Results of laser scans, testbeam setup

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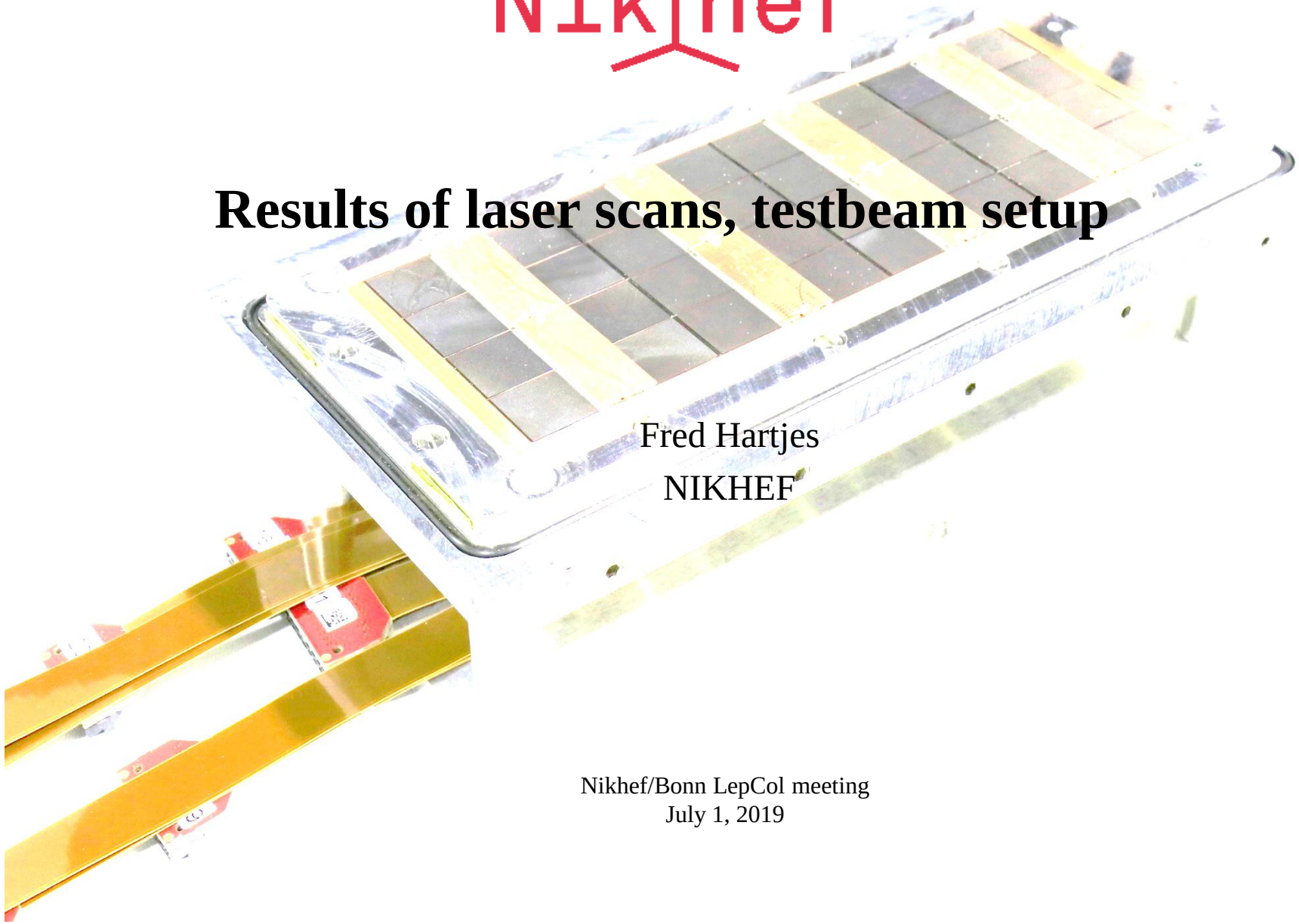
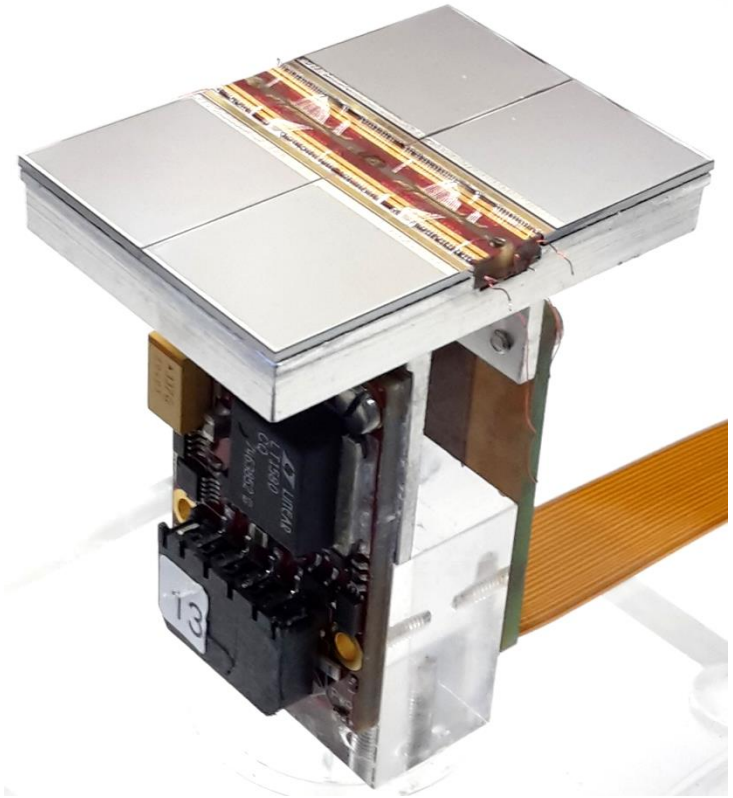


Nikhef/Bonn LepCol meeting
July 1, 2019

QUAD production finally completed

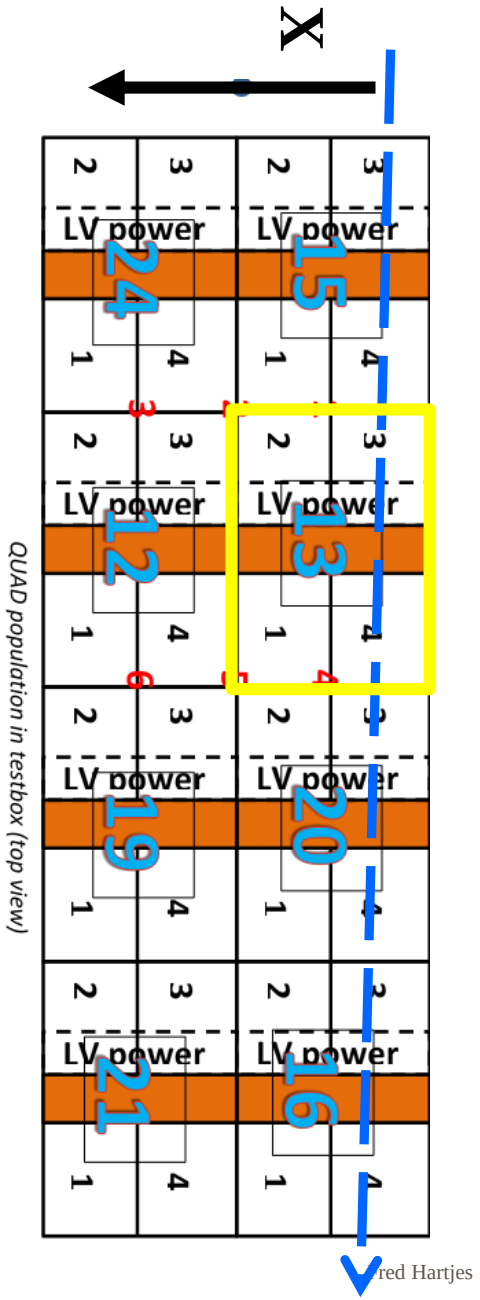
- All guard electrodes produced (Ad)
- All 15 QUADs are assembled now

