Exercise: cross section evaluation with MC data

Evaluate the differential cross section wrt kinetic energy ***dσ/dk*** of a particular fragment *f* using only MC data

$$\frac{d\sigma(f)}{dk} = \frac{N_{real}(f)}{N_{Total\ events} \cdot \epsilon_{MC}(f)}$$

- $N_{real}(f)$ number of fragments selected from real data
- $\varepsilon_{MC}(f)$ selection efficiency of the fragment "f"
- $N_{total\ events}$ number of total generated events

MC (^{16}O, 200 MeV, V14.1.1) divided in 2 samples:

- If (number_of_events == even) → Real data
- If (number_of_events == odd) → MC

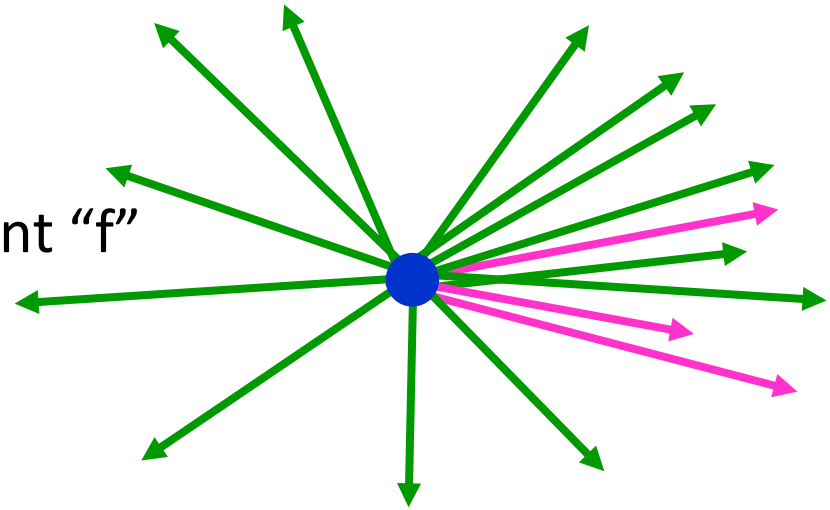
MC Efficiency

$$\epsilon_{MC}(f) = \frac{N_{RECO}(f)}{N_{GEN}(f)}$$

$N_{GEN}(f)$: kinetic energy distribution (inverse kinematic) of the fragment " f " without cuts (type of fragment identified by the MC truth)

$N_{RECO}(f)$: is the subsample of **$N_{GEN}(f)$** of the reconstructed fragment " f ":

- fragments that deposit energy in all detector (geom acceptance)
- X^2 of the ALM method < 5



