

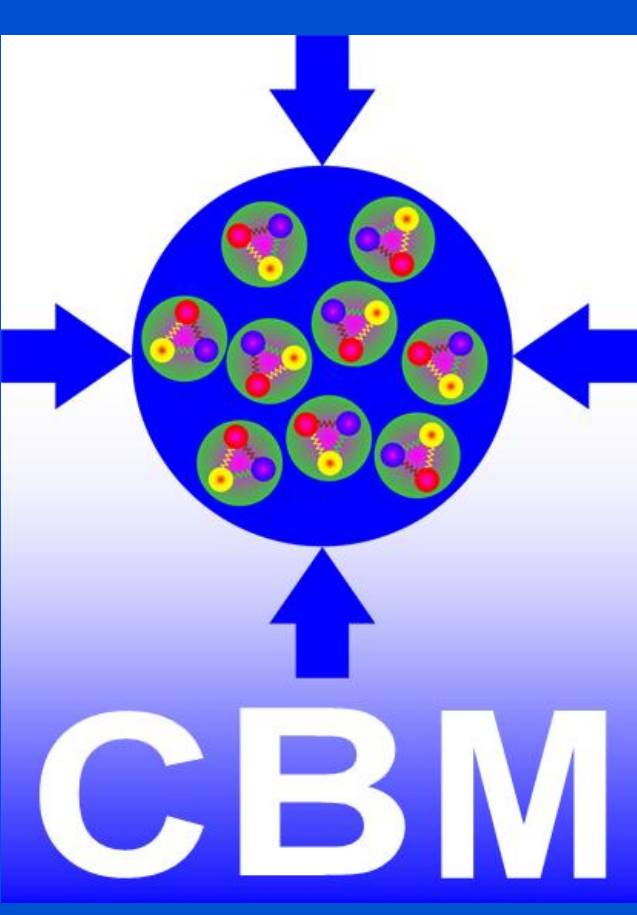
Ladder Assembly for the Silicon Tracking System of the CBM Experiment at FAIR

