All-Si tracker studies
Progress Update

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LBNL EIC Meeting

09/01/2020

Outline

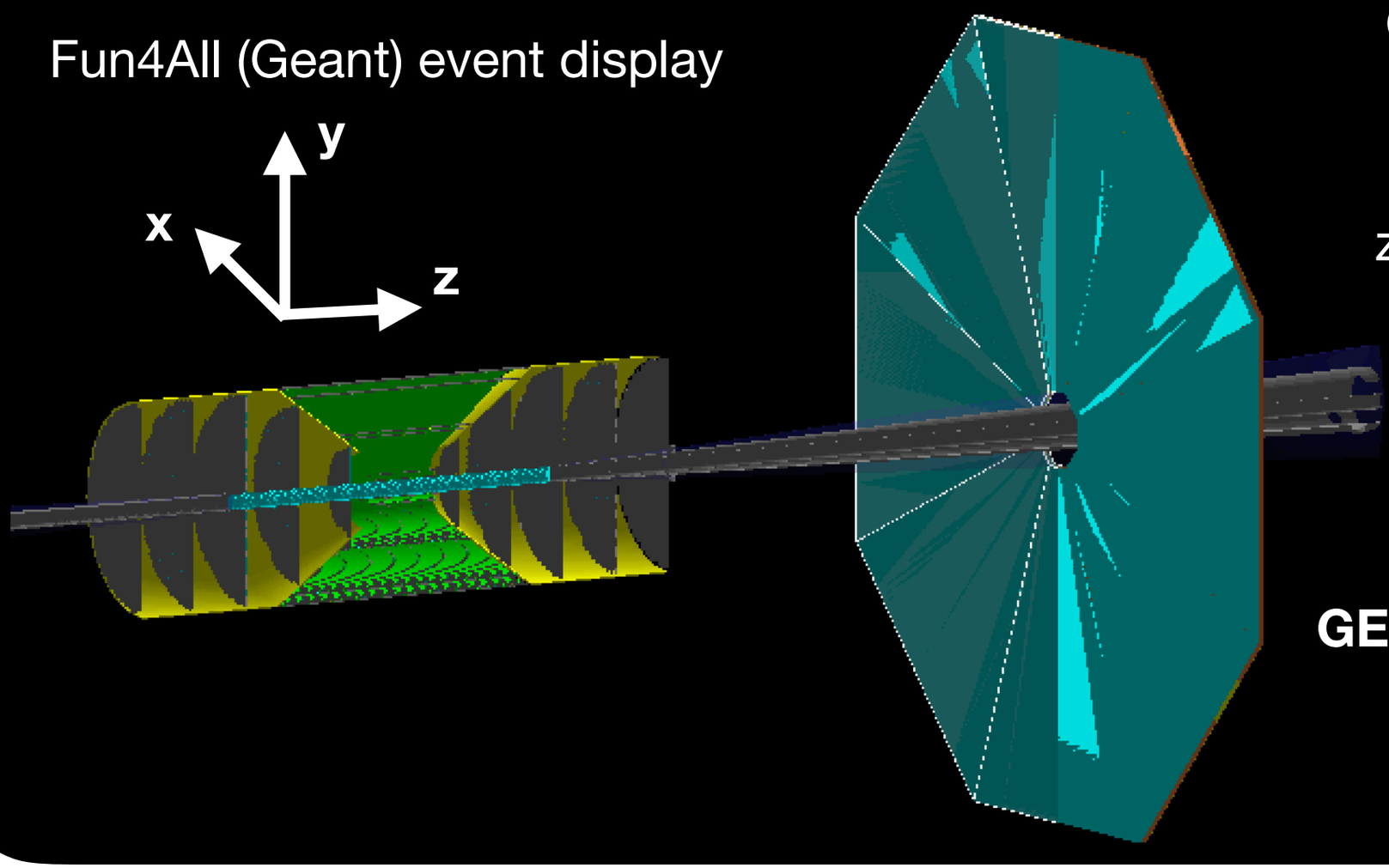
- Complementing All-Si tracker

- Azimuthal momentum-resolution asymmetry in hadron direction

To Recap:

* Started exploring GEMs to complement All-Si tracker in forward region.

Fun4All (Geant) event display



GEM Parameters:

$\eta_{\min}$ = 1.40

$\eta_{\max}$ = 3.69

z position = 300 cm

sectors = 8

GEM spatial resolution:

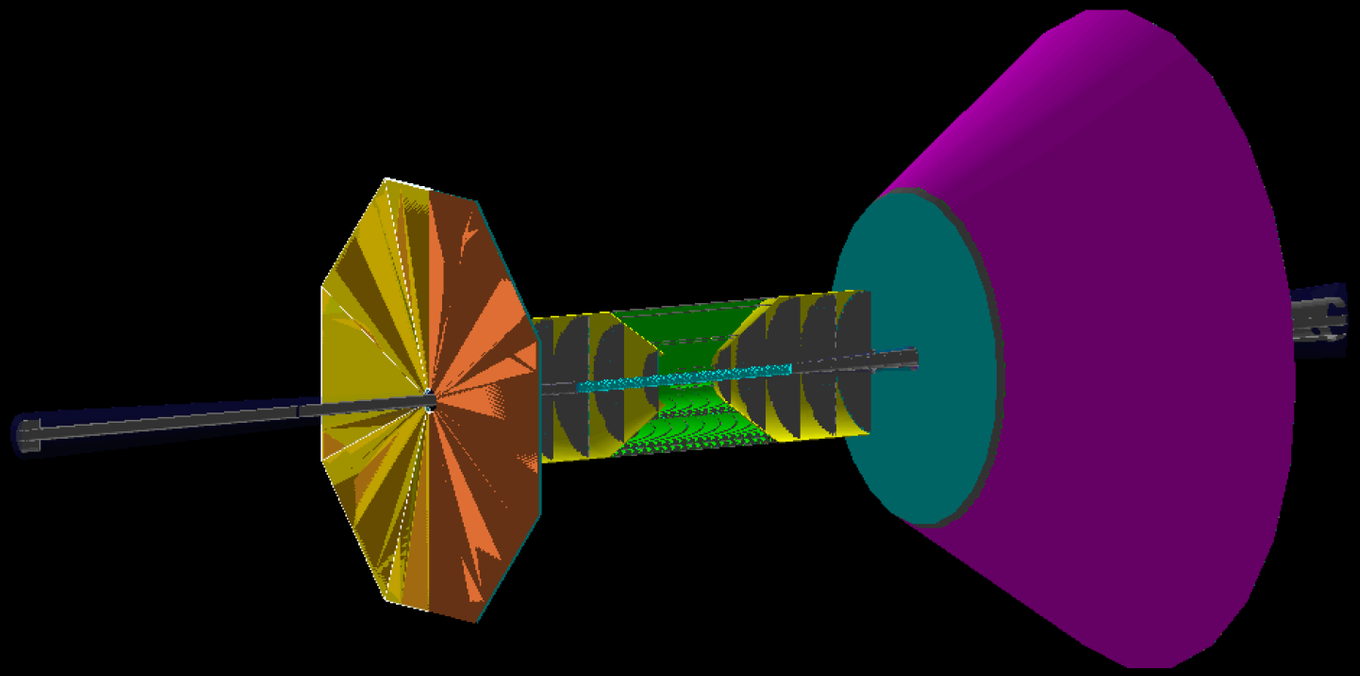
$\sigma(\hat{r}) = 50\ \mu\text{m}$

$\sigma(\hat{\phi}) = 50\ \mu\text{m}$

To do:

* Add RICH volume between All-Si tracker and forward GEM
* Add Backward GEM

RICH geometry details from Evaristo Cisbani
(evaristo.cisbani@roma1.infn.it)



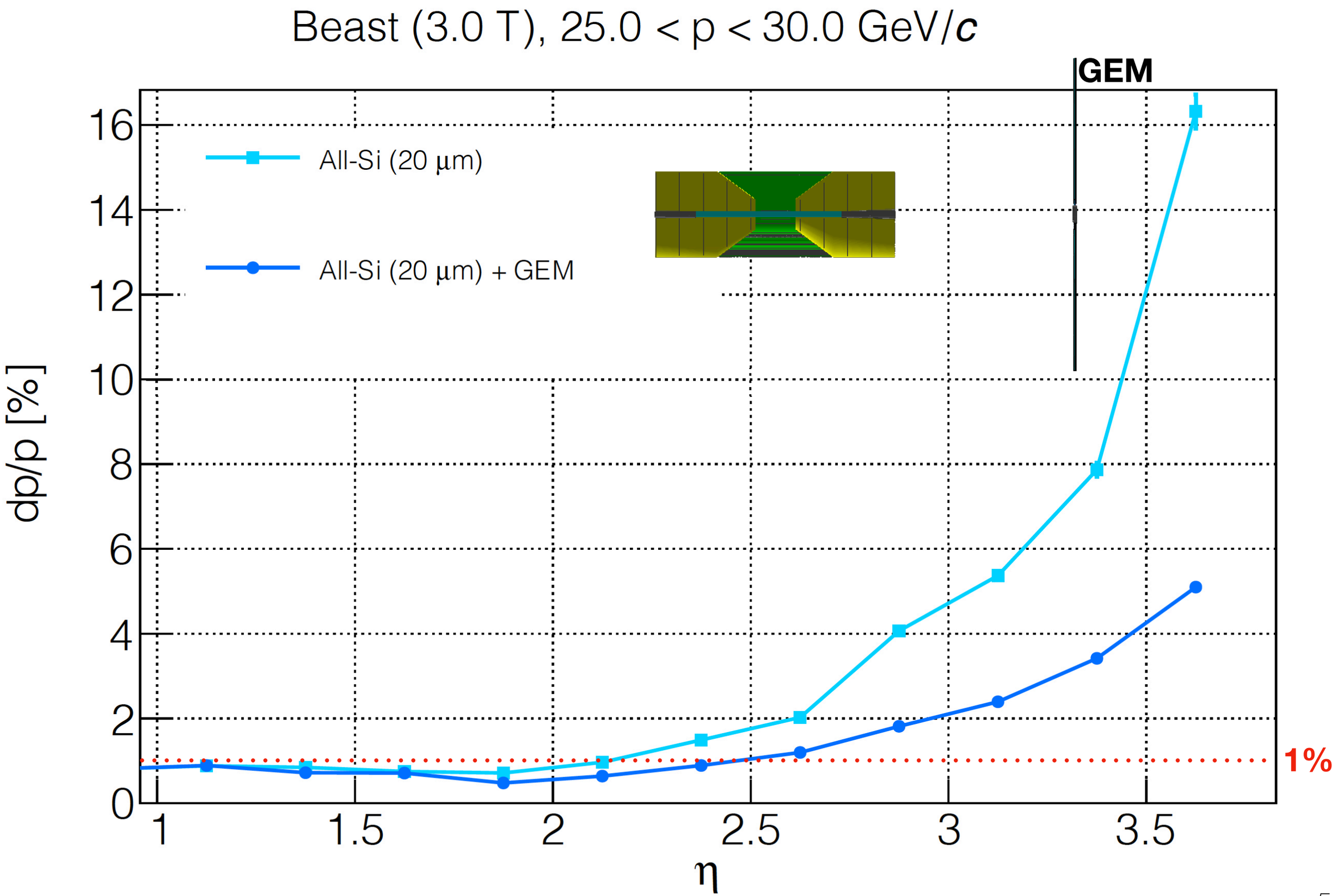
GEM

All-Si tracker

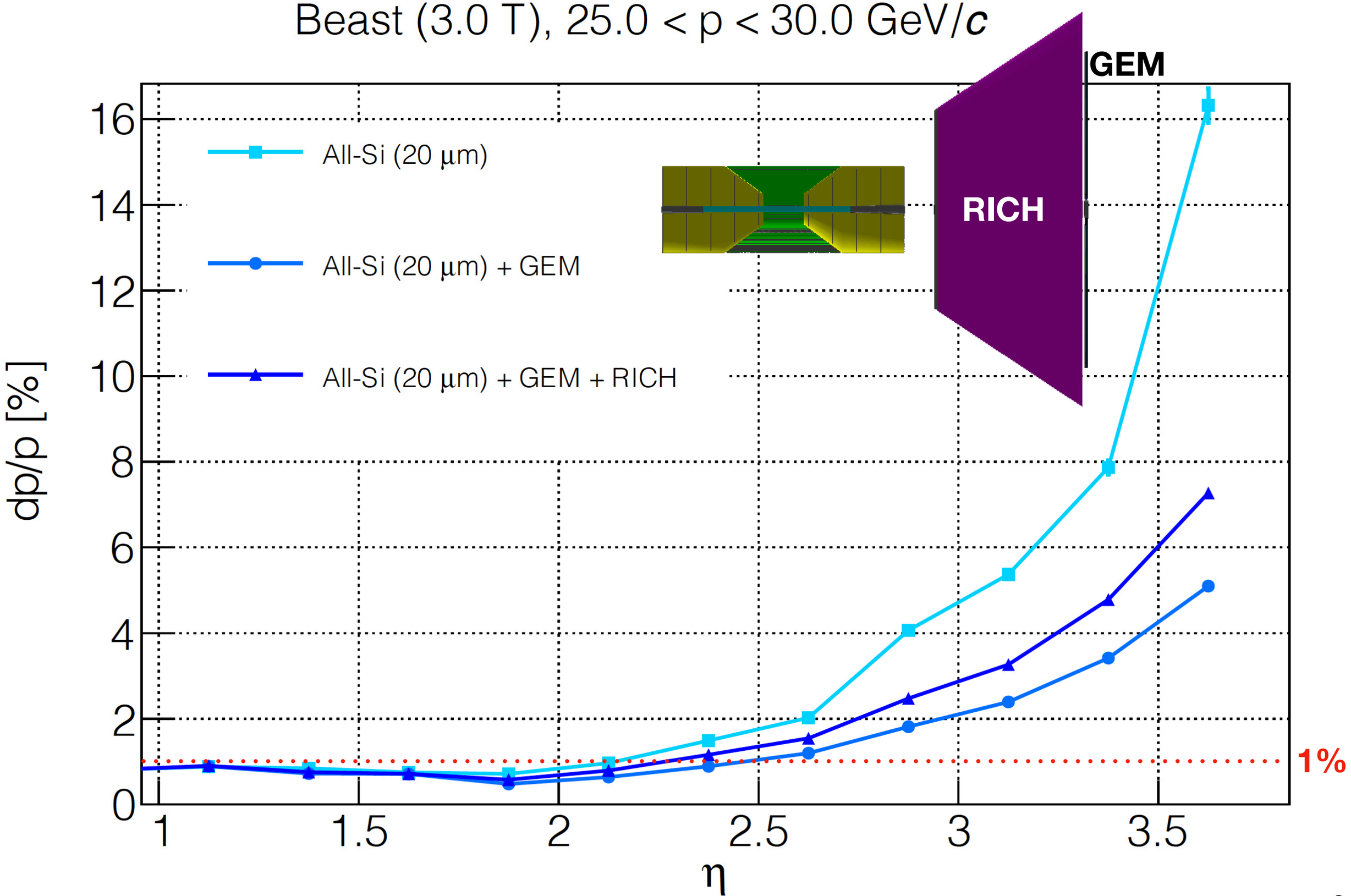
RICH

GEM

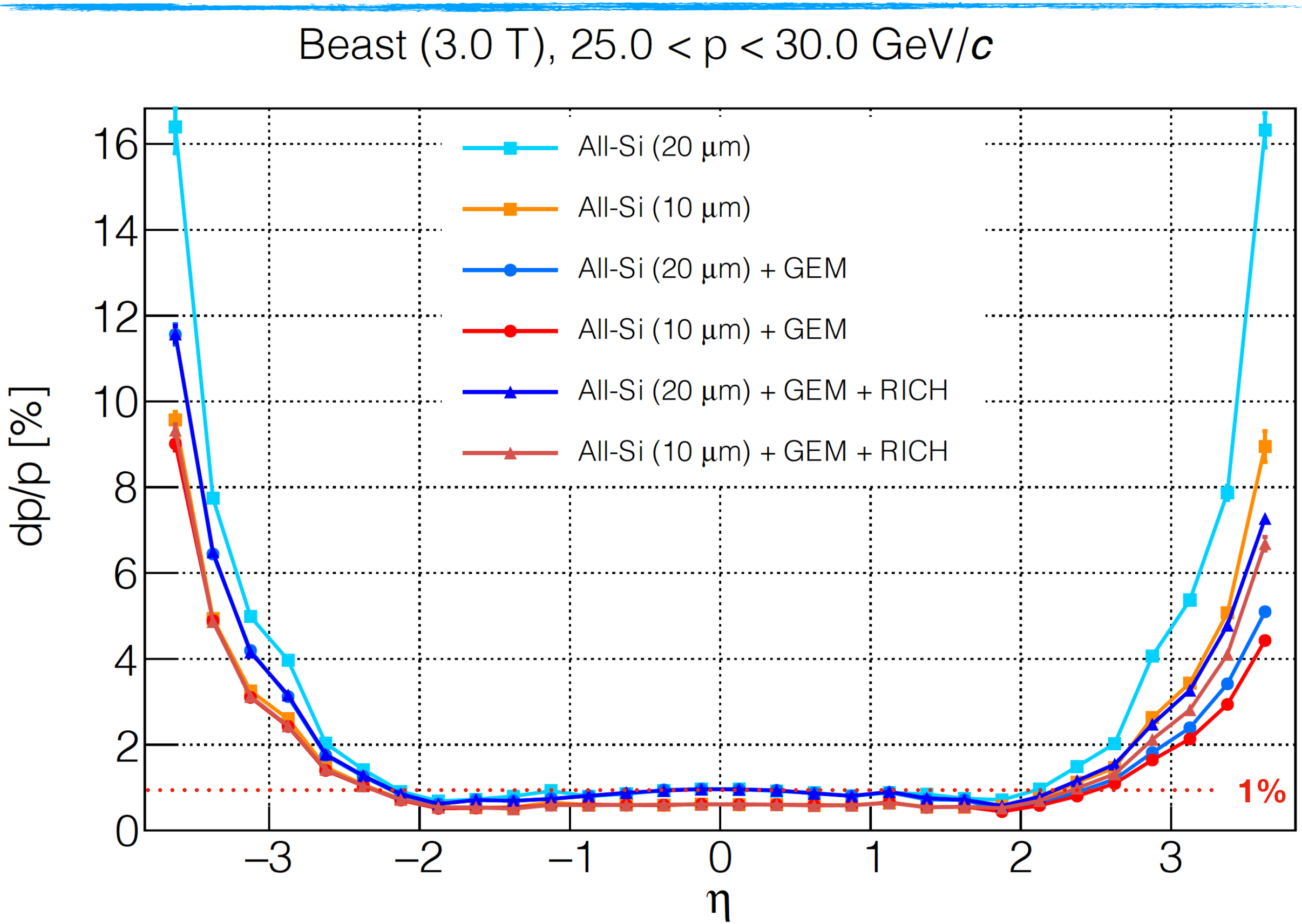
GEM and RICH effect on momentum resolution



