

Mu3e SSW–cabling–plumbing

17 Nov 2020 Meeting

Scope

This meeting discusses all the aspects of services inside the magnet. In other words: “the cage”. We do not discuss the detectors itself but everything between the flanges on the magnet to the detectors and what is in between. This covers:

- Flanges
- Cables/optical fibres/piping/tubing from flanges to SSW
- SSW
- Cables from SSW to the detectors
 - power
 - HV
 - data
 - monitoring
- Water cooling loops
 - SciFi
 - SciTile
 - SSW (FEB, power crates, HV crates, DAB, ...)
- Helium cooling (distribution, feeding along beampipe, exhaust)
- “Weather station”, slow control (besides the detectors)
- Camera alignment system
- Mounting of detectors on beampipe
- Services around beampipe: busbars, helium ducts, cable bundles, ...
- ...

Complete? Well-ordered?

Goals for this meeting

The list is quite long. We have to organise ourselves. I would like to

- Discuss if this is complete
- Sort out who is responsible for what
- Define requirements
- We should not build anything before we have
 - A valid CAD model, stored at PSI
 - A signed-off set of drawings
 - Specifications

- Plan to write specifications (SpecBook): who? when?
 - The SpecBook is a success story for those who used it so far. It helped a lot. Take the time and write good, reliable, complete specs
- Break-out groups?
- When do we like to make a break?

Mechanical support detector-beampipe

- Proposal: SB+YM+JV+LV+**BW**(SM)
- Existing: DS beampipe with target mount **but** still short length (old design)
- Non-existing: US beampipe and DS beampipe at full lengths
About to be fabricated at PSI
- Also consider the setup for the commissioning

Front-end boards

- There are 112 or 114 FEBs, 56/57 per side
- On each side:
 - 7 boards for the tile detector
 - 6 boards for the fibre detector
 - 2 boards for pixel layer 1
 - 2 or 3 boards for pixel layer 2 (two maps the half shells, three would require only one type of Pixel DAB and solve all our FPGA resource issues)
 - Decision: let's go for three boards.
 - 6 FEBs for pixel layer 3 central
 - 12 FEBs for pixel layer 3 recur
 - 7 FEBs for pixel layer 4 central
 - 14 FEBs for pixel layer 4 recur
- Where do these boards go in φ ? We have no constraints from the DAQ side
- Can we come up with a consistent nomenclature for the slots in φ ?
- There will be four logical crates with 16 slots per side
- Can we do the 3-board solution for layer 2 (or 4 boards?)
- How do we route the fibres from the FEB to the flange? Current idea is to a patch panel on each side (in CAD) and then bundled to the flange. Stress release in the first stretch is not obvious. Patch panel is needed.
- Cable lengths should be under control, especially for the timing detectors we should make sure that the signal paths are of the same length.

Detector Adaptor Boards

NB: DAB's are an abstraction layer

- How big can the DABs be (mainly in z)
 - First board (pixel case) will become available for review this week
- How are they fixed to the SSW
- How do we access that space between SSW and Cage Wheels? Tricky.

- How does each detector plan to do the connection at the DAB?

