Technical Details of the T2K Horns

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NBI2006

My part in T2K

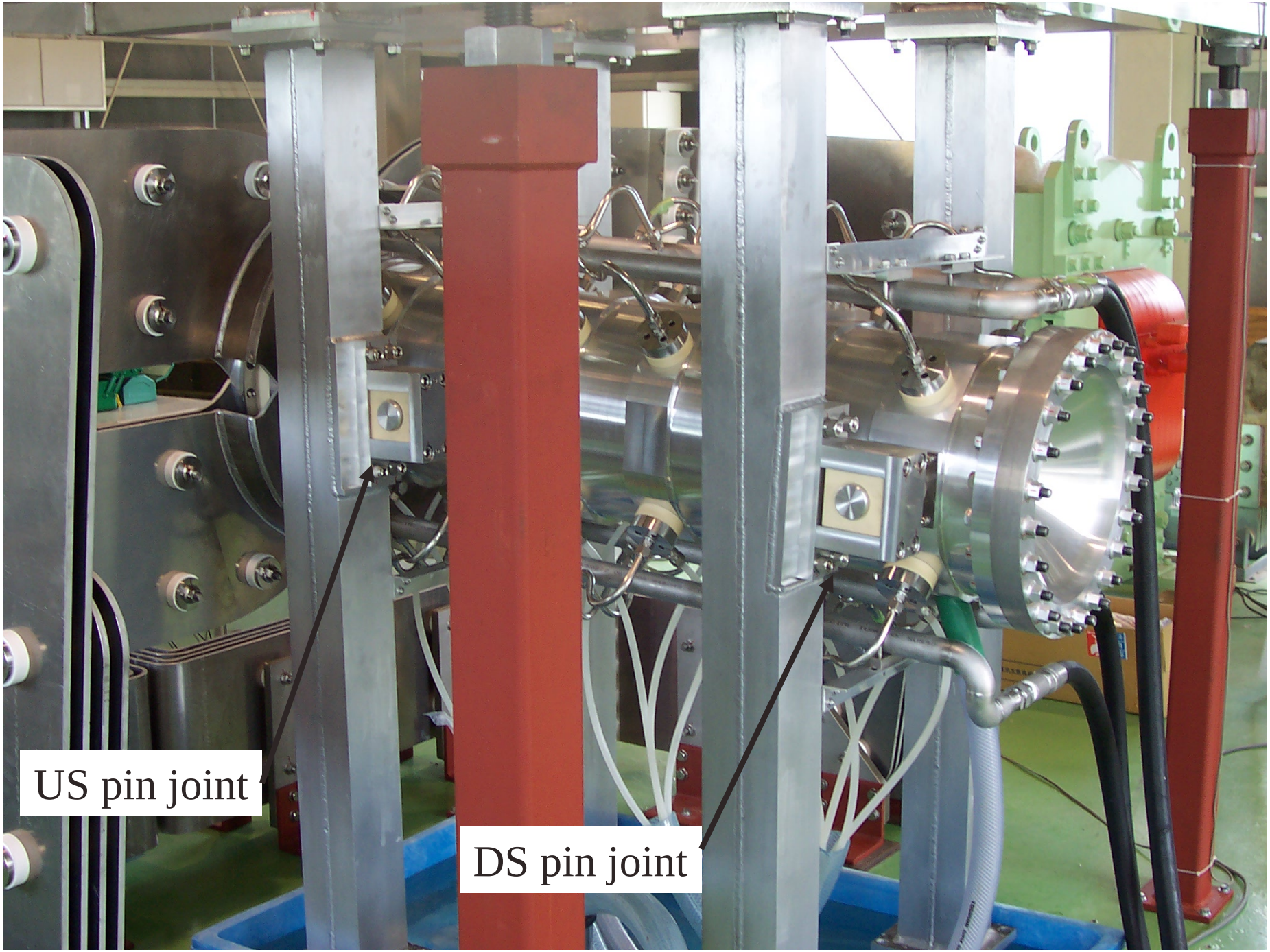
- I have been working with Ichikawa-san and the KEK group on horns 1 and 3
  - *I model the design in 3D (with much iteration with KEK group,) and Toshiba builds it*
- I am also working with Eric Zimmerman at CU to design and build horn 2
  - *Horn 2 is just now ramping up in effort*

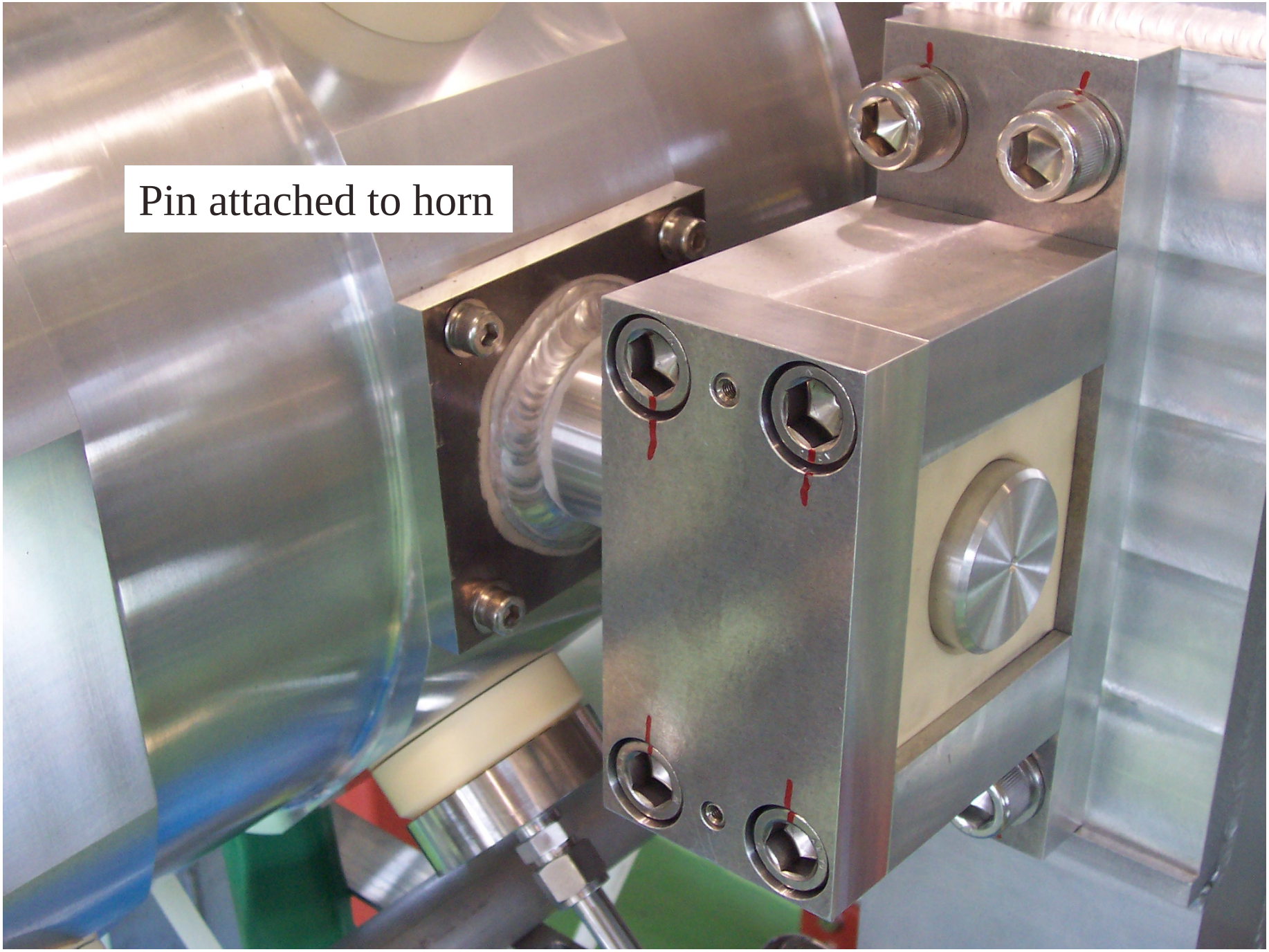
To be covered here:

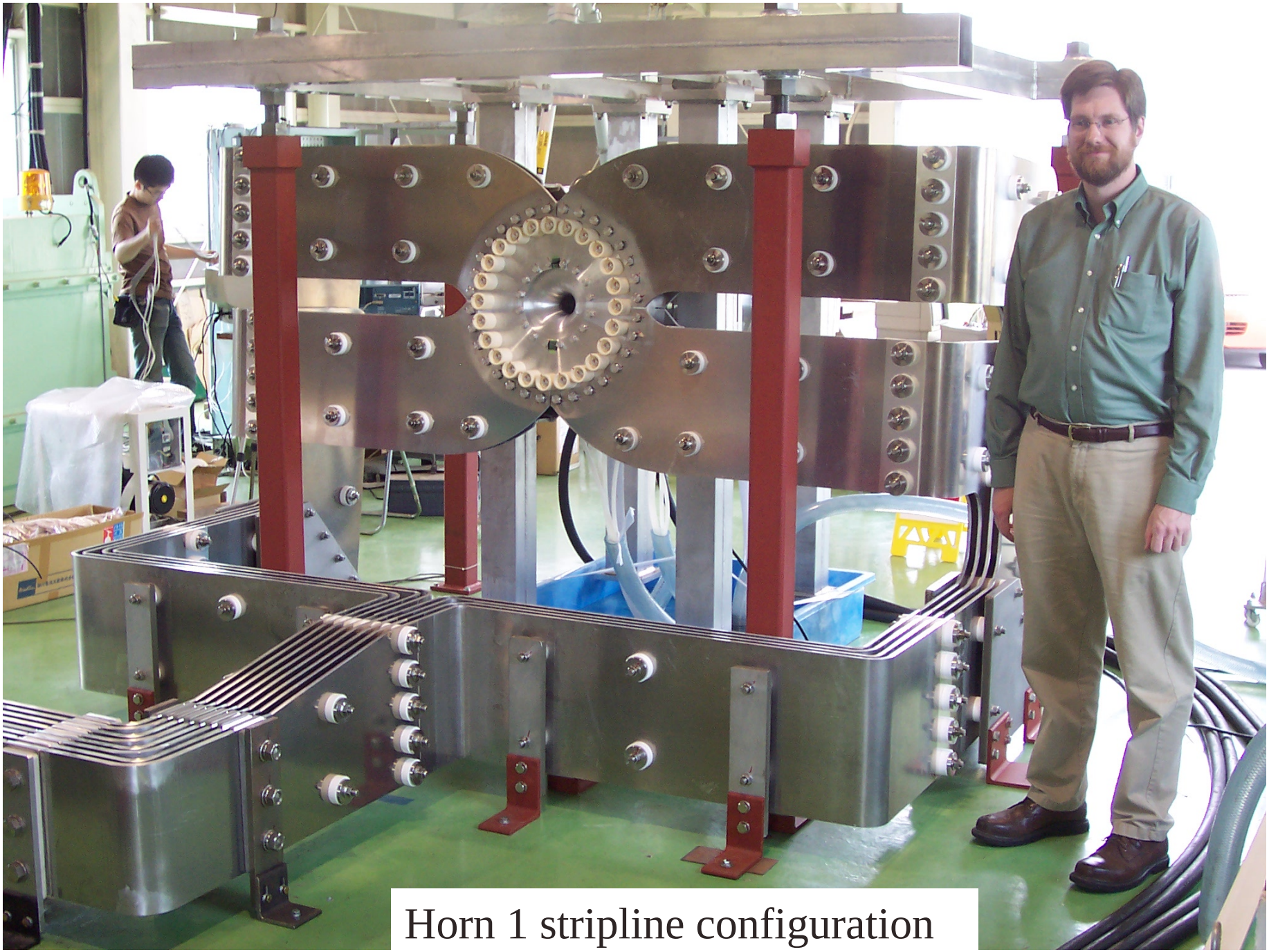
- Electrically isolated support that absorbs thermal expansion of the horn
- Details of stripline connections
- Design of a water connection between Stainless and Aluminum that prevents galvanic corrosion
- FSW welding in the US
  - *We might use this on horn 2*

