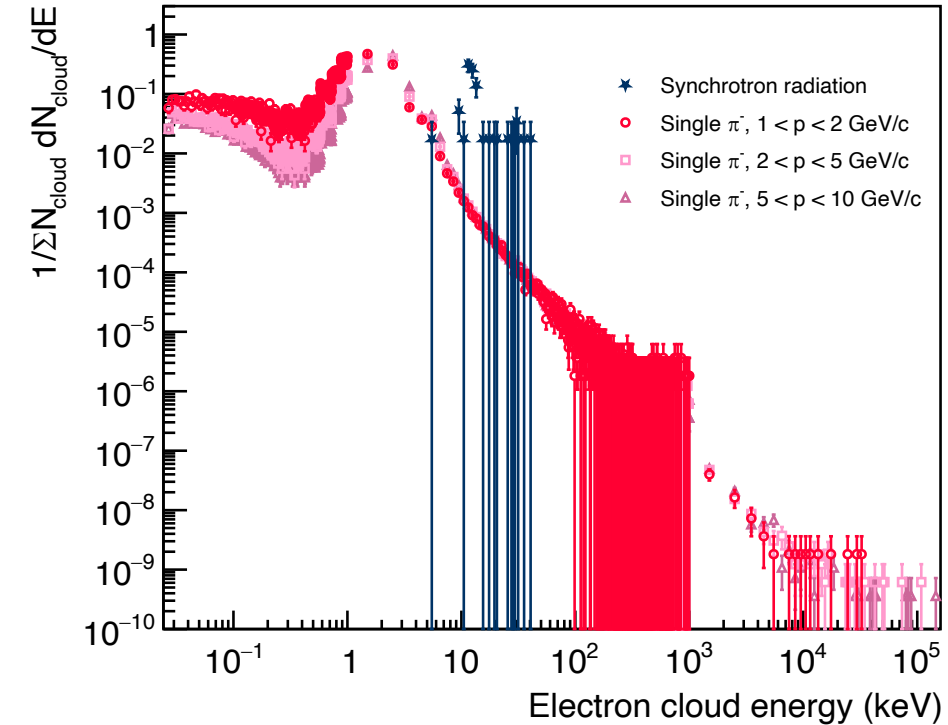
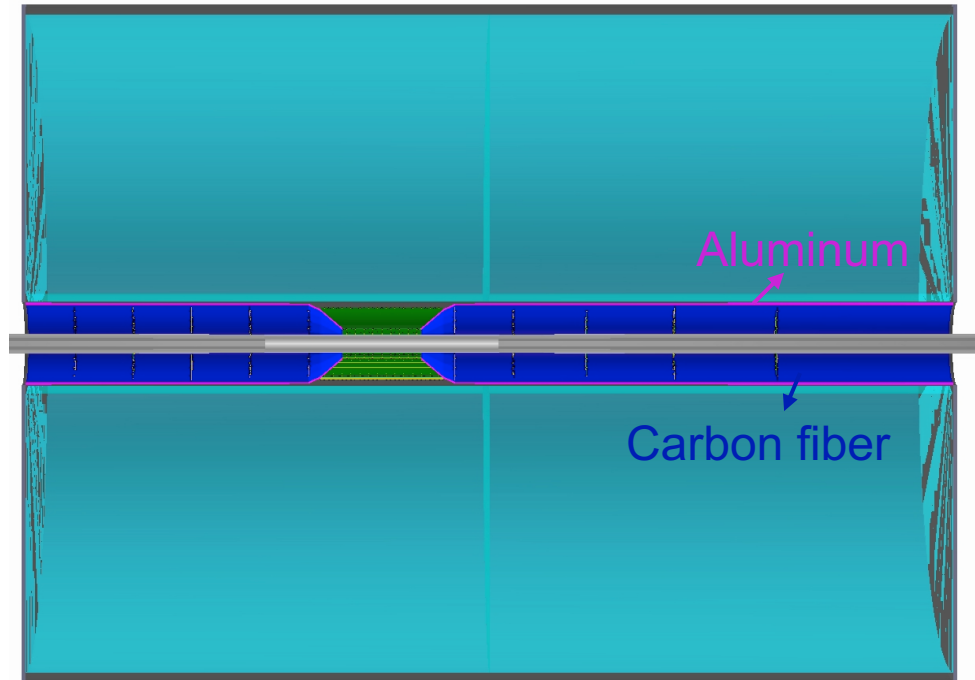


