CMS Status and Run 3

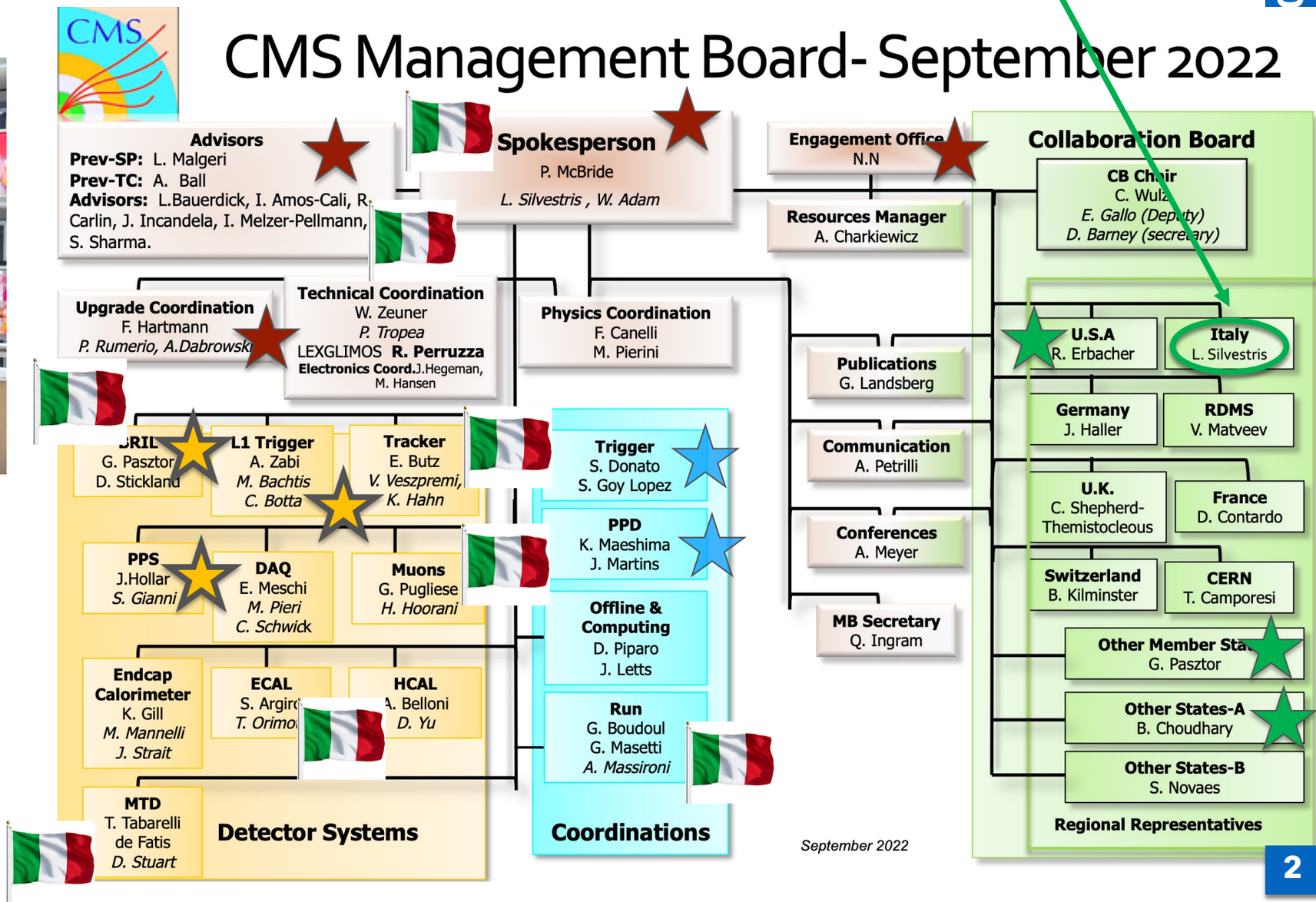
Lucia Silvestris
INFN-Bari, on behalf of CMS Italia
lucia.silvestris@cern.ch

CSN1 Sep 2022

New Management Board

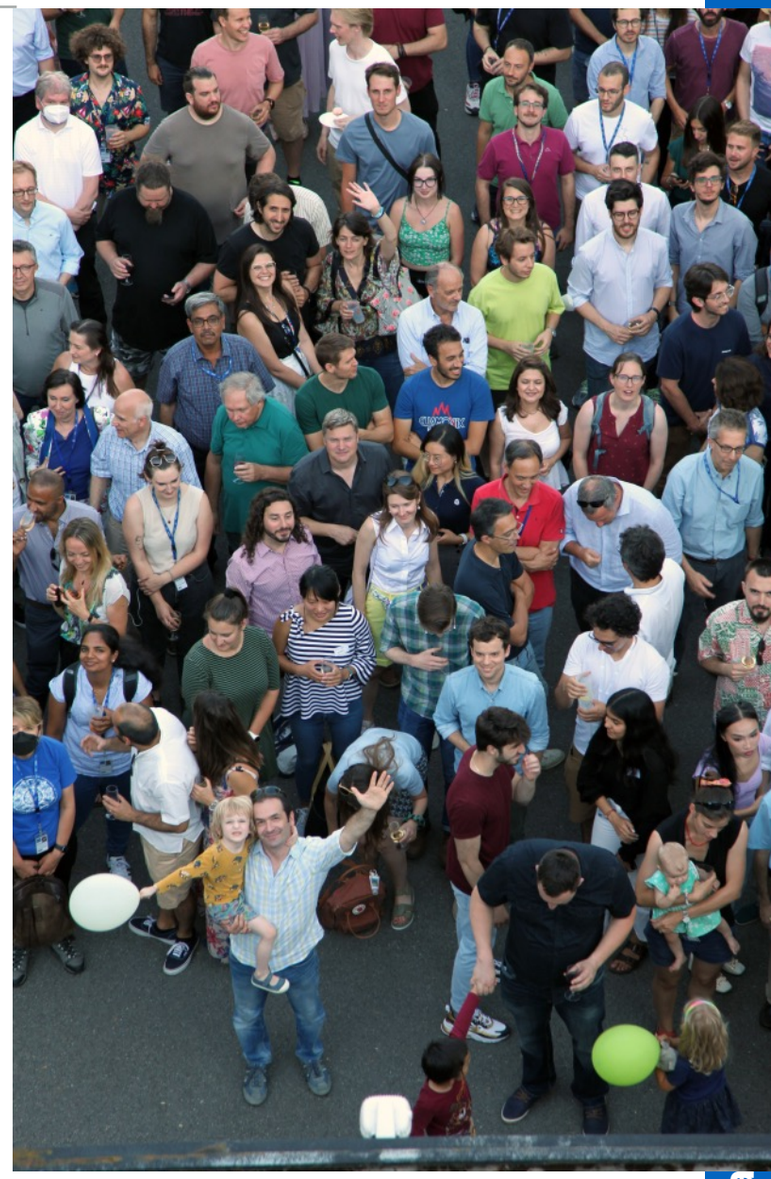
- Spokesperson Team transition on September 1 along with one new coordinator in Physics, Trigger,and PPD.
- Overall an experienced team
- New advisors and several new regional representatives.