Electrically isolated support

- Ceramic block electrically isolates the horn attachment to its support frame
- The upstream end is fixed in X,Y and Z (beam direction) with a pinned joint that allows rotation
- The downstream pin joint translates in Z as horn changes temperature

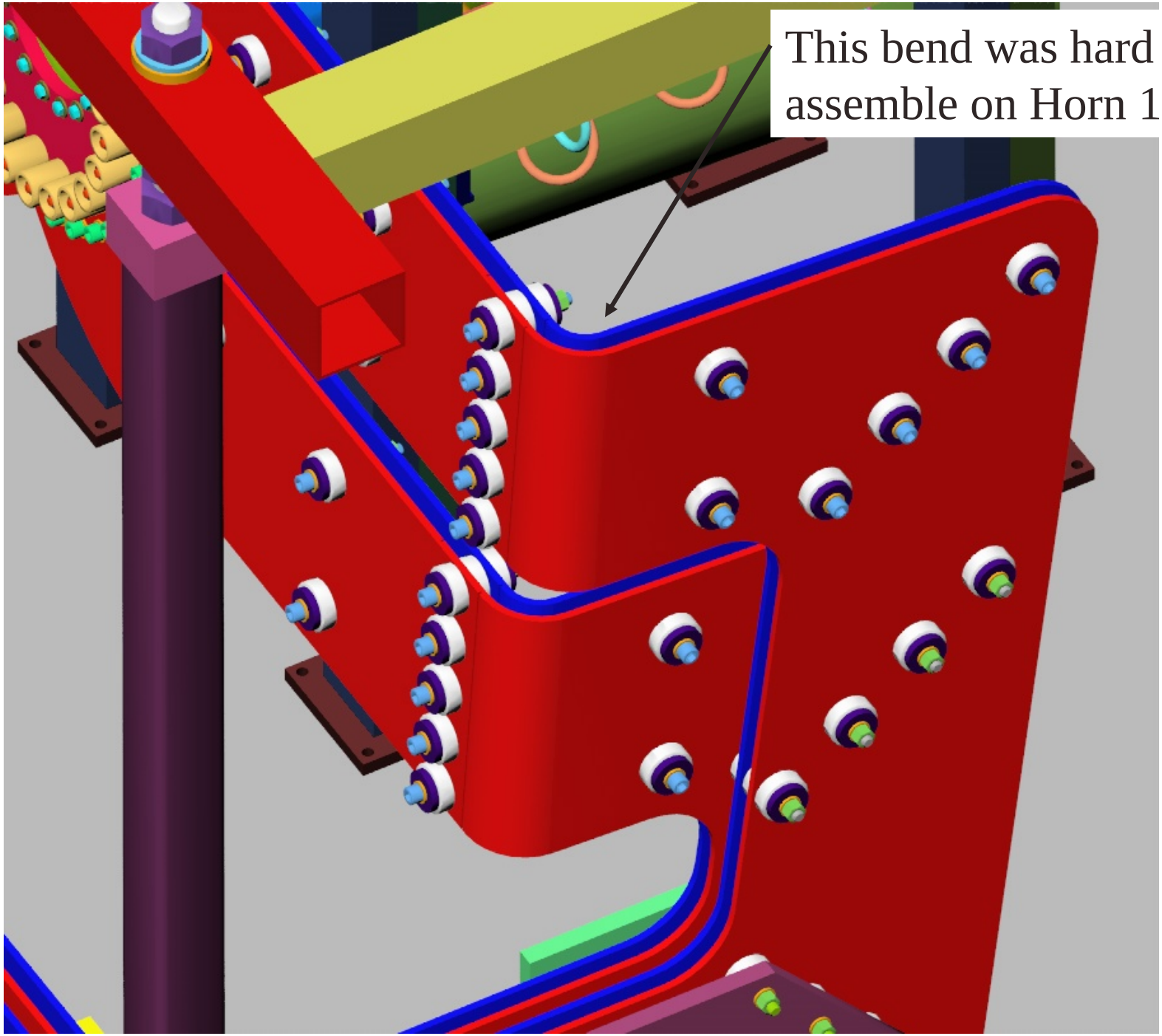

US pin joint
DS pin joint

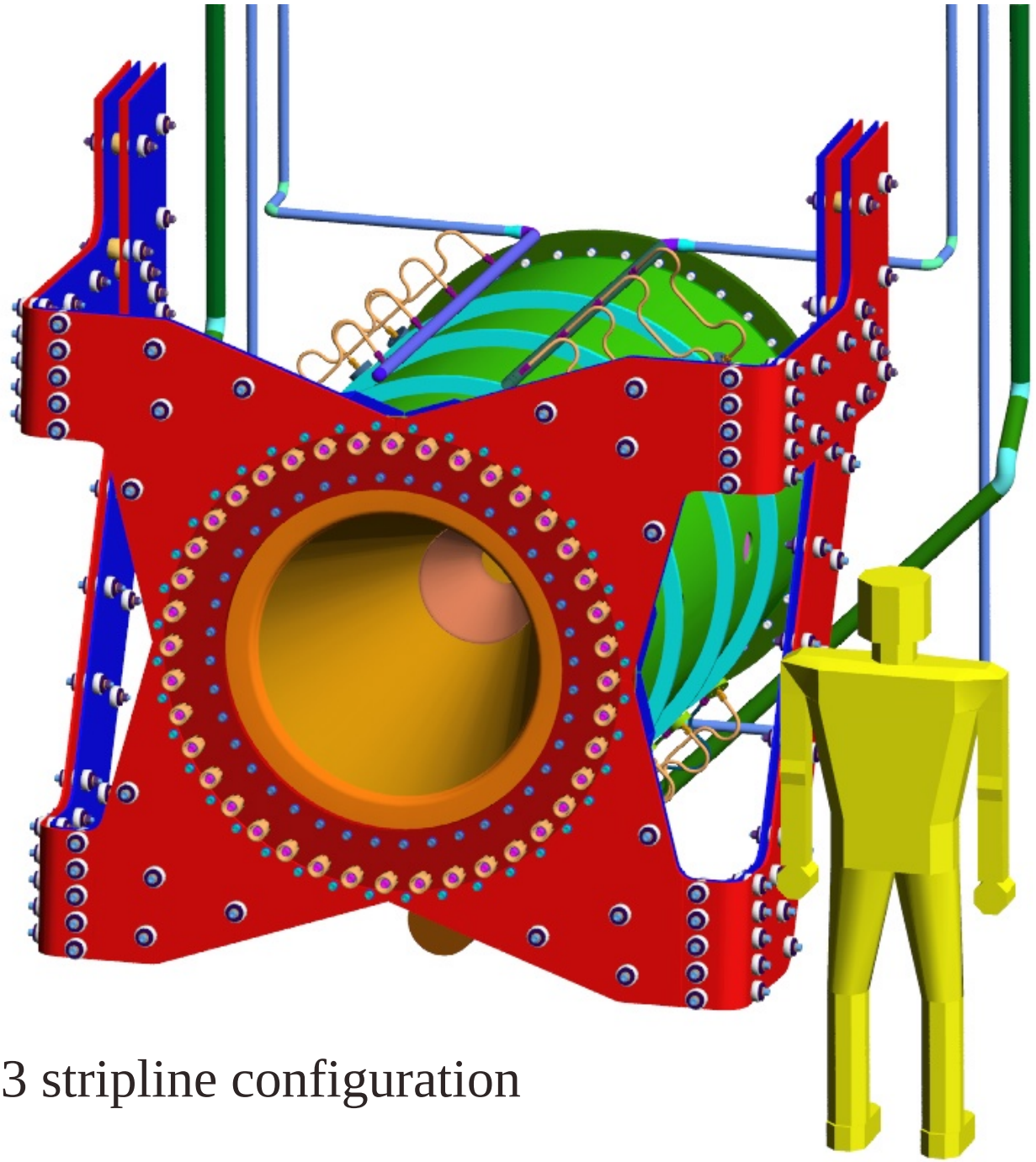

Pin attached to horn



