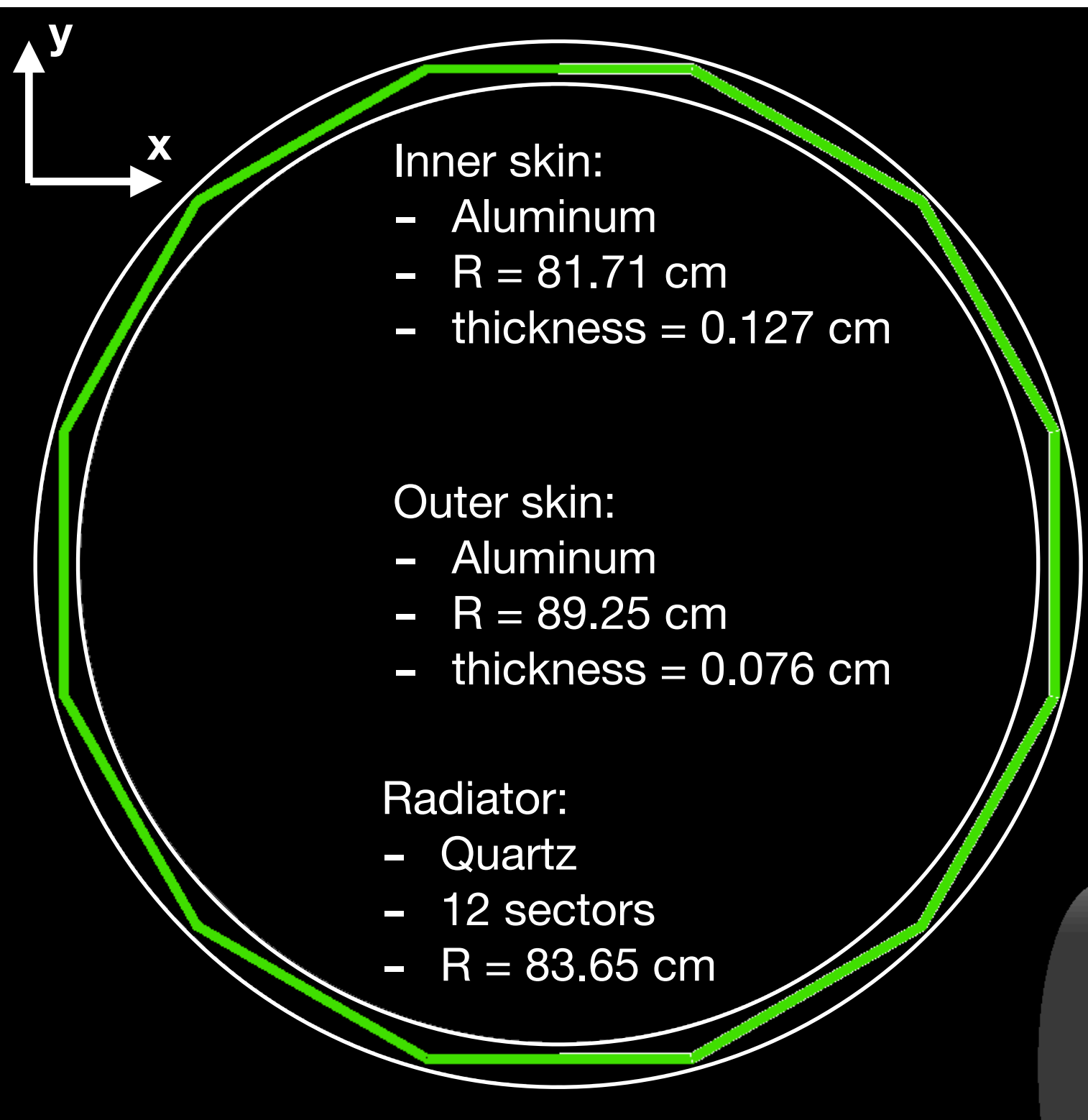


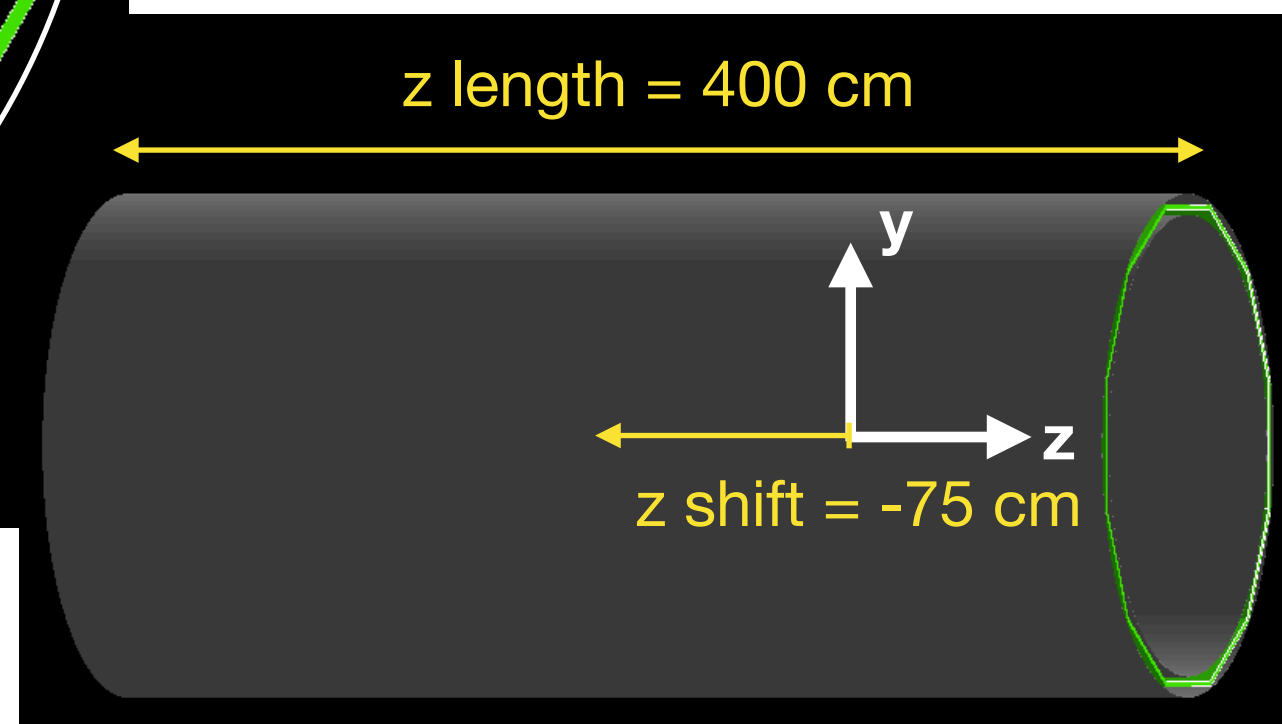
Study of momentum-resolution impact by complementing the all-si tracker with GEMs outside the DIRC

Rey Cruz-Torres
04/13/2021
EIC RNC Meeting

DIRC details



DIRC geometry taken from:
https://github.com/sPHENIX-Collaboration/macros/blob/master/common/G4_DIRC.C



