

Attività 2025
Richieste 2026

ALICE-HMPID (High Momentum Particle Identification) detector

09/07/2025

G. Volpe
University & INFN, Bari

Contributing institutes:

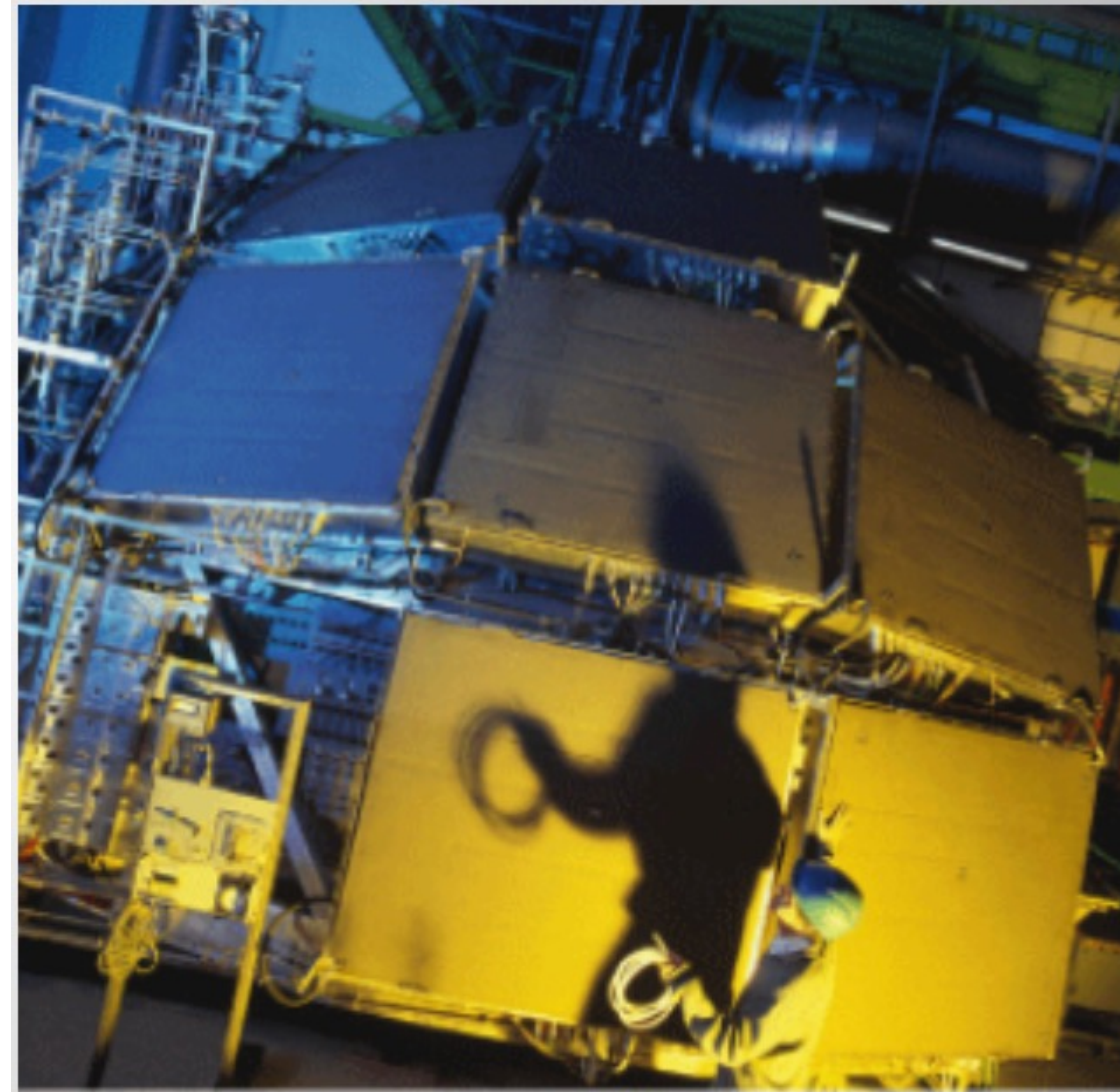
- 80% INFN Bari
 - G. Volpe PL and G. De Cataldo deputy PL
- 20% CERN team

Participating institutes with in-kind contributions:

- Centro de Aplicaciones Tecnológicas y Desarrollo Nuclear (CEADEN), Lavana, Cuba
- Wigner Inst. Budapest, Hungary.
- Dep. of Physics and CIT dept. of the University of Malta, Msida, Malta;
- The Malta College of Arts, Science and Technology (MCAST), Malta.

7 RICH (Ring Imaging CHerenkov) modules

- $\sim 1.3 \times 1.3 \text{ m}^2$ for a total CsI active area of $\sim 11 \text{ m}^2$
- (@ 3σ) π/k **identification** in 1-3 GeV/c and protons in 1.5-5 GeV/c momentum intervals;
- $|\eta| < 0.5$

