

Muon IDentifier: status e richieste

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ALICE Muon Identifier

- 72 Resistive Plate Chambers arranged in 4 detection planes
- Single RPC areas range from $72 \times 223 \text{ cm}^2$ to $76 \times 292 \text{ cm}^2$
- Main LS2 upgrades:
 - continuous read-out
 - new FEE with amplification
 - low-gain operation during Run3-4

Responsibilities:

Torino: Gas gaps, external mechanics, control system, gas system.

- ~ 7 FTE
- Ruoli di responsabilità in MID:

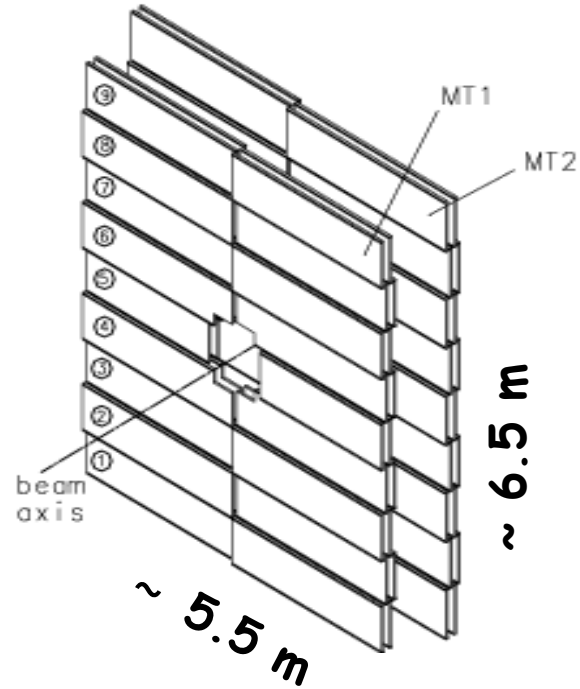
Muon Identifier Sub-Project Leader (A. Ferretti)

Muon Identifier Technical Coordinator (P. Mereu)

Muon Identifier (+MCH) Subsystem Run Coordinator (L. Terlizzi)

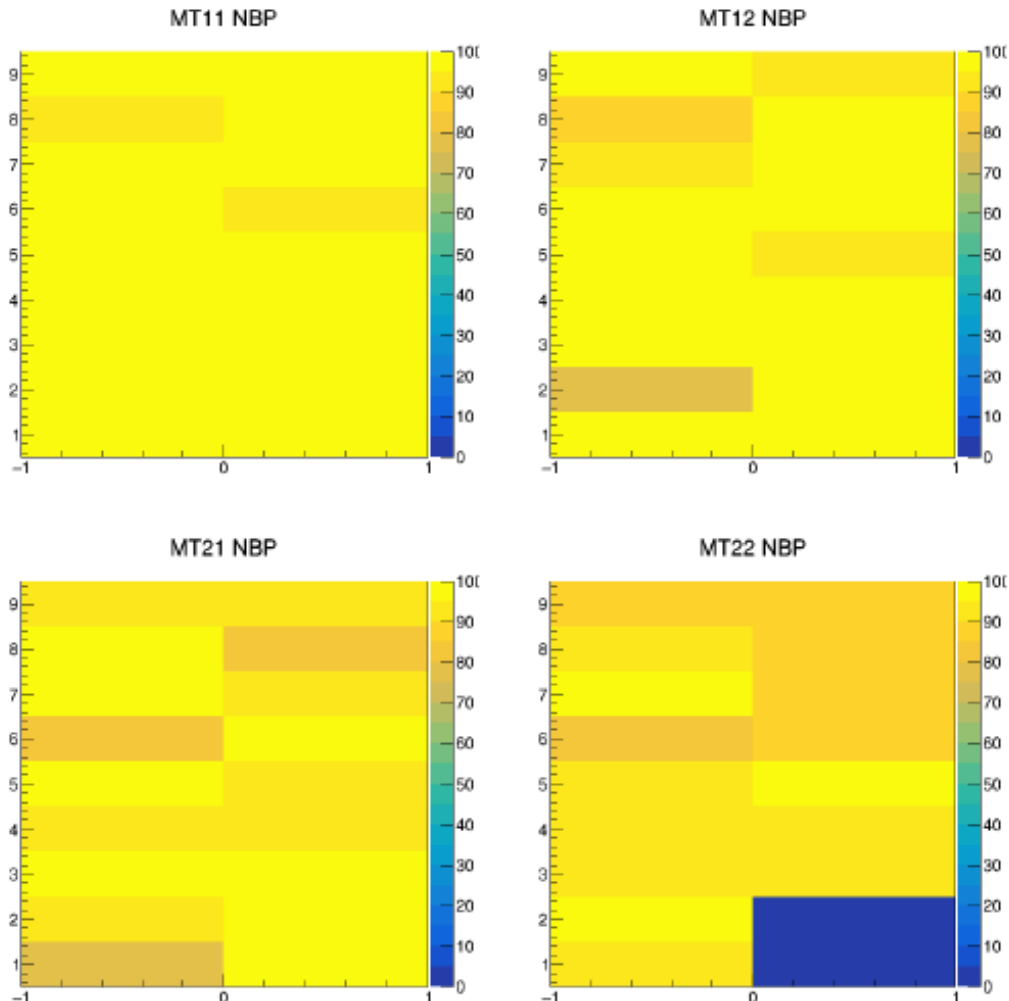
+ Muon Spectrometer Project Leader (M. Gagliardi)