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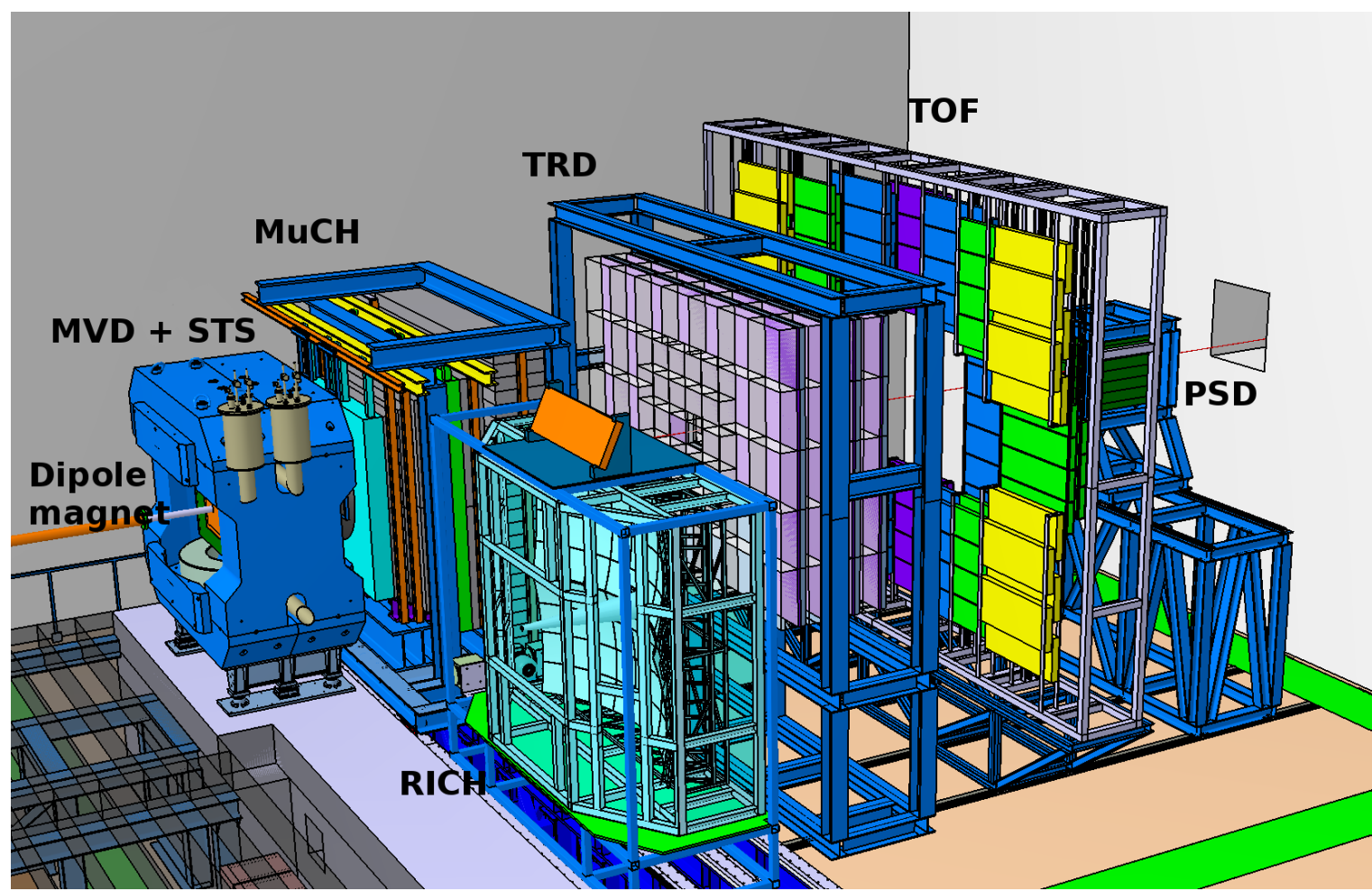
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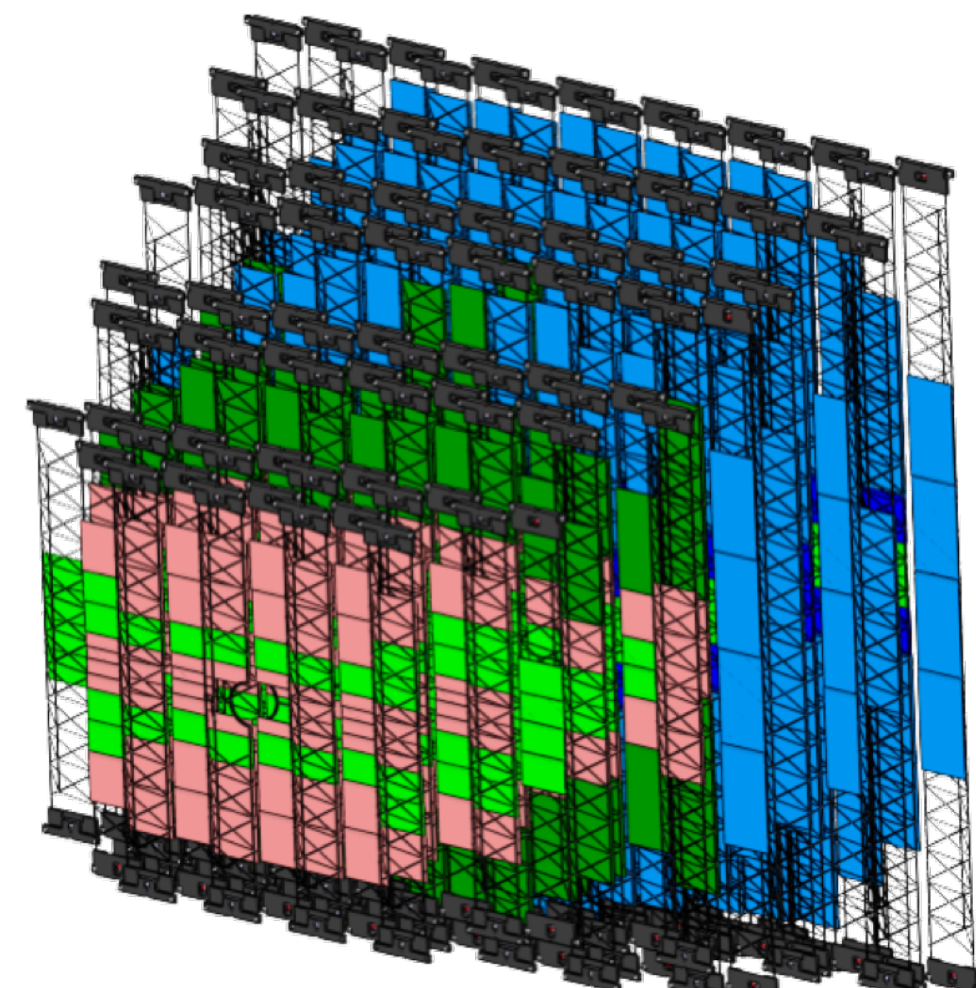
