REPORT ON AGATA EXPERIMENT 23.72

UNDERSTANDING MULTINUCLEON TRANSFER REACTIONS FOR THE PRODUCTION OF NEUTRON-RICH NUCLEI

— studying the ^{48}Ca + ^{208}Pb system

Speaker: **Laura Busak**[1]
Supervisor: **Dr. Tea Mijatović**[1]

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[4] **University of Ferrara**, Ferrara, Italy
[5] **INFN Milan**, Milan, Italy
[6] **INFN Florence**, Florence, Italy
[7] **Argonne National Laboratory**, Argonne (IL), USA
[8] **INFN Perugia**, Perugia, Italy

MOTIVATION

- neutron-rich region around N = 126
  - limits of stability, nucleosynthesis, largely untested theoretical understanding of nuclear structure

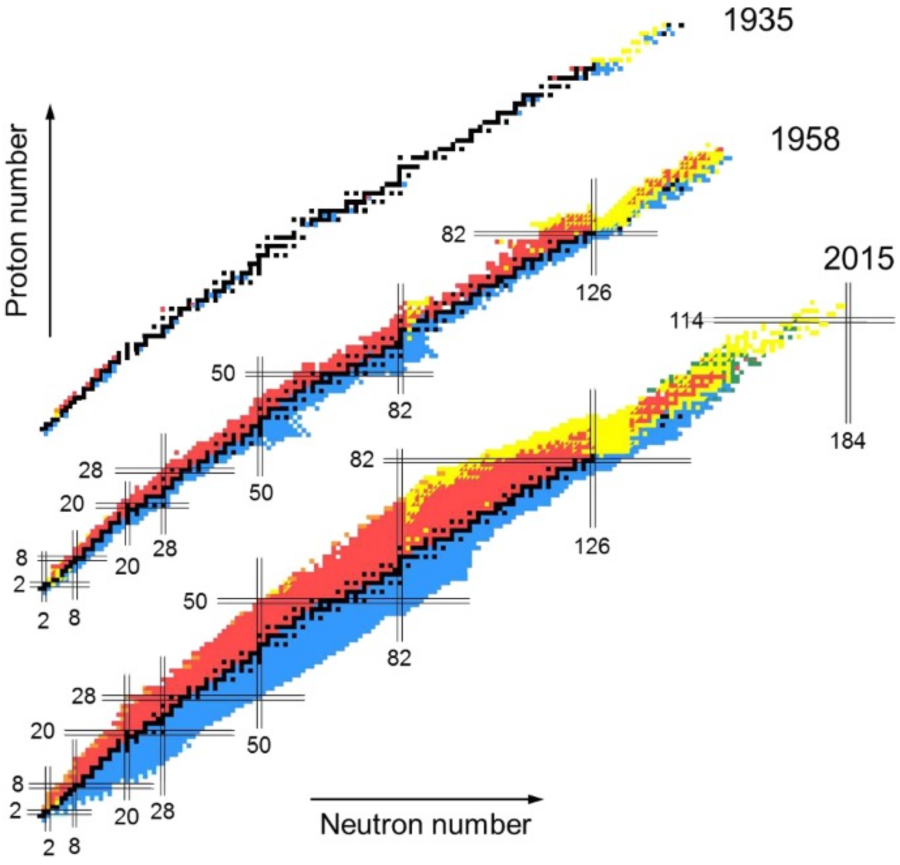

Figure 1. Expansion of the nuclide chart from 1935 to 2015. *From: Adamian et al. (2020).*

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  - pathway to exotic nuclei
  - probing nuclear structure

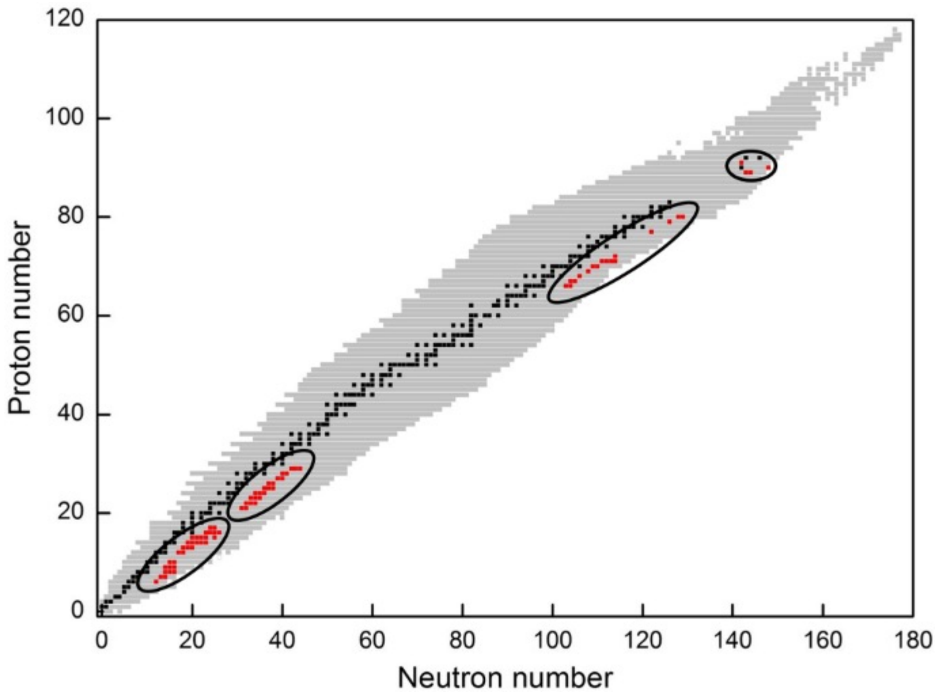

Figure 2. Chart of nuclides with 76 isotopes discovered in MNT reactions marked in red. *From: Adamian et al. (2020).*

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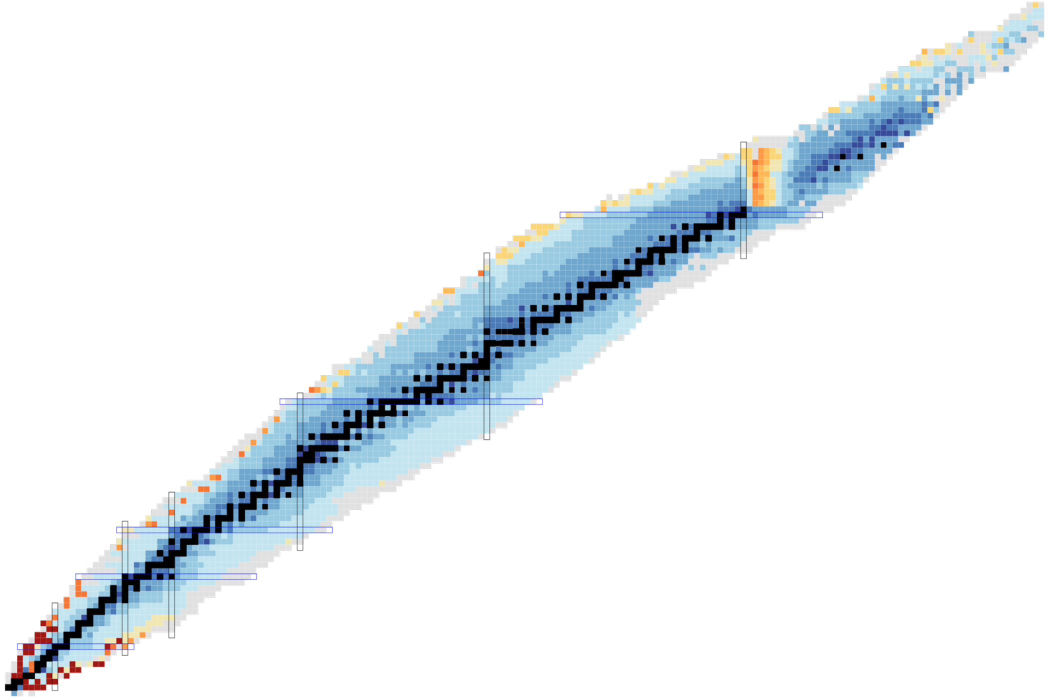

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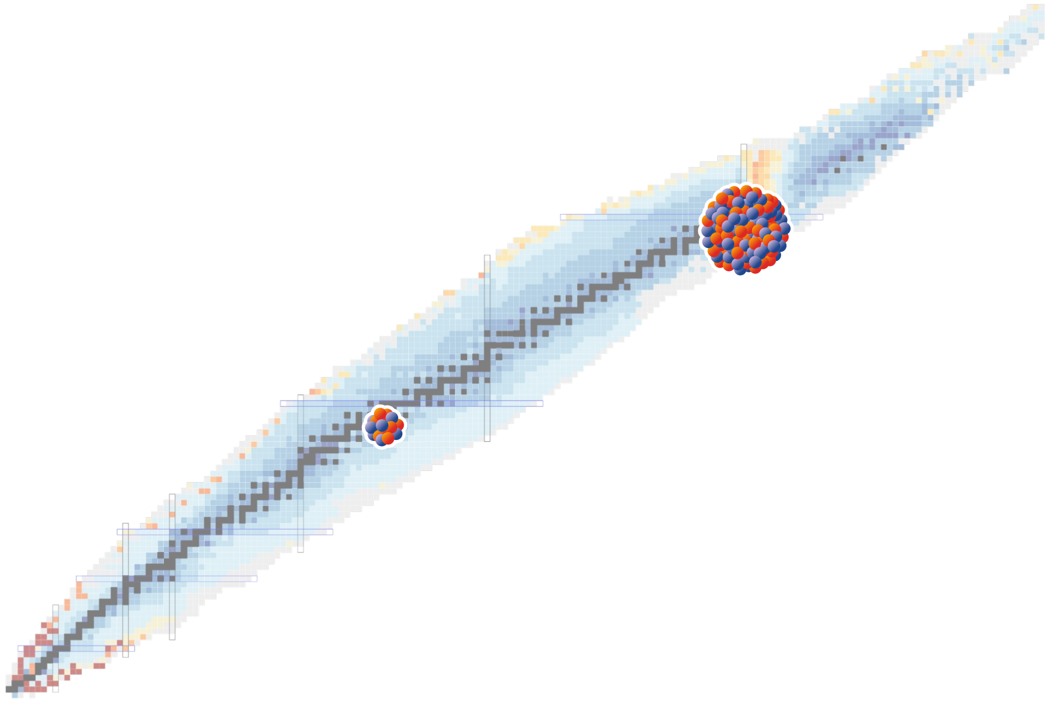

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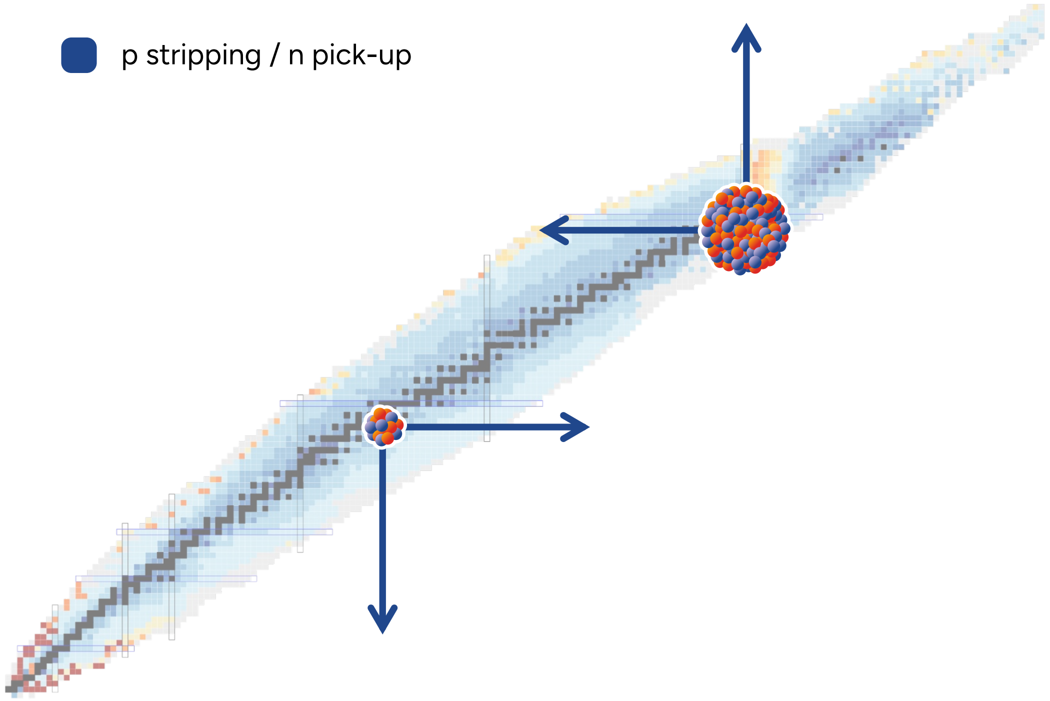

