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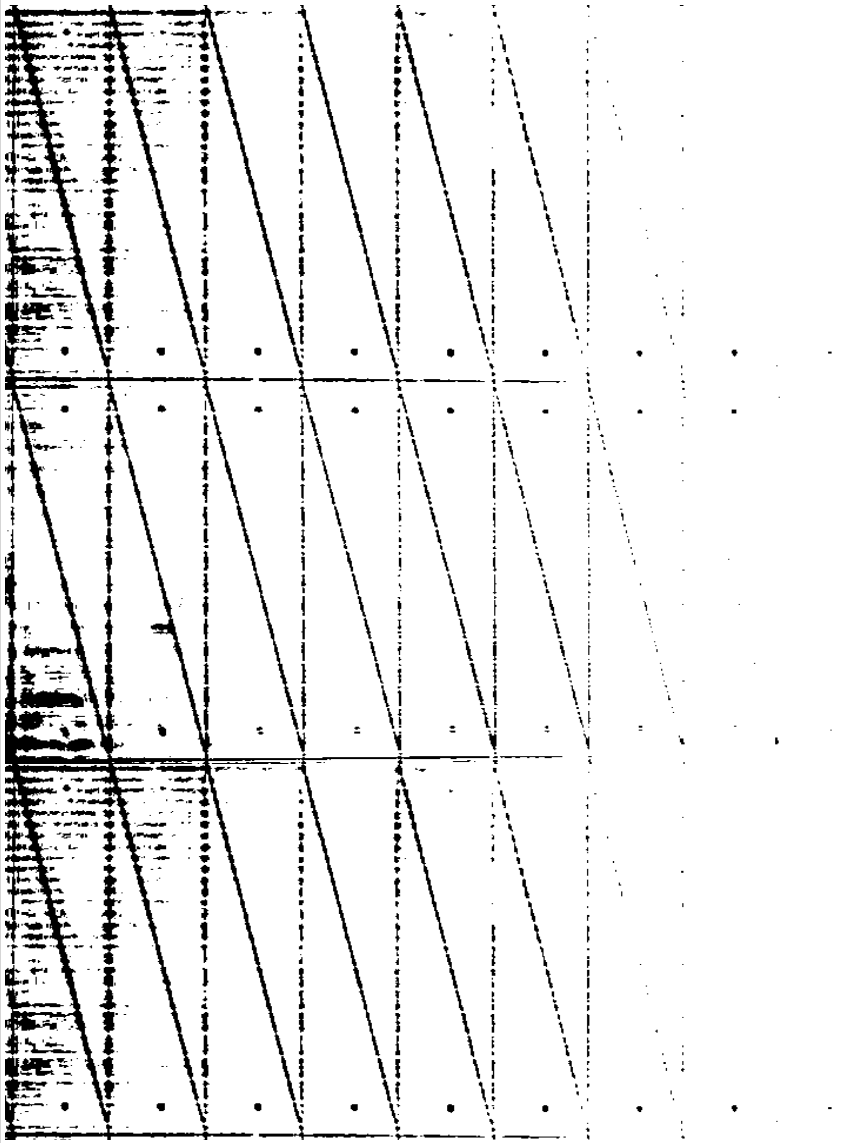
TRD2D production and FEE status

Alex Bercuci

on behalf of the Bucharest TRD2D team

44th CBM Collaboration Meeting
16th September 2024
Prague

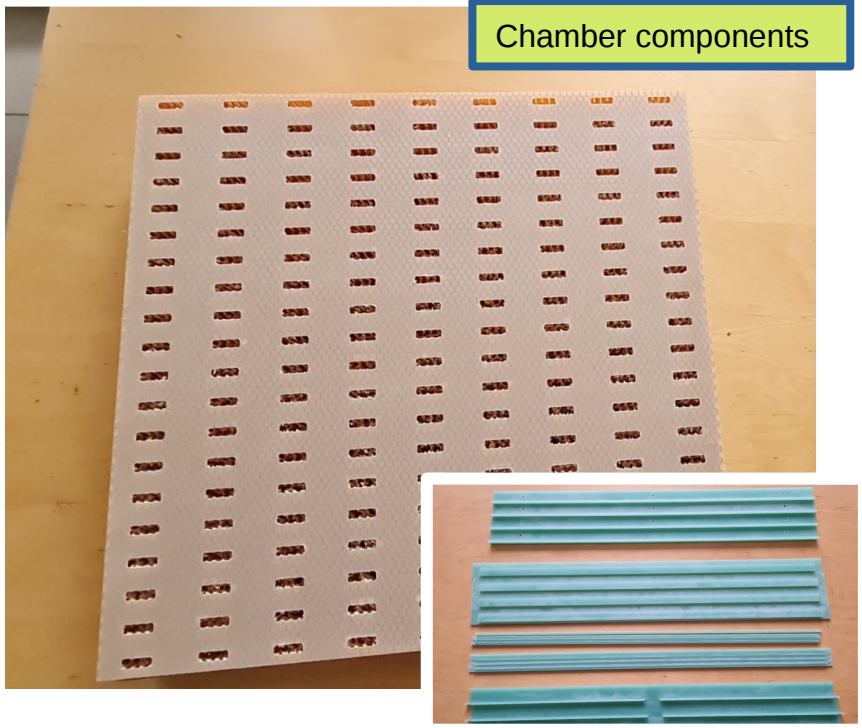
Overview of TRD2D production status

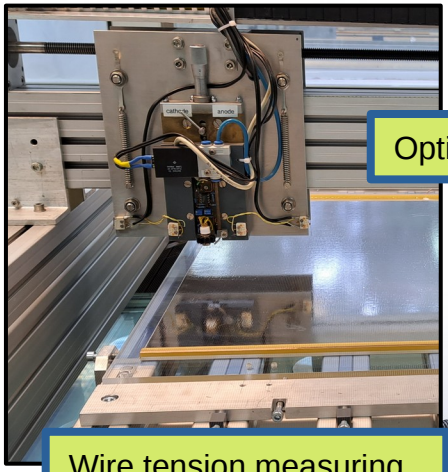


- Status of the TRD2D from the last CM
- Chamber assembly line
  - first production chamber
- Front-End Electronics (FEE)
  - full read-out module
- QA tests, production acceptance tests, etc
  - chamber elements
  - FEE

TRD2D wire installation infrastructure status @ 43rd CM GSI (March '24)

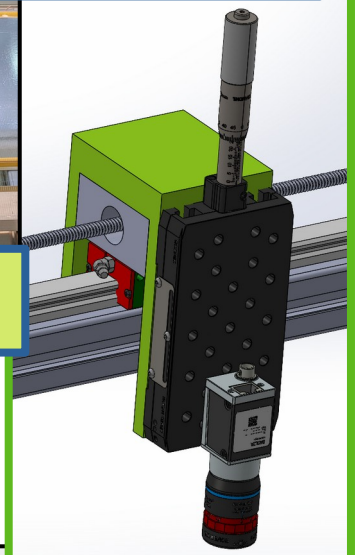
Chamber components

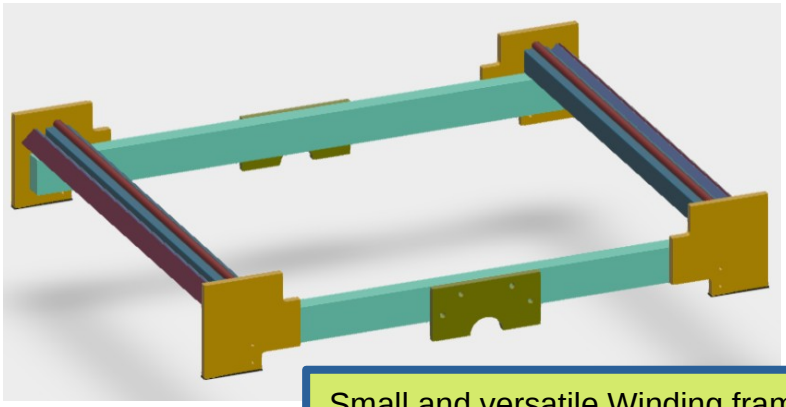




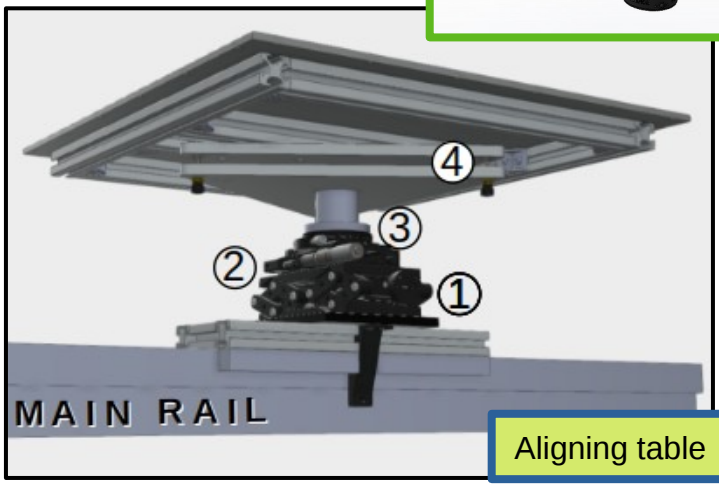
Wire tension measuring device (ALICE TRD)

