

EIC Tracking and PID studies beyond the Yellow Report



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Complementing the all-si tracker in the barrel region

Goal: Study the possibility of improving momentum resolution

Variant #1:

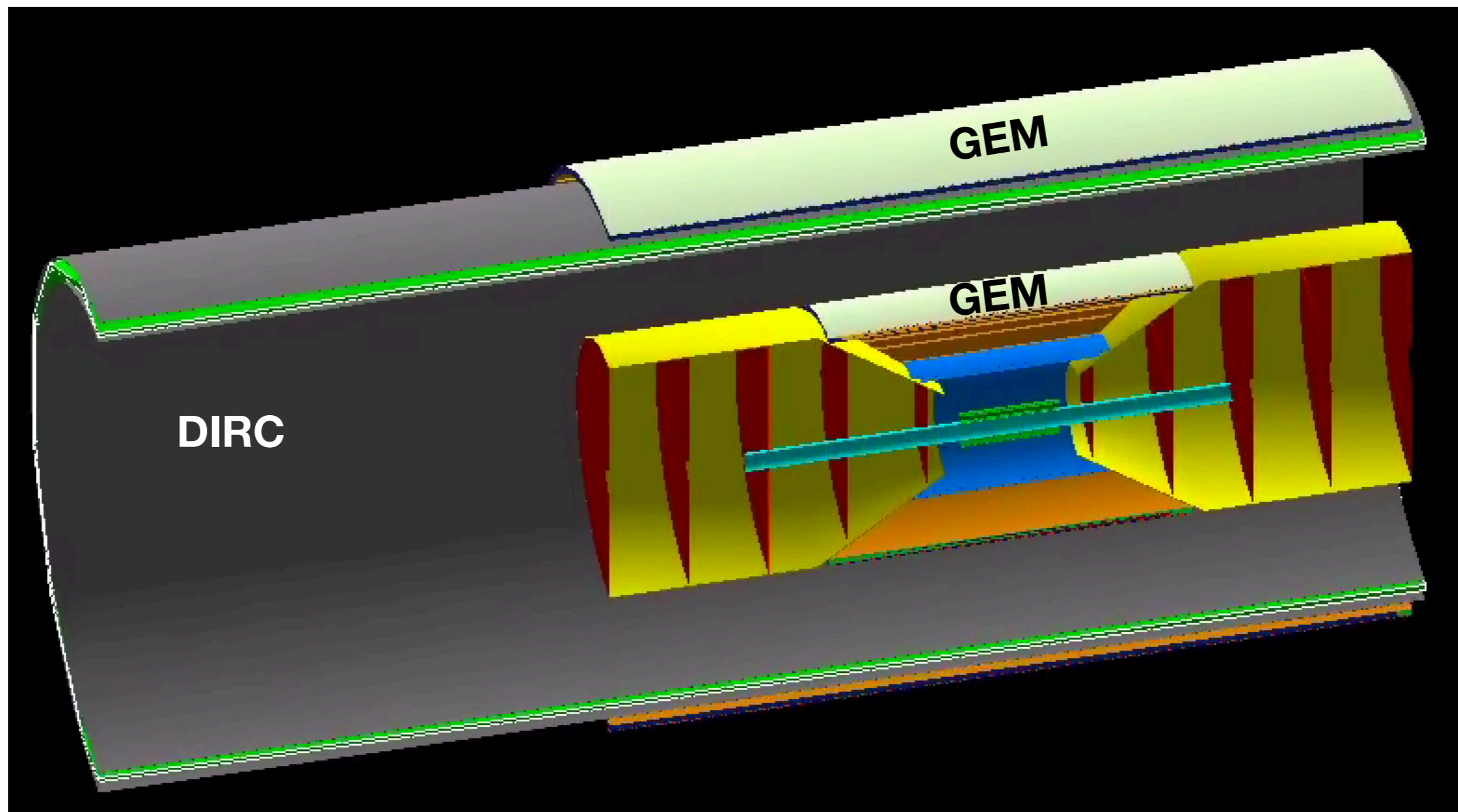
All-silicon tracker + GEM outside the DIRC