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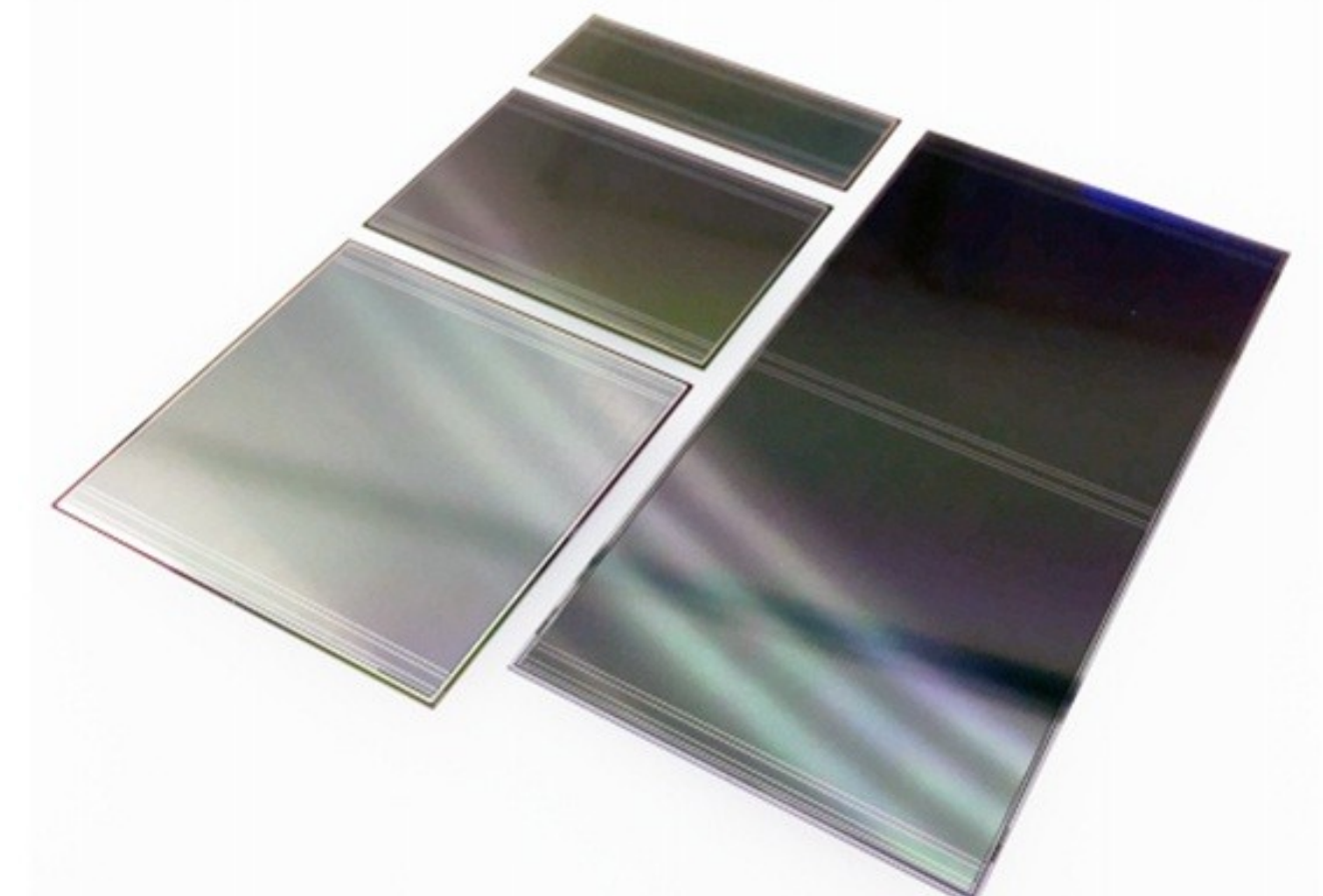
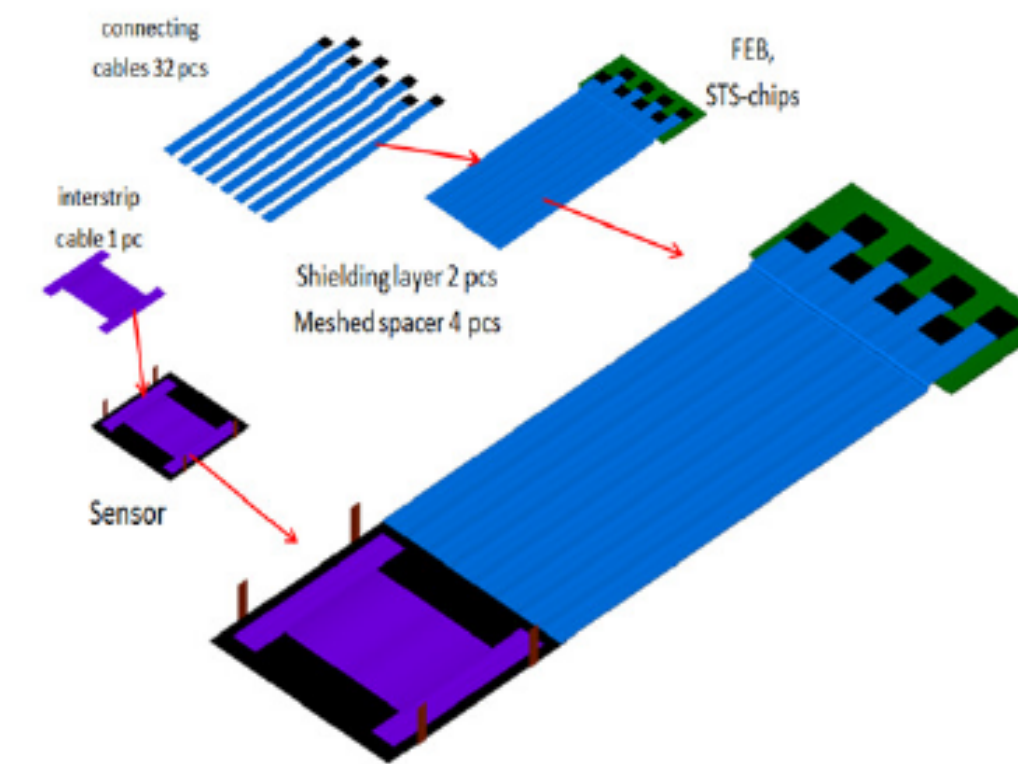
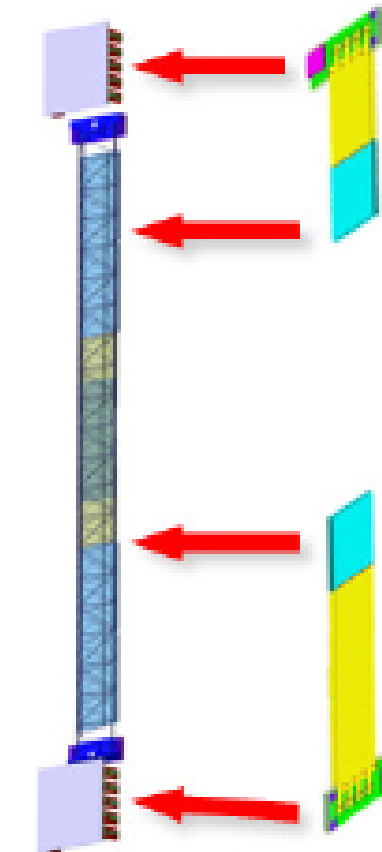
The STS for the CBM experiment at FAIR



