



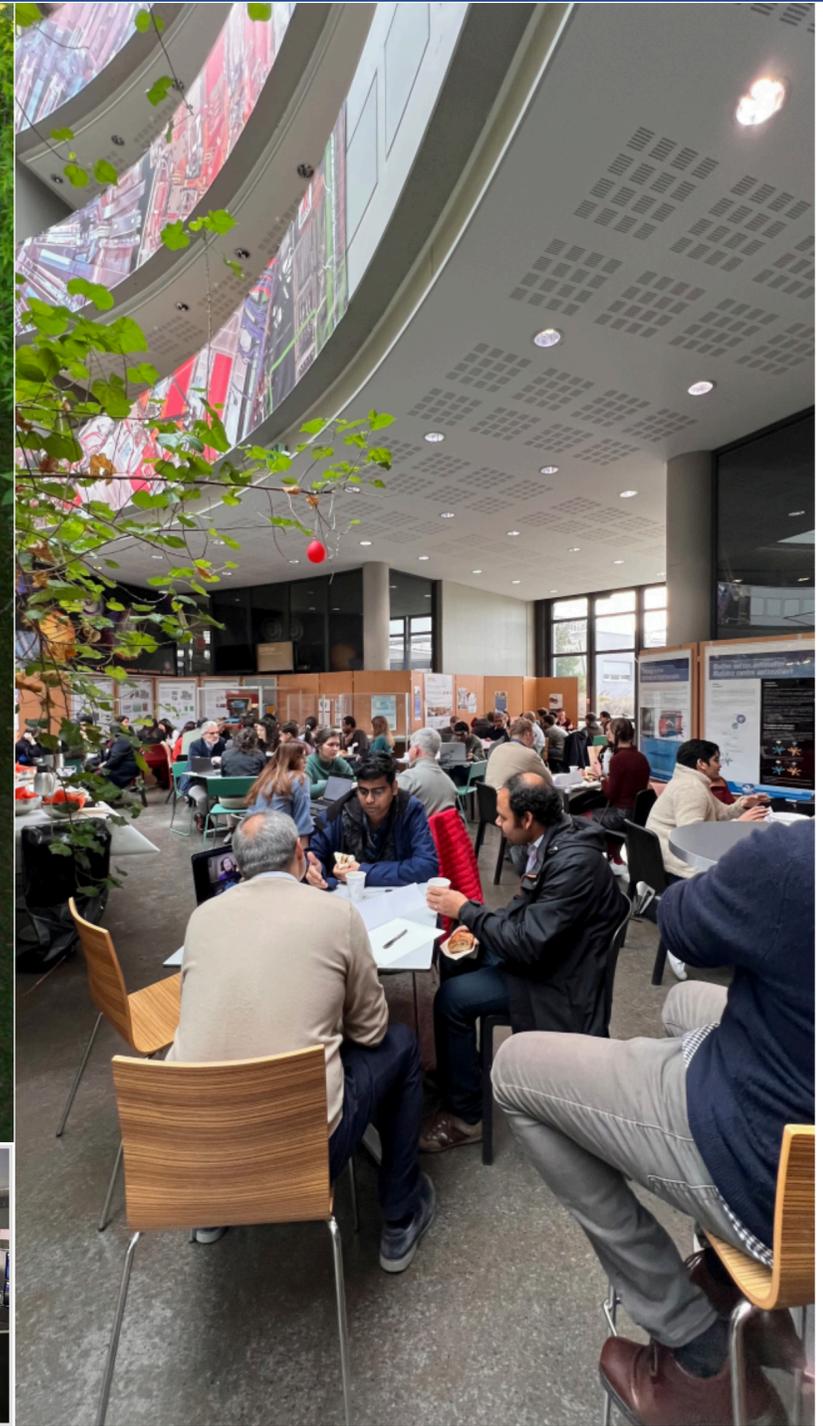
CMS Experiment at the LHC, CERN
Data recorded: 2018-Aug-09 21:56:30.285184 GMT
Run / Event / LS: 321067 / 853682455 / 591

CMS Highlights

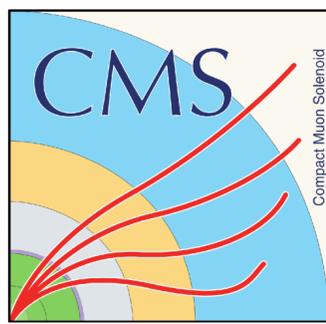
Patricia McBride
CERN-Ukraine
May 28, 2024



CMS - The Collaboration



CMS Collaboration



The CMS experiment has **5924** active members from **255** institutes coming from **58** countries.



CMS Membership

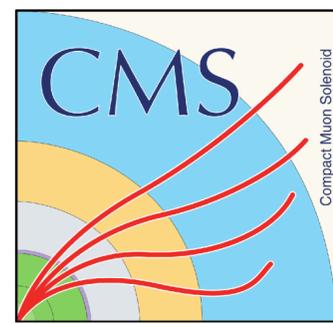
216 Full member institutes

29 Associated Institutes

10 Cooperating Institutes

2069	1187	1315	987	251	110
Phd Physicists (402 women 1667 men)	Physics Doctoral Students (324 women 863 men)	Non Doctoral Students (359 women 956 men)	Engineers (147 women 840 men)	Technicians (22 women 229 men)	Administratives (70 women 40 men)

CMS Communications



10 Geneva, Switzerland

Satisfy your curiosity about quantum physics, and your cravings for chocolate



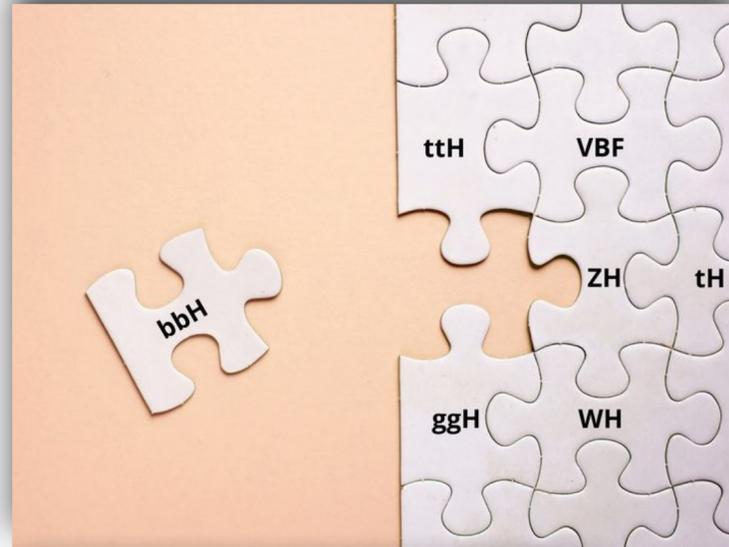
GENEVA

Architecture, Food and Drink, History

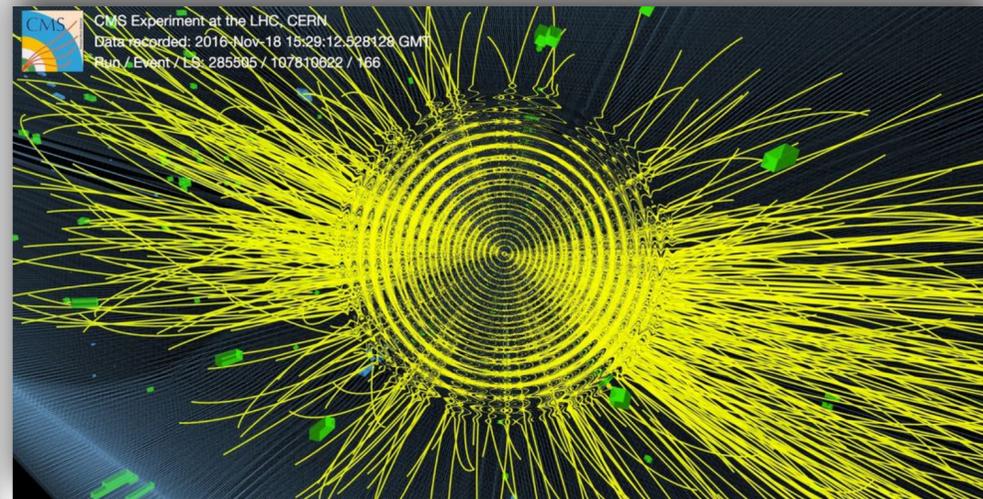
The tiniest bits of nature are the biggest attraction at the European Organization for Nuclear Research, or CERN, and its 17-mile-long particle accelerator on the outskirts of Geneva. But until recently, visitors had limited options for nerding out. Open since October, the family-friendly, Renzo Piano-designed **CERN Science Gateway** changes that with activities like quantum karaoke, quantum air hockey and miniature magnetic accelerators modeled after the Large Hadron Collider, where in 2012 physicists discovered the elusive **Higgs boson**, seen as a key to understanding the universe's origins.

Less mind-blowing but still satisfying to hungry scientists and laypeople alike, the **Choco Pass**, a self-guided chocolate tour that debuted in 2022, lets visitors sample Geneva's famous truffles, bonbons and pralines. And if you want to explore the nature of time — or timepieces — book a table at **Breitling Kitchen**, the Swiss watch brand's fourth crossover restaurant, which features menus designed by Juan Arbelaez of "Top Chef."

— Adam H. Graham



Communication of our work to the public is an important responsibility of the collaboration.



58th Rencontres de Moriond 2024

24/03 to 31/03 :
Electroweak Interactions & Unified Theories
Very High Energy Phenomena in the Universe

31/03 - 07/04 :
Cosmology
QCD and High Energy Interactions

Attention!
Sunday to Sunday

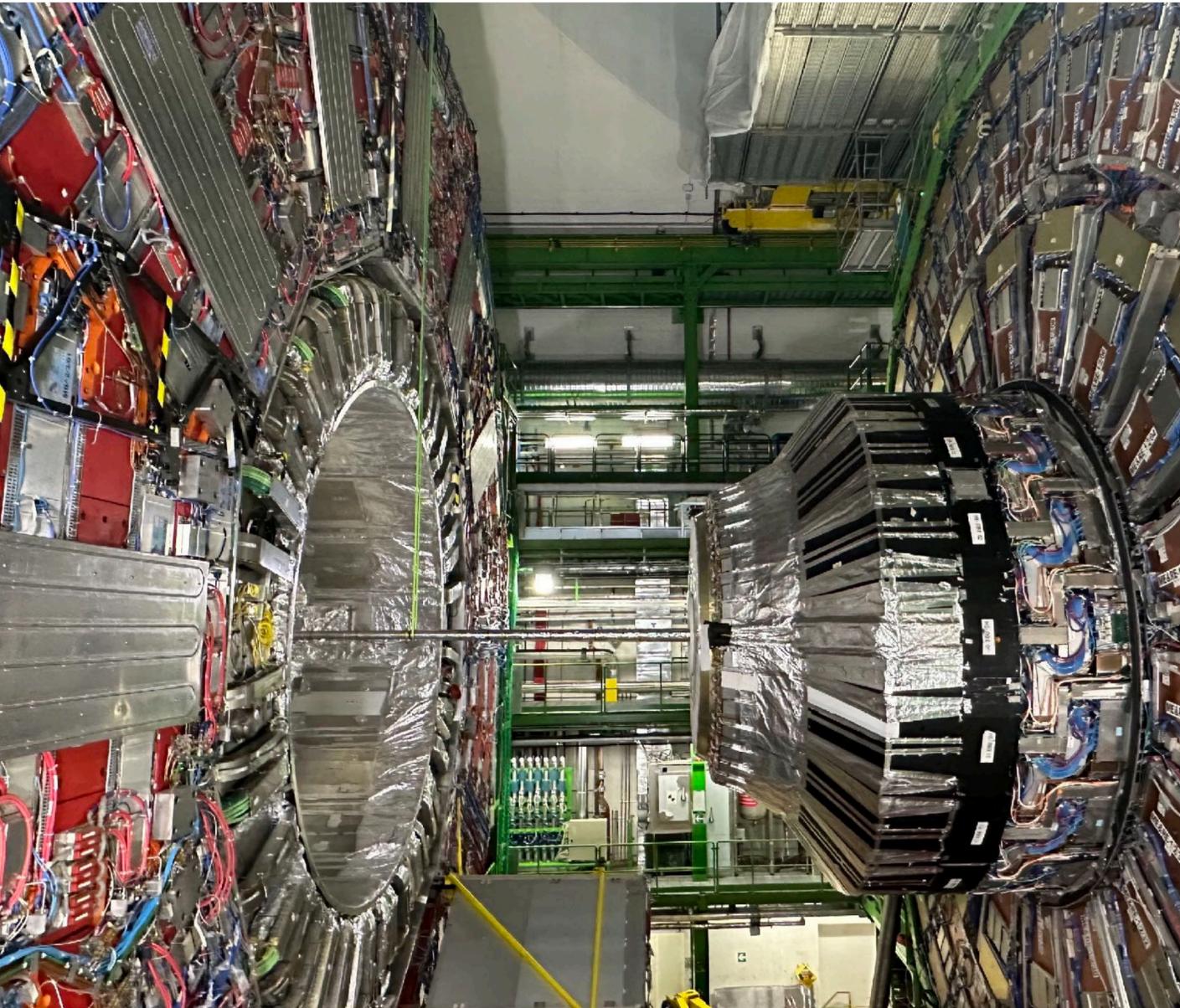
Compact Muon Solenoid

CMS WOMEN
HAPPY INTERNATIONAL DAY OF WOMEN AND GIRLS IN SCIENCE!

*ALL SCIENTISTS INTERVIEWED WHILE WORKING AT CMS



CMS Today



Operations

- Run 3 pp collisions @ 13.6 TeV ongoing
 - LHC integrated luminosity in 2024 - on track to reach target
- Steady CMS operations with new triggers for 2024
 - Data taking and shifts going well at Point 5 and at Remote Centers

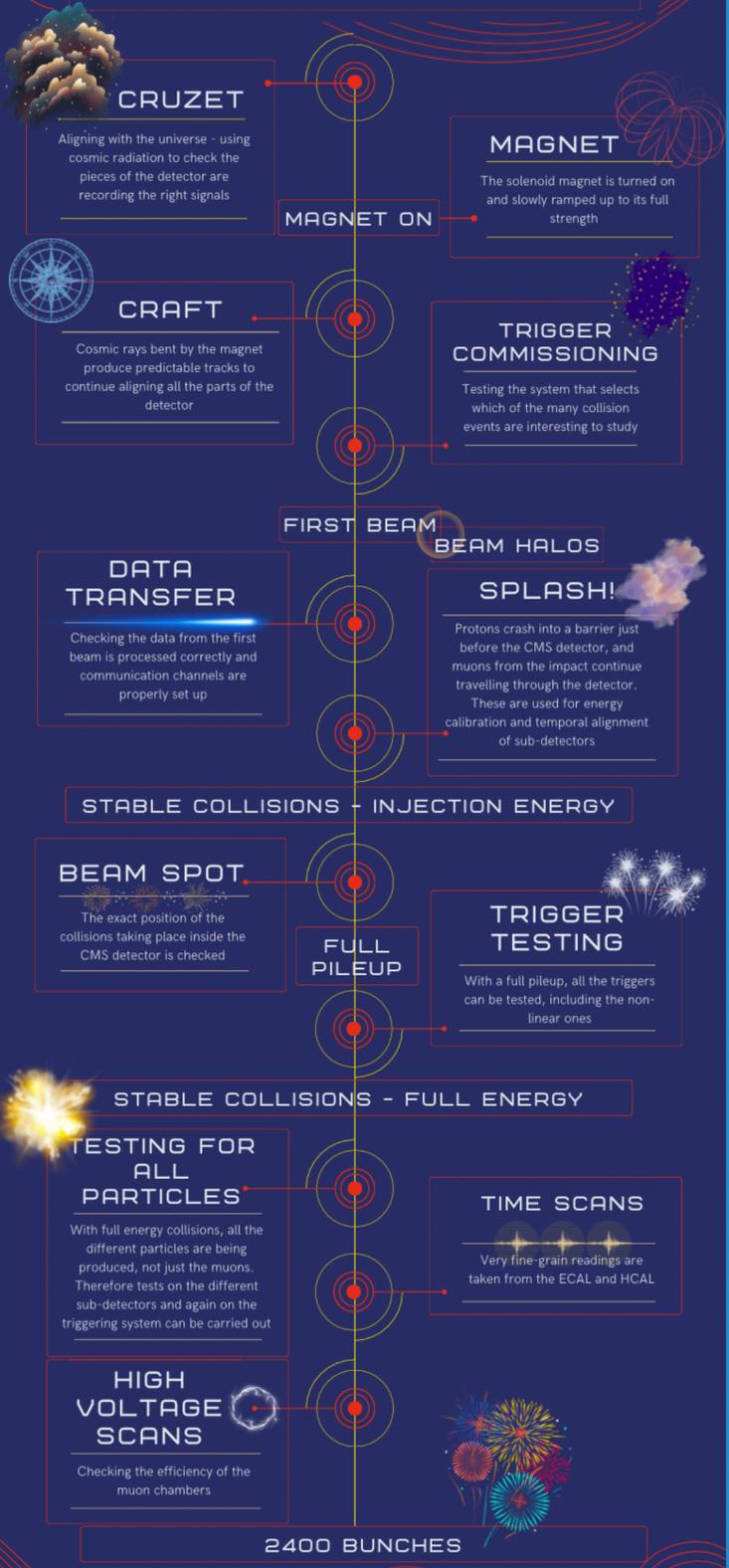
Physics

- Many new results from Run 2 and Run 3 and many more planned.

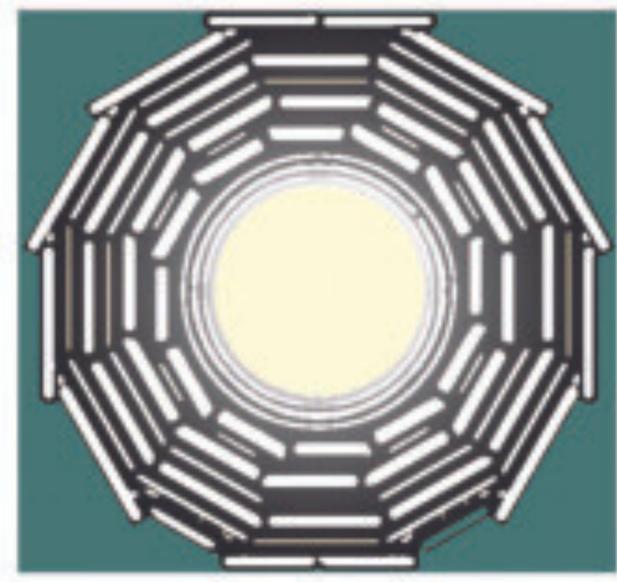
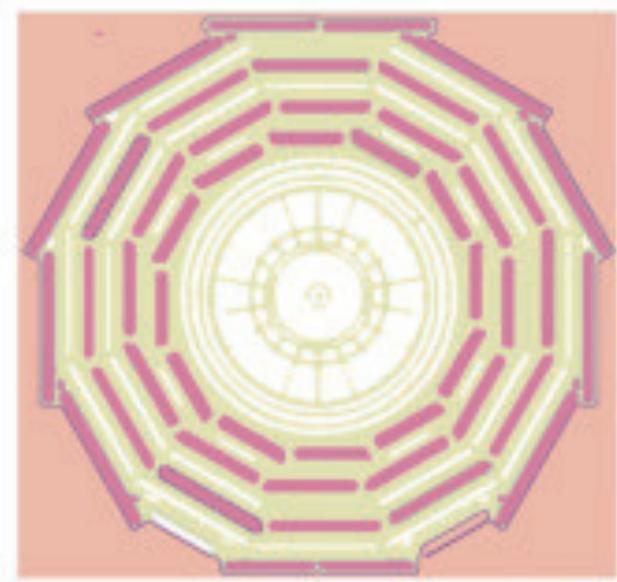
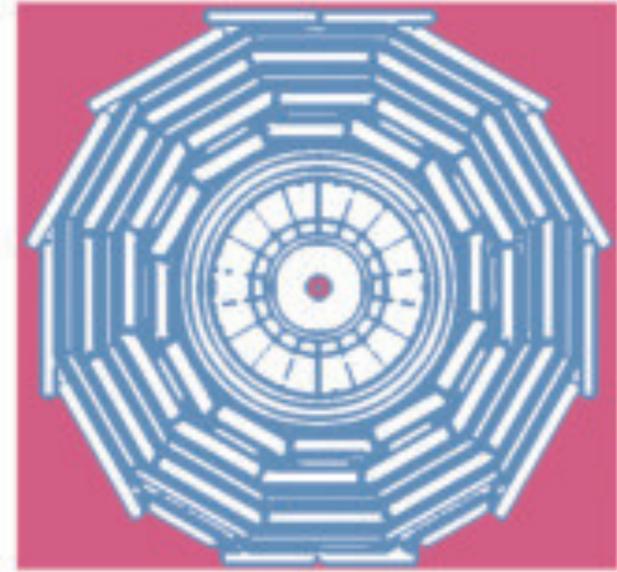
Upgrades

- Steady progress in the transition to production.

