46th CBM Collaboration Meeting

Oct 19 – 24, 2025

Institute of Modern Physics, Chinese Academy of Sciences

FAIR — Facility for Antiproton and Ion Research in Europe

TOF status

Ingo Deppner

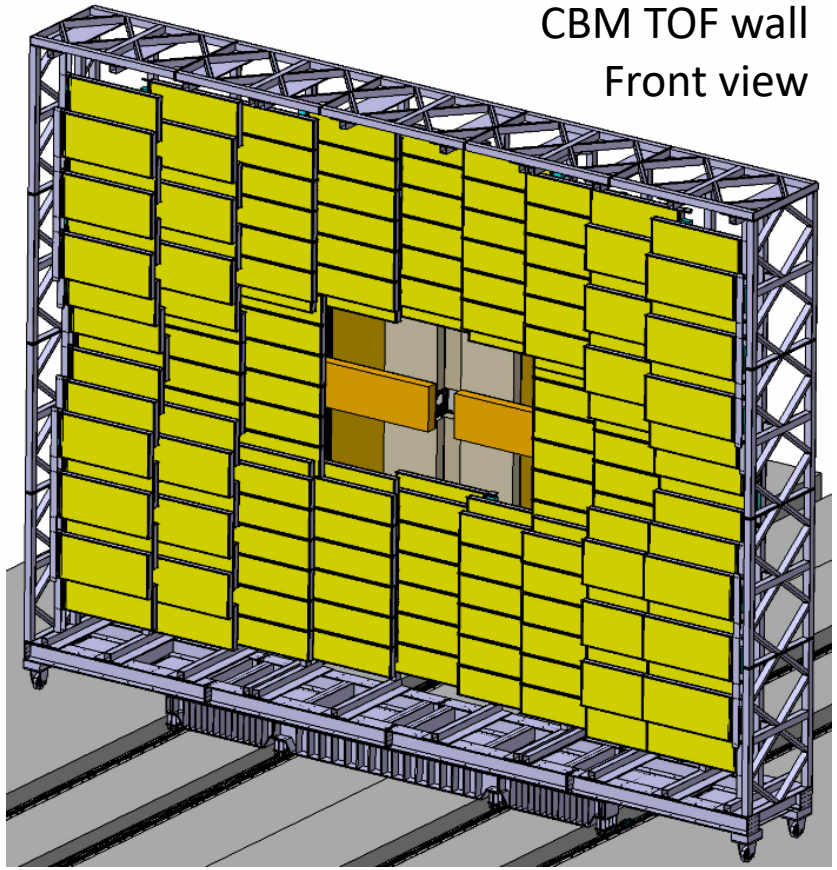
GSI Helmholtzzentrum für Schwerionenforschung GmbH

22.10.2025

Outline

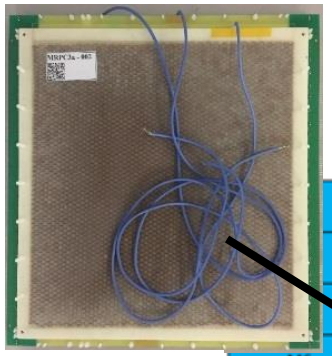
- Extremely brief introduction to CBM-TOF
- Status on counter production not discussed here

  (see talk by Kai, Mariana and Ming)
- Status - outer module production
- Status - Front End Electronics (FEE)
- Status – Firmware and DCS
- Status on beam time and cosmic test analysis
- Summary and time line