Clermont-Ferrand + Nantes (F), iThemba (SA):
front end and readout electronics, software



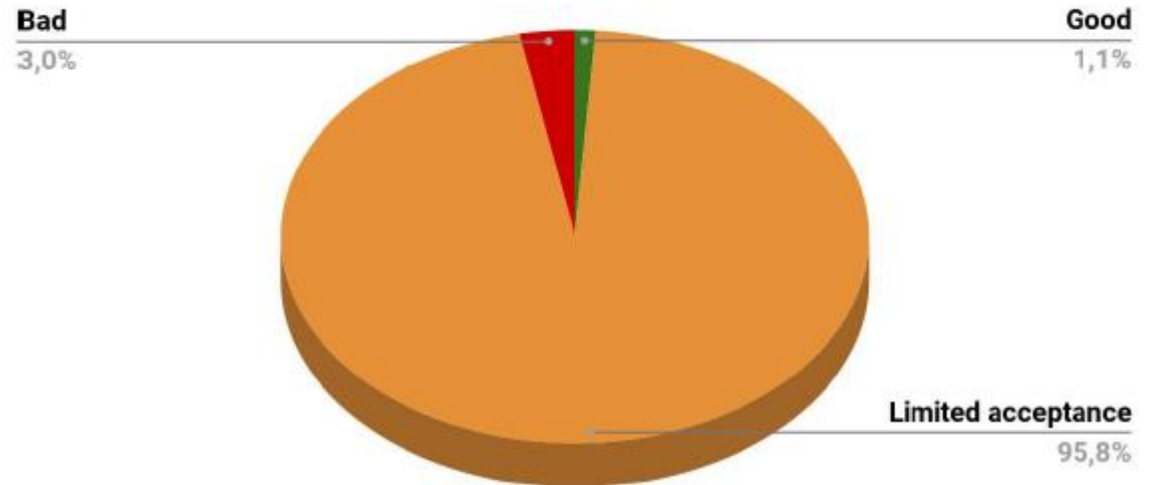
Detector status: 2023 proton data-taking

RPC efficiency (non-bending plane)



- Participation in runs: 99.5%
- Two RPCs replaced during YETS 22/23, but the new ones had wrong HV polarity → loss of acceptance (< 3%)

