MINISTERUL CERCETĂRII, INOVĂRII ŞI DIGITALIZĂRII

IFIN-HH

www.ifin.ro

TRD2D status

Alex Bercuci

47th Collaboration Meeting
3rd March 2026
GSI

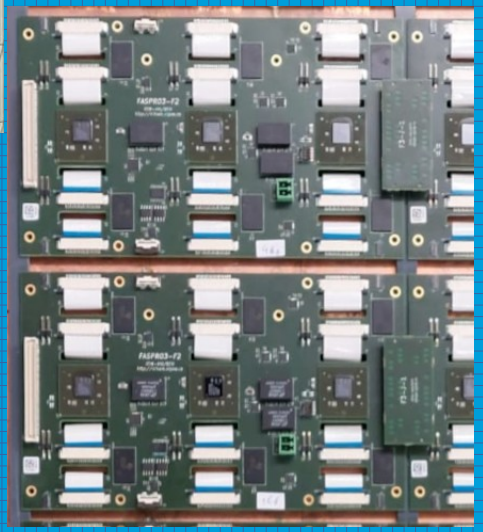
Overview

1. Production readiness prototype Construction and Tools

19 % + 56%

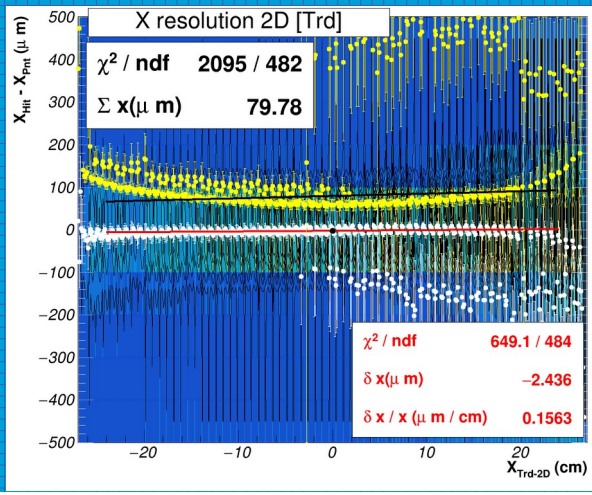
2. FEE update

6 %



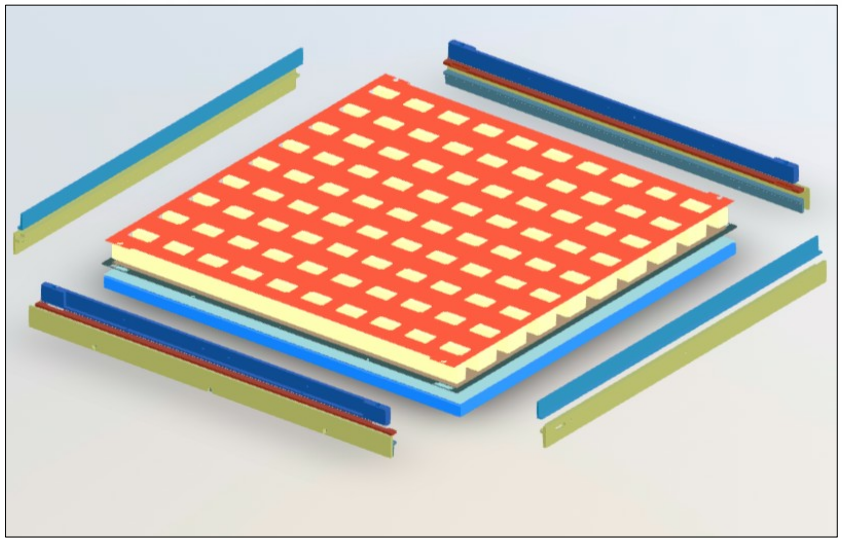
3. Data analysis

19 %

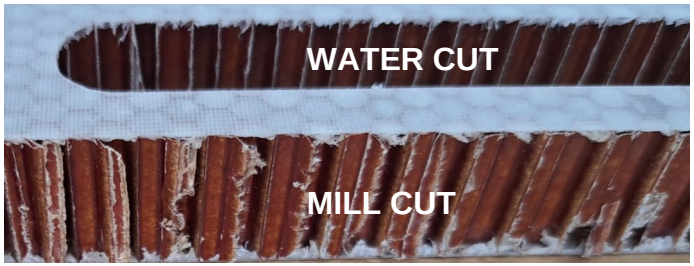


CHAMBER COMPONENTS READINESS

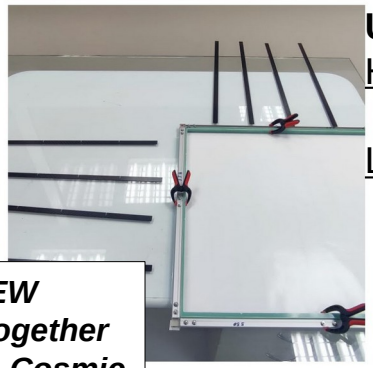
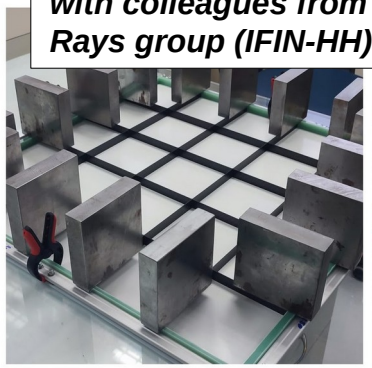
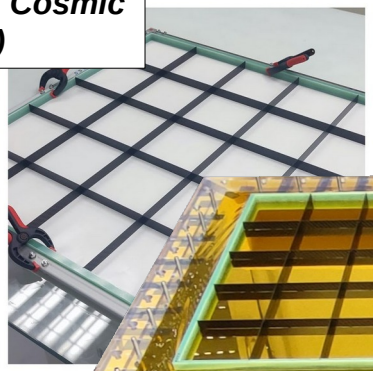
Ledges & HC plates



→ components for 2 chambers (+ 2 entrance window frames) were realized by our external collaborators **ProPlastic** (Laura)
→ HC processing improved (CR group)
→ the gas inlet / outlet ledge ■ was adapted to the SERTO gas connection of the TRD gas system (Daniel B. & Laura) see S7.

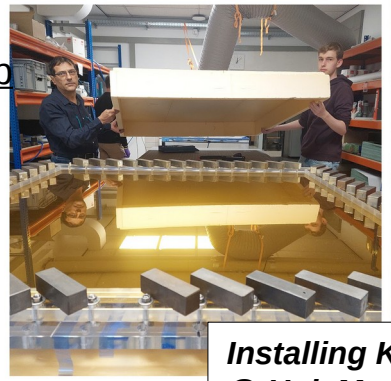
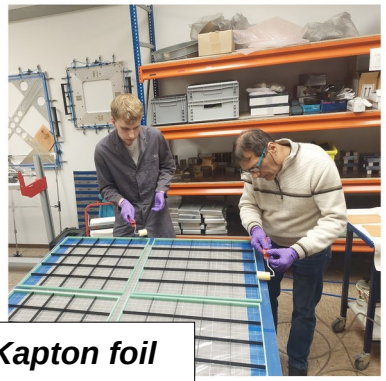


Entrance window

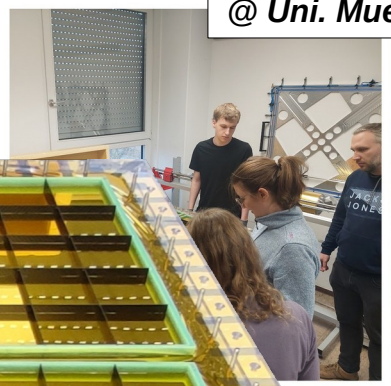
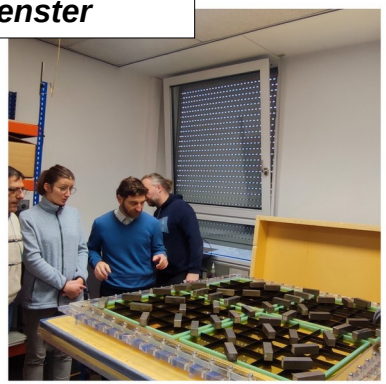





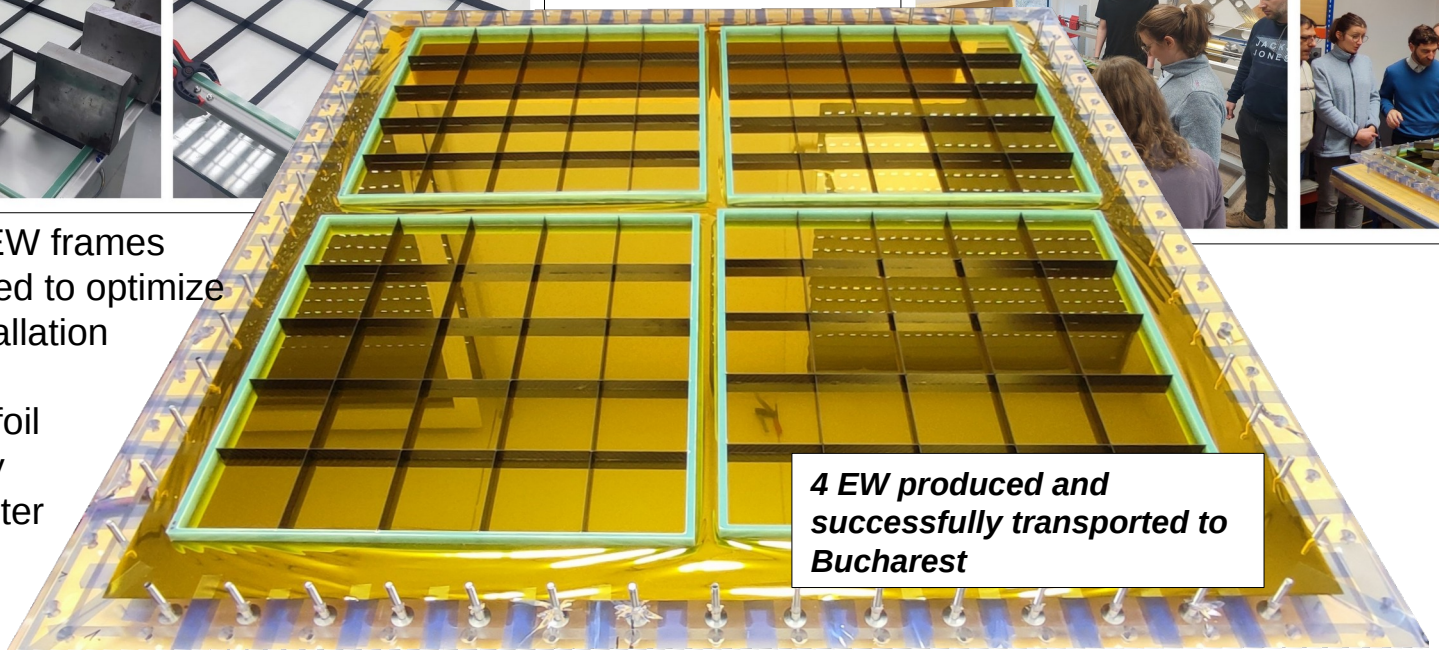
Construction of the EW frame in Bucharest together with colleagues from Cosmic Rays group (IFIN-HH)

