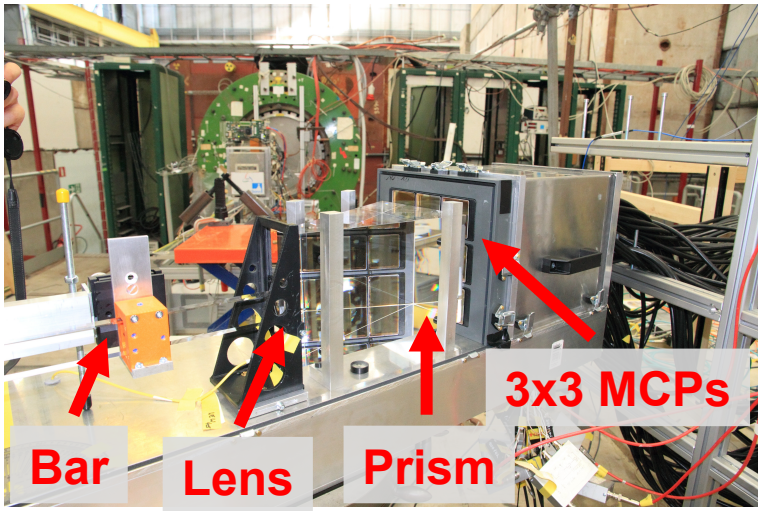
GSI Activities

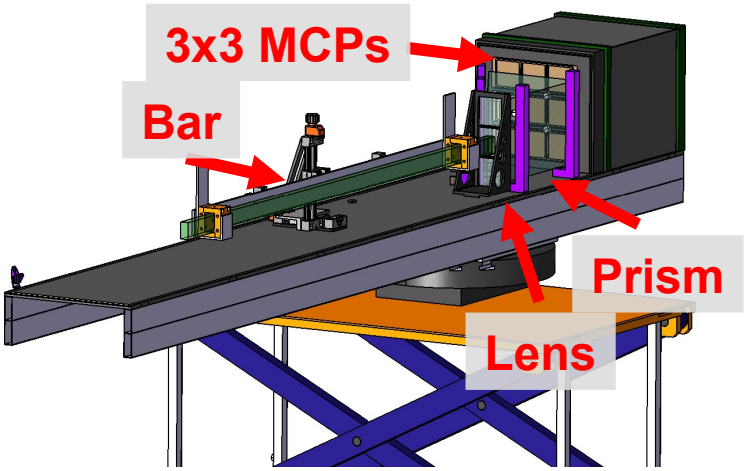
C.Schwarz, GSI

Test beam analysis
PID Reconstruction for plates
Electronic time resolution
Mechanical drawings
Radiator shape measurements

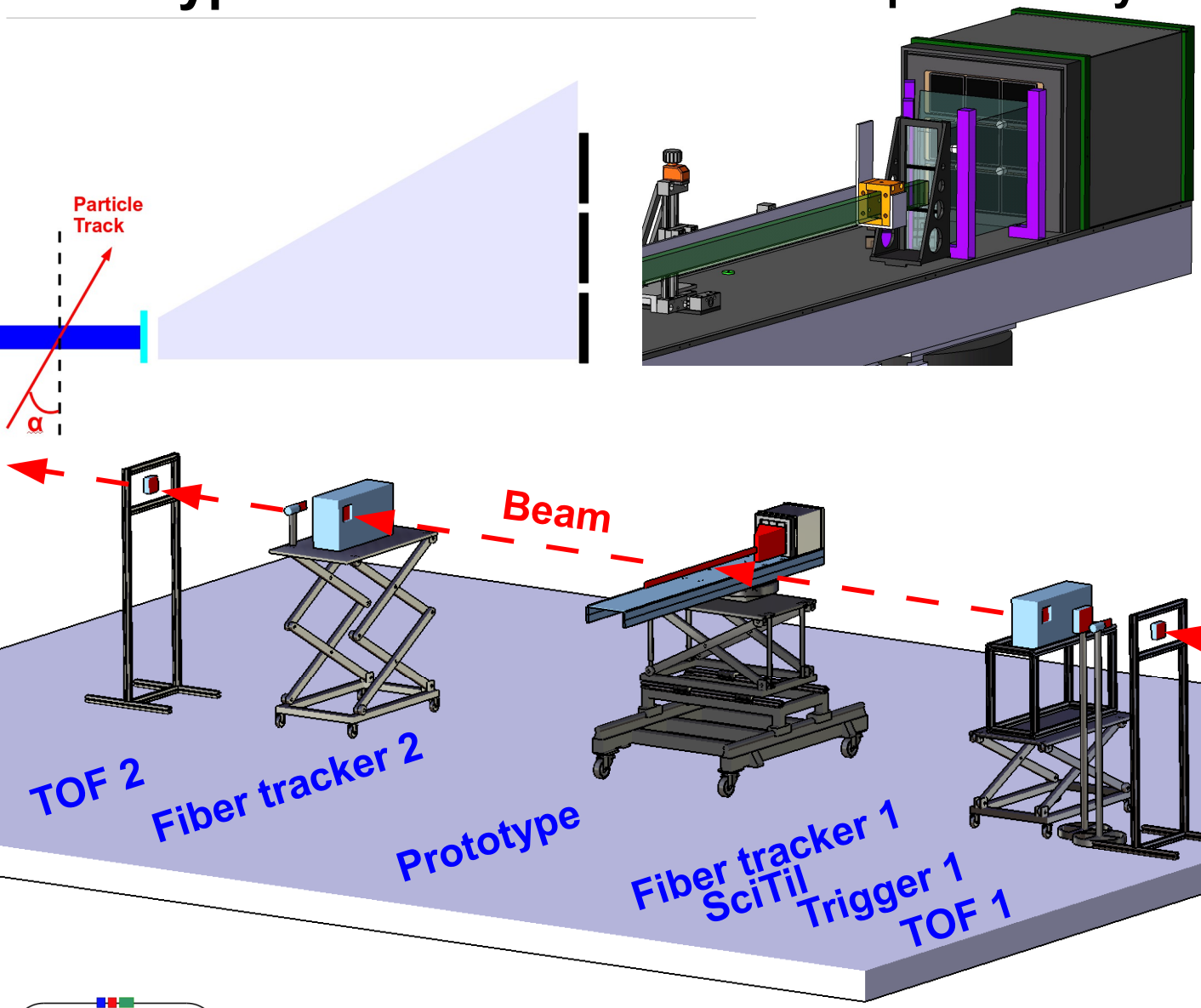
Test Beam 2012 Varied parameters

- **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**





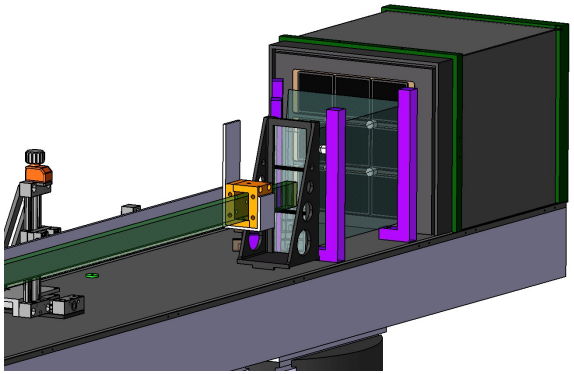
Prototype 2012 Additional tools to improve analysis

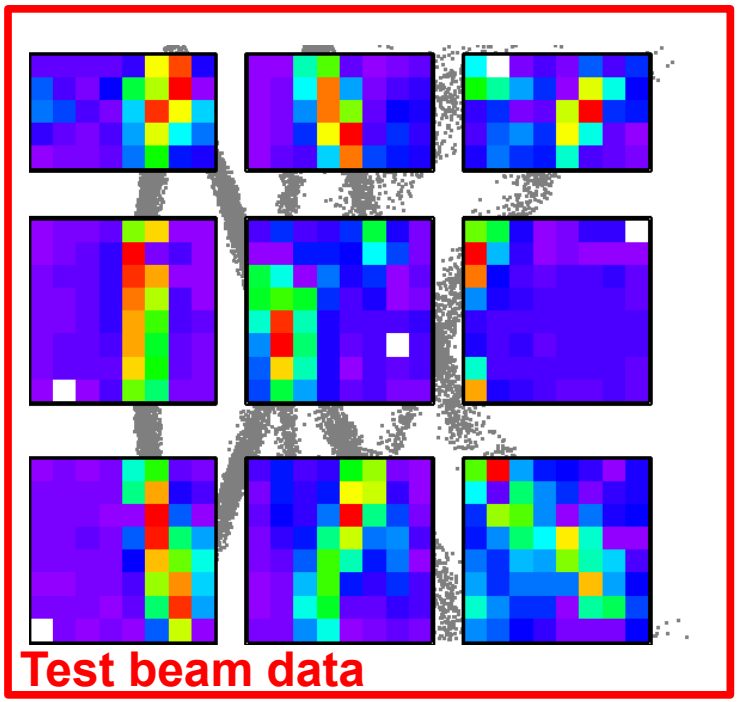


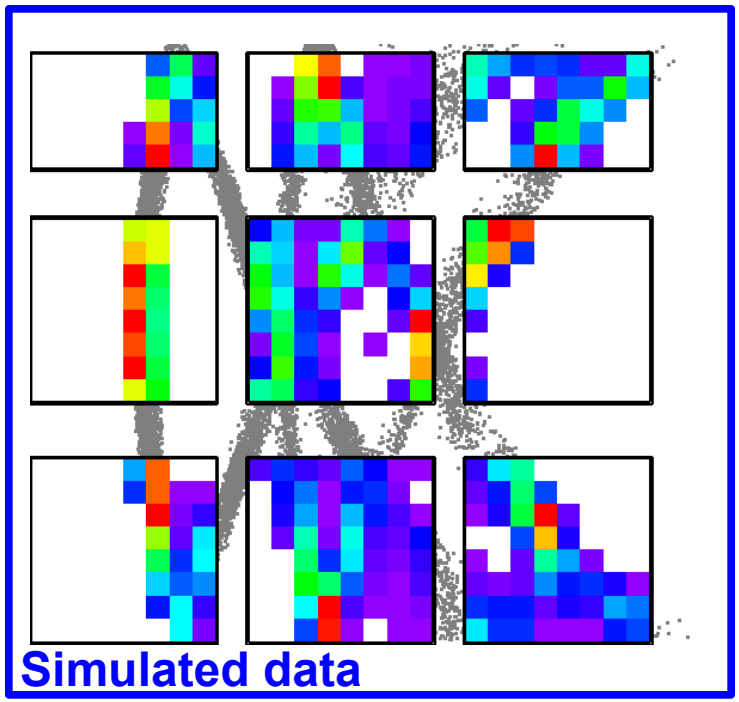
- **Triggers & SciTil** to improve timing
- **Fiber Trackers** to define better track direction
- **Time of flight system** to enhance pion/proton separation

