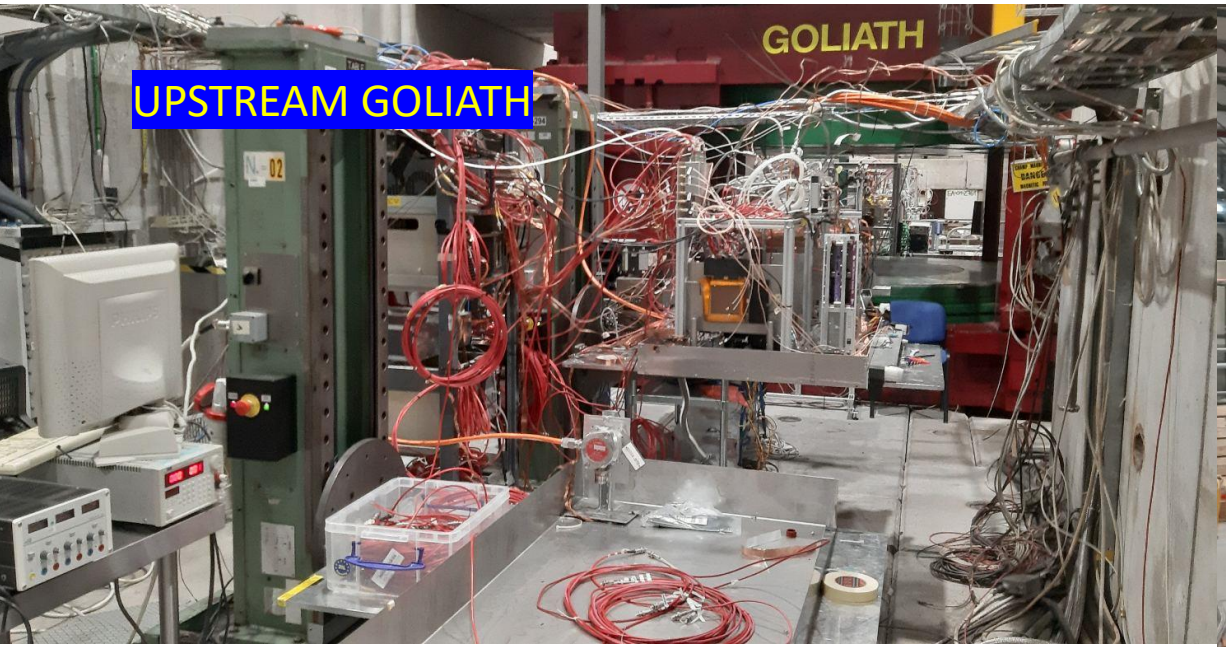
DRD1-WG7: Common Test Facilities
Status Report of the SPS/H4 “playground”
(runs in parallel with EURO 2024)

TB1: 10 – 24 April 2024
TB2: 26 June – 10 july 2024
TB3: 18 Sept. – 2 Oct. 2024

Y.Tsipolitis

K.J.Floethner ↑

E. Oliveri ↓



DRD1 H4(PPE134) 2024 Test Beam

Generic and Application driven R&D

- **Technologies:** Micromegas, uRWELL, uRGroove, GEM
- **Application:** High Rate, Timing
- **Readout:** Capacitive Coupling, Resistive Sharing

