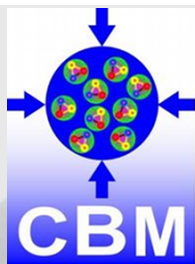


FAIR



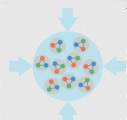
MINISTERUL CERCETĂRI ȘI INOVĂRII

Lessons learned from building and testing

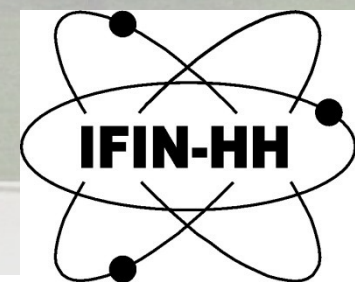
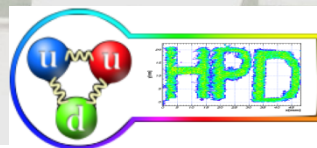
24% of ALICE-TRDs and 50% of ALICE-OROCs

**Mariana Petris for Hadron Physics Department (HPD) team
National Institute for Physics and Nuclear Engineering (IFIN-HH),
Bucharest, Romania**

CBM

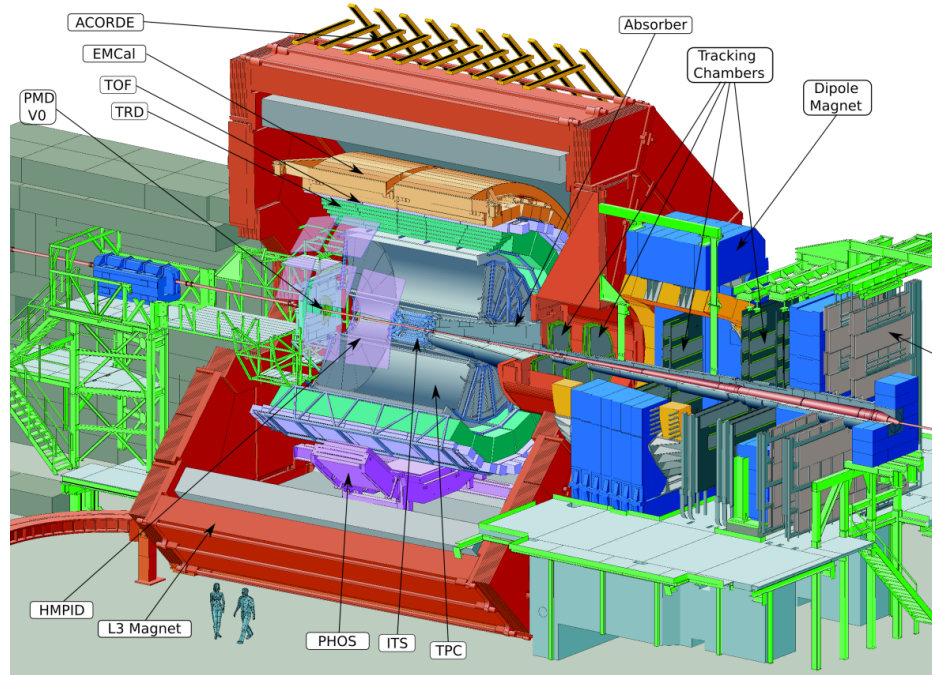


TRD



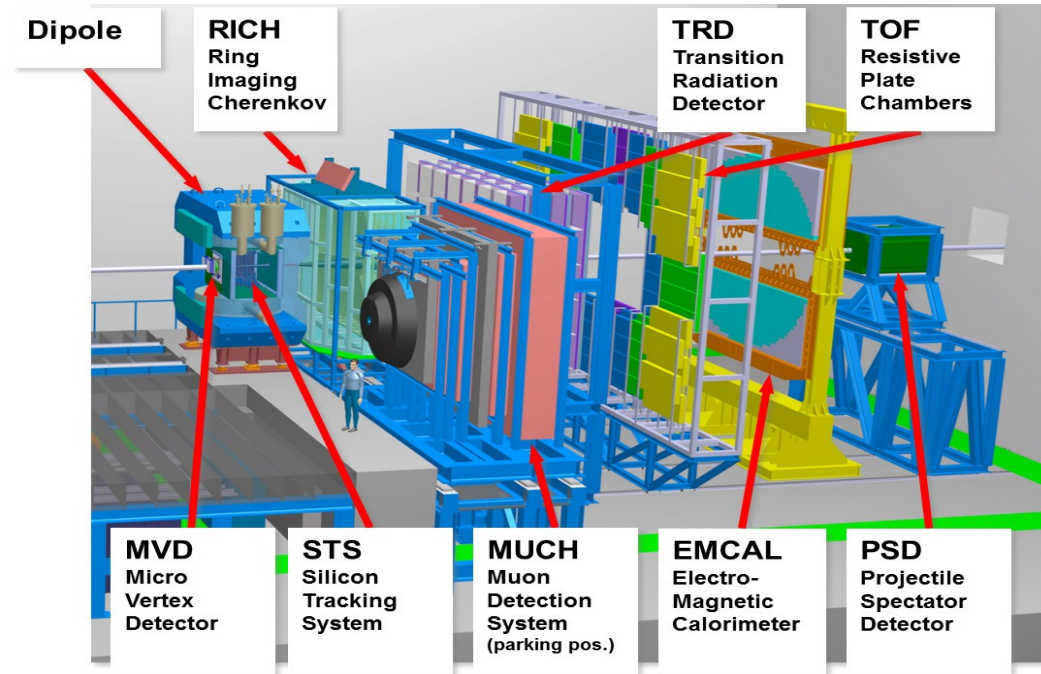
Major projects in which HPD is involved

ALICE experiment at LHC



- *ALICE-TRD prototype tests*
- *Design of the FEE chip (PASA)*
- *ALICE-TRD chamber assembling & tests*
- *ALICE-TRD SMs installation*
- *ALICE-TPC upgrade based on GEM technology, OROC assembling & tests*
- *Data analysis*

CBM experiment at FAIR

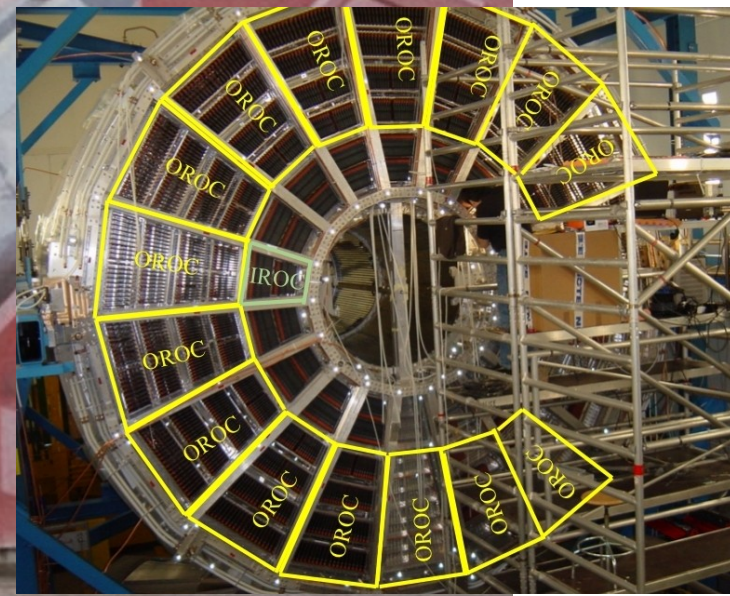


➤ *R&D activities for:*

➔ *CBM-TRD subsystem*

➔ *CBM-TOF subsystem*

Construction of 20 (50%) out of 40 ALICE-TPC OROCs



ALICE-TPC OROC assembling – 1000 part./ft³ clean room

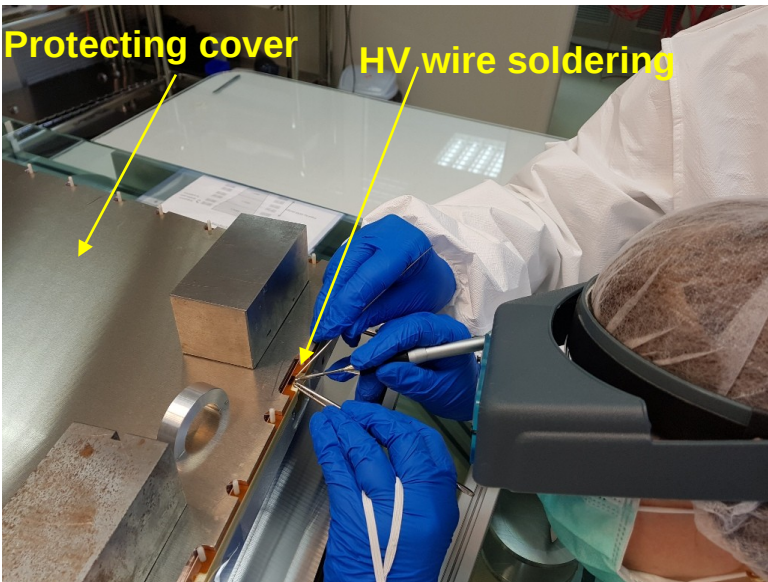
Protecting equipment & clean environment