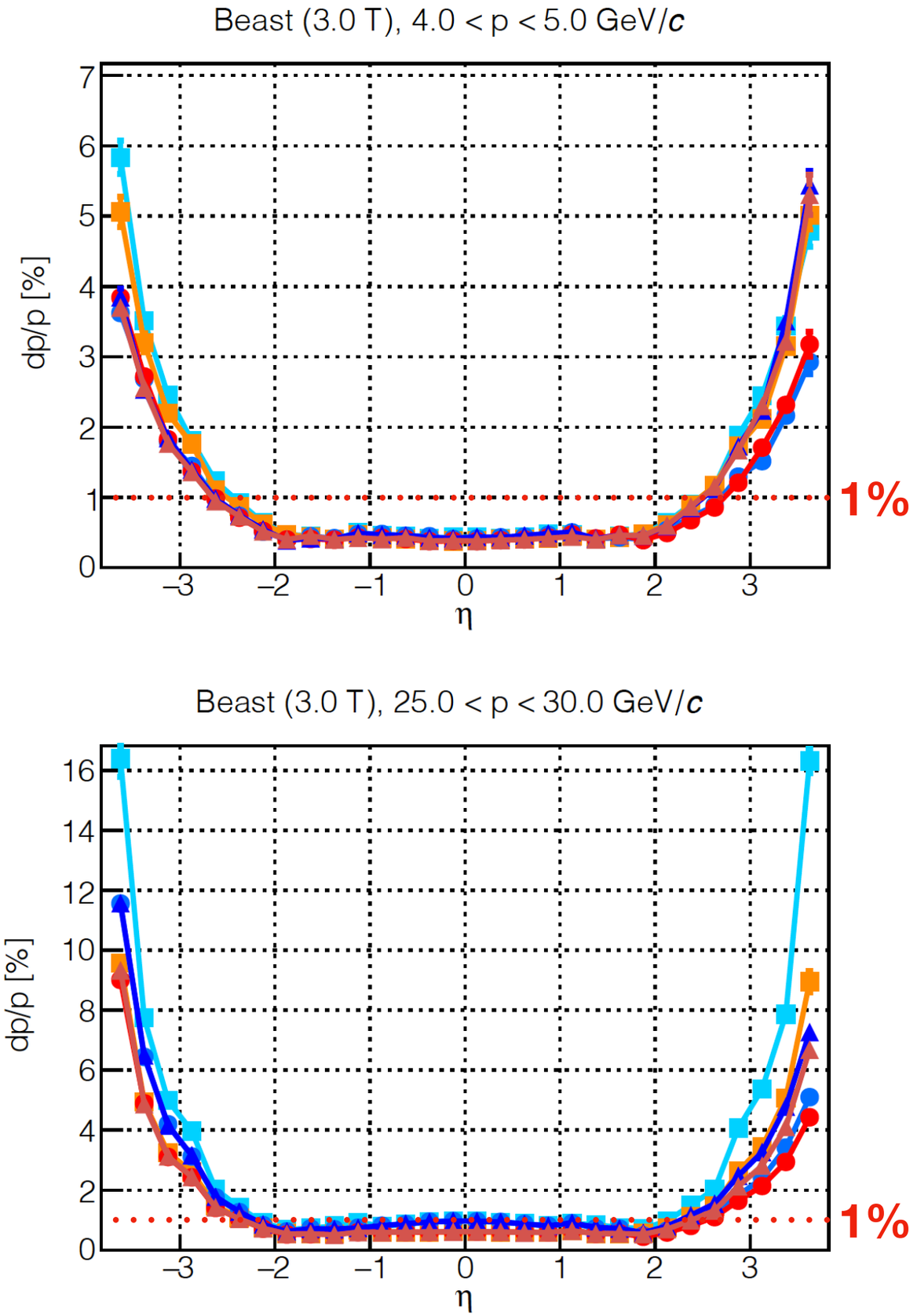
GEM and RICH effect on momentum resolution