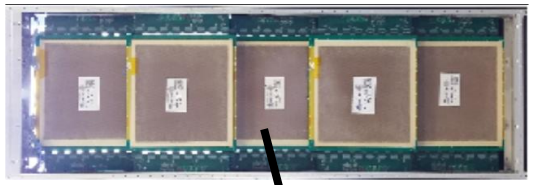


CBM TOF wall
Front view

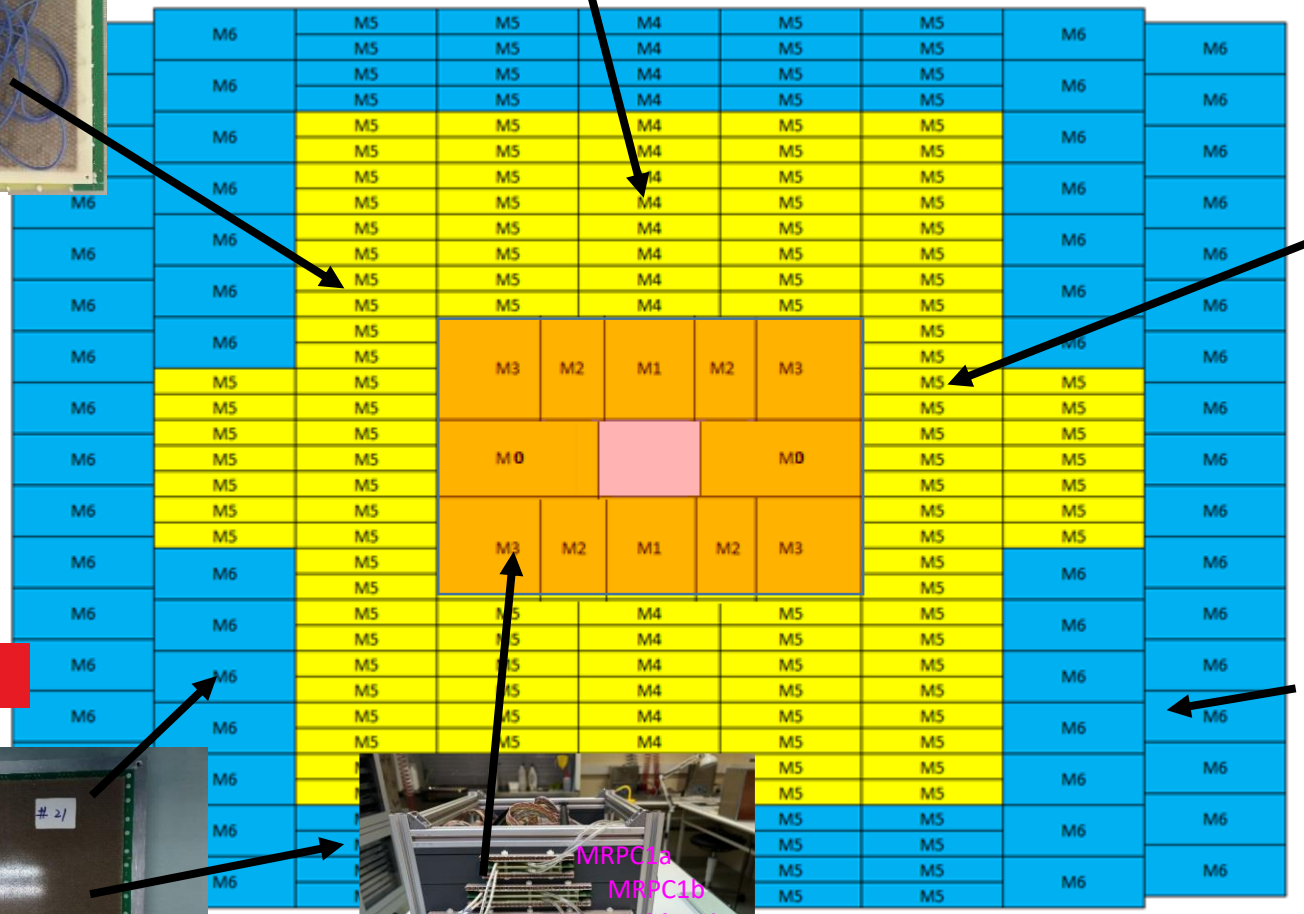
CBM TOF in the nut shell



MRPC2
(Tsinghua)



M4 Module
(Heidelberg (HD))



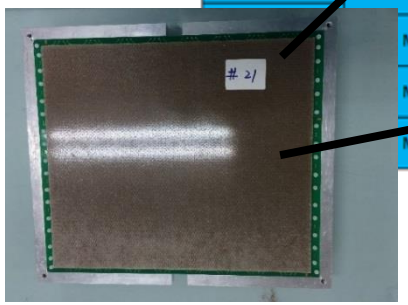
M5 Module (HD)

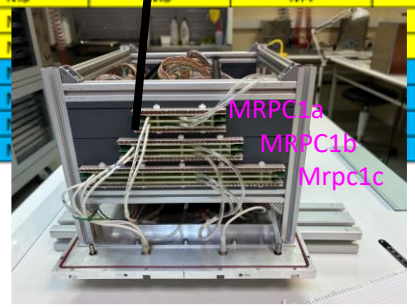
- **Active area**
  13.5 x 8,75 m² ≈120 m²
- **Full size counter with final design for all regions build and tested**
- **M4, M5 and M6 full size modules constructed and tested at mCBM**

≈ 230 modules
≈ 1400 MRPCs
≈ 90000 channels

M6 Module (HD)

MRPC3/4
(USTC)





MRPC1a - 1c
(NIPNE Bucharest)

Main Requirements

- Time resolution < 80 ps
- Efficiency > 95 %
- Rate capability up to 45 kHz/cm²

Status - Outer Module Production

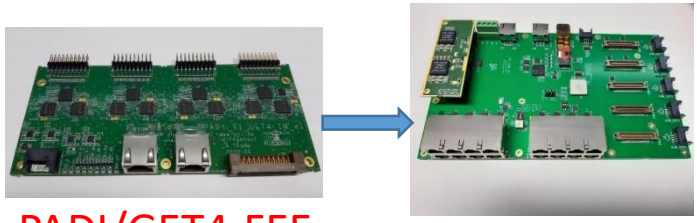
- In total 218 outer modules foreseen for CBM-TOF
- Counter for 50 modules produced
- 3 modules with final design in production
- Final QA tests (mounting stability, gas tightness)
- FDR after successful QA (Q4/25)
- 20 more modules boxes in production pipeline
  (a study to use manufacturing machines efficiently)
- Material for 50 modules procured
- Mounting strategies tested

