

TPC Simulation in EicRoot

Synchrotron Radiation and TPC Dimensions

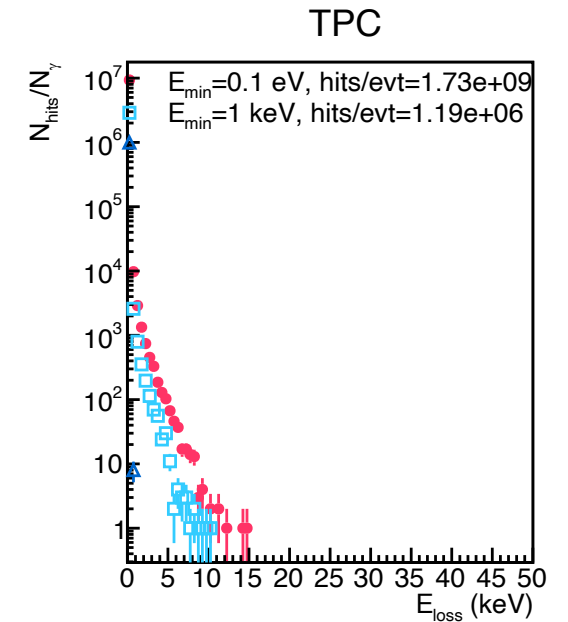
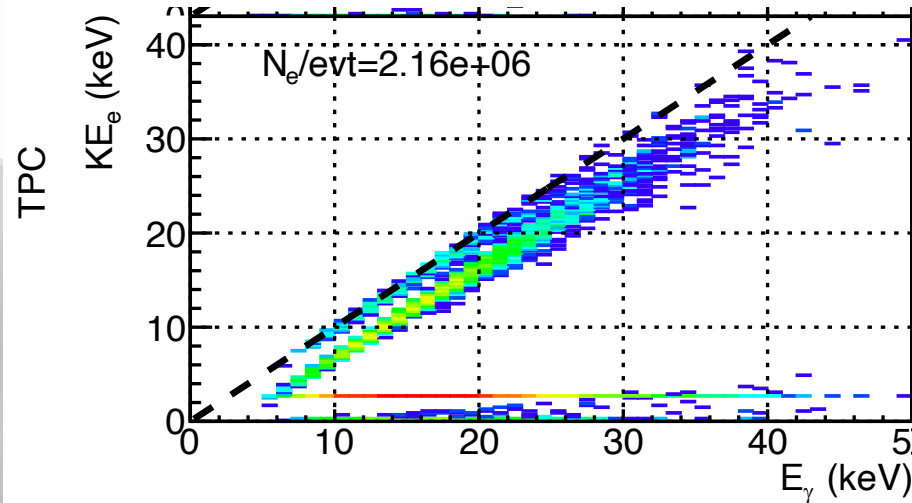
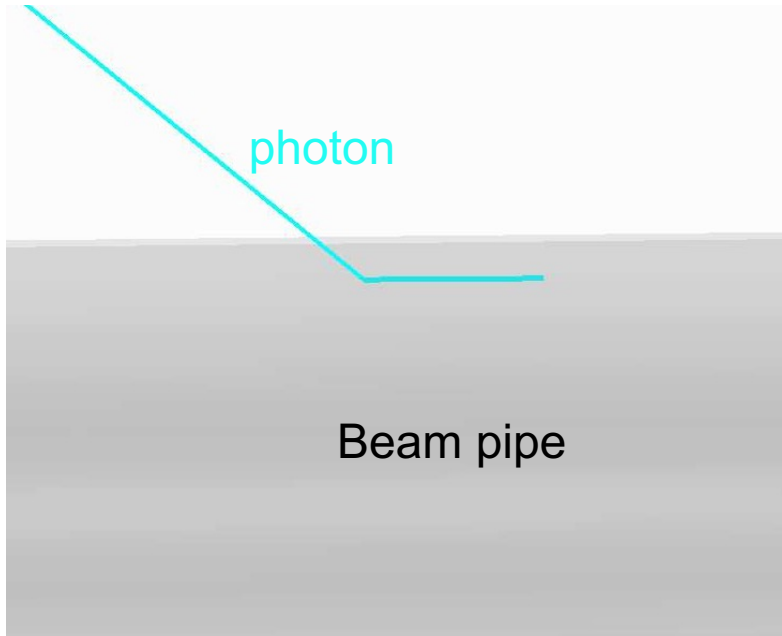
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03-17-2025

