Current design/ideas of the QBB

T. Kohriki (KEK) and K. Suzuki (Nagoya)

List of topics to discuss (1)

1. Securing of quartz in QBB

a) Review of prism gas seal and fixtures

b) Review of forward z-spring

c) Adjusting PEEK screws etc. to locate and secure quartz with minimal stress

d) Alignment techniques to ensure glue joints are not stressed

e) Metrology in QBB to verify flatness of optics?

– *What do we do to determine the optics are installed "correctly" and remain flat in QBB?*

2. Installation and securing of PMT sub-assemblies

a) Includes "front board", 8 PMTS and wavelength filters

b) Optical coupling is the primary issue

c) Fragility of PMTs must be discussed

d) Tools for inspection (cameras etc.)

List of topics to discuss (2)

3. Electronics stack installation/servicing

a) Overview of idea from UH meeting (to be drawn in SolidWorks)

b) Cooling paths and requirements (heat loads, allowable temps)

c) Modifications required to QBB design

d) Modifications required to CDC support cylinder (if needed)

4. Laser calibration integration

a) Integration in to QBB design

b) Coupling to optics (no ports exist on current mirror design)

5. QBB structure

a) Many design features follow from the discussions above.

b) Stiffness requirements

- *Overall end-to-end deflection*
- *Local stiffness around readout region to ensure opto-mechanical integrity*

c) Gas seal (we have a solution, but needs tests)

d) Integration of remaining services

e) Mounting to ECL flanges

List of topics to discuss (3)

6. Module assembly through installation

a) Map out full life cycle from Honeycomb panel fabrication (installation of buttons) through to installation in Belle II

b) Strong-back

- *Use during assembly steps in clean room to ensure QBB remains flat from start to finish as we have no means to correct it later if we do not maintain flatness using jigs and tooling from start to finish.*

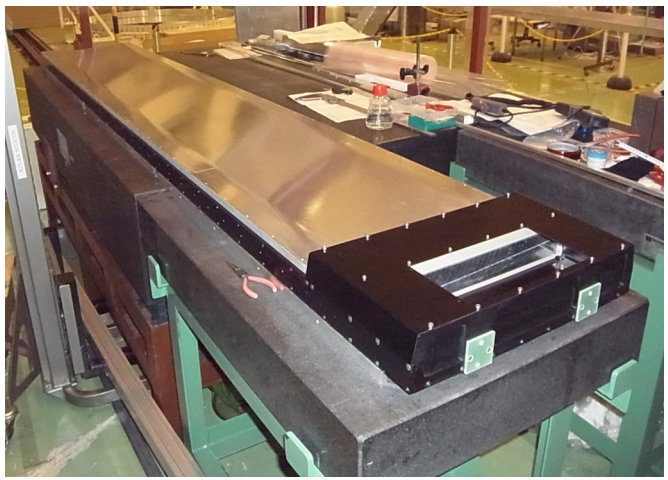
TOP counter module (1)

Based on the QBB "Prototype-III"

