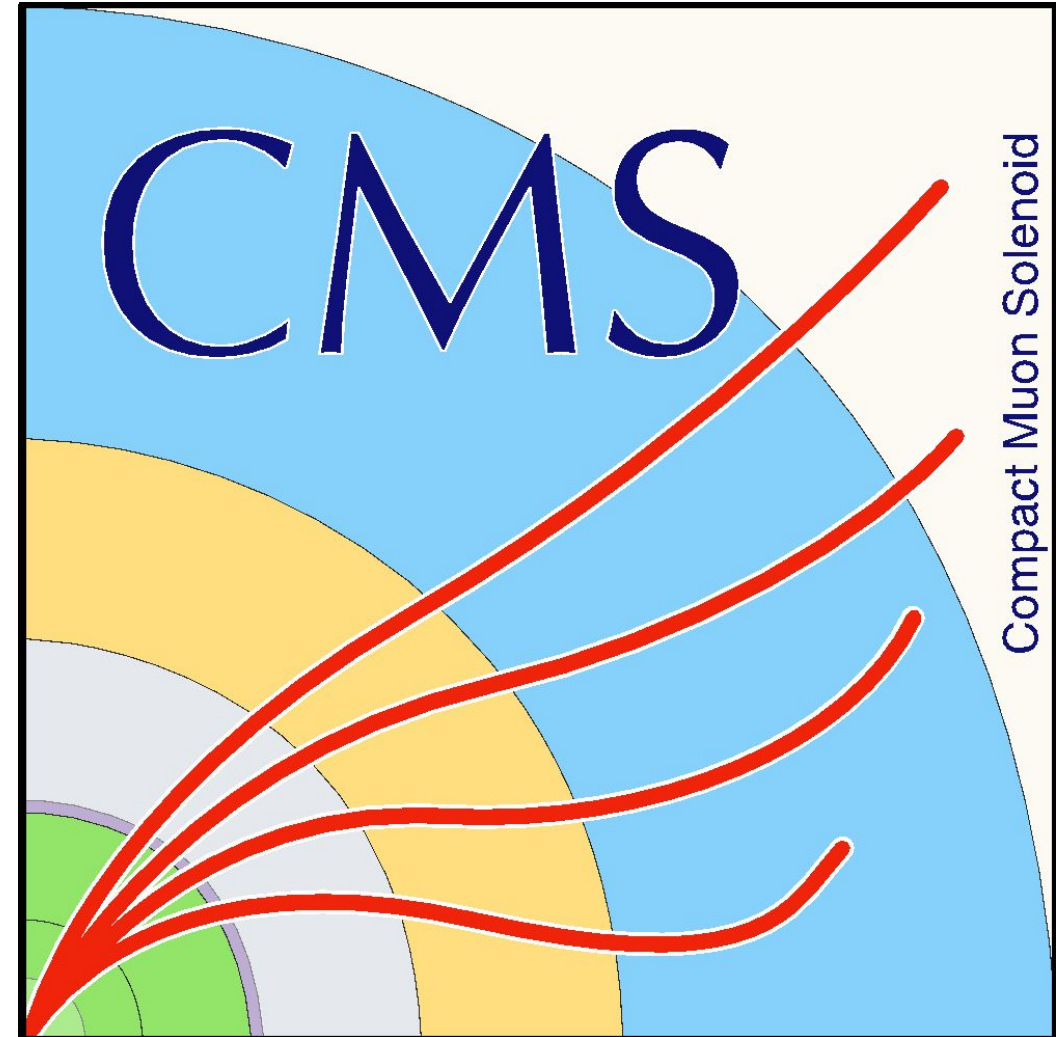


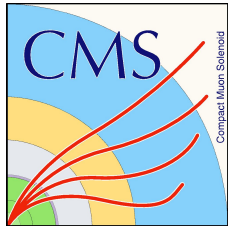
Preventivi 2026

Rosamaria Venditti

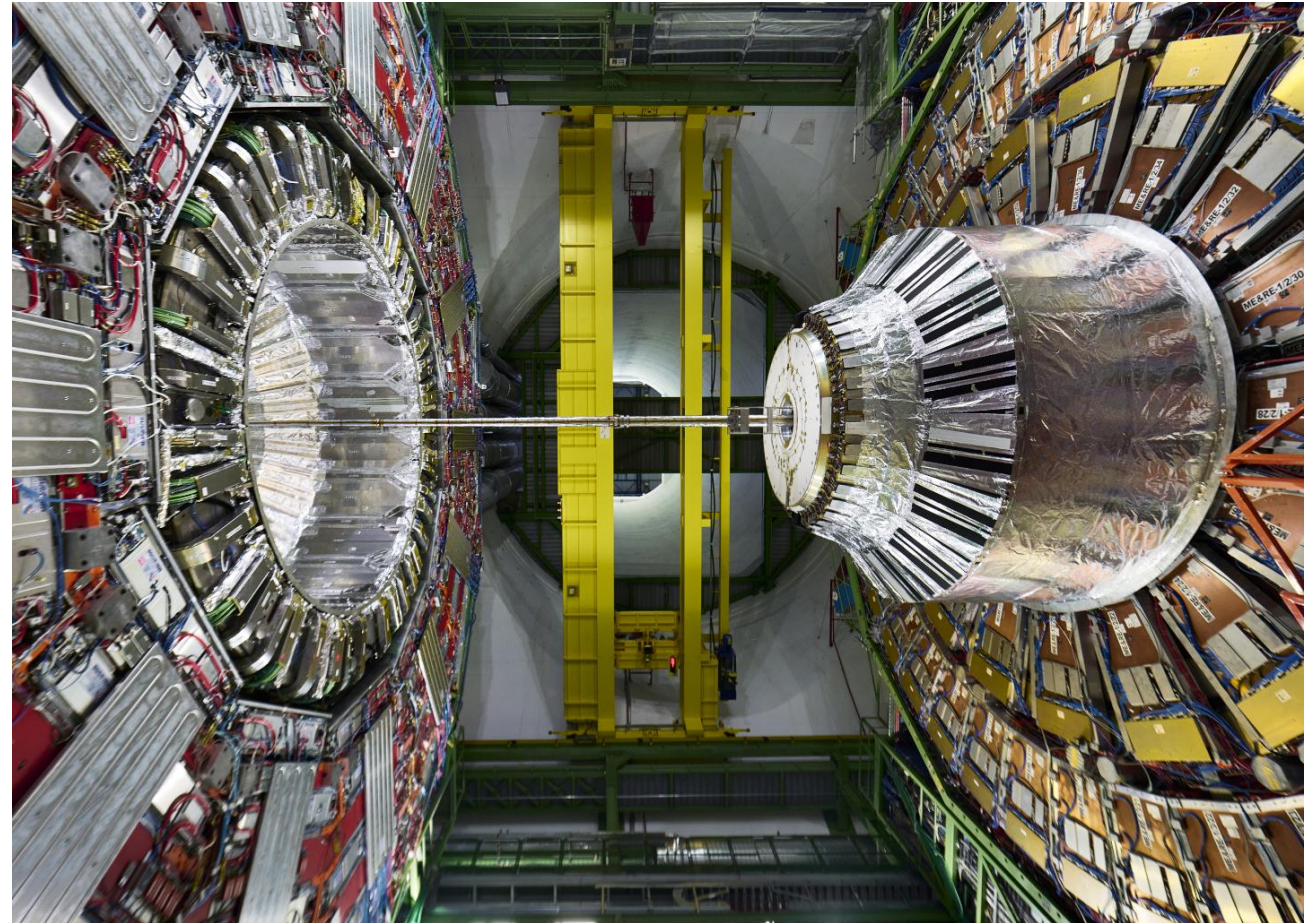
Università e INFN Bari



Summary attività



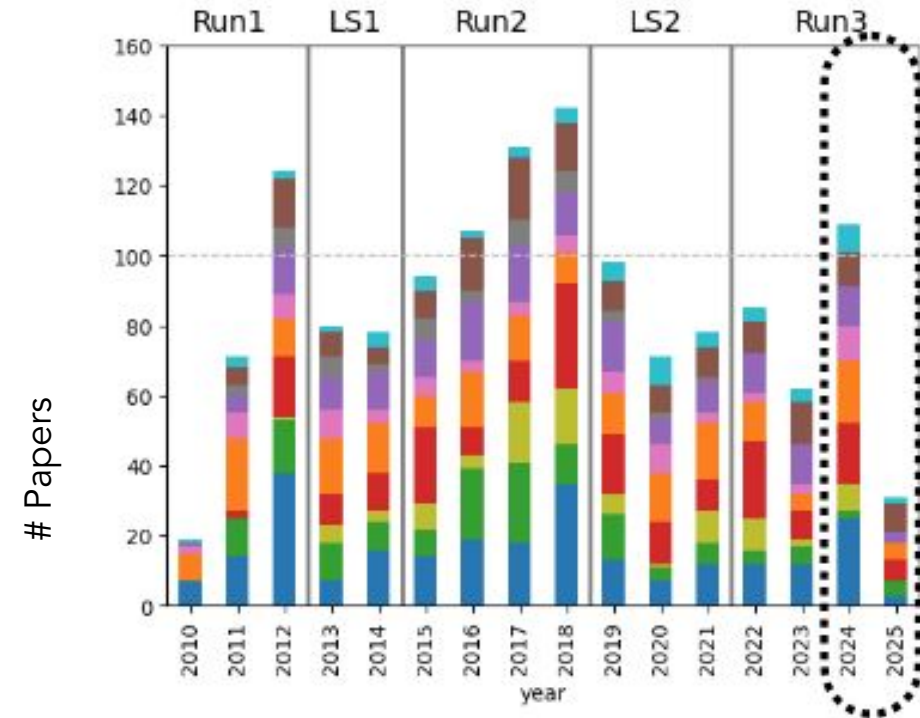
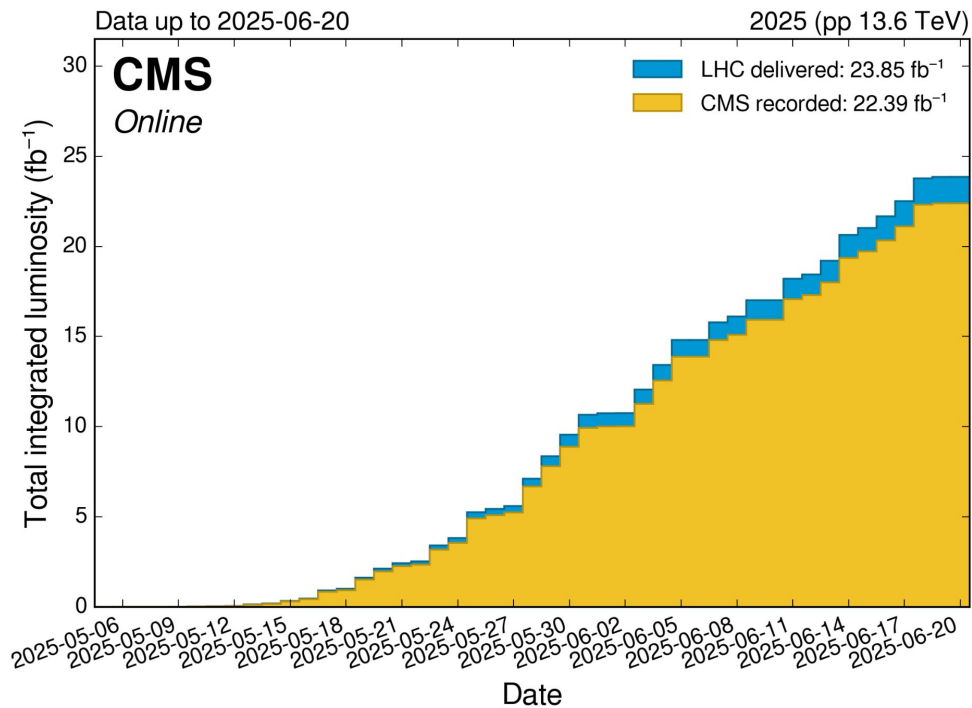
- **Apparato Sperimentale**
 - Run3 Operation
 - RPC, GE1/1, CT-PPS
 - GE2/1 e iRPC
 - Upgrade di fase II:
 - Produzione moduli Outer Tracker,
 - Produzione moduli GEM-ME0
- **Analisi dati**
 - Finalizzazione di analisi con i dati di Run-2 (Higgs, B-Physics)
 - Primi studi sui dati Run3: ricostruzione muoni, tracce, jet flavor tagging
- **Calcolo** Not covered
 - Ottima affidabilità del Tier2 di Bari, attualmente il primo Tier2 italiano per numero di risorse fornite all'esperimento
- **Outreach** Not covered
 - Contributi a ERN, Masterclass, Art and Science across Italy, HEPscape!, Premio Asimov



CMS Performance in 2025

Successful operations in 2025

- $\sim 22 \text{ fb}^{-1}$ of integrated luminosity recorded by CMS in 2025 (pp collisions)
