On the Nature of Yrast States in Neutron-Rich Polonium Isotopes

Presented by: Razvan Lica, IFIN-HH

Experiment spokespersons:

R. Lica, *IFIN-HH (Romania)*
A.N. Andreyev, *University of York (UK)*

Theory:

H. Naidja*, Universite Constantine (Algeria)*
A. Blazhev, *IKP Koln (Germany)*

On behalf of the IS650 and IDS Collaborations

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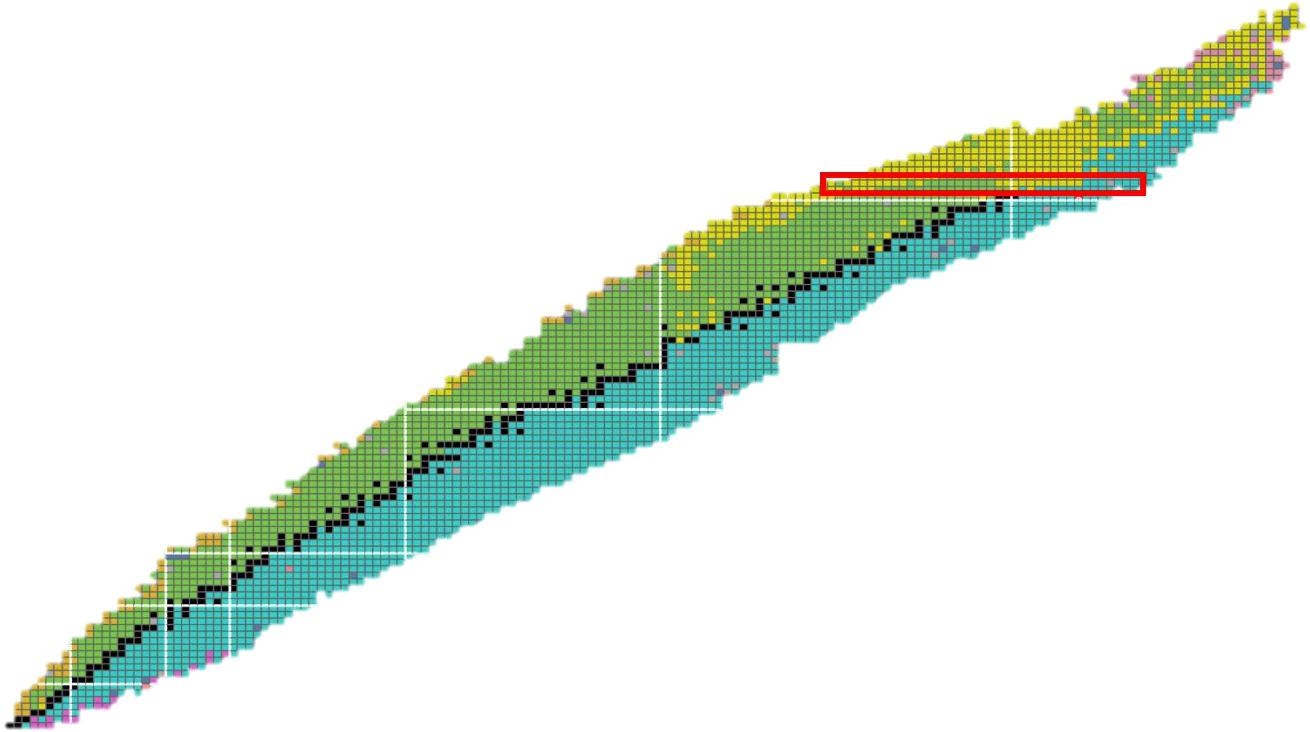
Physics motivation

- Po isotopes (Z = 84)

→ text-book example for studying the seniority scheme
→ presence of $\pi(h_{9/2})$ 8^+ isomers in the even-even Po



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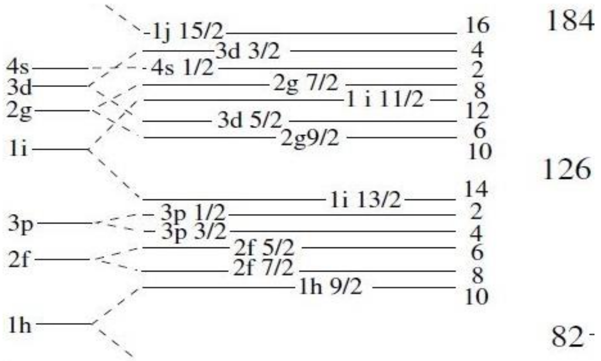
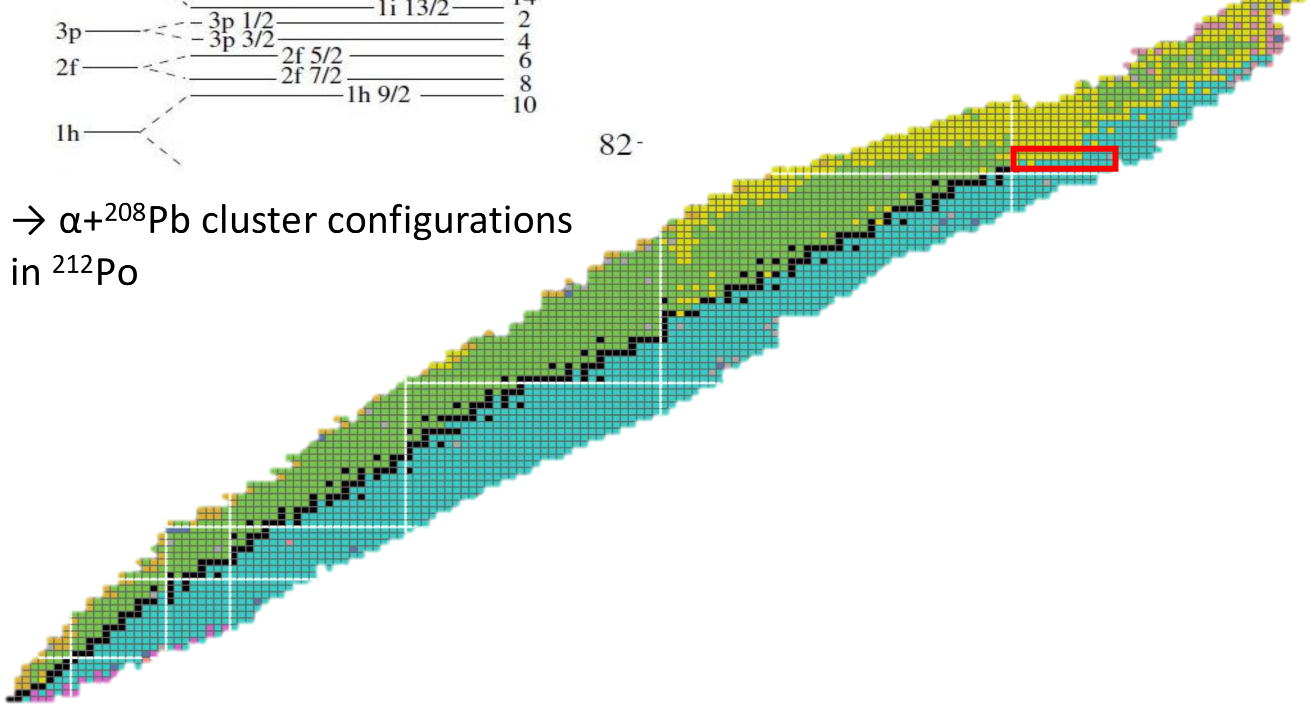
- Po isotopes with N>126

→ shell-model test using ^{208}Pb as an inert core

→ study the filling of the $\nu g_{9/2}$ orbital





→ α+^{208}Pb cluster configurations in ^{212}Po

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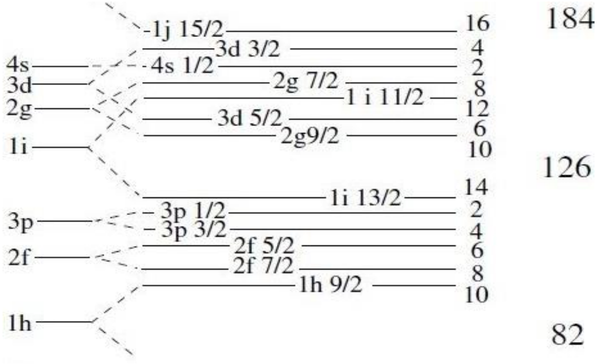
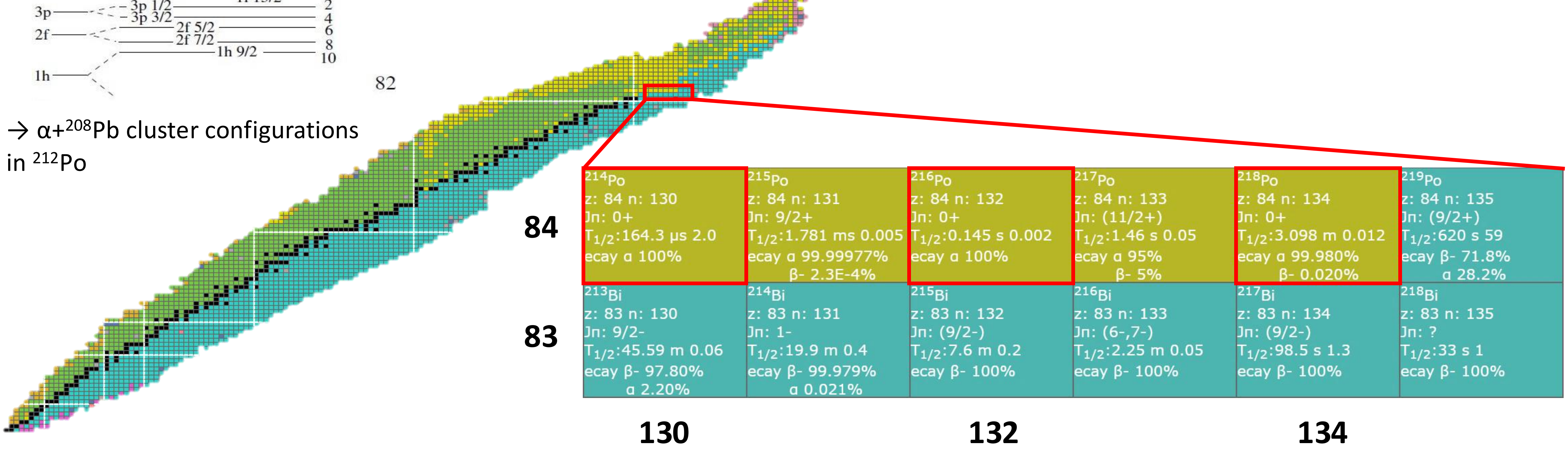


→ α+^{208}Pb cluster configurations in ^{212}Po

- ^{214,216,218}Po

→ Lack of experimental data for the heavier Po isotopes due to difficulties in producing them using stable beams



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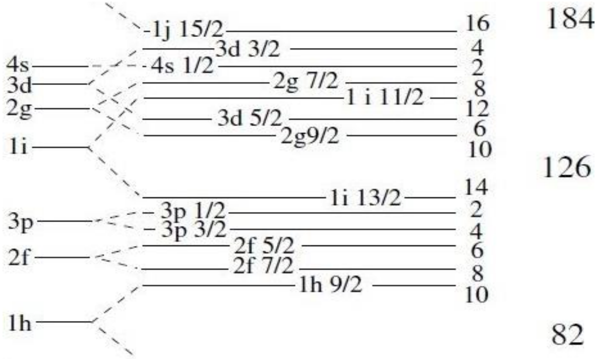

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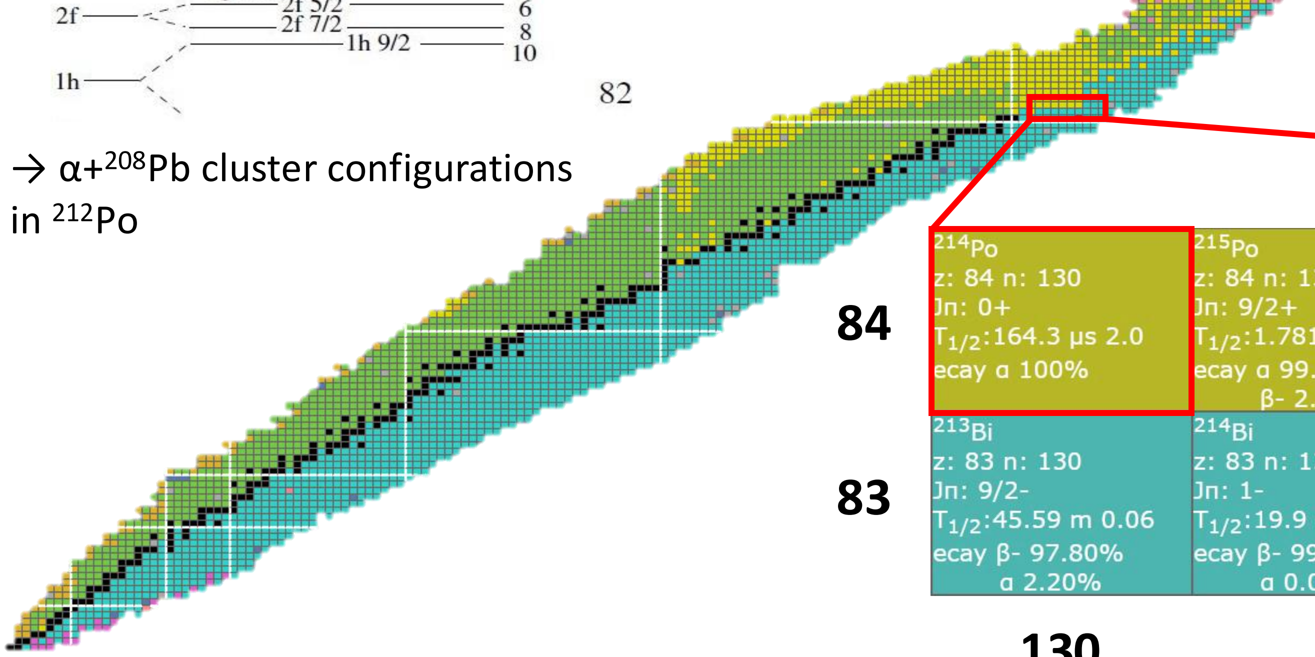
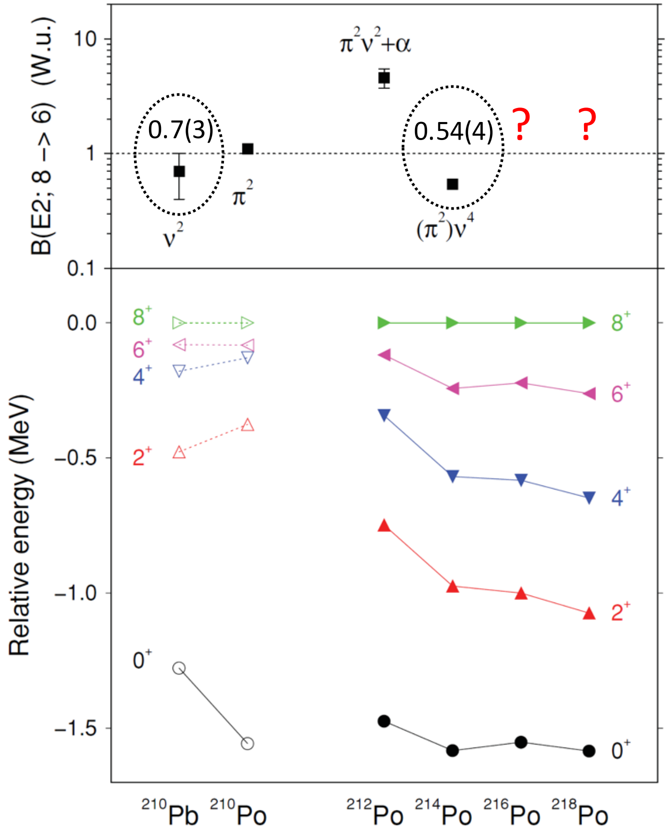


	130	131	132	133	134	135
84	^{214}Po z: 84 n: 130 Jπ: 0+ $T_{1/2}$:164.3 μs 2.0 ecay α 100%	^{215}Po z: 84 n: 131 Jπ: 9/2+ $T_{1/2}$:1.781 ms 0.005 ecay α 99.99977% β- 2.3E-4%	^{216}Po z: 84 n: 132 Jπ: 0+ $T_{1/2}$:0.145 s 0.002 ecay α 100%	^{217}Po z: 84 n: 133 Jπ: (11/2+) $T_{1/2}$:1.46 s 0.05 ecay α 95% β- 5%	^{218}Po z: 84 n: 134 Jπ: 0+ $T_{1/2}$:3.098 m 0.012 ecay α 99.980% β- 0.020%	^{219}Po z: 84 n: 135 Jπ: (9/2+) $T_{1/2}$:620 s 59 ecay β- 71.8% α 28.2%
83	^{213}Bi z: 83 n: 130 Jπ: 9/2- $T_{1/2}$:45.59 m 0.06 ecay β- 97.80% α 2.20%	^{214}Bi z: 83 n: 131 Jπ: 1- $T_{1/2}$:19.9 m 0.4 ecay β- 99.979% α 0.021%	^{215}Bi z: 83 n: 132 Jπ: (9/2-) $T_{1/2}$:7.6 m 0.2 ecay β- 100%	^{216}Bi z: 83 n: 133 Jπ: (6-,7-) $T_{1/2}$:2.25 m 0.05 ecay β- 100%	^{217}Bi z: 83 n: 134 Jπ: (9/2-) $T_{1/2}$:98.5 s 1.3 ecay β- 100%	^{218}Bi z: 83 n: 135 Jπ: ? $T_{1/2}$:33 s 1 ecay β- 100%

130 132 134

- ^{214,216,218}Po

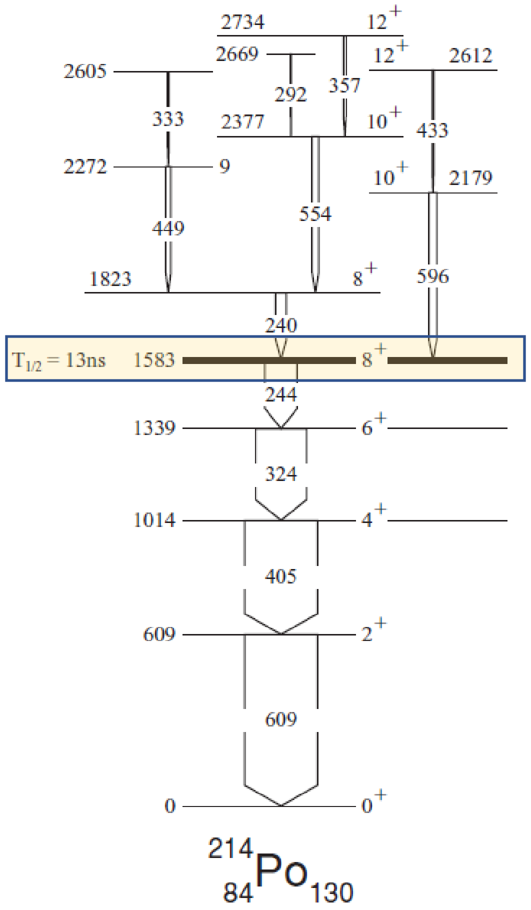
→ Lack of experimental data for the heavier Po isotopes due to difficulties in producing them using stable beams
→ Recent measurement by *Astier et al.* [1] of the 8_1^{+} state half-life $T_{1/2}$= 13(1) ns in ^{214}Po indicating a similar excitation mechanism as for ^{210}Pb, one-neutron-pair breaking

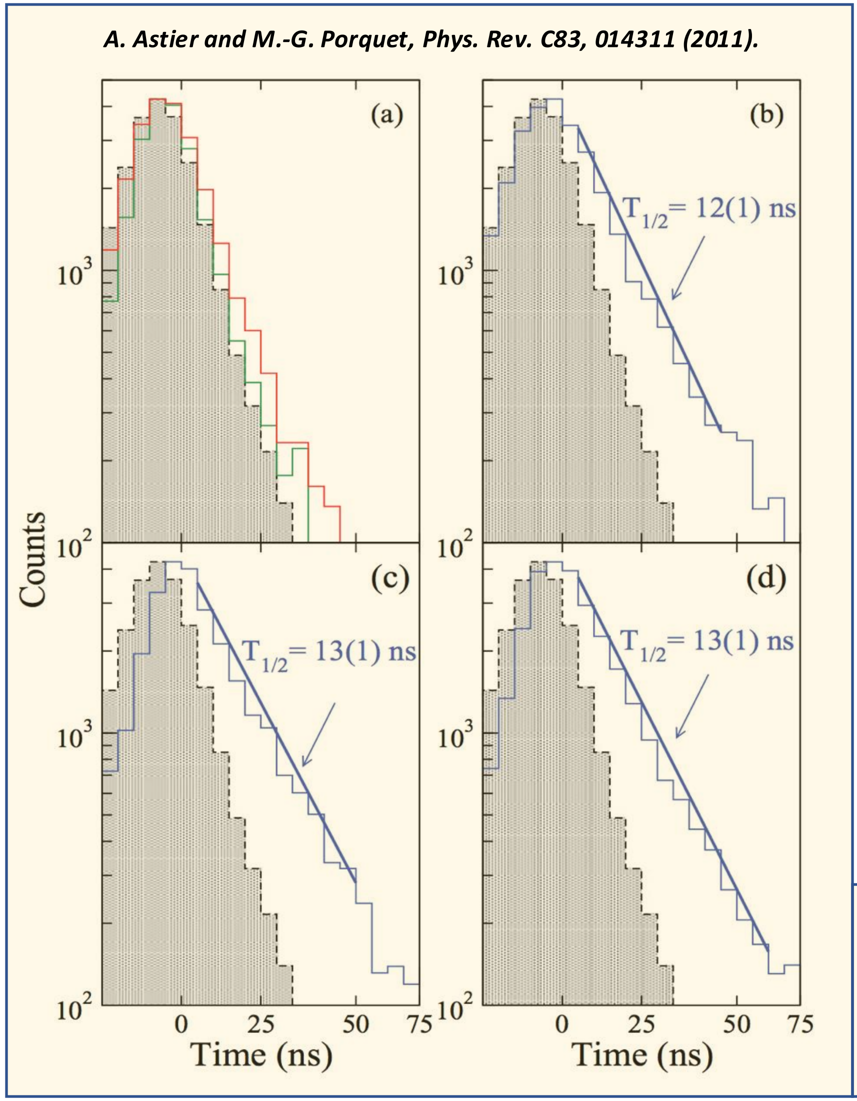


[1] A. Astier and M.-G. Porquet, Phys. Rev. C83, 014311 (2011).