Project driven R&D

- **CMS ME0**

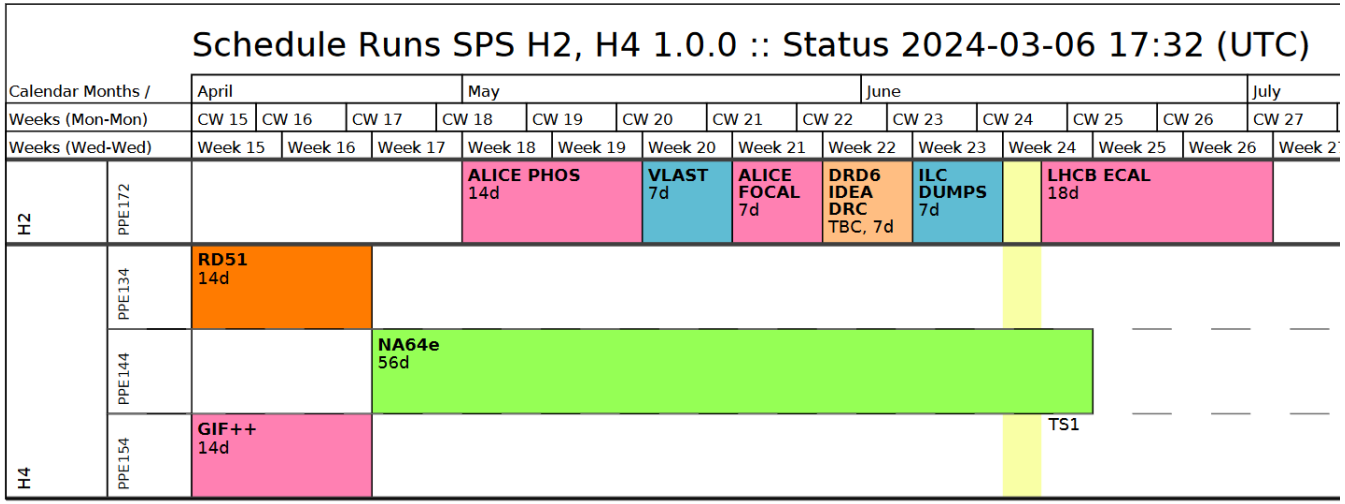
Detector Commissioning

- **Twin TPC for MIXE**

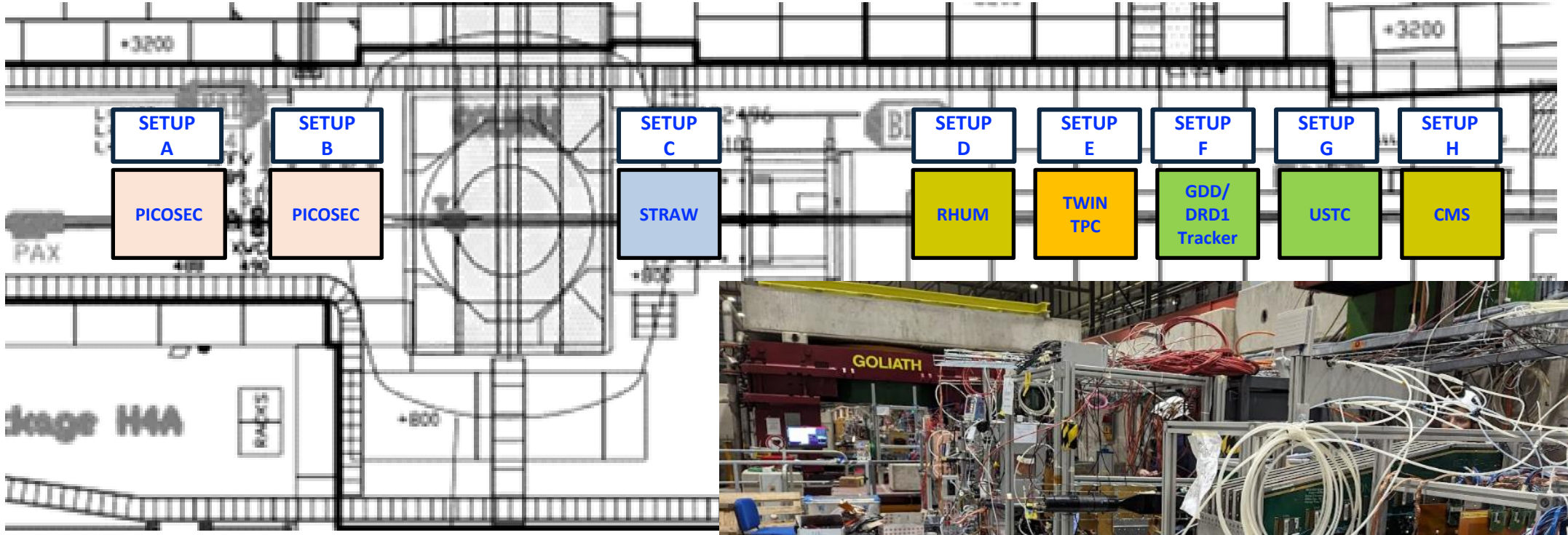
FE electronics and DAQ

- **Straw, VMM3a and TPC**

Wed. 10/04/2024 – Wed. 24/04/2024



Setups (8)



- SETUP A, B: PICOSEC (F. Brunbauer, M. Lisowska)
- SETUP C: STRAW (T. Enik, K. Kuznetsova)
- SETUP D: RHUM (M. Iodice, G. Sekhniaidze)
- SETUP E: TWIN TPC (F. Garcia Fuentes)
- SETUP F: GDD/RD51 Tracker (K. Floethner)
- SETUP G: USTC (Y. Zhou)
- SETUP H: CMS ME0 (A. Pellecchia, P. Everaerts)

PICOSEC Micromegas – April 2024

- **PICOSEC Micromegas** – a gaseous detector that aims at reaching a time resolution of **tens of picoseconds**
- **Objective:** Robust multi-channel detector modules for large-area detection systems requiring good time resolution
- **Experimental setup:** tracking/timing/triggering telescope: GEMs + MCP PMT + PICOSEC MM detectors
- **Test beam campaign April 2024 measurements**:

→ Single-pad photocathodes studies (CERN,CEA,Bari): CsI with Cr/Ti, DLC, nanodiamonds → DLC σ ~ 31 ps

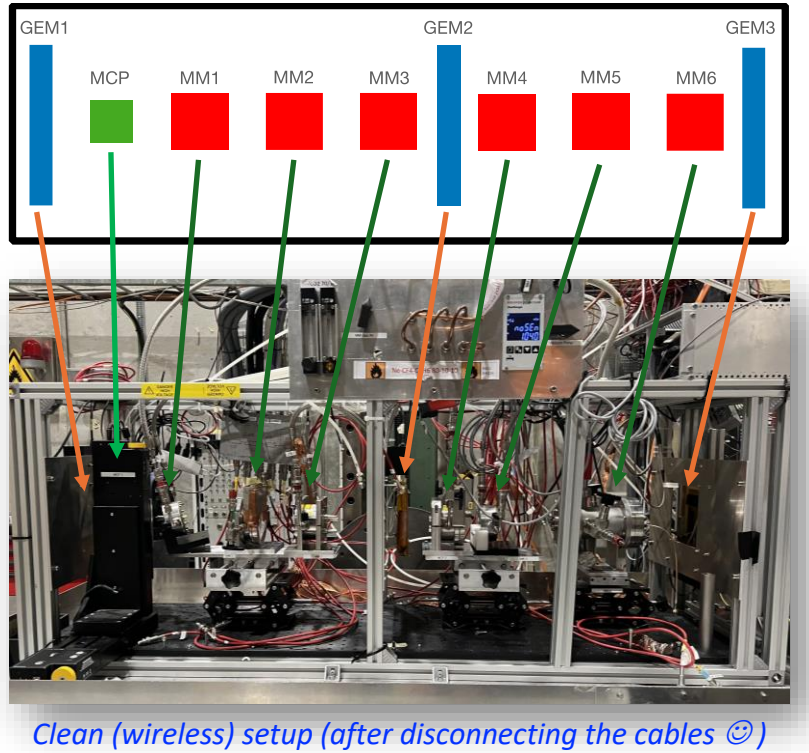
→ Single-pad resistive MM (CERN,RB): 20 MΩ/□, 10 + 15 mm dia. → **10 mm MM + CsI time resolution σ ~ 12 ps**

→ Single-pad uRWELL (JLAB): 7 different prototype geometries tested with CsI photocathodes → σ ~ 23 ps

→ Large area detector (USTC): 20x20 cm^2 MM with different photocathodes: DLC, B_4C, CsI → with CsI σ ~ 25 ps

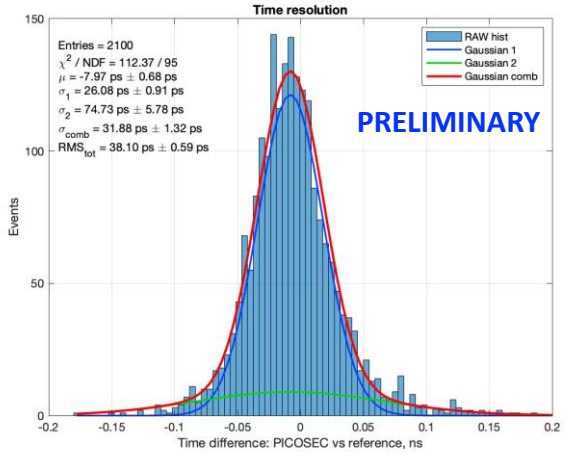
→ Gas studies: Ne/Iso mixture at different ratios as an alternative to the std gas Ne:CF_4:C_2H_6 (80:10:10) → σ ~ 17 ps