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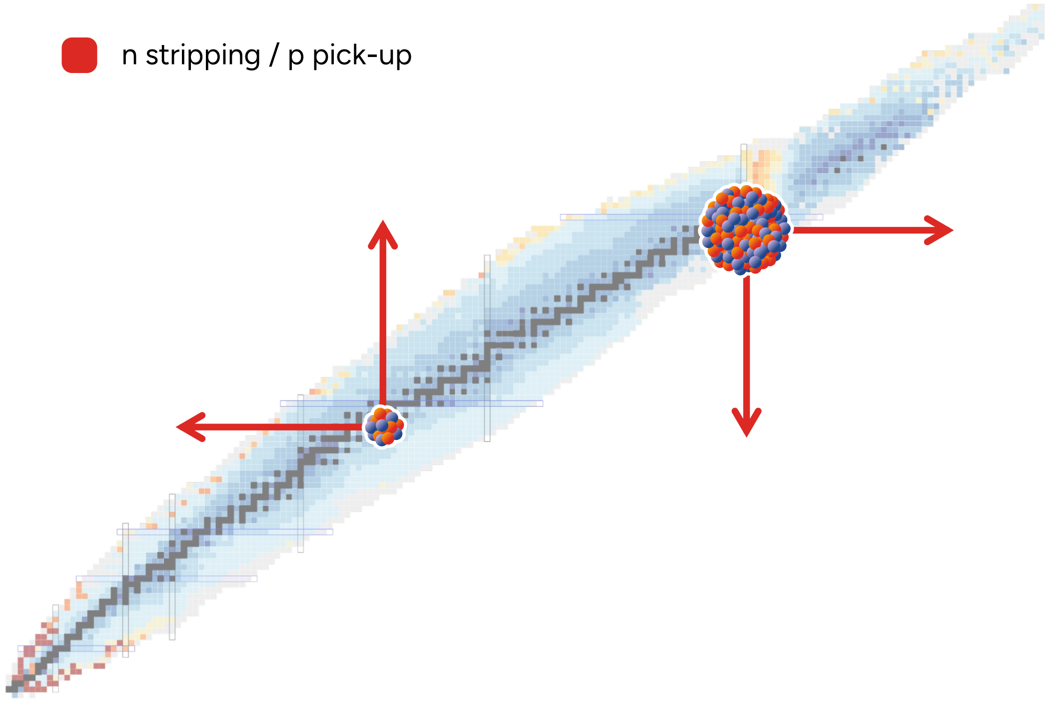

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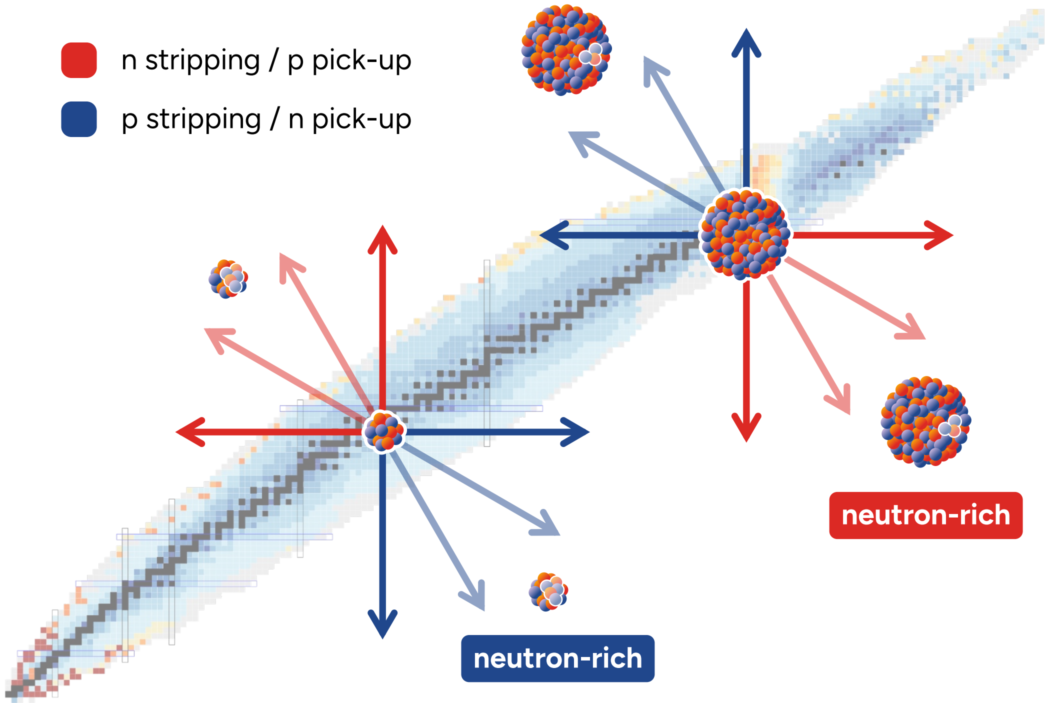

MOTIVATION

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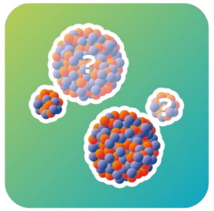
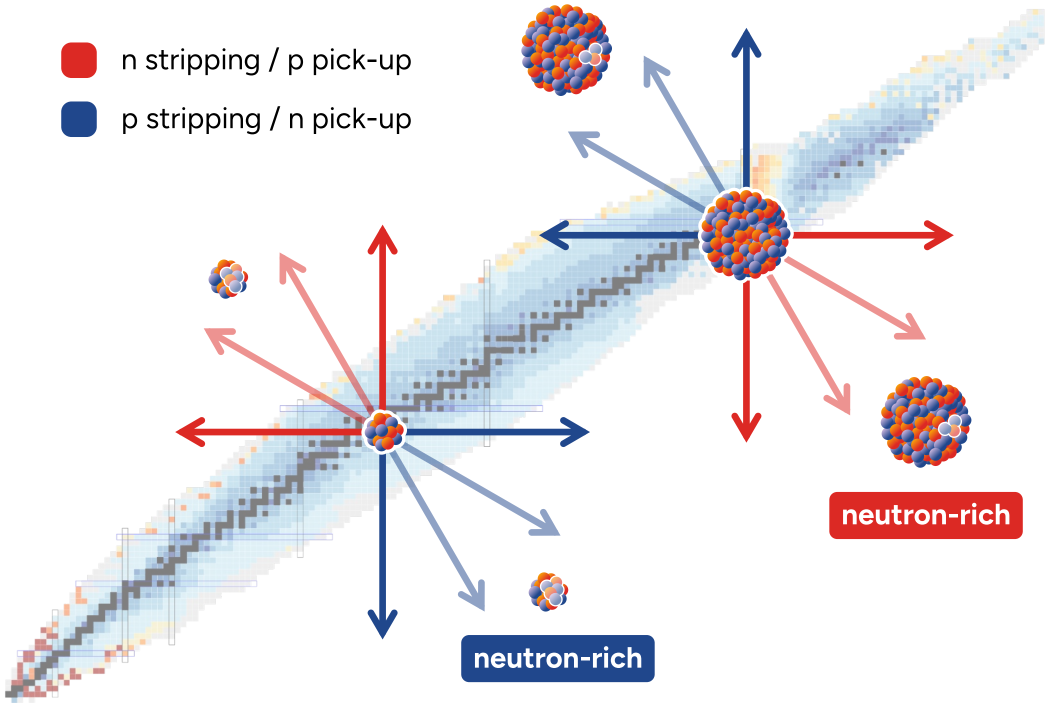


- complex reaction dynamics
  - challenging both theoretically and experimentally
- modern large-acceptance mass spectrometers



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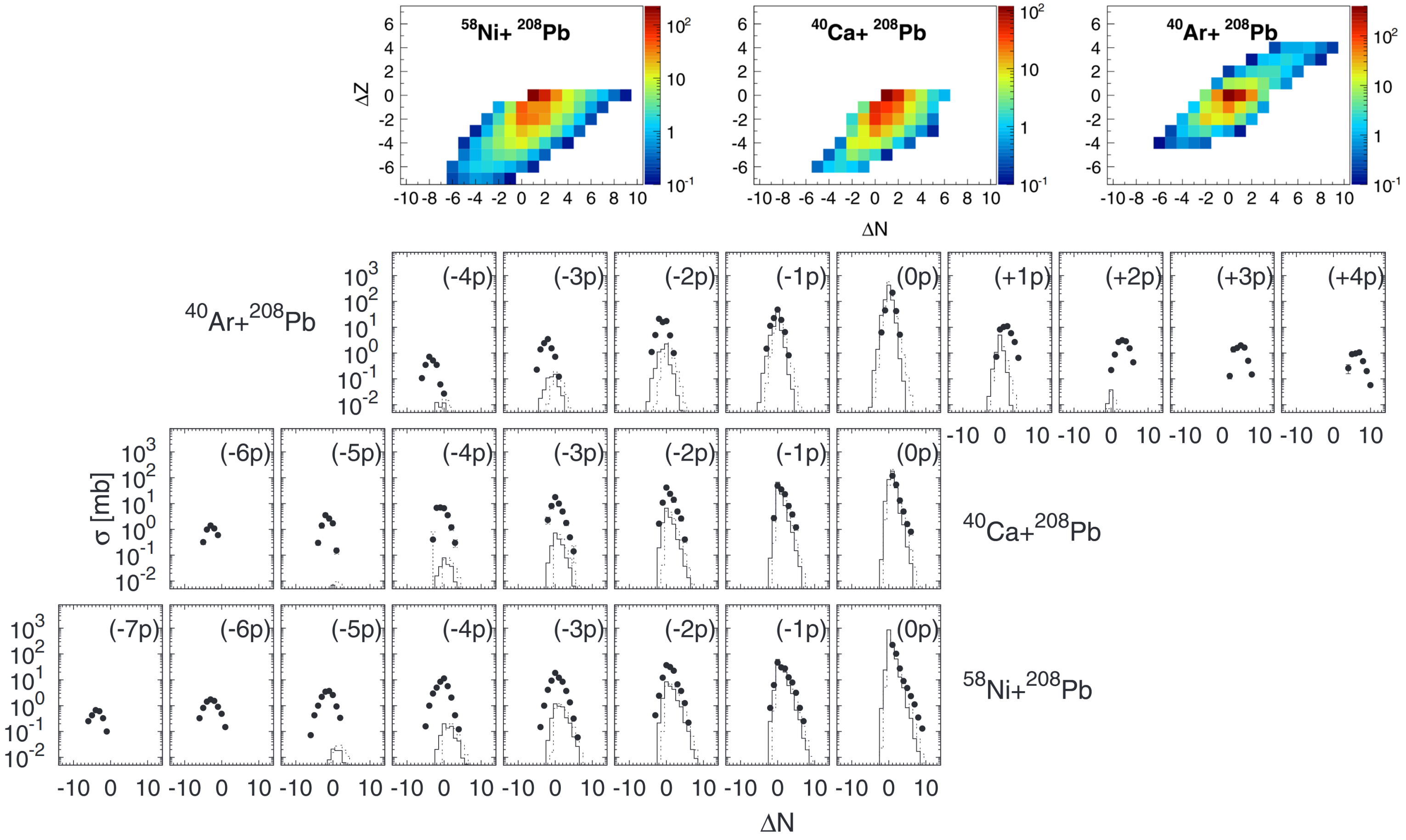

Figure 3. Total cross sections calculated with GRAZING (top, in color) and total experimental cross sections (bottom) compared with GRAZING predictions (lines) for ^{40}Ar, ^{40}Ca and ^{58}Ni induced reactions on a ^{208}Pb target, all at similar energies near the Coulomb barrier. *From: Mijatović et al. (2016).*