Test Beam 2012 Comparison of the test beam data to simulation

- **Tuning Monte Carlo simulation to match test beam data:**
  - Using information from database
  - Vary the parameters within measurement uncertainty



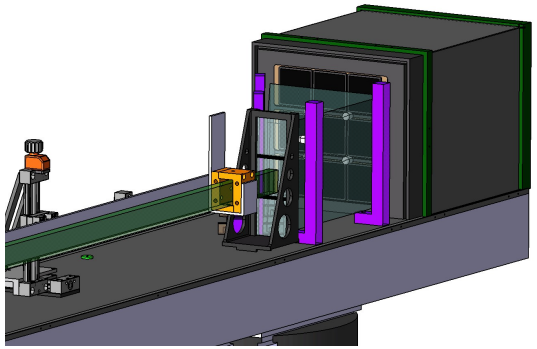


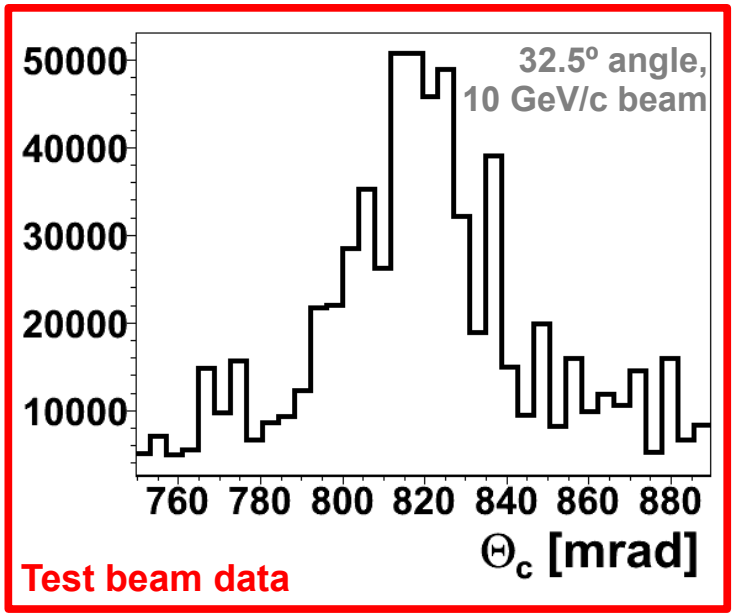


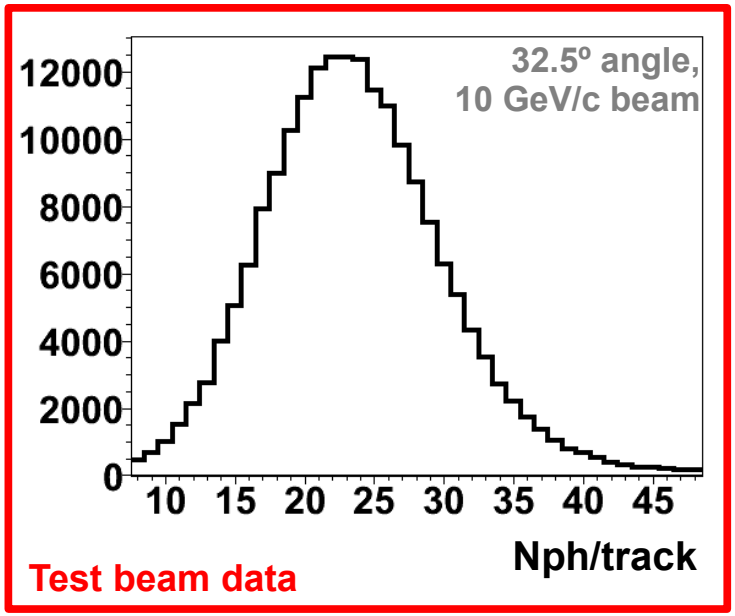
Test Beam 2012 Preliminary performance example

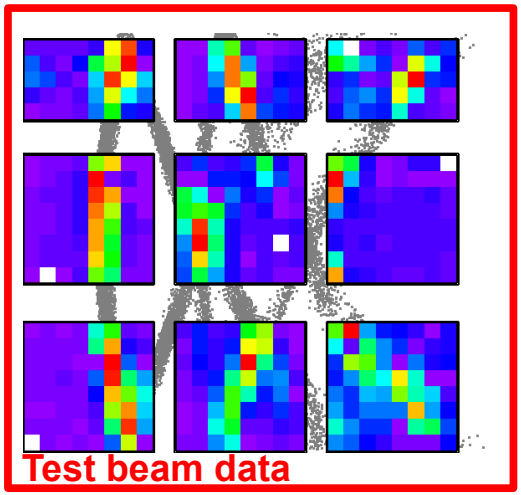
- **Single photon Cherenkov angle reconstruction** algorithm produces clear signal in expected region (Expected Θ_C for 10 GeV/c 821.9 mrad for pions, 817.9 mrad for protons), detailed analysis has started.

- Significant improvement in **number of photons per trigger** (no charge sharing correction yet).