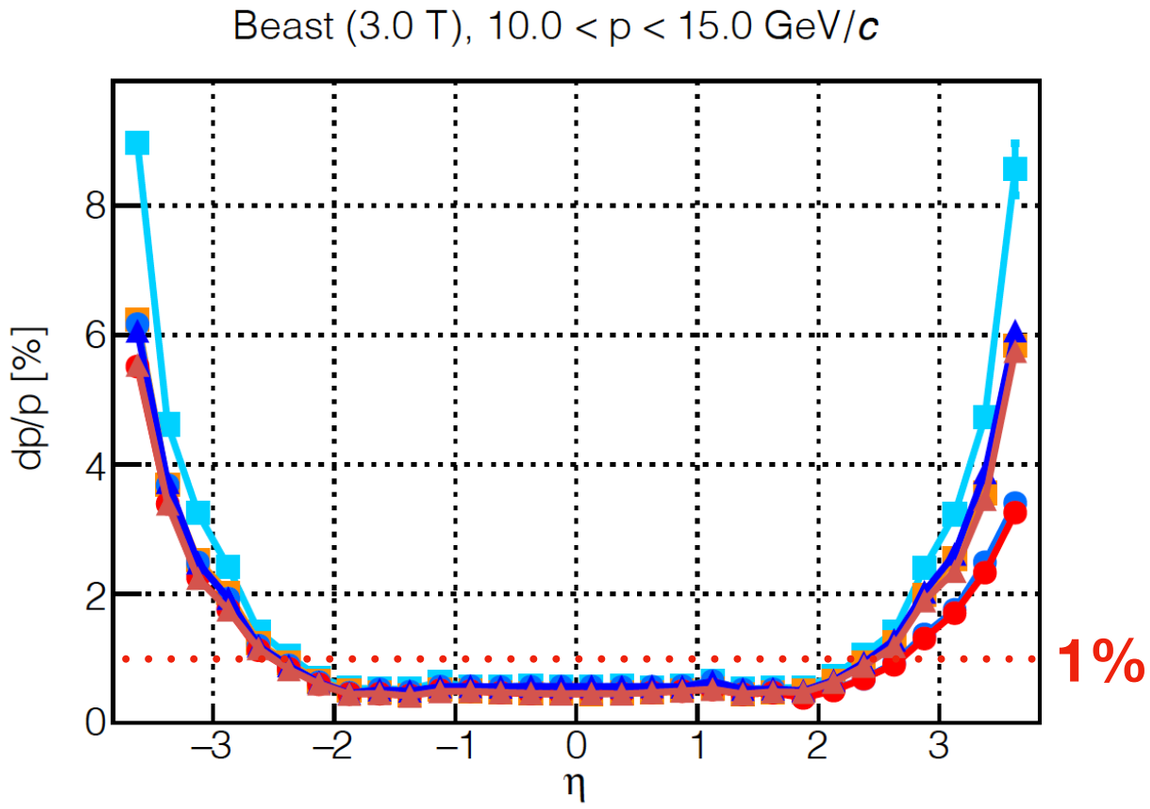


GEM and RICH effect on momentum resolution

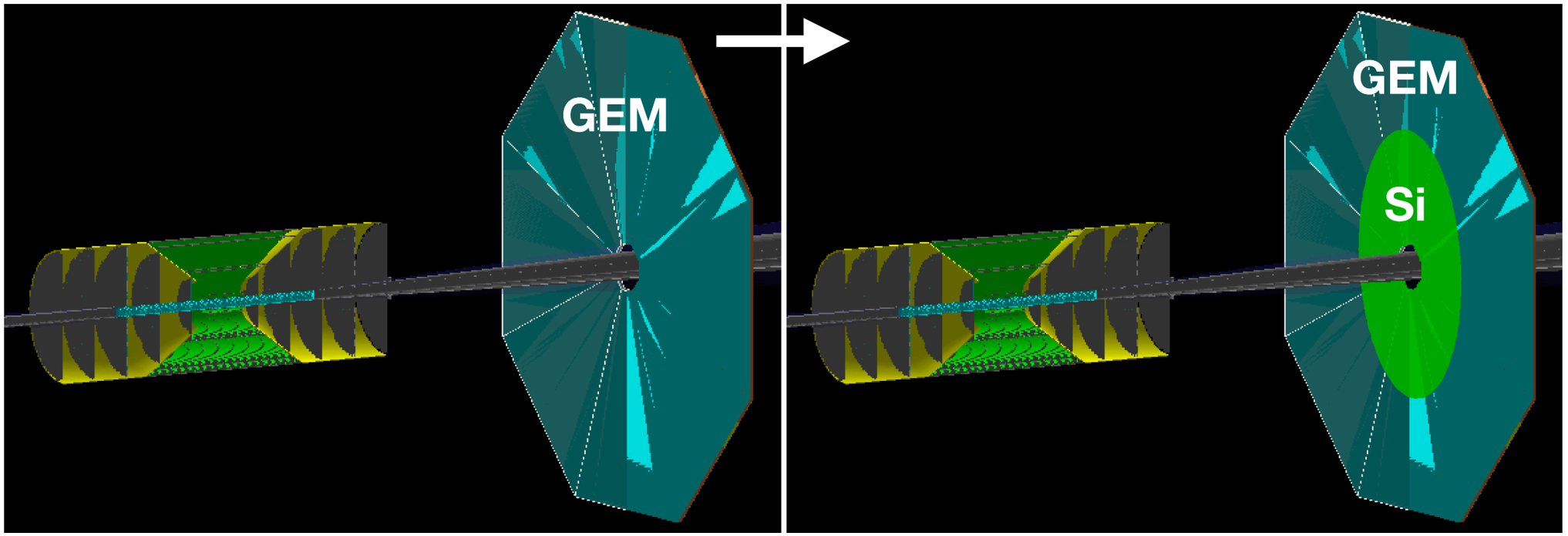


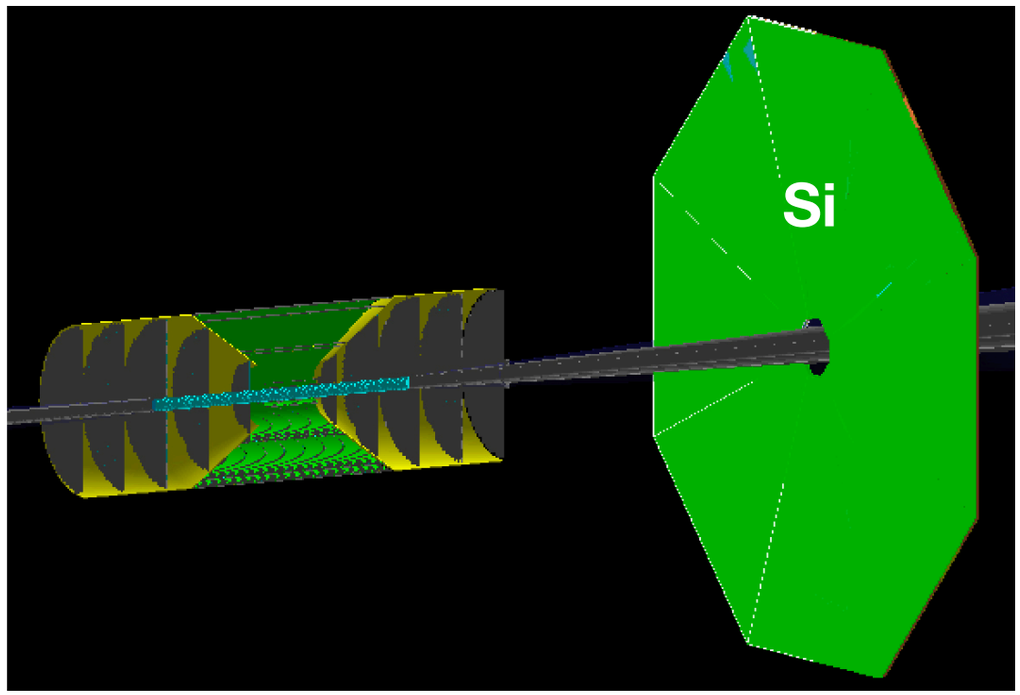
Momentum resolution for 3 momentum bins





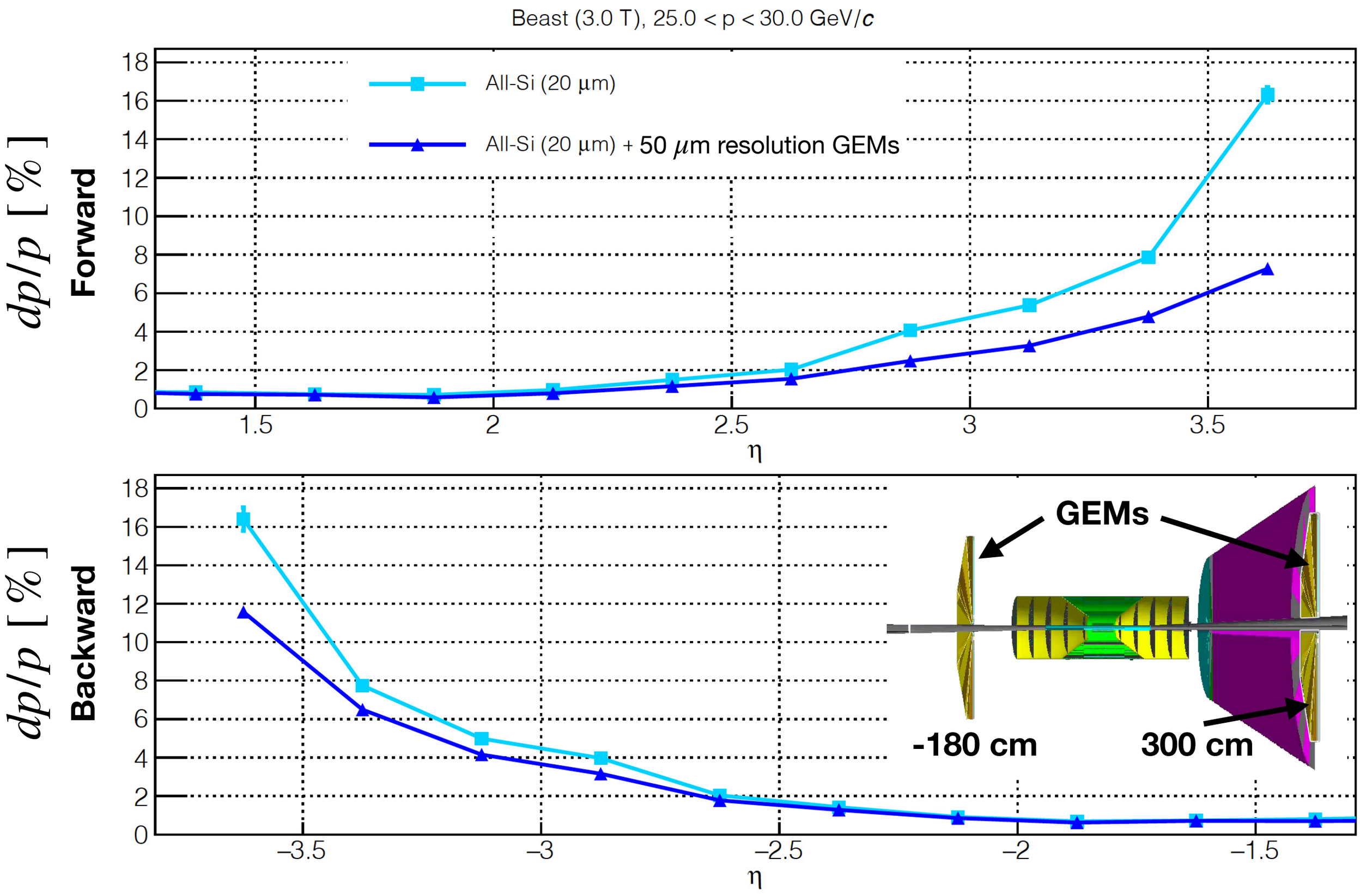
From GEM to Si disk



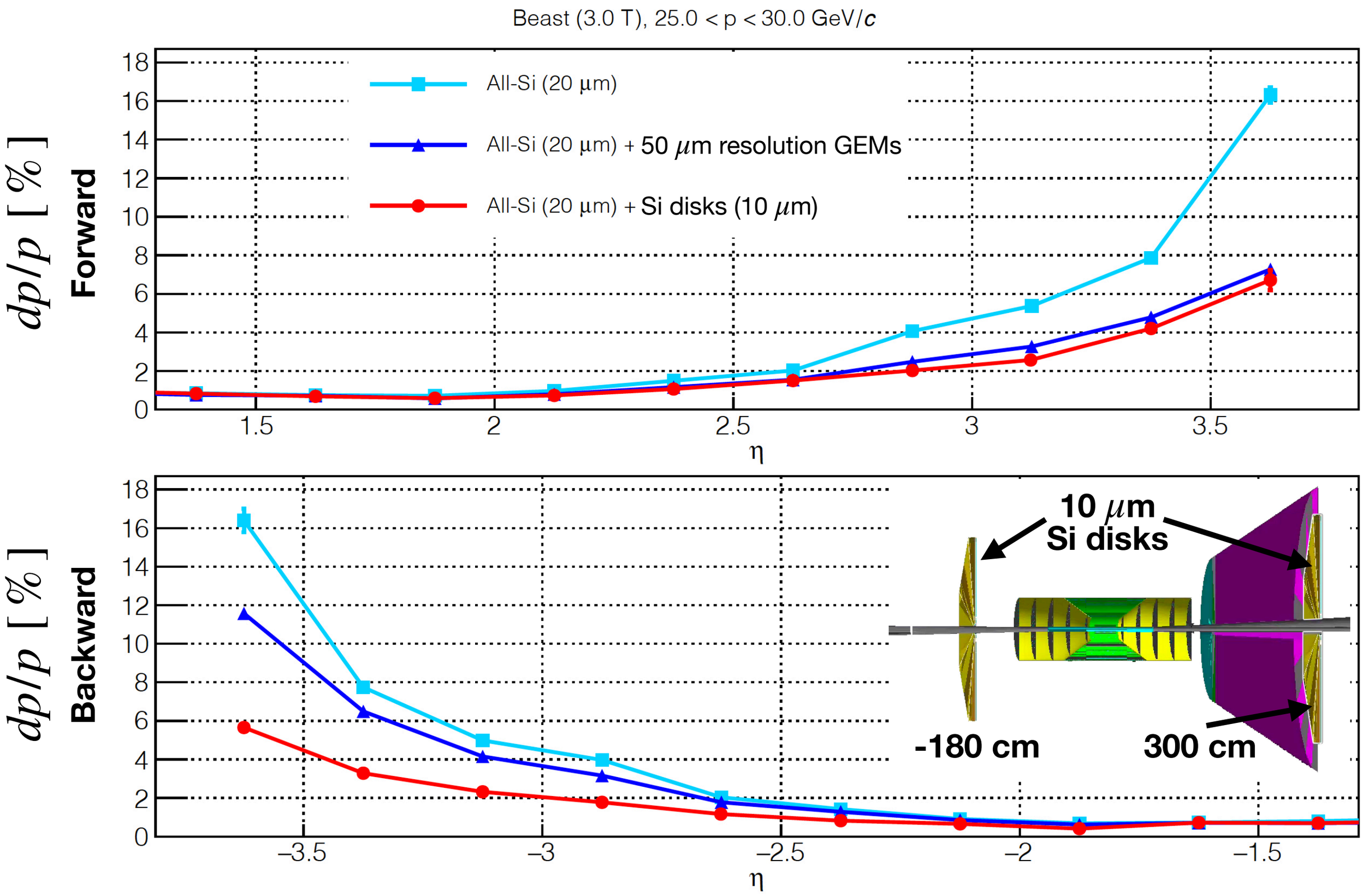


Explore possibility of using a Si disk instead of a GEM

Complementing All-Si tracker with other detectors



Complementing All-Si tracker with other detectors



Summary and Conclusions

- Added GEMs in the available space at backward pseudorapidities.

- Implemented “effective” RICH geometry between All-Si tracker and forward GEM.

- $50\ \mu\mathrm{m}$ GEM have strong impact on momentum resolution at higher momenta and pseudorapidities.

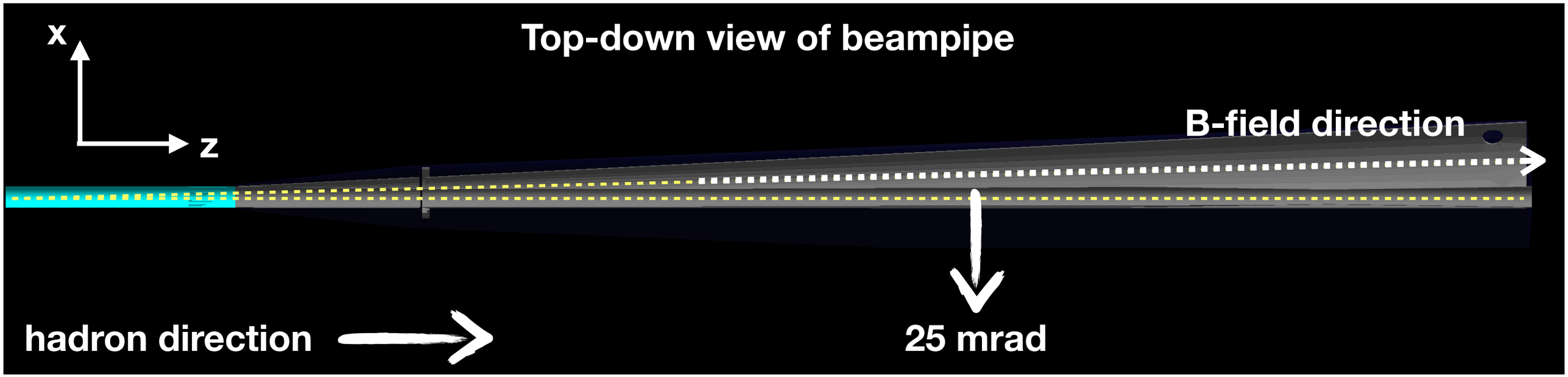
- Replacing GEM with Si disk has a more significant impact in the backward region.

Outline

- Complementing All-Si tracker

- Azimuthal momentum-resolution asymmetry in hadron direction

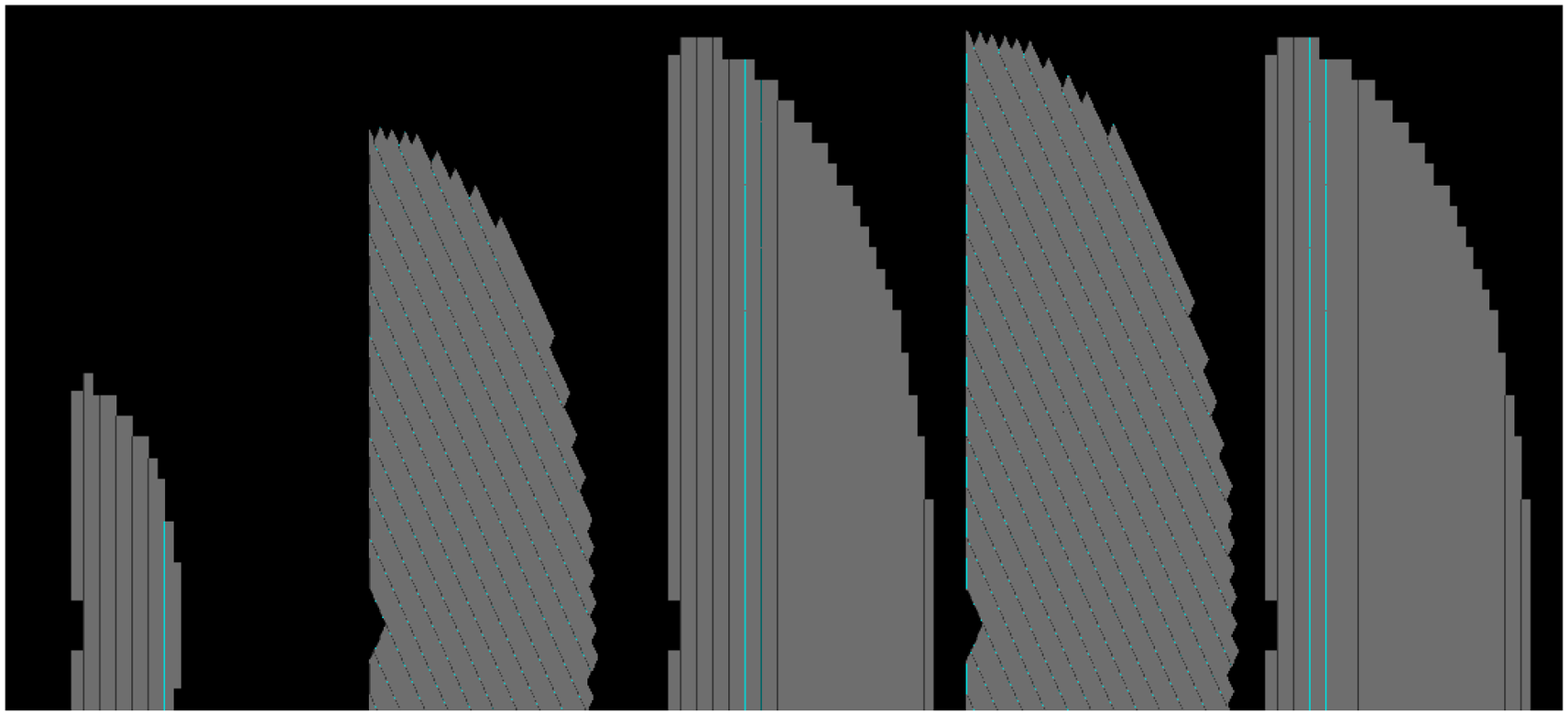
Introduction



- **B field rotated by 25 mrad in hadron-going direction**
- $\int B \cdot dl$ **depends on** ϕ
- **Assess asymmetry impact on momentum resolution**

Simplifying the geometry

The realistic Berkeley All-Si tracker is not azimuthally symmetric:



B field: uniform 3.0 T

Silicon disks

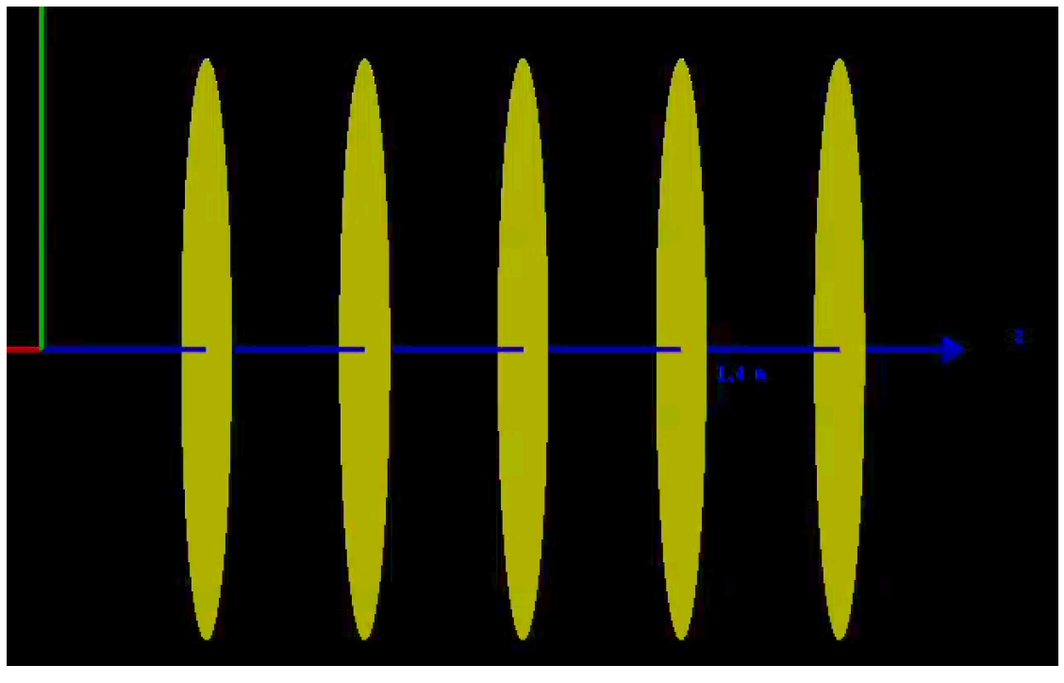
z = 25, 49, 73, 97, 121 cm

r_{min} = 0

r_{max} = 44 cm

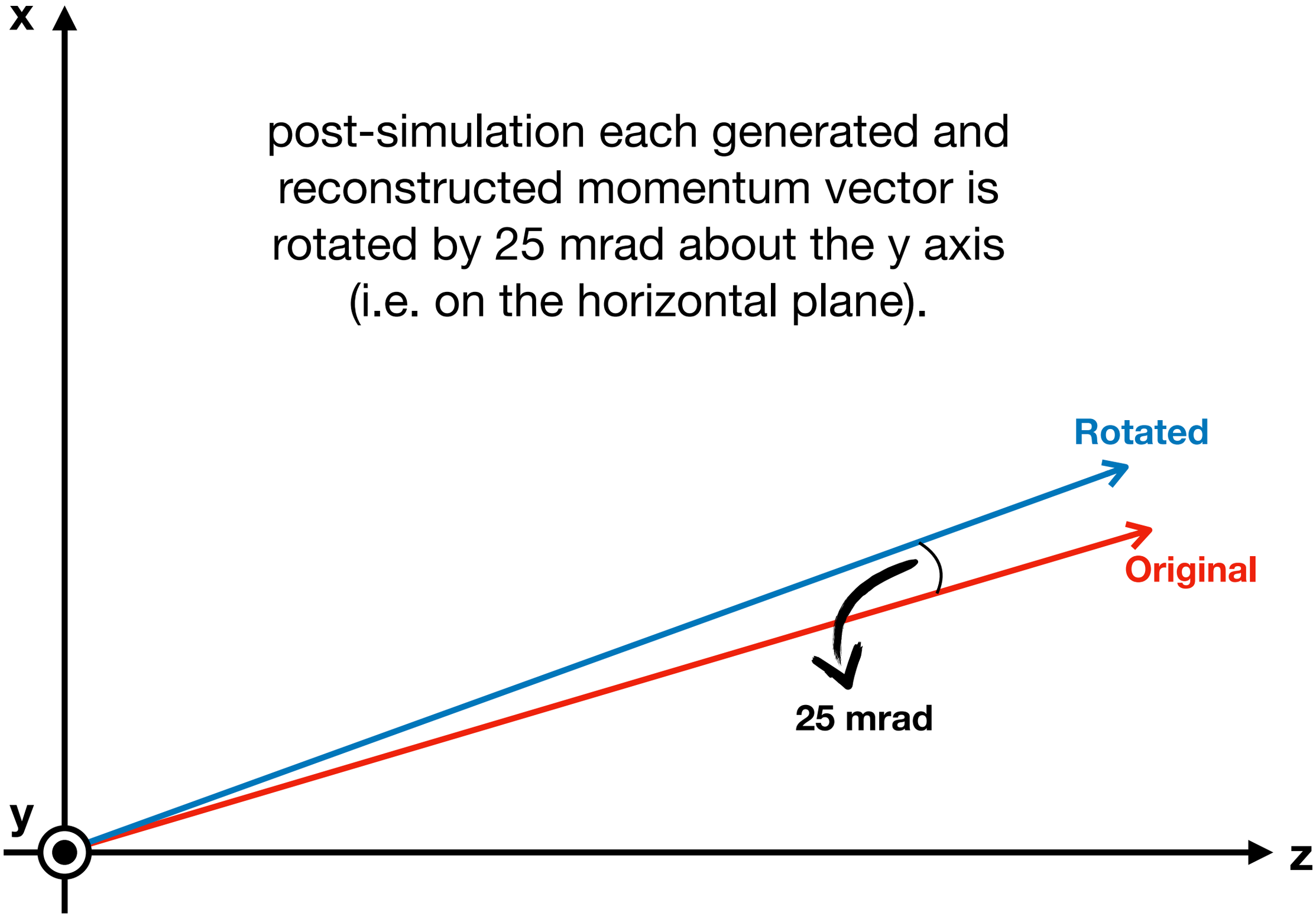
pixel size = 20 μm

material = 0.3% X/X_0 each

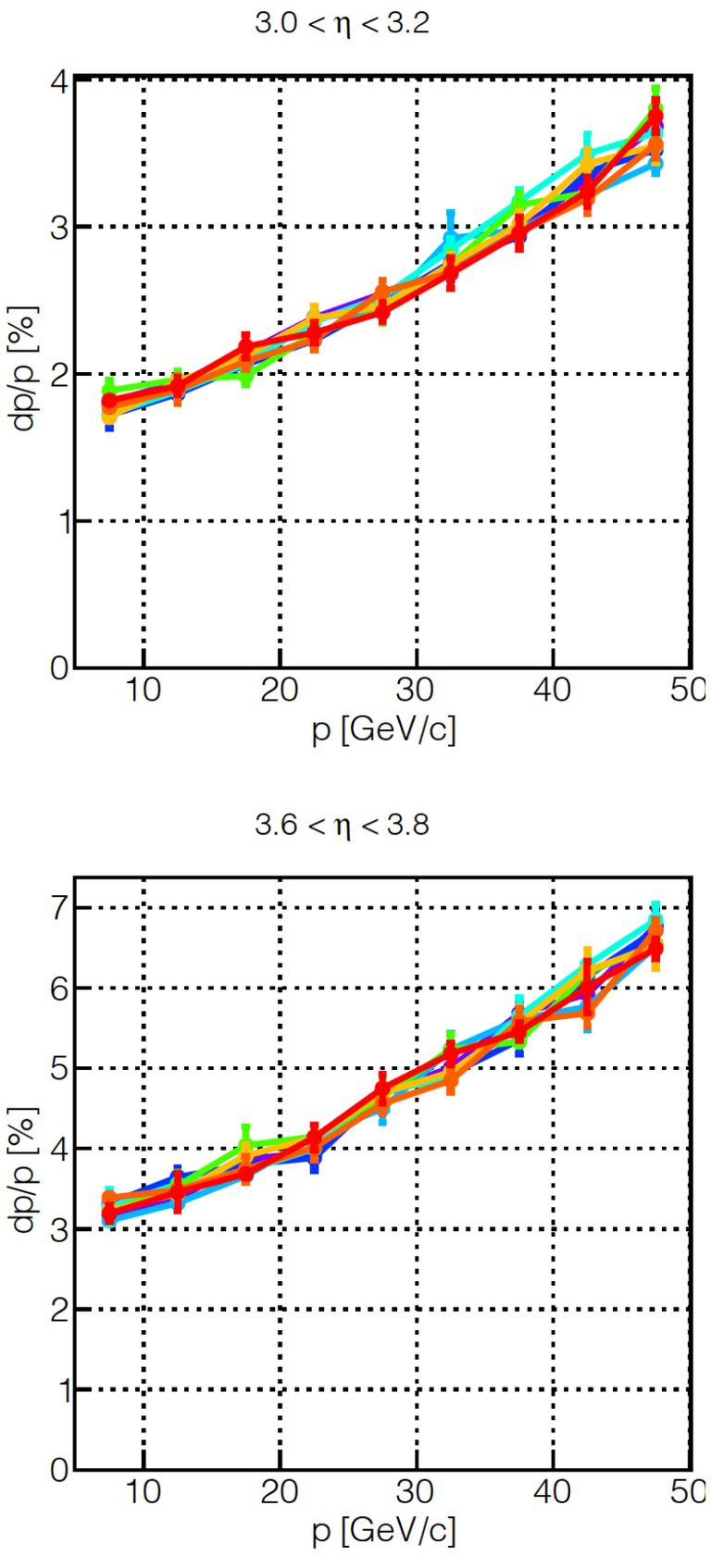


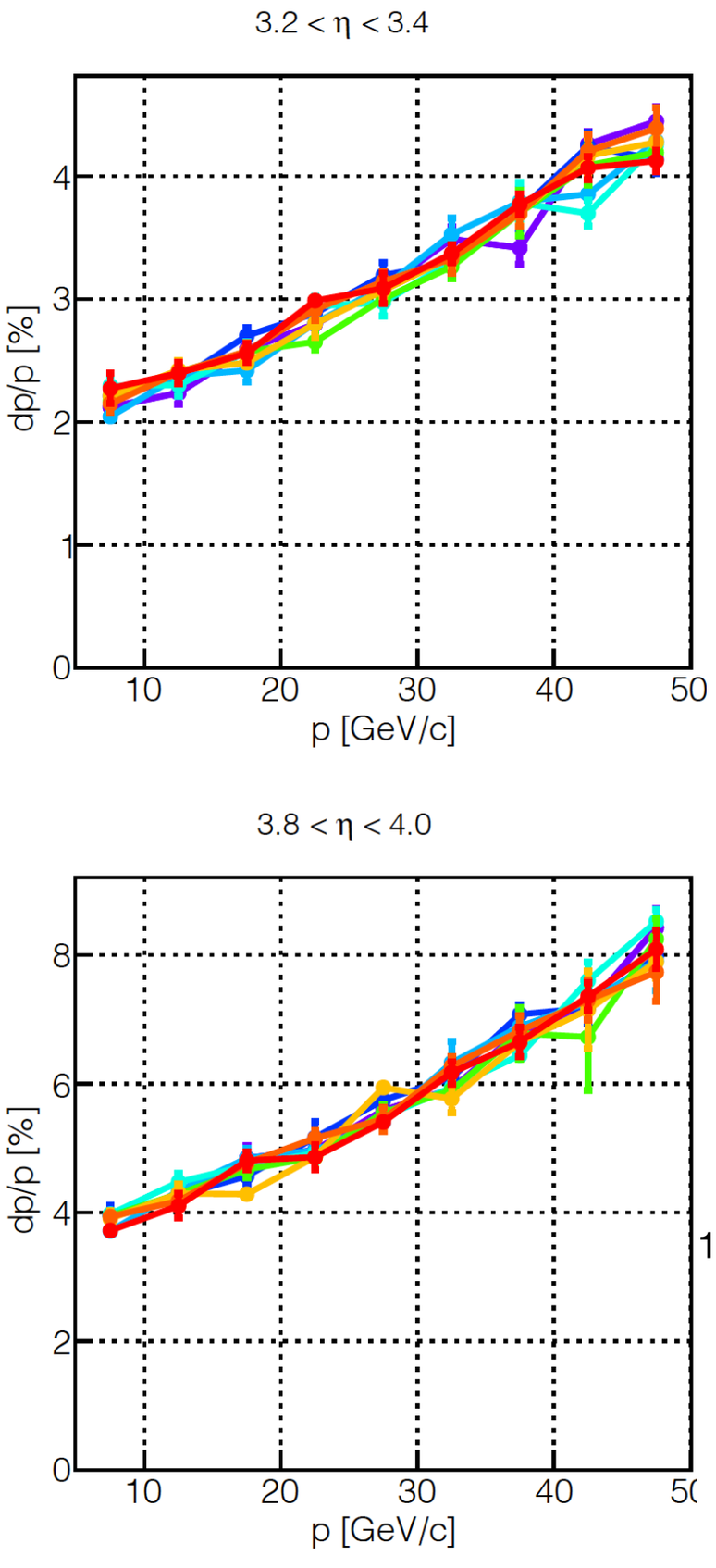
Rotation

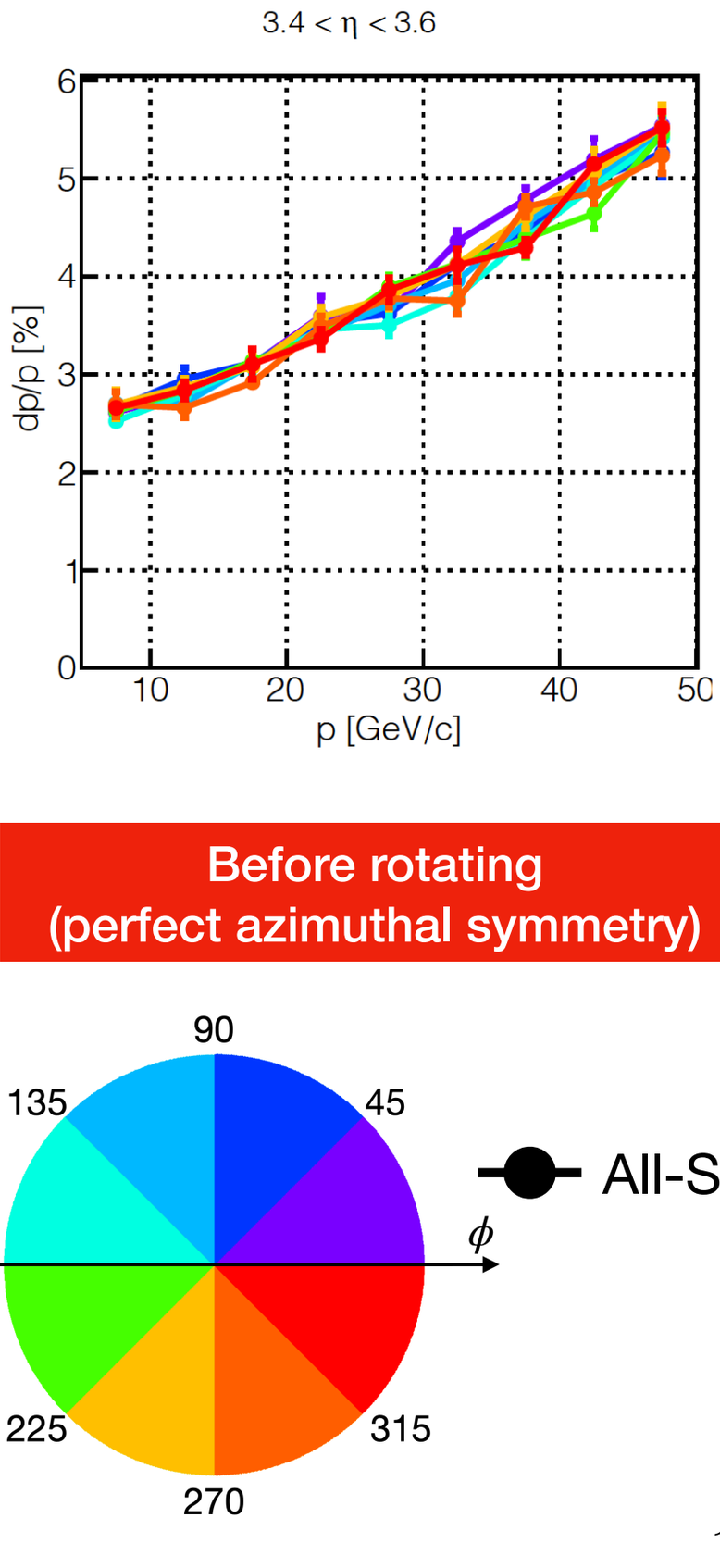
post-simulation each generated and reconstructed momentum vector is rotated by 25 mrad about the y axis (i.e. on the horizontal plane).