Synchrotron Radiation in EicRoot with a TPC -- Hit Density Study

Cheuk-Ping Wong

04-14-2025

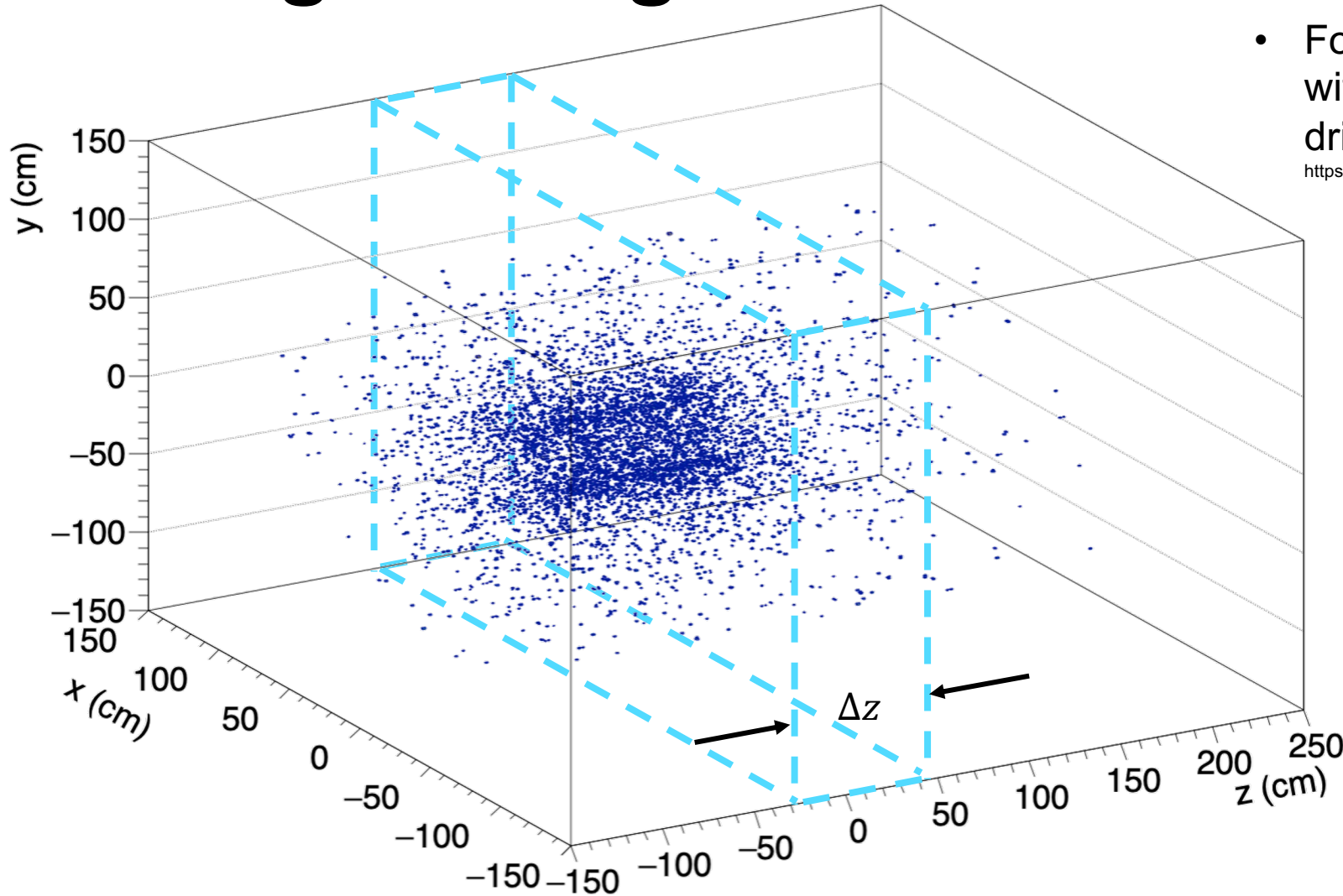
Last Update



- Added service/support of the inner silicon tracker that help reduce SR background by a factor of 10
- SR electron clouds in the TPC could be eliminated by a cloud energy cut, which results to 6-12% removal of single-track hits/clouds