Variant #2:

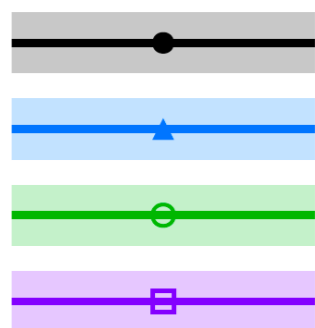
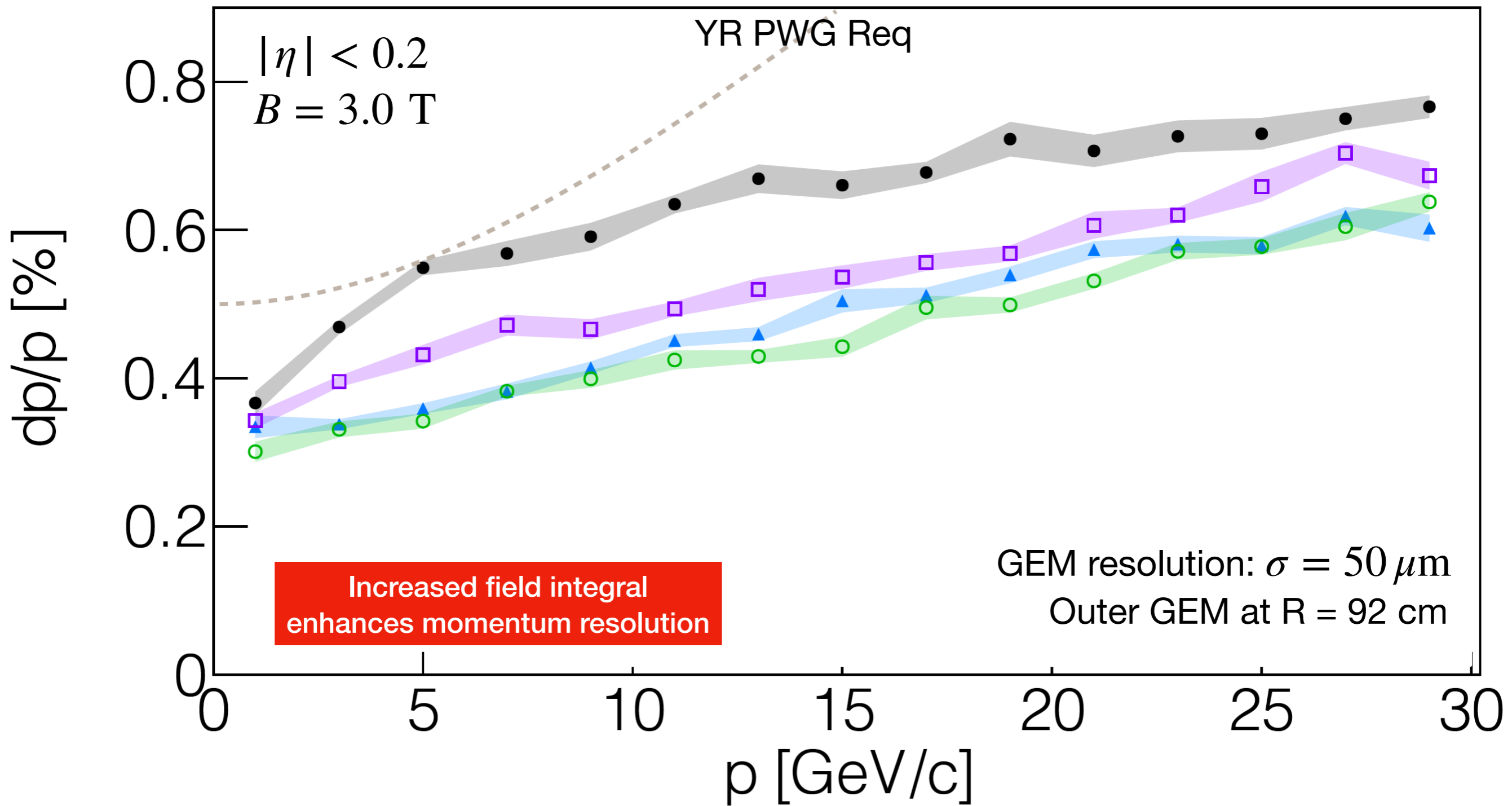
Outermost two barrel layers replaced with a GEM, and a second GEM added outside the DIRC

