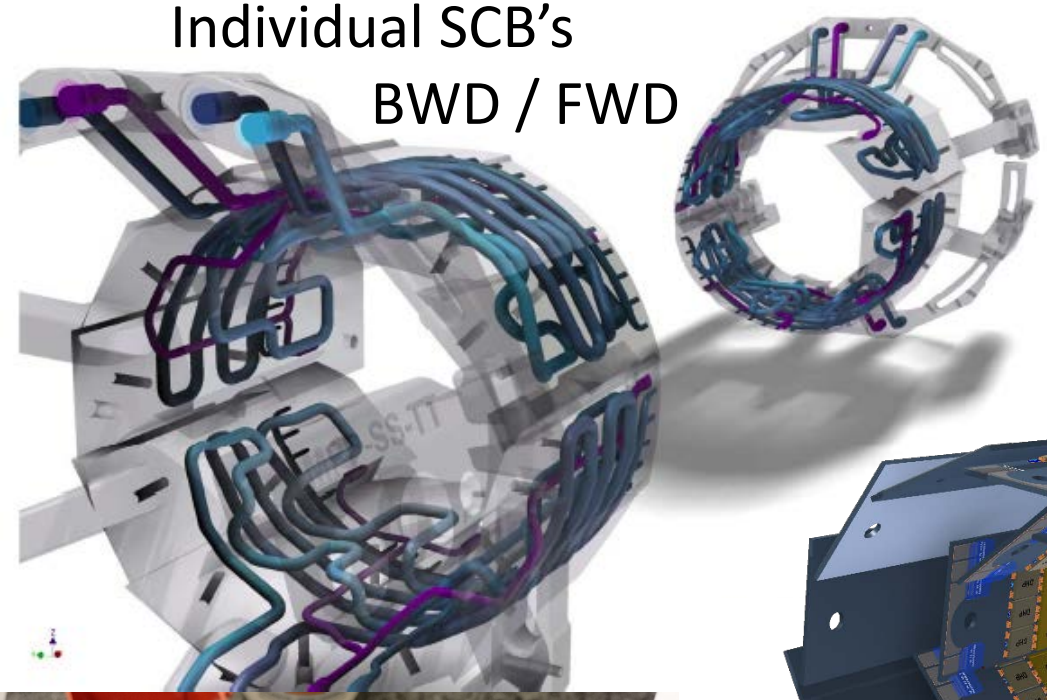
PXD-Mechanics:

SCB Half Shell
Ladder Mounting
PXD Assembly

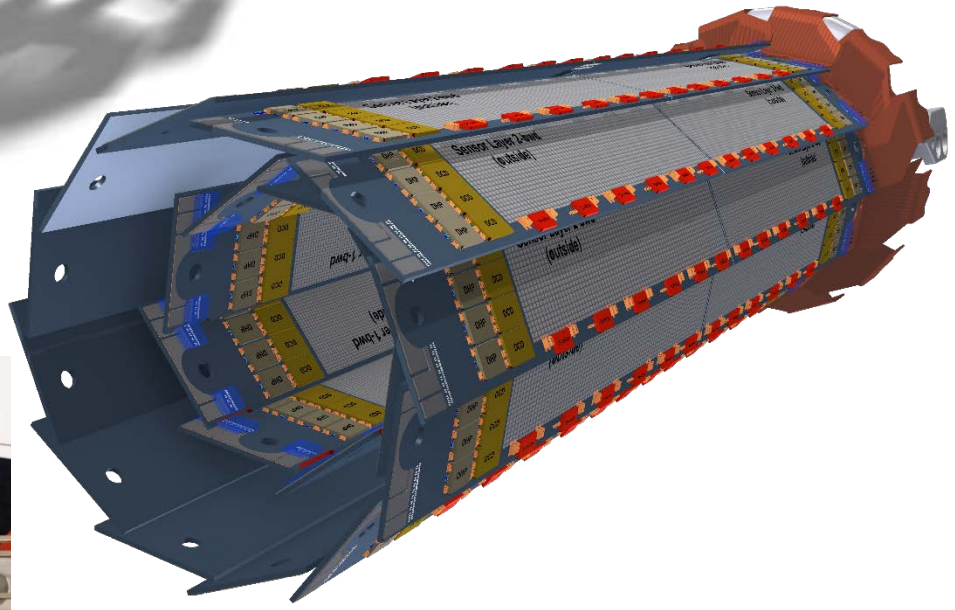
Tscharlie Ackermann, CK

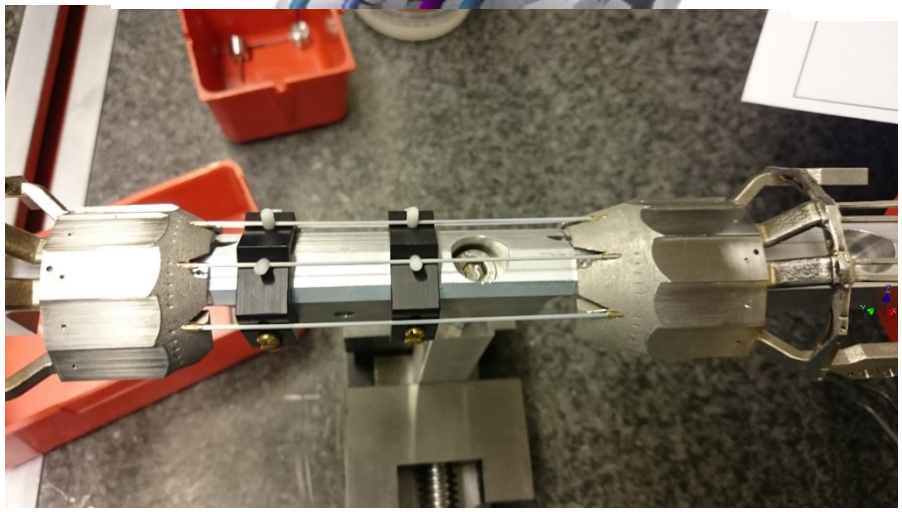
Ladder Mounting: Overview

Individual SCB's
BWD / FWD



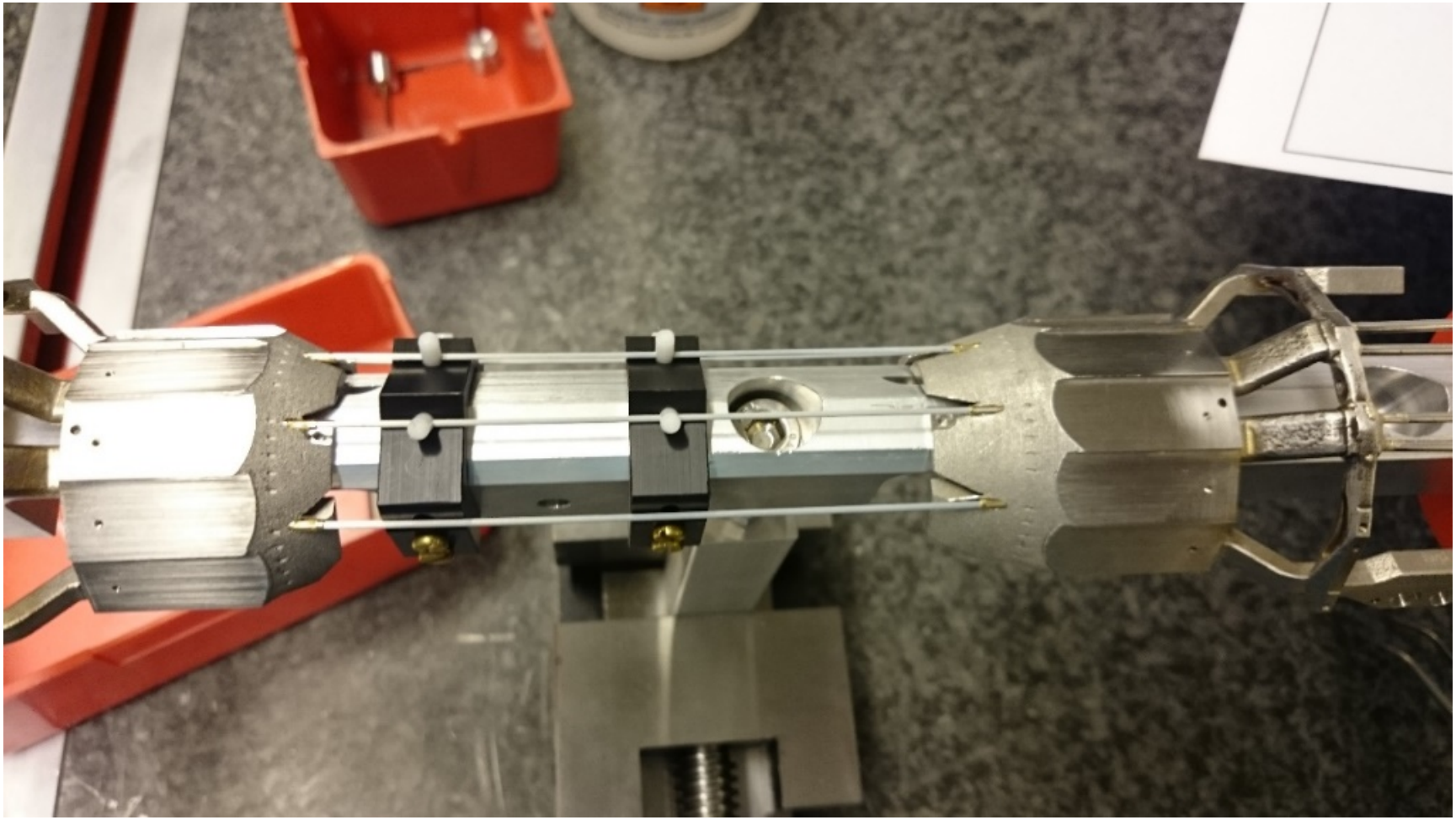
40 modules glued to
20 ladders
(8 inner, 12 outer)
L1 L2





SCB Half Shell (SCB-HS) prepared for the ladder mount
[SCB: Support and Cooling Block]

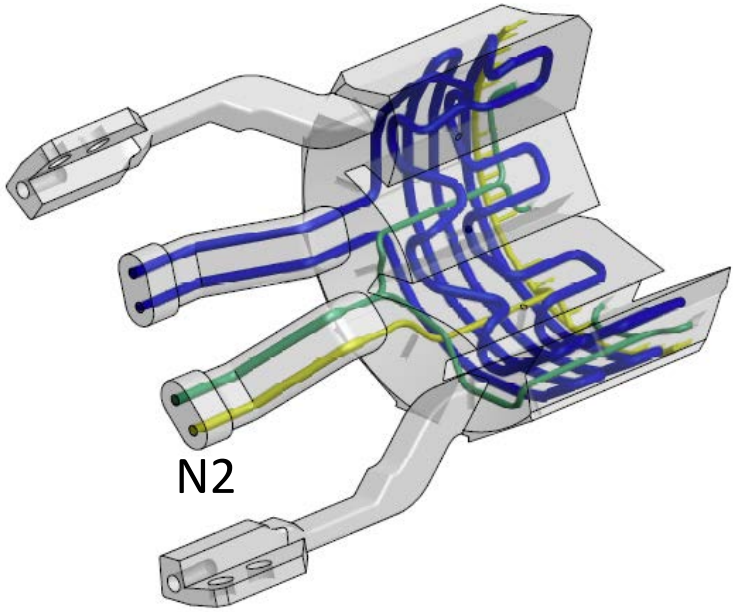
Fully Assembled SCB Half Shell, Phase 2



Used for Phase 2, SCB Half Shell for Phase 3 in production

SCB Assembly Steps (I)

- 3D printed non-magnetic stainless steel (in industry), special surface treatment and cleaning of internal channels
- 2 types: BWD and FWD
- Braizing of CO2 and N2 tubes (at MPI)
- Tightness / Pressure (with 186 Bars) / Tightness (< 1 x 10^{-9} mbar l/s)
- Parylen coating (at industry)
- Drill aluminized carbon pipes (outlets of N2 at the switcher loacations)
- Prepare SCBs to receive carbon pipes (drilling for gold spring contacts)
- Prepare PEEK parts for isolation of SCBs
- Gold spring contacts exist, also reinforcement ladders for mechanical stability



SCB Assembly Steps (II)

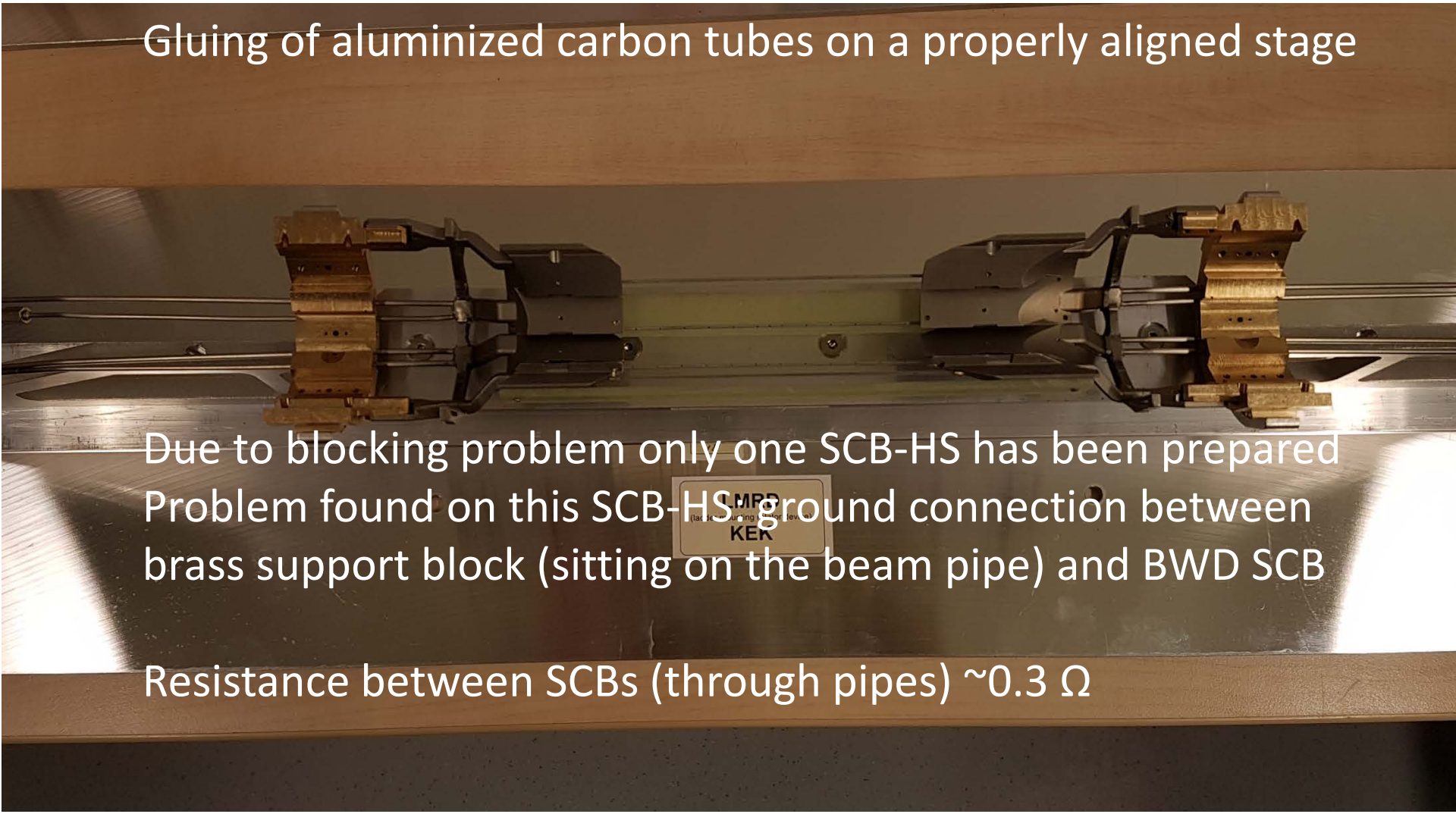
Further work before gluing:

(parts for 2 full sets of half shells)

- Test all channels for passage (after braizing and Parylen)
- Clean all threads and test for same torque
  (important: sensors were found not well fixed at early tests at DESY despite correct torque: sensors were moving)
- Remove all non-conducting residues at the contact points between Kapton and SCB ground bus

Observations:
- 3 out of 4 SCBs pass all tests
- For one SCB (BWD) we find that there is a blocked N2 line
  (supplying N2 for the aluminized carbon tubes)
- Investigation is of the blocked line is ongoing

SCB Assembly Steps (III)

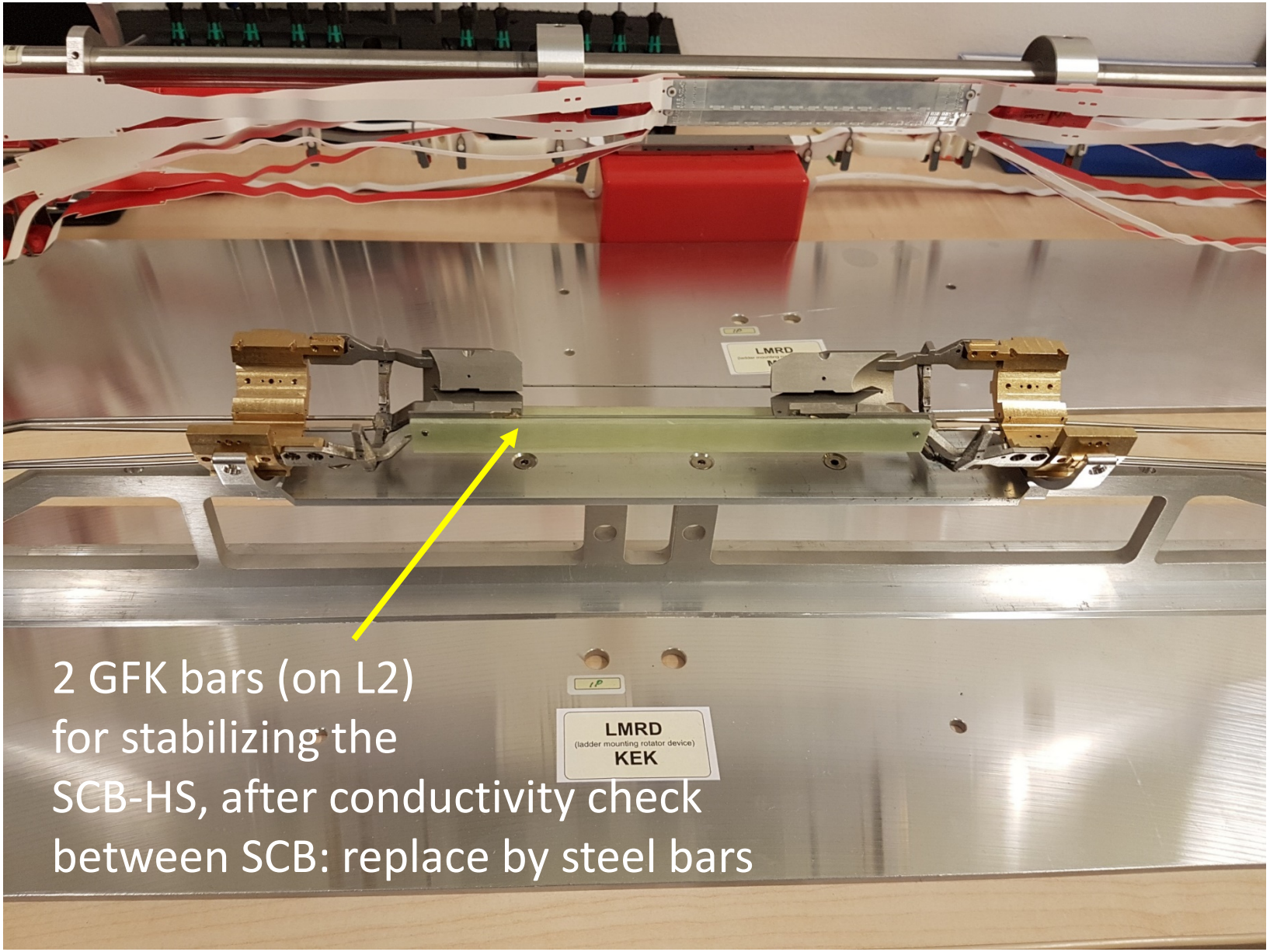


Gluing of aluminized carbon tubes on a properly aligned stage

Due to blocking problem only one SCB-HS has been prepared
Problem found on this SCB-HS: ground connection between brass support block (sitting on the beam pipe) and BWD SCB

Resistance between SCBs (through pipes) ~0.3 Ω

Fully Assembled SCB Half Shell, Phase 3

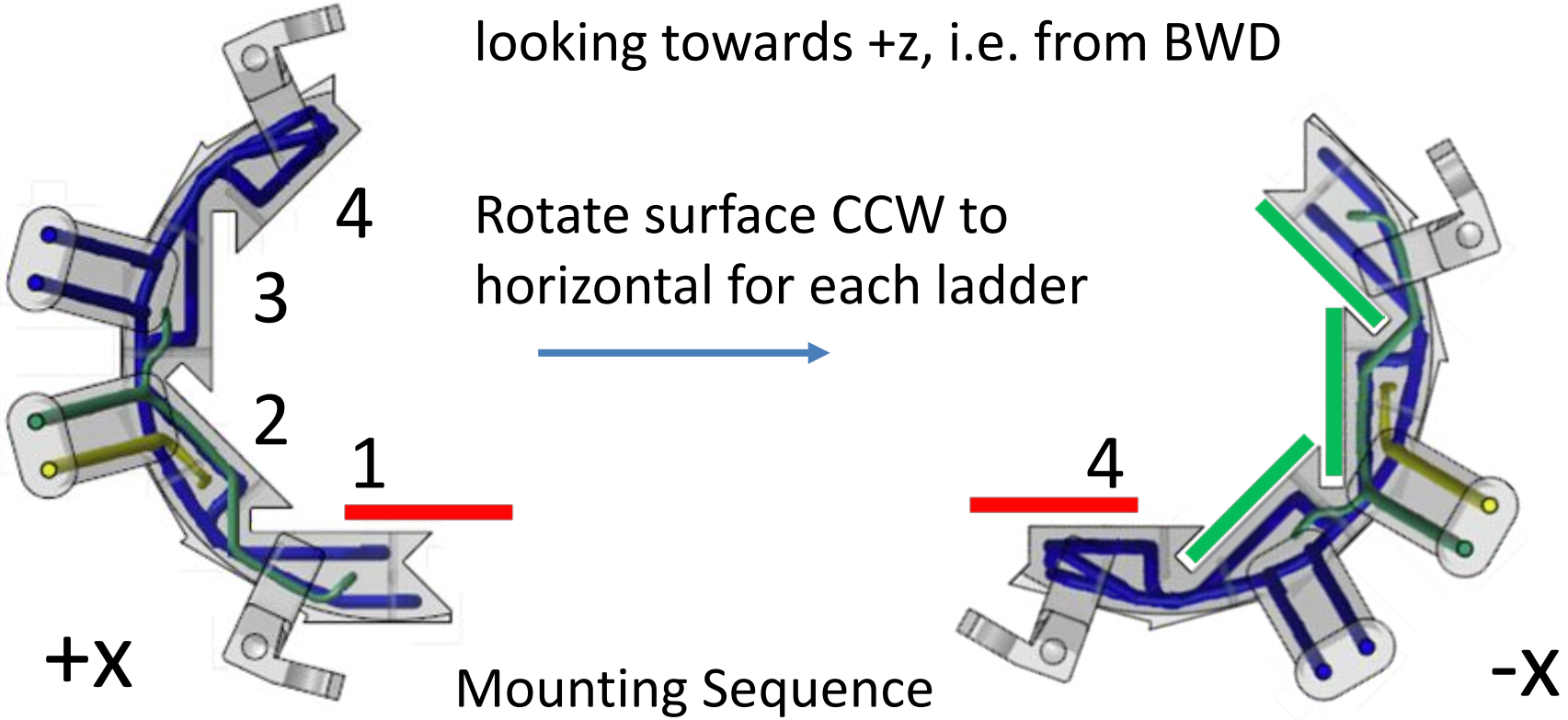


Ladder Mounting: Overview for Phase 3

Principle: Mount ladders always from top; first L1, then L2

looking towards +z, i.e. from BWD

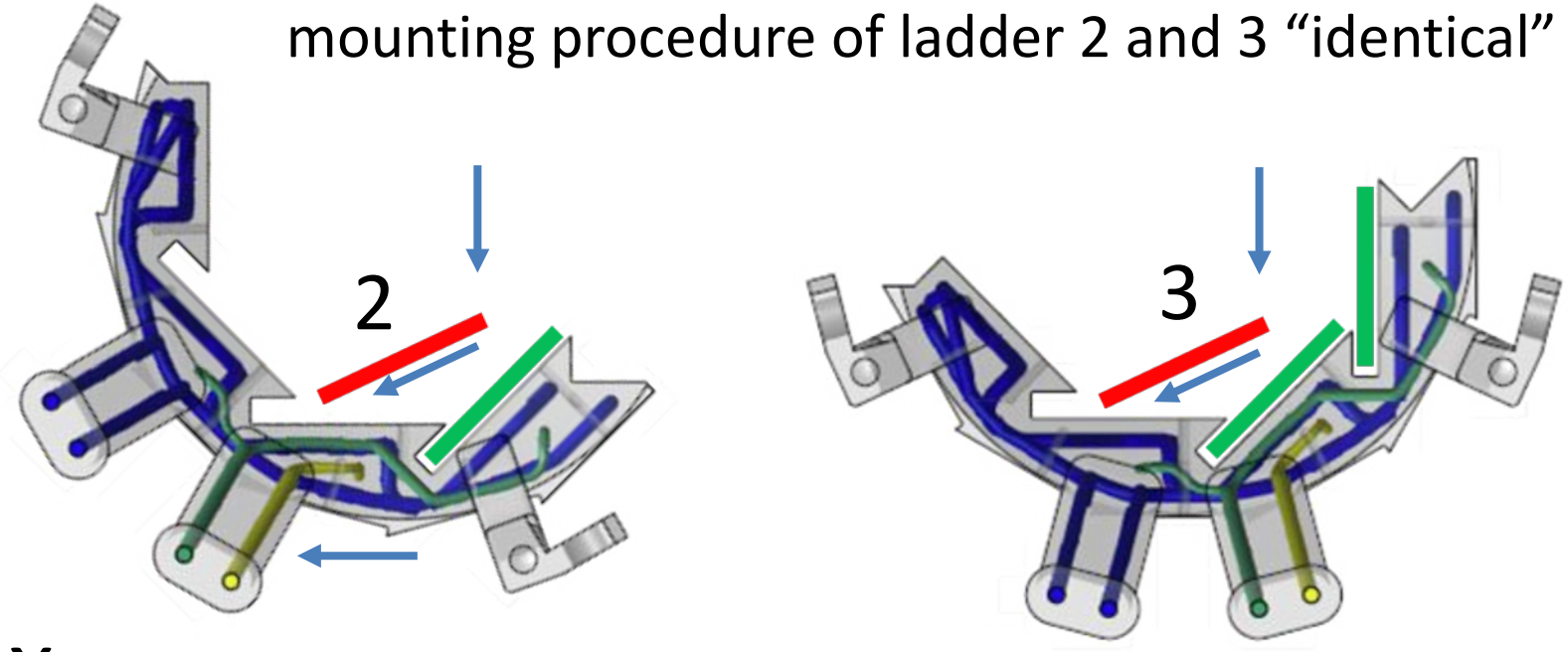
Rotate surface CCW to horizontal for each ladder



1st and last ladder are “easy”, 2 and 3 “tricky”

Ladder Mounting: Layer 1

Ladder 1 mounted, now mount ladders 2 and 3, mounting procedure of ladder 2 and 3 “identical”



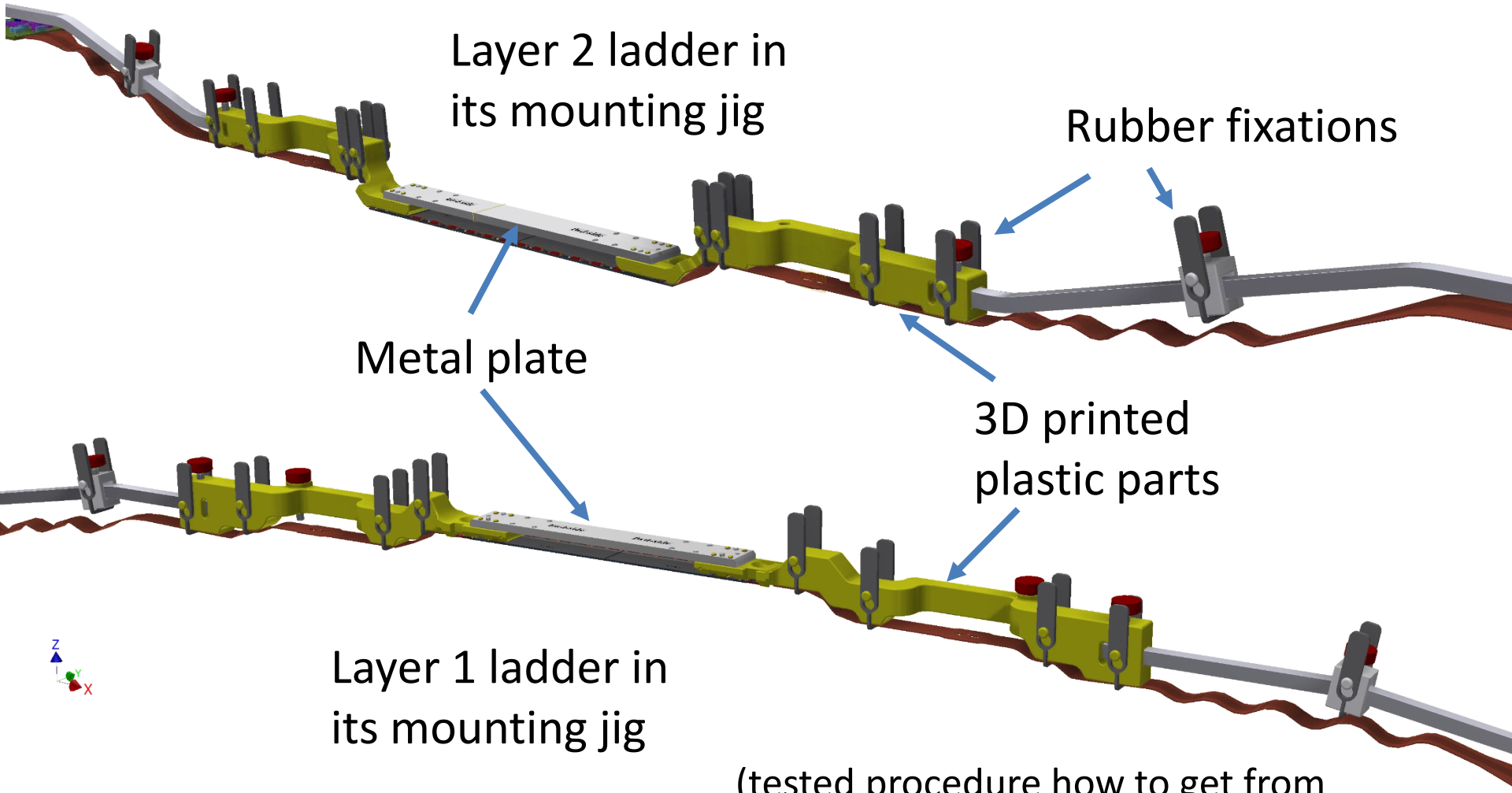
+x

-x

Ladder 2(3) must be guided “down” and “left” in a well coordinated way (tactile feedback mandatory)

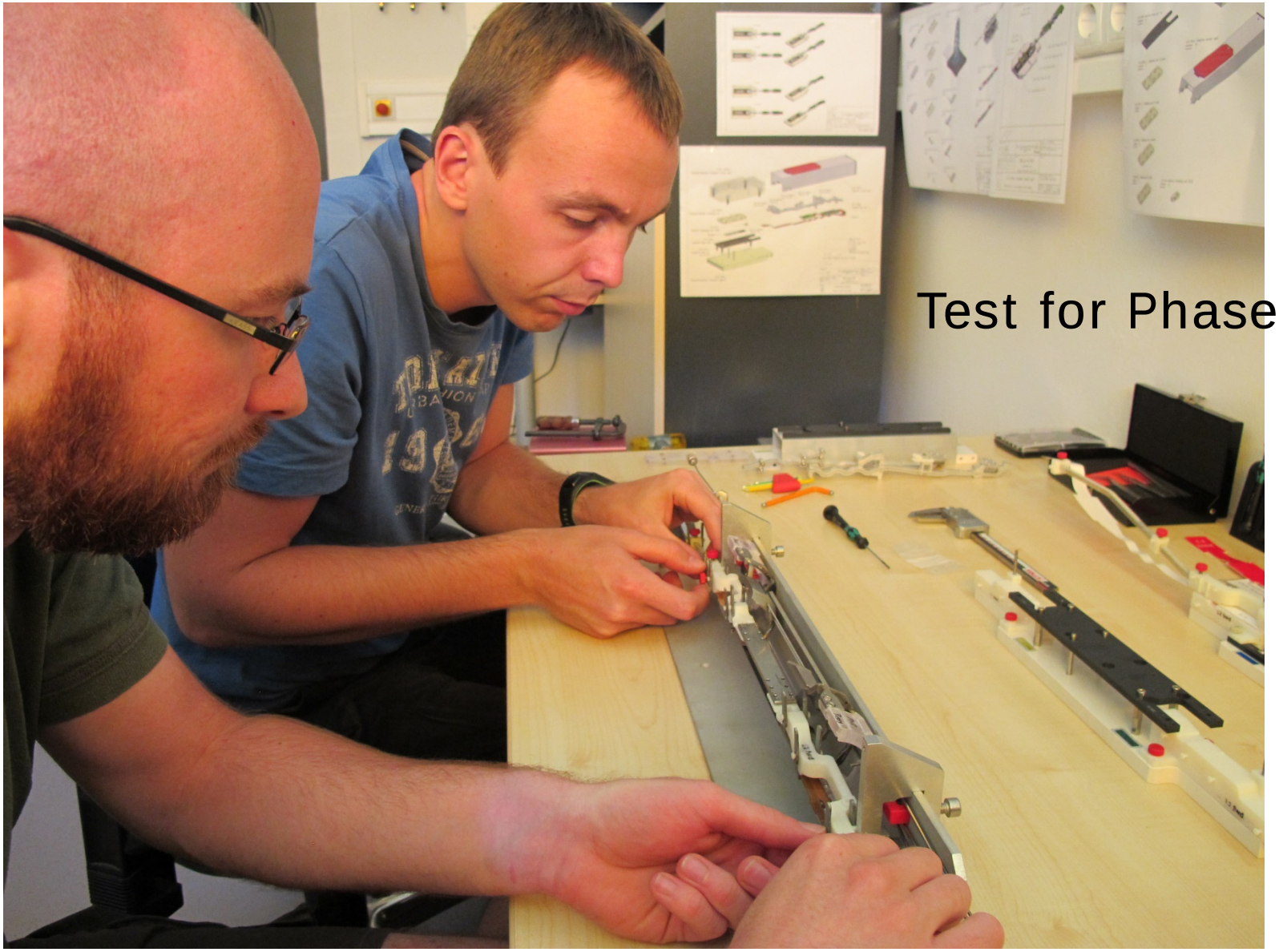
- Need a rotation mechanism for SCB half shell
- Need mounting jig (protection) for each layer

