Status of SCD in HerdSoftware

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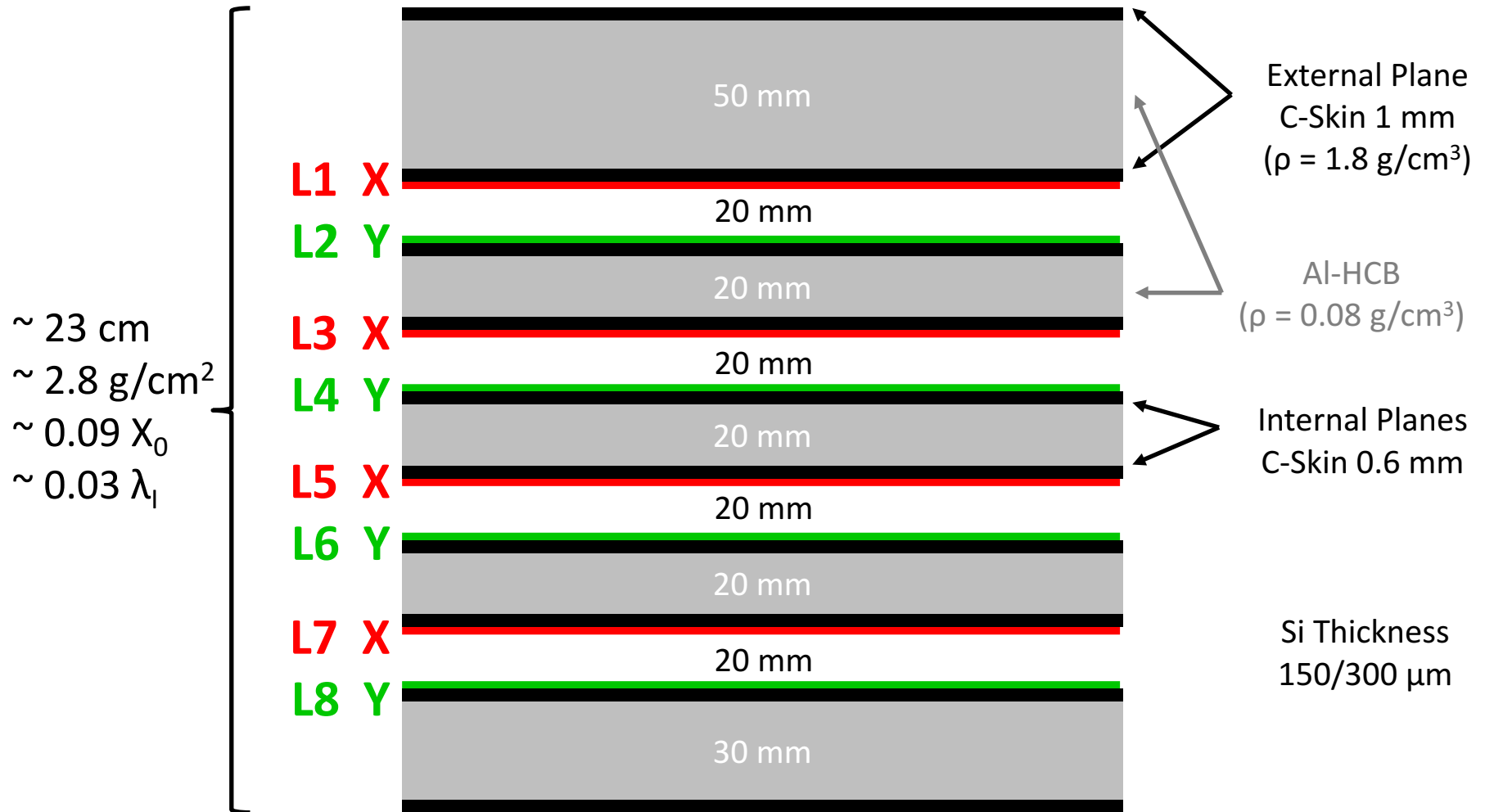
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Current Layout of SCD in HerdSoftware

L1 X
L2 Y

Si Thickness
150/300 μm

3 mm

L3 X
L4 Y

~ 1 cm
~ 0.3 g/cm^2
~ 0.01 X$_0$
~ 0.003 λ$_l$

3 mm

Al-HCB
(ρ = 0.03 g/cm^3)

L5 X
L6 Y

3 mm

L7 X
L8 Y

The geometry is fully parameterized (thicknesses, gaps, …), i.e. decided in production.
This layout is not realistic, but it is still **good for basic estimations** of resolution.

Proposal of Modification of the Layout "à la DAMPE"

~ 23 cm
~ 2.8 g/cm^2
~ 0.09 X_0
~ 0.03 λ_I

50 mm

L1 X
20 mm
L2 Y
20 mm
L3 X
20 mm
L4 Y
20 mm
L5 X
20 mm
L6 Y
20 mm
L7 X
20 mm
L8 Y
30 mm

External Plane
C-Skin 1 mm
(ρ = 1.8 g/cm^3)

Al-HCB
(ρ = 0.08 g/cm^3)

Internal Planes
C-Skin 0.6 mm

Si Thickness
150/300 µm

We can most probably have some better ideas for the layout.
However this proposal seems more reasonable for estimating interaction.

MC Production

**HerdSoftware version**: 42f9aae7 (somehow "old")
Geometry: CALO+FIT+PSD+SCD(very thin)
Digitization: default from Ex01

Production:
- "Beam test", i.e. vertical, down-going particles from (1,1,200) cm.
- Particles: ^{1}H, ^{4}He, ^{12}C, ^{16}O, ^{28}Si, ^{56}Fe
- Momenta: 10 GeV/A, 100 GeV/A, 1 TeV/A, 10 TeV/A, 100 TeV/A
- Target: at least 10k per species per energy point (… still to be finished)
- Production is done at CNAF (using non-HERD resources)