Optical camera for QA





Small and versatile Winding frame



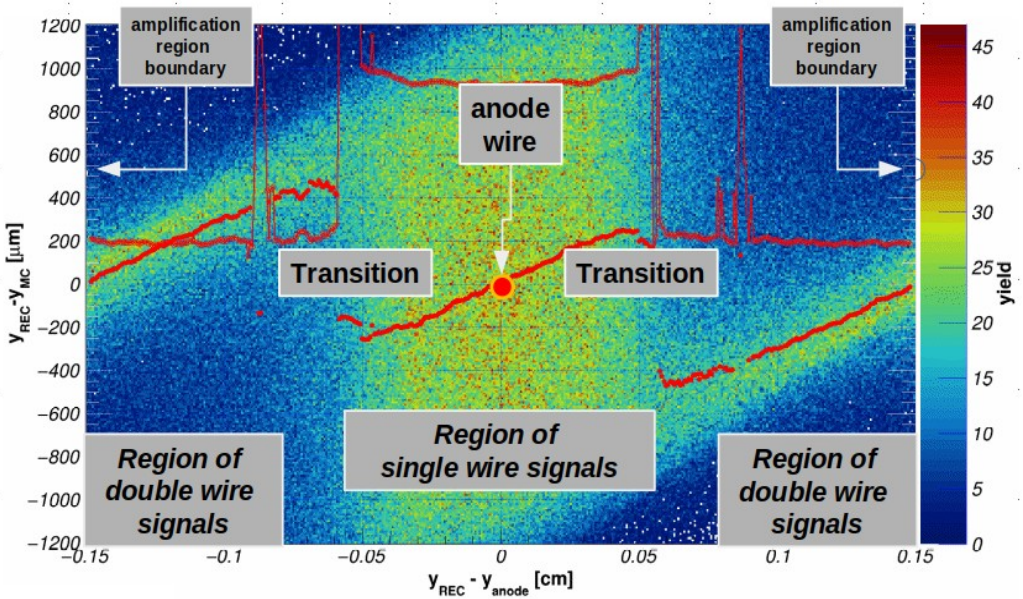
Aligning table

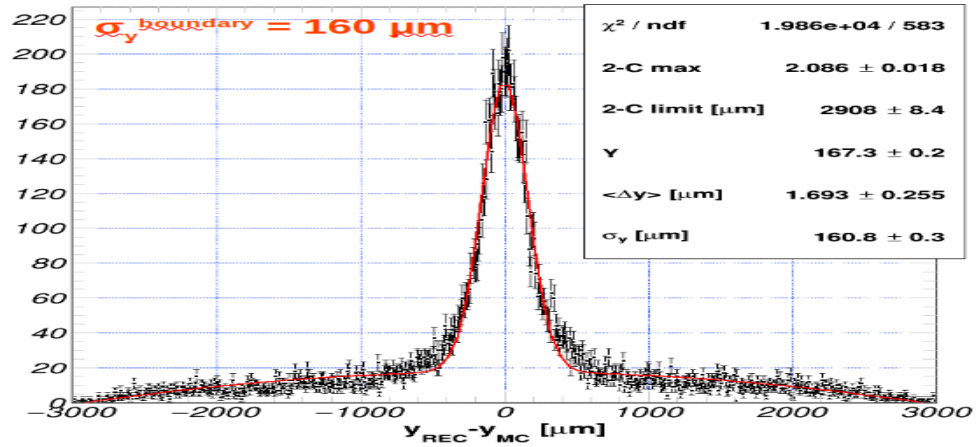
Motivation : TRD2D performances

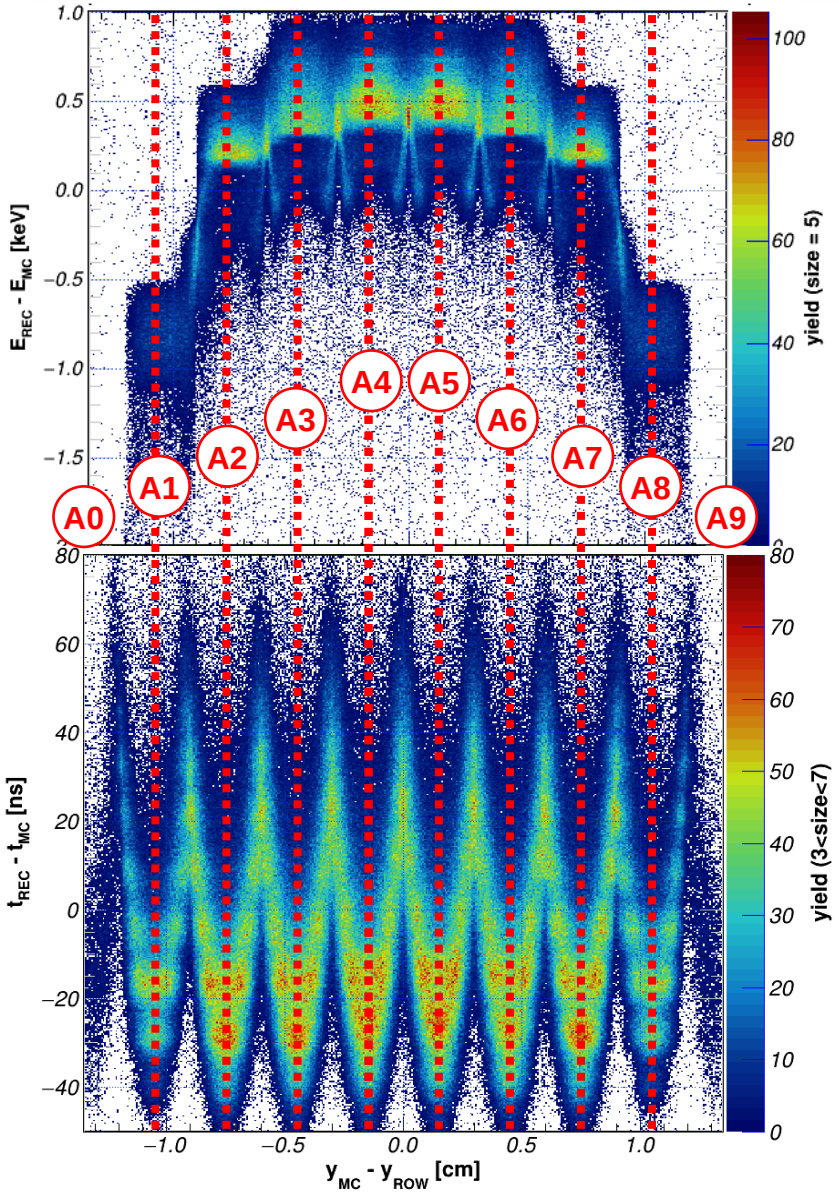
[TRD2D Addendum]

Consequences of **Anode Wire Identification**

- Position resolution
- Energy systematics
- Time anisochronicity



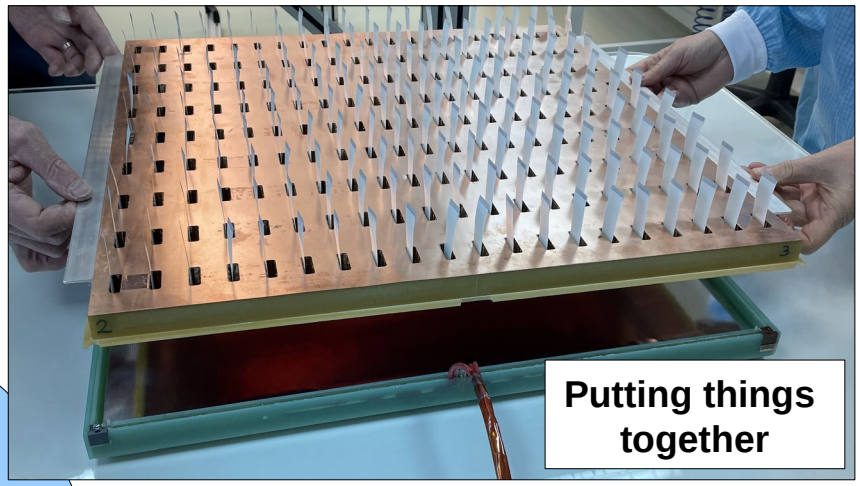




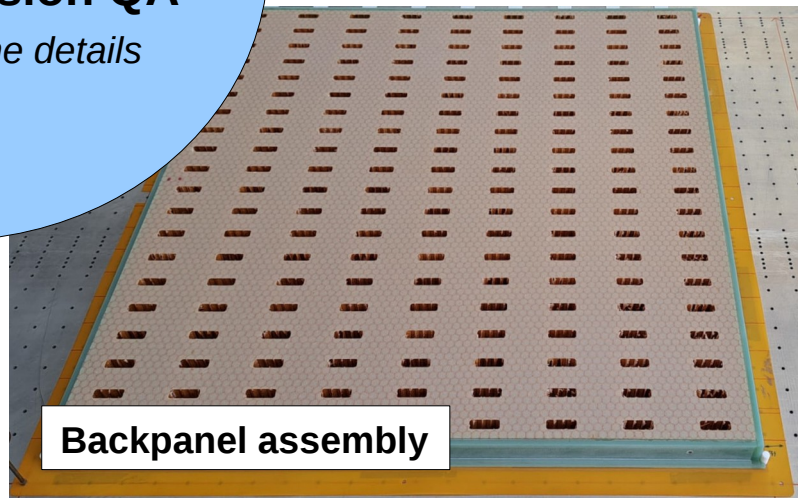
The assembly process in a nutshell

Entrance window component

Anode / Cathode wires
winding, installing, aligning, tension QA
Next slides for the details