- *L: 2869 mm*
- *W: 466 mm*
- *T: 75.6 / 103 mm (w/o M4 bolt)*

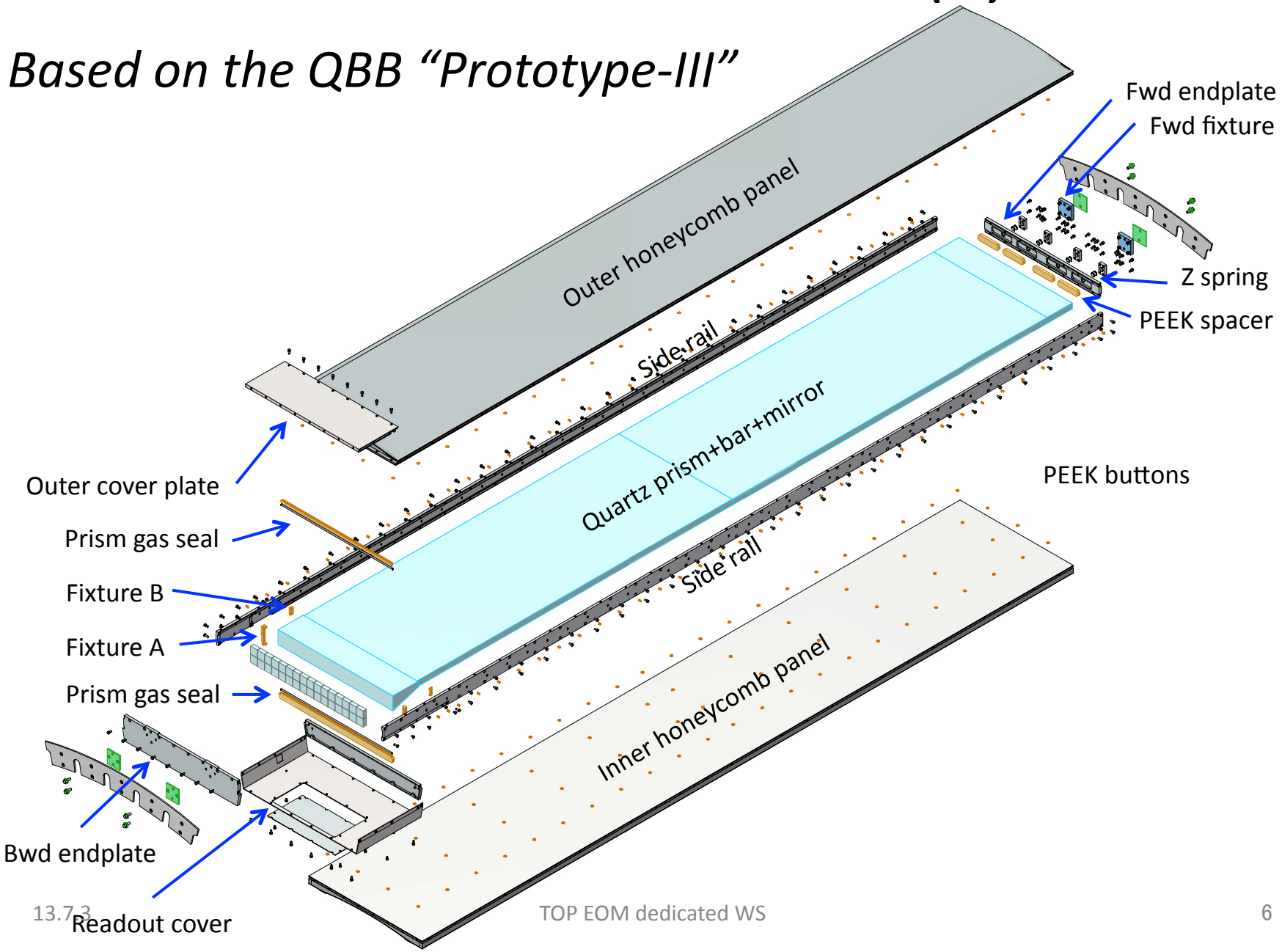
Forward

Backward

