JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

HGS-HIRe for FAIR
Helmholtz Graduate School for Hadron and Ion Research

ATLAS PANDA HERMES AG Düren

GCS Status Update - Simulations and Measurements

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Online PANDA Meeting

March 9, 2021

Measurements with the Prototype in the GCS GCS

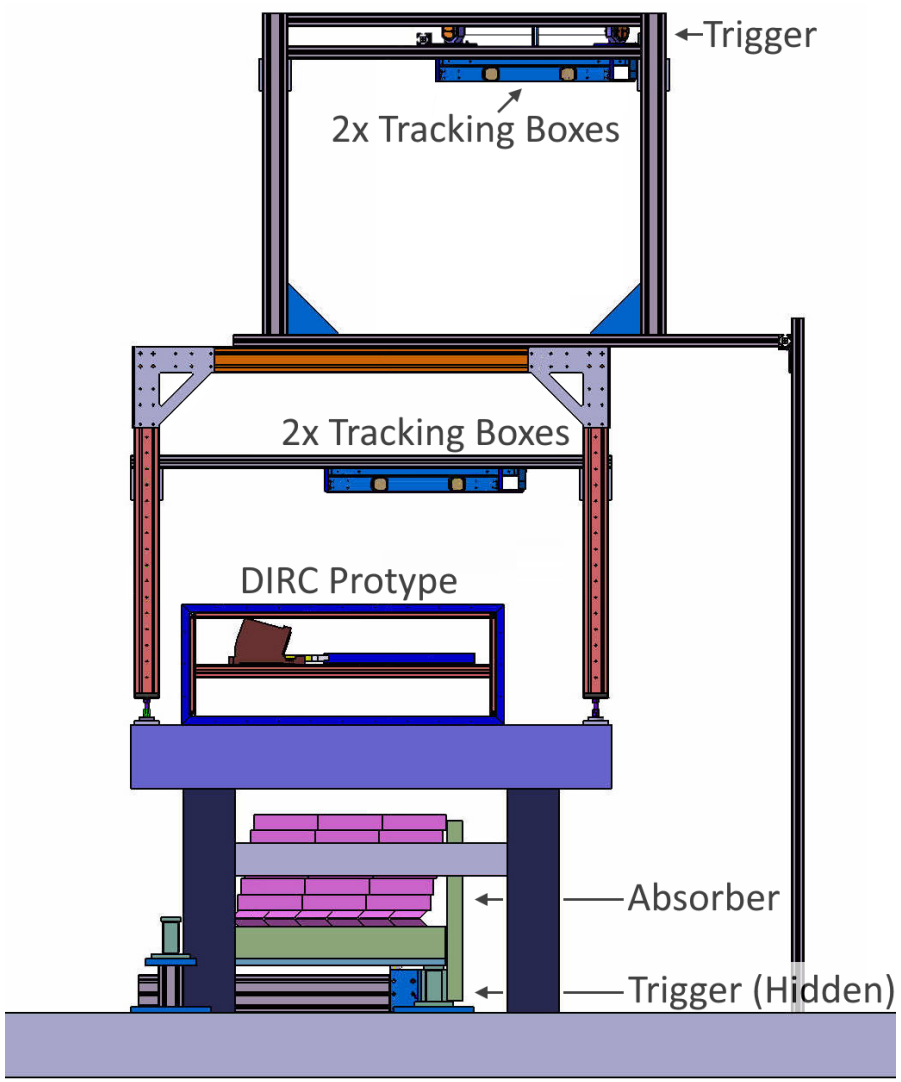

Figure: Overview of the GCS with prototype setup.

Prototype inside GCS

Preliminary Setup

- Components: Radiator,MCP + Readoutmodule, Laser
- No light shielding
- Used until december

Radiator

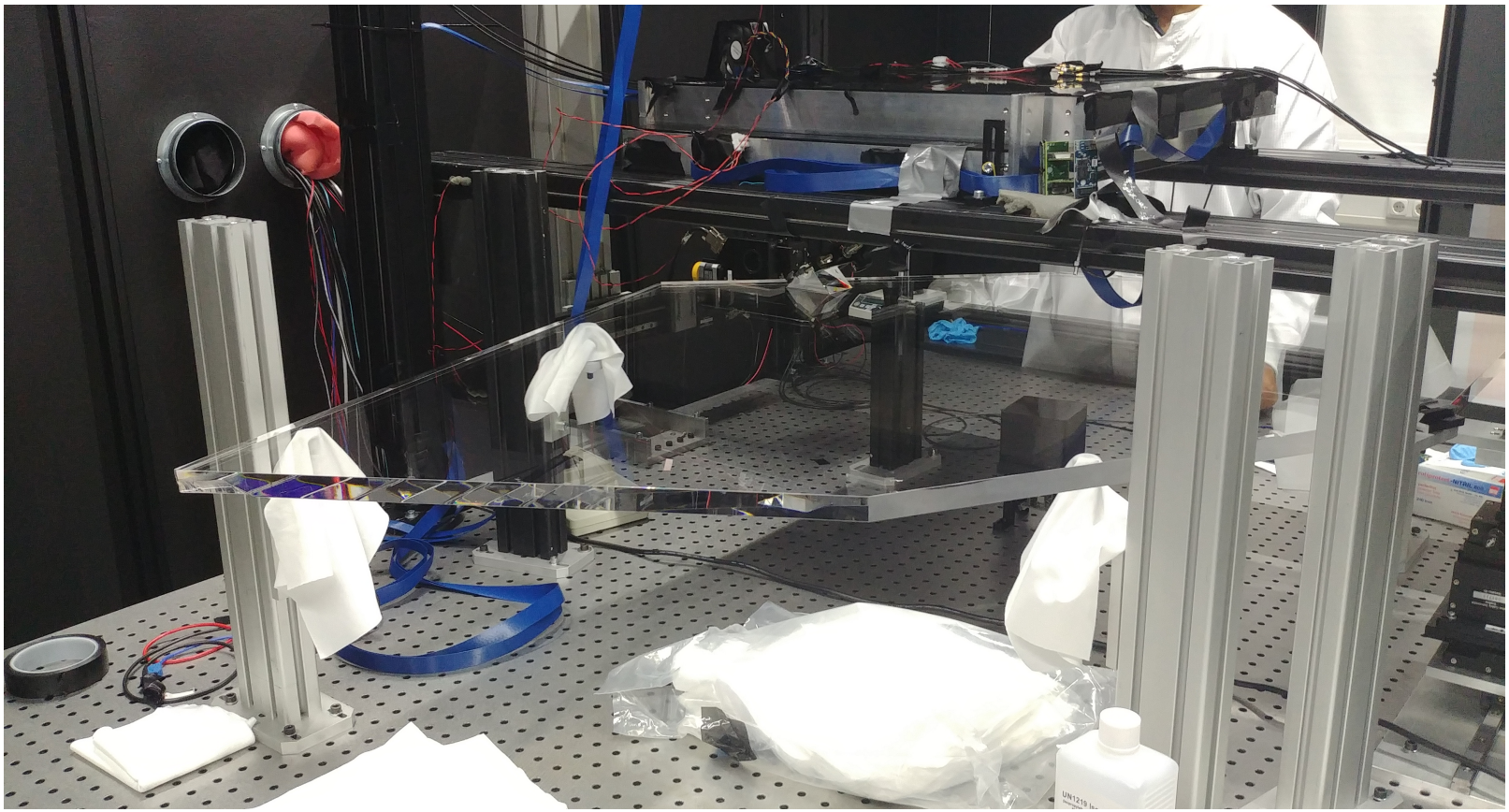

Figure: Radiator without shielding inside the GCS.