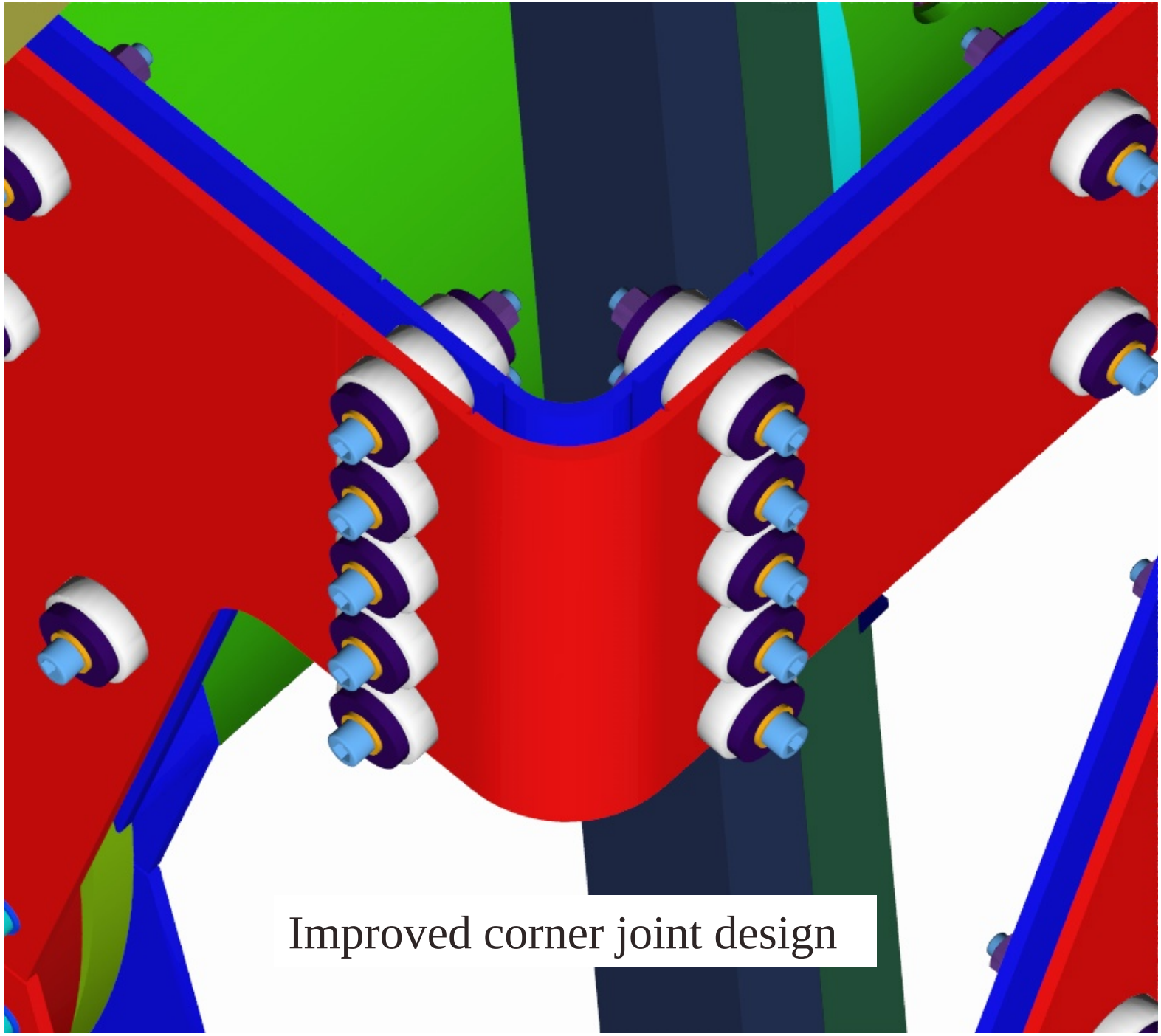
Horn 1 stripline configuration


Ceramic disks clamped by threaded rods
restrain Lorentz forces on stripline


This bend was hard to assemble on Horn 1

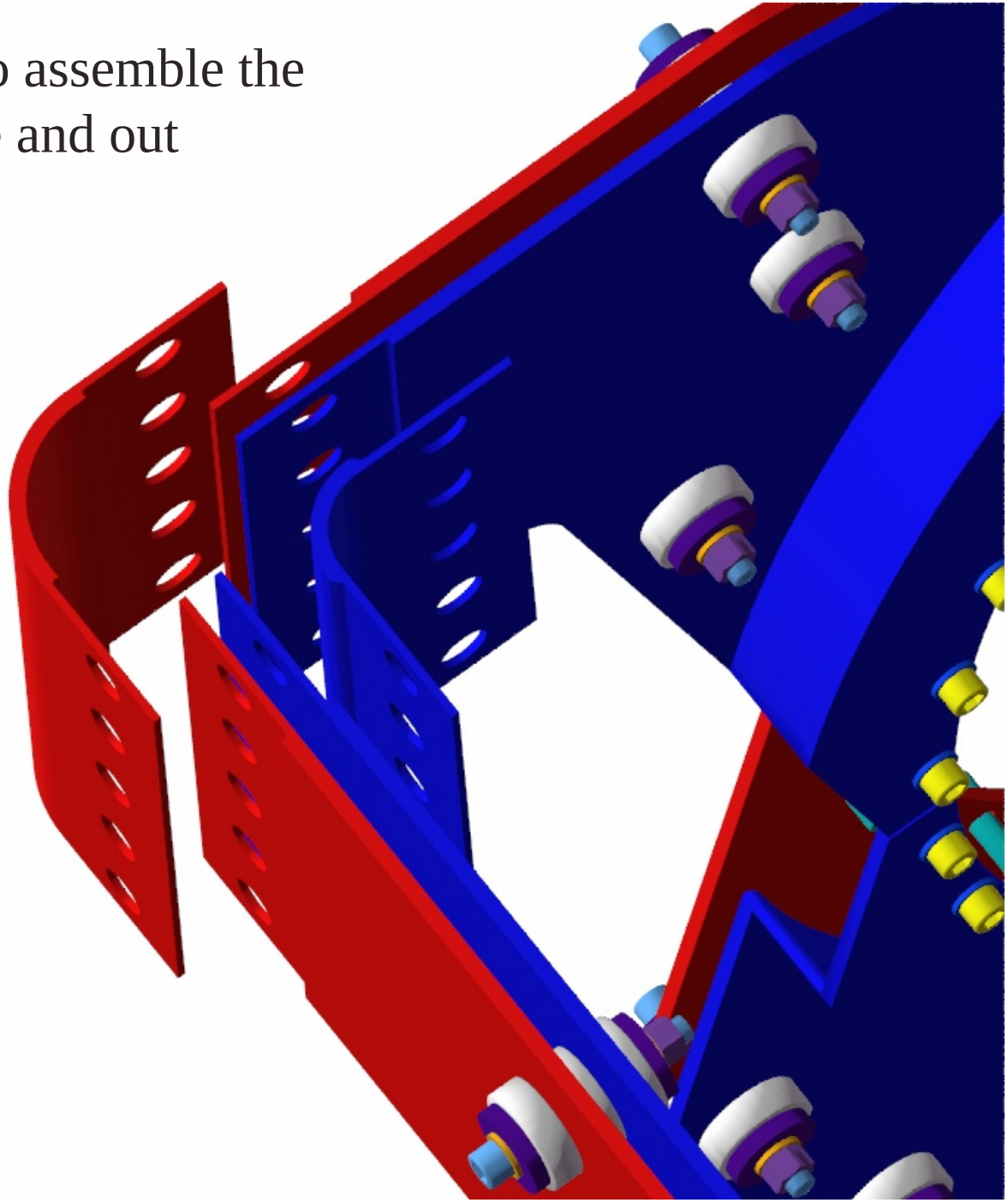


Horn 3 stripline configuration

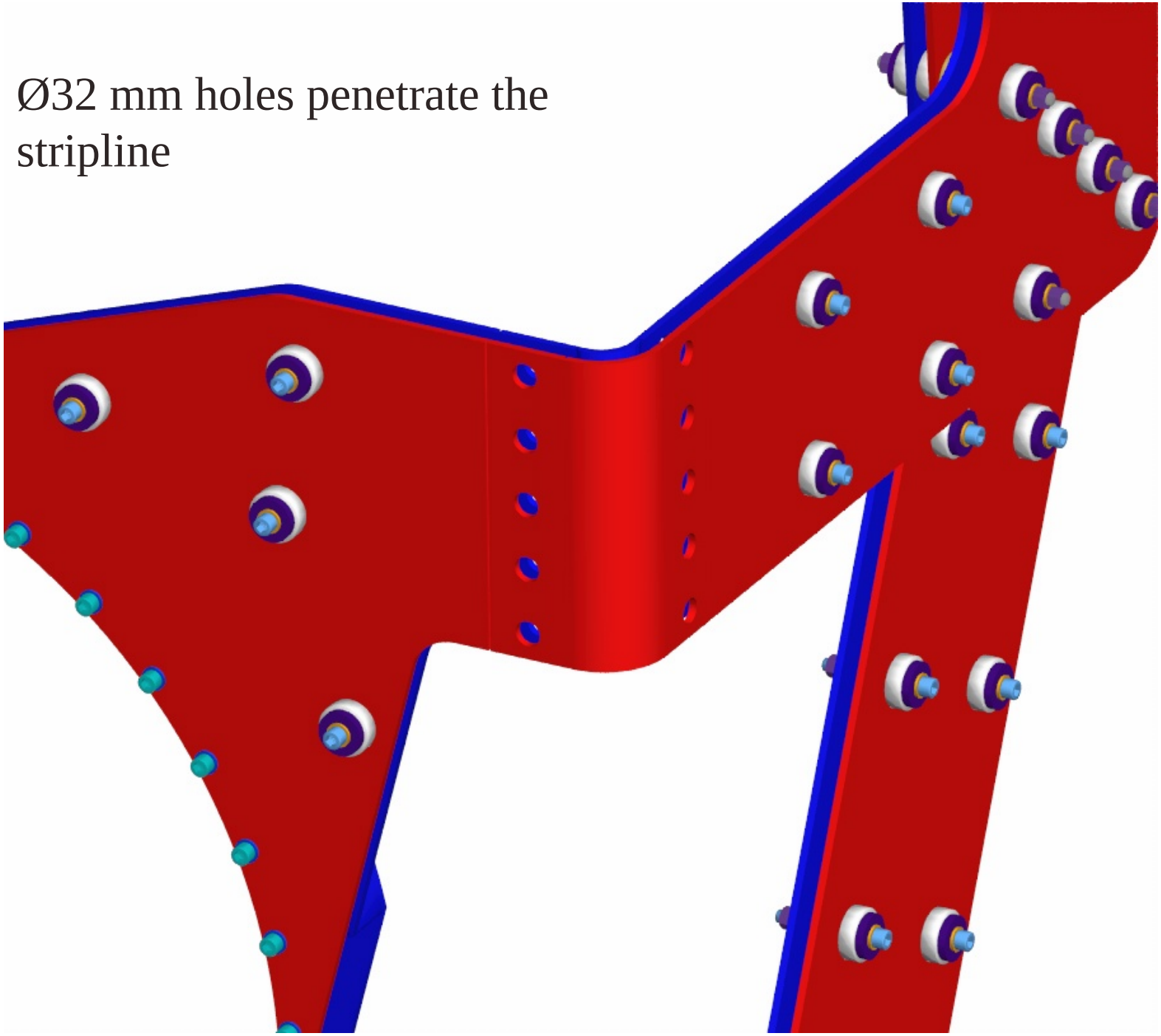


Improved corner joint design

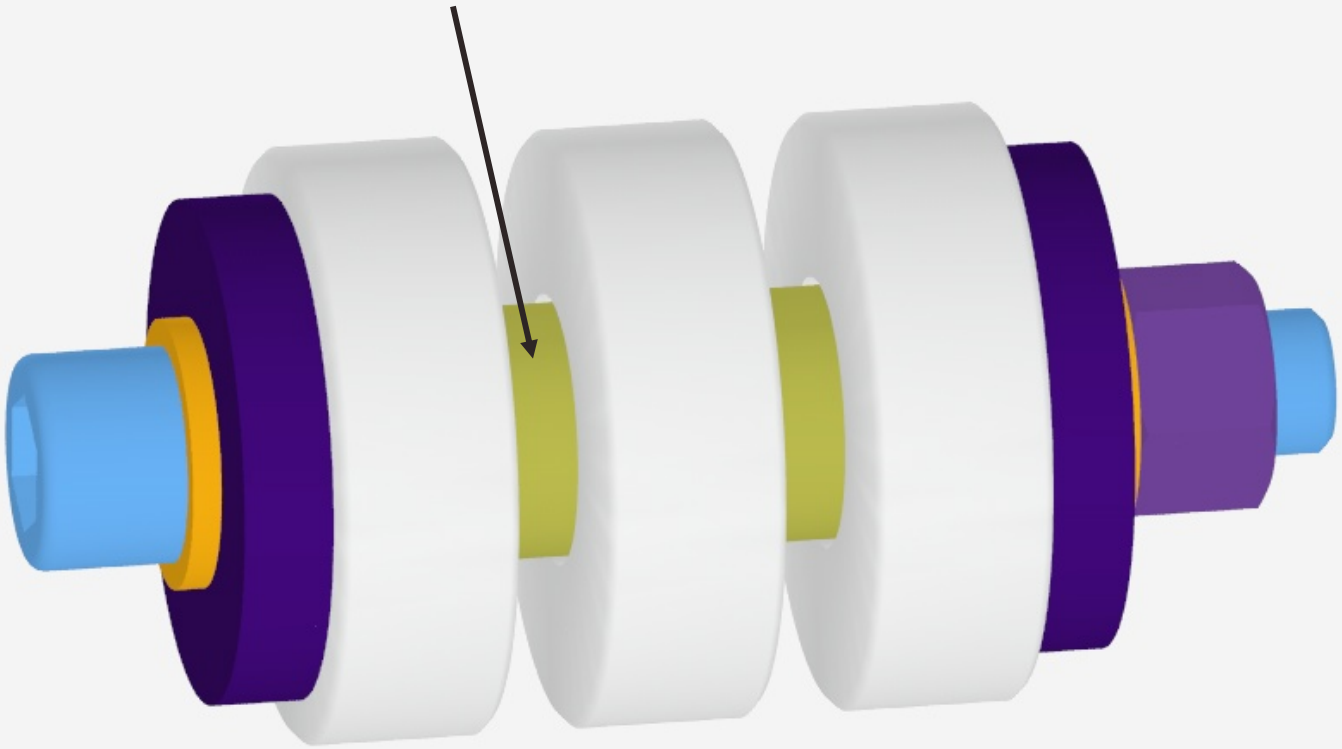
Will be possible to assemble the corner from inside and out



