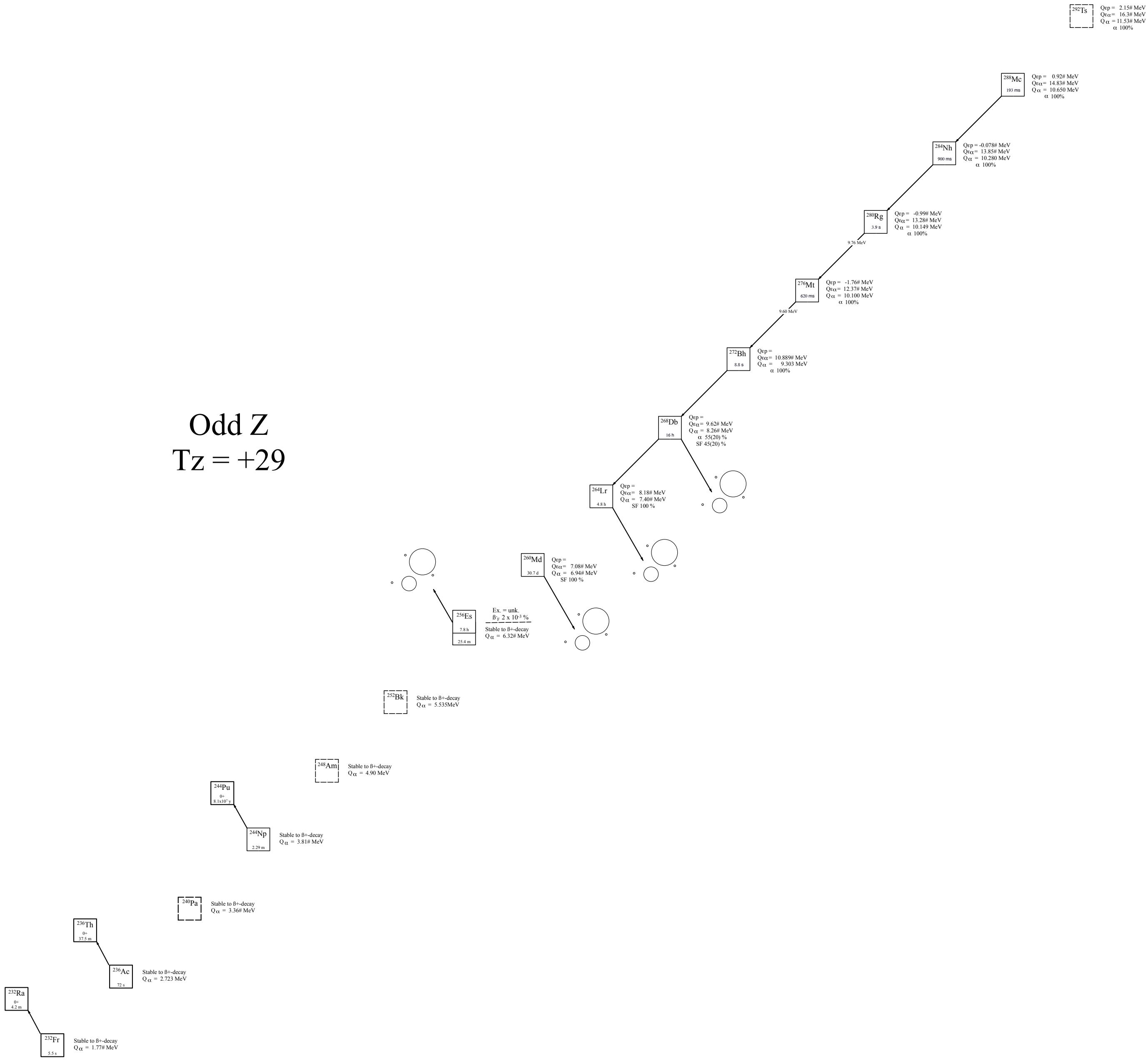


**Fig. 1**: Known experimental values for heavy particle emission of the odd-Z $T_z$= +29 nuclei.

Last updated 5/27/25

**Table 1**
Observed and predicted $\beta$-delayed particle emission from the odd-$Z$, $T_z$ = +29 nuclei. Unless otherwise stated, all Q-values are taken from [2021Wa16] or deduced from values therein.