- $\mathcal{L}(\text{Run2+Run3}) \sim 354 \text{ fb}^{-1} \rightarrow$ unprecedented dataset
- Time for precision measurement, search for rare decays, new physics



2025 : 31
submitted
papers

Selected 2024/2025 Physics results:

- [W Mass measurement](#)
- [Observation of a pseudo scalar excess at the \$t\bar{t}\bar{b}\$ production threshold](#)
- [UL on \$H \rightarrow c\bar{c}\$](#)
- [All-charm tetraquarks](#)

2026: End of Run3, LS3 startup

Longer term LHC schedule



Overlap of different activities in 2026

- Detector operations
- Run3 data analysis
- Increase the work on the Phase II object reconstruction algorithm
- Phase2 detector production
- Refurbishment of legacy detectors
- Preparation of services for the new detectors

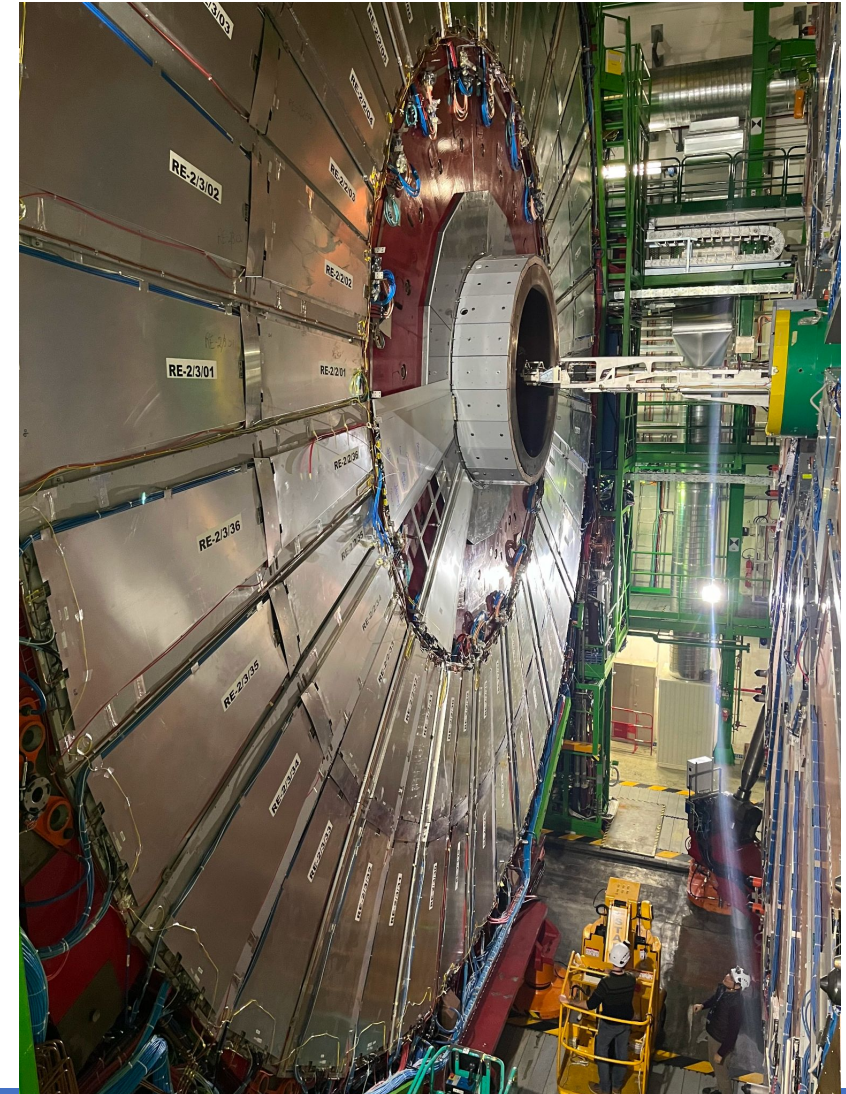
CMS Detector - Muon System

G. Pugliese (MUON System Manager L1)

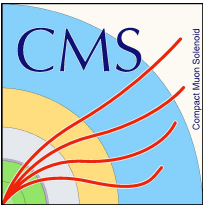
- All iRPC RE4/1 and RE(3/1) installed on -Z
- 4 GEM (GE2/1) chambers installed