Ladder Mount Jigs

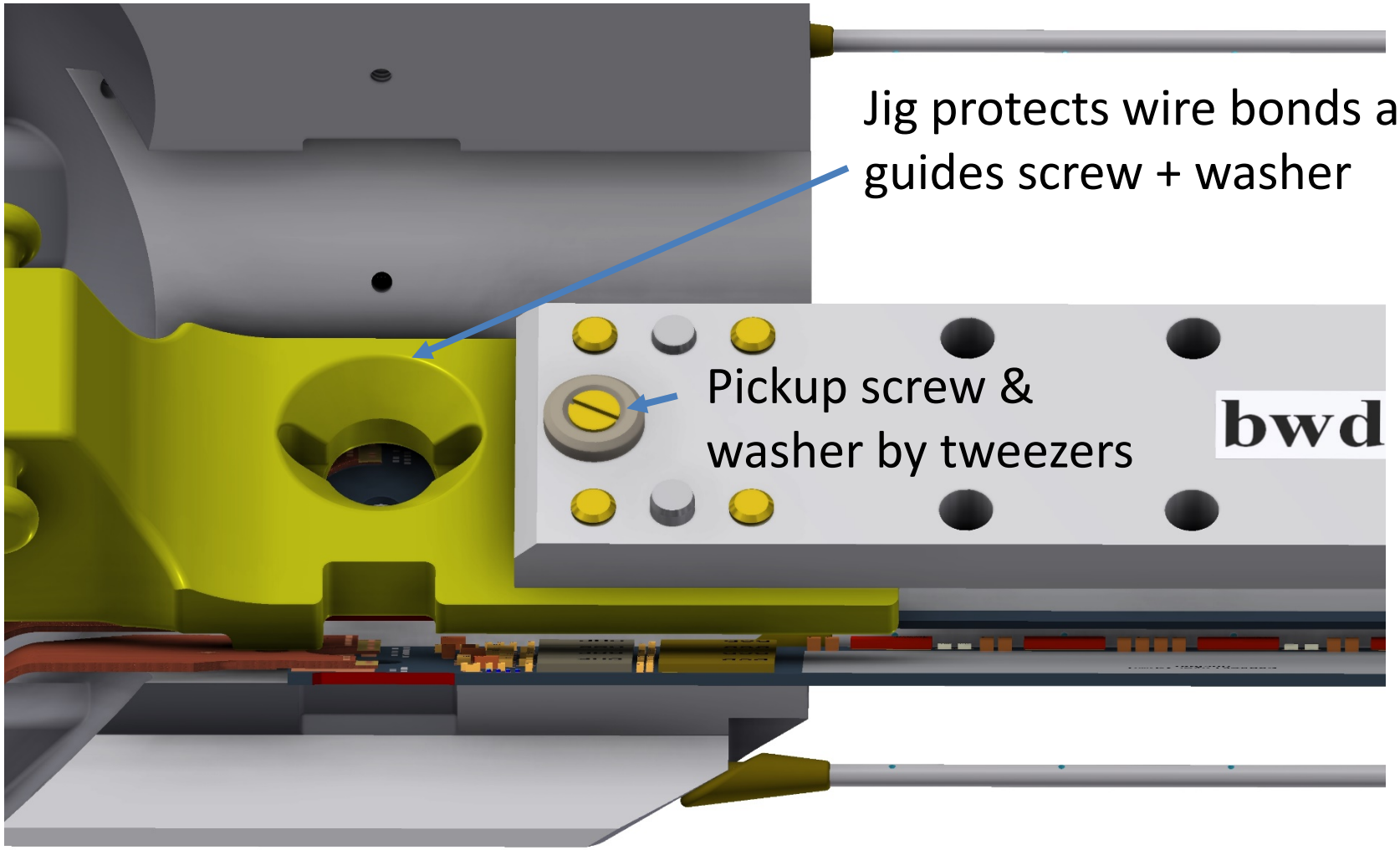


(tested procedure how to get from base jig to ladder mount jig -> backup)

Test Installation of Ladder in Mounting Jig

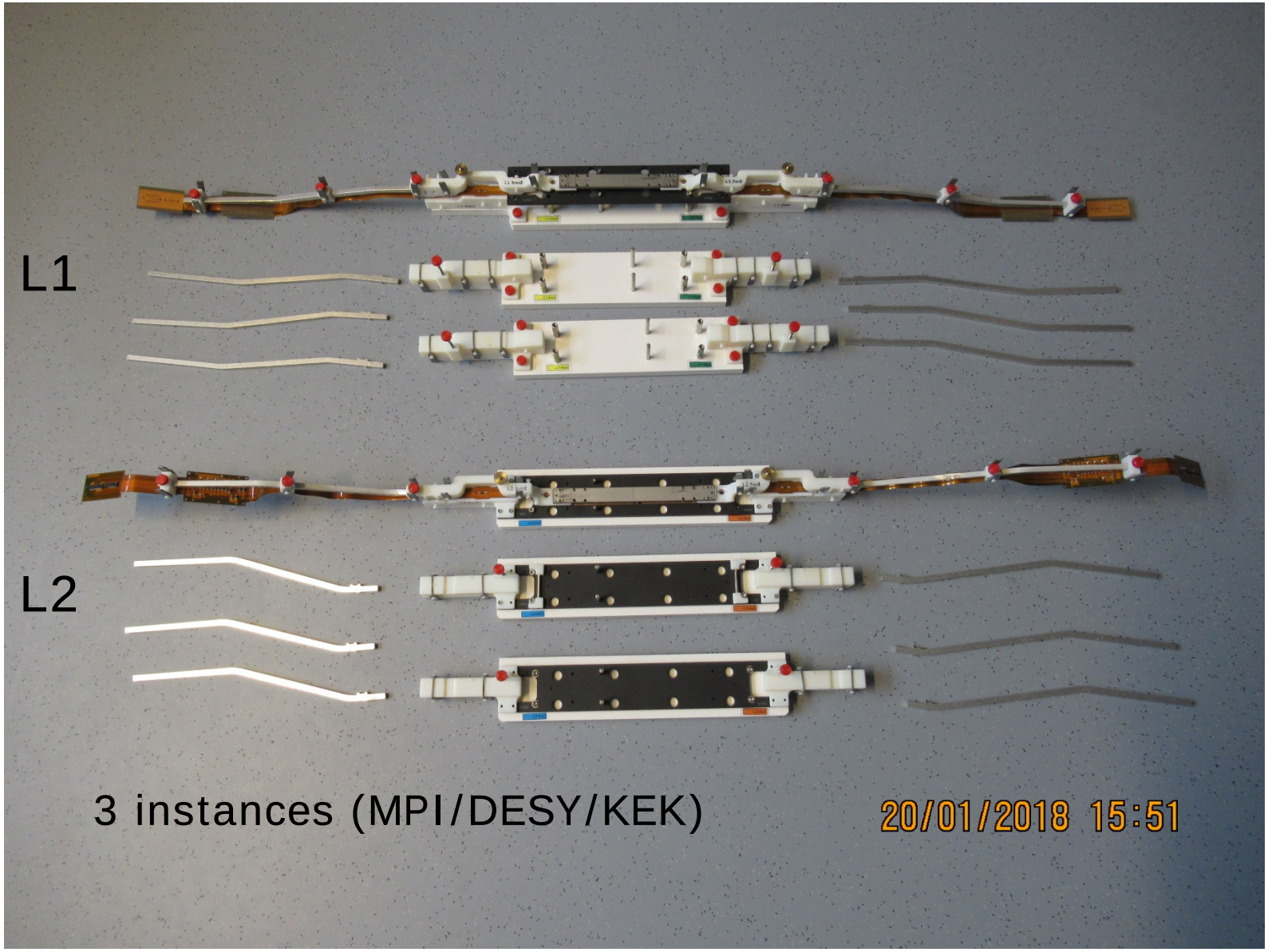


Ladder Fixing on SCB



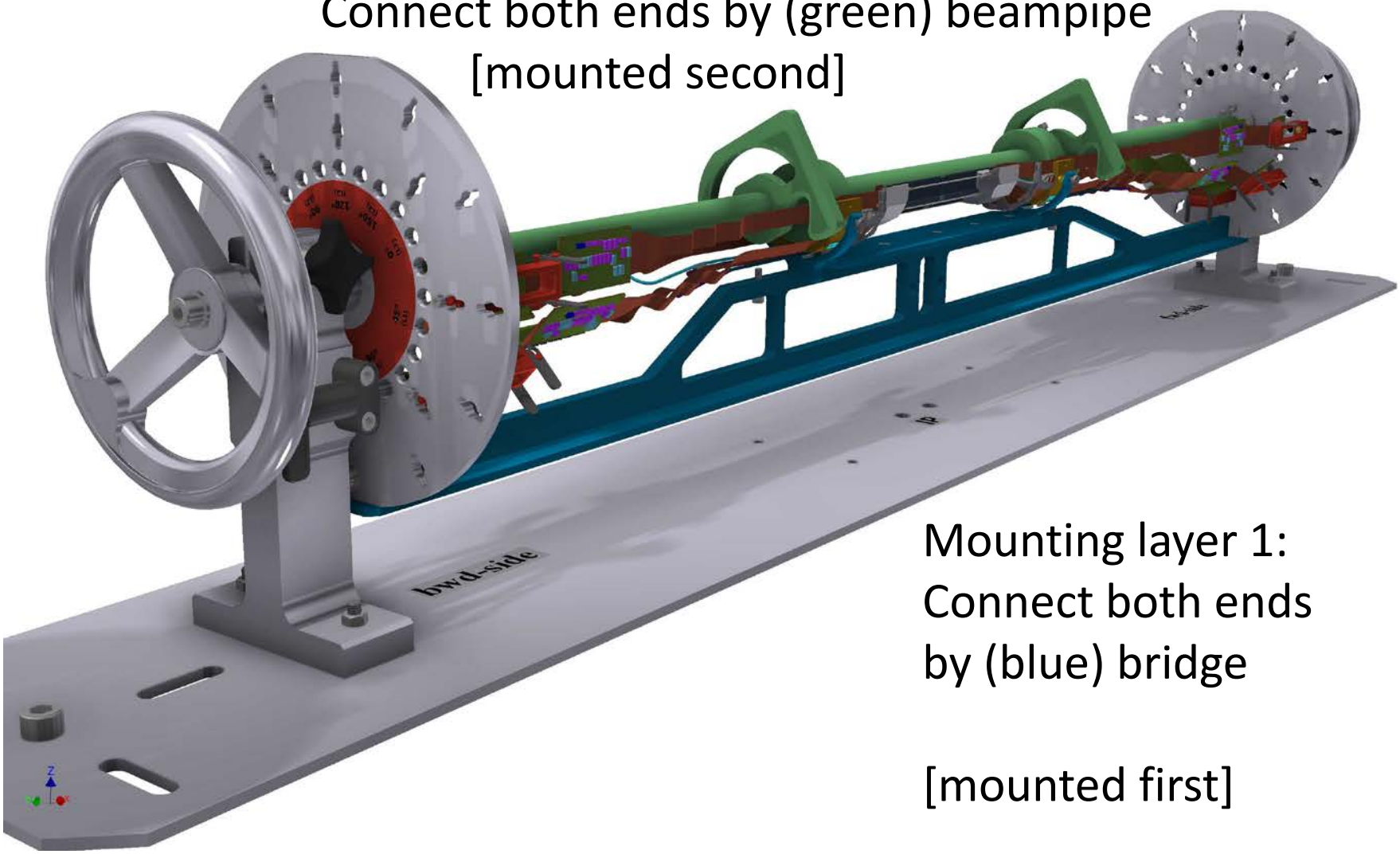
M1.2 screw, 15 mNm torque

Ladder Mounting Tools



Ladder Mounting and Rotation Device (LMRD)

Mounting layer 2:
Connect both ends by (green) beampipe
[mounted second]



Mounting layer 1:
Connect both ends
by (blue) bridge

[mounted first]

Assembled LMRD

Fully assembled LMRD

3 complete mechanisms are being built:

MPI

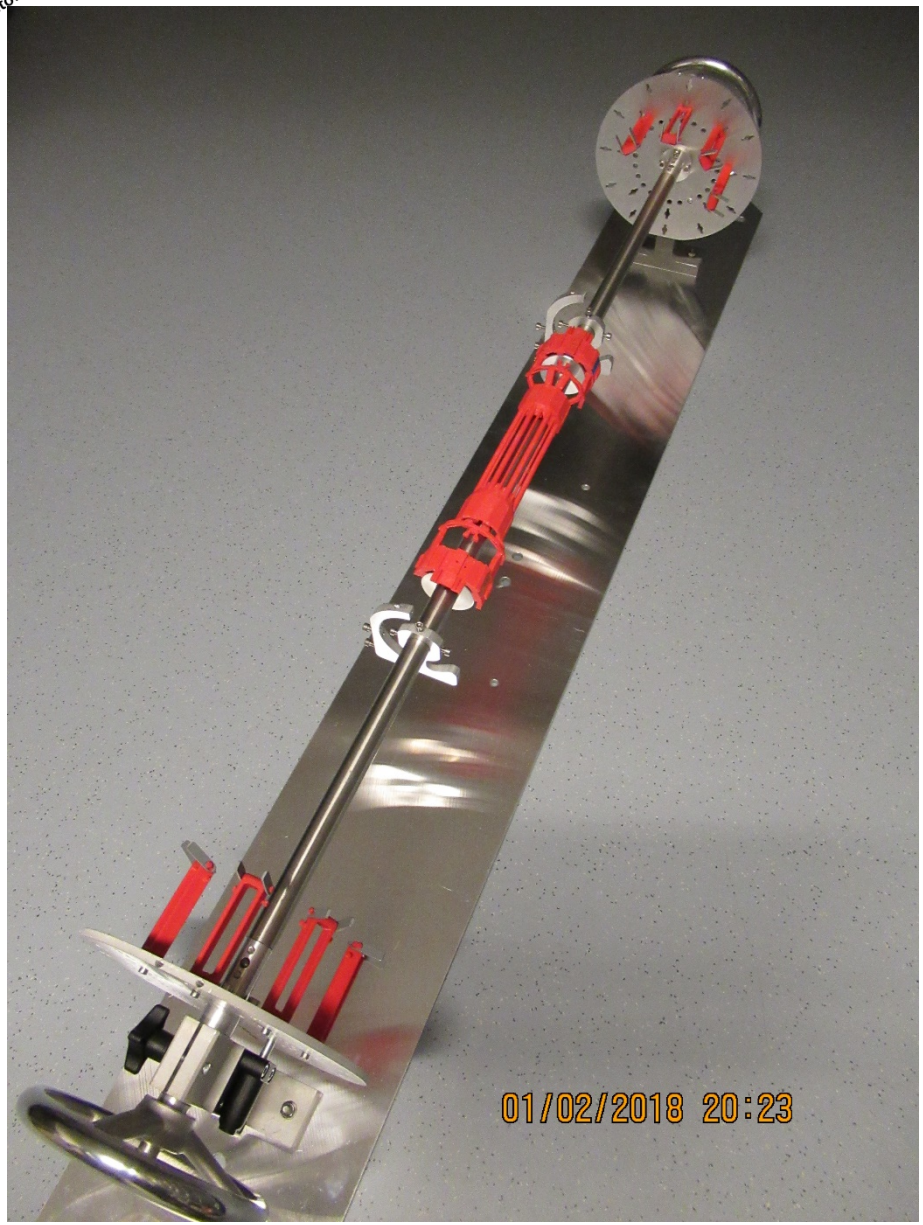
DESY

KEK

Name of rotation mechanism:

LMRD (= ladder mount and rotation device)

Test of LMRD Functionality



Test procedure:

Use 3D printed half shell for rotation and mounting

Here:

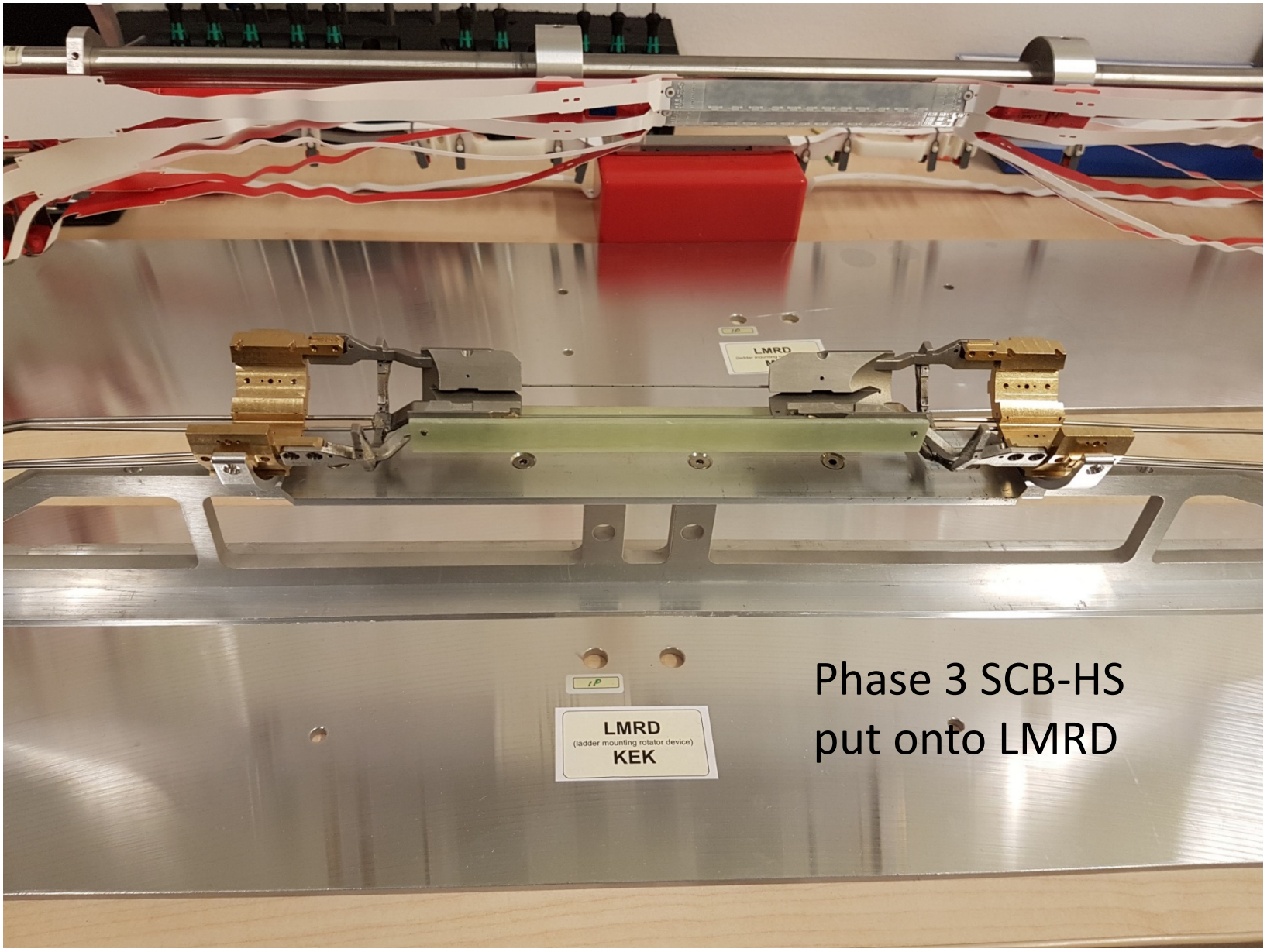
position to install ladder 2 of outer layer

also here we will use plastic models of ladders (available or to be produced)

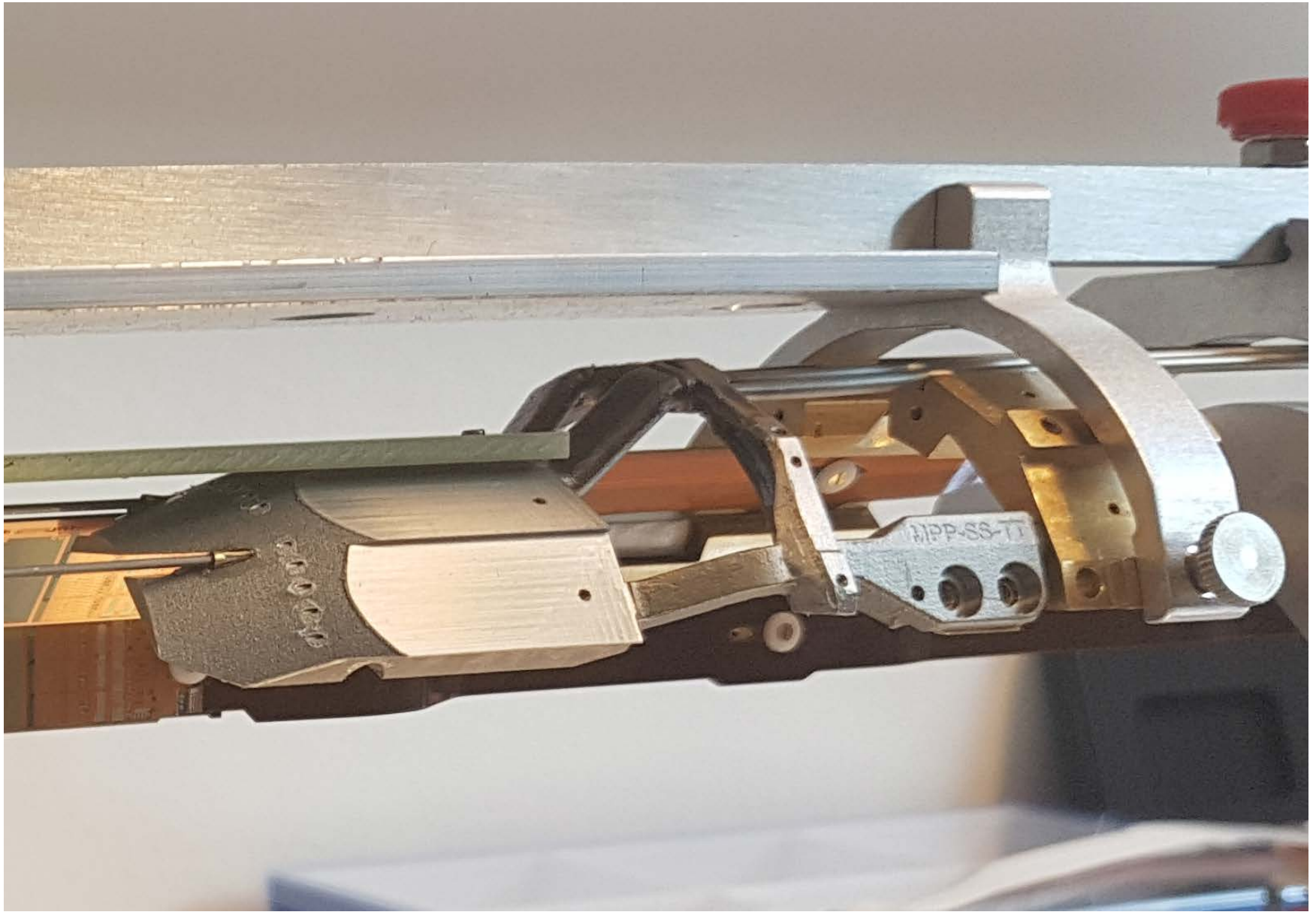
Test was OK, now repeat with dummy ladders

follow established protocol

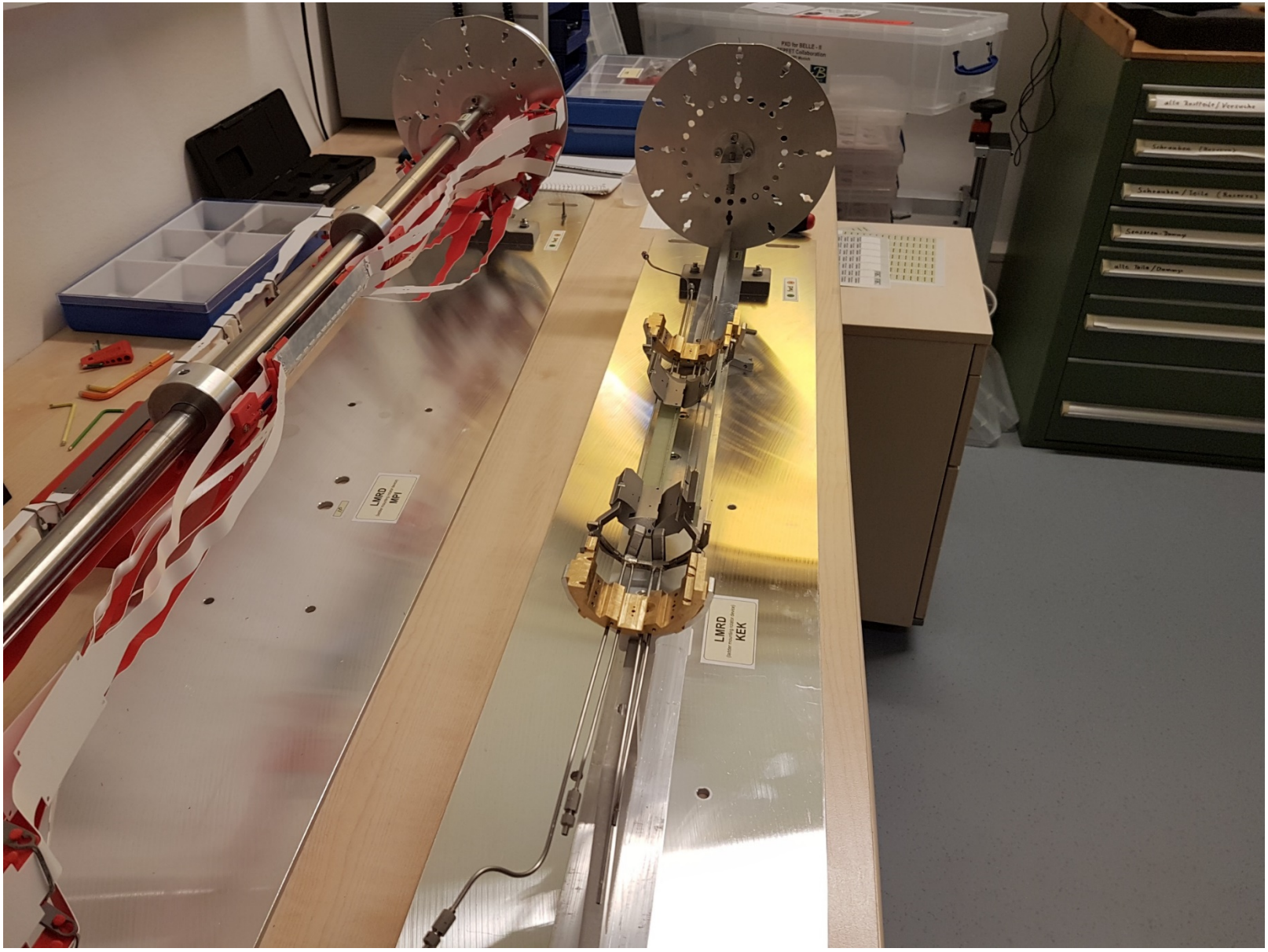
Test of LadderMount Procedure



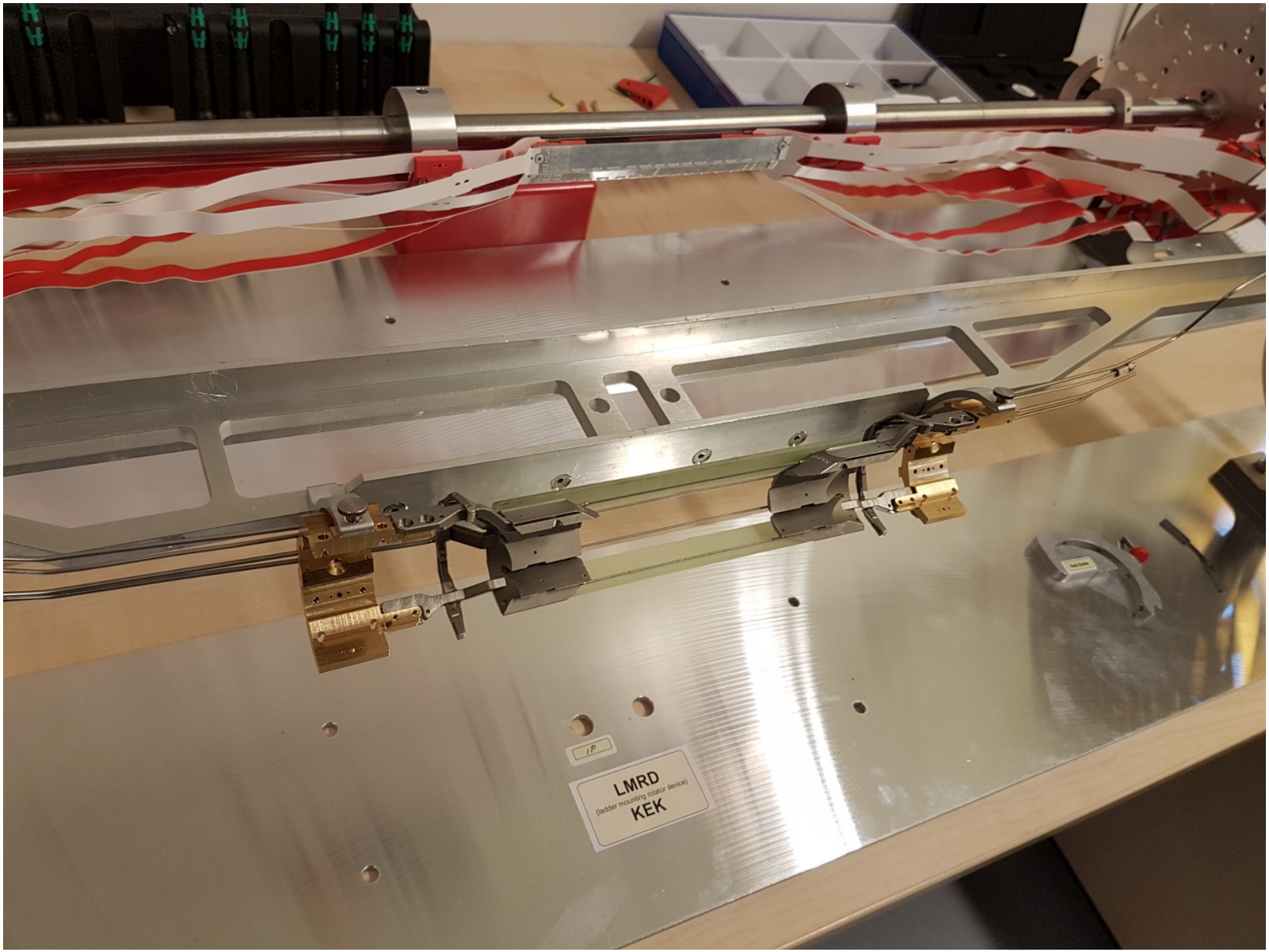
Fix New SCB-HS to LMRD



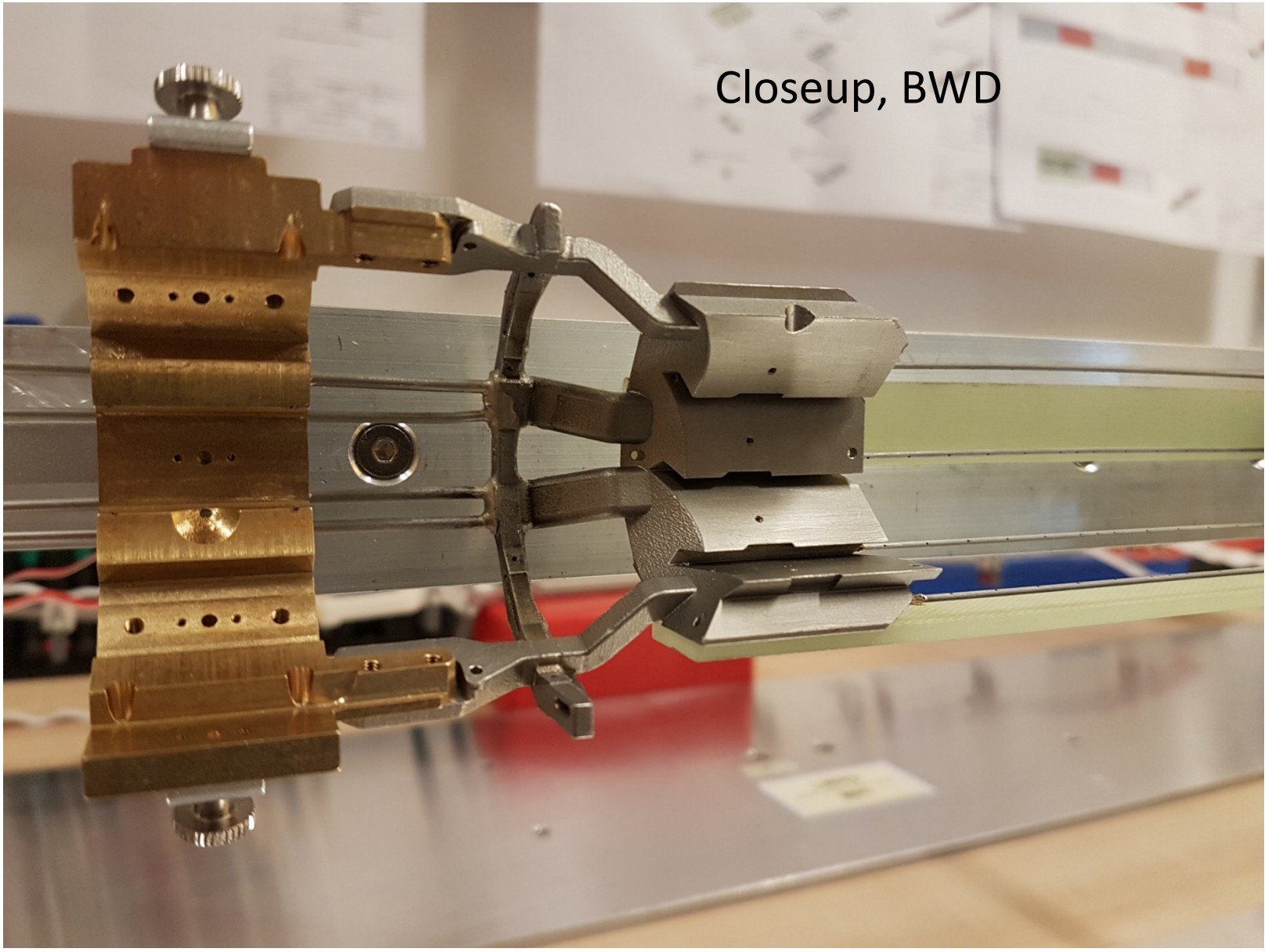
SCB-HS fixed to LMRD



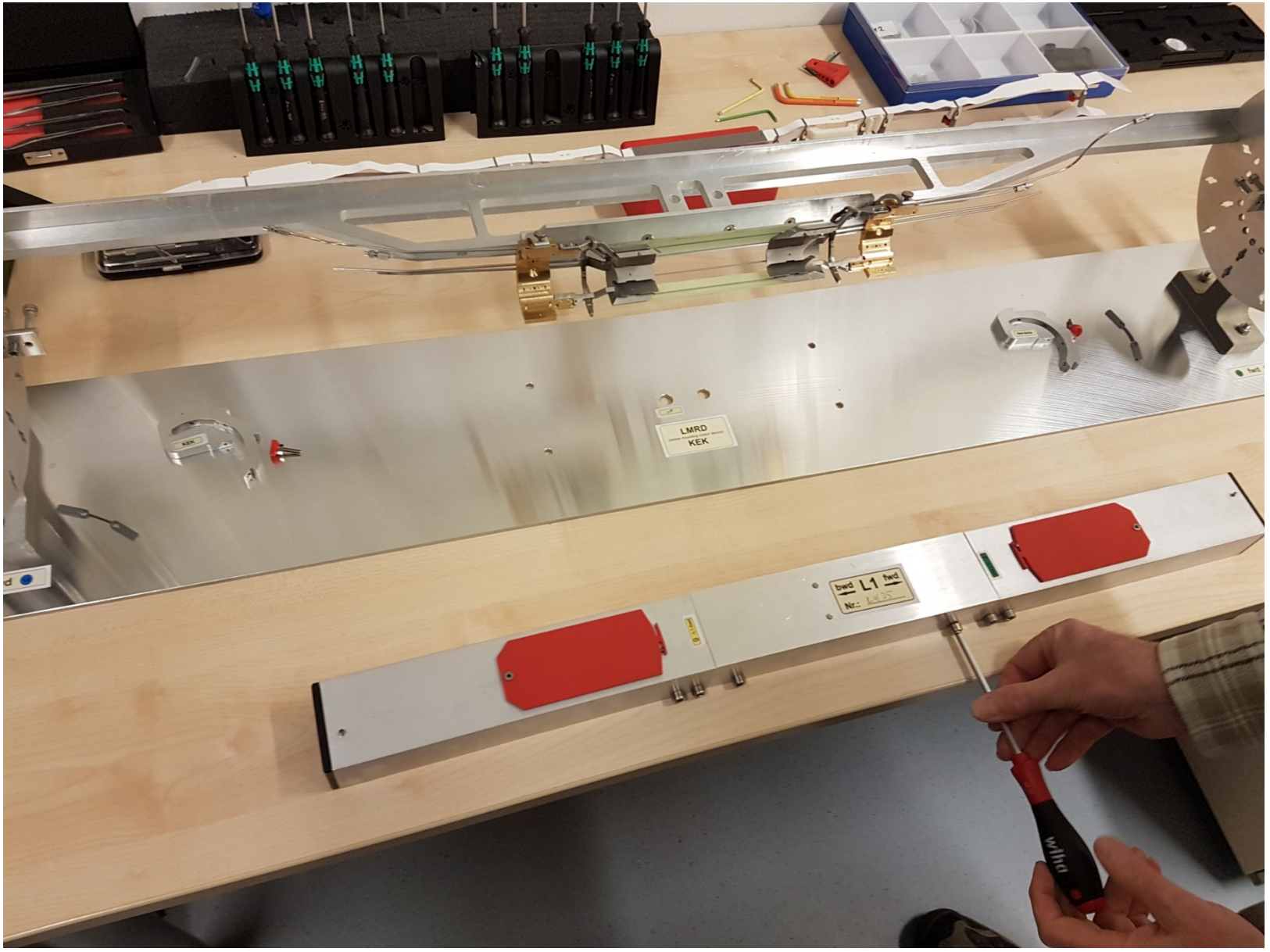
LMRD Rotated to the Proper Position for Lad 1