All-si tracker material budget (X/X₀):

- Vertexing layers: 0.05%
- Barrel Layers: 0.55%
- Disks: 0.24%



GEM Material Budget Effect



all-si only

all-si + DIRC + GEM (R = 92 cm)

all-si outer two layers replaced with GEM (X/X0=0.7%) + DIRC + GEM (R = 92 cm)

all-si outer two layers replaced with GEM (X/X0=2.4%) + DIRC + GEM (R = 92 cm)

DIRC radius effect

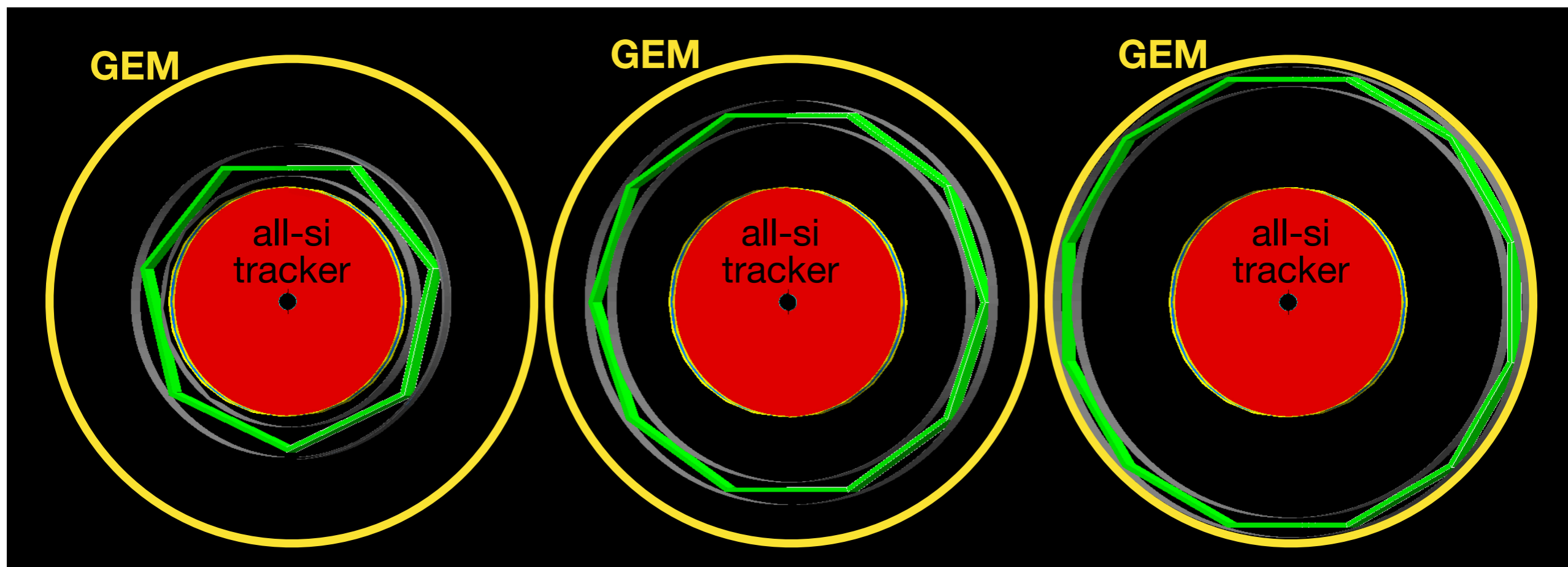
Previous study assumes outer GEM is very close to DIRC (and there is no additional material between DIRC and all-si tracker)