Stability test in mockup frame

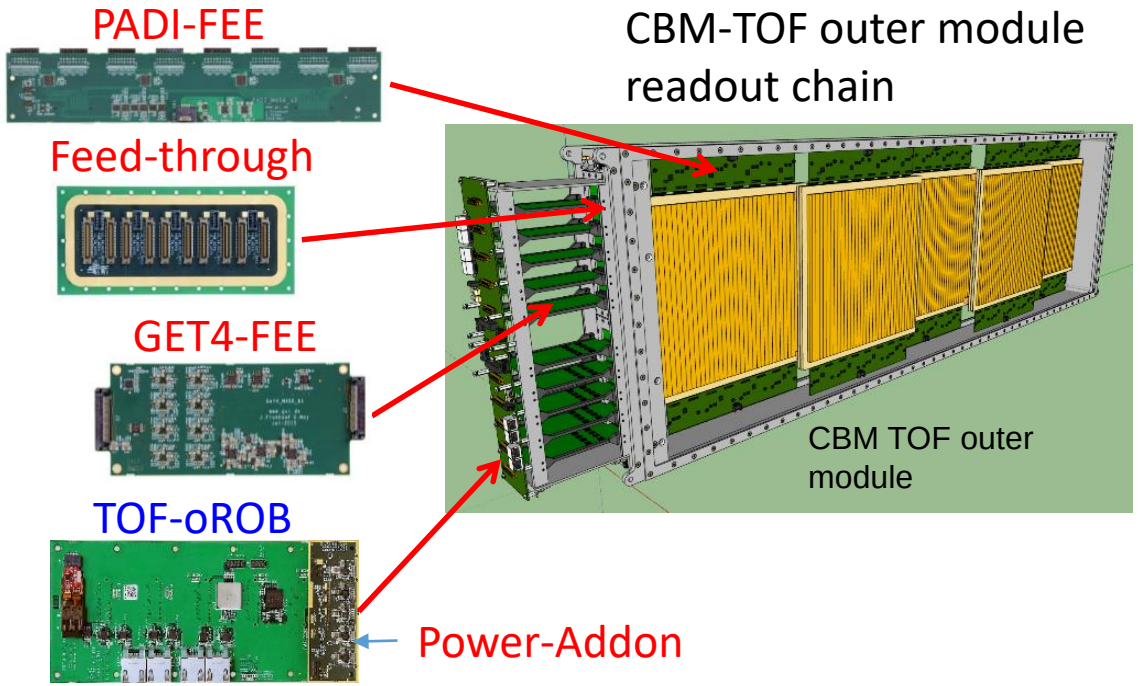
Status - Front End Electronics

- All FEE ASICs available
- All PRRs done
- 1st batch of electronic boards received (50 mod + sp.)
  - 600 PADI-FEE
  - 600 GET4-FEE
  - 120 Feed-through
  - 120 Power-Addon
  - 120 TOF-oROB
- QA for 1st batch almost finished
  For more Information see TB from 02.10.2025
- Next batches to be ordered in 2026/27

Inner TOF FEE



PADI/GET4-FEE TOF-iROB



Red: produced in China (CCNU)
Blue: produced in Germany

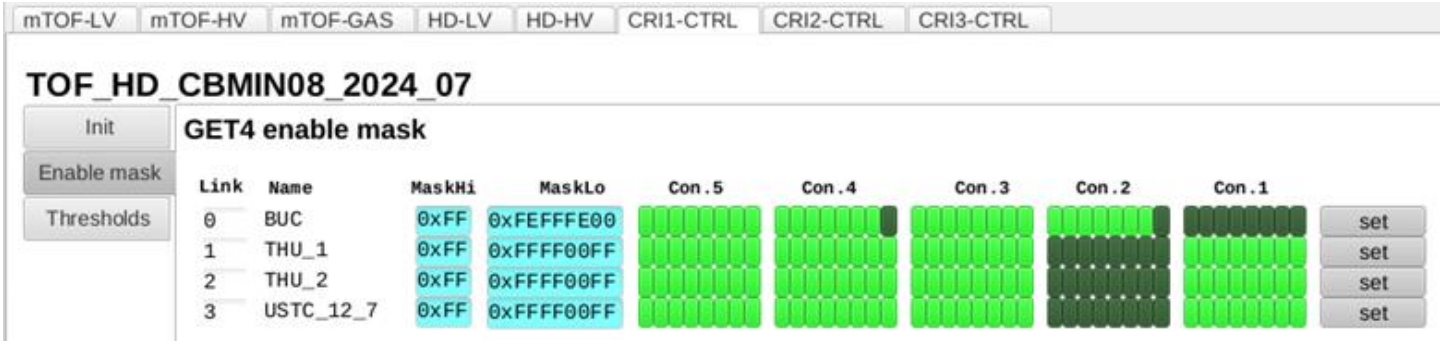
Status - Firmware and DCS

Firmware

- Already implemented
  - Full firmware functionality for the CRI1, tested under beam condition several times at mCBM
- TODO
  - Implement the FLIM Version 2 (4 links instead of 16), the data merger must be changed
  - Port the TOF firmware to the new CRI2
  - Lost thresholds recognition using Time Over Threshold values
  - Fast control, Alarms

DCS

- Already implemented
  - See DCS workshop in April 25 https://indico.gsi.de/event/21972/
- TODO
  - Alarms for HV, LV, RPC rates and GAS
  - EPICS IO server integration of HV power distribution Box and GAS system
  - EPICS clients in order to load/save/set values and limits for HV, LV, RPC Rates and Gas
  - Automatic security copies of the databases
  - Check the scalability of the EPICS servers (25 CRI, 4 HVPS, ...)