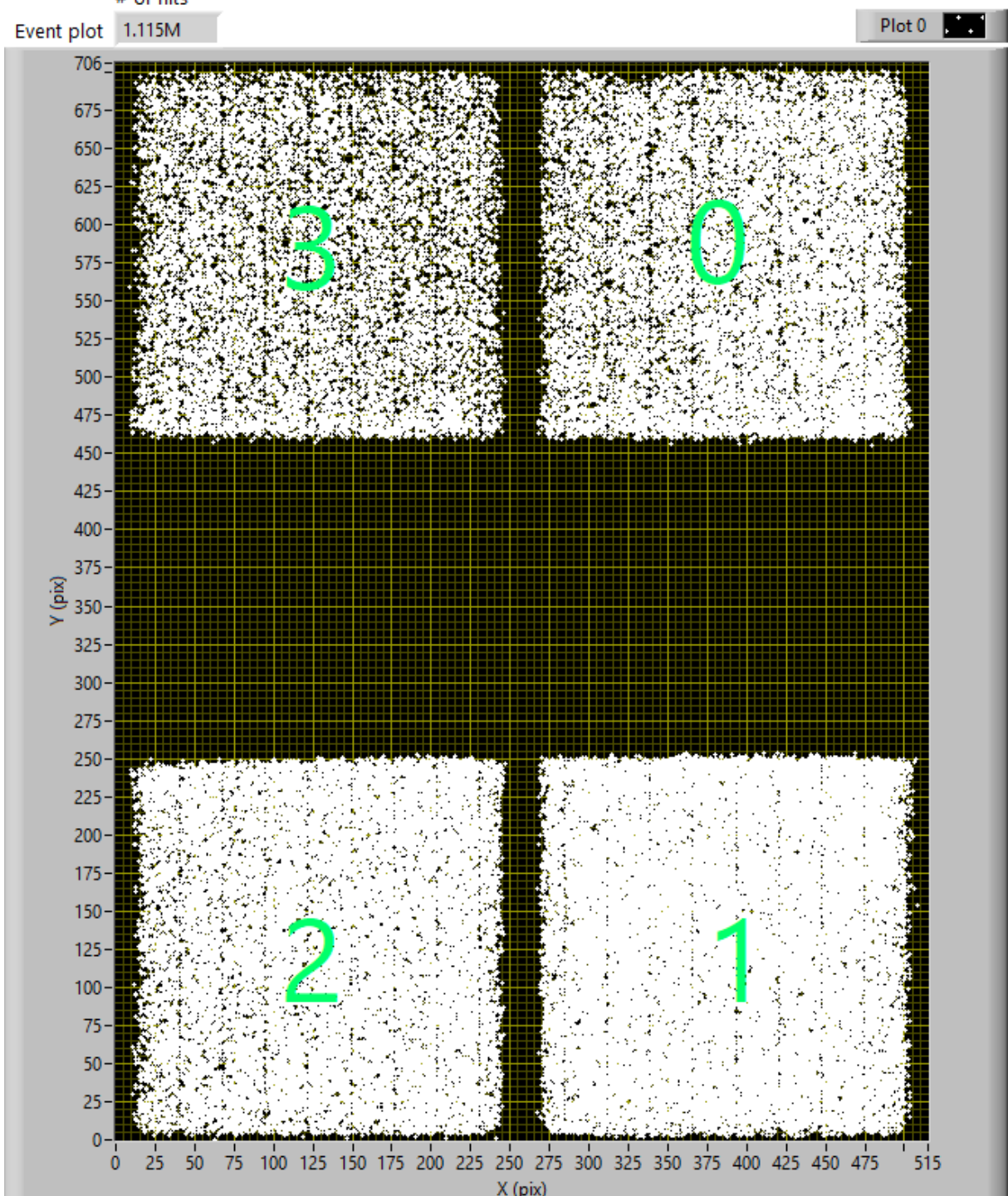
- 12 operational
  - 8 in new testbox
  - 1 in single QUAD testbox
    - Used for master students project
  - 3 in storage box for Bonn
- 1 QUAD has broken flex (machining error)
  - => demo model with not-functional chips
- 1 minor flex damage
  - 2 chips operational?
- 1 not operational for unknown reasons
  - 1? chip is alive



Laser track scan across XY plane of QUAD13

- Distance to grid ~ 10 mm
- T2K gas
- Vgrid = -330 V
- Threshold 55 (550 e-)
  - ToT ≈ 800 ns expected
  - => SE efficiency 82%
  - => secondary emission hits 45%
  - =>100 electrons give ~120 hits of which 82 originate from ionization electrons
- Field 280 V/cm
- Scan in X across the full QUAD in 0.5 mm steps
- 100 laser shots per stage position