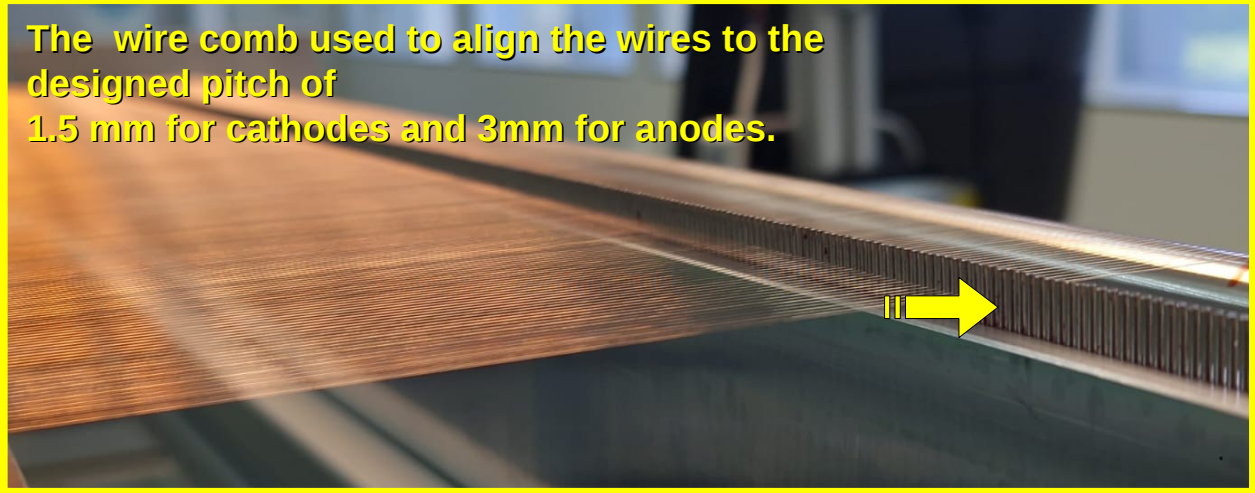
Putting things together



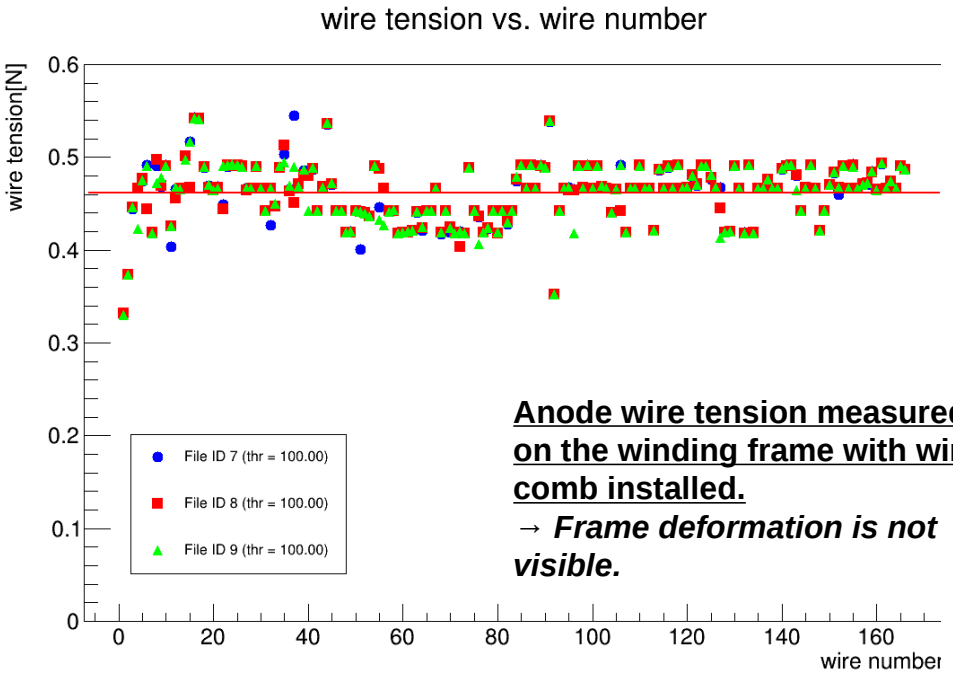
Backpanel assembly

TRD2D wire winding infrastructure status @ now

The wire comb used to align the wires to the designed pitch of
1.5 mm for cathodes and 3mm for anodes.

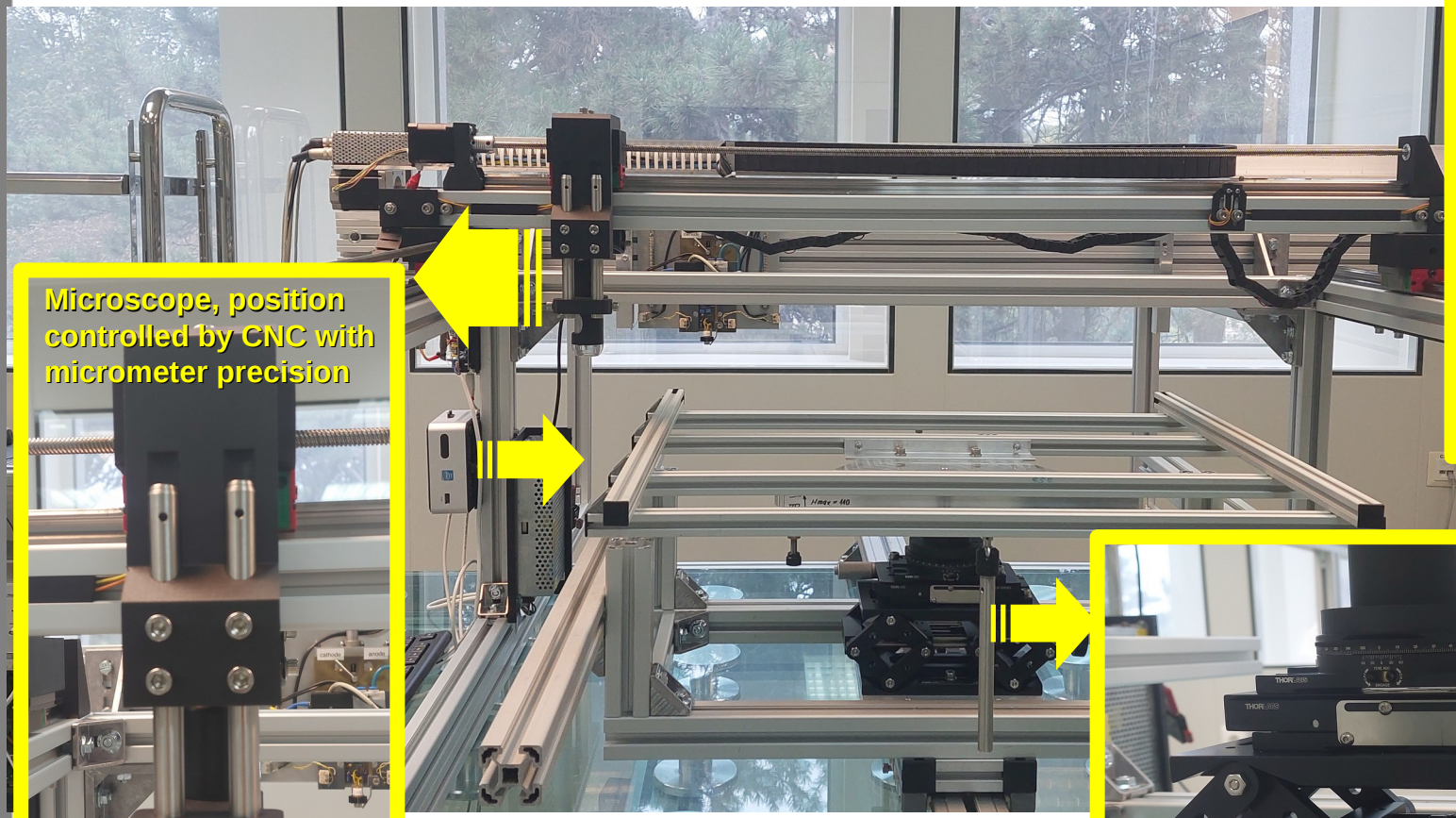


The *new, smaller and optimized* winding frame
on the machine used previously
for producing 25% of ALICE-TRD detectors

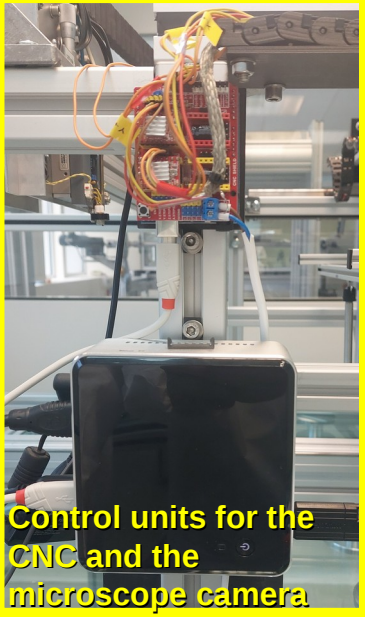


Anode wire tension measured on the winding frame with wire comb installed.
→ ***Frame deformation is not visible.***

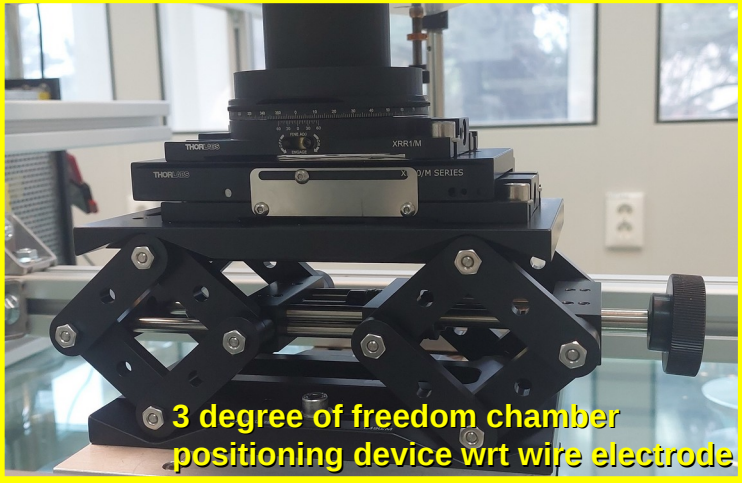
TRD2D wire installation infrastructure status @ now



