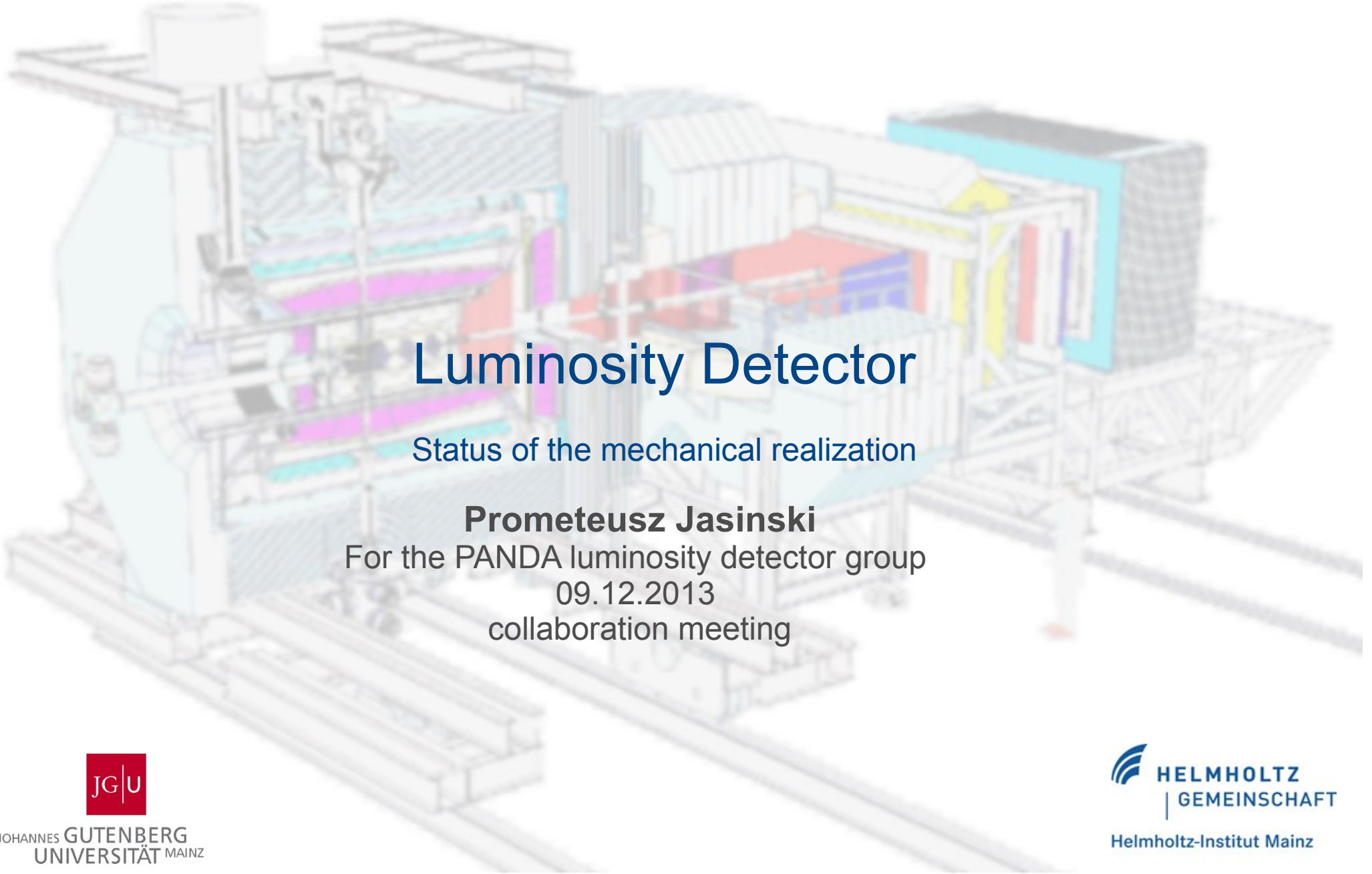


Luminosity Detector

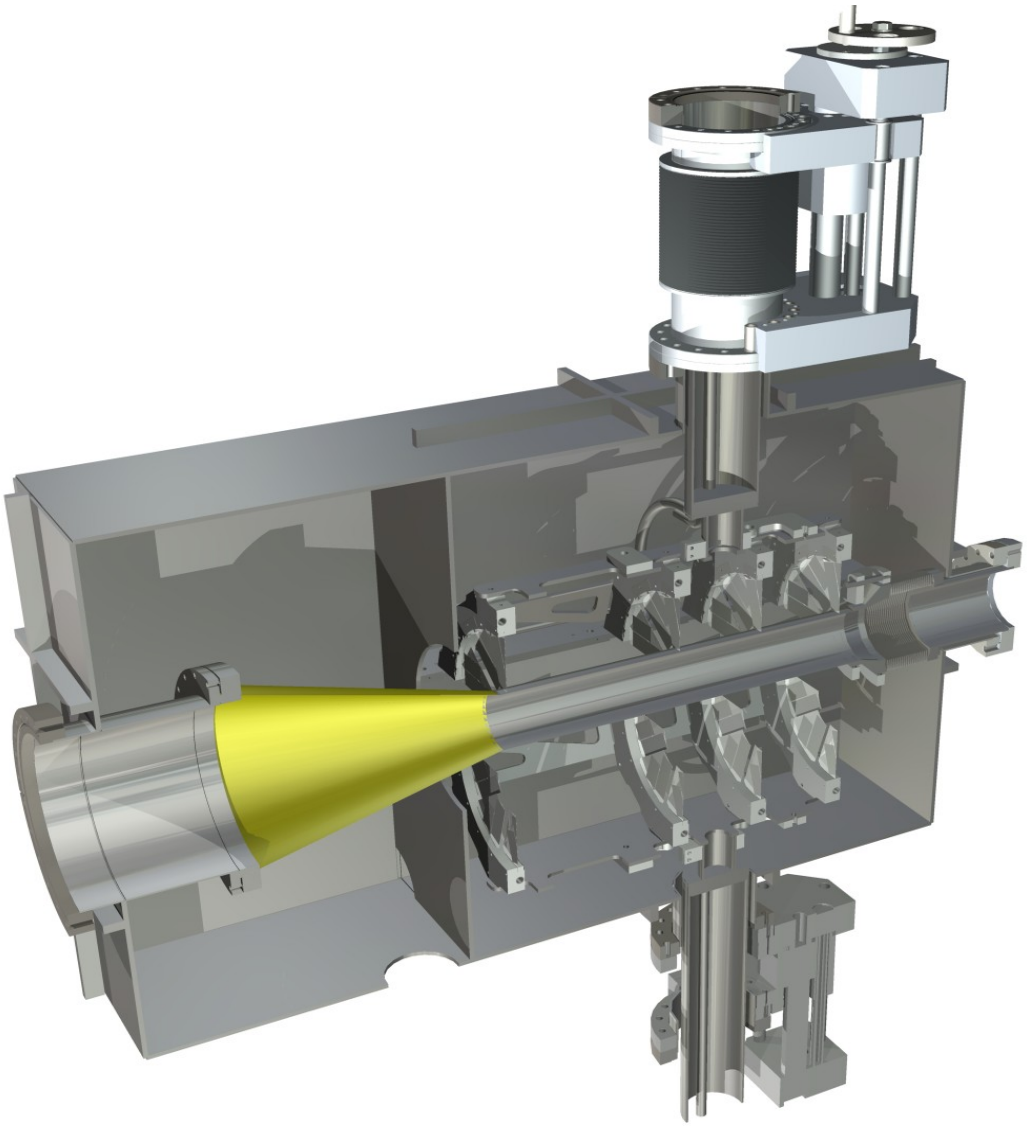
Status of the mechanical realization

Prometeusz Jasinski
For the PANDA luminosity detector group
09.12.2013
collaboration meeting