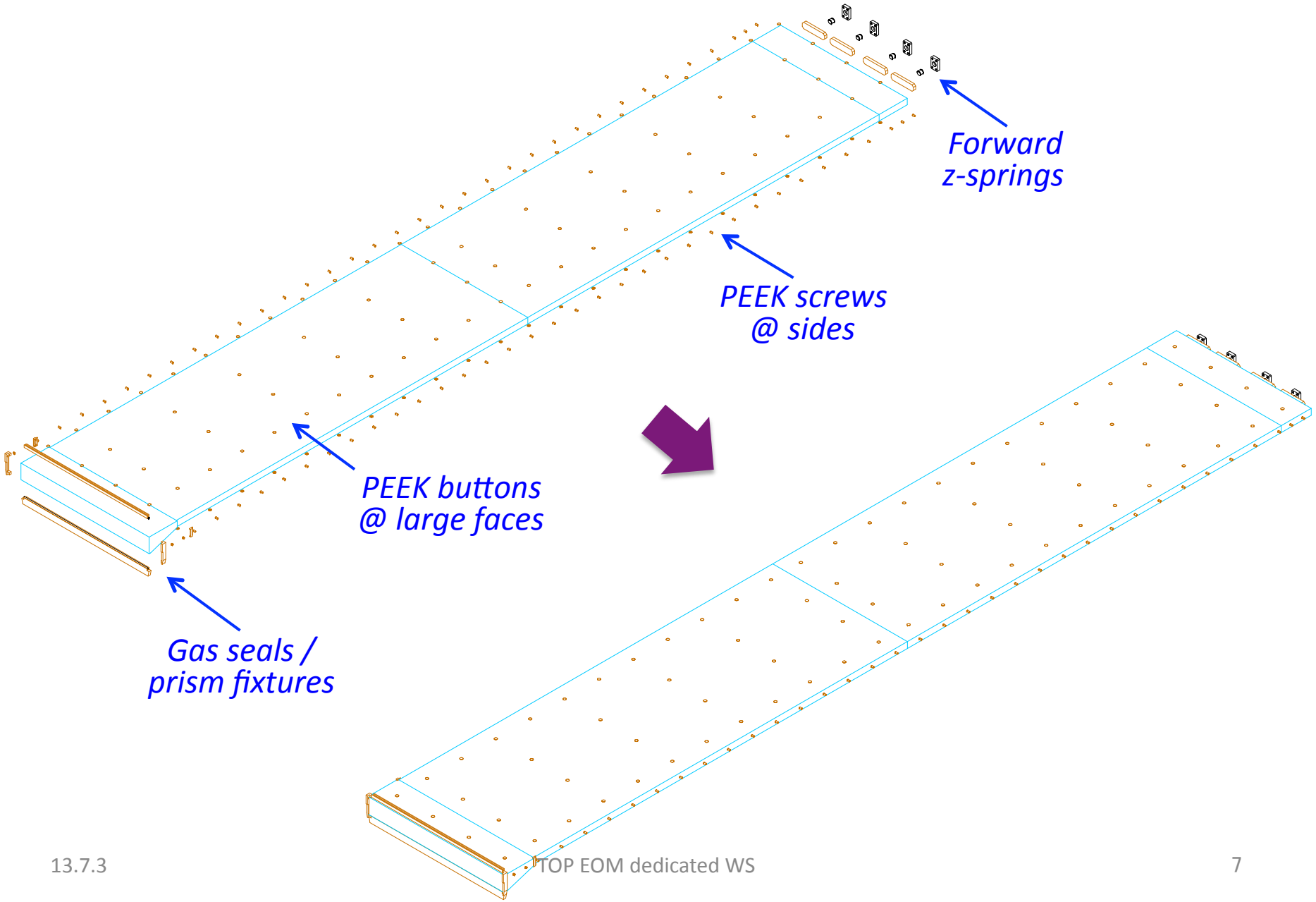


TOP counter module (2)

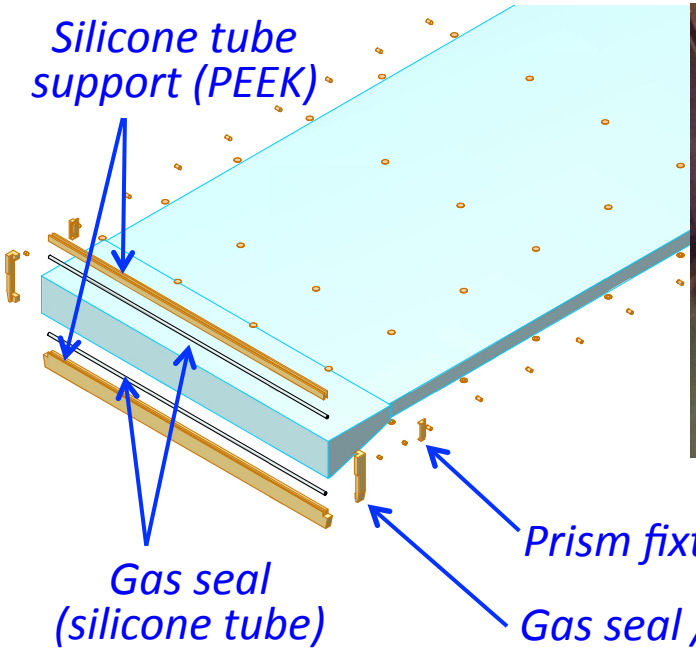
Based on the QBB "Prototype-III"

