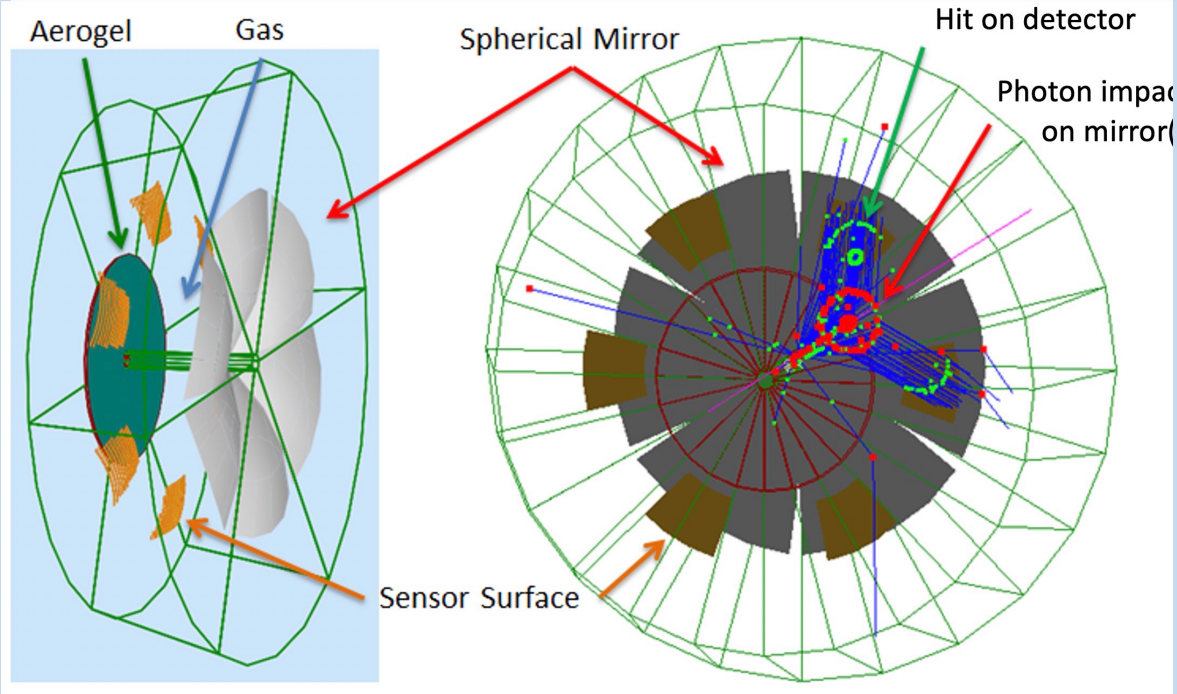
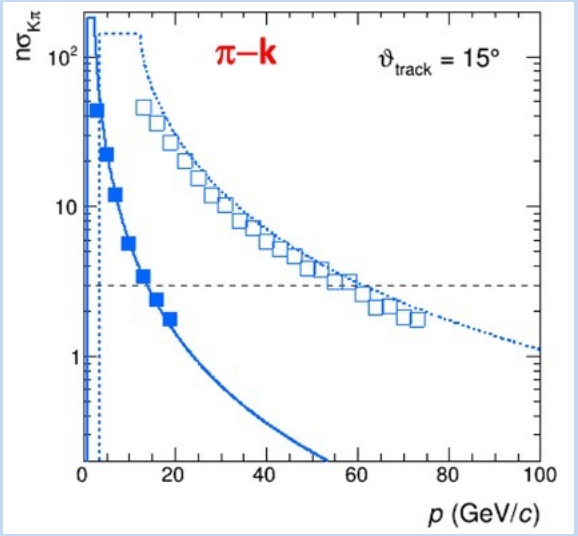
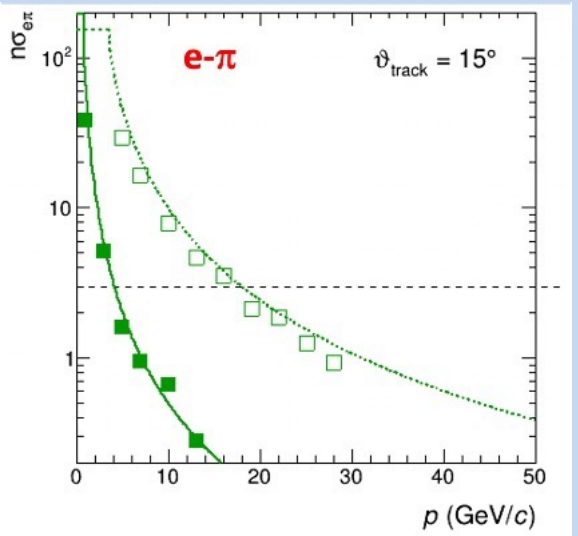
Dual Radiator RICH @ EIC

