

Status of the Barrel DIRC Prototype Test Beam Data Analysis

Grzegorz Kalicy

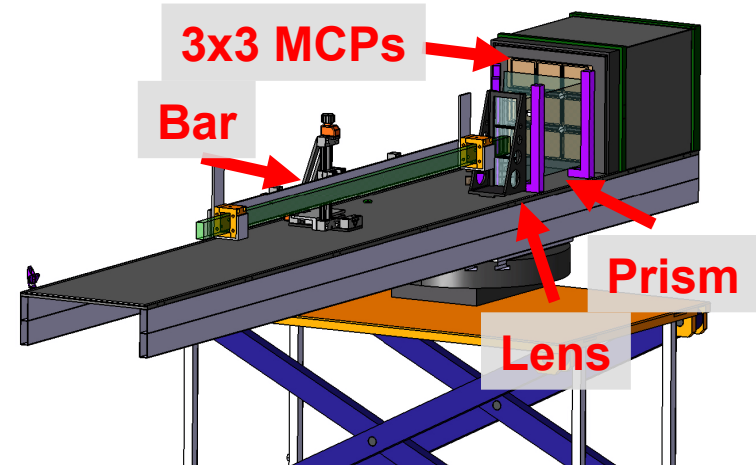
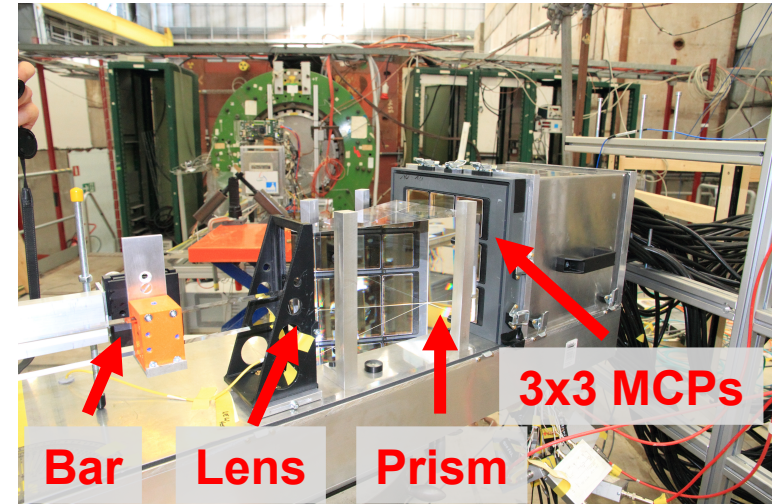
GSI, Darmstadt
Goethe Universität Frankfurt

**PANDA Collaboration Meeting
at GSI**
June 25, 2013



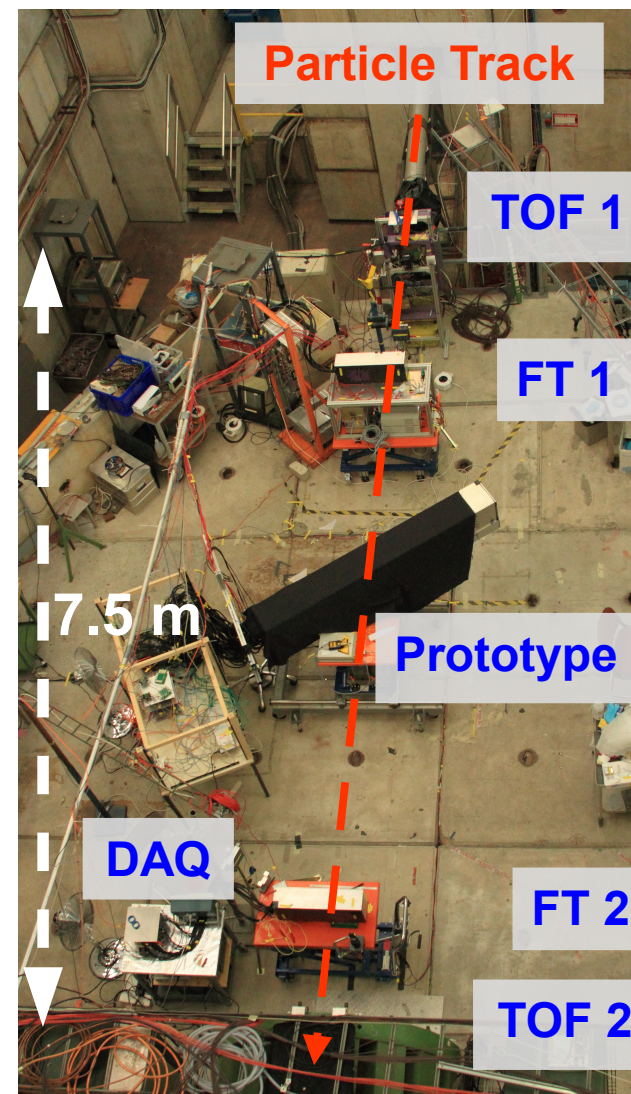
Test Beam 2012 Varied parameters

- **Focusing** (different lenses, no lens - w/ and w/o air gap)
- **Bar prototypes** (InSync, LZOS, Zeiss, Lithotec, acrylic glass)
- **Coupling MCP/prism/bar** (matching liquid, optical grease, silicone sheet)
- **Beam momentum** (for PID study)
- **Polar/azimuth angle of beam to bar** (fine and coarse step polar angle scans)
- **Beam position** (mainly z) on bar



Test Beam 2012 Varied parameters

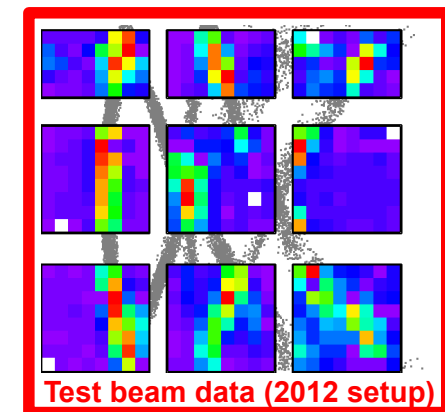
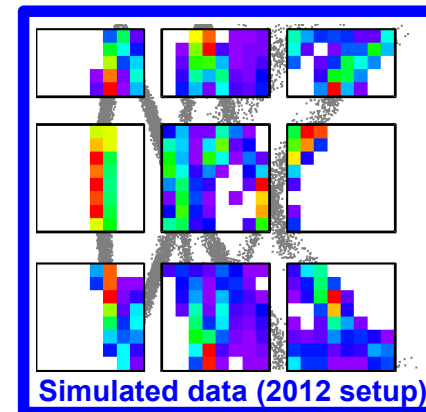
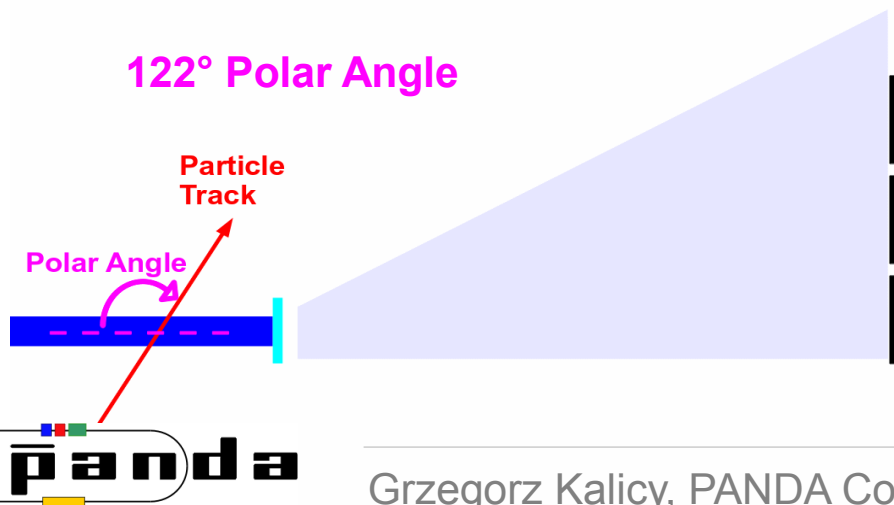
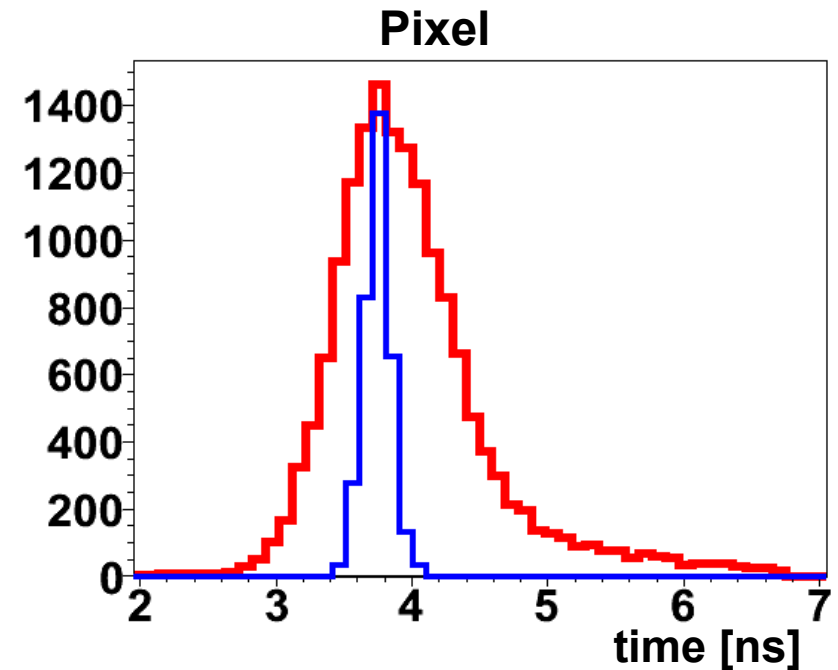
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Data Analysis Time resolution