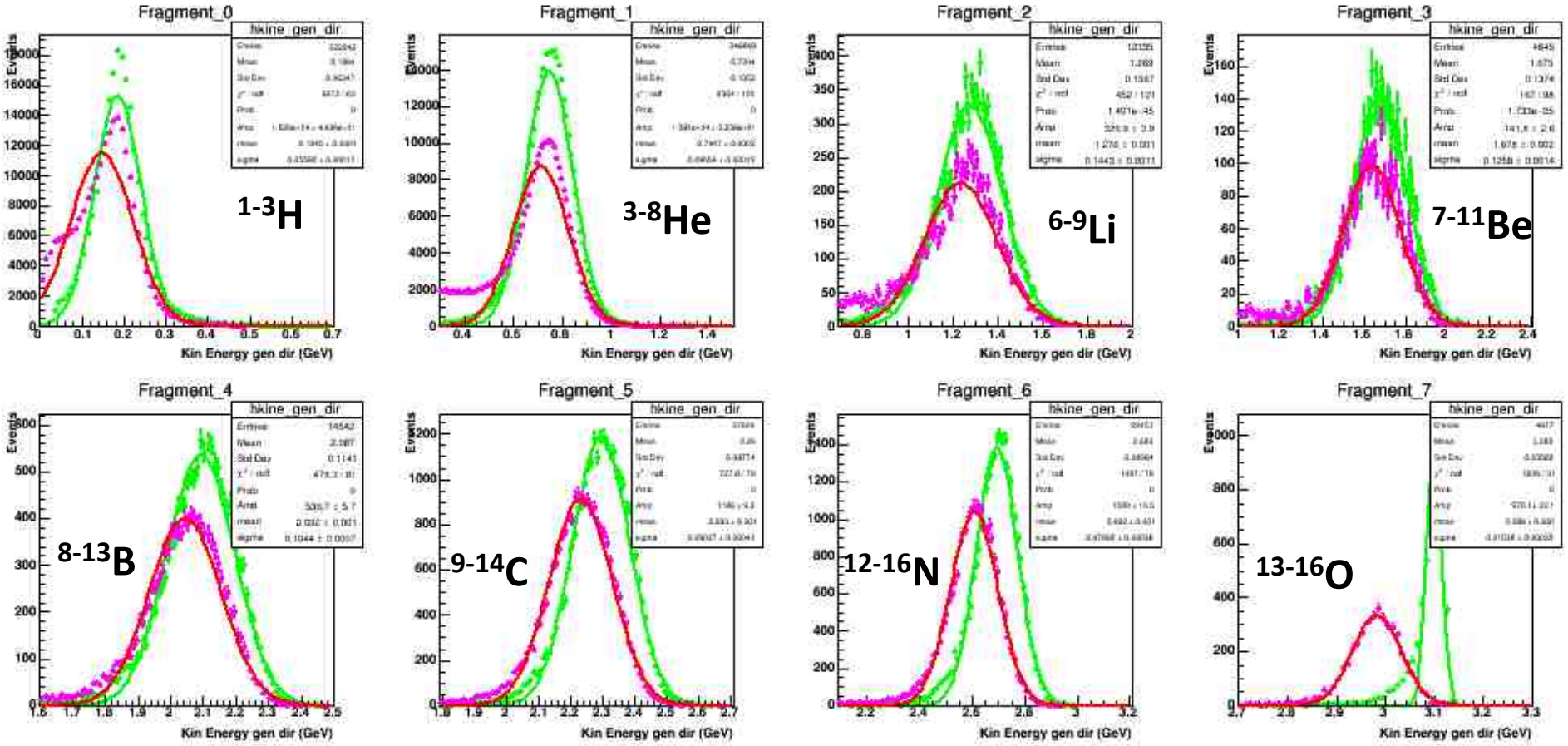
INPUT RESOLUTIONS:

- **Momentum → 5%**
- **Kinetic Energy (Calo) → 1.5%**
- **Tof : [100:150] ps depending on Z**
- **ΔE (scint): [3:10]% depending on energy released**

