

PAUL SCHERRER INSTITUT



WIR SCHAFFEN WISSEN – HEUTE FÜR MORGEN

Thomas Michlmayr :: CAD Engineer :: Paul Scherrer Institute

SM-CC Subscale Mechanical Design 3rd Common Coil Meeting

19.10.2023



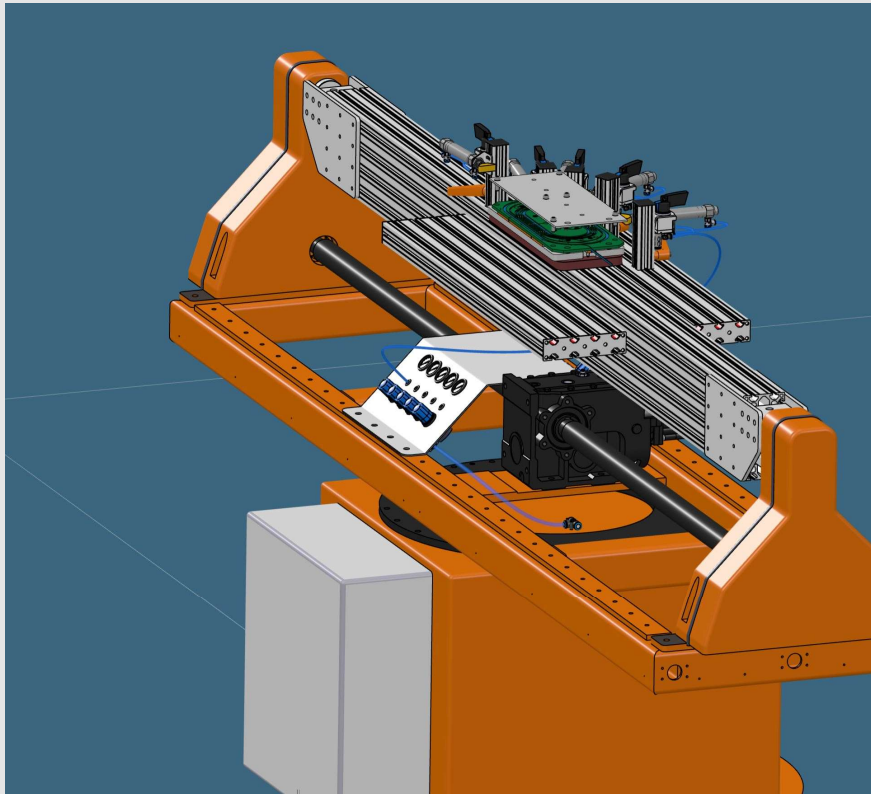


Outline

Mechanical design of a subscale SM-CC with a total of four identical coils.

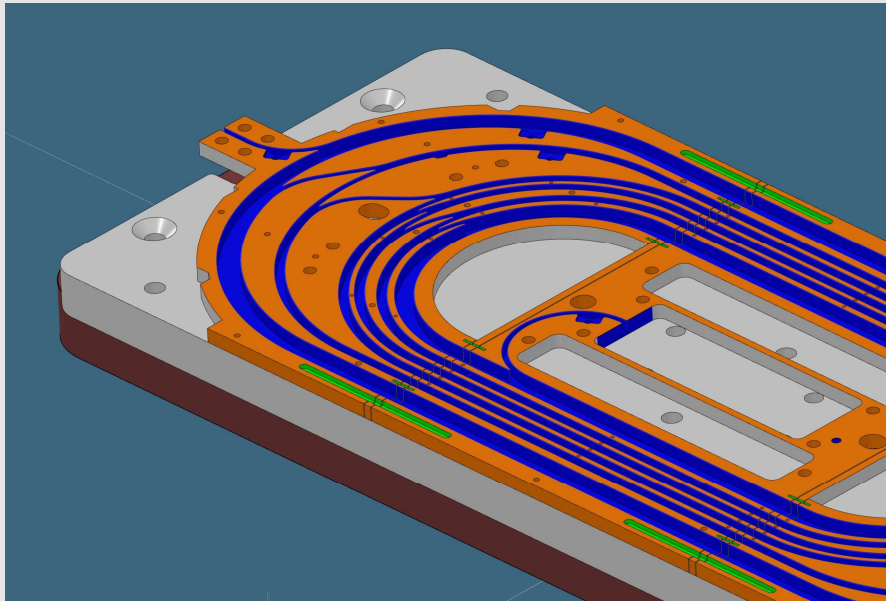
- Winding technique
- Reaction tooling
- Vtap design and impregnation
- Assembly of double coil pack
- Inner splice
- Magnet assembly and closing
- Axial load