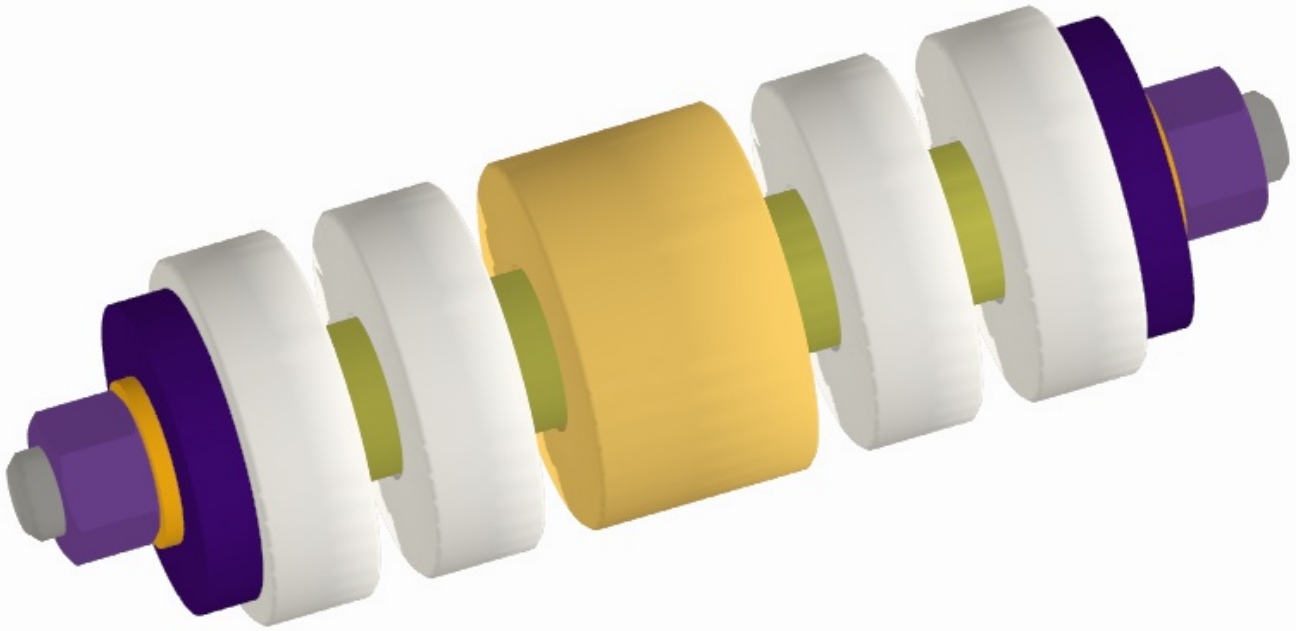
Ø32 mm holes penetrate the stripline



Ceramic sleeve isolates the
threaded rod from the SL plates

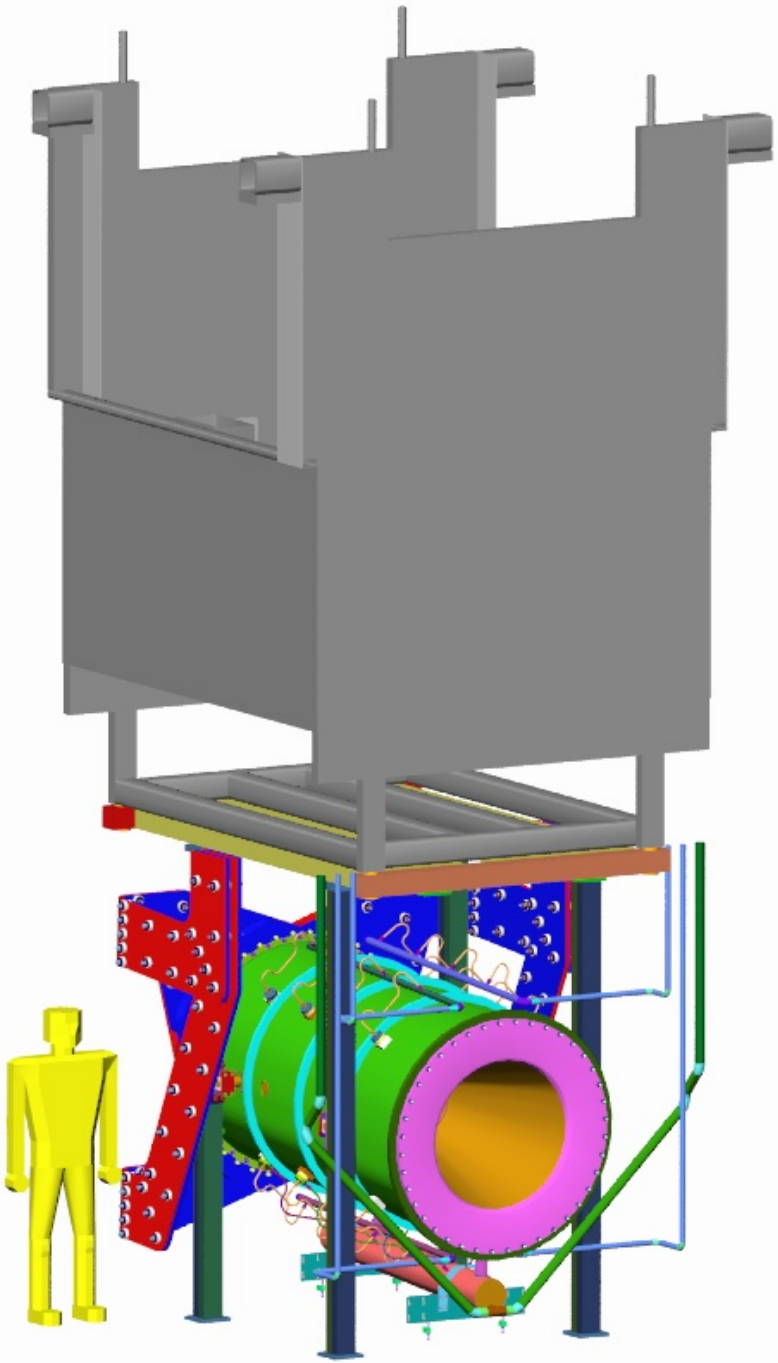


Clamp for 4 plates just below the remote disconnect showing the larger gap

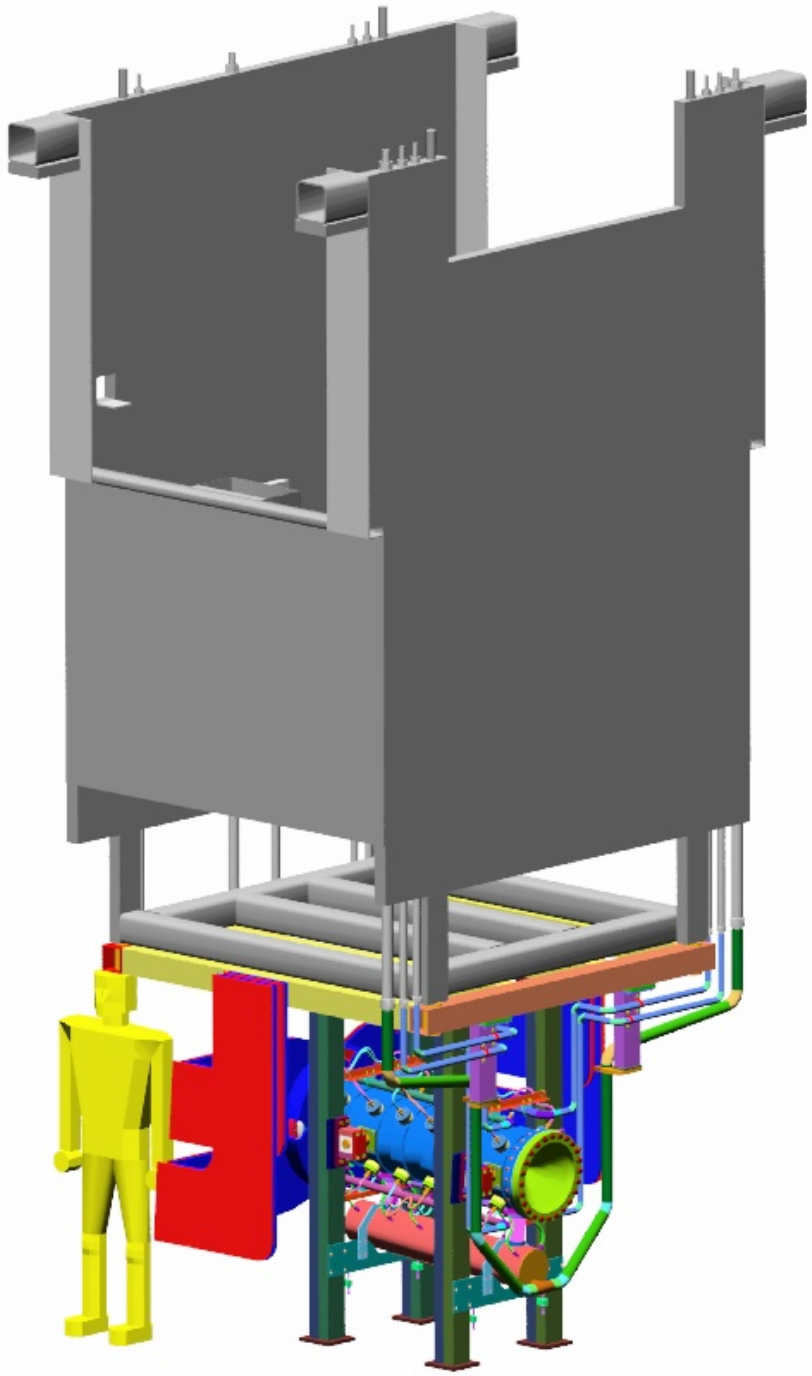


How are disks inserted?