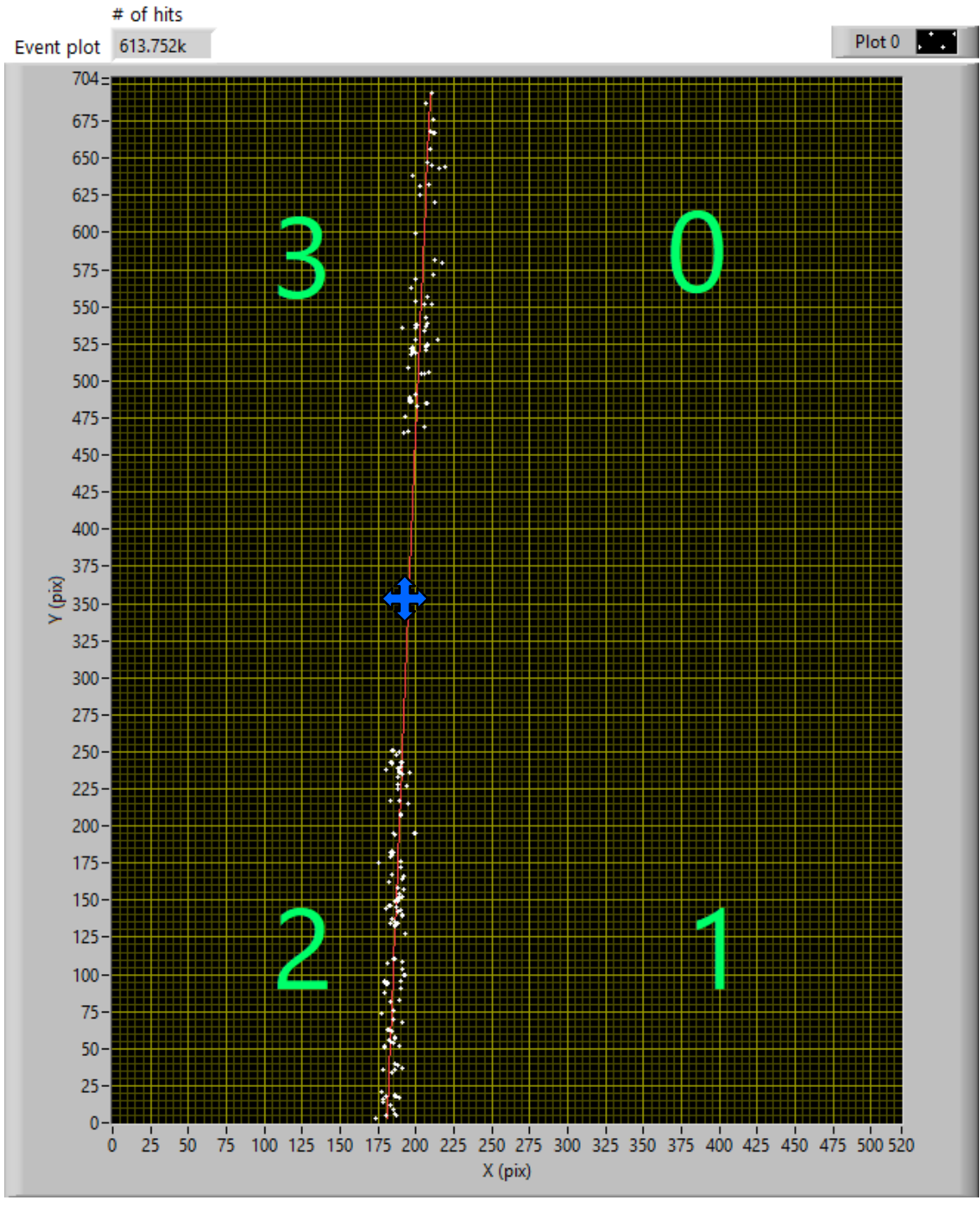




Fit through single track

- Td min = 200 ns
  - Rejecting spurious laser hits on grid
- Linear fit through all points
- Number of hits comparable to what can be expected from MIP

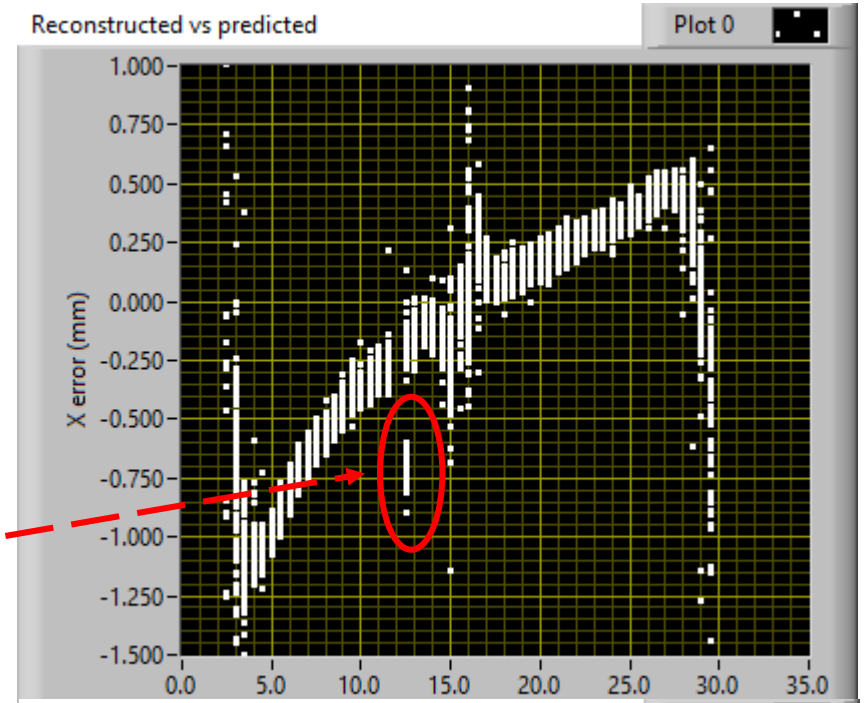
- Centre and slope of fitted line investigated



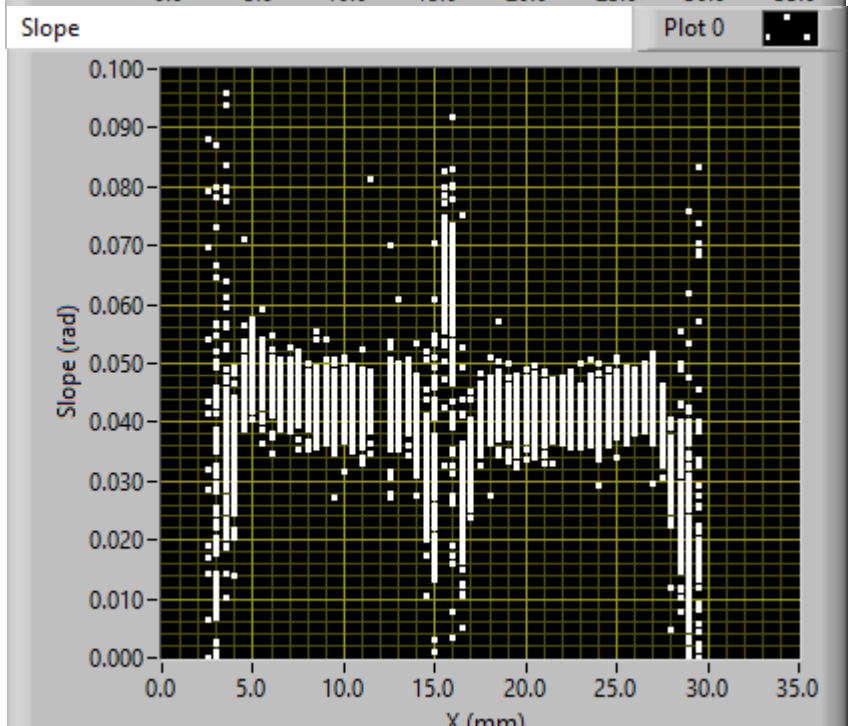
Results of track fits (raw fit data)

- X scan in 0.5 mm steps
- Centre of fitted line plotted
- Ignore the bad measurement at X = 12 mm
- Track angle 40 mrad
- **No fine tuning yet** on guard, guard cage and guard wires

