Optimizing the EIC tracker configuration (Continuation)

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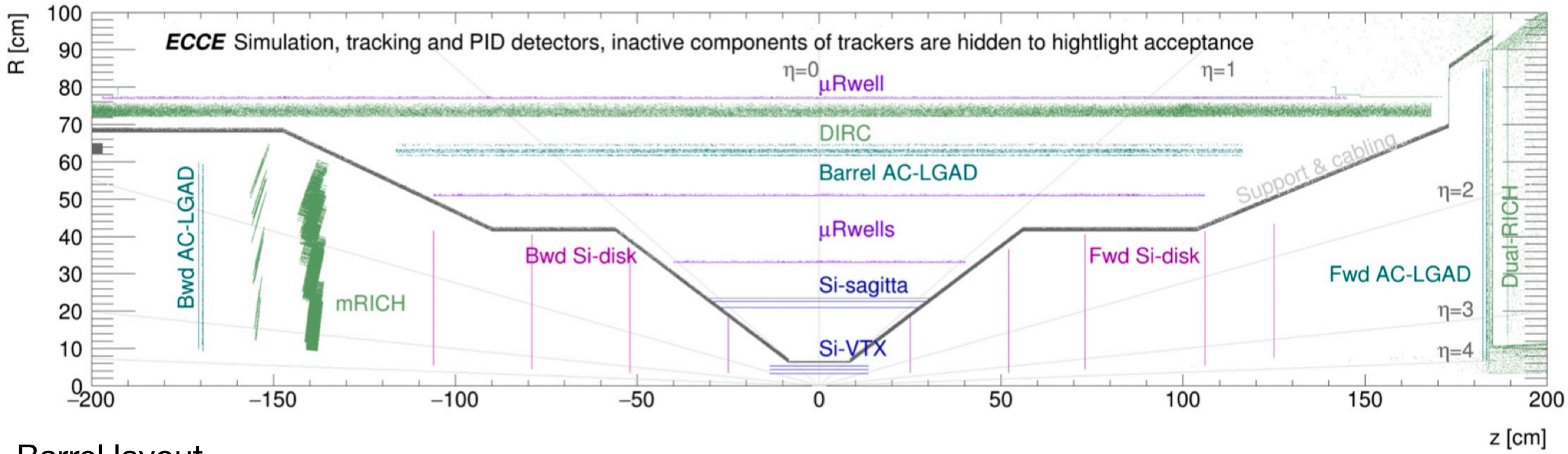
RNC EIC Meeting
July 5th, 2022

Barrel

The ECCE configuration



Barrel layout

Si	r (cm)	length (cm)	X
1	3.3	27	0.05
2	4.35	27	0.05
3	5.4	27	0.05
4	21	54	0.05
5	22.68	58	0.05