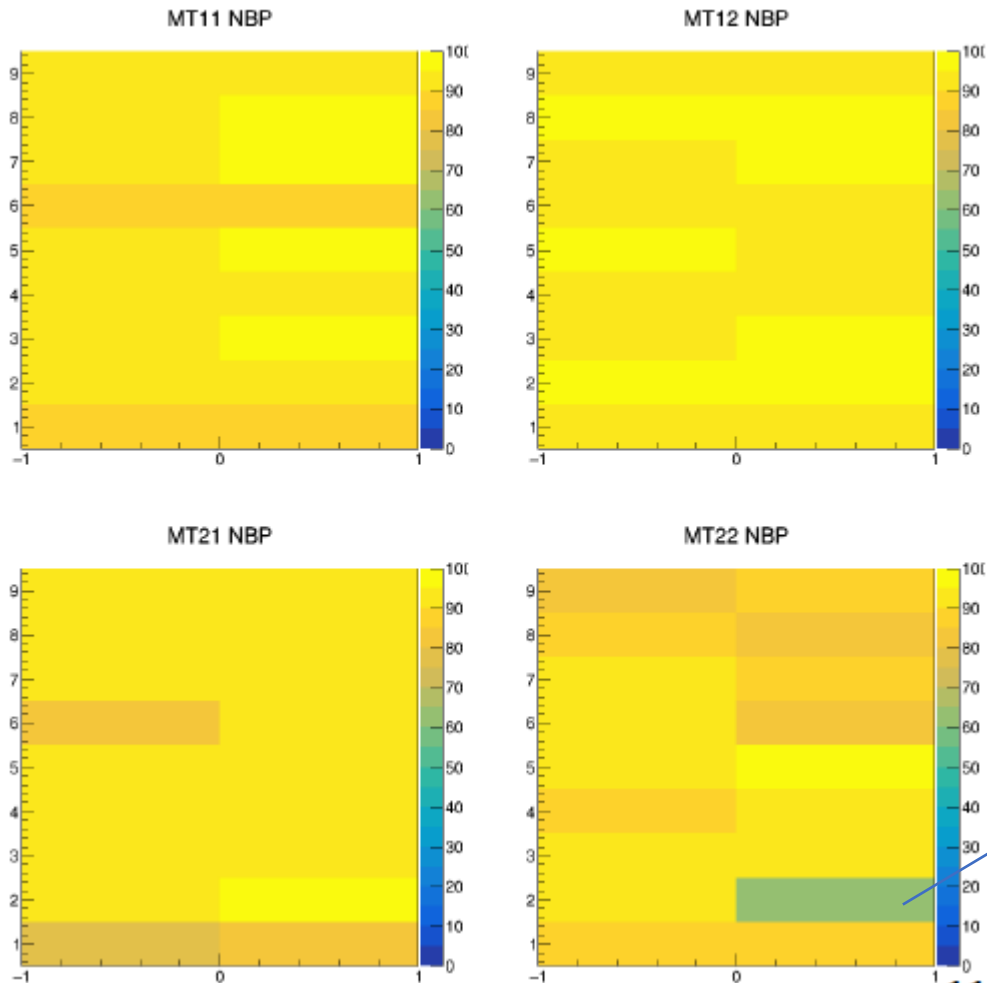
Total runs: 268



Run quality evaluated after asynchronous reconstruction

Detector status: 2023 Pb-Pb data-taking

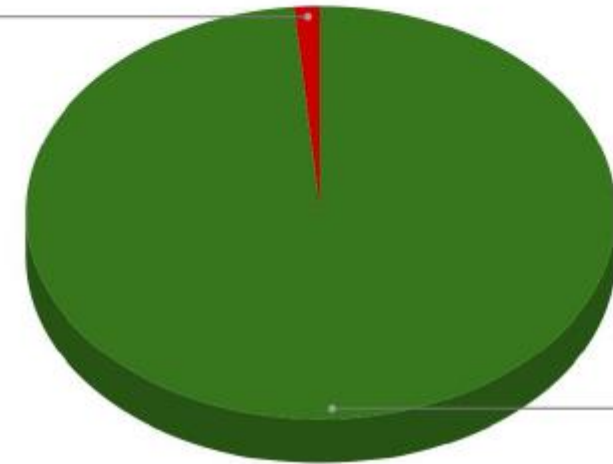
RPC efficiency (non-bending plane)



- Participation in runs: 99%