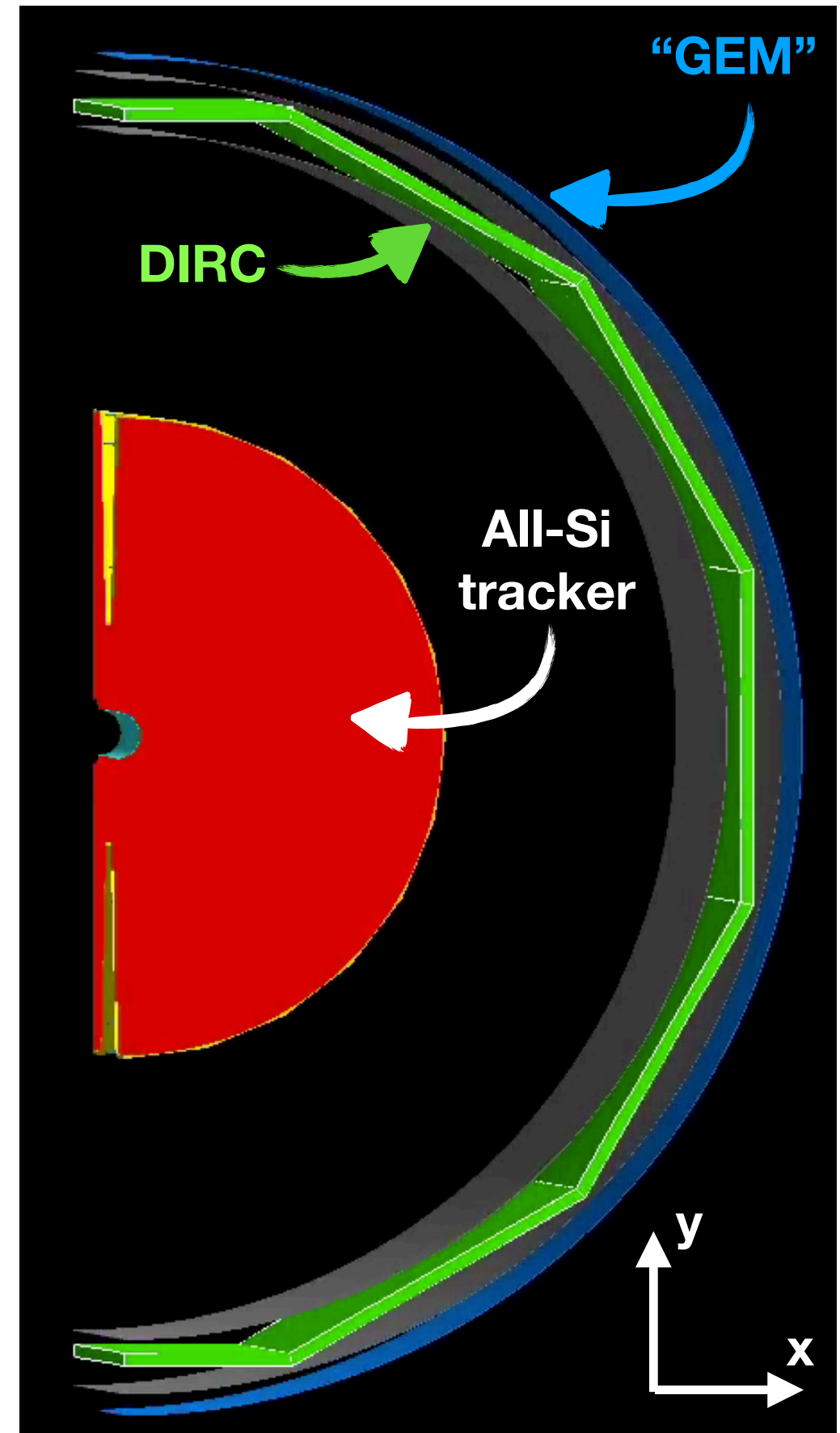
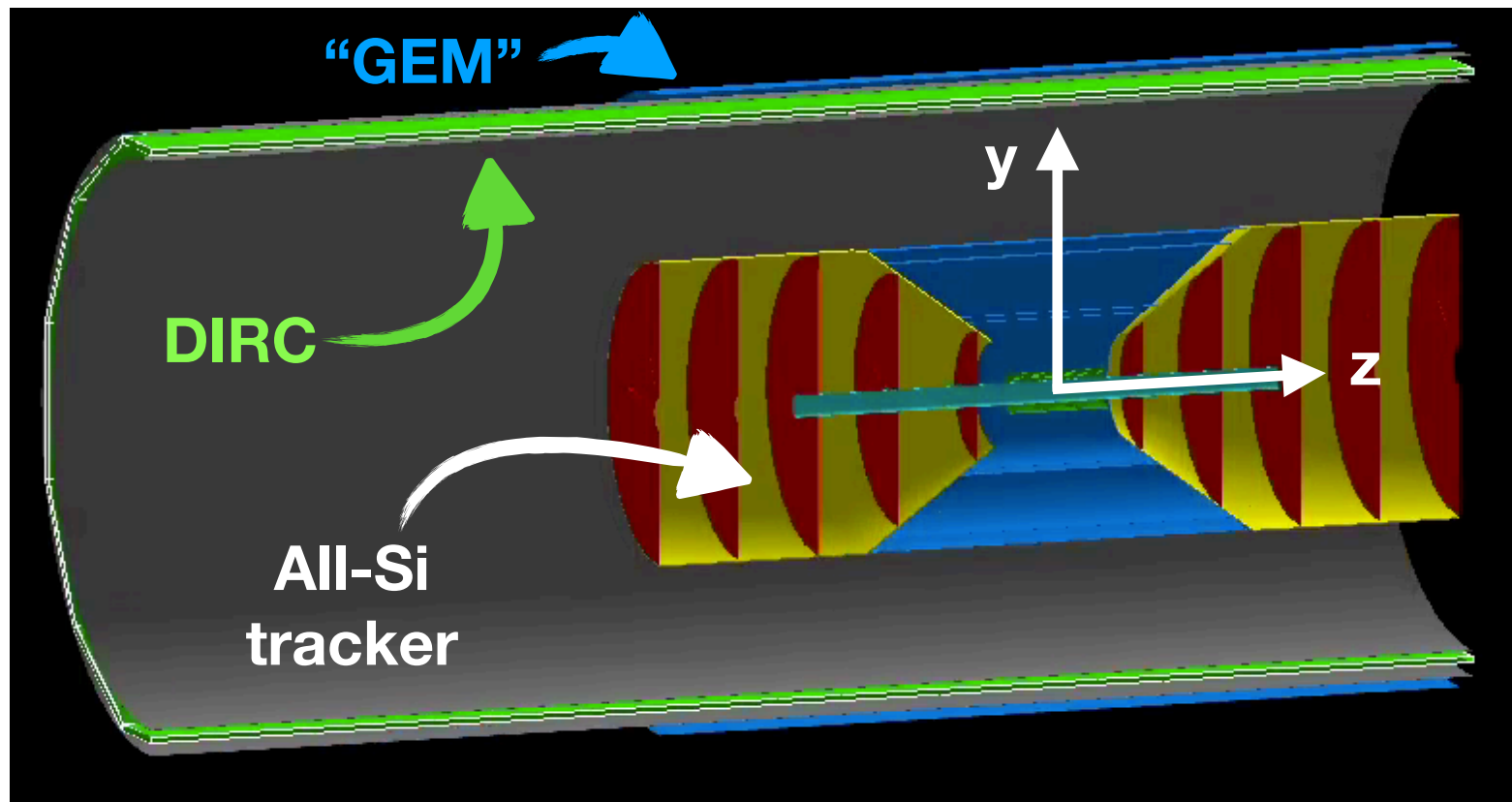
Geometry Implementation

Simplified version of the All-Silicon tracker

DIRC geometry taken from: https://github.com/sPHENIX-Collaboration/macros/blob/master/common/G4_DIRC.C

“GEM” outside the DIRC:

- silicon layer
- $R = 92$ cm
- $-121 < z < 121$ cm (length of all-si tracker)
- $\sigma_\phi = \sigma_z = 50 \mu\text{m}$



Event Generation

Single-particle generator (PHG4ParticleGenerator)