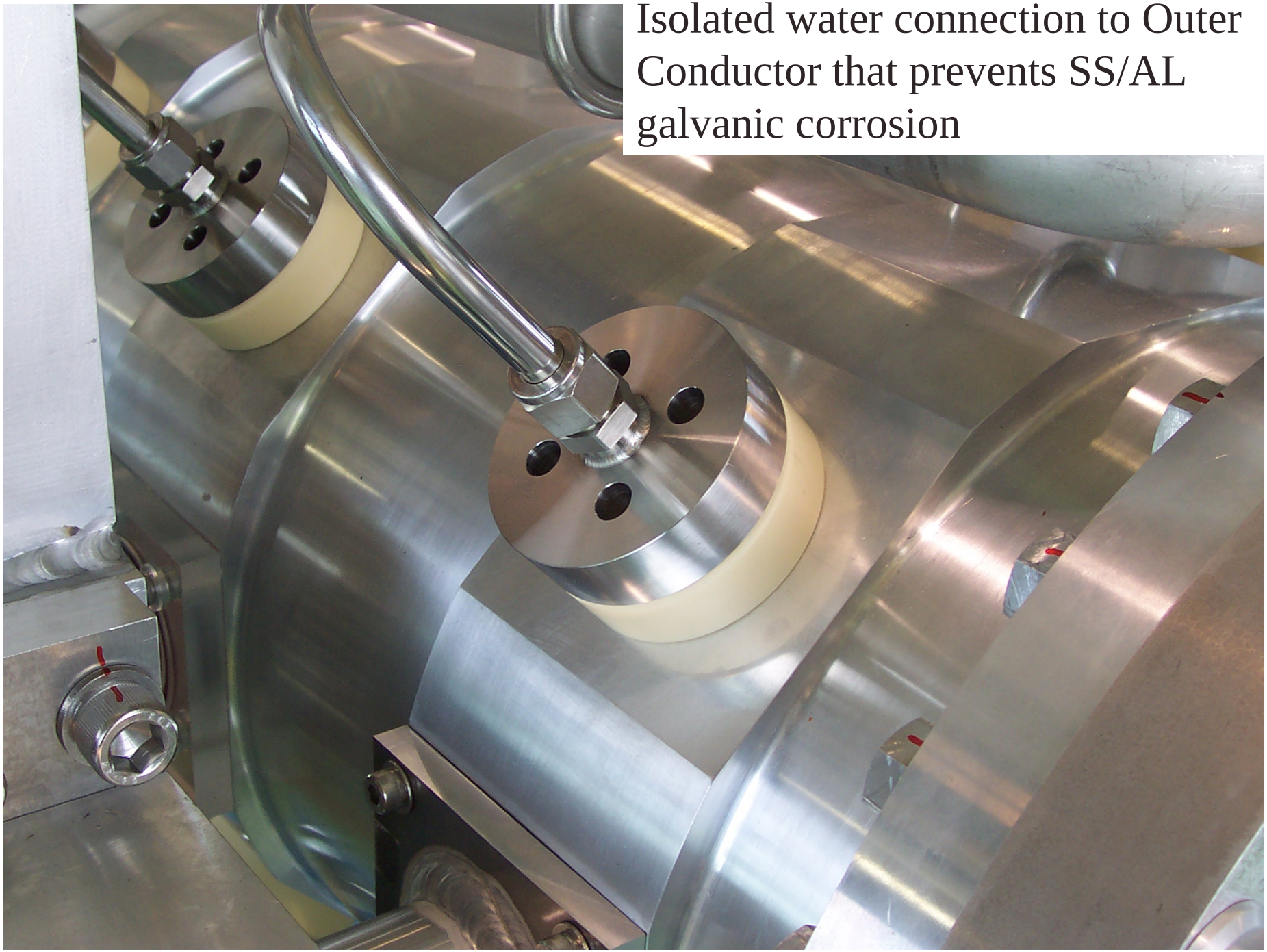
Draft of Horn 3
on its module

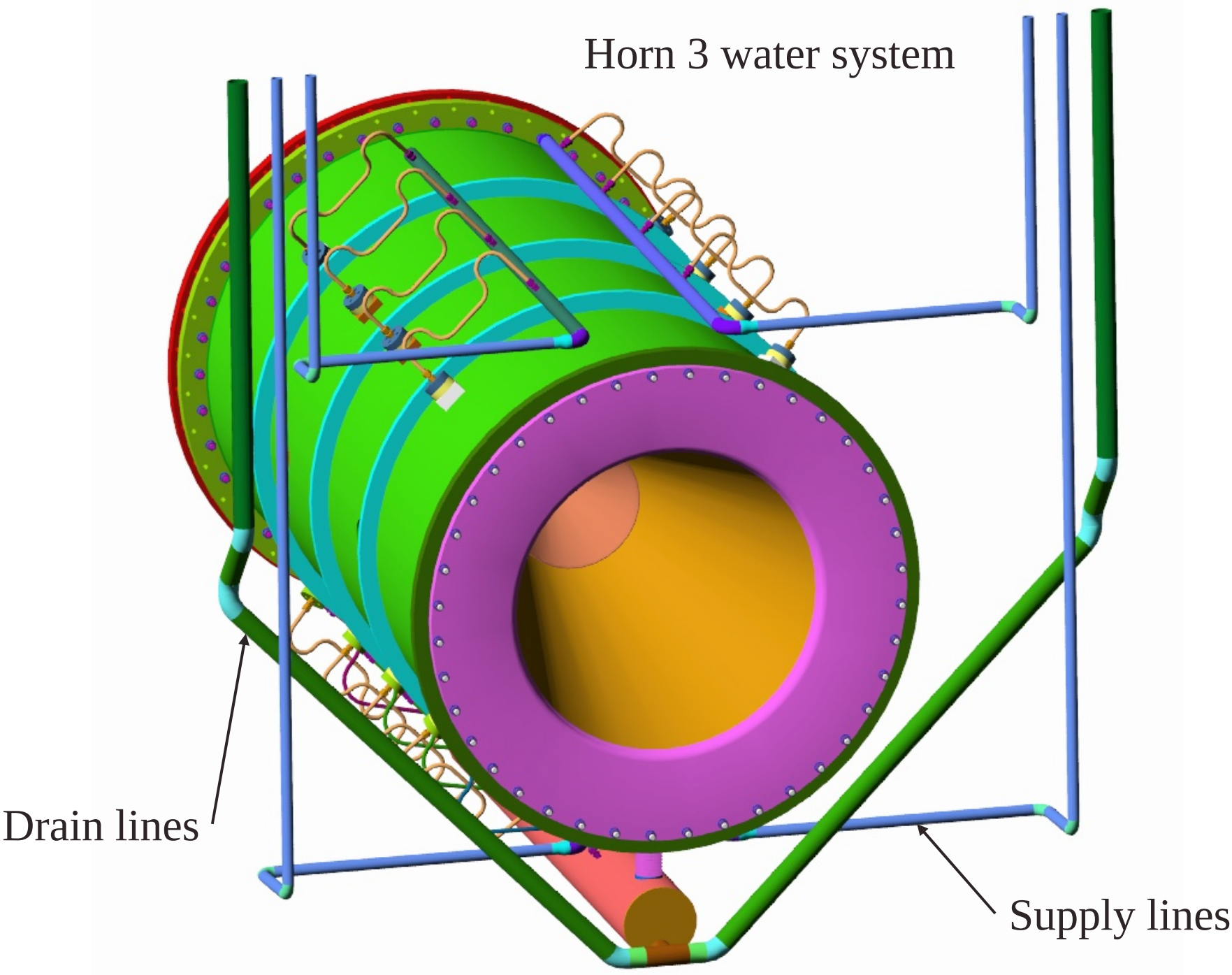


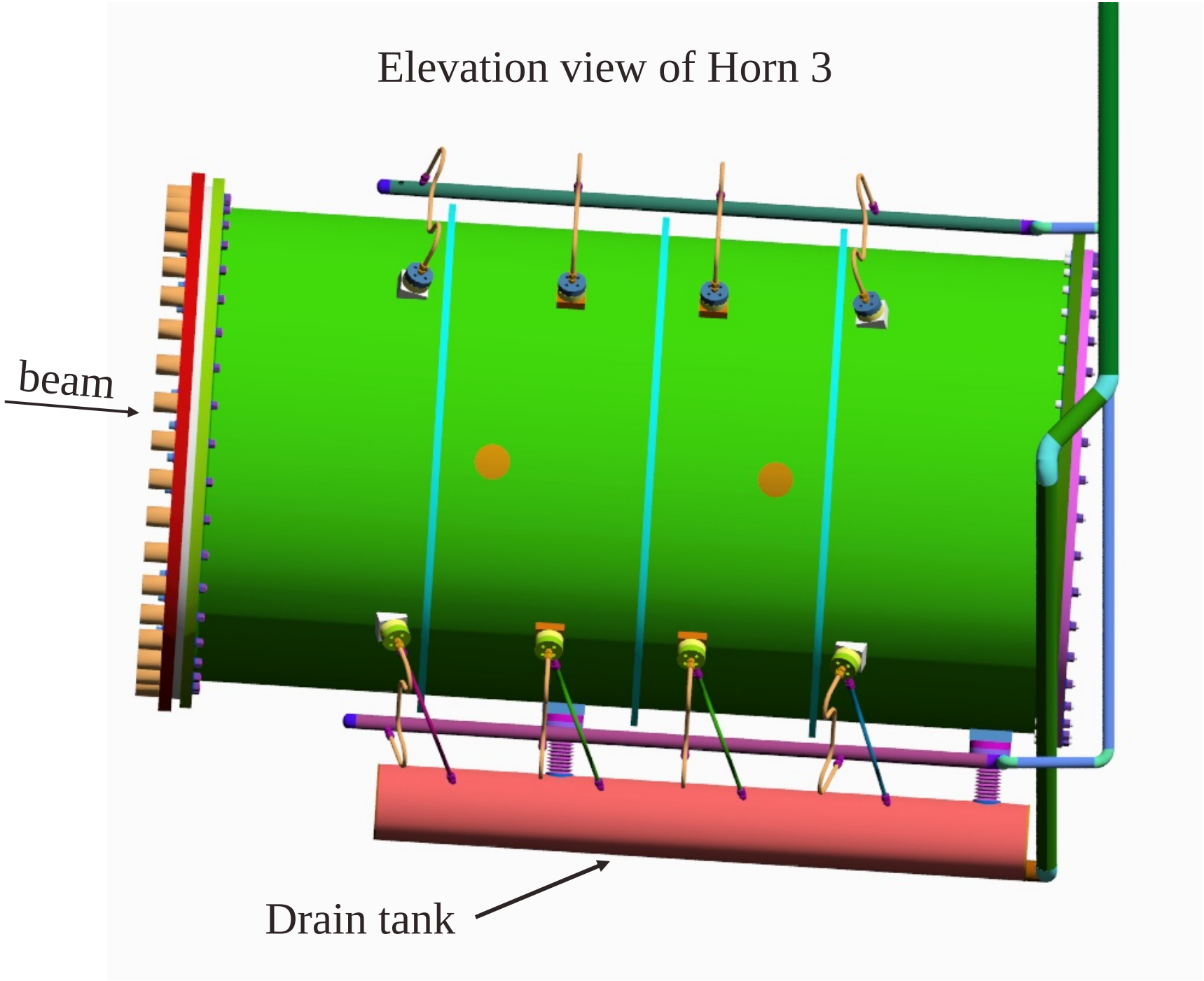
Draft of horn 1
