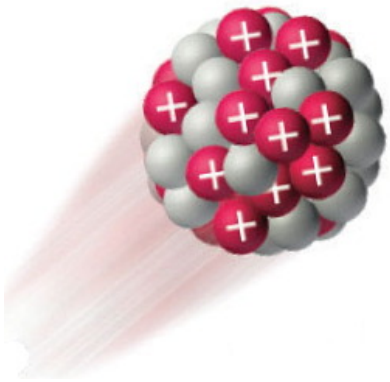
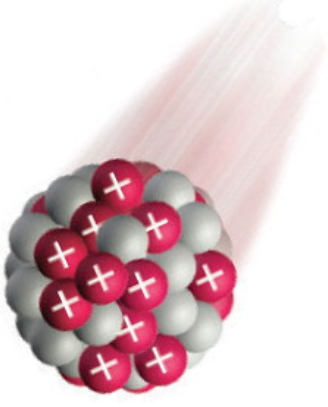
Simone Valdré
Grand Accélérateur National
d'Ions Lourds



Recent results from the ISOFAZIA experiment



NUSYM 2017

GANIL, Maison d'hôtes
September 7th, 2017

ISOFAZIA experiment at LNS

Aim of this work

Study of $^{80}\mathbf{Kr} + ^{40,48}\mathbf{Ca}$ reactions at 35 MeV/u

- **Multifragmentation** in central collisions
- Quasi-projectile **dynamical fission**
- **Isospin transport** effects in semi-peripheral collisions

G. Pastore *et al.*, Nuovo Cimento C **39**, 383 (2016)
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Outline

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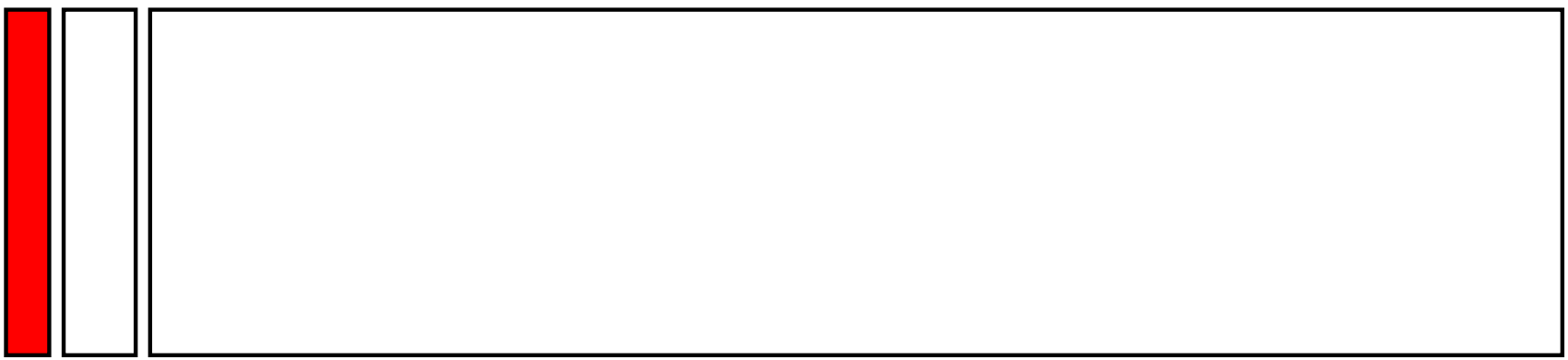
FAZIA @ LNS

The telescope stages

1. 300 µm reverse-mounted Si detector;
2. 500 µm reverse-mounted Si detector;
3. 10 cm CsI(Tl) cristal read by a photodiode.

To achieve the best possible energy resolution and A and Z identification Si detectors come from a nTD ingot cut at random angle to avoid channeling effects.



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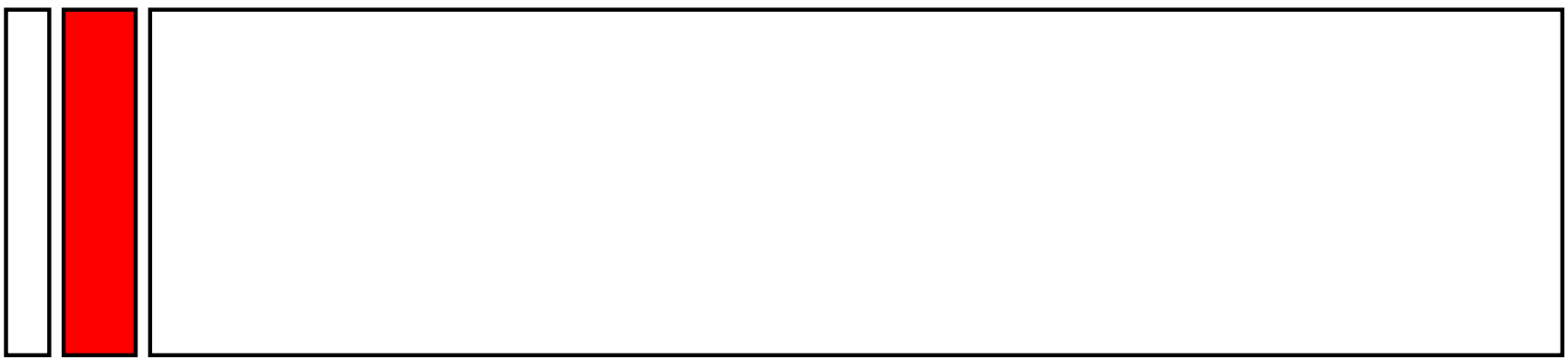

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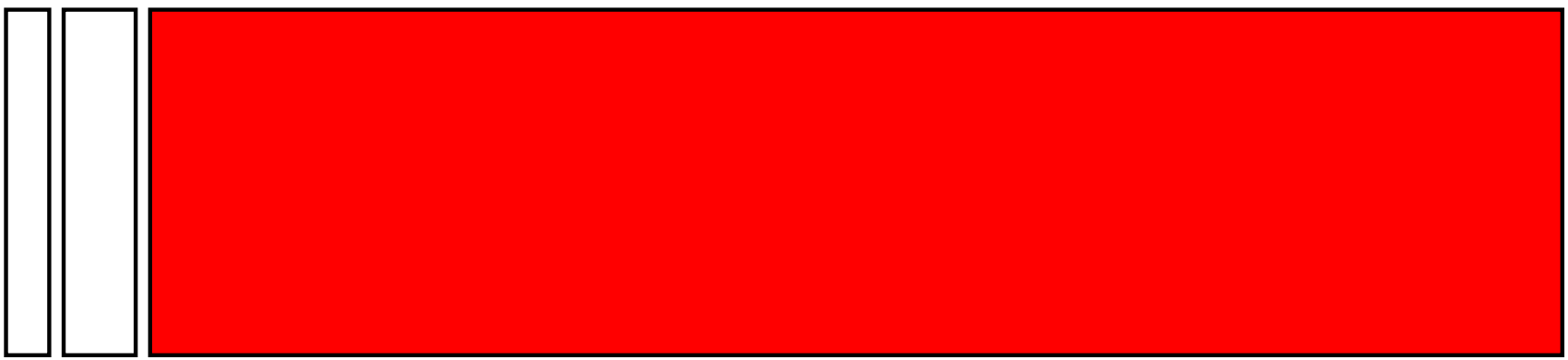
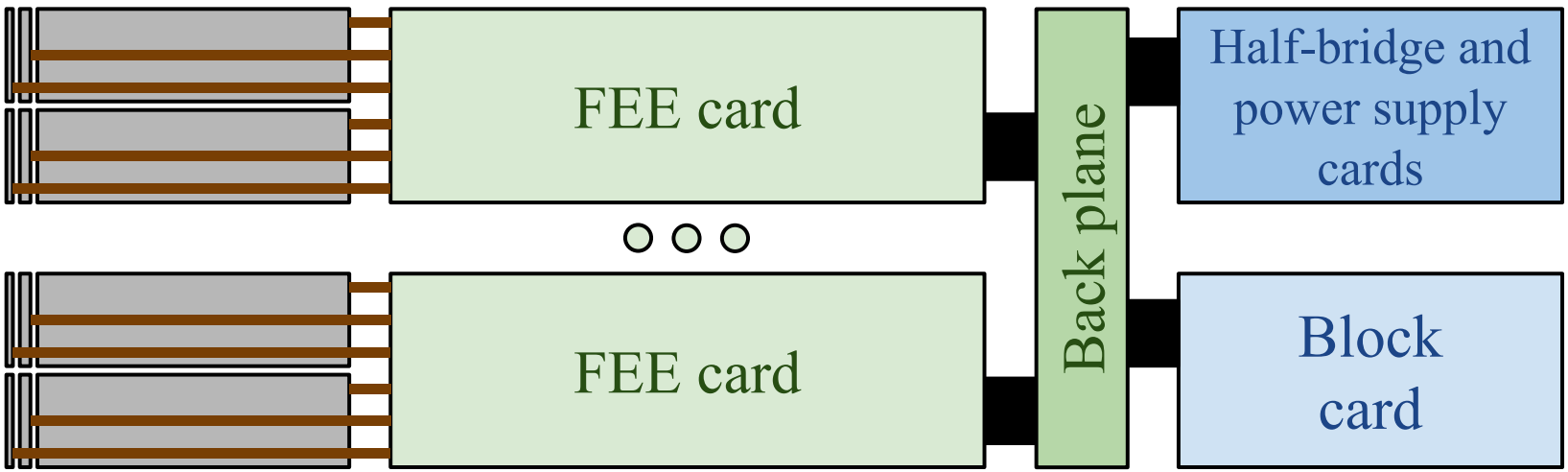


The FAZIA block

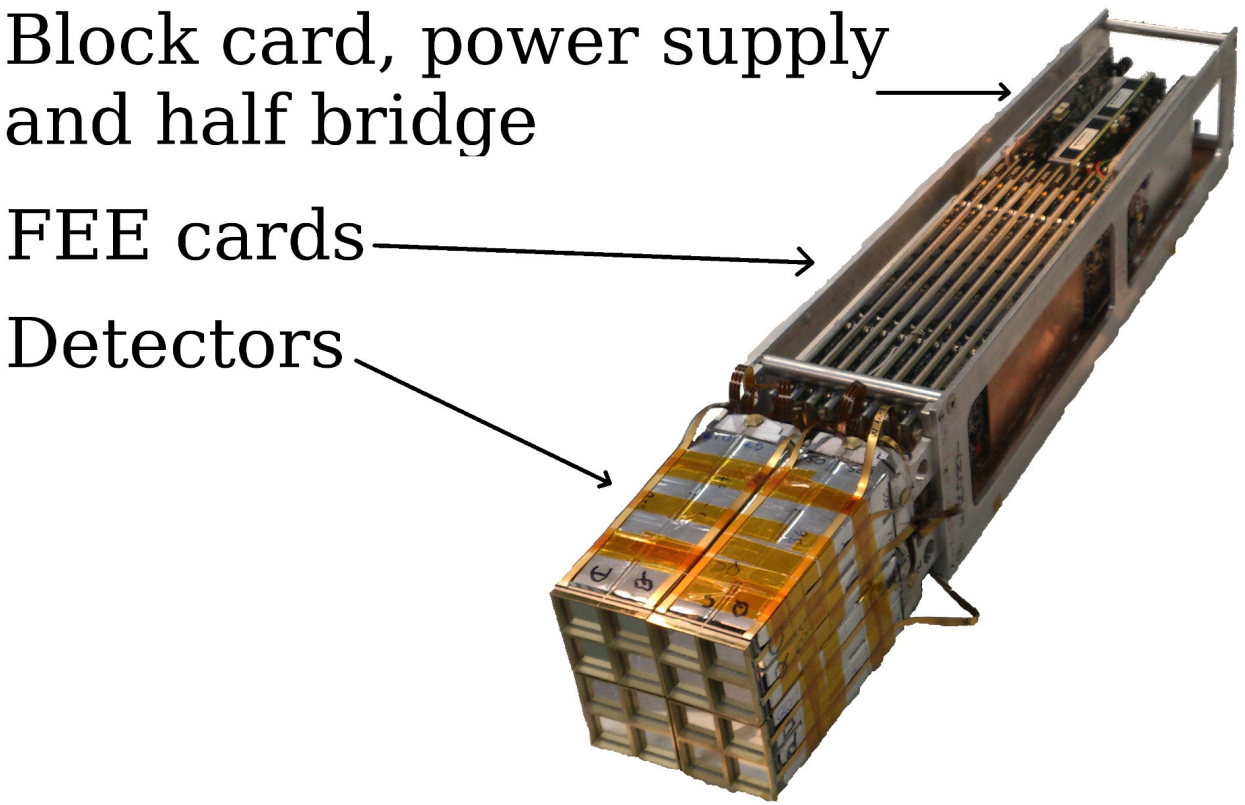
2 telescopes are connected to a FEE card.