π^-

$|p| < 30 \text{ GeV}/c$

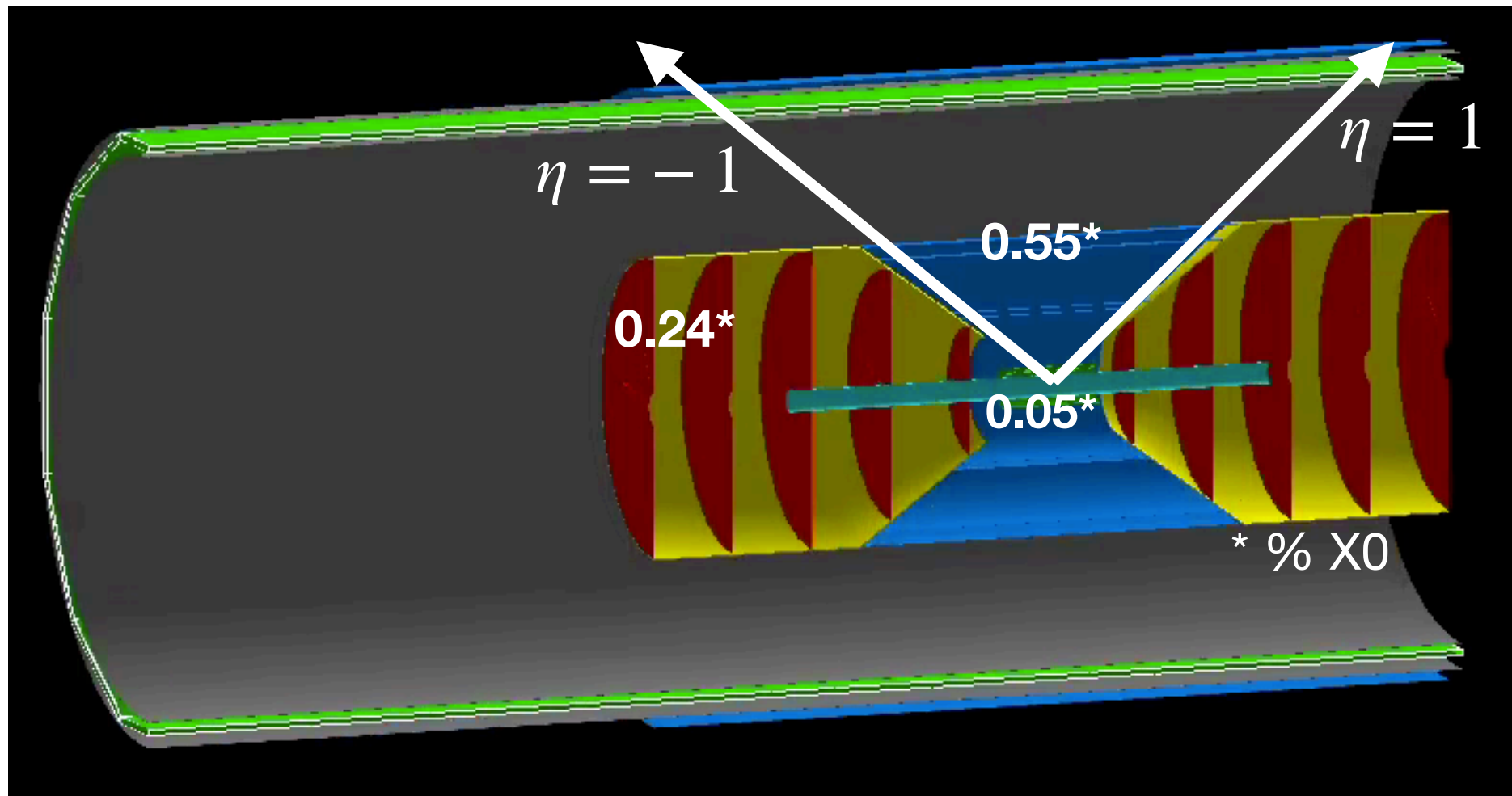
$-1 < \eta < 1$

$0 \leq \phi < 2\pi$

vertex at $(x,y,z) = (0,0,0)$

all-silicon tracker resolution: $10/\sqrt{12} \mu\text{m}$

GEM resolution: $50 \mu\text{m}$

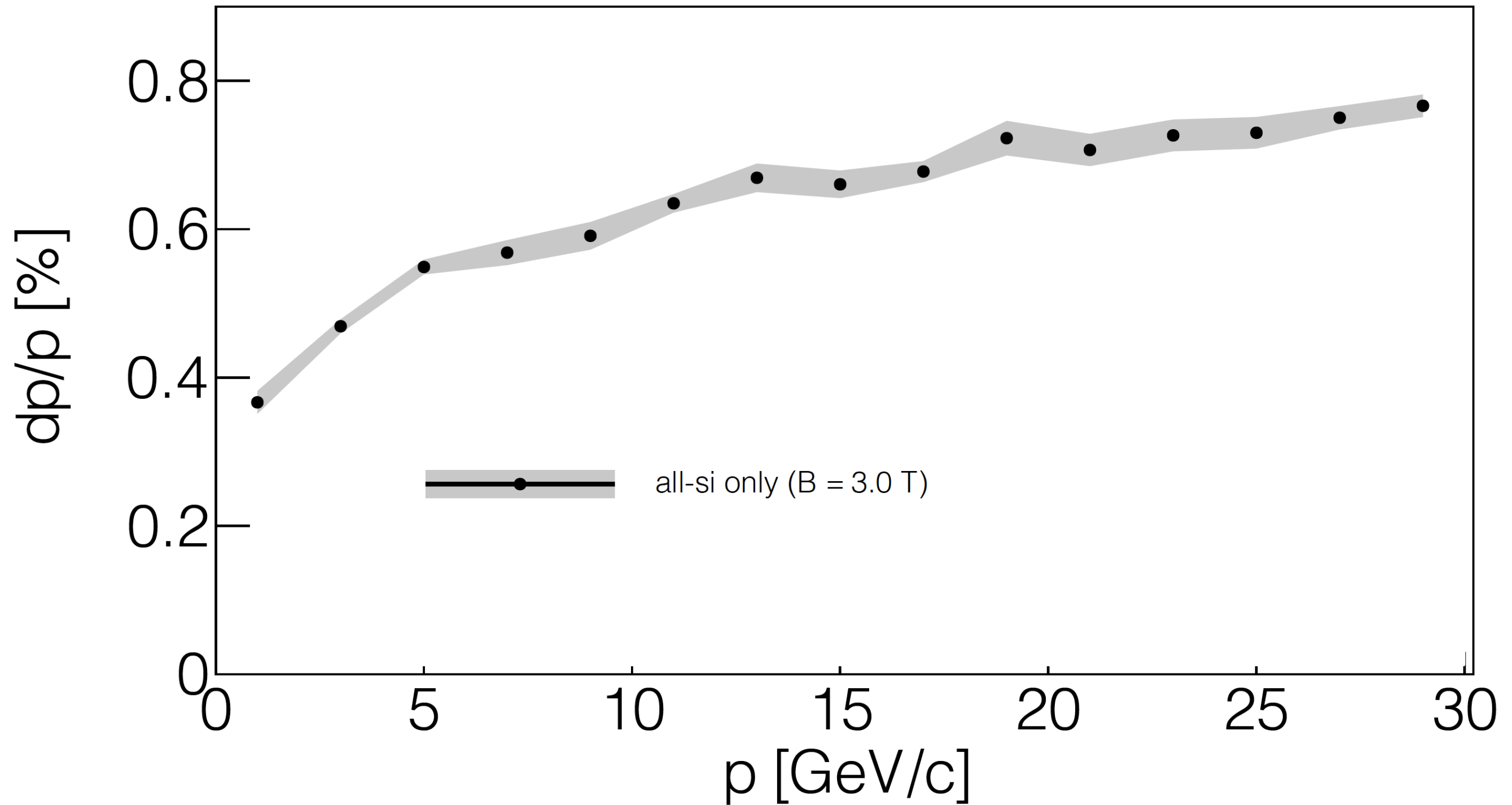


code [here](#)

