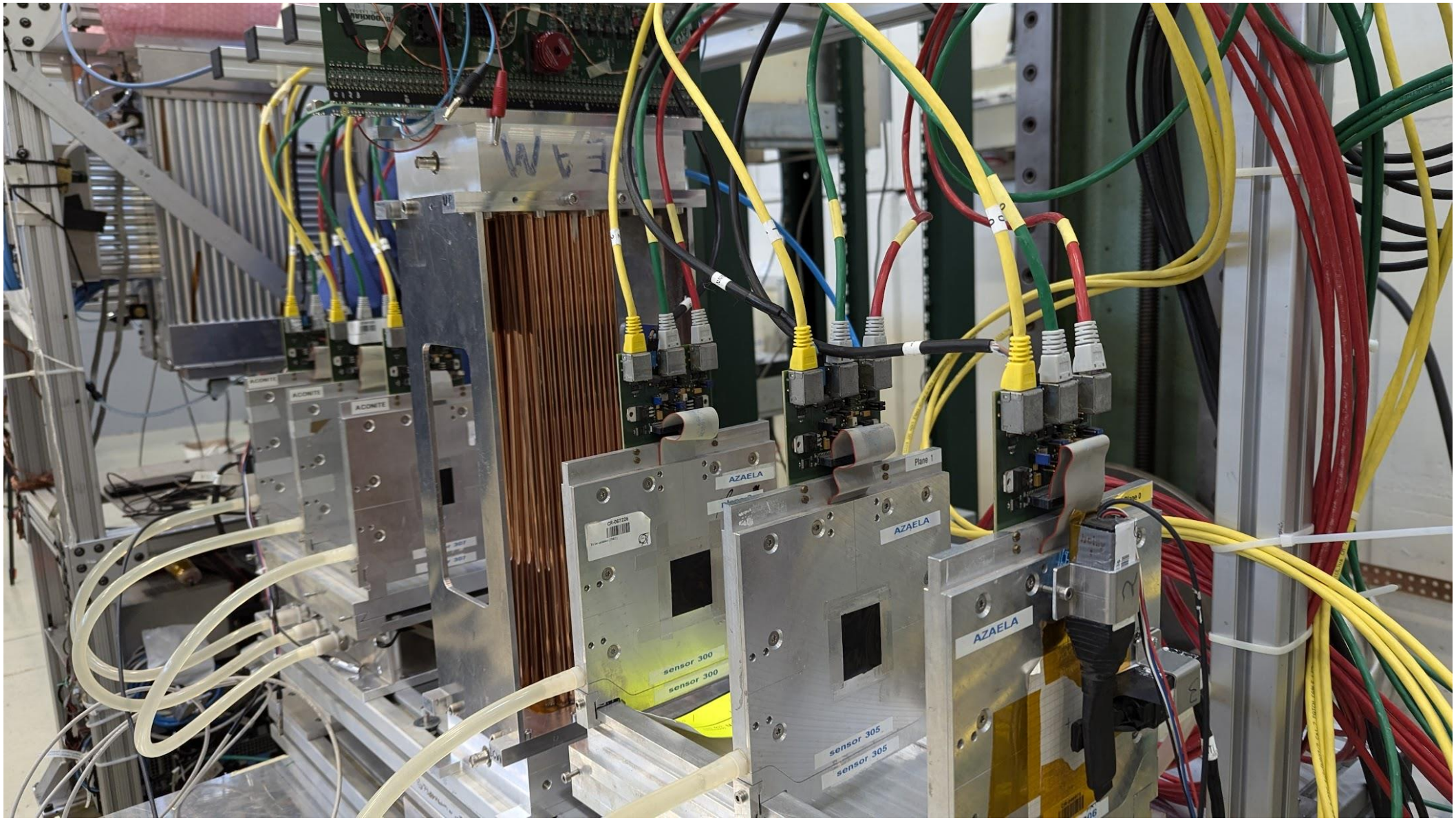
Straw-Barrel status report



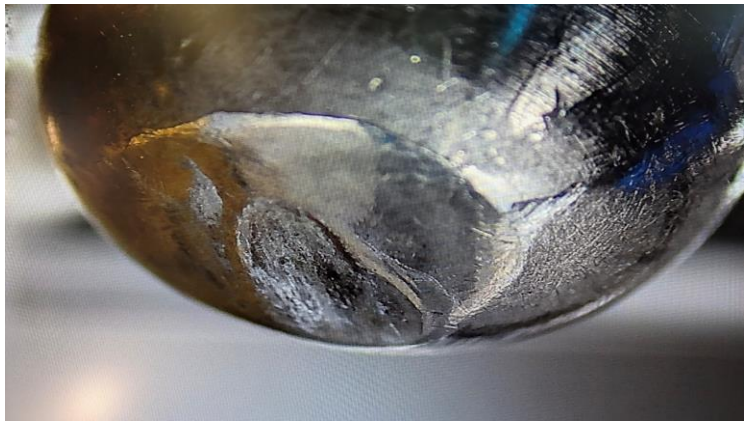
STRAW production line

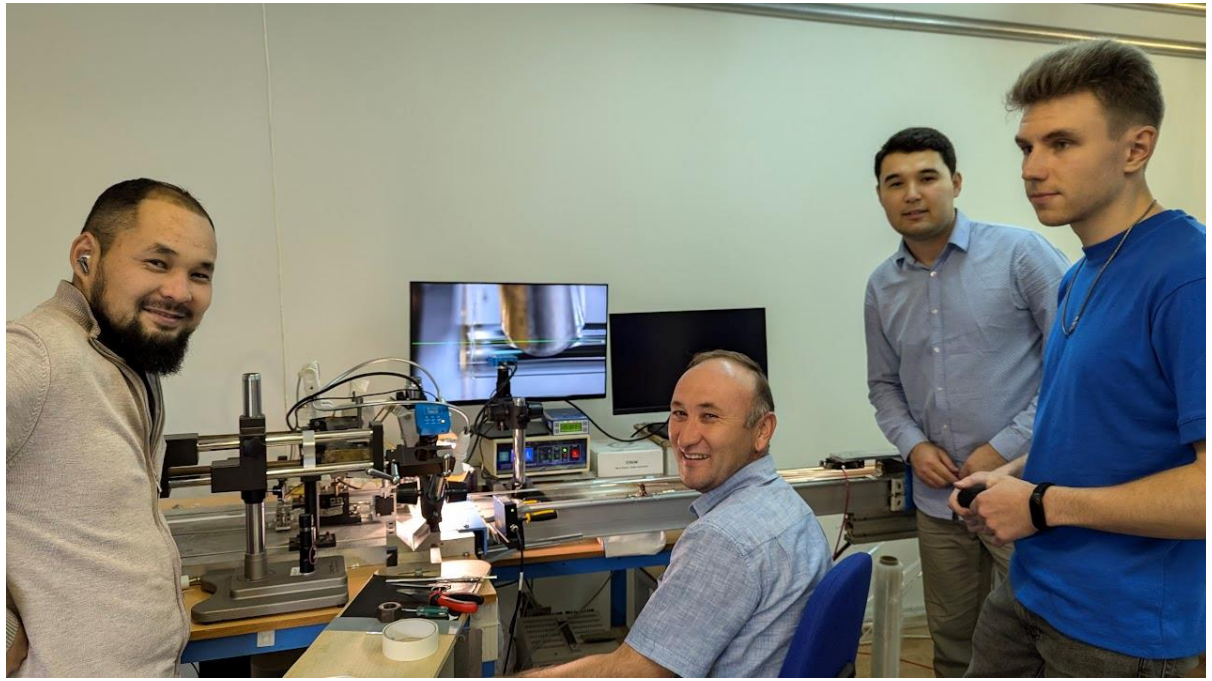
Au+Cu → Al+Al

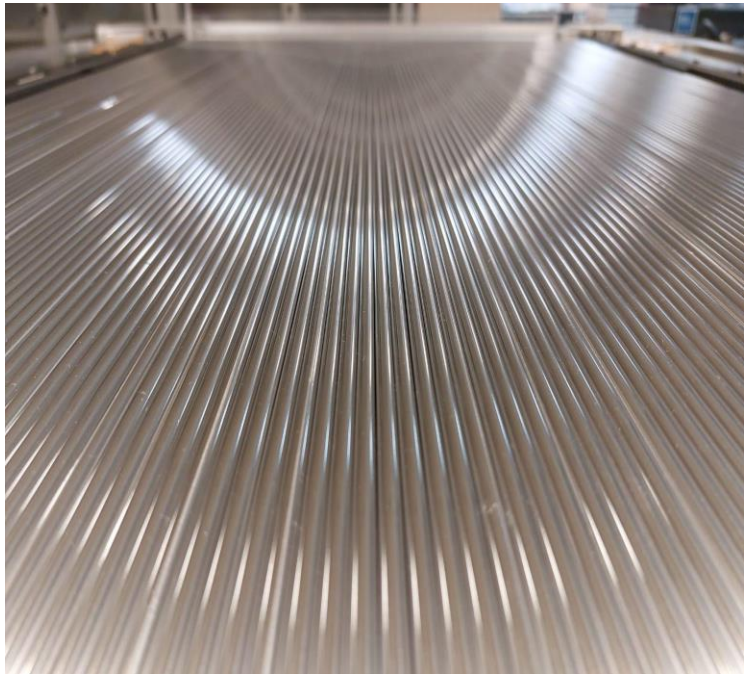
Al+Al → Al

- Productivity- 1m/min
- Length- 5.5m
- Diameter-from 10 mm
- Film thickness-36 microns
- Number of employees-10FTE
- Coating thickness 50-100nm
- Coating is carried out in the RF

