PAUL SCHERRER INSTITUT

PSI

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SwissFEL – Athos Undulator U38

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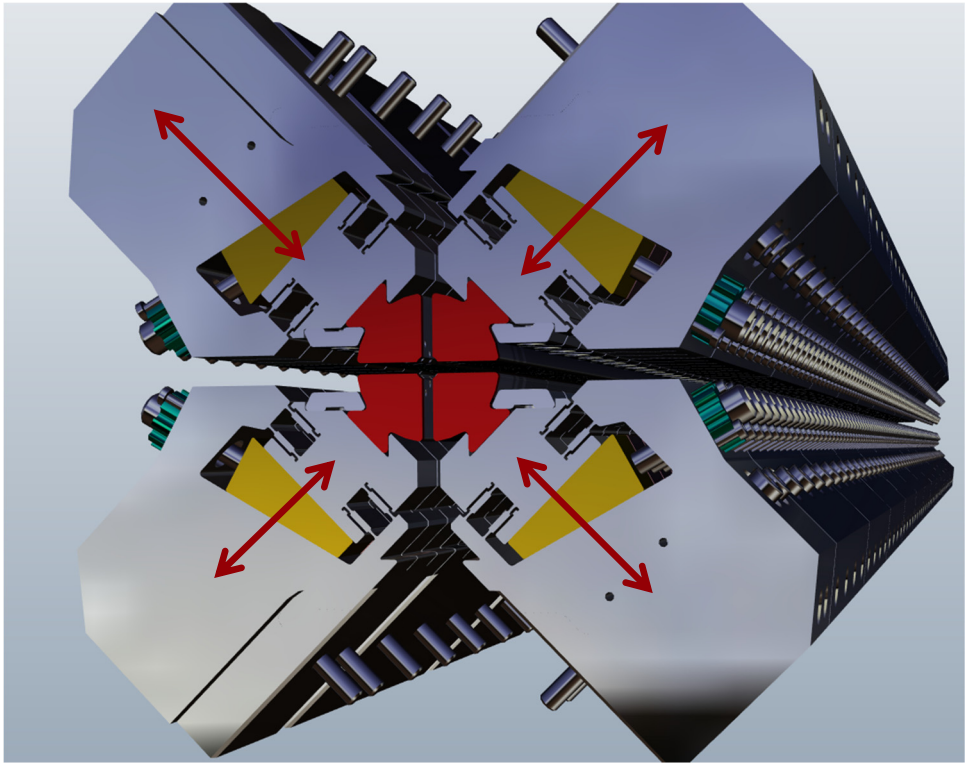
Table of contents