The FAZIA block



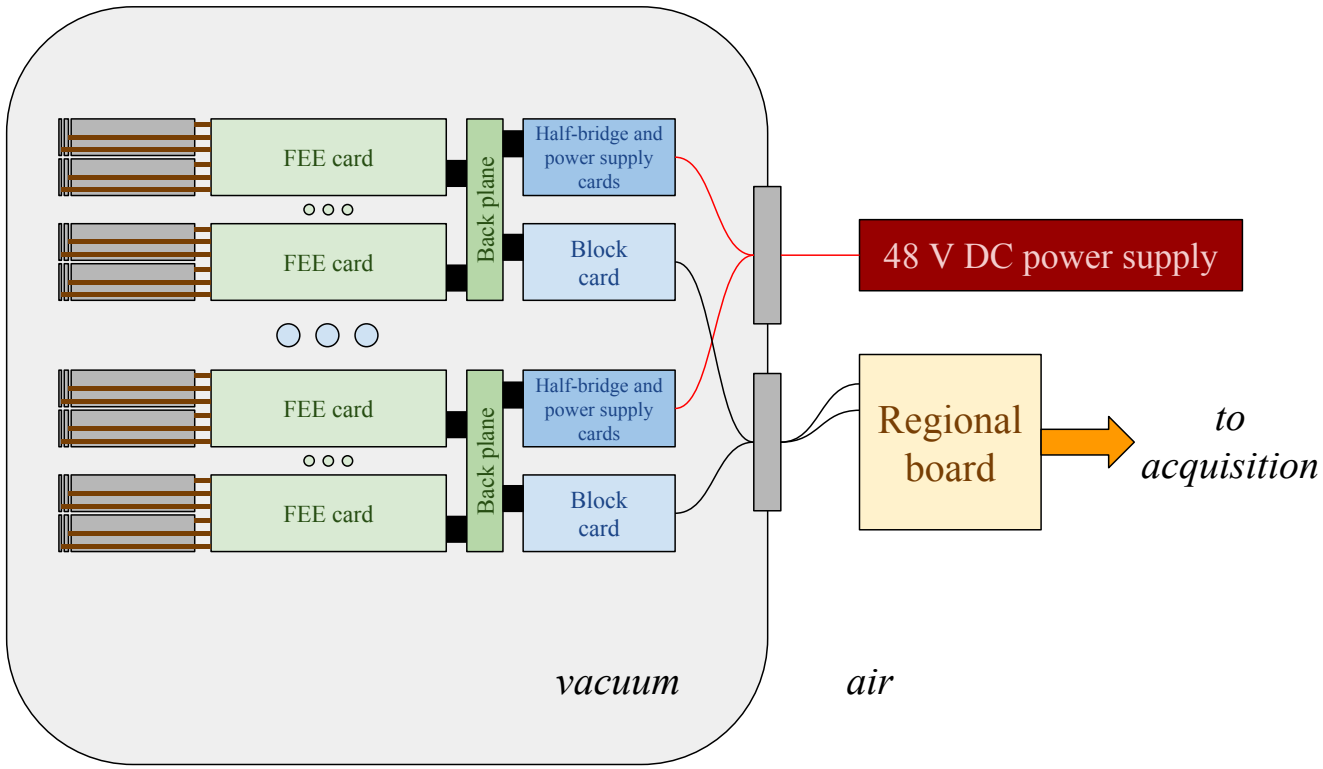
8 FEE cards are connected to a block card via a back plane.

The FAZIA block



Block is mounted on a copper base in which water flows to provide cooling

The FAZIA block



up to 36 block cards are connected to a regional board via a full duplex 3 Gb/s *optical link*

FAZIA innovative features

- FAZIA implements **compact electronics** that permit to do on-line analysis just next the detectors
  - minimization of signal distortion
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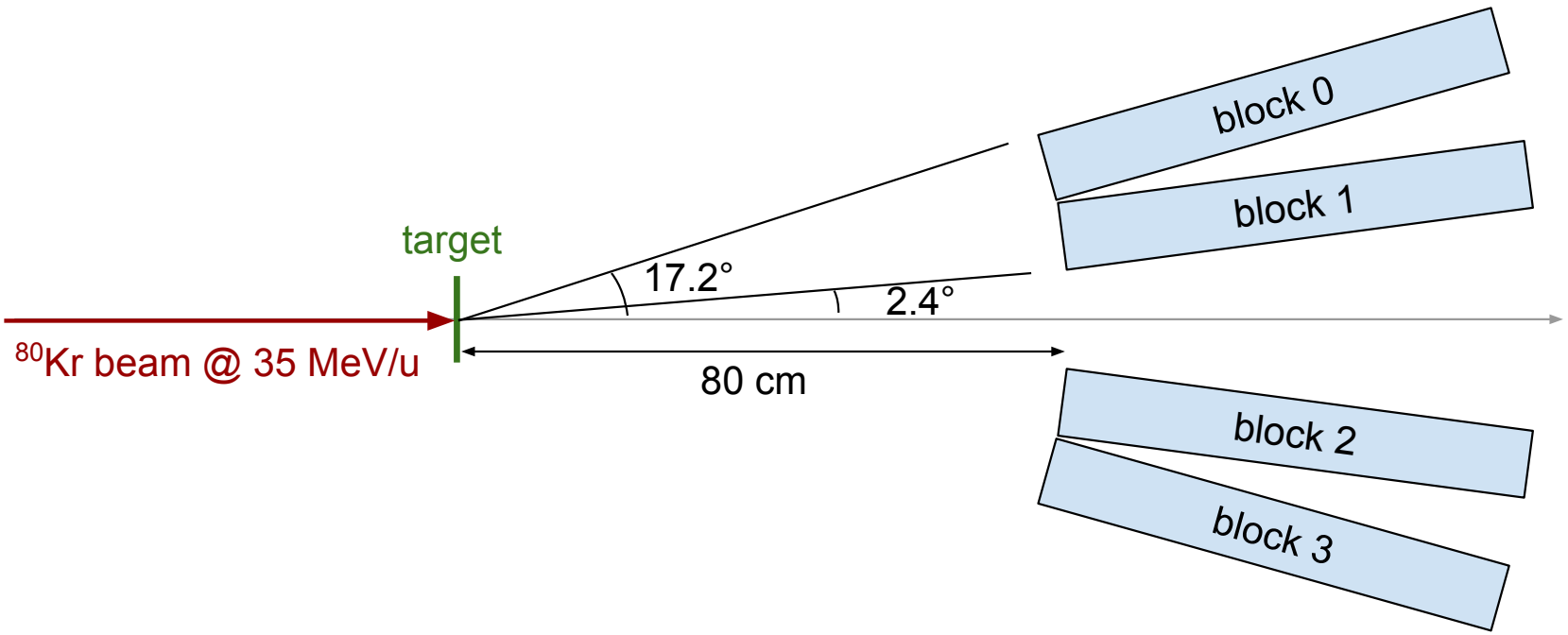
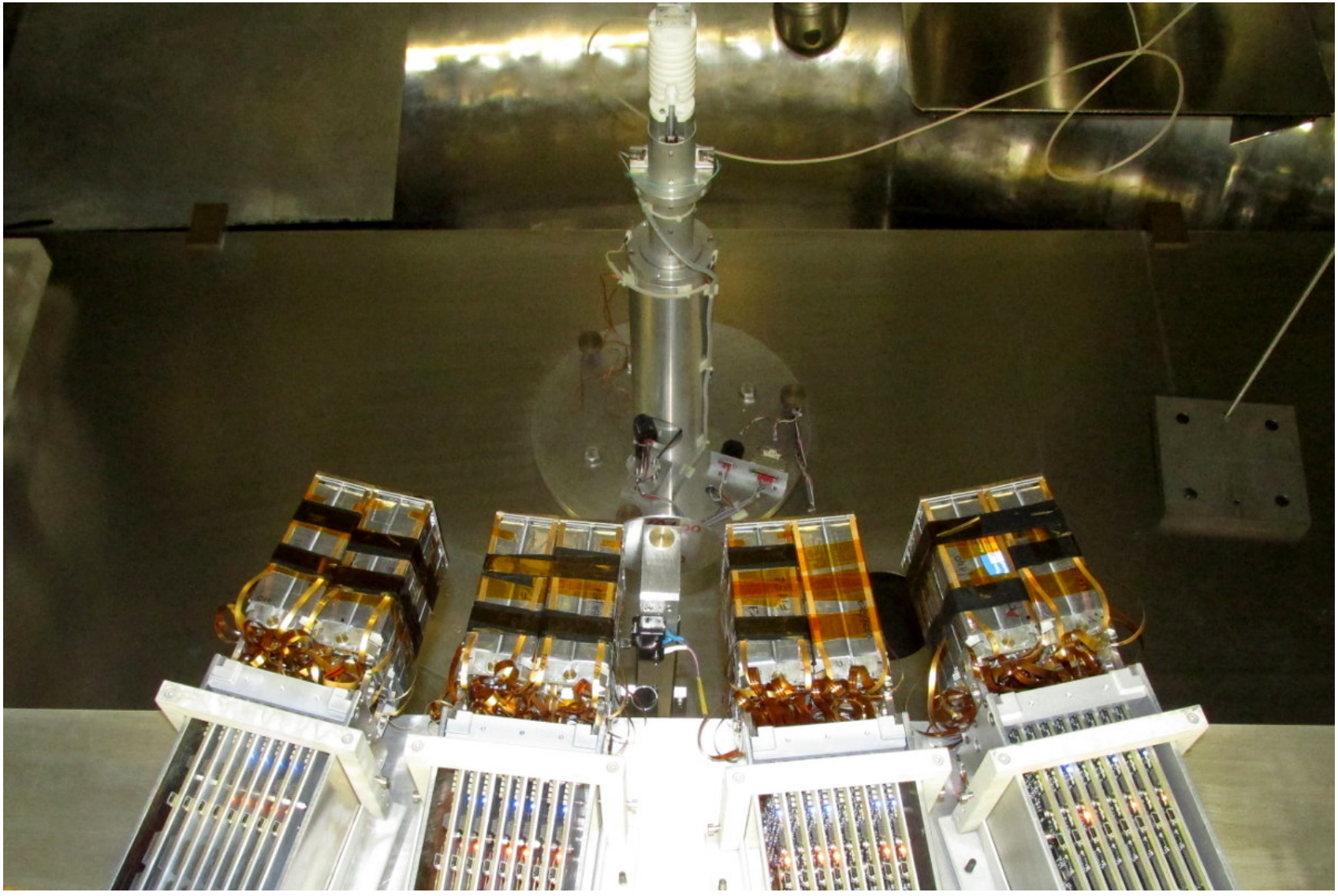
- Despite its compact design, the FAZIA block has a good energy resolution and isotopic discrimination up to $Z \sim 25$

ISOFAZIA setup



View from above

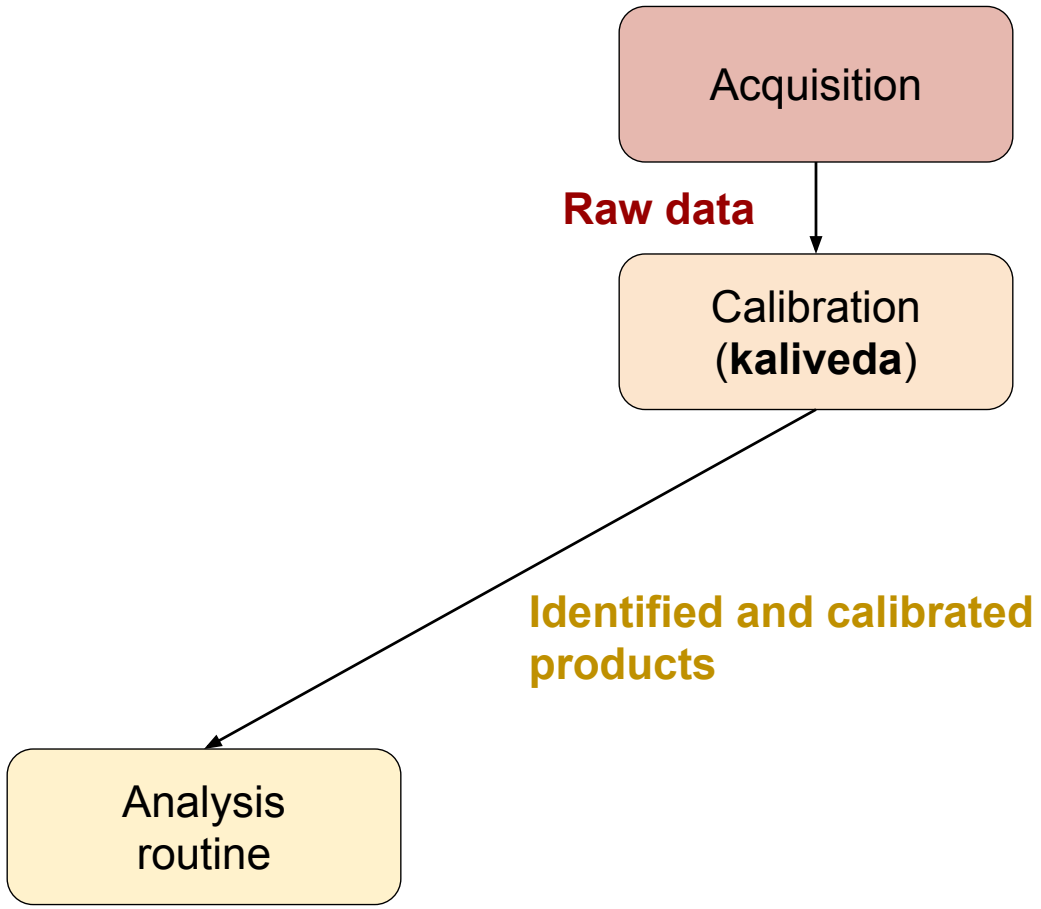
ISOFAZIA setup



ISOFAZIA data processing

Raw data

ISOFAZIA data processing



Physics case

Asymmetric nuclear matter Equation of State (*asy*EoS)