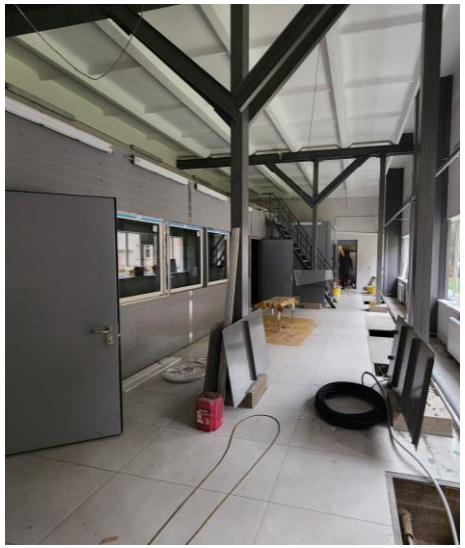
- Produced ~20km straw
- Installed ~8000 straw
- After 10 years of operation non-working- 3 straw
- Film is available in Russia
- Number of employees-10FTE







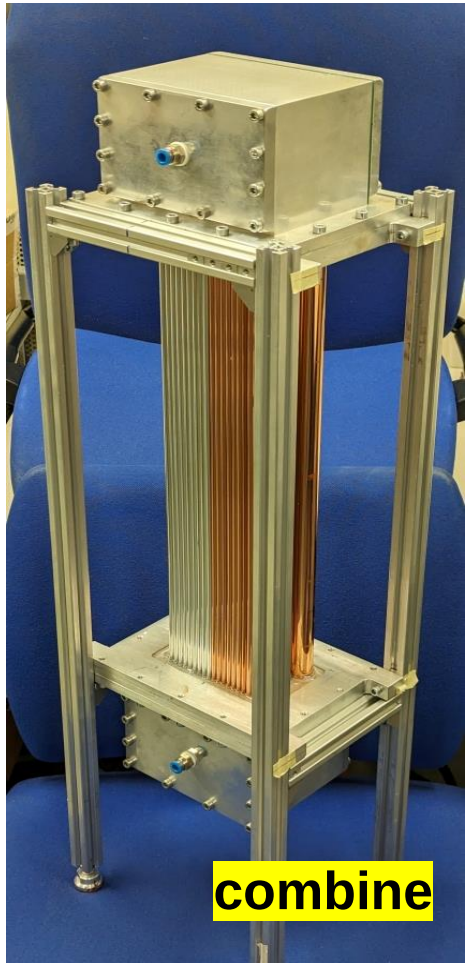
New Straw production line and assembling place

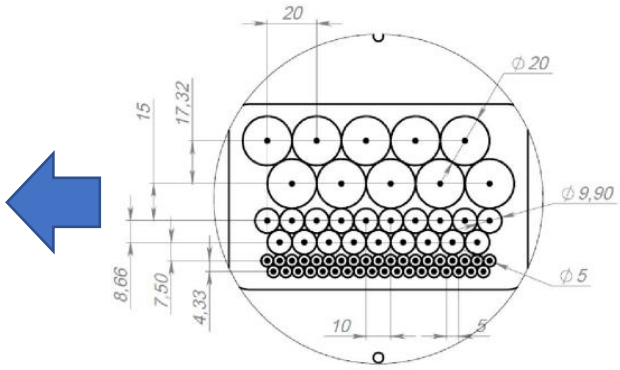


- Area ~200 sq.m., clean room~100 sq.m, machine shop and assembling hall~50 sq.m and 8,5 m high
- Double Production line length~12m
- The deadline is the beginning of the 3rd quarter of 2024
- Commissioning works-the beginning of the 4th quarter of 2024
- Necessary materials and equipment have been purchased
- Planned volume ~60km straw

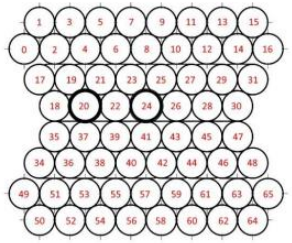
Prototyping

- Small prototype production (lab and test beam straw and readout performance studies)
- development and prototyping of the construction elements (gas supply, sealing)
- development and optimization of the electrical

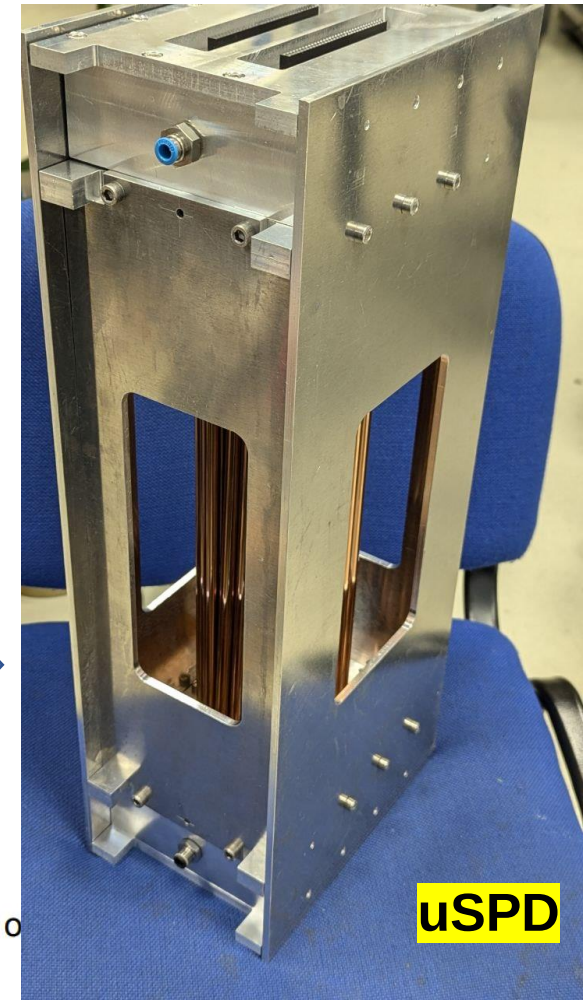


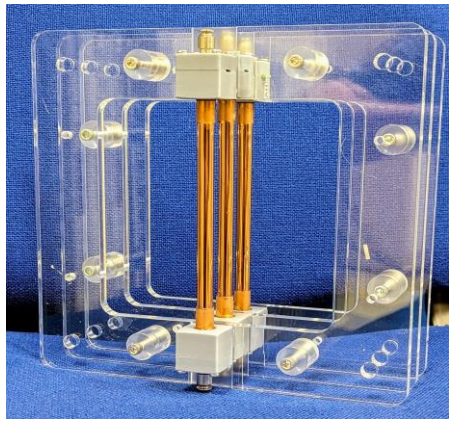


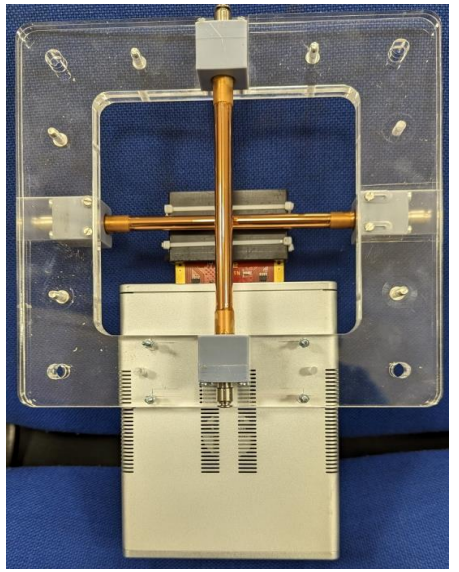
Prototype 1: 5 mm, 10 mm, and 20 mm tubes area



Prototype 2: 10 mm tube area only. Two planes of X, two planes of U (2°), two planes o V (−2°) and two planes of X.