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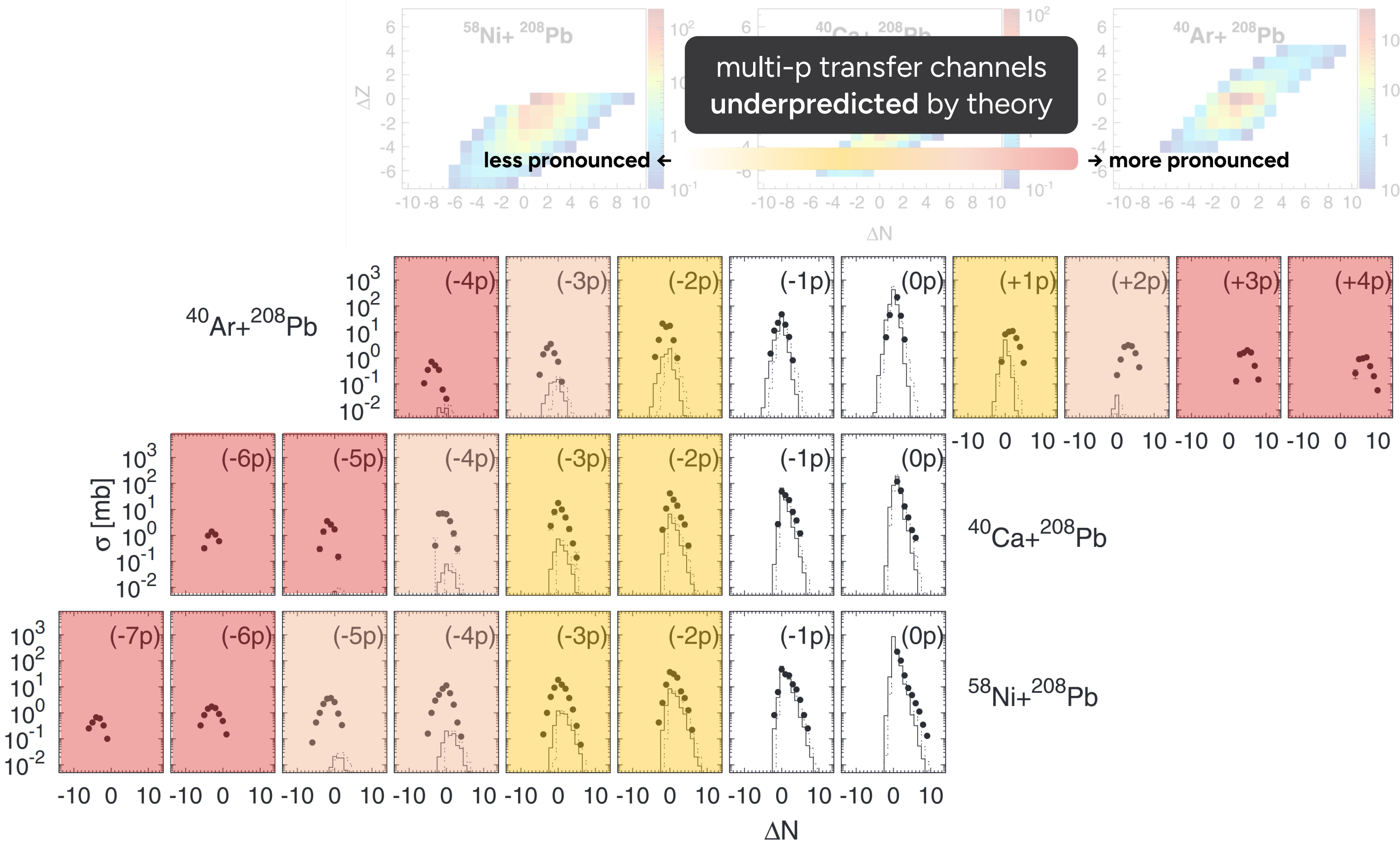

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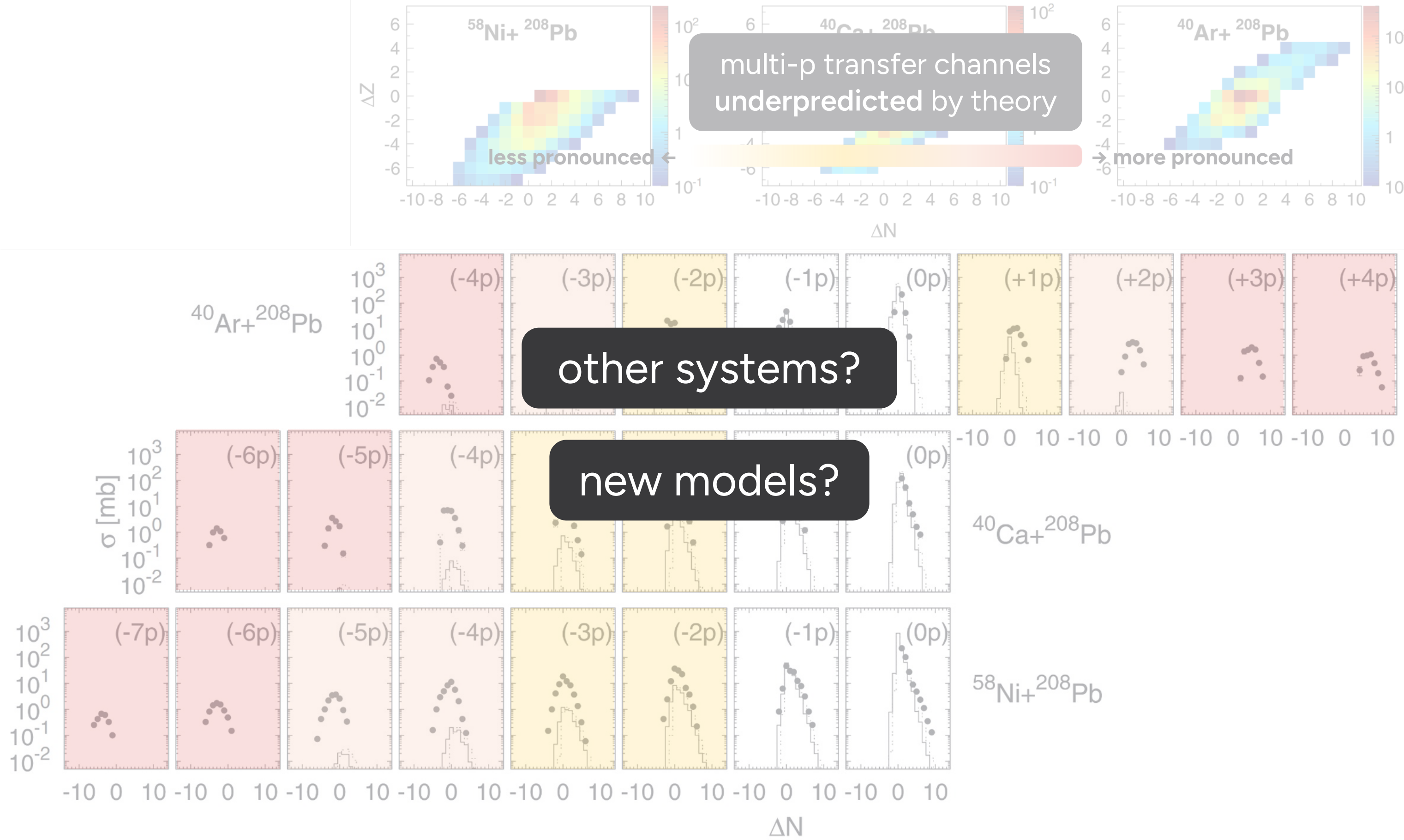

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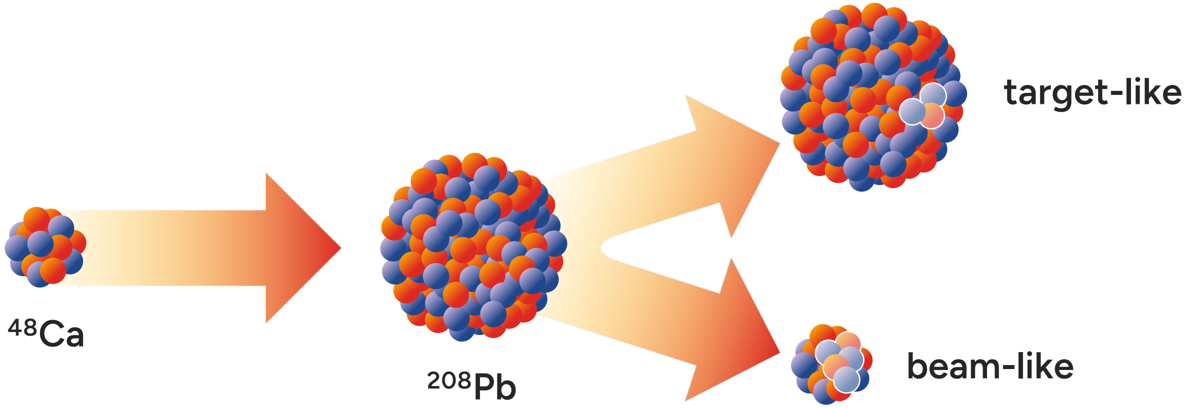
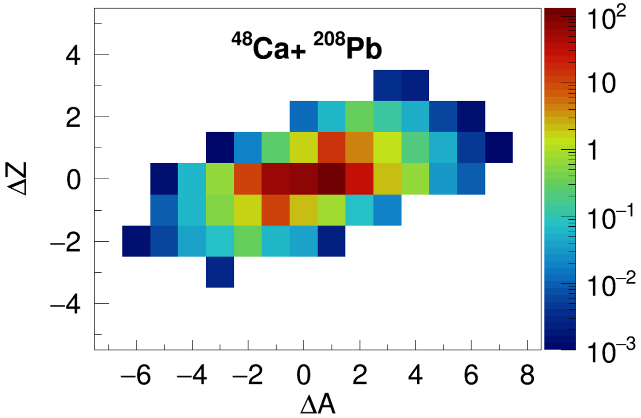
EXPERIMENT

REACTION ^{48}Ca + ^{208}Pb (direct kinematics)

- both reaction partners closed-shell in *Z* and *N*
- relatively neutron-rich projectile
  - expected population of proton stripping *and* pick-up channels – opportunity to investigate both **addition and removal** of nucleons and nucleon **pairs**
- few measurements exist





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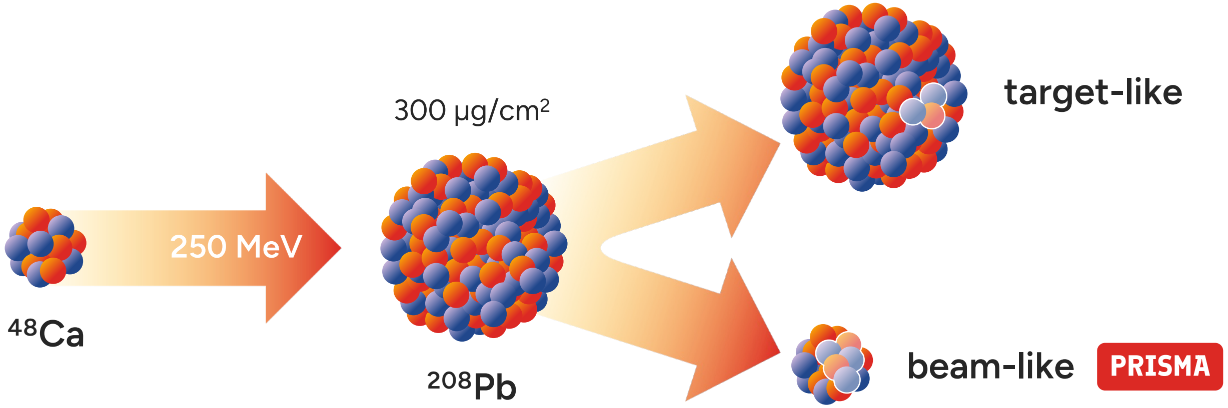

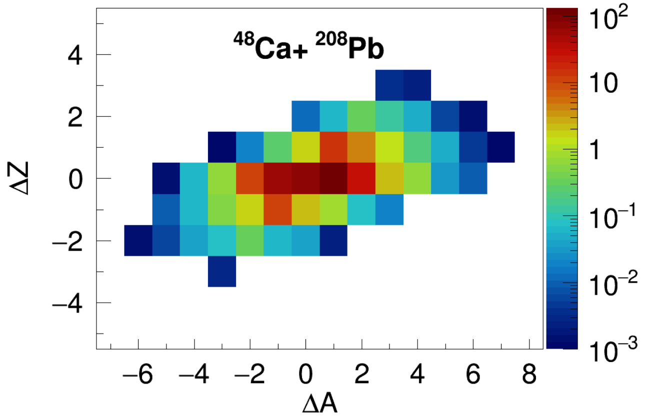

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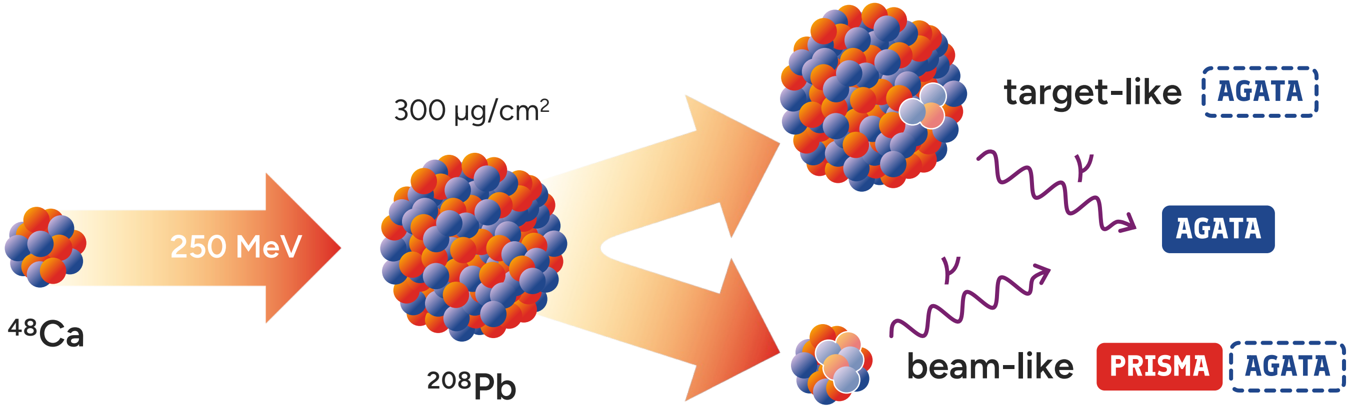
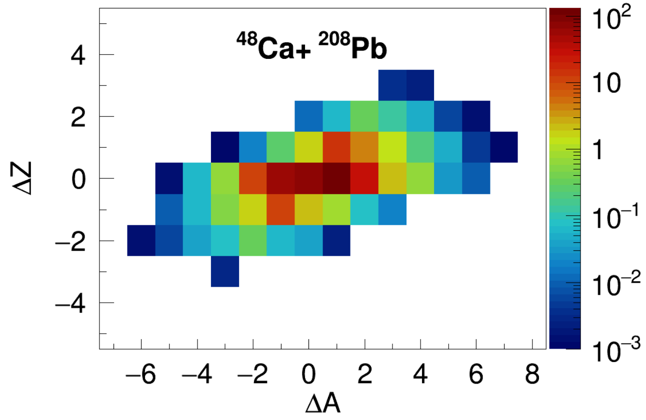
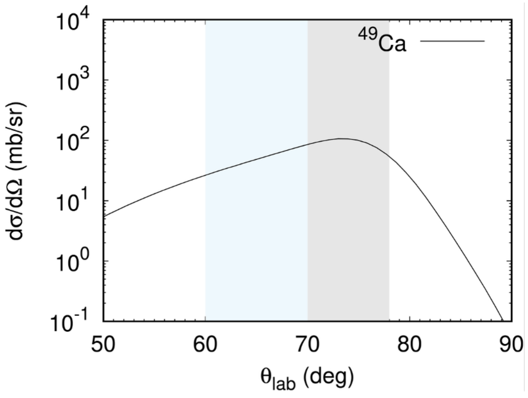


