All-silicon tracker studies presented to ECCE

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RNC EIC Meeting
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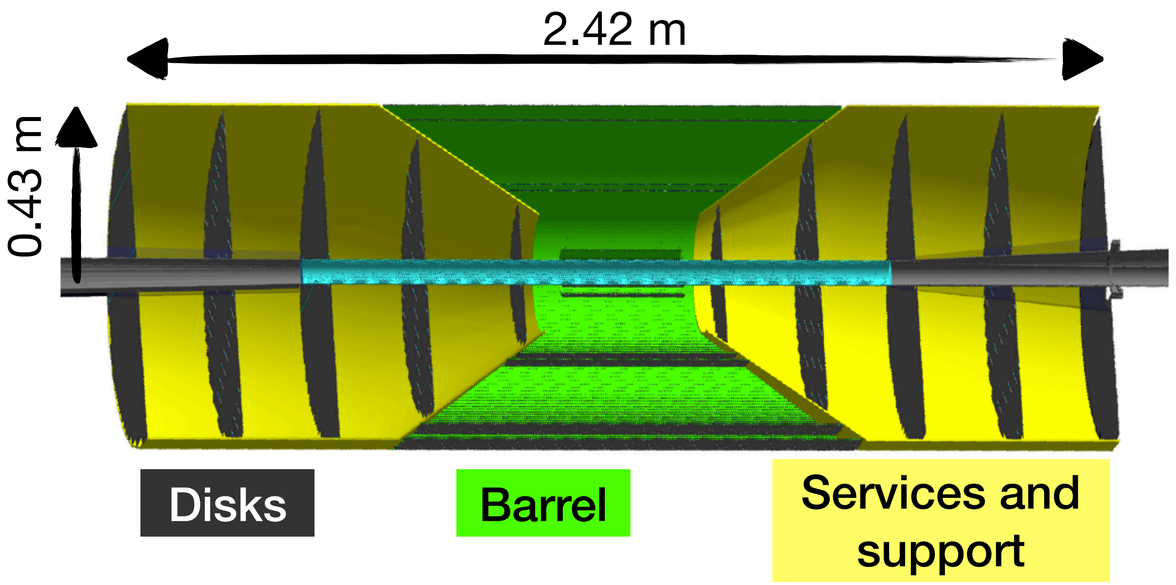
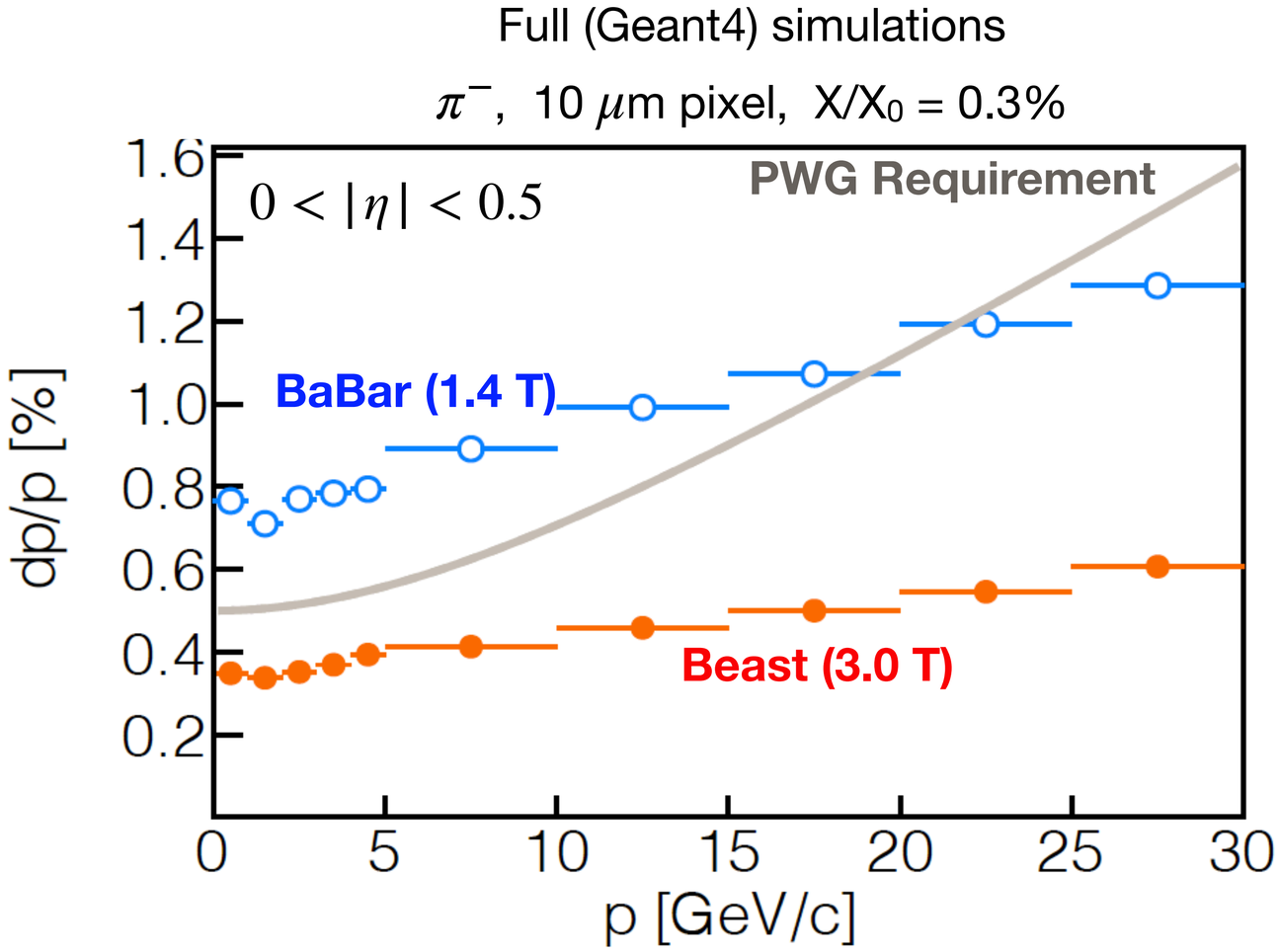
Disclaimer

All these results have been shown here in the past (i.e. no new information)