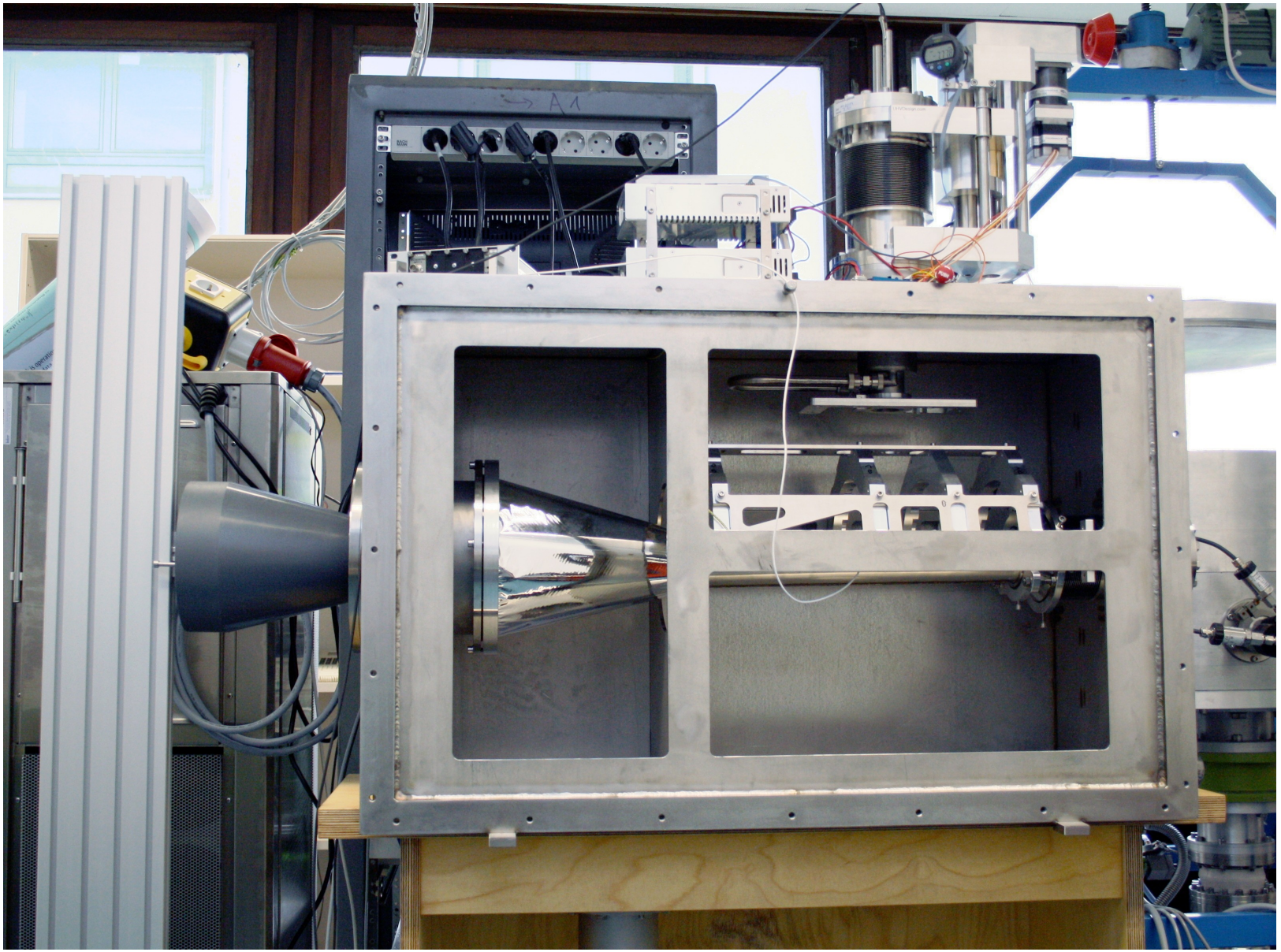
JOHANNES GUTENBERG UNIVERSITÄT MAINZ

HELMHOLTZ GEMEINSCHAFT
Helmholtz-Institut Mainz

On the way from paper ...