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

Study effect of changing DIRC radius

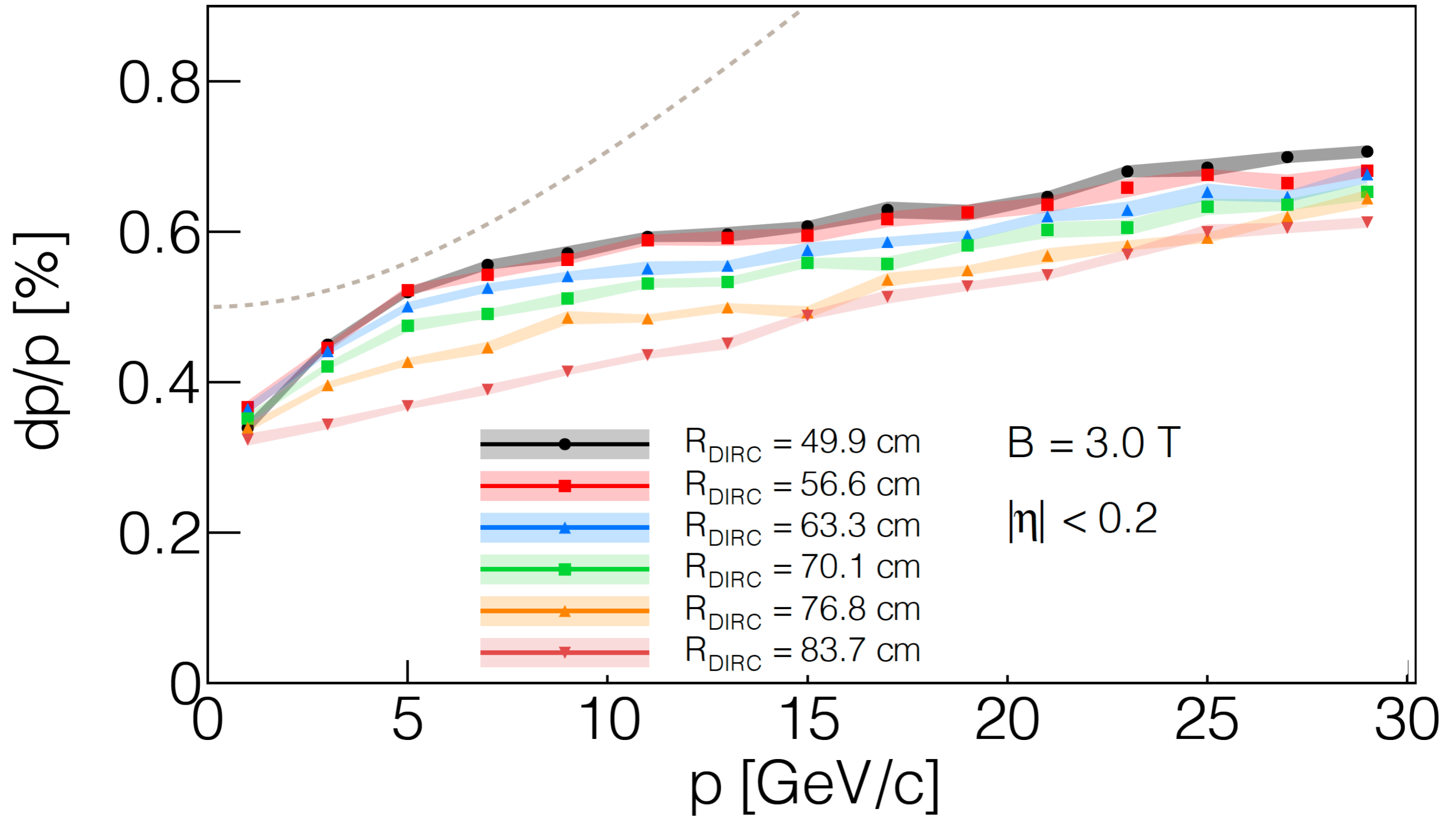
DIRC modules exist (BaBar), so DIRC radius is quantized

