Status update of Beam pipe

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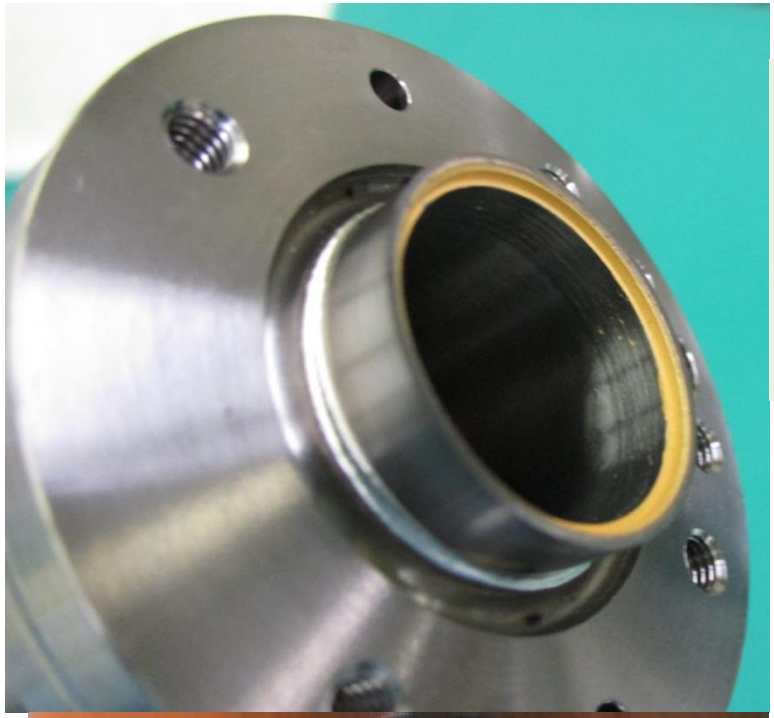
KEK

Gold peel-off problem: Phase 3 Beam pipe



Gold peel-off has discovered after the sputtering.

Considerable reason of this issue

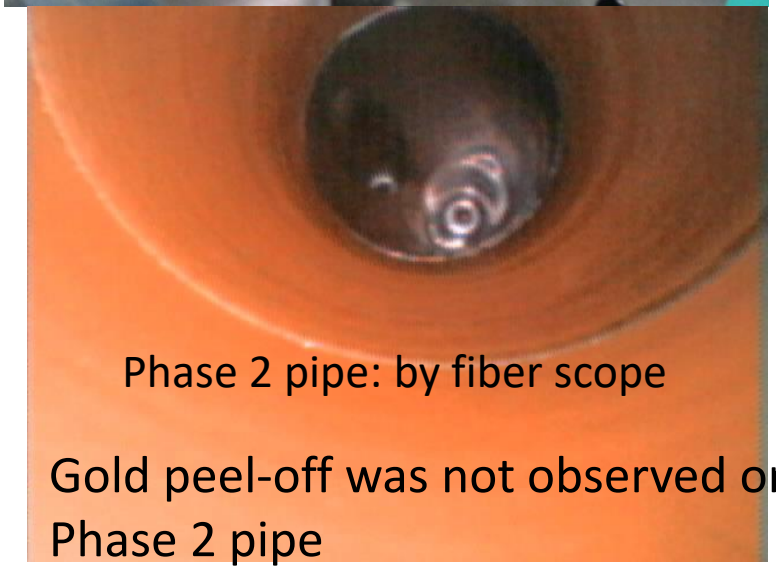
1, The pipe is an double tube with Titanium part and sputtering is applying on vacuum condition

The heating up process might not be enough, as like "thermos structure".

Remedy plan (3 options):

re-production of IP part,

- It started (preparation process)
  - BP will complete in Apr. 2018 which was expectation of last BPAC



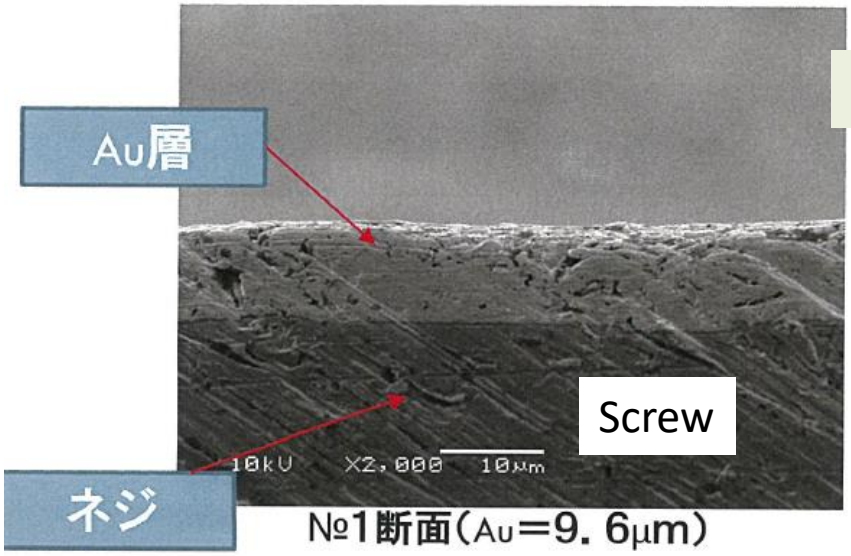
Phase 2 pipe: by fiber scope

Gold peel-off was not observed on Phase 2 pipe

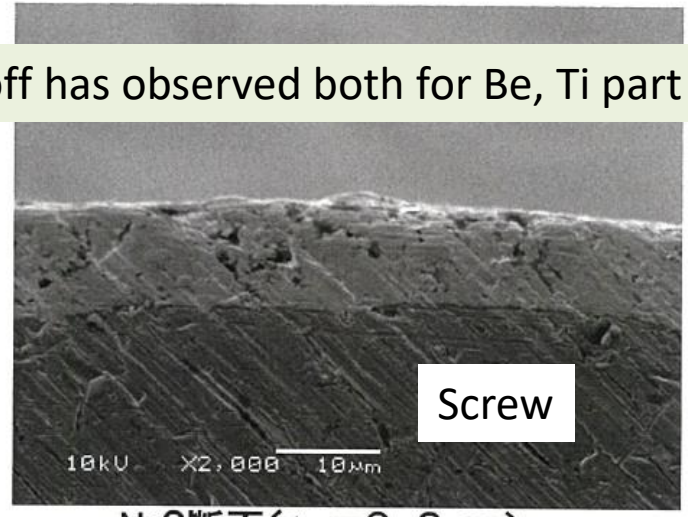
- Gold sputtering inside after removing of Gold.
  - We couldn't remove Au completely
- Gold plating on BP outer surface
  - Most quicker and safe solution but this may gives lower vertex resolution
    - BP Can complete in Mar. 2018

Second test (parameter re-optimized)