Synchrotron Radiation

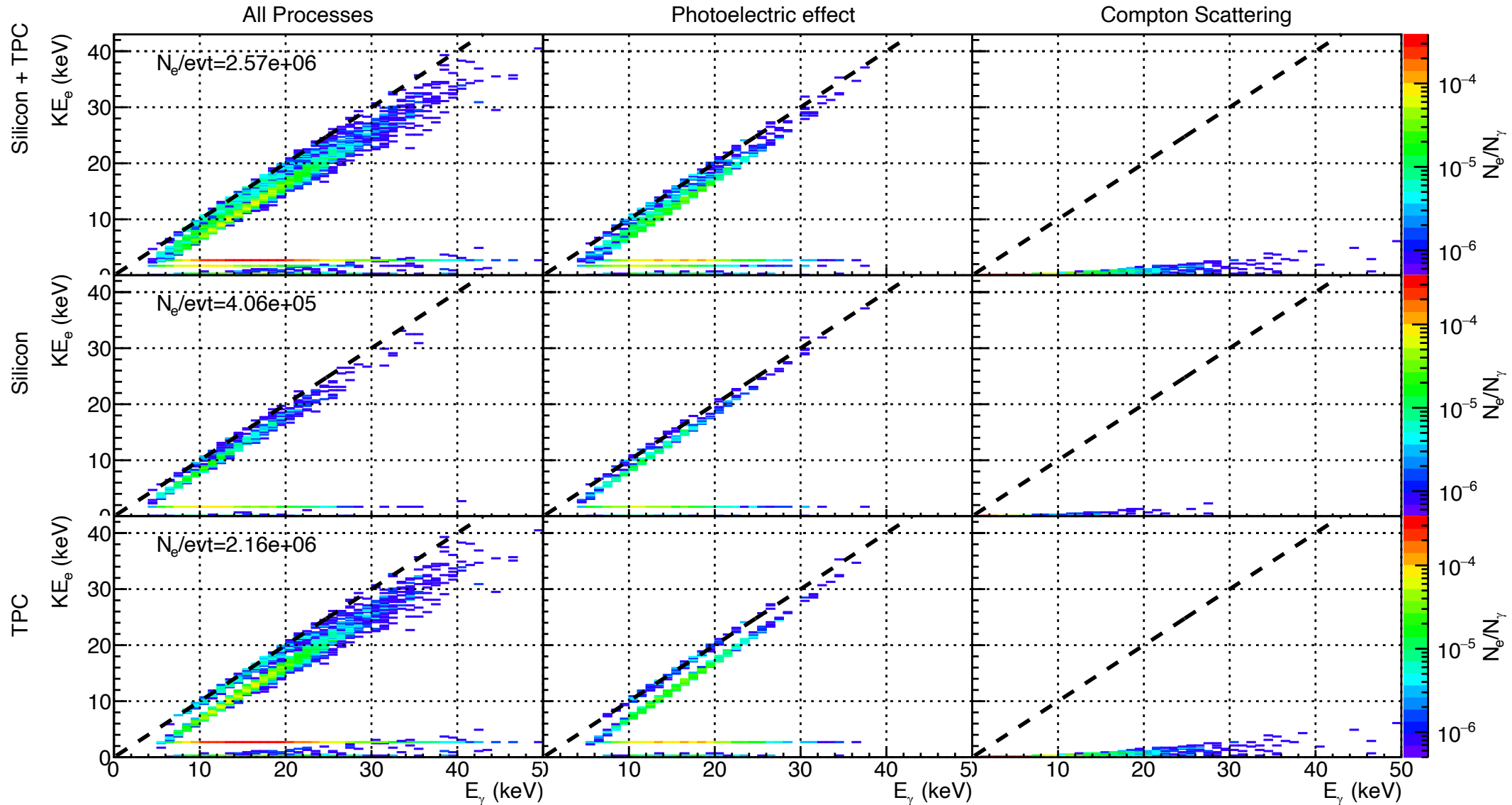
Last Update

Updated beam pipe

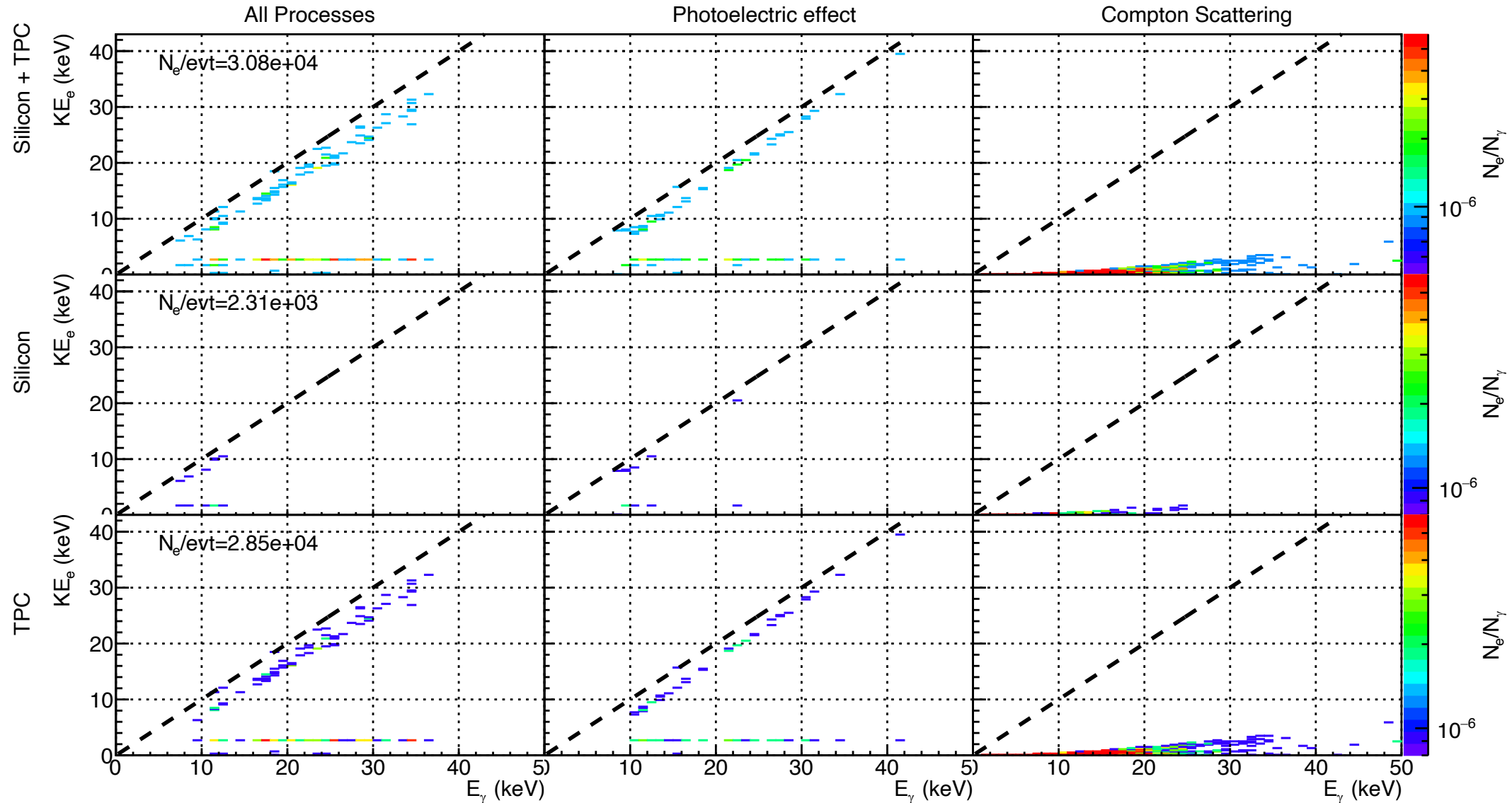


- $r = 3.2 \text{ cm}$ (slightly larger than ePIC's)
- $t_{\text{beryllium}} = 800\mu\text{m}$