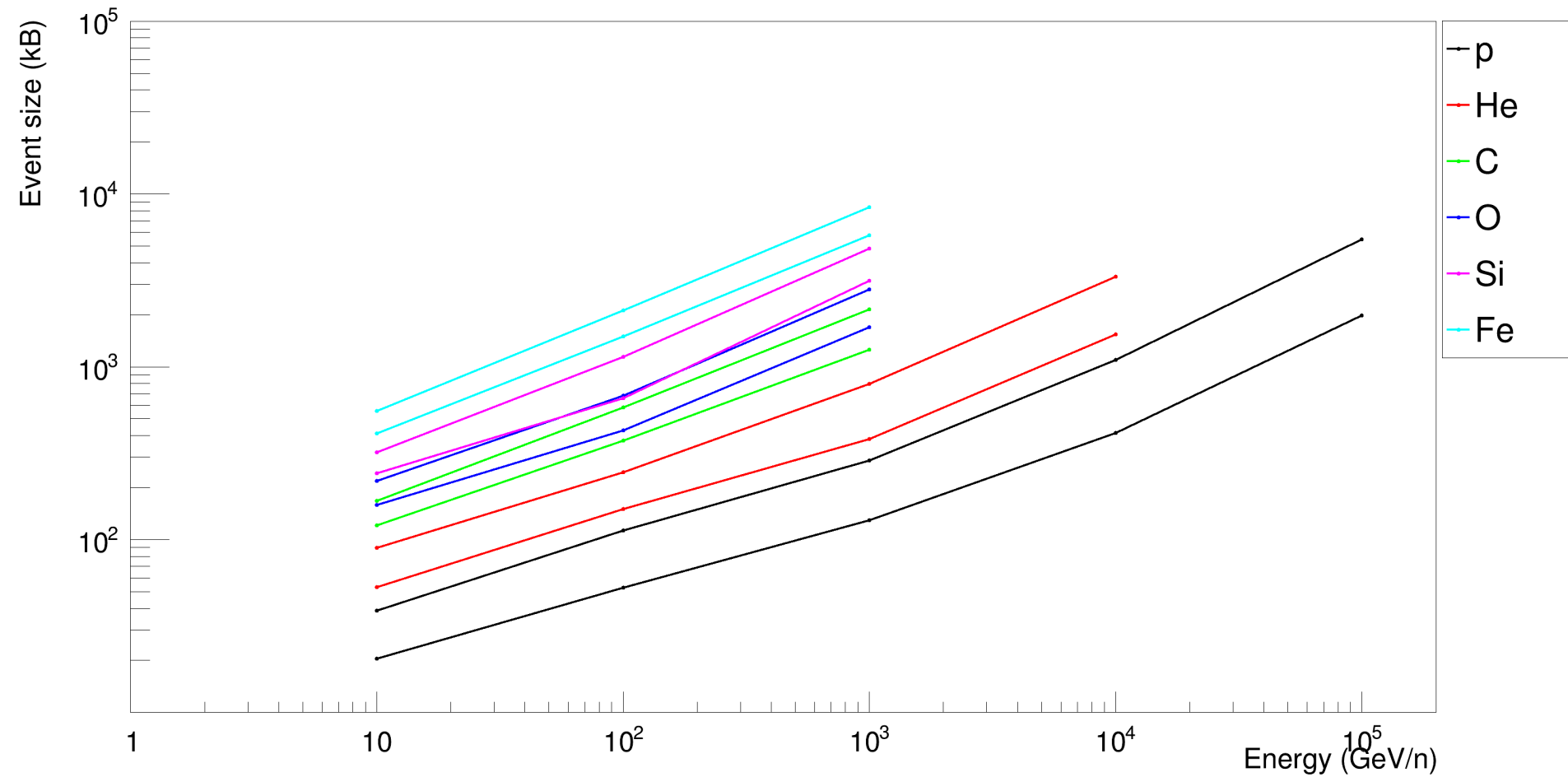# MC Production: **Execution Time**
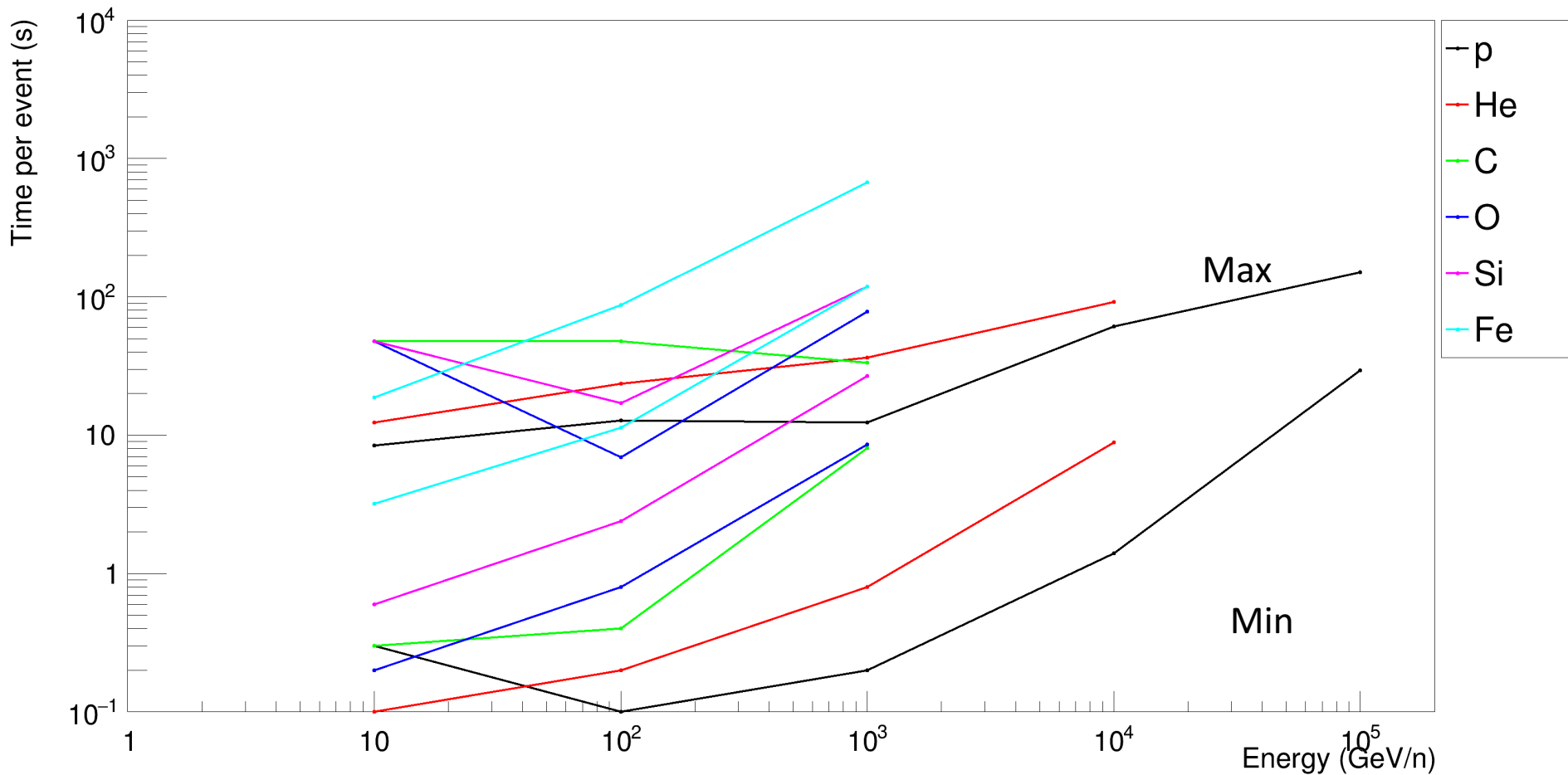
Processing time increases with Z and with energy.