Physics motivation

^{214}Bi - Previous study of Astier (2011)





^{18}O + ^{208}Pb reaction at 85-MeV + Euroball IV @IReS (Strasbourg)

$T_{1/2}$ (8^+) = 13(1) ns using HPGe detectors

B(E2; $8^+ \rightarrow 6^+$) = 0.54(4) W.u.

Time distributions between the emissions of γ rays of ^{214}Po showing either prompt coincidences [curves in red and green, panel (a)] or delayed ones corresponding to the decay of the 1583-keV state [curves in blue, panels (b), (c), and (d)].

Physics motivation

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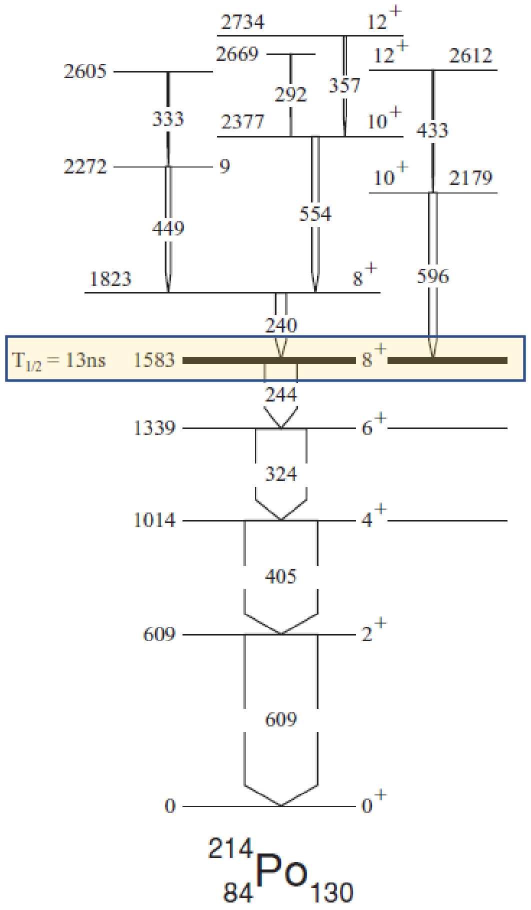

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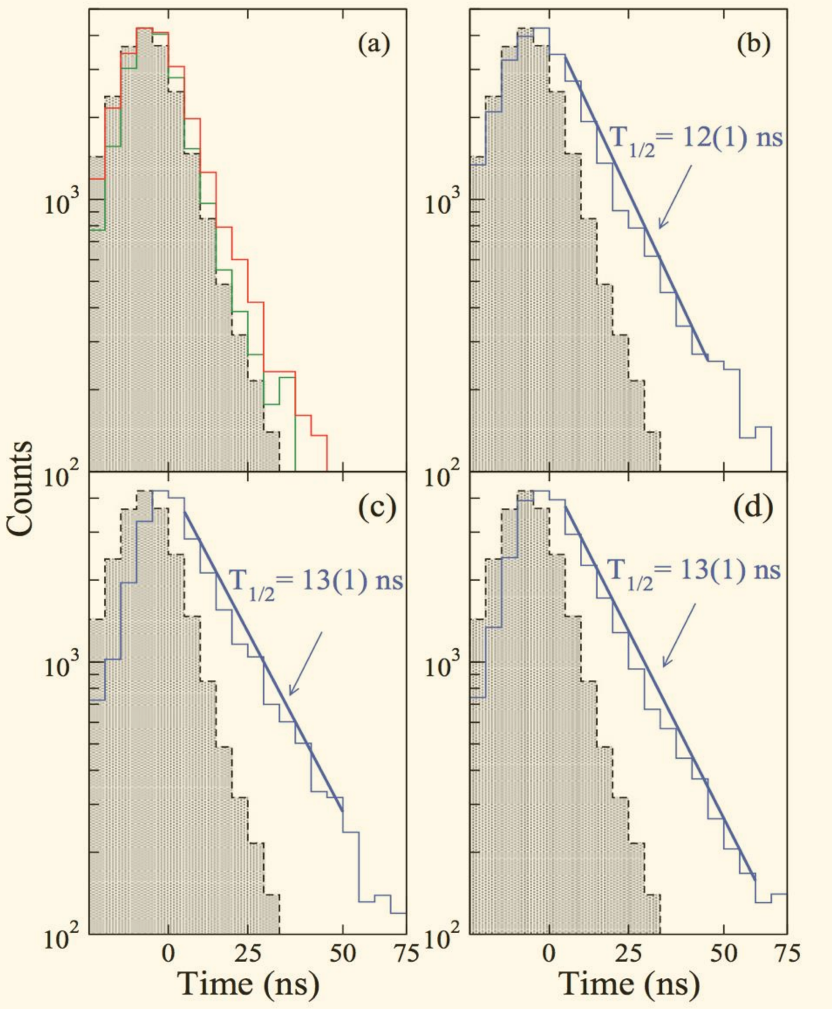

Understand the nature of yrast states in neutron-rich Po: is it really one neutron-pair breaking for the 8^+ ?

- → $T_{1/2}$(8+) can be re-checked using fast-timing detectors
- → measure other yrast states
- → go to heavier masses
- → compare with Shell Model calculations

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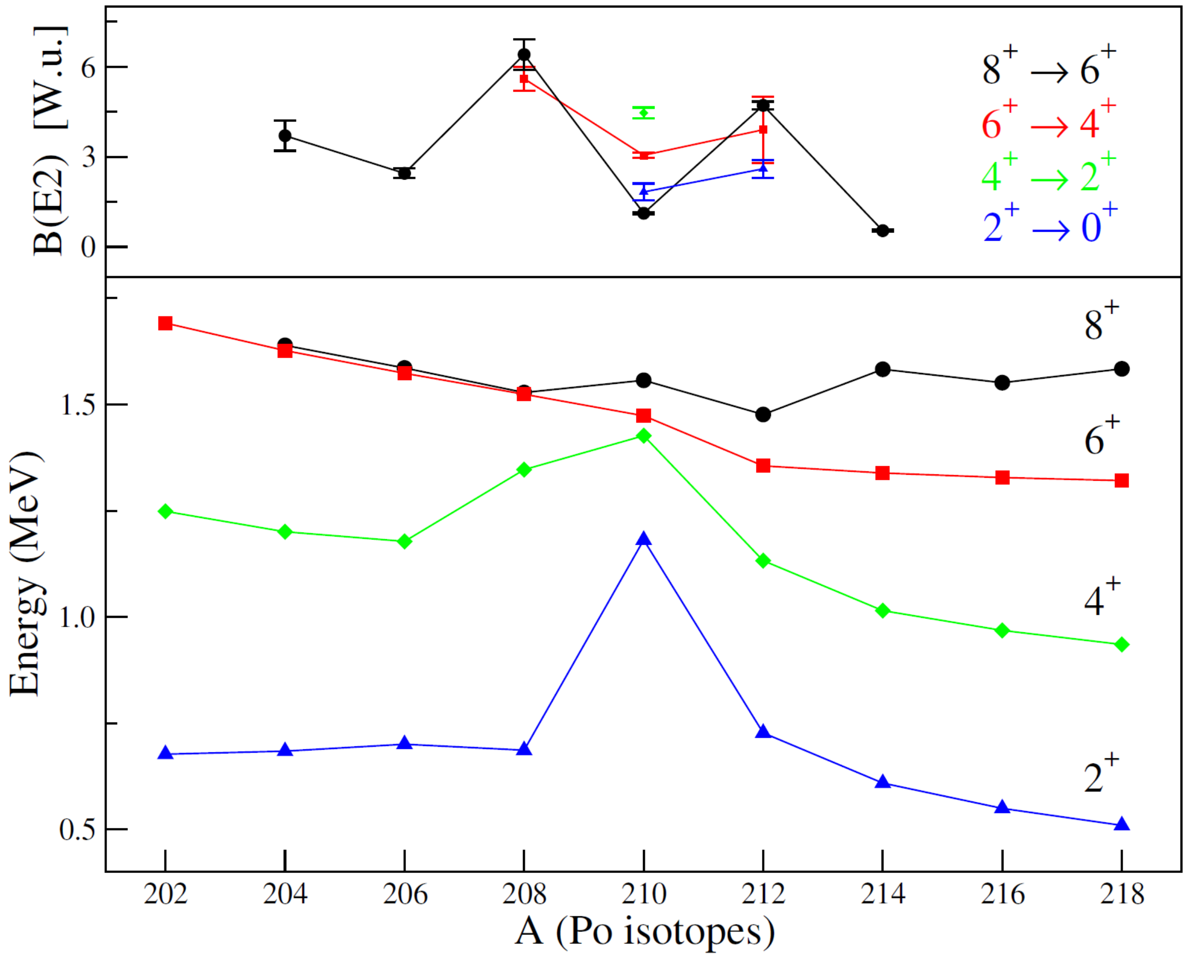
Lifetime estimates

- Half-lives for yrast states in ^{214,216,218}Po estimated using:

B(E2) < 10 W.u. for 2,4,6$^+$ states

B(E2) ~ 0.5 W.u. for 8$^+$ states

Nucleus/Yield	J^π	E_γ (keV)	$T_{1/2}$	Events/shift
^{214}Po 10^4 ions/s	2_1^+	609.0	>9 ps	4.9×10^4
	4_1^+	405.4	>68 ps	9.5×10^4
	6_1^+	324.4	>210 ps	1.7×10^5
	8_1^+	244.1	13(1) ns [6]	7.7×10^5
^{216}Po 10^3 ions/s	2_1^+	549.7	>15 ps	5.9×10^3
	4_1^+	418.8	>58 ps	9.7×10^3
	6_1^+	359.5	>120 ps	1.7×10^4
	8_1^+	223.4	~27 ns	7.6×10^4
^{218}Po 10^2 ions/s	2_1^+	509.7	>21 ps	6.5×10^2
	4_1^+	425.5	>52 ps	1.1×10^3
	6_1^+	385.7	>86 ps	1.4×10^3
	8_1^+	263.0	~12 ns	6.1×10^3

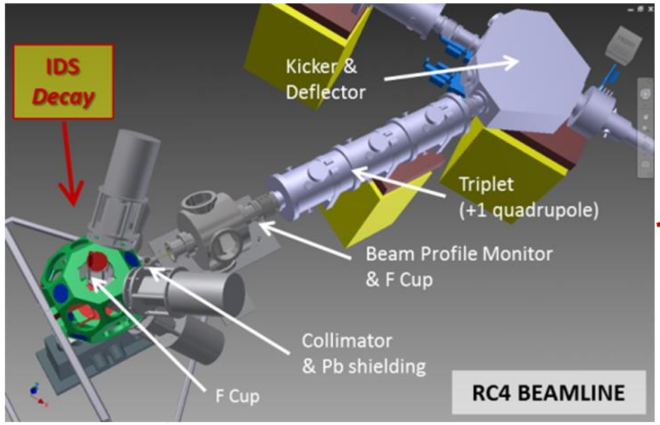


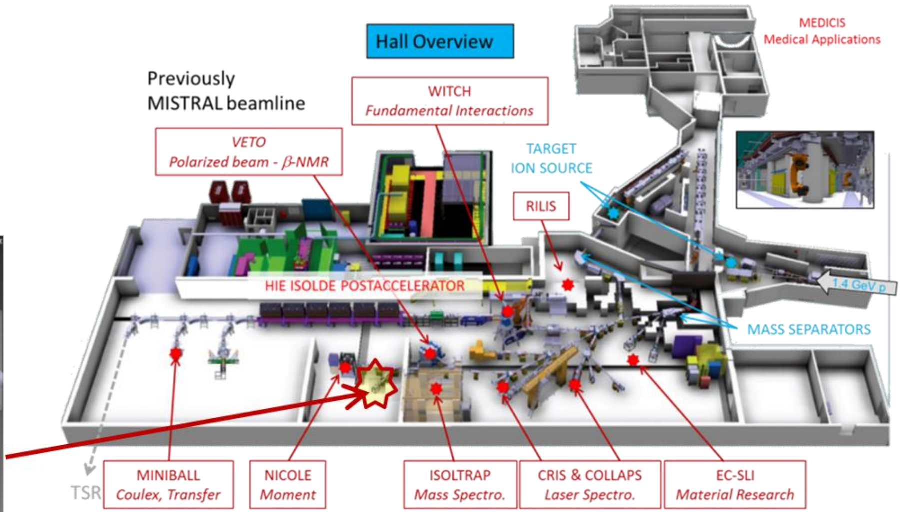
- **Within the reach of the fast-timing setup available at IDS (> 10 ps)**
- **Can be populated via β^- decay from high-spin states in $^{214-218}$Bi**

The ISOLDE Decay Station

- Permanent setup at the low-energy branch of ISOLDE

- **Physics programme**
  - Nuclear structure physics (80%)
  - Nuclear astrophysics (10%)
  - Nuclear industry and medicine (5%)
  - Solid state physics (5%)





≈150 researchers from 19 institutions

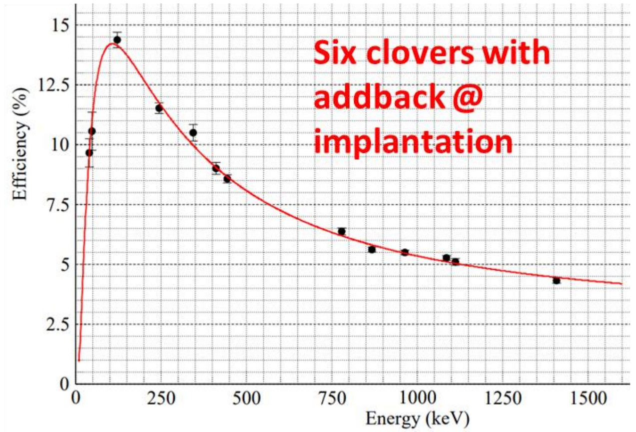
- Belgium (KU Leuven)
- Denmark (Aarhus University, Department of Physics and Astronomy)
- Finland (University of Jyväskylä)
- Germany (Institut für Kernphysik - Universität zu Köln)
- Italy (Università degli Studi e INFN Milano)
- Poland (Faculty of Physics, University of Warsaw)
- Romania (IFIN-HH Bucharest)
- South Africa (iThemba LABS; University of the Western Cape)
- Spain (IEM-CSIC Madrid; IFIC-CSIC Valencia; UCM Madrid)
- Sweden (Lund University)
- Switzerland (CERN - ISOLDE)
- UK (STFC Daresbury Laboratory; University of Liverpool; University of York; University of Surrey)
- USA (University of Tennessee)

IDS is supported by 19 institutes across the world, and used by many more globally.

Core IDS setup

Six HPGE clover detectors (+6 Aug. 2024)

- 4 crystals / clover
- 20% relative eff. / crystal
- 2 thin-carbon window detectors for low-E (~10 keV)

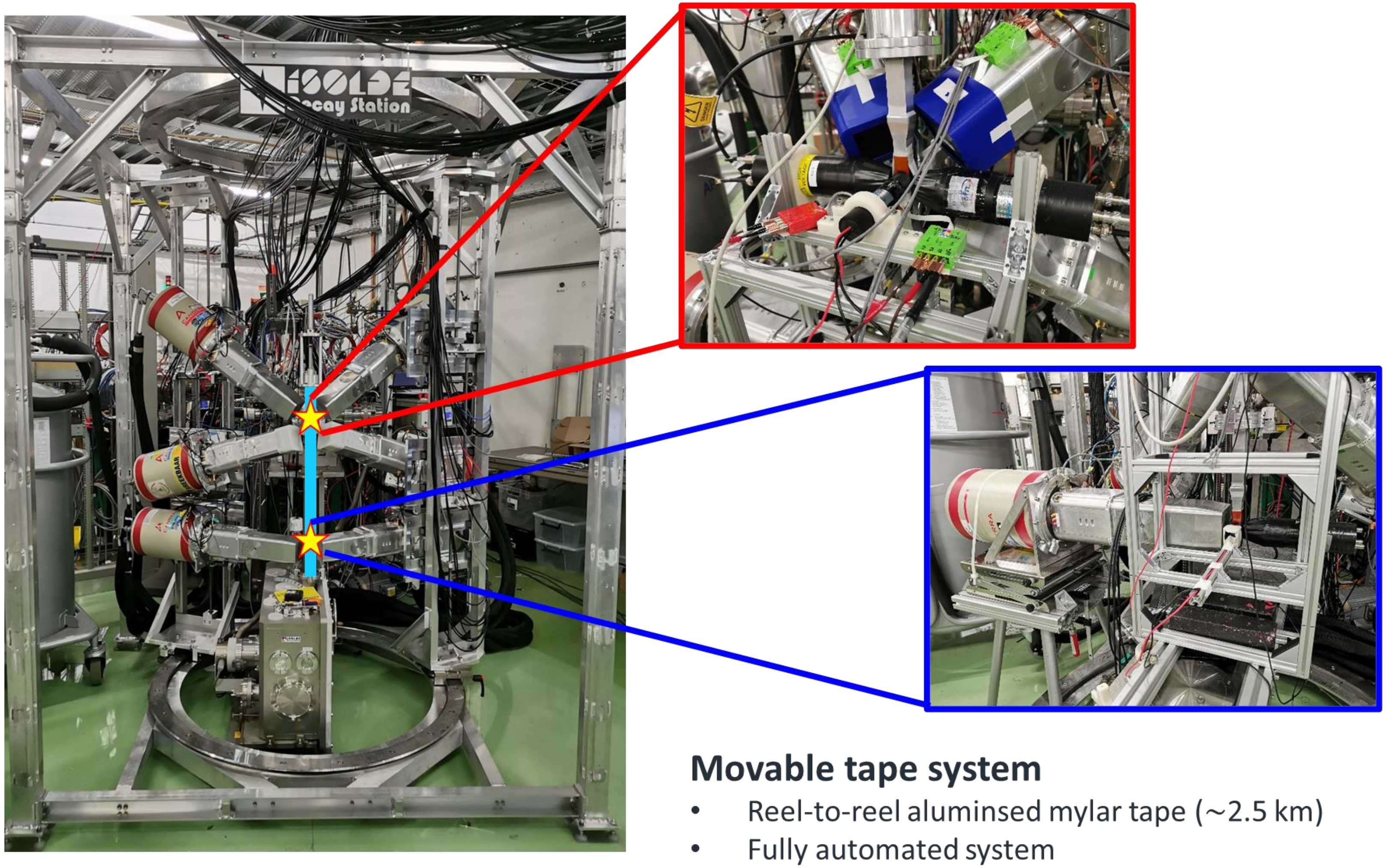


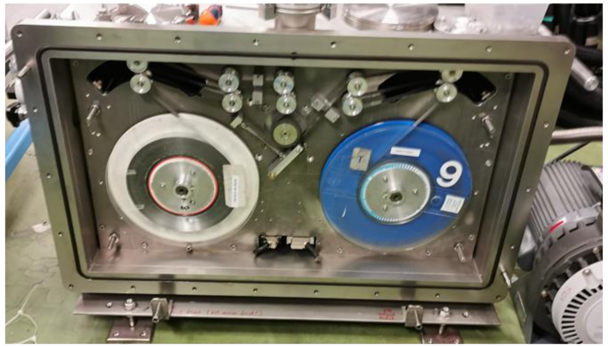
Flexible + dynamic support structure (2023)

- Minimise material around implantation position
- Detectors mounted on vertical gantries, 3 clovers per gantry, gantries mounted on circular rails
- Can move detectors radially + vertically, tilt vertically, rotate on axes

Digital XIA pixie-16 acquisition system

- 16 channels per module
- 12-16 bit ADC
- 100, 250 and 500 MHz modules
- 208 channels/crate



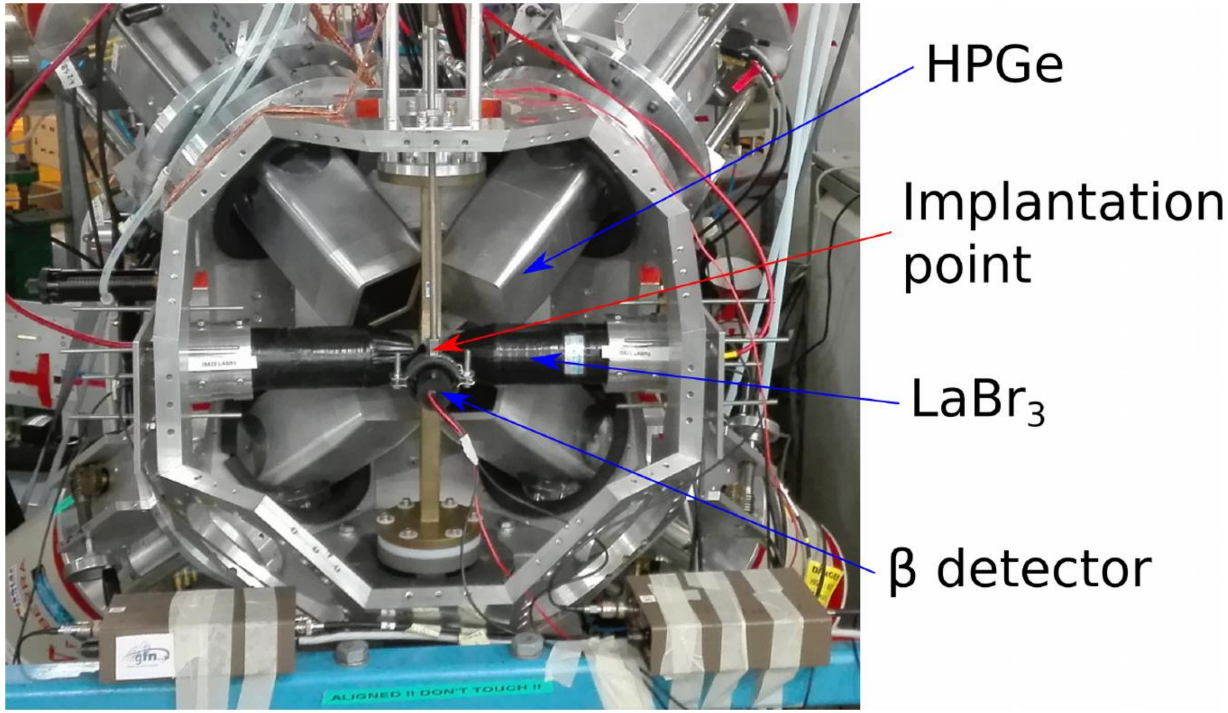


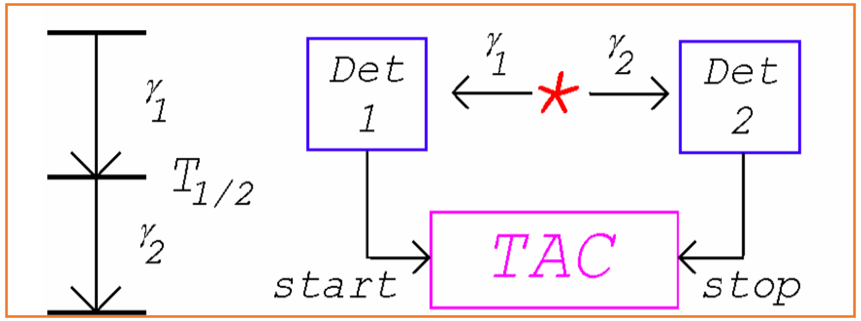
Movable tape system

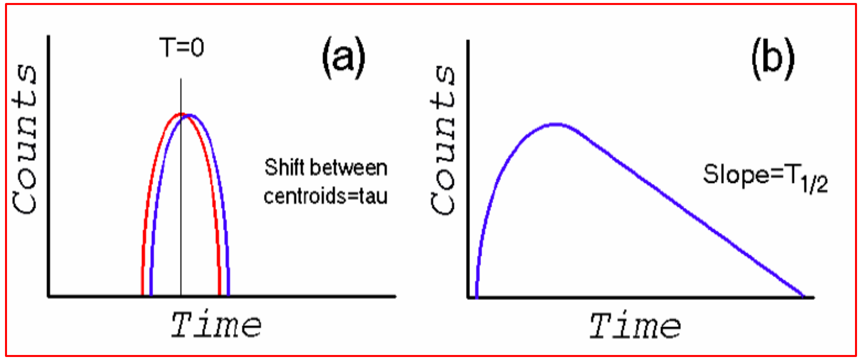
- Reel-to-reel aluminsed mylar tape (~2.5 km)
- Fully automated system
- Integrated with ISOLDE beam logic, RILIS laser system, and our DAQ
- **Primary "implantation" position**
  For main aims of experiments
- **Secondary "decay" position**
  Free "bonus" experiment, long-lived activity

Fast-timing studies at IDS

- Well established technique at IDS since 2014
- Detection system comprising of:
  - 4 Clover HPGe - 7% abs. eff. at 500keV
  - 2 $LaBr_3$(Ce) - 3% abs. eff. at 500keV
  - 1 Plastic Scintillator - 20% abs. eff.