Uni. Muenster :
Henning, Laura, Philipp
IFIN-HH :
Laura, Marian, Alex

Installing Kapton foil @ Uni. Muenster

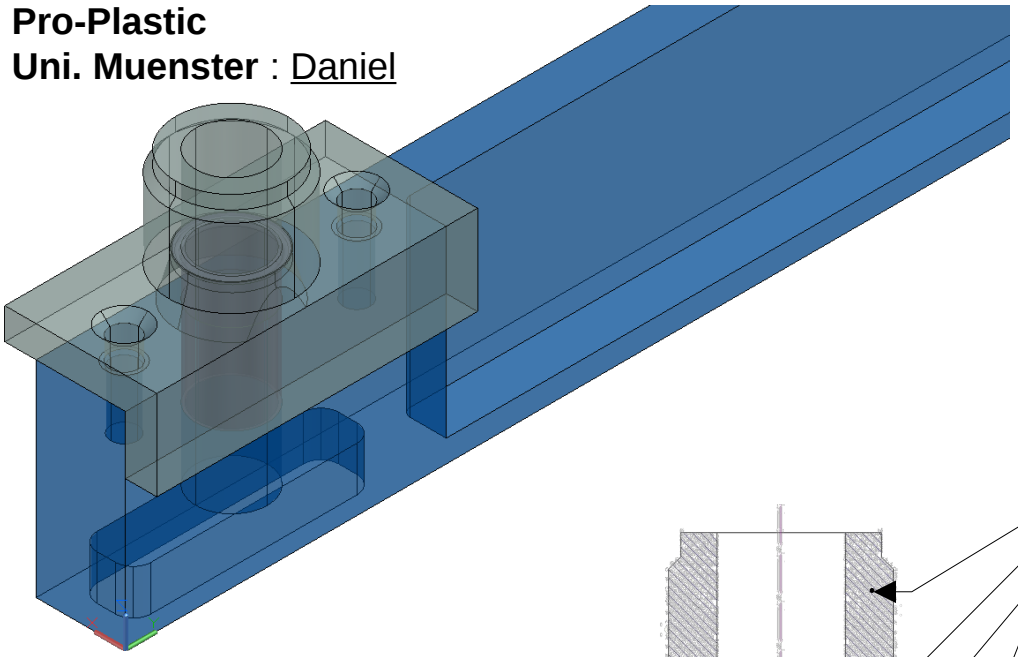


4 EW produced and successfully transported to Bucharest

*) 2 **extra** EW frames were realized to optimize the foil installation procedure
**) Kapton foil provided by Uni. Muenster

Gas

IFIN-HH : Laura, Alex
Pro-Plastic
Uni. Muenster : Daniel

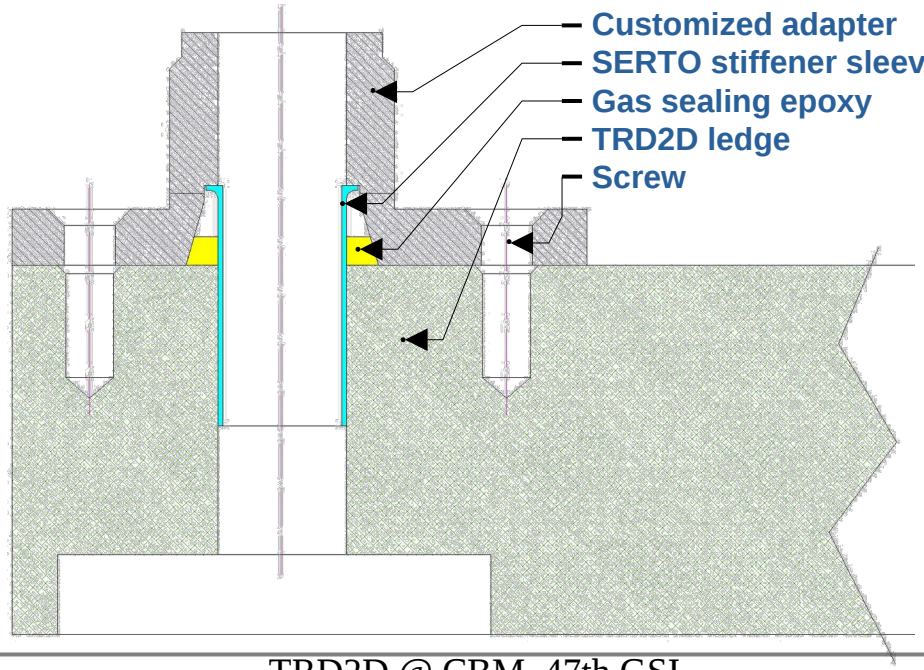


→ feed through opening of 8mm diameter and M14 adapter for 10 mm SERTO piping (Daniel, Laura)

→ designed for good gas tightness and assembly

→ outward connectivity & components SERTO™

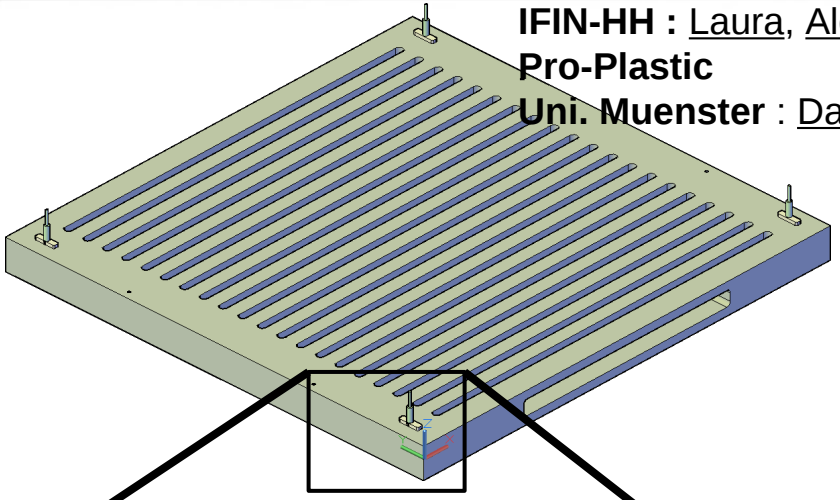
→ SERTO™ components for 2 chambers available (Uni. Muenster), and adapters & devices in production (IFIN-HH / Pro-Plastic)

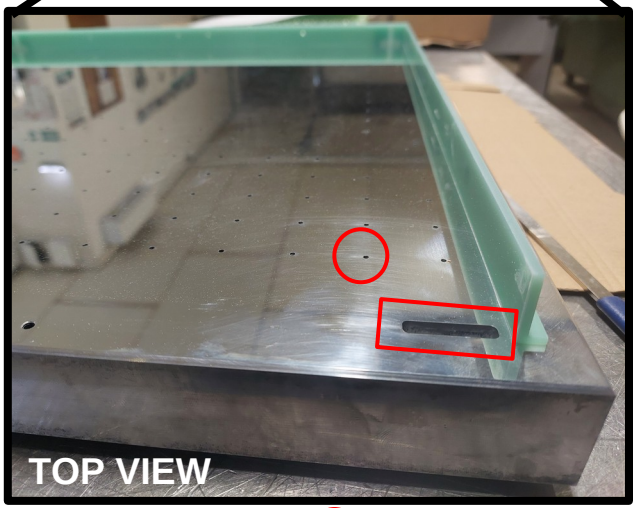


CONSTRUCTION TOOLS AND PROCEDURES

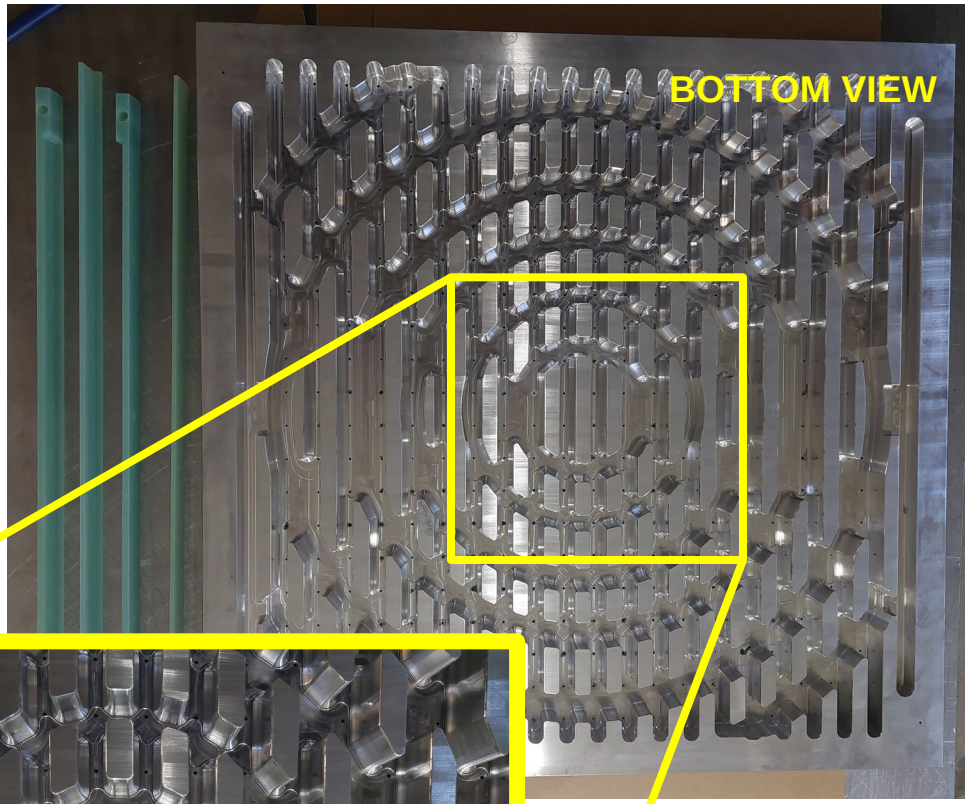
CHAMBER assembly device

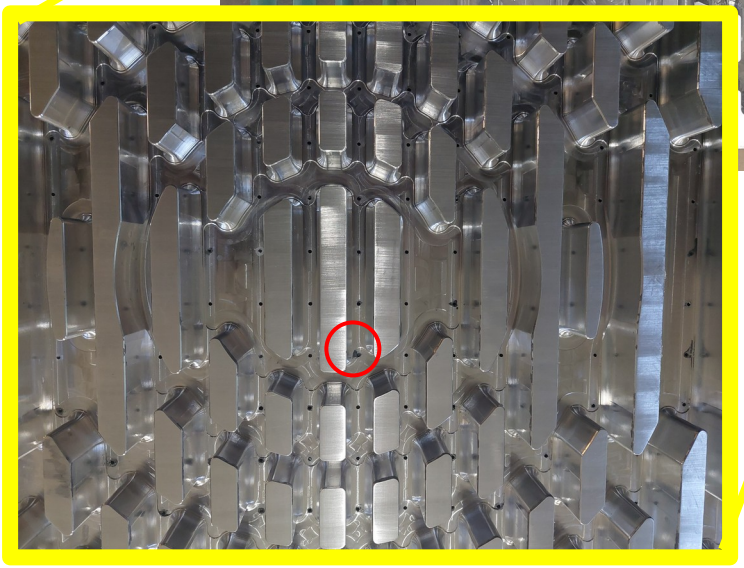
IFIN-HH : Laura, Alex
Pro-Plastic
Uni. Muenster : Daniel





→ Anchoring points ◯ for the pad-plane far from vias-es.
→ best calibrated planarity and alignment of grooves ▭