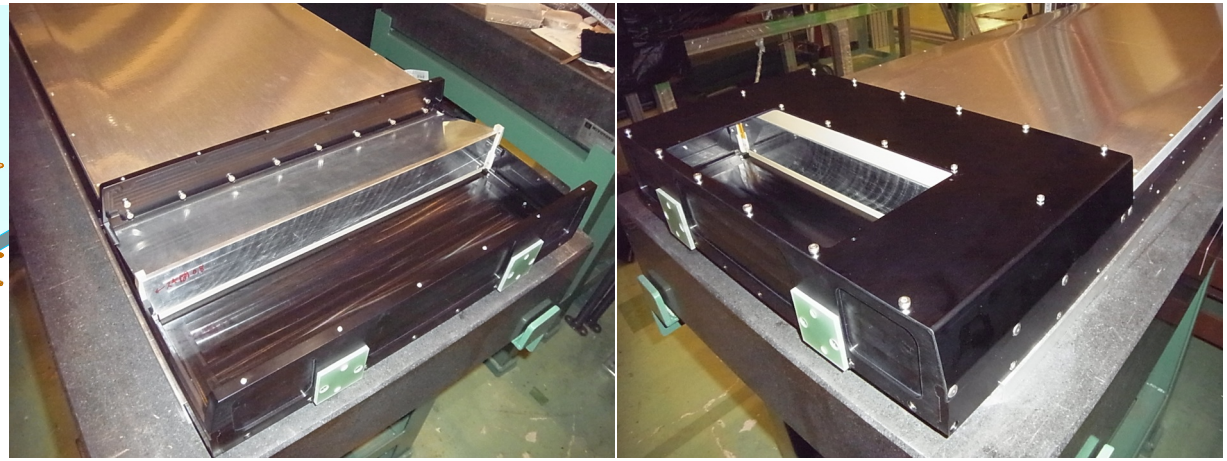


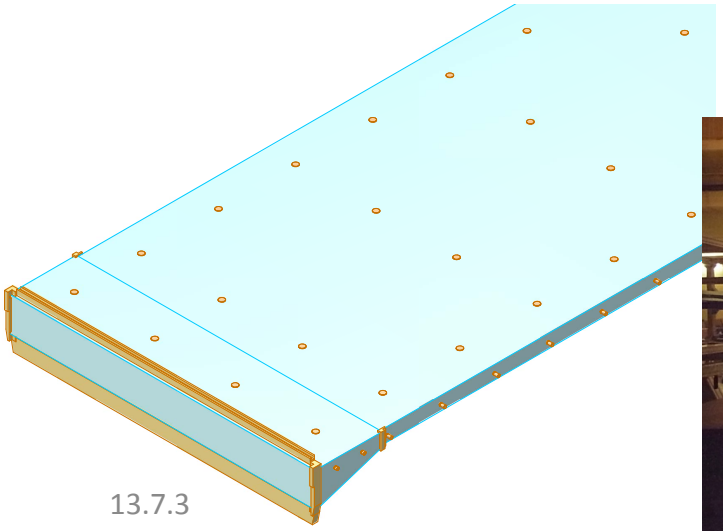
1. Securing of quartz in QBB



1-a) Prism gas seal and fixtures



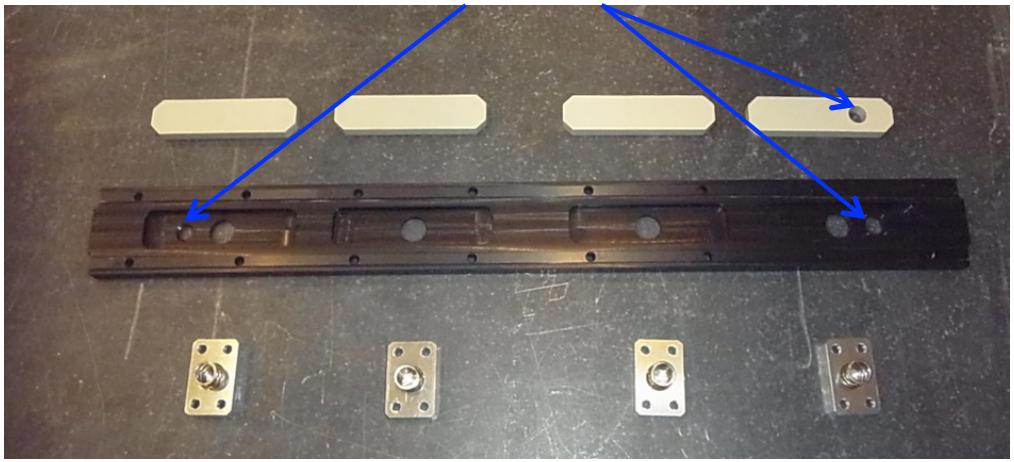


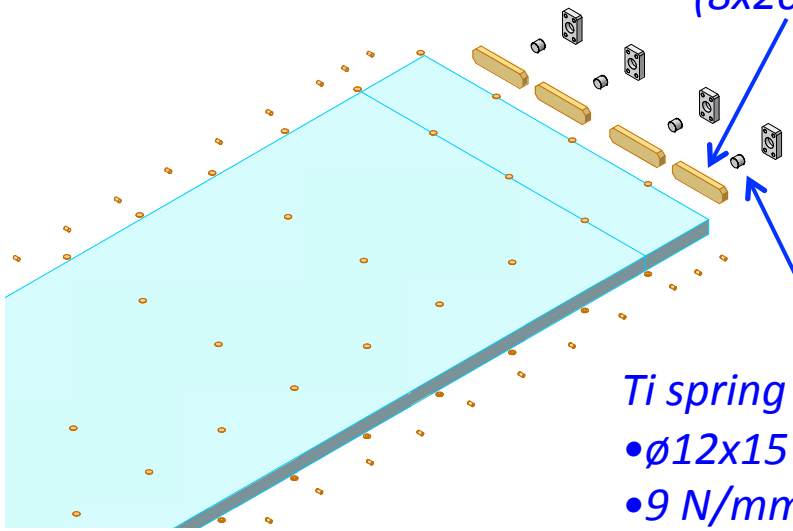


1-b) Forward z-spring (1)