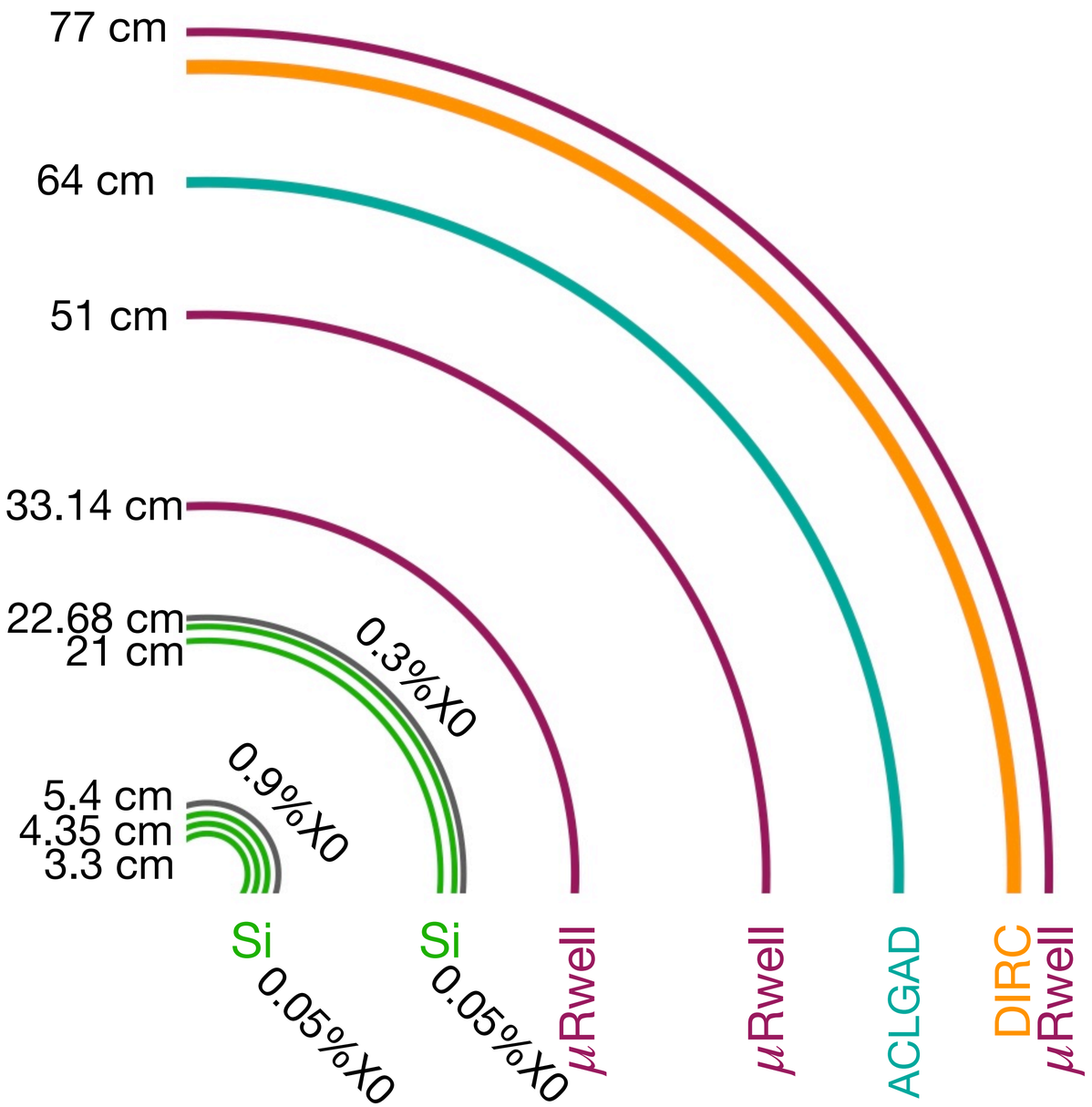
→ Pitch = 10 um

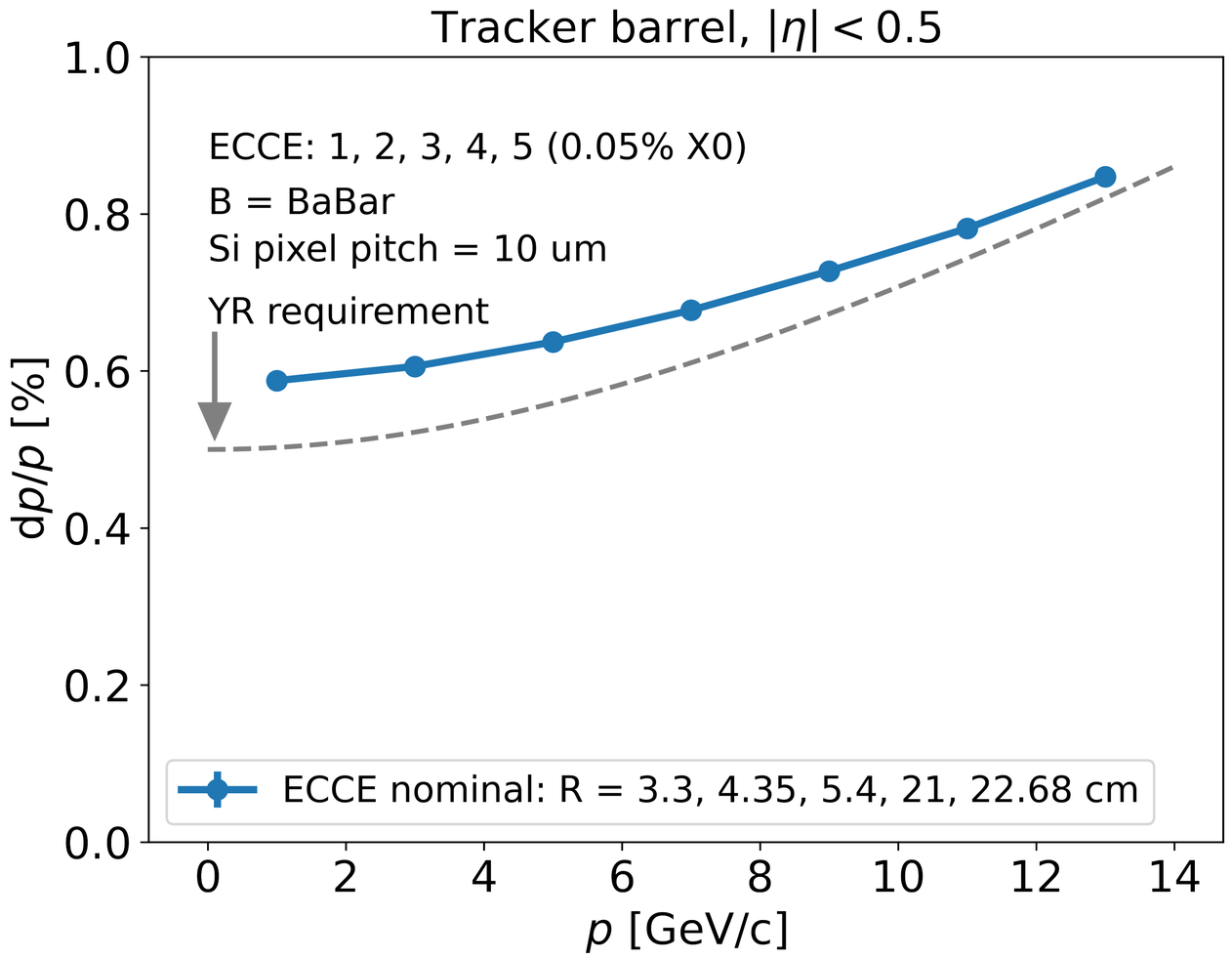
	r (cm)	length (cm)	point res
uRwell1	33.14	80.16	55 um
uRwell2	51	212	55 um
ACLGAD	64	140	30 um
uRwell3	77.0175	342	55 um

And also two support cylinders:

- r = 6.3 cm, 0.9% X0
- r = 23.5 cm, 0.3% X0

Momentum resolution performance of ECCE Barrel



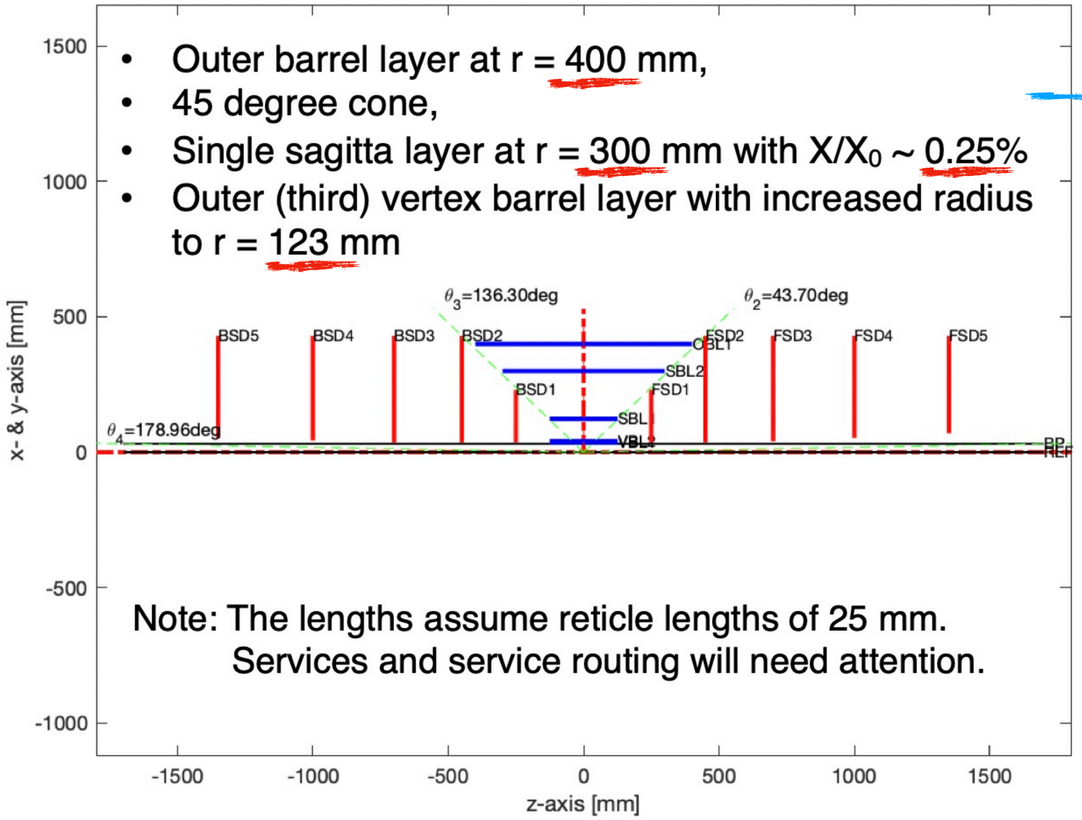


Barrel optimization with fast simulations

Work by E. Sichtermann

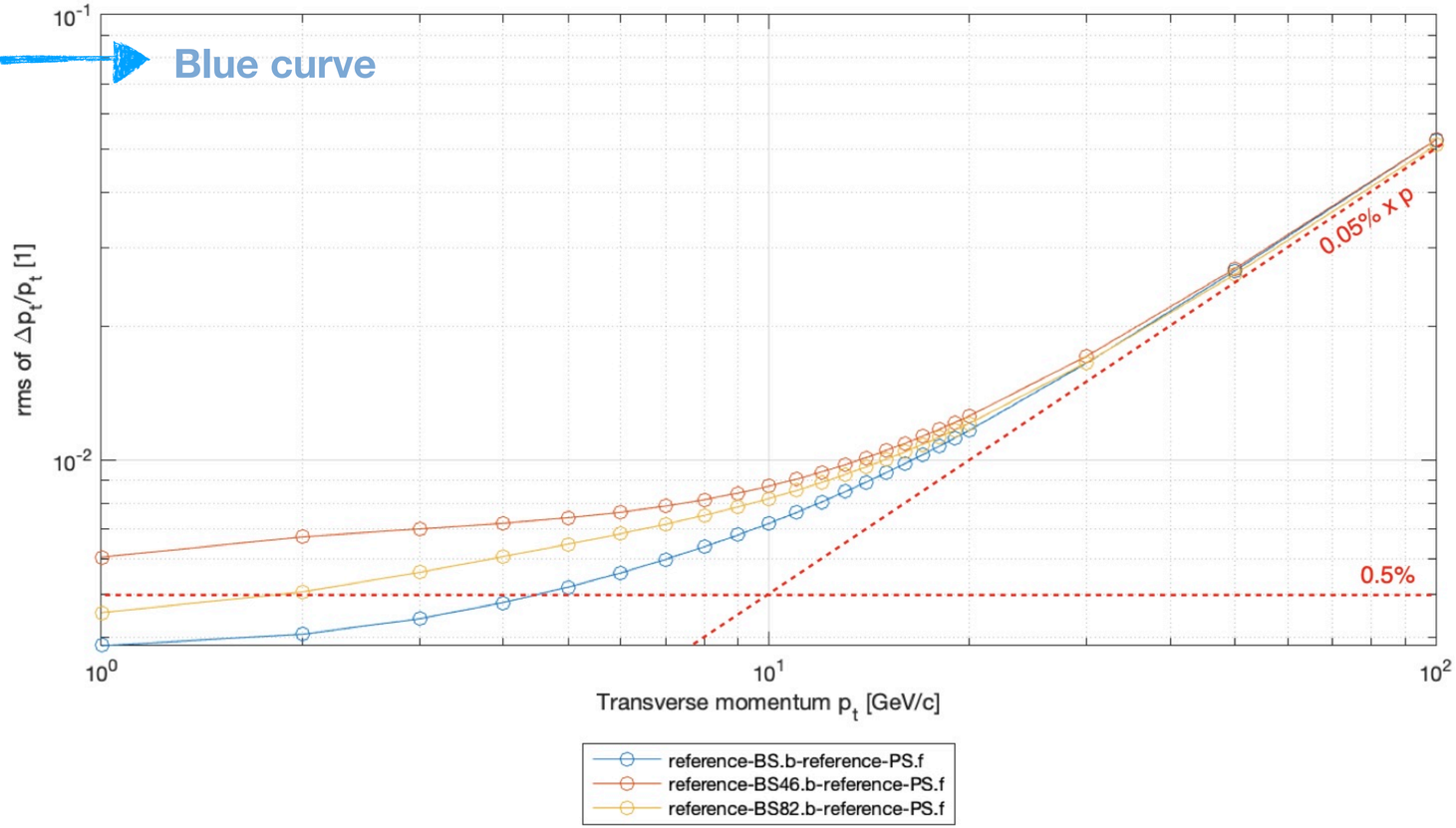
See slides from https://conferences.lbl.gov/event/974/