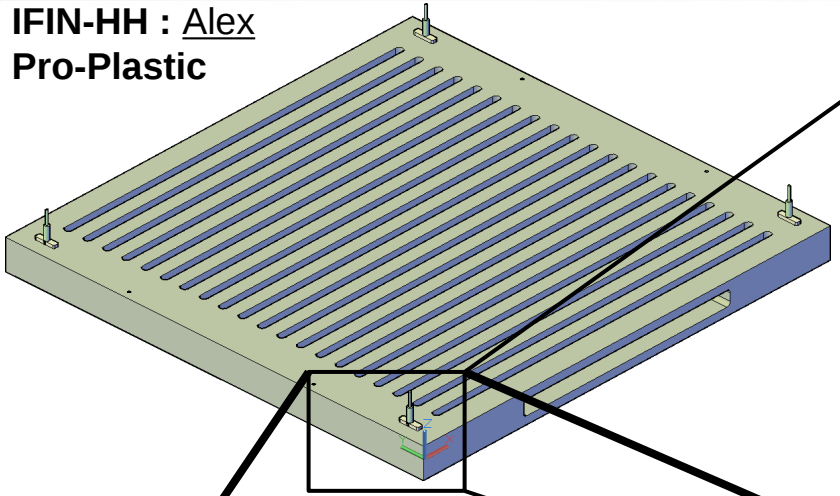


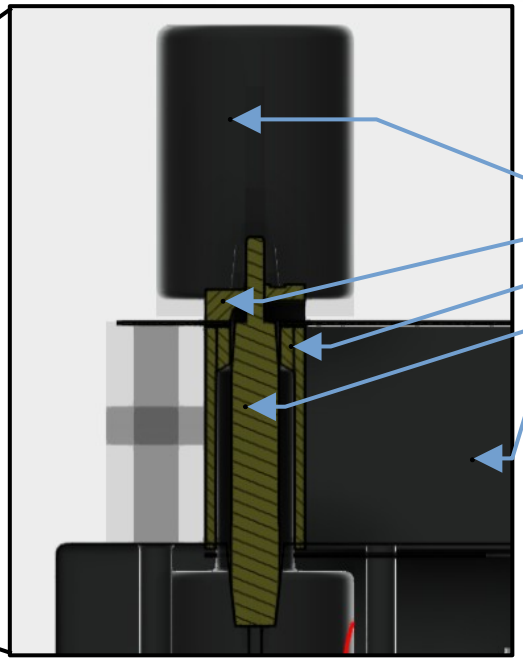


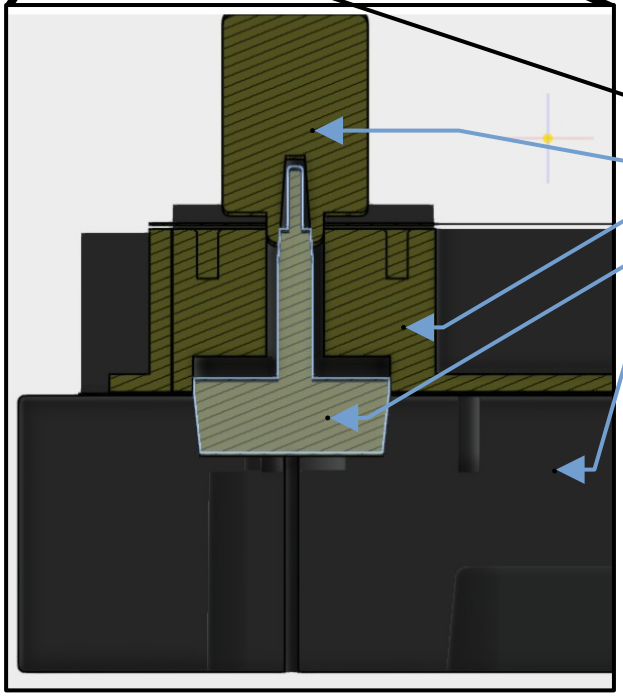
Carvings used for:
→ adapting the vacuum table to the pad-plane
→ increase resilience against deformation
→ decrease weight

CHAMBER
assembly device [cont'd]

IFIN-HH : Alex
Pro-Plastic





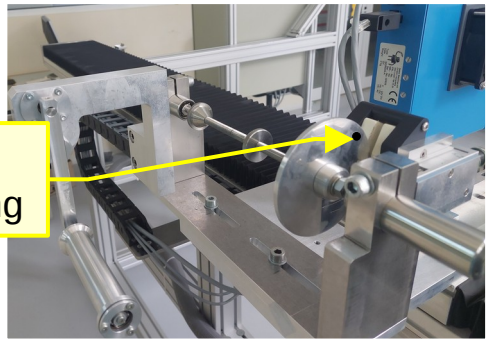


The system of alignment grooves / pins allow for the relative positioning of all ledges with respect to the same calibrated reference

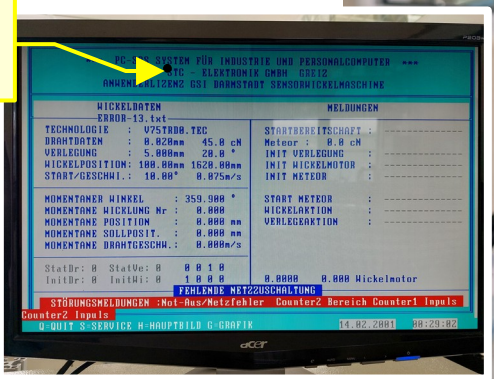
ELECTRODES winding

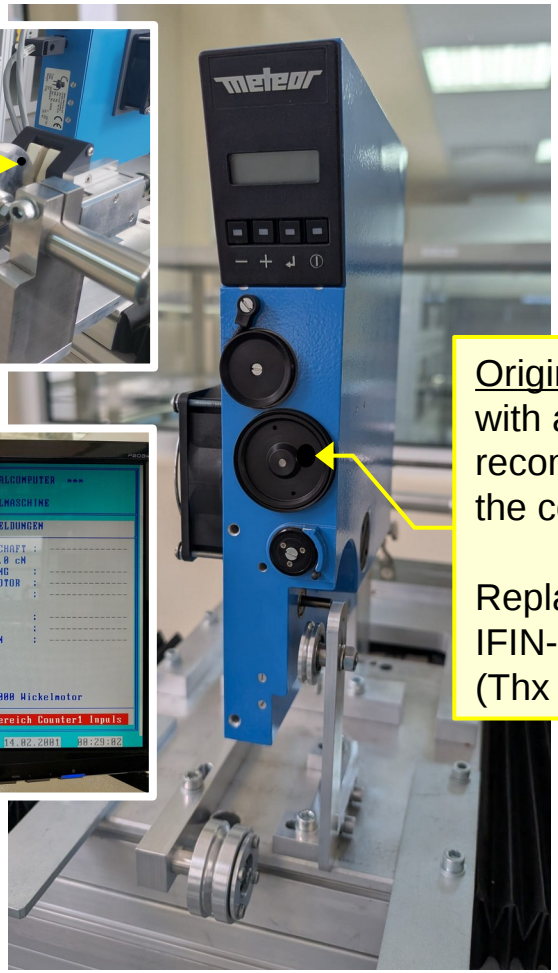
Device for wire winding inherited from **ALICE TRD** construction.
No updates planned or possible similar to those done by Uni. Frankfurt.

Magnetic break for pre-tension smoothing



Original control & SW





Original component with a life-time recommended by the company of 1-2 y

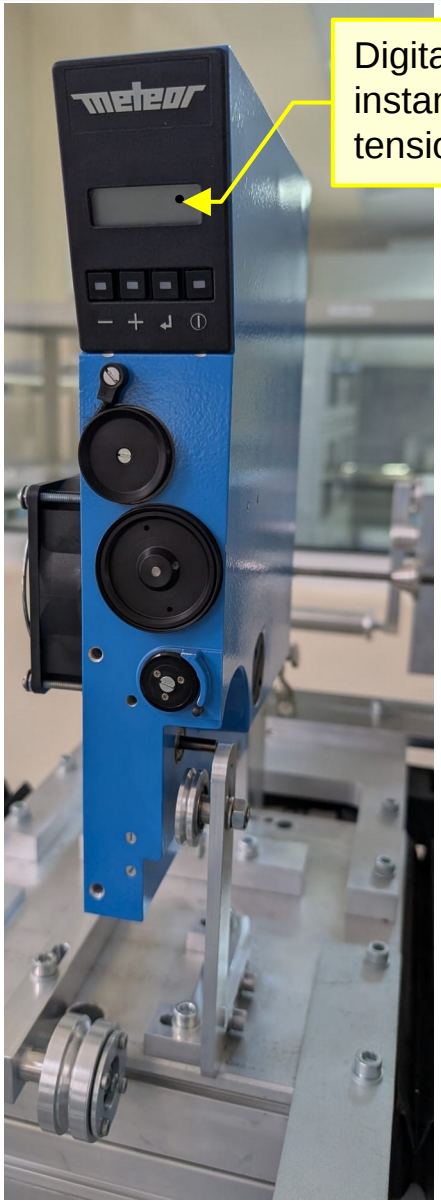
Replacement by IFIN-HH in progress (Thx Philipp)

interoperability with Uni. Fra. lost due to :

→ device generational gap and functionality

→ frame size difference

ELECTRODES winding plans

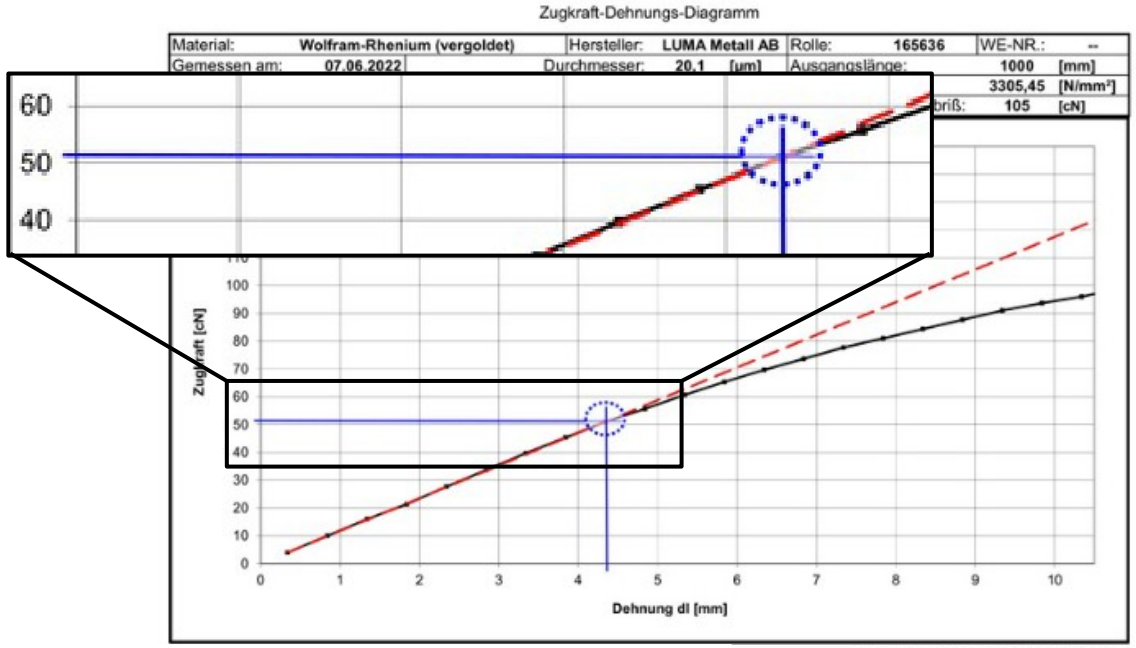


Digital display – instantaneous wire tension info ONLY !

