Linear Motion Control and Positioning Process

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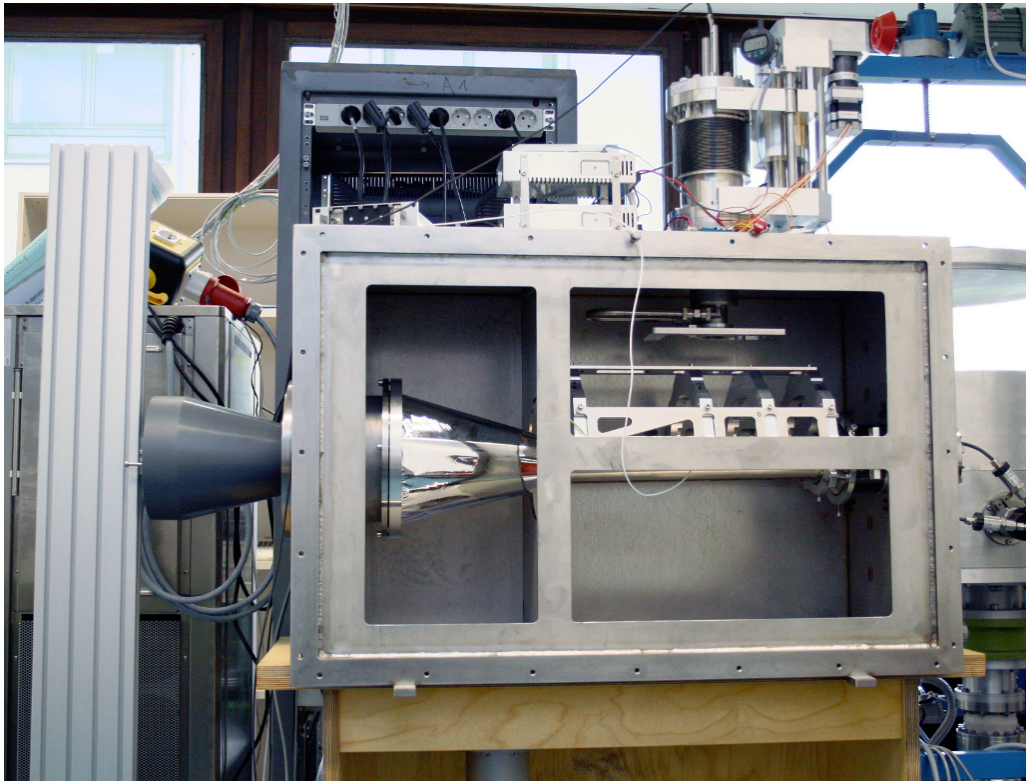
The $\overline{\text{P}}$ANDA Luminosity Detector

- Movement of Sensors necessary for maintenance and to prevent radiation damage to sensors
- Linear motion via stepper motors
  - Resolution: 100 nm/halfstep
  - Range: 275 mm
  - Control via EPICS

