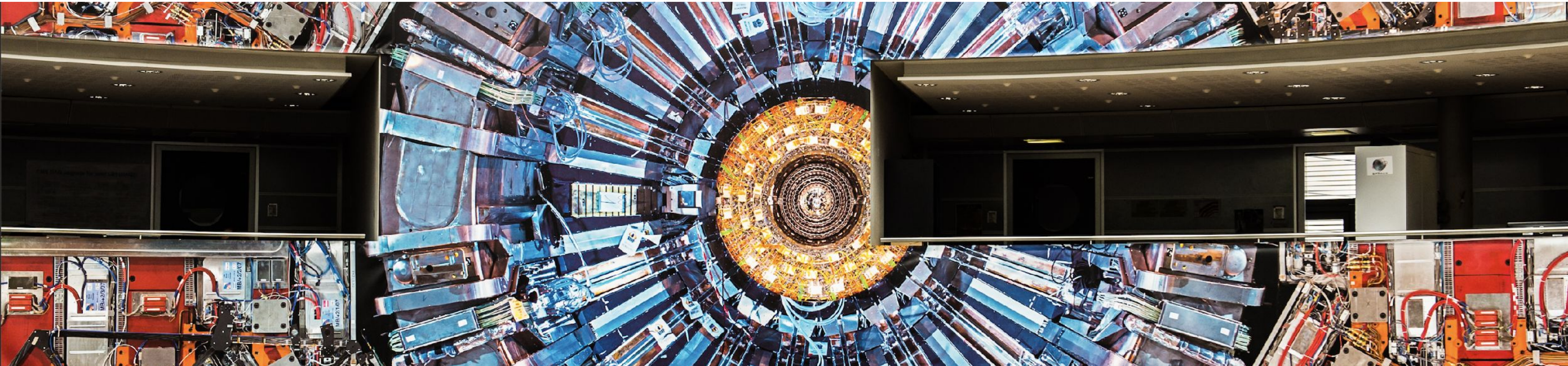
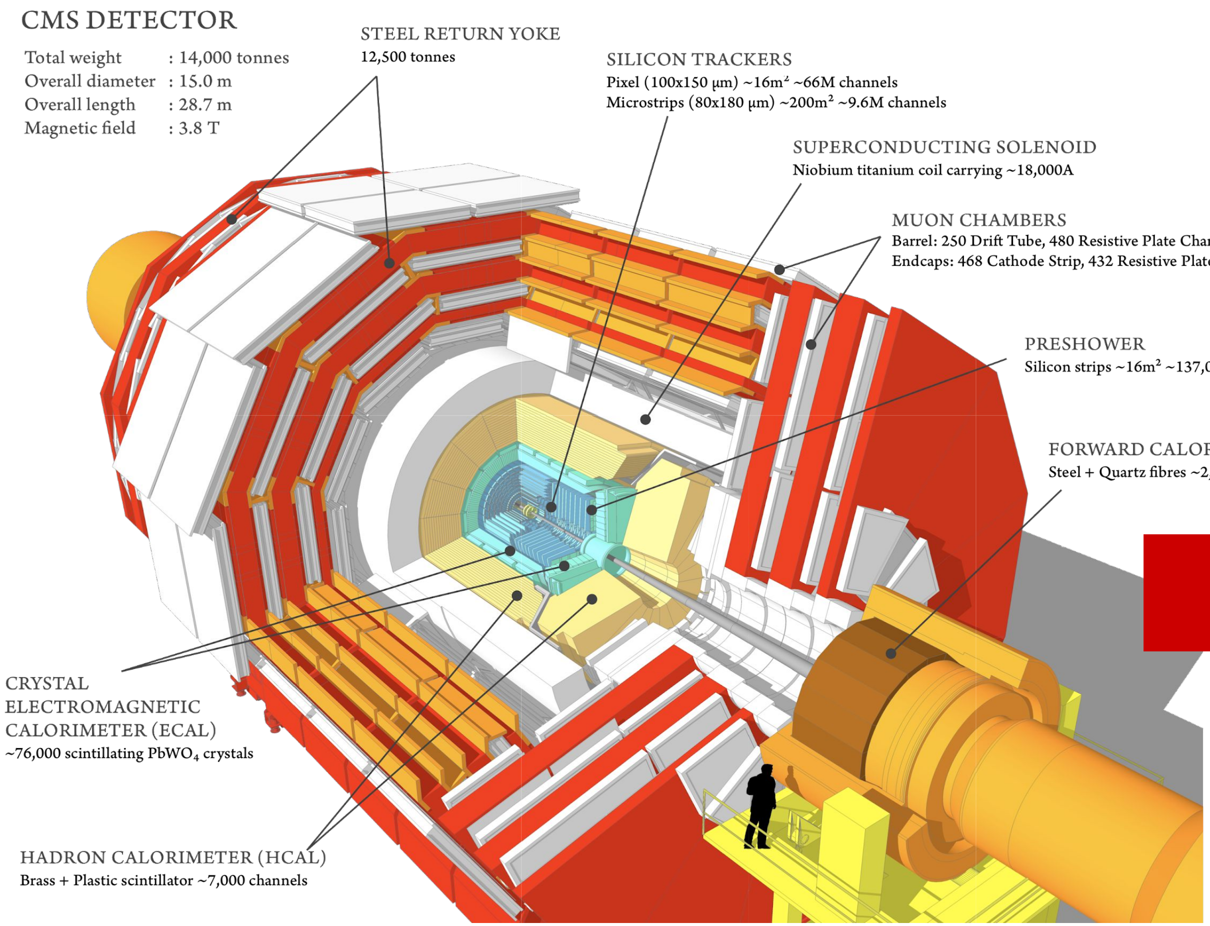
Offline Data Preparation, Processing Software and Computing