	1-2 GeV/c	2-5 GeV/c	5-10 GeV/c
e-	11.6%	12.0%	12.3%
π^-	5.8%	7.3%	8.8%

Slicing in Longitudinal Direction



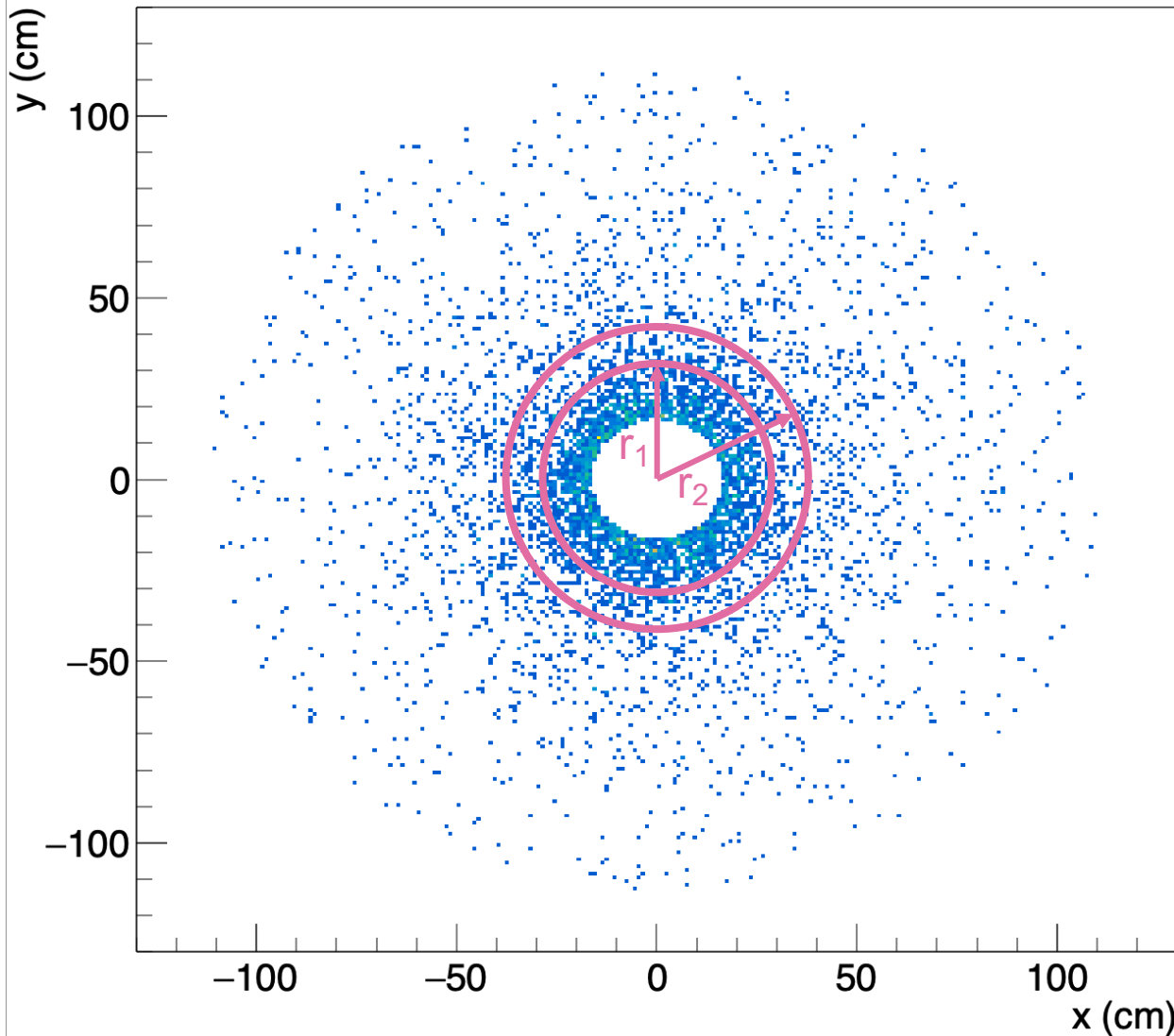
- For an Ar-CF₄-iC₄H₁₀ (95-3-2) mixture, with a drift field (E_d) of 500 V/cm, the drift velocity v_d is about 74.5 $\mu\text{m/ns}$
https://tpc_gas.cfnssbu.physics.sunysb.edu/tpc_gas/HTML_Gases_Argon/split_data.html

