

MID

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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 $76 \times 292 \text{ cm}^2$

Responsibilities:

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

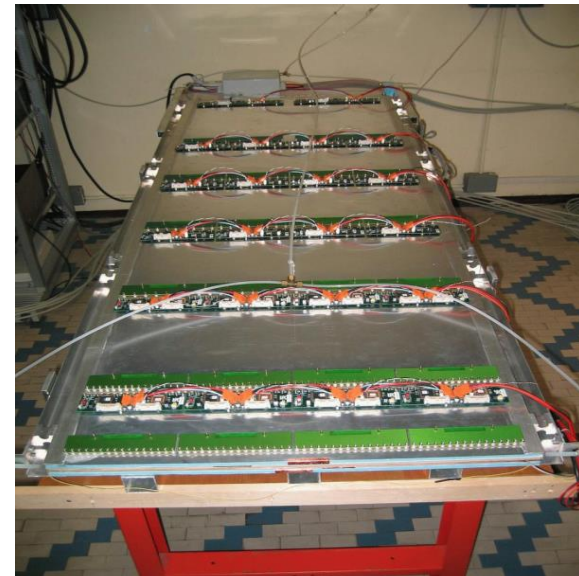
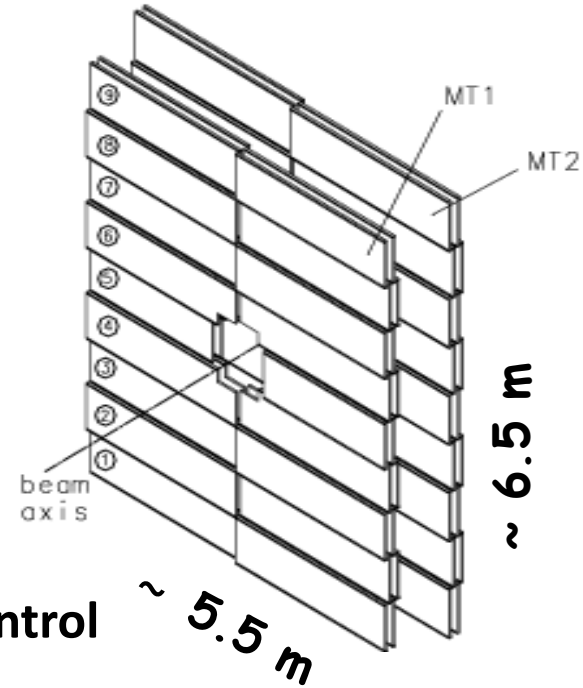
- ~ 7 FTE

- Ruoli di responsabilità in MID:

Muon Identifier Technical Coordinator (P. Mereu)

Muon Identifier Project Leader (A. Ferretti)

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



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
→ **DONE**
 - b) replace ~30% most irradiated RPCs → **in progress**
- ❑ **Goal #2:** dead time-free readout (vs present 150 μ s)
 - > **readout electronics upgrade** (Subatech Nantes, LPC Clermont Ferrand)

New RPCs



- RPC status after Run 1 & 2
 - ▶ Detectors in a quite good shape, but some showed an increase of dark current
 - ▶ Replace the most exposed detectors => start the Run 3 in optimal conditions
- New RPC production
 - ▶ We observed issues during the production of the first gas gaps in 2018/2019 => solved
 - ▶ 20 new RPCs built @ General Tecnica in Jan. 2021
 - ▶ All detectors now in the Torino since May (delayed due to COVID restrictions)
- Torino new lab.
 - ▶ The INFN technological lab. in Torino moved in a new building since January, 2021
 - ▶ Refitting has been a lengthy task due to COVID restrictions

The new Torino Lab



- Set-up of the new test bench being completed
- Tests to start asap (although priority is now the re-commissioning at CERN)
- Goal: install ~5-10 RPCs during winter shutdown, depending on test and commissioning result

RPC activities @ CERN



- Search for gas leaks
→ no major issues found
- HV ramp-up to nominal voltage
→ ongoing
→ 2 RPCs KO (most likely due to HV cable failure)
- Main commissioning goal (cosmics)
re-characterize all RPCs with the
new FEERIC electronics
(HV, threshold..)