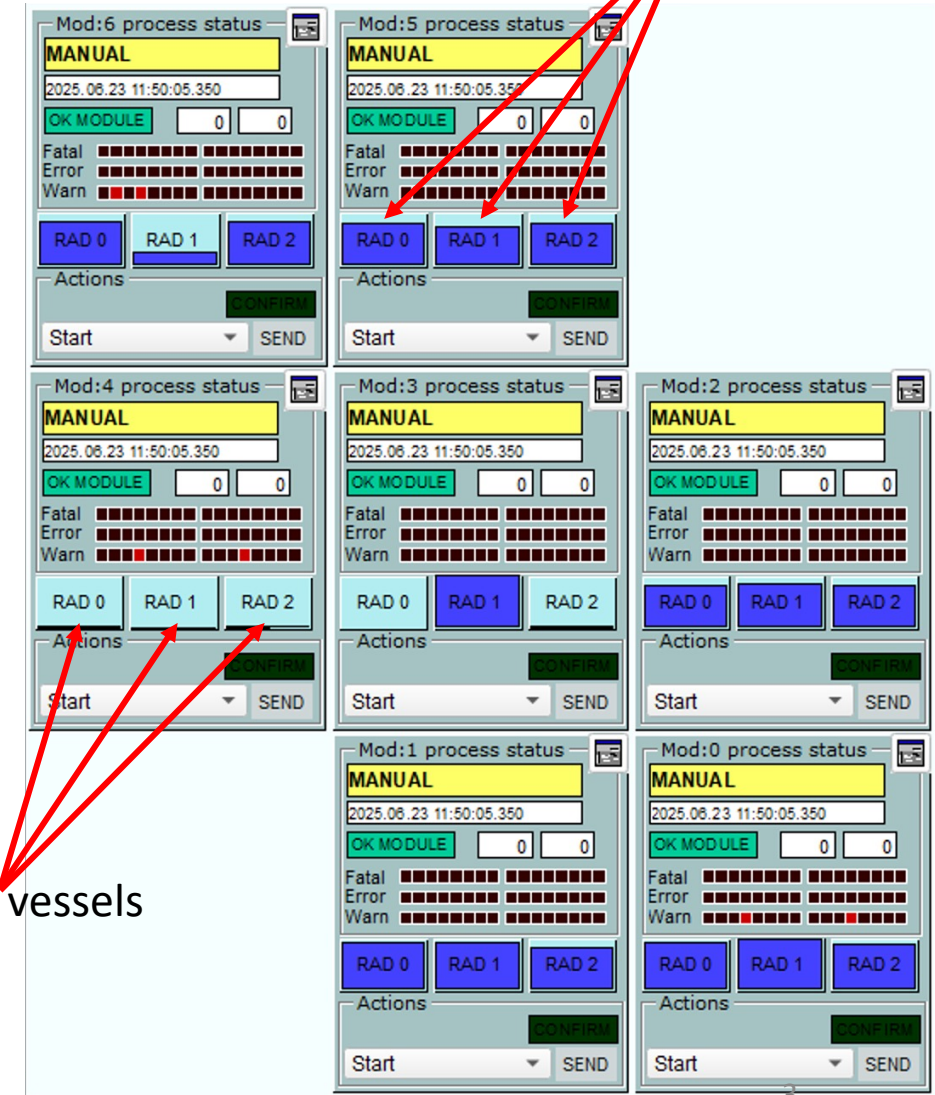
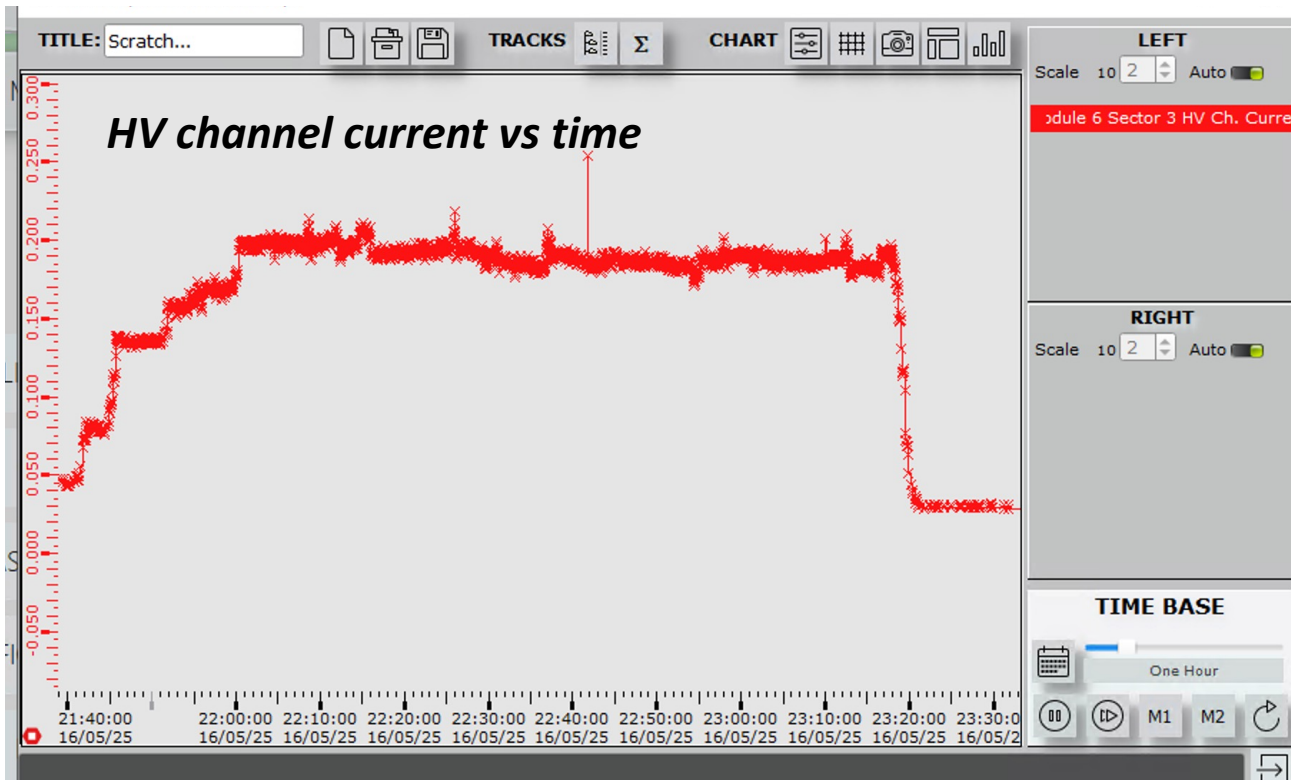