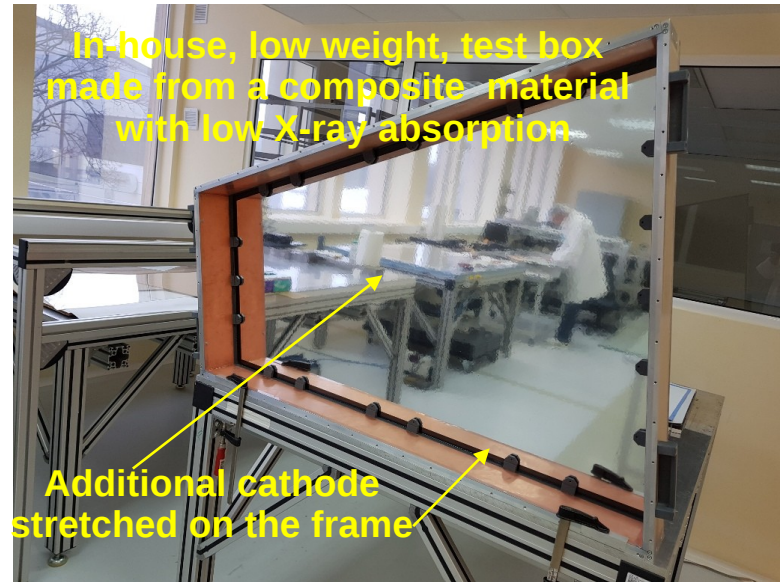
Assembled OROC – 3 stacks of GEM foils



Protecting cover HV wire soldering

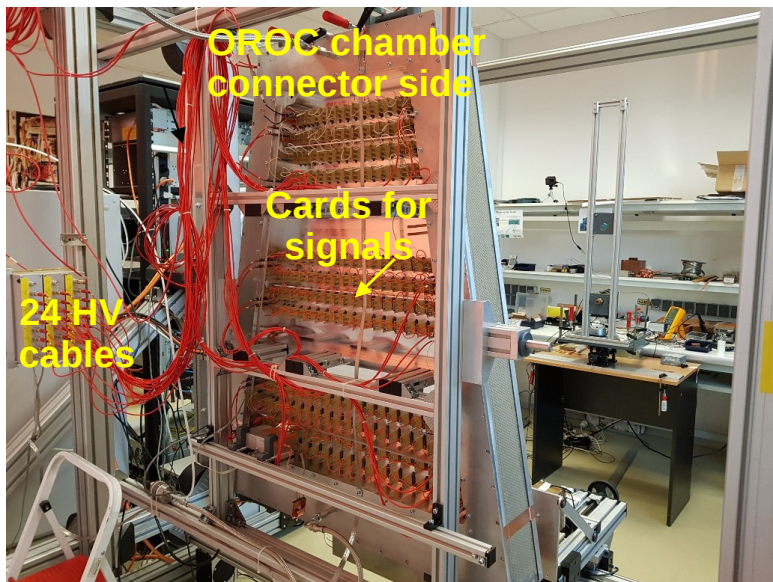


In-house, low weight, test box made from a composite material with low X-ray absorption

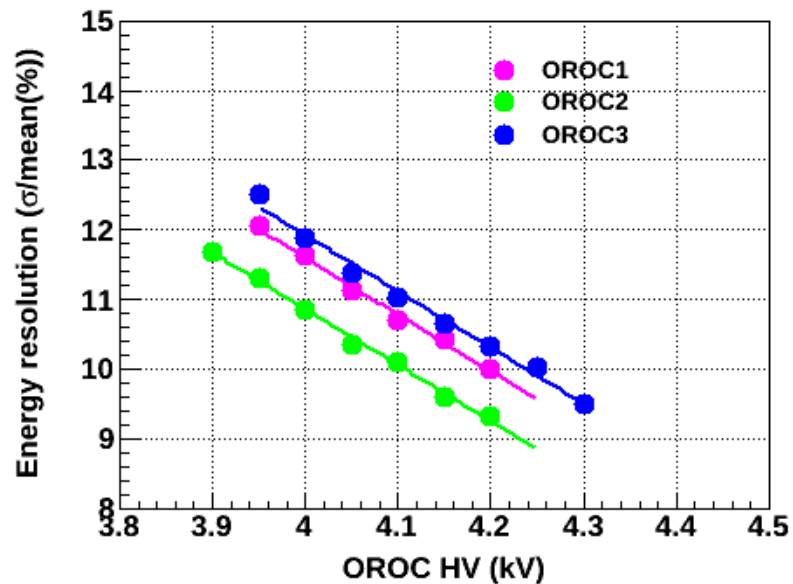


Additional cathode stretched on the frame

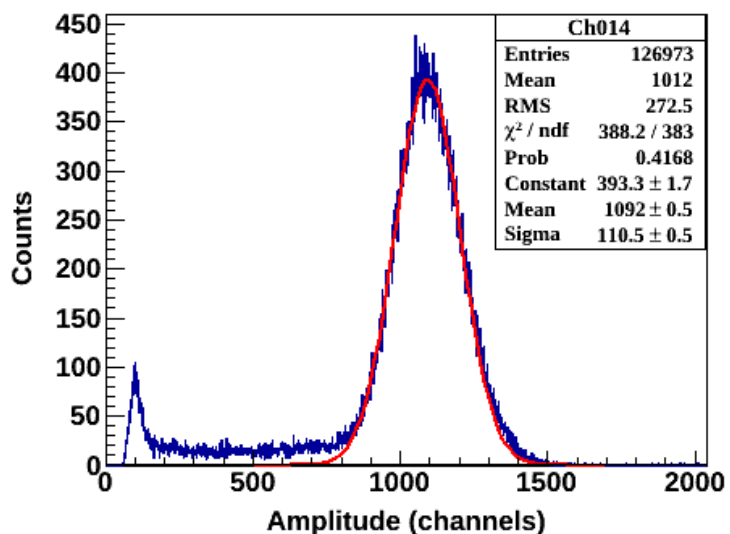
ALICE-TPC OROC tests



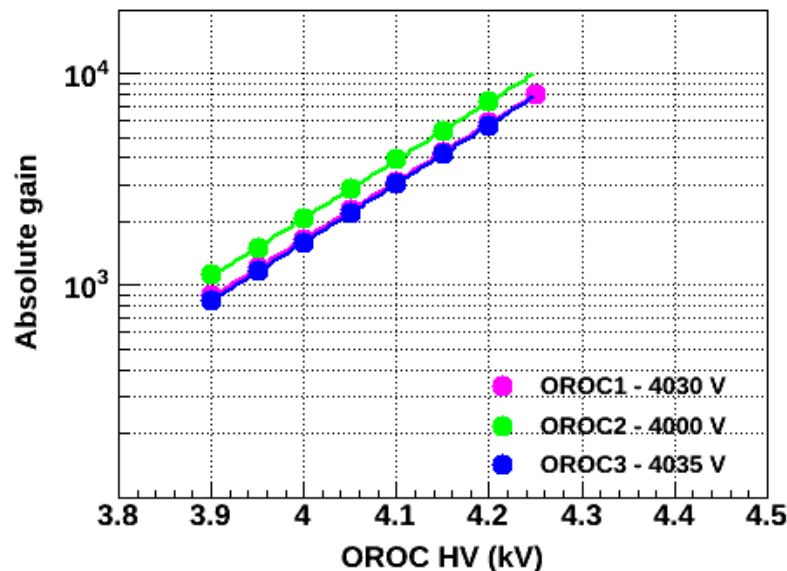
OROC/15 energy resolution



Raw Spectrum (ADC[0] Ch[14])