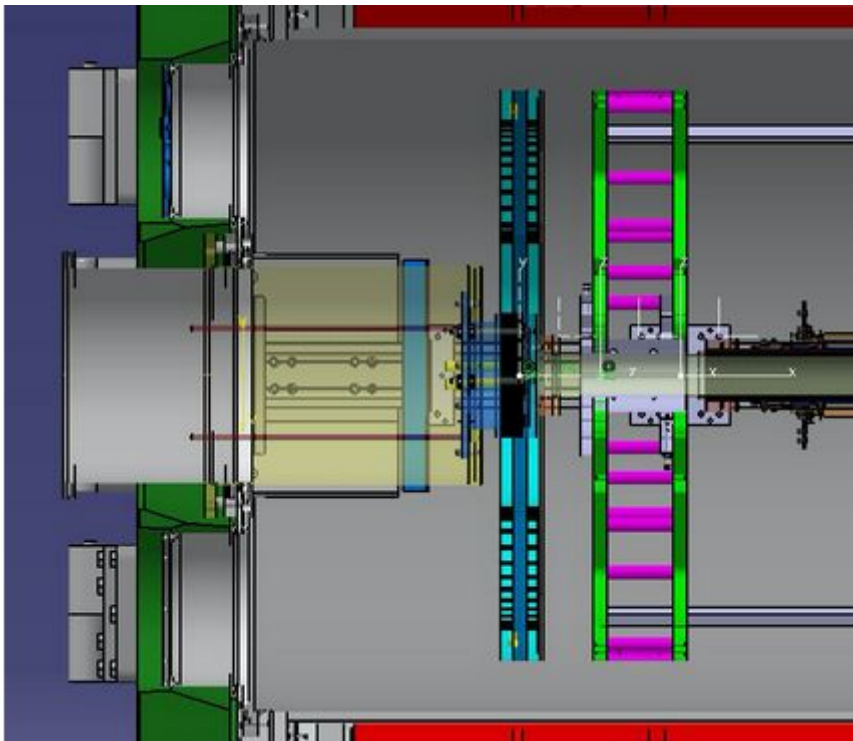
Camera alignment system

- How to mount cameras to the cage?
- (Not clear yet how many and what cables to the outside world)

Mock-up discussion

Happened in HD around the mock-up.

- Most constrained region is the area behind the backplane where the DAB will be.
- **A dedicated mock-up of one SSW is planned. Two wheels with beampipe, first segment, plus flange plate.**



- Connectors not decided. We should converge.
 - List of connections need to be done.
 - Soldering least viable option.
 - The DAB could be considered being the connector. Reduces the granularity.
- Define volumes what is used by whom. Will require re-iteration. **High prio.**
- Top priority: Connector of μ twisted pair cables
- $8 \times 36 \text{ mm}^2$ of a crimped detector.
- HV: Should be separate cables, preferably micro coaxial. **micro-micro.**
 - SciFi: 12 lines, gives a bundle
 - Baseline: Coax with shielding floating on one end. Natural choice: detector end floating. Prevents from that shielding becoming a giant pick-up antenna for the detectors.

Mock-up planning

- Will be in HD
- Production
 - 2 wheels additional from current production
 - PVC tube for beampipe, 3d printed parts glued to it for the features
 - Crate placeholder: HD will take care
 - One quadrant of real FEB crate but boards as wooden dummies
 - Cable dummies
 - Dummy backplane: piece of wood and a bunch of connectors
 - Mock-up for HV and power crates
- Detector cabling studies
 - Pixel and Tiles:
 - **HD** organise themselves
 - SciFi:
 - Arrange video meeting between UniGE and HD.
SB and AS will take care
 - 3.5 V issue still pending
 - Helium:
 - **FM** and BW+AS
 - FEB crate
 - **NB** and BW+AS+DG
 - Power crate
 - **FW** and BW+AS+SH
 - HV crate + cabling
 - **SR** and AS
 - Water pipes
 - SB and YM and **AS**+BW
 - Weather station / slow control (MSCB sub-masters et.al.)
 - **FW** and SR
 - Services for camera alignment/surveillance cameras, that may end up in that region
 - **NB**+GS and ?
 - μ twisted connectors:
 - TR+LV+FS and SB. YM will join for a meeting with Comtronic.
 - cable prototypes
- Timeline
 - Mock-up
 - design is ready, maybe adopt certain drawings for that special purpos
 - ~3 weeks the mock-up should become available (our Xmas gift)
 - In Jan we can start to do some cabling studies
 - Other groups will prepare their mock-up/dummy parts to become ready for shipping to HD in Jan.
 - Video sessions for cabling studies/demos will follow afterwards.
 - Feb we should schedule a big meeting again to collect insights from all these studies.
 - AS will be the “pusher” for this. There is a weekly progress meeting in HD. Thu 10 am.