Kinetic energy derived from output parameters of ALM Fit

Generated and Reconstructed kinetic Energy: direct kinematics

All isotopes added in charges



Generated energy

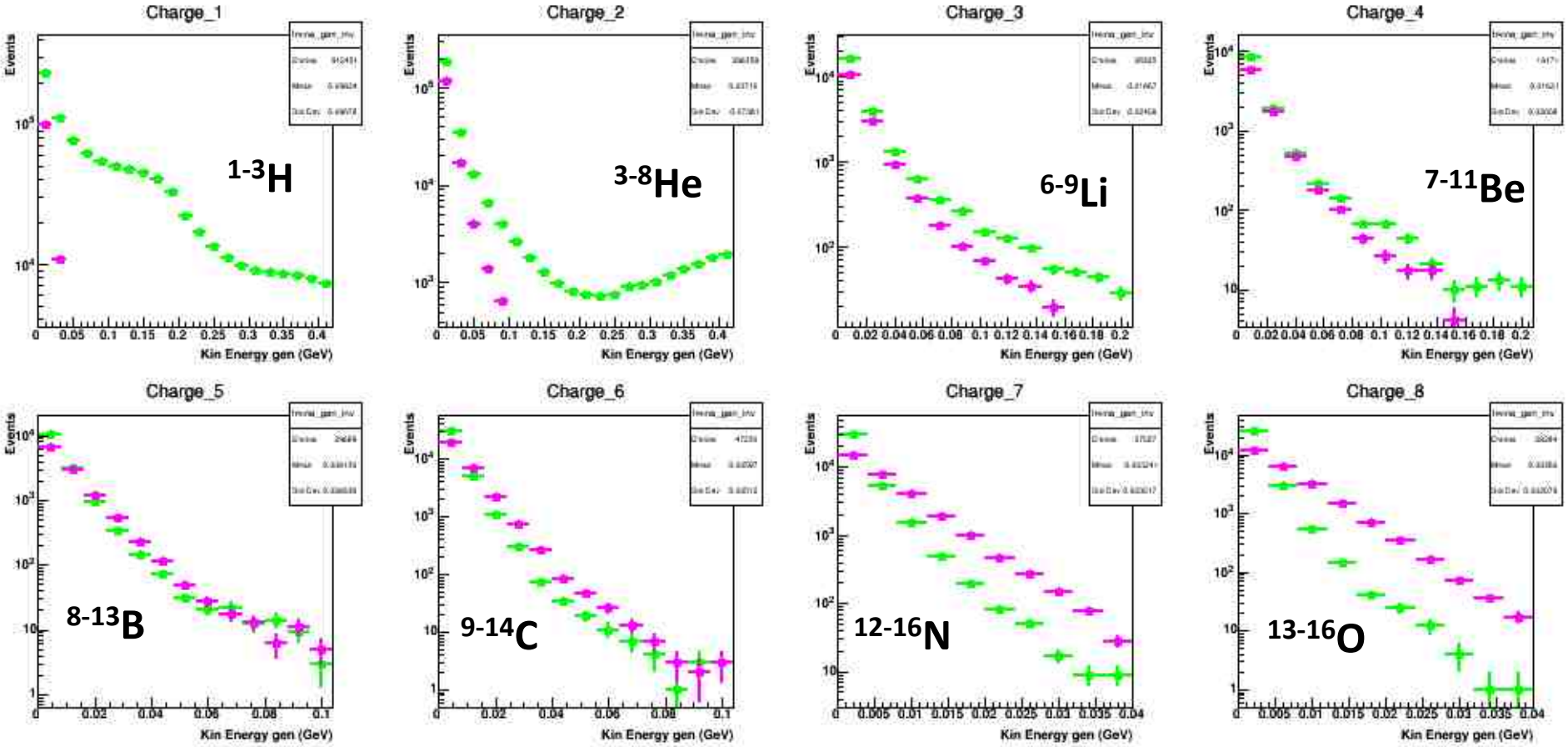
Reconstructed energy: out of fit ALM with $\chi^2<5$

Problem: the reconstructed energy is under-estimated (neutrons?)