Centre

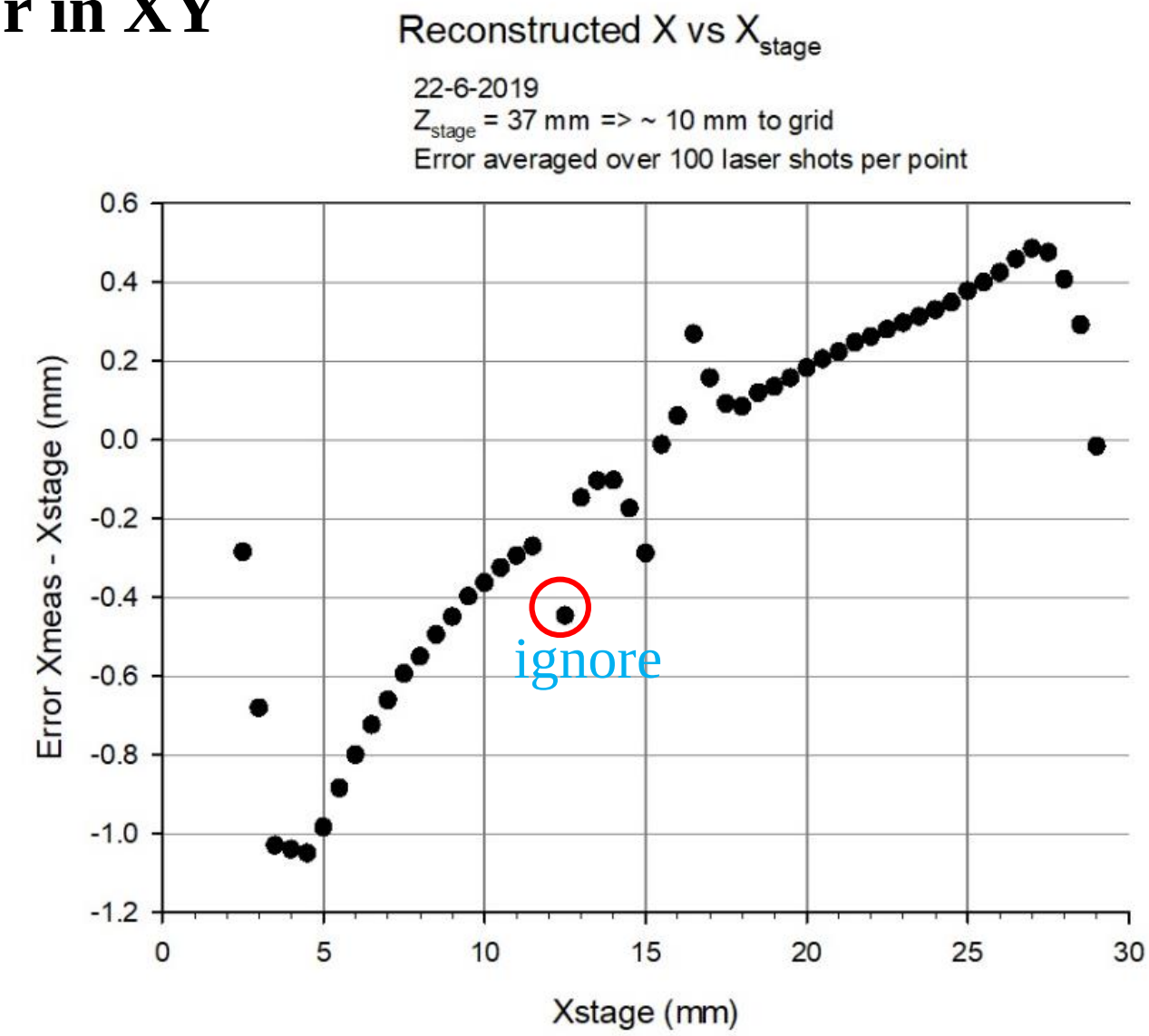


Slope



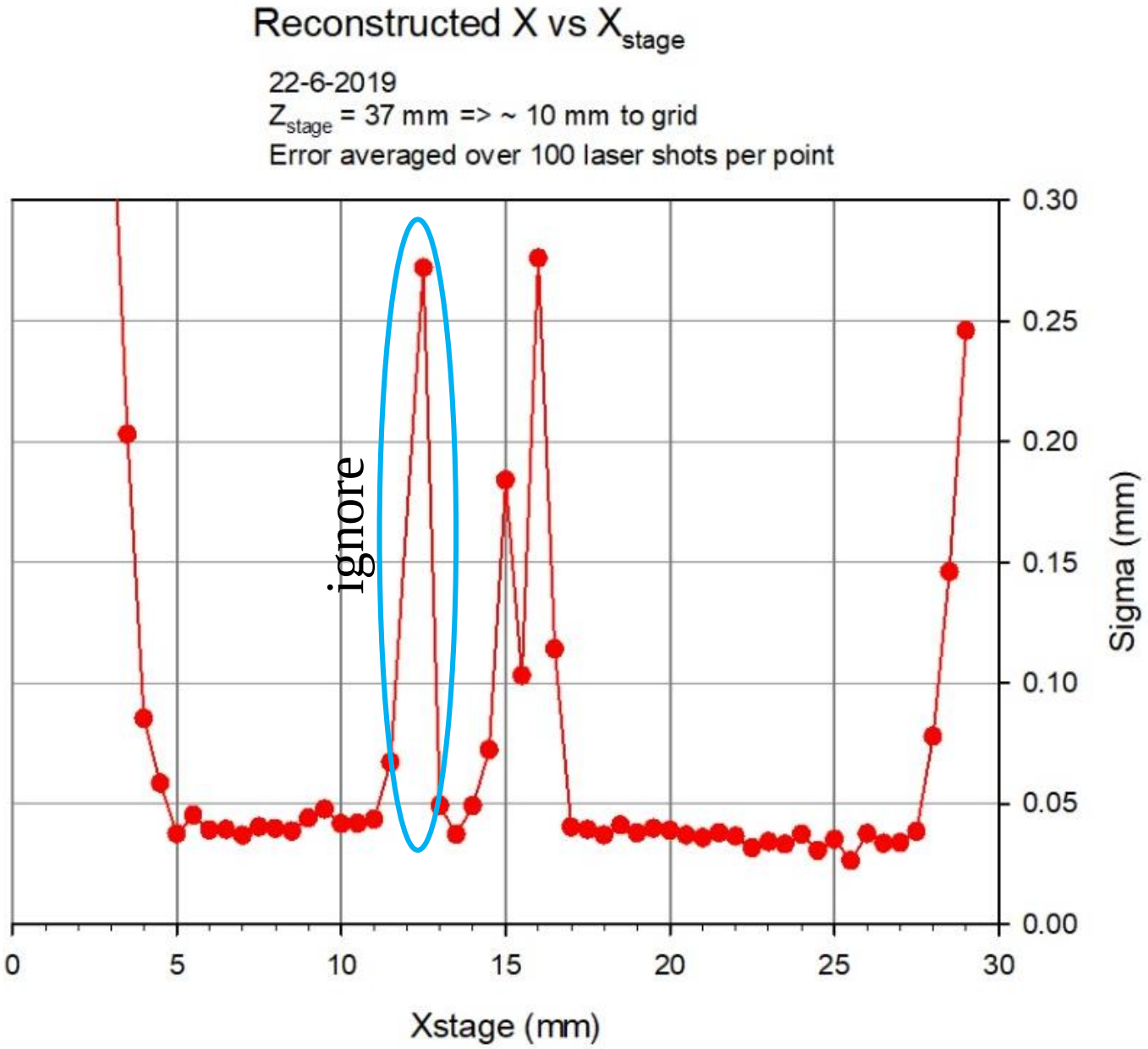
Averaged reconstruction error in XY

- Averaged across 100 laser shots
- Scan starting near the edge of the field cage
- Width of measured scan across 28 mm is about 1.6 mm too wide
- Note that for 10 mm drift distance track reconstruction still works (with limited accuracy) at the boundary between the two chips
- At 5 mm drift distance part of the tracks in the boundary cannot be reconstructed
- Track reconstruction at boundary expected to be better at bigger drift distances