- RPC polarity issue fixed before Pb-Pb run (discrimination threshold inverted in firmware)
- HV settings still need fine-tuning

Total runs: 141

Bad
1,4%



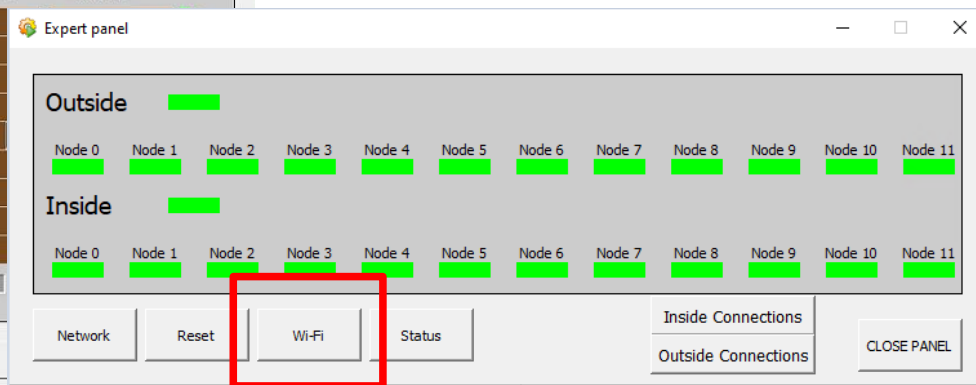
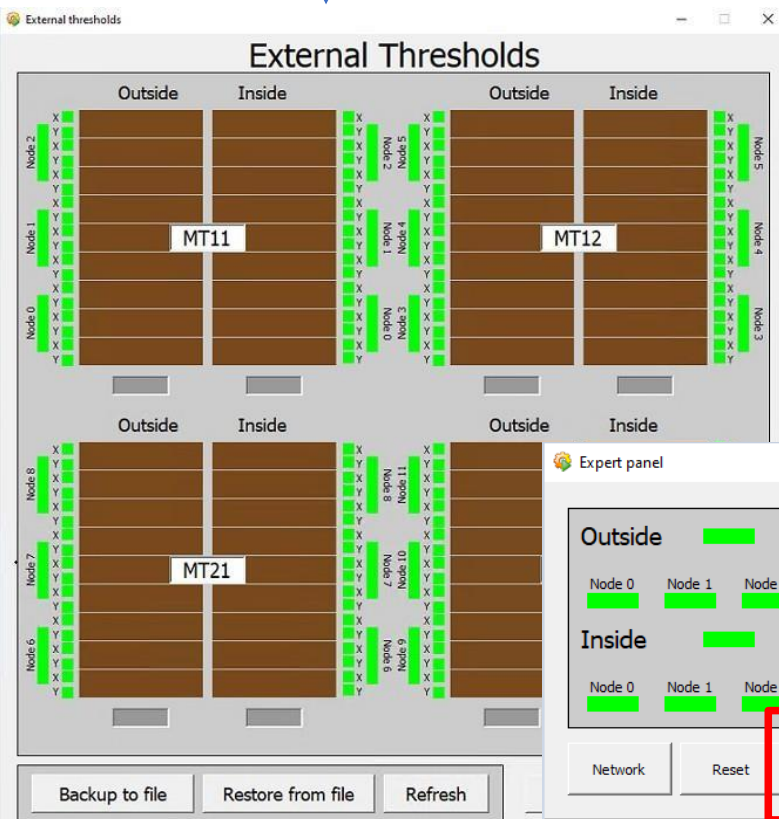
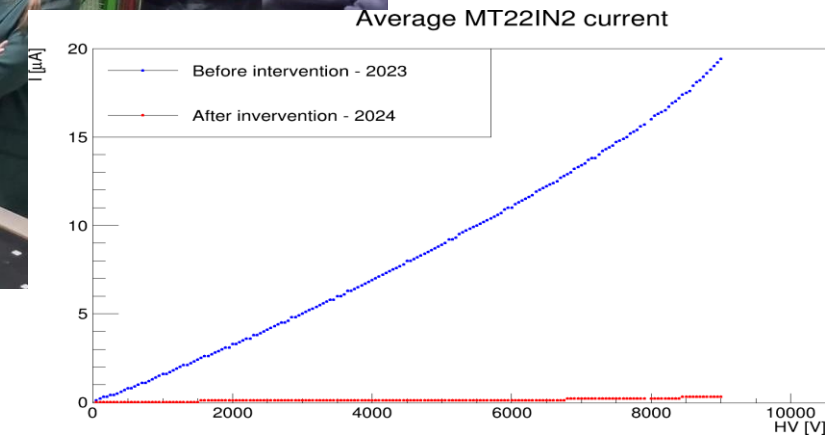
Good
98,6%