on its module

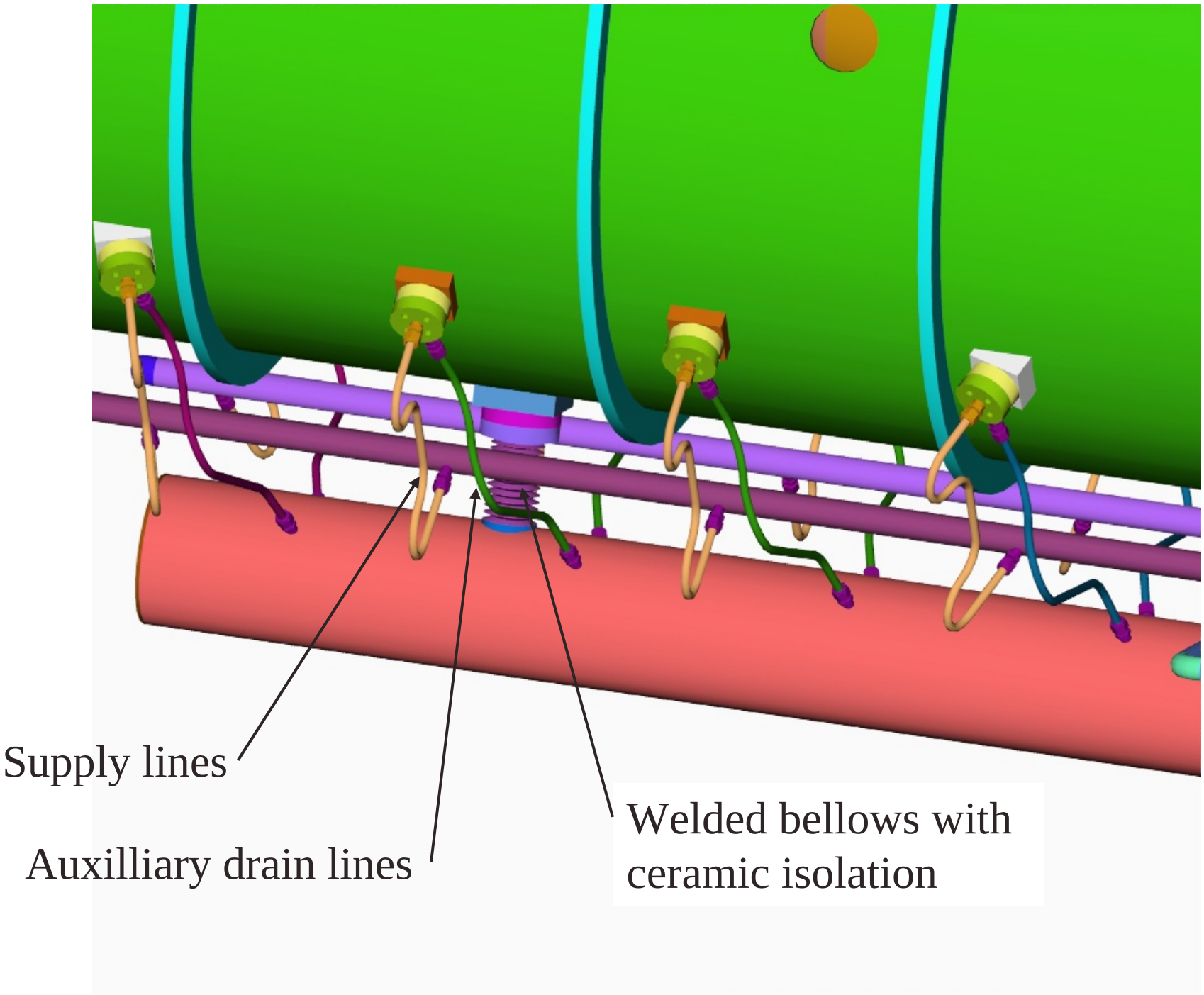


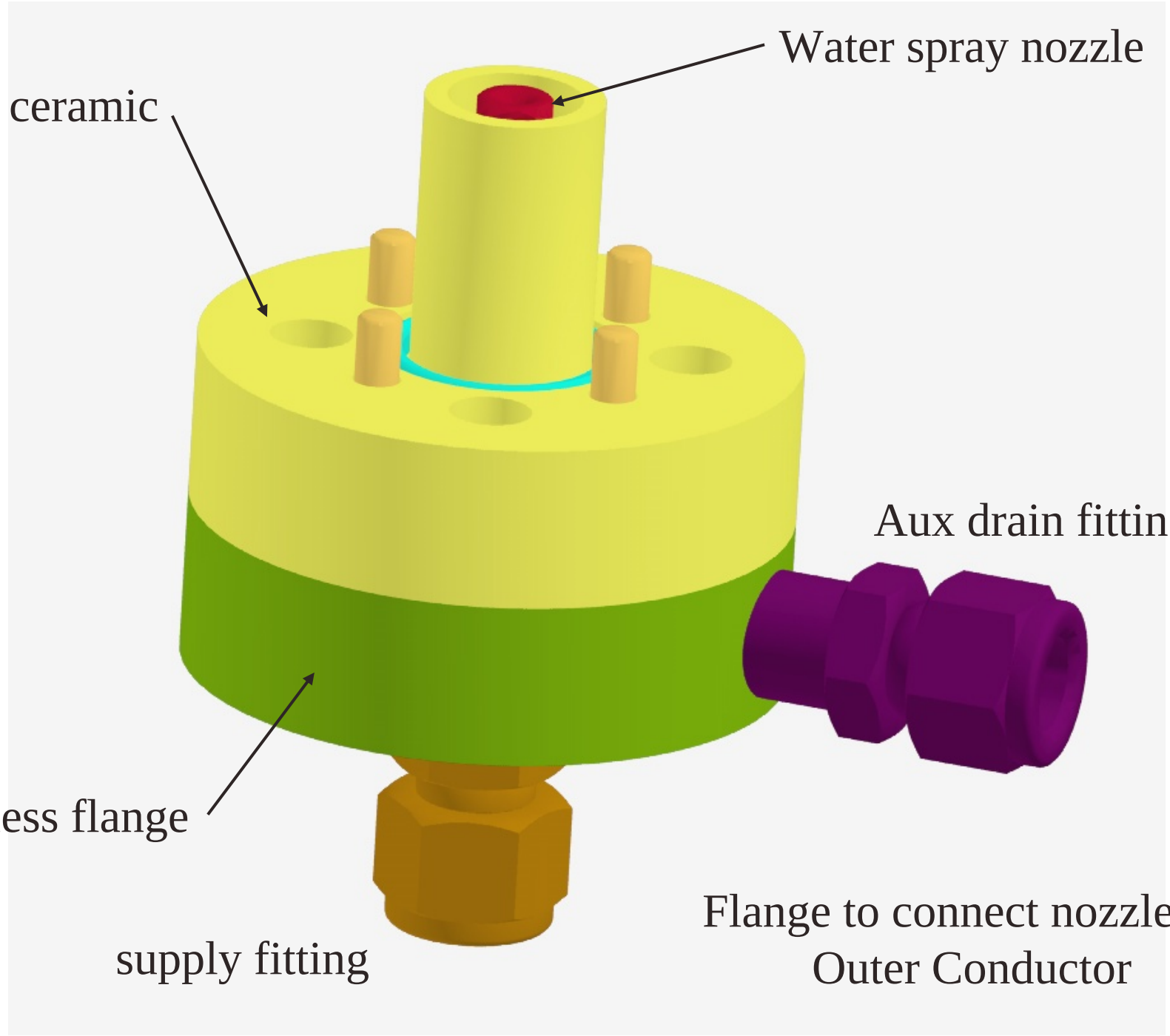
Isolated water connection to Outer Conductor that prevents SS/AL galvanic corrosion