New italian representative will be elected end of September



Events: CMS and CMS Italia

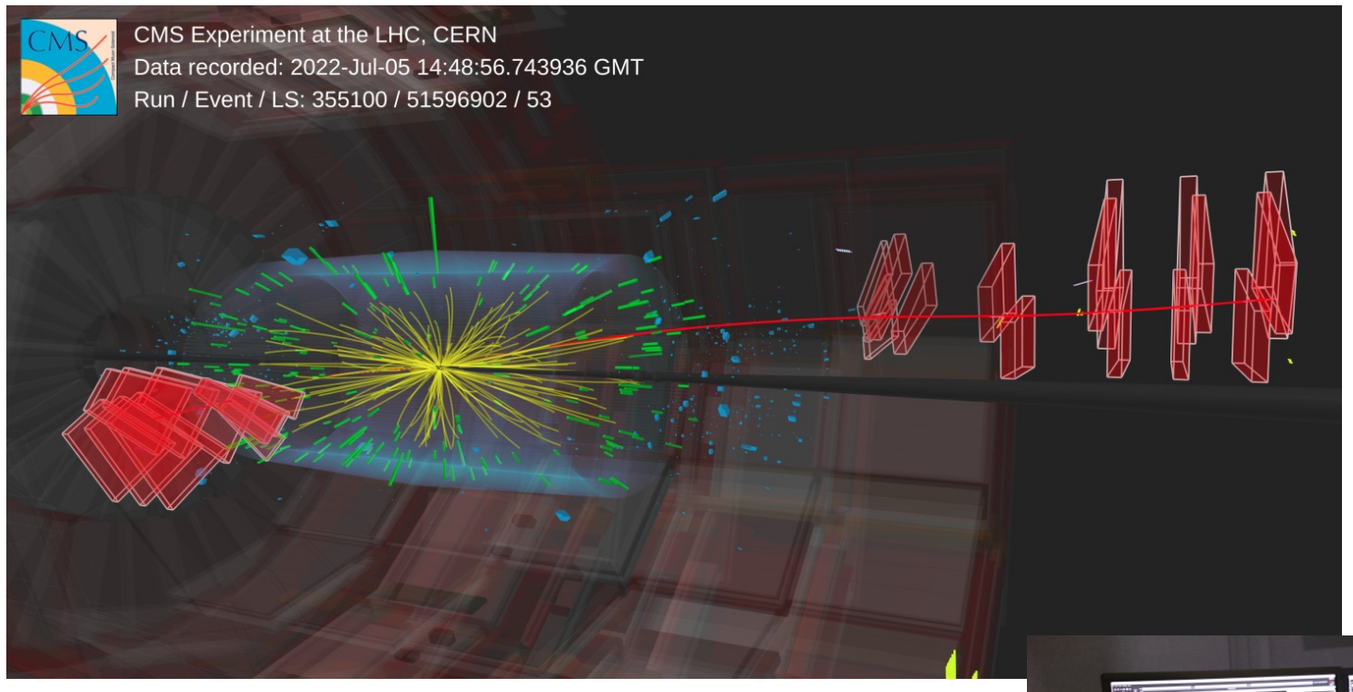
- CMS Week (Sept 19-23) will follow the hybrid format
- New events:
  - "Physics Days" - encourage broad discussion of physics
    - First event will be this week: focus on intriguing results from Run 2.
    - Expect to hold more topical Physics Days throughout the year. Engage more students and senior scientists in these discussions
  - "Upgrade Days" - first planned for early 2023.
- Will celebrate 30 years of CMS during December CMS Week.
- First CMS Week away from CERN after COVID is planned for Spring 2023.

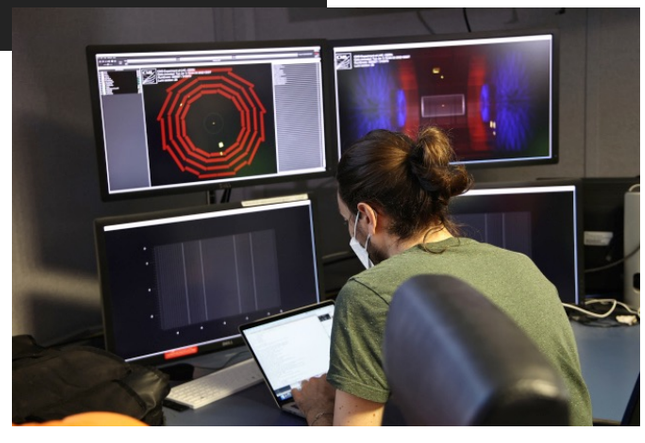


- Several CMS Italia physics workshops held this year.
- CMS Italia (Sep 26-28) in Florence.
- CMS Italia public event on Sep 26th 10 years Higgs boson discovery.

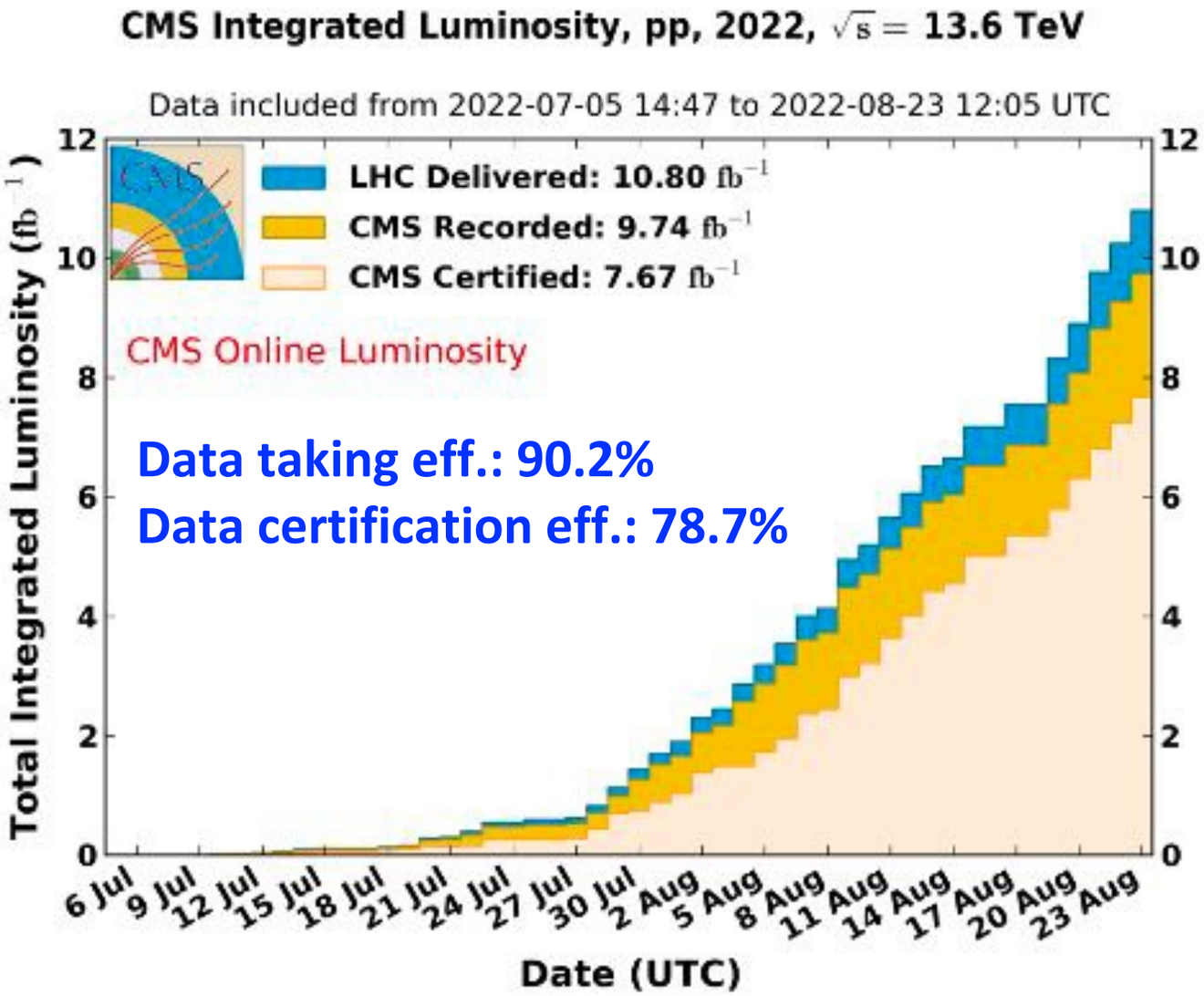
Official Launch of Run 3

- On the 5th of July 2022, the LHC delivered stable proton-proton collisions at the energy of 13.6 TeV for the first time. The CMS experiment, recorded these first collisions with all its systems on and working well.