Winding stress managed coil



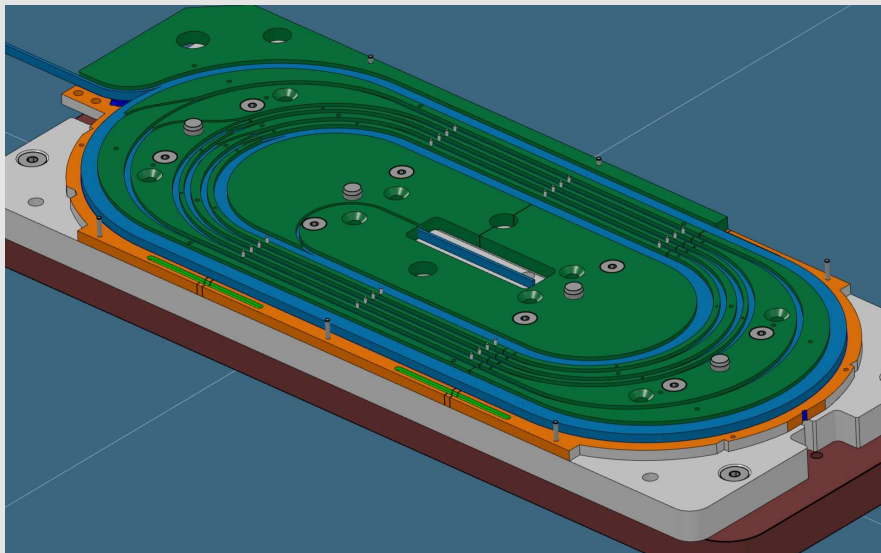
- Winding with 5 axis winding machine (only 4 axis used)
- Wind-and-react technique

Winding stress managed coil



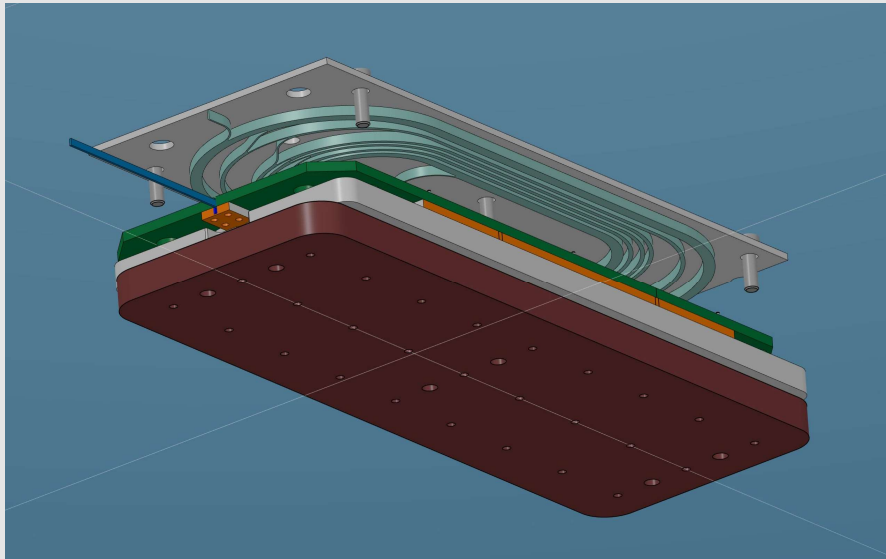
- Single-piece ribs-and-spar-former (orange), channel isolated
- Winding "above" final former
- Winding around insertable tooling rib pieces (green, 3 per block)
- Tooling ribs are pinned to final former
- Coil is pushed down into final former

Winding stress managed coil



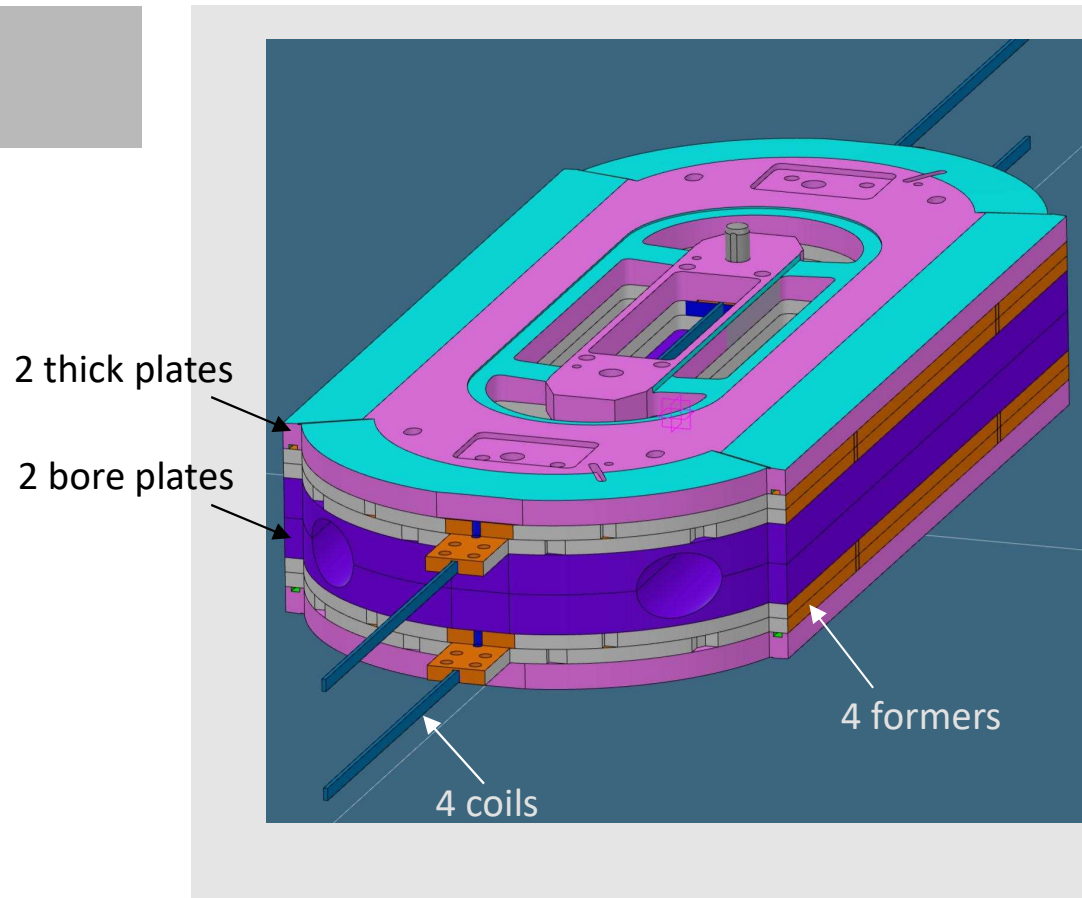
- Single-piece rip-and-spar-former (orange), isolated
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- Winding around insertable tooling rib pieces (green, 3 per block)
- Tooling ribs are pinned to final former
- Coil is pushed down into final former