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

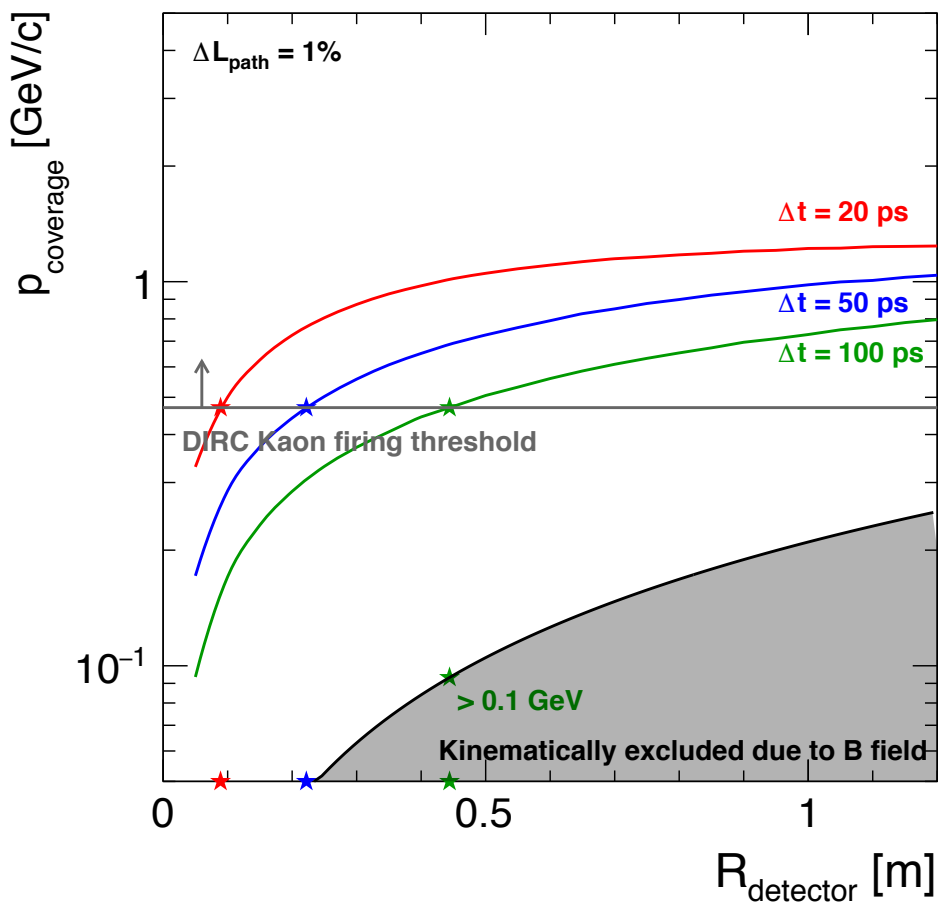
Al-Si + DIRC + GEM (R = 92 cm)