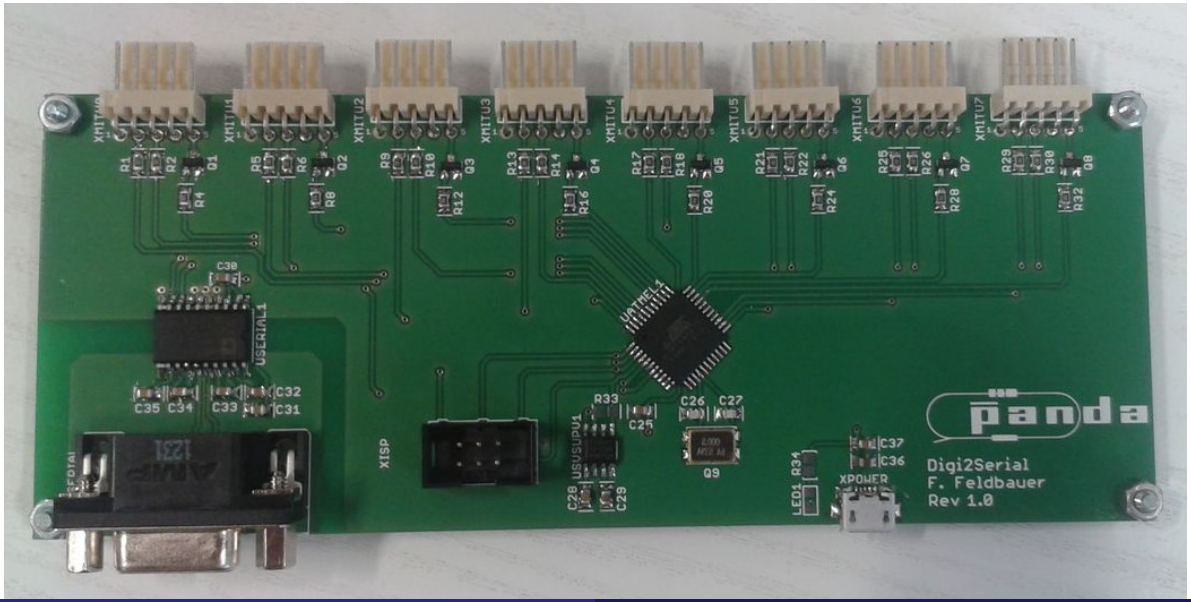


Position and Distance Measurement

Mitutoyo digital gauges

- Accuracy: $1\,\mu m$
- Range: 12,7 mm
- Readout with microcontroller using Digimatic interface

Measurement of sensor position and hull deformation under vacuum

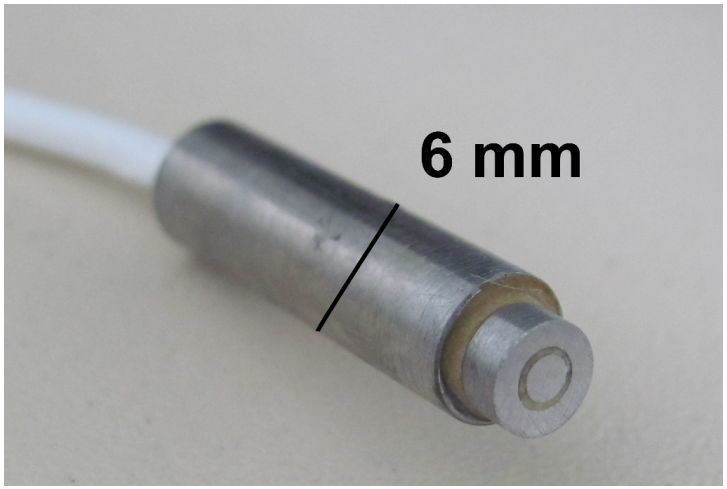


Position Measurement Inside Vacuum

Capacitec 208-ACU capacitive sensors

- ± 5 V differential analog output
- Resolution: ca. 40nm (0.2 mV noise at 2mm range)
- Range: ca. 2 mm
- Readout via differential ADC