GE2/1 demonstrator installation



Muon System Run3: GE11 Operations

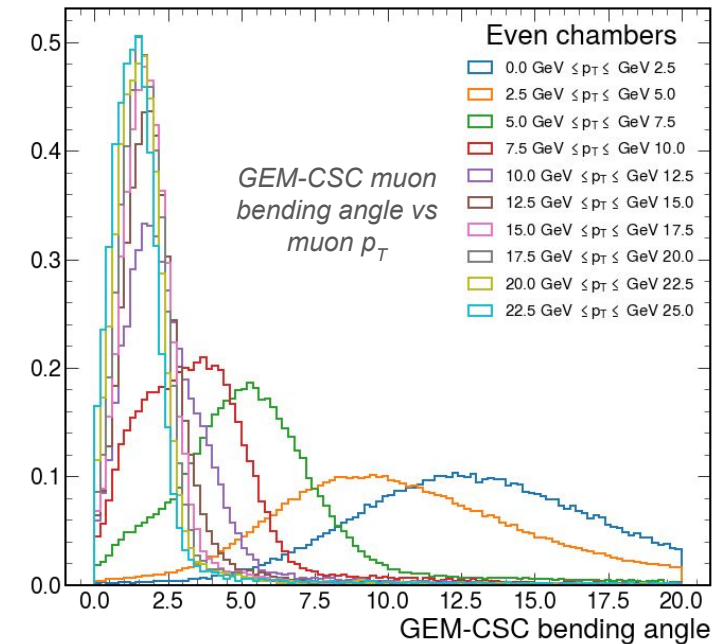
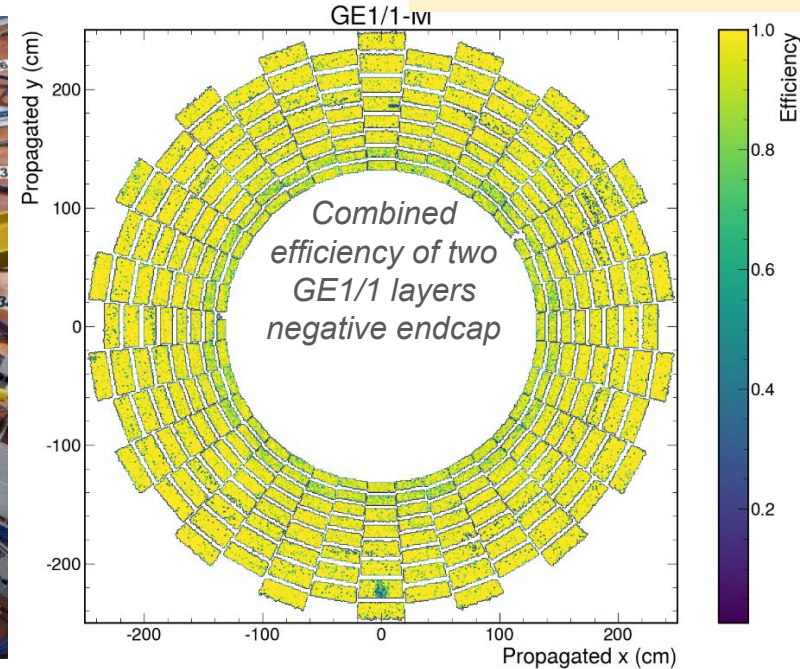
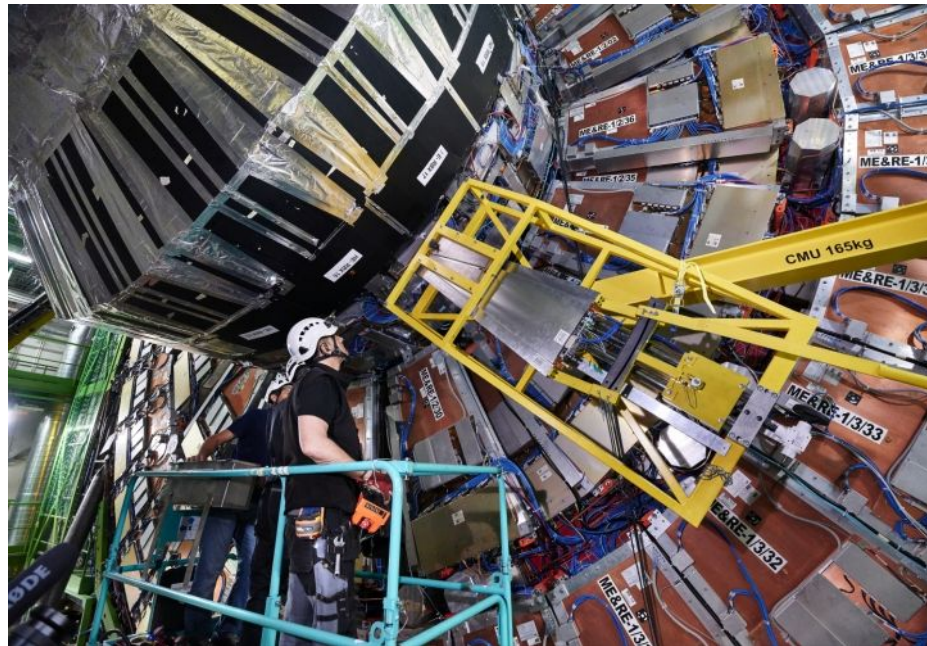


Attività 2025: Operations (DOC and coordination) and performance study

- Excellent efficiency, thanks to redundancy of 2 GEM layers
- Ongoing optimization of time resolution (~ 17 - 12 ns) for best matching efficiency with CSC ME1/1 station

Plans for 2026:

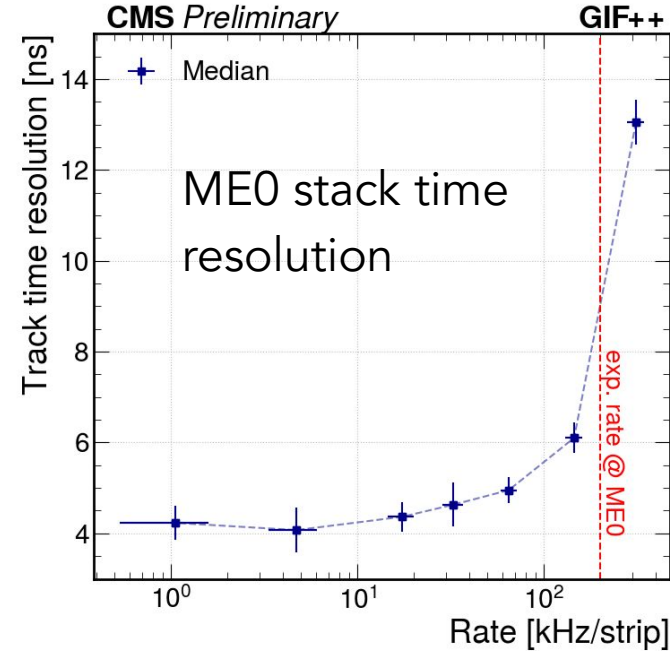
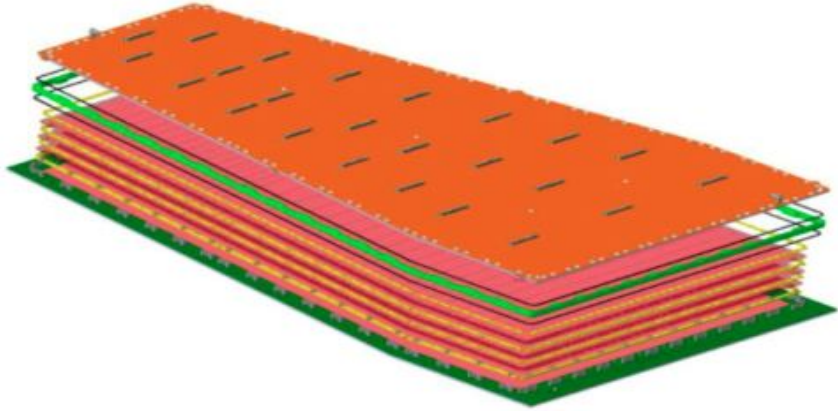
- participate to the operations with DOCs
- GE1/1 modules extraction and refurbishment during LS3 startup



A. Pellecchia GEM Run Coordinator
F. Licciulli GEM Electronics Coordinator

Muon System Upgrade: ME0 in 2025

Complementing and extending the CMS Muon system acceptance up to $|\eta| = 2.8$. stack of 6 triple GEM



Attività 2025: misura di prestazioni in campo magnetico

2025 Activities

- Measurement of segment timing, rate capability with a 6-layer stack at GIF++
- Discharge rate in magnetic field
- **Production and test of ME0 modules**
- At CERN: construction of ME0 stack, electronics dressing and test with cosmics

Plans for 2026

- Production of ME0 modules in Bari
- Test with cosmics at CERN
- Preparation of services in CMS P5 during LS3

Muon System Upgrade: ME0 in 2026

Bari is a qualified ME0 modules site
production center

ME0 modules produced in Bari so far: **15/50**

- 1st round of production: July – September 2024
 - 5 high quality chambers produced and tested
- 2nd round: January - May 2025
 - 10 chambers produced and tested
- 3rd round: from July 2025
 - 10 chambers to be produced
- 4th round: Jan 2026 → **25 chambers**

At CERN: construction of ME0 stack, electronics dressing and test at cosmic ray stand

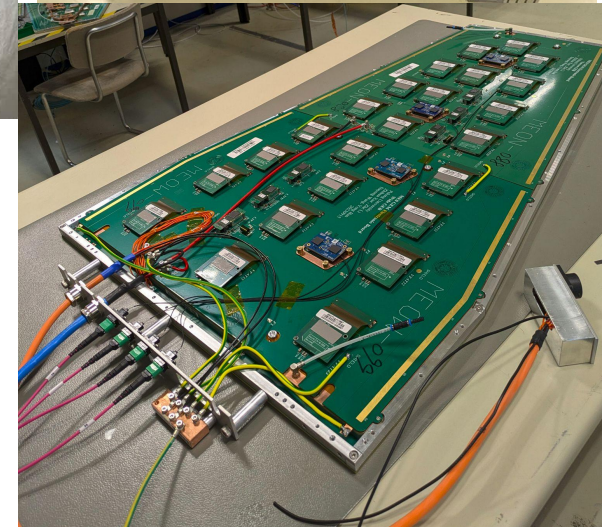
Coordination

- L. Longo: Hardware coordinator (L2)
- P. Verwilligen Upgrade Coordinator (L2)



