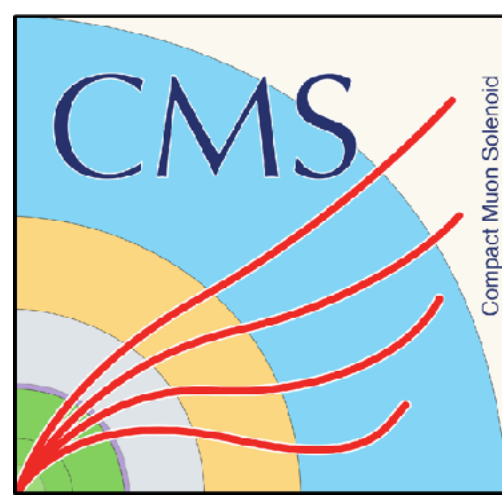


CMS Status Report



CERN-Korea committee meeting - 22/40/2024
P. McBride for the CMS Collaboration

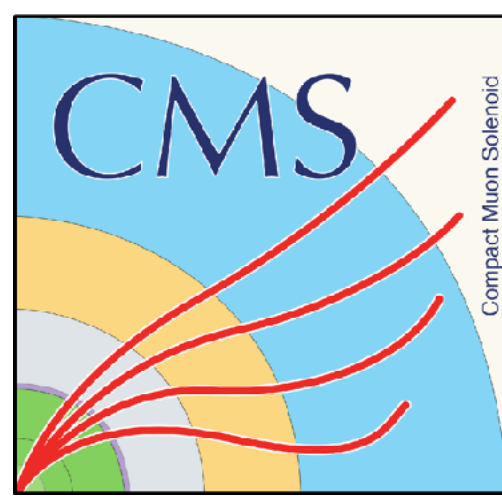
CMS Today



[NFS timelapse](#)

- **Year End Technical Stop (YETS)** work was completed successfully and CMS was commissioned for the start of the 2024 Run.
- **Operations** - CMS has a new control room for 2024
 - 2024 pp physics run has started (pp collisions @ 13.6 TeV)
- **Physics** - Many new results from Run 2 and Run 3 for the Winter conferences - highlights [here](#).
 - Preparations for the Summer conferences ongoing
- **Upgrades** - Steady progress in the transition to production.
 - Preparing LS3 - decommissioning, installation, commissioning

CMS Collaboration



CMS Membership

- 218 Full Member institutes
- 29 Associated Institutes
- 10 Cooperating Institutes

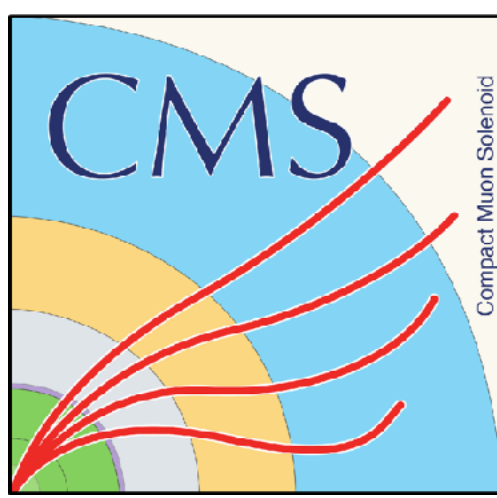
Korea in CMS:
11 full Member Institutes
1 Associated Institute
151 members
69 authors (including students)
2-3% of all CMS

The CMS experiment has **5869** active members from **257** institutes coming from **58** countries.

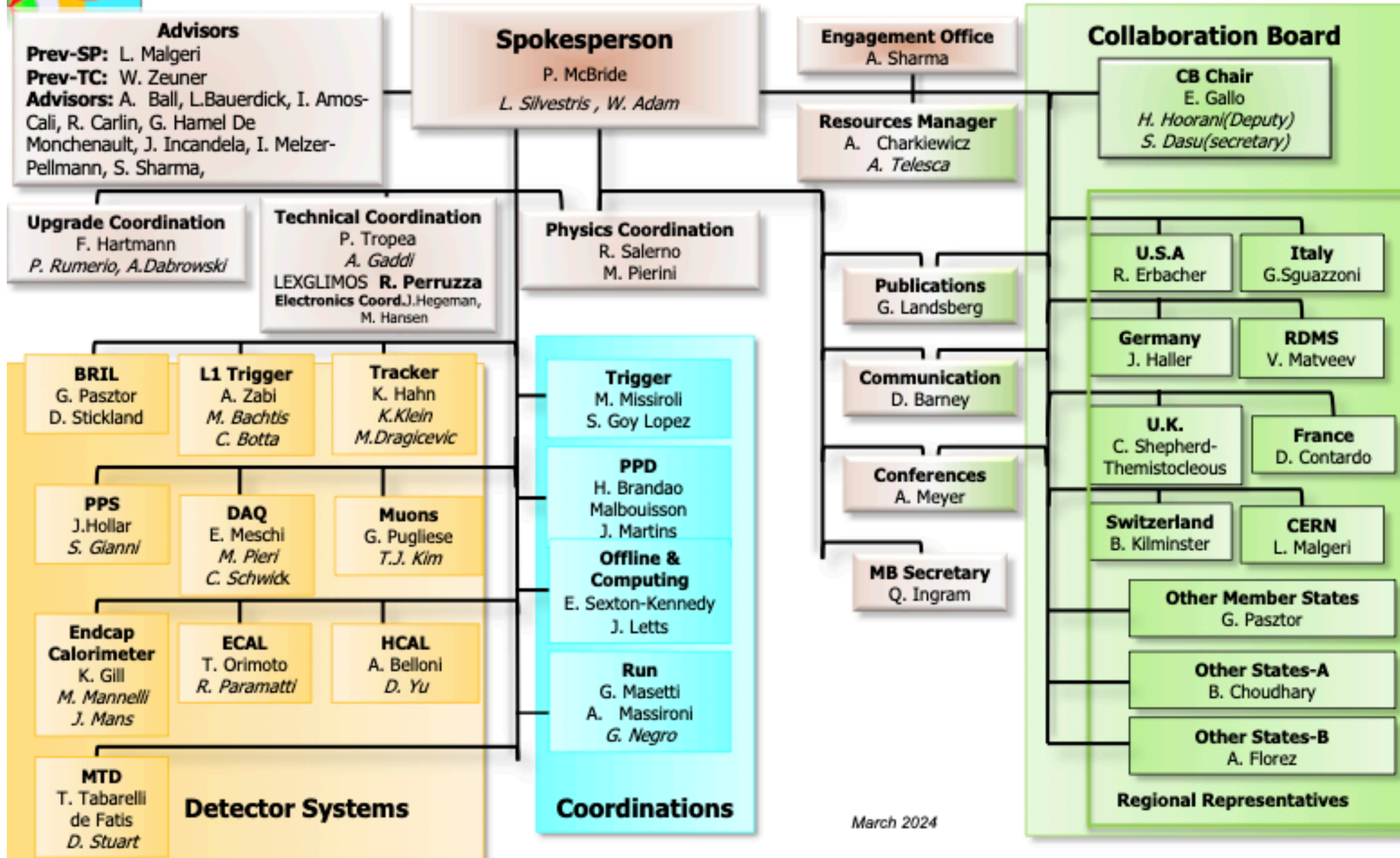


2062	1171	1293	978	252	108
Phd Physicists (396 women 1666 men)	Physics Doctoral Students (319 women 852 men)	Non Doctoral Students (364 women 929 men)	Engineers (147 women 831 men)	Technicians (22 women 230 men)	Administratives (69 women 39 men)

CMS Management



CMS Management Board- March 2024



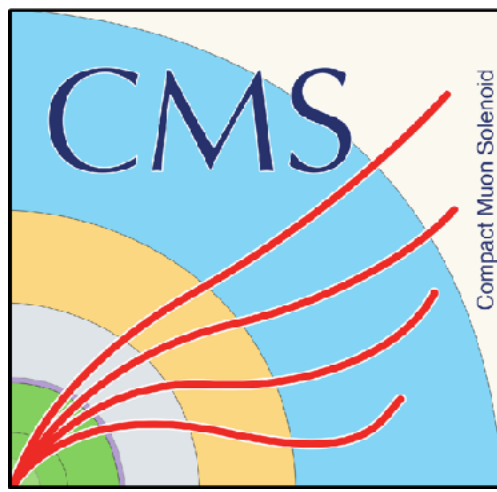
Muon Deputy System Manager:
Tae Jeong Kim, Hanyang University

New leadership appointments to start in Sept 2024:

- S. Sekmen (Kyungpook): SUS PAG Convener
- S. Lee (Korea Univ) Trigger Field Operations Group Convener



Spokesperson elect



The CMS Spokesperson elects a new Spokesperson (SP) every two years.

The election was held in February 2024.

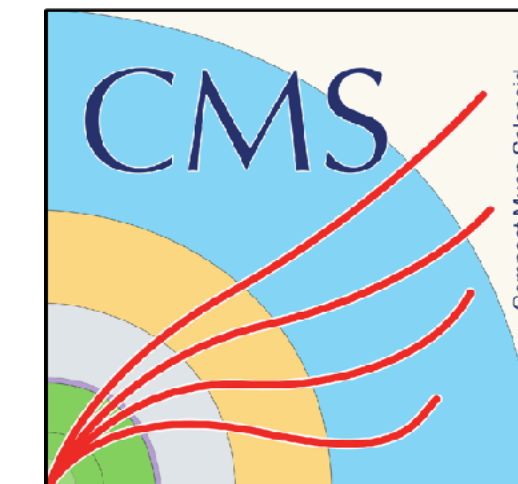
Term: **Sept 1, 2024 - Aug 31, 2026**

Warmest congratulations to the next CMS Spokesperson: Gautier Hamel de Monchenault

- ▶ Staff physicist at CEA Paris-Saclay
- ▶ Gautier has served as CMS Deputy Spokesperson, Publications Committee chair
- ▶ <https://ghm.web.cern.ch/ghm/web/gautier.html>



2024 LHC Schedule



		Apr			May			Jun							
Wk		14	15	16	17	18	19	20	21	22	23	24	25	26	
Mo	Easter	1	8	15	22	29	6	13	Whitsun	20	27	3	10	17	24
Tu								MD 1							
We			Interleaved commissioning & intensity ramp up		1st May							TS1			
Th						Ascension		VdM program							
Fr		Cryo reconfig.									MD 2				
Sa		Scrubbing										spare			
Su															

		Jul			Aug			Sep			Oct			
Wk		27	28	29	30	31	32	33	34	35	36	37	38	39
Mo		1	8	15	22	29	5	12	19	26	2	9	16	23
Tu														
We									MD 3					
Th											Jeune G.			
Fr														
Sa														MD 4
Su														

		Nov			Dec									
Wk		40	41	42	43	44	45	46	47	48	49	50	51	52
Mo	VIP visits CERN 70	30	7	14	21	28	4	11	18	25	2	9	16	23
Tu					TS2	p-p ref run		MD 6						
We														Xmas
Th					p-p ref setup						YETS			Annual Closure
Fr				MD 5	Cryo reconfig.									
Sa					Pb ion setting up									
Su														

The 2024 LHC Schedule was recently updated

4 weeks of pp was moved from 2025 to 2024

Collisions for physics started ~10 days ahead of schedule and CMS was well prepared.

Pb-Pb ion run to start on Nov 5th

Start of 2024-2025 YETS moved from Oct 28th to Nov 25th.