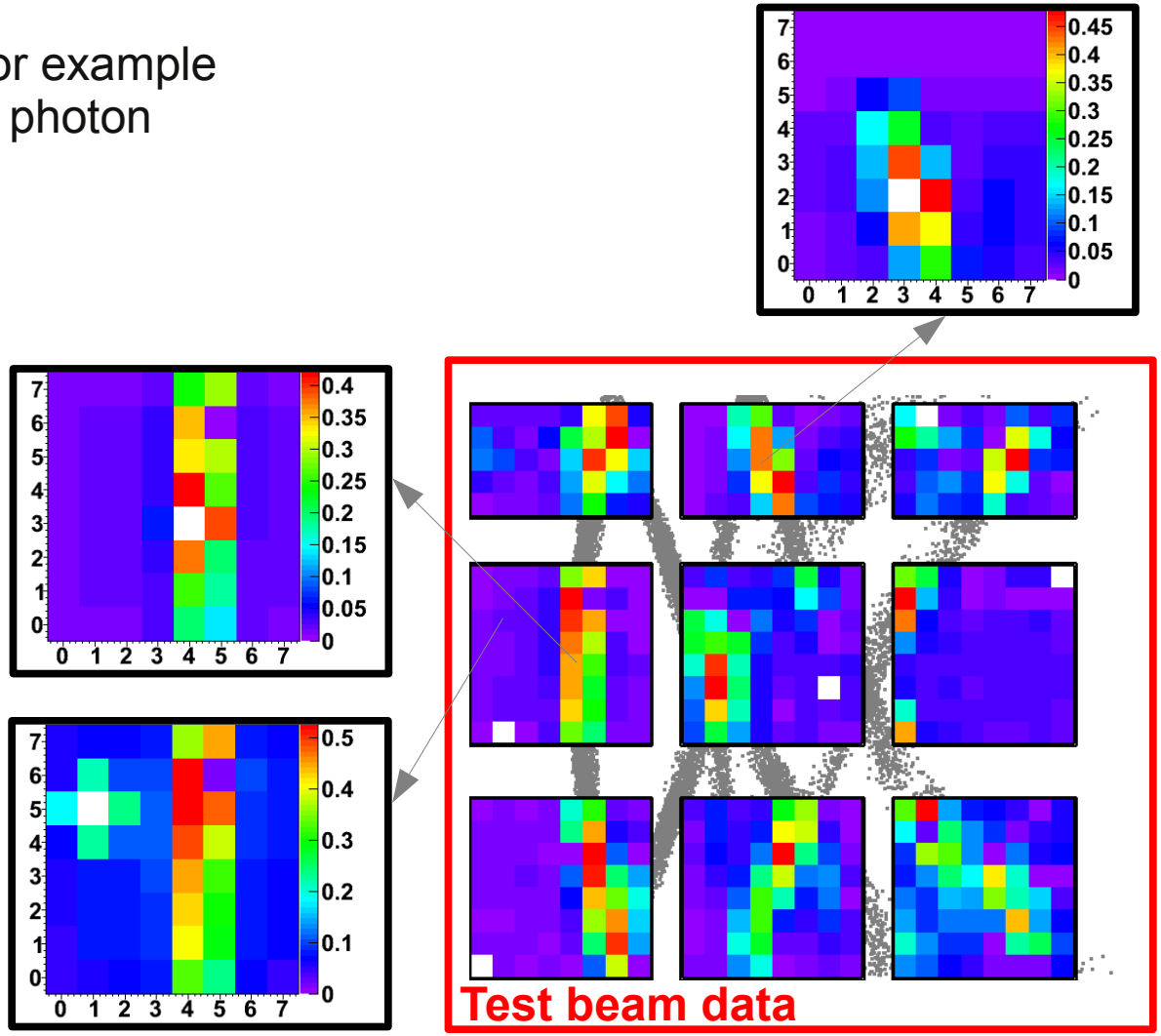




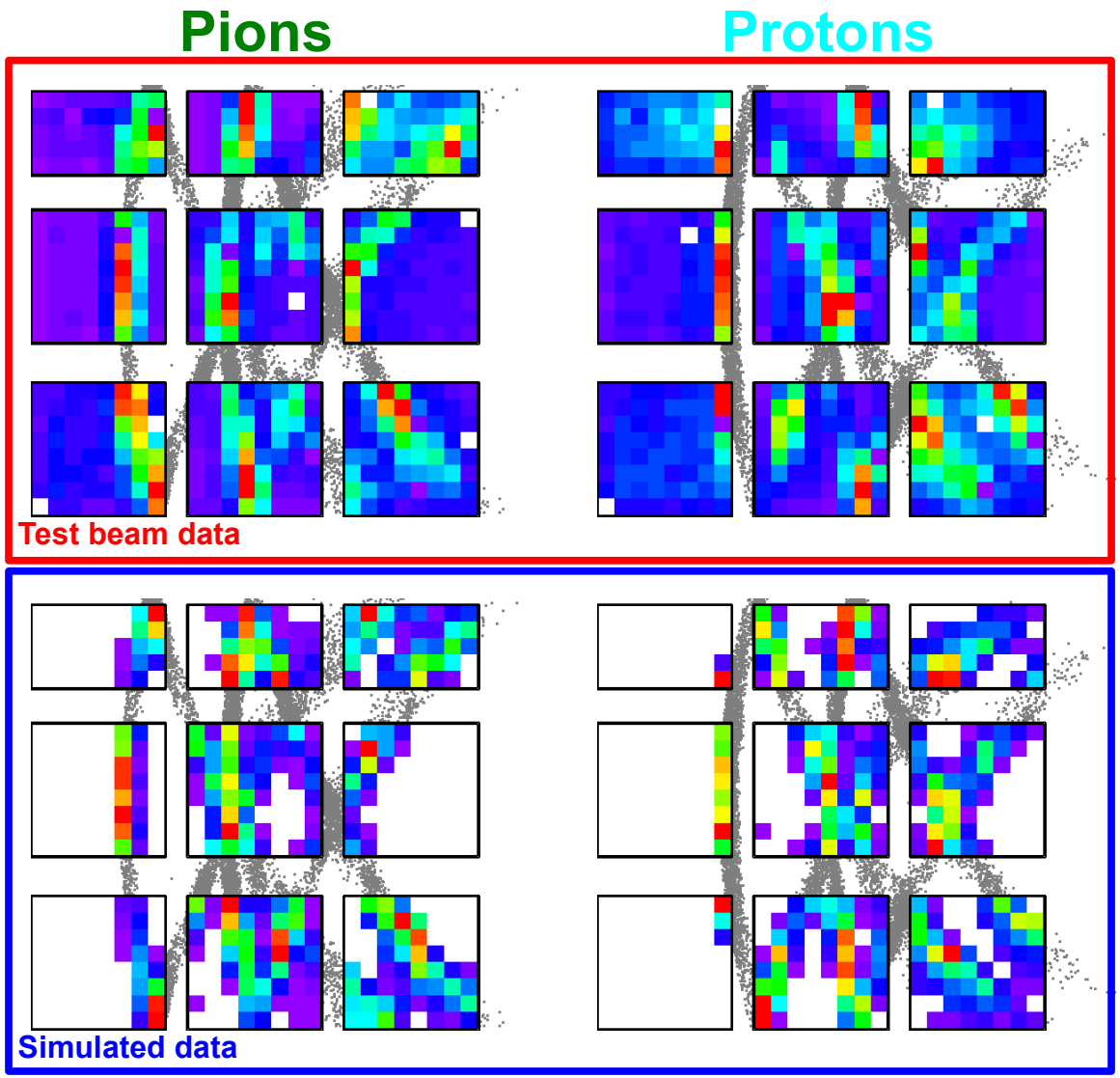


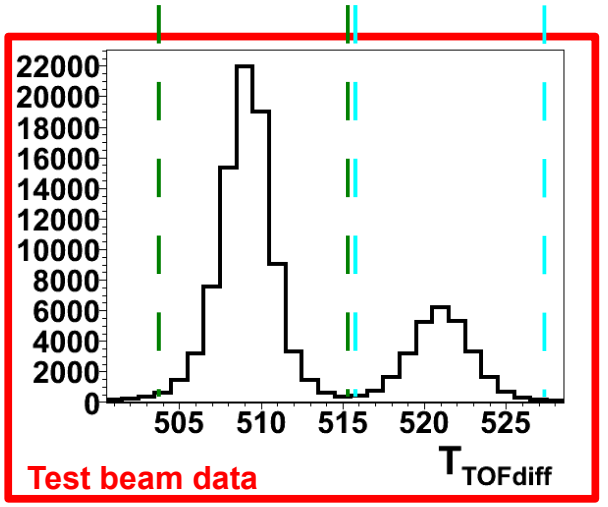
Test Beam 2012 Charge sharing

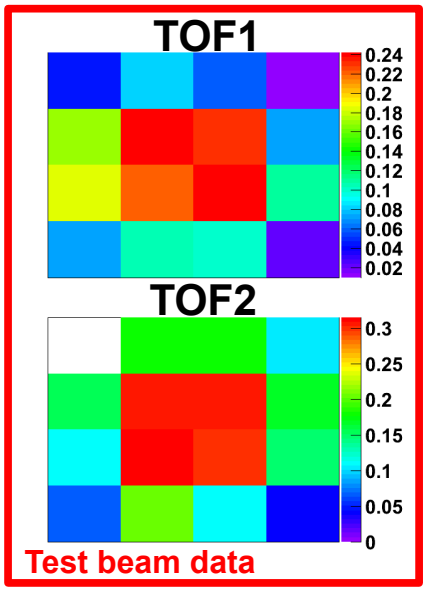
- Dealing with additional issues like for example **charge sharing** that influence both photon yield study and Θ_C resolution
- If chosen pixel fired in an entry, which other pixels from the same MCP recorded a hit in the same event? - clear signature of charge sharing
- Probability for neighboring hits in the same event in Monte Carlo data ~10%.
- Now developing algorithm to estimate and correct the effect in test beam data.