Microscope, position controlled by CNC with micrometer precision



Control units for the CNC and the microscope camera

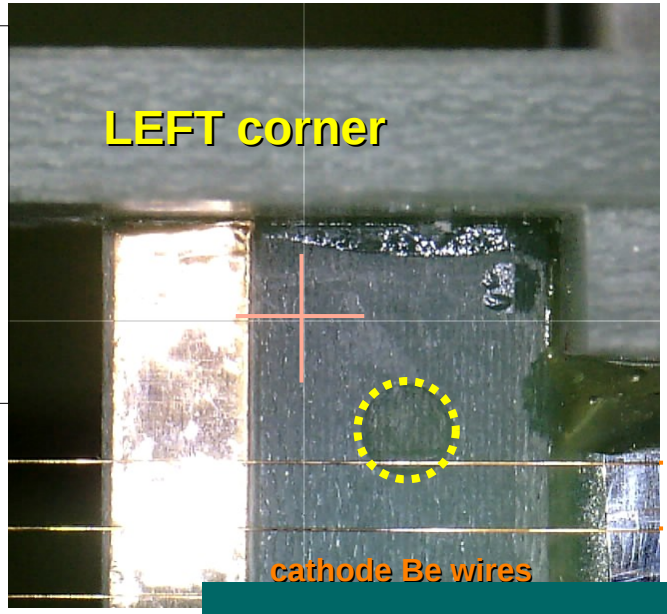


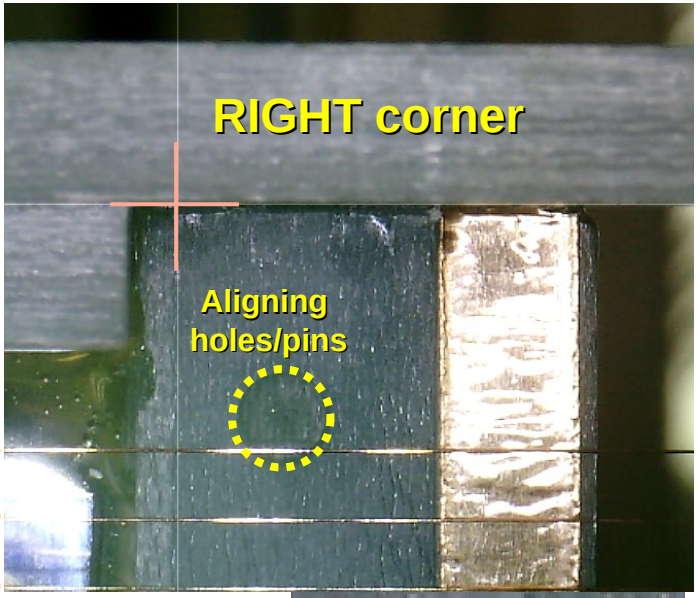
3 degree of freedom chamber positioning device wrt wire electrode

QA tests ALIGNMENT for the cathode electrodes

ROTATION ALIGN.

Matching the wire-to-pin relative position using the LEFT and the RIGHT corners (normal camera focus).

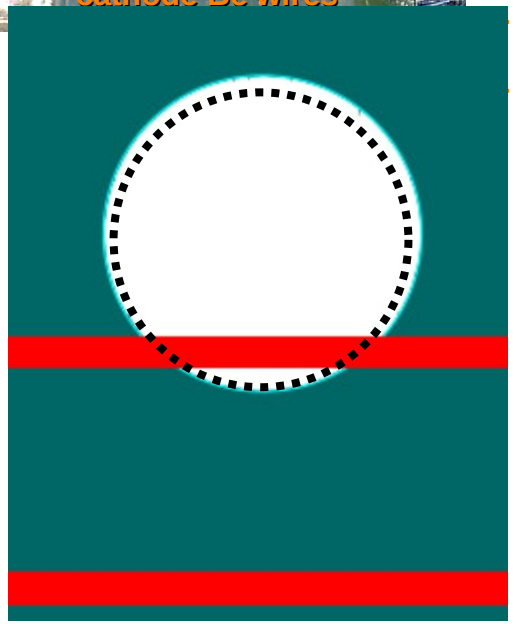


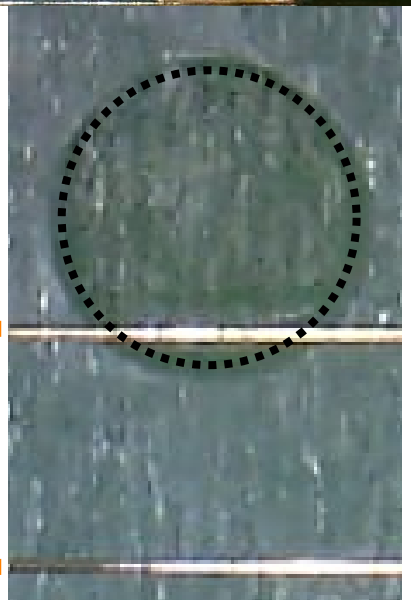


TRANSLATION ALGN.

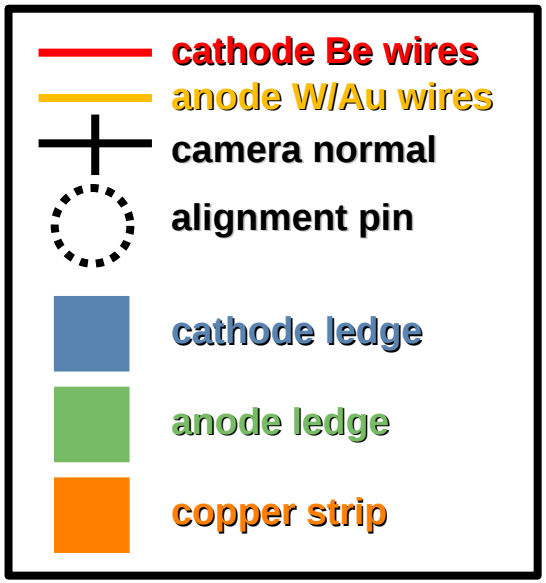
Matching the designed wire-to-pin relative position for the RIGHT corner (normal camera focus).

*) The few tenths of microns deviation can be also induced by a slightly off-normal camera image

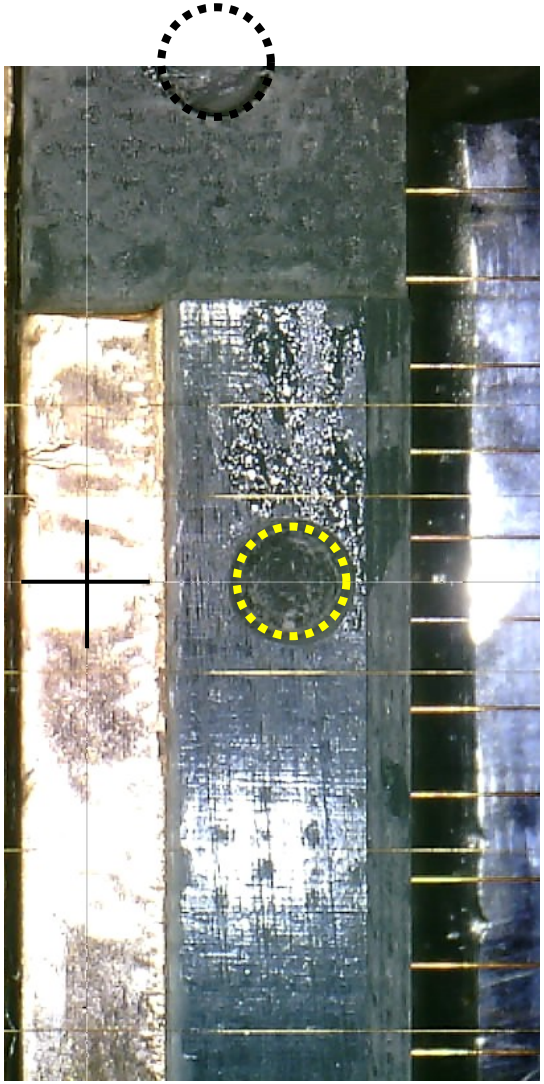




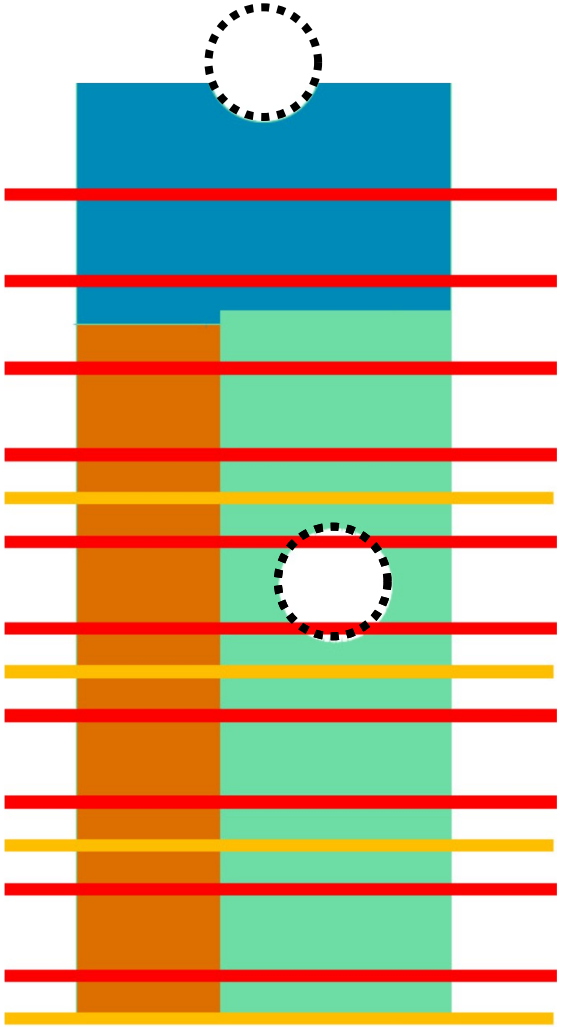
QA tests ALIGNMENT for the anode electrodes



