A Belle II Vertexing and Material Distribution Study

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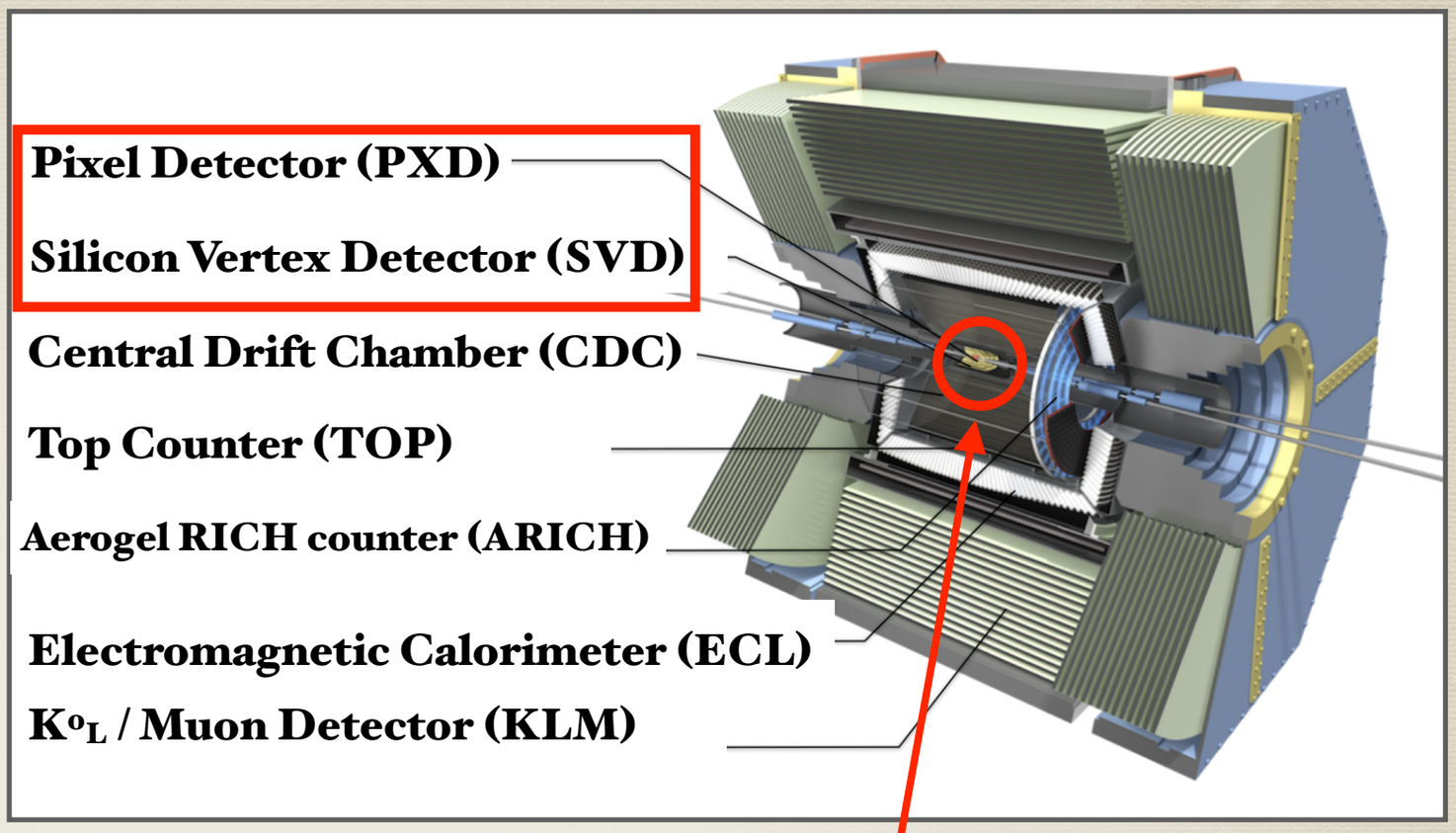
Introduction

In This Presentation:

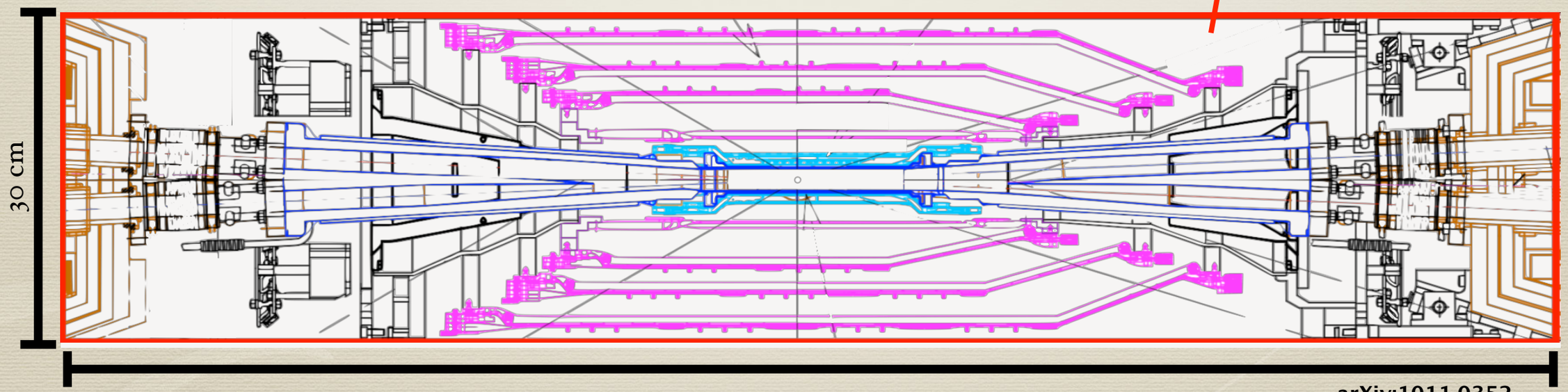
I) Lightly Talk about Belle II's tracking system and vertex analysis procedure.

II) Cover vertexing and material analysis results for commissioning and physics runs.