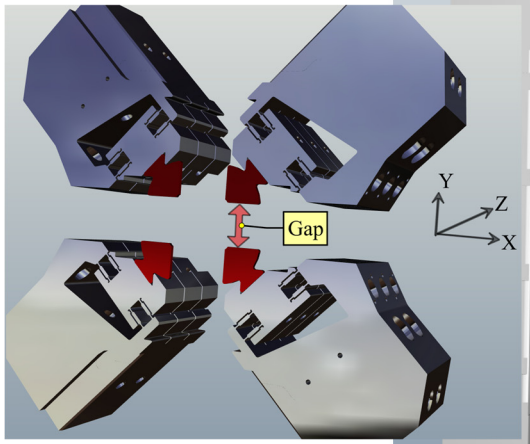
Athos Undulator UE38

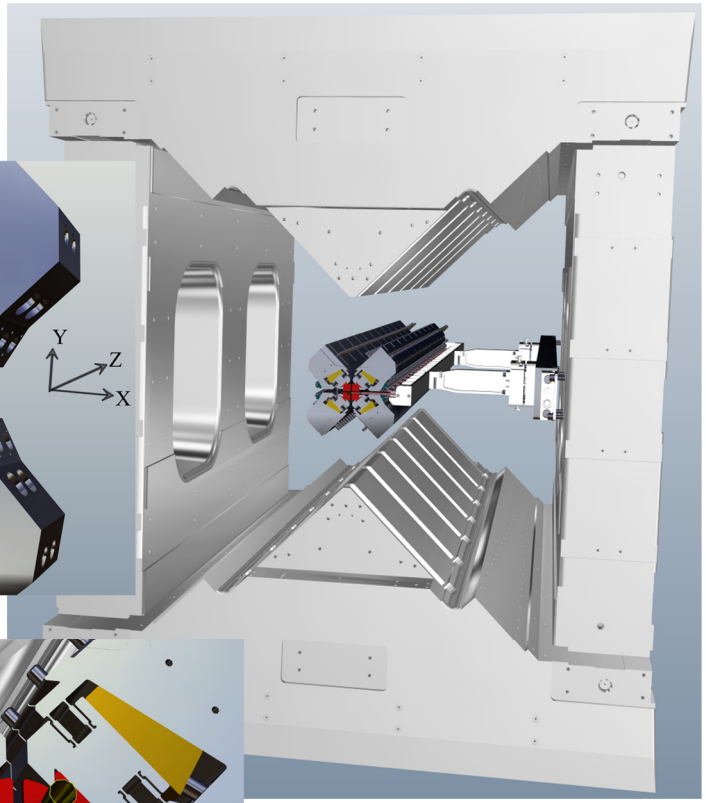


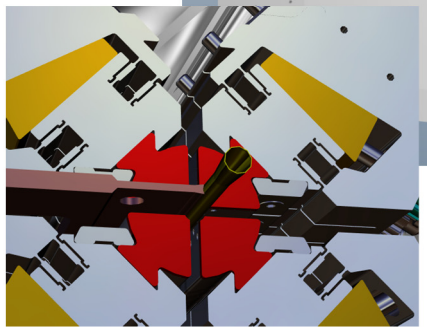
Overview

Main Specification:

Length	: 2m
Periods	: 52
Gap Range	: 3 – 21mm
Shiftrange	: +/- 21mm
Magn. Forces in X	: 1.6 tons
Magn. Forces in Y	: 1.6 tons
Magn. Forces in Z	: 2.0 tons
Stroke for shimming	: +/- 0.1mm
Shimming precision	: 1.5 µm
(with robot screwdriver)	





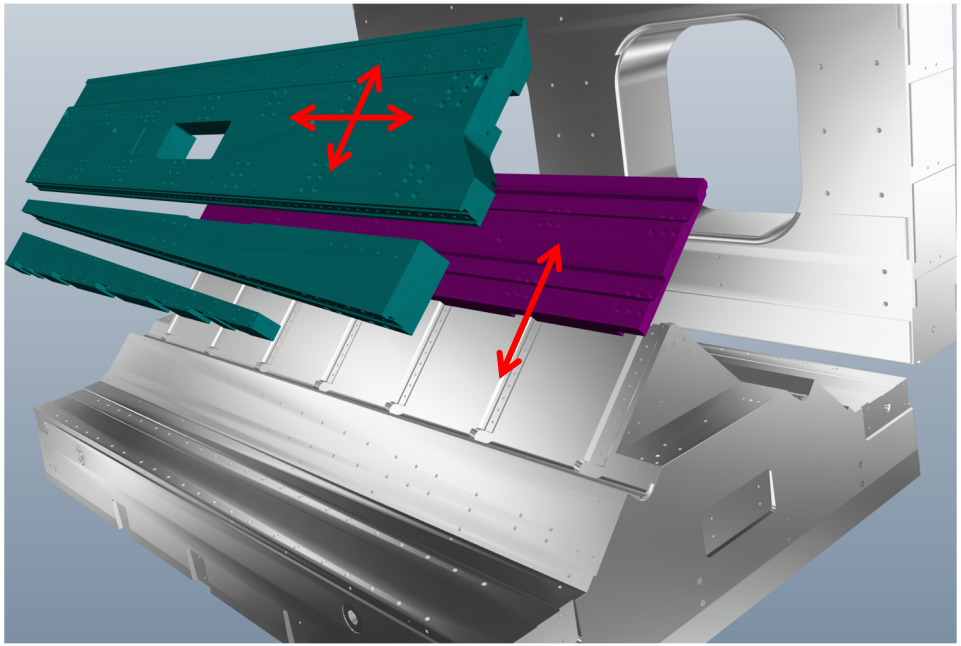


Frame with cast iron

The arragement of the linear guides is very sensitiv of thermal expension. Therefore we decided to design the main part with the same material: Cast iron