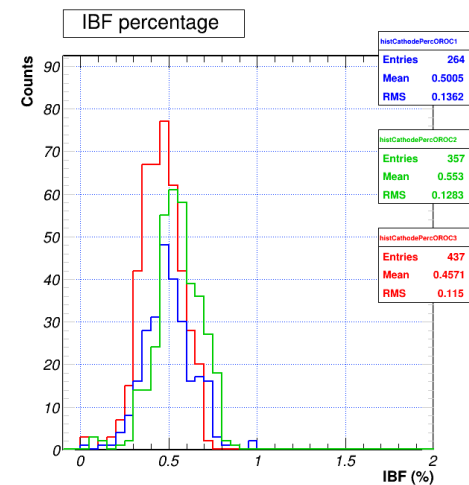
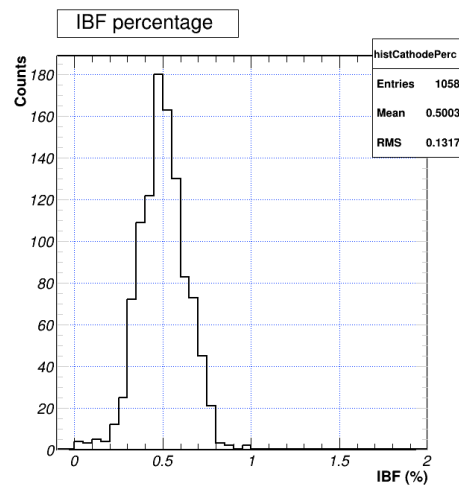
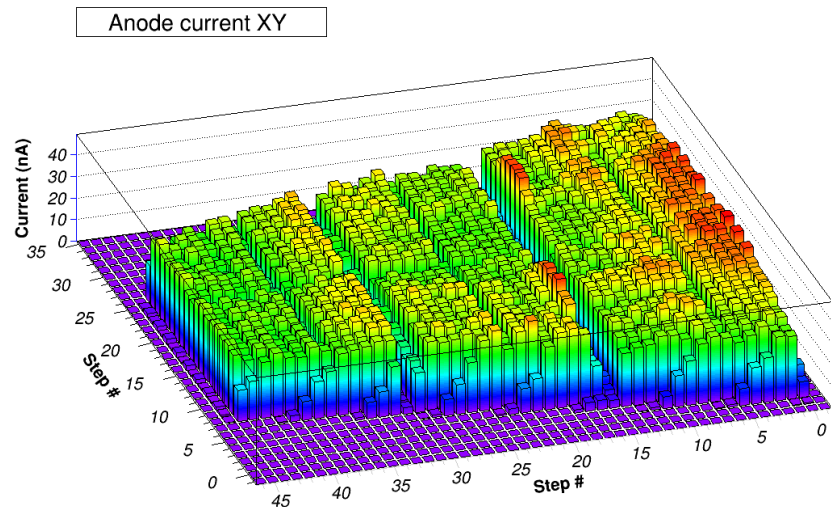
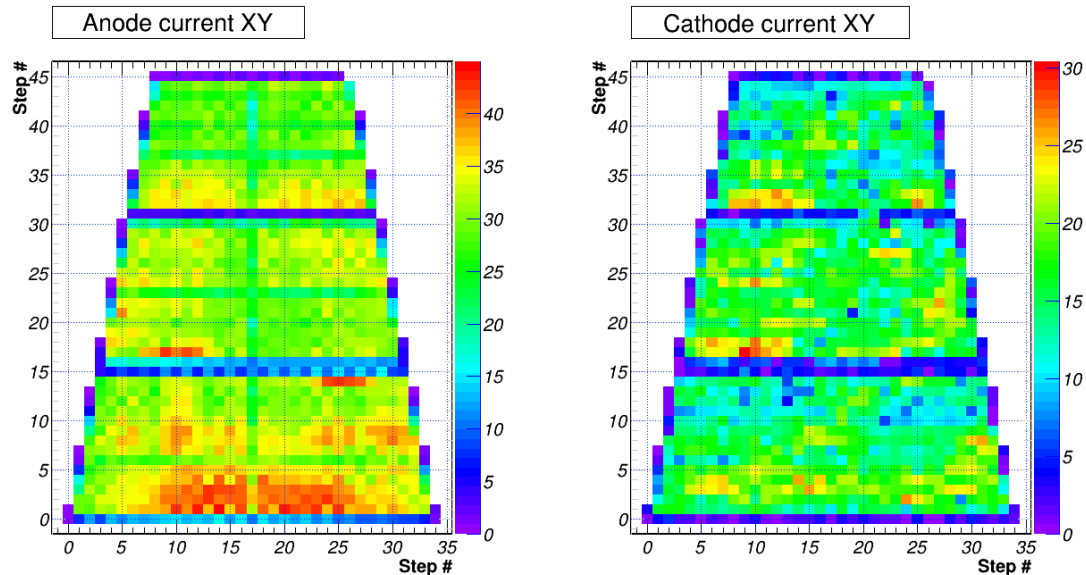
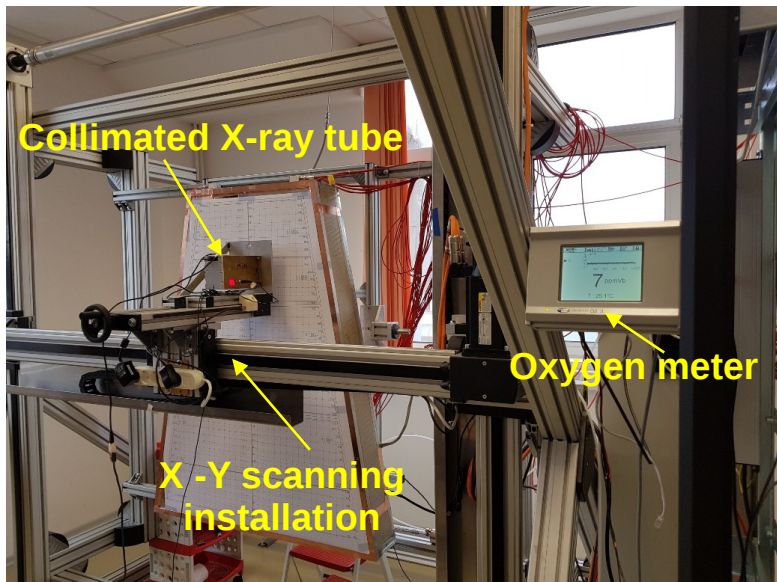
OROC/35 gain



Gas mixture: Ne-CO₂-N₂ (90-10-5)

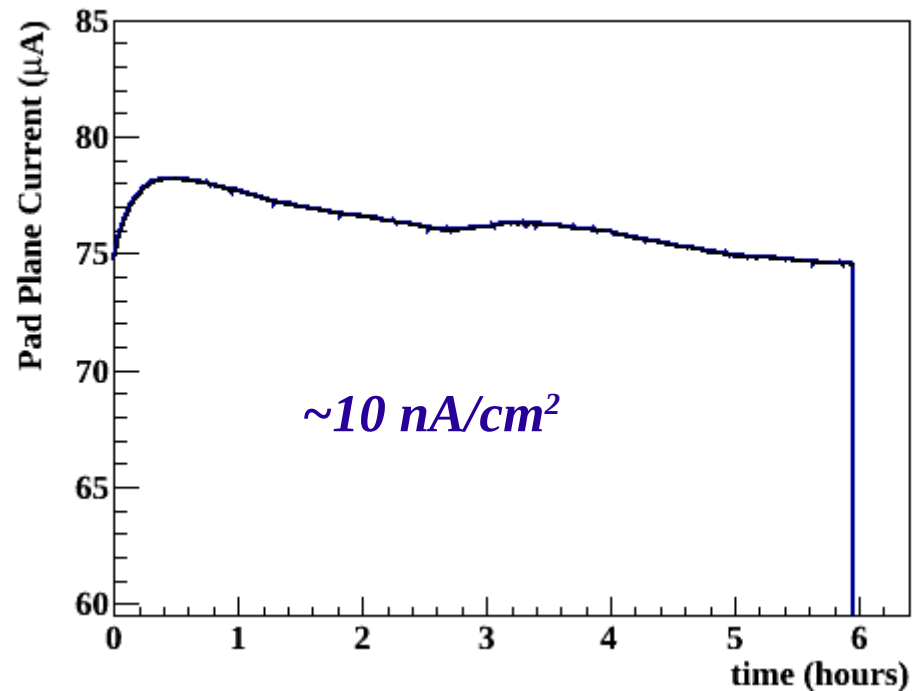
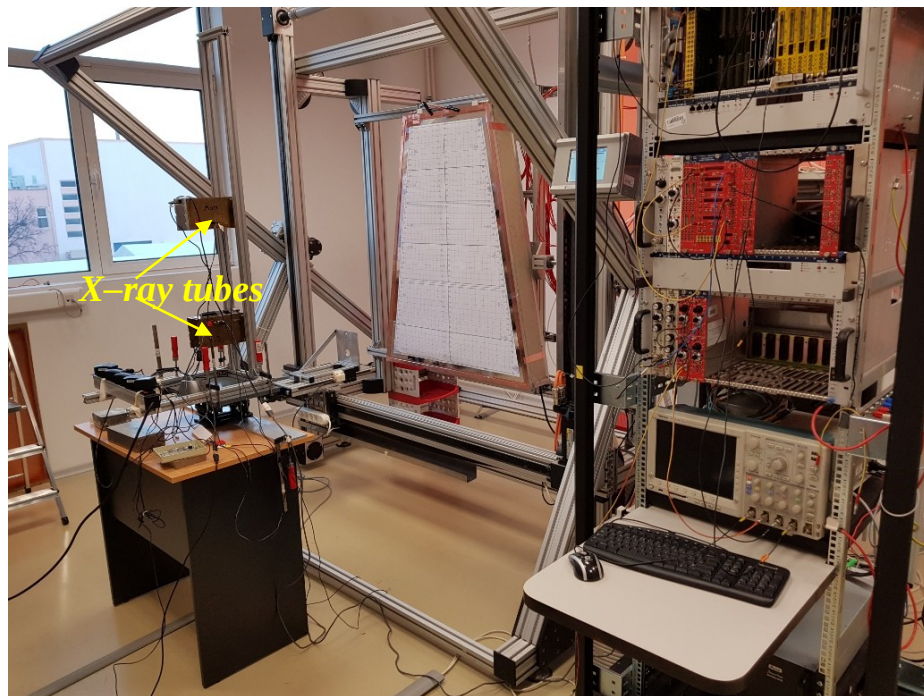
ALICE-TPC OROC tests