Winding stress managed coil

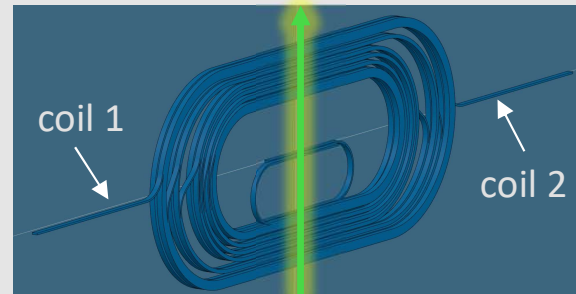


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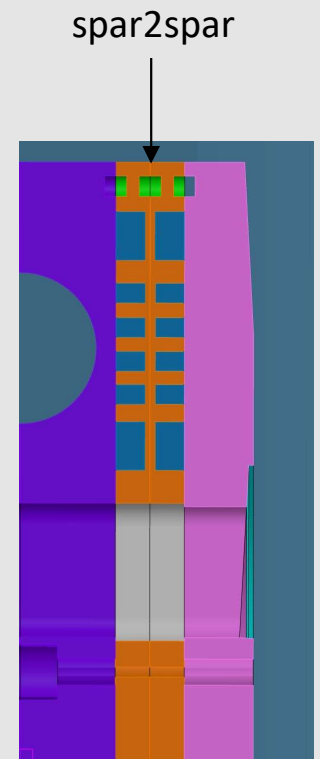
Magnet layout



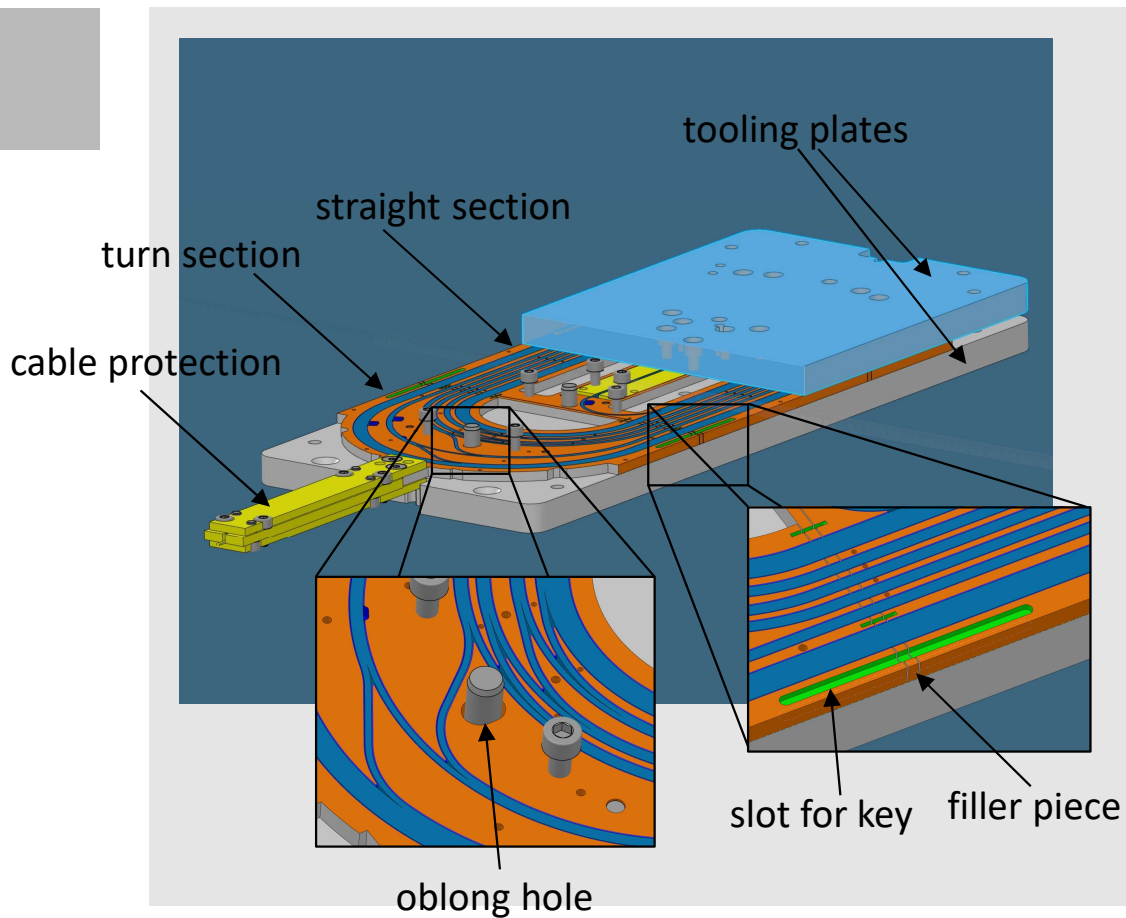
- Use four identical coils
 - cost effective
 - coils exchangeable



