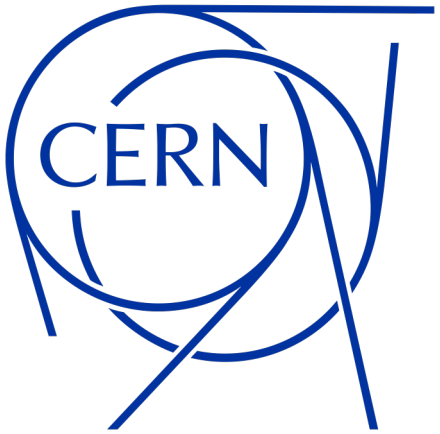
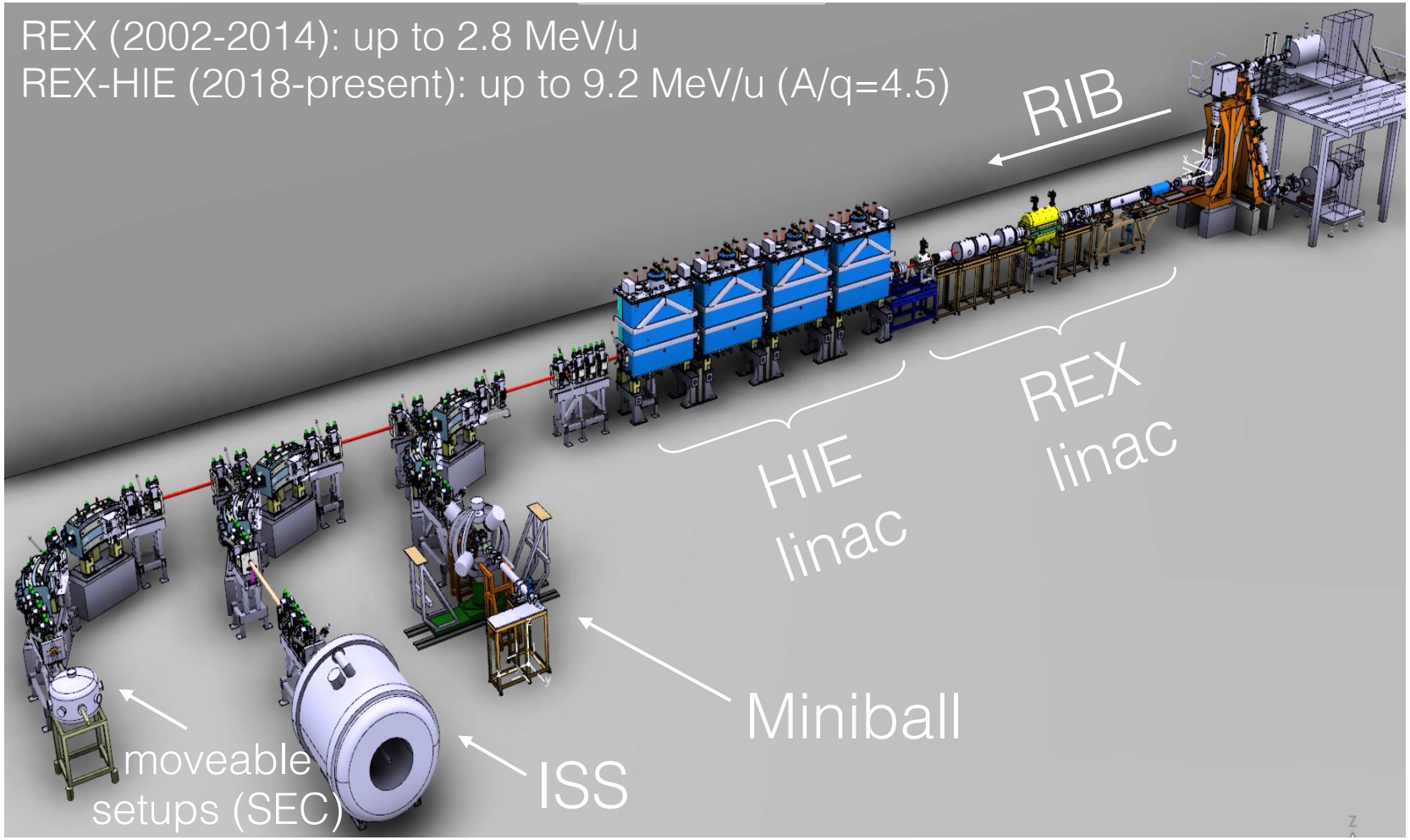


Overview of the 2024 Miniball campaign at ISOLDE

Carlotta Porzio

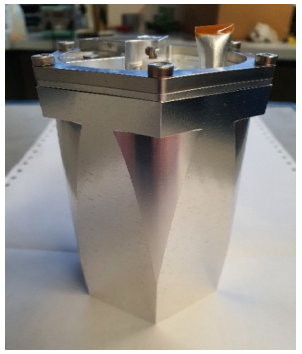
29th November 2024, ISOLDE Workshop and Users Meeting 2024

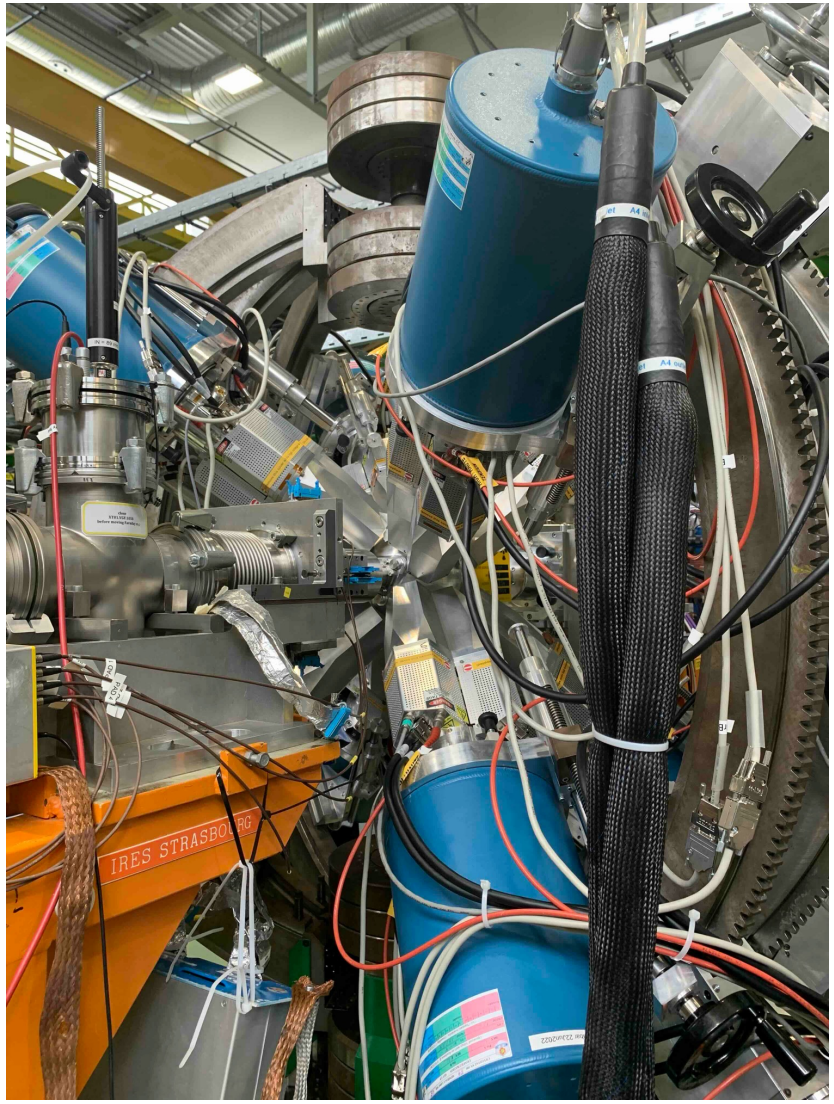
HIE-ISOLDE


REX (2002-2014): up to 2.8 MeV/u
REX-HIE (2018-present): up to 9.2 MeV/u (A/q=4.5)
RIB
HIE linac
REX linac
Miniball
ISS
moveable setups (SEC)

The Miniball array
Gamma-ray detection

- Eight triple-crystal cryostats
- Six-fold segmented HPGe crystals
- 2022 refurbishment:
  - New encapsulation and cryostats
  - New electronics (AGATA-like preamplifiers)
  - New DAQ (FEBEX by GSI)