Momentum resolutions before rotation

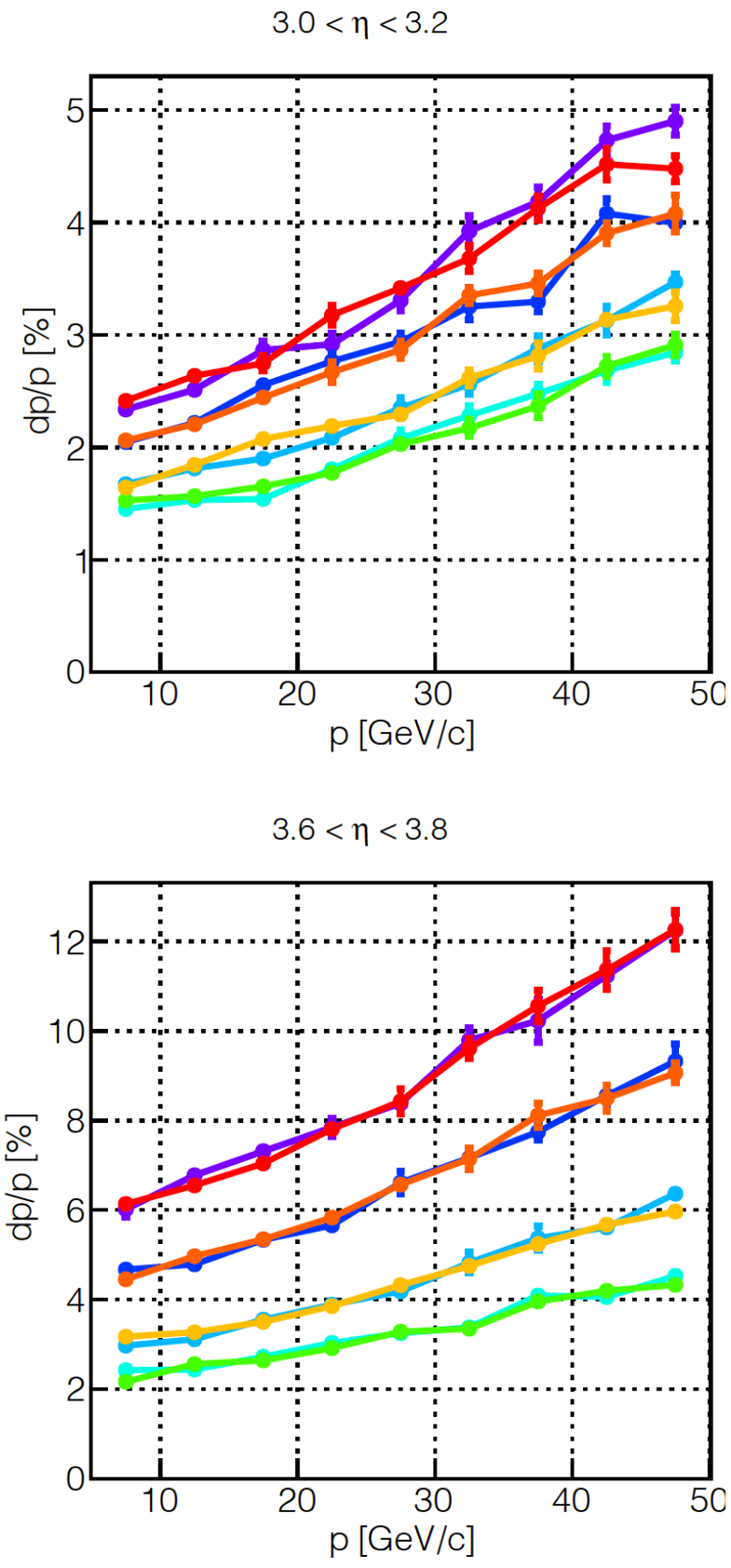


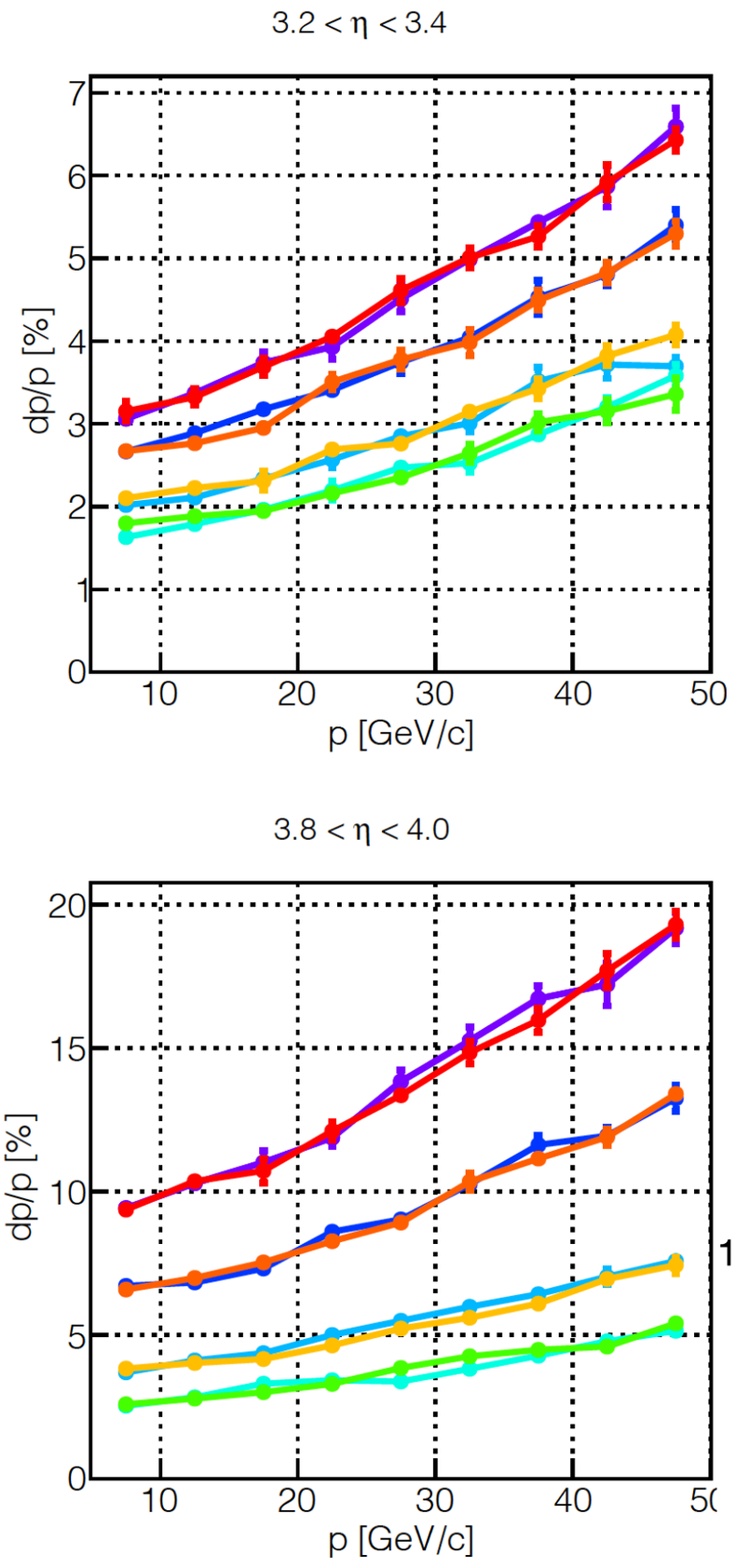


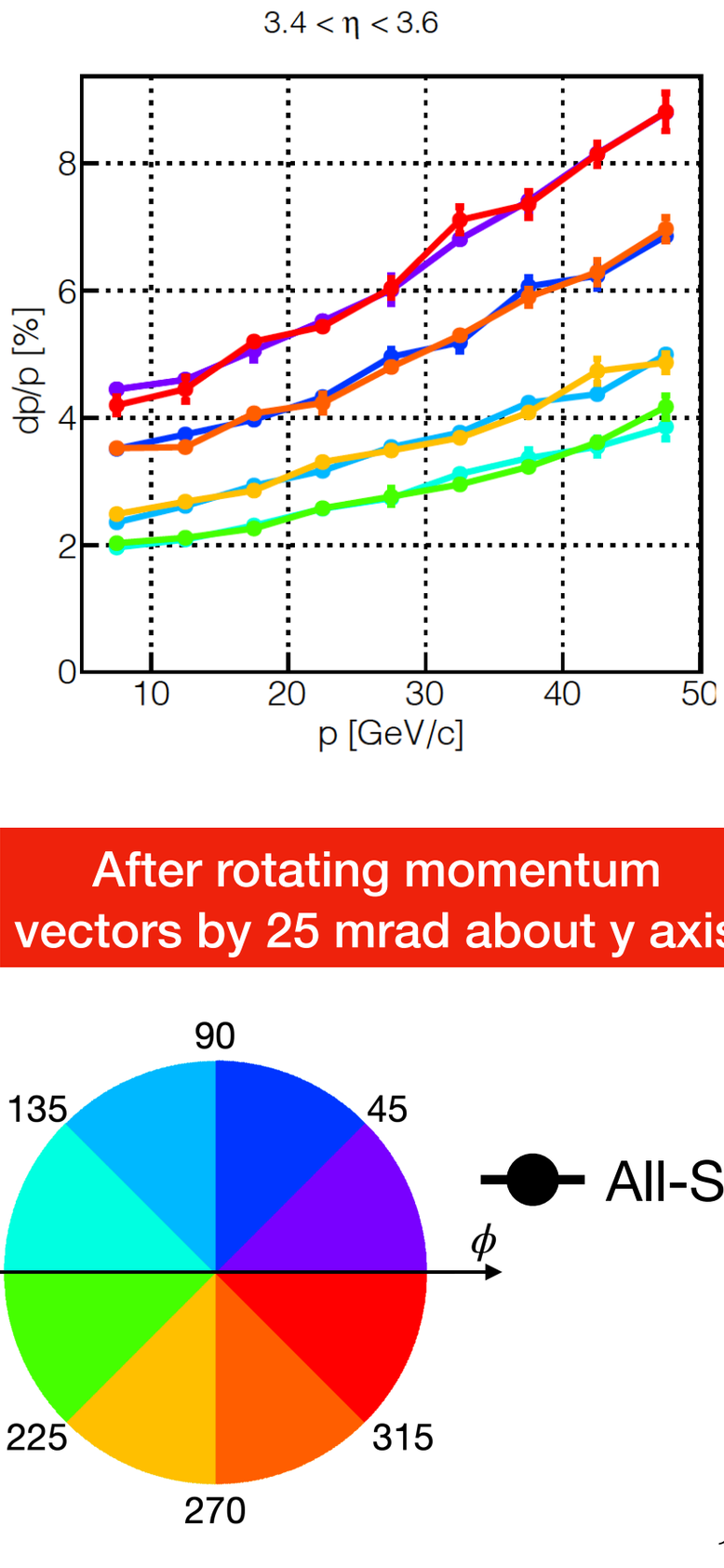


Before rotating (perfect azimuthal symmetry)

Momentum resolutions after rotation

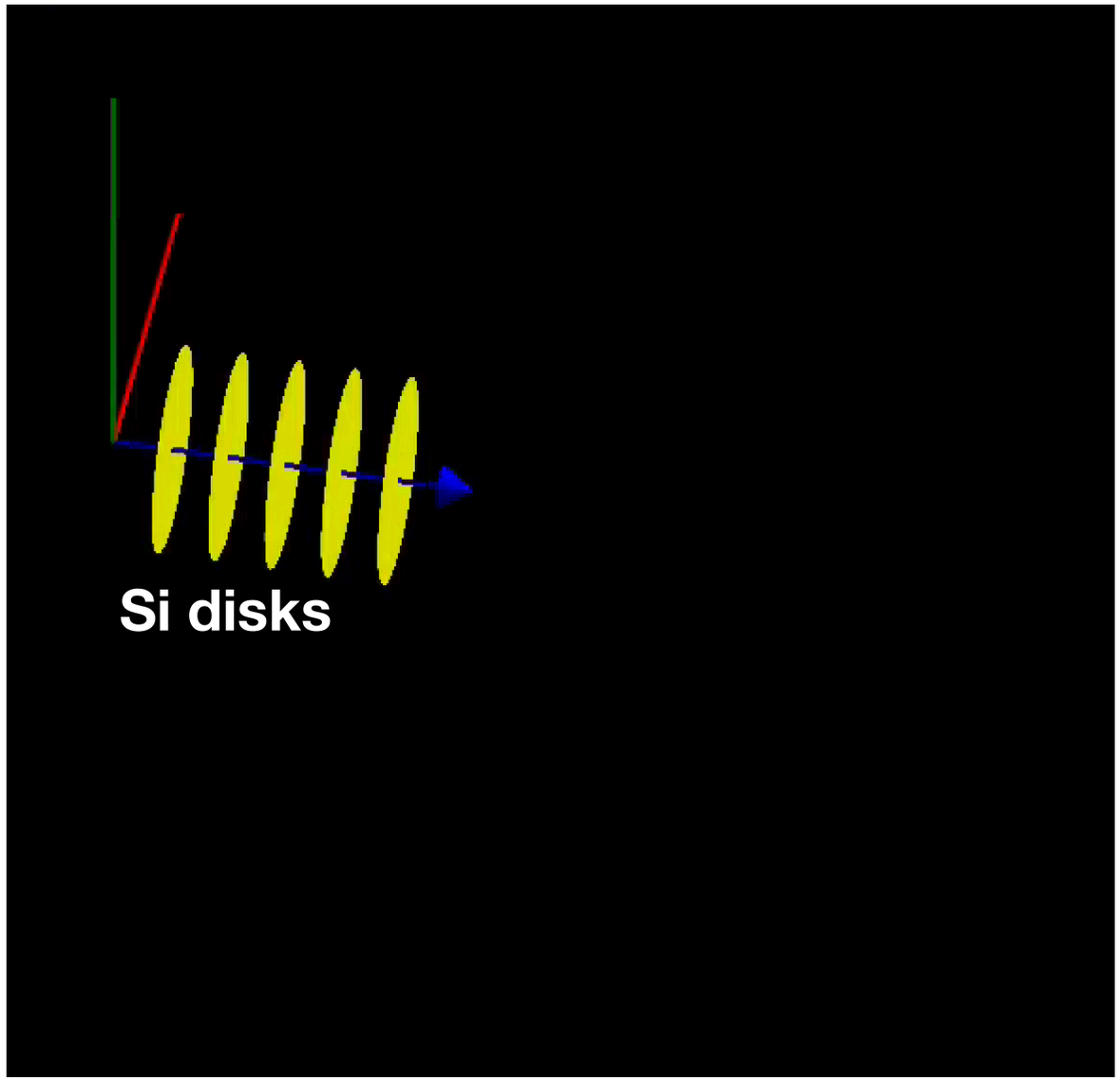






After rotating momentum vectors by 25 mrad about y axis

Detector layout (Si disks)



B field: uniform 3.0 T

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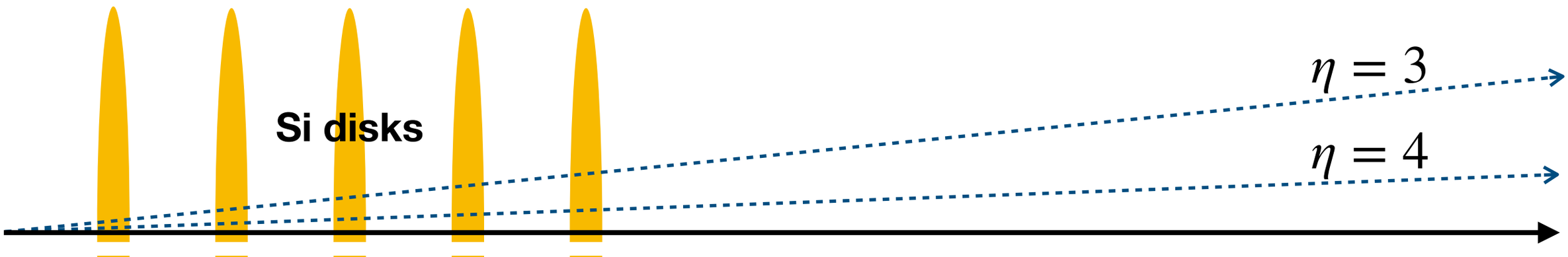
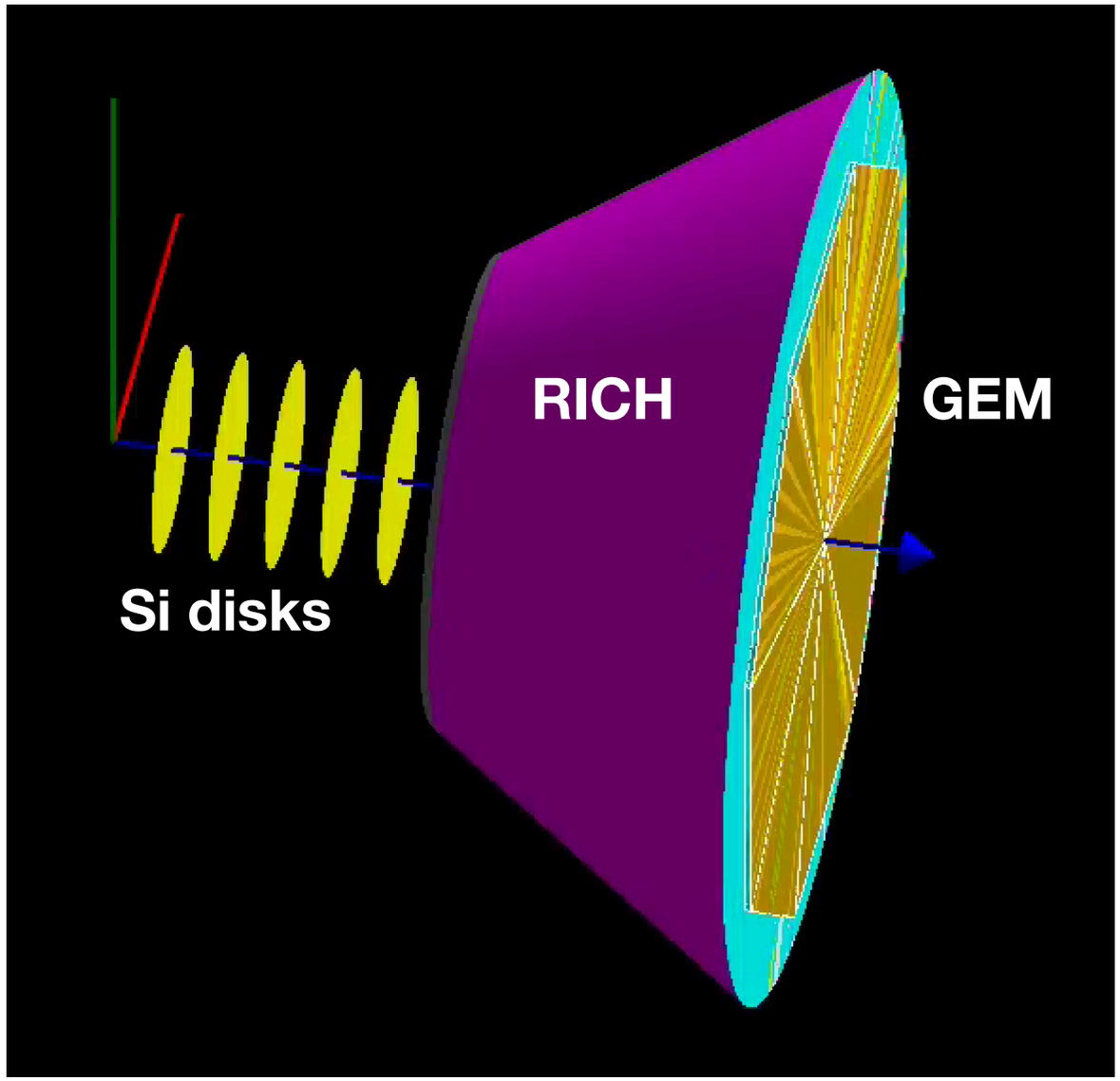


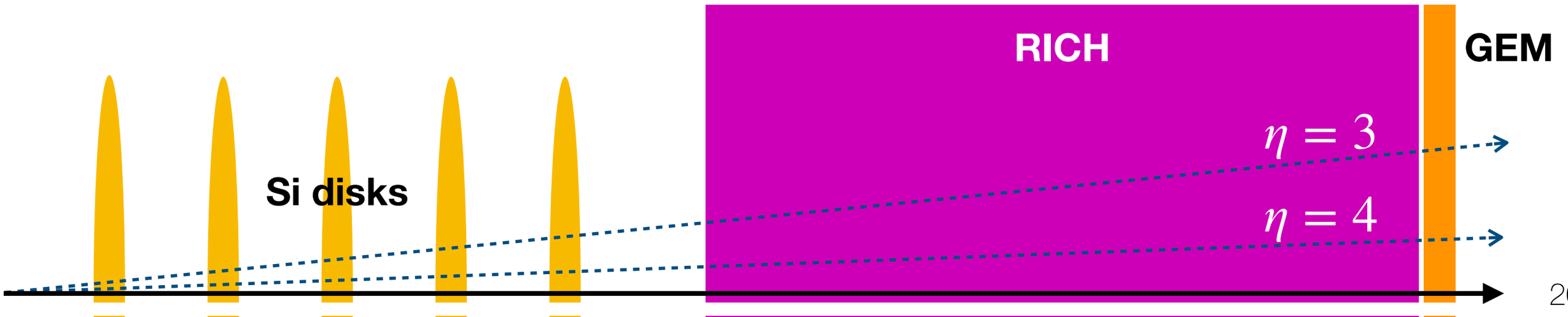
Detector layout (Si disks + GEM)



