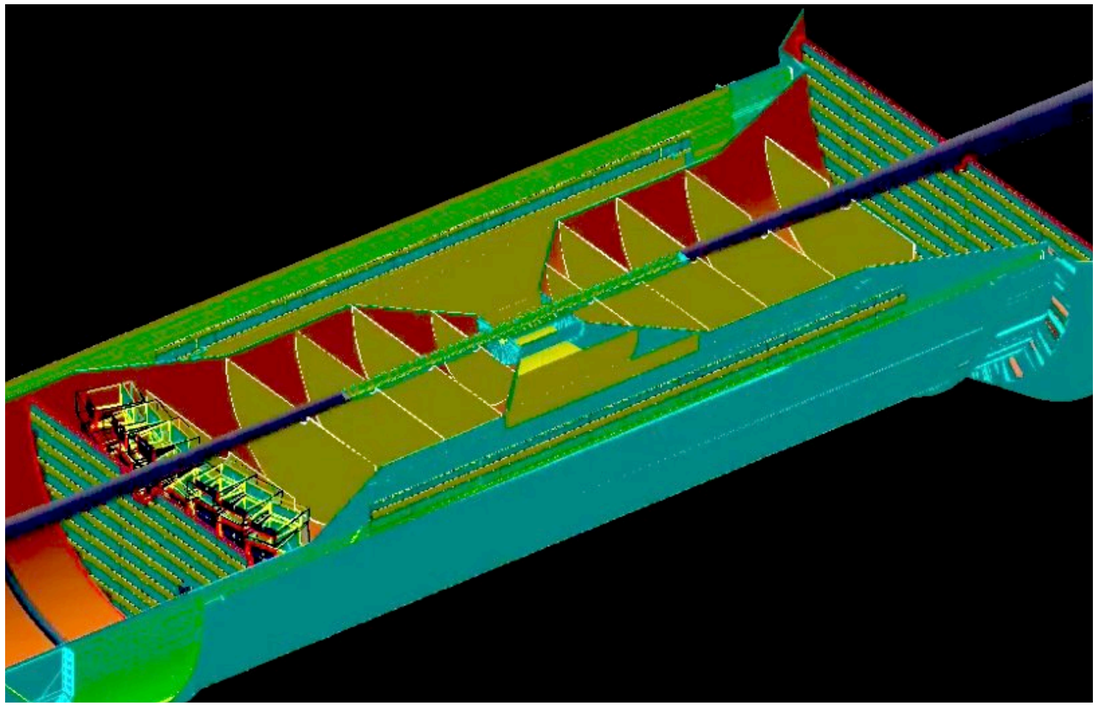
Tracking updates

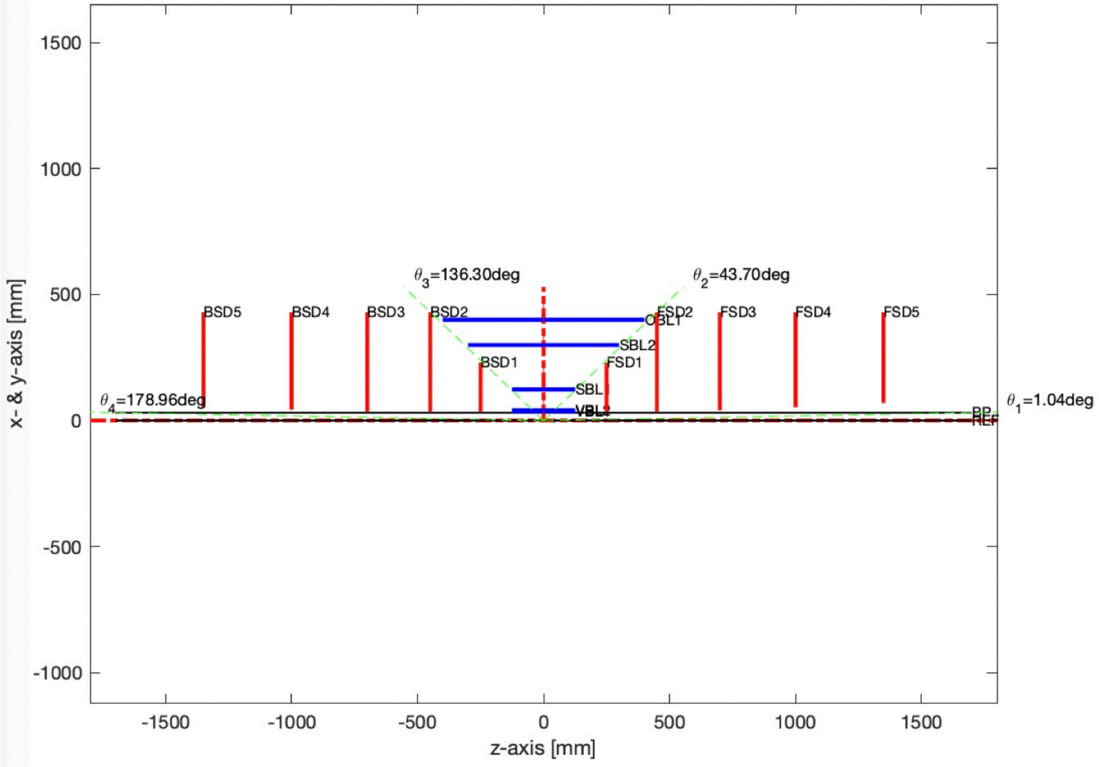


Rey Cruz-Torres
Aug 30th, 2022

Slide from E. Sichtermann

New proposed configuration

This path to recovering YR mid-rapidity performance in 1.7 T with ePIC



Barrel:

- ~45° degree projective cone,
- Outermost barrel layer at r = 420 mm, l = 840 mm,
- Single “conventional” sagitta layer with r = 270 mm, l = 540mm, $X/X_0 \sim 0.25\%$,
- Outer (third) vertex barrel layer with increased radius to r = 120 mm while preserving l = 270 mm and $X/X_0 \sim 0.05\%$,
- Two inner vertex barrel layers with r = 36, 48 mm and l = 270 mm and $X/X_0 \sim 0.05\%$ per layer,

Disks:

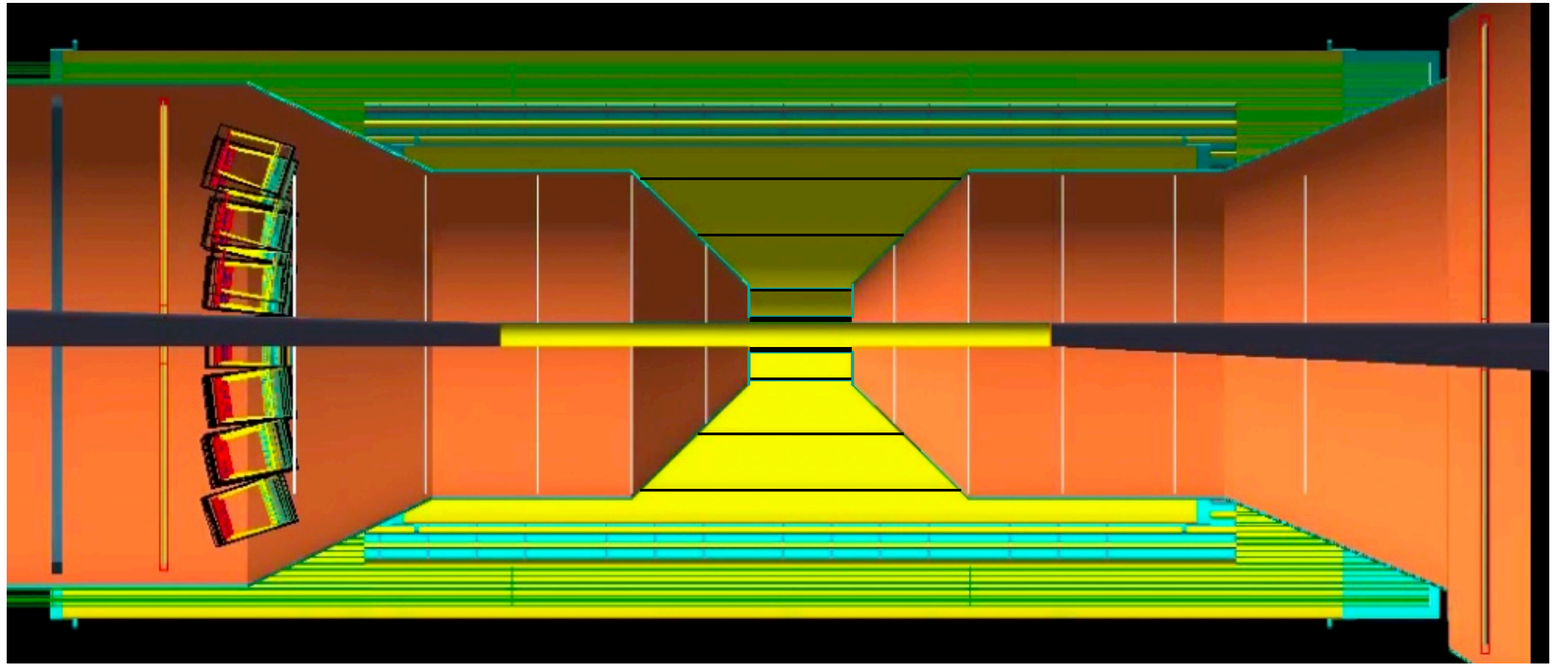
- Suggest |z| = 250, 450, 700, 1000, 1350* mm,
- r_{out} = 430 mm at |z| > 430 mm, ~230 mm at |z| = 250 mm
- $X/X_0 \sim 0.24\%$ per disk,
- $r_{in} \sim$ 5mm away from beam pipe,
- Outer support / service cylinders for 450 < |z| < 1350* mm

* 1350mm will “butt up” right to the mRICH volume according to the menagerie / geometry DB; GD/I considerations may reduce this, e.g. to 1300 mm, but my suggestion is to request this — otherwise empty (!) — space now.