- The drift distance Δz is written as $\Delta z = v_d \times \Delta t$

Δt	Δz
5 μs Silicon integration window	37.25 cm
10.2ns Branch crossing	0.76mm
12 μs Event rate	89.4cm

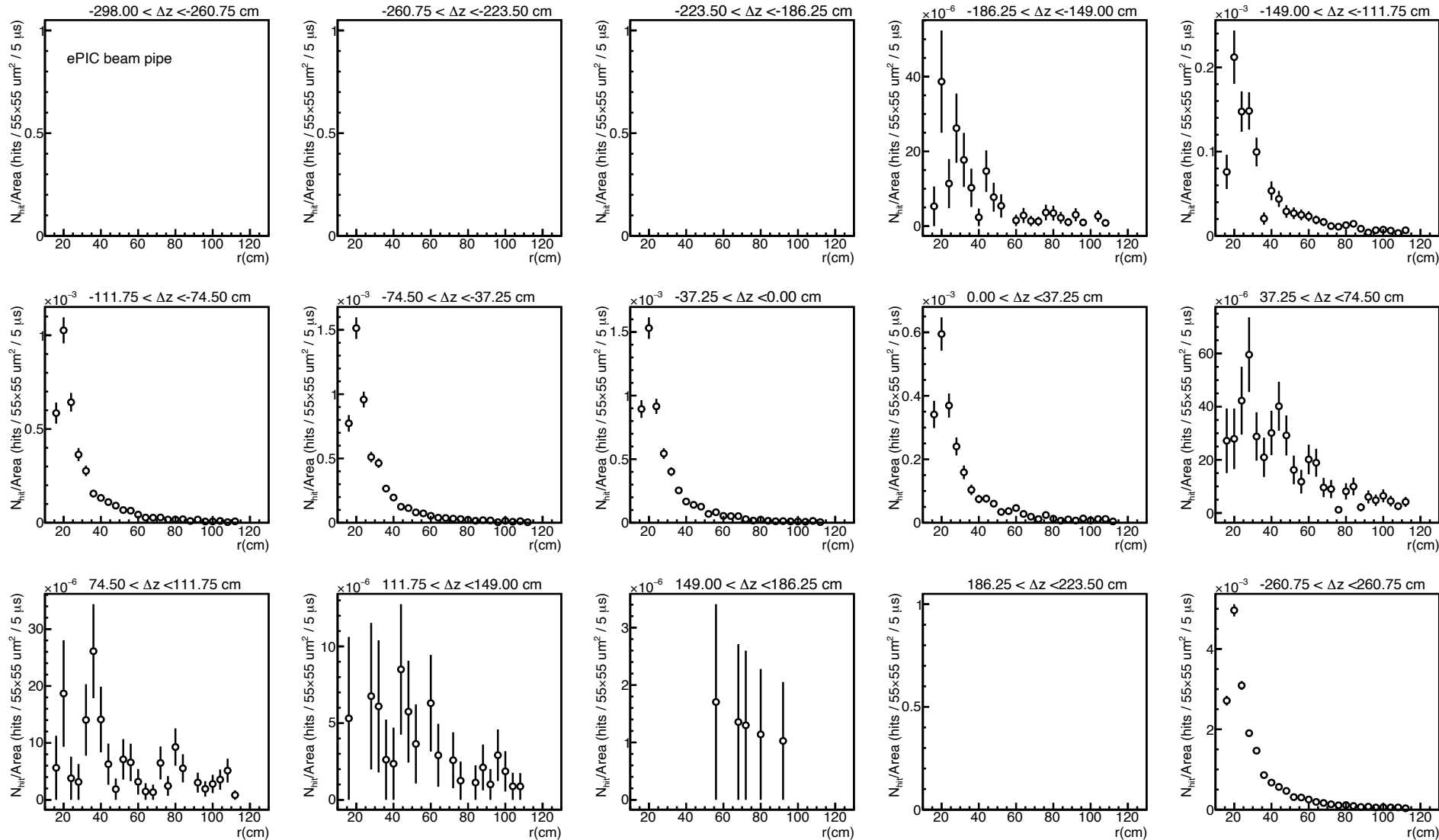
- Calculate hit density per Gridpix pixel with a pixel size of $55 \times 55 \mu\text{m}^2$