Impact on momentum resolution

$$0.0 < |\eta| < 0.2$$

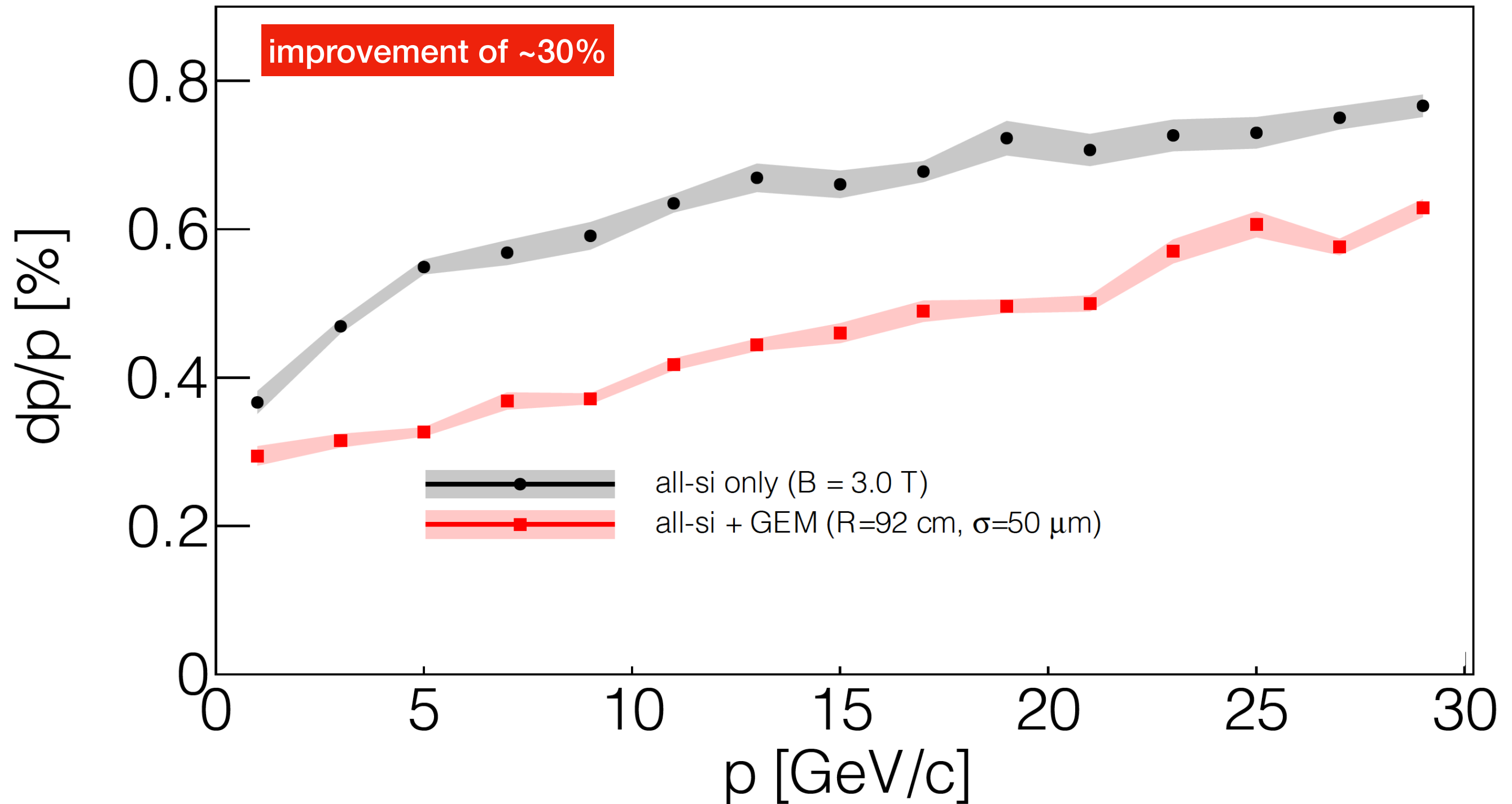
B = Beast (3.0 T)



Impact on momentum resolution

$$0.0 < |\eta| < 0.2$$

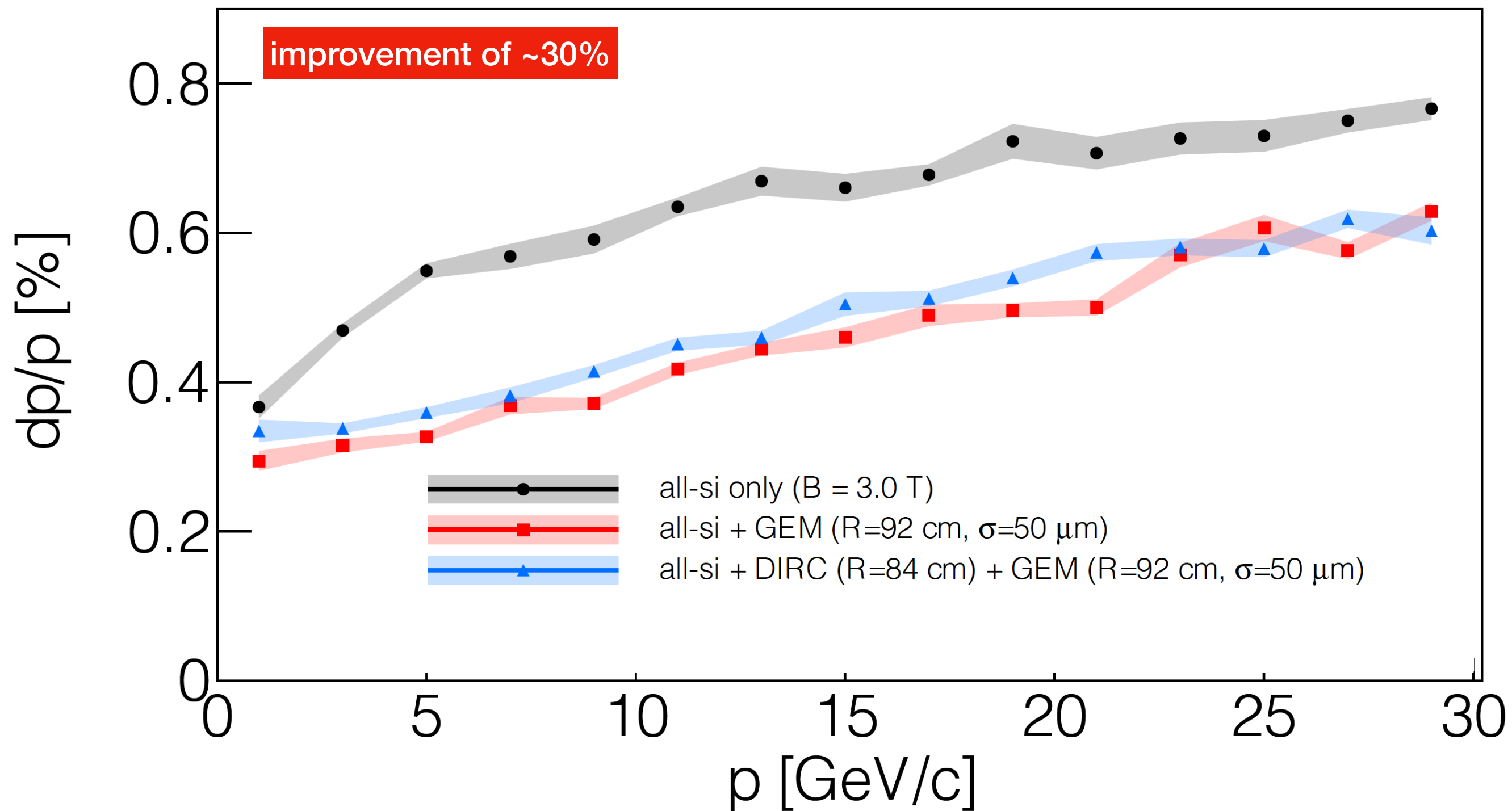
B = Beast (3.0 T)