→ aged consumable will be replaced.

→ instantaneous tension monitoring not implemented anywhere but critical for assessing the quality of the wire winding.

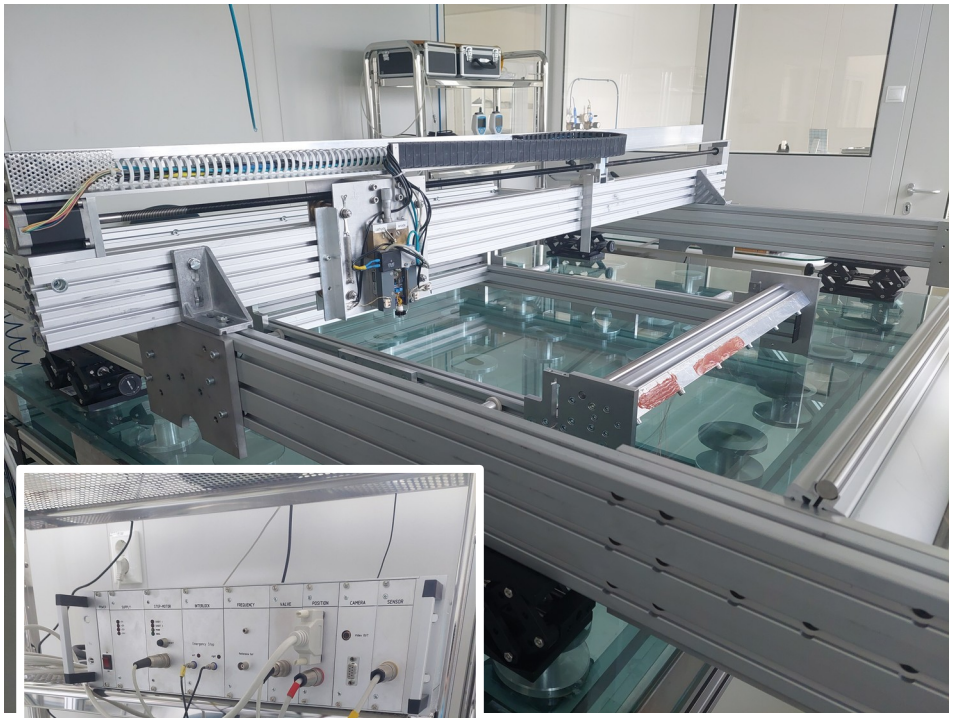
- **active pre-tension** (implemented by Uni. Fra) to reduce wire tension oscillation ±1cN . No updates planned or possible for IFIN-HH.
- **continuous monitoring** and quantifiable limits (planned Marian, Laura.)



anode tensile test

ELECTRODES
QA of positioning & tension

Device for wire QA inherited from **ALICE TRD** construction.
No updates planned or possible similar to those done by Uni. Frankfurt.



interoperability with Uni. Fra. lost due to :
→ device generational gap
→ electrode-chamber assembly procedure.

The ALICE TRD wire tension device was recently refurbished @ Uni Fra.

Dennis Spicker : https://indico.gsi.de/event/24456
https://indico.gsi.de/event/24419/

1. **Investigation of a possible similar update @ IFIN-HH.**
   - LabVIEW adapter + license 9k+ Euro
   - Control Unit 18k Euro (company)
   - Mechanical refurbishing to be done in house (man-power)
   - High mechanical noise during measuring due to missing heavy and sturdy support (no longer considered for TRD2D assembly)
   - Compatibility issues with the new chamber design (background suspicions, freq range)

STILL OPERATIONAL WITHOUT UPDATE.
GOOD FOR REFERENCE !

IFIN-HH : Andrei H.

ELECTRODES
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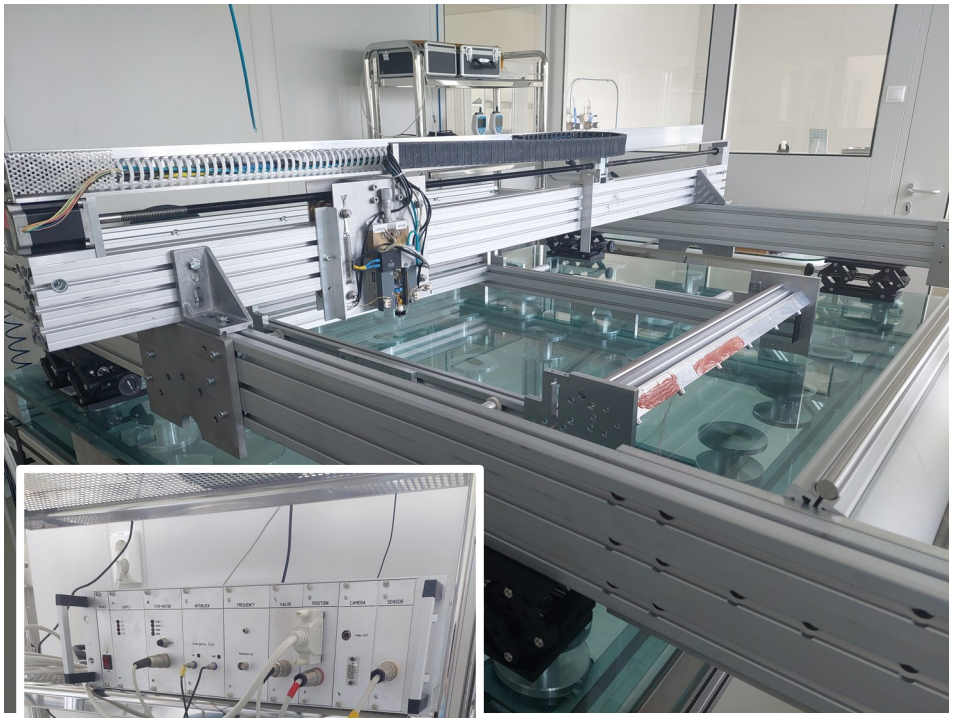

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IFIN-HH : Andrei H.

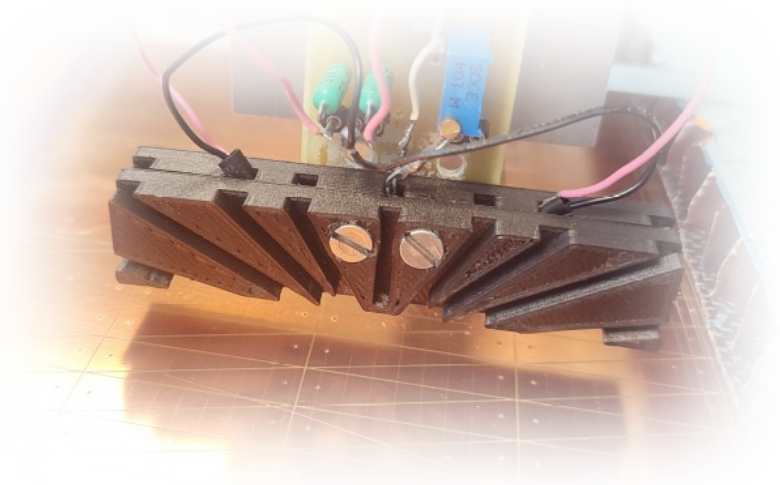
ELECTRODES position&tension plans

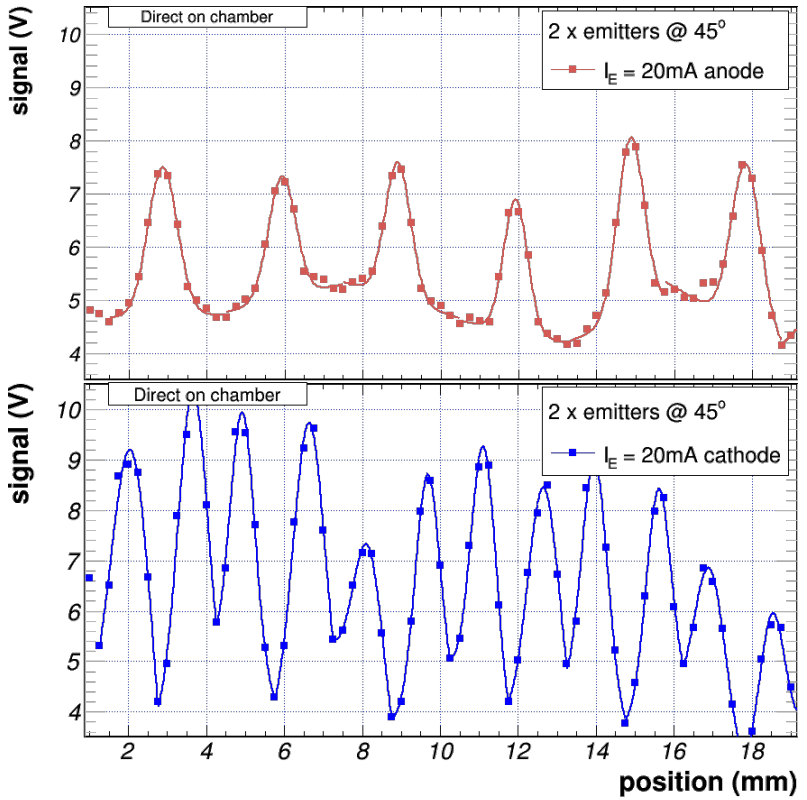
IFIN-HH : Marian, Alex
Uni. Muenster : Hannes, Philipp

The Uni. Muenster radical "update" !

- Open-market HW components and open-source SW
- CAN-BUS integration and seamless integration in the assembly procedure.
- Specific work for the sensor HW (analog).

CAN WE HAVE A WORKING VERSION IN TIME FOR THE PROTOTYPE ?



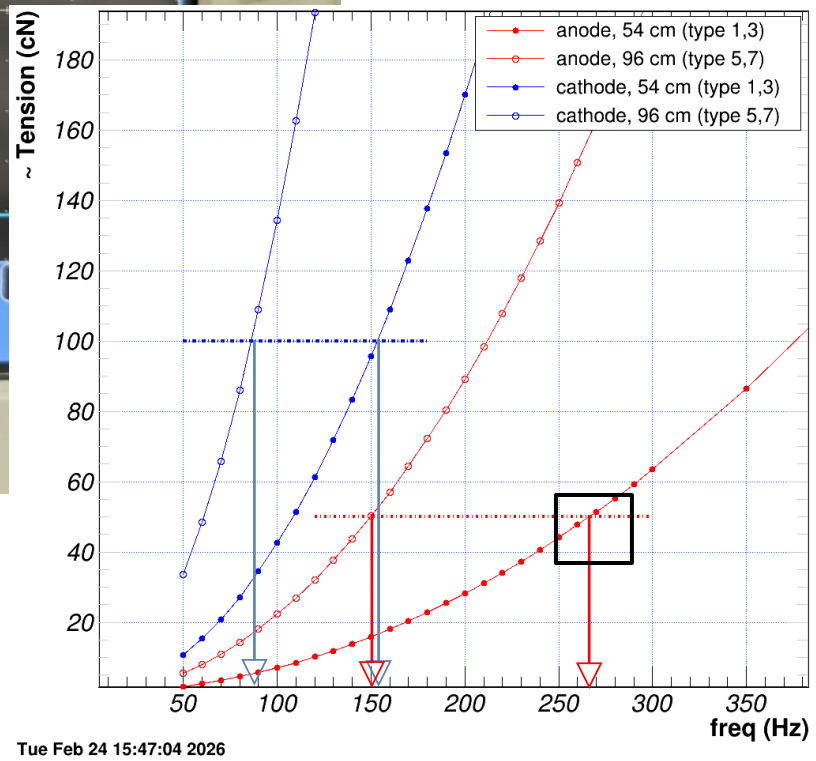


https://indico.gsi.de/event/24352/
https://indico.gsi.de/event/23594/
https://indico.gsi.de/event/23391/
https://indico.gsi.de/event/23101/