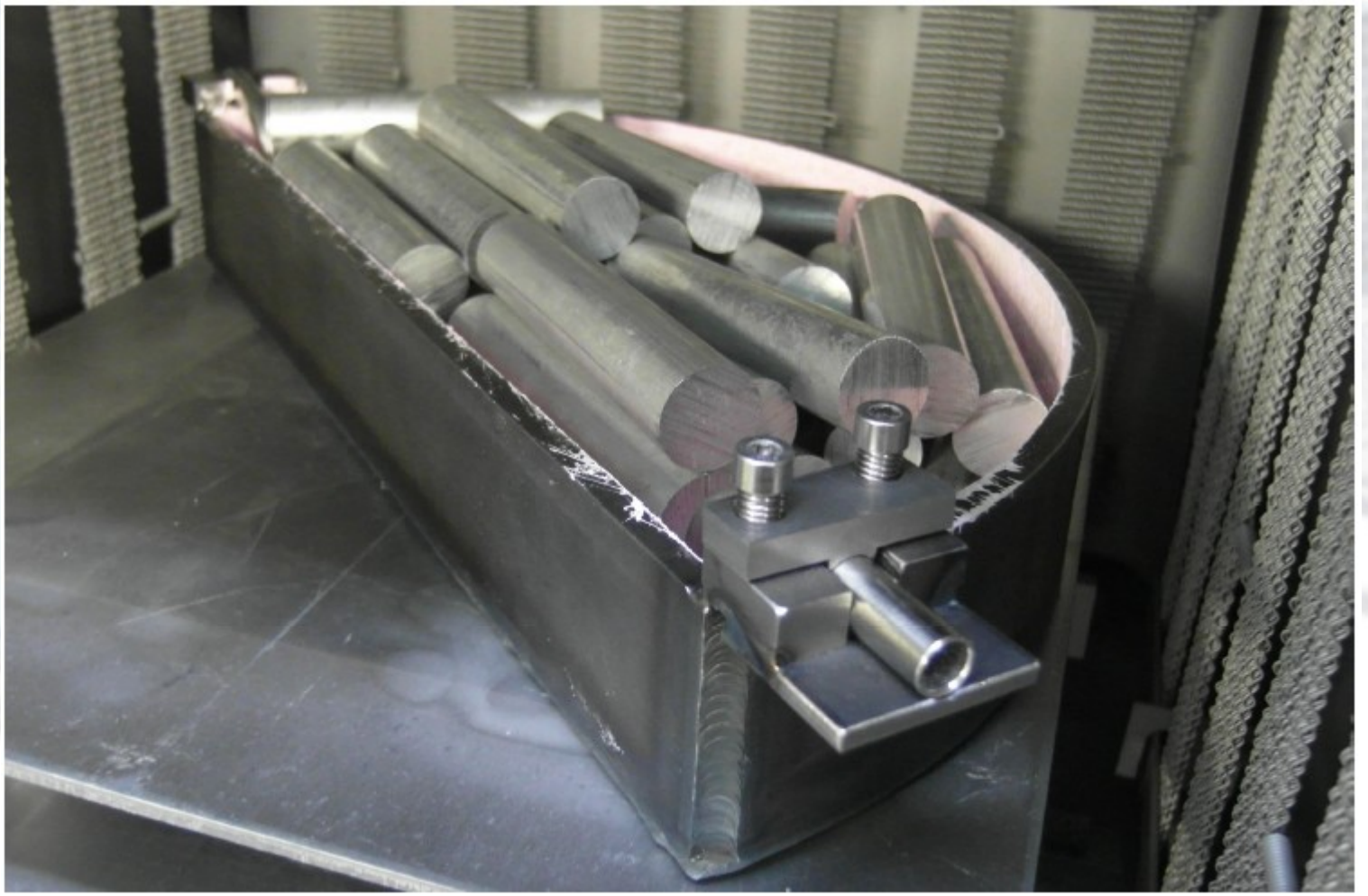
… to reality



Mechanical Realization

Melting aluminum stainless steel pipes

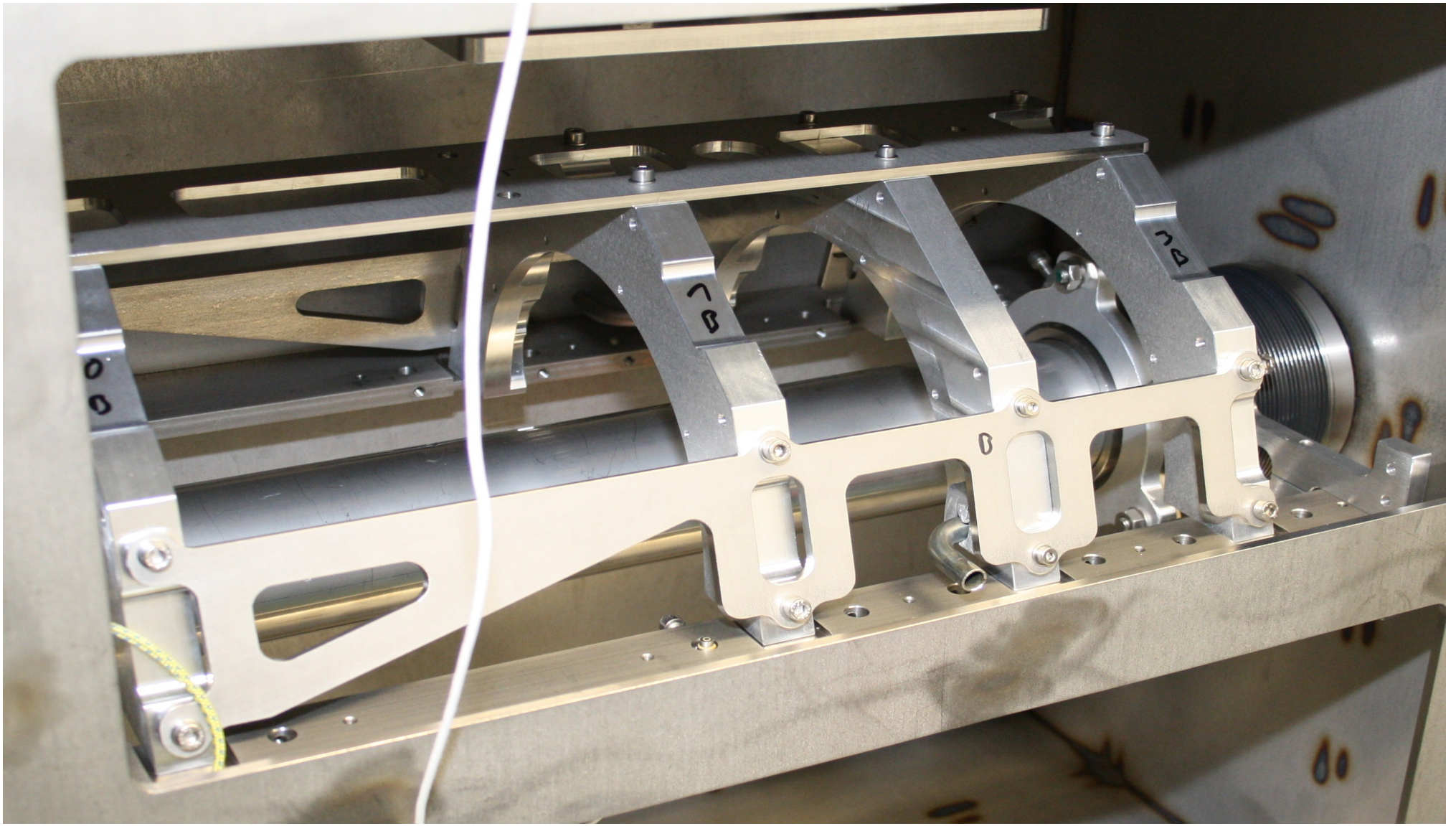
Melting aluminum around stainless steel pipes



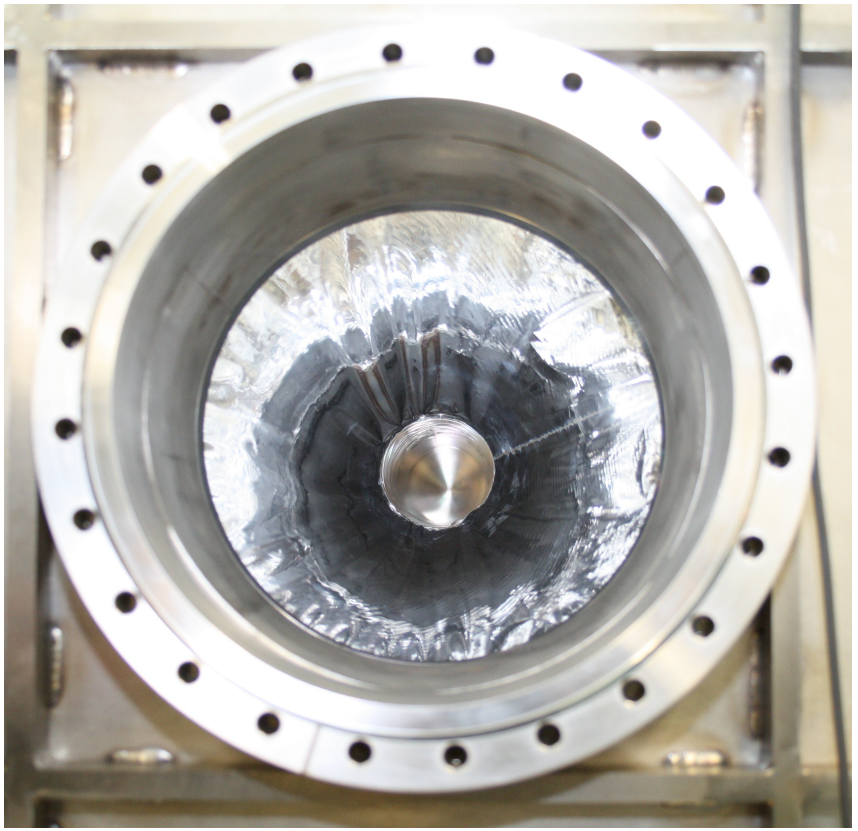
The 'cookie'