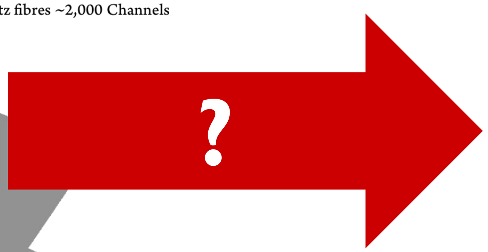
Offline Software and Computing (O&C)
and
Physics Performance and Datasets (PPD)

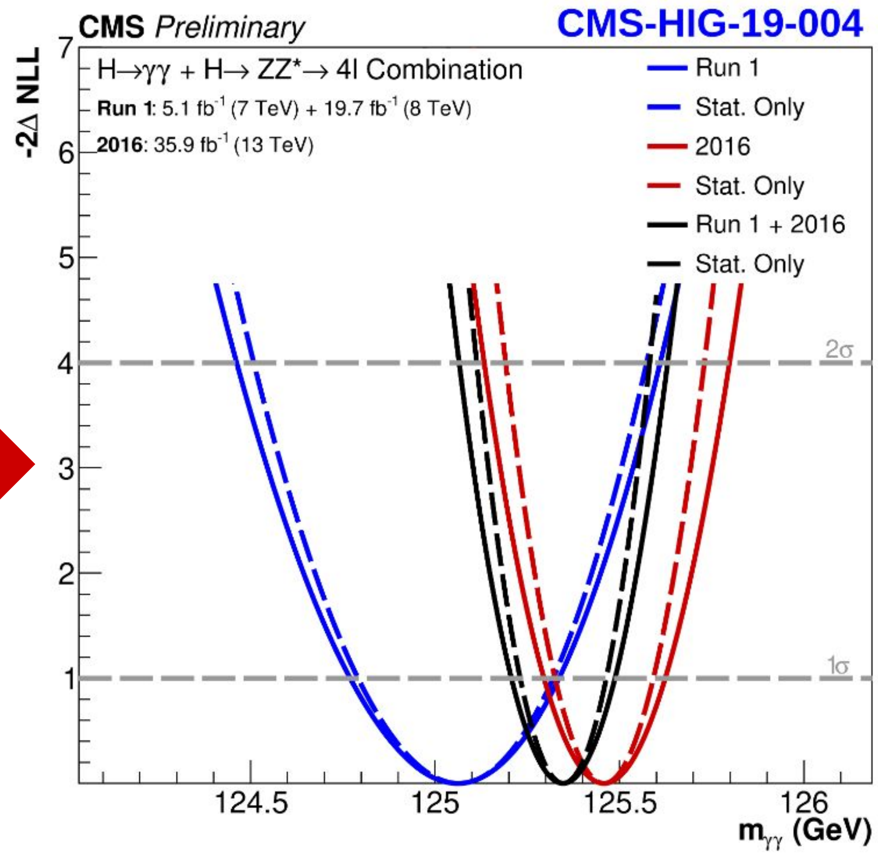
S. Rappoccio (Univ at Buffalo) for O&C and PPD - CMS Induction Course - 23-09-2021