- STS is the core detector of CBM
- Located inside the dipole magnet
- Track reconstruction, momentum measurement



- Consists of 8 tracking stations
- 896 detector modules mounted on 106 Carbon Fiber (CF) ladders
- 8-10 modules on each CF ladder
- Requirement: Positioning of sensors in 3D with in the order of 100 μm

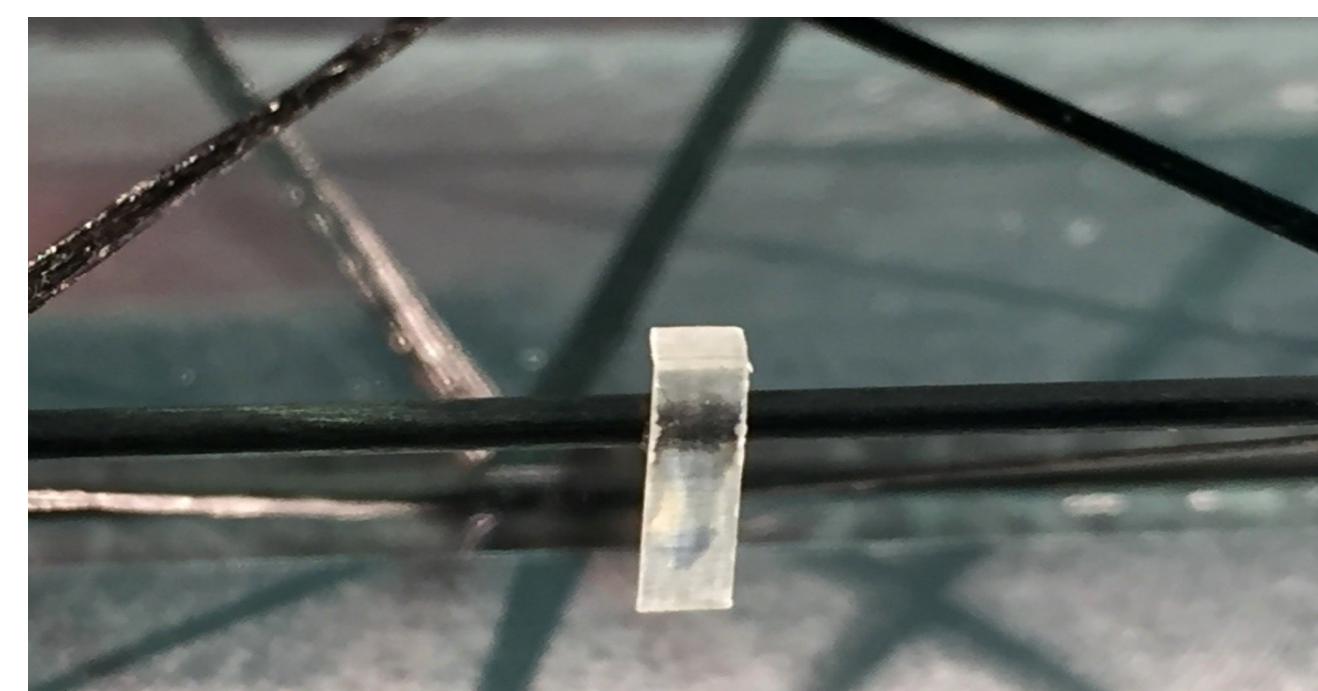


- Double-sided silicon micro-strip sensors
- Stereo angle between front /back strips 7.5°
- 1024 strips on each side
- Strip length 2/4/6/12 cm, width 6 cm

STS ladder components



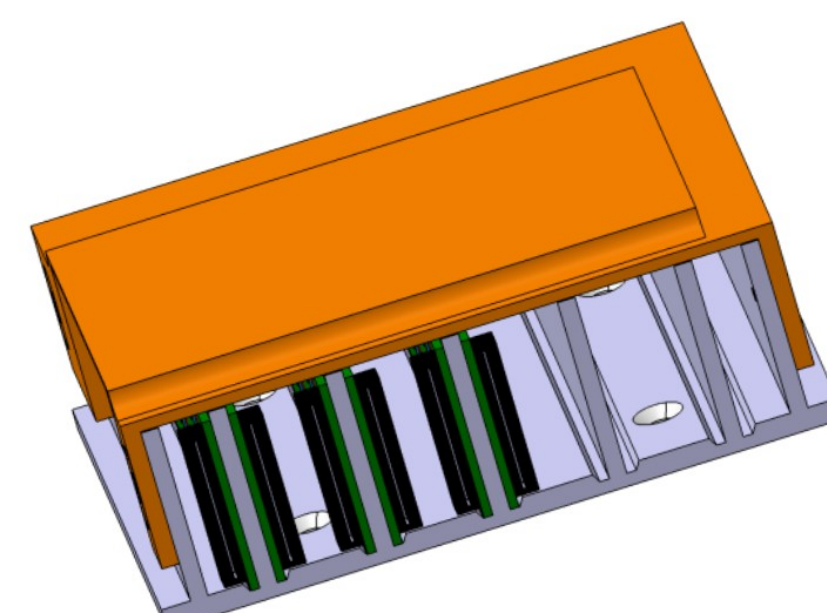
Carbon Fiber support structures produced with winding technique