Yes, there are other aspects, many of which require further study and further optimizations — a straightforward example would be z-extent / a 6th disk in the hadron-direction.

Material on the essential service cylinders is being worked out. This is, in my opinion, absolutely essential to incorporate soon and optimize — especially further routing.

New LBNL/EPIC geometry



Barrel

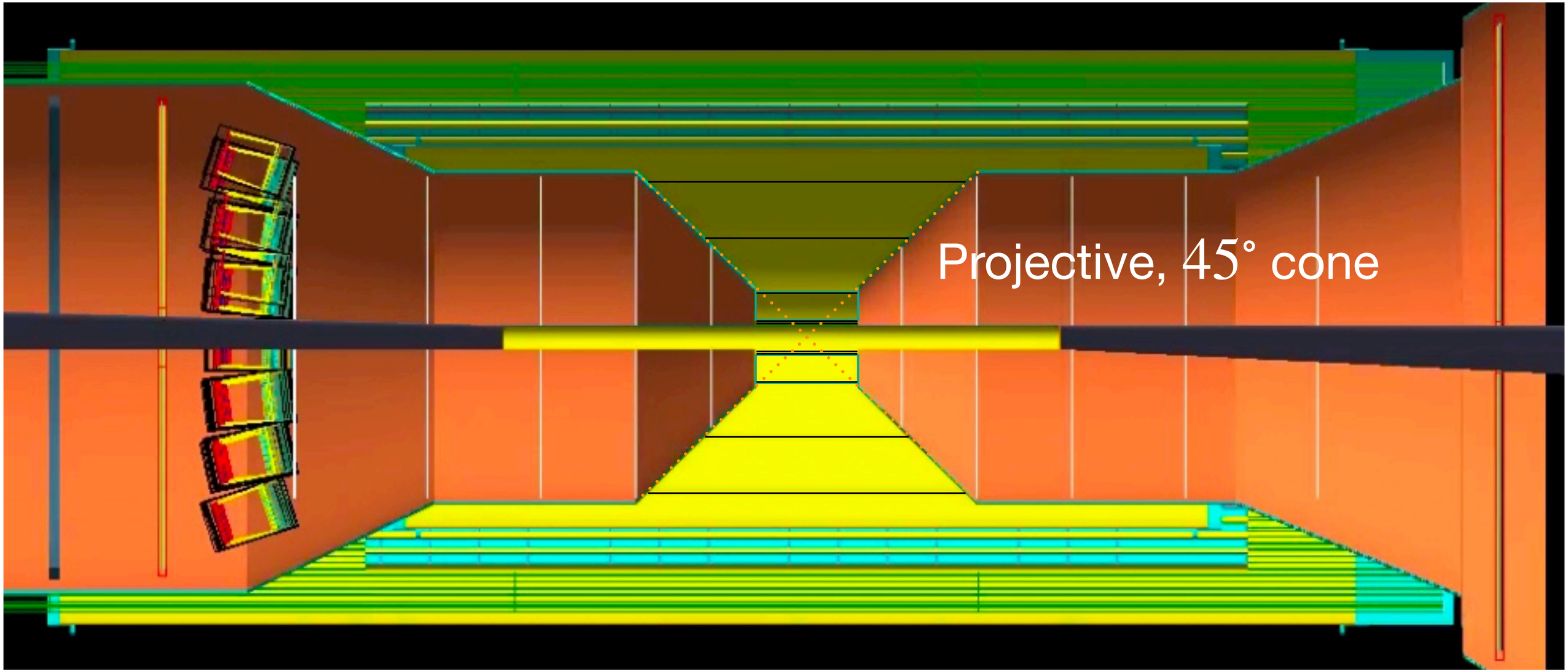
Si	r (cm)	length (cm)	X
1	3.6	27	0.05
2	4.8	27	0.05
3	12	27	0.05
4	27	54	0.25
5	42	84	0.55

Disks

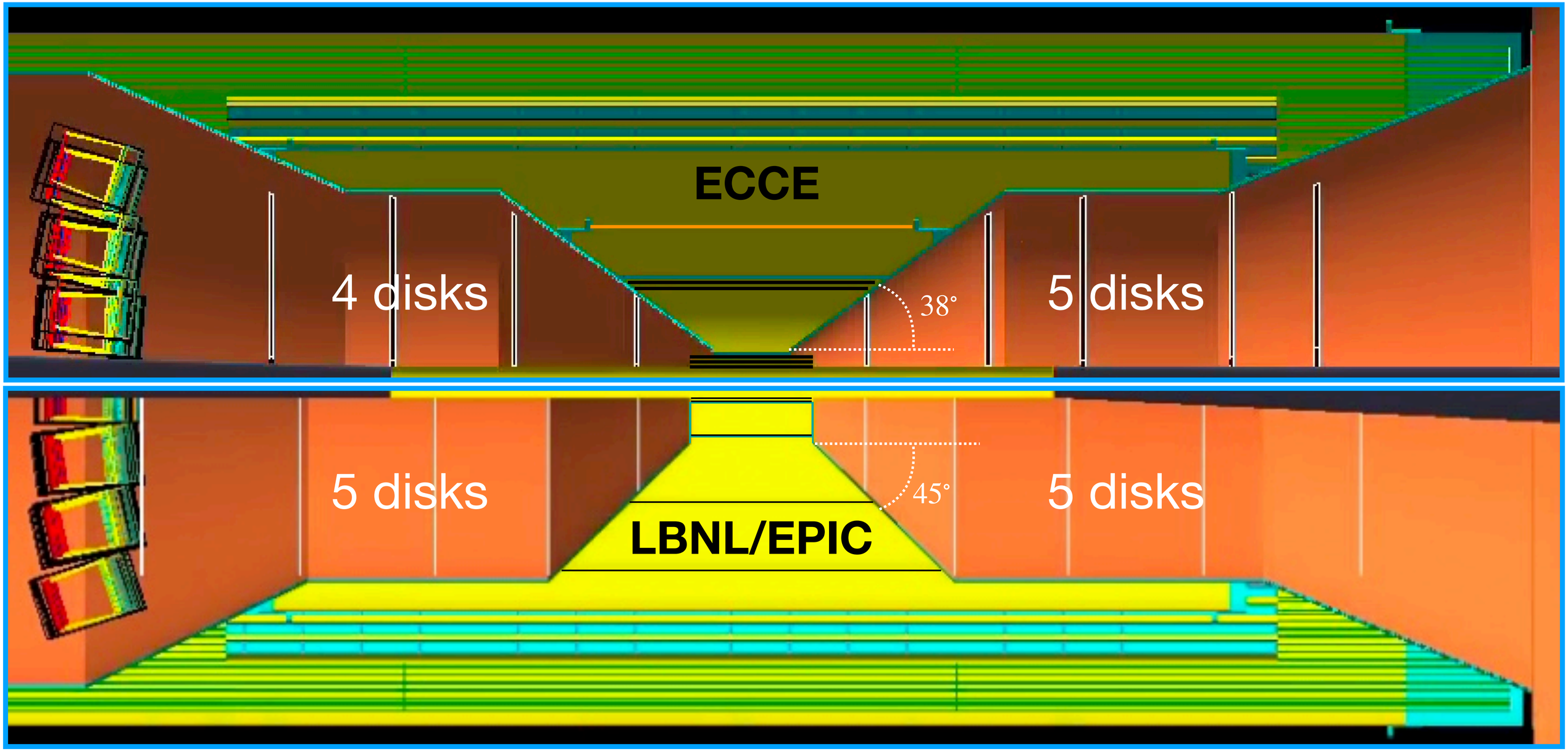
	z (cm)	r_{min} (cm)	r_{max} (cm)
1	25	3.6+0.5	23.9
2	45	3.6+0.5	43.0
3	70	4+0.5	43.0
4	100	5.3+0.5	43.0
5	135	7+0.5	43.0