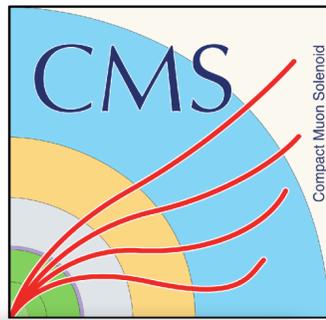
THE CMS DETECTOR JOURNEY TO PHYSICS



Run 3



LHC 2024

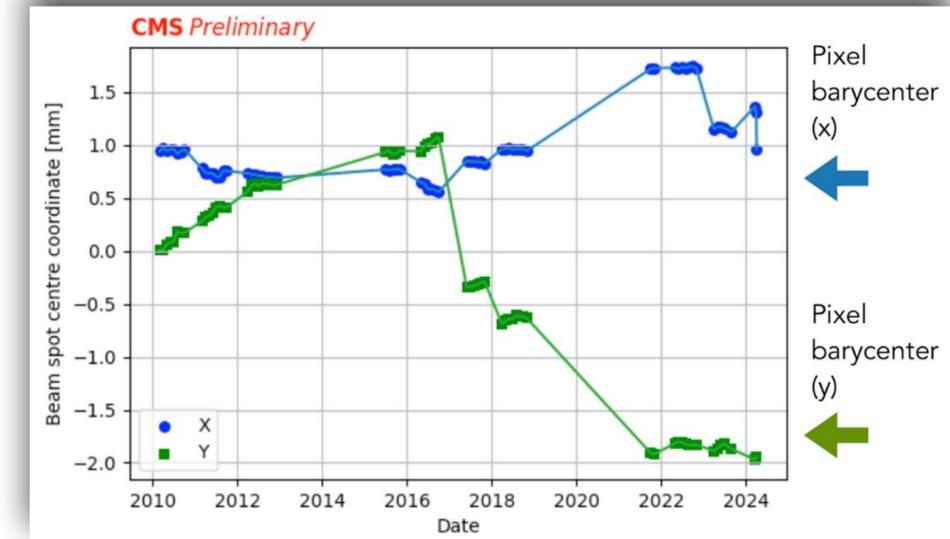


LHC in 2024

- First splashes - 8 March and 13 March
- Stable collisions at 900 GeV and 13.6 TeV achieved as planned
- Stable beams at 13.6 TeV for physics in mid April
 - Beamspot at CMS was displaced in x but has been corrected.

CMS Detector

- The detector is operating well with 2024 LHC beam conditions and pileup > 60
- Integrated luminosity in Run 3 (2022- 2024) $\sim 86 \text{ fb}^{-1}$ (so far)

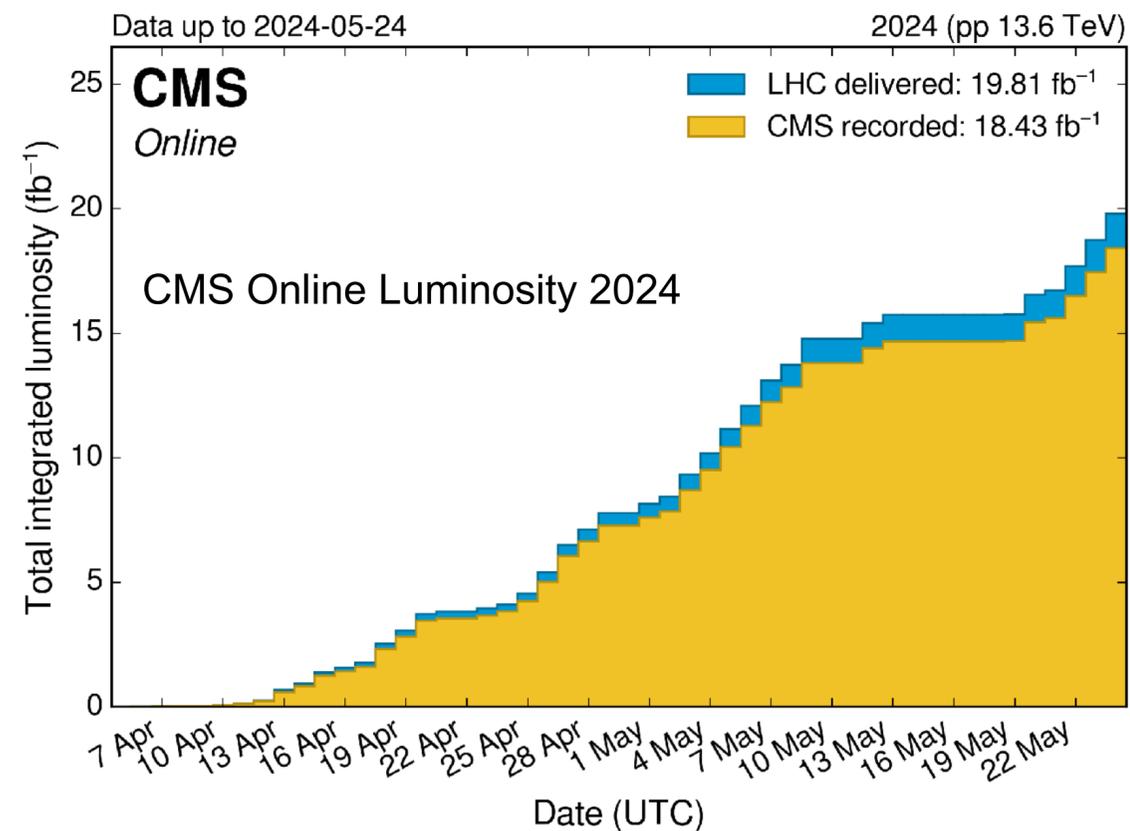


Data Collection and Certification

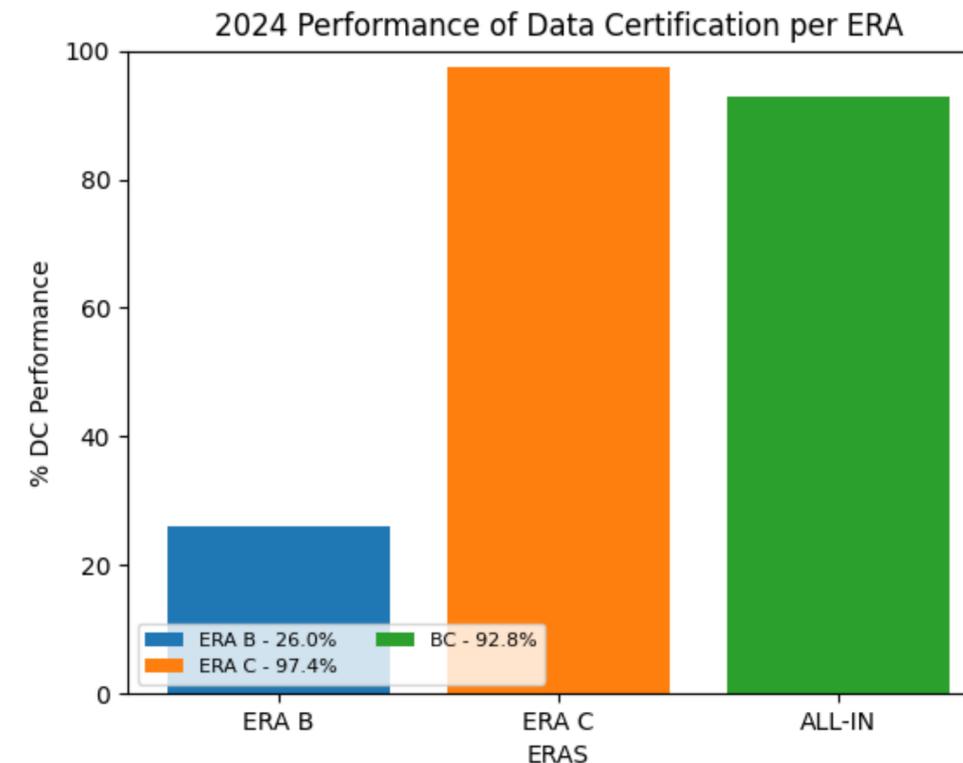
pp collisions



2024 CMS Recorded data



2024 CMS Certified data

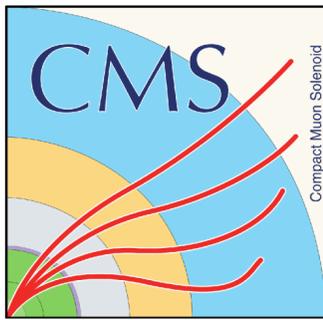


High data certification efficiency after the commissioning phase during LHC ramp up: ~ 97%

[Run 3 Lumi: [public twiki](#)]

[Data Certification: [public twiki](#)]

CMS Heavy Ions



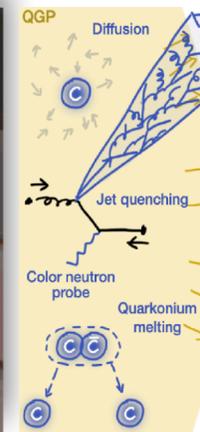
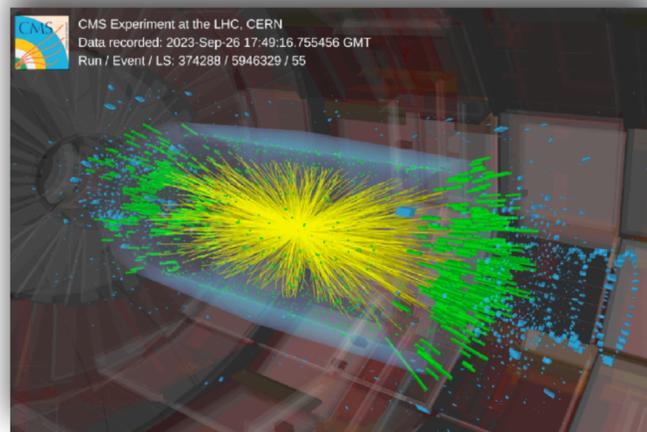
Run 3 PbPb data-taking @5.36 TeV in 2023

- ~1.98 nb⁻¹ delivered by LHC (note: ~1.8 nb⁻¹ in 2018)

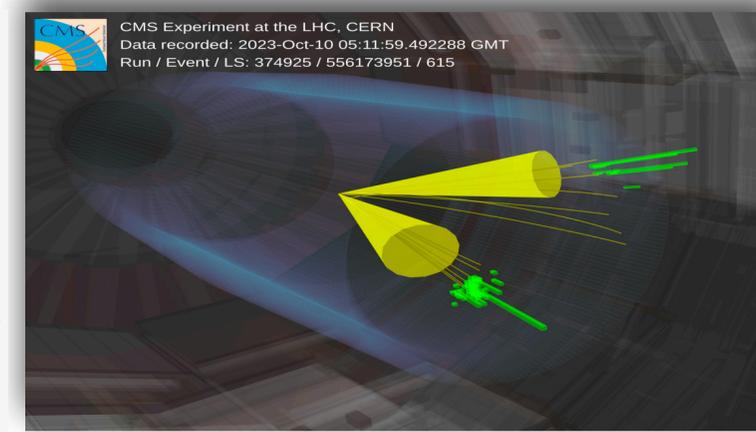
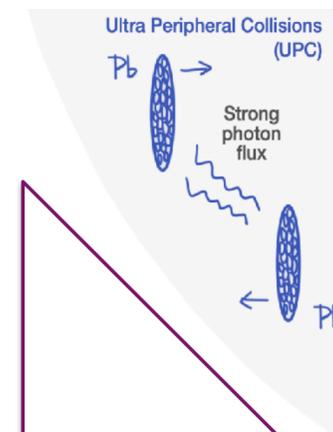
Smooth operation of the CMS detector during 2023 HI run

- Collected ~17 billion Minimum Bias (MB) events
- Collected ~10 billion Ultra Peripheral Collisions (UPC) events

Looking forward to HI Runs in both 2024 and 2025

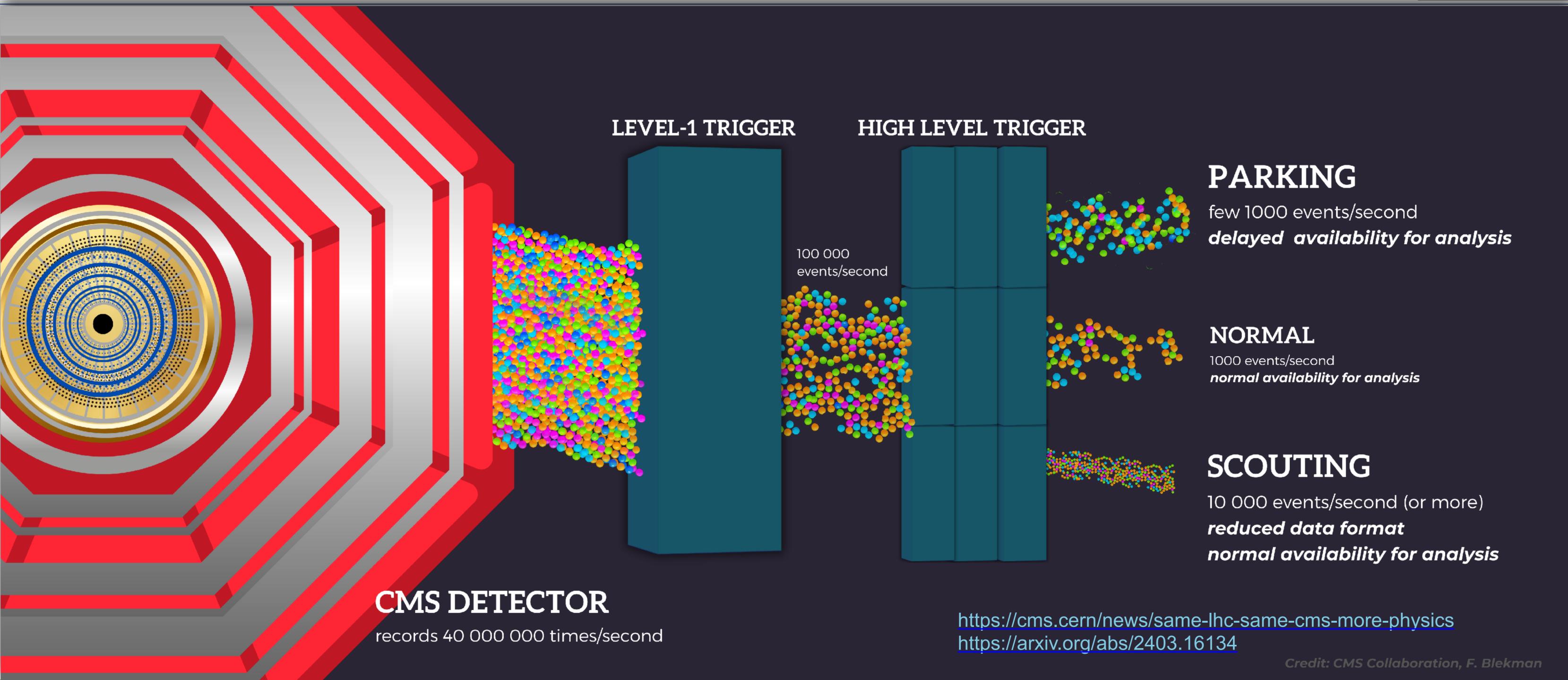
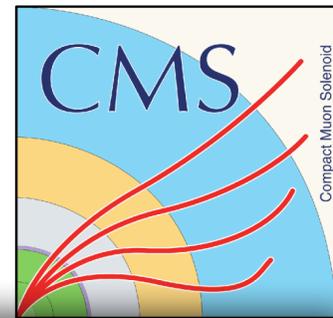


Hadronic collisions: QGP studies
correlations and flow
jet quenching
quarkonia and open-heavy flavor production modifications
EM probes to control nuclear effects



UPC: γN and $\gamma\gamma$ collisions
study gluon nuclear PDFs at low-x
unique source of background-less jets at the LHC
unique environment to study SM and BSM processes

Run 3 Triggers



Level 1 Trigger 2024



► **L1 Trigger was well prepared for the 2024 running period.**

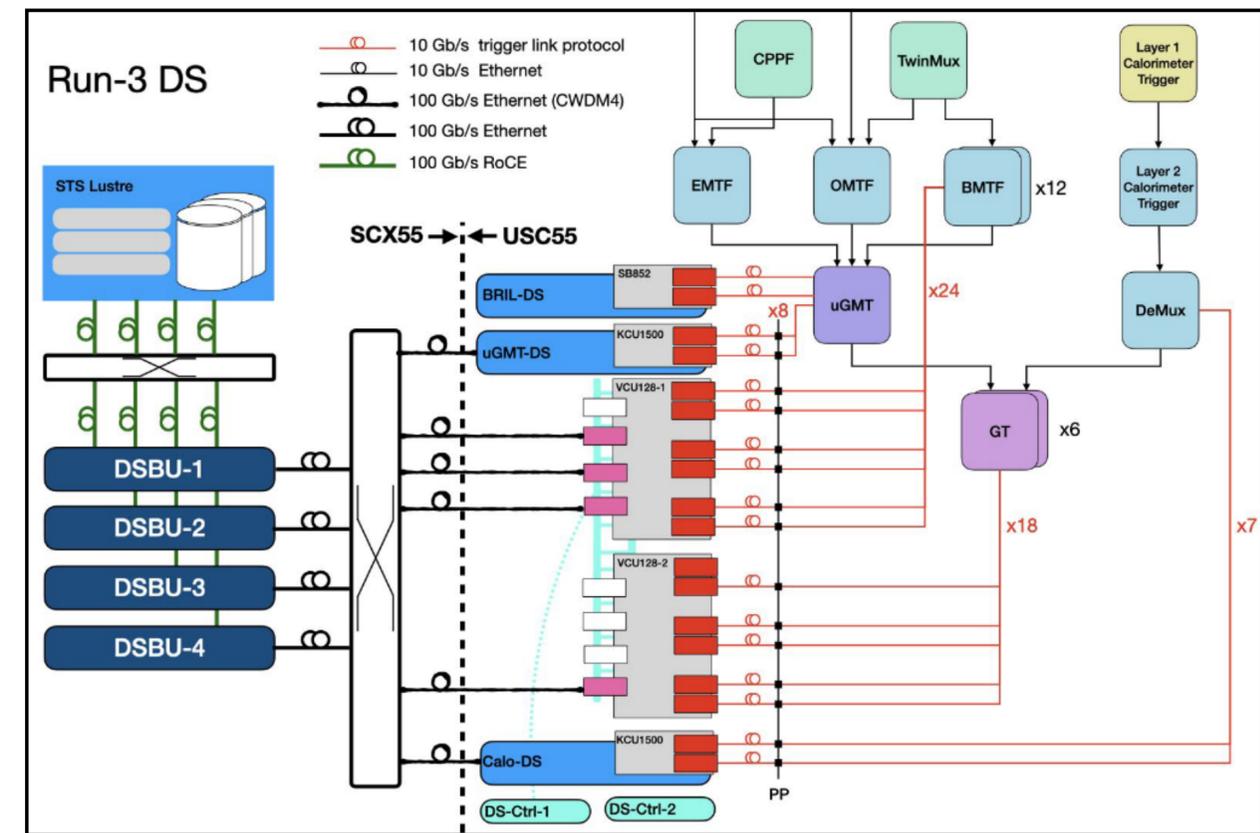
► Collecting data at ~110 kHz with pileup conditions (PU 60-65) - similar to 2023

► **Developments in the L1 Trigger for 2024:**

- Low p_T "very high quality" single muon seeds for B physics
- Displaced dimuon seeds for LLP searches
- New seeds targeting $HH \rightarrow bbWW$
- Anomaly detection trigger (using Machine Learning @ L1 Trigger) added.

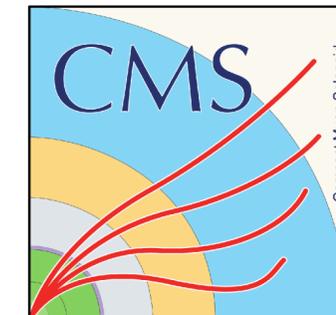
Development of Phase-2 HL-LHC Scouting @40 MHz

- Goal: scout every bunch crossing in HL-LHC collisions
- Demonstrator is already taking data with muons and calorimeter information during Run 3.



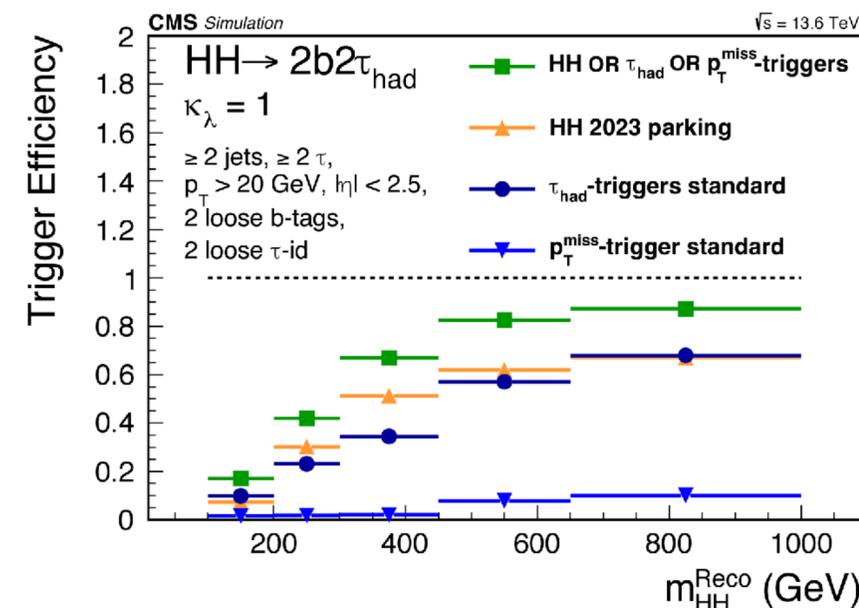
Dedicated system to readout, process & analyze data from L1 Trigger @40Mhz

HLT triggers in 2024

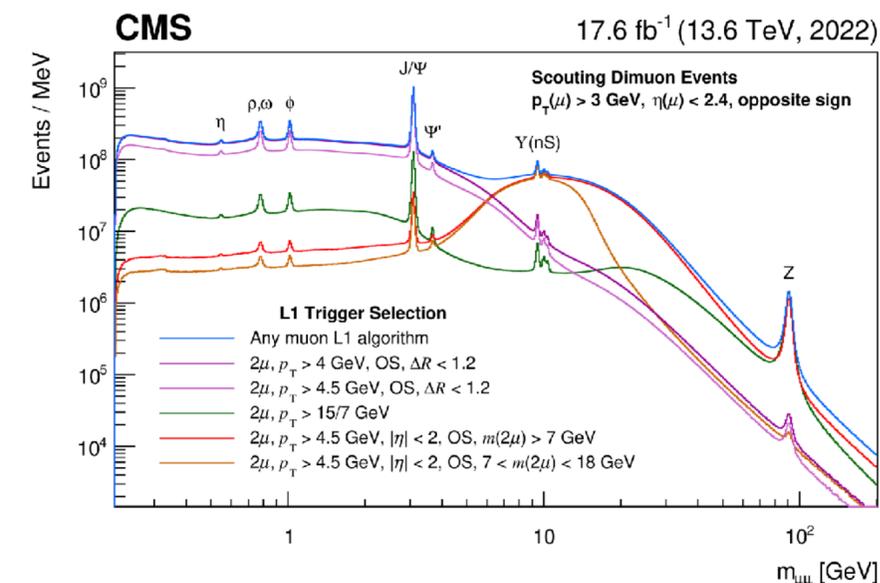


Many improvements for the 2024 High Level Trigger (HLT)

- Parking
 - New triggers to increase efficiency of $HH \rightarrow bb + X$.
 - Low- p_T single-muon triggers
- New single-photon trigger with $p_T > 50$ GeV
- HLT Scouting
 - Improvements to the ParticleFlow reconstruction in HLT Scouting
 - Addition of more tracking-related information in the event content
 - Addition of new single-muon triggers in HLT Scouting.
- Many other additions of new triggers for specific signatures
- Ported the heterogeneous (CPU+GPU) reconstruction of Pixel, ECAL and PFClusters to the Alpaka portability library.



