# IMPACT Retreat – Readiness for Long Shutdown Beam Instrumentation

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Beam Instrumentation, Proton Beam (TP03)
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# Acknowledgements

The following colleagues have contributed to this work:

Rudolf Doelling, Marcel Kalt, Tamino Wirz, Martin Leber, Lukas Trondle, Stephan Hirt, Sina Jaroslawzew,

Simulations by Vadim Talanov and Xinyu Wang

(I’m sorry if I forgot somebody)

# Content

1. In-Shield Wire Scanners
2. In-Shield Ionization Chamber
3. Segmented aperture foils
4. Electronics upgrade: SoM-CAM
5. Other works: fast wire scanners

Additional wire scanners, beam current transformer and haps for TATTOOS - not covered.

# In-Shielding Profile Monitors: MHP/S23/24 and MHP/S23B/24B

1 Measurement of beam profile (MHP) and beam position (MHS).

2 New, modular design, tested as MBPT (since 2022) and MHP/S45/46.

3 Electronics based on the SoM-CAM system, a new motor controller, and DBPM3-HIPA platform for MHS (Boris Keil: on time)
(MESON system as a fallback solution).

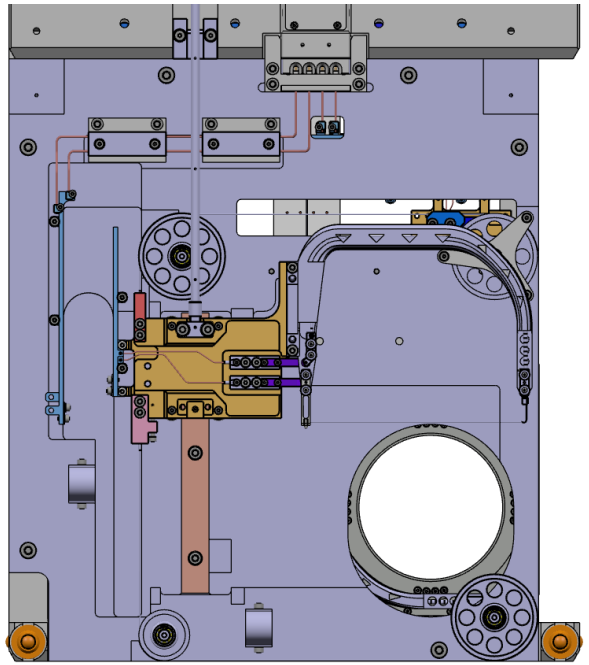
4 AEK request for control system integration sent.

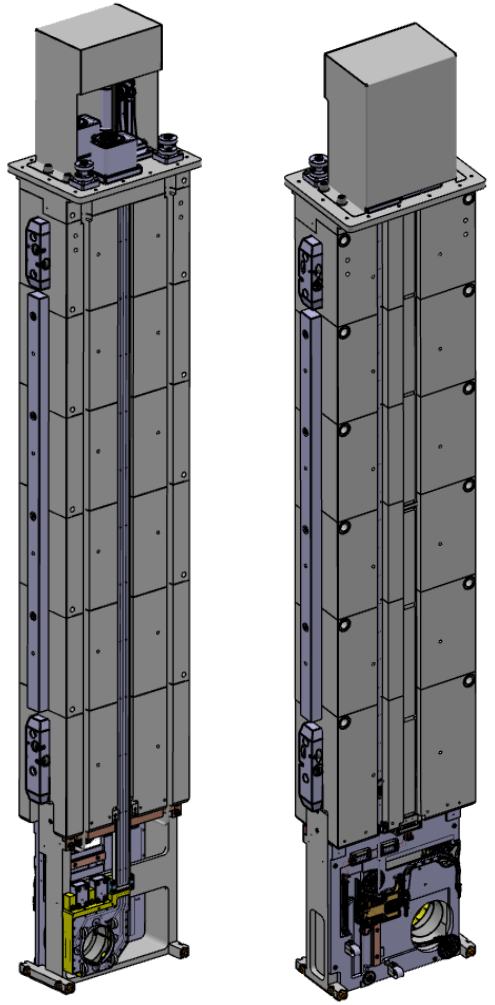
5 In production including spare parts.