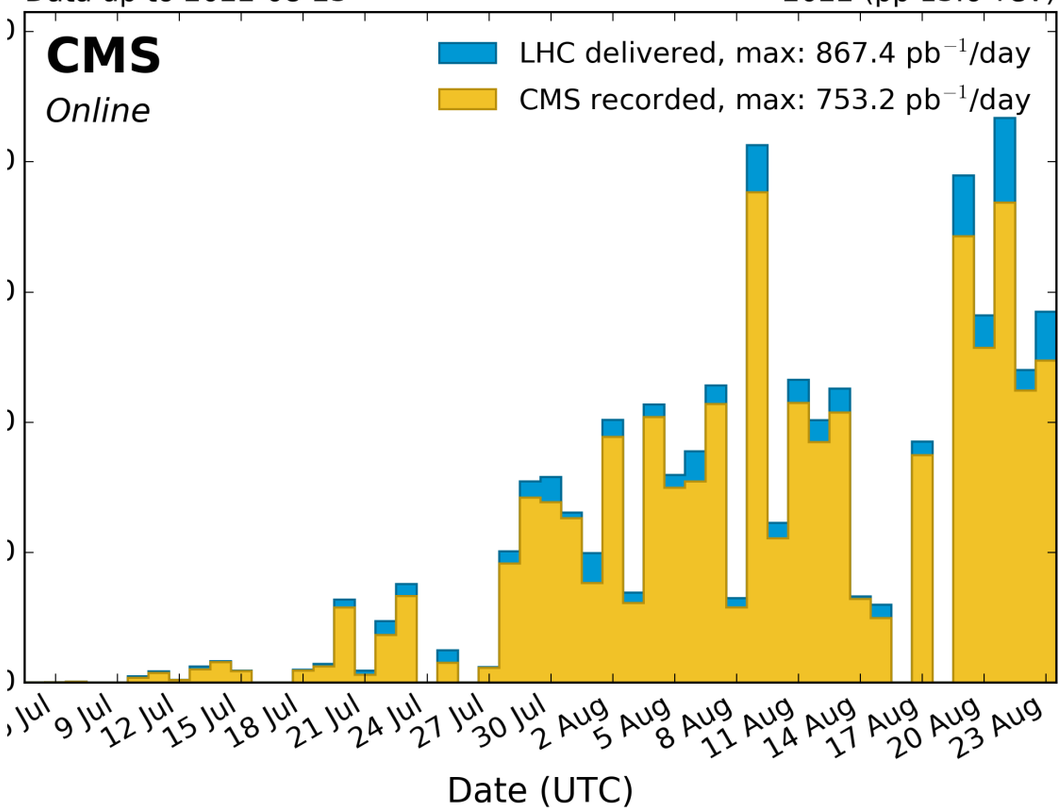




CMS Run 3 Integrated Luminosity



Peak day-by-day integrated luminosity



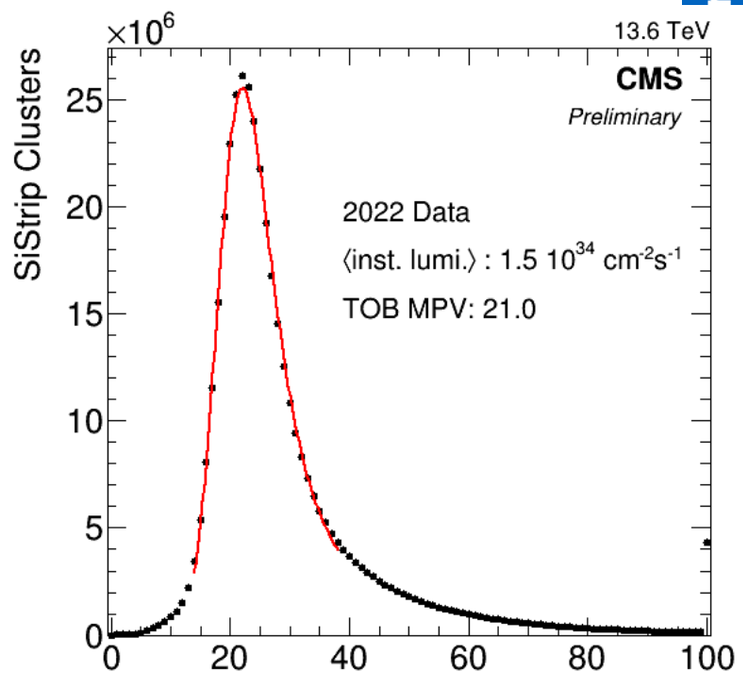
- Less luminosity than expected, but enough to work on first analyses
  - Mostly cross-section measurements at new energy
- Efficient data taking for a first-year run: compared to 2015 (first year of Run 2)
  - Similar detector efficiency
  - Higher fraction of certified good data

CMS Run 3 Status

- In 2022, LHC has delivered 10.8 fb-1 and CMS has collected 9.74 fb-1 up to now.
  - The run was paused on August 23 due to an incident in the LHC which required a warm-up to repair.
- Four weeks needed to complete the repair, reducing planned p-p running by about 2 weeks since a technical stop was already planned for this period.
- Startup is likely to be between Sept 19-25. Discussions of the fall run plan are ongoing.
- CMS was running well at the time of the incident with some minor issues.

Tracker Status

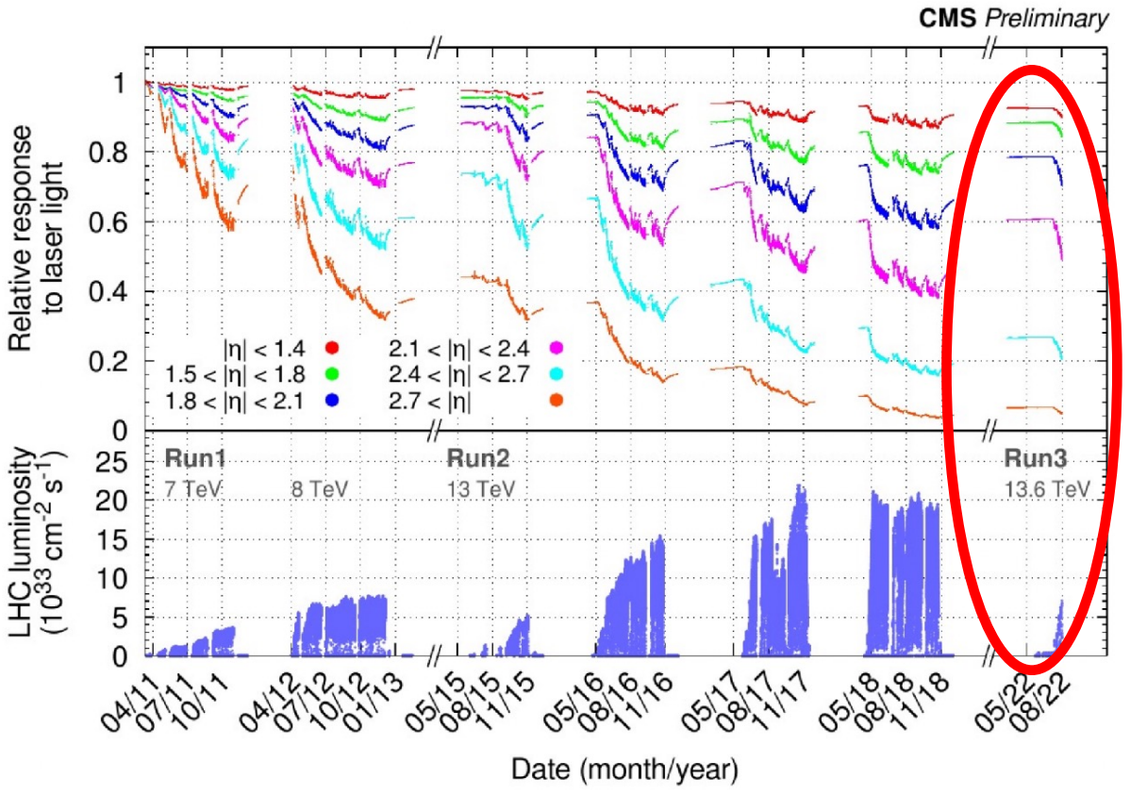
- Both pixel and strip tracking detectors successfully took data during July 5th collision event
  - First special runs to refine time alignment and other parameters
- New BPIX layer 1 has been taking data successfully
  - New readout chips working well
  - New features to enable proper time-alignment relative to layer 2 (not possible in Run 2) working well
  - Status is being monitored closely
- Number of active channels very similar to 2021 beam test and 900 GeV collisions in 2022
- Detector alignment is being continuously refined and offline processing conditions are being updated to follow evolution of sensor properties with irradiation
- Beam position after LSS5 re-alignment spot on with expectations in y coordinate → very well centered with respect to y position of barrel pixel
  - Likely will ask for slight re-adjustment of x-position during upcoming YETS.