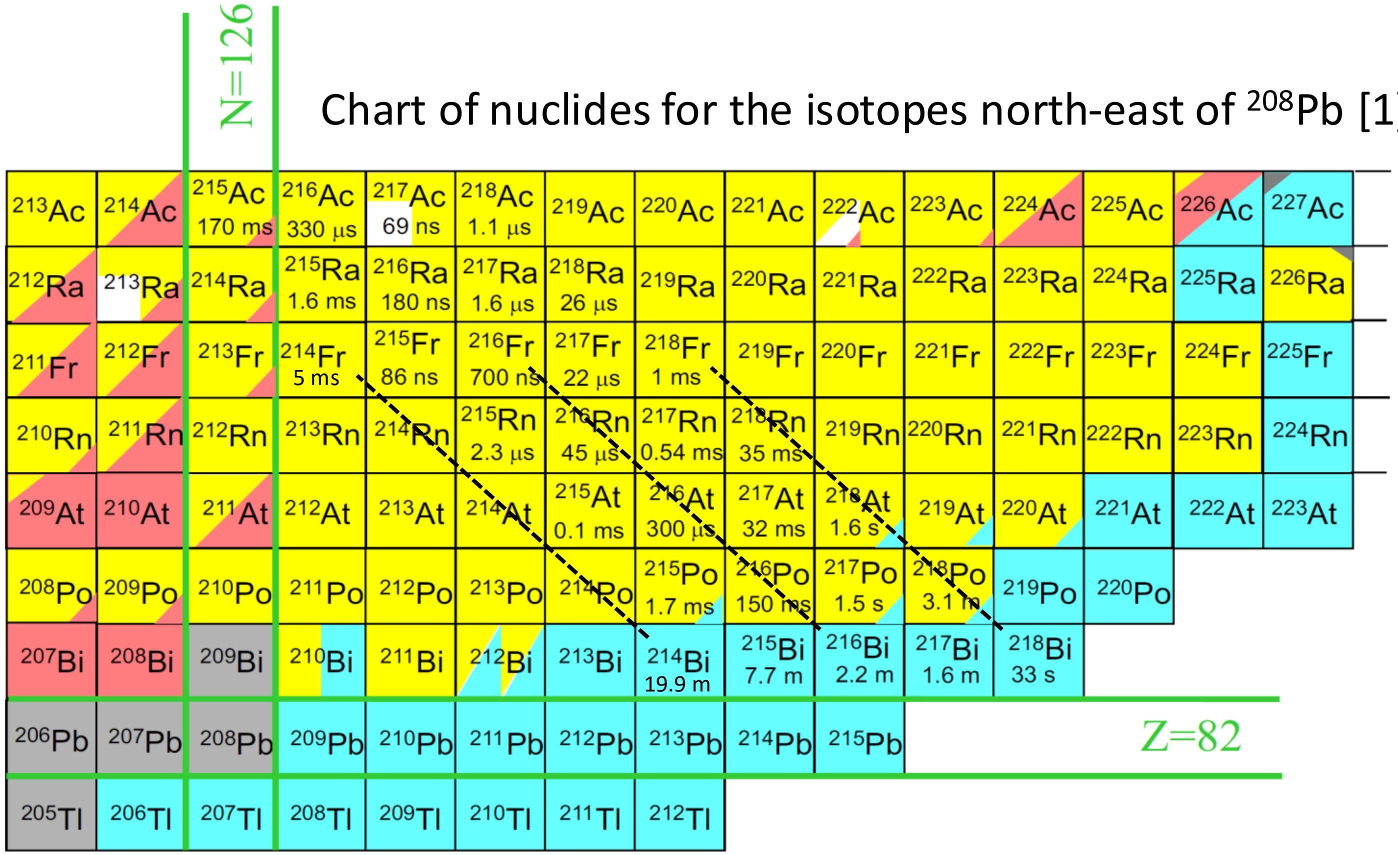
Ranges:
Centroid shift method: - **10 ps - 100 ps**
Slope method - **50 ps - 50 ns** (or longer)
[H. Mach et al. NIM A 280, 49 (1989)]

Beam production (July 2018)

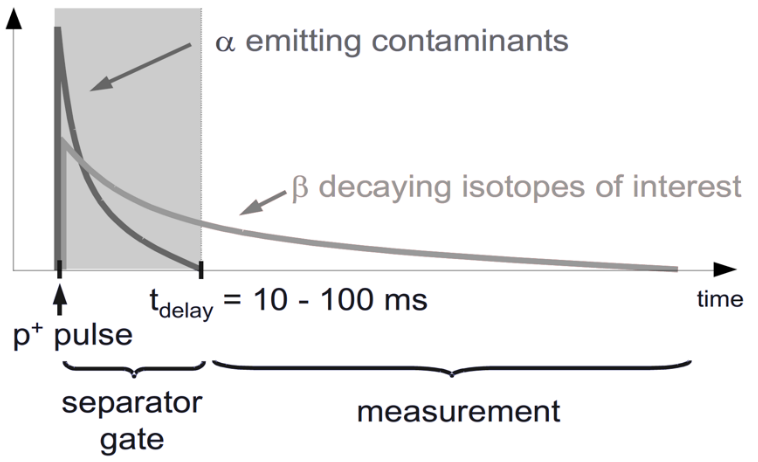
- Old proven method of producing up to ^{218}Bi [1,2]: **UCx** target + **RILIS**
- Yields **2x** better than previously extracted during IS608 at MR-ToF in 2016.
- Short-lived contaminants such as **Fr** were easily removed using the pulsed release technique and the **High Resolution Separator (HRS)**

Isotope	Rate (ions/uC)	Runtime (h)
^{214}Bi	> 2 x 10^4	3.0
^{216}Bi	1.5 x 10^3	6.5
^{218}Bi	2 x 10^2	13.0

Chart of nuclides for the isotopes north-east of ^{208}Pb [1]



The pulsed release technique [1]: the different time scales for the α decay of the contaminants and the β^- decay under investigation allow for a selective suppression.



[1] H. De Witte, PhD Thesis, KU Leuven (2004)
[2] U. Koster et al., Nucl. Instr. and Meth. B204, 347-352 (2003).

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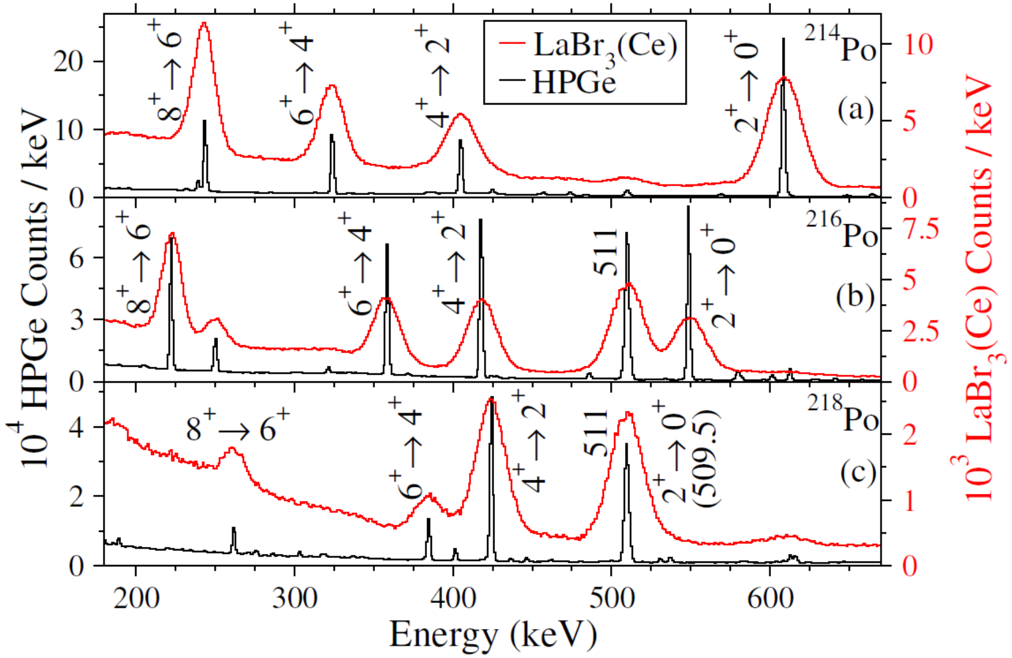
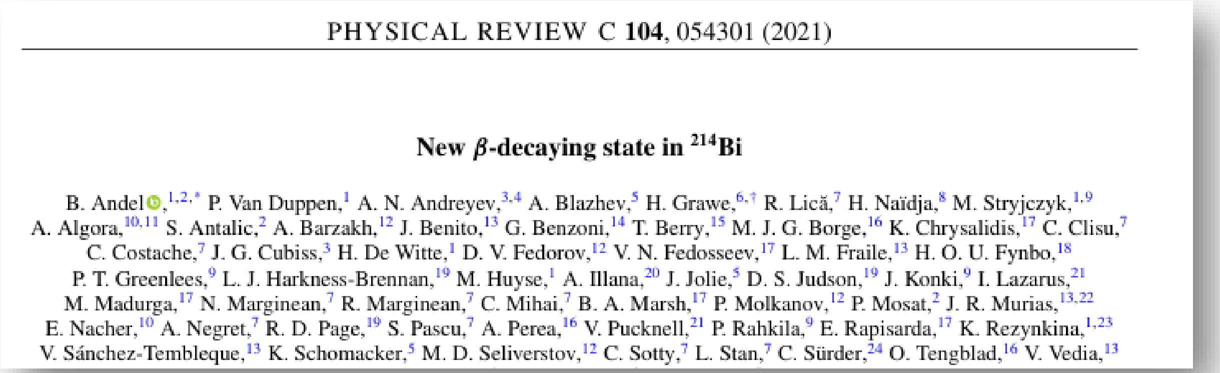


FIG. 1. β-gated γ-ray spectra recorded by the HPGe (black) and LaBr$_3$(Ce) (red) detectors following the β^- decay of ^{214}Bi (a), ^{216}Bi (b) and ^{218}Bi (c). The yrast transitions in ^{214,216,218}Po are labeled.

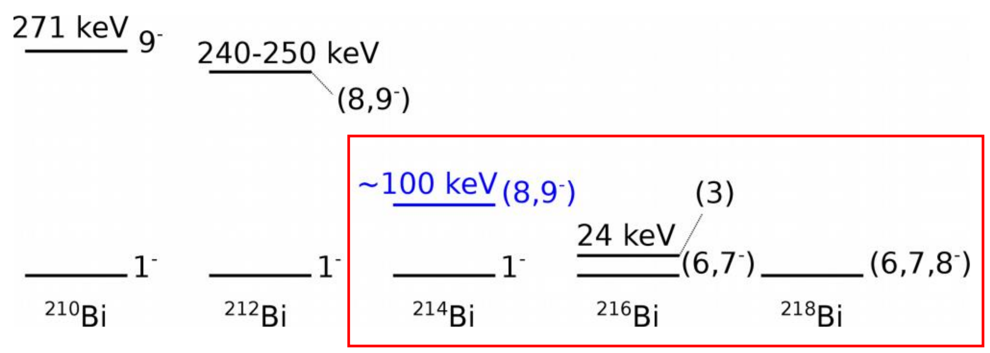
^{214}Bi - direct identification and spectroscopy of the (8$^-$) beta-decaying isomer


PHYSICAL REVIEW C **104**, 054301 (2021)

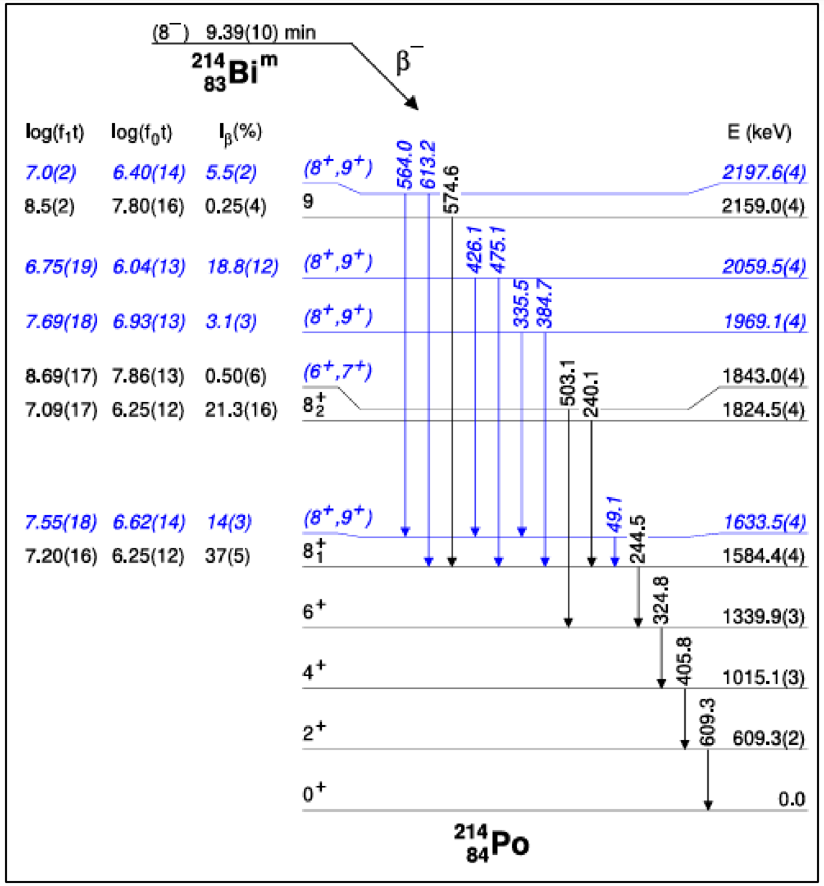
New β-decaying state in ^{214}Bi

B. Andel,[1,2,*] P. Van Duppen,[1] A. N. Andreyev,[3,4] A. Blazhev,[5] H. Grawe,[6,†] R. Lică,[7] H. Naïdja,[8] M. Stryjczyk,[1,9] A. Algora,[10,11] S. Antalic,[2] A. Barzakh,[12] J. Benito,[13] G. Benzoni,[14] T. Berry,[15] M. J. G. Borge,[16] K. Chrysalidis,[17] C. Clisu,[7] C. Costache,[7] J. G. Cubiss,[3] H. De Witte,[1] D. V. Fedorov,[12] V. N. Fedosseev,[17] L. M. Fraile,[13] H. O. U. Fynbo,[18] P. T. Greenlees,[9] L. J. Harkness-Brennan,[19] M. Huyse,[1] A. Illana,[20] J. Jolie,[5] D. S. Judson,[19] J. Konki,[9] I. Lazarus,[21] M. Madurga,[17] N. Marginean,[7] R. Marginean,[7] C. Mihai,[7] B. A. Marsh,[17] P. Molkanov,[12] P. Mosat,[2] J. R. Murias,[13,22] E. Nacher,[10] A. Negret,[7] R. D. Page,[19] S. Pascu,[7] A. Perea,[16] V. Pucknell,[21] P. Rahkila,[9] E. Rapisarda,[17] K. Rezynkina,[1,23] V. Sánchez-Tembleque,[13] K. Schomacker,[5] M. D. Seliverstov,[12] C. Sotty,[7] L. Stan,[7] C. Sürder,[24] O. Tengblad,[16] V. Vedia,[13]

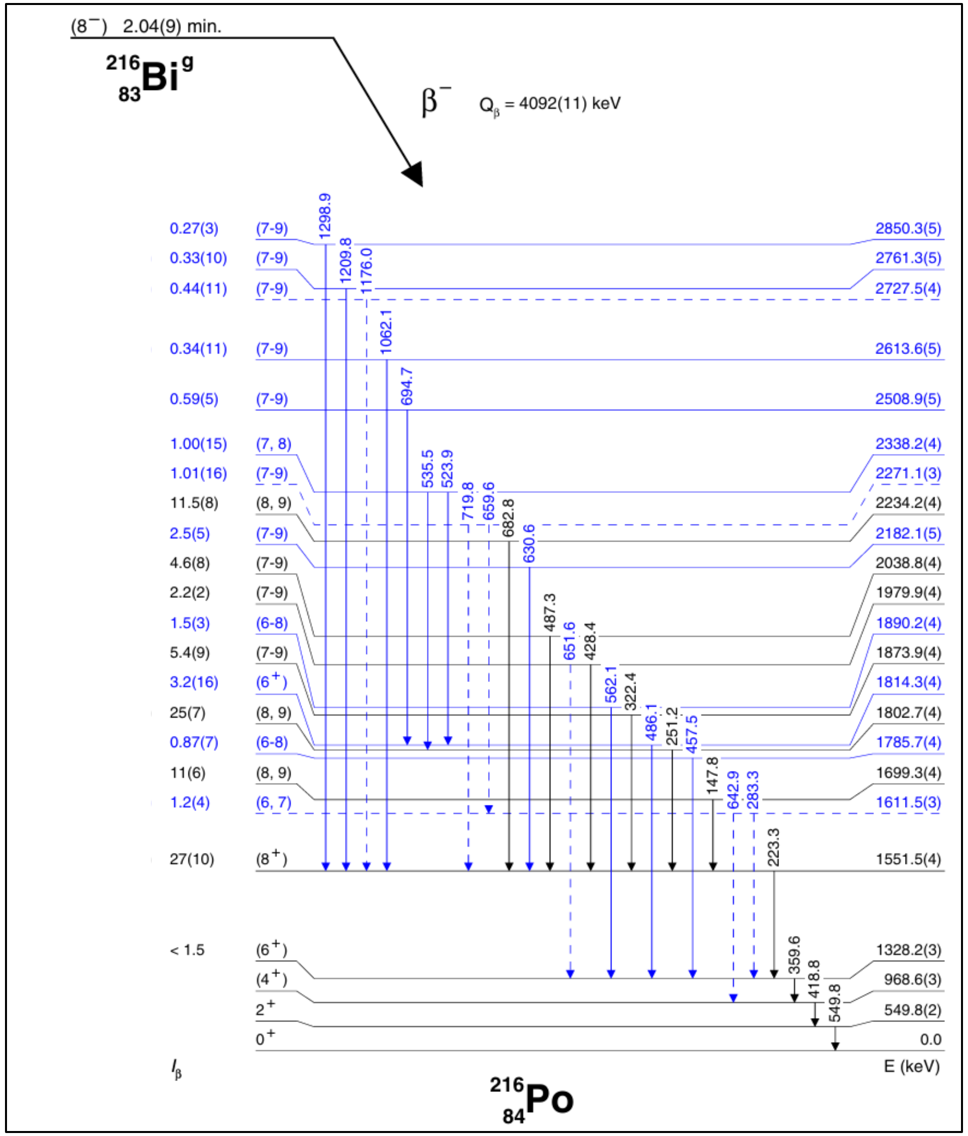
- Half-life measurement: $T_{1/2}$ (8$^-$) = 9.39(10) min
- Extended decay scheme of ^{214}Po (4 new levels, 7 new transitions)
- Deduced the most likely I^π = (8$^-$, 9$^-$) in agreement with Shell model calculations predicting I^π = 8$^-$

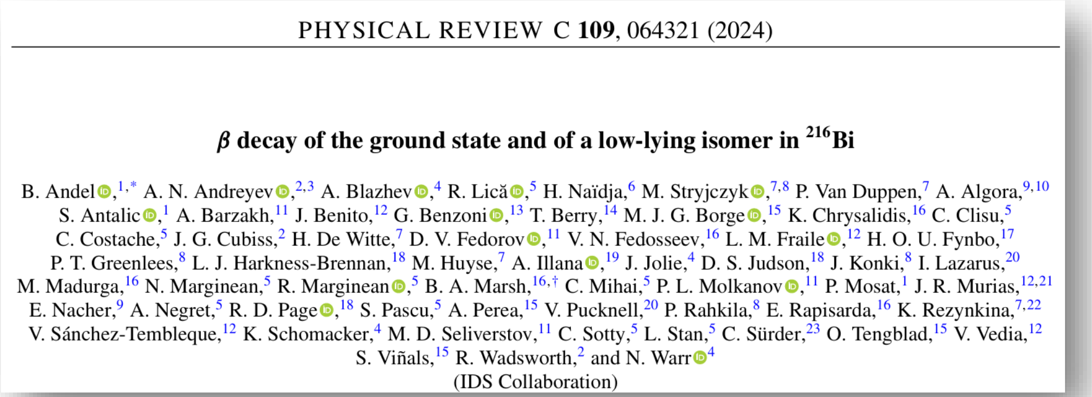


Systematics of ground states and low-lying isomers in odd-odd $^{210-218}$Bi
Information on isomer in ^{214}Bi is from this work, the rest is from ENSDF.