Hit Density Calculation



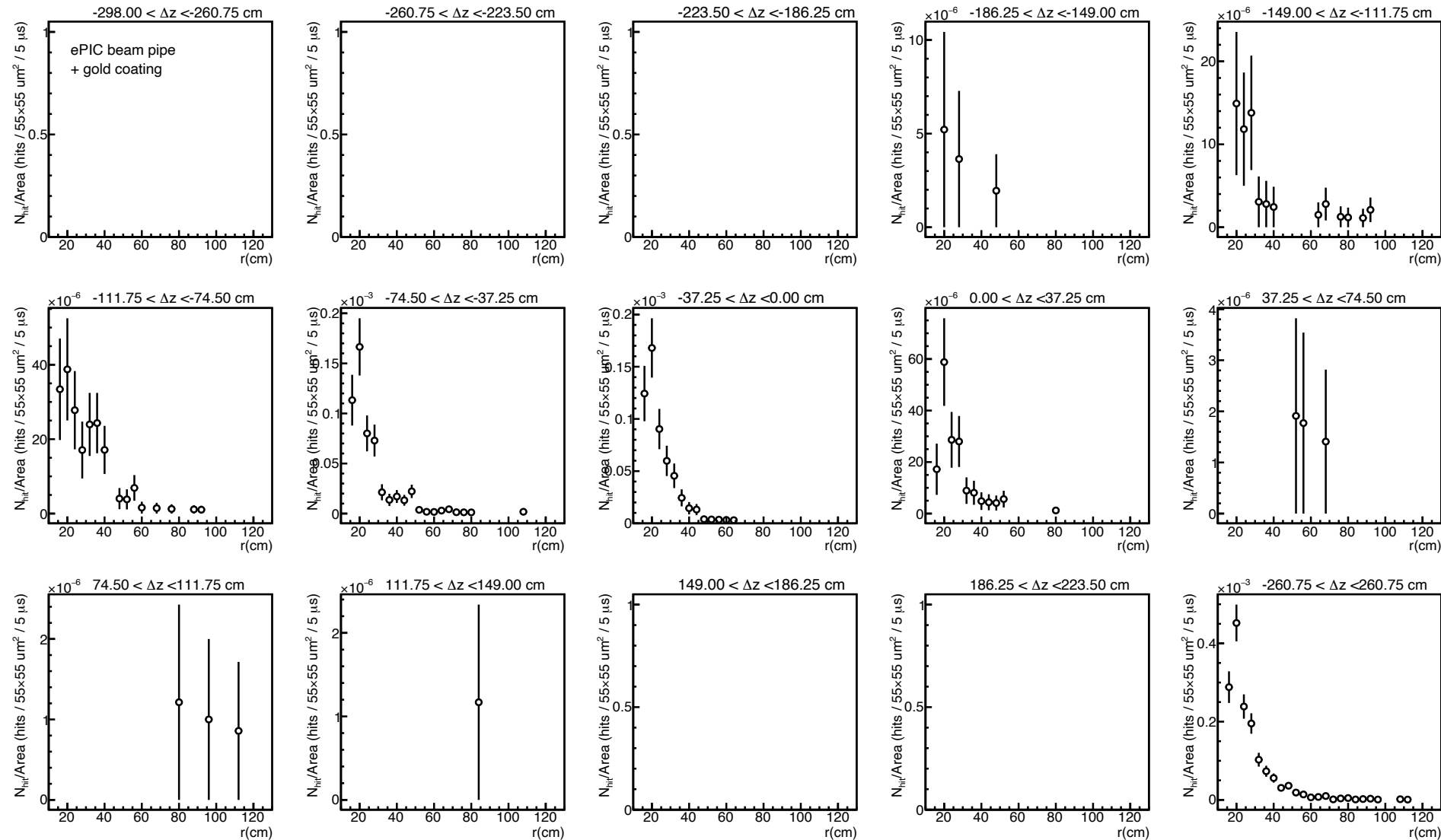
- $A = \pi(r_2^2 - r_1^2)$
- $hit\ density = N_{hit}/A$
- The hit density is scaled to be hits / $55 \times 55\ \mu m^2$ / 5us
- No hit/cloud energy selection

