Discussion on Rate and µTPC

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July 2nd , 2026 – ECT Meeting

Rate

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The Issue at Hand: Concerning Rates on ECT Forward

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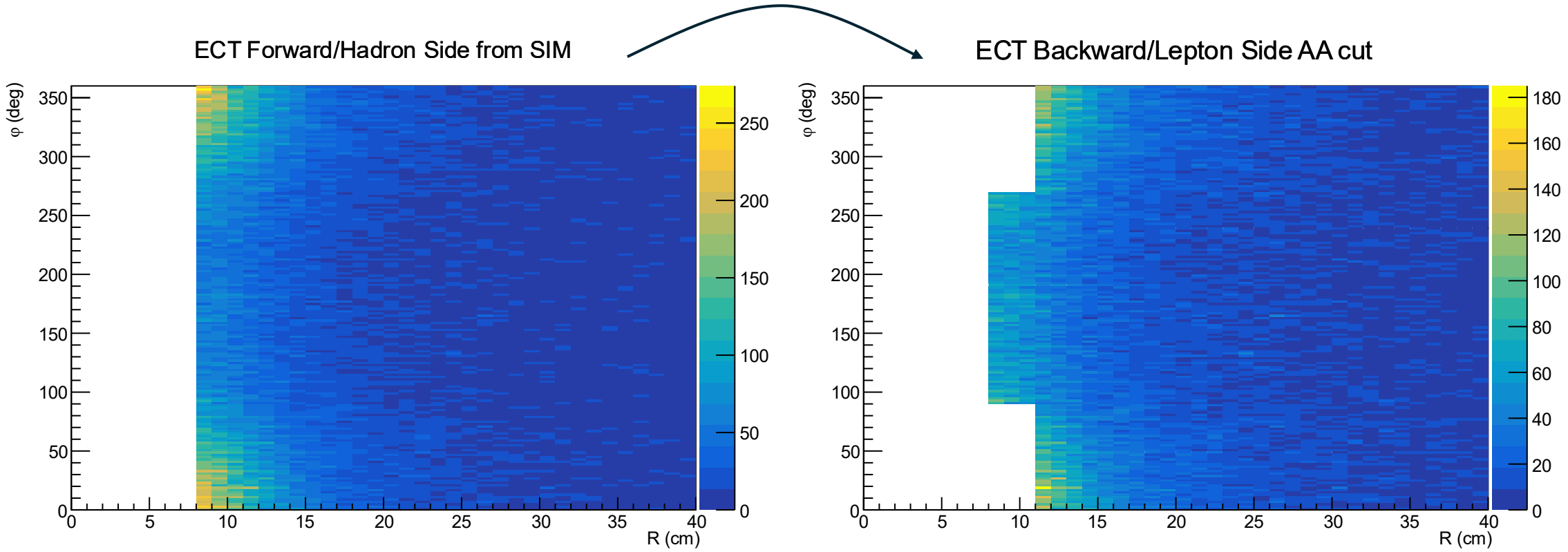
ECT Forward AA cuts



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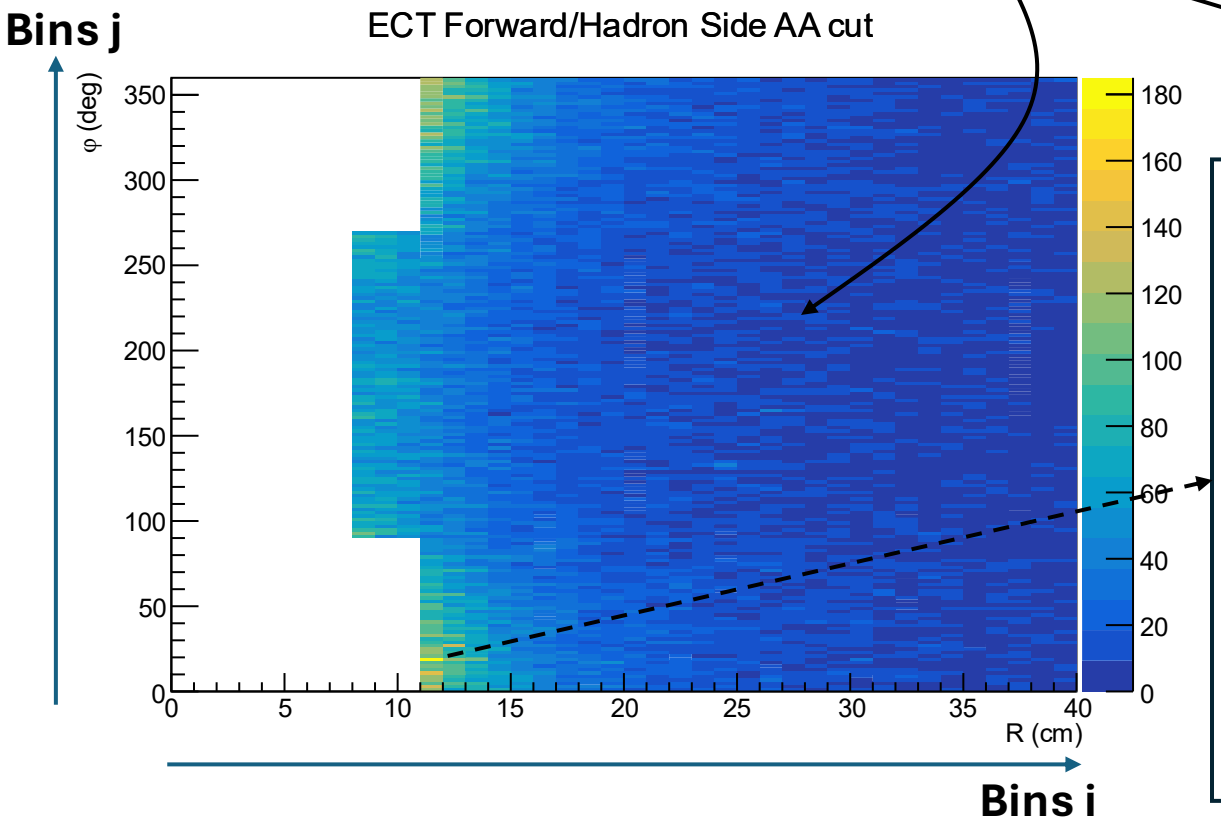
Hottest Channel Calculation