Today's Talk, In a Nutshell

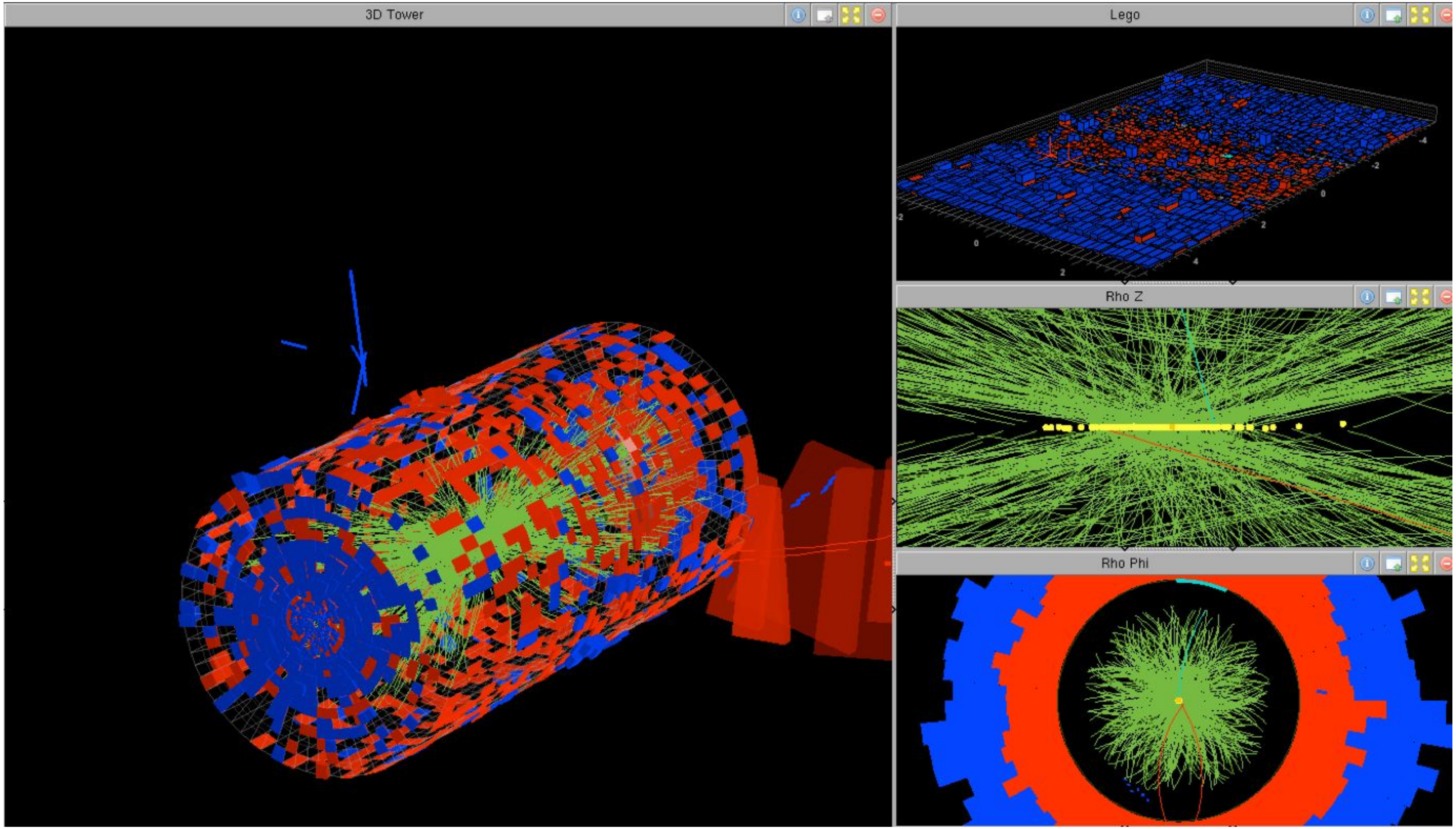






The slides in this talk were created by Phat Srimanobhas, Andreas Meyer, Danilo Piparo, and Sal Rappoccio

