

Portable CMM survey on the example of the Luminosity Detector

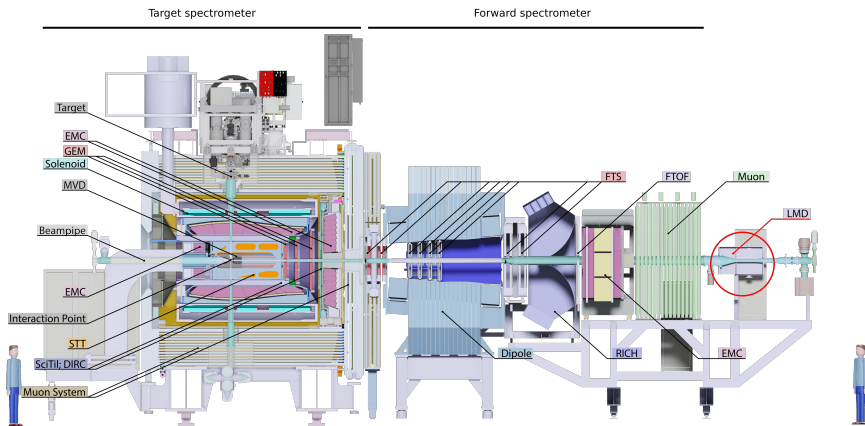
Christof Motzko
on behalf of the Luminosity Detector Group

Helmholtz-Institut Mainz
Johannes Gutenberg-Universität Mainz

PANDA Collaboration Meeting
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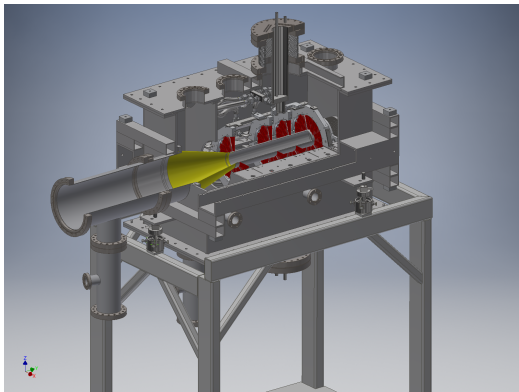
The Luminosity Detector at \bar{P} ANDA



tracking detector for elastically scattered antiprotons from 3 - 8 mrad

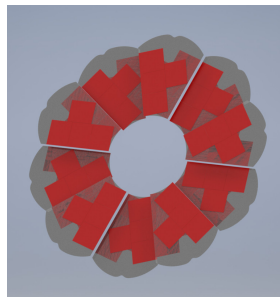
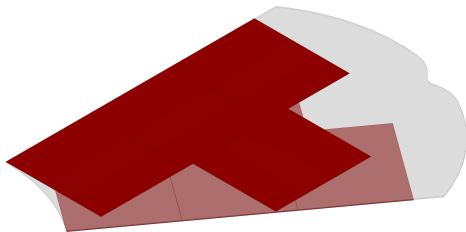
PANDA Luminosity Detector

- 4 planes in line
- 10 modules on each plane
- 8 sensors on each module
- 320 pixel sensors in total



Single Plane, 10 Modules

- 10 modules, 36° angle between sensors
- High Voltage Monolithic Active Pixel Sensor
- sensor size: $2\text{ cm} \times 2.3\text{ cm}$
- pixel size: $80\ \mu\text{m} \times 80\ \mu\text{m}$
- total module thickness: $350\ \mu\text{m}$

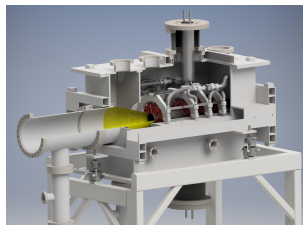
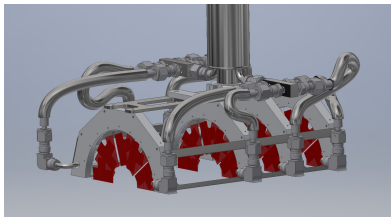
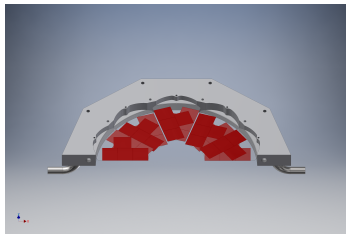
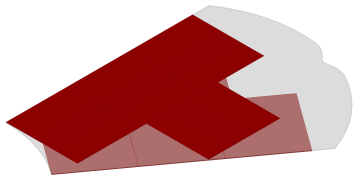


reconstructed θ of scattered particle beam is most important for Lumi reconstruction