Impact on momentum resolution

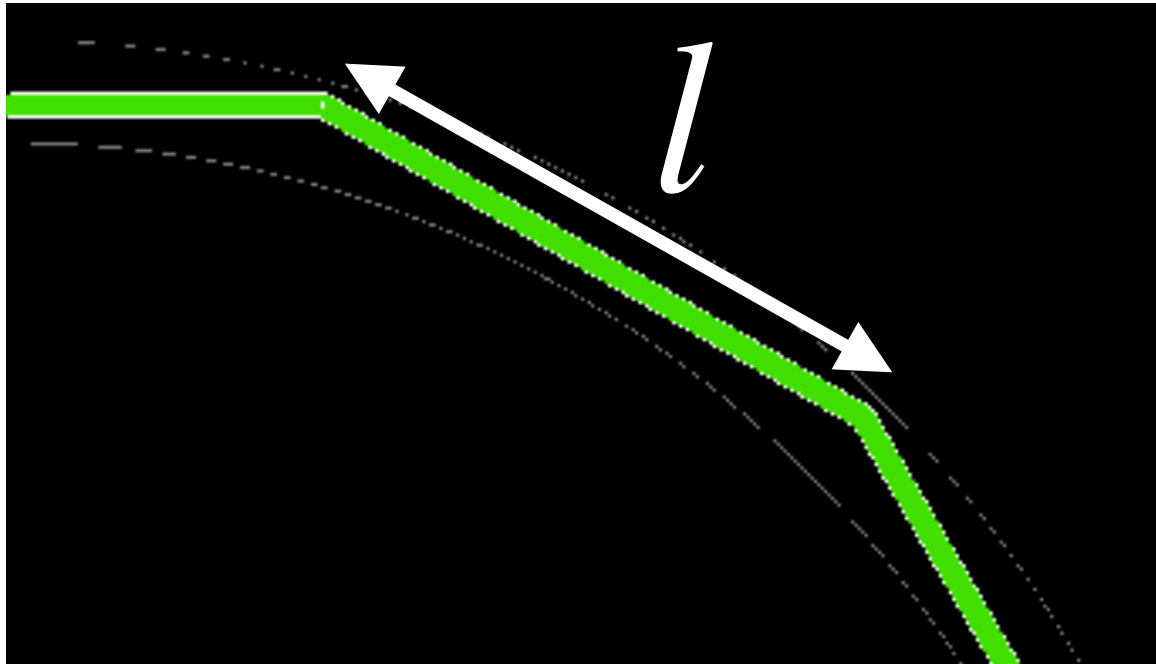
$$0.0 < |\eta| < 0.2$$

B = Beast (3.0 T)



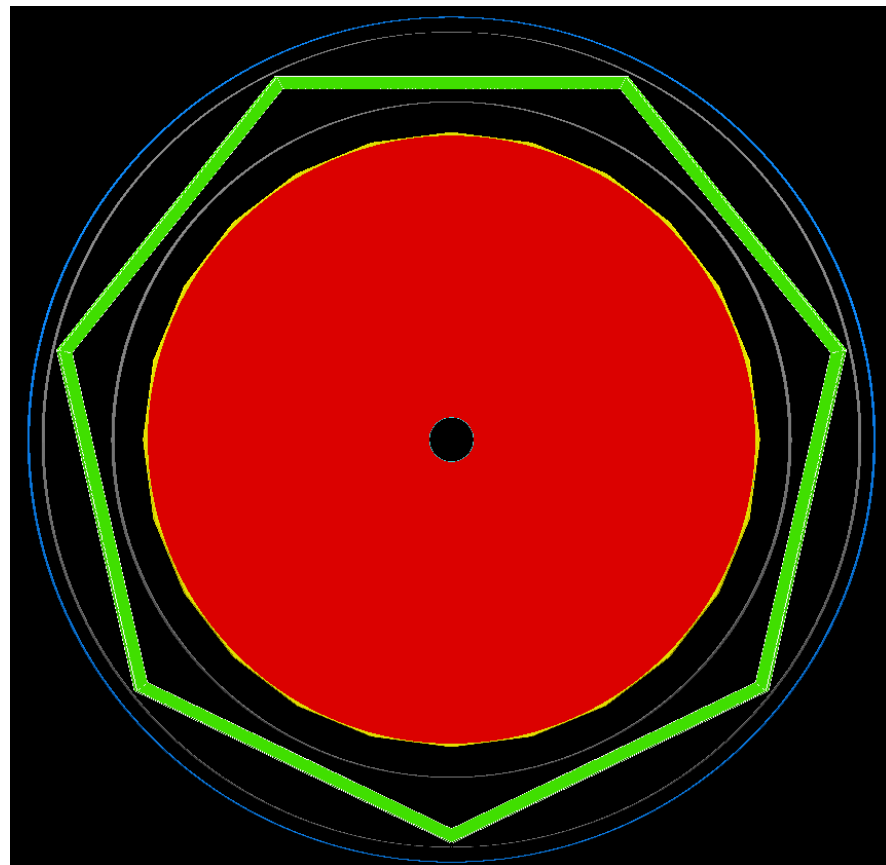
Smaller-radius DIRC

To preserve the radiator geometry (given that the DIRC already exists), the radius has to be quantized