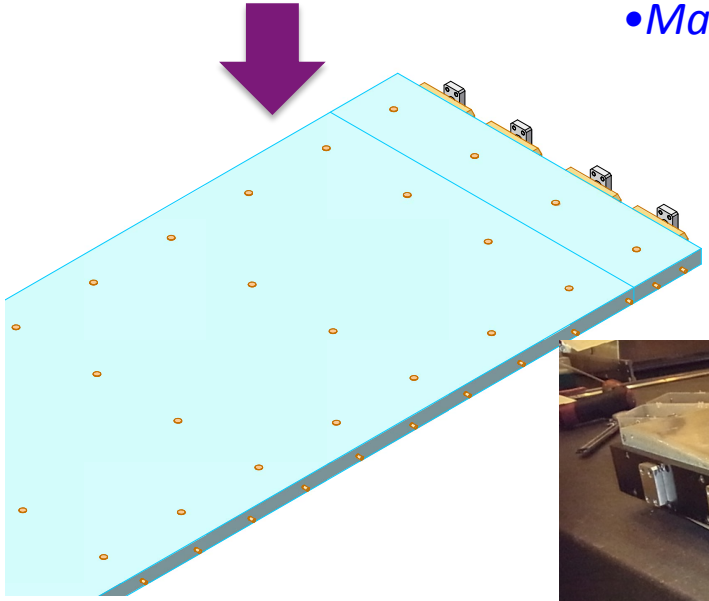
PEEK spacers (8x20x80)

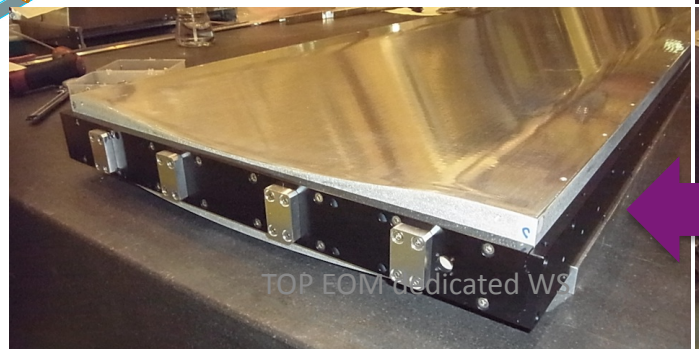
Inlets for dry gas / optical fiber



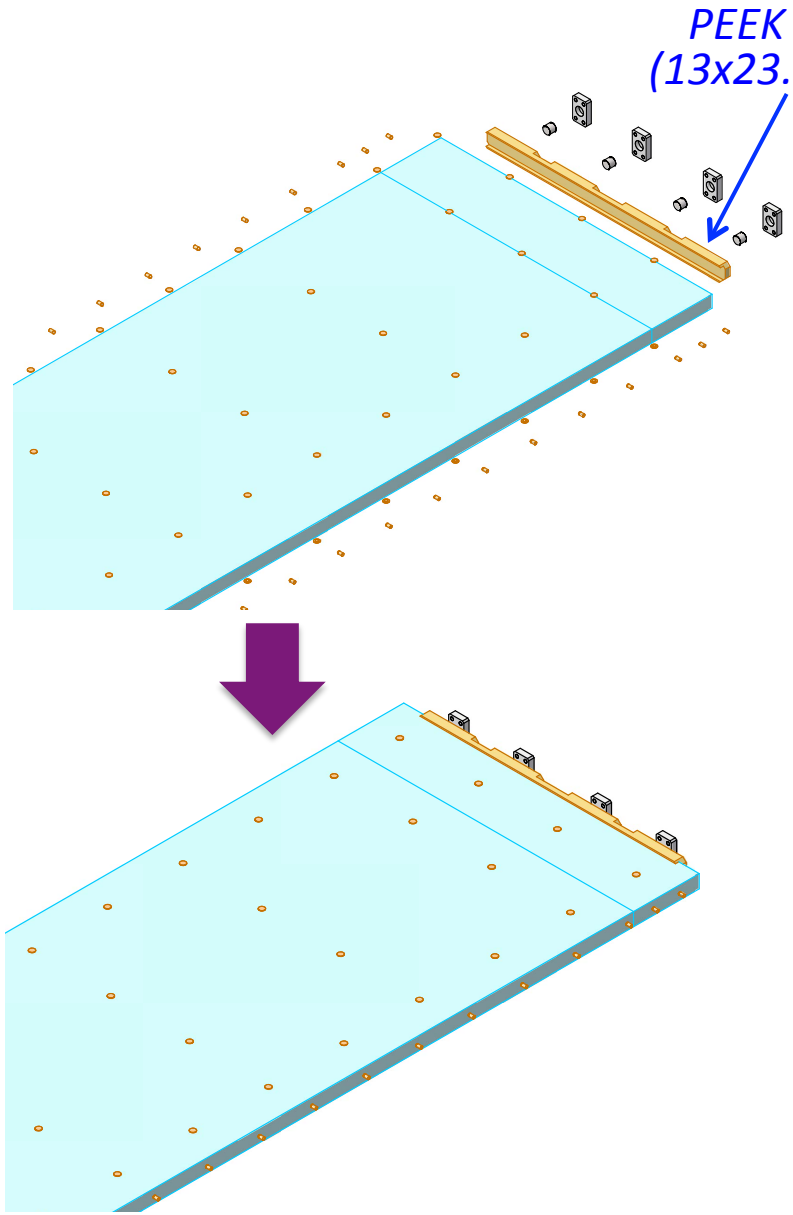


Ti spring
- ø12x15
- 9 N/mm
- Max. load 56 N





1-b) Forward z-spring (2)