PRODUCTION CHAMBER



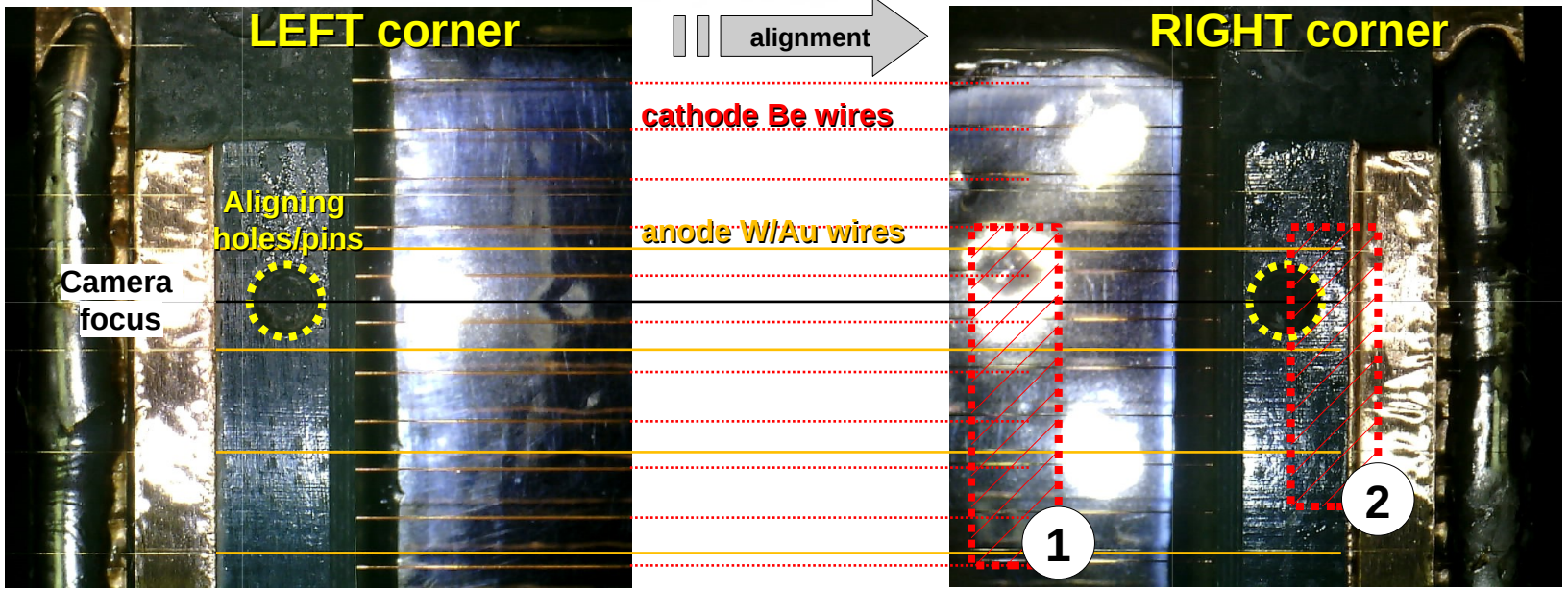
DESIGN



TRANSLATION ALGN.

Aligning one corner of the chamber to the designed configuration of A and K wires to the aligning pins (close to normal camera focus).

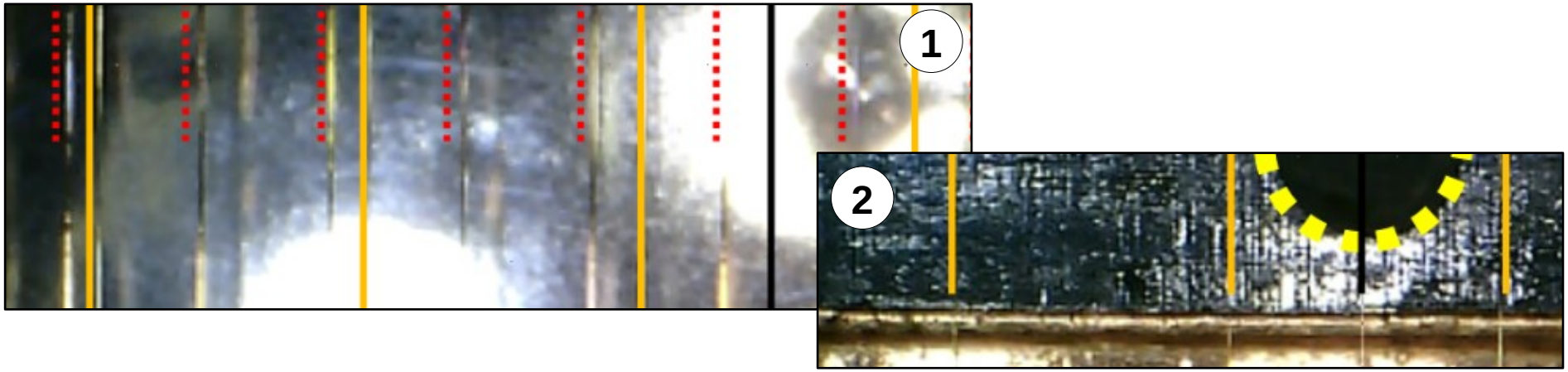
QA tests ROTATION ALIGNMENT for the anode electrodes



The optical A wire-to-chamber alignment procedure is iterated until :

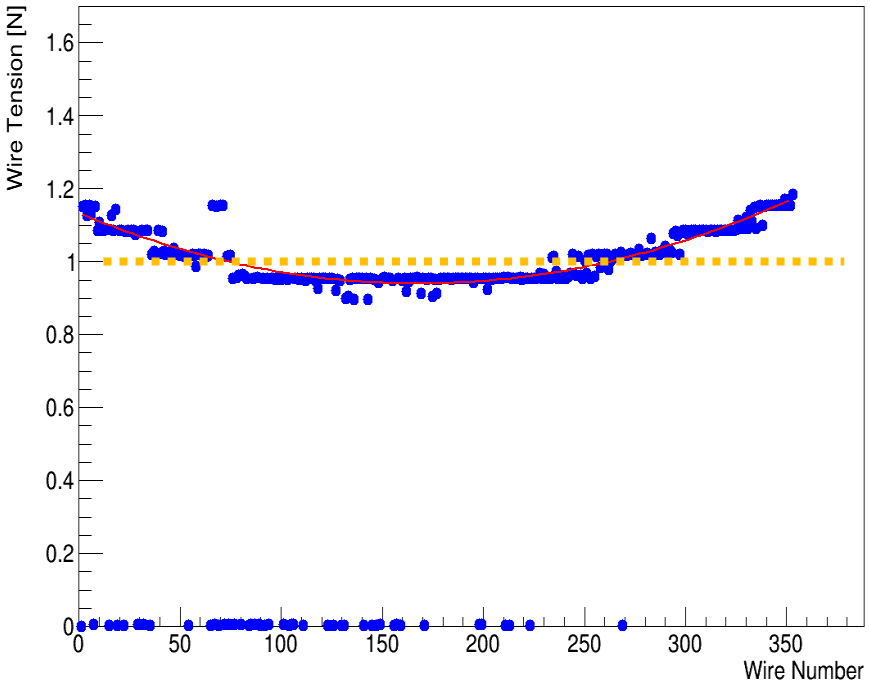
→ the LEFT corner wire to pin relative positioning match the design [Slide 9].

→ the LEFT corner matches the right corner configuration.



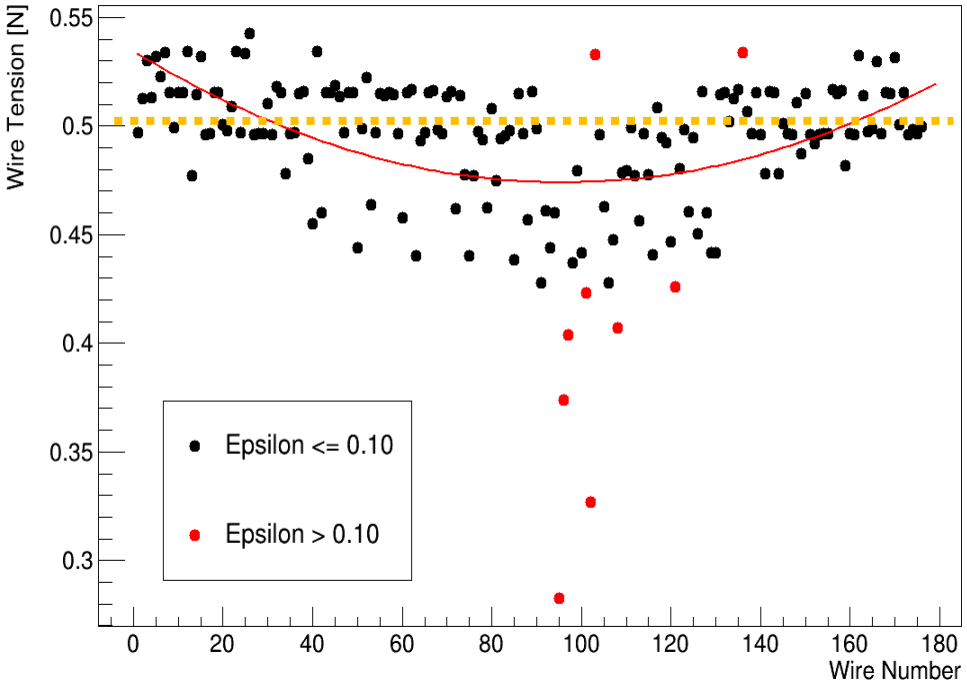
QA tests WIRE TENSION of the electrodes

Cathode wire tension glued on the chamber support.