0.24% X0 per disk

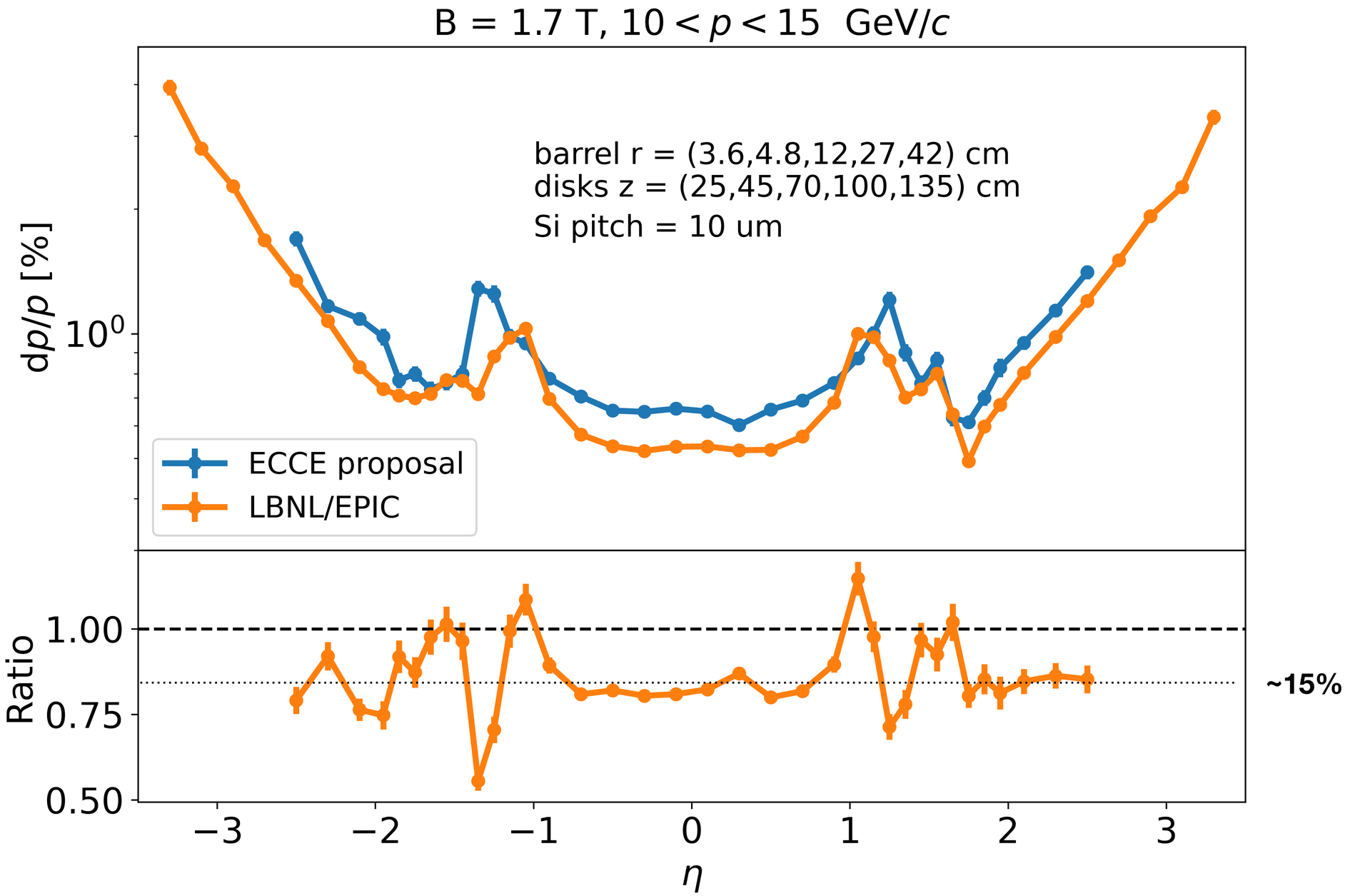
New LBNL/EPIC geometry



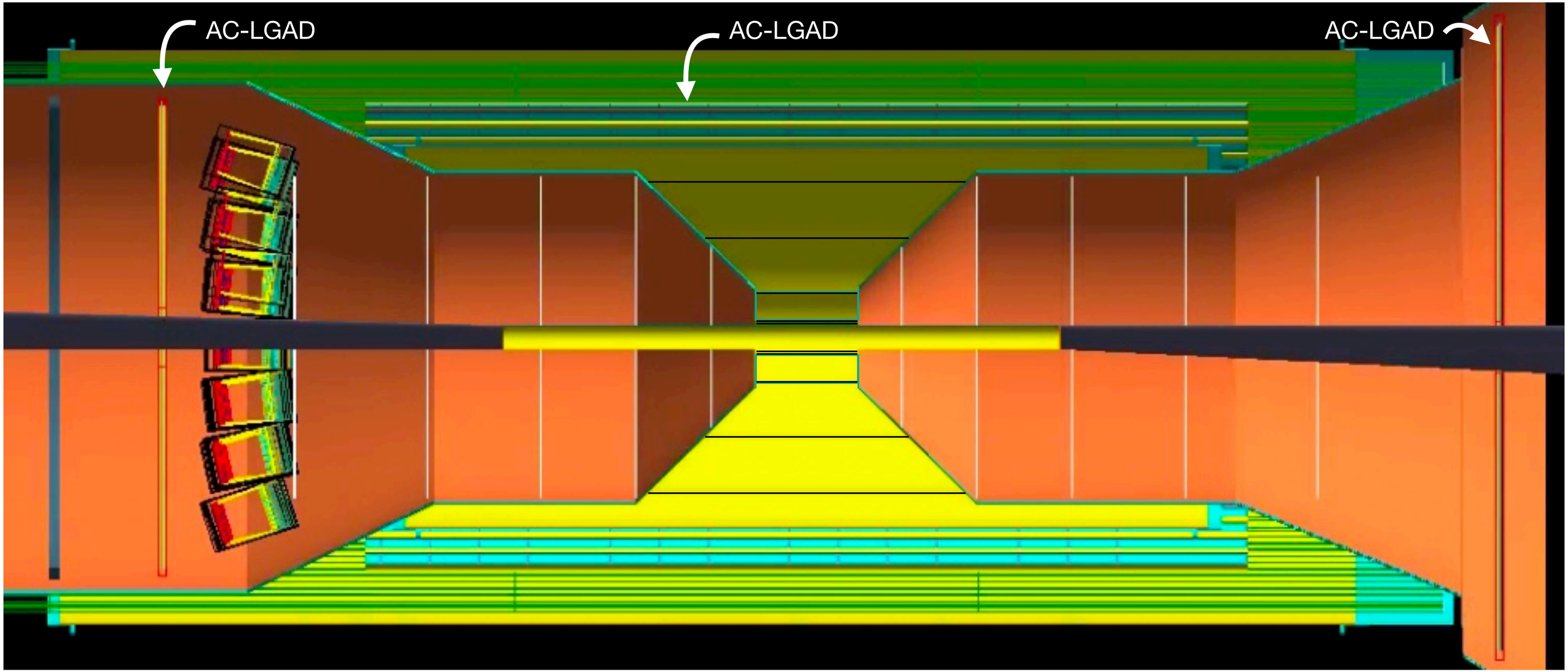
Comparison ECCE - LBNL/EPIC geometry



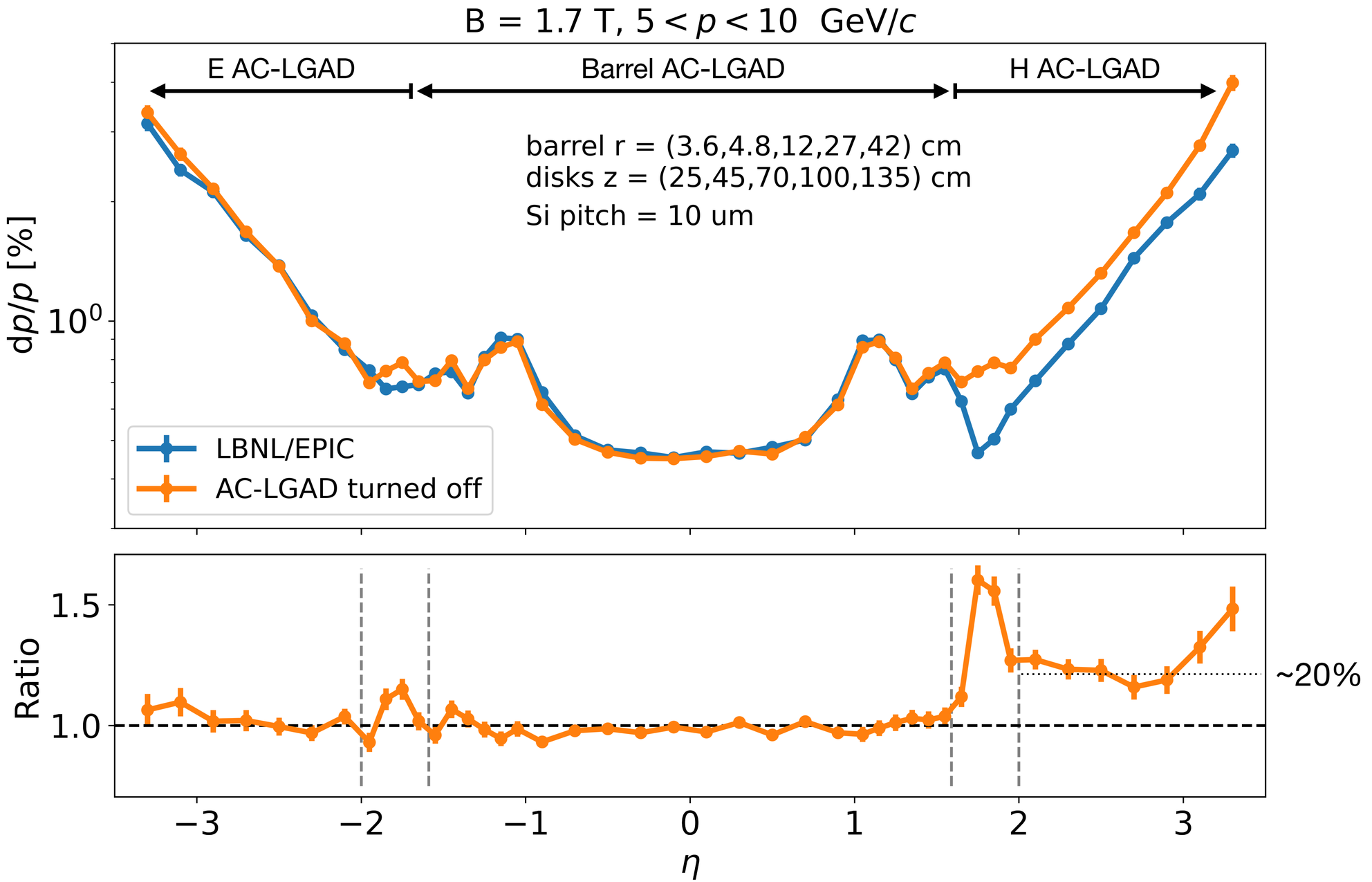
Comparison ECCE - LBNL/EPIC geometry



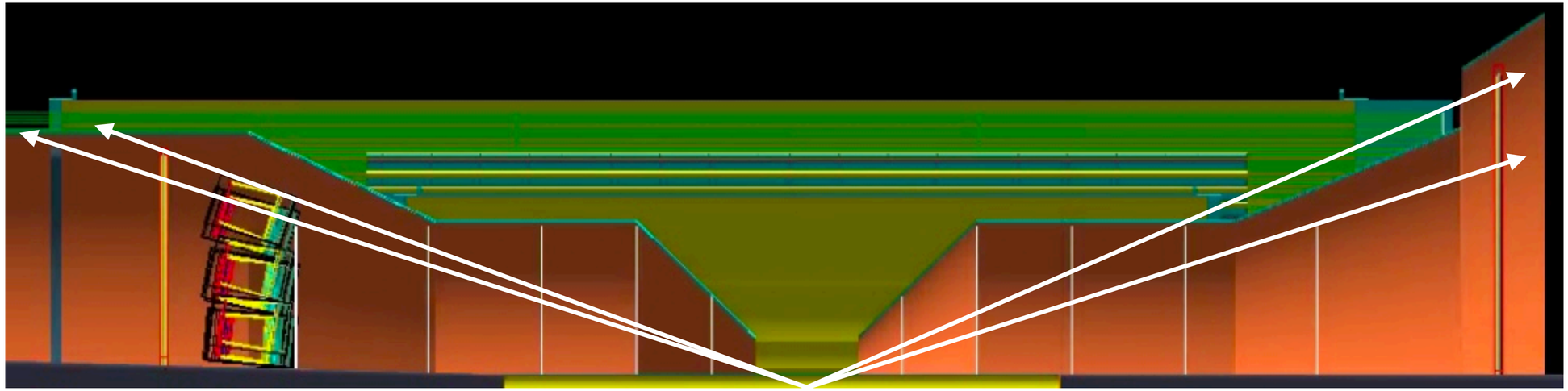