Status - Infrastructure

High Voltage (HV)

- HV-PS for full TOF purchased (CAEN)
- HV-Distribution box successfully tested, ordering process of components ongoing
- PRR in preparation

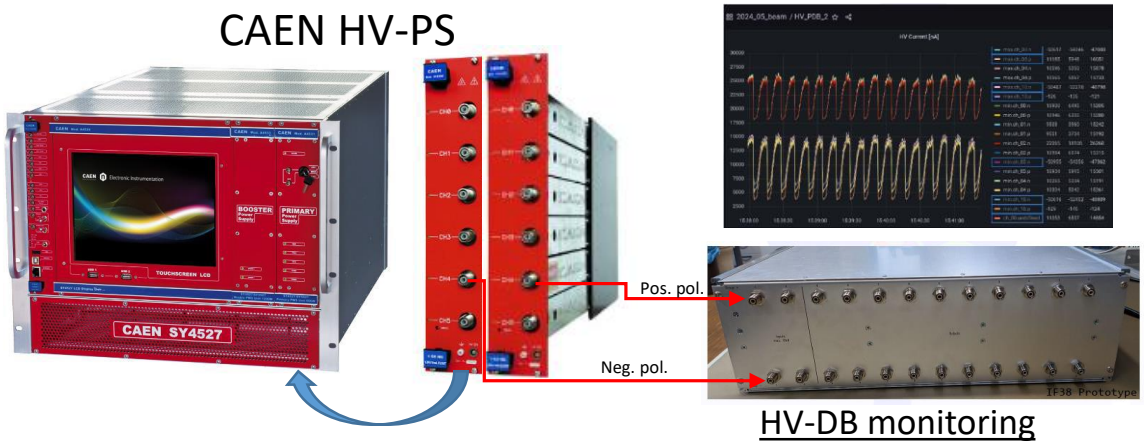
Low Voltage (LV)

- LV-PS for full TOF purchased (MeanWell 48V)
- LV-Distribution box successfully integrated in the cosmic test stand
- PRR in preparation

Gas system

- Gas system not addressed yet -> gas task force
- Development of gas recuperation system and purification system at Râmnicu Vâlcea/Romania
- Pilot installation for mCBM planed (first steps done)
- Funding for gas system not secured yet

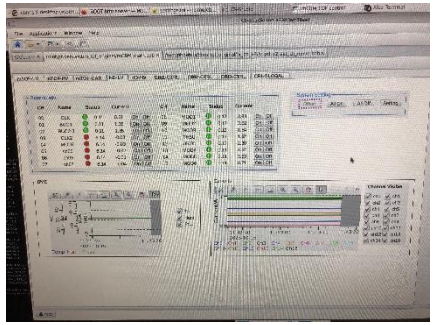
CAEN HV-PS

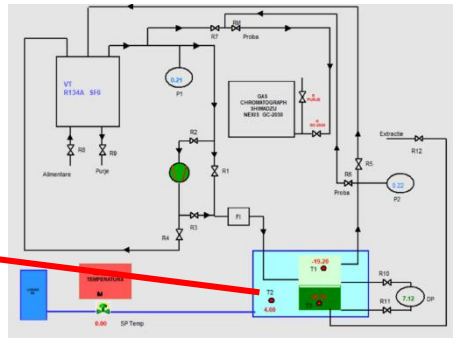


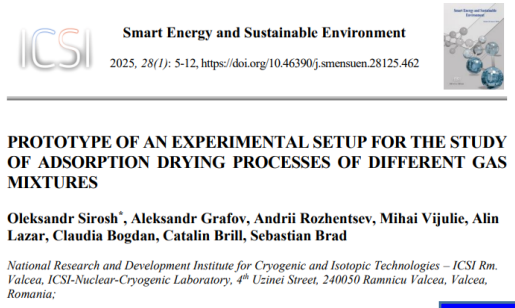
HV-DB monitoring

- 100 x higher current res.

LV distribution box (16 Ch.)