Sensor holding structures, L-legs made of Glass fibres



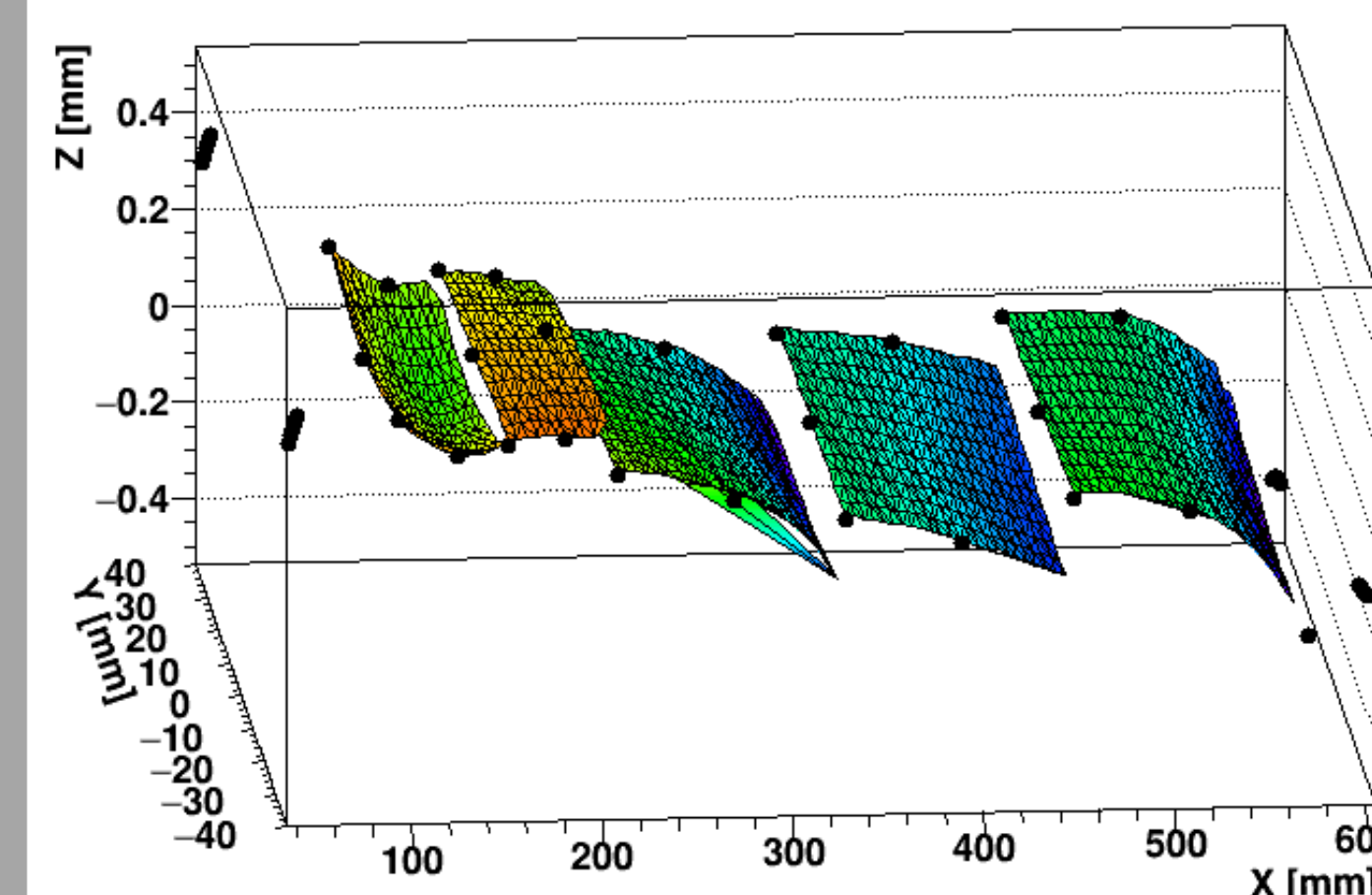
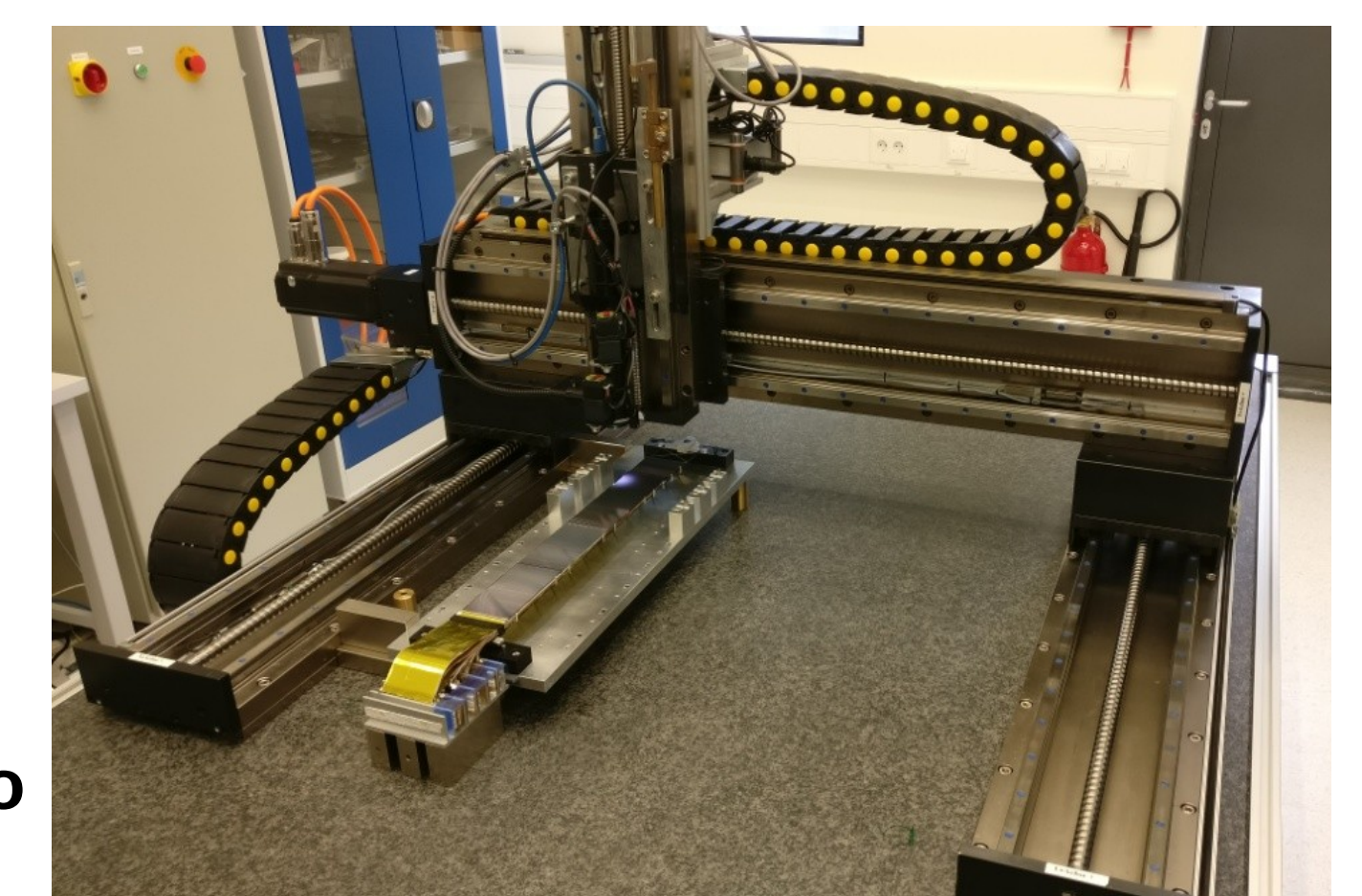
Sensor module: sensors, micro cables, FEBS



FEBS (Front End Boards) in cooling box

Optical survey and measurement technique

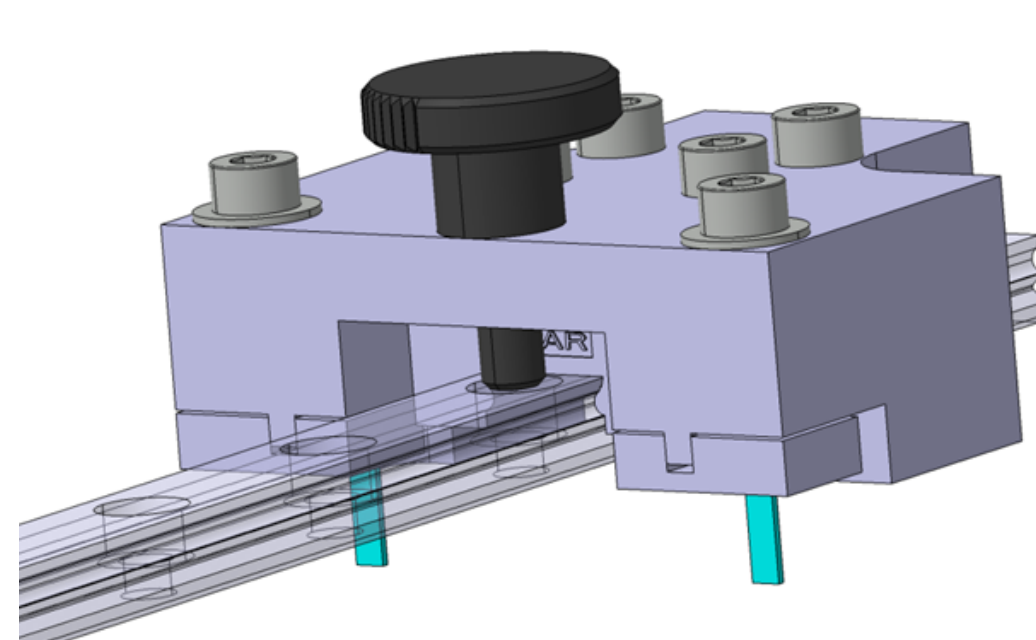
- Three-axis measurement instrument (1100 x 800 x 170 mm)
- Equipped with camera and motorized optics
- Overall precision of table taking long term reproducibility of measurement is $\pm 10 \mu\text{m}$.
- LABVIEW software from NI is used for the optical survey of the table.
- The goal is that the sensor positions do not deviate from the nominal position by more than 100 μm .