AC-LGAD momentum-resolution impact

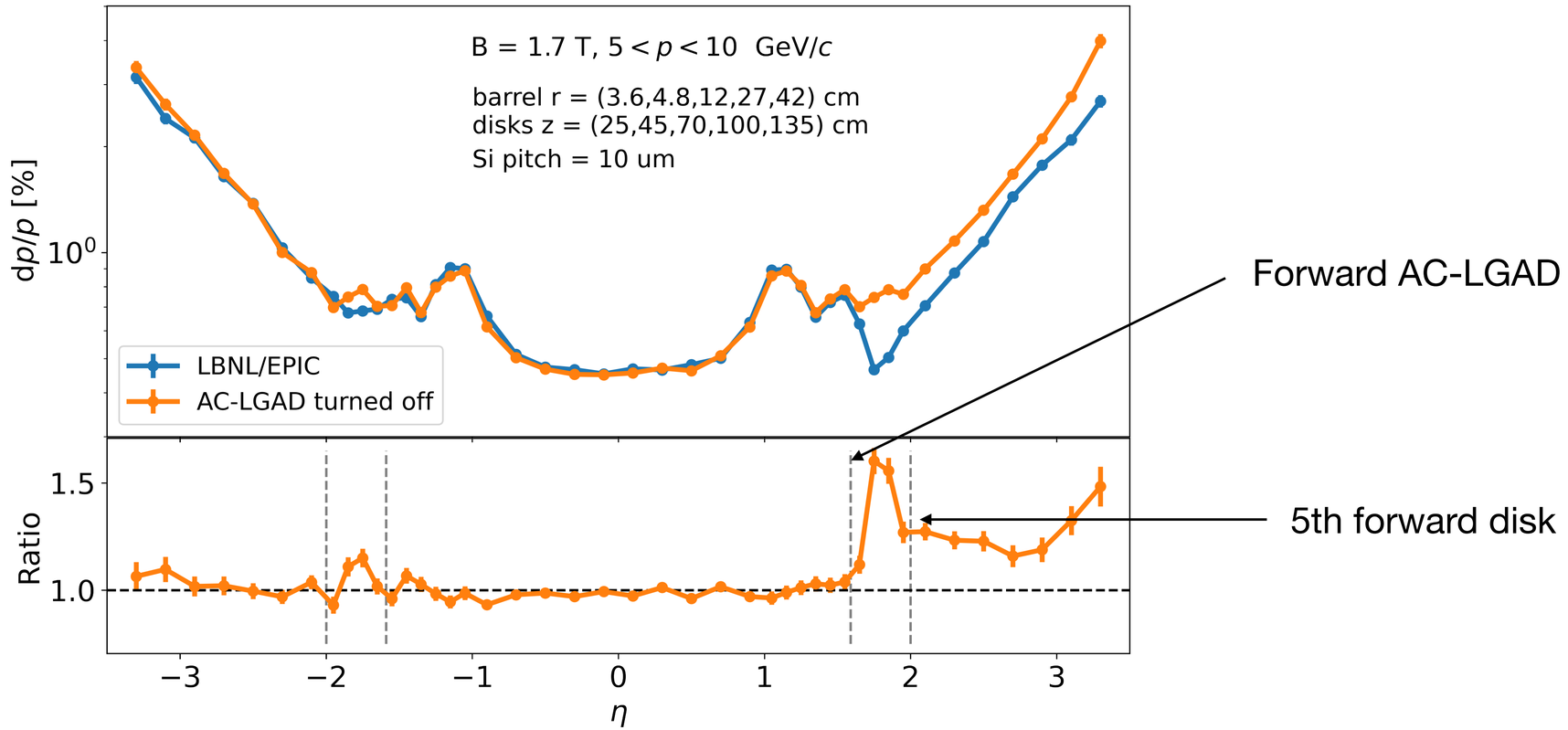


AC-LGAD momentum-resolution impact

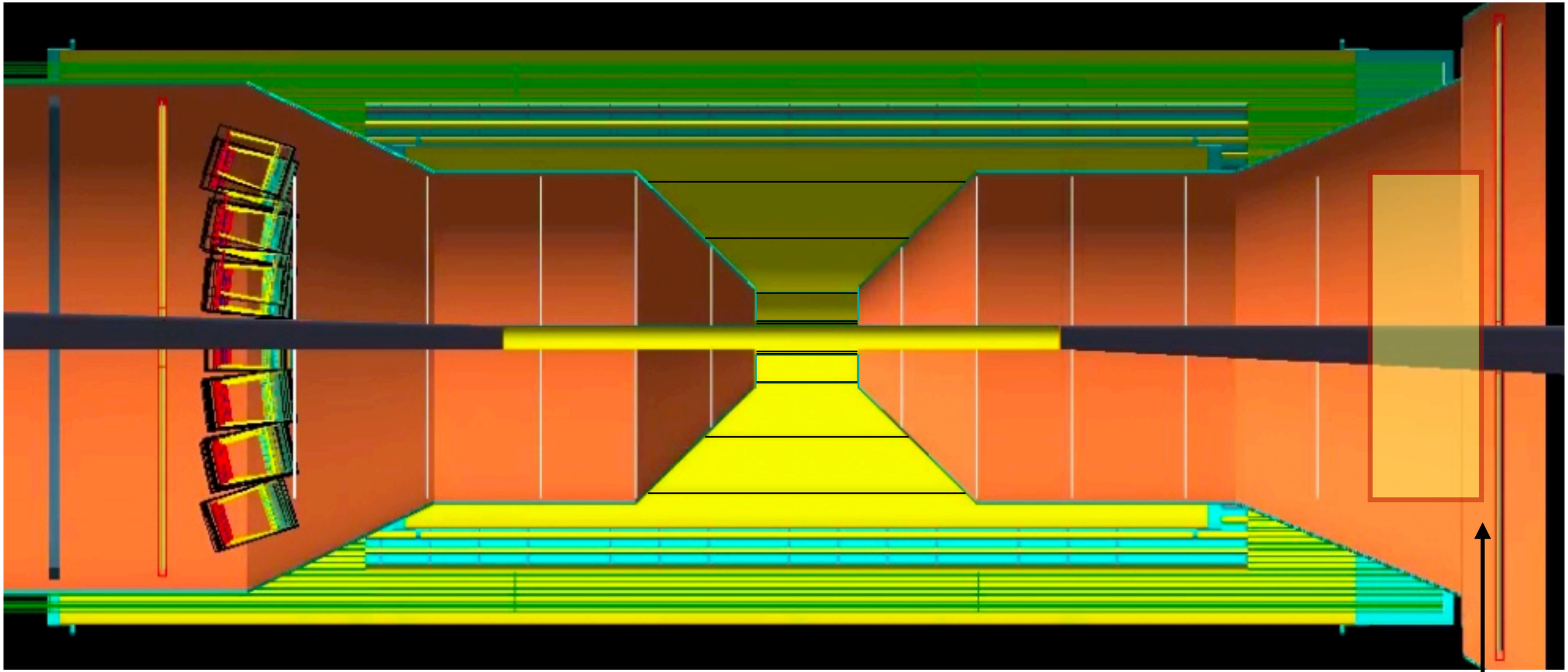


AC-LGAD momentum-resolution impact

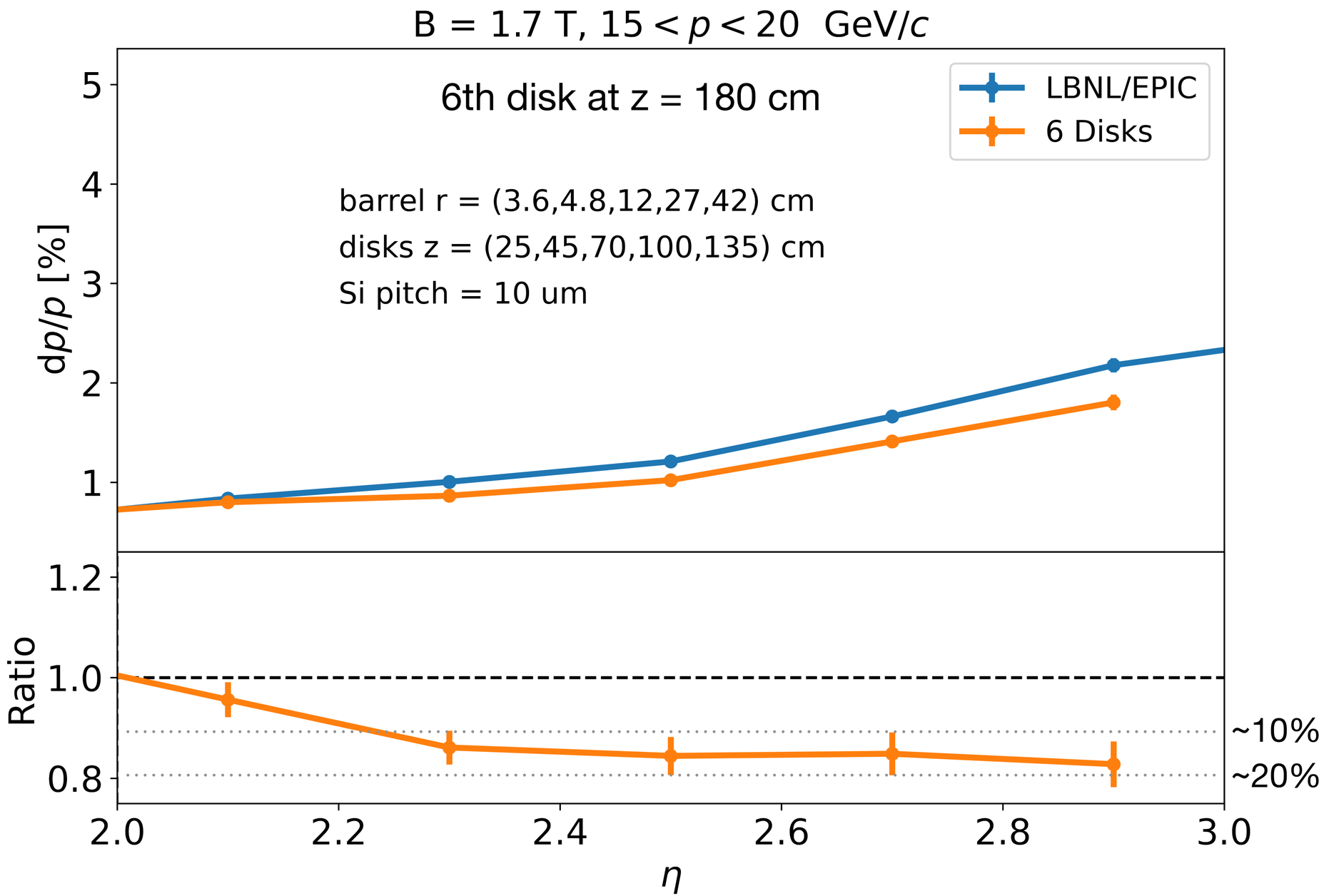




Disk layout in the forward region



6th disk in the hadron-going direction