Two main challenges : **cover wide momentum range 3 - 60 GeV/c**
work in high (~ 1T) magnetic field







dRICH: effective solution for ePIC detector

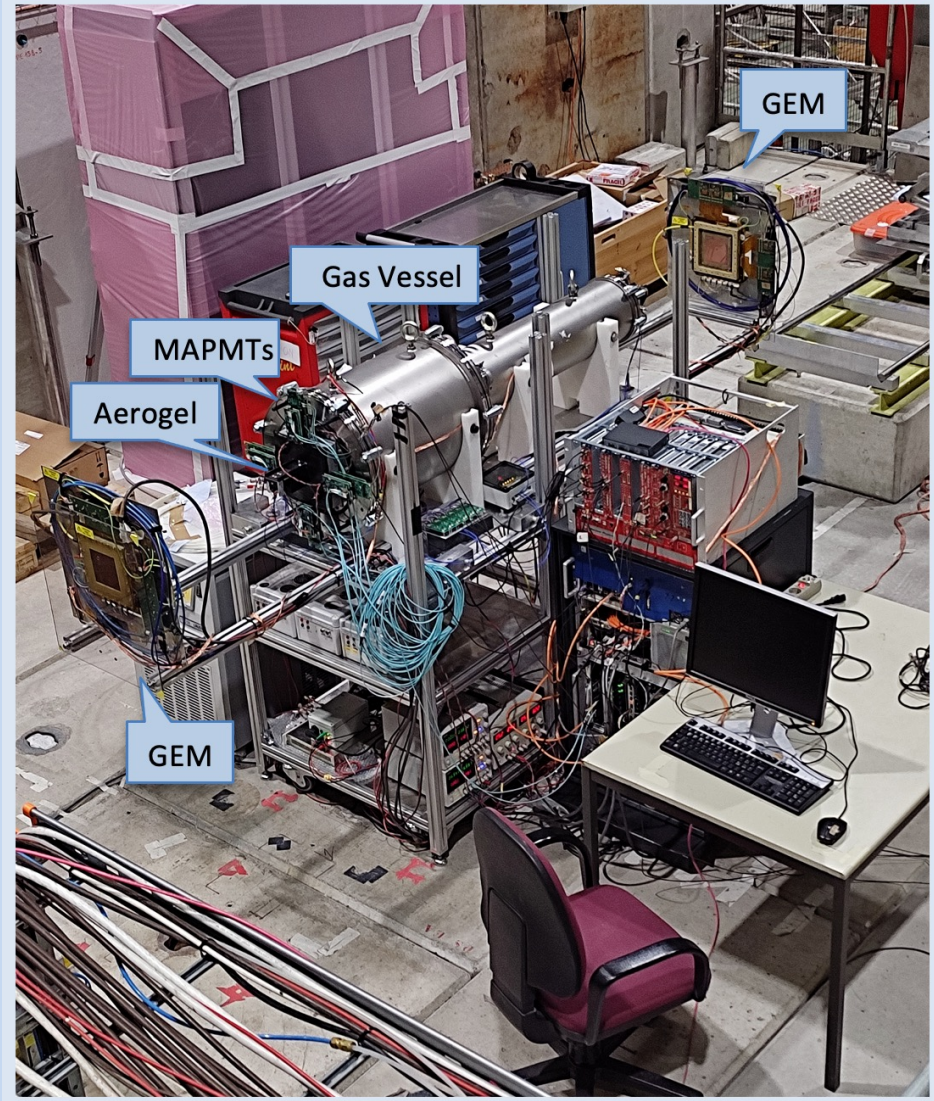
Two radiators: Aerogel (n_{AERO}~1.02) + Gas (n_{C2F6} ~ 1.0008)