Compared to mineral cast:

- Milling instead of grinding (costs)
- High young's modulus
- More freedom in the design



All these parts are in cast iron

Linear Guides and Drives

Drives and Encoders

Servodrives with

Spindles:

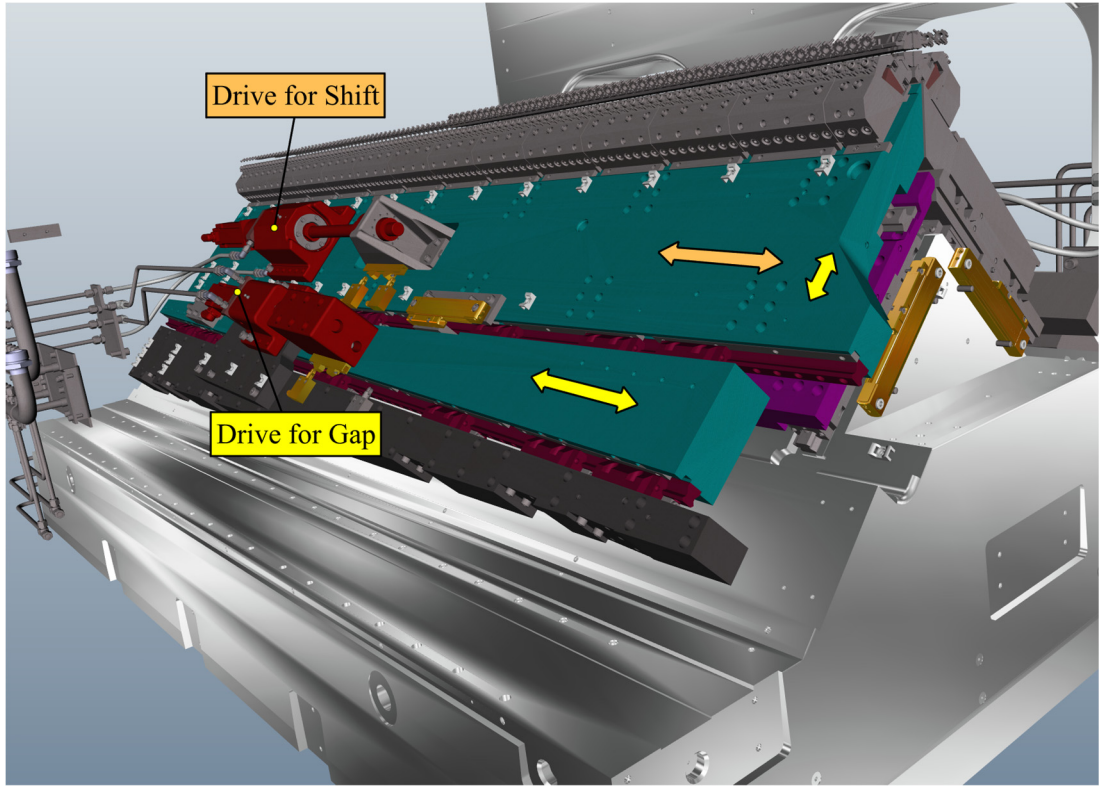
- Beckhoff AM8023-0E21
- satellite roller screws

– Slope for shift : 1.0mm

– Slope for gap : 0.5mm

Linear Encoders:

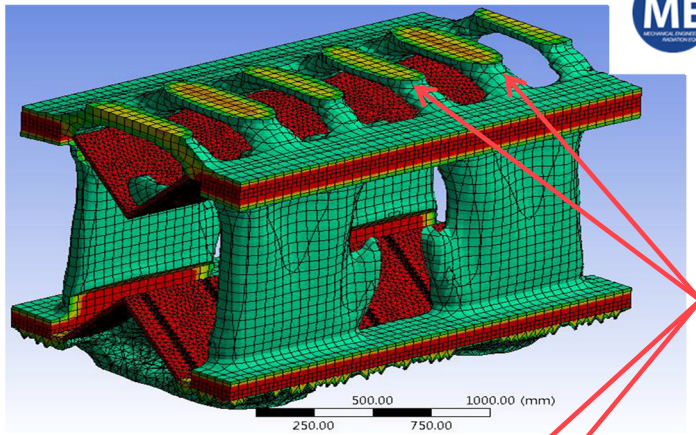
- Heidenhain LC 415-ML70



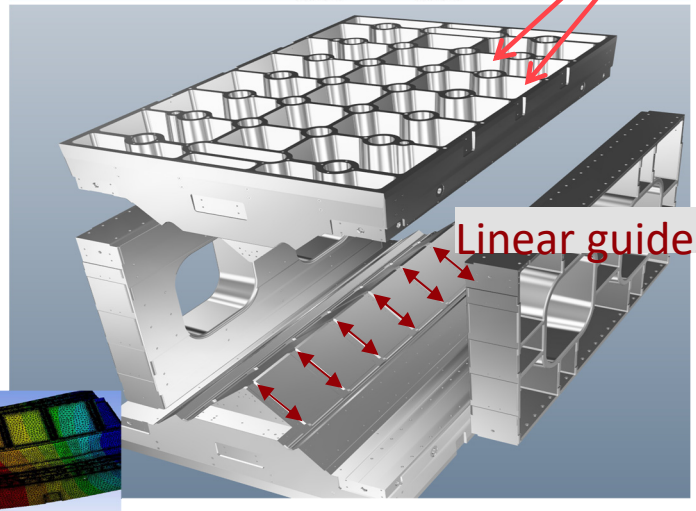
Frame

Topology Optimization:

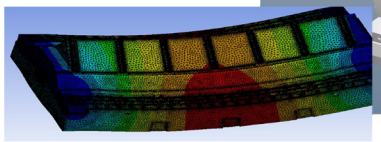
- First impression looks strange, but main finding was, that a rip has to be over each linear guide for the gap
- This principle was taken for the design of ironcast parts
- Upper and lower part identical
- Sidewalls identical
- Main goal is stiftness with changing forces. No clear limit, but we wanted to reach less then 20 micron