ELECTRODES
wire tension CBM method

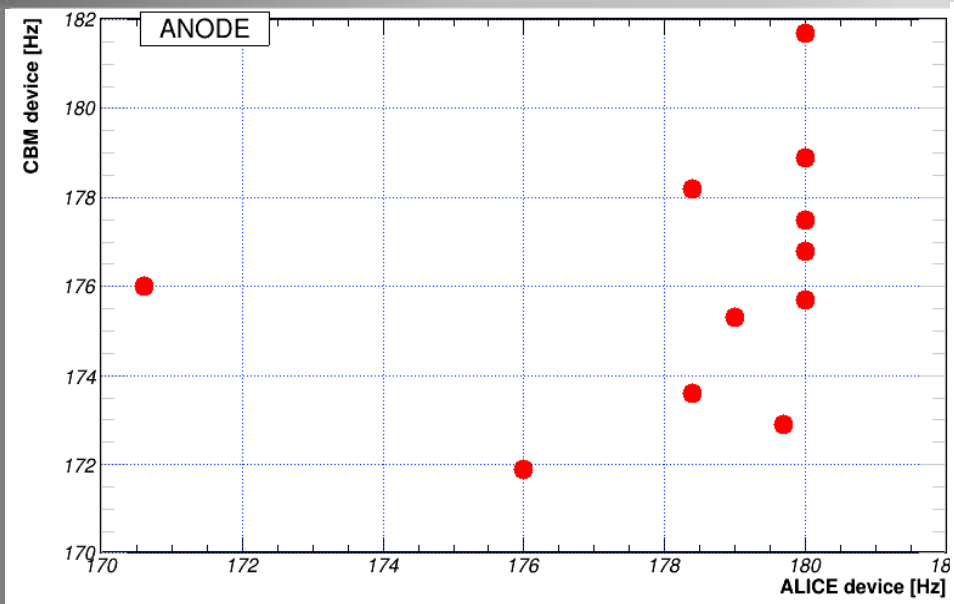
Marian, Alex

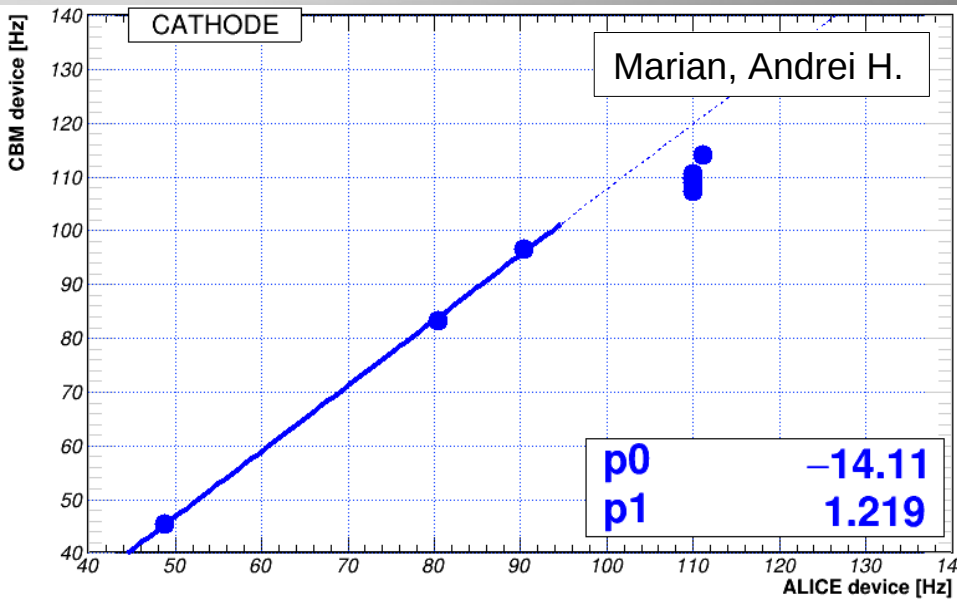
Measurement setup :
- anode wire (WRe3+Au) L = 54cm
- pad-plane gold
- wire pad-plane spacing 4 mm
- no N2 blower/exciter.

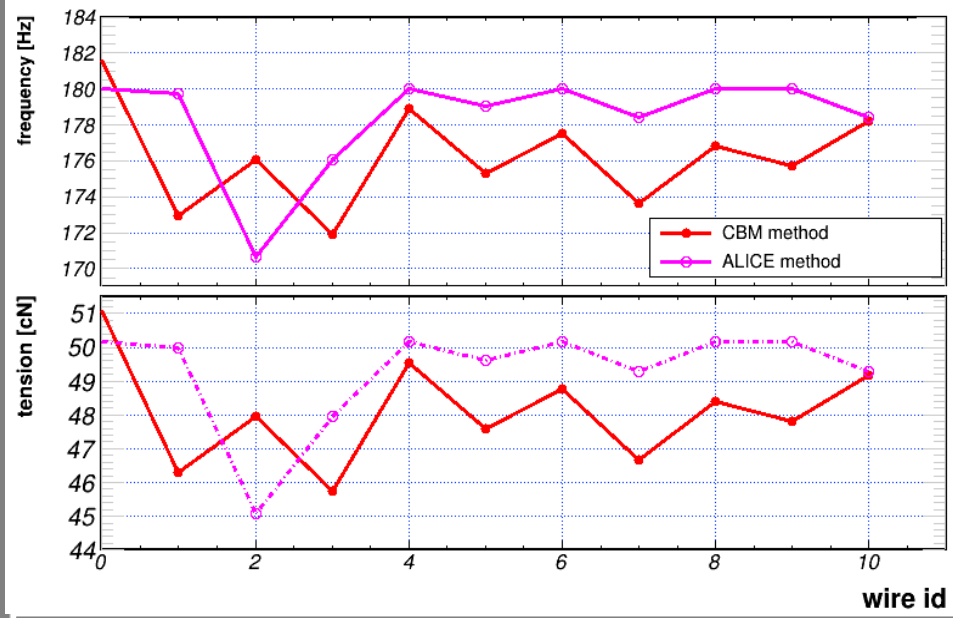


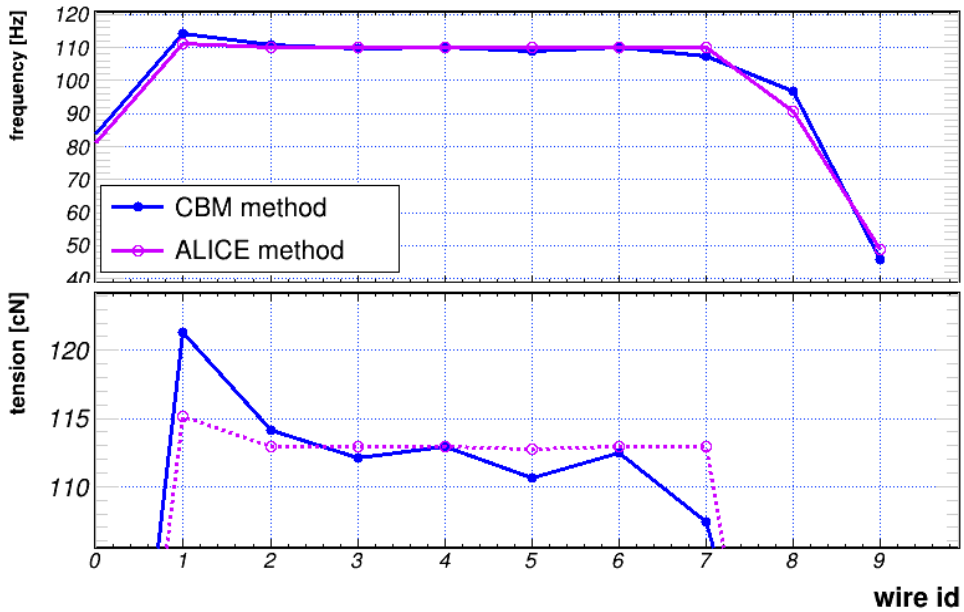
→ Freq measured 271 Hz (wires not fixed on supports).
→ Estimated tension ~52 cN – “probably” compatible with METEOR continuous measurements.
→ **DIRECT MEASUREMENT VIA CAN ADC @ 1kHz ????**

ELECTRODES
wire tension CBM – ALICE methods









FRONT-END ELECTRONICS

FEB

1. ASIC – FASP Production

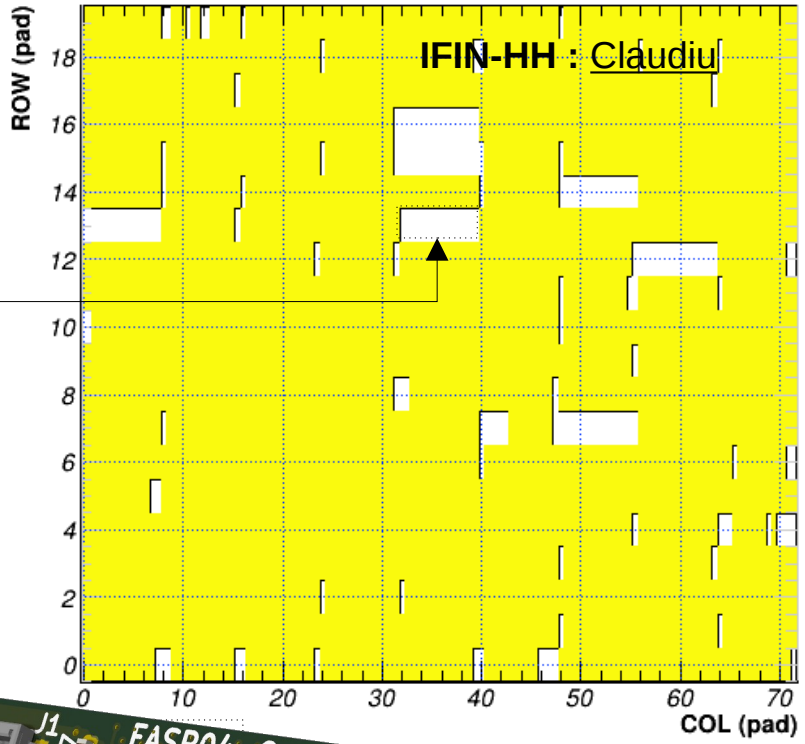
→ Test production (0.2k) / *wire bonding* > 90% dice (+bonding) efficiency (mCBM 21-24)

→ Test production (0.5k) / *flip-chip bonding* (mCBM 25)

→ ~ 80% bonding efficiency (first batch)

→ ~ 50% bonding efficiency (second batch) !!