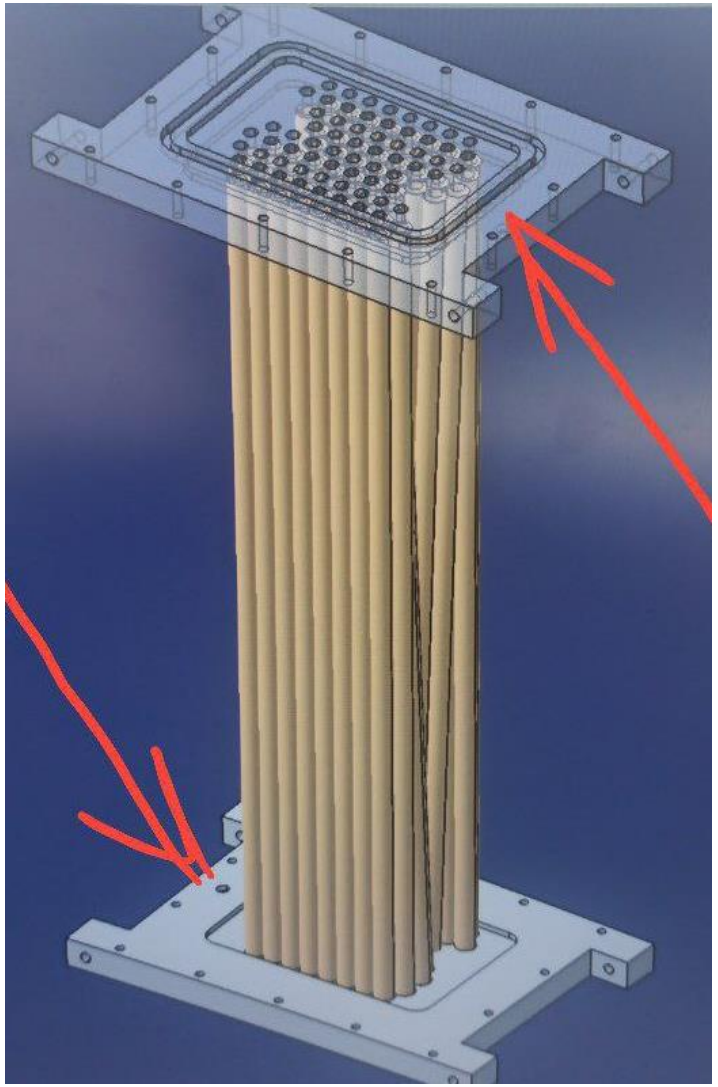


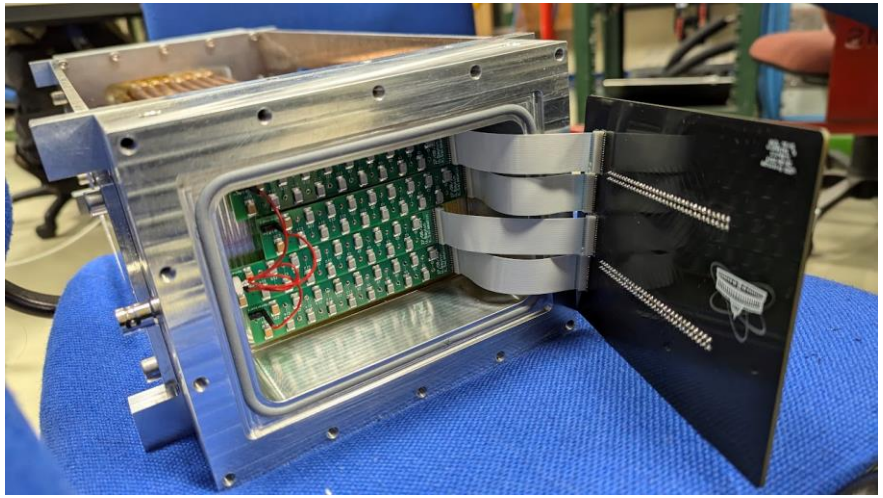


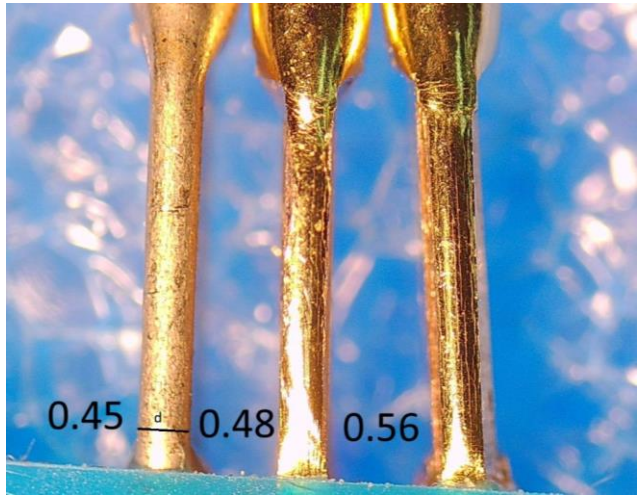


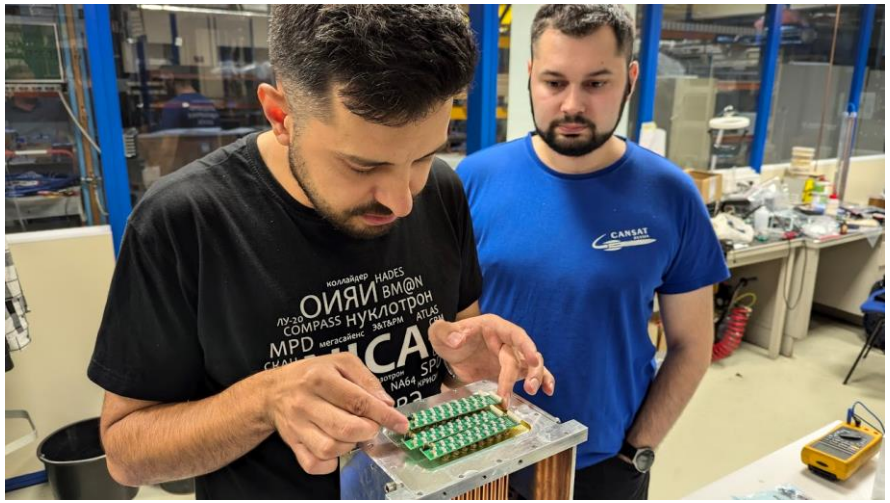
Prototyping

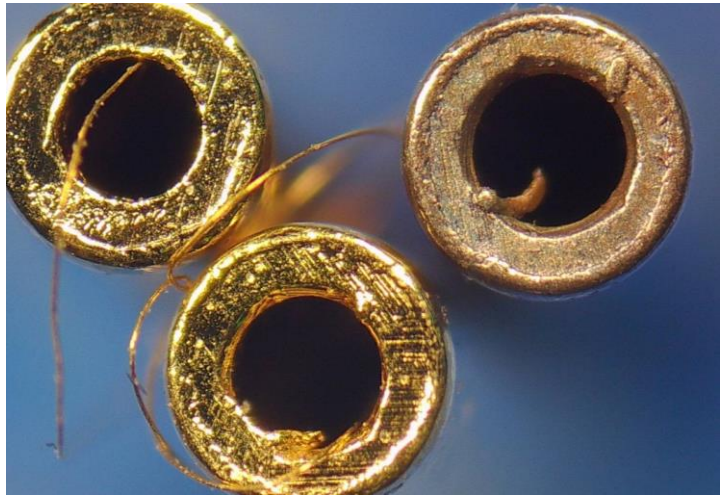
Connectors, HV distribution board, new pin, assembling, grounding



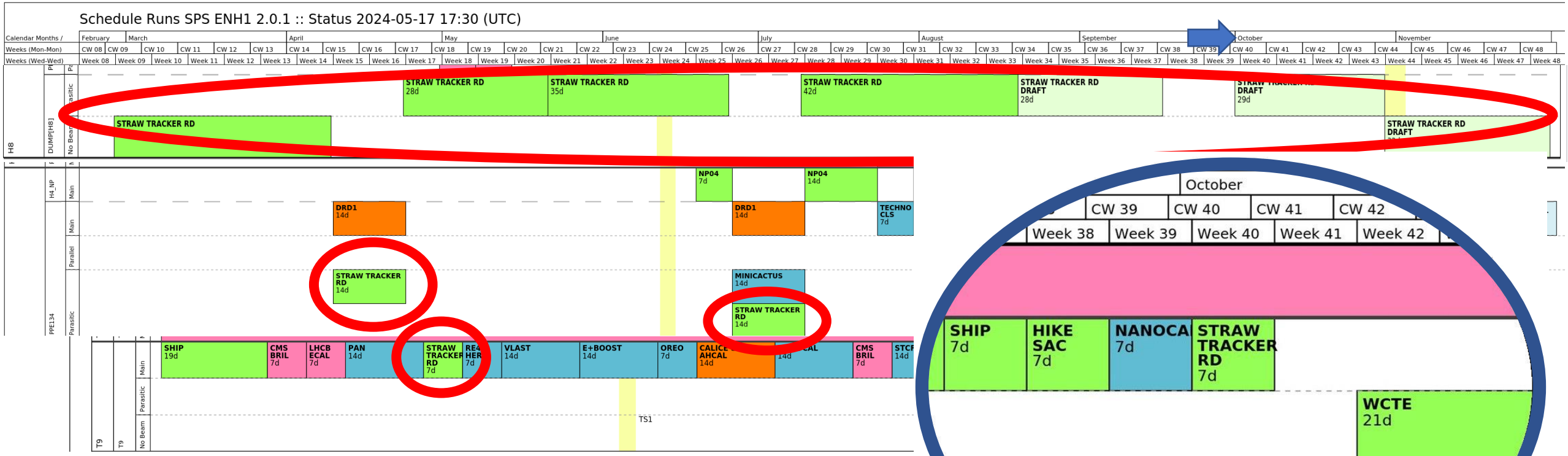








Test beam periods 2024 at SPS and PS



Three different tasks:

