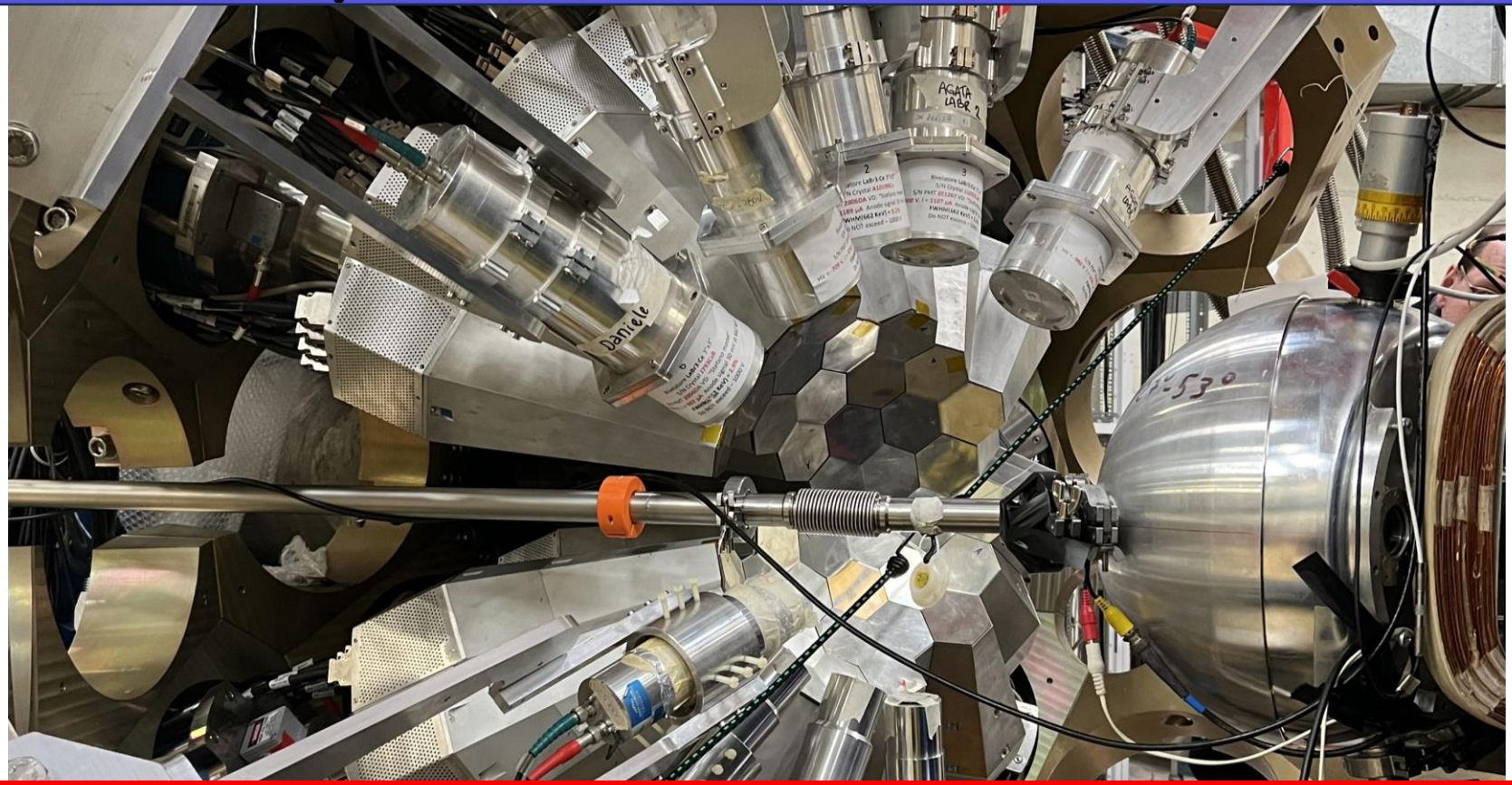
Report on the AGATA@Legnaro experiment EXP 22.04



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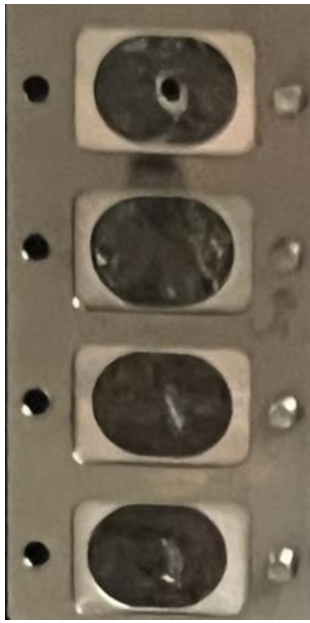
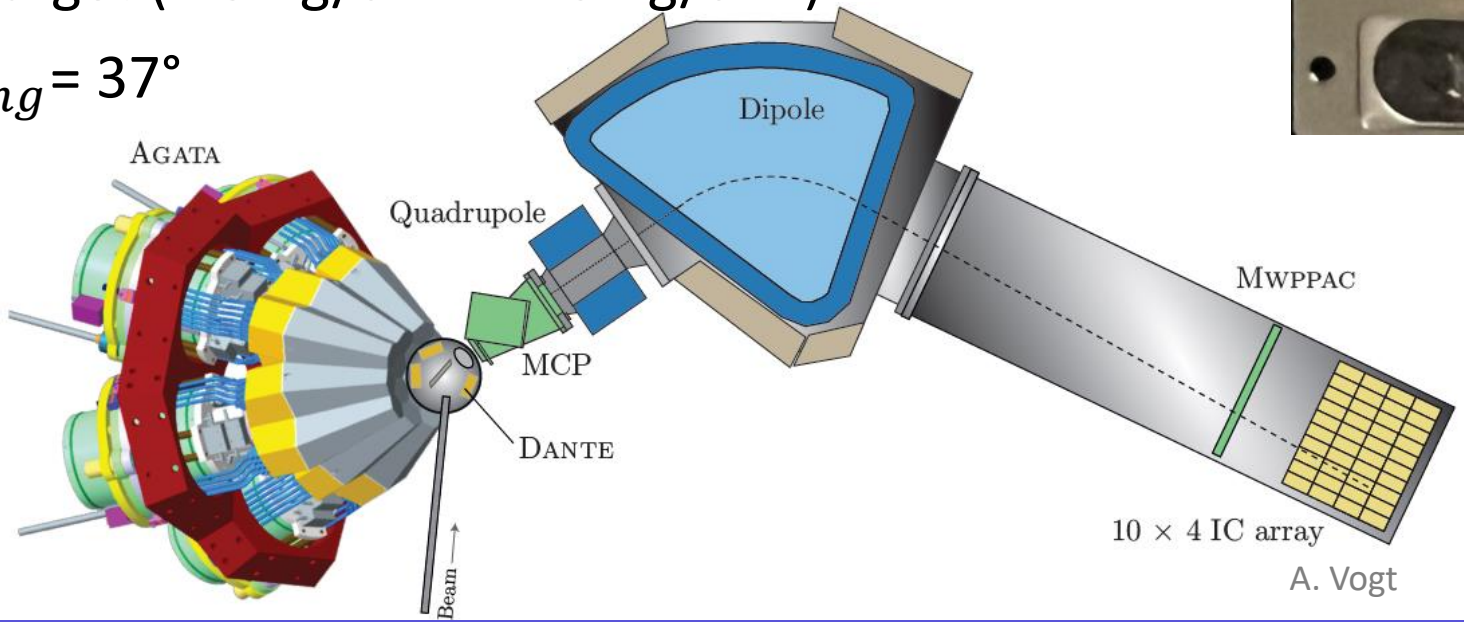
Physics motivation

- MNT in the vicinity of ^{208}Pb
  - Lack of knowledge for nuclei east of ^{208}Pb
  - Gamma transitions can uniquely attributed
  - Shall give insights to the evolution of shell structures in N>126 nuclei
- Investigations in the Xe-Ba region
  - Solve open questions between shell-model theory and experiments (e.g. in ^{131}Te)
- MNT reactions are a competitive tool to populate exotic neutron-rich nuclei along the valley of stability