6 Complex devices, 2 months for assembly and testing (each).

7 Final assembly in the Montagehalle – monitors are long and heavy.

8 Movement calibration and testing - in Experimentalhalle.





# Example: MHPS45/46 installation

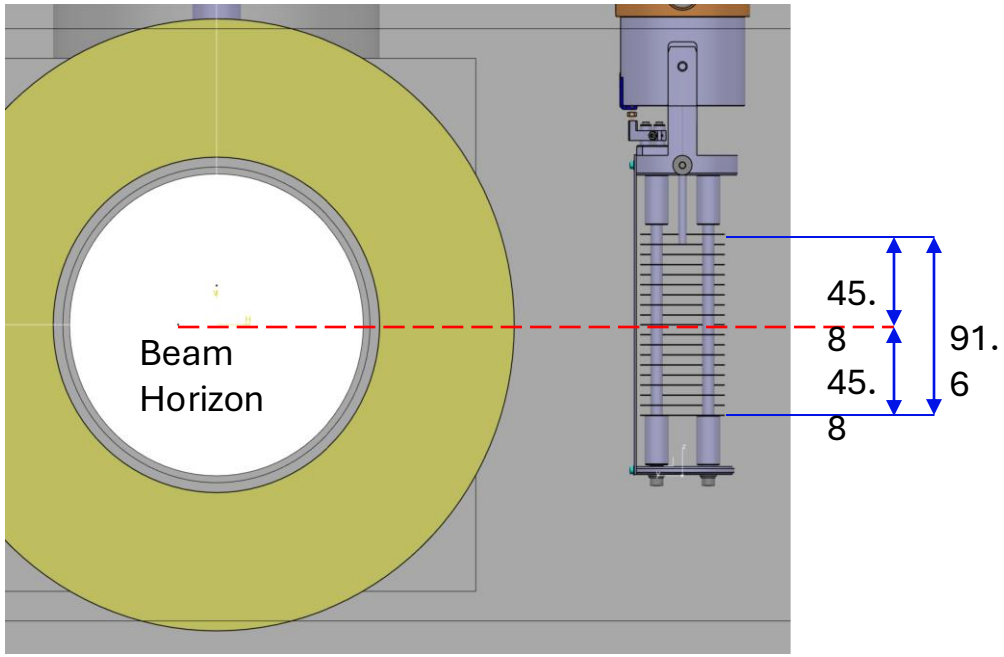
# In-Shielding Ionisation Chamber: MHI11

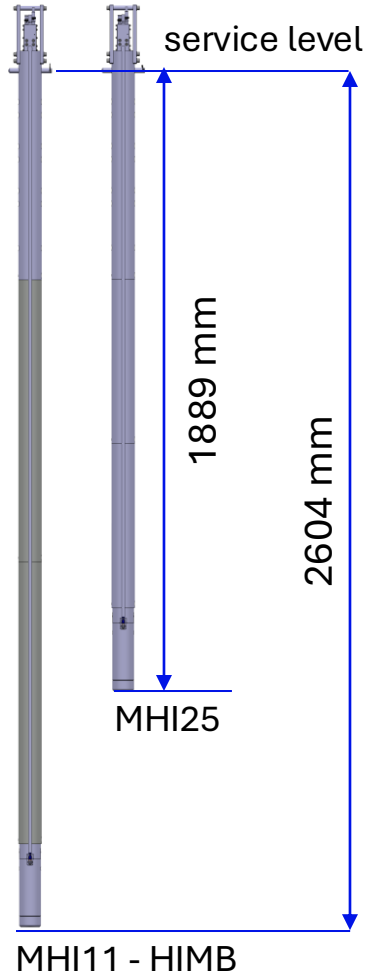
1 Measurement of the beam loss.

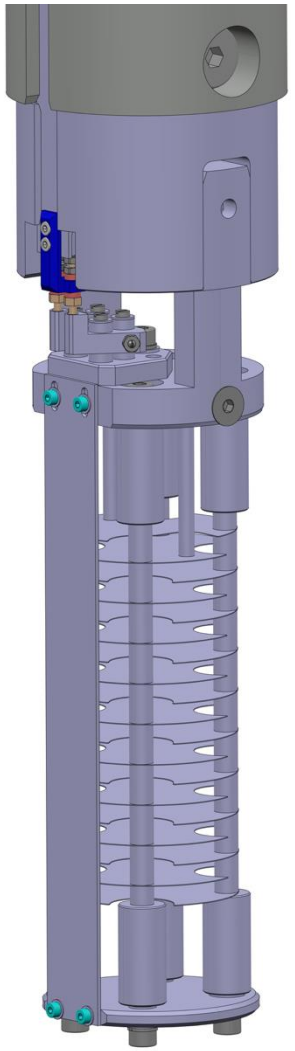
2 Similar to MHI25, larger.