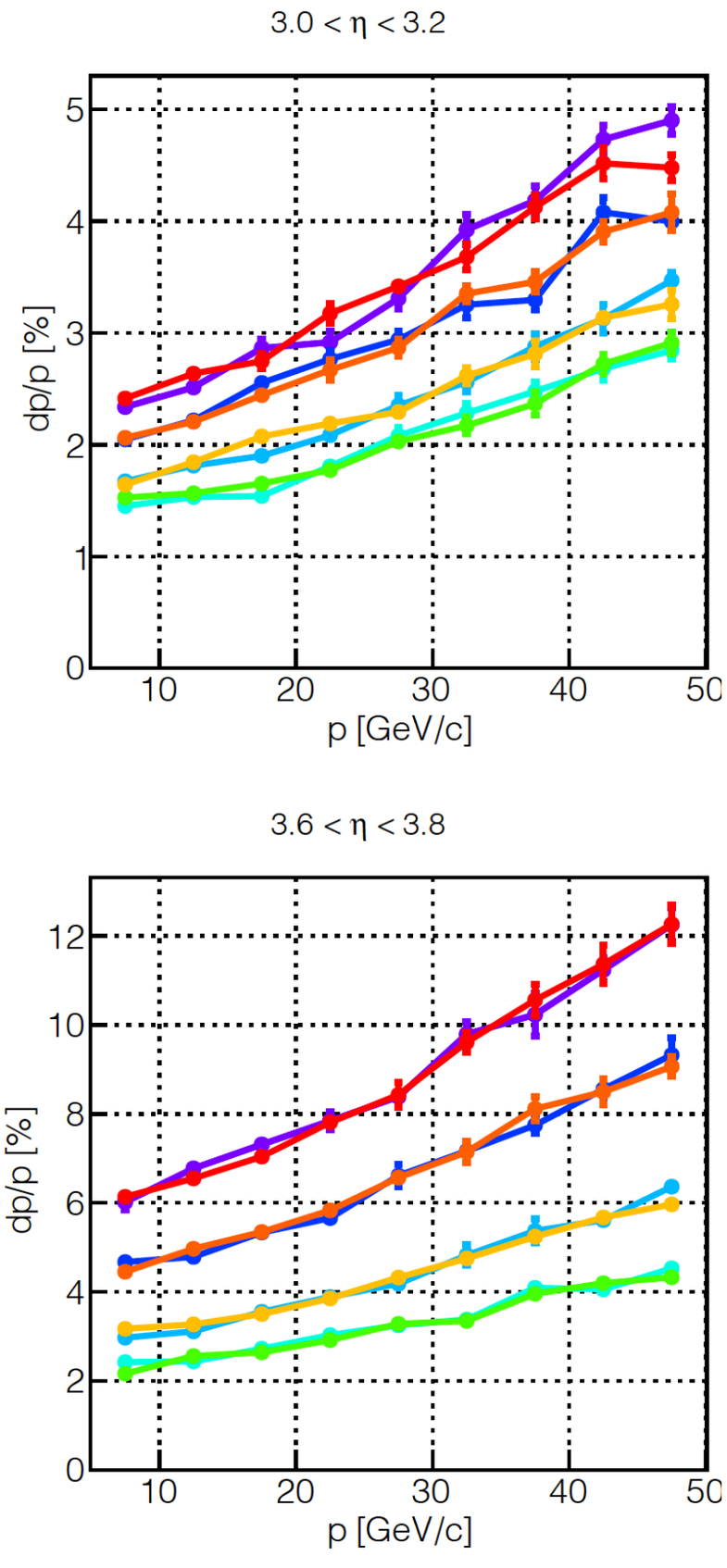
B field: uniform 3.0 T

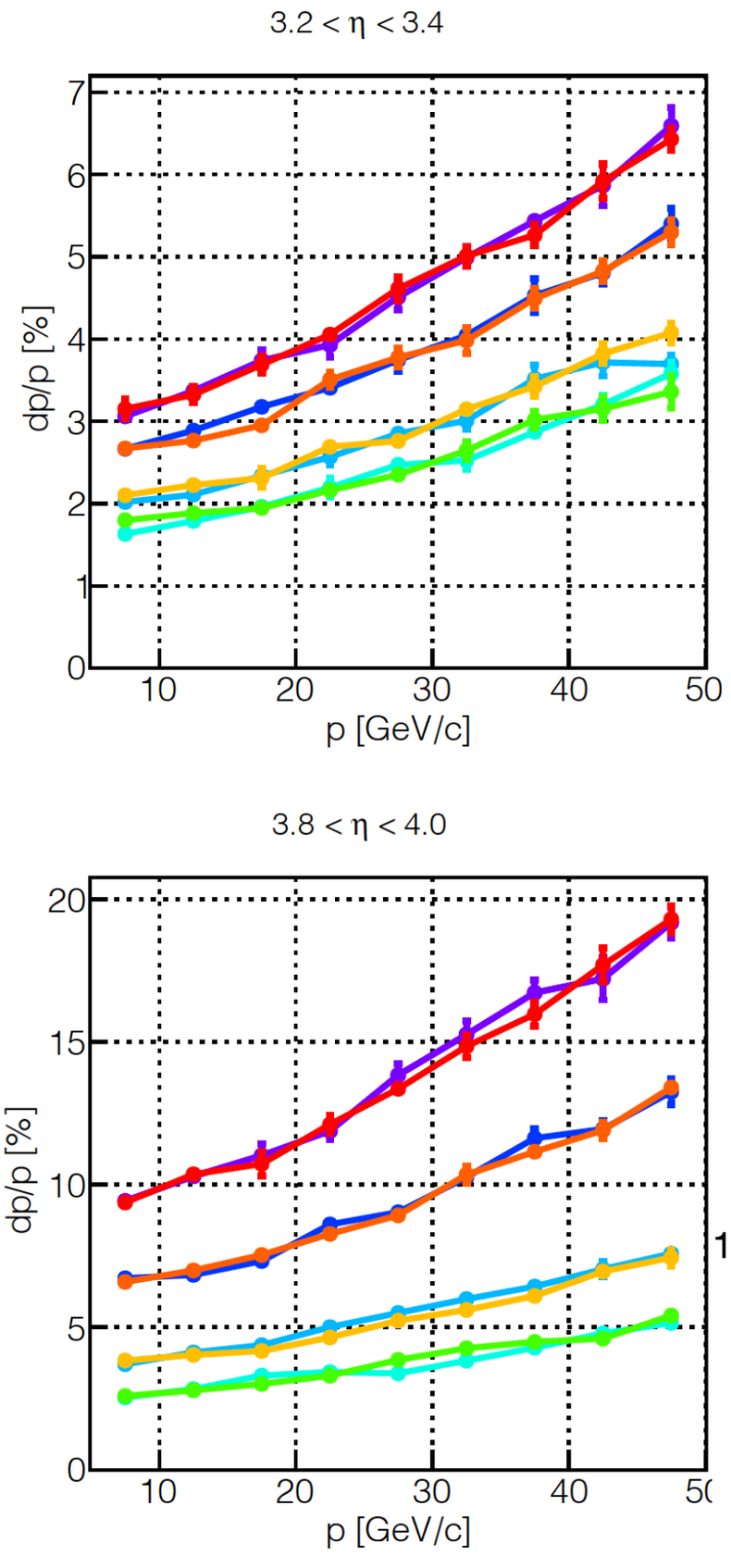
Silicon disks
z = 25, 49, 73, 97, 121 cm
r_{min} = 0
r_{max} = 44 cm
pixel size = 20 μm
material = 0.3% X/X_0 each

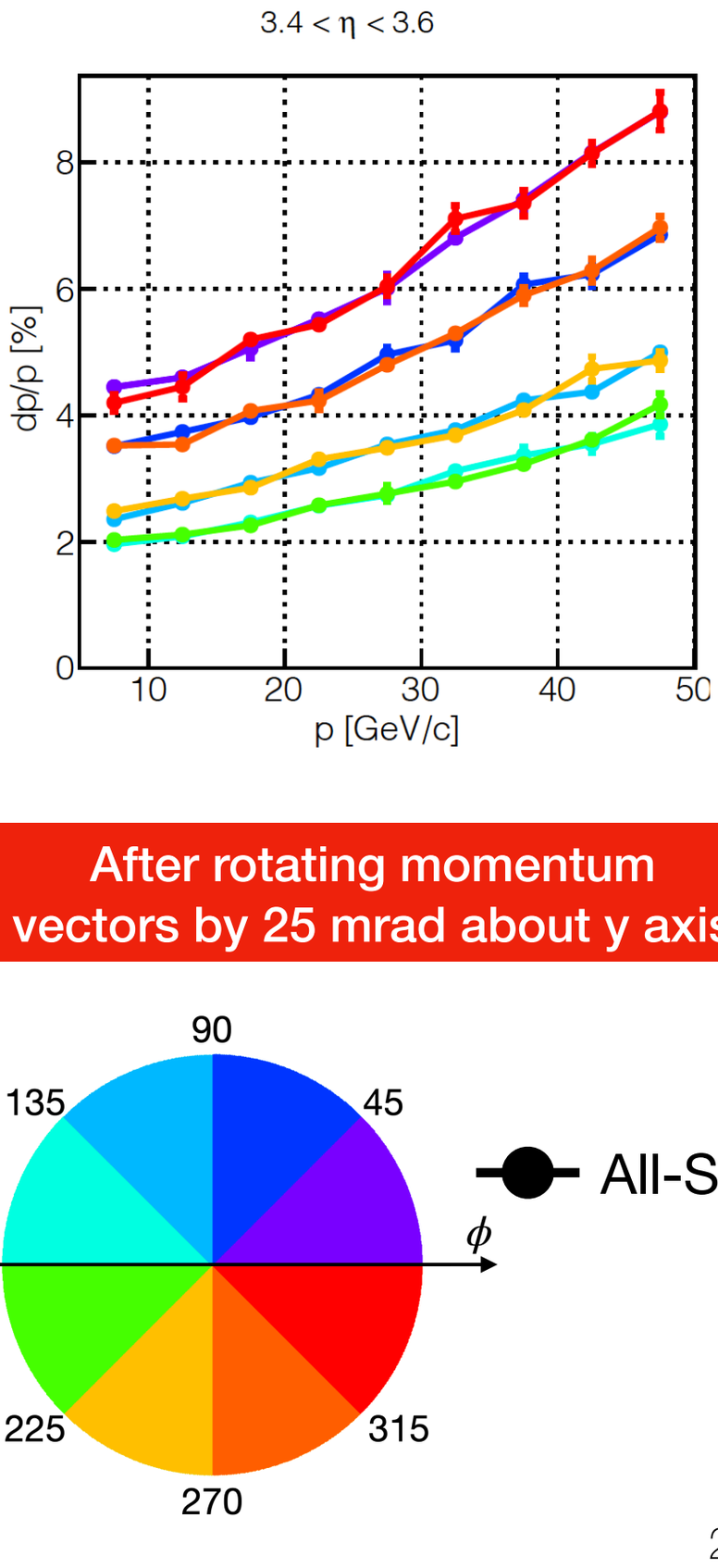
GEM
z position = 300 cm
$\sigma(\hat{r}) = 50\ \mu\mathrm{m}$
$\sigma(\hat{\phi}) = 50\ \mu\mathrm{m}$