YR results



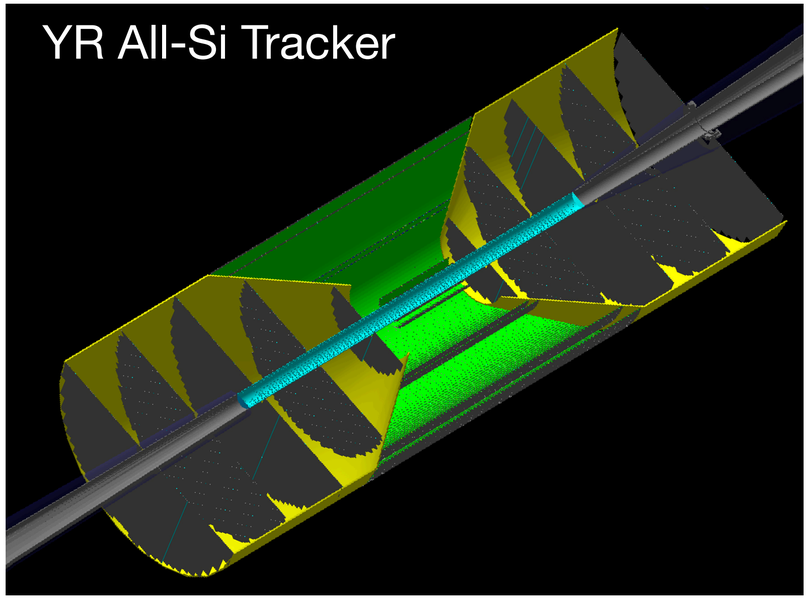


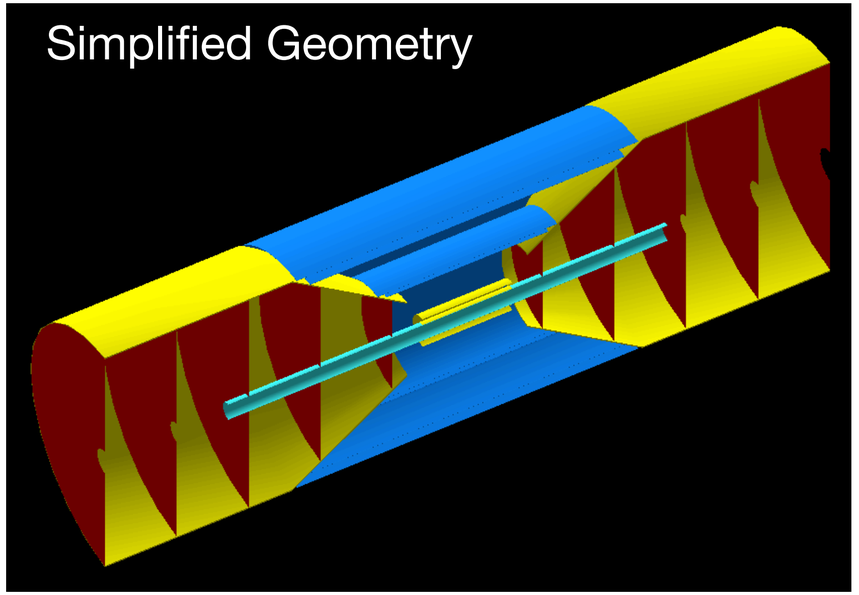
- Geometry made out of Alice ITS2-like staves (material budget X/X0 = 0.3%)

- silicon pixel of 10 μm pitch based on MAPS

- Simulations in Fun4All

Simplified geometry for easy manipulation





* Made up of ITS2 inner-layer staves
* Imported as a binary file into Fun4All (hard to implement modifications)

* Smooth (silicon-only) surfaces that can be effectively scaled to the appropriate material budget
* geometry directly coded in Fun4All

Outline

- Pixel scan
- Complementing the barrel
- DIRC radius effect
- Material near sagitta

Outline

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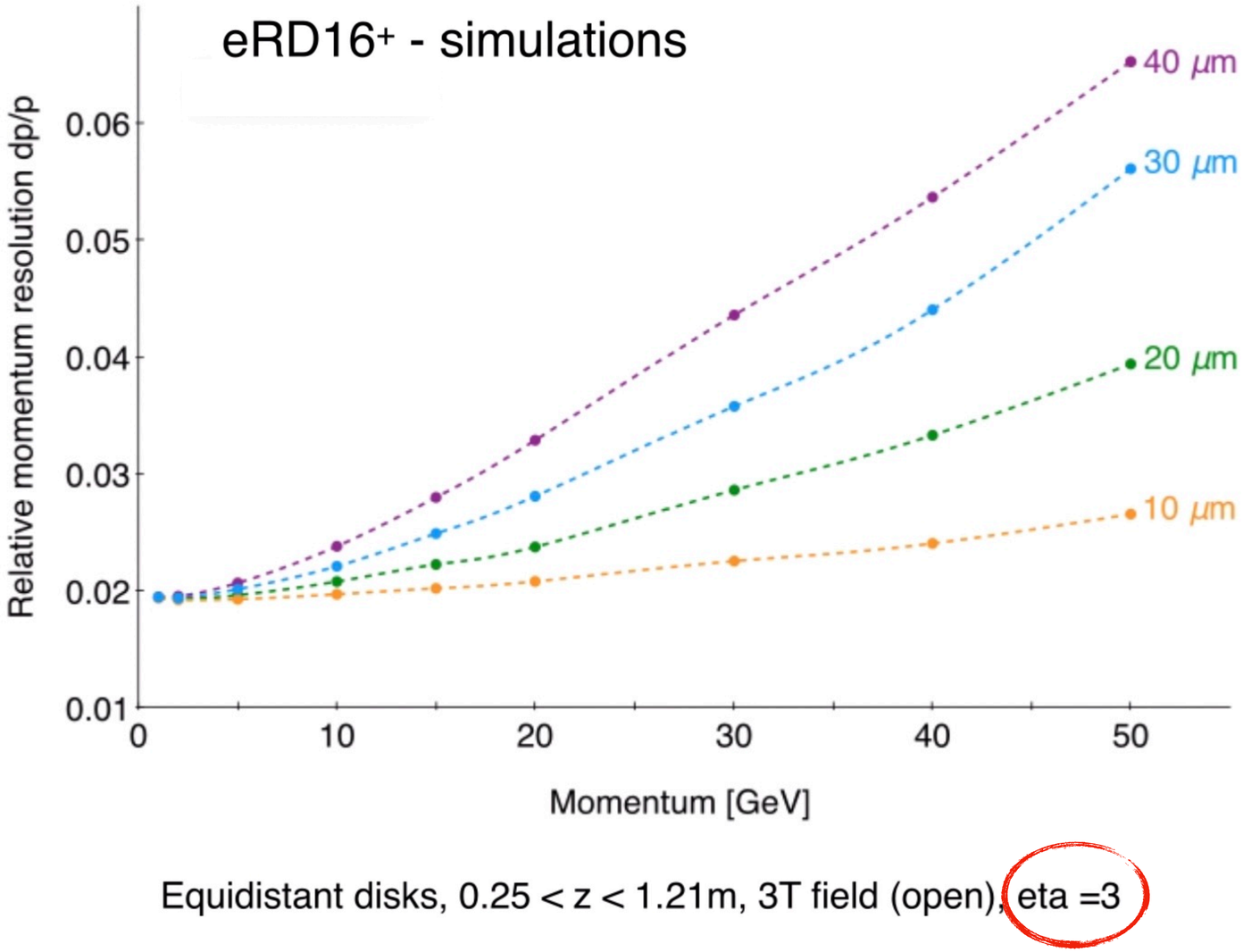
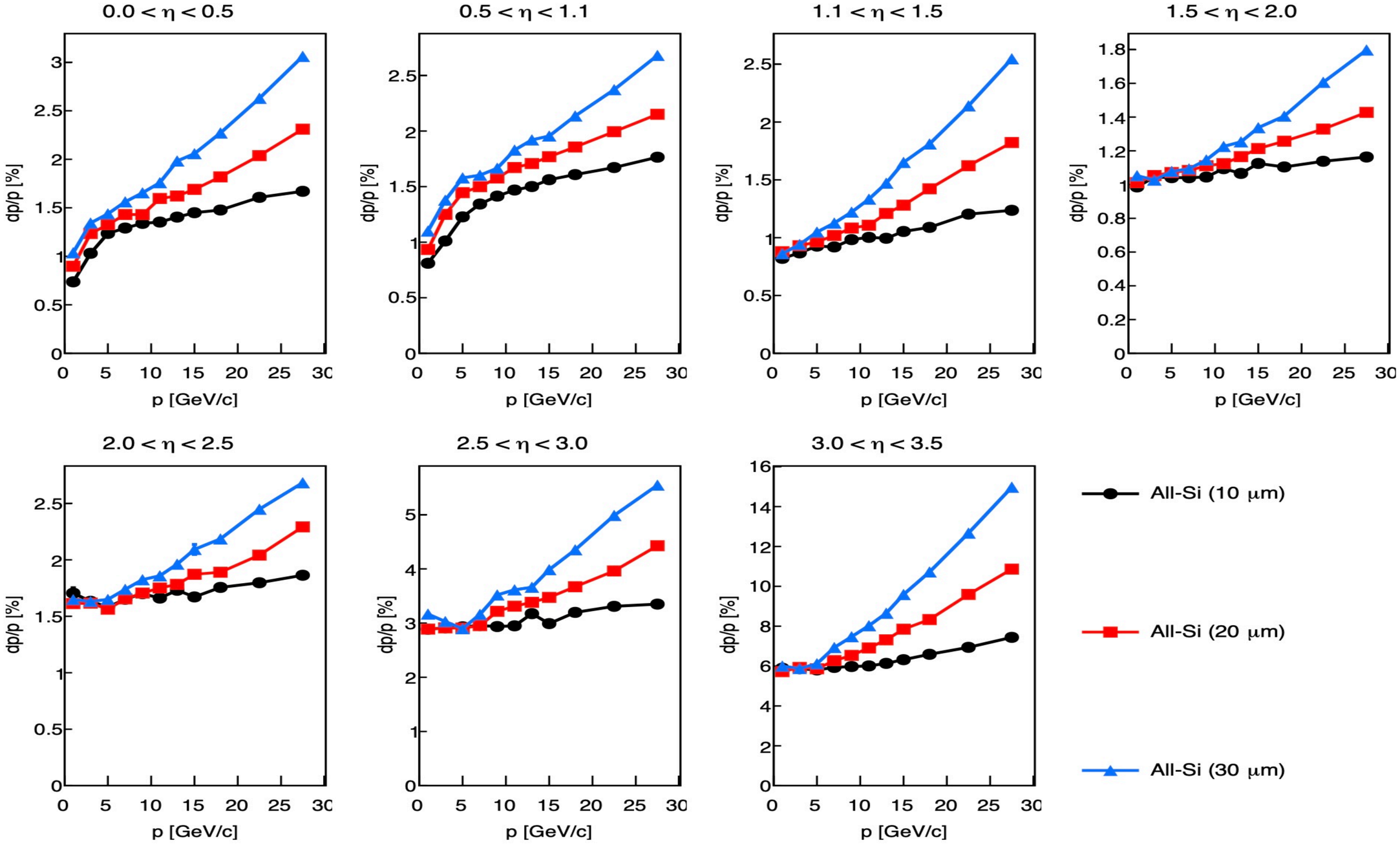
Pixel scan