3 Electronics: SoM-CAM
+ mezzanine HV4.

4 In production.



# 4-segment aperture foil: MHBEI

1 Measure beam centering in front of KHHEI.

2 Mechanically a part of KHHEI.

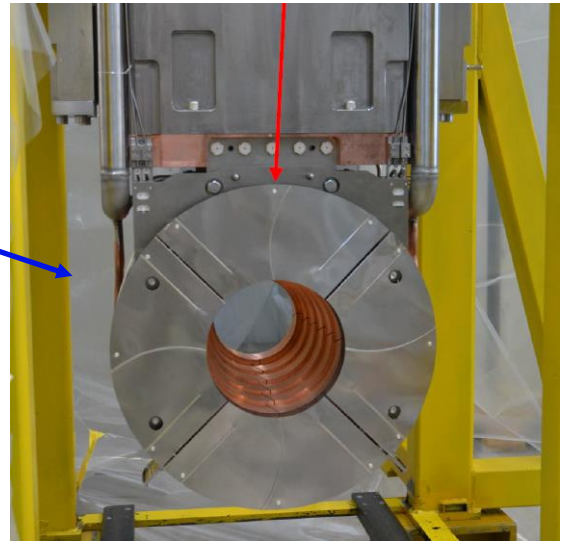
3 Electronics: SoM-CAM.

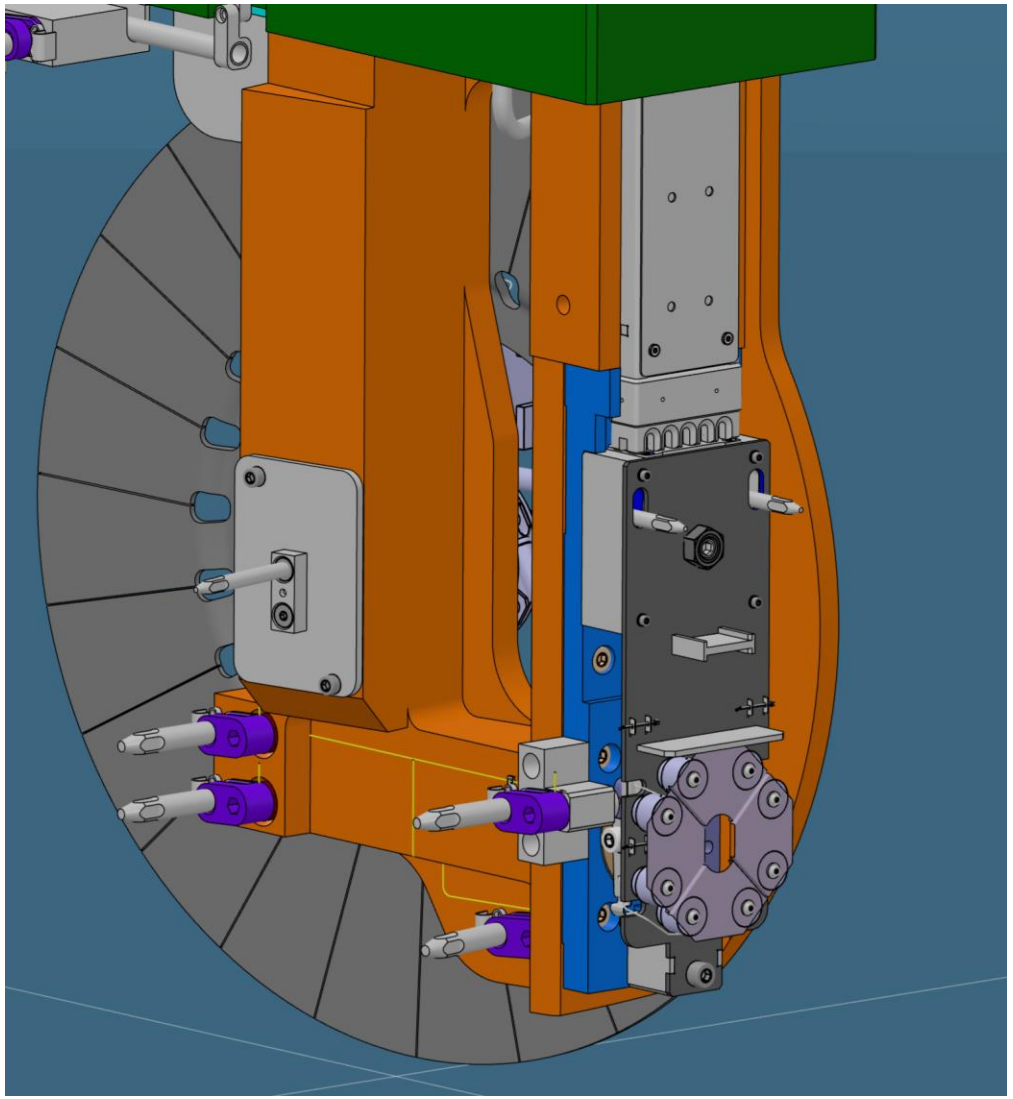
4 AEK request - done.