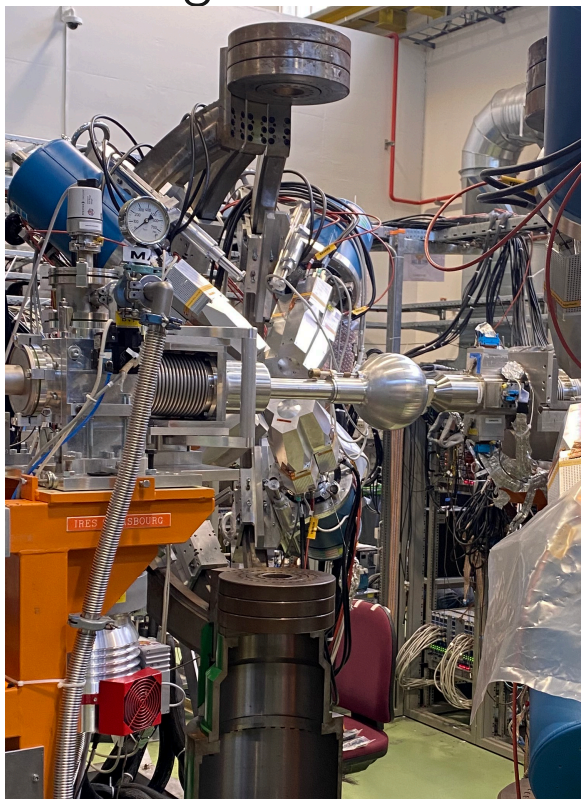




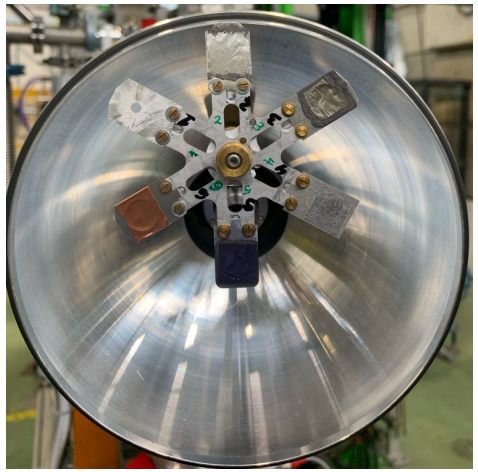
The Miniball array

A versatile instrument

Plunger chamber

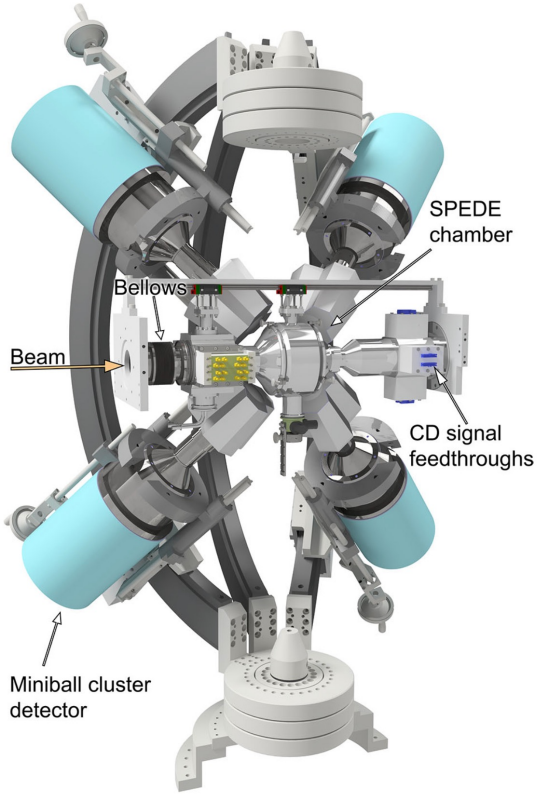


Target wheel



up to 6 targets installed in the chamber

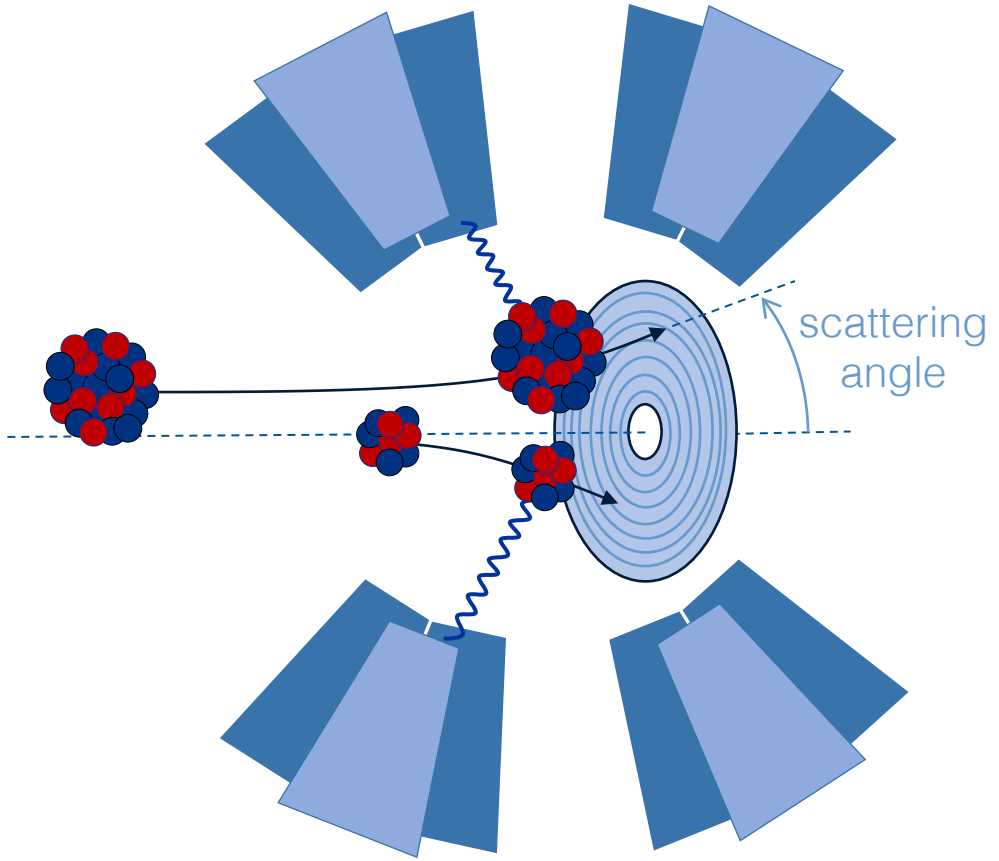
SPEDE chamber



P. Papadakis *et al.*, EPJ A 54 (2018) 42

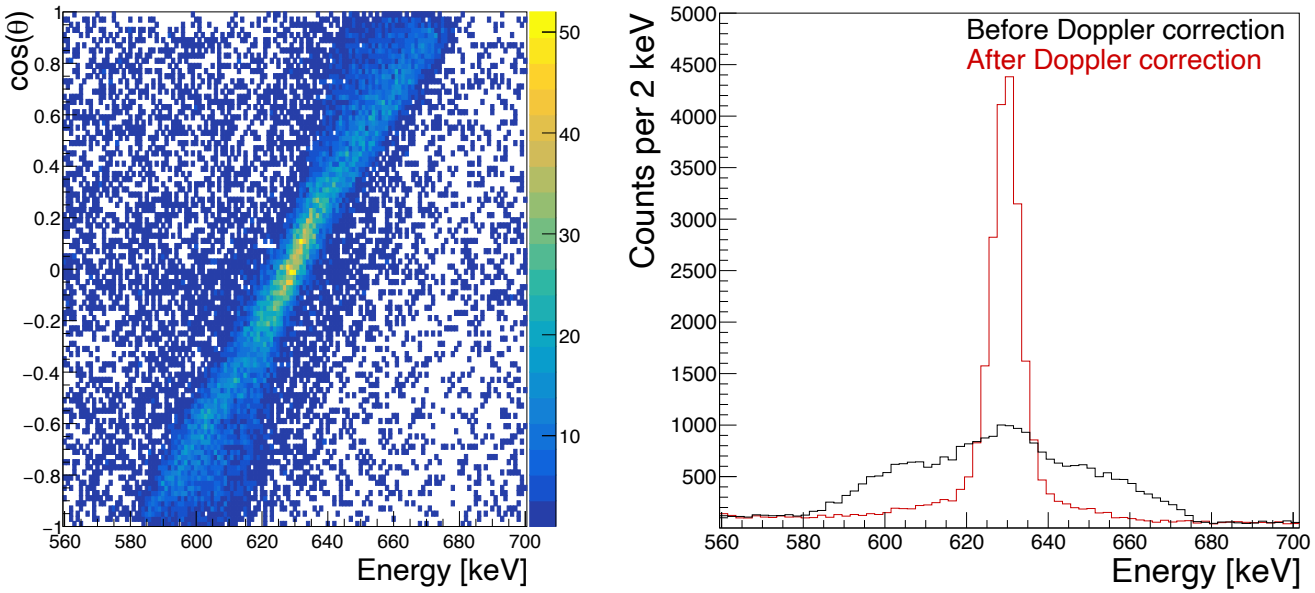
Coulomb excitation reactions

- Low energy (few MeV/u): “safe” Coulex
- Only electromagnetic interaction
- Extract matrix elements and transition strengths