Readout and Optics

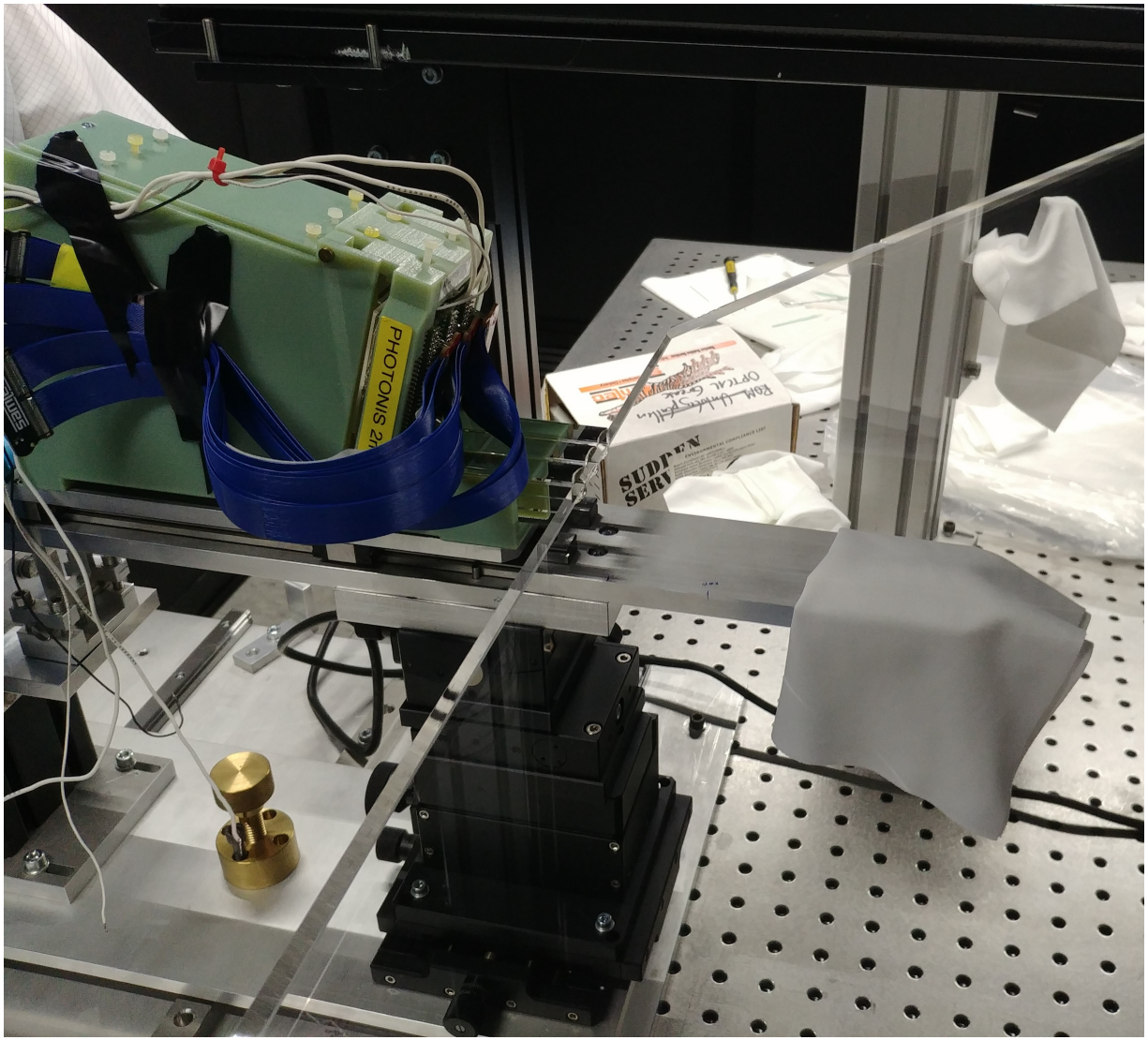

Figure: Focus optics with attached MCP.

Schematic Top-Down-View

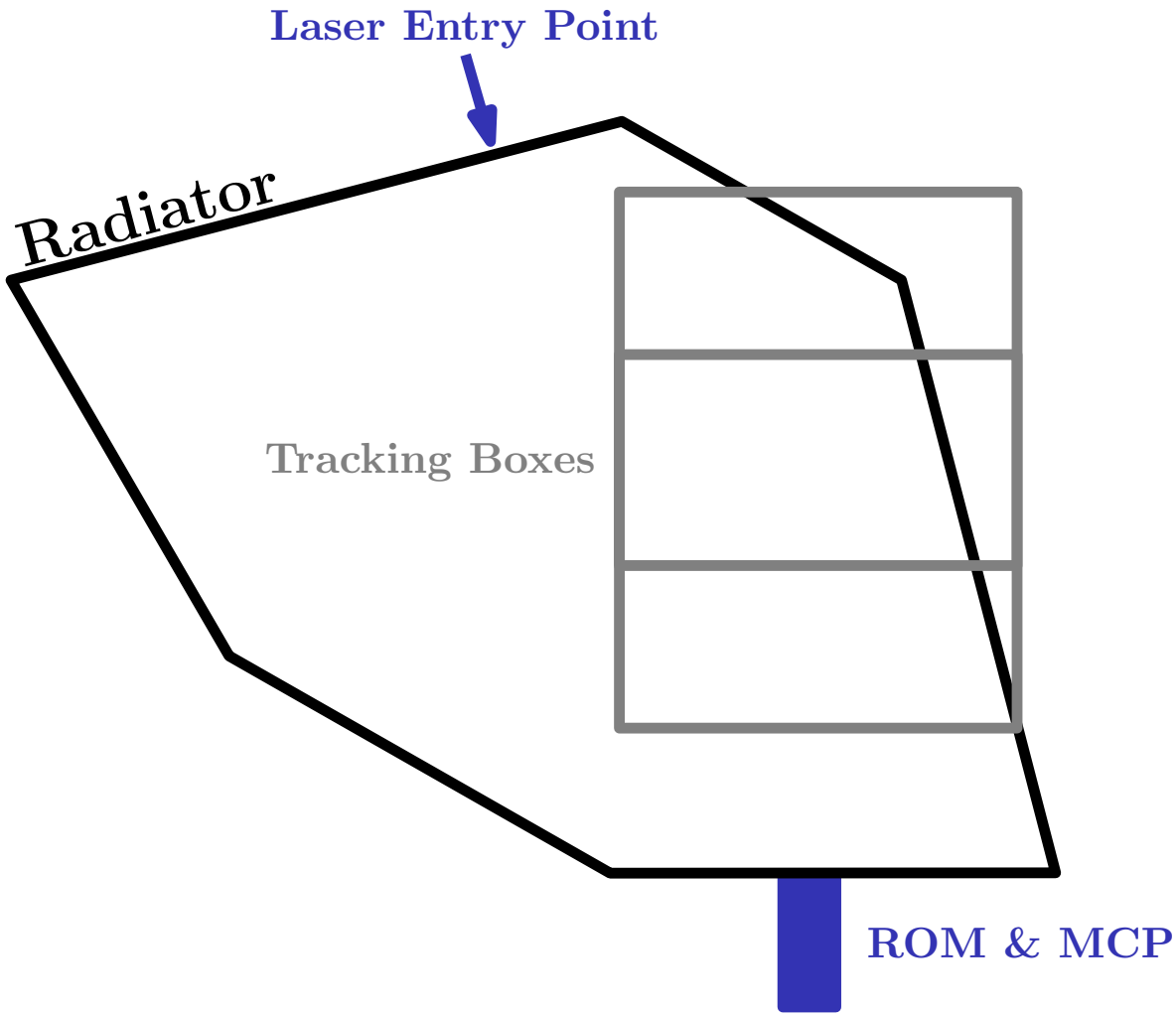

Figure: Schematic drawing of the positioning of each component.

Prototype inside GCS - Part II

Current Setup

- Same components as previous setup
- Fully shielded from light
- Currently running