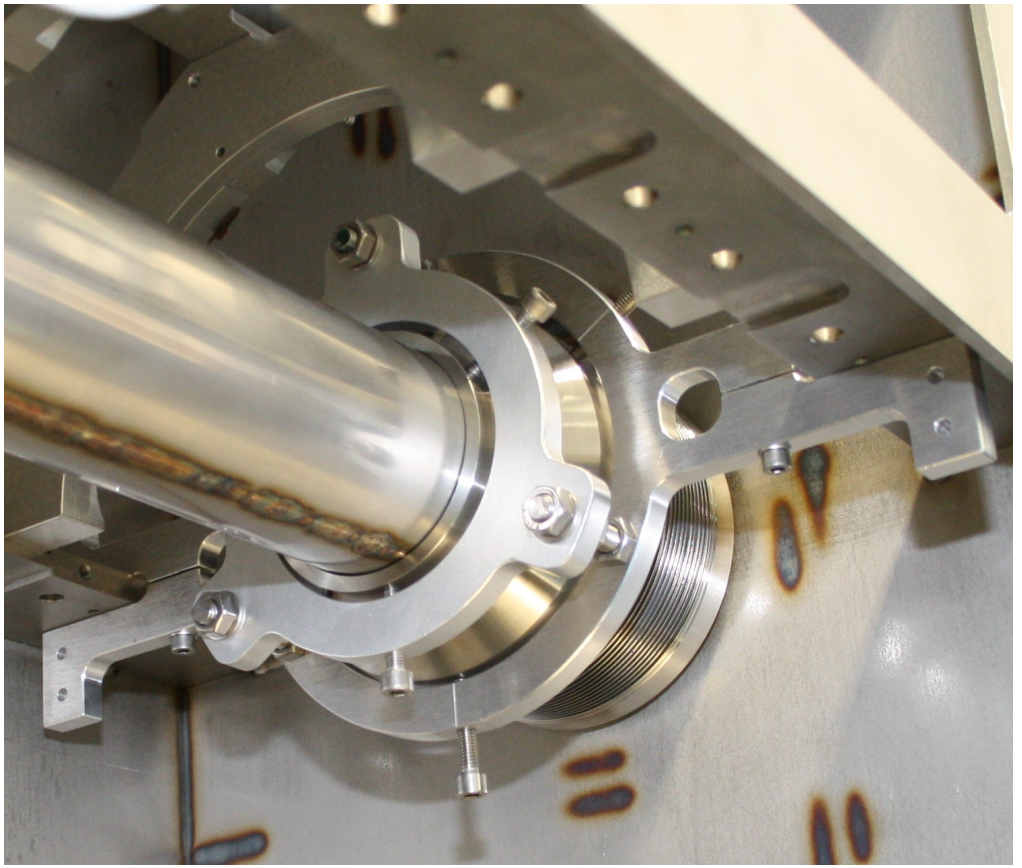
Summary of production stages

Mechanical assembly tests

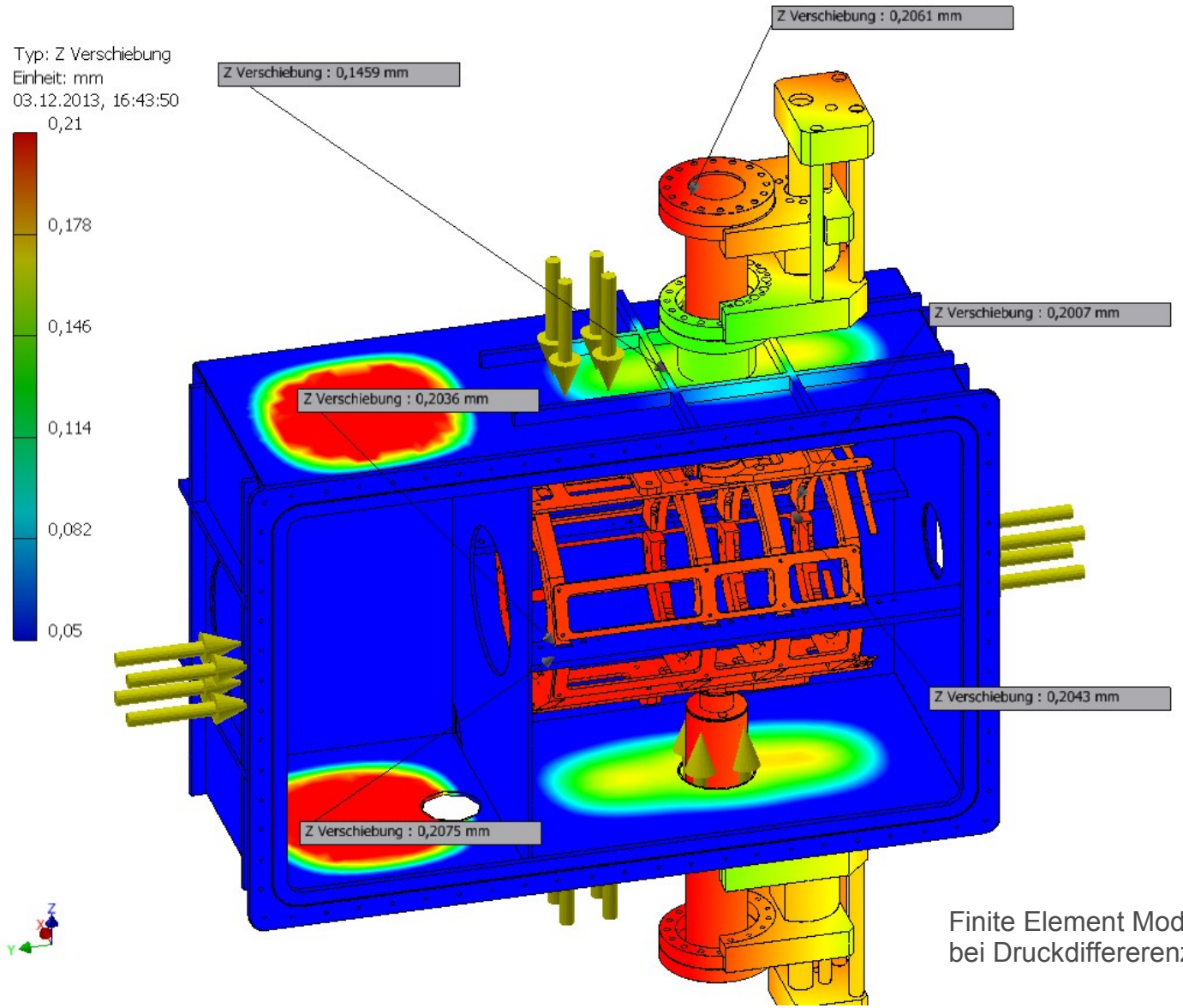


Mechanical assembly tests



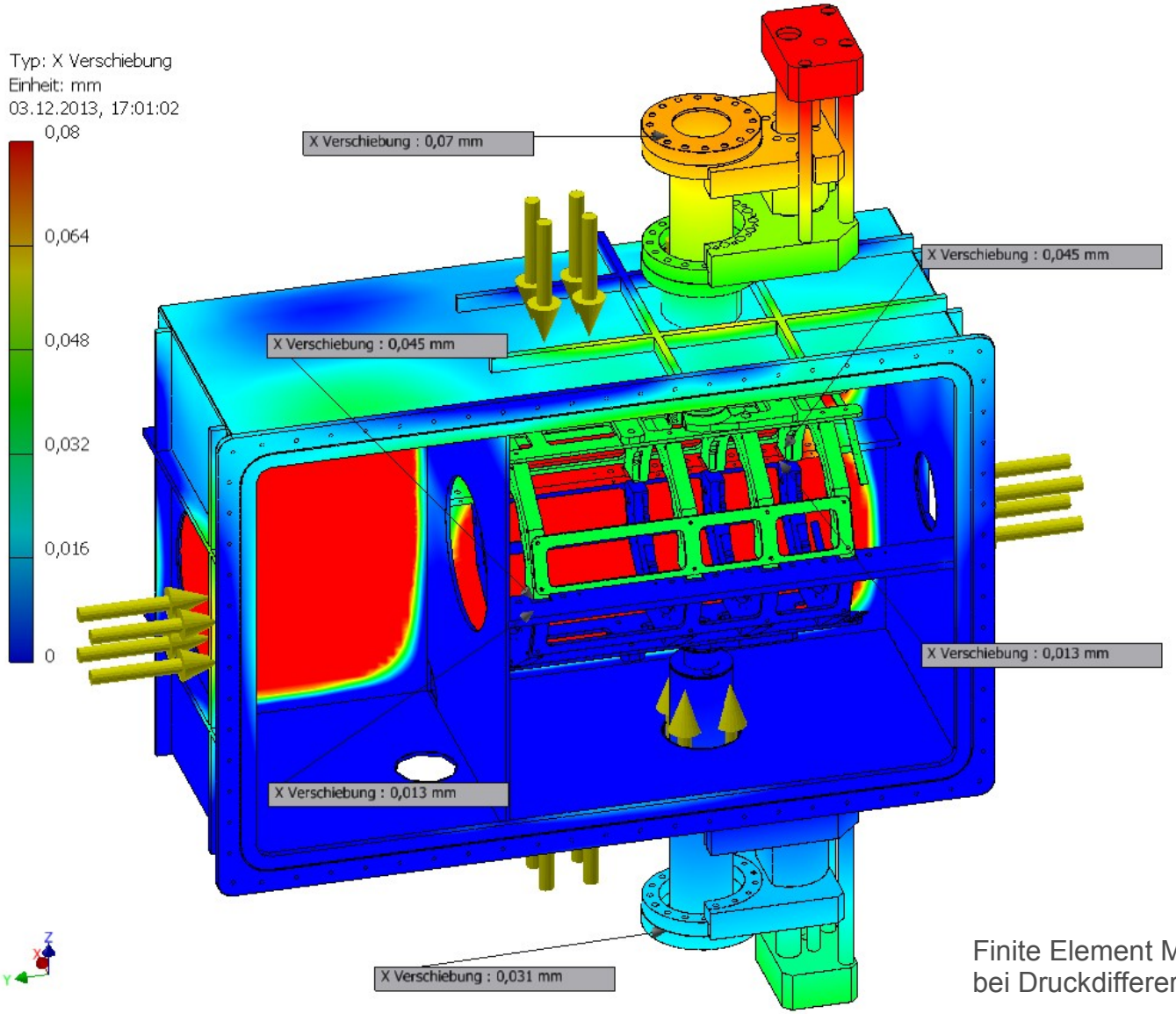


Box deformation



Finite Element Model (FEM)
bei Druckdiffererenz von 1 bar

Box deformation



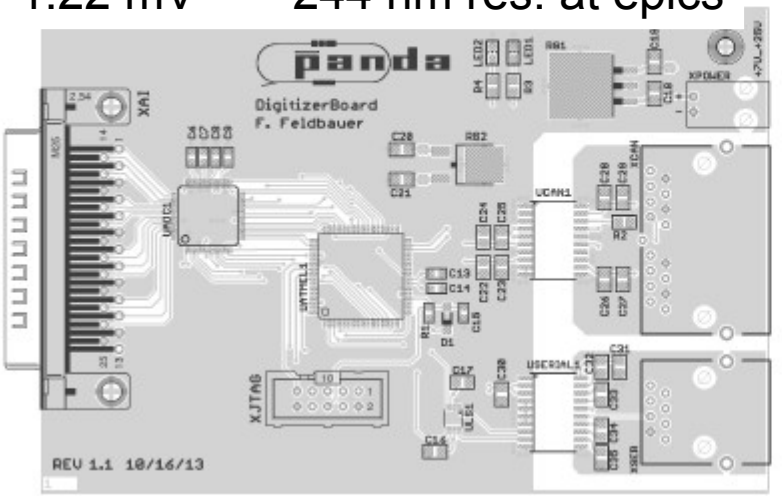
Finite Element Model (FEM)
bei Druckdiffererenz von 1 bar