Trigger efficiency for $HH \rightarrow bb\tau\tau$ with Run 3 conditions



Invariant mass of opposite-sign muons from 2022 (Run 3) scouting.

For more info, see [EXO-23-007](#)

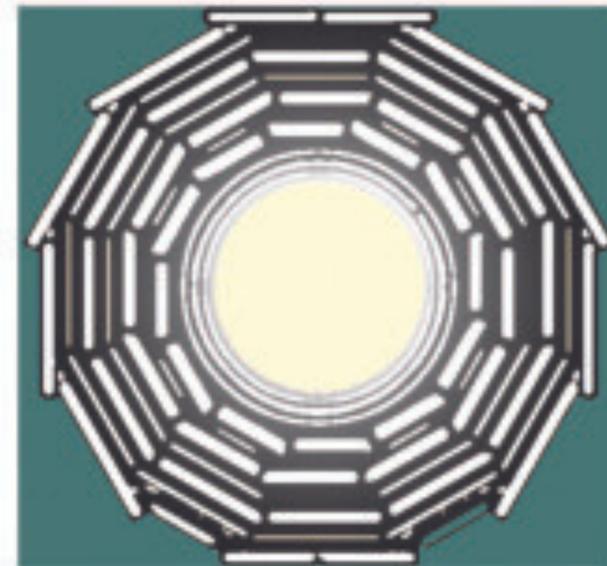
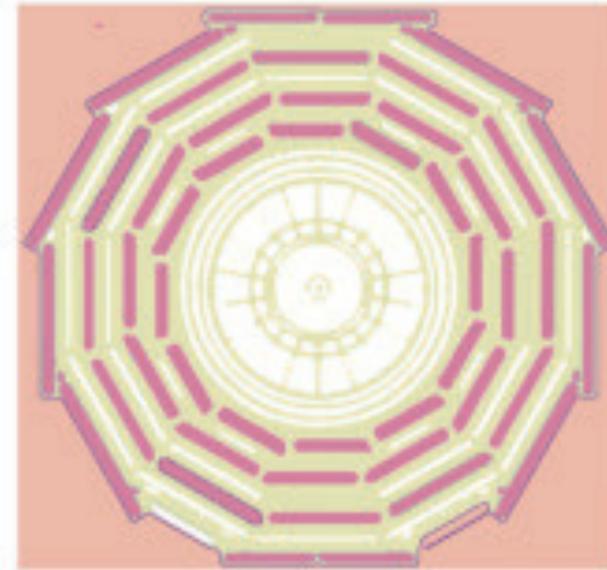
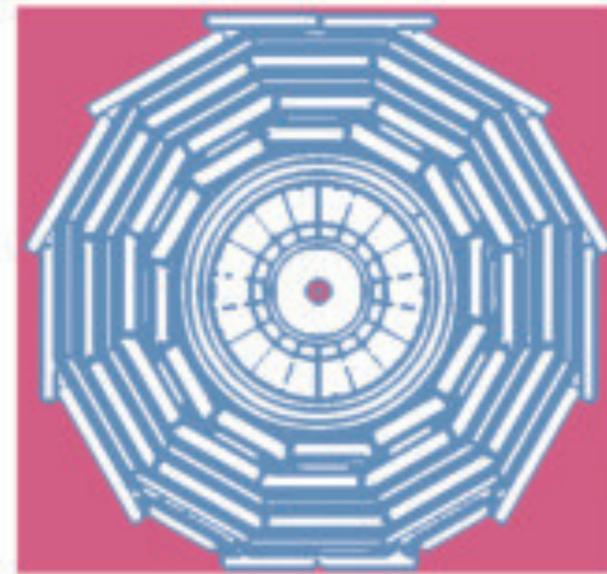
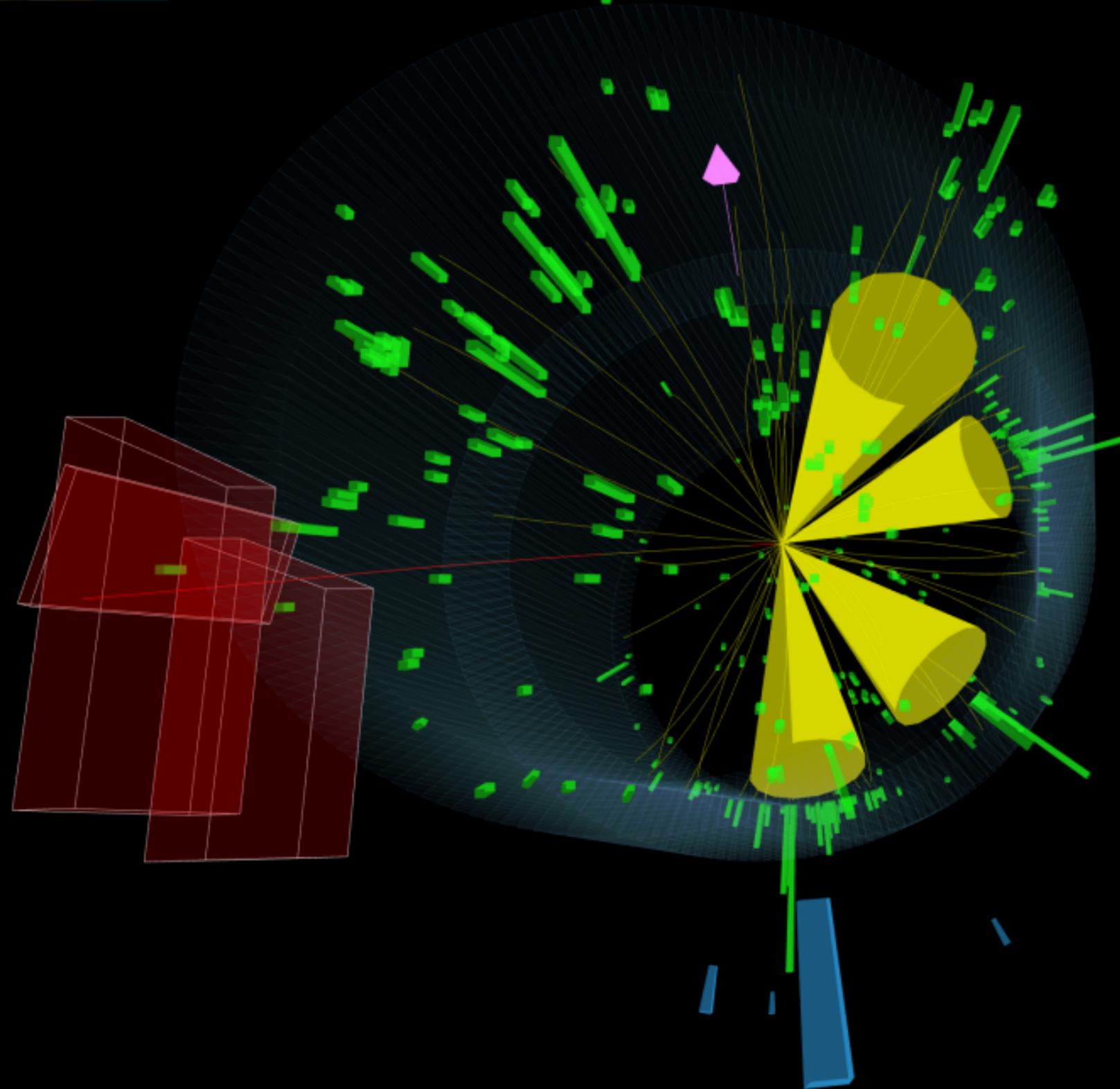


CMS Experiment at the LHC, CERN

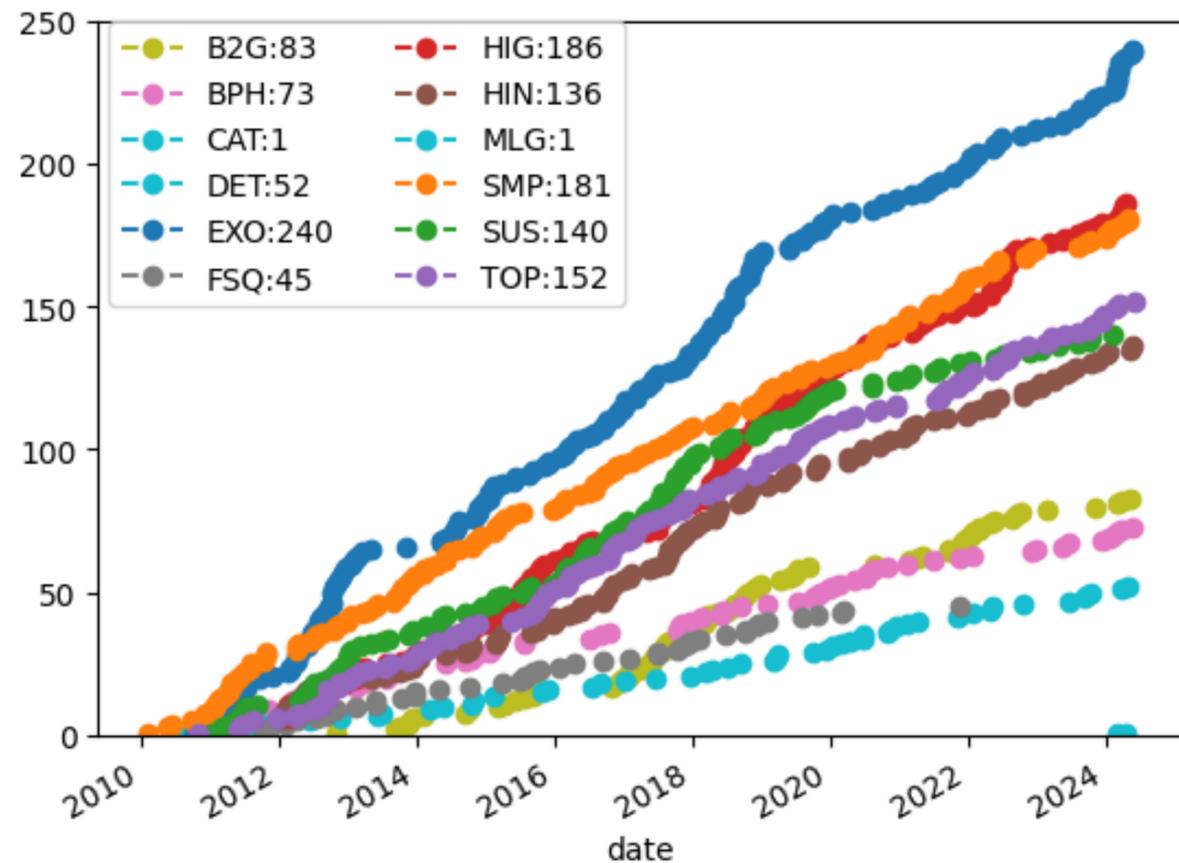
Data recorded: 2016-Aug-17 08:01:23.065024 GMT

Run / Event / LS: 278969 / 229126383 / 184

Physics



CMS Physics Publications



Publication and analysis statistics

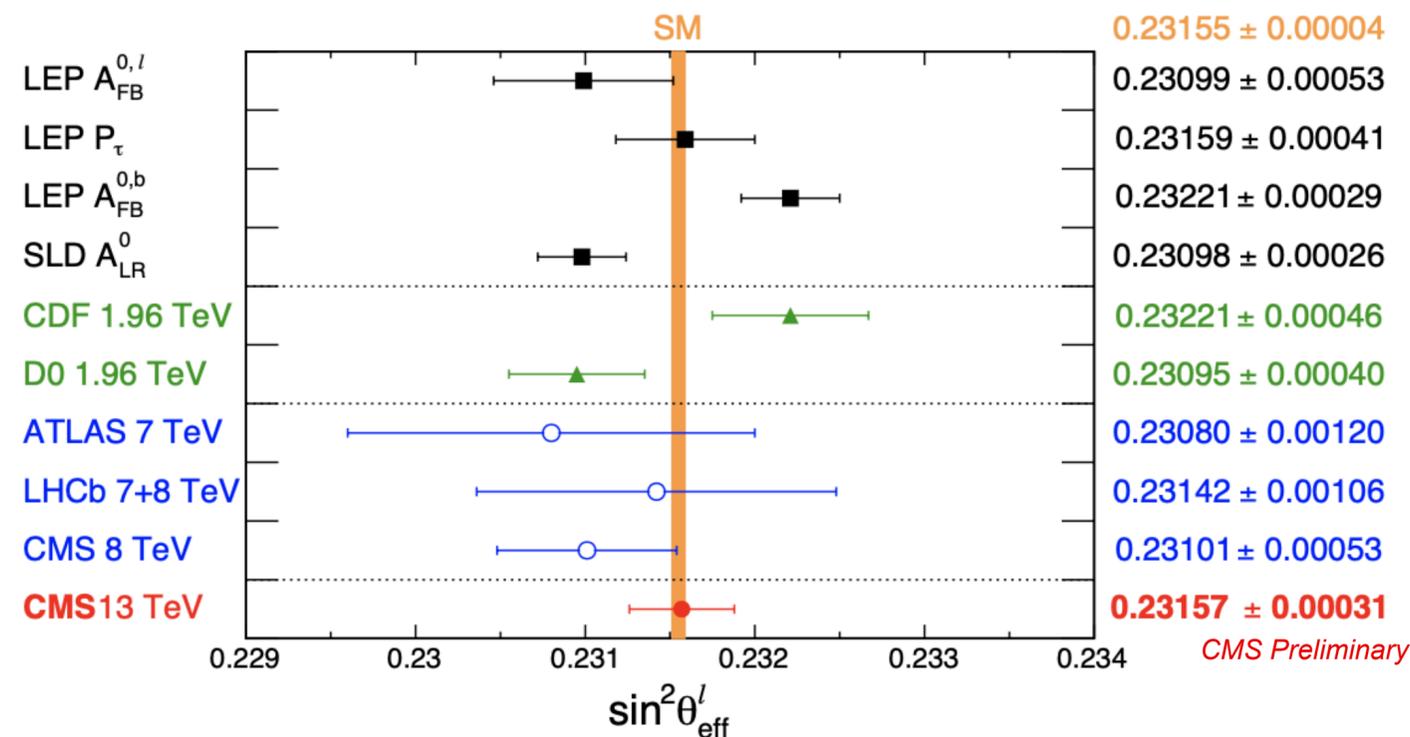
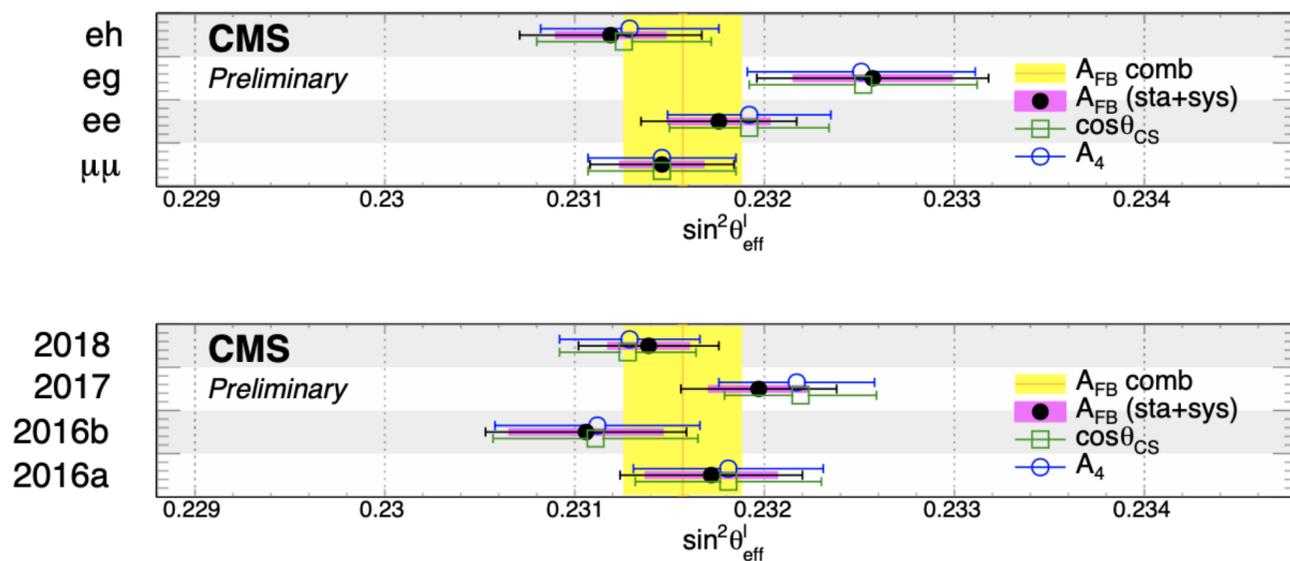
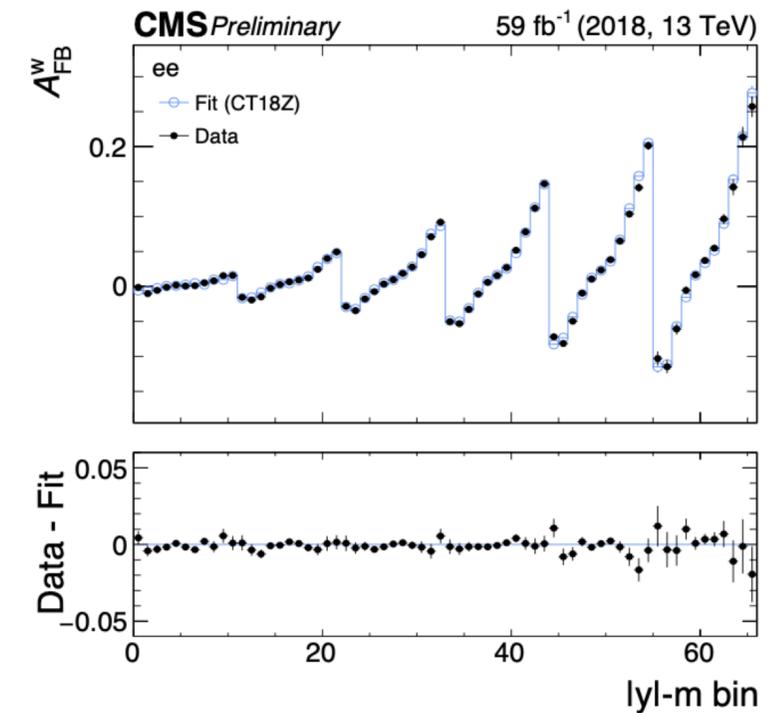
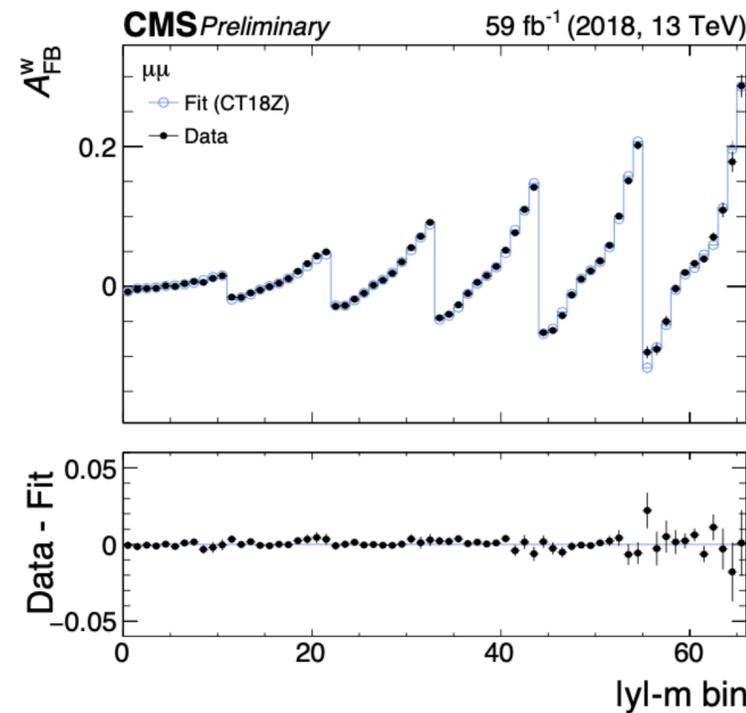
- Currently at 1290 papers on collision data
- [Detector Paper for Run 3](#) has been published in JINST.