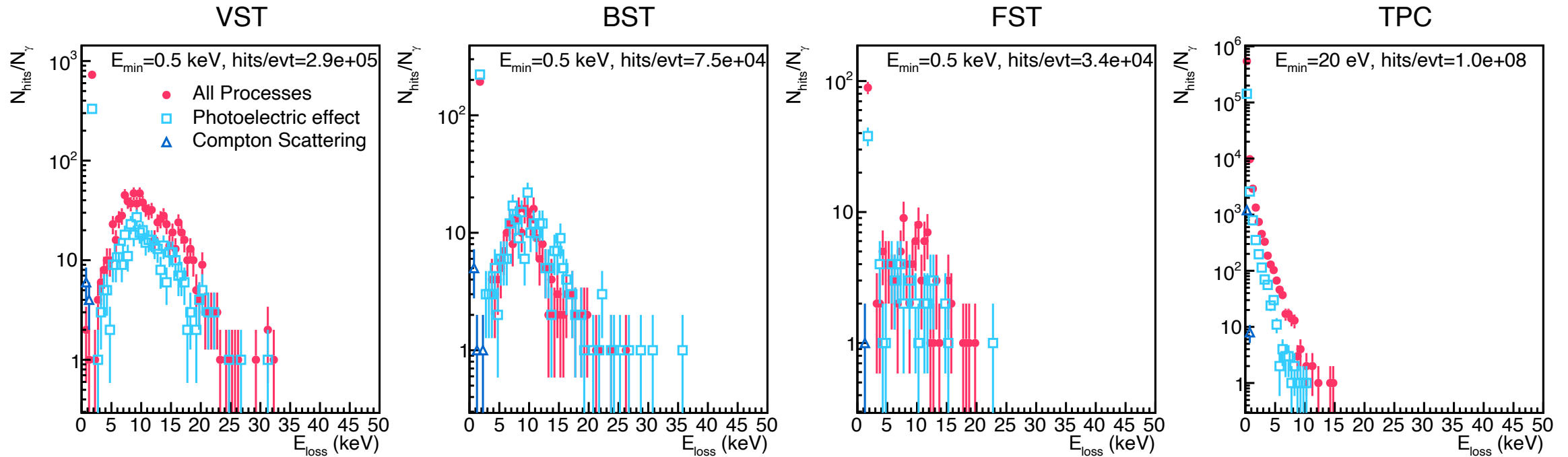
Secondary Electrons K.E. Distribution (w/o Gold Coating)



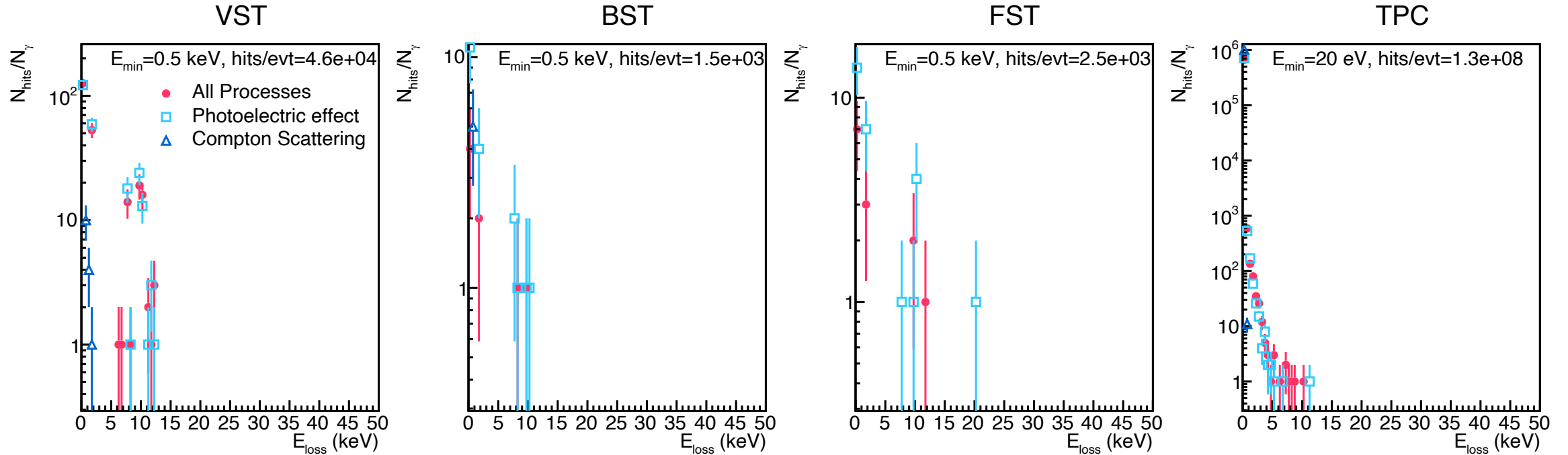
Secondary Electrons K.E. Distribution (w/ Gold Coating)