for heavy fragments

Generated and Reconstructed kinetic Energy: inverse kinematics

All isotopes added in charges



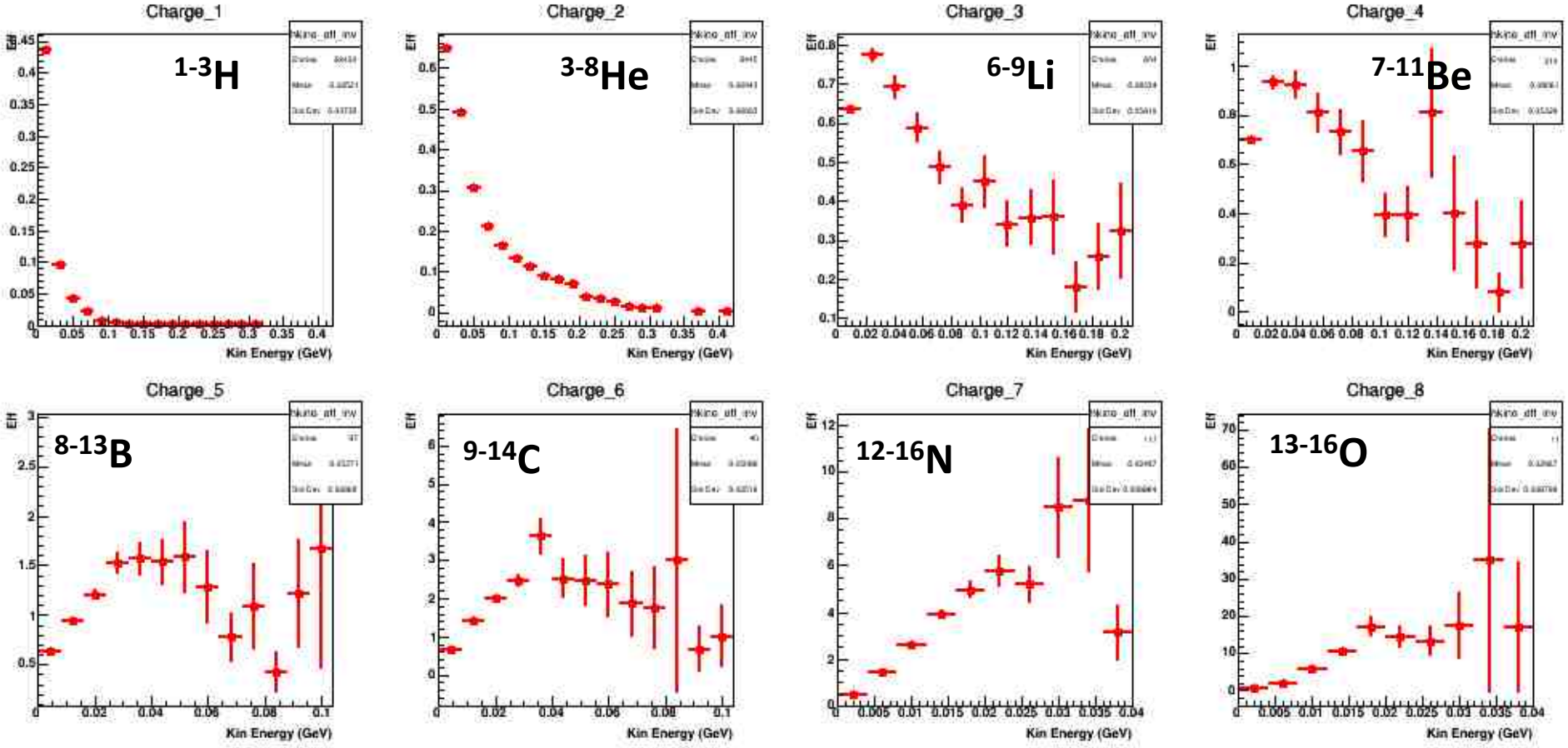
Generated energy

Reconstructed energy: out of fit ALM with $\chi^2<5$

Problem: the reconstructed energy is over-estimated (neutrons?)

Efficiency wrt kinetic Energy: inverse kinematics

All isotopes added in charges



Correct distributions for light fragments, not for heavy ones

«Real Data»

Fragments reconstructed $N_{real}(f)$ without to know truth information

$N_{REAL}(f)$: reconstructed fragment (same cuts as $N_{reco}(f)$):

- fragments that deposit energy in all detector (geom acceptance)
- X^2 of the ALM method < 5