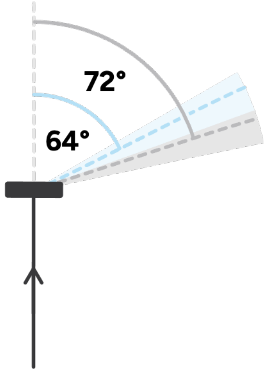


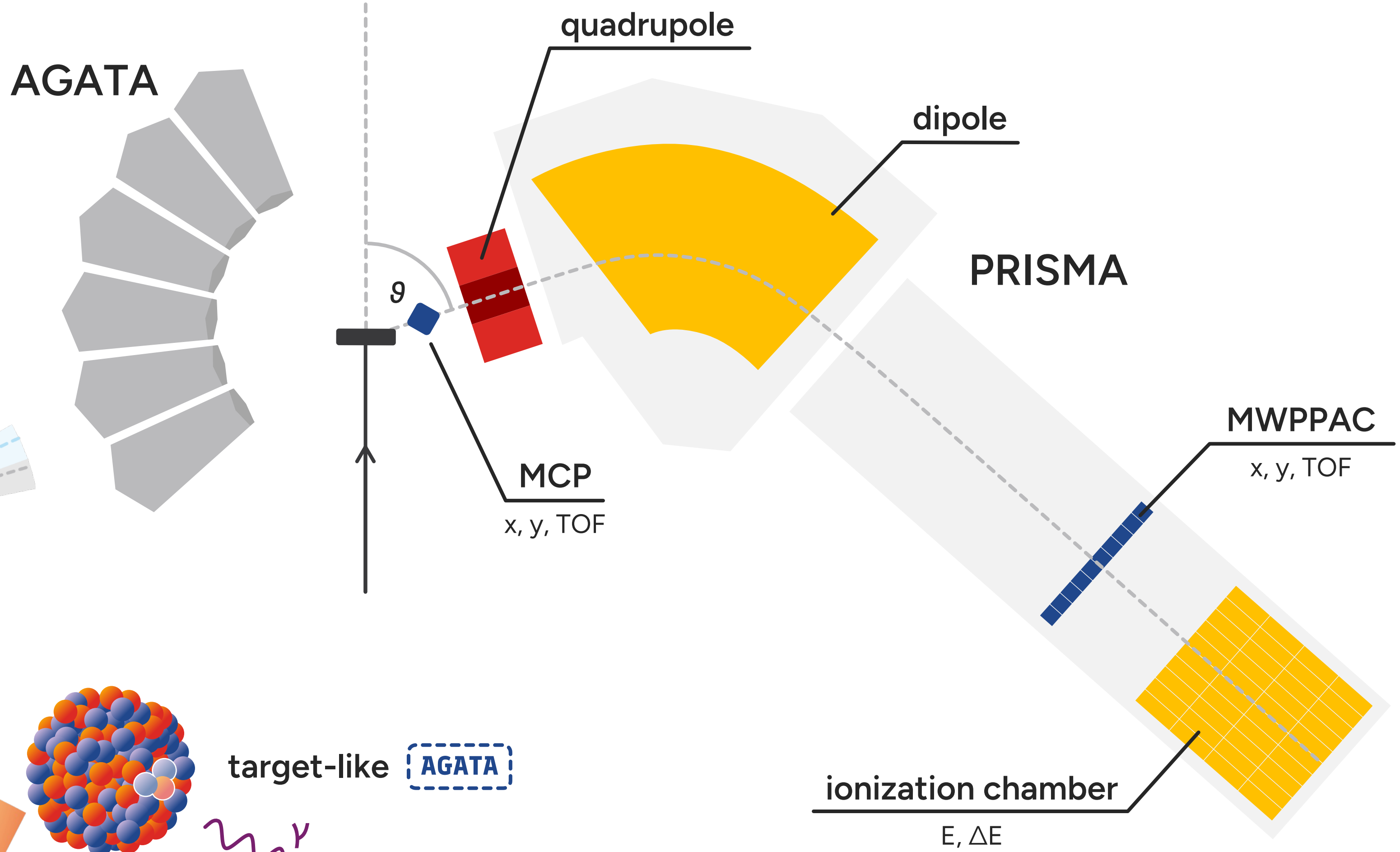
EXPERIMENT

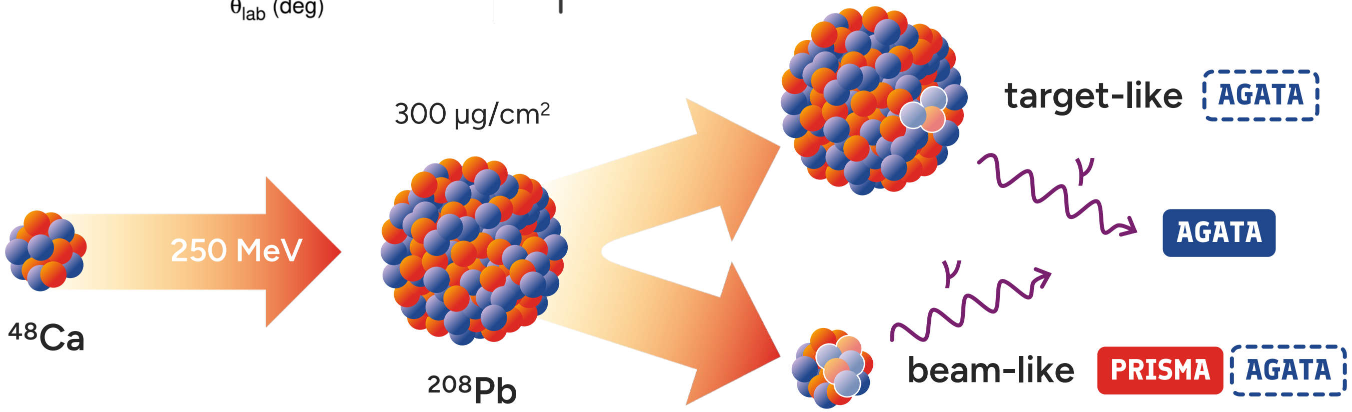
REACTION ^{48}Ca + ^{208}Pb (direct kinematics)

FACILITY ALPI-PIAVE accelerator complex (INFN-LNL, Legnaro, Italy)









PRELIMINARY

DATA ANALYSIS

position/time/energy calibration | Z identification | q identification | mass calibration

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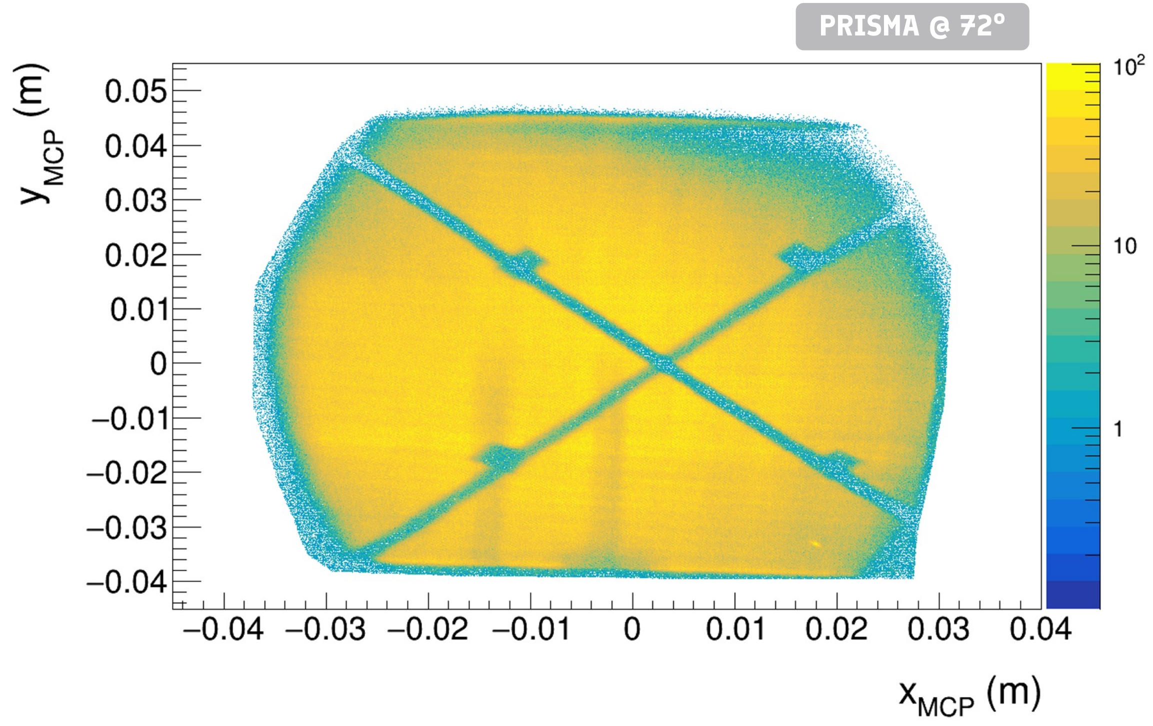