- Maintaining current direction leads to spar2spar contact



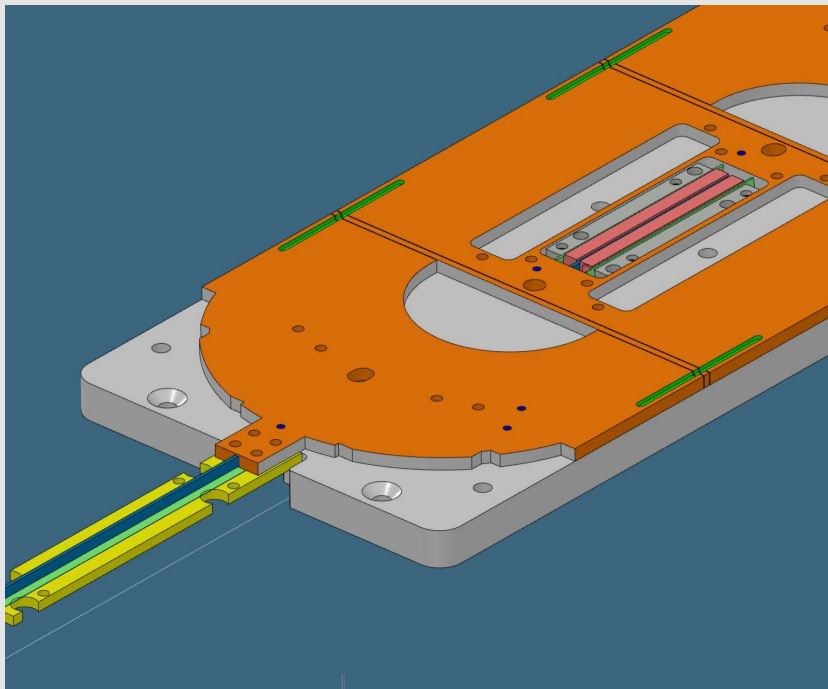
Reaction Nb₃Sn coil



- Former split in turn-straight-turn section allows for cable shrinkage
- Former sandwiched between two tooling plates during reaction
- Straight section fixed
- Turn sections allowed to move only axially
- Fillers can be replaced after reaction

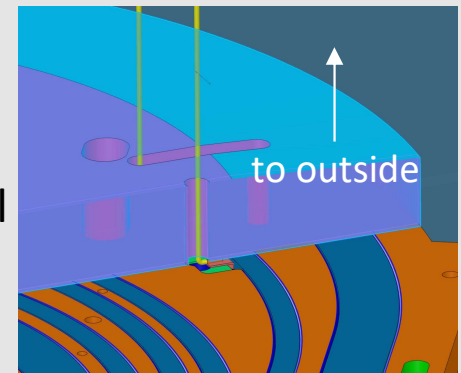
Pretinning, Vtaps, outer splice and impregnation