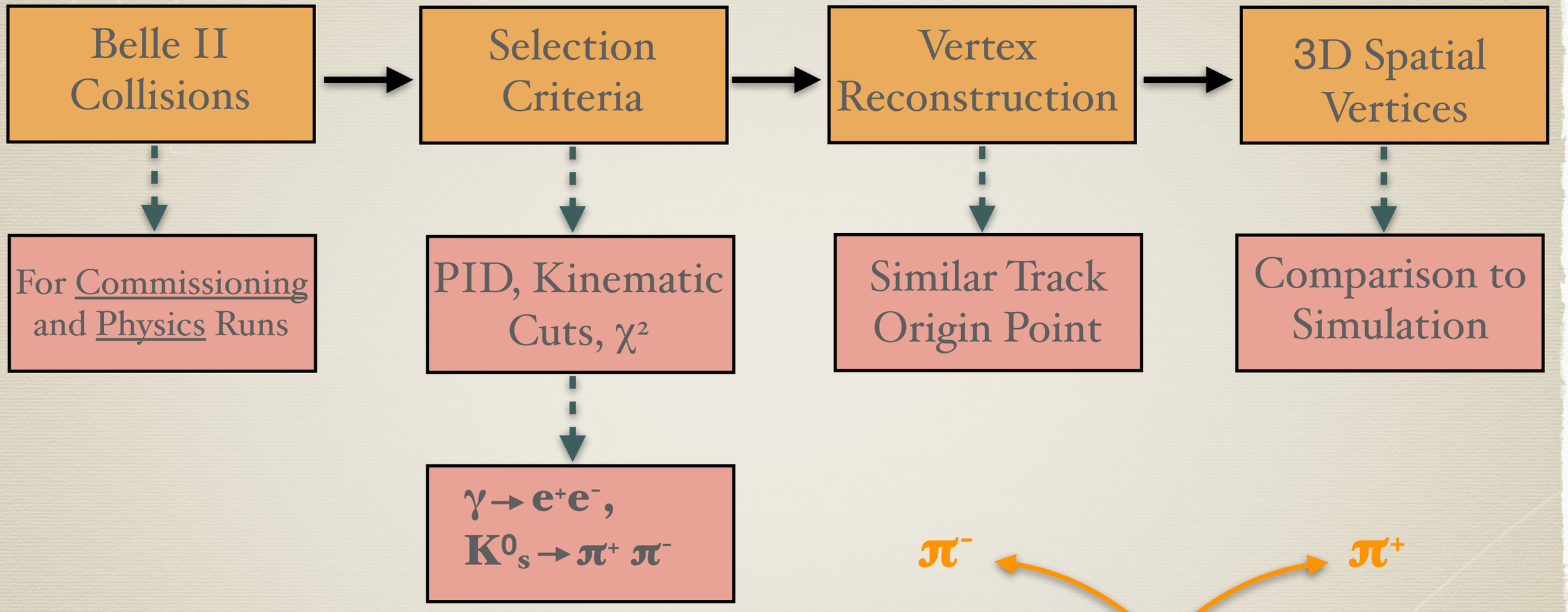
Belle II Technical Report
arXiv:1011.0352