No peel-off has observed both for Be, Ti part

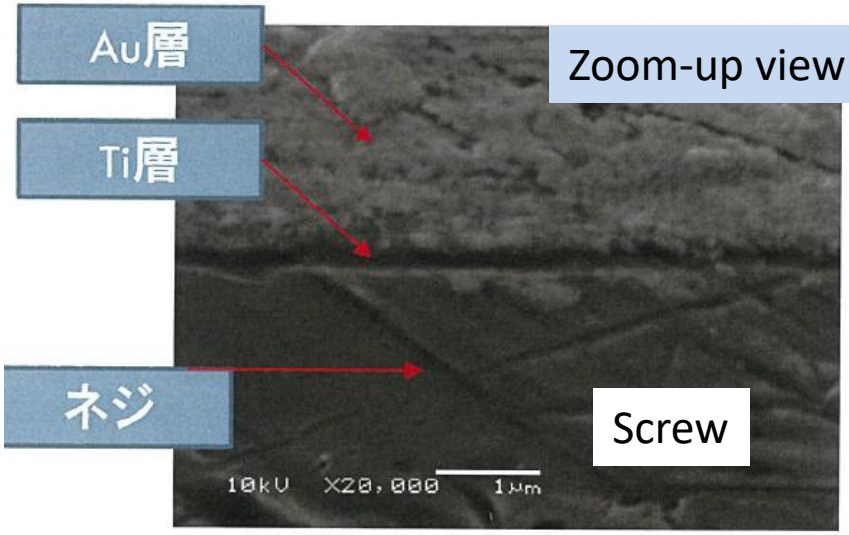


№1断面(Au=9.6μm)



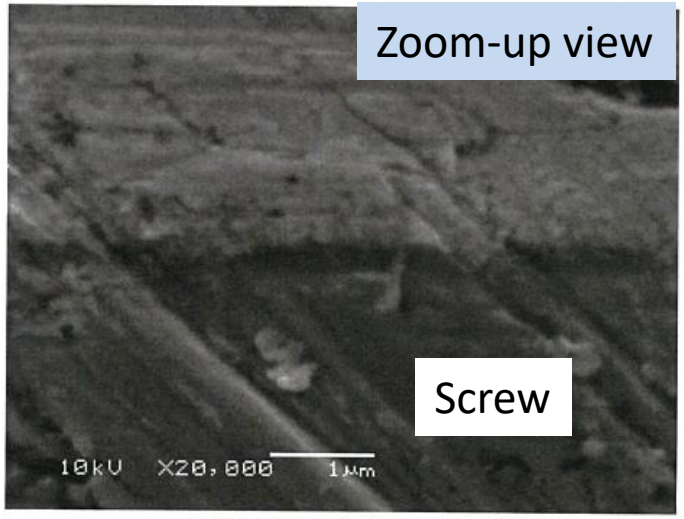
№2断面(Au=9.8μm)

Zoom-up view



№1断面拡大(Ti=0.26μm)

Zoom-up view



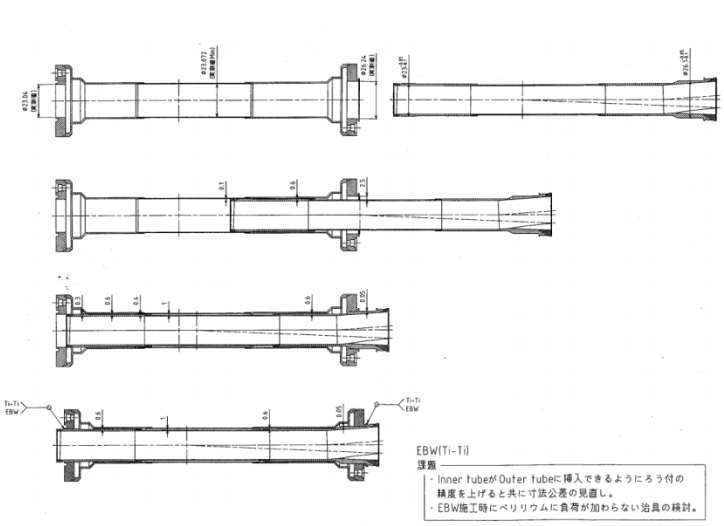
№2断面拡大(Ti=0.29μm)

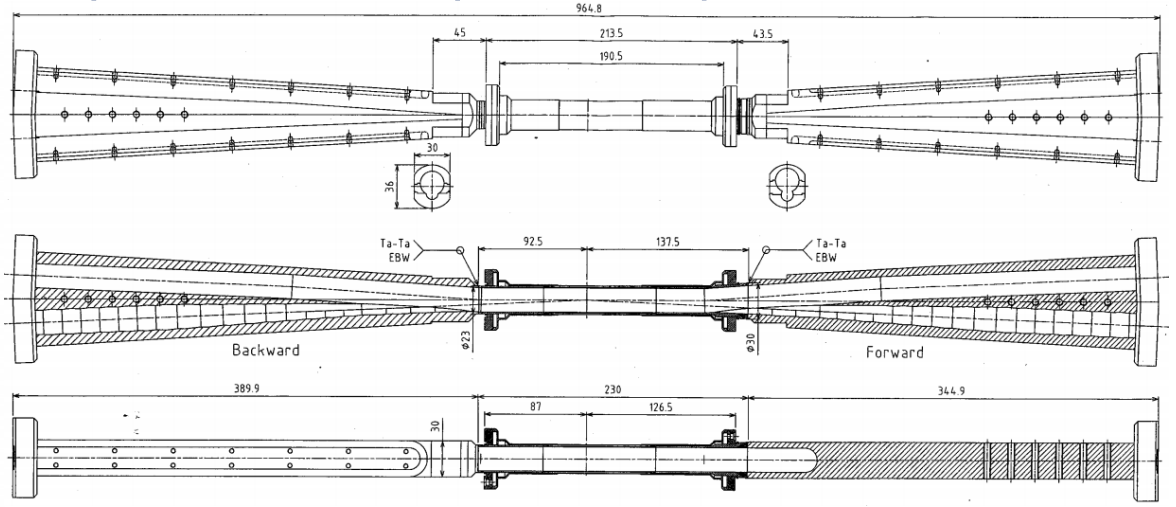
Gold layer seems smoothly connected with Ti layer

Schedule until completion

- ~30th Jan.:
  - Au sputtering for Inner tube
  - 1um Al plating for Outer tube surface to avoid water corrosion

- ~Middle of Feb.
  - Inner tube + Outer tube by EBW
- Adding 2um Ti plating by Laci's advice in B2GM (Al coat has a potential of corrosion by liquid CO2 with low temp, which can be happen during VXD assembly: namely liquid CO2 leak onto the pipe)
- ~End of March
  - IP tube + Crotch part (final process on the production)