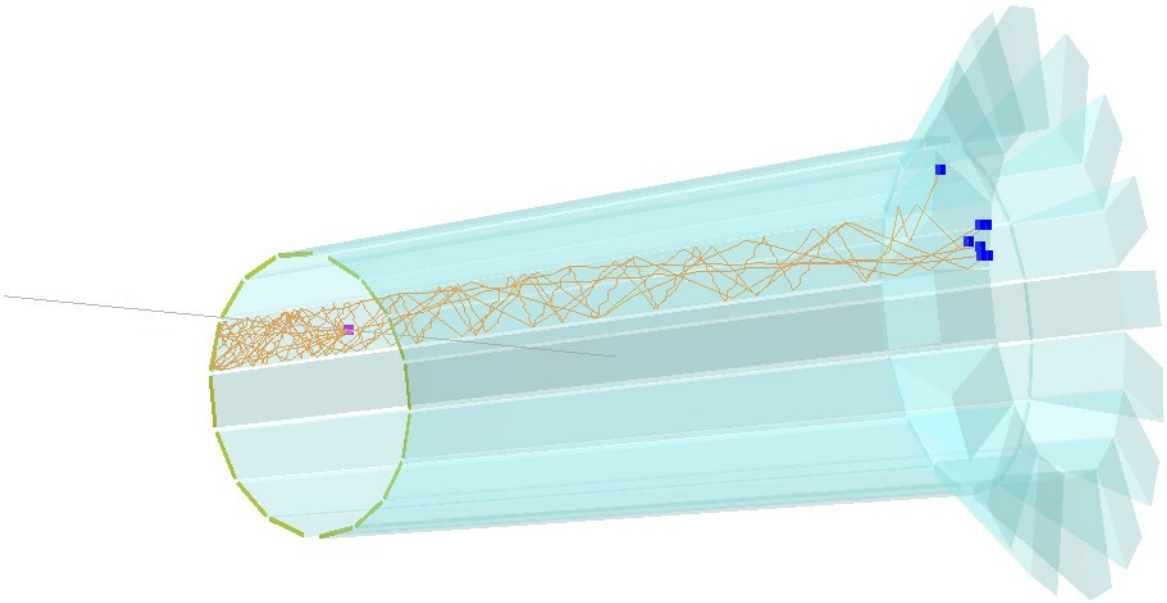
Test Beam 2012 Time of flight system







Reconstruction of plates

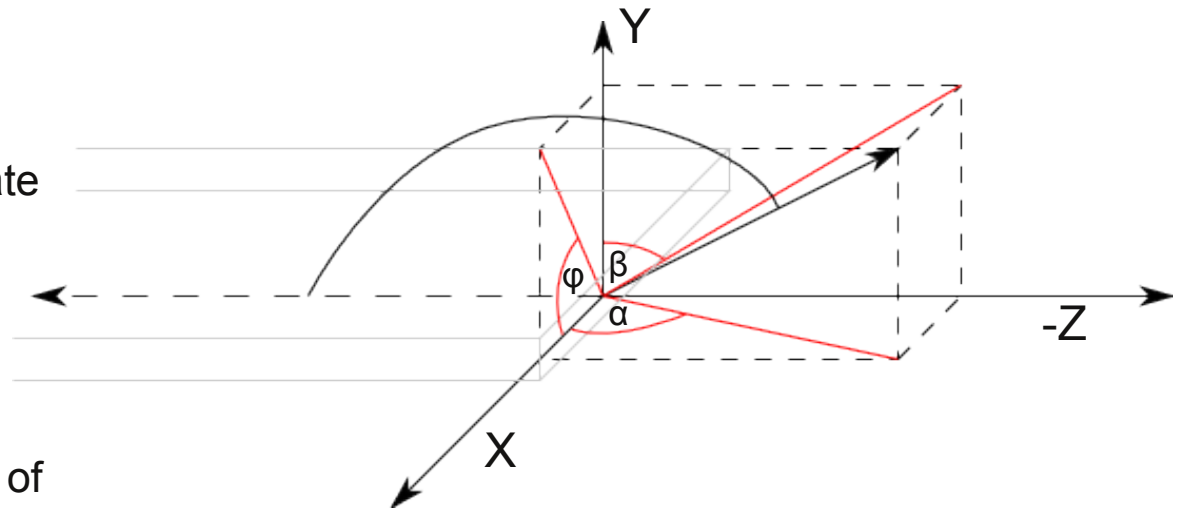


Idea:

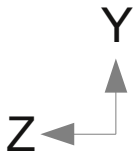
- Using wide plates instead of bars for the Barrel DIRC
  - Lesser radiator pieces
  - Substantial cost savings

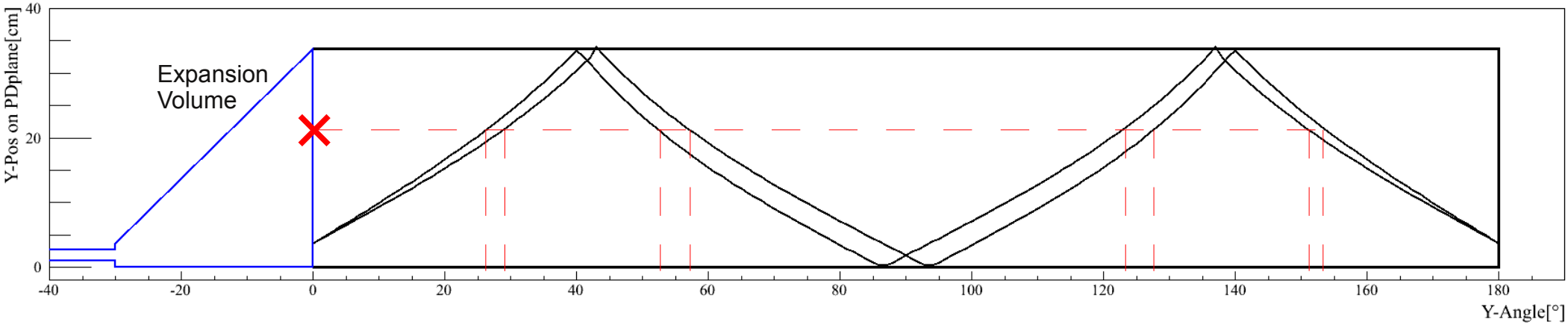
Reconstruction

- Photon direction is factorized in two independent projections of the local coordinate system
  - X-Z-projection (“α”)
  - Y-Z-projection (“β”)
- With these one can get the polar coordinates of the photon direction



Reconstruction of plates
Y-Z-projection

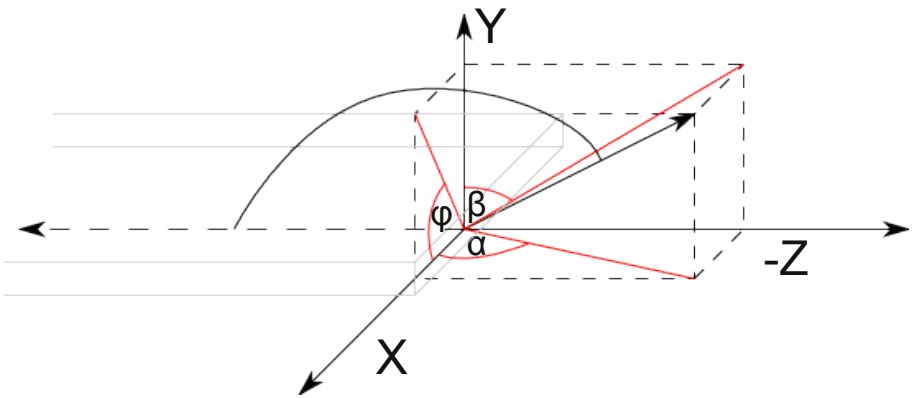




Ambiguities:

- Up to 4 different possibilities to reach Hit Pixel
- (due to reflecting sides in the expansion volume)
- Each possibility has a symmetric partner in Y 
- And in Z 
- <u>In total 16 ambiguities coming from this step of reconstruction</u>

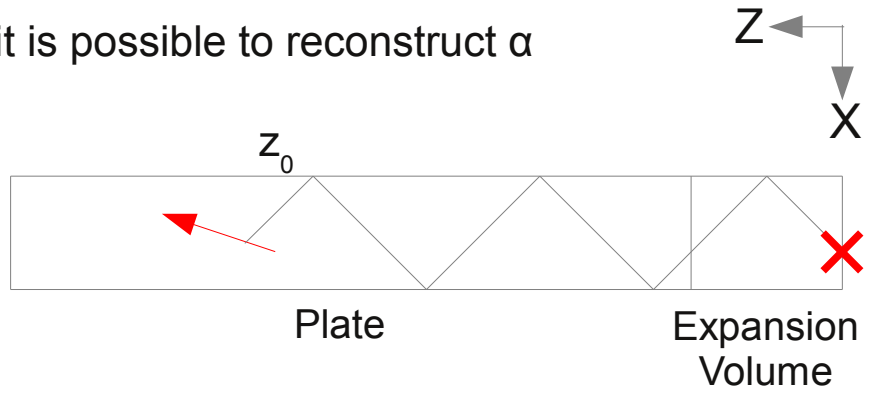
Reconstruction of plates
X-Z-projection



With knowledge of

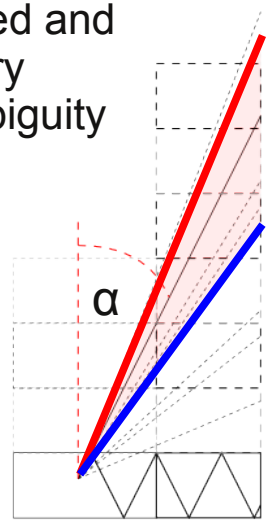
- z_0
- Previously reconstructed β
- Hit Pixels
- Photon ToP
- Photon velocity

it is possible to reconstruct α

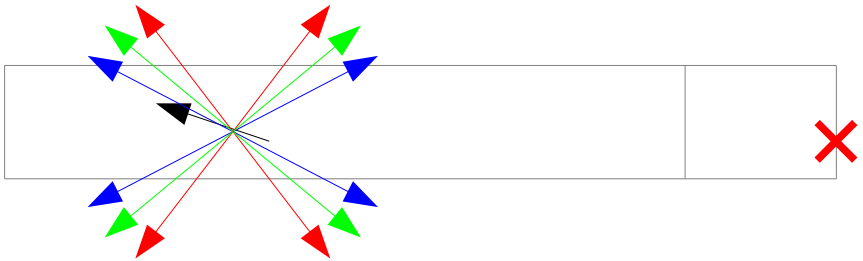


Photon wavelength is not known

- So calculate solution for red and blue photon and treat every intermediate value as ambiguity