Momentum resolutions after rotation

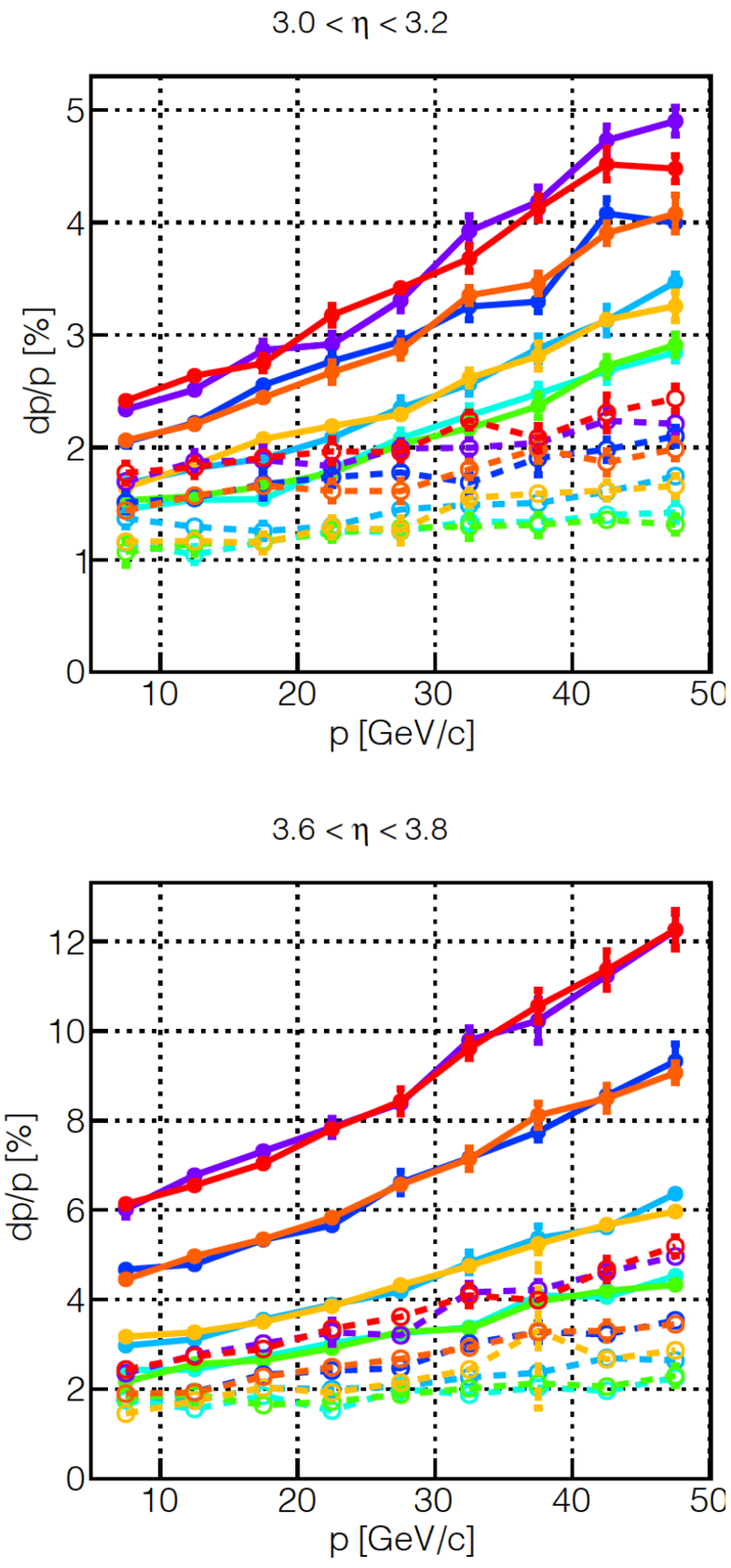


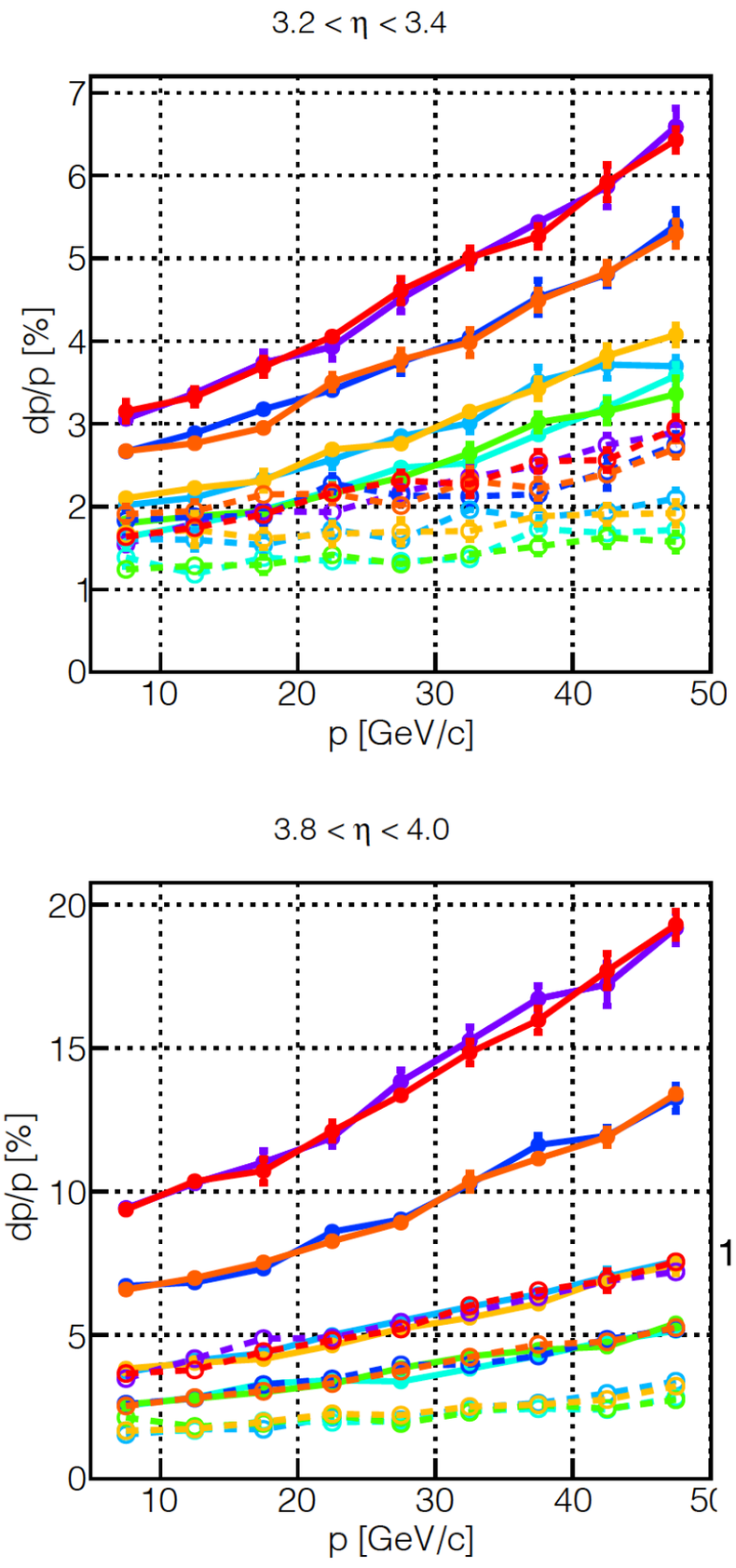


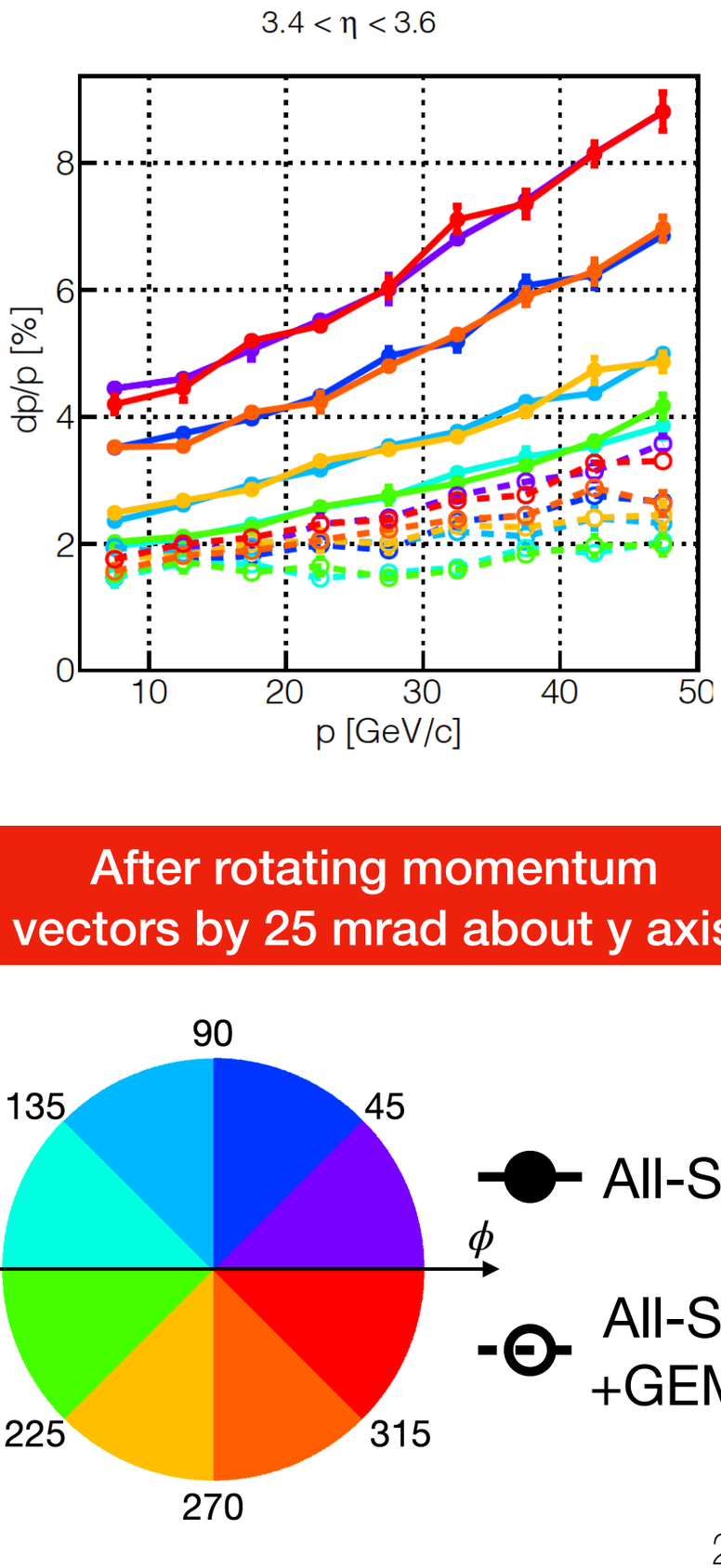


After rotating momentum vectors by 25 mrad about y axis

Momentum resolutions after rotation







After rotating momentum vectors by 25 mrad about y axis

All-Si

All-Si +GEM

Summary and Conclusions

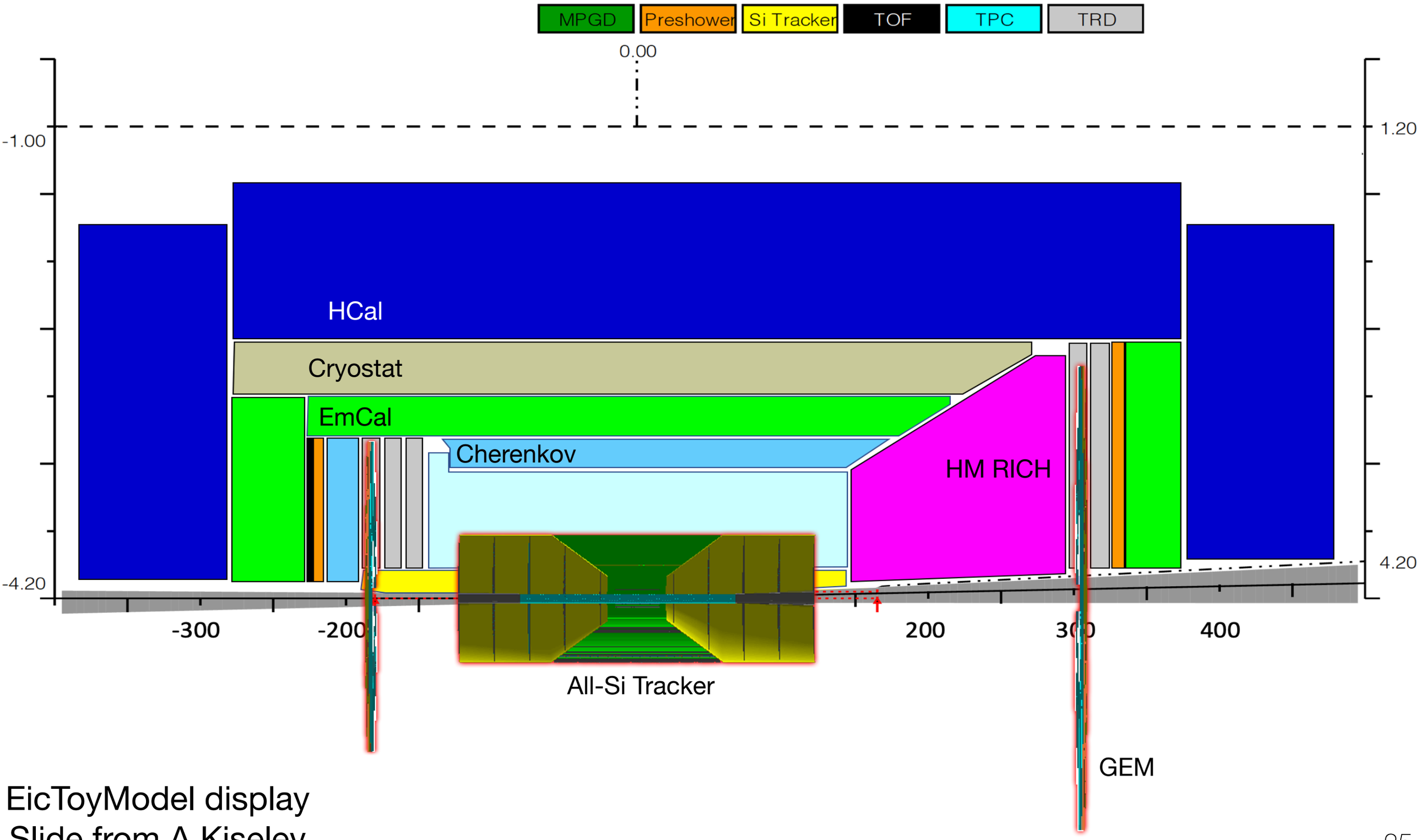
- Azimuthal momentum-resolution asymmetry needs to be taken into account in the hadron direction

- Significant momentum-resolution deterioration at higher momenta for $\phi \sim 0$

- Momentum resolution loss is recoverable with auxiliary tracking

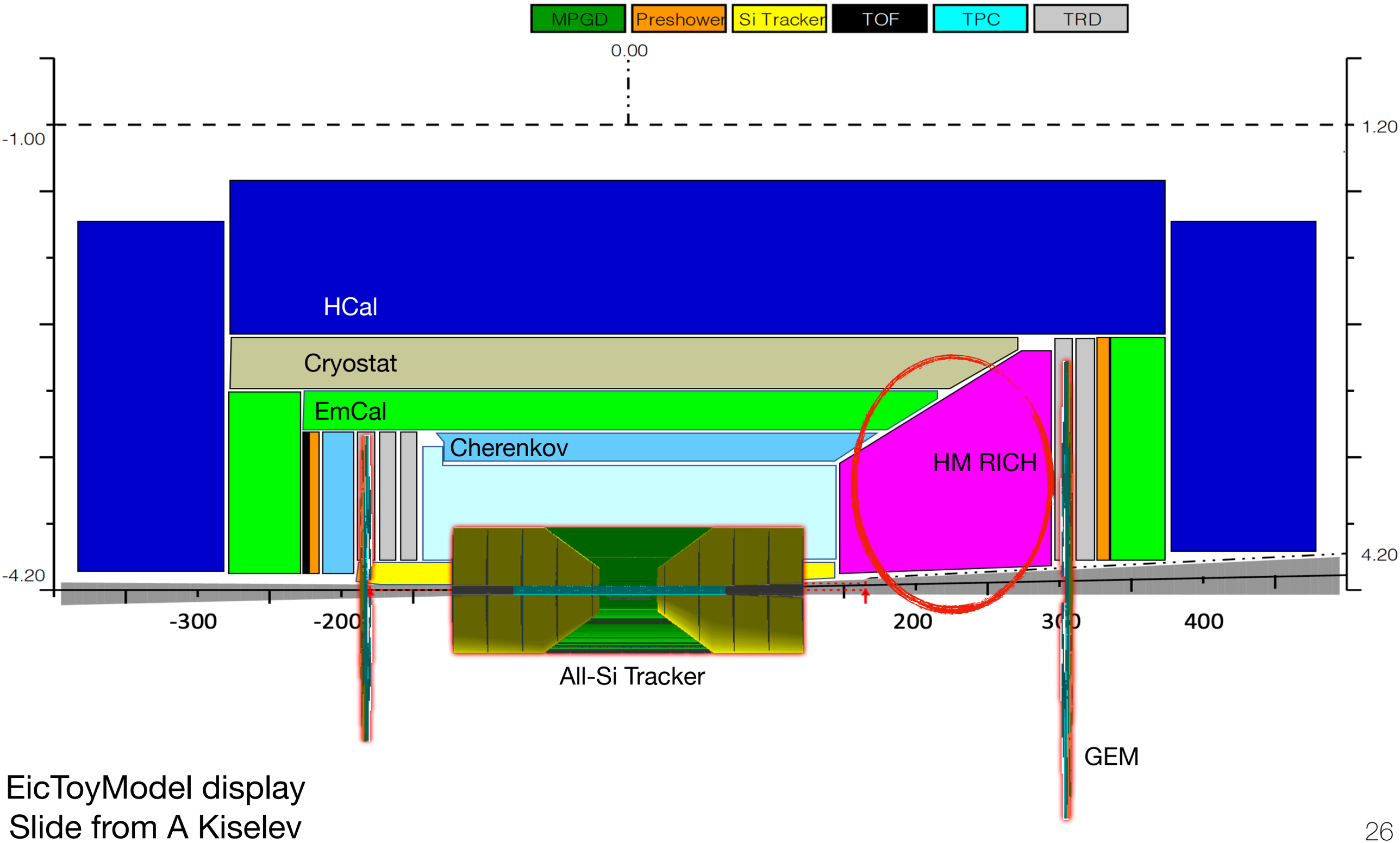
Backup slides

Placement of GEM in forward region



EicToyModel display
Slide from A Kiselev

Placement of GEM in forward region



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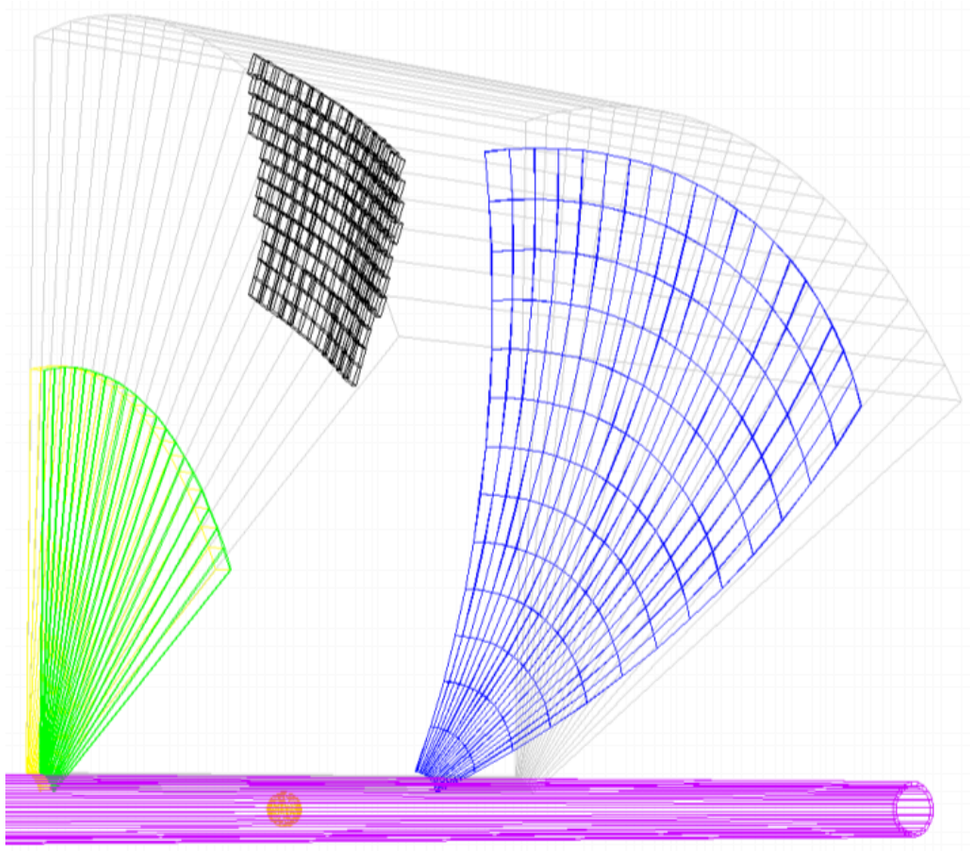
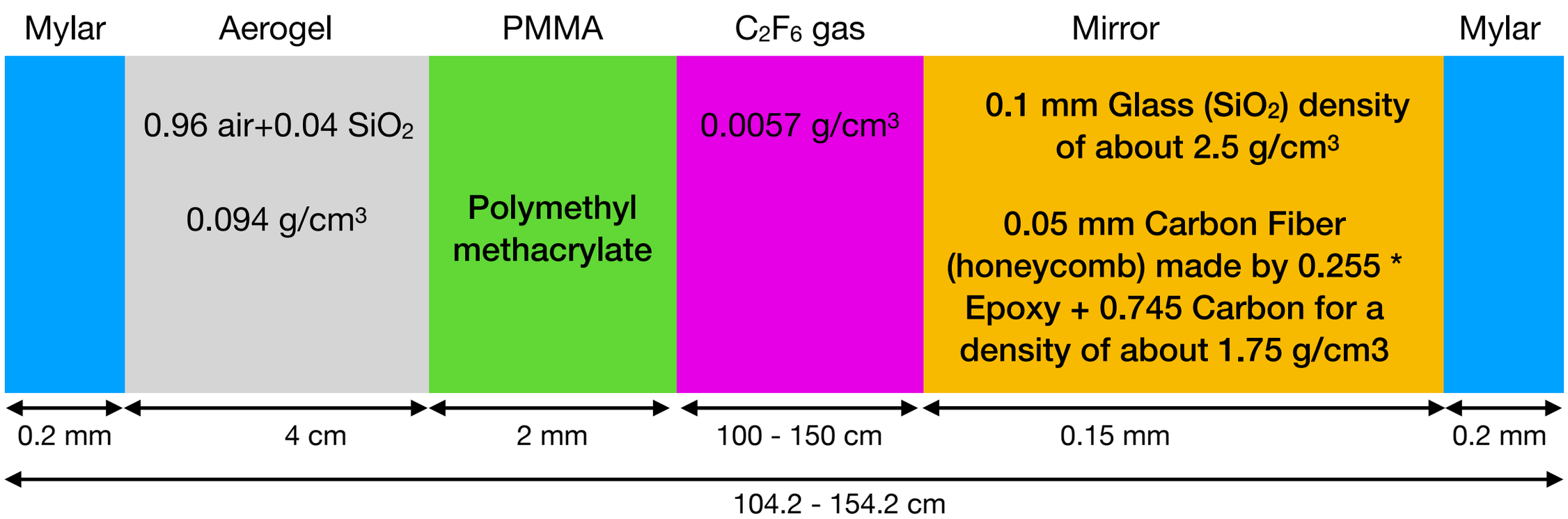
RICH parametrization