In a tracking meeting it was suggested that the pixel size did not have a significant impact at large pseudorapidities

Figure by E. Sichtermann



Fun4All pixel scan



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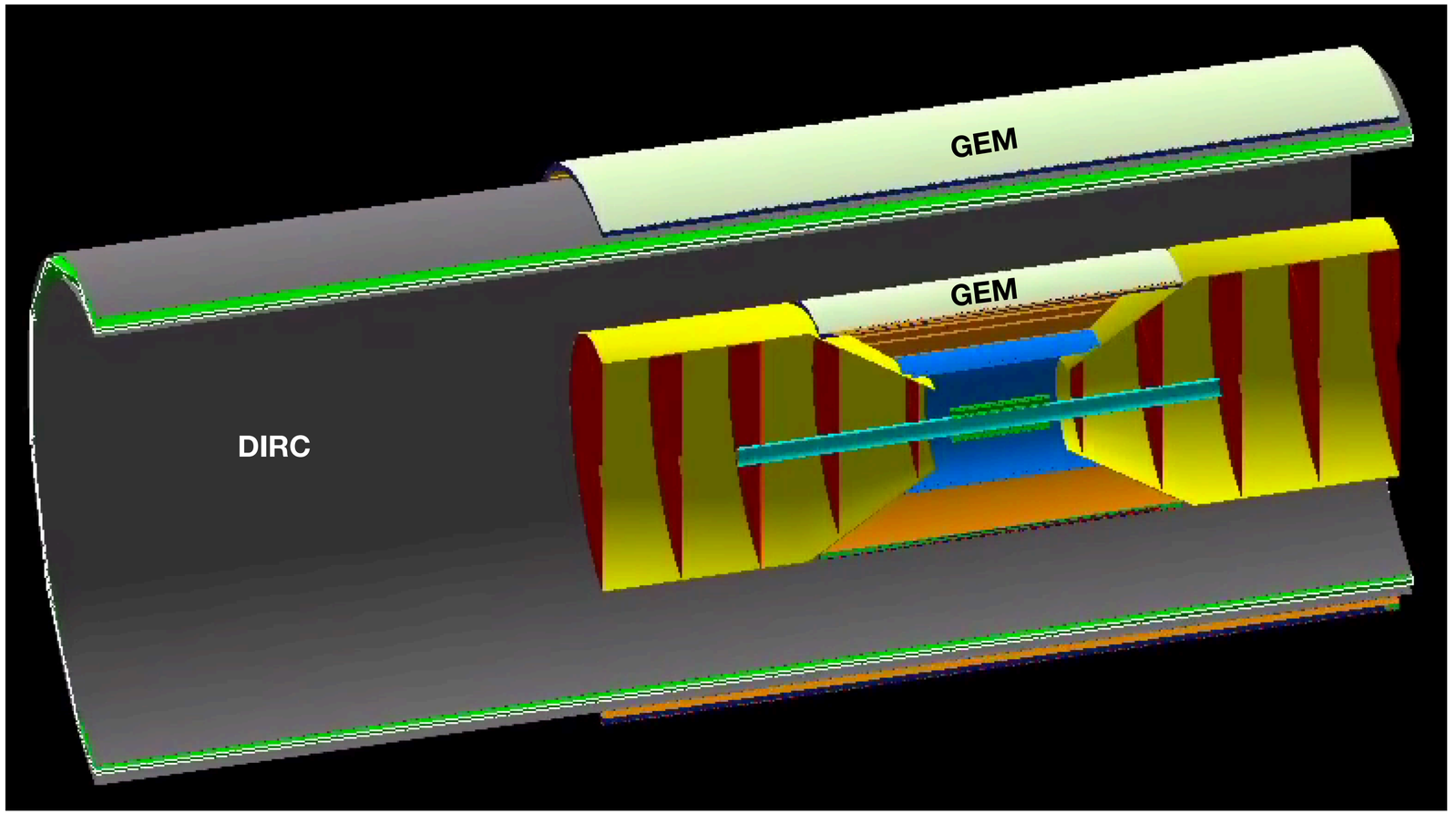
Complementing the all-silicon tracker barrel