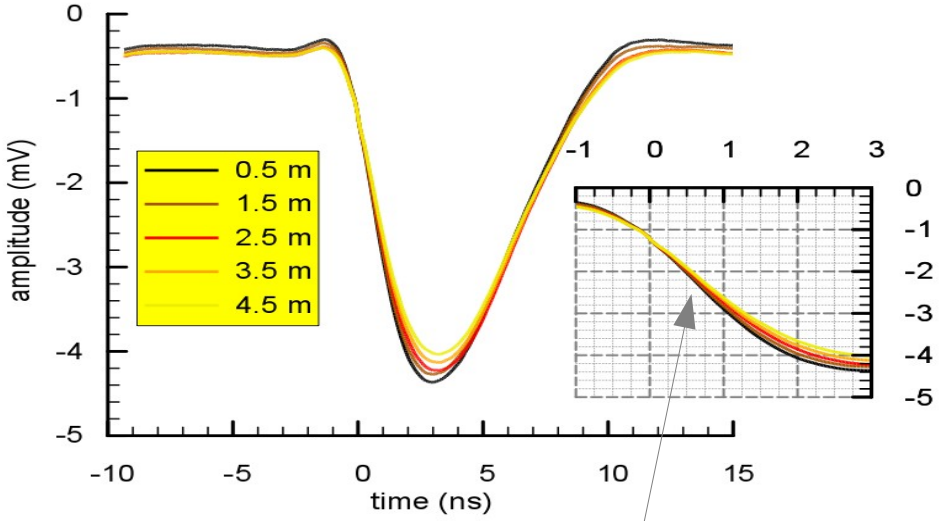


Again symmetric in Y and Z

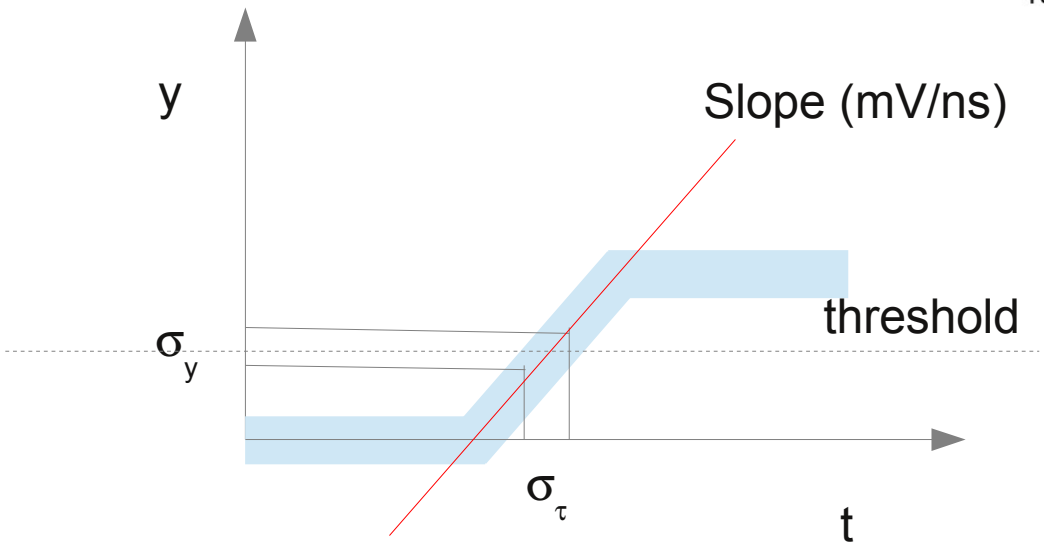


Electronic time resolution

Marvin Krebs, master thesis

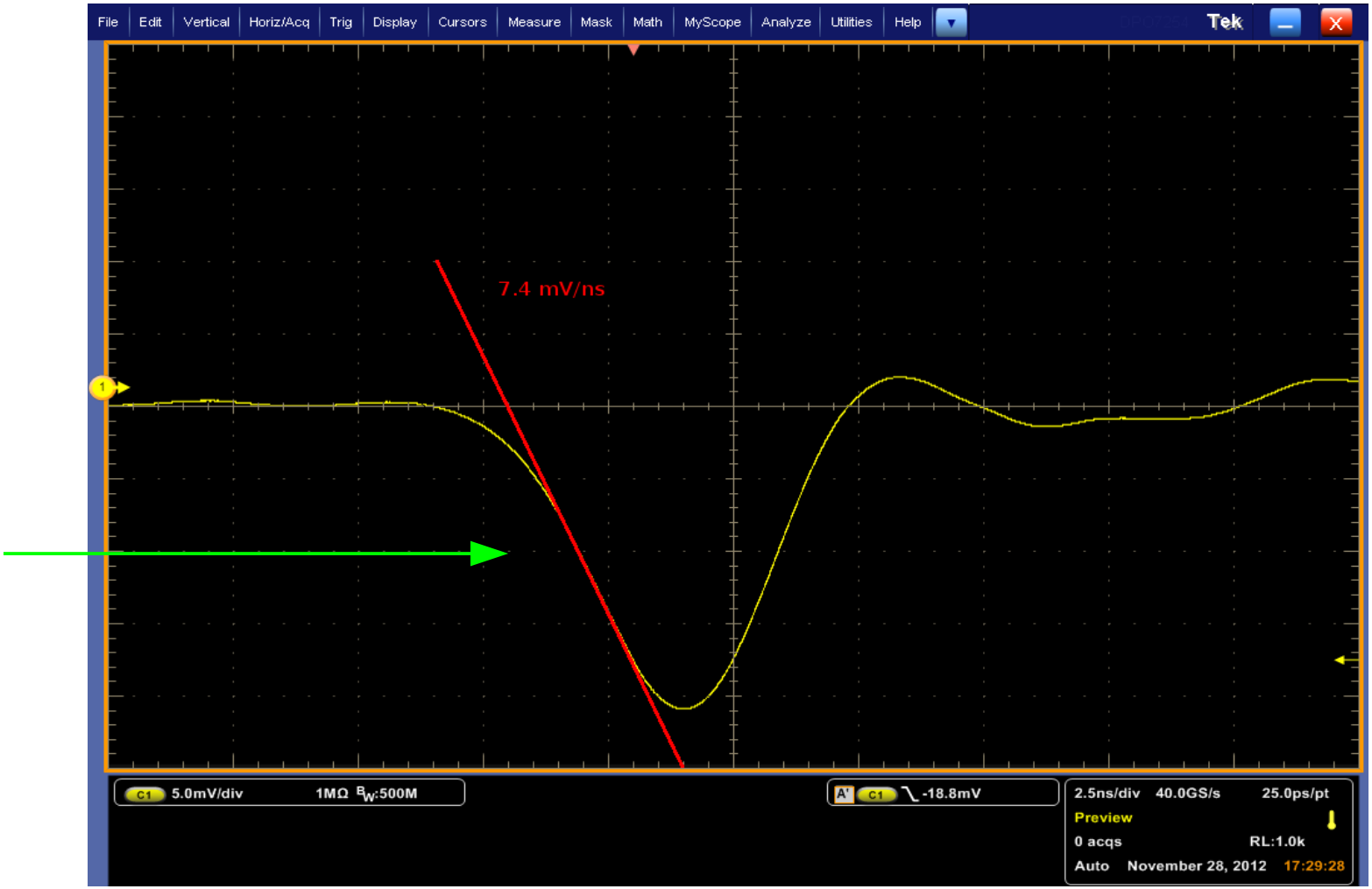


Pulser: 2.2mV/ns



Noise: $\sigma_\tau = \frac{\sigma_y}{\text{slope}}$