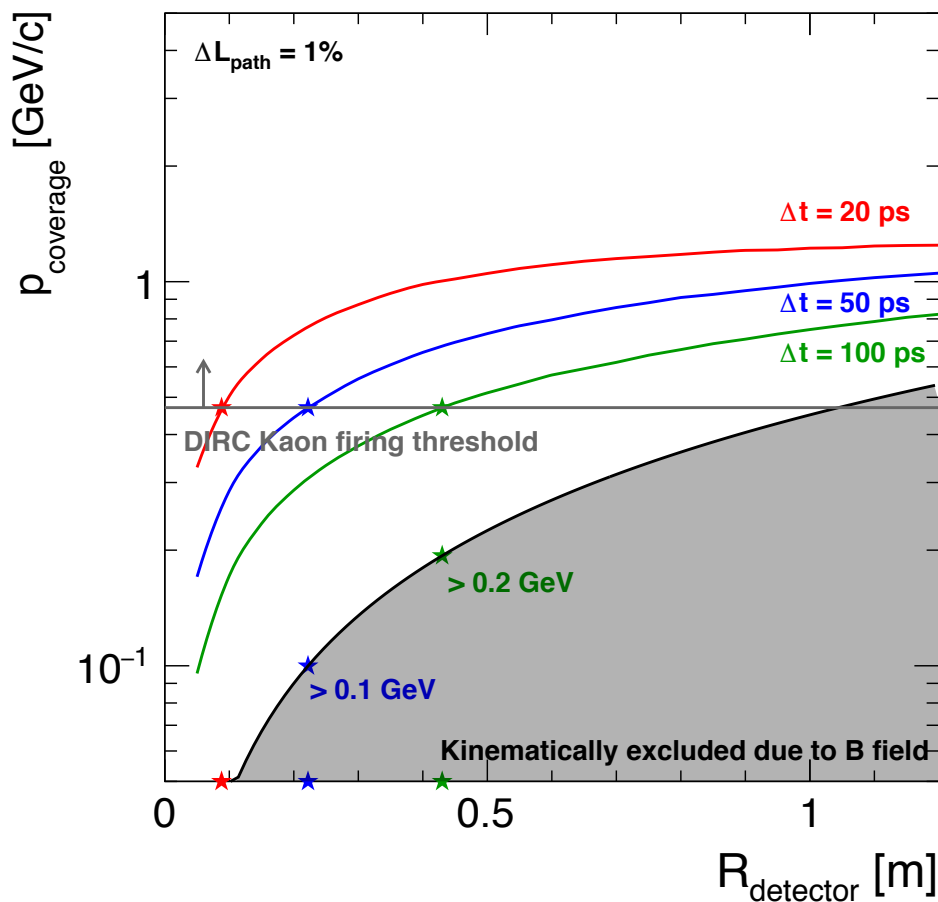
Effect of timing resolution

- TOF with better intrinsic resolution can be put closer to the interaction point \rightarrow smaller area

Central Barrel PID (Barbar magnet 1.4T)