5 Foil thickness: 50 µm, Molybdenum.

6 Not yet in production.

7 Similar aperture foils exist in HIPA e.g. MHB7.





# 4-segment aperture foil: MHB0

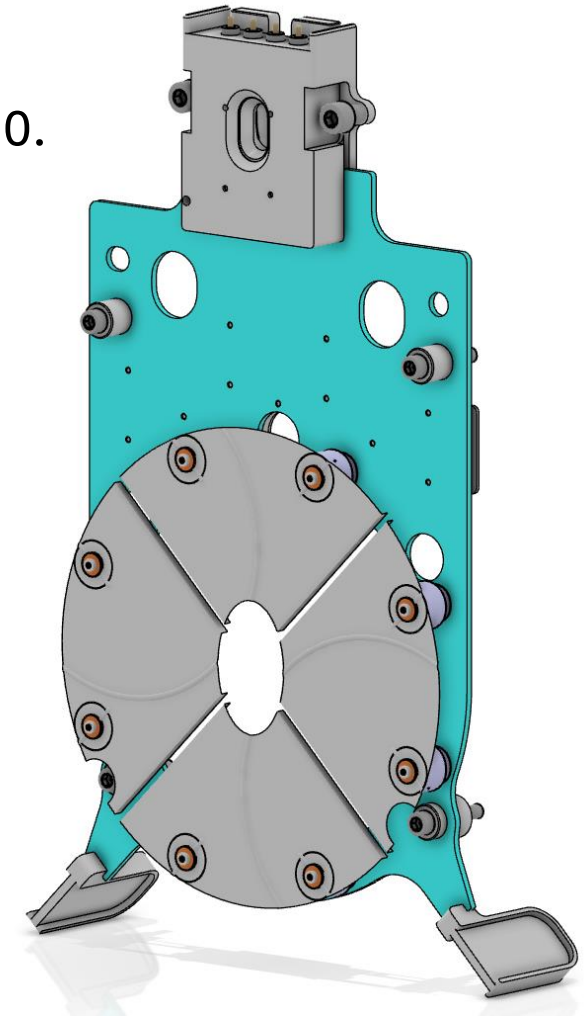
1 Measure beam tails/position in front of KHH0.

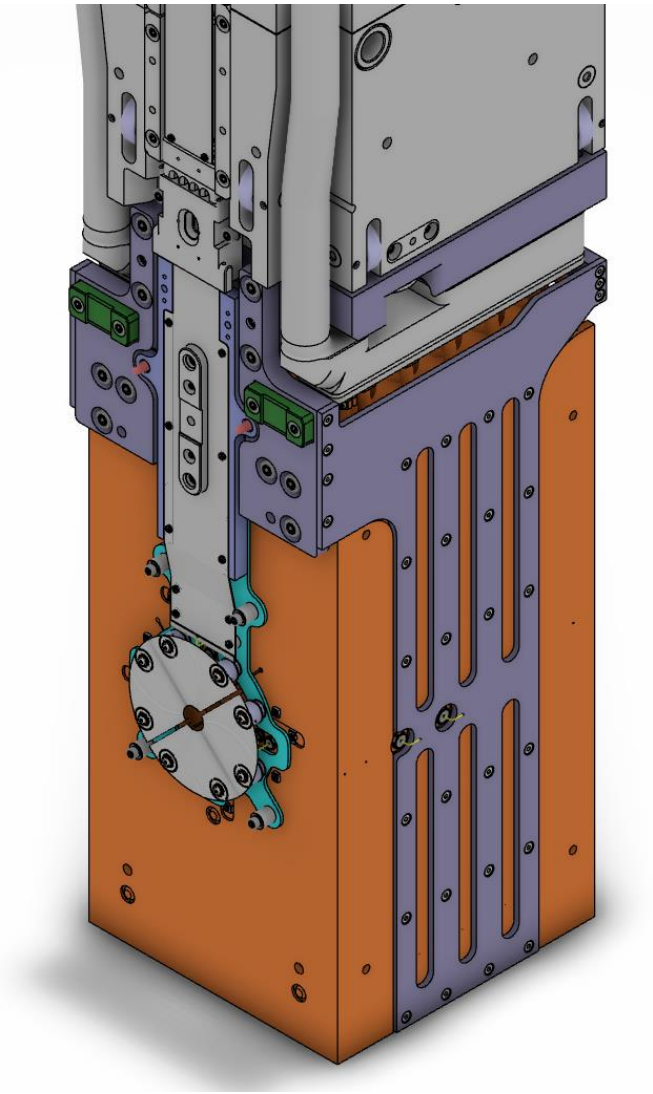
2 Electronics: SoM-CAM.