Smart Energy and Sustainable Environment

2025, *28(1)*: 5-12, https://doi.org/10.46390/j.smensuen.28125.462

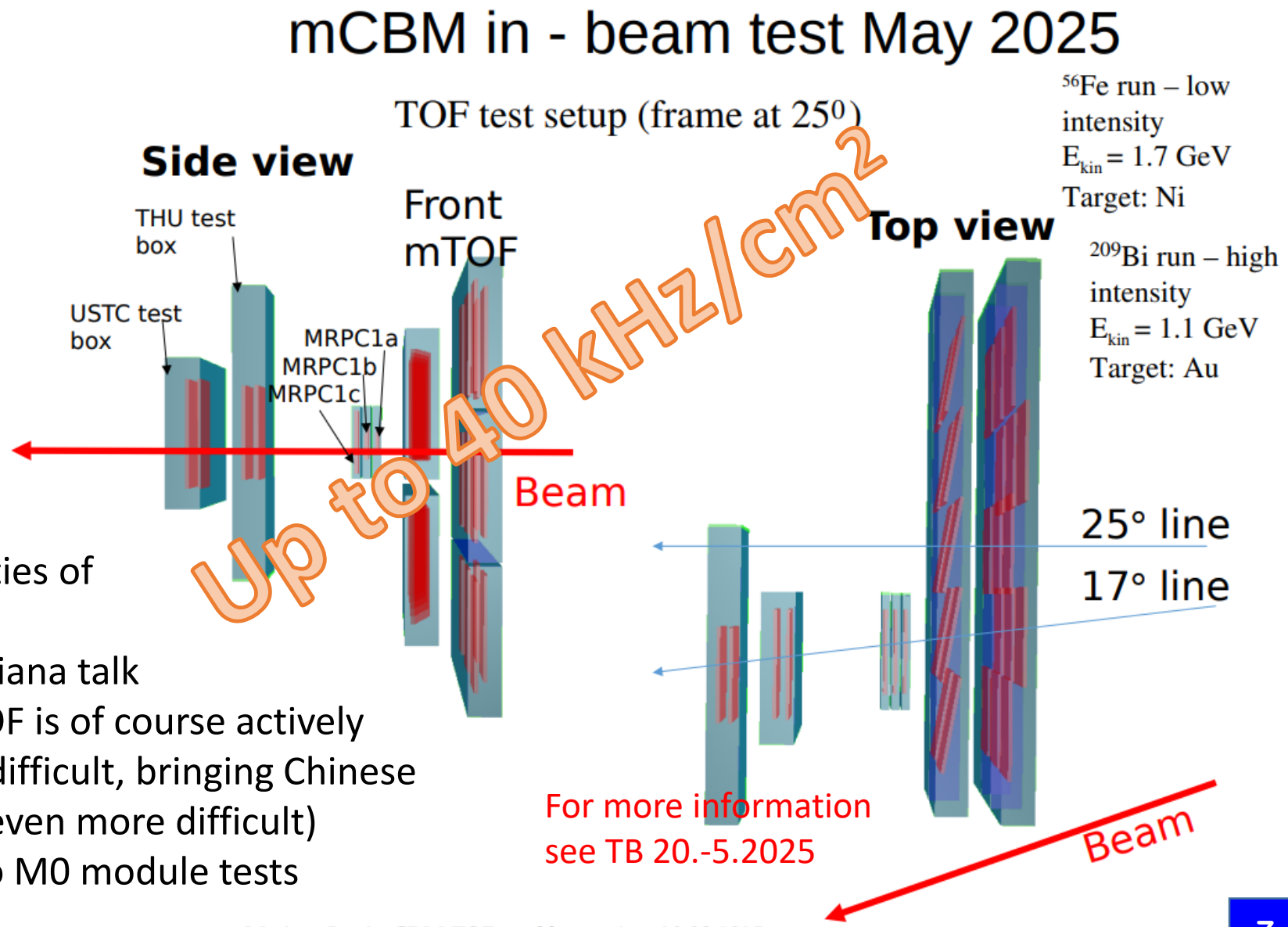
PROTOTYPE OF AN EXPERIMENTAL SETUP FOR THE STUDY OF ADSORPTION DRYING PROCESSES OF DIFFERENT GAS MIXTURES

Oleksandr Sirosh*, Aleksandr Grafov, Andrii Rozhentsev, Mihai Vijulie, Alin Lazar, Claudia Bogdan, Catalin Brill, Sebastian Brad

National Research and Development Institute for Cryogenic and Isotopic Technologies – ICSI Rm. Valcea, ICSI-Nuclear-Cryogenic Laboratory, 4th Uzinei Street, 240050 Ramnicu Valcea, Valcea, Romania;