Secondary Electron Hits (w/o Gold Coating)

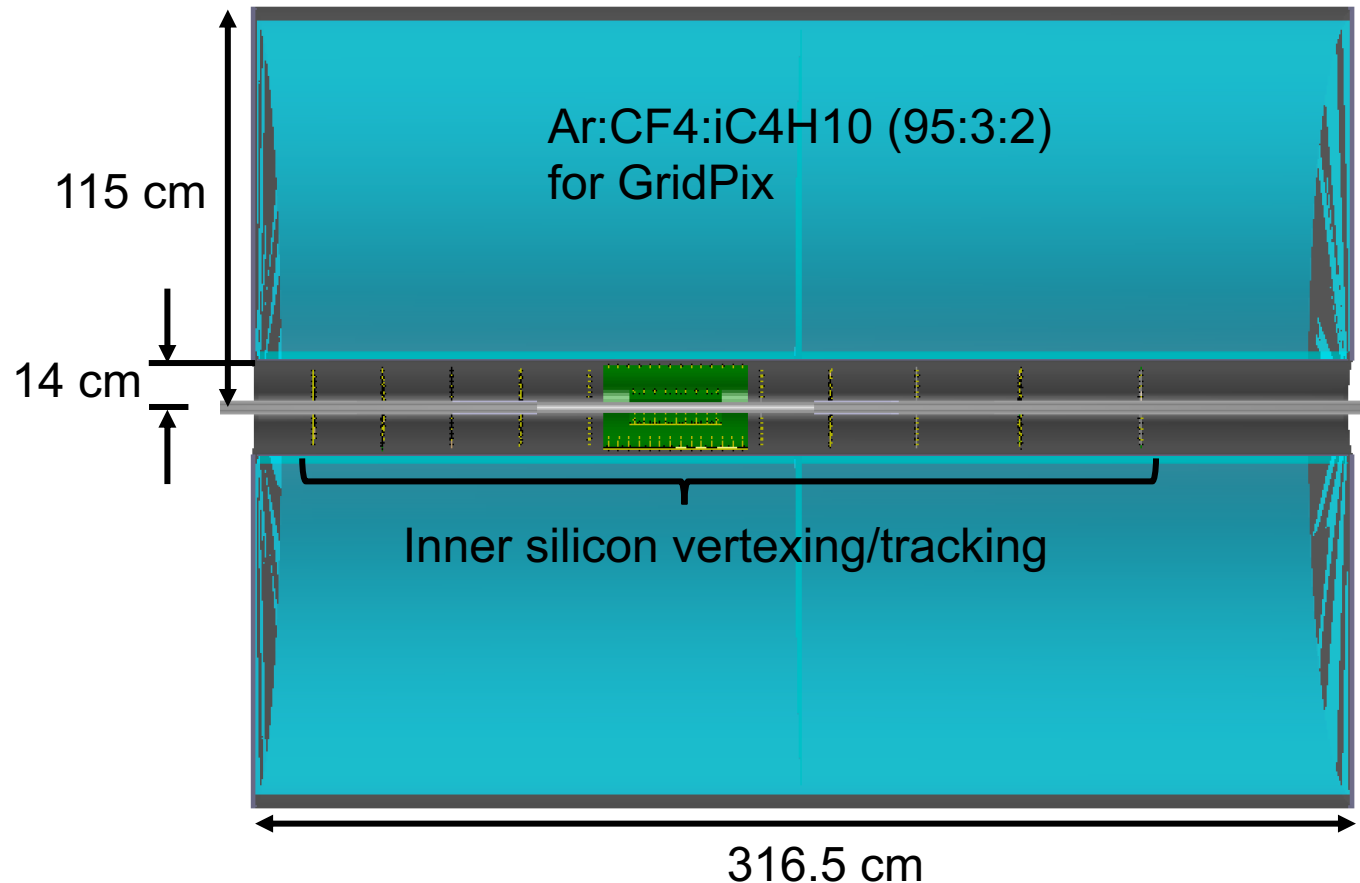


Secondary Electron Hits (w/ Gold Coating)