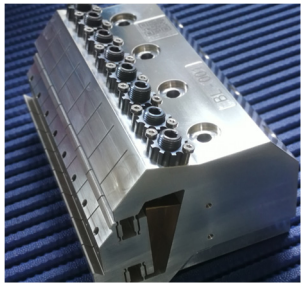
ribs

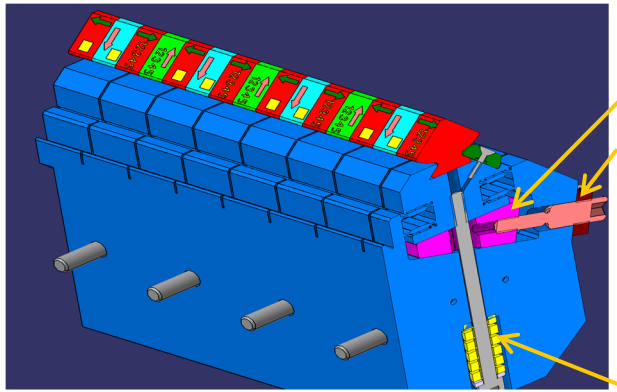


Linear guides



Keeper Design: Each magnet adjustable

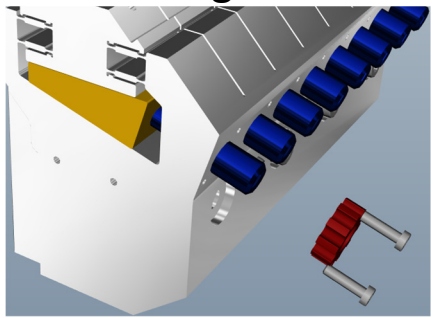




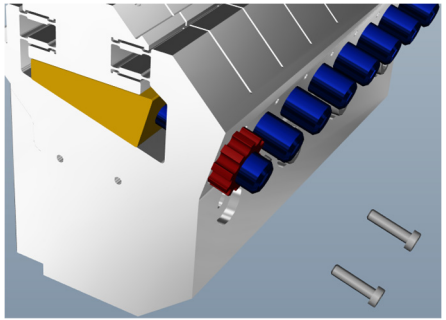
Differential screw thread
1/4 – 28 UNF : 0.907 mm
M10 x 1 : 1.0 mm
-> 0.093mm Movement by 1 turn
Wedge: Bronce (CuSn12-C-GC) with Dicronite coating

Spring to pull the keeper to the wegde

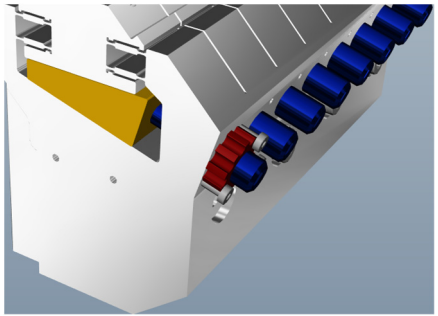
Assembling of the wedge:



1. Step:



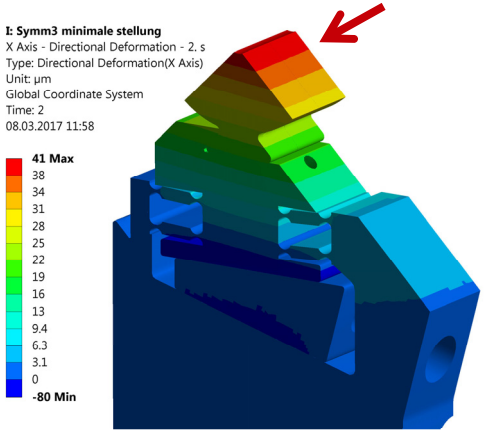
2. Step:

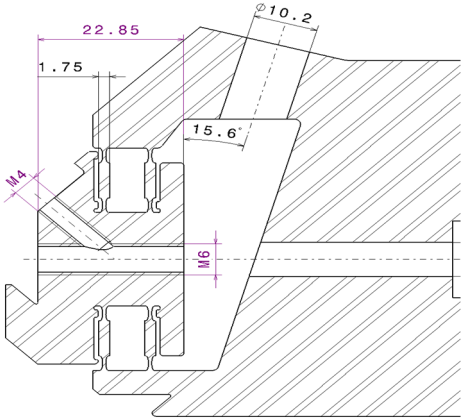


3. Step:

Keeper Design: Simulation of forces

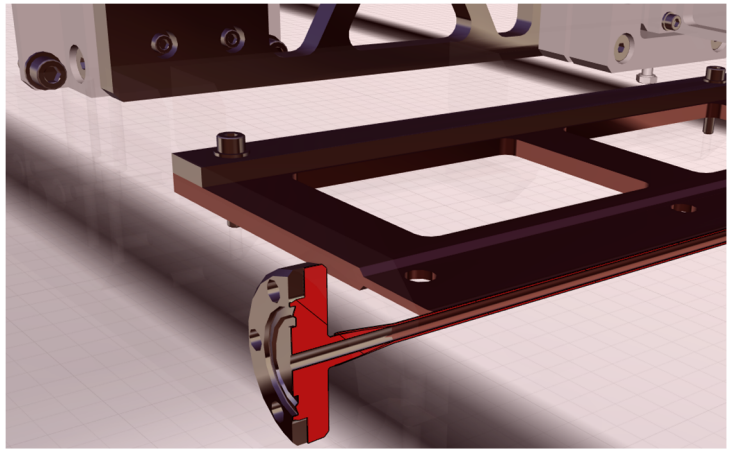
- Simulation of various geometries.
- Main goal: Smallest deformation in beam direction
- Main findings:
  - Flexure has to be weak (this is important, if the flexor is in a lower position)
  - Spring has to be strong
  - Displacements in the other directions are not critical
  - Flexures has to be symmetric