Beam time in May 2025

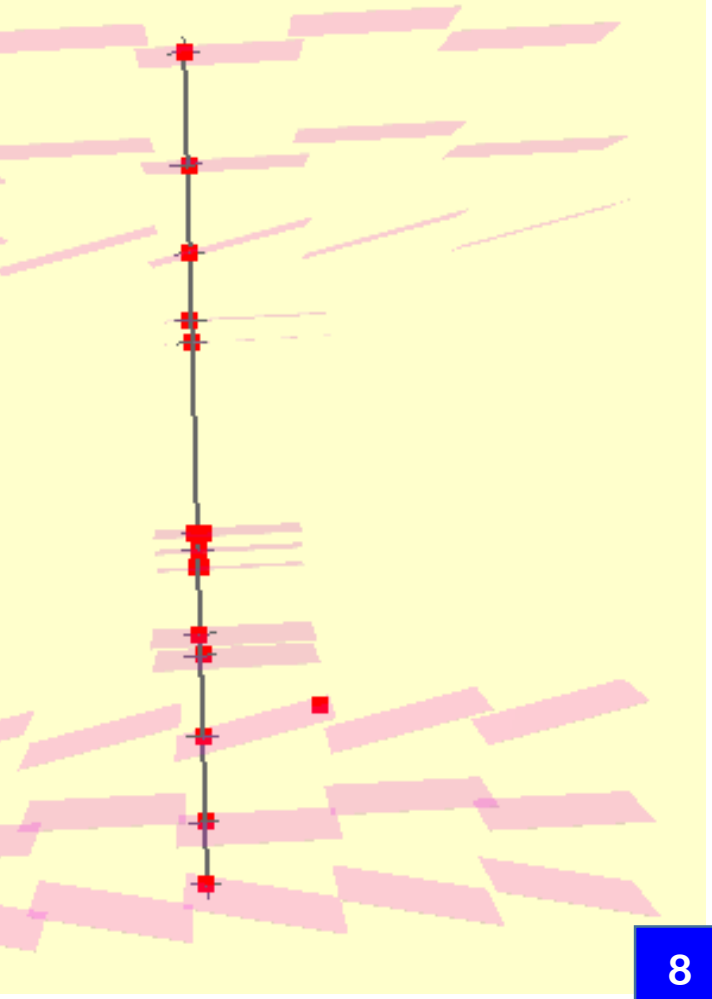
- Data analysis (still) ongoing – majorities of runs not analyzed yet
- First results will be presented in Mariana talk
- More human recourses required - TOF is of course actively searching (data analysis from China difficult, bringing Chinese students to GSI is in the meanwhile even more difficult)
- Beamtime in 2026 mainly devoted to M0 module tests (M0 build by Bucharest)



Cosmic setup in Heidelberg

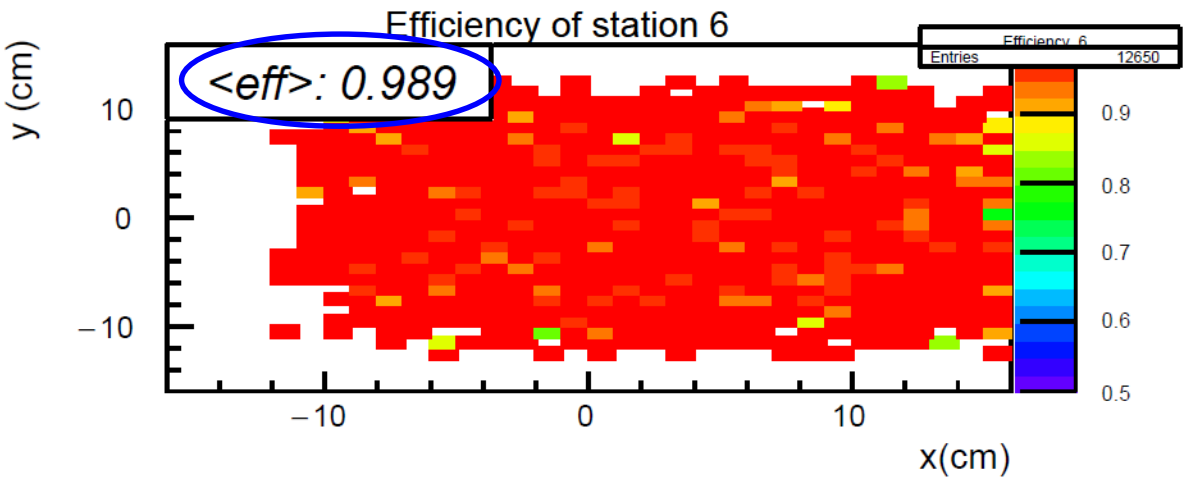
- 6 full size modules (ref.)
- 2 MRPC1a (Buc.)
- 1 MRPC1b (Buc.)
- 1 MRPC1c (Buc.)
- 1 MRPC2 test box (THU)
- 1 MRPC3 test box (USTC)
- 38 MRPCs in total
- 2432 channels
- Event selection FAIR MQ based
- About 10000 good tracks per day for counter performance evaluation