Take-aways and pro memoria

- Magnetic field changes and current changes
 - Cables need to be mounted rigid enough to withstand any forces from switching on and off the current.
 - Planned B-field changes
 - Emergency shut-down is major issue, as well is a magnet quench
 - **Specification:** All the wires have to survive a power-cut in the B field
- Next meetings:
 - **Around Feb next big meeting** to discuss outcomes of the various studies planned today
 - Whenever a discussion in a larger audience is required, ping Frank and we will try to schedule a meeting. Tell Frank the scope and whom to invite.
- Discussion please go for <https://elog.psi.ch/elogs/Mu3e+Services/> (“Mu3e powering” was renamed renamed to “Mu3e Services”)
- Whenever you have converged on something, write it to the SpecBook (<https://bitbucket.org/mu3e/mu3especbook/src/master/>)

Screenshots from meeting

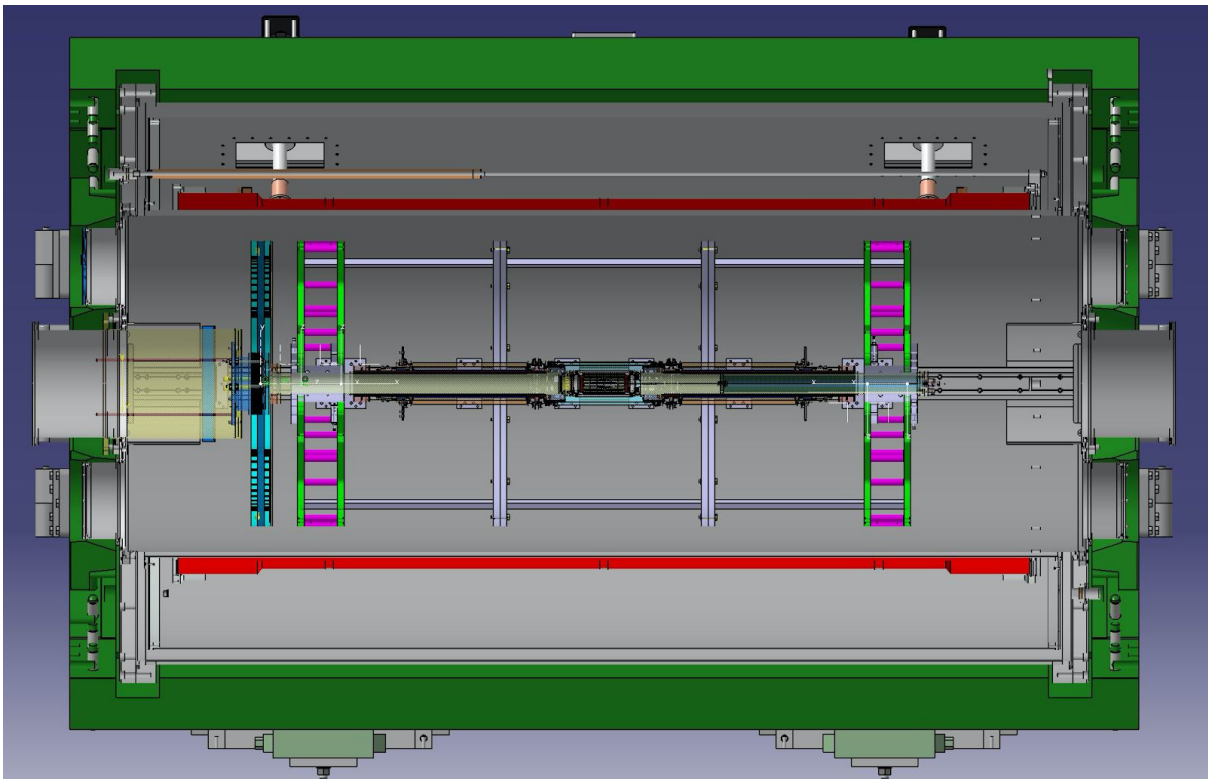


Fig 1: Side view of current CAD model. The yellow “pot”-structure on the left is the transition region from the beamline (large diameter) to the beampipe (small diameter)