SiPM Detector: 0.5 m^2/sector , 3x3 mm^2 pixel

Phase Space:
- Polar angle: 5-25 deg
- Momentum: 3-60 GeV/c

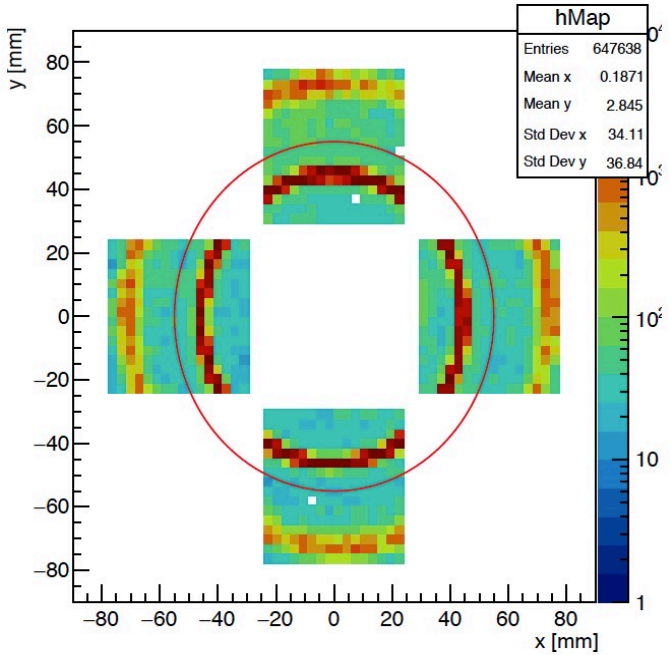
dRICH Prototype - MAPMTs

Operative prototype commissioned. Double ring imaging achieved. Performance in line with expectations except for aerogel single-photon angular resolution (worse by a factor ~ 1.5)



Two radiator concept validation (with a reference MAPMT readout)

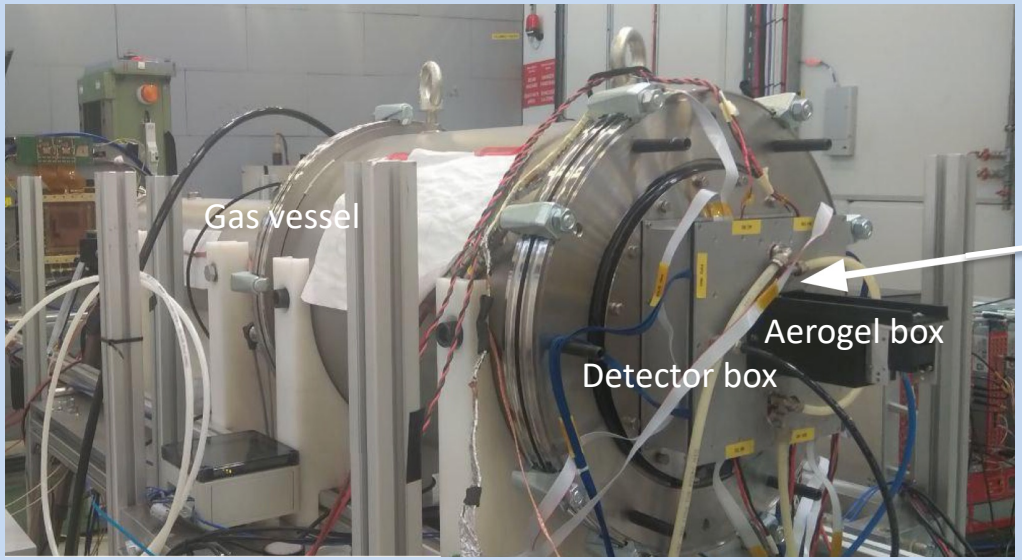
Reference readout from CLAS12 RICH:
H13700 MA-PMTs + ALCOR3 ToT chip

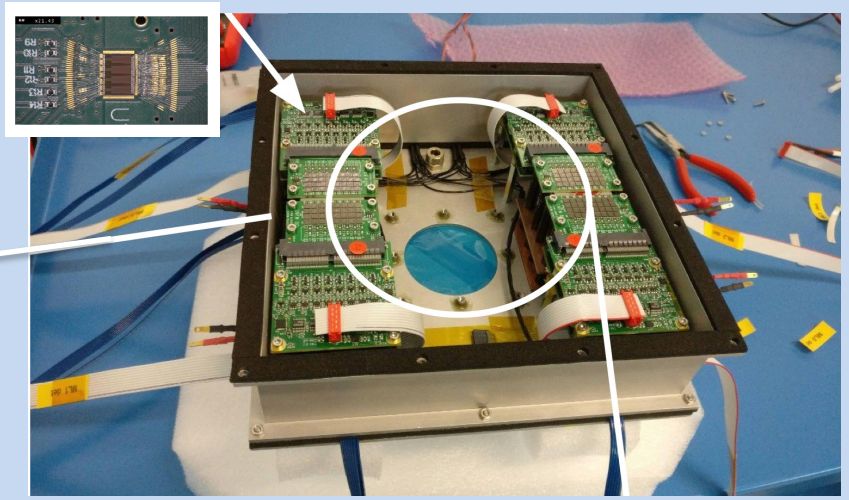


Gas ring coverage: 60%
Aerogel ring coverage: 40 %

dRICH Prototype - SiPM

Irradiation and annealing campaign performed on various SiPM sensor from different manufacturers