No activities on the detector hardware are ongoing or foreseen

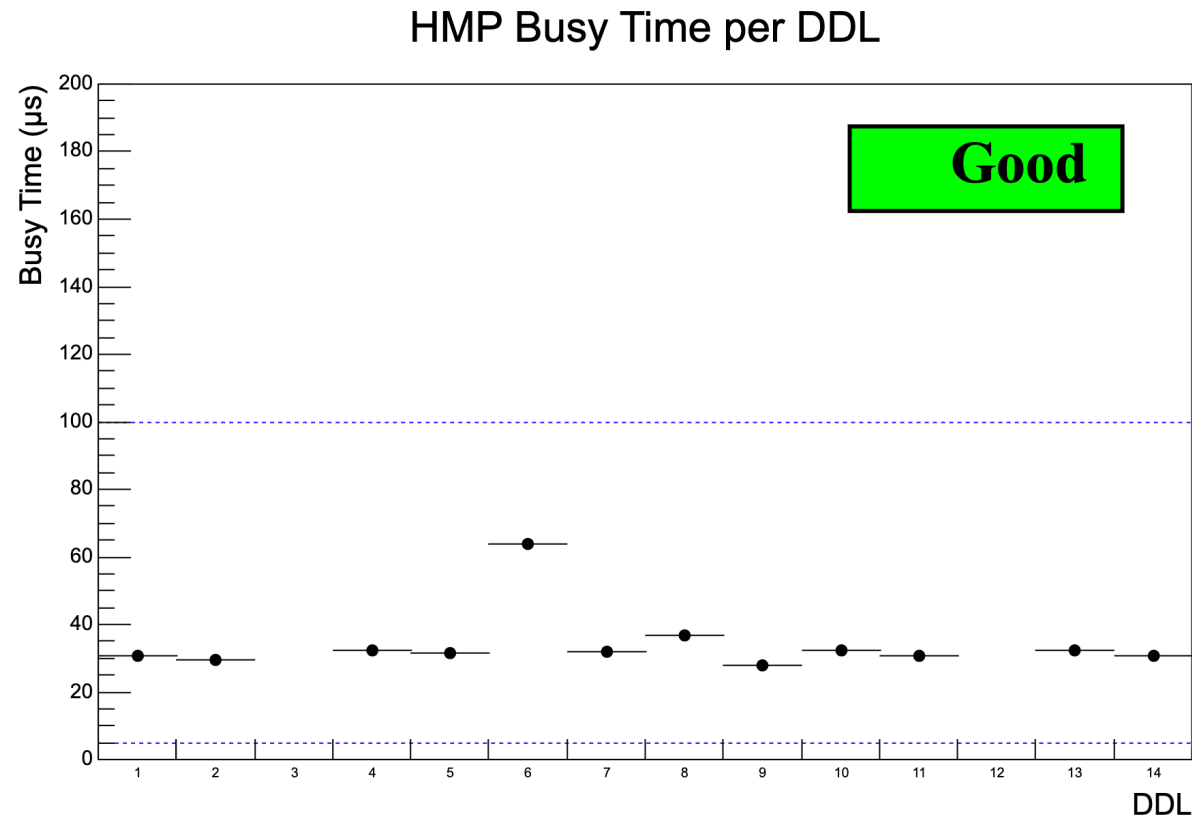
- MWPCs flushed with CH_4 and C_6F_{14} radiator vessels with no leaks filled-up.
- The High Voltage Channel stability is very good.

Filled vessels

Empty vessels



- The readout is in general very stable.
 - Event readout rate up to $\cong 21$ kHz (in pp collisions)
- HMPID has so far participated in almost all the good physics runs



Simulation and reconstruction

- HMPID geometry and hits creation → implemented and committed
 - Implement aluminium absorbers in the detector geometry → implemented and committed
- Digitization from hits → implemented and committed
- Digit from raw data → implemented and committed
- Raw data simulation → implemented and committed
- Clusterization → implemented and committed
- Track matching and Cherenkov angle reconstruction → implemented and committed
- AO2D → implemented and committed

Calibration

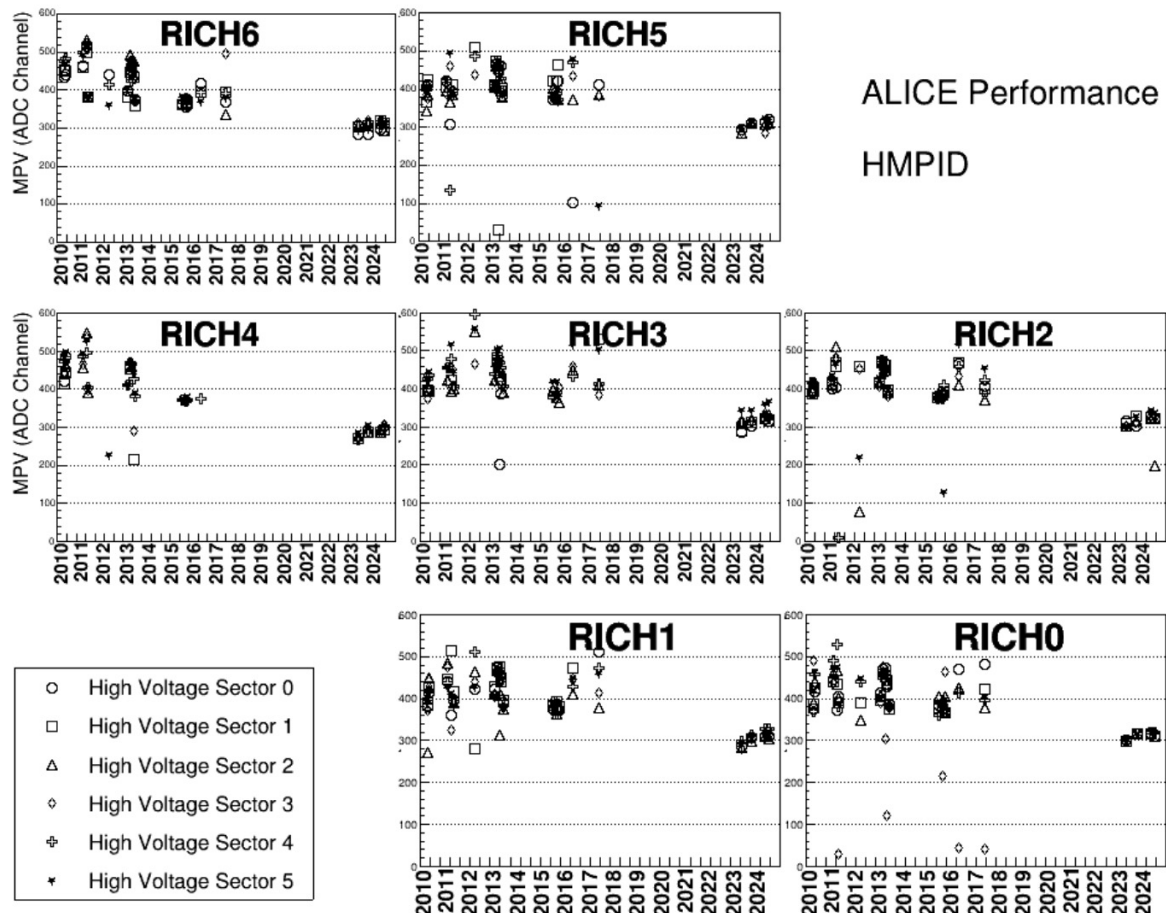
- calibration procedure for HMPID similar to that used in RUN1 and RUN2
 - Pedestal calculation and CCDB writing workflow: implemented and committed
 - Chamber gain and refractive index calibration and CCDB writing workflow: implemented and committed