| Nuclide | Ex. | $J^{\pi}$ | $T_{1/2}$ | $Q_{\varepsilon}$ | Q$_{\beta}$- | Q$_{\beta}$- $_{\alpha}$ | BR$_{\beta-F}$ | Experimental |
|---|---|---|---|---|---|---|---|---|
| $^{228}$At* | | | obs | | 6.64(40)# | 9.73(45)# | | [**2010Al24**] |
| $^{232}$Fr* | | | 5.5(6) s | | 5.576(17) | 8.585(23) | | [**2004Pe17**] |
| $^{236}$Ac* | | | $72^{+345}_{-33}$ s | | 4.970(40) | 8.483(41) | | [**2010Ch19**] |
| $^{240}$Pa | | | | | 4.30(20)# | 8.51(20)# | | |
| $^{244}$Np | | | 2.29(16) m | | 3.43(10)# | 8.28(10)# | | [**1987Mo29**] |
| $^{248}$Am | | | | | 3.17(20)# | 8.51920)# | | |
| $^{252}$Bk | | | | -0.52(36)# | 2.50(20)# | 8.90(20)# | | |
| $^{256}$Es* | | | 25.4(24) m | -0.14(33)# | 1.70(10)# | 8.91(10)# | | [**1981Lo15**] |
| $^{256m}$Es* | x | | 7.6 h | -0.14(33)# | 1.70(10)# | 8.91(10)# | $2\times10^{-3}$% | [**1989Ha10, 1976HoZB**, 1987HaZL] |
| | | | | | $Q_{\varepsilon p}$ | $Q_{\varepsilon\alpha}$ | | |
| $^{260}$Md | | | 30.7(5) d** | 0.78(54)# | | 7.08(45)# | | [**1986Lo1, 1992LoZV**] |
| $^{264}$Lr | | | $4.8^{+2.2}_{-1.3}$ h | 1.36(73)# | | 8.18(62)# | | [**2022Og08**] |
| $^{268}$Db | | | $16^{+6}_{-4}$ h | 1.58(85)# | | 9.62(79)# | | [**2022Og07**] |
| $^{272}$Bh | | | 8.8(7) s | 2.270(87)# | | 10.889(85)# | | [**2022Og08**] |
| $^{276}$Mt | | | $620^{+60}_{-40}$ ms | 3.13(90)# | -1.76(80)# | 12.37(87)# | | [**2022Og08**] |
| $^{280}$Rg | | | 3.9(3) s | 3.57(92)# | -0.99(86)# | 13.28(90)# | | [**2022Og08**] |
| $^{284}$Nh | | | $900^{+70}_{-60}$ ms | 4.18(93)# | -0.078(86)# | 13.85(92)# | | [**2022Og08**] |
| $^{288}$Mc | | | $193^{15}_{-13}$ ms | 4.75(93)# | 0.92(89)# | 14.83(93)# | | [**2022Og08**] |
| $^{292}$Ts | | | | 5.5(10)# | 2.15(99)# | 16.3(10)# | | |

* 100% $\beta^-$-emitter.
** Weighted average of 31.8(5) d [1986Lo16] and 27.8(8) d [1992LoZV].

**Table 2**
Particle separation, Q-values, and measured values for direct particle emission of the odd-$Z$, $T_z$ = +29 nuclei. Unless otherwise stated, all S and Q-values are taken from [2021Wa16] or deduced from values therein.