Total time resolution: $\sigma_m^2 = \sigma_d^2 + \left(\frac{\sigma_y}{\text{slope}}\right)^2$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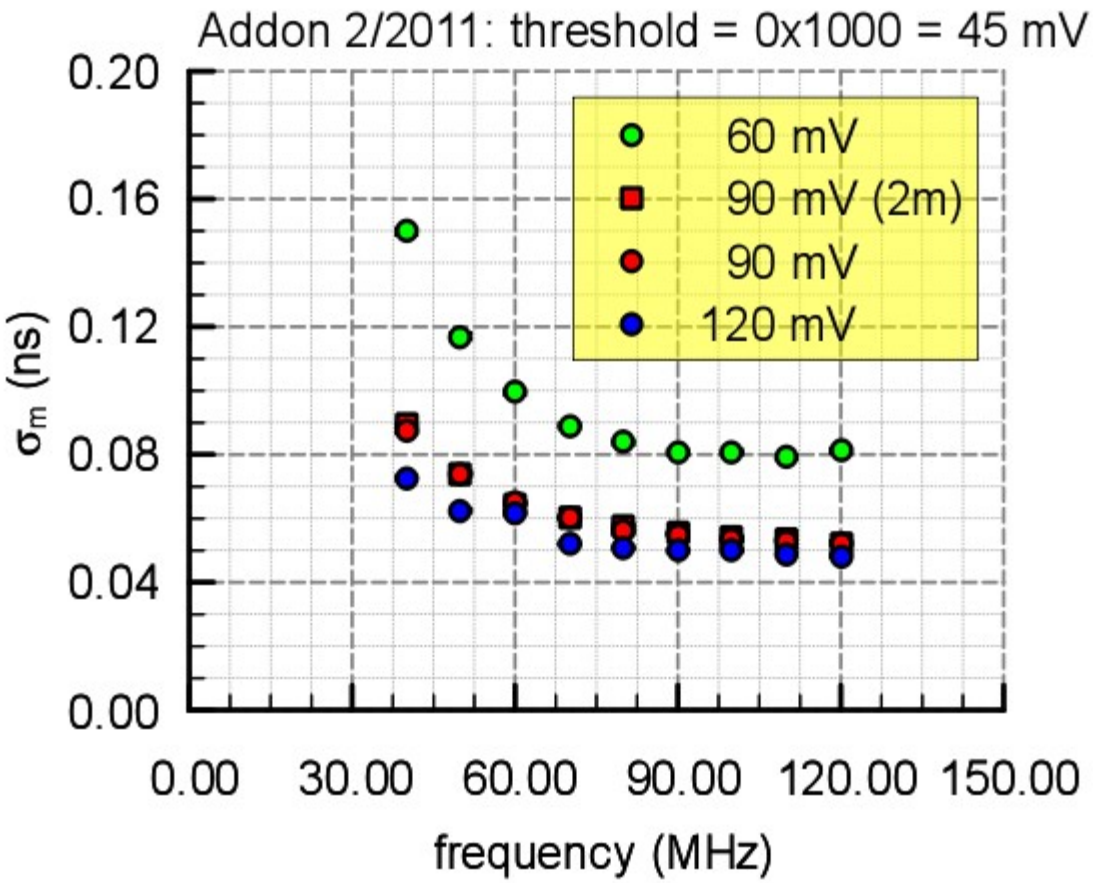
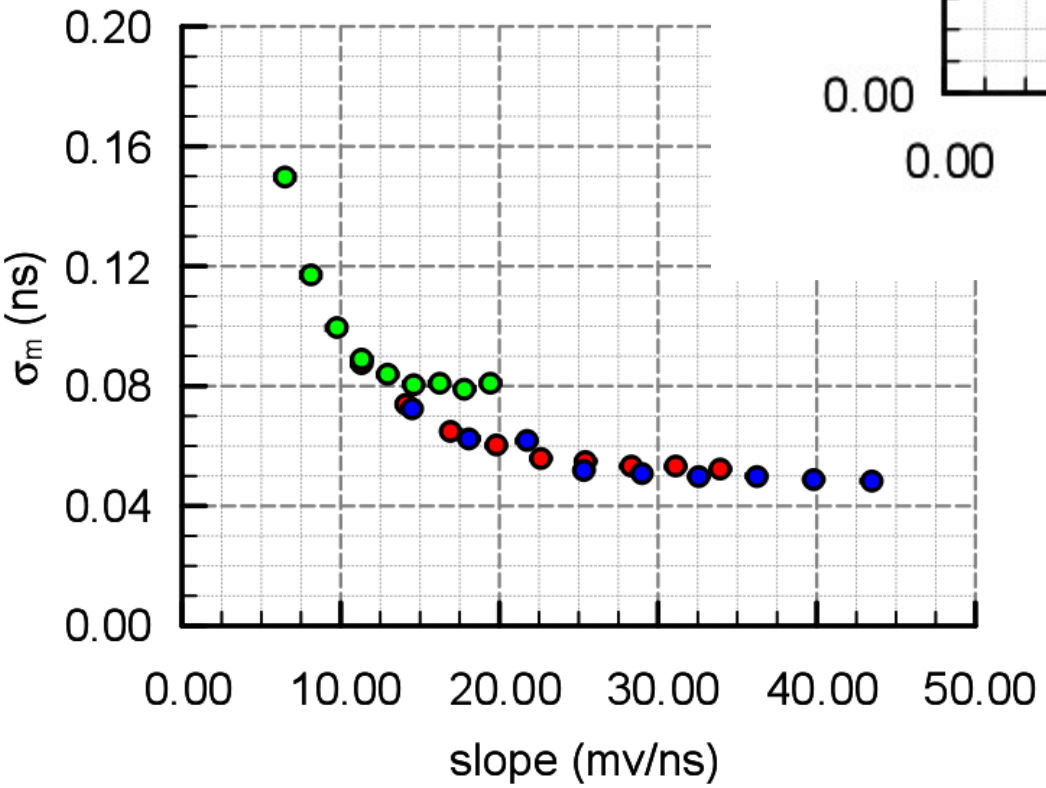
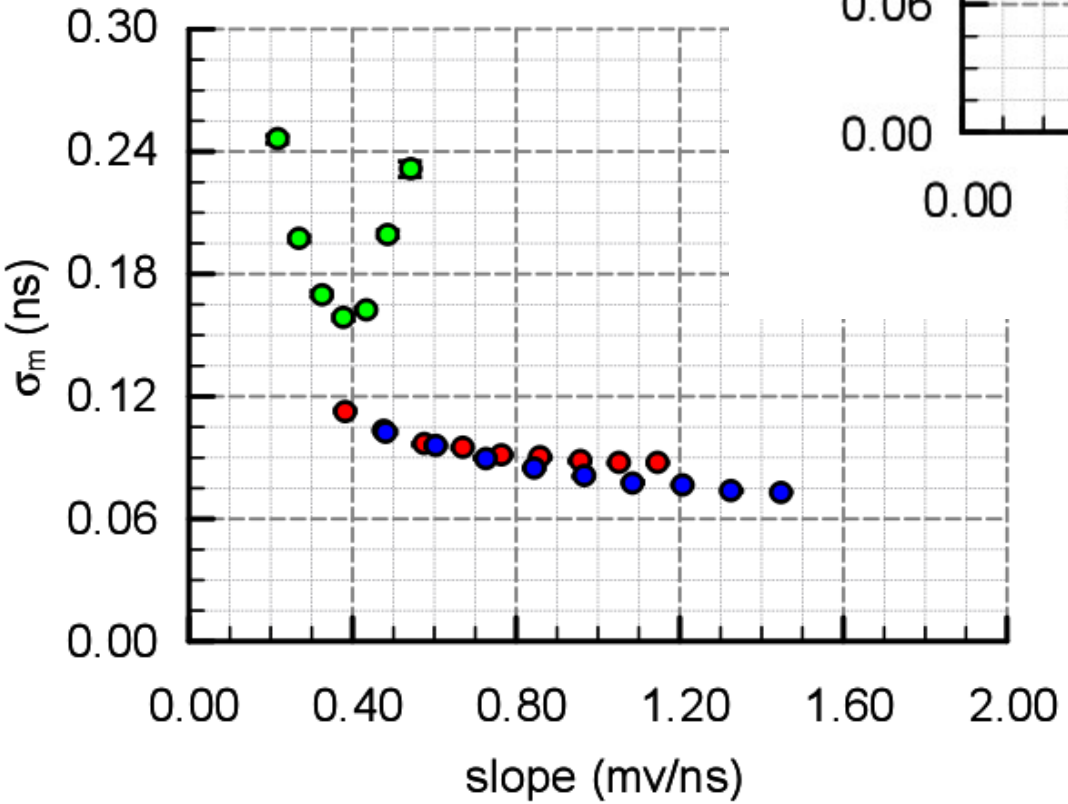
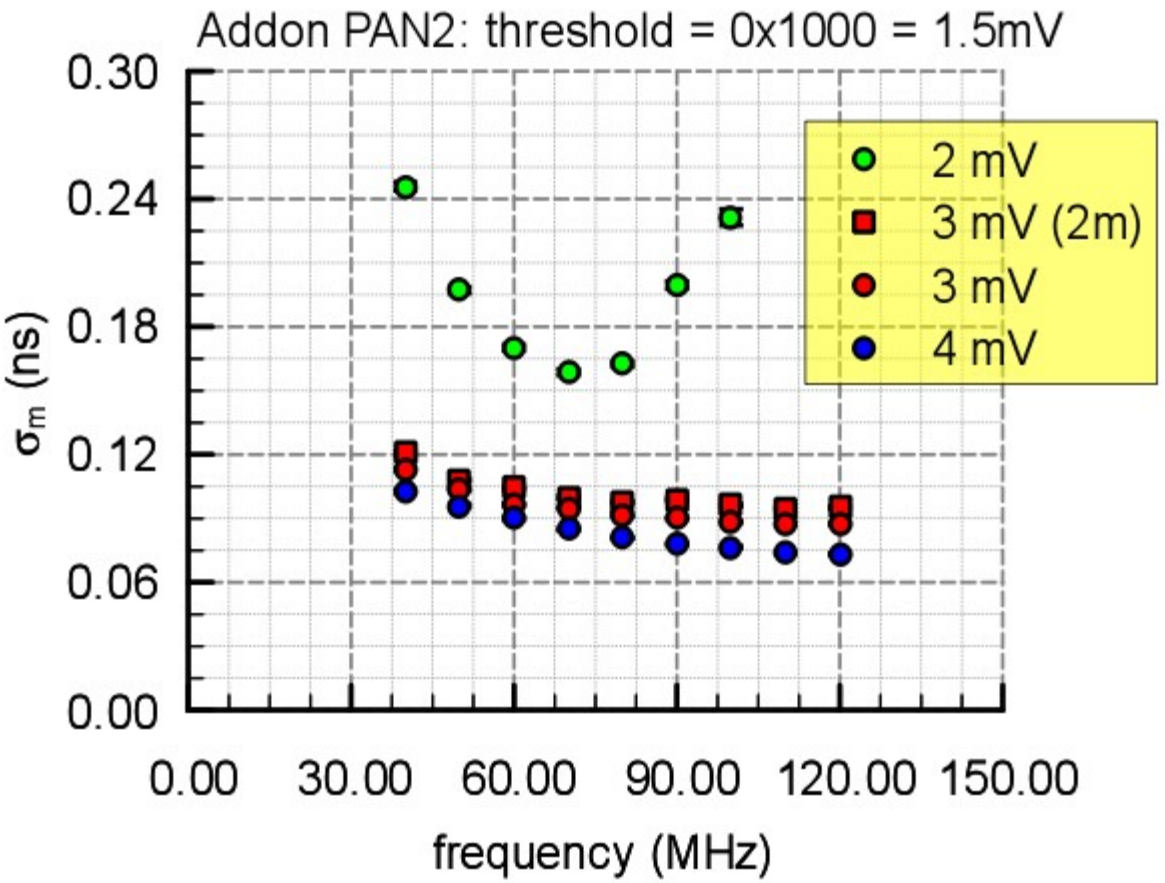
Addon 2
with internal attenuation