$N_{real}(f)$ and $N_{reco}(f)$ are different

Reconstructed from ALL events,

possible mis-identification

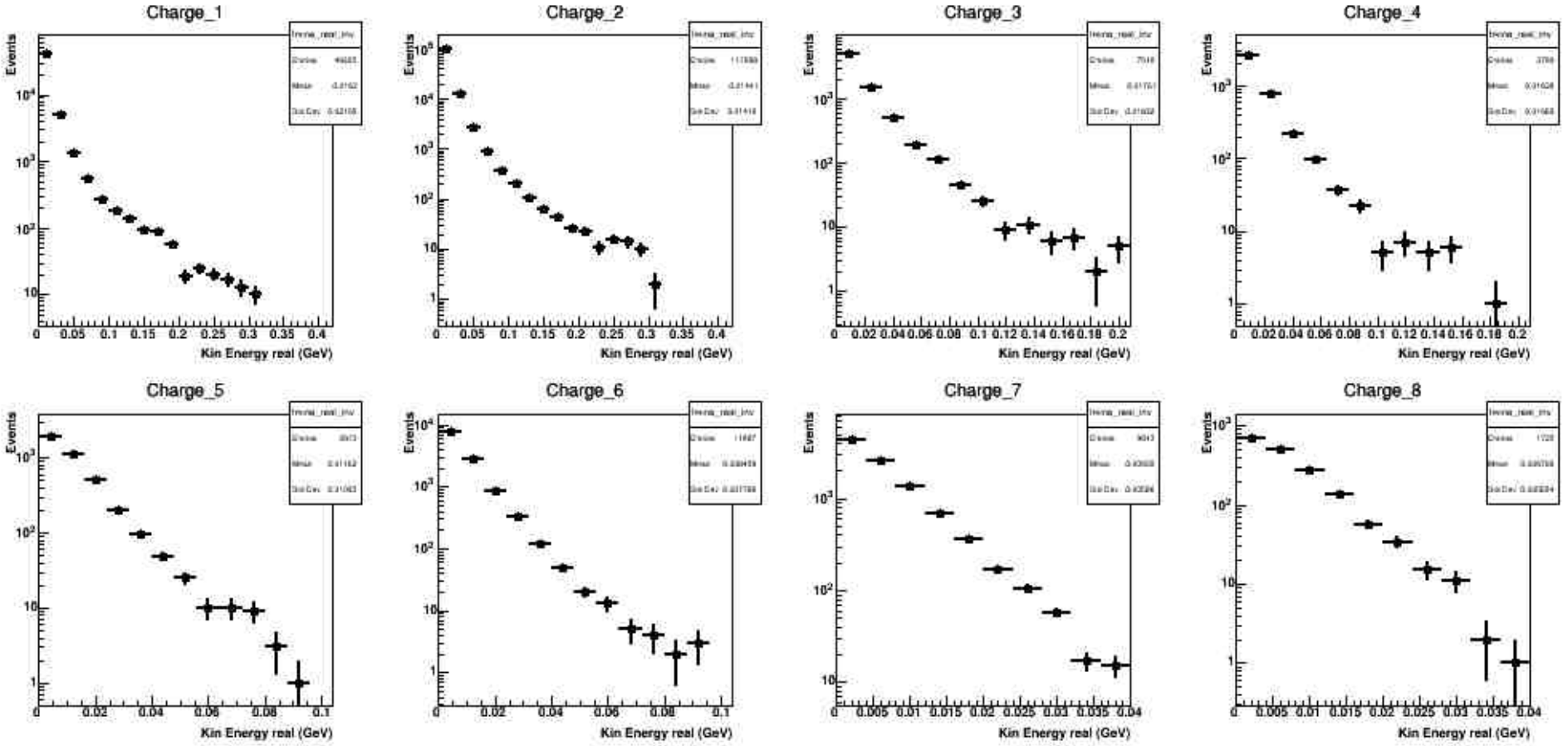
Reconstructed from fragments

of a determined type

At the moment all isotopes added

Charge determined by the dE/dx on SCN

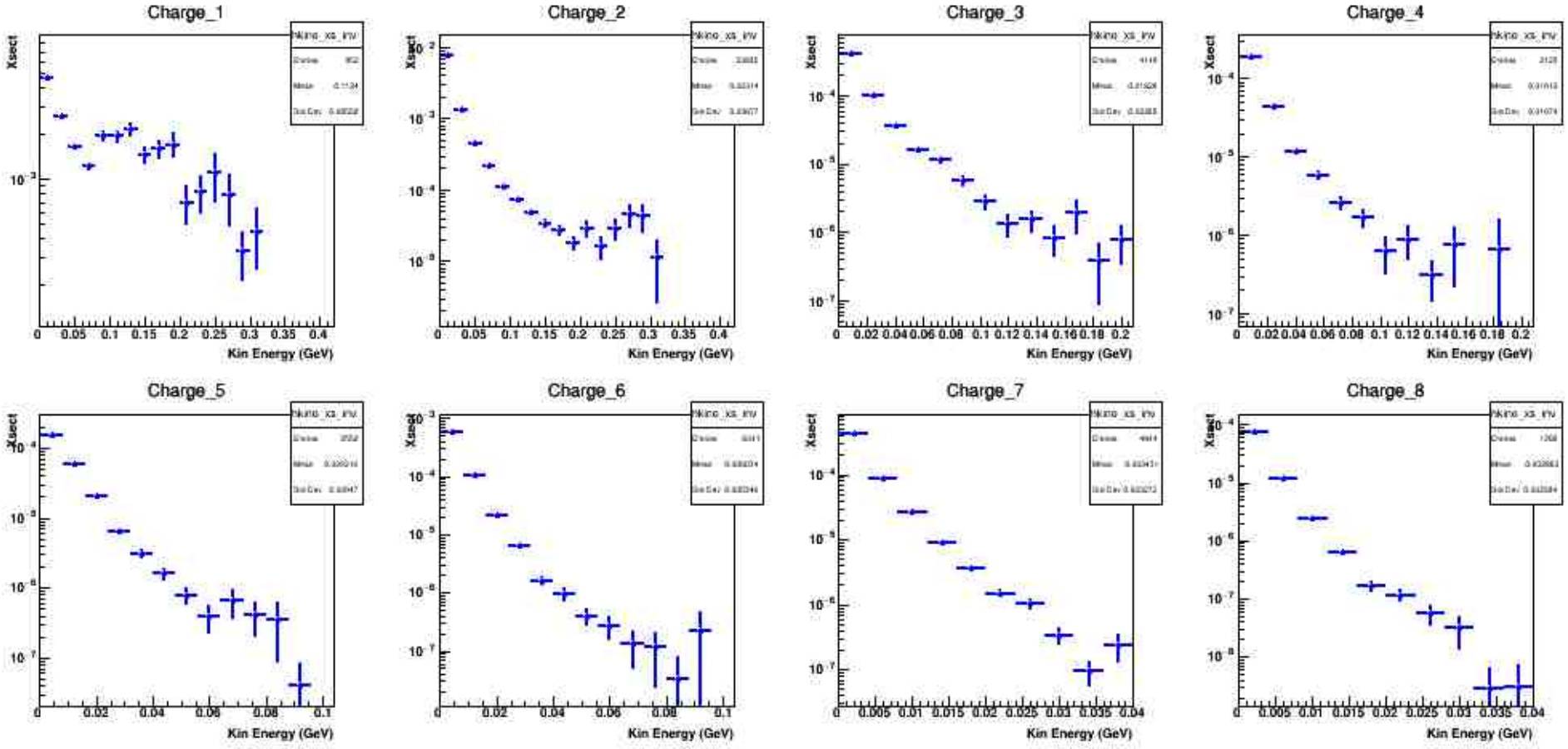
«Real Data»