| Nuclide | S$_p$ | Q$_{\alpha}$ | BR$_{\alpha}$ | BR$_{SF}$ | Experimental |
|---|---|---|---|---|---|
| $^{228}$At | 7.69(57)# | 2.39(57)# | | | |
| $^{232}$Fr | 7.77(30) | 1.77(40)# | | | |
| $^{236}$Ac | 7.20(30)# | 2.723(41) | | | |
| $^{240}$Pa | 6.78(45)# | 3.36(20)# | | | |
| $^{244}$Np | 6.53(32)# | 3.81(22)# | | | |
| $^{248}$Am | 5.94(28)# | 4.90(22) | | | |
| $^{252}$Bk | 5.40(20)# | 5.55(28) | | | |
| $^{256}$Es | 4.91(22)# | 6.23(22)# | | | |
| $^{260}$Md | 4.44(42)# | 6.94(30)# | $\leq$10% | 100%* | [**1986Lo16, 1992LoZV**, 1990Wi01, 1989Hu09, 1987HuZW] |
| $^{264}$Lr | 4.04(66)# | 7.40(30)# | | 100%* | [**2022Og07, 2022Og08**, 2023Ko22] |
| $^{268}$Db | 3.67(78)# | 8.26(30)# | $55^{+20}_{-15}$% | $45^{+15}_{-20}$% | [**2022Og08**, 2023Ku17, 2022Og07, 2016Fo10, 2015Ga24, 2015Ru11, 2014Ru04, 2013Og01, 2013Ru11, 2012Og02, 2012OgZZ, 2004Og03, 2004Og10, 2003OgZY] |
| $^{272}$Bh | 3.12(80)# | 9.303(54) | 100%** | | [**2022Og08, 2004Og03**,2023Ku17, 2022Og07, 2018Ga34, 2016Fo10, 2015Ga24, 2015Ru11, 2014Ru04, 2013Og01, 2013Ru11, 2012Og02, 2012OgZZ, 2007Og05, 2005Og02, 2004Og10, 2003OgZY] |
| $^{276}$Mt | 2.47(80)# | 10.100(10) | 100%** | | [**2022Og08, 2015Ga24, 2014Ru04, 2004Og03**,2023Ku17, 2022Og07, 2018Ga34, 2016Fo10, 2015Ru11, 2013Og01, 2013Ru11, 2012Og02, 2012OgZZ, 2007Og05, 2005Og02, 2004Og10, 2003OgZY] |
| $^{280}$Rg | 2.43(81)# | 10.149(10) | 100%** | | [**2022Og08, 2015Ga24, 2004Og03**,2023Ku17, 2022Og07, 2018Ga34, 2016Fo10, 2015Ru11, 2014Ru04, 2013Og01, 2013Ru11, 2012Og02, 2012OgZZ, 2007Og05, 2005Og02, 2004Og10, 2003OgZY] |
| $^{284}$Nh | 2.04(81)# | 10.280(38) | 100%** | | [**2022Og08, 2004Og03**,2023Ku17, 2022Og07, 2018Ga34, 2017Ak02, 2016Fo10, 2015Ga24, 2015Ru11, 2014Ru04, 2013Og01, 2013Ru11, 2012Og02, 2012OgZZ, 2007Og05, 2005Og02, 2004Og10, 2003OgZY] |
| $^{288}$Mc | 1.55(82)# | 10.650(50) | 100%** | | [**2022Og08, 2004Og03**, 2023Ku17, 2022Og07, 2018Ga34, 2017Ak02, 2017Ak02, 2016Fo10, 2015Ga24, 2015Ru11, 2014Ru04, 2013Og01, 2013Ru11, 2012Og02, 2012OgZZ, 2007Og05, 2005Og02, 2004Og10, 2003OgZY] |
| $^{292}$Ts | 0.91(91)# | 11.53(40)# | | | |

* Only SF has been observed.
** Only $\alpha$-decay has been observed.

**Table 3**
direct $\alpha$ emission from $^{268}$Db*, $T_{1/2} = 16^{+6}_{-4}$ h, $BR_{\alpha} = 55^{+20}_{-15}$%.

| $E_{\alpha}$(c.m.) | $E_{\alpha}$(lab) | $I_{\alpha}$(abs) | $J^{\pi}_{f}$ | $E_{daughter}(^{264}$Lr) | coincident $\gamma$-rays (keV) | HF |
|---|---|---|---|---|---|---|
| 7.7-8.1 | 7.6-8.0 | $55^{+20}_{-15}$% | | | | |

* All values from [2022Og07], which contains all measured data. As an odd-odd nucleus, one would expect that several transitions to low-lying levels would be present. Due to low statistics, the $E_{\alpha}$ is presented as a range of energies that includes x number of unresolved peaks.

**Table 4**
direct $\alpha$ emission from $^{272}$Bh*, $T_{1/2}$ = 8.8(7) s, $BR_{\alpha}$ = 100%**.

| $E_{\alpha}$(c.m.) | $E_{\alpha}$(lab) | $I_{\alpha}$(abs) | $J^{\pi}_{f}$ | $E_{daughter}(^{268}$Db) | coincident $\gamma$-rays (keV) | HF |
|---|---|---|---|---|---|---|
| 8.41-9.35 | 8.29-9.21 | 100%** | | | | |

* All values from [2022Og07], which contains all measured data. As an odd-odd nucleus, one would expect that several transitions to low-lying levels would be present. Due to low statistics, the $E_{\alpha}$ is presented as a range of energies that includes x number of unresolved peaks.
** Only $\alpha$-decay has been observed.

**Table 5**
direct $\alpha$ emission from $^{276}$Mt*, $T_{1/2} = 620^{+60}_{-40}$ ms**, $BR_{\alpha}$ = 100%***.

| $E_{\alpha}$(c.m.) | $E_{\alpha}$(lab) | $I_{\alpha}$(rel) | $I_{\alpha}$(abs) | $J^{\pi}_{f}$ | $E_{daughter}(^{272}$Bh) | coincident $\gamma$-rays (keV) | HF |
|---|---|---|---|---|---|---|---|
| 9.62 | 9.48@ | 6% | 5%@ | | 0.480 | 480@ | |
| 9.67 | 9.53@ | 6% | 5%@ | | 0.434 | 434@ | |
| 9.74 | 9.60 | 100% | 80% | | 0.362 | 136, 166, 302@, 362 | |
| 10.04 | 9.90@ | 13% | 10%@ | | 0.042 | | |

* All values from [2015Ga24], except where noted.
** [2022Og07]. $E_{\alpha}$ reported as 8.52-10.1 MeV.
*** Only $\alpha$-decay has been observed.
@ Tentative assignment.