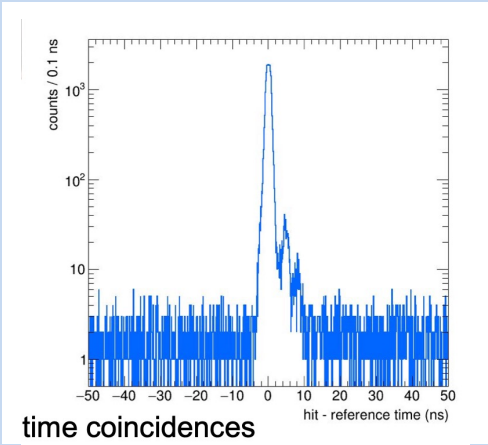


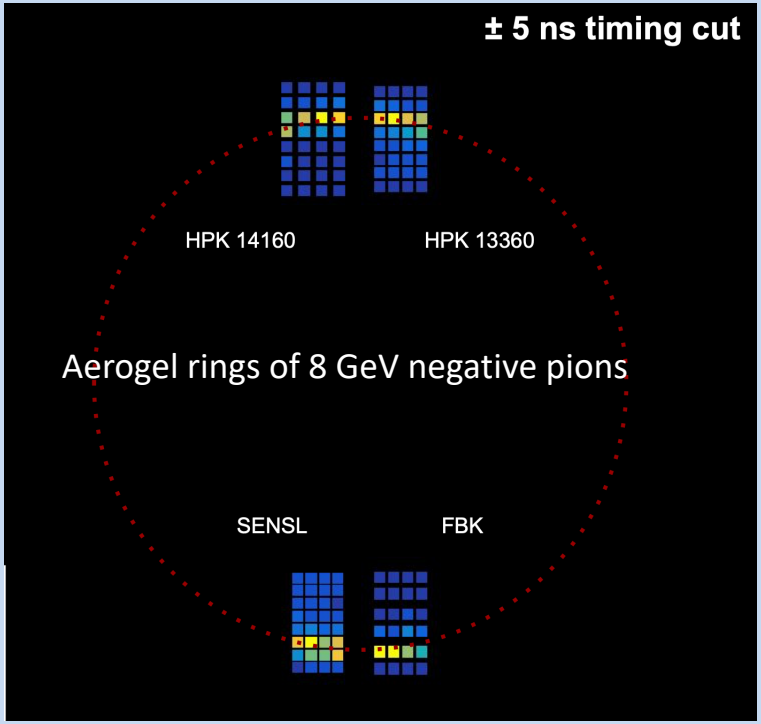
Test beam at CERN PS
dRICH prototype with SiPM+ALCOR readout

Successful Cherenkov ring detection with SiPM

- irradiated
(with protons up to 10^{10} n_{eq})

- annealed
(in oven at 150 C)





EIC-driven Readout Plane

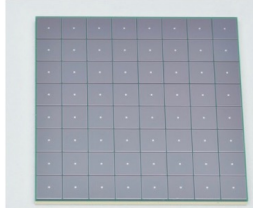
Compact 256 ch unit with integrated cooling and annealing capability

