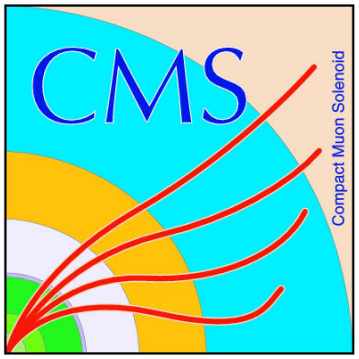
Optical Deformation Measurement Setup (ODM)

Status of ODM – Measurements for Testing the Recent Setup



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DESY

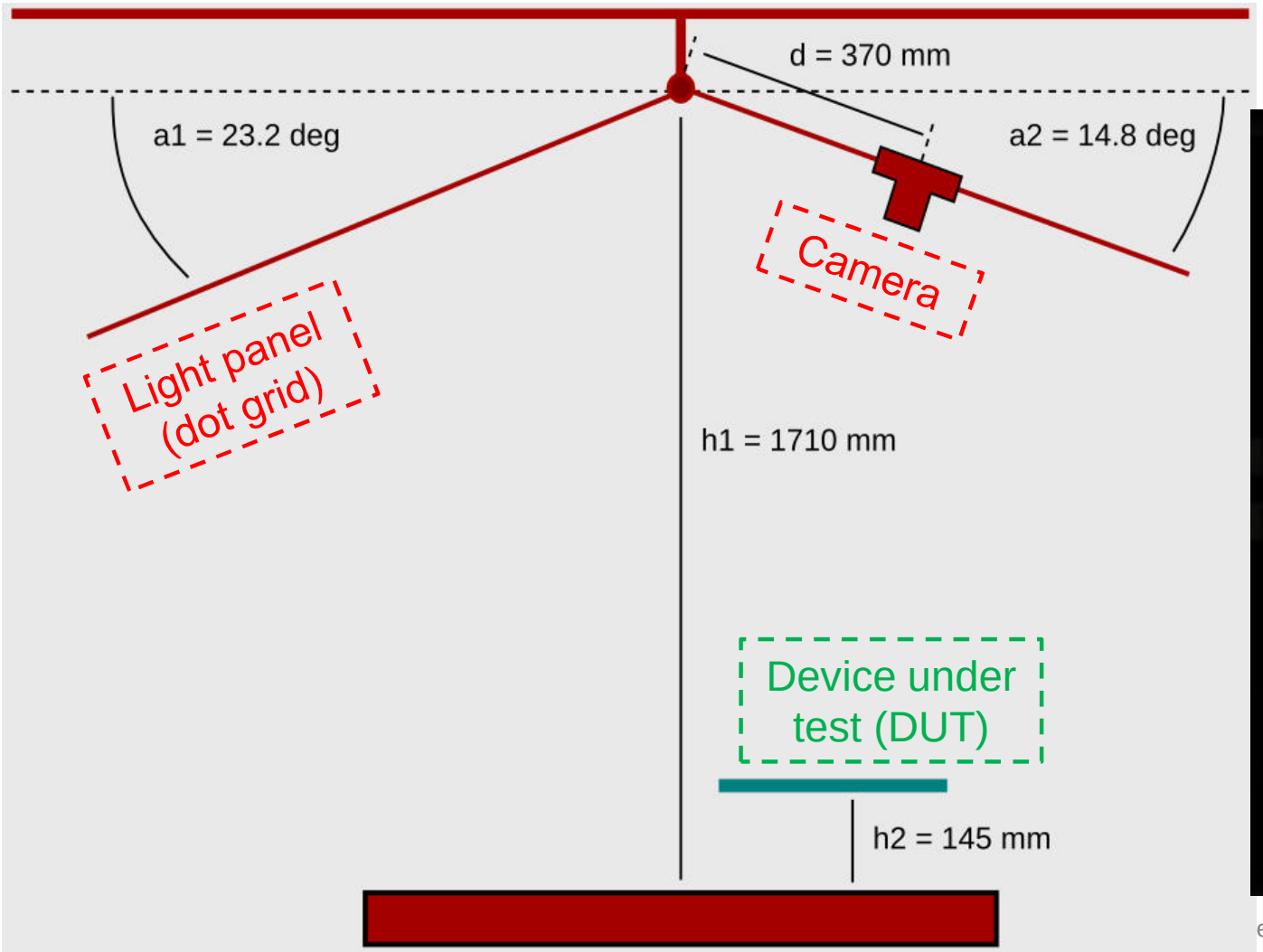
Hamburg-CMS Tracker Upgrade Meeting
10.05.2013

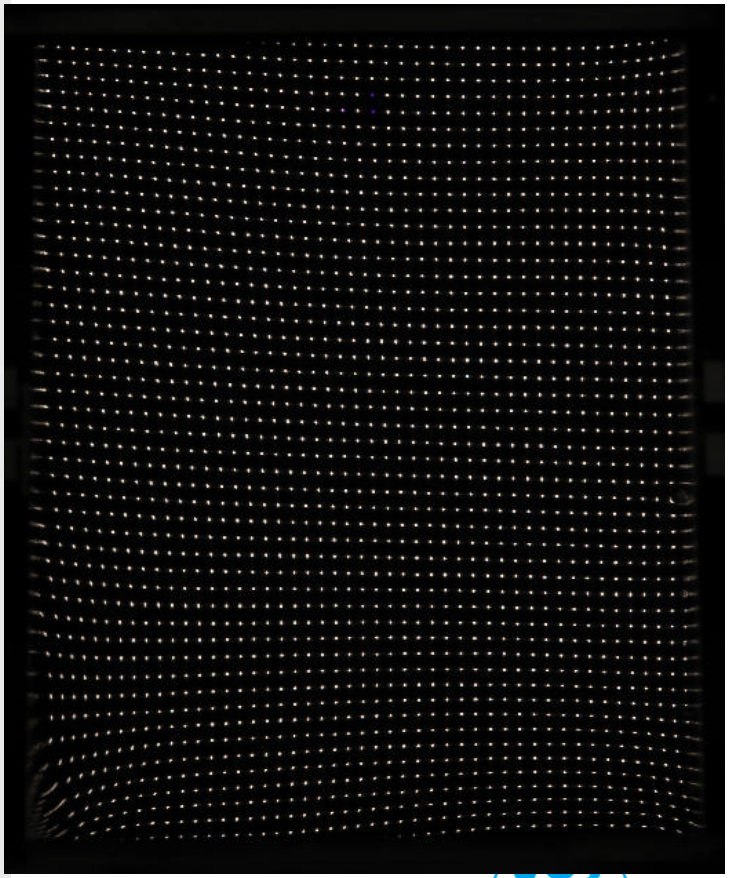
HELMHOLTZ ASSOCIATION

DESY

Experimental Setup

- Idea: measure deformations of a surface via reflections of light points
  - Needs dark chamber (you can visit this in the E-Lab)
  - Needs well reflective surface





Data Acquisition – Input

- Relative deformation measurement between two states of the DUT
  - Compare photos of two different states, i.e. their relative shift of the light points
  - For absolute measurements, calibration will be needed to define flat surface
- Here: some metal plate as DUT
  - Not really flat, not perfectly polished before usage, some scrapes, BUT reflecting
  - Good enough for testing recent setup
- Here: using calibration table, deformation enforced by micrometer screw

Recent Measurement Series

- Move screw several times up and down in certain steps
- Steps:

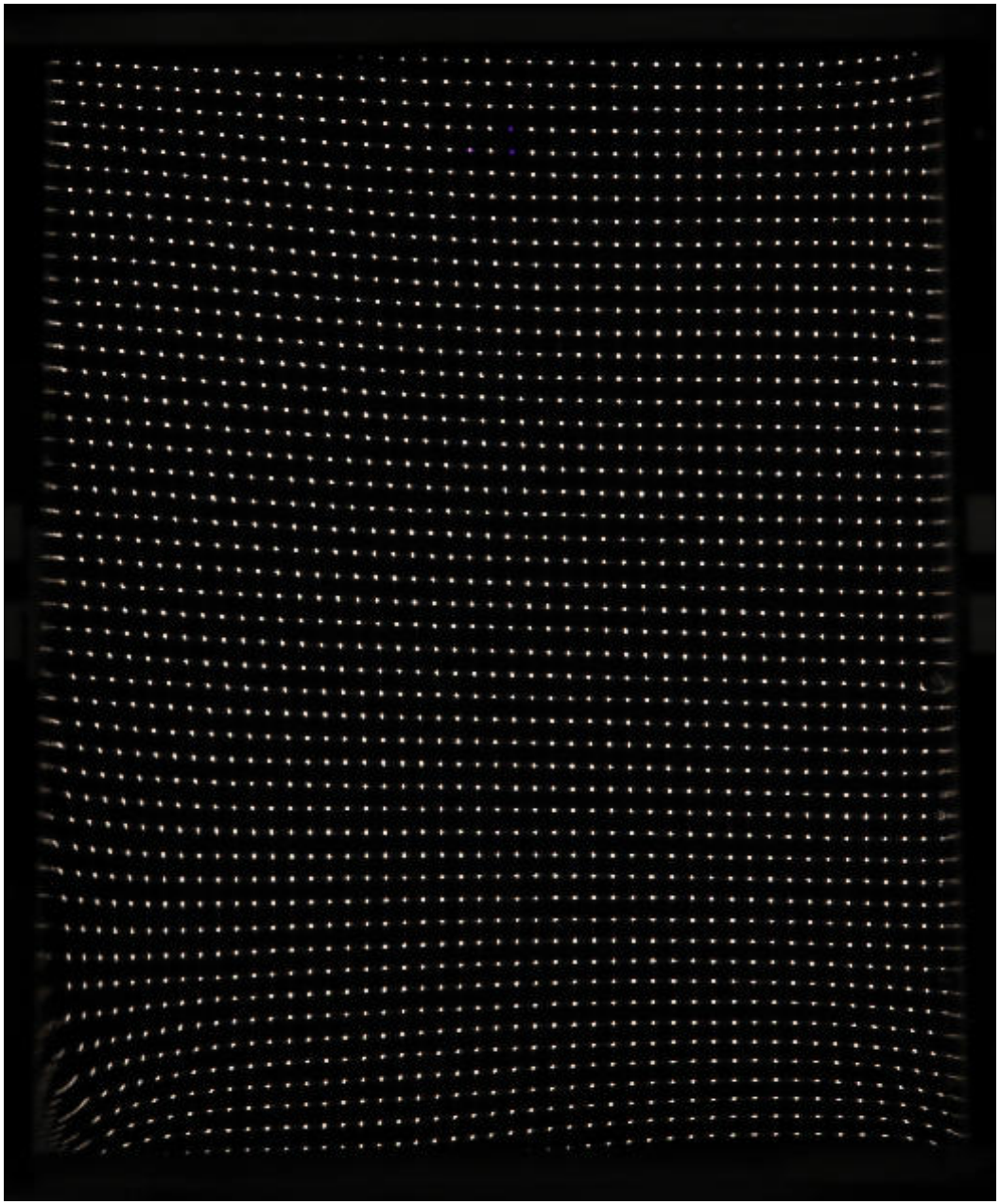
01:	0 µm
02:	0 µm
03:	100 µm
04:	200 µm
05:	250 µm
06:	200 µm
07:	100 µm
08:	0 µm
09:	100 µm
10:	200 µm
11:	250 µm
12:	200 µm
13:	100 µm
14:	0 µm