**Table 6**
direct $\alpha$ emission from $^{280}$Rg*, $T_{1/2}$ = 3.9(3) s**, $BR_{\alpha}$ = 100%***.

| $E_{\alpha}$(c.m.) | $E_{\alpha}$(lab) | $I_{\alpha}$(abs) | $J^{\pi}_{f}$ | $E_{daughter}(^{276}$Mt) | coincident $\gamma$-rays (keV) | HF |
|---|---|---|---|---|---|---|
| 9.41 | 9.28@ | 17% | 10%@ | | 0.732@ | 237, 280@, 494@ |
| 9.86 | 9.72@ | 17% | 10%@ | | 0.280@ | 280@ |
| 9.90 | 9.76 | 100% | 60% | | 0.237 | 237 |
| 9.94 | 9.80 | 33% | 20% | | 0.194 | 194 |

* All values from [2015Ga24], except where noted.
** [2022Og07]. $E_{\alpha}$ reported as 9.09-10.07 MeV.
*** Only $\alpha$-decay has been observed.
@ Tentative assignment.

**Table 7**
direct $\alpha$ emission from $^{284}$Nh*, $T_{1/2} = 900^{+70}_{-60}$ ms, $BR_{\alpha}$ = 100%**.

| $E_{\alpha}$(c.m.) | $E_{\alpha}$(lab) | $I_{\alpha}$(abs) | $J^{\pi}_{f}$ | $E_{daughter}(^{280}$Rg) | coincident $\gamma$-rays (keV) | HF |
|---|---|---|---|---|---|---|
| 9.23-10.31 | 9.10-10.16 | 100%** | | | | |

* All values from [2022Og08], which contains all measured data. Fig. 1 of this reference suggests a 100% peak at ≈9.97 MeV.
** Only $\alpha$-decay has been observed.

**Table 8**
direct $\alpha$ emission from $^{288}$Mc*, $T_{1/2}$ = $193^{15}_{-13}$ ms, $BR_\alpha$ = 100%**.

| $E_\alpha$(c.m.) | $E_\alpha$(lab) | $I_\alpha$(abs) | $J^\pi_f$ | $E_{daughter}$($^{284}$Nh) | coincident $\gamma$-rays (keV) | HF |
|---|---|---|---|---|---|---|
| 10.35-10.82 | 10.21-10.67 | 100%** | | | | |

* All values from [2022Og08], which contains all measured data. Fig. 1 of this reference suggests two major peaks at 10.36 MeV (≈30 counts) and 10.50 MeV (≈90 counts).

** Only $\alpha$-decay has been observed.

## References used in the Tables


[1] **1976HoZB** R. W. Lougheed, J. H. Landrum, D. C. Hoffman, W. R. Daniels, J. B. Wilhelmy, M. E. Bunker, J. W. Starner, S. V. Jackson, CERN-76-13, p. 563 (1976).

[2] **1981Lo15** R. W. Lougheed, E. K. Hulet, J. F. Wild, B. J. Qualheim, J. E. Evans, R. J. Dupzyk, J. Inorg. Nucl. Chem. **43**, 2239 (1981). https://doi.org/10.1016/0022-1902(81).80239-4

[3] **1986Lo16** R. W. Lougheed, E. K. Hulet, R. J. Dougan, J. F. Wild, R. J. Dupzyk, C. M. Henderson, K. J. Moody, R. L. Hahn, K. Summerer, G. Bethune, J. Less-Common Met. **122**, 461 (1986). https://doi.org/10.1016/0022-5088(86).90442-X

[4] **1987HaZL** H. L. Hall, R. A. Henderson, K. E. Gregorich, D. M. Lee, D. C. Hoffman, J. B. Wilhelmy, M. E. Bunker, J. W. Starner, M. Fowler, P. Lysaight, LBL-22820, p. 54 (1987).

[5] **1987HuZW** E. K. Hulet, Contrib. Proc. 5th Int. Conf. Nuclei Far from Stability, Rosseau Lake, Canada, H2 (1987).

[6] **1987Mo29** K. J. Moody, W. Bruchle, M. Brugger, H. Gaggeler, B. Haefner, M. Schadel, K. Summerer, H. Tetzlaff, G. Herrmann, N. Kaffrell, J. V. Kratz, J. Rogowski, N. Trautmann, M. Skalberg, G. Skarnemark, J. Alstad, M. M. Fowler, Z. Phys. A**328**, 417 (1987).