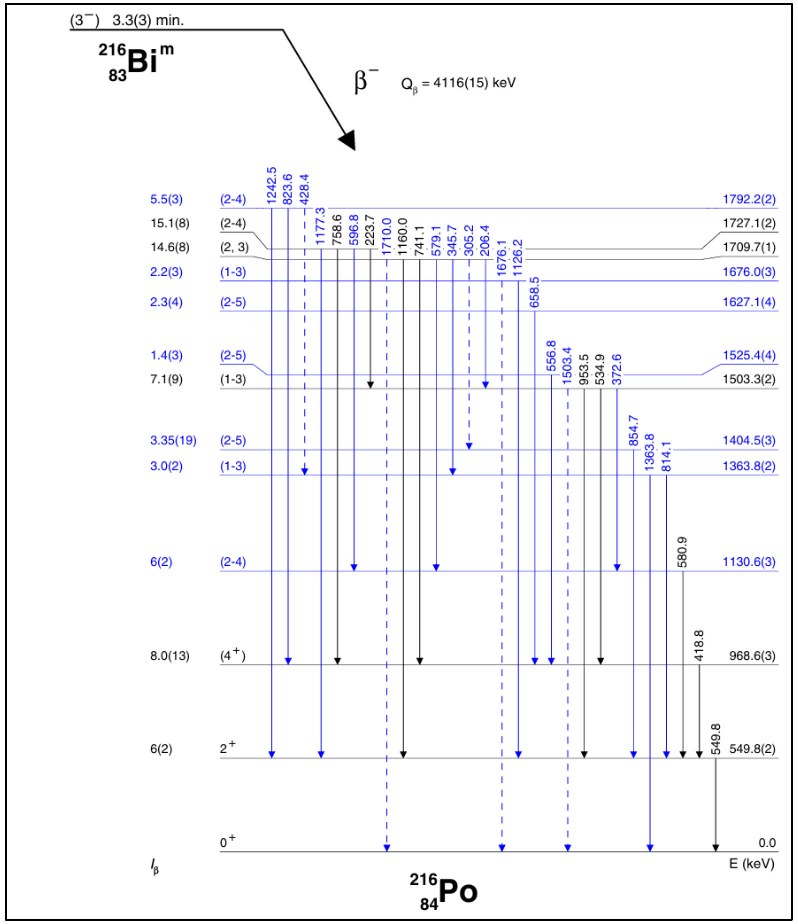
^{216}Bi - Extended level scheme of ^{216}Po following the decay of both ground state and isomer




PHYSICAL REVIEW C **109**, 064321 (2024)

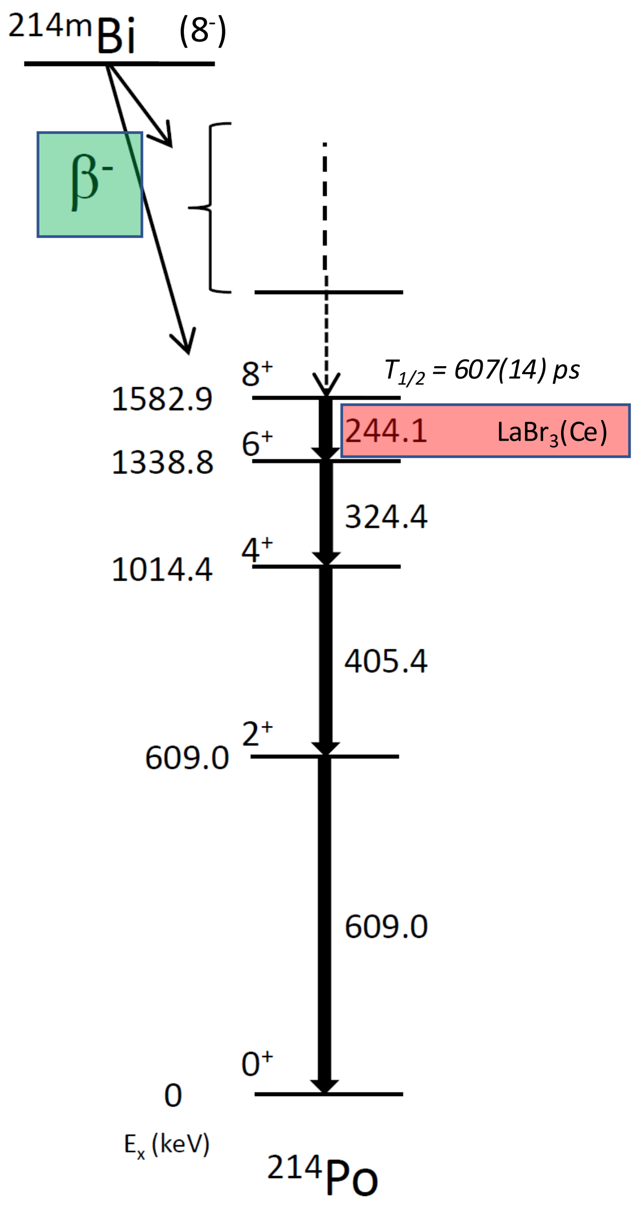
β decay of the ground state and of a low-lying isomer in ^{216}Bi

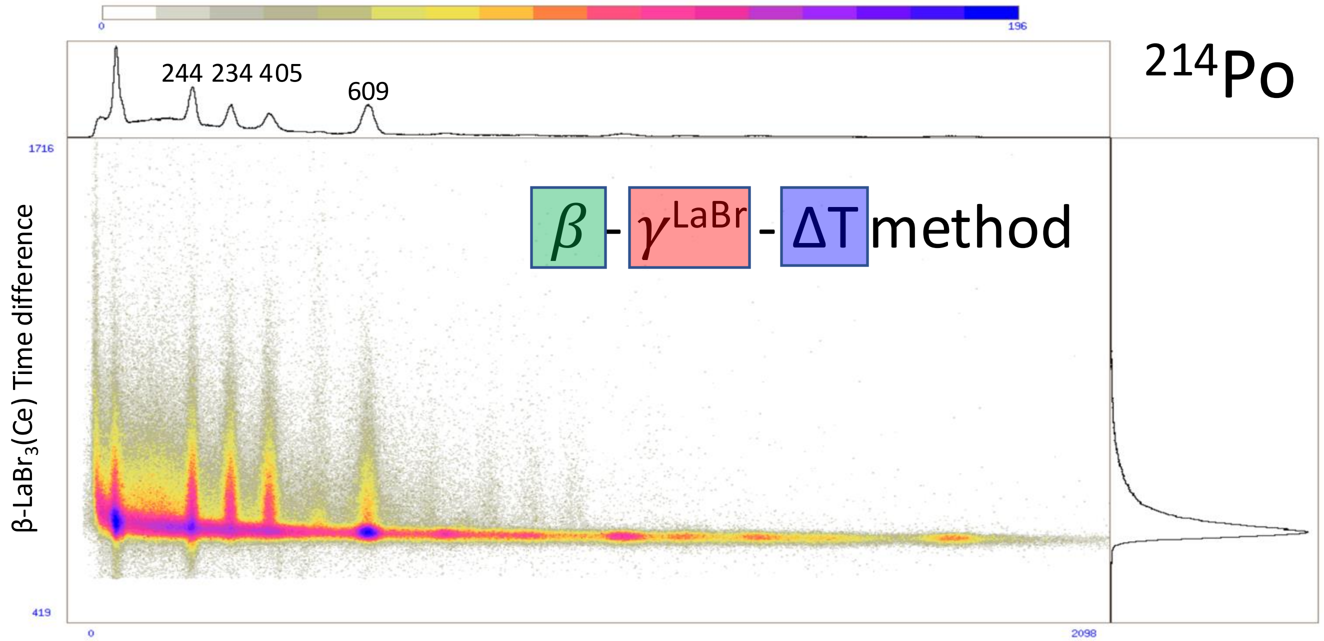
B. Andel,[1,*] A. N. Andreyev,[2,3] A. Blazhev,[4] R. Lică,[5] H. Naïdja,[6] M. Stryjczyk,[7,8] P. Van Duppen,[7] A. Algora,[9,10] S. Antalic,[1] A. Barzakh,[11] J. Benito,[12] G. Benzoni,[13] T. Berry,[14] M. J. G. Borge,[15] K. Chrysalidis,[16] C. Clisu,[5] C. Costache,[5] J. G. Cubiss,[2] H. De Witte,[7] D. V. Fedorov,[11] V. N. Fedosseev,[16] L. M. Fraile,[12] H. O. U. Fynbo,[17] P. T. Greenlees,[8] L. J. Harkness-Brennan,[18] M. Huyse,[7] A. Illana,[19] J. Jolie,[4] D. S. Judson,[18] J. Konki,[8] I. Lazarus,[20] M. Madurga,[16] N. Marginean,[5] R. Marginean,[5] B. A. Marsh,[16,†] C. Mihai,[5] P. L. Molkanov,[11] P. Mosat,[1] J. R. Murias,[12,21] E. Nacher,[9] A. Negret,[5] R. D. Page,[18] S. Pascu,[5] A. Perea,[15] V. Pucknell,[20] P. Rahkila,[8] E. Rapisarda,[16] K. Rezynkina,[7,22] V. Sánchez-Tembleque,[12] K. Schomacker,[4] M. D. Seliverstov,[11] C. Sotty,[5] L. Stan,[5] C. Sürder,[23] O. Tengblad,[15] V. Vedia,[12] S. Viñals,[15] R. Wadsworth,[2] and N. Warr[4]
(IDS Collaboration)



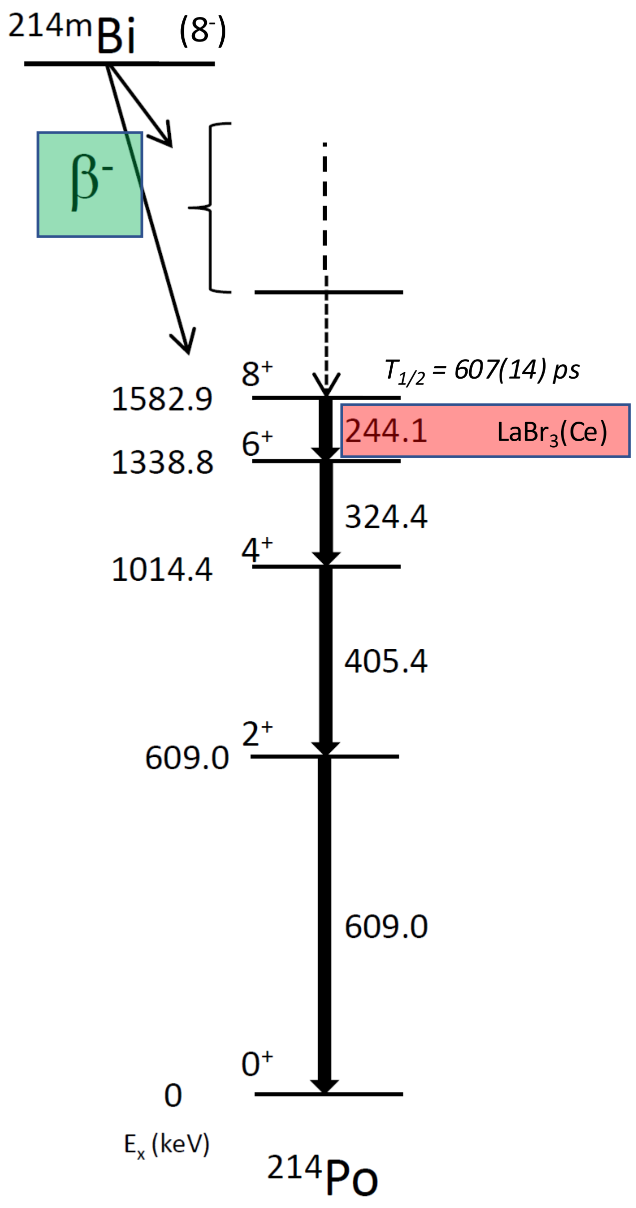
- 48 new levels, 83 new transitions in ^{216}Po
- Ground state and isomer I^π proposed based on I_β and SM calculations (H208 and KHPE)
- The ground state and isomer order is not firmly established

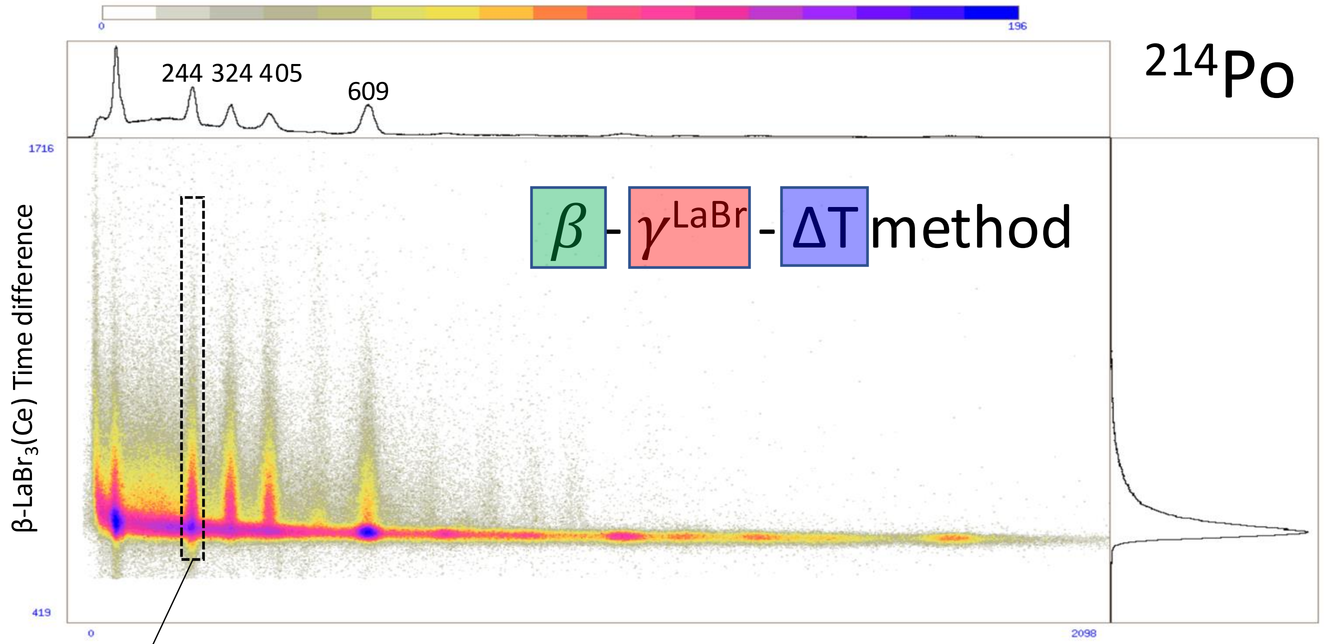
Fast-timing measurement of the 8$^+$ state in ^{214}Po

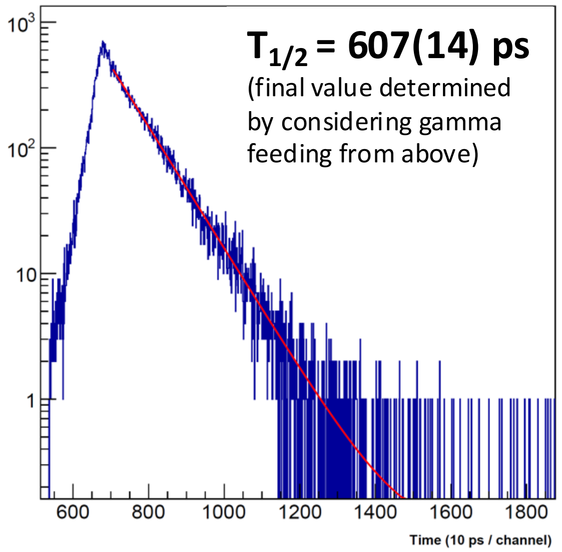




Fast-timing measurement of the 8^+ state in ^{214}Po







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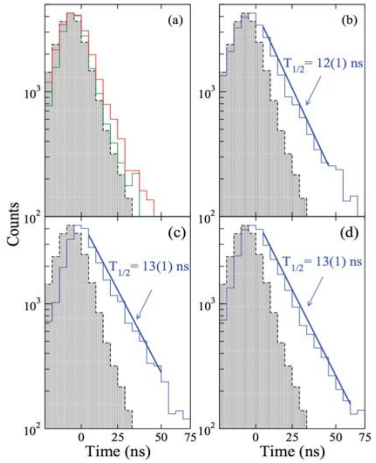
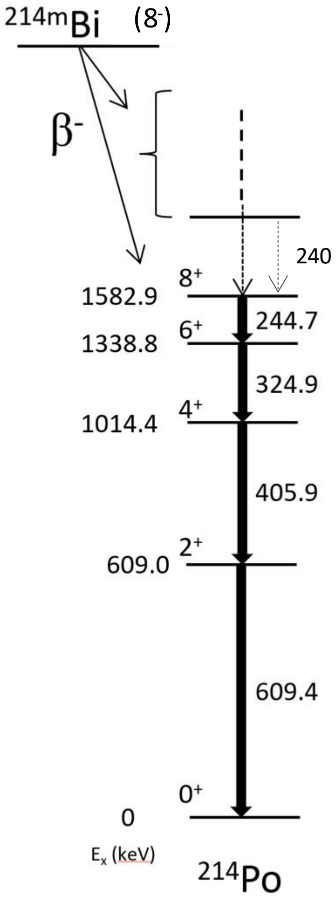
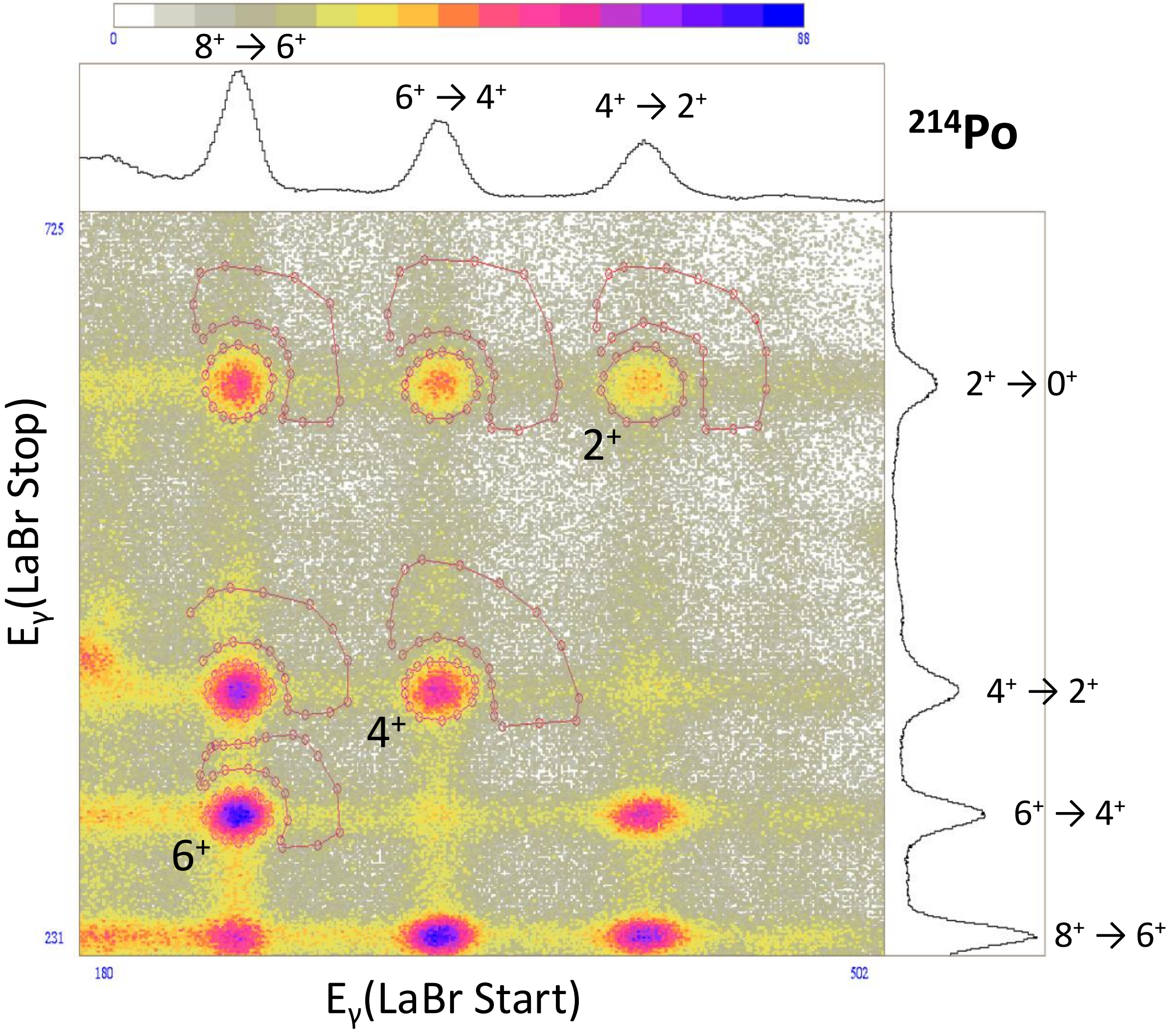


