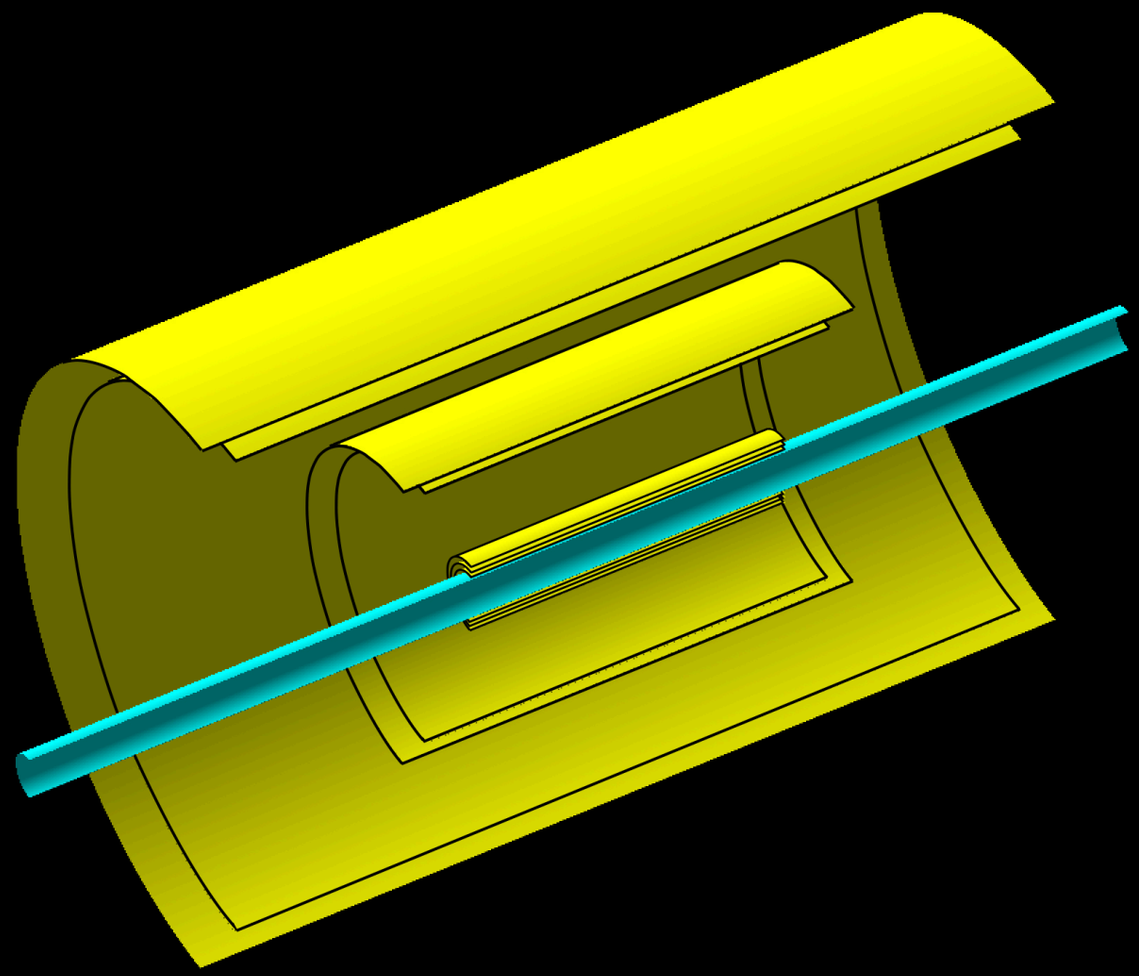
Vertexing-configuration study



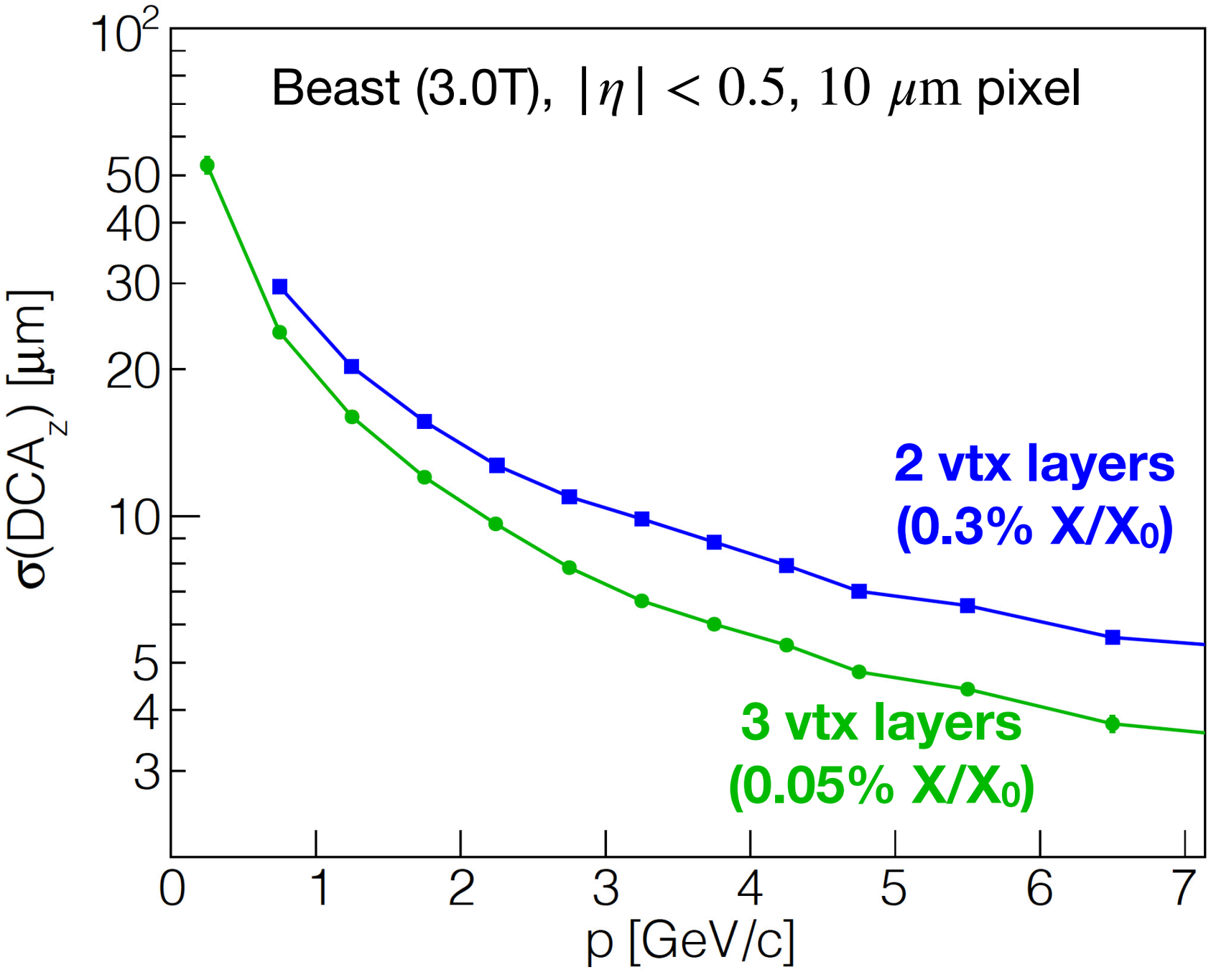
Rey Cruz-Torres

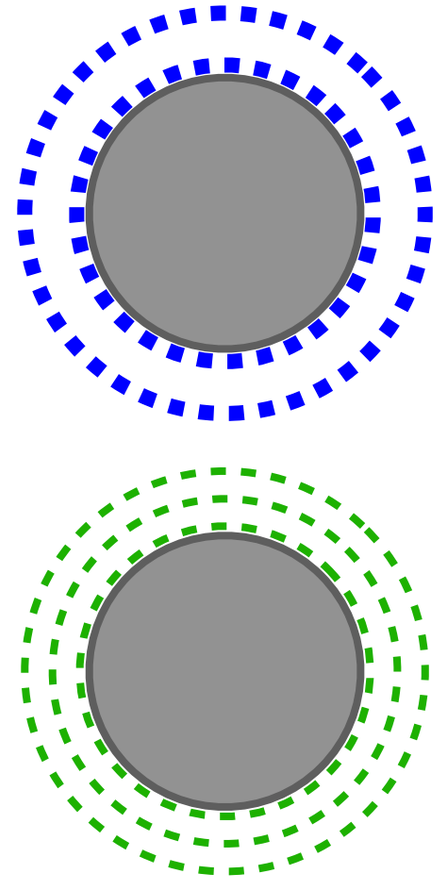
EUC YR Tracking Meeting

10/08/2020

Motivation

Design of optimal vertexing-layer configuration for All-Silicon tracker



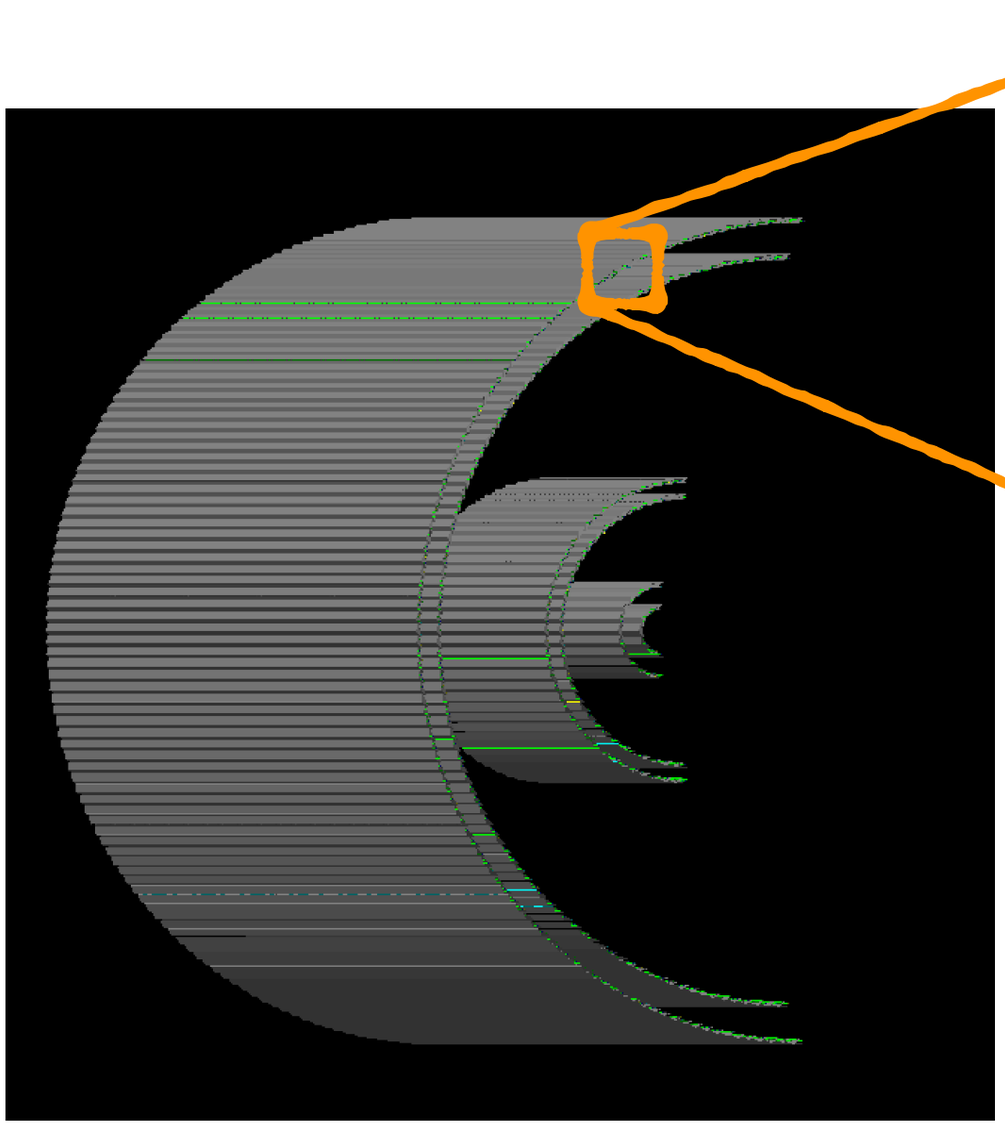


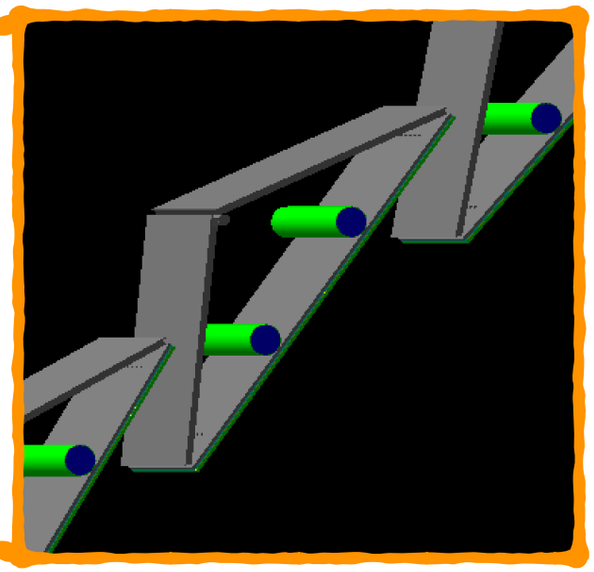
Two parameters (#layers and material budget) changing from blue to green

Introduction and goals

Design of optimal vertexing-layer configuration for All-Silicon tracker

Doing these checks with ‘standard’ All-Si tracker is costly





1) Define geometry variations in EICroot
2) Export geometry in TGeo format
3) Load in Fun4All to run simulations

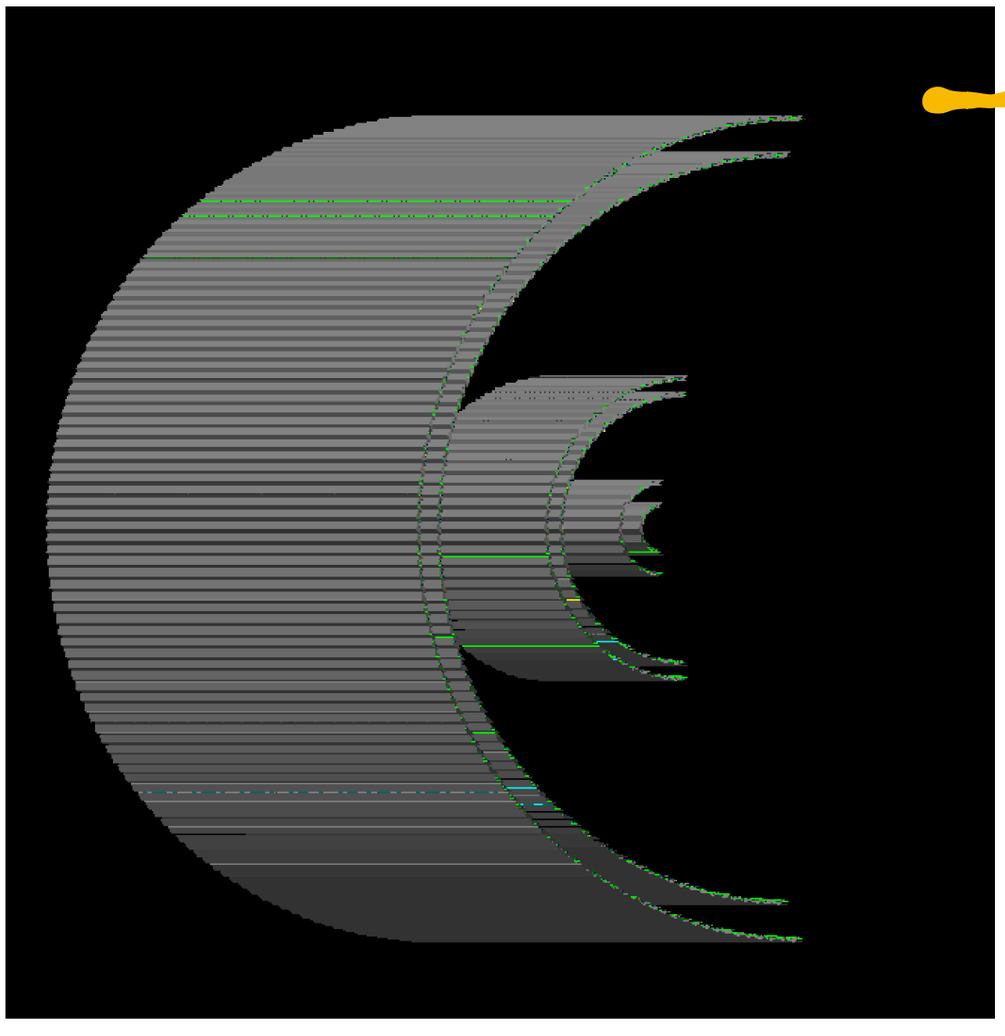
* Need a TGeo file per geometry variation