→ New readout electronics(CERN,RB,SBU): integrated preamp on the outer PCB → σ ~ 14 ps, DRS4 v5 12bit, 5GS/s

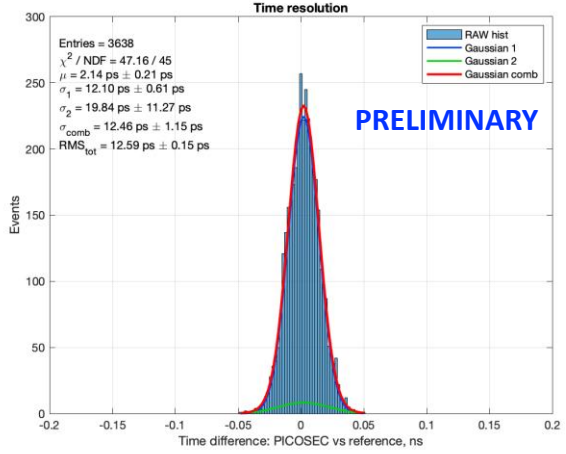


Clean (wireless) setup (after disconnecting the cables ☺)

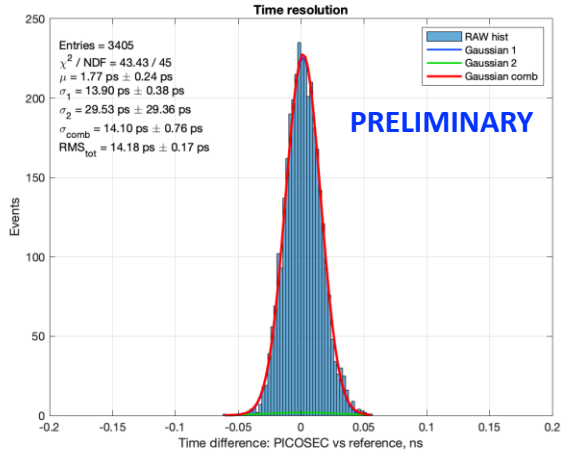
Single-pad + DLC photocathode **σ ~ 31 ps**



Single-pad resistive MM 20 MΩ + CsI **σ ~ 12 ps**



Single-pad + CsI + integrated preamp **σ ~ 14 ps**

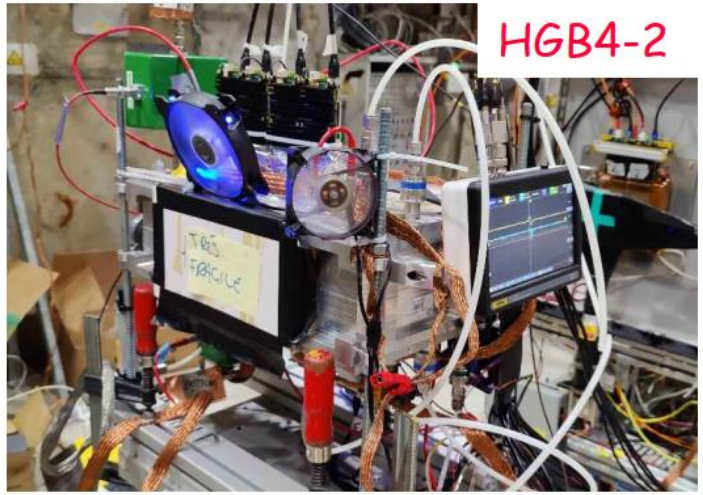


The Ultra-low Material Budget GEM-TPC in Twin

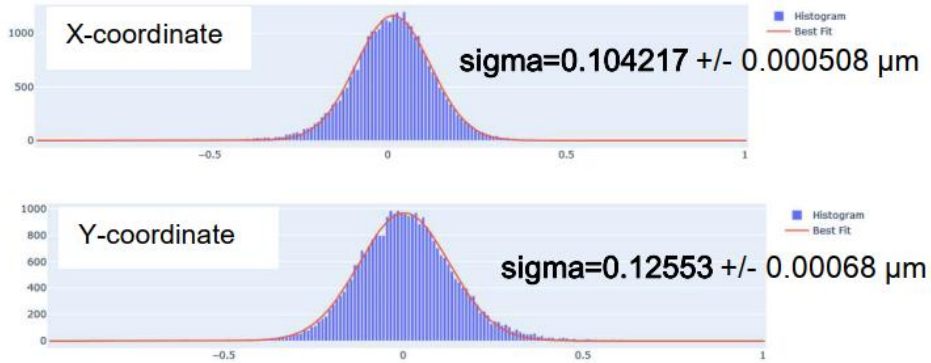
F. García, K. Floethner, M. Heiss, M. Meurer, E. Oliveri, L. Scharenberg, B.Zeh, X. Zhao

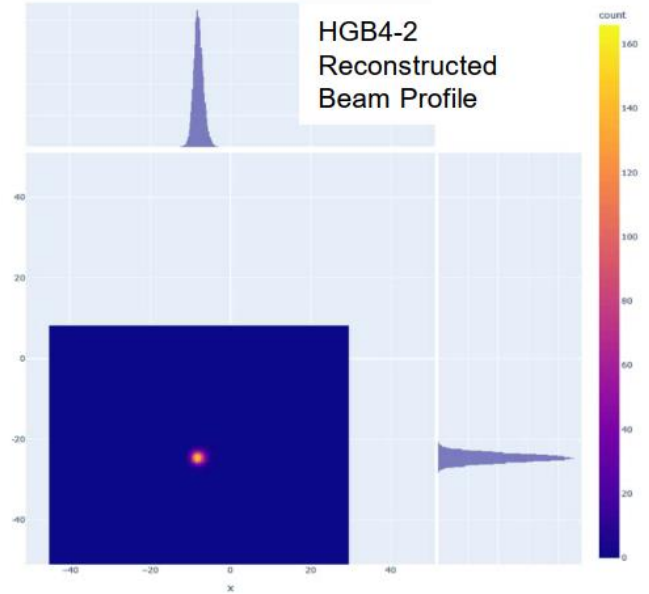
PHYSICS PROGRAM

$ArCO_2$(70/30)	$HeCO_2$(90/10)	$HeCO_2$(70/30)
-	Field scans 240 – 345V/cm	-
Muons	Muons	Muons
Pions	Pions	Pions
Rate scans ~100k – 10M per spill	Rate scans ~100k – 10M per spill	Rate scans ~100k – 10M per spill
Entrance window beam scan	Entrance window beam scan	Entrance window beam scan