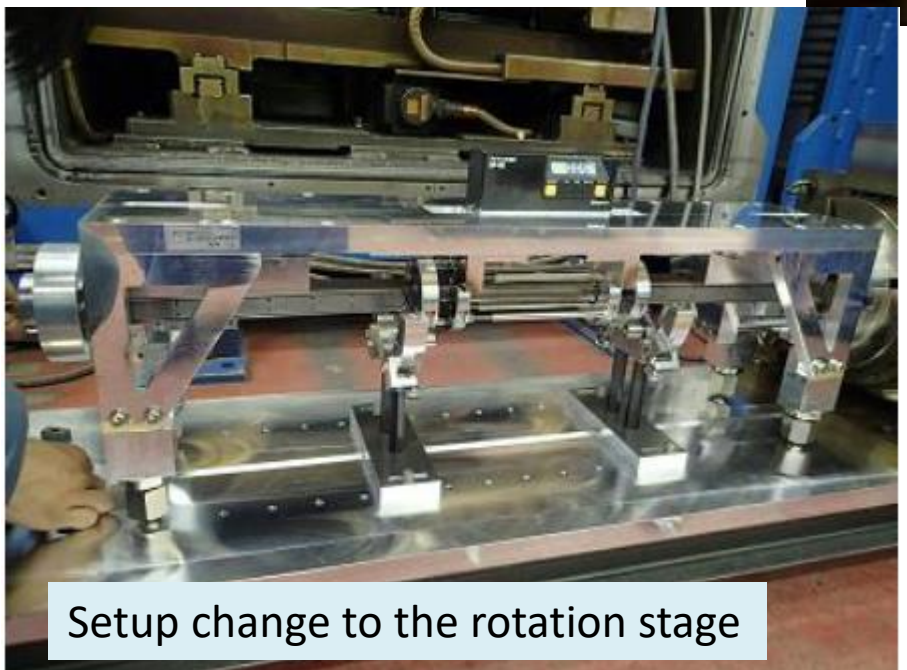




IP+crotch EBW connection

Positioning of IP and crotch pipe

Track weld (4 points for each)



Setup change to the rotation stage

Setup just before final EBW

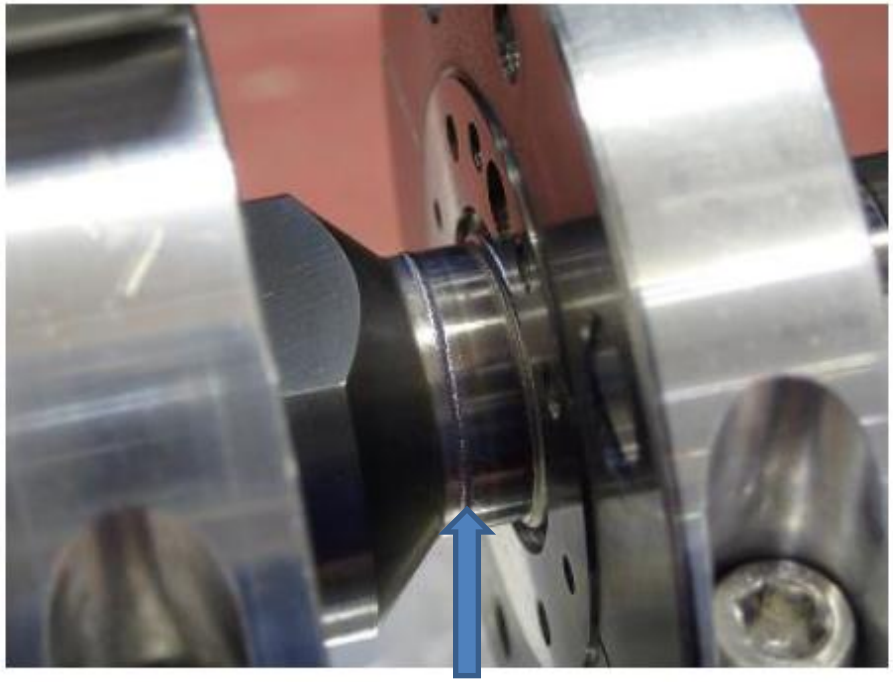


写真 7　接合部(Backward 側)

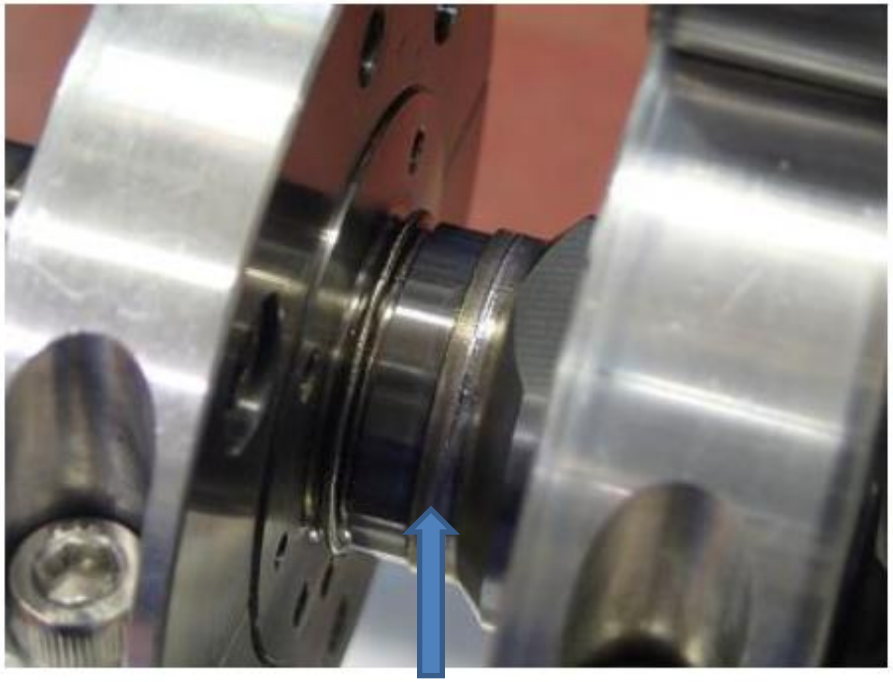
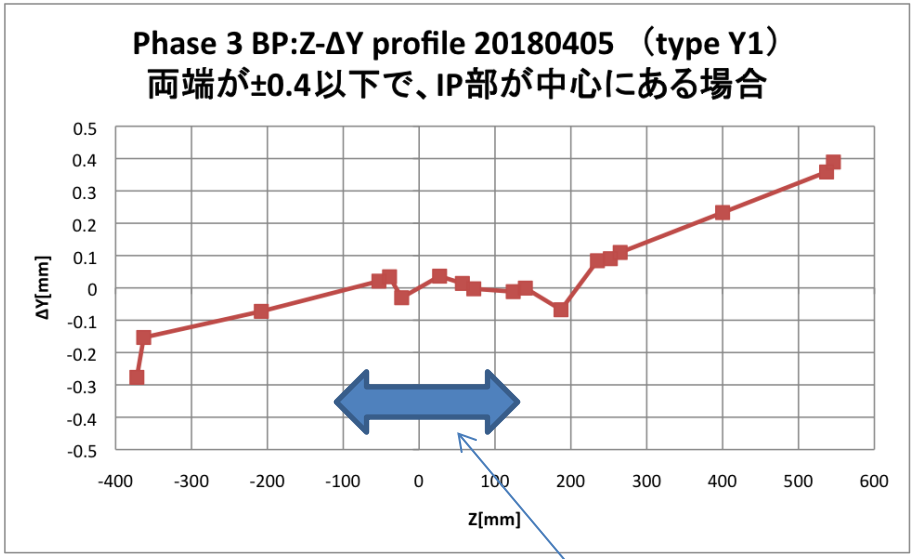