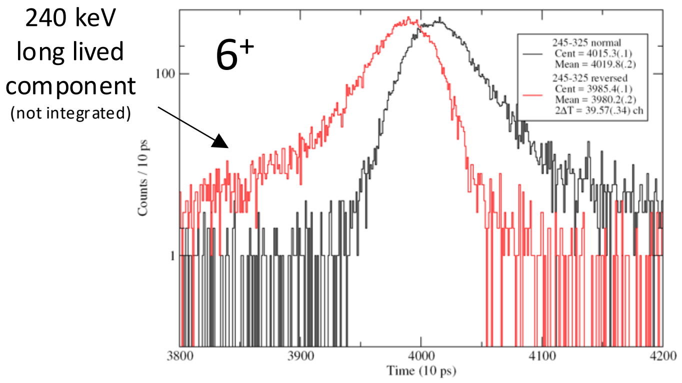
$T_{1/2}$ (Astier 2011) = 13(1) ns

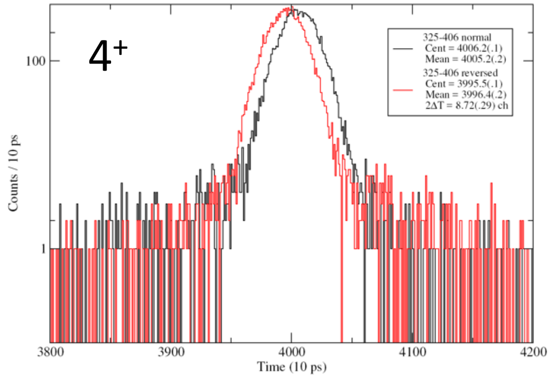
Fast-timing measurement of the 2,4,6$^+$ states in ^{214}Po

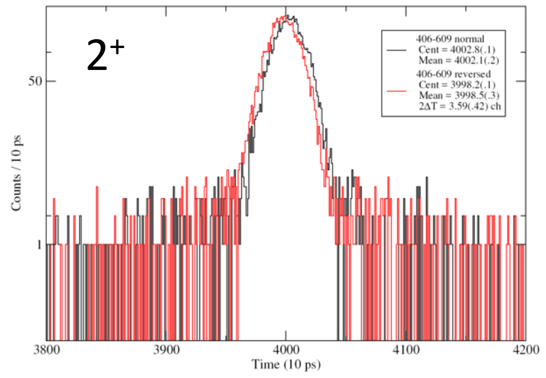


γ^{LaBr} - γ^{LaBr} - ΔT method

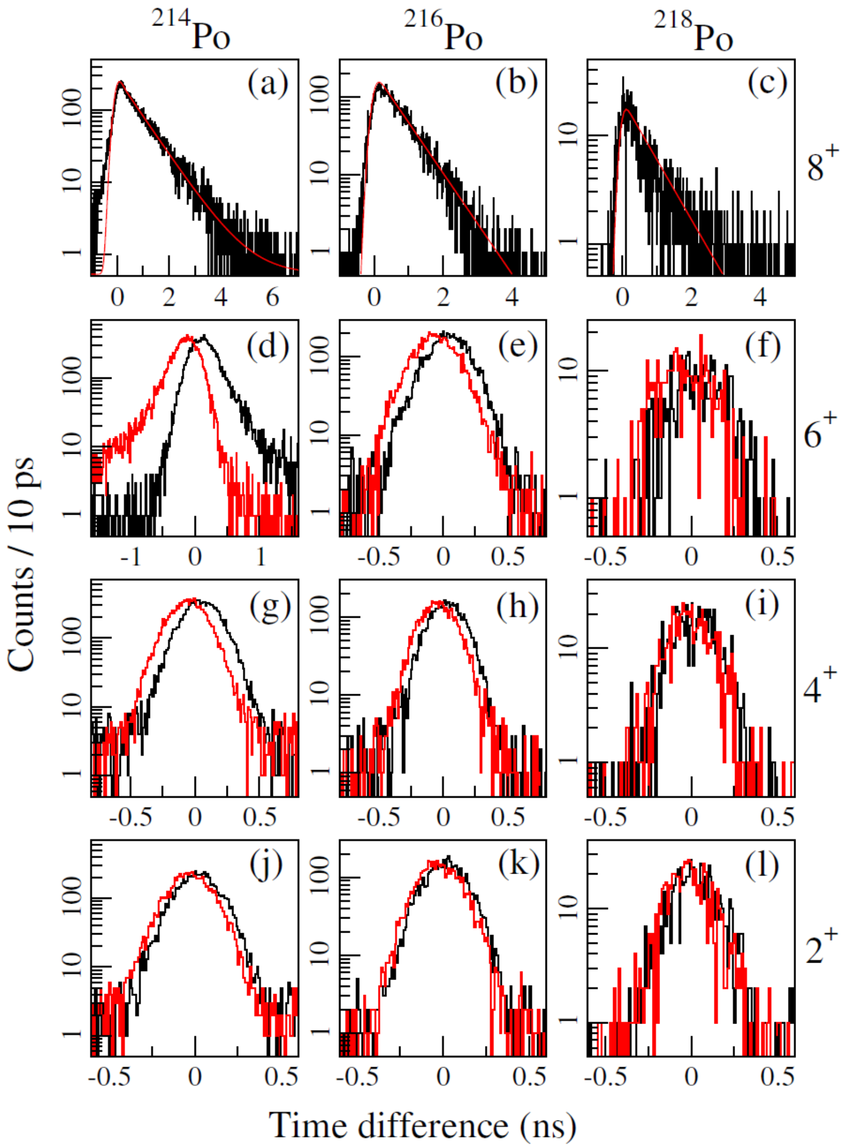


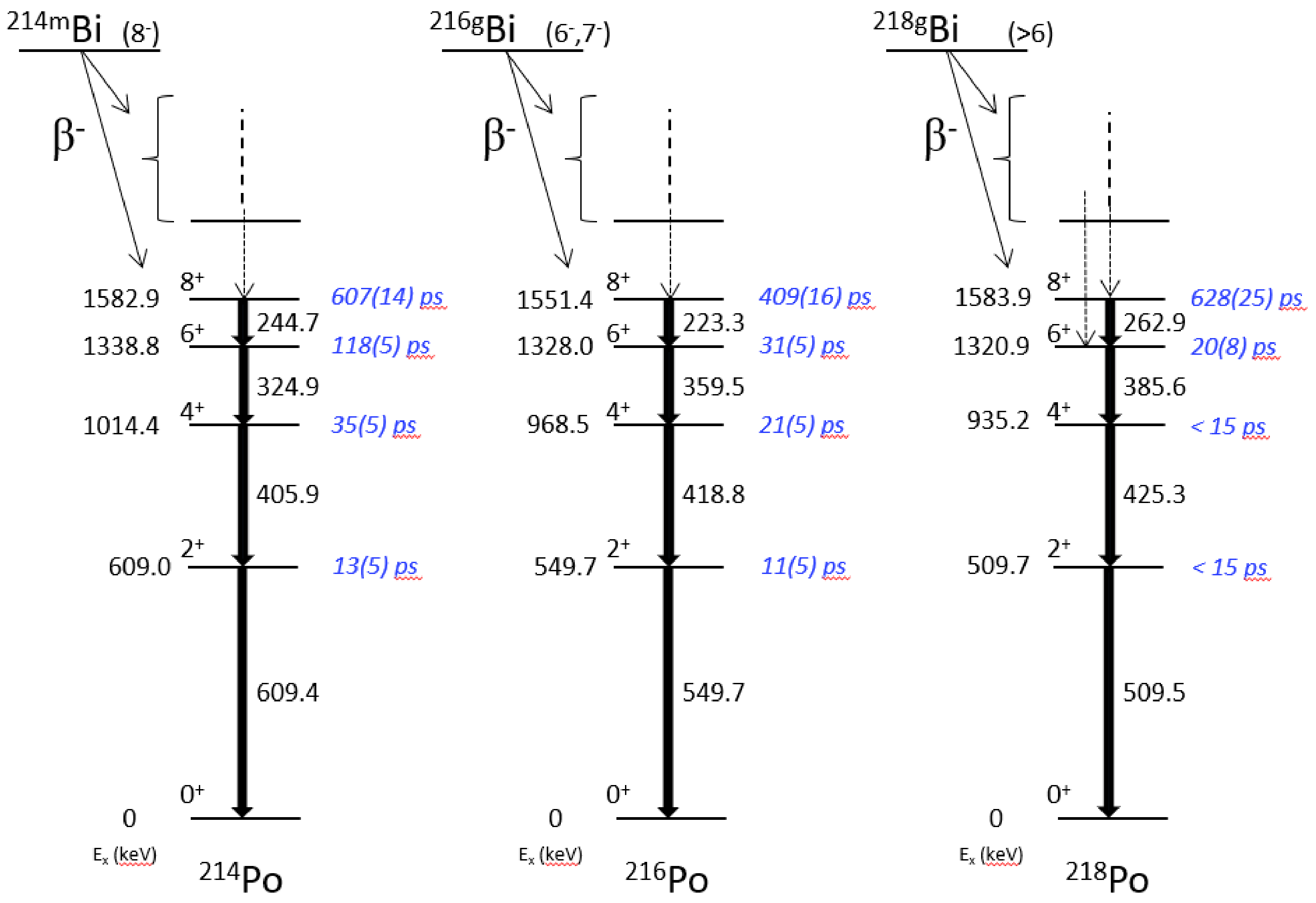




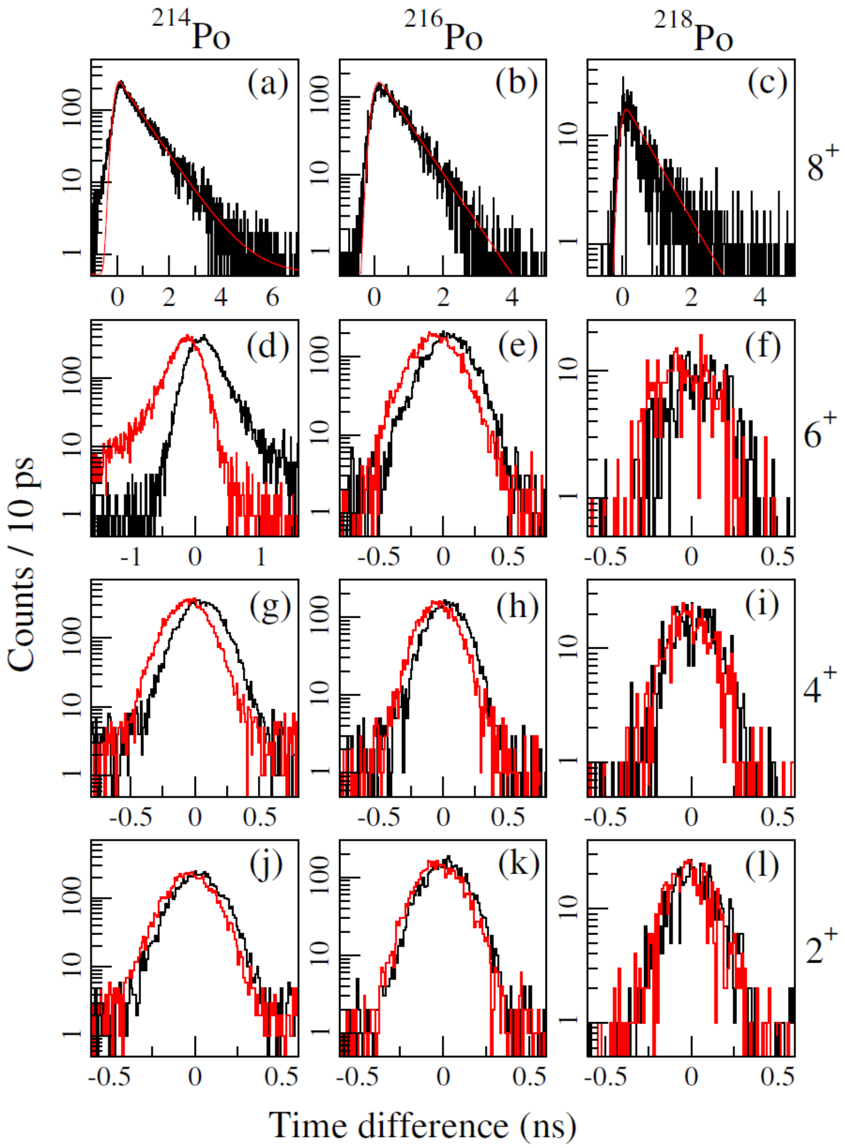


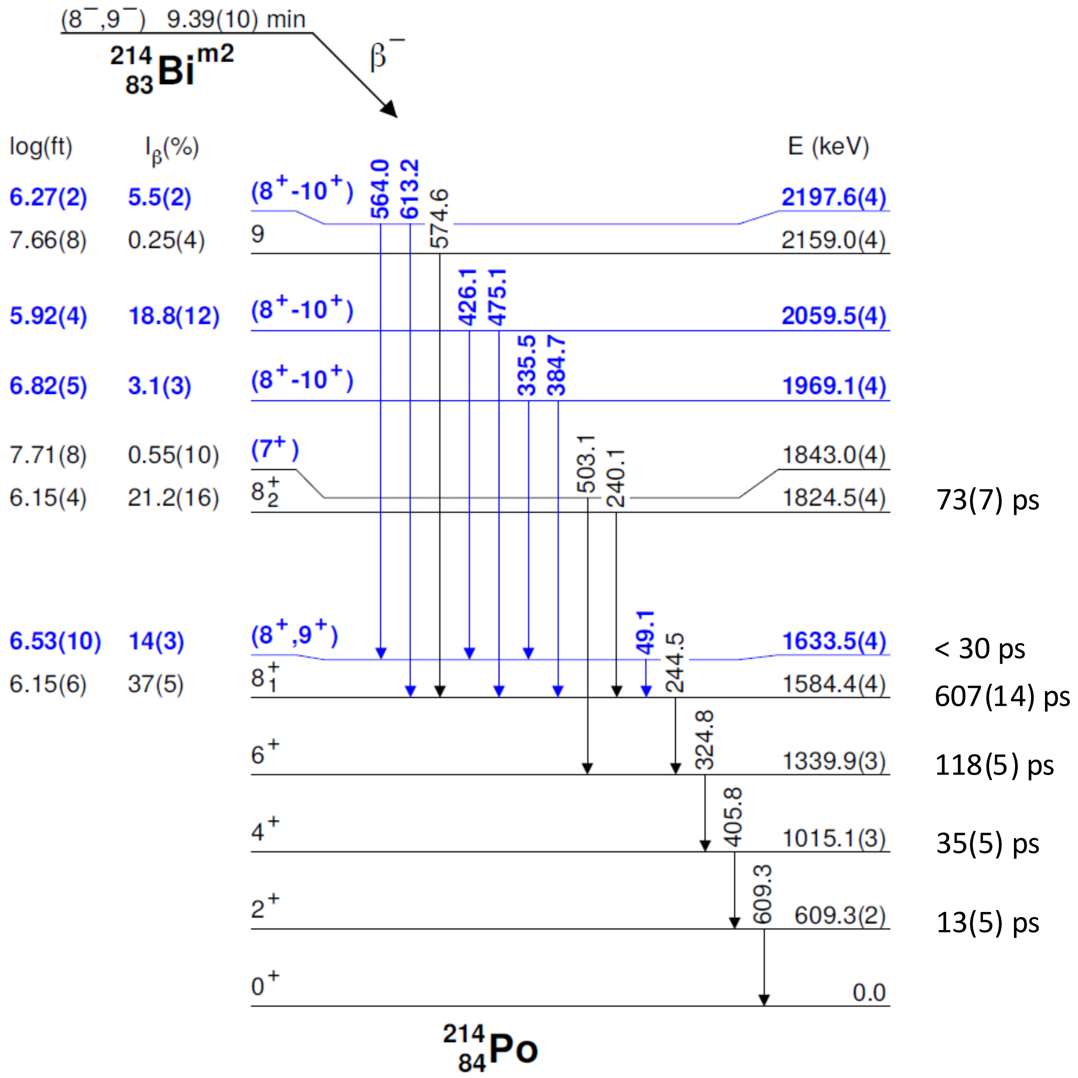
$^{214,216,218}Po$ – Summary of fast-timing results



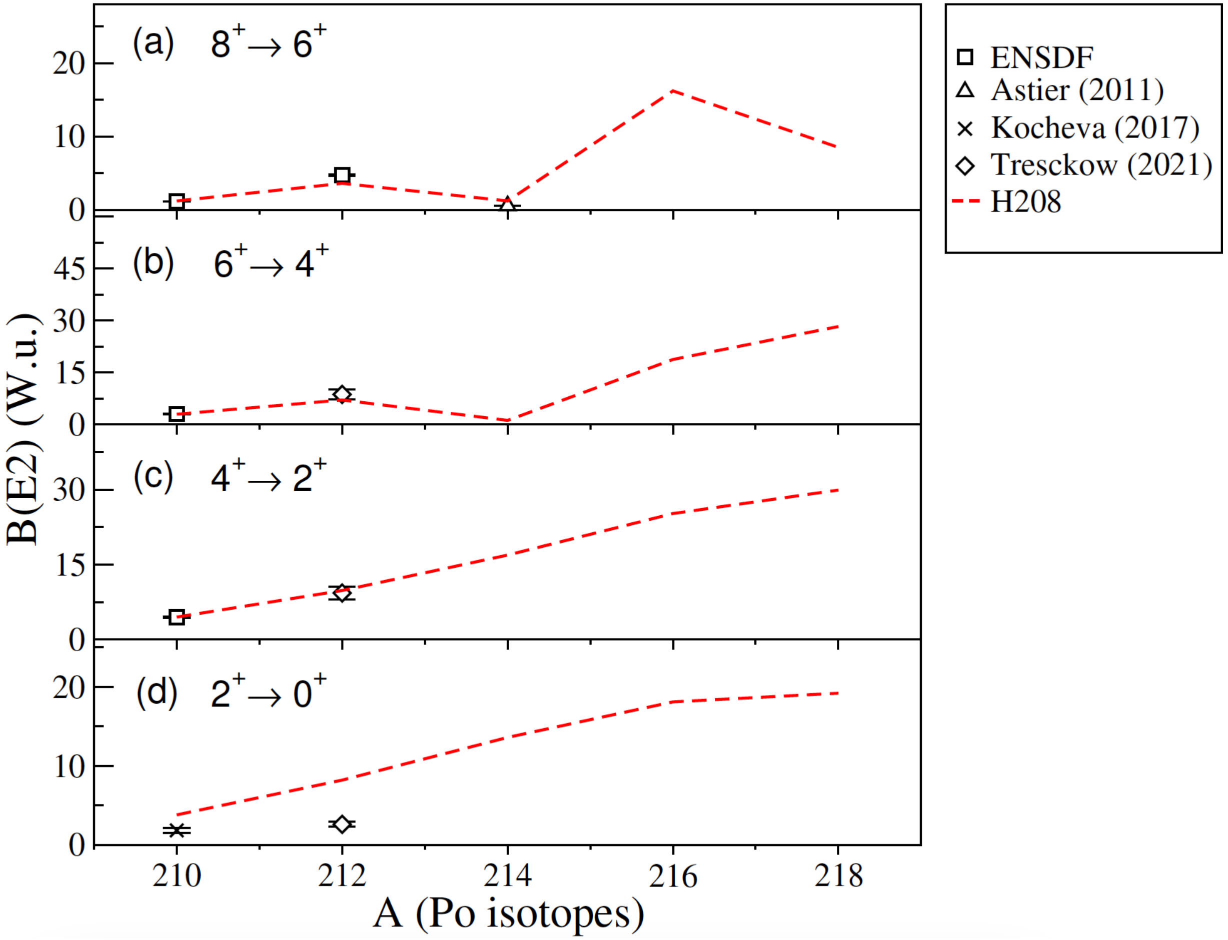


$^{214,216,218}Po$ – Summary of fast-timing results





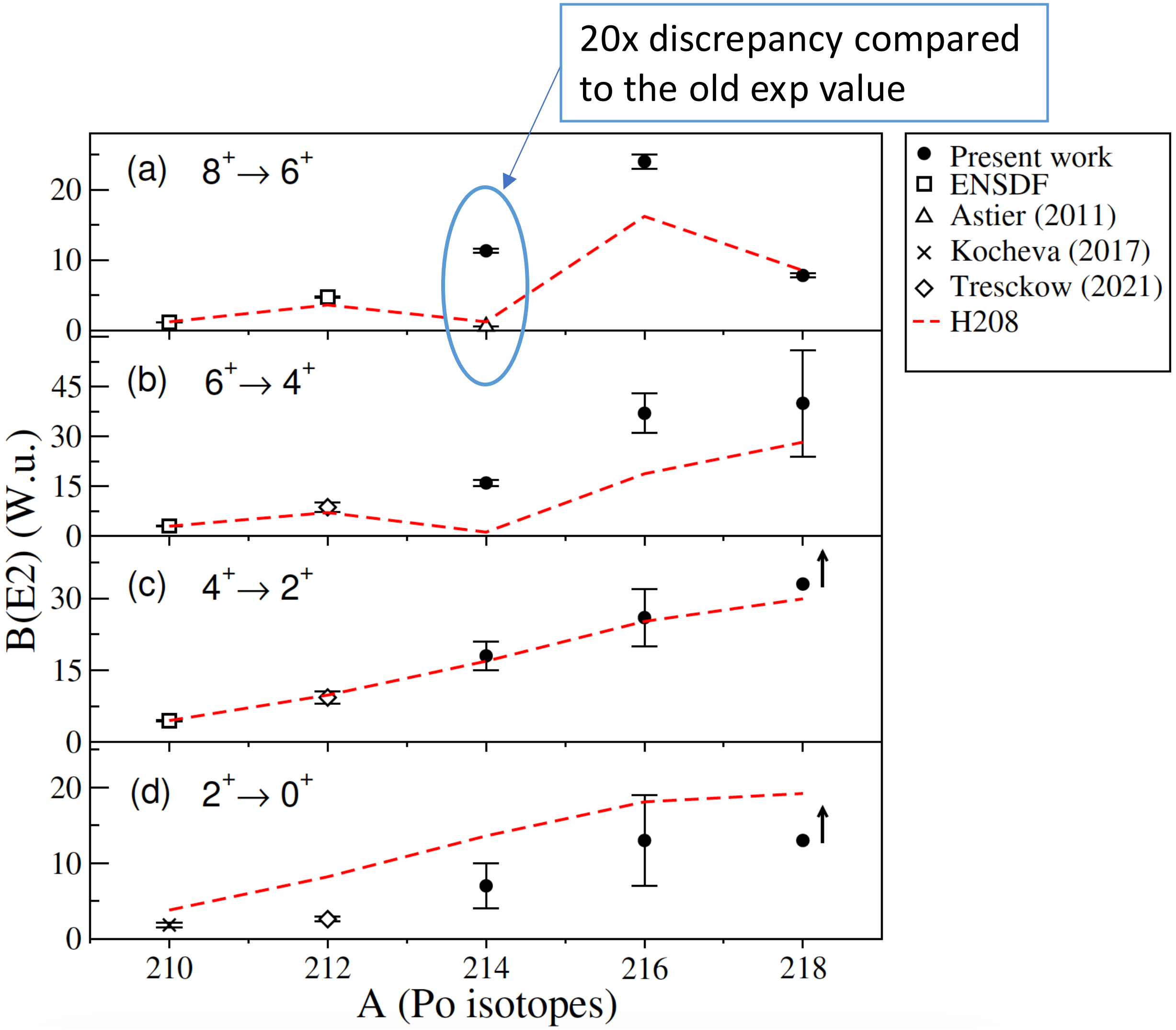
B(E2) values and comparison with Shell Model calculations



- Experimental data was compared to shell-model calculations using H208 [1] and KHPE [2] effective interactions.