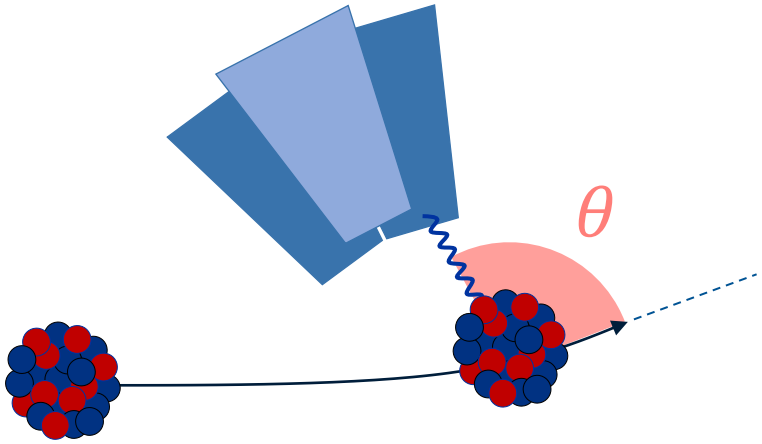


Doppler correction

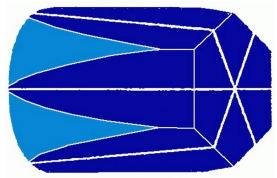
Data collected during IS748



$$E_{\mathrm{lab}} = \frac{\sqrt{1-\beta^2}}{1-\beta\cos\theta} E_{\mathrm{cm}}$$



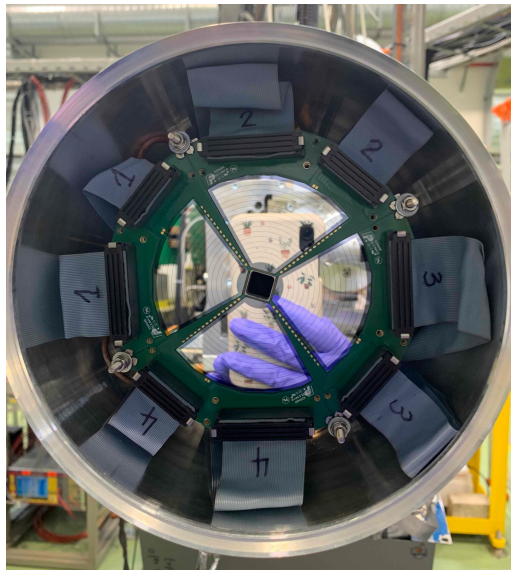
- β ~ 0.1
- Crystal six-fold segmentation improves precision on θ

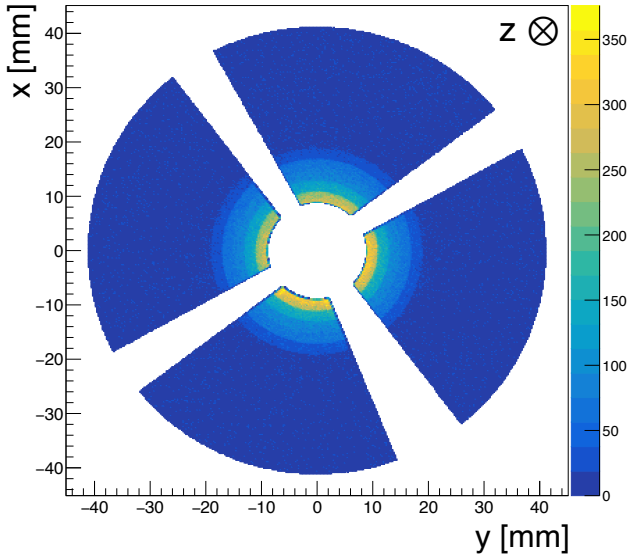


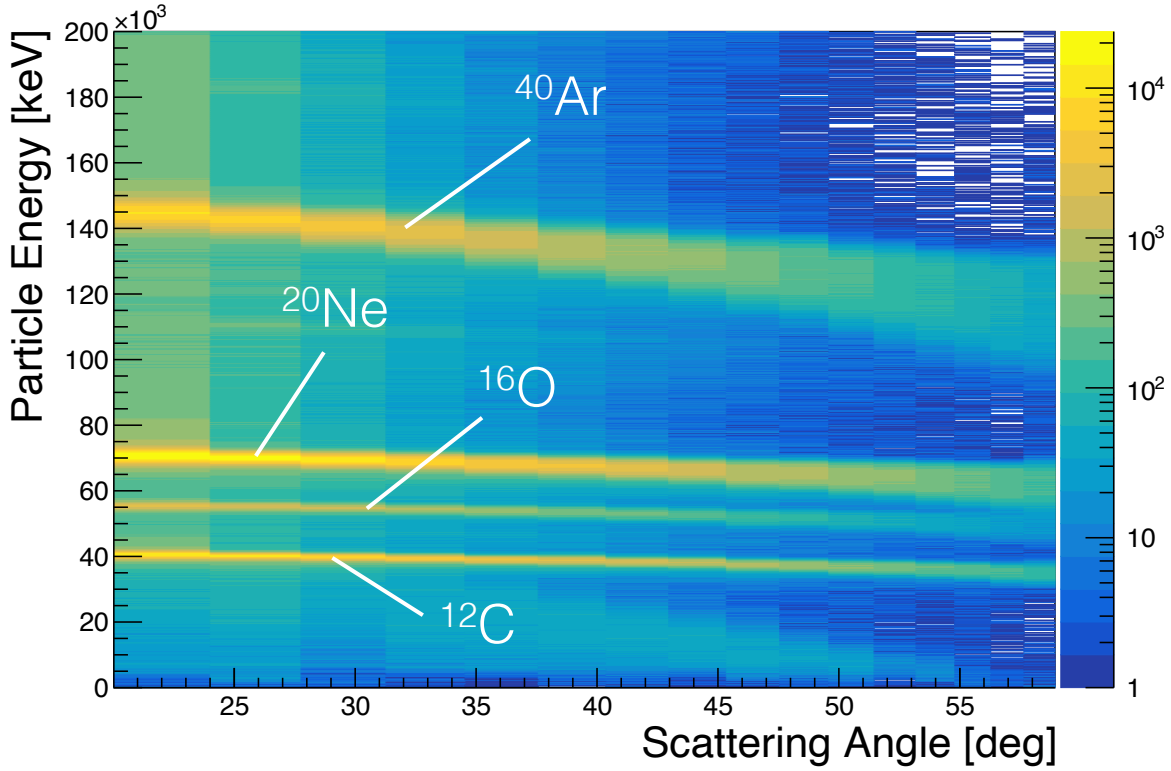
Particle detection at Miniball

CD detector (DSSSD):