$$l = 2 \times R_{12} \times \sin\left(\frac{\pi}{12}\right)$$

$$R_n = \frac{l}{2 \times \sin\left(\frac{\pi}{n}\right)}$$

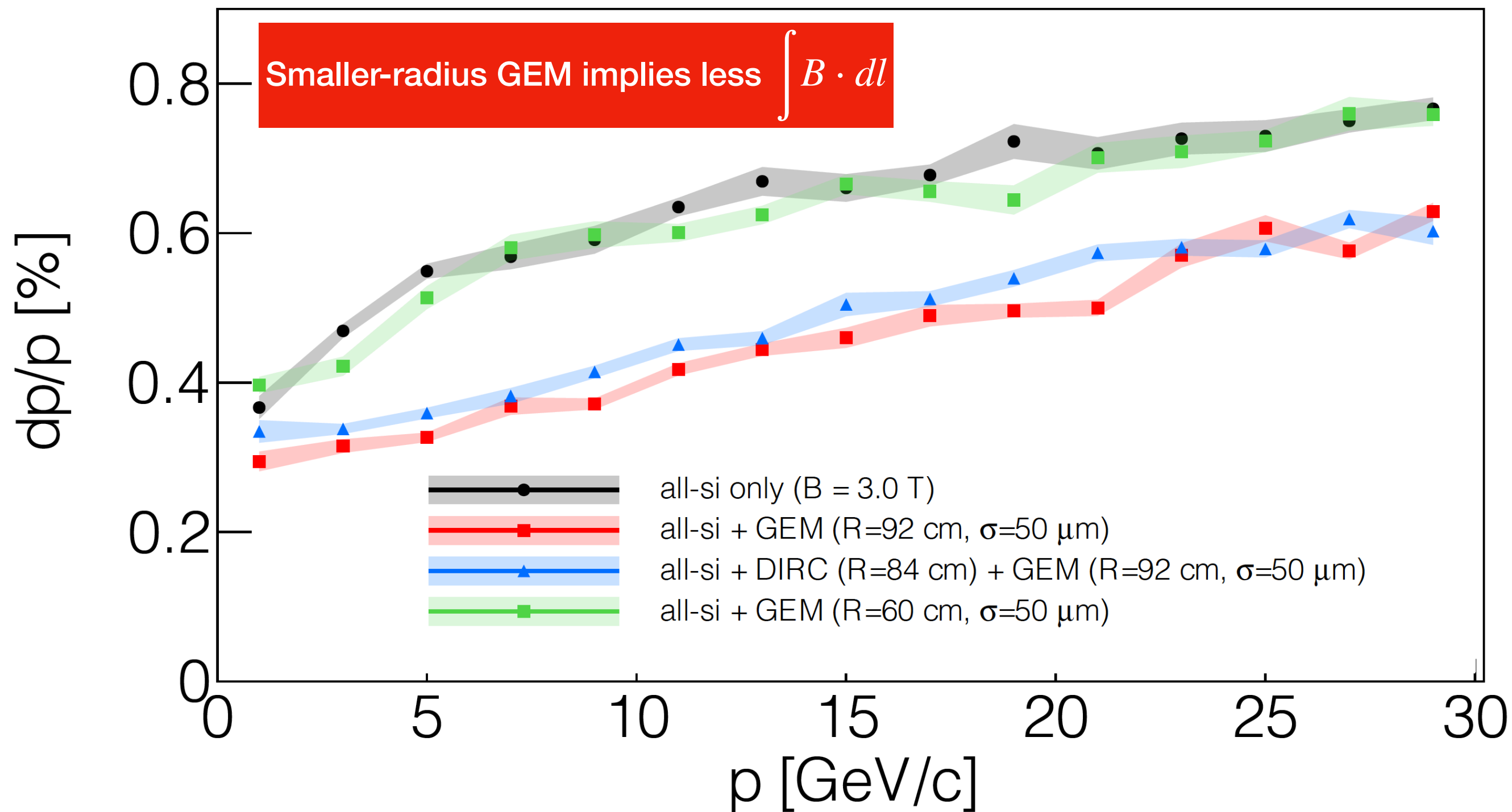


n	R_n [cm]
5	36.83
6	43.30
7	49.90
8	56.57
9	63.30
10	70.06
11	76.85
12	83.65

Impact on momentum resolution

$$0.0 < |\eta| < 0.2$$

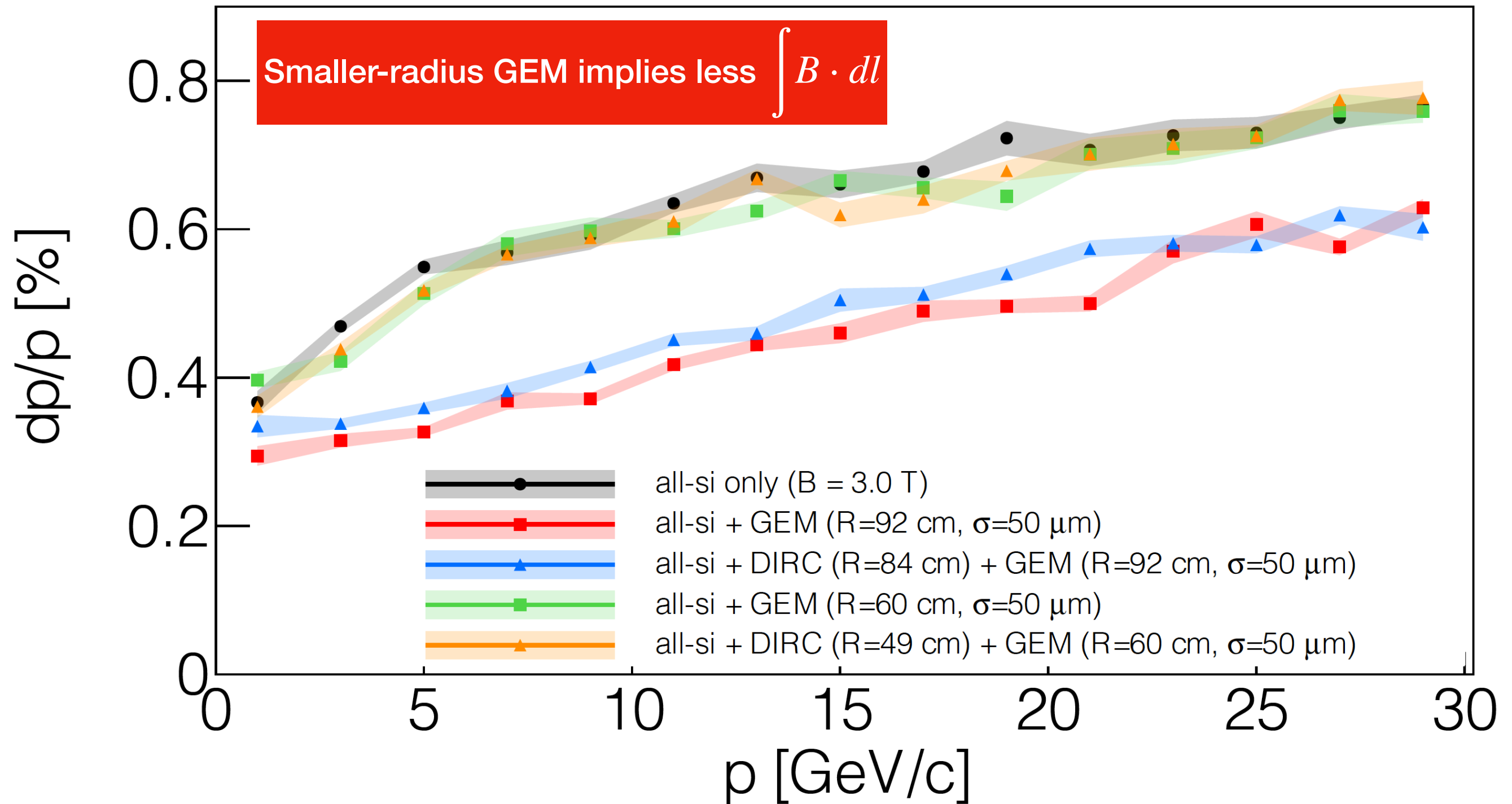
B = Beast (3.0 T)



Impact on momentum resolution

$$0.0 < |\eta| < 0.2$$

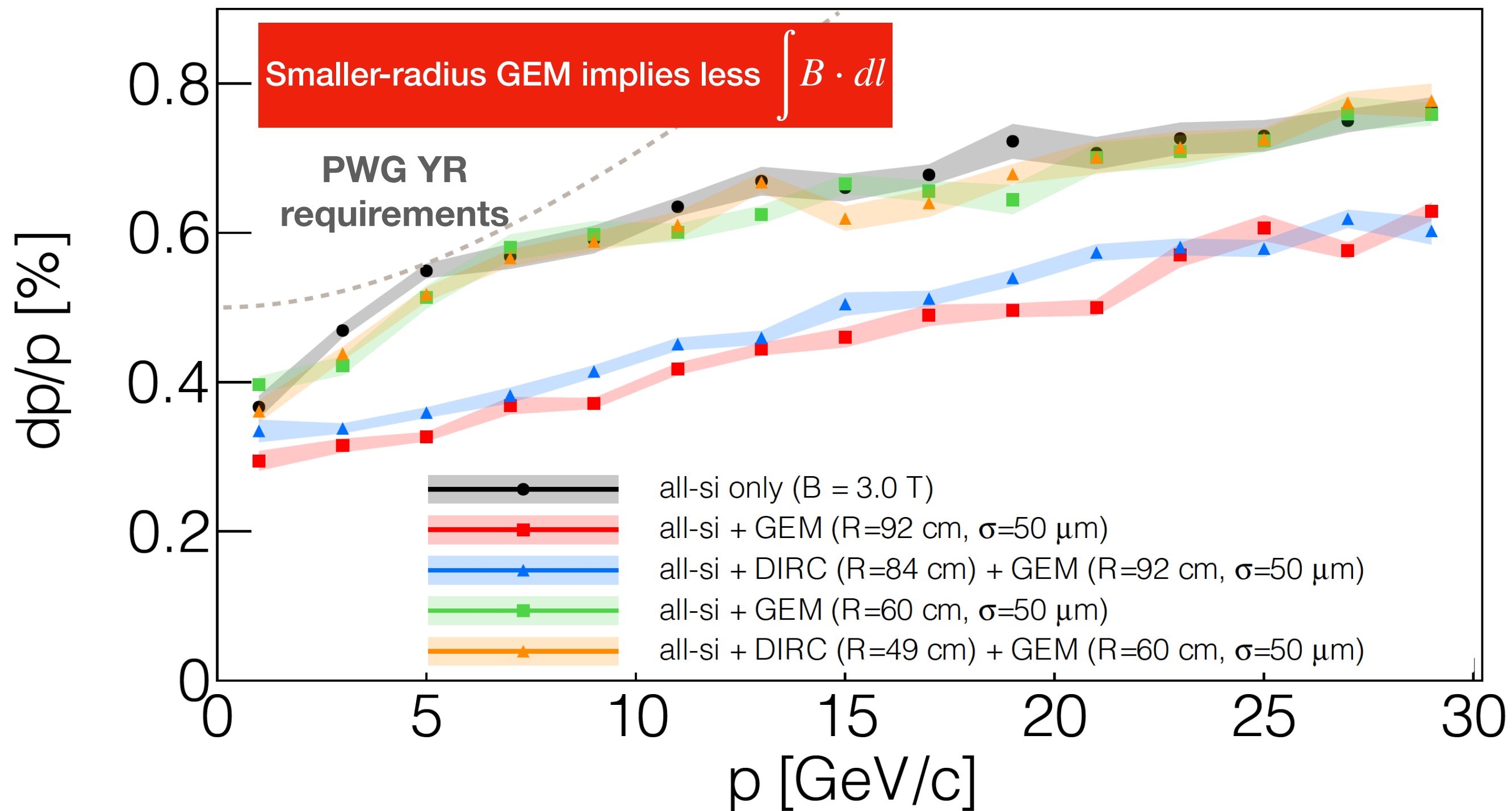
B = Beast (3.0 T)