- Outer barrel layer at r = 400 mm,
- 45 degree cone,
- Single sagitta layer at r = 300 mm with $X/X_0 \sim 0.25\%$
- Outer (third) vertex barrel layer with increased radius to r = 123 mm



Note: The lengths assume reticle lengths of 25 mm.
Services and service routing will need attention.

Blue curve

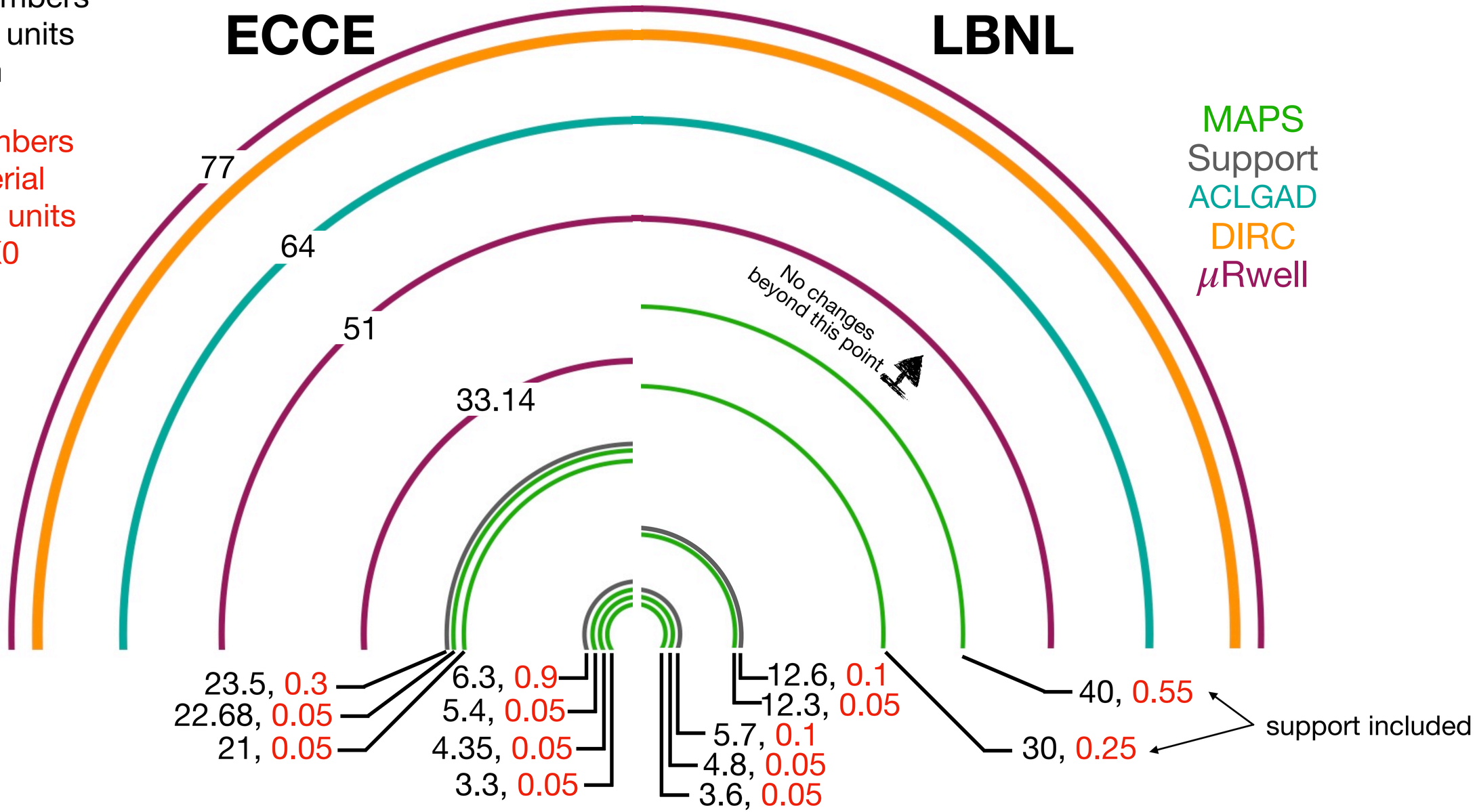


It seems sensible to simulate this in Fun4All already now, even though other changes will be needed. Volunteers ;-)?

New proposed barrel configuration

All black numbers are radii in units of cm

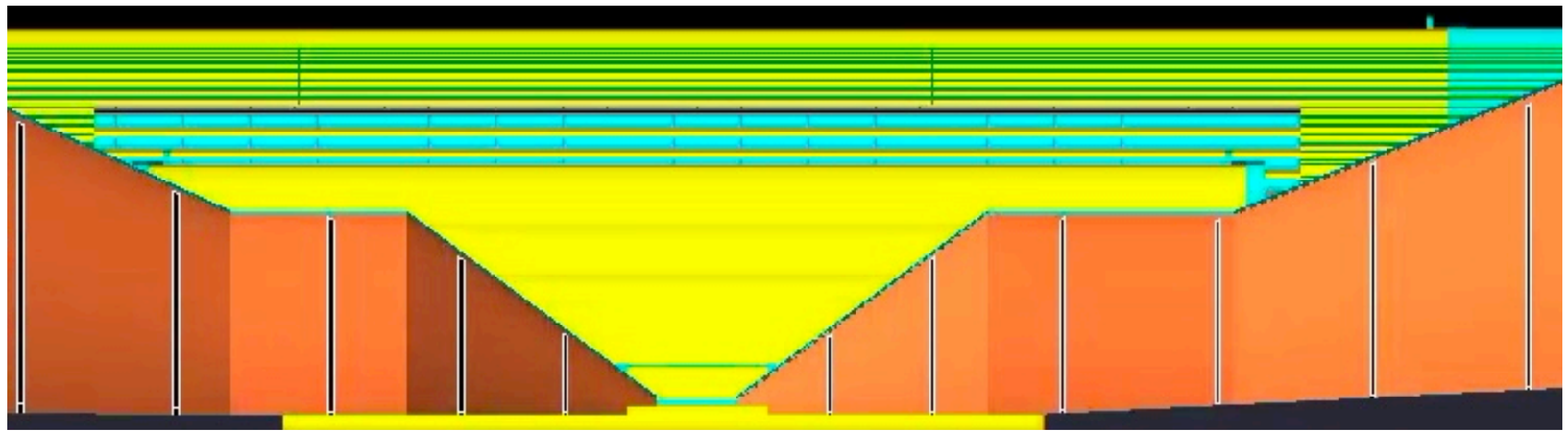
All red numbers are material budgets in units of % X0