Recent Results and briefings for the public:

- <https://cms.cern/news/cms-moriond-2024>

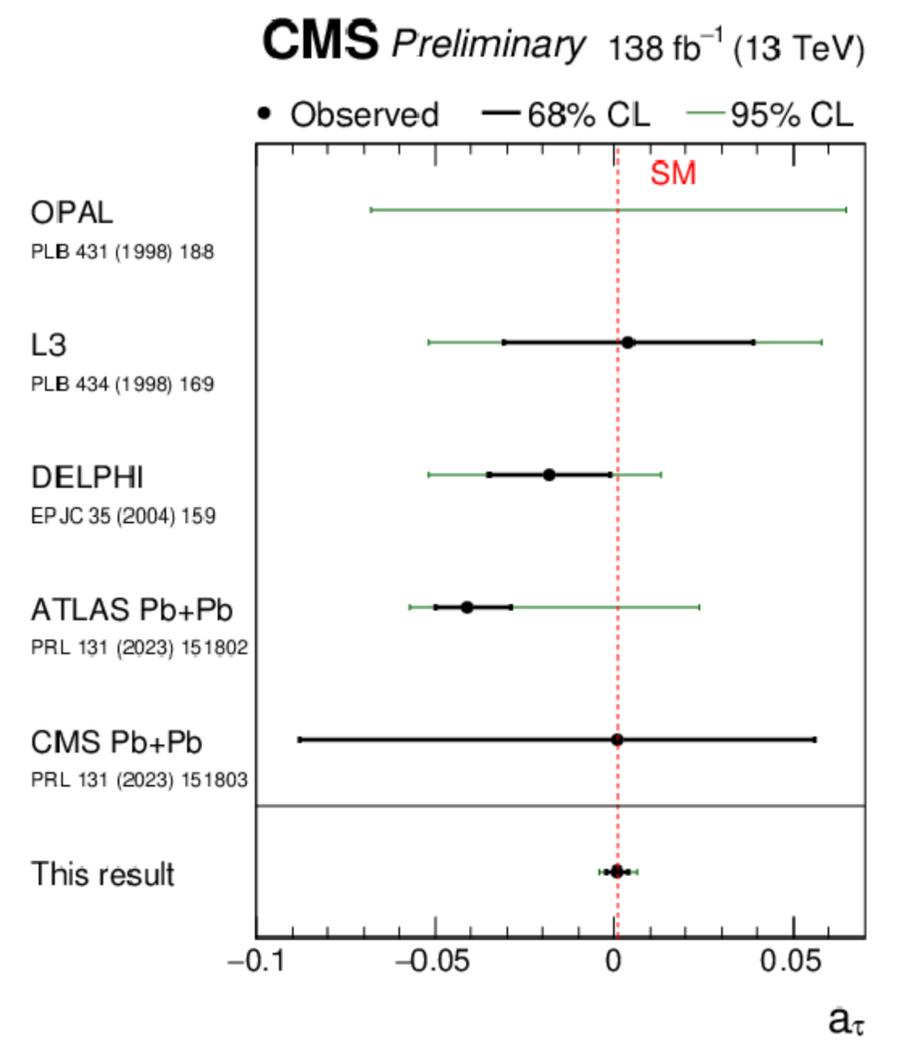
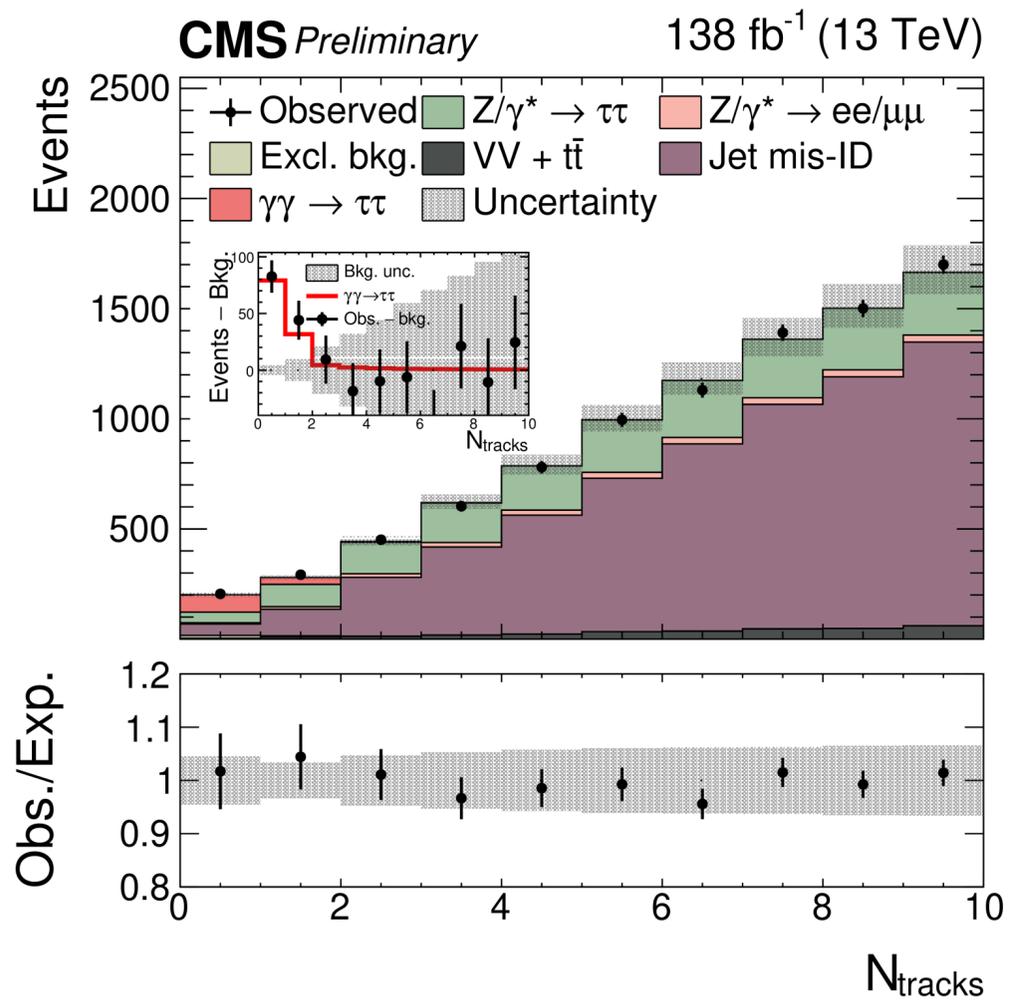
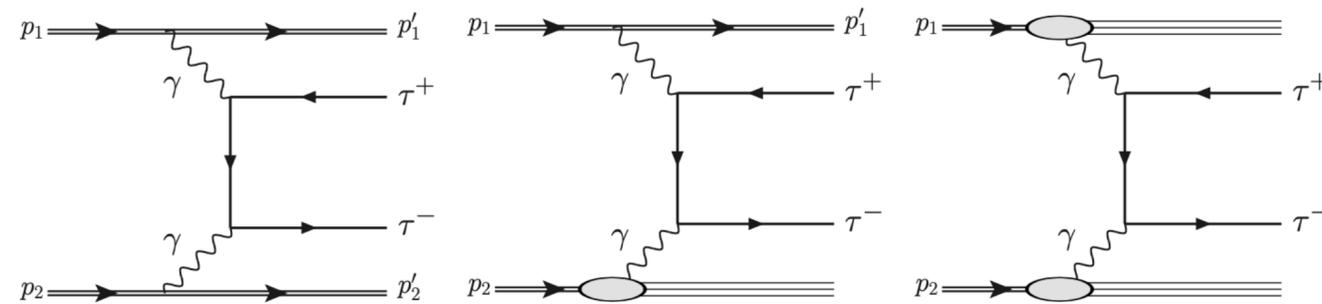
Z/γ → ℓℓ forward/backward asymmetry and $\sin^2\theta_{\text{eff}}^{\ell}$

- $\sin^2\theta_W$ 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}



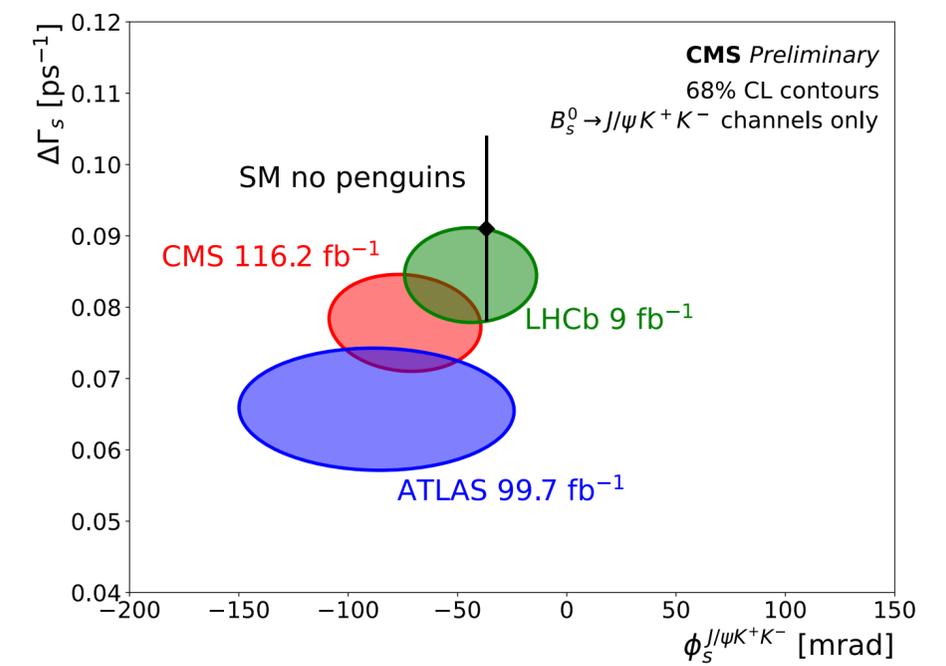
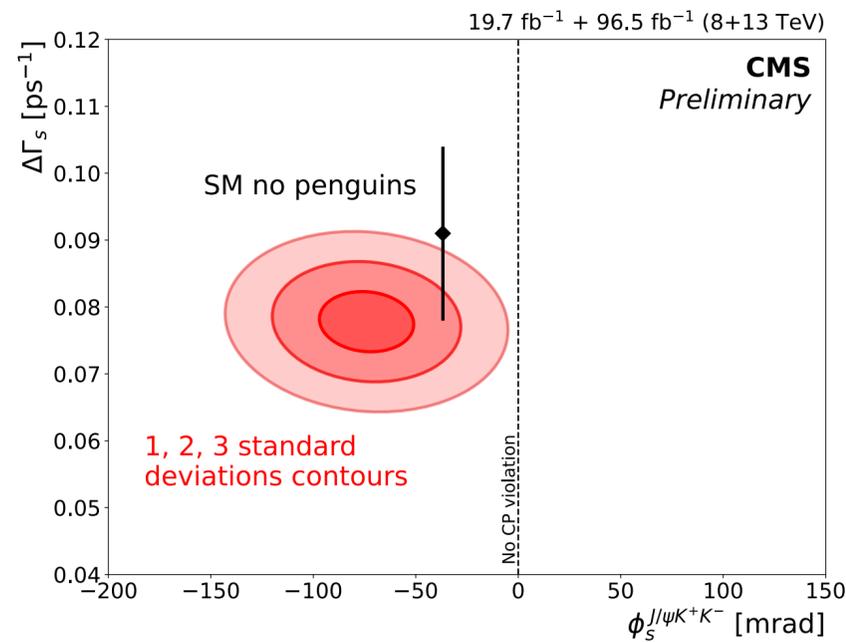
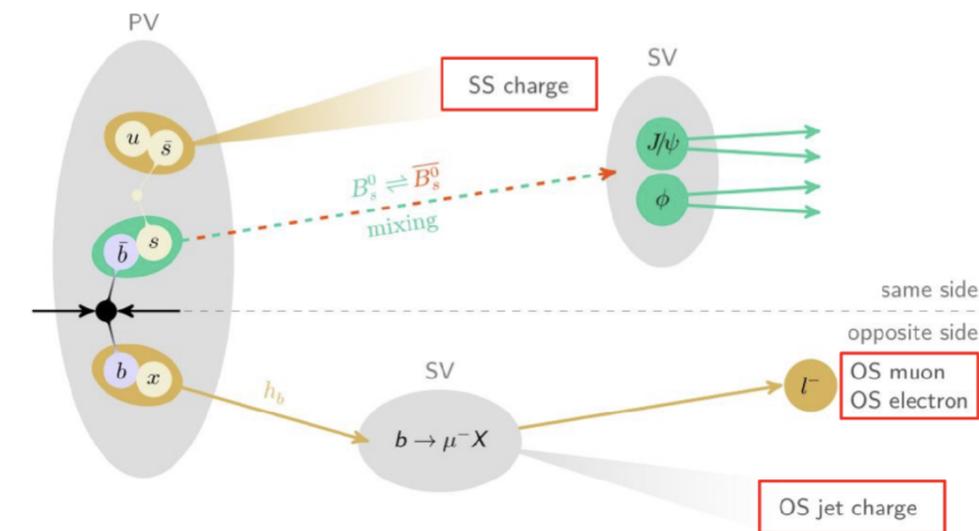
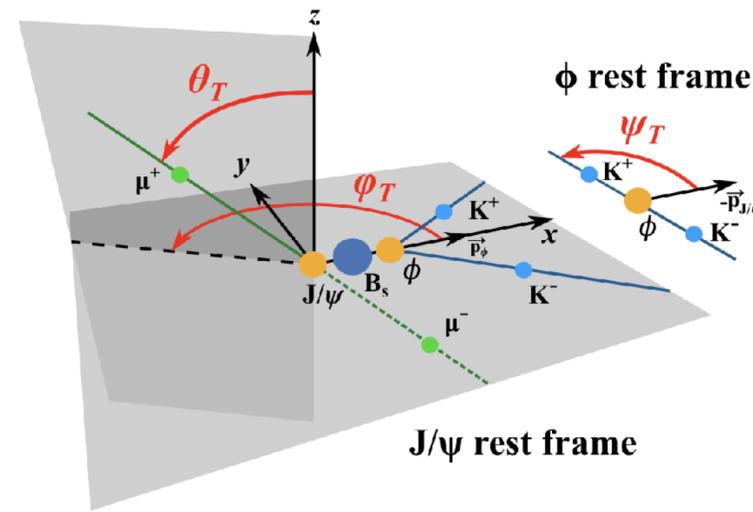
Observation of $\gamma\gamma \rightarrow \tau\tau$ and bound on tau $g-2$

- Look for $\tau\tau$ production in $\gamma\gamma$ collisions
 - Isolate a sample enriched in photon collisions, selecting low-multiplicity vertices
 - Considerable challenge to control impact of PU
- First observation of this process in pp (has been seen in PbPb).
 - Sets limits on the anomalous electromagnetic moment of the tau (τ) lepton.
- Determination of a_τ using an EFT model: 5x increase in precision on tau $g-2$ w.r.t. LEP



CP Violation in $B_s \rightarrow J/\psi \phi$ time-dependent asymmetry

- Measure CPV in the interference between mixing and decay of B_s / \bar{B}_s
- Exploits new **flavor taggers using machine learning**, outstanding performance at hadron colliders
 - Exploits charge correlation on same-side tagger
- Extracts 5 parameters of interest including the weak phase, $\Delta\Gamma_s$, and Δm_s
- **First evidence of CP violation in this decay mode**



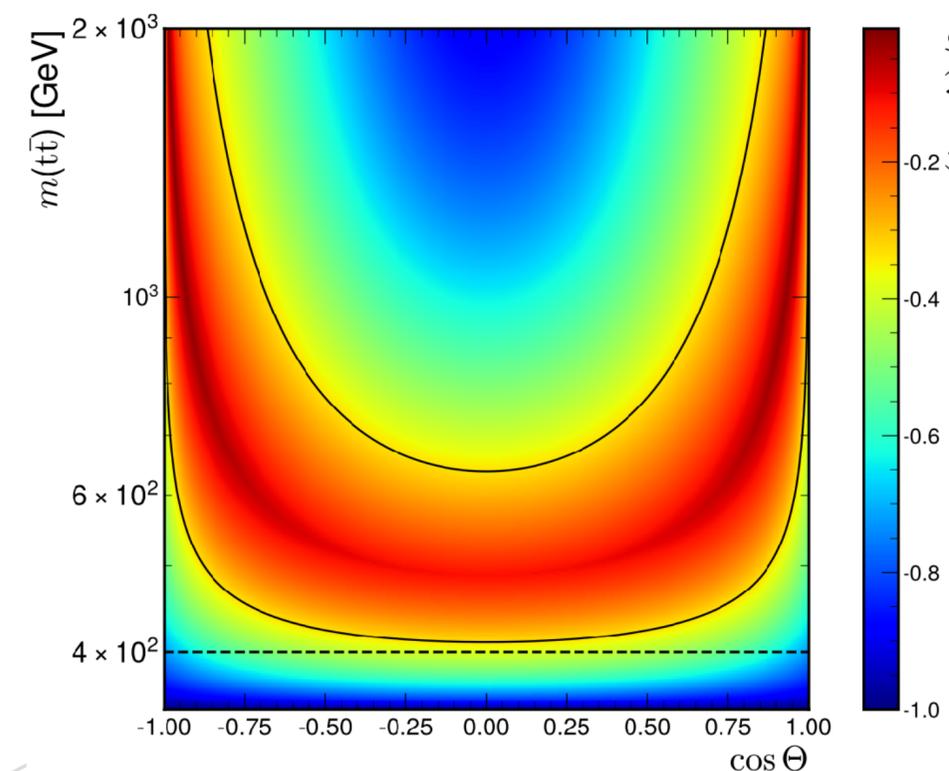
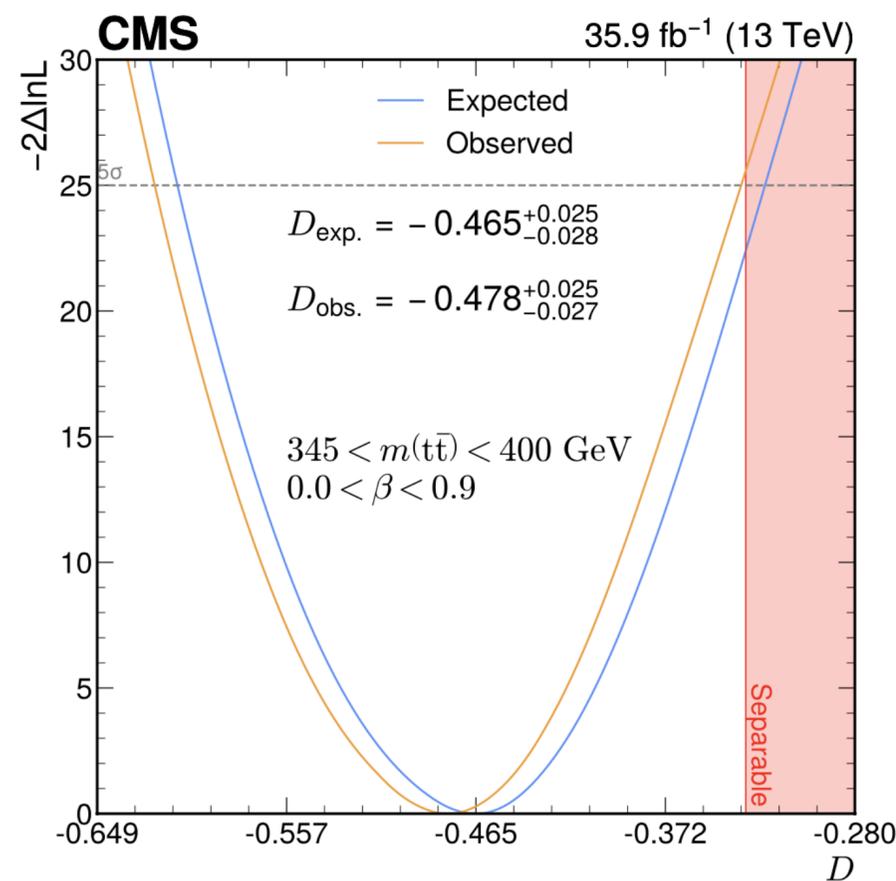
Entanglement in top quark production

- Measure **entanglement** by looking for an excess of spin correlation wrt no-entanglement hypothesis
- Key observable should be $D > -1/3$ if top quarks are not entangled at threshold
- Use angle between leptons in fully-leptonic $t\bar{t}$ events as a proxy
- **Establishes entanglement at $>5\sigma$**
- Interesting byproduct: it requires a bound-state component in the bkg fit to describe data at $t\bar{t}$ threshold

$$\frac{1}{\sigma} \frac{d\sigma}{d\Omega_1 d\Omega_2} = \frac{1}{(4\pi)^2} \left(1 + \mathbf{B}^+ \cdot \hat{\ell}^+ + \mathbf{B}^- \cdot \hat{\ell}^- - \hat{\ell}^+ \cdot \mathbf{C} \cdot \hat{\ell}^- \right)$$