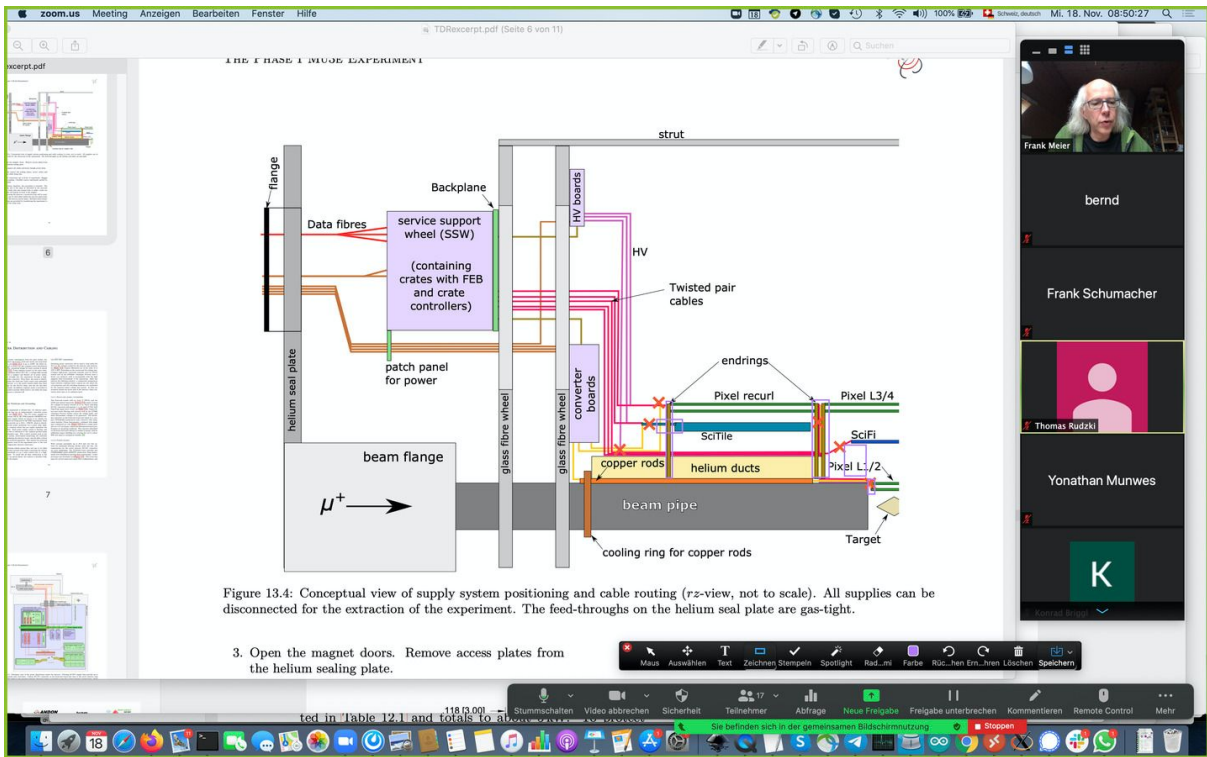


Fig. 2: The crosses indicate the interfaces between detector and cage.