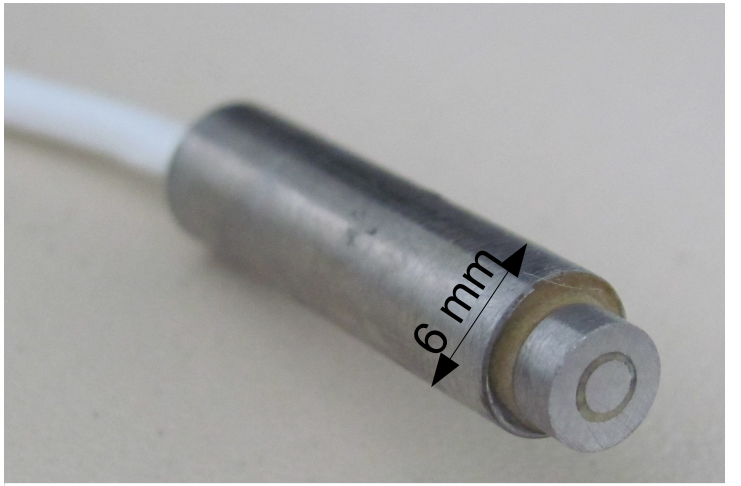
Capacitive measurement of distances in vacuum

Measurement of position inside the detector:
Capacitec 208-ACU

- ± 5 V differential analog output
- Up to 8 channels
- Position measurement $\leq 1\,\mu$m
- Read out via 18-bit differential ADC and μC with CAN interface

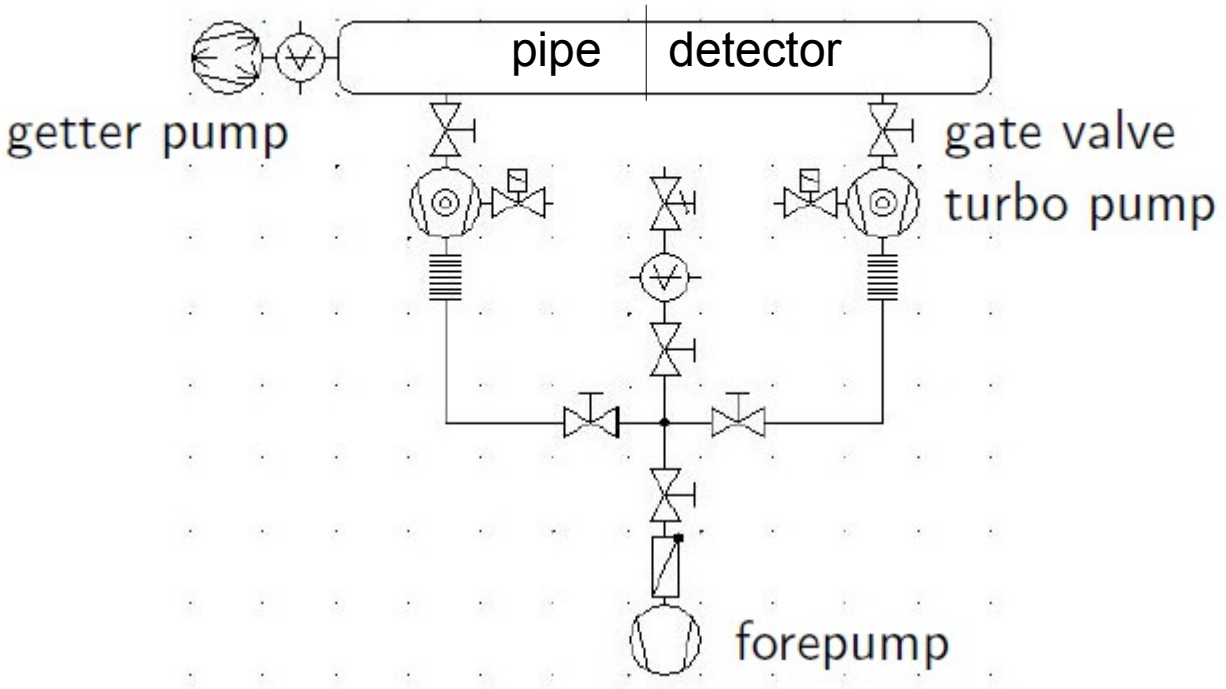
40 V range with 15 effective bits:
1.22 mV = ~ 244 nm res. at epics





+-5 V differential output with
0.2 mV (rms) noise for 2 mm range
= 40nm resolution

Pumping scheme

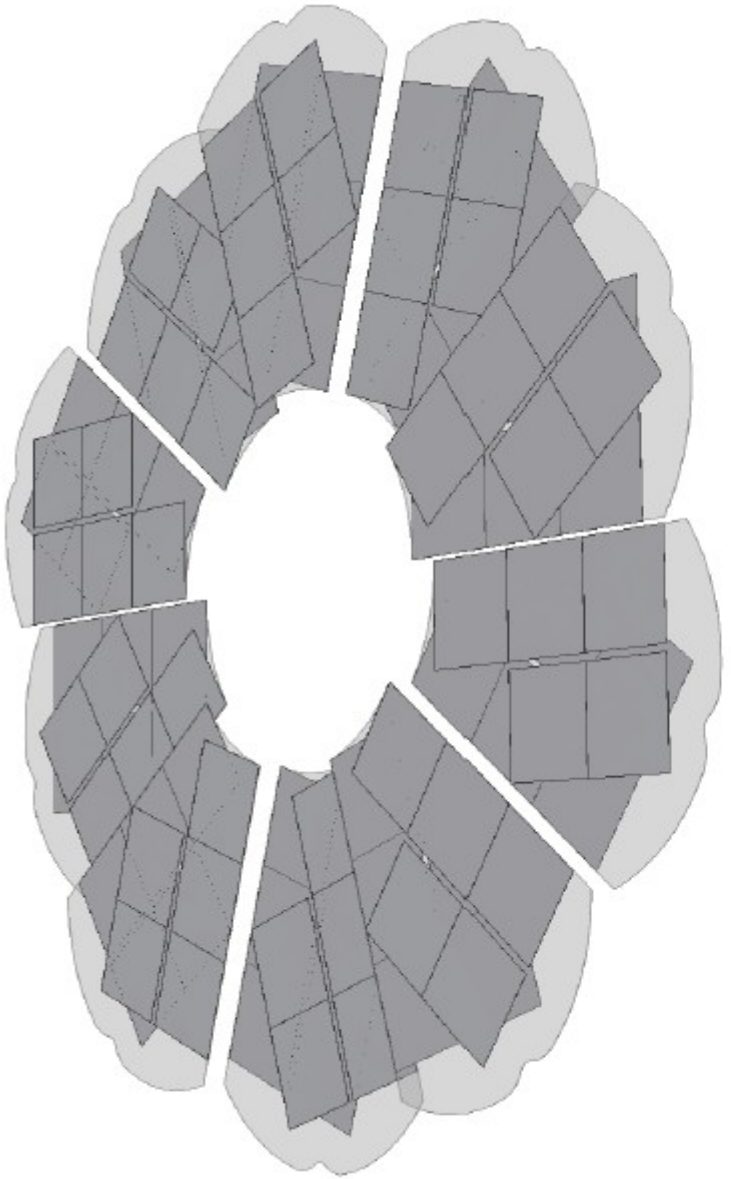


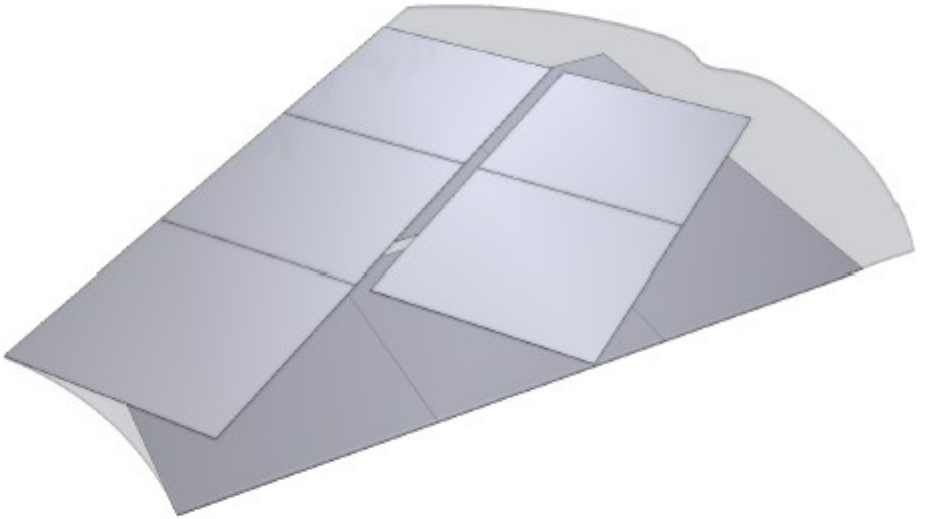
- Using HiPace300 turbo drag pumps for both volumina
- Communication of both systems realized with common forepump
- Controlled via RS485 with EPICS
- Using getter pump (from our workshop) to reach 10^{-9} mbar inside beam pipe