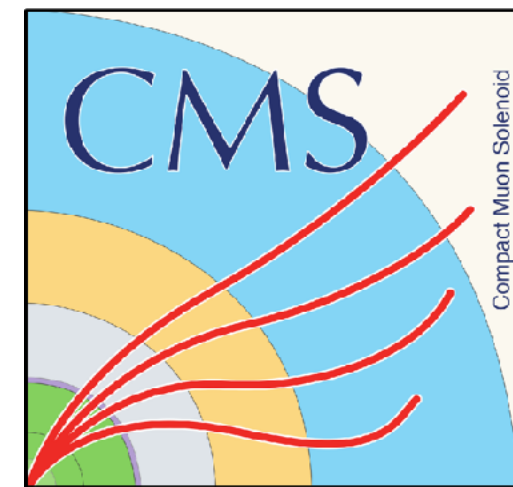
The new schedule preserves the length of the YETS — as requested by CMS for installation of cooling infrastructure during the YETS.

Details of the 2025 schedule are still under consideration.

The CMS HL-LHC Upgrade

Technical proposal CERN-LHCC-2015-010 <https://cds.cern.ch/record/2020886>

Scope Document CERN-LHCC-2015-019 <https://cds.cern.ch/record/2055167/files/LHCC-G-165.pdf>

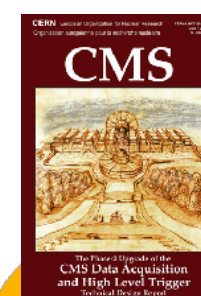
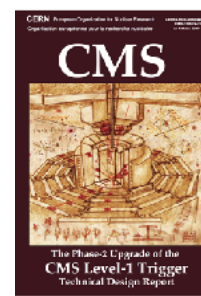


L1 Trigger/HLT/DAQ

<https://cds.cern.ch/record/2283192>

<https://cds.cern.ch/record/2283193>

- L1 40 MHz in/750 kHz out
- Tracking for PF-like selection
- HLT 7.5 kHz out



Beam Radiation and Luminosity

<https://cds.cern.ch/record/2020886>

- Bunch-wise Luminosity
- Beam Monitoring



Tracker

<https://cds.cern.ch/record/2272264>

- Si Strip Outer Tracker designed for L1 Track Trigger
- Pixelated Inner Tracker extends coverage to $|\eta| < 3.8$



Barrel Calorimeters

<https://cds.cern.ch/record/2283187>

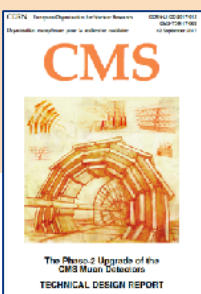
- ECAL single crystal granularity in L1 Trigger v
- precise timing for e/γ at 30 GeV
- ECAL and HCAL new back-end electronics



Muon Systems

<https://cds.cern.ch/record/2283189>

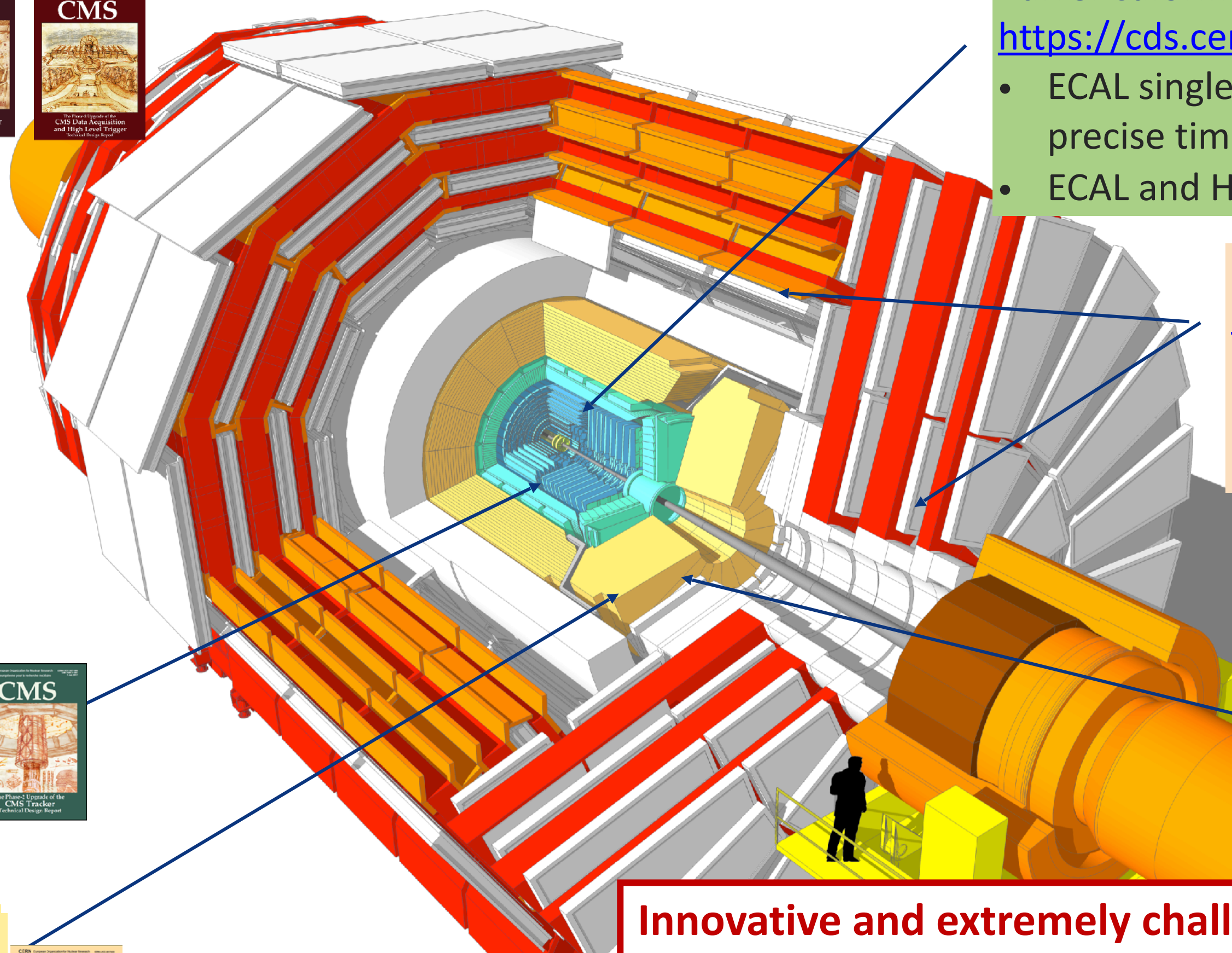
- DT & CSC new FE/BE readout
- New GEM/RPC $1.6 < |\eta| < 2.4$
- Extended coverage to $|\eta| < 3.0$



MIP Timing Detector

<https://cds.cern.ch/record/2296612>

- < 75 ps resolution
- Barrel: Crystals + SiPMs
- Endcap: LGADs



Innovative and extremely challenging new capabilities:

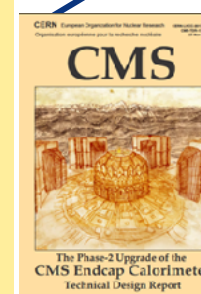
- Level 1 track trigger
- Timing detector
- Highly granular endcap calorimeter