- Symmetry energy term depending on proton and neutron densities:

$$\frac{E}{A}(\rho,\delta) = \frac{E}{A}(\rho,0) + \frac{E_{\mathrm{sym}}}{A}(\rho)\delta^2 + \mathcal{O}\left(\delta^4\right)$$

Isospin parameter

$$\delta = \frac{(\rho_n - \rho_p)}{\rho} \sim \frac{N-Z}{A}$$

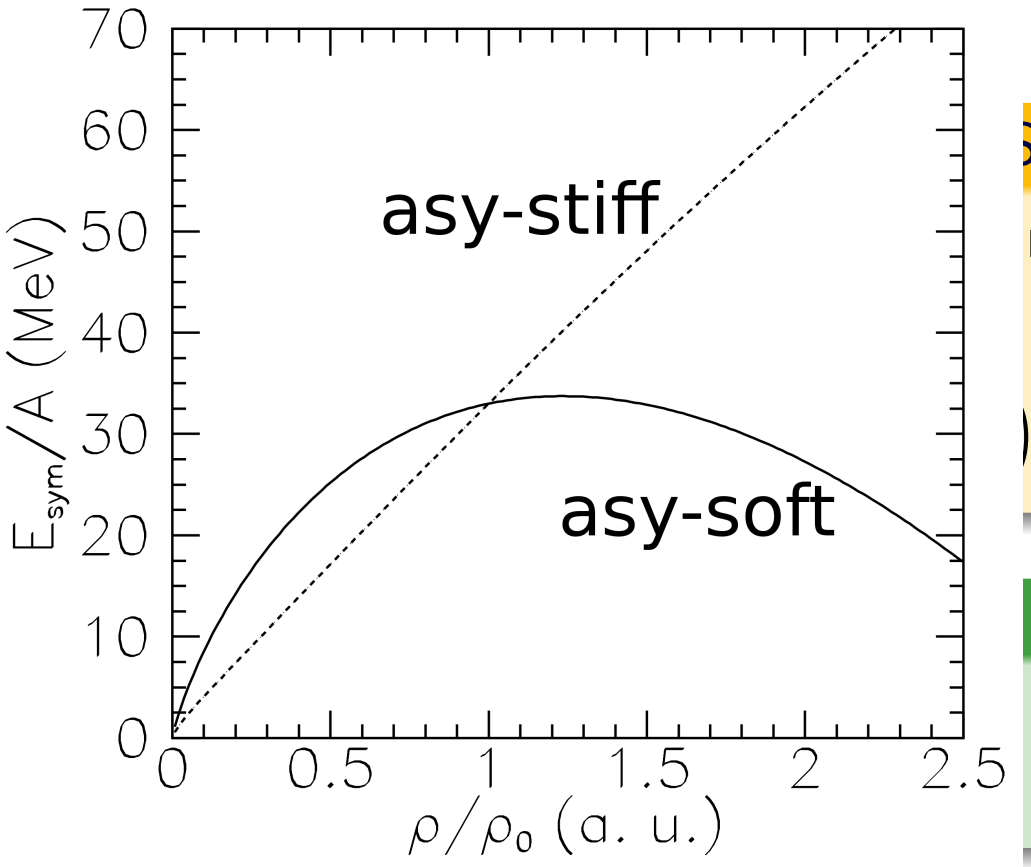
E_{sym} behaviour is known only near ρ_0

Physics case

Asymmetric

- Symmet
densitie

Isospin para



)

neutron

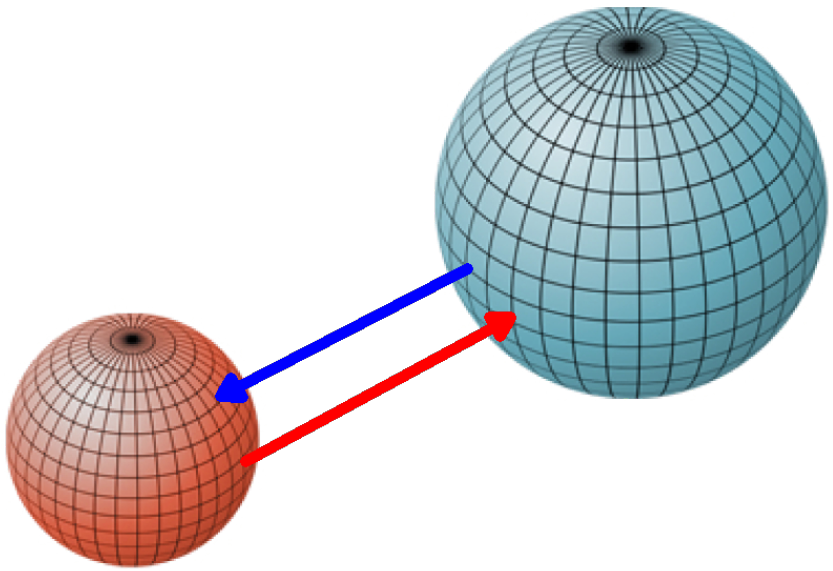
)

E_{sym} behaviour is known only near ρ_0

Isospin transport

Isospin diffusion

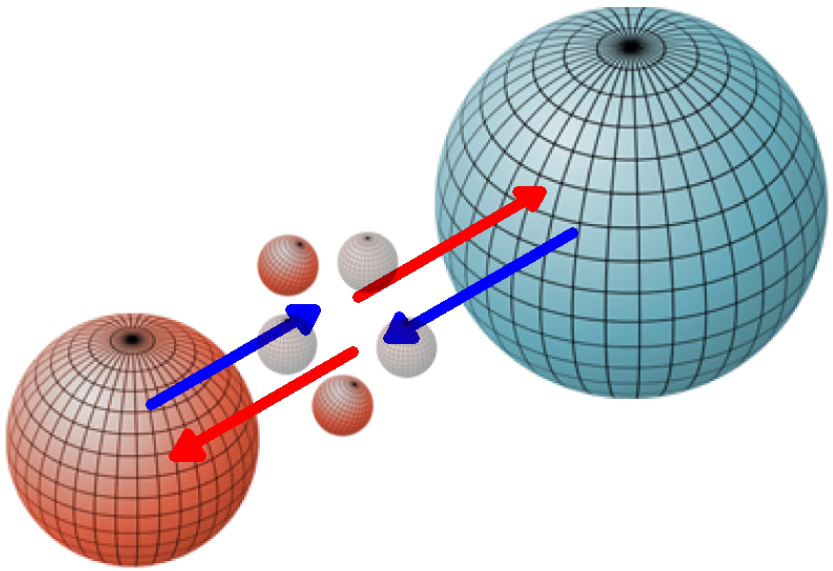
- Projectile and target isospins tend to **equilibrate** during interaction
- Isospin diffusion favoured by an **asy-soft** EoS parametrization



Isospin transport

Isospin drift

- Neutrons tend to migrate toward **low density** regions (neck)
- Isospin drift favoured by an **asy-stiff** EoS parametrization



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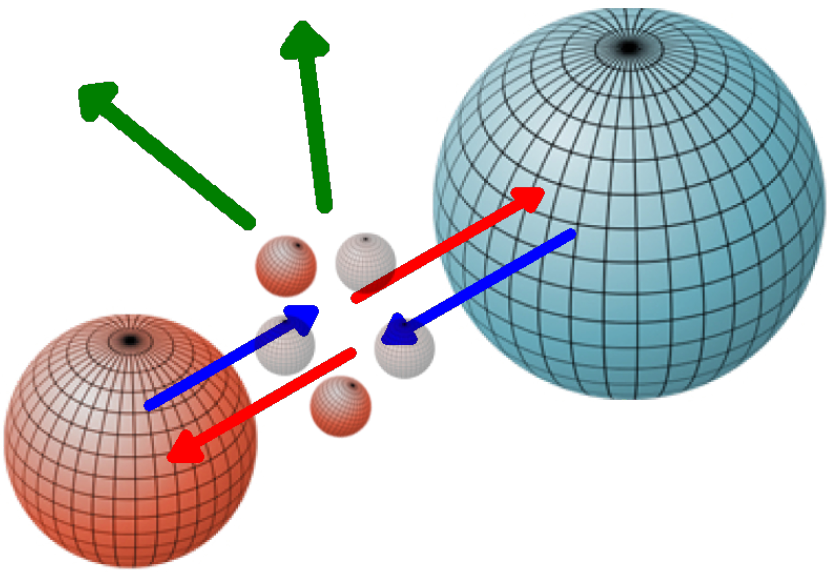

Reaction simulation

Antisymmetrized Molecular Dynamics (AMD)

It considers the evolution via the equations of motion of **single nucleons**, modeled as gaussian packets under the effect of a mean field and two-body interactions

A. Ono *et al.*, Phys. Rev. C **59**, 853 (1999)

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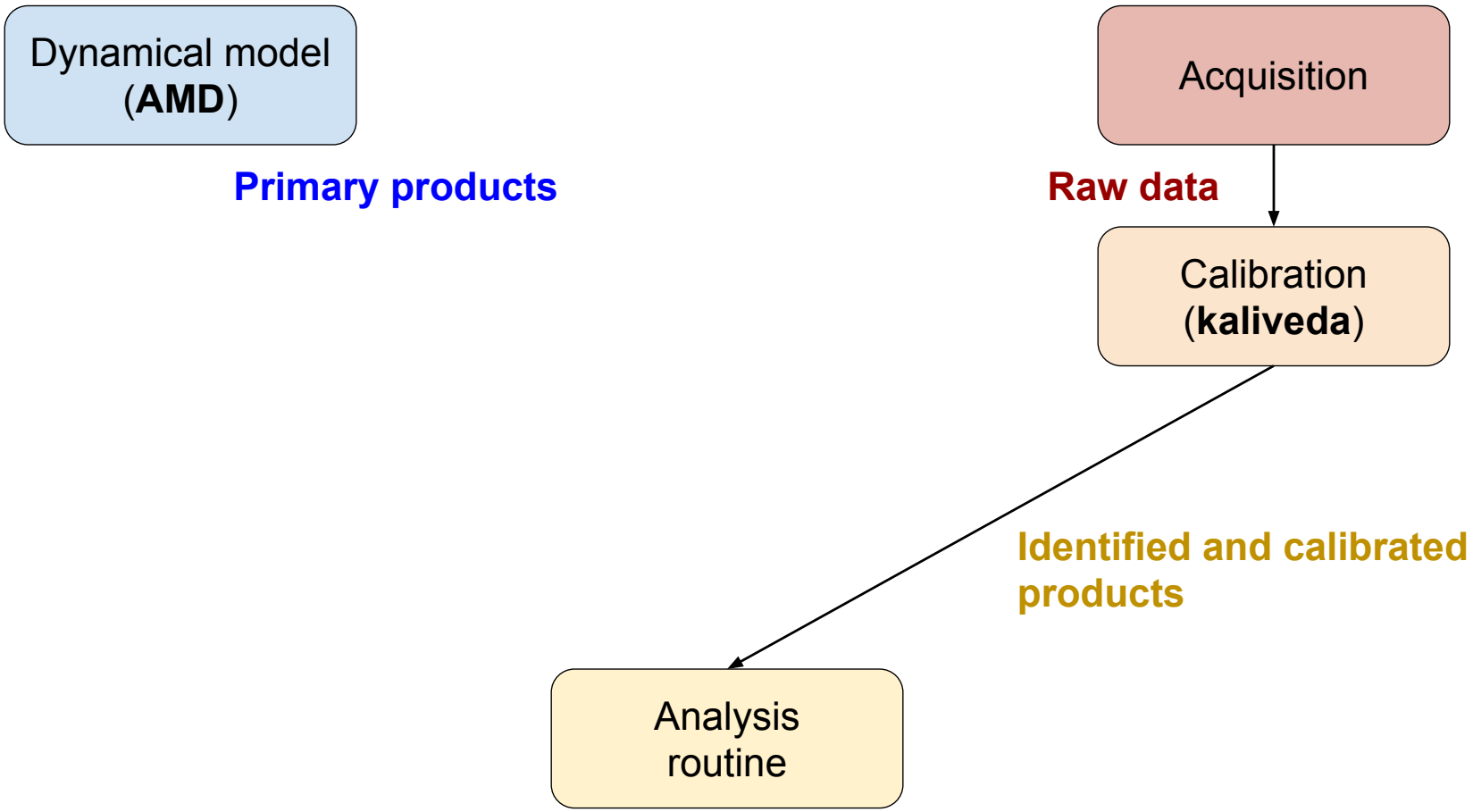
GEMINI++ code

Used as **afterburner** to produce secondary particle distributions from primary fragments