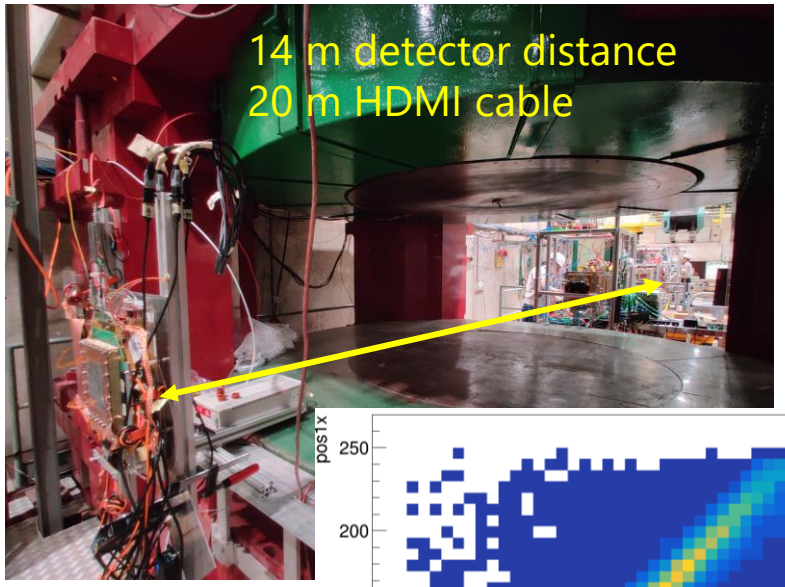
Pion beam @ 370k per spill in $HeCO_2$ (90/10)

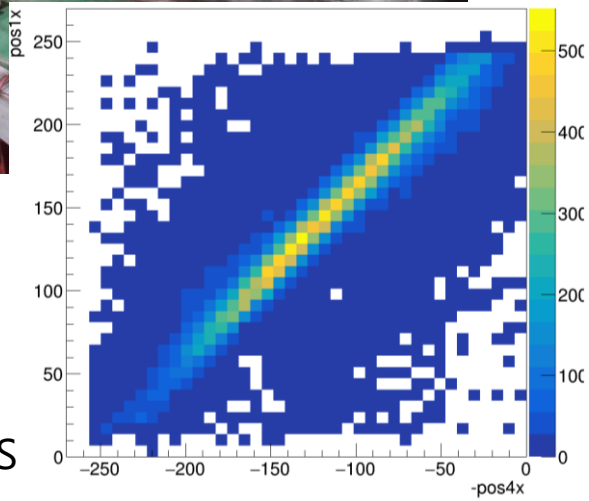




RD51/DRD1 VMM3a/SRS beam telescope: April 2024

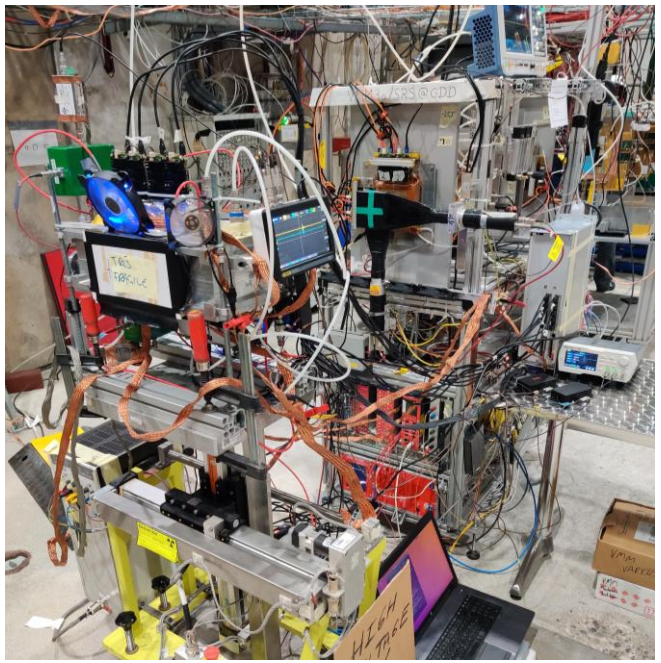
Distributed readout system





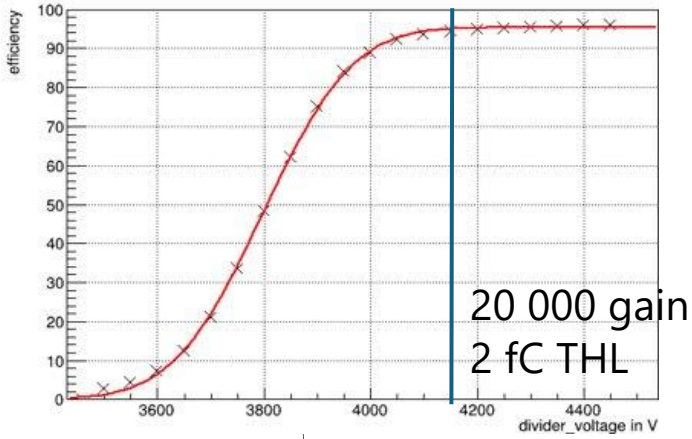
Due to new external powering scheme for VMM3a/SRS

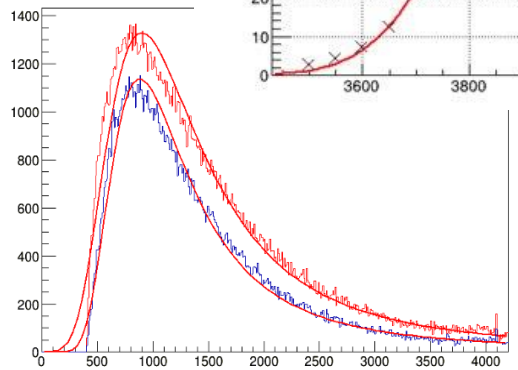
GEM twin-TPC



Characterisation of low material budget TPC for MIXE@PSI with He/CO2 (90/10 %) gas mixture