[7] **1989Ha10** H. L. Hall, K. E. Gregorich, R. A. Henderson, D. M. Lee, D. C. Hoffman, M. E. Bunker, M. M. Fowler, P. Lysaight, J. W. Starner, J. B. Wilhelmy, Phys. Rev. C**39**, 1866 (1989). https://doi.org/10.1103/PhysRevC.39.1866

[8] **1989Hu09** E. K. Hulet, J. F. Wild, R. J. Dougan, R. W. Lougheed, J. H. Landrum, A. D. Dougan, P. A. Baisden, C. M. Henderson, R. J. Dupzyk, R. L. Hahn, M. Schadel, K. Summerer, G. R. Bethune, Phys. Rev. C**40**, 770 (1989). https://doi.org/10.1103/PhysRevC.40.770

[9] **1990Wi01** J. F. Wild, J. van Aarle, W. Westmeier, R. W. Lougheed, E. K. Hulet, K. J. Moody, R. J. Dougan, E. -A. Koop, R. E. Glaser, R. Brandt, P. Patzelt, Phys. Rev. C**41**, 640 (1990). https://doi.org/10.1103/PhysRevC.41.640

[10] **1992LoZV** R. W. Lougheed, E. K. Hulet, J. F. Wild, R. J. Dougan, R. J. Dupzyk, C. M. Henderson, K. J. Moody, R. E. Glaser, R. L. Hahn, K. Summerer, G. R. Bethune, UCRL-JC-109951 (1992).

[11] **2003OgZY** Yu. Ts. Oganessian, V. K. Utyonkov, Yu. V. Lobanov, F. Sh. Abdullin, A. N. Polyakov, I. V. Shirokovsky, Yu. S. Tsyganov, G. G. Gulbekian, S. L. Bogomolov, A. N. Mezentsev, S. Iliev, V. G. Subbotin, A. M. Sukhov, A. A. Voinov, G. V. Buklanov, K. Subotic, V. I. Zagrebaev, M. G. Itkis, J. B. Patin, K. J. Moody, J. F. Wild, M. A. Stoyer, N. J. Stoyer, D. A. Shaughnessy, J. M. Kenneally, R. W. Lougheed, JINR-E7-2003-178 (2003).

[12] **2004Og03** Yu. Ts. Oganessian, V. K. Utyonkov, Yu. V. Lobanov, F. Sh. Abdullin, A. N. Polyakov, I. V. Shirokovsky, Yu. S. Tsyganov, G. G. Gulbekian, S. L. Bogomolov, A. N. Mezentsev, S. Iliev, V. G. Subbotin, A. M. Sukhov, A. A. Voinov, G. V. Buklanov, K. Subotic, V. I. Zagrebaev, M. G. Itkis, J. B. Patin, K. J. Moody, J. F. Wild, M. A. Stoyer, N. J. Stoyer, D. A. Shaughnessy, J. M. Kenneally, R. W. Lougheed, Phys. Rev. C **69**, 021601 (2004). ; Erratum Phys. Rev. C 69, 029902 (2004). https://doi.org/10.1103/PhysRevC.69.021601

[13] **2004Og10** Yu. Ts. Oganessian, V. K. Utyonkov, Yu. V. Lobanov, F. Sh. Abdullin, A. N. Polyakov, I. V. Shirokovsky, Yu. S. Tsyganov, G. G. Gulbekian, S. L. Bogomolov, B. N. Gikal, A. N. Mezentsev, S. Iliev, V. G. Subbotin, A. M. Sukhov, A. A. Voinov, G. V. Buklanov, K. Subotic, V. I. Zagrebaev, M. G. Itkis, K. J. Moody, J. F. Wild, M. A. Stoyer, N. J. Stoyer, D. A. Shaughnessy, J. M. Kenneally, J. B. Patin, R. W. Lougheed, Prog. Theor. Phys. (Kyoto). , Suppl. **154**, 406 (2004). https://doi.org/10.1143/PTPS.154.406

[14] **2004Pe17** K. Perajarvi, J. Cerny, L. M. Fraile, A. Jokinen, A. Kankainen, U. Koster, J. Aysto, for the ISOLDE Collaboration, Eur. Phys. J. A **21**, 7 (2004). https://doi.org/10.1140/epja/i2004-10038-4

[15] **2005Og02** Yu. Ts. Oganessian, V. K. Utyonkov, S. N. Dmitriev, Yu. V. Lobanov, M. G. Itkis, A. N. Polyakov, Yu. S. Tsyganov, A. N. Mezentsev, A. V. Yeremin, A. A. Voinov, E. A. Sokol, G. G. Gulbekian, S. L. Bogomolov, S. Iliev, V. G. Subbotin, A. M. Sukhov, G. V. Buklanov, S. V. Shishkin, V. I. Chepigin, G. K. Vostokin, N. V. Aksenov, M. Hussonnois, K. Subotic,