- 16 annular strips
- 12 sector strips

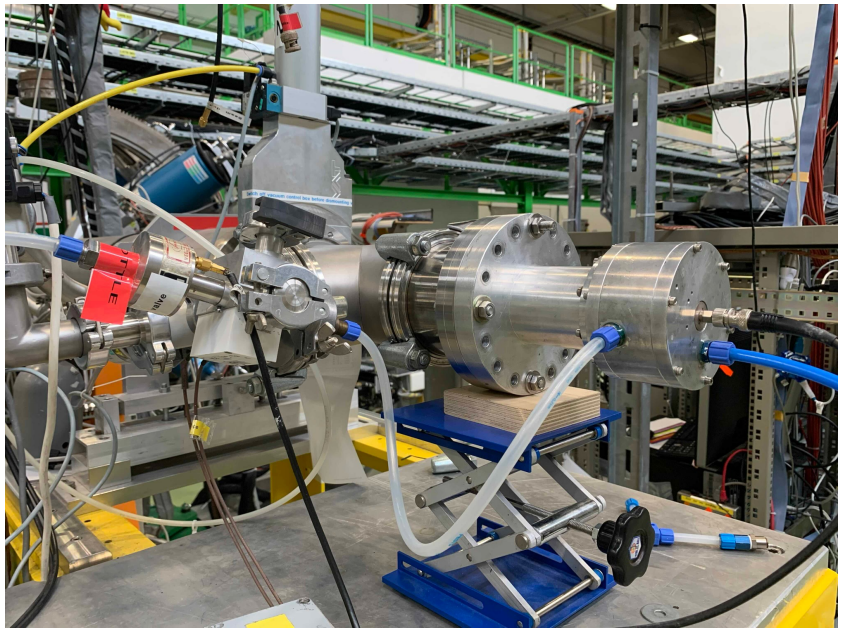


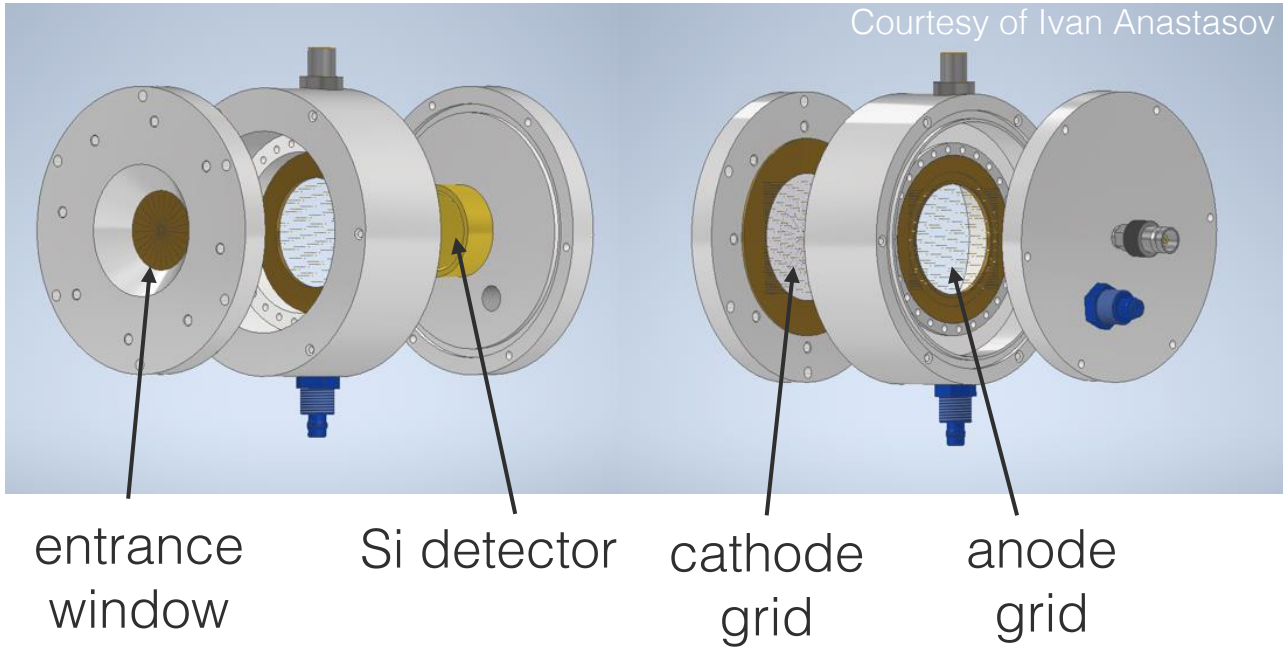




Ionization chamber

Ionization chamber at the end of the Miniball beam line for beam composition analysis.



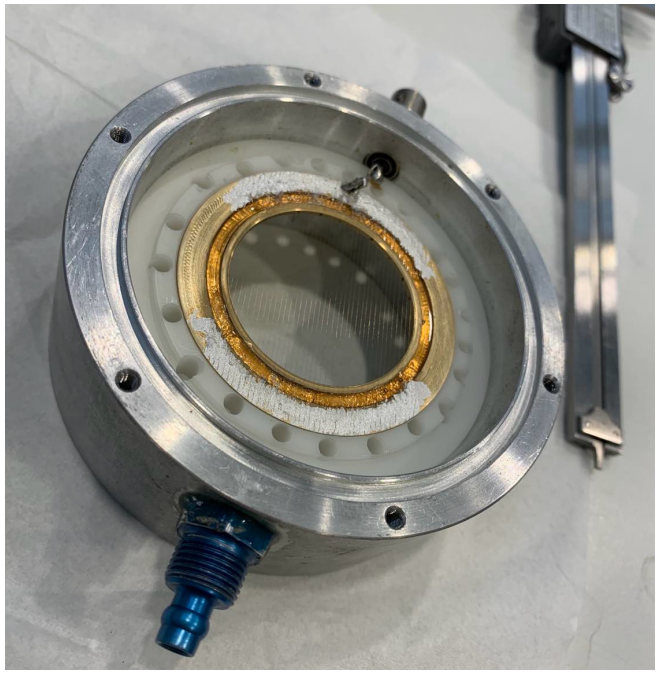


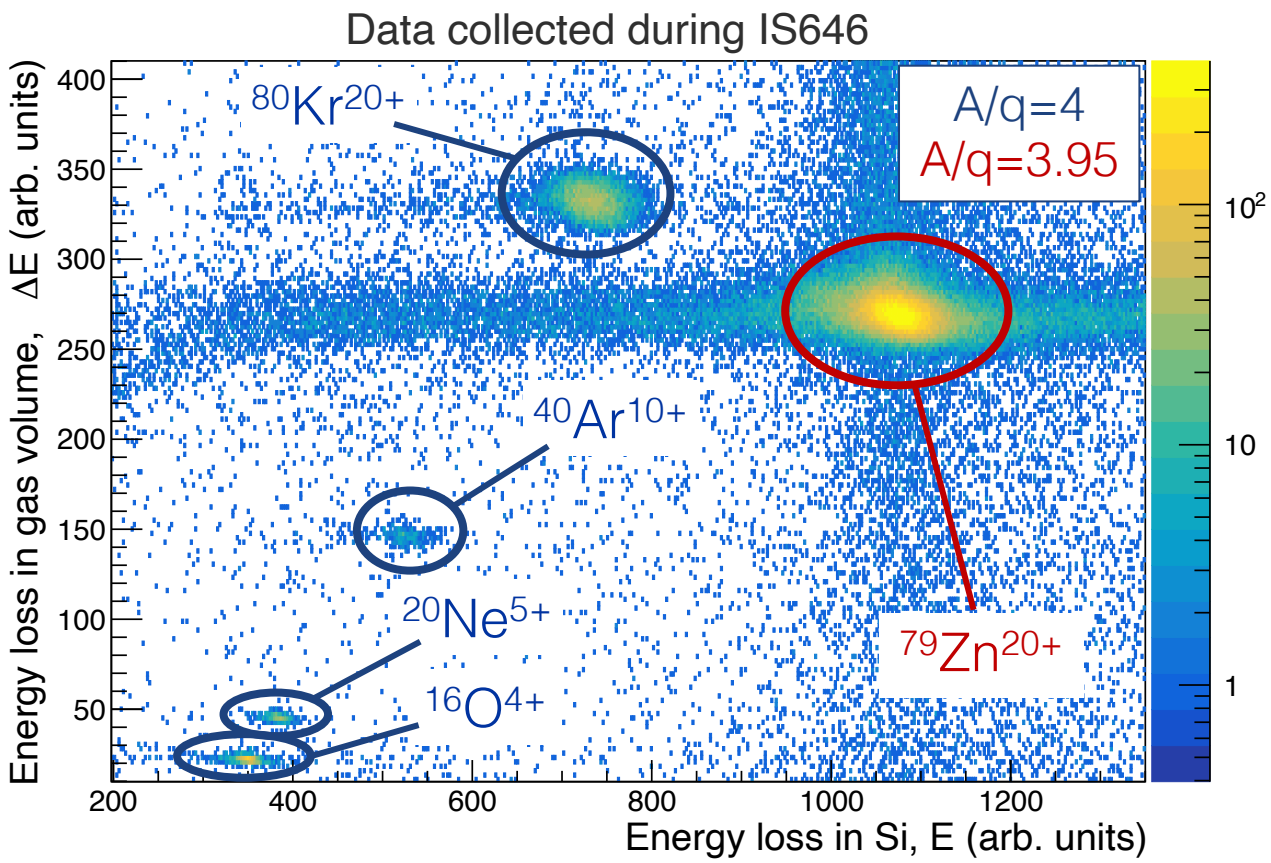
- Fill gas: CF_4.
- Operating pressure: 400-500 mbar.