Challenge: Triggering, Calibration, Reconstruction



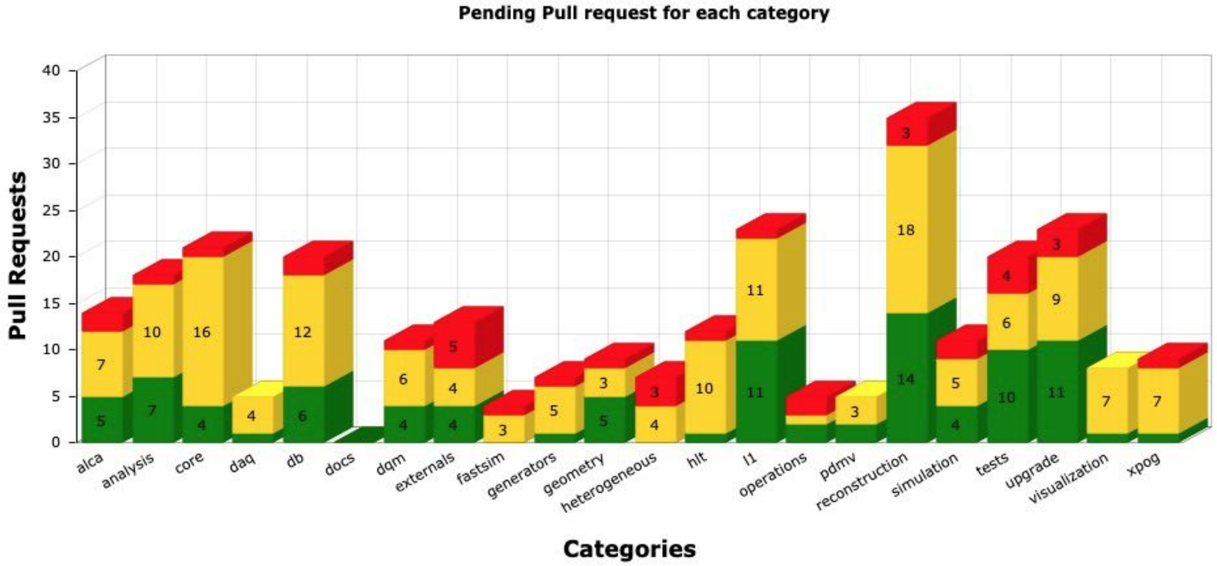
http://cms.web.cern.ch/news/reconstructing-multitude-particle-tracks-within-cms

Challenge: Software

https://github.com/cms-sw/cmssw

https://github.com/cms-sw/cmssw/graphs/contributors

Introduction to CMSSW, documentation, tutorials and FAQ at: http://cms-sw.github.io/