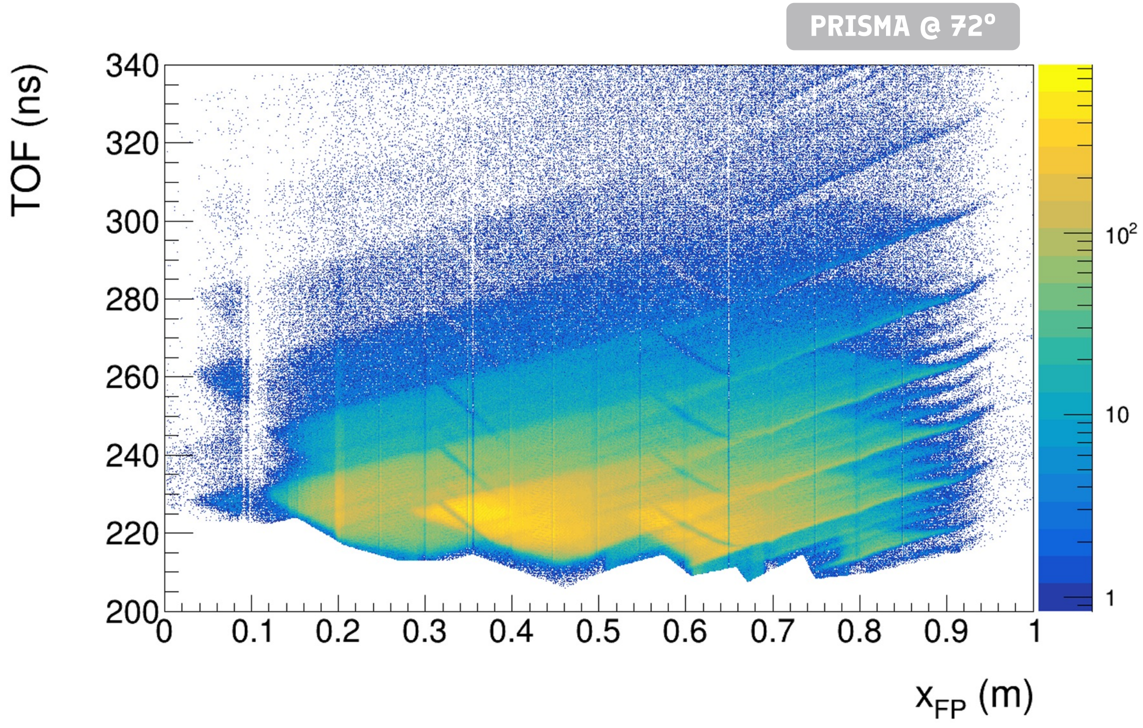

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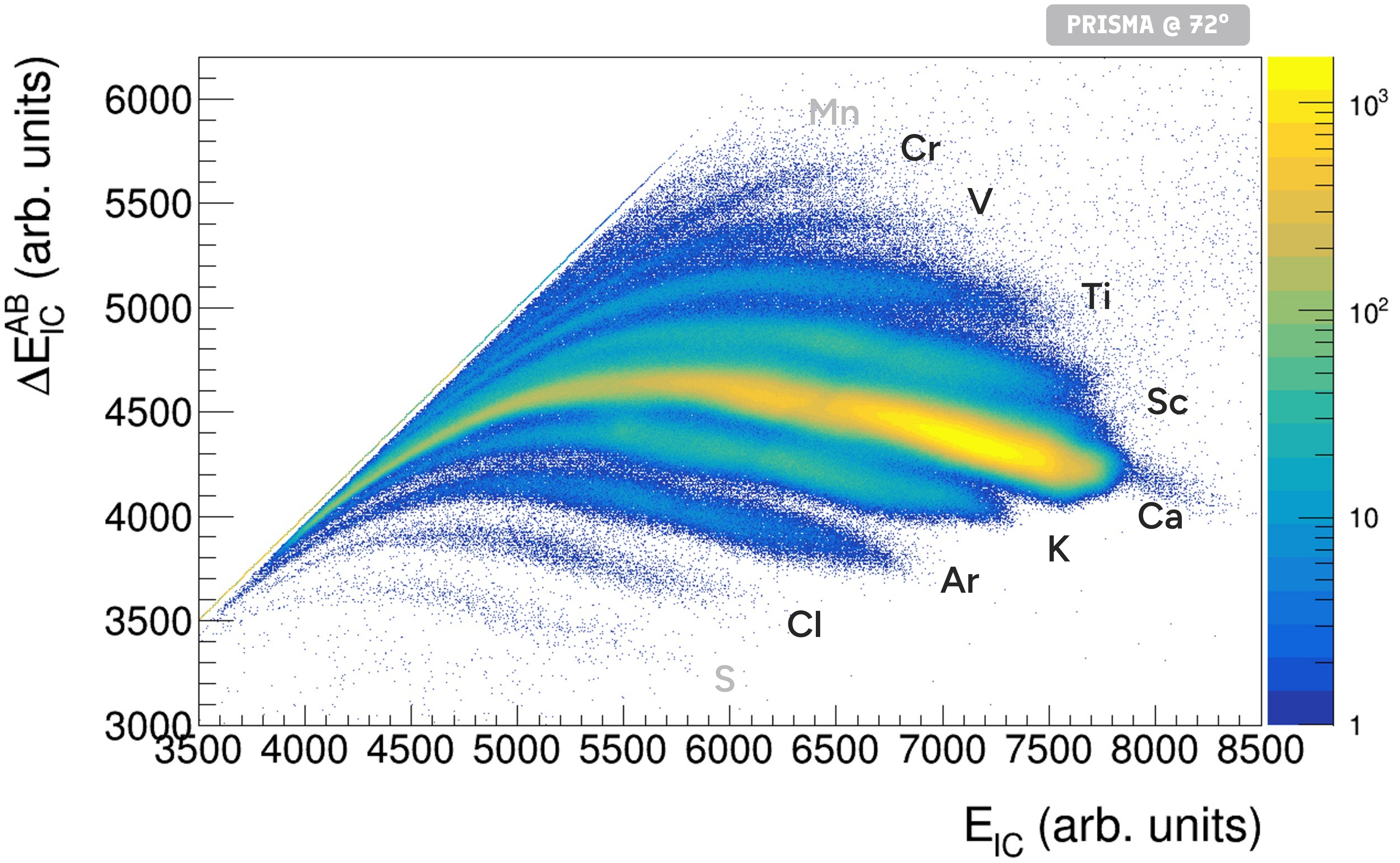

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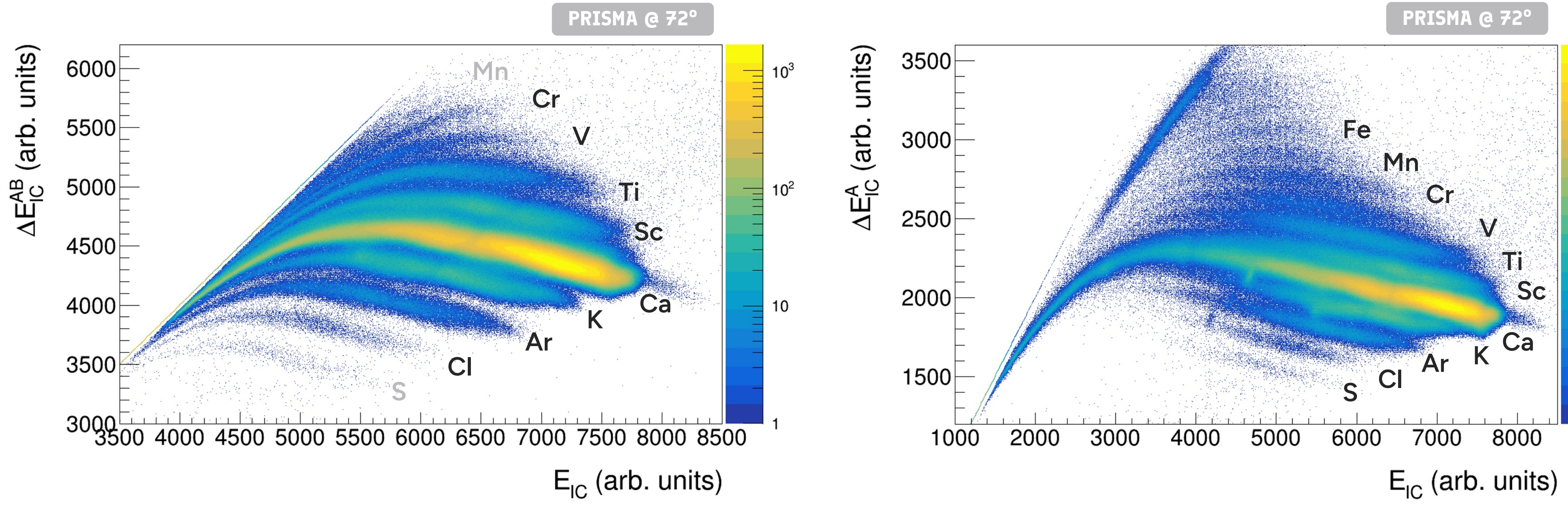

up to (+6p) and down to (-4p)

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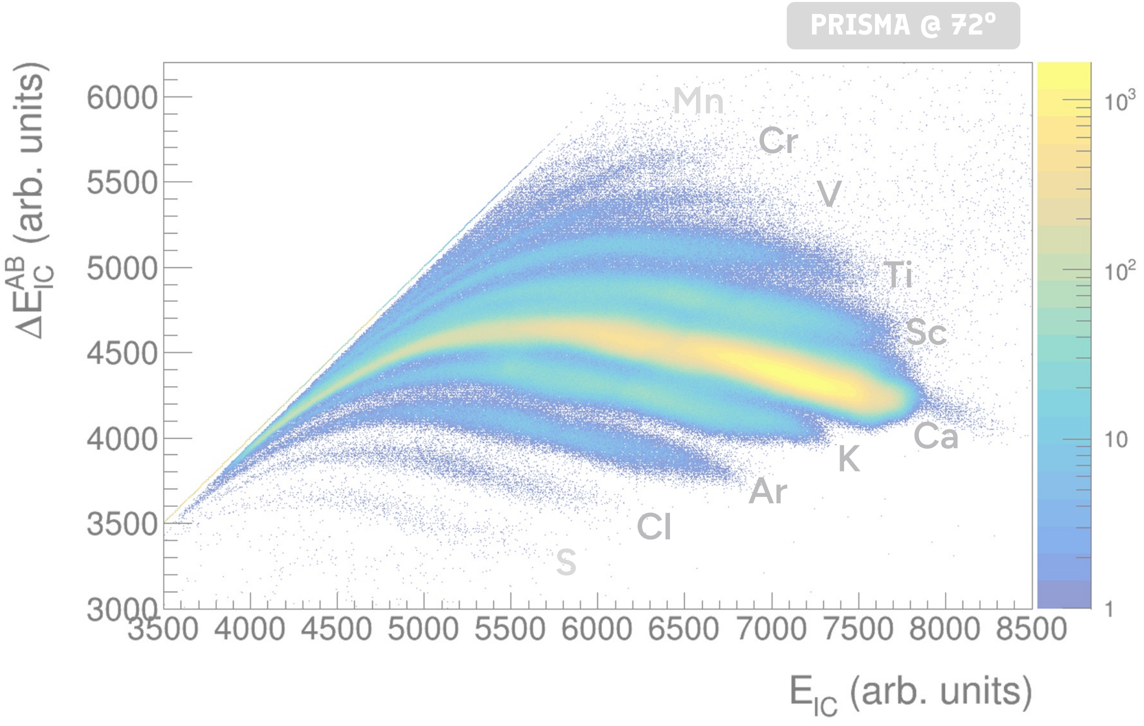

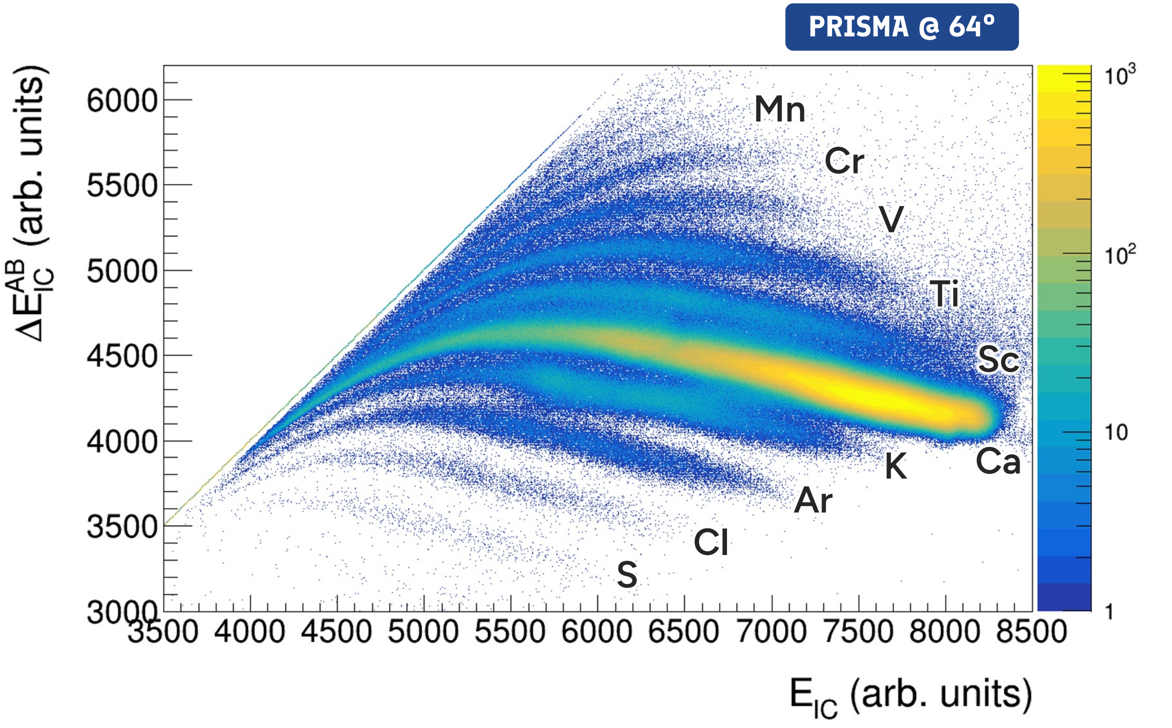

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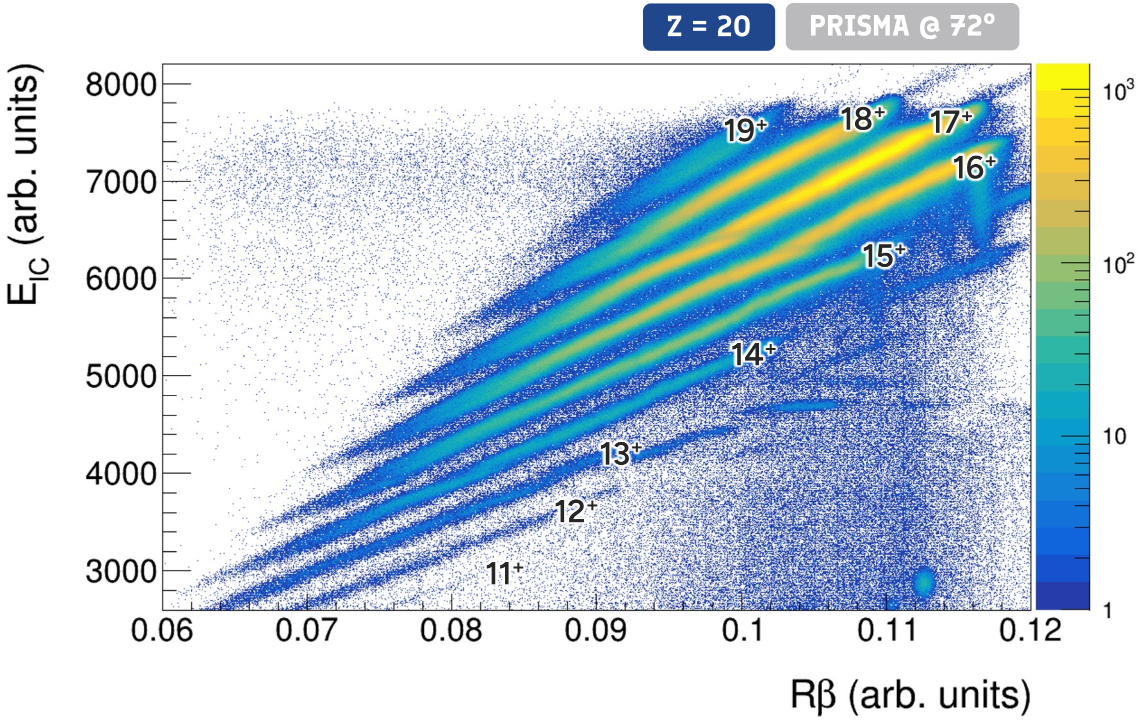