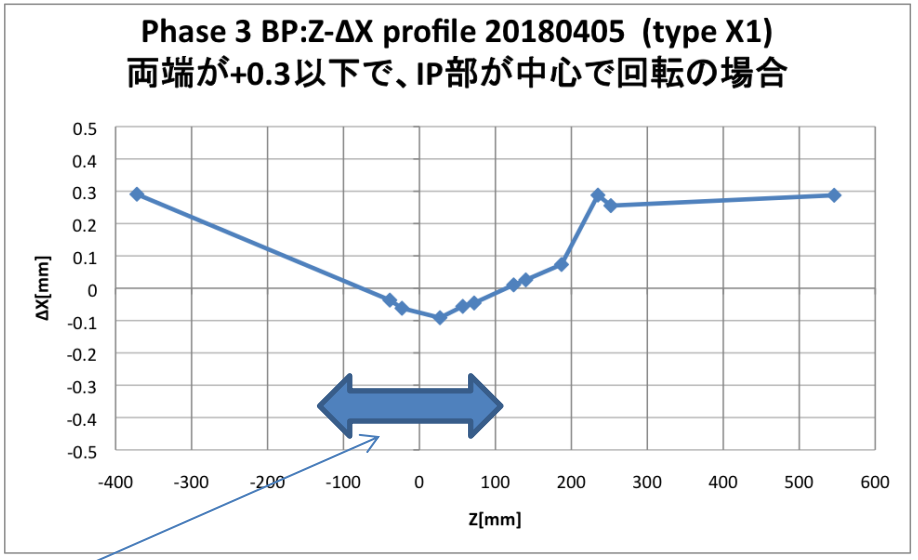
写真 8　接合部(Forward 側)

CMM measurement

The profile of the Phase 3 Beam pipe

- Phase3　BP positioning plan (by CMM data)
  - dx, dy: displacement from the design

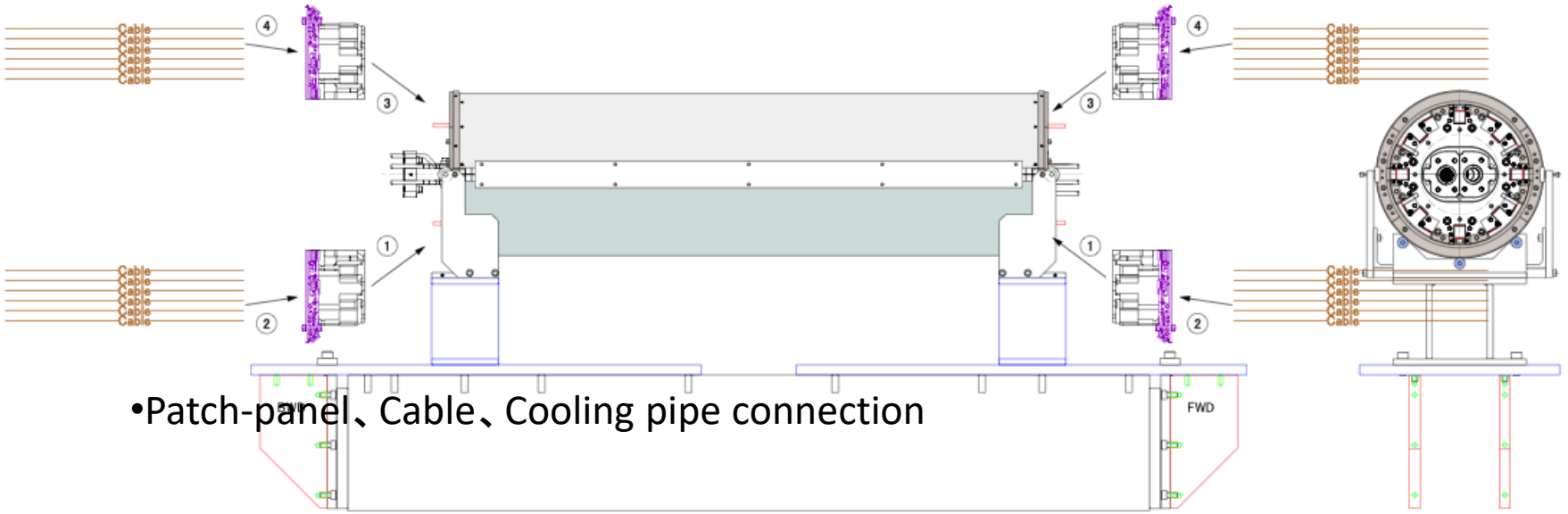




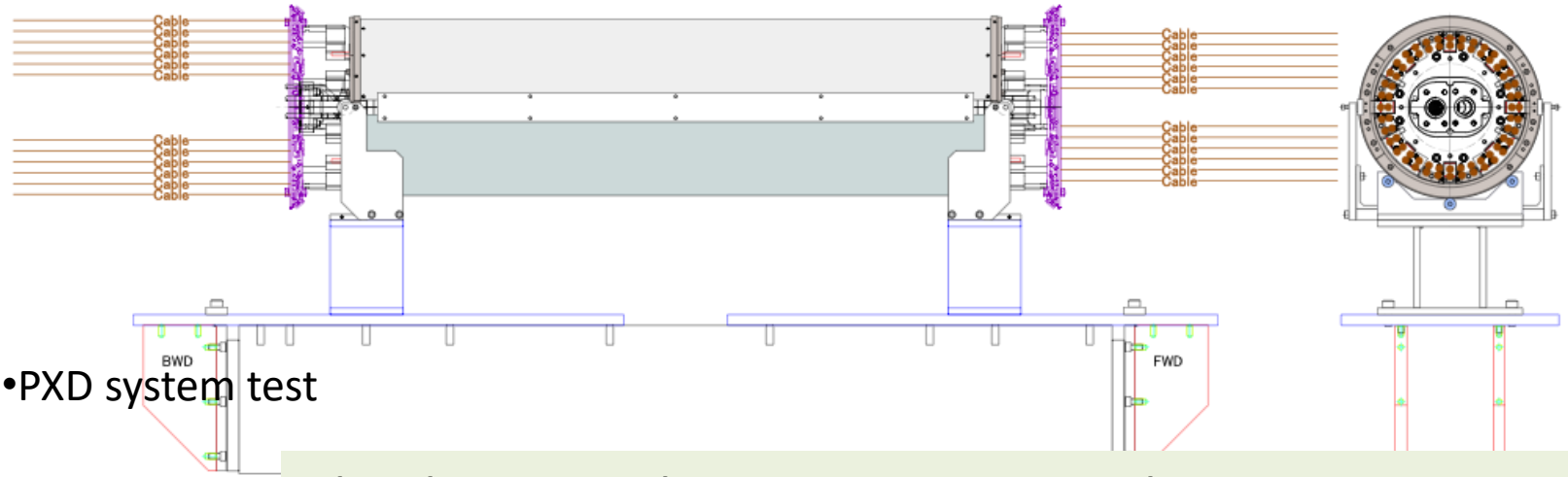
IP chamber/PXD area

Phase 3 VXD assembly (PXD part)

