Study of the Transport of the PRISMA magnetic spectrometer

Monte Carlo simulation based on a ray tracing code originally developed by A. Latina and E. Farnea

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Generation of Monte Carlo
INPUT events distribution in $[E_{kin}, \theta, \phi]$

↓ **Input**

Transport event by event in PRISMA

↓ **Trasp**

Sorting of transported events by PRISMA Analysis software package (GSORT)

↓ **Response of PRISMA**

$$f(E,\theta,\phi)=\frac{\#\ \text{INPUT Events: at MCP}(E,\theta,\phi)\ \ \textbf{Input}}{\#\ \text{OUPUT Events: at Focal Plane}(E,\theta,\phi)\ \ \textbf{Trasp}}$$

OUTLINE

Physics case: ^{48}Ca

θ_{PRISMA} = 20°, E_{LAB} = [200-400]MeV

→ Comparison with experimental data
^{48}Ca on ^{64}Ni @ 270 MeV
Milano Group

- 1. STEP: Check of Magnetic Fields
  consistency between Simulation and Experiment

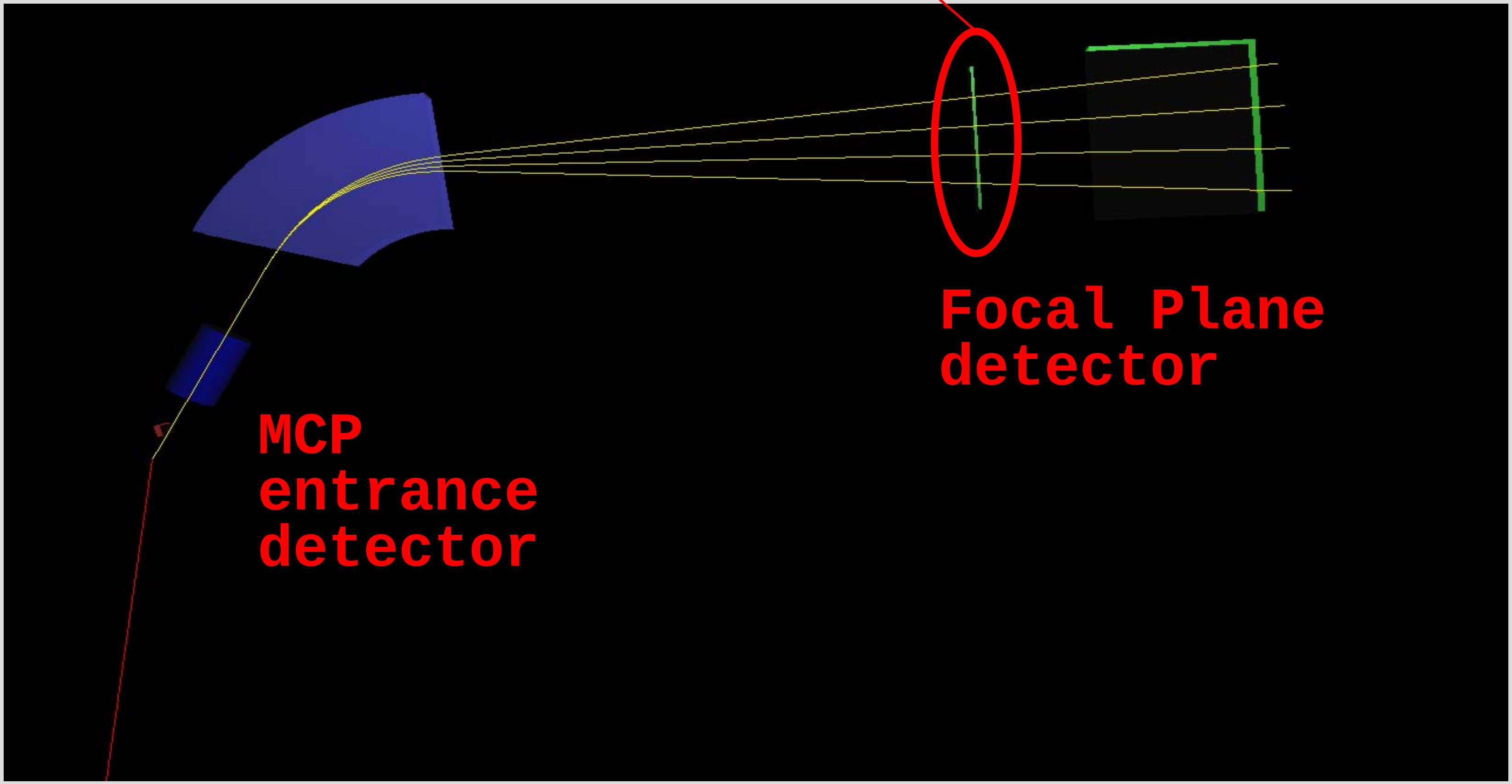
- 2. STEP: Transport of uniform distribution in $[E,\theta,\phi]$
  individual and total charge state distributions

- 3. STEP: Transport of known distributions in $[E,\theta,\phi]$
  GRAZING calculations for ± 1n and ± 1p
  i.e. ^{47}Ca, ^{49}Ca, ^{47}K and ^{49}Sc