Calorimeter Endcap

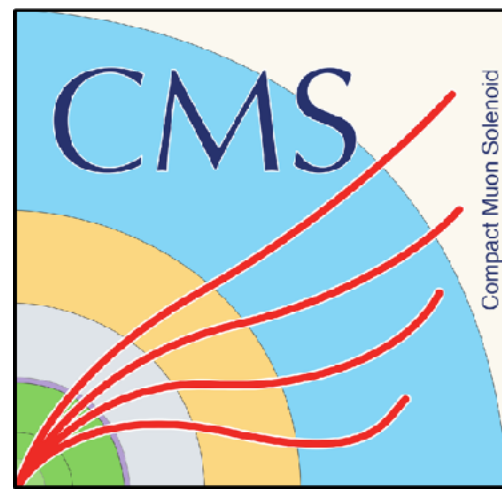
Also known as HGCAL

<https://cds.cern.ch/record/2293646>

- Si, Scint + SiPM in Pb-W-SS
- 3D shower imaging with precise timing

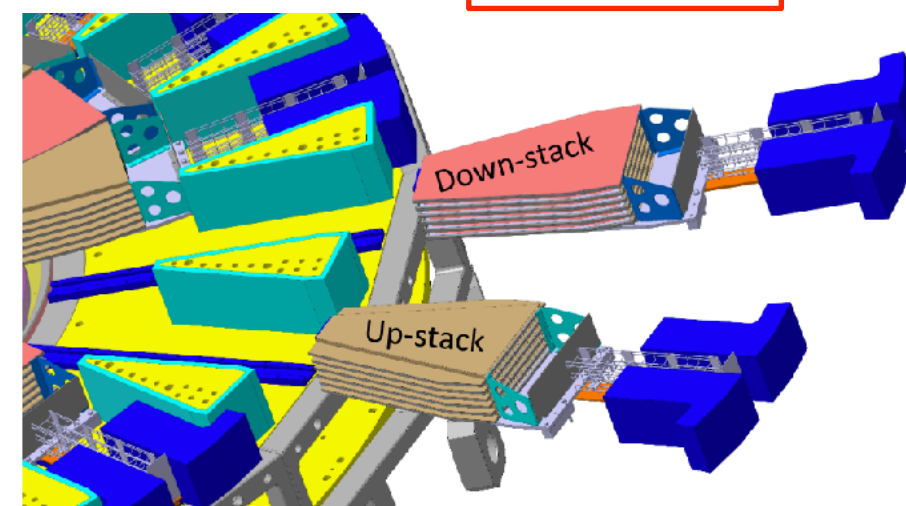
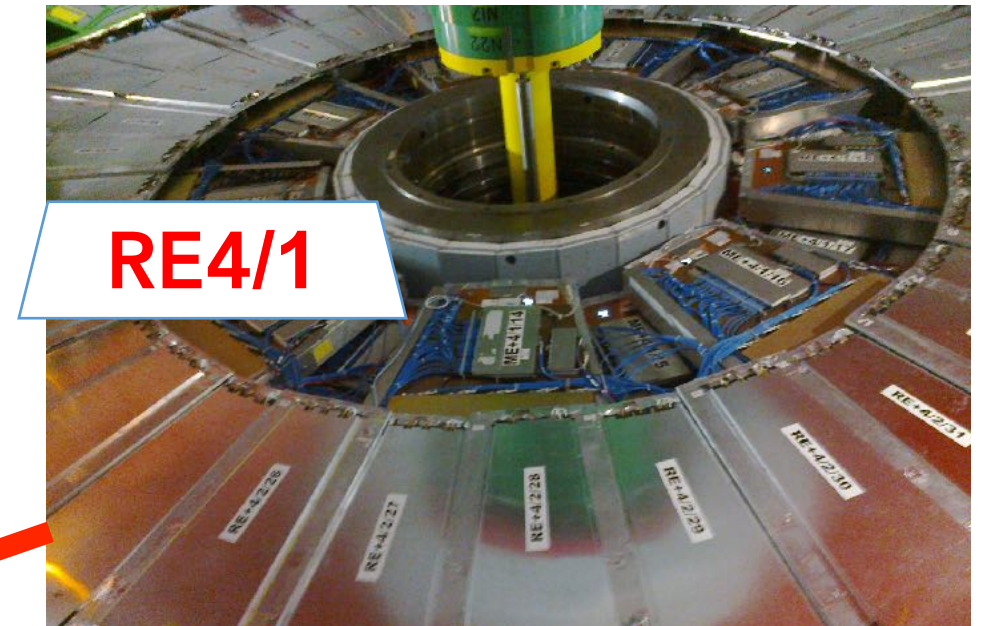
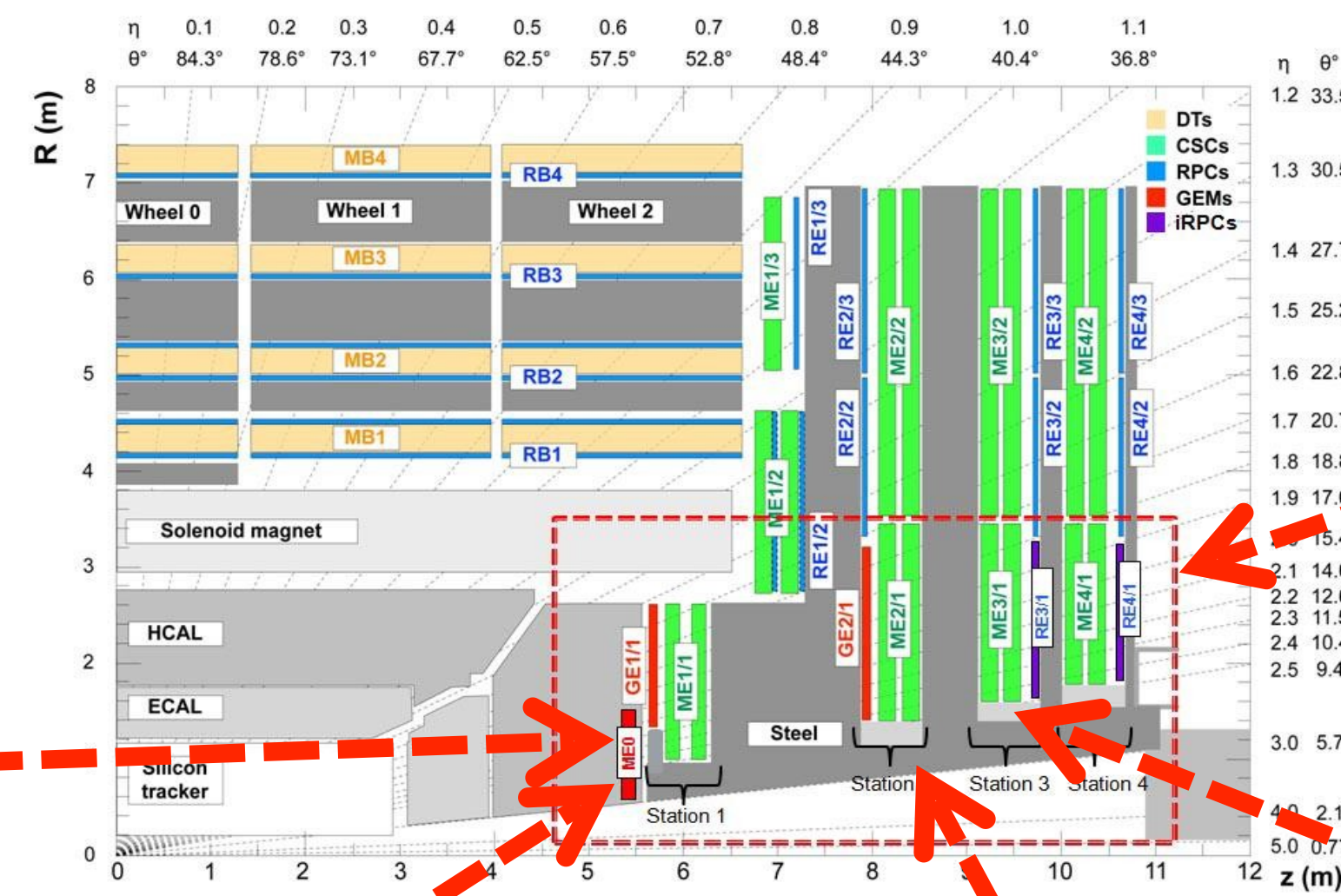


KCMS contributions to Muon Upgrade for the HL-LHC



Muon Upgrade Scope for Phase 2:

1. **New detectors** to enhance the challenging forward region: restore redundancy and extend the muon coverage up $\eta = 2.8$
2. **New electronics** for the legacy detectors



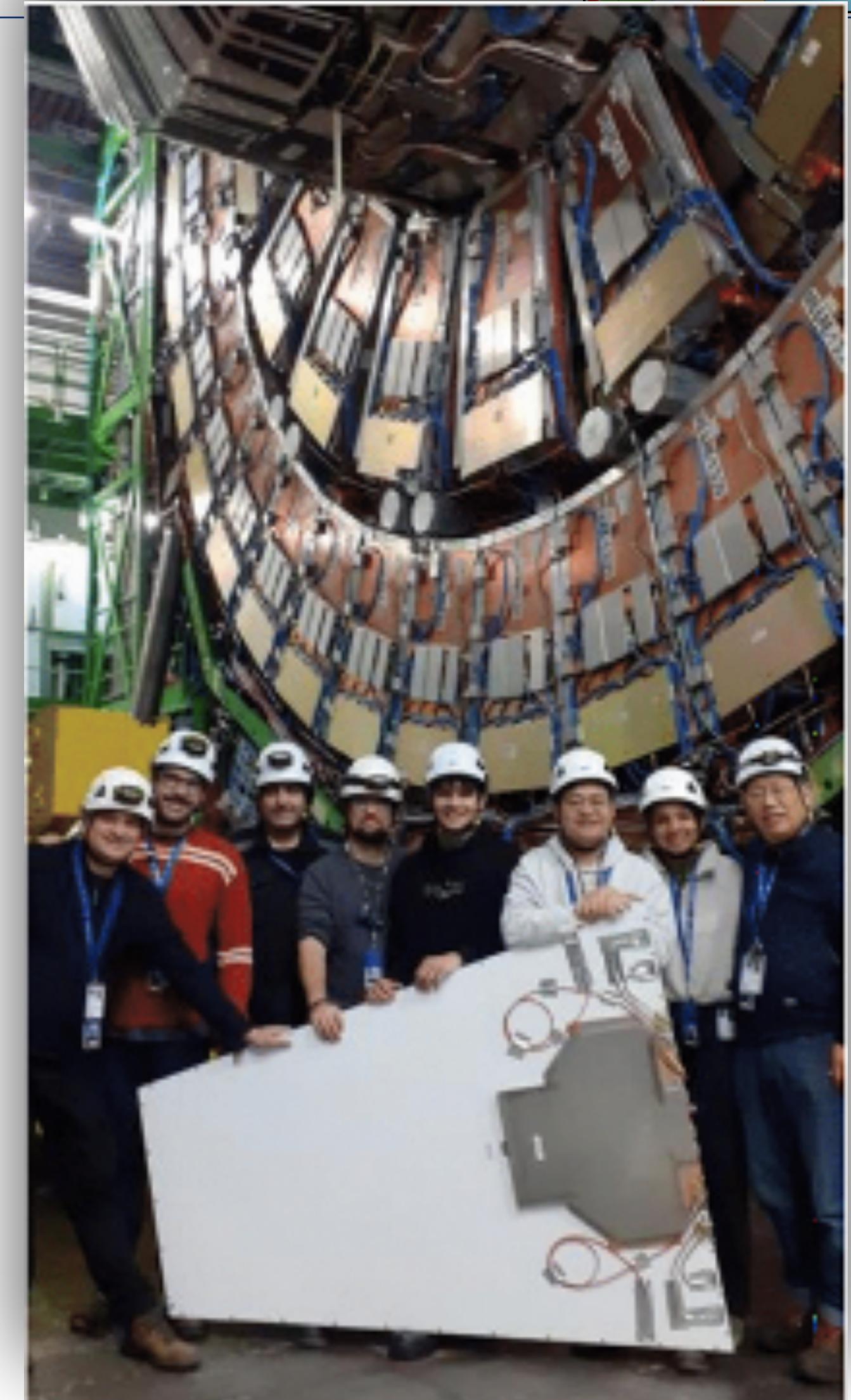
GE1/1 stations were installed in LS2 and in operations

RE3/1 and RE4/1 (iRPC)

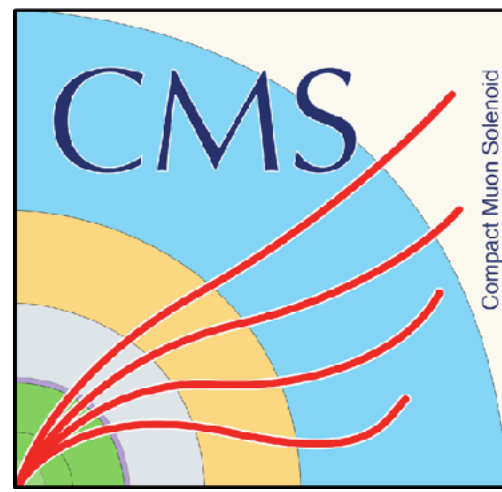
- Gaps were produced at Korea University with procedures optimized for Resistive Plate Chambers with thinner gas gaps and thinner electrodes
- Installation of four demonstrator iRPC@P5 completed in January 2021
- New: 2 chambers were installed during the 2023-2024 YETS
- The gaps needed for the 72 RE3/1 and RE4/1 chambers are nearly complete.