TPC Dimension

Initial TPC Dimensions



TPC

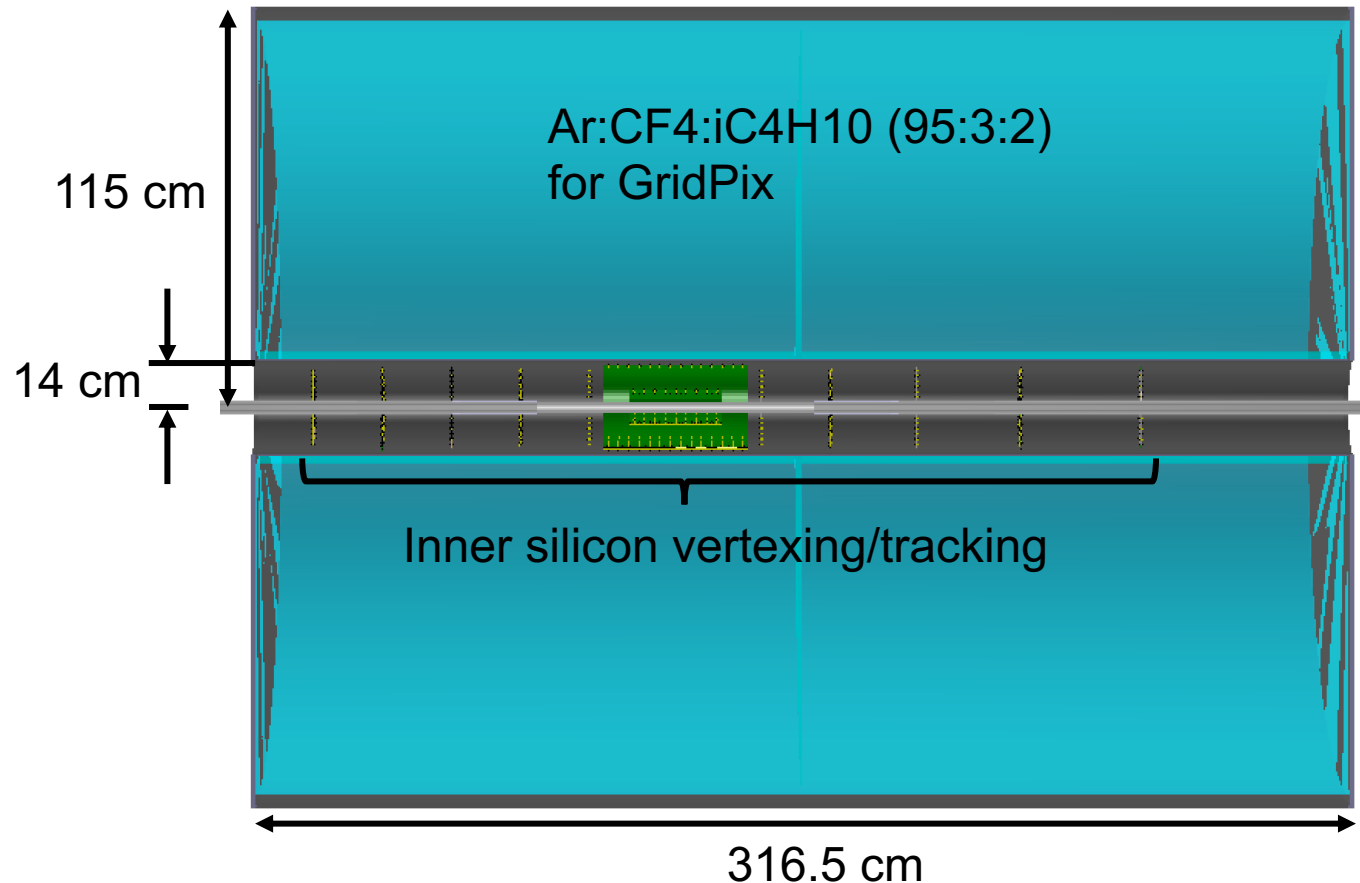
- Gas: Ar:CF₄:iC₄H₁₀ (95:3:2)
- Field cage
 - carbon fiber
 - inner cage t=2.62mm
 - outer cage t=9.28mm
 - Kapton t=150um
 - Aluminum t =50um
- Central membrane: Kapton t=100um
- Endcaps:
 - aluminum t=13.4mm