STEP 9 *(whole steps are shown in backup slides)*



•Patch-panel、Cable、Cooling pipe connection



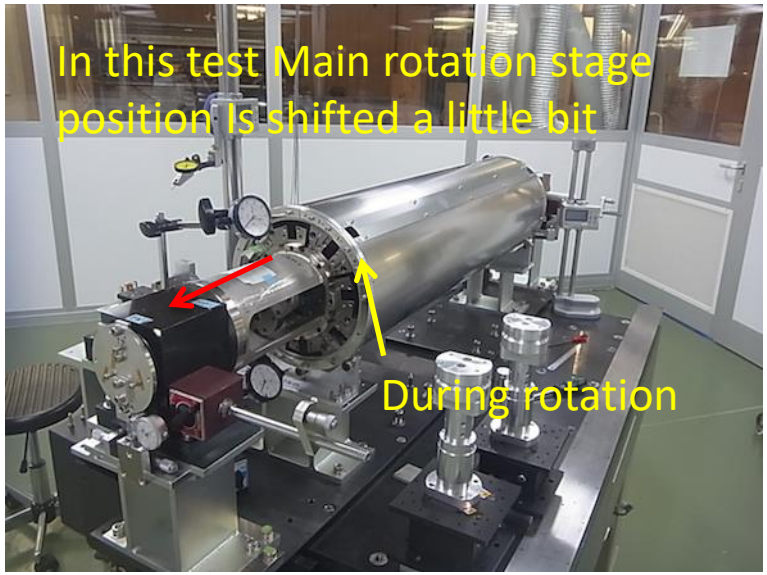
•PXD system test

Check point: The outer cover can keep structure?

Phase 3 VXD assembly test(1)

Outer cover stiffness check for PXD assembly

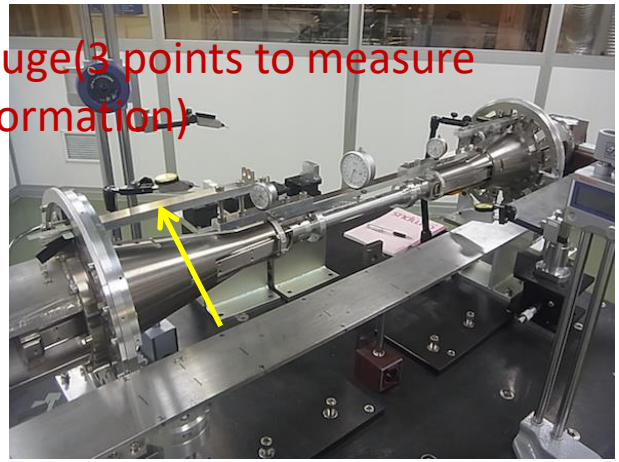
- Purpose
  - For PXD half system mount, BP+HM structure have to rotate 180 degrees.
  - On the rotation, main rotation stage at each end have to be dismantled for avoiding conflict with PXD cables.
    - Main rotation stage is the key structure to keep BP+HM structure until SVD connection
  - In order to avoid sagging of BP+HM, special outer cover is mounted to keep structure



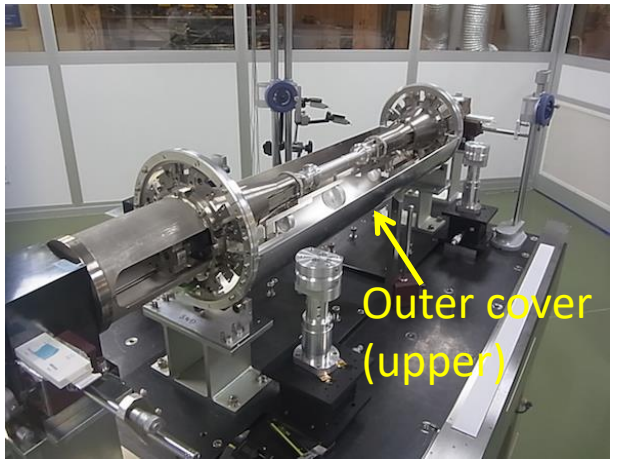
Phase 3 VXD assembly test(2)

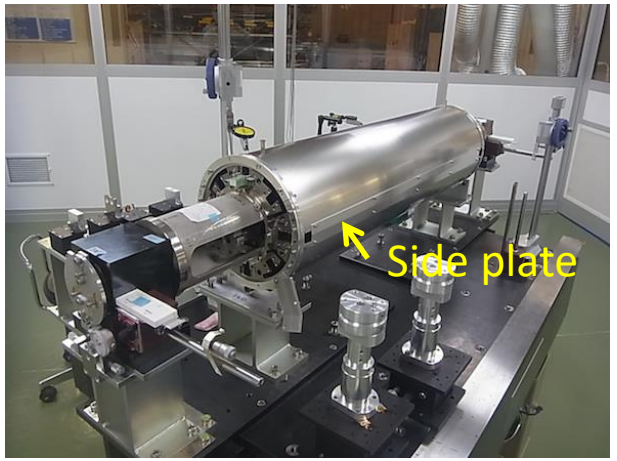
- PXD outer cover connection
  - Setting dial gauges to measure BP deformation

Dial gauge(3 points to measure BP deformation)