- *Option for an integral PEEK spacer.*
  - *Can "grab" the mirror at large faces.*
  - *Machining would be easy.*
  - *Flexibility to the tolerance of the mirror machining is a question.*
  - *Need to test.*

1-c) Adjusting PEEK screws etc. to locate and secure quartz with minimal stress

- *Quartz optics will be placed on the PEEK buttons of an outer Honeycomb panel.*
  - *Having a side rail with pre-aligned PEEK screws.*
- *An inner Honeycomb panel will be placed (gently) on the quartz optics.*
  - *Facing the interior side, which has PEEK buttons, to the quartz optics.*
  - *Set to the socket-and-spigot joint of the side rail.*
  - *The inner Honeycomb panel is only the load during the work.*
- *PEEK screws will be adjusted controlling the torque.*
  - *Using a torque driver.*
- *See the assembly procedure drawings for details.*

1-e) Metrology to verify flatness of optics

- The socket-and-spigot joint of a side rail positions Honeycomb panels and, hence, the PEEK buttons.
  - —Positioning quartz optics in y.
  - —PEEK screws provide x-positioning.
- The prism fixtures are fixed at side rails and positions a prism in three dimensions.
- The rigidity of quartz is lower than that of a QBB.
  - —So the deflection of quartz optics follows that of the QBB.
- A QBB deflection along z can be represented by the side rail deflections.
  - —Based on FEM studies.
  - —The QBB deflection along x is negligibly small.
- Therefore side plates are good references of the quartz positions and deflection.
  - —As examined using Prototype II with Al dummy optics.

5-b) Stiffness requirements (1)

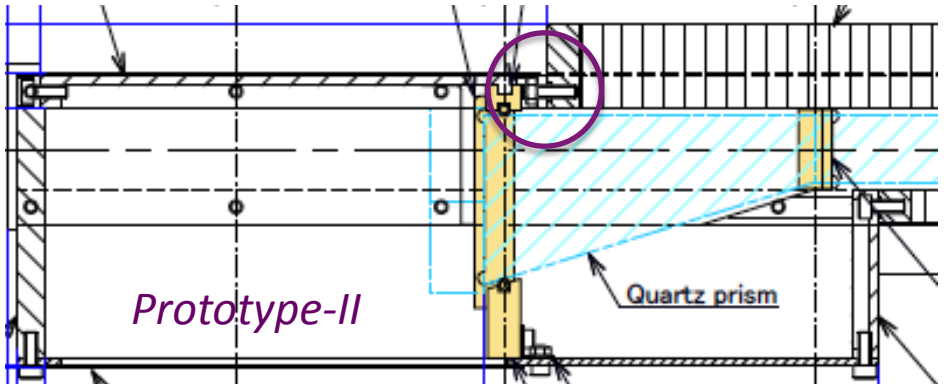
– for overall deflection –

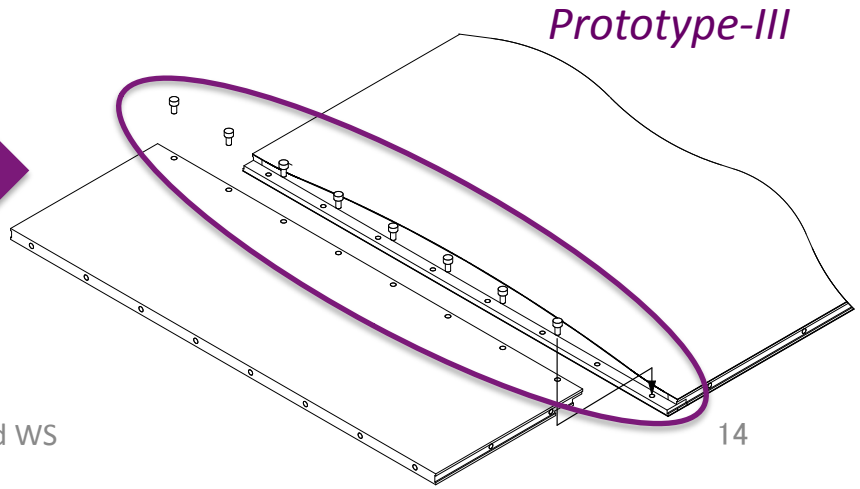
- *The target has been set that a bend of quartz optics, i.e. a module deflection, should be < 0.5 mm.*
  - *–Based on the MC study for a kink-like bending.*
  - *–For a dynamic bend, such as the one during the installation, on-going adhesive strength tests could refine the target.*
- *Cylindrically joined 16 modules seem to be stiff enough.*
  - *–Based on FEM studies.*
- *Round-shape Honeycomb panels and z-beam joints seem to work very well.*
  - *–The panel production has no problem so far.*
  - *–See a report on the installation practice for the z-beam joints.*
- *Side rails should be integral and machined precisely.*
  - *–To provide a smooth deflection and to be the reference.*
  - *–Prism fixtures should be fixed to side rails.*

5-b) Stiffness requirements (2)

– for local stiffness around the readout region –

- The joint between the outer Honeycomb panel and the outer cover plate has to be stiff enough.
  - The joint stiffness has been improved in Prototype-III.
- The panel and plate should not be integral, e.g. merging into a single panel, to make a modification easier.
  - The cover plate is highly tied to the front-end electronics installation and would have a complex structure.
  - However, the scheme has not been established yet.