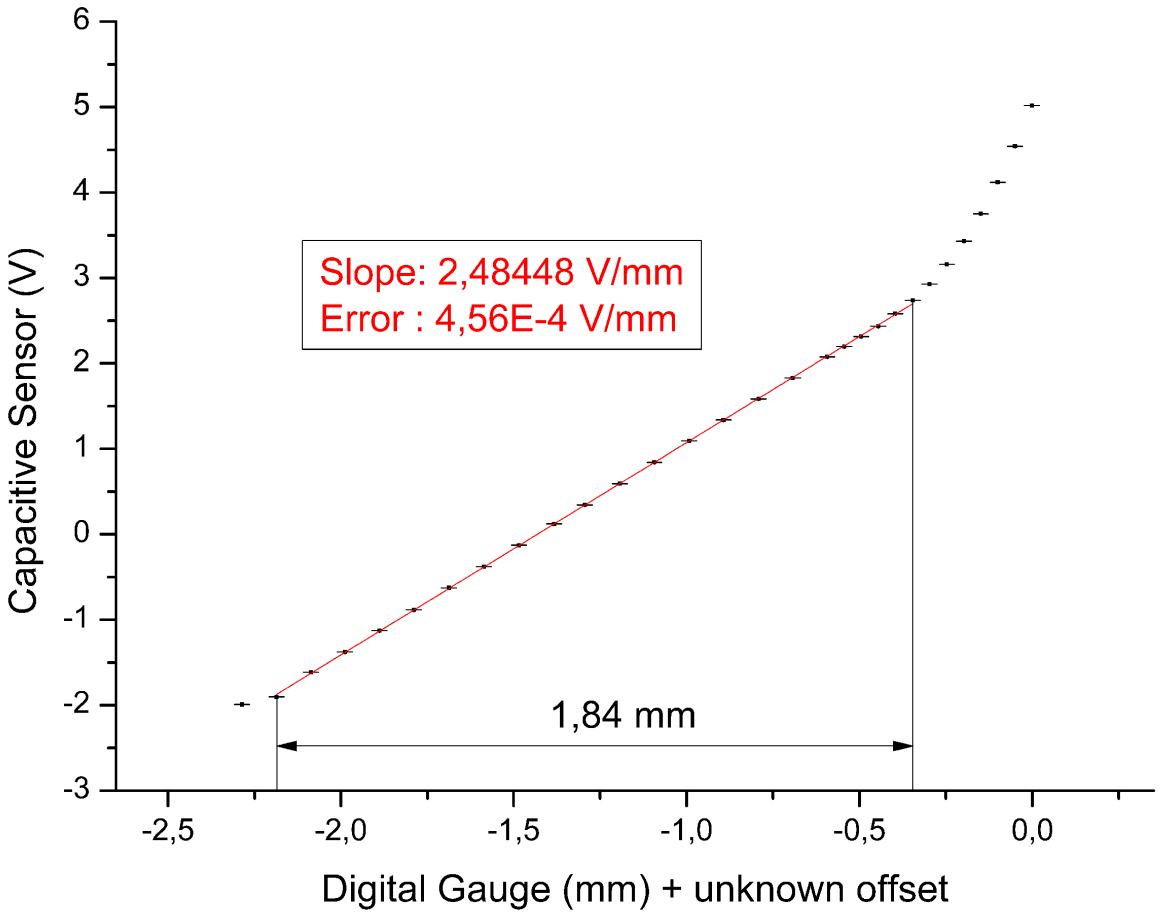
Measurement oft several positions of sensors inside vacuum box



Testing Capacitive Sensors

- Parallel measurement of fixed distances with digital gauge and capacitive sensors