Step 01 and 02 identical (2 photos without any setup change), used for getting an idea of systematic effect from measurement system only

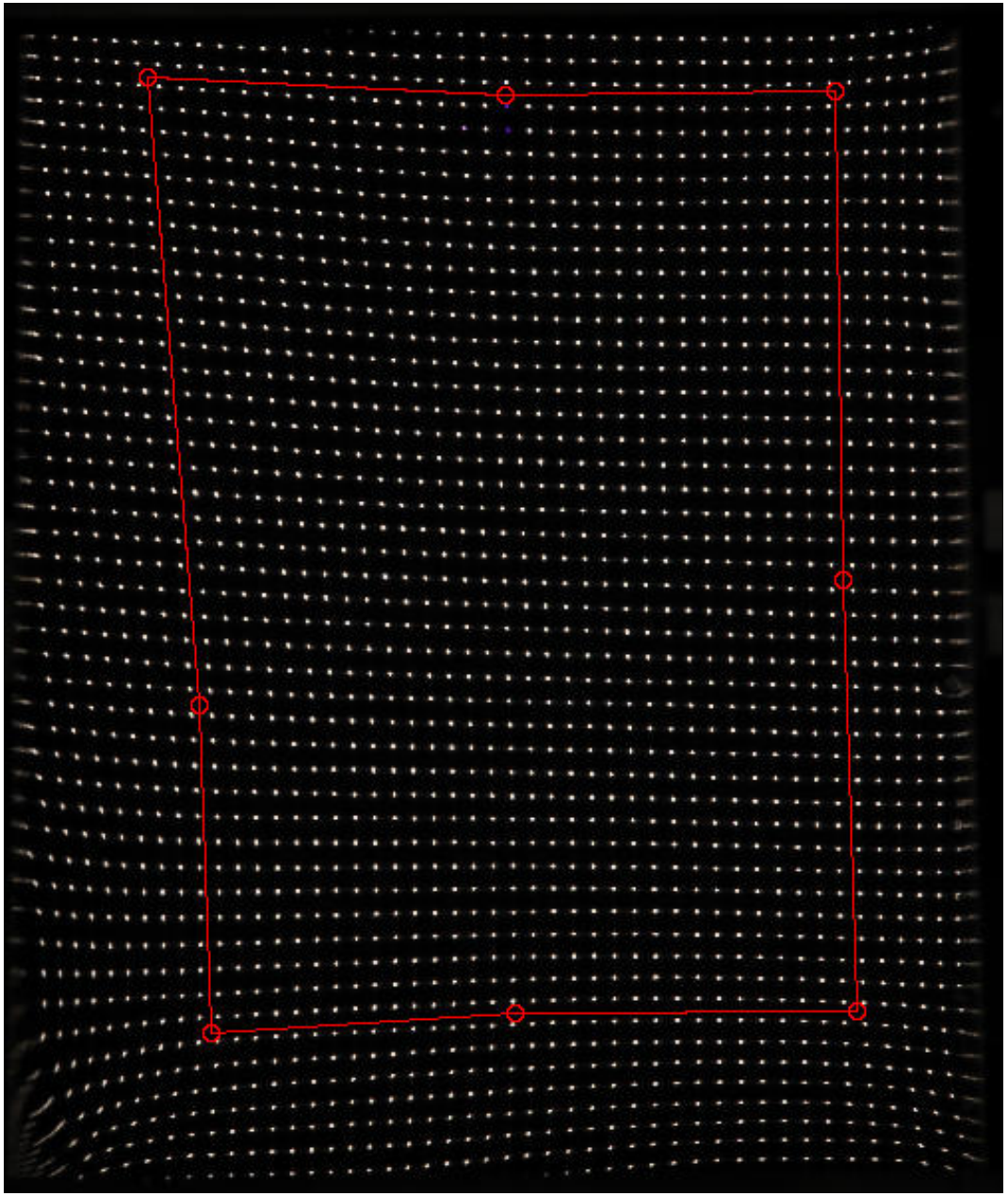
Using step 01 as reference, reconstruct all other steps as deformation relative to this one

- Do this series twice, second one with rotating calibration table by 90°

Reconstruction – From Original Photo …

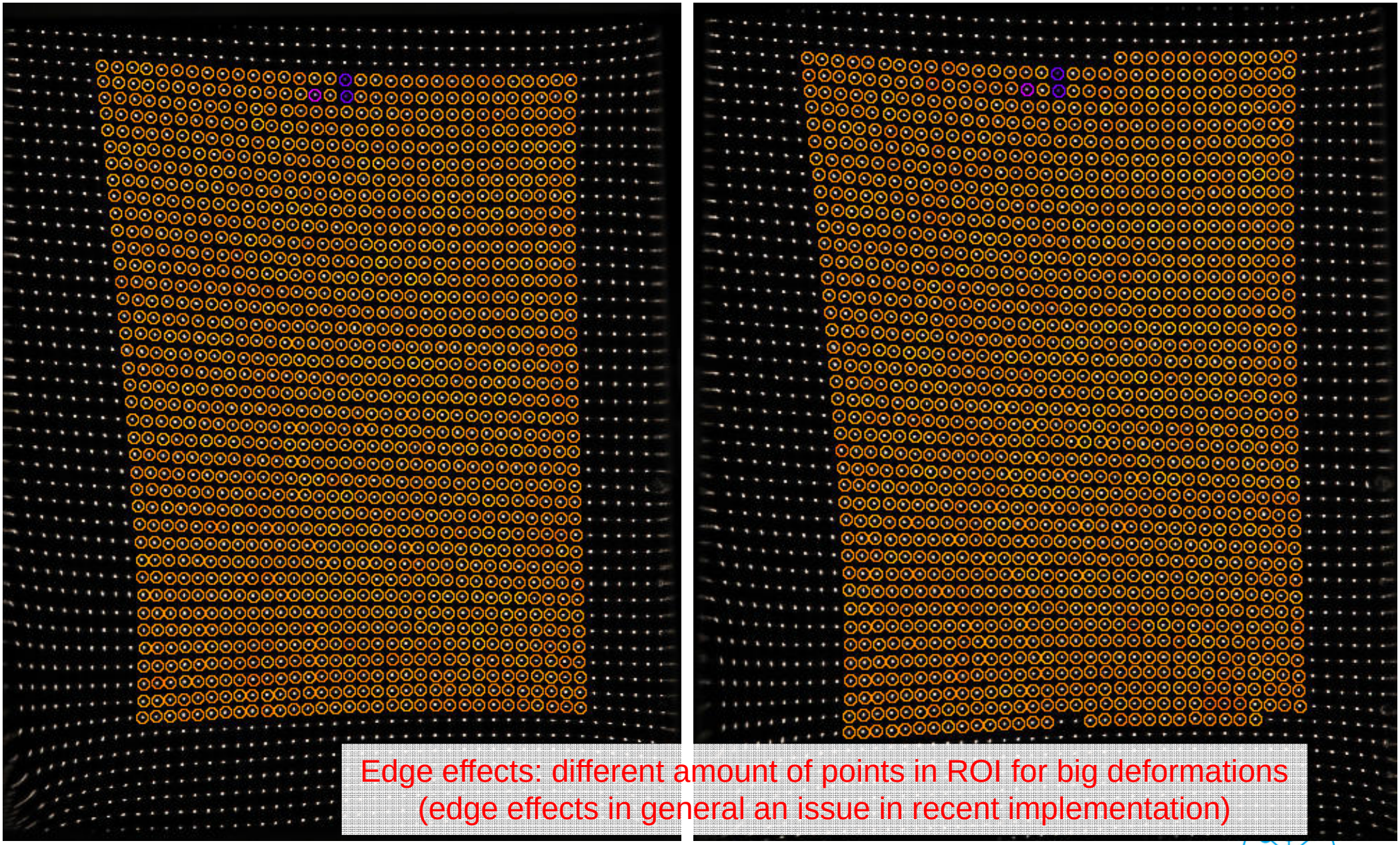


Reconstruction – over Definition of Region of Interest …



Definition of Region of Interest (ROI) via straight lines, forming a polygon with favoured number of angles (≥4)

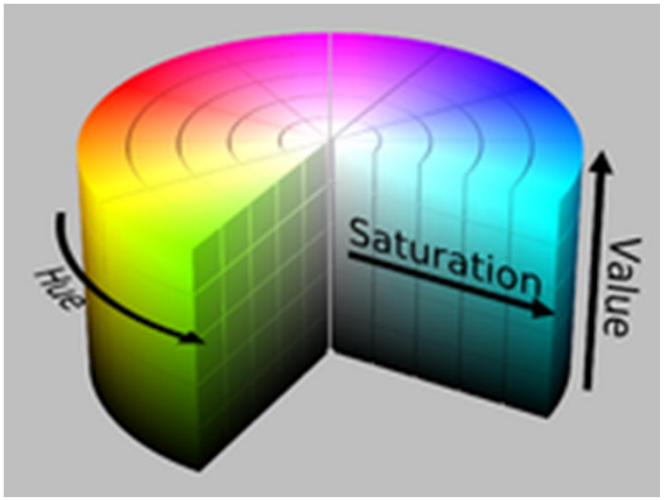
Reconstruction – over Point Reconstruction …



Edge effects: different amount of points in ROI for big deformations
(edge effects in general an issue in recent implementation)