Hamamatsu S13361-3050

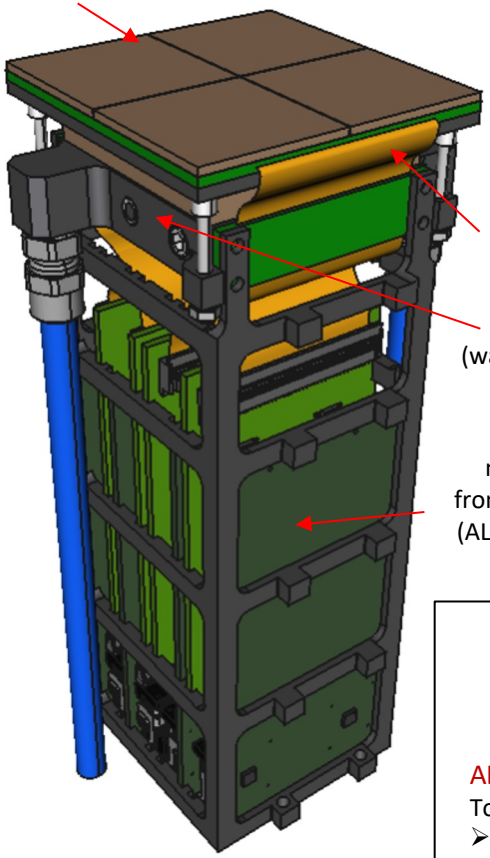
✓

8x8 array
50 µm cell
Excellent fill factor
Best DCR

S14160 alternative



4x SiPM matrix arrays
(256 channels)

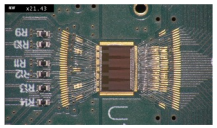


14 cm

flex PCB

cooling stack
(water-cooled Peltier)

minicrate with
fron-end electronics
(ALCOR ASIC inside)



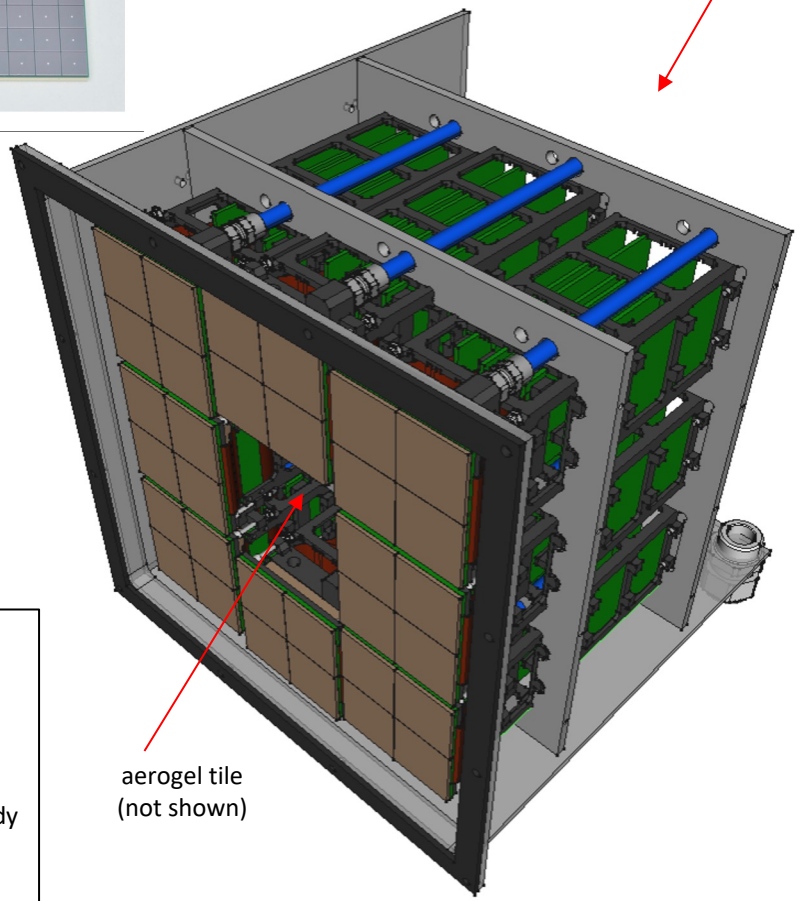
✓

ALCOR v2

ToT architecture, streaming mode ready

- 50 ps time bin
- 500 kHz rate per channel
- cryogenic compatible

cables and services
(not shown)