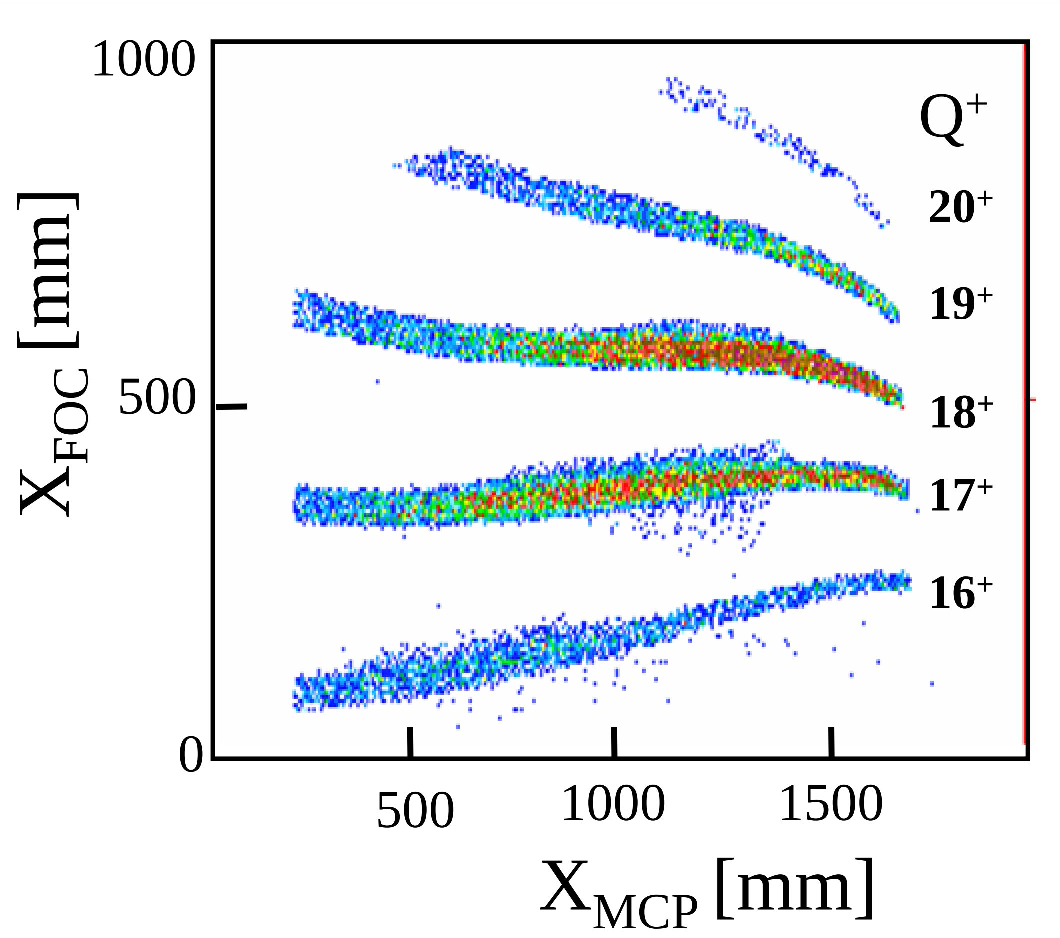
First Step:

Check of Magnetic Fields

The charge states deflection in the simulation has to be the same as in the experiment