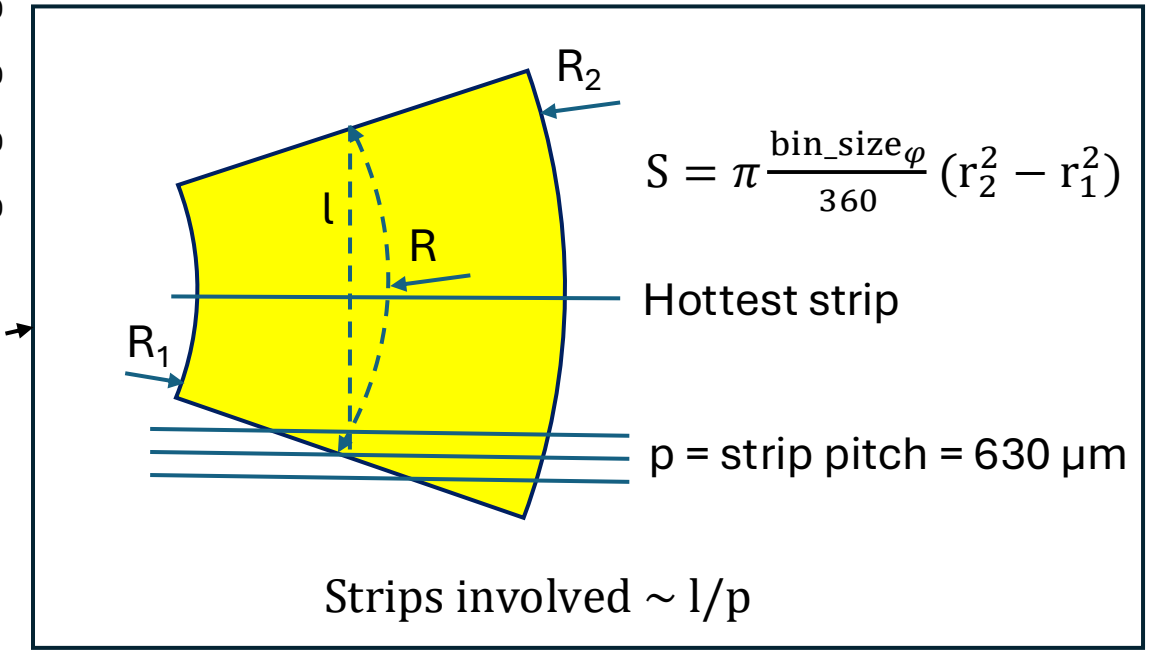
Total events = N = 6000
Event duration = t = 2 μs

Aggregated data for both disks

$$\text{Hotest Bin Rate} = \frac{1}{2}\frac{\text{BinContent(Hottest\_Bin)}}{\text{N S t}}$$

$$\text{Hotest Channel Rate} = \frac{1}{2}\sum_{i}\frac{\text{BinContent(i)}}{\text{N t}}\frac{\text{p}}{\text{l}}$$





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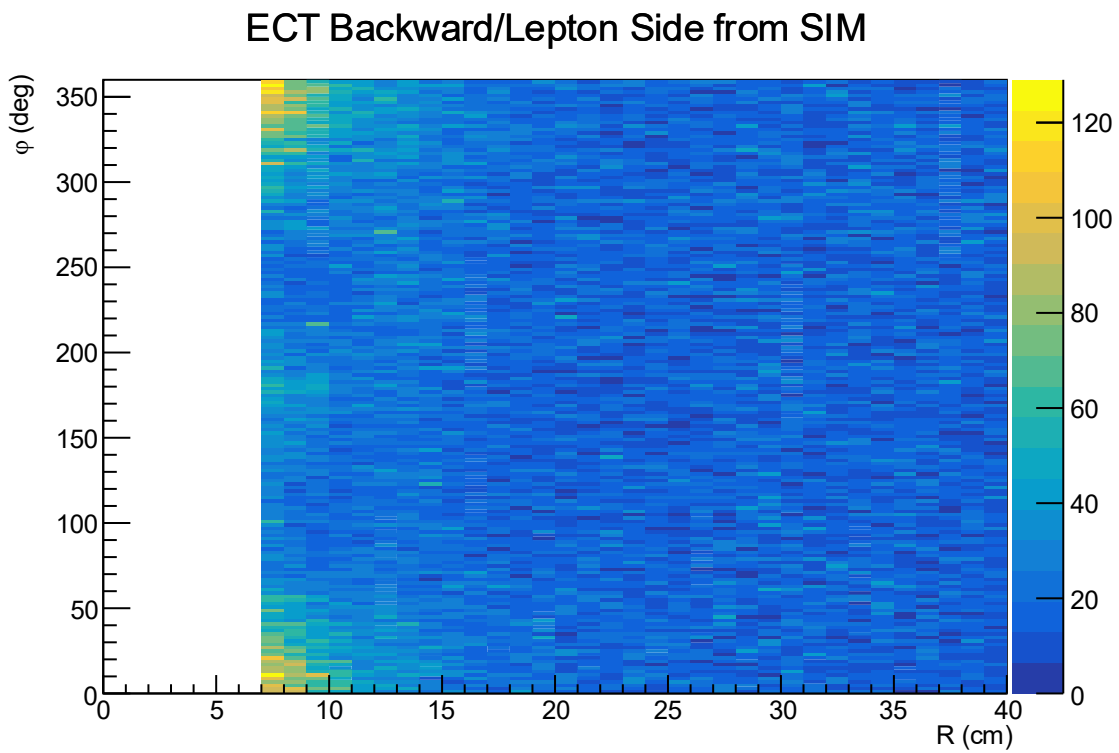
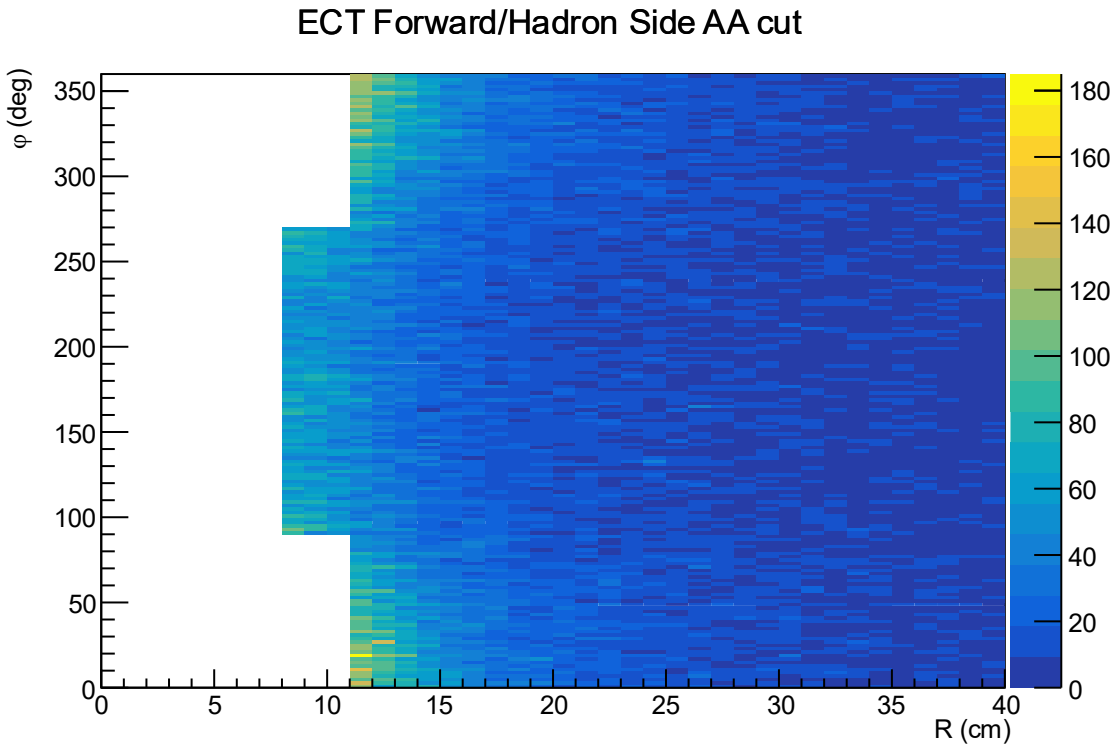
Rate Summary