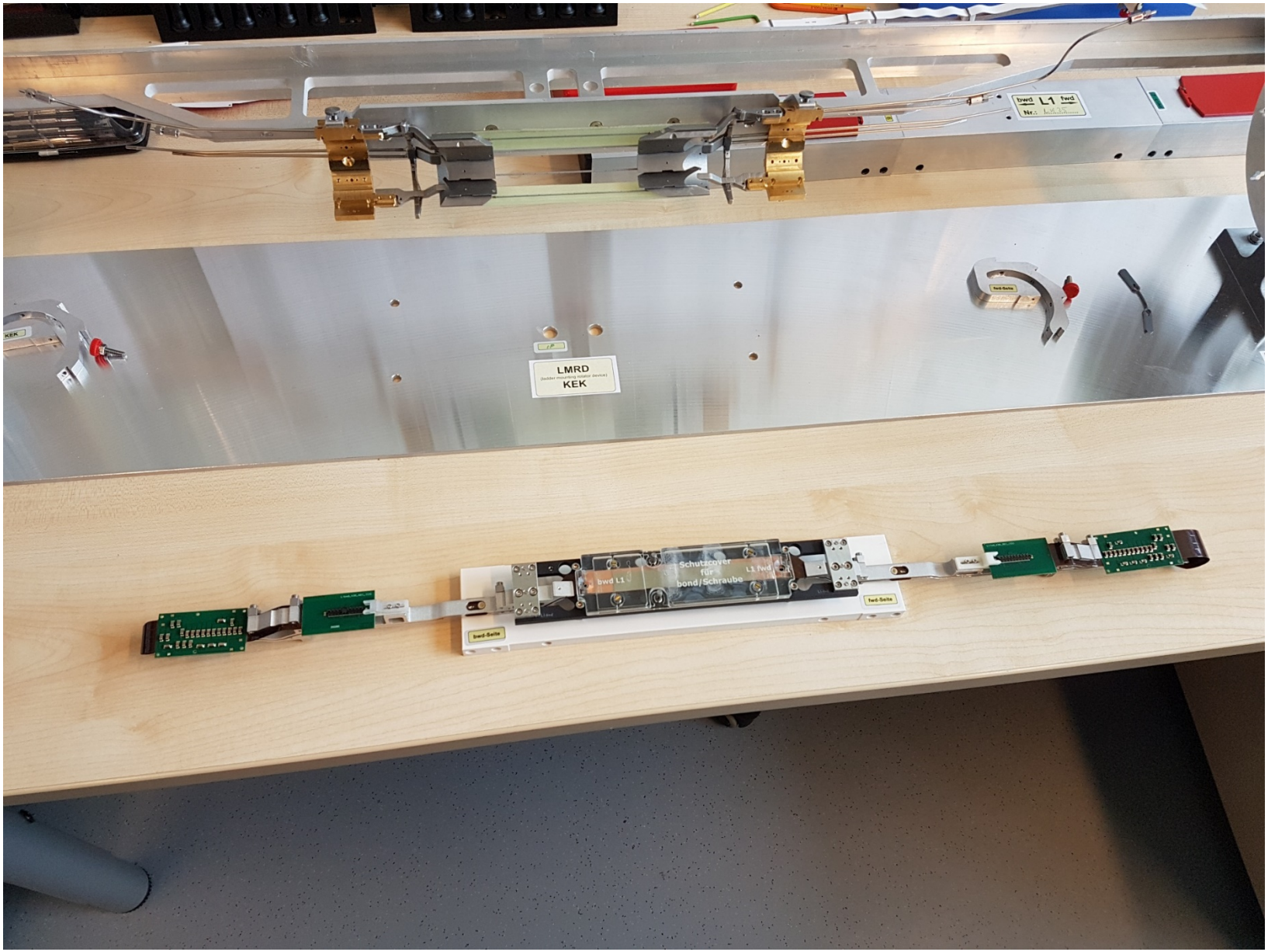
LMRD Rotated to the Proper Position for Lad 1



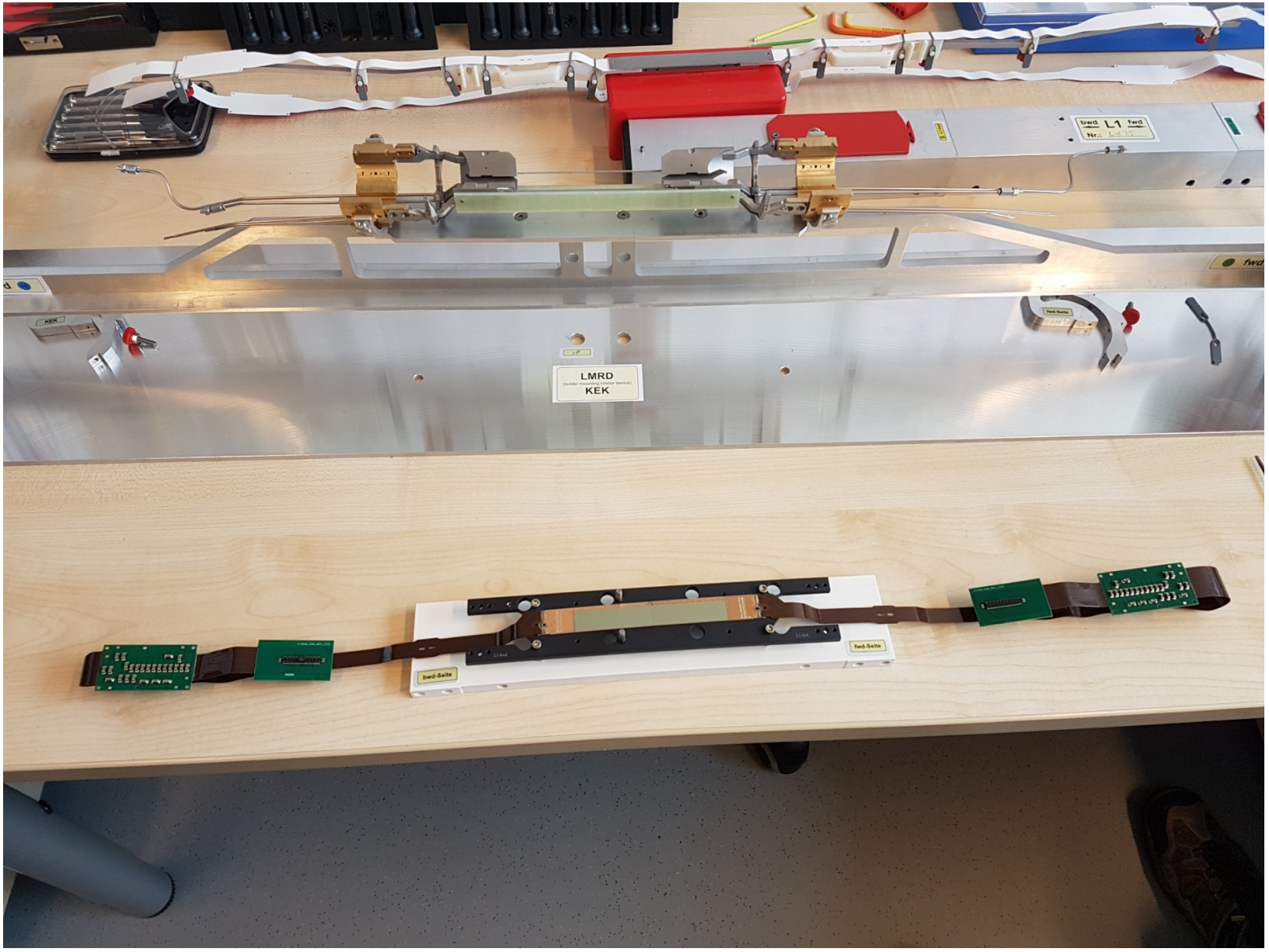
Prepare Ladder 1 for Mounting



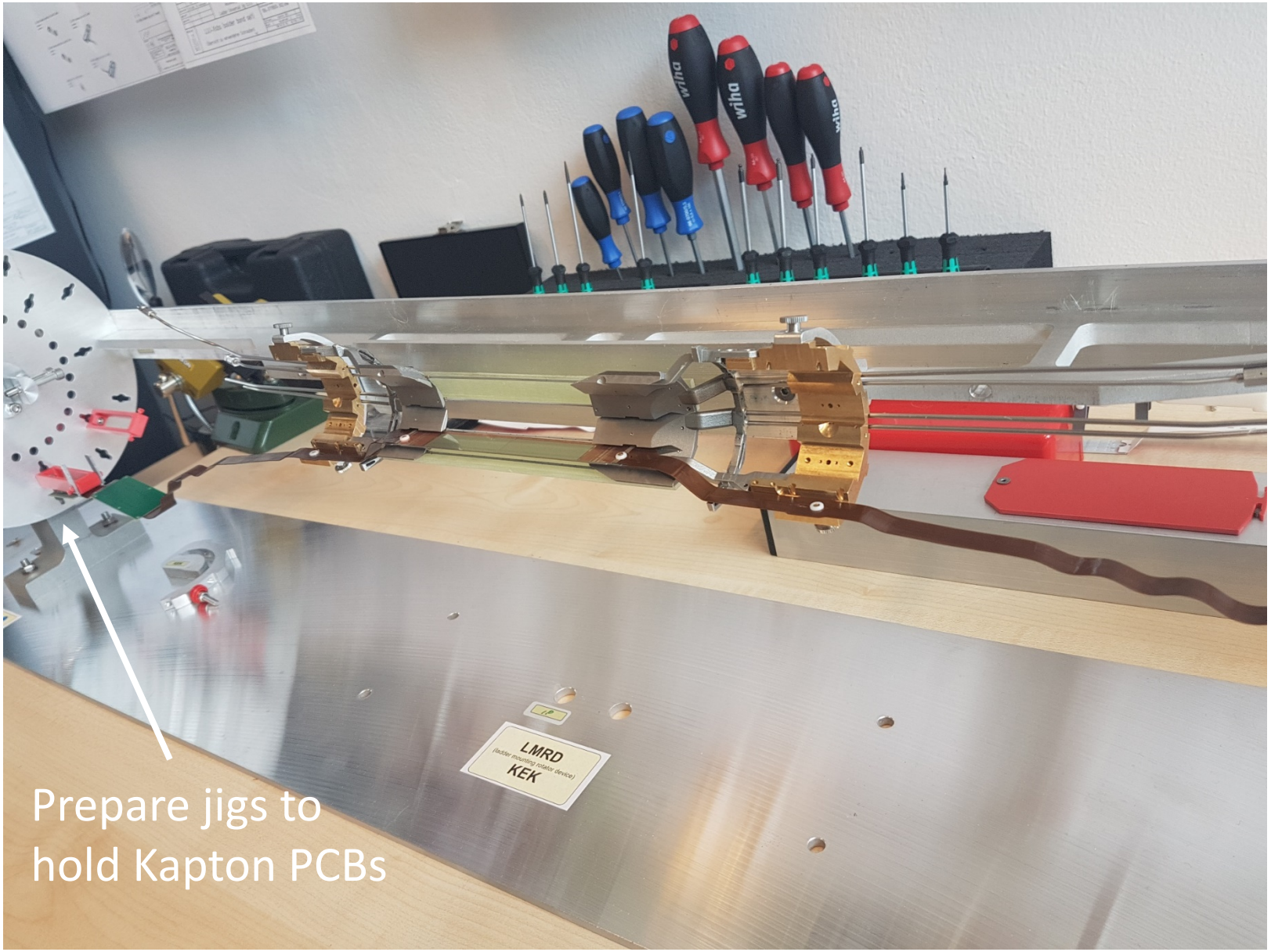
Prepare Ladder 1 for Mounting



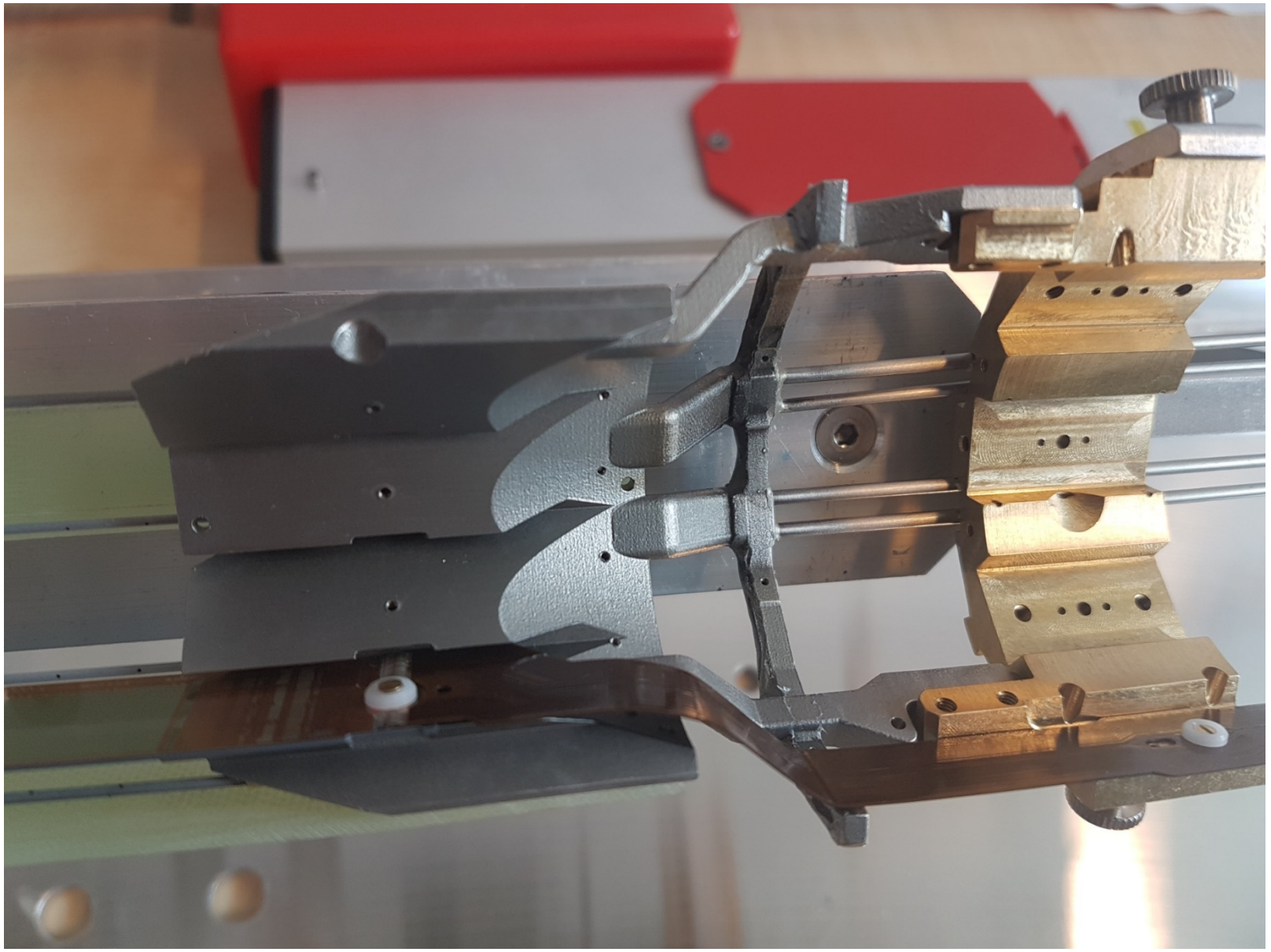
Ladder 1 Free for Picking up by Hand



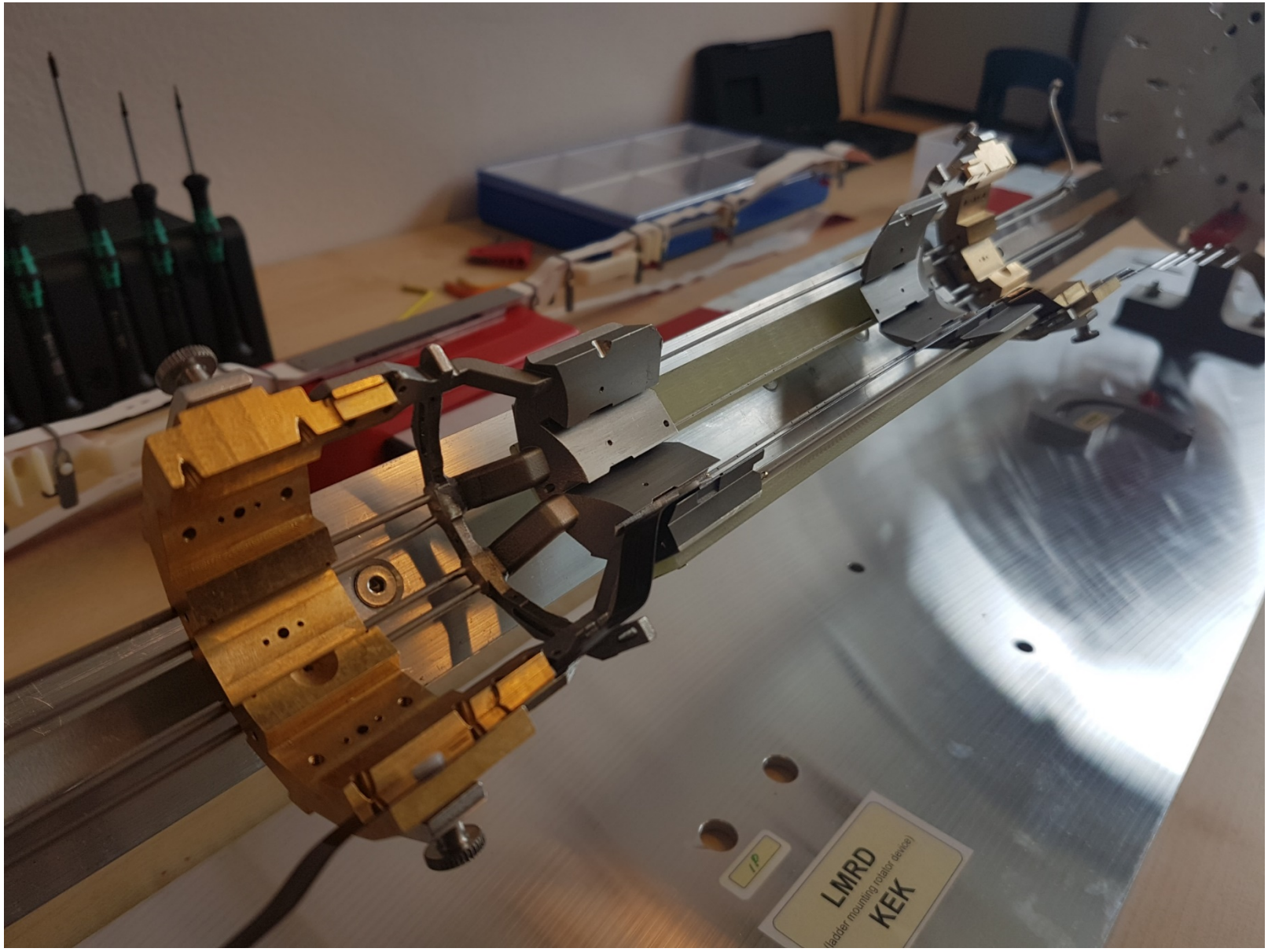
Ladder 1 Short-Cut : No Mounting Jig Used



Ladder 1 Mounted: Closeup FWD

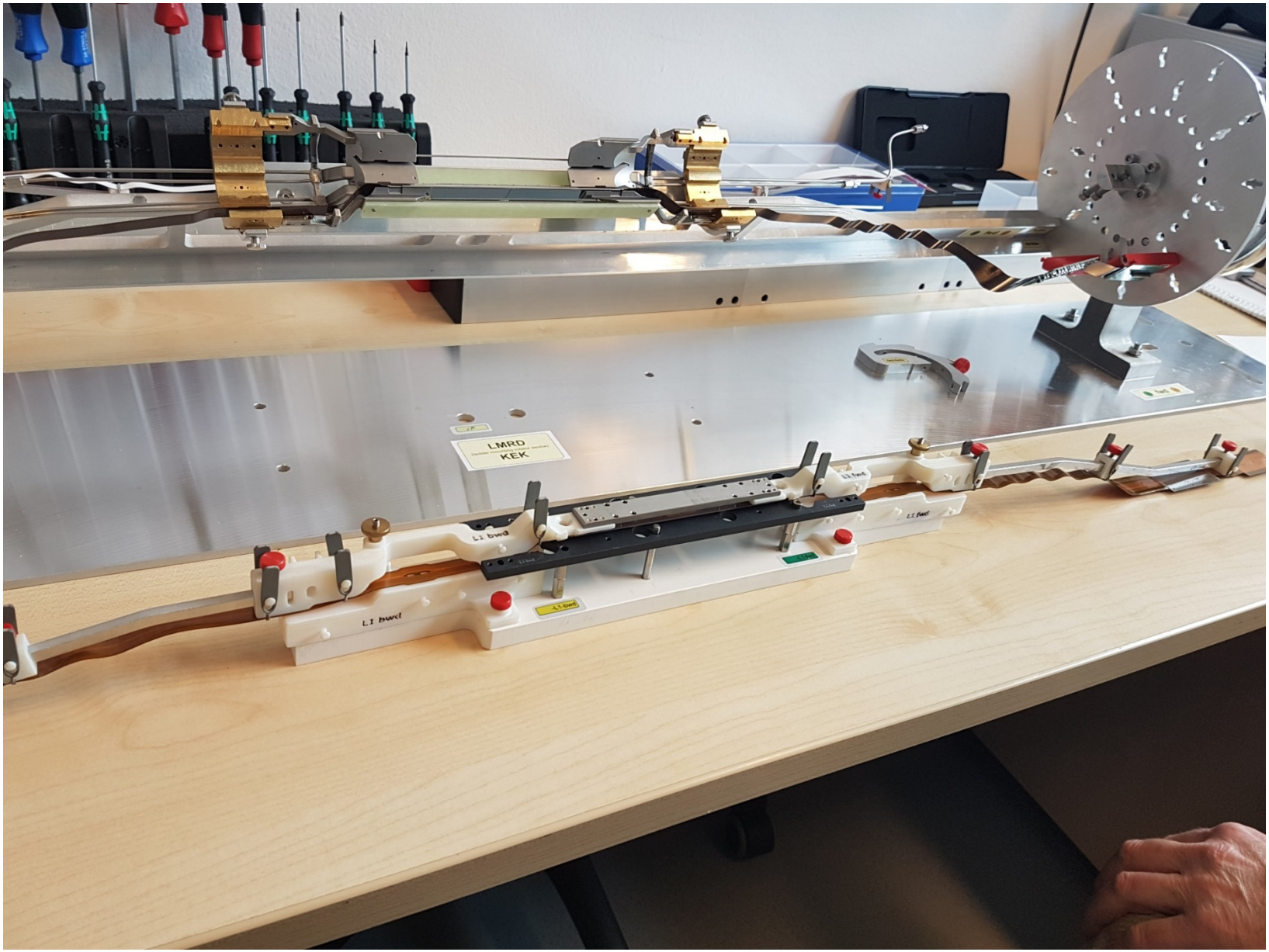


LMRD Rotated to Receive Ladder 2

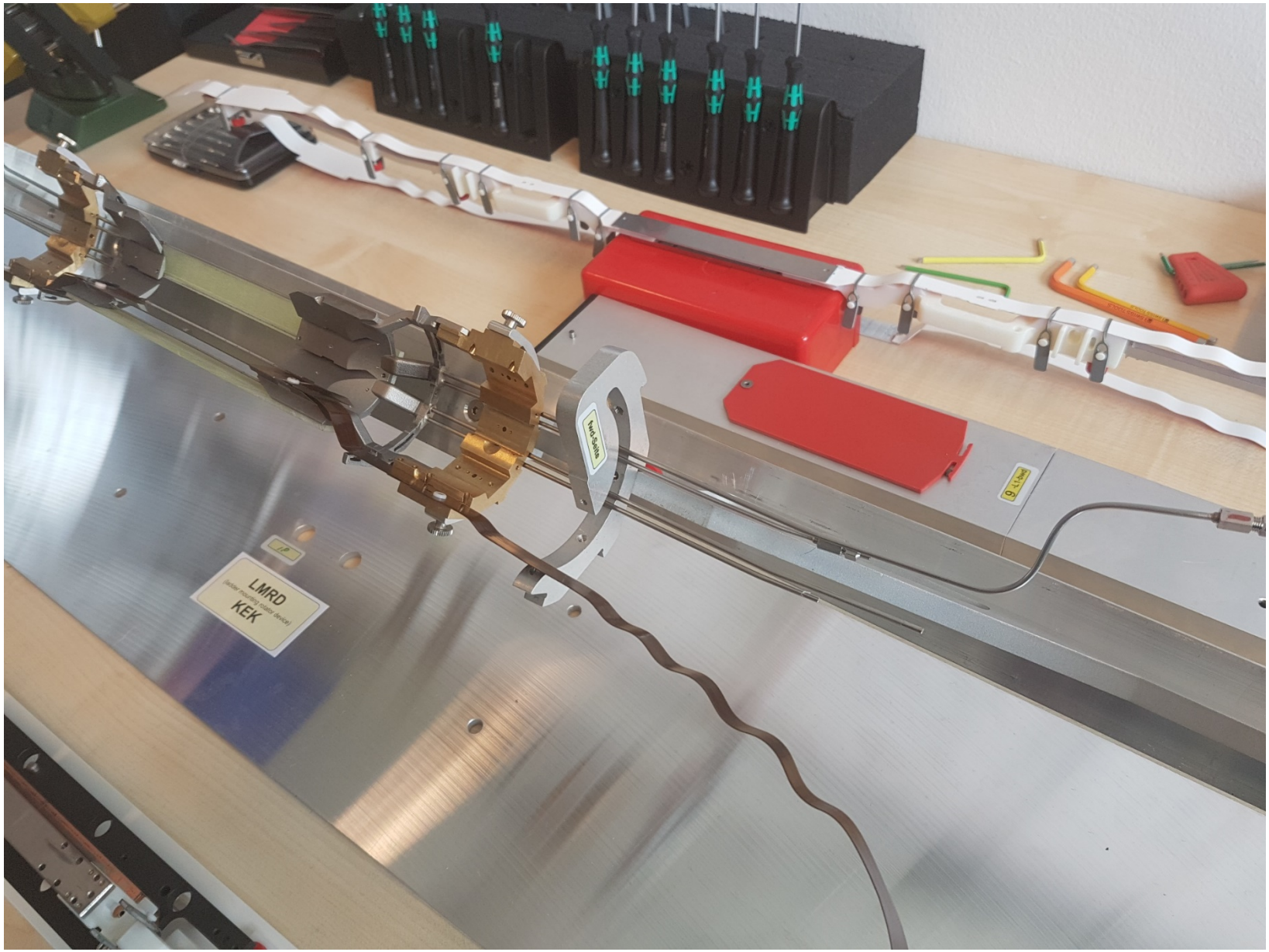


LMRD Rotated to Receive Ladder 2: Closeup

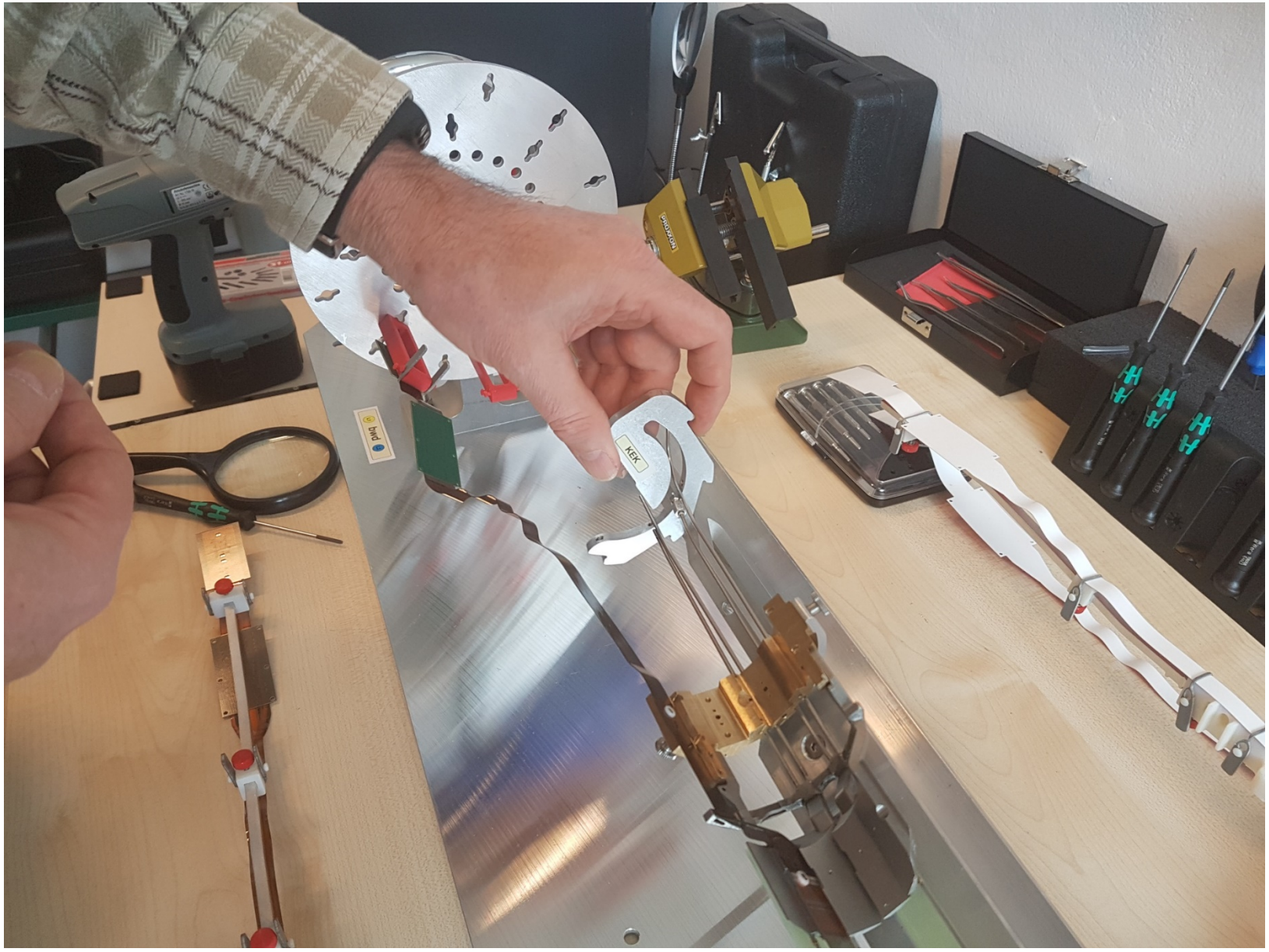
Ladder 2 in the Ladder Mount Jig



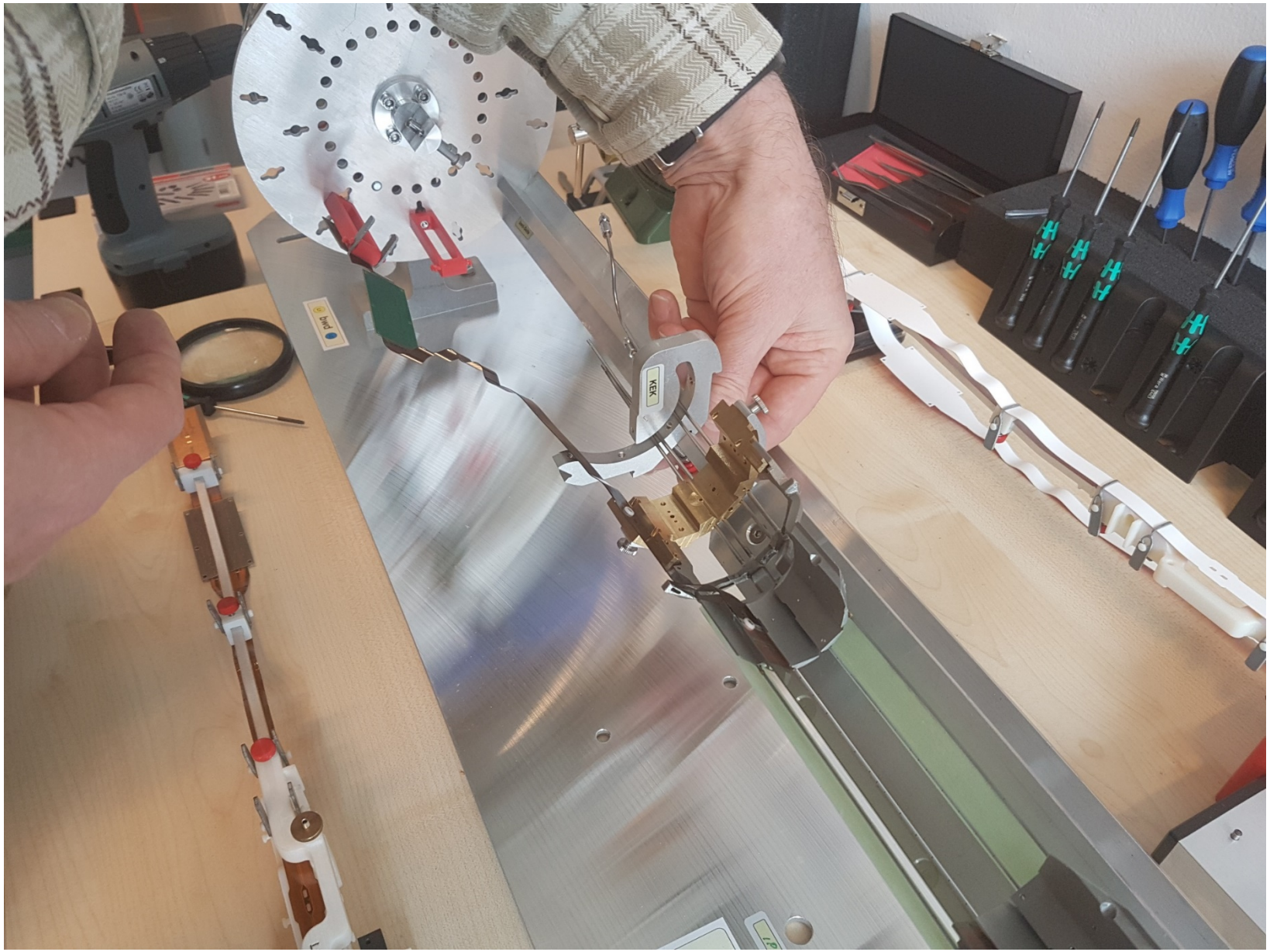
Adjustment of z-Guide (I)



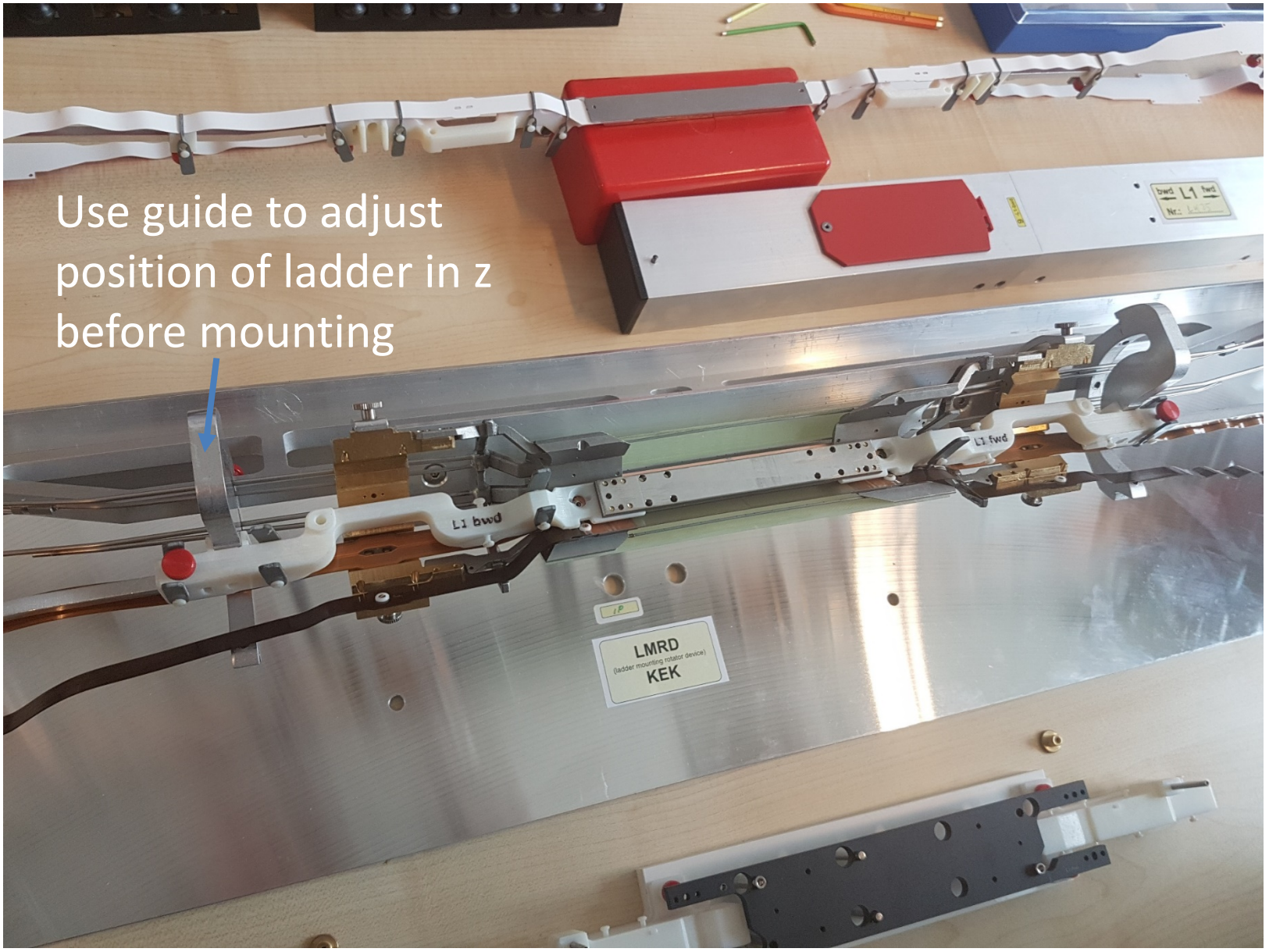
Adjustment of z-Guide (II)