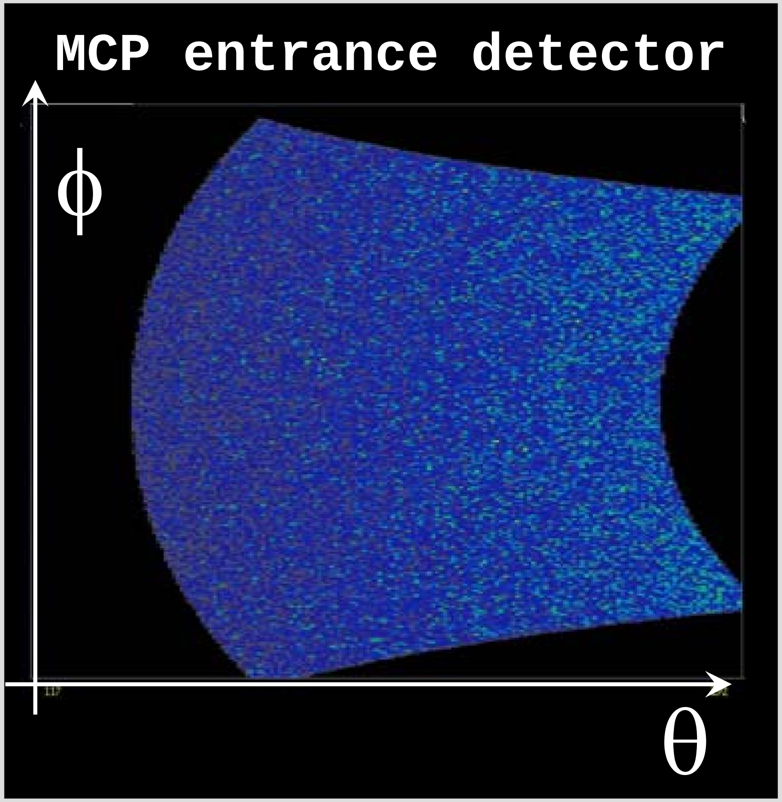
Simulated charge states distribution



^{48}Ca

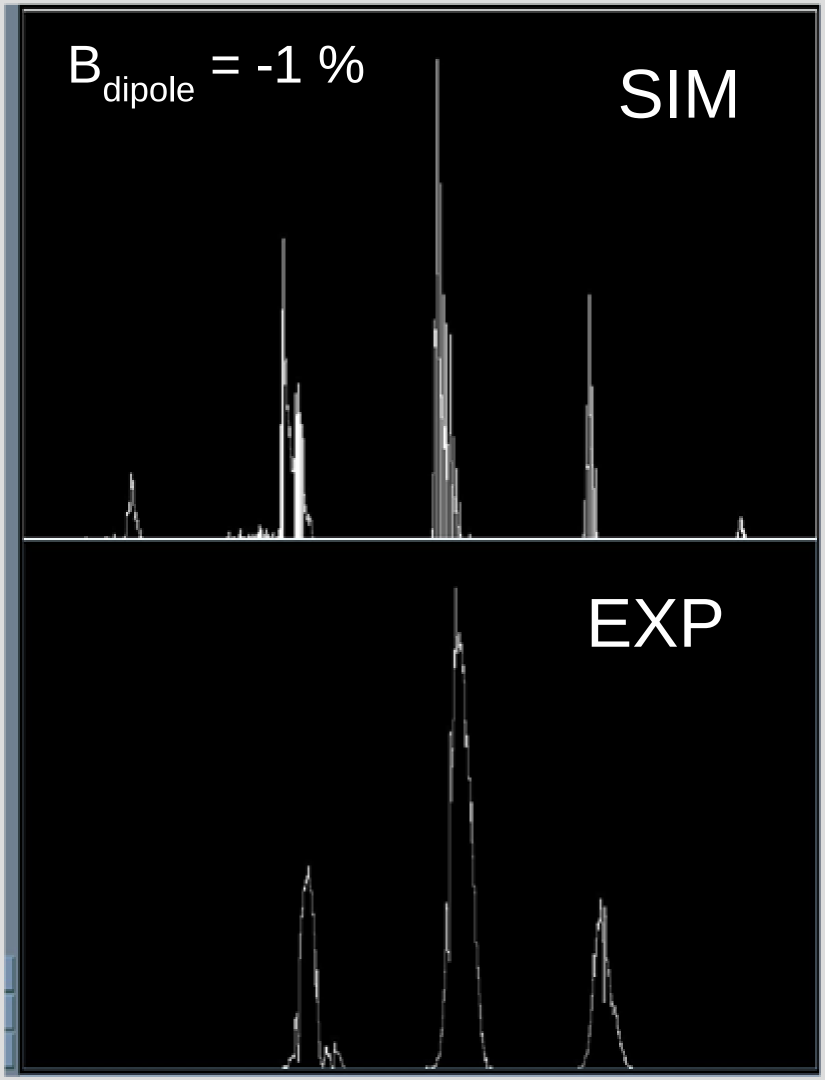
Fixed energy: 244 MeV

Uniform in $[\theta, \phi]$



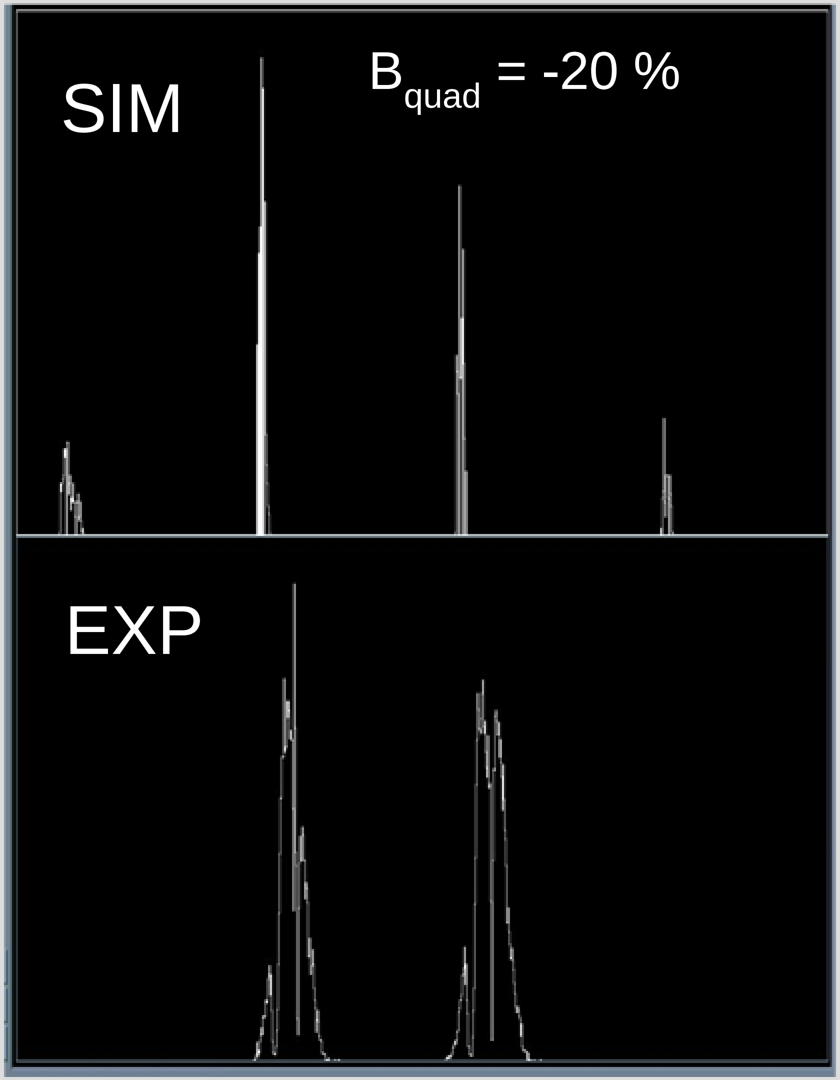
X ppac – ^{48}Ca – 244 MeV

Trajectory ALONG optical axis