By Feldbauer / Kauth

Detector Alignment

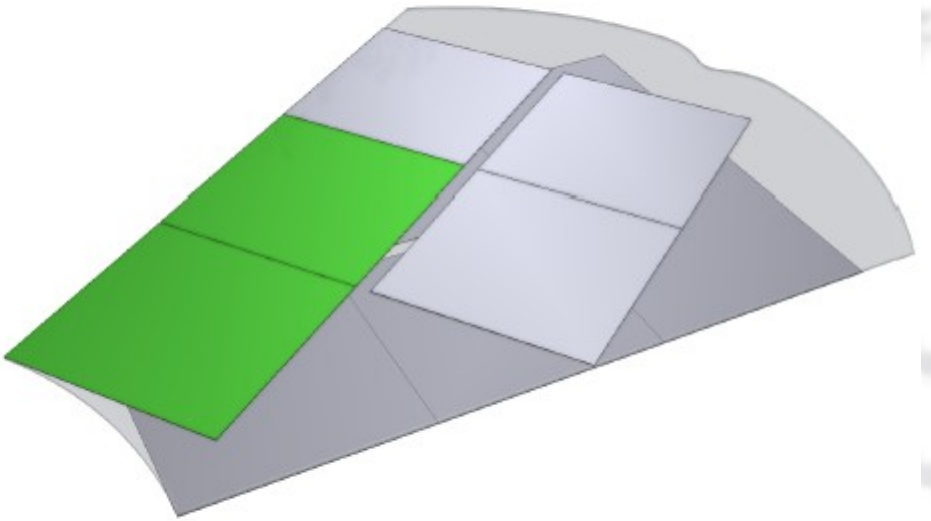
Current arrangement of HV-MAPS





Current arrangement of HV-MAPS

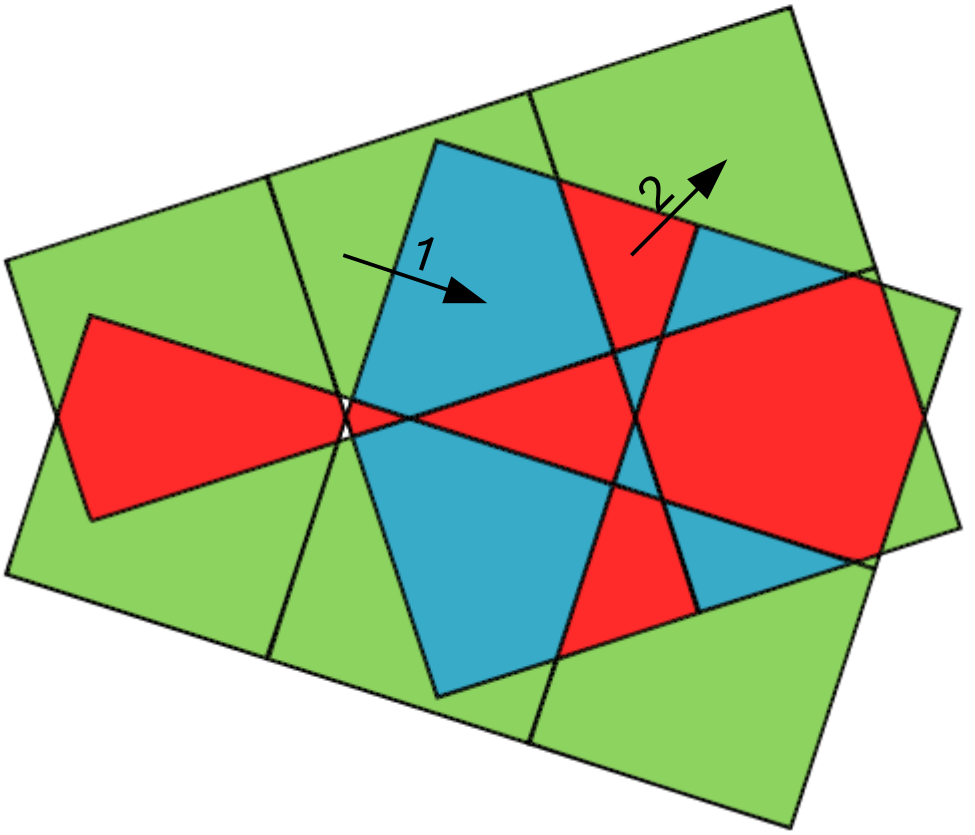
- pixel sensors glued on thin diamond plane from both sides
- quality fluctuations $\rightarrow$ only few sensors grouped to arrays of $(2 \times 4) cm^2$ (green), rest will be $(2 \times 2) cm^2$ sensors (grey)
- full disc coverage $\rightarrow$ 36° angle between sensors
- exact position and rotation of sensors must be known for track reconstruction



Overlapping regions of HV-MAPS

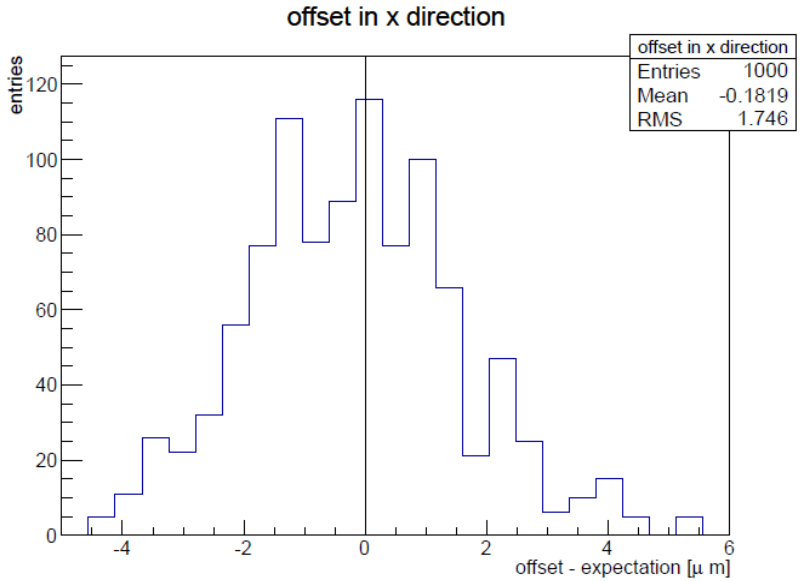
Using overlapping area

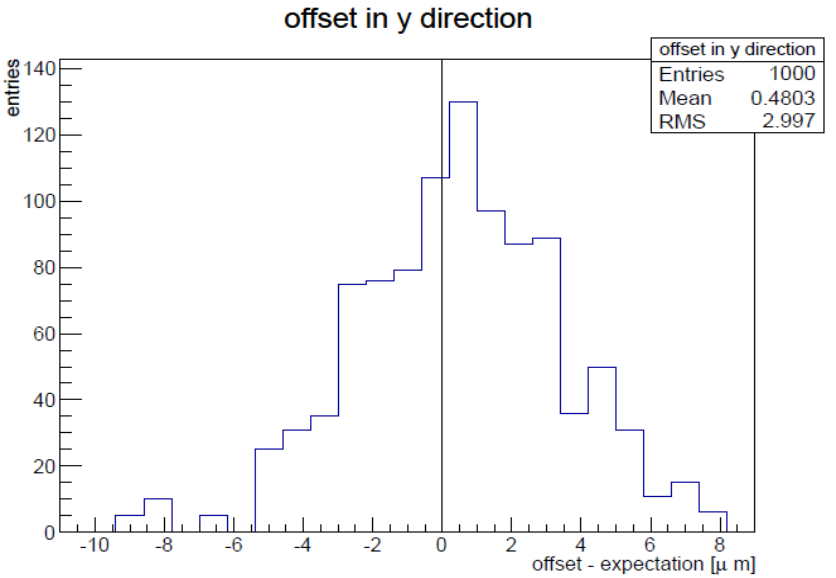
- sensors will overlap partially
- use overlapping area to determine the alignment of each sensor pair