Ionization chamber
2024 refurbishment

- Rewired anode and cathode grids (U. Manchester).
- Tested with stable beam.
- Operated with RIB during IS646.

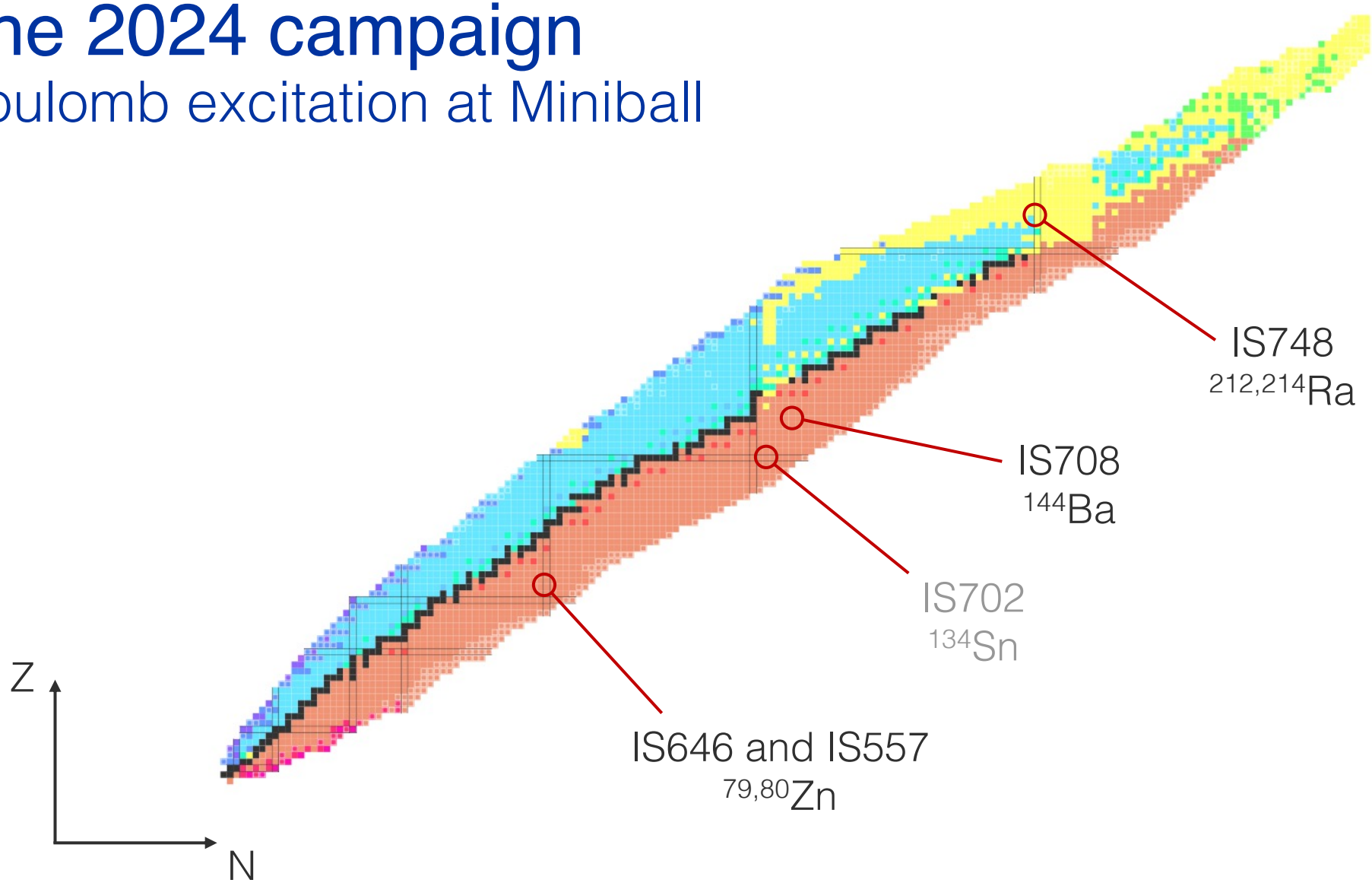
Ivan Anastasov
(U. Sofia, BG)





The 2024 campaign

Coulomb excitation at Miniball



IS646 and IS557: ^{79,80}Zn Coulex

Spokespeople: A. Gottardo, M. Zielinska, A. Illana, P. Van Duppen

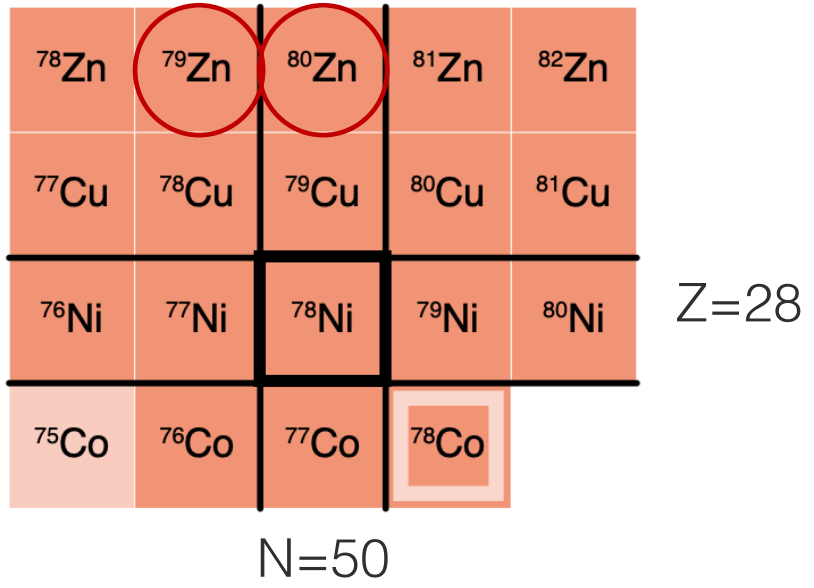
^{79}Zn (IS646):

Identify the nature of $1/2^+$ isomeric state: almost spherical, large $s_{1/2}$ intruder state *or* deformed configuration with $d_{5/2}$ component? Predicted different level schemes and B(E2) strengths.

^{80}Zn (IS557):

Complete systematic study of B(E2) in even-even n-rich Zn nuclei.

[^{74,76}**Zn** (IS557) Coulex results in:
A. Illana *et al.*, PRC 108 (2023) 044305]



→ See talk by A. Gottardo on Thursday 28/11

IS646 and IS557: ^{79,80}Zn Coulex

Primary target: UC with n-converter, quartz line, RILIS

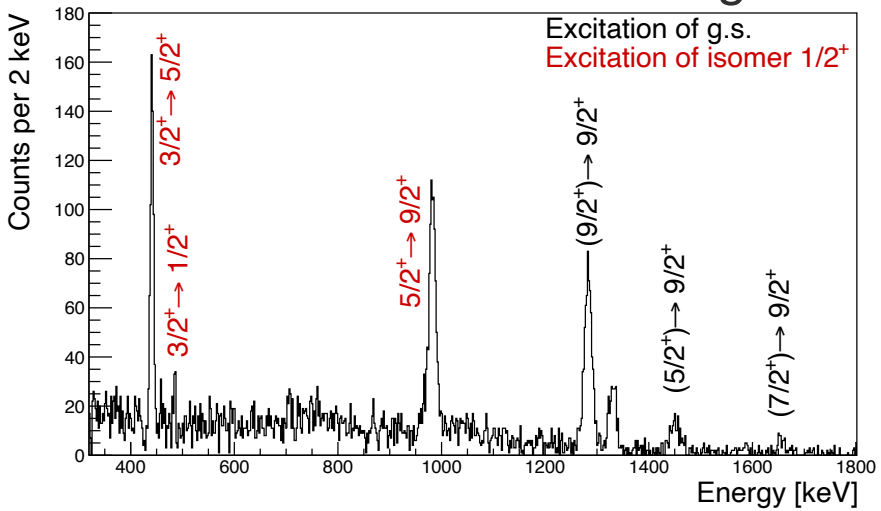
IS646:

- ^{79}Zn beam (**9/2$^+$ g.s.** and **1/2$^+$ isomeric state**), 4 MeV/u
- ^{208}Pb target (4 mg/cm^2) and ^{196}Pt target (3 mg/cm^2)
- 4.5 days of beamtime
- 8 × 10^4 ions/s [PhD project of F. Angelini]