- Cleaning and pretinning

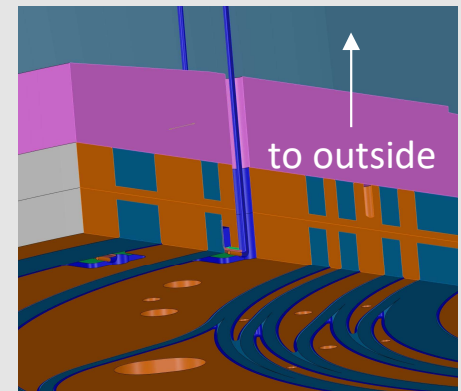


- Outer splice

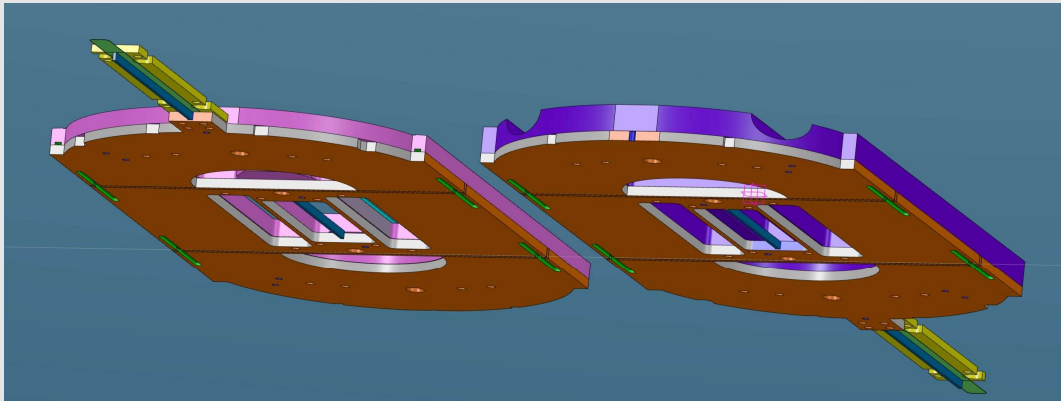
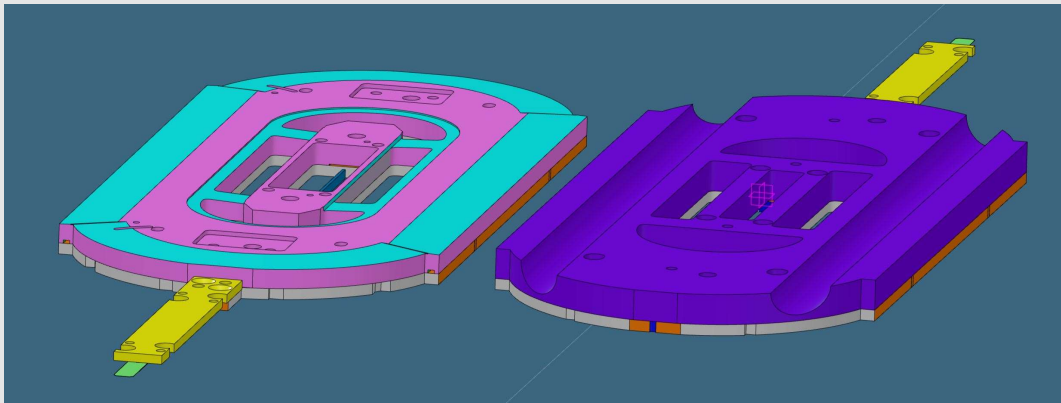
- Vtap outer coil



- Vtap inner coil



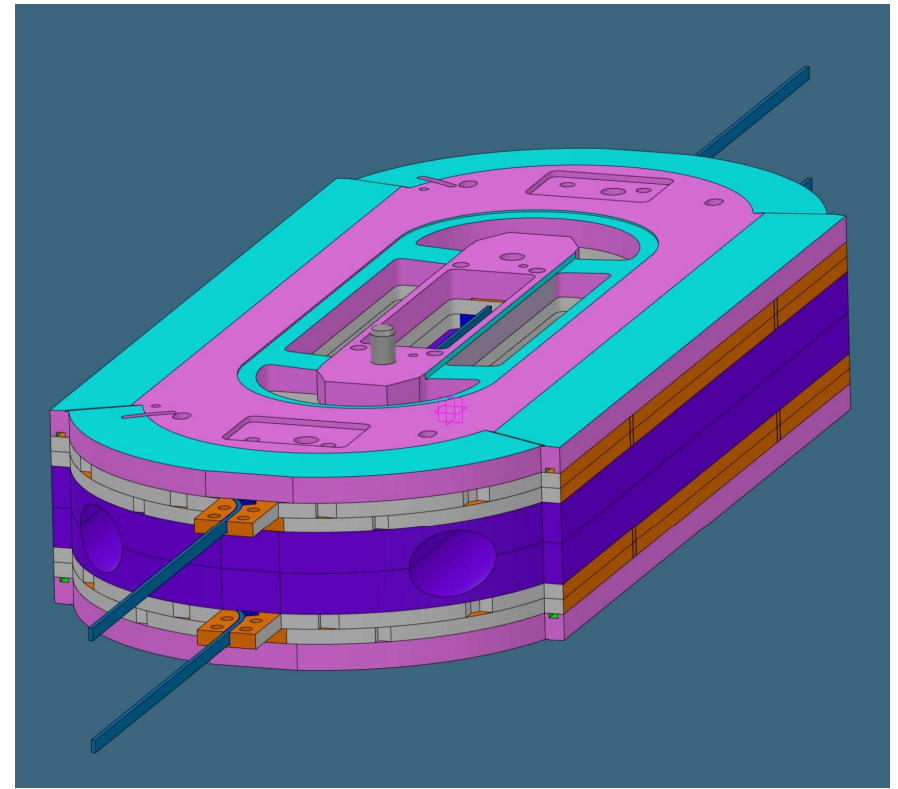
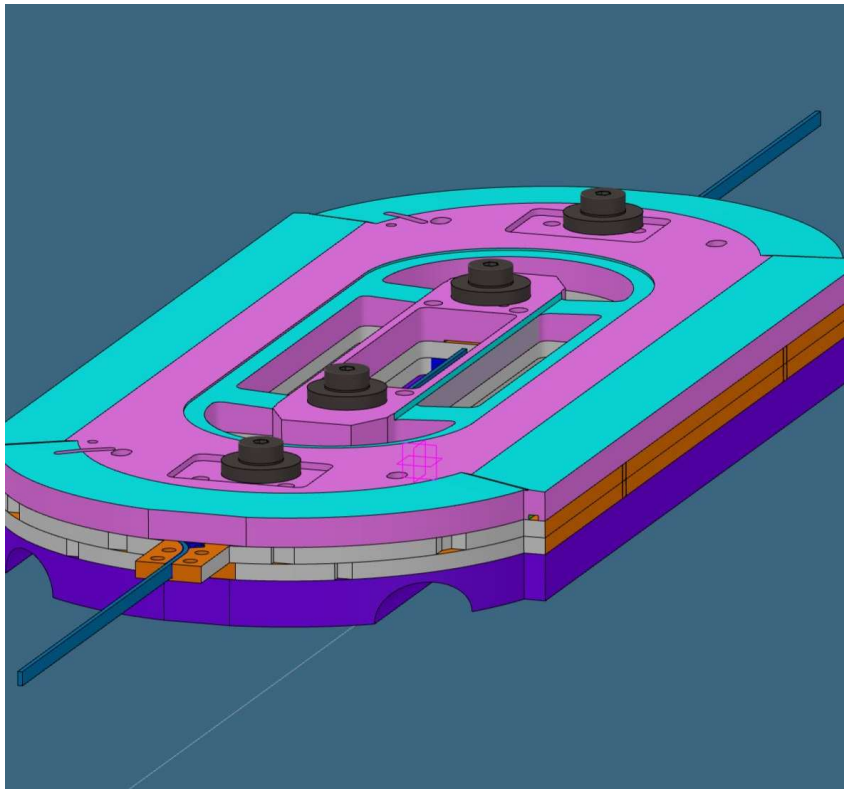
Replacing tooling plates