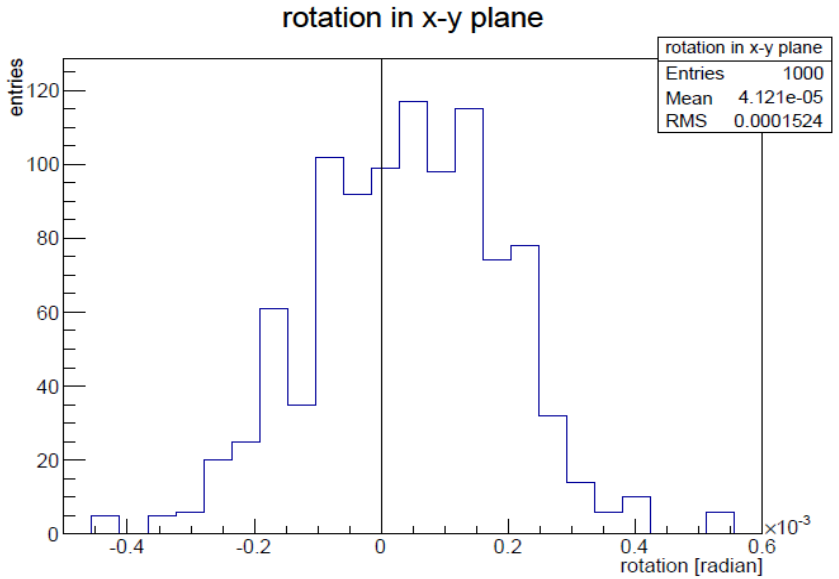


Some results by icp alignment

taking ≈ 10.000 elements from pool of ≈ 100.000 per entry

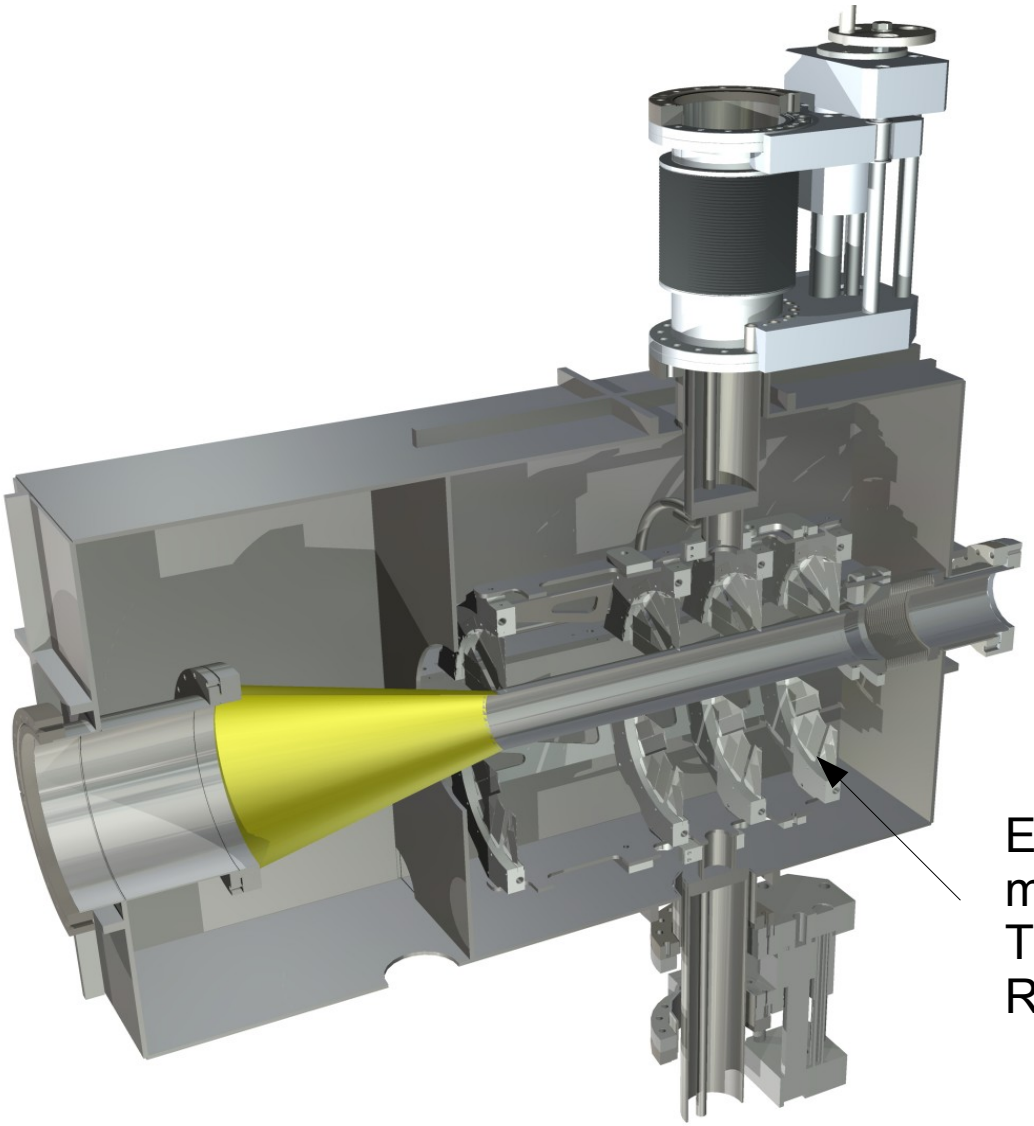






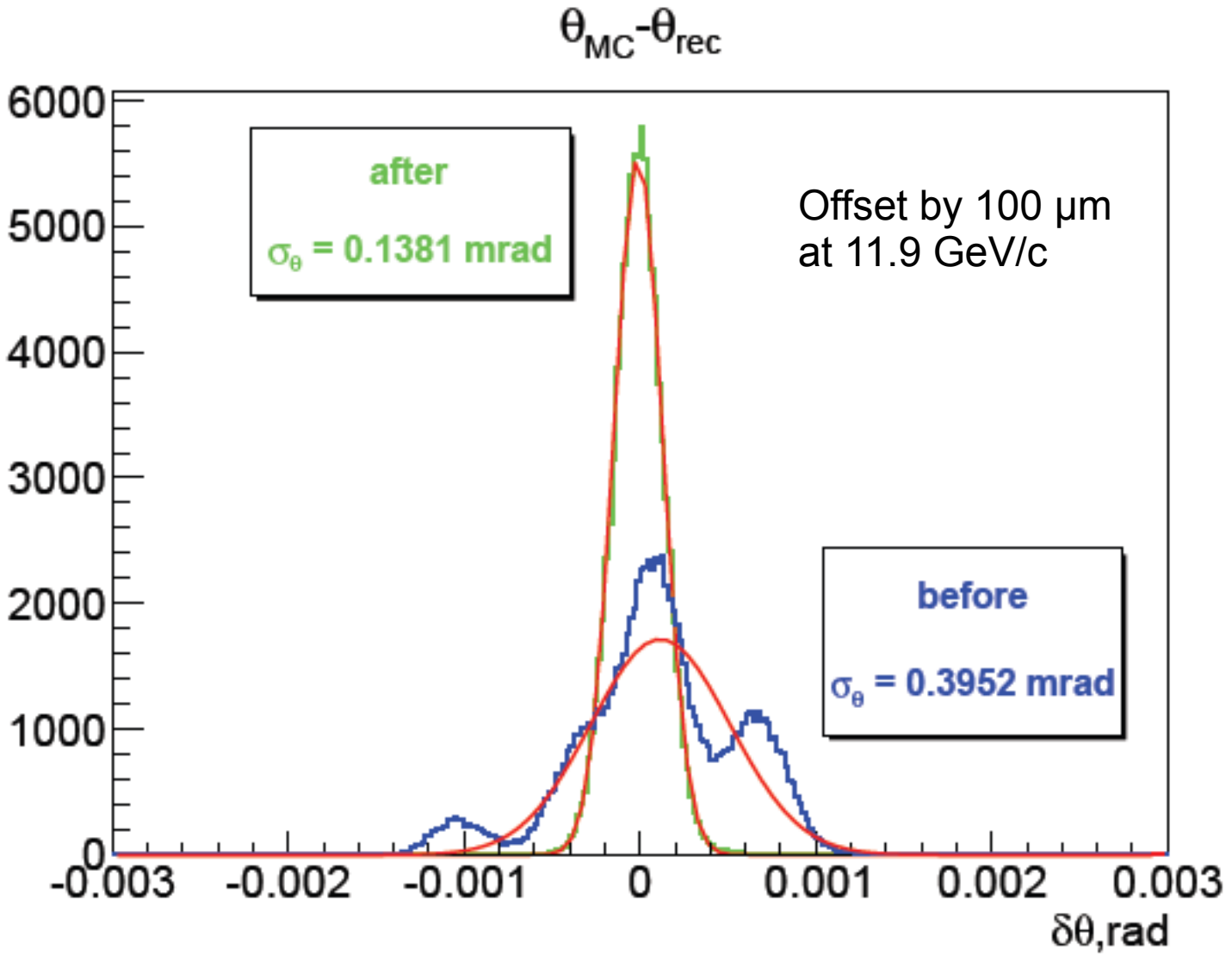
direction	value	error
x	$-0.18\mu m$	$1.75\mu m$
y	$0.48\mu m$	$2.99\mu m$
rotation	$0.041 mrad$	$0.152 mrad$