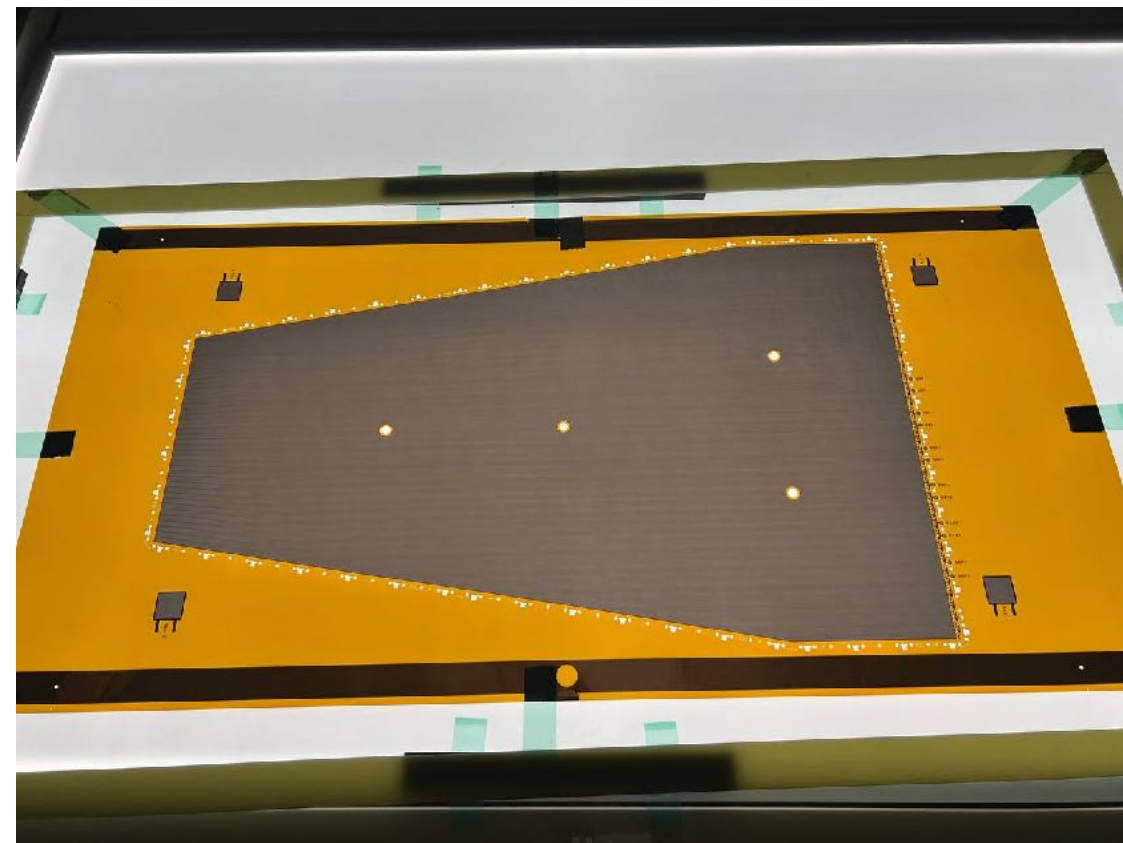
New RE3/1 chambers installed



GEM production

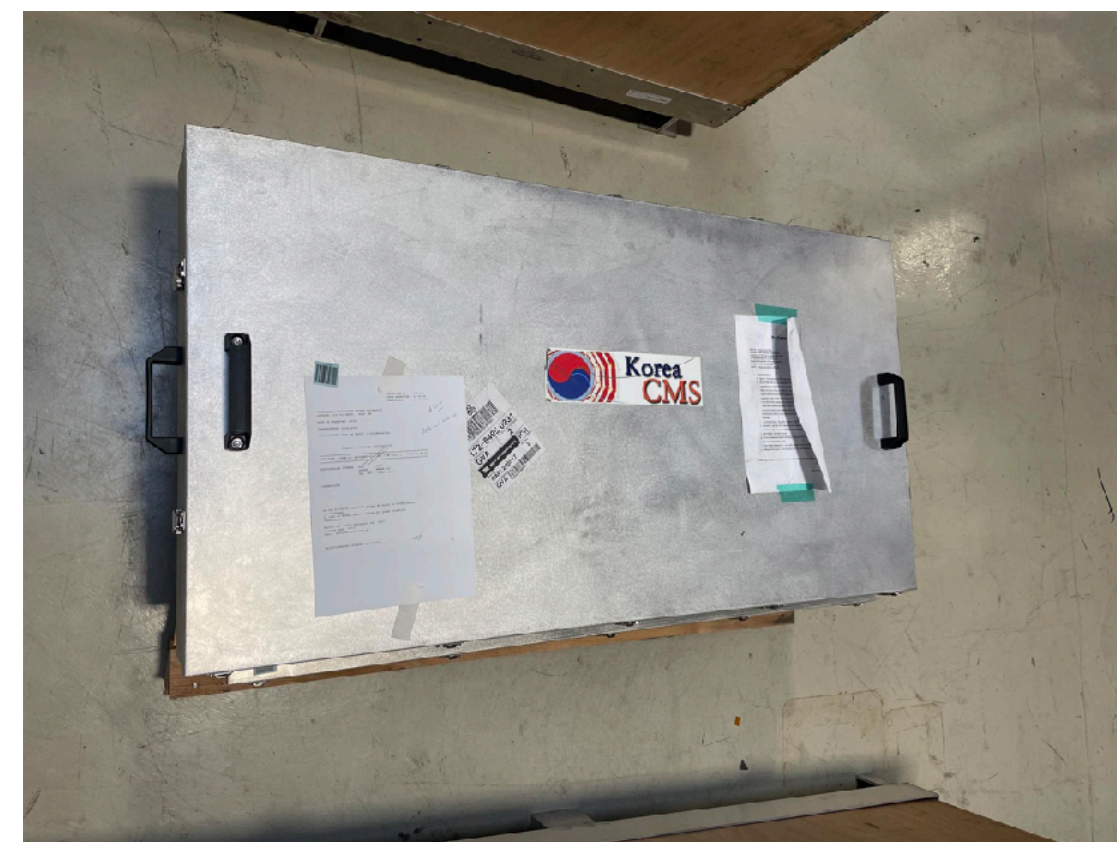


- Status in October 2023:
First ME0 GEM foils were sent from Korea to CERN



✓ME0 module production ready to start:

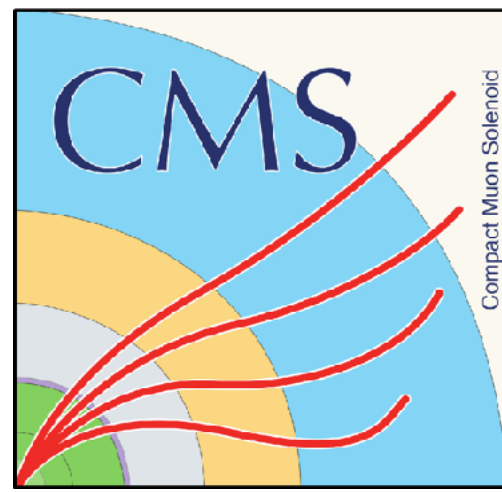
- **PCB:** 15 kits, produced in India, arrived and validated at CERN
- **FOILS:**
 - 53 foils, produced in Korea, arrived
 - 35 more produced, under test now
- 91 **external frames** received from China
- 500 **O-rings** received from the company



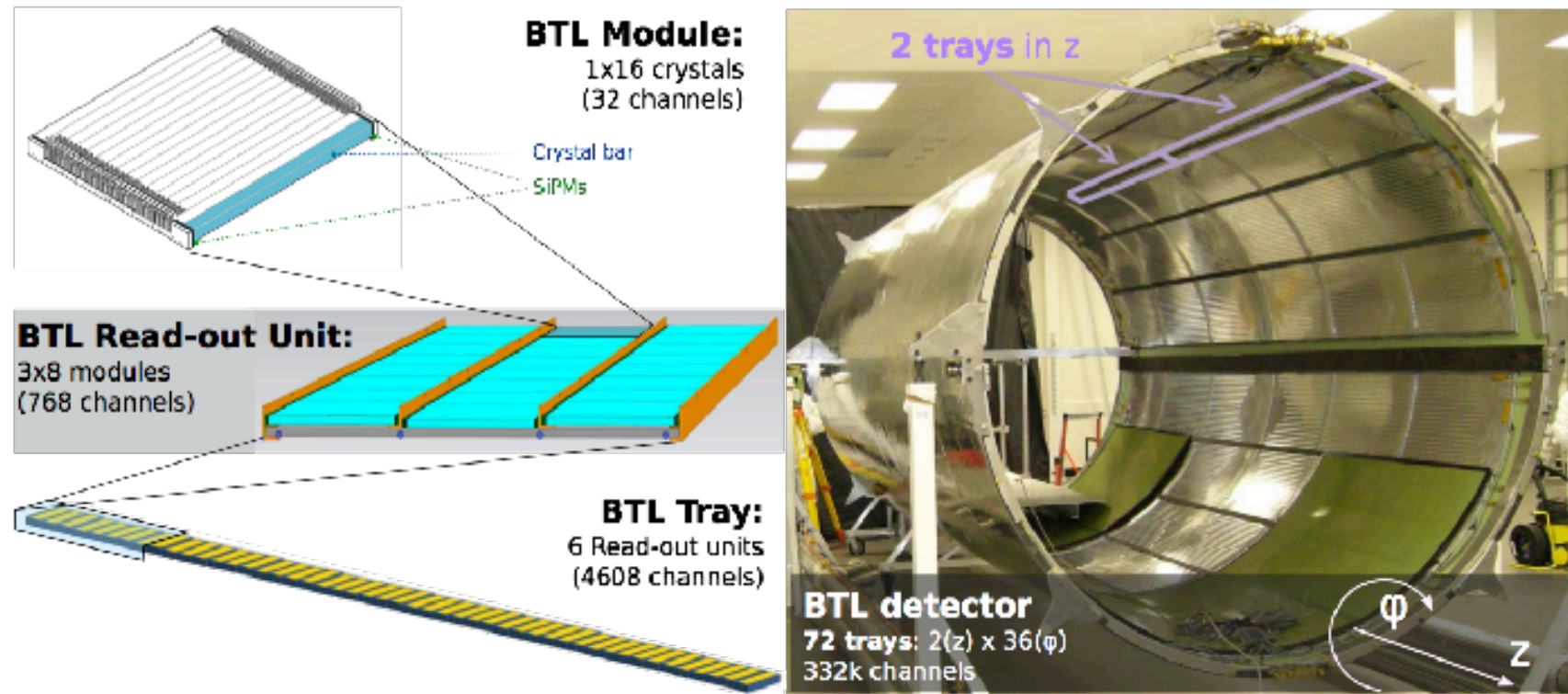
✓The first full ME0 stack completed and in the test beam



MIP Timing Detector - a reminder



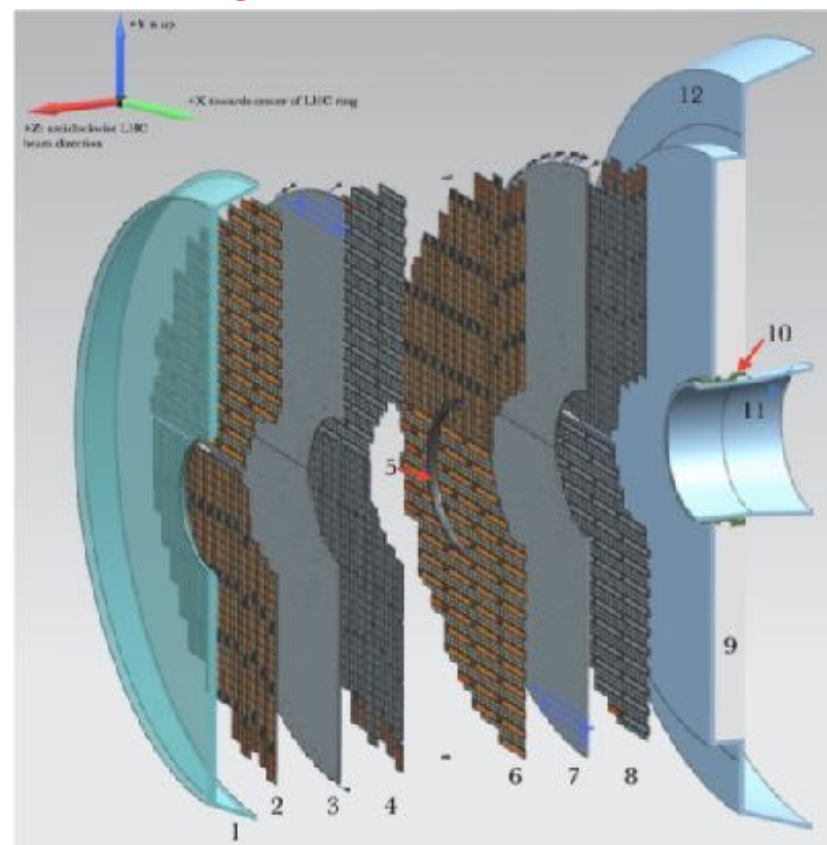
Barrel:



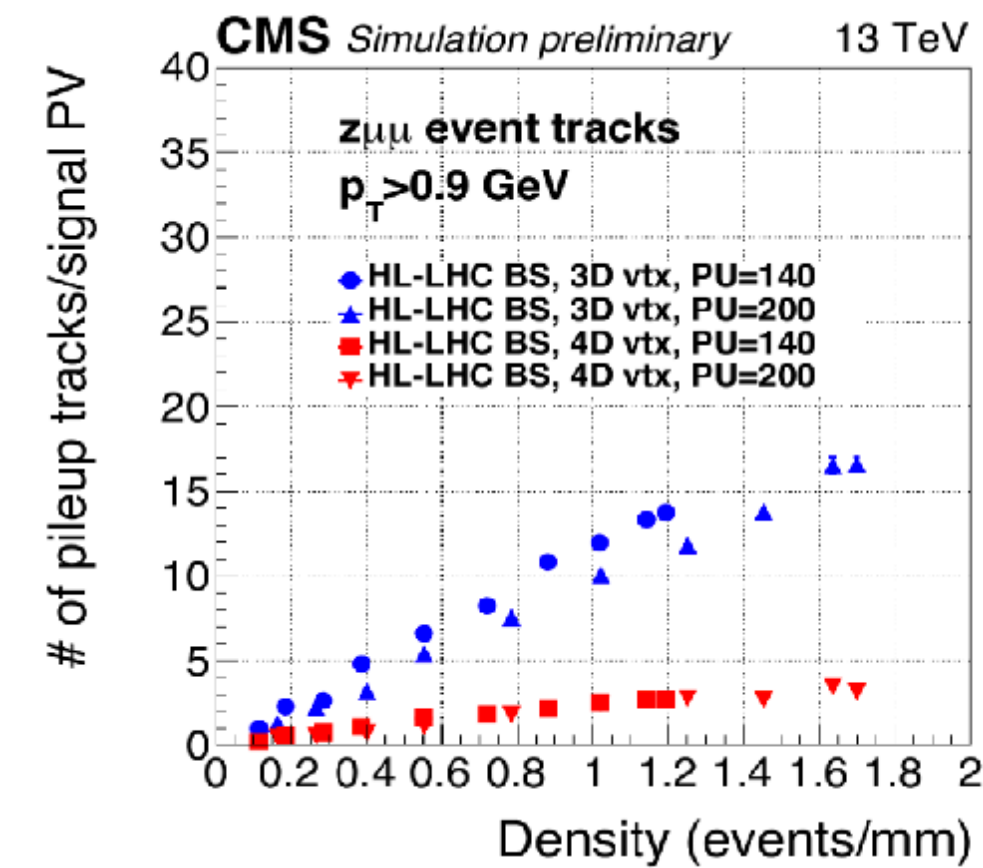
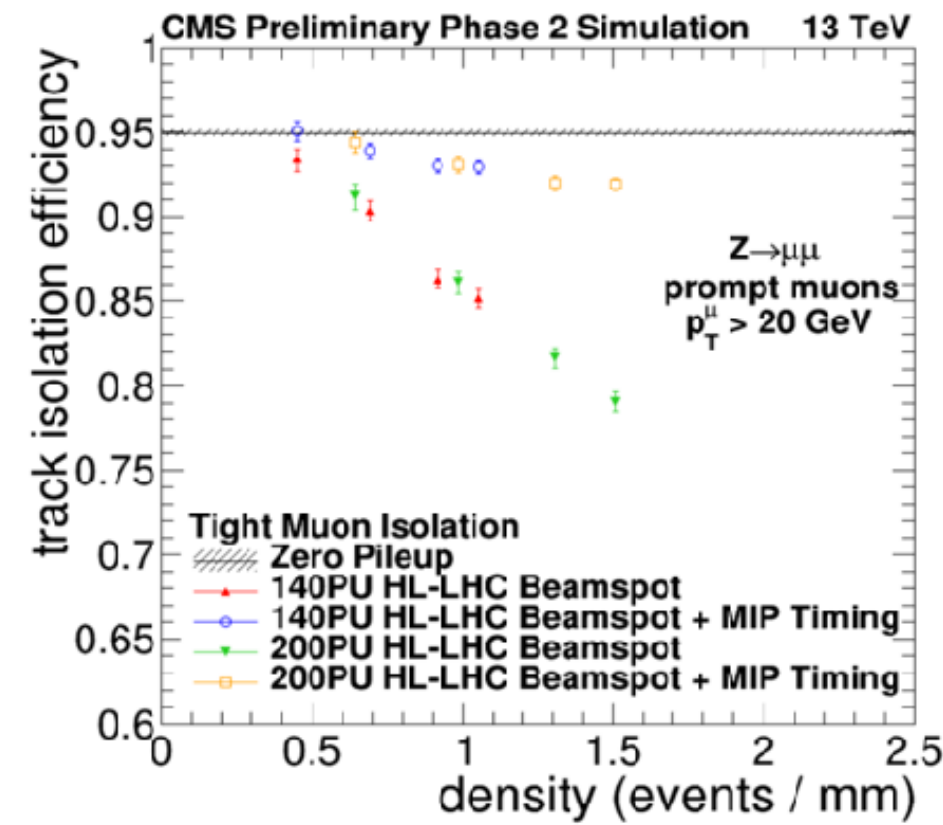
Time resolution: 30 ps (to 50ps)

Lyso Crystals 3x3x57mm³, ~330k channels, 38m²

Endcap:



Time resolution: 30 ps
Silicon LGAD 1x3mm²
pads, ~8.5M ch, 14 m²

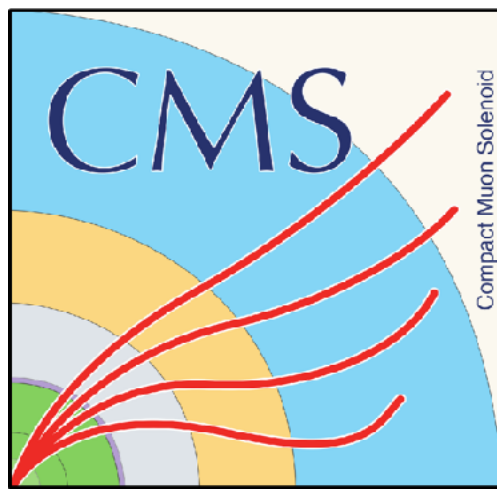


- A reduction of 2-4 times effective pile-up
- a significant improvement in lepton isolation and missing ET is expected

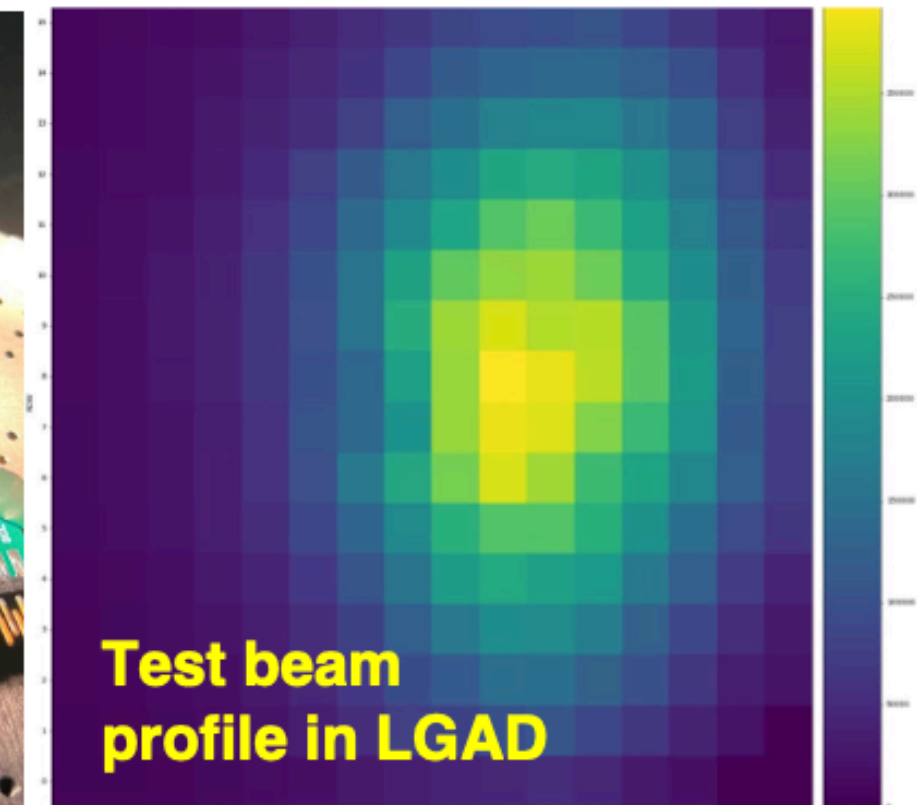
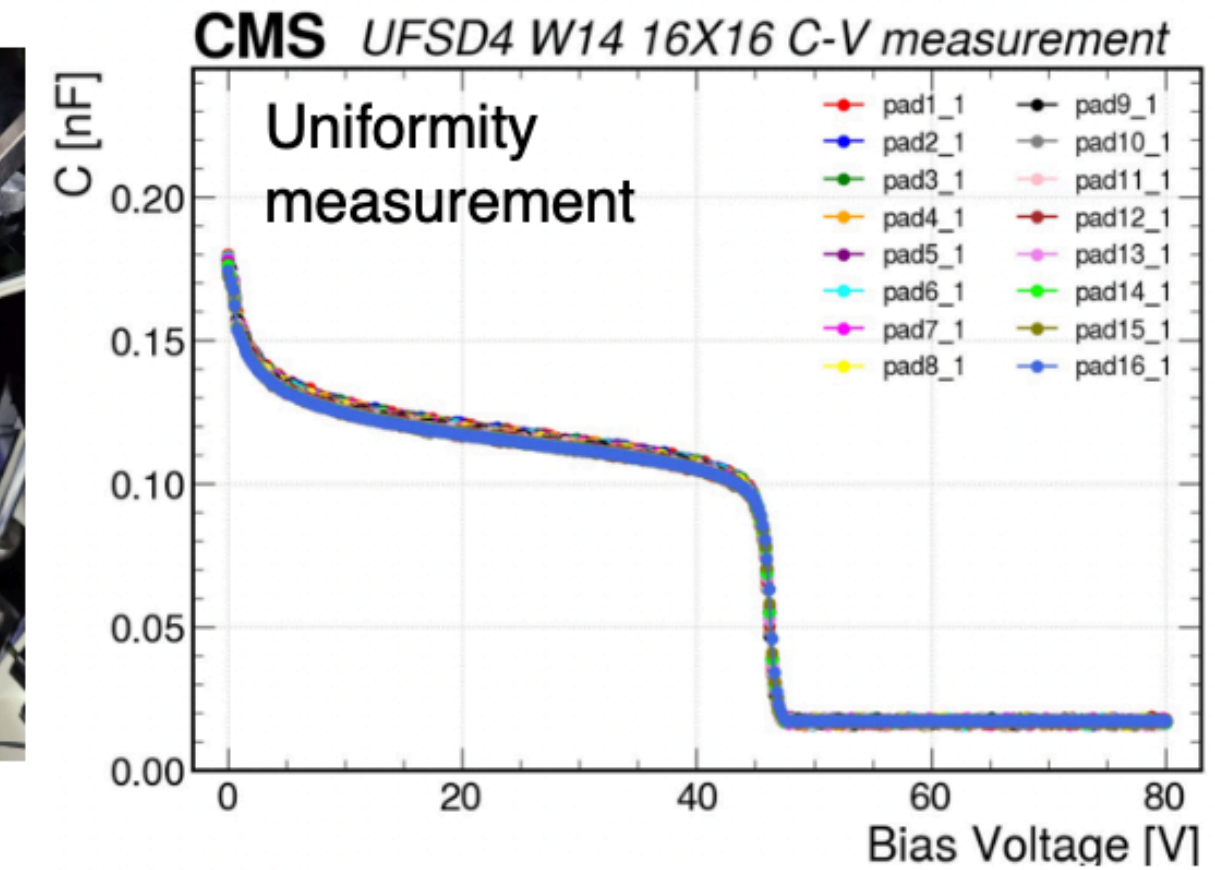
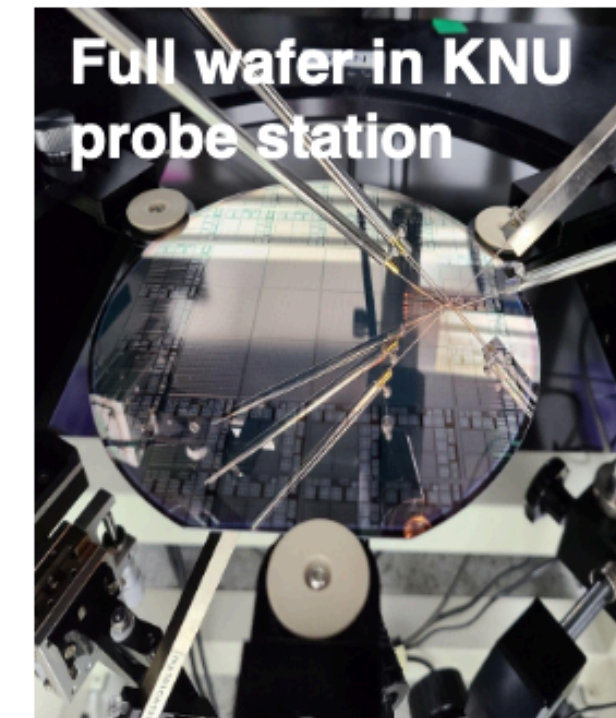
The MTD is one of the most challenging and rewarding detector of our upgrades.