Number of events per job are adjusted to have ~ 6h processing time.
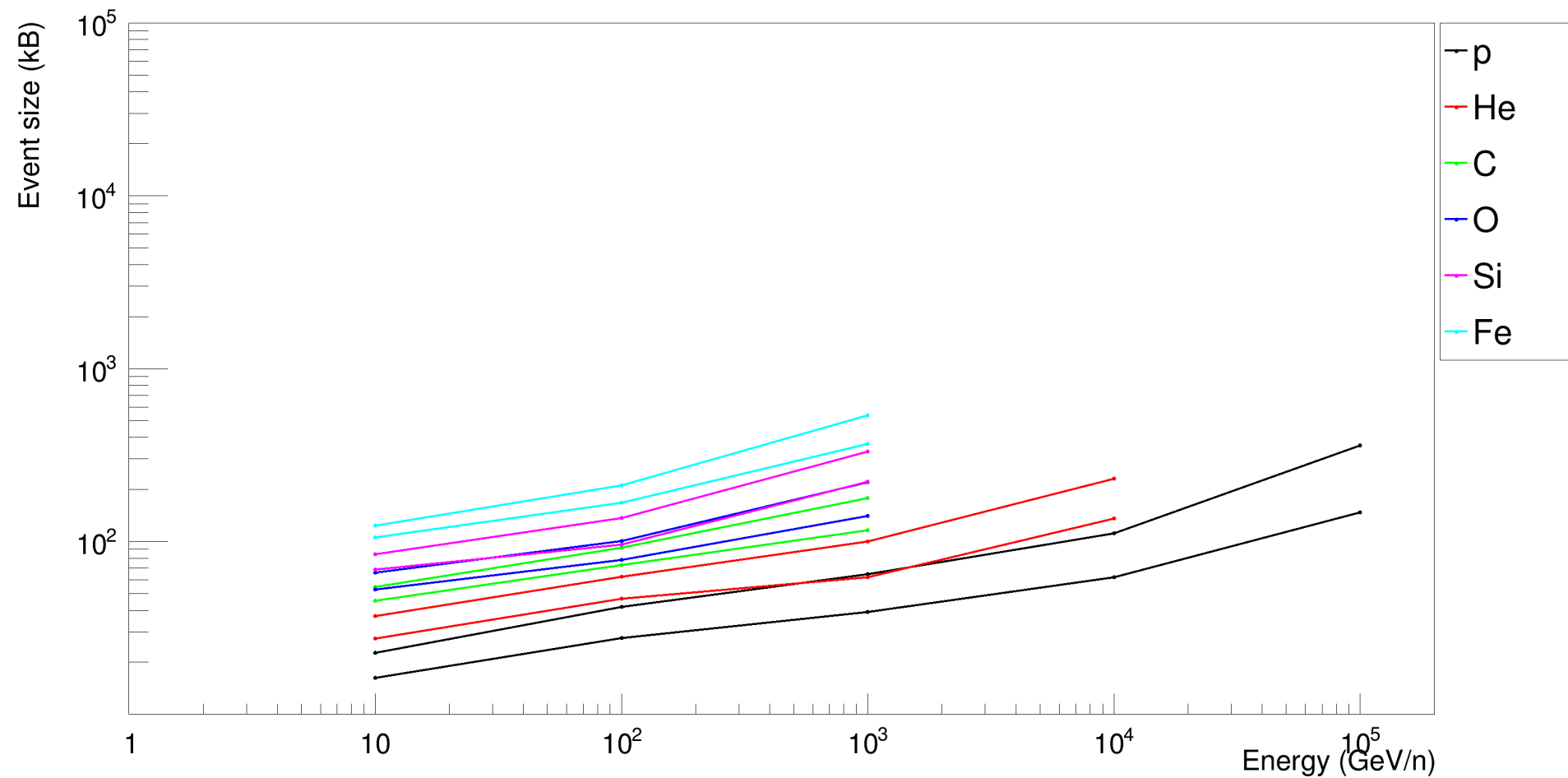→ Iron takes a lot of time.