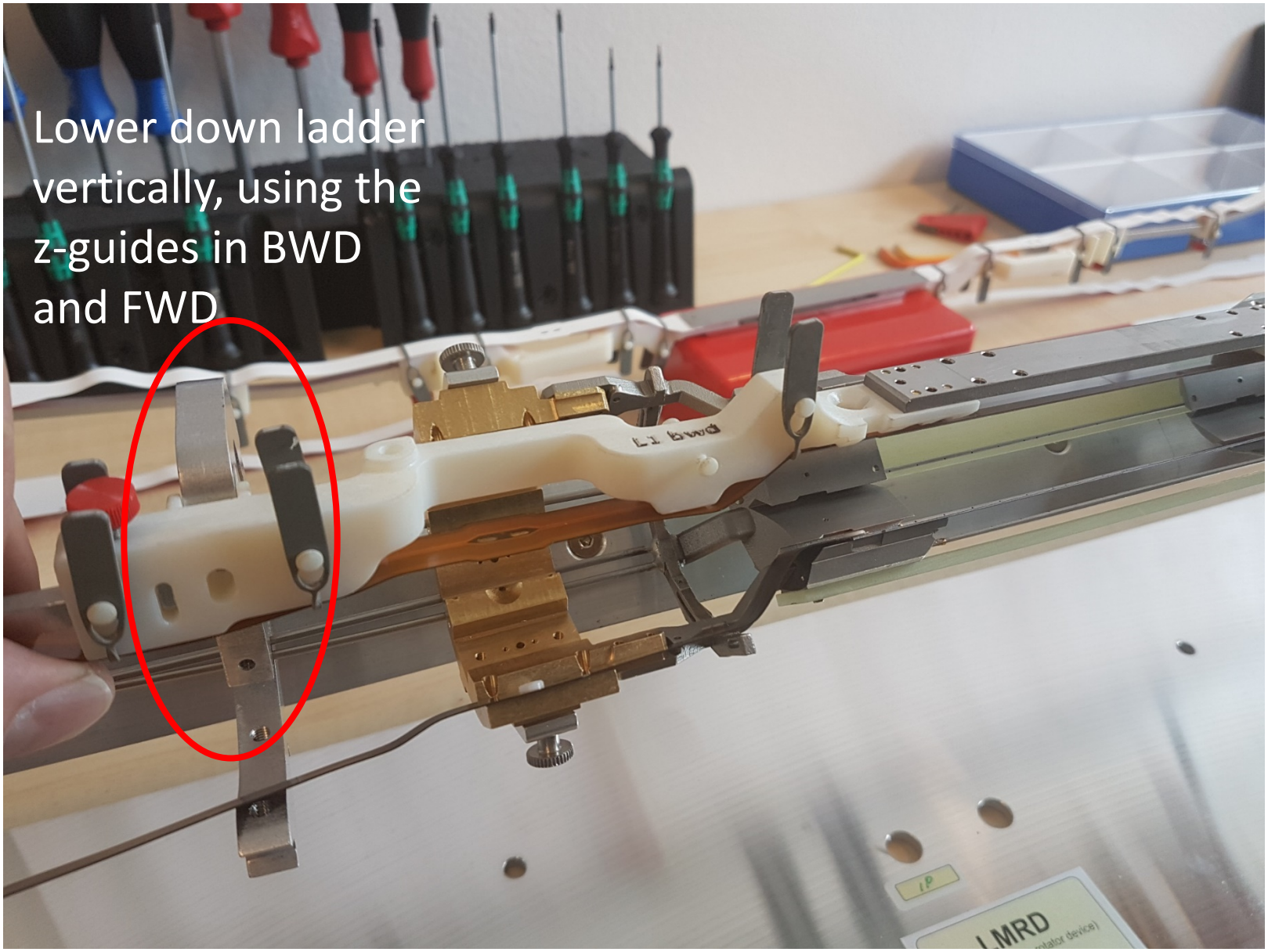
Adjustment of z-Guide (III)



Ladder put onto the SCB-HS

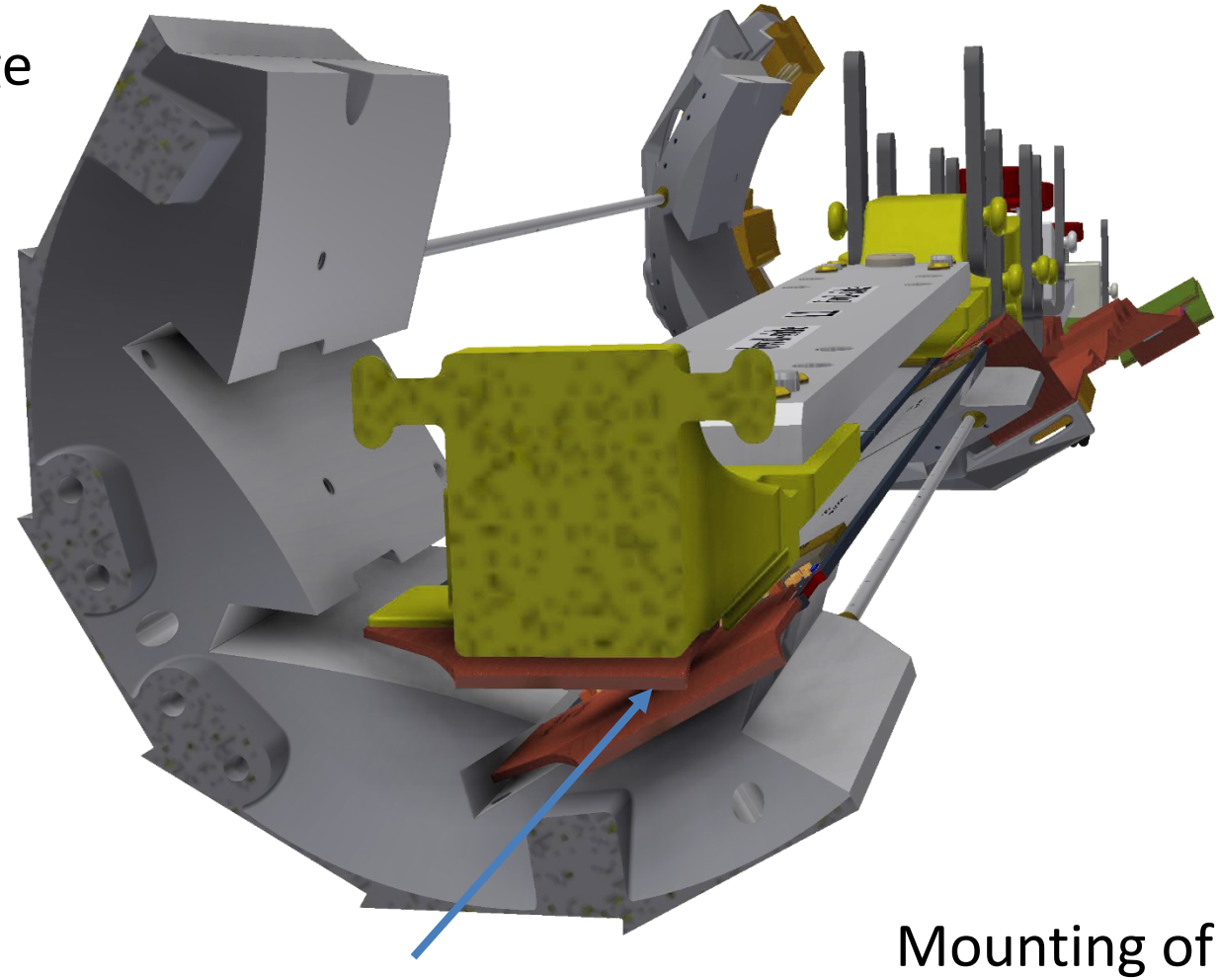


Ladder Ready to Rotate on the SCB-HS (z-Guide)



Ladder Mounting: Layer 1, Ladder 2(3)

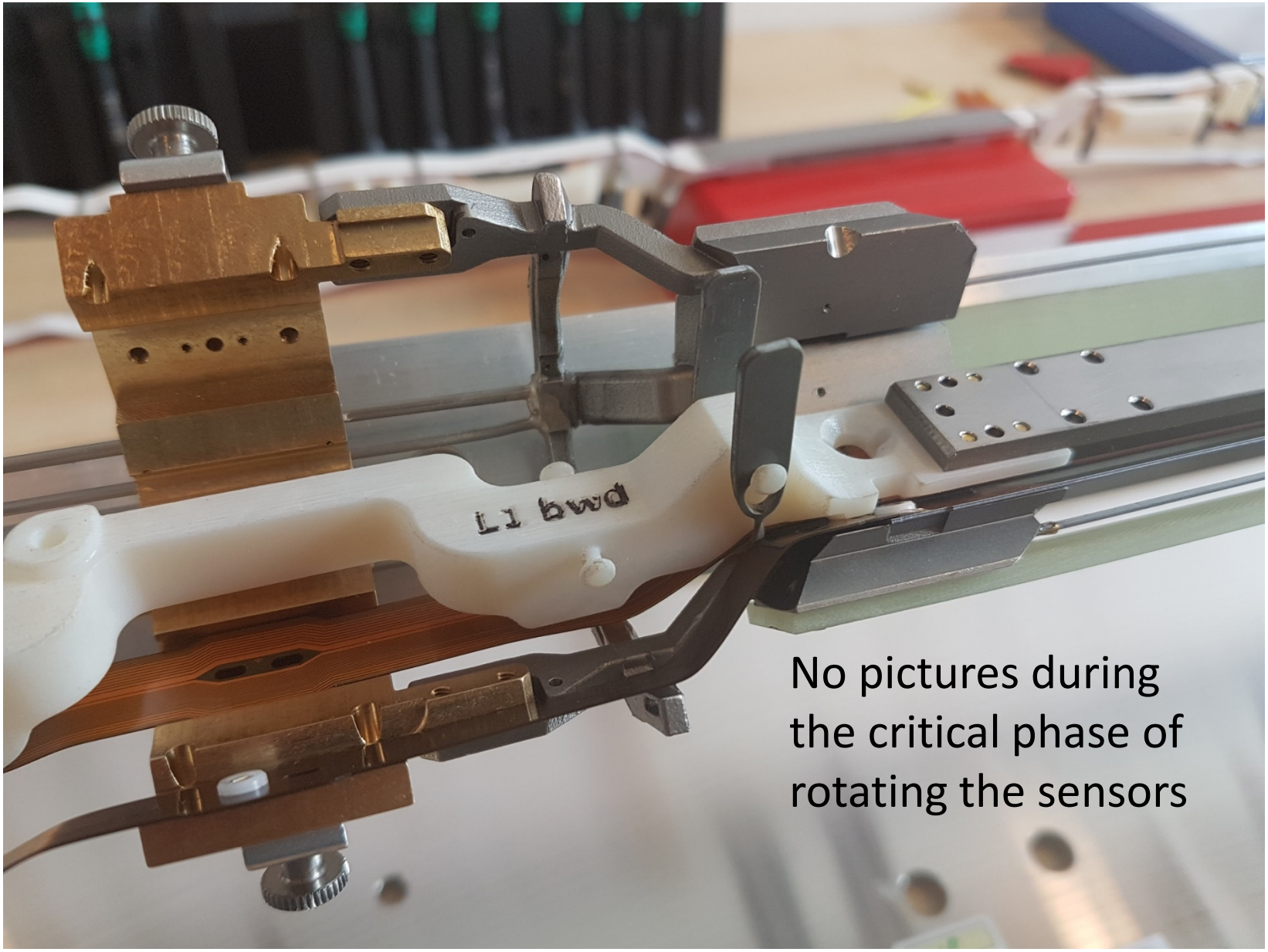
Rotate stage by 45°



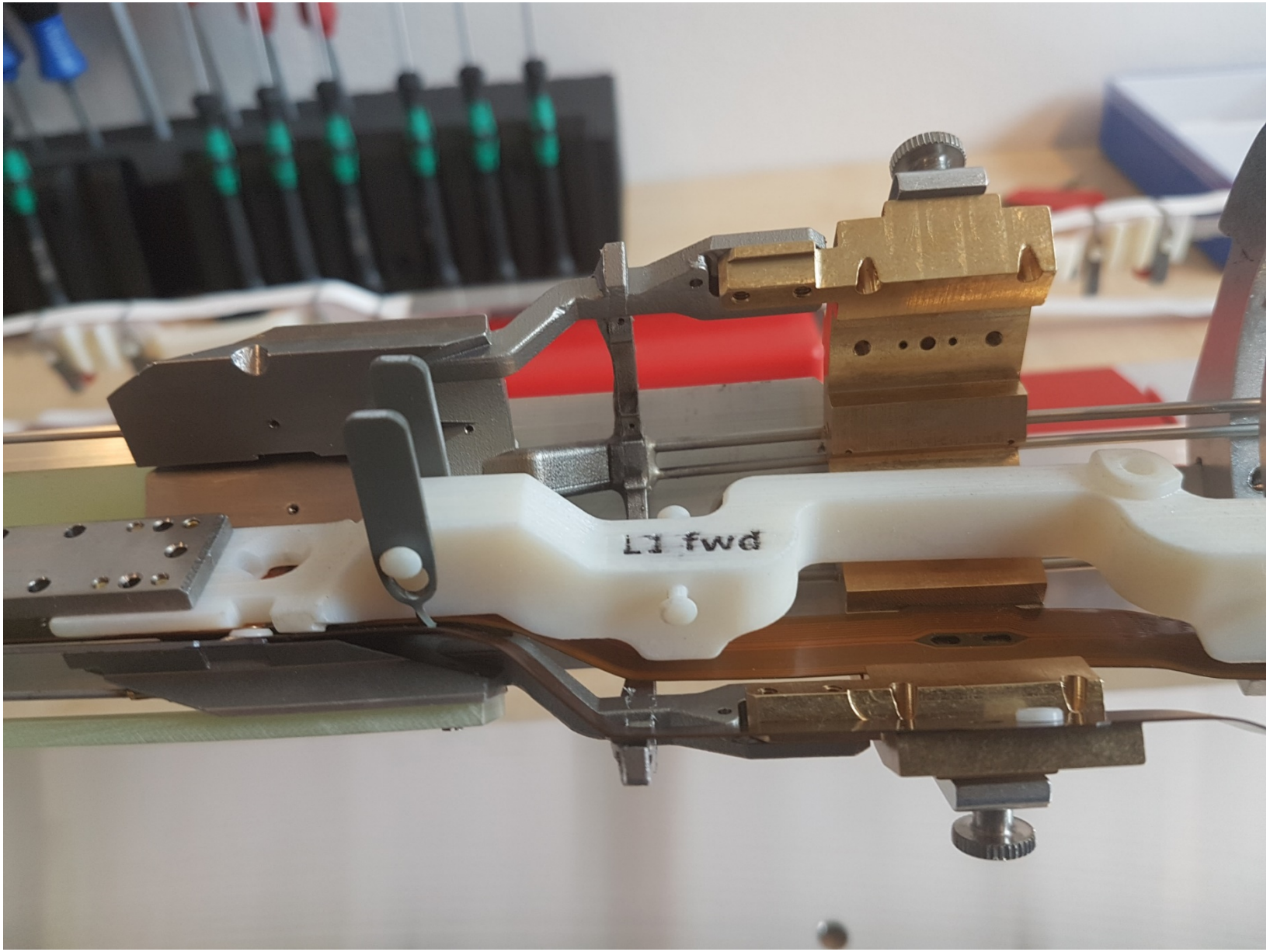
Mounting of Ladder 2

Kapton(2) touches Kapton(1)

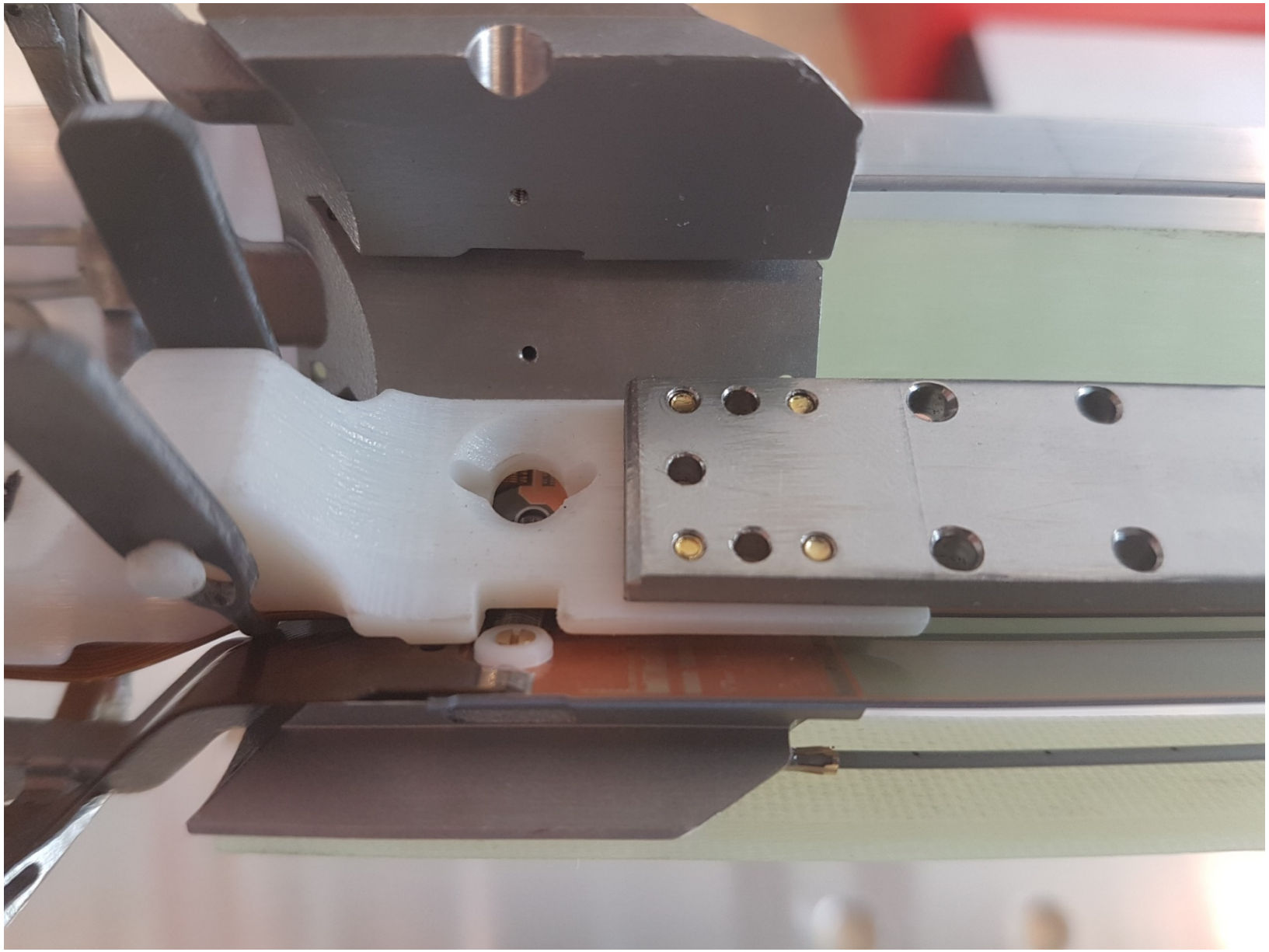
Ladder2 Rotated, in Position (BWD)



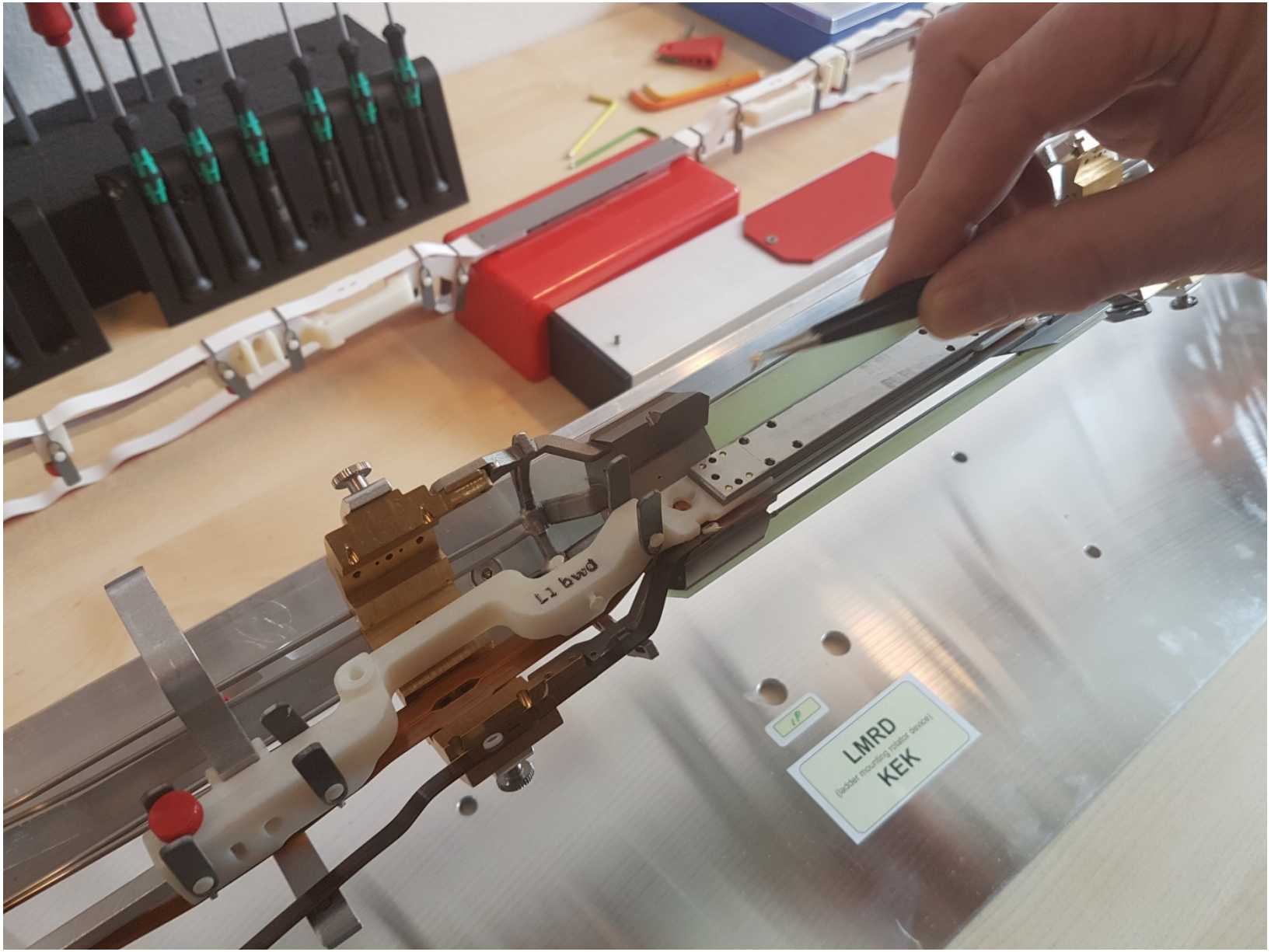
Ladder2 Rotated, in Position (FWD)



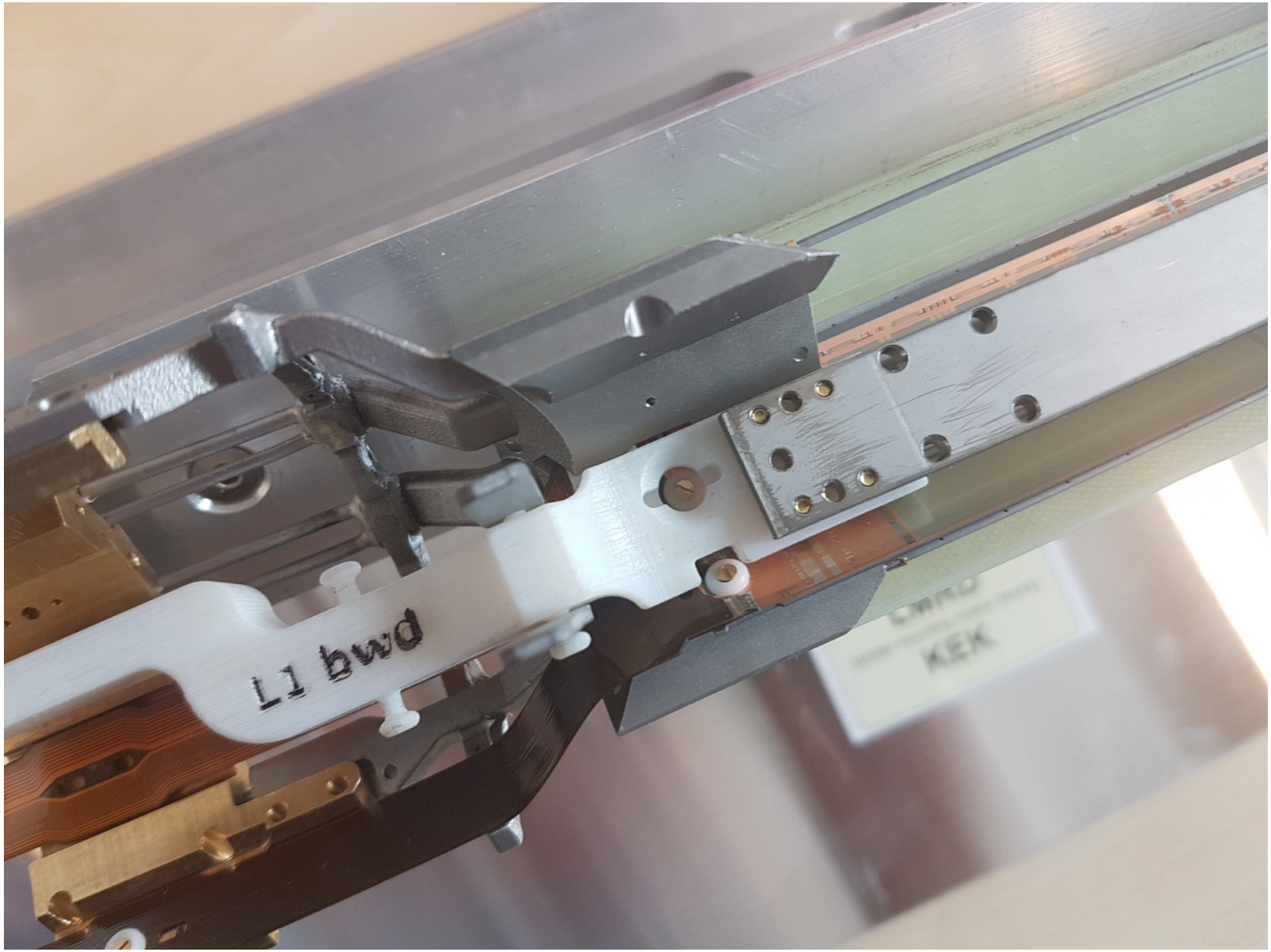
Ladder2 Ready to be Fixed (BWD)



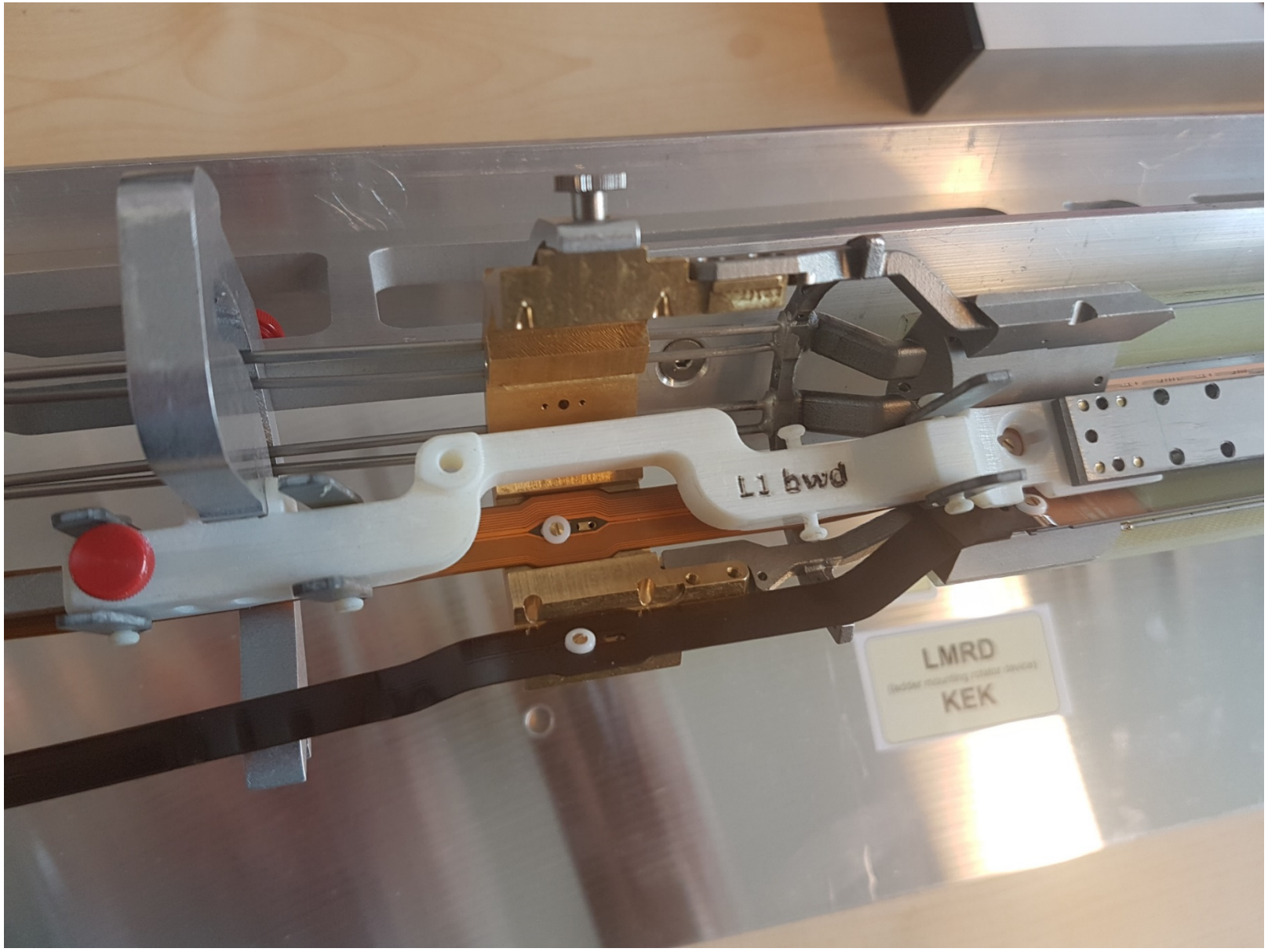
Ladder2 Ready to be Fixed (BWD)



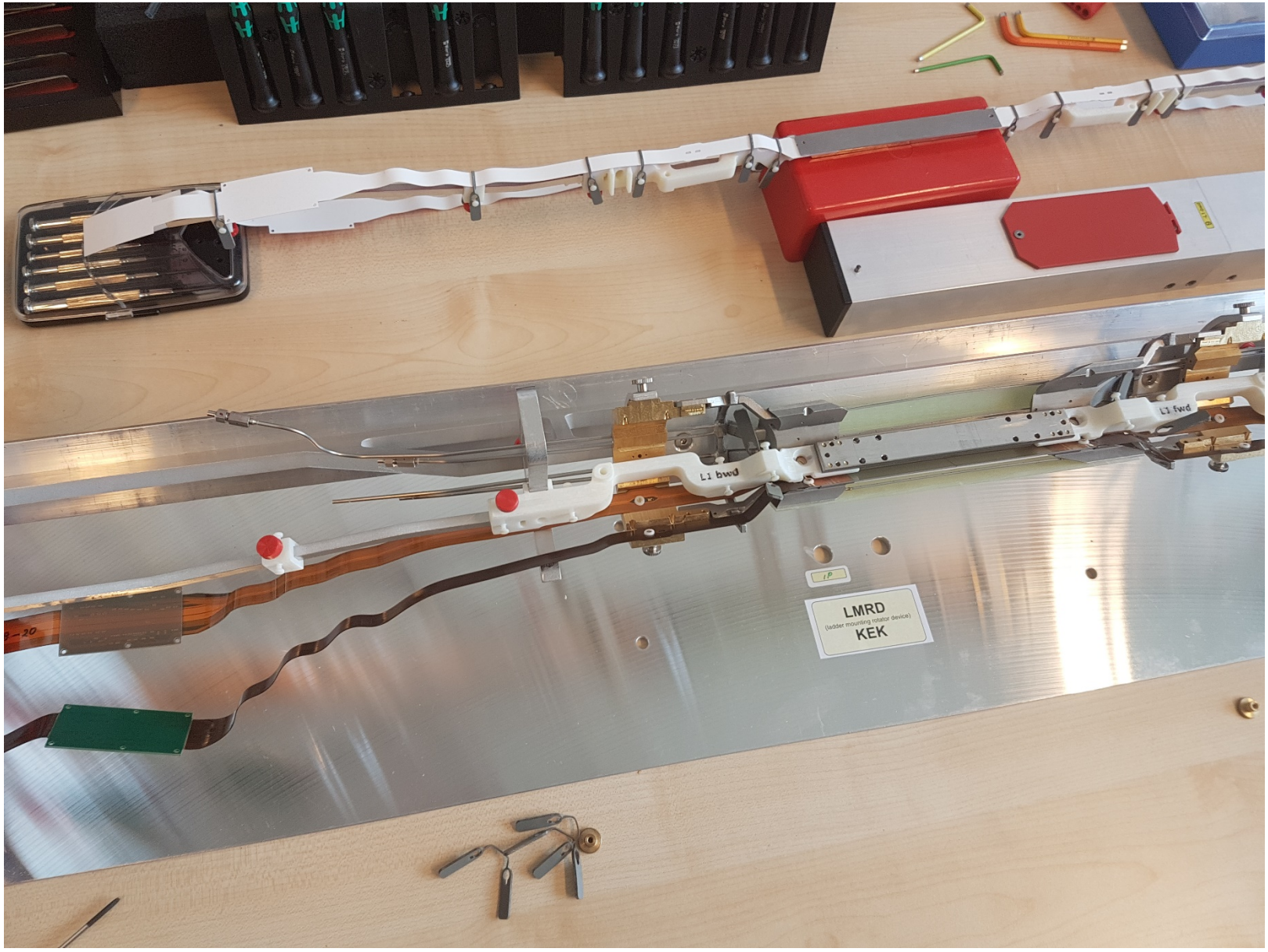
Ladder2 Fixed (BWD)