Quality Control

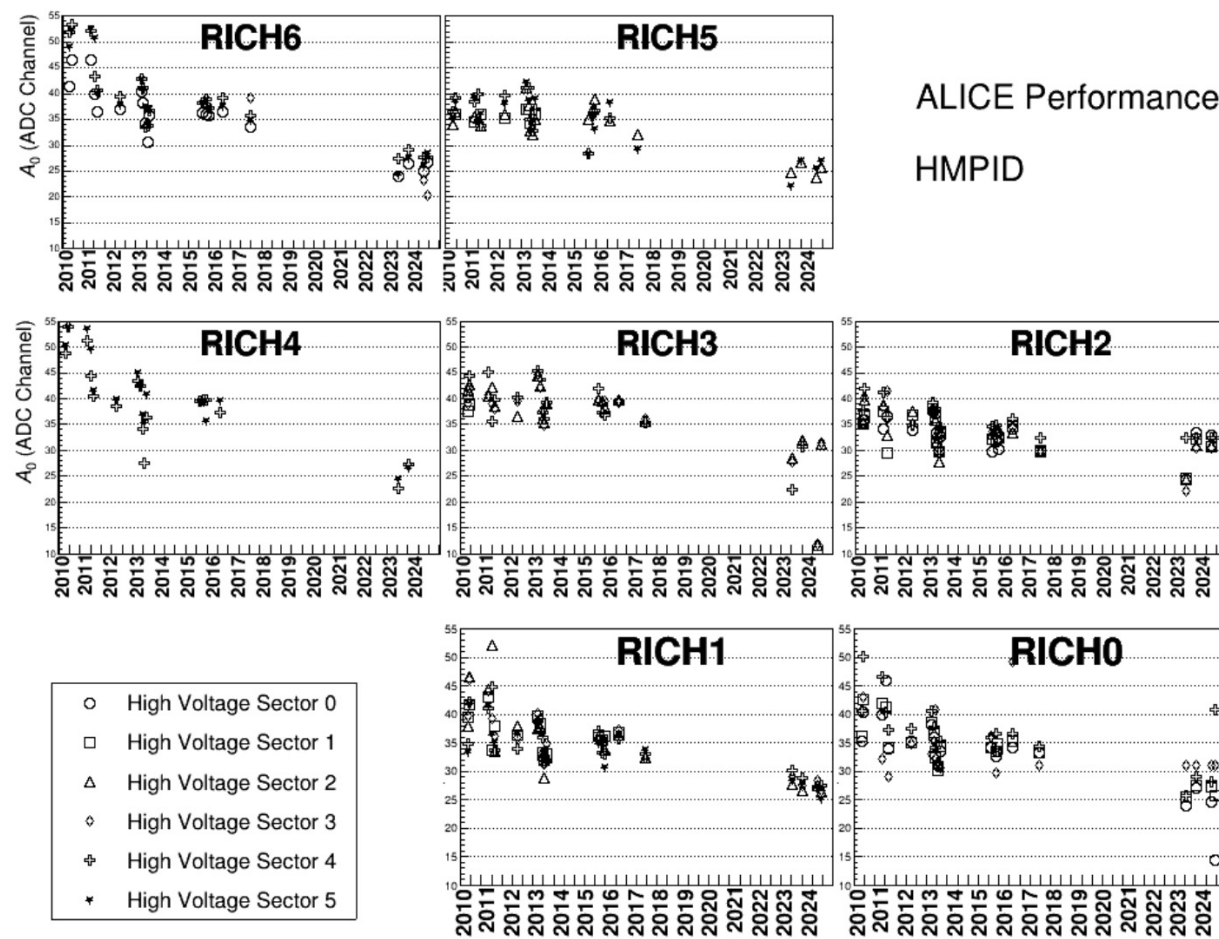
- Sync QC: raw data task → implemented and committed
- Quality raw data checker → implemented and committed
- Async QC: clusters and matching infos → implemented and committed

HMPID performance in Run 3

Most probable value (MPV) of the MIP charge distributions for each chamber and HV sector