Hit Density (ePIC Beam Pipe)

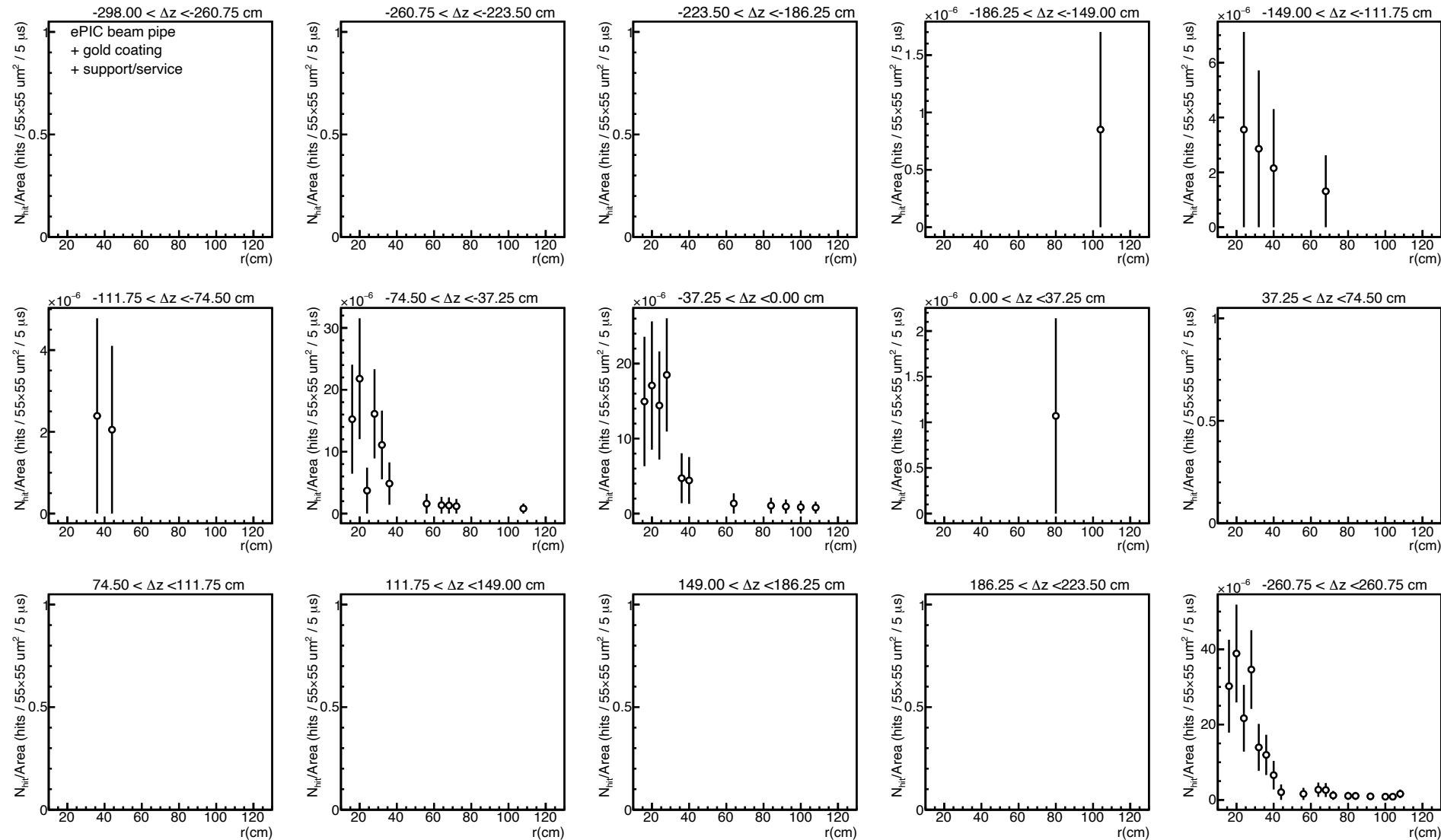


$$t_{window} = 5 \mu\text{s}$$

Hit Density (ePIC Beam Pipe+Gold Coating)