5-c) Gas seal

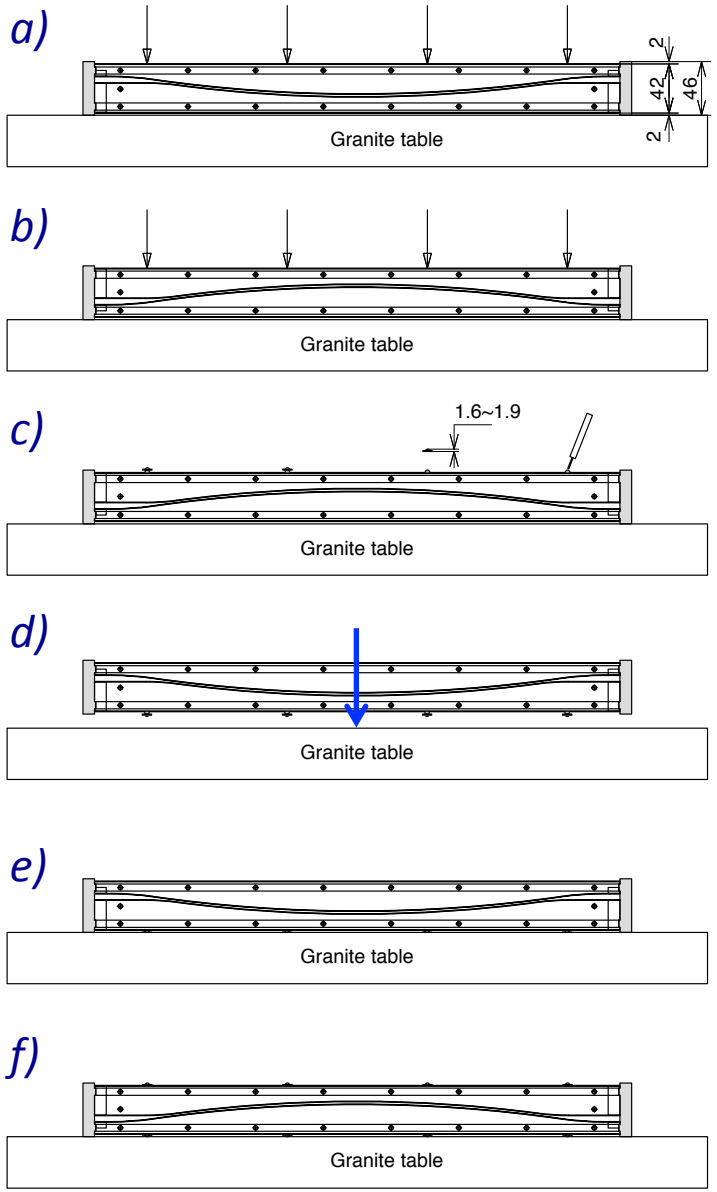
- *Silicone RTV will be examined for gas sealing except the prism end.*
  - *For the joints between side rails, Honeycomb panels and/or end plates, dedicated grooves or chamfers will be introduced to put the silicone RTV (as done for CDC).*
  - *For the screws, once a module is assembled, each screw will be removed and reinserted after putting the silicone RTV at the screw hole.*
  - *Silicone tube and PEEK fixtures will be used at the prism end.*
- *Use of adhesive during the module assembly might be another option.*
  - *It is much more difficult and riskier, and not preferred.*

5-e) Mounting to ECL flanges

- *We should target the ECL flange holes (Φ10) directly and measure the module position later accurately.*
  - *Based on the experience of the installation practice.*
    - *We intended to target the ideal position by measuring module position, but it seemed not practical to do so during the complex installation work.*
    - *It is quite simple and efficient to position a module utilizing only the flange holes (Φ10) with cylindrical spacers (Φ_{in}6.2, Φ_{out}9.8).*
  - *To set the modules along a perfect circle, we need extra clearance to the ECL cylinder which we cannot afford.*
    - *Since the vertical diameter of the ECL flange is 3-5 mm shorter than the horizontal one.*
    - *The flange holes are accurately machined so that there is no problem to join adjacent modules.*
  - *It is more important to know the module positions accurately than to set them on a perfect circle.*