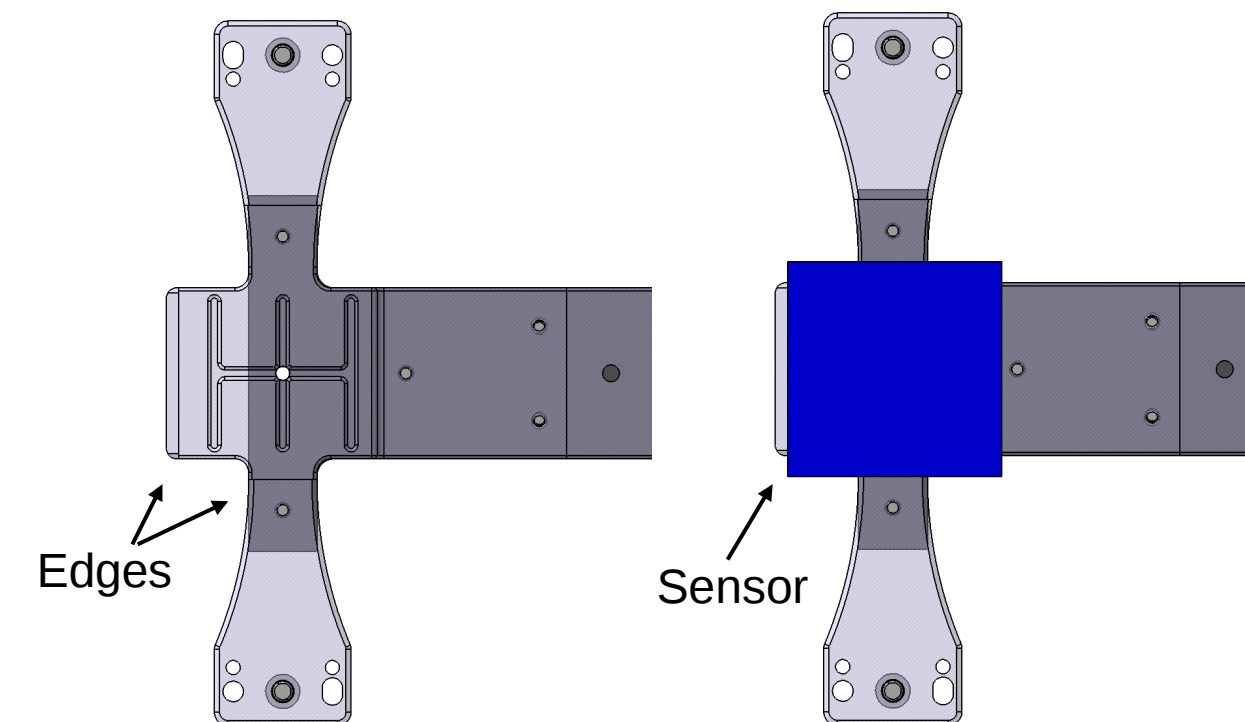
- 3D-position of sensors is determined from alignment marks on their surface.
 - The black dots refer to the alignment marks on the sensors.
 - Measurement of XY surface is based on pattern recognition technique.
 - Measurement of height (in Z direction) is based on focusing technique.
 - Nominal module Z position was shifted to zero for all the sensors
- Z Max-Min: Surface 417 μm
Marks 483 μm