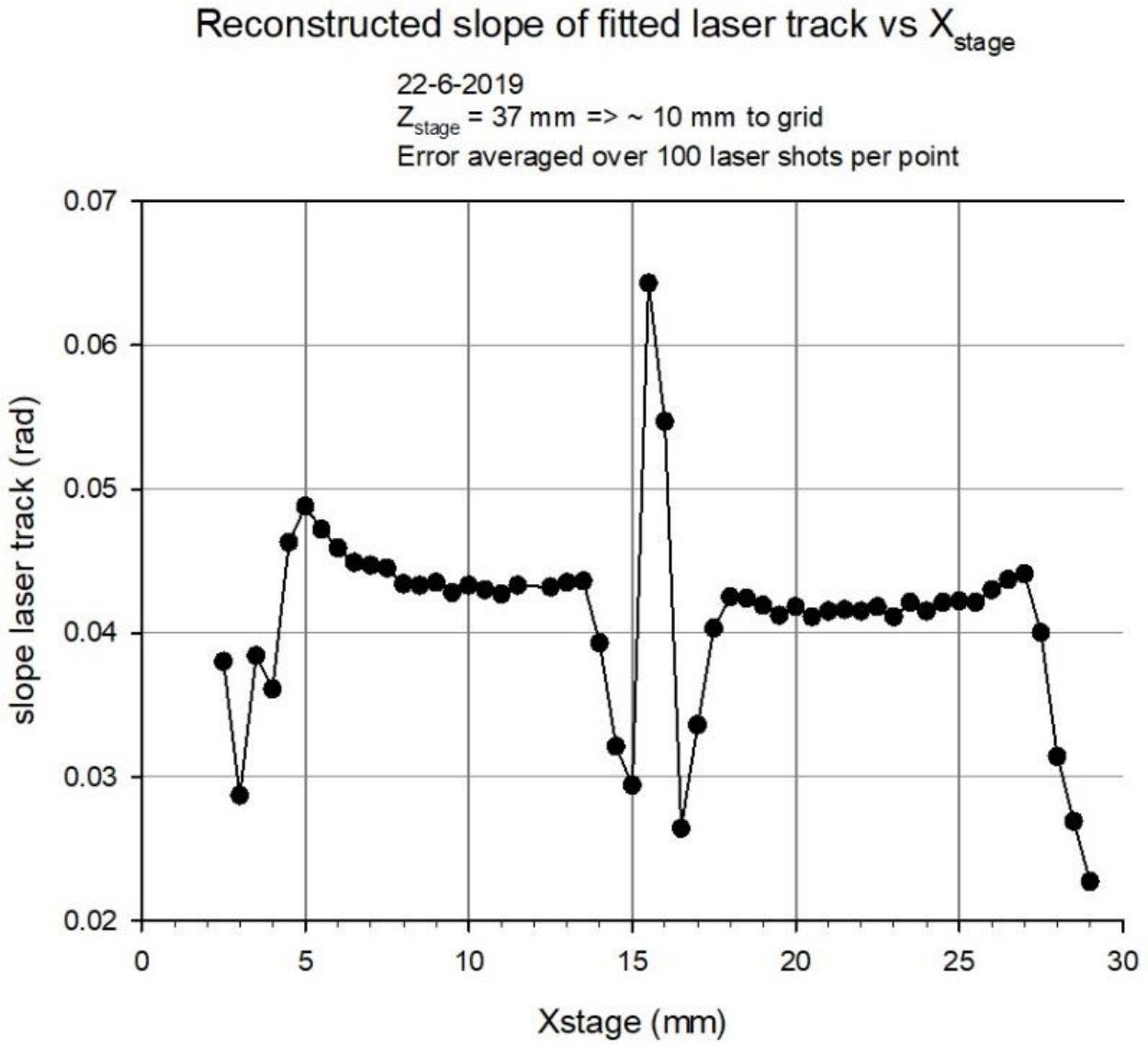
Statistical error in XY

- Statistical error of track fitted through one QUAD is mostly below 50 um
- Statistical error until 280 um in the 2 mm wide boundary region
- But all tracks in the boundary region are detected



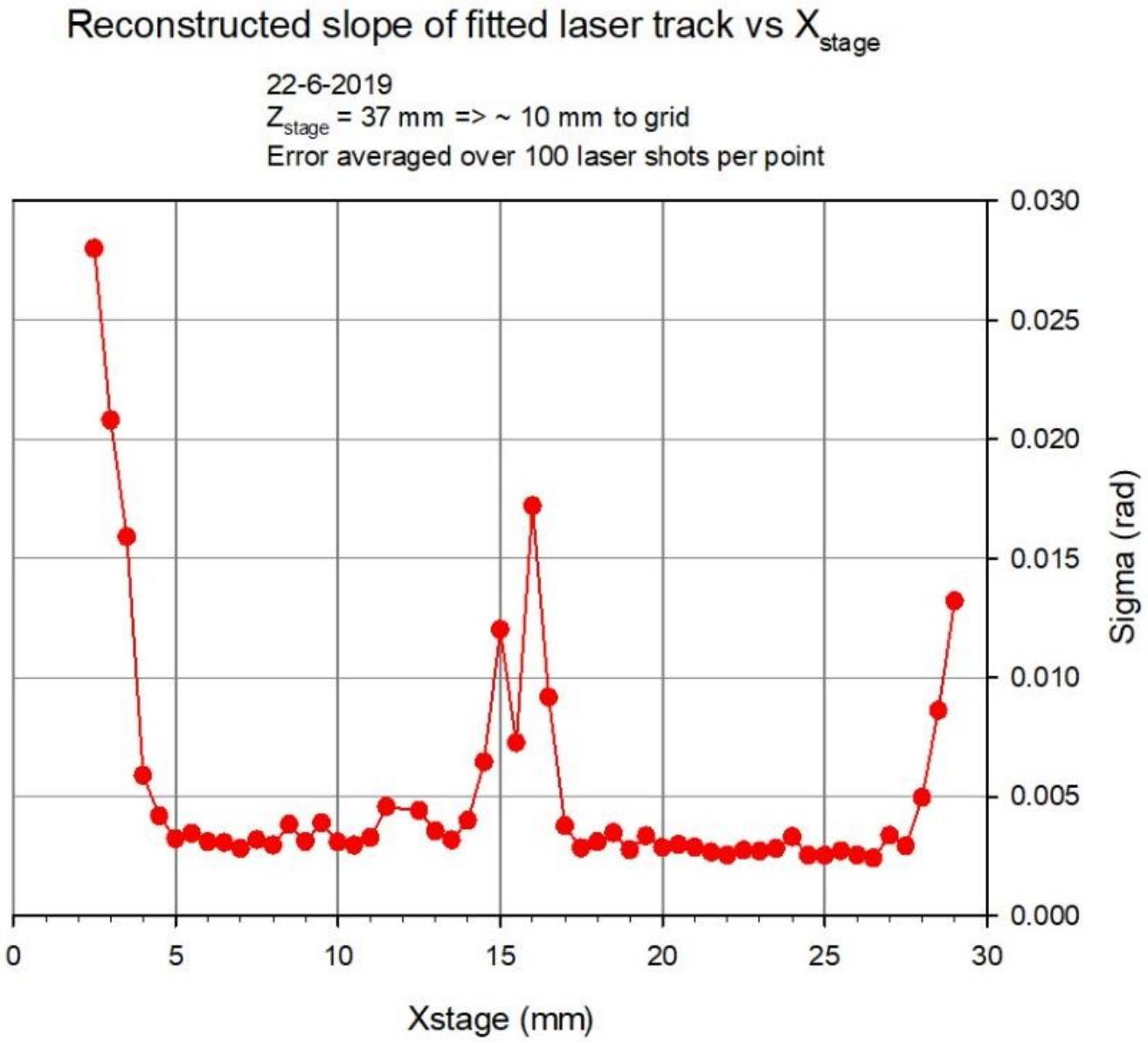
Averaged slope of fitted laser track vs Xstage