A. Ono *et al.*, Phys. Rev. C **59**, 853 (1999)
R. J. Charity, Phys. Rev. C **82**, 014610 (2010)

ISOFAZIA model data processing



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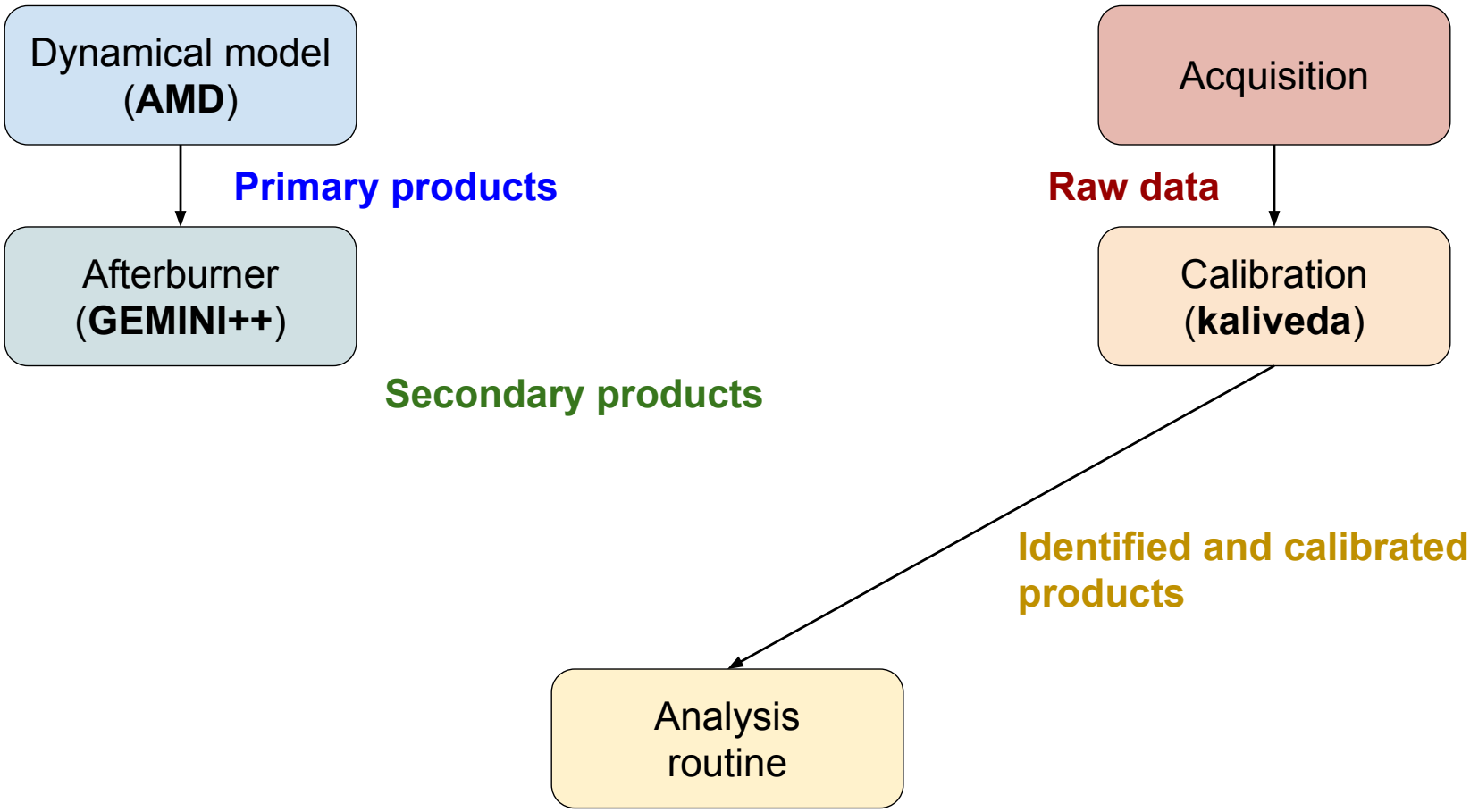

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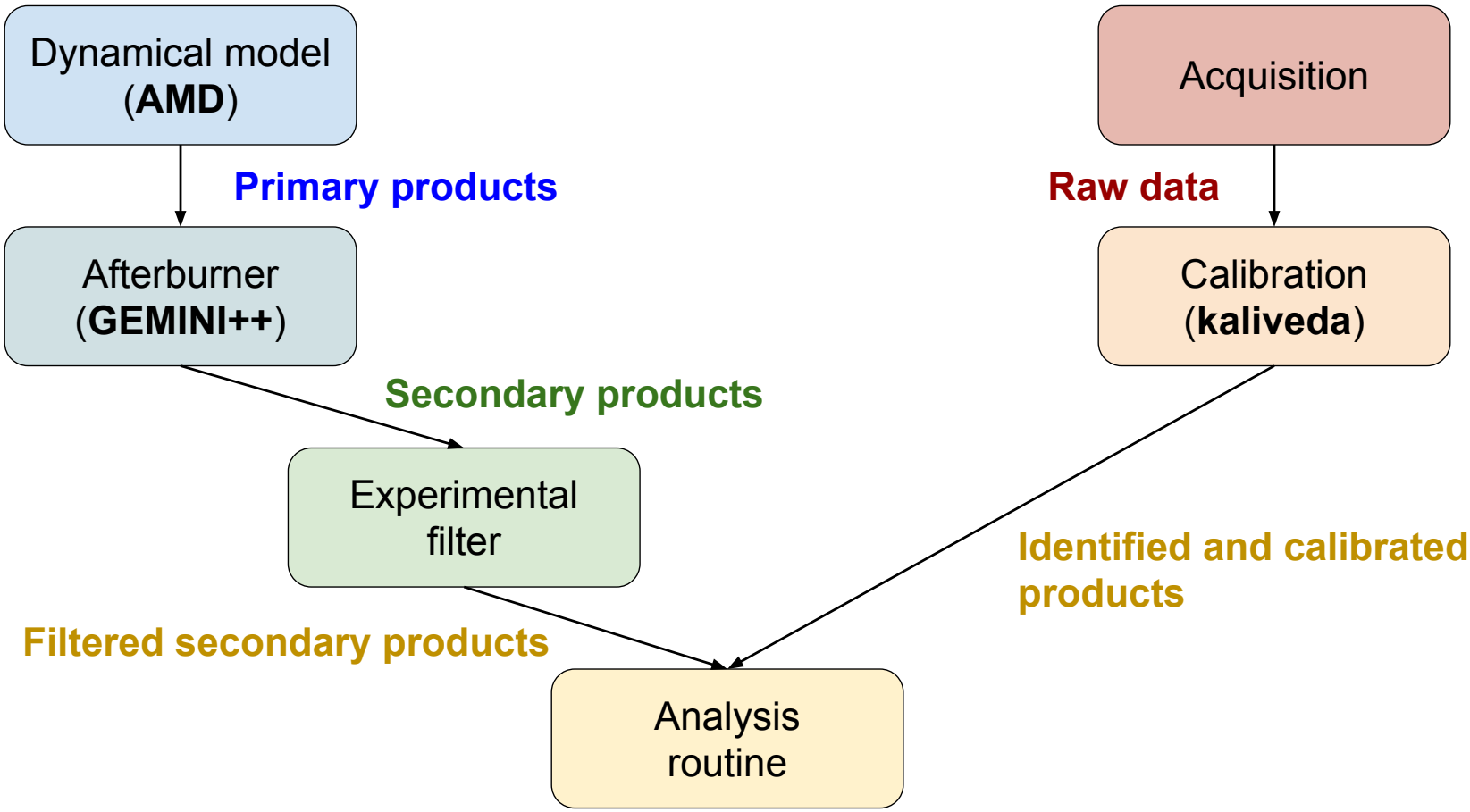
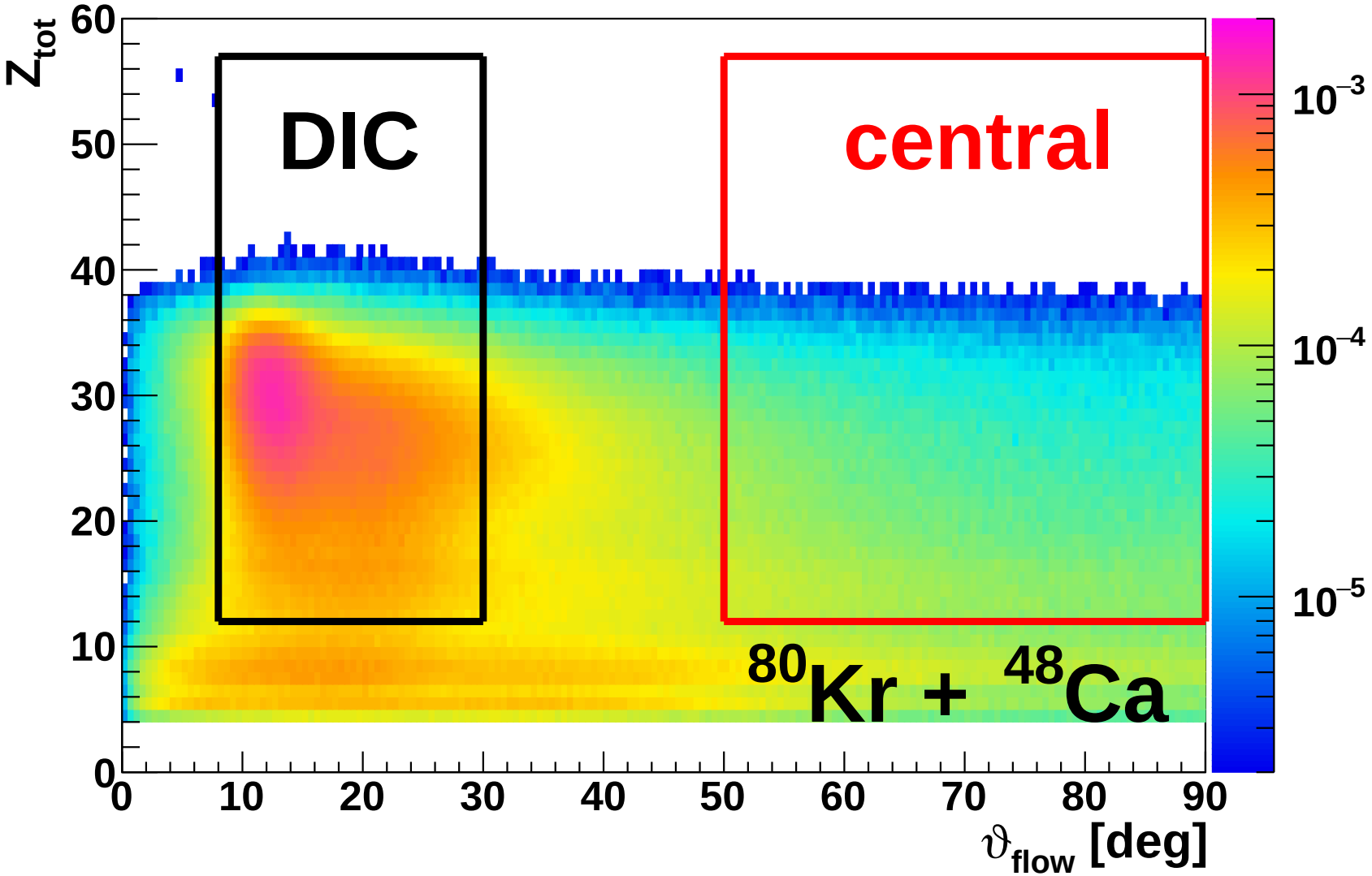


Analysis — event selection



M. D'Agostino *et al.*, Nucl. Phys. A **861**, 47 (2011)

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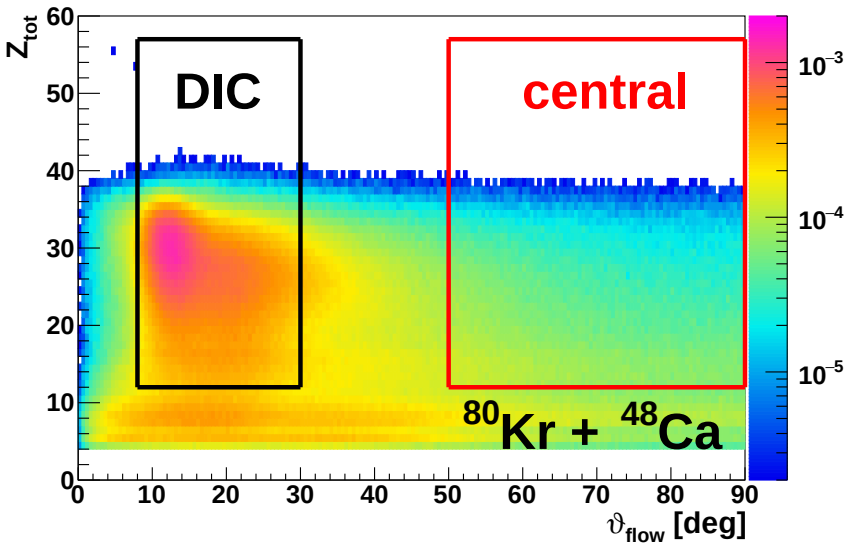