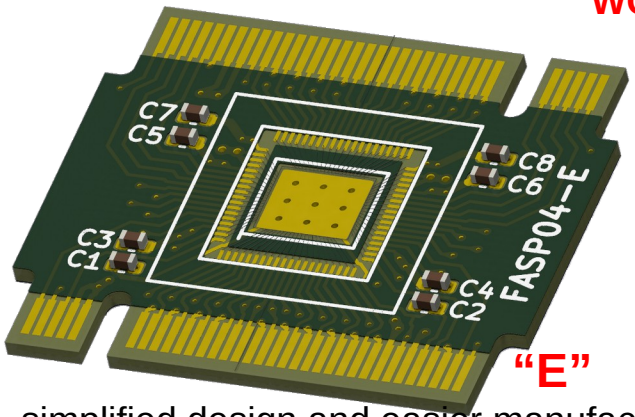
→ further problems when bonded to FEB



2. ASIC bonding solutions

→ A redesign of the TRD2D FEE is currently on course, aiming primarily to accommodate a **field-replaceable** and **wire-bonded FASP**. Several optimized solutions are followed at this stage compatible with the TRD2D prototype interface.

WORK IN PROGRESS

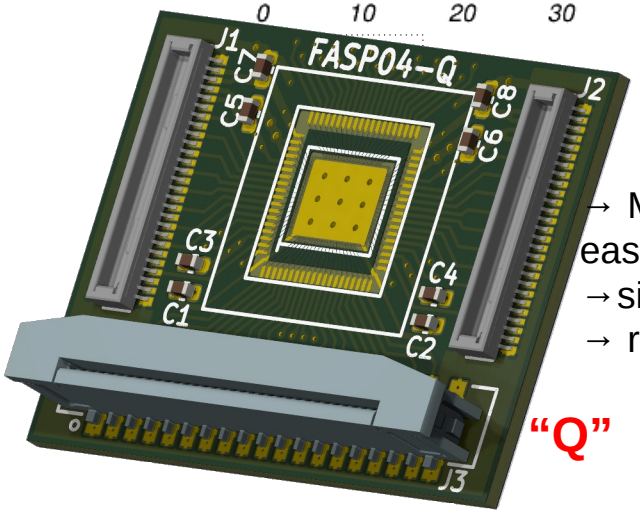


"E"

→ simplified design and easier manufacture processes

→ Optimized for costs 50% of flip-chip

→ Possible mechanical draw-backs



"Q"

→ Mechanical safe and easier to maintain.

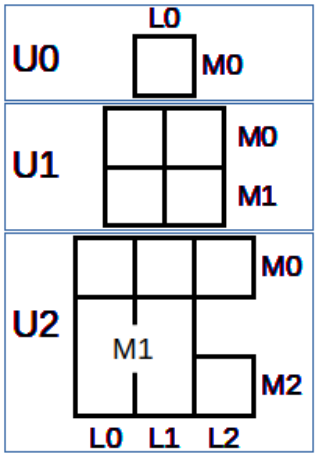
→ similar with "E" version

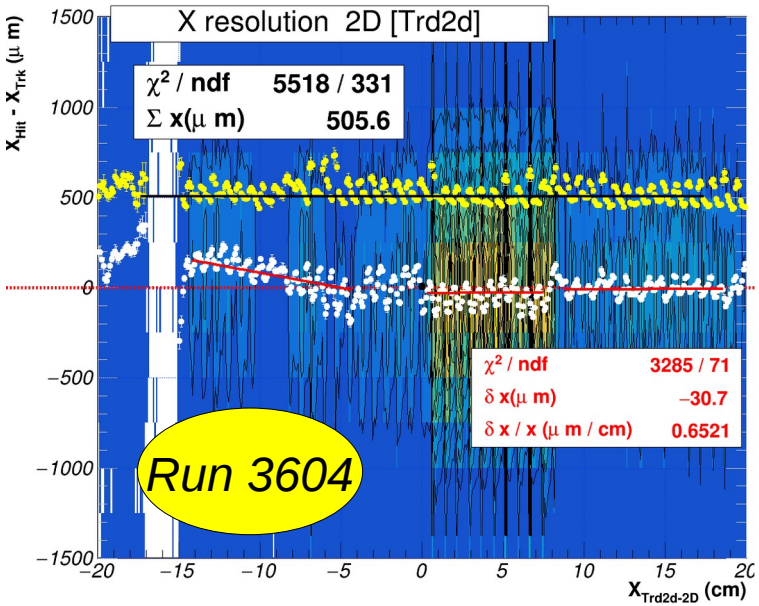
→ realization to be tested

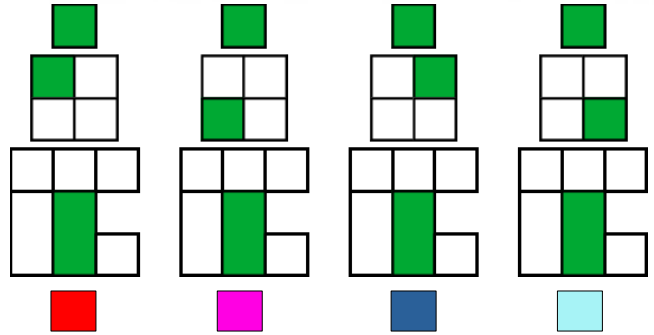
DETECTOR PERFORMANCES

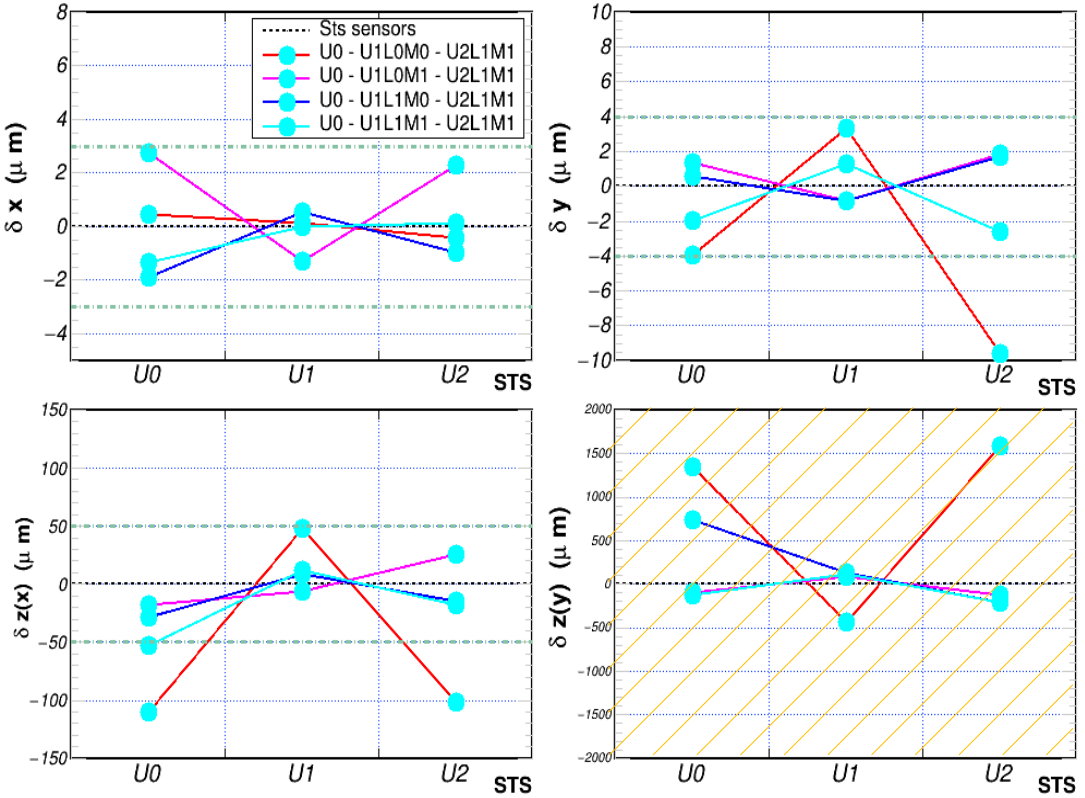
PERFORMANCE
special STS alignment

- Use 3 STS hit tracks to generate reference ALIGNMENT AND RESIDUALS
- Study RESIDUALS for measurements and MC



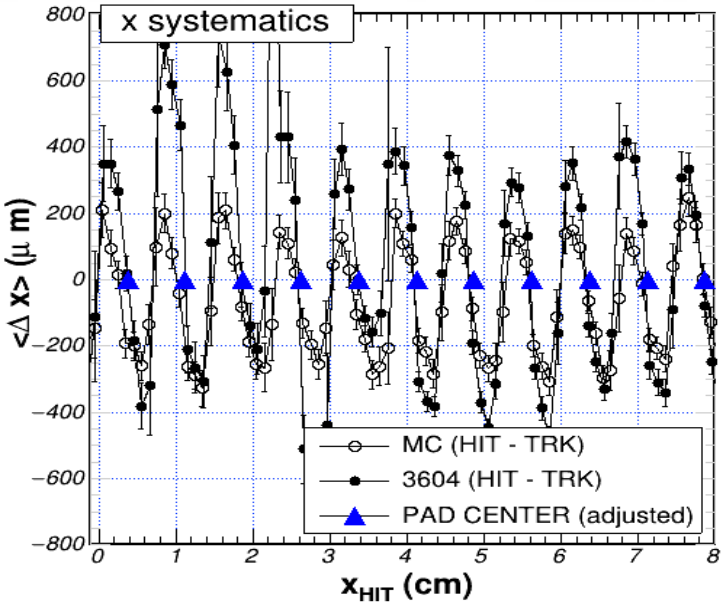


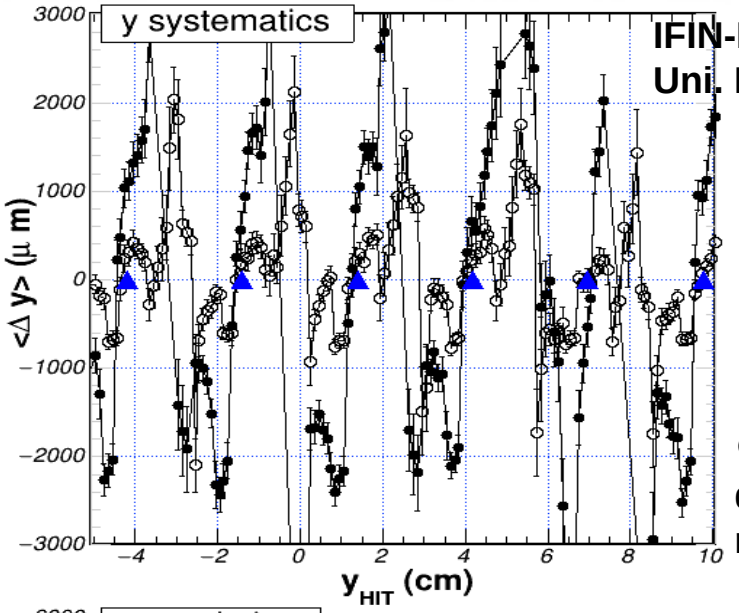




TRD2D RECONSTRUCTION DOMINATED BY SYSTEMATIC EFFECTS !