We are very grateful for Korea's participation in the MTD project.

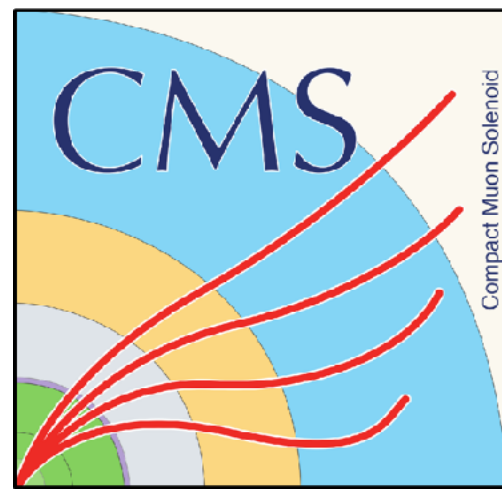
Korea contributions to the MTD Endcap (ETL)



- ▶ **Significant contributions to prototyping towards production:**
 - ▶ **LGADs prototyping and validation:** Detailed testing of prototype LGADs informed vendor qualification
 - ▶ Probe station measurements to verify quality and uniformity of full-size wafers
 - ▶ **ETROC2 testing,** including test beam campaigns for validation LGADs + ETROC performance
 - ▶ **Wafer processing:** Exploring wafer processing with one of the qualified LGADs vendors for wafer thinning, dicing, and surface preparation at Korean companies for the production phase
 - ▶ **Bump-bonding:** Exploring options with Korean companies for LGAD-to-ETROC bump-bonding during production



CMS Upgrade overview

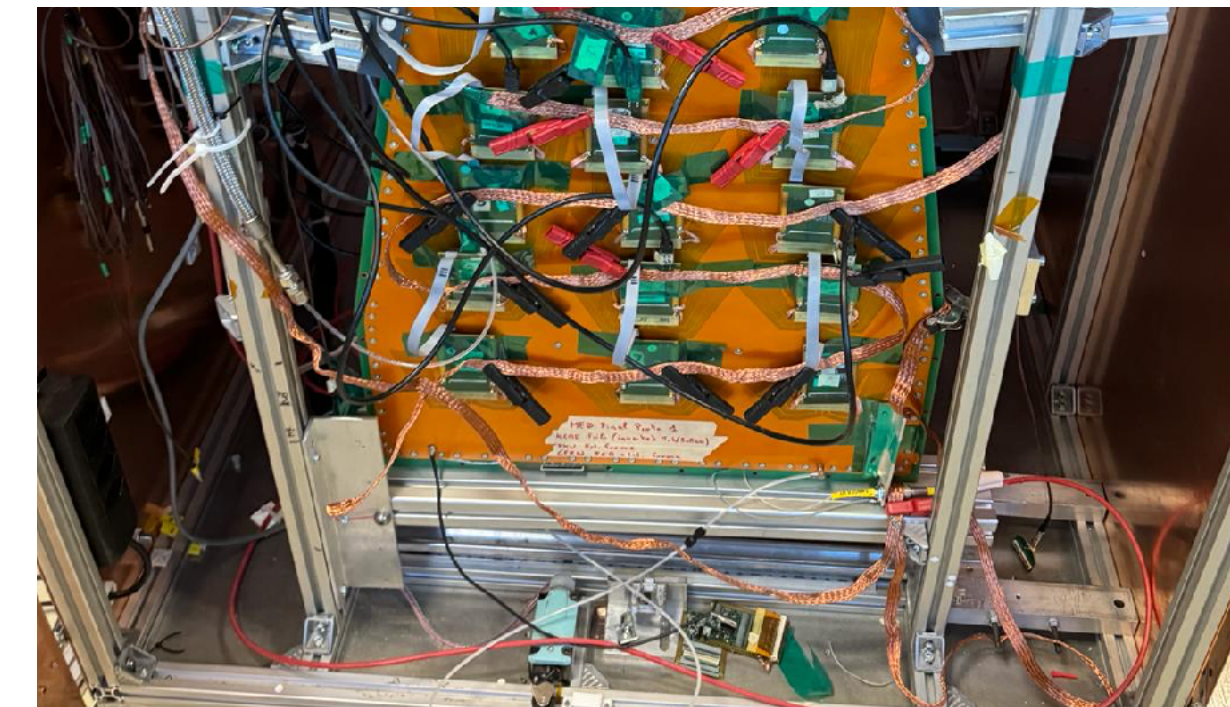


CMS finished most design reviews and many procurement readiness reviews

Many items moving into production (ASICs, modules...)

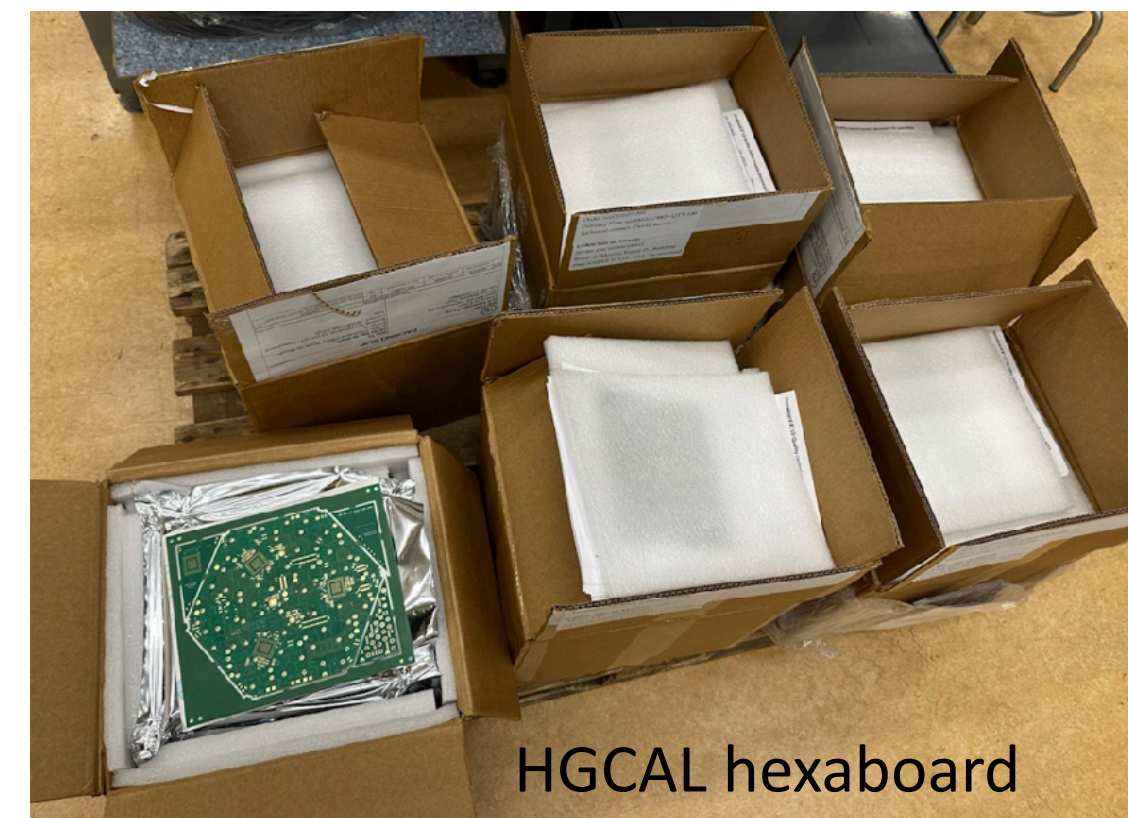
Focus - Assembly facilities for production and infrastructure.

ME0 module - testing with X-rays



Not yet in full production
Resource availability issues will result in unnecessary delays.

EDR Engineering Design Review – LHCC Step-III
ESR Electronic System Review – LHCC Step-III
PRR Procurement Readiness Review

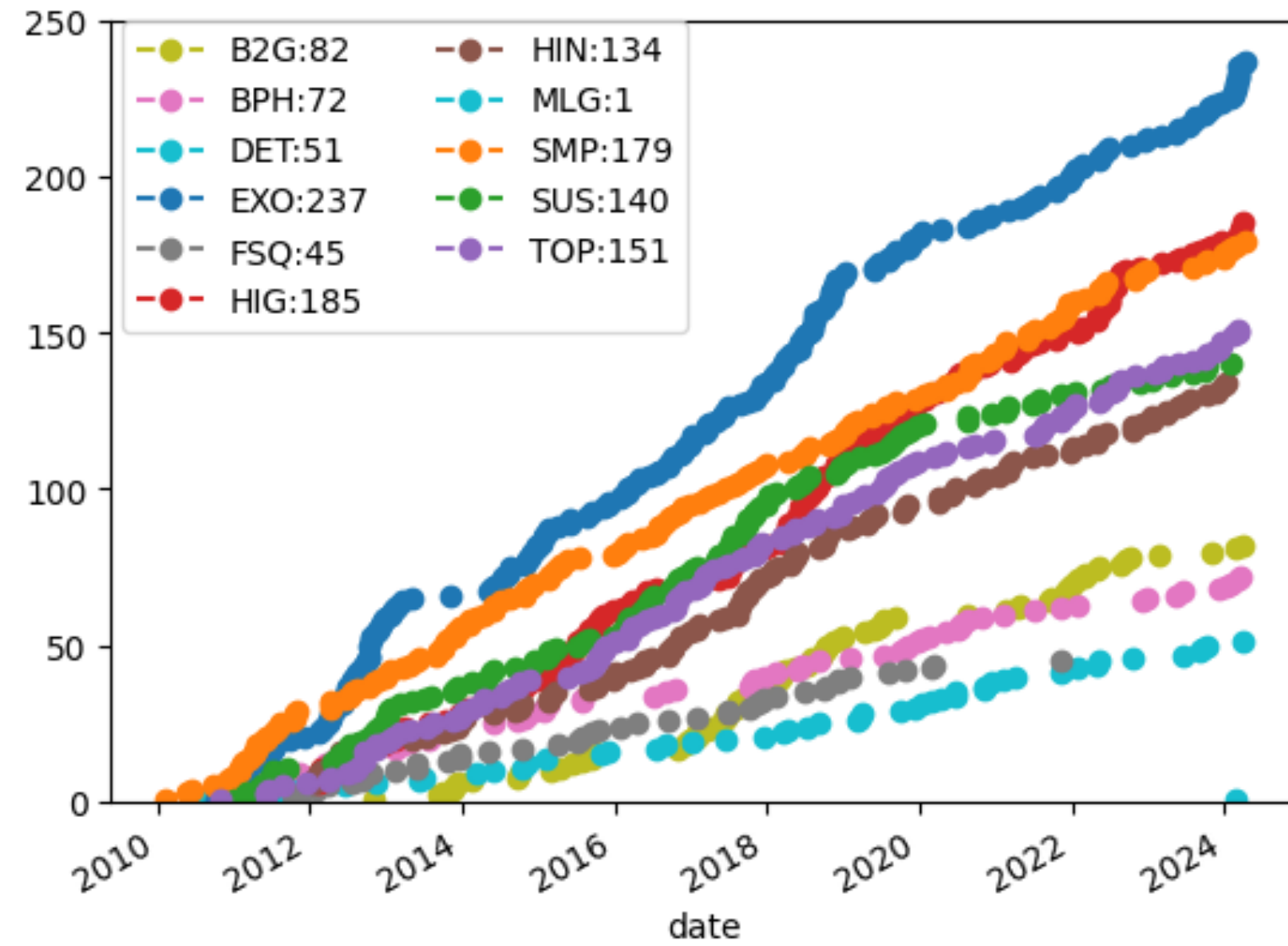
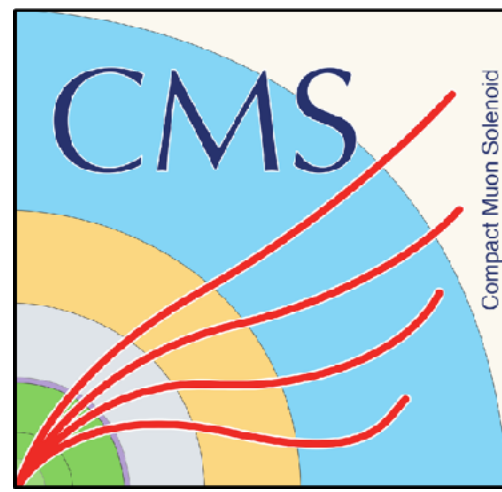