Gain mapping



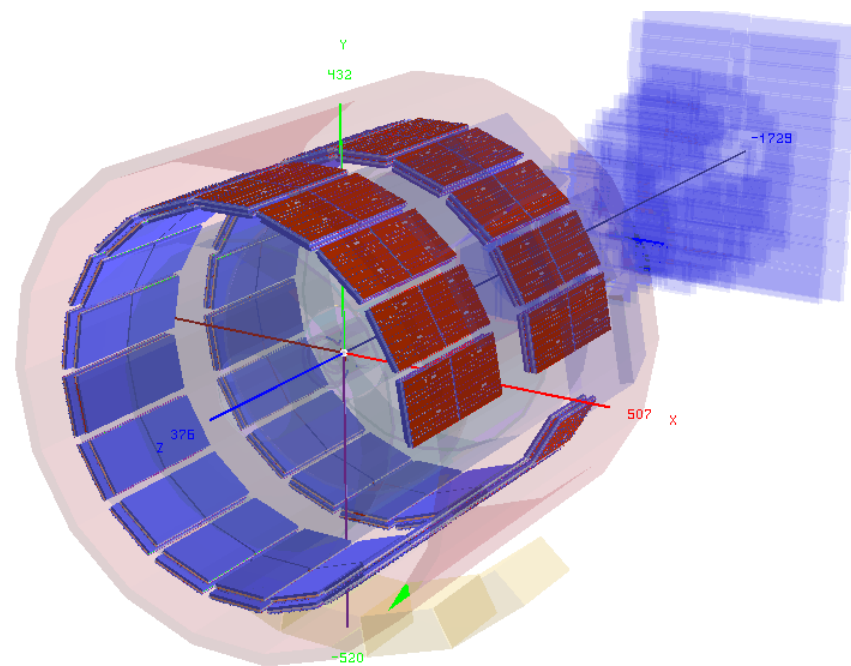
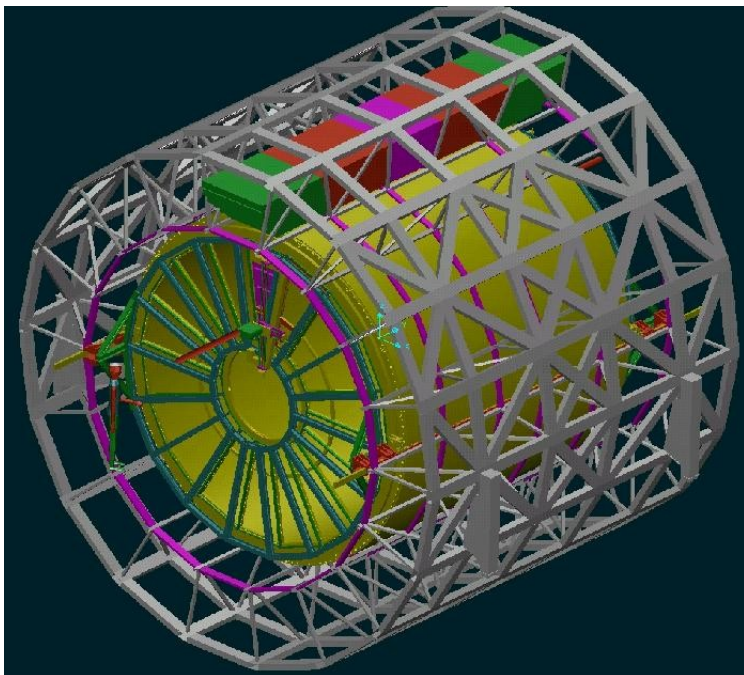
ALICE-TPC OROC tests

Long Term Test – exposure to High X-ray flux



It should be considered such a test also for TRD commissioning !

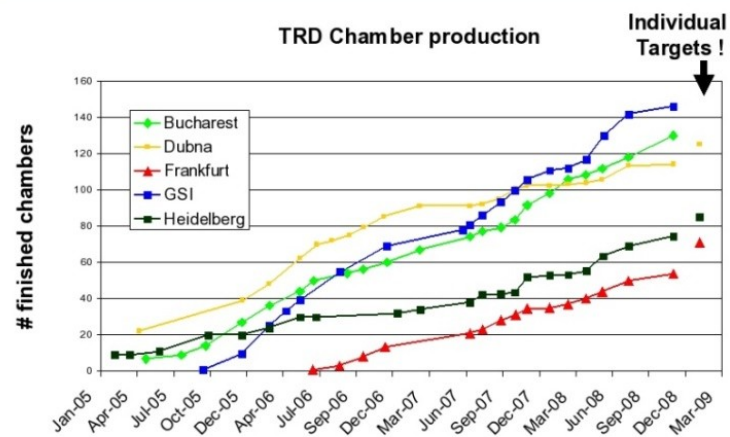
Construction of 130 (24%) out of 540 ALICE-TRD chambers



Constructed TRD chambers - 130:

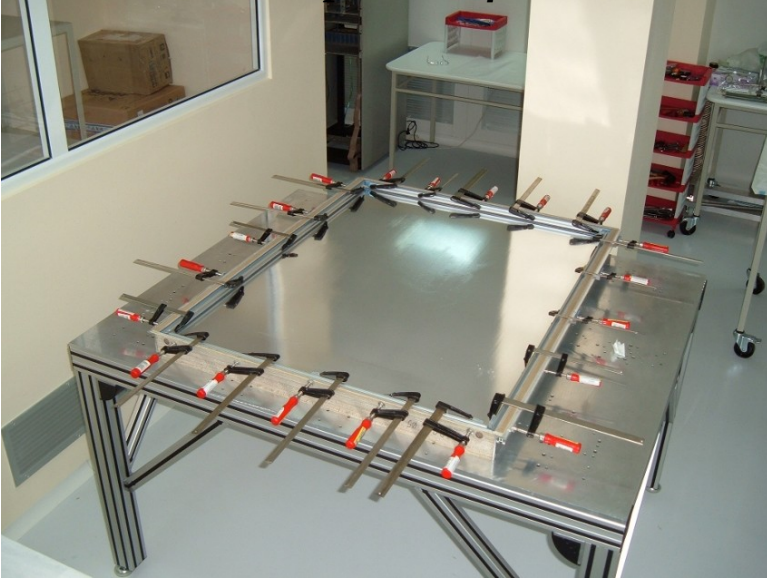
- 2 L1C0
- 1 L2C0
- 54 L2C1
- 73 L3C1

TRD Chamber Production



ALICE-TRD chamber construction

*Frame assembly on the gluing table
in 100000 particles/ft³ room*



*Pad plane assembling on the vacuum table
in 10000 particles/ft³ room*



*Multiwire electrodes winding
using winding machine*



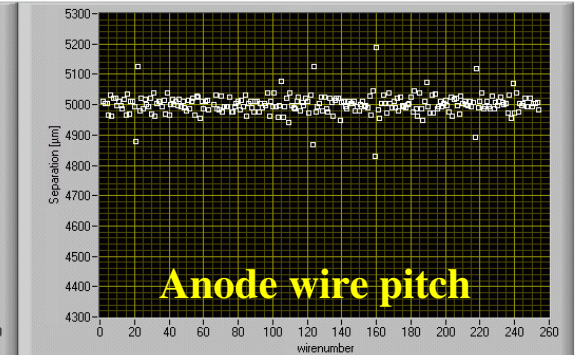
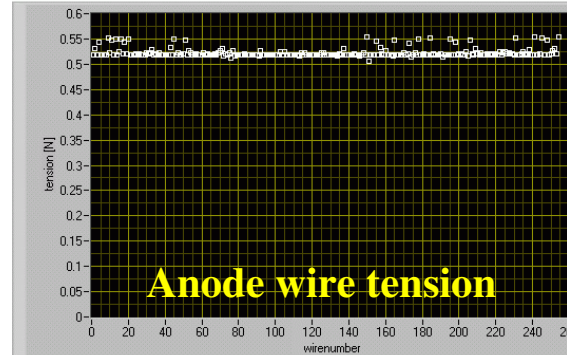
*Soldering of the electrical connections of the
multiwire electrodes in 10000 particles/ft³ room*