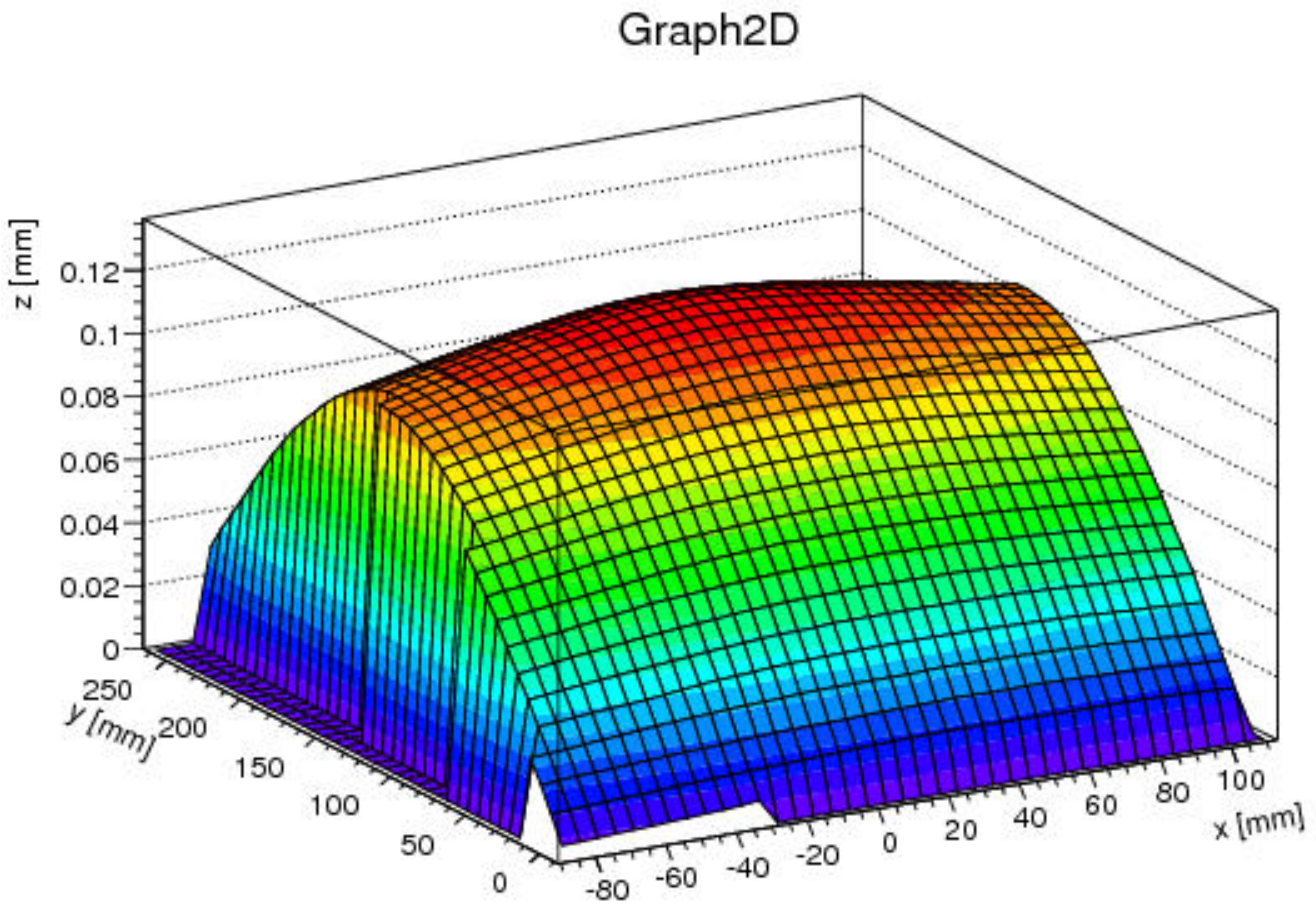
Reconstruction – over Definition of Origin for Indexing …

- Some light dots have colour filter (see colour of circles in previous page)
  - Using HSV colour space representation (Hue-Saturation-Value)
  - Colours can be identified in Hue-Saturation plane
- Choose clearly identified single point for origin of indexing
  - Here: choose pinkish point
  - Remark: white points not perfectly white



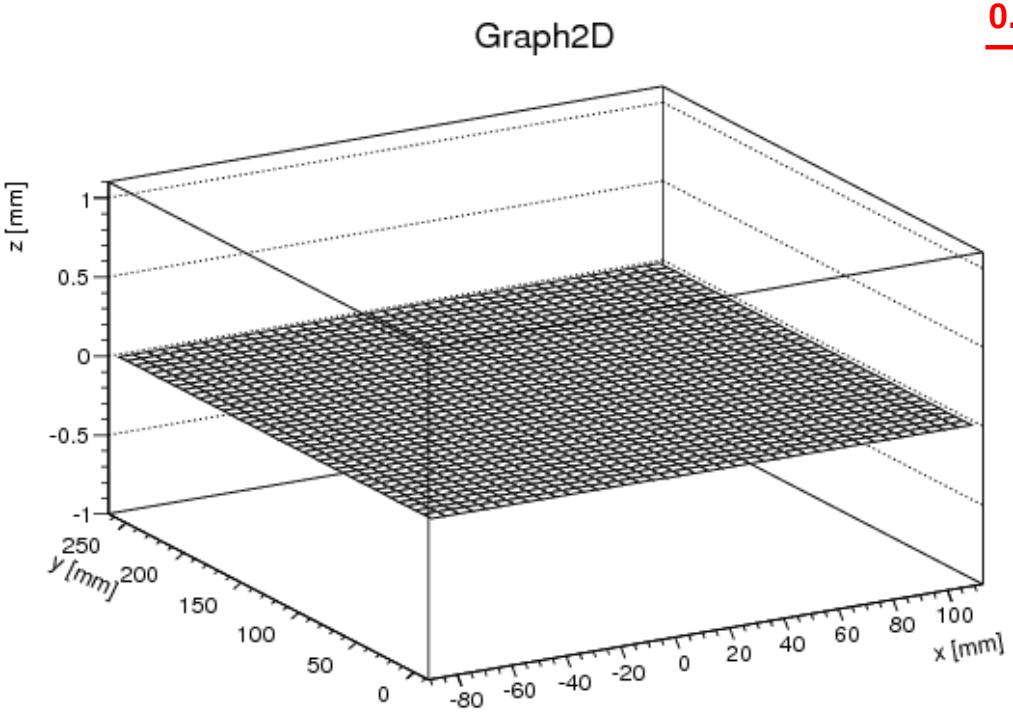
Reconstruction – … to a Reconstructed Deformation

- Measurement values are not correct, but in right ballpark
  - Improper configuration parameters hardcoded
  - Did screw really touch the plate at 0 µm?

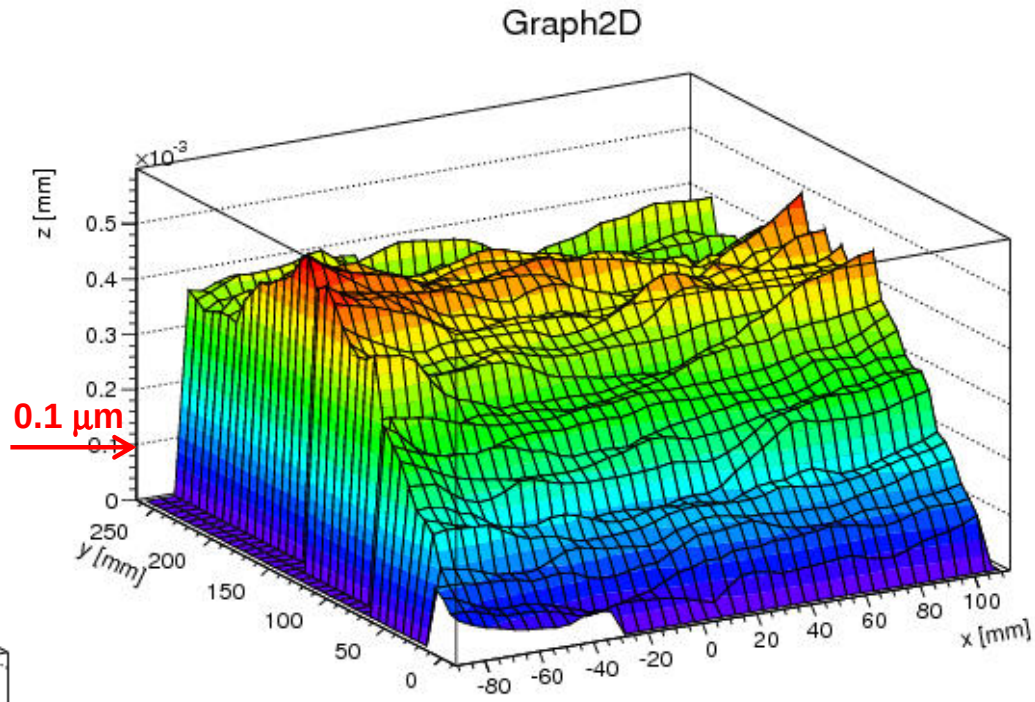


Measurement Series 1 – 0 µm

- Step 01 (self-consistency check)

