaZU].

Table 9
direct α emission from ^{233}Cm*, $T_{1/2} = 23^{+13}_{-6}$ s, BR_α = 20(10)%.

E_α(c.m.)	E_α(lab)	I_α(rel)	I_α(abs)	J_f^π	$E_{daughter}$(^{229}Pu)	coincident γ-rays	R_0 (fm)	HF
7.381(20)	7.254(20)	43^{+47}_{-34}%	6^{+7}_{-5}%		0.092(28)		1.502(33)	1^{+9}_{-1}
7.473(20)	7.345(20)	100(43)%	14(9)%		0.0	——	1.502(33)	1^{+5}_{-1}

* All values from [2010Kh06].

Table 10
direct α emission from ^{237}Cf*, $T_{1/2}$ = 0.8(2) s, BR_α = 70(10)%.

E_α(c.m.)	E_α(lab)	I_α(abs)	J_f^π	$E_{daughter}$(^{233}Cm)	coincident γ-rays	R_0 (fm)	HF
8.220(20)	8.081(20)	70(10)%		0.0	——	1.471(55)	$0.3^{+0.8}_{-0.3}$

* All values from [2010Kh06].

References used in the Tables

[1] **1951Ka03** D. G. Karraker, D. H. Templeton, Phys. Rev. **81**, 510 (1951). https://doi.org/10.1103/PhysRev.81.510

[2] **1951Ka37** D. G. Karraker, A. Ghiorso, D. H. Templeton, Phys. Rev. **83**, 390 (1951). https://doi.org/10.1103/PhysRev.83.390

[3] **1953AsZZ** F. Asaro, Thesis, Univ. California (1953); UCRL-2180 (1953).

[4] **1961Gr43** R. D. Griffioen, R. D. Macfarlane, Lawrence Radiation Laboratory, Chemistry Division Annual Report (1961), UCRL-10023, p. 50 (1961).

[5] **1966Ha29** G. R. Hagee, R. C. Lange, J. T. McCarthy, Nucl. Phys. **84**, 62 (1966). https://doi.org/10.1016/0029-5582(66)90433-0

[6] **1966Ho16** K. J. Hofstetter, P. J. Daly, Phys. Rev. **152**, 1050 (1966). https://doi.org/10.1103/PhysRev.152.1050

[7] **1966Ro12** H. Rotter, A. G. Demin, L. P. Pashchenko, H. F. Brinckmann, Yad. Fiz. **4**, 246 (1966); Soviet J. Nucl. Phys. **4**, 178 (1967).

[8] **1969Go23** N. A. Golovkov, S. Guetkh, B. S. Dzhelepov, Y. V. Norseev, V. A. Khalkin, V. G. Chumin, Izv. Akad. Nauk SSSR, Ser. Fiz. **33**, 1622 (1969); Bull. Acad. Sci. USSR, Phys. Ser. **33**, 1489 (1970).

[9] **1969MaZT** R. D. Macfarlane, ORO-3820-1 (1969).

[10] **1969ToXX** D. F. Torgerson, Ph. D. Thesis, McMaster University, Canada, 1969 (unpublished).

[11] **1970TaZS** N. I. Tarantin, A. P. Kabachenko, A. V. Demyanov, N. S. Ivanov, Proc. Int. Conf. Mass Spectrosc. , Kyoto (1969), K. Ogata, T. Hayakawa, Eds. , University Park Press, Baltimore, p. 548 (1970).

[12] **1970To07** D. F. Torgerson, R. D. Macfarlane, Nucl. Phys. A**149**, 641 (1970). https://doi.org/10.1016/0375-9474(70)91053-5

[13] **1970Va13** K. Valli, E. K. Hyde, J. Borggreen, Phys. Rev. C**1**, 2115 (1970). https://doi.org/10.1103/PhysRevC.1.2115

[14] **1970VaZZ** K. Valli, E. K. Hyde, J. Borggreen, CONF Leysin Vol1 P545, CERN 70-30

[15] **1978Pe08** J. G. Pengra, H. Genz, R. W. Fink, Nucl. Phys. A**302**, 1 (1978). https://doi.org/10.1016/0375-9474(78)90283-X

[16] **1988AnZS** A. N. Andreev, D. D. Bogdanov, A. V. Eremin, A. P. Kabachenko, O. A. Orlova, G. M. Ter-Akopyan, V. I. Chepigin, JINR-P7-88-830 (1988).

[17] **1989An13** A. N. Andreev, D. D. Bogdanov, A. V. Eremin, A. P. Kabachenko, O. A. Orlova, G. M. Ter-Akopyan, V. I. Chepigin, Yad. Fiz. **50**, 619 (1989); Sov. J. Nucl. Phys. **50**, 381 (1989).