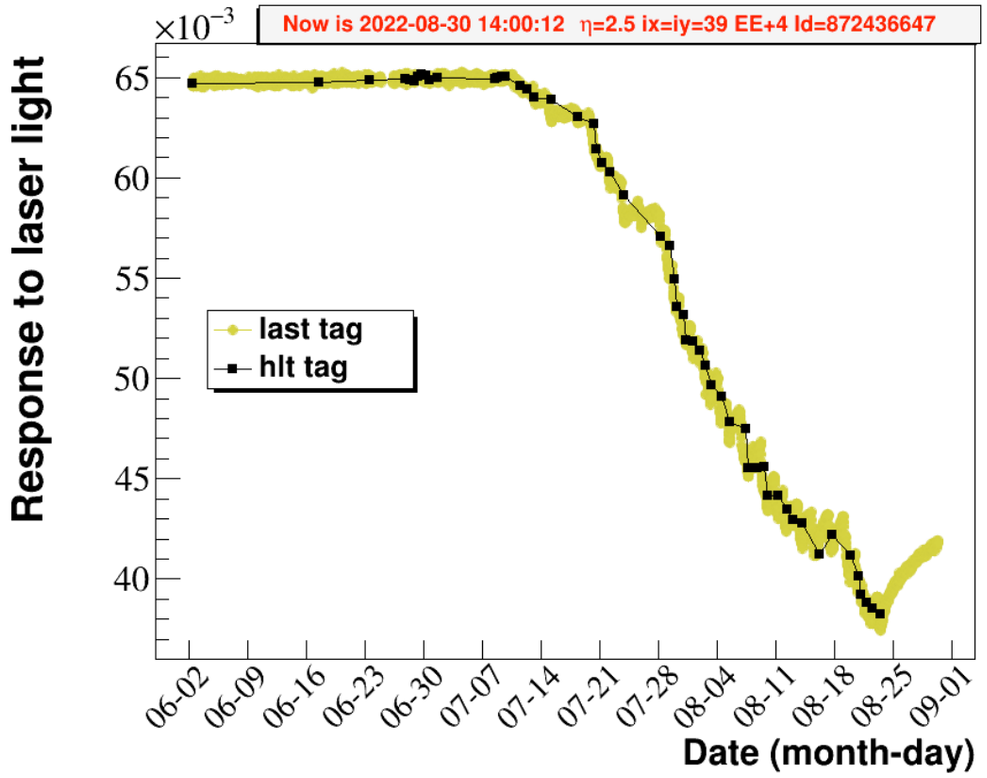
ECAL Status

ECAL was commissioned for Run3, with updates to pedestals, pulse shapes, calibrations, timing, etc.

The automatization of the calibration workflows is being commissioned. The new laser workflow, which allows updates to HLT conditions once per fill, has been successfully deployed.



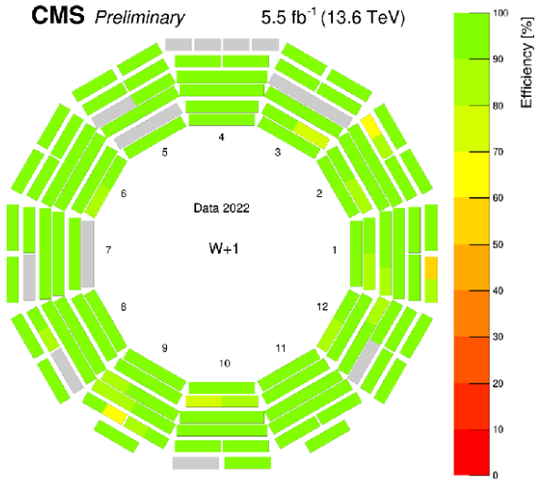
The updated laser transparency plot, that, in the right-hand side, shows the transparency at turn-on in April and the effect of collisions in Run 3

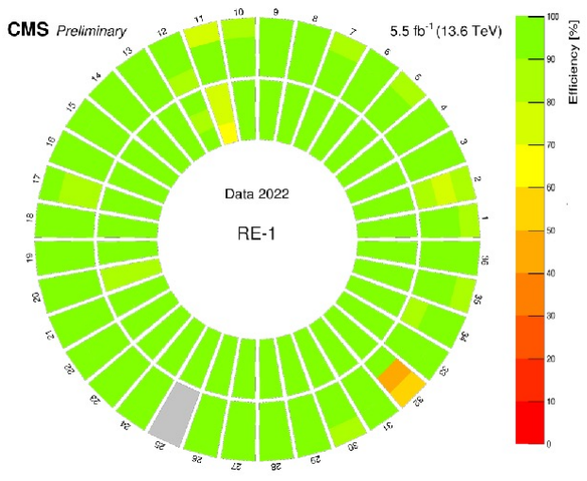


The 2022 history of one channel in EE, showing that the per-fill update of the HLT tag (which is not performed in no-collision periods) follows closely the system response.

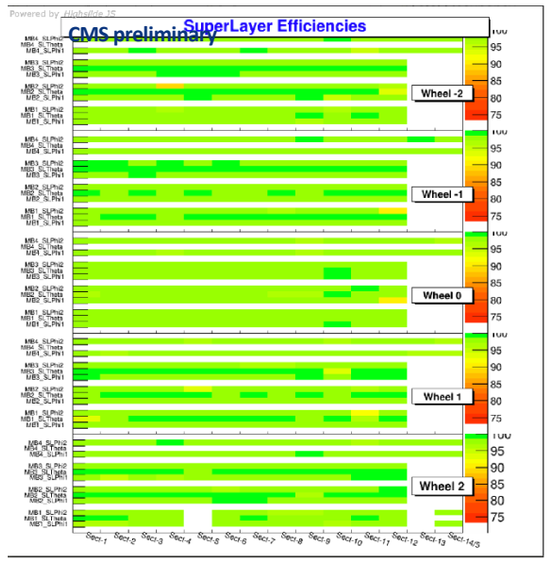
Muon Status

Muon system smoothly participating in RUN3 proton-proton collision runs. Online and offline analyses are showing detector performance in agreement with RUN2 results.