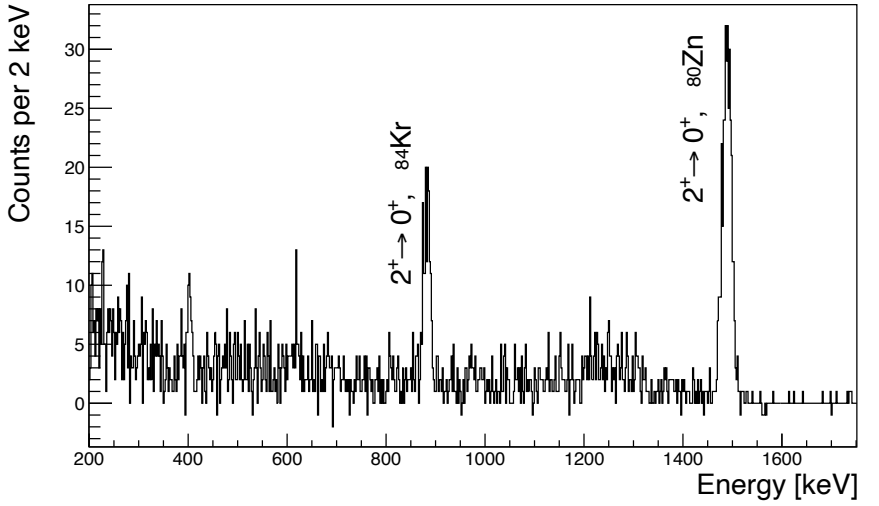
IS557:

- ^{80}Zn beam, 4.75 MeV/u
- ^{208}Pb target (4 mg/cm^2) and ^{196}Pt target (3 mg/cm^2)
- 4.5 days of beamtime
- 7 × 10^3 ions/s

^{79}Zn beam on ^{208}Pb target



^{80}Zn beam on ^{208}Pb target

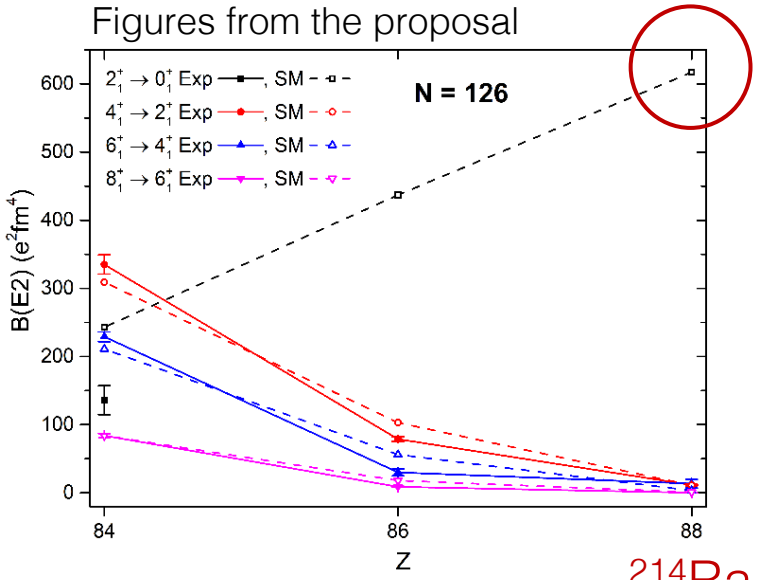


IS748: ^{212,214}Ra Coulex

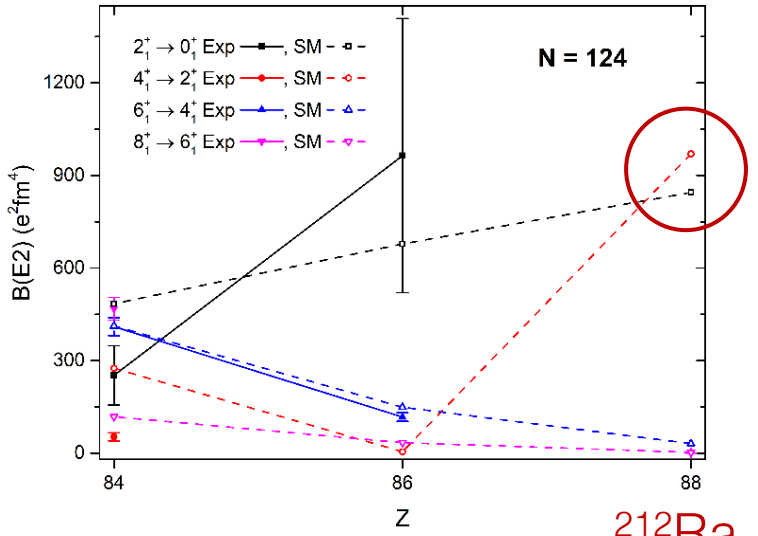
Spokespeople: G. Rainovski, G. Georgiev

- To what extent does the seniority scheme remain valid in the Po-Rn-Ra isotones with N = 126 and 124?
- Experiment goal: measure B(E2; $2^+ \rightarrow 0^+$) in ^{212,214}Ra and possibly B(E2; $4^+ \rightarrow 2^+$) in ^{212}Ra.
- Comparison with B(E2) values predicted within the shell model using the KHM3Y interaction.