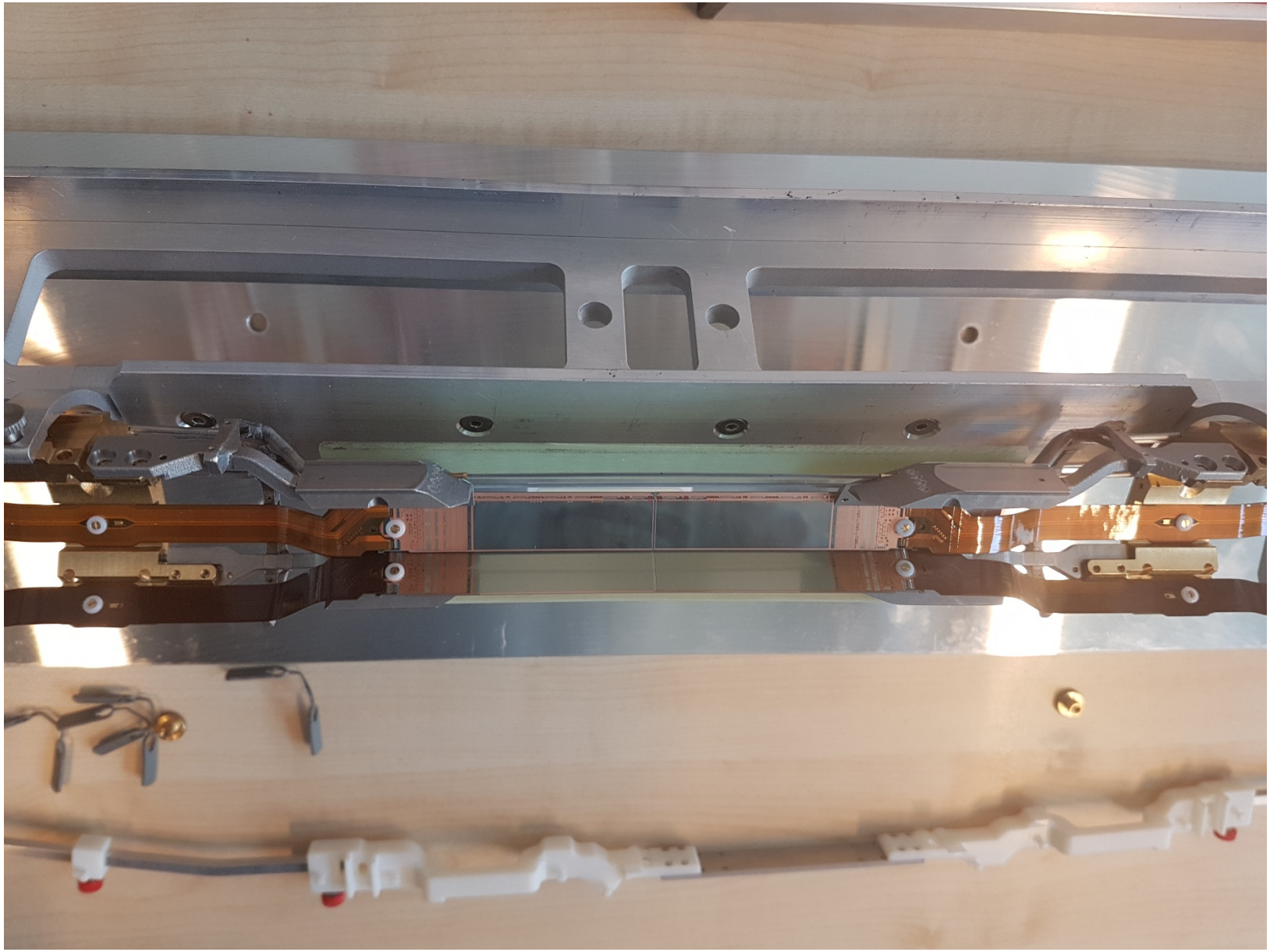
Kapton Fixed (BWD)



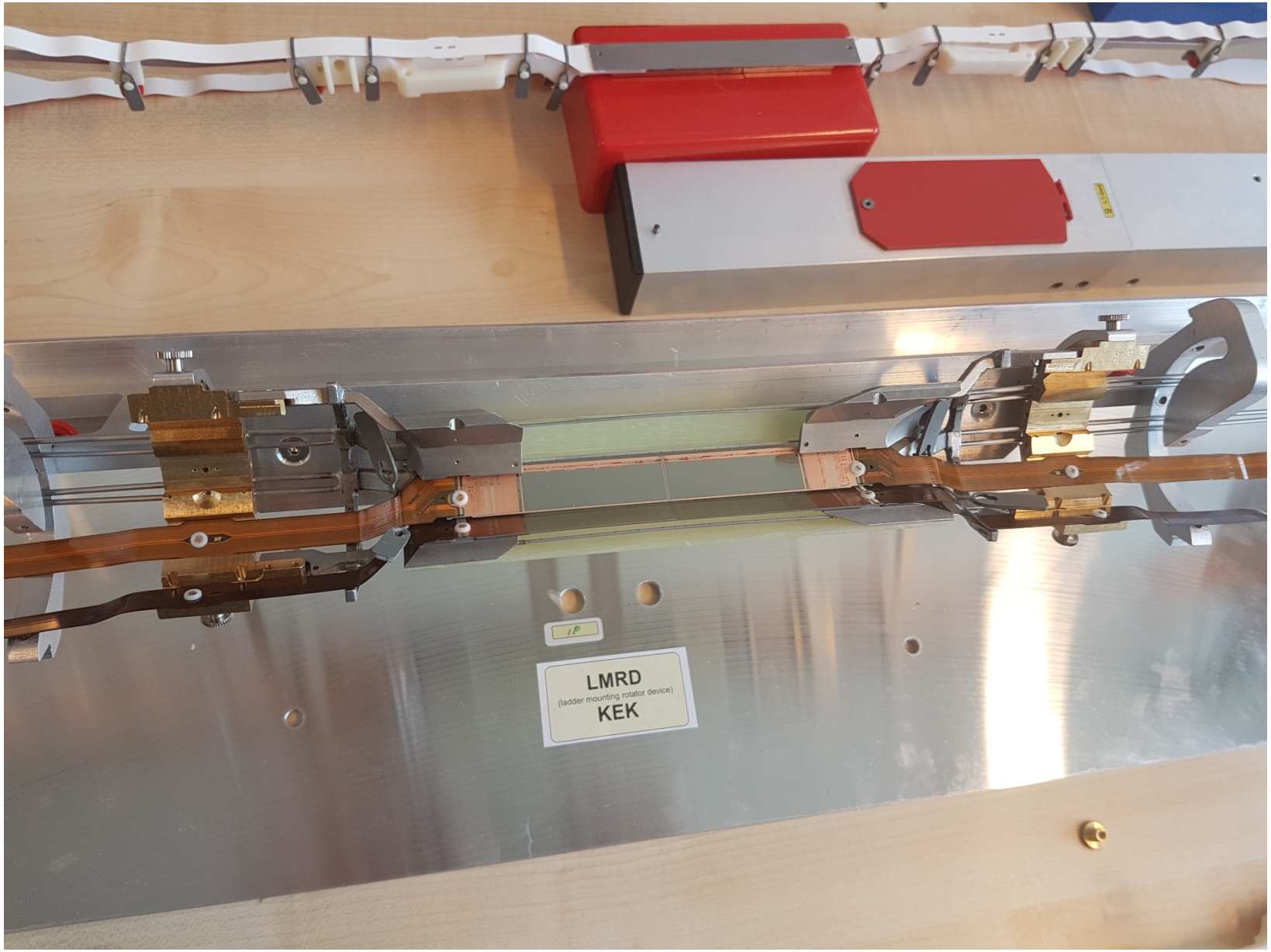
Remove Rubber Fixtures From Kapton



Ladder Mount Jig Removed

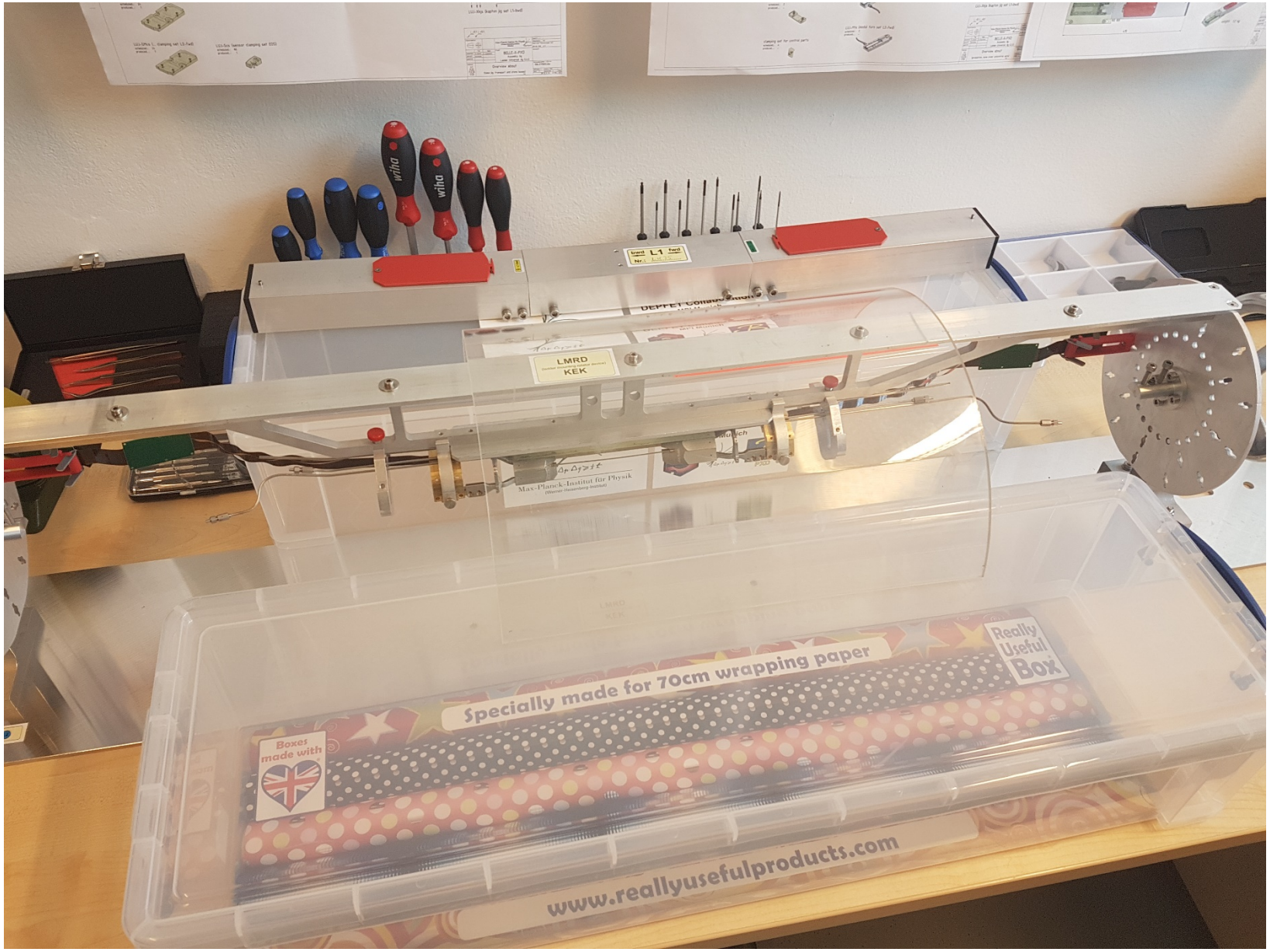


Ladder Mount Jig Removed



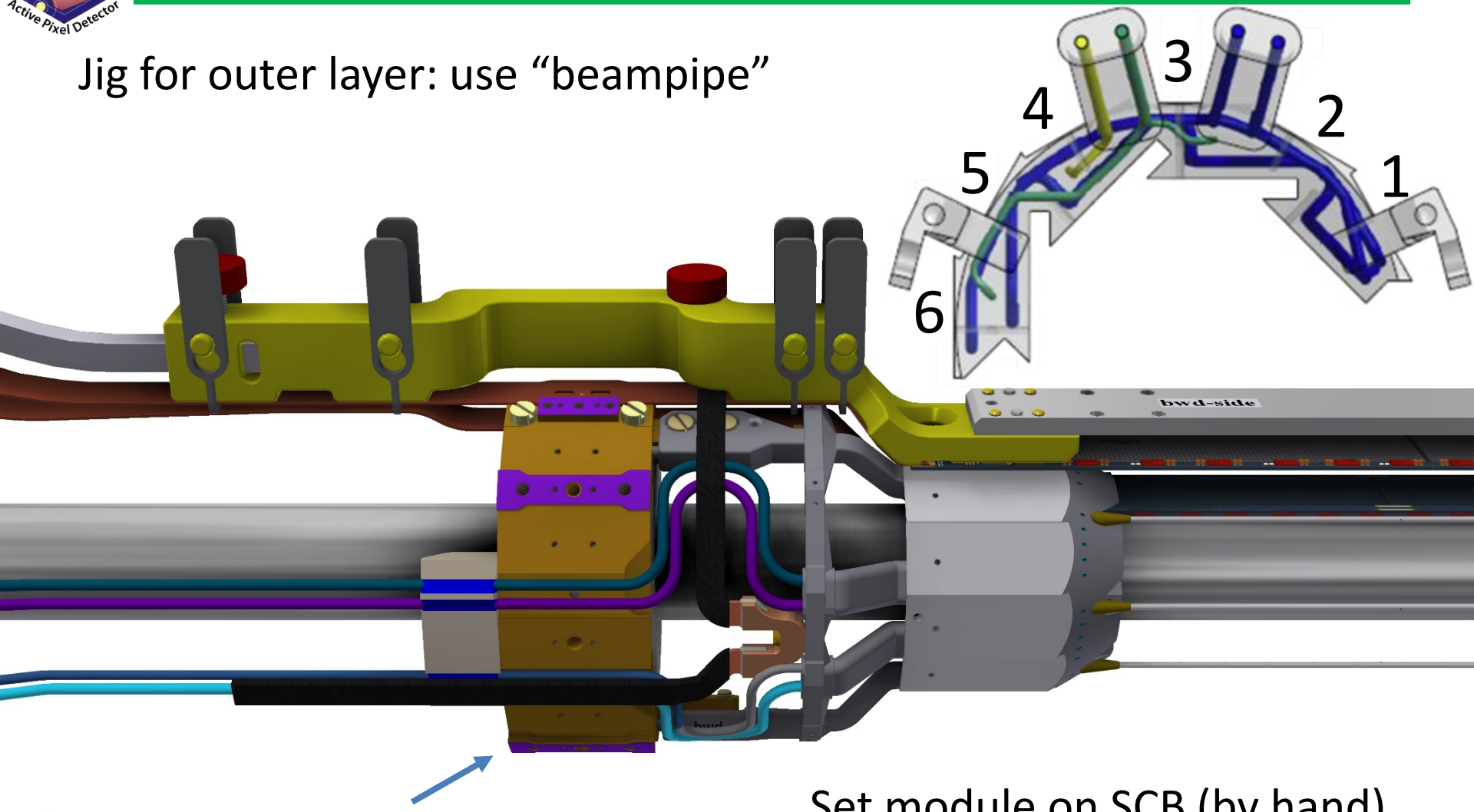
LMRD Rotated (for Protection of the Ladders)

Assembly Secured by Plastic Cover



Mount Outer Ladders on Half Shell

Jig for outer layer: use “beampipe”



Half Shell support
(fixed on “mount block”)

Set module on SCB (by hand)
- Screw module to SCB
- Screw Kapton to SCB support

Summary of Ladder Mount Procedure

- 1st SCB-HS built, can be used for ladder mount, but ohmic connection observed between SCB and brass support (=beampipe) -> to be fixed

- 2nd half shell on hold: problem with blocked N2 line to switchers on BWD SCB - > should be fixed first before gluing

- Fallback: have 4 more SCBs for another 2 full SCB Half shells –> need to braize SS tubes and Parylen (~ 4 weeks)

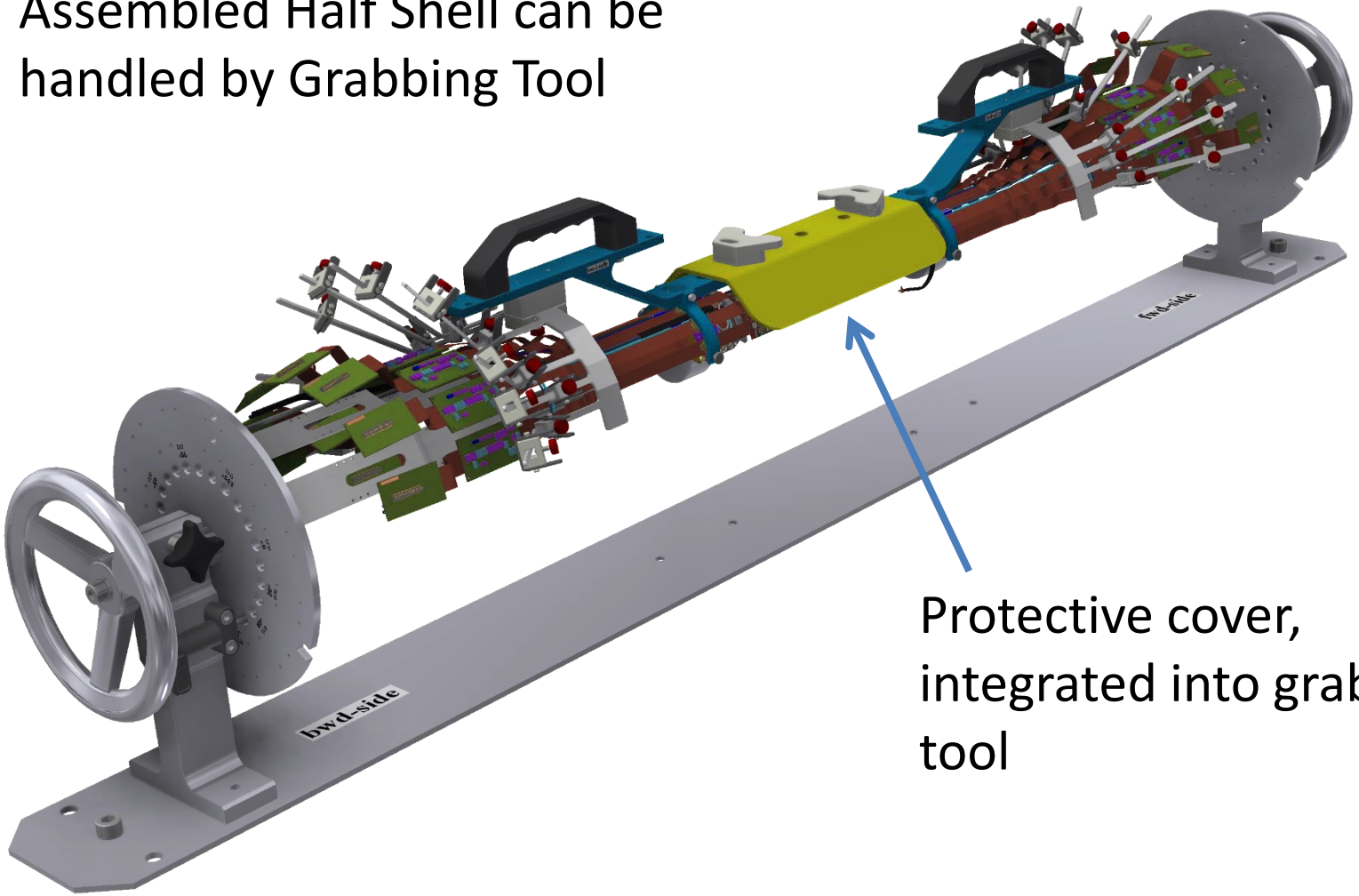
- Ladder mount procedure has been exercised for critical Layer1, dummy ladder 1 and 2 (no ASICs, but Kapton) were mounted -> Tscharlie‘s procedure / tooling works!

- Now documentation steps need to be completed, all 4 dummies for L1 to be mounted by technicians according to docu.

- Mounting of SCB-HS to be exercised at DESY (fix grounding first)

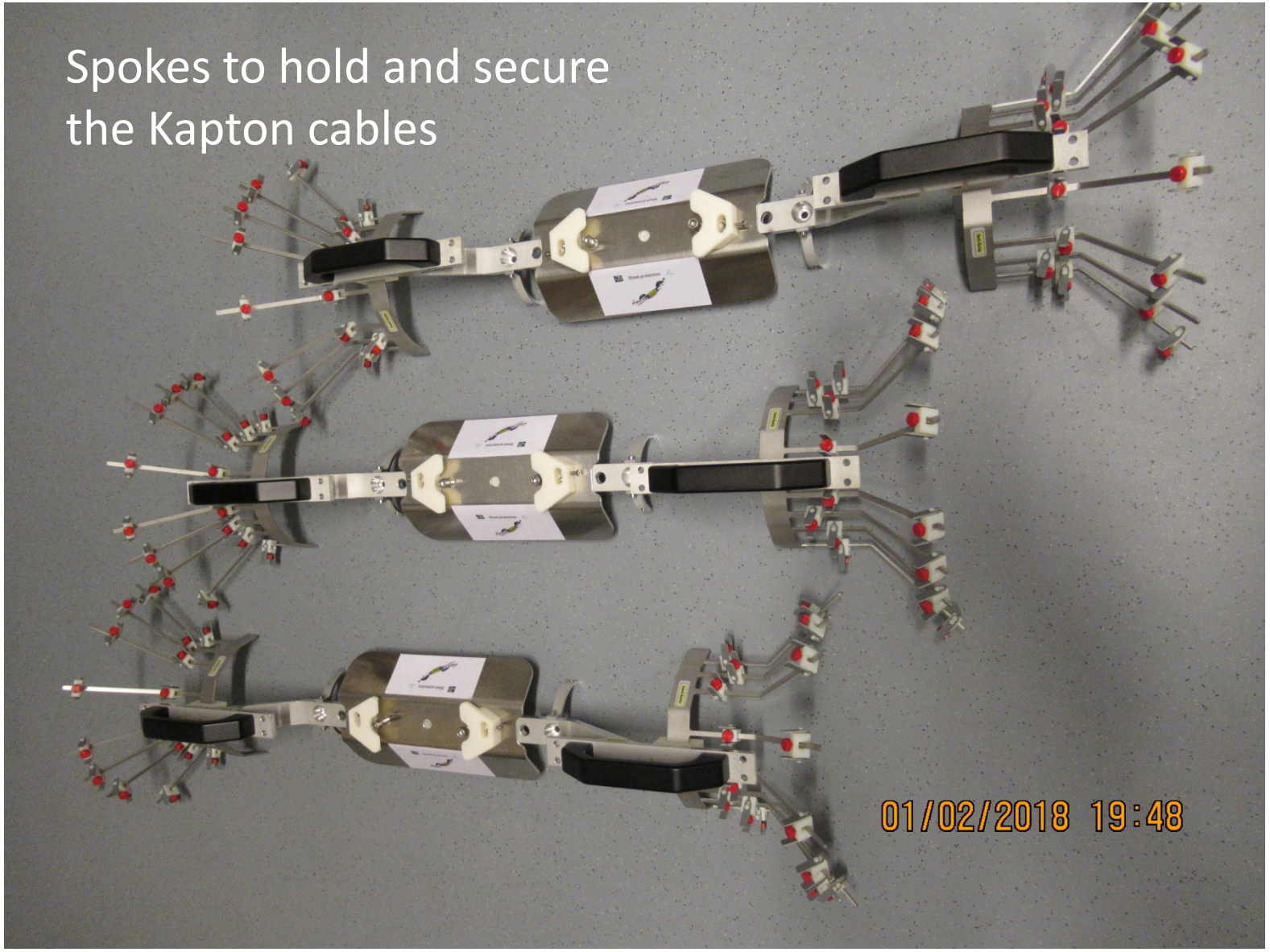
Mounting on Beampipe: Grabbing Tool

Assembled Half Shell can be handled by Grabbing Tool

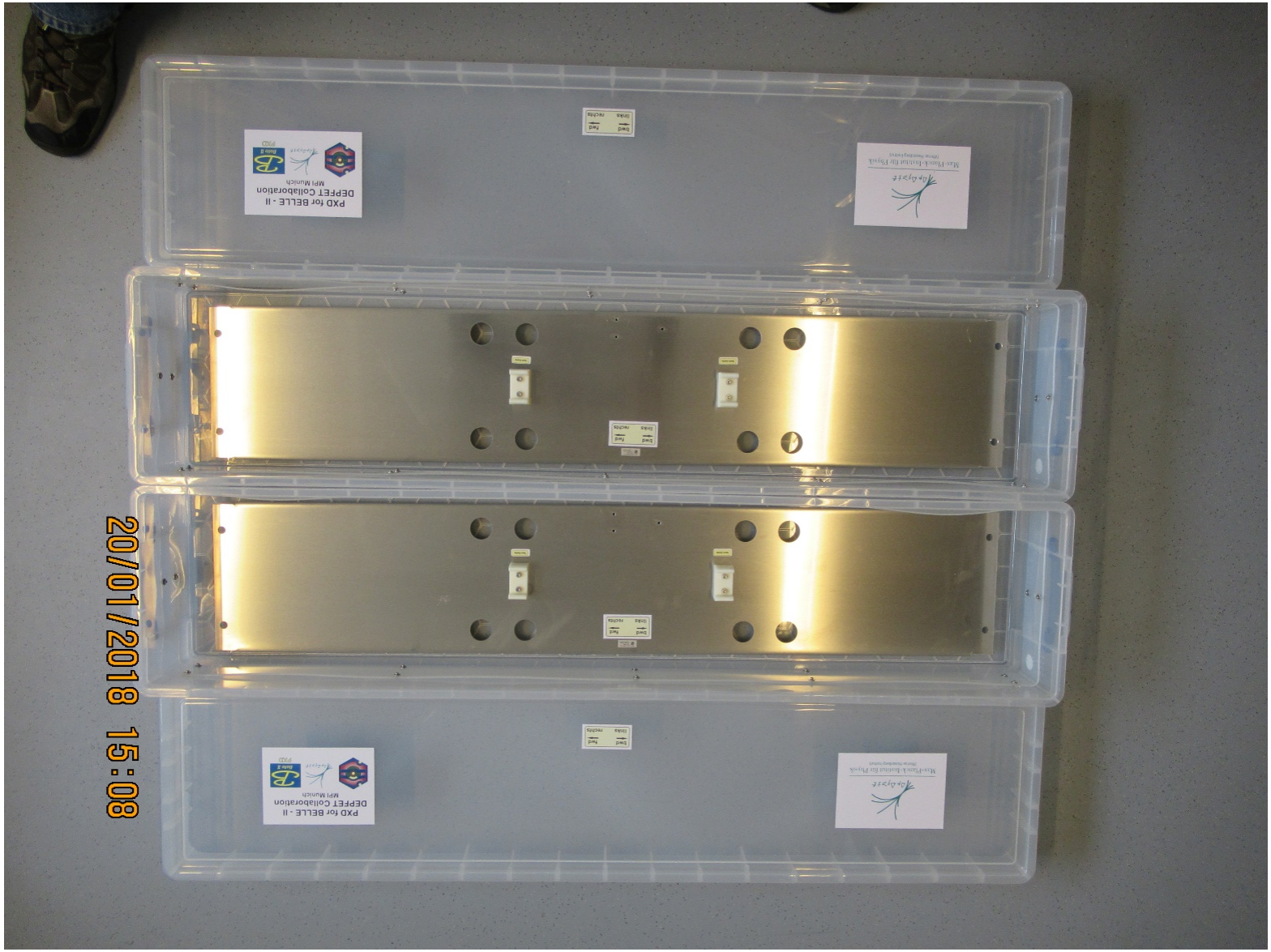


Protective cover, integrated into grabbing tool

Hardware Preparation of Grabbing Tool

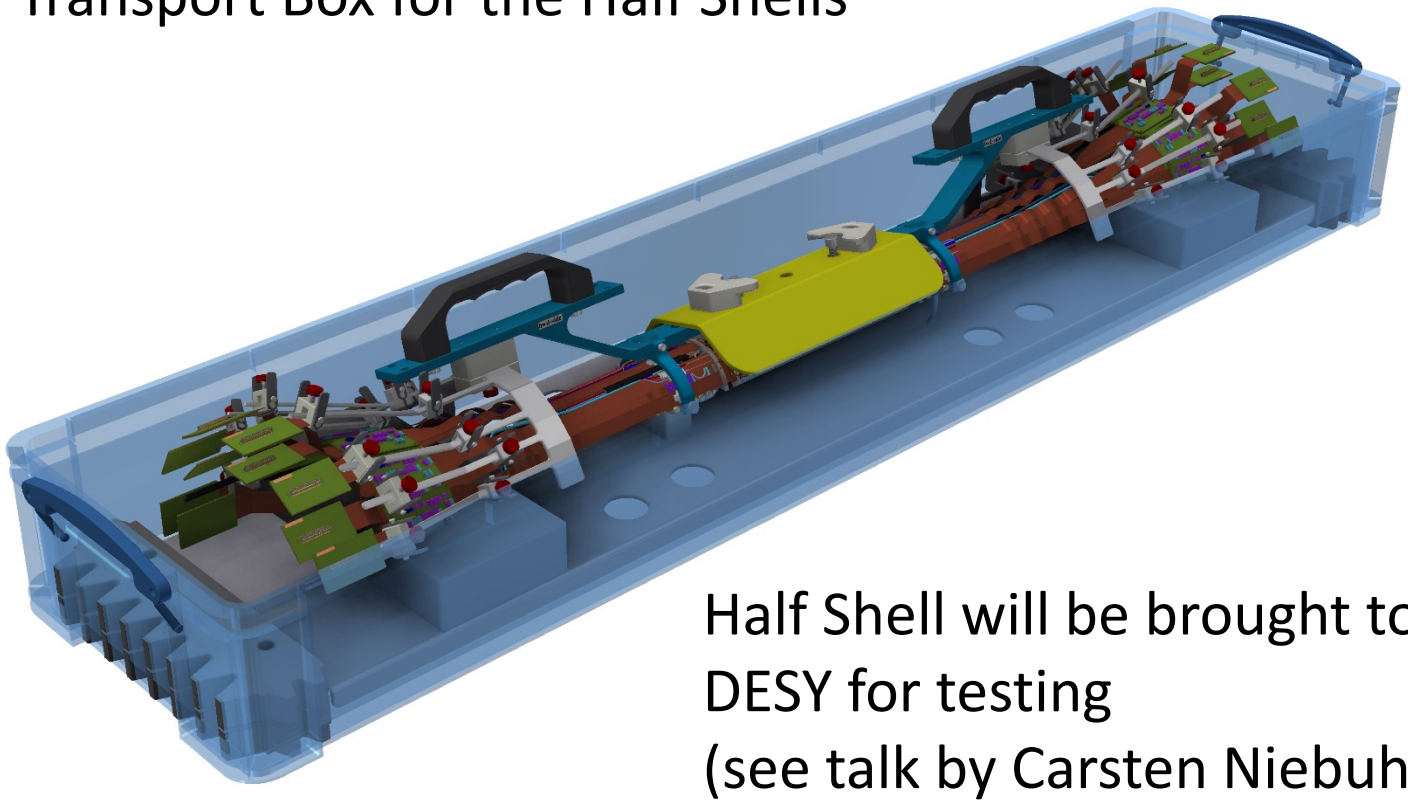


Transport of Half Shells



Transport of Half Shells

Transport Box for the Half Shells

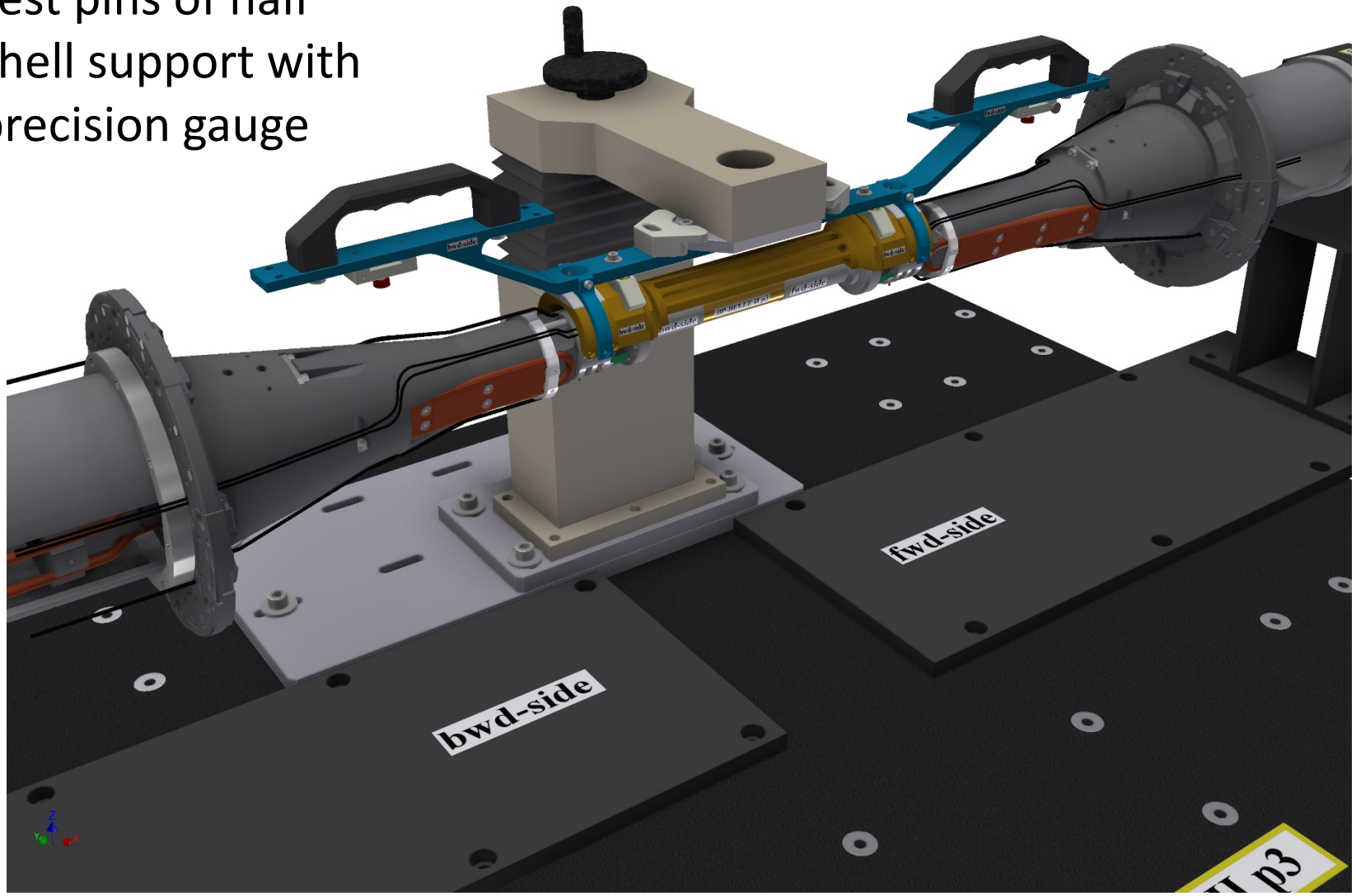


Half Shell will be brought to DESY for testing
(see talk by Carsten Niebuhr at Oct 2017 B2GM)

After DESY test half shell goes to KEK

Half Shell Mounting Tool

Test pins of half shell support with precision gauge

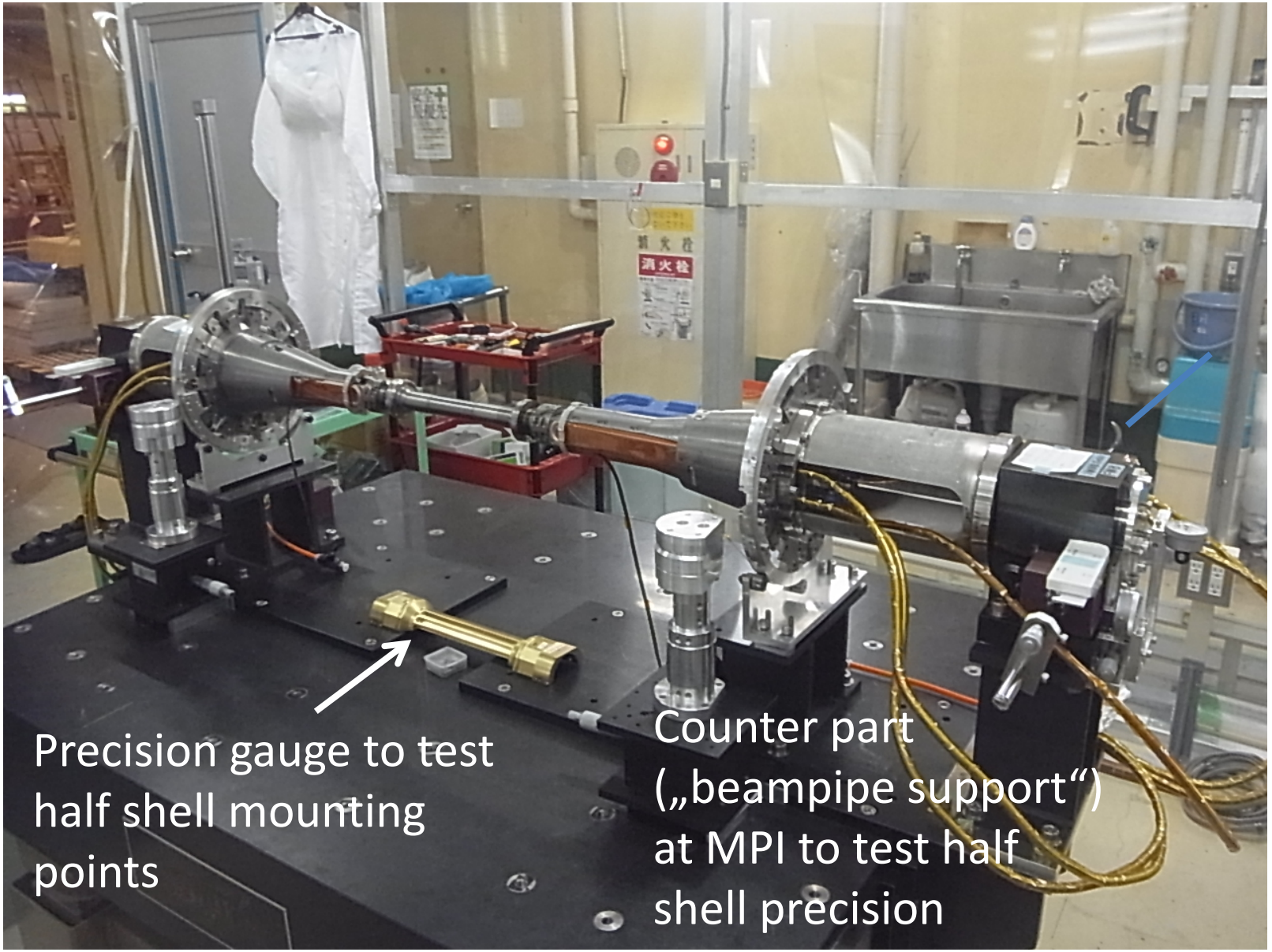


First Half Shell Mounting Exercises

PXD half shell mounted from top

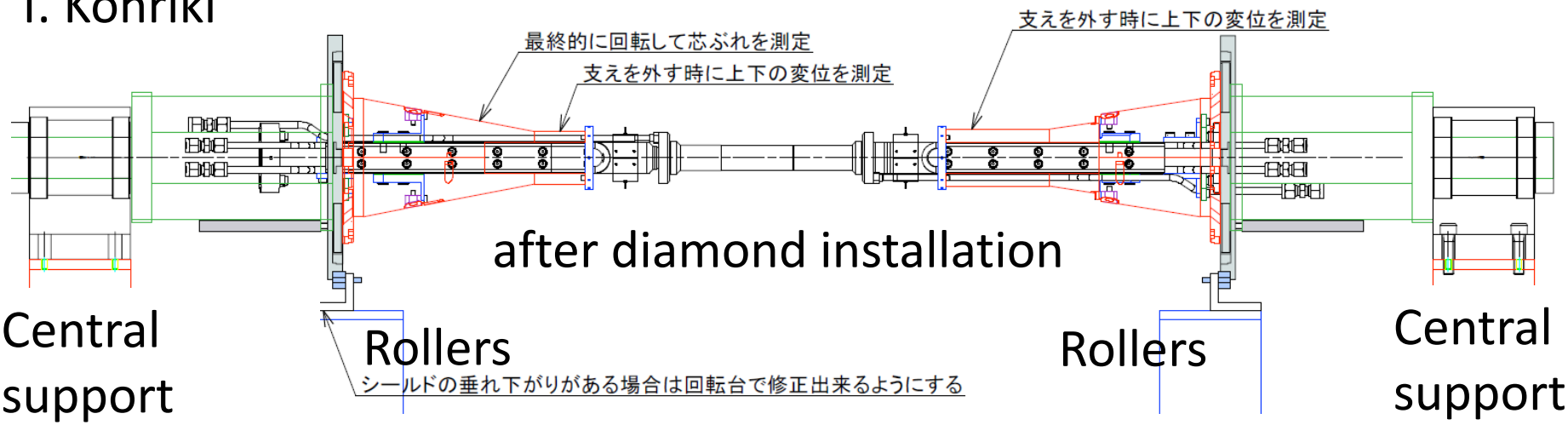
Mechanical / electrical isolation test of half shell to beampipe