MC Production: **Event Size** of the GGS File

This intermediate file is not stored.
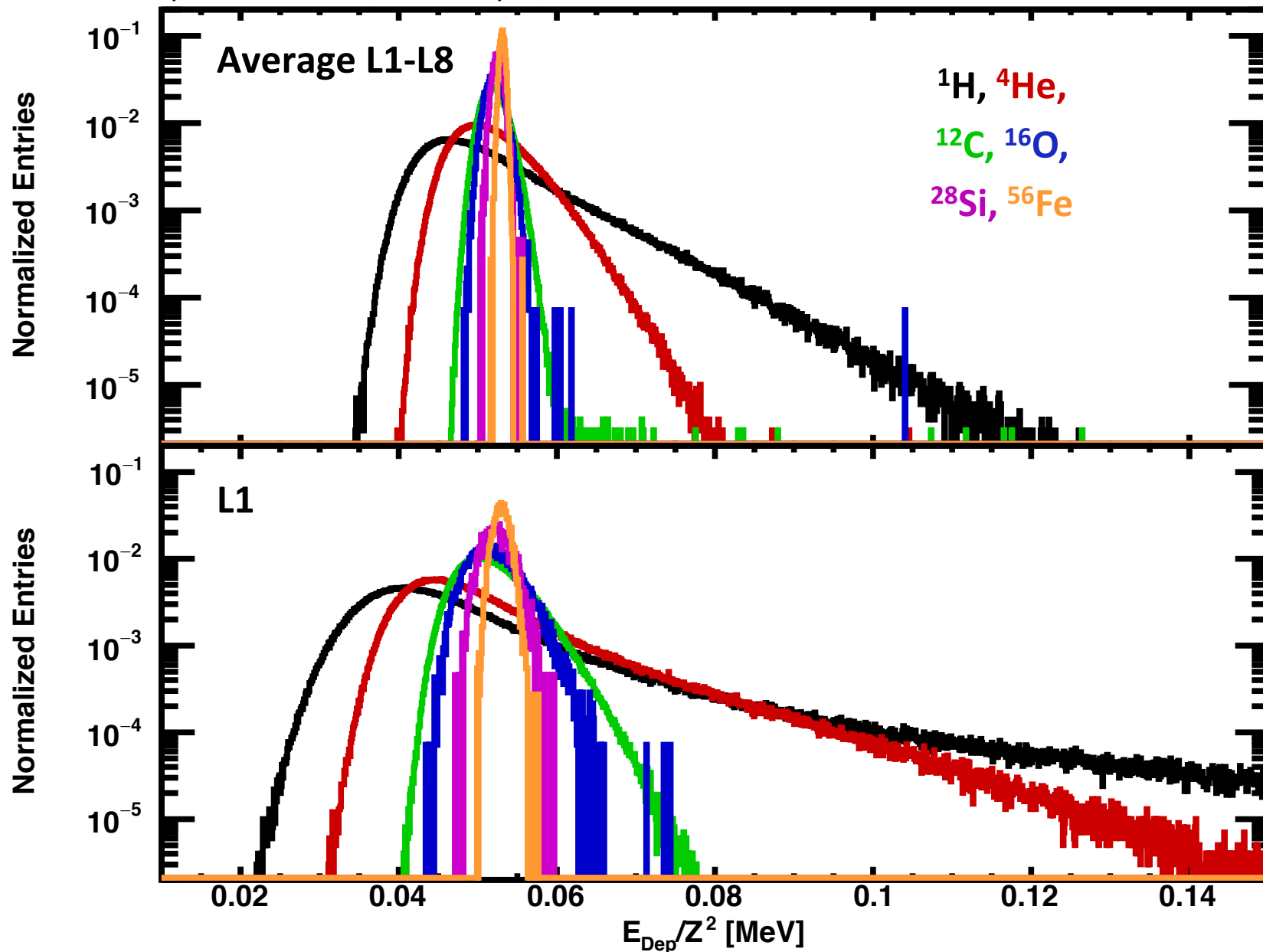However one should be careful.

MC Production: **Event Size** of the Digitized File

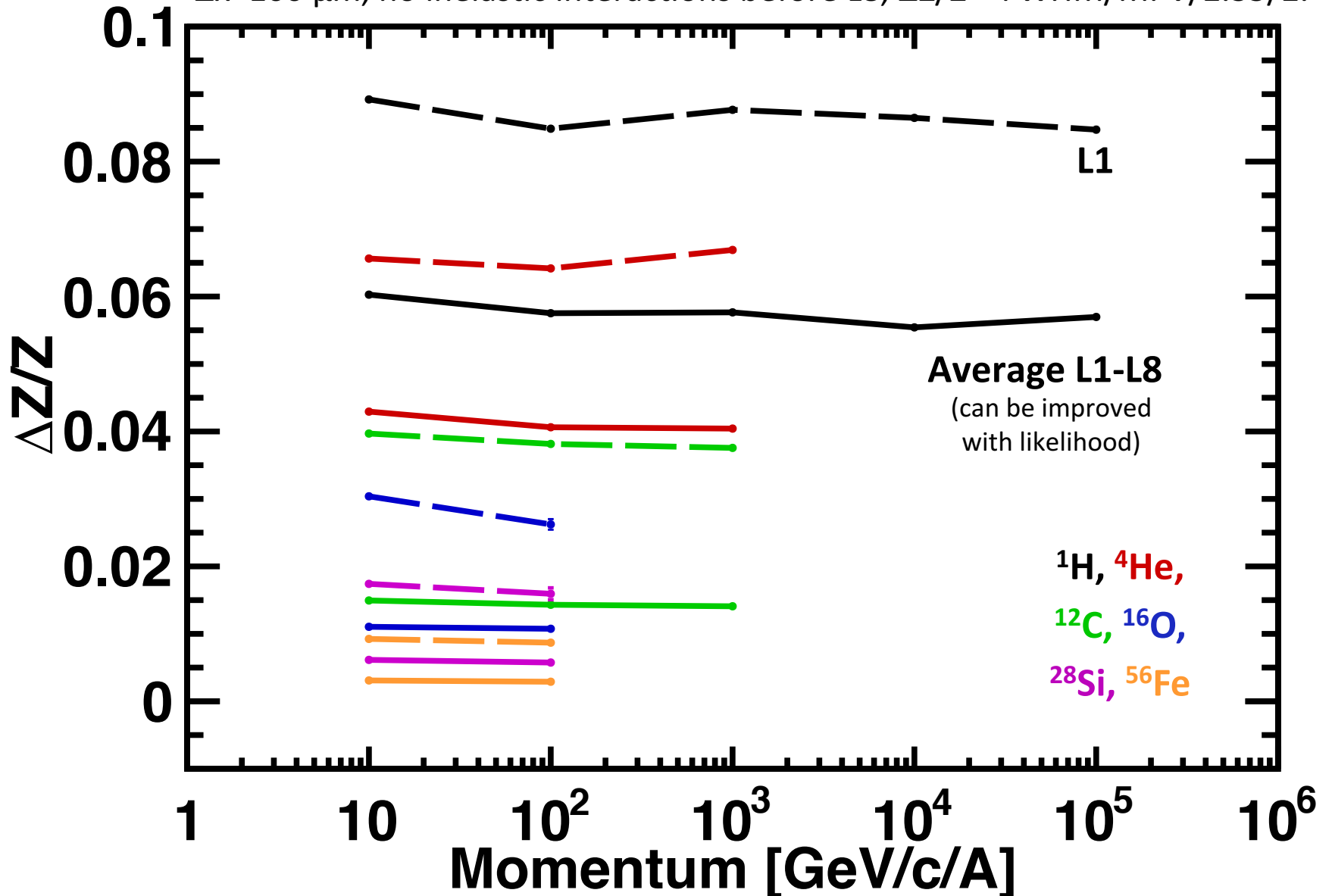Digitized file is the only one that we keep.