Vacuum Chamber:

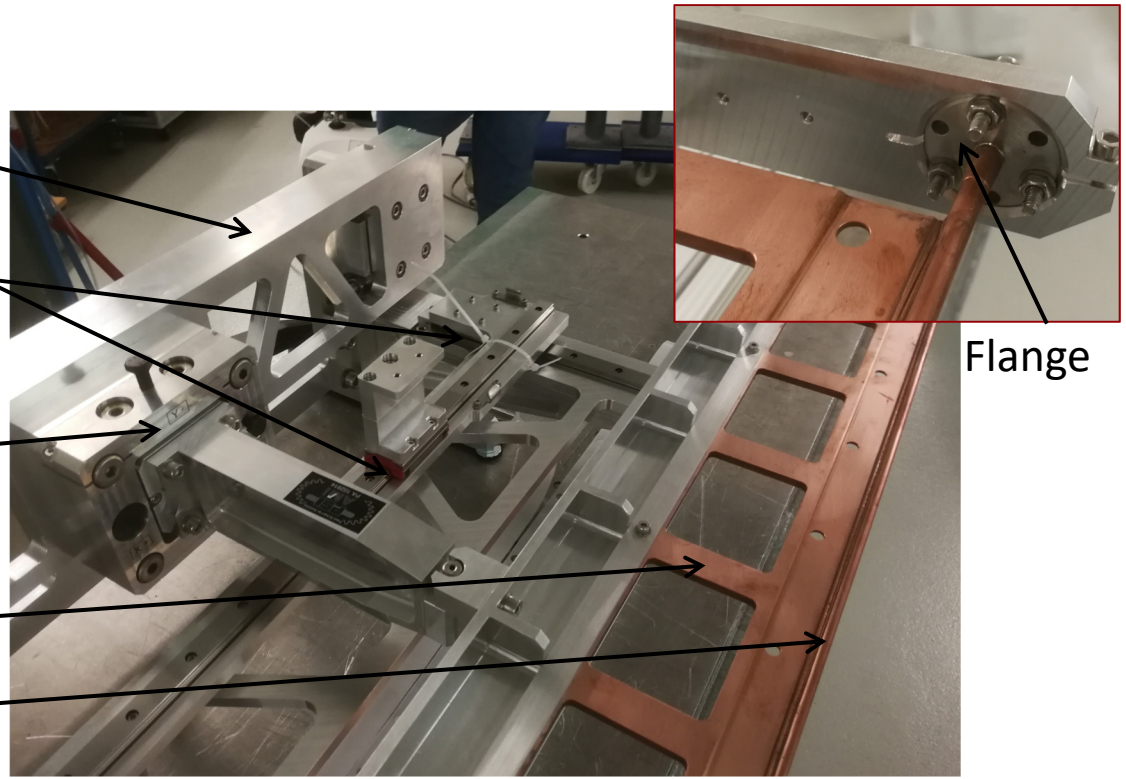
- Length : 2m
- Diameter : 5.5mm with 0.2mm wall
- Material : Copper



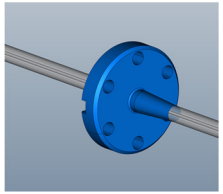
- Prototypes are manufactured
- Straightness vertically : ca. 0.3 mm
- Straightness horizontally : ca. 0.7 mm (has to be optimized for the series)

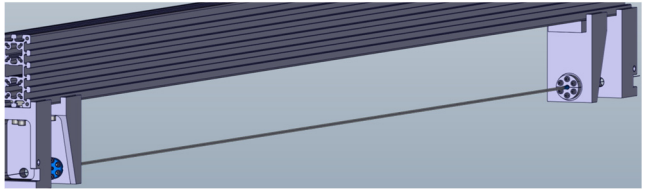
Vacuum Chamber with support

- Frame
- Linear guides for the positioning during assembling (temporarly)
- Interface for the alignment
- Support in copper
- Pipe