V. I. Zagrebaev, K. J. Moody, J. B. Patin, J. F. Wild, M. A. Stoyer, N. J. Stoyer, D. A. Shaughnessy, J. M. Kenneally, P. A. Wilk, R. W. Lougheed, H. W. Gaggeler, D. Schumann, H. Bruchertseifer, R. Eichler, Phys. Rev. C **72**, 034611 (2005). https://doi.org/10.1103/PhysRevC.72.034611

[16] **2007Og05** Yu. Ts. Oganessian, Nucl. Phys. A**787**, 343c (2007). https://doi.org/10.1016/j.nuclphysa.2006.12.055

[17] **2010Al24** H. Alvarez-Pol, J. Benlliure, E. Casarejos, L. Audouin, D. Cortina-Gil, T. Enqvist, B. Fernandez-Dominguez, A. R. Junghans, B. Jurado, P. Napolitani, J. Pereira, F. Rejmund, K. -H. Schmidt, O. Yordanov, Phys. Rev. C **82**, 041602 (2010). https://doi.org/10.1103/PhysRevC.82.041602

[18] **2010Ch19** L. Chen, W. R. Plass, H. Geissel, R. Knobel, C. Kozhuharov, Yu. A. Litvinov, Z. Patyk, C. Scheidenberger, K. Siegien-Iwaniuk, B. Sun, H. Weick, K. Beckert, P. Beller, F. Bosch, D. Boutin, L. Caceres, J. J. Carroll, D. M. Cullen, I. J. Cullen, B. Franzke, J. Gerl, M. Gorska, G. A. Jones, A. Kishada, J. Kurcewicz, S. A. Litvinov, Z. Liu, S. Mandal, F. Montes, G. Munzenberg, F. Nolden, T. Ohtsubo, Zs. Podolyak, R. Propri, S. Rigby, N. Saito, T. Saito, M. Shindo, M. Steck, P. Ugorowski, P. M. Walker, S. Williams, M. Winkler, H. -J. Wollersheim, T. Yamaguchi, Phys. Lett. B **691**, 234 (2010). https://doi.org/10.1016/j.physletb.2010.05.078

[19] **2012Og02** Yu. Ts. Oganessian, F. Sh. Abdullin, S. N. Dmitriev, J. M. Gostic, J. H. Hamilton, R. A. Henderson, M. G. Itkis, K. J. Moody, A. N. Polyakov, A. V. Ramayya, J. B. Roberto, K. P. Rykaczewski, R. N. Sagaidak, D. A. Shaughnessy, I. V. Shirokovsky, M. A. Stoyer, V. G. Subbotin, A. M. Sukhov, Yu. S. Tsyganov, V. K. Utyonkov, A. A. Voinov, G. K. Vostokin, Phys. Rev. Lett. **108**, 022502 (2012). https://doi.org/10.1103/PhysRevLett.108.022502

[20] **2012OgZZ** Yu. Ts. Oganessian, F. Sh. Abdullin, S. N. Dmitriev, J. M. Gostic, J. H. Hamilton, R. A. Henderson, M. G. Itkis, K. J. Moody, A. N. Polyakov, A. V. Ramayya, J. B. Roberto, K. P. Rykaczewski, R. N. Sagaidak, D. A. Shaughnessy, I. V. Shirokovsky, M. A. Stoyer, V. G. Subbotin, A. M. Sukhov, Yu. S. Tsyganov, V. K. Utyonkov, A. A. Voinov, G. K. Vostokin, JINR-E7-2012-58 (2012).

[21] **2013Og01** Yu. Ts. Oganessian, F. Sh. Abdullin, S. N. Dmitriev, J. M. Gostic, J. H. Hamilton, R. A. Henderson, M. G. Itkis, K. J. Moody, A. N. Polyakov, A. V. Ramayya, J. B. Roberto, K. P. Rykaczewski, R. N. Sagaidak, D. A. Shaughnessy, I. V. Shirokovsky, M. A. Stoyer, N. J. Stoyer, V. G. Subbotin, A. M. Sukhov, Yu. S. Tsyganov, V. K. Utyonkov, A. A. Voinov, G. K. Vostokin, Phys. Rev. C **87**, 014302 (2013). https://doi.org/10.1103/PhysRevC.87.014302

[22] **2013Ru11** D. Rudolph, U. Forsberg, P. Golubev, L. G. Sarmiento, A. Yakushev, L. -L. Andersson, A. Di Nitto, Ch. E. Dullmann, J. M. Gates, K. E. Gregorich, C. J. Gross, F. P. Hessberger, R. -D. Herzberg, J. Khuyagbaatar, J. V. Kratz, K. Rykaczewski, M. Schadel, S. Aberg, D. Ackermann, M. Block, H. Brand, B. G. Carlsson, D. Cox, X. Derkx, K. Eberhardt, J. Even, C. Fahlander, J. Gerl, E. Jager, B. Kindler, J. Krier, I. Kojouharov, N. Kurz, B. Lommel, A. Mistry, C. Mokry, H. Nitsche, J. P. Omtvedt, P. Papadakis, I. Ragnarsson, J. Runke, H. Schaffner, B. Schausten, P. Thorle-Pospiech, T. Torres, T. Traut, N. Trautmann, A. Turler, A. Ward, D. E. Ward, N. Wiehl, Phys. Rev. Lett. **111**, 112502 (2013). https://doi.org/10.1103/PhysRevLett.111.112502