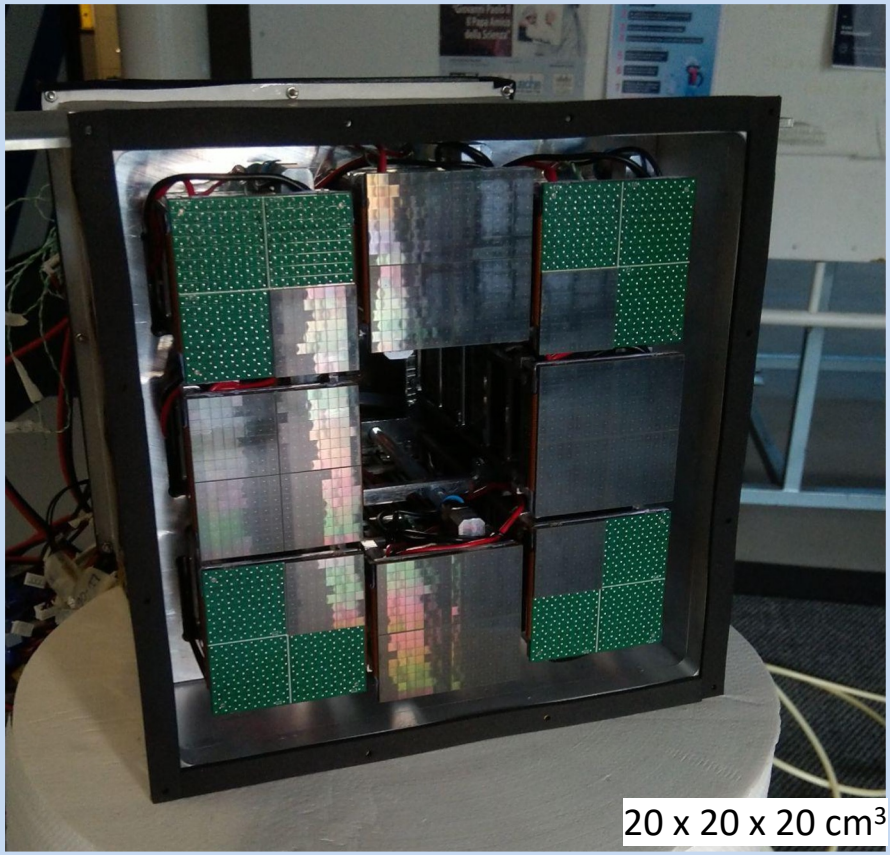


aerogel tile
(not shown)

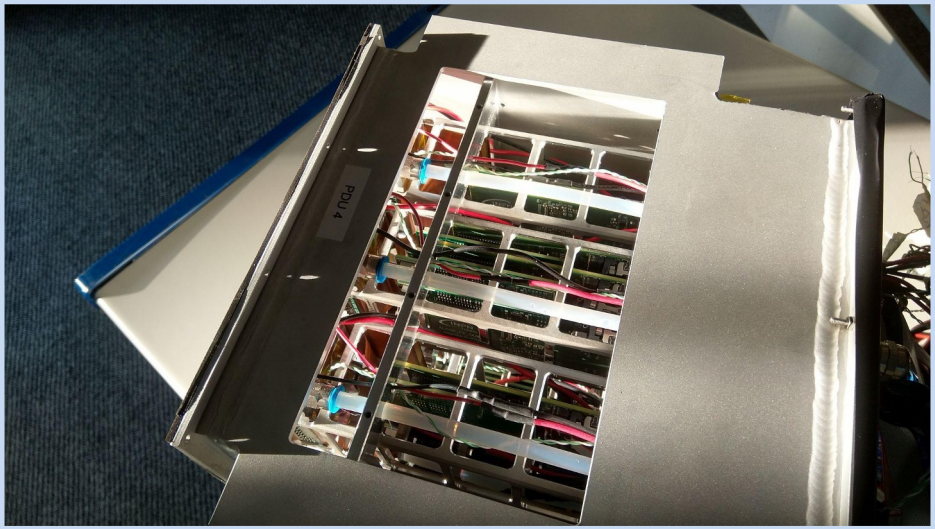
EIC-driven Readout Plane

Compact 256 ch unit with integrated cooling and annealing capability

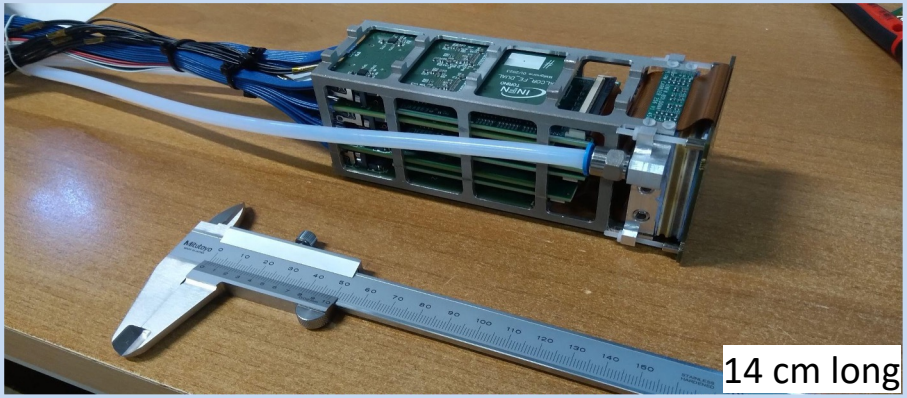
Readout Box (front)
Instrumented with more than 1000 channels