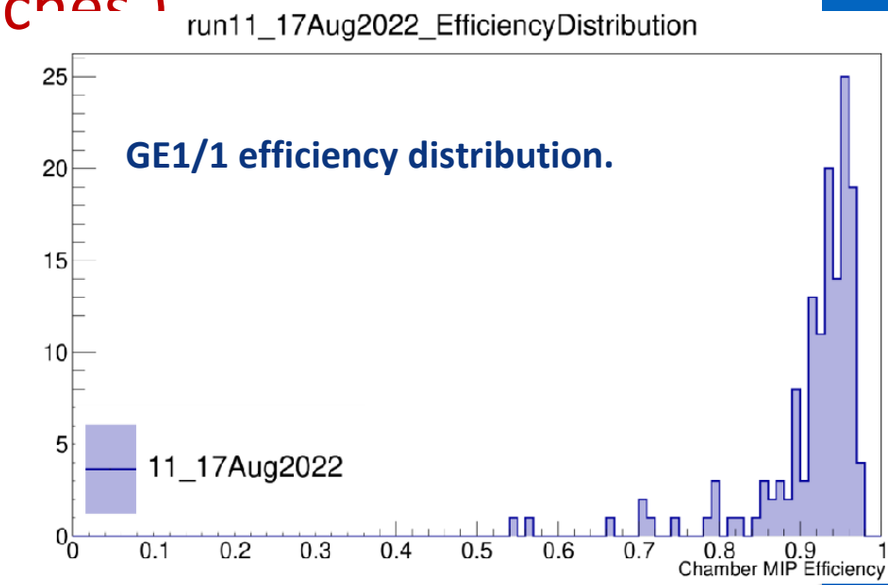


Barrel and Endcap RPC Efficiency



DT Super Layer Efficiency

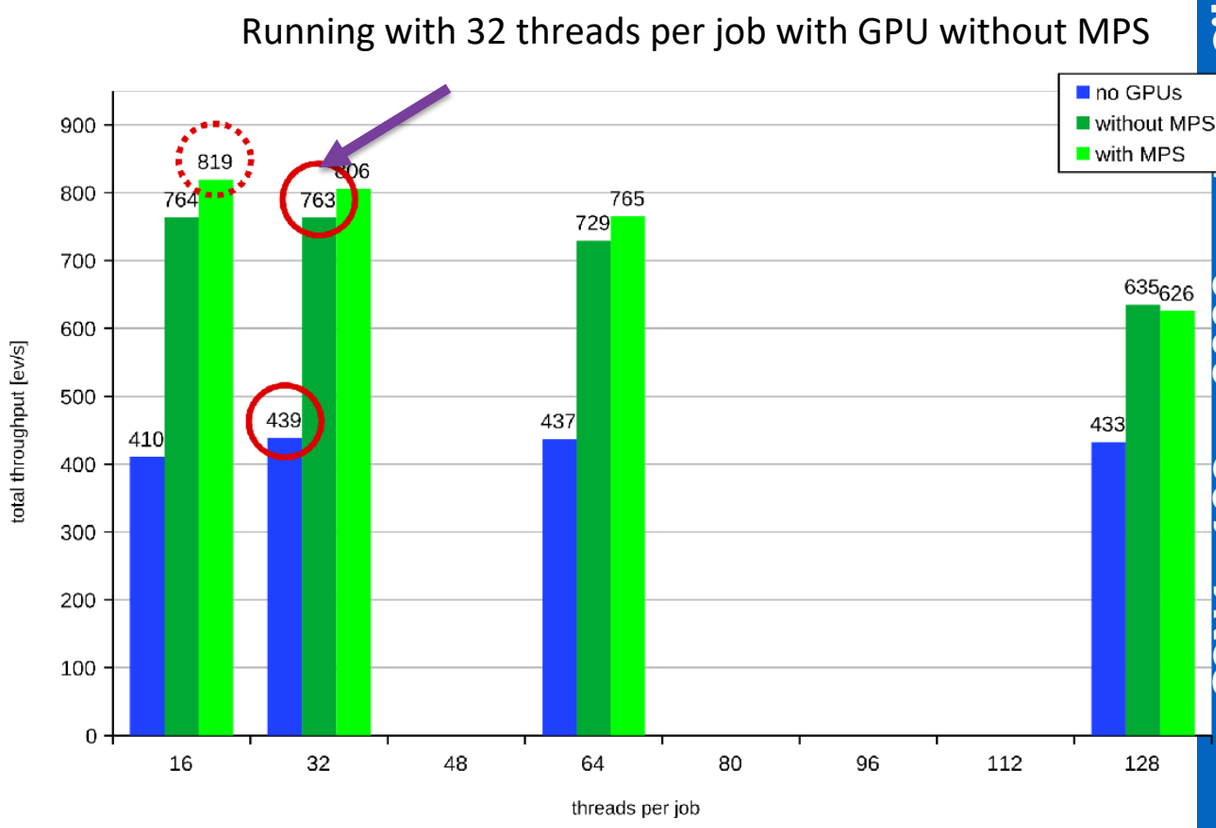
GE1/1: High number of trips in several GEM chambers observed at beginning of July 7th, with the first LHC fills. Mitigation procedure: lower the HV working point and keep the induction gap OFF (cleaning procedure). The spike rate decreased over the time (despite the increase of LHC bunches)



Performance of the DT Phase-2 Slice demonstrator, equipped with both the legacy system and the new phase-2 on-board electronics, has been studied.

DAQ and Trigger

- DAQ3 was commissioned before the start of the run
- No major problems in the L1 trigger
- GPUs are in production and exceeding expectations.
- Intense commissioning period for HLT during initial ramp up
- The HLT now performs pixel, ECAL and HCAL local reco in GPUs
  - Initial GPU errors/crashes were continuously monitored and fixed and now are very rare
  - Differences GPU vs CPU being continuously monitored in DQM



Comparison of Throughput - no GPU, GPU with MPS, GPU without MPS

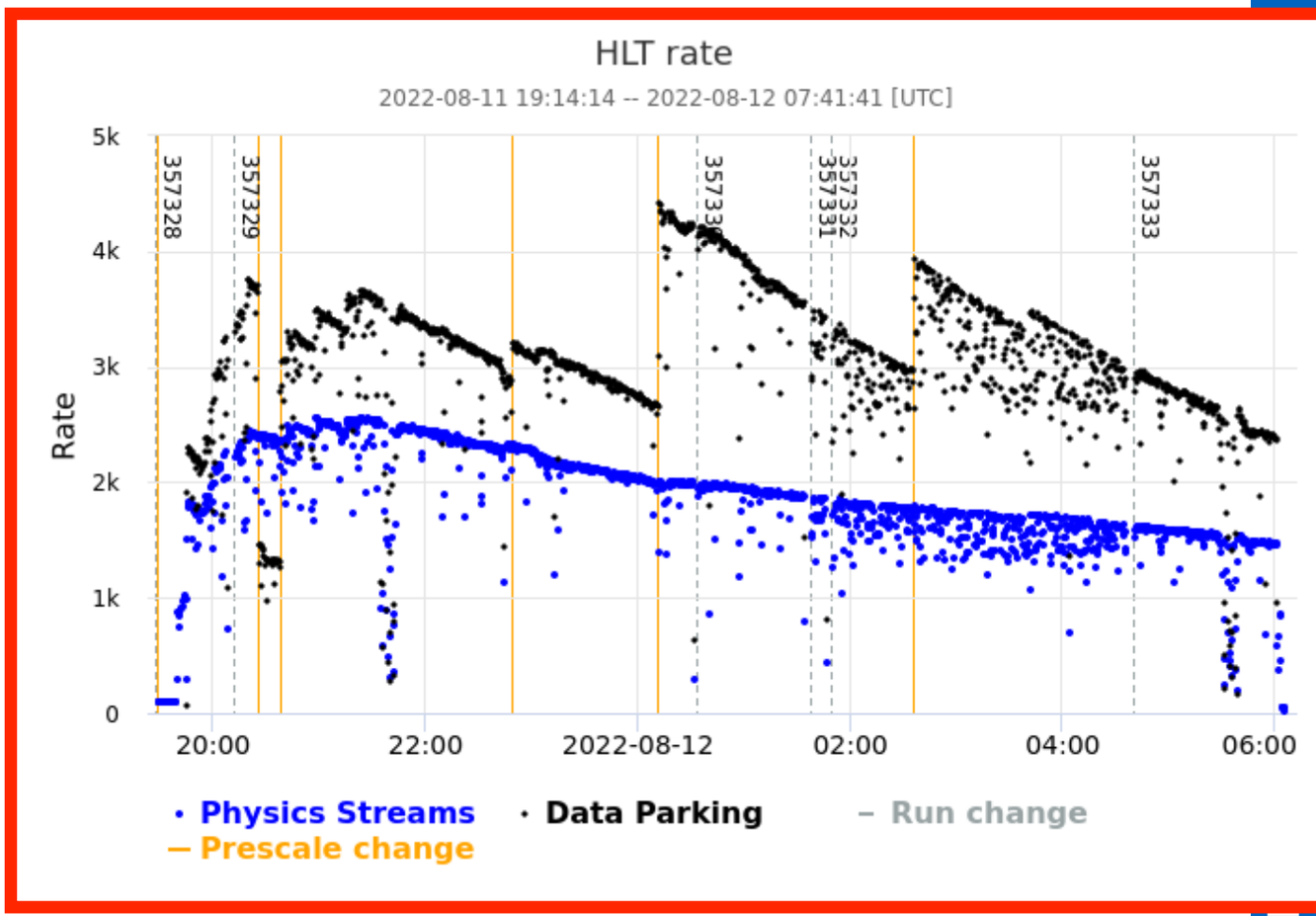
GPUs bringing ~40% offload, higher than the anticipated 25%