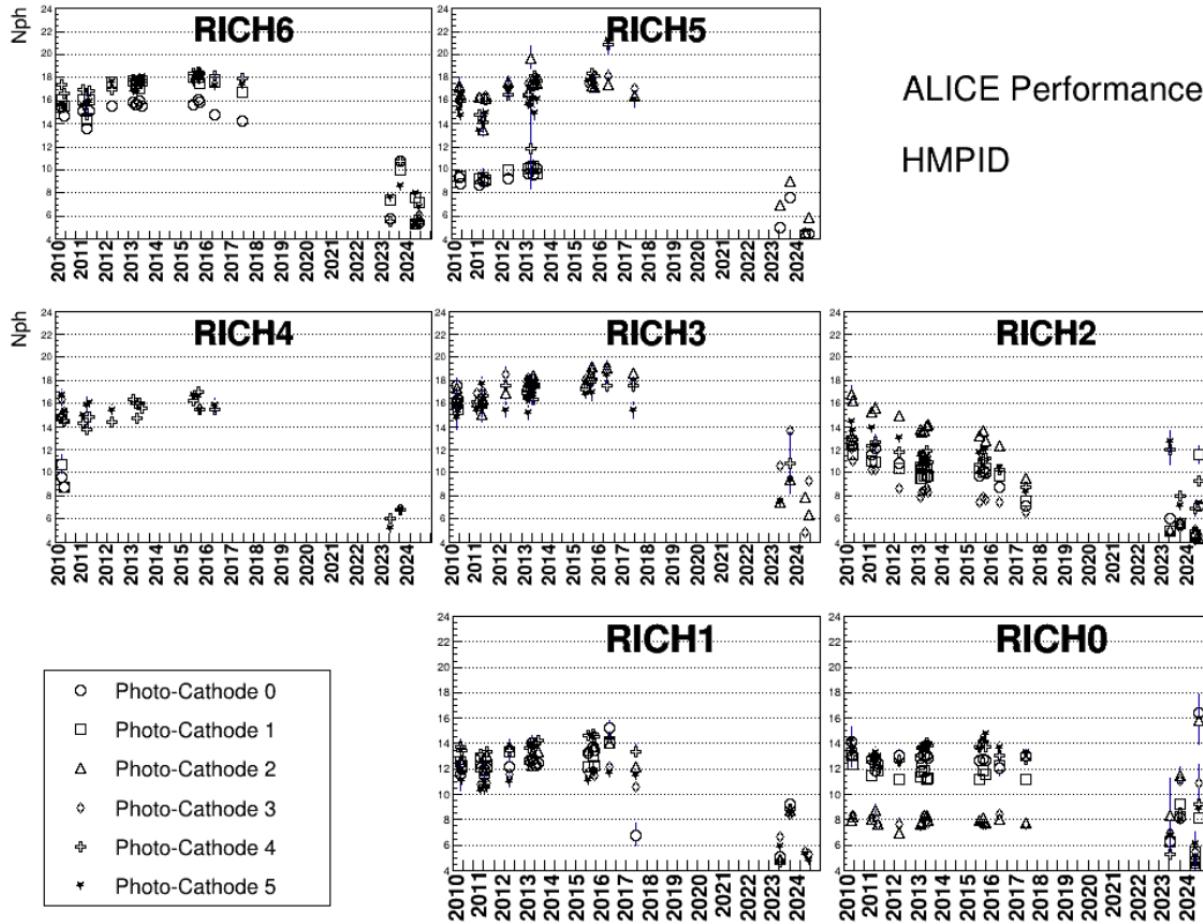
Gas Gain for each chamber and HV sector



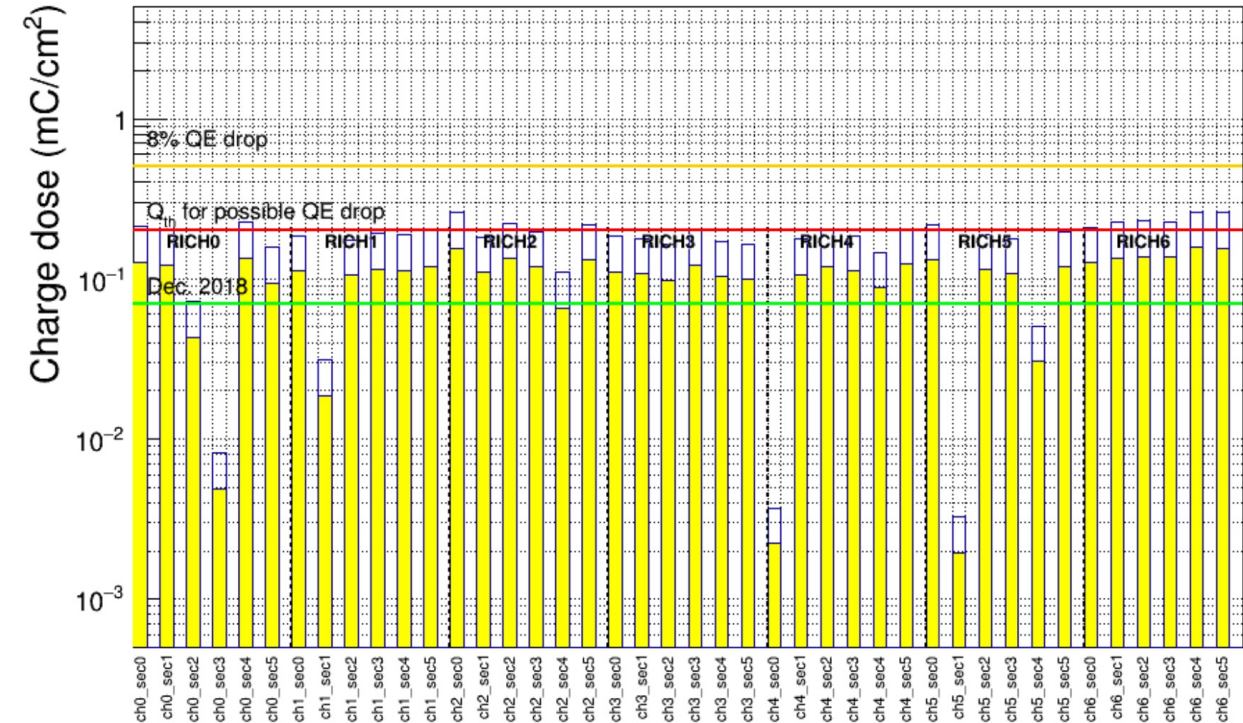
Lower gain in RUN 3, to be investigated!