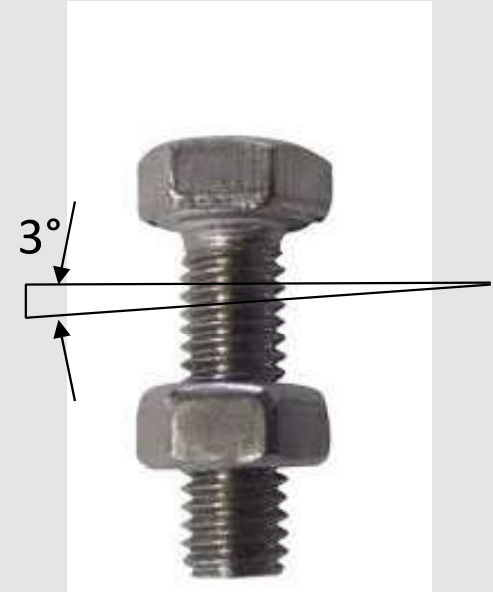
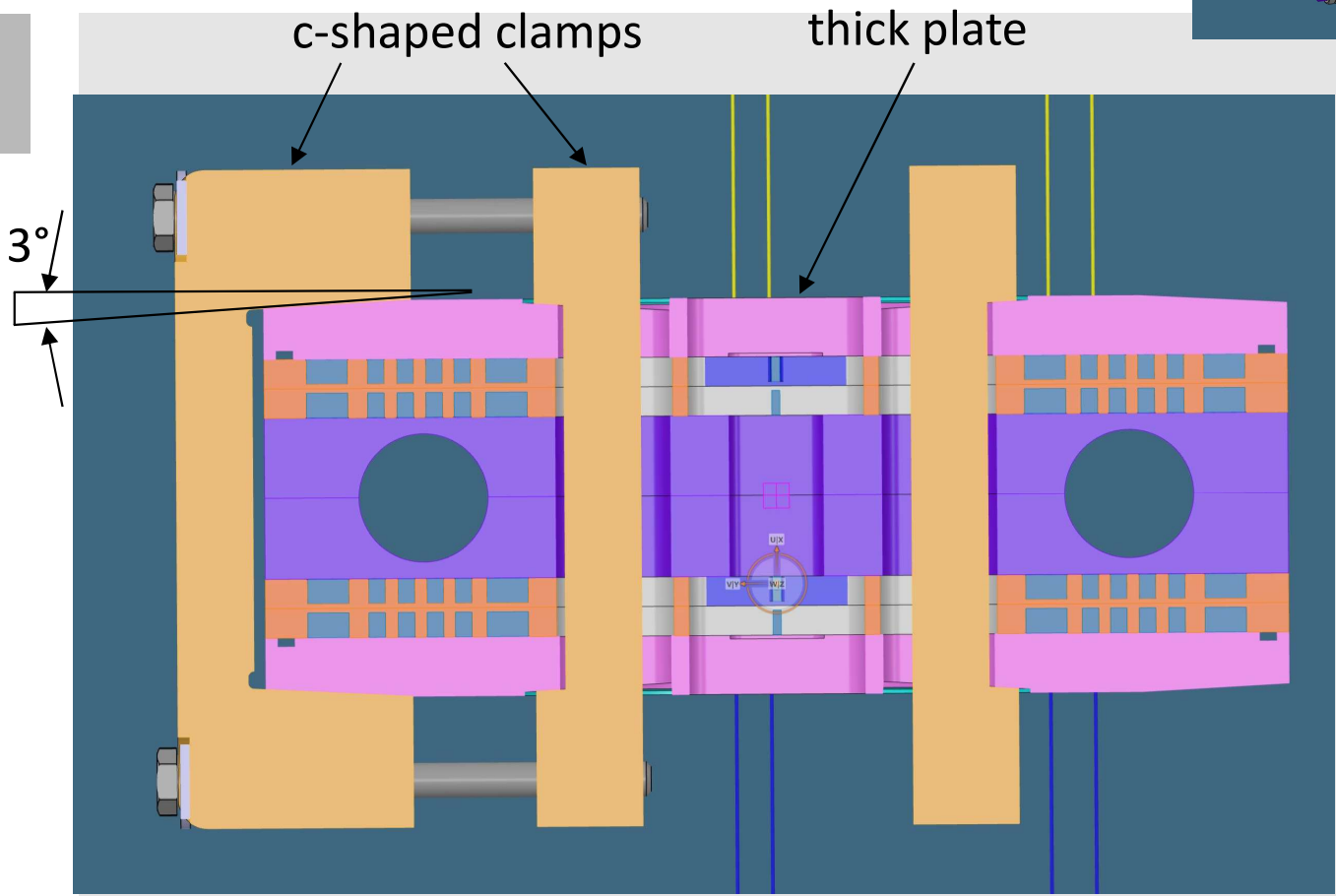
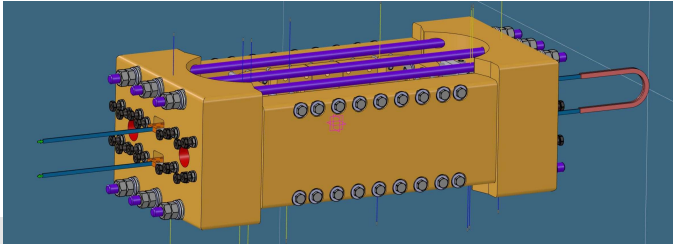
- Coils are always supported from at least one side
- Final plates are facing to coil (ribs)