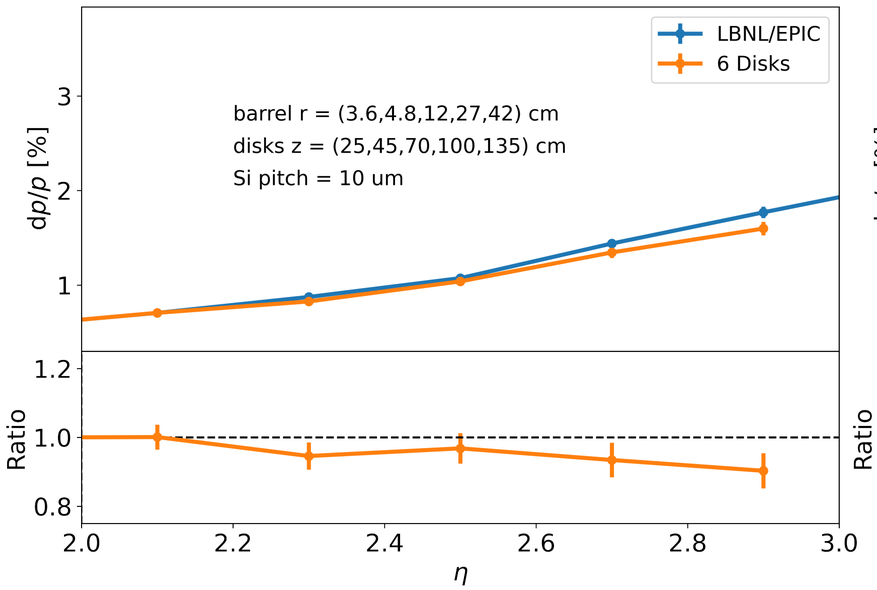


6th disk in the hadron-going direction

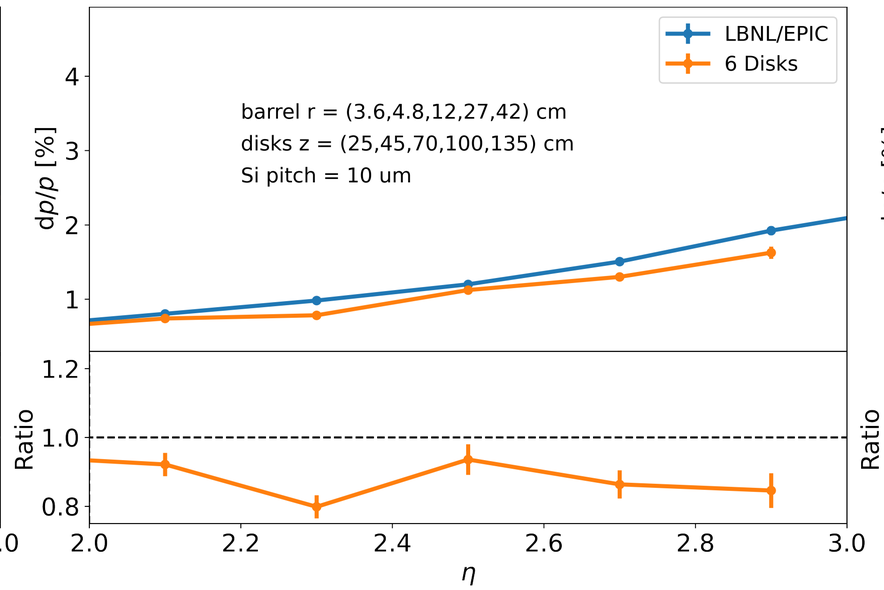
$B = 1.7$ T

6th disk at z = 180 cm

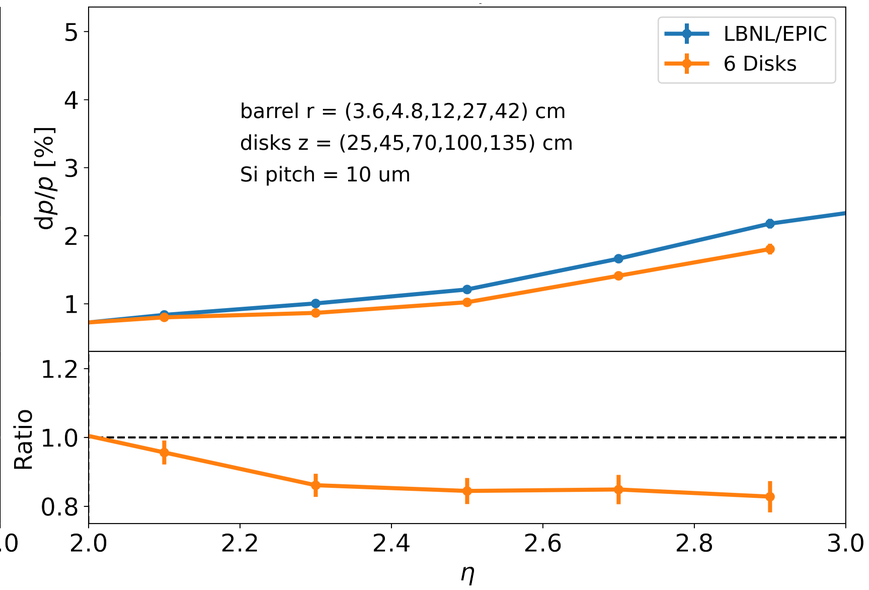
$5 < p < 10$ GeV/c



$10 < p < 15$ GeV/c

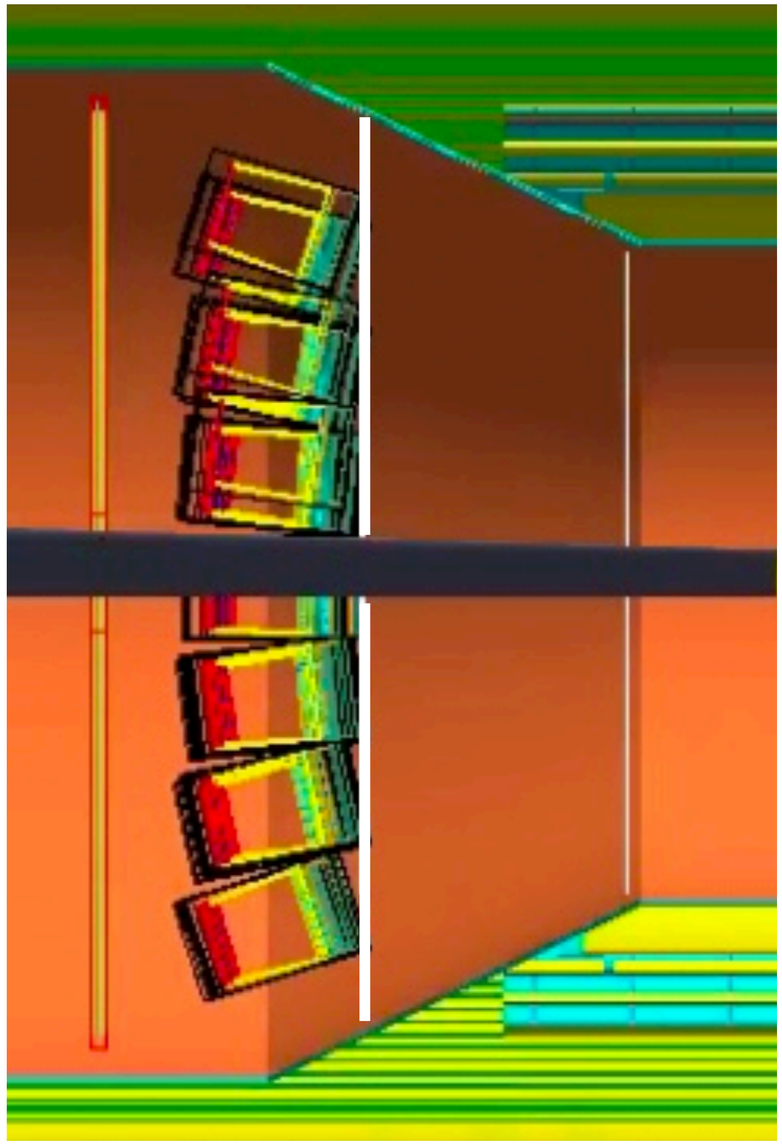