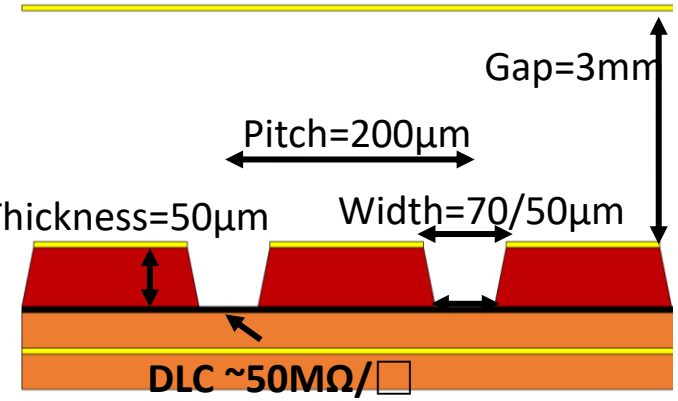
GEM prototype for AMBER



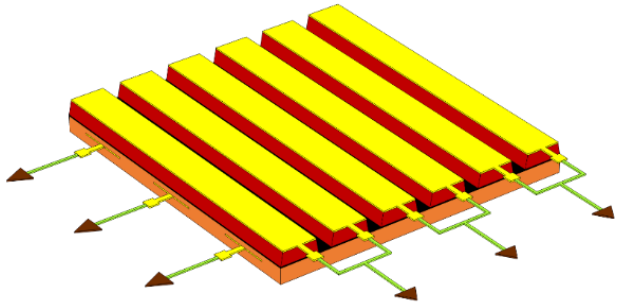


Characterisation of tracking detector in terms of efficiency and gain behaviour

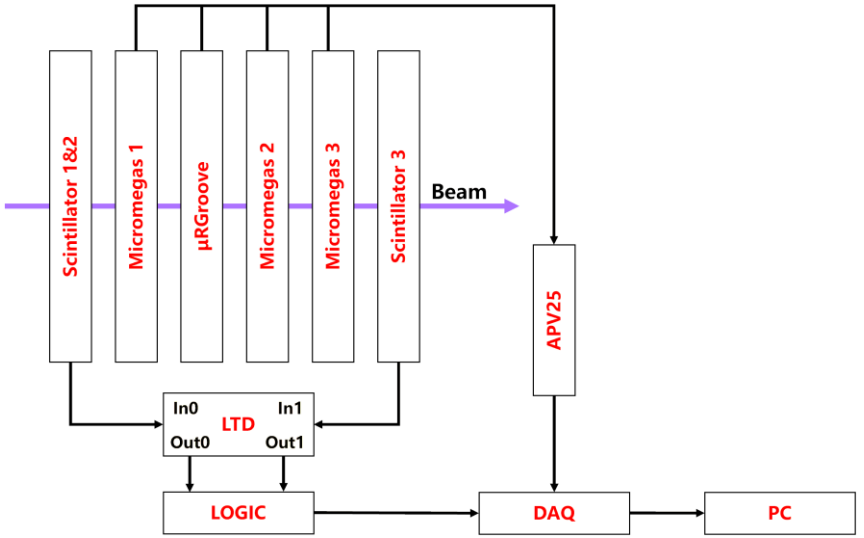
µRGroove test results from April



µRGroove

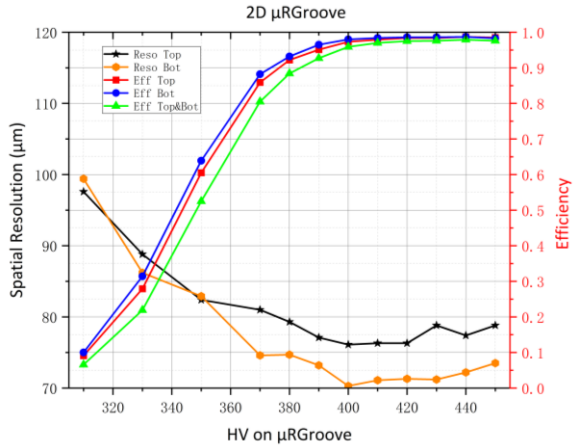


Siqi He, RD51 Mini-Week, 02/27/2023



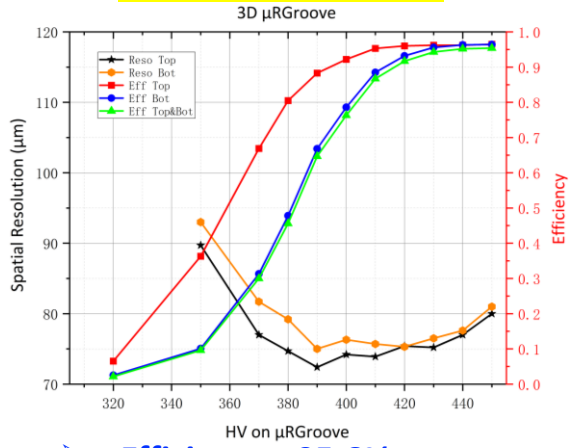
- Gas: Ar:ISO/90:10

10cm ×10cm 2D



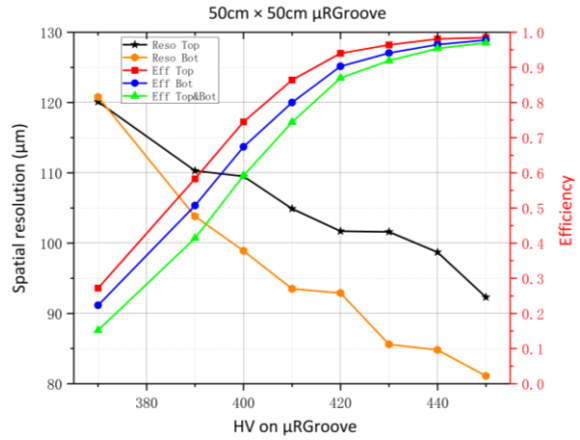
- Efficiency ~97.9%
- Spatial resolution ≤76µm