Time resolution [ns] :

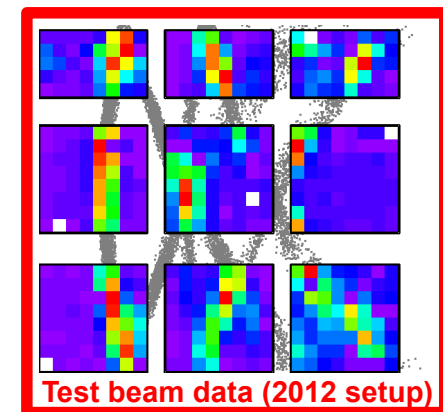
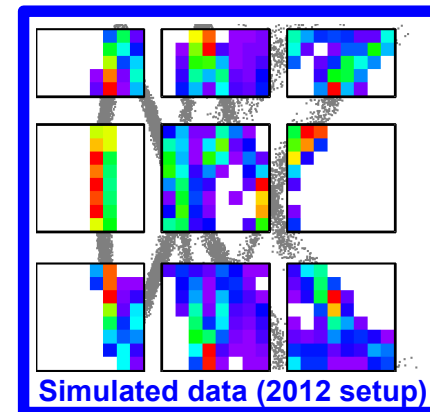
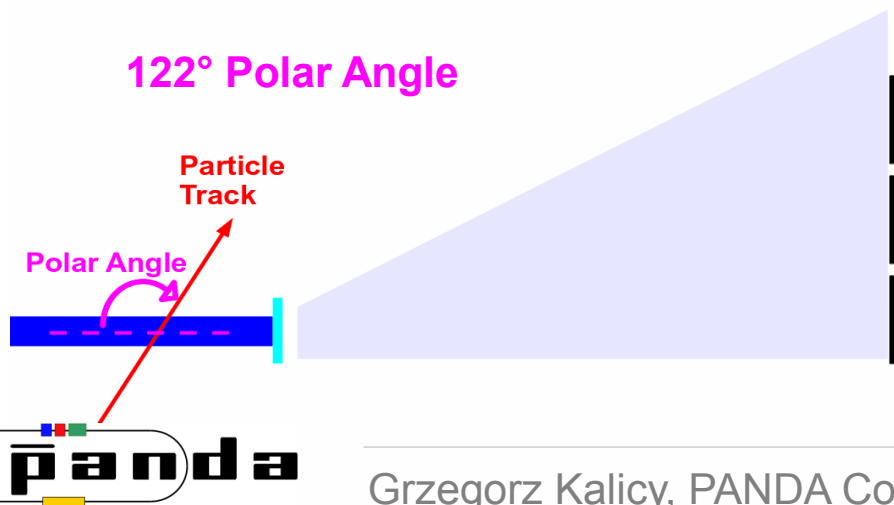
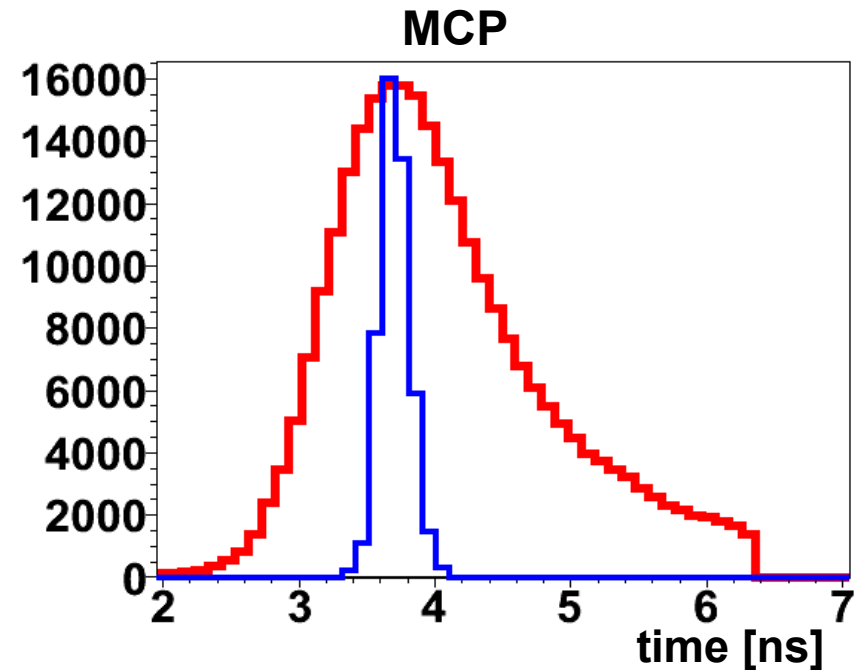
	Test beam	Monte Carlo
Pixel	0.38	0.08
MCP	0.78	0.11
TRB	0.90	X
System	0.97	0.36