- Around 43 mrad, systematically affected by the drift field deformation



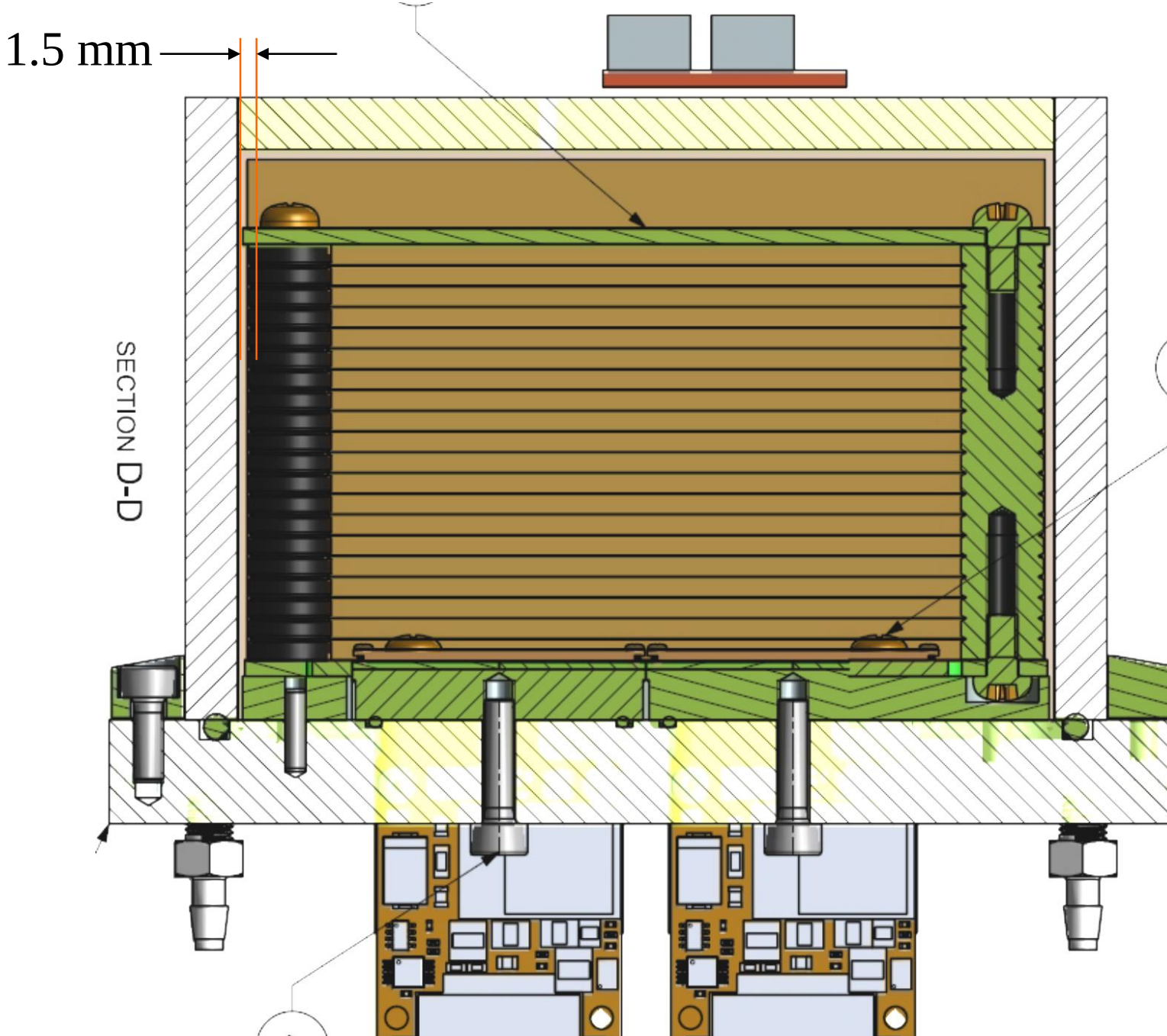
Statistical slope error

- On most places around 3 mrad for tracks measured by a single QUAD
- Up to 18 mrad in the 2 mm wide boundary region



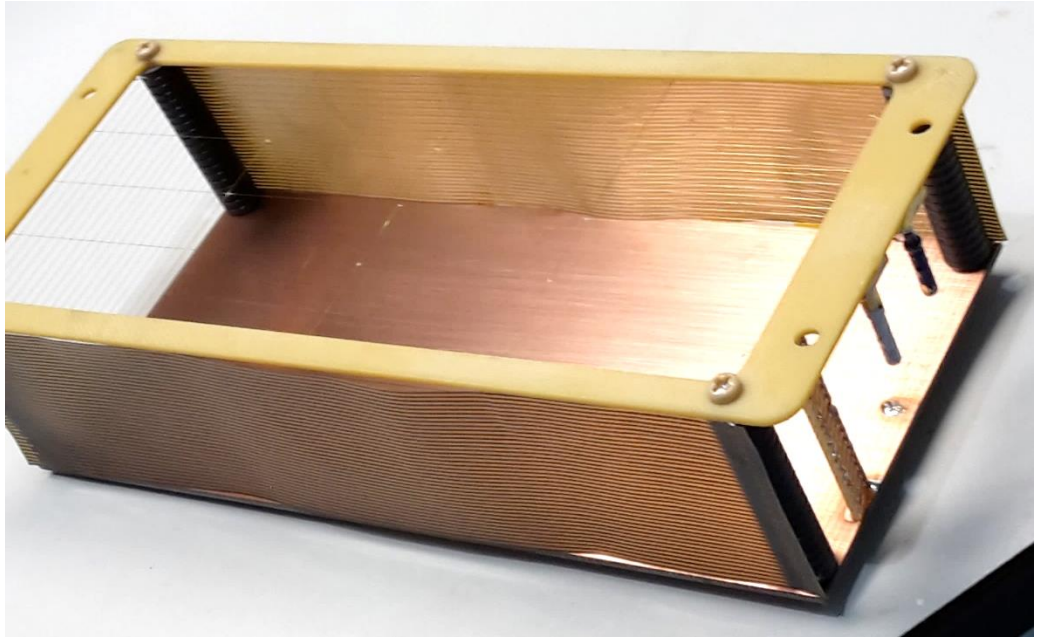
Field shaping in the 8-QUAD testbox

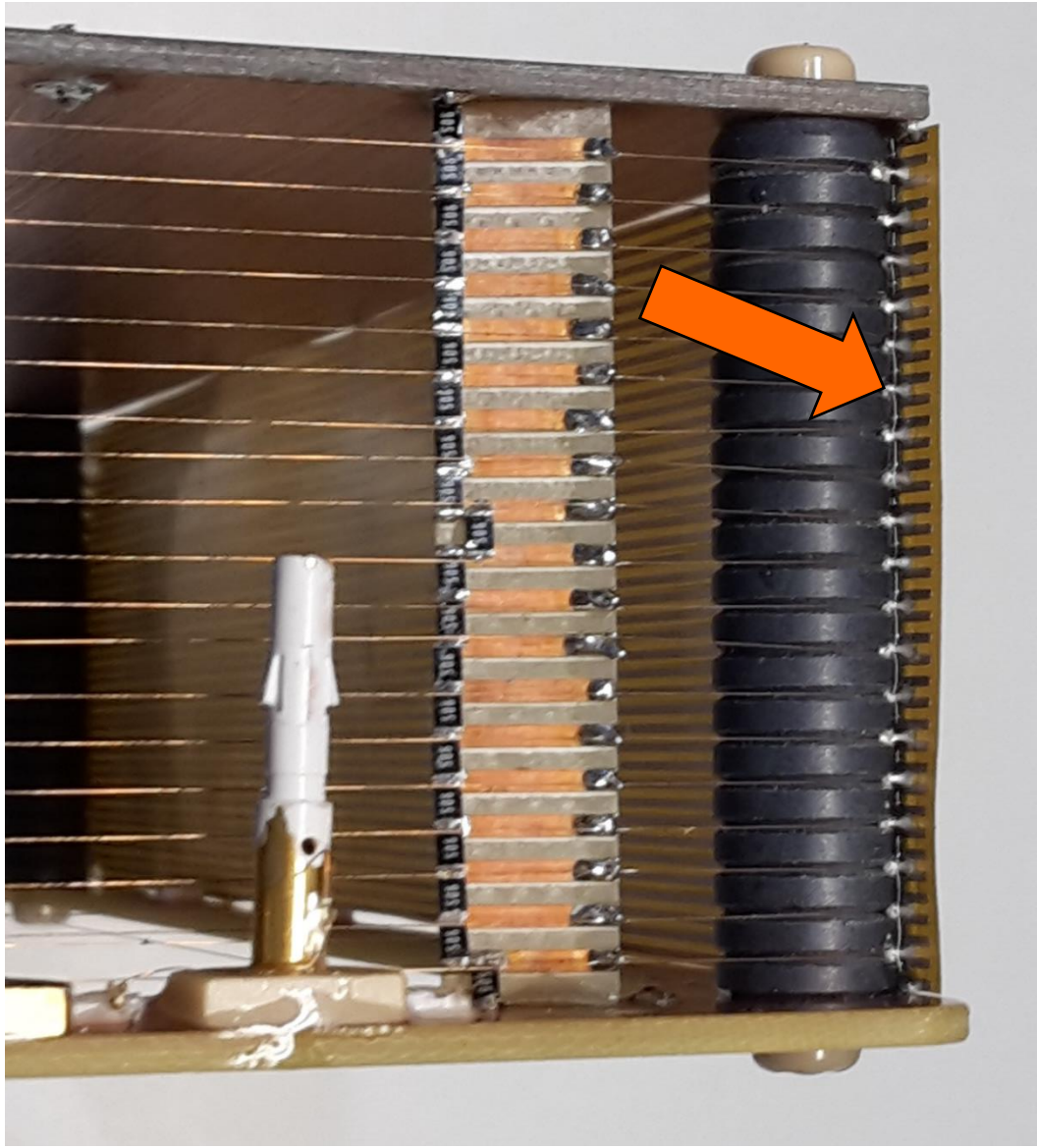
- Nominal distance of the field shaping wires to glass plate of gas envelope: 1.5 mm
- Possibly large charges on the glass plate affect the electrical field in the cage