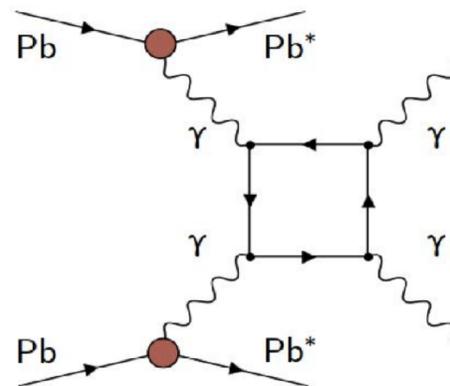
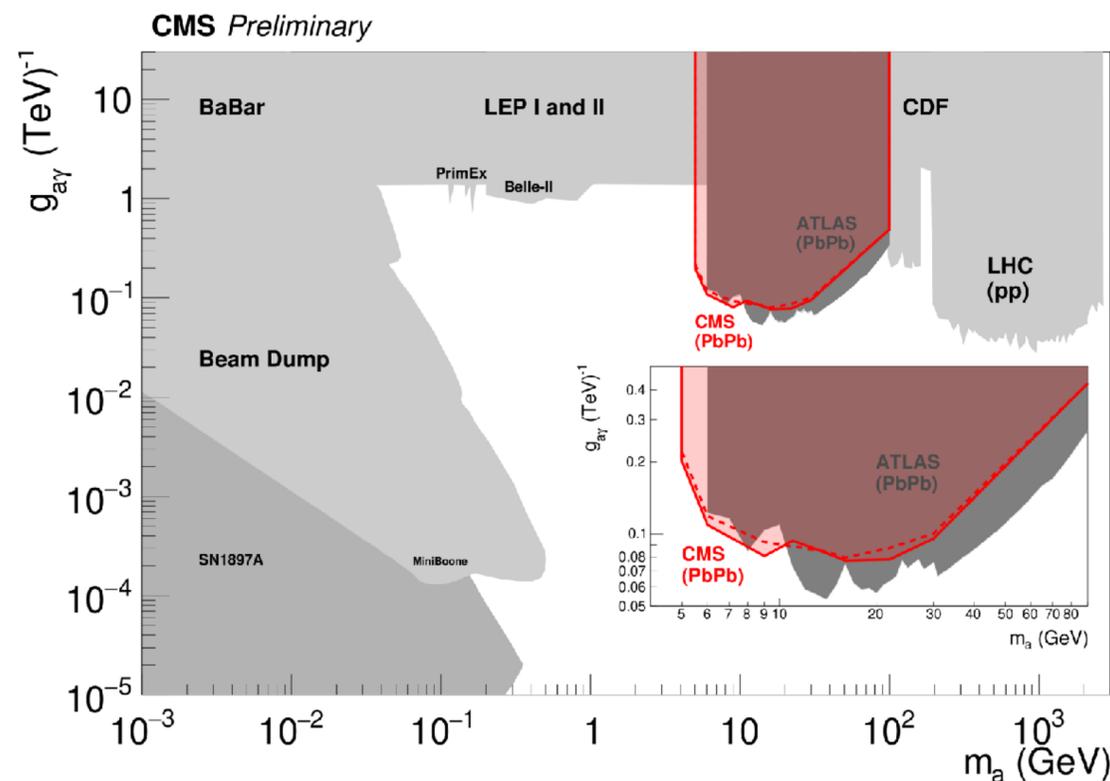
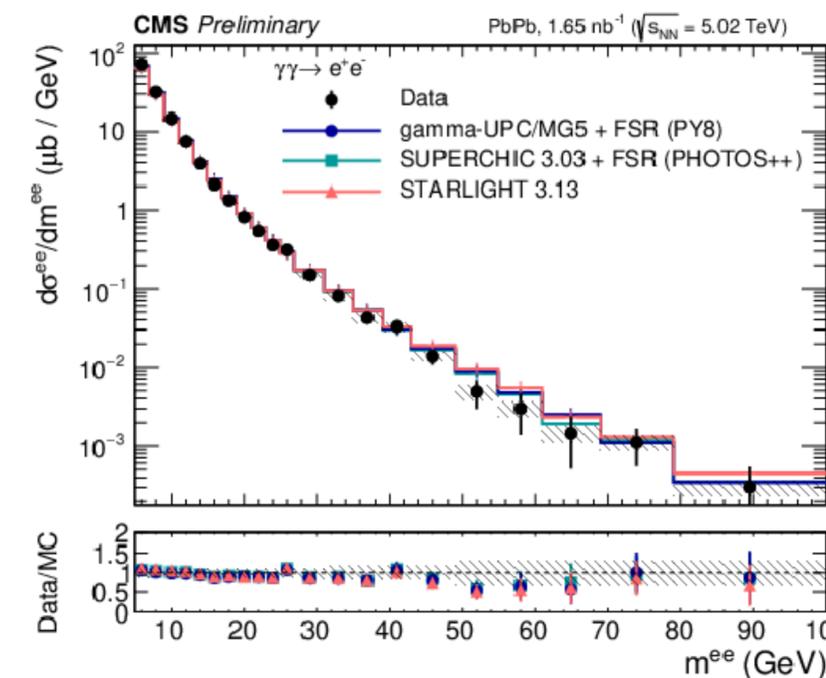
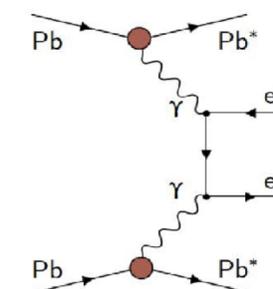
$$\Delta \equiv C_{33} + |C_{11} + C_{22}| - 1 > 0.$$

$$\Delta + 1 = \text{tr}[\mathbf{C}] = -3D > 1.$$



Light-by-Light scattering and Breit–Wheeler processes

- Probe photon collisions to **diphotons** and **e+e-**, using **ultra-peripheral collisions** in PbPb
 - Clean experimental environment
 - Cross section enhancement $\sim Z^4$
- Set limits on the resonant production of axion-like particles (ALPs) coupling to photons are set for masses $m_a = 5\text{--}100$ GeV



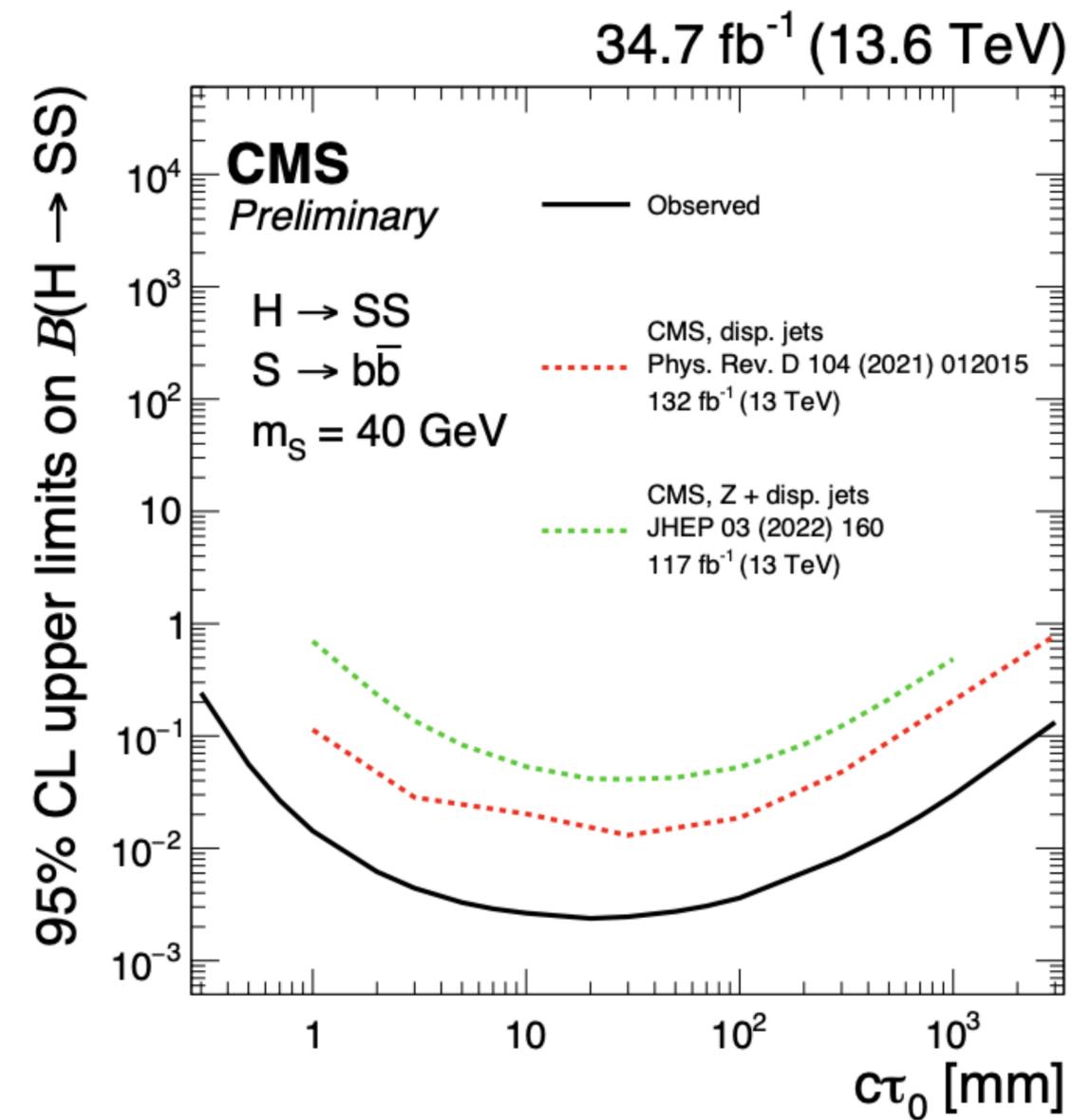
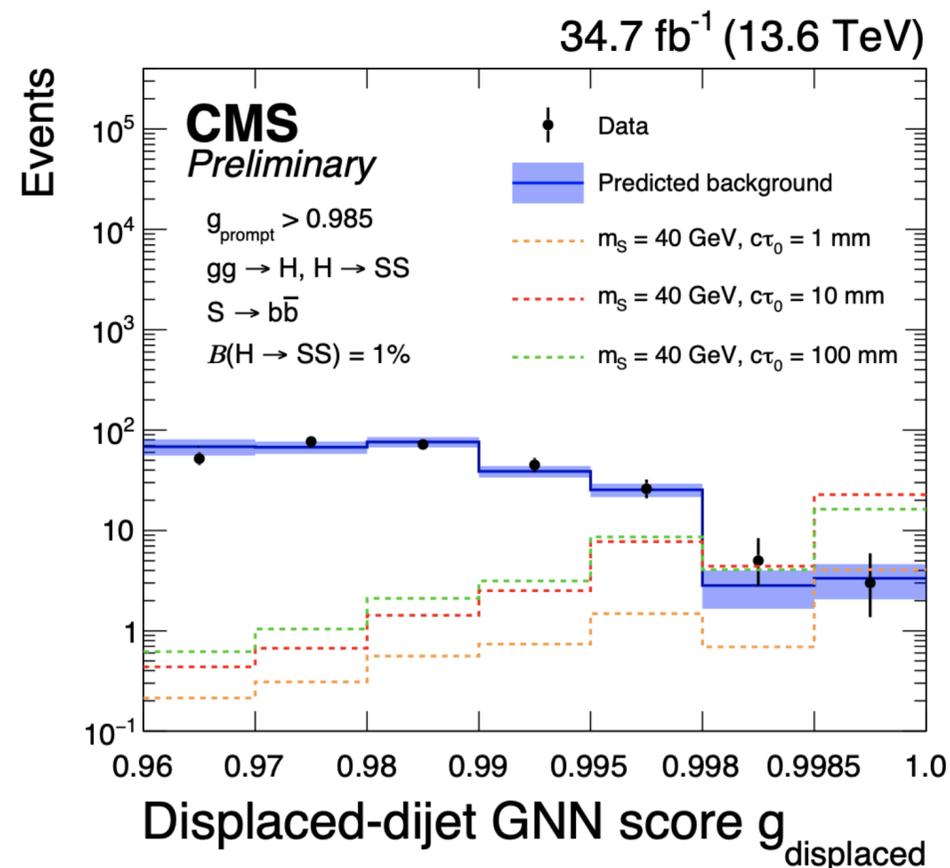
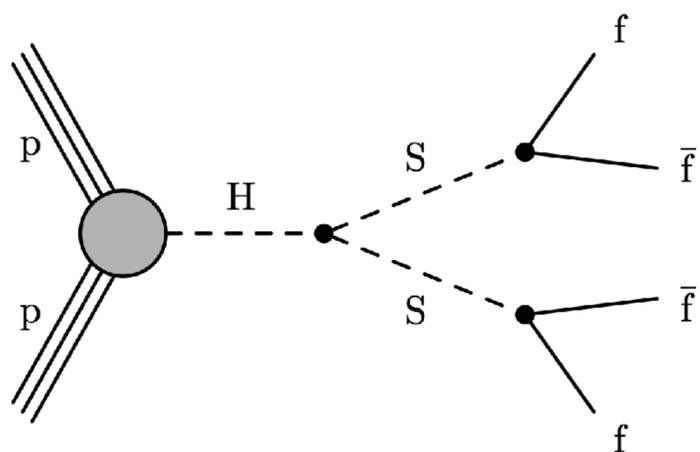
$$\sigma_{\text{fid}}(\gamma\gamma \rightarrow e^+e^-) = 271.5 \pm 1.9 (\text{stat}) \pm 18.3 (\text{syst}) \mu\text{b}$$

[CMS-PAS-HIN-21-015](#)

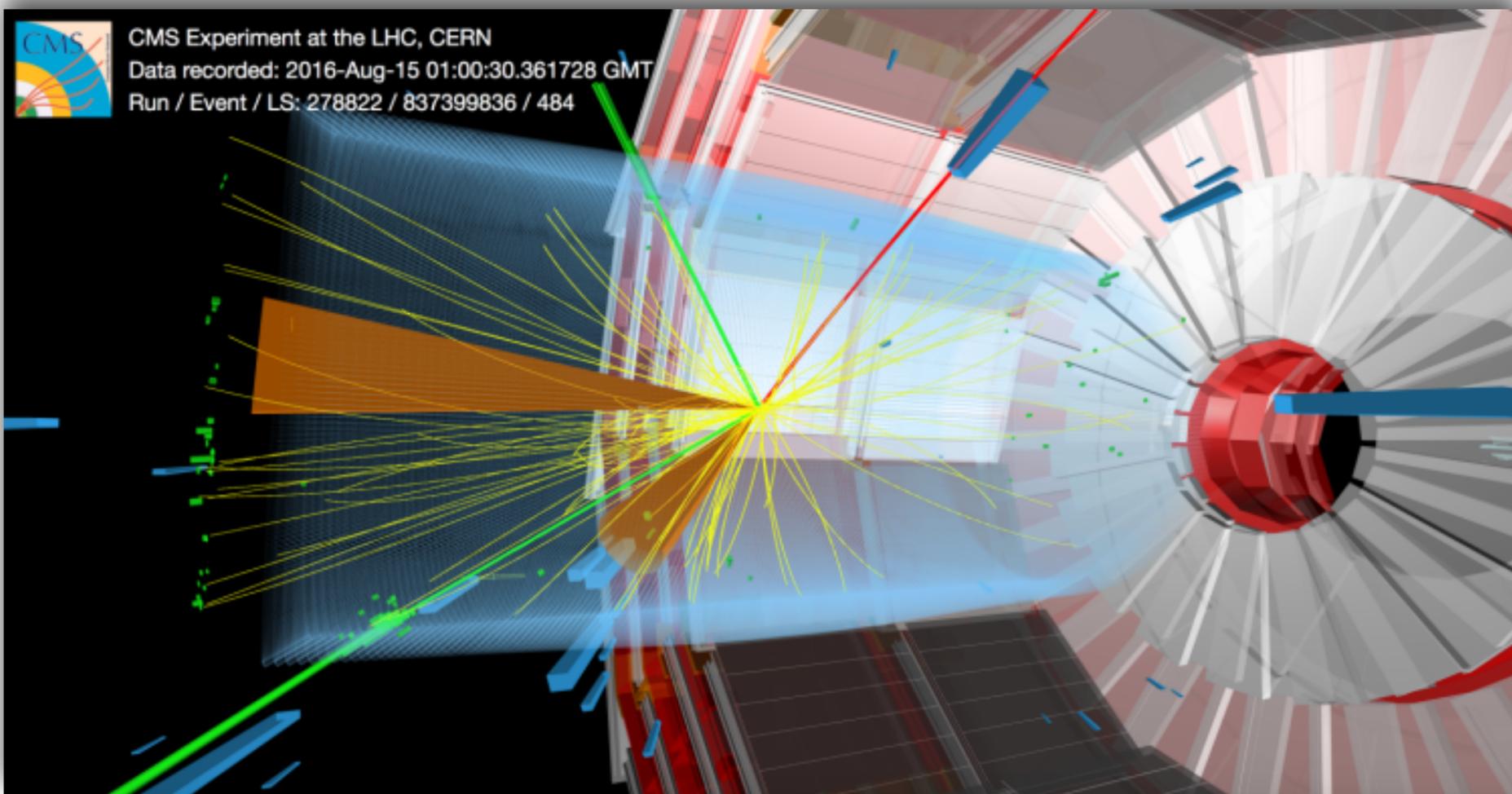
$$\sigma_{\text{fid}}(\gamma\gamma \rightarrow \gamma\gamma) = \frac{N_{\gamma\gamma,\text{data}} - N_{\gamma\gamma,\text{bkg}}}{C_{\gamma\gamma} \mathcal{L}_{\text{int}}} = 107 \pm 33 (\text{stat}) \pm 20 (\text{syst}) \text{nb}$$

- Search for resonance decaying to displaced jets
- Building on Run2 analysis experience and adding
 - new dedicated triggers
 - a novel displaced dijet ID based on graph NNs
- **Improved on Run2 sensitivity, using only 2022 data**

CMS-PAS-EXO-23-013



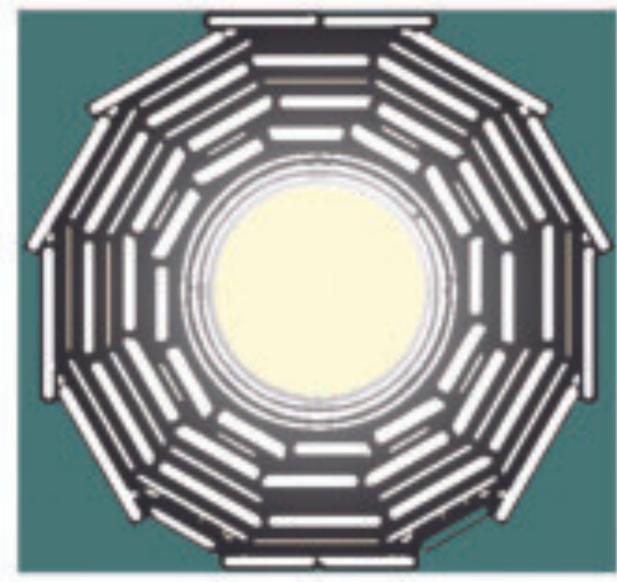
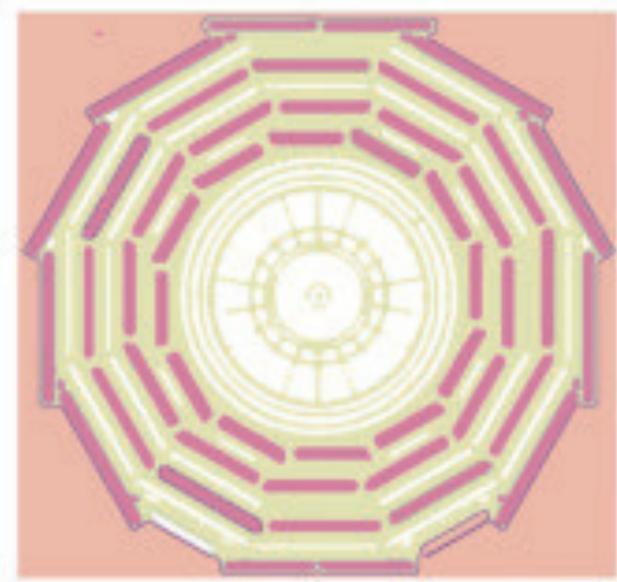
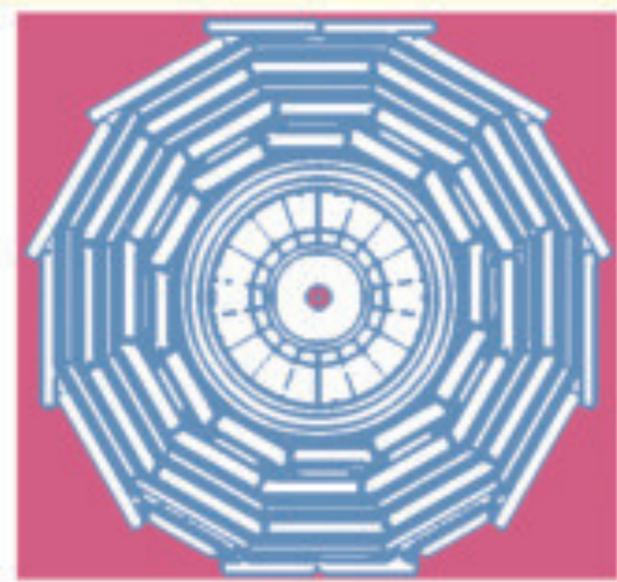
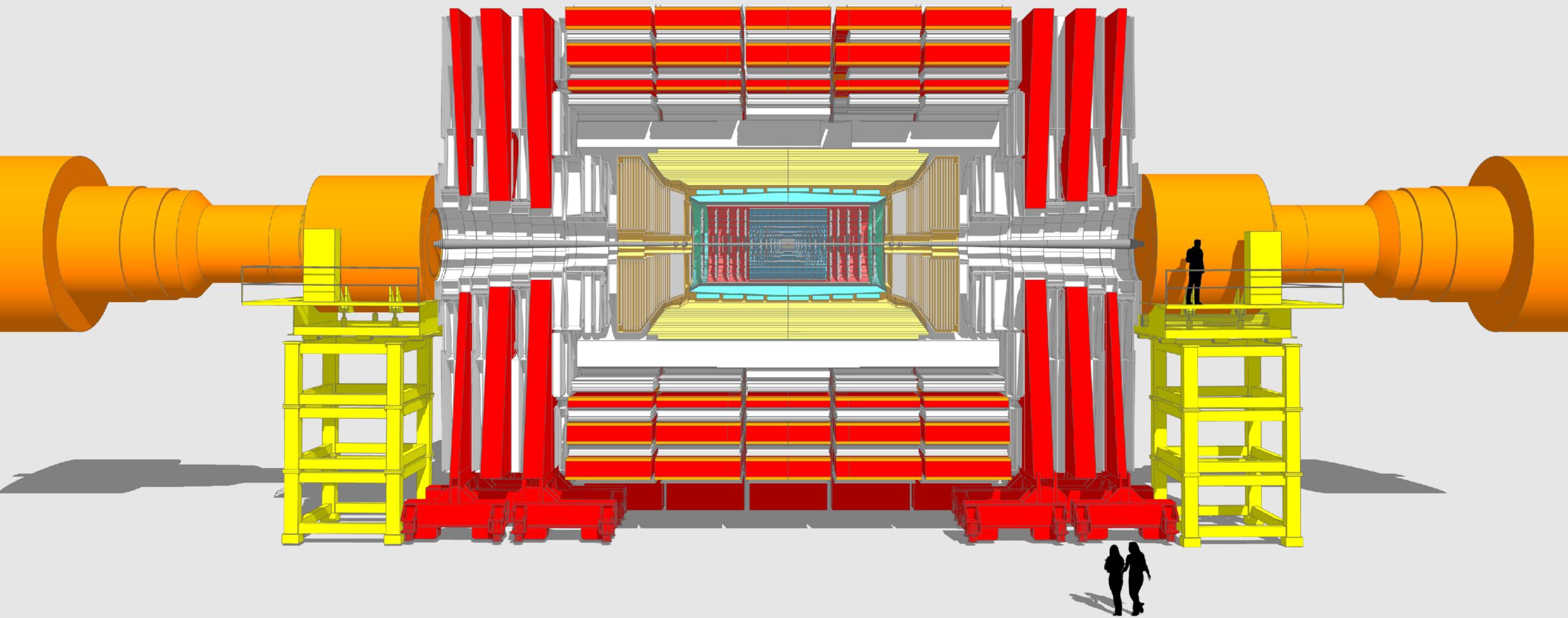
New 13 TeV Data Release



<https://cms.cern/news/cms-releases-13-tev-proton-collision-data-2016>

In April, CMS announced the release of 13 TeV proton-proton collision data collected in 2016.