Small Chamber Area

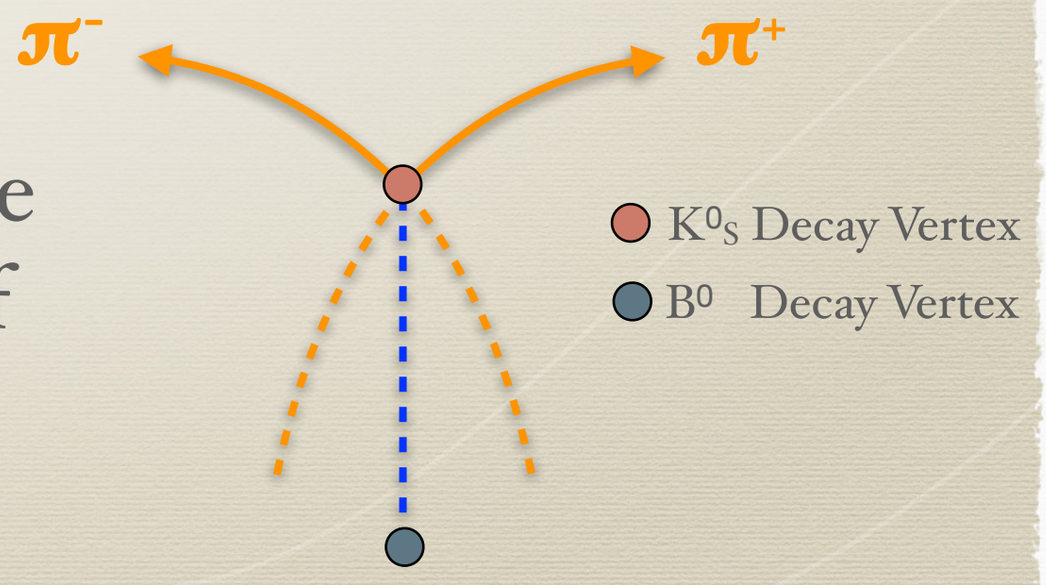


arXiv:1011.0352

A Vertexing Analysis

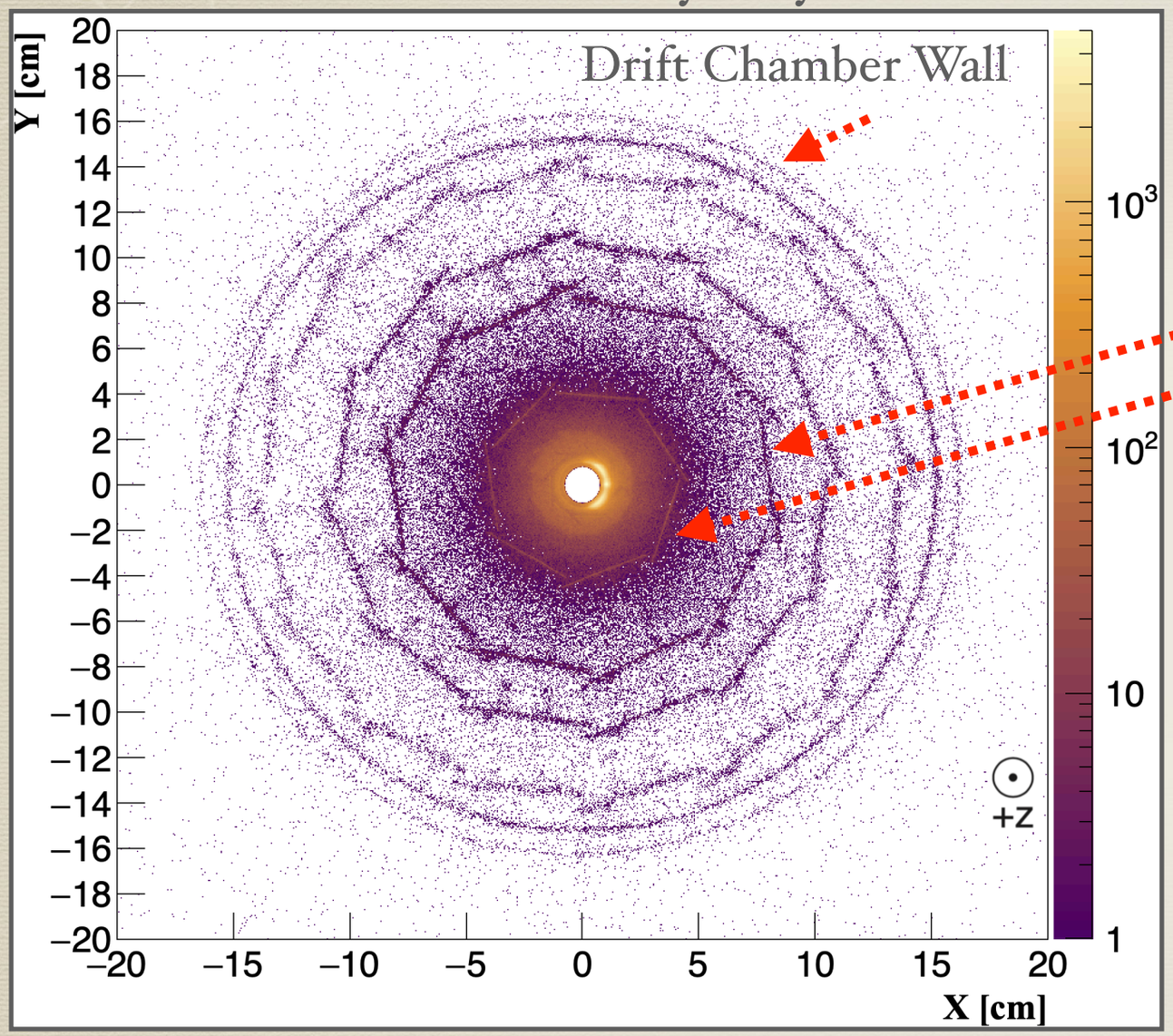


Goal: Compare vertex data to Monte Carlo simulation with the purpose of studying the distribution of material within the detector

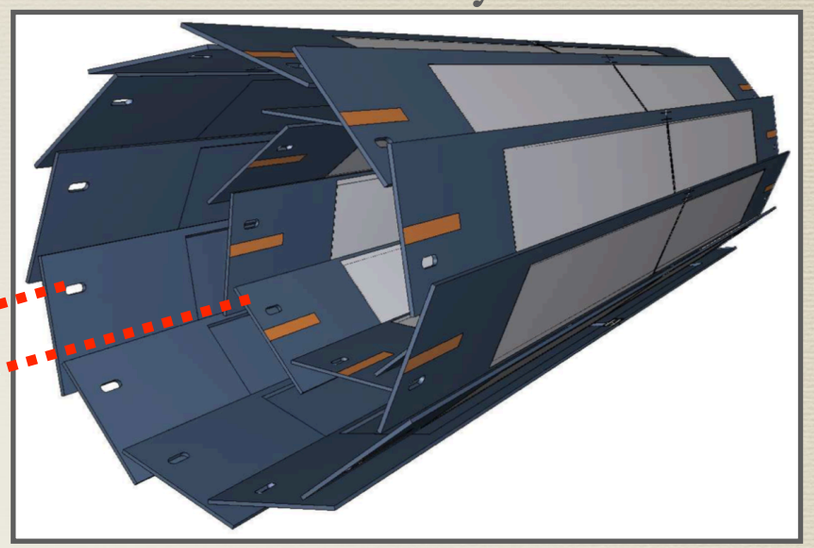


“Slicing” the Detector

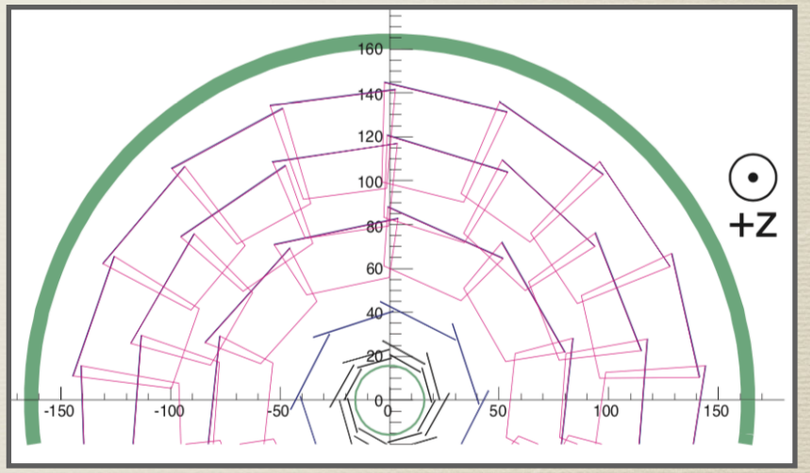
Reconstruction for early Physics Runs



SVD Inner 2 Layers



SVD/PXD Wafer Orientation



arXiv:1011.0352

Requirements:

1: Collecting vertices for oppositely charged daughters

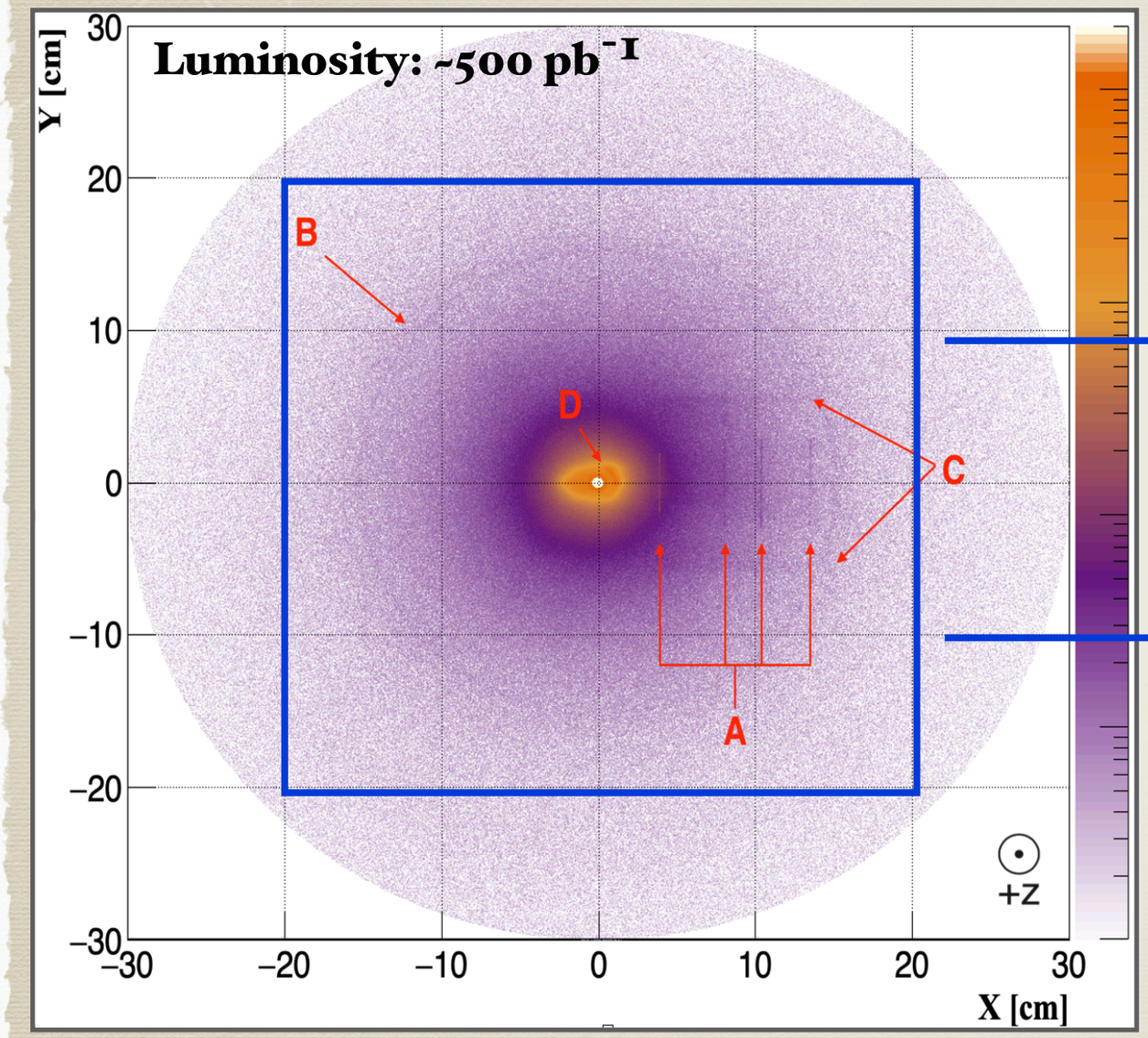
2: $|Z| < 15$ cm

3: Uncertainty on (X, Y, & Z) < 0.4 cm

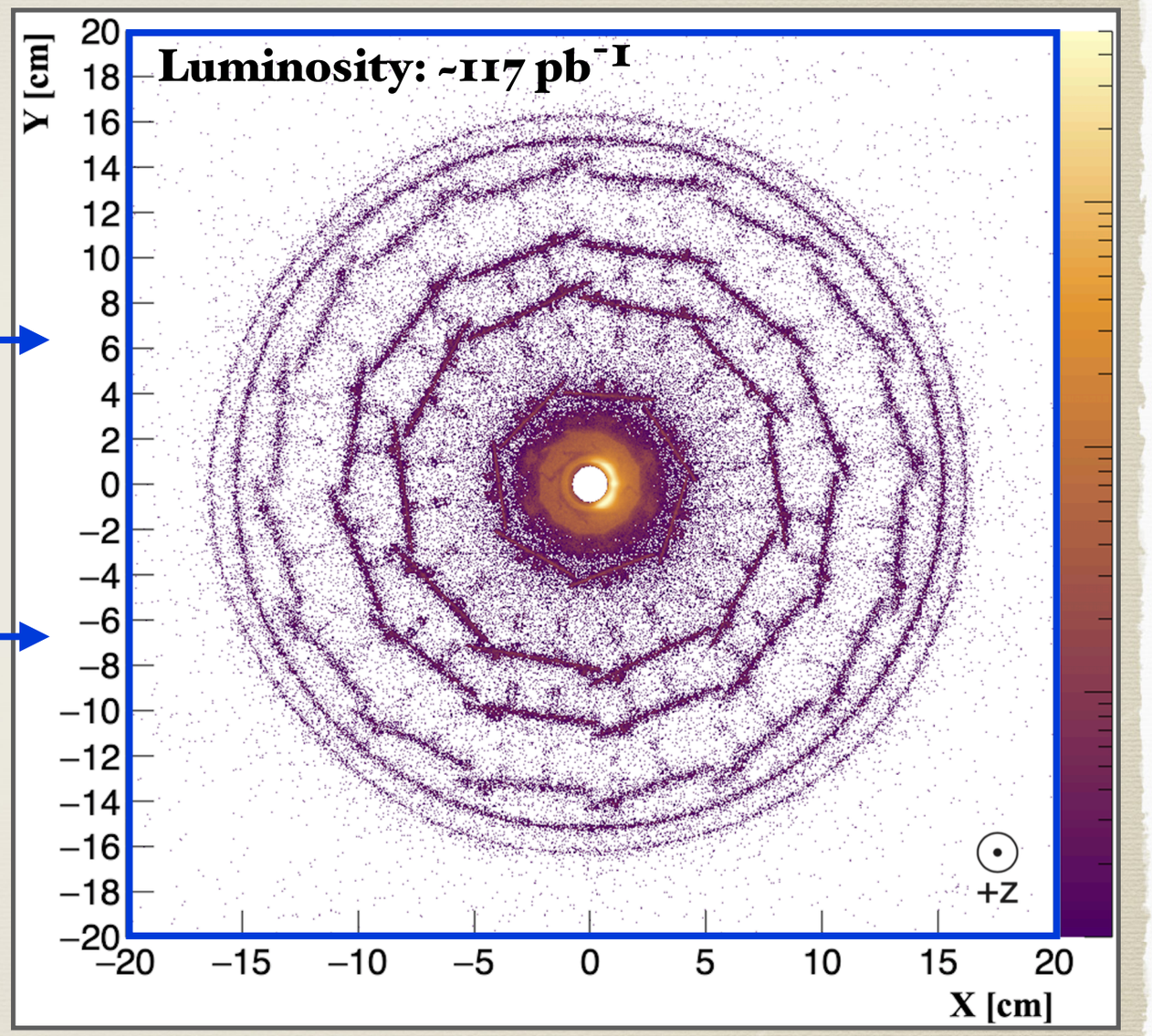
4: Radius > 0.8 cm

Commissioning Runs vs Physics Runs

Commissioning Runs (Phase 2): (Feb-July / 2018)