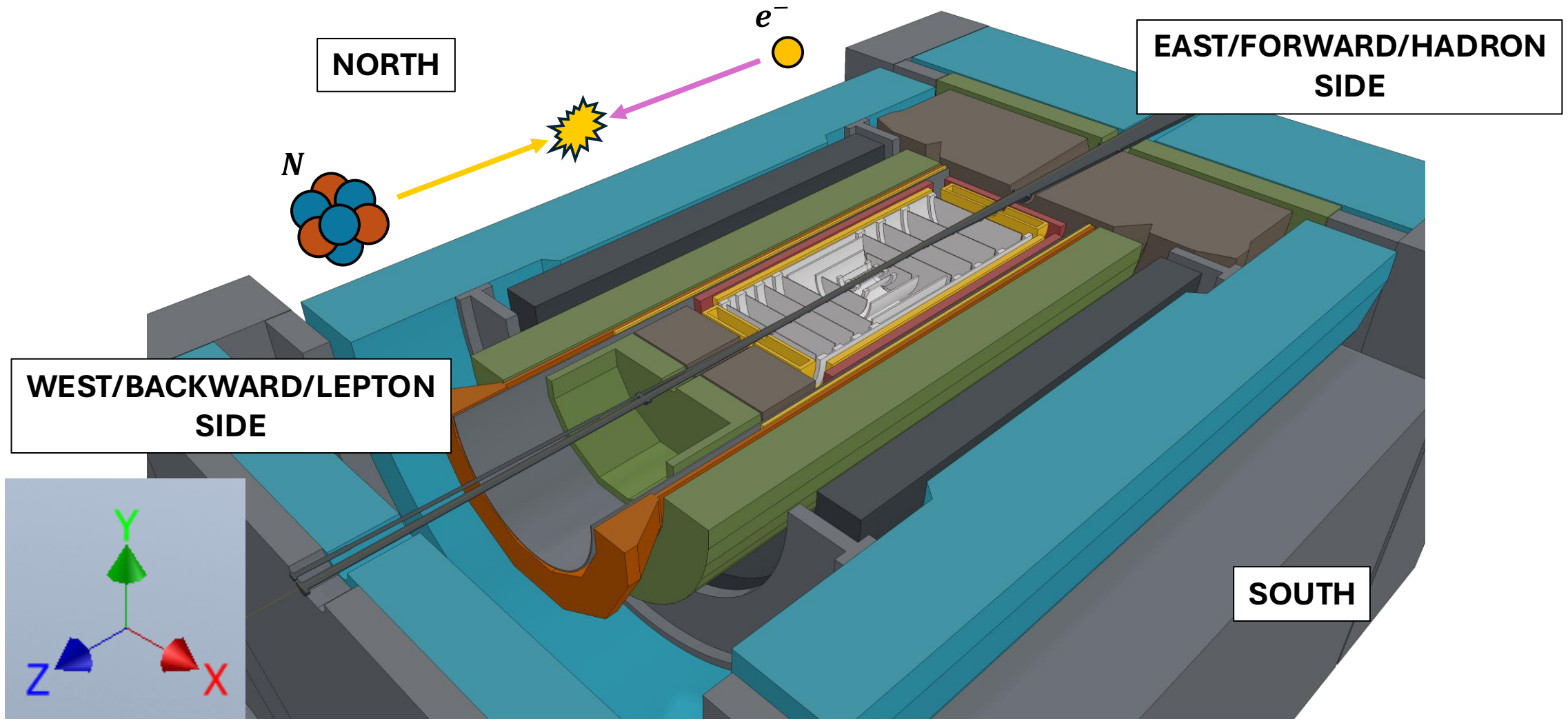




	Backward/Lepton	Forward/Hadron	Max SALSA rate
Hottest Bin Rate	20531 Hz/cm^2	19202 Hz/cm^2	
Hottest Channel Rate	5681 Hz	4266 Hz	364 KHz/ 270 KHz