Impact on momentum resolution

$$0.0 < |\eta| < 0.2$$

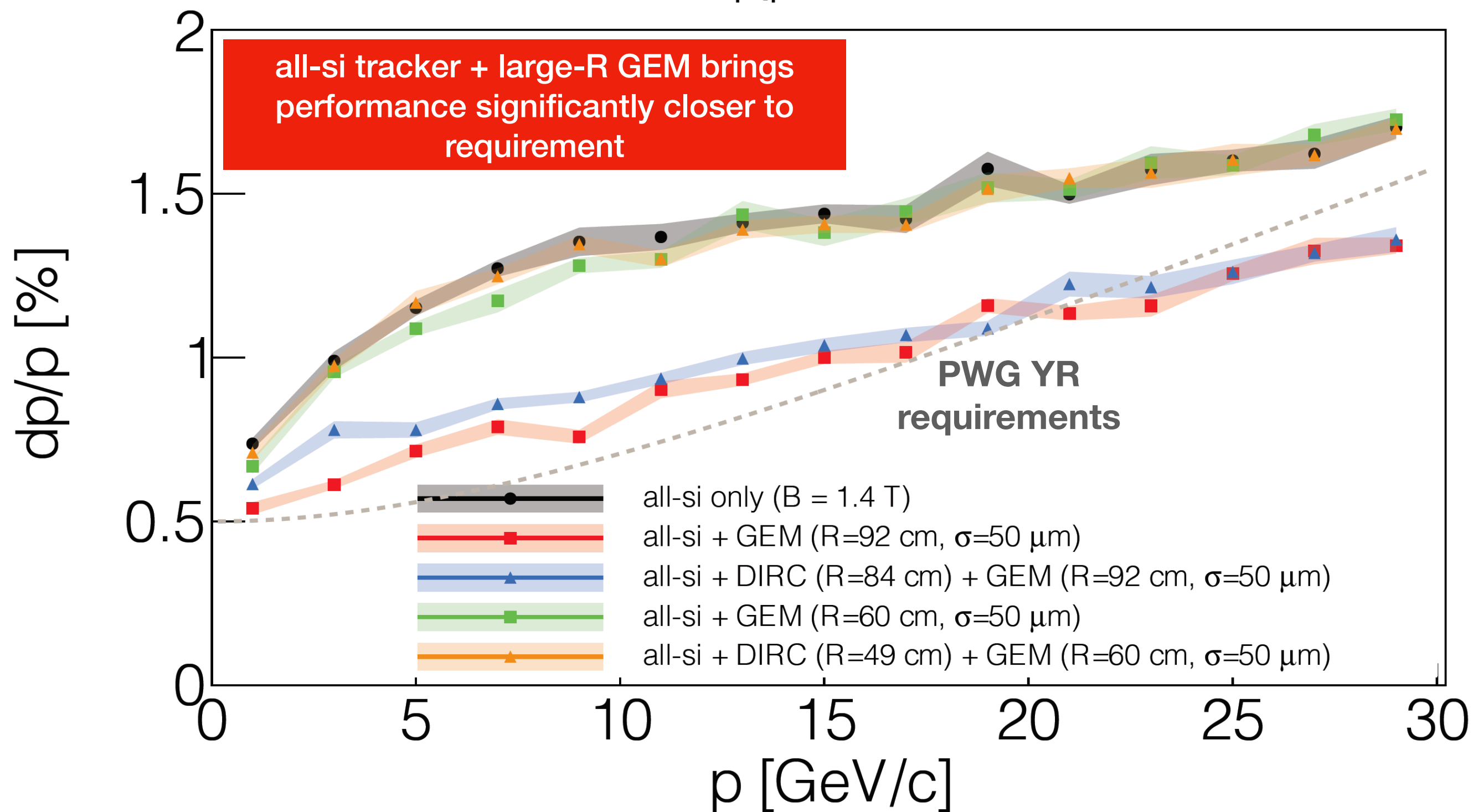
B = Beast (3.0 T)



Impact on momentum resolution

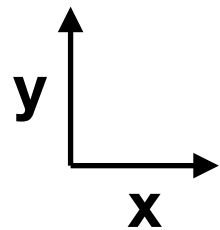
$$0.0 < |\eta| < 0.2$$

B = BaBar (1.4 T)