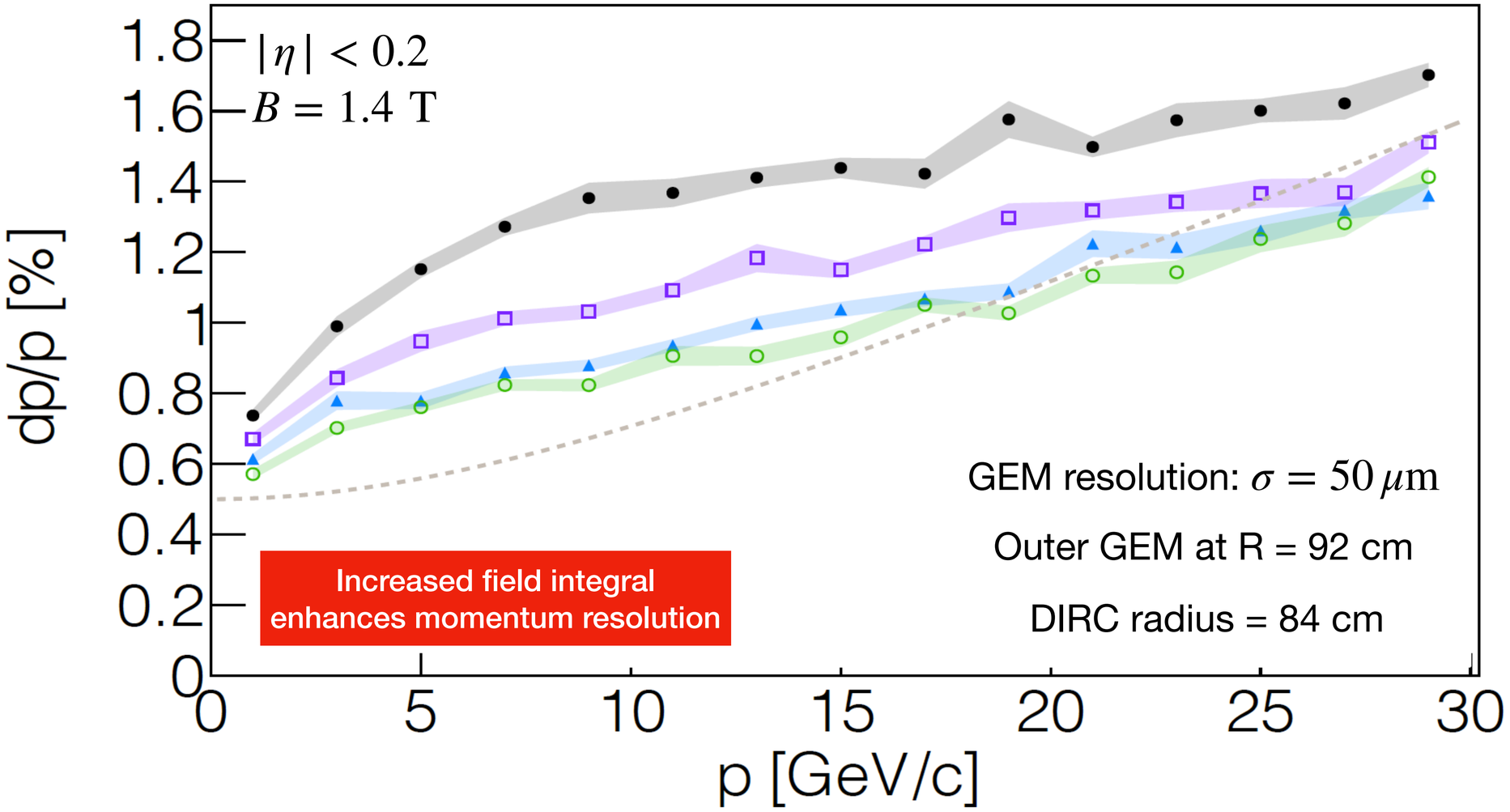
Variant #1:
All-silicon tracker + GEM outside the DIRC

Variant #2:
Outermost two barrel layers replaced with a GEM, and a second GEM added outside the DIRC



All-si tracker material budget (X/X0):
- Vertexing layers: 0.05%
- Barrel Layers: 0.55%
- Disks: 0.24%

GEM material-budget effect



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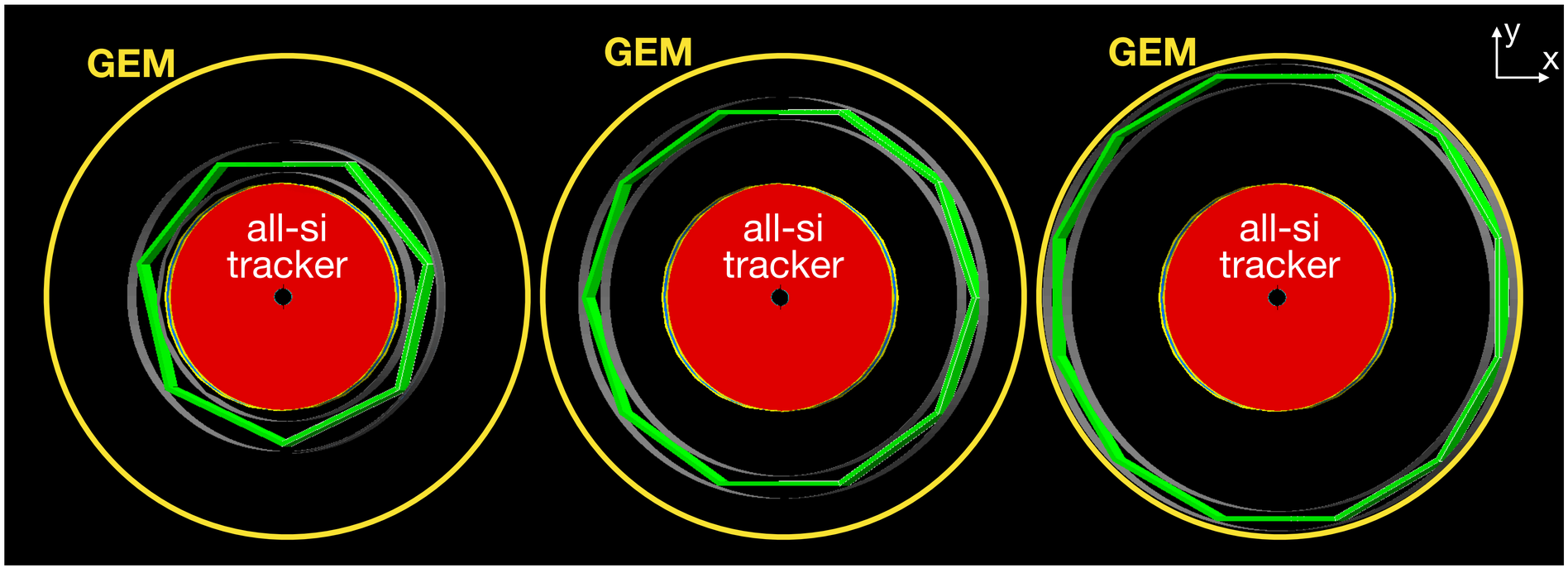
DIRC radius effect