3 AEK request – done.

4 Foil: 50 µm Molybdenum.

5 In production.





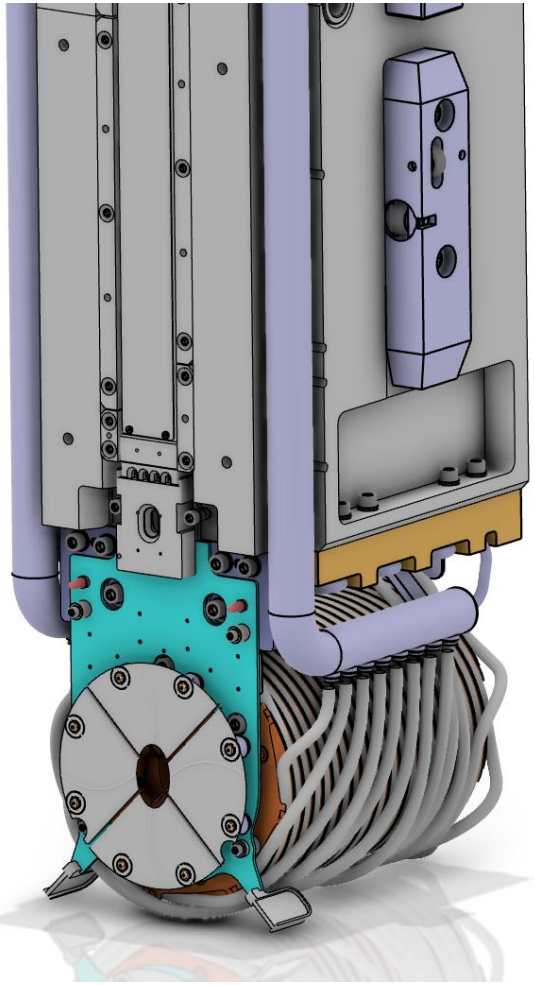
# 4-segment aperture foils: MHB1 and MHB2

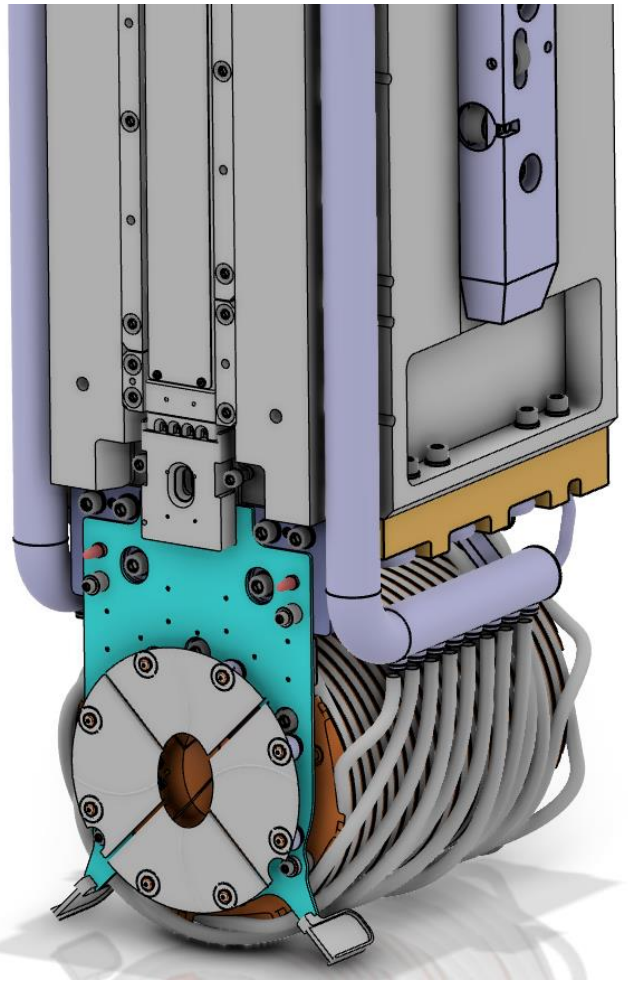
1 Measure beam tails/position in front of KHH1 and KKH2.