- setup development, readout electronics test and debugging :
  SPS H8 beam dump (low intensity muons)
- spatial resolution: **SPS H4**
- charge measurements for low momentum particles: **PS T09**

T9 PS		08/05-15/05				02/10-09/10
H4 SPS	10/04-24/04		26/06-10/07		18/09-02/10	
H8 SPS dump	10/04-26/10					

Measurements of the straw performance and choice of the readout electronics parameters

- **Spatial resolution** (SPS)
  - – influence of the readout parameters
    - electronics noise, threshold
  - influence of the wire displacement
  - different operation conditions (gas gain, pressure dependence)
  - measurements in the magnetic field (H4)

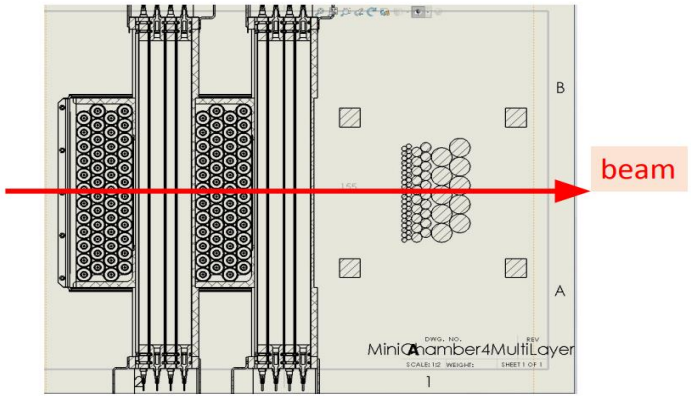
- **Charge measurements** (PS, low momentum pi, mu, e)
  - charge distribution for different particle momenta
  - multiple scattering probability
  - electronics dynamic range for PID (protons are required, under discussion)
  - measurements at PNPI under discussion

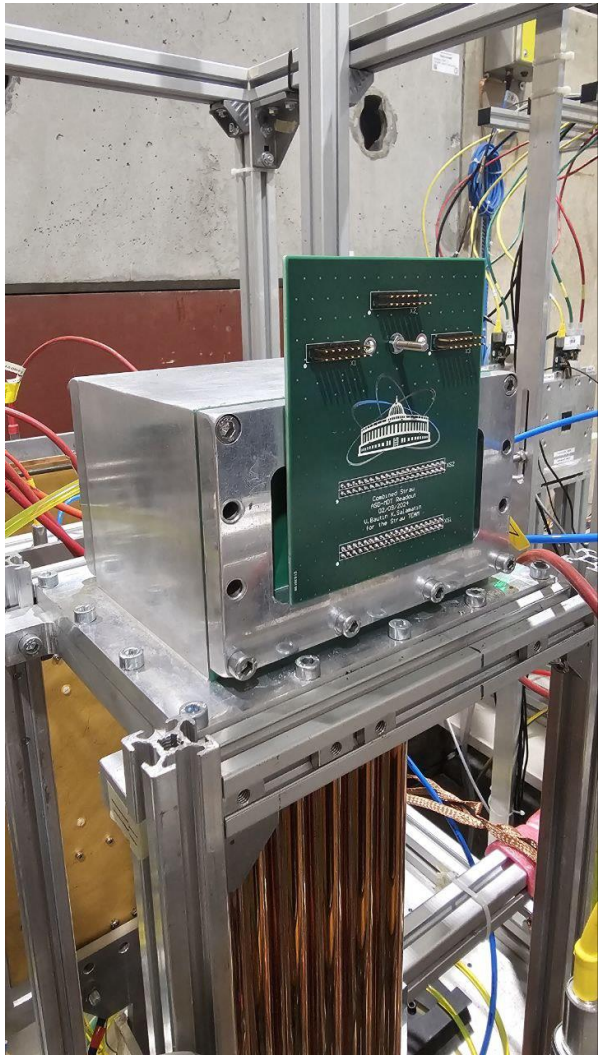
Beam Test activity

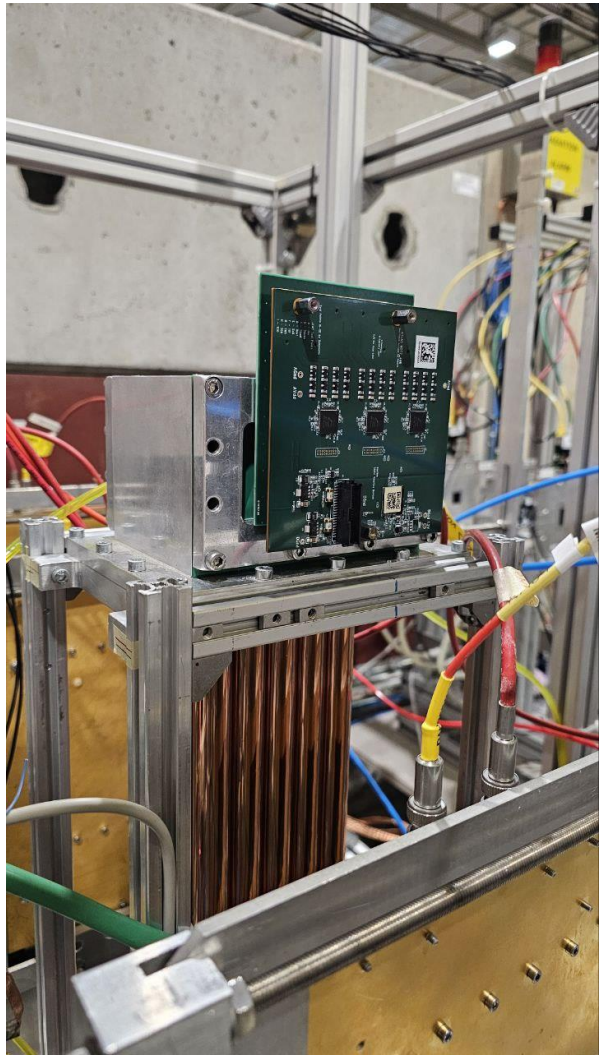
Beam Test activity

- sMDT telescope with total 16 tube layers (assembled in 4 mini-chambers, each with 4-layers, two in x and two in y directions); Single wire resolution ~100 μm, tracking slope ~0.4 mrad (in each direction). Tube diameter 15 mm
- Front-end electronics mezzanine mounted 3 ASD, 1 TDC 24 ch. With TDC resolution of 0.78ns
- MiniDAQ system capable to handle 100 kHz trigger rate and readout 500 channels
- Online monitoring
- Offline data analysis

The UM sMDT telescope
8-layers in x and y directions







Beam Test activity

sMDT front-end electronics – used for test beam readout

- ATLAS sMDT ASD (developed at MPI) and TDC (Michigan) are suitable for the straw readout and tracking with similarly expected gas gain (2-5 x10^4) and a drift time of a few hundred ns.
- Initial measurements at H4 beam line showing promising result to fit the 10mm straw readout within the charge/time dynamic rate of the sMDT Front—end electronics.