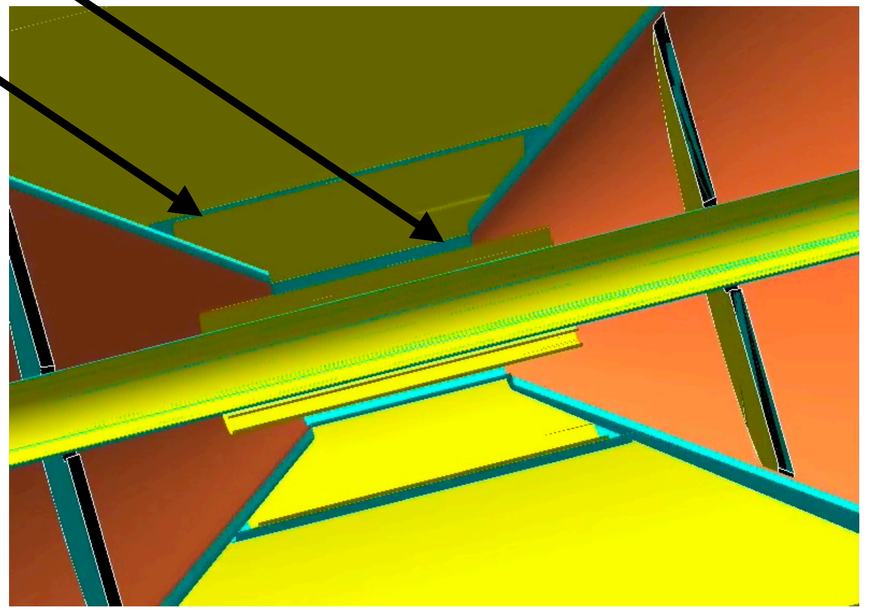


New proposed barrel configuration

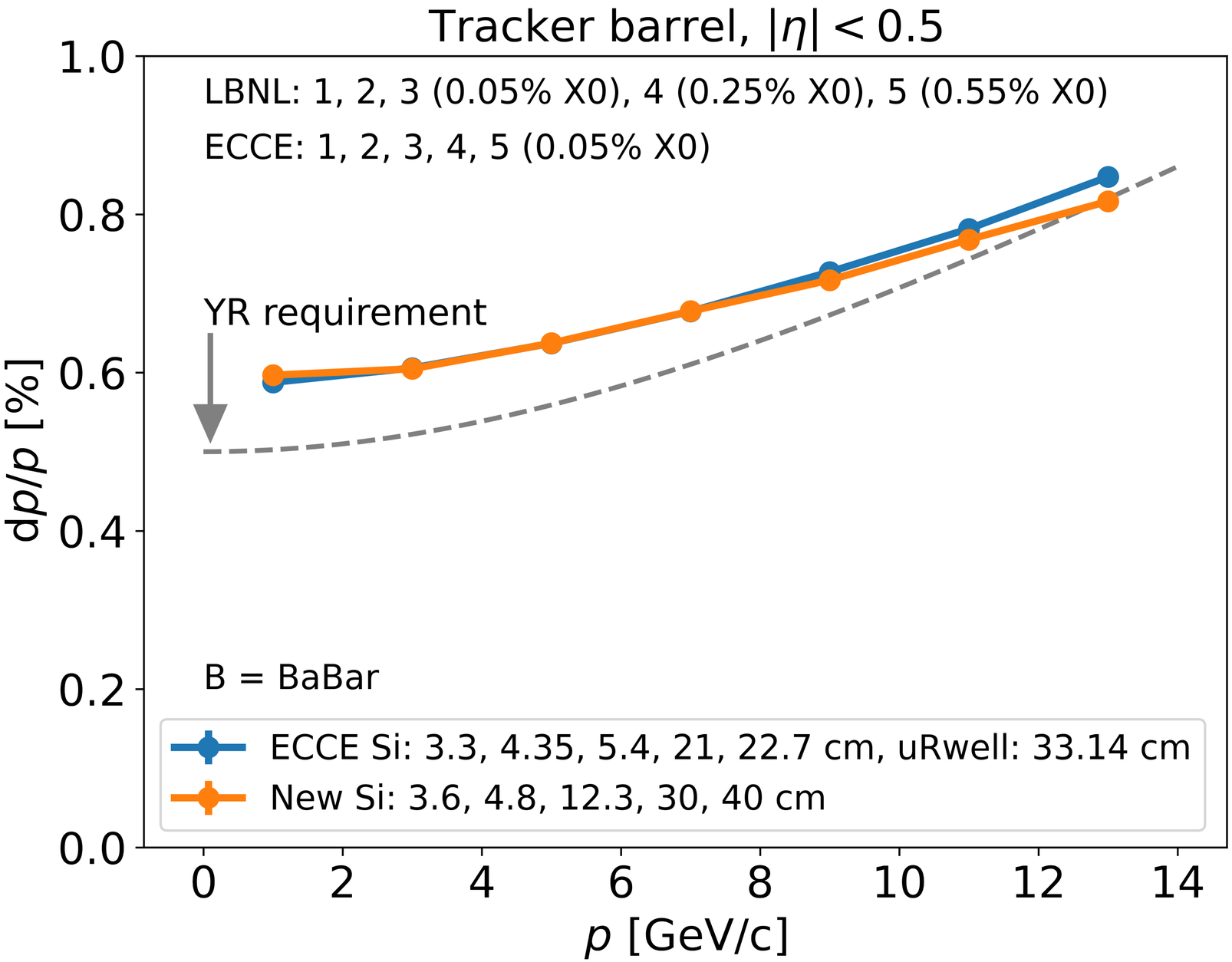
	r (cm)	length (cm)	X/X0	A (m^2)
1	3.6	27	0.05%	0.061
2	4.8	27	0.05%	0.081
Support	5.7	15.4	0.1%	
3	12.3	27	0.05%	0.21
Support	12.6	30.6	0.1%	
4	30	77	0.25%	1.5
5	40	104	0.55%	2.6

	r (cm)	length (cm)	point res
uRwell2	51	212	55 um
ACLGAD	64	140	30 um
uRwell3	77.0175	342	55 um





New proposed barrel configuration



Both settings have:
uRwell R = 51, 77 cm
ACLGAD R = 64 cm

ECCE has support layer:
R = 6.3 (0.9%), 23.5 cm (0.3%X0)

New has support layer:
R = 5.7 (0.1%), 12.6 cm (0.1%X0)

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

Can we improve this performance even further?