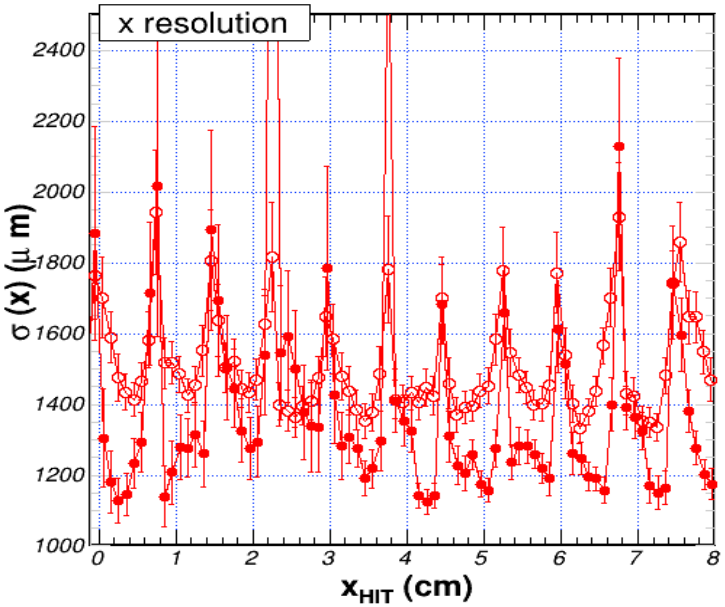
PERFORMANCE
TRD2D : *MC* - ***Hit*** - *Trk*

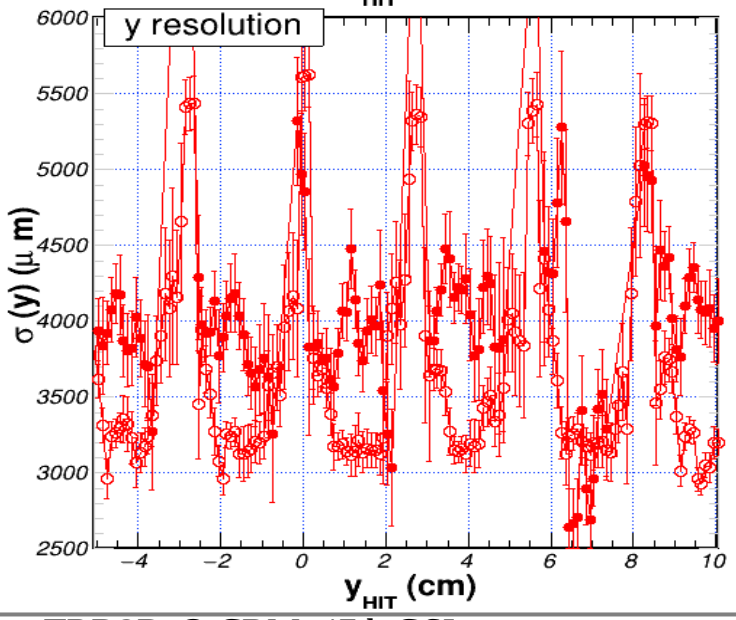




IFIN-HH : Alex
Uni. Muenster : Axel, Henning

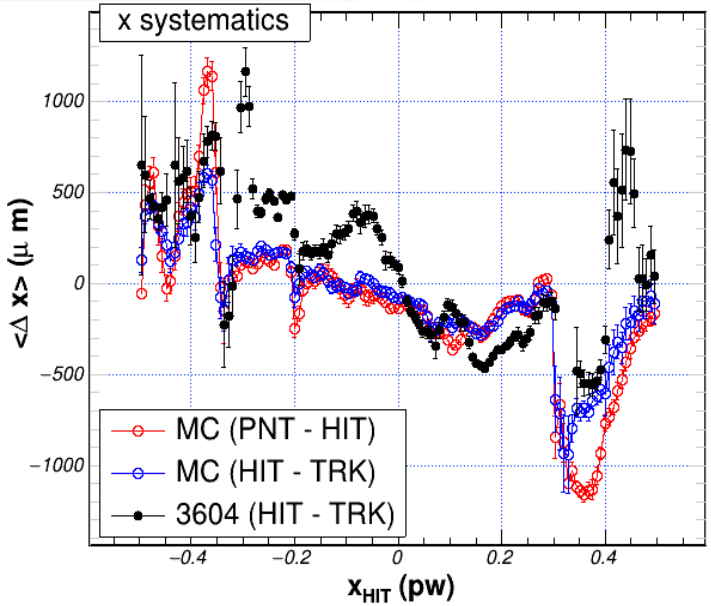
- TRD2D residuals still dominated by local reconstruction effects

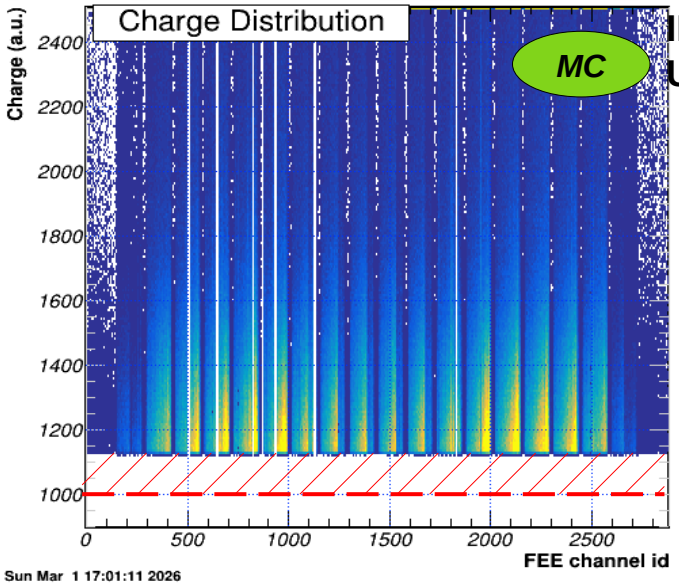


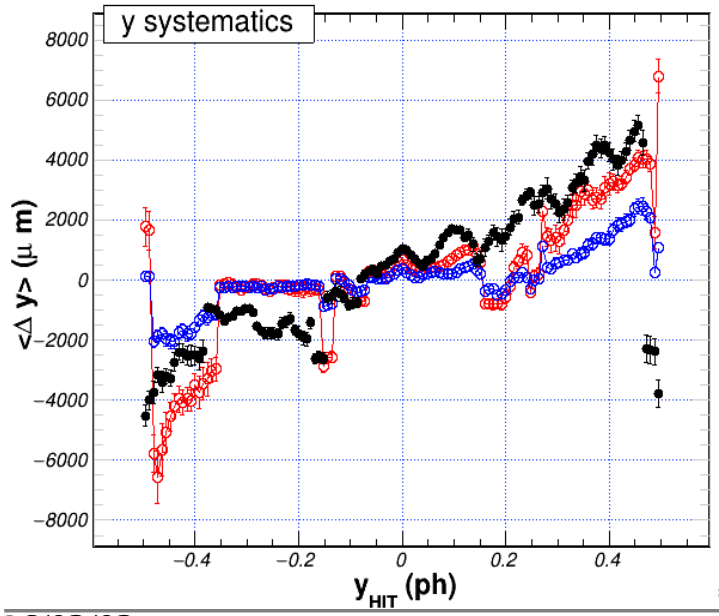


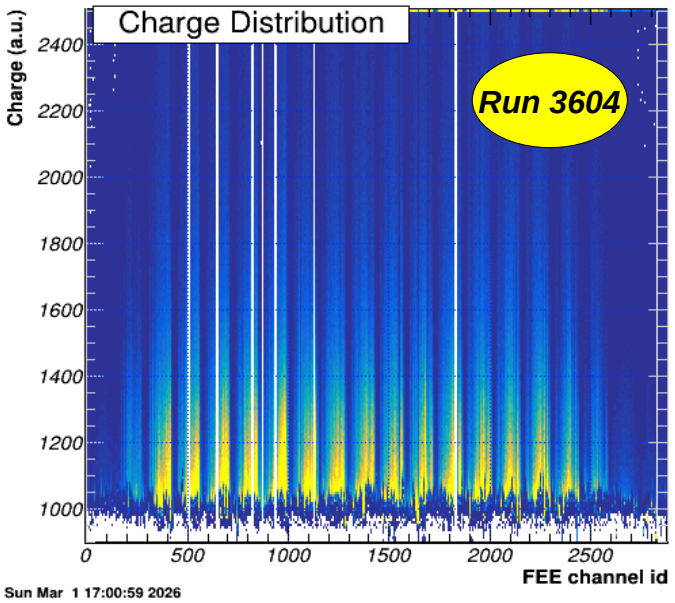
- Measured resolution might point to random hit attachment.

PERFORMANCE
Local reco systematic effects









IFIN-HH : Alex
Uni. Muenster : Axel, Henning

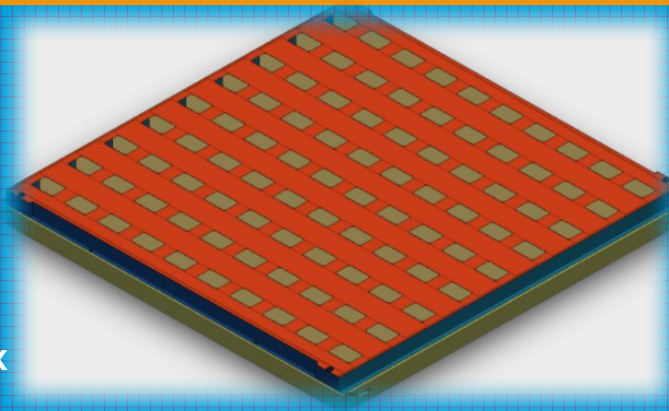
- Systematic effects were followed in both x and y up to the level of MC points
- Effects @ the level of baseline and gain calibration are visible in charge distribution.
- Fake hits attachment are visible already in MC for large systematics
- Such effects are critical for energy dep. reconstruction. Need to be fixed before adding TRD2D to default reconstruction.

Conclusions

1. The CHAMBER

- Rapid progress due to collaboration with Uni Muenster
- All components for at least 2 prototypes are available.
- Tools for construction are being finalized.
- Milestone Q2/26
- Testing to be discussed

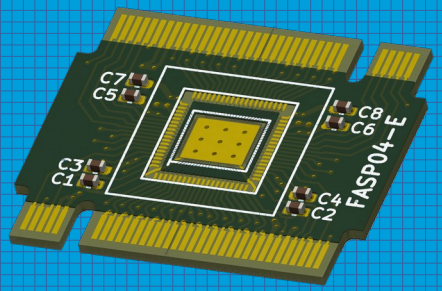
Laura, Marian, Alex



2. The FEE

- Base solution available and tested.
- ~~Flexible bonding technology defined and ready for production~~.
- Optimizations of FASP integration are in progress
- Milestone Q3/26

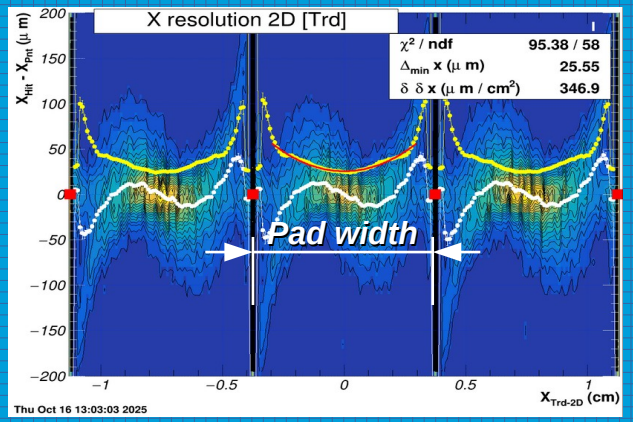
Claudiu



3. The DATA

- mCBM data and MC can be joined to shed light on the detector systematic effects. Sensitivity to construction details reconfirmed.
- Learning curve (calibrations, LUT) for analysis production is steep but populated with very good data.
- Milestone Q2/26 for performance paper.