Physics Runs (Phase 3): (Start Date: March 11th/2019)



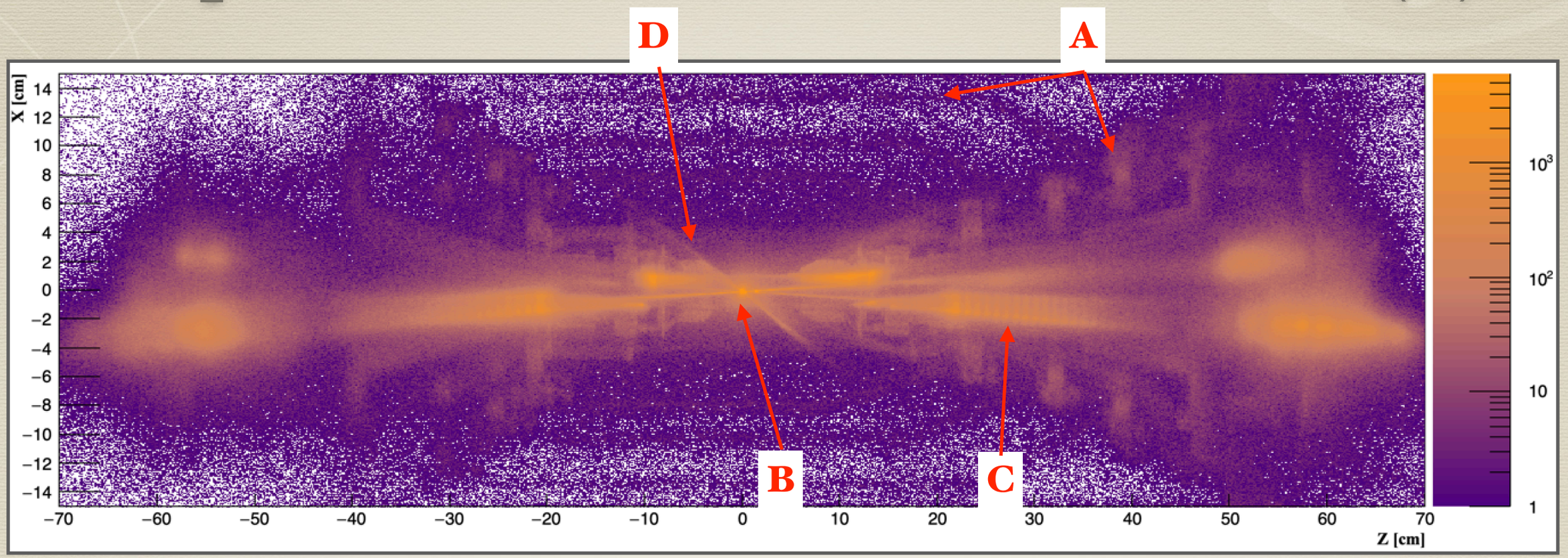
Legend:

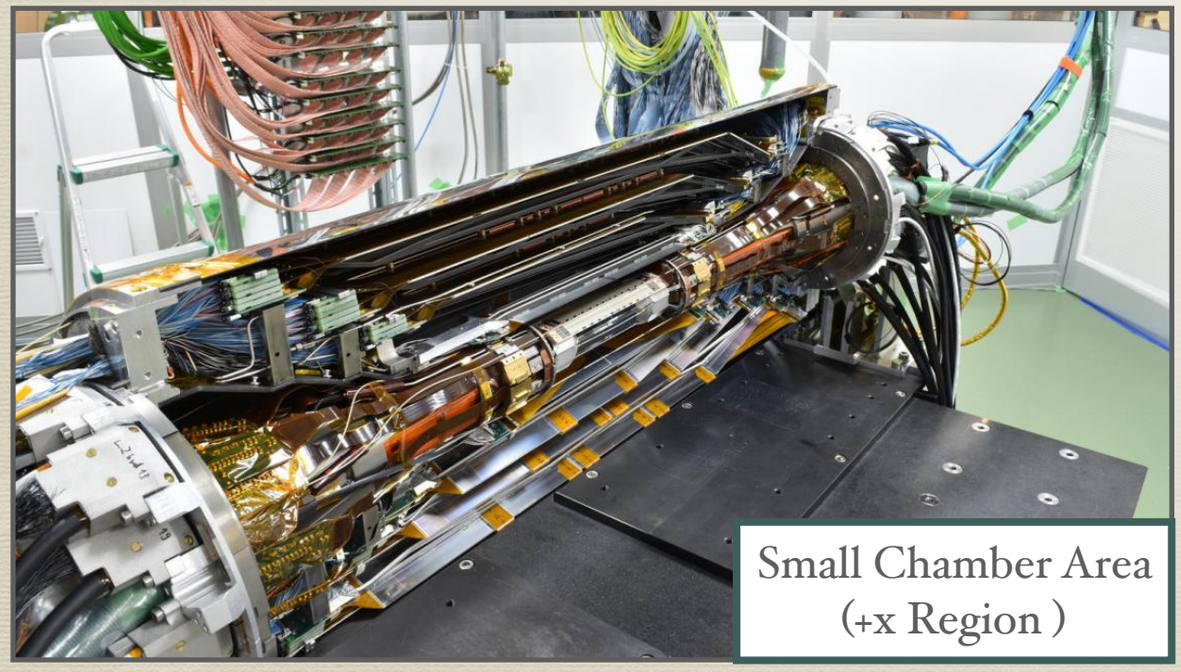
A: Partially Installed Vertex Detector
B: Inner Drift Chamber Wall
C: Temporary Vertex Detector Support Walls
D: IR and Beam Pipe Hits