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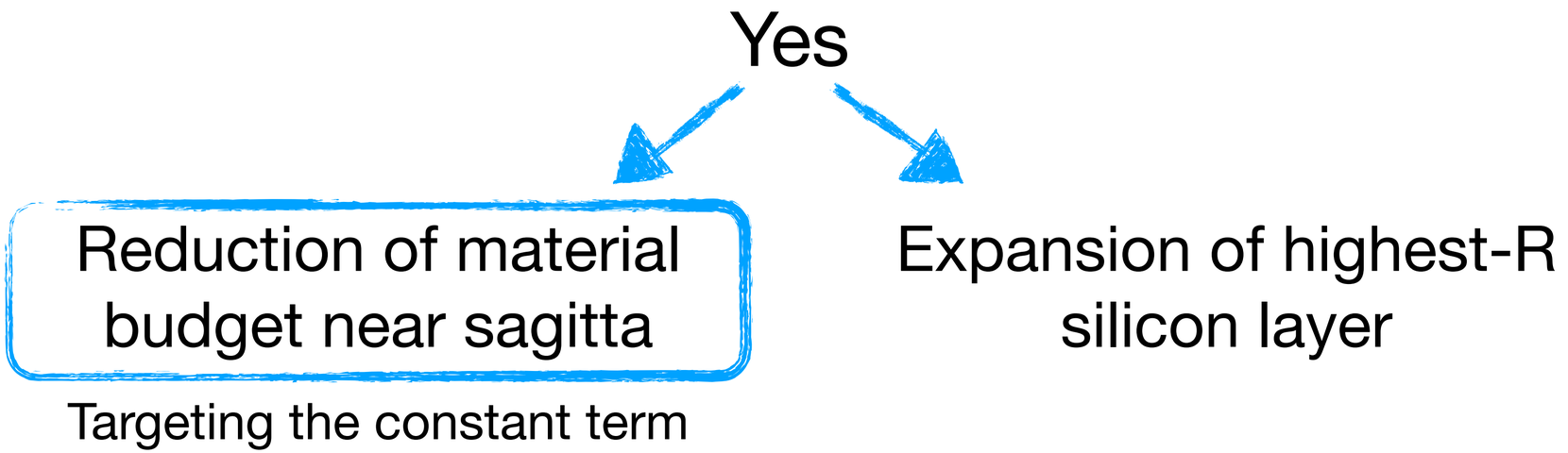
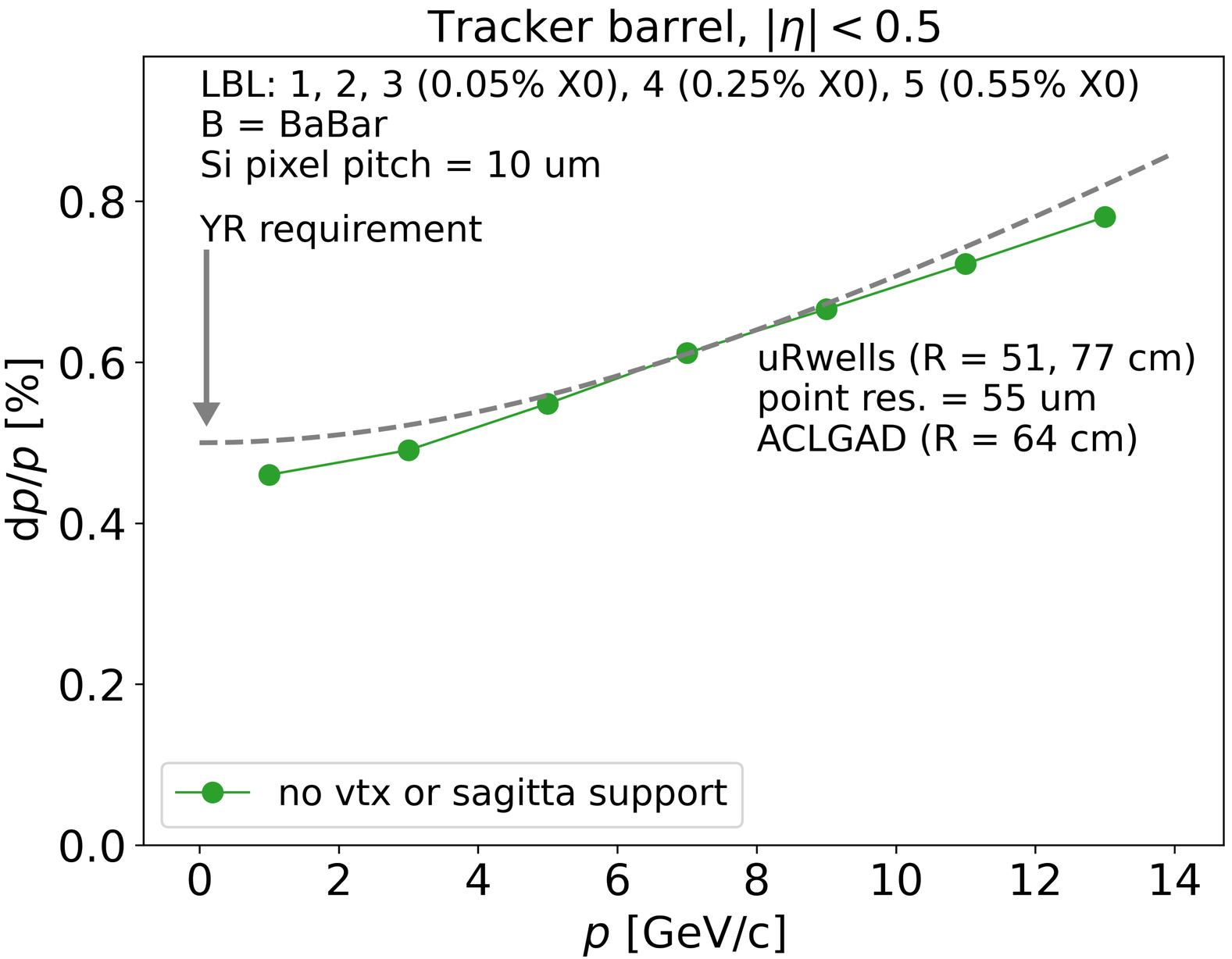
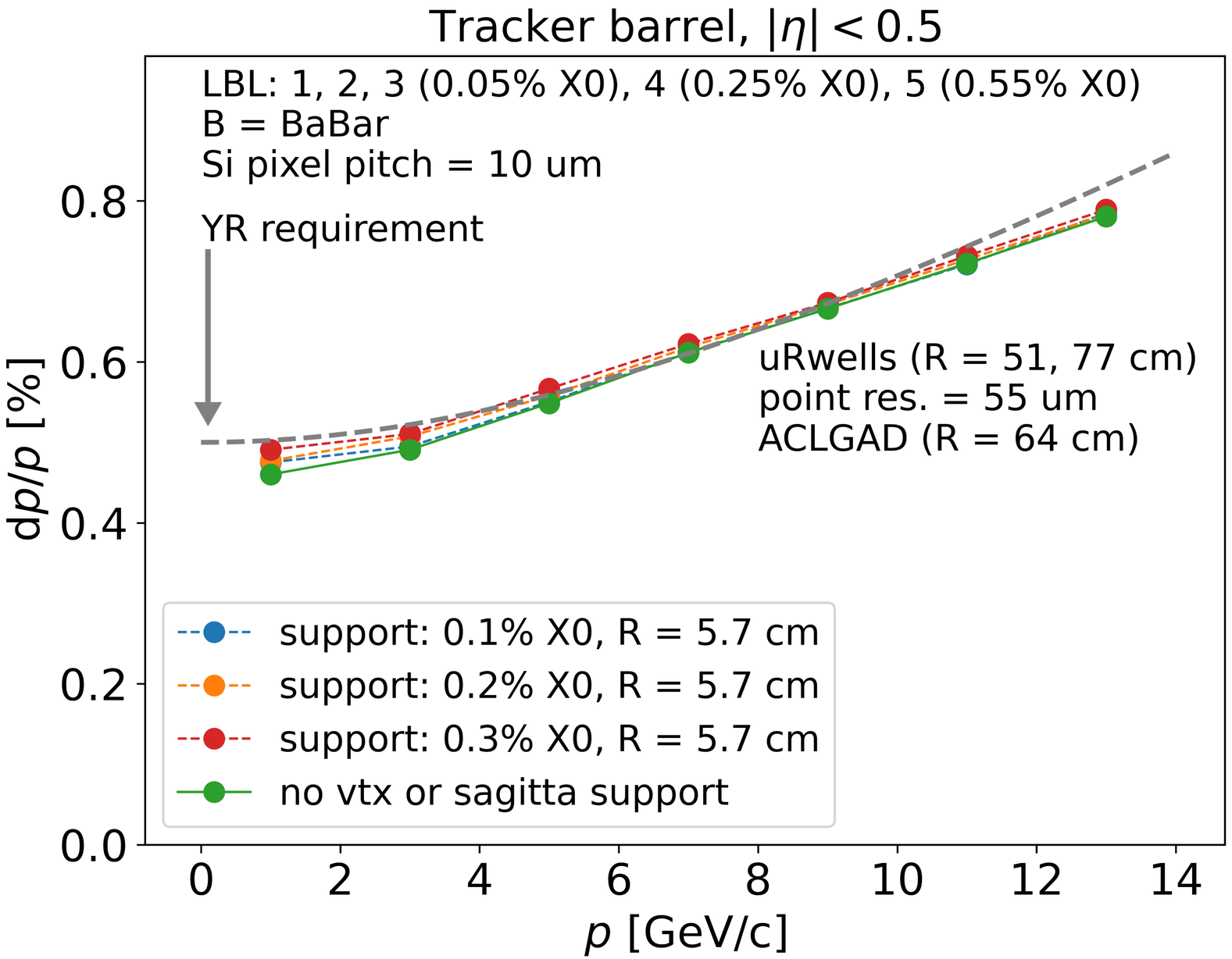