Backup

Determining the Coordinate System



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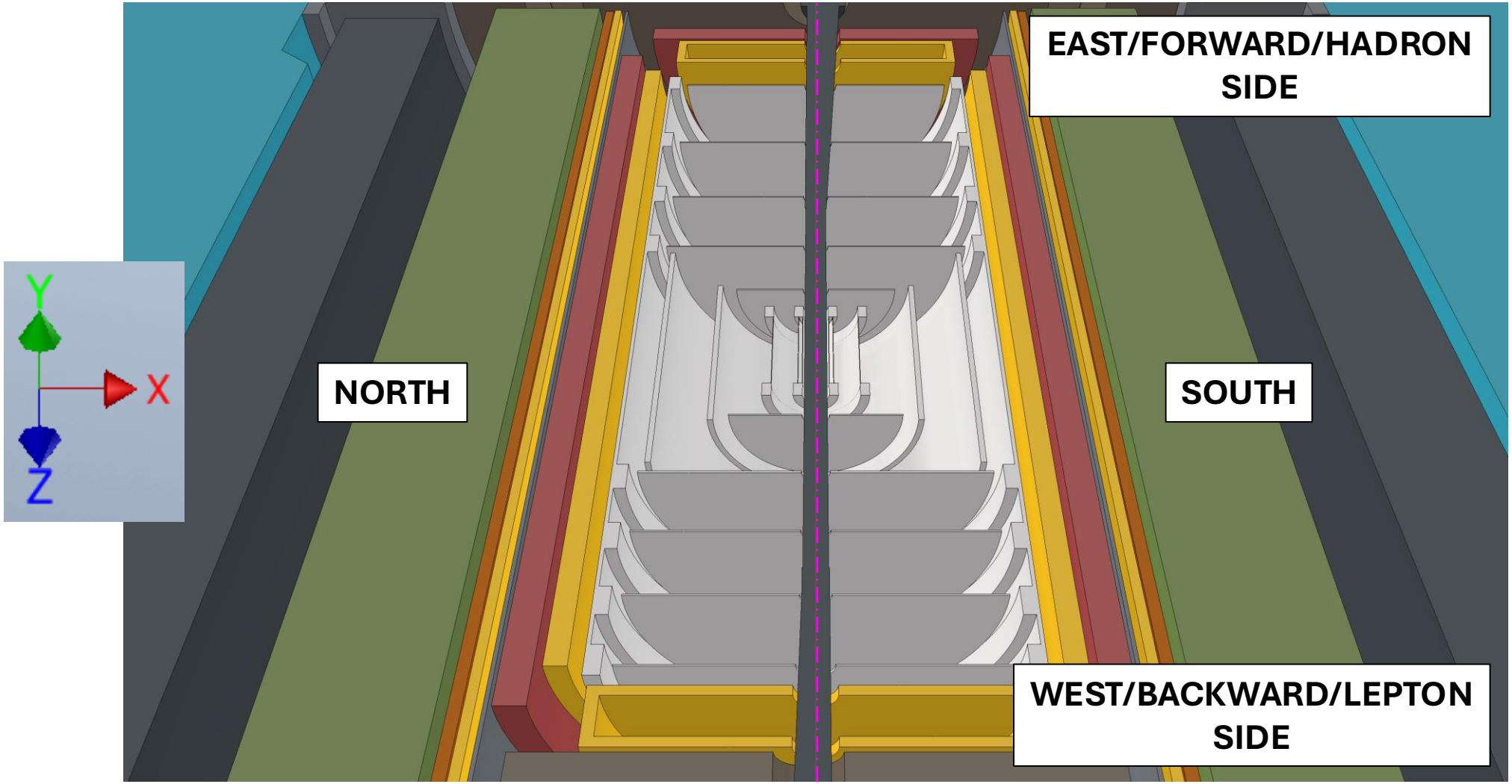
Determining the Coordinate System