[23] **2014Ru04** D. Rudolph, U. Forsberg, P. Golubev, L. G. Sarmiento, A. Yakushev, L. -L. Andersson, A. Di Nitto, Ch. E. Dullmann, J. M. Gates, K. E. Gregorich, C. J. Gross, R. -D. Herzberg, F. P. Hessberger, J. Khuyagbaatar, J. V. Kratz, K. Rykaczewski, M. Schadel, S. Aberg, D. Ackermann, M. Block, H. Brand, B. G. Carlsson, D. Cox, X. Derkx, K. Eberhardt, J. Even, C. Fahlander, J. Gerl, E. Jager, B. Kindler, J. Krier, I. Kojouharov, N. Kurz, B. Lommel, A. Mistry, C. Mokry, H. Nitsche, J. P. Omtvedt, P. Papadakis, I. Ragnarsson, J. Runke, H. Schaffner, B. Schausten, P. Thorle-Pospiech, T. Torres, T. Traut, N. Trautmann, A. Turler, A. Ward, D. E. Ward, N. Wiehl, Acta Phys. Pol. B**45**, 263 (2014). https://doi.org/10.5506/APhysPolB.45.263

[24] **2015Ga24** J. M. Gates, K. E. Gregorich, O. R. Gothe, E. C. Uribe, G. K. Pang, D. L. Bleuel, M. Block, R. M. Clark, C. M. Campbell, H. L. Crawford, M. Cromaz, A. Di Nitto, Ch. E. Dullmann, N. E. Esker, C. Fahlander, P. Fallon, R. M. Farjadi, U. Forsberg, J. Khuyagbaatar, W. Loveland, A. O. Macchiavelli, E. M. May, P. R. Mudder, D. T. Olive, A. C. Rice, J. Rissanen, D. Rudolph, L. G. Sarmiento, J. A. Shusterman, M. A. Stoyer, A. Wiens, A. Yakushev, H. Nitsche, Phys. Rev. C **92**, 021301 (2015). https://doi.org/10.1103/PhysRevC.92.021301

[25] **2015Ru11** D. Rudolph, U. Forsberg, P. Golubev, L. G. Sarmiento, A. Yakushev, L. -L. Andersson, A. Di Nitto, Ch. E. Dullmann, J. M. Gates, K. E. Gregorich, C. J. Gross, R. -D. Herzberg, F. P. Hessberger, J. Khuyagbaatar, J. V. Kratz, K. Rykaczewski, M. Schadel, S. Aberg, D. Ackermann, M. Block, H. Brand, B. G. Carlsson, D. Cox, X. Derkx, K. Eberhardt, J. Even, C. Fahlander, J. Gerl, E. Jager, B. Kindler, J. Krier, I. Kojouharov, N. Kurz, B. Lommel, A. Mistry, C. Mokry, H. Nitsche, J. P. Omtvedt, P. Papadakis, I. Ragnarsson, J. Runke, H. Schaffner, B. Schausten, P. Thorle-Pospiech, T. Torres, T. Traut, N. Trautmann, A. Turler, A. Ward, D. E. Ward, N. Wiehl, J. Radioanal. Nucl. Chem. **303**, 1185 (2015). https://doi.org/10.1007/s10967-014-3445-y

[26] **2016Fo10** U. Forsberg, D. Rudolph, L. -L. Andersson, A. Di Nitto, Ch. E. Dullmann, C. Fahlander, J. M. Gates, P. Golubev, K. E. Gregorich, C. J. Gross, R. -D. Herzberg, F. P. Hessberger, J. Khuyagbaatar, J. V. Kratz, K. Rykaczewski, L. G. Sarmiento, M. Schadel, A. Yakushev, S. Aberg, D. Ackermann, M. Block, H. Brand, B. G. Carlsson, D. Cox, X. Derkx, J.