MPS (Multi-Process Service) improves the situation by allowing multiple process to (instantaneously) share GPU compute resources (SMs)

Processing Run-3 Data

- Both “Prompt” and “Parking” streams successfully promptly processed at the Tier-0!
  - Run 4-like rates already achieved (> 5kHz)
- Introduced new compression algorithm for RAW data:
  - LZMA replaced GZIP thanks to ROOT
  - 10% smaller RAW event size

Successful prompt processing @ > 5 kHz, 10% smaller RAW events



- Smooth transfers to tapes at the Tier-0 and Tier-1 sites:
- Network and tape infrastructure are healthy
- Tune the new data management system (RUCIO) for data taking.

LHC Schedule

- On account of the incident on August 23, will remain down until at least September 19.
- There remains an unknown impact on the schedule related to the electrical power - see article in the WSJ.
- The 2022 might end early (no official decision at this time) but could still maintain a HI (Pb-Pb) run (still under discussion). Decisions and details in the coming days/week(s)

SWI swissinfo.ch

Swiss perspectives in 10 languages

Science

CERN drafts plans to idle accelerators due to Europe's energy crunch

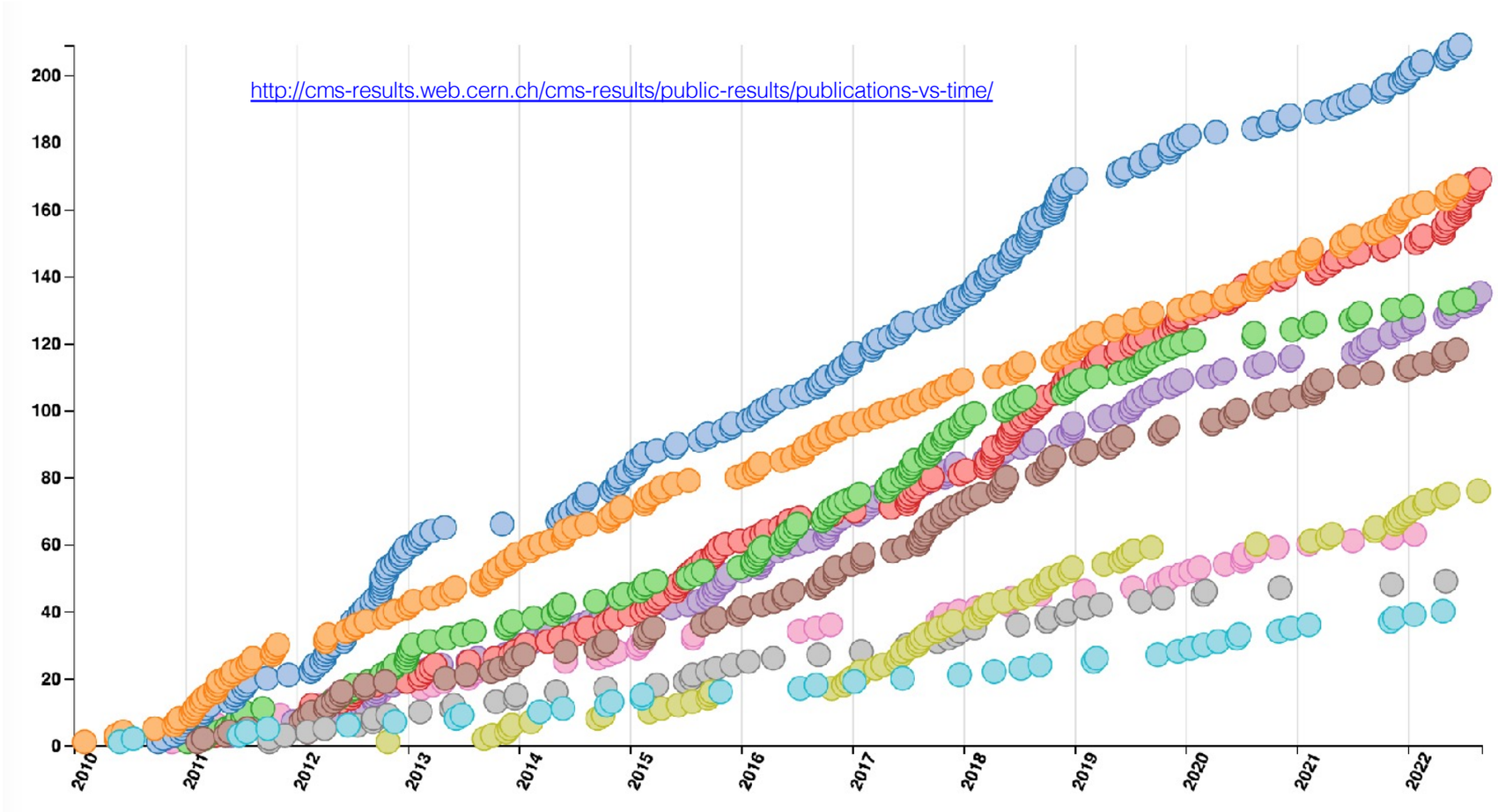
A view inside the CMS (Compact Muon Solenoid) detector, one of the physics experiments at CERN's Large Hadron Collider, located near Geneva. (© Keystone / Christian Beutler)

Europe's energy crisis is threatening to slow fundamental particle physics experiments at the European Organization for Nuclear Research (CERN), located near Geneva, according to the Wall Street Journal (WSJ).

September 5, 2022 - 09:47

CMS Physics and Publications

- 1159 papers on collision data submitted
  - Nature paper on the Higgs boson published “A portrait of the Higgs boson by the CMS experiment ten years after the discovery”
- Many ongoing Run 2 analysis and many interesting results are coming out.
- Planning for early Run 3 analyses is ongoing
  - first preliminary Run 3 result was presented at TOP2022



Authorship status

On July 28 and September 7 there were special CMS CB meetings to discuss authorship. CMS papers remain in a “suspended” state. There have been no publications since Feb 24th, the date of the military invasion of Ukraine by the Russian Federation), apart from an article in Nature published as “CMS Collaboration”.

Currently 13 papers have been accepted and are still pending at the journals.

Many more (~40) have been submitted as CMS Collaboration pending the author list decision.