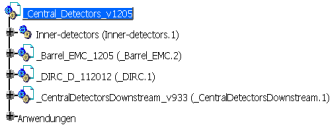


Addon 2c
without internal attenuation

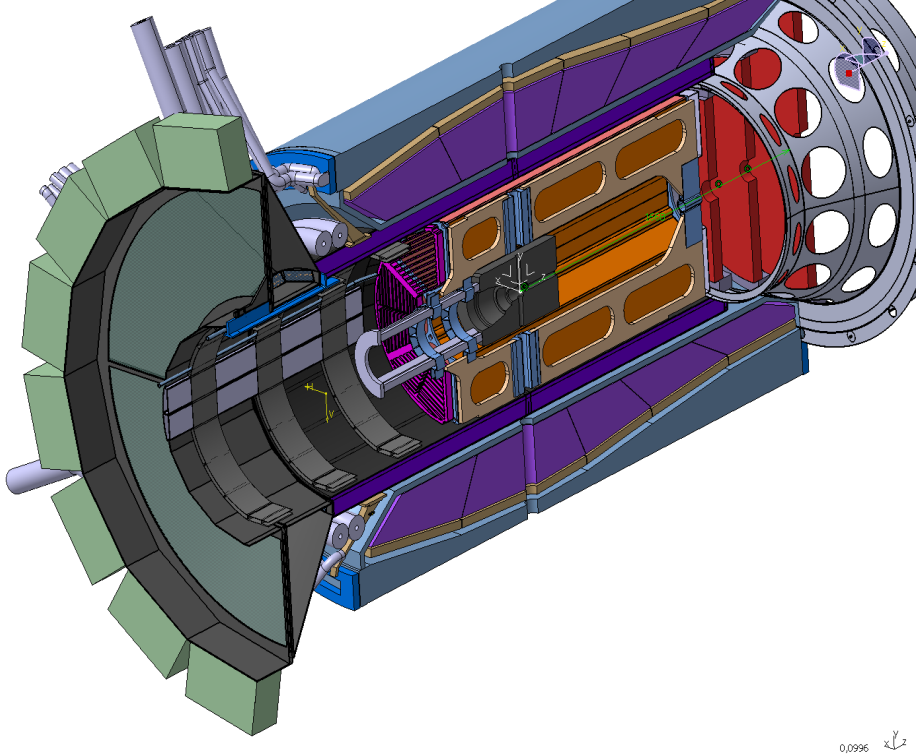


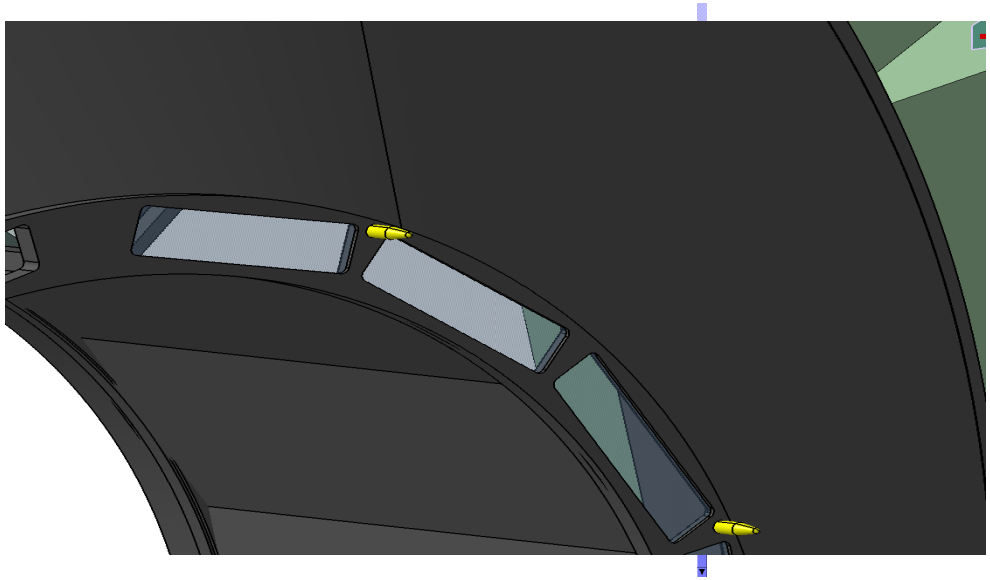


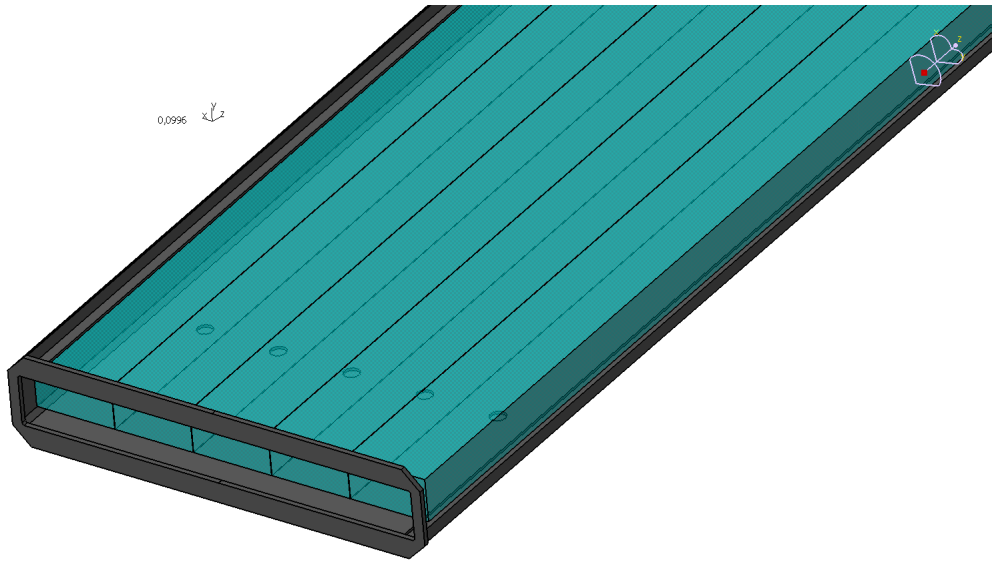
Electronics shows time resolution
in order of 50-60 ps