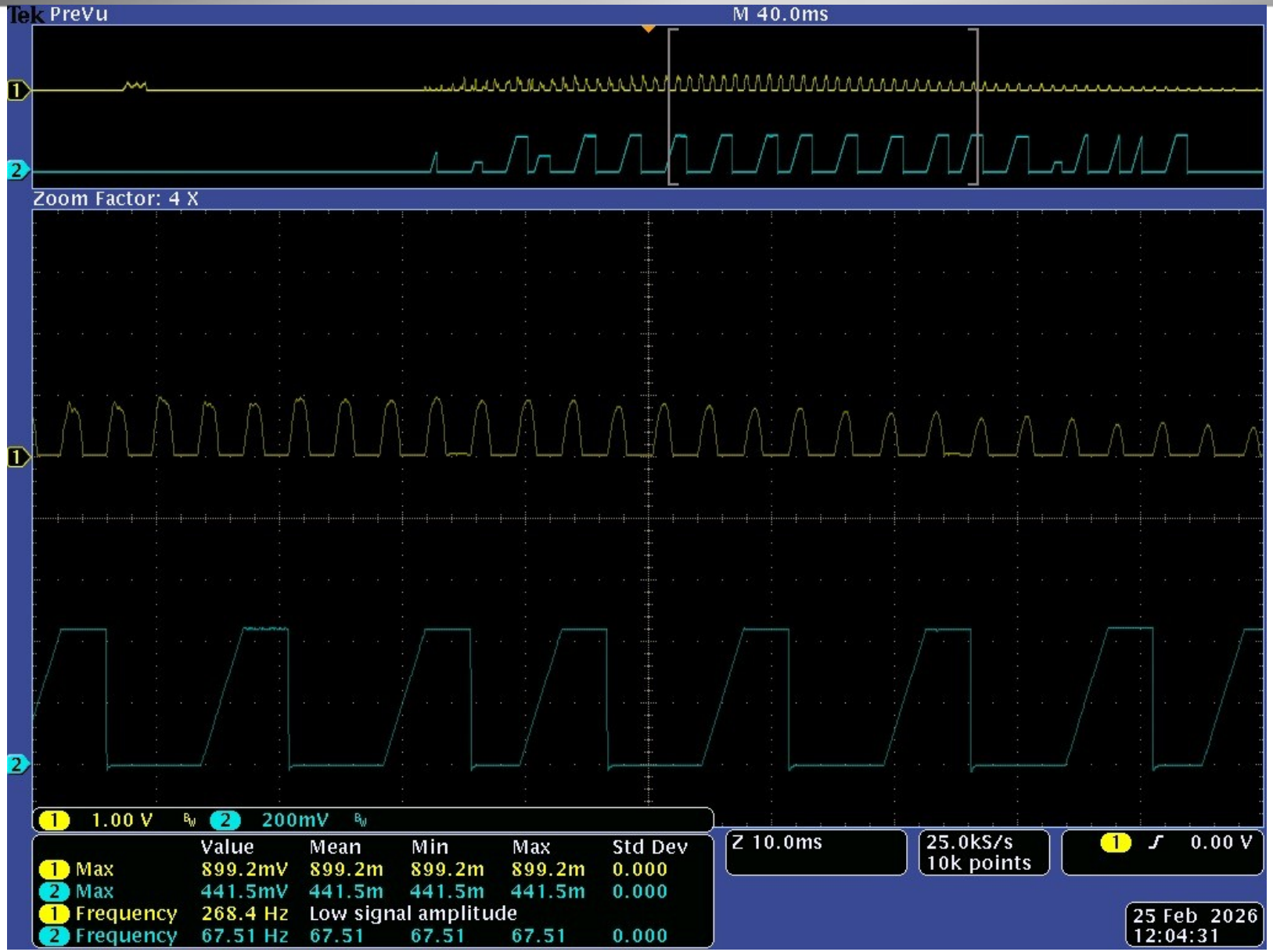
Alex



Thank you

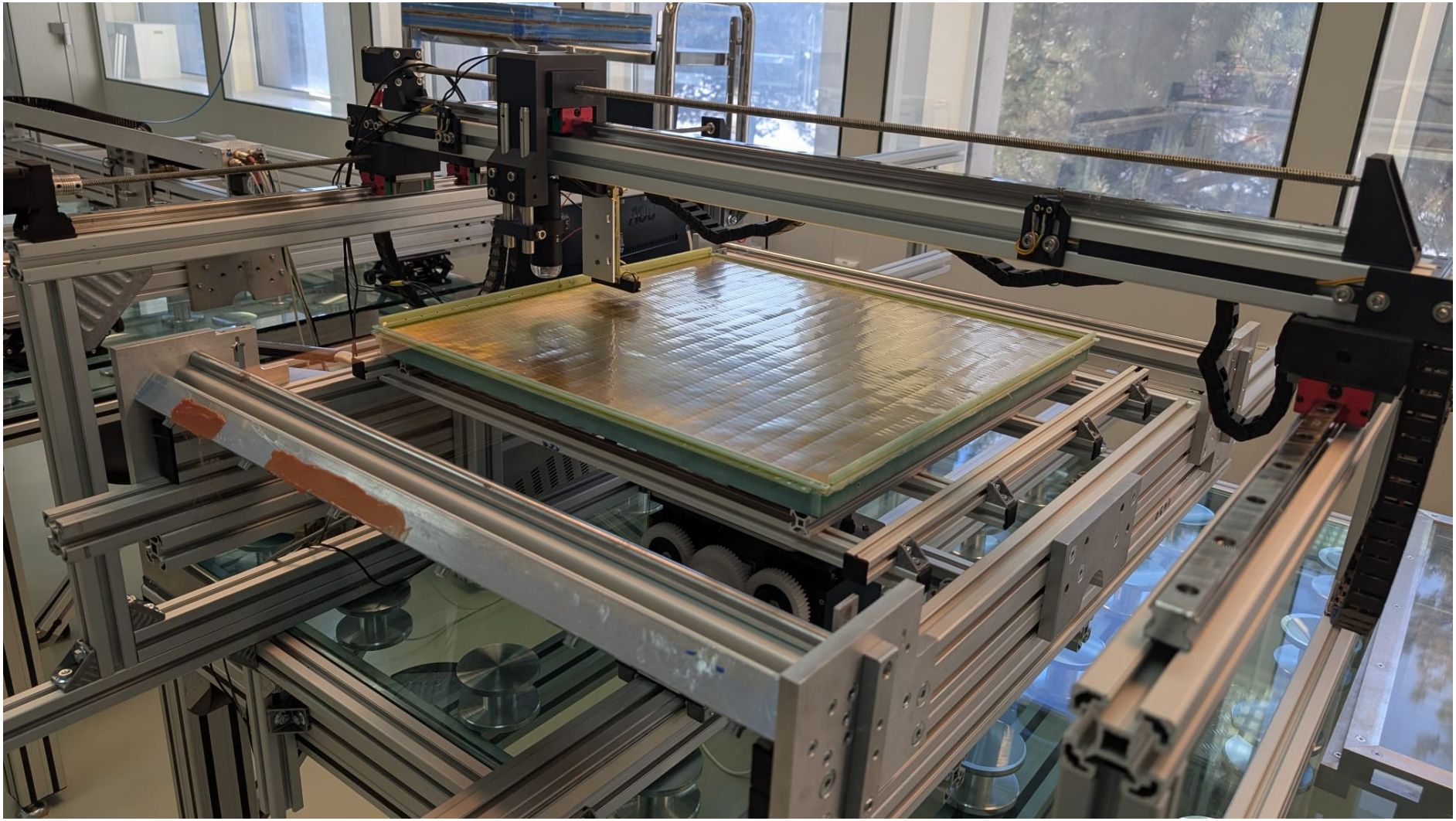
BACKUP

Wire tension estimation method



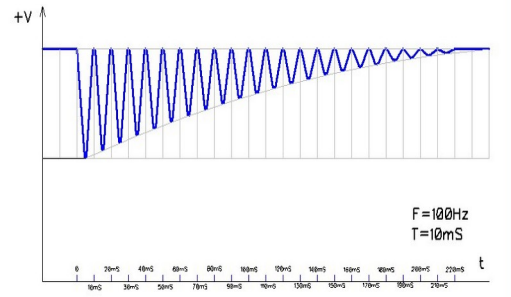
Marian, Alex

Wire positioning & tension



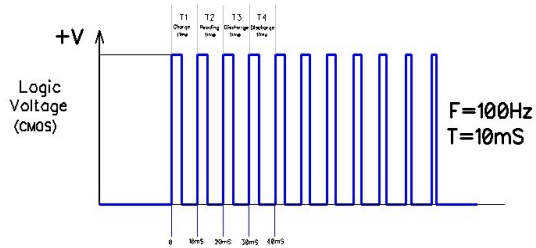
ELECTRODES
wire tension CBM method [cont'd]

Marian, Alex



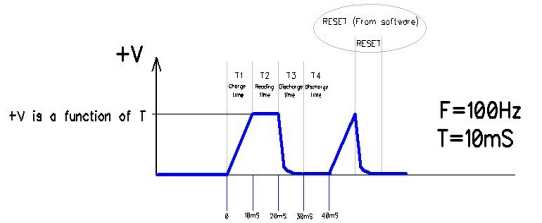
Signal in Emitter af Phototransistar (PH1)

Fig.1



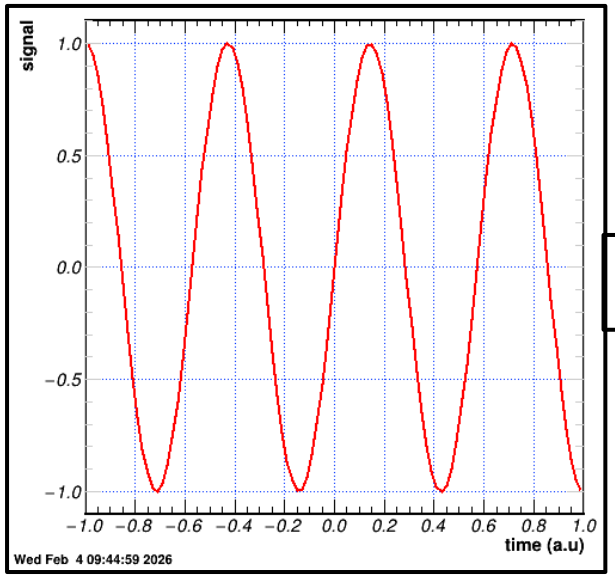
Signal after Comparator (U2)

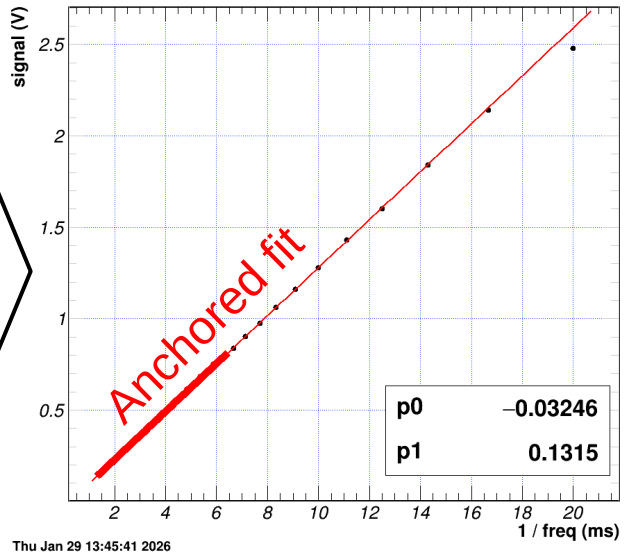
Fig.4



Signal after T/V Converter (on C9)

Fig.5





PERFORMANCE
TRD2D : *MC* - ***Hit*** - *Trk*