During August, the four LHC Spokespersons, in collaboration with the CB Chairs and in consultation with the CERN management, worked out a common document, with two proposals, and a procedure to reach a decision.

The joint document represents the output of a long process where different views are reflected with the ultimate aim to find a **common approach among all LHC collaborations**.

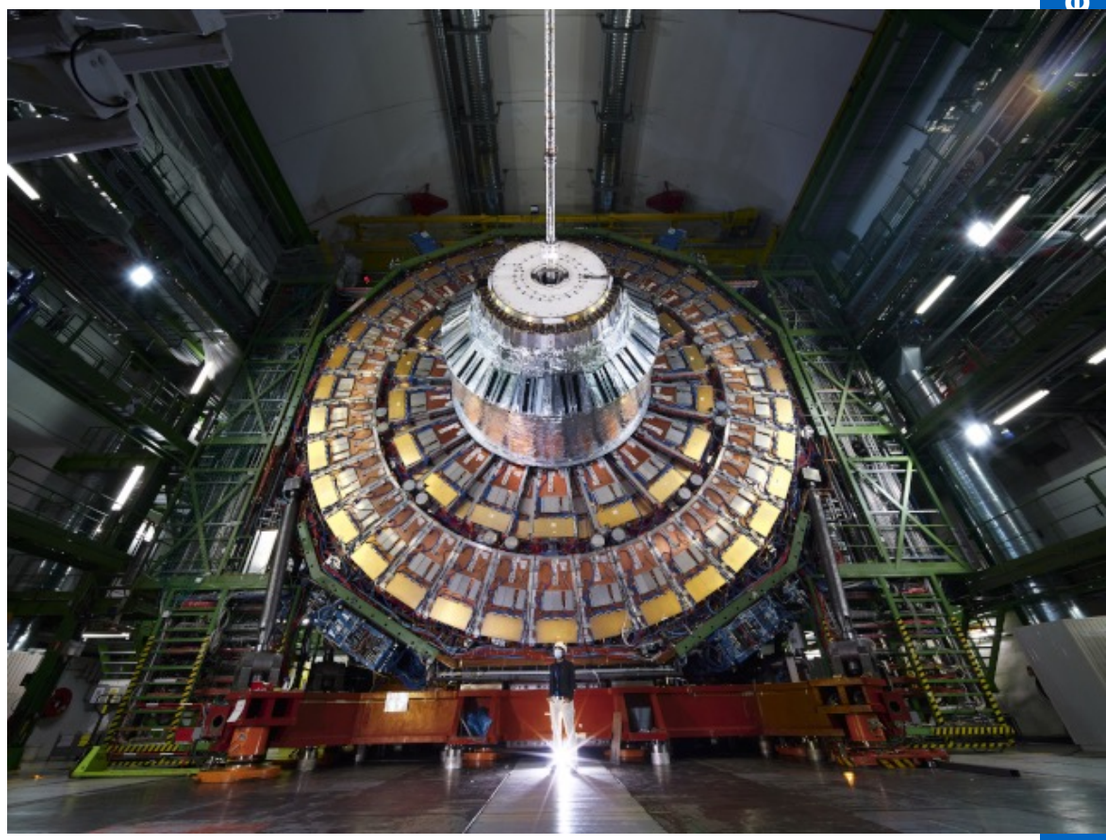
CMS strives to find a compromise that enables the entire collaboration to continue in the spirit and tradition of CMS and CERN.

Authorship discussions

- Following the discussions in the special CB meetings, CMS has launched a poll of the collaboration (institute leaders) on three proposals for authorship.
- We recognize that the effect of such decision, either practical or symbolic, will be different institute by institute and country by country.
  - CMS Polling will close on Wednesday
- Following similar polls (opinion votes) in all four collaborations, a single proposal will be formulated by the LHC Spokespersons and CB Chairs, and a formal vote on is planned before the end of September.
- In the unlikely event that none of the proposals would be acceptable to a large fraction of CB members of each collaboration, new attempts to reach a common solution will be undertaken, but this is likely to take more time.

Summary

- CMS was ready for the start of Run 3 and is looking forward a successful Run 3.
- The detectors are in good shape and despite a few unexpected hiccups, the data taking is going well.
- Physics publications are continuing. (See Mia's talk) We are anxious to find a solution the authorship that will keep the collaboration whole.
- The HL-LHC upgrades are moving forward. (See Sandro's talk)



Back-up

Proposal A

Authors affiliated with Russian and Belarussian institutes, and with JINR, sign the Collaboration's scientific publications with their names, and the institute affiliation is replaced, respectively, by the reference:

"Affiliated with an institute of the Russian Federation"
"Affiliated with an institute of the Republic of Belarus"
"Affiliated with JINR"

No acknowledgement to their funding agencies is made. On request, the experiment management will release a certificate attesting the contribution of the aforementioned institutes and funding agencies, or of JINR, to the work presented in the publication.

Proposal B

Authors affiliated with Russian and Belarussian institutes, and with JINR sign the Collaboration's scientific publications with their names and institute affiliation, and their funding agencies are acknowledged. However, the aforementioned institutes and funding agencies have a reference to the following text placed next to the author list:

"As a consequence of the Russian military invasion of Ukraine, CERN Council has taken measures against institutes and funding agencies of the Russian Federation, the Republic of Belarus, and JINR (CERN/3626, CERN/3637, CERN/3638). In line with the principles that apply to scientific publishing and the CERN policy in matters of scientific publications, the -XYZ- Collaboration recognises the work of all those who have contributed to the experiment used to obtain the results described in this paper."

The following will be added to the acknowledgments:
"We recognize the core values of CERN based upon scientific collaboration across borders as a driver for peace, and work together in this spirit. Our collaboration cannot be interpreted as an endorsement of any statement made by any of our institutes, funding agencies or governing bodies." If there is no participation from Belarus or JINR in the collaboration, then the above text and references to CERN Council documents are shortened accordingly.

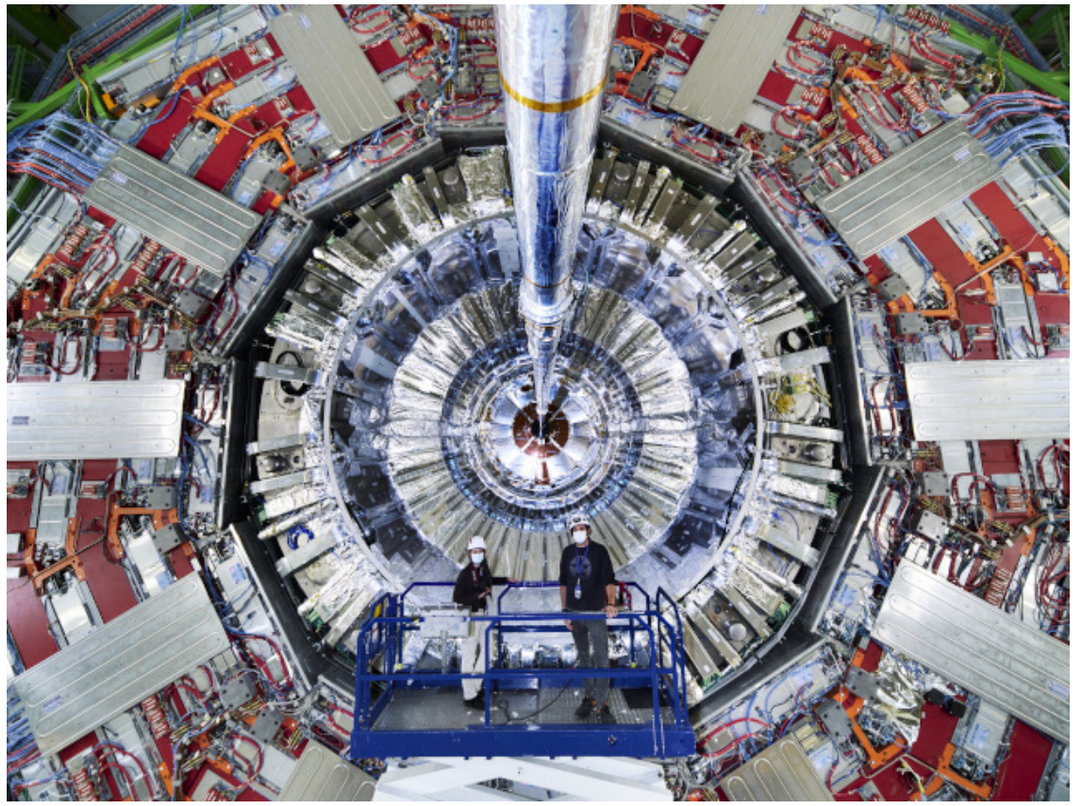
Proposal from Ukrainian colleagues ("Option C")