Readout Box (top)

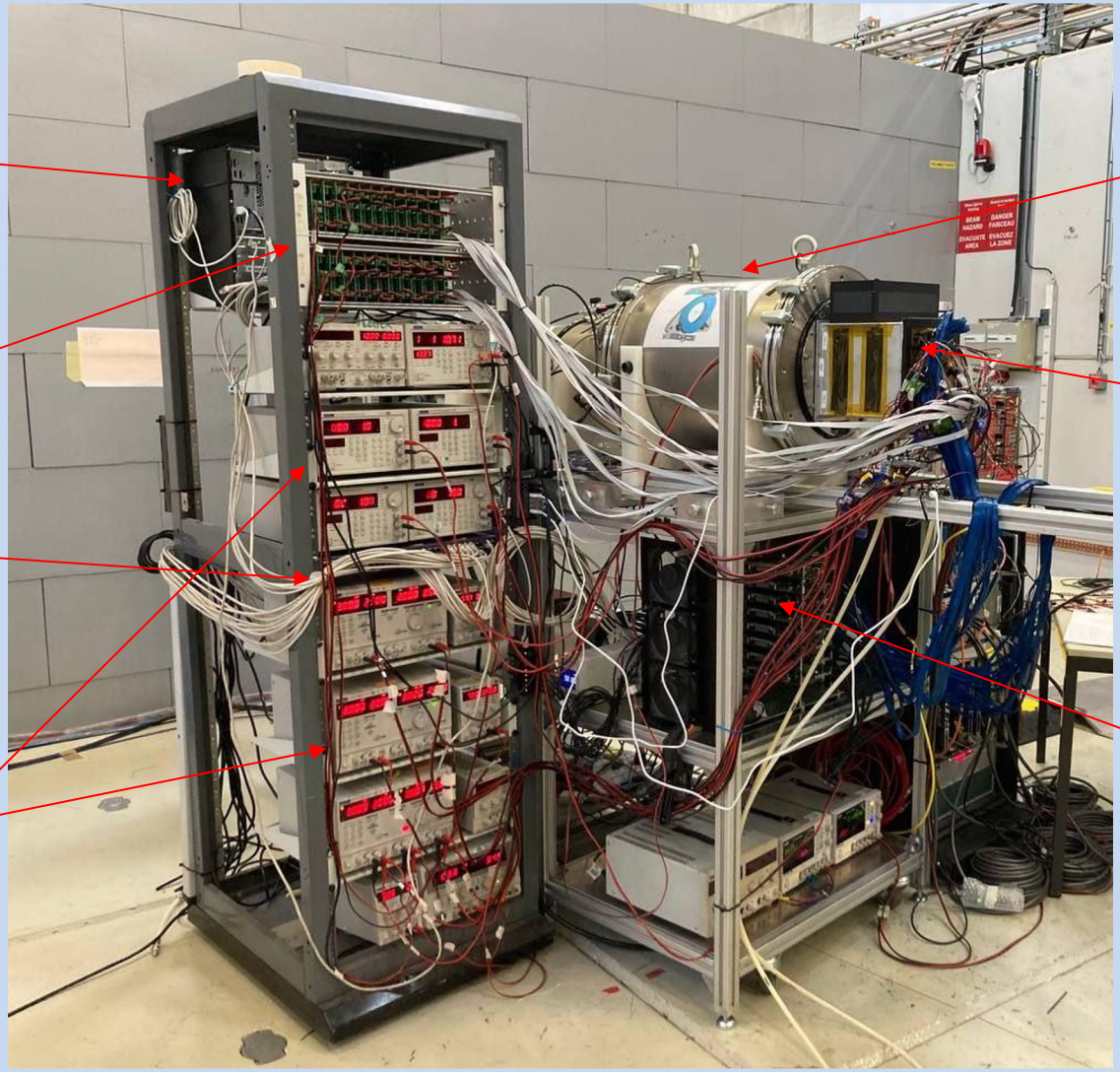


Photon Detector Unit (PDU)