Additional field shaping foil added to field cage

- Kapton with tinned strips
- Strip pitch 1 mm
- 2 strips connected to a single field shaping wire
  - Using Traduct silver glue
  - Reinforced with Araldite
- Detector operational again but gas leak still needs repair





Conclusions laser measurements

- Serious field deformation in our testbox
  - Field lines are fanning out towards the grids
- Might be solved by additional field shaping foils

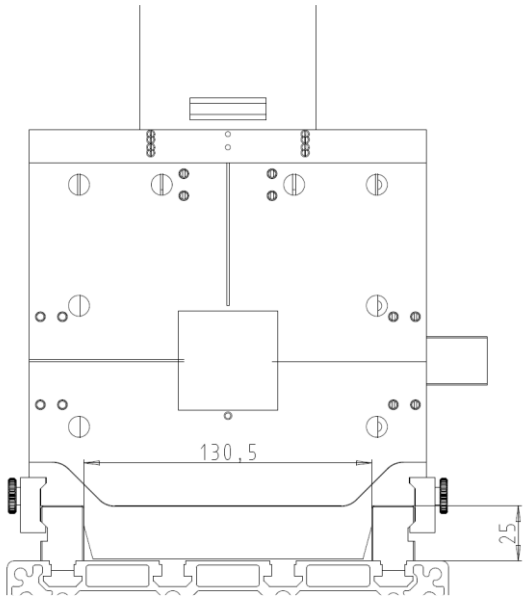
- Statistical errors for a track defined by one QUAD are small
  - 40 um in X
  - 3 mrad in slope

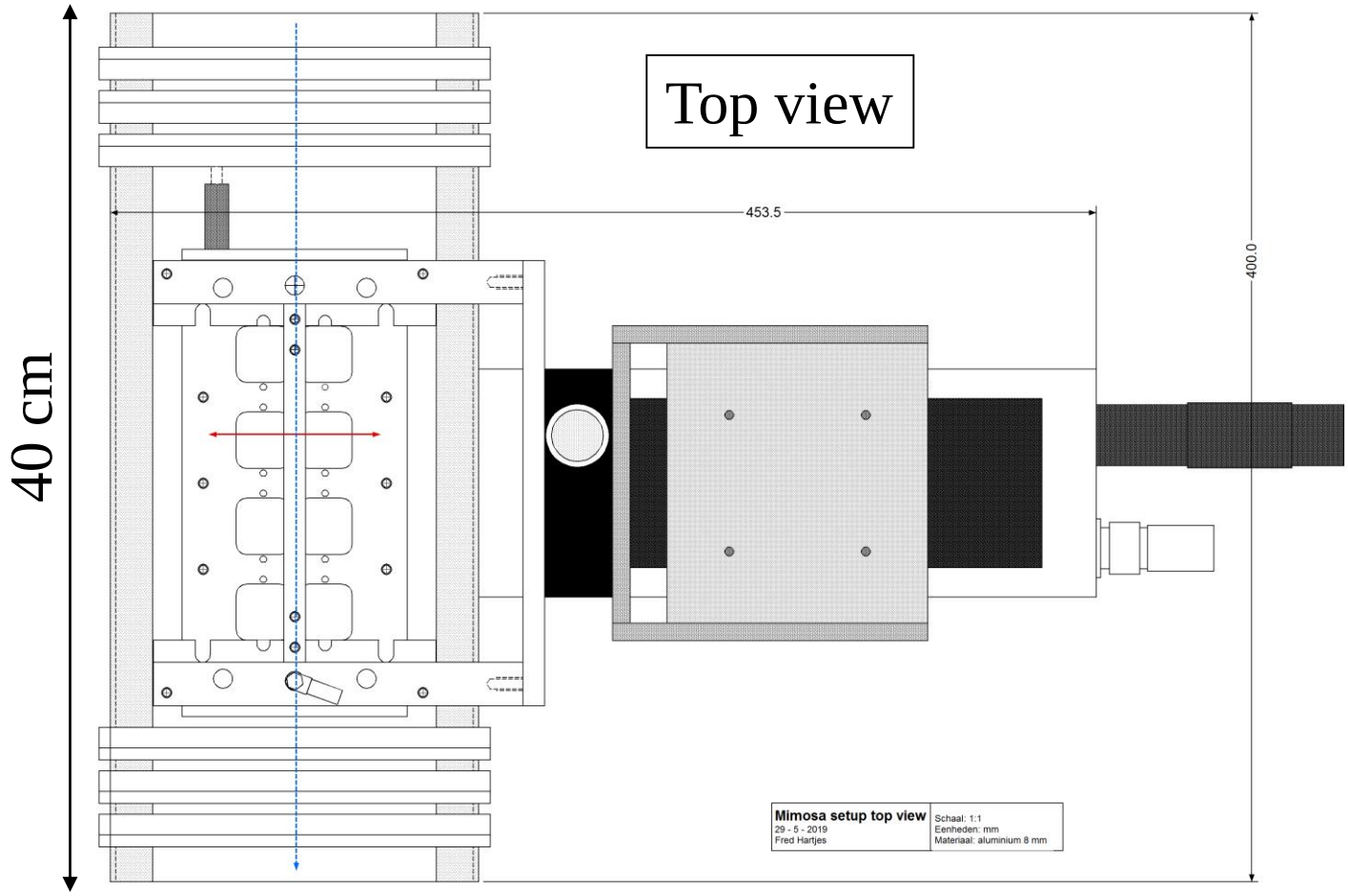
- Tracks on the boundary between two chips are detected with 100% efficiency and limited accuracy
  - Only for $Z \geq 10$ mm at $B = 0$ T
  - Statistical error in boundary region up to 300 um

- Laser measurements are expected to be comparable with MIP results

ELSA testbeam in September 2?

- T-shaped master plate carrying a rail system for the 6 Mimosa planes and XZ stages for the 8-QUAD testbox
- Testbox hanging on 2 bars
- Manual goniometer will be added
  - Rotation in horizontal plane around centre testbox