Requirements:

1: Both tracks pass PID for being Protons
2: $|Z| < 15$ cm
3: Uncertainty on (X, Y, & Z) <0.4 cm
4. Radius >1 cm

Top View Of Inner Detector (1)





Small Chamber Area
(+x Region)

https://www.interactions.org/press-release/superkekb-phase-3-belle-ii-physics-run-starts

Vertices Show:

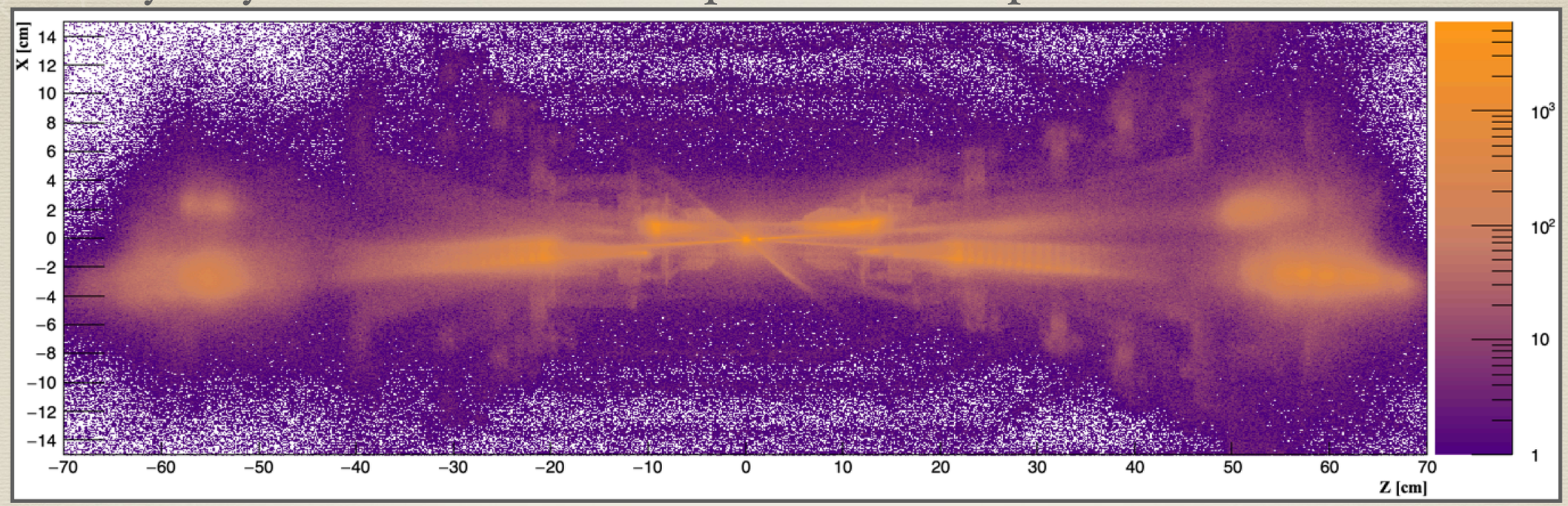
A. SVD Wafers & Endrings
B. Interaction Region & Interaction Point
C. Beam Pipe “Synchrotron” Grooves
D. “X-Feature”

Requirements:

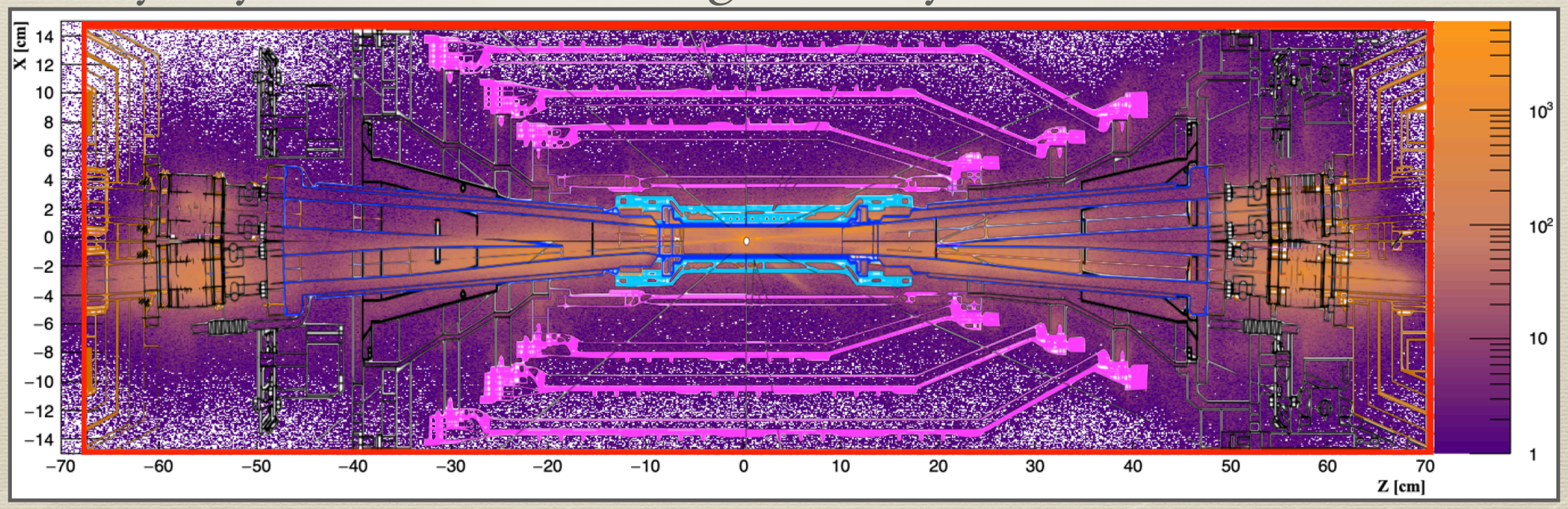
1: Both Particles are Positive
2: |Y| < 4 cm
3: Collecting all vertices from paired particles