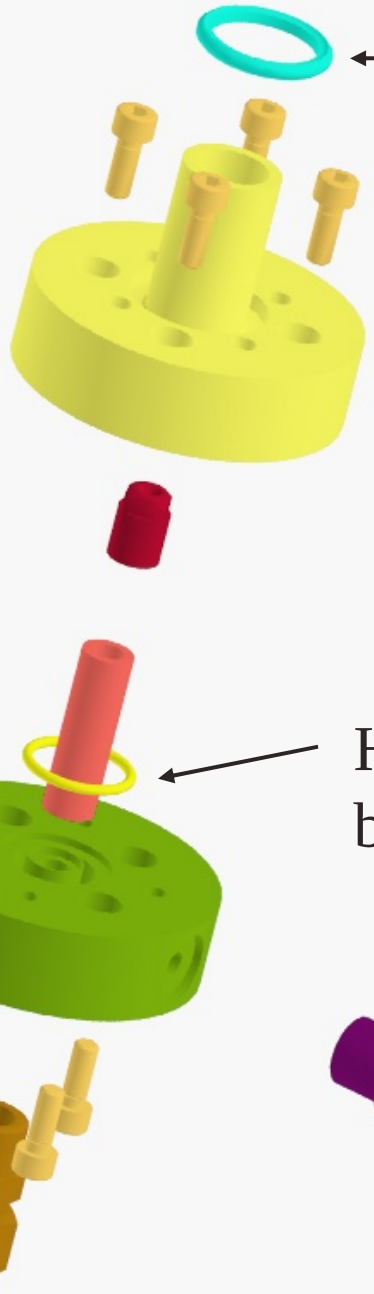

Horn 3 water system
Drain lines
Supply lines


Elevation view of Horn 3
beam
Drain tank


Supply lines
Auxilliary drain lines
Welded bellows with ceramic isolation


Water spray nozzle
ceramic
Aux drain fitting
Stainless flange
supply fitting
Flange to connect nozzles to
Outer Conductor

Exploded view of connection

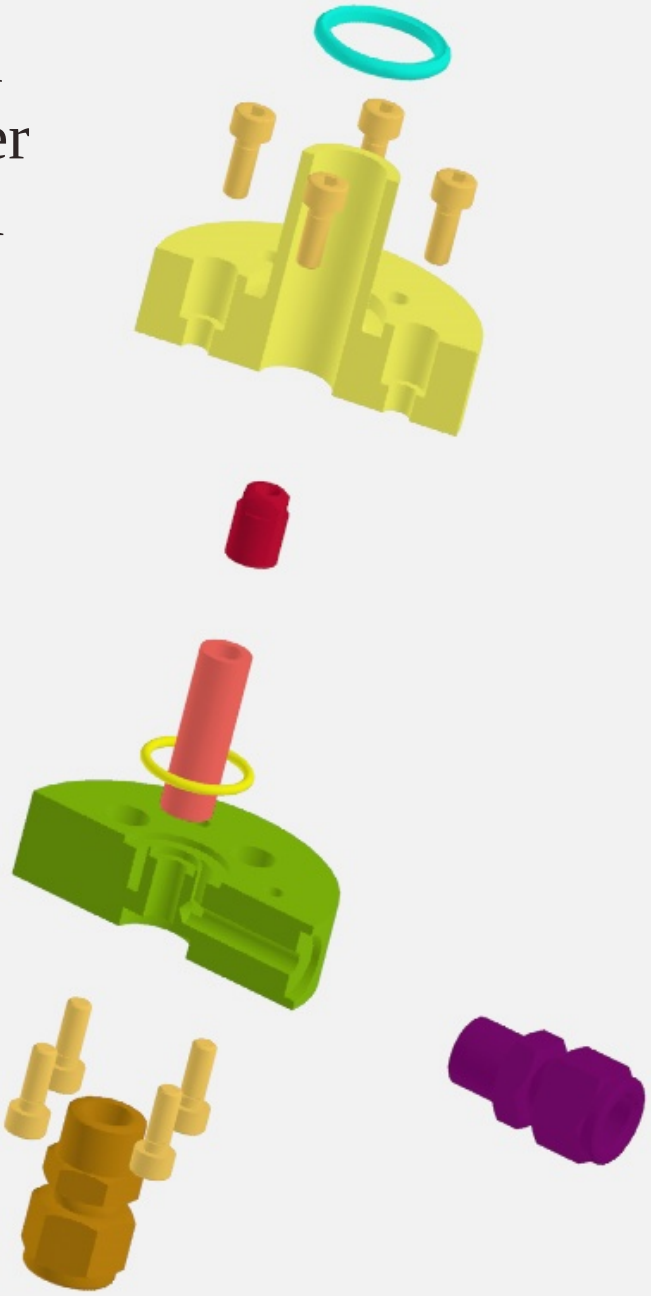


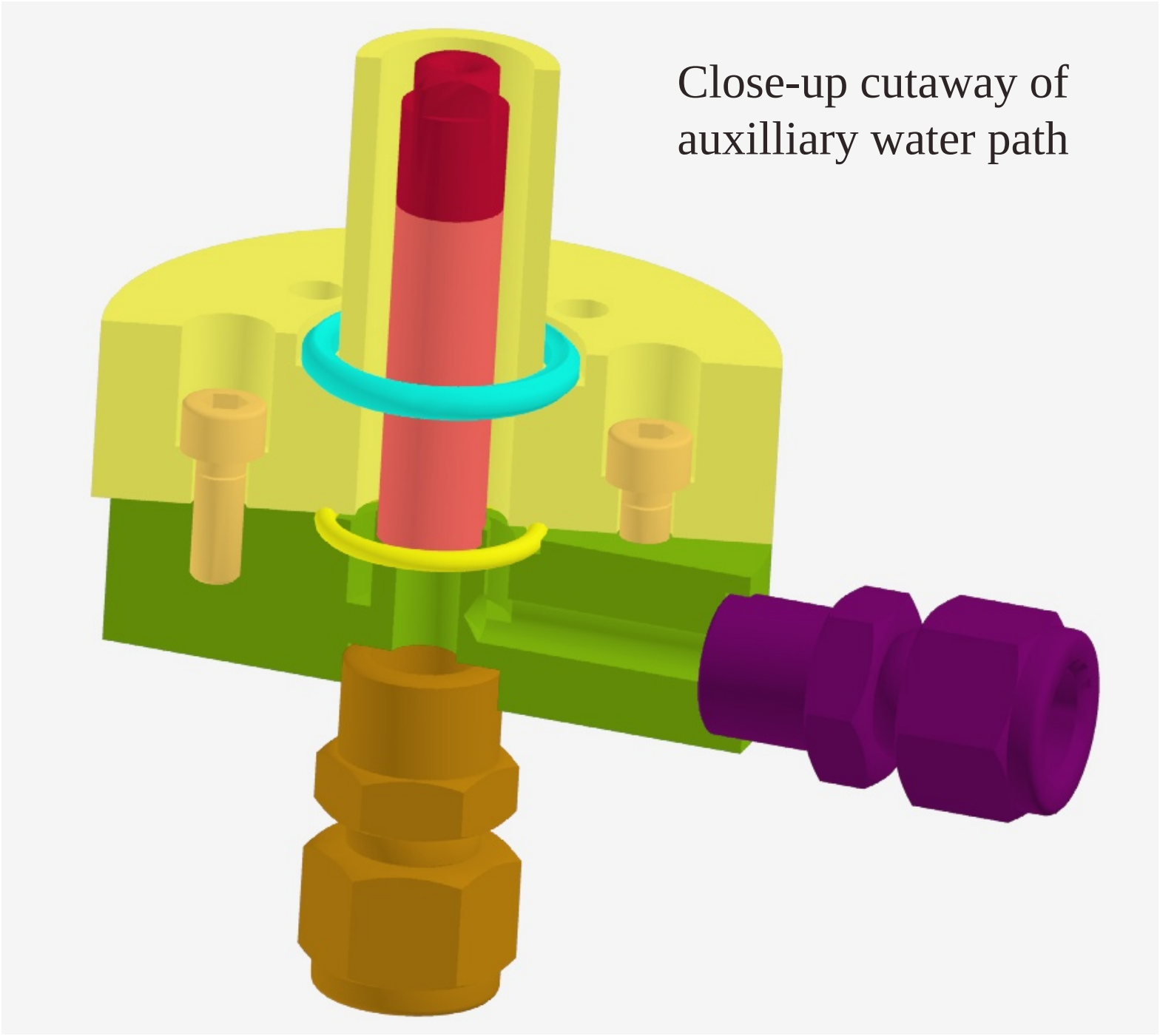
EVAC NW25 Al seal between ceramic and horn Al