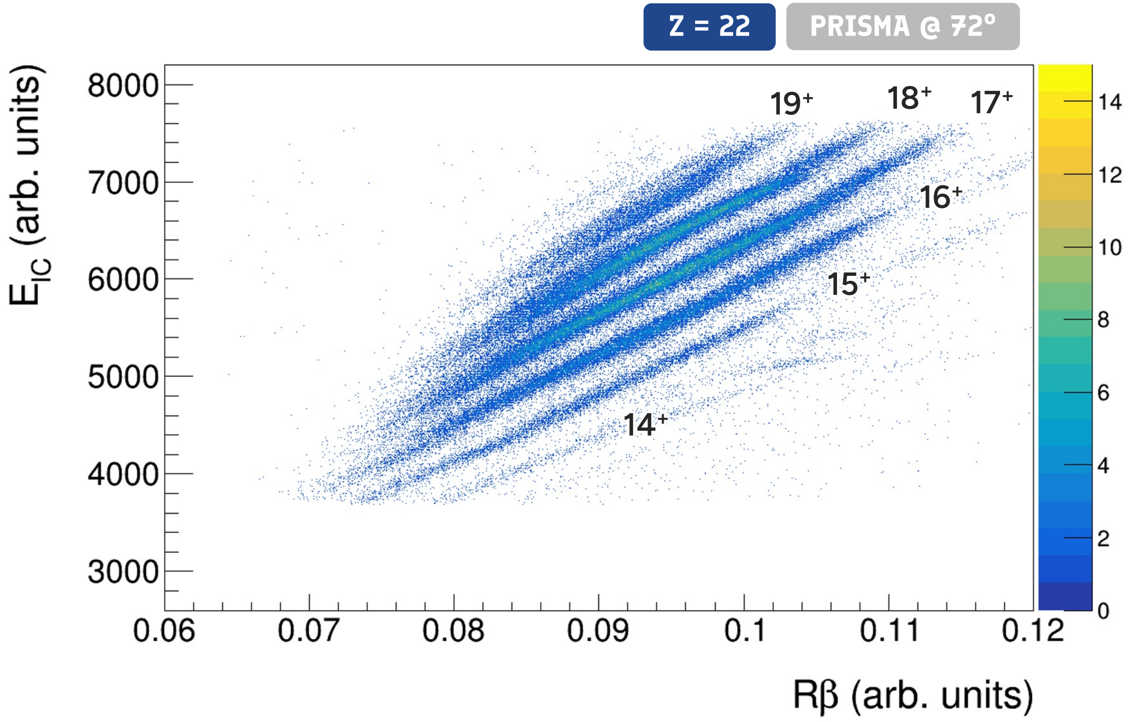

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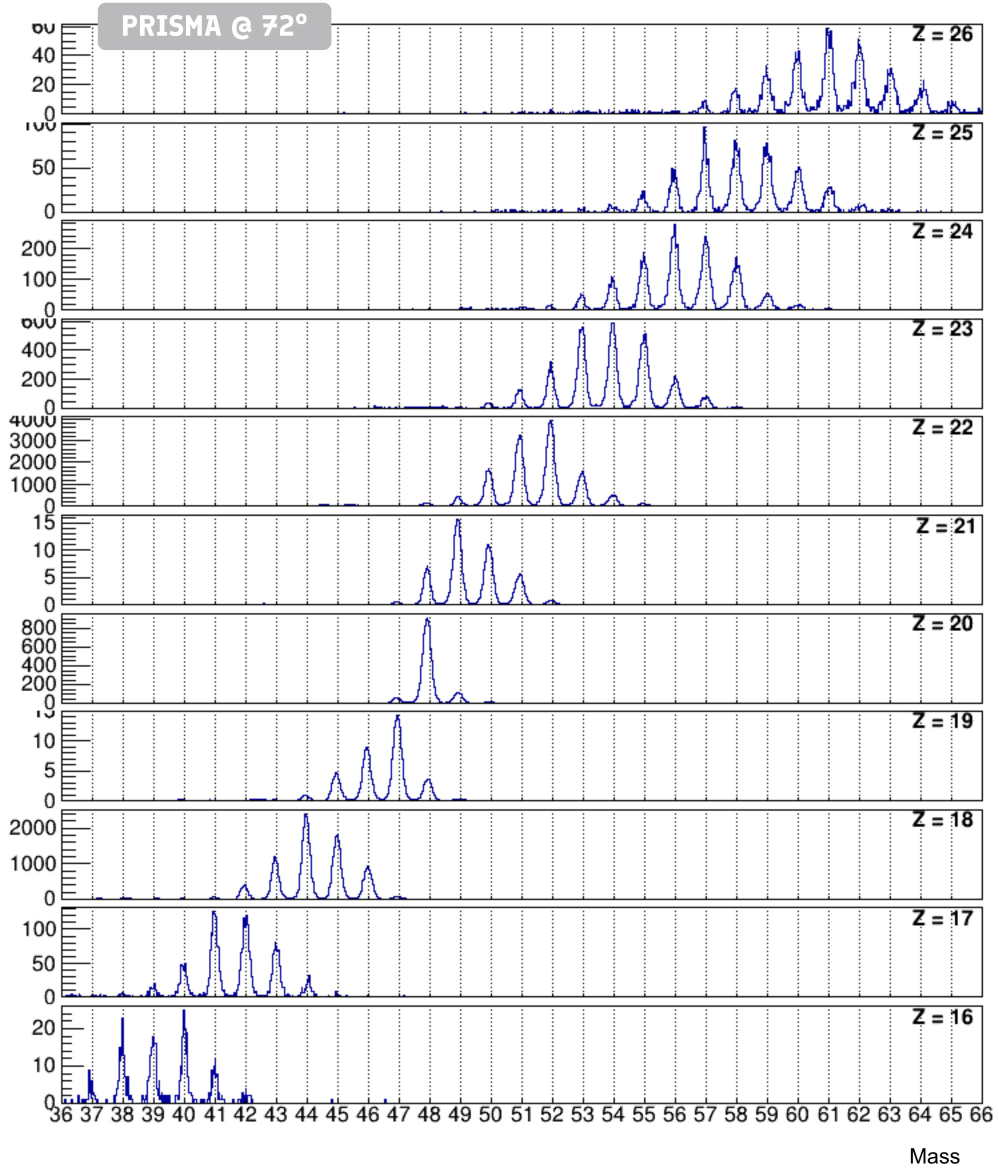
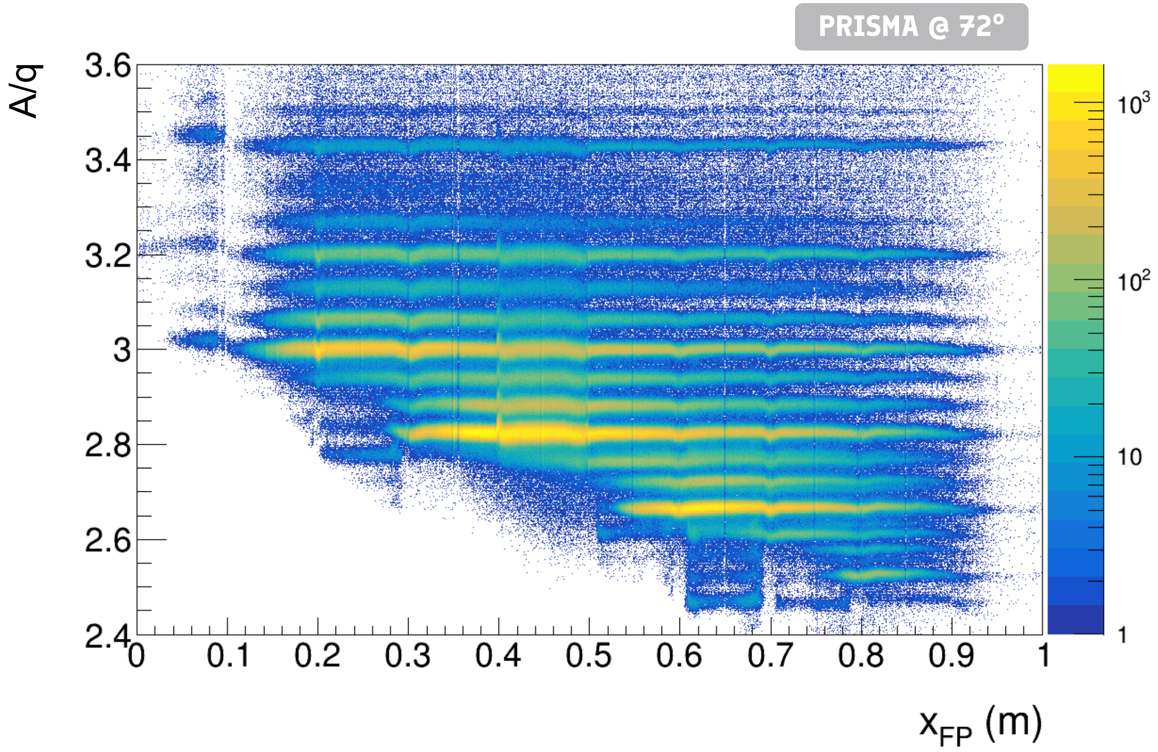
position/time/energy calibration → Z identification → q identification → **mass calibration**





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DATA ANALYSIS

fine-tuning

position/time/energy calibration → Z identification → q identification → mass calibration

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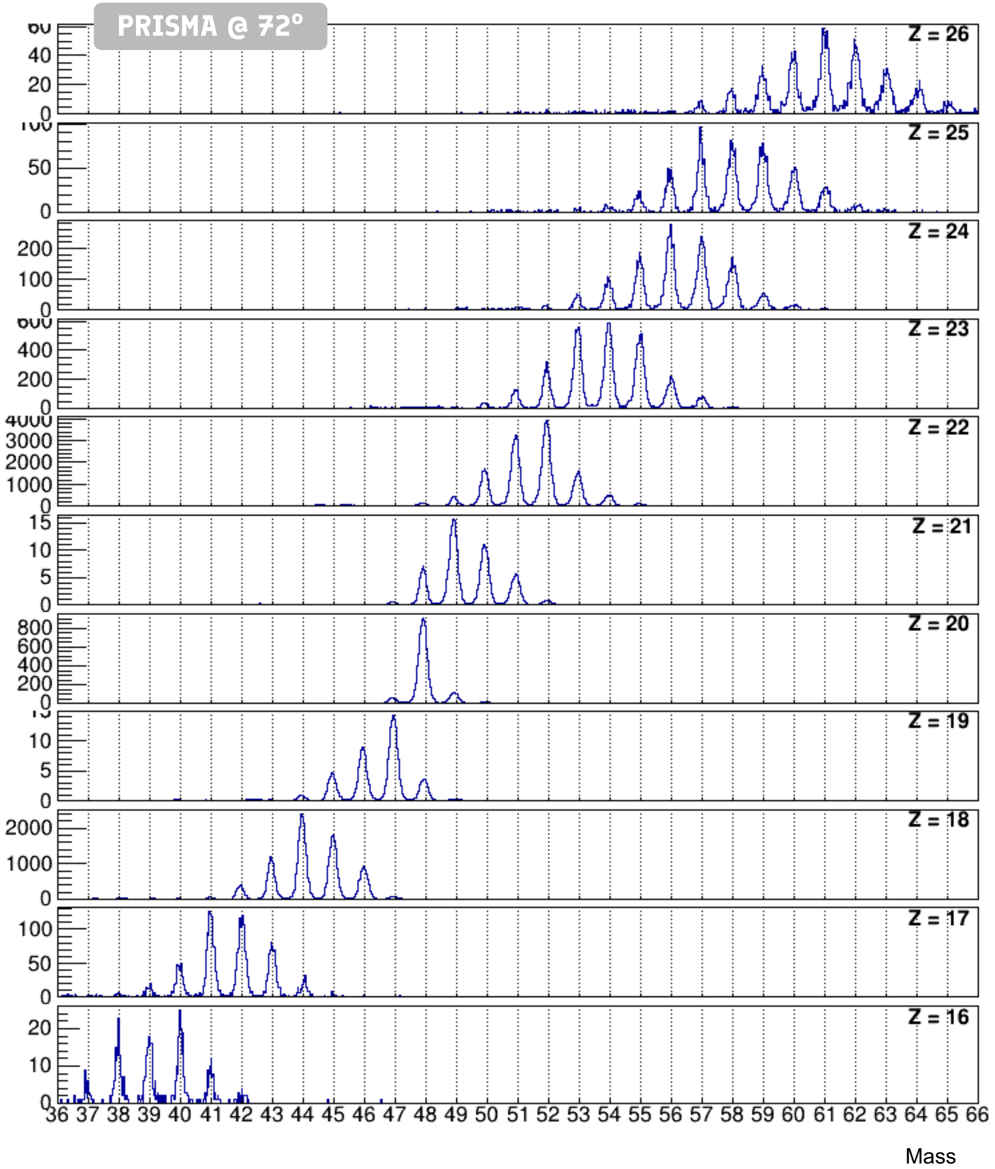