[1] H. Naidja, Phys. Rev. C 103, 054303 (2021).
[2] E. K. Warburton and B. A. Brown, Phys. Rev. C 43, 602 (1991).

B(E2) values and comparison with Shell Model calculations



- Experimental data was compared to shell-model calculations using H208 [1] and KHPE [2] effective interactions.
- Good agreement for low-lying transitions but deviations in the case of $8^+ \rightarrow 6^+$ and $6^+ \rightarrow 4^+$ transitions.

[1] H. Naidja, Phys. Rev. C 103, 054303 (2021).
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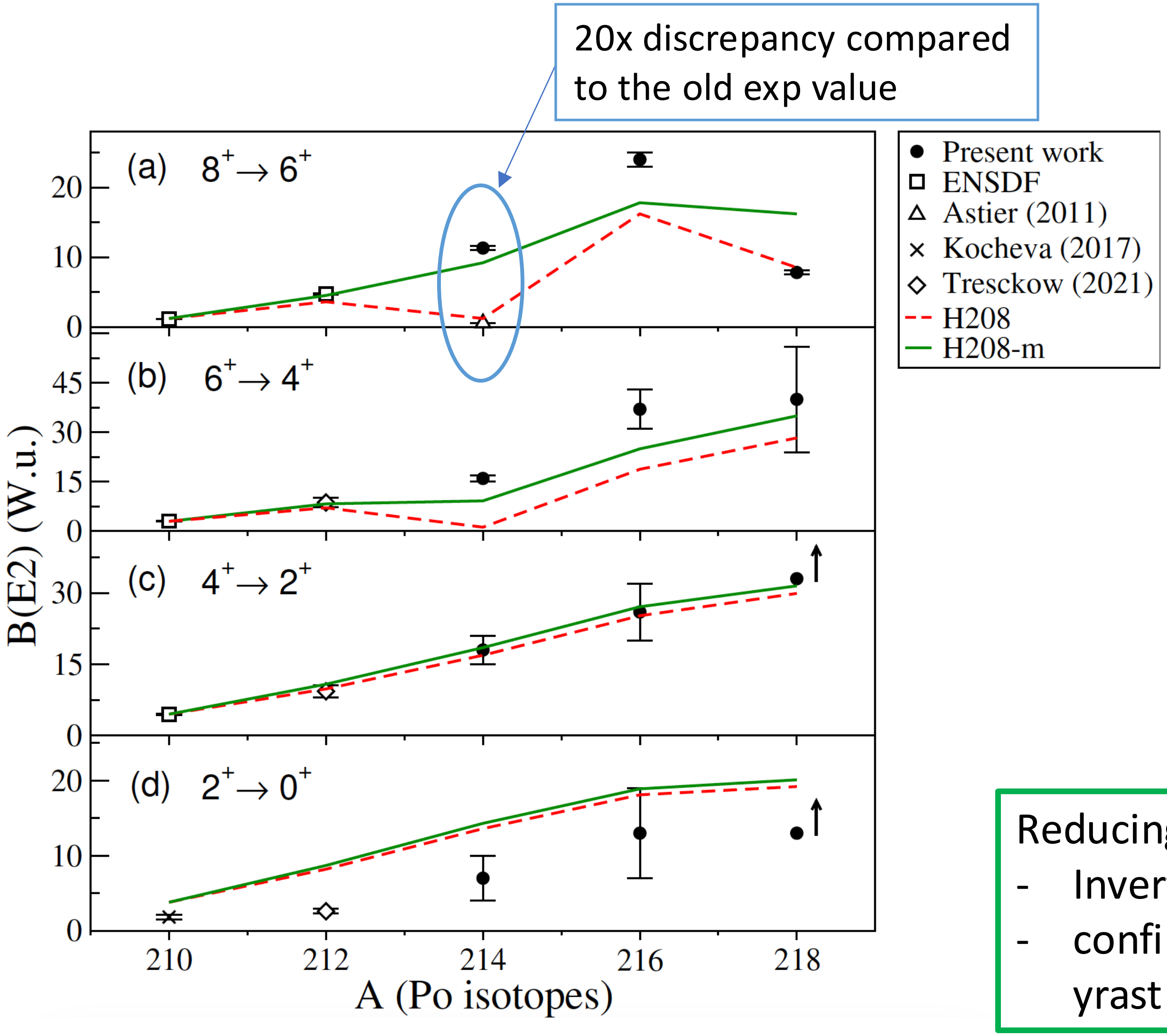
B(E2) values and comparison with Shell Model calculations



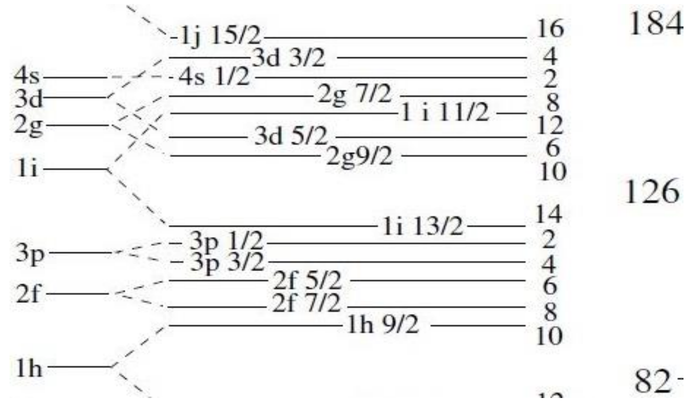
- Experimental data was compared to shell-model calculations using H208 [1] and KHPE [2] effective interactions.
- Good agreement for low-lying transitions but deviations in the case of $8^+ \rightarrow 6^+$ and $6^+ \rightarrow 4^+$ transitions.
- A proton pairing reduction of 100 keV in the interactions addresses the large discrepancies
- The increasing trend was explained through the increase of the collectivity and quadrupole correlations with respect to the neutron number

Reducing the proton pairing strength:
- Inverts of the lowest predicted 8^+ states in ^{214}Po
- confirms the **two-proton** configuration $\pi(1h_{9/2}1f_{7/2})$ of the yrast 8^+ states dominated by quadrupole correlations.

[1] H. Naidja, Phys. Rev. C 103, 054303 (2021).
[2] E. K. Warburton and B. A. Brown, Phys. Rev. C 43, 602 (1991).

Nucleus	J^π	H208	H208-m
^{210}Po	0_1^+	$76\%\ \pi 1h^2_{9/2} + 14\%\ \pi 1i^2_{13/2}$	$77\%\ \pi 1h^2_{9/2} + 15\%\ \pi 1i^2_{13/2}$
	2_1^+	$95\%\ \pi 1h^2_{9/2}$	$95\%\ \pi 1h^2_{9/2}$
	4_1^+	$98\%\ \pi 1h^2_{9/2}$	$98\%\ \pi 1h^2_{9/2}$
	6_1^+	$99\%\ \pi 1h^2_{9/2}$	$99\%\ \pi 1h^2_{9/2}$
	8_1^+	$99\%\ \pi 1h^2_{9/2}$	$99\%\ \pi 1h^2_{9/2}$
^{212}Po	0_1^+	$46\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$	$46\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$
	2_1^+	$53\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$	$53\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$
	4_1^+	$57\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$	$56\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$
	6_1^+	$58\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$	$56\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2}$
	8_1^+	$54\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^2_{9/2}$	$47\%\ \pi 1h^2_{9/2} \otimes \nu 1g^2_{9/2} + 15\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^2_{9/2}$
^{214}Po	0_1^+	$22\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 12\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$	$21\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 12\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$
	2_1^+	$20\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$	$19\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 10\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$
	4_1^+	$20\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 12\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$	$18\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$
	6_1^+	$23\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 14\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$	$18\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 13\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$
	8_1^+	$34\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 16\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$	$28\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^4_{9/2} + 11\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^2_{9/2} 1i^2_{11/2}$
	8_2^+	$26\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^4_{9/2} + 10\%\ \pi 1f^2_{7/2} \otimes \nu 1g^2_{9/2} 1i^2_{11/2}$	$33\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} + 16\%\ \pi 1f^2_{7/2} \otimes \nu 1g^4_{9/2}$
^{216}Po	0_1^+	$13\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$	$12\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$
	2_1^+	$13\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$	$12\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$
	4_1^+	$12\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$	$11\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$
	6_1^+	$10\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$	$10\%\ \pi 1h^2_{9/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$
	8_1^+	$12\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$	$16\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^4_{9/2} 1i^2_{11/2}$
^{218}Po	0_1^+	$13\%\ \pi 1h^2_{9/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$	$12\%\ \pi 1h^2_{9/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$
	2_1^+	$13\%\ \pi 1h^2_{9/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$	$12\%\ \pi 1h^2_{9/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$
	4_1^+	$12\%\ \pi 1h^2_{9/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2} + 12\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$	$11\%\ \pi 1h^2_{9/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2} + 12\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$
	6_1^+	$12\%\ \pi 1h^2_{9/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2} + 11\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$	$10\%\ \pi 1f^2_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$
	8_1^+	$12\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$	$19\%\ \pi 1h_{9/2} 1f_{7/2} \otimes \nu 1g^6_{9/2} 1i^2_{11/2}$

TABLE II. The principal wave function components ($\geq 10\%$) for yrast states in ^{210,212,214,216,218}Po isotopes, calculated using the two versions of the effective interaction: H208 (initial) and H208-m (reduced pairing).



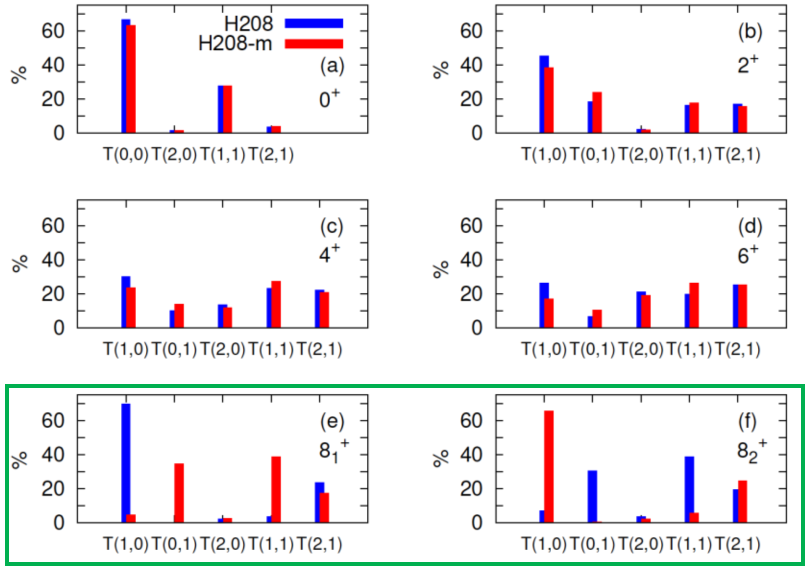


FIG. 5. The wave-function components of ^{214}Po states calculated in seniority scheme where $T(x, y)$ represents the number of neutron (x) or proton (y) pairs being broken. The initial and pairing-modified versions of the H208 effective interaction are employed within the NATHAN code.

Thank you for your attention!

On the nature of yrast states in neutron-rich polonium isotopes

R. Lică,[1,*] A.N. Andreyev,[2] H. Naïdja,[3] A. Blazhev,[4] P. Van Duppen,[5] B. Andel,[6] A. Algora,[7,8] S. Antalic,[6] J. Benito,[9] G. Benzoni,[10] T. Berry,[11] M. J. G. Borge,[12] C. Costache,[1] J. G. Cubiss,[2] H. De Witte,[5] L. M. Fraile,[9] H. O. U. Fynbo,[13] P. T. Greenlees,[14] L. J. Harkness-Brennan,[15] M. Huyse,[5] A. Illana,[16] J. Jolie,[4] D. S. Judson,[15] J. Konki,[14] I. Lazarus,[17] M. Madurga,[18] N. Marginean,[1] R. Marginean,[1] C. Mihai,[1] R. E. Mihai,[1] P. Mosat,[6] J. R. Murias,[9,19] E. Nacher,[7] A. Negret,[1] R. D. Page,[15] A. Perea,[12] V. Pucknell,[17] P. Rahkila,[14] K. Rezynkina,[5,20] V. Sánchez-Tembleque,[9] K. Schomacker,[4] M. Stryjczyk,[5,14] C. Sürder,[21] O. Tengblad,[12] V. Vedia,[9] and N. Warr[4]

(IDS Collaboration)

[1]*Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, RO-077125 Bucharest, Romania*
[2]*School of Physics, Engineering and Technology, University of York, York, YO10 5DD, United Kingdom*
[3]*Université Constantine 1, Laboratoire de Physique Mathématique et Physique Subatomique, Constantine 25000, Algeria*
[4]*Institut für Kernphysik, Universität zu Köln, D-50937 Köln, Germany*
[5]*KU Leuven, Instituut voor Kern- en Stralingsfysica, B-3001 Leuven, Belgium*
[6]*Department of Nuclear Physics and Biophysics, Comenius University in Bratislava, 84248 Bratislava, Slovakia*
[7]*Instituto de Física Corpuscular, CSIC - Universidad de Valencia, E-46980, Valencia, Spain*
[8]*Institute of Nuclear Research (ATOMKI), P.O.Box 51, H-4001 Debrecen, Hungary*
[9]*Grupo de Física Nuclear, EMFTEL & IPARCOS, Universidad Complutense de Madrid, 28040 Madrid, SPAIN*
[10]*Istituto Nazionale di Fisica Nucleare, Sezione di Milano, I-20133 Milano, Italy*
[11]*Department of Physics, University of Surrey, Guildford GU2 7XH, United Kingdom*
[12]*Instituto de Estructura de la Materia, CSIC, Serrano 113 bis, E-28006 Madrid, Spain*
[13]*Department of Physics and Astronomy, Aarhus University, DK-8000 Aarhus C, Denmark*
[14]*University of Jyväskylä, Department of Physics, Accelerator laboratory, P.O. Box 35(YFL) FI-40014 University of Jyväskylä, Finland*
[15]*Department of Physics, Oliver Lodge Laboratory, University of Liverpool, Liverpool L69 7ZE, United Kingdom*
[16]*Instituto Nazionale di Fisica Nucleare, Laboratori Nazionali di Legnaro, I-35020 Legnaro, Italy*
[17]*STFC Daresbury, Daresbury, Warrington WA4 4AD, United Kingdom*
[18]*Dept. of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37996, US*
[19]*Institut Laue-Langevin, CS 20156, 38042 Grenoble Cedex 9, France*
[20]*Université de Strasbourg, CNRS, IPHC UMR7178, F-67000, Strasbourg, France*
[21]*Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany*

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Happy birthday!

Happy birthday!

Balabanski Crag (Bulgarian: *Балабански камък*, ‘Balabanski Kamak’ \ba-la-'ban-ski 'ka-m&k\) is the rocky peak rising to 833 m[1] in eastern Bigla Ridge on Heros Peninsula, Foyn Coast on the Antarctic Peninsula. It surmounts Cabinet Inlet to the northeast.
The feature is named after Dimitar Balabanski, physicist at St. Kliment Ohridski Base in 1994/95 and subsequent seasons.

Source: Wikipedia & Google Maps

Extra slides

			$B(E2; J^\pi \rightarrow (J-2)^\pi)$ (W.u.)				
Nucl.	J^π	$T_{1/2}$ (ps) Exp.	Exp.	H208	H208 -m	KHPE	KHPE -m
^{214}Po	2_1^+	13(5)	7(3)	13.6	14.3	12.3	13.2
	4_1^+	35(5)	18(3)	16.9	18.5	13.3	16.5
	6_1^+	118(5)	16(1)	11.4	14.7	5.9	12.6
	8_1^+	607(14)	11.3(3)	1.2	9.2	0.1	6.6
		13(1) ns	**0.54(4)**[14]				
^{216}Po	2_1^+	11(5)	13(6)	18.1	18.9	17.7	18.7
	4_1^+	21(5)	26(6)	25.2	27.1	22.1	25.2
	6_1^+	31(5)	37(6)	18.8	25.0	9.8	23.2
	8_1^+	409(16)	24(1)	16.2	17.8	3.2	15.5
^{218}Po	2_1^+	$<$15	$>$13	19.2	20.1	14.8	15.3
	4_1^+	$<$15	$>$33	29.9	31.5	21.5	22.9
	6_1^+	20(8)	40(16)	28.3	35.0	2.8	3.2
	8_1^+	628(25)	7.8(3)	8.5	16.2	1.0	0.003

TABLE I. Experimental $T_{1/2}$ and $B(E2)$ values in $^{214-218}$Po measured in the present work and Ref. [14] (bold), compared to calculated $B(E2)$s using various effective interactions: H208, KHPE, and their pairing-modified versions.