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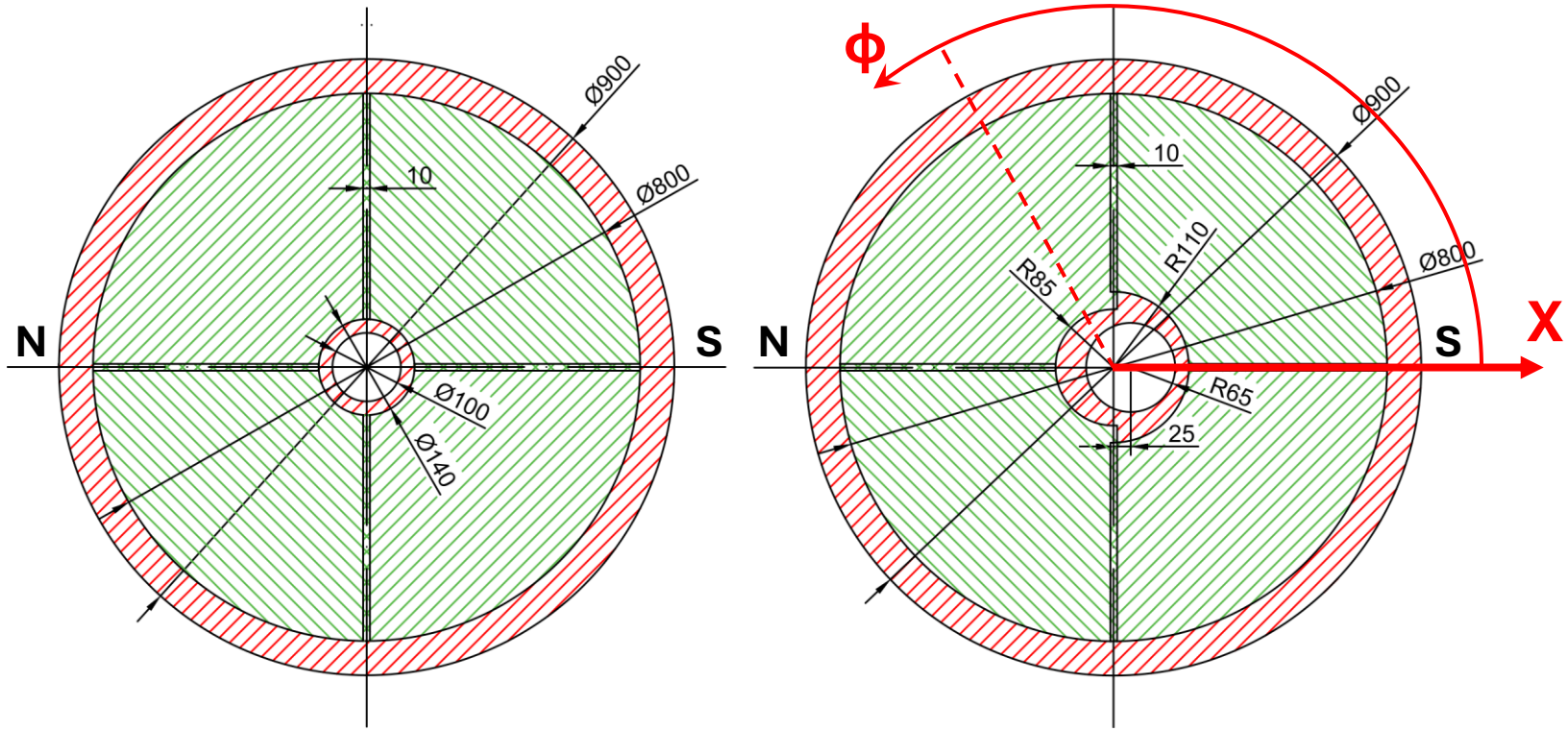
Determining the Coordinate System

WEST/ELECTRON/BACKWARD SIDE

EAST/HADRON/FORWARD SIDE



Rate distribution seems symmetric w.r.t. the horizontal plane → **sense of rotation does not matter**

The orientation of +X does

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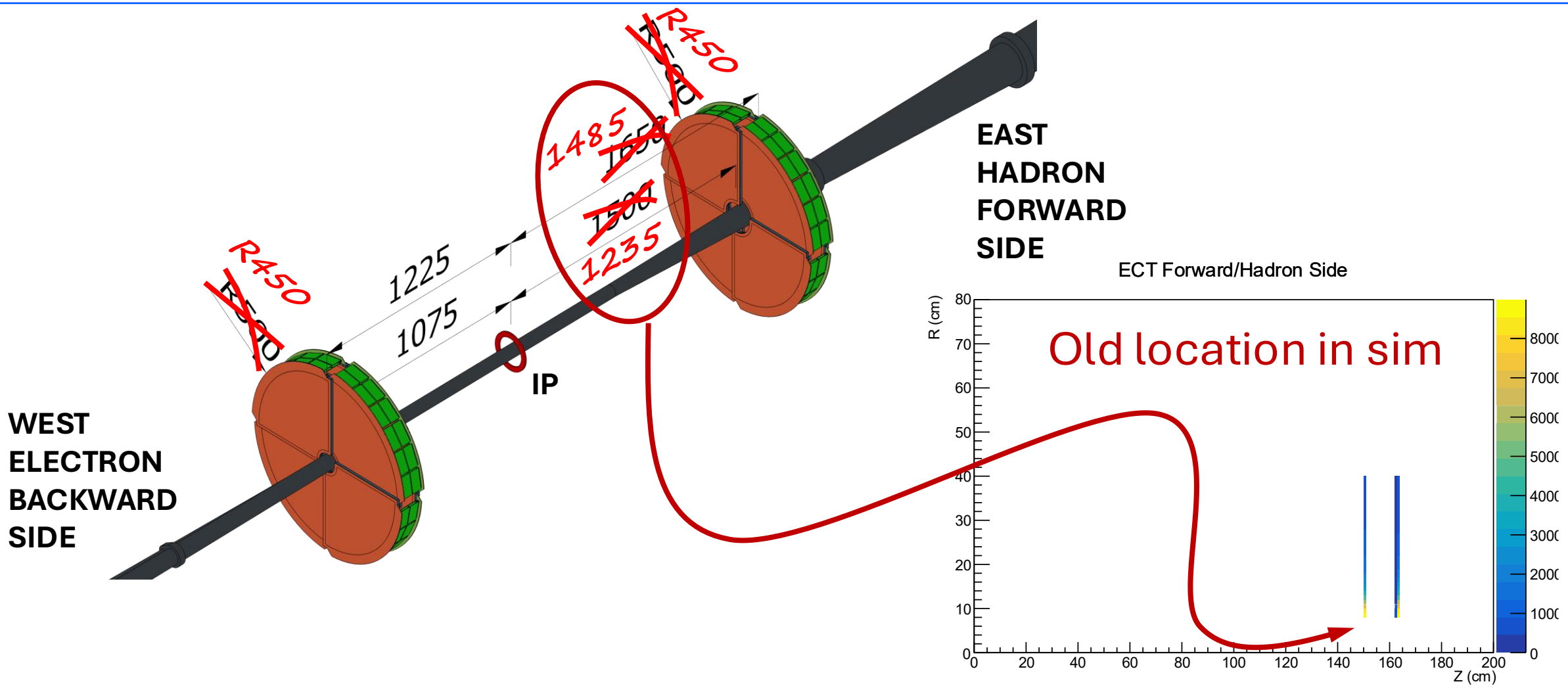
Problem with the Location of the Hadron Disks



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Summary

- The geometry of the ECT in the simulation does not match the latest CAD model
- If the coordinate systems of CAD and simulation match, then the rate distribution's main bump will be cut after the implementation of the latest geometry
- I will work at a new simplified geometrical model to be used in the simulation (AA, overall geometry, materials' table)