High current
-> lower HV

Run quality evaluated after asynchronous reconstruction

Main activities during the 23/24 winter shutdown

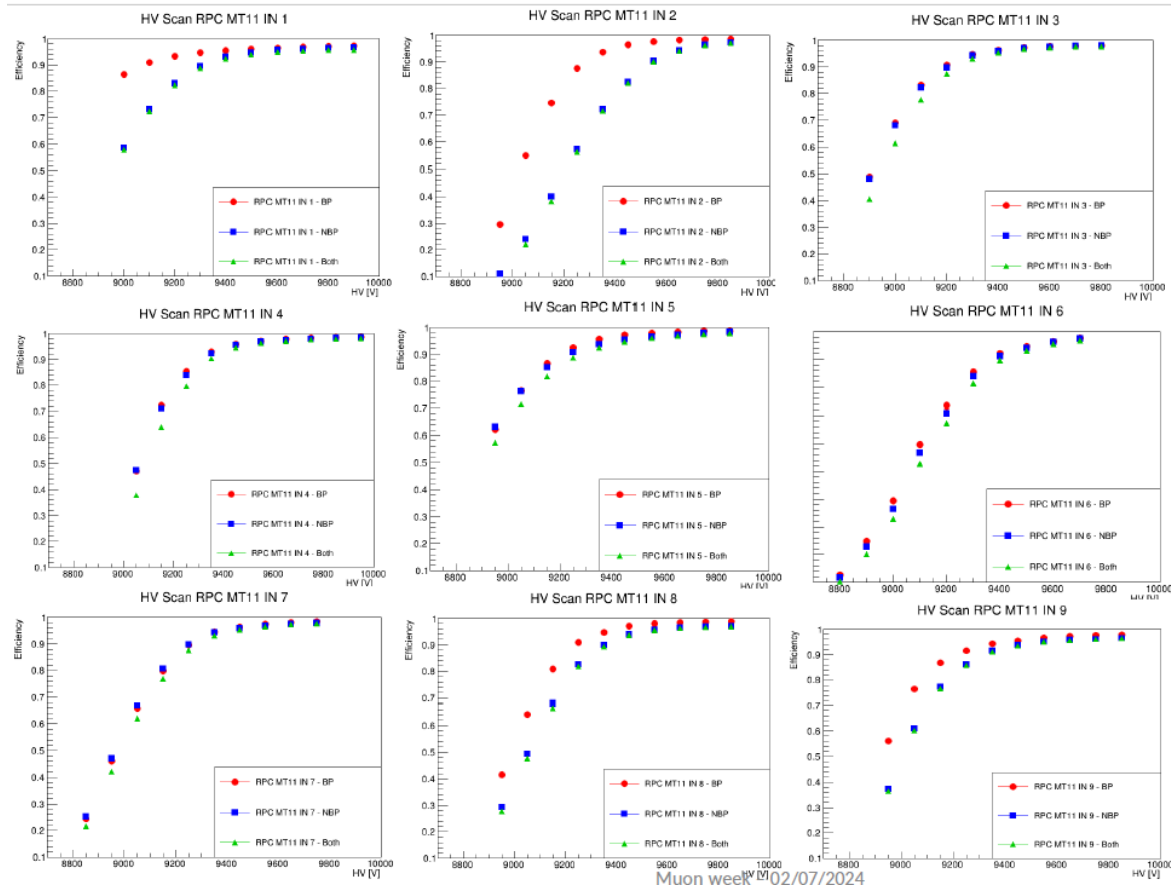
- Repair (by improved insulation) of 1 RPC with high current
- Installation of a new, Wi-fi based, FEE threshold distribution system