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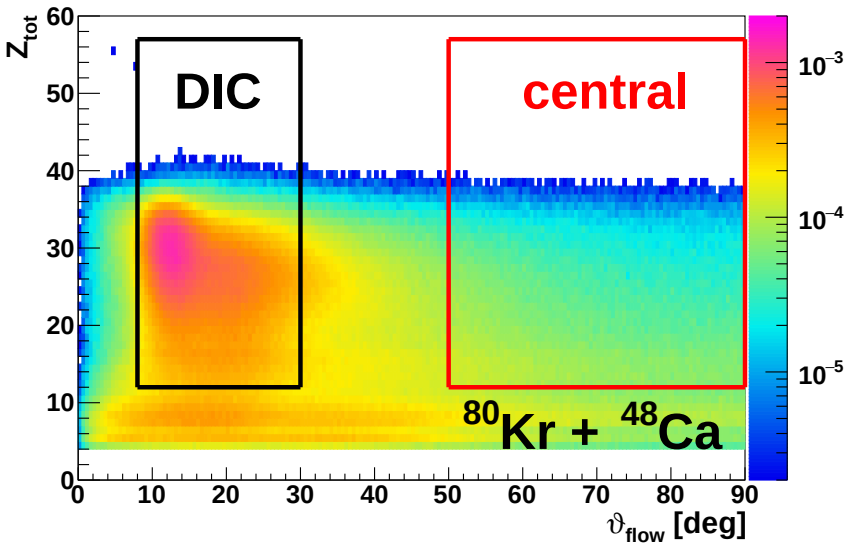
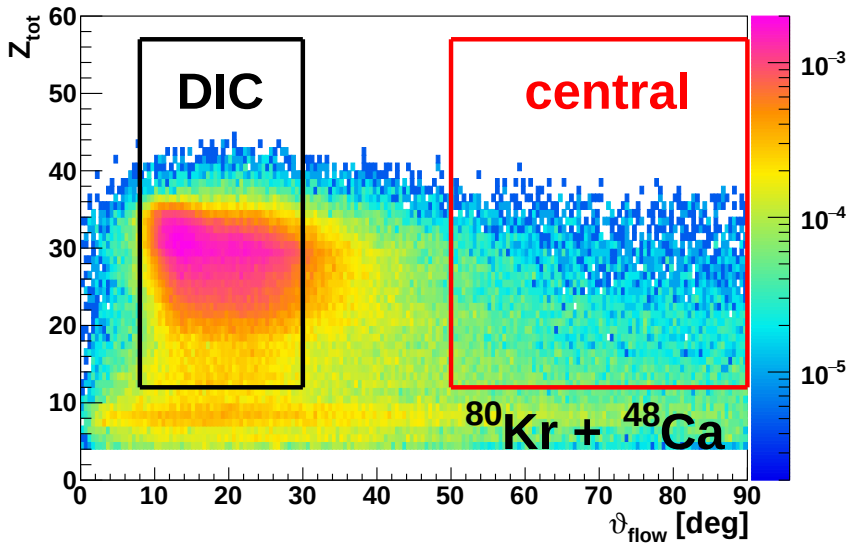


AMD + GEMINI++



- Correlations are normalized to the same integral (1)
- $M \geq 2$ condition has been imposed

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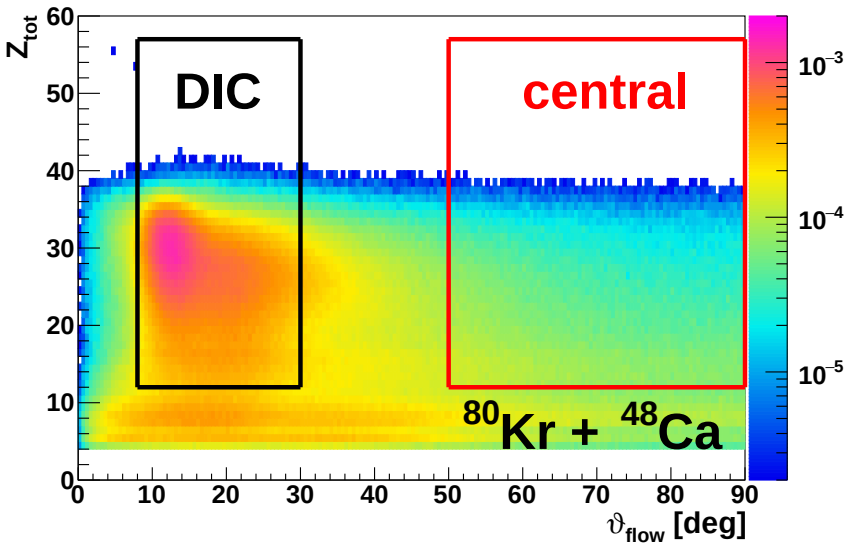

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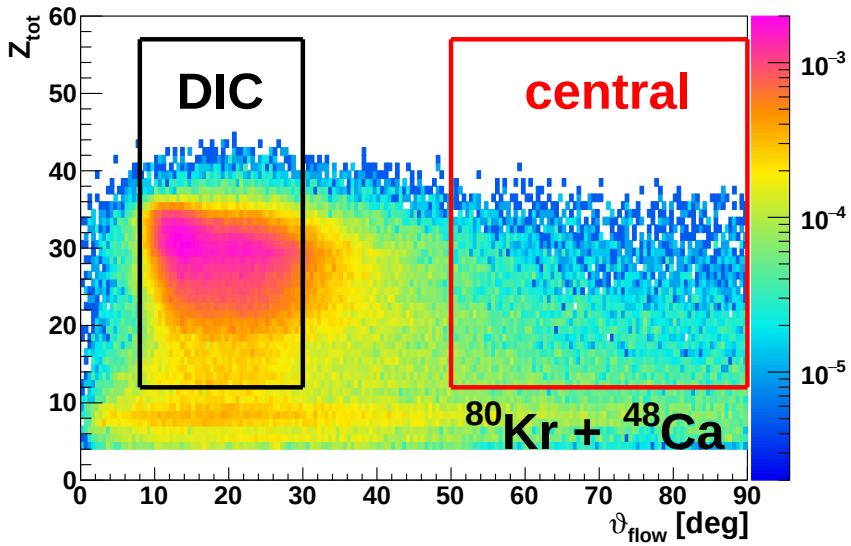

- Correlations are normalized to the same integral (1)
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- AMD produces less central collisions than experimental data

Analysis — event selection

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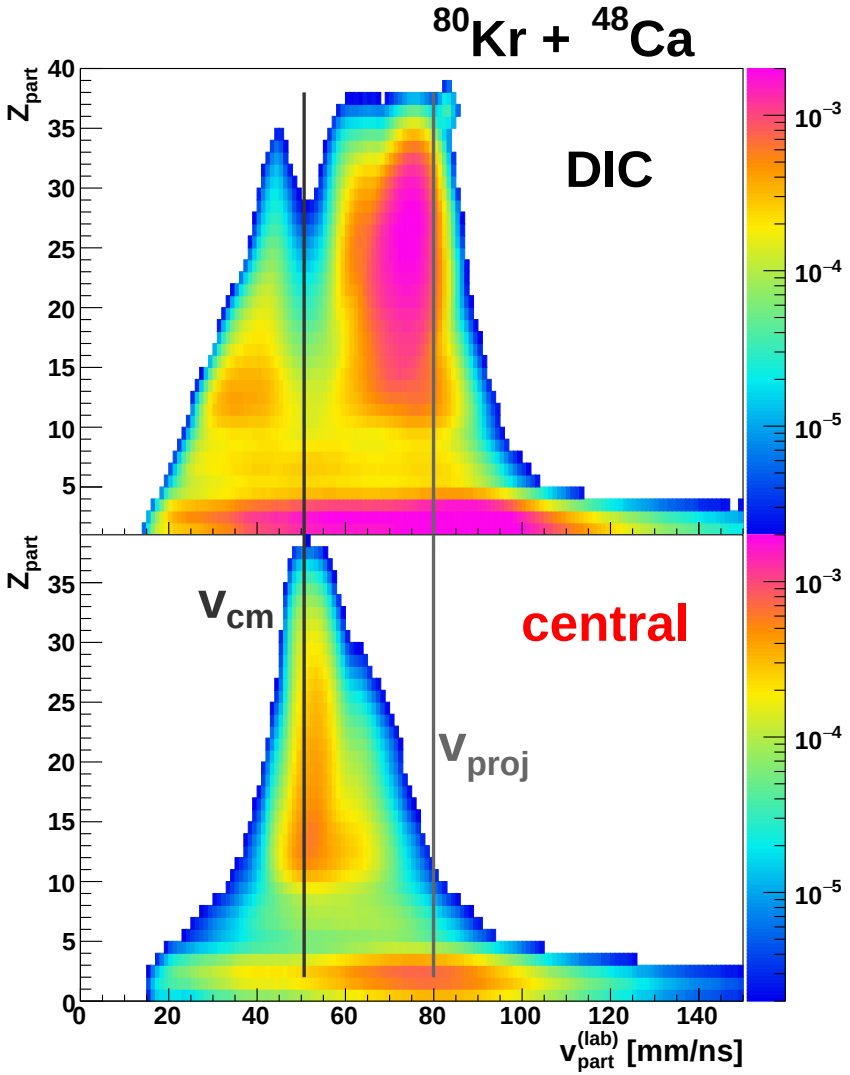

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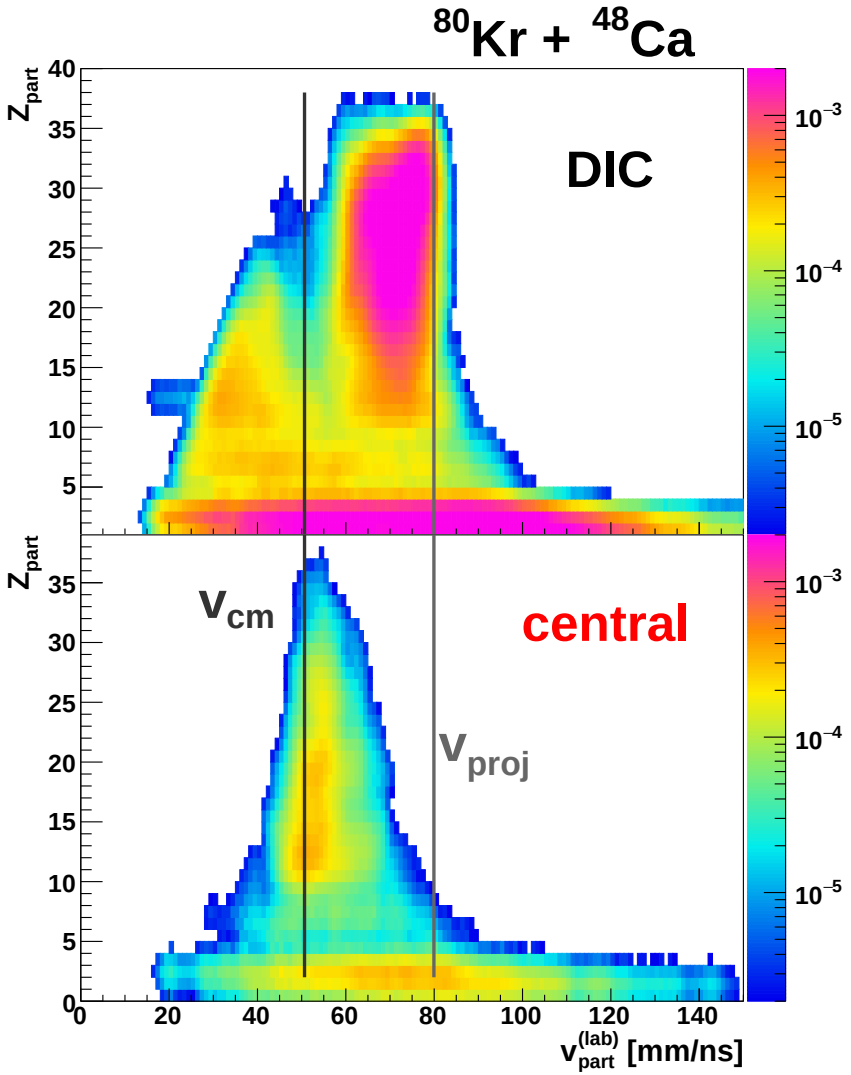

Analysis — isospin transport

To study **isospin transport** we'll focus on the **DIC channel**

Further selections

In addition to the Z_{tot} vs $\vartheta_{\mathrm{flow}}$ cut we impose:

- QP-only: One fragment (QP) with $\boldsymbol{Z \geq 12}$ and $\boldsymbol{v_z^{(\mathrm{cm})} > 0}$; no other fragments with $\boldsymbol{Z \geq 5}$
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Isospin drift could be evidenced by neck emission isotopic composition