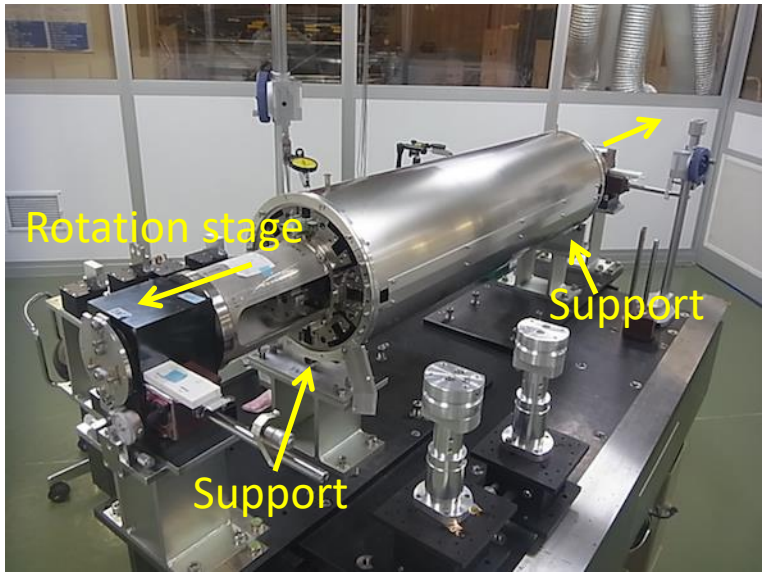
Mockup BP is used on this test



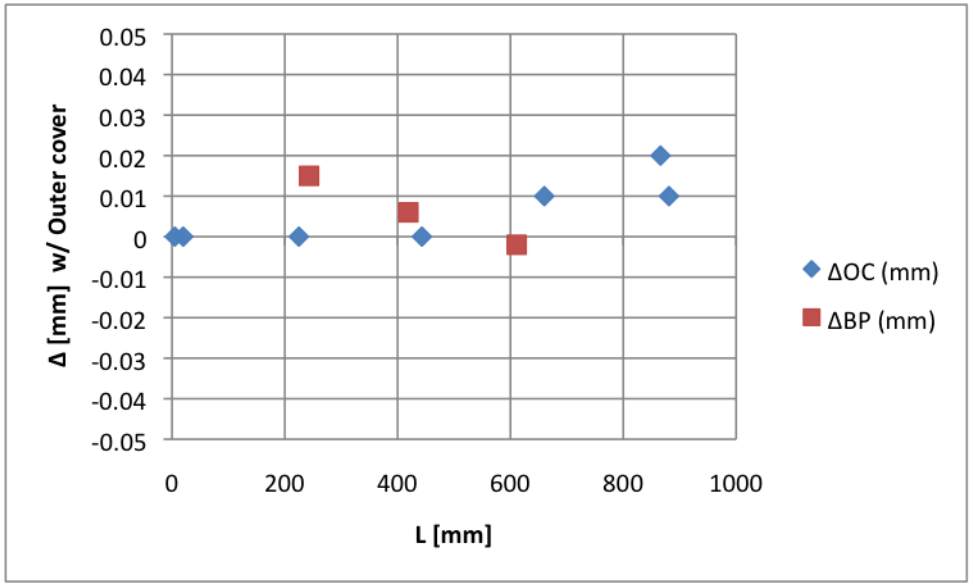


Phase 3 VXD assembly test(3)

- Measuring deformation after PXD outer cover connection
  - ΔOC: Upper position difference before/after disconnecting rotation stage (by height gauge)
  - ΔBP: BP position difference before/after disconnecting rotation stage (by dial gauge)

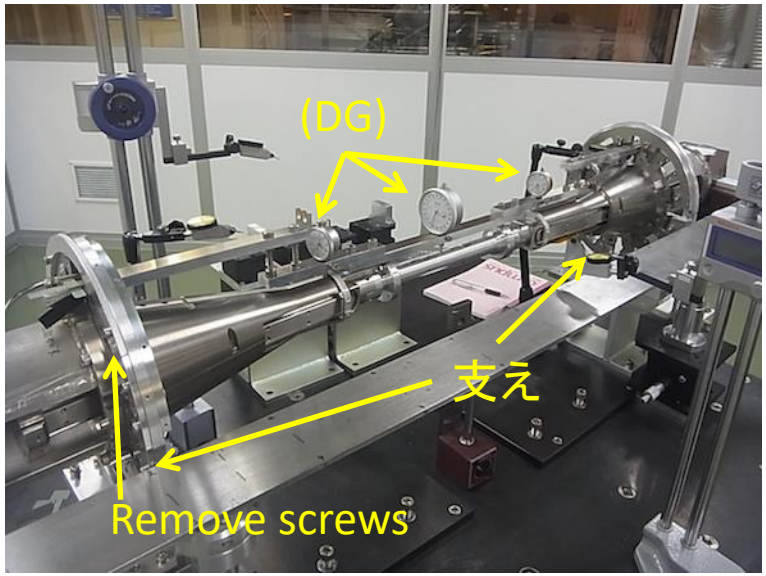


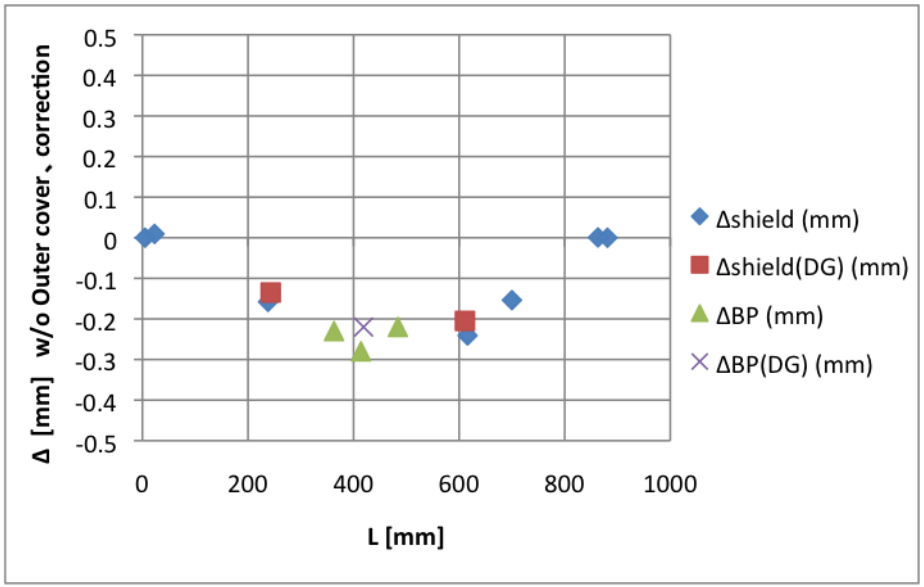
The difference seems quite small (< 20um)



Phase 3 VXD assembly test(4)

- For the comparison, the deformation measurement without outer cover
  - 0.3mm at maximum





Plan for phase 3 assembly

- Phase 3 pipe has delivered in this Monday
- Phase 2 VXD mechanical assembly start from this week.
  - Until today, SVD group has SVD halve connection test
- BP+HM integration will be finished in end of May.