- Previous study assumes outer GEM is very close to DIRC (and there is no additional material between DIRC and all-si tracker)

- The distance between scattering centers and tracking layers affects the momentum resolution

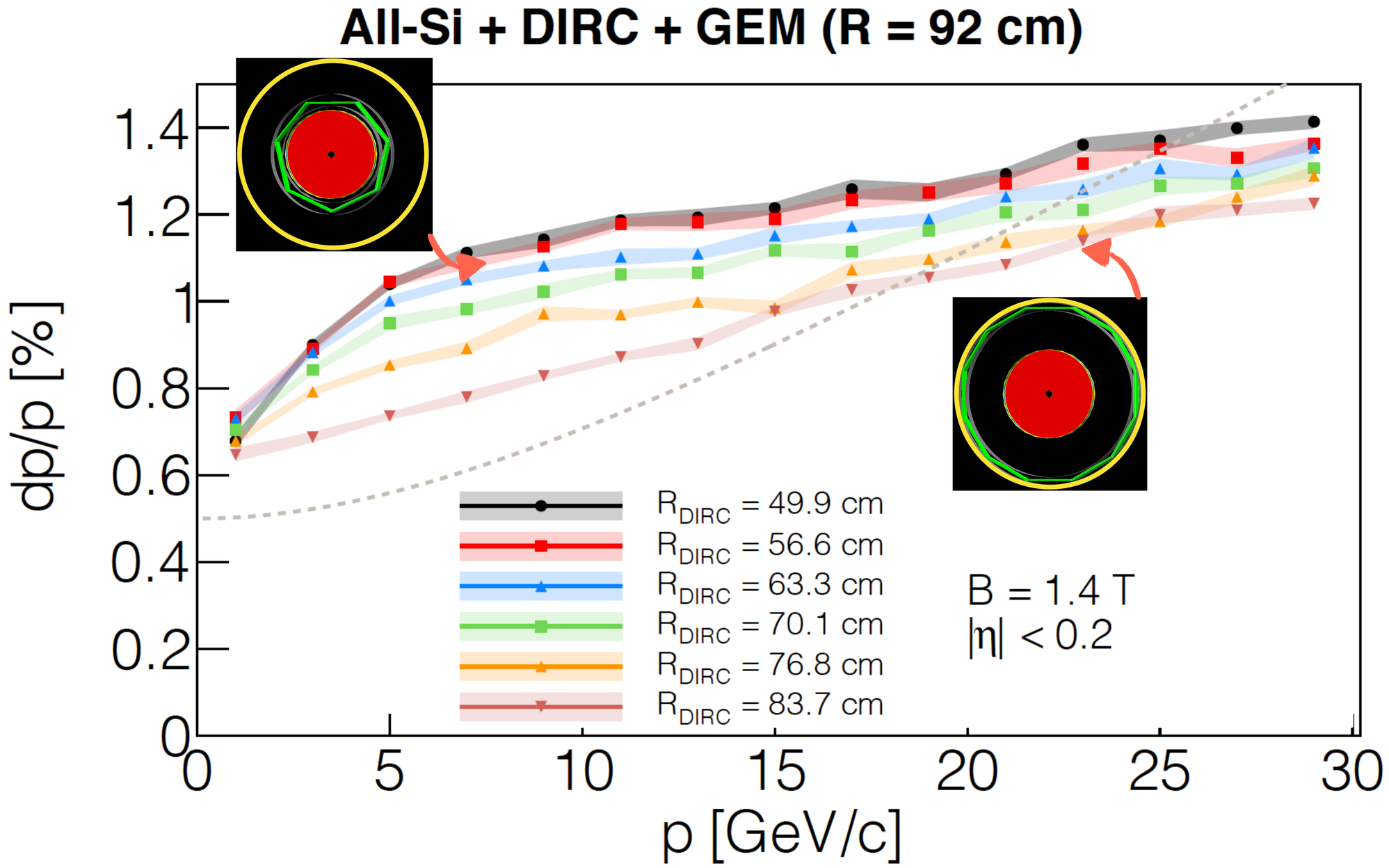
- Study effect of changing DIRC radius

- DIRC modules exist (BaBar), so DIRC radius is quantized