ATLAS sMDT ASD Spec.	
Technology	CMOS 130nm
#. of channels	8
Power consumption	10 mA/ch
Input capacitance	60pF
Shaper	bipolar
Peaking time	12 ns
Dynamic range	5-100 fC
sensitivity	8 mV/fC
ENC	1 fC
Charge readout	ADC, ToT

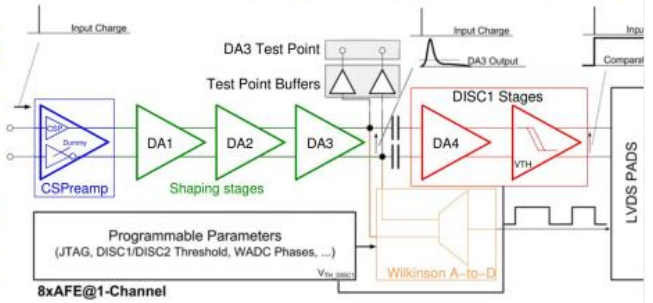
ATLAS sMDT TDC Spec.	
Technology	CMOS 130nm
#. of channels	24
Package	BGA 144
TDC LSB	0.78 ns
Nonlinearity	+- 80 ps
Power consumption	360 mW per chip
Dynamic range	17 bits (102μs)
Output data rate	320 Mbps x 2
Max. hit rate	400 kHz/ch
Mode	Lead/trail edge, pair

Stacked mezzanine card

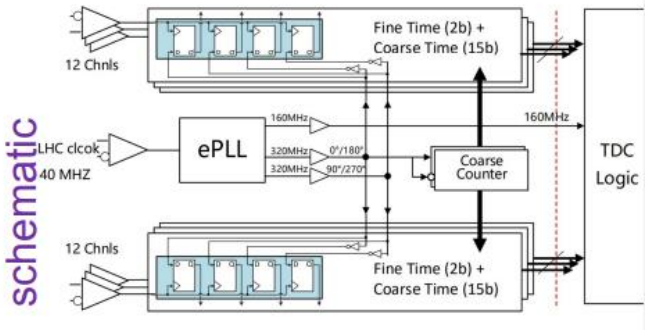
Flat mezzanine card

ATLAS sMDT/MDT Front-end Mezz

ASD schematic



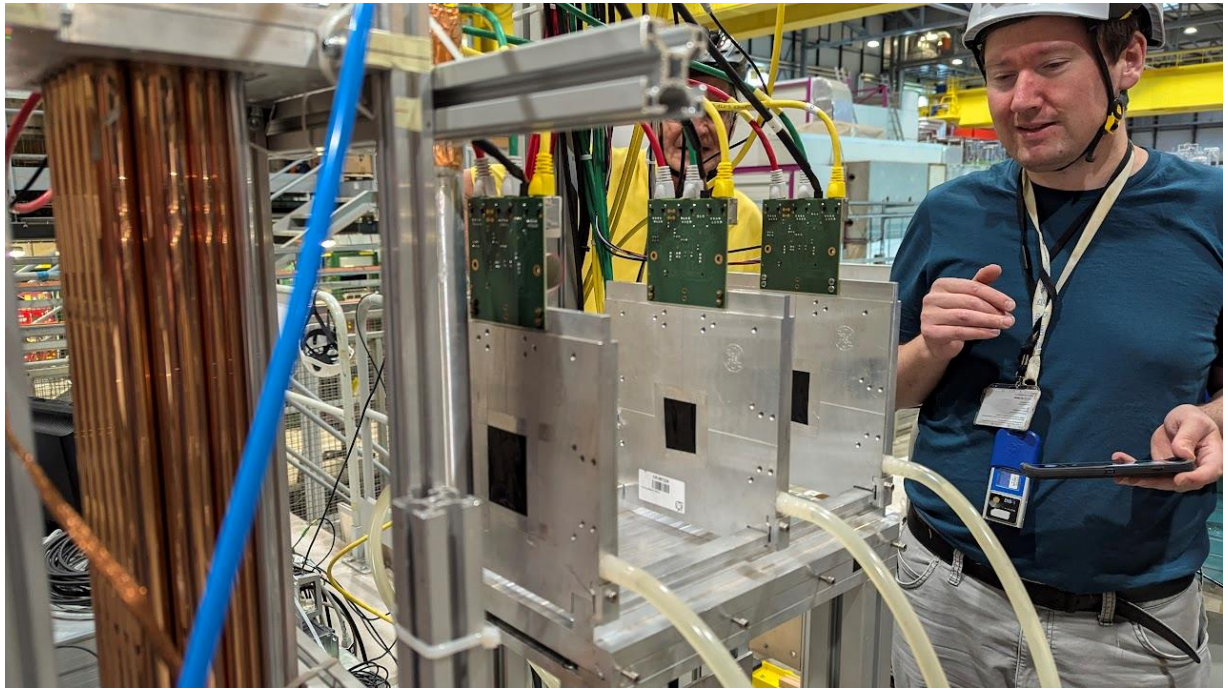
TDC schematic



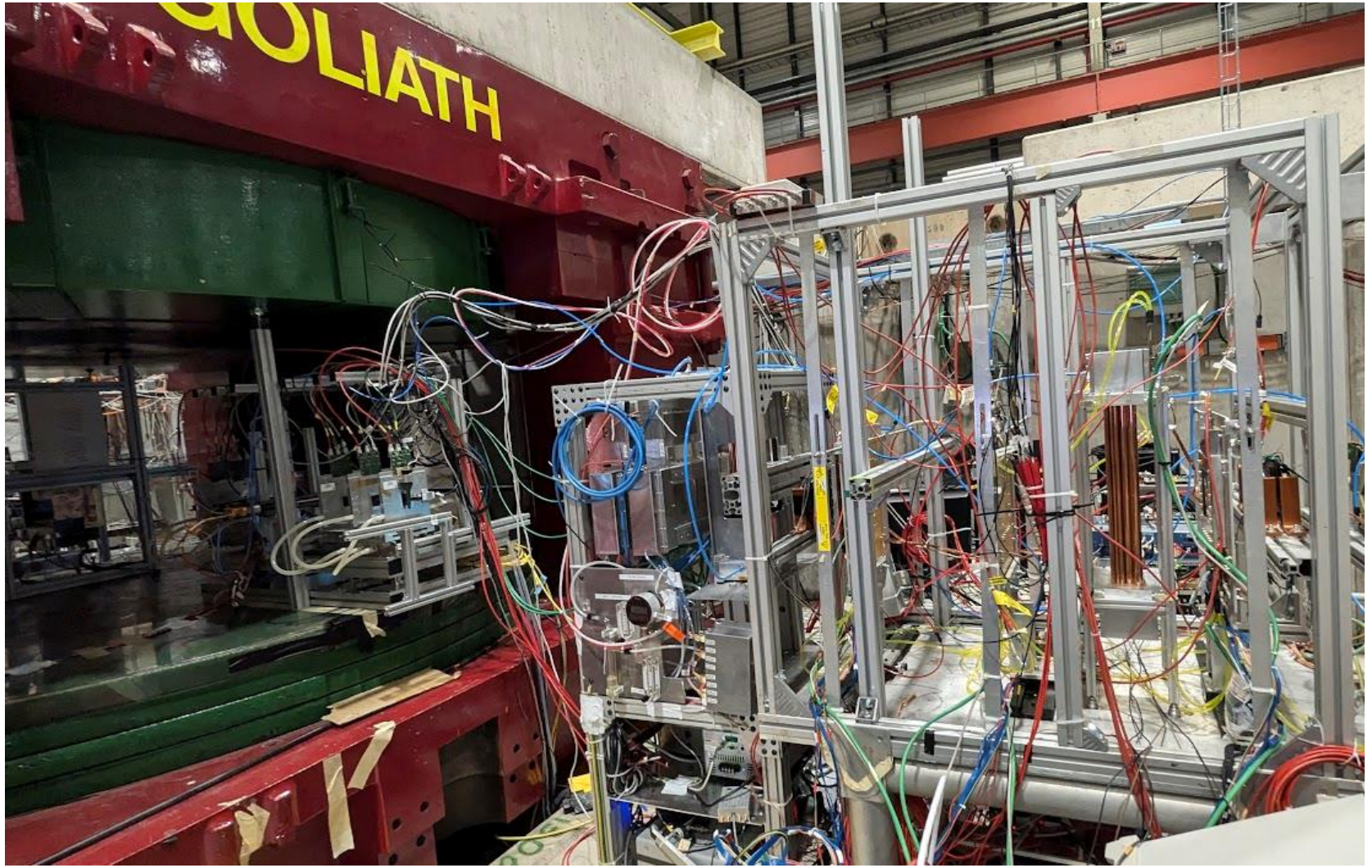
Beam Test activity

The AIDA-2020 Zero-suppressed Acquisition Located at the East-Area (AZALEA) telescope

- **Baseline: EUDET-type telescopes + AIDA2020 upgrades (WP5)**
  - Full package for the users: >99% eff. sensors ↔ TDAQ ↔ reconstruction SW
  - 50 µm thin sensor suitable for > ~1 GeV/c beam lines
  - Active area < 2x1 cm^2 & Pointing resolution: > 1.8 µm (Miomsa26 limits)
  - Avg. trigger rate < 1MHz & Time resolution: > 781 ps (AIDA TLU limits)