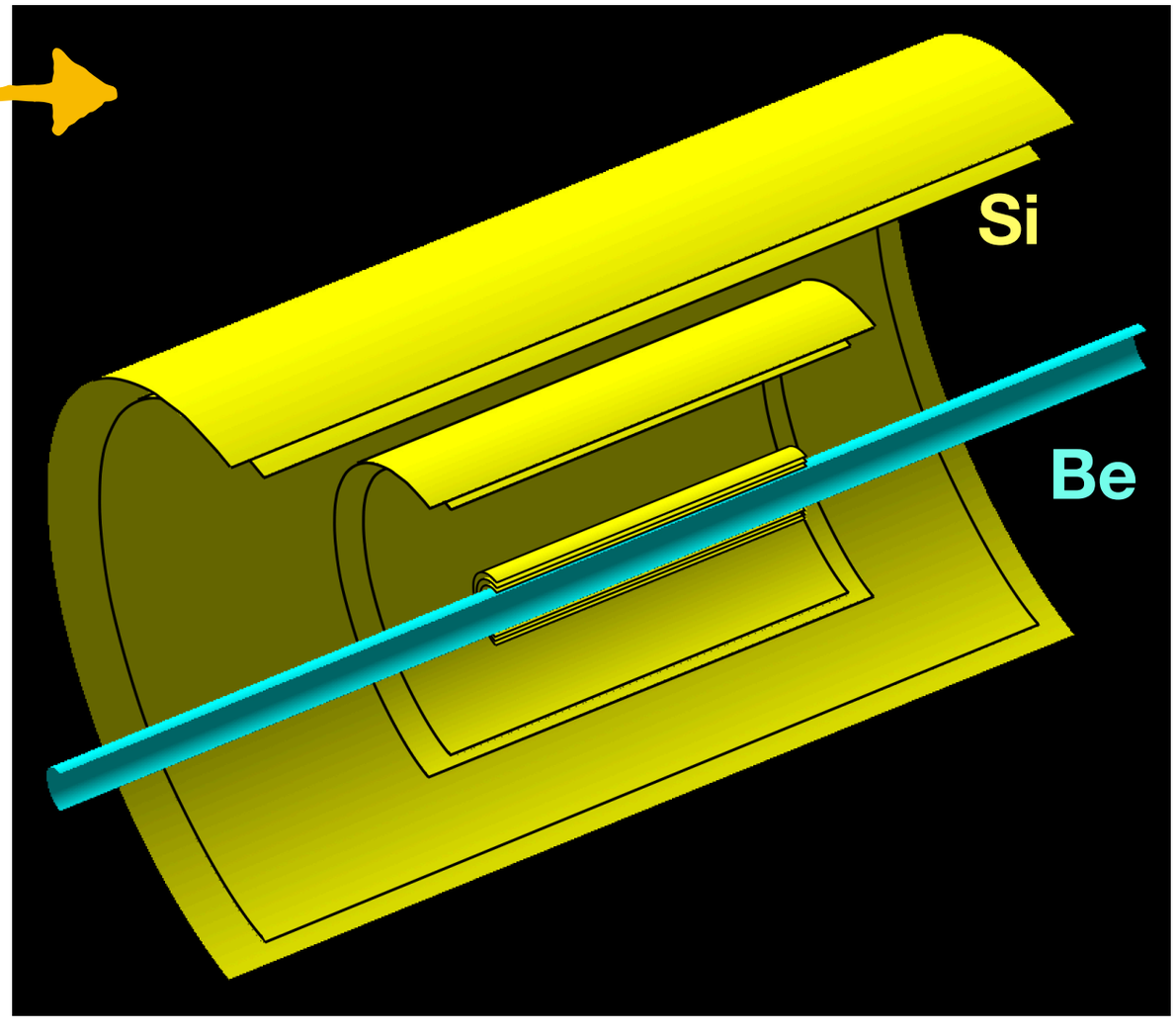
Introduction and goals

Design of optimal vertexing-layer configuration for All-Silicon tracker

Doing these checks with ‘standard’ All-Si tracker is costly

Solution: define simplified geometry directly in Fun4All → capture the essential features but with more flexibility to ‘tweak’ detector parameters





Introduction and goals

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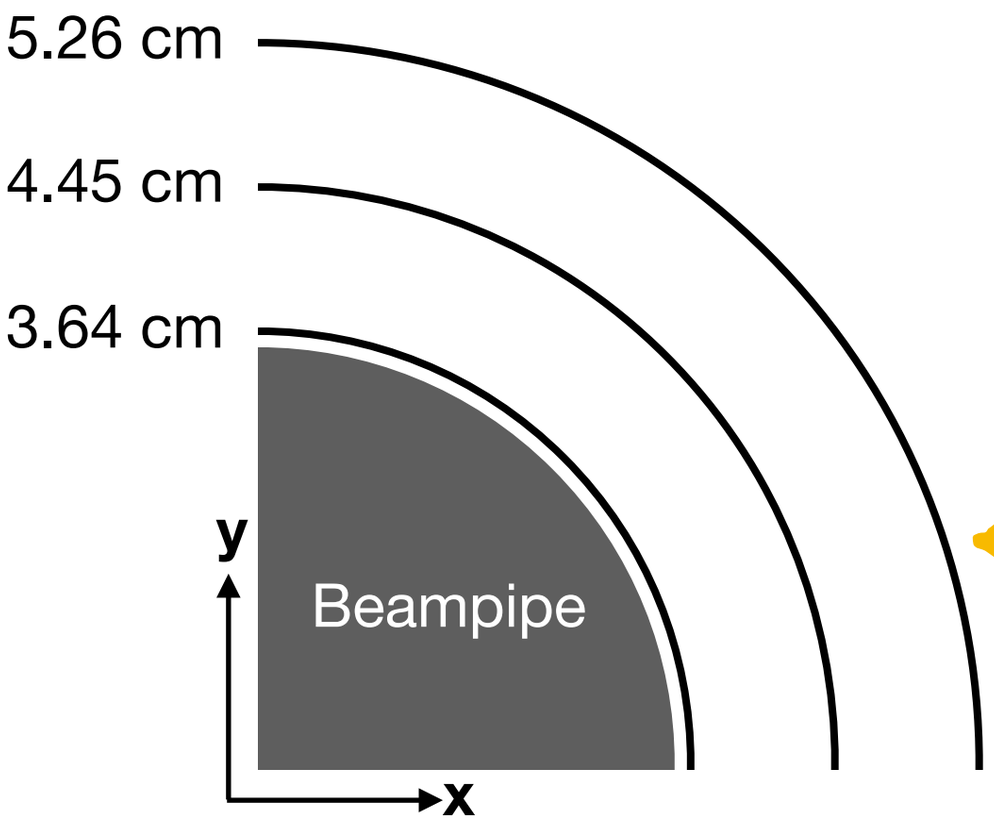

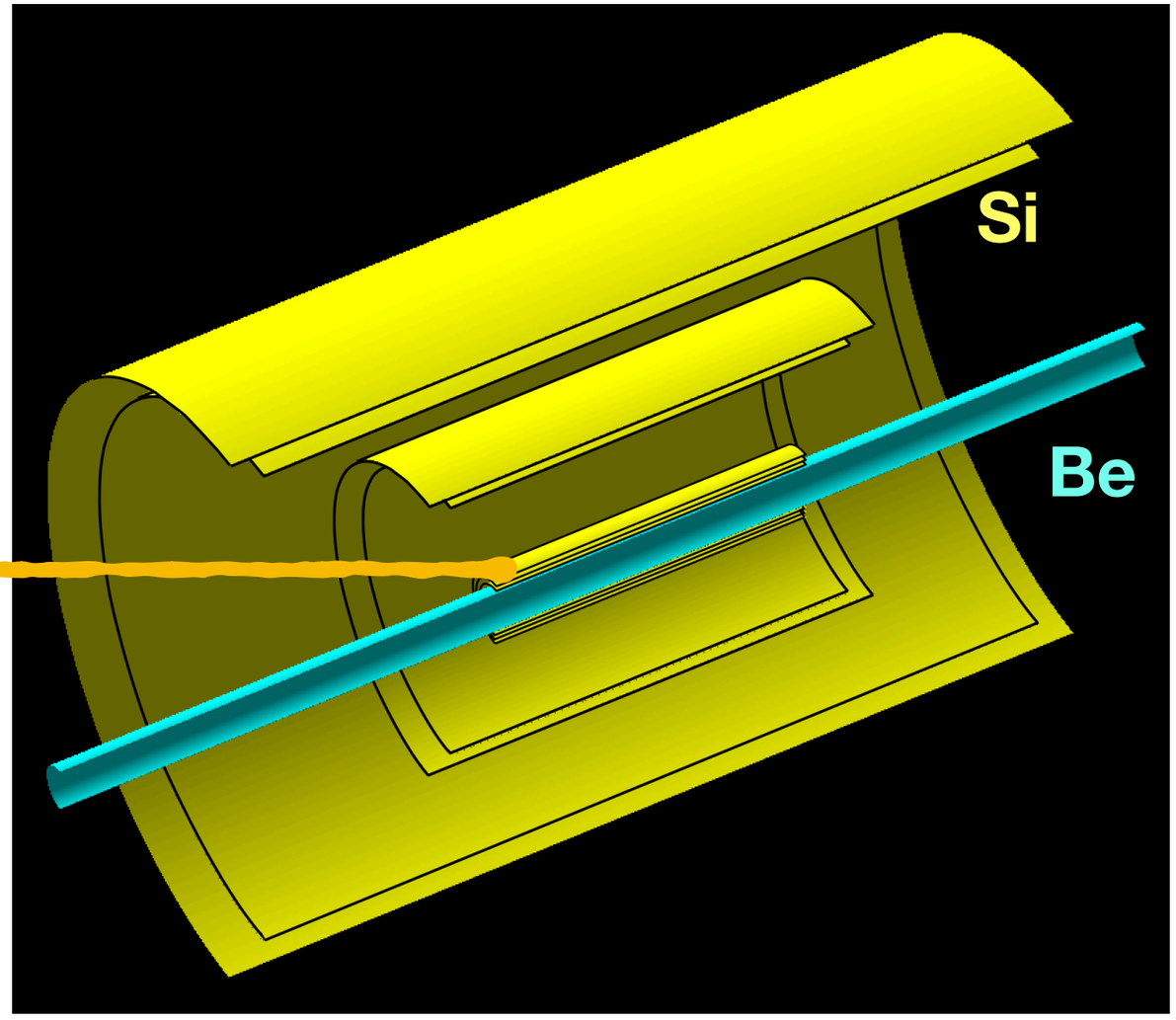

- 0.05% X/X0 -> vertexing layers
- 0.55% X/X0 -> tracking layers

Outline

1) Performance of different vertexing configurations

2) Comparison to fast simulations

3) Misalignment effects

4) Comparison to physics “requirements”

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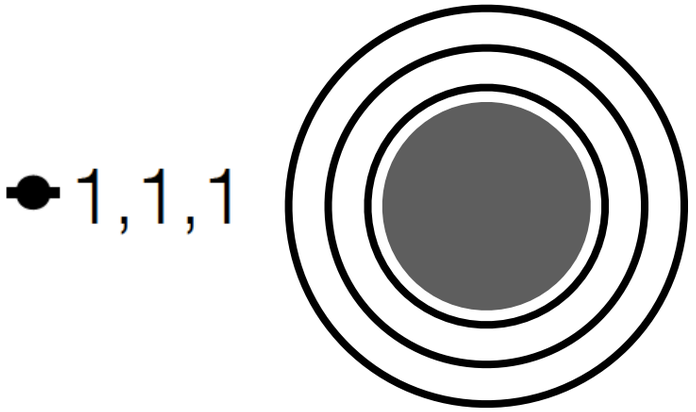
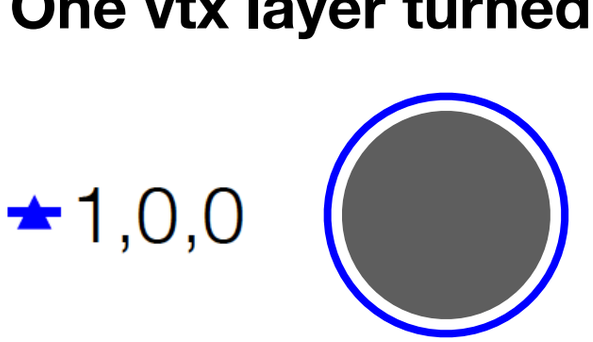
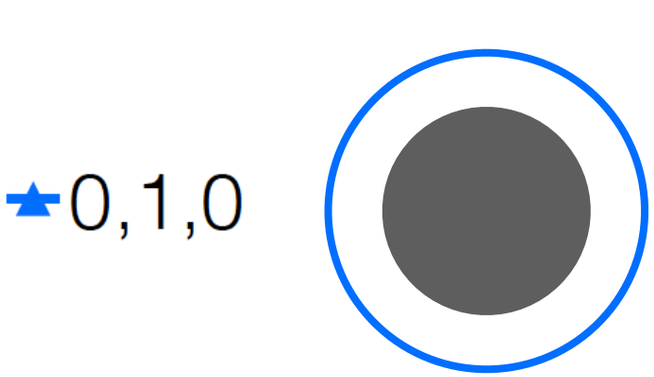
$2^3 - 1$ possible vertexing combinations

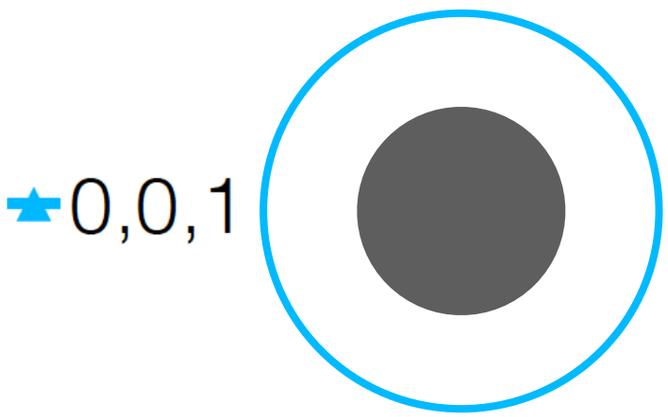
Three vtx layer turned on:



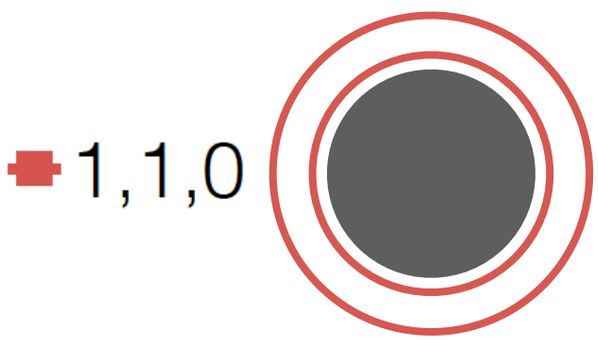
One vtx layer turned on:

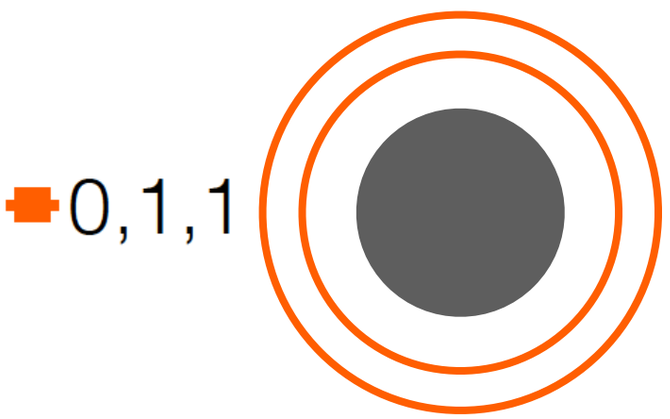


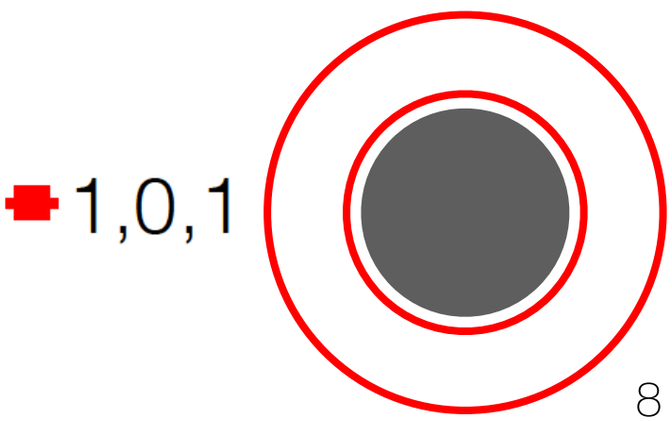




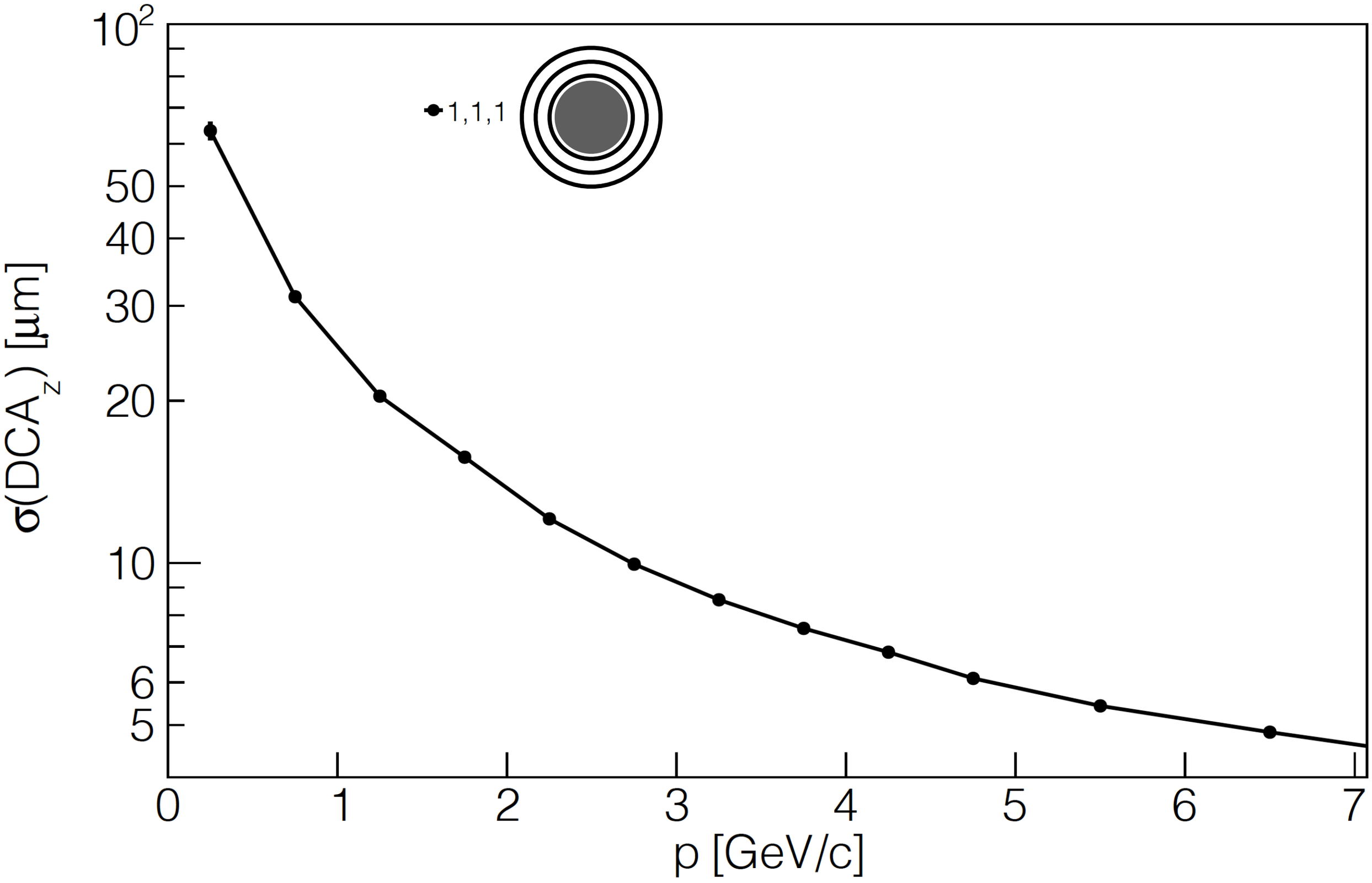
Two vtx layers turned on:



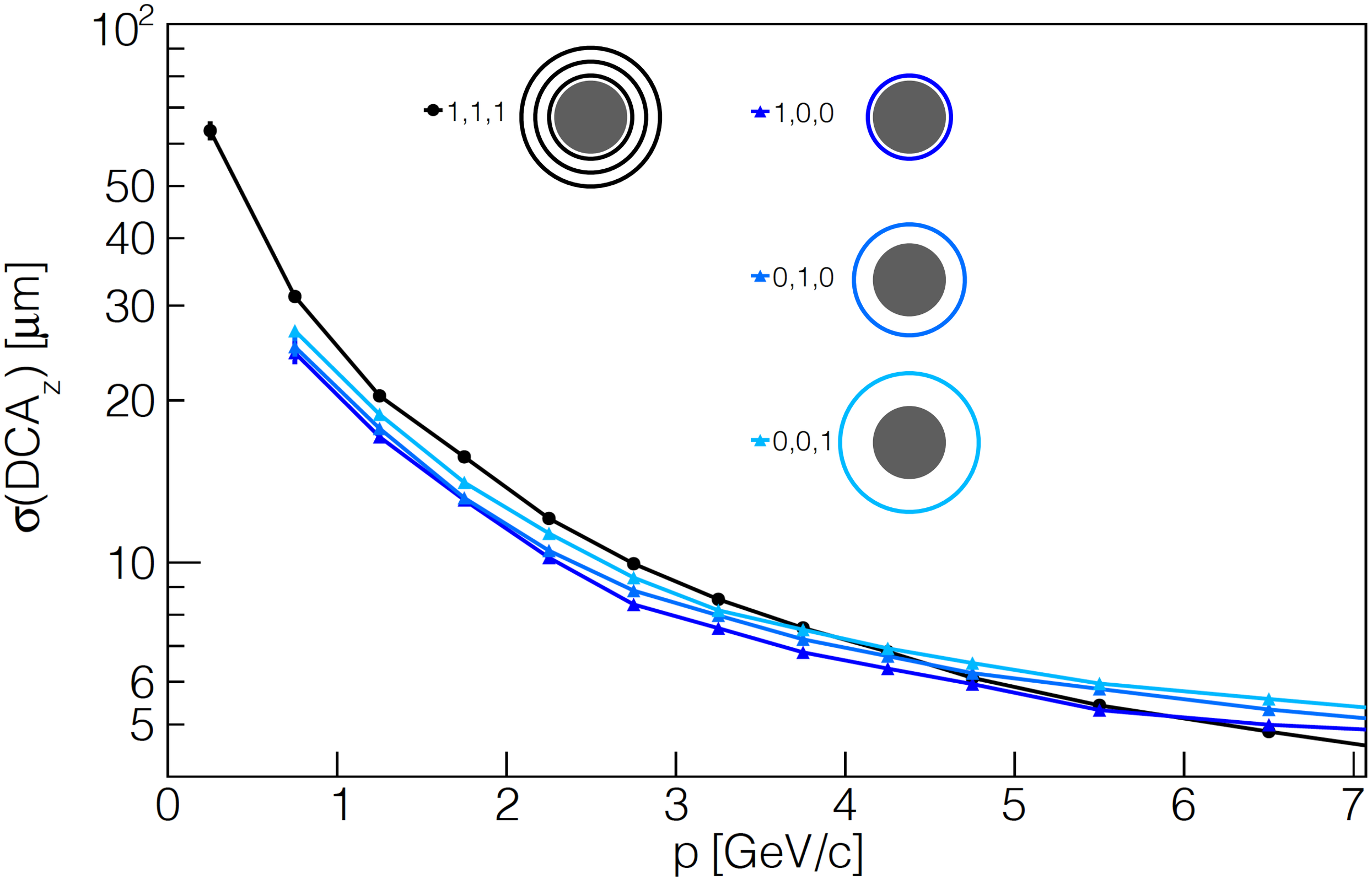




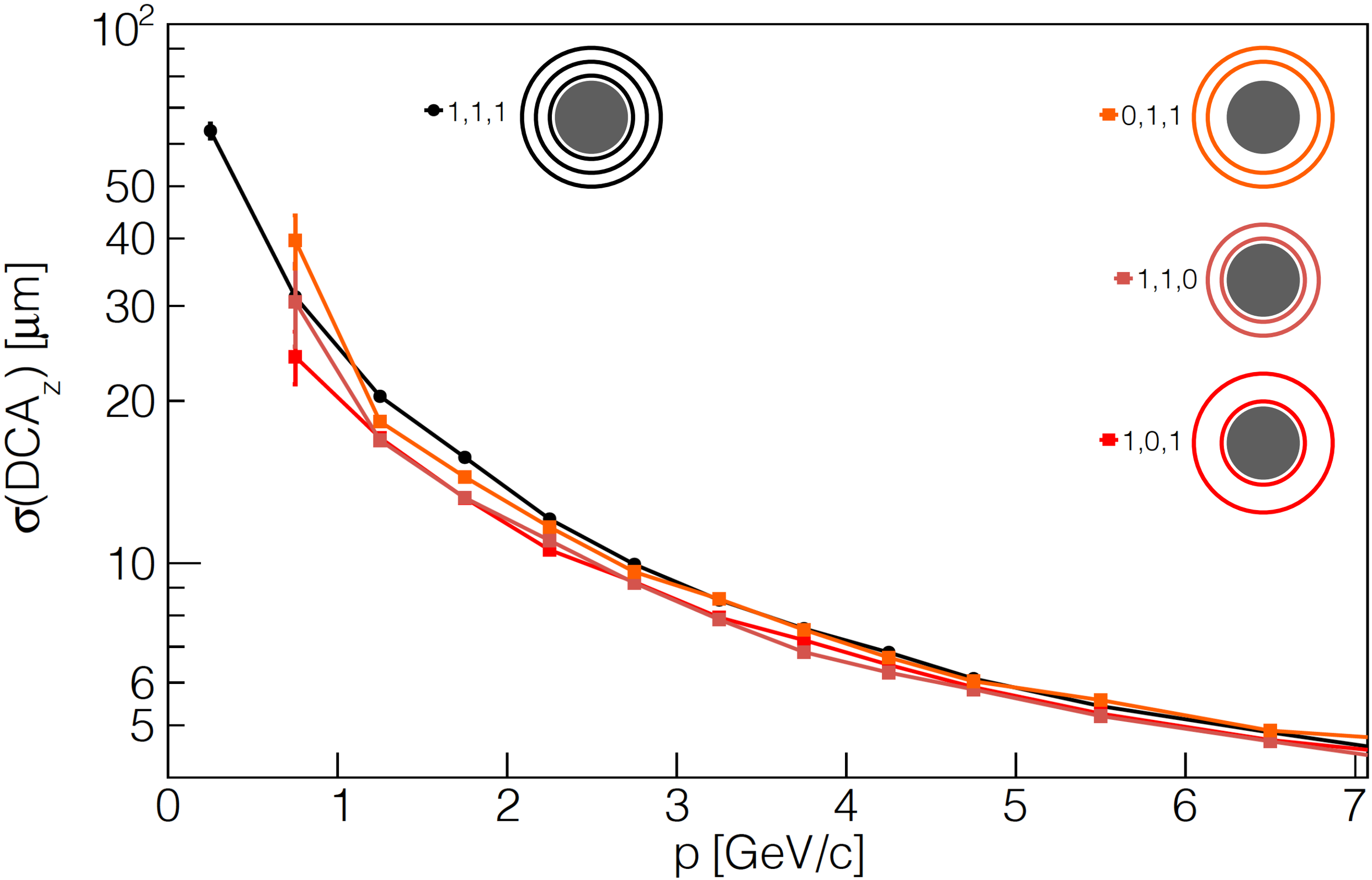
Beast (3.0 T), 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel

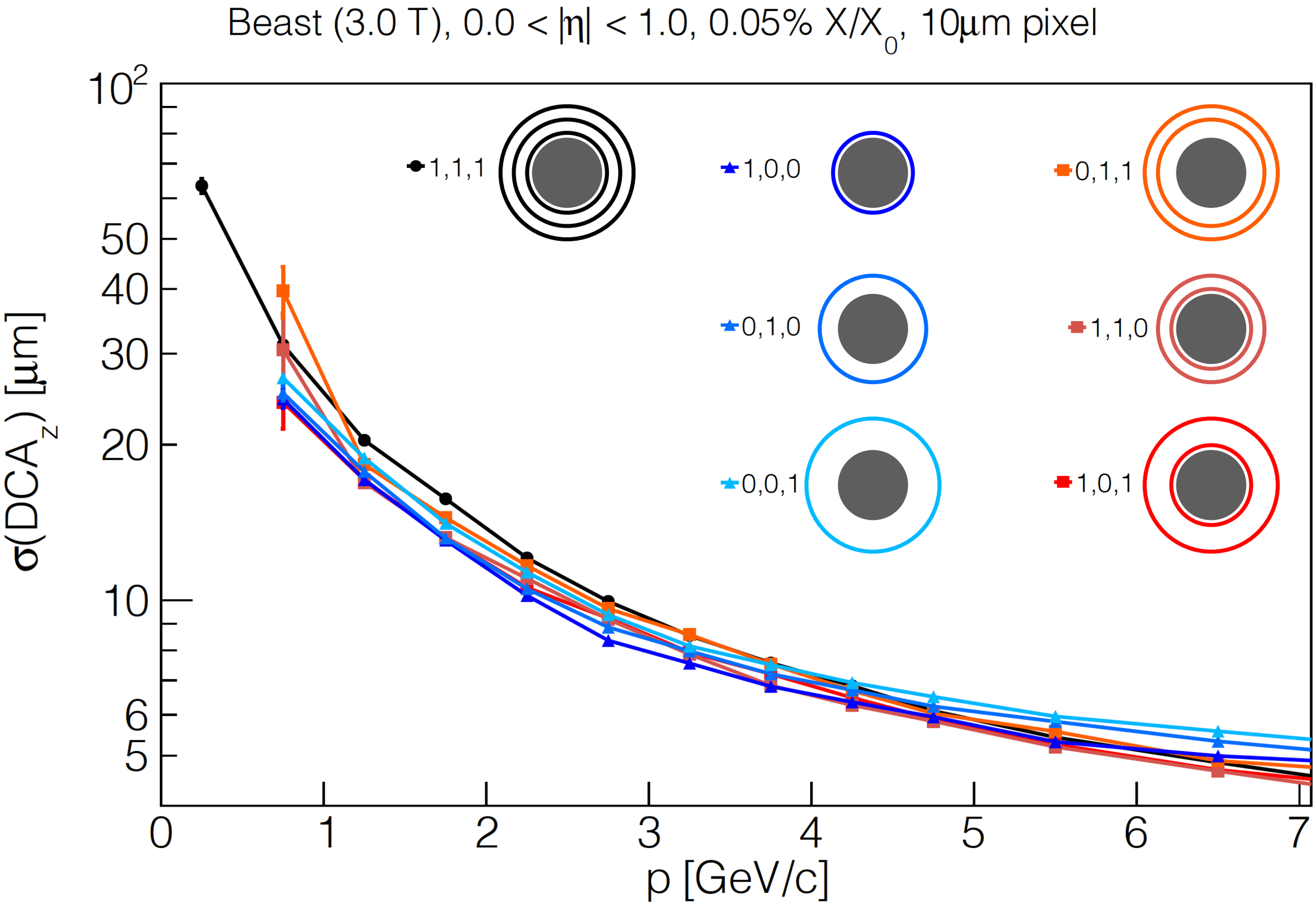


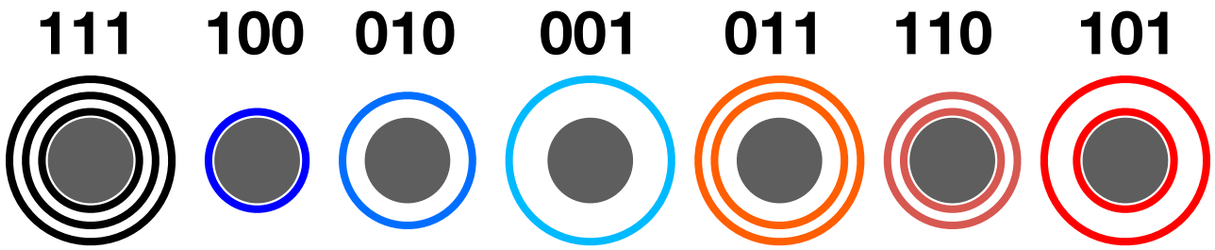
Beast (3.0 T), 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel



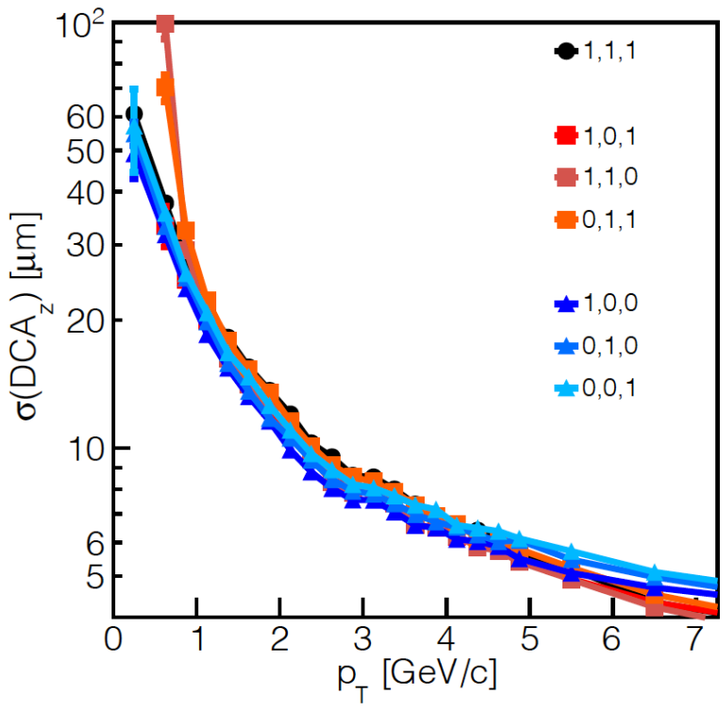
Beast (3.0 T), 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel

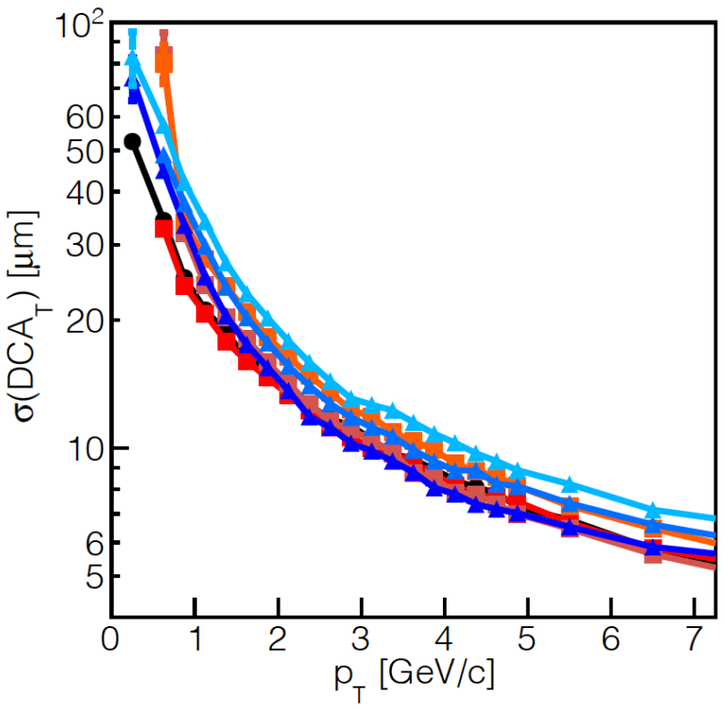


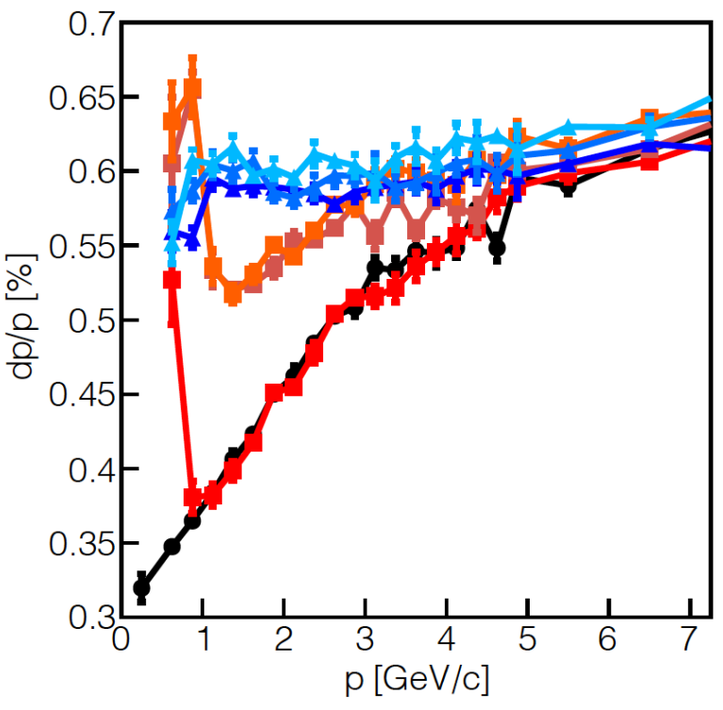

Beast (3.0 T), 0.0 < |η| < 1.0, 0.05% X/X0, 10μm pixel
σ(DCAz) [μm]
p [GeV/c]
1,1,1
1,0,0
0,1,1
0,1,0
1,1,0
0,0,1
1,0,1

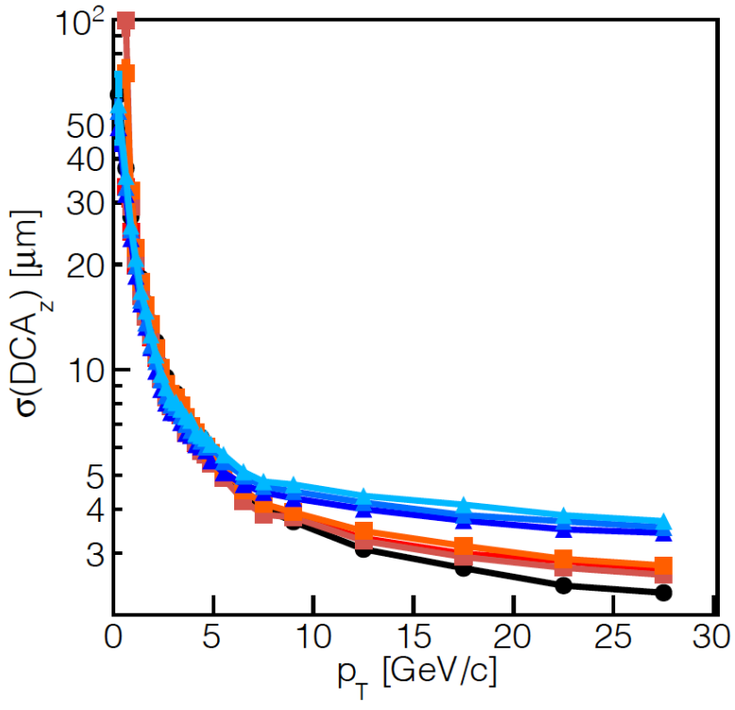


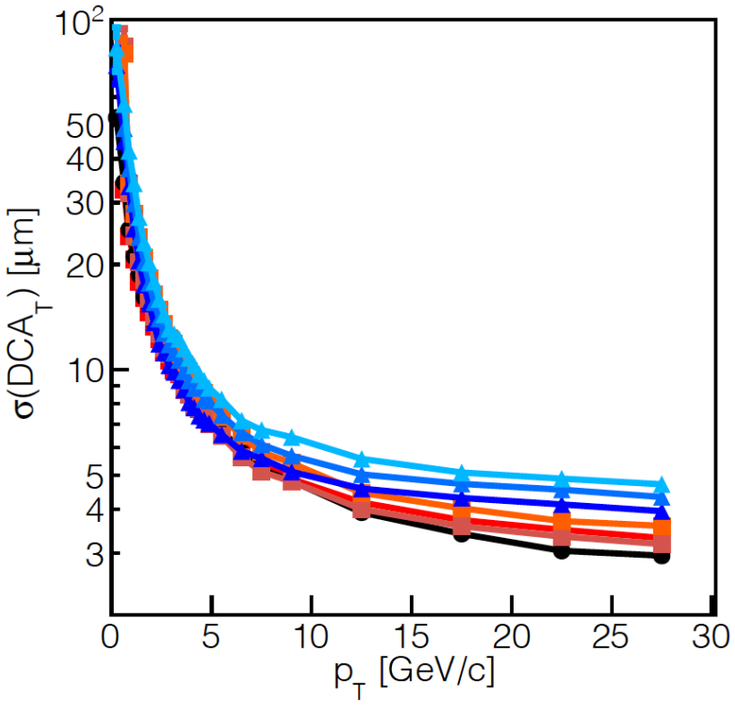
3.0 T, 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel

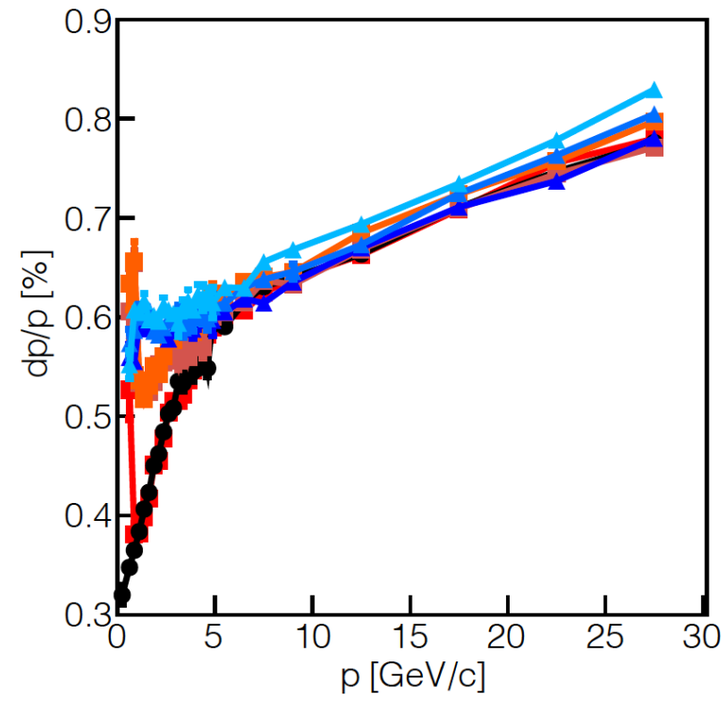


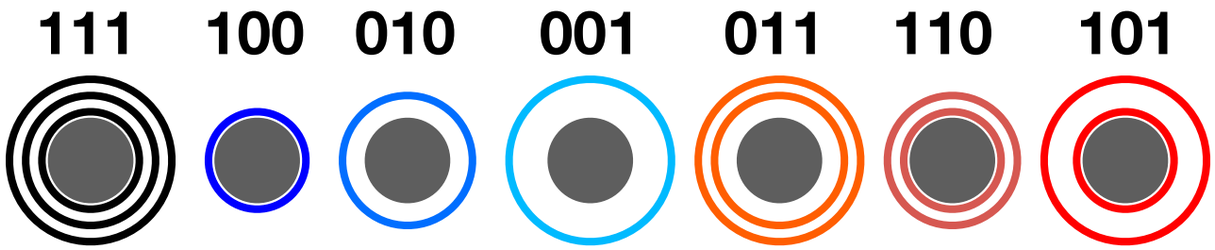




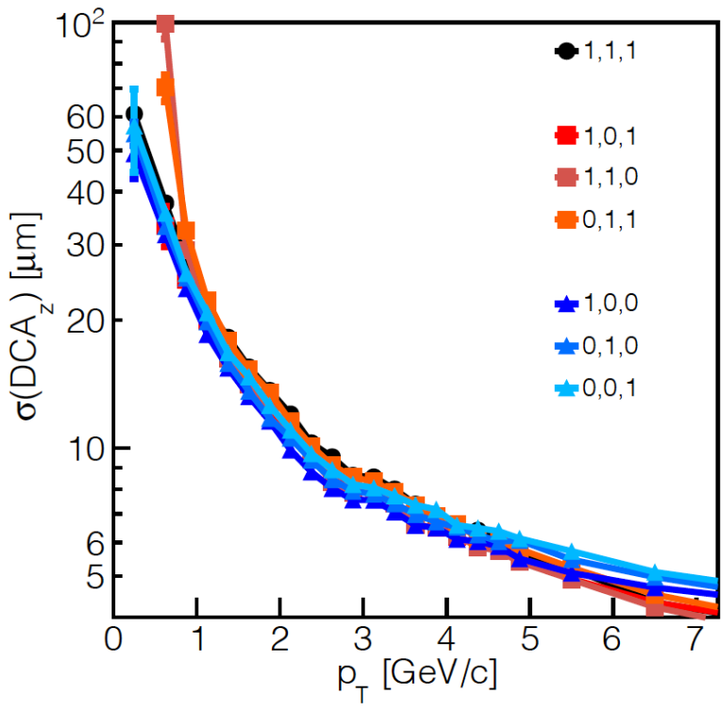


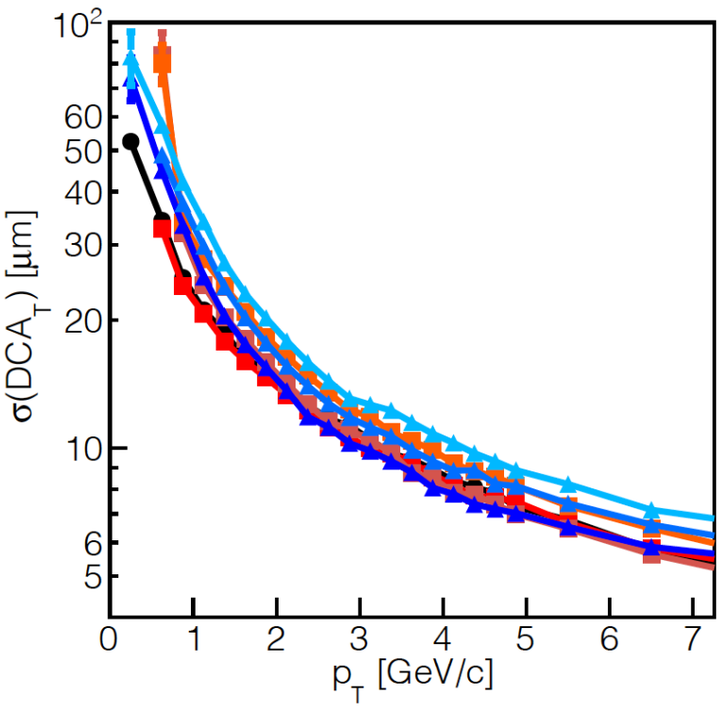


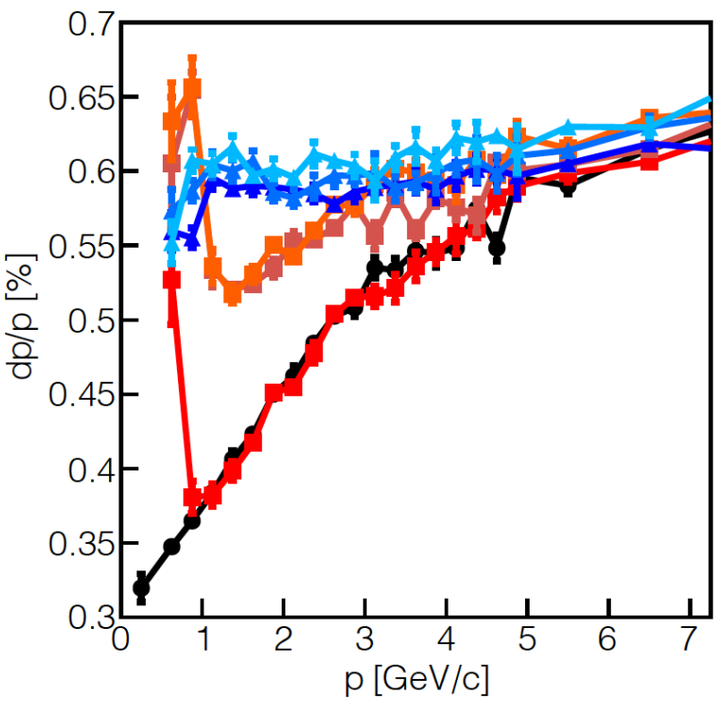


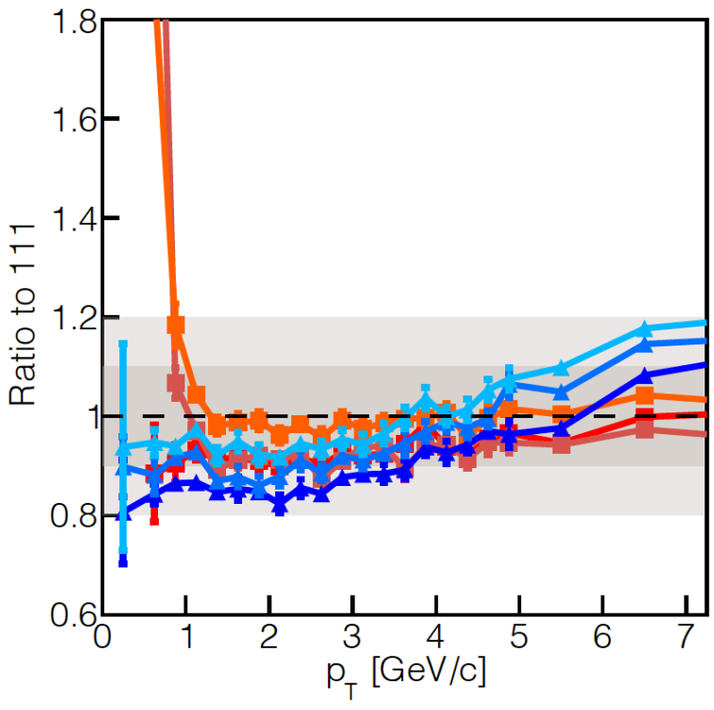


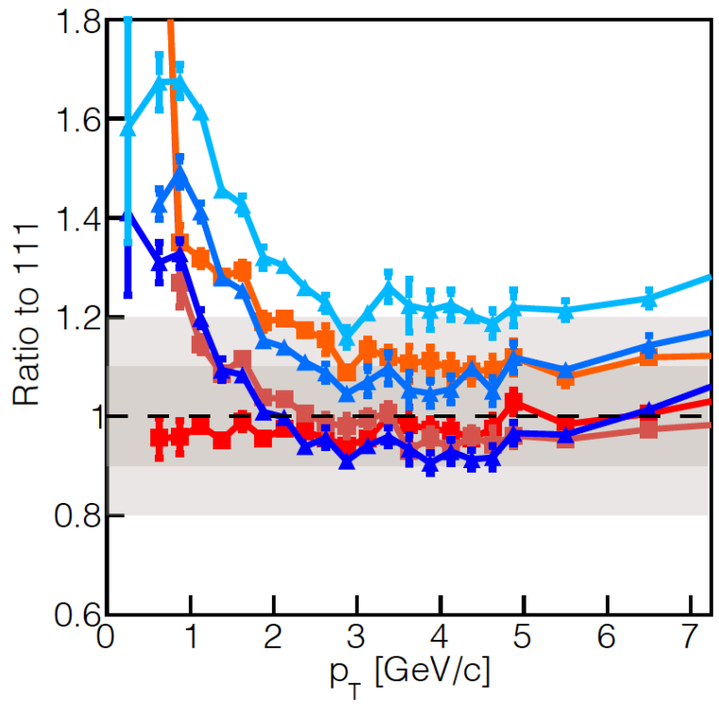
3.0 T, 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel

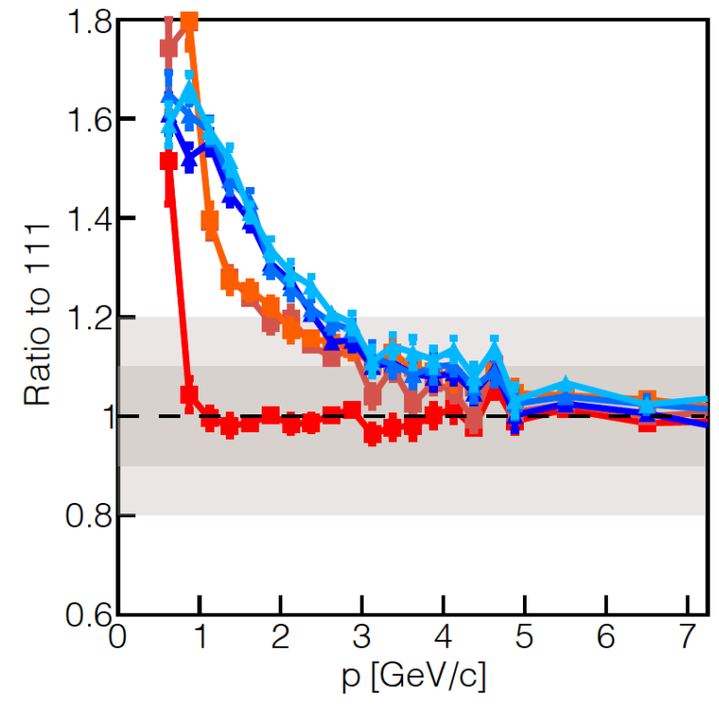






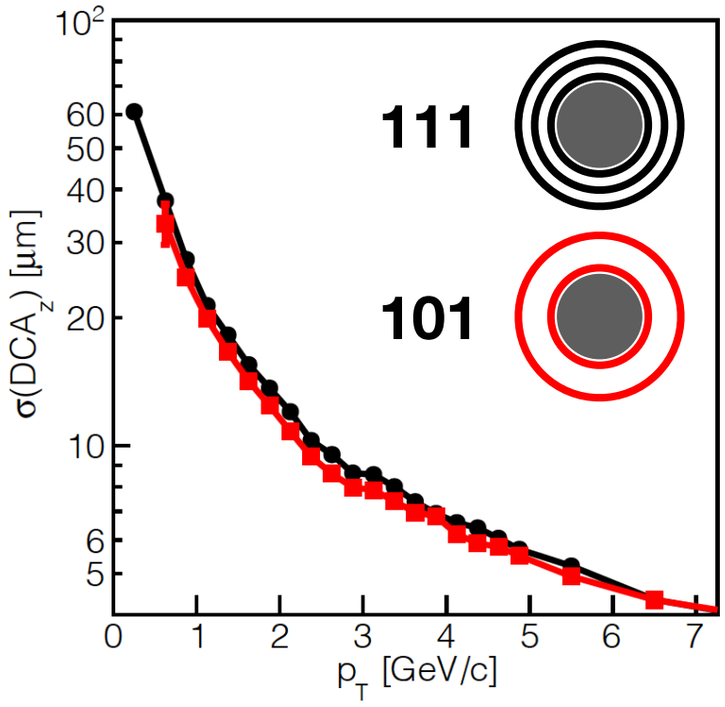


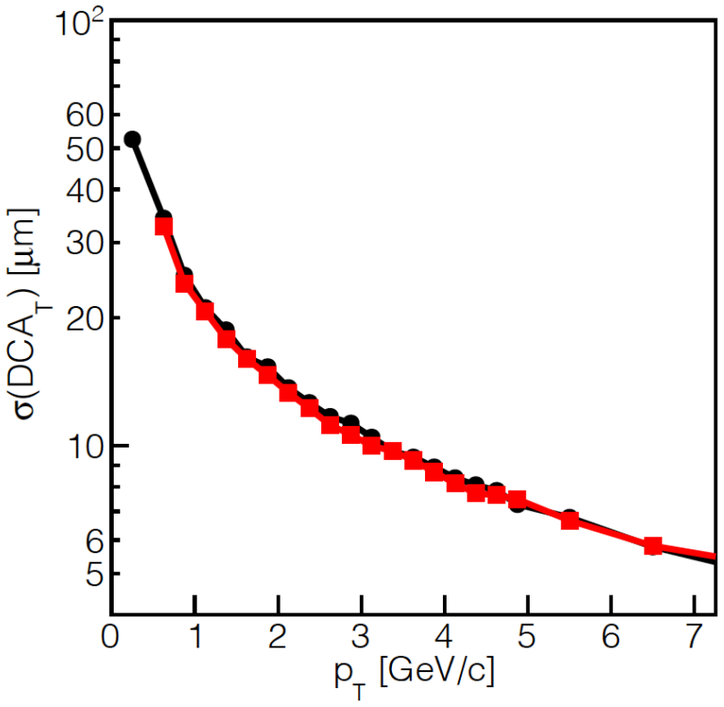


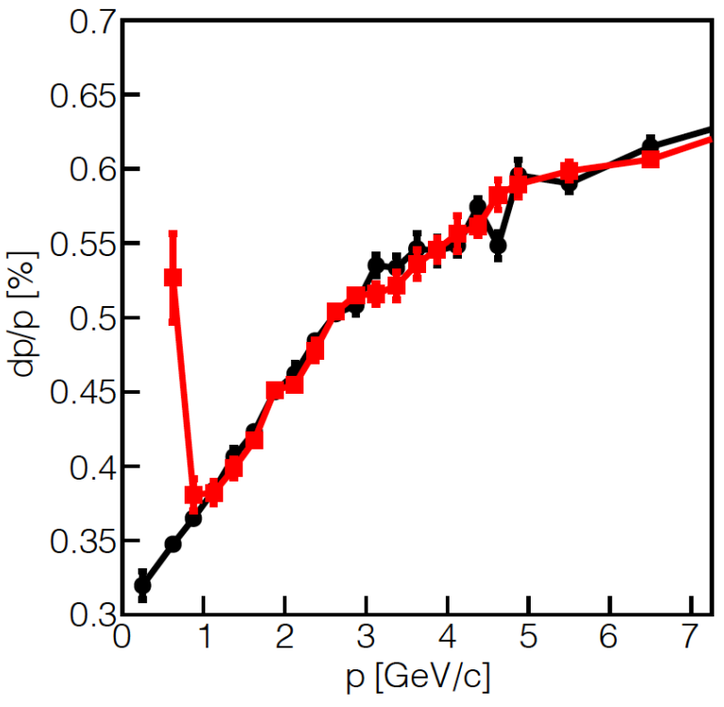


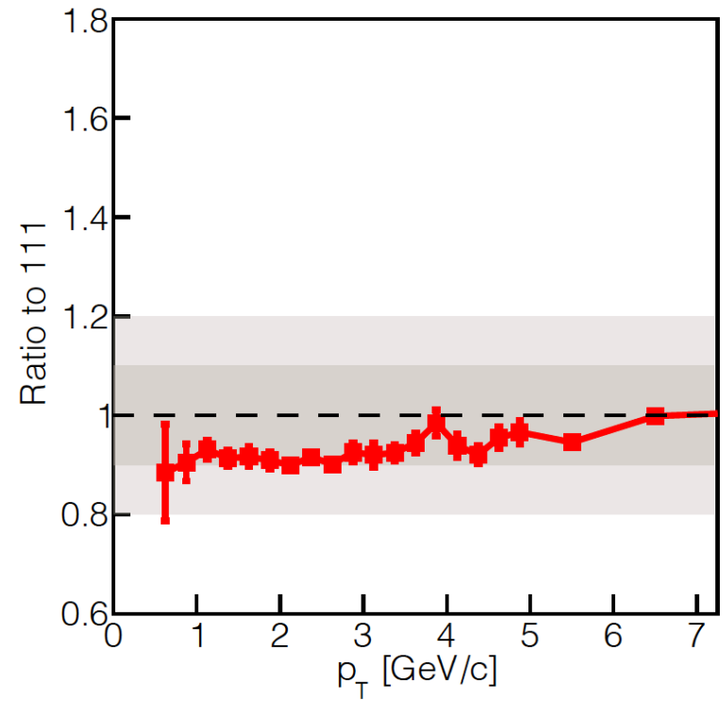
Main configurations:

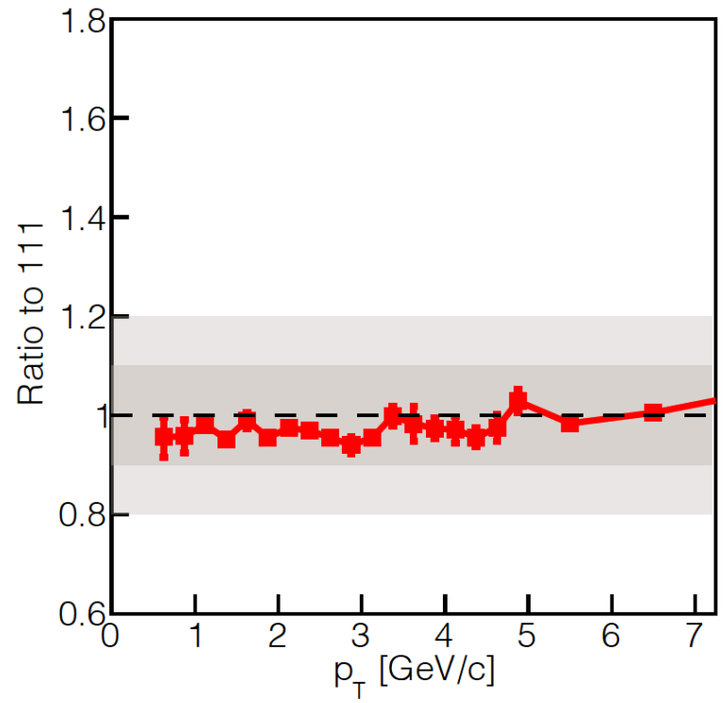
3.0 T, 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel

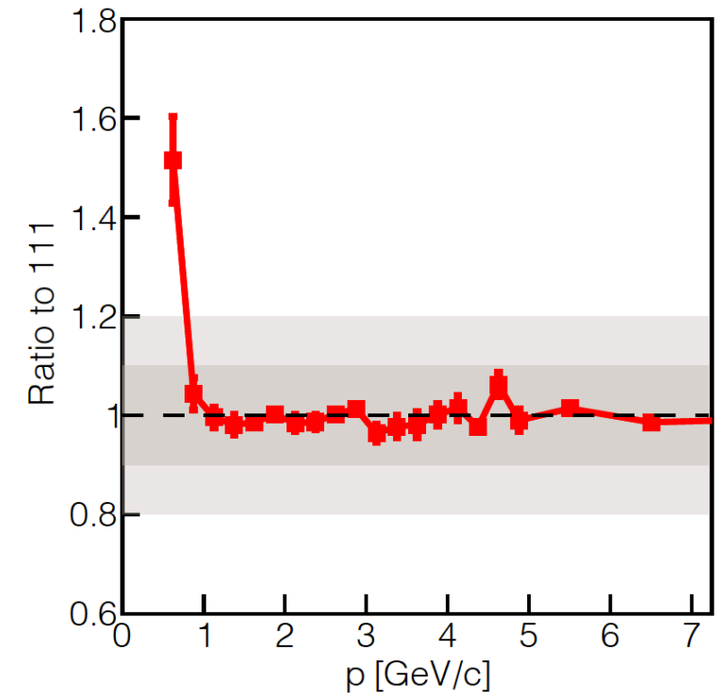










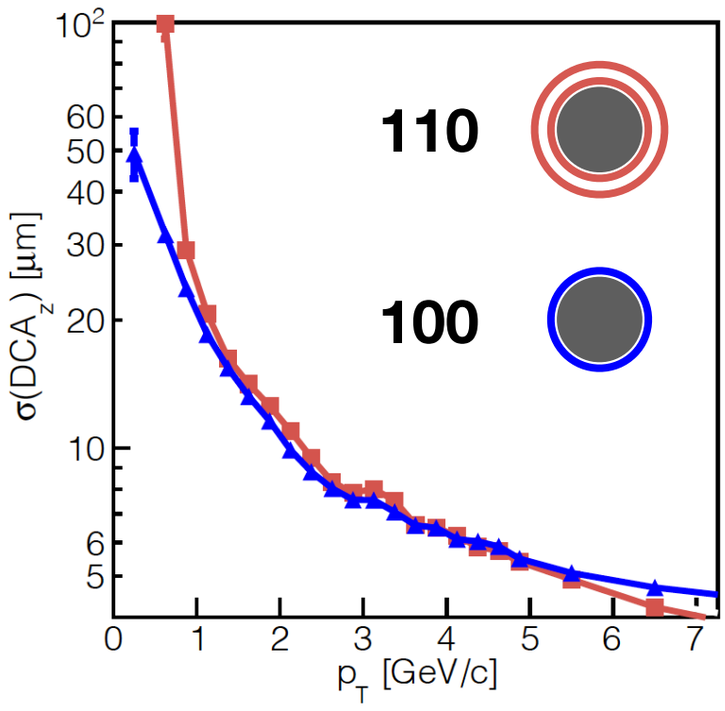


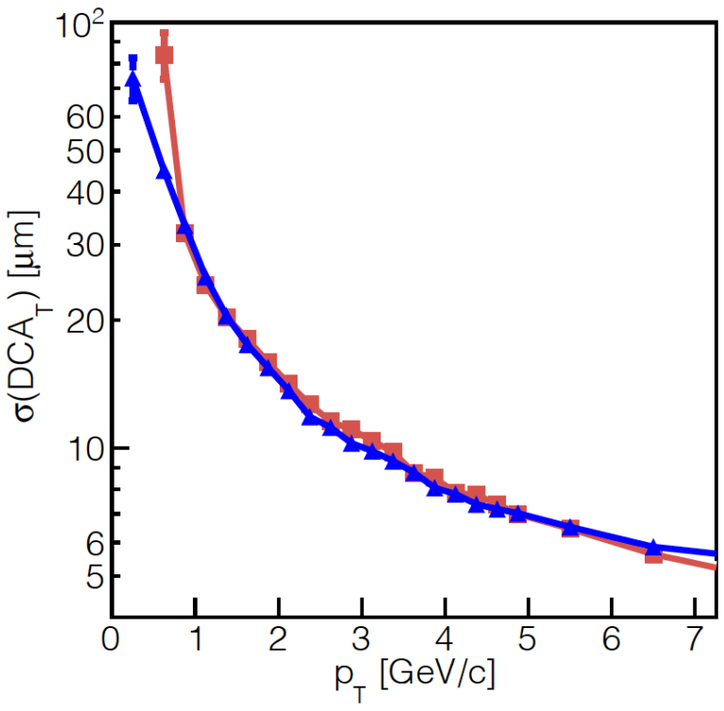
If the **outer** layer fails:

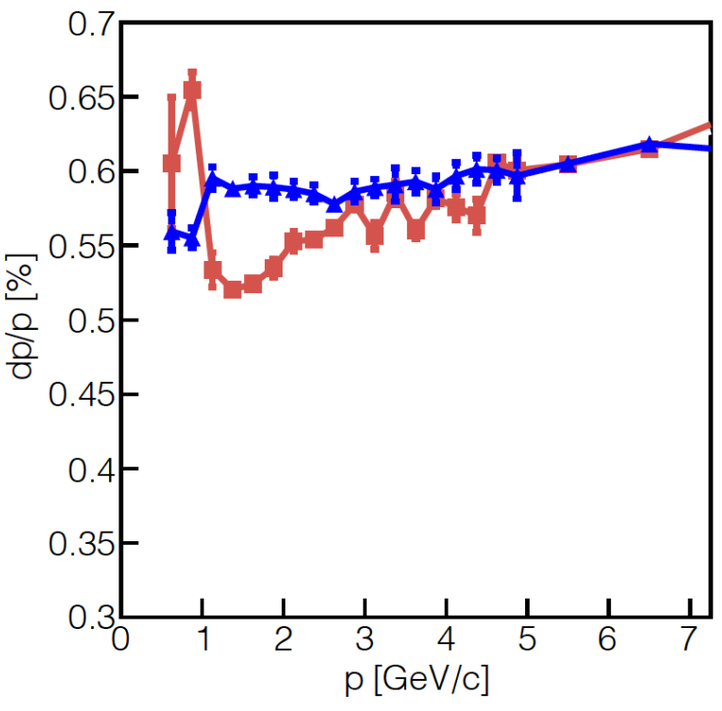
(1,1,1) → (1,1,0)

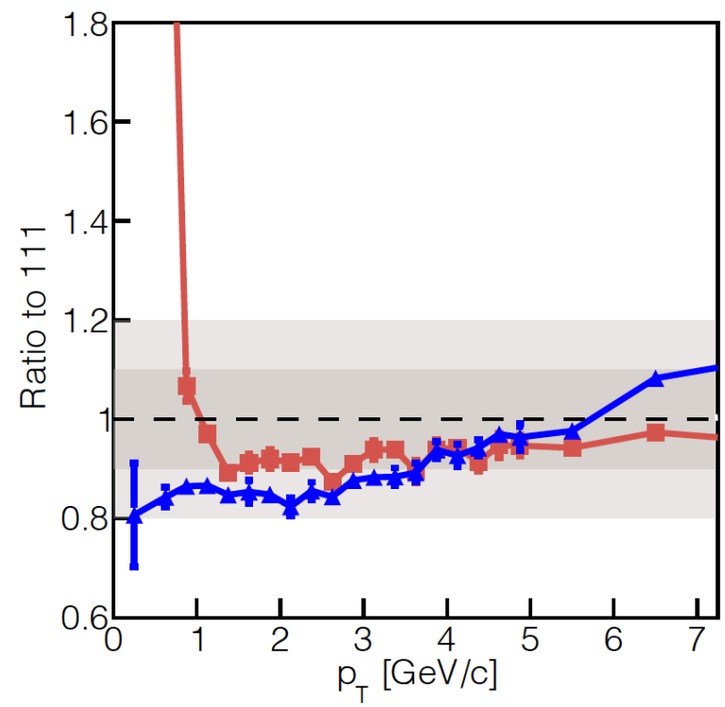
(1,0,1) → (1,0,0)

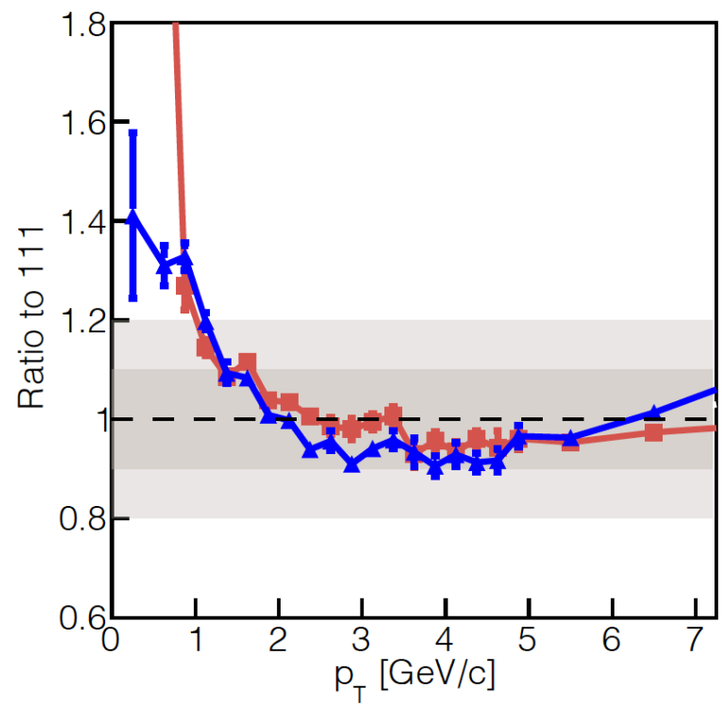
3.0 T, 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel

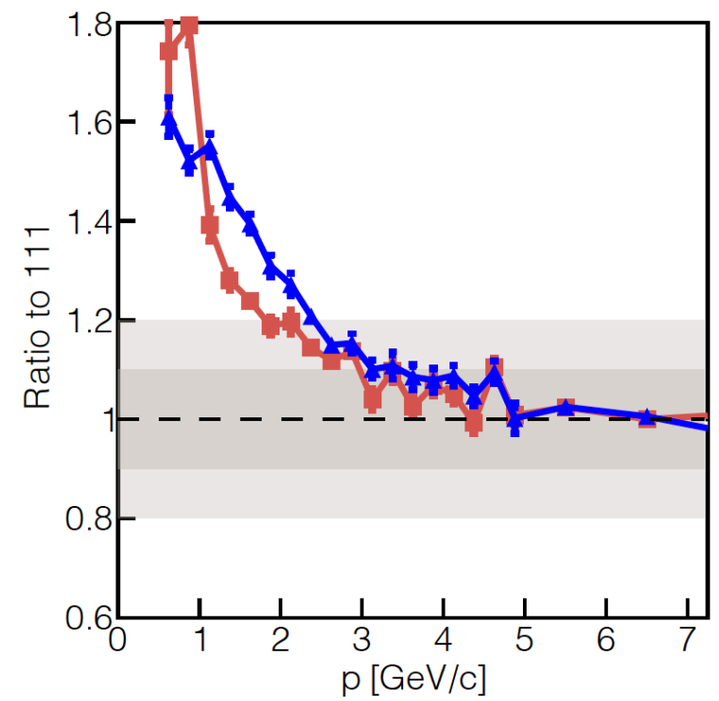










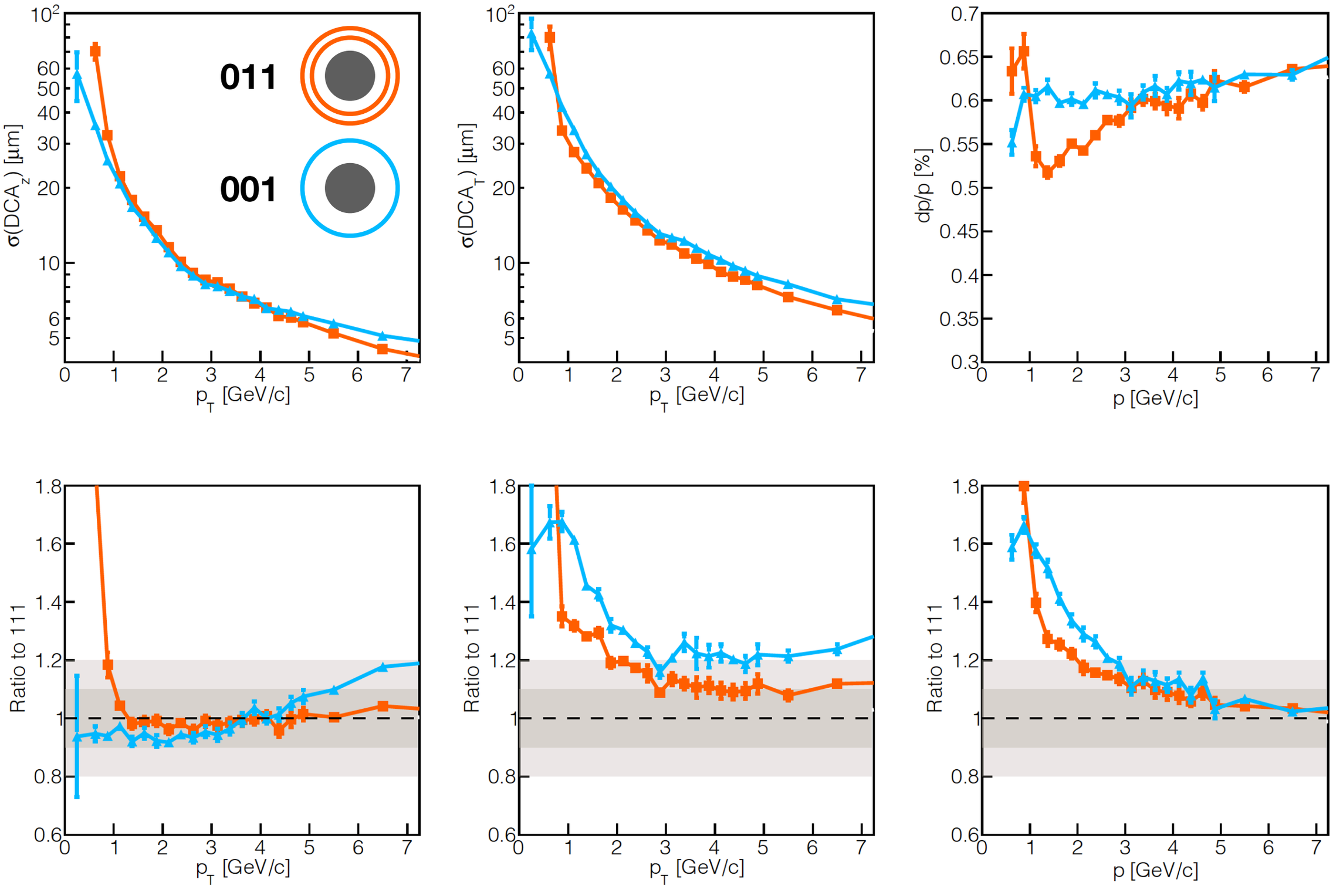


If the **inner** layer fails:

(1,1,1) → (0,1,1)

(1,0,1) → (0,0,1)

3.0 T, 0.0 < |η| < 1.0, 0.05% X/X_0, 10μm pixel



Outline

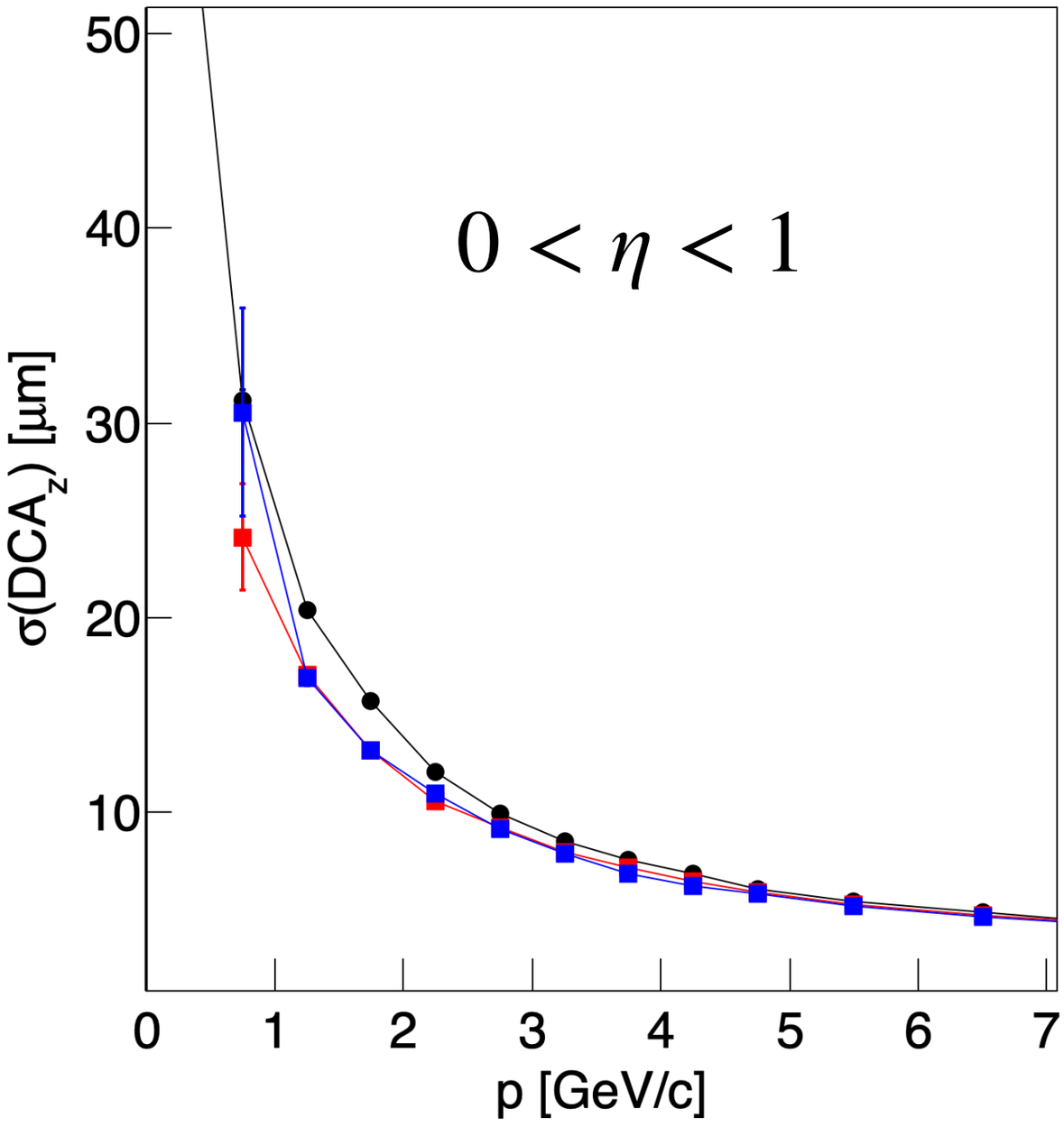
1) Performance of different vertexing configurations

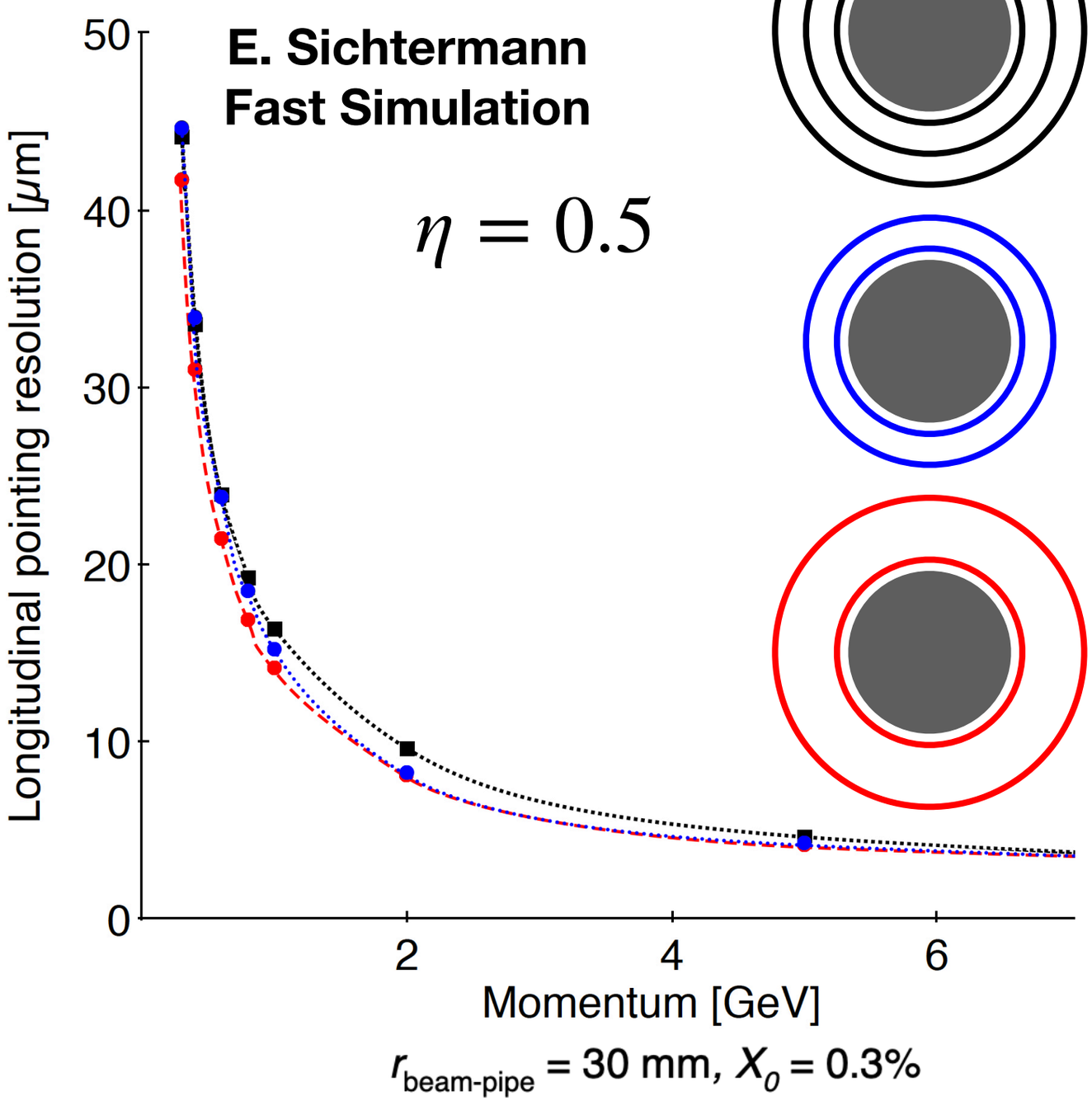
2) Comparison to fast simulations

3) Misalignment effects

4) Comparison to physics “requirements”

Comparison to fast simulations





B=3.0T, $10\ \mu\text{m}$ **pixel, vtx 0.05% X/X₀, barrel 0.5% X/X₀**

Outline

1) Performance of different vertexing configurations

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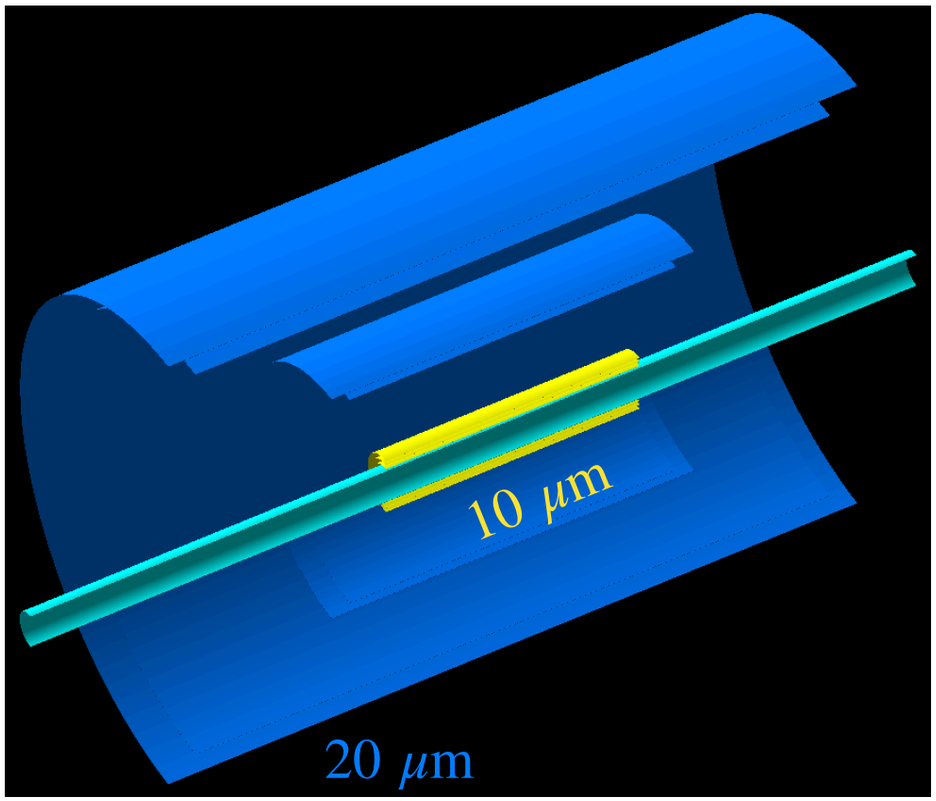
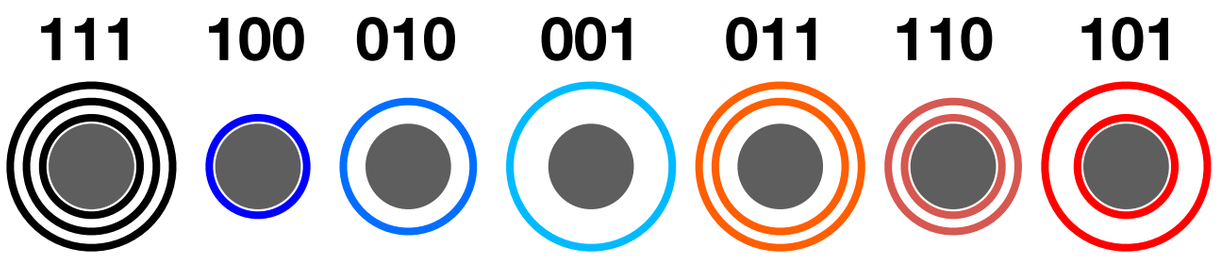
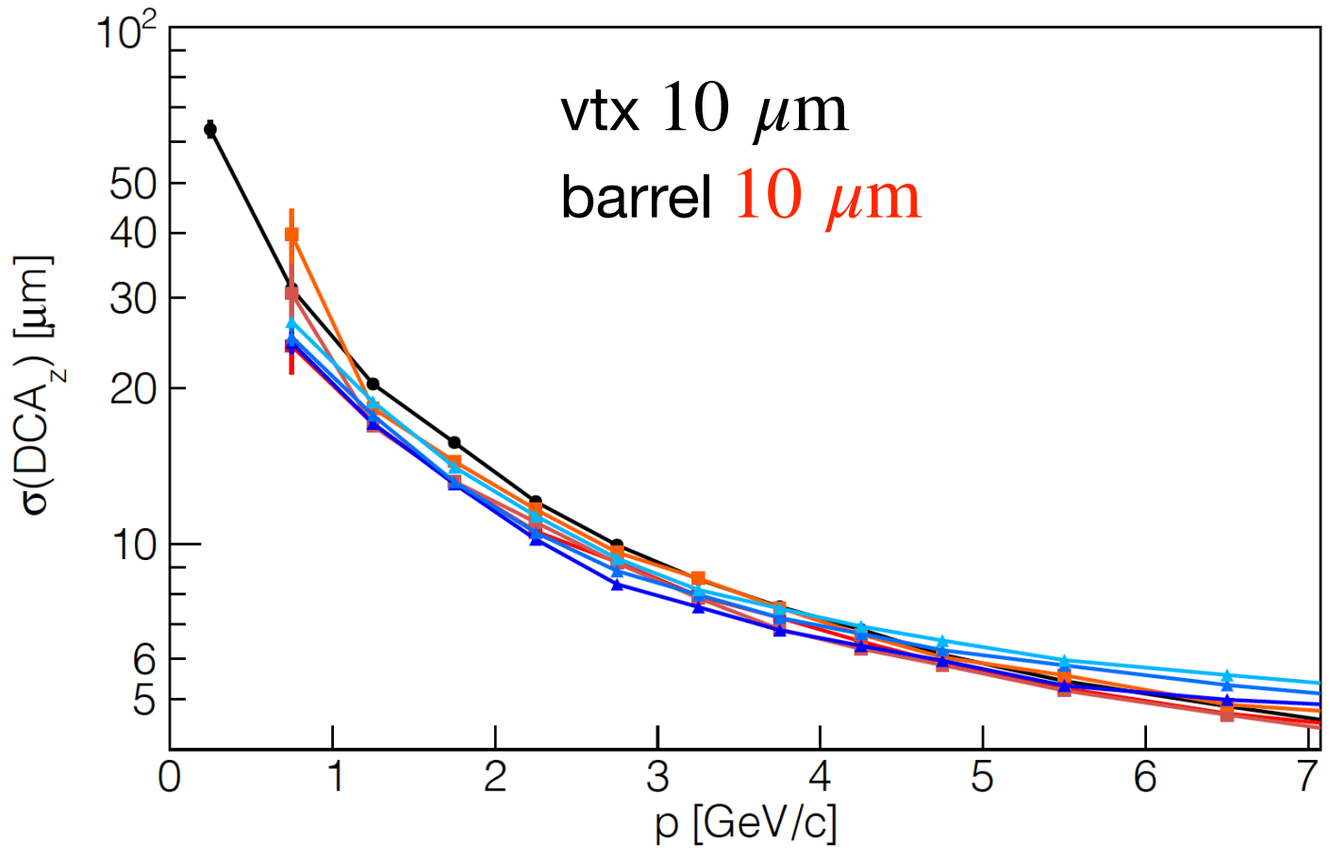
Effect of misalignment on vertexing