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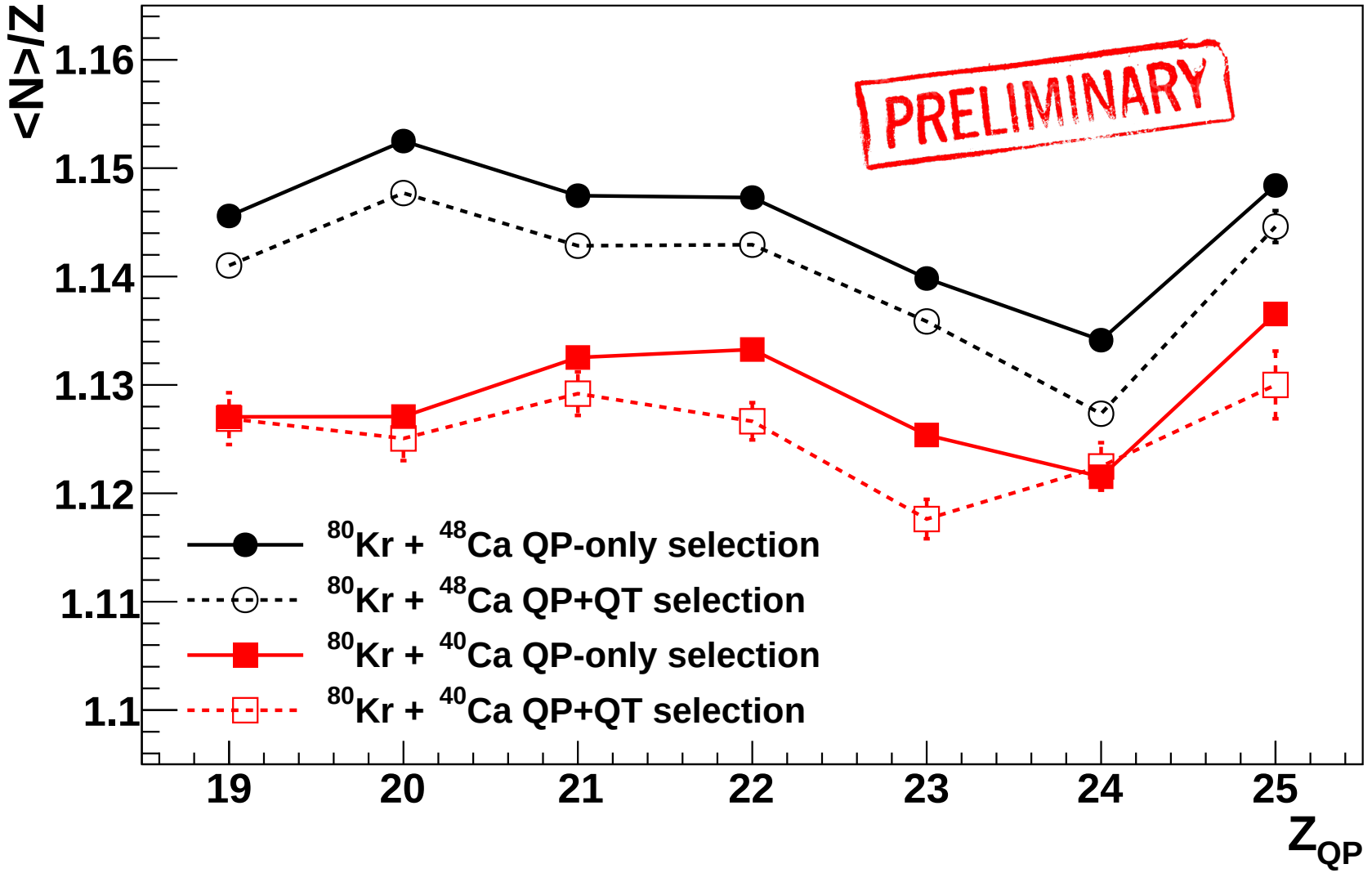

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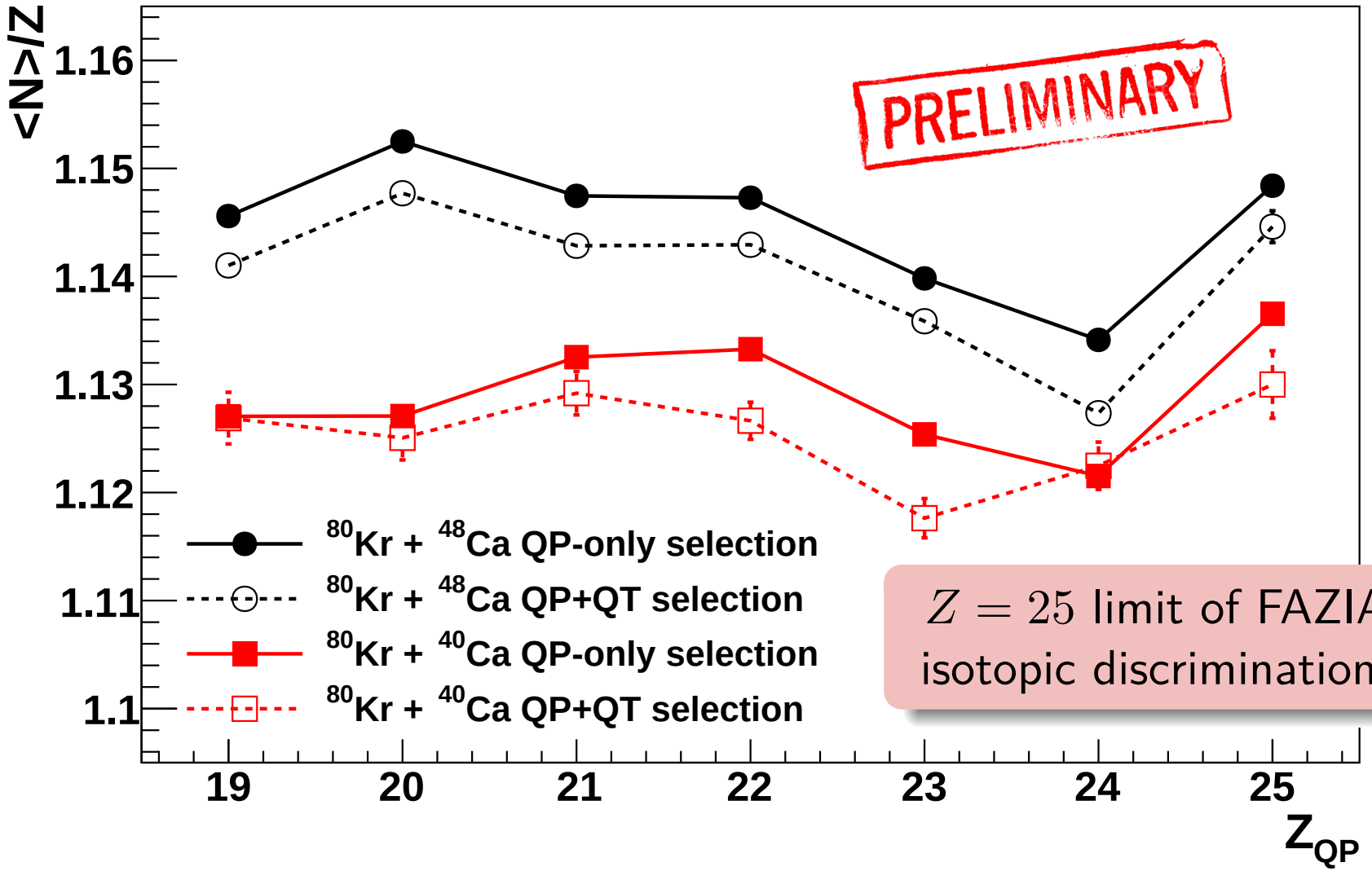
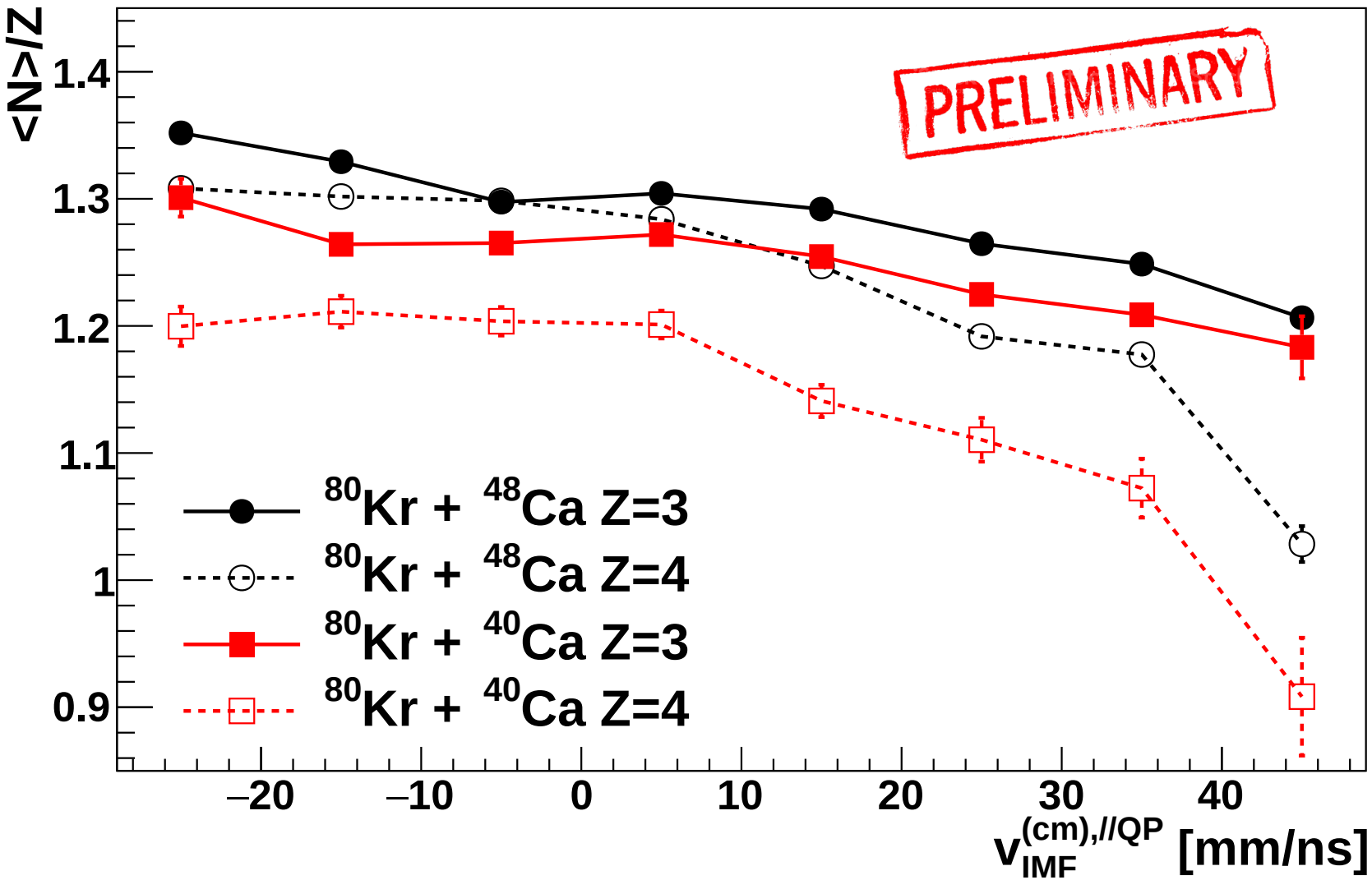