Energy Deposition **without** Interactions Above L8

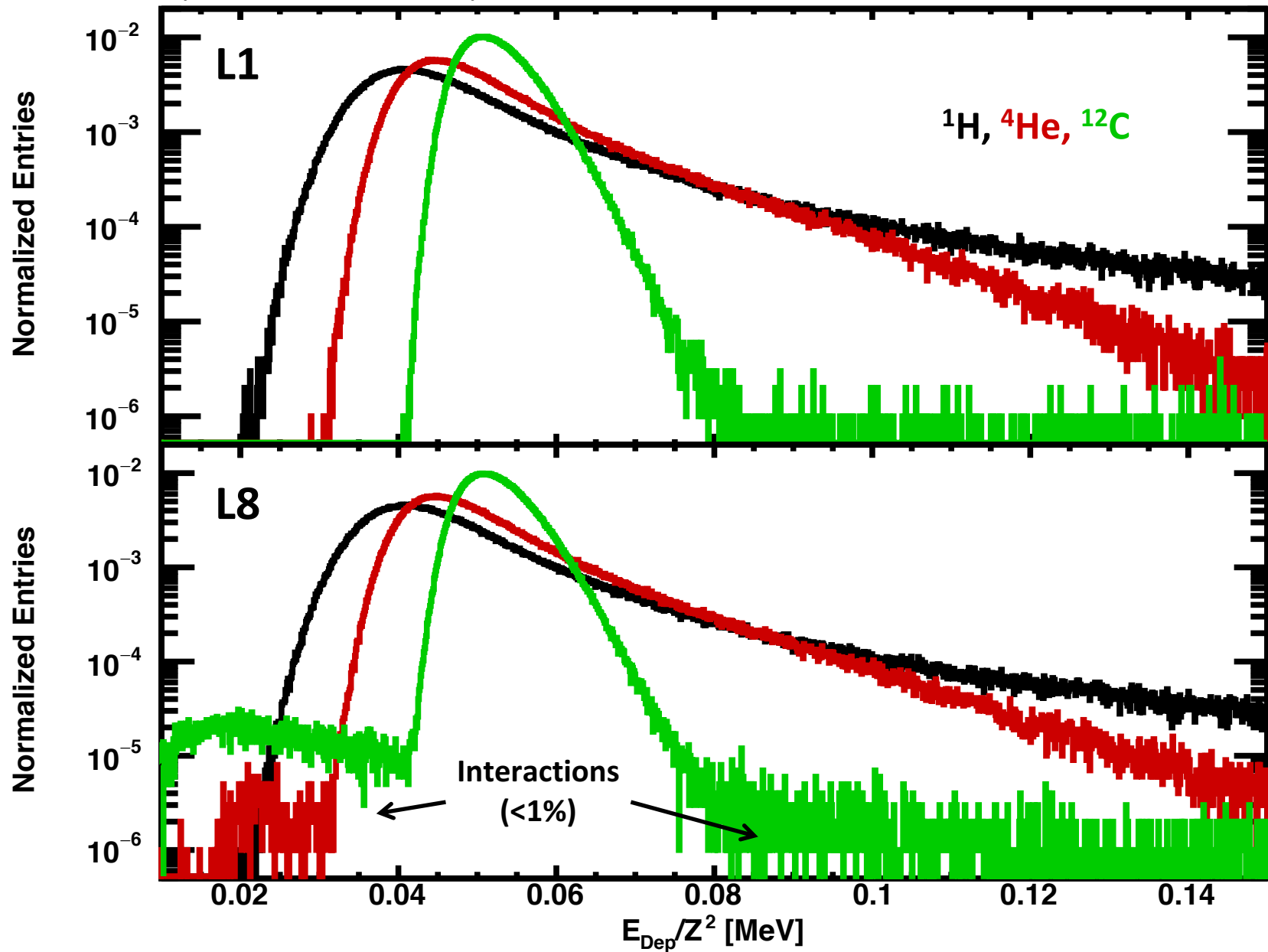p=100 GeV/c/A, Δx<100 μm, no inelastic interactions before L8

Average L1-L8

^{1}H, ^{4}He, ^{12}C, ^{16}O, ^{28}Si, ^{56}Fe

L1

Normalized Entries

E_{Dep}/Z^2 [MeV]

Charge Resolution **without** Interactions Above L8

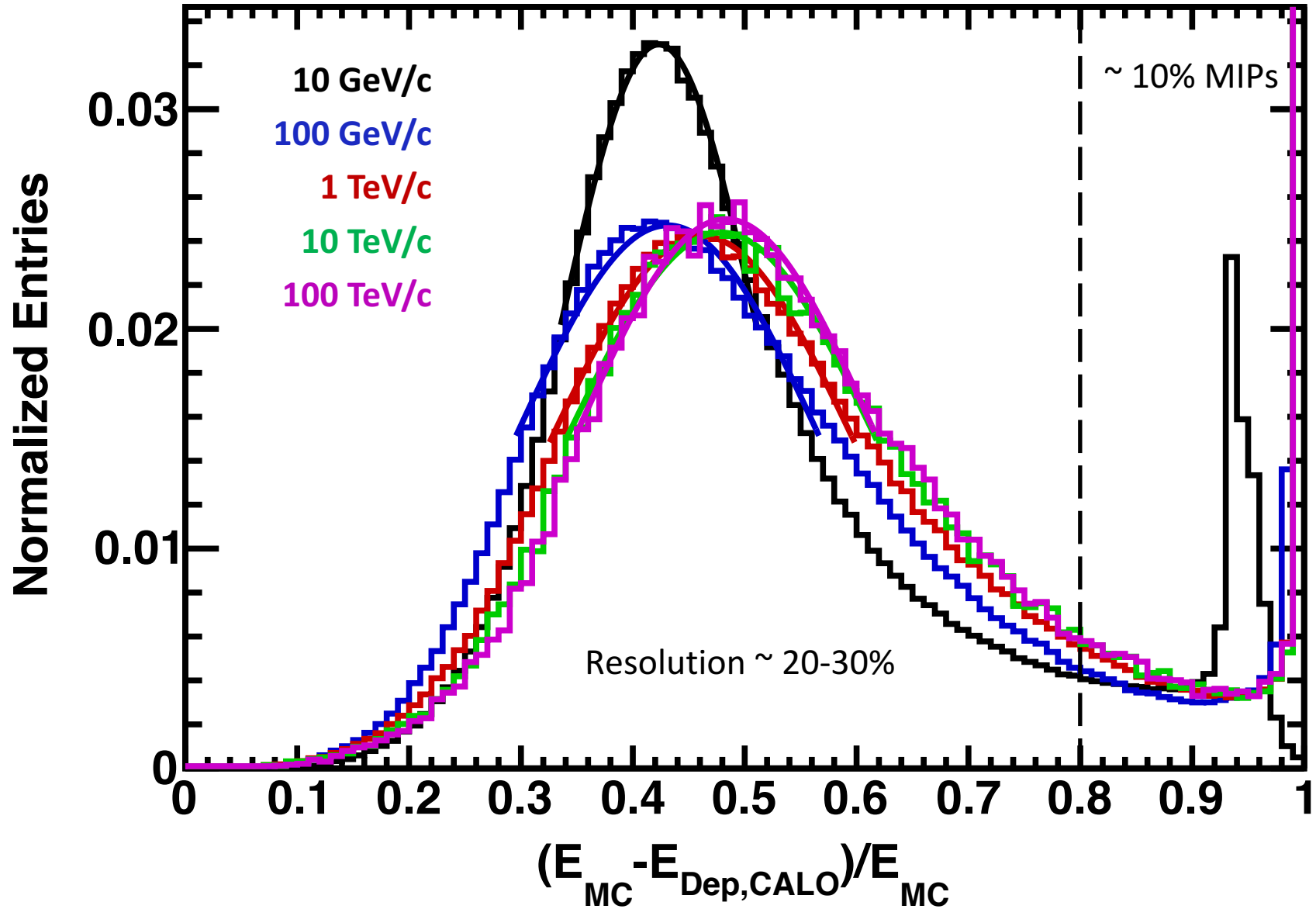$\Delta x < 100$ μm, no inelastic interactions before L8, $\Delta Z/Z$ = FWHM/MPV/2.35/2.