Figures from the proposal



^{214}Ra

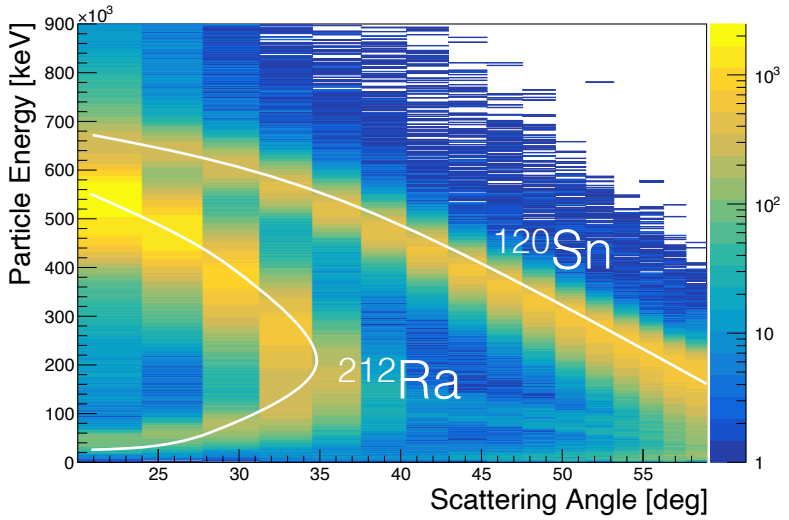


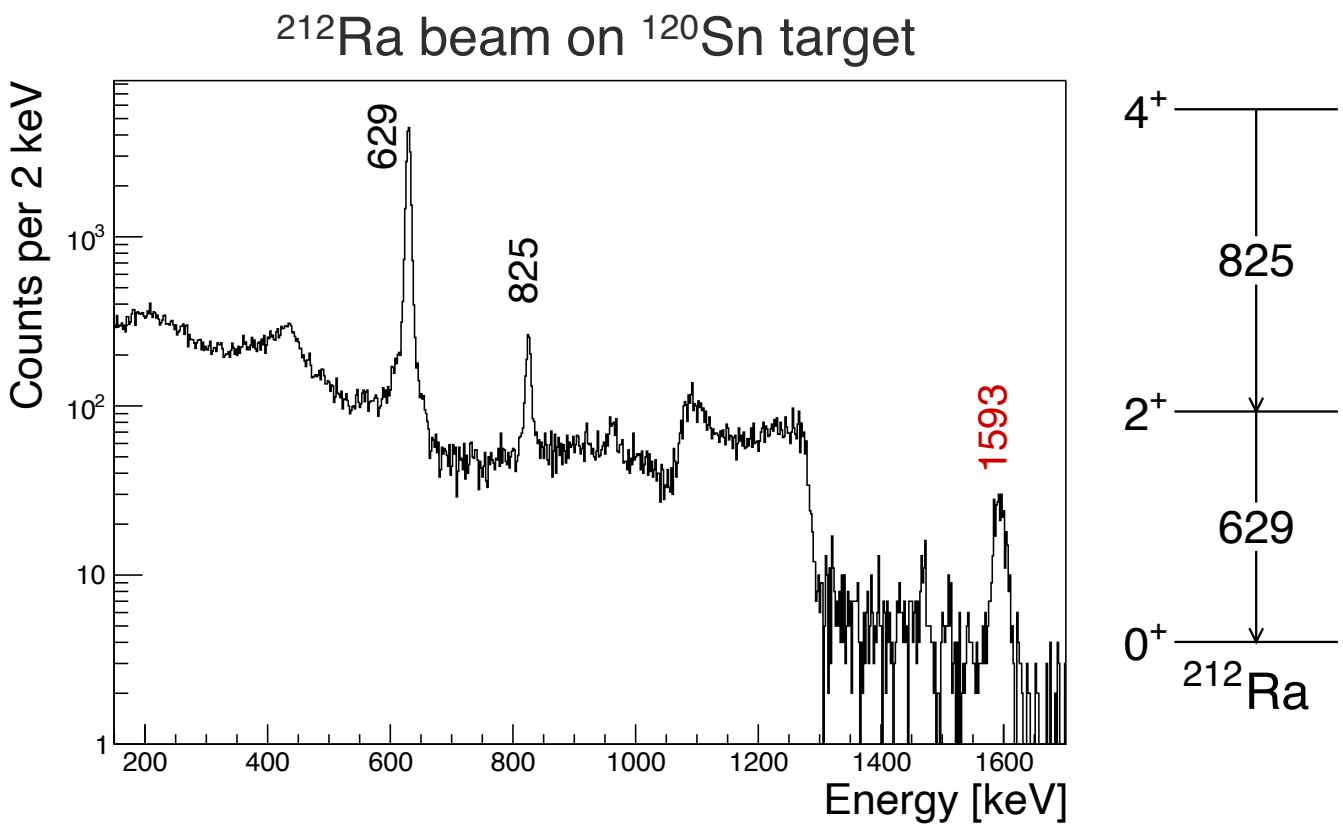
^{212}Ra

IS748: ^{212,214}Ra Coulex

[PhD project of H. Mayr]

- Primary target: ThC, surface ionization
- Beams extracted as $^{212}Ra^{19}F^{+1}$ and $^{214}Ra^{19}F^{+1}$
- ^{212}Ra beam: 4.5 MeV/u, 4 × 10^5 ions/s
- ^{120}Sn target (2.2 mg/cm^2) and ^{58}Ni target (2.0 mg/cm^2)
- 2 days of beamtime

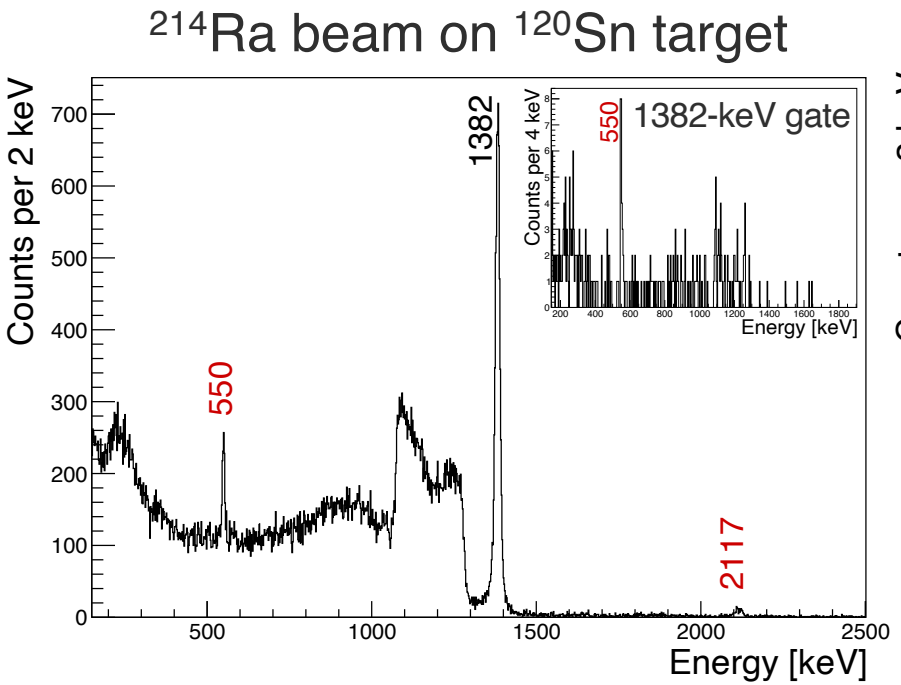


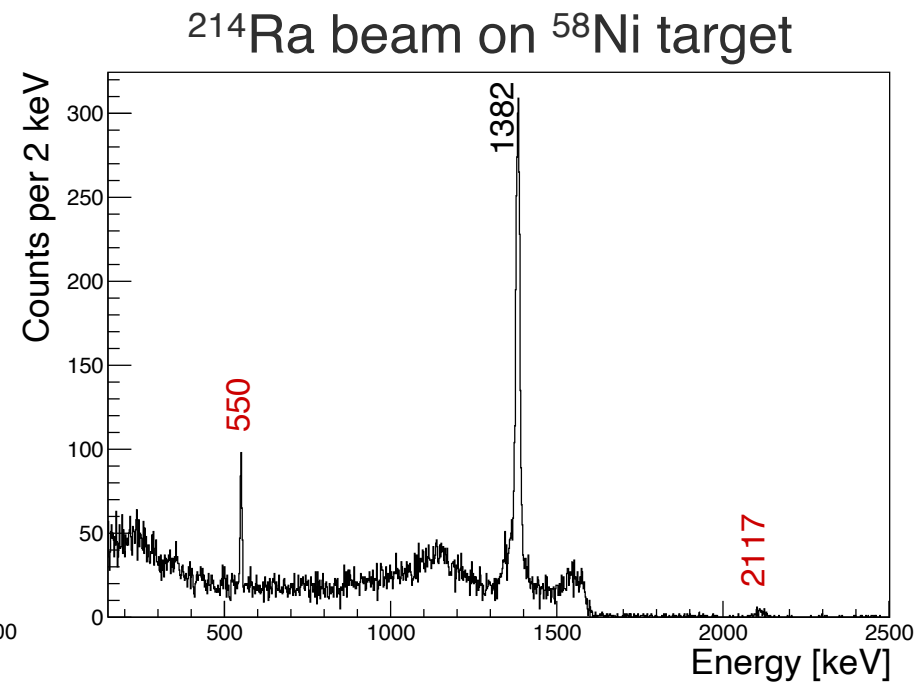


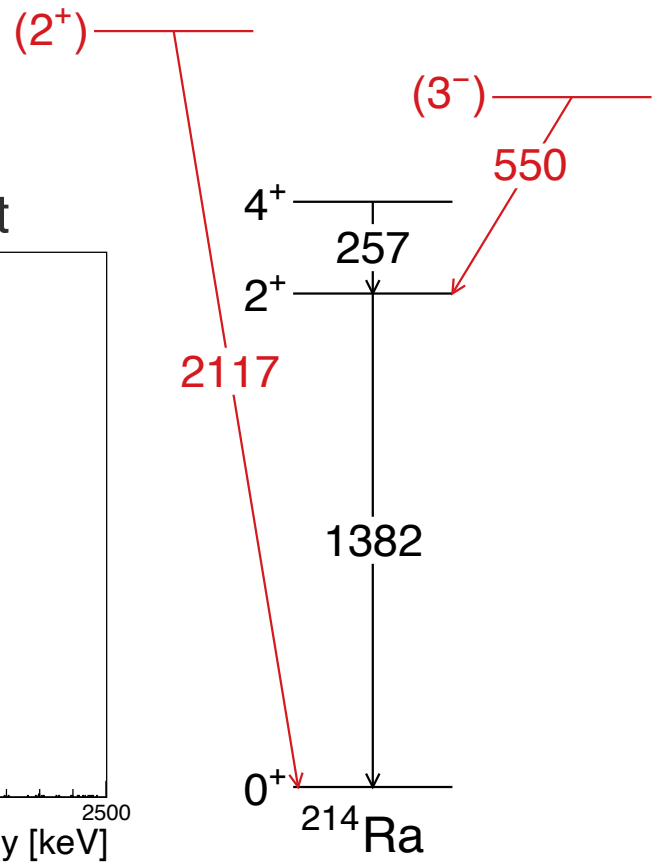
IS748: ^{212,214}Ra Coulex

[masters project of I. Anastasov]