Stacking coils, inner splicing

- Double coil pack
- Inner splice with 2 NbTi cable pieces
- Final coil pack

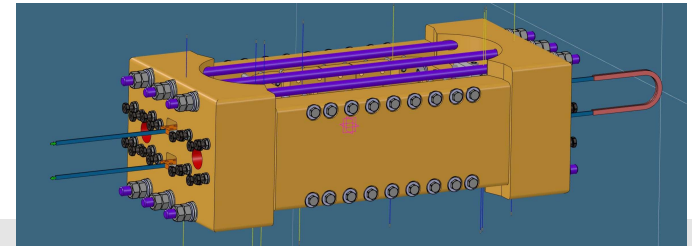


Closing magnet

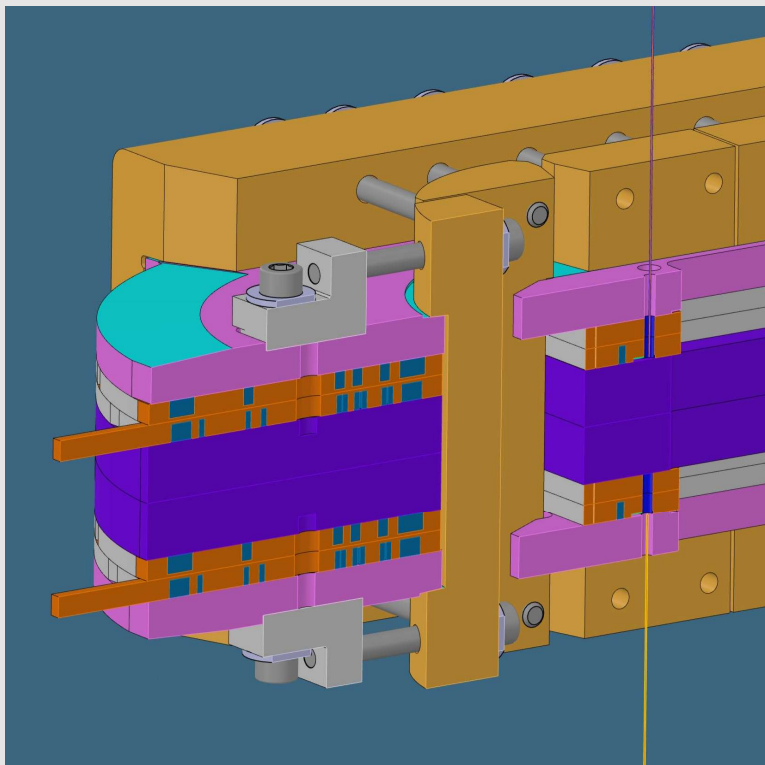


- Clamps and thick plates with 3° inclined faces

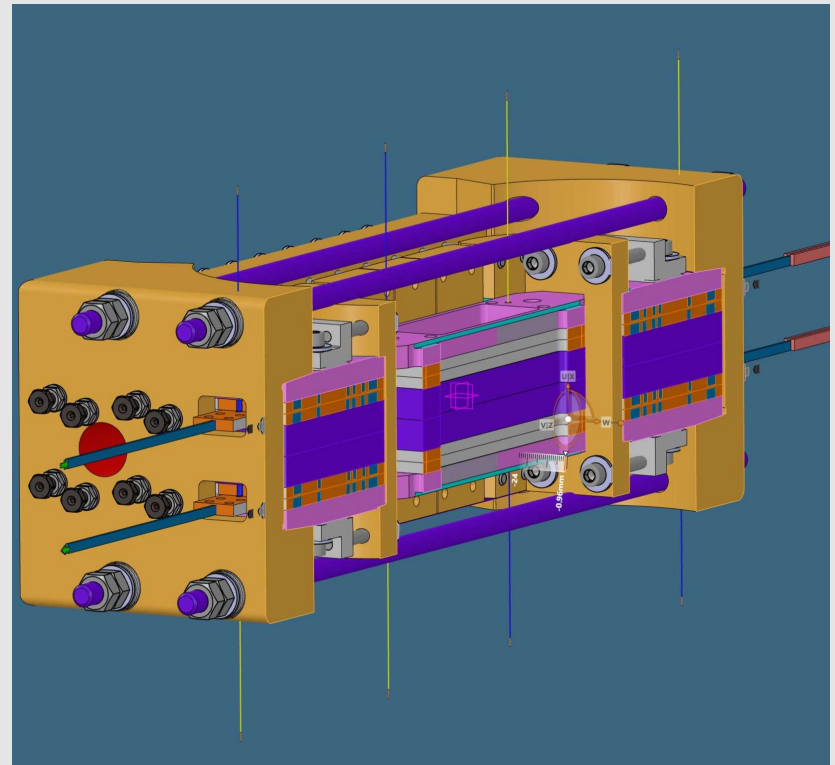