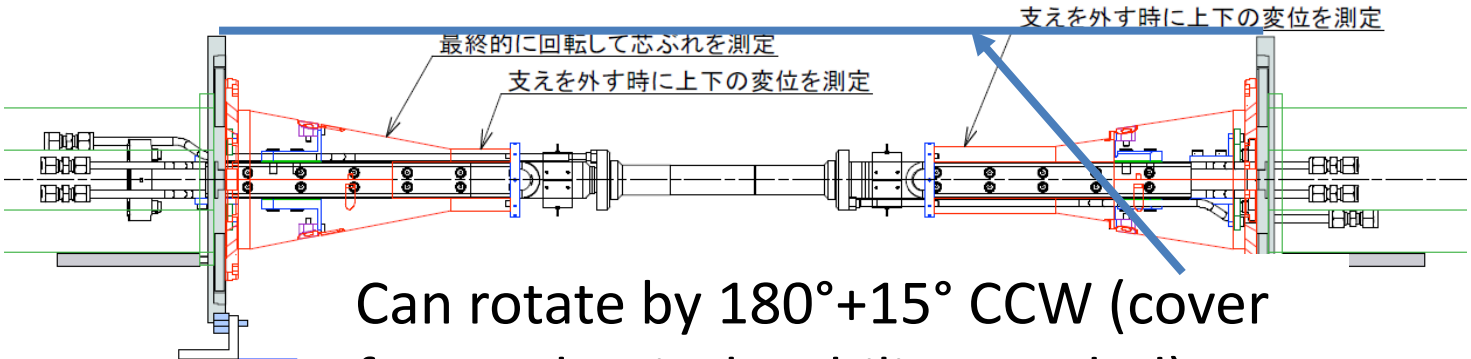
Half Shell Mounting in Clean Room



PXD Assembly (Discussion Finalized)

T. Kohriki



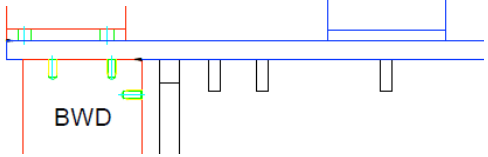


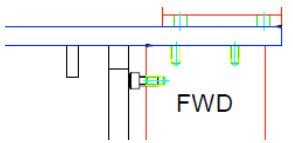
Rollers

シールド

Can rotate by 180°+15° CCW (cover for mechanical stability needed)
mount -y half shell, test
rotate by 180° CW,
mount +y half shell, test

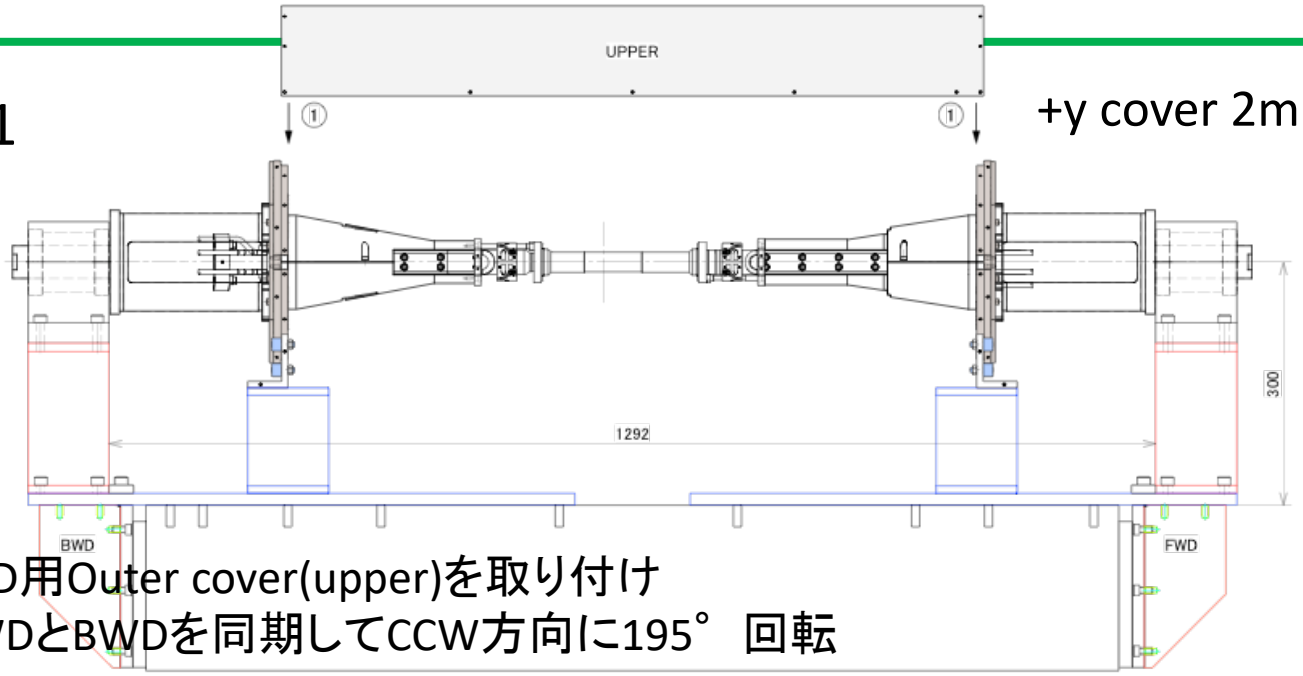
Rollers



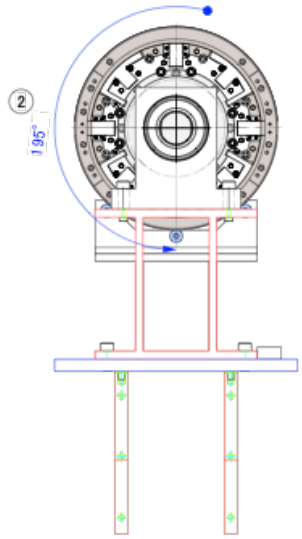


PXD Assembly

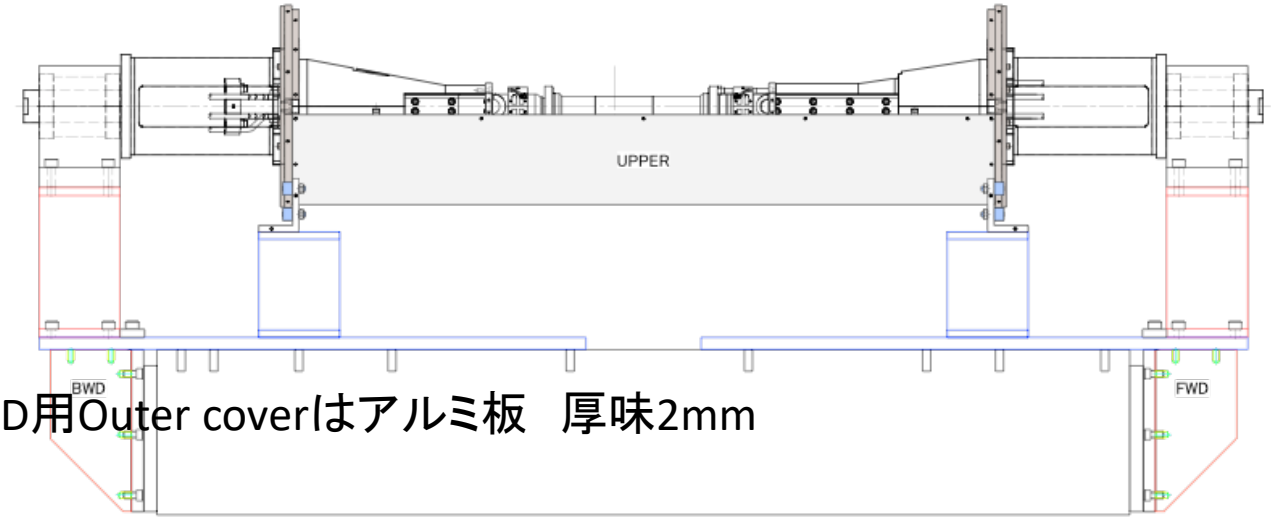
- STEP 1

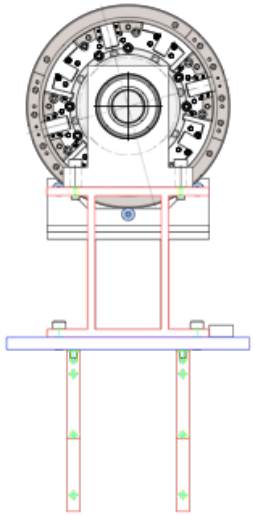


+y cover 2mm Al



- PXD用Outer cover(upper)を取り付け
- FWDとBWDを同期してCCW方向に195°　回転

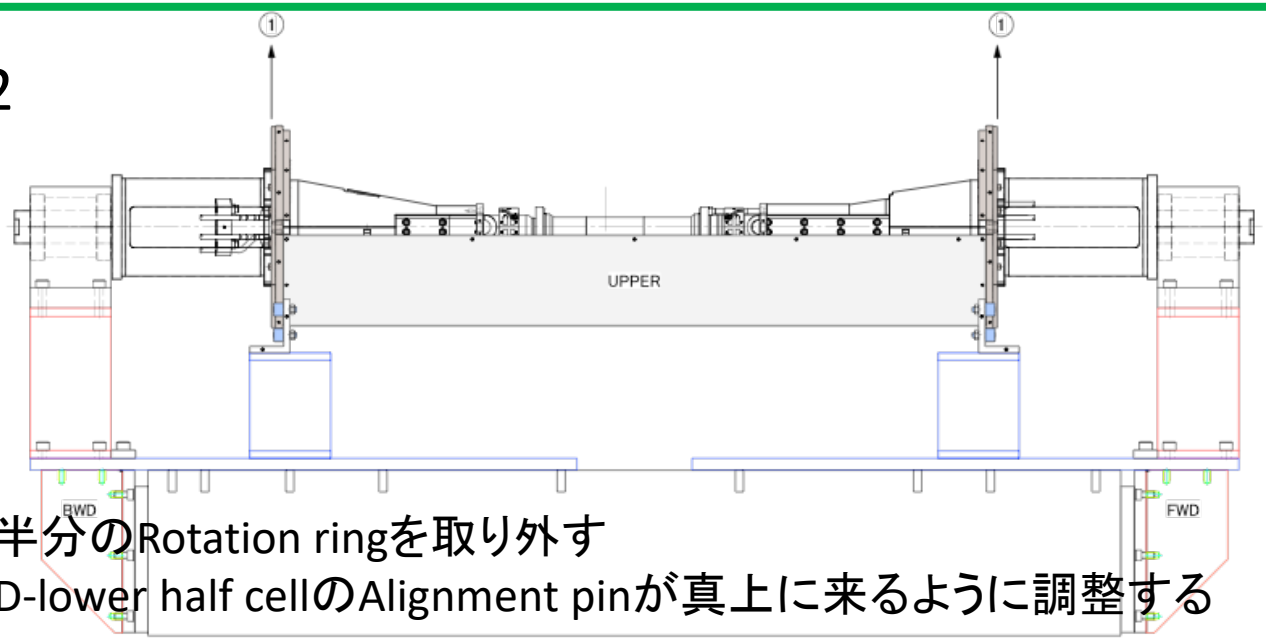


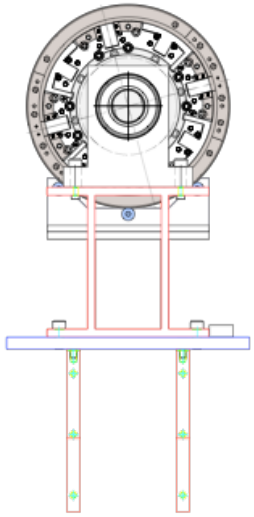


- PXD用Outer coverはアルミ板　厚味2mm

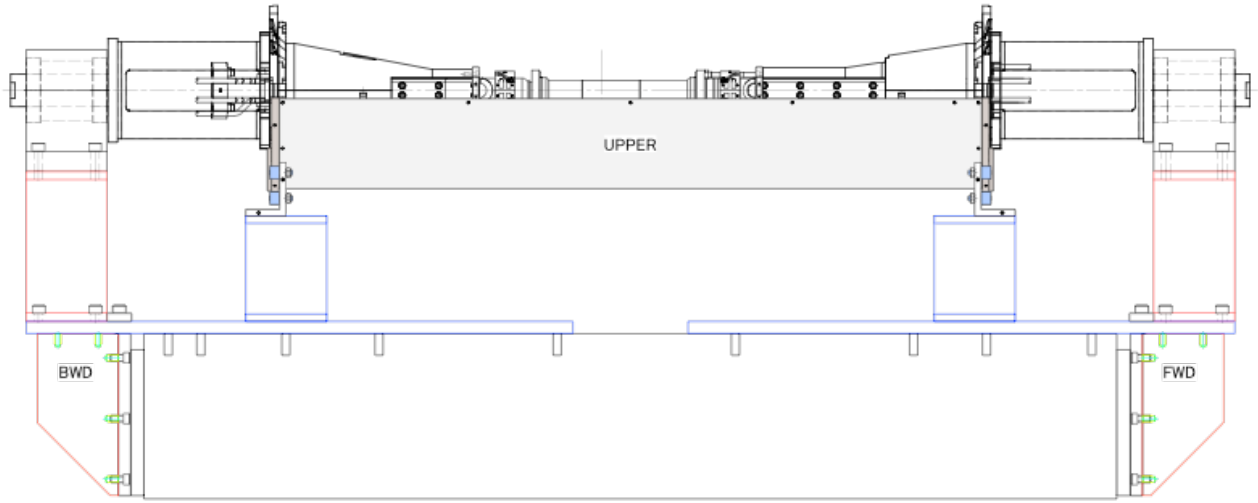
PXD Assembly

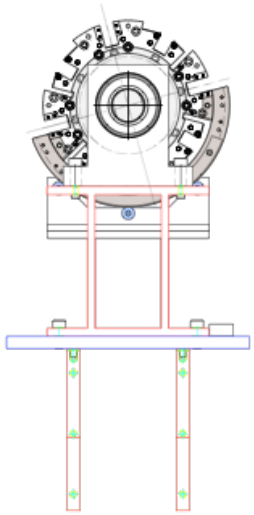
- STEP 2





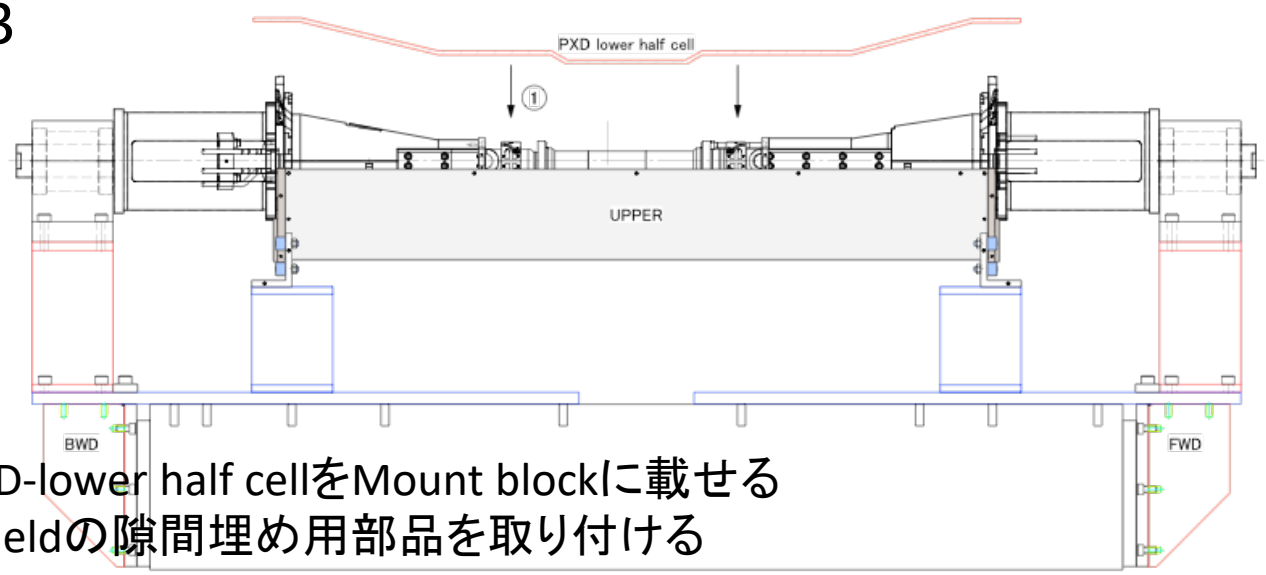
- 上半分のRotation ringを取り外す
- PXD-lower half cellのAlignment pinが真上に来るように調整する

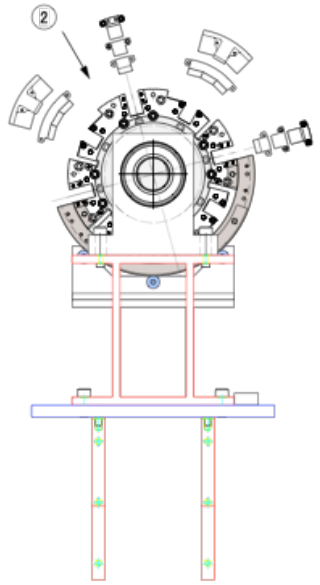




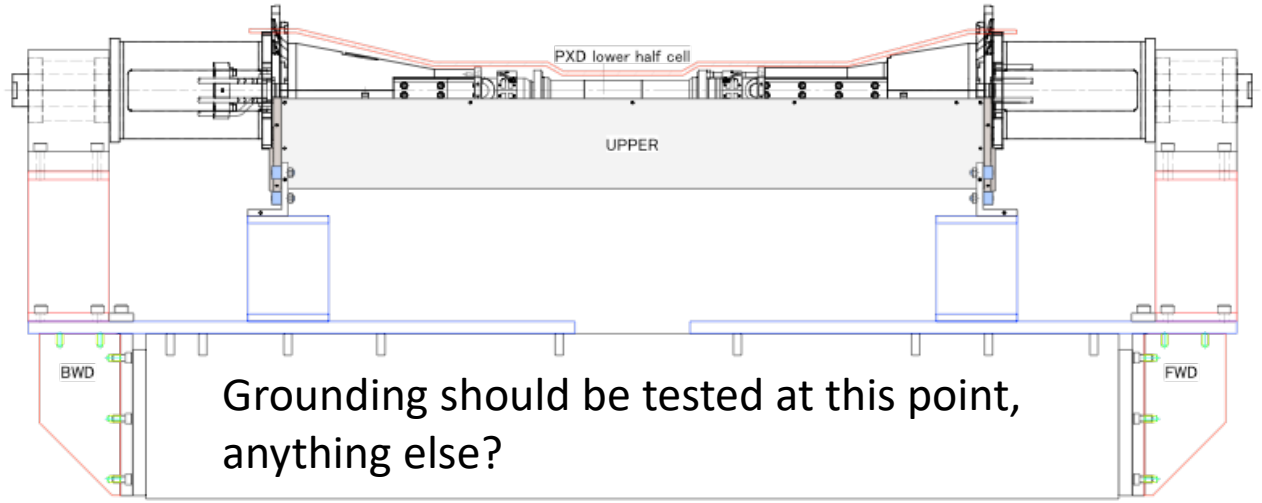
PXD Assembly

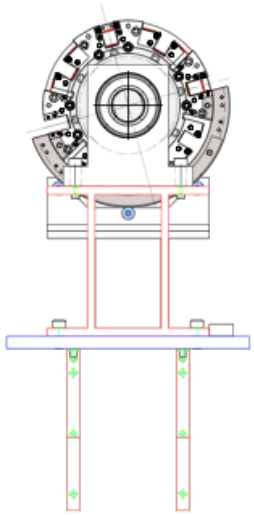
- STEP 3





•PXD-lower half cellをMount blockに載せる
•Shieldの隙間埋め用部品を取り付ける

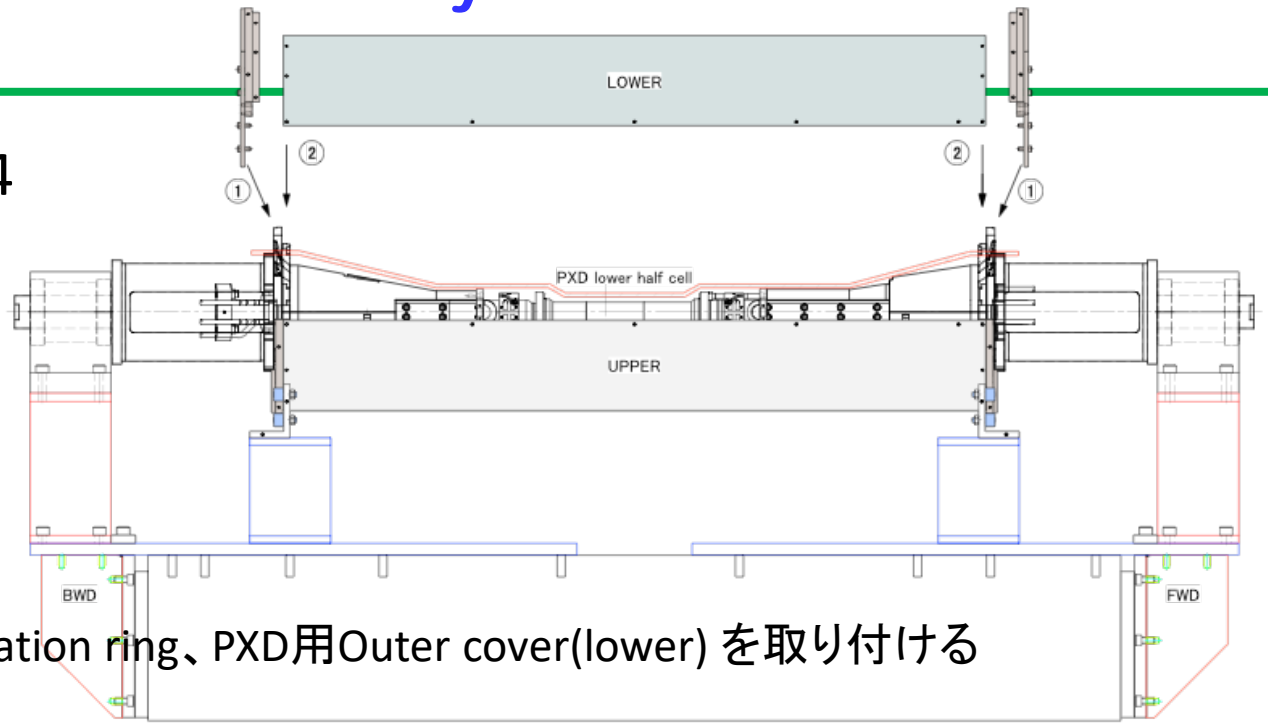


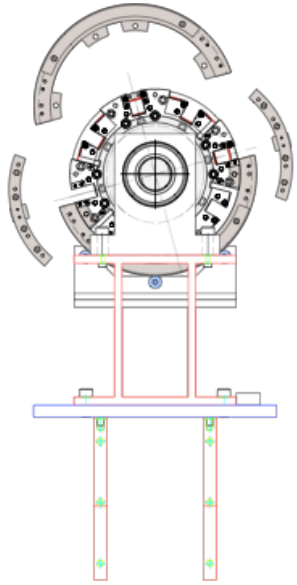


Grounding should be tested at this point, anything else?

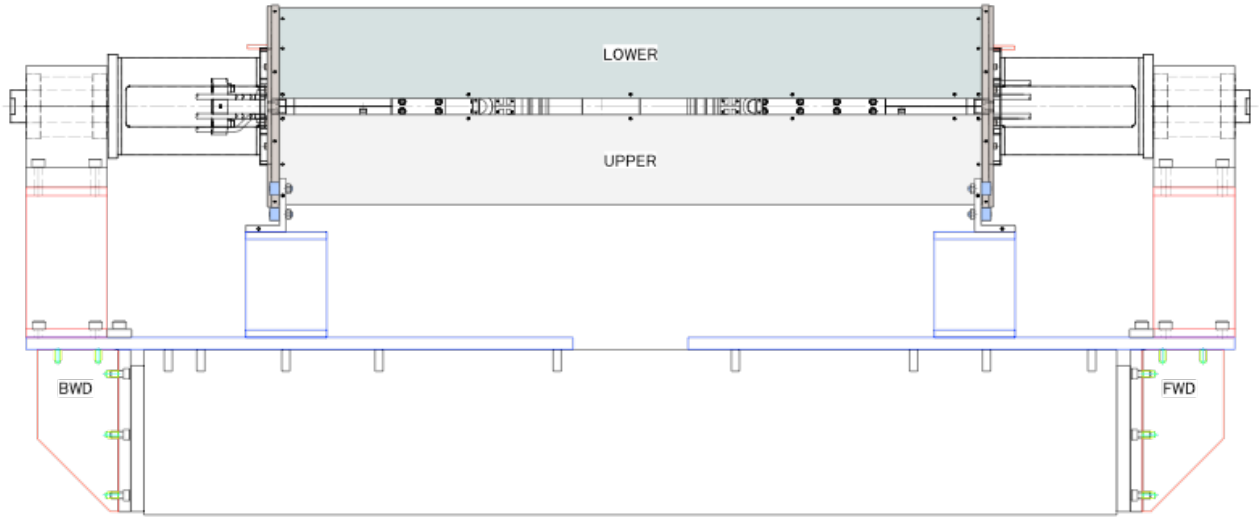
PXD Assembly

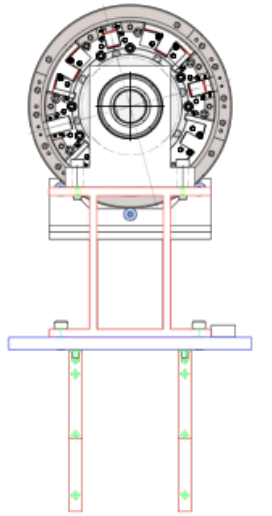
- STEP 4





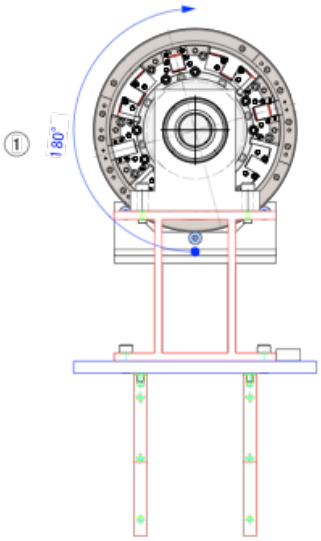
•Rotation ring、PXD用Outer cover(lower) を取り付ける



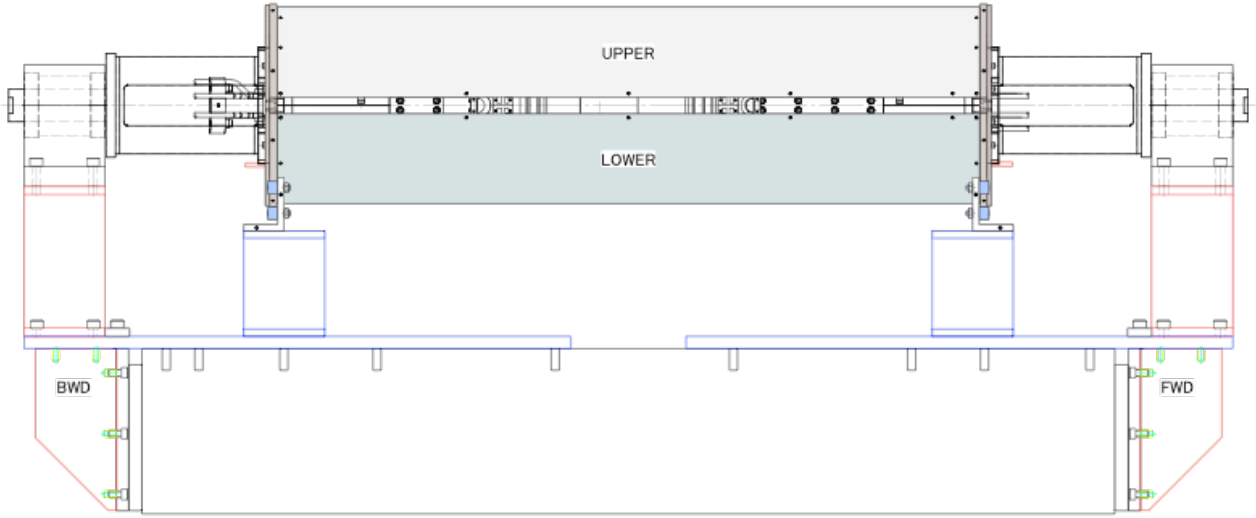


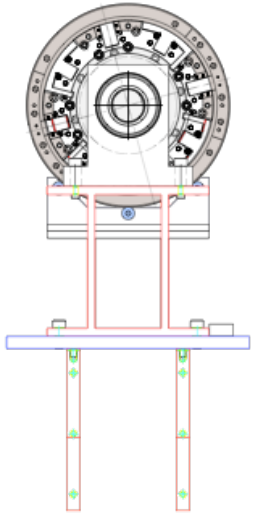
PXD Assembly

- STEP 5



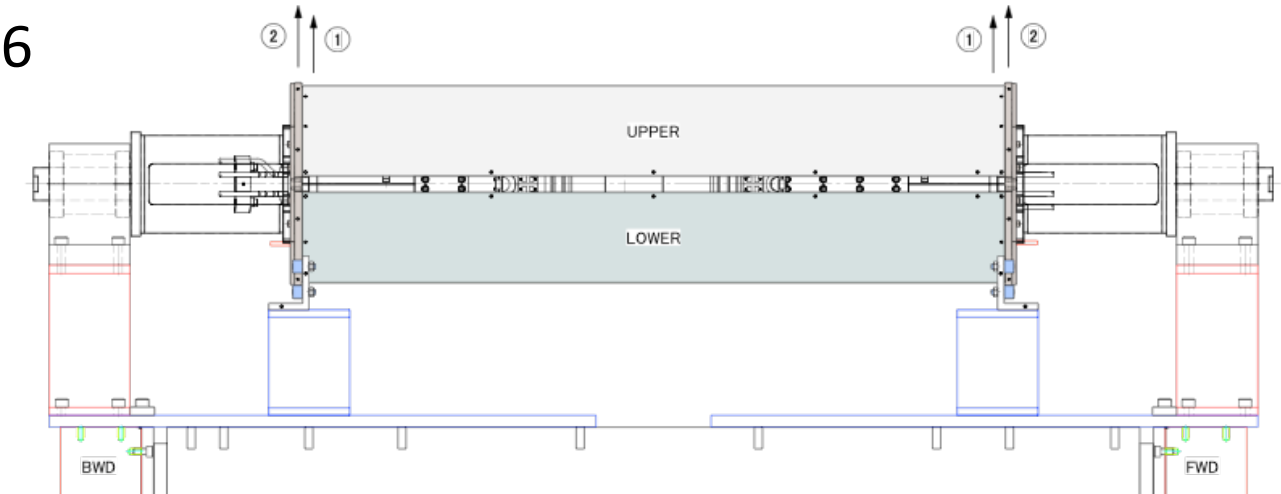
•FWDとBWDを同期してCW方向に180° 回転する

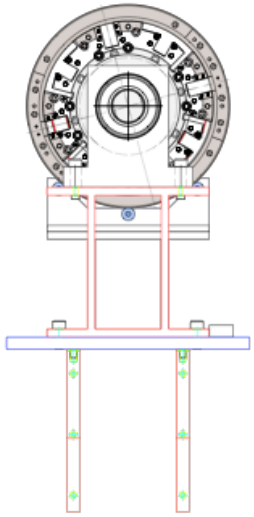




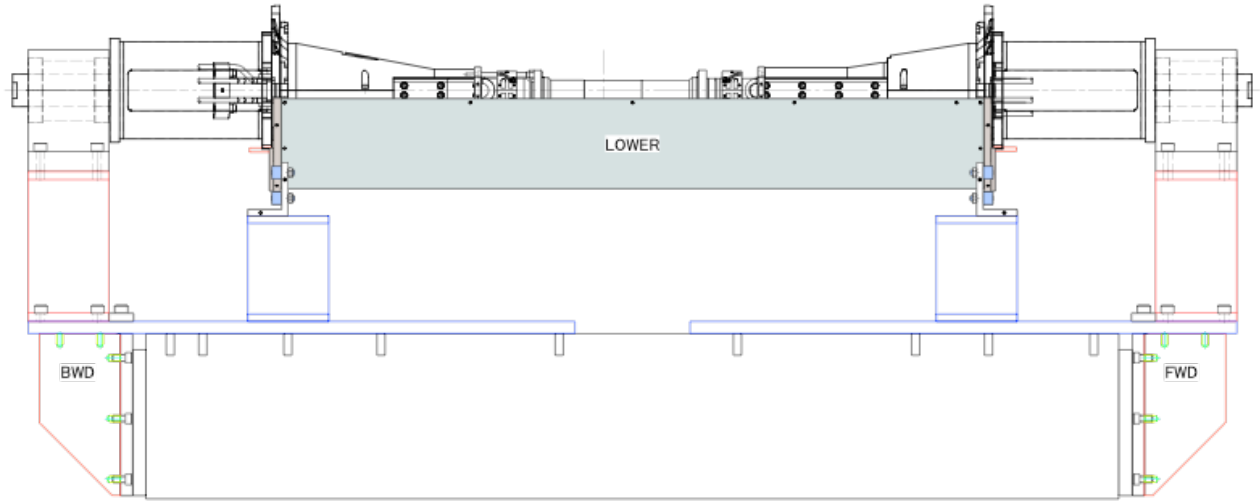
PXD Assembly

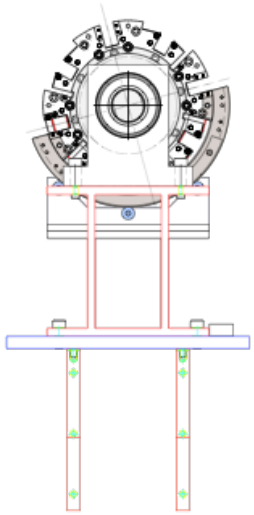
- STEP 6





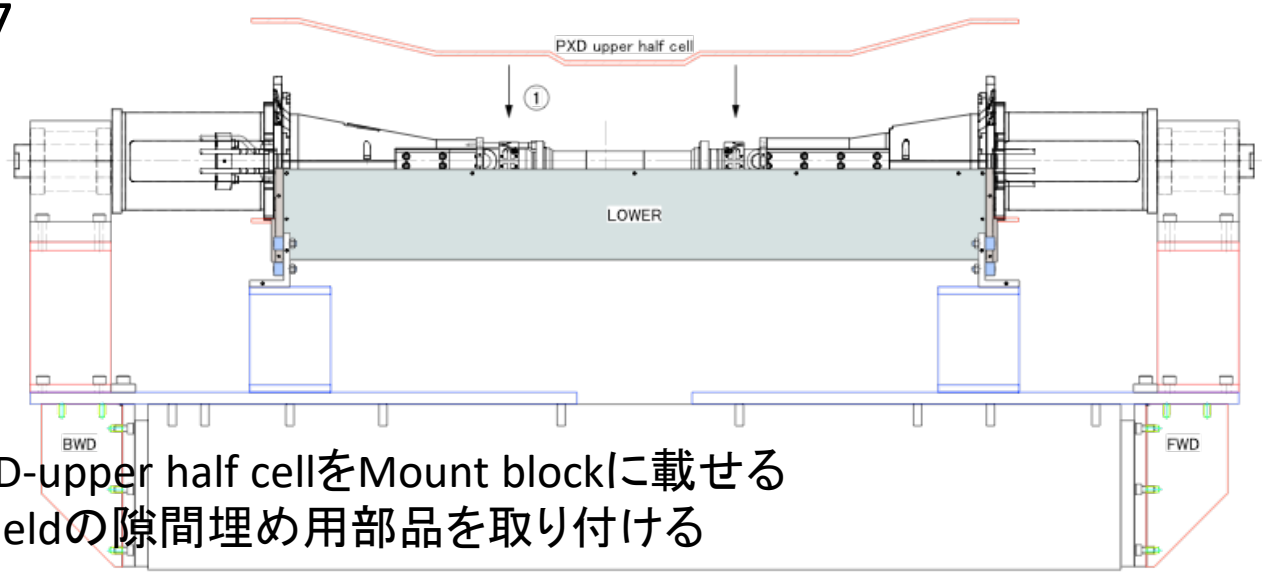
•PXD用Outer cover(upper)、上半分のRotation ringを取り外す
•PXD-upper half cellのAlignment pinが真上に来るように調整する