2 Electronics: SoM-CAM.

3 AEK request – done.

4 Foil: 100 µm Molybdenum



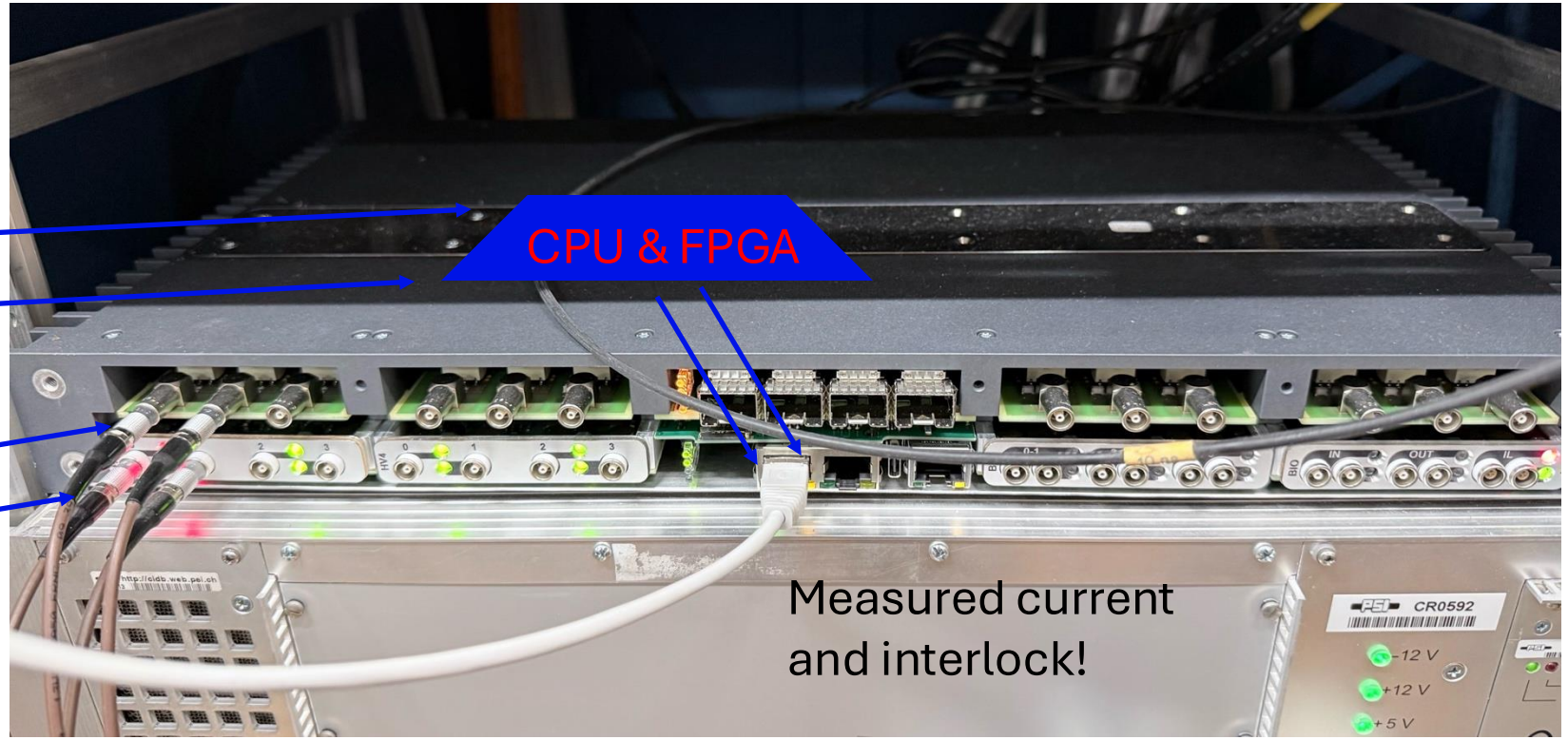


# SoM-CAM project: a must-have

- Most HIPA instrumentation electronics is still based on CAMAC standard.
- CAMAC stands for Computer Automated Measurement And Control.
  - developed around 1968.
  - since 1990s gradually replaced by VME and other standards, most labs do not use it anymore.
- SoM-CAM – in-house, modern, standalone current measurement module with powerful FPGA
- It will replace all CAMAC and (most) VME electronics.
- Motor drivers and controlers - additional electronics to be replaced; they are needed for wire scanners, radial probes, slits and collimators.
- SoM-CAM prototypes are tested since 2 years, e.g. on some ionisation chambers and collimators.
- If Injector 2 is running in 2027 - we ask for beam time.
- We plan to begin gradual deployment of SoM-CAM in 2027; however, substantial development and validation work remains. This is currently our main area of concern and focus.