Data Analysis Time resolution

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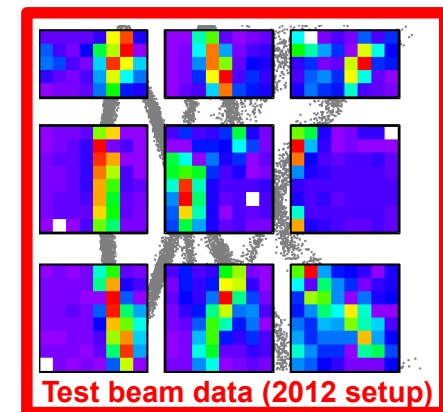
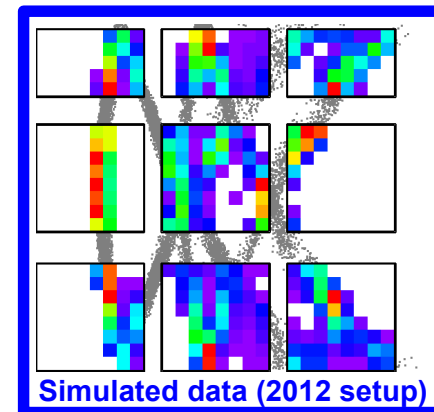
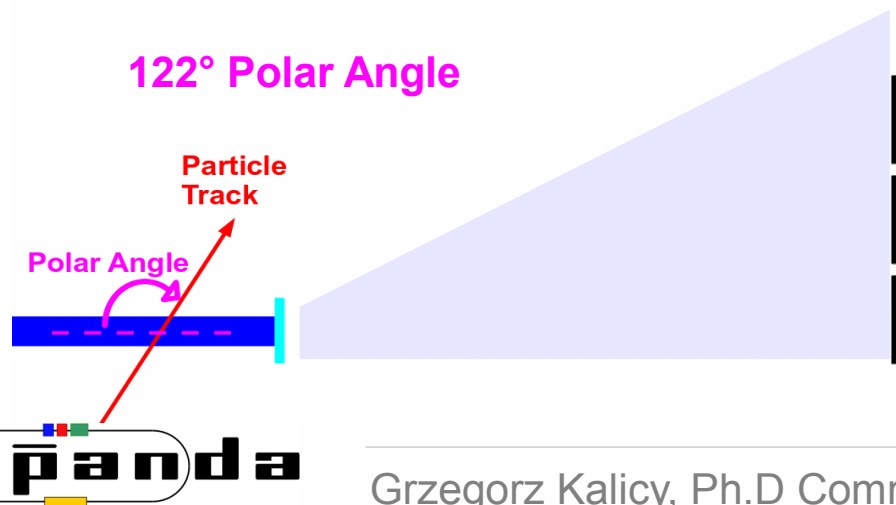
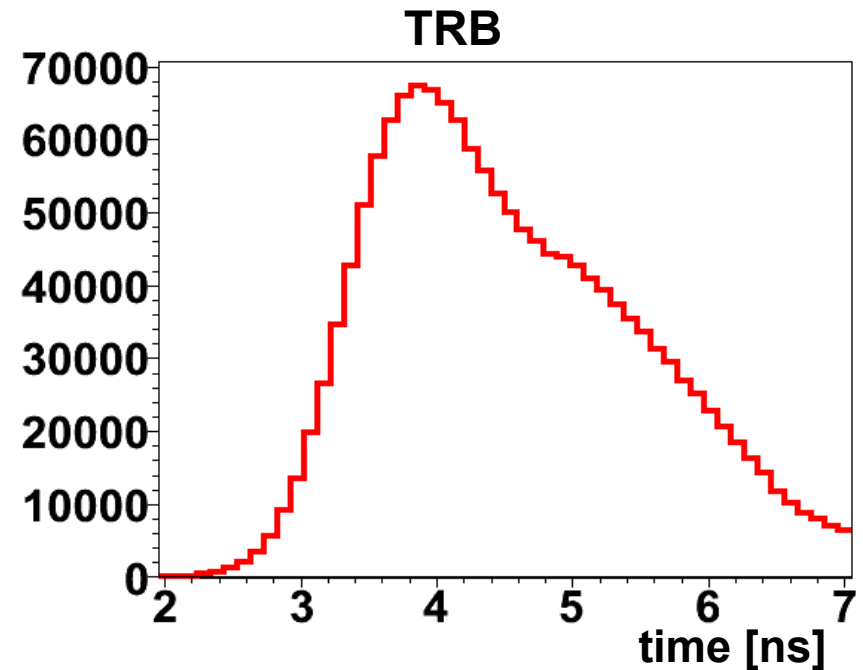
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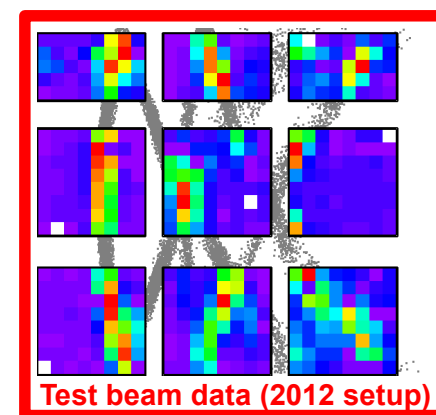
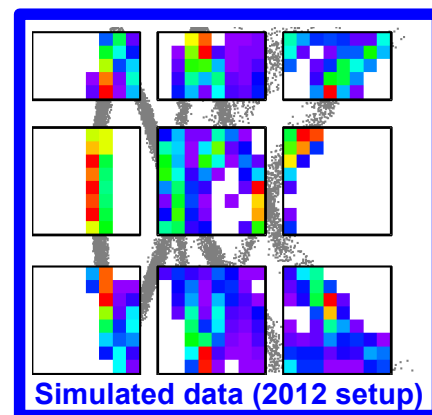
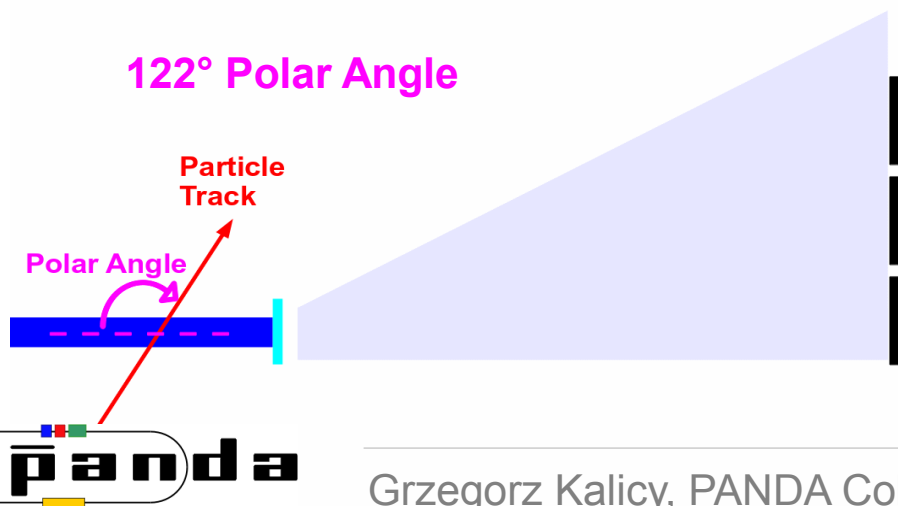
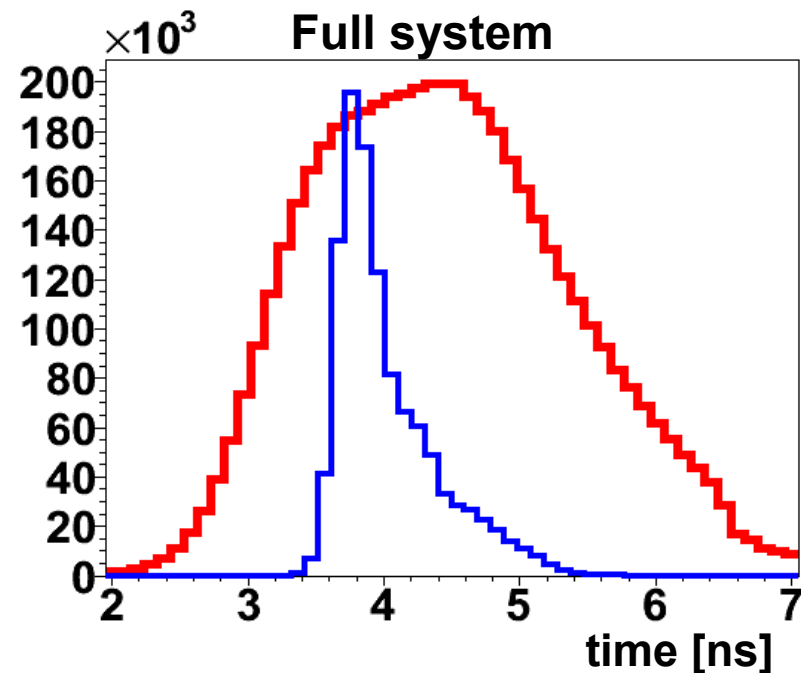
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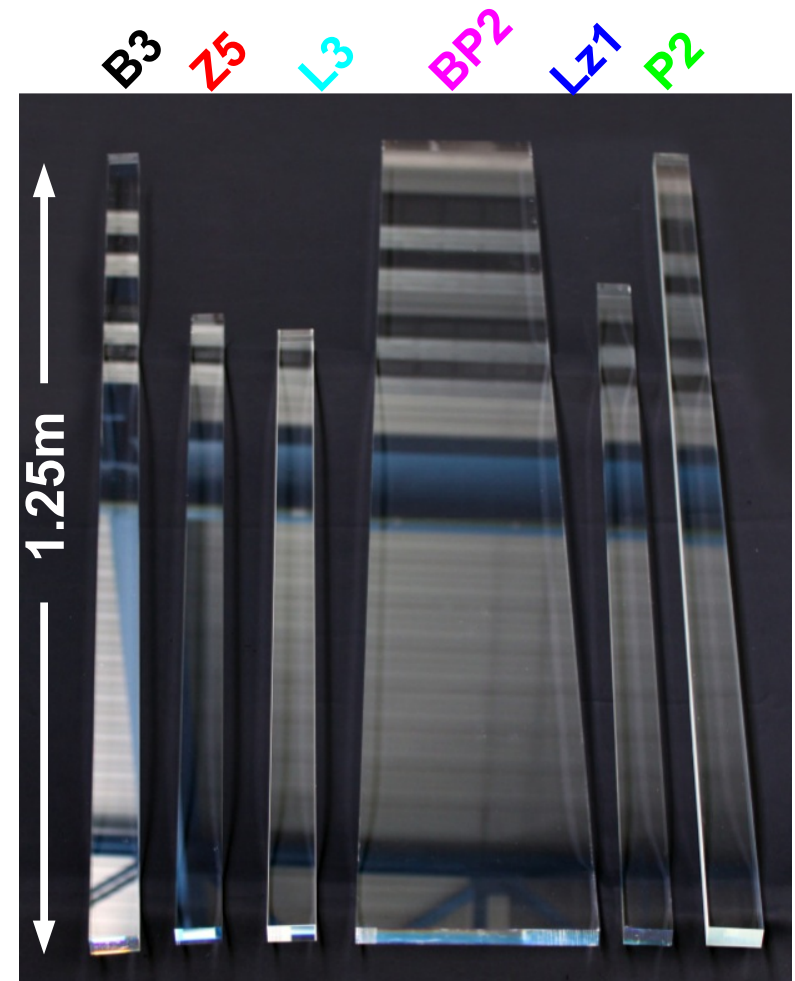
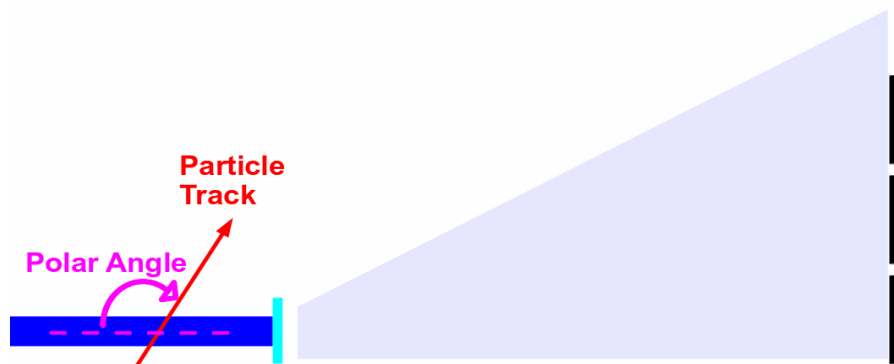
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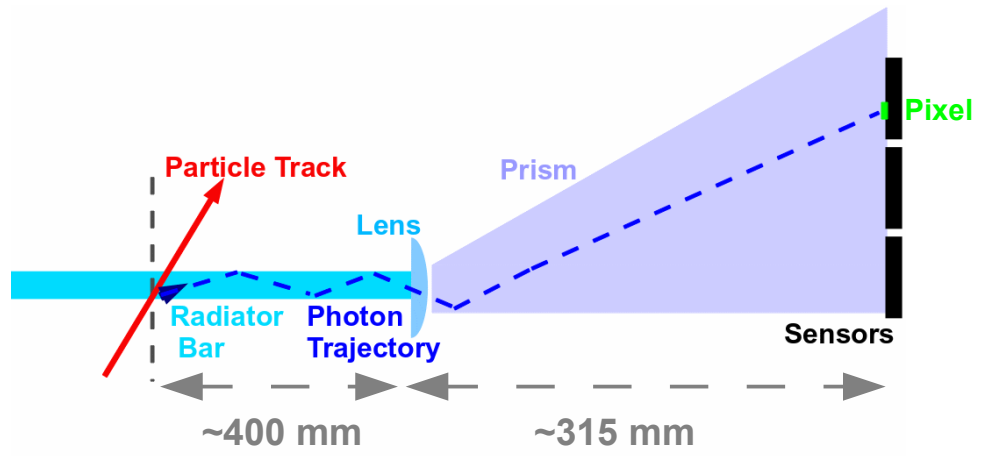
Data Analysis Different prototype bars