µTPC

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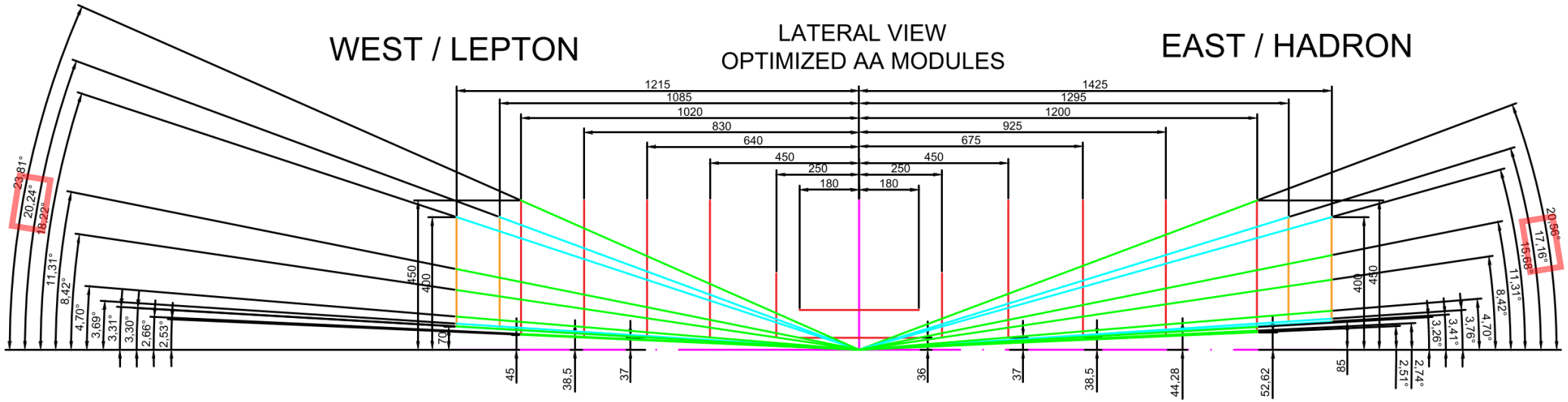
Angles of Incidence for the ECT



Ignoring **B** contribution:

Maximum Angle of Incidence on the Detectors	
West/Backward/Lepton Side	**East/Forward/Hadron Side**
20.24°	**17.16°**

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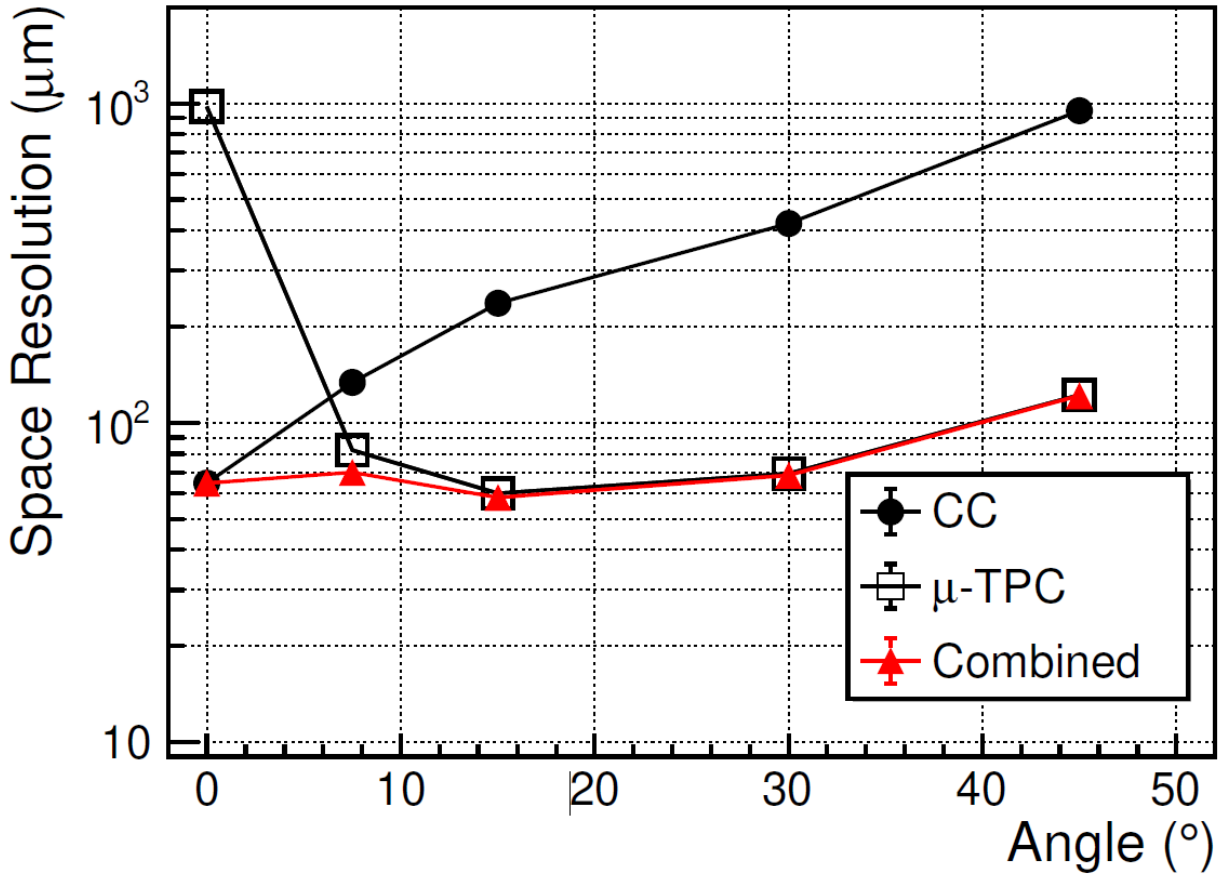
μTPC with μ-RWELL (Ar:CO_2:CF_4)



(a) Comparison of the two algorithms at a drift field E_D=1 kV/cm.