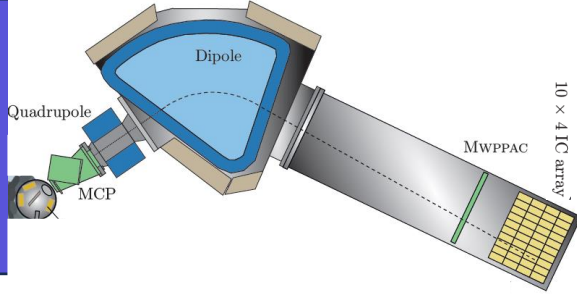
Experiment setup

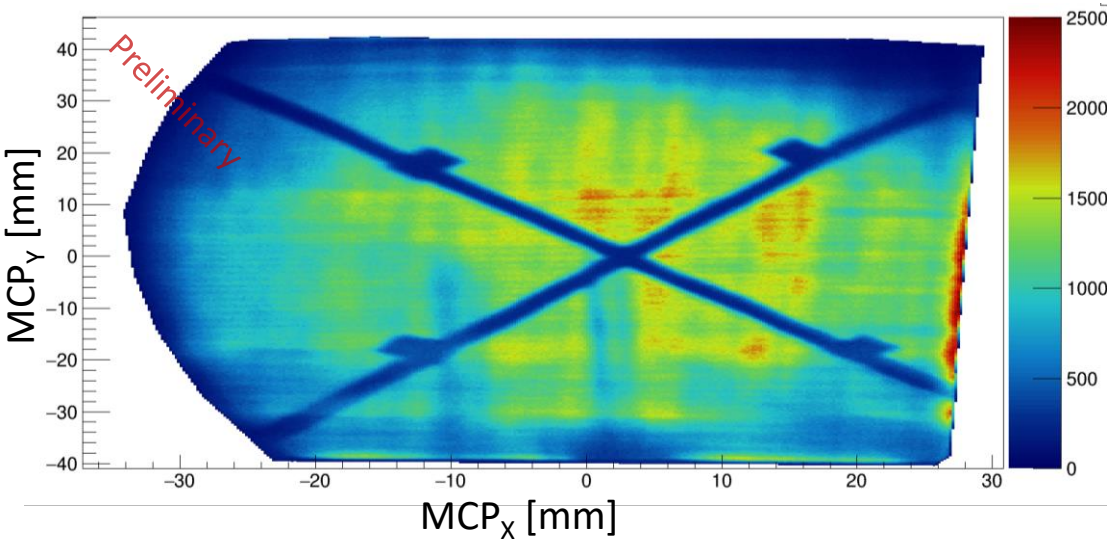
- First experiment 22.04 – January 2023
- Recovery – February 2024
- Multi Nucleon Transfer reactions
- ^{136}Xe Beam @ 1GeV , ~20 enA
- ^{208}Pb Target (1.8mg/cm^2 – 2.6mg/cm^2)
- $\theta_{grazing}$ = 37°





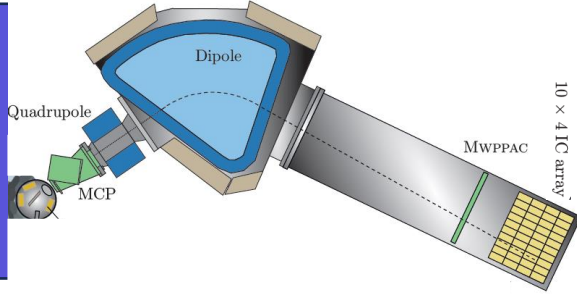
PRISMA system

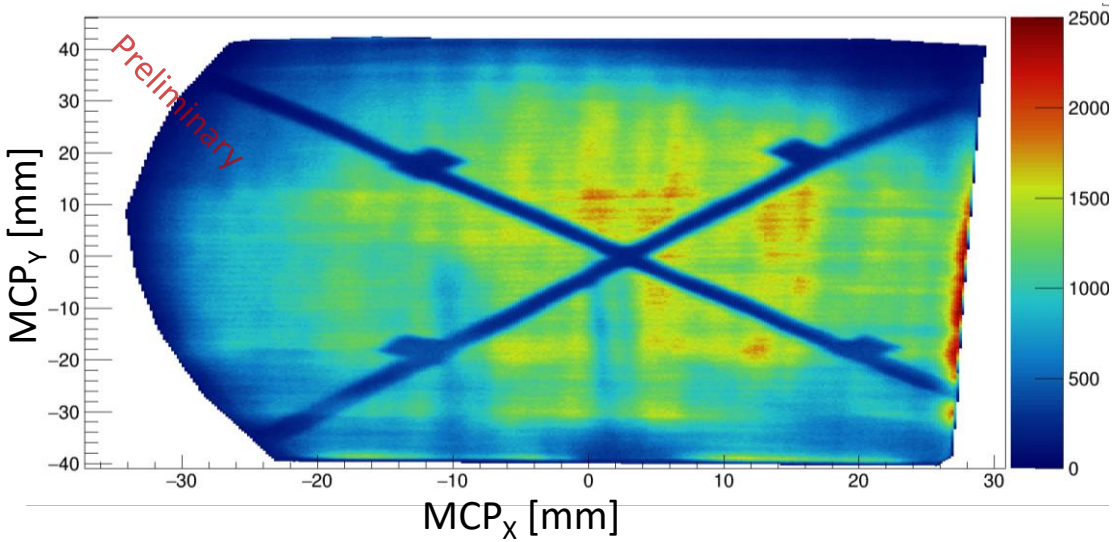




- MCP:
  - First position information
  - TOF start detector
- Quadrupole magnet
- Dipole magnet

PRISMA system

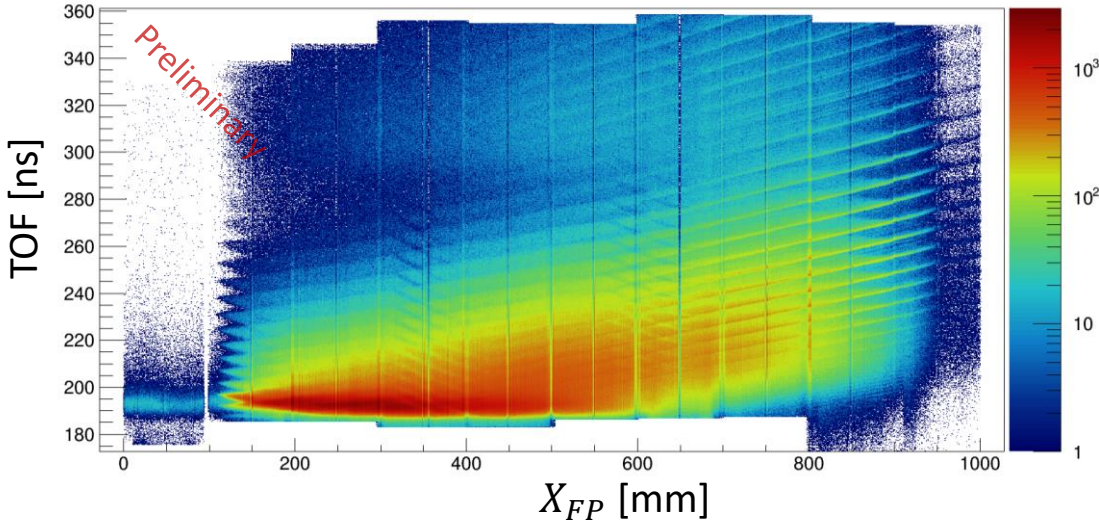




- MCP:
  - First position information
  - TOF start detector
- Quadrupole magnet
- Dipole magnet