n	R_n [cm]
6	43.30
7	49.90
8	56.57
9	63.30
10	70.06
11	76.85
12	83.65

DIRC radius effect



Outline

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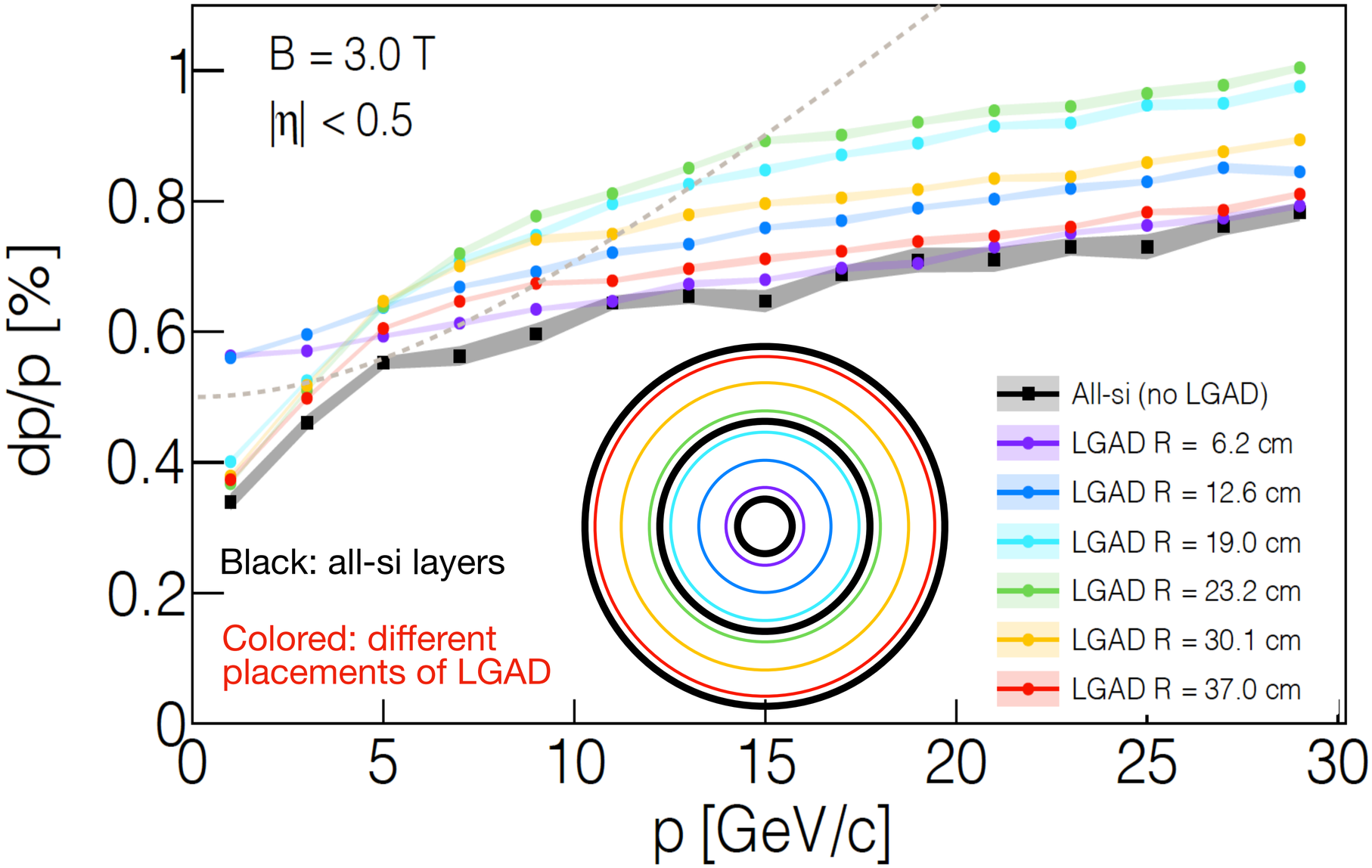
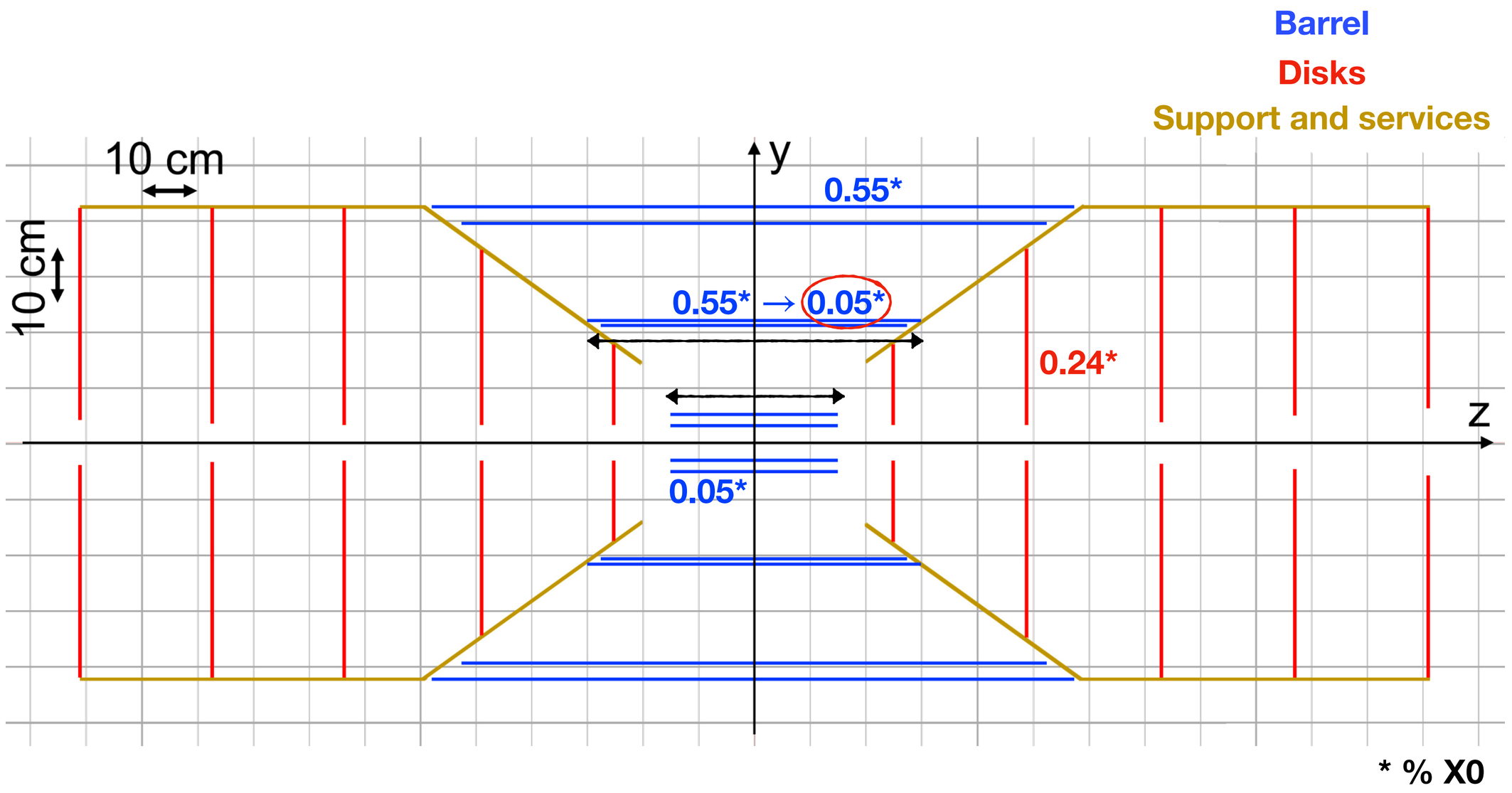
Material near sagitta



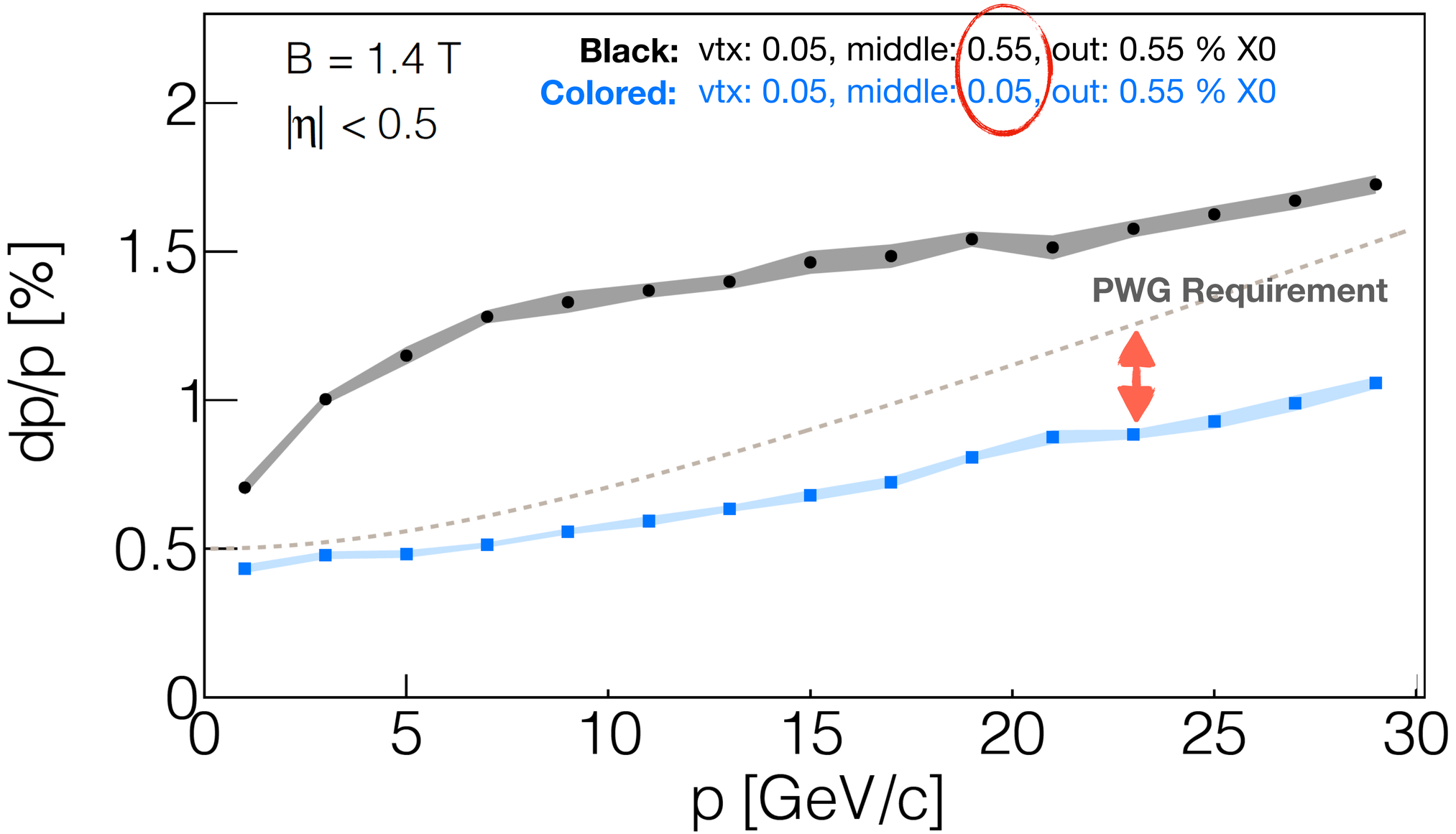
momentum resolution is very sensitive to material near sagitta