ALICE-TRD chamber tests

Anode tension (AT) ~ 50 cN
40 cN < CT < 60 cN

Anode L2C1-05
ResultsCHL2C1-05A_021705_0.txt



0 → Z

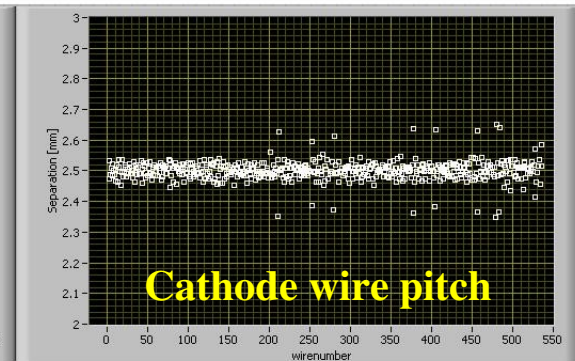
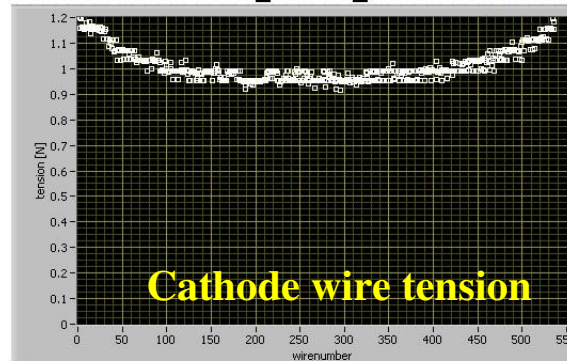
Wire tension & pitch measuring

10000 particles/ft³ room



Cathode tension (CT) ~ 100 cN
80 cN < CT < 120 cN

Cathode L3C1-47
ResultsCHL3C1-47C_051608_0



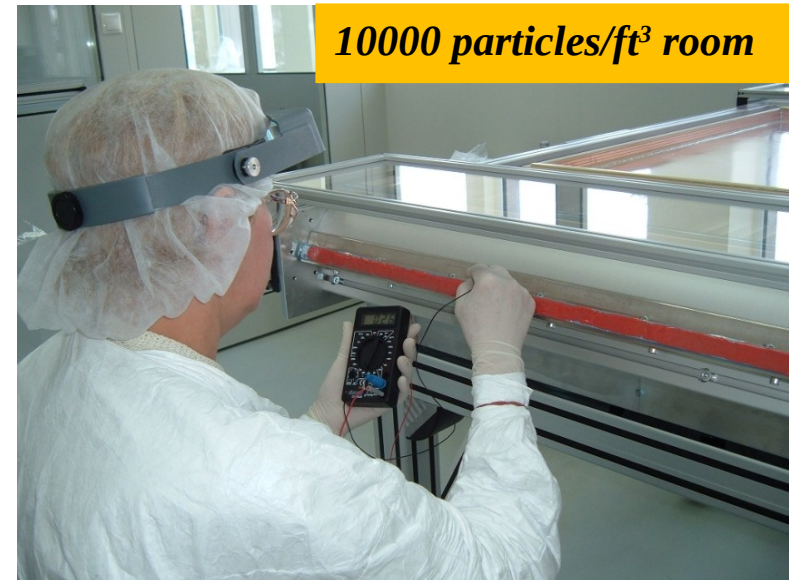
Z ← 0

ALICE-TRD chamber tests

Pad connectivity check



Checks of electrical connections of multiwire electrodes



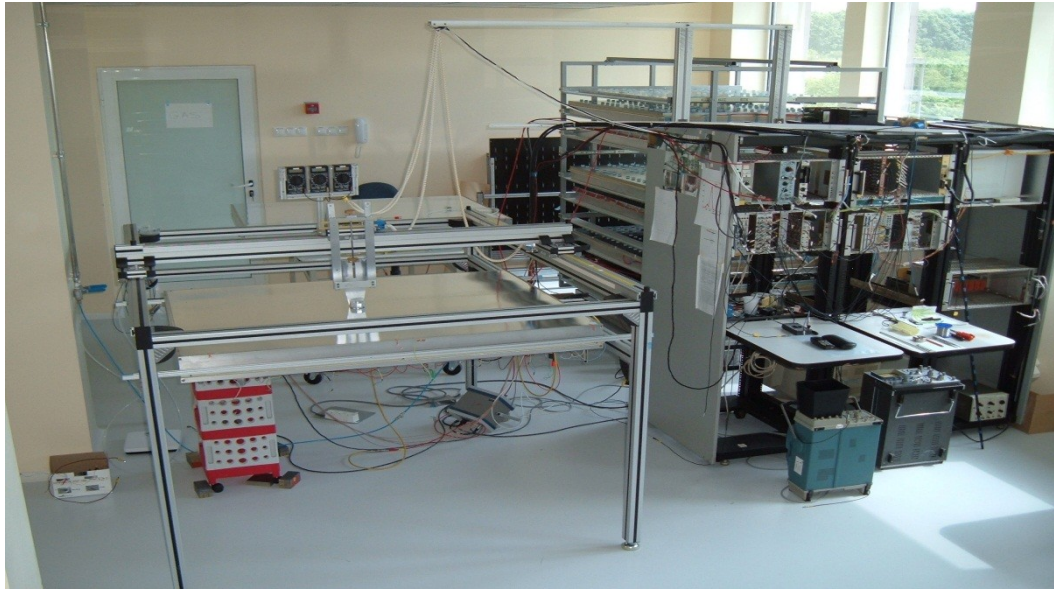
Gas leak rate test



Absolute gain, gain uniformity & energy resolution @⁵⁵Fe source



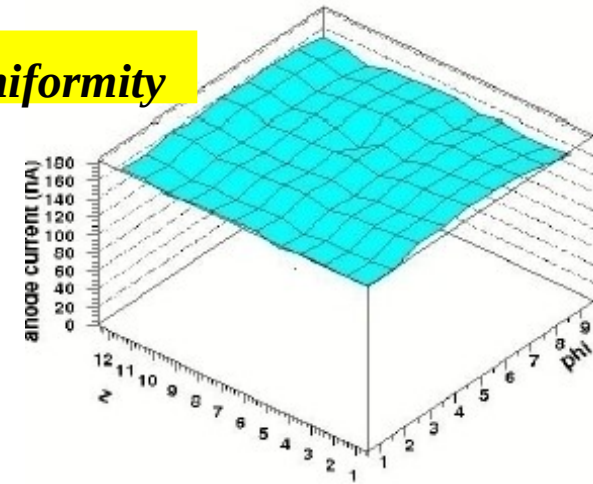
ALICE-TRD chamber tests



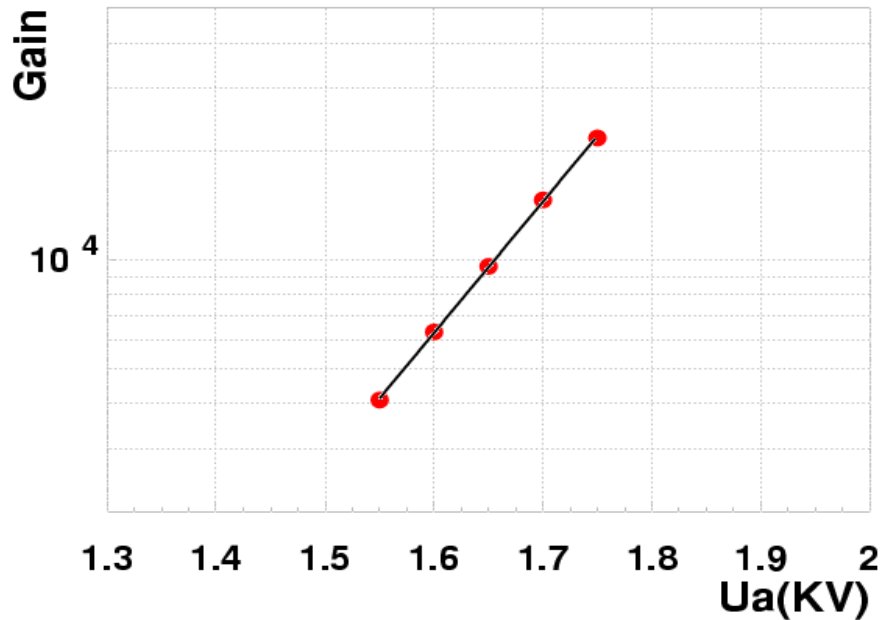
Dark current
Oxygen content

Oxygen = 15 ppm
 $I^{\text{dark}} = 1-2 \text{ nA}$
 70% Ar + 30% CO₂

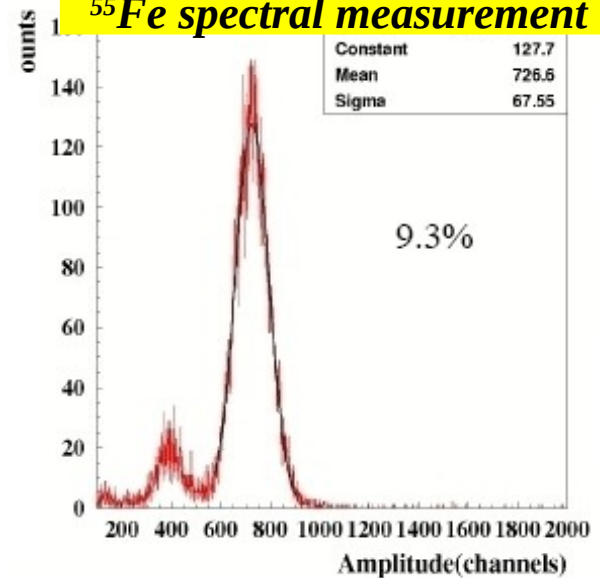
Gain uniformity



Absolute gas gain



⁵⁵Fe spectral measurement



***Some problematic issues encountered in
the mentioned activities***



Surface leakage currents

1. Jerky, unquiet, jumpy leakage from anode to pads, cathode or both.

- **Can usually be annealed with HV applied → need patience, time scale several hours to days**