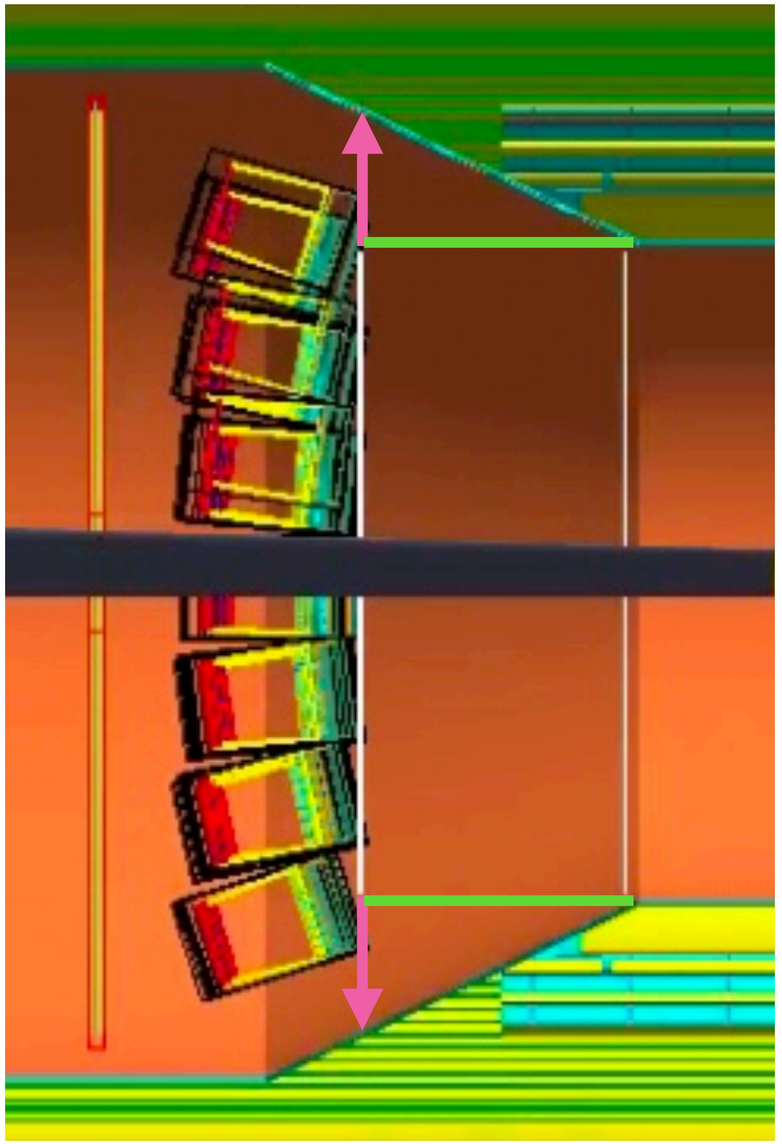
$15 < p < 20$ GeV/c

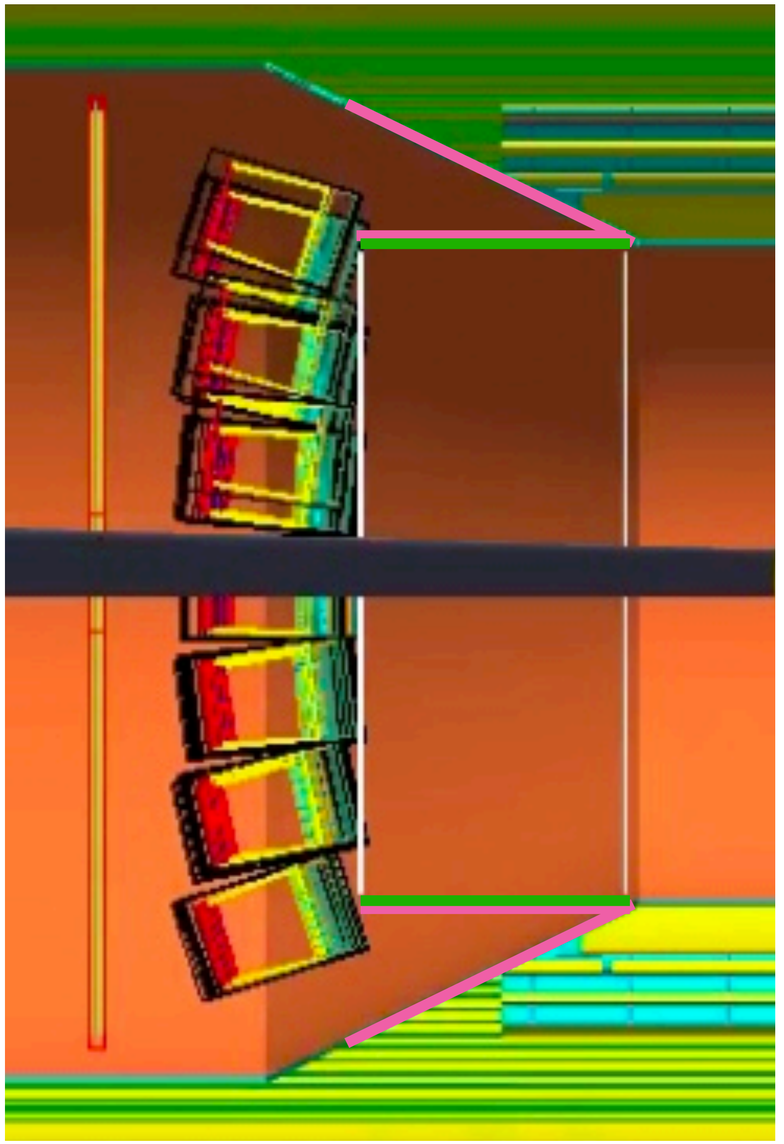


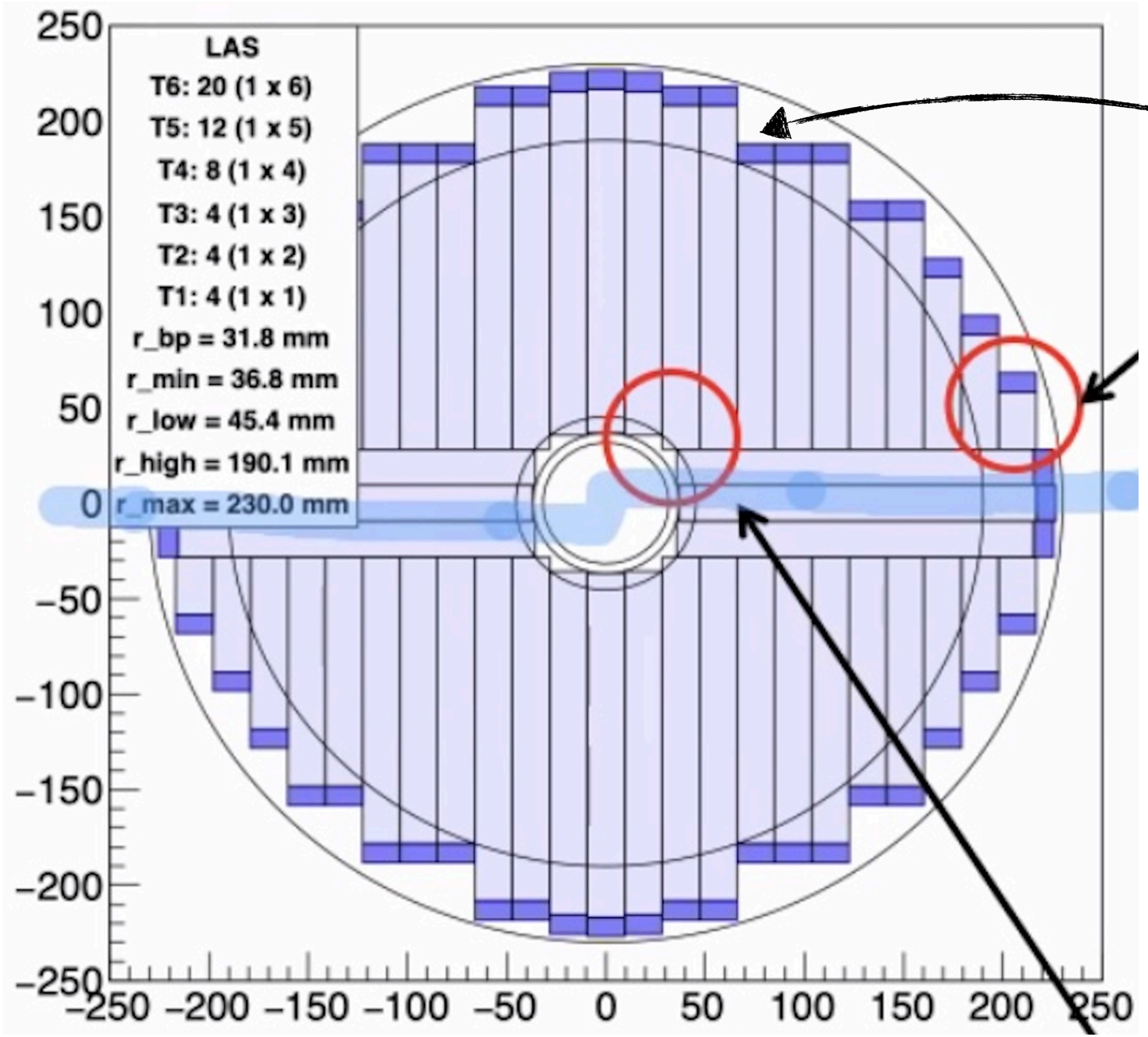
Impact larger at higher momenta

Proposed service routing options for high-|z| disks









Why do these three “staves”(?) need to have the same length?