Detector Control System status

- SW/HW upgrades:
 - new version of control software (WinCC)
 - new operation framework (JCOP)
 - new communication protocol (OPC DA v vs UA)
 - migration to a new computer cluster
 - done, re-commissioning ongoing
- Development:
 - VTRx monitoring
 - done
 - integration of the read-out electronics configuration and monitoring in WinCC as per ALICE requirement
 - ongoing

RPC activities @ GIF



- RPC Gas R&D join effort (ATLAS, CMS, ALICE)
 - ▶ Replace tetrafluoroethane from the RPC gas mixture (high value of Global Warming Potential)
 - ▶ Tetrafluoropropene-CO₂-based gas mixtures already tested with cosmics with promising results
- Tests @ GIF
 - ▶ Since 2020, prototype RPCs flushed with the new mixture have been exposed to gamma irradiation at CERN GIF to check the aging, working current and dark current have been monitored
- What next
 - beam tests under irradiation in July (ongoing) and October
 - rate capability studies



Milestones

2020

	Data	Descrizione	Completamento al 30.06.2020 (%)	Commenti al 30.06.2020	Completamento al 31.12.2020 (%)	Commenti al 31.12.2020	Completamento al 30.06.2021 (%)
MID	30-Jun-2020	MID Upgrade - Completamento test dei nuovi RPC	15%	Non si andrà oltre il 50% per trasferimento laboratorio tecnologico INFN e Covid	15%	Test ancora fermi causa Covid e trasferimento Lab. Tecnologico non completato. Milestone rinviata al 2021	15%
MID	31-Dec-2020	MID Upgrade - Completamento commissioning standalone del rivelatore	0%	Inizio a settembre causa Covid	80%	Lieve ritardo causa Covid. Completamento entro 06/21	95%

2021

Data	Descrizione	Completamento al 30.06.2021 (%)	Completamento al 31.12.2021 (%)	Commenti al 30/06/2021
30-Jun-2021	MID - Completamento test dei nuovi RPC	15%		dal 2020 - Lab Tecnologico non ancora operativo
31-Dec-2021	MID - Completamento dell'integrazione in ALICE e del commissioning globale	0%		Inizio global commissioning luglio 2021

2022

3	MID	31/12/22	Partecipazione presa dati con collisioni pp e Pb-Pb
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MID M&O-B 2022

budget description	Spesa (kCHF)	Commenti
Mechanics	4	
Gas Systems	4	
Cooling Systems		
FEE spares		
Standard Electronics LV/HV PS	5	
Standard Electronics Crates	5	
Standard Electronics R/O modules		
Controls (DCS & DSS)		
Sub-Detector spares	5	
Areas		
Communications	3	
Store Items	2	
Technical Manpower @ CERN: Industrial Support		
Technical Manpower @ CERN: subsistence	38	
Totale	66	

INFN share in MID M&O-B: 44% → INFN contribution = 29 kCHF

Richiesta specifica Missioni per installazione nuove RPC in ALICE

Installazione (1 giorno/RPC) e pre-commissioning (0.5 giorni/RPC) in ALICE
per ~10 RPC:

15 giorni al CERN per 4 persone (1 fisico 1 tecnologo 2 tecnici)
→ **9 kEuro MISSIONI**

Backup

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.

- **Richiesta di 12 kEuro APPARATI (13 kCHF) per il 2021**
(s.j. ai risultati dei test)

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

Status produzione RPC

- ~50 RPC finanziate (~1300 euro/RPC)
- ~25 prodotte nel primo batch, non utilizzabili (problemi gravi di efficienza o corrente instabile), di bassa qualità (problemi non gravi di efficienza o corrente alta, utilizzabili come spares), o non ancora testate
- Secondo batch:
 - 3 RPC in pre-produzione → testate, OK
 - ~20 RPC in produzione
- Goal: 25-30 nuove RPC installabili
 - assumendo un accept rate del 70%: ~40 RPC da produrre
 - **richiesta aggiuntiva per ~15 RPC**
- Strategia proposta:
 - bakelite:
 - * ~10 RPC ricavabili da bakelite già a disposizione
 - * acquisto bakelite per ulteriori ~10 RPC mediante **sblocco fondi s.j. 2020 a settembre (in attesa preventivo)** per approfittare di un fondo di magazzino presso la ditta
 - taglio + produzione nel 2021 (~800 euro / RPC)
 - **richiesta 2021: 12 kEuro s.j. ai risultati dei test del secondo batch**