http://cms-sw.github.io/stats/pending-all-prs.html

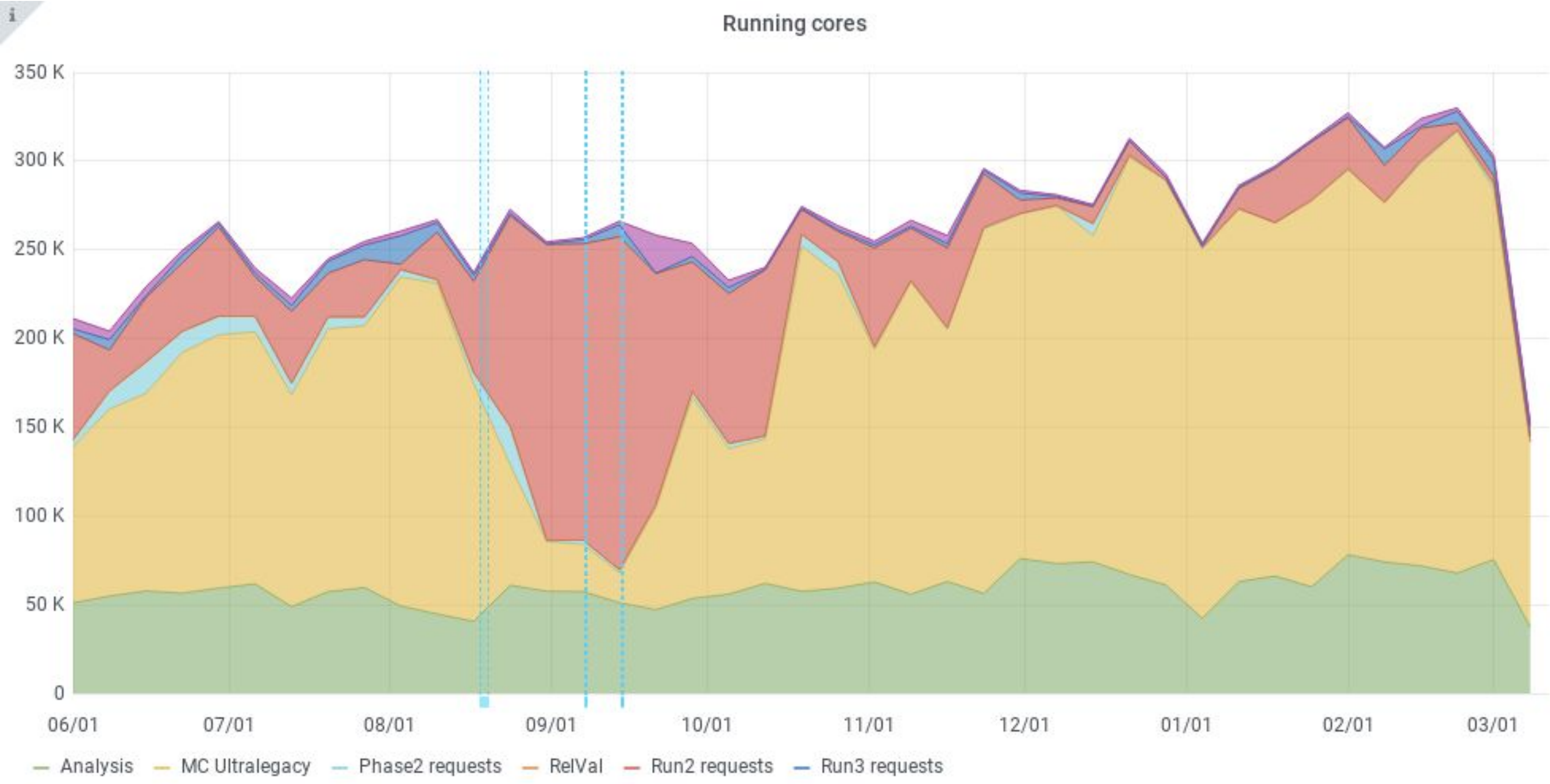
Challenge: Distributed Computing

[CMS Monitoring Dashboard]