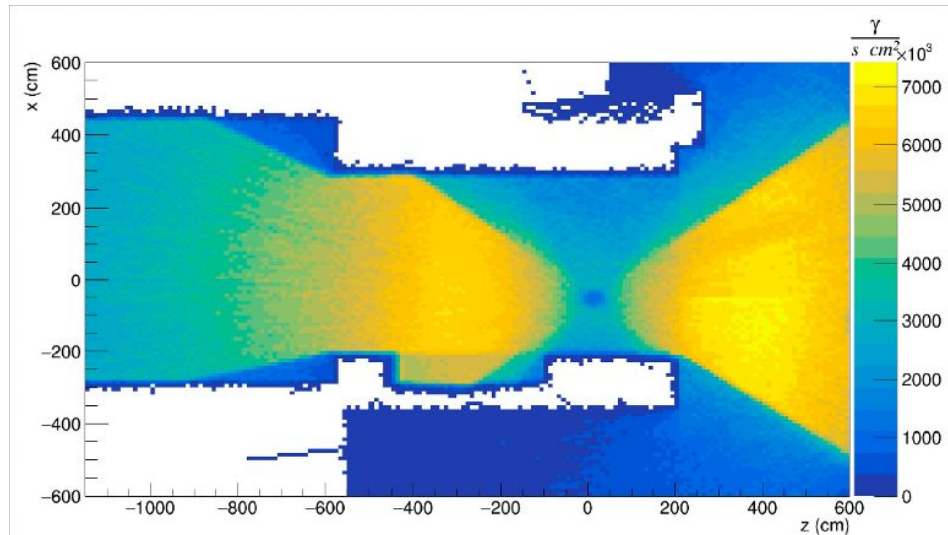
ME0 production workflow

- Assembly in clean room
- Quality control and validation in lab
 - GEM foil training
 - Gas leak measurement
 - Linearity and Noise measurement
 - Effective Gain (x-ray)
 - Response uniformity (x-ray)
- Modules shipped to CERN



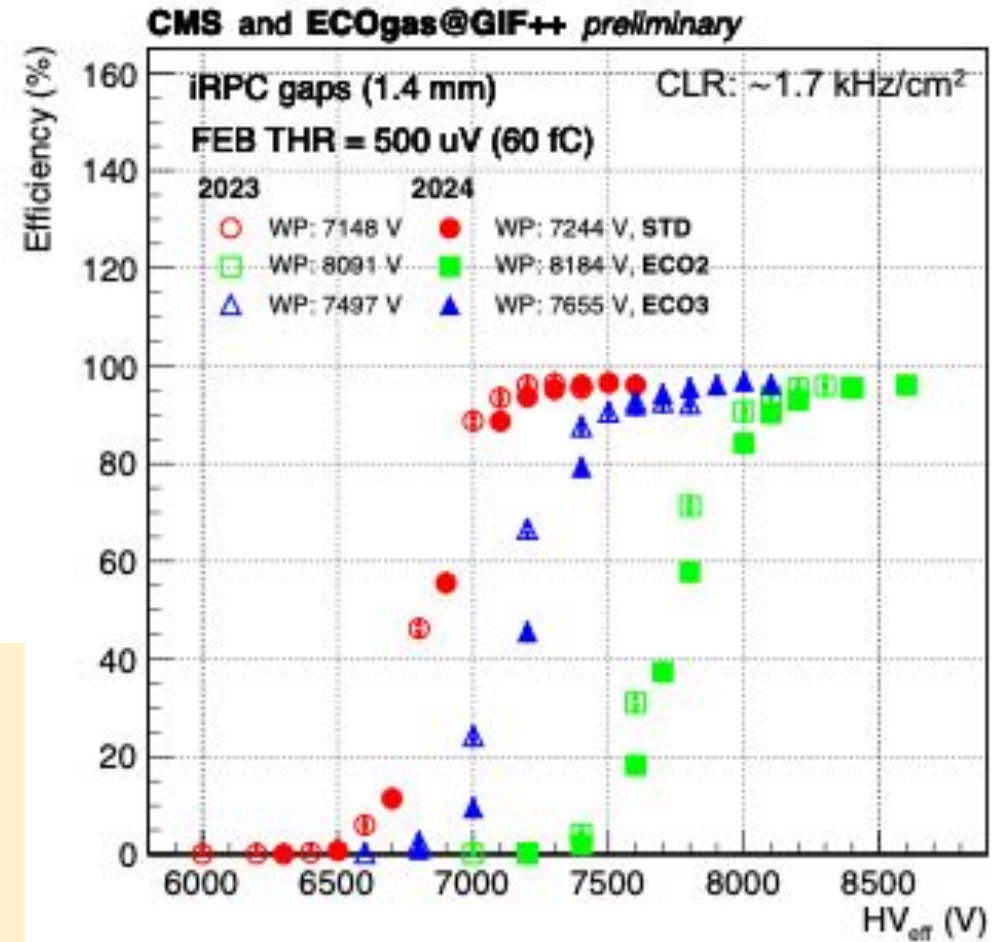
RPC Summary attività 2025

- The Bari technicians were strongly involved in the development of the technique used for RPC leak repairs.
- R&D on new eco-friendly gaseous mixtures for RPC operation (beam tests at GIF++)
- Irradiation campaign for ageing studies of
 - legacy RPC with HFO
 - iRPC with CO₂.
- Monte Carlo simulations of radiation dose at GIF++



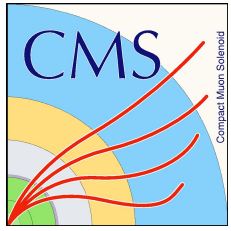
Photon flux simulation at GIF++

Same activities in 2026



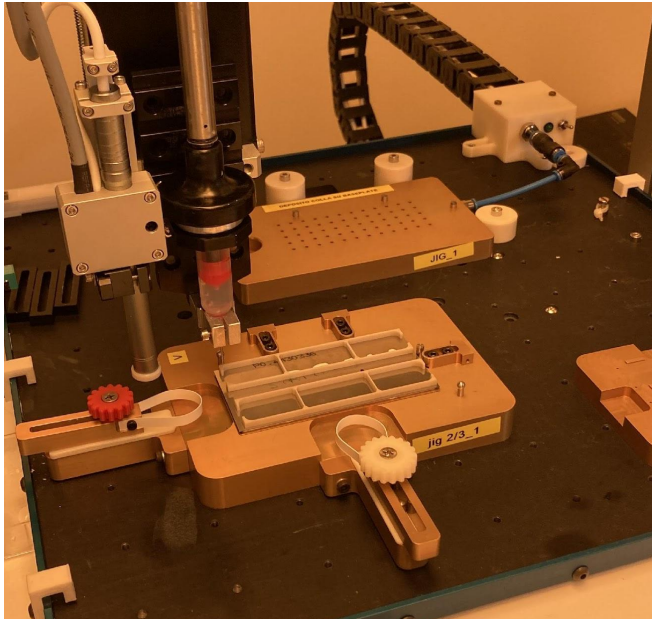
iRPC efficiency for several gas mixtures

Tracker Phase II Upgrade: Status

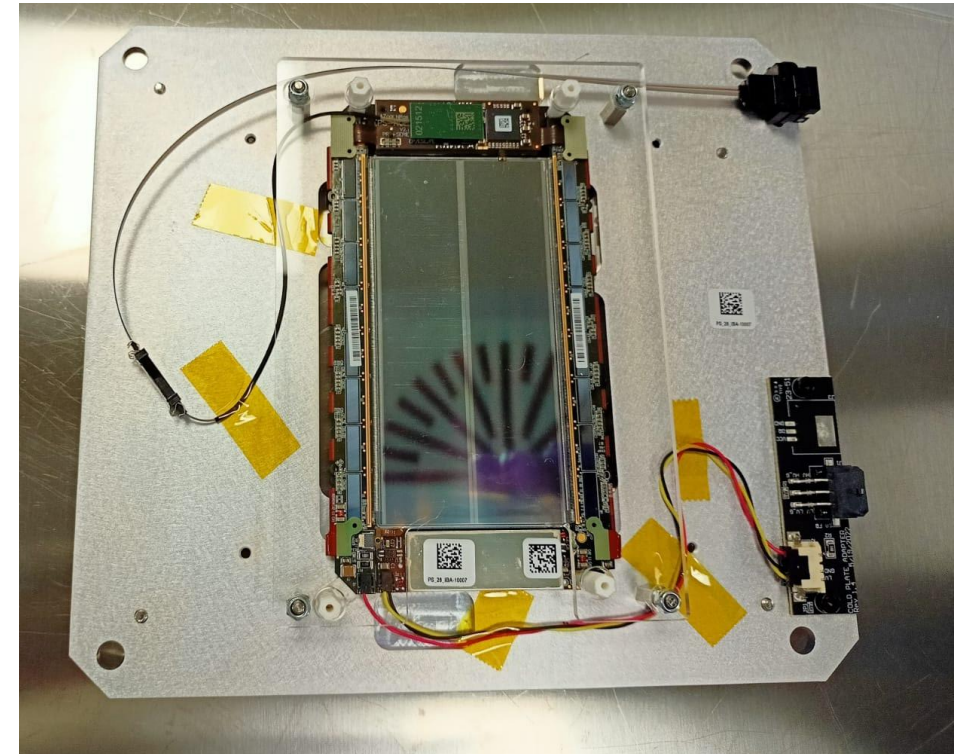
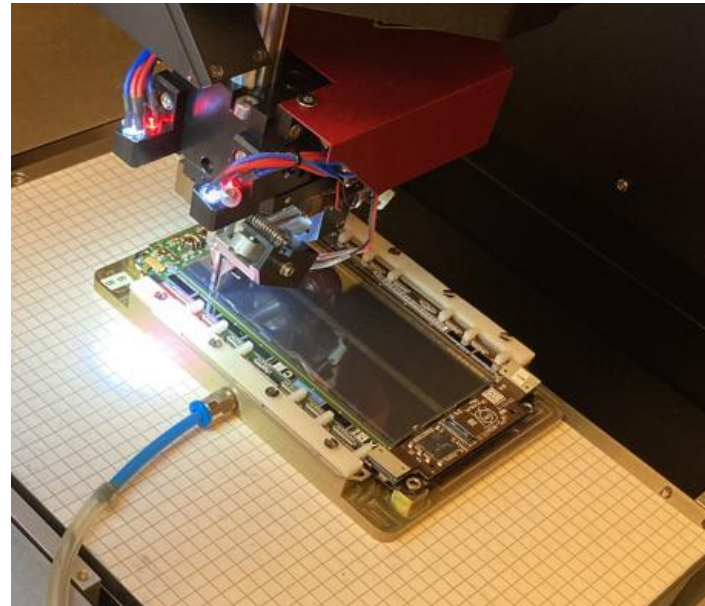