Ref paper: <http://arxiv.org/abs/1812.00917>

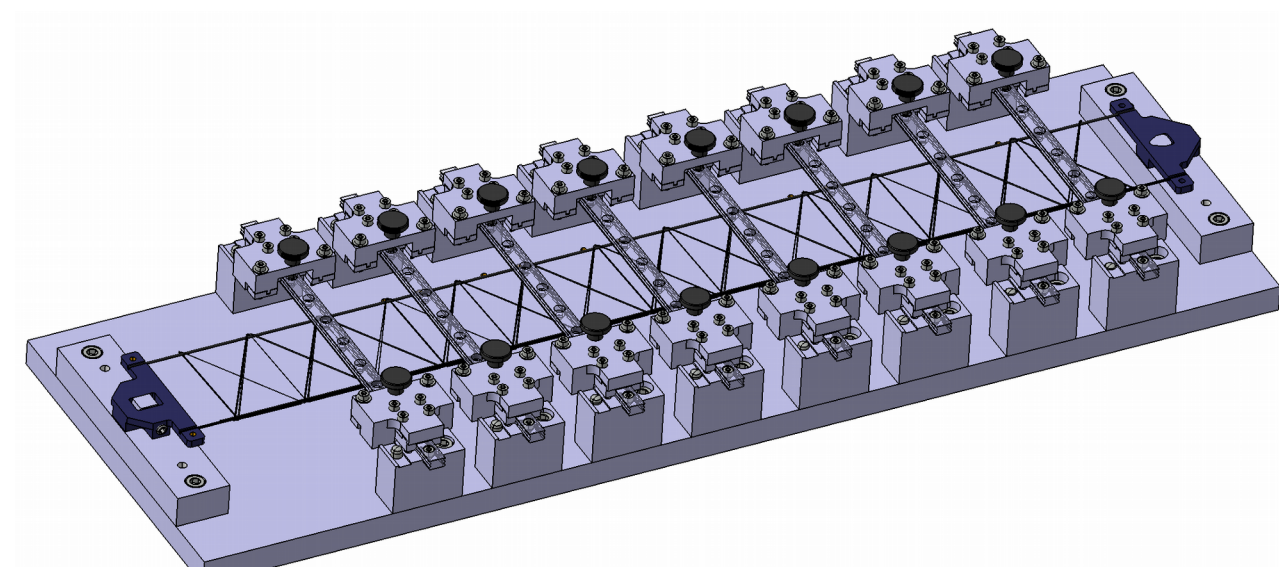
Assembly technique



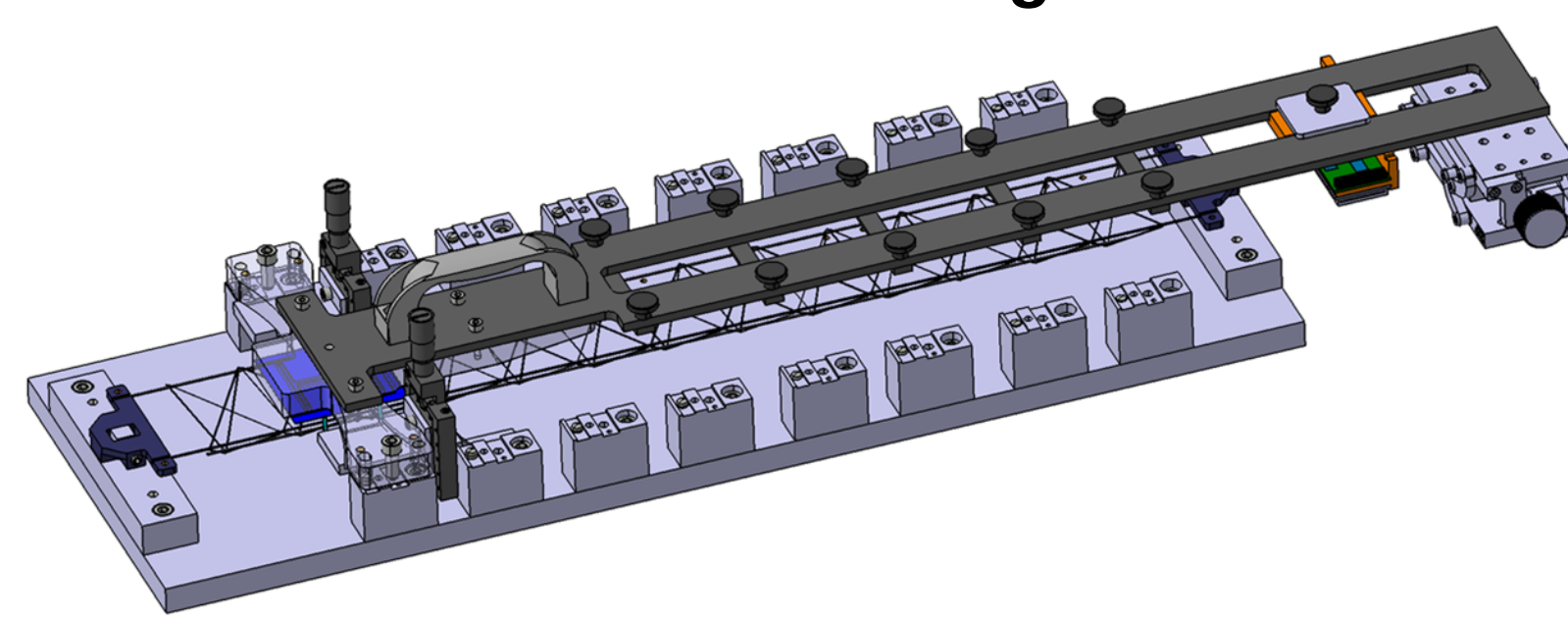
L-leg mounting tool holding I-legs (two I-legs goes in one fixture)