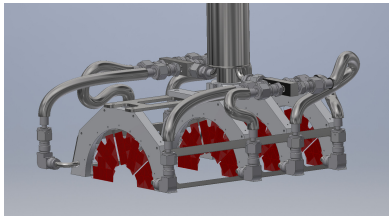
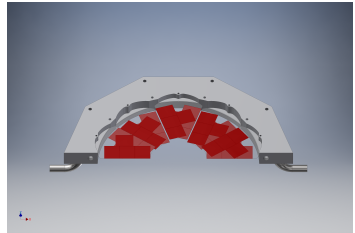
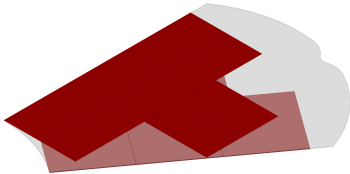
but:

- sensor position is invisible from outside!
- only outer shell of box is accessible for survey
- total uncertainty is total of external survey uncertainty and internal fiducialisation

Measuring sub-steps



Measuring sub-steps

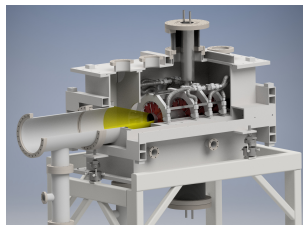
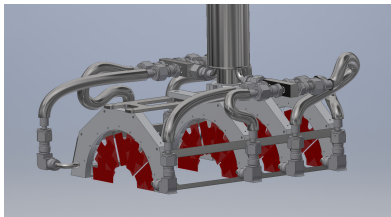
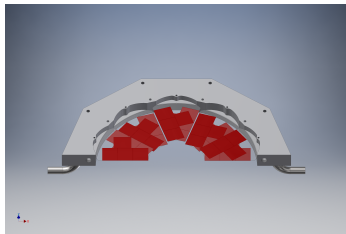
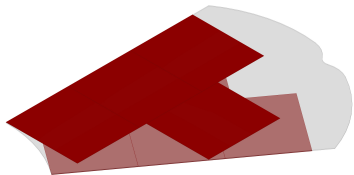


ZEISS CMM O-INSPECT 543 CFS

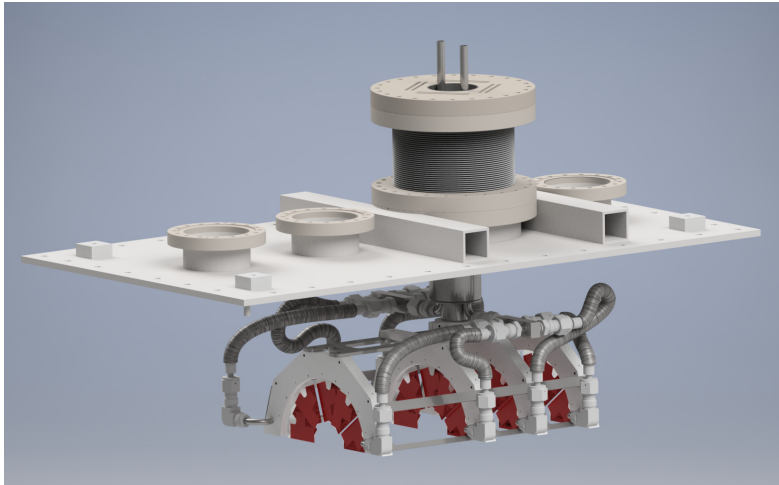


- Optical (2D) and tactile (3D) measurement
(Optical 3D possible, but expensive)
- Measuring range:
50 cm x 40 cm x 30 cm
- Accuracy: 1.7 μm - 4.9 μm ,
scales with distance