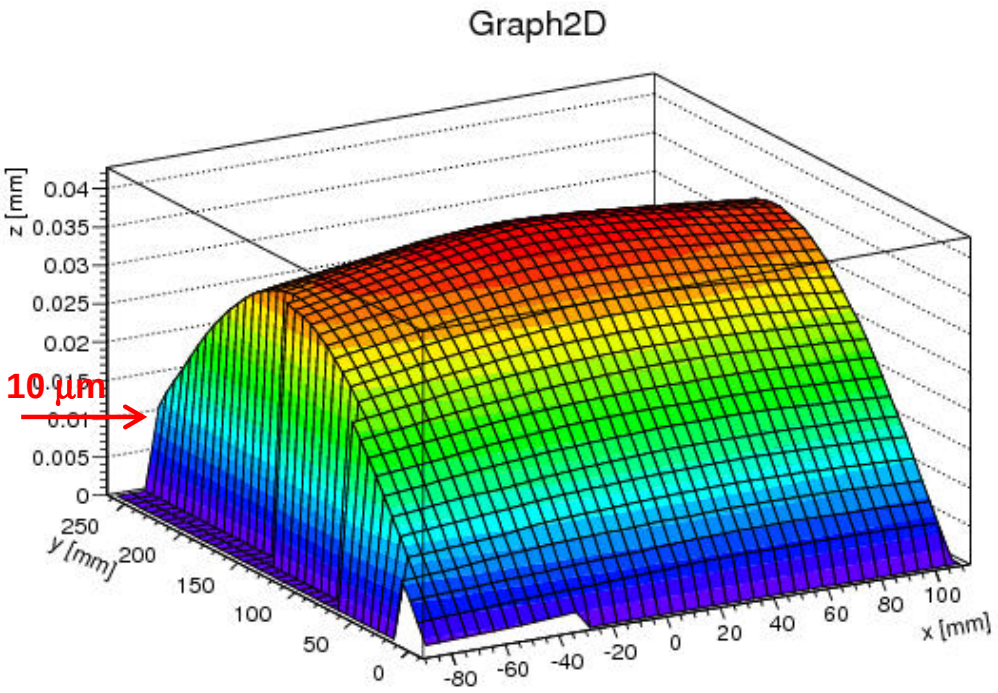


Step 02

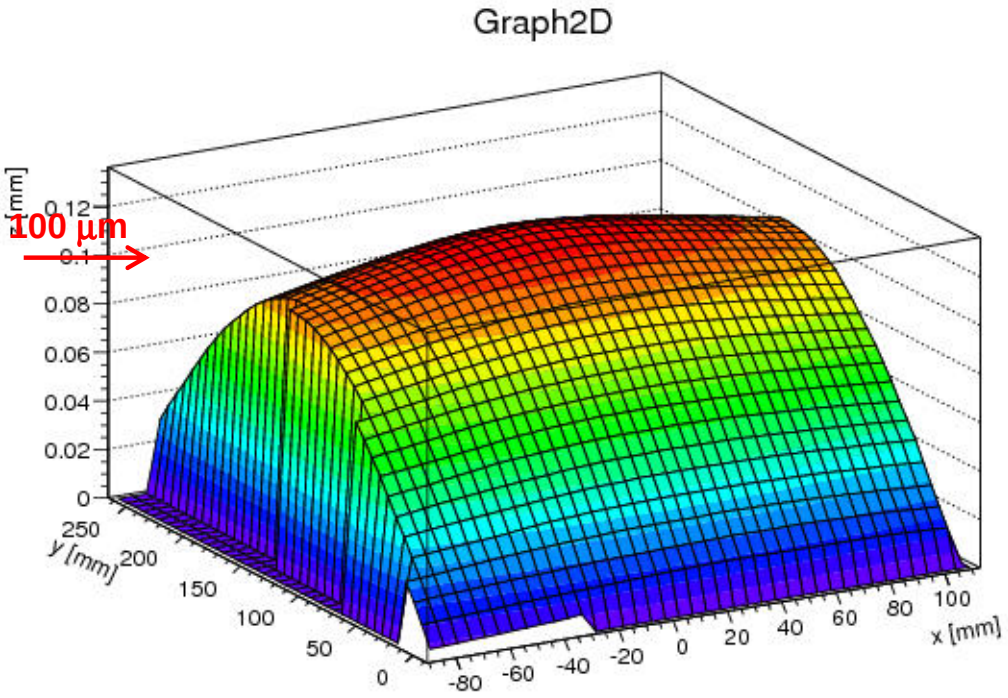


Measurement Series 1 – 100, 200 µm

- Step 03

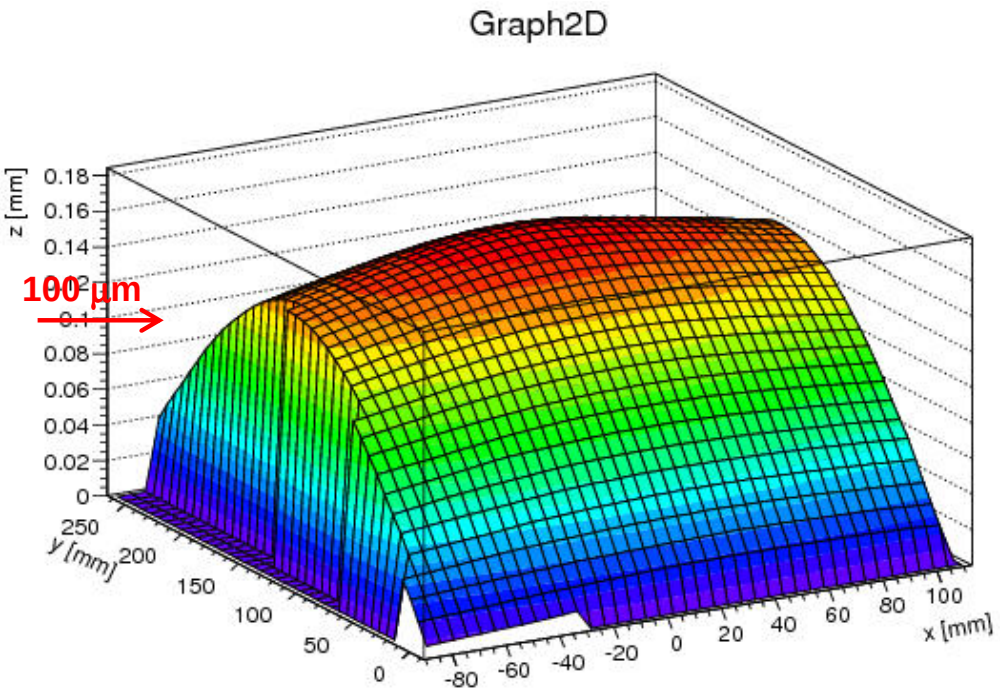


Step 04

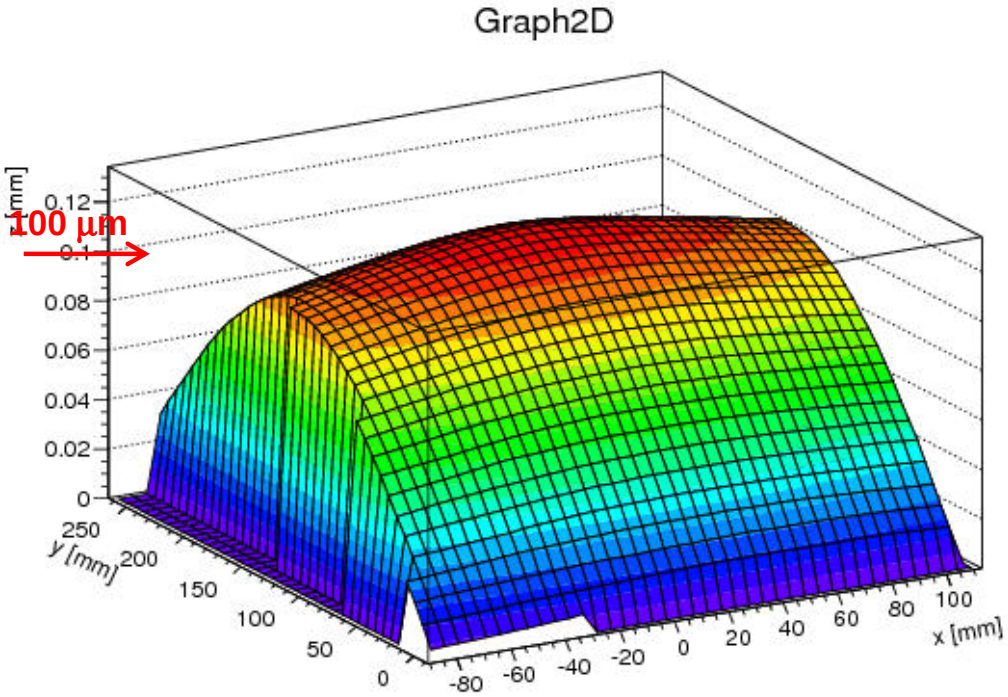


Measurement Series 1 – 250, 200 µm

- Step 05

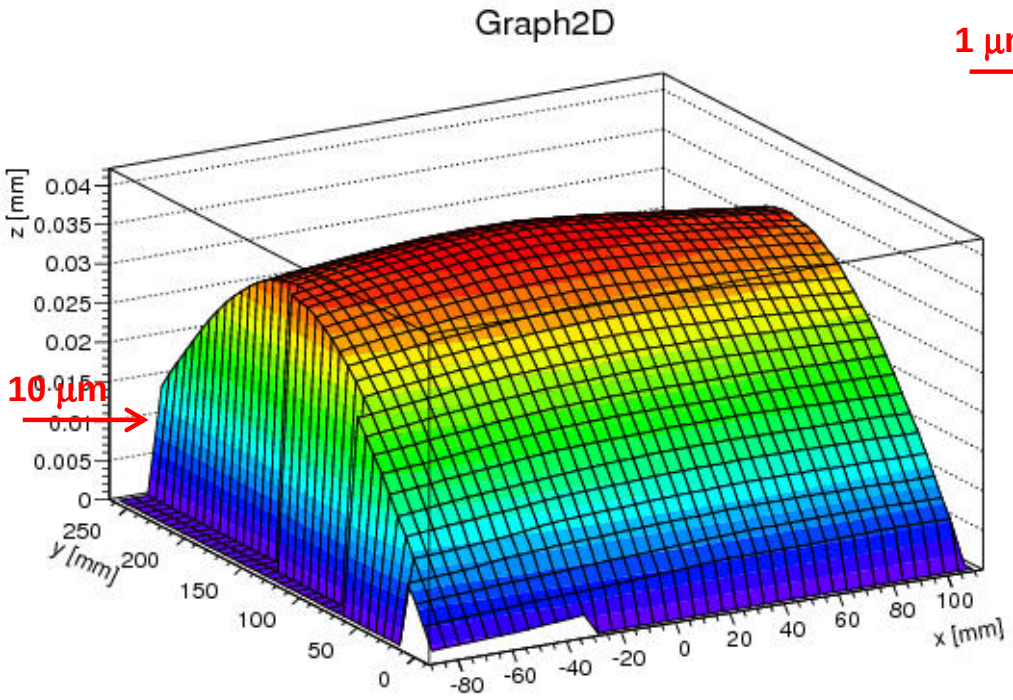