G. Bencivenni *et al* 2021 *JINST* **16** P08036

Parameters	
Technology	μ-RWELL
Gas mixture	Ar:CO_2:CF_4 (45:15:40)
Drift gap	6 mm
R/O segmentation	1D, 400 μm pitch
R/O electronics	APV25-SRS
Particle species	Muons, 150 GeV

$$\frac{1}{\sigma^2_{comb}} = \frac{1}{\sigma^2_{cc}} + \frac{1}{\sigma^2_{\mu TPC}}$$

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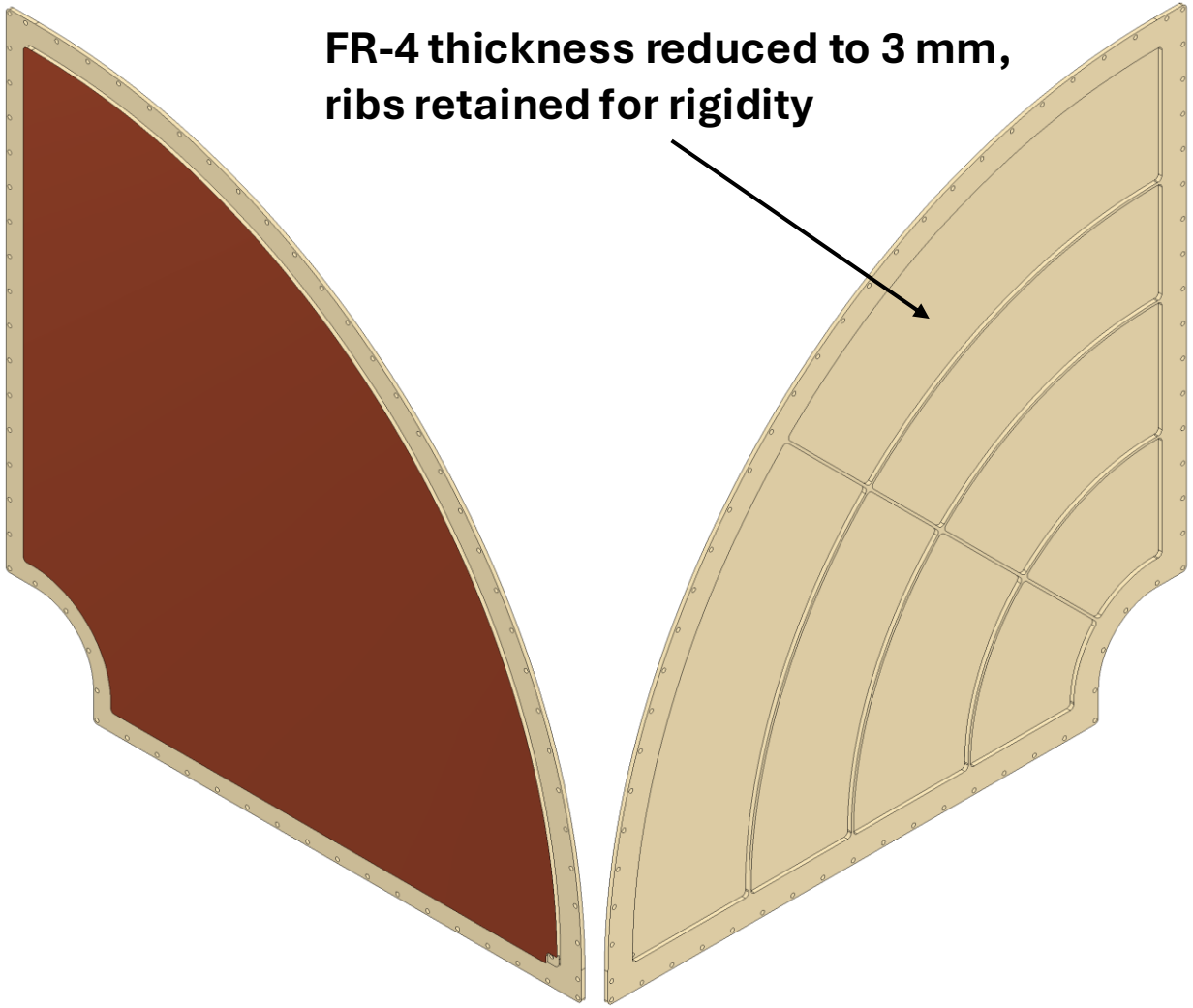
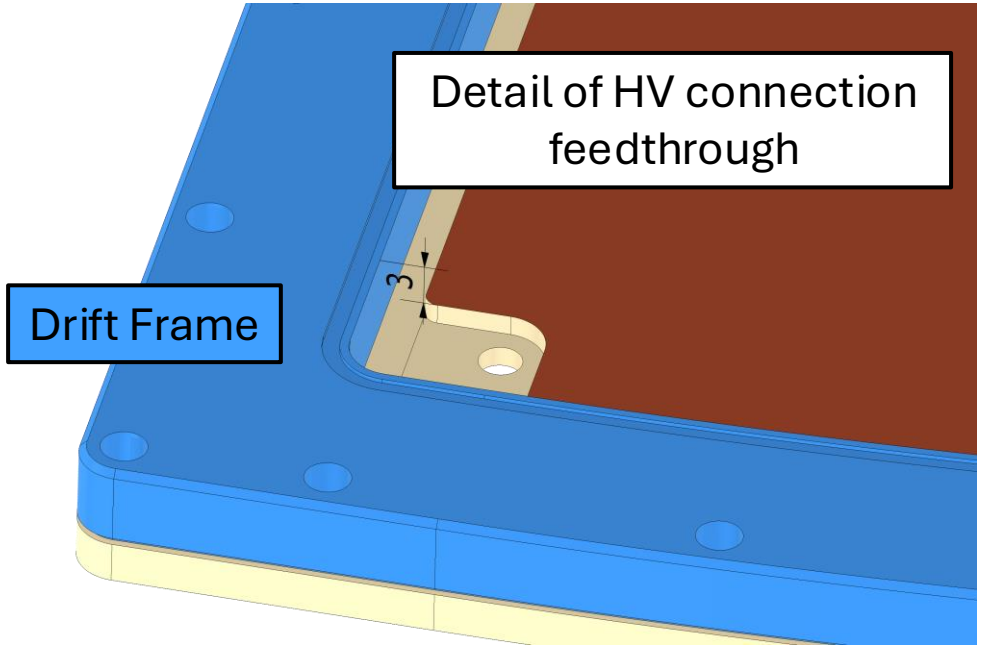
Summary