Beam Test activity



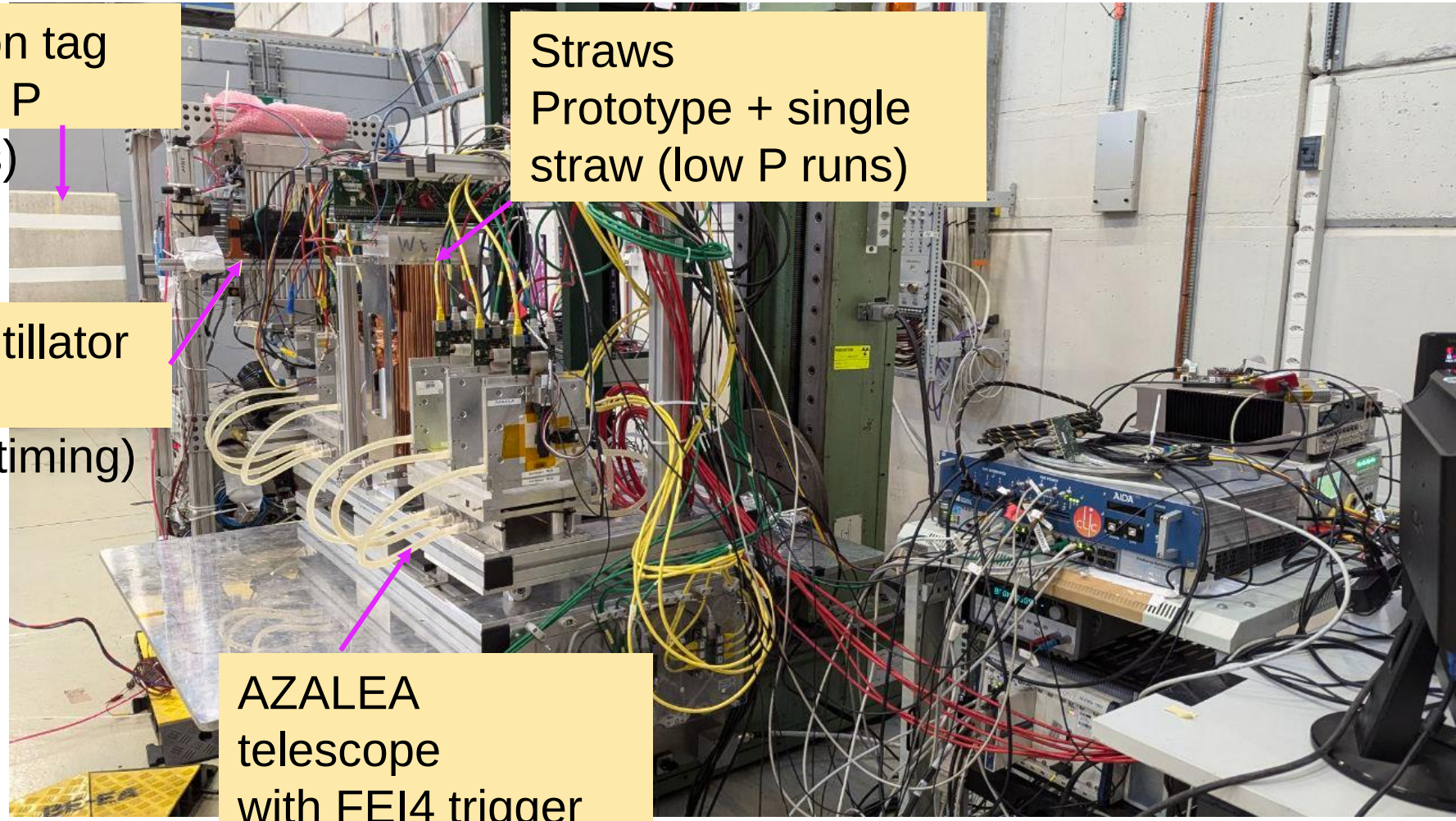
Straw PS setup

- ***Ref. Tracking***
  (AZALEA)

- ***Ref. Timing***
  (scint ~200 ps)

- ***DUT:***
  tracker prototype
  - VMM3 readout
  - ASD readout
  (uni Michigan)
  single straw – custom charge sensitive PA (1 us peaking time) + CAEN digitizer

- ***Additional downstream***
  TimePix4, sMDT drift tubes



Datataking: 02-09 October

Straw PS program

- ***High momenta*** *- timing performance*

  t vs R with VMM3 and ASD readouts

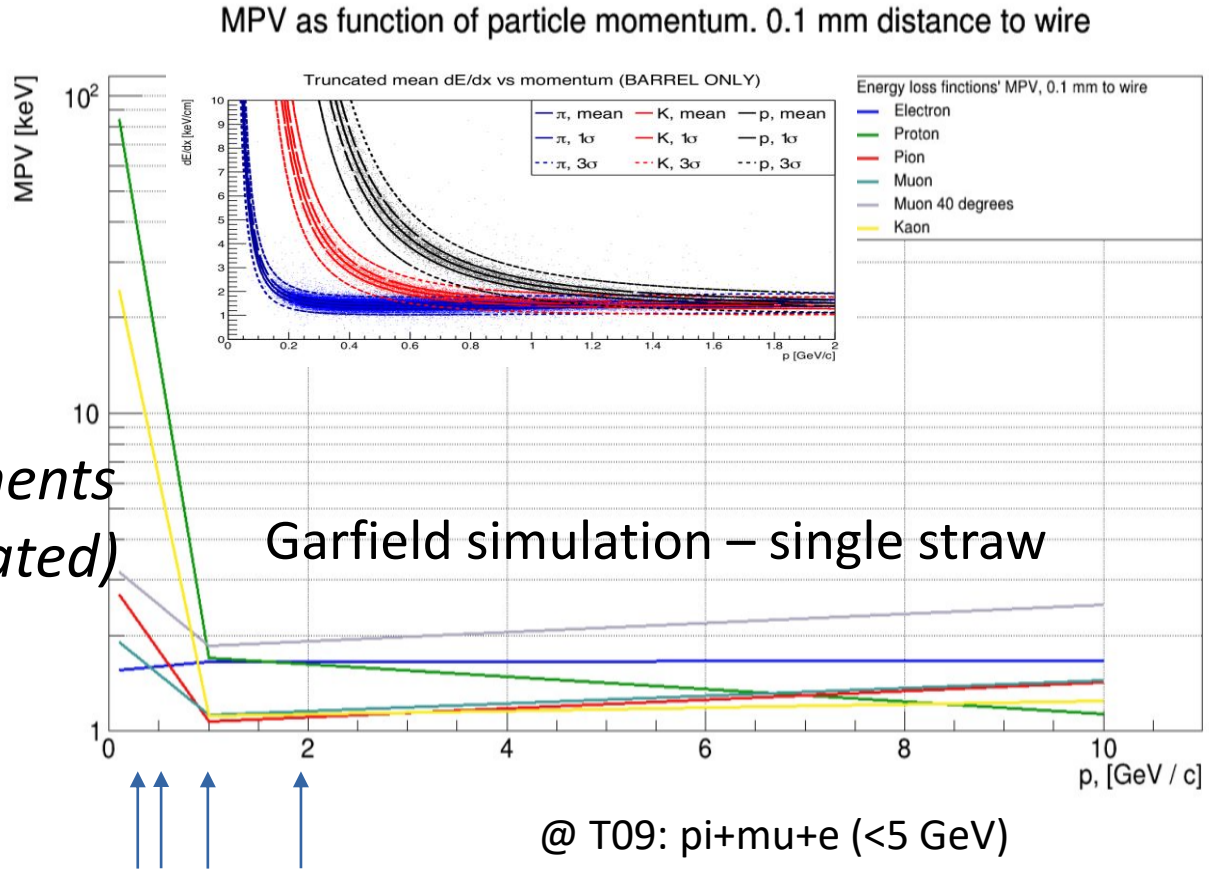
  15, 5 and GeV h+, large statistics

- ***Low momenta <=2 GeV –*** *charge measurements*

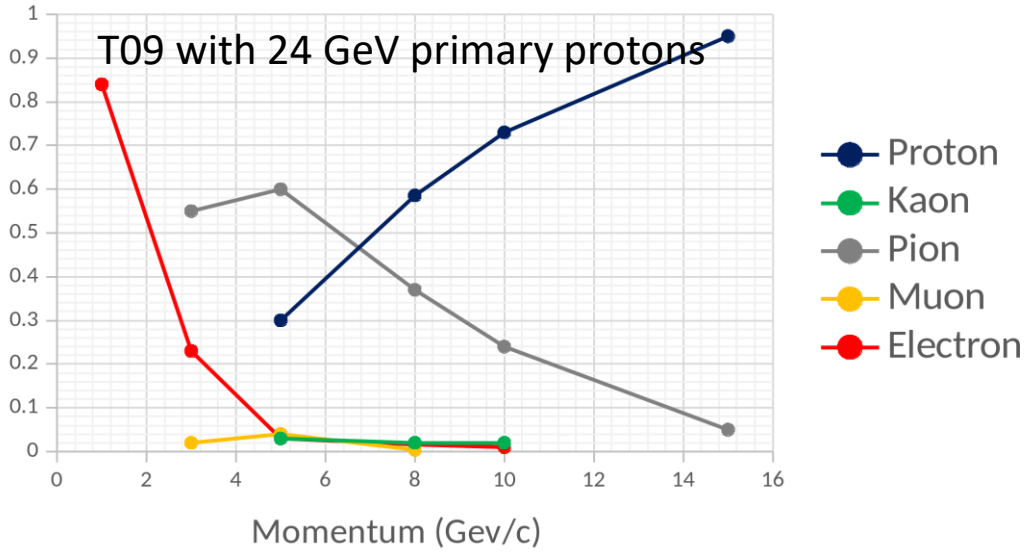
  - 2, 1, 0.5, 0.3 GeV (purity to be evaluated)