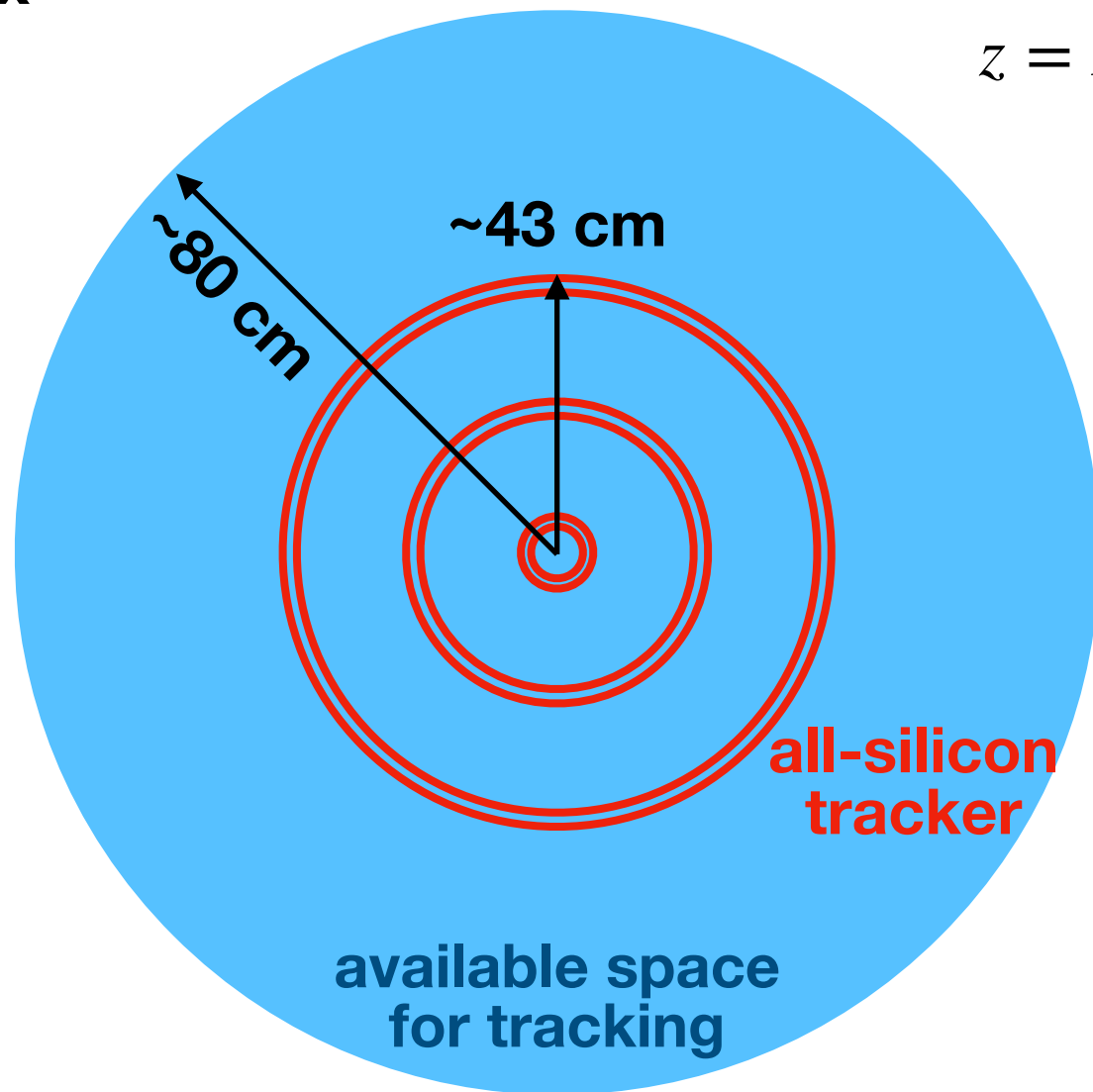


Space allocated for tracking

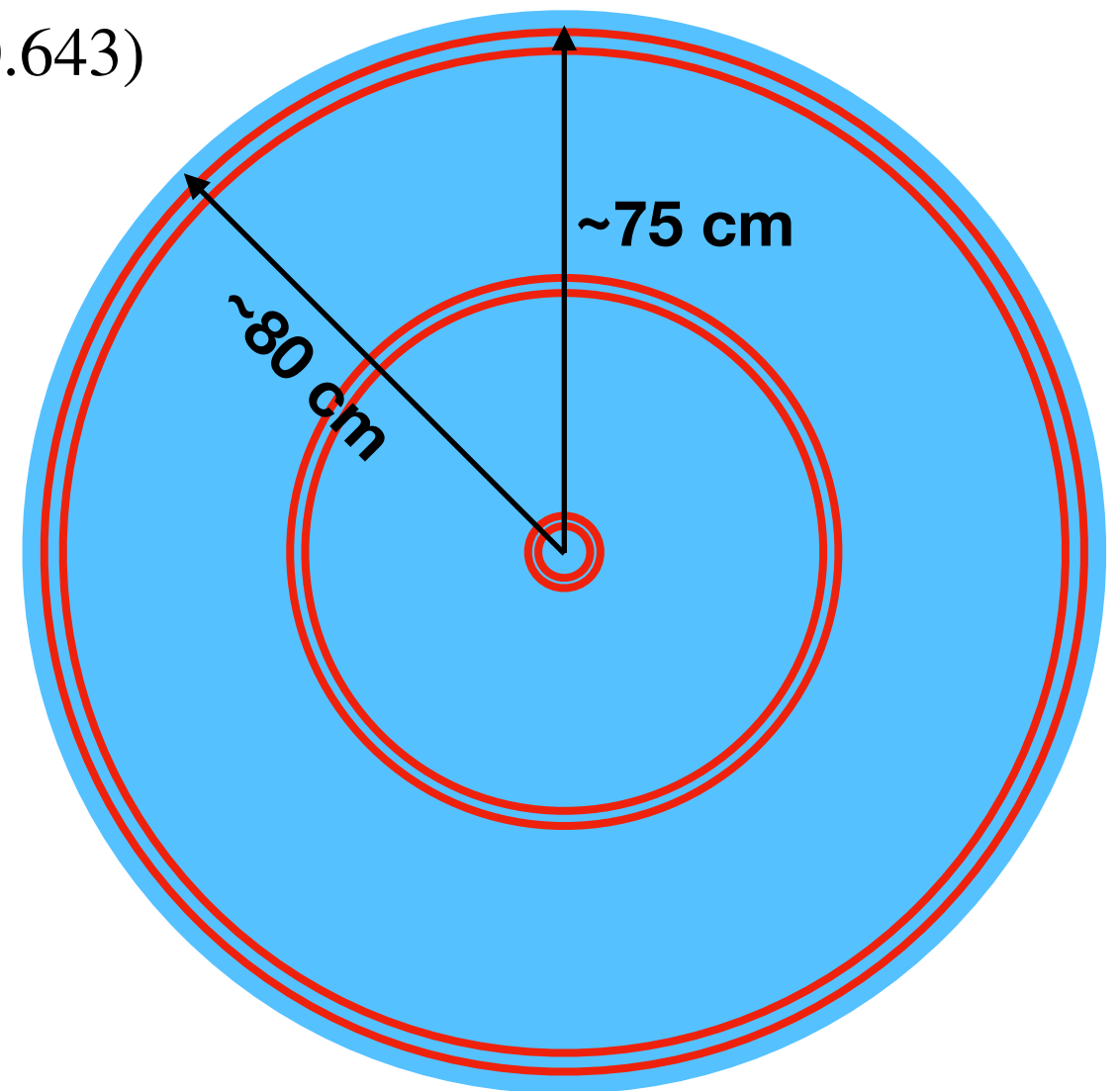
$dp/p \sim R^{-2}$, where R is the tracker outer radius



$$z = R/\tan(0.643)$$



LBNL all-silicon tracker

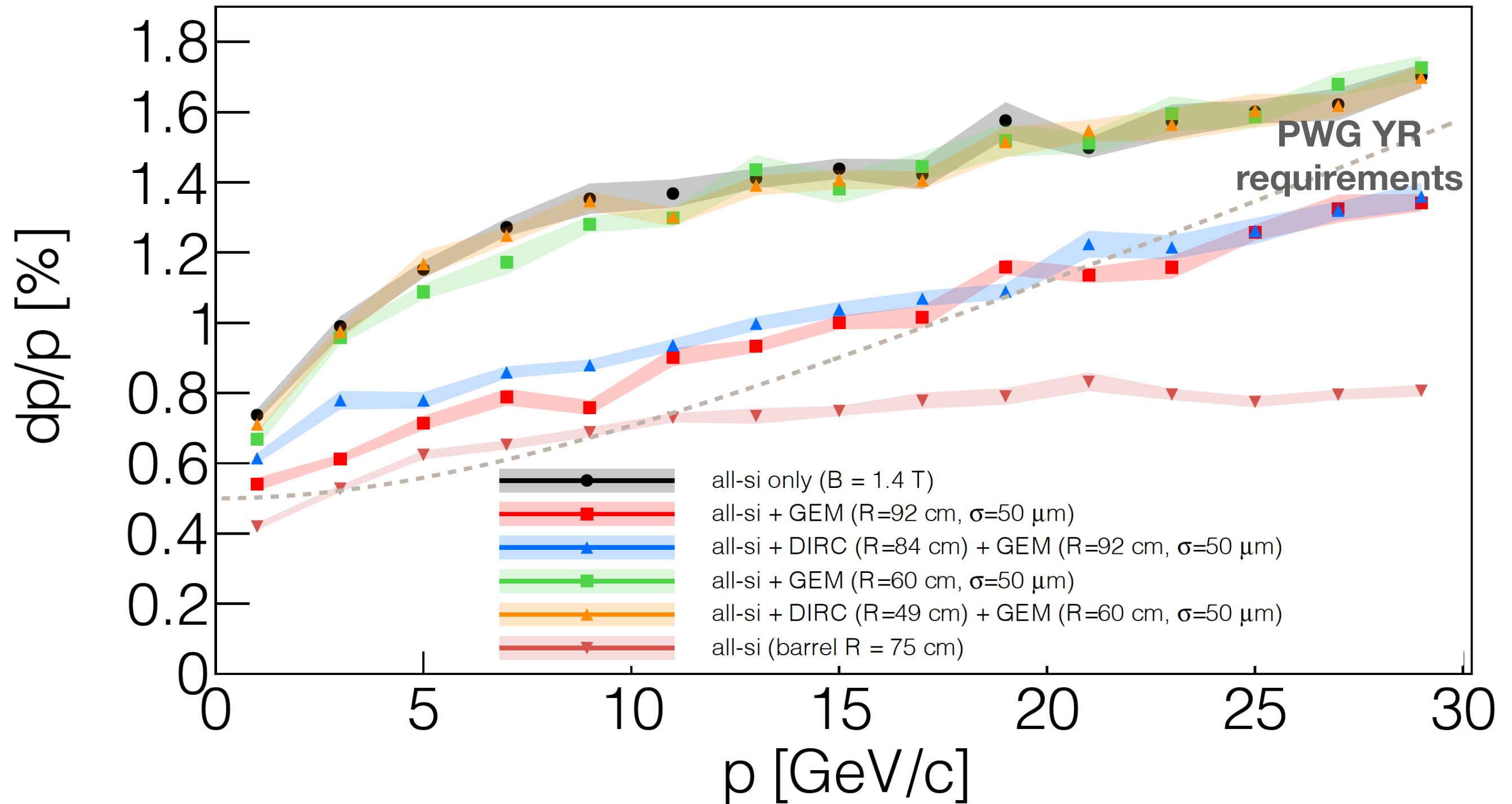


Try an all-silicon tracker with outer layers at $R = 75$ cm and central layers at $R/2$

Impact on momentum resolution

$$0.0 < |\eta| < 0.2$$

B = BaBar (1.4 T)



Summary

- Study of impact complementing the all-si tracker with GEMs outside the DIRC has on the momentum resolution.
- DIRC geometry taken from Fun4All
- GEM simulated as a silicon layer with $\sigma = 50 \mu\text{m}$
- Momentum resolution improves by $\sim 30 \%$ on average when the GEM at $R = 92 \text{ cm}$
- No significant momentum resolution improvement is achieved when the GEM is placed at $R = 60 \text{ cm}$
- Not possible to fully supply the momentum-resolution required from the PWG at low $|\eta|$ with the 1.4 T field