https://docs.google.com/document/d/1ou9HTOHFhZ3qRXBCBWwvCaDFbQpeH6UO5d3ONBpxvz0/

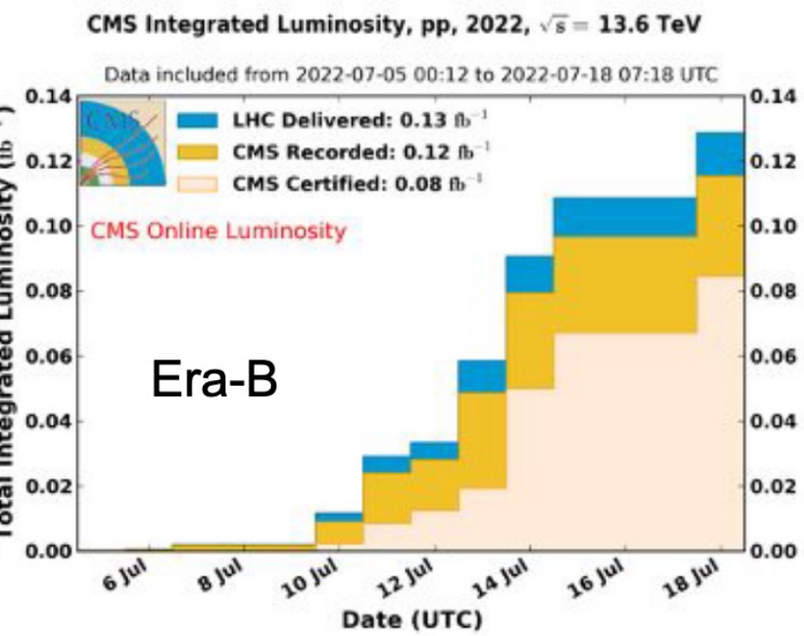
- Variant of "Proposal A
- Difference: does not explicitly mention affiliations with institutions of the Russian Federation, Belarus, or JINR
- A reference like "Affiliated with an [institute / international laboratory] [associated / collaborating / covered by a collaboration agreement] with CERN" is proposed.
- At the CB meeting last week, it was decided to add the additional option C to the opinion vote in the CMS CB.
- The exact text for "Proposal C" may have to be slightly amended, if adopted

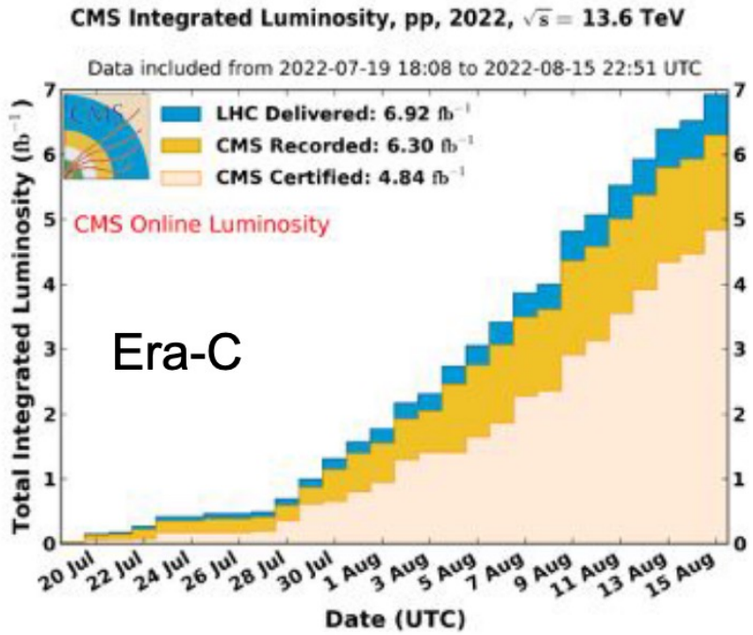
HL-LHC Upgrades

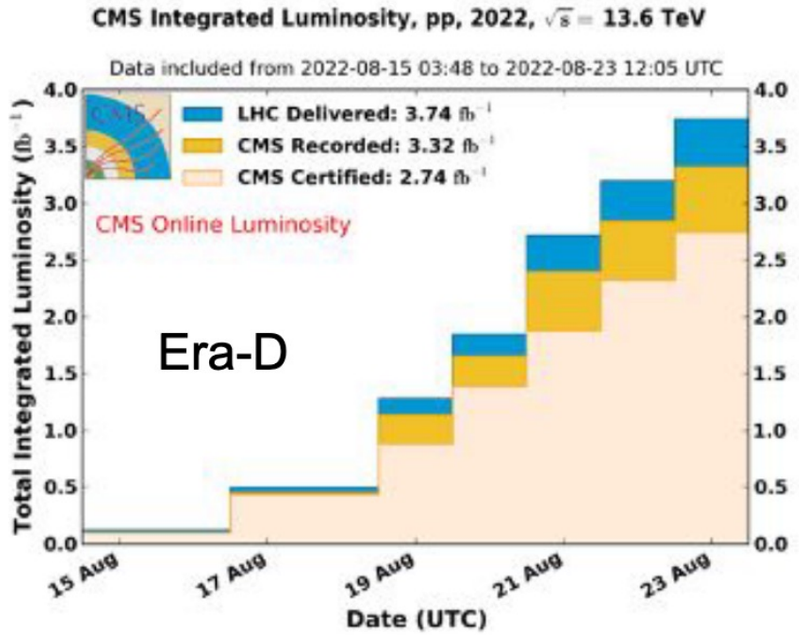
- There has been progress on the upgrades, but there have also been challenges.
  - Inflation, COVID is still with us, and the conflict in Ukraine.
  - CMS is working on finding alternate solutions to mitigate the risk to CMS if Russian Federation is unable to deliver.
  - The Council decision in June to maintain the collaboration agreement with the Russian Federation until the end of 2024 has created an unclear situation for the experiments.
  - CERN management has encouraged us to pursue alternative solutions. This is a work in progress.



Data taking and data certification efficiency







	Data taking eff	Certification eff
Era B (mainly commissioning)	92.3%	66.6%
Era C	91.0%	76.8%
Era D	88.7%	82.5%

Worse data taking condition during LHC ramp-up (higher instantaneous luminosity, higher pilu-up) had a direct impact in the data taking efficiency

3

CMS Italia e decennale della scoperta dell'Higgs

Riunione CMS Italia: Firenze 26-28 Settembre

Evento pubblico Higgs10 la sera del 26 Settembre

Il nuovo mondo dietro la scoperta: scenari futuri per la comprensione dell'Universo.

- Oscar Adriani (Università di Firenze)
- Roberto Carlin (Università di Padova, INFN Padova & CERN)
- Stefania De Curtis (Galileo Galilei Institute, Firenze & INFN Firenze)
- Luca Malgeri (CERN)
- Lucia Silvestris (INFN Bari & CERN)
- Guido Tonelli (Università di Pisa, INFN Pisa & CERN)

Modera la serata

Paola Catapano (Giornalista scientifica & comunicazione CERN)