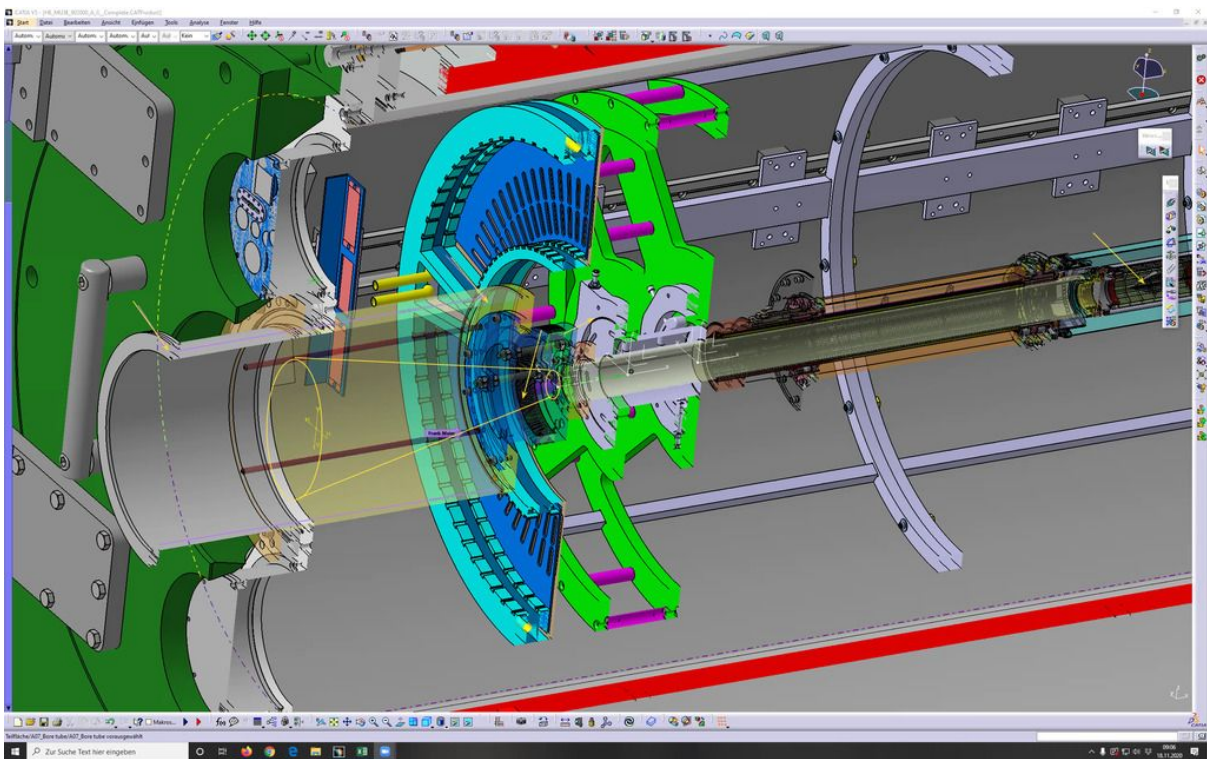


Fig. 3: The cone (yellow lines) indicates the contraction of the beam. This illustrates why we cannot e.g. move the SSW further upstream