Changing the sagitta-layer material

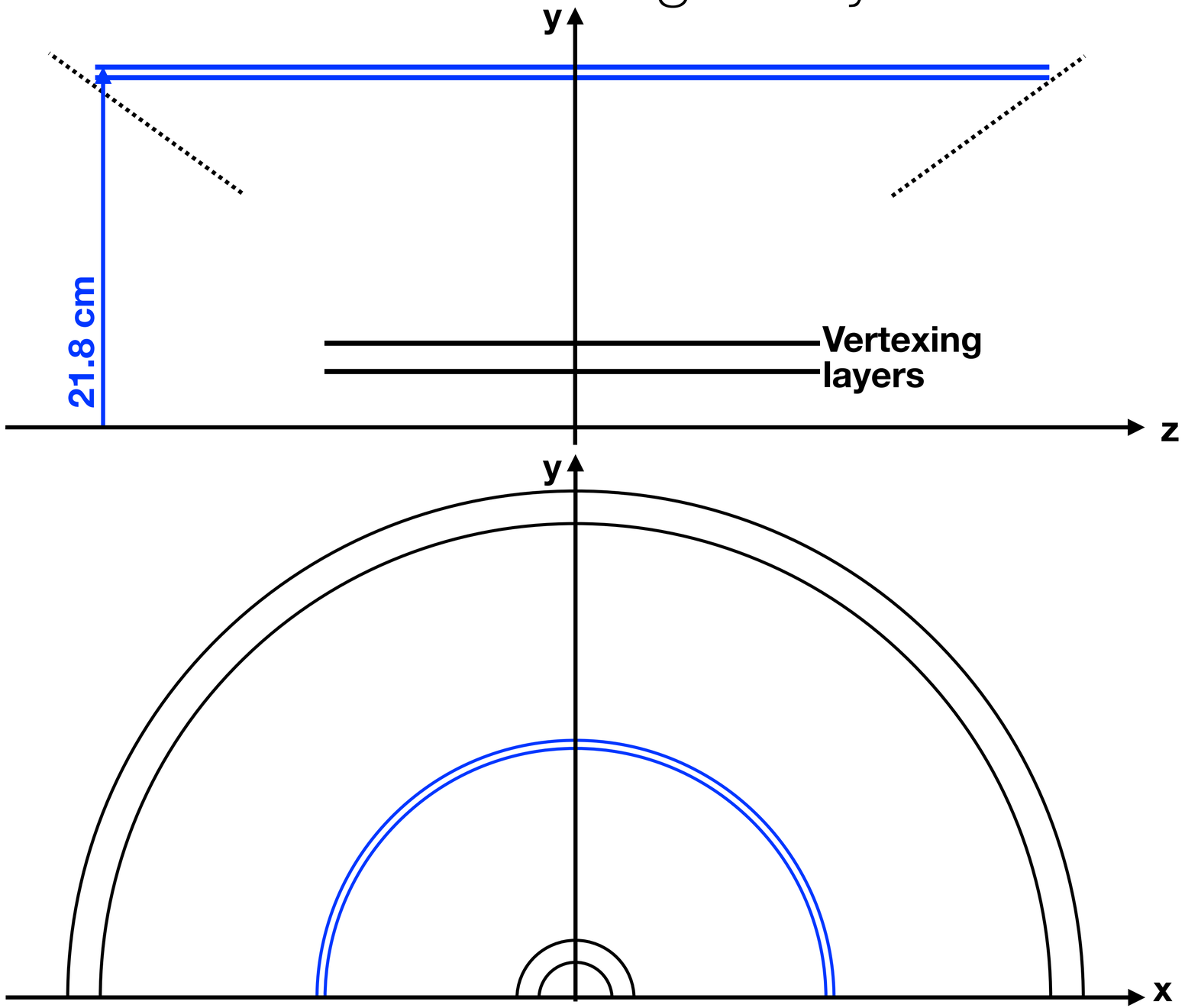


The middle layers are not much longer in z than the vertexing layers. Can we use the ultra thin (0.05 % X0) bent-silicon technology there? What do we gain?