→ Dipole Field



X ppac

Trajectory OFF optical axis
→ Quadrupole Field



X ppac

Second Step:

Transport in PRISMA of known distributions in (E_{kin}, θ, ϕ)

First Case:

Uniform INPUT distribution

E_{kin} = [200,400] MeV

θ = [10°, 40°]

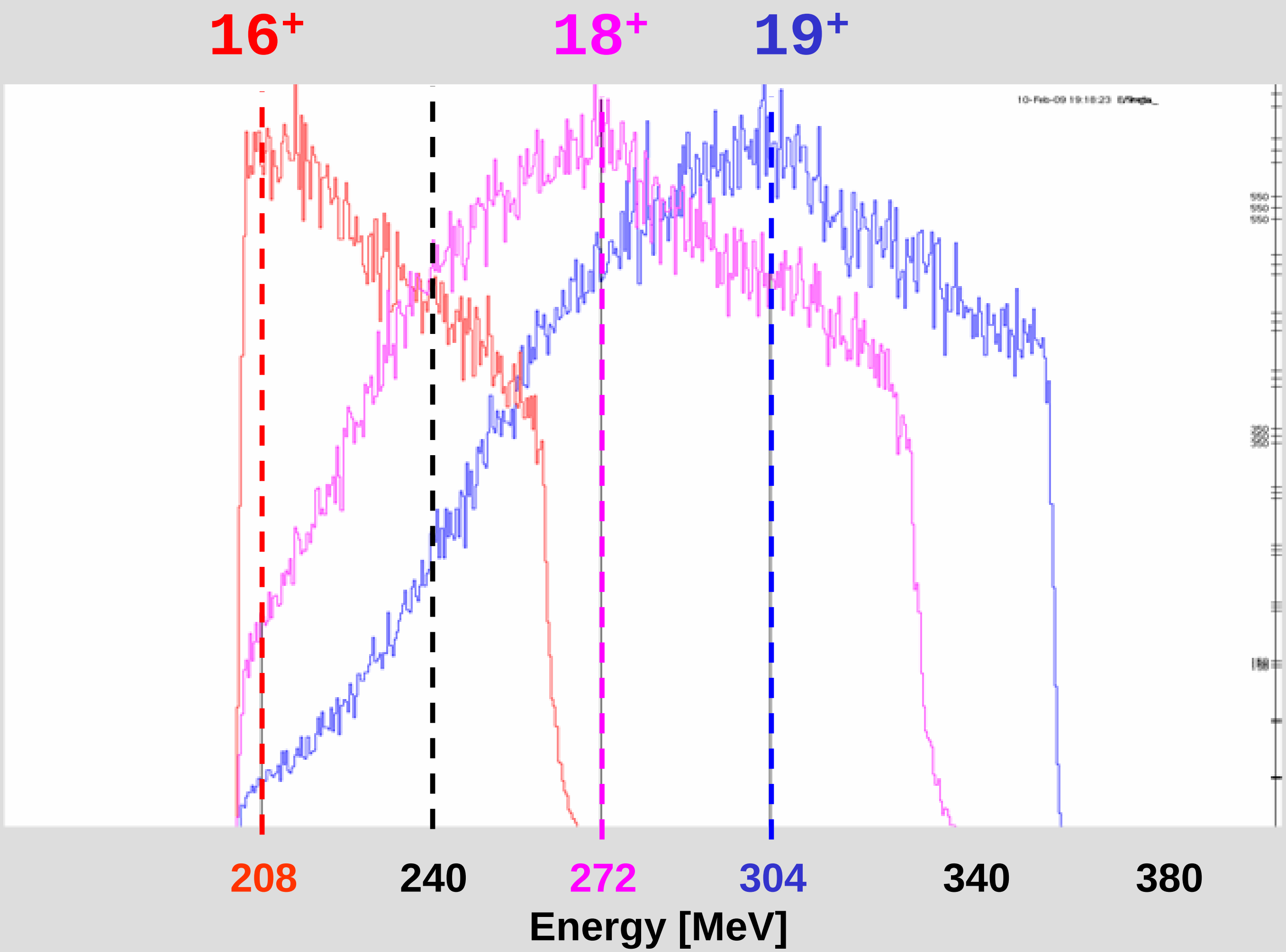
ϕ = [-40°,40°]