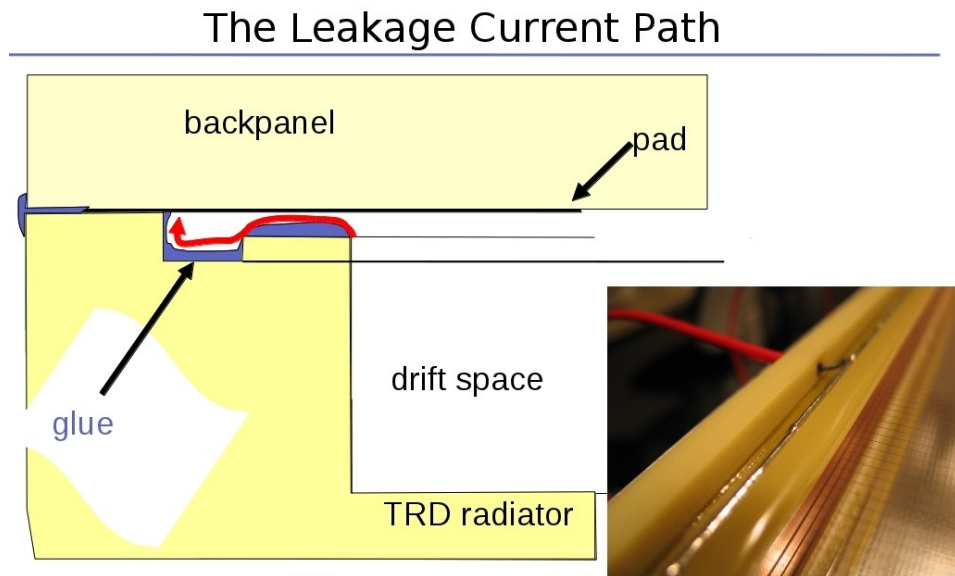
2. Leakage from anode to pads appears beyond a certain starting voltage and then happens to gradually increase to large, sustained, steady currents. Once established, it reproduces even upon repeated disconnection of the chamber.

- **Here, patience is of little help.**

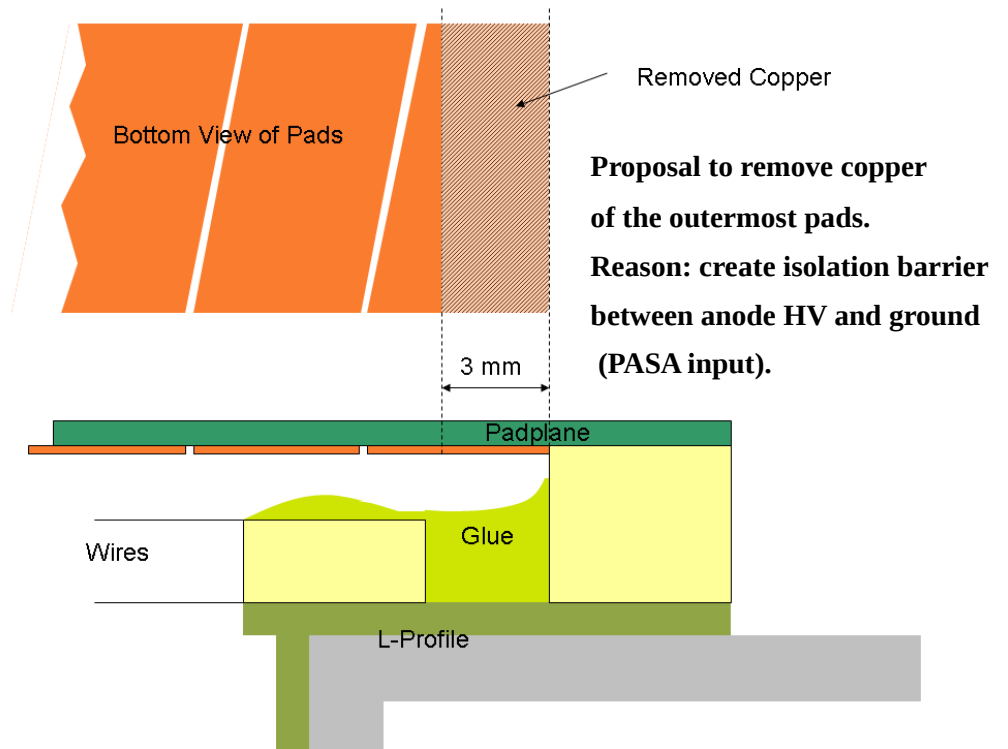
ALICE - TRD Production Status Meeting,
Heidelberg, Nov.25th 2005

More Glue issues?

- Recent dark current problems at Bucharest:
 - μA dark currents at 1300-1500 V in 2 chambers
 - Disappeared after some time.



Leakage current appeared after final gluing;
They were localized to pads that touch the frame;
“Sticky” surface of the glue.

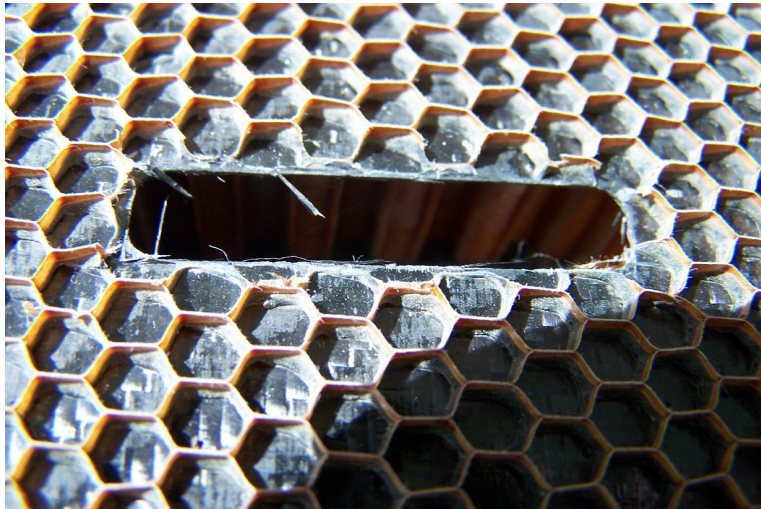
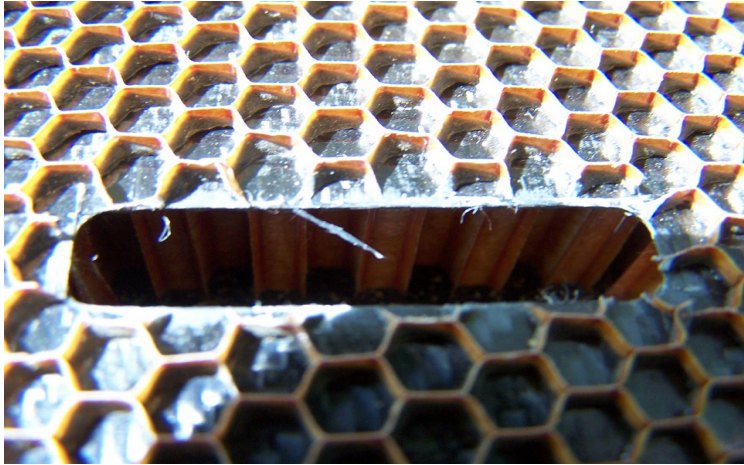


The resin and hardener were bought with quality certificate (mechanical and electrical properties)

ALICE - TRD Production Status Meeting GSI, 19.12.2005

'Grounded Pads'