→ Verification of linearity for capacitive sensors

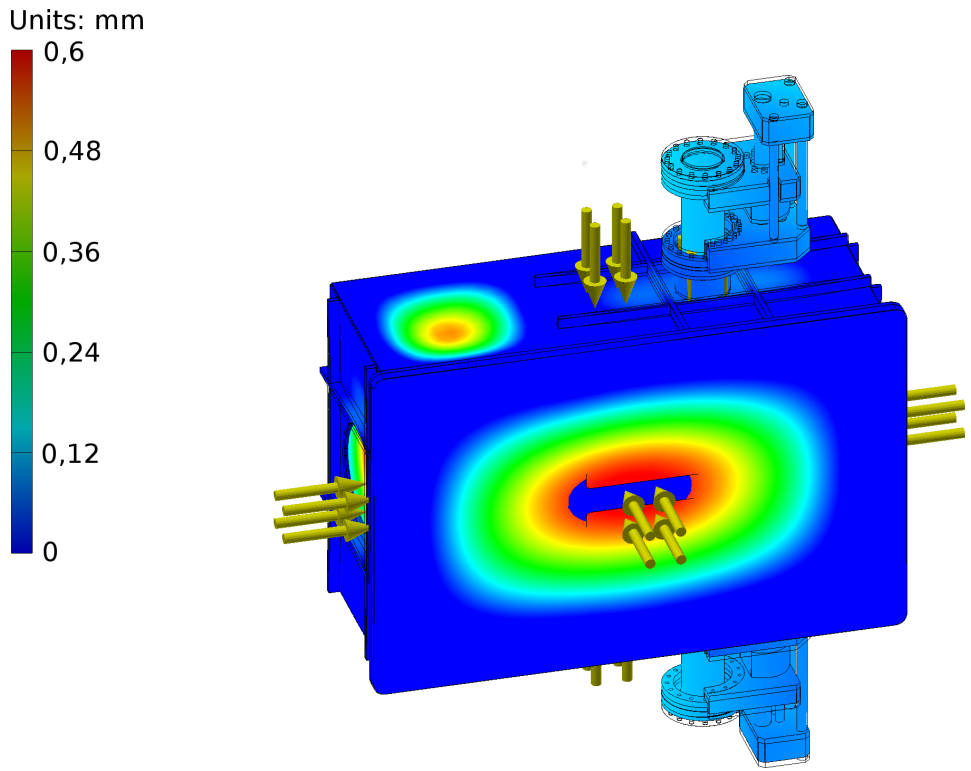


Influence of Vacuum

Autodesk Inventor Simulation

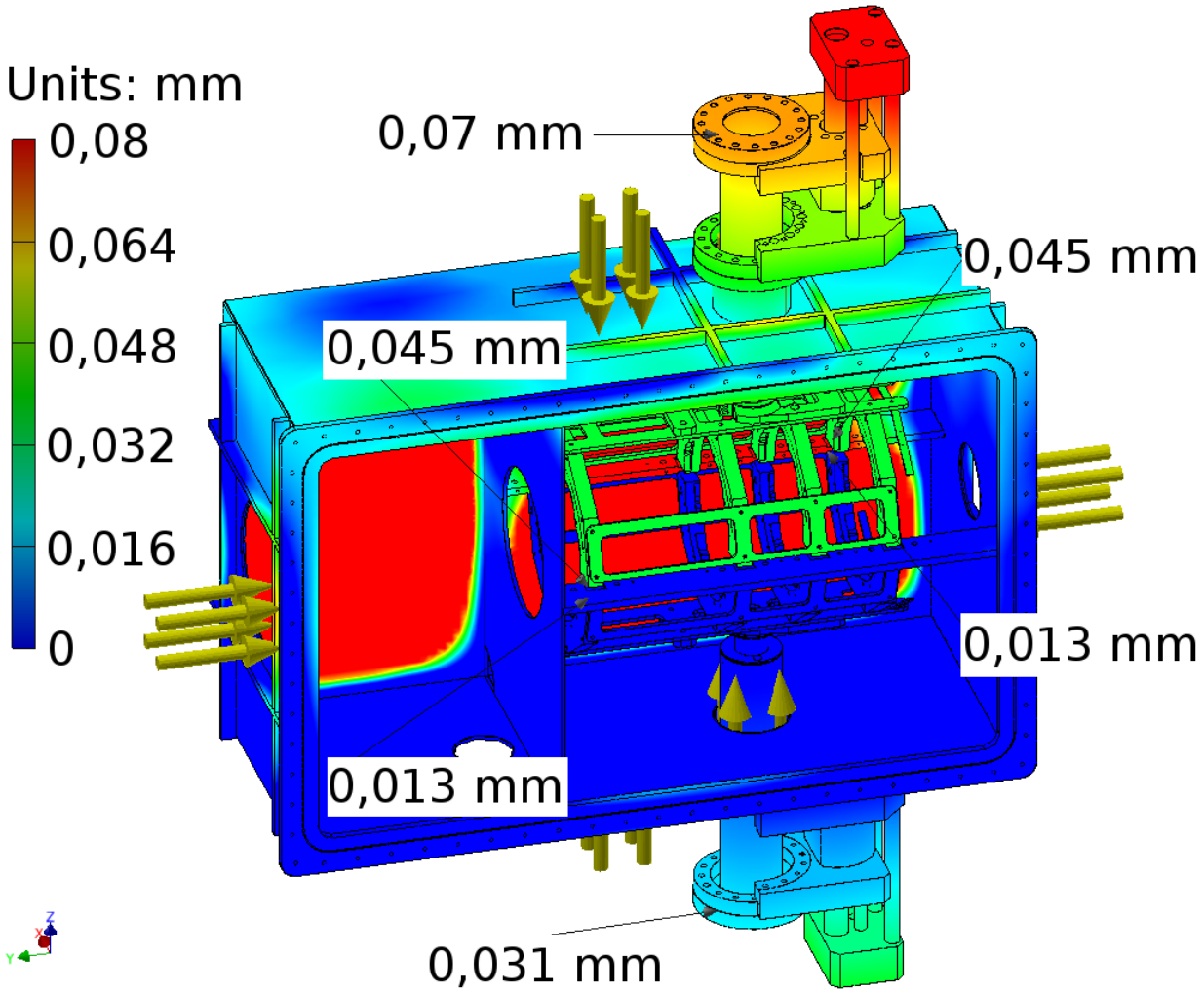
- Deformation of vacuum box influences positioning of sensors
- (Attention! Local coordinate system different to PANDA c.s.)