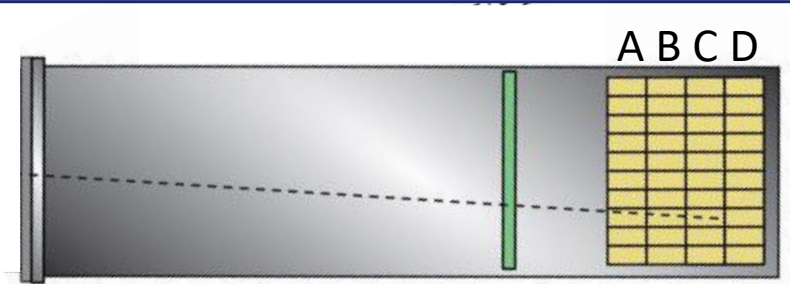
- MWPPAC:
  - 10 segments with 100 mm
  - x, y position
  - TOF stop detector

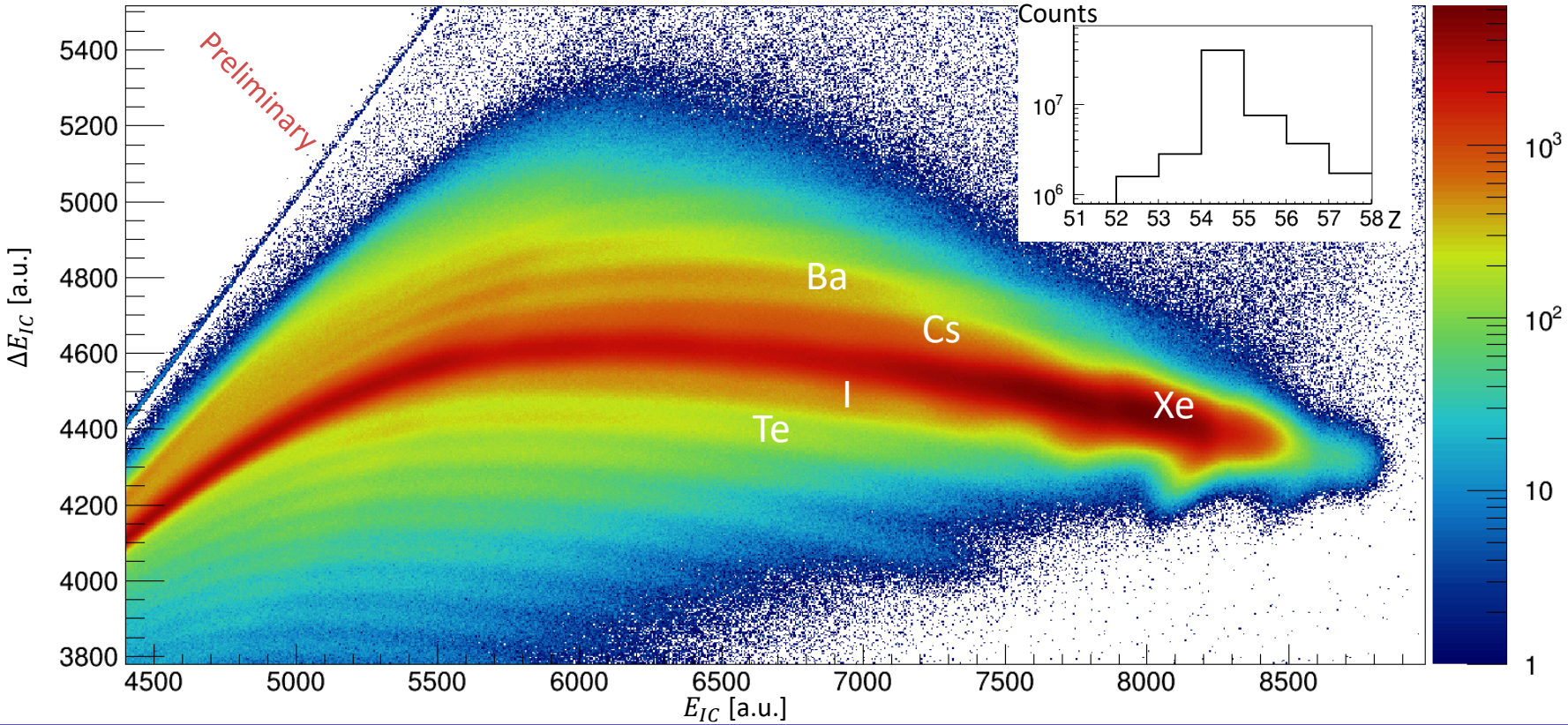
→ Ion tracks reconstructed event-by-event



Element (Z) identification

- 4 columns with 10+2 segments
- Different nuclear charges via stopping power in CH_4 gas
  - $-\frac{dE}{dx} \propto \frac{Z^2}{E}$