Radiator

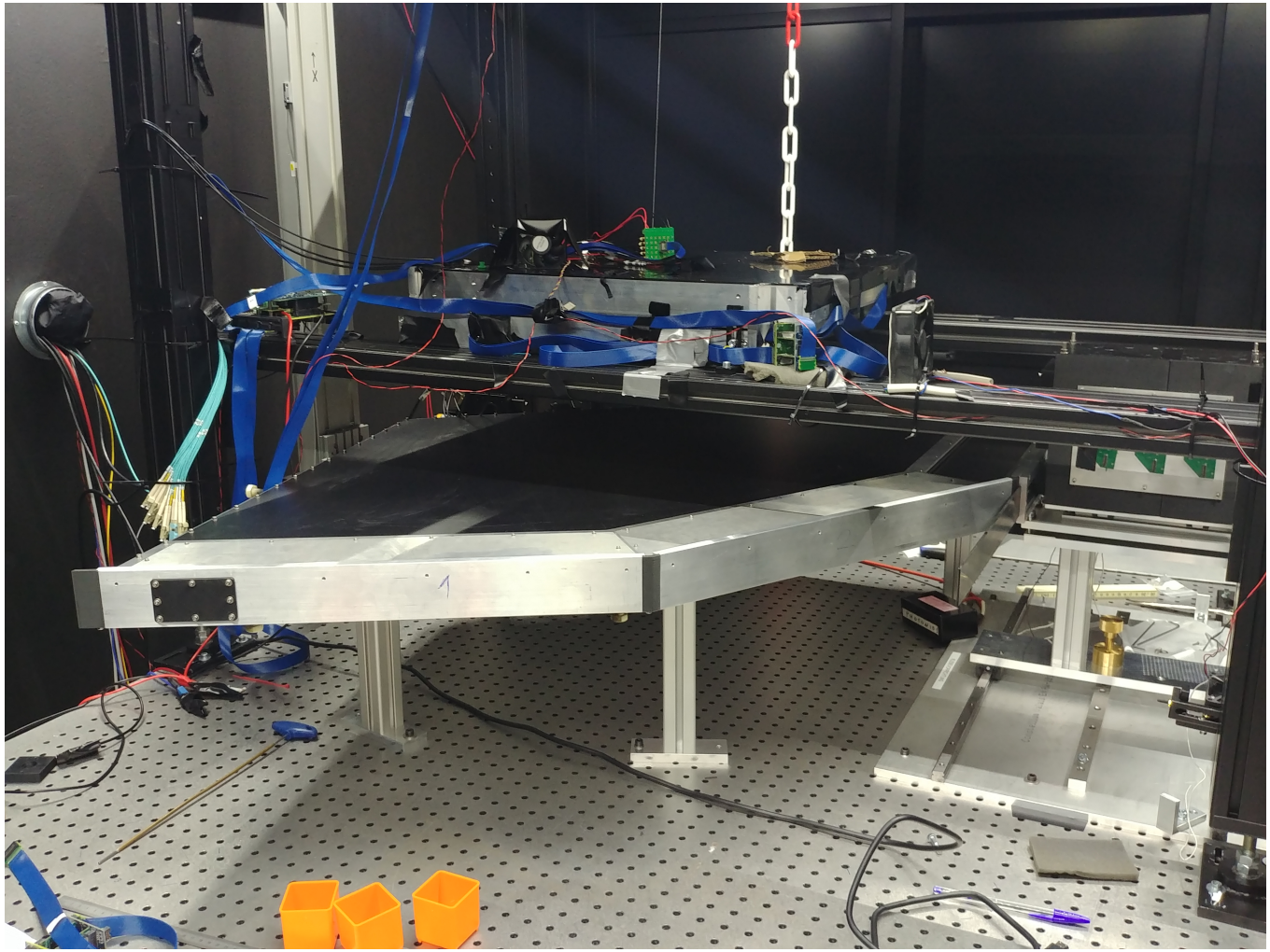

Figure: New fully light-tight radiator box.

Readout and Optics

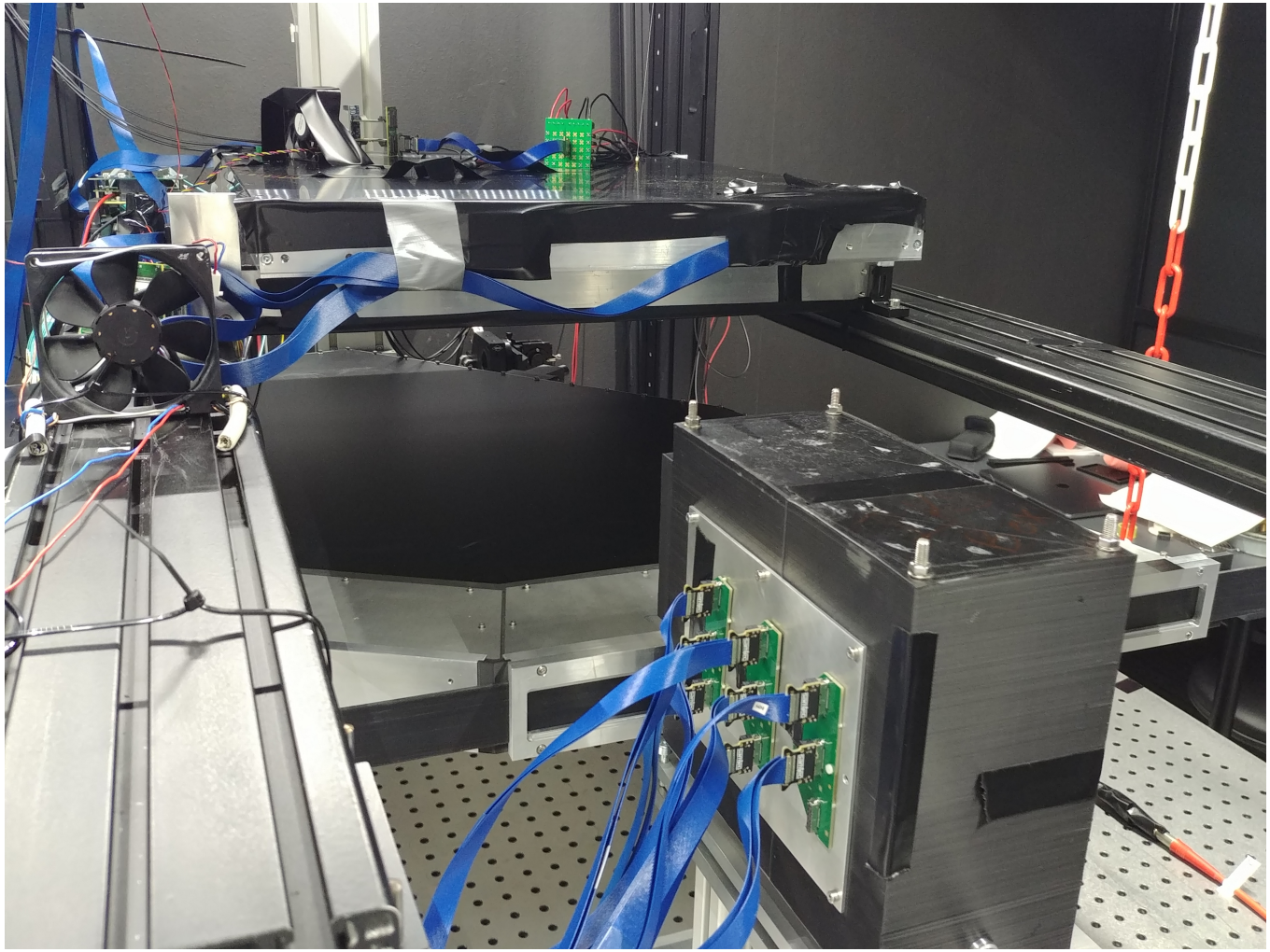

Figure: New MCP and optics housing.

Readout and Data Taking

Data Acquisition

- Data acquisition in 30 minute blocks
- Event selection and reconstruction performed offline

Connected Components

- MCP (256 channels)
- Trigger und finger counters (10 channels)
- Tracking (192 channels)
- Mini GCS (128 channels)