Step 06

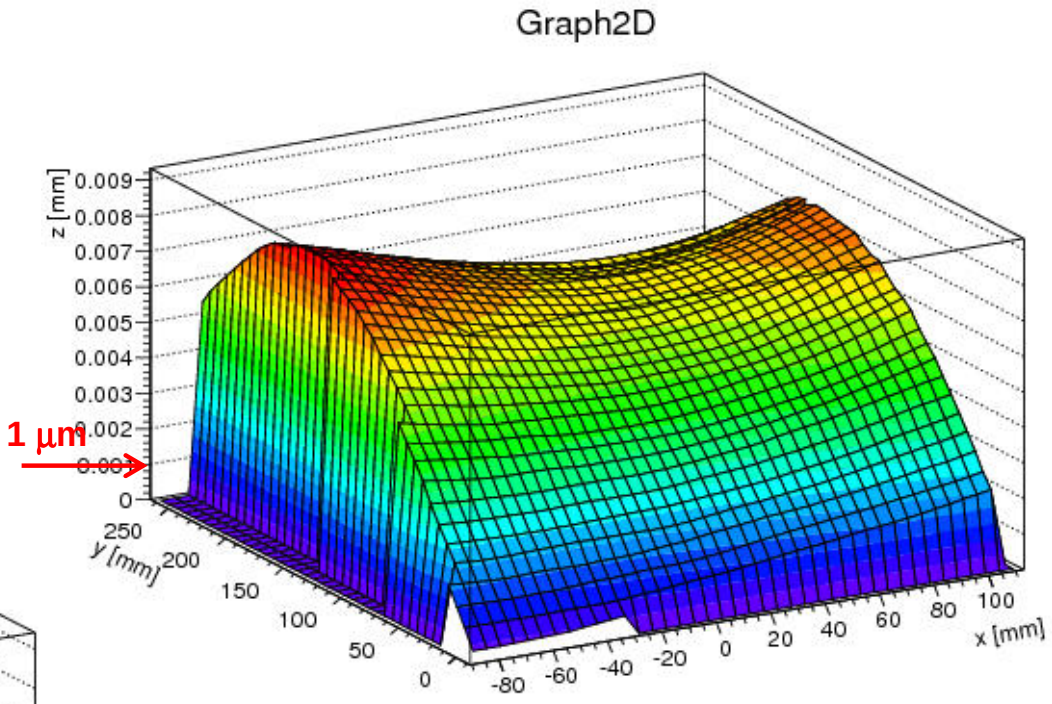


Measurement Series 1 – 100, 0 µm

- Step 07

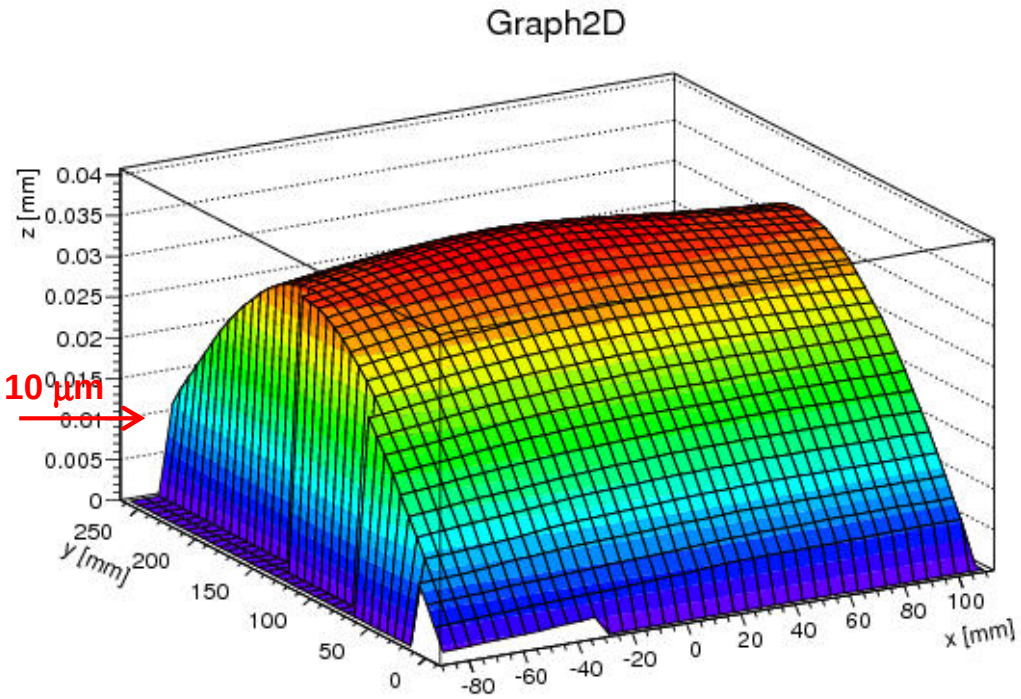


Step 08

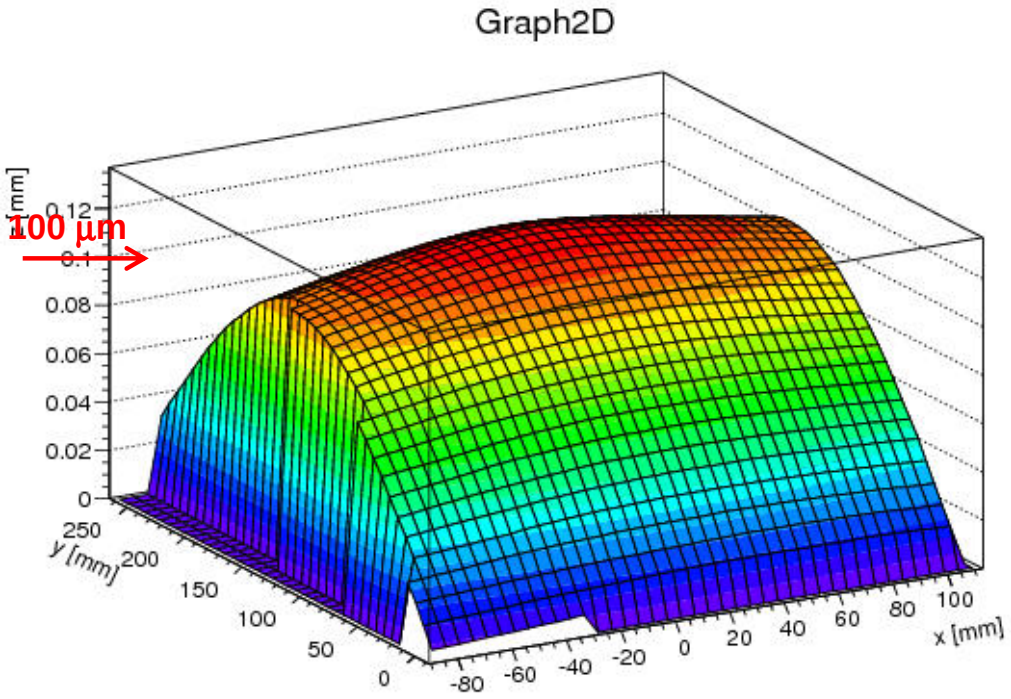


Measurement Series 1 – 100, 200 µm

- Step 09



Step 10

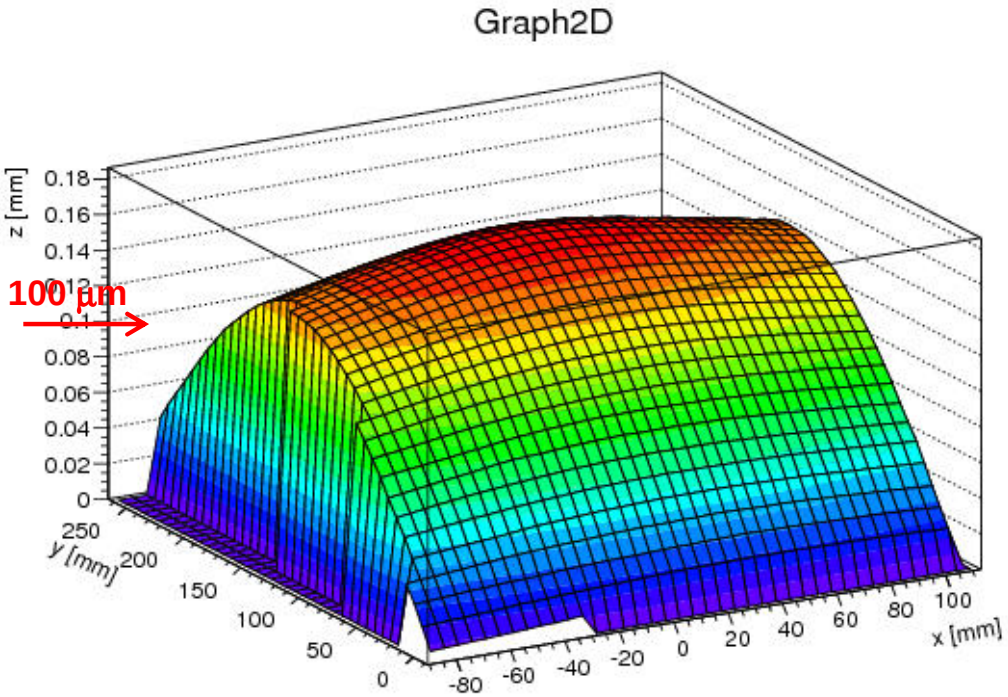


Measurement Series 1 – 250, 200 µm