- Replacement of 1 LVPS
- Implementation of a mechanism to spot and unmask "fake dead" channels

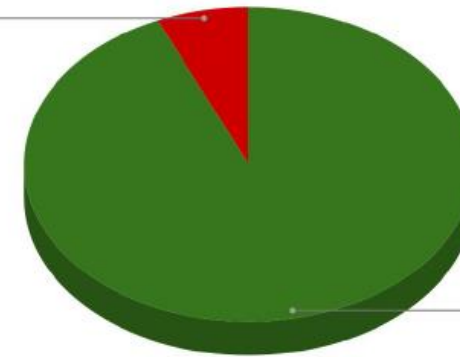
2024 proton data-taking and efficiency studies

- Stable data-taking since the LHC restart
- Efficiency scan carried out in April '24
→ HV fine-tuned during TS1 (June '24)



Total runs: 167

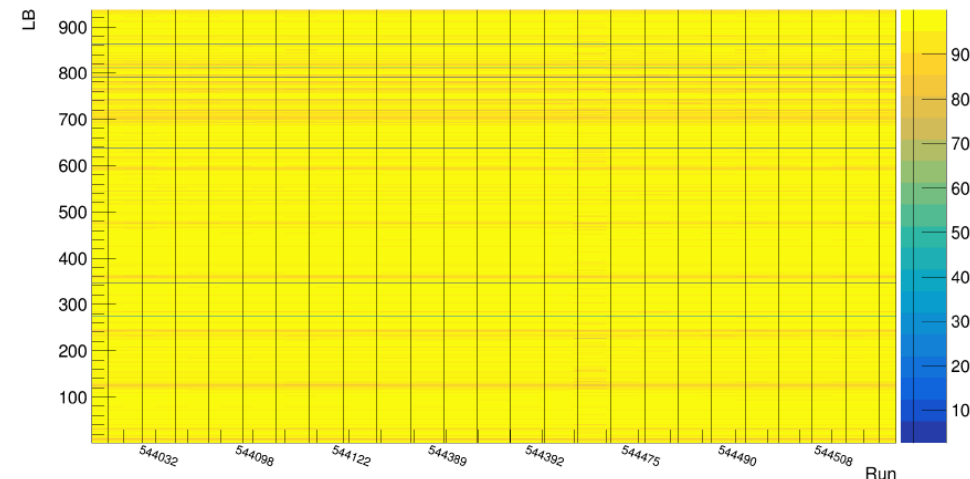
Bad
6,6%



Run quality evaluated after asynchronous reconstruction

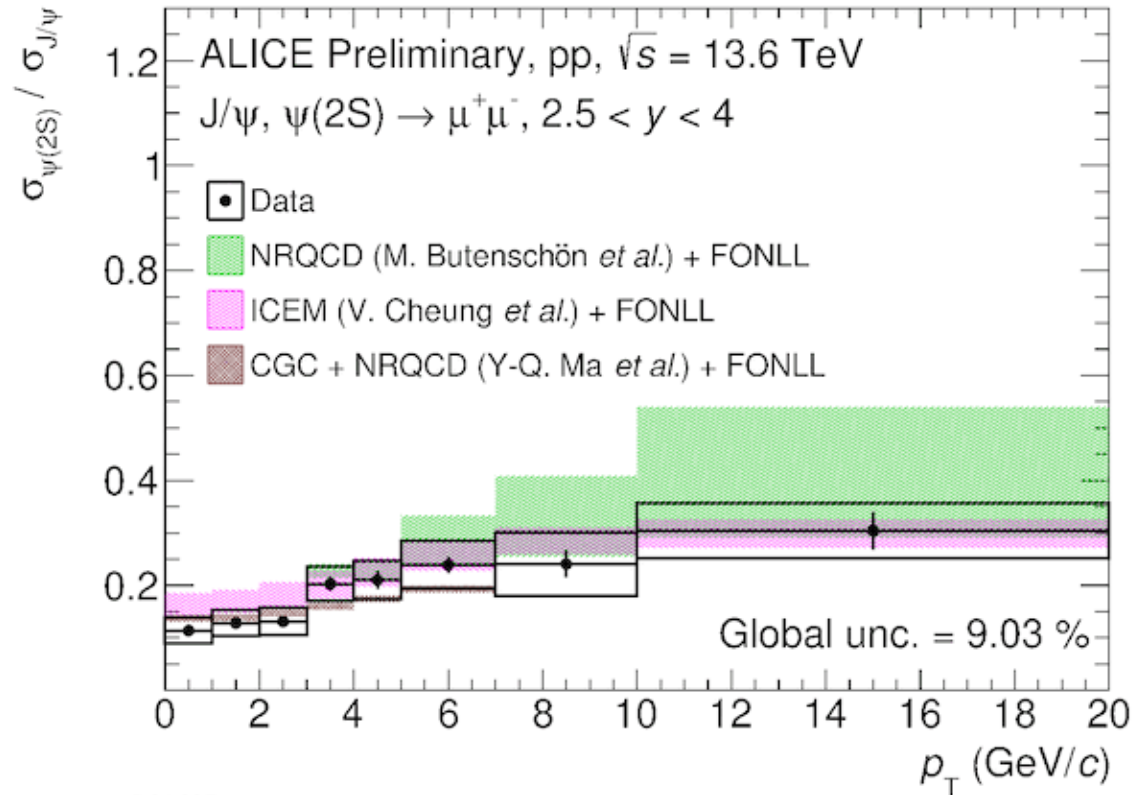
Good
93,4%

- Sub-RPC level efficiency measurement integrated in the ALICE analysis framework