Dobaczewski, K. Eberhardt, J. Even, J. Gerl, E. Jager, B. Kindler, J. Krier, I. Kojouharov, N. Kurz, B. Lommel, A. Mistry, C. Mokry, W. Nazarewicz, H. Nitsche, J. P. Omtvedt, P. Papadakis, I. Ragnarsson, J. Runke, H. Schaffner, B. Schausten, Y. Shi, P. Thorle-Pospiech, T. Torres, T. Traut, N. Trautmann, A. Turler, A. Ward, D. E. Ward, N. Wiehl, Nucl. Phys. A**953**, 117 (2016). https://doi.org/10.1016/j.nuclphysa.2016.04.025

[27] **2017Ak02** N. V. Aksenov, P. Steinegger, F. Sh. Abdullin, Y. V. Albin, G. A. Bozhikov, V. I. Chepigin, R. Eichler, V. Ya. Lebedev, A. Sh. Madumarov, O. N. Malyshev, O. V. Petrushkin, A. N. Polyakov, Y. A. Popov, A. V. Sabelnikov, R. N. Sagaidak, I. V. Shirokovsky, M. V. Shumeiko, G. Ya. Starodub, Y. S. Tsyganov, V. K. Utyonkov, A. A. Voinov, G. K. Vostokin, A. V. Yeremin, S. N. Dmitriev, Eur. Phys. J. A **53**, 158 (2017). https://doi.org/10.1140/epja/i2017-12348-8

[28] **2018Ga34** J. M. Gates, G. K. Pang, J. L. Pore, K. E. Gregorich, J. T. Kwarsick, G. Savard, N. E. Esker, M. Kireeff Covo, M. J. Mogannam, J. C. Batchelder, D. L. Bleuel, R. M. Clark, H. L. Crawford, P. Fallon, K. K. Hubbard, A. M. Hurst, I. T. Kolaja, A. O. Macchiavelli, C. Morse, R. Orford, L. Phair, M. A. Stoyer, Phys. Rev. Lett. **121**, 222501 (2018). https://doi.org/10.1103/PhysRevLett.121.222501

[29] **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

[30] **2022Og07** Yu. Ts. Oganessian, V. K. Utyonkov, N. D. Kovrizhnykh, F. Sh. Abdullin, S. N. Dmitriev, D. Ibadullayev, M. G. Itkis, D. A. Kuznetsov, O. V. Petrushkin, A. V. Podshibiakin, A. N. Polyakov, A. G. Popeko, R. N. Sagaidak, L. Schlattauer, I. V. Shirokovski, V. D. Shubin, M. V. Shumeiko, D. I. Solovyev, Yu. S. Tsyganov, A. A. Voinov, V. G. Subbotin, A. Yu. Bodrov, A. V. Sabelnikov, A. V. Khalkin, V. B. Zlokazov, K. P. Rykaczewski, T. T. King, J. B. Roberto, N. T. Brewer, R. K. Grzywacz, Z. G. Gan, Z. Y. Zhang, M. H. Huang, H. B. Yang, Phys. Rev. C **106**, L031301 (2022). https://doi.org/10.1103/PhysRevC.106.L031301

[31] **2022Og08** Yu. Ts. Oganessian, V. K. Utyonkov, N. D. Kovrizhnykh, F. Sh. Abdullin, S. N. Dmitriev, A. A. Dzhioev, D. Ibadullayev, M. G. Itkis, A. V. Karpov, D. A. Kuznetsov, O. V. Petrushkin, A. V. Podshibiakin, A. N. Polyakov, A. G. Popeko, I. S. Rogov, R. N. Sagaidak, L. Schlattauer, V. D. Shubin, M. V. Shumeiko, D. I. Solovyev, Yu. S. Tsyganov, A. A. Voinov, V. G. Subbotin, A. Yu. Bodrov, A. V. Sabelnikov, A. V. Khalkin, K. P. Rykaczewski, T. T. King, J. B. Roberto, N. T. Brewer, R. K. Grzywacz, Z. G. Gan, Z. Y. Zhang, M. H. Huang, H. B. Yang, Phys. Rev. C **106**, 064306 (2022). https://doi.org/10.1103/PhysRevC.106.064306

[32] **2023Ko22** N. D. Kovrizhnykh, Yu. Ts. Oganessian, V. K. Utyonkov, F. Sh. Abdullin, S. N. Dmitriev, A. A. Dzhioev, D. Ibadullayev, M. G. Itkis, A. V. Karpov, D. A. Kuznetsov, O. V. Petrushkin, A. V. Podshibiakin, A. N. Polyakov, A. G. Popeko, I. S. Rogov, R. N. Sagaidak, L. Schlattauer, V. D. Shubin, M. V. Shumeiko, D. I. Solovyev, Yu. S. Tsyganov, A. A. Voinov, V. G. Subbotin, A. Yu. Bodrov, A. V. Sabelnikov, A. V. Khalkin, Bull. Rus. Acad. Sci. Phys. **87**, 1098 (2023). https://doi.org/10.3103/S106287382370291X

[33] **2023Ku17** A. A. Kuznetsova, Bull. Rus. Acad. Sci. Phys. **87**, 1105 (2023). https://doi.org/10.3103/S1062873823702921