Magnetic field

Constant 2T, solenoid

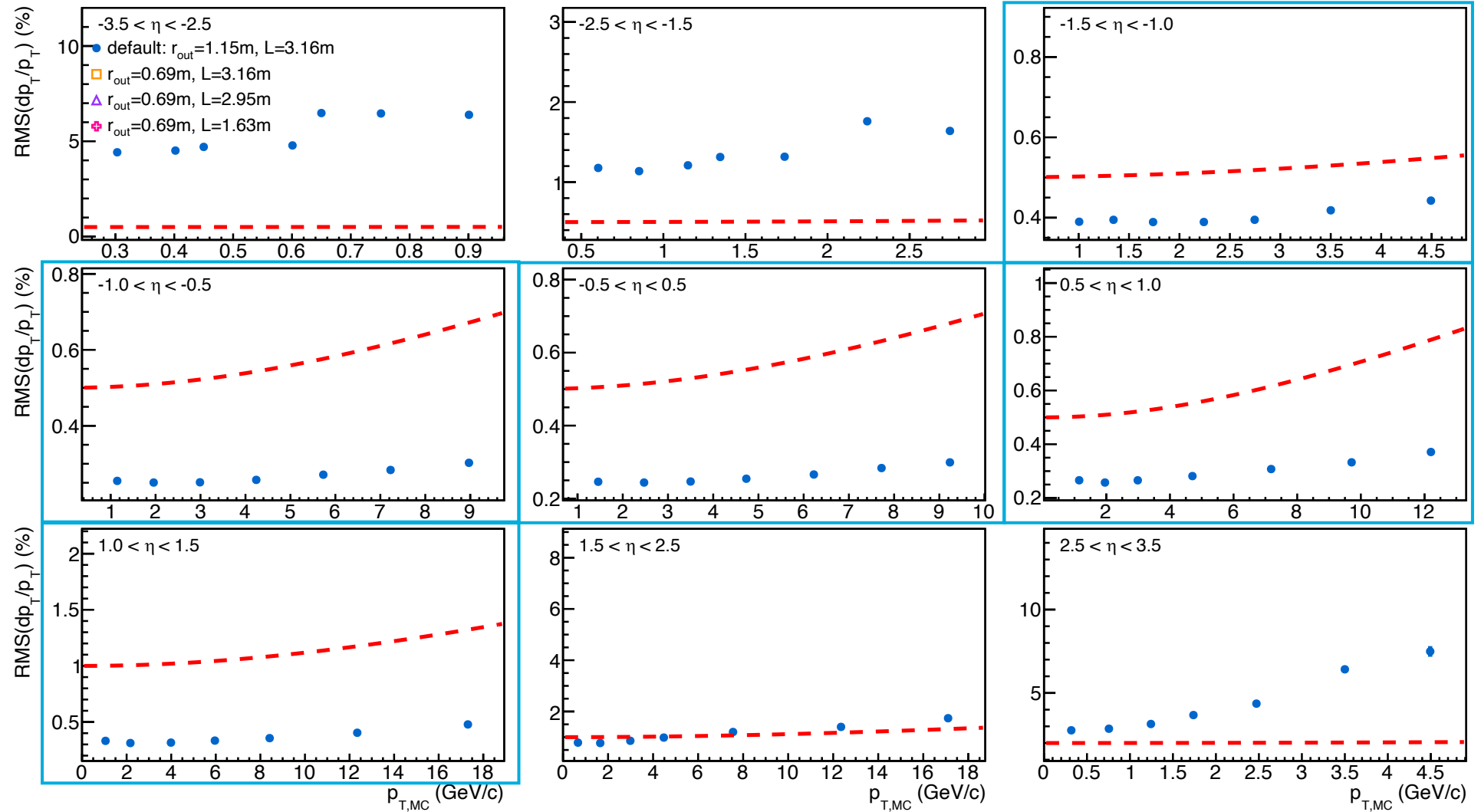
Transverse dispersion	$8.94 / \left(\frac{2}{1.4} \right) = 6.258 \text{ um}/\sqrt{\text{cm}}$ Assuming same gas as sPHENIX
Longitudinal dispersion	$1 \text{ um}/\sqrt{\text{cm}}$
Transverse intrinsic resolution	55 um
Longitudinal intrinsic resolution	1 um
Radial intrinsic resolution	0 um
Vertical Pad Size	1 cm

Modification on TPC Dimensions



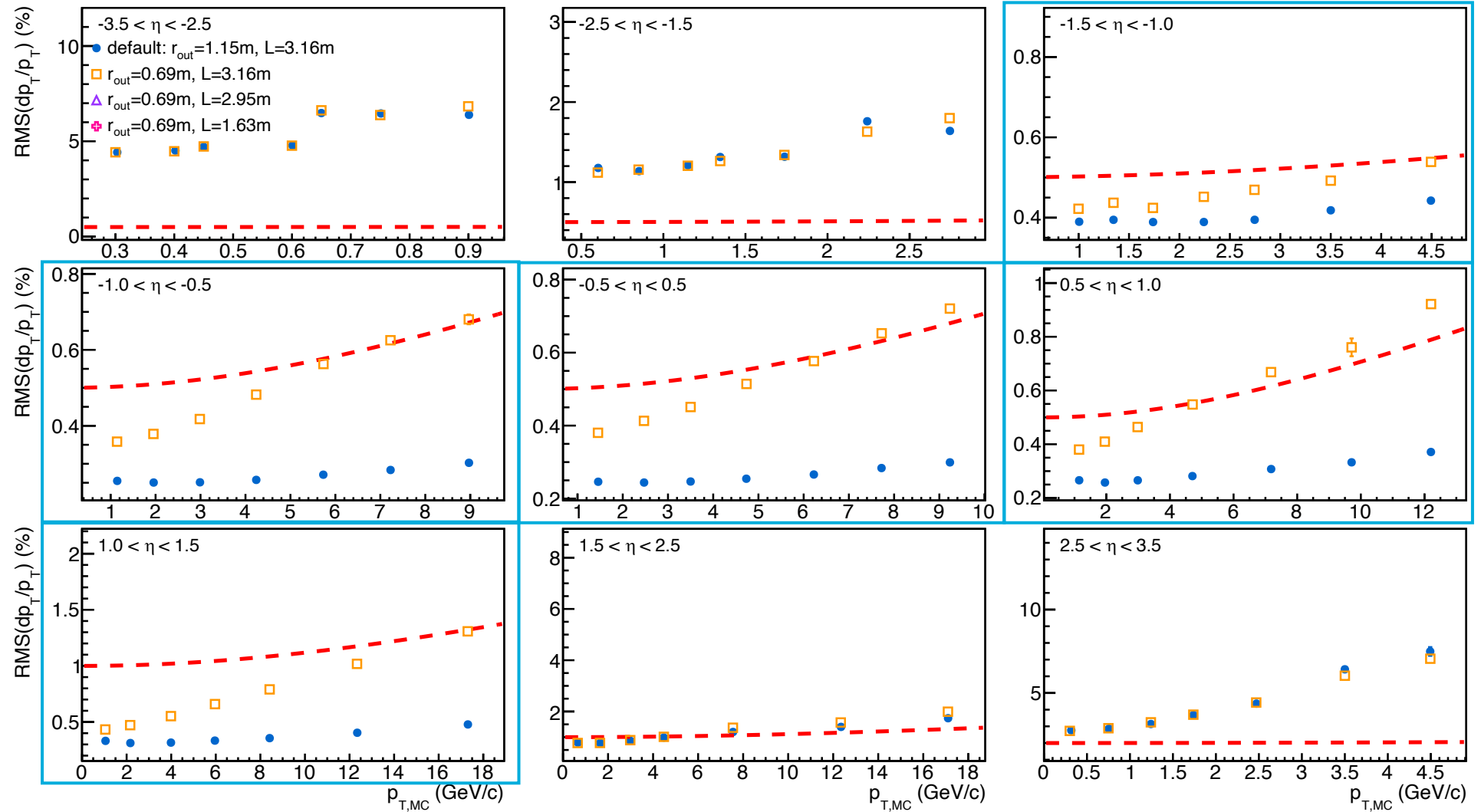
- Reduced the **outer radius** from 1.15m to **0.69m**
→ Worsen p_T resolution in mid rapidity
- Reduced the **full length** from 3.16m to **2.95m**, and centered the TPC at $z=0$ m
→ Limit acceptance to $\eta = \pm 1.5$
→ Worsen forward/backward p_T resolution
- Reduced the **full length** from 3.16m to **1.63m**, and centered the TPC at $z=0$ m
→ Limit acceptance to $\eta = \pm 1$
→ Worsen forward/backward p_T resolution