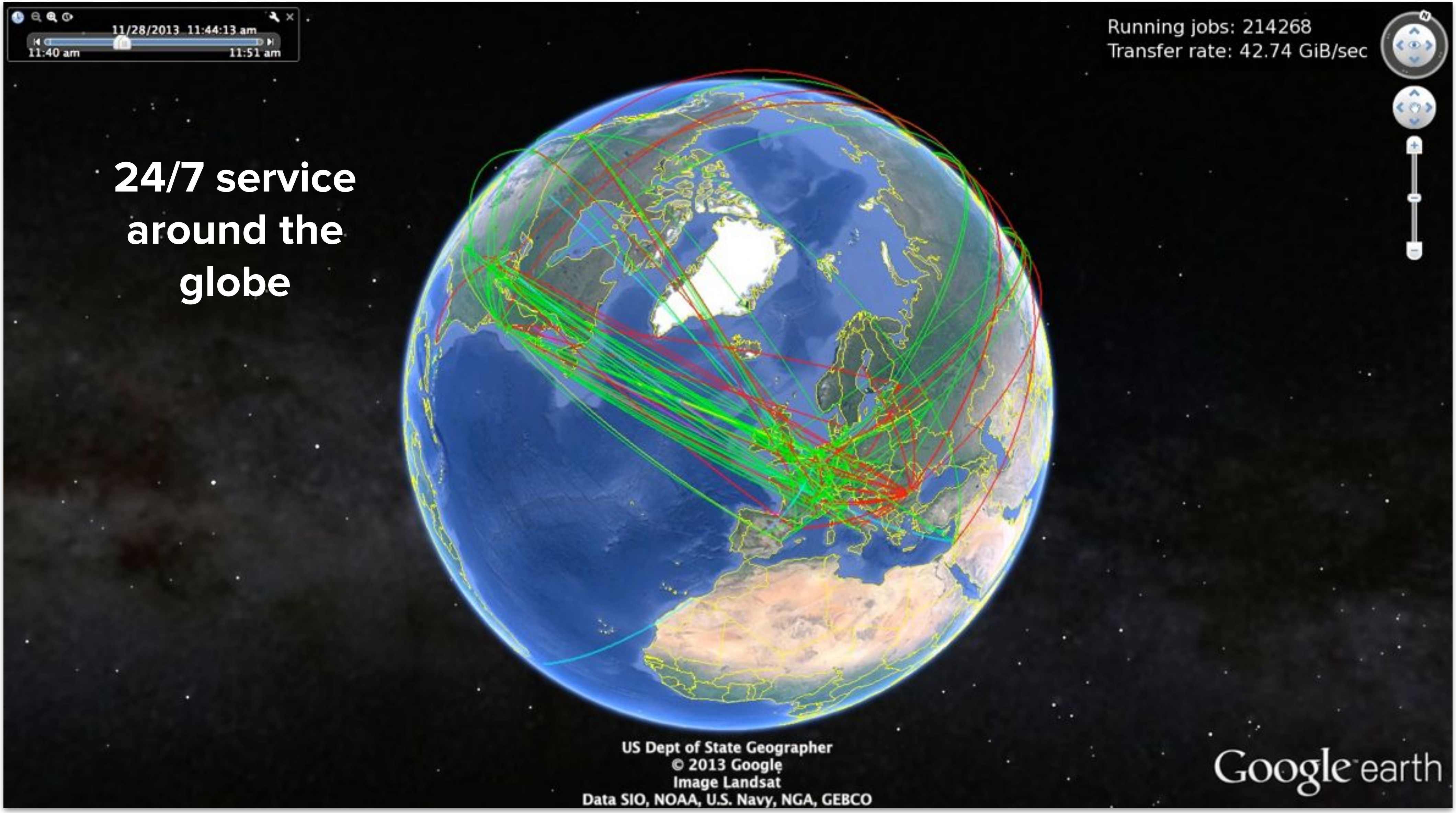
24/7 service around the globe

~300k running cores

Traditional Grid Sites and High Performance Computers!