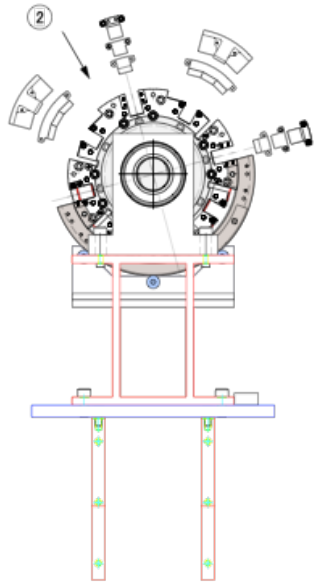




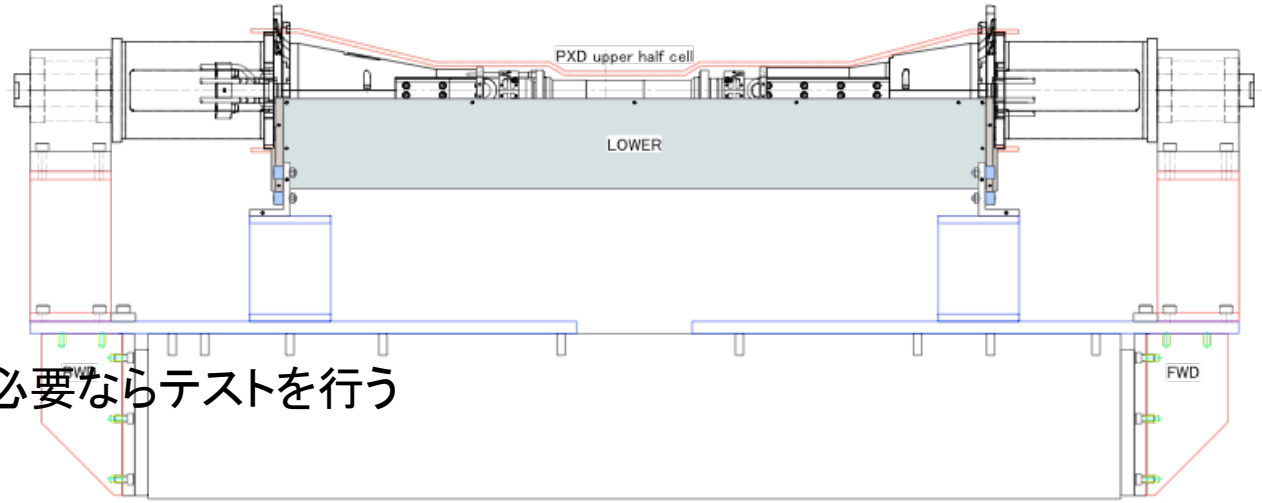
PXD Assembly

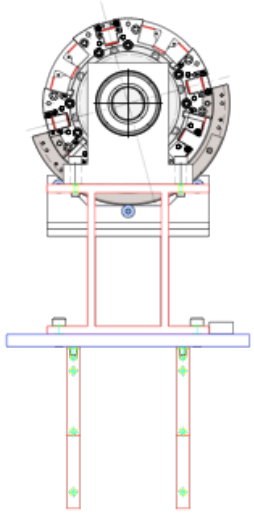
- STEP 7





- PXD-upper half cellをMount blockに載せる
- Shieldの隙間埋め用部品を取り付ける

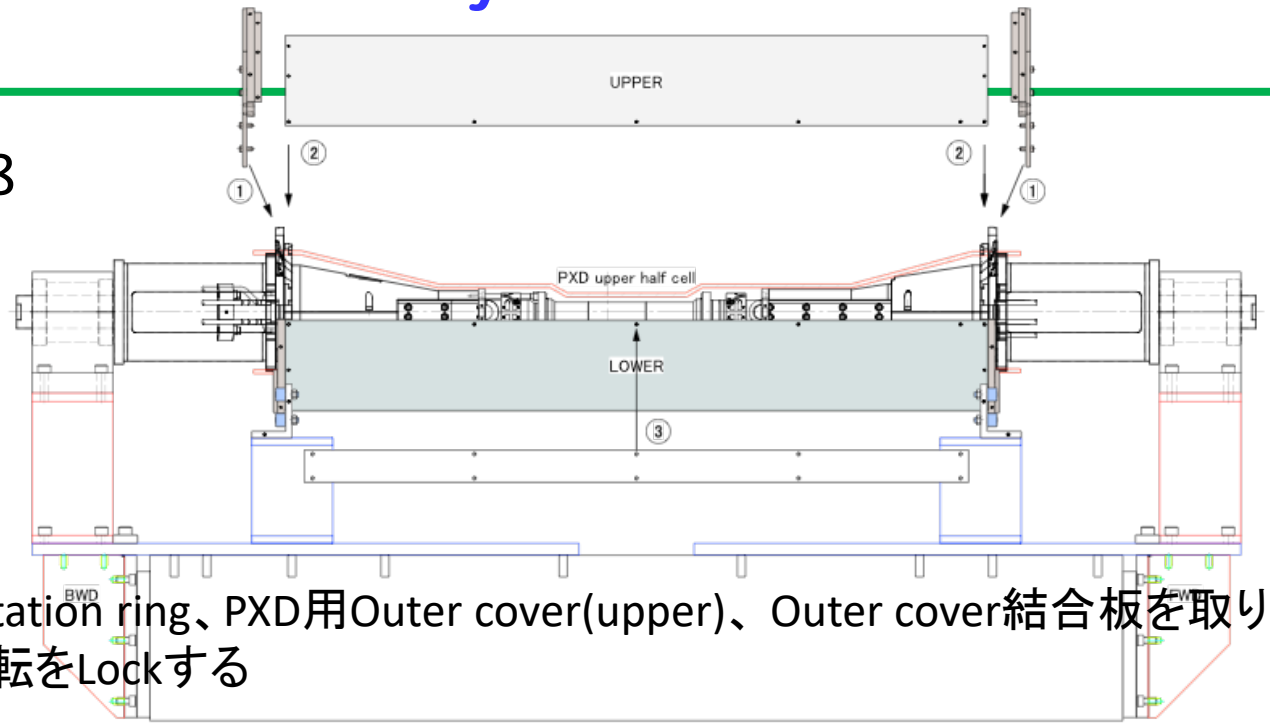


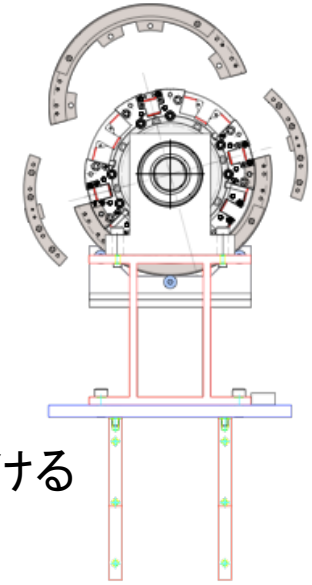


- 必要ならテストを行う

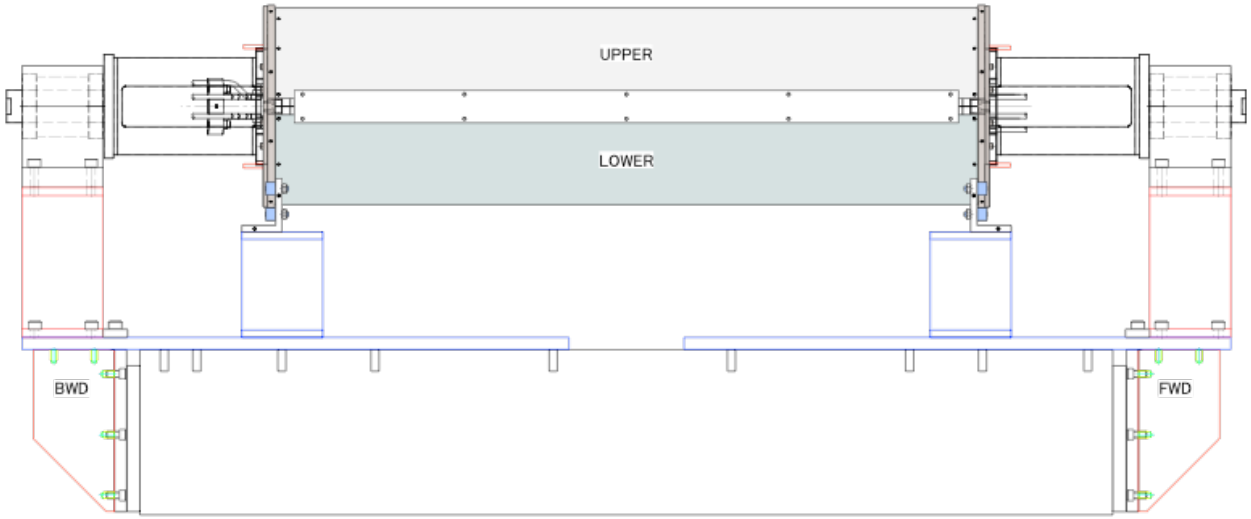
PXD Assembly

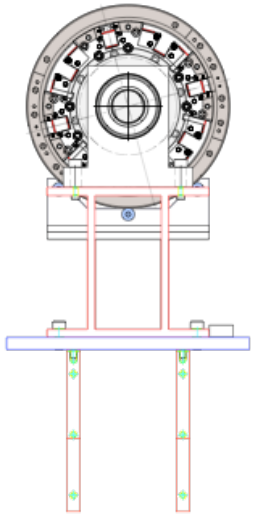
- STEP 8





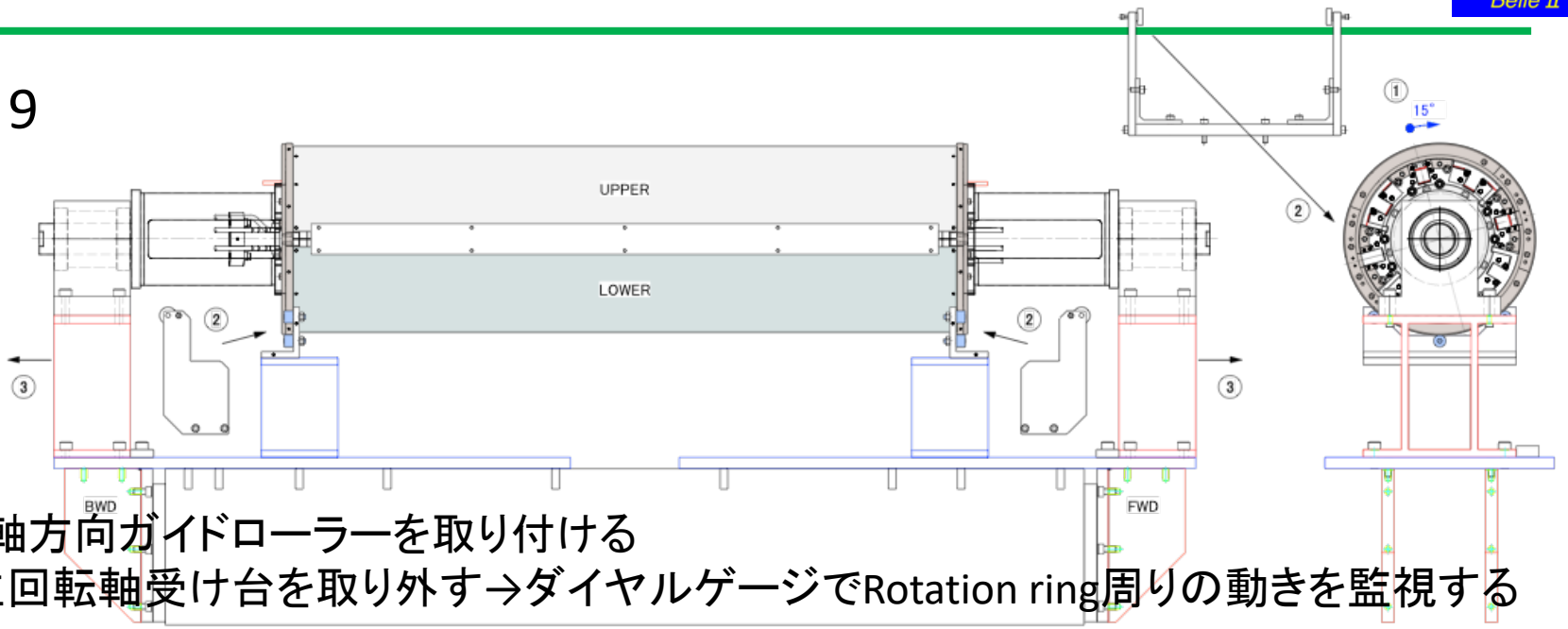
- Rotation ring、PXD用Outer cover(upper)、Outer cover結合板を取り付ける
- 回転をLockする



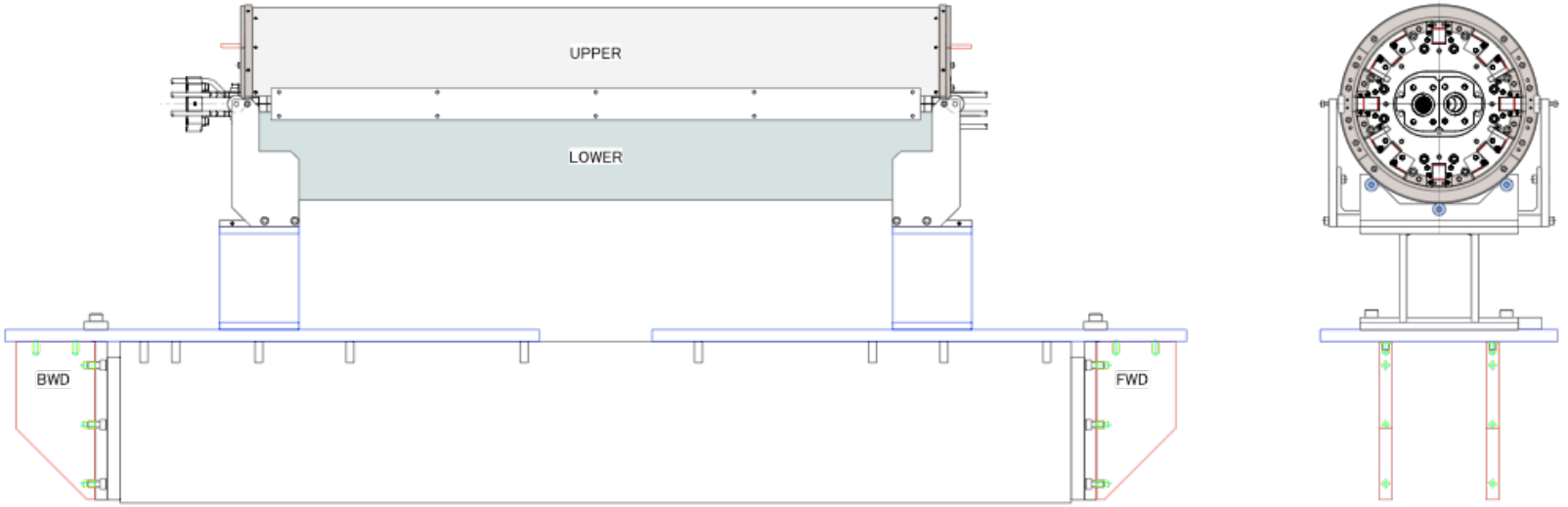


PXD Assembly

- STEP 9

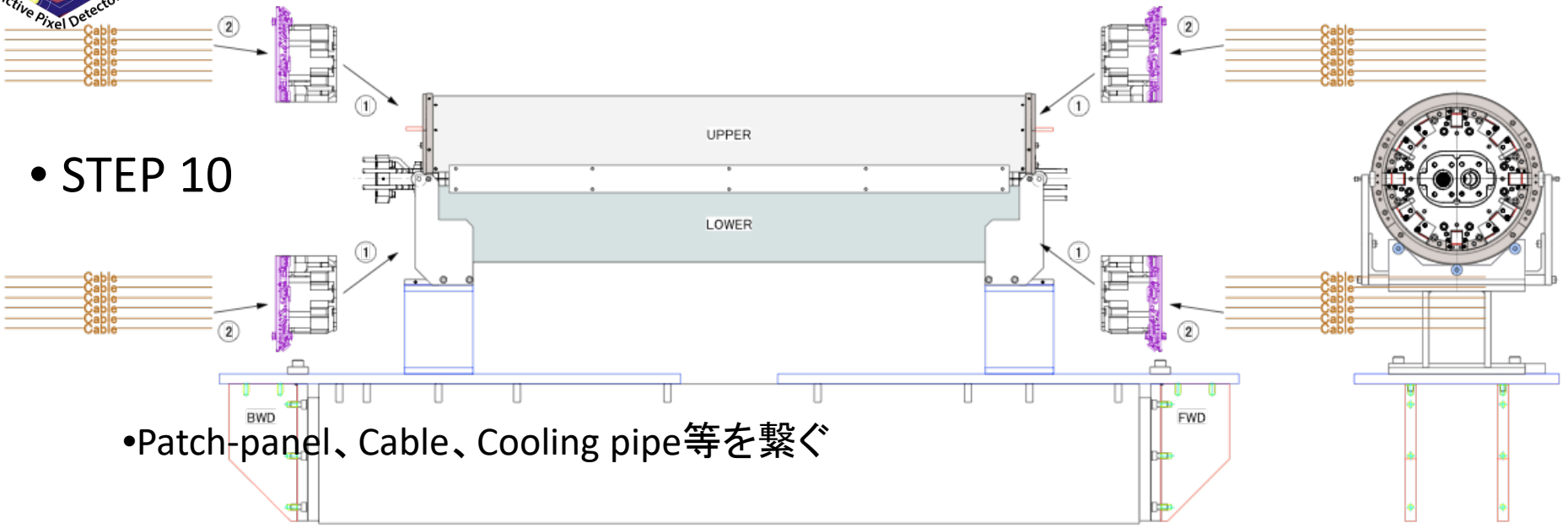


•Z軸方向ガイドローラーを取り付ける
•主回転軸受け台を取り外す→ダイヤルゲージでRotation ring周りの動きを監視する

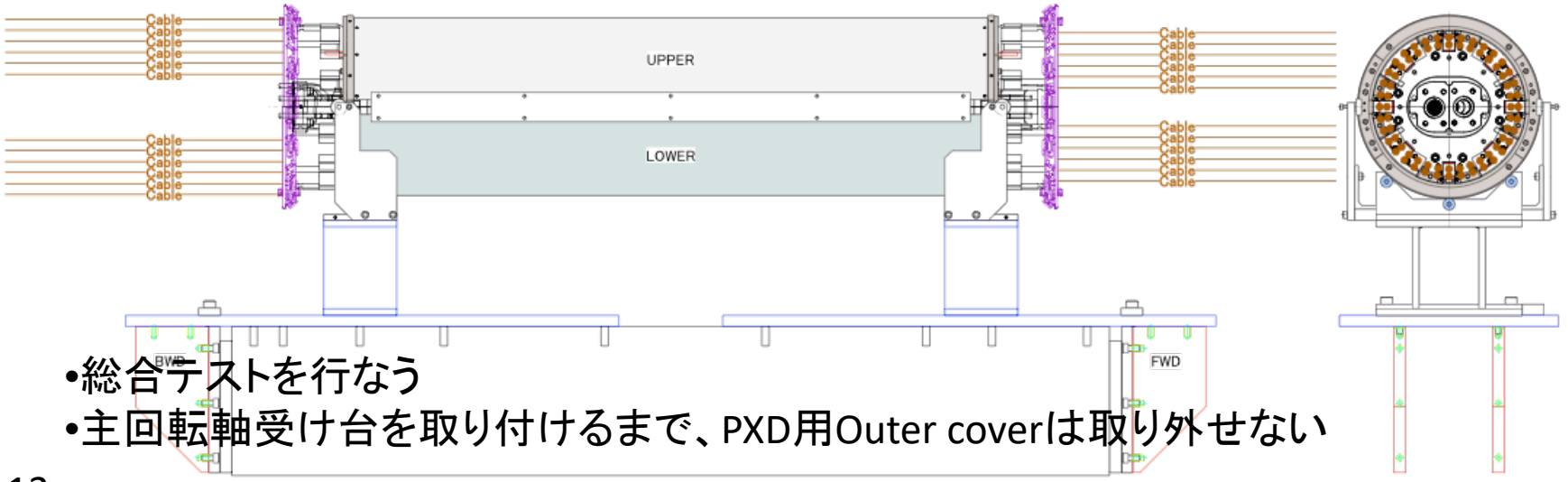


PXD Assembly

- STEP 10



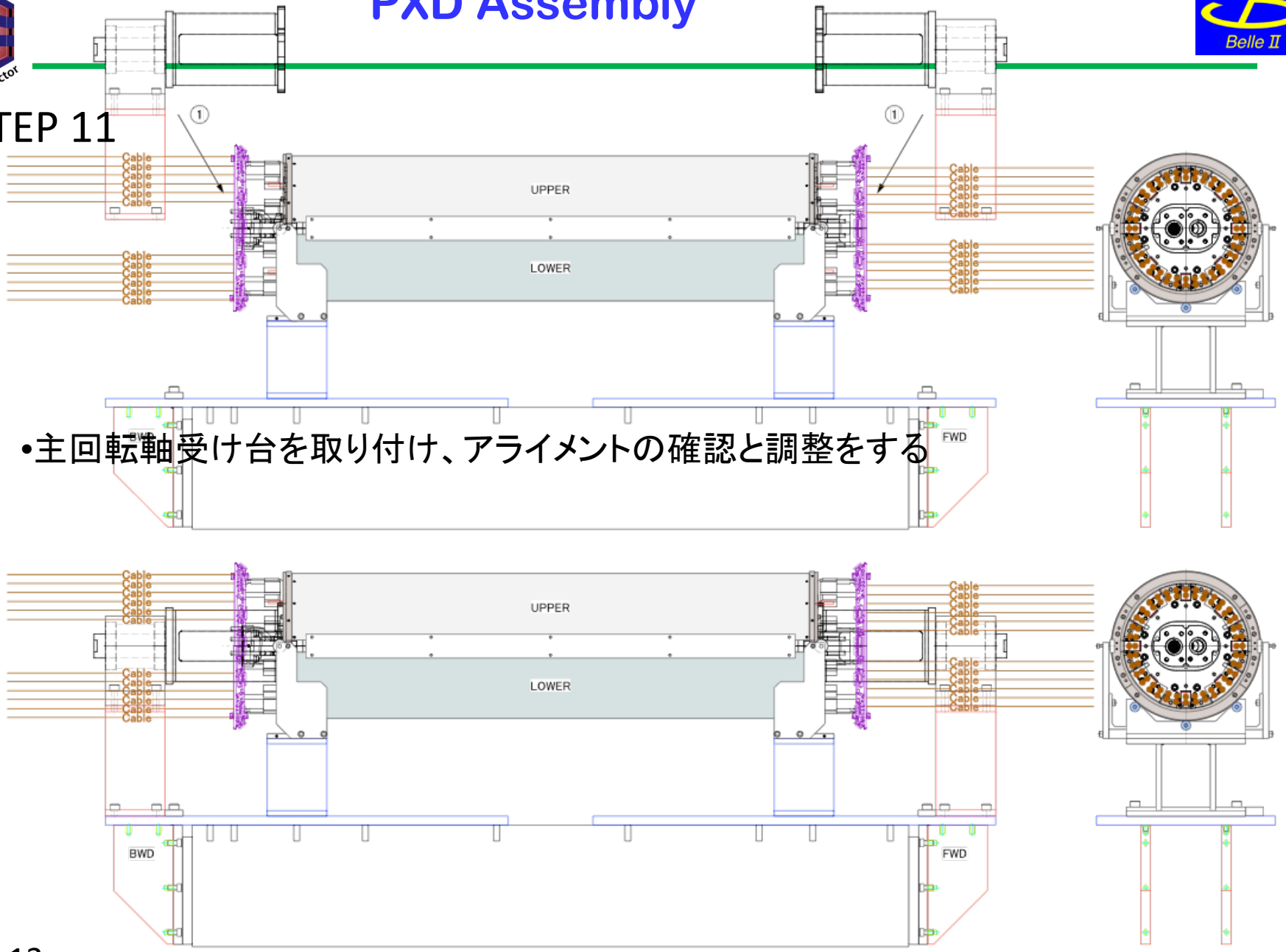
•Patch-panel、Cable、Cooling pipe等を繋ぐ



•総合テストを行なう
•主回転軸受け台を取り付けるまで、PXD用Outer coverは取り外せない

PXD Assembly

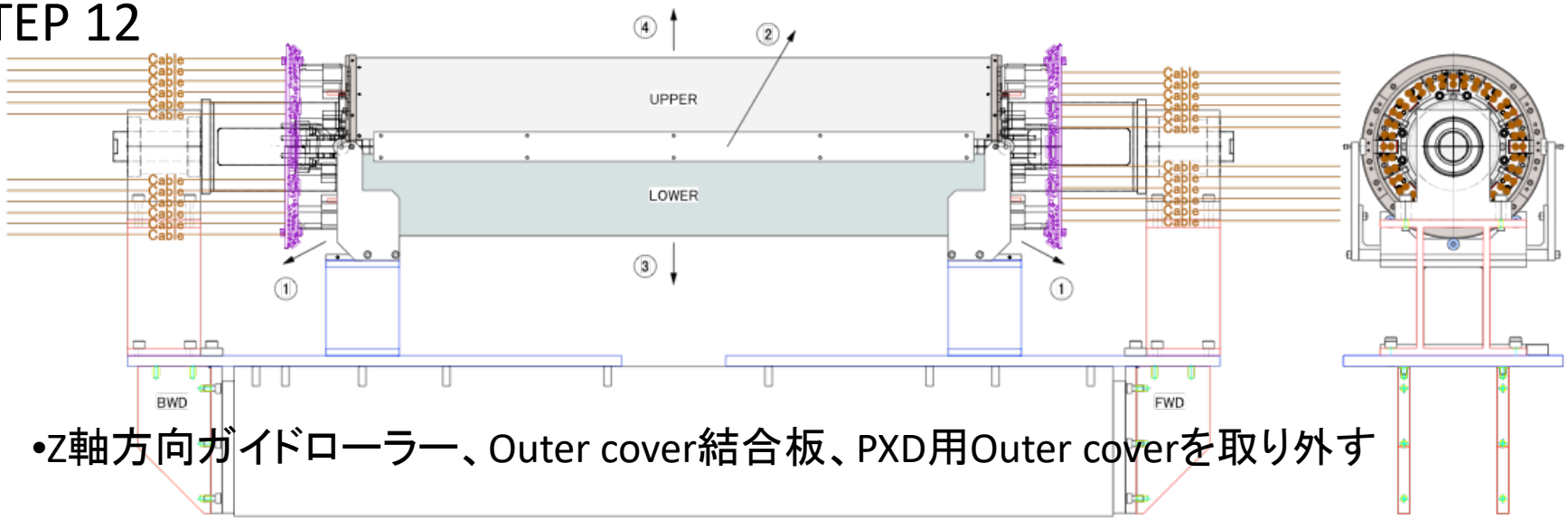
- STEP 11



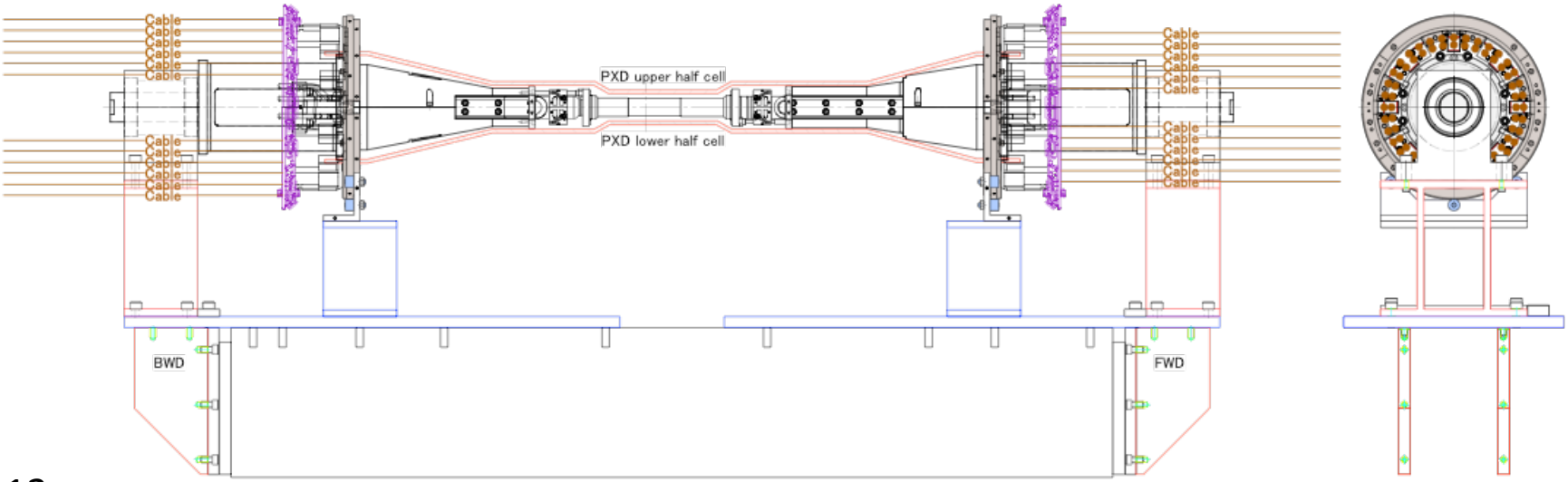
•主回転軸受け台を取り付け、アライメントの確認と調整をする

PXD Assembly

- STEP 12

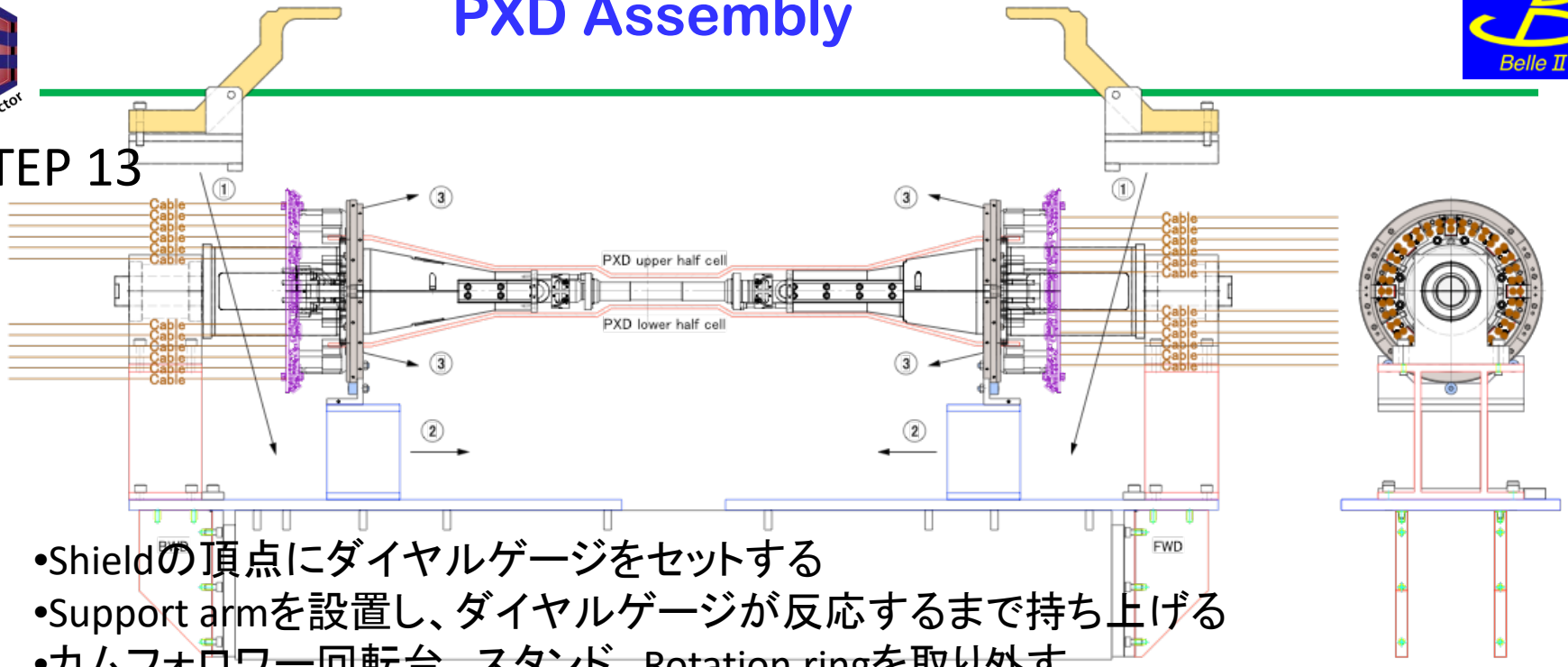


•Z軸方向ガイドローラー、Outer cover結合板、PXD用Outer coverを取り外す

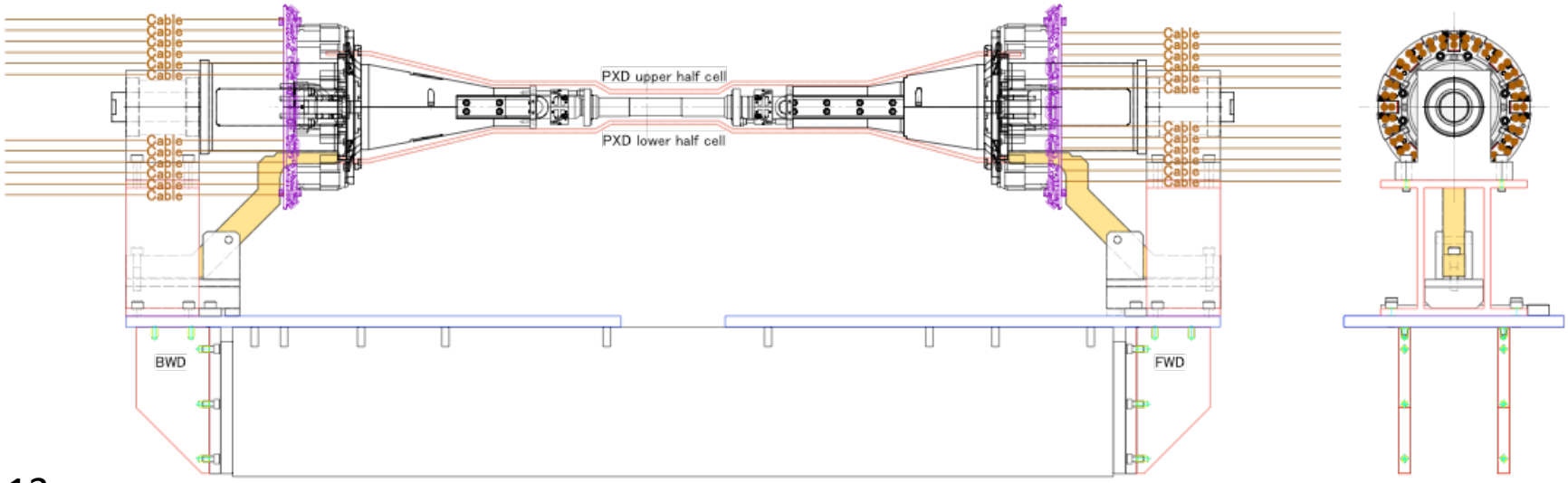


PXD Assembly

- STEP 13

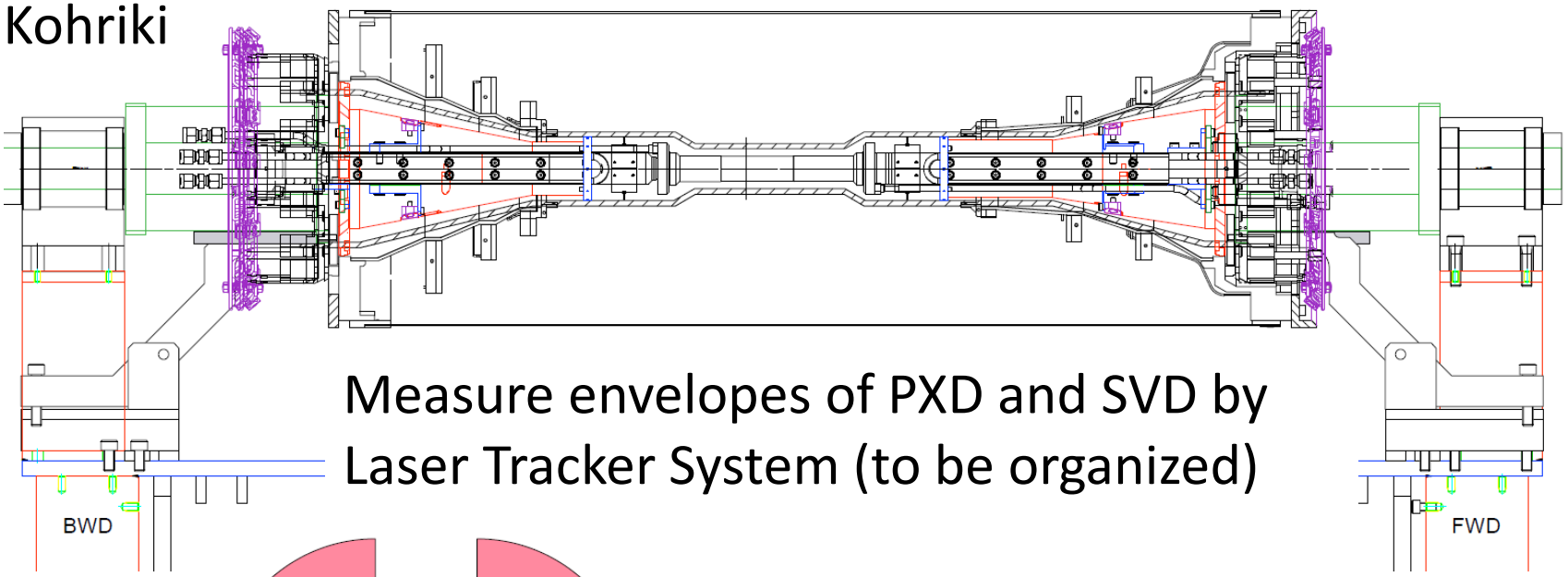


•Shieldの頂点にダイヤルゲージをセットする
•Support armを設置し、ダイヤルゲージが反応するまで持ち上げる
•カムフォロワー回転台、スタンド、Rotation ringを取り外す