Transverse Momentum Resolutions



Transverse Momentum Resolutions

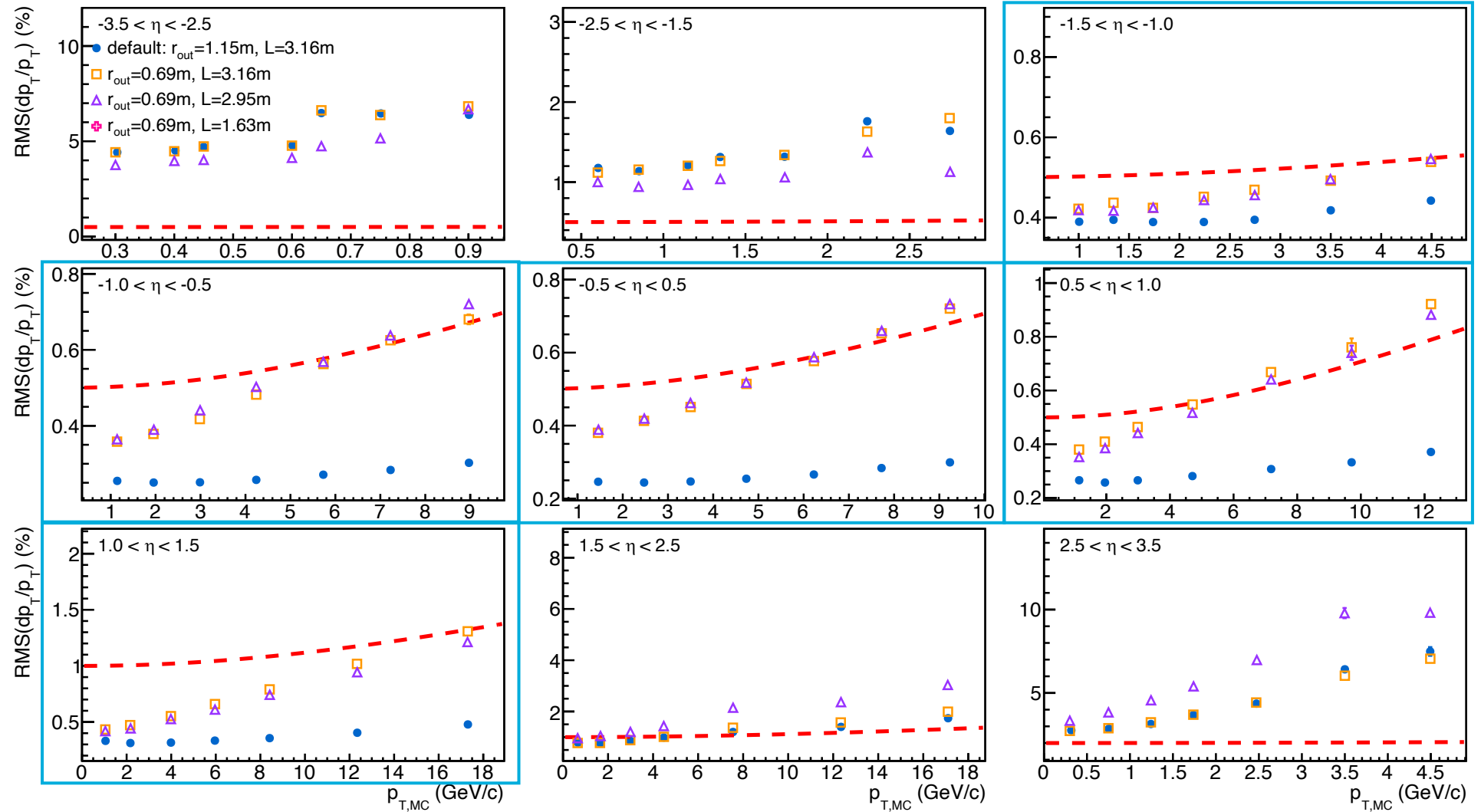
$$r_{out} = 1.15 \rightarrow 0.69 \text{ m}$$