- **B3** – InSync Inc
- **Z5** – Zeiss
- **L3** – Shott Litchotec
- **BP2** – InSync Inc
- **Lz1** – Lytkarino
- **P2** – Röhme (Acrylic glass)

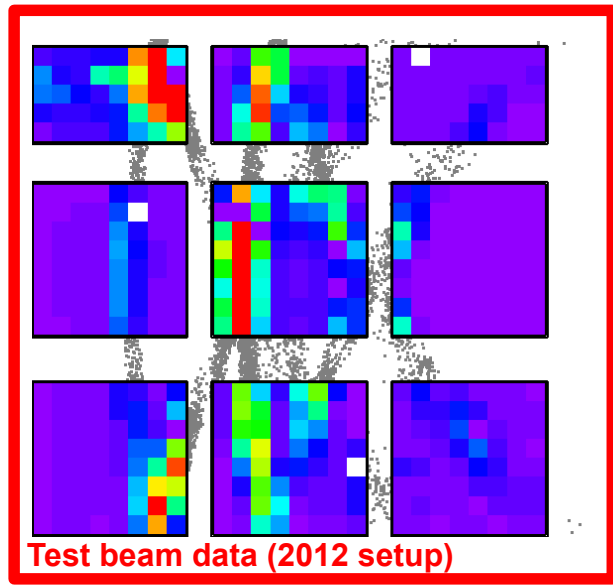


Radiators used in 2012 test beam

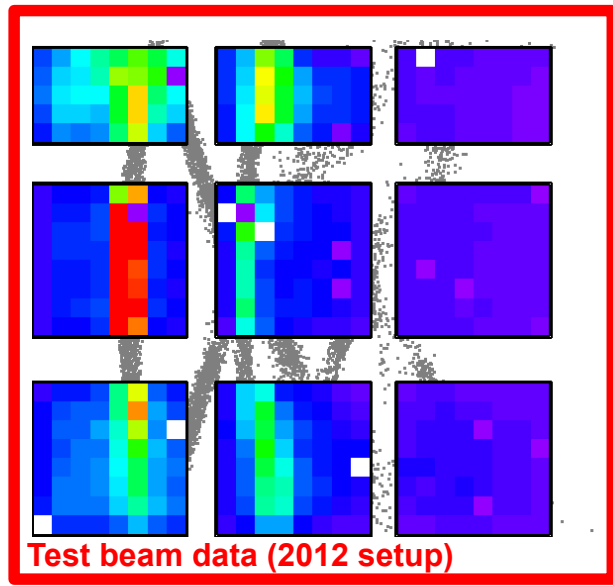
Data Analysis Number of hits per track



B3:



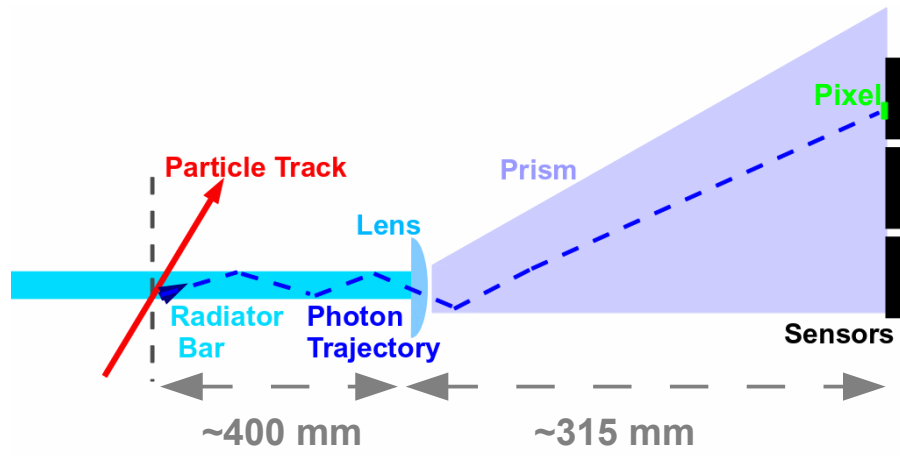
P2:



Bar	Test beam	Monte Carlo
B3	23.7	18.7
Z5	21	19.3
L3	20.7	18.9
Lz1	20.2	18.0
P2	6.9	21.9

(Test beam data including contribution from crosstalk effects)

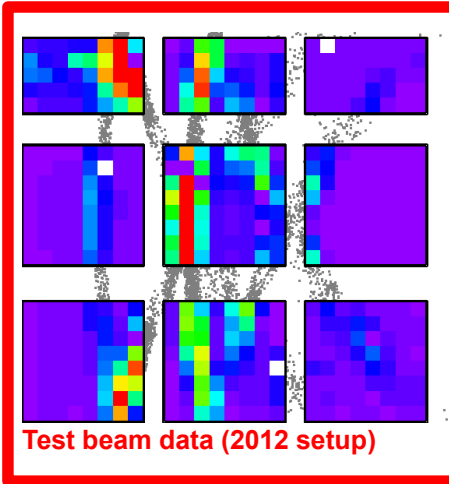
Data Analysis Single photon Cherenkov angle reconstruction



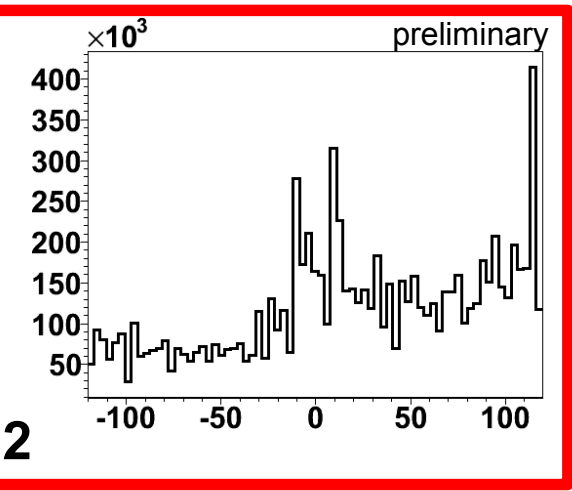
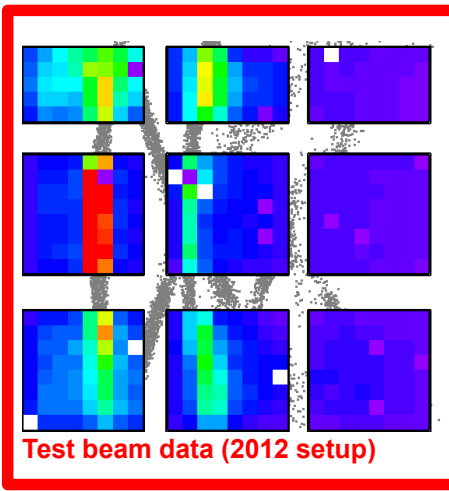
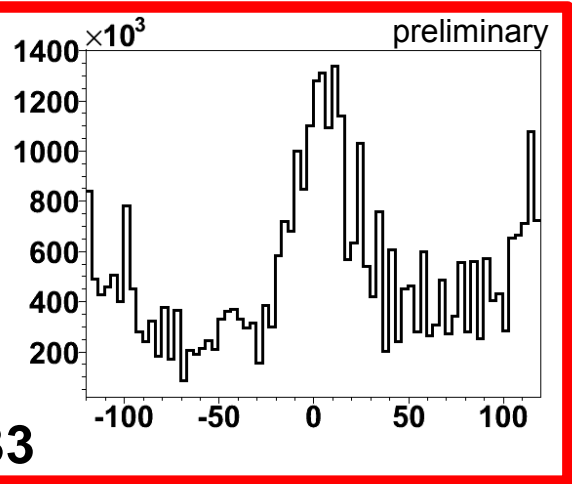
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(Test beam data including contribution from crosstalk effects)

Normalized occupancy plots



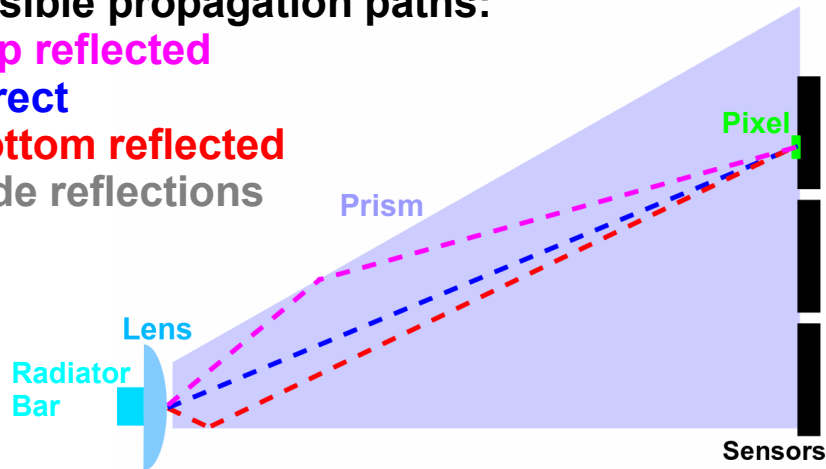
Reconstructed single photon Cherenkov angle resolution



Data Analysis Single photon Cherenkov angle reconstruction

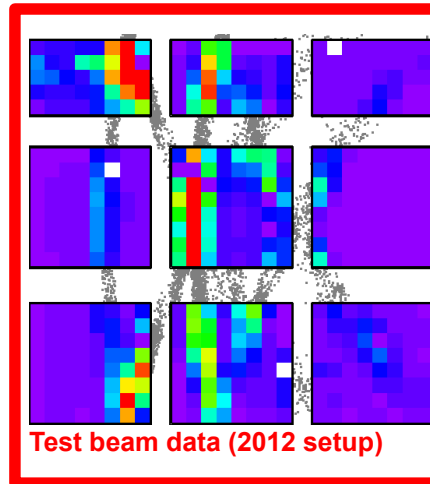
Possible propagation paths:

- **Top reflected**
- **Direct**
- **Bottom reflected**
- **Side reflections**

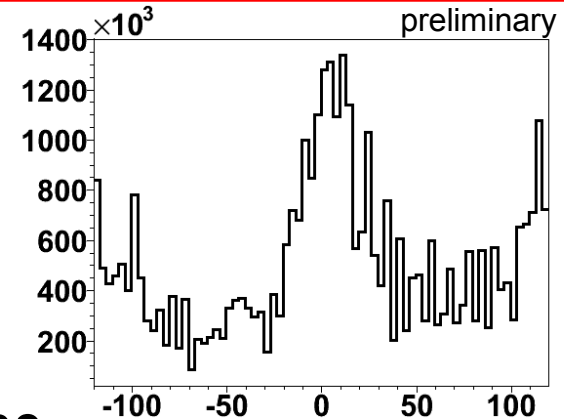


- **Path pixel – bar not unique**
combinatorial background in Θ_c
not easy to handle even in Monte Carlo data.