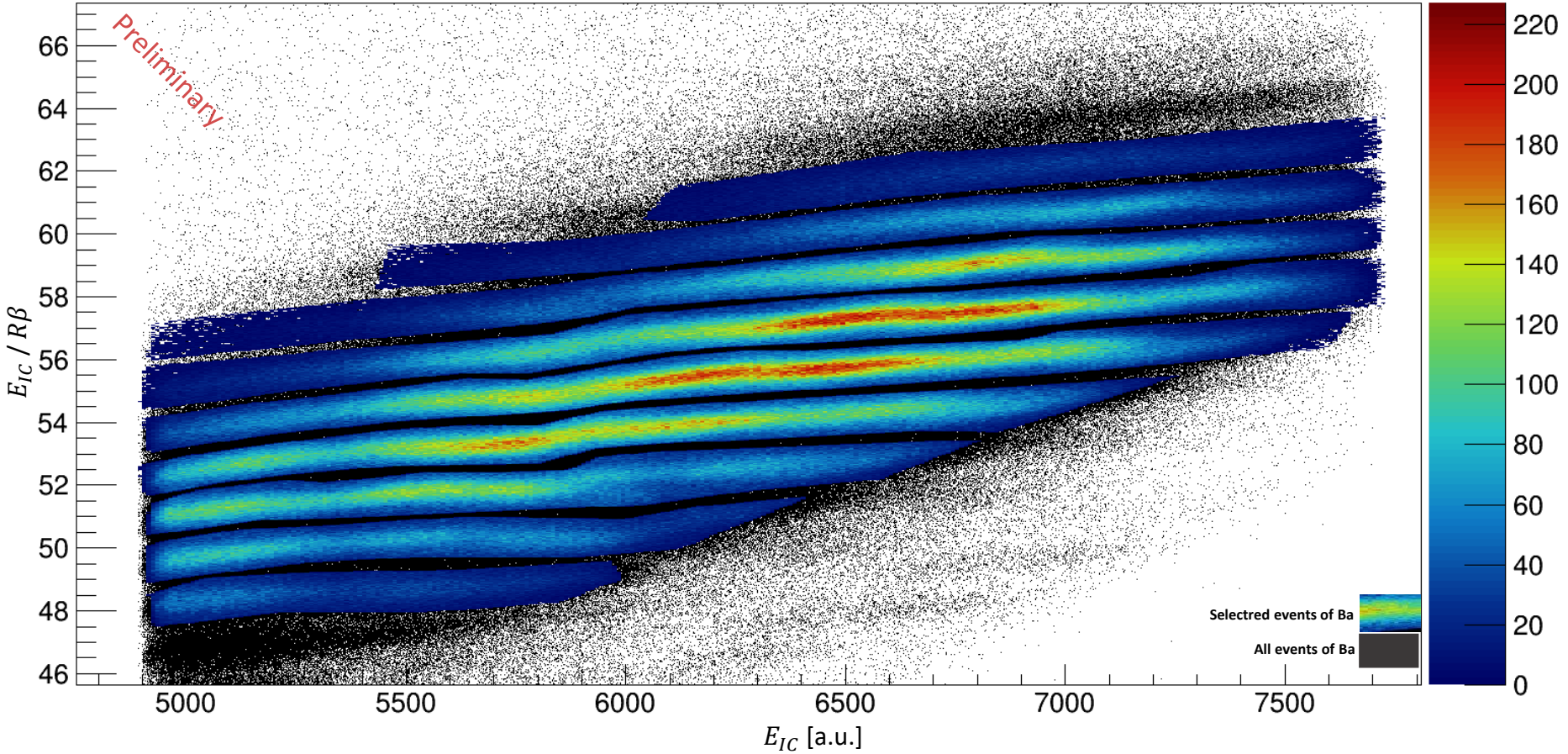




Charge state identification

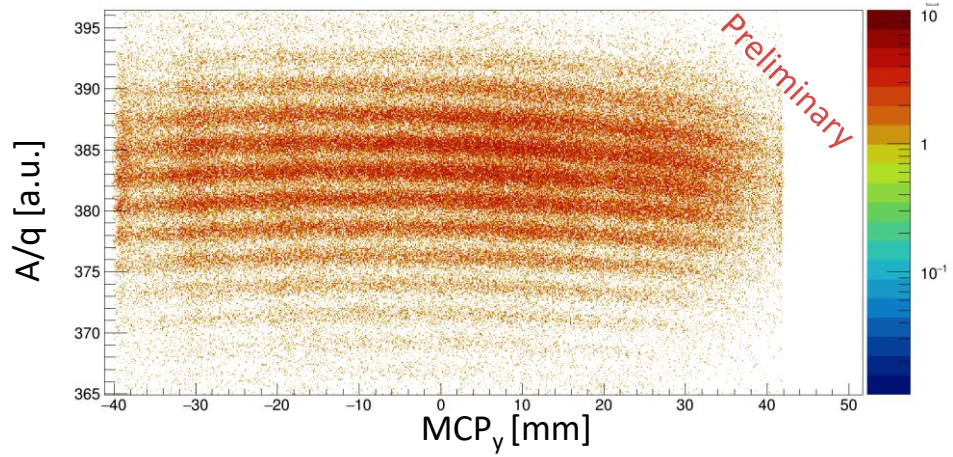
- Radius iterative reconstructed
- $\frac{E_{IC}}{R\beta} \propto q$

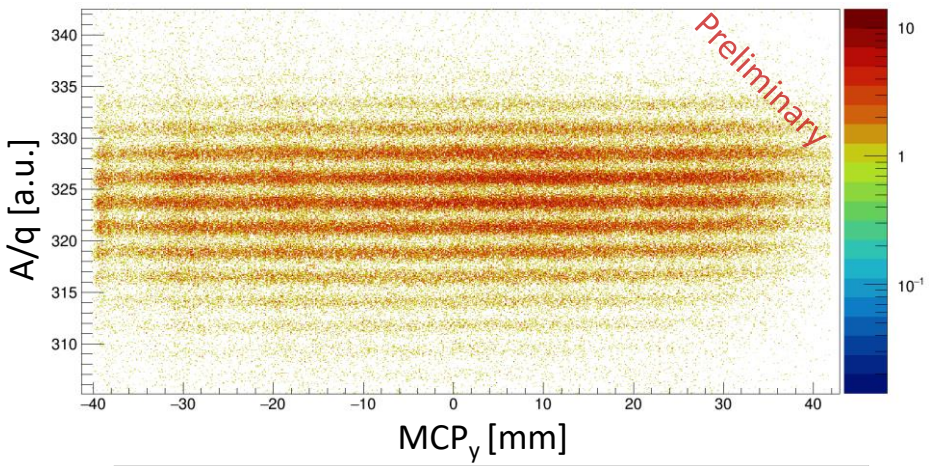
Z = 56

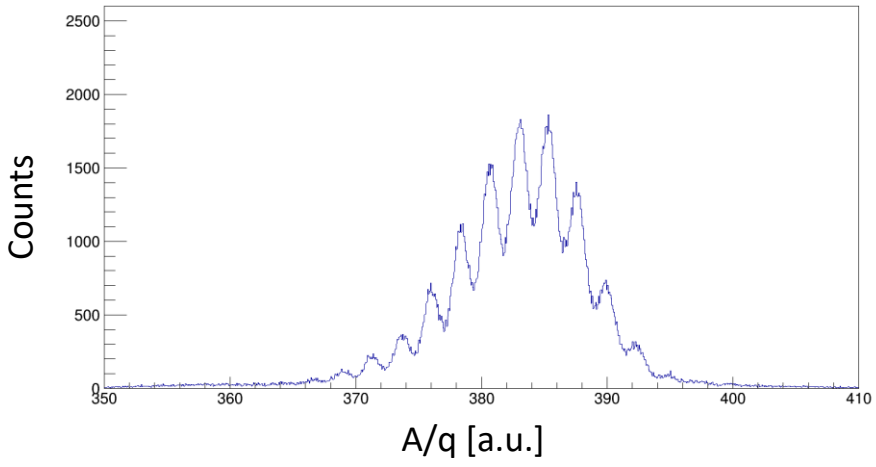


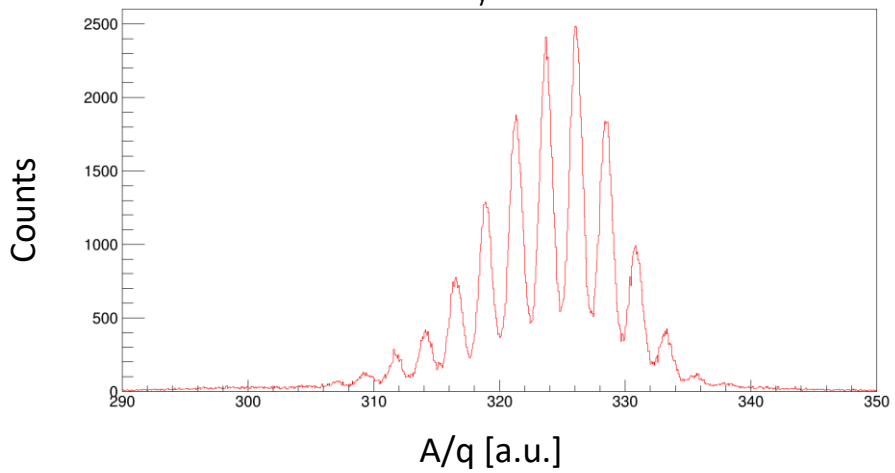
Aberration correction for Z =56

- $\frac{A}{q} = \mathrm{B} \bullet \mathrm{R} \bullet \frac{t_{TOF}}{D}$
- Systematic effects concern trajectory reconstruction
  - Correct: MCPx MCPy X_{FP}