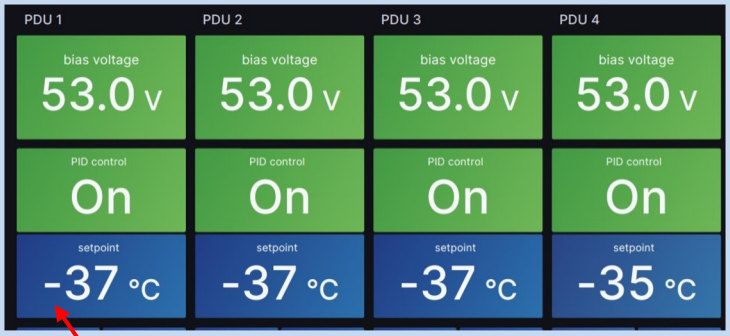
dRICH Prototype – EIC readout

Beam test at CERN PS-T10 beam line: October 2023



dRICH Prototype – EIC readout

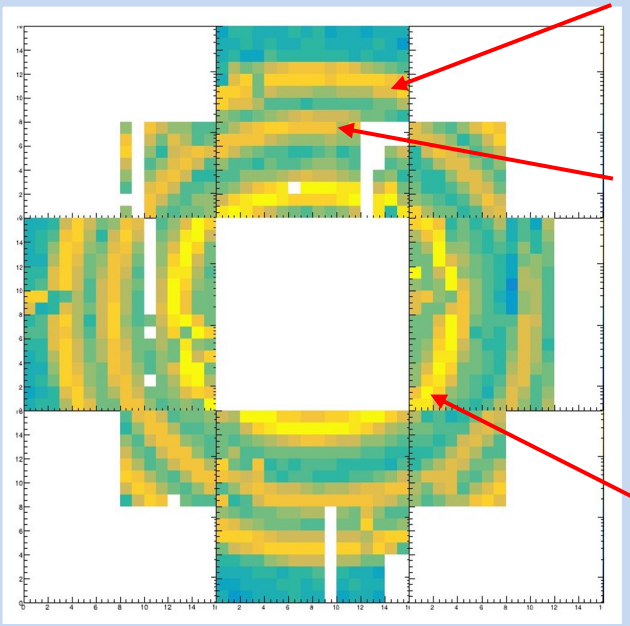
Online monitors and QA plots indicate a successful beam test. Analysis is ongoing



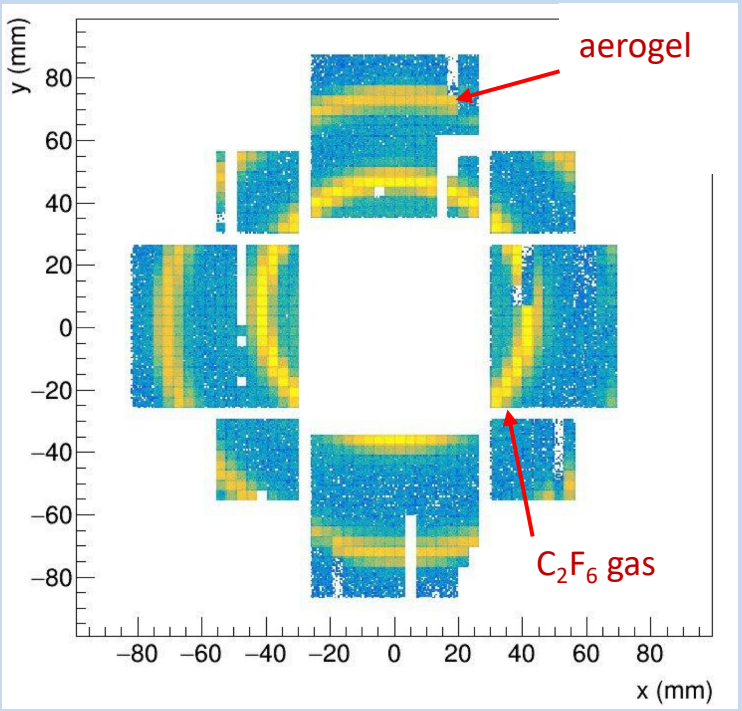
low temperature SiPM operation

Successful imaging with a compact EIC-driven readout plane based on SiPM + ALCOR

8 GeV positive beam



10 GeV positive beam



Status and Plans

2022: dRICH imaging with reference detectors

Extended SiPM irradiation + annealing campaign

Cherenkov light detection with irradiated SiPM

2023: EIC-drive photon-detector plane

dRICH imaging with EIC-driven detector plane

Outlook: Refined data analysis and simulation

Final assessment