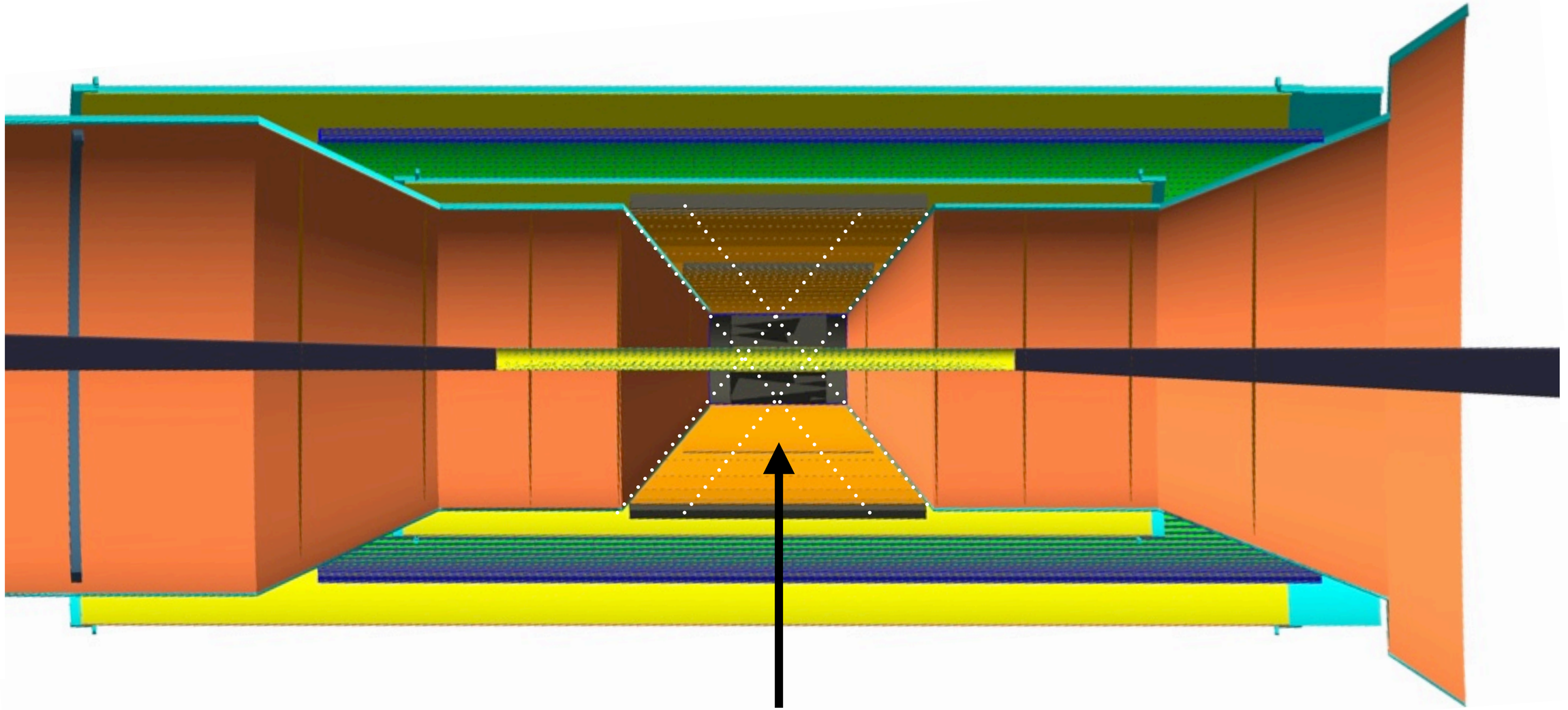
Have these layouts been worked out for other disks? (i.e. larger inner and outer radii)

How wide are these “staves”(?)

Summary

- Fully implemented new geometry in Fun4All (disks and details of support newly implemented)
  - Also propagated this info to Shujie for DD4HEP implementation
- Compared to the ECCE configuration, the new geometry improves dp/p by ~15% on average
- Studied impact of AC-LGADs on dp/p:
  - Central and backward AC-LGADs have negligible impact on dp/p
  - Forward AC-LGAD improves performance
- A 6th disk in the hadron-going direction improves dp/p by ~10-20% at higher momenta

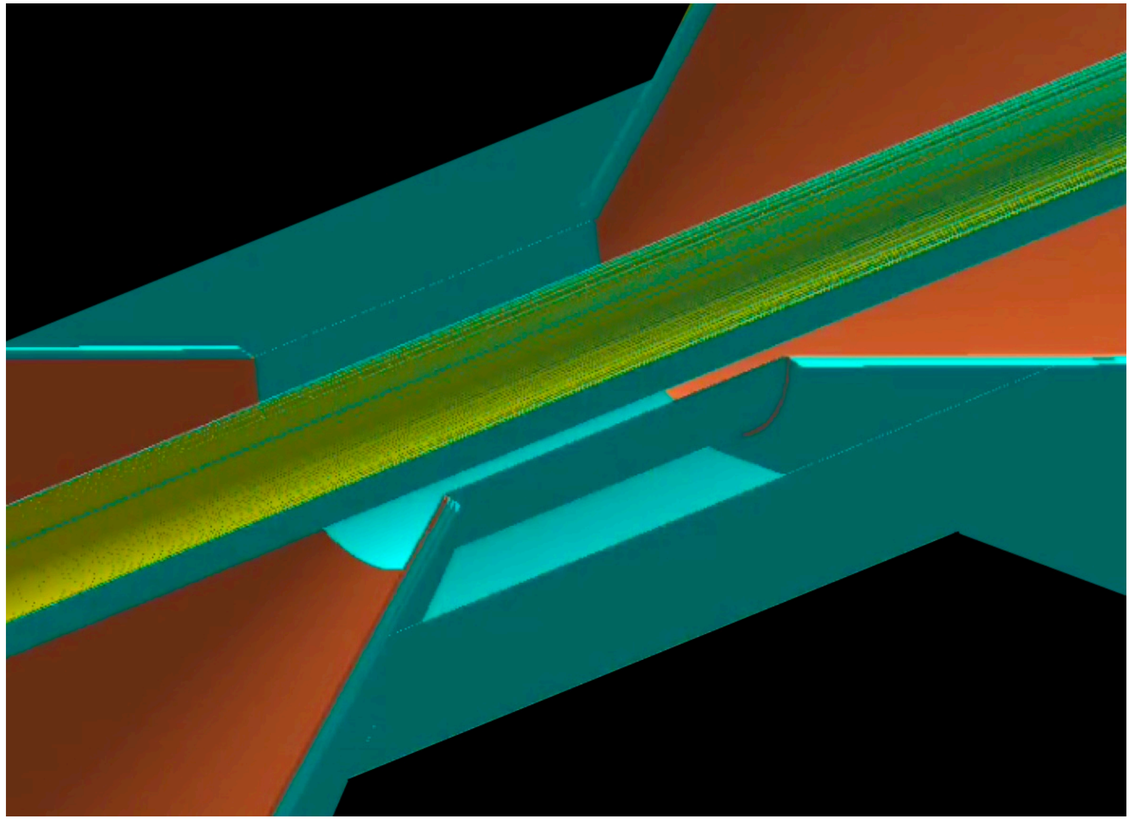
Oak Ridge National Lab implementation of LBNL geometry