HMPID performance in Run 3

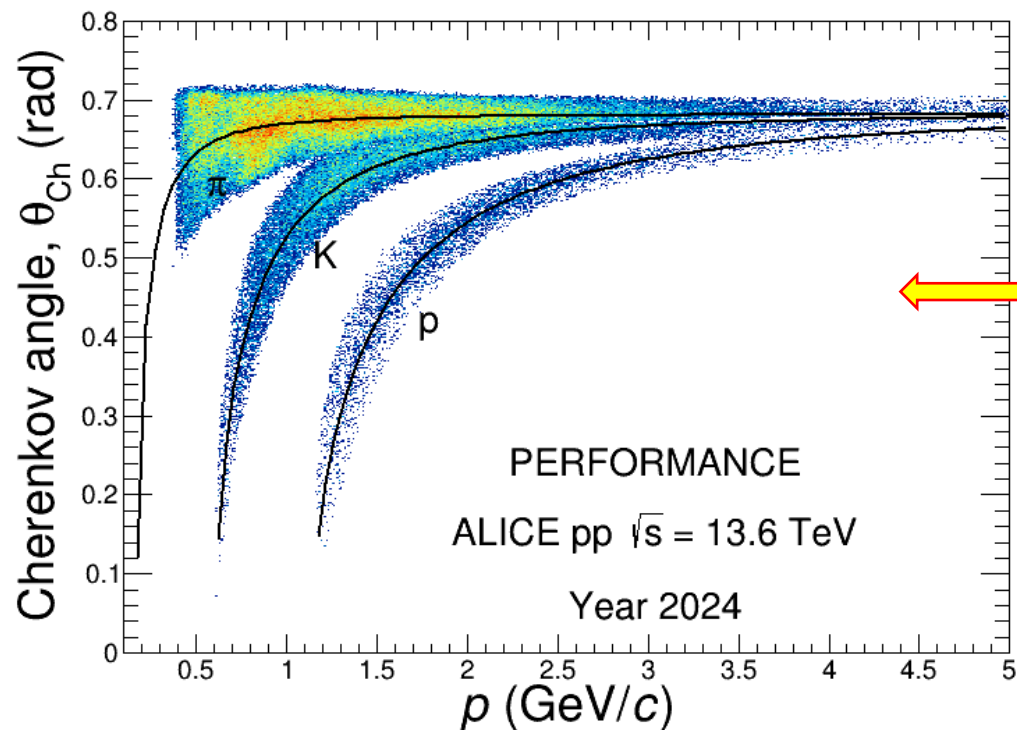
Number of photons for each chamber and photocathode (PC)