Deformation of vacuum box



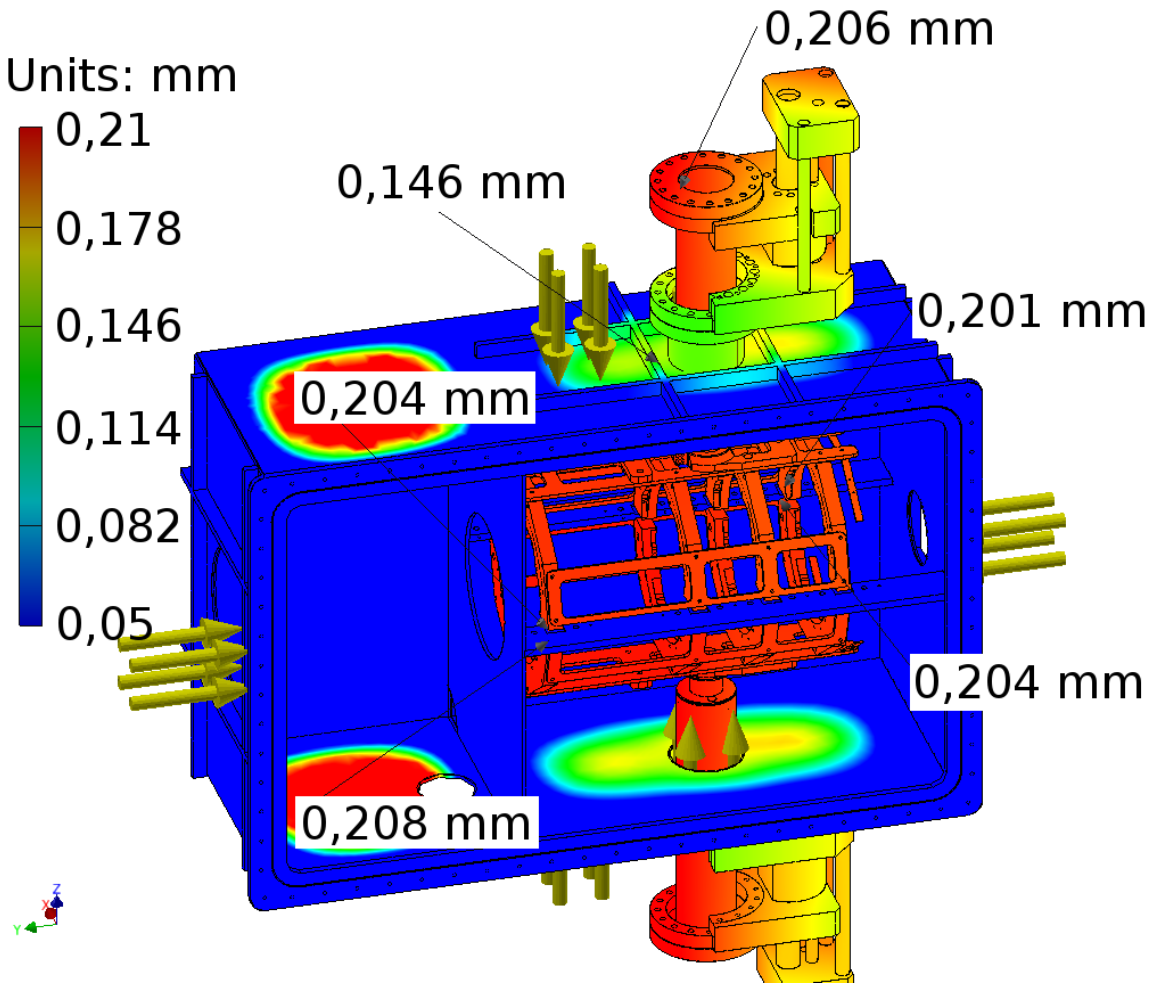
Simulation x-Axis

Shift of sensors in x-direction caused by vacuum $\approx 1/2$ Pixel



Simulation z-Axis

Shift of sensors in z-direction caused by vacuum $\approx 2,5$ Pixel



Simulation Results

- Largest shift in motor axis direction ca 200 μm

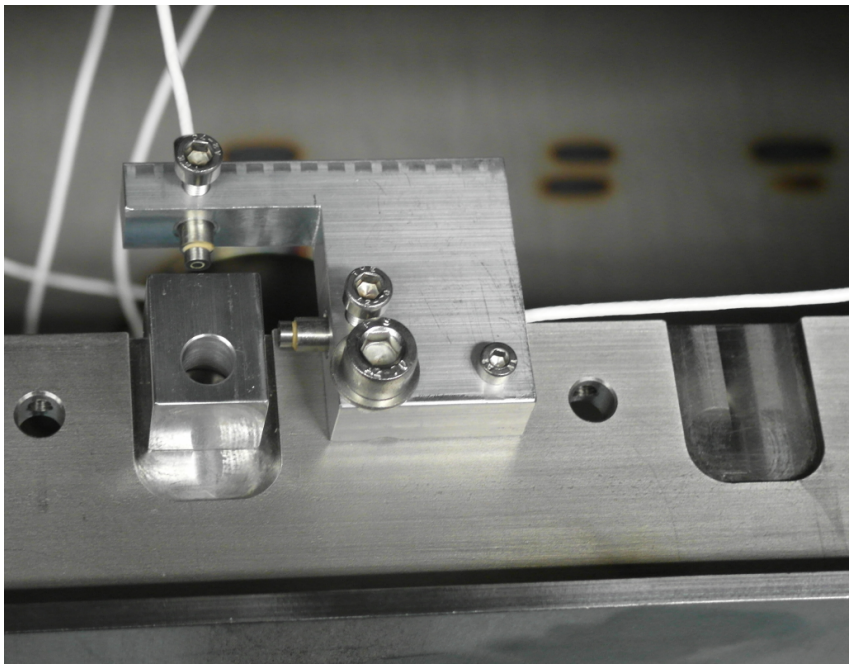
$\rightarrow$ not critical, sensors position fixed in axis direction

- Small shifts perpendicular to motor axis ca 45 μm
- Shifts could add to inaccuracies of sensor alignment

$\rightarrow$ Need to be known precisely

- Position measurement of sensor position with capacitive sensors needed

$\rightarrow$ verification of simulations



Outlook

- Prototype hull of luminosity monitor ready for vacuum testing

→ Measurements of fixed sensor position with capacitive sensors during evacuation process

→ Measurements for different directions according to simulations

→ Measurement of hull deformation under vacuum

- Further long-time measurements of capacitive sensors and motor positions
- Calibration of readout ADC using direct measurements of motor movement