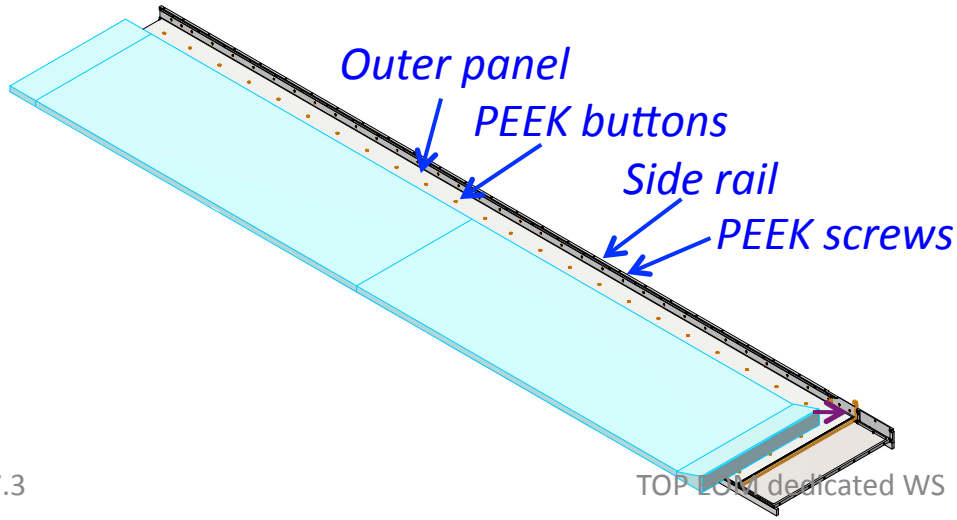
6. QBB assembly (1)

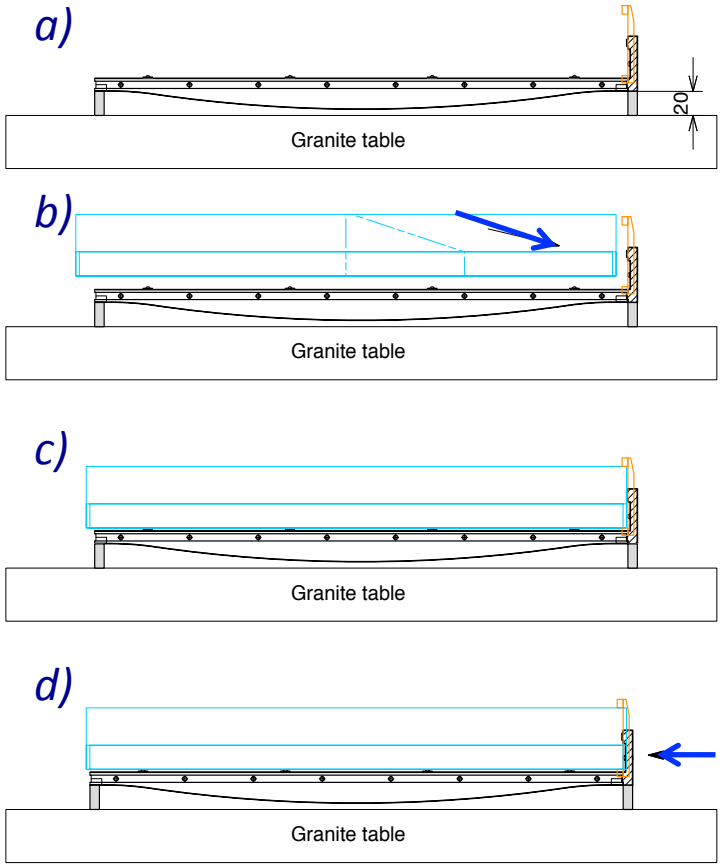
- *Step1: Gluing PEEK buttons*
  - *a)Measure the thickness of the surface of a Honeycomb panel.*
  - *b)Measure the thickness of the surface of the other panel.*
  - *c)Put the adhesive at the PEEK button locations and place the buttons.*
    - *Using a dispenser at the pre-marked locations.*
  - *d)Flip the panel face worked in c) to the granite table surface.*
  - *e)Cure the adhesive reflecting the flatness of the granite table.*
  - *f)Repeat c)-e) for the other panel.*



6. QBB assembly (2)

- *Step2: Dummy optics installation*
  - *a)Set an outer Honeycomb panel with shim bars on the granite table, having a side rail with shim bars.*
  - *b)Lowering the dummy optics.*
  - *c)Making the dummy optics approach to the target position.*
  - *d)Precisely align the outer panel to the dummy optics and place the dummy*





6. QBB assembly (3)

- *Step3: Set all the other parts*
  - *a)Set an inner panel, mating to the socket-and-spigot joint of the side rail.*
  - *b)Set the other side rail.*
  - *c)Set the other utilities.*
    - *z-springs, fwd end-plate, bwd end-plate, readout cover, etc.*
  - *d)Join a strong-back.*