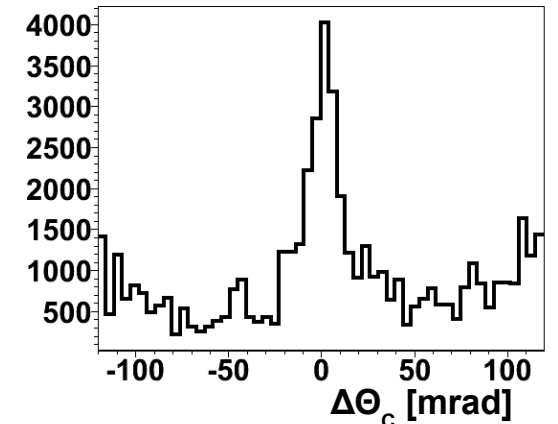
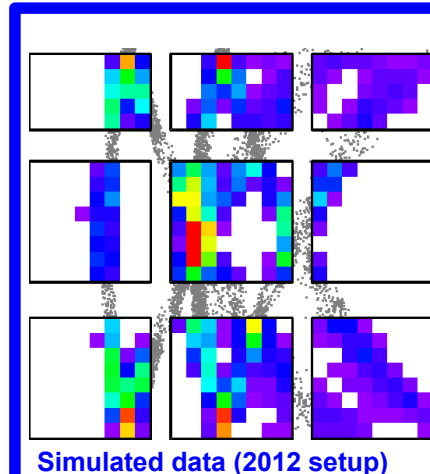
Normalized occupancy plots



Reconstructed single photon Cherenkov angle resolution



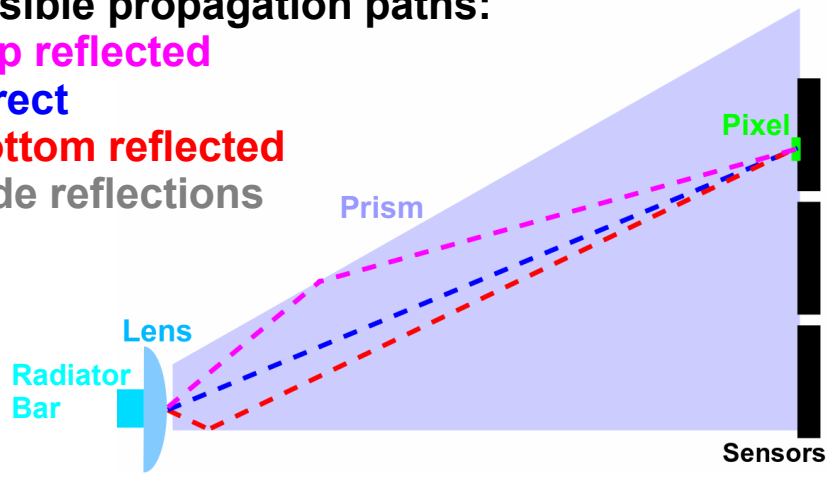
B3



Data Analysis Combinatorial background in Θ_c

Possible propagation paths:

- Top reflected
- Direct
- Bottom reflected
- Side reflections



• Possible photon paths:

- Bar ambiguities
- Prism ambiguities

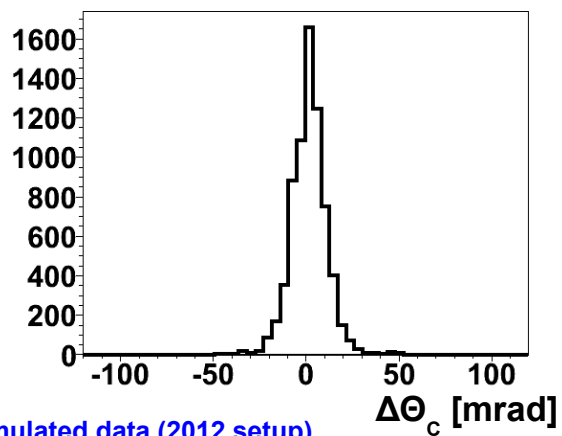
• Time cut:

$(t_{\text{measured}} - t_{\text{expected}})$ can be used to solve some of the ambiguities.

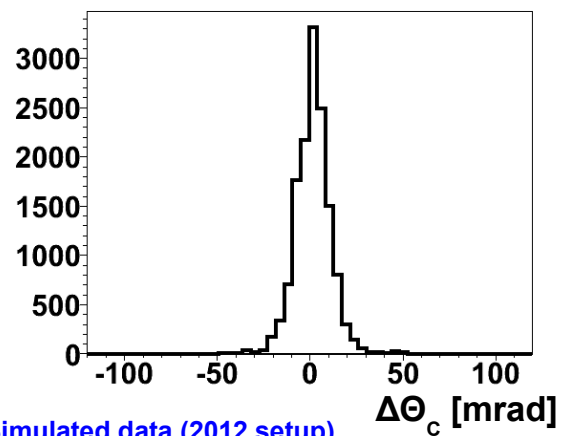
No ambiguities

Only bar ambiguities

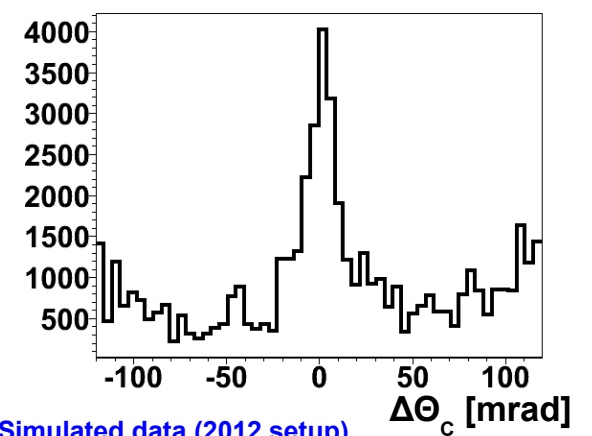
Bar & Prism ambiguities



Simulated data (2012 setup)



Simulated data (2012 setup)



Simulated data (2012 setup)

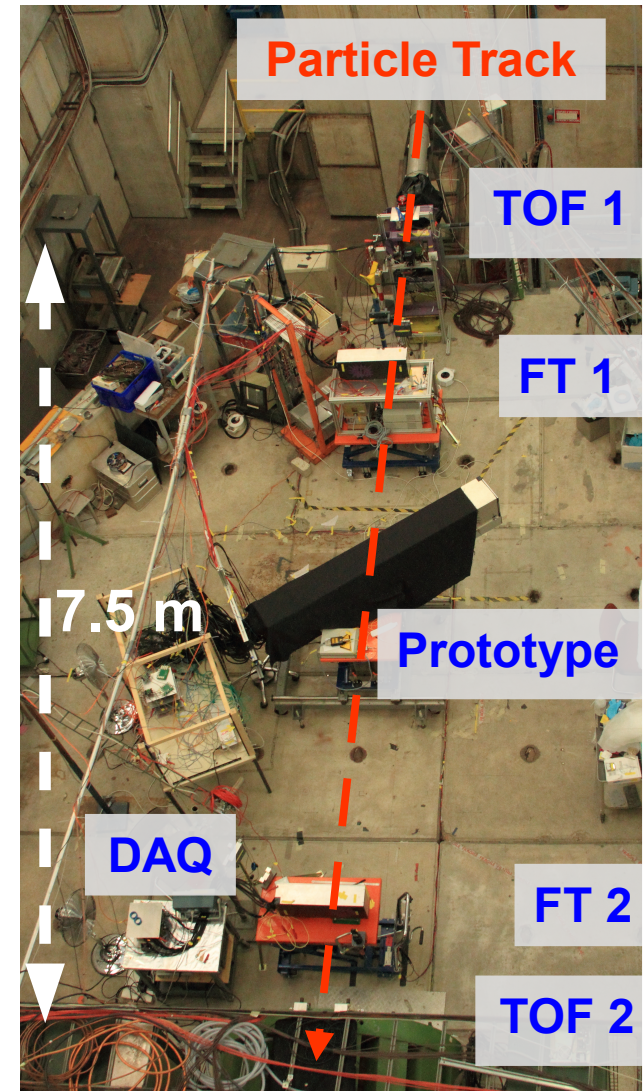
CERN Test Beam Data Update

- **Time resolution:** Poor due to the slow start counter and lack of usable calibration data.
- **Bar prototypes** (InSync, LZOS, Zeiss, Lithotec, acrylic glass). Significant differences in light yield observed.