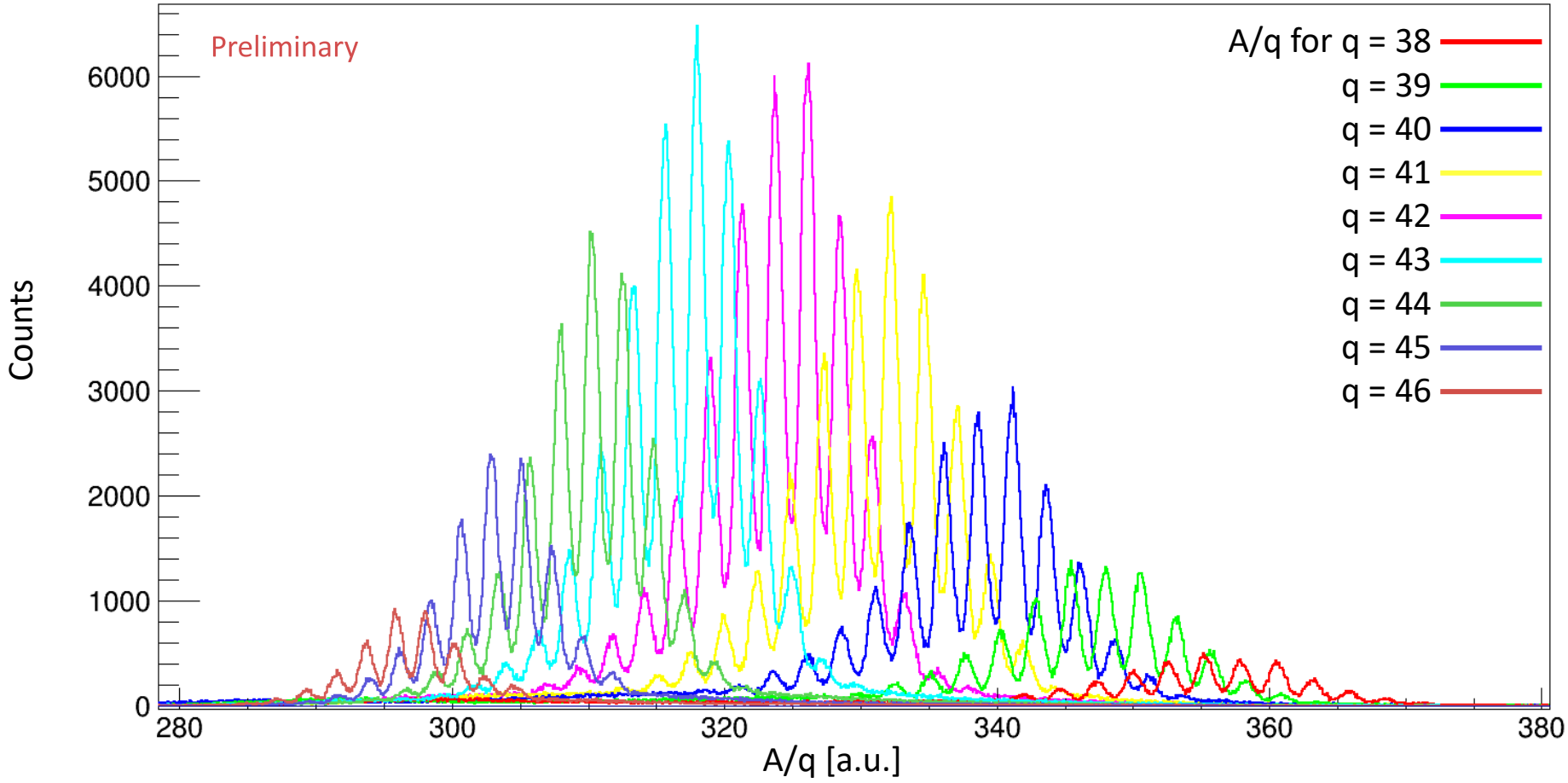






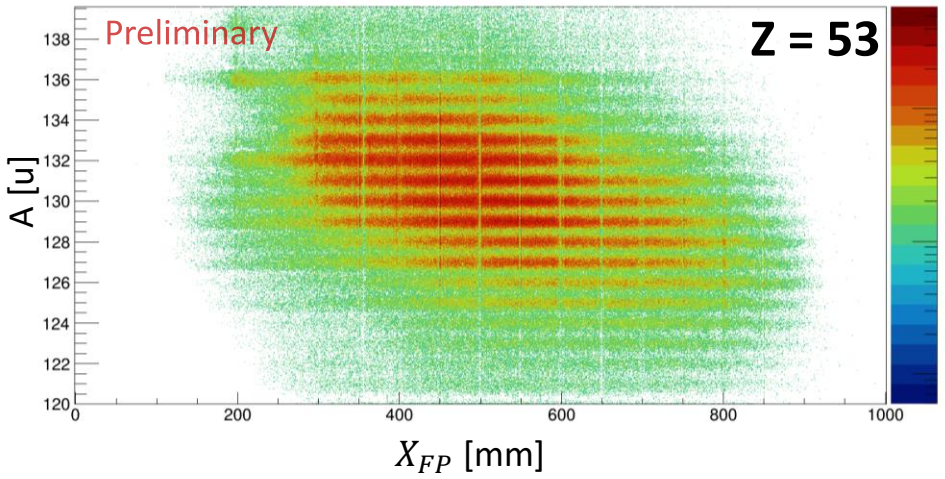
Mass spectra for each atomic charge state Z = 56

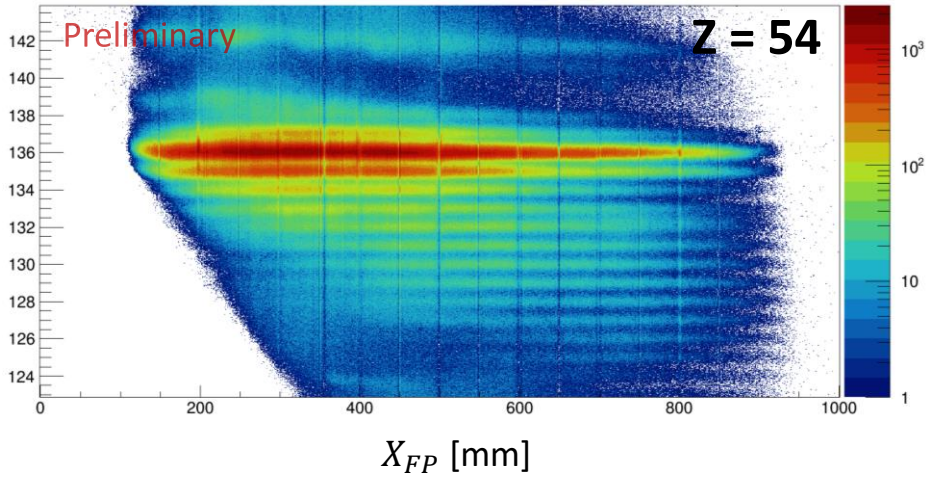
- $\frac{A}{q} = a_i \bullet \frac{A}{q_{uncal}} + b_i$