[18] **1989HeZK** F. P. Hessberger, P. Armbruster, W. Bruchle, H. Folger, S. Hofmann, G. Munzenberg, V. Ninov, M. Schadel, K. Summerer, H. Gaggeler, D. Jost, J. V. Kratz, U. Scherer, M. E. Leino, A. Turler, D. Ackermann, Univ. Mainz, 1988 Ann. Rept., p. 18 (1989).

[19] **1989HeZZ** F. P. Hessberger, P. Armbruster, W. Bruchle, H. Folger, S. Hofmann, G. Munzenberg, V. Ninov, M. Schadel, K. Summerer, H. Gaggeler, D. Jost, J. V. Kratz, U. Scherer, M. E. Leino, A. Turler, D. Ackermann, GSI-89-1, p. 17 (1989).

[20] **1989Ma05** A. M. Mandal, S. K. Saha, S. M. Sahakundu, A. P. Patro, J. Phys. (London) G**15**, 173 (1989). https://doi.org/10.1088/0954-3899/15/2/008

[21] **1990An19** A. N. Andreev, D. D. Bogdanov, V. I. Chepigin, A. P. Kabachenko, S. Sharo, G. M. Ter-Akopian, A. V. Eremin, Z. Phys. A**337**, 229 (1990).

[22] **1990AnZQ** A. N. Andreev, D. D. Bogdanov, A. V. Eremin, A. P. Kabachenko, G. M. Ter-Akopyan, V. I. Chepigin, Sh. Sharo, Program and Thesis, Proc. 40th Ann. Conf. Nucl. Spectrosc. Struct. At. Nuclei, Leningrad, p. 131 (1990).

[23] **1990AnZU** A. N. Andreev, D. D. Bogdanov, A. V. Eremin, A. P. Kabachenko, O. N. Malyshev, G. M. Ter-Akopyan, V. I. Chepigin, JINR-P7-90-232 (1990).

[24] **1990YeZY** A. V. Yeremin, A. N. Andreev, D. D. Bogdanov, A. P. Kabachenko, O. N. Malyshev, O. A. Orlova, G. M. Ter-Akopyan, V. I. Chepigin, JINR-E15-90-347 (1990).

[25] **1992An13** M. S. Antony, D. Oster, A. Hachem, J. Radioanal. Nucl. Chem. **164**, 303 (1992). https://doi.org/10.1007/BF02164953

[26] **1992To02** K. S. Toth, H. J. Kim, J. W. McConnell, C. R. Bingham, D. C. Sousa, Phys. Rev. C**45**, 856 (1992). https://doi.org/10.1103/PhysRevC.45.856

[27] **1992ToZV** K. S. Toth, H. J. Kim, J. W. McConnell, C. R. Bingham, D. C. Sousa, Contrib. 6th Intern. Conf. on Nuclei Far from Stability + 9th Intern. Conf. on Atomic Masses and Fundamental Constants, Bernkastel-Kues, Germany, PE37 (1992).

[28] **1993AnZS** A. N. Andreyev, D. D. Bogdanov, V. I. Chepigin, M. Florek, A. P. Kabachenko, O. N. Malyshev, S. Sharo, G. M. Ter-Akopian, M. Veselsky, A. V. Yeremin, Proc. 6th Intern. Conf. on Nuclei Far from Stability + 9th Intern. Conf. on Atomic Masses and Fundamental Constants, Bernkastel-Kues, Germany, 19-24 July, 1992, R. Neugart, A. Wohr, Eds. , p. 759 (1993).

[29] **1993Yu01** S. Yuan, T. Zhang, Q. Pan, X. Zhang, S. Xu, Z. Phys. A**344**, 355 (1993).

[30] **1994An02** A. N. Andreyev, D. D. Bogdanov, V. I. Chepigin, A. P. Kabachenko, O. N. Malyshev, A. G. Popeko, R. N. Sagaidak, G. M. Ter-Akopian, M. Veselsky, A. V. Yeremin, Z. Phys. A**347**, 225 (1994).

[31] **1994AnZX** A. N. Andreev, D. D. Bogdanov, A. V. Eremin, A. P. Kabachenko, O. N. Malyshev, A. G. Popeko, R. N. Sagaidak, G. M. Ter-Akopyan, V. I. Chepigin, Program and Thesis, Proc. 44th Ann. Conf. Nucl. Spectrosc. Struct. At. Nuclei, Kharkov, p. 89 (1994).