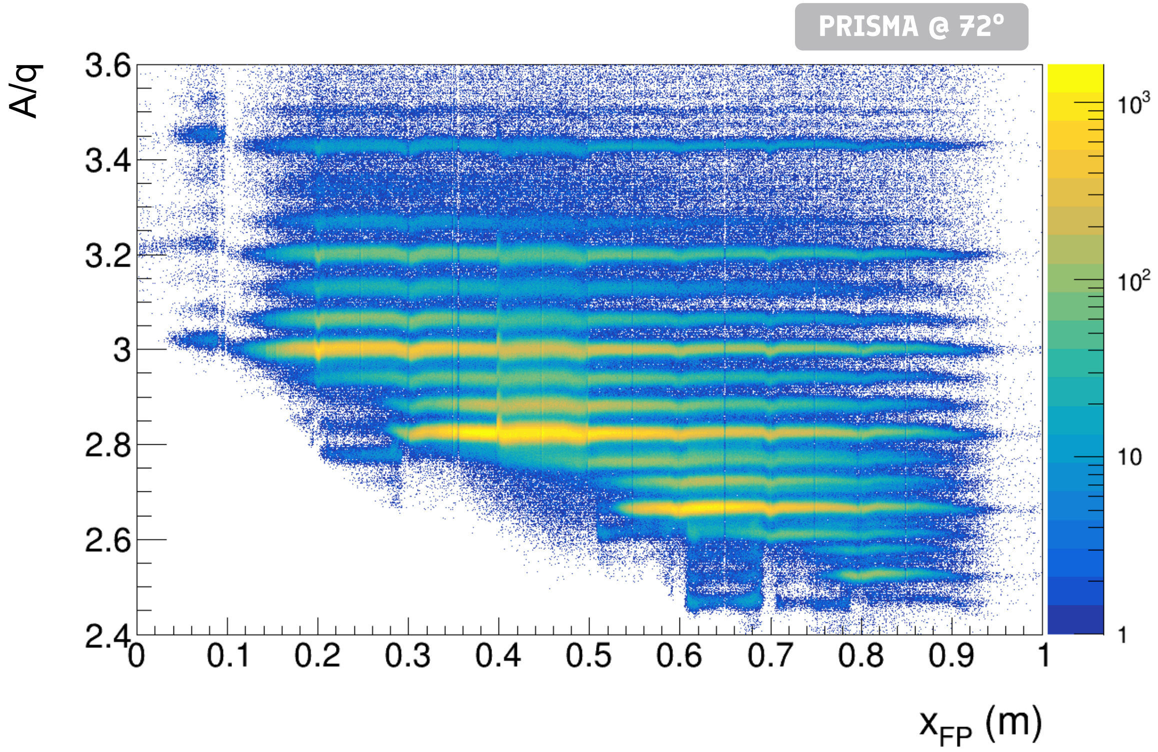

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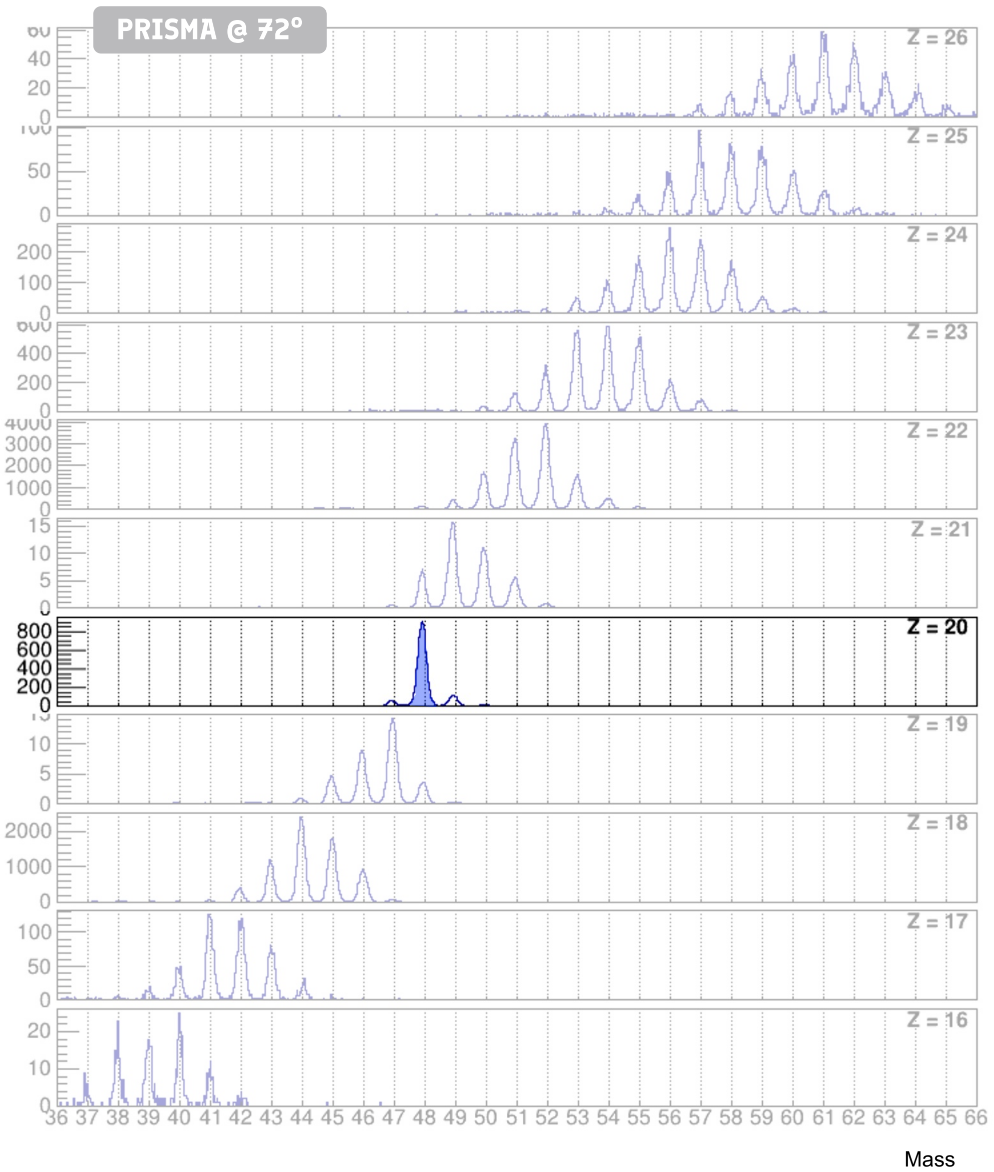