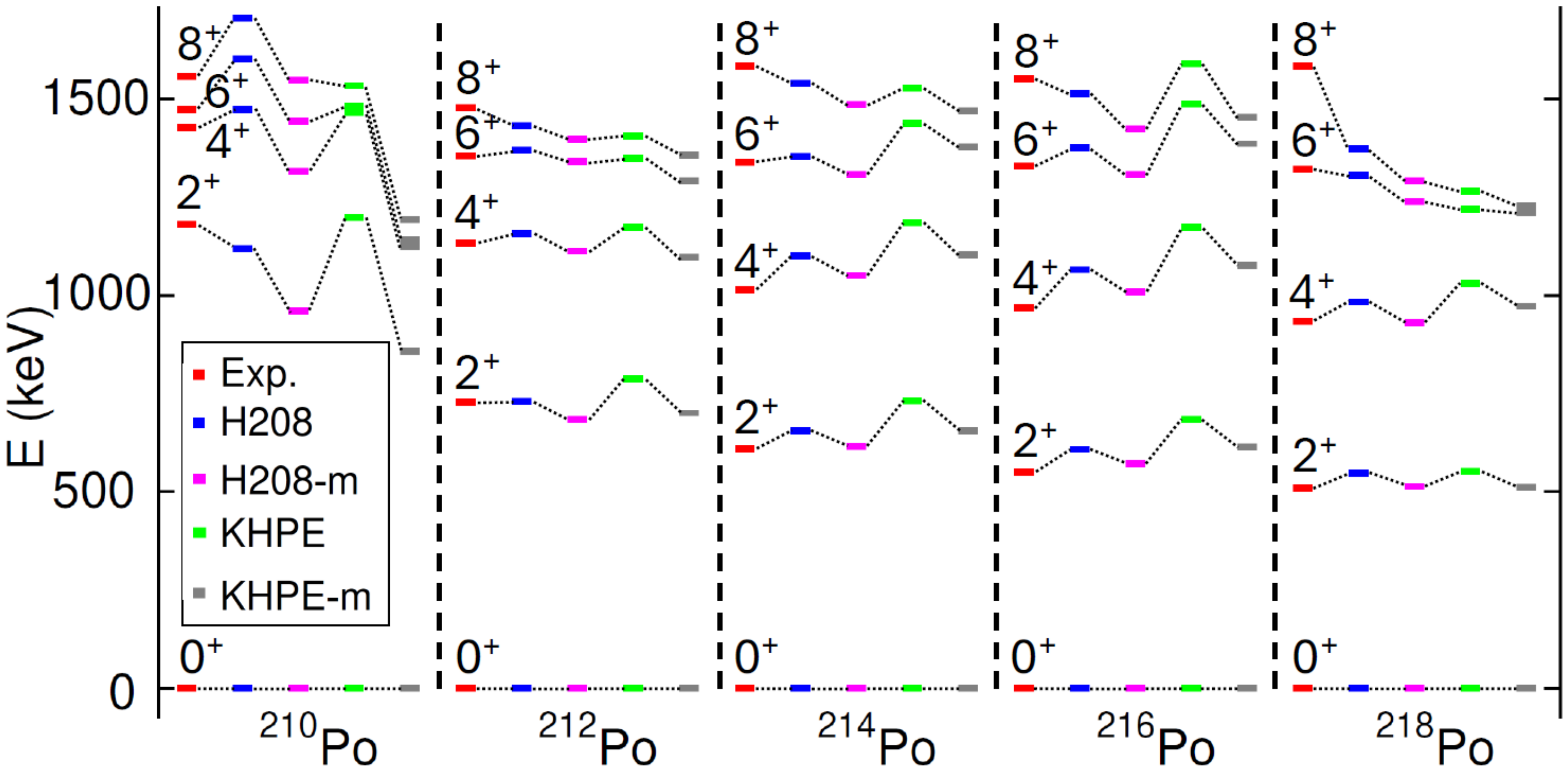
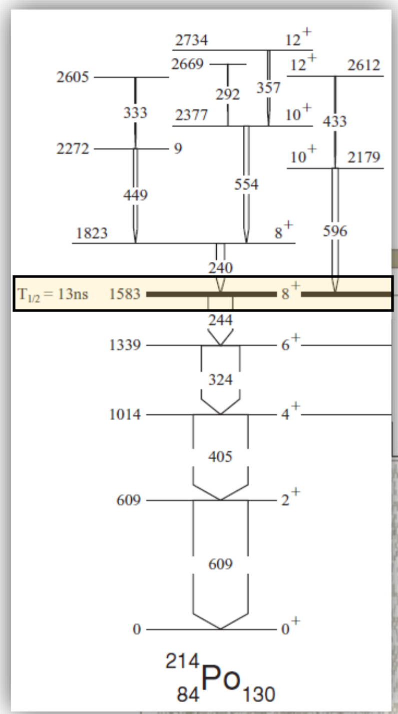
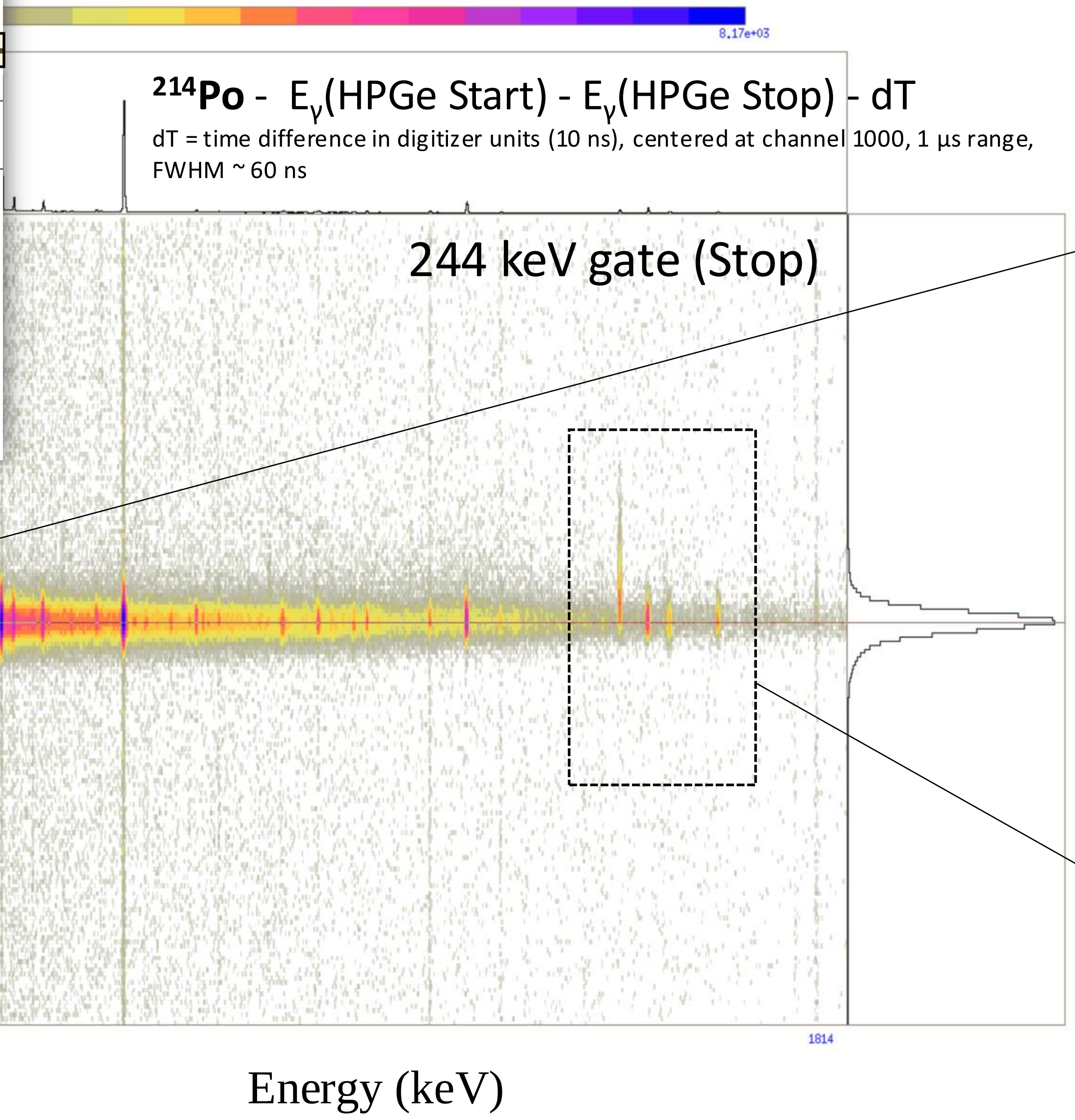


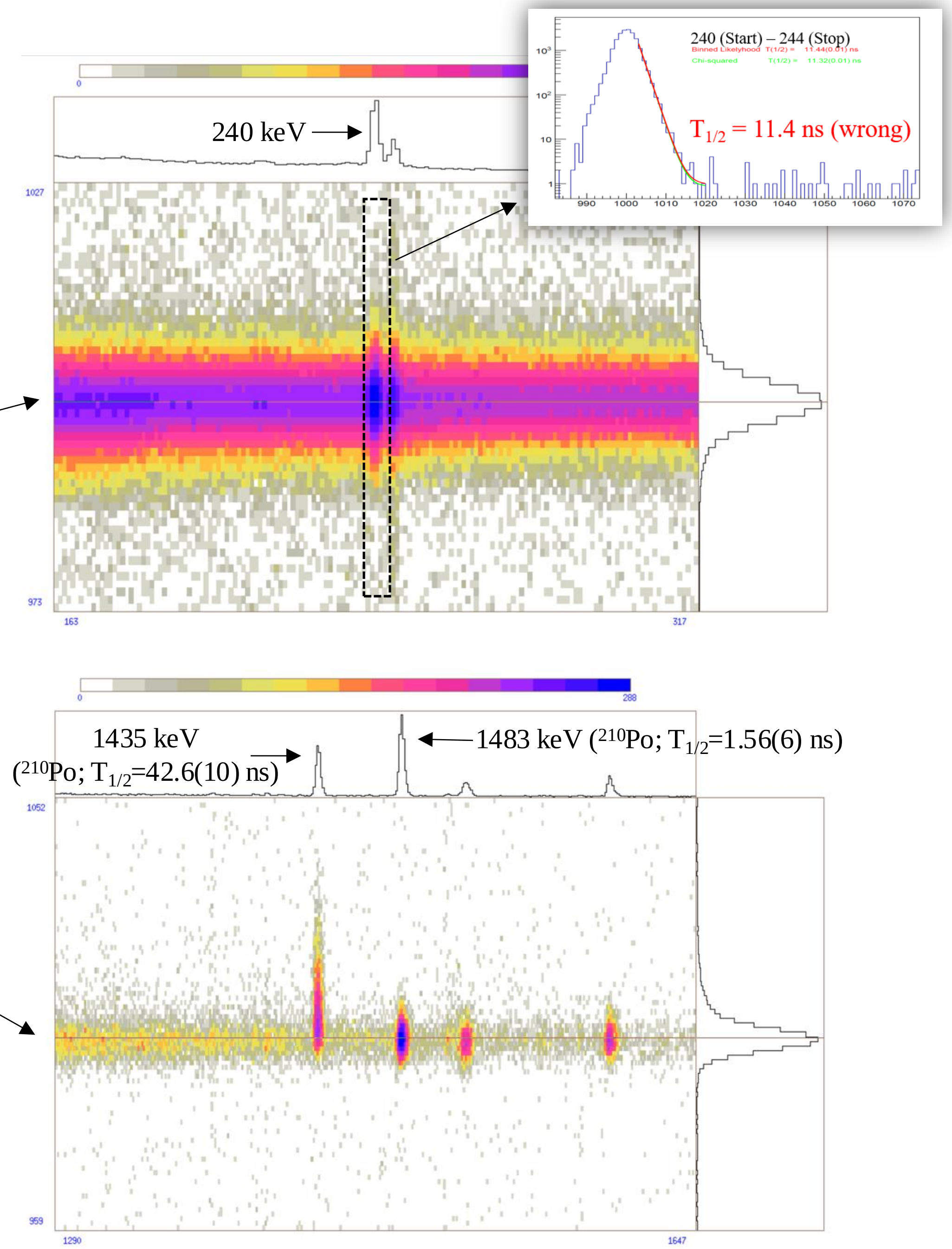
FIG. 3. The calculated $0^+ - 8^+$ yrast energy levels of even-even $^{210-218}$Po isotopes using H208, H208-m, KHPE and KHPE-m interactions, compared to the available experimental data [14, 35–39].

HPGe 'not-so-fast'-timing

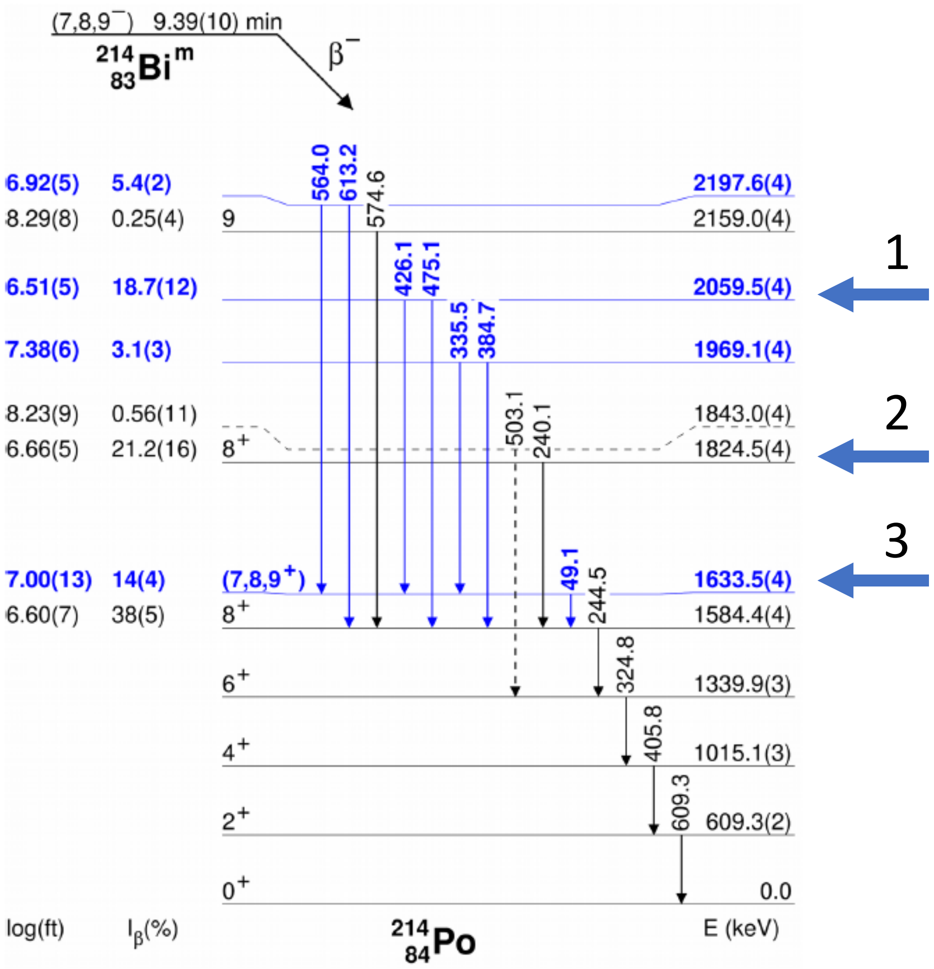
reproducing the results of *A. Astier and M.-G. Porquet, Phys. Rev. C83, 014311 (2011)*

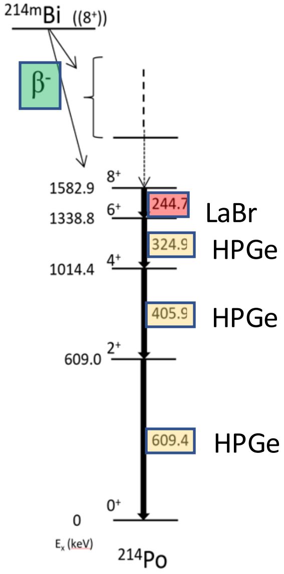






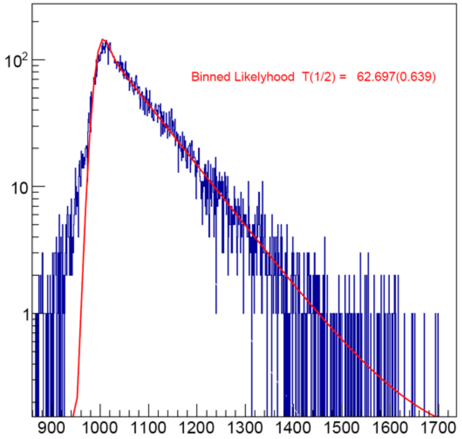
8_1^+ level in ^{214}Po: feeding from above

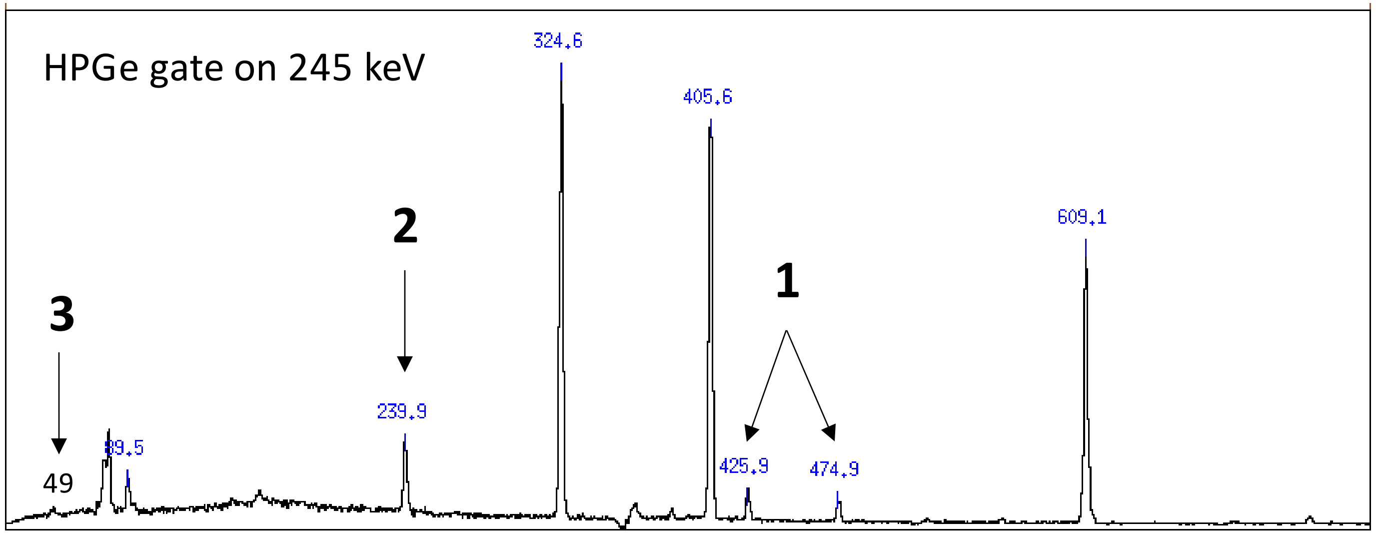




- HPGe gate: 324, 405, 609 keV
- LaBr gate: **245 keV**

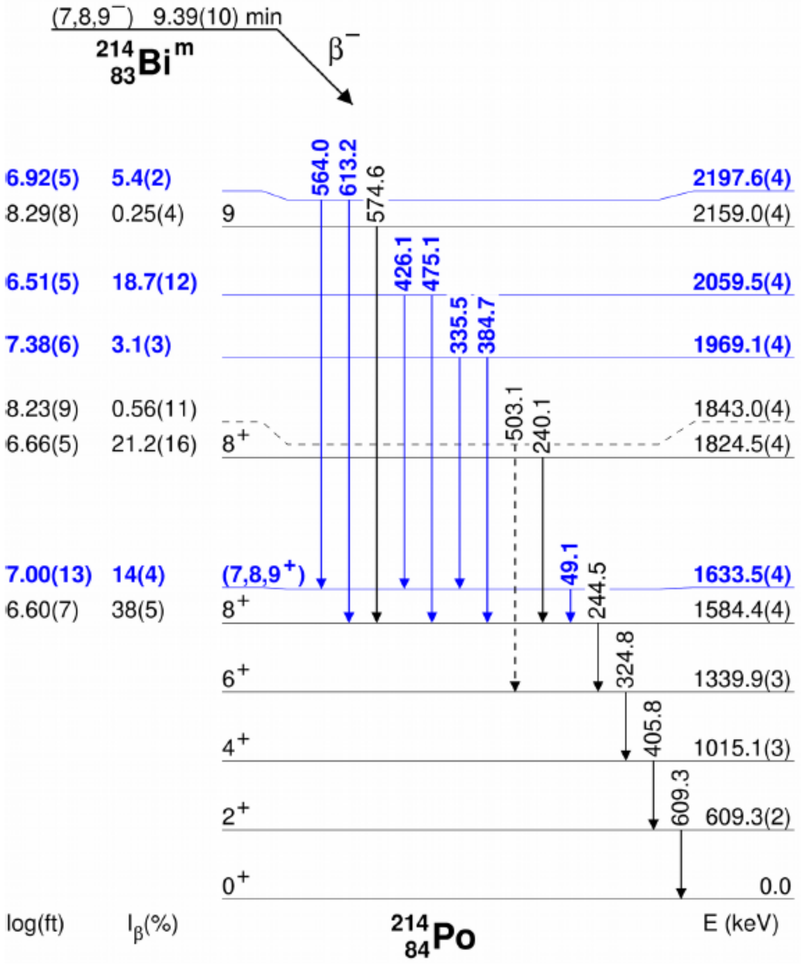
$T_{1/2}(8^+)$ = 622(7) ps



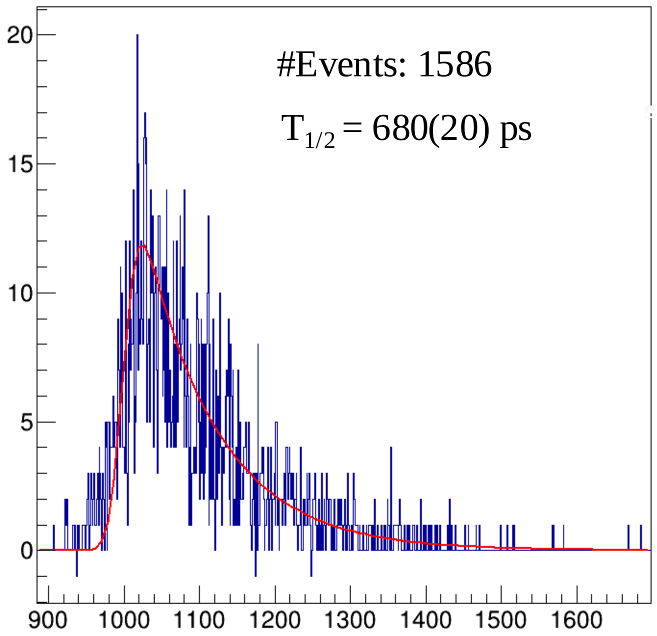


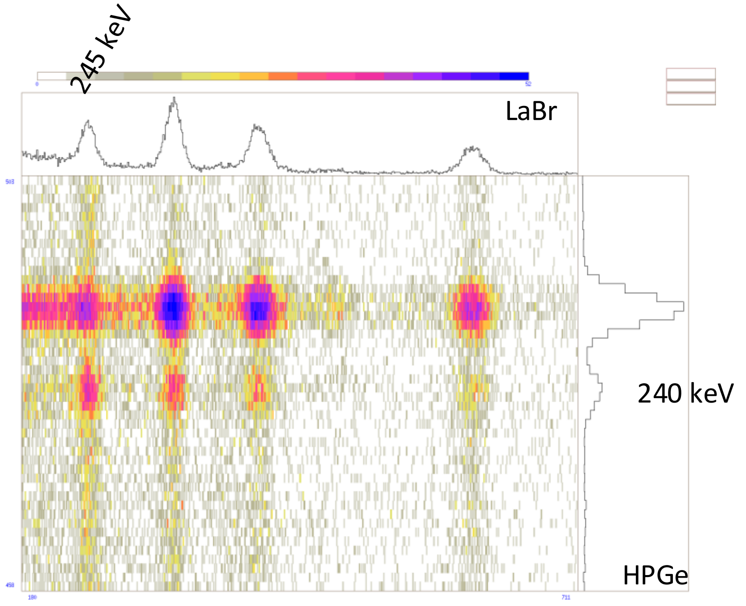
8_1^+ level in ^{214}Po: feeding from above

Previously: $T_{1/2}(8_1^+)$ = 622(7) ps
Now:
$T_{1/2}(8_1^+$; 1584 keV) = 607(14) ps
$T_{1/2}(8^+$; 1824 keV) = 73(7) ps