→ Deviations larger than 10% of the nominal value are observed but not wrt deformed.
→ Chamber frame deformation are visible.
→ Some values are not correctly estimated due to wrong settings

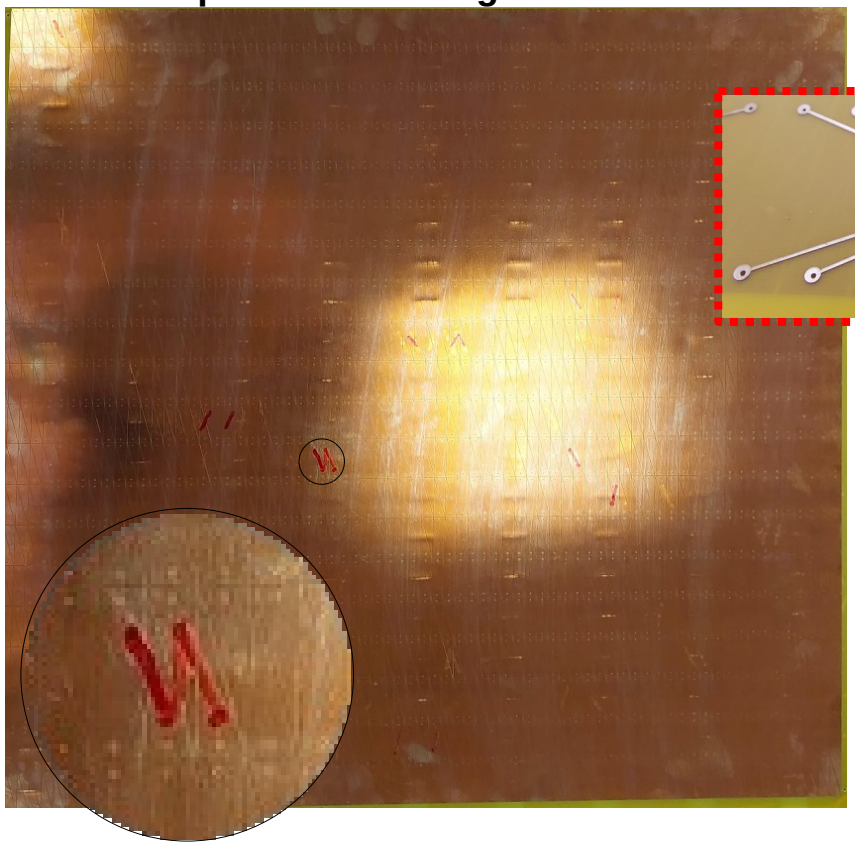
Anode wire tension glued on the chamber support + K wires.

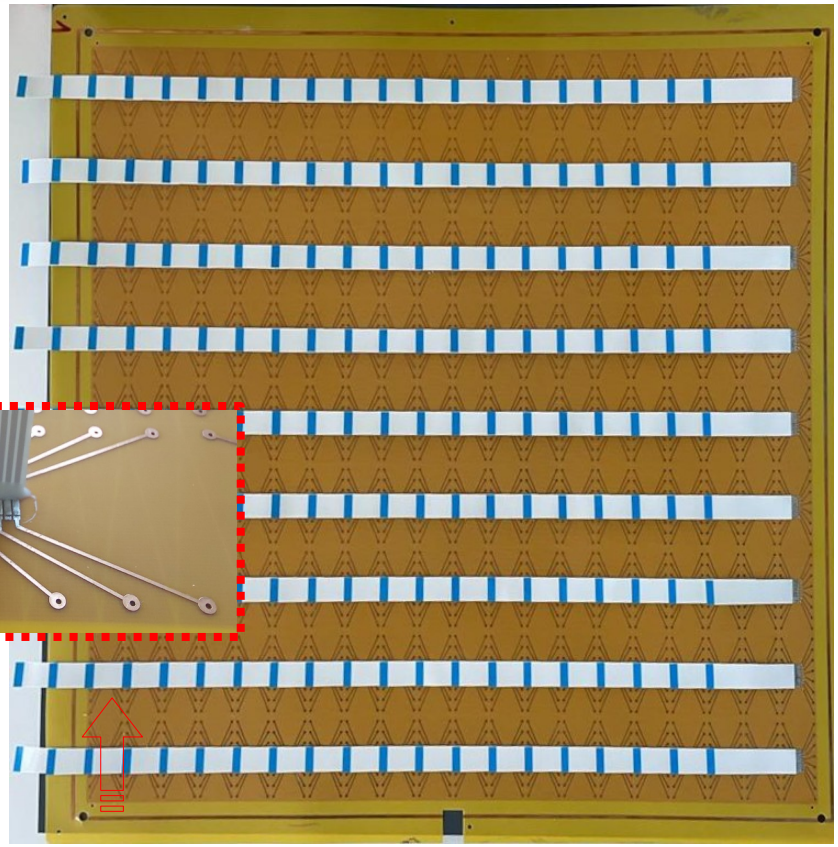


→ Deviations larger than 10% of the nominal value are observed especially in the middle. Need inspection
→ Chamber frame deformation are less visible.
→ Repeated measurements with various systematics confirm the observation.

QA tests for CONNECTIVITY and SHORTS of the pad-plane (PP)

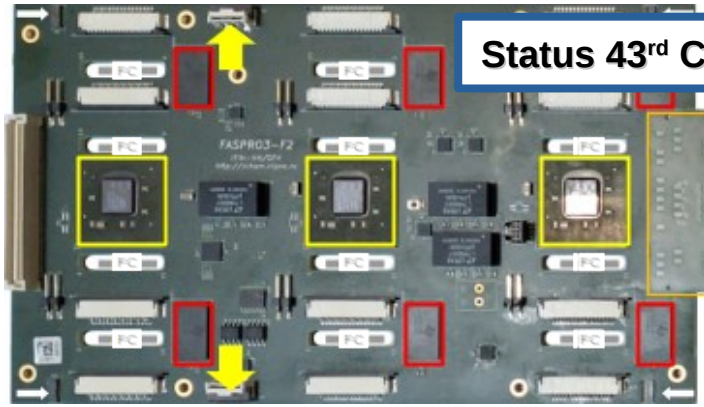
→ ALICE TRD technology used to solder directly flat-cables on the PP.
→ The operation can be executed only MANUALLY by dedicated personnel.
→ Connectivity and shorts for each channel tested by manufacturer, in-house upon receiving, and during various steps of the montage.





→ After gluing the PP on the honeycomb support some shorts are visible (marked in RED).
→ The issue is under investigation
→ A critical decision was taken to upgrade to connector interface. Possible delays in the project milestones.
→ New PP design is ready. Manufacturer and technology are being identified.

TRD2D FEE
setup for full performance tests @ mCBM



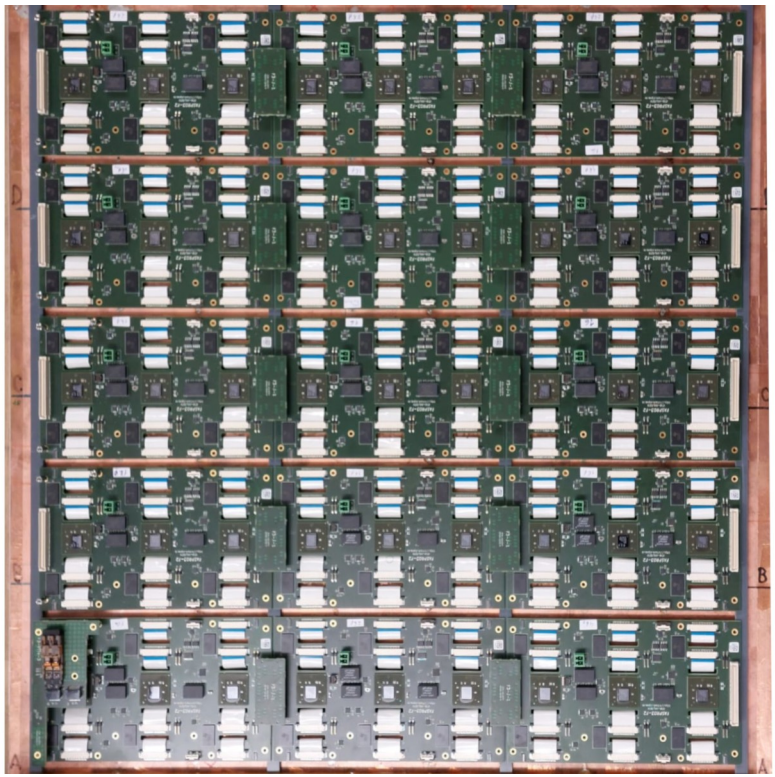
Status 43rd CM GSI

→ 15 FEBs were successfully installed on the TRD2D prototype @ mCBM in May.

→ The Ni-Ni data taking was still missed.

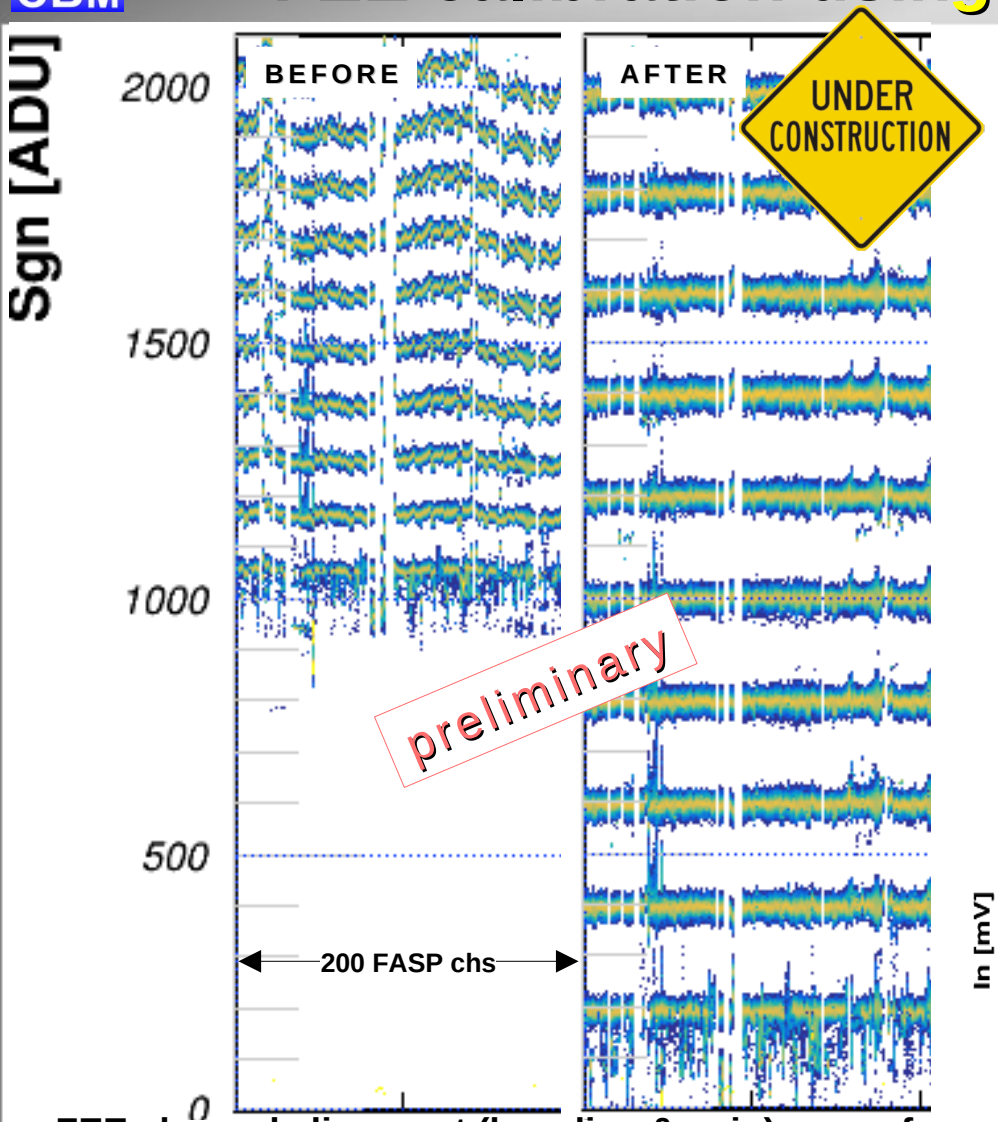
→ The U beam from June did not yield as expected (fast extraction only)