We first study the individual charge states

10^6 events

Kinetic Energy Distributions

of different charge states after the Transport in PRISMA



ΔE = 32 MeV

Bidimentional Matrices Theta vs Energy

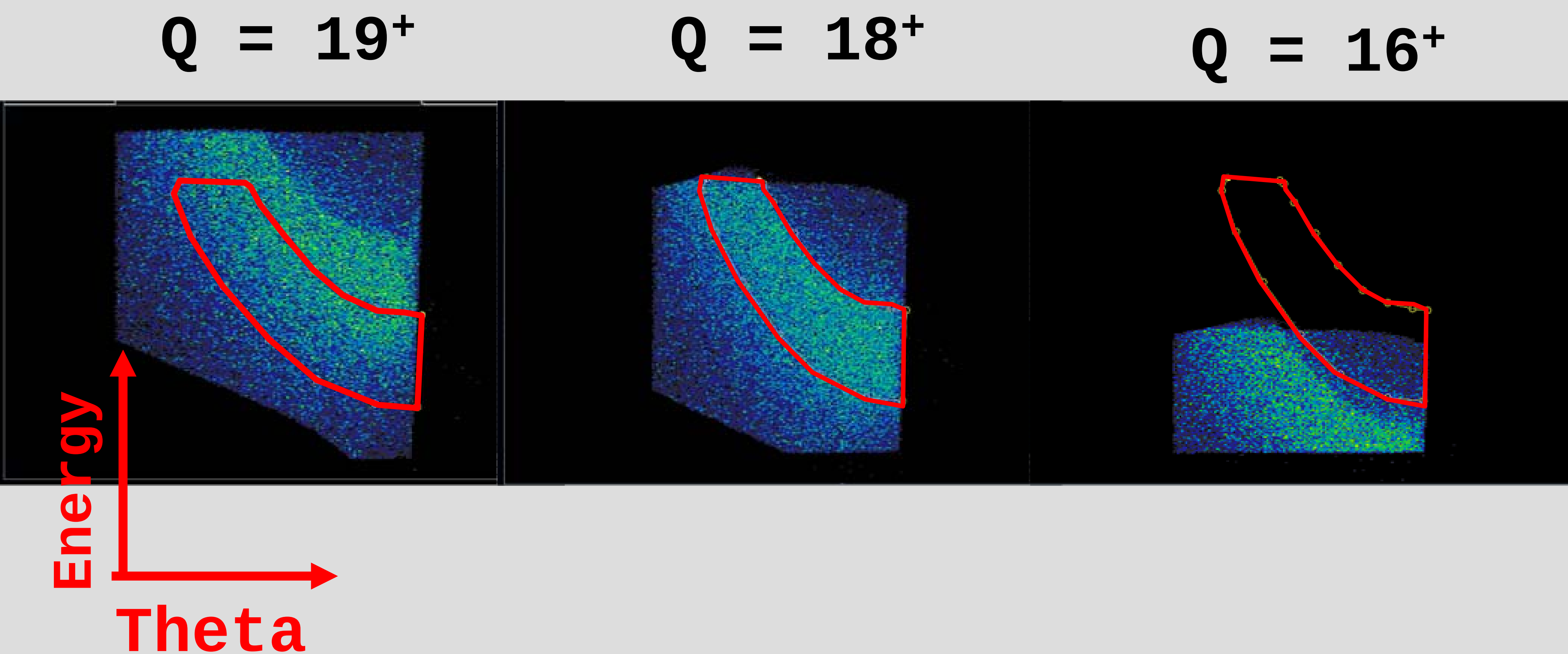
Uniform INPUT distributions in E, θ, ϕ