  - Q vs P (single straw)

  - time-over-threshold vs P (ASD readout)



@ T09: pi+mu+e (<5 GeV)



Electrons are tagged with the Cherenkov detector 15 mV threshold

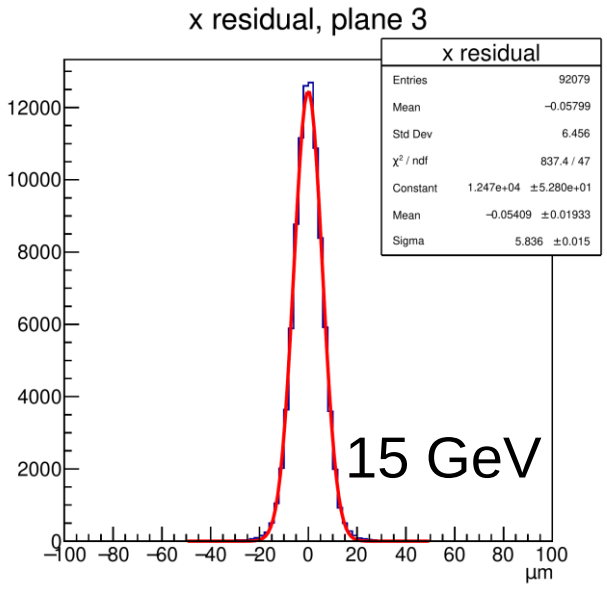
Tried to veto muons behind the concrete block

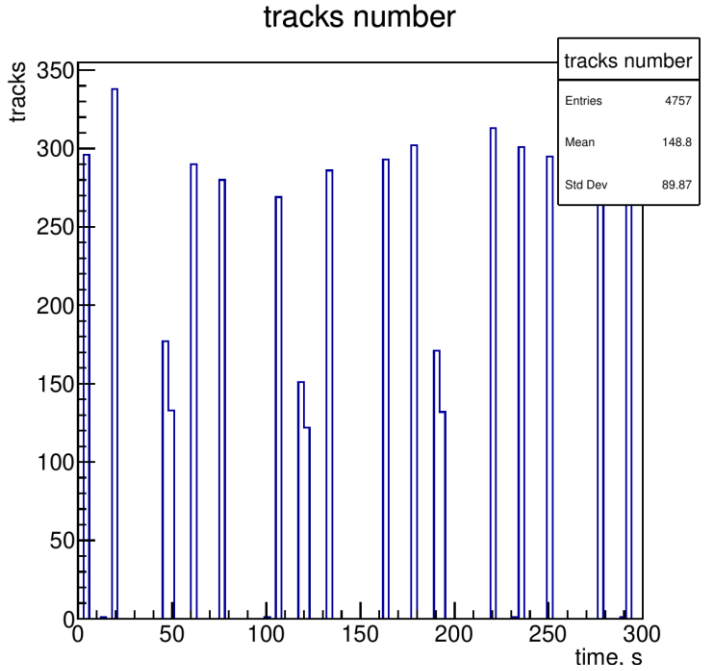
Last two days :

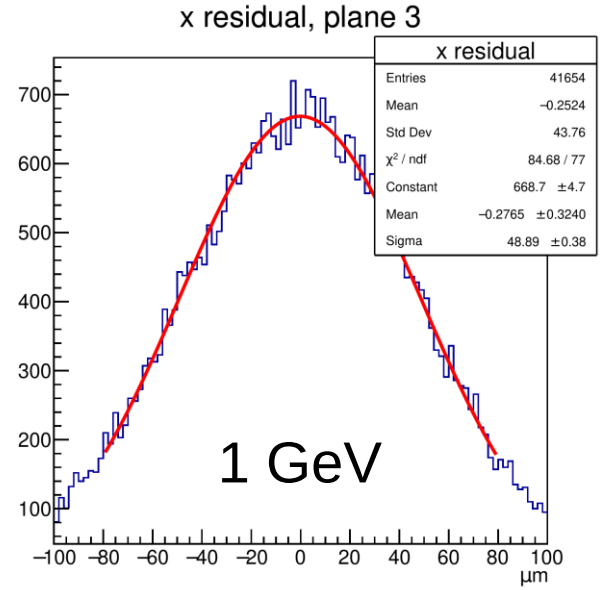
- decreased momenta of primary protons (down to 15 GeV)

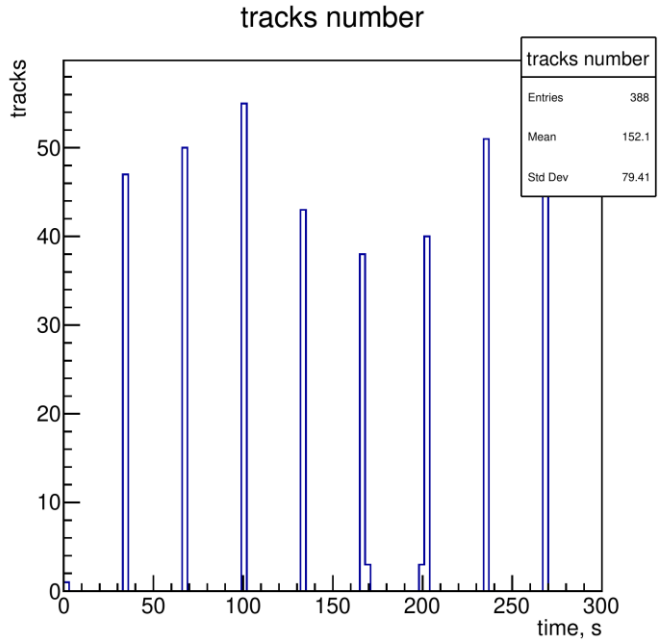
=> higher population of low momentum hadrons