Detailed study of single photon Cherenkov angle resolution in progress.

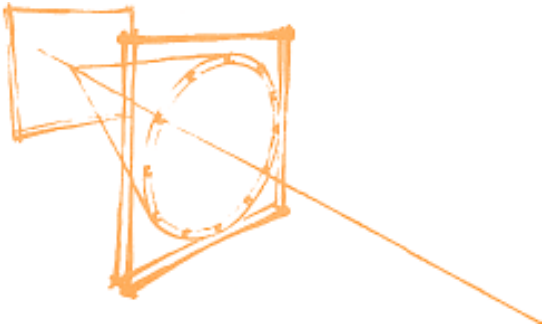
- **Prism geometry:** Combinatorial background understood.

Study how to handle it in reconstruction is ongoing.

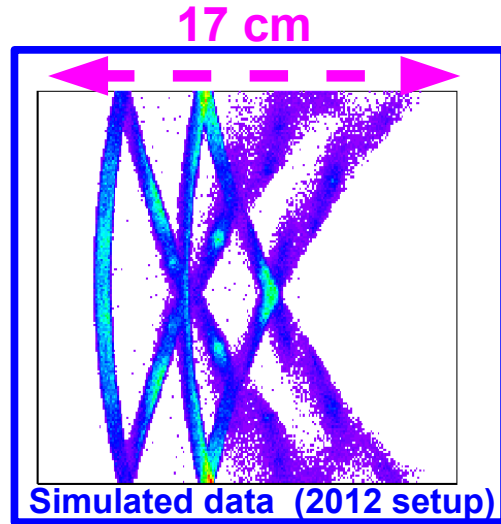
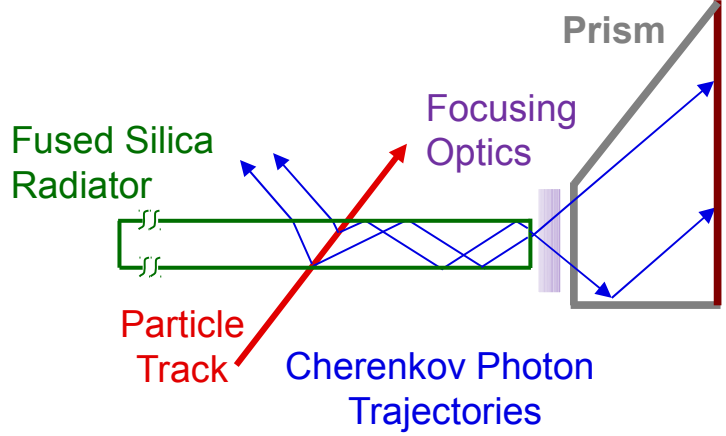
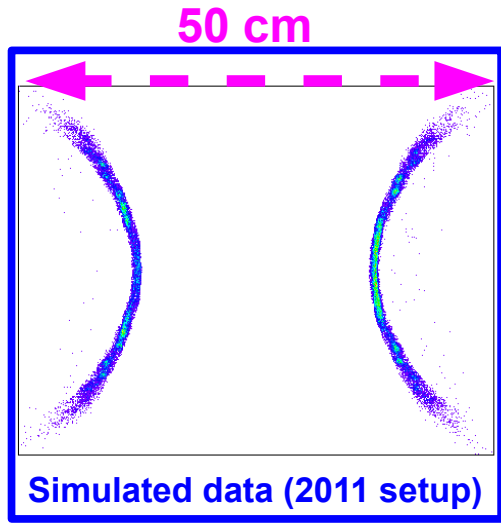
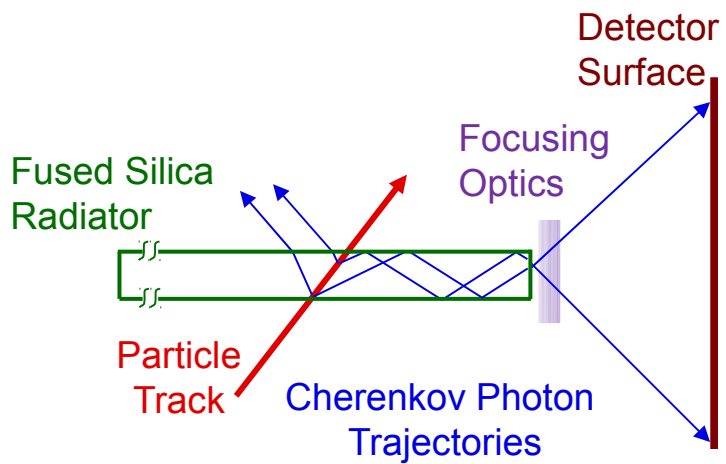


Backup Slides

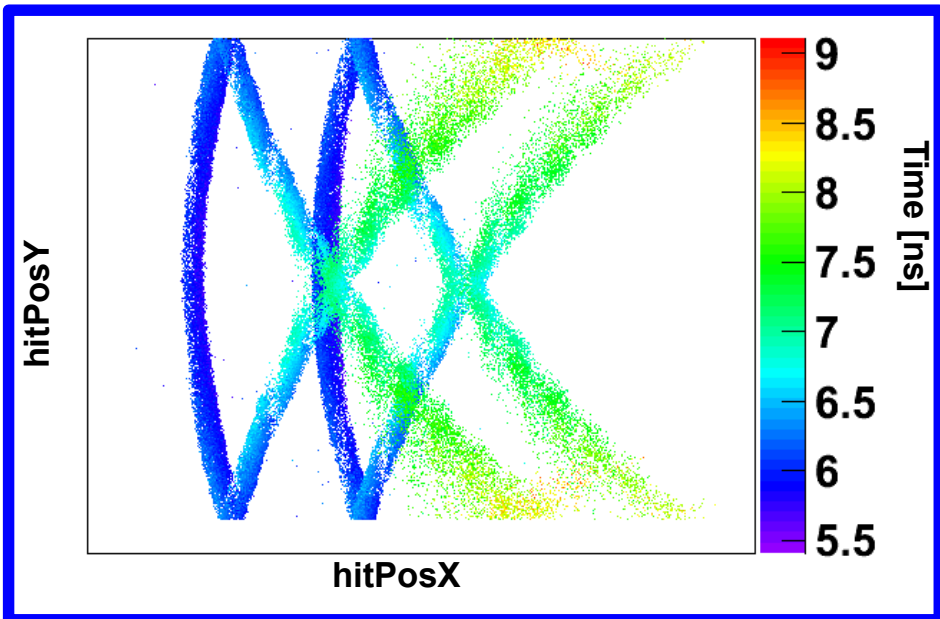
Test Beam 2012 Hit pattern



- DIRC hit patterns do not look like typical RICH detector.
- Part of the ring escapes, not totally internally reflected.
- Ring image gets folded due to propagation in bar/plate.
- Additional folding in the prism expansion volume.