- The **maximum angles of incidence** on the ECT are **about 20°** and 17° for the lepton and hadron side, respectively
- In μ-RWELL detectors with 1-D 400 μm pitch strip readout and 6 mm drift gap operating in Ar:CO_2:CF_4 (45:15:40) μTPC significantly improves the resolution at angles of incidence between 10° and 20°
- In triple-GEM detectors with 2-D 630 μm pitch strip readout and 5 mm drift gap operating in Ar:iC_4H_{10} (91.5:8.5) the improvement between 10° and 20° seems much lower
- **Hard to tell solely from literature if μTPC could be effective in our final configuration**, dedicated simulations could shed some light on the matter
- Alternatively, **it could be worth studying both 3 and 6 mm configurations**

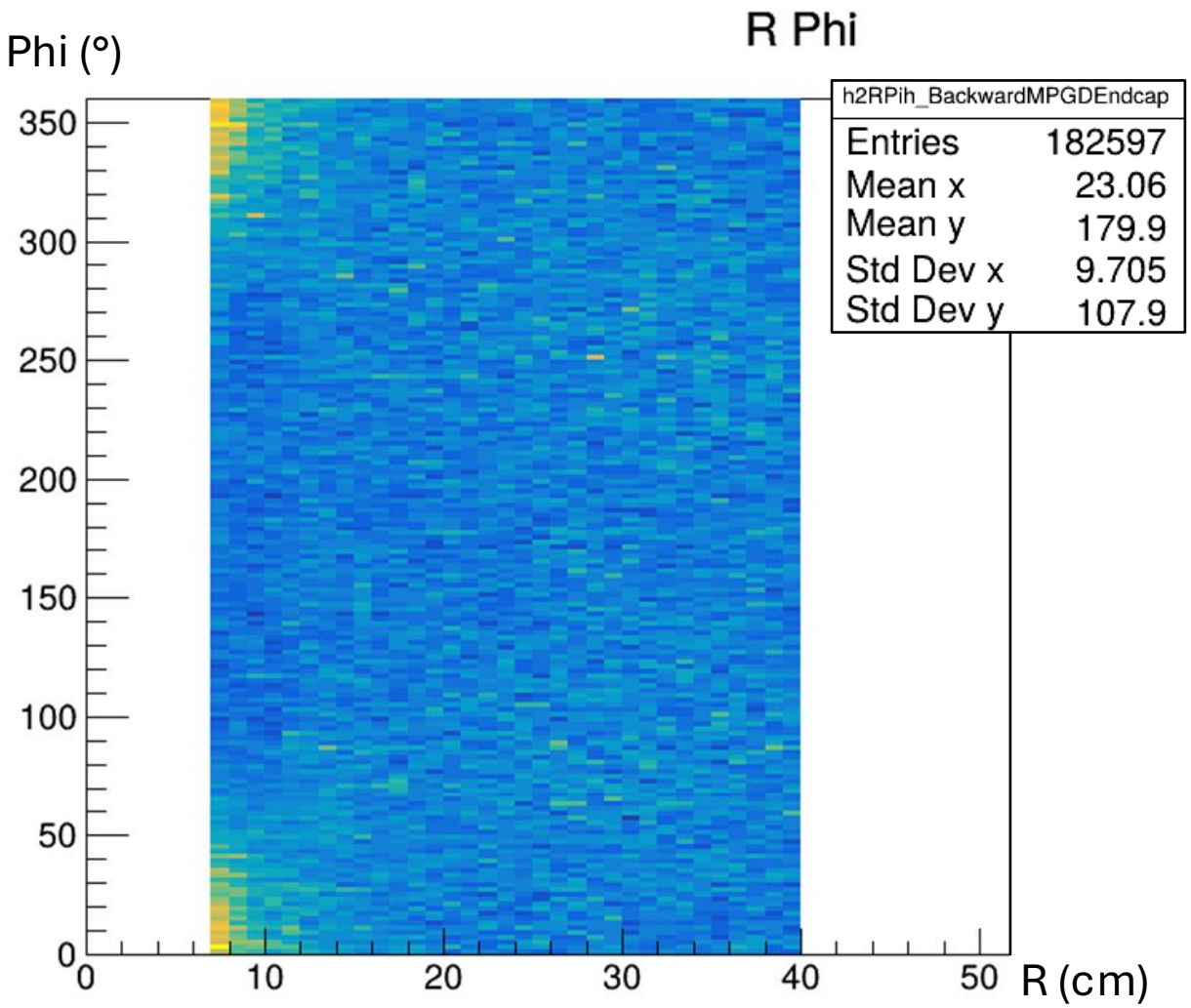
Special Cathode for 3 mm Drift Gap Study





Enables 3 mm drift gap testing by replacing a single component of the current quadrant prototypes

ECT Backward



5 µm

	10x275		10x100	
	Hz/cm2	Hz/channel	Hz/cm2	Hz/channel
ECT Backward Near	6.77E+03	1.67E+04	6.14E+03	1.51E+04
ECT Backward Far	6.78E+03	1.67E+04	6.06E+03	1.49E+04
ECT Forward Near	1.26E+04	3.11E+04	1.27E+04	3.12E+04
ECT Forward Far	1.34E+04	3.30E+04	1.35E+04	3.33E+04

10 µm

	10x275		10x100	
	Hz/cm2	Hz/channel	Hz/cm2	Hz/channel
ECT Backward Near	6.63E+03	1.63E+04	5.99E+03	1.47E+04
ECT Backward Far	6.48E+03	1.59E+04	5.73E+03	1.41E+04
ECT Forward Near	1.25E+04	3.08E+04	1.24E+04	3.06E+04
ECT Forward Far	1.38E+04	3.39E+04	1.33E+04	3.27E+04

No change for the backward side
The geometry matches the model

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