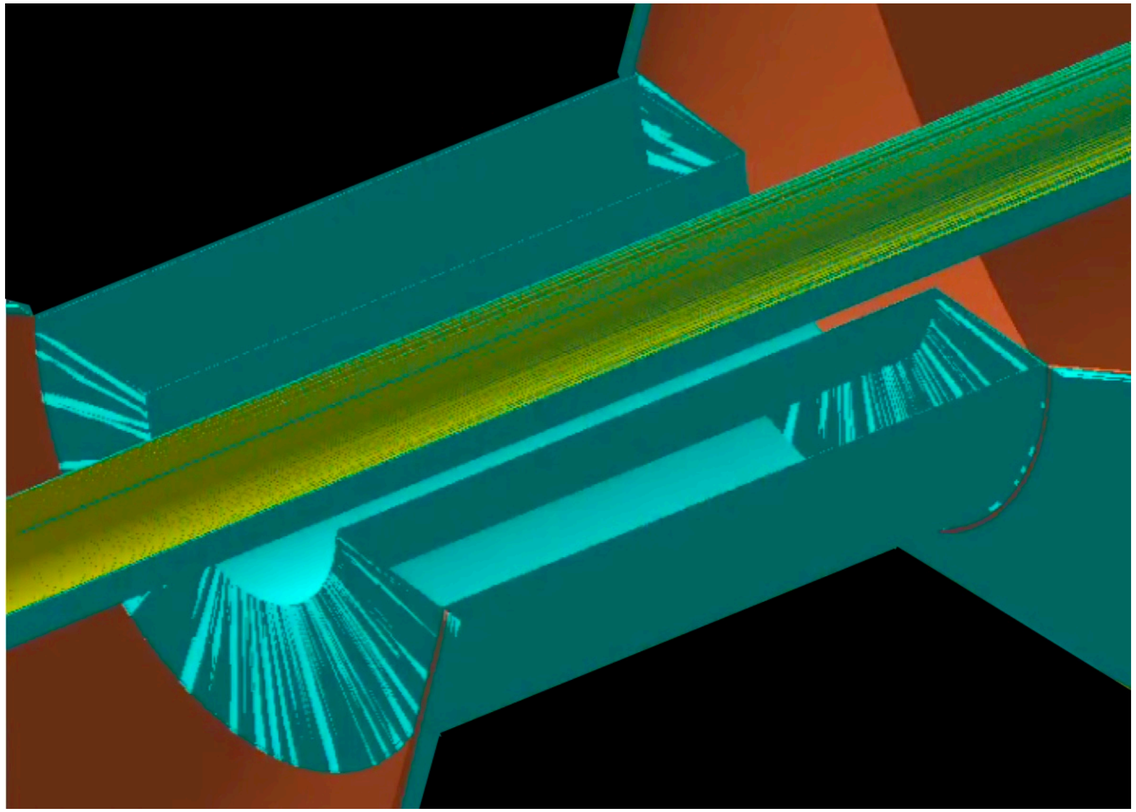
Non-projective configuration

Support/service structure comparison

ECCE

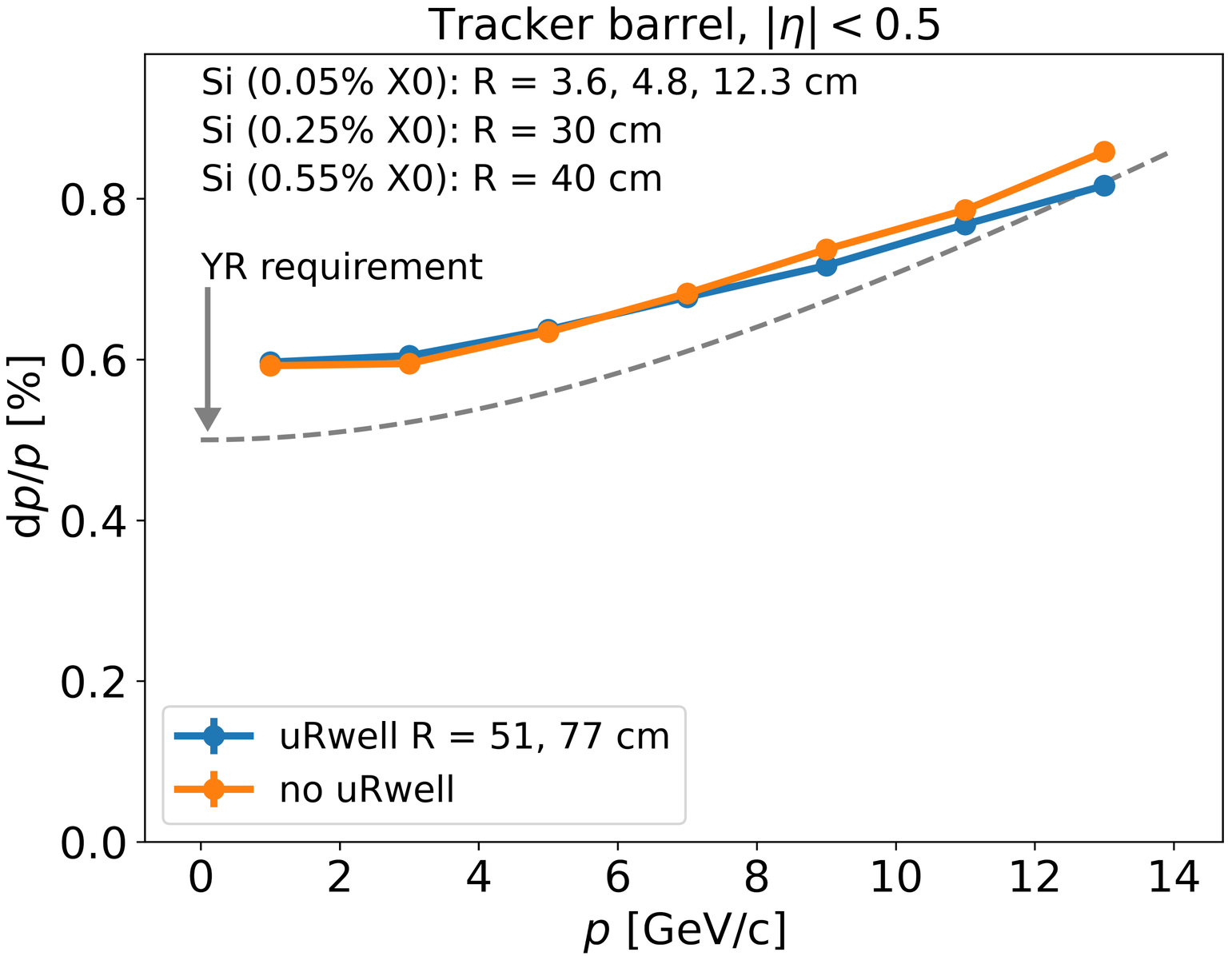


LBNL



dp/p impact of MPGDs in the barrel

dp/p impact from barrel MPGDs



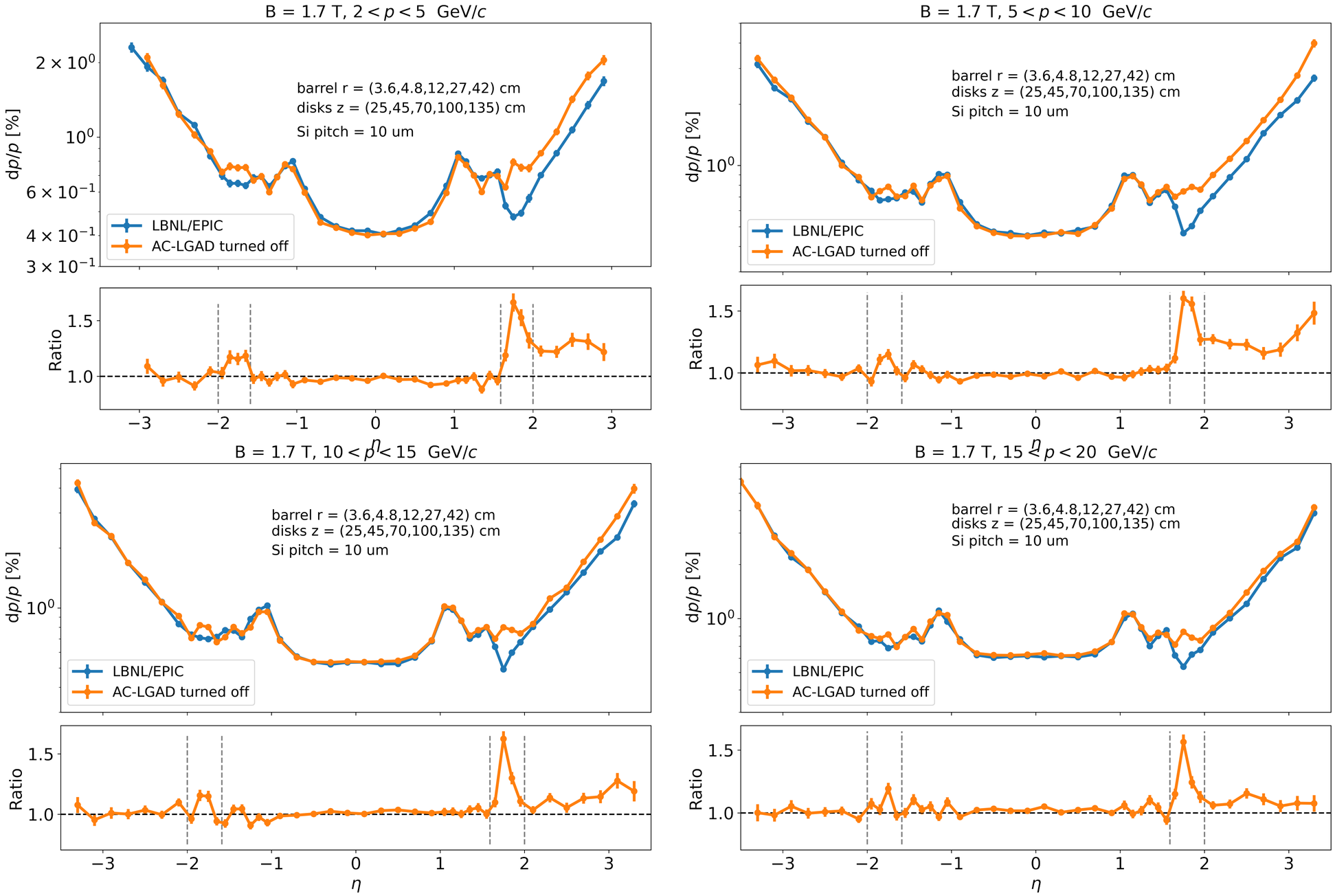
Barrel MPGDs (as specified in this configuration) only has some dp/p-resolution impact in the higher-momentum regime.

However, this is not the only figure of merit and, when simulations with backgrounds are carried out, these layers may have a larger impact

MAPS $\sigma = 10/\sqrt{12}$ μm
μRwells $\sigma = 55$ μm
ACLGAD $\sigma = 30$ μm

B = BaBar

AC-LGAD momentum-resolution impact



New proposed barrel configuration