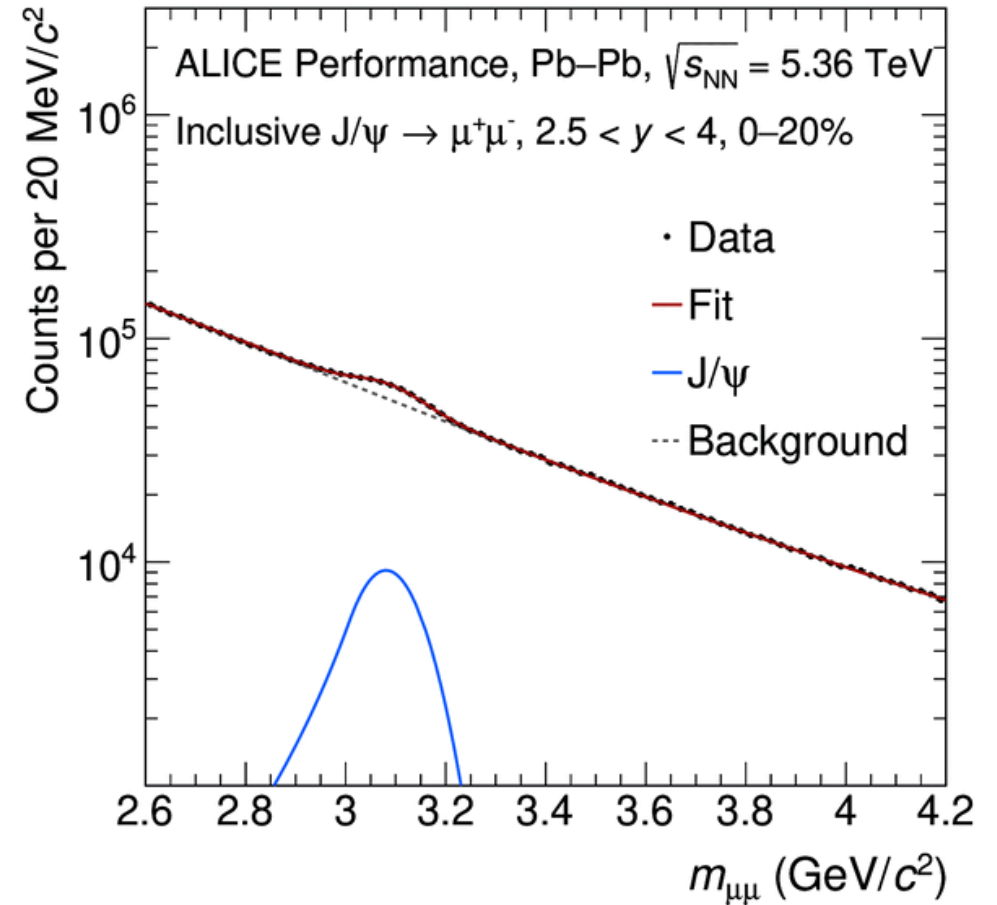


Local-board efficiency vs run during 2023 Pb-Pb data-taking

MCH+MID physics performance and first results



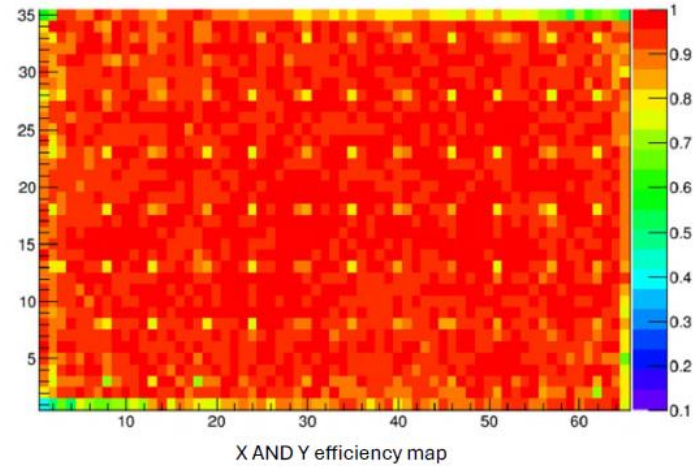
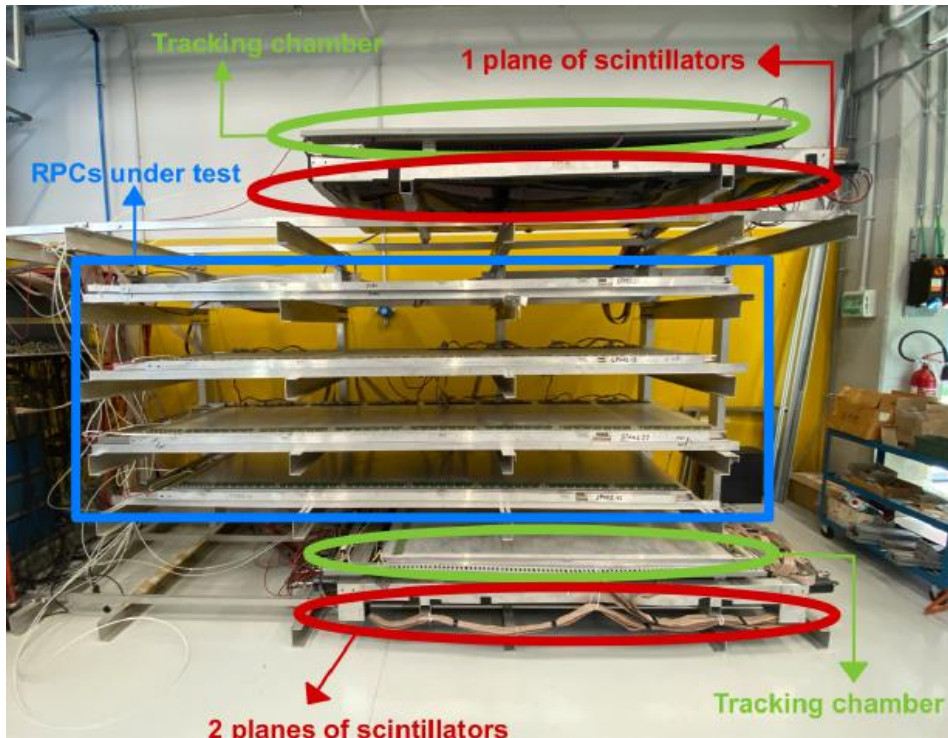
ALI-PREL-564627



ALI-PERF-568650

- First physics result (*Quark Matter 2023*): $\psi(2S)/\psi$ ratio in pp
- Expect large reduction of systematics from recent improvements in mass resolution
- Effort ongoing to implement realistic detector status in MC \rightarrow fully corrected quantities
- Analysis of the muon spectrometer data from the 2023 Pb-Pb run also gaining momentum

Test of the new RPC production at the INFN-TO lab



RPC	WP (streamer)	Type	Status
716-21	8100	C1	2
707-21	8100	L2	2
706-21	8200	L2	2
717-21	8200	C1	2
715-21	8100	C2	2
714-21	8100	C2	2
711-21	8200	C2	2
720-21	8200	L1	2
718-21	8100	C1	1
705-21	8100	L2	1
681-19	8500	S1	1
682-19	8500	S1	1
680-19	8400	S1	1

Substituted
in the cavern

Status legend:
0 not ok
1 in case of need
2 all ok

- ~20 new RPCs built, will be kept as spares
- Full characterization almost completed in Torino (current, dark rate, high-granularity efficiency map..)
- Good results so far, most detectors are OK and all are at least “usable”