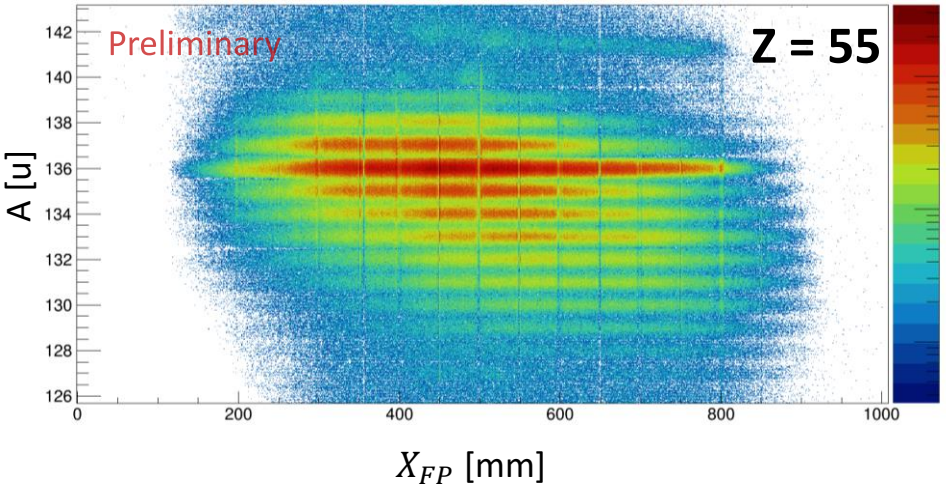


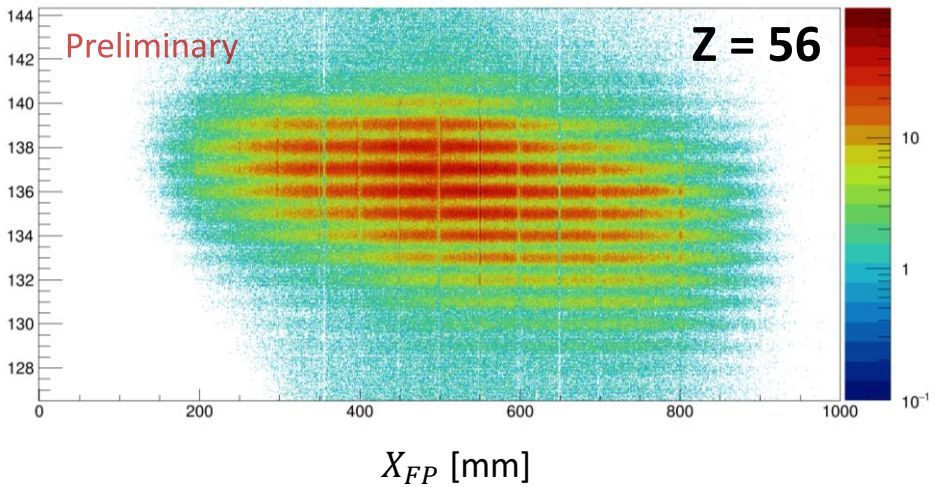
Final mass identification

- mass $= (\frac{A}{q})_{cal} \bullet q_{eff}$

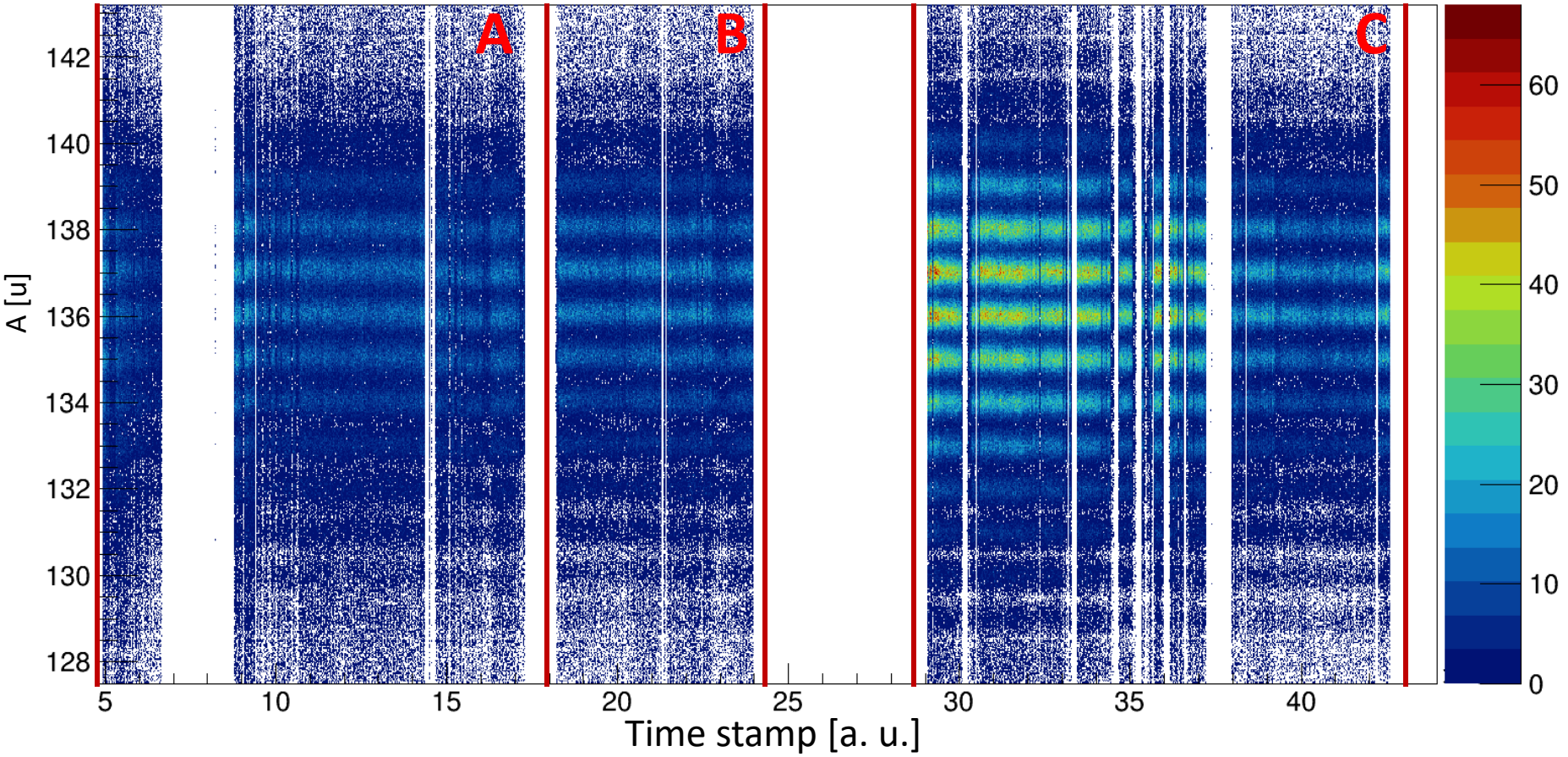








Mass time shifts for Ba

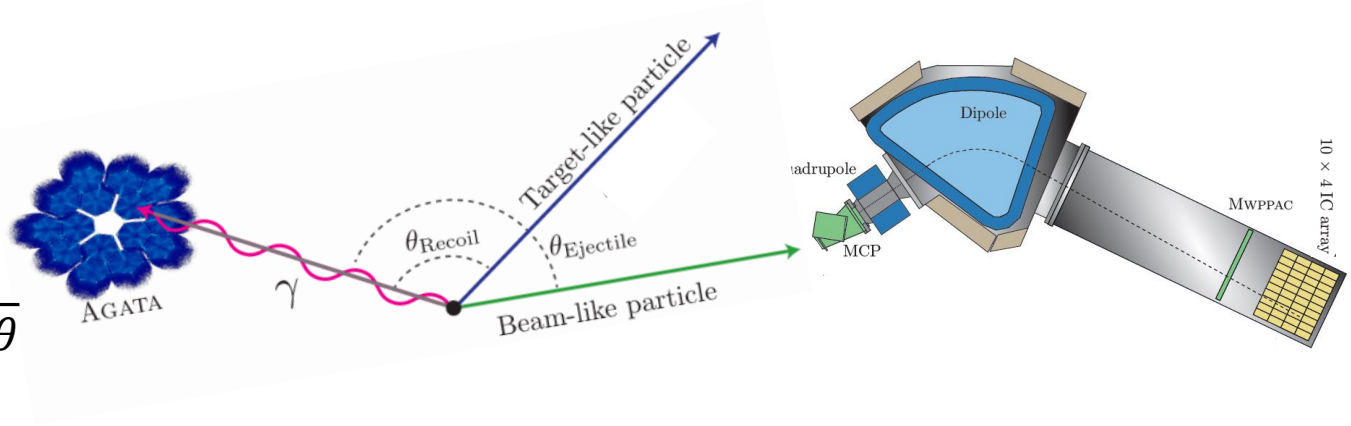


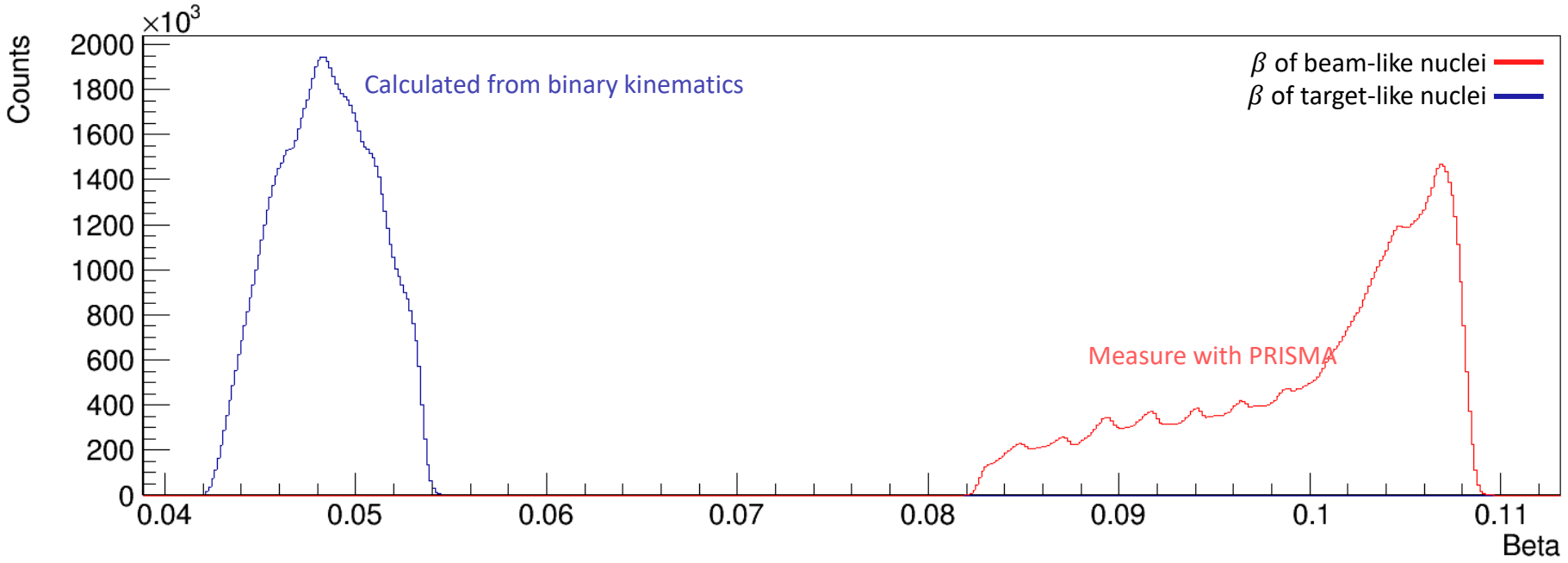
^{136}Ba	A	B	C	All
$m/\Delta m$	214.5±1.4	234.0 ±1.2	250.2±0.6	233.4 ±0.1