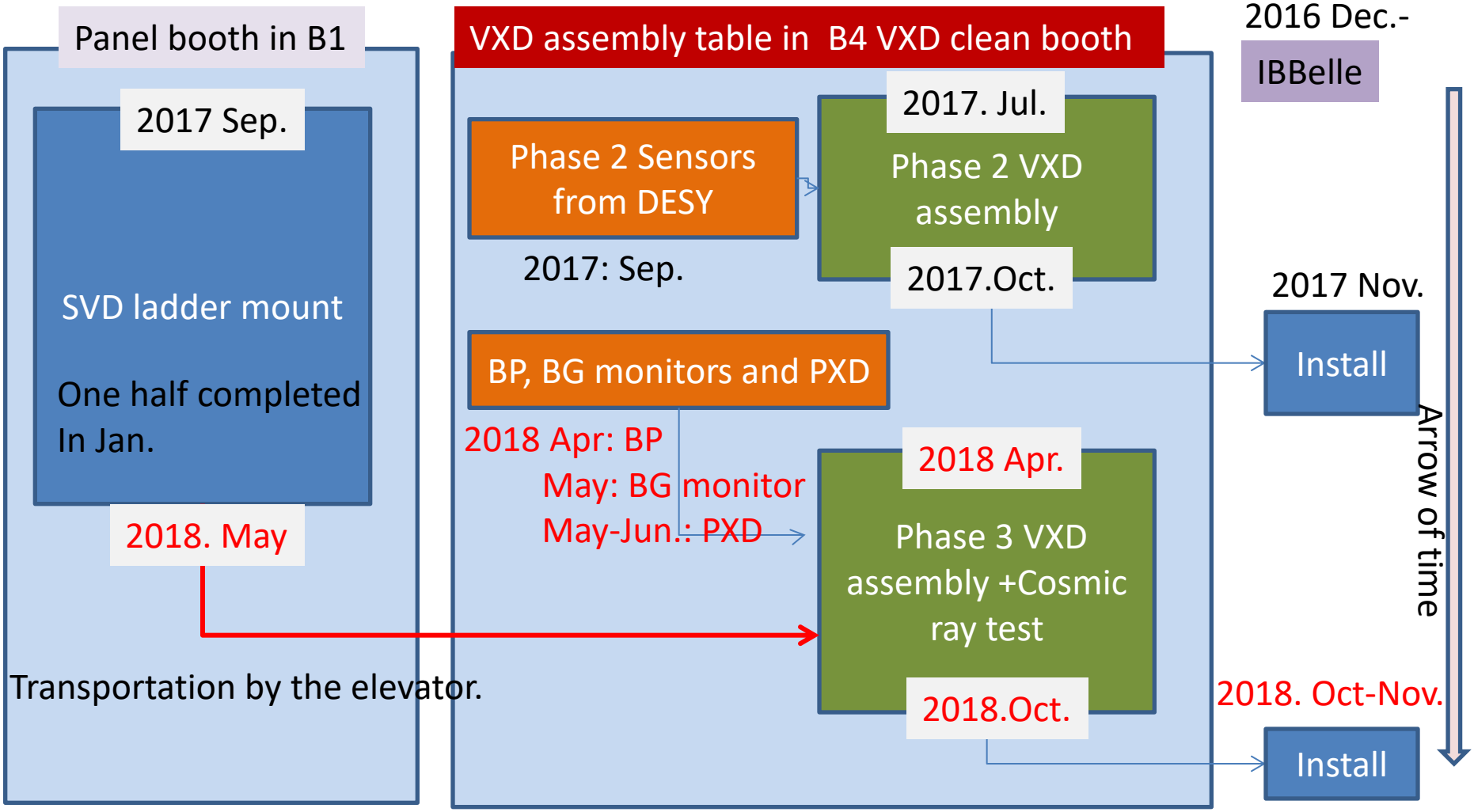
There is no schedule change from last B2GM

SVD connection test

- For fine tuning of SVD halve position, position alignment tools and positioning knobs are prepared.

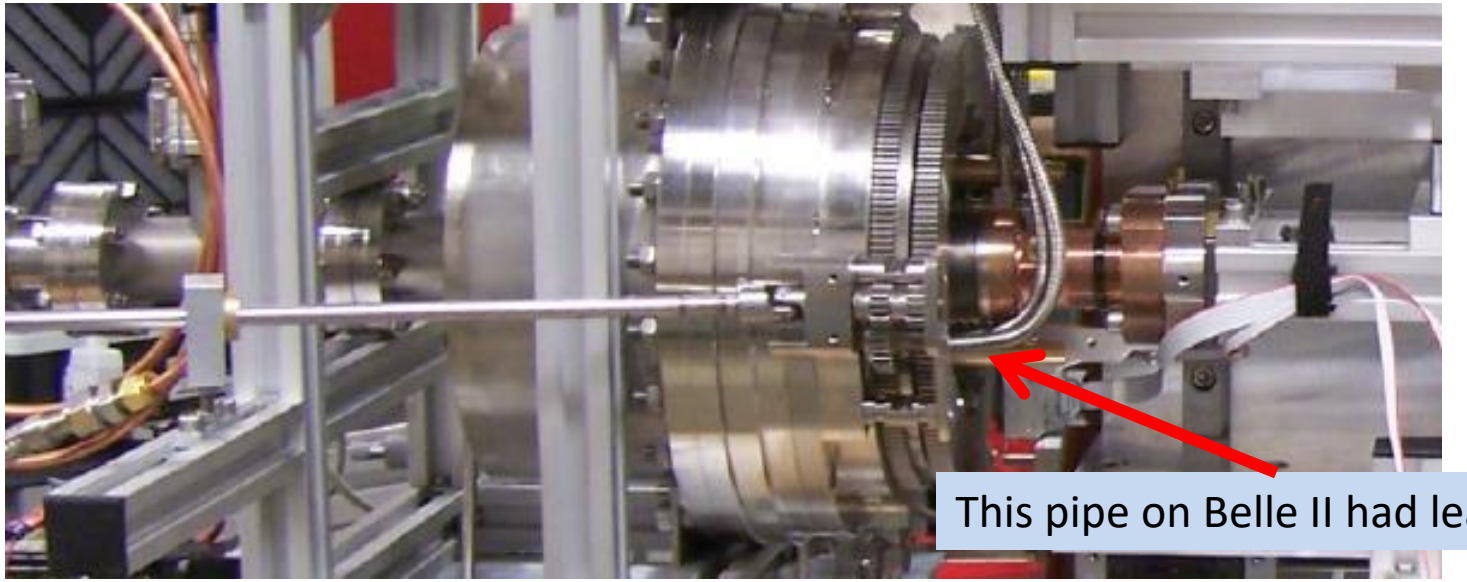
VXD Assembly work management

- We will assemble two sets of VXD system
  - VXD for BEAST phase II
  - VXD for phase III physics run



Water leakage from cooling water pipe of Bellows pipe

- Water leakage from cooling water pipe of BWD Bellows pipe(HER) has detected on 16th Feb.

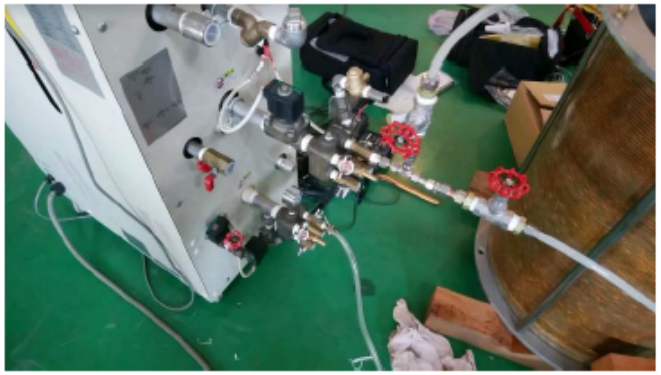


We can not access to the leaked area…

Remedy for phase 2

- Baseline option
  - Apply N2 gas flow ~(30L/min flow)
- Plan B
  - sealing by resin
    - On second test, we found dropping of resign from leakage point…..(leaked position is just RVC space)
  - Water flow with negative pressure (sucking cooling water)

Water circulation test (negative pressure)



高低差3．5m位

1/4インチ全長　10m

漏れている
フレキシ

SUS flex tube
(small hole to simulate
leakage)

priming water

½インチ　10m

呼び水用

負圧循環
装置

水の流れ

呼び水用
バイパス

水の流れ

½インチ　10m

Bypass for priming water

On this setup: Water flow was ~0.5 L/min

Current status

- HER Beam current currently: 0.2 A (target is 1A on phase 2)
  - There is still no significant temp. change
- Water circulation with negative pressure
  - 0.5 L/min has achieved
  - Setup can be prepared in first week of June.