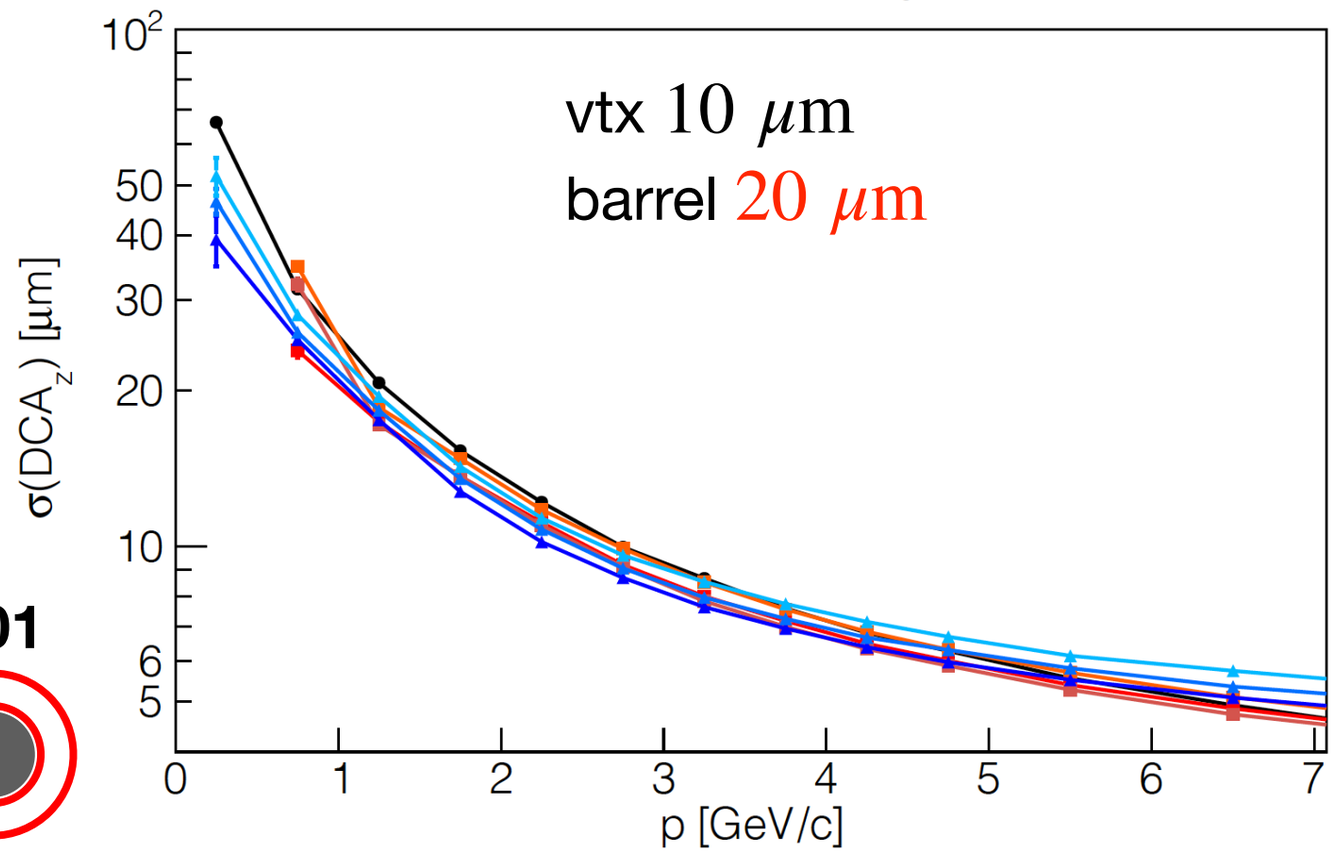
Added capability to have different pixel sizes in different layers to study effect of outer-layer misalignments



No significant differences found (consistent with fast simulations)







Outline

1) Performance of different vertexing configurations

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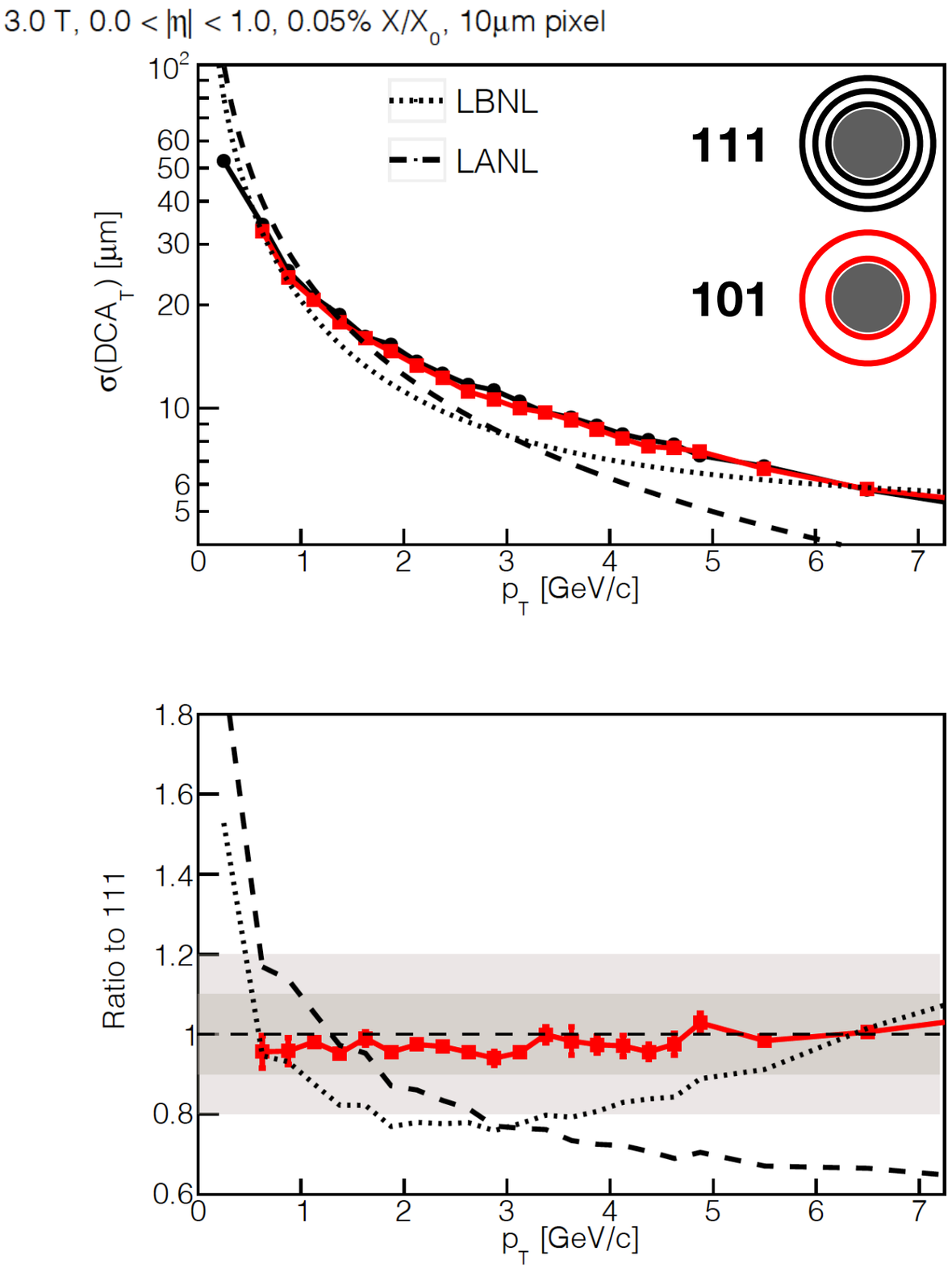
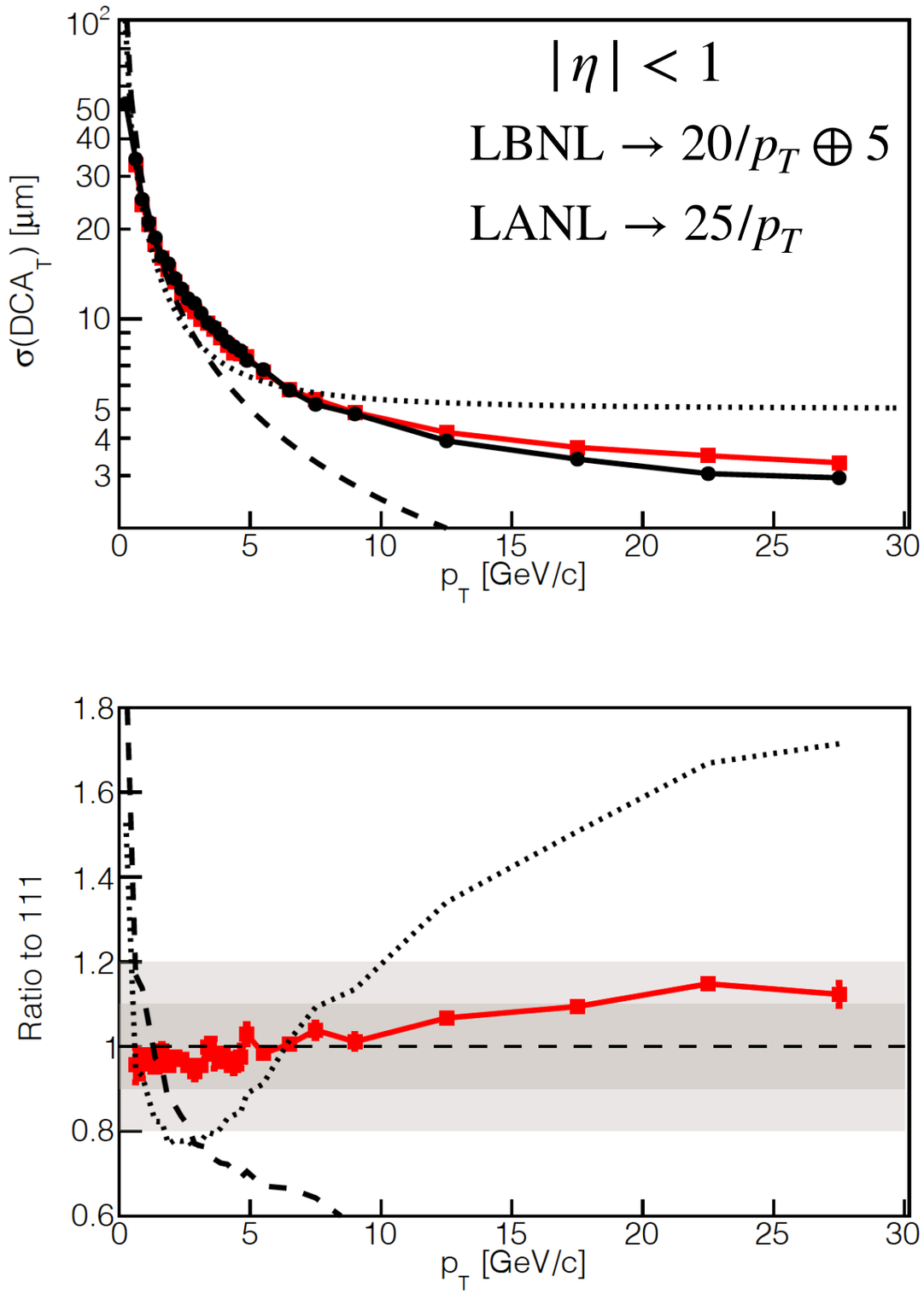
Comparison to physics “requirements”

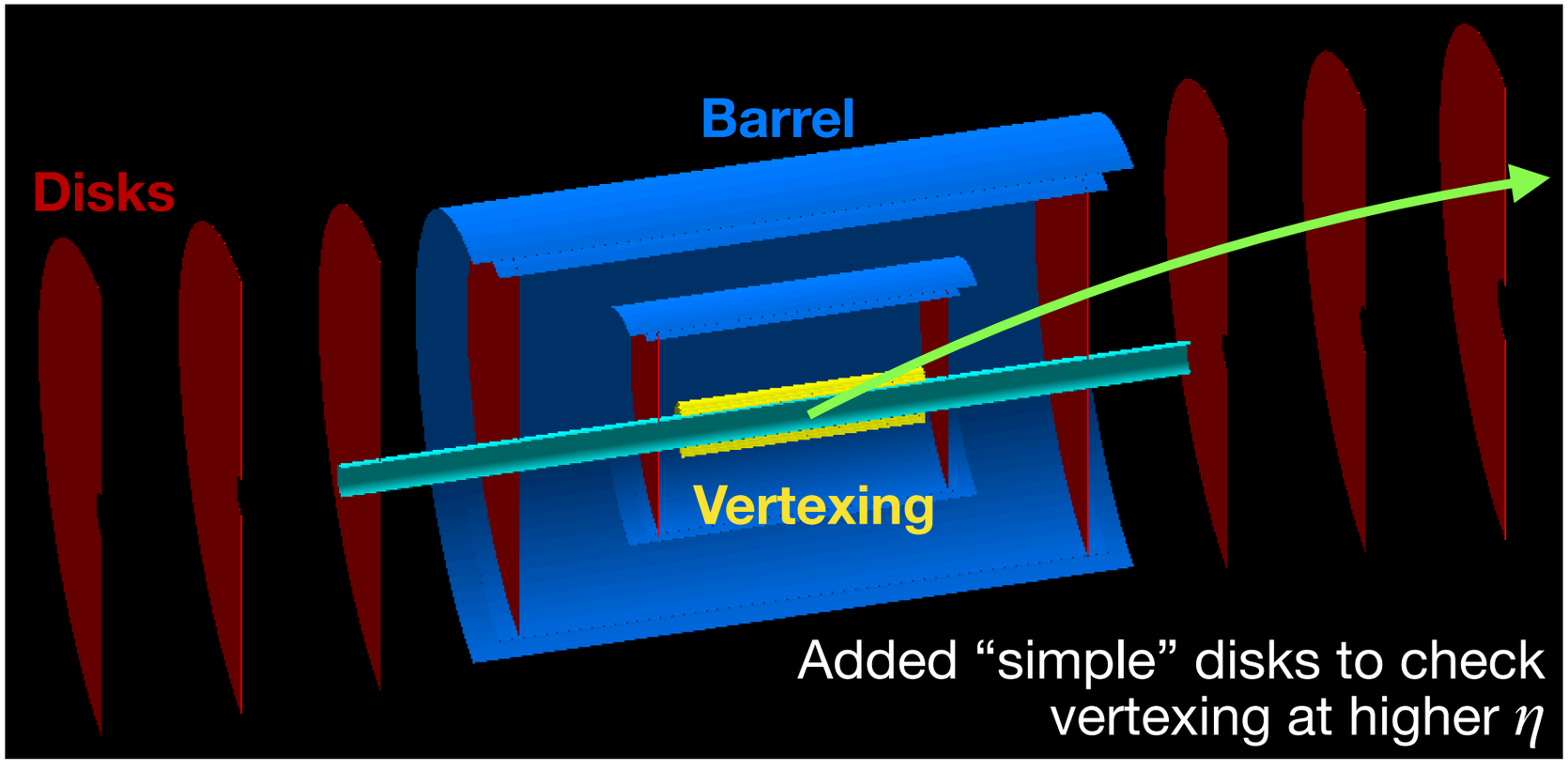




* parametrizations provided by M. Kelsey

Next Steps

Remake these plots for higher η:



Cori has been down for two weeks

Summary and Conclusions

For $p_T < 6$ GeV/c

- Found small (<10%) differences between 111 and 101 configurations.
- Overall, 101 offers slightly better DCA resolutions.
- 111 only outperforms 101 when the outer layer fails (but differences are still small).
- 101 also cheaper (+less material budget)