Bari centro di produzione dei moduli Pixel Strip (PS) dell'outer tracker

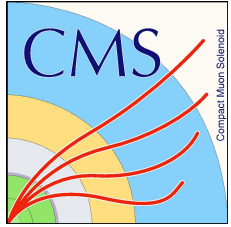
- 10 moduli di produzione assemblati e spediti a Pisa per test in camera climatica
- Pipeline Test in corso: assemblaggio in parallelo di 4+4 moduli (simulazione mass production)



Slow glue dispensing on spacer glued to the MAPSA under the robot and fast glue dots on spacer nots



Tracker Phase II Upgrade: 2026 activities

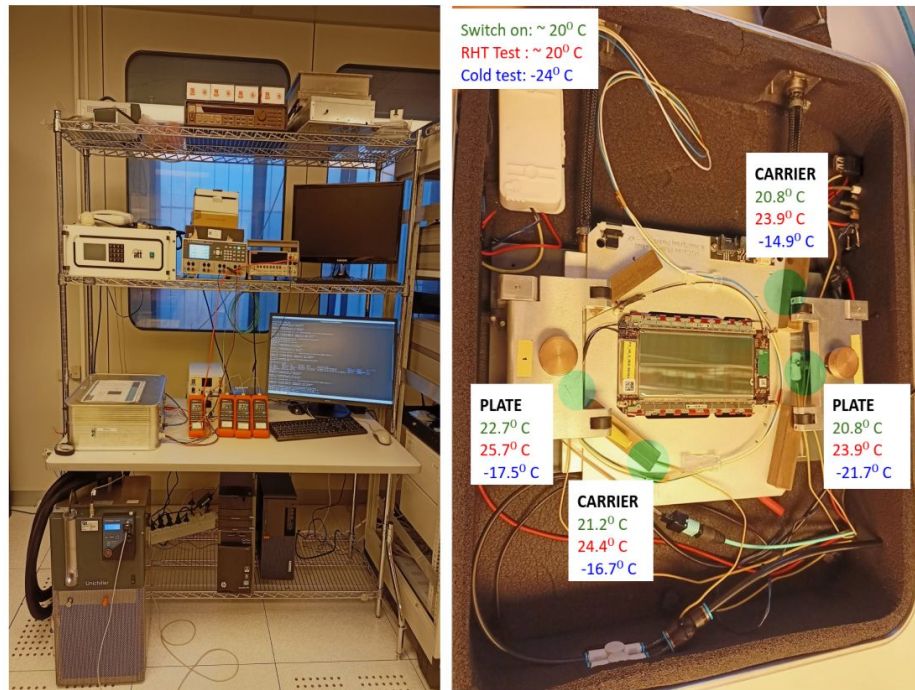


- Produzione di massa moduli PS (~1k moduli)
- Assemblaggio e test di validazione in camera pulita
 - Incollaggio e saldatura sono fasi cruciali
 - Forte collaborazione tra tecnici e fisici richiesta

Test di validazione

- Noise measurement
- I-V characterization before and after assembly of the sensors
- Calibration of the software and firmware (Ph2_ACF)

Set-up test at room and low temperatures (up to $\sim -24^{\circ}\text{C}$)



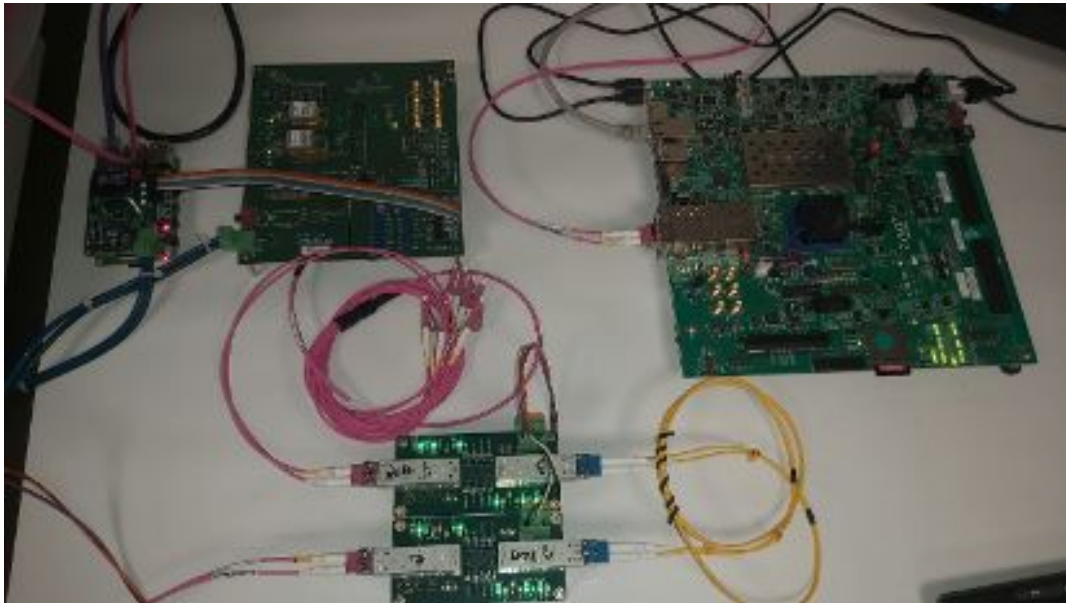
4 moduli/giorno - 10 giorni per costruire un modulo

- 1 mp tecnico per incollaggio
- 0.5 mp tecnico per wire bonding (+1 for backup)
- 1 mp fisico per coordinamento
- 1 mp fisico per metrologia e test

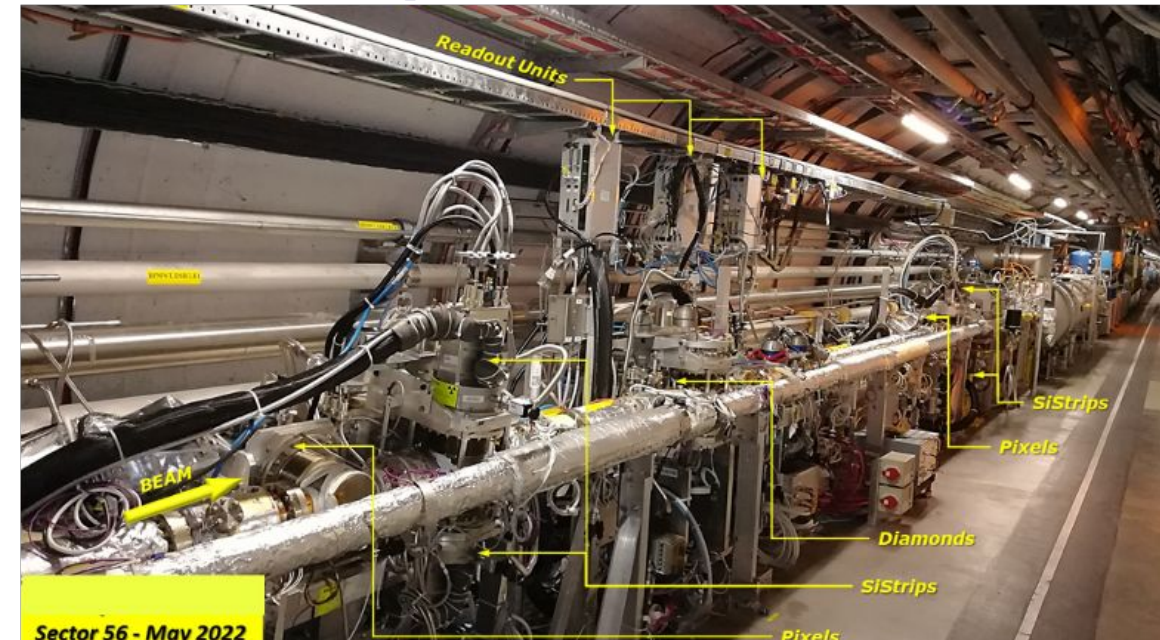
Richiesta di 1 CdR o AdR per 2026

- Online coordination:
 - DAQ;
 - Online software;
 - Precision clock.
- Participation to PPS2 DAQ development.