First Plots - MCP Pixel vs Polar Angle

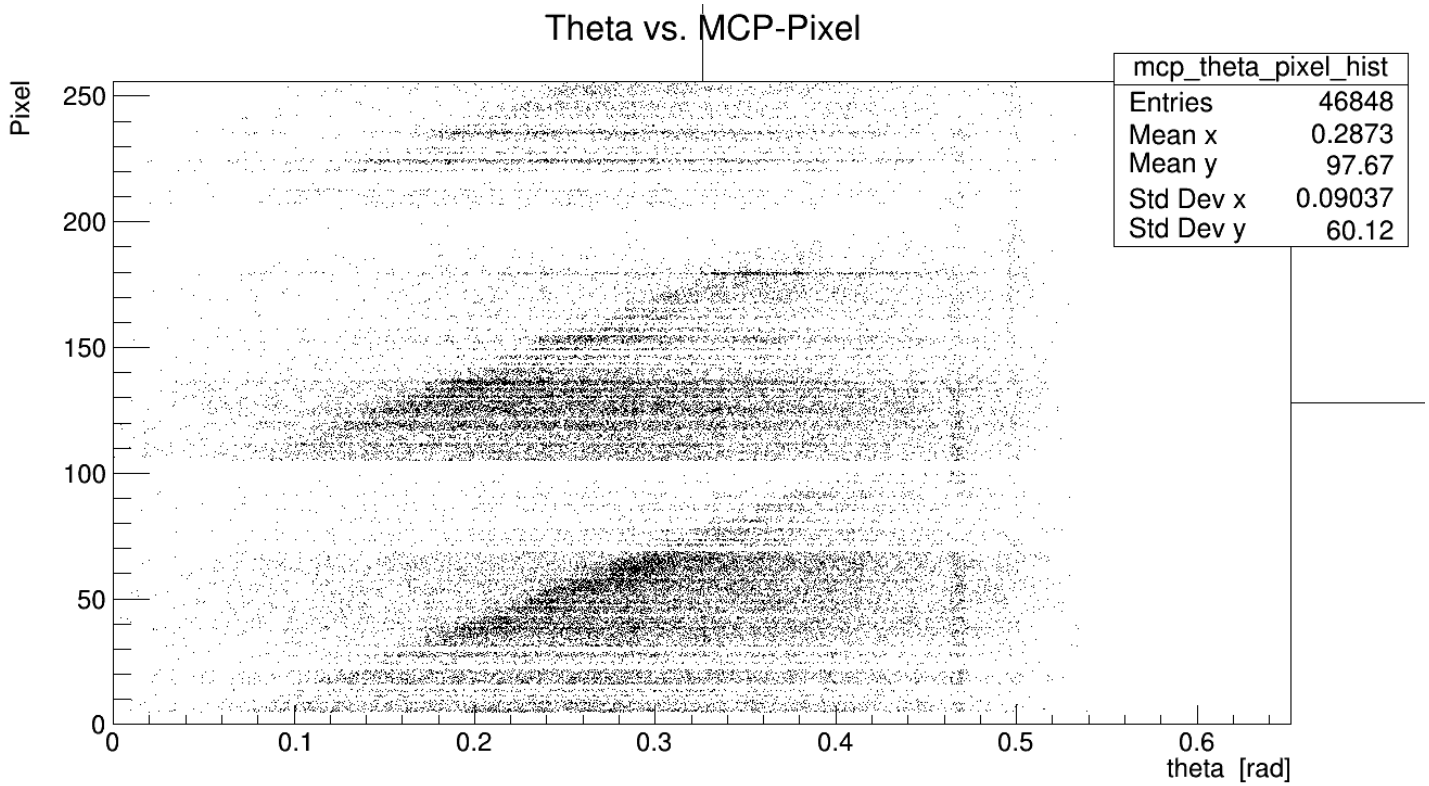

Figure: Histogram of Pixel vs Polar Angle Distribution.

First Plots - MCP Pixel vs Azimuthal Angle

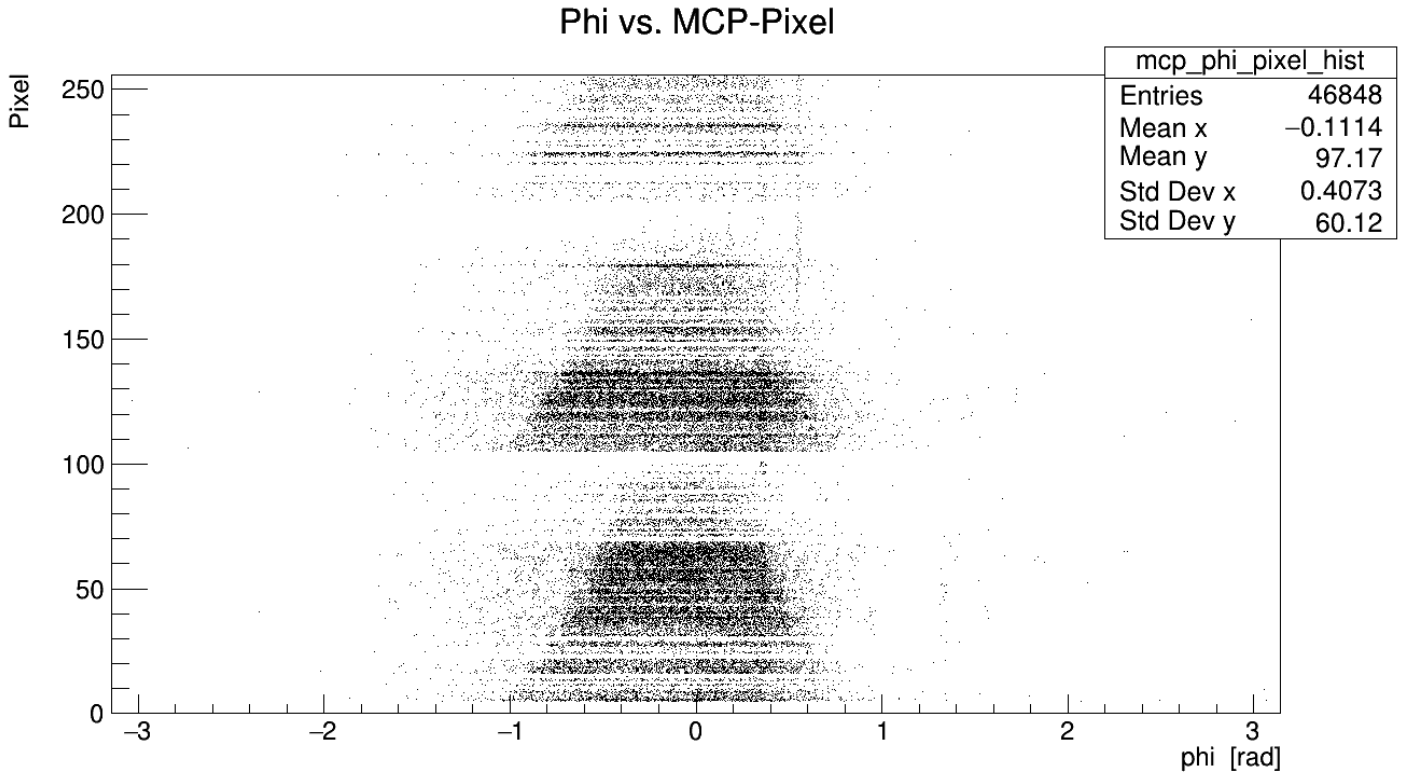

Figure: Histogram of Pixel vs Azimuthal Angle Distribution.

Monte-Carlo Simulation

Goals

- Reproduction of all measured distributions
- Useful for efficiency estimation, etc. . . .

Implementation

- Built using Geant4
- Includes full GCS and prototype.
- Time based instead of event based hit handling
- Exact same output format like the real system
- Physics: Default Physic Lists, Sellmeier Equation, Quantum Efficiency, CRY Generator

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Simulation - Geometry

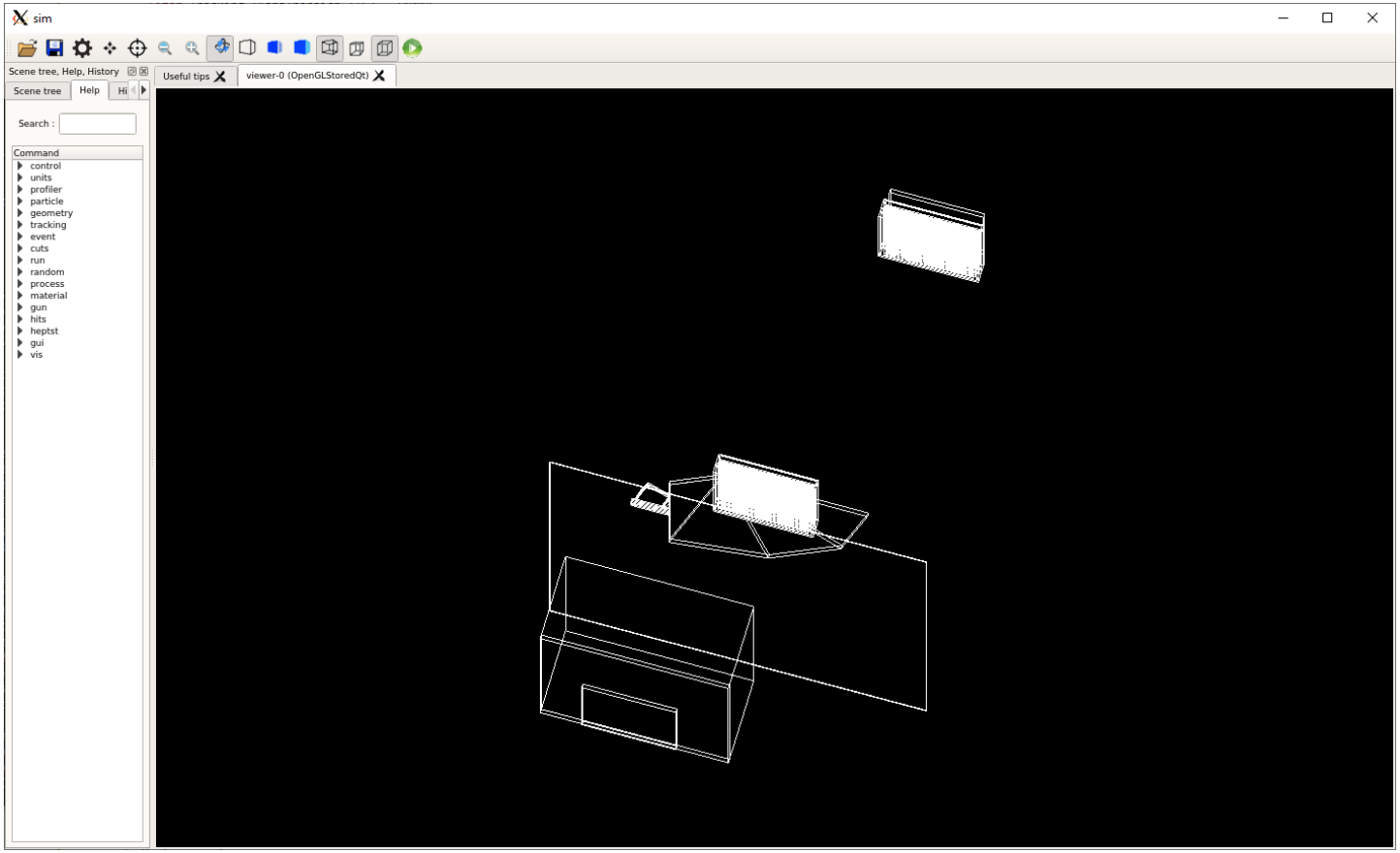

Figure: Implemented geometry inside the Geant4 GUI.