Challenge: Distributed Computing

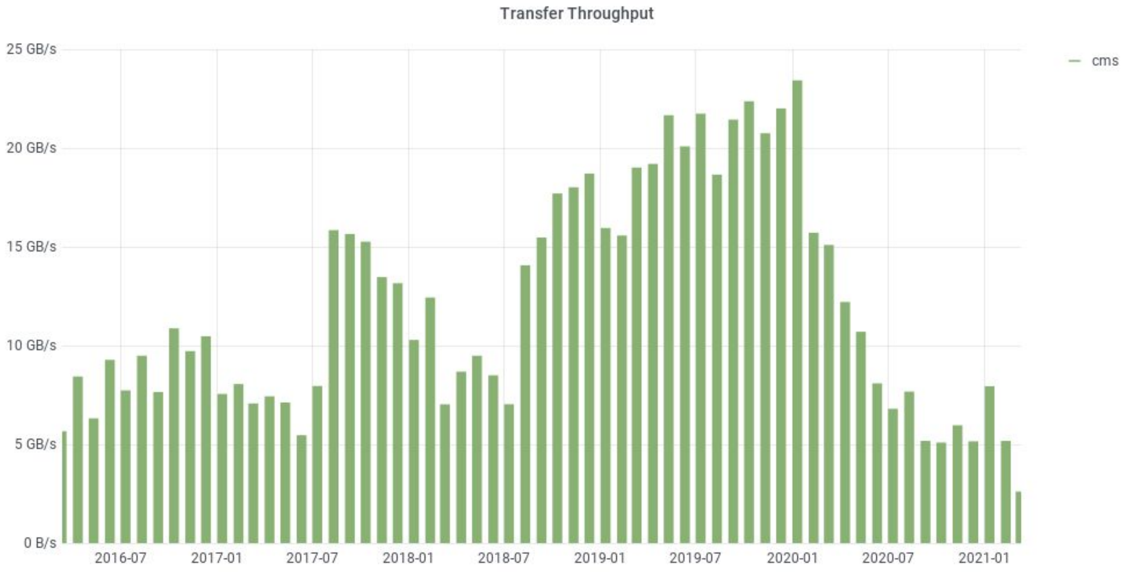


Data Transfer and Production Monitoring

Offline and Computing:

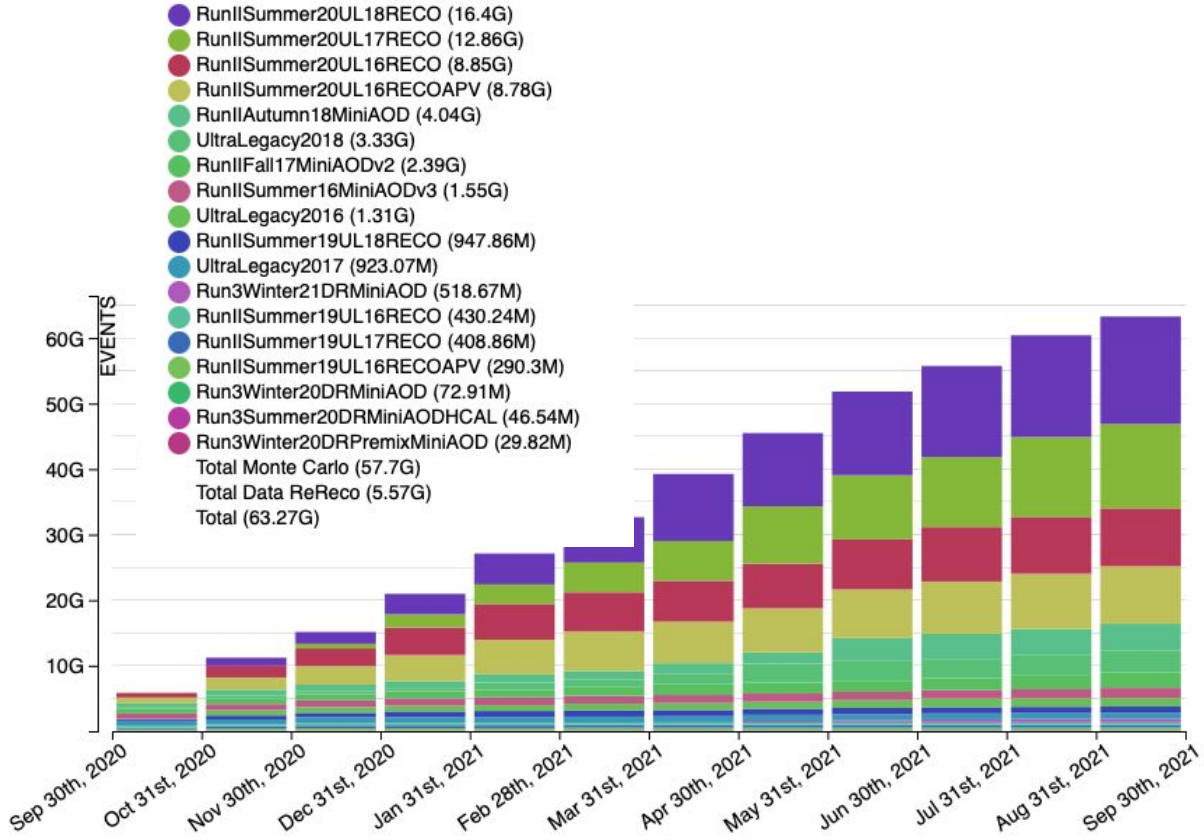
Transfer of data between CMS computing centers

- Total volume in one year: ~500,000 TB
- Transfer rate: 5 GB/s !