F. Cafagna PPS Online Coordinator



RP layout in sector 56



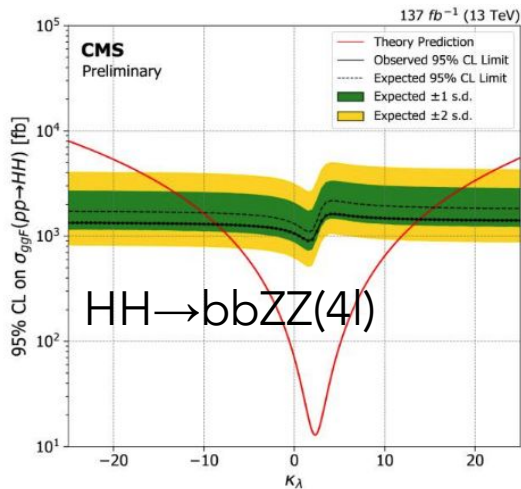
- PPS2: 3D pixels read out by the CROC for tracking and LGADs read out by the ETROC for the timing.
 - Contribution to the DAQ for both detectors readout.

IpGBT and VTRX+ tunnel link testbench for PPS2

Higgs Searches

Double Higgs searches

- $HH \rightarrow bb\mu\mu$: [PhD thesis, B. D'Anzi]
- $HH \rightarrow bbZZ(4l)$ res and non-res: [PhD thesis, M. Louka]
- Differential cross section (res and non-res)
- Run2 HH combination
- xsection modeling with ML in modelli di EFT

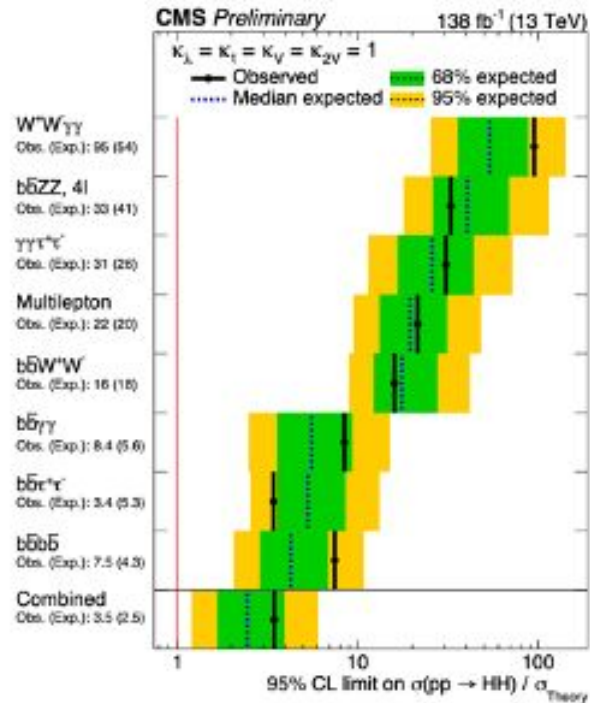


HH Run2 combination

UL on $\alpha_{HH} \sim 3.5$ (2.5) x SM

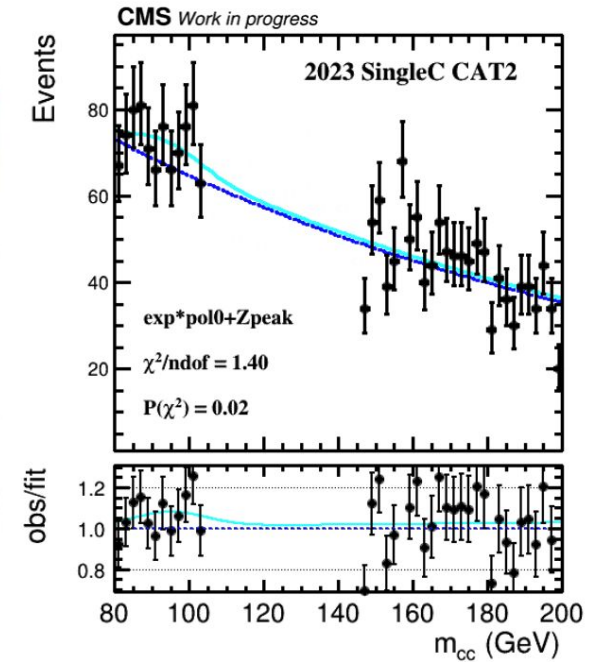
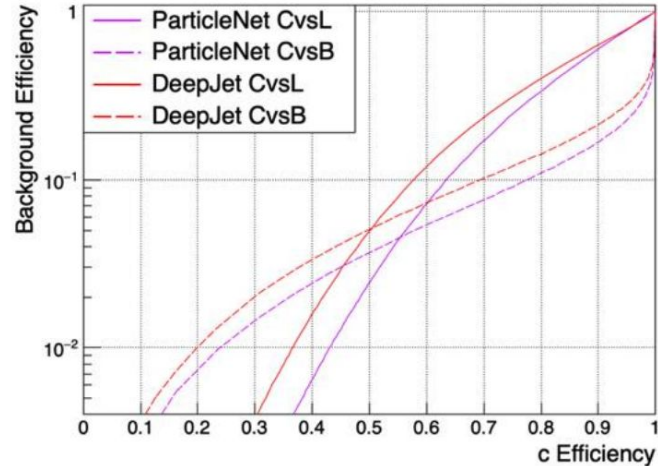
► [Nature vol. 607, pages 60–68 \(2022\)](#)

HIG-20-011 in CWR

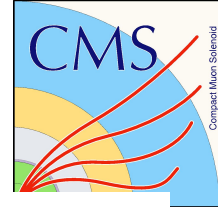


Higgs decays: VBF $H \rightarrow cc$

- 2023 dataset, first HLT path with PNet [2024 PhD thesis: A. Zaza] → Upper limit on $\mu \sim 30$
 - Sensitivity comparable with ttH , VH
- 2024-2025, VBF parking dataset [PhD thesis: L. Generoso] → analysis ongoing



B-Physics: rare decays and spectroscopy



Phys. Lett. B 853 (2024) 138633

Rare decays

- LFV $\tau \rightarrow 3\mu$ (HF channel):
 - Run2: Upper limit $\text{BR}(\tau \rightarrow 3\mu)$ published on PLB
 - Run3: preapproval of 2022+2023 (combined expected UL compatible with Belle II)
 - HL-LHC: muon acceptance and ID with ME0 [phD thesis Felice Nenna]
Contribution to the ESPP document
- $B_s \rightarrow 4\mu$ and $\text{Eta}' \rightarrow 4\mu$ [PhD thesis, M. Buonsante]
 - 2022-2024 inclusive double muon triggers
 - 30% improvement of the current world-best upper limit on the $B_0(B^0) \rightarrow 4\mu$
 - Evidence of $\text{Eta}' \rightarrow 4\mu$

F.M. Simone: BPH Rare decays Coordinator

Bottomonium Spectroscopy

- B_c lifetime [PhD thesis, U. Solibziri]



Contents lists available at ScienceDirect

Physics Letters B

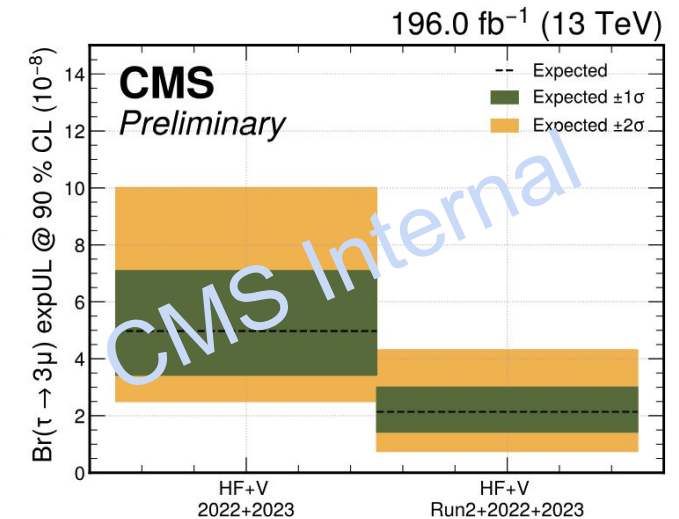
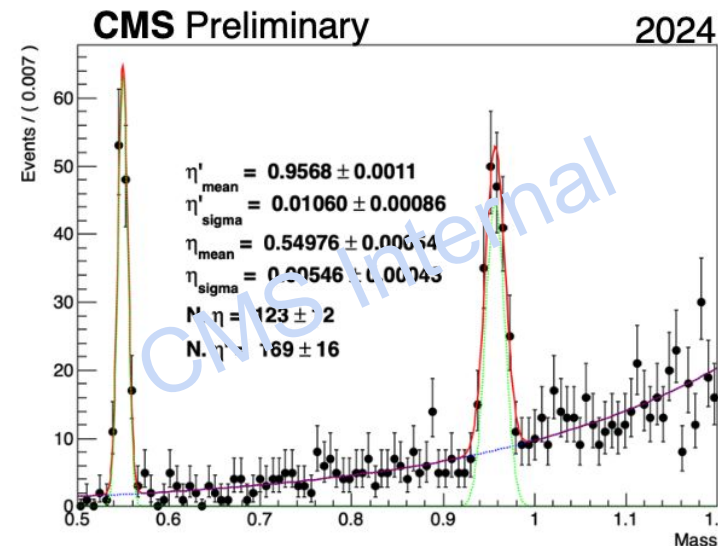
journal homepage: www.elsevier.com/locate/physletb

Letter

Search for the lepton flavor violating $\tau \rightarrow 3\mu$ decay in proton-proton collisions at $\sqrt{s} = 13 \text{ TeV}$