- Over 70 TB of 13 TeV [collision data](#) and 830 TB of [corresponding simulations](#) are now accessible to the global scientific community and enthusiasts alike through the [CERN Open Data Portal](#).



Upgrades

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>

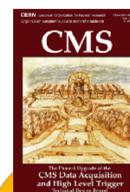
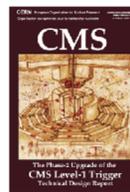


L1 Trigger/HLT/DAQ

<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>

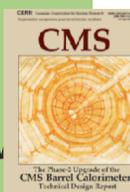
- Si Strip Outer Tracker designed for L1 Track Trigger
- Pixelated Inner Tracker extends coverage to $|\eta| < 3.8$



Barrel Calorimeters

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

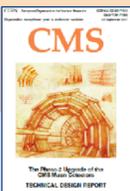
- ECAL single crystal granularity in L1 Trigger v
- precise timing for e/γ at 30 GeV
- ECAL and HCAL new back-end electronics



Muon Systems

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

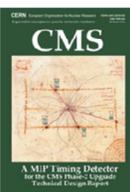
- DT & CSC new FE/BE readout
- New GEM/RPC $1.6 < |\eta| < 2.4$
- Extended coverage to $|\eta| < 3.0$



MIP Timing Detector

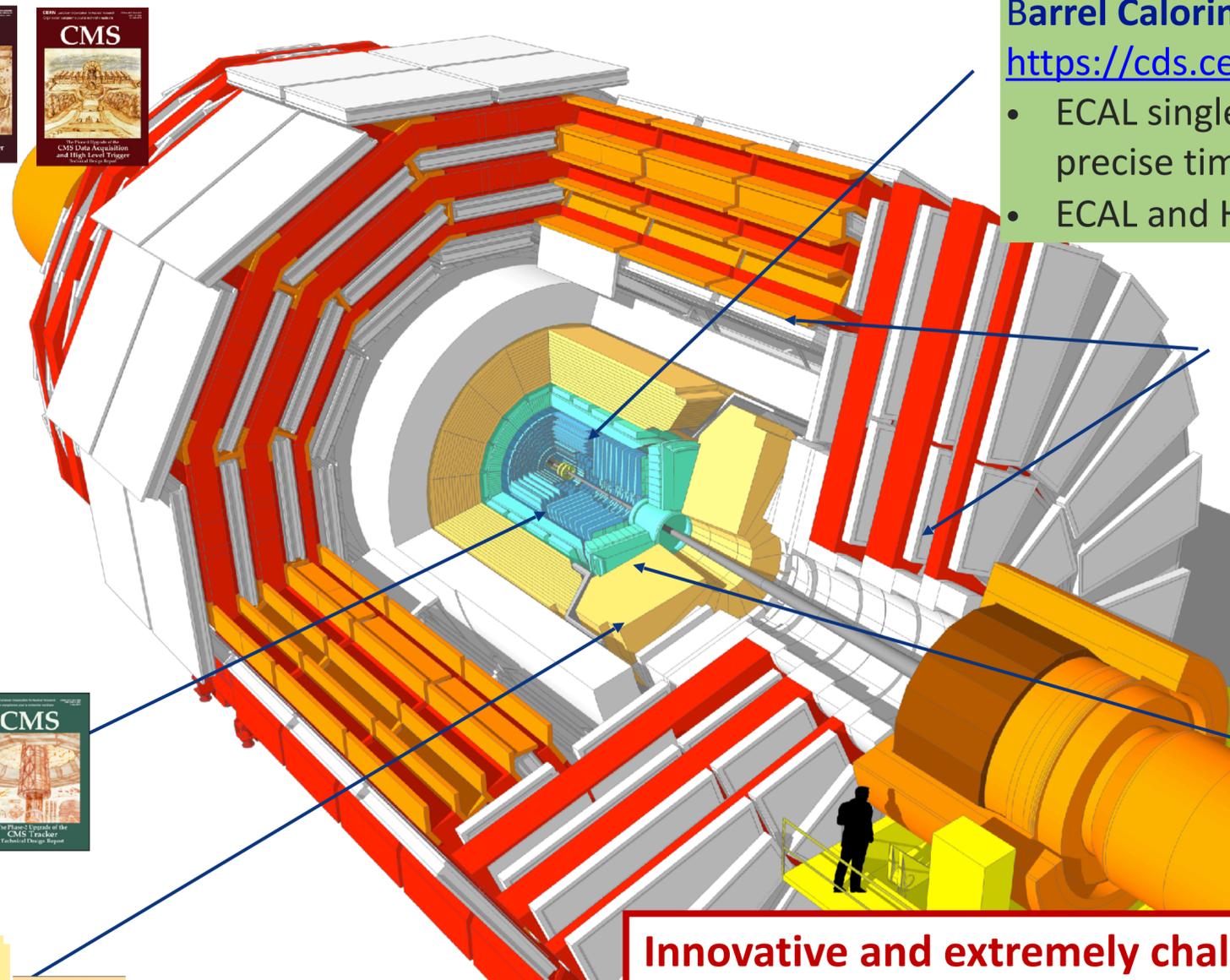
<https://cds.cern.ch/record/2296612>

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



Innovative and extremely challenging new capabilities:

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

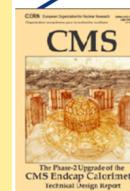


Calorimeter Endcap

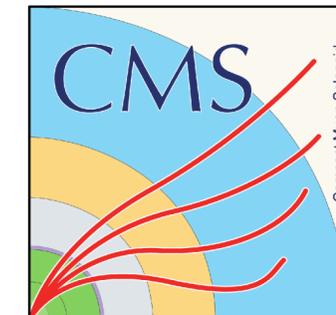
Also known as HGCAL

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

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

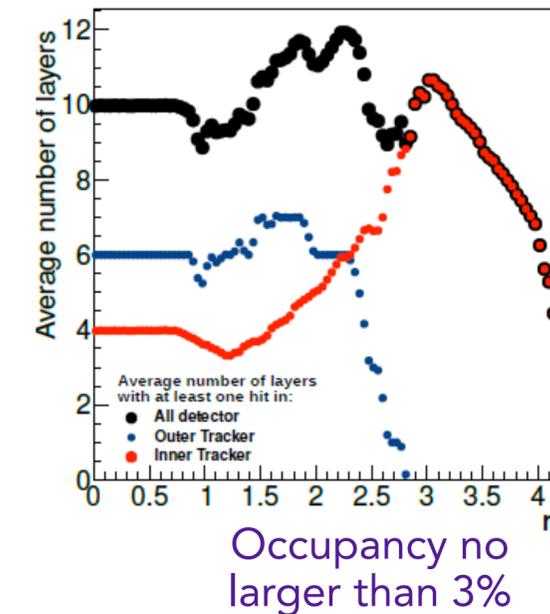
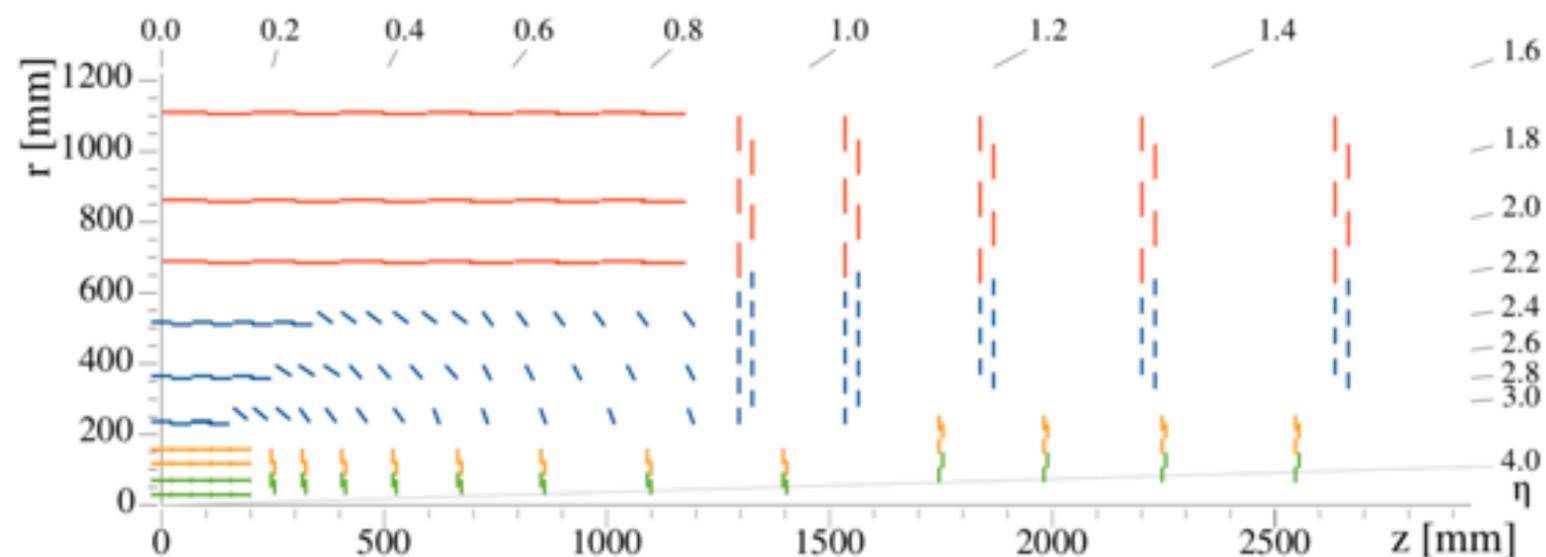


CMS Phase2 Tracker



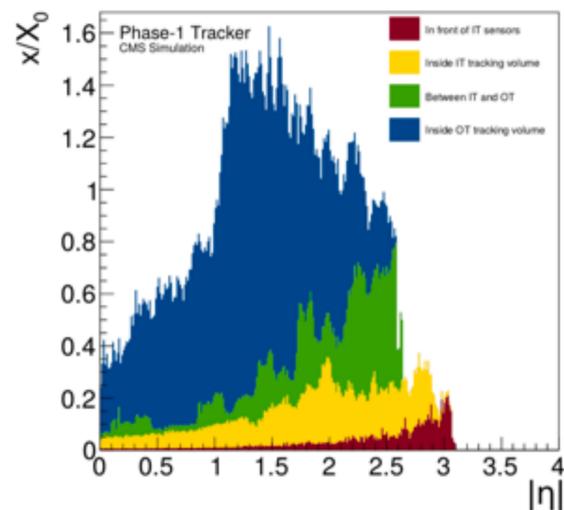
Key features

- more granularity
- lower material budget
- extended coverage
- tracking included at L1-trigger level

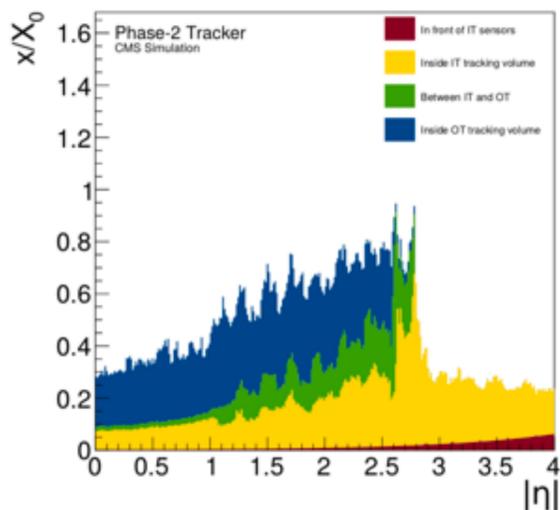


Material budget

present tracker

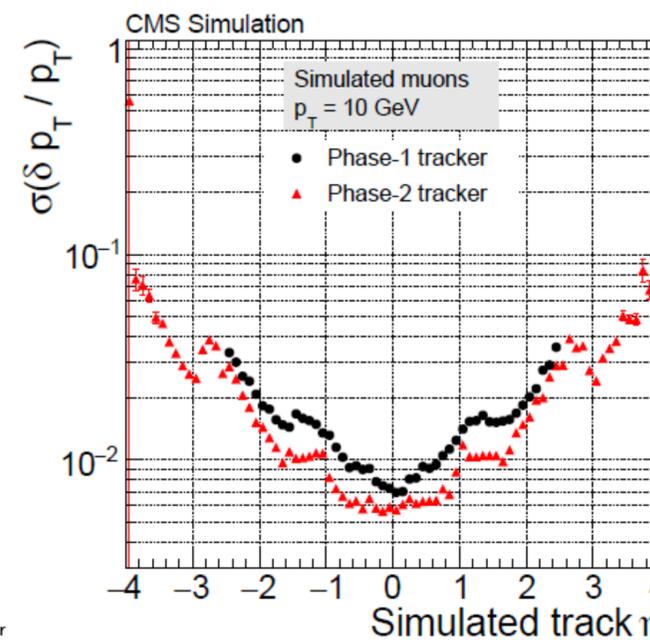
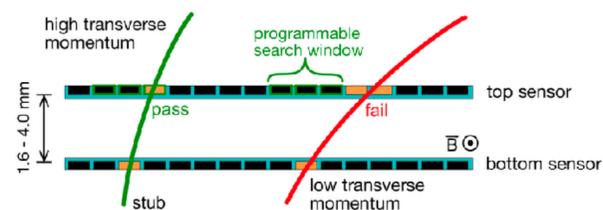


upgraded tracker

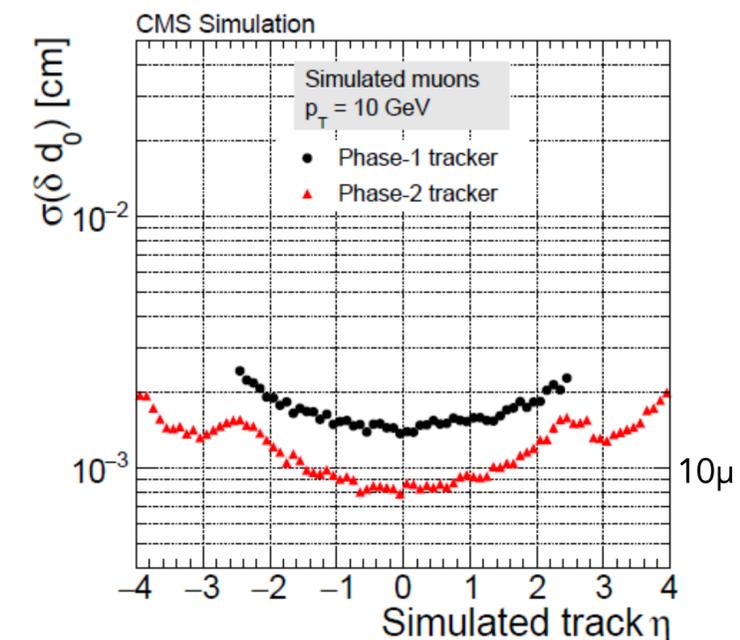


Expected performance compared to present tracker

Local rejection of low p_T tracks

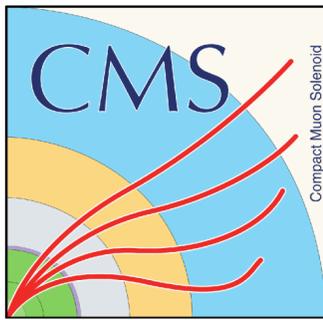


transverse momentum

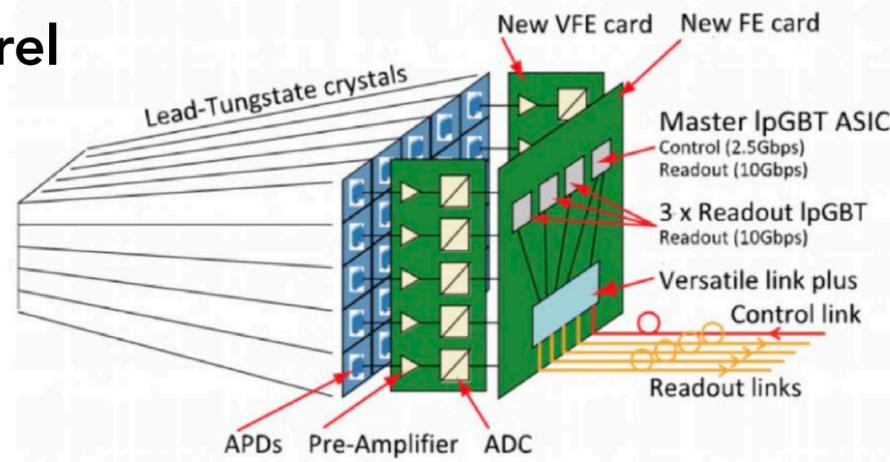


transverse impact parameter

CMS Phase2 Calorimetry



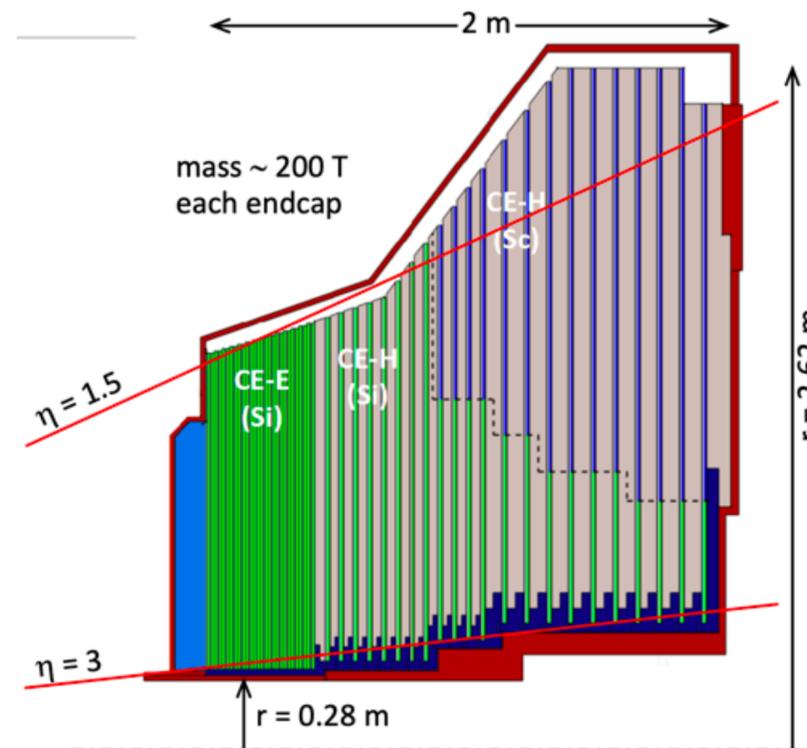
Barrel



New ECAL on-detector electronics

- digitization at 160 MHz
- online pulse shape discrimination against spikes
- trigger granularity = single crystal
- 30 ps time resolution ($E_\gamma > 50$ GeV)
- cooled at 9°C to mitigate APD ageing

Endcaps: High-Granularity Calorimeter (HGCAL)

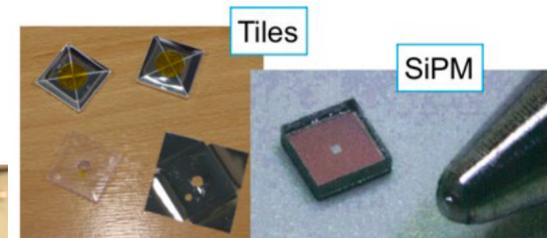


Electromagnetic (CE-E)

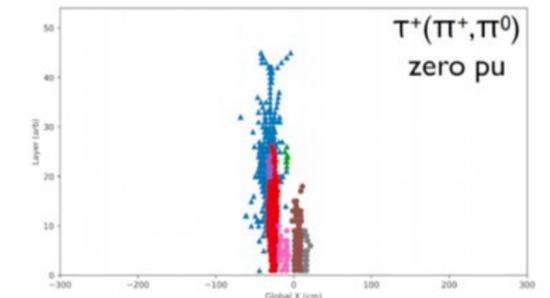
- Cu/CuW/Pb absorbers
- Si sensors, hexagonal modules
- 27 layers
- $25.5X_0$ and 1.7λ

Hadronic (CE-H)