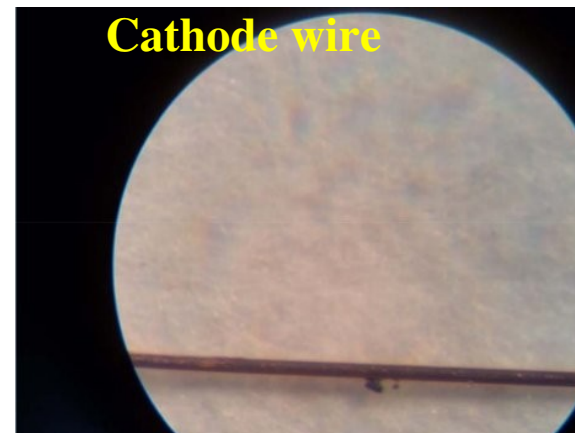
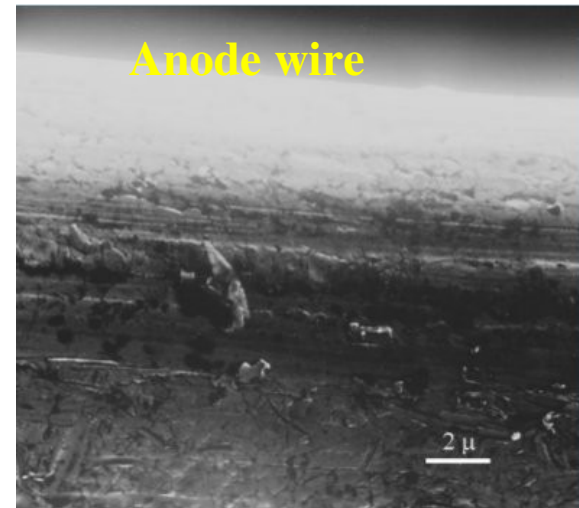
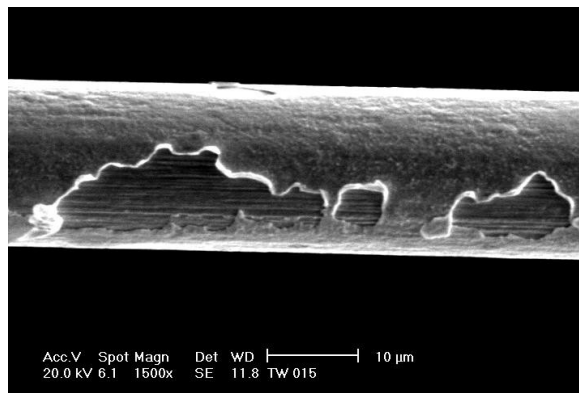
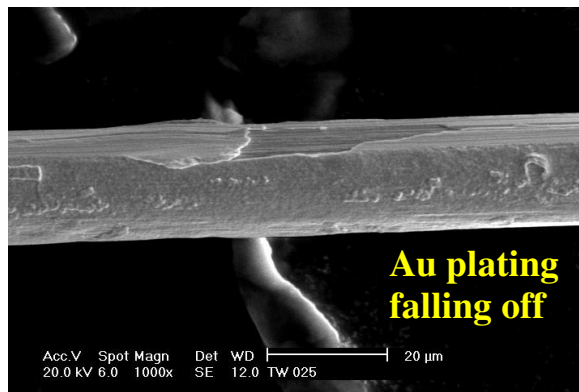
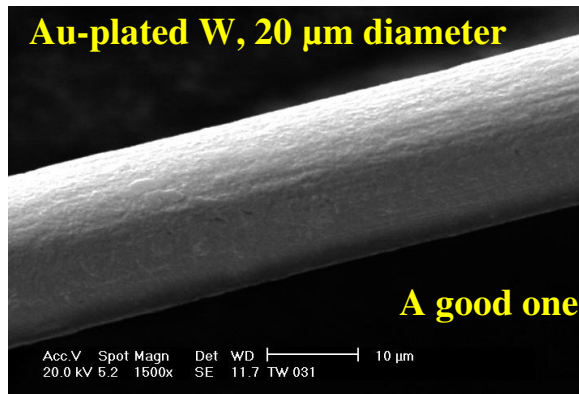
Cut-out of the back panel with fibers



- 3 Pad panels in Bucharest:
1 pad is connected to carbon of panel-> connected to PASA ground.
- 2 cases of connected pads discovered (only checked in Bucharest).

ALICE - TRD status meeting 15.05.2006
GSI, Darmstadt

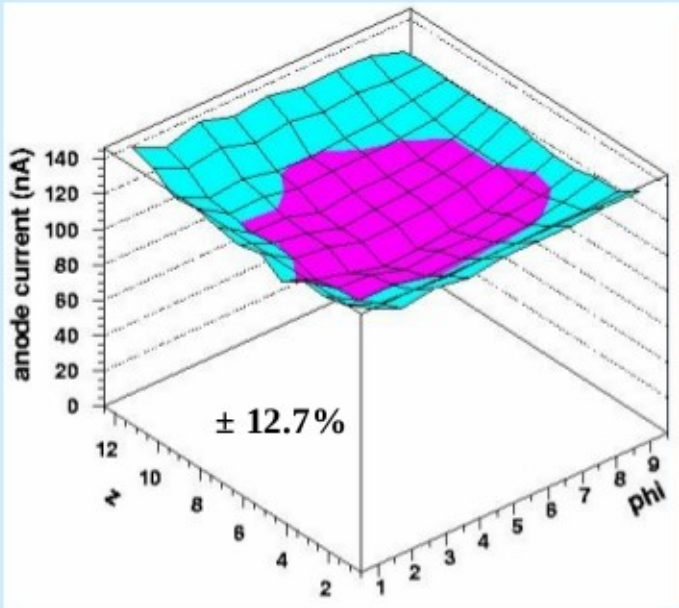
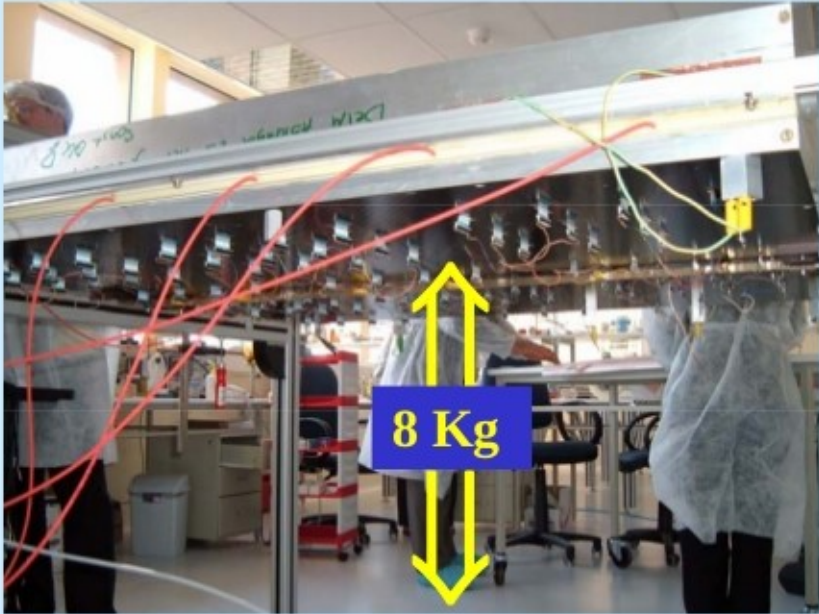
Anode and Cathode wire issues



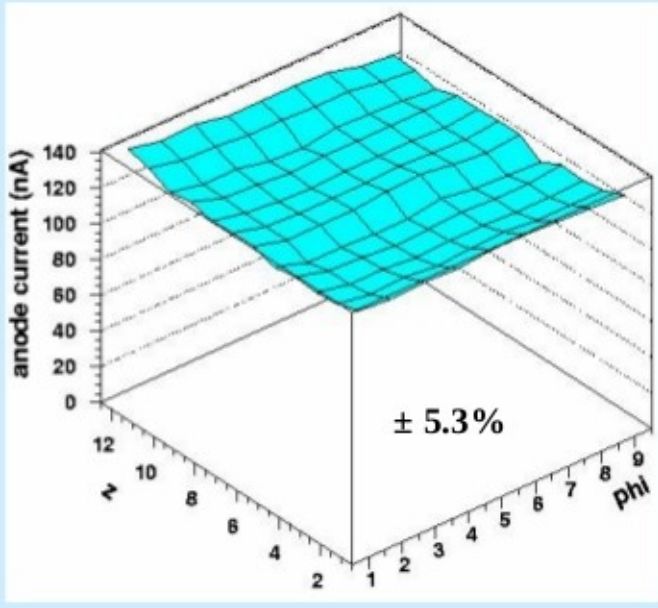
M. Petrovici, talk TRD Collaboration Meeting,
Cheile Gradistei, Romania, Sept.26-27, 2005