Milestones MID

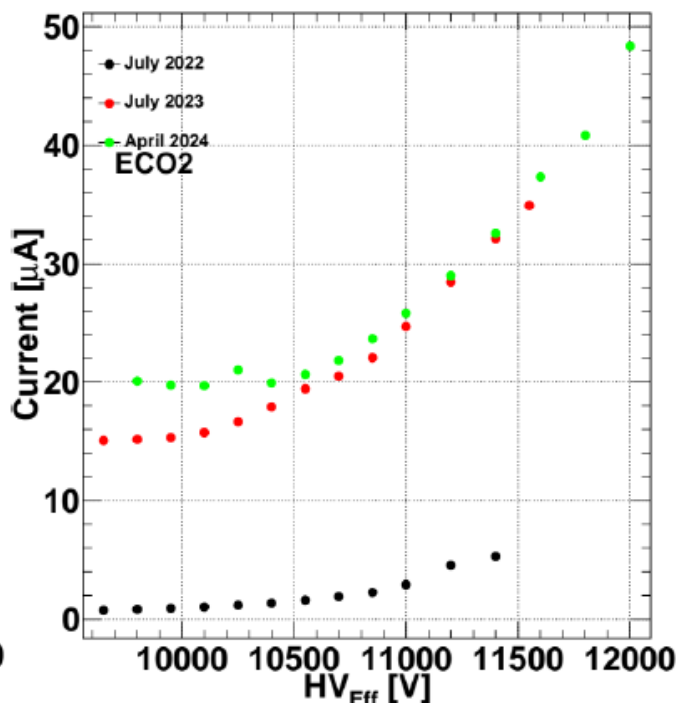
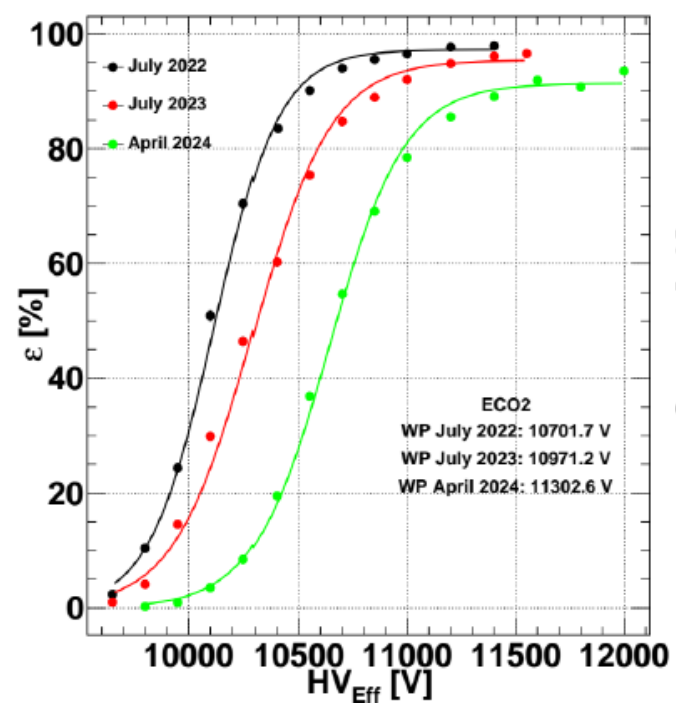
Anno-ID	Milestone	Compl. al 30/06/24	Commenti
2023-02	Partecipazione costante e regolare alla presa dati con collisioni pp e Pb-Pb	100%	
2024-29	Partecipazione costante e regolare alla presa dati con collisioni pp e Pb-Pb	50%	presa dati Pb-Pb ancora da svolgere, rivelatore stabilmente in presa dati
2025-22	Partecipazione costante e regolare alla presa dati con collisioni pp e Pb-Pb		

R&D on freonless gas mixtures

Investigating replacement (in Run 4) of $C_2H_2F_4$
(subject to usage restrictions by EU
→ cost and availability affected)

Main candidate for replacement: $C_3H_2F_4+CO_2$

At CERN: beam and ageing tests at GIF++ (CERN)
in the framework of ECOgas@GIF++
collaboration (CMS, ATLAS, ALICE, SHiP, EP-DT)



L. Quaglia- ALICE Thesis award 2024



- Analysis of 2023 and 2024 beam tests ongoing
→ aim at systematic comparison with 2022 results
in time for the RPC2024 conference (September)
- 1 more beam test in September 2024,
2 foreseen in 2025
- Activities in Torino (cosmic-ray station):
 - characterization of aged prototypes
 - search for SF_6 replacement

Richieste 2025

Richieste specifiche

- Interventi di maintenance durante i technical stop:
 - 5 settimane al CERN per 2 tecnici + 1 fisico/tecnologo
 - *15 kEuro missioni*
- Partecipazione ad attività progetto Ecogas@GIF++ (beam + ageing tests)
 - 4 settimane al CERN
 - *4 kEuro missioni*
- Acquisto gas per stazione raggi cosmici INFN-TO
 - *5 kEuro consumo*

+M&O-B: *36 kCHF Servizi*

Backup

MID M&O-B 2025

budget description	Spesa (kCHF)	Commenti
Mechanics	1	
Gas Systems	2	
Cooling Systems		
FEE spares		
Standard Electronics LV/HV PS	3	
Standard Electronics Crates	2	
Standard Electronics R/O modules		
Controls (DCS & DSS)		
Sub-Detector spares	3	
Areas		
Communications	2	
Store Items	1	
Technical Manpower @ CERN: Industrial Support		
Technical Manpower @ CERN: subsistence	68	
Totale	82	

INFN share in MID M&O-B: 44% → INFN contribution = 36 kCHF

Profilo di spesa RPC + gas system

	2015	2016	2017	2018	2019	2020	2021	Tot
MoU (kCHF)	41	17	7	37	0	0	0	102
Finanziamento INFN (kCHF)	41	17	7	0	23	5-9 (sblocco s.j. settembre)	13 s.j.	93-97+13 s.j.

Profilo di spesa FEERIC

	2015	2016	2017	2018	2019	2020	Tot
MoU (kCHF)	16.5	32	30.5	10	5	0	94
Effettivo (kCHF)	17.5		48	0	10	0	75.5
Finanziamento INFN (kCHF)	30	32	3.5	0	10	0	75.5

The Muon Trigger upgrade to Muon Identifier

- ❑ **Goal #1:** detector performance and safe long-term operation in such a scenario
 - > **detector and FEE upgrade** (INFN Torino, LPC Clermont-Ferrand)
 - a) reduce charge-per-hit by a factor 3-5 by developing FEE cards with amplification
 - b) replace ~30% most irradiated RPCs → **production of new RPCs**

- ❑ **Goal #2:** dead time-free readout (vs present 150 μ s)
 - > **readout electronics upgrade** (Subatech Nantes, LPC Clermont Ferrand)