- Step 11

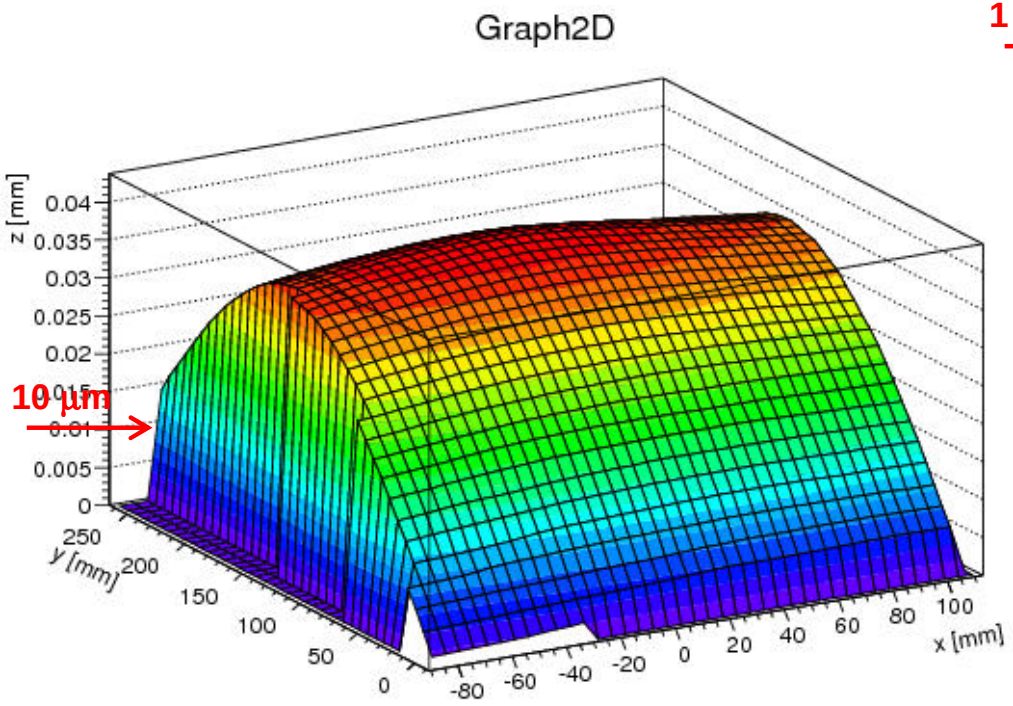
Step 12

No photo taken

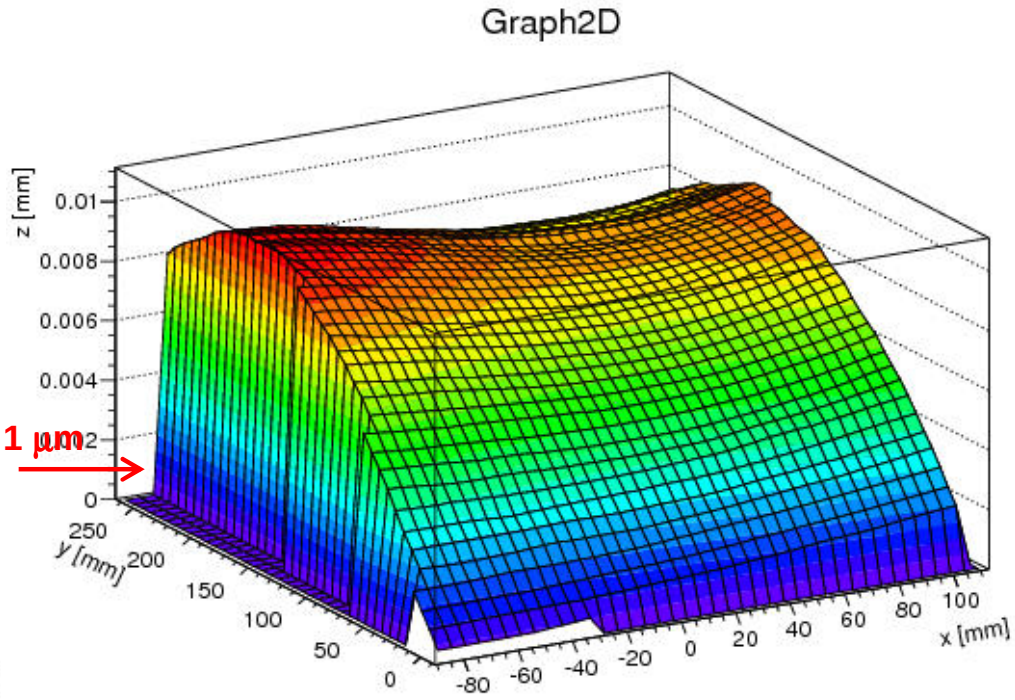


Measurement Series 1 – 100, 0 µm

- Step 13



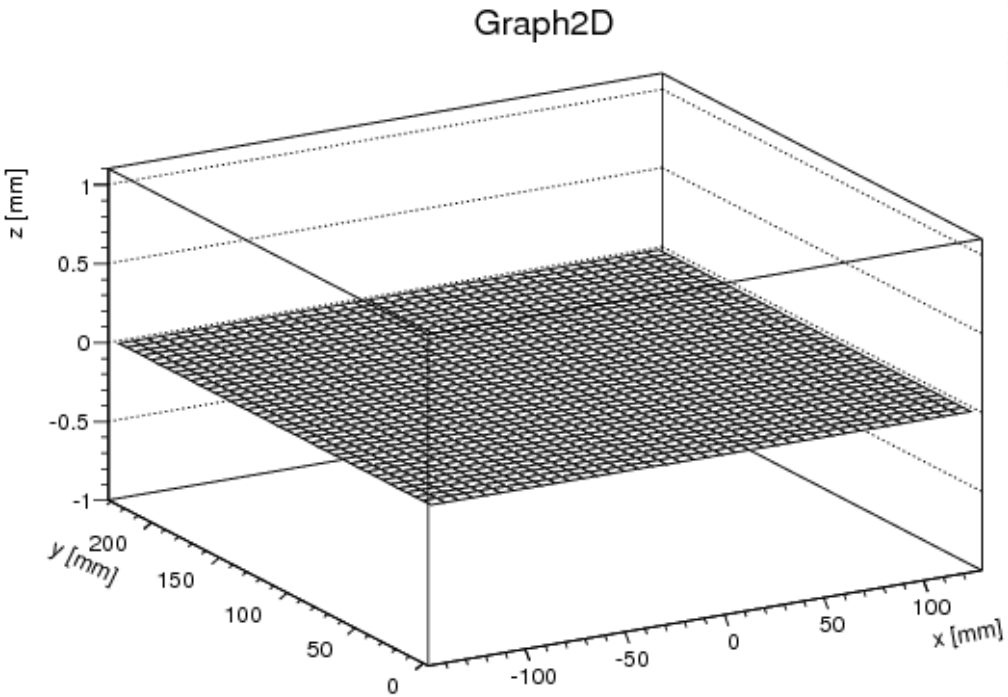
Step 14



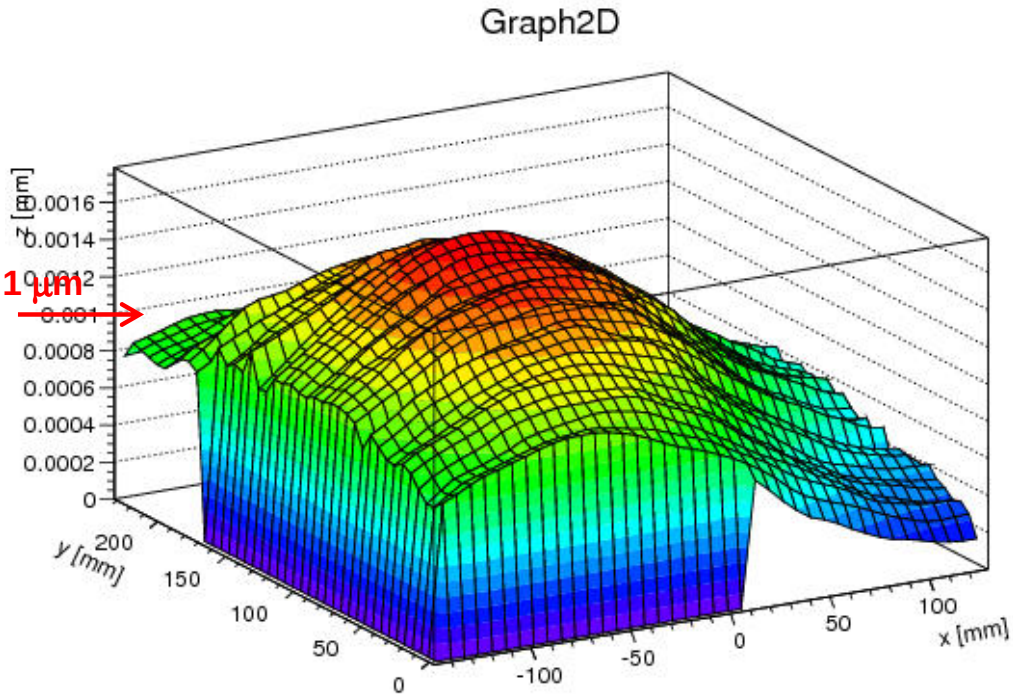
Backup

Measurement Series 2 – 0 µm

- Step 01 (self-consistency check)