The CMS Collaboration*

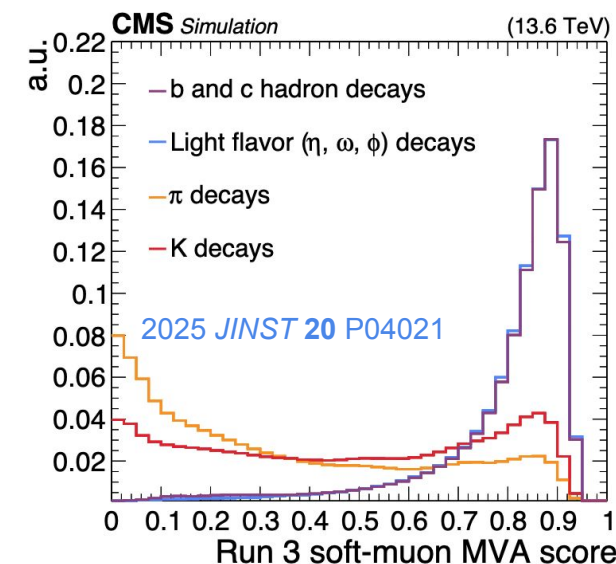
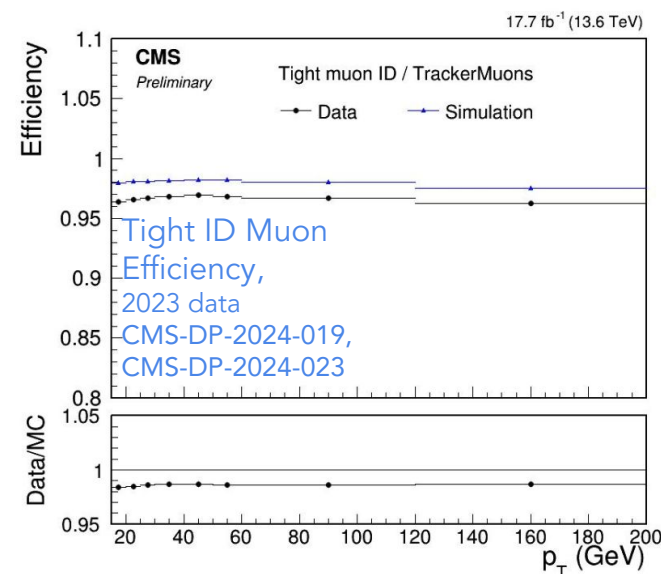
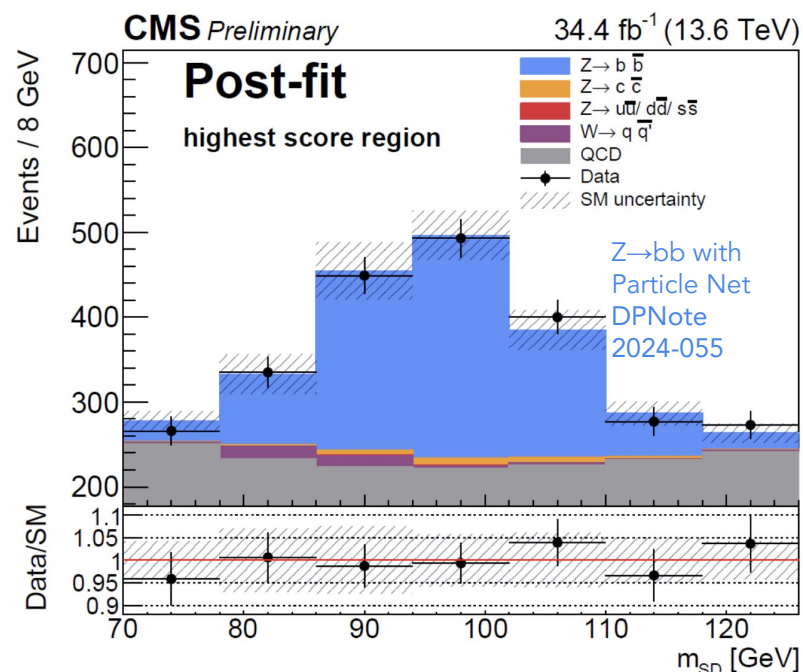
CERN, Geneva, Switzerland



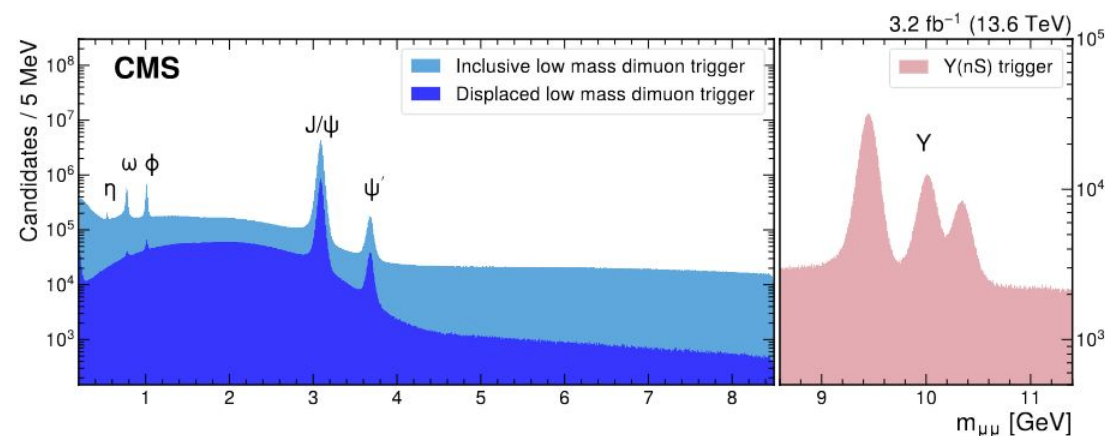
Object reconstruction

- Offline: Muon identification, Jet flavor tagging [PhD thesis ongoing, D. Troiano], Tracking efficiency

R. Radogna: Muon POG Selection and Identification Coordinator

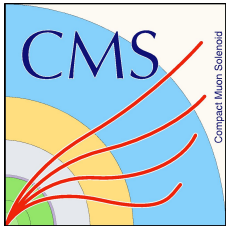


- Trigger performance:
 - Tracking
 - B-Physics
 - B-tagging



[Run3 Trigger Performance, link to arXiv](#)

Anagrafica



- L'anagrafica sulla sigla FASE2_CMS va azzerata
- 2 dottorandi entrati a fine 2024 (Generoso, Nenna)
- 1 PhD al primo anno ha abbandonato (Barbieri)
- 4 dottorati nel 2025 (D'Anzi, Louka, Sozbilir, Zaza)
 - AdR: Zaza e Sozbilir
- 1 pensionamento (Fiore)
- 1 AdR scaduto (Mastrapasqua)
- ICSCS2 (sinergico a CMS) chiude nel 2025 e le percentuali tornano in CMS
- *Sinergia con IGNITE
- Totale: **23.75 FTE**

		CMS (%)
1	Abrescia M.	75
2	Bermudez C.	50 *
3	Buonsante M.	100
4	Cafagna F.	50
5	Colaleo A.	70
6	Creanza D.M.	70
7	De Filippis N.	70
8	De Robertis G.	20 *
9	Donvito G.	20
10	Elmetenawee W.	70
11	Ferrara N.	100
12	Generoso L.	80
13	Iaselli G.	20
14	Lakshima U.	30
15	Licciulli F.	20 *
16	Loddo F.	50 (20) *
17	Longo L.	70

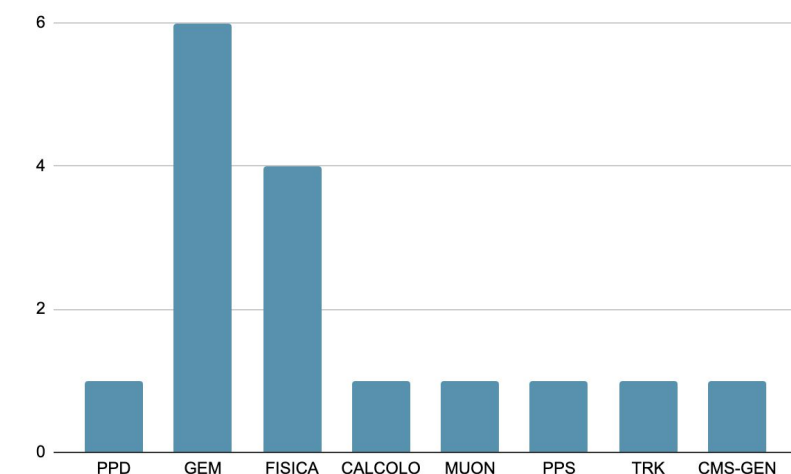
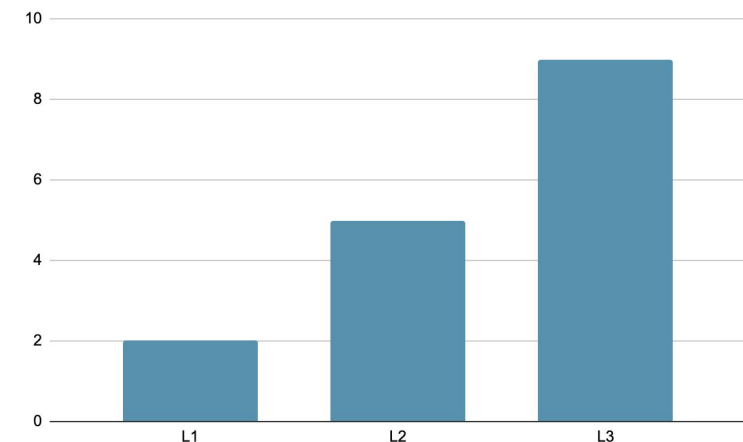
18	Maggi M.	70
19	Marzocca C.	50
20	Matarrese	80
21	My S.	70
22	Nenna F.	100
23	Pellecchia A.	70
24	Pompili A.	100
25	Pugliese G.	70
26	Radogna R.	70
27	Ramos D.	70
28	Simone F.M.	70
29	Silvestris L.	100
30	Sozbilir U.	100
31	Stamerra A.	70
32	Troiano D.	100
33	Venditti R.	70
34	Verwilligen P.	80
35	Zaza A.	70