Mechanical drawings



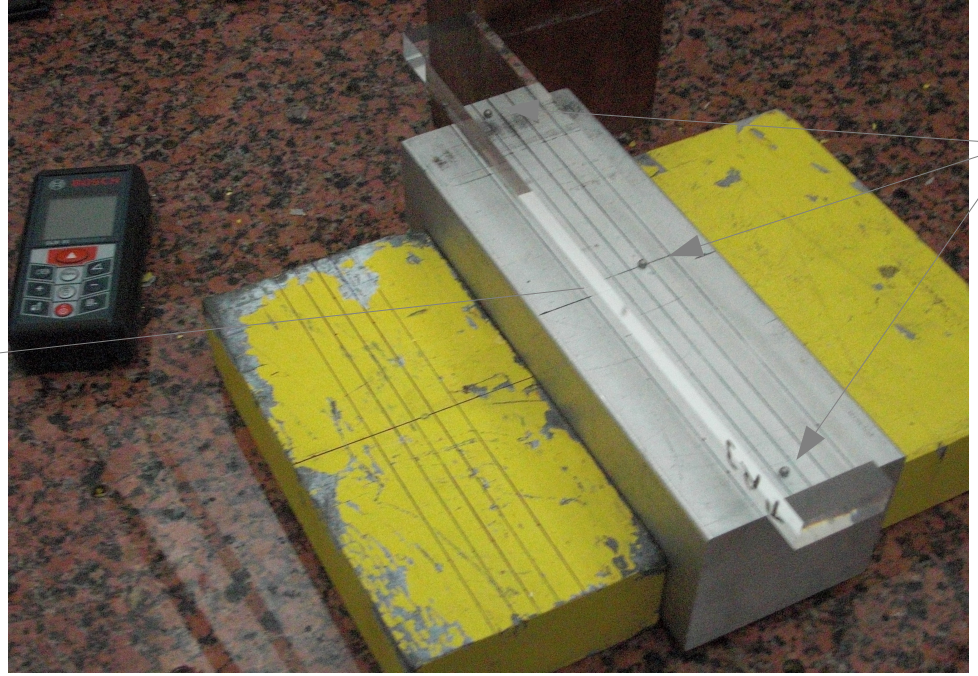


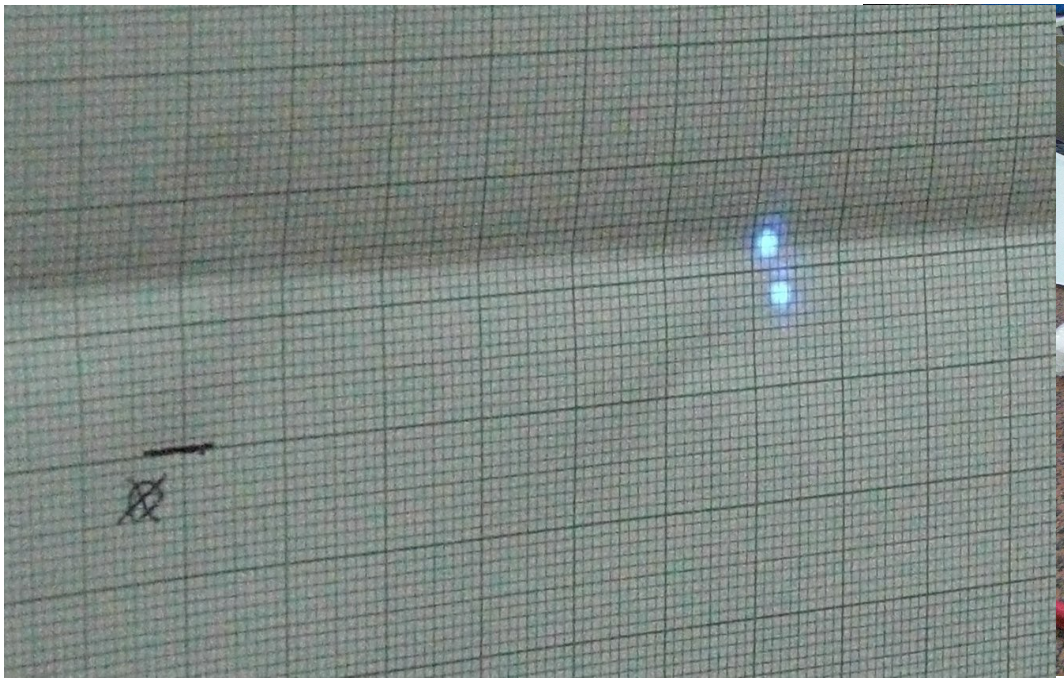


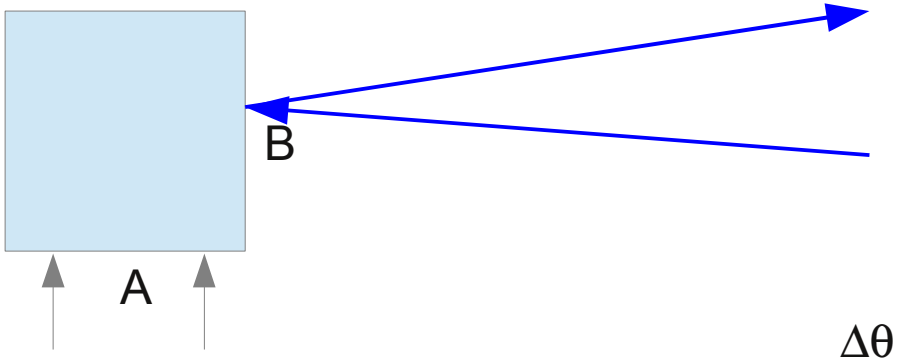
Doro Lehman

More detailed drawings

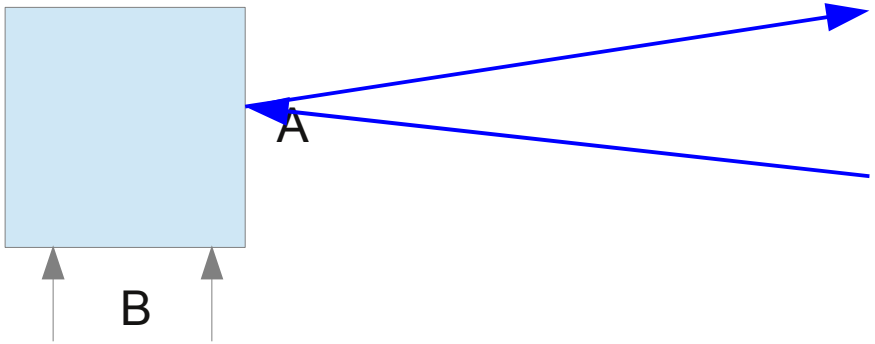
Radiator shape measurements

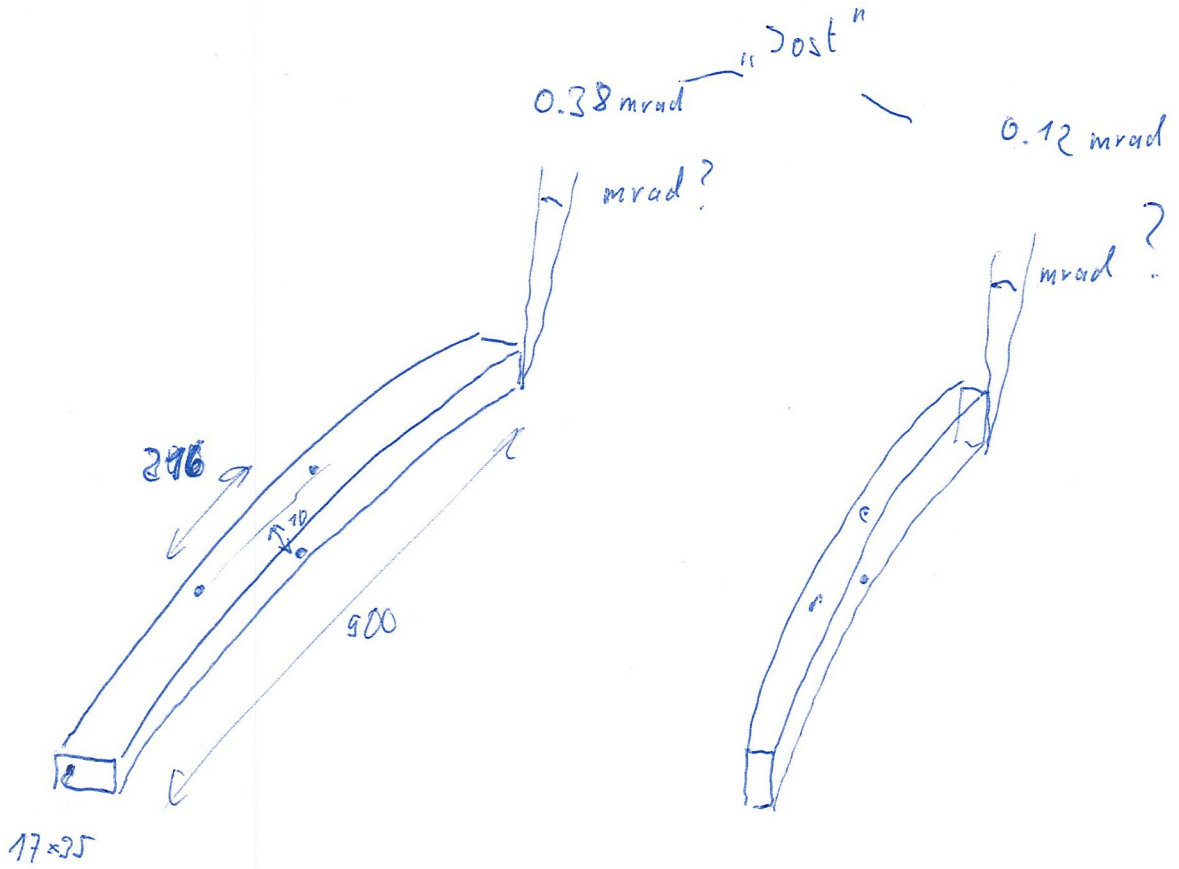






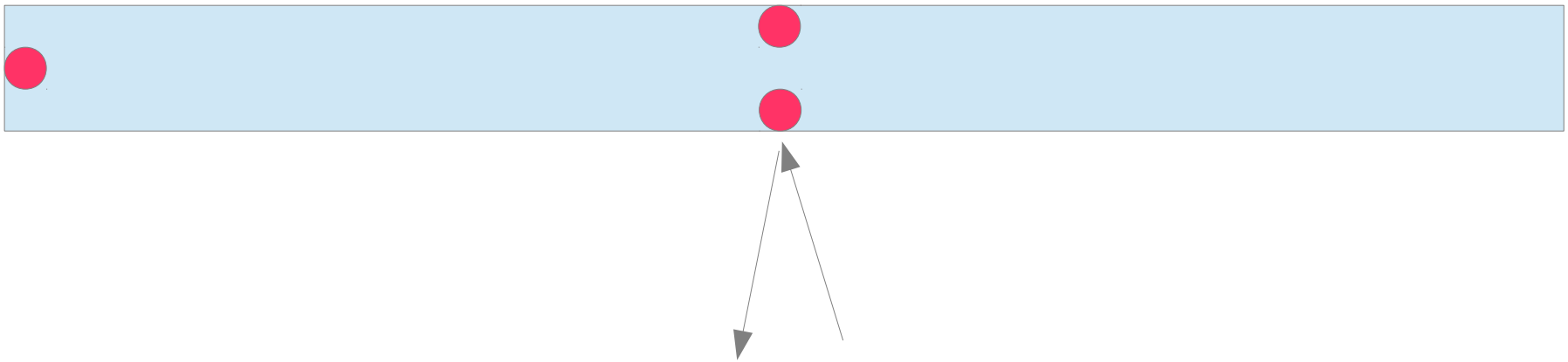
$\Delta\theta$ = 1.55 mrad





Bending and 3 point support → angular deviation

New support schemes



LZOS #3 90cm

Sides	Original (mrad)	Flipped (mrad)
DA	-0.710(6)	**-0.712(6)**
AB	**0.667(4)**	0.603(9)
BC	-0.499(5)	**-0.426(8)**
CD	**0.543(11)**	0.535(5)

LZOS #4 90cm

Sides	Original (mrad)	Flipped (mrad)
DA	-1.030(29)	**-1.030(4)**
AB	**0.946(2)**	0.994(4)
BC	-0.872(8)	**-0.873(4)**
CD	**0.958(6)**	0.957(4)

LZOS #2 90cm

Sides	Original (mrad)	Flipped (mrad)
DA	0.414(10)	**0.428(6)**
AB	**-0.221(4)**	-0.238(2)
BC	0.240(7)	**0.242(6)**
CD	**-0.423(4)**	-0.421(6)

Zeiss #5 83cm

Sides	Original (mrad)	Flipped (mrad)
DA	-0.050(2)	**-0.081(6)**
AB	**0.082(4)**	0.087(2)
BC	-0.061(8)	**-0.070(-)**
CD	**0.033(5)**	0.054(-)

Zeiss:
-0.0481

0.0602

-0.0631

0.0399

LZOS bars have larger deviations than 0.25 mrad

Work is in progress for

Data analysis CERN experiment 2012 (Greg)
Reconstruction of quartz plates (Marko)
Electronic time resolution is being investigated (Marvin)
Mechanical drawings become more detailed (Dorothee)
Bar shape measurements improved accuracy (C.S)

Reconstruction of quartz bars → next talk (Maria)