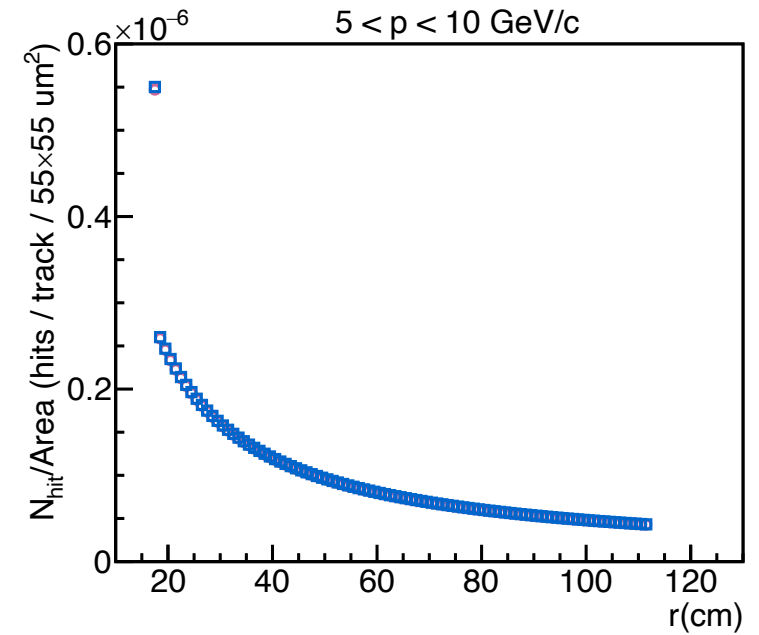
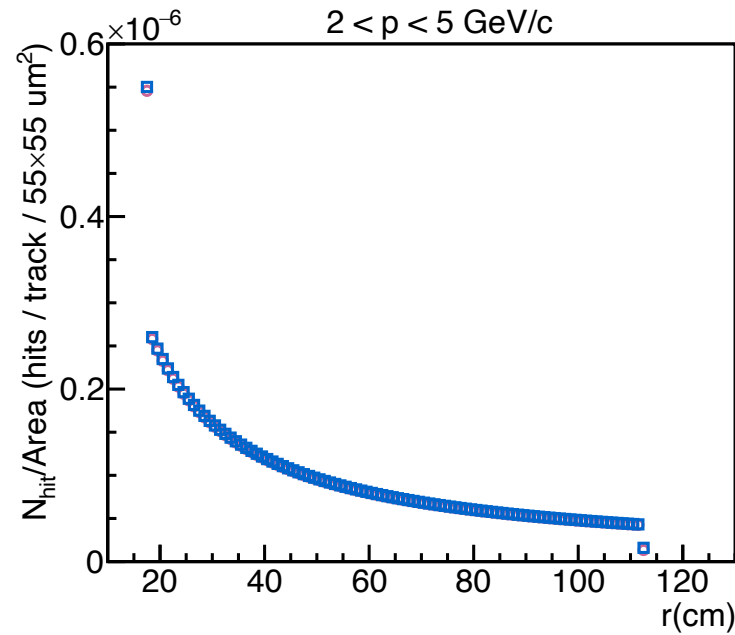
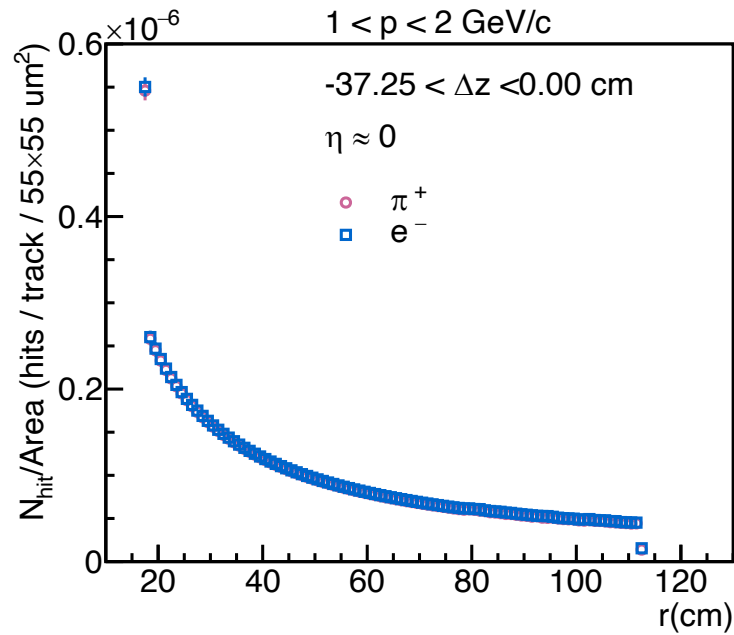