Charge dose summary

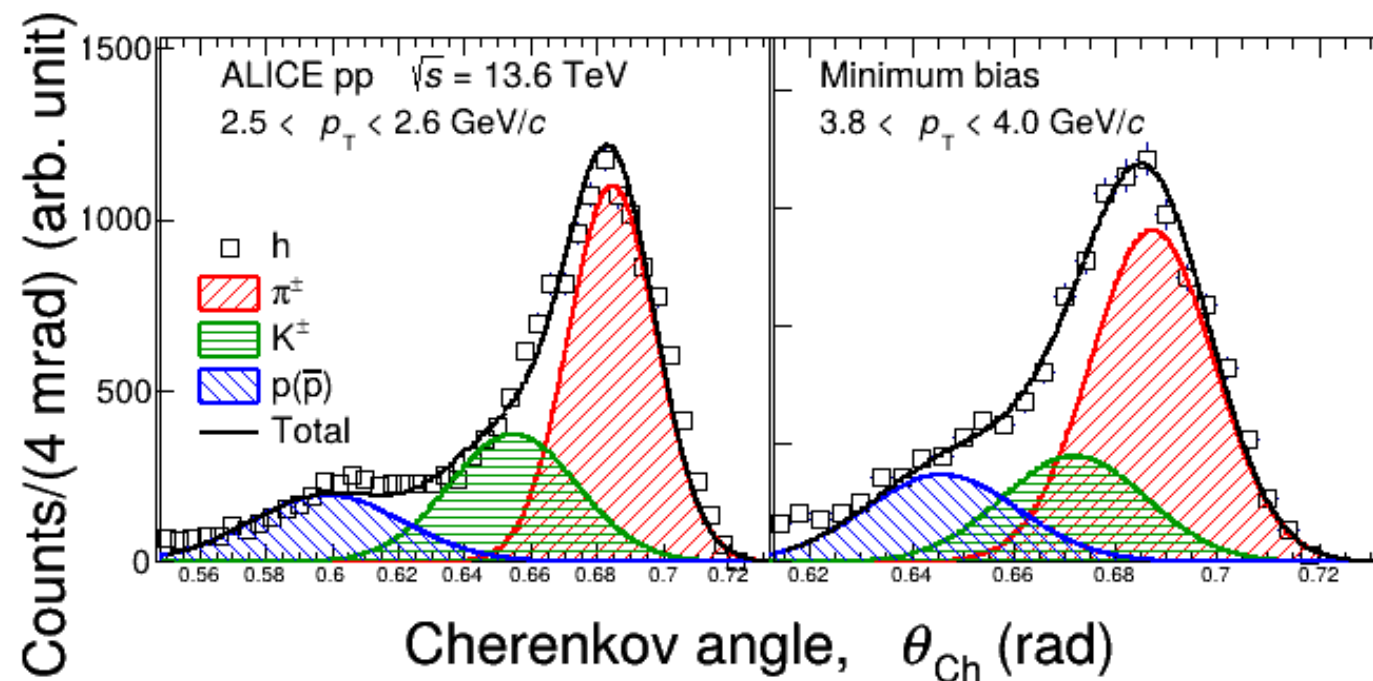


HMPID performance in Run 3



*Cherenkov angle vs
track momentum*

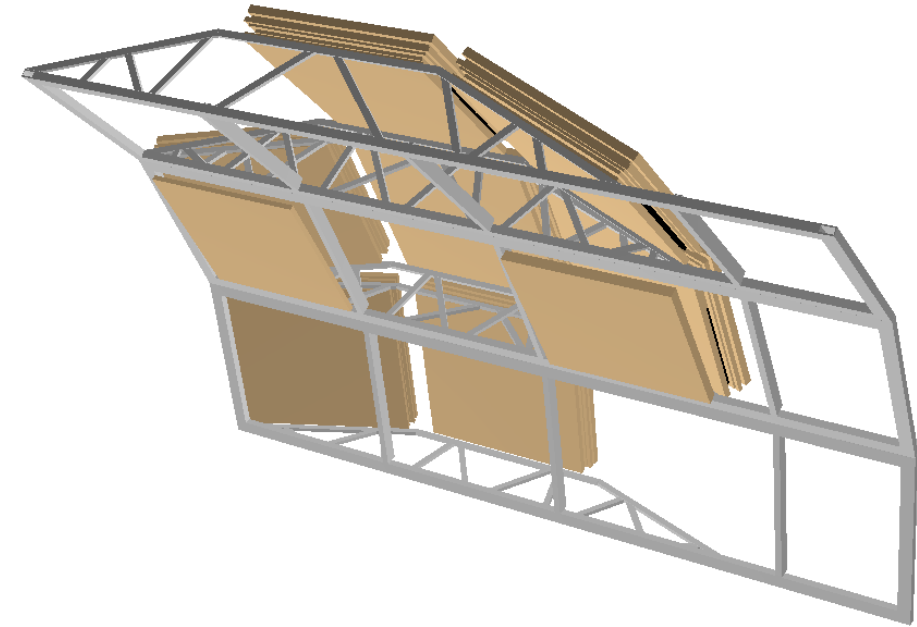
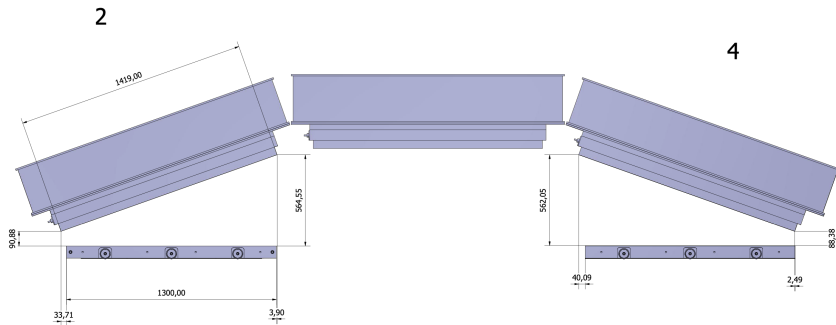
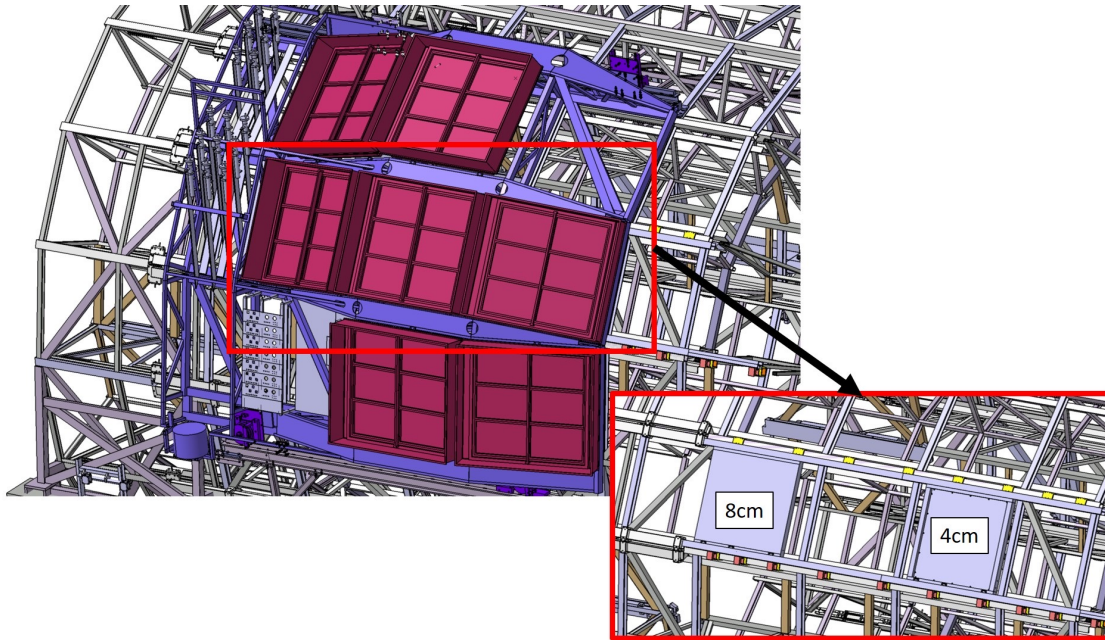
*Distribution of the Cherenkov angle
measured in the HMPID for positive
tracks in two transverse momentum bins*



Absorbtion cross section measurement

Two aluminium absorbers were installed on front to HMPID chamber 2 and 4 for anti-deuteron inelastic absorbtion cross section measurements

- Implemented in the detector geometry in O²



Development of software tools for analysis of anti-deuteron absorbtion cross section and pions, kaons, protons and light nuclei momentum spectra.