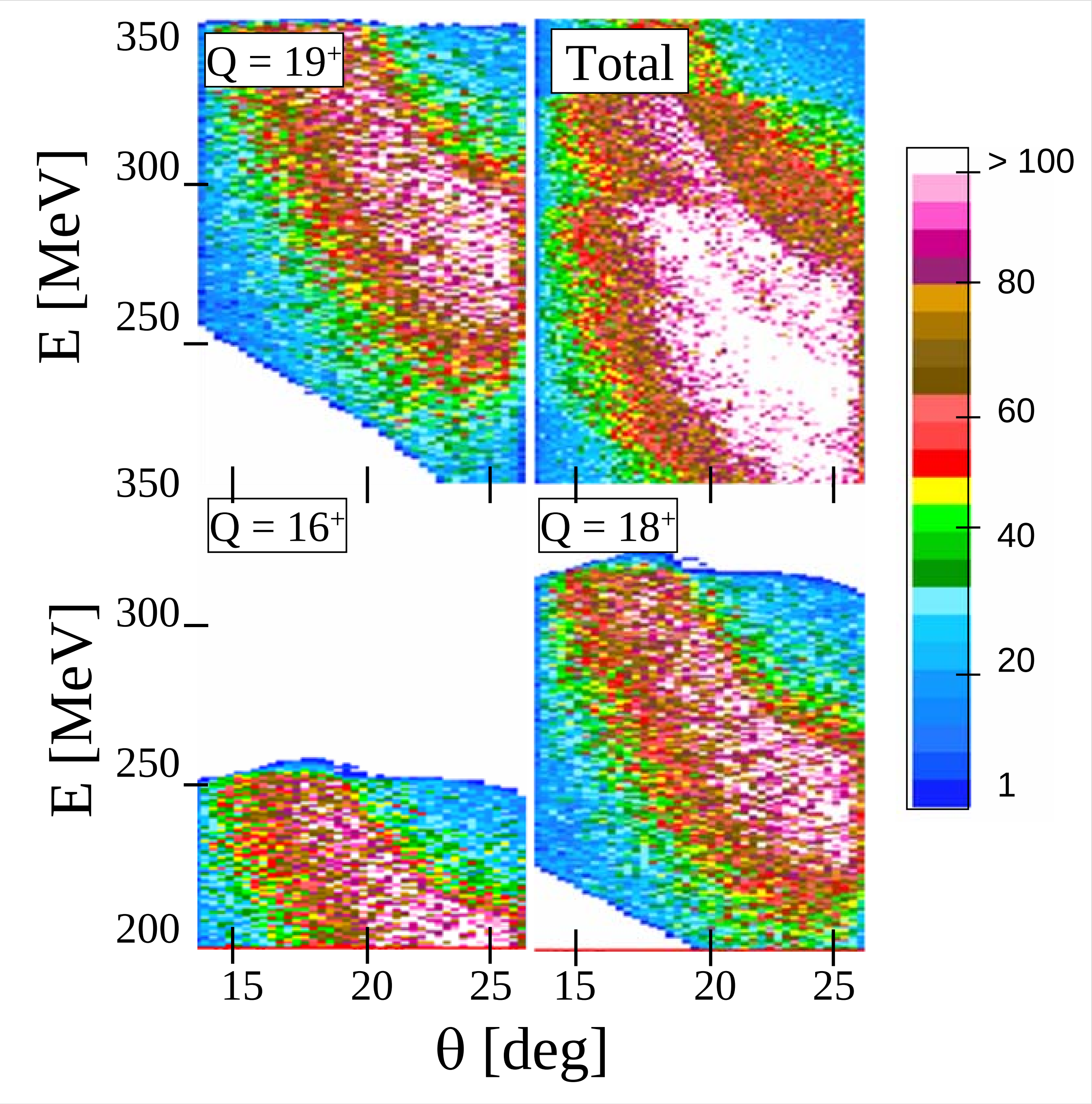
E = [200,350] MeV

θ = [5,35]°

ϕ = [-40,+40]°

Transported distributions:





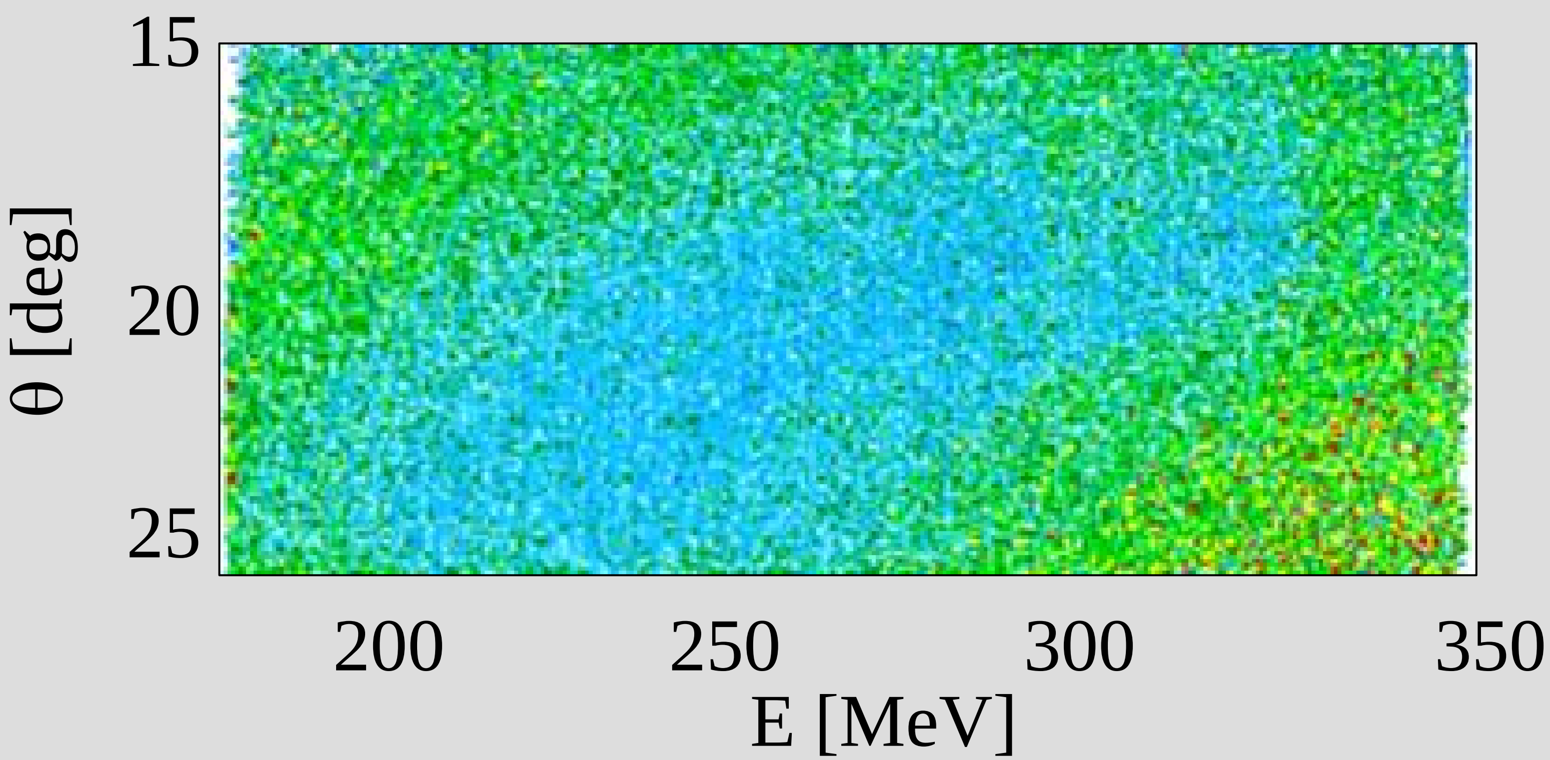
Q = 19+
Total
Q = 16+
Q = 18+
350
300
250
350
300
250
200
E [MeV]
E [MeV]
15
20
25
15
20
25
θ [deg]
> 100
80
60
40
20
1