Top View Of Inner Detector (2)

Early Physics Runs (Same Requirements as previous slide):

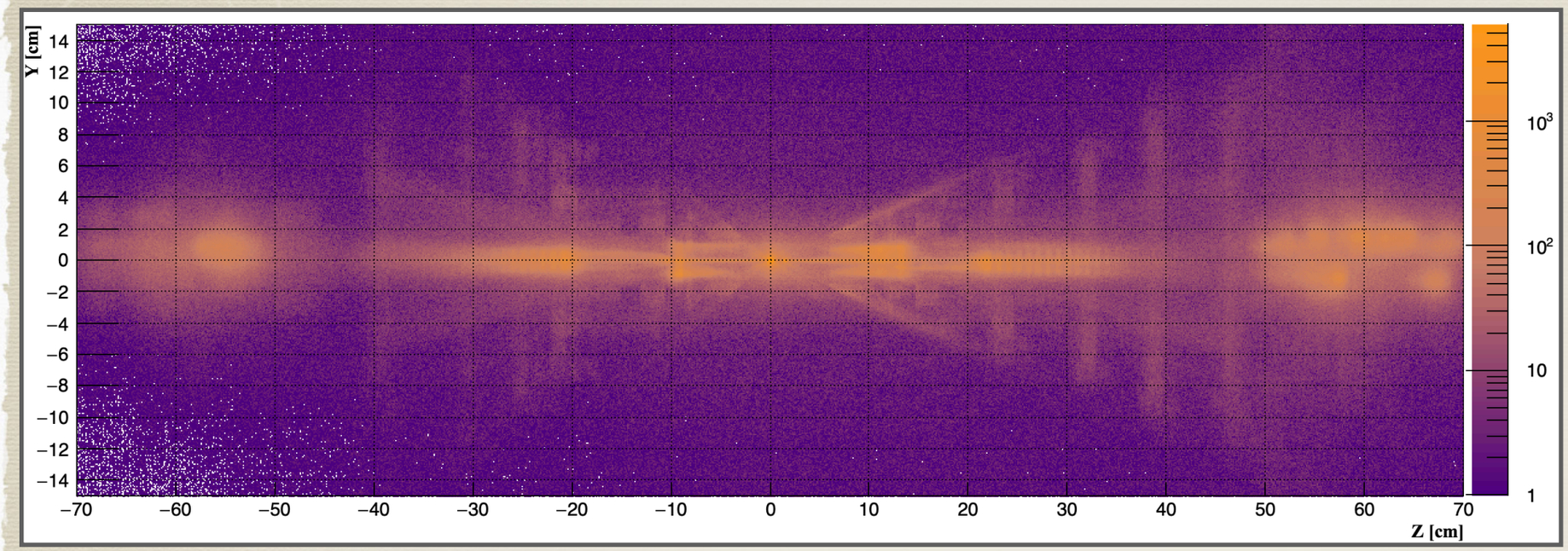


Early Physics Runs (with Design Overlay):



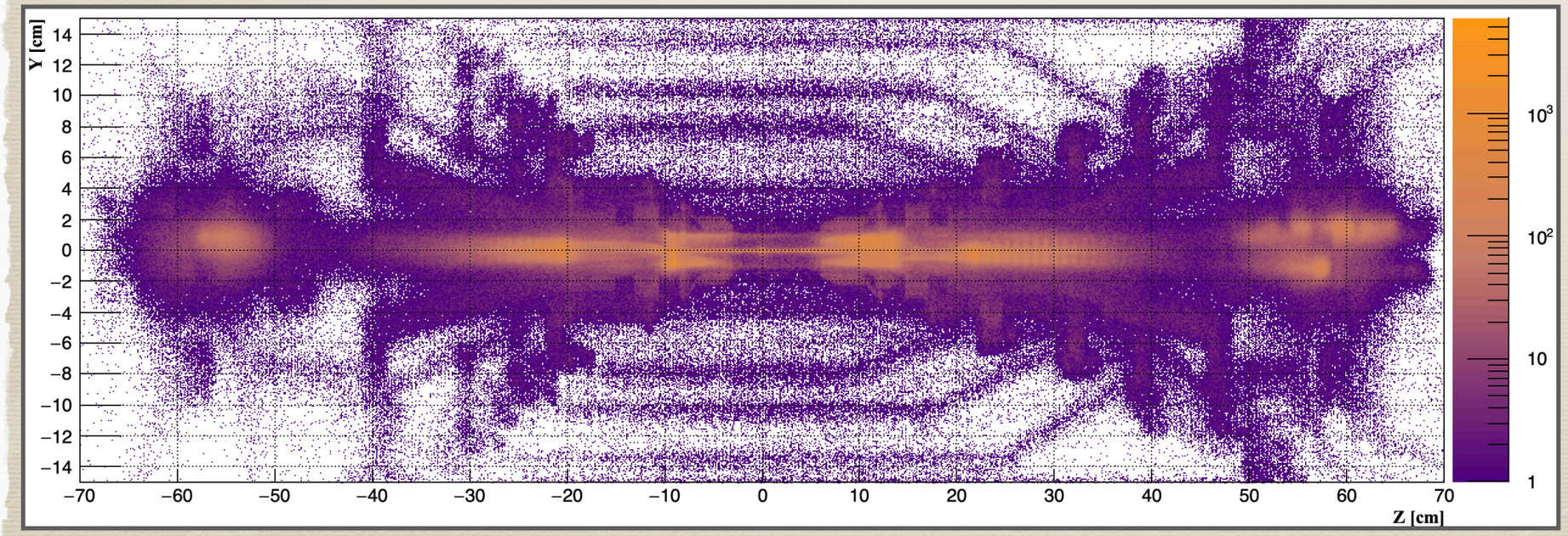
Proton PID Vertexing (Optimization Example)

Z vs Y: Early Physics Runs



Requirements:

- |Z| <70 cm
- |X| <15 cm
- Photon Conversion Candidates



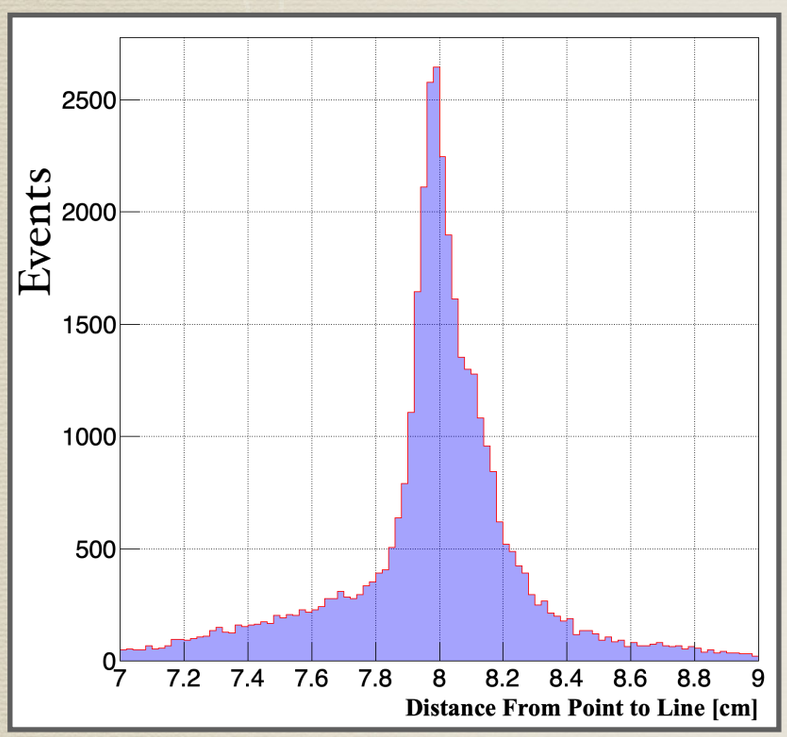
Requirements:

- |Z| <70 cm
- |X| <15 cm
- |Y| <4 cm
- (X,Y,Z) uncertainty <0.4 cm
- Both particles pass PID for being protons
- Shows nuclear structure/ hard surface collisions

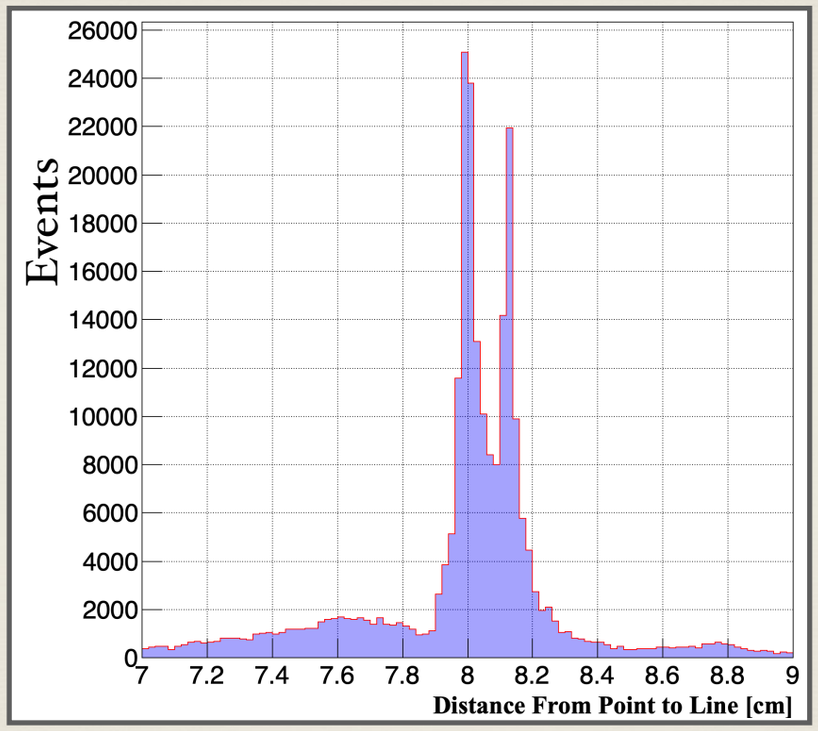
Material Comparison to Simulation

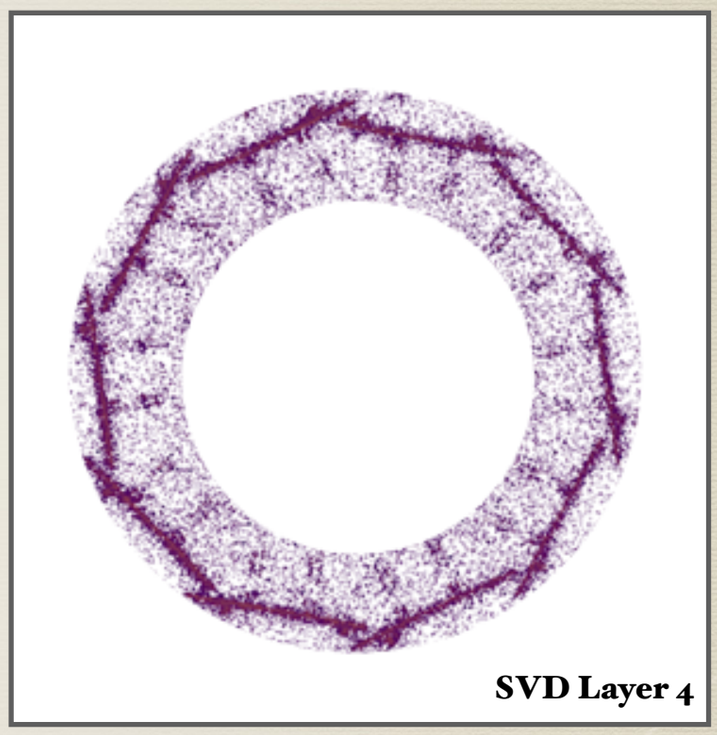
Material Scan over ALL the Wafers in Layer 4 of Vertex Detector

Physics Data



MC Truth Material Location





Requirements:

1: Both tracks pass PID for being Protons

2: Uncertainty on (X,Y, & Z) <0.4 cm

✳ NOT For vertex-to-vertex comparison

✳ Too early for high resolution comparison

Summary

- Vertex work looks promising! Qualitative now, but leading to quantitative results soon.
- Belle II Physics runs well underway with increasing luminosity.
- Able to explore detector material with better and better resolution.
- My MSc is ending, but material study work to be completed by incoming students.

Thank you! Questions?

McGill