10cm ×10cm 3D



- Efficiency ~95.6%
- Spatial resolution ~80µm

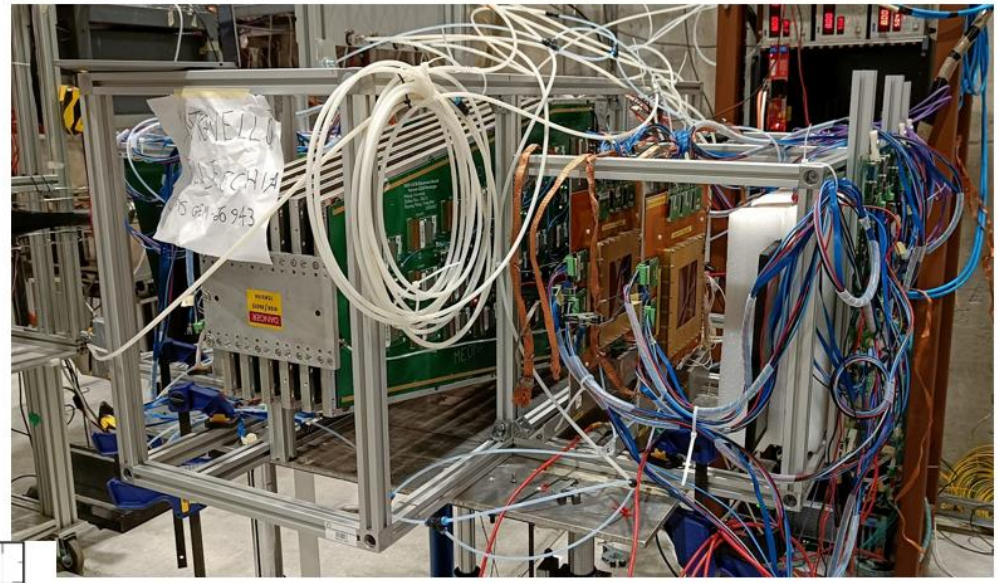
50cm ×50cm 2D

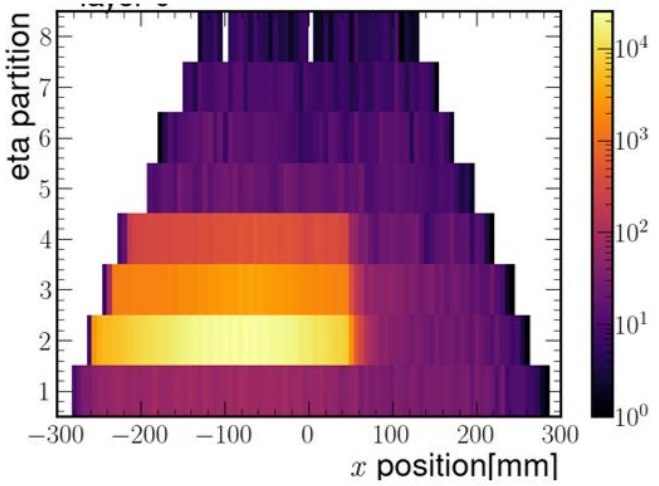


- Efficiency: ~96.9%
- Spatial resolution: ≤93µm

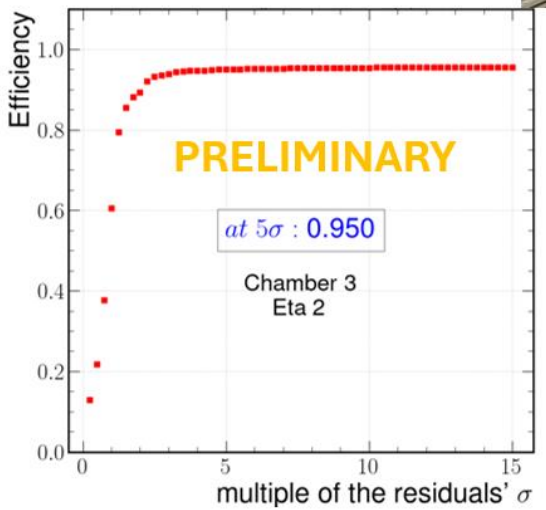
CMS GEM: stack for the ME0 station

- ME0 station for the CMS Phase-2 upgrade:
  - 36 stacks of six triple-GEM detectors (18 per endcap) instrumenting a total surface of 22 m^2
  - Physics goal: high-eta muon tagger for CMS endcap muon spectrometer ($|\eta| \leq 2.8$)
- Testing first full prototype of ME0 stack. Measuring:
  - Muon segment efficiency vs external tracker (> 99%)
  - Single layer time resolution (~ 12 ns)
  - Segment time resolution combining multiple layers

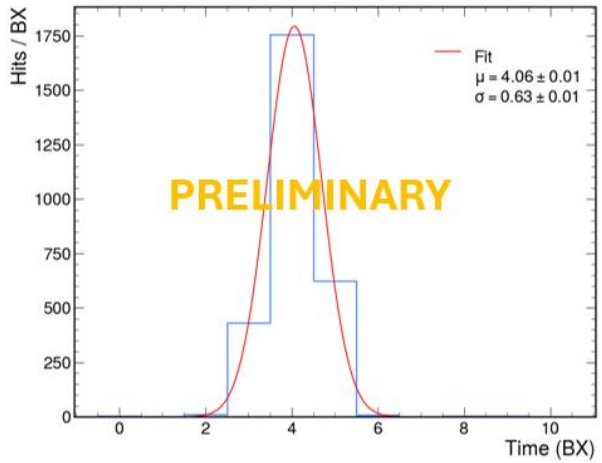




Beam occupancy (30x30 cm^2 scintillators)



Detector efficiency with standalone muon segment reconstruction



Detector time resolution

DRD1 H4(PPE134) 2024 Test Beam

Generic and Application driven R&D

Technologies: Micromegas, uRWELL, uRGroove, GEM
Application: High Rate, Timing, Calorimetry
Readout: Capacitive Coupling, Resistive Sharing