Obvioulsy these plots are affected by two possible problems:

- Not correct kinetic energy estimation
- Possible wrong charge identification

Cross Section wrt kinetic energy (inverse kinematics)



To have a reliable result → better kinetic energy reconstruction

Conclusion

The machinery for the cross section evaluation is ready in a private code → include it in SHOE

Find a method to take care of the systematic kinetic energy under-estimation

Try to estimate the mass with higher resolution so to have the cross section for each isotope

General Paper

Goal: paper (JINST?) on FOOT detector

Each sub-detector will be written by the responsible institute

Internal editors:

- Introduction-Motivation: Battistoni, Durante, Patera, + EB
- Start Counter: Patera, Sarti, Sciubba
- Beam Monitor: Battistoni, Tommasino
- Target:
- Vertex and Inner Tracker: Spiriti
- MSD: Ambrosi, Servoli
- Magnet:
- SCN: Morrocchi
- CAL: Cerello
- EMULSION chamber: Lauria, Montesi
- DAQ: Biondi
- Simulation
- Performance Spighi
- Make a homogeneous text: Battistoni, Patera, EB

Volunteers are welcome!!!

Possible general scheme

The FOOT detector

- Introduction
- Apparatus
- Upstream and target Region
- Tracking system
- Particle Identification
- Trigger and data acquisition system
- Emulsion Chamber setup
- Performances
- Conclusions

More detailed scheme, 1

The FOOT detector

- Introduction
  - from "Introduction" and "Motivation and research Program" of CDR

- Apparatus
  - Requirements in terms of the resolution to be achieved
  - Electronic setup
    - Upstream and target region
    - Tracking system
    - Particle Identification
    - Trigger and data acquisition system
  - Emulsion chamber setup

More detailed scheme, 2

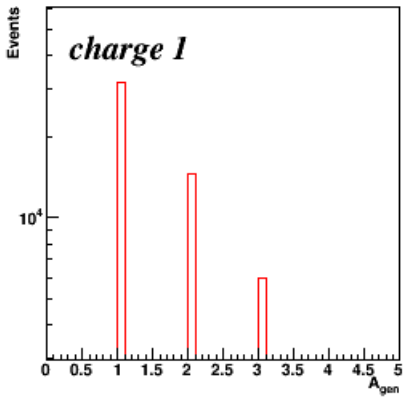
- Upstream and target Region
  - Start Counter
  - Beam monitor
  - Target
- Tracking system
  - magnetic system
  - vertex
  - inner tracker
  - micro strip detector
- Particle Identification
  - Scintillator
  - Calorimeter