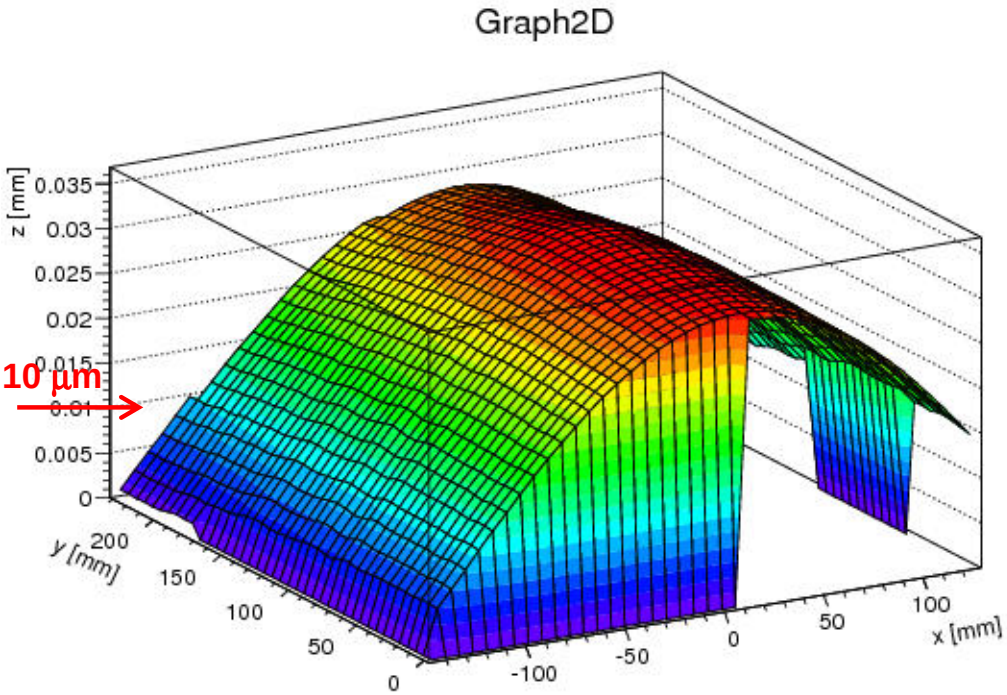


Step 02

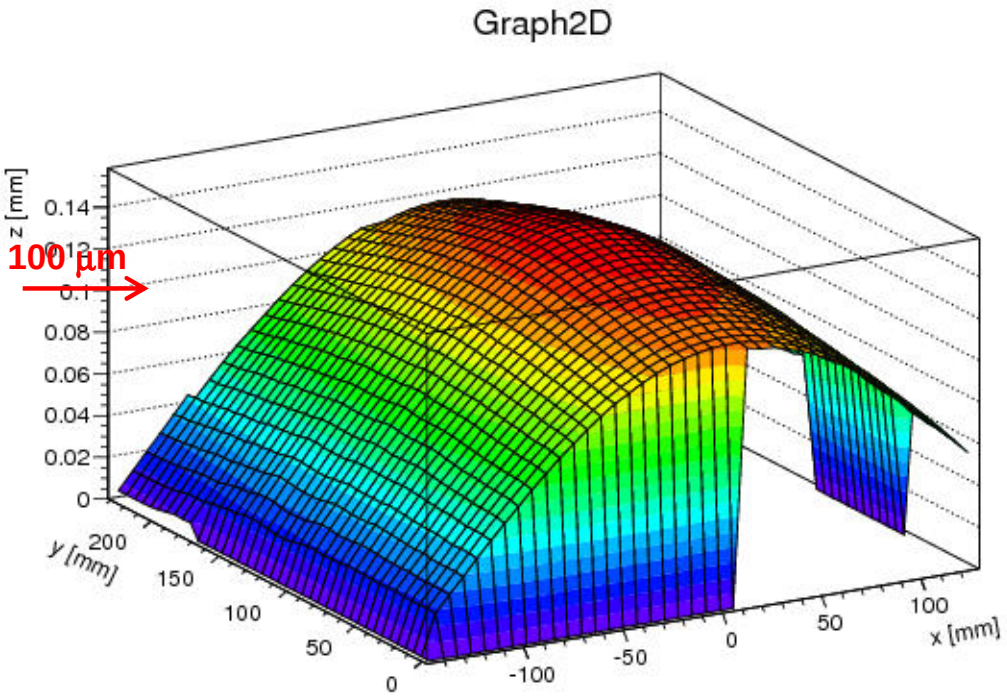


Measurement Series 2 – 100, 200 µm

- Step 03

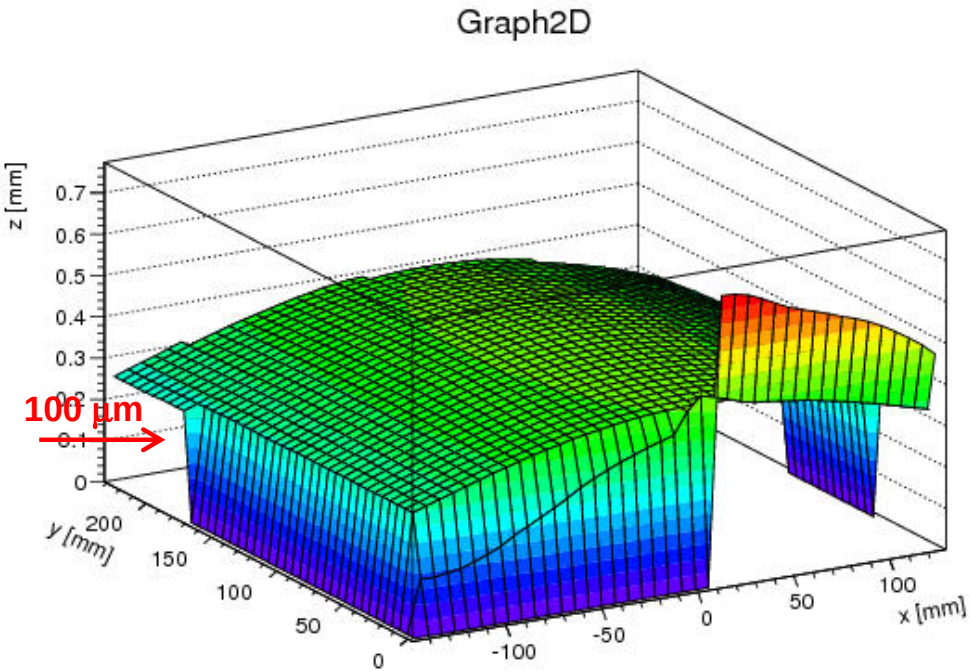


Step 04

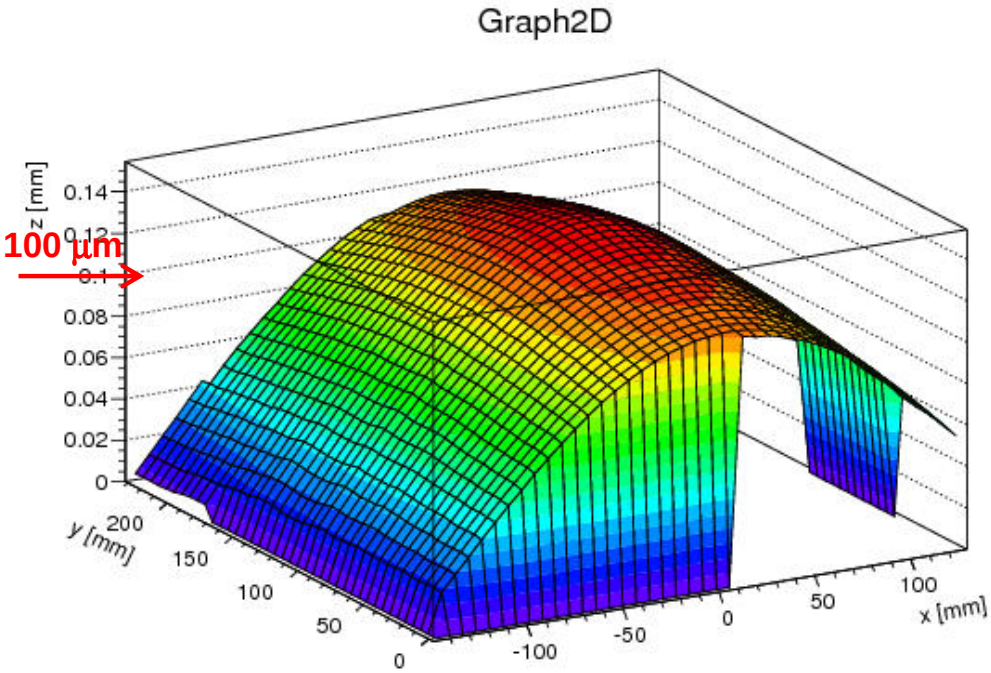


Measurement Series 2 – 250, 200 µm

- Step 05

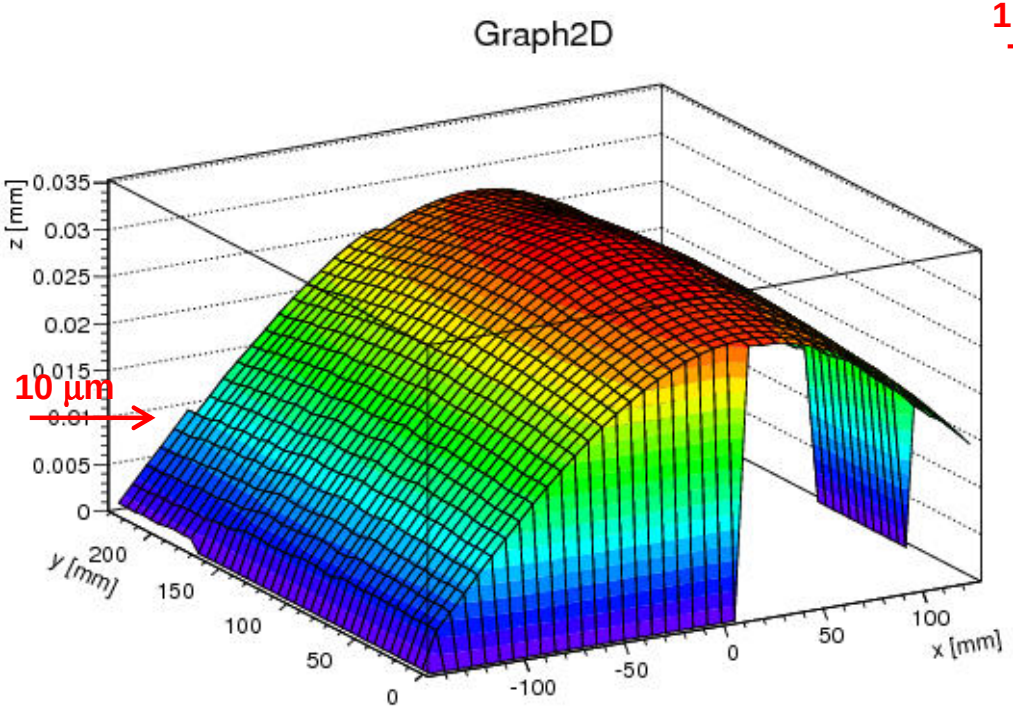


Step 06

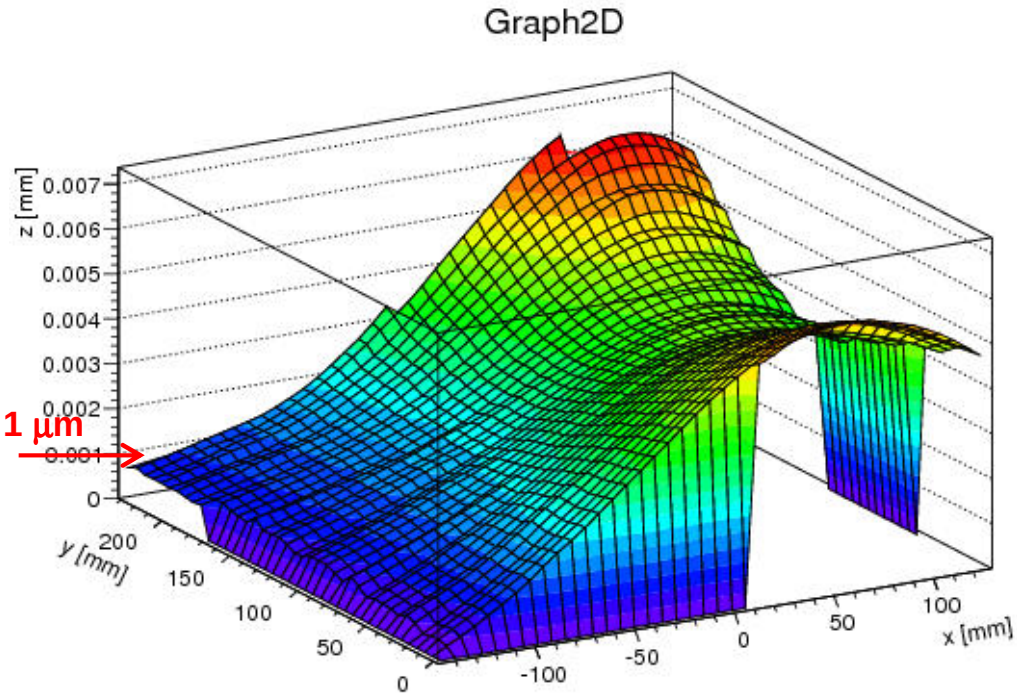


Measurement Series 2 – 100, 0 µm