Alignment of Modules

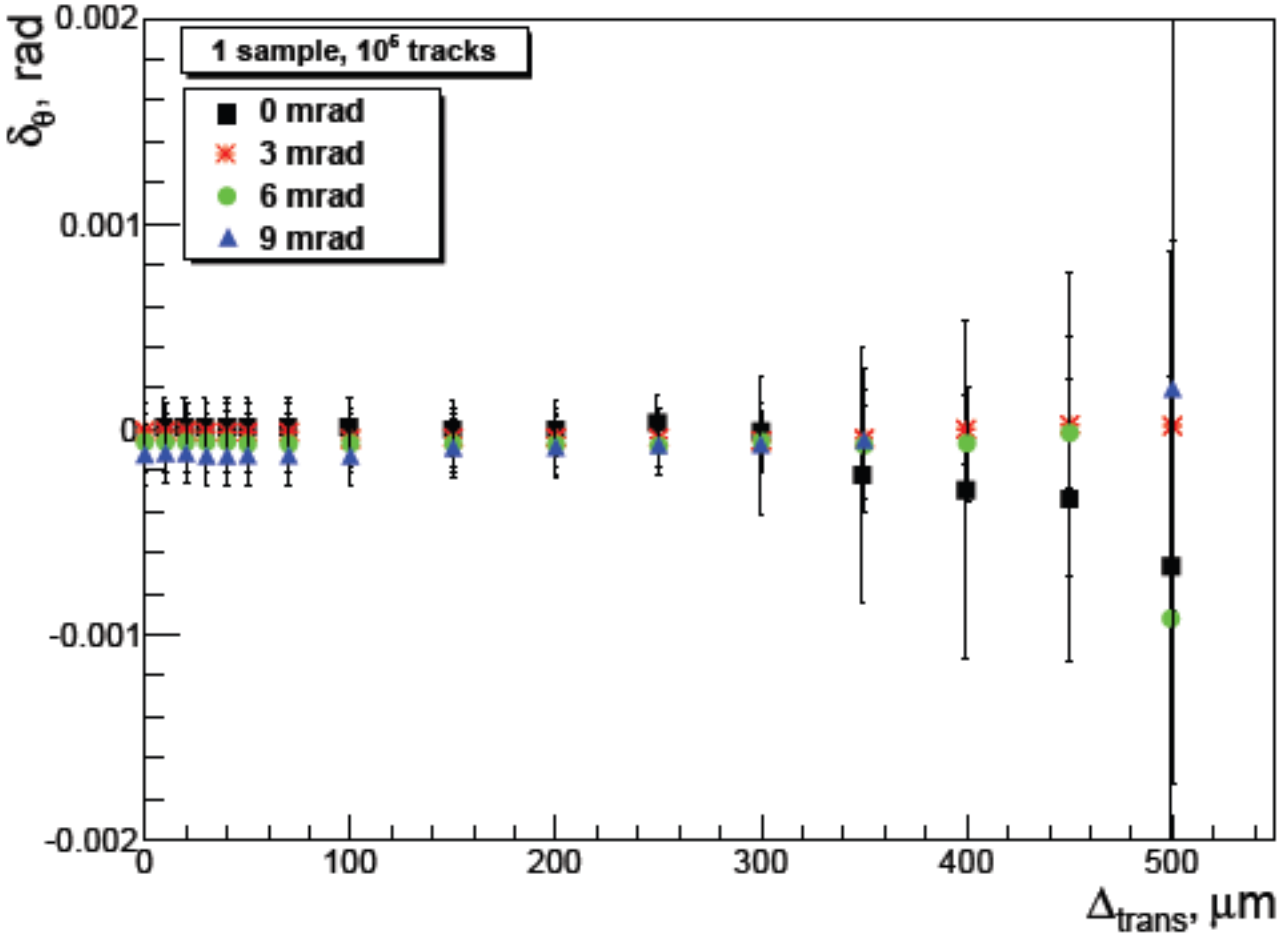


Expected precision for modules in the plane array:
Translation ~200 μm
Rotation ~3 mrad

Module alignment



Current limits by our software



Momentum: 11.9 GeV/c

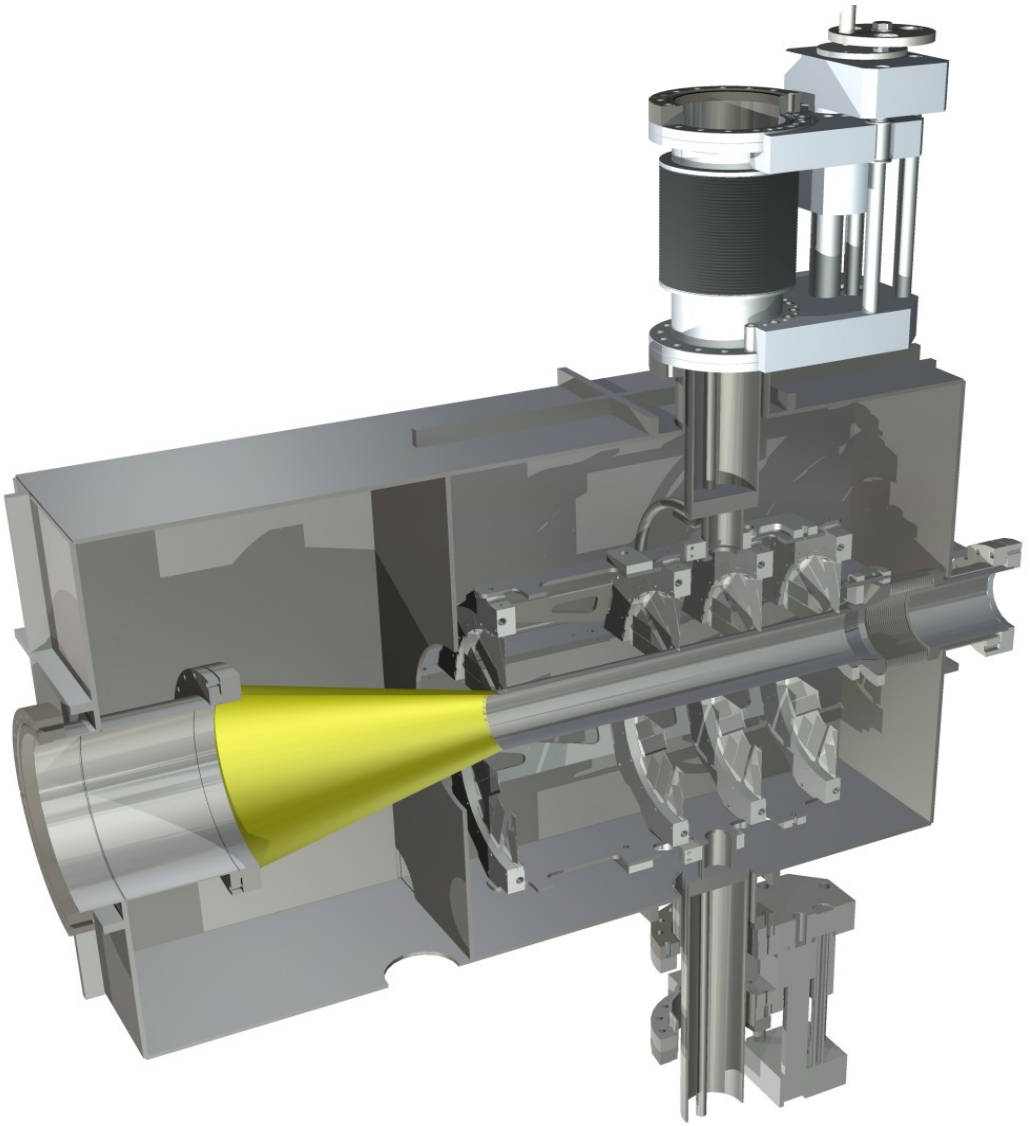
Limits

translation 300 μm
rotation 6 mrad

Expectation from mechanical point

translation 200 μm
rotation 3 mrad

Alignment of the Box ???



Thank you

Iterative Closest Point Algorithm

- algorithm to align two clouds of points in three dimensions (i.e. translation, rotation, scaling)
- here: determine transformation matrices from one sensor to every other sensor
- 9 overlapping areas $\rightarrow$ 9 matrices

$\Rightarrow$ position of every sensor with respect to reference sensor is known

Iterative Closest Point Algorithm

Inputs:

- points from two raw scans
- initial estimation of the transformation
- criteria for stopping the iteration

Output:

- refined transformation