Momentum Resolution Performance

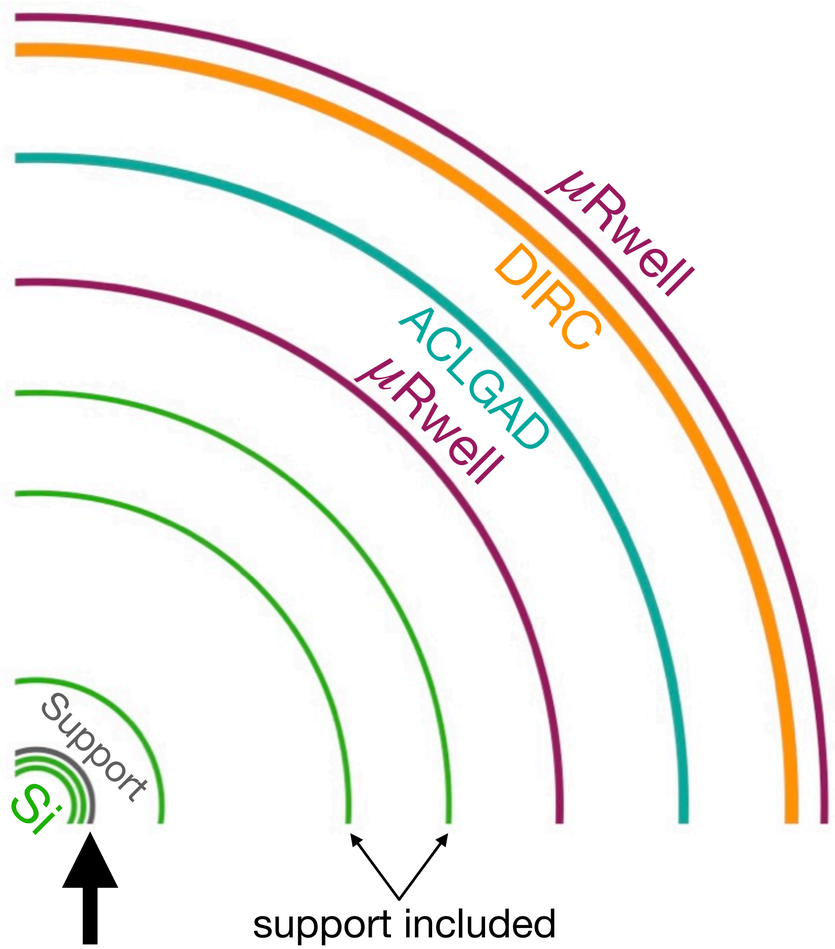


Performance below requirement when innermost three layers are not supported

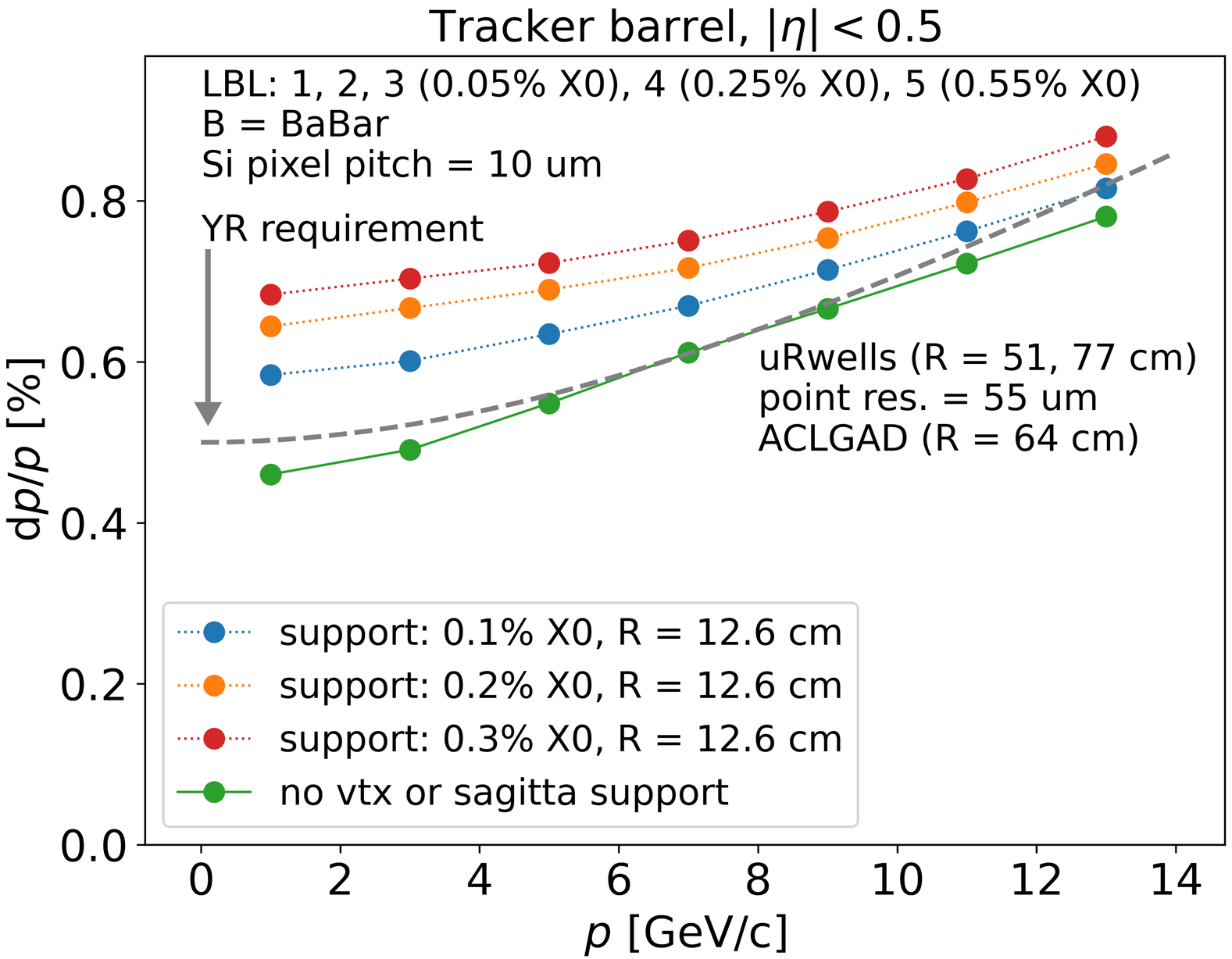
Momentum Resolution Performance



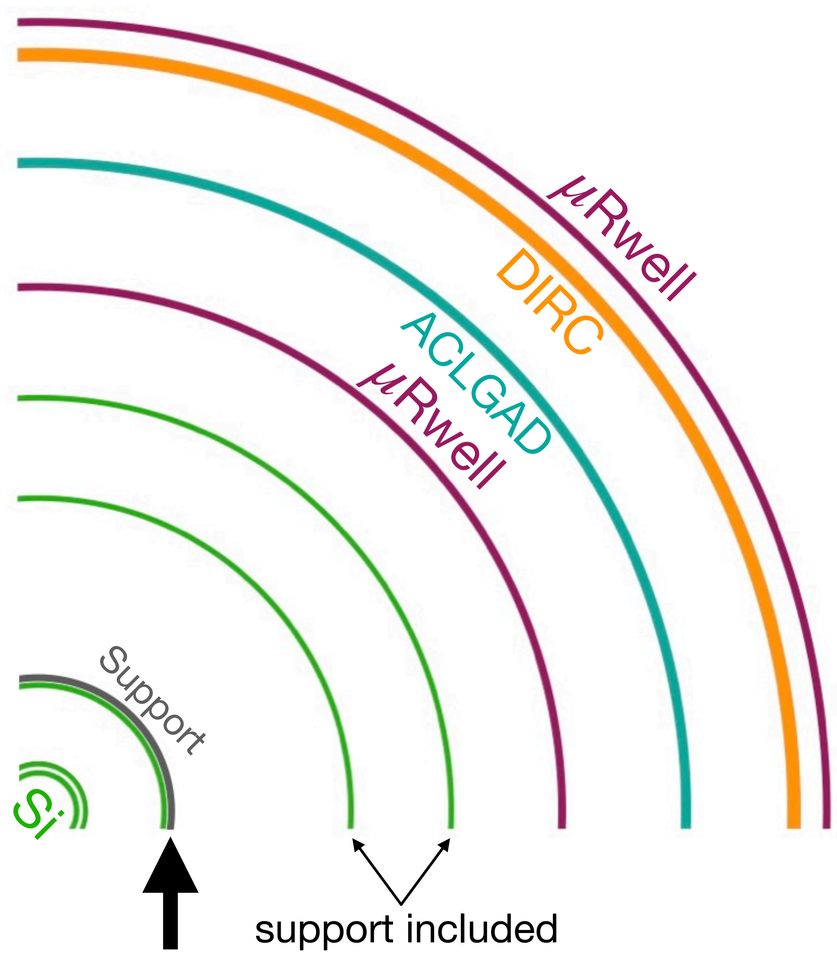
Material near innermost two layers doesn't significantly degrade dp/p