Overview responsabilità 2026



Ongoing →in DB

Nome/Cognome	Progetto	Descrizione	Livello	Data Inizio	Data Fine
Francesco Cafagna	PPS	PPS - Coordinatore dell'Online	2	01/03/2018	30/09/2025
Donvito Giacinto	CALCOLO	T2 site manager	3	01/01/2016	31/12/2025
Licciulli Francesco	GEM	GEM Electronics Coordinator	2	01/09/2023	31/08/2025
Alexis Pompili	FISICA	BPH-TOP PubComm member	3	01/10/2021	31/12/2025
Alexis Pompili	FISICA	CMS @ LHC-HFWG	3	01/10/2021	31/12/2026
Gabriella Pugliese	MUON	Muon Project Manager	1	01/09/2023	31/08/2025
Anna Stamerra	GEM	GEM Bari Site Manager	3	01/01/2025	31/08/2025
Piet Verwilligen	MUON	Background studies coordinator	3	01/01/2022	31/08/2025
Luigi Longo	GEM	Hardware Coordinator	2	01/09/2023	31/08/2027
Antonello Pellecchia	GEM	Deputy Run Coordinator	2	01/09/2023	31/08/2025
Piet Verwilligen	GEM	Upgrade Coordinator	2	01/09/2023	31/08/2025
Raffaella Radogna	FISICA	Selection and Identification coordinator	3	01/09/2023	31/08/2025
Federica Simone	FISICA	BPH Rare decays coordinator	3	01/09/2023	31/08/2025
Marco Buonsante	PPD	ML4DQM-DC	3	01/11/2024	31/10/2026
Lucia Silvestris	GEN	Engagement Office chair	1	01/10/2024	31/08/2026
Flavio Loddo	Tracker	Phase-2 CMS Inner Tracker ASIC Project Coordinator	3	01/05/2018	31/08/2027



Richieste Servizi di Sezione

	Richieste Officina Meccanica	mp Bari	mp @ CERN	Totale
RPC	riparazione leak	0	1	1
RPC	test & longevity legacy system GIF++	0	1	1
RPC	Estrazione camere e servizi Y1 RPC	0	1	1
RPC	test RPC a GIF++ con Ecogas	0	1	1
GEM	Beam and magnet test for CMS GEM (costruzione e supporto setup)	0	0.5	0.5
GEM	Preparazione PCB per costruzione ME0	0.5	0	0.5
GEM	Refurbishment GE1/1	0	1	1
GEM	Preparation services to test ME0 inside HGCal in P5	0	1	1
GEM	GE1/1 Extraction (m.p. tecnici) - off mecc	0	1	1
GEM	Construction of GE1/1 stack storage	0	1	1
GEM	Tooling and storage per ME0 stack	0	1	1
TRK	Realizzazione Tools di assemblaggio Moduli OT CMS	1	0	1
	Totale RPC	0	4	4
	Totale GEM	0.5	5.5	6
	Totale TRK	1	0	1
	Totale CMS	1.5	9.5	11

Richiesta inoltrata,
in attesa di
feedback per
rinormalizzazione
finale

Richieste Servizi di Sezione

	Richieste Servizio Elettronico	mp @ Bari	mp @ CERN
RPC	Assistenza su elettronica di lettura RPC	1	0
GEM	Modifica elettronica stack ME0	0	2
GEM	Assistenza in ME0 Assembly (SMD Soldering)	1	0
TRK	Assistenza su elettronica di lettura moduli	1	0
TRK	Ricezione e test cavi	0	1
Totale CMS		3	3

	Richieste Progettazione Meccanica	mp
RPC	Progettazione supporto meccanico di prototipi RPC veloci	1
GEM	Design GE1/1 storage	1
GEM	Small Design Projects GEM Lab	0.5
TRK	progettazione tools per assemblaggio moduli	0.5
Totale CMS		3

Richieste inoltrate, in attesa di feedback per rinormalizzazione finale

	Richieste personale Camera Pulita	mp
TRK	Camera Pulita - Costruzione moduli	20
GEM	Camera Pulita - Costruzione moduli ME0	1
Totale CMS		21

Richieste Finanziarie a CSN1

Capitolo	Progetto	Tipo	Descrizione	Richiesta (kE)
CONS	TRACKER	META	Contributo per manutenzione camere pulite	4.0
CONS	MUON	META	Contributo per manutenzione laboratori	1.5
SPSERVIZI	GEM	MOF-B	GEM MOFB	Da formulare

- 32 ke consumi da metabolismo
- 360 ke missioni

Spokesperson team visit

- Lo SP e l'upgrade coordinator hanno visitato i nostri lab il 18 giugno
- Focus su produzione dei rivelatori per Fase 2 (ME0, outer tracker)
- Feedback positivo, richiesta di forte impegno sulla produzione dei moduli del tracciatore
 - Indagata la possibilità di incrementare rate di produzione 4moduli/giorno → 6 moduli al giorno

CMS SP and UC visit to Bari

Wednesday 18 Jun 2025, 09:20 → 16:55

Europe/Rome

Rosamaria Venditti

(Istituto Nazionale di Fisica Nucleare)

Videoconference

CMS SP and UC visit to Bari

Join

09:30 → 14:10

1: Bari activities

Conveners: Piet Omer J Verwilligen (Istituto Nazionale di Fisica Nucleare), Rosamaria Venditti (Istituto Nazionale di Fisica Nucleare)

09:30

Welcome to Bari INFN

Speaker: Vito Manzari (Istituto Nazionale di Fisica Nucleare)

5m

09:35

Welcome to Bari Physics Department

Speaker: Antonio Marrone (Istituto Nazionale di Fisica Nucleare)

5m

09:40

CMS Bari Overview

Speaker: Rosamaria Venditti (Istituto Nazionale di Fisica Nucleare)

20m

CMS Bari Overview

link

10:00

ME0 Modules production in Bari

Speakers: Anna Stamerra (Istituto Nazionale di Fisica Nucleare), Antonello Pellecchia (Istituto Nazionale di Fisica Nucleare)

20m

ME0 module produc...

10:20

PS Modules production in Bari

Speaker: Ilirjan Margjeka (Istituto Nazionale di Fisica Nucleare)

20m

PS module producti...

11:10

Visit to Tracker and GEM Clean Room

1h

12:10

Visit to Bari T2

10m

12:20

Visit to GEM Lab

30m

12:50

Visit to RPC Lab

10m

13:00

Lunch break

1h

14:00 → 16:00

2: Discussion with ECS

Conveners: Federica Maria Simone (Istituto Nazionale di Fisica Nucleare), Raffaella Radogna (Istituto Nazionale di Fisica Nucleare)

14:00

Double Higgs searches

Speakers: Magdy Louka (Istituto Nazionale di Fisica Nucleare), Walaa Elmetenawee (Istituto Nazionale di Fisica Nucleare)

5m

HPLsearches_@Bari...

14:05

VBF H→cc

Speakers: Angela Zaza (Istituto Nazionale di Fisica Nucleare), Lisa Generoso (Istituto Nazionale di Fisica Nucleare)

5m

VBFHccOverview_S...

14:10

Flavor tagging for Boosted Jets

Speakers: Donato Troiano (Istituto Nazionale di Fisica Nucleare), Luigi Longo (Istituto Nazionale di Fisica Nucleare)

5m

boosted_jets.pdf

14:15

Bottomonium spectroscopy with Run 2 + Run 3 data

Speaker: Vincenzo Mastrapasqua (Istituto Nazionale di Fisica Nucleare)

5m

YKKspectroscopy_f...

14:20

Search for rare decays with four muons in the final state and Machine Learning for DQM

Speakers: Federica Maria Simone (Istituto Nazionale di Fisica Nucleare), Marco Buonsante (Istituto Nazionale di Fisica Nucleare)

5m

RDAML_SPVisit.pdf

14:25

GEM upgrade performance studies

Speakers: Antonello Pellecchia (Istituto Nazionale di Fisica Nucleare), Felice Nenna (Istituto Nazionale di Fisica Nucleare)

5m

SP_visit_bari2025.pdf

14:30

RPC studies and performance

Speakers: Dayron Ramos Lopez (Istituto Nazionale di Fisica Nucleare), Nicola Ferrara (Istituto Nazionale di Fisica Nucleare)

5m

meeting_BARI_SP_U...

21

Spokesperson team visit





Richieste Finanziarie a CSN1

Capitolo	Progetto	Tipo	Descrizione	Richiesta (kE)
CONS	TRACKER	META	Contributo per manutenzione camere pulite	4.0
CONS	MUON	META	Contributo per manutenzione laboratori	1
SPSERVIZI	GEM	MOF-B	GEM MOFB	124.5

Richiesta a CSN1

- XX ke consumi da metabolismo
- XXX ke missioni metaboliche
- XX ke missioni per responsabilità L1,L2