Response of PRISMA

$$f(E,\theta,\phi)=\frac{\text{\# INPUT Events: at MCP}(E,\theta,\phi)}{\text{\# OUPUT Events: at Focal Plane}(E,\theta,\phi)}$$

Input

Trasp



Third Step:

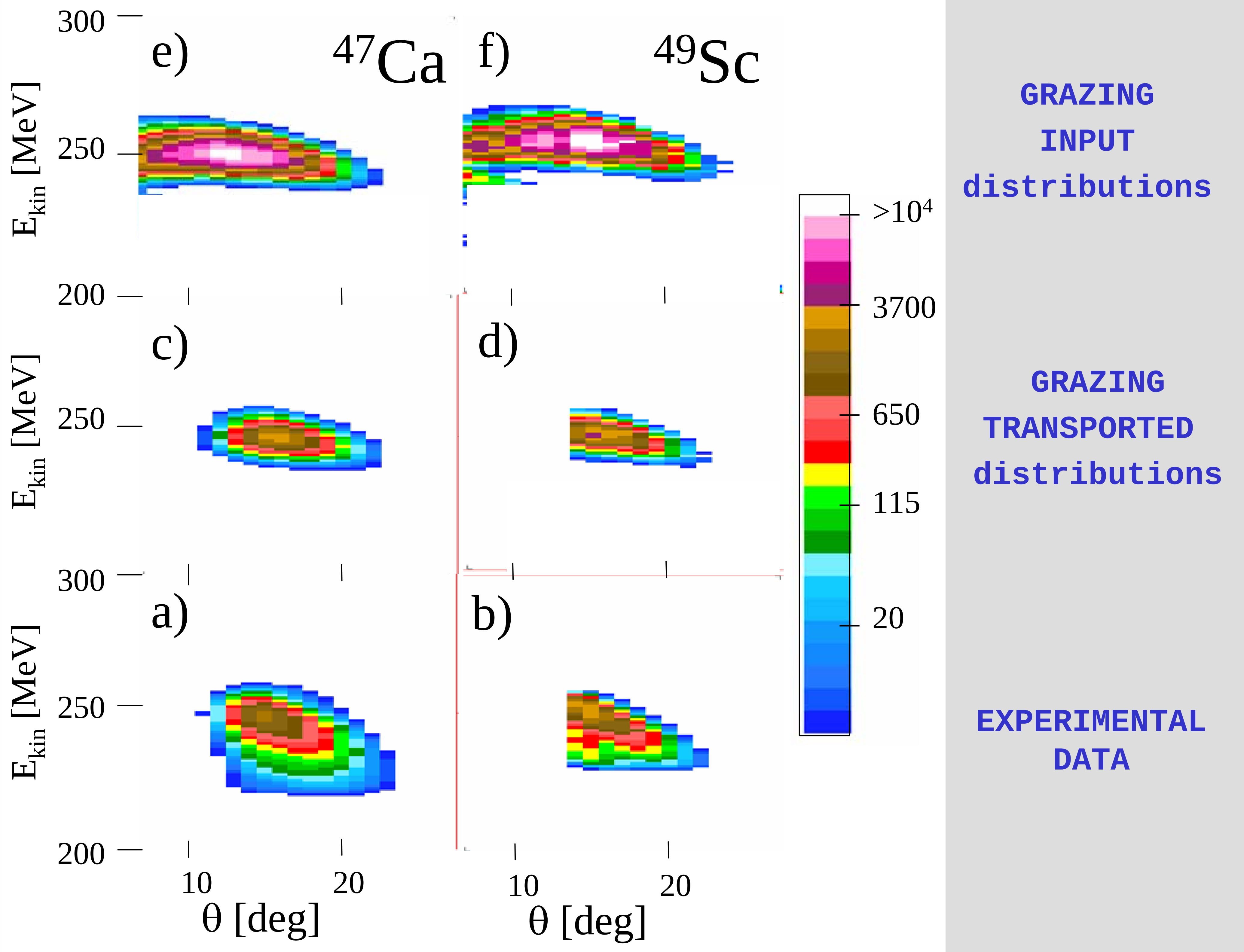
Transport and Correction by $f(E,\theta,\phi)$

of known Distributions

GRAZING: $d\sigma/d\Omega dE$ per ^{47}Ca, ^{49}Ca, ^{47}K, ^{49}Sc

Comparison with Milano Experiment

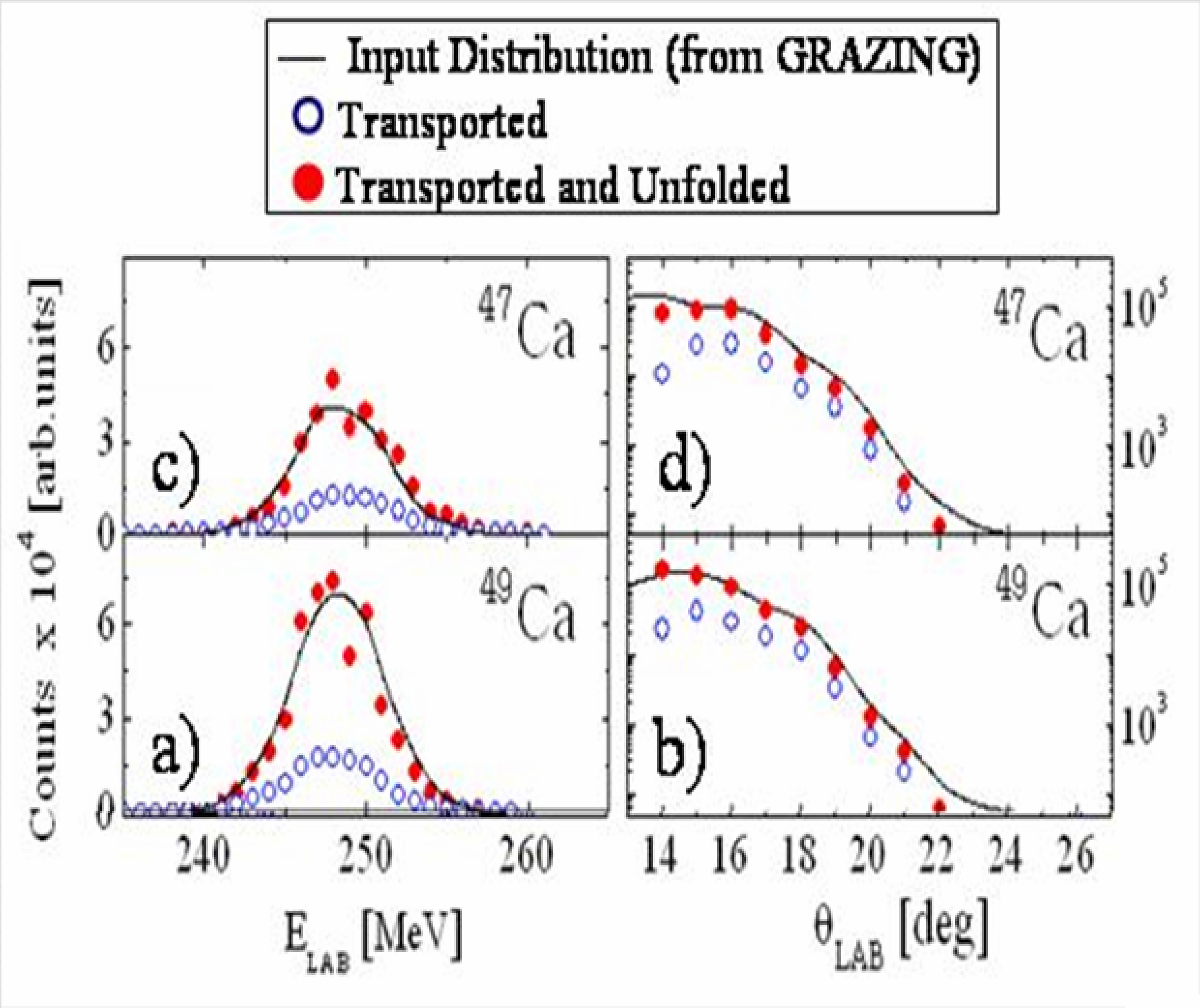
$^{48}Ca + ^{64}Ni$ $E_{beam} = 270$ MeV