Closing magnet



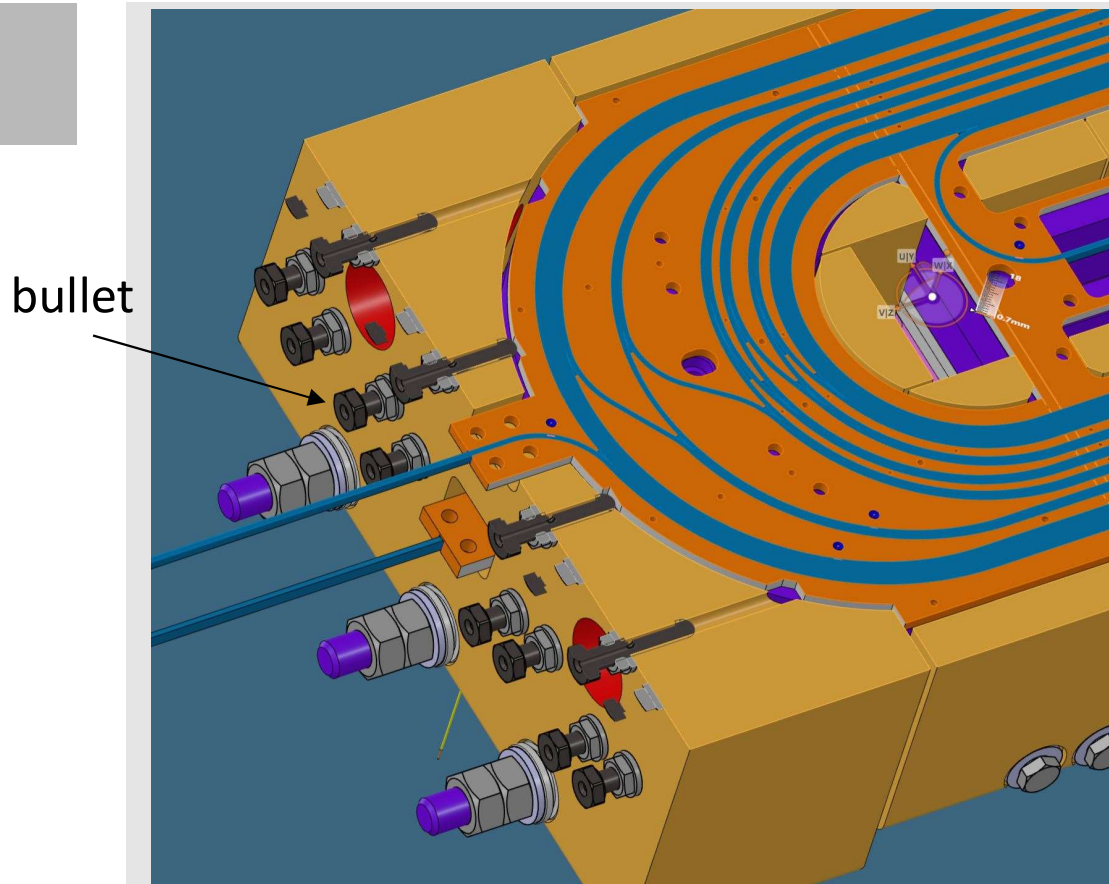
- Inner turn closing: M6 screws



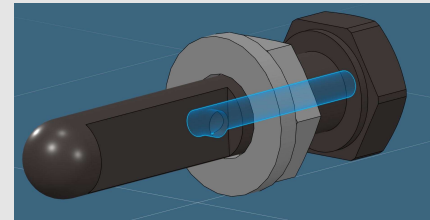
- Outer turn closing: M10 (Al) rods



Bullets



- 4 bullets with strain gauges (not shown) at each sides of coils



from M6 x 30

Wir schaffen Wissen – heute für morgen