[32] **1994AnZY** A. N. Andreev, D. D. Bogdanov, A. V. Eremin, A. P. Kabachenko, O. N. Malyshev, A. G. Popeko, R. N. Sagaidak, G. M. Ter-Akopyan, V. I. Chepigin, Program and Thesis, Proc. 44th Ann. Conf. Nucl. Spectrosc. Struct. At. Nuclei, Kharkov, p. 85 (1994).

[33] **1994Ye08** A. V. Yeremin, A. N. Andreyev, D. D. Bogdanov, G. M. Ter-Akopian, V. I. Chepigin, V. A. Gorshkov, A. P. Kabachenko, O. N. Malyshev, A. G. Popeko, R. N. Sagaidak, S. Sharo, E. N. Voronkov, A. V. Taranenko, A. Yu. Lavrentjev, Nucl. Instrum. Methods Phys. Res. A**350**, 608 (1994). https://doi.org/10.1016/0168-9002(94)91265-3

[34] **1996Sc24** F. J. Schima, R. Colle, Nucl. Instrum. Methods Phys. Res. A**369**, 498 (1996). https://doi.org/10.1016/S0168-9002(96)80038-6

[35] **1997Ya03** W. F. Yang, Z. Z. Zhao, Z. W. Li, W. T. Mou, Z. Phys. A**357**, 353 (1997). https://doi.org/10.1007/s002180050254

[36] **2000He17** F. P. Hessberger, S. Hofmann, D. Ackermann, V. Ninov, M. Leino, S. Saro, A. Andreyev, A. Lavrentev, A. G. Popeko, A. V. Yeremin, Eur. Phys. J. A **8**, 521 (2000); Erratum Eur. Phys. J. A **9**, 433 (2000). https://doi.org/10.1007/s100500070075

[37] **2001Ku07** P. Kuusiniemi, J. F. C. Cocks, K. Eskola, P. T. Greenlees, K. Helariutta, P. Jones, R. Julin, S. Juutinen, H. Kankaanpaa, A. Keenan, H. Kettunen, M. Leino, M. Muikku, P. Nieminen, P. Rahkila, J. Uusitalo, Acta Phys. Pol. B**32**, 1009 (2001).

[38] **2002CaZU** P. Cagarda, S. Antalic, S. Saro, S. Hofmann, F. P. Hessberger, D. Ackermann, B. Kindler, B. Lommel, J. Kojouharova, R. Mann, H. J. Schott, A. V. Yeremin, A. G. Popeko, J. Uusitalo, Proc. 5th International Conference on Dynamical Aspects of Nuclear Fission, Casta-Papiernicka, Slovak Republic, 23-27 Oct. 2001, p. 398 (2002).

[39] **2002CaZZ** P. Cagarda, S. Antalic, D. Ackermann, F. P. Hessberger, S. Hofmann, B. Kindler, J. Kojouharova, B. Lommel, R. Mann, A. G. Popeko, S. Saro, J. Uusitalo, A. V. Yeremin, GSI 2002-1, p. 15 (2002).

[40] **2003Ni10** K. Nishio, H. Ikezoe, S. Mitsuoka, K. Satou, C. J. Lin, Phys. Rev. C**68**, 064305 (2003). https://doi.org/10.1103/PhysRevC.68.064305

[41] **2005Li17** Z. Liu, J. Kurcewicz, P. J. Woods, C. Mazzocchi, F. Attallah, E. Badura, C. N. Davids, T. Davinson, J. Doring, H. Geissel, M. Gorska, R. Grzywacz, M. Hellstrom, Z. Janas, M. Karny, A. Korgul, I. Mukha, M. Pfutzner, C. Plettner, A. Robinson, E. Roeckl, K. Rykaczewski, K. Schmidt, D. Seweryniak, H. Weick, Nucl. Instrum. Methods Phys. Res. A**543**, 591 (2005). https://doi.org/10.1016/j.nima.2004.12.023

[42] **2007Co07** R. Colle, L. Laureano-Perez, I. Outola, Appl. Radiat. Isot. **65**, 728 (2007). https://doi.org/10.1016/j.apradiso.2006.10.007

[43] **2008Kh10** J. Khuyagbaatar, S. Hofmann, F. P. Hessberger, D. Ackermann, H. G. Burkhard, S. Heinz, B. Kindler, I. Kojouharov, B. Lommel, R. Mann, J. Maurer, K. Nishio, Yu. Novikov, Eur. Phys. J. A **37**, 177 (2008). https://doi.org/10.1140/epja/i2008-10608-4

[44] **2010Kh06** J. Khuyagbaatar, F. P. Hessberger, S. Hofmann, D. Ackermann, V. S. Comas, S. Heinz, J. A. Heredia, B. Kindler, I. Kojouharov, B. Lommel, R. Mann, K. Nishio, A. Yakushev, Eur. Phys. J. A **46**, 59 (2010). https://doi.org/10.1140/epja/i2010-11026-9