- ^{214}Ra beam: 4.5 MeV/u, 2.3 × 10^5 ions/s
- 3.5 days of beamtime





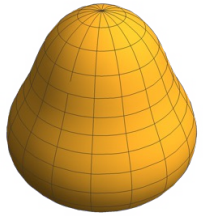


IS748: ^{212,214}Ra Coulex

IS708: ^{144}Ba Coulex

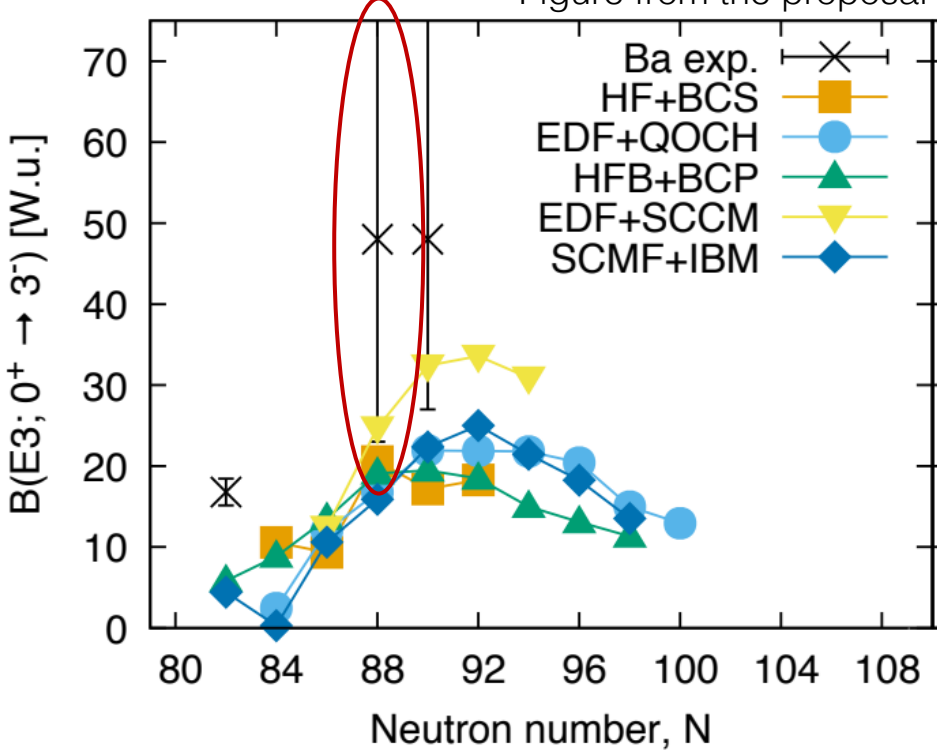
Spokesperson: L. Gaffney

- Probe octupole collectivity in the lanthanide region.



- Initial goal: octupole collectivity in ^{146}Ce.
- Measure B(E3; $0^+ \rightarrow 3^-$) in ^{144}Ba.
  Improve previous measurement from ANL
  [Bucher *et al.*, PRL 116 (2016) 112503].

Figure from the proposal

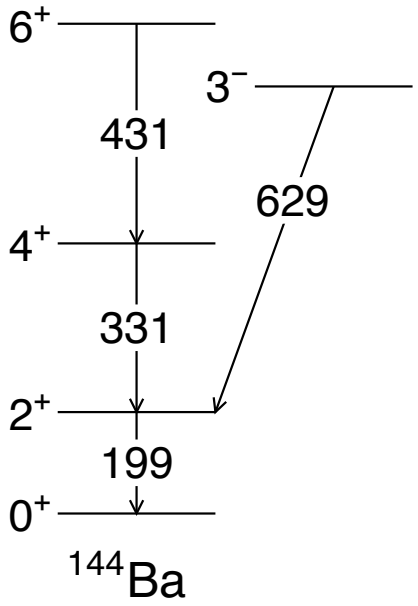


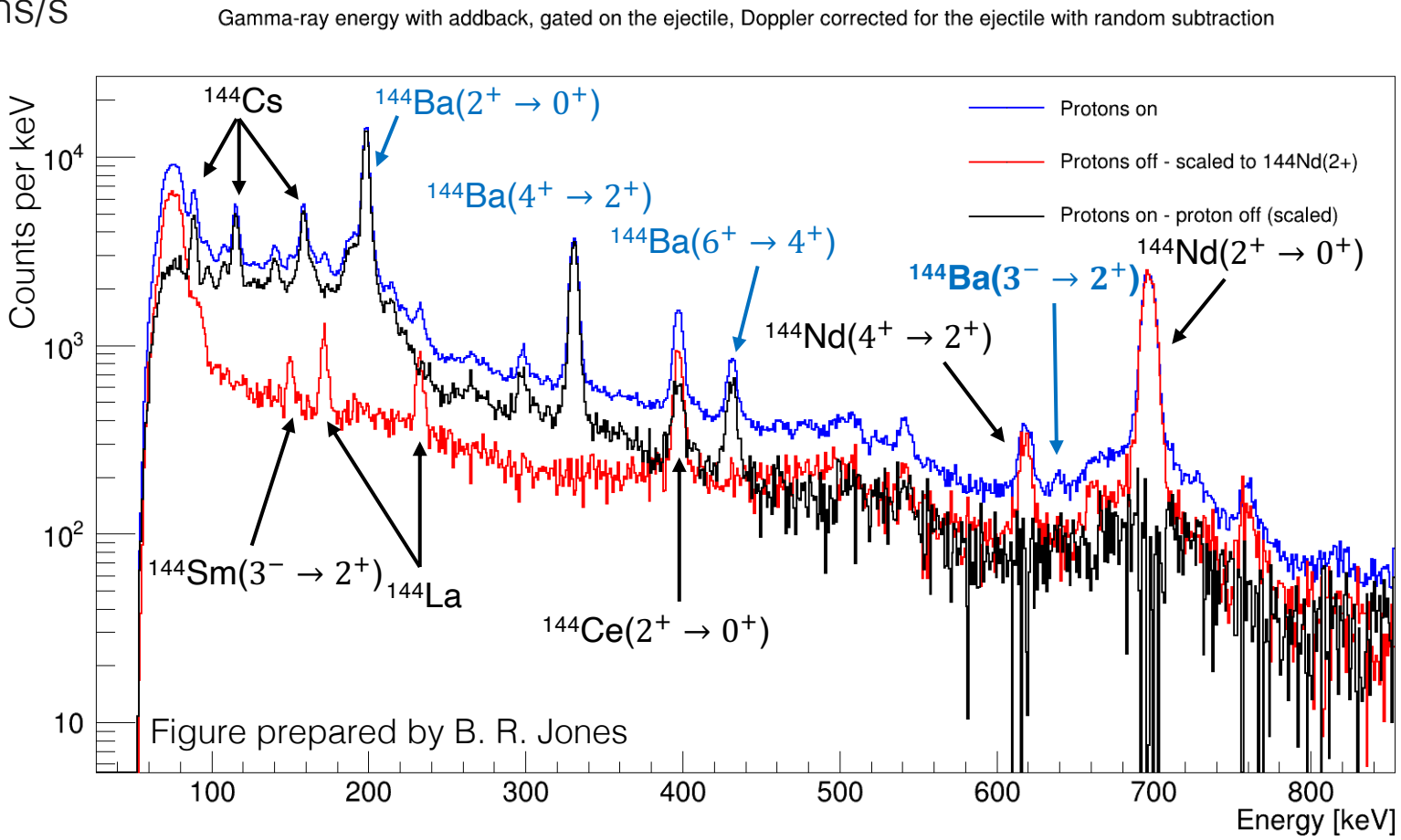
⟶ See talk by B. R. Jones on Thursday 28/11

IS708: ^{144}Ba Coulex

[PhD project of B. R. Jones]

- Primary target: UC, surface ionization
- ^{144}Ba beam, 4.5 MeV/u, ~10^6 ions/s
- ^{208}Pb target, 2.5 mg/cm^2
- 2.5 days of beamtime





Summary

- Miniball and Coulex excitation at HIE-ISOLDE
- Ionization chamber back into operations
- Four experiments run in 2024
- Multiple approved experiments to run yet!

Thank You

Setup: I. Anastasov, F. Browne, L. P. Gaffney, H. Hess, H. Kleis, P. Reiter, S. Thiel, C. Unsworth, N. Warr

Machine supervisors: A. Rodriguez, E. Fadakis, E. Piselli, E. Siesling, M. Lozano, S. Mataguez
Target team: S. Rothe, M. Au, I. Frank, A. Schmidt, S. Stegemann
RILIS team: K. Chrysalidis, C. Bernerd, R. Heinke, J. Reilly

Collaborations: IS702, IS646, IS557, IS748, IS708

The research leading to these results has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement no. 101057511.

home.cern