L1

Average L1-L8
(can be improved
with likelihood)

^{1}H, ^{4}He,

^{12}C, ^{16}O,

^{28}Si, ^{56}Fe

$\Delta Z/Z$

Momentum [GeV/c/A]

Energy Deposition **with** Interactions Above L8

p=1 TeV/c/A, Δx<100 μm

^{1}H, ^{4}He, ^{12}C

Energy Deposited in the Calorimeter: **Proton**

10 GeV/c
100 GeV/c
1 TeV/c
10 TeV/c
100 TeV/c

~ 10% MIPs

Resolution ~ 20-30%

Normalized Entries

$(E_{MC} - E_{Dep,CALO})/E_{MC}$

Energy Deposited in the Calorimeter: **Carbon**

10 GeV/c/A
100 GeV/c/A
1 TeV/c/A

~ 1% MIPs

Resolution ~ 15%

Normalized Entries

$(E_{MC} - E_{Dep,CALO})/E_{MC}$
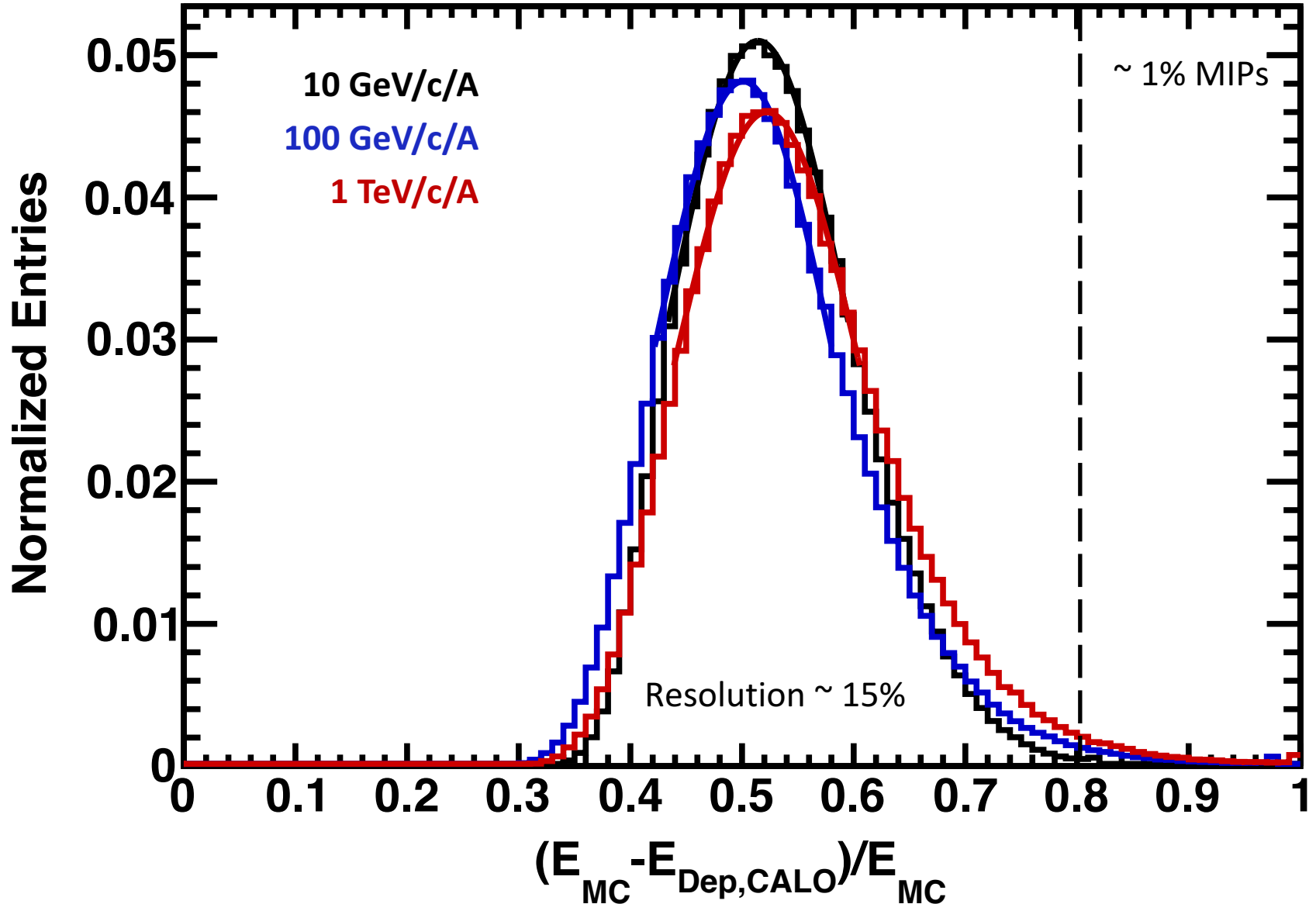
Backsplash Effect: **Protons**