[45] **2012Kr05** K. S. Krane, Phys. Rev. C **85**, 044319 (2012). https://doi.org/10.1103/PhysRevC.85.044319

[46] **2014Co16** R. Colle, R. P. Fitzgerald, L. Laureano-Perez, J. Phys. (London) G**41**, 105103 (2014). https://doi.org/10.1088/0954-3899/41/10/105103

[47] **2014Lo10** A. Lopez-Martens, K. Hauschild, K. Rezynkina, O. Dorvaux, B. Gall, F. Dechery, H. Faure, A. V. Yeremin, M. L. Chelnokov, V. I. Chepigin, A. V. Isaev, I. N. Izosimov, D. E. Katrasev, A. N. Kuznetsov, A. A. Kuznetsova, O. N. Malyshev, A. G. Popeko, E. A. Sokol, A. I. Svirikhin, J. Piot, J. Rubert, Eur. Phys. J. A **50**, 132 (2014). https://doi.org/10.1140/epja/i2014-14132-8

[48] **2015Ch30** J. Chen, F. G. Kondev, Nucl. Data Sheets **126**, 373 (2015). https://doi.org/10.1016/j.nds.2015.05.003

[49] **2015Li17** H. J. Li, Z. G. Xiao, S. J. Zhu, M. Patial, C. Qi, B. Cederwall, Z. Zhang, R. S. Wang, H. Yi, W. H. Yan, W. J. Cheng, Y. Huang, L. M. Lyu, Y. Zhang, X. G. Wu, C. Y. He, Y. Zheng, G. S. Li, C. B. Li, H. W. Li, J. J. Liu, P. W. Luo, S. P. Hu, J. L. Wang, Y. H. Wu, Phys. Rev. C **91**, 054314 (2015). https://doi.org/10.1103/PhysRevC.91.054314

[50] **2015Po03** S. Pomme, H. Stroh, L. Benedik, Appl. Radiat. Isot. **97**, 84 (2015). https://doi.org/10.1016/j.apradiso.2014.12.025

[51] **2019Mi08** A. K. Mistry, J. Khuyagbaatar, F. P. Hessberger, D. Ackermann, B. Andel, S. Antalic, M. Block, P. Chhetri, F. Dechery, C. Droese, Ch. E. Dullmann, F. Giacoppo, J. Hoffmann, O. Kaleja, N. Kurz, M. Laatiaoui, L. Lens, J. Maurer, P. Mosat, J. Piot, S. Raeder, M. Vostinar, A. Yakushev, Z. Zhang, Nucl. Phys. A**987**, 337 (2019). https://doi.org/10.1016/j.nuclphysa.2019.05.003

[52] **2019Ya04** H. B. Yang, Z. G. Gan, Z. Y. Zhang, M. M. Zhang, M. H. Huang, L. Ma, C. L. Yang, Eur. Phys. J. A **55**, 8 (2019). https://doi.org/10.1140/epja/i2019-12684-7

[53] **2020Ko17** F. G. Kondev, Nucl. Data Sheets **166**, 1 (2020). https://doi.org/10.1016/j.nds.2020.05.001

[54] **2020Pa44** E. Parr, J. F. Smith, P. T. Greenlees, K. Auranen, R. Chapman, D. M. Cullen, T. Grahn, L. Grocutt, A. Herzan, R. -D. Herzberg, D. Hodge, U. Jakobsson, R. Julin, S. Juutinen, J. Konki, C. McPeake, D. Mengoni, A. K. Mistry, K. F. Mulholland, G. G. O'Neill, J. Pakarinen, P. Papadakis, J. Partanen, P. Peura, P. Rahkila, P. Ruotsalainen, M. Sandzelius, J. Saren, M. Scheck, C. Scholey, M. Siciliano, M. Smolen, J. Sorri, S. Stolze, M. J. Taylor, J. Uusitalo, Phys. Rev. C **102**, 054335 (2020). https://doi.org/10.1103/PhysRevC.102.054335

[55] **2021Hu19** W. Hua, Z. Zhang, L. Ma, Z. Gan, H. Yang, M. Huang, C. Yang, M. Zhang, Y. Tian, X. Zhou, C. Yuan, C. Shen, L. Zhu, Chin. Phys. C **45**, 044003 (2021). https://doi.org/10.1088/1674-1137/abe0bd

[56] **2021Wa16** M. Wang, W. J. Huang, F. G. Kondev, G. Audi, S. Naimi, Chin. Phys. C **45**, 030003 (2021). https://doi.org/10.1088/1674-1137/abddaf