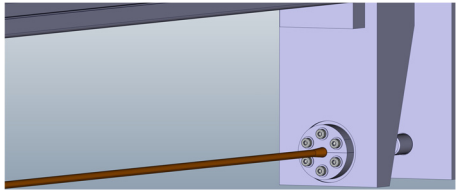


Vacuum Chamber: Manufacturing



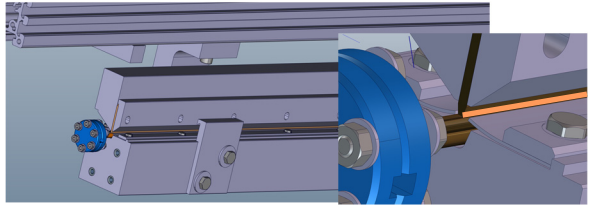


1. Step: Flanges and a silicone wire with a coating of silver powder. The wire has to be strechted and fixed in a frame



2. Step: Galvanize the tube with copper. All the rest has to be insulated

3. Step: Pulling out the silicone wire

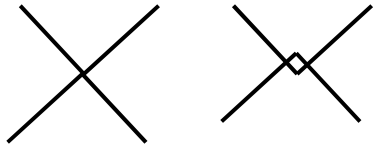


4. Step: Add (galvanize) the support

Manufacturing by:
Galvano-T
51570 Windeck
Germany

Measurement

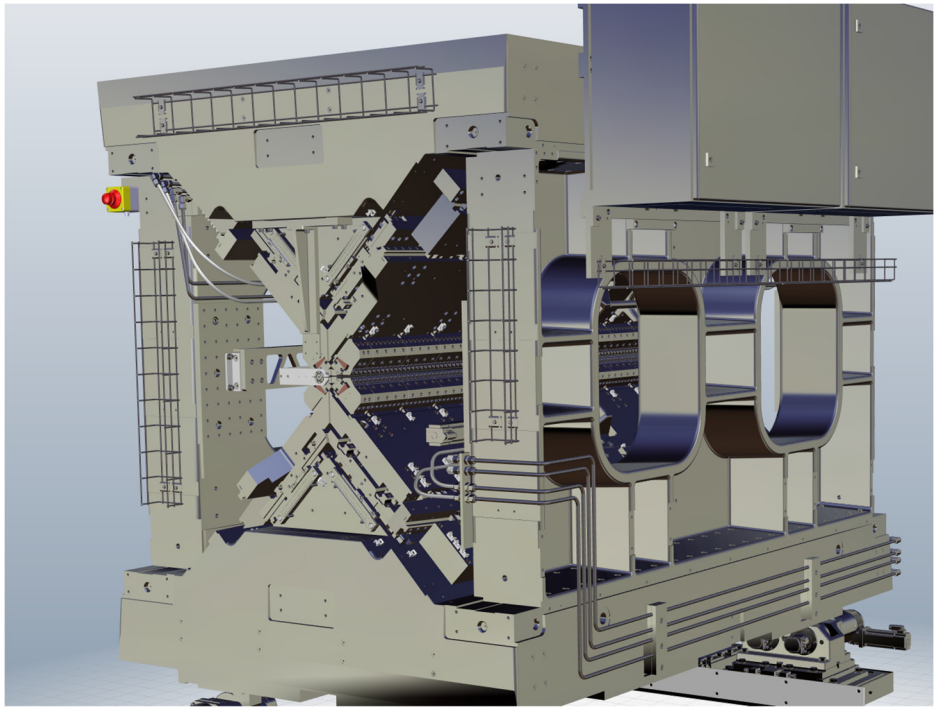
- Check the of tolerances with Lasertracker
- Gauges for the control of the keeper position and the straightness
- Straitness tolerance: +/- 10 um
- The basis has to be correct, because it cannot be corrected by changing the gap. The sidewalls will be finished after the measurement



Actual Situation, Next Steps

Prototype is in fabrication

- We expect the delivery of the frame with the drives in July
- Keeper for the prototype are ready
- Vacuum chamber should be ready in July
- Assembling and measuring the magnets in August / September



We create knowledge – today for tomorrow

My thanks go to

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- Marcel Locher
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- Adriano Zandonella

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