A real cosmic event
with hit multiplicity 13

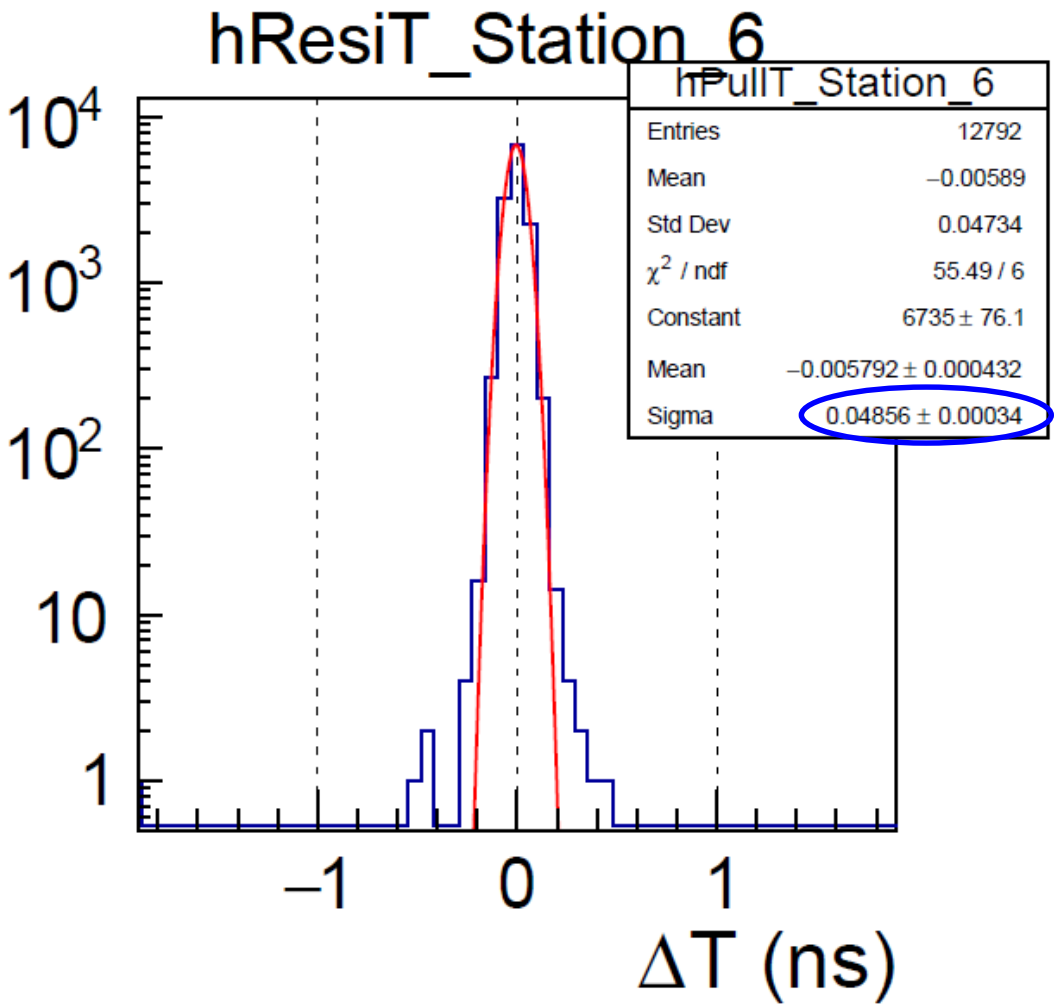


Cosmic setup in Heidelberg

Efficiency – Dut: MRPC3 (USTC)

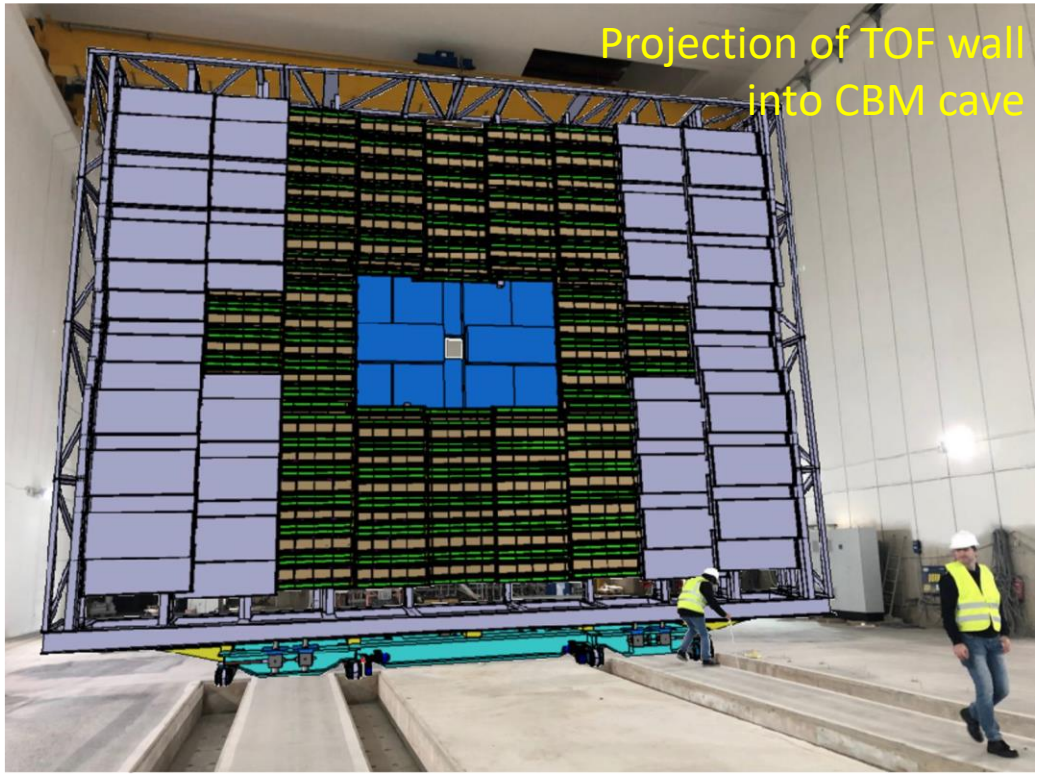


Time resolution – Dut: MRPC3 (USTC)