Reference tracking performance

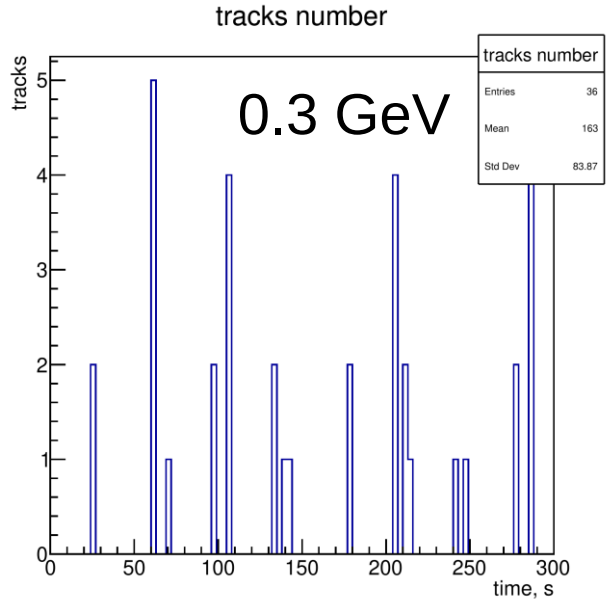






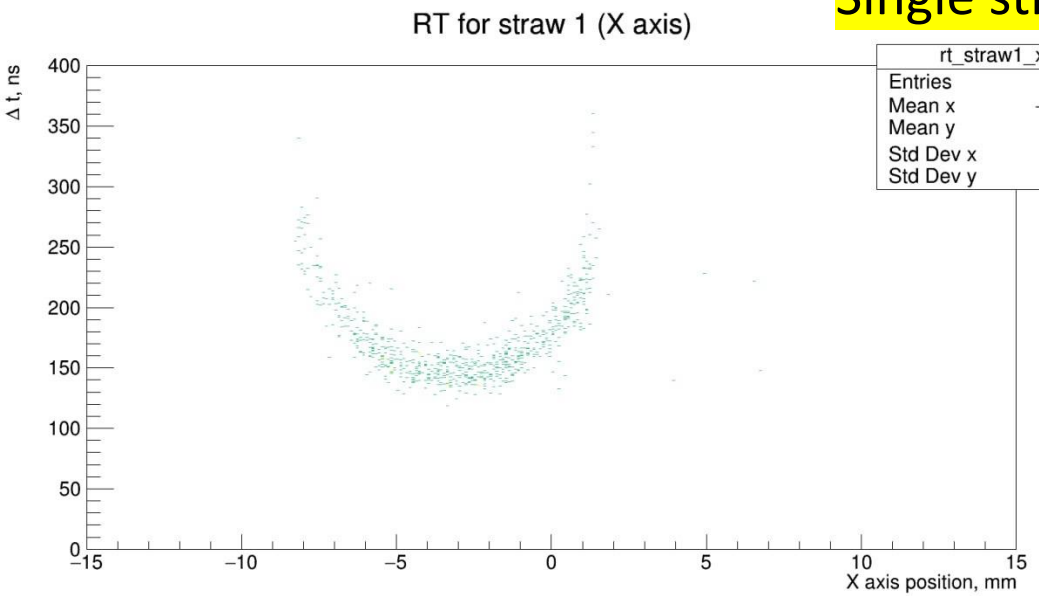


Analysis ongoing



Prompt results – just a first glance

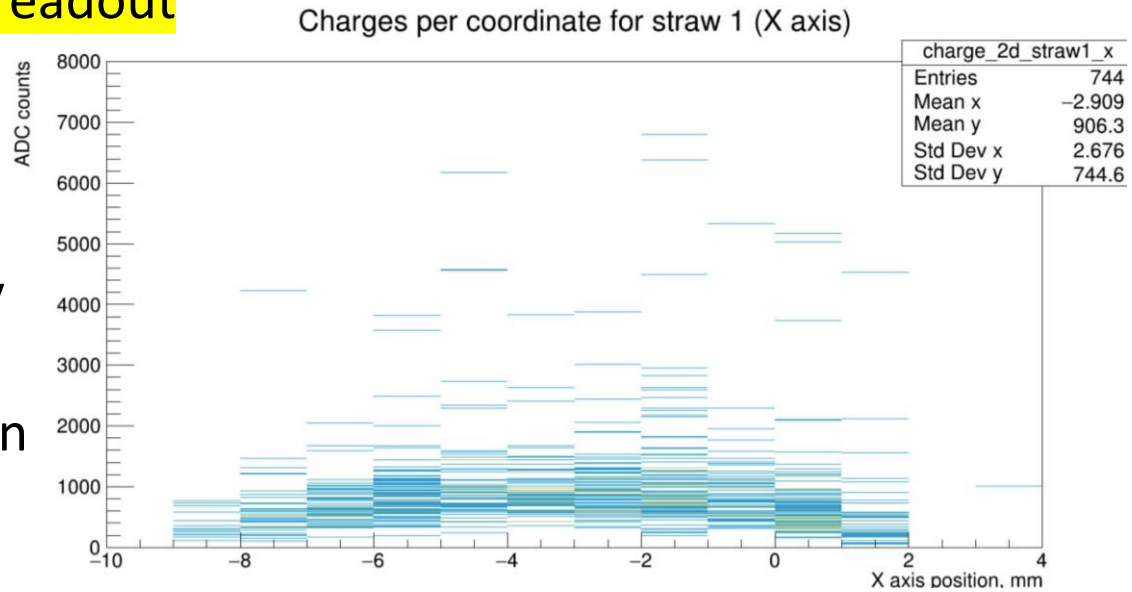
Single straw + custom readout



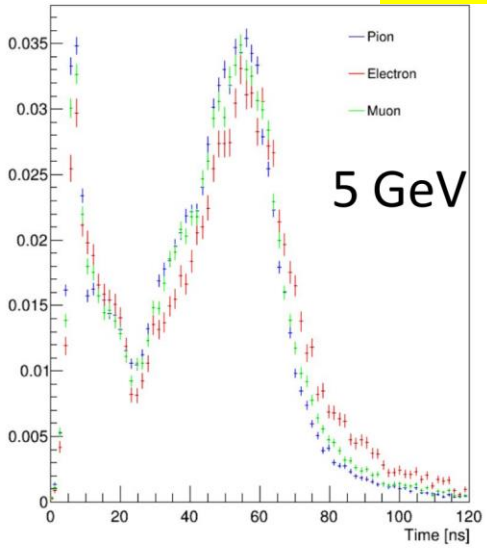
1 GeV

Preliminary

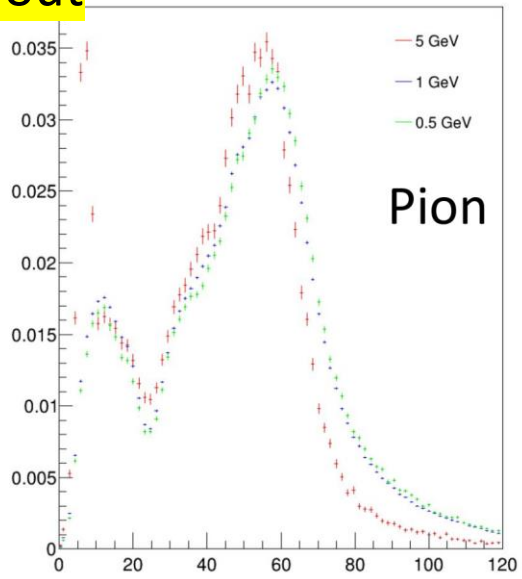
No selection



Prototype + ASD readout



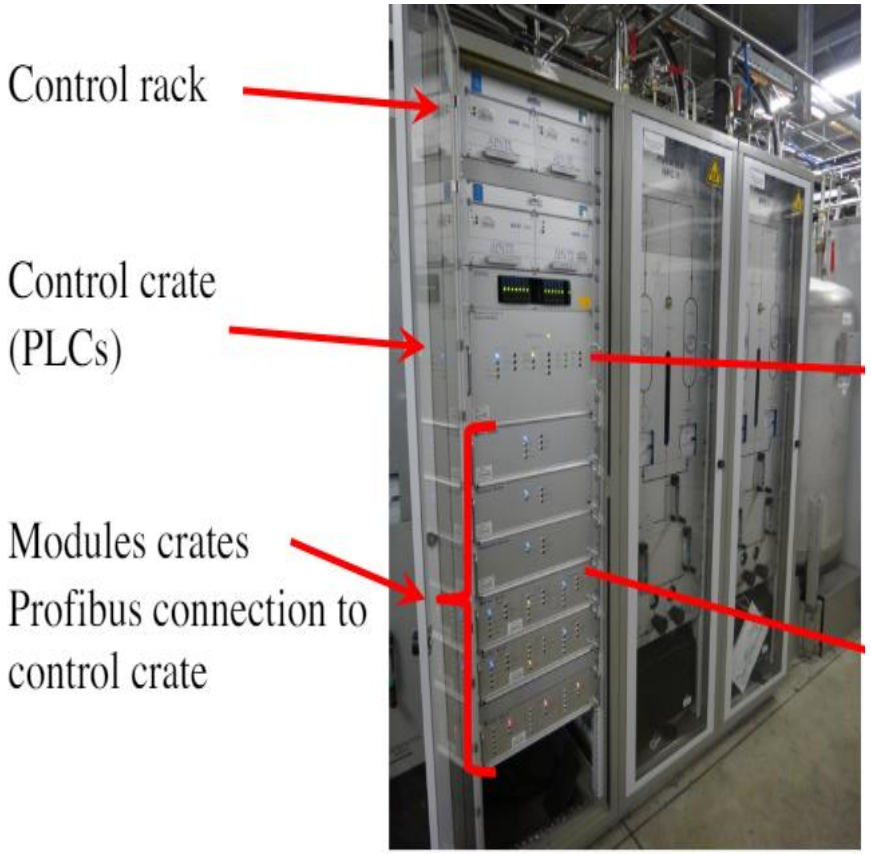
TOT spectra



Gas System: design requirement

Gas systems (as detectors) are subject to severe requirements on material & gas for safe detector operation:

- Mainly (or exclusively) stainless steel pipe and components
- Need to validate most of the gas system components
- Documentation for QA and operation/maintenance follow up
- Monitoring of gas system operation
- Monitor of supply gases and mixture composition
- Evaluation of operational cost
- Flexible design to accommodate detector requirements/upgrades
- Careful evaluation of
  - resources for operation
  - resources for maintenance activity
  - Stability required
  - Balance requirements vs safety (as much as possible)



Plans

- straw tracker prototyping
- new assembling and production lab spaces
  - recovery of the miniSPD setup
  - readout electronics prototyping
  - test beam measurements at SPS and PS, the corresponding data analysis and feedback to FEE developers
- - evaluating possibilities for the testbeam measurements at PNPI (Gatchina), INP (Almaty) and JINR
- concept development of the gas supply system
  - longevity study for straw and supporting element material
- LV and HV power supply development