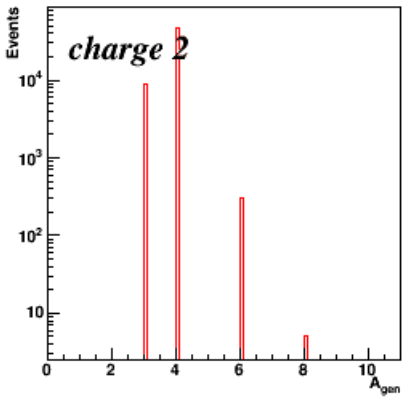
More detailed scheme, 3

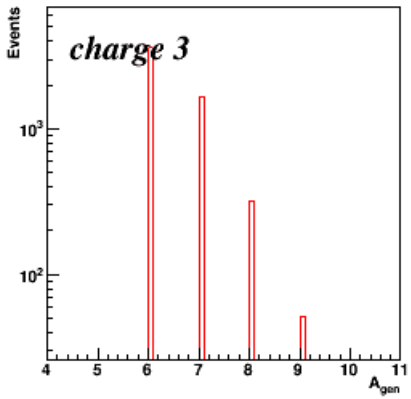
- Trigger and data acquisition system
- Emulsion Chamber setup
- Performances
  - Electronic Setup
  - Emulsion Chamber
- Conclusions

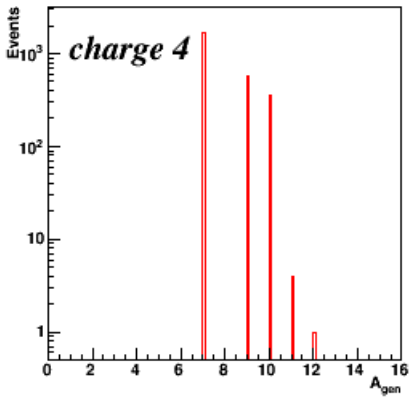
Backup slides

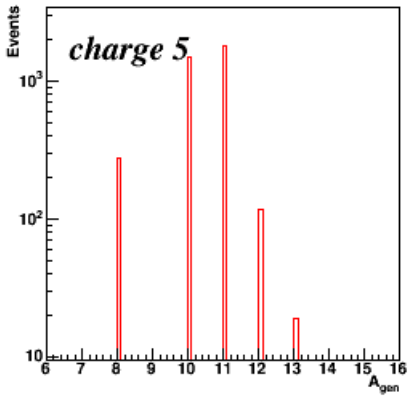
Types of Fragments present on simulated data

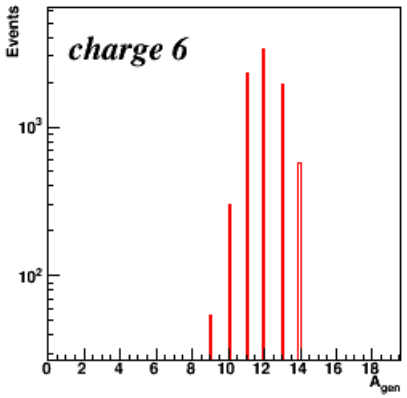


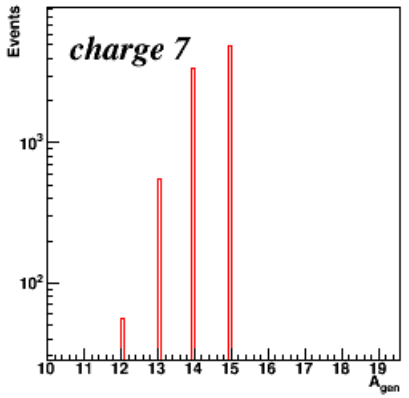


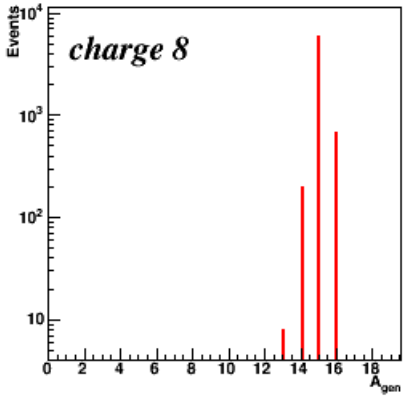












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