Momentum resolution impact



Placement of sagitta layers



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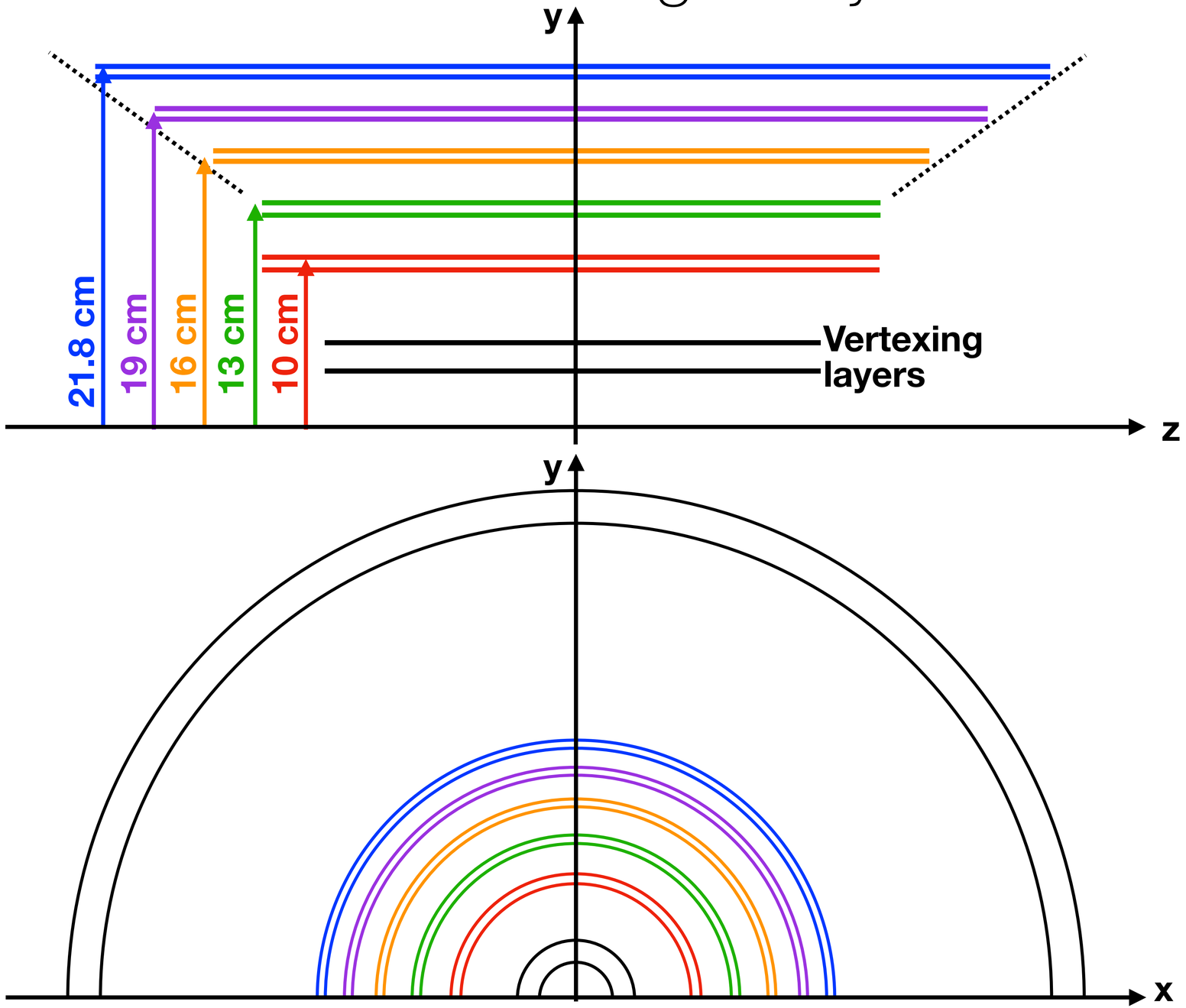
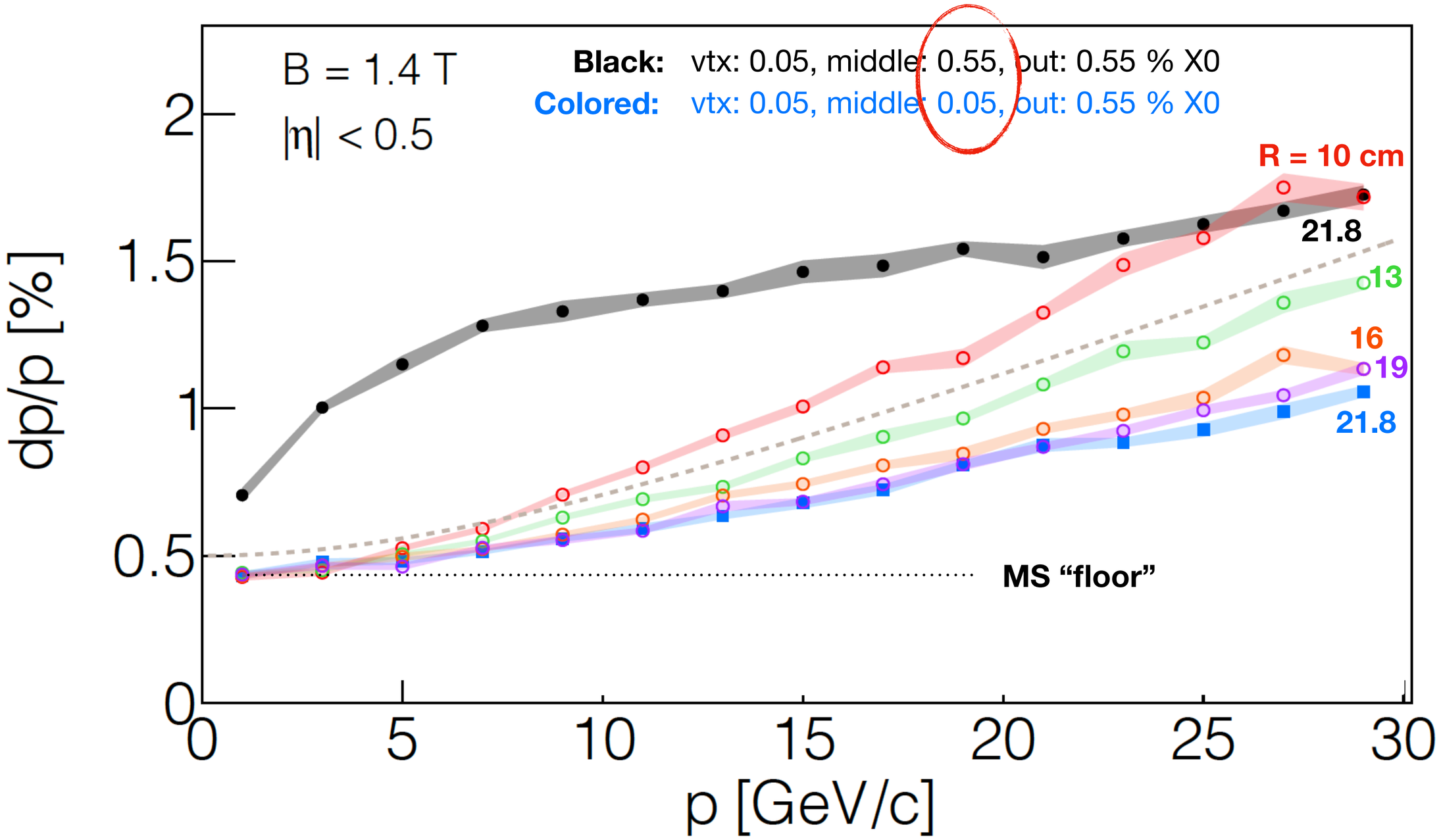


Momentum resolution impact



Summary

- Series of studies (focused on the barrel) were presented last year to ECCE in the tracking meetings
- Studies included additional information not included here (e.g. angular and vtx resolutions in addition to dp/p)
  - Pixel scan
  - Effect of complementing barrel in various ways and quantification of performance impact
  - Effect of relative position between scattering centers and tracking layers
  - Performance improvement from thinned-down sagitta layers
    - dp/p significantly enhanced (~50%) if ITS3 vtx technology is used for the middle (sagitta) barrel layers
    - dp/p (for $|\eta| < 0.5,\ B = 1.4\,\mathrm{T}$) below the PWG requirements.
    - radius (and thus length in z) can be reduced significantly (from $r_s \approx 22\,\mathrm{cm}$ down to $r_s \approx 13\,\mathrm{cm}$) while still achieving a dp/p better than the PWG requirements.
    - emphasized that it is not clear whether this is achievable, what cost it may add to the overall detector, etc.