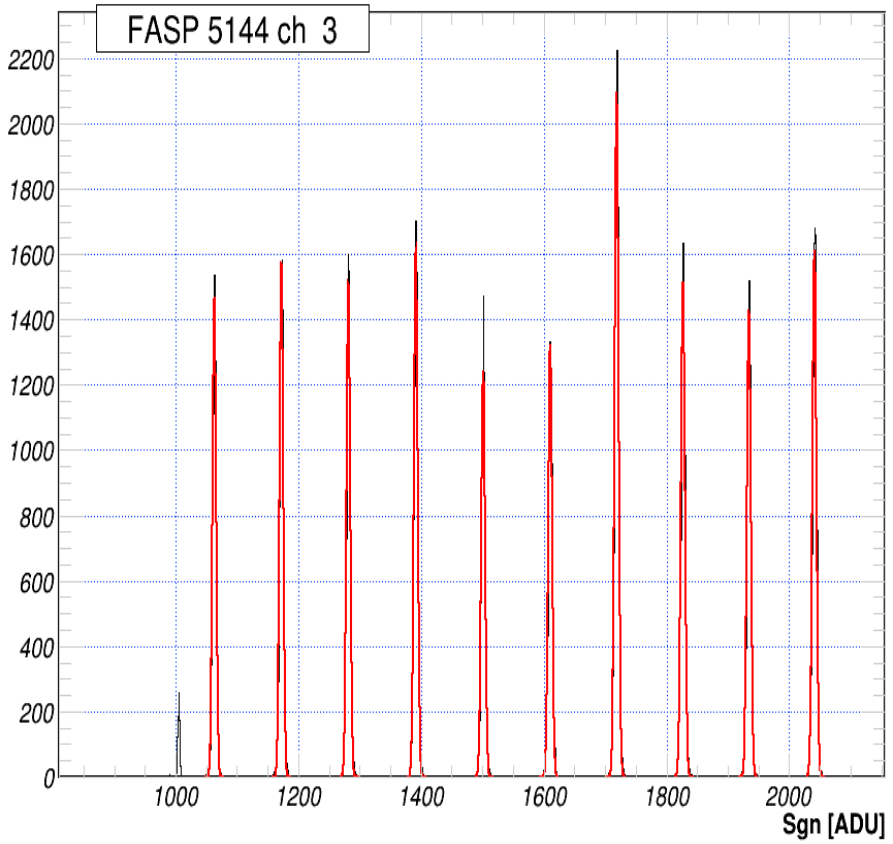
→ Only basic tests with pulser and ^{55}Fe

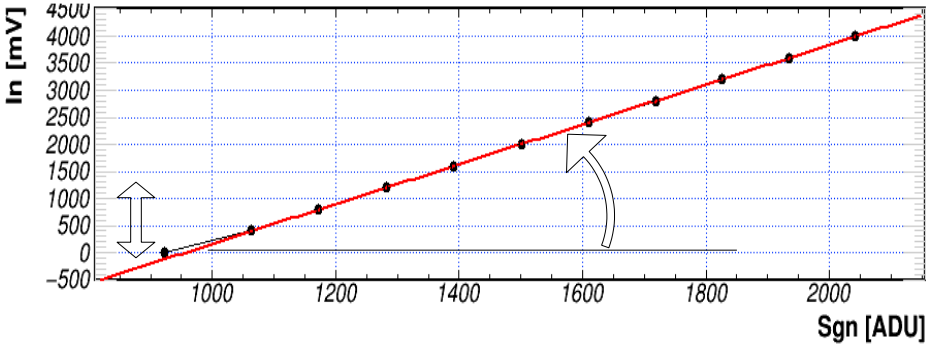


TRD2D as seen by the TRD1D.

TRD2D FEE
FEE calibration using pulser on anode







→ **FEE channel alignment (baseline & gain) – proof of principle.**

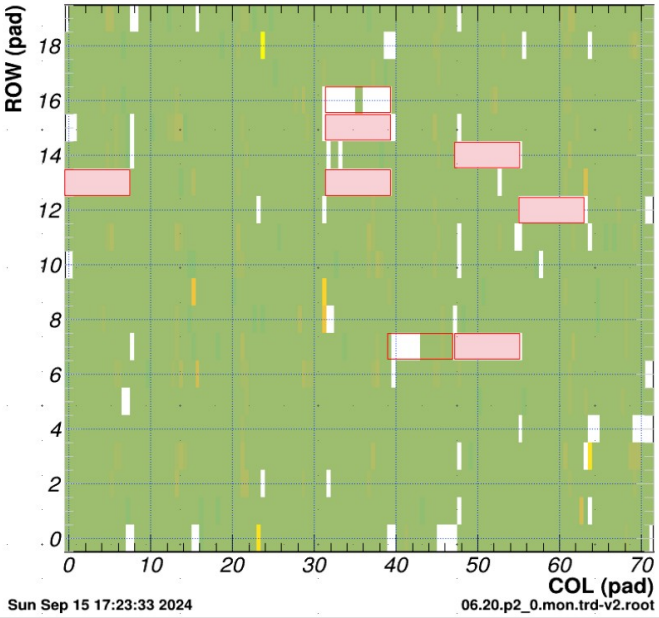
→ **All plots from CbmRoot official SW.**

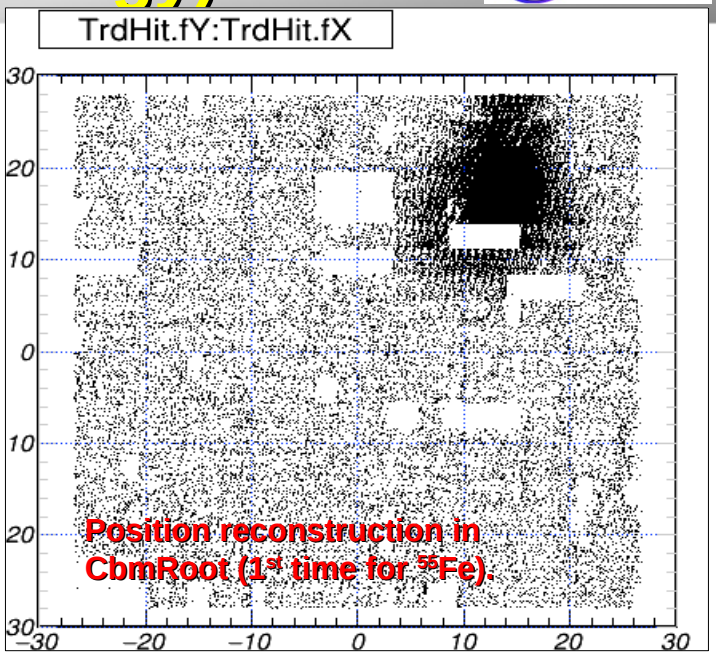
TRD2D FEE
^{55}Fe local reco (position & energy)

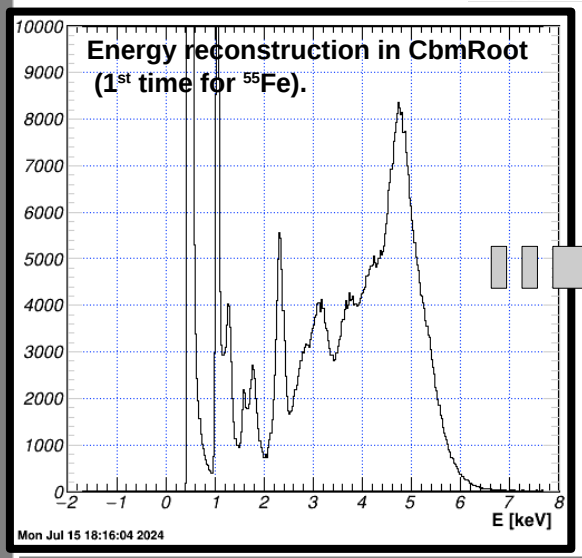
→ **Active area read-out. 6/180 FASP are off, 2/180 are poorly working.**

→ **Missing FASP ch0.**

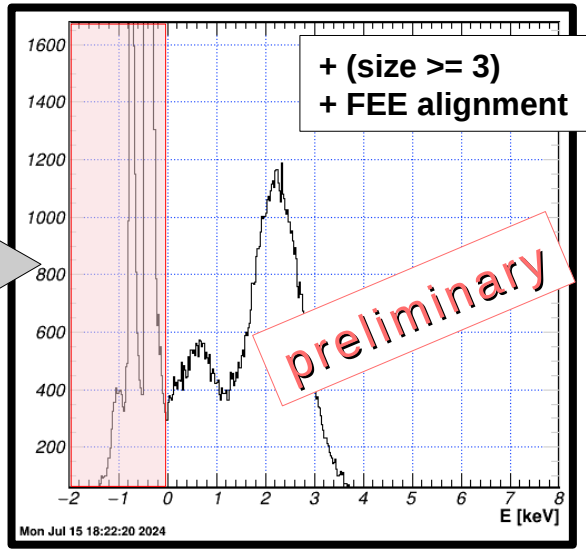
→ **Few noisy channels.**







ch. alignment



→ **Energy spectrum measured over a large area (many channels, ASICs).**

→ **Low energies are due to incomplete signals over pad-row sharing.**

Conclusions

1. The **final chamber assembly line** was realized and *first chamber* was produced.
   a) High spatial precision in chamber assembly reached.
   b) Hick-ups identified during wire installation
   c) Pad-plane design modified
2. The **final FEB** was installed at mCBM
   a) Full acceptance / fully integrated in CBM
   b) FEE calibration in progress
   c) HW issues with FASP chip testing and ch0
3. Significant steps from **R&D** to **Production** were made for both chamber and FEE

==========

4. Unexpected delays observed in chamber production.
5. A chain of unfortunate events delayed full tests of FEB.
6. A new **diploma student** (Madalina) joined us for a possible longer time.