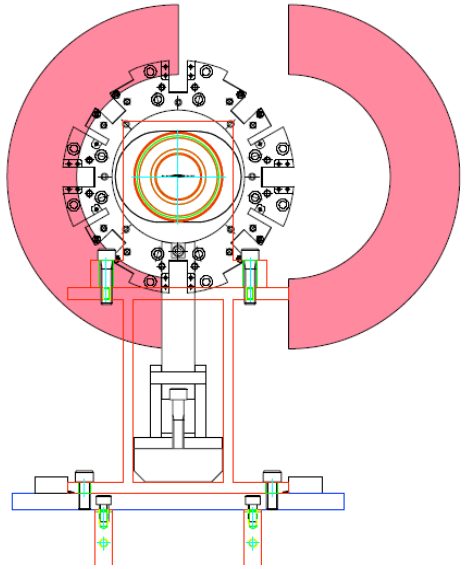


VXD Assembly (under Discussion)

T. Kohriki



Measure envelopes of PXD and SVD by Laser Tracker System (to be organized)

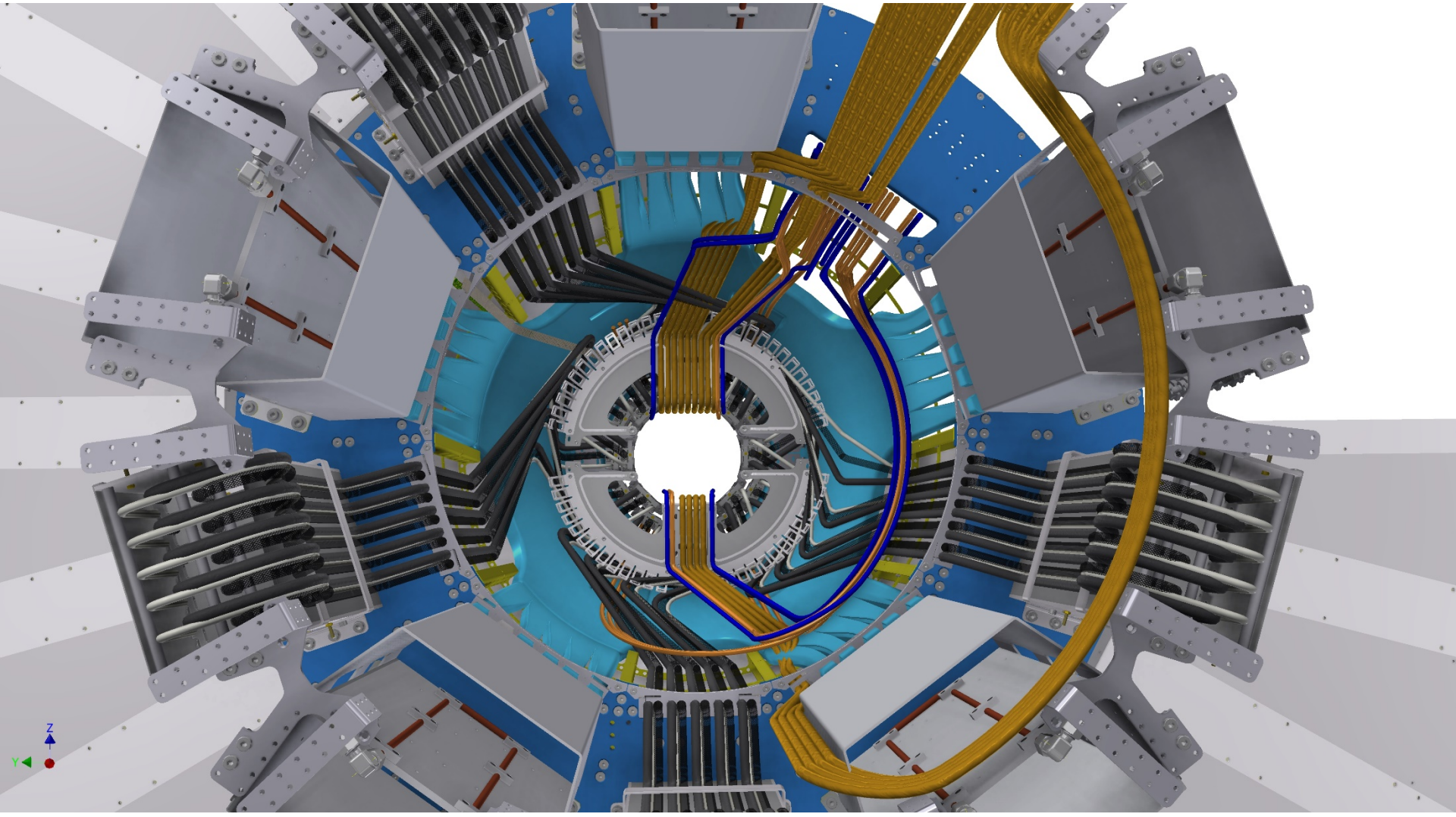


install +x SVD half shell,

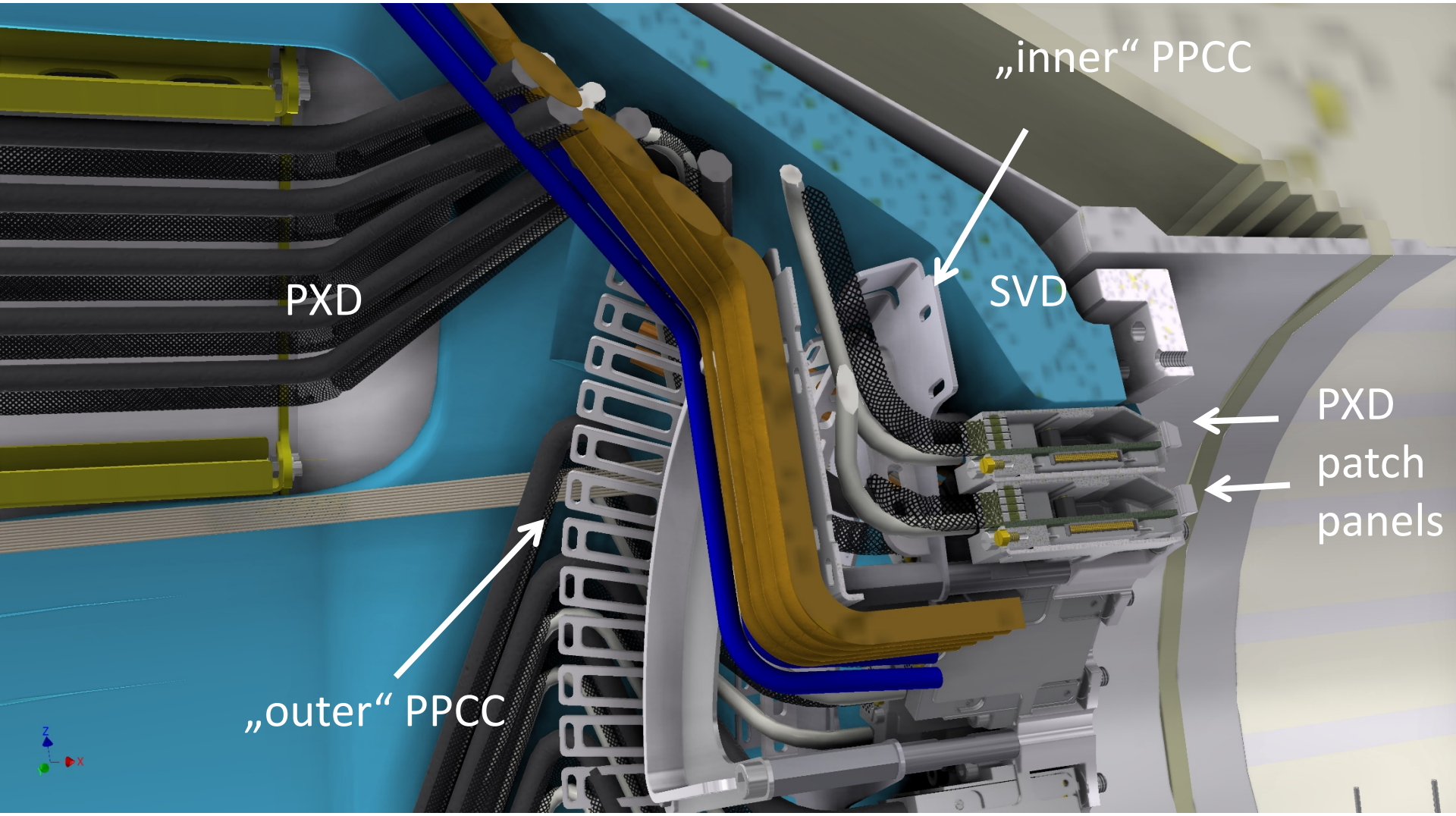
then –x SVD half shell

Patch Panel Cable Cage (BWD)

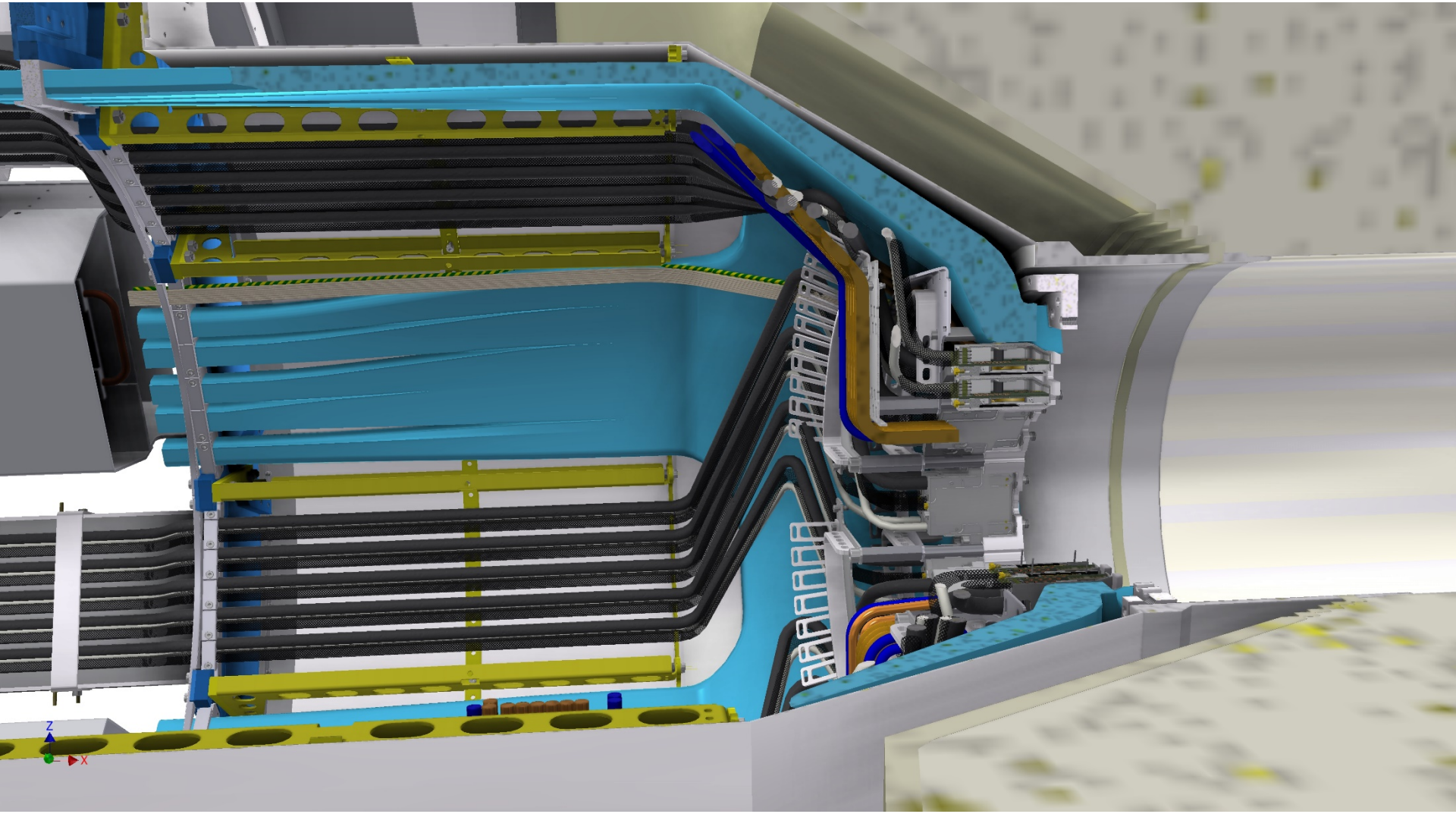
Purpose: keep space free for QCS with RVC



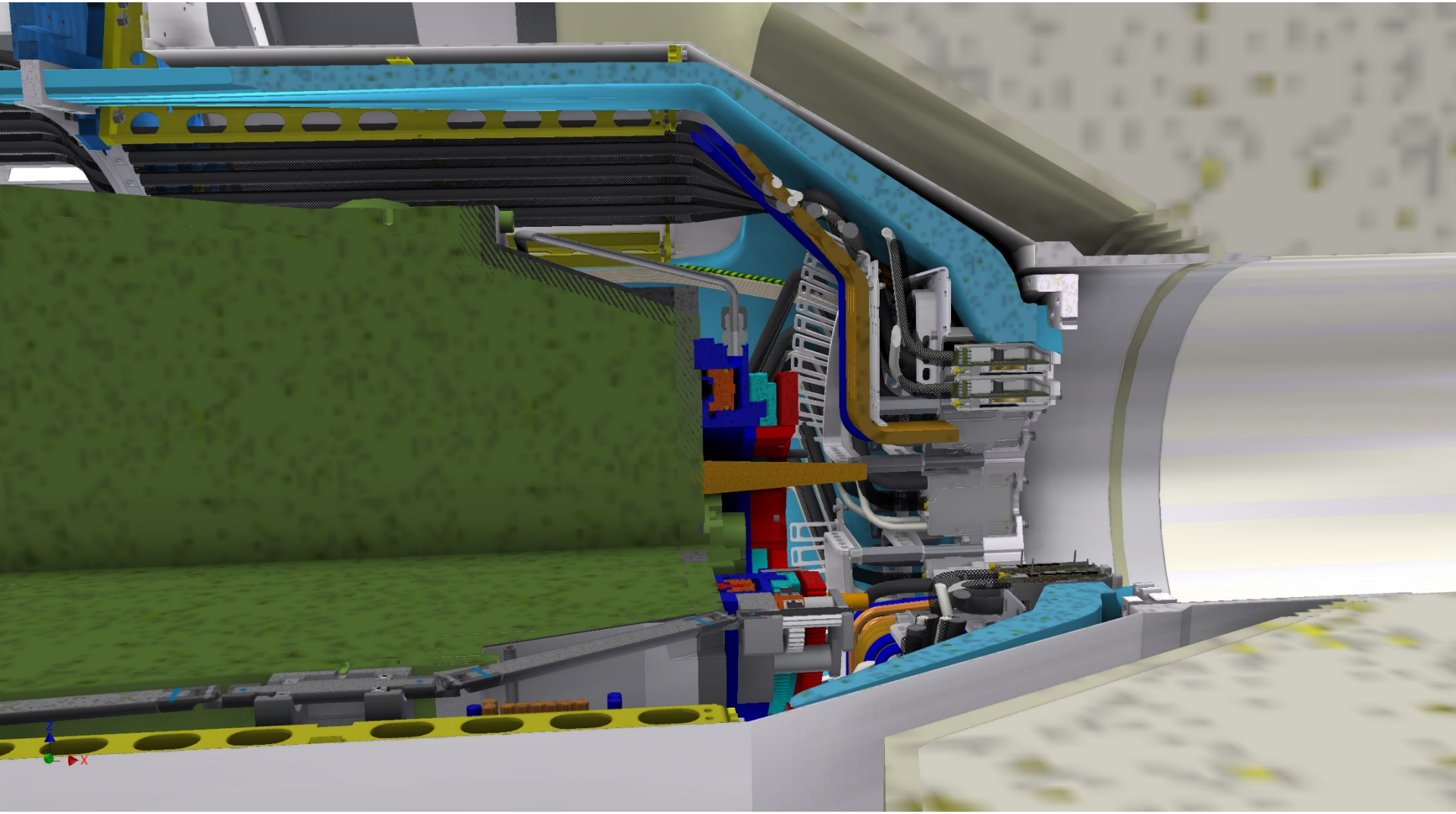
Patch Panel Cable Cage (BWD)



Patch Panel Cable Cage (BWD)



Patch Panel Cable Cage (BWD)



[FWD PPCC more difficult, under design]

Summary and Next Steps

- VXD Installation into Belle II well exercised and under control
- Concept for mounting of PXD sensors onto half shell and on beam pipe exists, partly exercised with BEAST detector
- Ladder mount rotation device built, tested successfully
- Clean room layout fixed, infrastructure being developed
  caveat: no working area for PXD (similar to „B1“ for the SVD)
- BWD PP Cable Cage is designed, FWD PPcc ongoing
- MARCO arrived at KEK, available for testing the SVD, then PXD and VXD

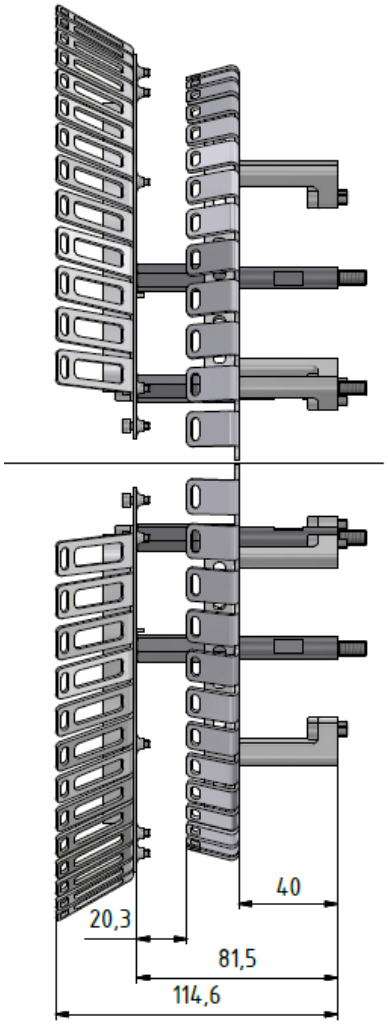
Backup

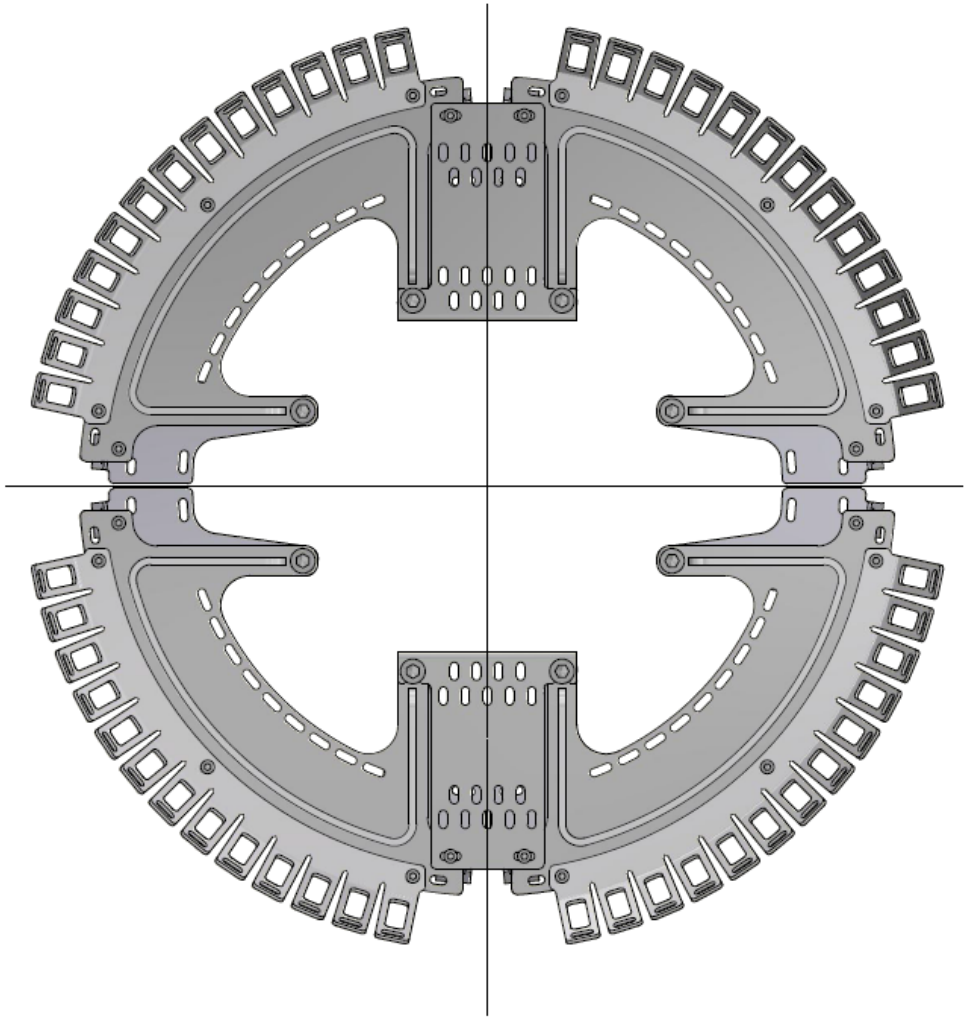
Schedule for PXD Mounting and Test

Activity	Days
Diamonds. Installation and tests	2
Survey beam pipe and PXD at arrival. Rotation beam pipe	2
Cabling clean room to back end	2
Dock boxes (mechanical installation, DockBoxPCB, cabling)	5
(First) Half shell installation	5
Connection patch panels	2
CO2, nitrogen and closing the volume for testing	2
Test 20 modules (half shell)	7
Disconnection patch panels and CO2, opening the volume and rotation	2
(Second) Half shell installation	5
Connection patch panels	2
CO2, nitrogen and closing the volume for testing	2
Test 20 modules (half shell)	7
Disconnection patch panels and CO2, opening the volume and rotation	2
Total	47

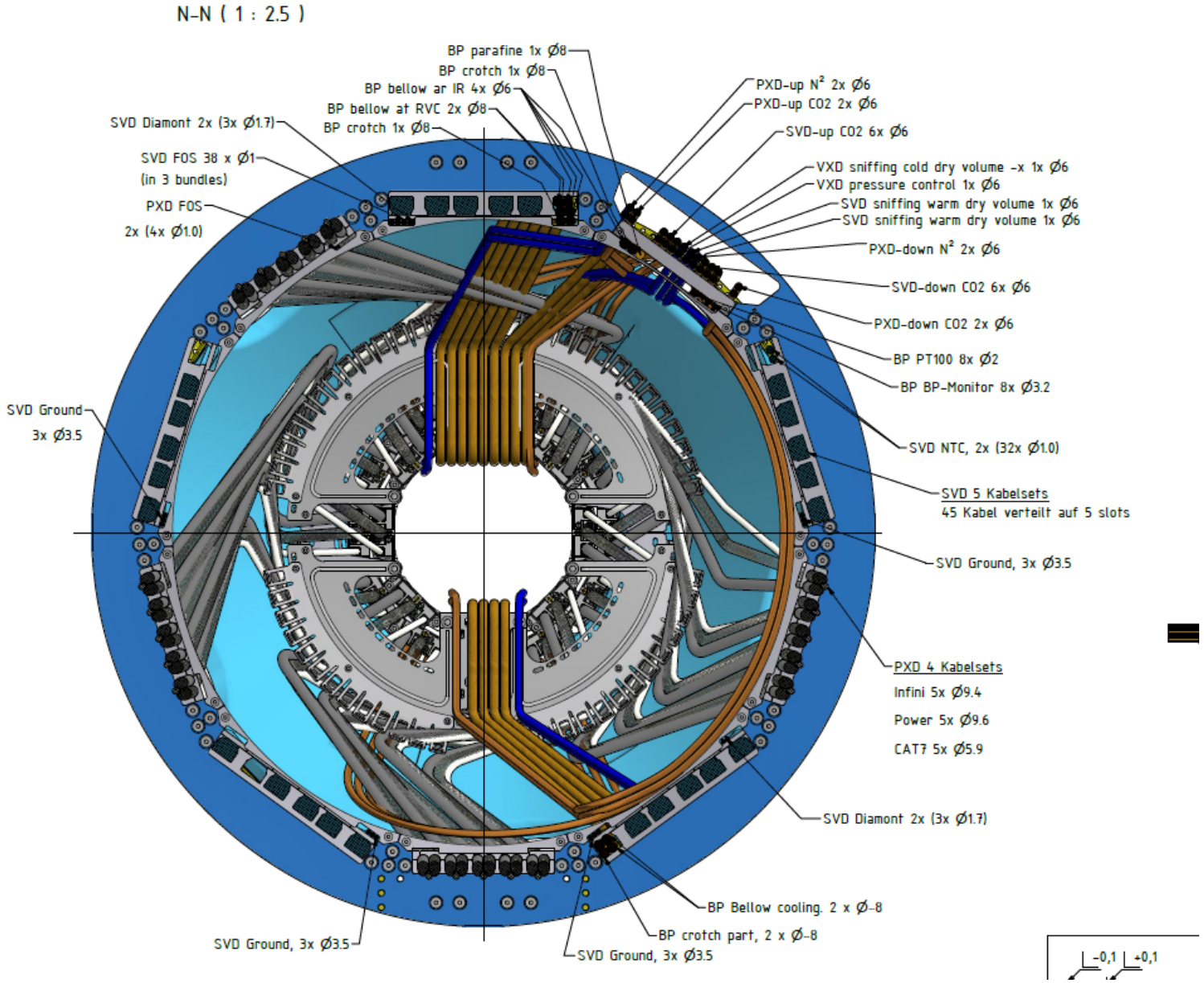
Patch Panel Cable Cage (BWD)

PPcc (bwd) (1 : 2)

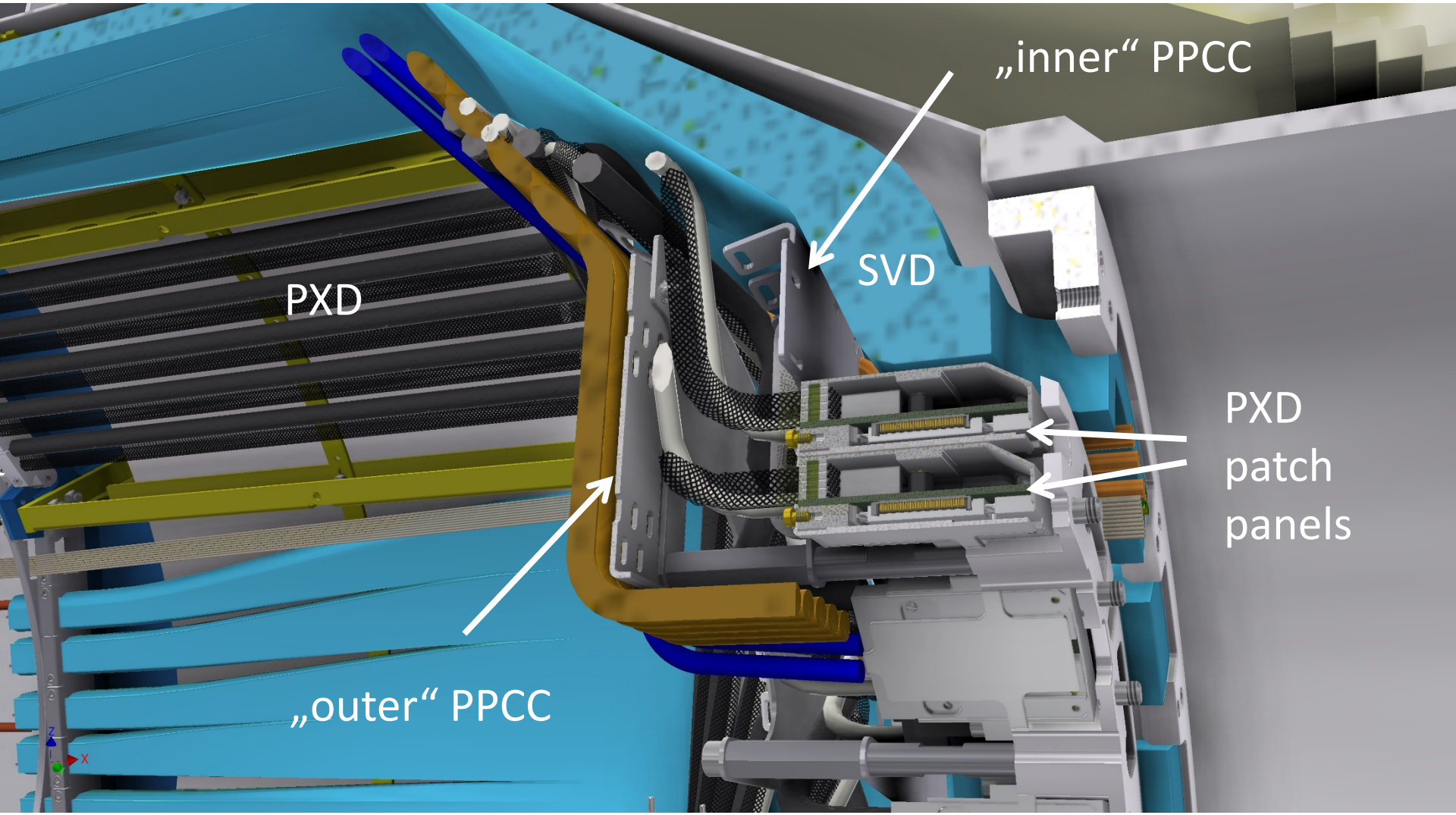




Cables on the BWD Side

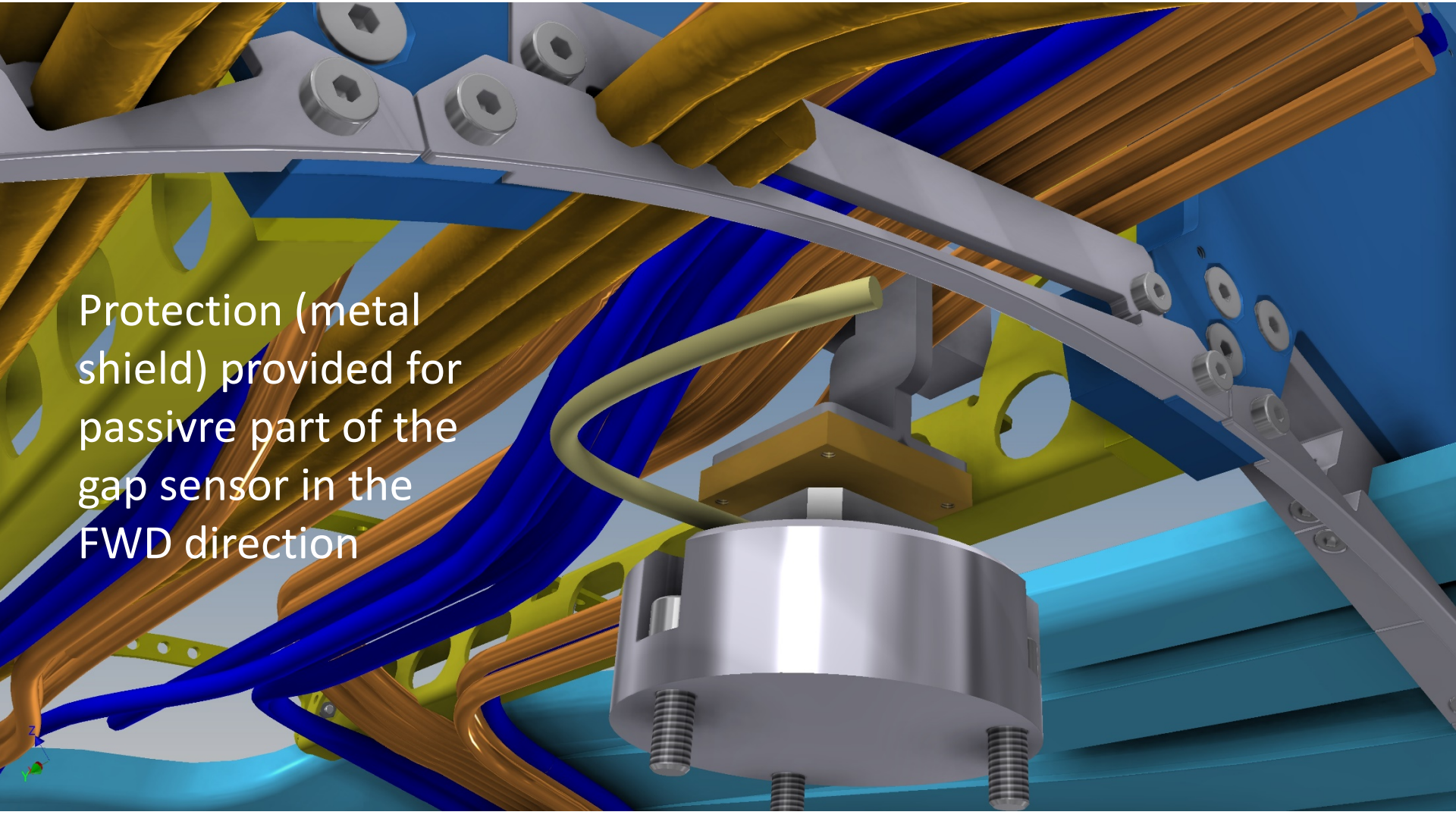


Patch Panel Cable Cage (BWD)



Change of Gap Sensor Support

agreed by machine for Phase 3



Preparation for Cable Installation BWD

Support tool during cable installation inside the CDC cone on the BWD side

(platform for easy and relaxed body position while working - over the dock box area – on the inner cable fixation.

FWD: Here we have the improved „Ferrari“ -> „Bugatti“ (see David‘s presentation)