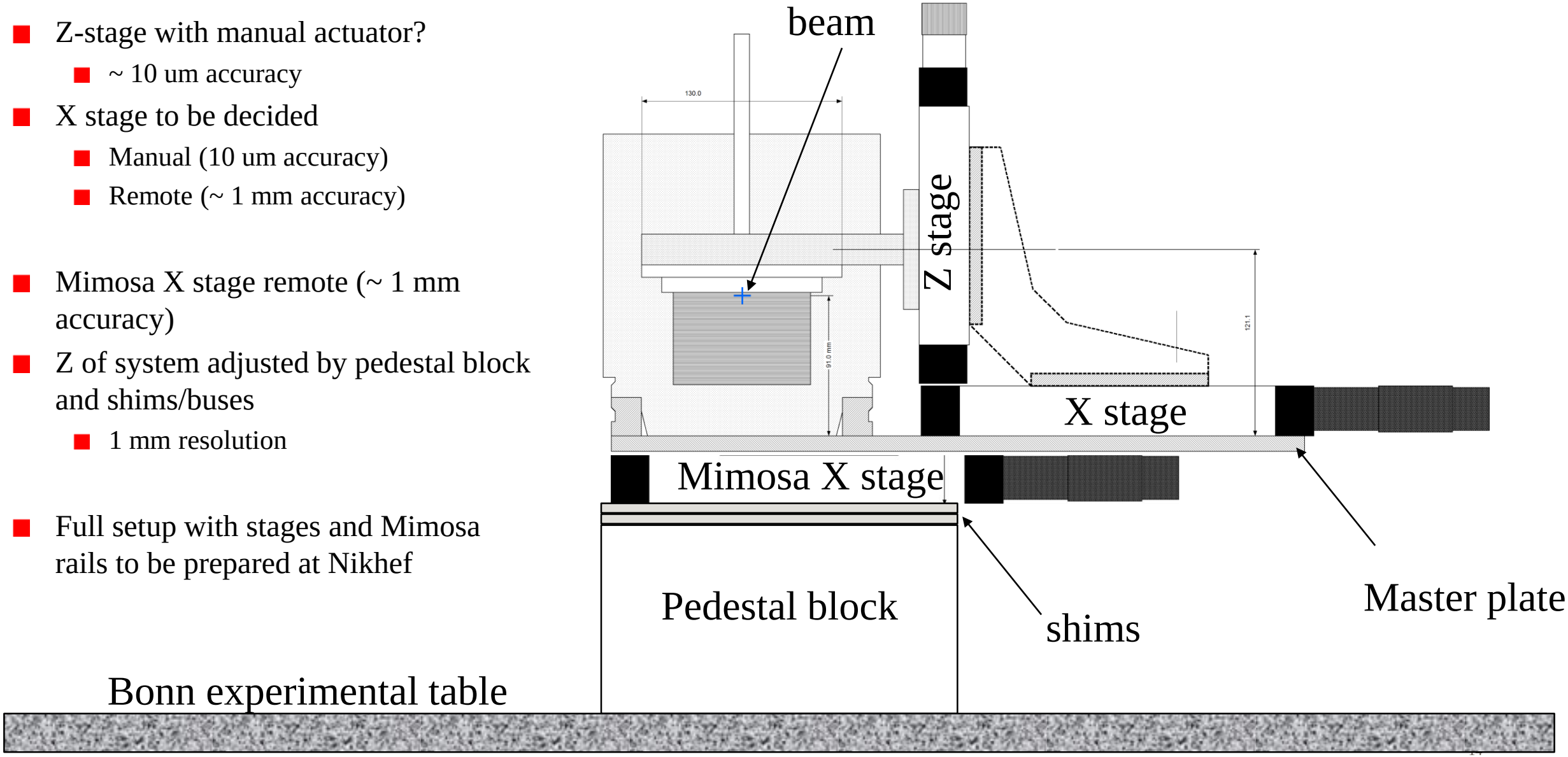


Stage setup

- Z-stage with manual actuator?
  - ~ 10 um accuracy
- X stage to be decided
  - Manual (10 um accuracy)
  - Remote (~ 1 mm accuracy)

- Mimosa X stage remote (~ 1 mm accuracy)
- Z of system adjusted by pedestal block and shims/buses
  - 1 mm resolution

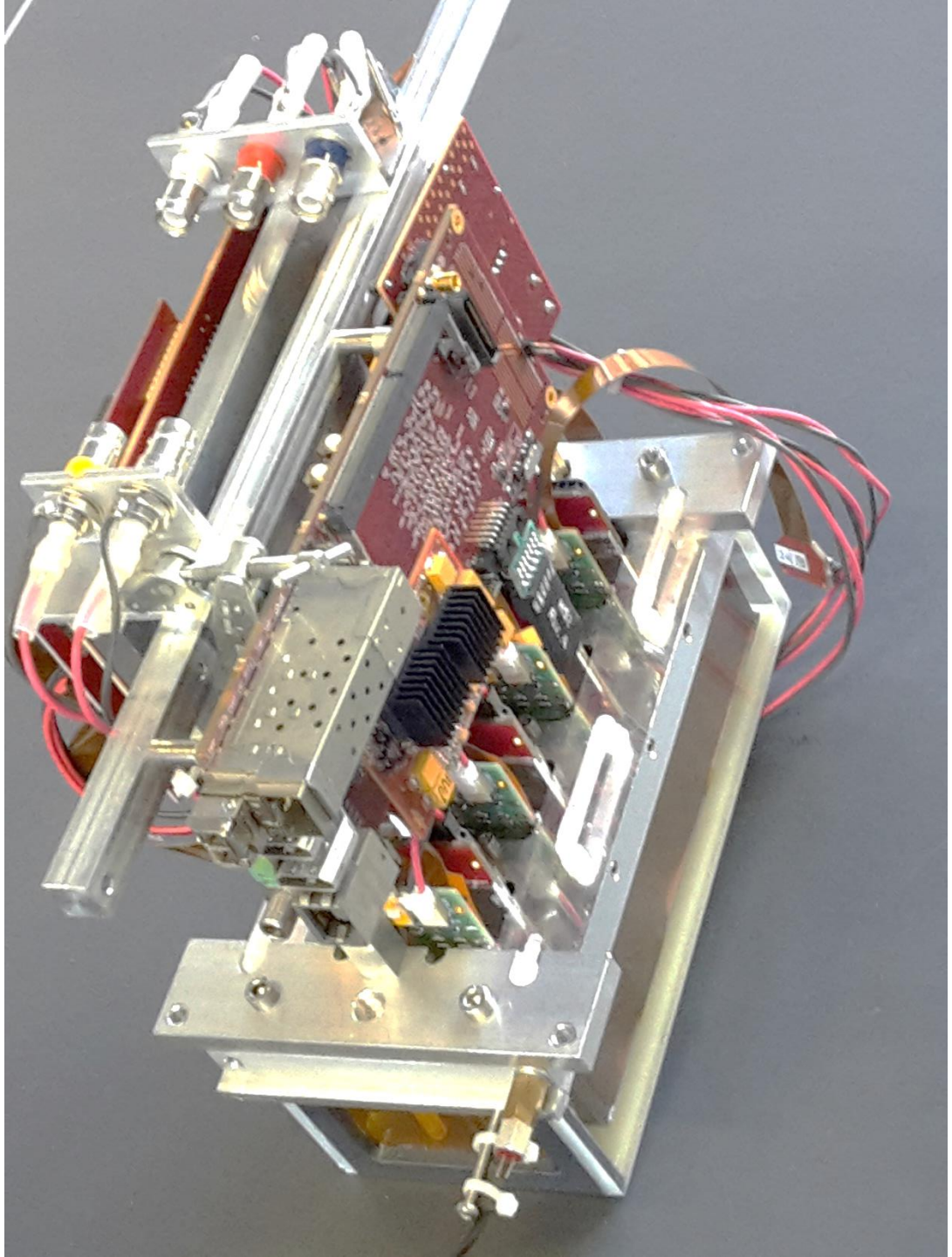
- Full setup with stages and Mimosa rails to be prepared at Nikhef



To be decided this week

- **Stages**
- Z stage high precision manual
  - Requires access every time
- X stage
  - High precision manual operation?
    - Requires access every time
  - Or low precision (1 mm) remote?
- Testbox angle to beam
  - Exactly parallel?
  - Or angles up to +/- 270 mrad?
    - Using manual goniometer

- **DAQ**
- All 8 QUADs with 2 concentrators and 2 SPIDRs?
  - Will this working in time?
- Fall back: 2 QUADs on 2 SPIDRs, to be tested week 29
  - Second QUAD sideward or behind the other QUAD?
  - May be modified during the testbeam



Reference

Hits vs ToT for T2K and 18% iC4H10

- At SE efficiency above 80% we have more than 40% secondary emission hits