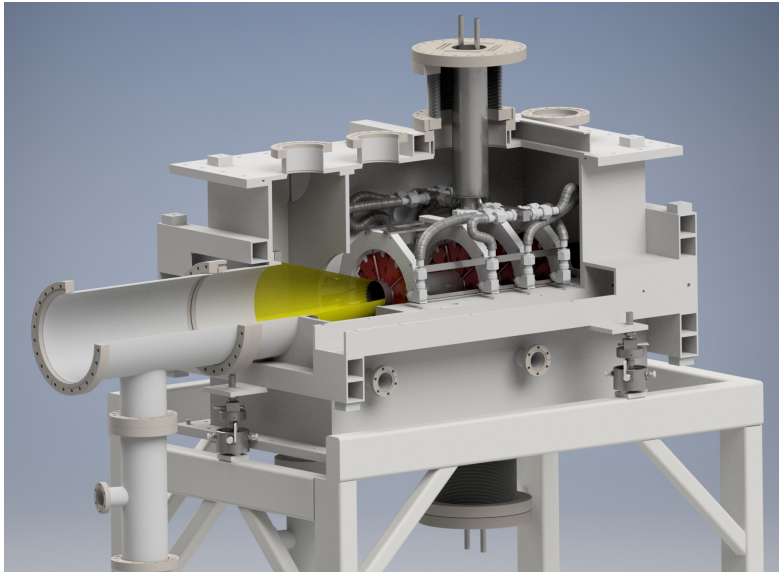
Measuring sub-steps



Measuring sub-steps

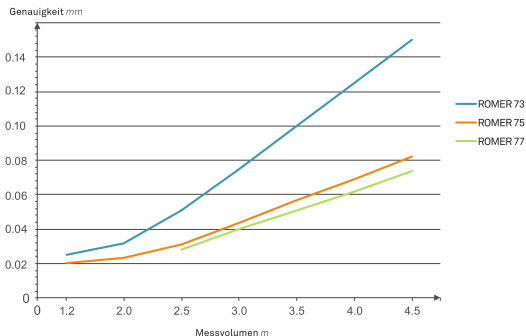


Measuring sub-steps



Portable CMM

- Optical and tactil measurement possible
⇒ We need only tactil measurement
- Measuring distance: 1.2 m - 4.5 m
- Accuracy: 26 μm - 110 μm (ROMER 77)
- Easy to transport:
 - < 10 kg
 - No calibration after transport

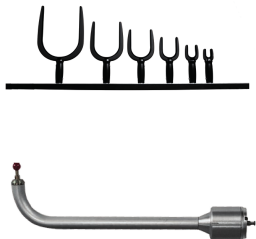


Laserscanner

- Scan width: 80 mm
- Point-to-point distance: 11 μm
- Accuracy: 28 μm (2σ)

Probes and sensors

- Infrared sensors for tube inspection
- Arched probes



GridLOK

- Expanded measurement system
- Accuracy: 50 μm plus accuracy of arm
- Measuring area: 4 m x 6 m



	7725 (2.5 m)	7730 (3.0 m)	7735 (3.5 m)	7740 (4.0 m)	7745 (4.5 m)	
6-ACHSEN	Einzelpunkt-Reproduzierbarkeit	0.017 mm / 0.0007 in	0.026 mm / 0.0010 in	0.034 mm / 0.0013 in	0.047 mm / 0.0019 in	0.060 mm / 0.0024 in
	Volumetrische Genauigkeit	± 0.026 mm / 0.0010 in	± 0.040 mm / 0.0016 in	± 0.051 mm / 0.0020 in	± 0.062 mm / 0.0024 in	± 0.074 mm / 0.0029 in
7-ACHSEN (SI)	Einzelpunkt-Reproduzierbarkeit	0.023 mm / 0.0009 in	0.036 mm / 0.0014 in	0.047 mm / 0.0019 in	0.057 mm / 0.0022 in	0.071 mm / 0.0028 in
	Volumetrische Genauigkeit	± 0.034 mm / 0.0013 in	± 0.052 mm / 0.0020 in	± 0.073 mm / 0.0029 in	± 0.088 mm / 0.0035 in	± 0.107 mm / 0.0042 in
	Scangenaugigkeit (mit RS3)	0.050 mm / 0.0020 in	0.066 mm / 0.0026 in	0.081 mm / 0.0032 in	0.095 mm / 0.0037 in	0.110 mm / 0.0043 in

Price:

- 7725 inkl. Software Polyworks and training: ~60 k€
- 7740 inkl. Software Polyworks and training: ~70 k€
- 7725SI inkl. Software Polyworks and training: ~90 k€

Portable CMM needed for survey by our group

- Versions available with different measuring length and accuracy
- Easy to transport
 - < 10 kg
 - no calibration necessary

Question

Is a portable CMM needed or useful for other groups?