Status RPC installate in ALICE

Summary of RPC effective voltages* and currents

MT11 INSIDE		MT12 INSIDE		MT21 INSIDE		MT22 INSIDE	
RPC 1	0397 V 3.1 µA	RPC 1	0362 V 5.3 µA	RPC 1	0211 V 1.3 µA	RPC 1	0308 V 10.8 µA
RPC 2	0344 V 0.6 µA	RPC 2	0368 V 1.5 µA	RPC 2	0253 V 2.0 µA	RPC 2	0295 V 24.0 µA
RPC 3	0291 V 1.5 µA	RPC 3	0249 V 3.0 µA	RPC 3	0252 V 2.3 µA	RPC 3	9998 V 1.1 µA
RPC 4	0449 V 7.7 µA	RPC 4	0245 V 1.0 µA	RPC 4	0152 V 7.5 µA	RPC 4	0145 V 1.6 µA
RPC 5	0335 V 8.2 µA	RPC 5	0170 V 4.5 µA	RPC 5	0114 V 8.3 µA	RPC 5	0357 V 2.8 µA
RPC 6	0189 V 4.2 µA	RPC 6	0344 V 4.7 µA	RPC 6	0077 V 2.1 µA	RPC 6	0152 V 11.2 µA
RPC 7	0257 V 0.8 µA	RPC 7	0386 V 0.5 µA	RPC 7	0191 V 0.5 µA	RPC 7	0051 V 1.9 µA
RPC 8	0338 V 1.2 µA	RPC 8	0198 V 0.3 µA	RPC 8	0168 V 1.6 µA	RPC 8	0060 V 6.2 µA
RPC 9	0372 V 0.7 µA	RPC 9	0358 V 0.4 µA	RPC 9	0237 V 1.3 µA	RPC 9	0147 V 1.6 µA

MT11 OUTSIDE		MT12 OUTSIDE		MT21 OUTSIDE		MT22 OUTSIDE	
RPC 1	0305 V 7.2 µA	RPC 1	0408 V 13.0 µA	RPC 1	0199 V 19.6 µA	RPC 1	0242 V 18.3 µA
RPC 2	0346 V 3.4 µA	RPC 2	0385 V 17.4 µA	RPC 2	0361 V 5.3 µA	RPC 2	0243 V 6.7 µA
RPC 3	0170 V 7.4 µA	RPC 3	0248 V 1.3 µA	RPC 3	0208 V 3.0 µA	RPC 3	0141 V 18.5 µA
RPC 4	0353 V 1.6 µA	RPC 4	0315 V 1.3 µA	RPC 4	0090 V 6.0 µA	RPC 4	0086 V 15.4 µA
RPC 5	0155 V 2.3 µA	RPC 5	0304 V 3.6 µA	RPC 5	0258 V 3.7 µA	RPC 5	0213 V 7.3 µA
RPC 6	0365 V 1.7 µA	RPC 6	0194 V 2.4 µA	RPC 6	0494 V 8.2 µA	RPC 6	0182 V 29.1 µA
RPC 7	0133 V 4.1 µA	RPC 7	0118 V 0.5 µA	RPC 7	0186 V 2.0 µA	RPC 7	0245 V 3.8 µA
RPC 8	0140 V 1.0 µA	RPC 8	0419 V 0.4 µA	RPC 8	0315 V 1.0 µA	RPC 8	0217 V 0.7 µA
RPC 9	0246 V 1.3 µA	RPC 9	0391 V 1.1 µA	RPC 9	0277 V 2.3 µA	RPC 9	0238 V 1.5 µA

*Effective voltage:
 $V_{eff} = V_{mon} * (P_0/P)^*(T/T_0)$
 $T_0 = 20^{\circ}C$ $P_0 = 970$ mbar

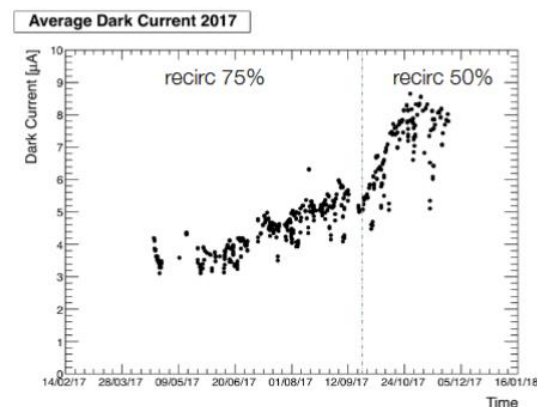
Average current

5.01 µA

Colour code for currents

I < 5 µA 5 µA < I < 10 µA I > 10 µA

Alcune camere mostrano un aumento di corrente di buio.



Scelta delle camere da sostituire in corso.

Possibile criterio:

Sostituire tutte RPC > 10 µA e centrali > 5 µA
 → 17 RPC