AGATA Doppler correction

Doppler correction for beam- and target-like particles

$$E_\gamma = E_{\gamma,0}\frac{\sqrt{1-\beta^2}}{1-\beta\ \cos\theta}$$





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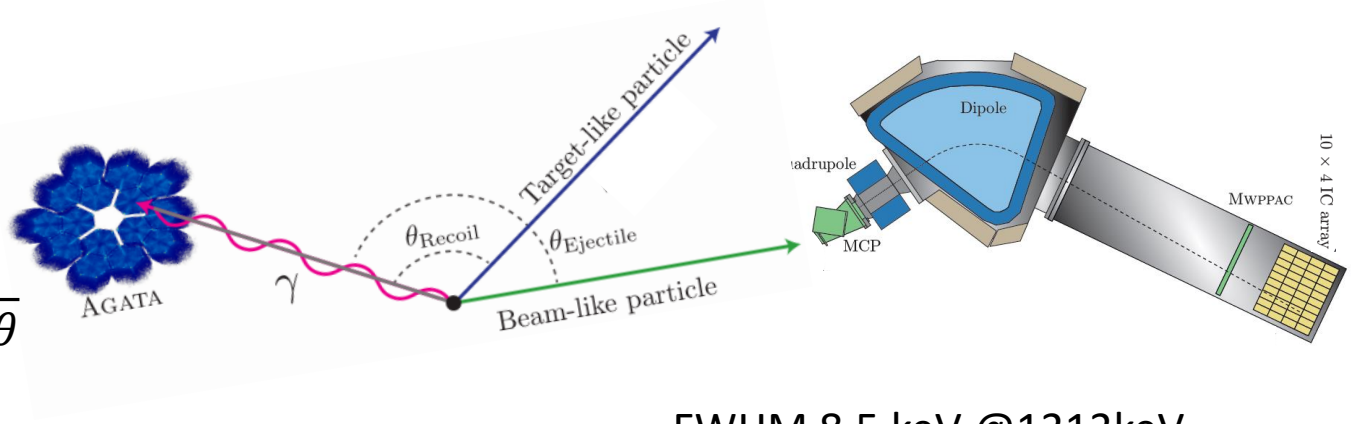
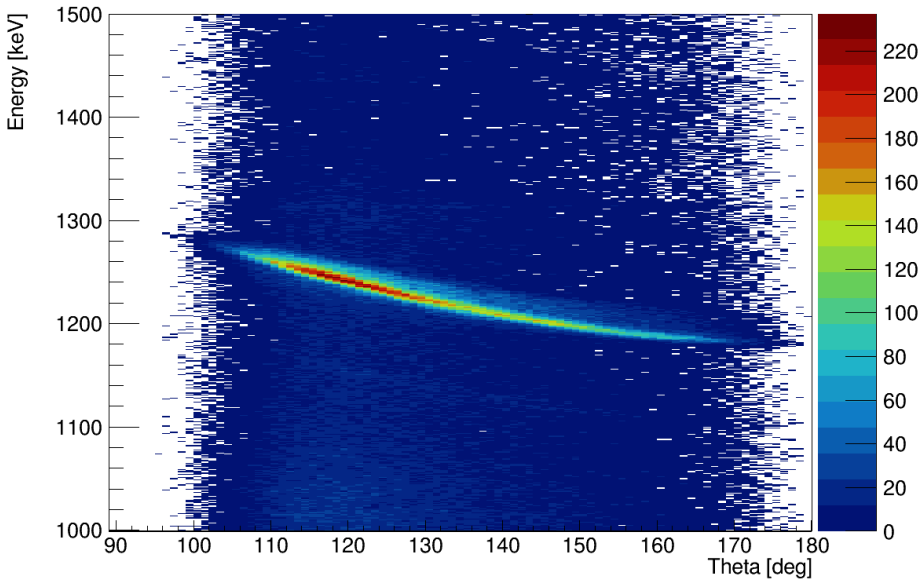
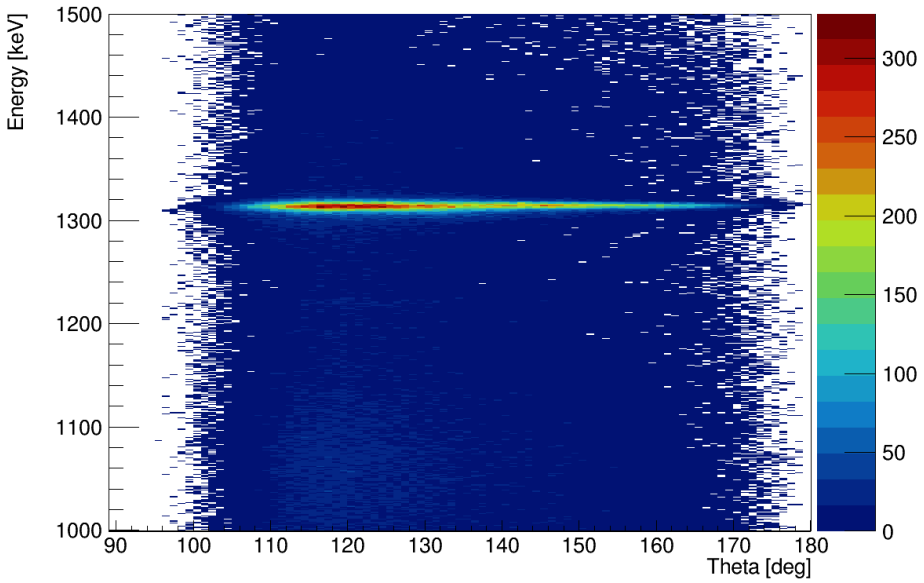
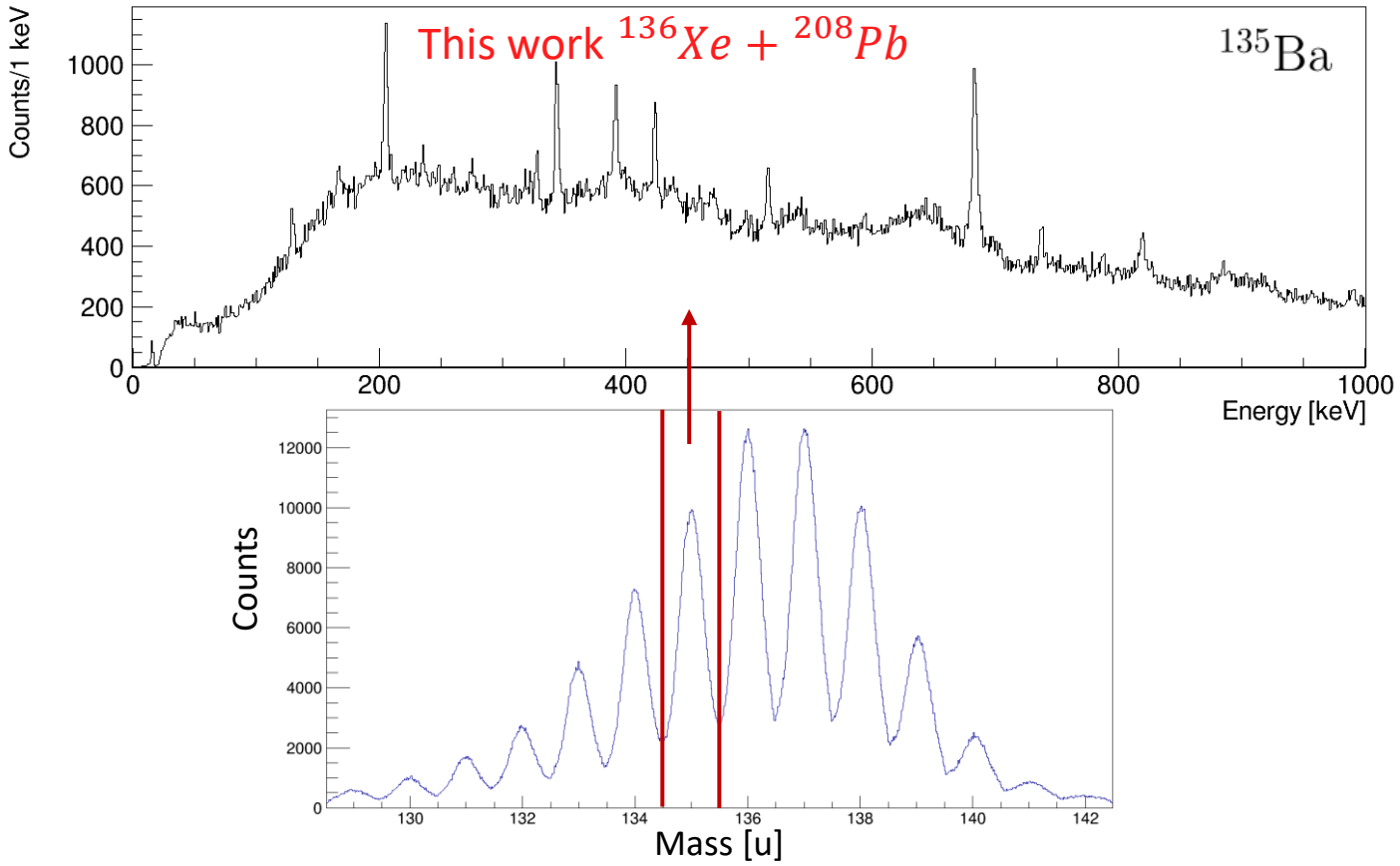