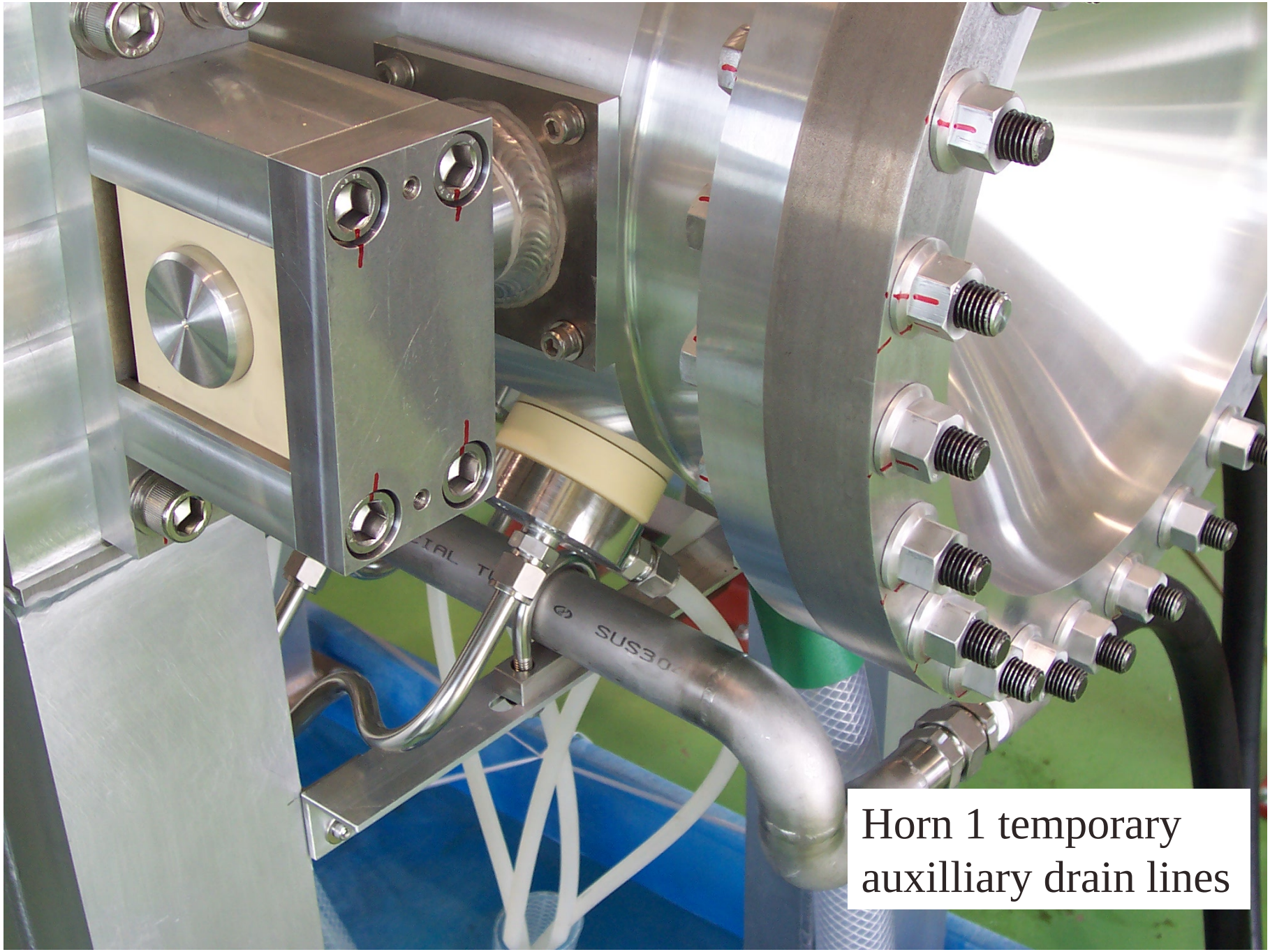
Tapping is done in SS flange and Al outer conductor, only counterbores in ceramic

Helicoflex SS seal between SS and ceramic

Cutaway Exploded view showing water routing channels in flange




Close-up cutaway of
auxilliary water path

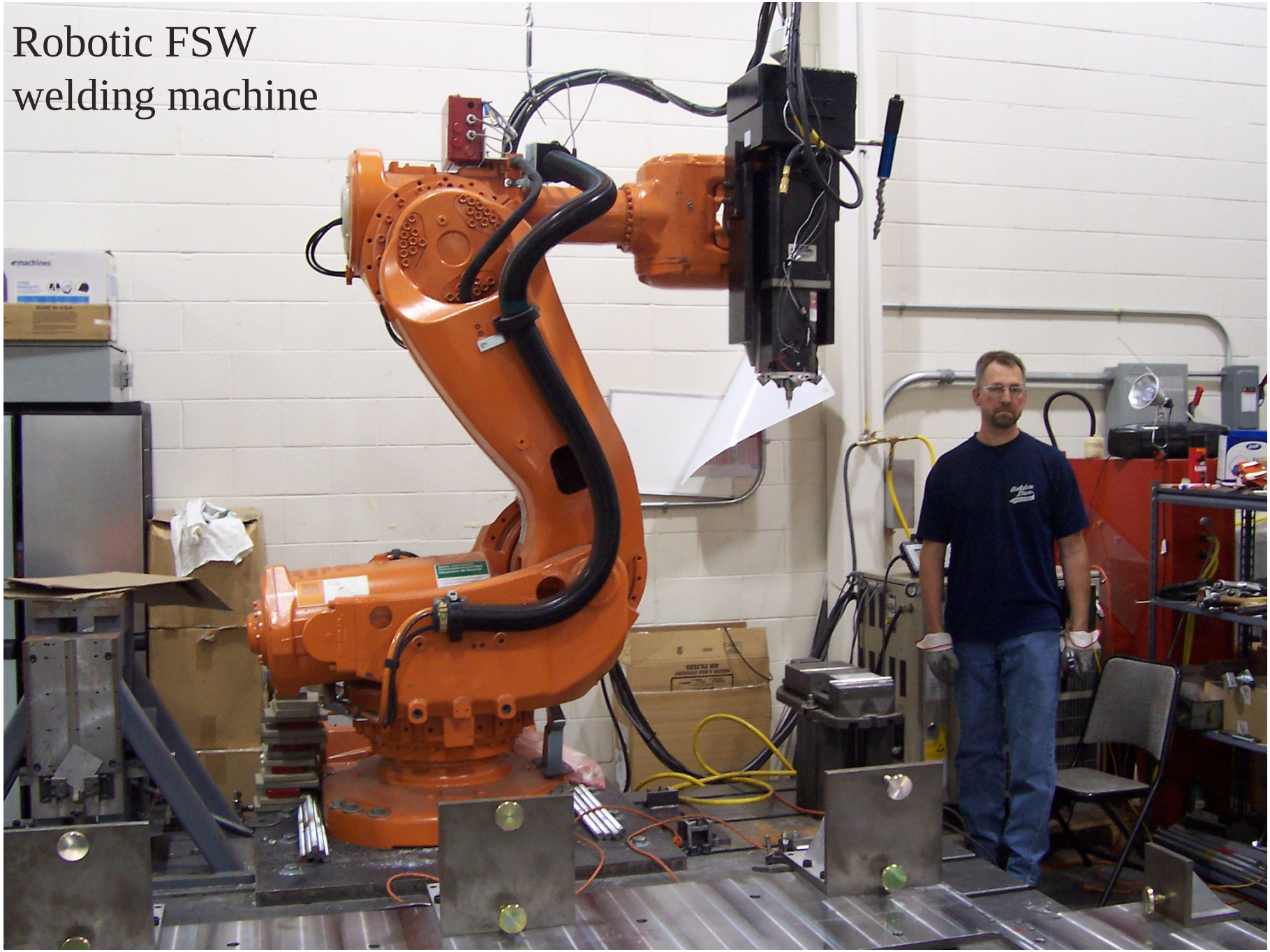


Horn 1 temporary auxilliary drain lines

FSW welding

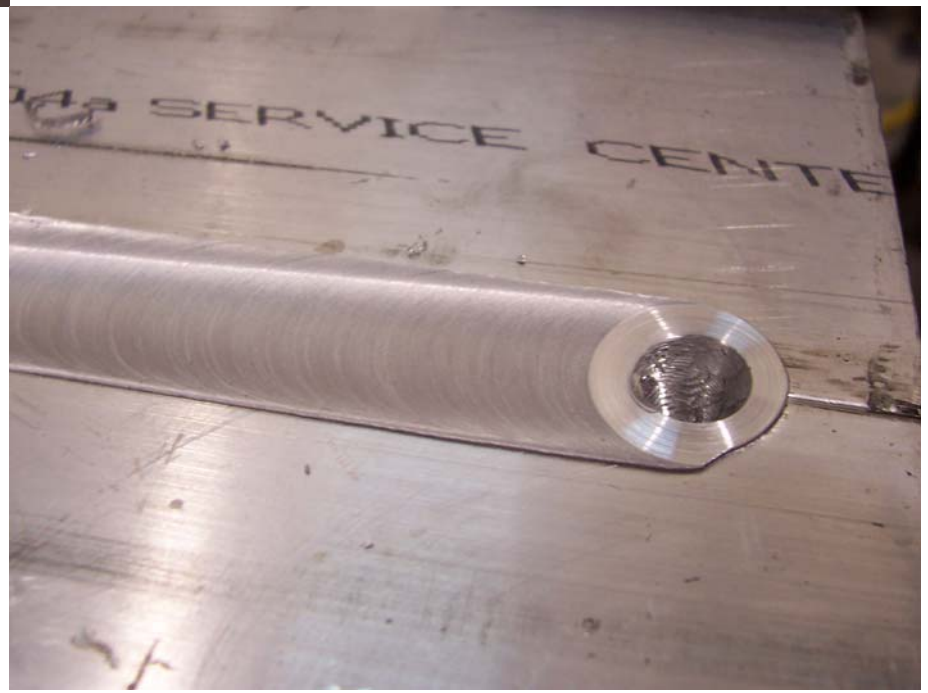
- Friction Stir welding produces welds with higher fatigue strength than TIG welding
- The Japanese are ahead of the US in commercializing the Friction Stir Welding process
- Friction Stir Link, Inc, a new company in WI offers robotic FSW for tube welding
  - *This is great news for the horn 2 effort!*
  - *Now we have an alternative to welding at FNAL*

Robotic FSW
welding machine



Entry point of FSW tool
on test weld

Exit point of FSW tool




Huuuuunnnnnhhhhh? Whhaaaattt?
立入禁止
DO NOT ENTER