Transverse Momentum Resolutions

$$r_{out} = 1.15 \rightarrow 0.69 \text{ m}$$

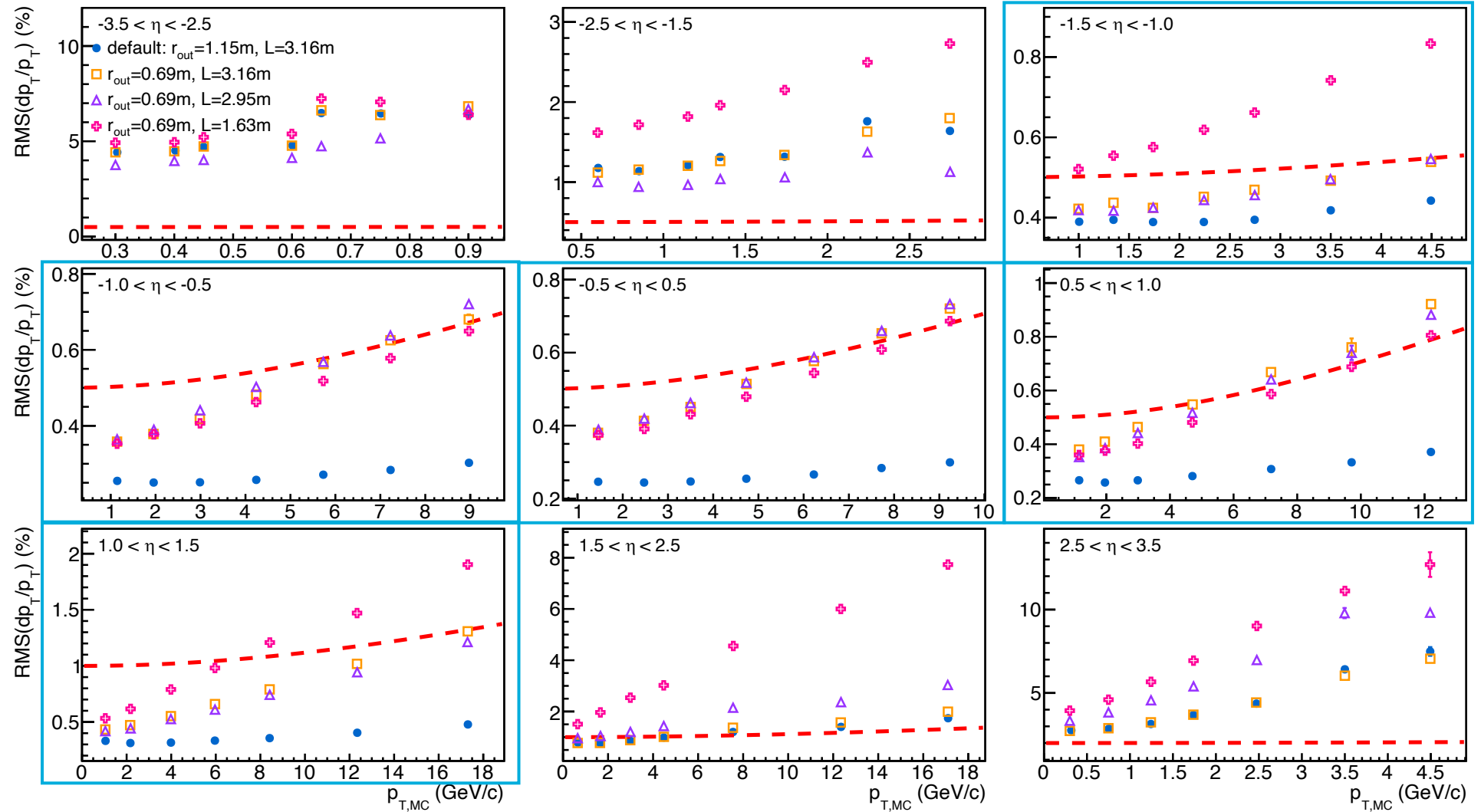
$$L = 3.16 \rightarrow 2.95 \text{ m}$$



Transverse Momentum Resolutions

$$r_{out} = 1.15 \rightarrow 0.69 \text{ m}$$

$$L = 3.16 \rightarrow 1.63 \text{ m}$$



Summary

- Added a gold coating (thickness=5 μm) on the inner surface of the beam pipe
 - $\sim 130\text{M}$ electron hits per event in the TPC
- What is the smallest TPC that can satisfy the YR requirements on p_T resolution?
 - For $r_{\text{in}}=14$ cm, minimum r_{out} is about 70cm
 - For tracking acceptance between $\eta = \pm 1.5$, $L=2.95$ m
 - For tracking acceptance between $\eta = \pm 1$, $L=1.65$ m
- To-do: rerun synchrotron radiation simulation with a smaller TPC and with service parts/supporting structure

Back Up

Material Budgets of Detector 2 Tracking