Analysis — isospin drift



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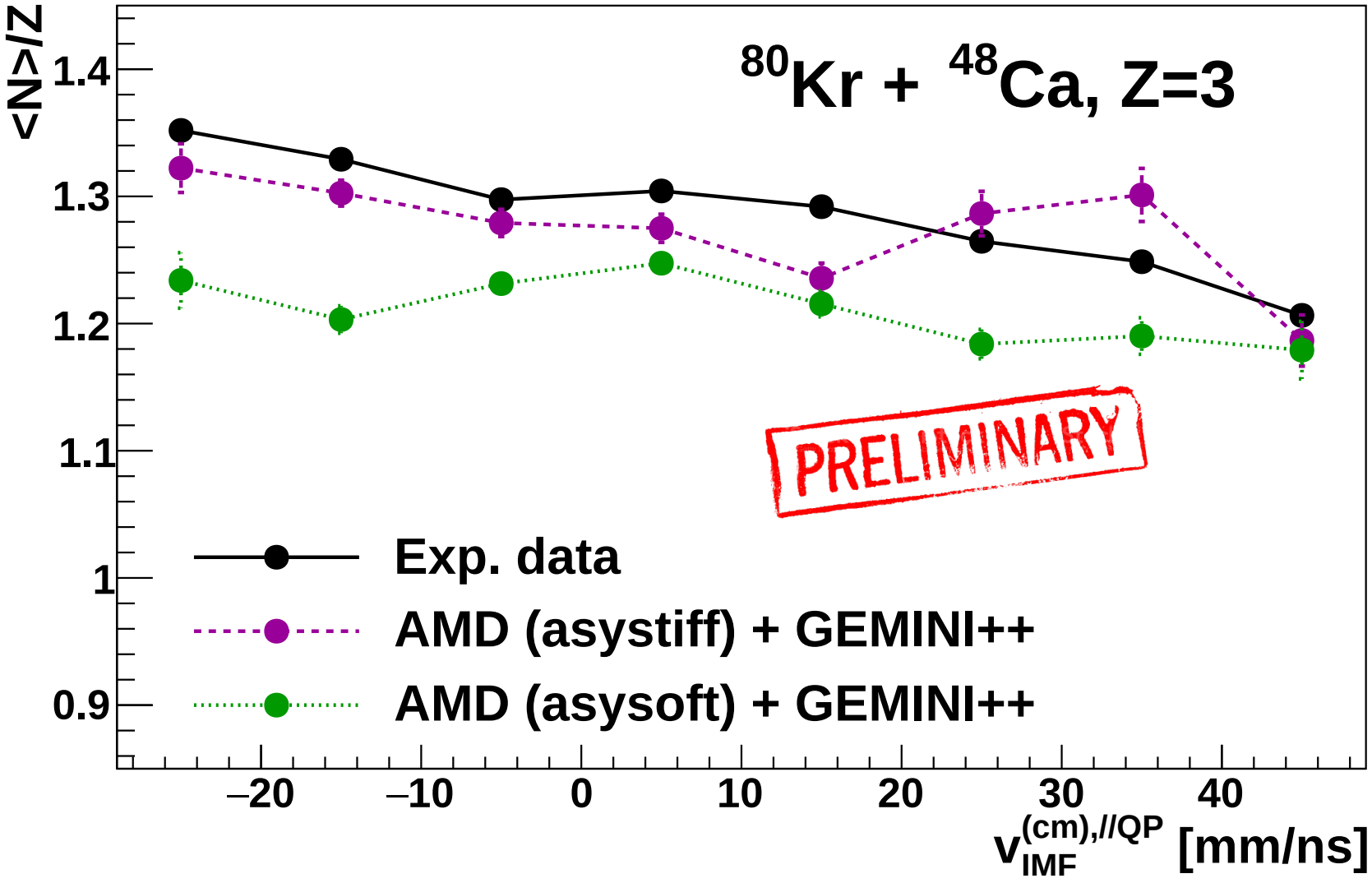
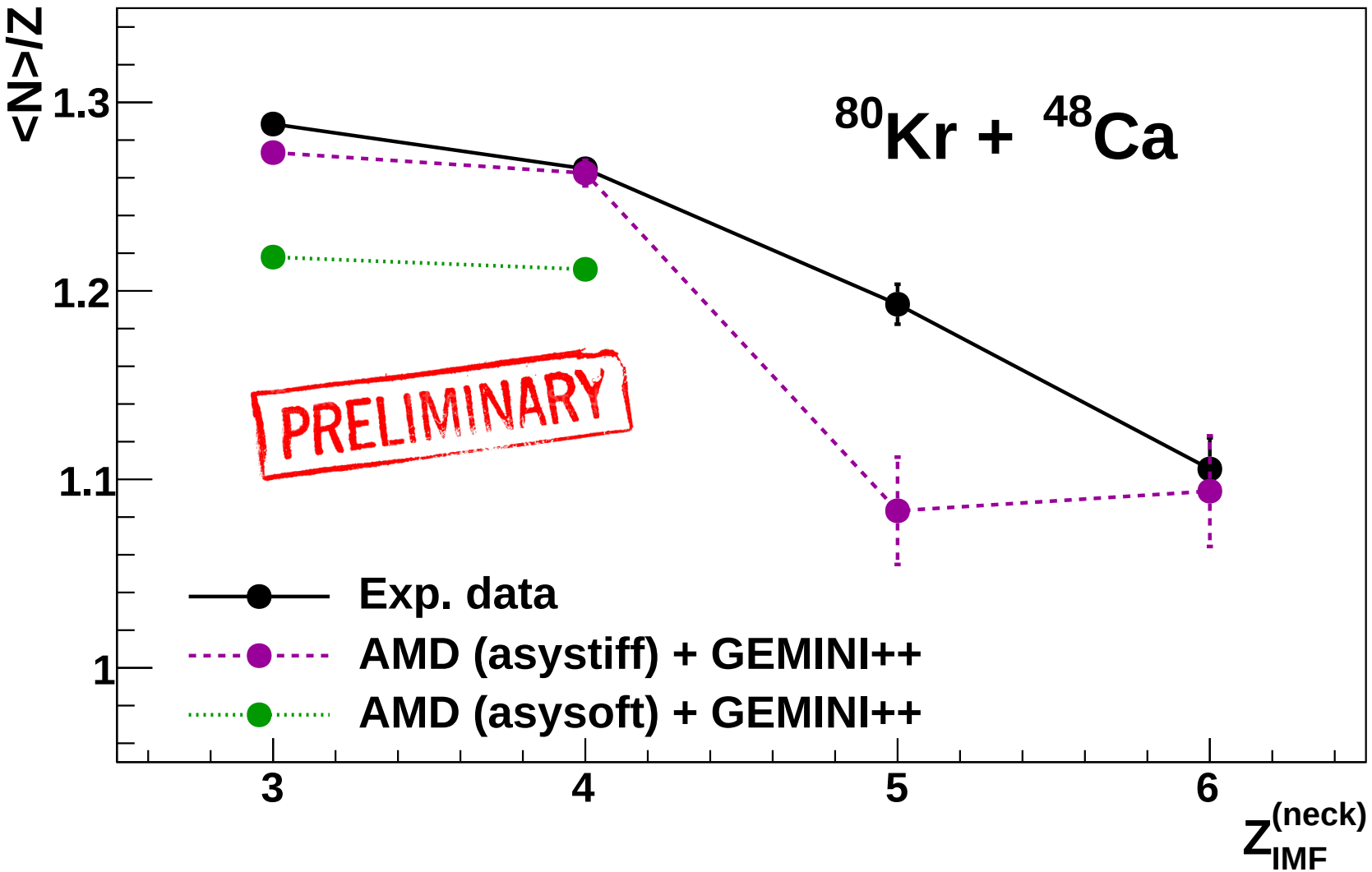


Analysis — neck emission



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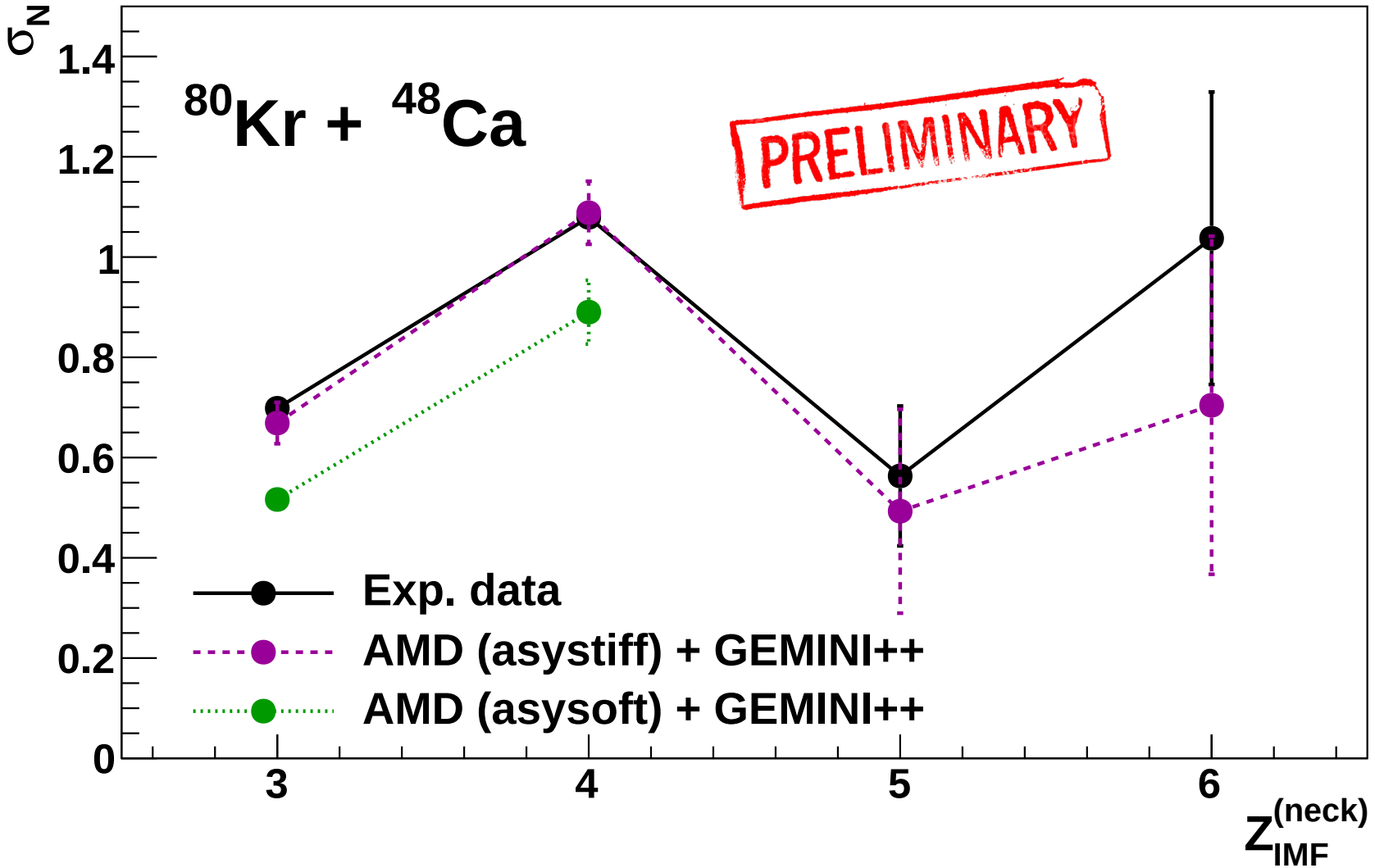

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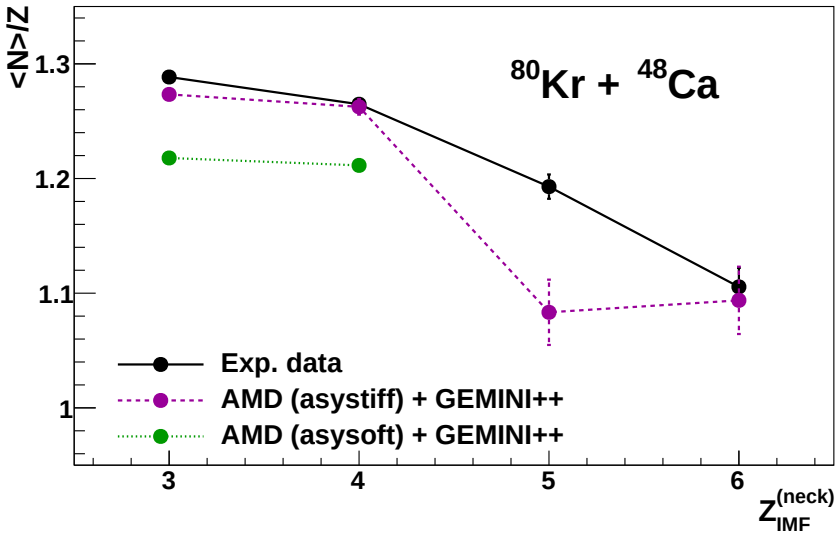

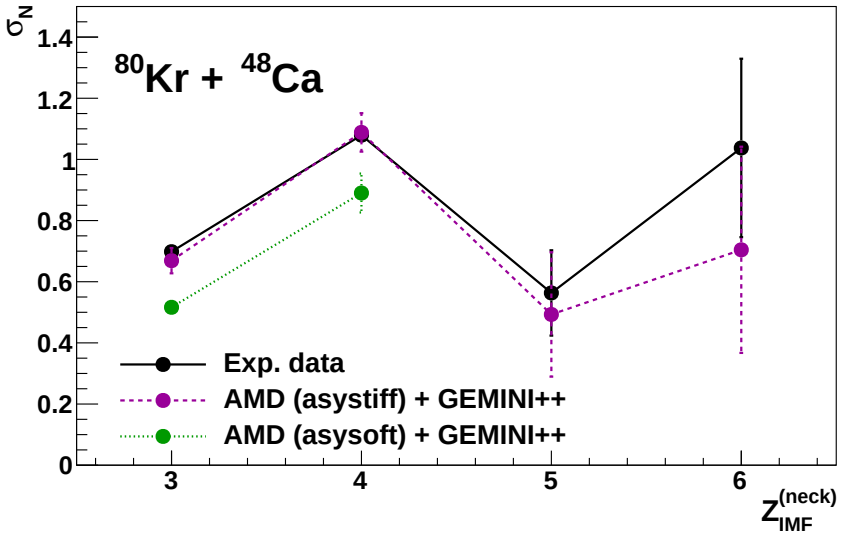

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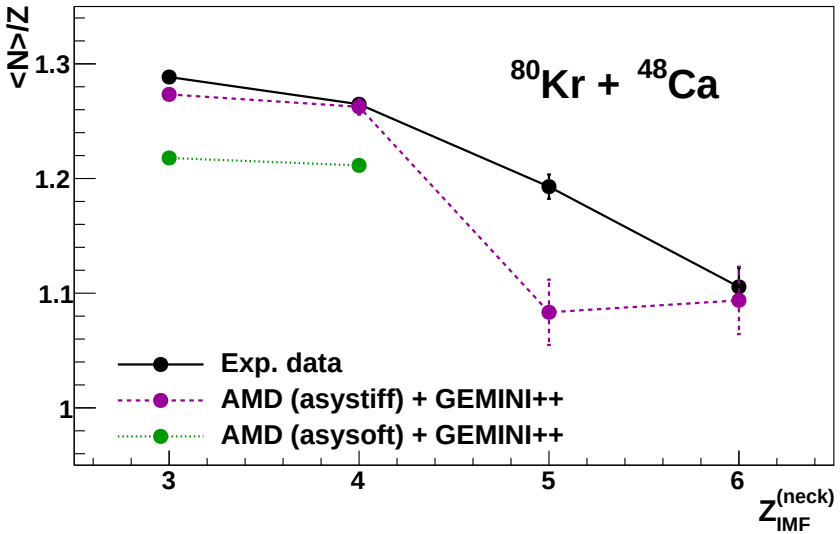