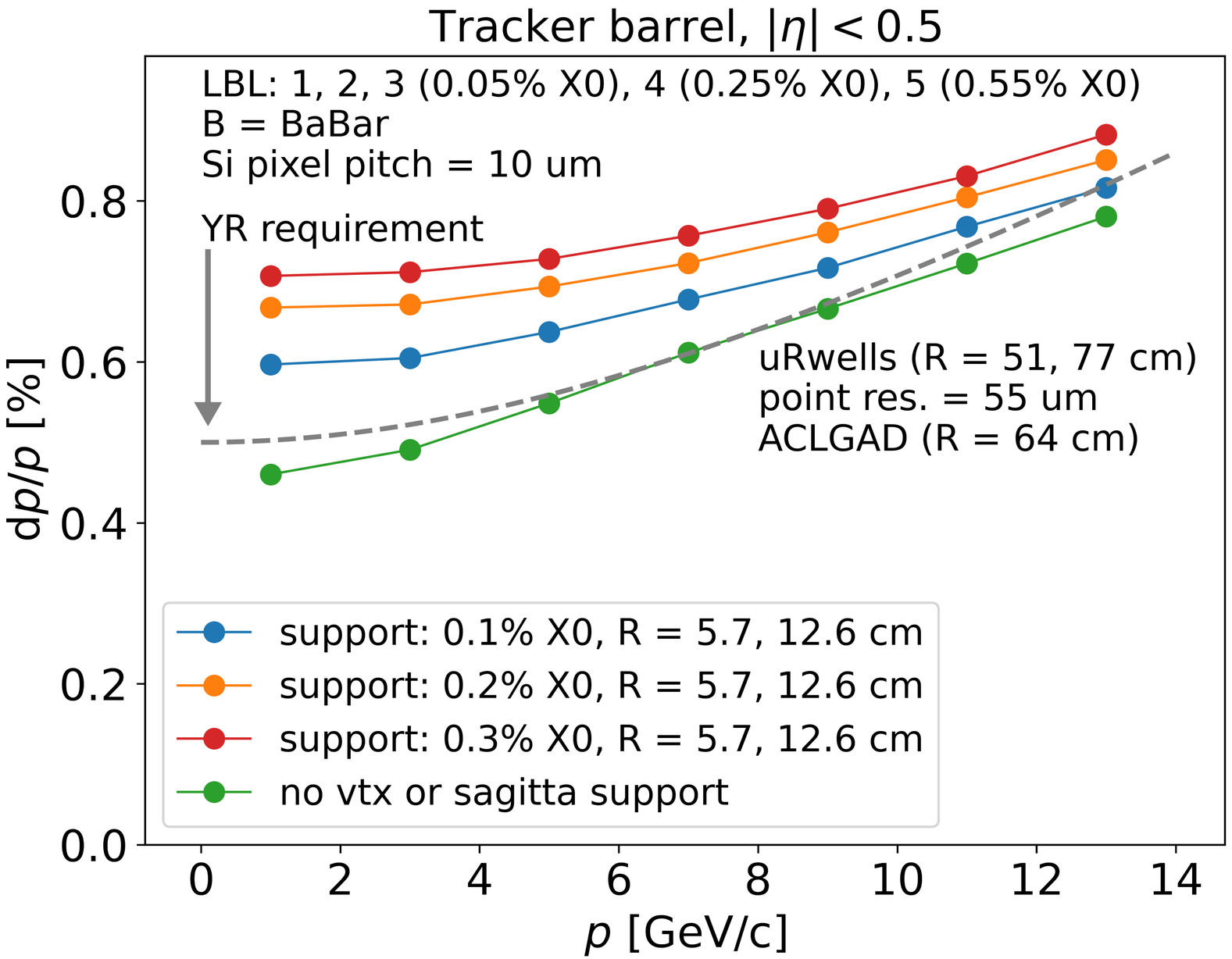
Momentum Resolution Performance



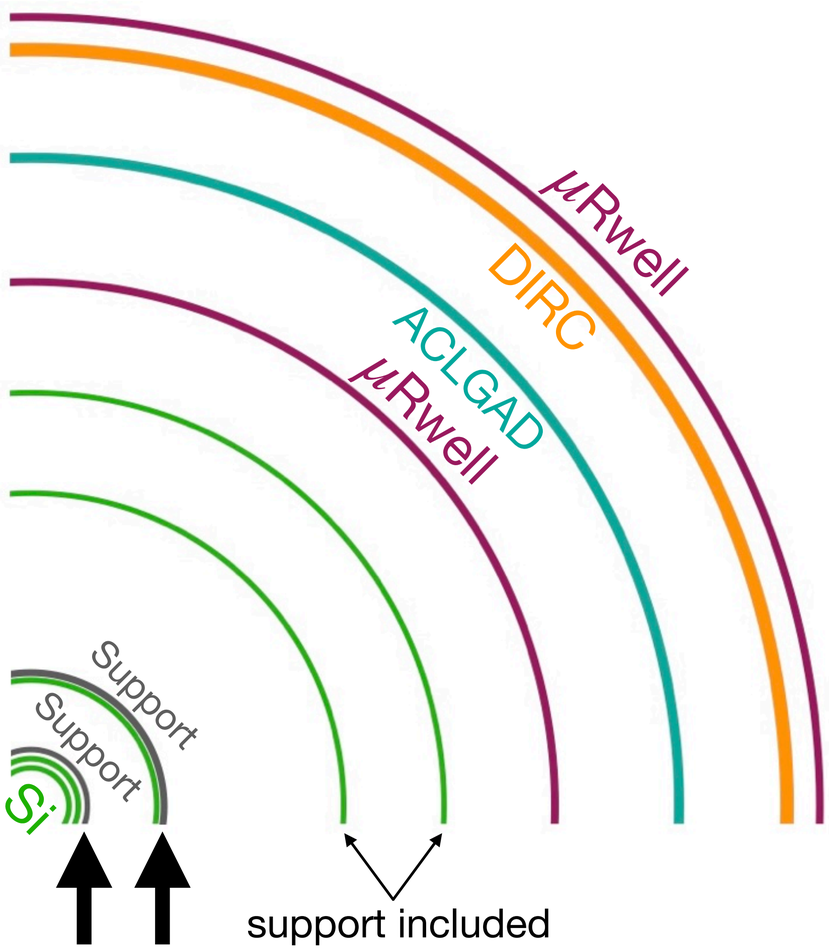
Material near sagitta significantly degrades dp/p



Momentum Resolution Performance



The performance with both layers is dominated by the support near the sagitta



Can we improve this performance even further?