# SoM-CAM project: why so difficult?

- Low-noise electric current measurement from picoamps to miliamps.
- Currently many versions of CAMAC cards, LLCam, LinCam, LogCam1-3, MATRIX, AFO, HV300/2.
- Many channels have specific analog filters at electronics input – replace with DSP (?).
- Various firmware versions, interlock algorithms.



# Other works during Long Shutdown

- Replace some of the wire scanners at 870 keV beamline with newly-developed, much faster devices we call Oscillating Arm Wire Monitors (OAWM).
  - They allow measuring the beam profile at all intensities.
- Other regular maintenance works.

# Summary

1. HIMB beam instrumentation hardware is on-track for shutdown 2027.
   All technical concepts are established and have been validated within HIPA
2. In-shield Wire Scanners are complex devices and require significant time to assembly and test (about 2 months/device).
3. New readout and control electronics, based on SoM-CAM, mezzanine cards and motion controllers - major development project;
   - Ensuring system readiness for wide deployment in 2027 is critical.
   - Manpower needed.
4. During the long shutdown, we plan to replace selected legacy wire scanners at the 870 keV beamline with newly developed high-speed Oscillating Arm Wire Monitors (OAWMs).

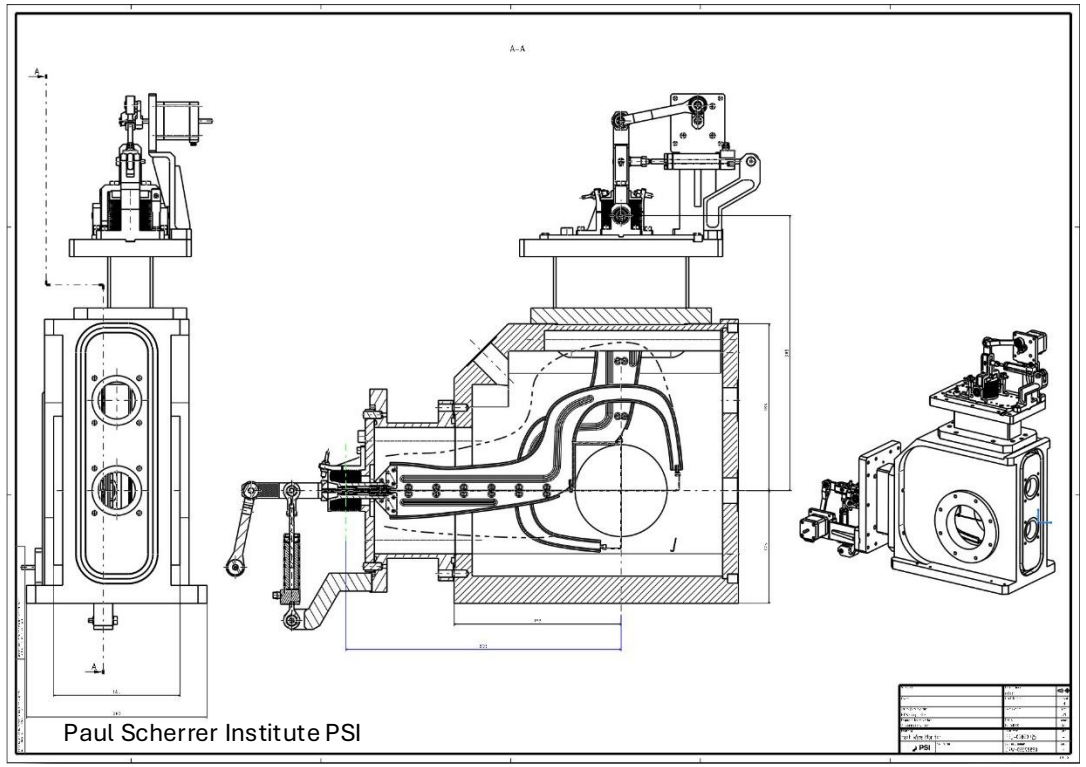
# Additional slides

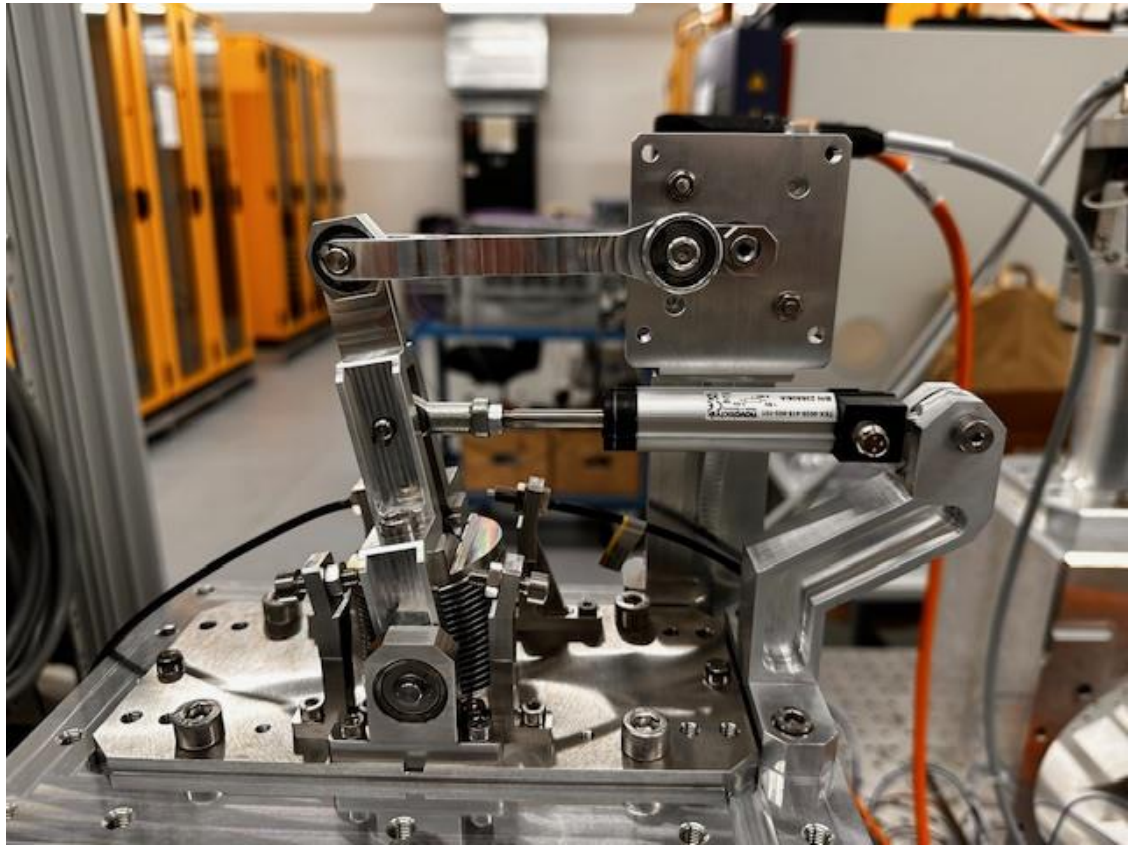
# Oscillating Arm Wire Monitor (OAWM)
# MDP1/2, MDP3/4 and HIPA 870 keV

1 Prototype tests successful in the lab, it can easily drive at 4 m/s.

2 Installation in CW for beam tests during Shutdown 2026.

3 Design and testing: Martin Rohrer,
Rudolf Doeling, Simon Lindner





# Harps
# MDH1/2

1 Permanently measure beam profile in front of TATTOOS target

2 Can be bought from e.g. NTG

3 Wires: simulations (next slide)

4 Readout electronics: LogIV32, but:

Evaluate using SoM CAM to replace LogIV for Harps

Fernandez Carmona Pablo
To Sapinski Mariusz Gracjan; Rizzi Mattia

Hello Mariusz, Mattia,

I am writing to you with a special request. Could I please ask you to discuss together if SoM CAM would be suitable for replacing LogIV for the Harps in IMPACT?
The background of my request is following. For the IMPACT TDR, AEK decided to use LogIV for Harps, basically the same solution as the existing HIPA devices.
However, afterwards AEK decided to phase out VME at PSI to save money on development VxWorks licenses, so we have a problem.
Thank you very much, in advance.

Regards,
Pablo