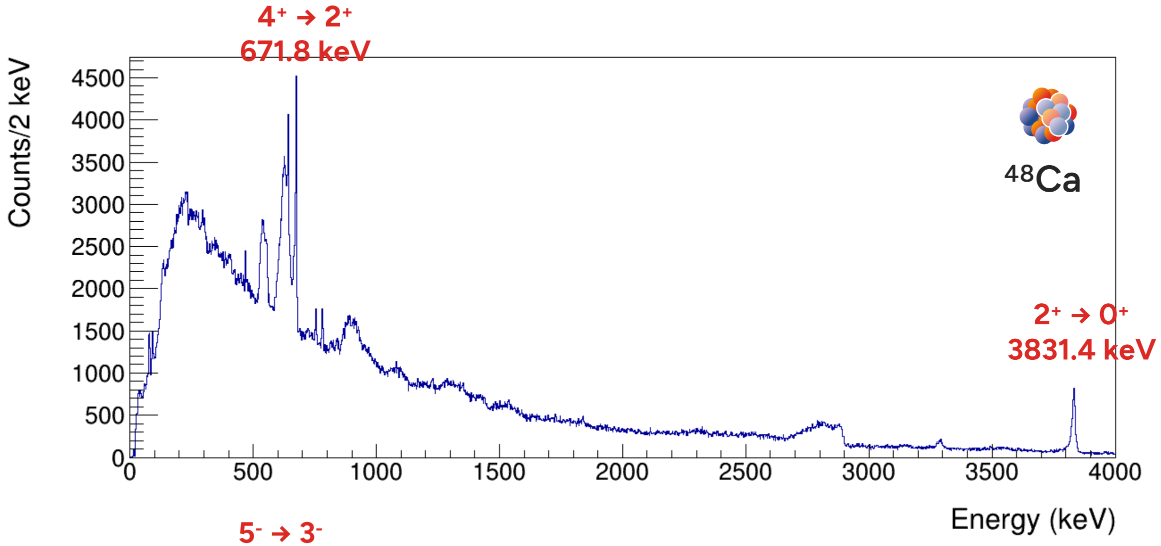

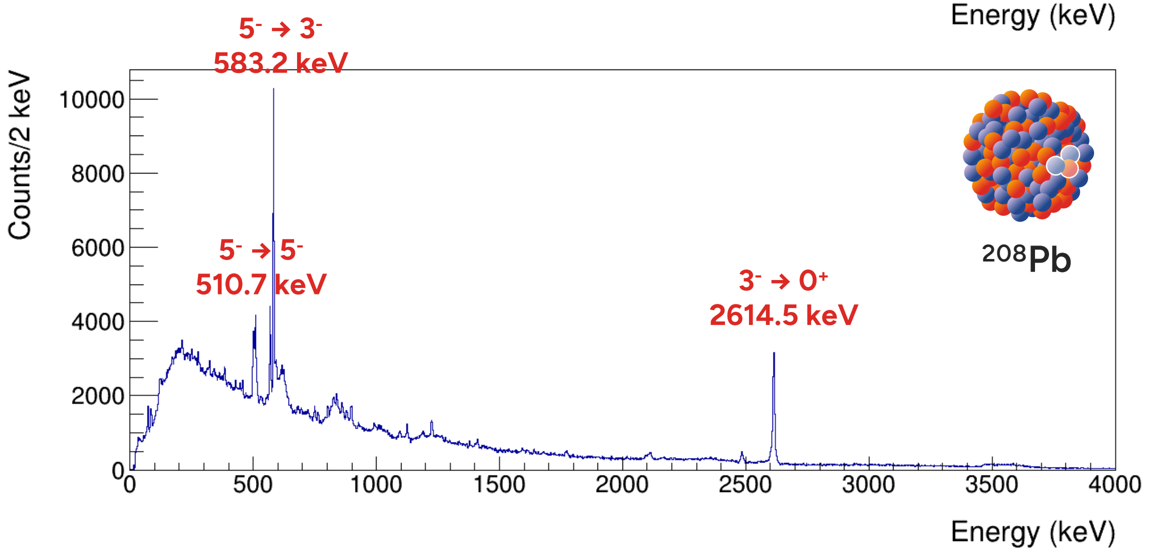

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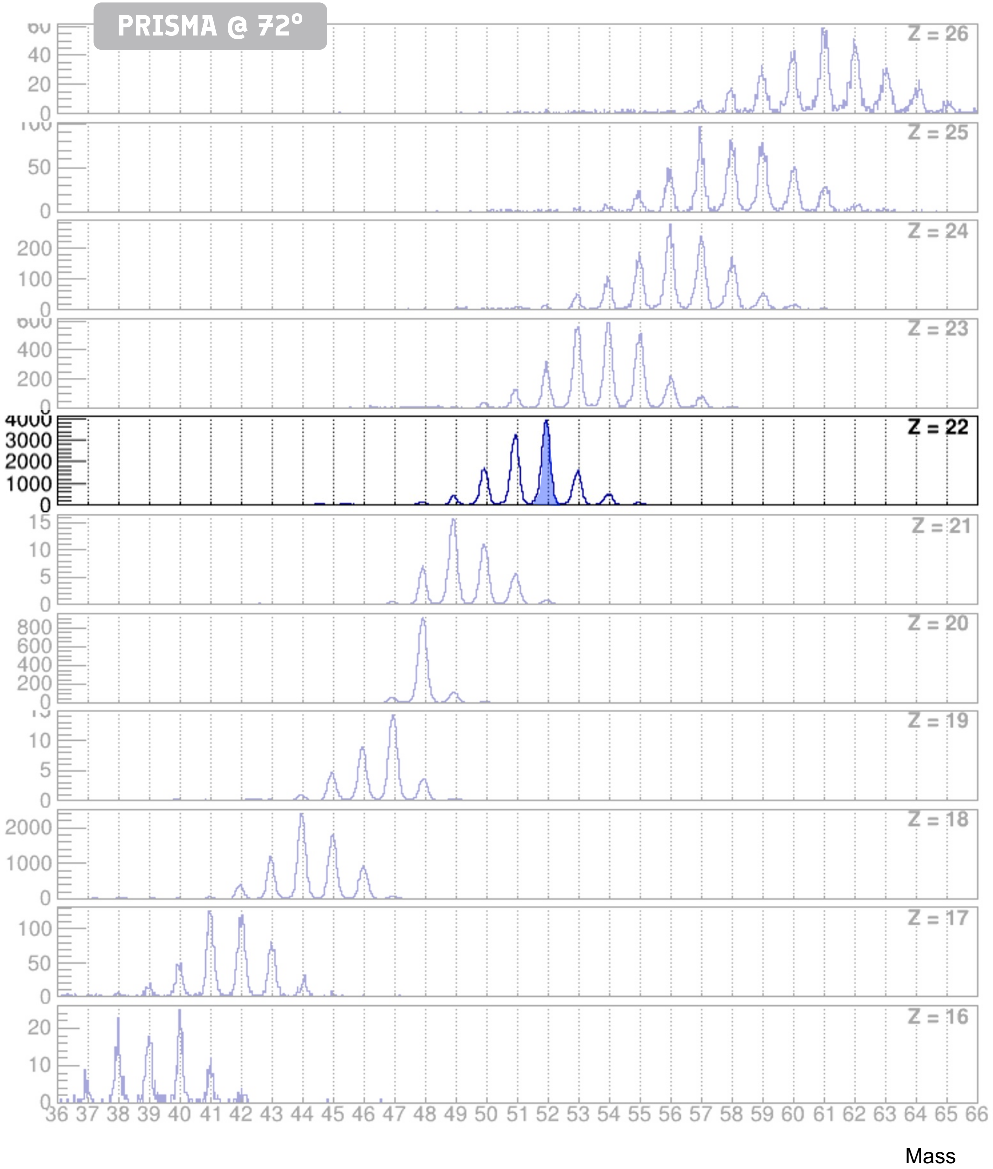
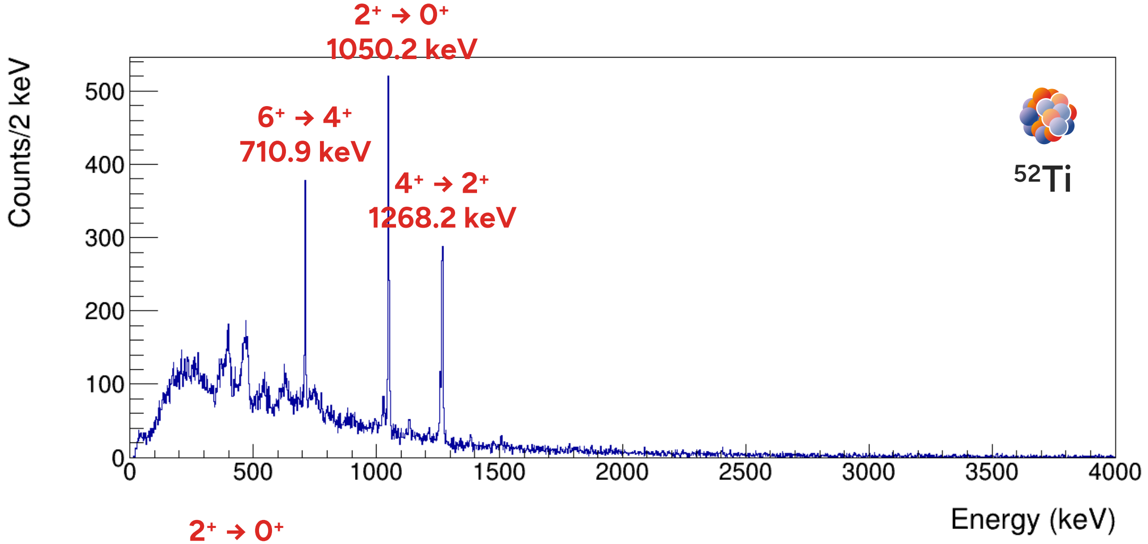
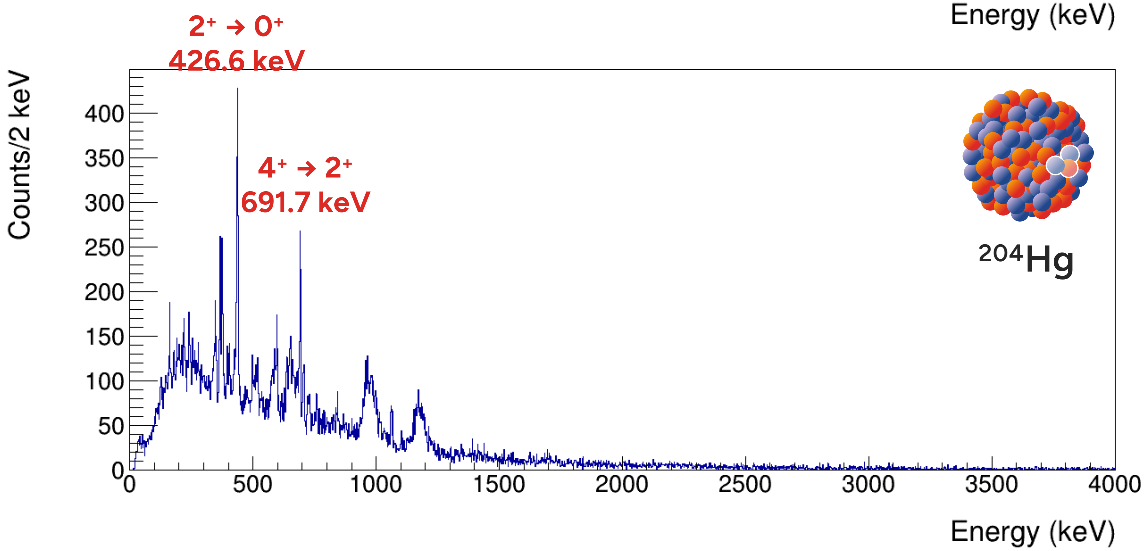
PRISMA @ 72°

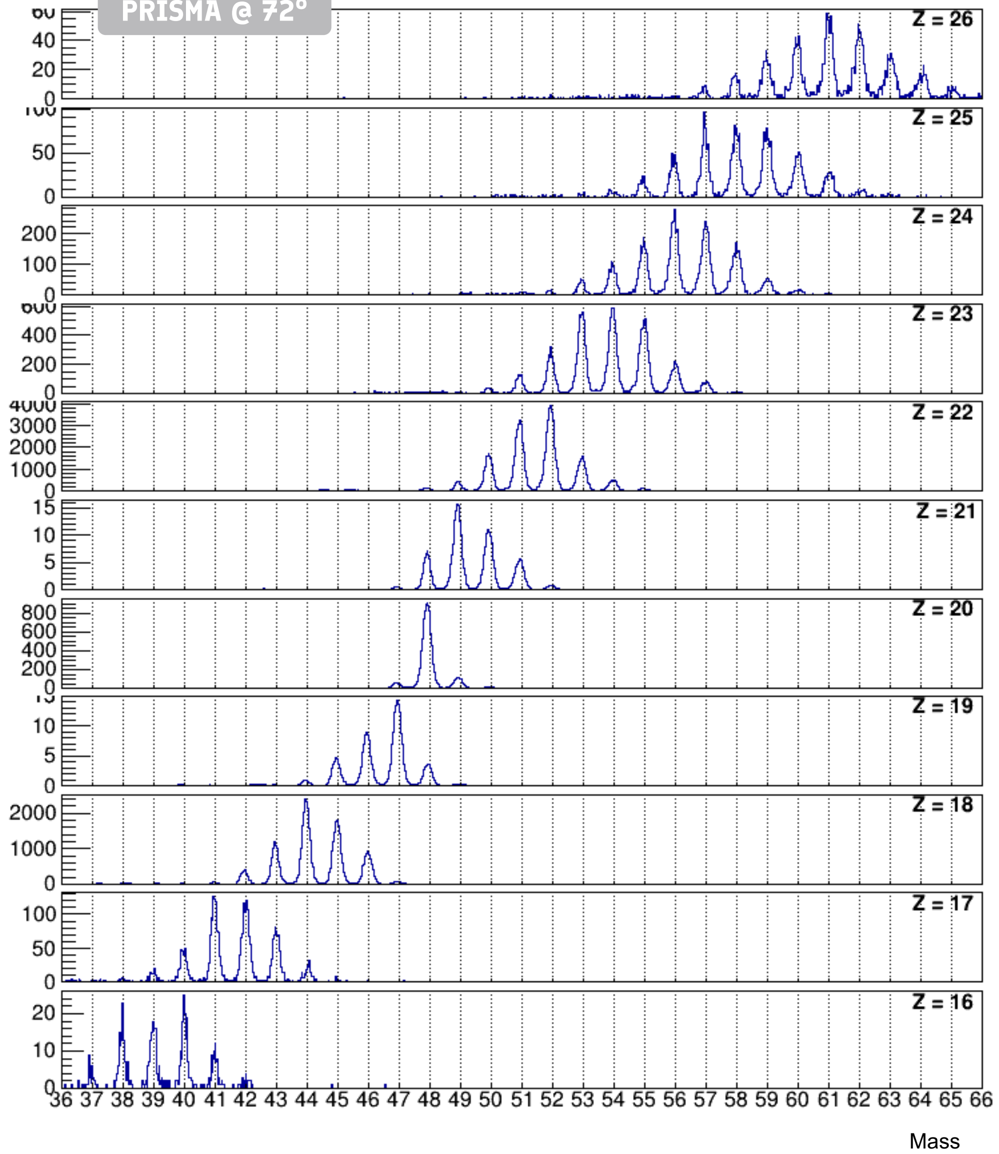




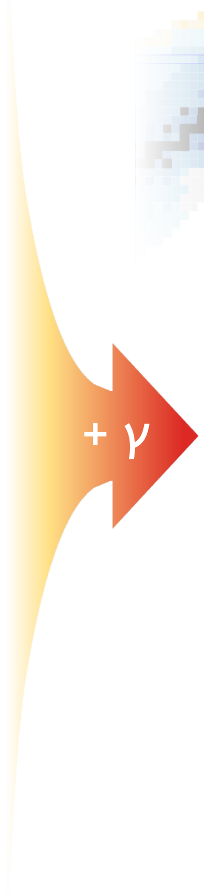


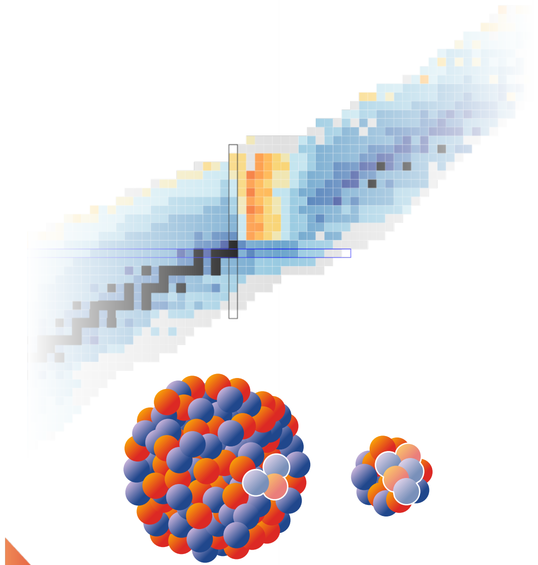
DATA ANALYSIS – future

PRISMA @ 72°



+ PRISMA @ 64°





- TKEL
- cross sections
  - angular distribution
- structure of light and heavy products
- new information about neutron-rich nuclides south of ^{208}Pb?

THANK YOU

This work was partly supported by the Croatian Science Foundation under the project number UIP-2025-02-8168.

References

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