Hit Density (ePIC Pipe+Gold Coating+Service)

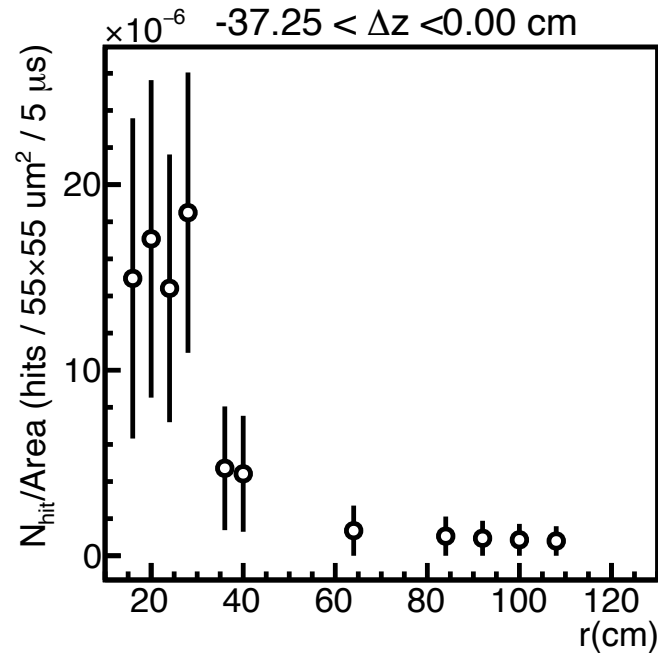
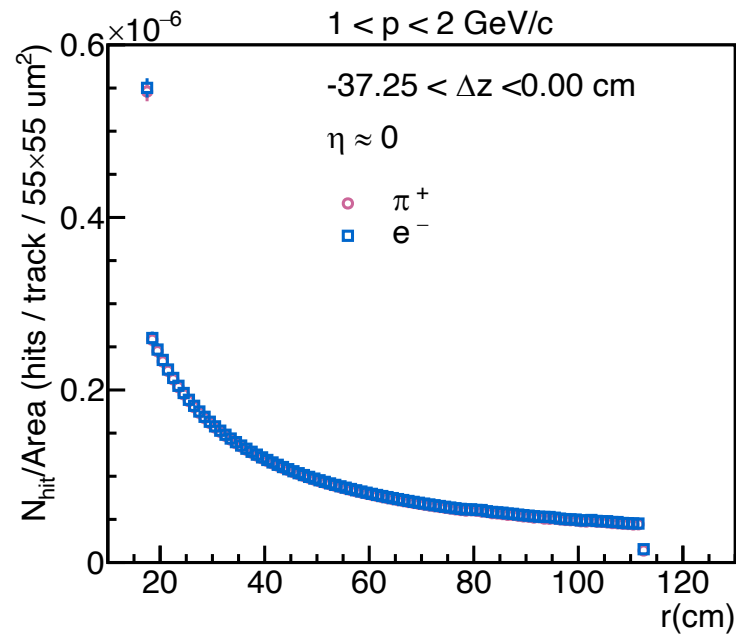


Hits are concentrated in the backward direction

Single-Track Hit Density



Single-Track Hit Density



The hit density of SR is 25 times higher than the single track at small r

Summary

- Hits of SR are concentrated in the backward direction
- Hit density of SR background is max at about 20×10^{-6} hit per $55 \times 55 \text{ } \mu\text{m}^2$ per 5 us at $Z \sim 0 \text{ cm}$ and $r \sim 20 \text{ cm}$
- Hit density of a single track is max at about 0.55×10^{-6} hit per $55 \times 55 \text{ } \mu\text{m}^2$ at $Z \sim 0 \text{ cm}$ and $r \sim 20 \text{ cm}$