The group

V. Aprodu,
A. Bercuci,
G. Caragheorgheopol,
V. Cătănescu,
A. Herghelegiu,
A. Naziru ,
M. Petriş,
M. Petrovici,
A. Radu,
L. Radulescu,
C. Şchiaua,
M. State,
G. Stoian

NuPECC Long Range Plane 2024

➥ identifying opportunities and priorities for nuclear science in Europe for the next 10 – 15 years

- To investigate nuclear matter at high baryonic density, the timely completion of **SIS-100** at **FAIR** and the realization of the **CBM** experiment are of utmost importance. Efforts should continue to support R&D activities related to advanced **CBM** silicon vertexing and tracking devices.

- Full exploitation of the novel research opportunities as pro… the **APPA**, **CBM**, **NUSTAR** and **PANDA** collaborations.
- Realization of First Science+ until 2028 followed by the **APPA** cave and the **Super-FRS** low-energy branch.

from Executive Summary (draft as of April 2024)

Thank you

BACKUP

TRD2D chamber components HV (Claudiu, Cara)

Status 42nd CM Bucharest

- Requirements;
  - Radiation tolerant;
  - connect TRD2D to patch panel *location;*
  - Small size up to 6 pcs./chamber (4A+D+K).
- Proposed solution;
  - Cable : DRAKA HTC 50-1-1;
  - Connector : LEMO FFR.05.403.LLAE.141.

HV filter box;

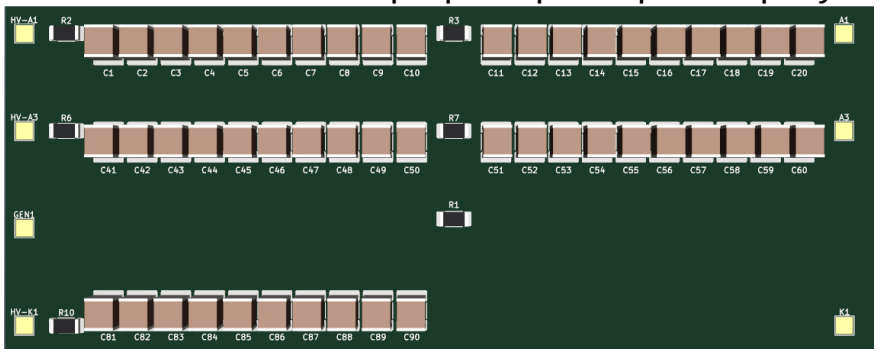
- Integrated in the mechanical structure;
  - 18(!) x 60(!) x 120 mm^3.
- Easy access and repair;
- RJ45 connector for DCS on-board facility;
  - Pulser calibration;
- SMD discreet components for filters
  - Values defined based on current
  - Components identified on the market
- Design in progress;
  - Components procurement in progress

The **filter box** design components/characteristics were identified

→ all components available in house

→ final version with 1A + 1D + pulser

→ a major design decision was to drop connectors (75E/ch) from the filter box in favor of a multi-purpose patch panel 1pc/ly



The **HV routing**

→ a proposal for a patch panel/layer can be made to the group

→ the routing/connectivity from the source to the detector was investigated and need coordination with group and experiment

→ a price/channel was identified out of which 50% is in connectivity

→ TRD2D require 80 chs which do not pack nicely in 48 / unit. Some synergy must be found for optimization.

Radiation tolerance

→DRAKA cable + LEMO (75E/ch) are OK (expensive and scarce)

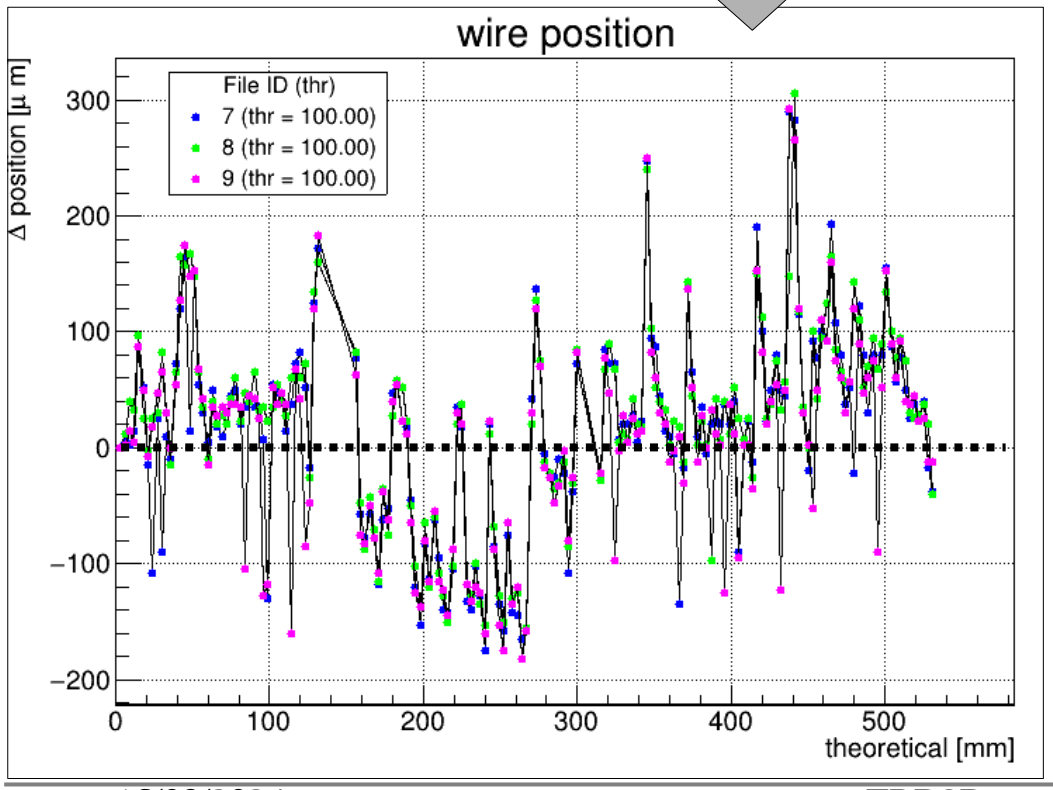
→SHV (40E/ch) being tested for

→ Local LV – HV sources are also being investigated

Position measurements

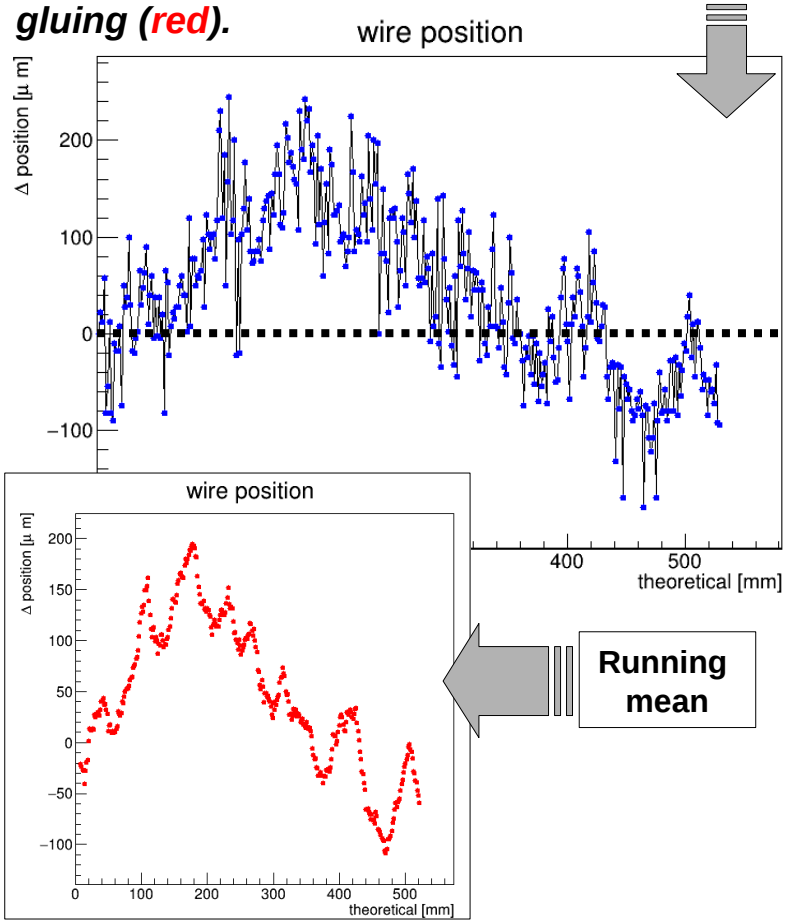
Relative anode wire position measured on the winding frame with wire comb installed.

→ Measurement repeated 3 times to check for the systematic effects in measuring device.
→ Deviations larger than 100 µm are confirmed by repeated measurements



Relative cathode wire position glued on the chamber support.

→ Deviations larger than 100 µm wrt the neighbors are observed (blue).
→ Some systematic effects are visible after gluing (red).



Running mean