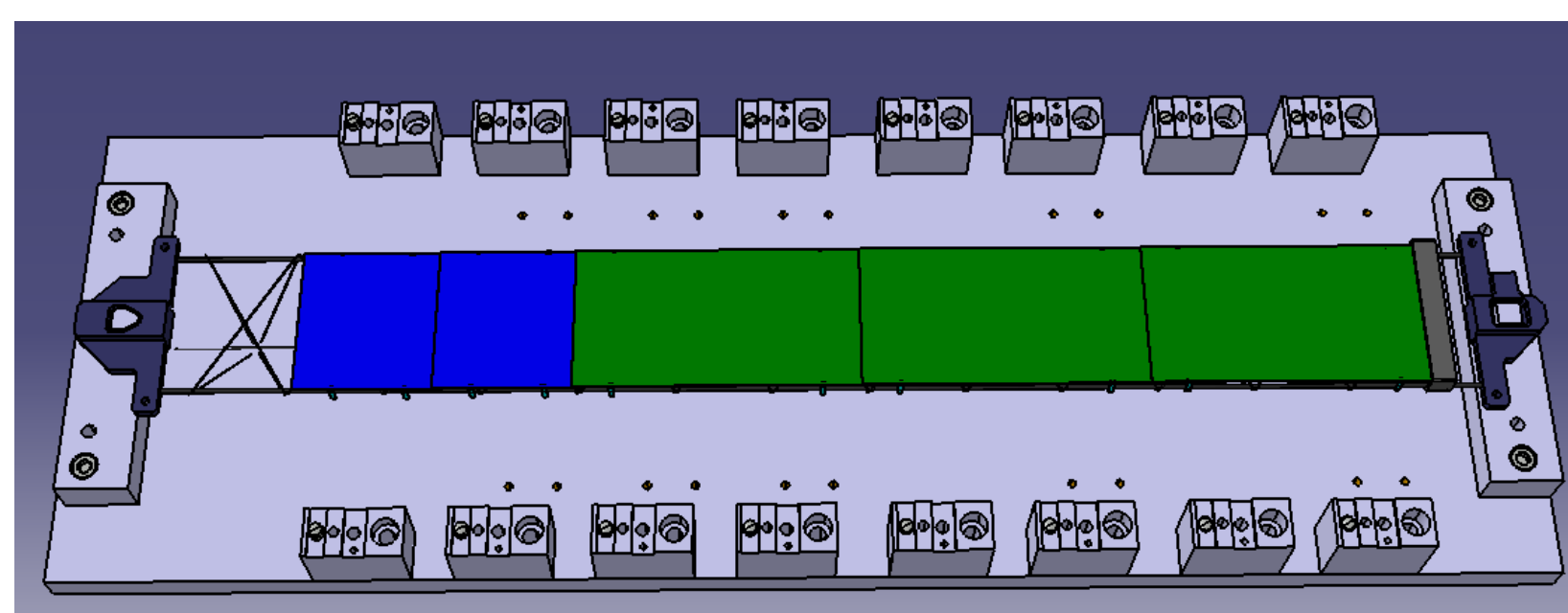
Sensor holding tool



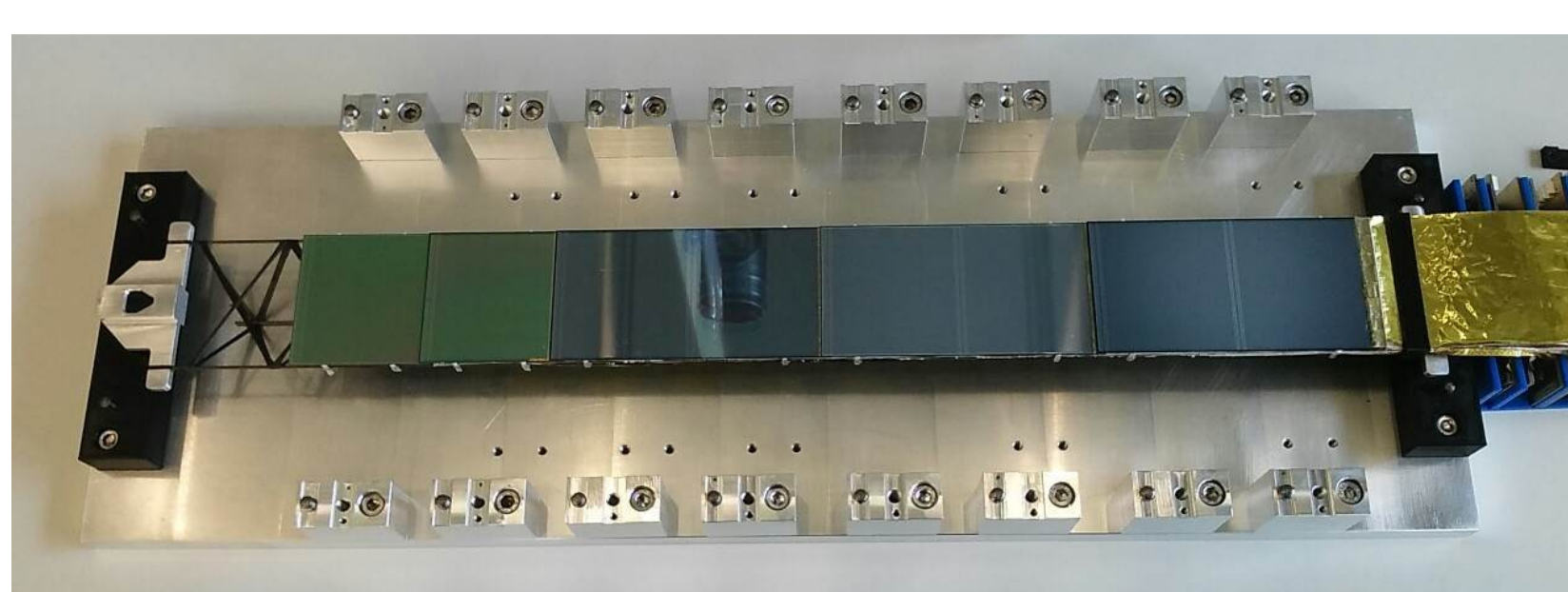
Tool to assemble 5 sensors on a ladder



Assembly of first module using module holder

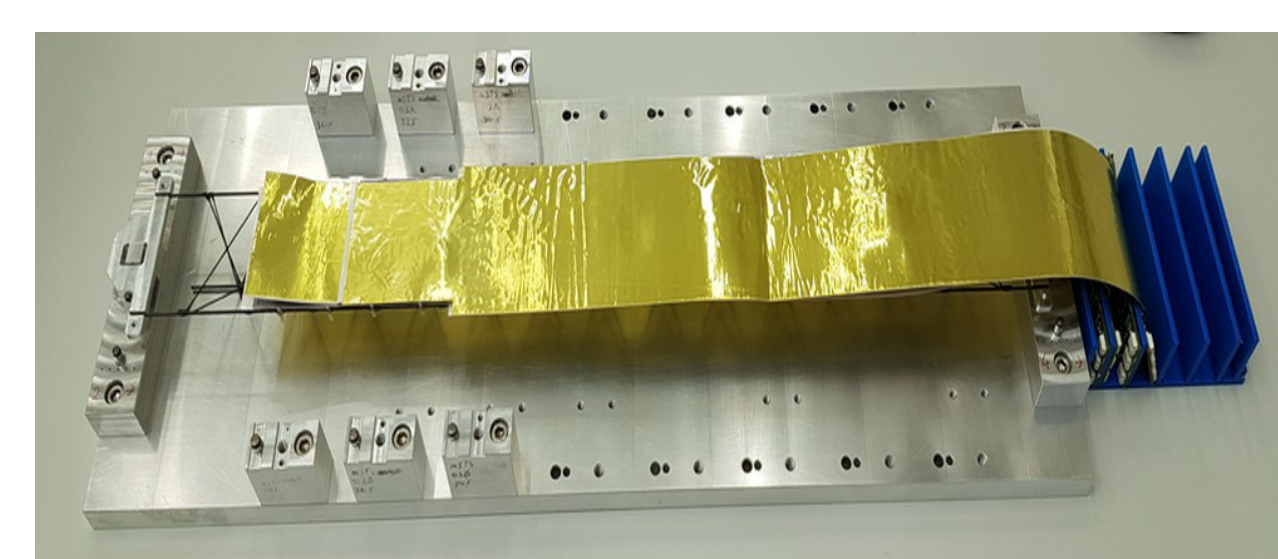


- A tool has been designed to mount the modules on the CF ladders.
- Sensors are positioned in respect to the edges on the sensor holder.
- Sensor holder is positioned to the tool with dowel pins.



- Assembly of CF ladder with 5 non-functional modules mounted on it.
- Ensures the feasibility to mount the modules on the tool.
- Technique was used to assemble the ladders for m-STs.

Conclusion & Outlook



Ladder assembled with modules covered by shielding



mSTS enclosure with ladder holding modules covered with shielding

- The technique used to assemble the ladder with modules equipped on it was promising.
- Based on the same assembly concept, further ladders will be assembled.
- Mounting tools and jigs can be improved for the better precision.
- A procedure is developed to determine the position of sensors in 3D.
- Measured sensor position will be further used as an input for the track based alignment.

mSTS

- First ladder with two 6.2 x 6.2 cm² sensors was assembled for the mini-STs ladder during Dec-2018 beam.
- 13 modules will be mounted on 5 ladders assembled on two tracking stations.