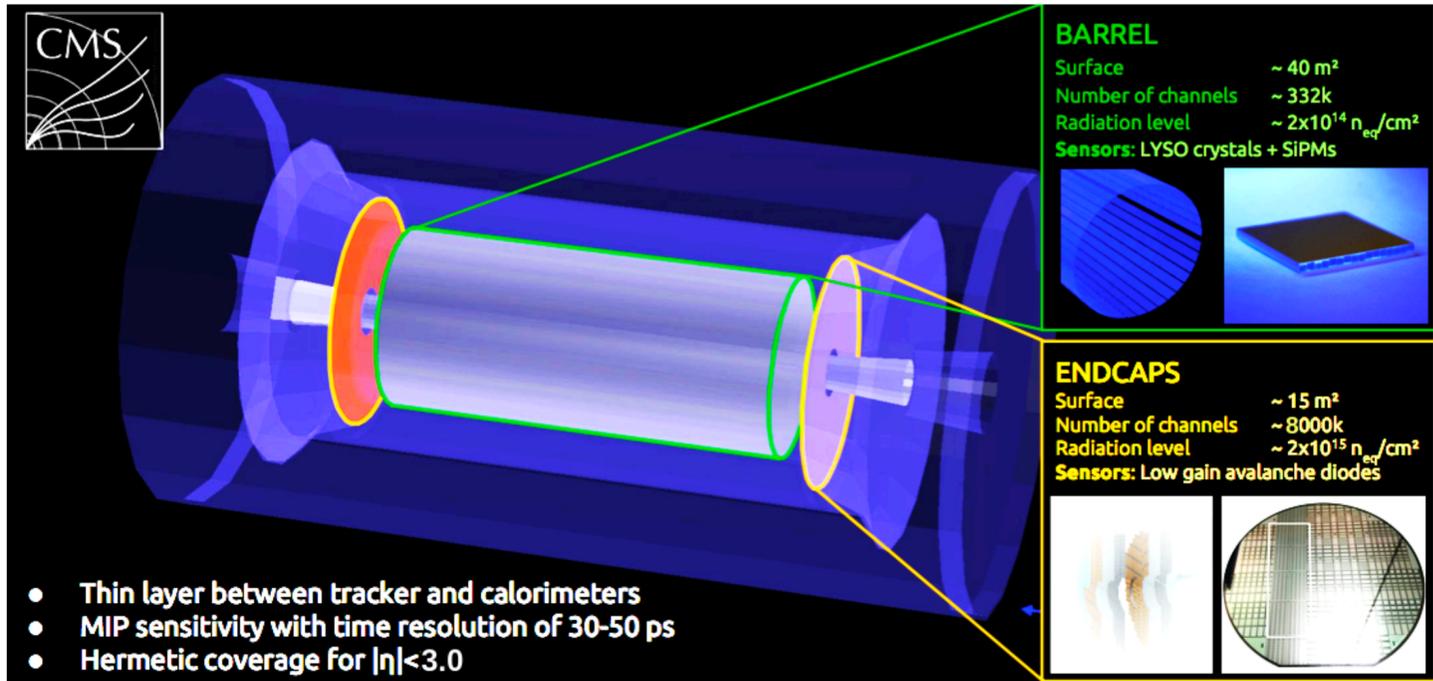
- steel absorbers
- High-radiation regions: Si sensors
- Low-radiation regions: scintillation tiles with SiPM readout
- 20 layers
- 9.5λ (including CE-E)



6M Si channels
240k scint. channels

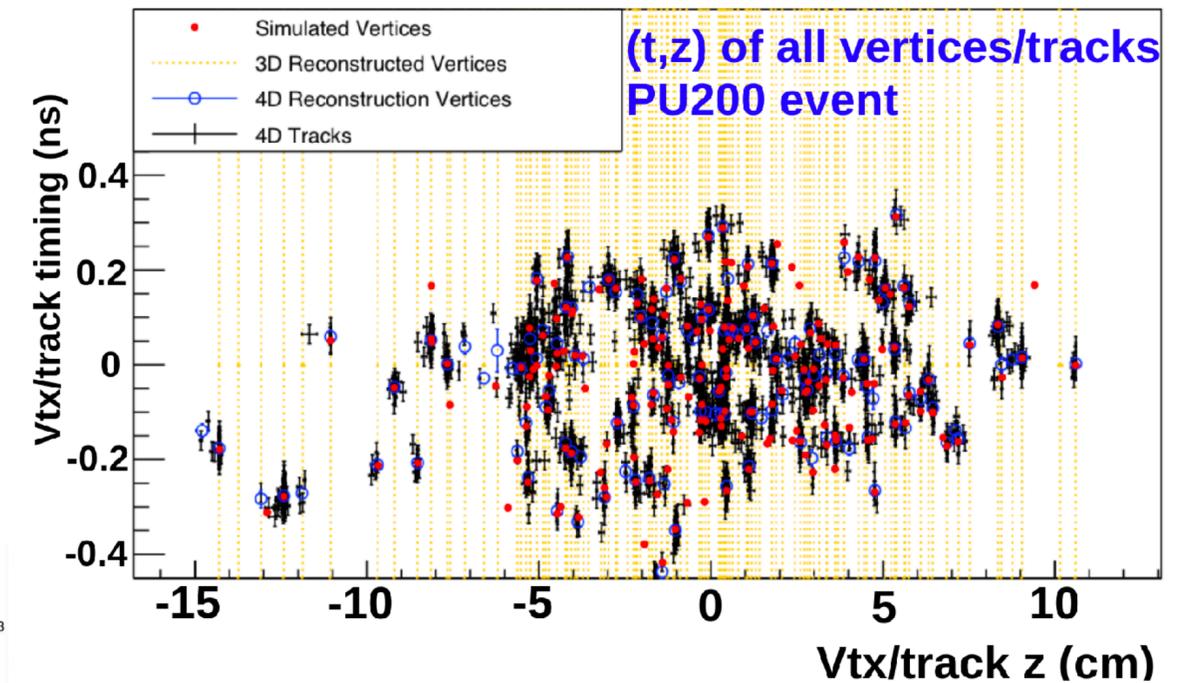


CMS Phase2 Timing Detector



The MTD features

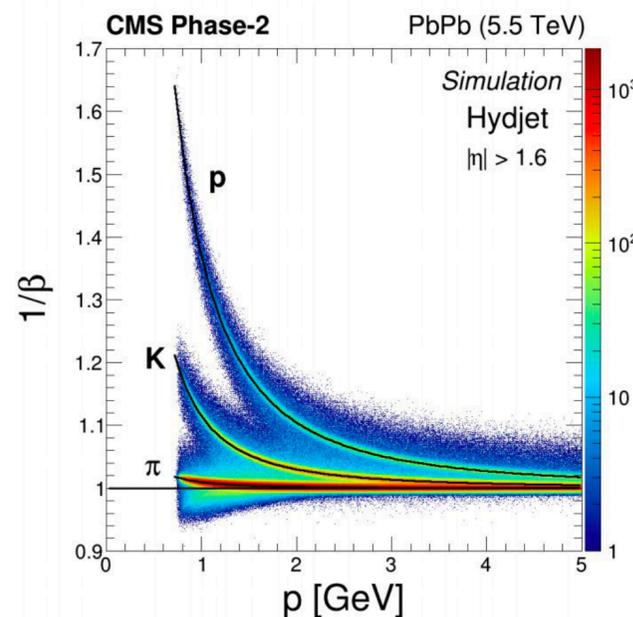
- a time resolution of 30-50 ps for MIPs
- a 4th dimension for PU rejection



Precise timing allows for the removal of spurious tracks from PU, this improving on

- lepton isolation and identification
- jet reconstruction and flavour tagging
- missing p_T reconstruction

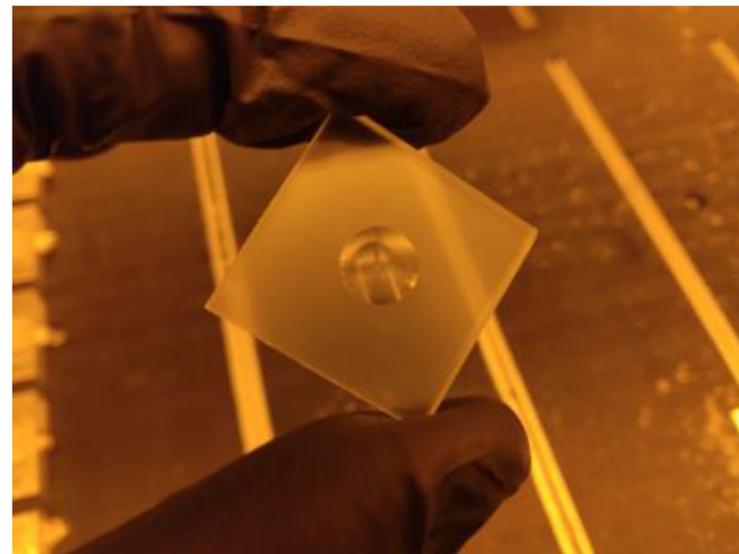
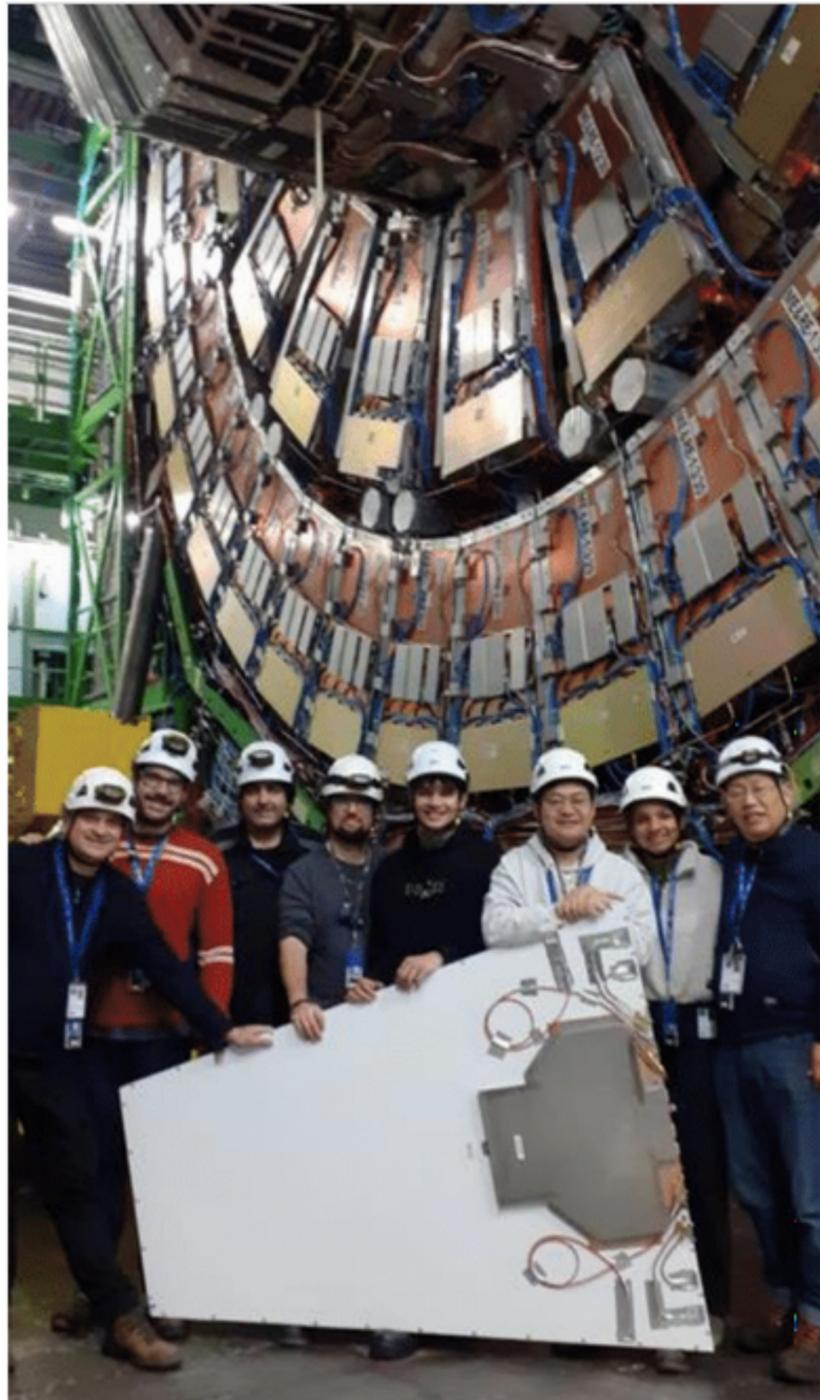
Precise timing also offers time-of-flight identification at low momenta (relevant in HI)



The MTD uses well-established technologies

- Barrel:
 LYSO crystals with dual end SiPM readout
- Endcaps:
 Low Gain Avalanche Detectors (LGAD)

Upgrade Status



CMS Upgrades:
Transitioning into
production



Progress on the Upgrades

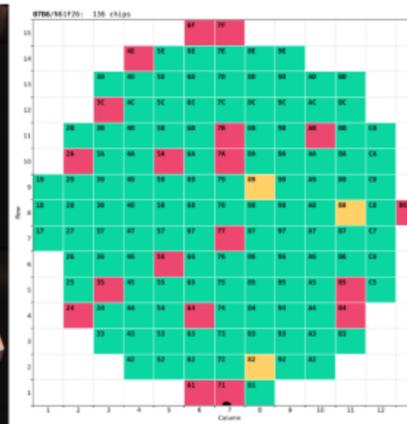
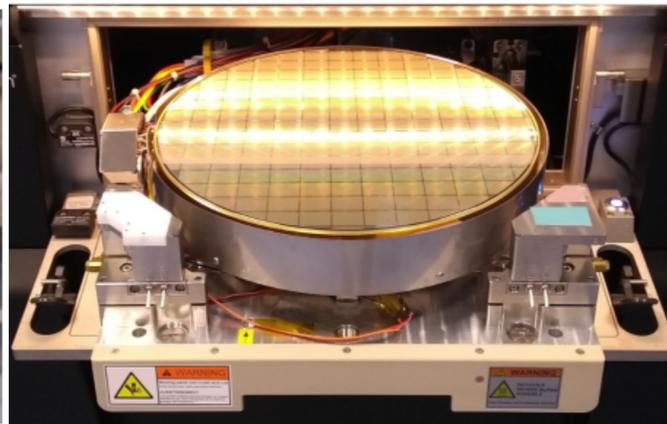
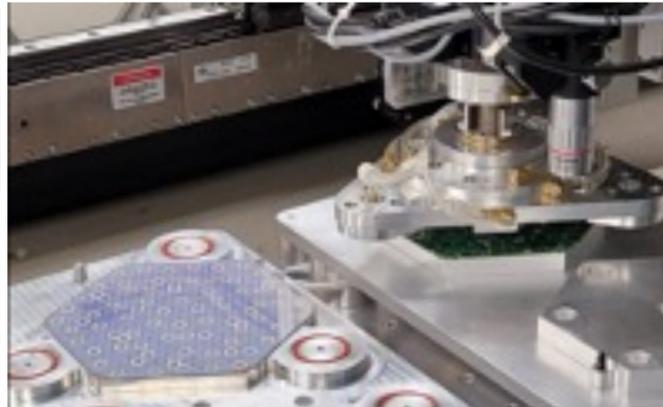
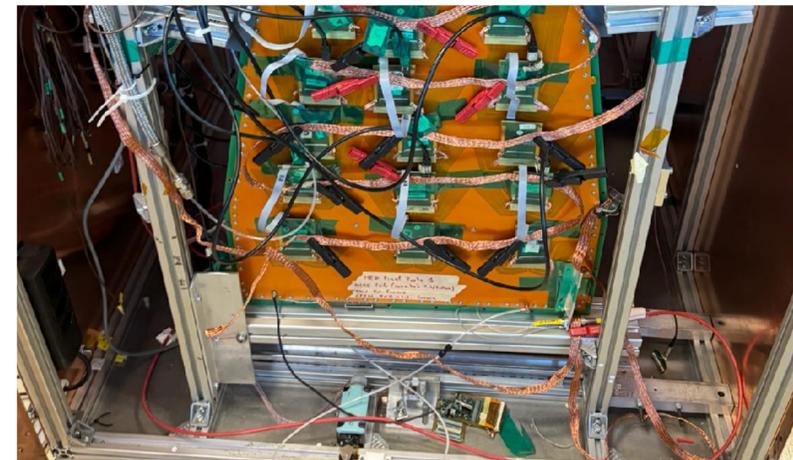


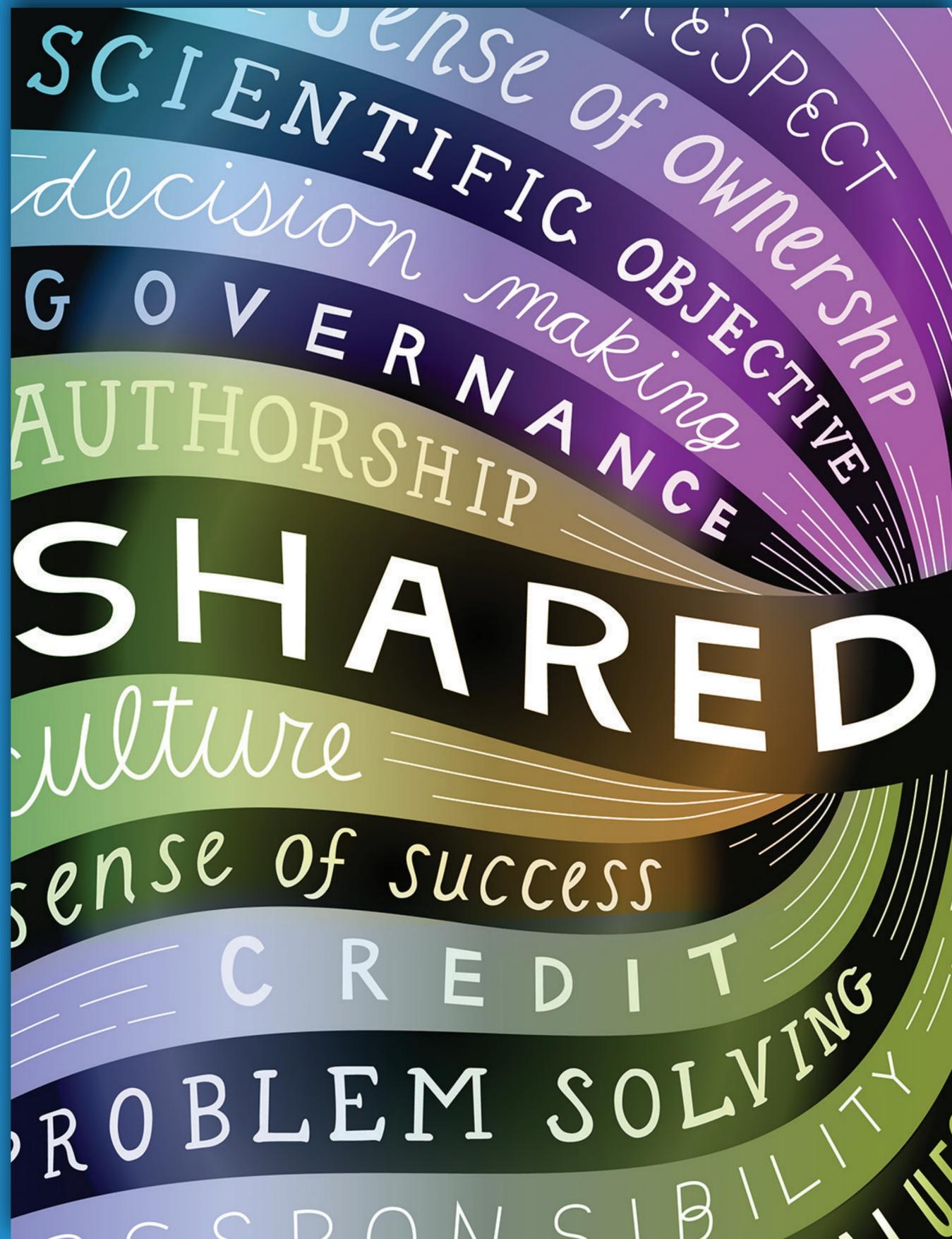
CMS upgrade projects have finished almost all design reviews and many procurement readiness reviews

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

Assembly facilities and infrastructure are a current focus

- Working with the collaboration to secure enough resources at the institutes/at CERN to enable full production and testing





Ukraine in CMS

Ukraine in CMS in 2024



Currently CMS has 14 members from Ukrainian institutes

- Institute for Scintillation Materials of the National Academy of Science of Ukraine
- National Science Centre, Kharkiv Institute of Physics and Technology,

CMS Upgrades

- Participation in HGCAL - planned to machine cast scintillator for the hadronic part of the calorimeter
- Exploring ways for Ukraine to contribute in the future

Collaboration

- Tier 2 (with efficient support) computing center is in operation for CMS
- Interns/students in Ukraine working on computing/physics projects
- Ukrainians within the CMS community
 - Active participation in Computing, Software, Machine Learning, BRIL (Luminosity and Backgrounds), Calorimetry - particularly HGCAL
 - Significant contributions to physics - in particular, in the B Physics Group

CMS Young Researchers Prize Winner 2023

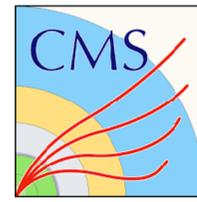


Olena Karacheban

For her crucial and sustained contributions to the measurement of luminosity, the operation of the BRIL system and her role in steering its HL-LHC upgrade.

“Since 2015, when I started my Ph.D. at the Brandenburg University of Technology Cottbus-Senftenberg, I have been involved in various aspects of CMS luminosity measurements. I joined the Beam Radiation Instrumentation and Luminosity (BRIL) project, working on the BCM1F detector, which was diamond-based at the time. From 2017, as a CERN fellow and BRIL detector performance group convener for two years, I was involved in luminosity detectors' operations, calibration, and data analyses. With BRIL colleagues, LHC operators, and the support of CMS run coordination, we turned emittance scans into a regular tool for assessing detectors' linearity and stability. In 2020, I joined Rutgers University, where I was focused on multilepton analysis and searches for physics beyond the Standard Model. Driven by my passion to contribute to future precision luminosity measurements, I took on a BRIL Phase-2 upgrade coordination role. In this capacity, I am responsible for prototyping and constructing the dedicated luminometer for Phase 2 and the best utilization of other CMS sub-systems for luminosity measurement purposes.”

Summer Student Fellows Program



We aim to keep Ukrainian researchers integrated into our international collaborations despite travel limitations. To that end, the U.S. NSF-funded [IRIS-HEP](#) software has had a program each summer since 2022 to connect Ukrainian students (in remote) with particle physics experiments for software-related R&D projects. Some dedicated funding from [IMPRESS-U](#) has been acquired for 2024 and 2025 (US contact Peter Elmer, Ukrainian contact Olga Gogota).