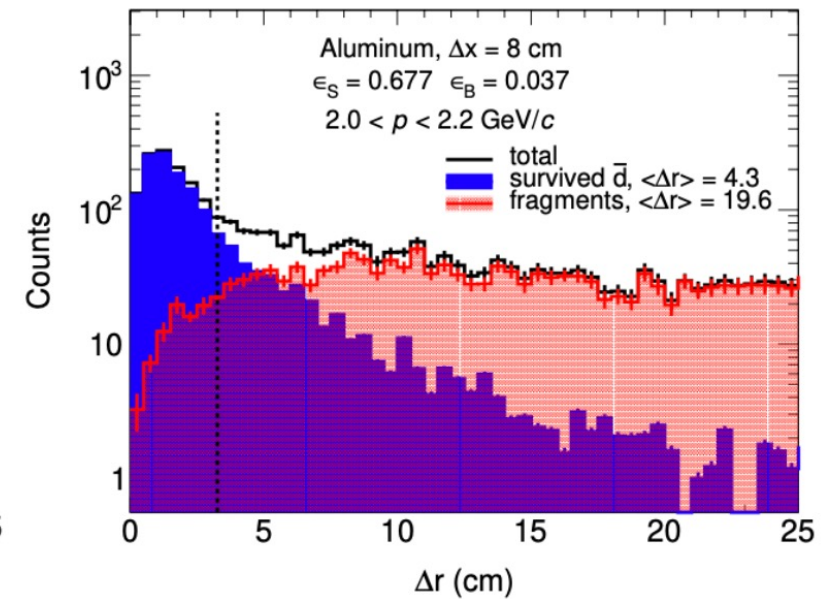
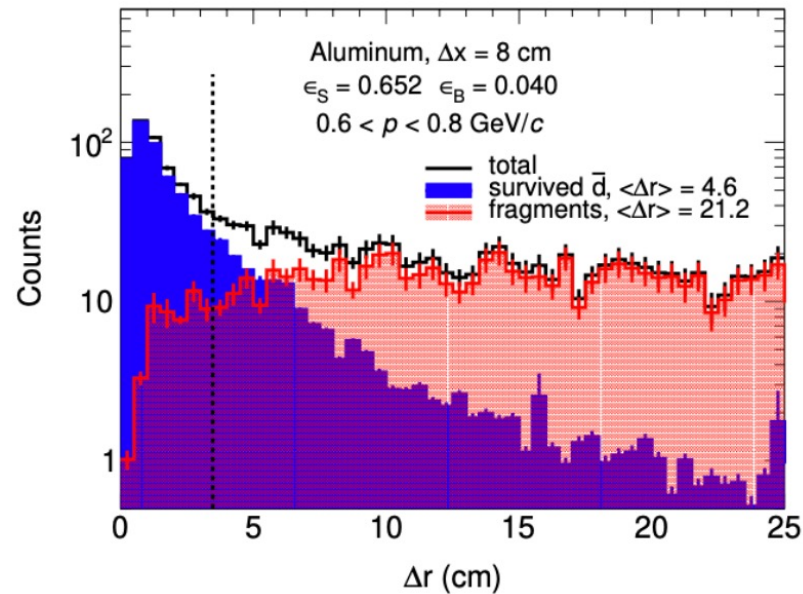
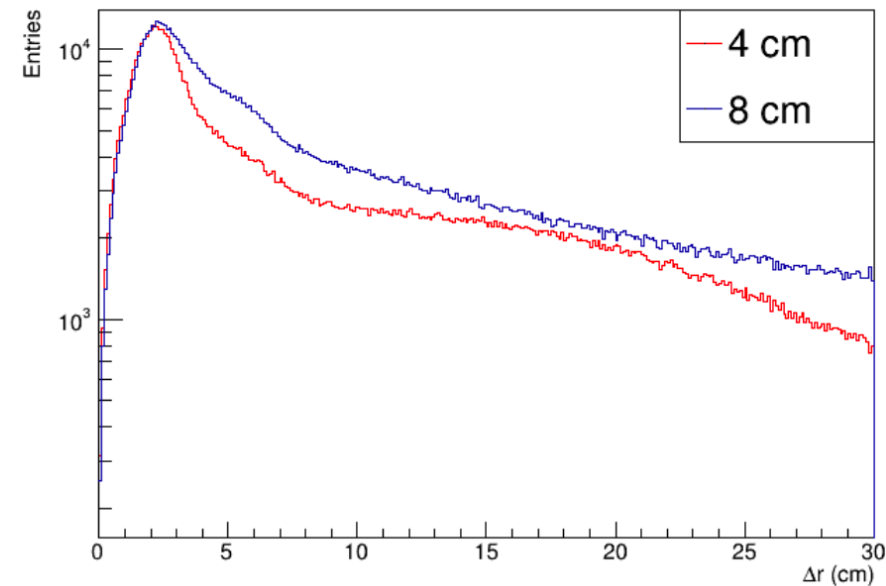
Next: extend the analysis of the absorbtion cross section also to pions, kaons and protons.

Milestone 2025: Implementazione strumenti software per le misure della sezione d'urto di assorbimento di pioni, kaoni e protoni → 60 %⁹

Absorption cross section measurement

- Δr is the distance between the reconstructed MIP track in HMPID and the extrapolated track from the ALICE tracking system.
- The number of surviving (anti-)deuterons will be extracted from the fitting procedure of the Δr distribution using the MC template to discriminate the signal from the background.

Surviving Anti-Deuterons



Budget request (M&OB) for 2025

The HMPID will be brought at the surface and dismantled during 2026;

As from 2023 till 2025, the maintenance and interventions will be reduced at the minimum;

The total for 2026 is an estimate for the detector removal and dismantling ;

The expected increase of A08 areas is just an estimate for the infrastructures in the dismantling area.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Budget	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Comments		
2	A01 Mechanics																Comment from A01 till A11.3 : the HMPID will be brought at		
3	A02 Gas Systems	25	15	10	15	15	15	15	5	5	10	10	5	5	5	0			
4	A03 Cooling Systems	4	4	4	4	4	4	4	2	2	4	4	1	1	1	0			
5	A04 FEE spares	6	1	1	1	1	1	1	1	1	0	0	0			0			
6	A05.1 Standard Electronics LV/HV PS	8.5	4	4	4	4	4	10	4	4	0	0	0			0			
7	A05.2 Standard Electronics Crates	2	1	1	1	1	1	1	1	1	0	0	0			0			
8	A05.3 Standard Electronics R/O modules																		
9	A06 Controls (DCS & DSS)	3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0	0	0			0			
10	A07 Sub-Detector spares																		
11	A08 Areas	50	35	30	25	25	25	25	20	15	10	10	5	5	5	10			
12	A09 Communications	8	8	8	8	8	8	8	8	8	8	5	5	5	5	0			
13	A10 Store Items	8	8	8	8	8	8	8	8	8	8	5	5	5	5	5			
14	A11.1 Technical Manpower @ CERN: Industrial Support	10	5	10	5	5	5	5	5	5	5	1	2	2	2	5	Comment from raw 1 to 15: the HMPID will be brought at t		
15	A11.3 Technical Manpower @ CERN from Collaborating Institutes	20	10	15	10	10	10	10	10	10	5	15	2	2	2	5			
16	Total	144.5	92.5	92.5	82.5	82.5	82.5	88.5	65.5	60.5	50	50	25	25	25	25			
17																			
18	A11.2 Technical Manpower @ CERN from Collaborating Institutes (in man-months)																		

M&OB = 20 kCHF (INFN) + 5 kCHF (CERN)

	P
5	2026
5	0
1	0
	0
	0
	0
5	10
5	0
5	5
2	5
2	5
5	25

- The HMPID detector is fully operational
 - Software in O² (simulation, reconstruction, quality control) completed.
 - Stable data taking.
 - Lower chamber gain observed in Run 3 w.r.t. Run2 → investigating
 - A huge amount of pp and Pb-Pb data have been collected so far
 - Performance studies have started. Physics measurements will come soon (light nuclei p_T spectra, anti-deuteron absorption cross section).
- **Milestone 2025:**
 - *Implementazione strumenti software per le misure della sezione d'urto di assorbimento di pioni, kaoni e protoni → 60 %*
 - *Partecipazione con alta efficienza alla presa dati durante tutti i periodi di fascio → so far participation in all the run periods: 50 %*
- **Milestone 2026:**
 - *Partecipazione con alta efficienza alla presa dati durante tutti i periodi di fascio*
- **After contributing to LHC Runs 1, 2, and 3, the detector will be removed from the ALICE apparatus at the end of Run 3, scheduled for next year.**