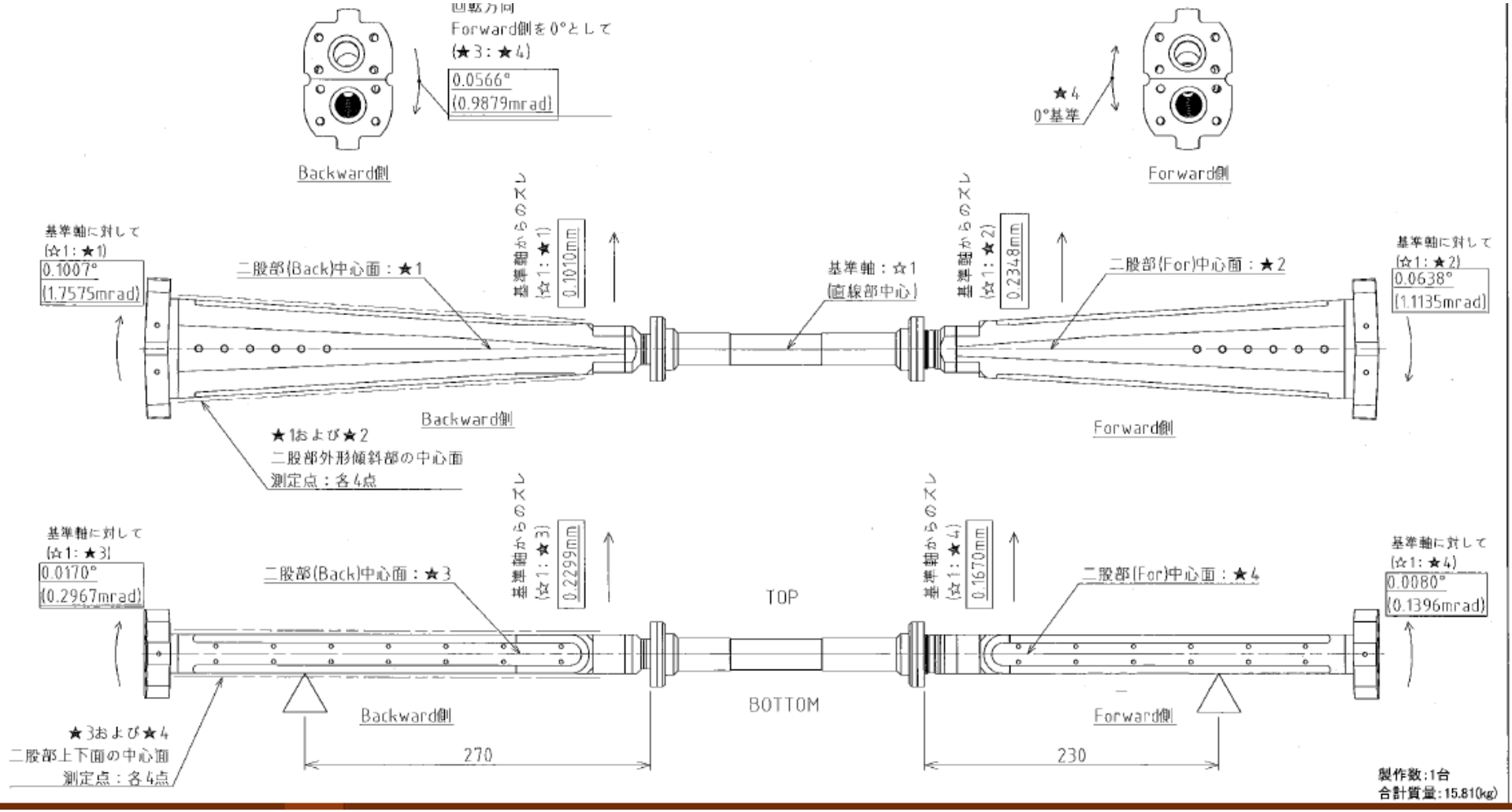
- Difficulty of estimating Heating power is by HOM (Higher Order Mode) heating induced by the beam.
  - It may be changed on the nano-beam

Summary

- Phase 3 Beam pipe has delivered
  - Deformation was acceptable level
  - BP+HM assembly starts from this week
- Mechanical assembly test for PXD system test
  - Setup has confirmed (only 30um deformation)
- Water leak issue of BWD HER bellows pipe
  - N2 gas cooling seems working well
  - Backup option is on preparation (water circulation with negative pressure)

Backup

CMM Results



The deformation is our acceptable level (300um at max. is much smaller than phase 2)

AL Corrosion possibility

- 0, Aluminum surface is covered by oxide layer which is stable material
  - In order to break this layer, Cathode (Reduction) reaction rate have to be faster than Anode (Oxidation) reaction
- 1, To fulfill above, acid or alkali condition is necessary

2, On the case of CO2 leak with water condensation.

$$CO_2(aq) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$$

This reaction can be occurred, but equilibrium Constant is 1.7×10^{-3} , which means almost CO2 molecule do not react.

pH level of atmosphere condition'CO2 level is 5.6.

In order to start AL uniform corrosion, both of
Water condensation and
CO2 leak are necessary.

Ti coating seems better solution

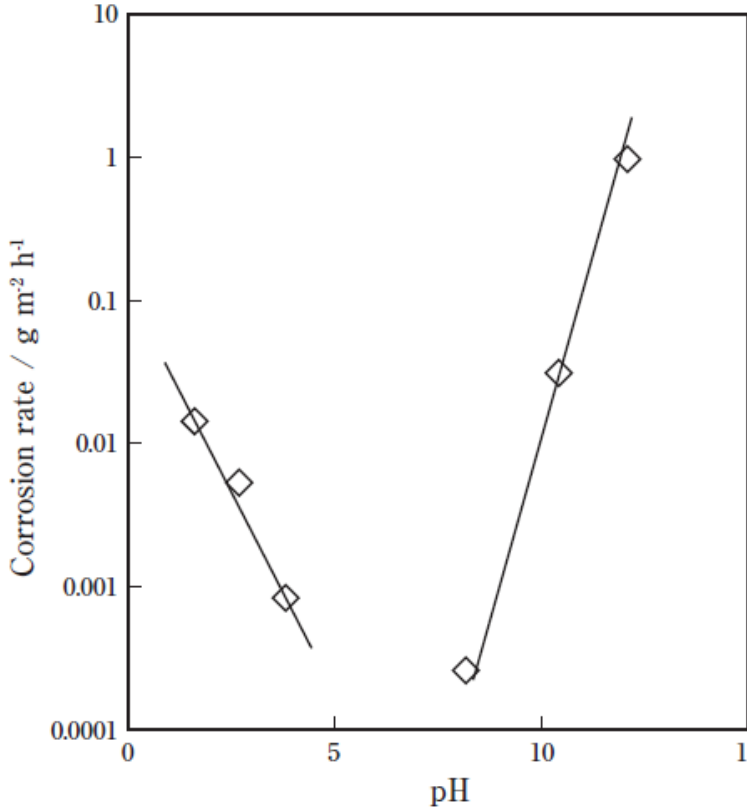


Fig. 2 pH influence on the corrosion rate of the aluminum in buffer solutions.