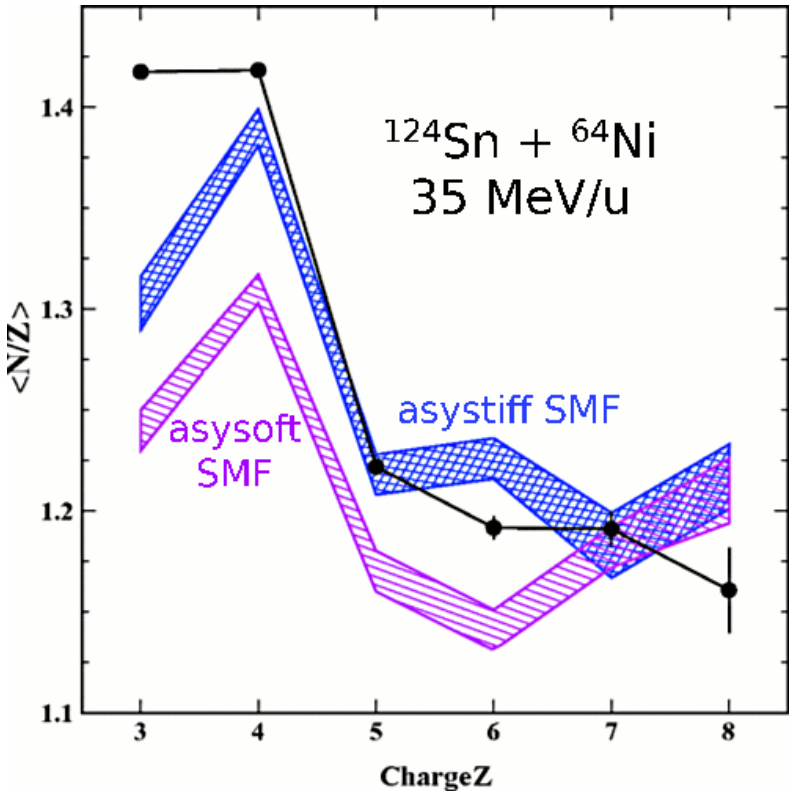

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- Agreement with previous results from CHIMERA experiment

E. De Filippo *et al.*, Phys. Rev. C **86**, 014610 (2012)

Conclusions and remarks

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- Comparison of isospin related observables with **AMD code**:
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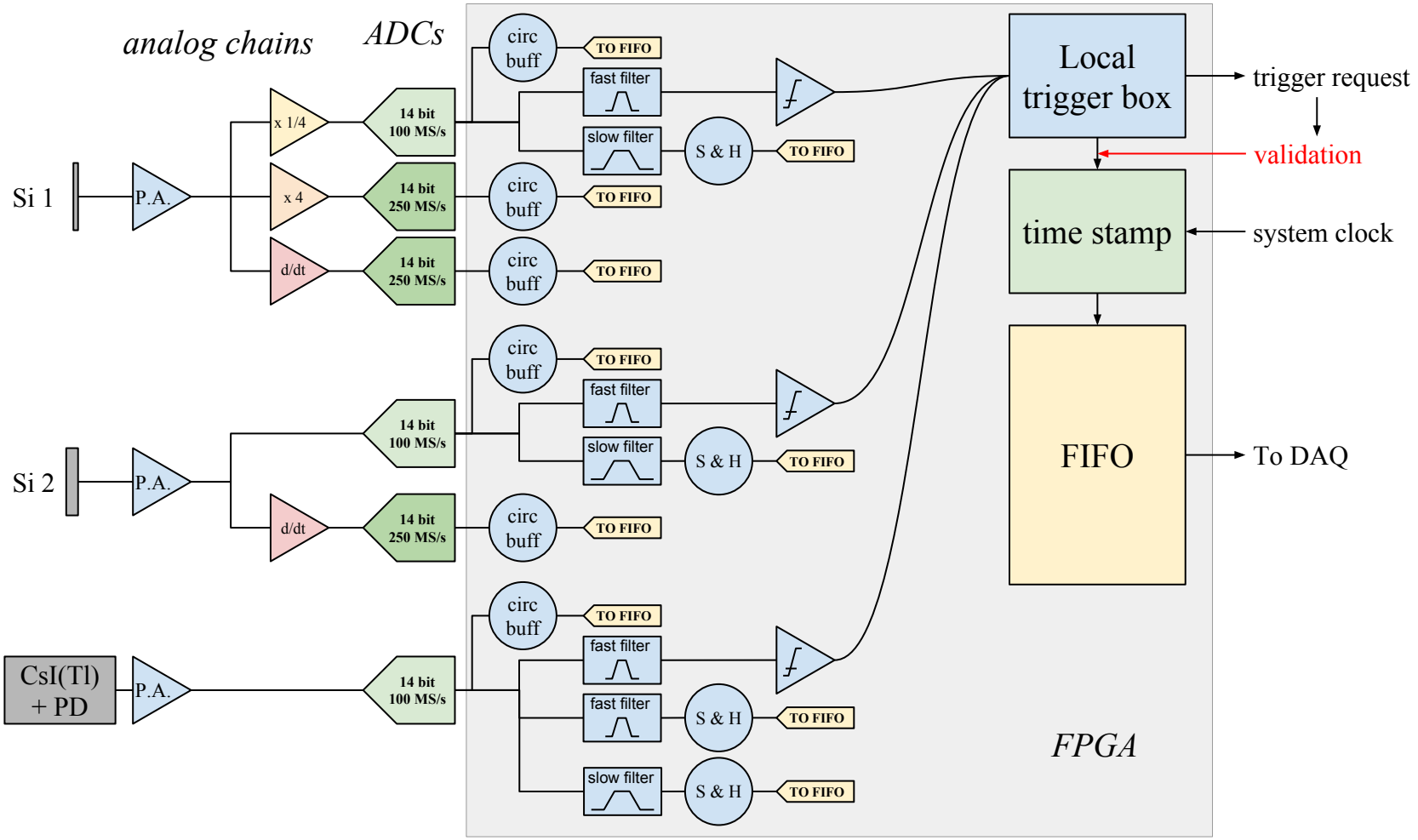
- We are still running AMD model code to have more simulated events and give more significance to our results

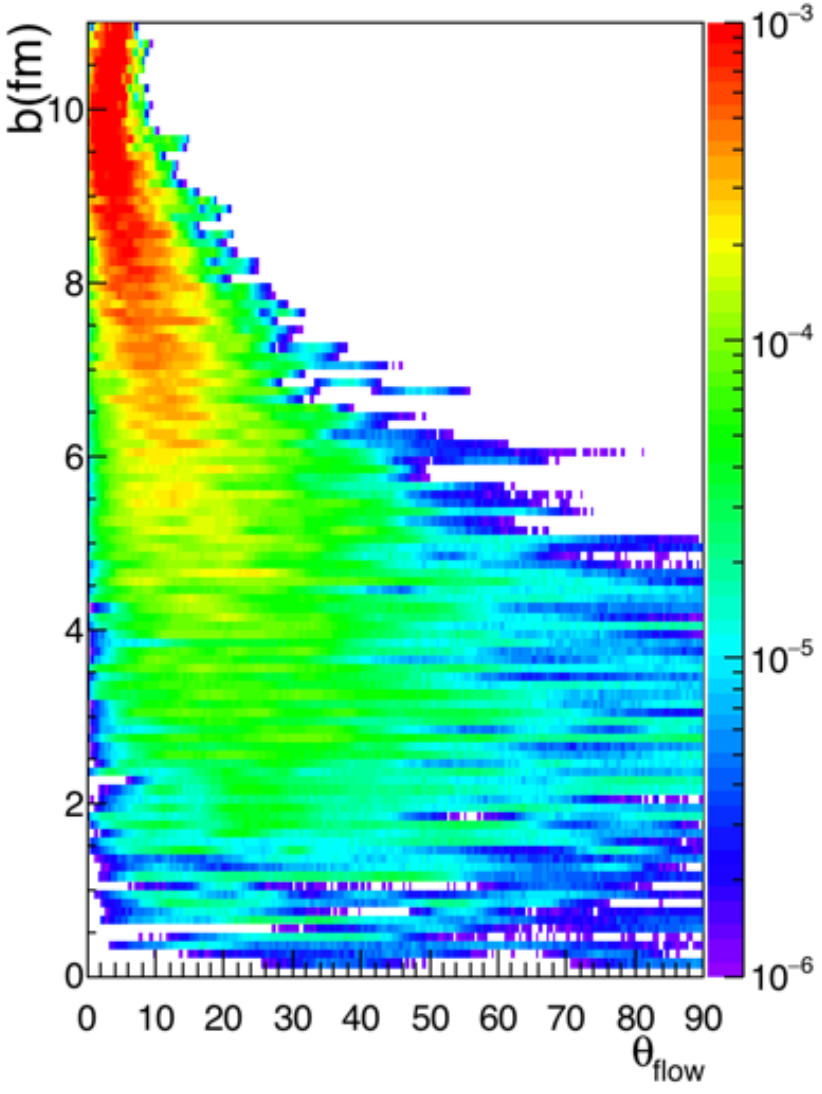
FAZIA collaboration

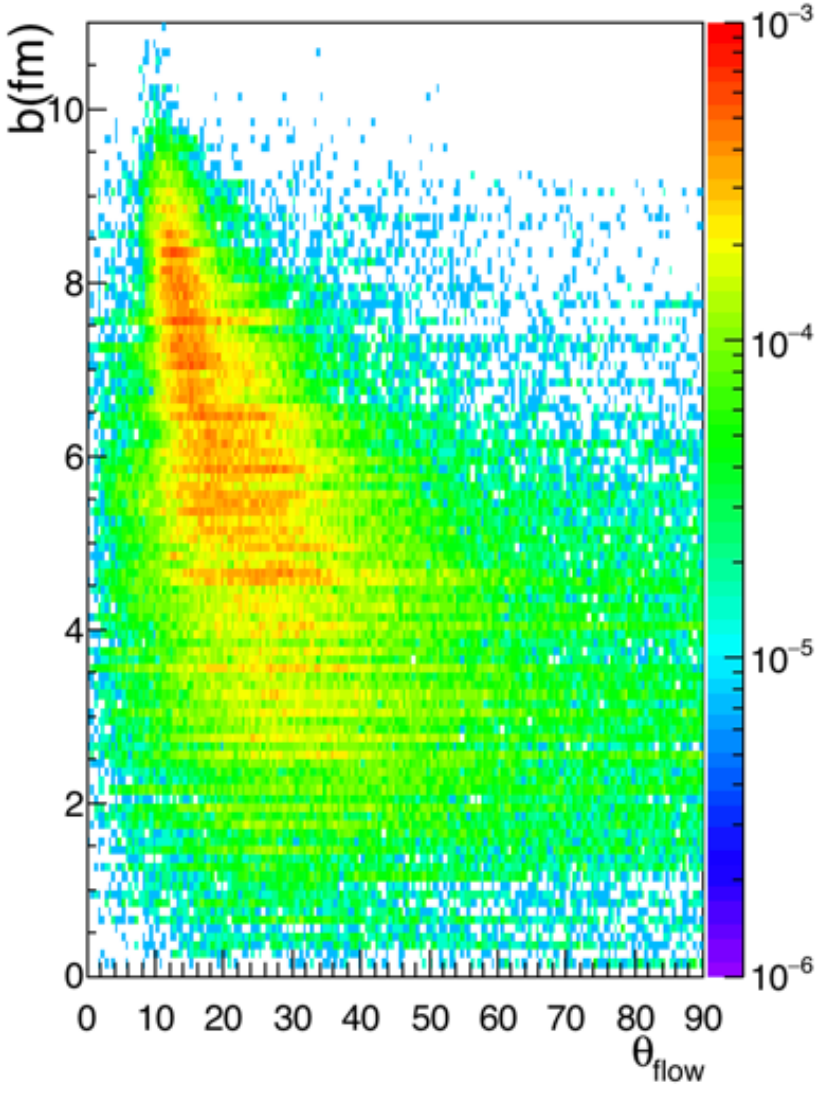
Thanks for your attention

Backup Slides



Backup Slides





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