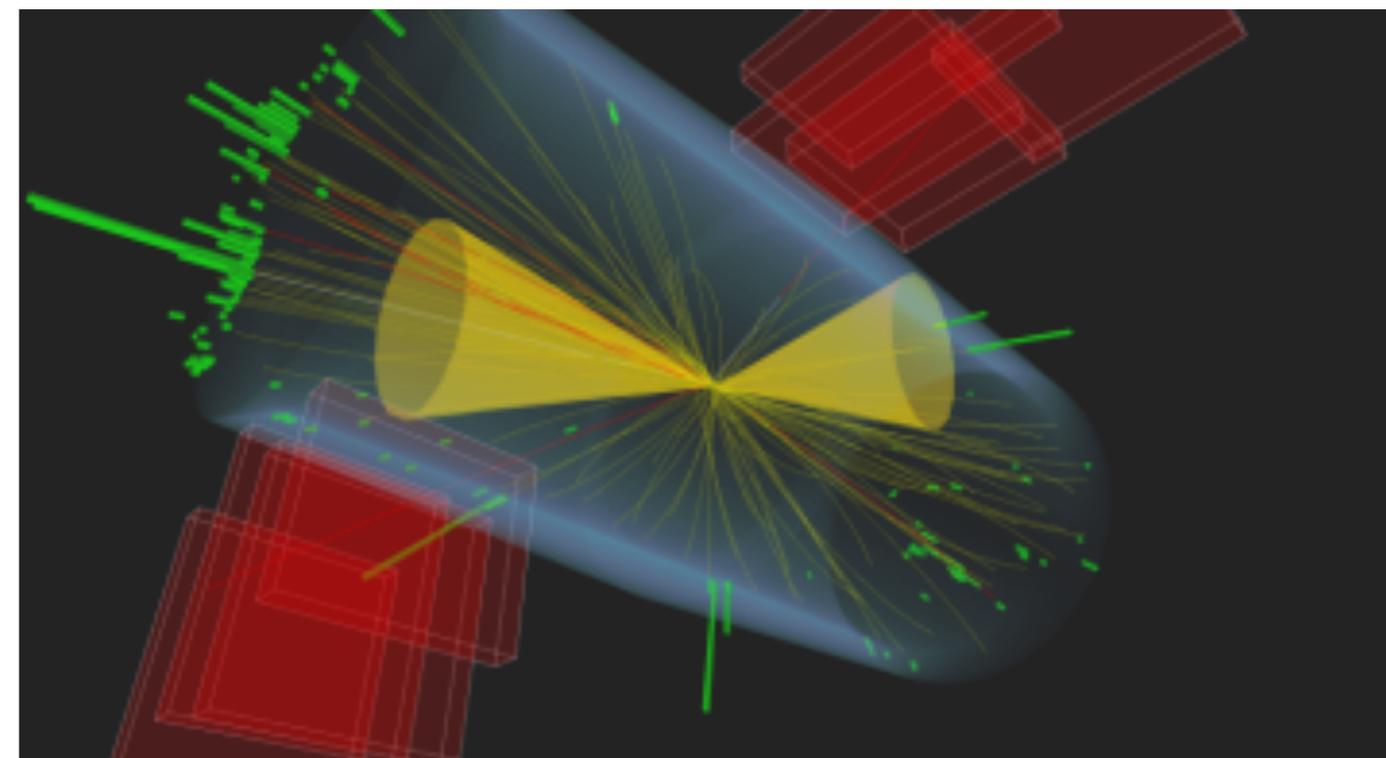
Examples include [deep learning for QCD background estimation in CMS](#), [long lived particle searches](#) and [GNN-based algorithms for the LHCb trigger](#), [data reduction for the ProtoDUNE detector control system](#) and many projects related to the [HL-LHC Analysis Grand Challenge](#).

26 students have been involved in 2022 and 2023 from Taras Shevchenko National University, Kyiv Academic University and others. See the individual Fellow links from <https://iris-hep.org/fellows.html> for information about specific projects (original proposals, presentations, videos). 15 additional Ukrainian students will be starting 12 week projects this summer in June and July, 2024 and will appear soon on that page.

Summary

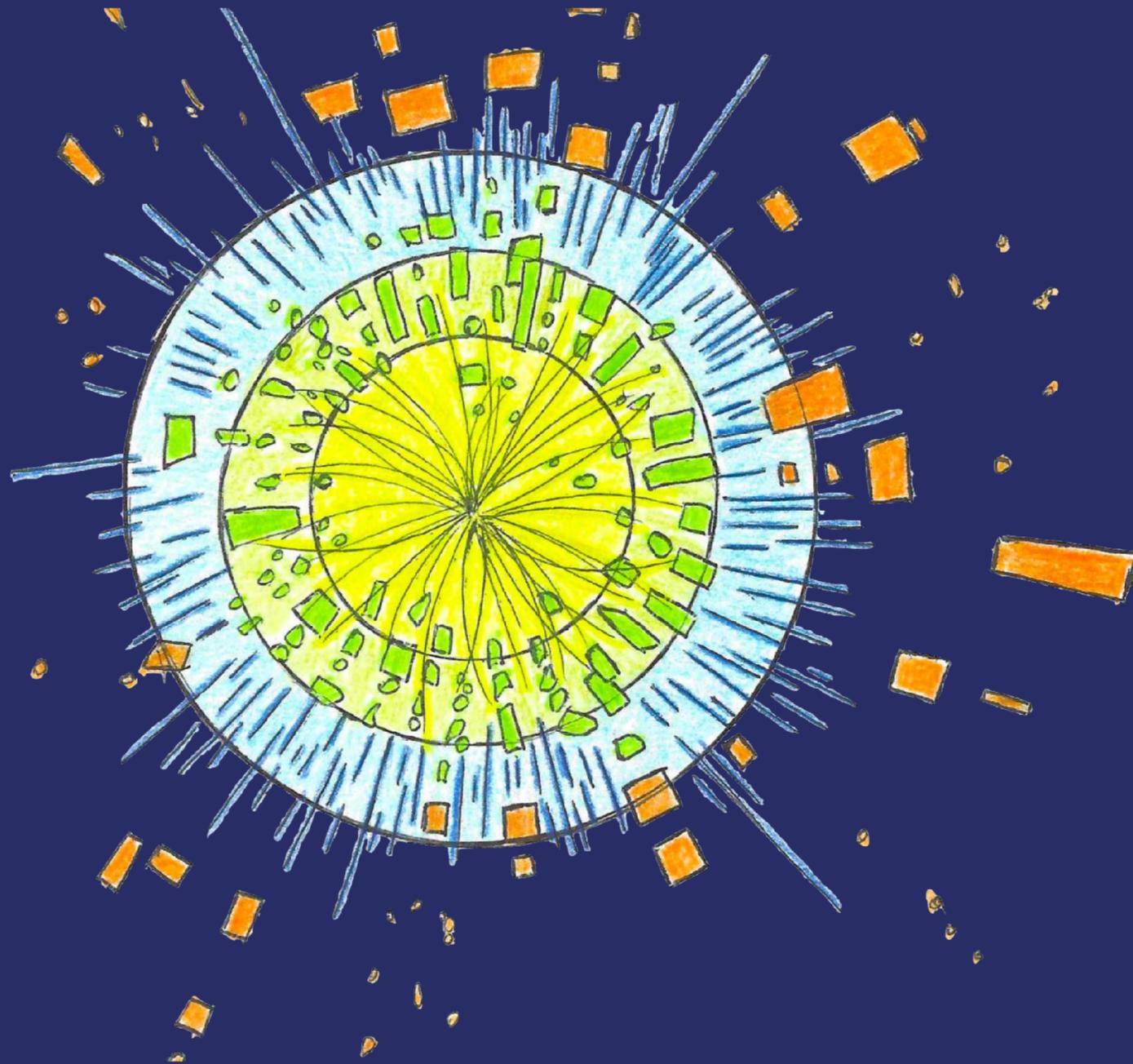


- **The 2024 pp run is going well.**
 - CMS has developed a robust trigger plan for the 2024 running conditions.
- **CMS continues to release many interesting physics results**
 - Many more to come in 2024 from both Run 2 and Run 3
- **The CMS upgrades for the HL-LHC are making good progress.**
 - Focus is on optimizing resources and moving into pre-production and production.
- **We look forward to continuing a very fruitful collaboration with our colleagues in Ukraine.**



Thank
you!

The CMS Experiment at CERN



More than 6000 scientists, engineers, and technicians from over 255 institutes and 57 countries.

Uncovering the deepest secrets of Nature

*Designs created by
Marta Tornago*

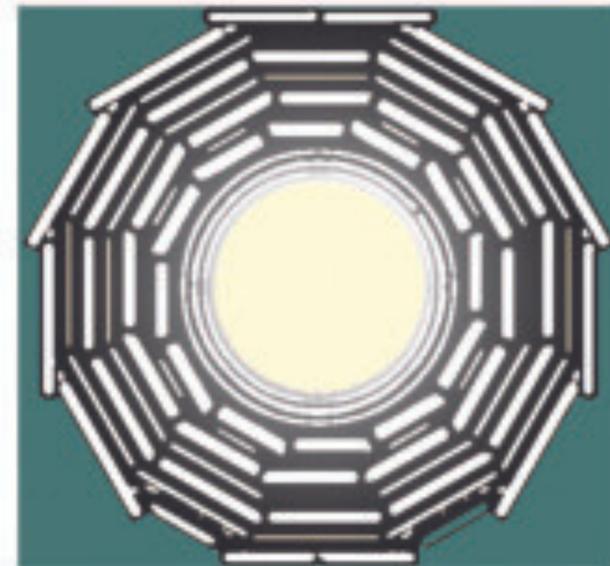
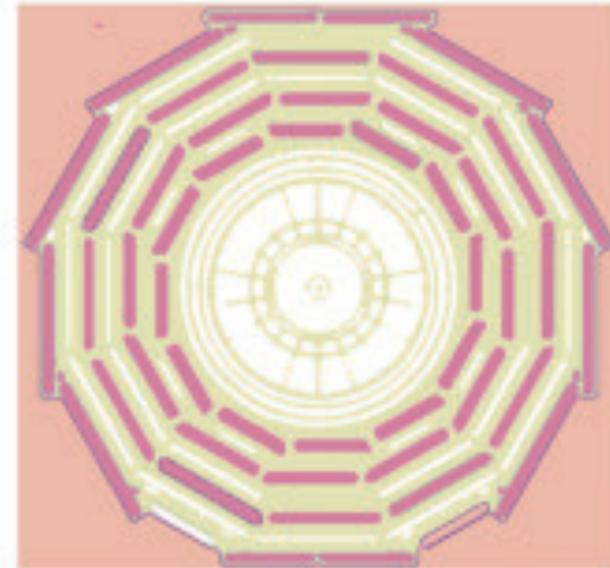
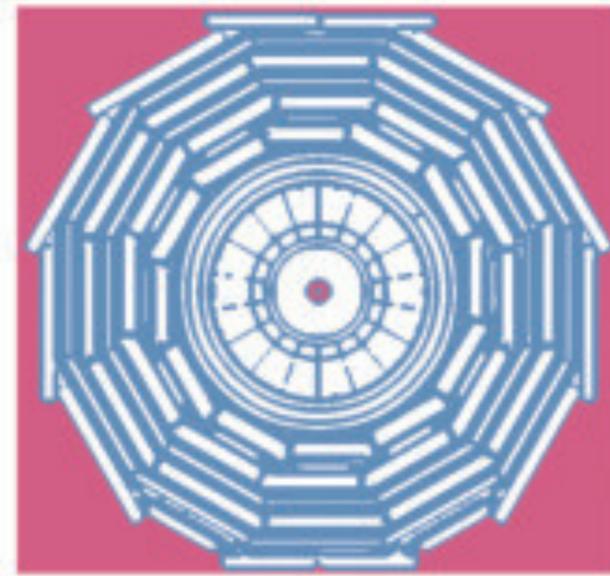


cms.cern



home.cern

Extra slides



CMS Review papers



Submitted to Physics Reports

Dark sector searches with the CMS experiment	EXO-23-005	CMS-EXO-23-005	Read the Physics Briefing here!
Review of searches for vector-like quarks, vector-like leptons, and heavy neutral leptons in proton-proton collisions at $s = 13$ TeV at the CMS experiment	EXO-23-006	CMS-EXO-23-006	
Enriching the physics program of the CMS experiment via data scouting and data parking	EXO-23-007	CMS-EXO-23-007	Read the Physics Briefing here!
Stairway to discovery: a report on the CMS program of cross section measurements from millibarns to femtobarns	SMP-23-004	CMS-SMP-23-004	
Searches for Higgs boson production through decays of heavy resonances	B2G-23-002	CMS-B2G-23-002	
Overview of high-density QCD studies with the CMS experiment at the LHC	HIN-23-011	CMS-HIN-23-011	
Review of top quark mass measurements in CMS	TOP-23-003	CMS-TOP-23-003	Read the Physics Briefing here!

Just published: CMS Detector paper “Development of the CMS detector for the CERN LHC Run 3” [JINST 19 P05064](#)

Recent CMS Results



WW cross section measurement at 13.6 TeV - Run3	SMP-24-001	CMS-PAS-SMP-24-001	Read the Physics briefing here!
Measurement of the differential $Z/\gamma \rightarrow \ell\ell$ forward-backward asymmetry and effective leptonic weak mixing angle	SMP-22-010	CMS-PAS-SMP-22-010	Read the Physics Briefing here!
Measurement of the $Z(\nu\nu) + \gamma$ production cross section and a search for anomalous neutral triple gauge couplings	SMP-22-009	CMS-PAS-SMP-22-009	
Observation of $\gamma\gamma \rightarrow \tau\tau$ in pp and limits on the anomalous electromagnetic moments of the τ lepton	SMP-23-005	CMS-PAS-SMP-23-005	Read the Physics Briefing here!
Search for the SM Higgs boson produced in association with bottom quarks in final states with leptons	HIG-23-003	CMS-PAS-HIG-23-003	Read the Physics Briefing here!
Search for the nonresonant and resonant production of a Higgs boson in association with an additional scalar boson in the $\gamma\gamma\tau\tau$ final state	HIG-22-012	CMS-PAS-HIG-22-012	
Model-independent search for pair production of new bosons decaying into muons	HIG-21-004	CMS-PAS-HIG-21-004	
Precision measurement of CP violation in $B_0^s \rightarrow J/\psi \phi(1020) \rightarrow \mu^+\mu^- K^+K^-$ decays	BPH-23-004	CMS-PAS-BPH-23-004	
Observation of the $\Xi_b^- \rightarrow \psi(2S)\Xi^-$ decay and studies of Ξ^*0_b baryon	BPH-23-002	BPH-23-002	
Observation of the $J/\psi \rightarrow \mu^+\mu^-\mu^+\mu^-$ decay in pp collisions at $\sqrt{s} = 13$ TeV	BPH-22-006	BPH-22-006	Read the Physics Briefing here!
Search for CP violation in $D_0 \rightarrow K_0^S K_0^S$ decays using pp collisions at 13 TeV	BPH-23-005	CMS-PAS-BPH-23-005	
Measurement of the B_0 effective lifetime in the decay $B_0^s \rightarrow J/\psi K_0^S$	BPH-22-001	CMS-PAS-BPH-22-001	



Search for baryon number violation using top quark events	TOP-22-003	<u>TOP-22-003</u>	Read the Physics Briefing here!
Simultaneous differential measurement of ttZ and tZq	TOP-23-004	<u>CMS-PAS-TOP-23-004</u>	Read the Physics Briefing here!
Probing entanglement in top quark production	TOP-23-001	<u>CMS-PAS-TOP-23-001</u>	Read the Physics Briefing here!
Measurement of the tW cross section at 13.6 TeV using 2022 data - Run3	TOP-23-008	<u>CMS-PAS-TOP-23-008</u>	Read the Physics Briefing here!
Observation of double-J/Psi meson production in pPb collisions at 8.16 TeV	HIN-23-013	<u>CMS-PAS-HIN-23-013</u>	
Search for dark matter produced in association with a pair of bottom quarks	SUS-23-008	<u>CMS-PAS-SUS-23-008</u>	
Search for RPV SUSY in trilepton + jets final states	SUS-23-015	<u>CMS-PAS-SUS-23-015</u>	
Search for heavy neutral Higgs bosons A and H in the ttZ final state	B2G-23-006	<u>CMS-PAS-B2G-23-006</u>	Read the Physics Briefing here!
Search for a heavy resonance decaying into ZH for final states with two electrons, two muons, or missing transverse momentum and an energetic jet	B2G-23-008	<u>CMS-PAS-B2G-23-008</u>	Read the Physics Briefing here!
Search for soft unclustered energy patterns	EXO-23-002	<u>EXO-23-002</u>	
Search for new resonances decaying to pairs of highly merged photons	EXO-22-022	<u>CMS-PAS-EXO-22-022</u>	
Search for Emerging Jets with full Run 2 data	EXO-22-015	<u>EXO-22-015</u>	
Search for HNL events with a lepton and a jet from a displaced vertex	EXO-22-011	<u>EXO-22-011</u>	
Search for long-lived Heavy Neutral Leptons in B-initiated decays using the CMS-B Parking dataset	EXO-22-019	<u>EXO-22-019</u>	
Search for new physics in high-mass diphoton events	EXO-22-024	<u>CMS-PAS-EXO-22-024</u>	
Search for HNL events with a lepton and a jet from a displaced vertex	EXO-21-011	<u>CMS-PAS-EXO-21-011</u>	
Searching for new physics detecting anomalies in jets	EXO-22-026	<u>CMS-PAS-EXO-22-026</u>	Read the Physics Briefing here!
Search for heavy long-lived charged particles with large ionization energy loss	EXO-18-002	<u>CMS-PAS-EXO-18-002</u>	
Search for long-lived particles decaying into displaced jets - Run 3	EXO-23-013	<u>CMS-PAS-EXO-23-013</u>	
Search for a resonance decaying to a W boson and a photon using leptonic W boson decays	EXO-21-017	<u>CMS-PAS-EXO-21-017</u>	

Moriond QCD

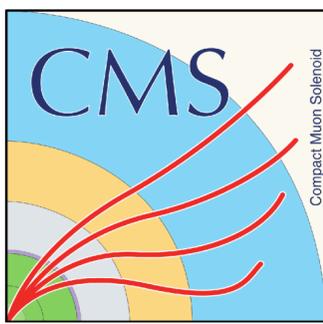


Search for dark matter produced in association with a single top quark or a top quark pair	EXO-22-014	CMS-PAS-EXO-22-014	
Energy scaling behavior of intrinsic transverse momentum in Drell-Yan events	GEN-22-001	CMS-PAS-GEN-22-001	
Search for H->gamma+rho/phi	HIG-23-005	CMS-PAS-HIG-23-005	
Inclusive tt cross section in final dates with one lepton at additional jets at 5.02 TeV with 2017 data	TOP-23-005	CMS-PAS-TOP-23-005	
Measurements of the light-by-light scattering and the Breit–Wheeler processes, and searches for axion-like particles in ultraperipheral PbPb collisions at $\sqrt{s_{NN}} = 5.02$ TeV	HIN-21-015	CMS-PAS-HIN-21-015	

Performance, etc.

The CMS statistical analysis and combination tool: Combine	CAT-23-001	CAT-23-01	Read the briefing here!
Luminosity measurement for the 2022 pp data-taking period - Run 3	LUM-22-001	CMS-PAS-LUM-22-001	

CMS in the news



58th Rencontres de Moriond 2024

24/03 to 31/03 :
Electroweak Interactions & Unified Theories
Very High Energy Phenomena in the Universe

31/03 - 07/04 :
Cosmology
QCD and High Energy Interactions

Attention!
Sunday to Sunday

For all CMS briefings see:
cms.cern/cms-updates

CERN COURIER | Reporting on international high-energy physics

Physics Technology Community In focus Magazine

HIGGS AND ELECTROWEAK | NEWS
CMS closes in on tau $g-2$
The CMS collaboration has reported the first observation of $\gamma\gamma \rightarrow \tau\tau$ in pp collisions, setting a new benchmark for the tau lepton's magnetic moment.

[CERN Courier News](#)
[CERN News](#)
[CMS Briefing](#)
[CMS-PAS-SMP-23-005](#)

CMS Open Data Release

CMS releases 13 TeV proton collision data from 2016

The CMS experiment at CERN is proud to announce the first release of 13 TeV proton-proton collision data collected in 2016. Over 70 TB of 13 TeV collision data and corresponding simulations are now accessible to the global scientific community and enthusiasts alike through the CERN Open Data Portal.

Probing matter-antimatter asymmetry with AI

Using a cutting-edge AI algorithm, the CMS collaboration has obtained the first evidence of CP violation in the decay of the strange beauty meson into a pair of muons and a pair of electrically charged kaons

30 APRIL, 2024 | By CMS collaboration

The open CMS detector during the second long shutdown of CERN's accelerator complex. (Image: CERN)

When we look at ourselves in a mirror, we see a virtual twin, identical in every detail except with left and right inverted. In particle physics, a transformation in which charge-parity (CP) symmetry is respected swaps a particle with the mirror image of its **antimatter** particle, which has opposite properties such as electric charge.

[CERN News](#)
[CMS Briefing](#)
[CMS-PAS-BPH-23-004](#)

CMS releases Higgs boson discovery data to the public

The collaboration has also made publicly available the software that it developed to search for the unique particle

16 APRIL, 2024 | By CMS collaboration

[CERN News](#)
[CMS Briefing](#)
[CMS-CAT-23-001](#)

The CMS experiment at CERN measures a key parameter of the Standard Model

With this measurement the LHC is again demonstrating its ability to provide very high-precision measurements and bringing new insights into an old mystery

3 APRIL, 2024

The CMS experiment (image: CERN)

Last week, at the annual [Rencontres de Moriond](#) conference, the CMS collaboration presented a measurement of the effective leptonic electroweak mixing angle. The result is the most precise measurement performed at a hadron collider to date and is in good agreement with the prediction from the Standard Model.

[CERN Press release](#)
[CMS Briefing](#)
[CMS-PAS-SMP-22-010](#)

30 Years of CMS Project



Video interviews exploring the roots of the CMS collaboration