Project driven R&D

FCC-muons uRWELL/TIGER

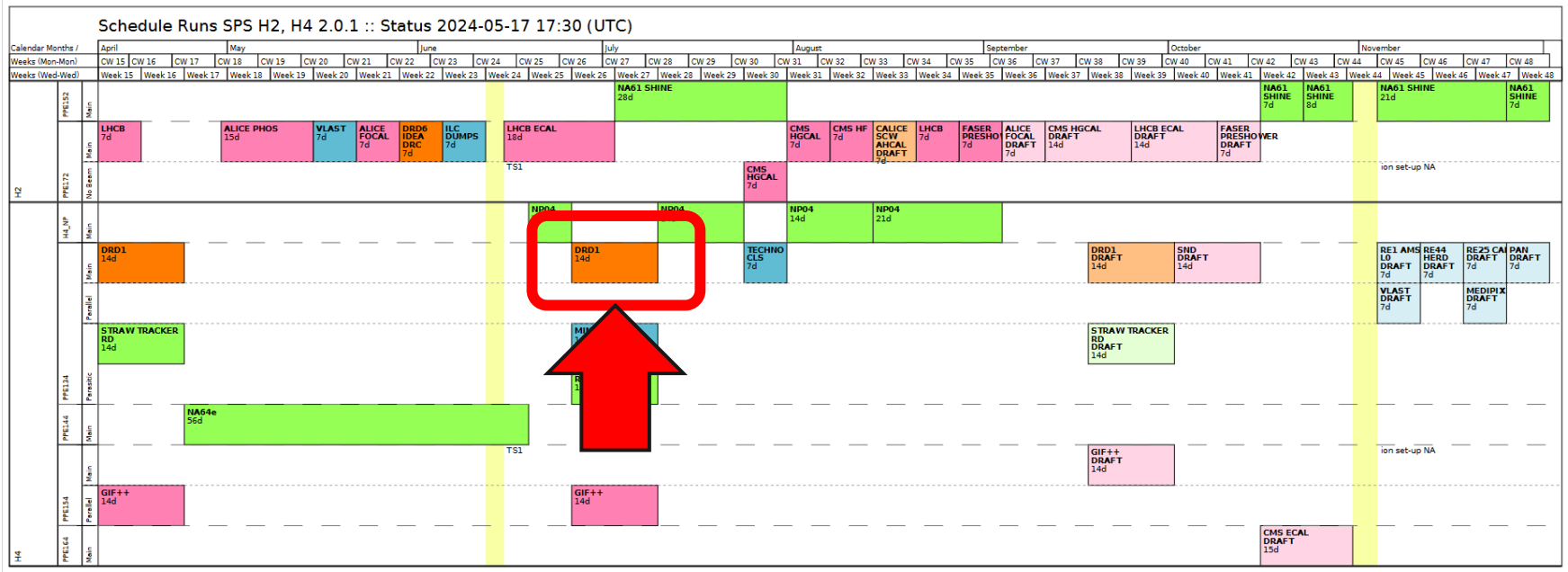
Detector Commissioning

Twin TPC for MIXE

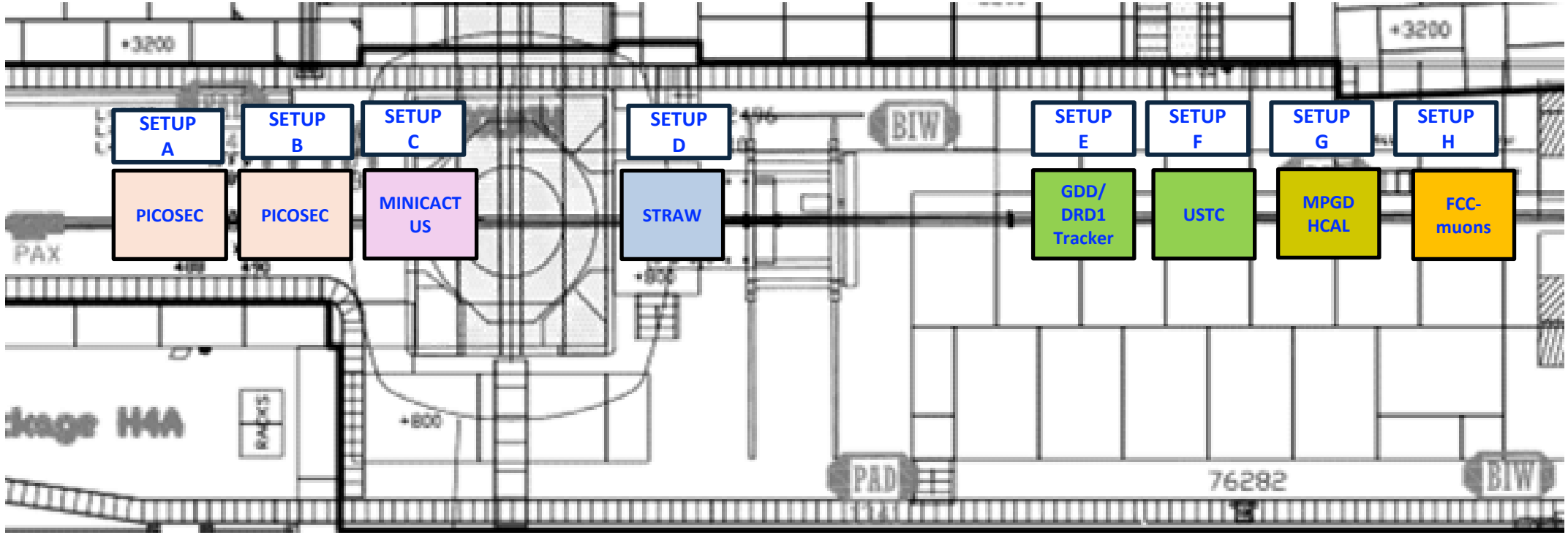
FE electronics and DAQ

Straw, VMM3a and TPC

Wed. 26/06/2024 – Wed. 10/07/2024



BEAM H4, PPE134 – INSTALLATION (DRD1, June 26 – July 10)



- SETUP A, B: PICOSEC (F. Brunbauer, M. Lisowska)
- SETUP C: MINNICACTUS (P. Schwemling)
- SETUP D: STRAW (T. Enik, K. Kuznetsova)
- SETUP E: GDD/RD51 Tracker (K. Floethner)
- SETUP F: USTC (Y. Zhou)
- SETUP G: MPGD HCAL (L. Longo, A. Pellecchia)
- SETUP H: FCC-muons (G. Cibinetto)

PICOSEC Micromegas – June 2024 plans

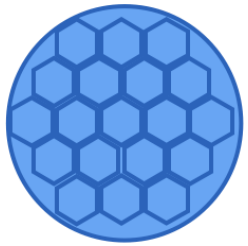
- Setup with two telescopes: PICOSEC Micromegas telescope and JLAB telescope dedicated to µRWELL studies
- Plans for June 2024 test beam period include the following developmens:

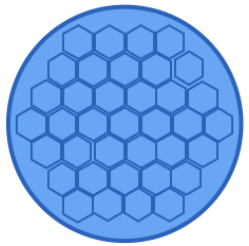
Single pad prototypes

Studies of stability with different meshes (standard woven, fine woven, electroformed mesh)