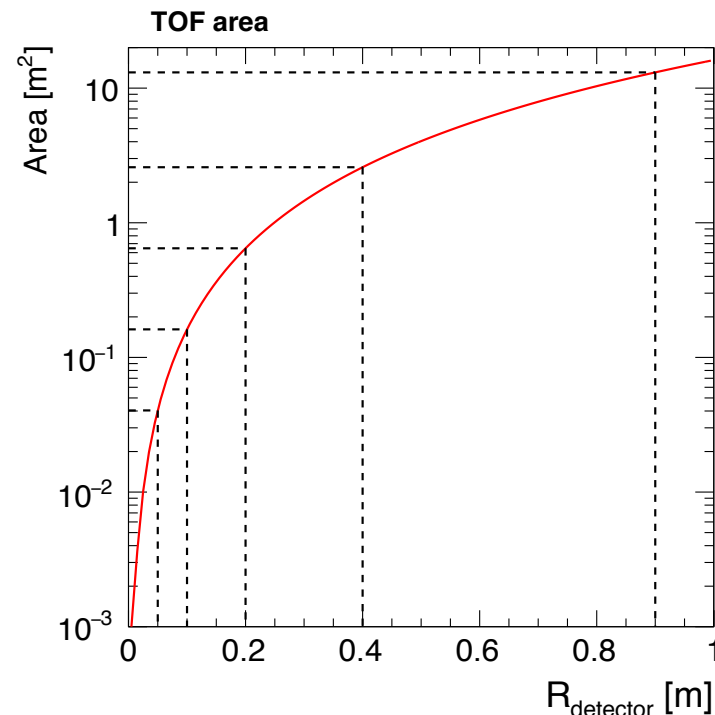
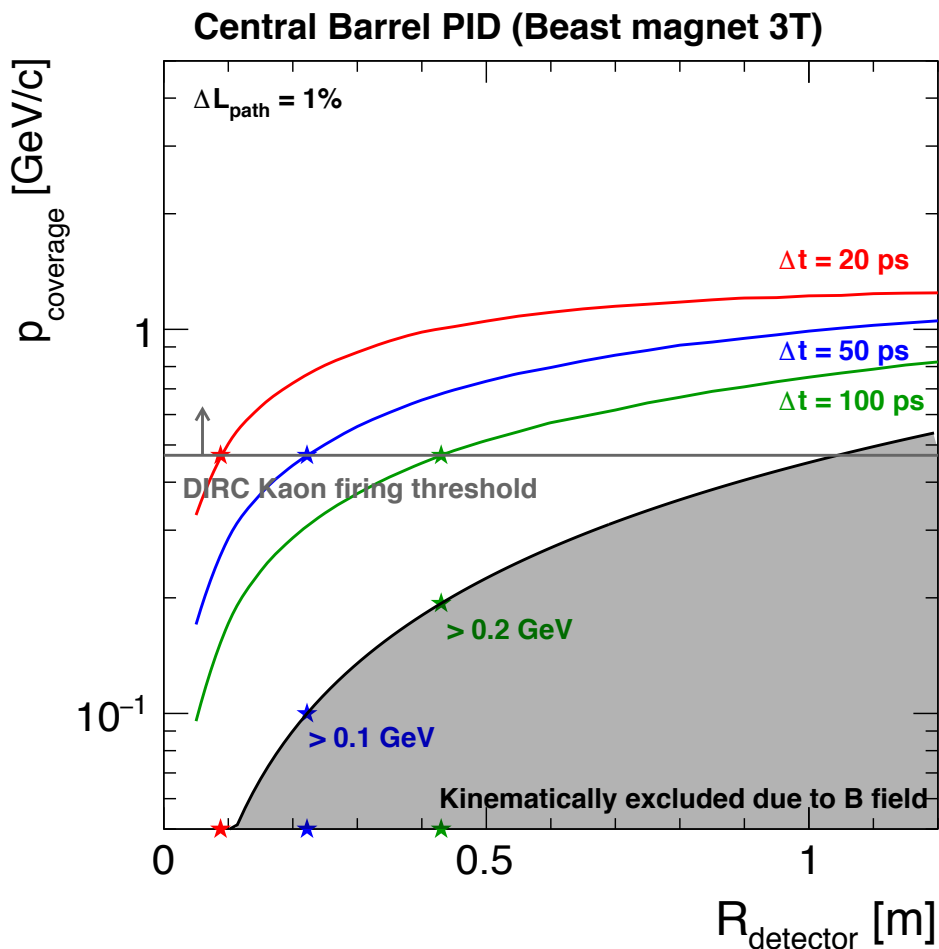


Central Barrel PID (Beast magnet 3T)



Effect of timing resolution

- TOF with better intrinsic resolution can be put closer to the interaction point → smaller area



20ps: 5-25cm (45cm) to reach down to 0.1GeV (0.2GeV)

50ps: 10-25cm (45cm) to reach down to 0.1GeV (0.2GeV)

100ps: cannot reach down to 0.1GeV, ~45 reach down to 0.2GeV

Summary

- Momentum resolutions can be enhanced by complementing detectors with additional tracking stations
- Amount of material and placement inside active tracking region may have a significant impact on tracking performance

This requires close coordination with PID efforts

- DIRC cannot identify particles below firing threshold or particles which can not reach it
- Complementary PID detector should be put close enough so low momentum particles can reach it
- TOF: further \rightarrow higher momentum reach; closer \rightarrow smaller area
- Results sensitive to the path length uncertainties
- Next step: put LGAD at different radial locations and study its impact on the momentum and projecting resolution