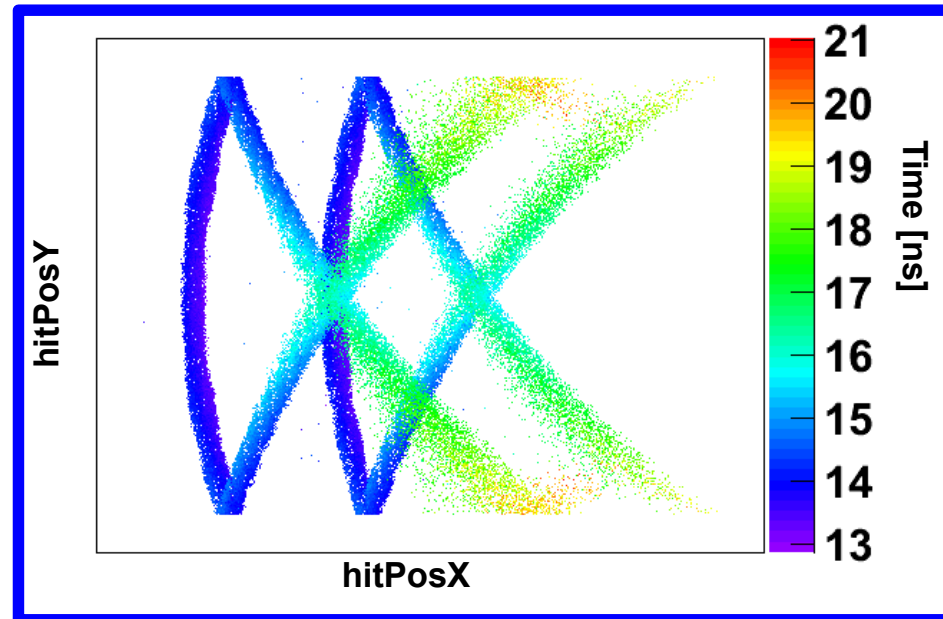
Monte Carlo data: X vs Y vs time [ns]



Particle Track: 123.4°

(33.4° in drc_prop)

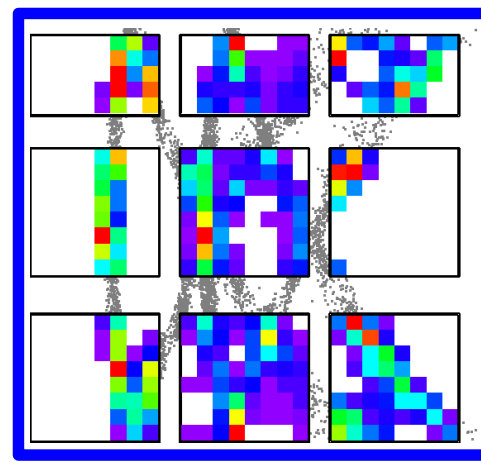
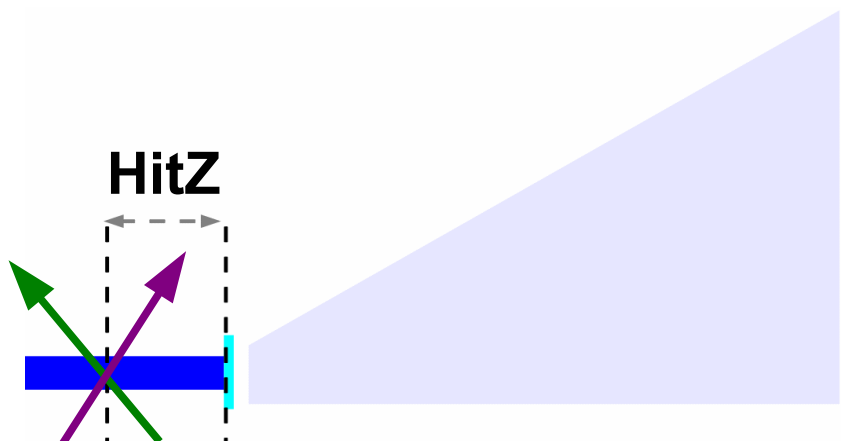
HitZ = 806 mm



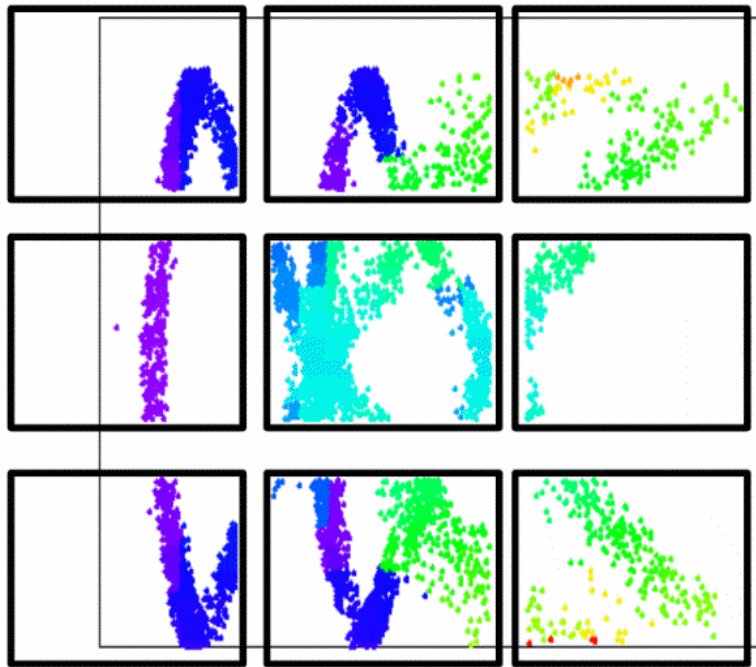
Particle Track: 57.6°

(-32.4° in drc_prop)

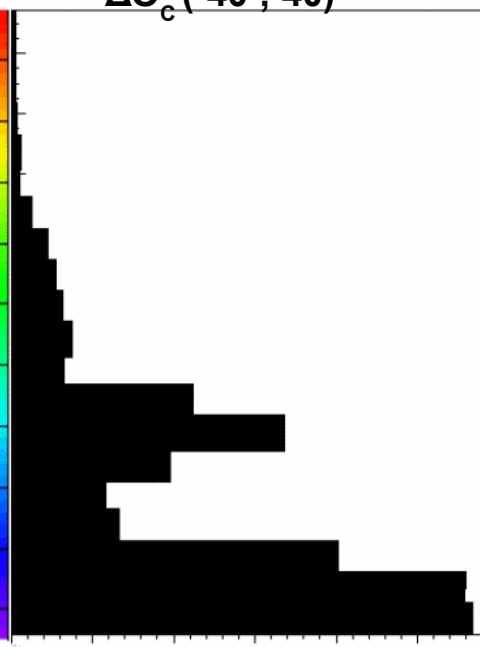
HitZ = 116 mm



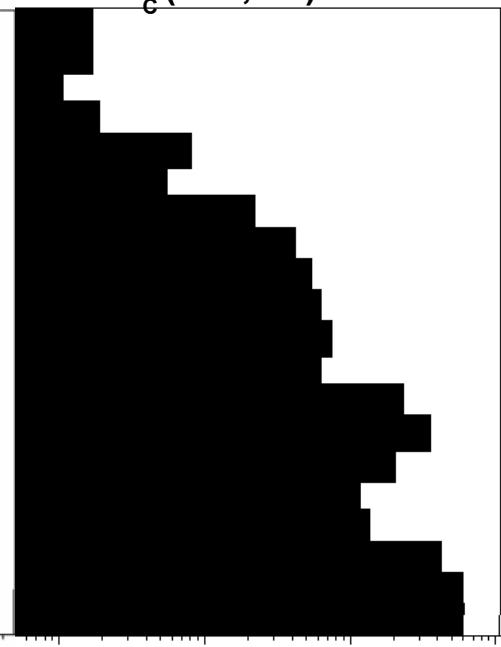
Monte Carlo data: X vs Y vs Nrefl (zoom)



Nreflections
 Monte Carlo data
 $\Delta\theta_c (-40 ; 40)$



Nreflections (log scale)
 Monte Carlo data
 $\Delta\theta_c (-40 ; 40)$



Simulation:

33.2°
 Lens: UV
 Air Gap: 3.2 mm
 Hit Z: 412 mm
 Step: 11.2 / 1.7 mm
 (17.1x35.9x1200 mm)

B3 Bar