Simulation - Example Event

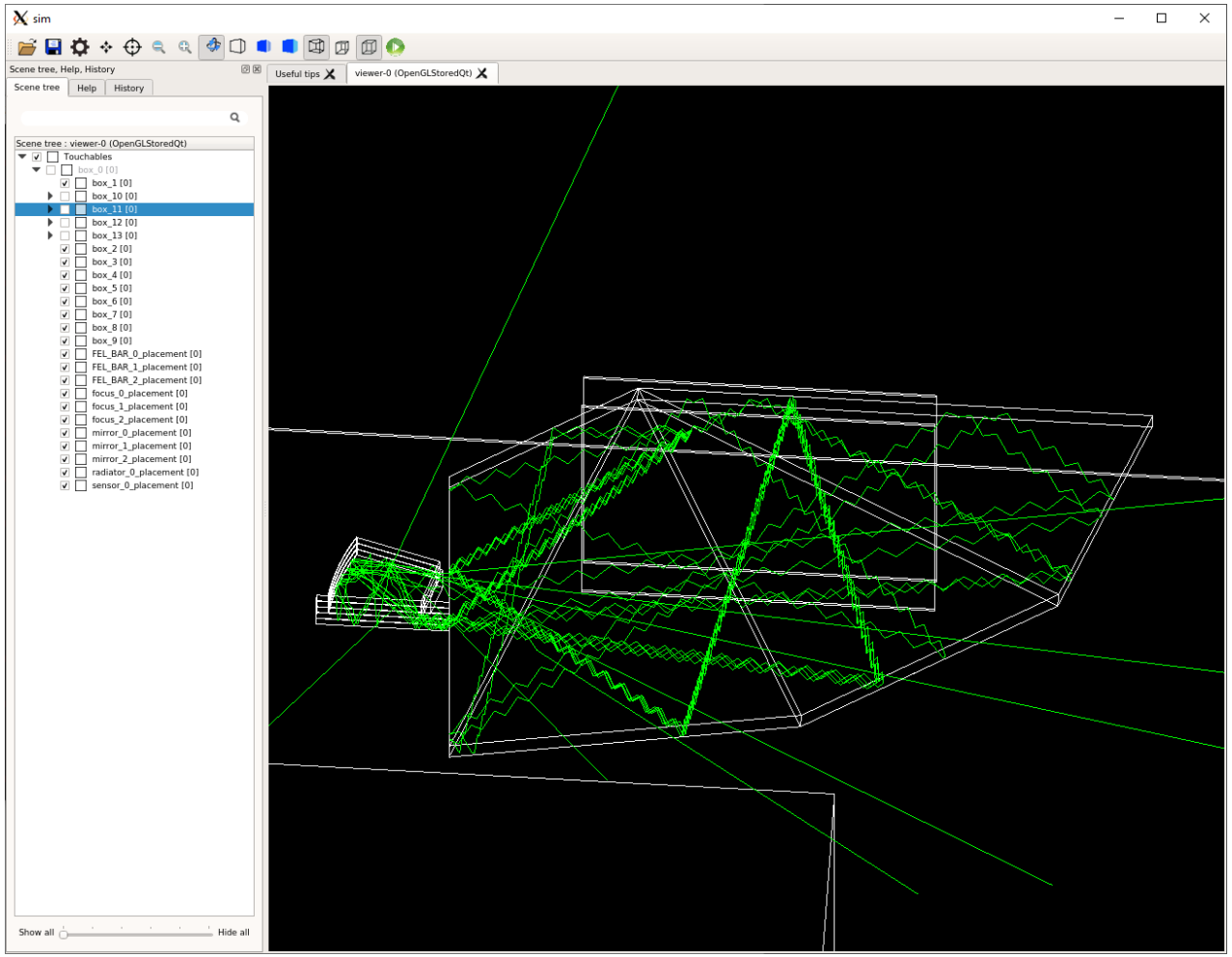

Figure: Event display of the generated photons entering the first focus element (randomly selected event).

Simulation - Problems

Probleme

- Large number of generated photons
- Very high number of reflections
  - Photons trapped in radiator
  - No concern in full disc setup
- Slowdown by 3 to 5 orders of magnitude with cherenkov enabled

Temporary Solution

- Hard limit of 200 reflections
  - Long Term Alternative: Introduction of reflection probability

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Comparison with Measurement - Polar Angle Distribution

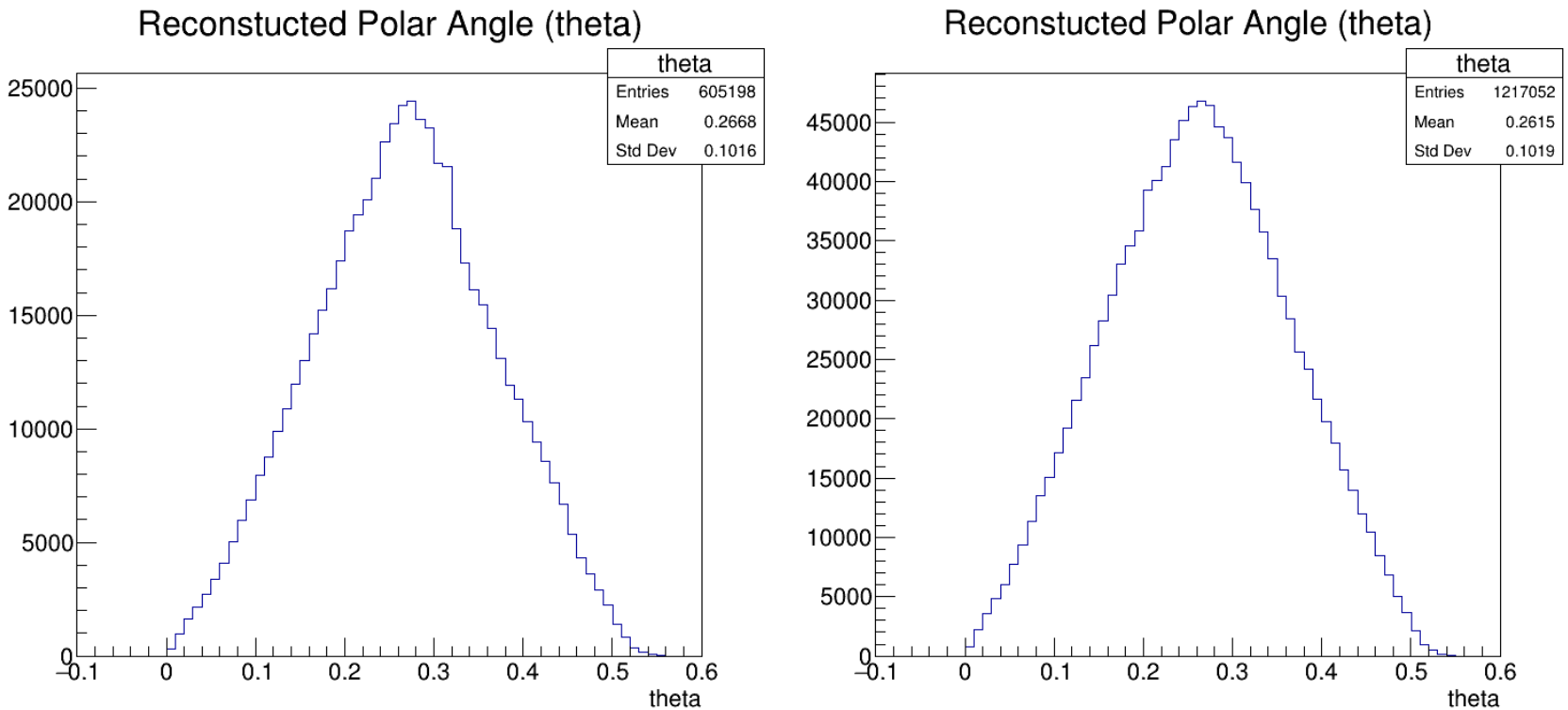


Figure: Reconstructed polar angle in simulation (left) and measurement (right).