Summary and Time line

- Module production started (FOS ready for tests)
- Counter for 50 modules produced
- Material for 50 outer module boxes procured
- 20% of FEE produced, QA almost finished
- Firmware and DCA is on the right track
- HV/LV system elaborated (ready for FDR)
- Gas systems needs more attention
- Analysis of beam time data ongoing but sluggish
- Cosmic stands at HD operational



Time line and major milestones

✓ Counter production start (China): 07/2024

➢ Outer module PRR Q4/25

➢ PRR for MRPC1a-c (Bucharest) Q1/26

➢ Main frame FDR Q2/26

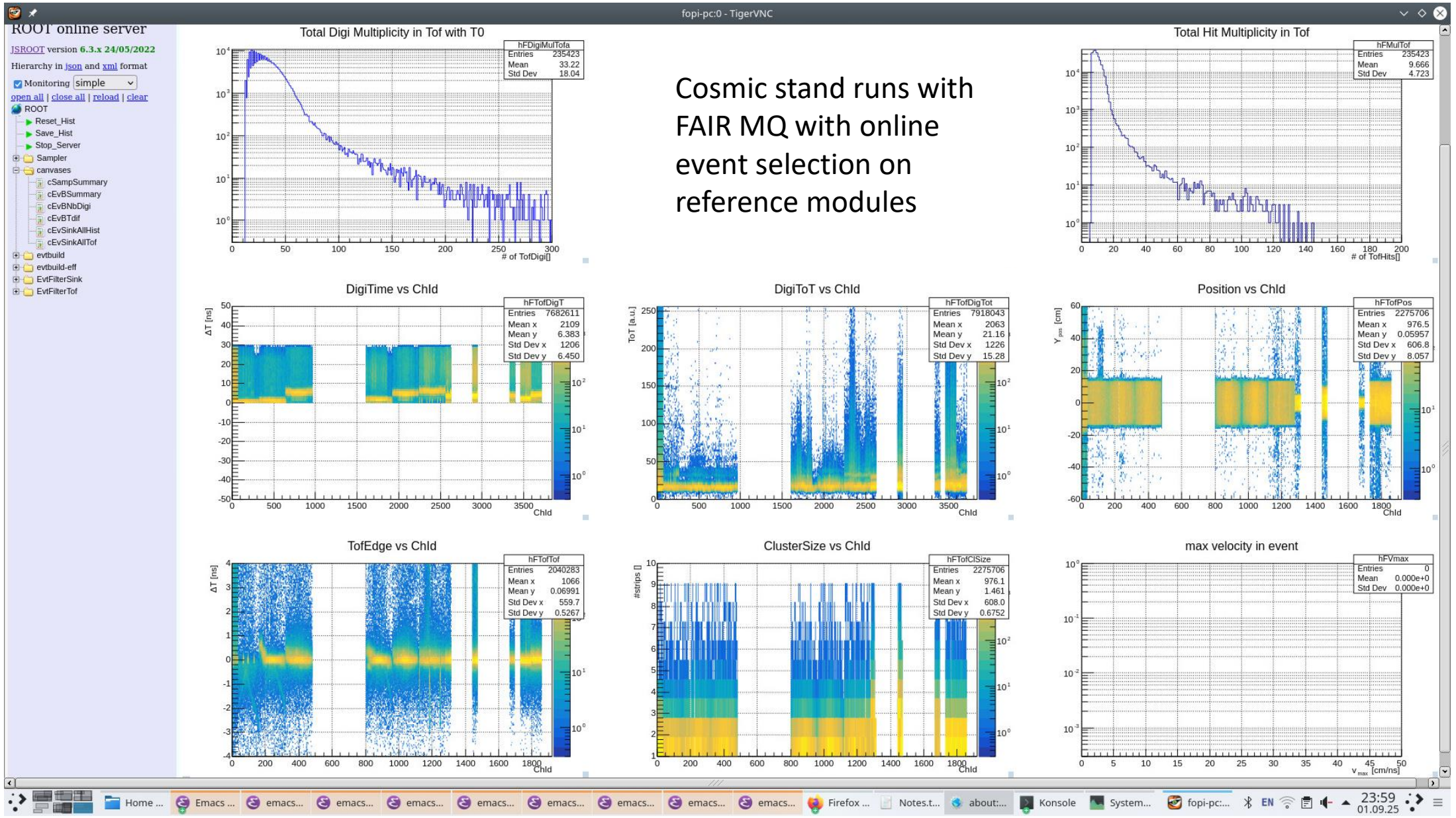
➢ TOF ready installed: end of 2027 (in line with FAIR schedule)

Thank you for your attention

Contributing institutions:

Tsinghua Beijing,
NIPNE Bucharest,
GSI Darmstadt,
USTC Hefei,
PI Heidelberg,
CCNU Wuhan,

Cosmic setup in Heidelberg



Cosmic stand runs with FAIR MQ with online event selection on reference modules