FWHM 8.5 keV @1313keV



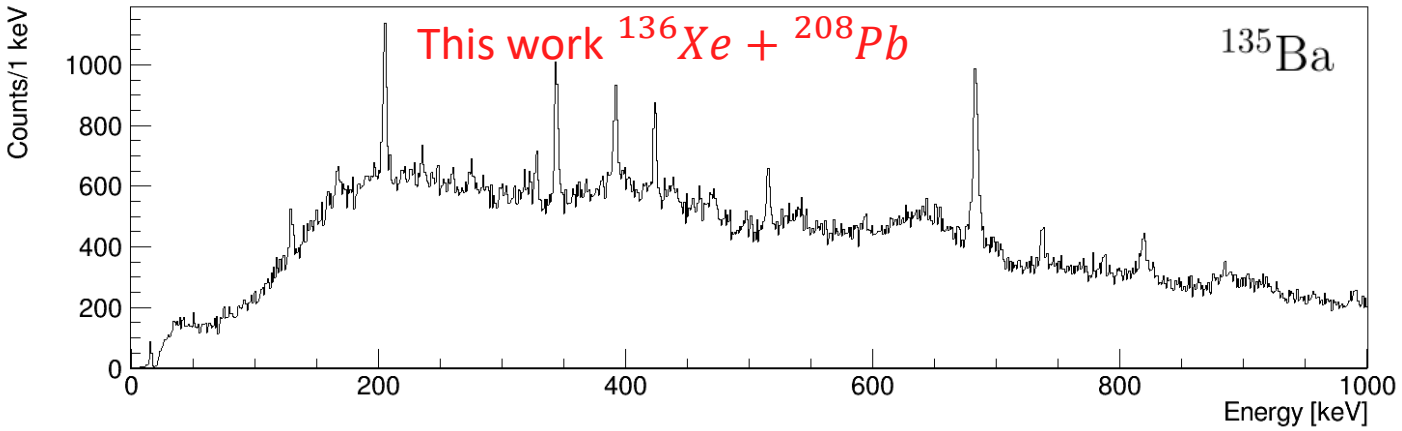


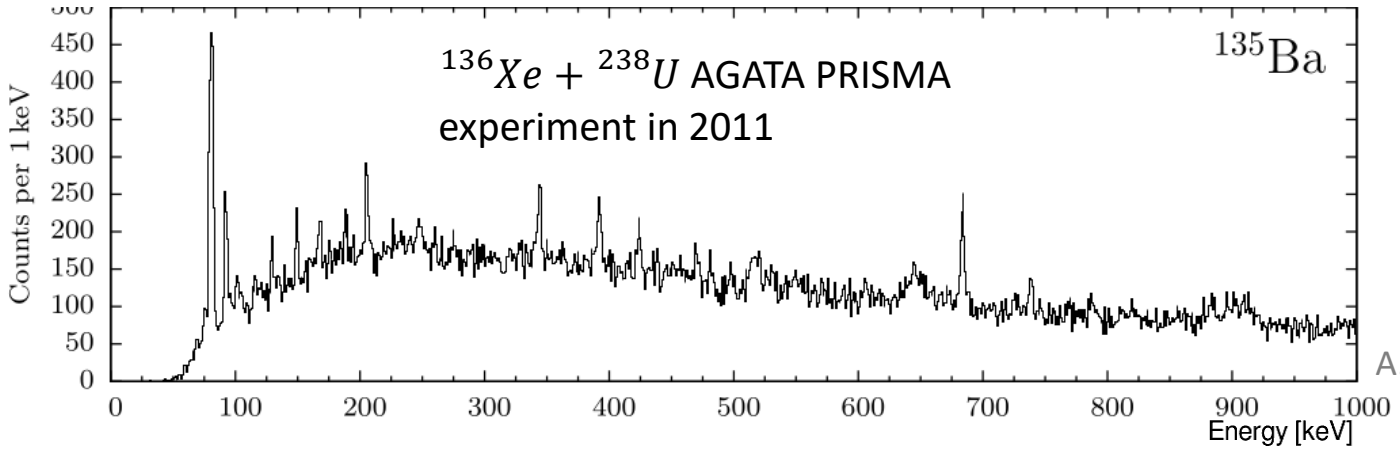
Doppler corrected ^{135}Ba spectra



E_γ[keV]	128.0	204.0	342.6	390.6	422.6	682.3
Volume$_{^{208}Pb}$	550(6)	1690(80)	1690(80)	1260(80)	910(70)	2900(90)

Doppler corrected ^{135}Ba spectra





A. Vogt

E_γ[keV]	128.0	204.0	342.6	390.6	422.6	682.3
Volume$_{^{208}Pb}$	550(6)	1690(80)	1690(80)	1260(80)	910(70)	2900(90)
Volume$_{^{238}U}$	129(1)	374(58)	284(40)	336(76)	236(46)	596(60)

Summary

- Done
  - Successful experiment with AGATA-PRISMA Setup
  - PRISMA analyses completed
  - Identified masses from ^{123}I to ^{140}Ba
  - Mass resolution of $m/\Delta m = 233$ for ^{136}Ba achieved
  - Doppler correction for beam-like-particles
- Outlook
  - Gamma spectroscopy analyses started
  - Improve Doppler correction
  - Doppler correction for target-like-particles
  - Investigation of the Pb isotopes and vicinity


Thank you for your attention