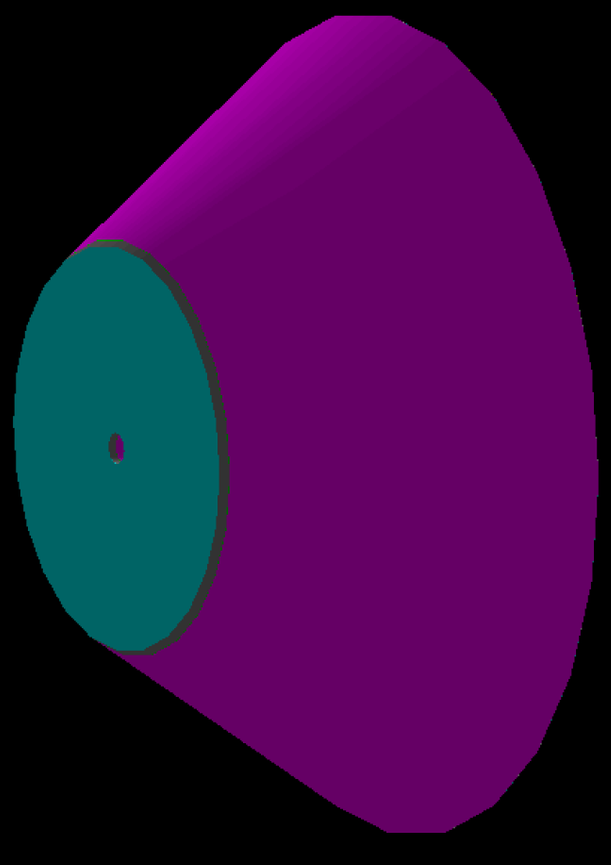
Info from Evaristo Cisbani
(evaristo.cisbani@roma1.infn.it)

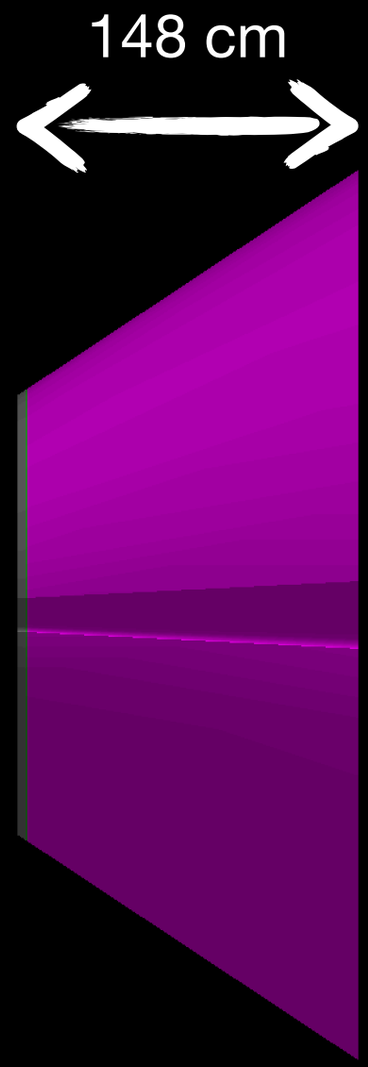
Main components and geometry baseline of one (out of 6) dRICH sector:
yellow: aerogel

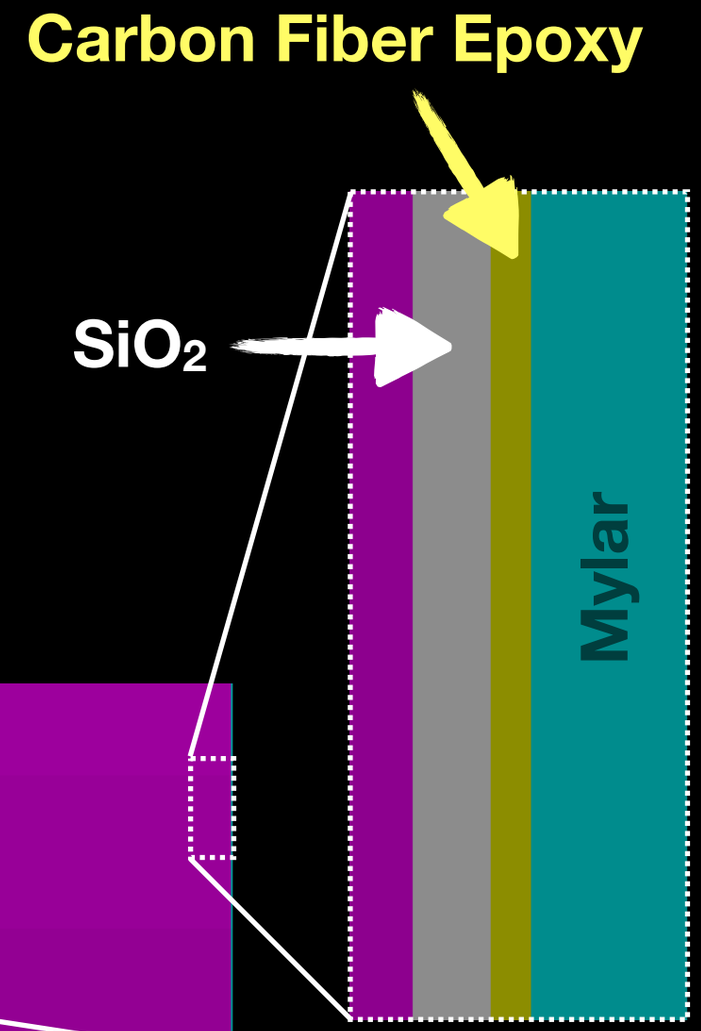
- green: optical filter
- blue: spherical mirror
- black: photosensor array (out of charged particles acceptance)
- pink: beam pipe region.

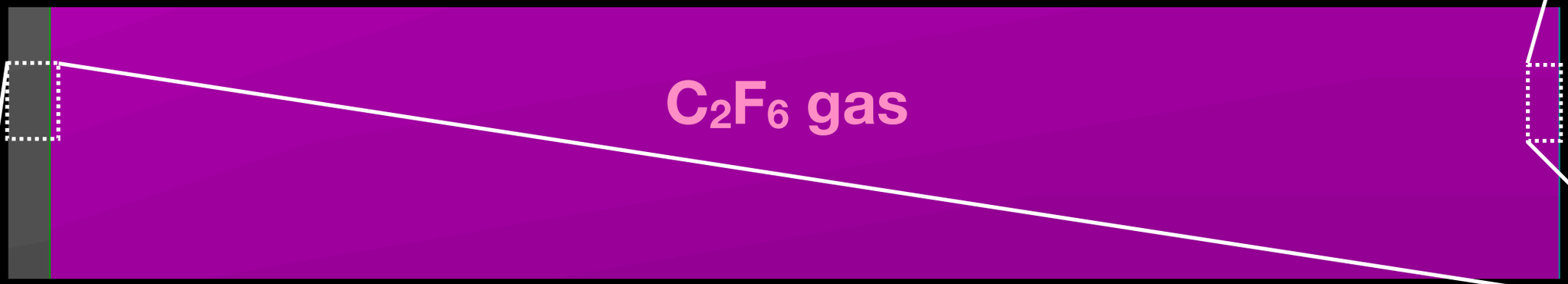


RICH parametrization in Fun4All

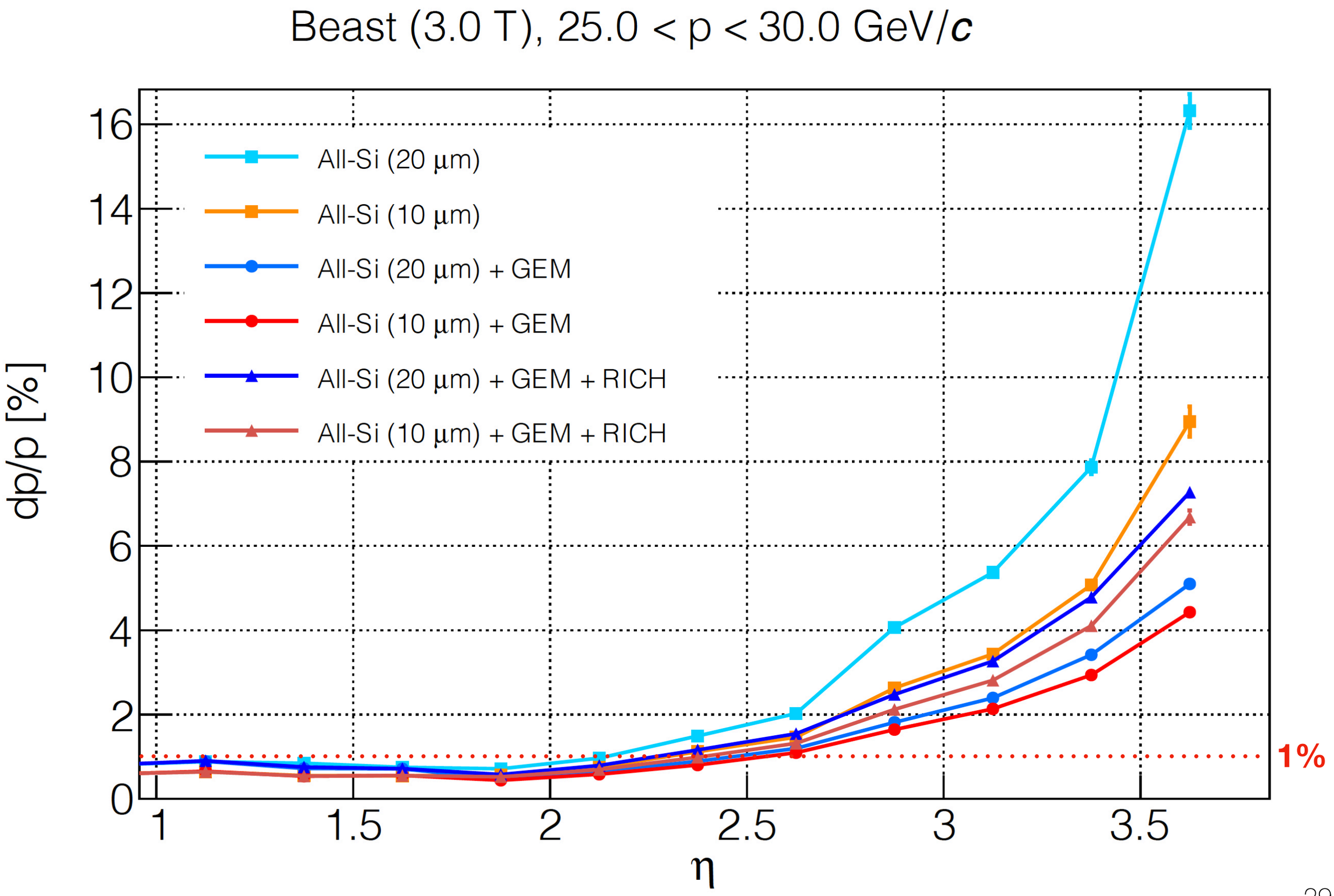




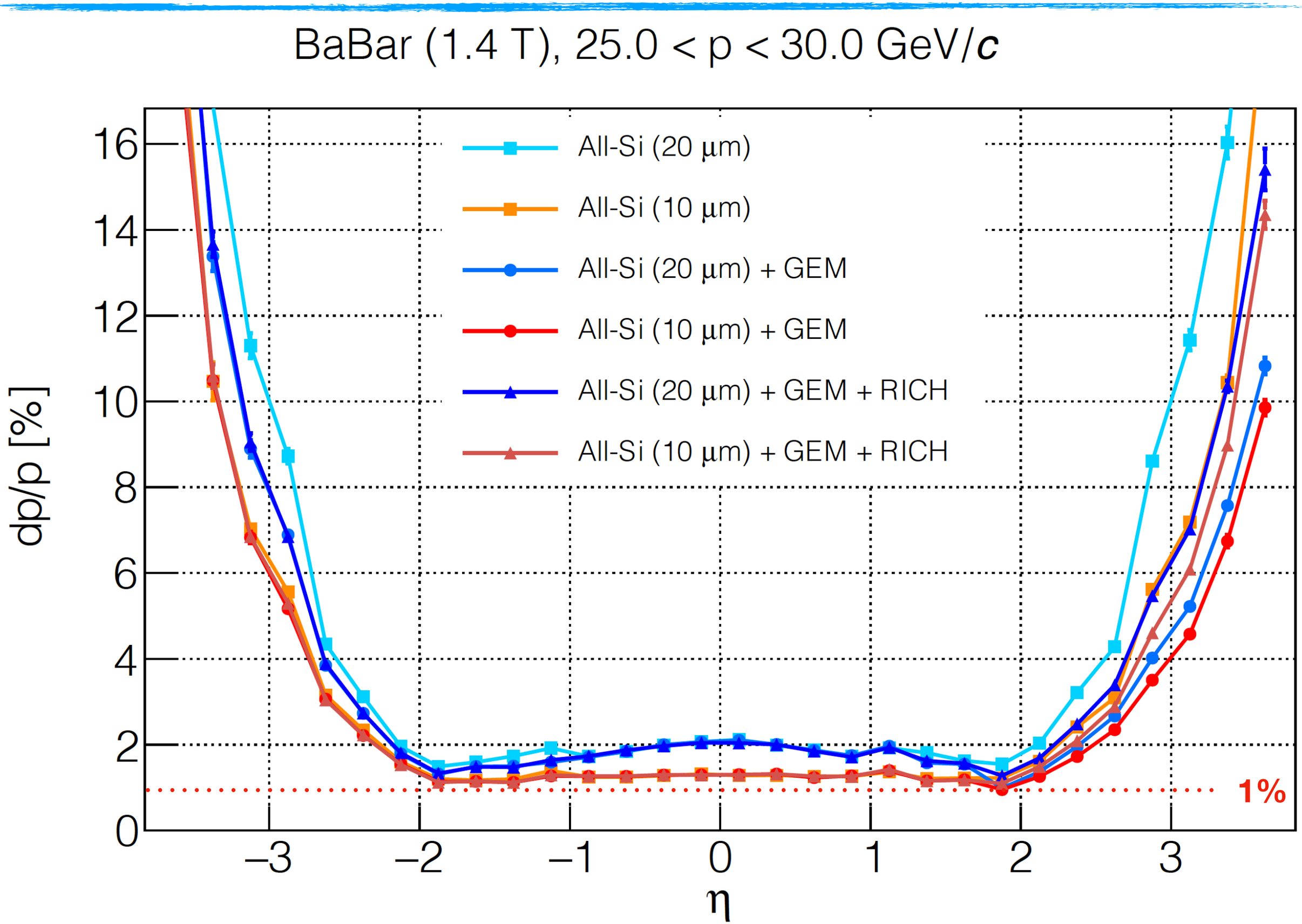




GEM and RICH effect on momentum resolution



GEM and RICH effect on momentum resolution



Momentum resolution for 3 momentum bins