Comparison with Measurement - Azimutalwinkelverteilung

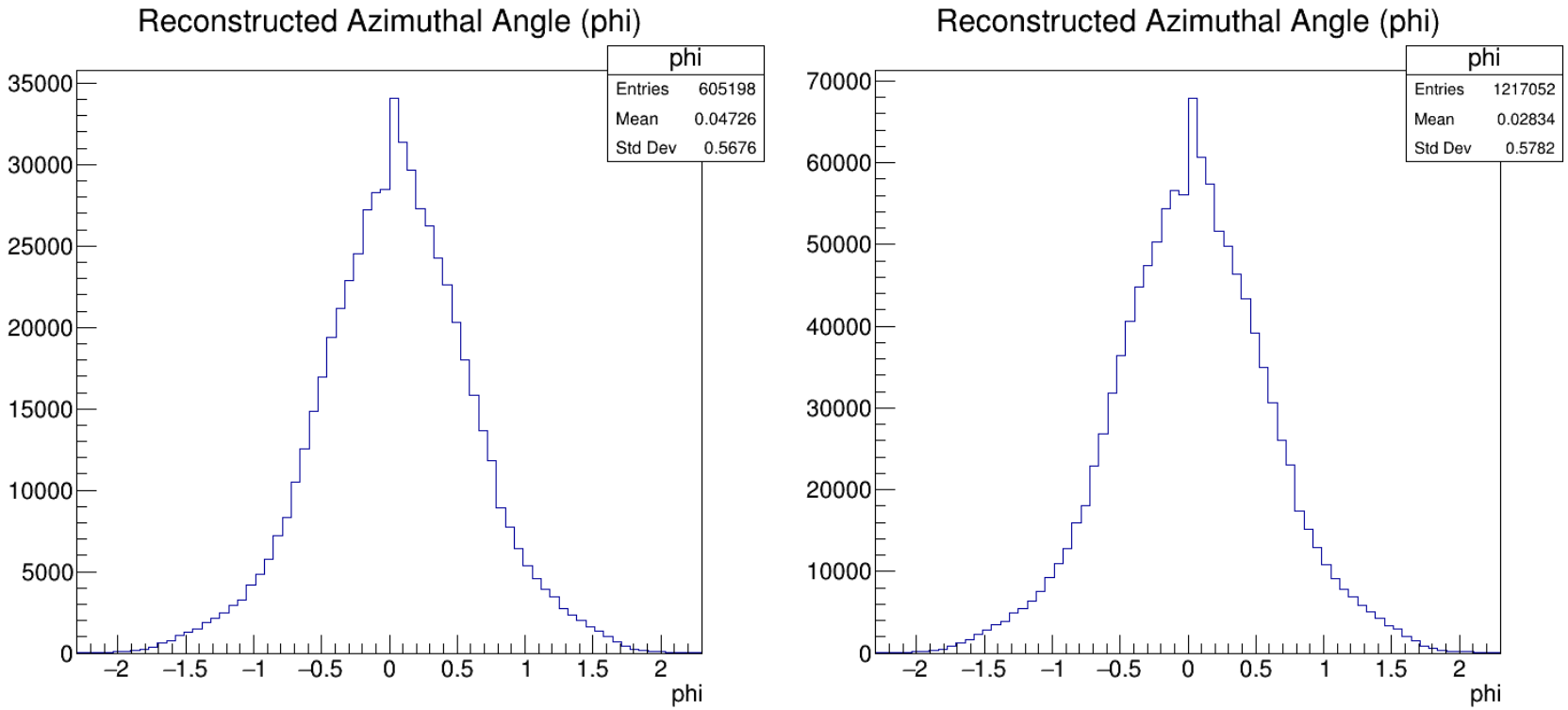


Figure: Reconstructed azimuthal angle in simulation (left) and measurement (right).

Comparison with Measurement - Rekonstruierte Position

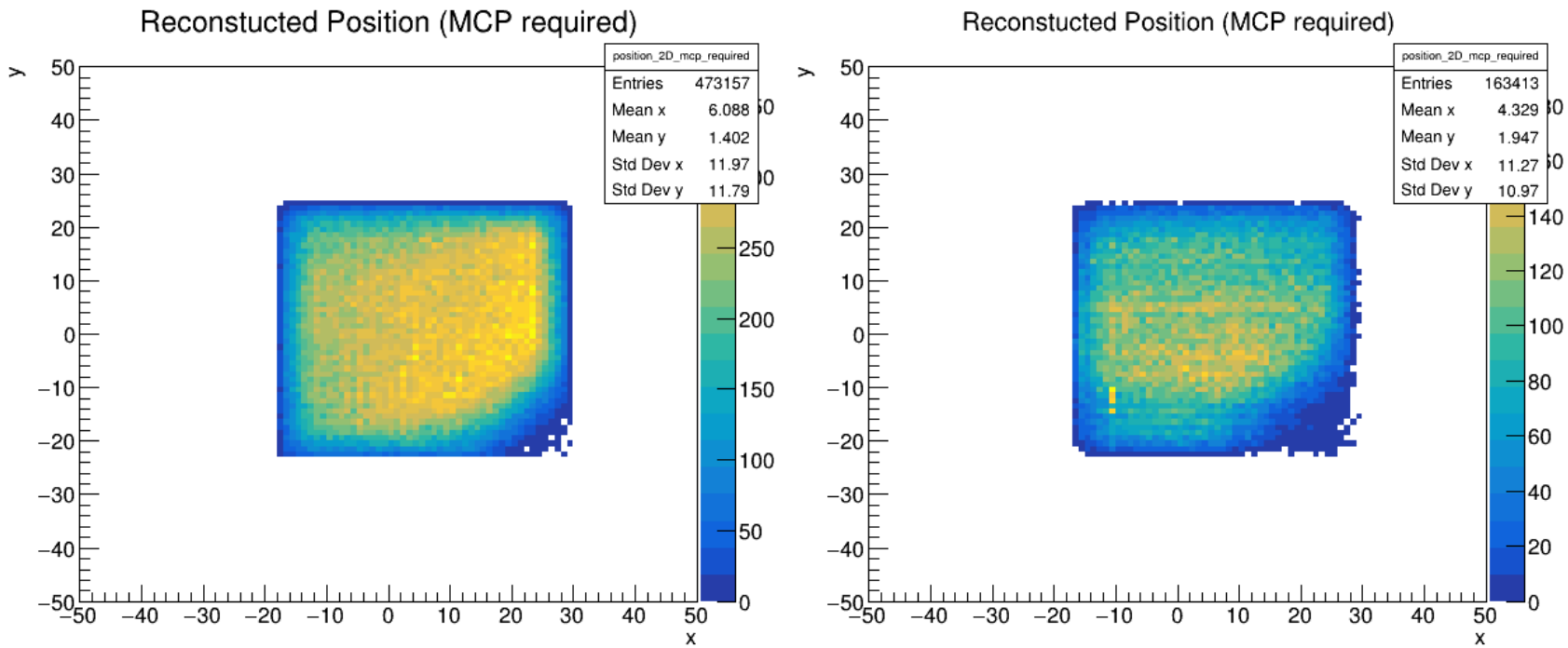


Figure: Histogram of the reconstructed xy-positions for events with MCP activity.