e)
^{47}Ca
f)
^{49}Sc
c)
d)
a)
b)
300
250
200
E_{kin} [MeV]
10
20
θ [deg]
>10^4
3700
650
115
20
GRAZING INPUT distributions
GRAZING TRANSPORTED distributions
EXPERIMENTAL DATA

Comparison with INPUT theoretical distributions

$$(d\sigma/d\Omega dE)_{GRAZING} \leftrightarrow (d\sigma/d\Omega dE)_{GRAZING\text{-}Trasp} * f(E,\theta)$$

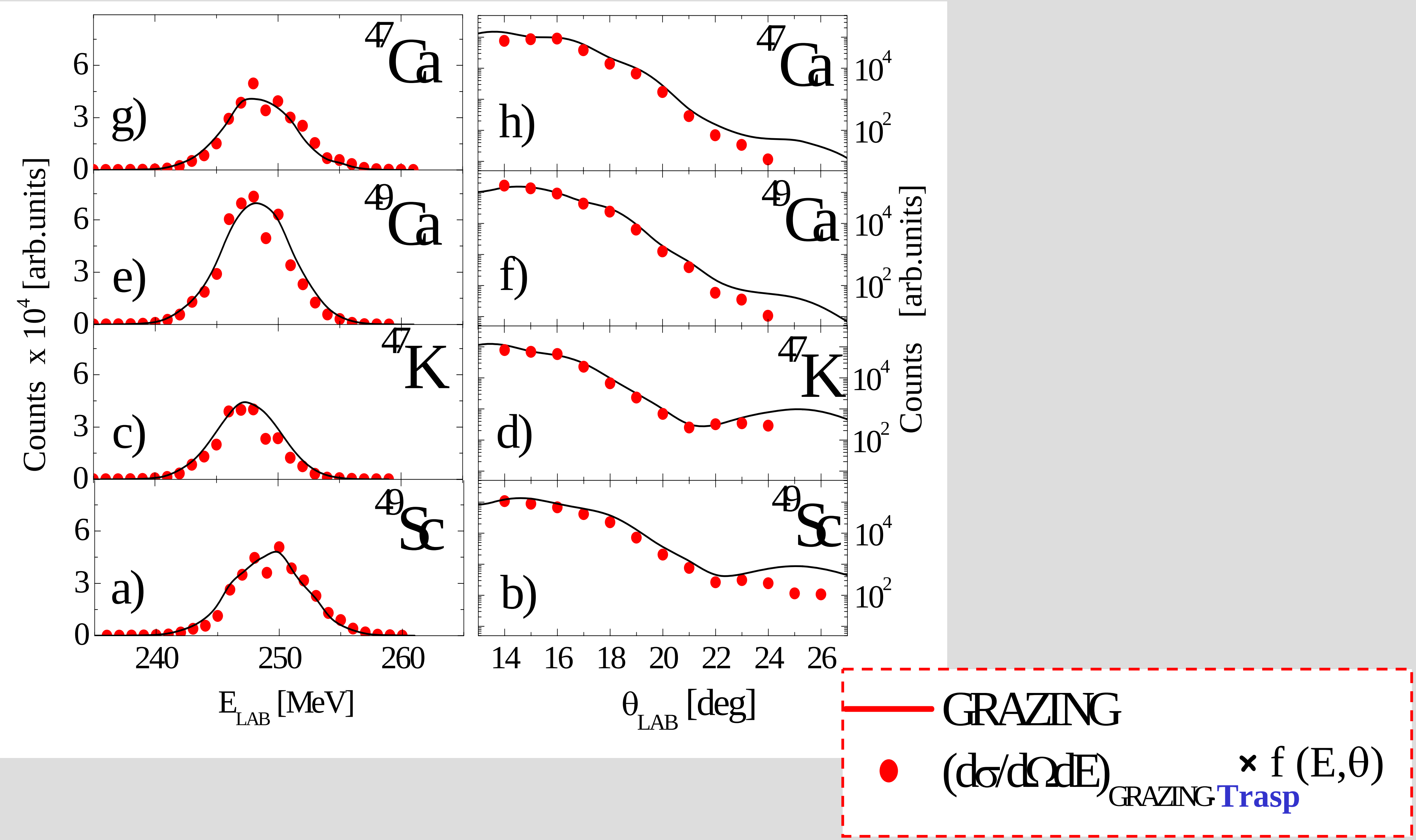


GRAZING

$(d\sigma/d\Omega dE)_{GRAZING\text{-}Trasp} \times f(E,\theta)$

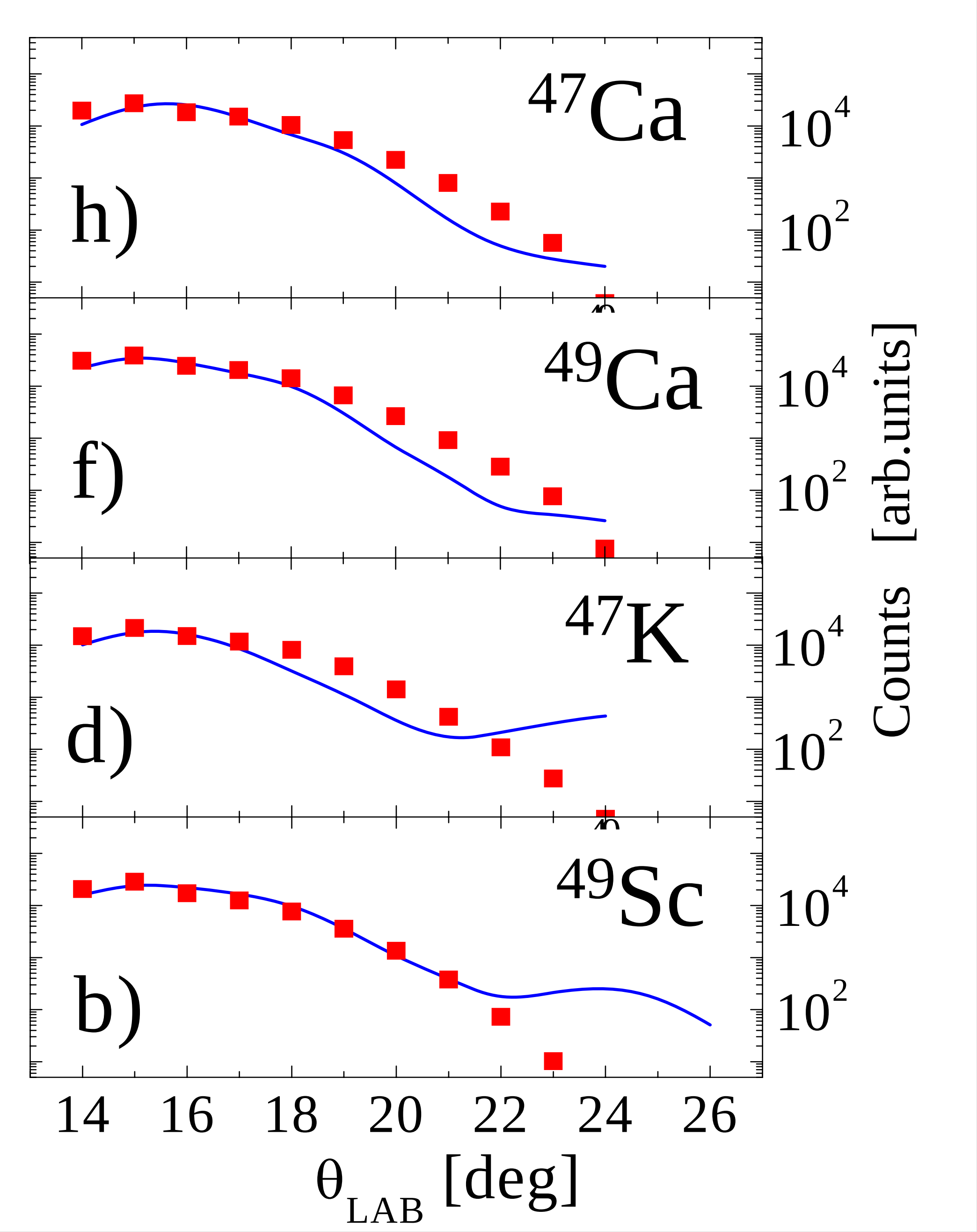
Comparison with INPUT theoretical distributions

$$(d\sigma/d\Omega dE)_{GRAZING} \leftrightarrow (d\sigma/d\Omega dE)_{GRAZING\text{-}Trasp} * f(E,\theta)$$



Comparison between EXPERIMENTAL DATA and GRAZING

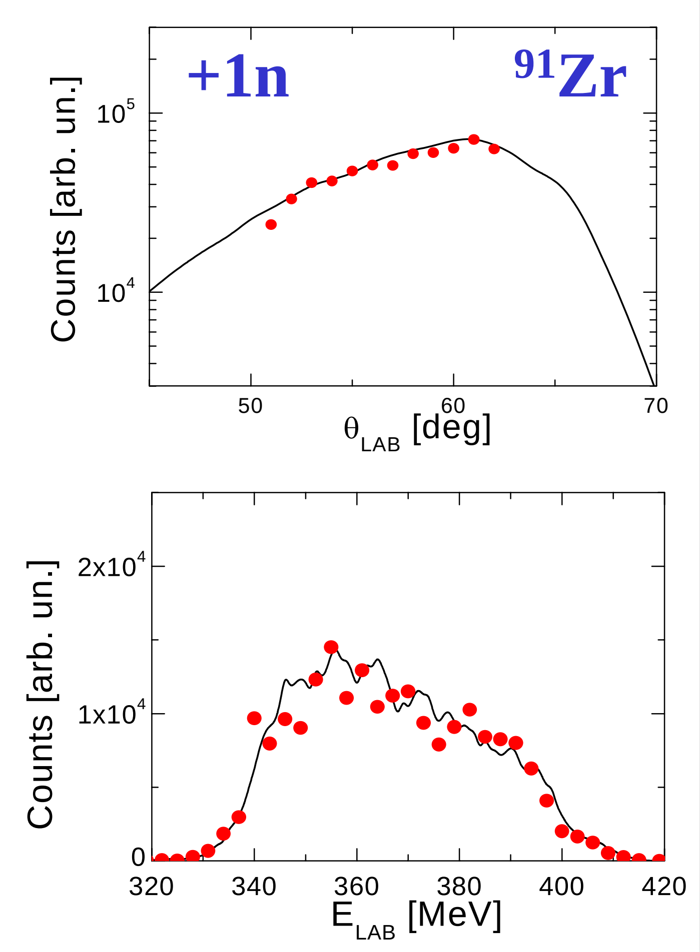
AFTER the TRANSPORT



Work in Progress

Another Physics Case

^{90}Zr + ^{208}Pb, E_{beam} = 340 MeV, θ_{PRISMA} = 56°



— GRAZING Input
● GRAZING Transported × f(θ,E)

Preliminary results show very good agreement between

GRAZING Input calculation and GRAZING Transported and corrected by PRISMA response

Experiment by
L. Corradi et al.

Fine