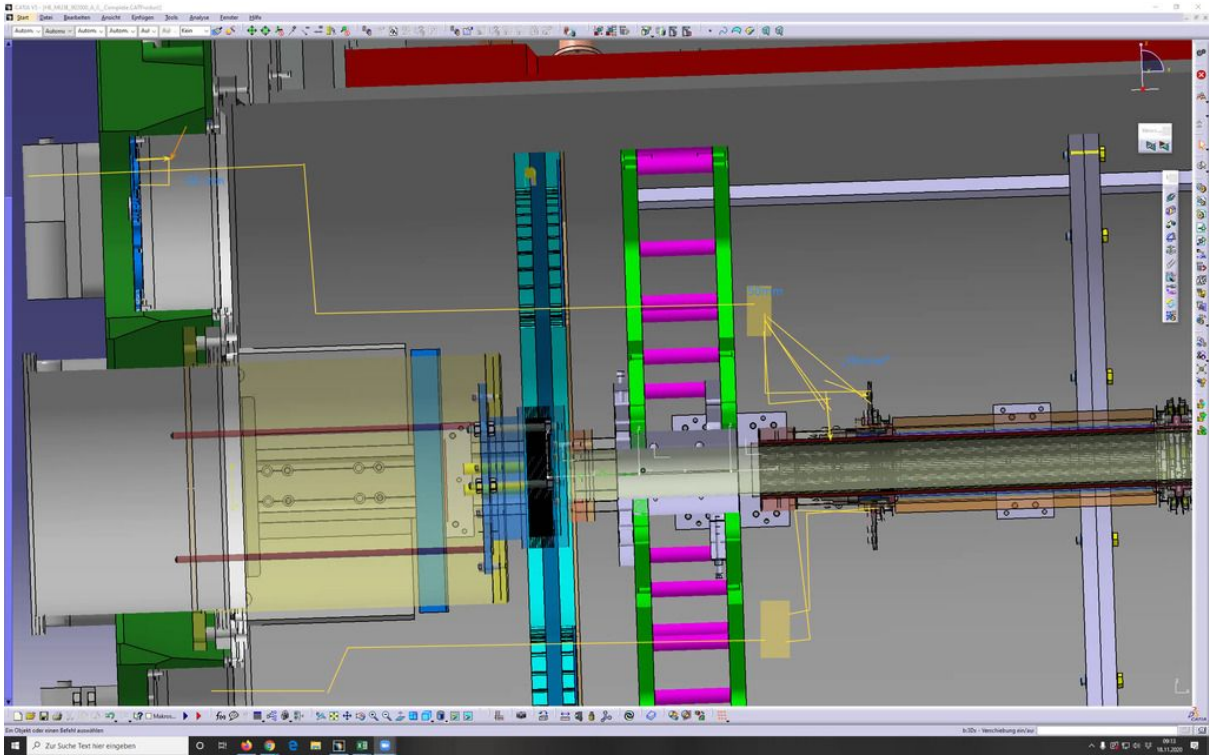


Fig. 4: The yellow lines indicate a possible routing of the helium tubing. Could well also be routed outside the SSW.

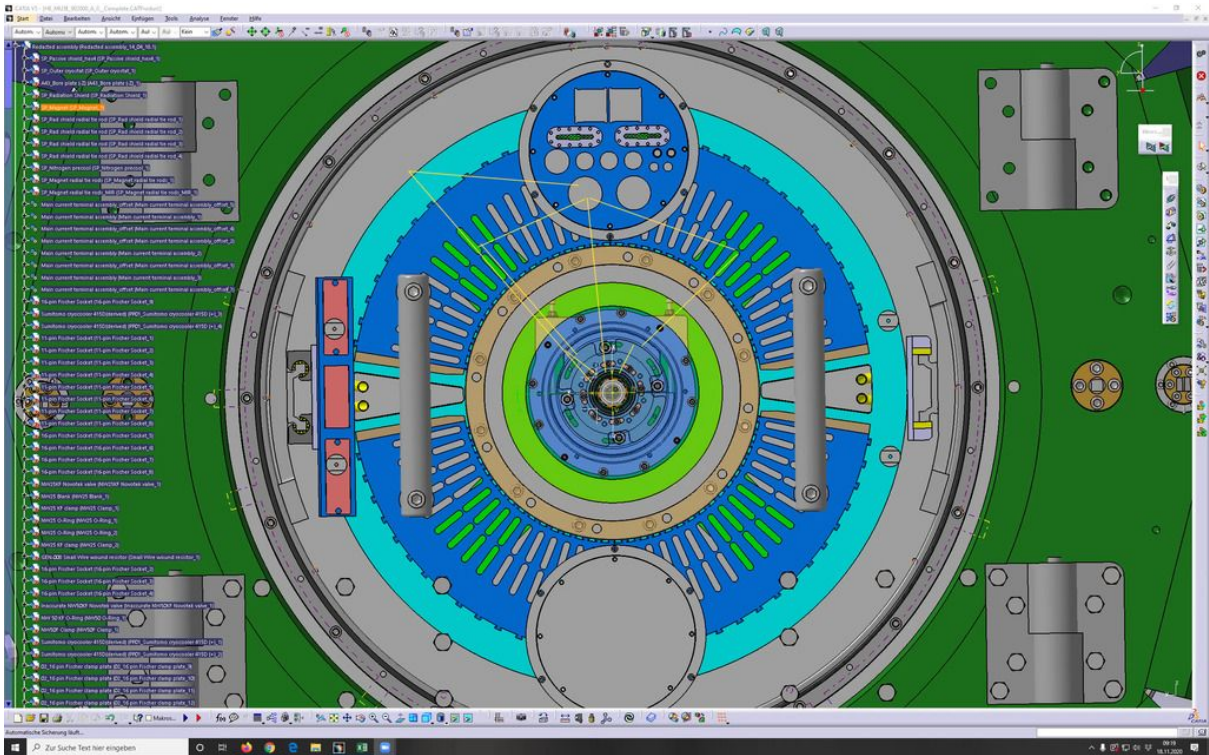


Fig. 5: Possible routing options in the $r\phi$ view. Keep in mind that this is a 3d structure and the tubing will not penetrate e.g. the FEB crates.