Comparison with Measurement - Channel Distribution

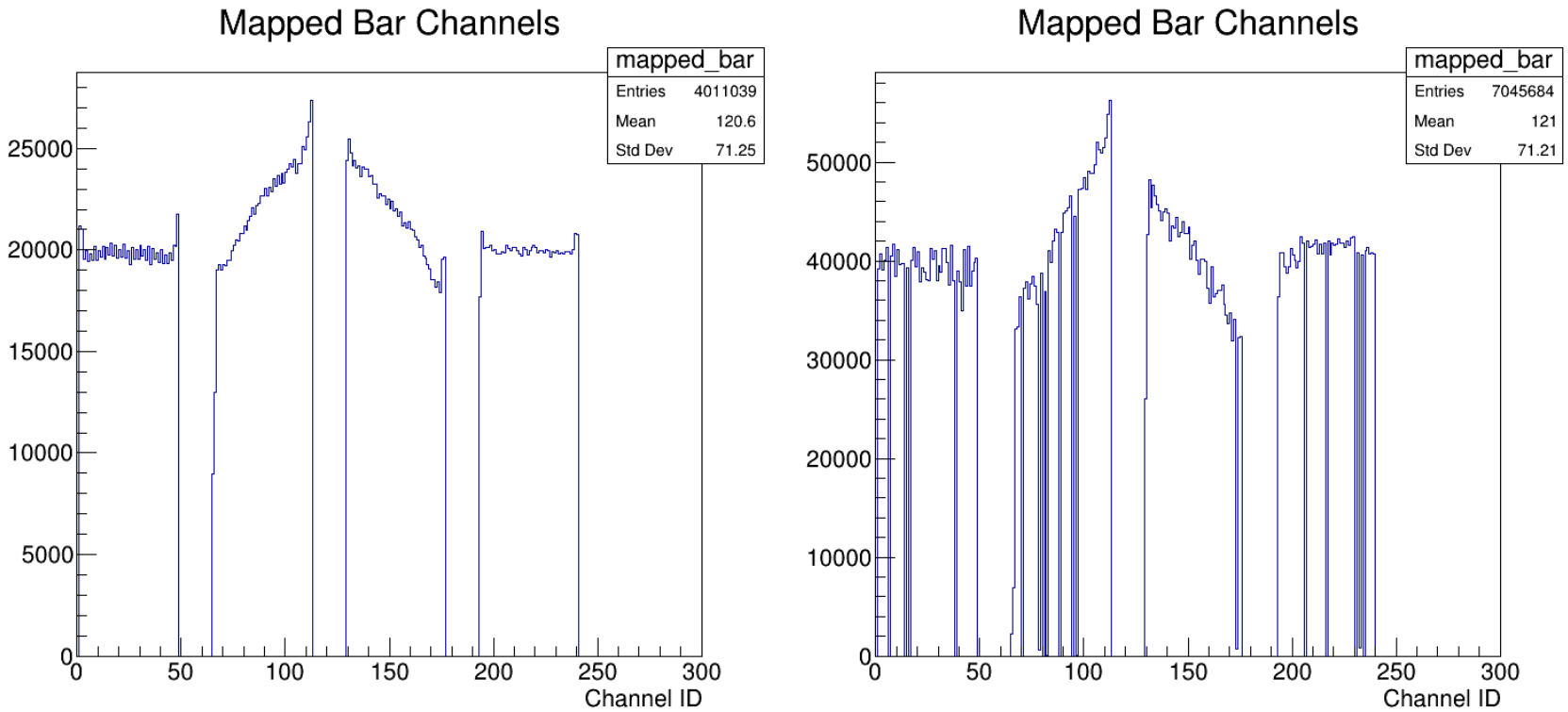


Figure: Channel distribution in simulation (left) and measurement (right) for valid tracking events.

Comparison with Measurement - Channel Distribution (w. MCP)

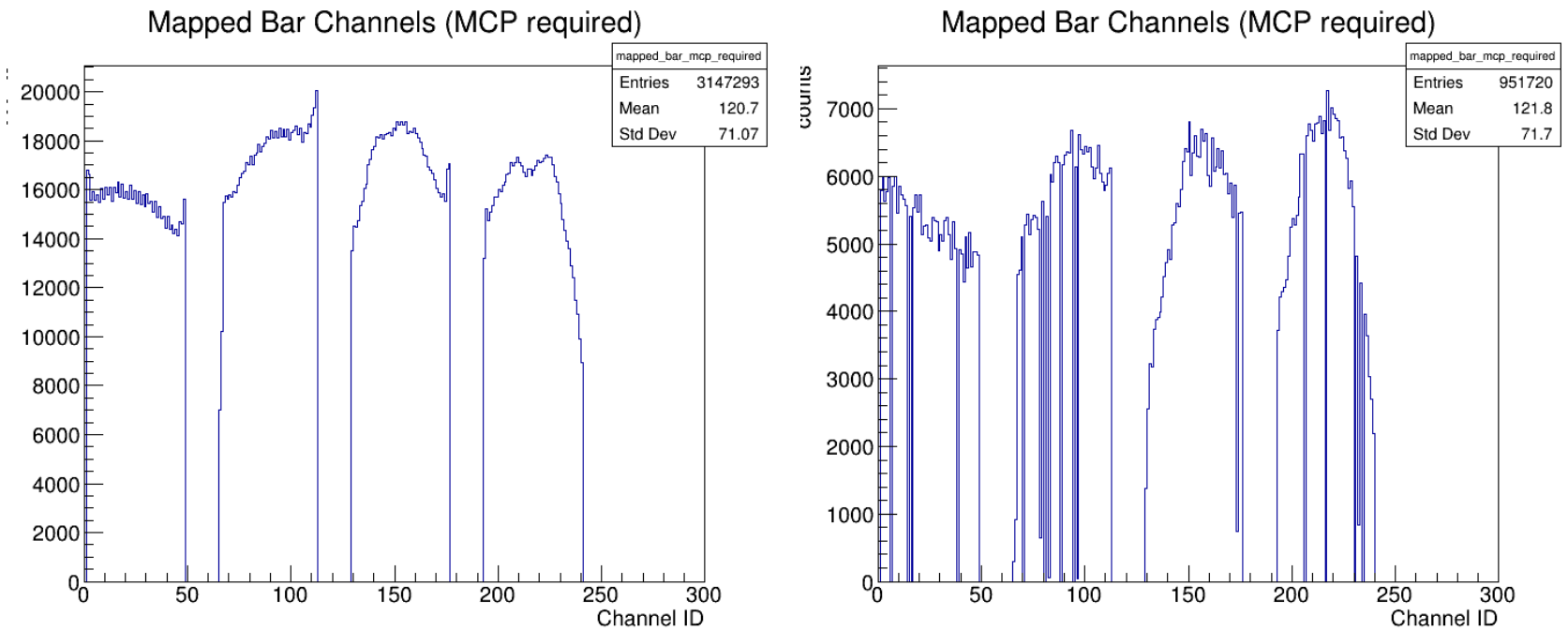


Figure: Channel distribution in simulation (left) and measurement (right) for events in coincidence with MCP.

Comparison with Measurement - Pixel vs. Polarwinkel

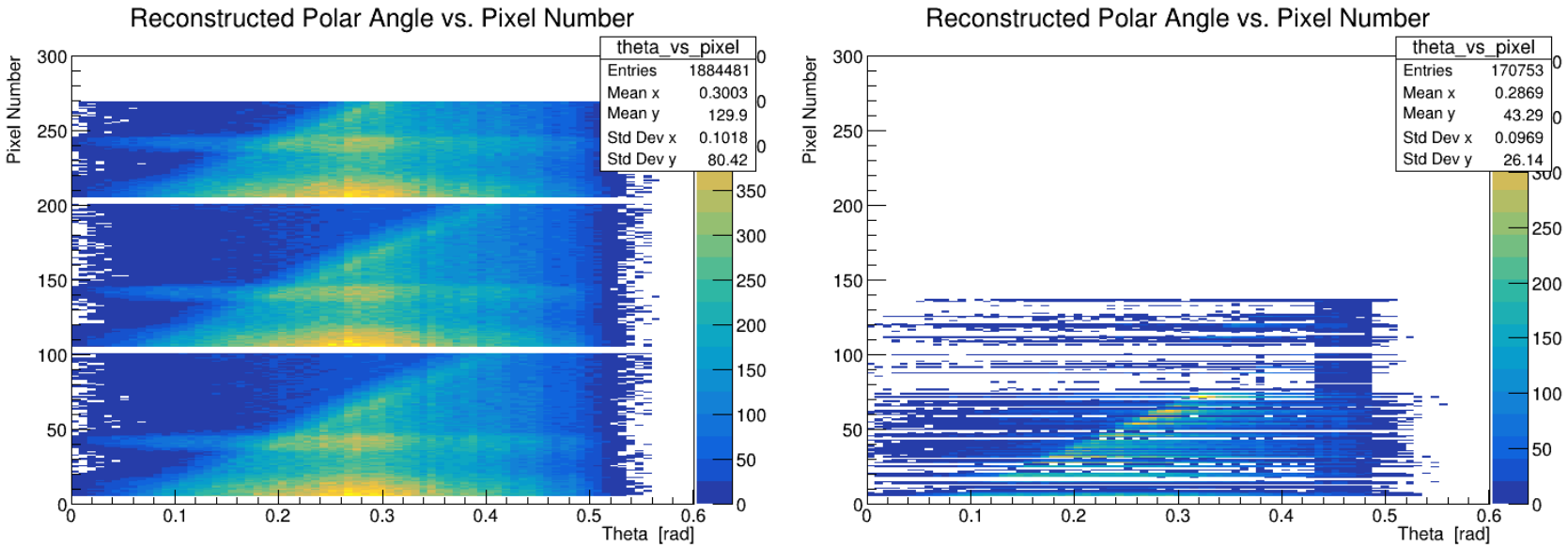


Figure: Hit MCP pixels versus the reconstructed polar angle in simulation (left) and measurement (right).