HGCal hexaboard



BTST

CMS Physics publications



Publication and analysis statistics

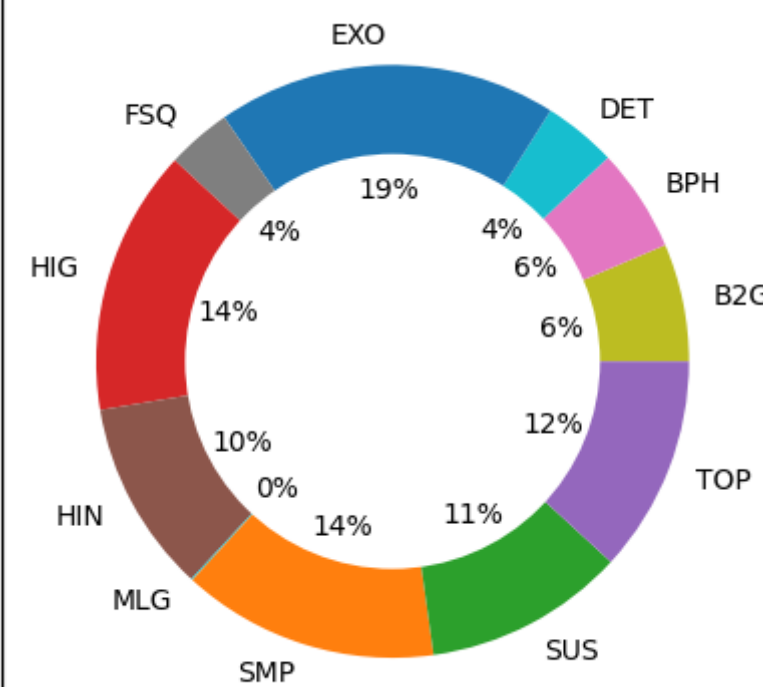
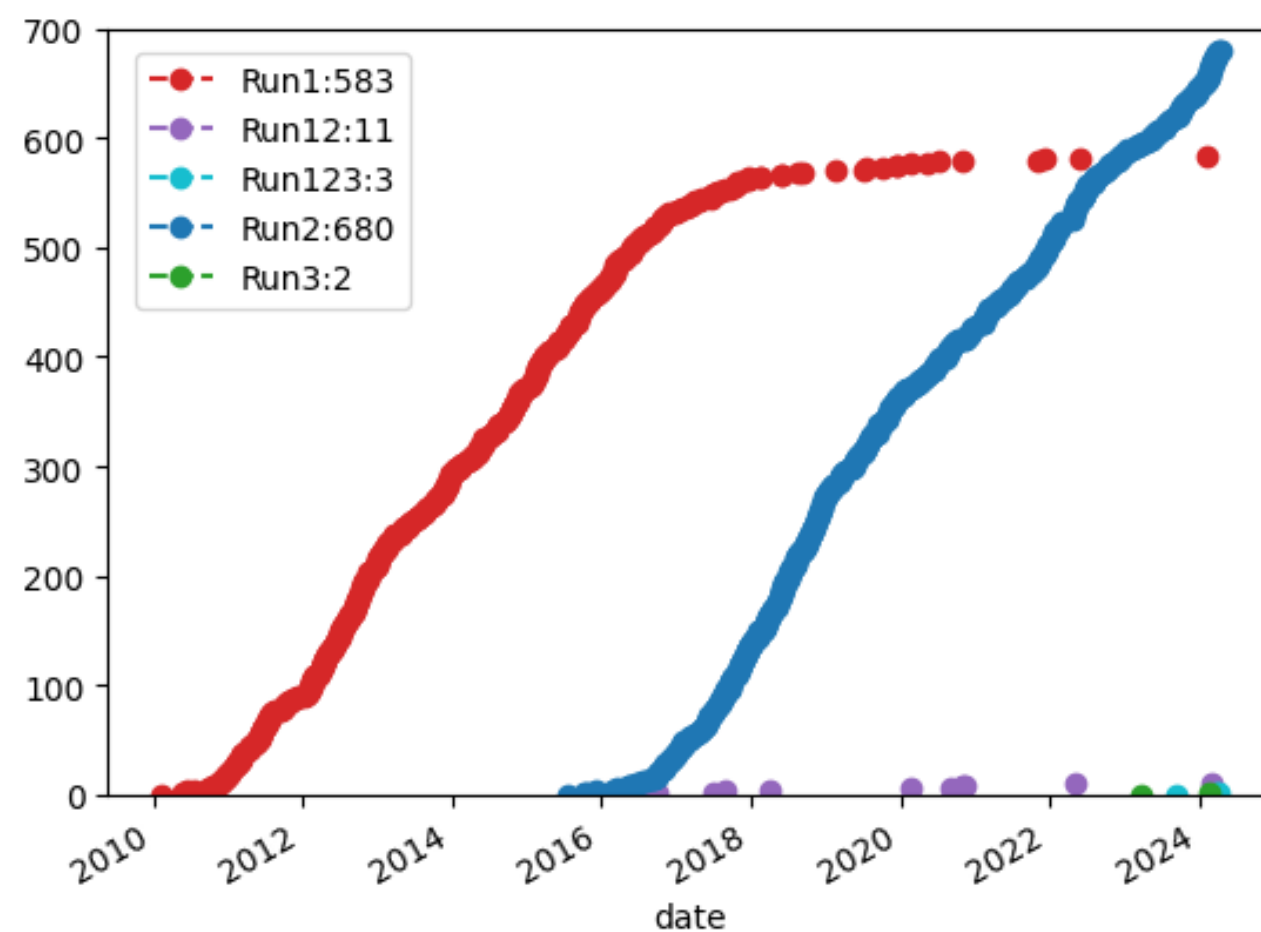
- Currently at 1279 papers on collision data
- 7 public results from Run 3
- Many new results planned for upcoming summer conferences

Review papers

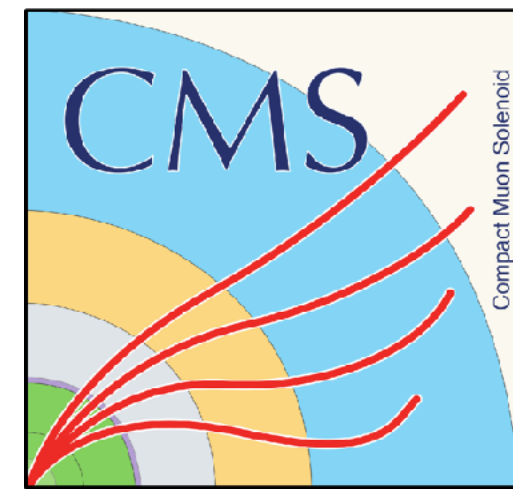
- Review articles planned for publication in Phys.Rept.

Task Force on Time to Publication

- Final report/recommendations expected in June.



2024 Physics Results



At the recent 58th Rencontres de Moriond we presented 48 new analyses
(including 7 physics reviews)

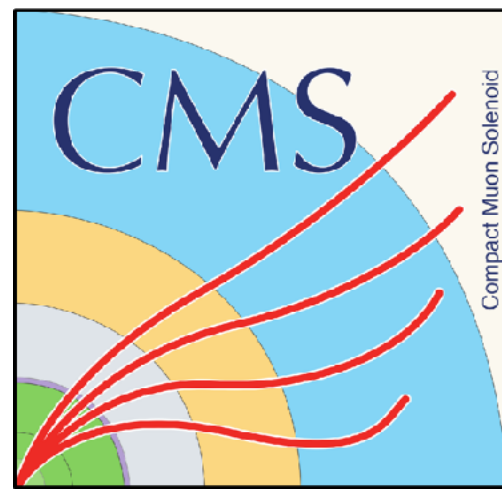
Links to Papers/PASes in the summary page check : <https://cms.cern/news/cms-moriond-2024>

CMS also released many briefings for the public: <https://cms.cern/tags/physics-briefing>