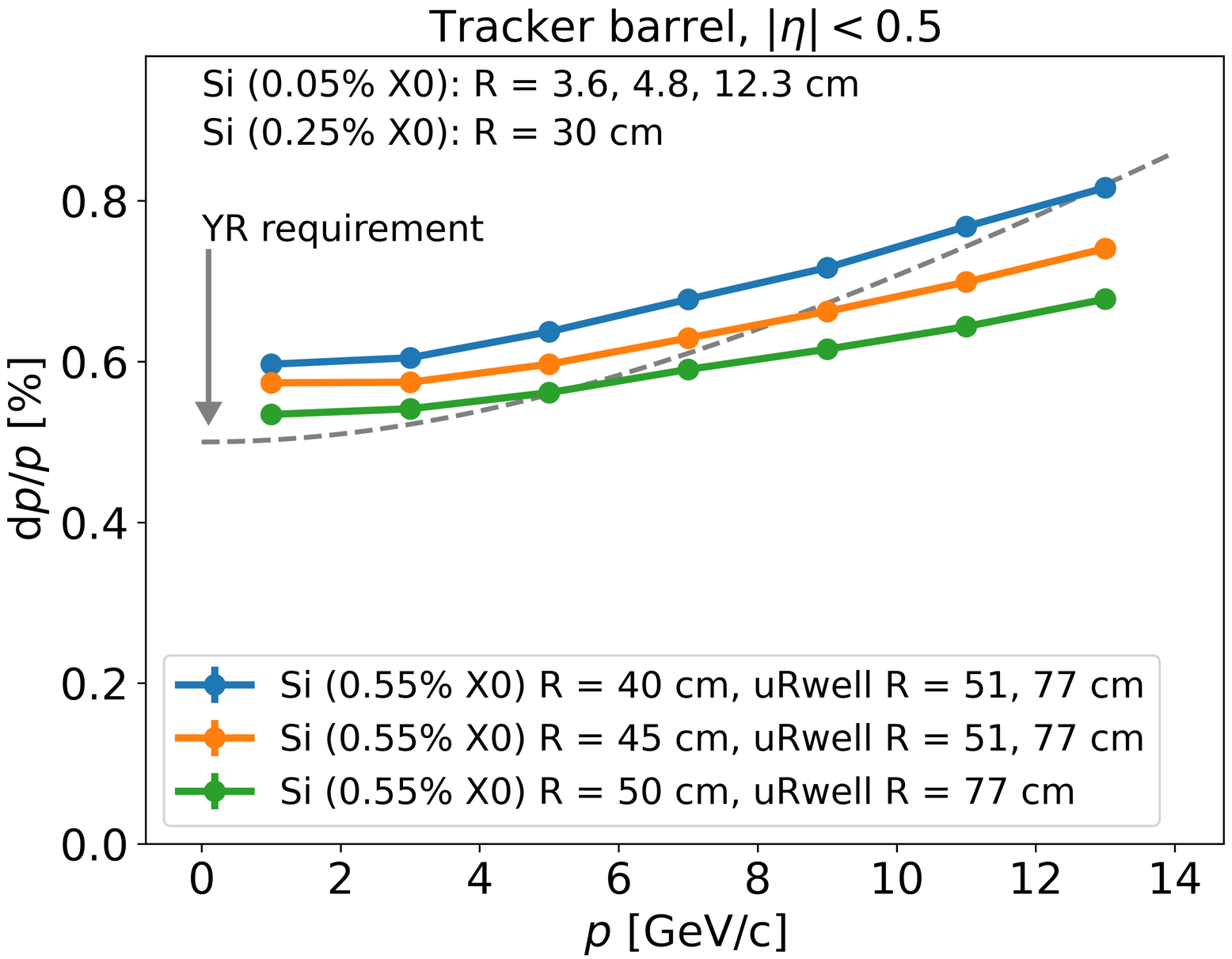
Yes

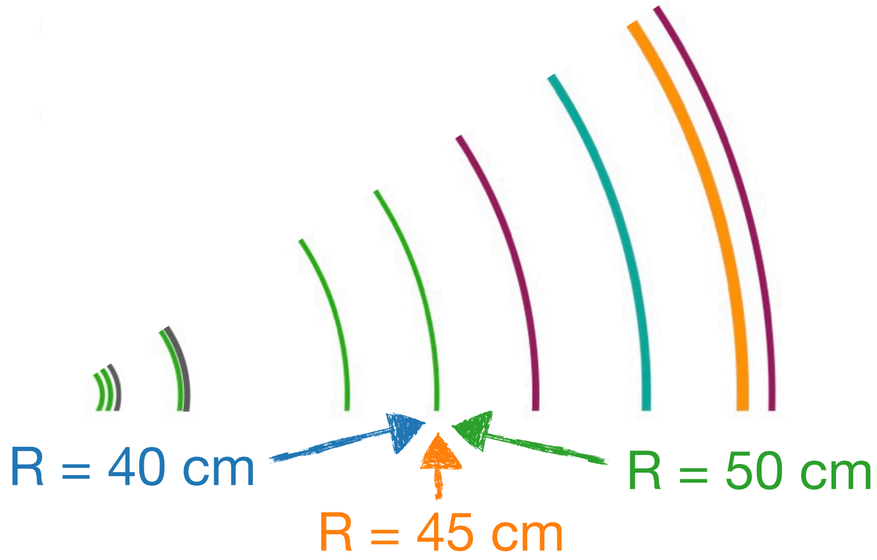
Reduction of material budget near sagitta

Expansion of highest-R silicon layer

Targeting the linear term

Impact from expanding radius of outermost silicon layer





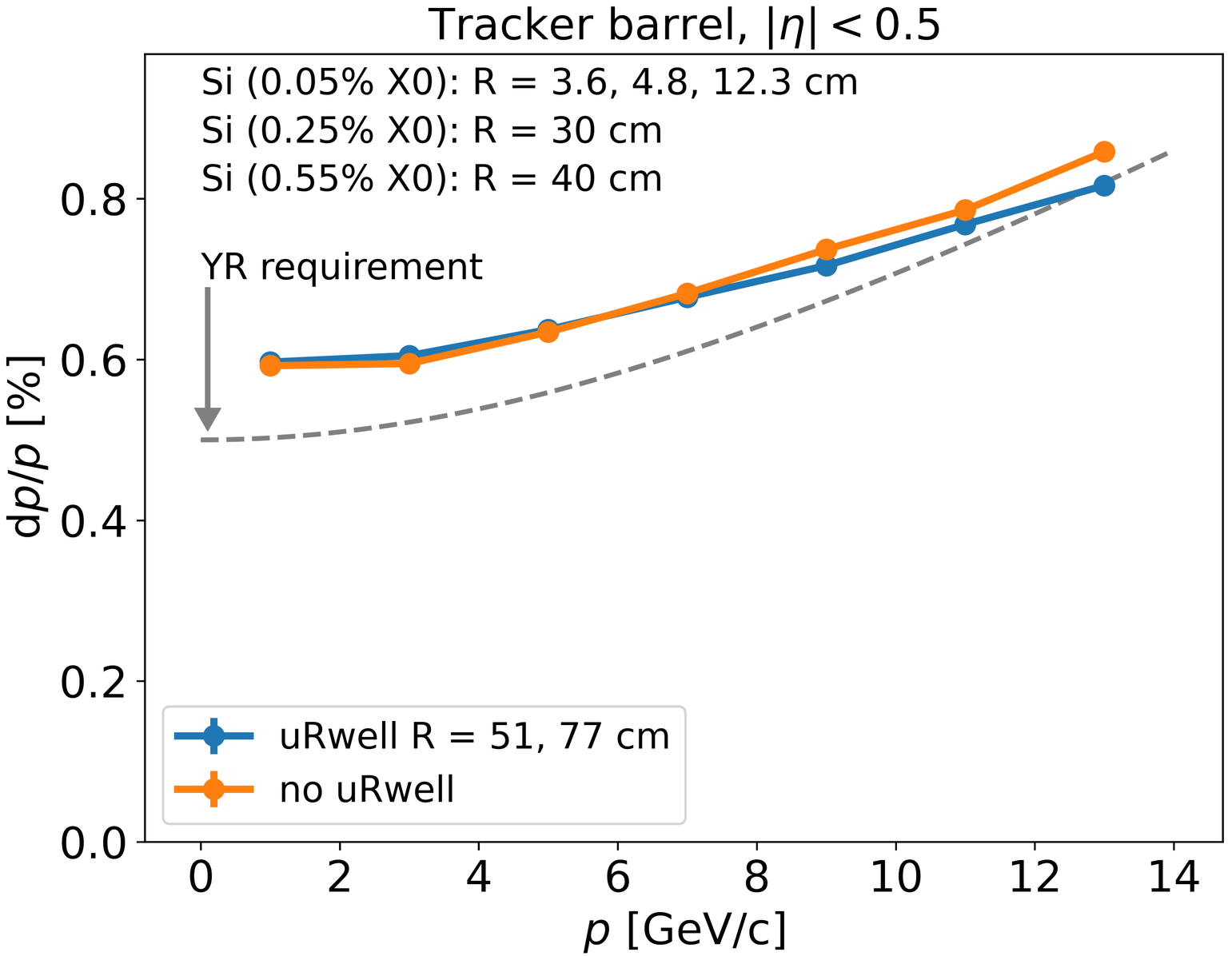
The larger the radius the better the dp/p performance (and the larger the area)

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

B = BaBar

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

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μRwells $\sigma = 55$ μm
ACLGAD $\sigma = 30$ μm

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