Comparison with Measurement - Pixel vs. Azimuthal Angle

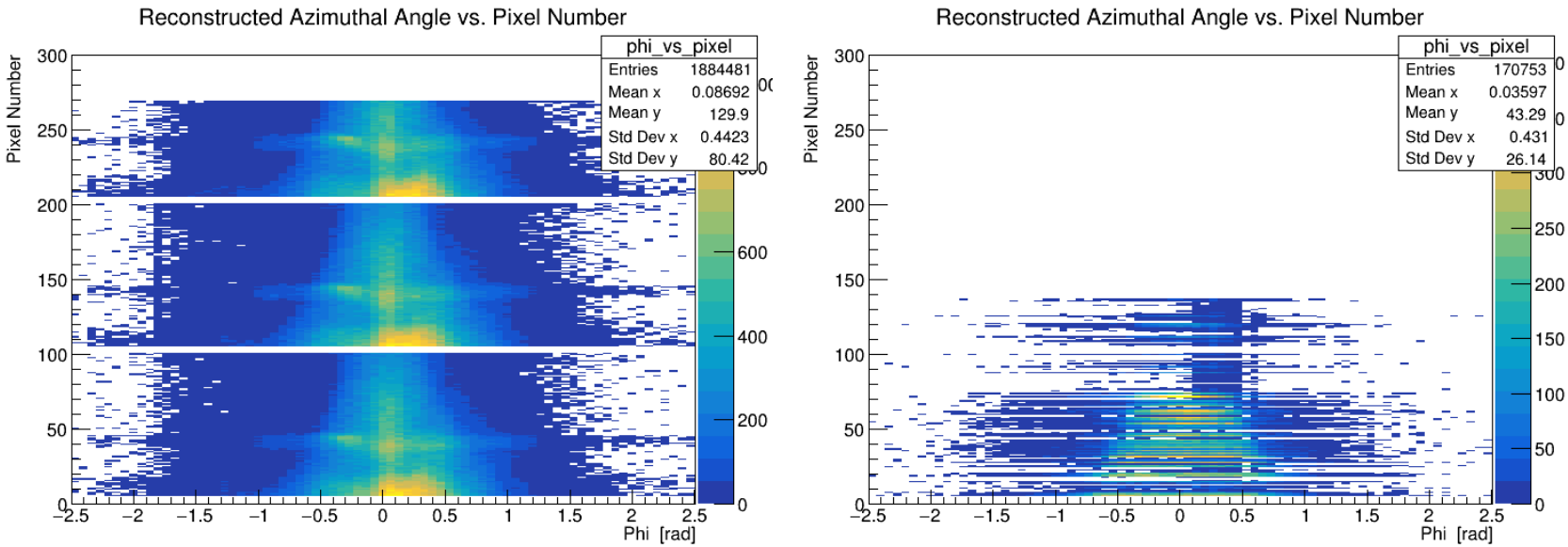


Figure: Hit MCP pixels versus the reconstructed azimuthal angle in simulation (left) and measurement (right).

Comparison with Measurement - Hit Multiplicity

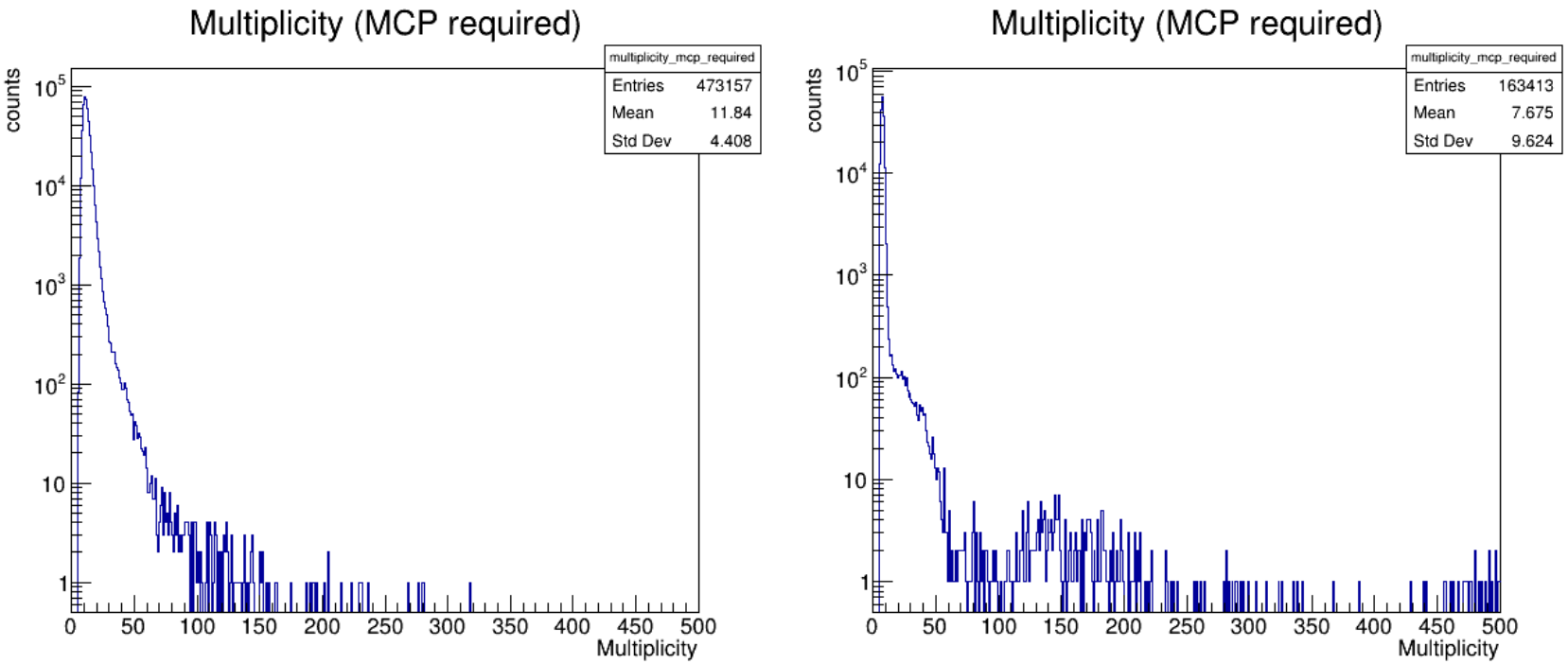
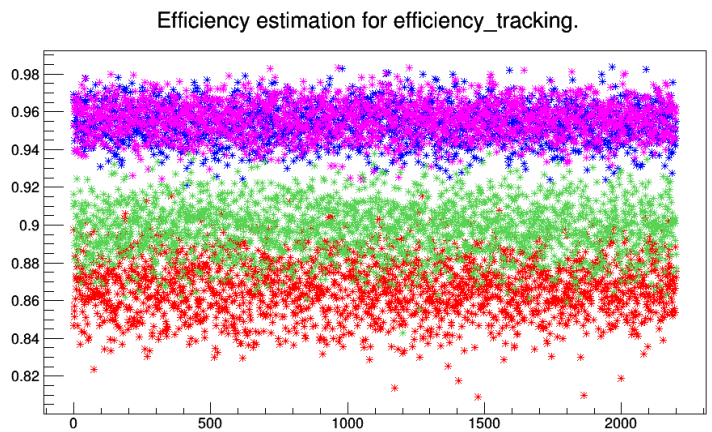


Figure: Hit multiplicity in simulation (left) and measurement (right).

Comparison with Measurement - Detection Probability



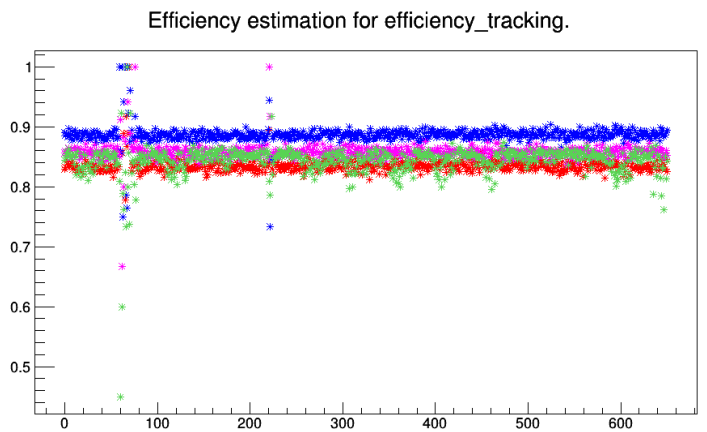


Figure: Detection probability for each tracking box in simulation (left) and measurement (right).

Summary

Simulation

- Simulation reproduces tracking well
- Deviations in MCP Pixel distributions
  - Reflection probability
  - Quantum efficiency and optical grease (wavelength cut)

Measurement

- Some suppressed channels
- MCP signal quality
- Tracking seems to be stable

Thank you!

Backup Slides