Z=1, p=1TeV/c/A

- all
- Δx<100 mm
- Δx<10 mm
- Δx<1 mm
- Δx<0.1 mm
- Δx<0.01 mm

Normalized Entries

E_{Dep}/Z^2 [MeV]
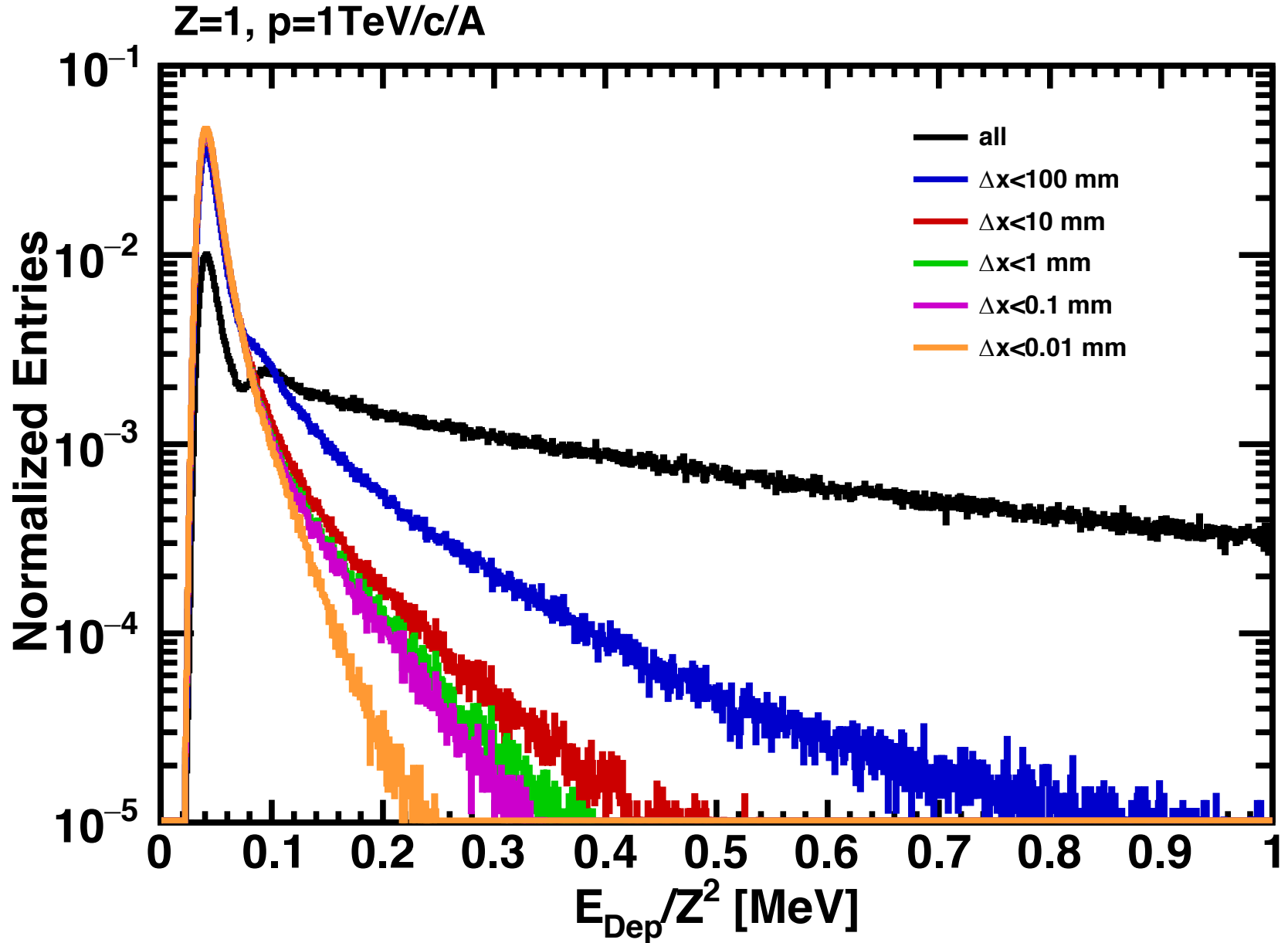
Backsplash Effect: **High-Energy Protons**

Z=1, p=100TeV/c/A

Legend:
- all (black)
- $\Delta x < 100$ mm (blue)
- $\Delta x < 10$ mm (red)
- $\Delta x < 1$ mm (green)
- $\Delta x < 0.1$ mm (magenta)
- $\Delta x < 0.01$ mm (orange)

Y-axis: Normalized Entries

X-axis: E_{Dep}/Z^2 [MeV]
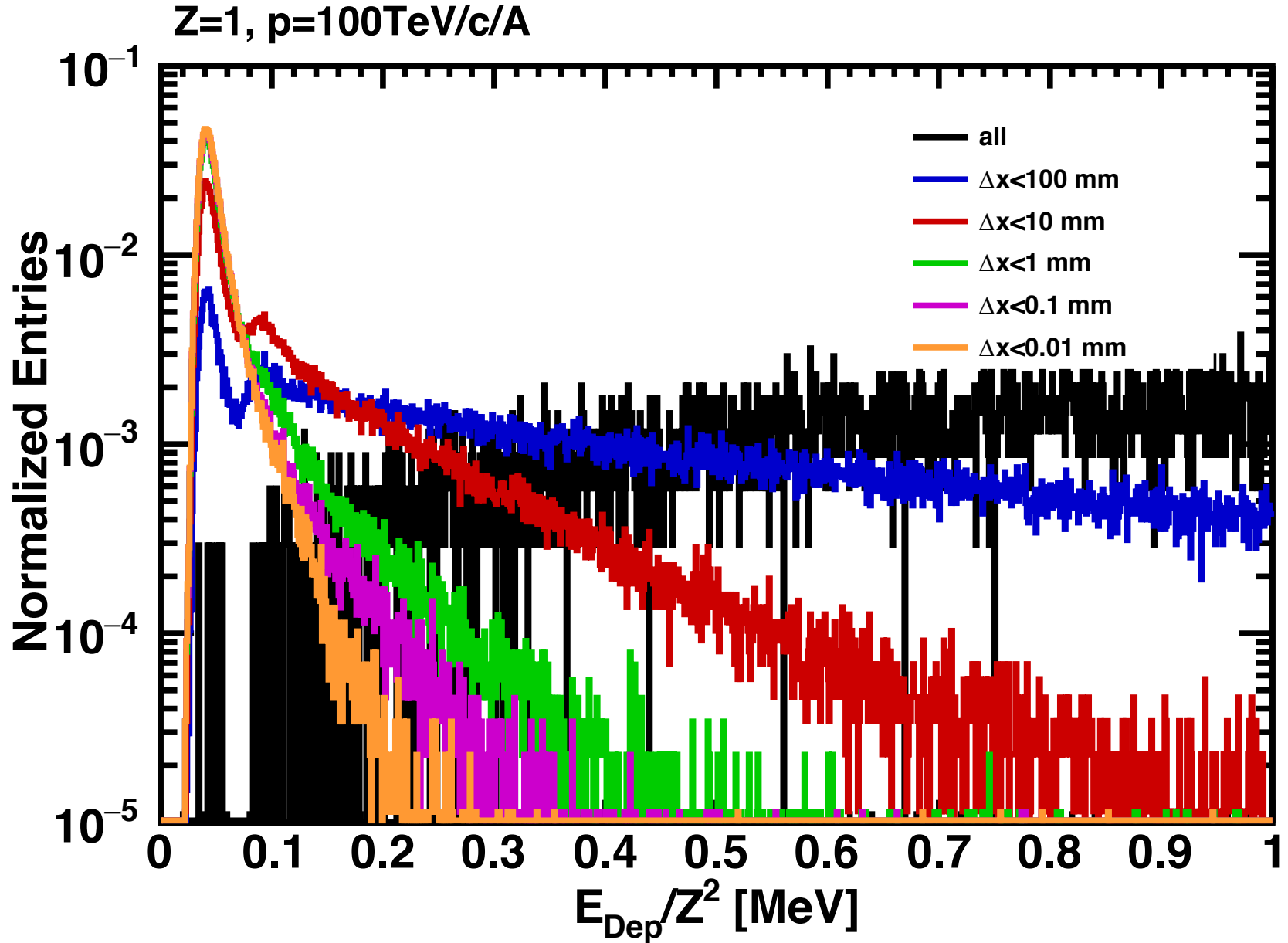
Backsplash Effect: **Carbon**