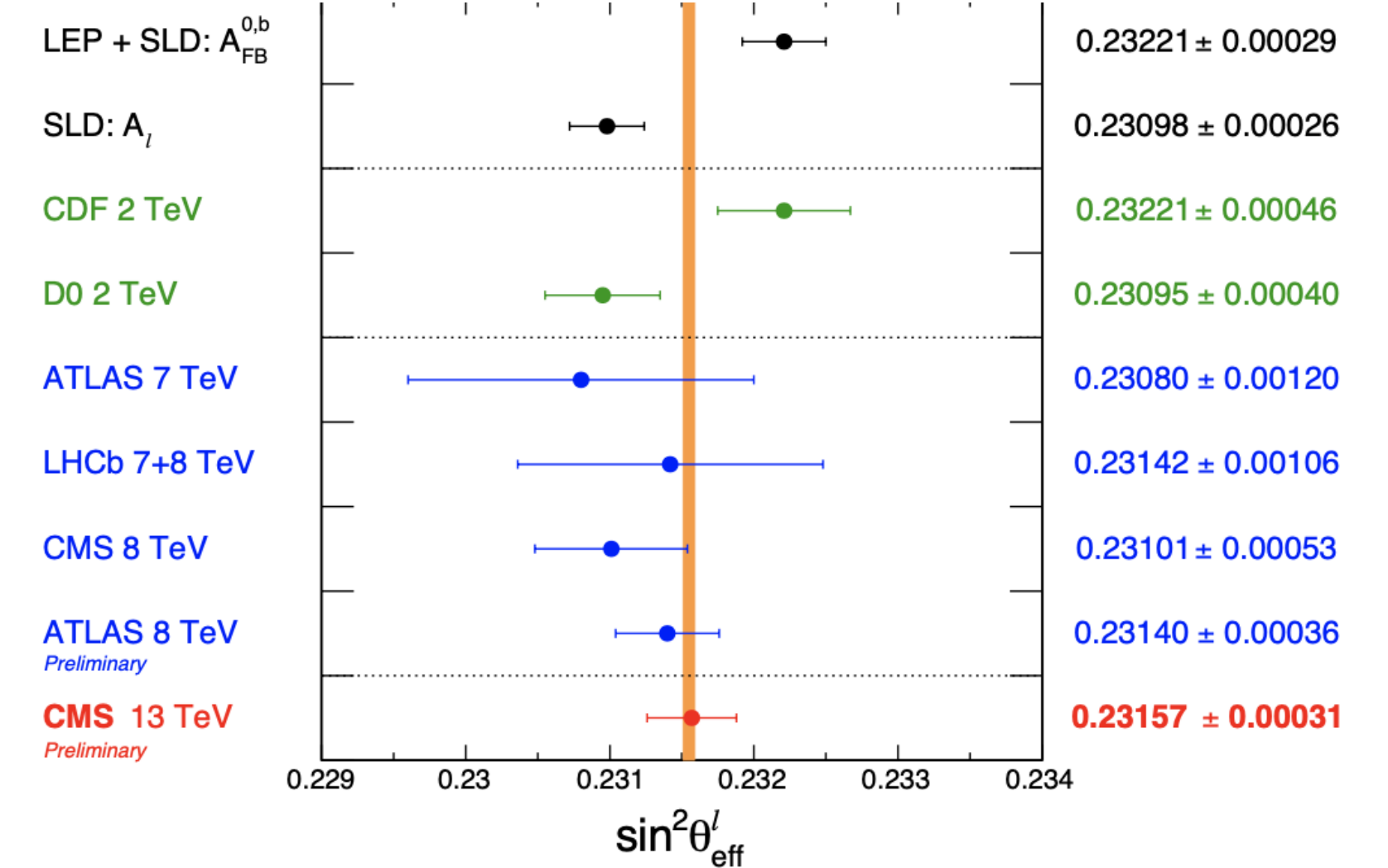
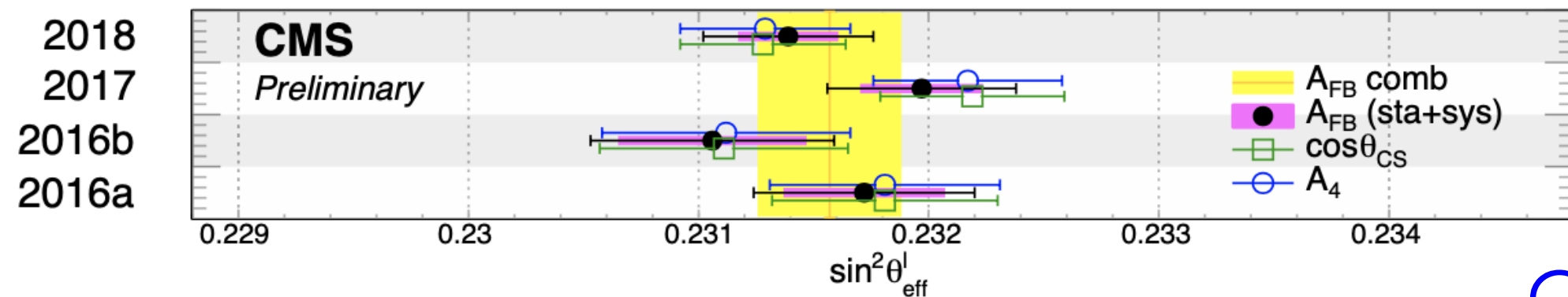
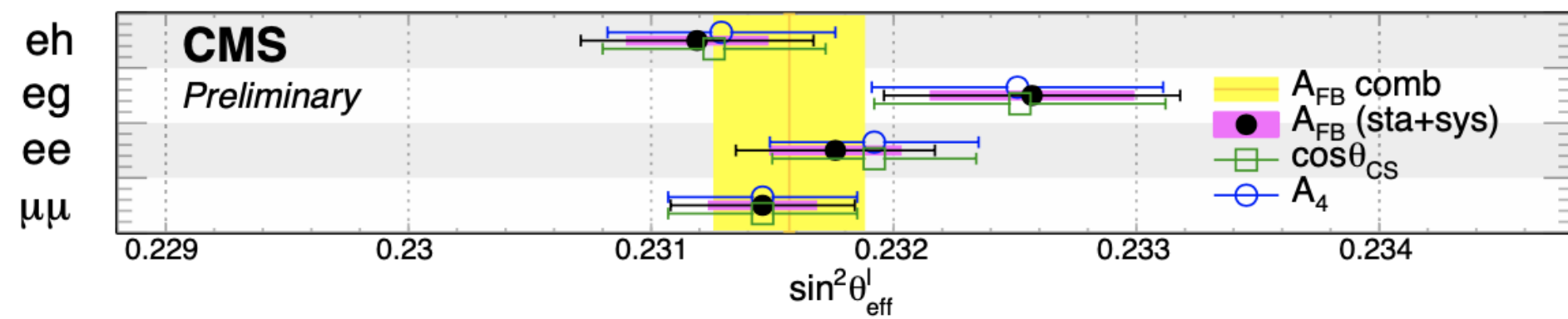
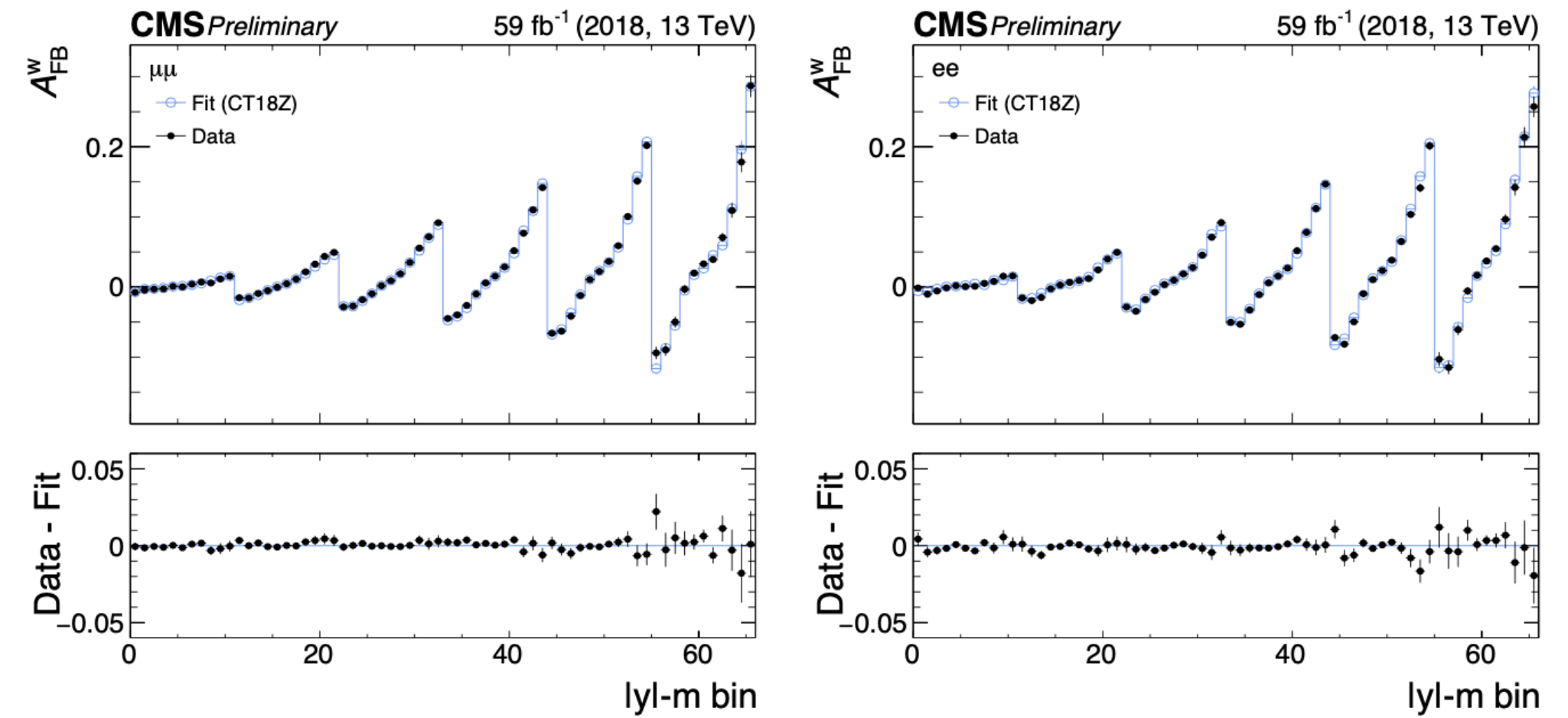


CMS has **4 new Run3** results and **exciting highlights: $g-2$, $\sin^2\theta_W$, CP-violation in B^0_s , entanglement, light-by-light scattering**

Z/ γ \rightarrow $\ell\ell$ forward/backward asymmetry and $\sin^2\theta_{\text{eff}}^{\ell}$



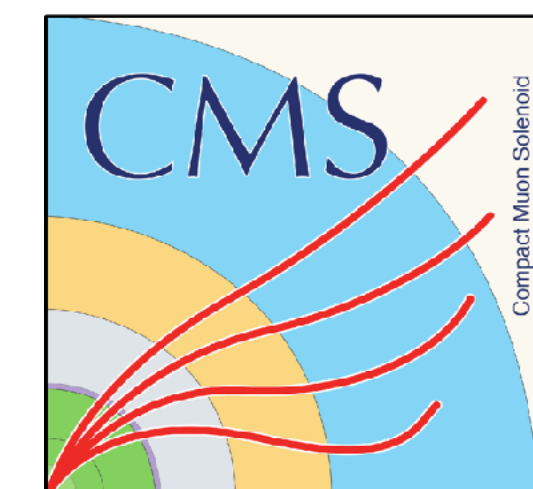
- $\sin^2\theta_W$ extracted from the FB asymmetry in DY events
 - Both electrons and muons
 - Measurement vs dilepton mass and rapidity
- Improves over similar measurements by LEP/SLD (same final state)
- Matches precision of b-quark A_{FB}



[CMS-PAS-SMP-22-010](#)



Summary



- **CMS is moving forward on many fronts in physics, operations, computing and upgrades.**
 - **CMS had a strong presence in 2023 Winter and Summer conferences!**
 - **CMS is looking forward to a successful Run 3 pp and HI run in 2024 and 2025.**
 - **CMS upgrades are moving into production.**
- **We welcome Korea's contribution in the CMS HL-LHC upgrades: in particular in our muon detectors (GEMS and RPCs) and the state-of-the art endcap timing detector MTD/ETL.**
- **Korean colleagues have made significant contributions to many physics analyses in SMP, TOP, EXO, SUS, and HI. Their contributions are highly appreciated!**
- **We continue to encourage our Korea colleagues and KISTI to explore the possibility for a Tier1 facility given their strong contributions to our computing infrastructure.**
 - **This should be a major benefit for the local Korean physics community.**

**CMS relies on strong and reliable partners.
We thank the Korean FAs for their sustained support!**