Spatial resolution studies with medium/high granularity Picosec

Test of TIA preamplifier

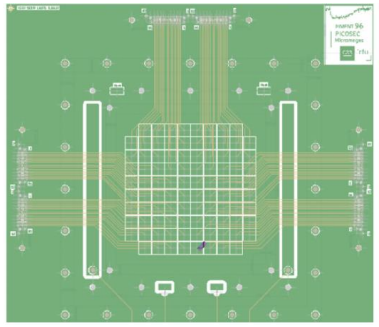




Low material budget detectors

96 readout pad prototype on thin substrate fixed to rigid, flat support structure

Custom preamp card with connection to SAMPIC WTDC

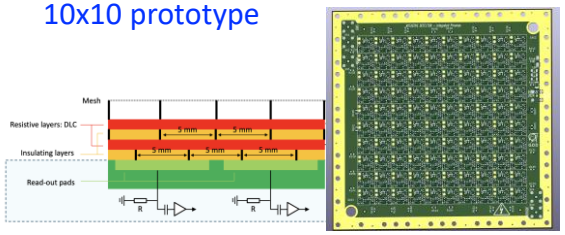


Multipad Micromegas

Possible time resolution measurement with **vertical charge evacuation** (double-DLC layers) 10x10 prototype

Repeated multi-pad measurement with FastIC readout chip

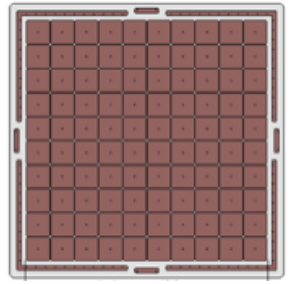
Possible evaluation of **integrated preamplifiers** on outer board of 10x10 prototype

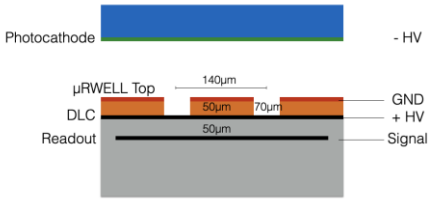


µRWELL Picosec

Operation of 10x10 µRWELL multi-pad preamp with SAMPIC readout

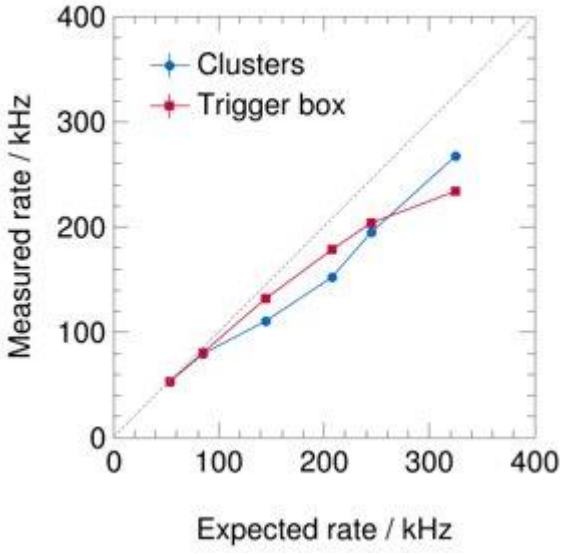
Continued performance studies and optimization of single pad prototypes





RD51/DRD1 VMM3a/SRS beam telescope: June/July 2024 plans

a) Test VMM3a/SRS triggered mode (developed by the colleagues from FRIB @ MSU) with MIPs and not only with X-rays



b) Studies on using the Corryvreckan tracking software with VMM3a/SRS: Corryvreckan / Corryvreckan · GitLab (cern.ch)

c) Further measurements with the distributed system (test also with the triggered mode) and possible re-measurements of existing detectors (AMBER prototype, XYU ambiguity free detector, finer-pitch GEM detector, etc.)

μRGroove test plans for June

Detectors to be tested：

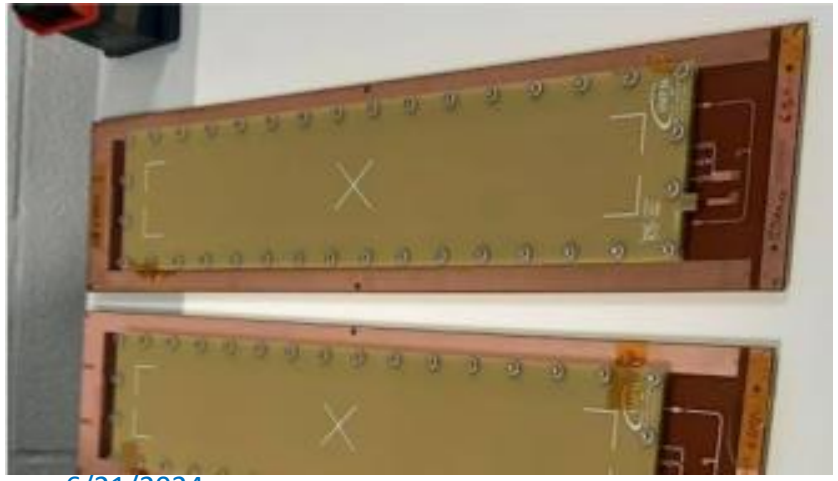
1. Two Cylindrical μRGroove detectors
2. A new 50cm×50cm planar μRGroove detector(not 100% sure)

Request to DRD1：

1. The MM tracker
2. SRS+APV25+mmDAQ
3. Flammable gas: Ar:ISO/95:5
4. A table is needed for operating during the setup and access

FCC-Muon: μRWELL detector TIGER readout

- **Tracking system:**
  - 2 x triple-GEM XY strips
- **Detector under test:**
  - 4 x μRWELL 1D strip
- **DUT setting:**
  - active area: 400x50 mm2 prepreg thickness: 50 μm resistivity range: 10-80 MΩ/❐ strip pitch: 400 μm
  - strip width: 150 μm
- **Gas mixtures:**
  - Ar:CO2 (70/30) Ar:CO2:CF4 (45:15:40)



- **8 TIGER electronics**
- **2 GEMROC FPGA**
- **1 FANOUT**
- **TIGER**: 110 nm CMOS fabrication technology Analog input - digital output S/H or ToT for energy measurement Simultaneous time and charge measurement ; Triggerless operation capability; Suitable for capacitances up to 100 pF and charges up to 50 fC
- **GEMROC** :Distribute digital and analogue voltage levels; Configure the TIGERs; Monitor currents and temperatures during operation; Collect and organize output data from the TIGERs; Receive trigger signal for trigger-matched operation