- Step 07

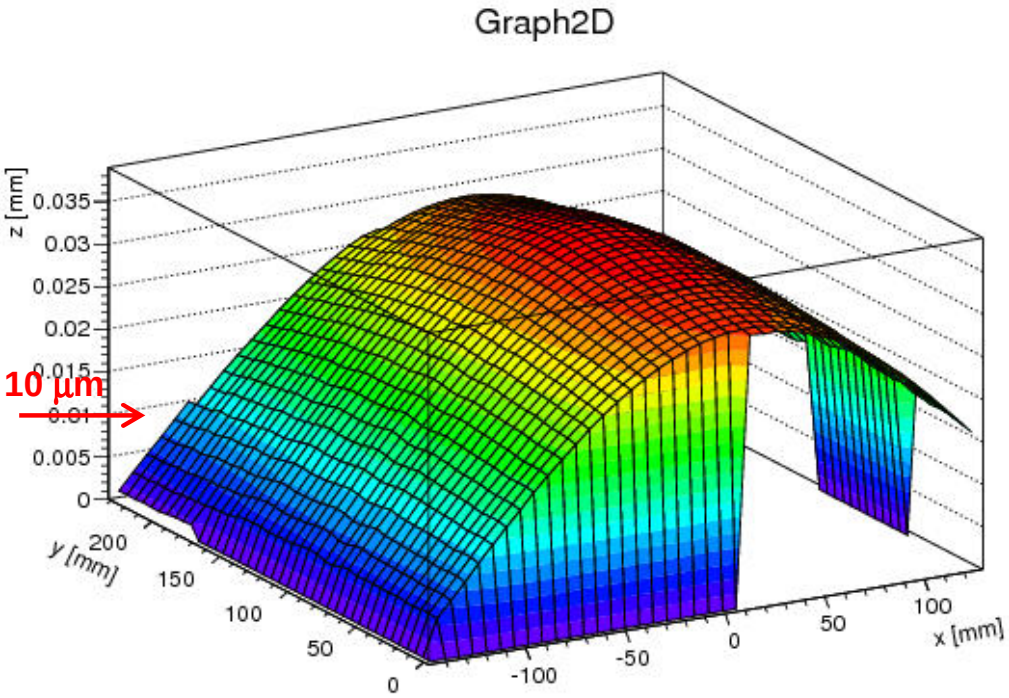


Step 08

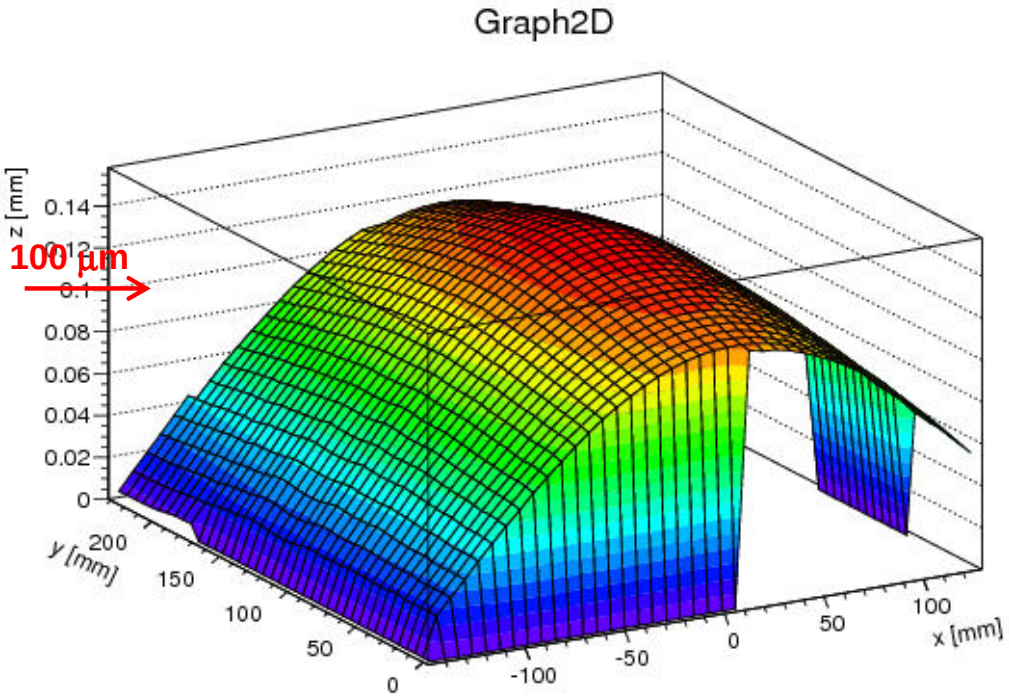


Measurement Series 2 – 100, 200 µm

- Step 09

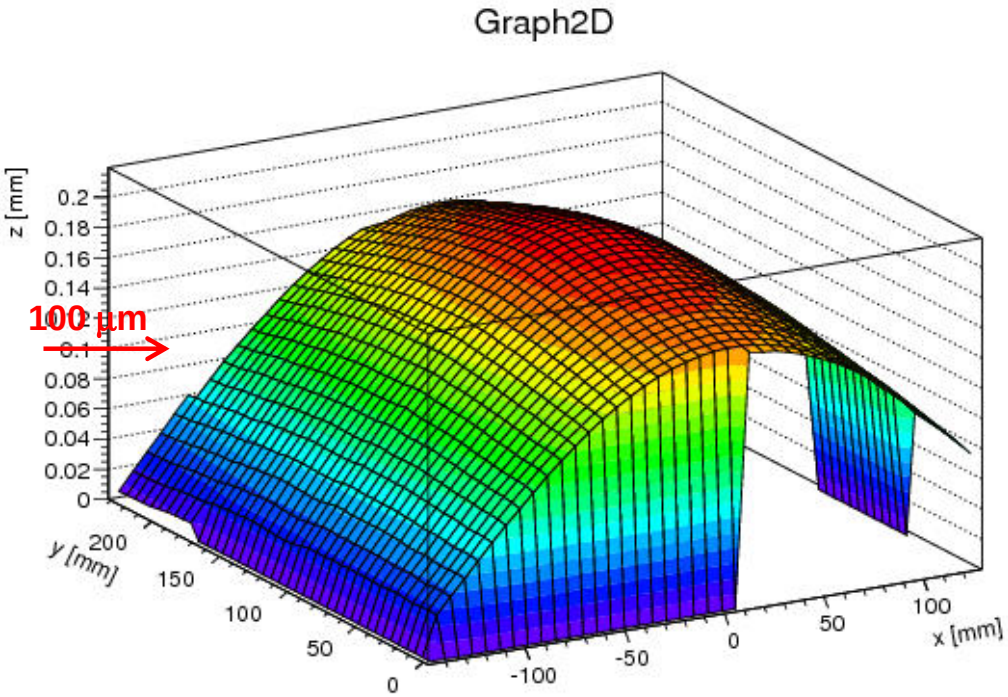


Step 10

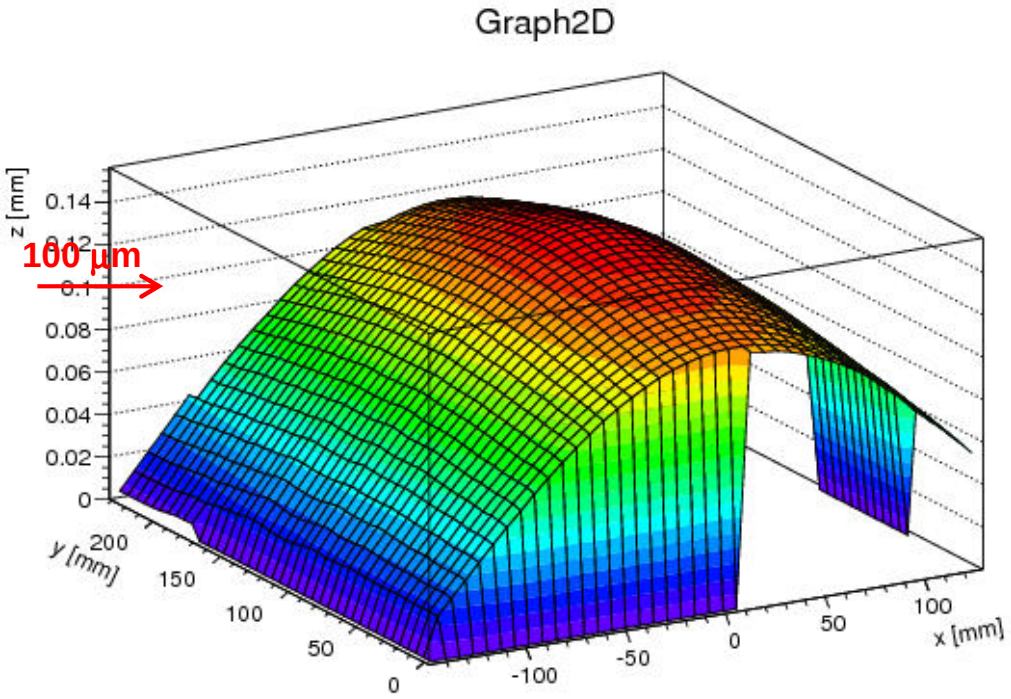


Measurement Series 2 – 250, 200 µm

- Step 11

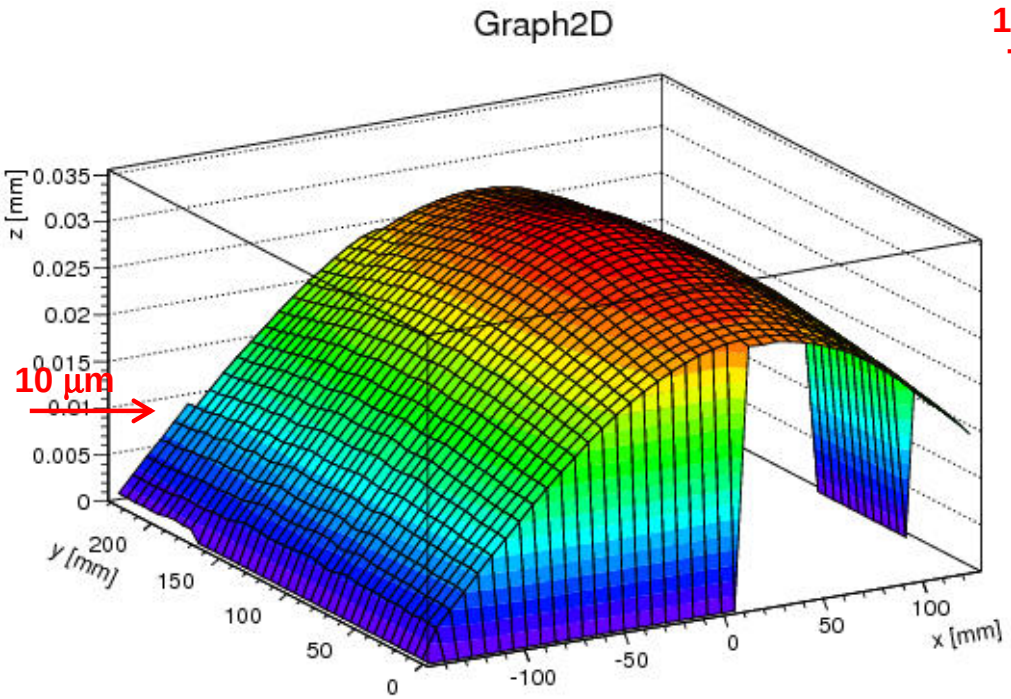


Step 12



Measurement Series 2 – 100, 0 µm

- Step 13



Step 14