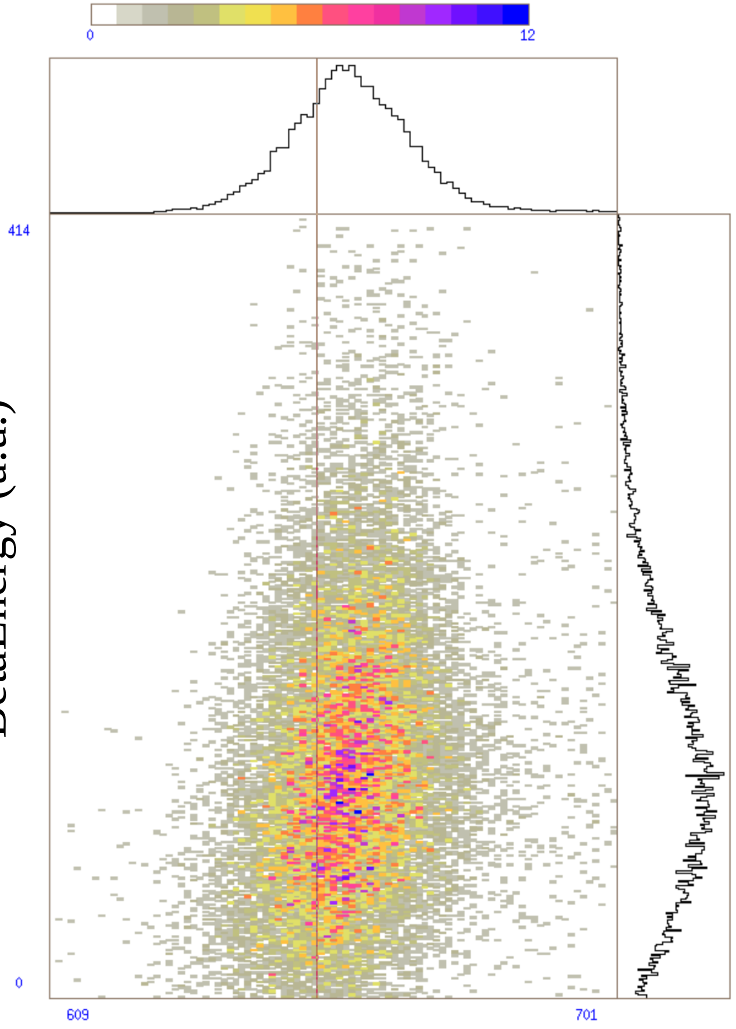
- HPGe gate: 240 keV
- LaBr gate: **245 keV**



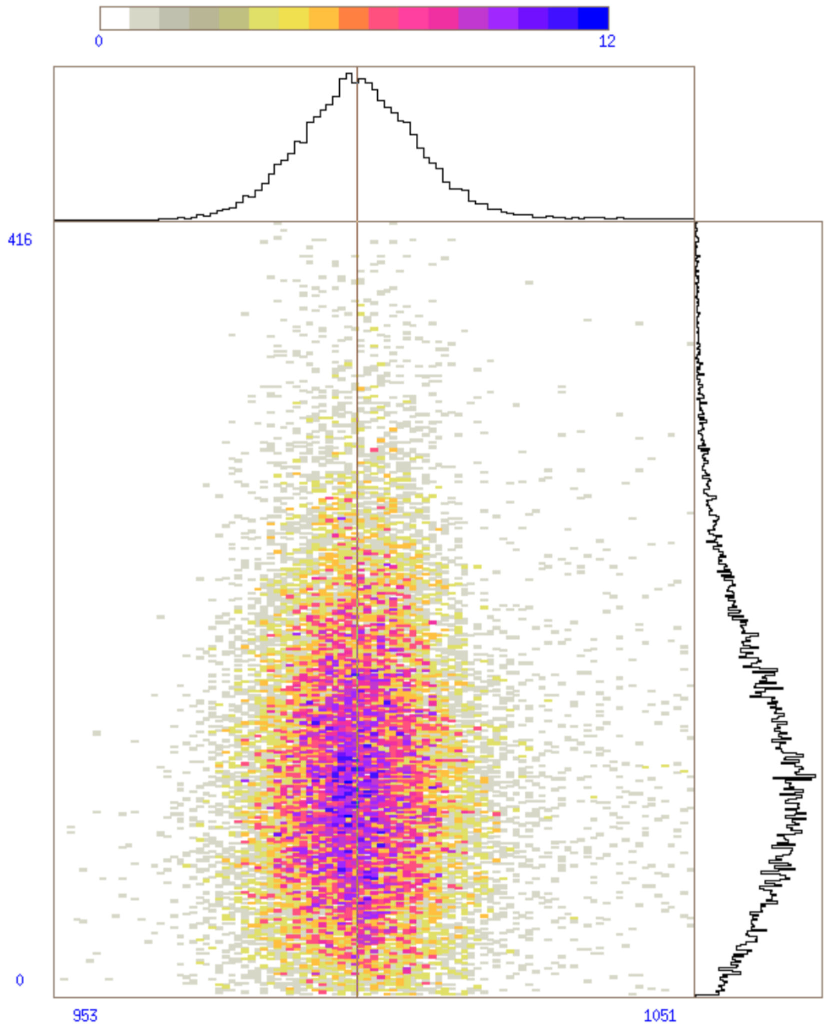


Reference (Beta) walk correction

^{138}Cs before



^{138}Cs after

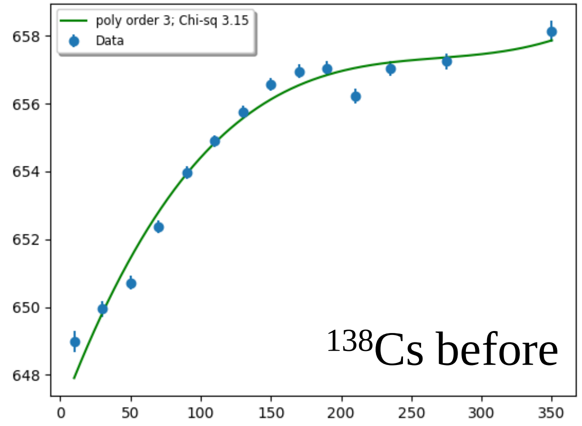


BetaEnergy (a.u.)

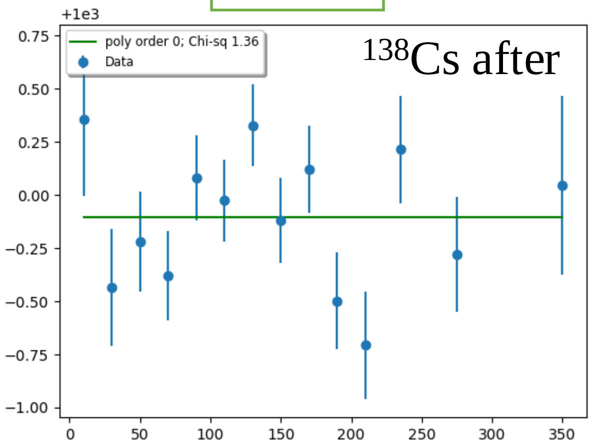
La$_1$ TAC (10ps/ch)

La$_1$ TAC (10ps/ch)

± 40 ps



± 5 ps



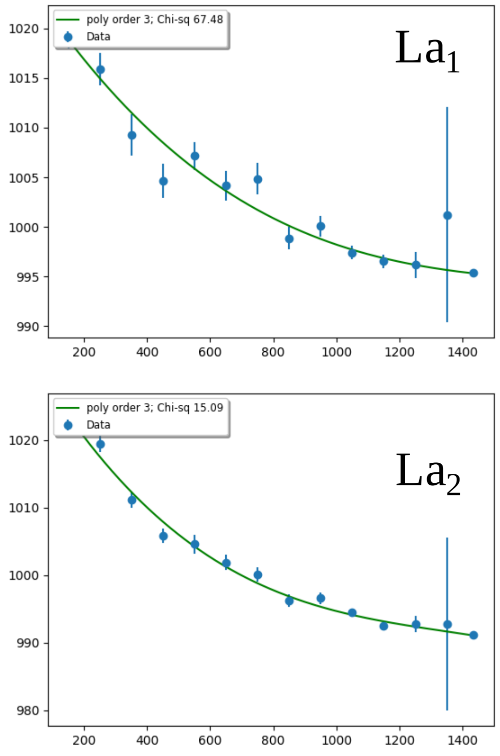
BetaEnergy (a.u.)

LaBr-walk correction with ^{138}Cs

± 150 ps

1. Compton correction

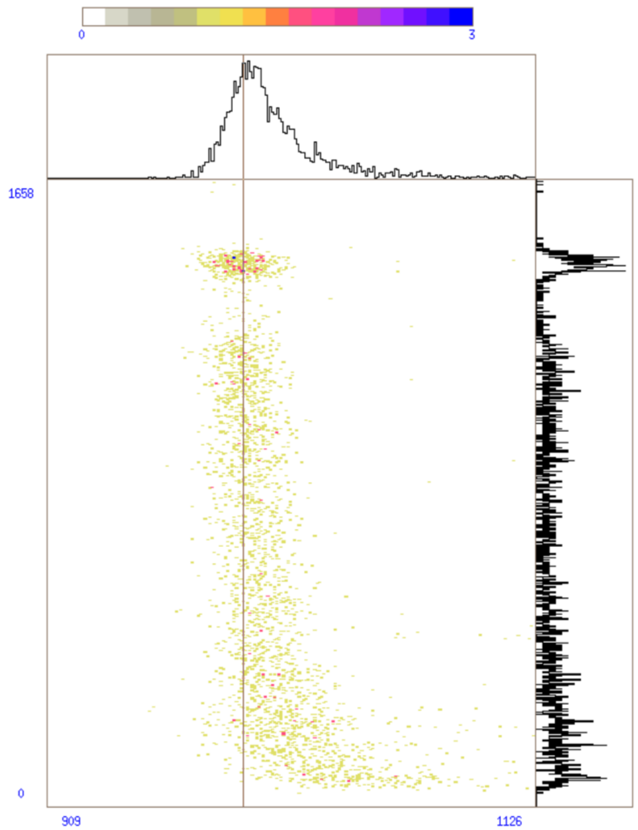
La-Beta TAC (10ps/ch)



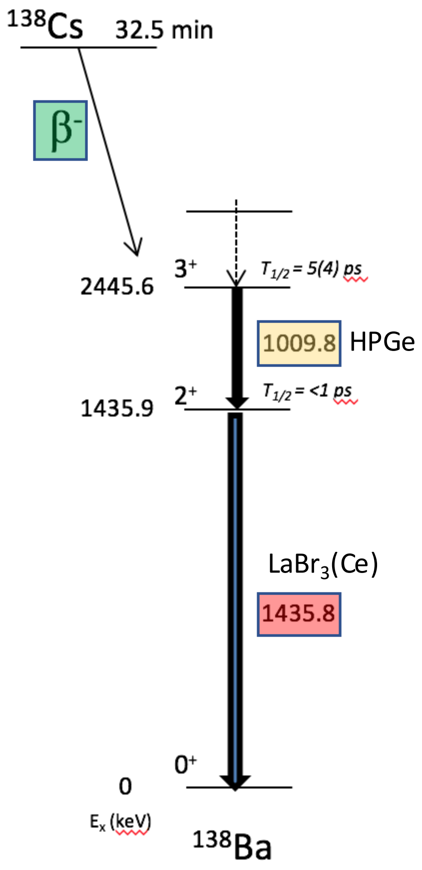
La Energy (keV)

Before

La Energy (keV)



La$_1$-Beta TAC (10ps/ch)



LaBr-walk correction with ^{138}Cs

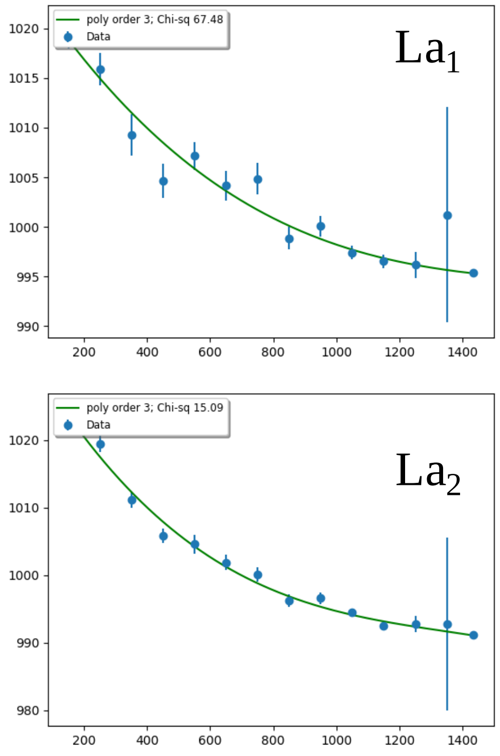
± 150 ps

1. Compton correction

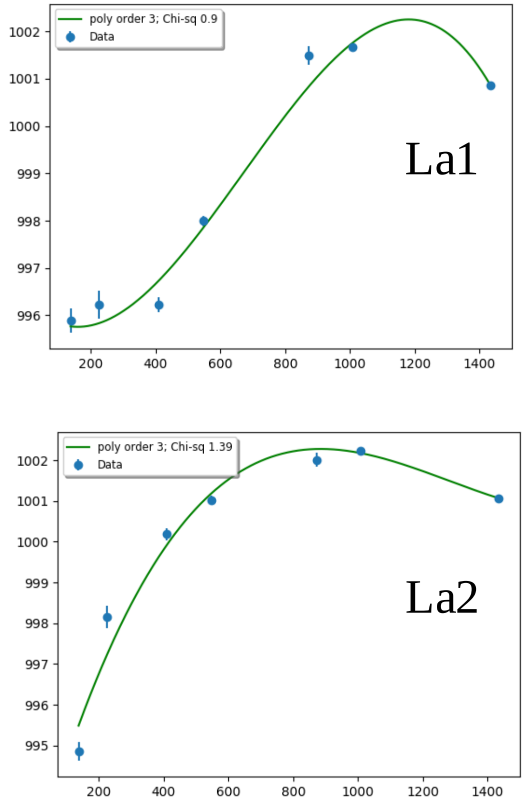
± 30 ps

2. Full Peak correction

La-Beta TAC (10ps/ch)

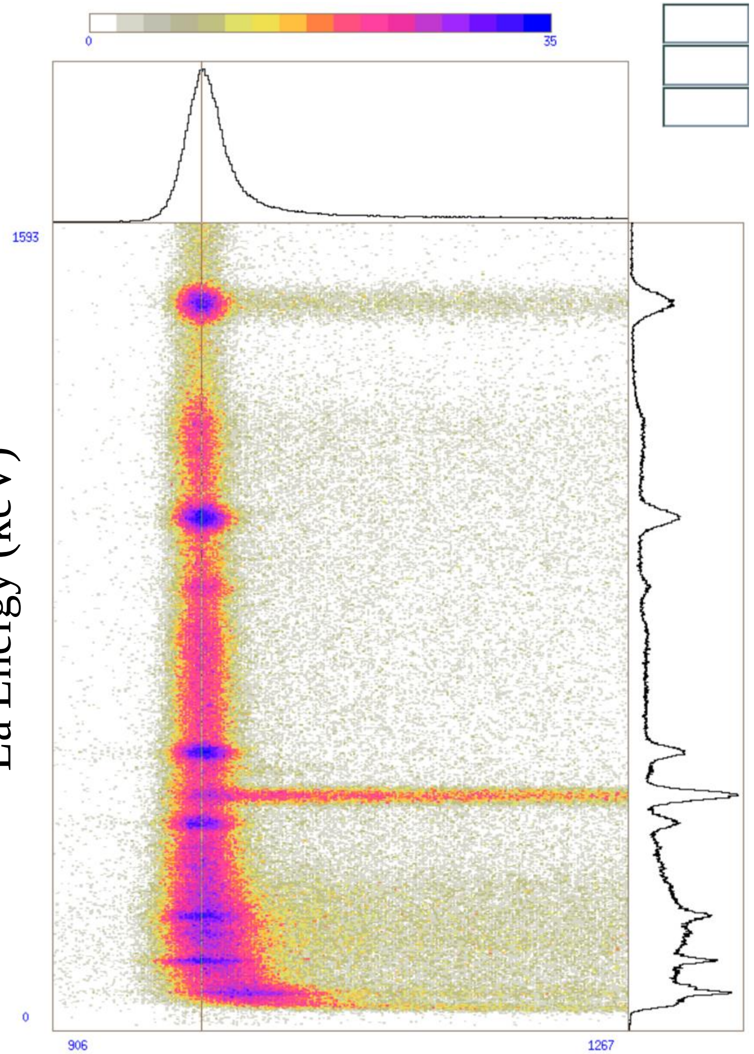


La Energy (keV)



La Energy (keV)

La Energy (keV)



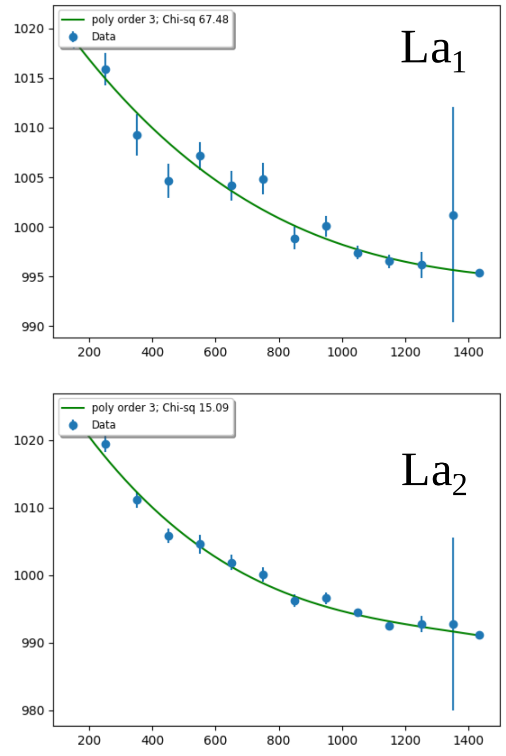
La_1-Beta TAC (10ps/ch)

LaBr-walk correction with ^{138}Cs

± 150 ps

1. Compton correction

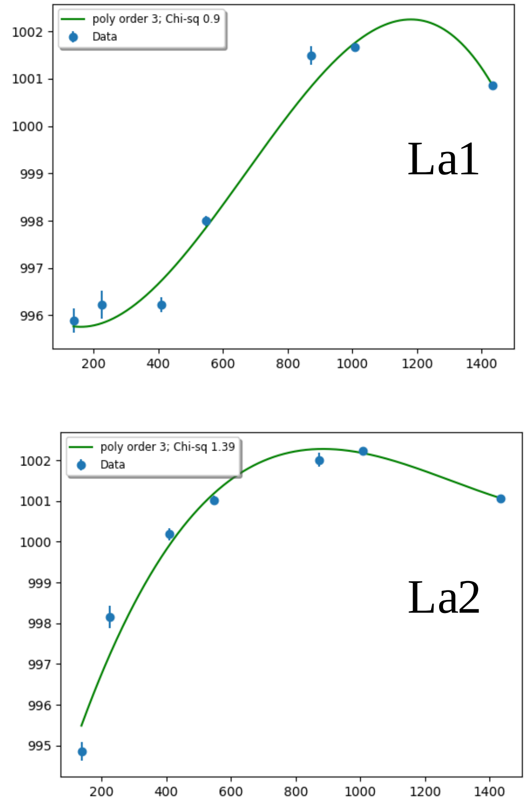
La-Beta TAC (10ps/ch)



La Energy (keV)

± 30 ps

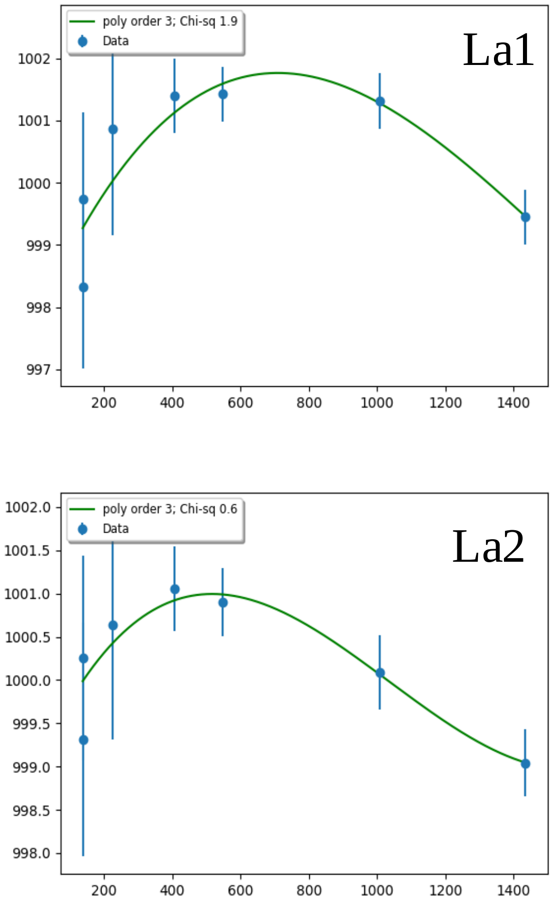
2. Full Peak correction



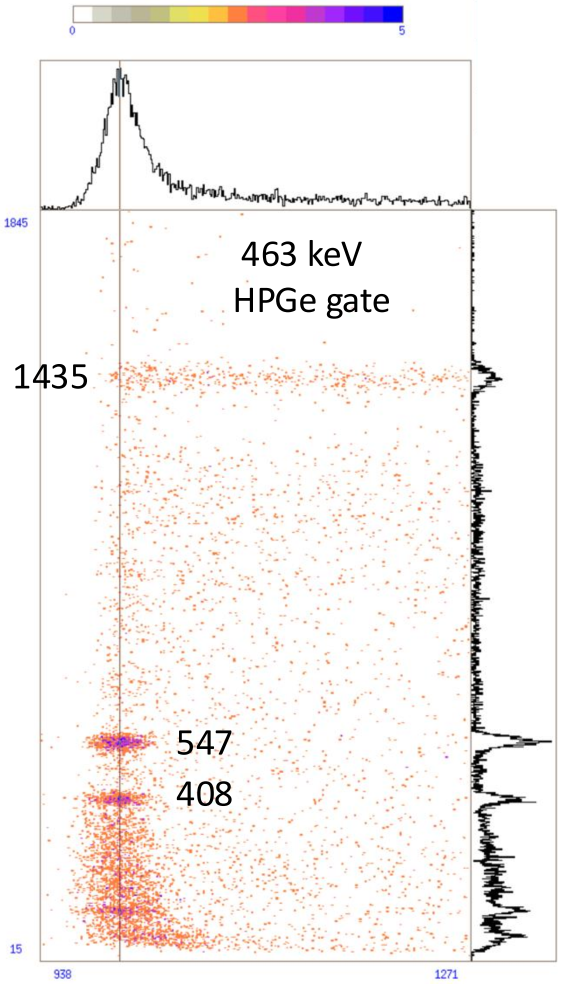
La Energy (keV)

± 10 ps

3. HPGe gated Full Peak correction



La Energy (keV)



LaBr-walk correction with ^{138}Cs