Z=6, p=1TeV/c/A

all
Δx<100 mm
Δx<10 mm
Δx<1 mm
Δx<0.1 mm
Δx<0.01 mm

E_{Dep}/Z^2 [MeV]

Normalized Entries
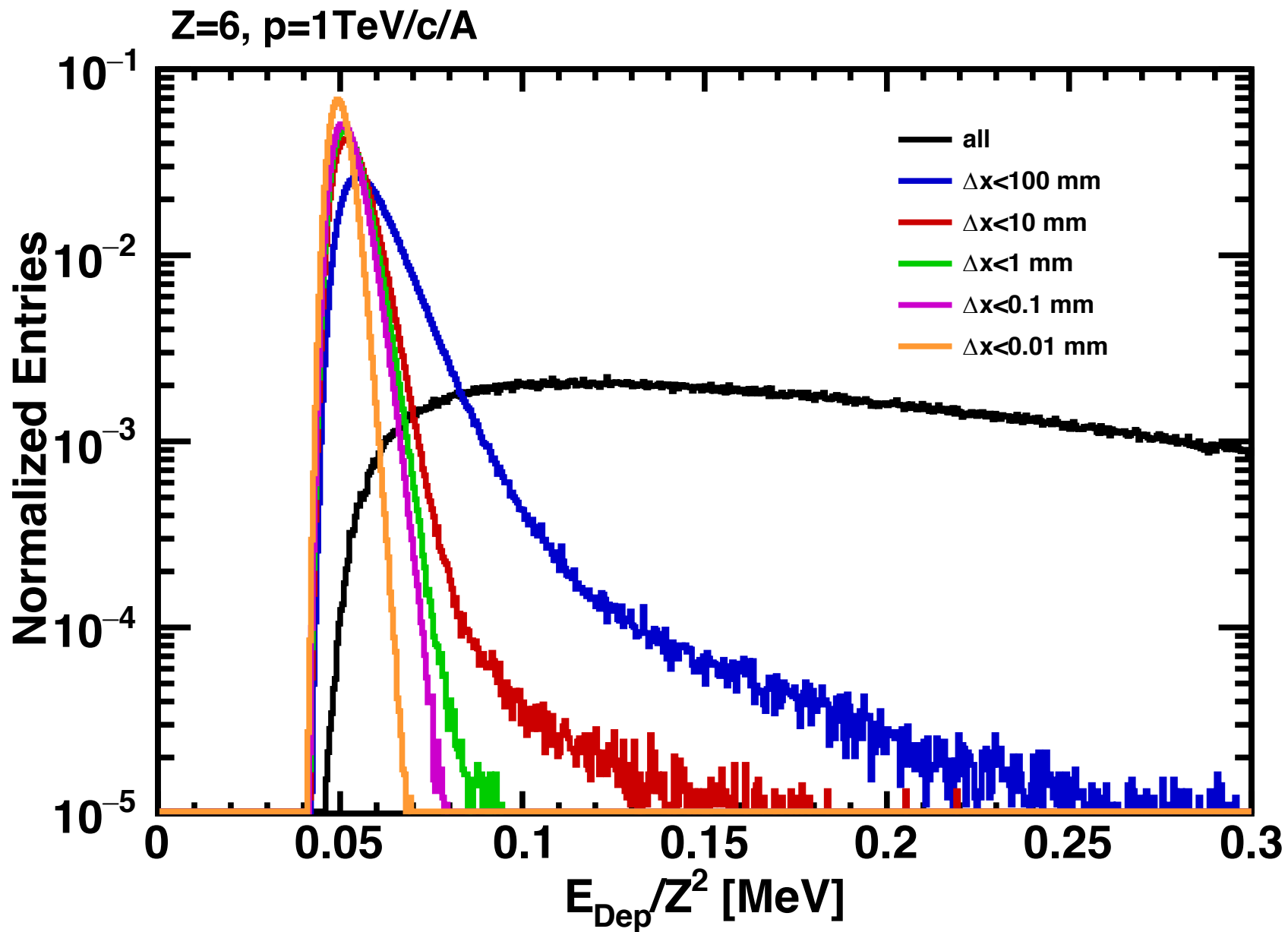
Conclusions

Intrinsic charge resolution seems to be adequate for all charges and similar to previous estimations. However, the concern here is for a realistic digitization performance of real prototype on beam.

The interactions from the top to L8 are not many (<%1), as expected for such a light configuration. Even if we hope to keep the SCD as light as possible, we would like to implement a SCD layout similar to DAMPE, to get an idea of a possible realistic scenario.

The effect of backsplash seems to be manageable with a segmentation < 1. This should be cross-checked after digitization.