<http://www-alice.gsi.de/trd/gallery/wires/wires.html>

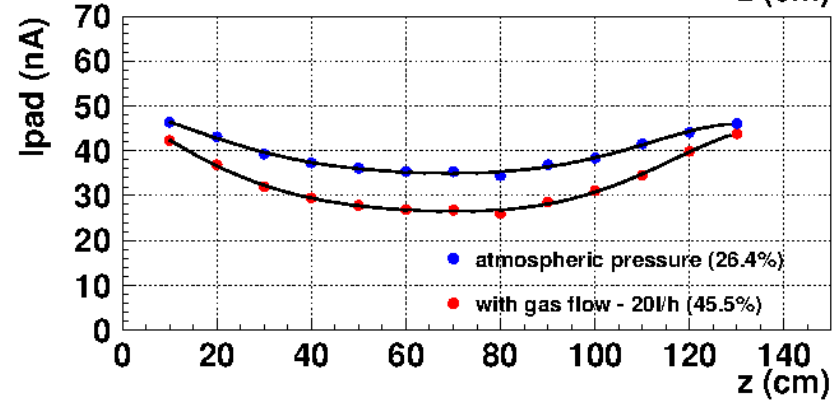
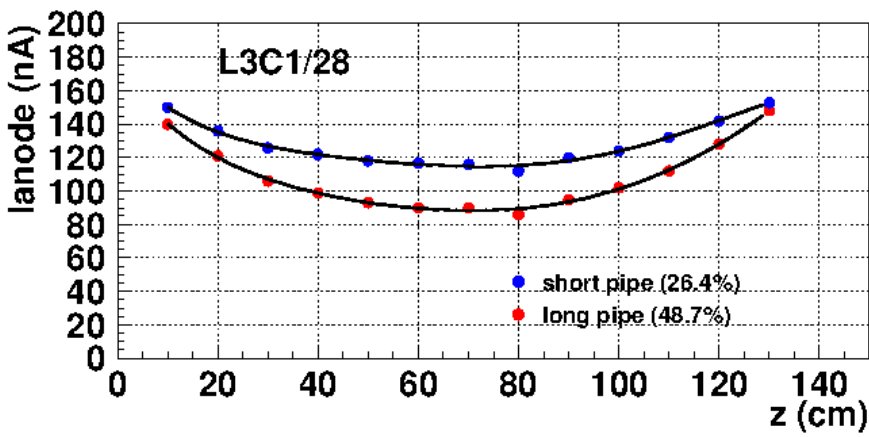
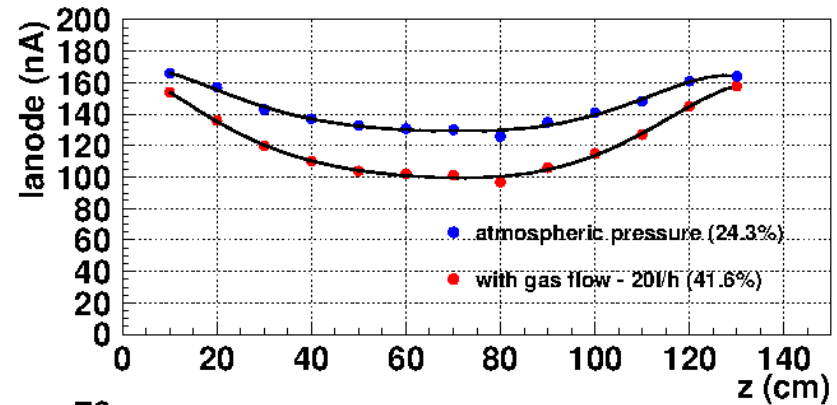
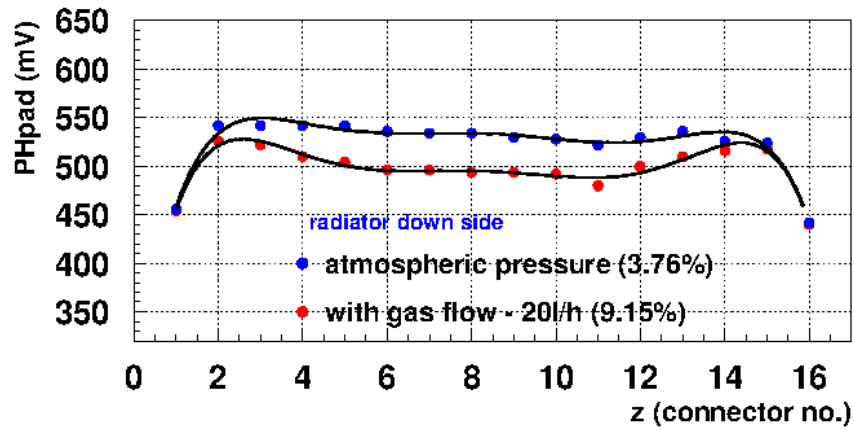
Gain non uniformity



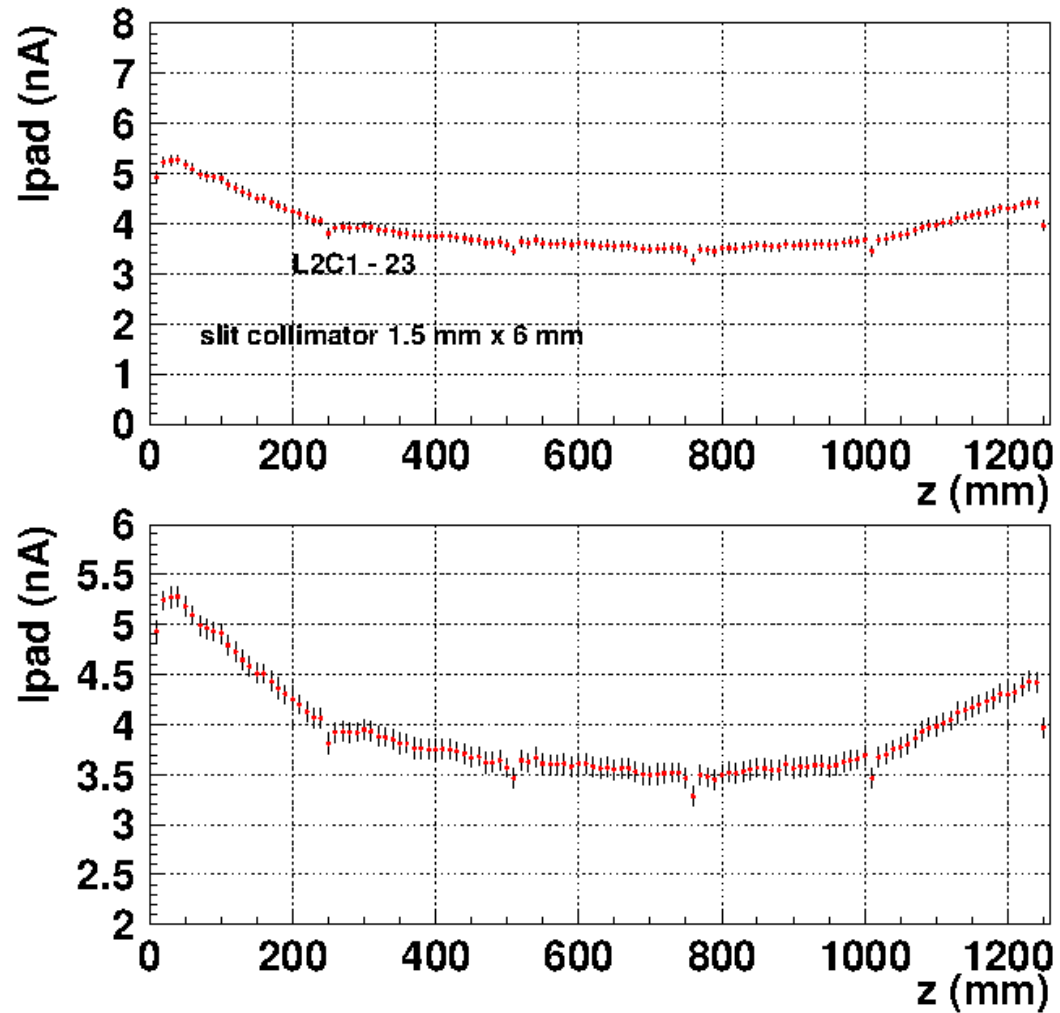
L2C1-32



Gain uniformity issues



Fine scan – anode wire connectivity



Summary

Each construction step has to be considered as critical for chamber operation:

- ✓ chamber body assembling -> tightness
- ✓ pad plane assembling -> tightness, flatness, pad connectivity ...
- ✓ chamber wiring -> alignment of the wire planes, gluing of the wire planes (no excess glue), wire soldering, cut of the wires (no leakage currents, no shorts), mechanical wire tension
- ✓ final chamber assembling-> close the chamber free of any 'dust'
- ✓ there are many other issues that we could share once the CBM-TRD assembling and testing will start.

For the developed activities we had assembling and commissioning protocols/manuals.

There is a saying quoted to different philosophers or/and politicians i.e. Edmund Burke, George Santayana, etc. :

“Learn from history or you're doomed to repeat it.”

Thank you for your attention!