Physics Performance and Datasets:

- > 1 Billion unique events processed per week
- Tens of data production and processing campaigns managed simultaneously

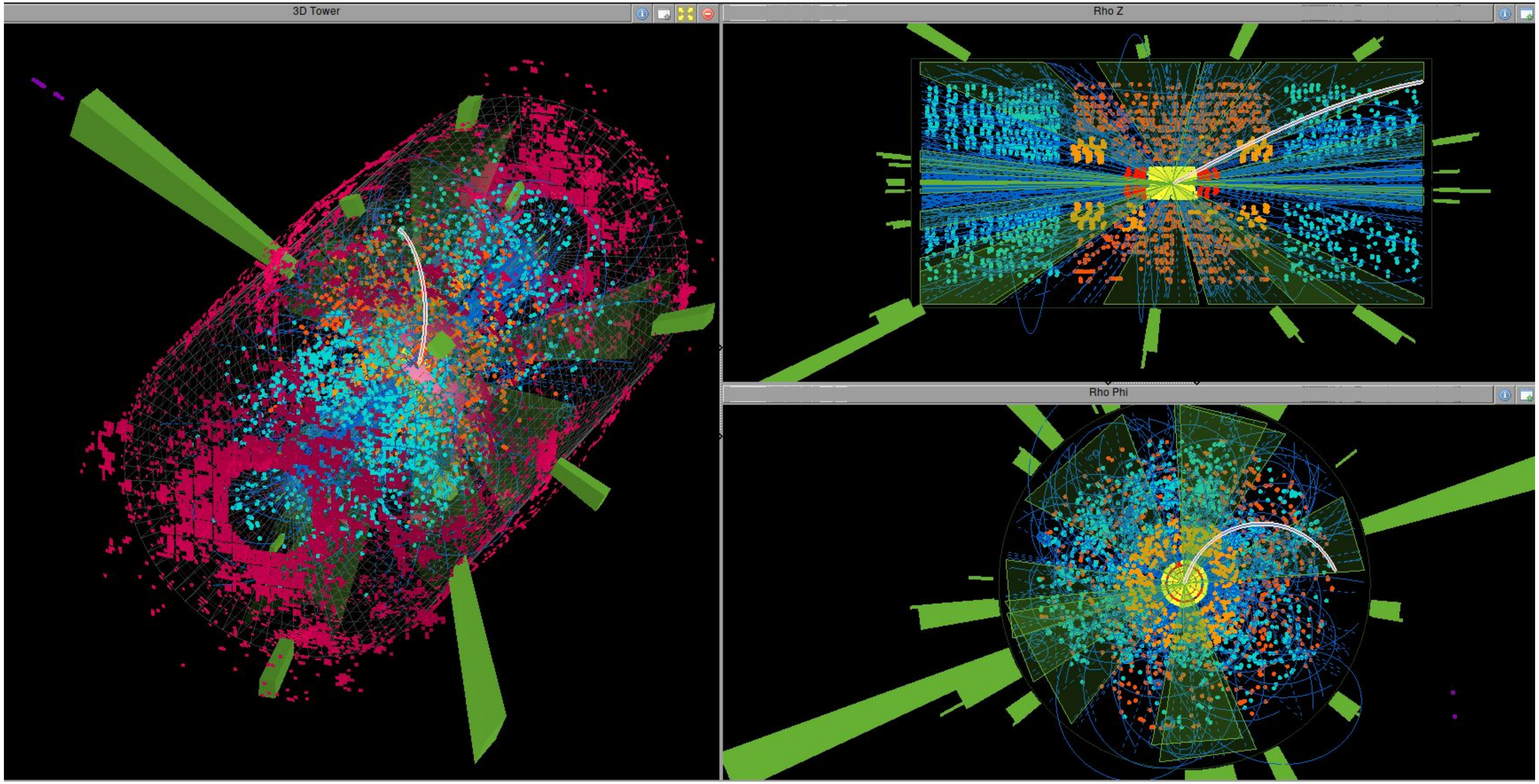


https://cms-pdmv.cern.ch/home/

Our Priority Now

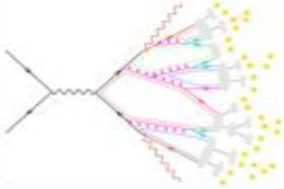
Prepare for data taking!

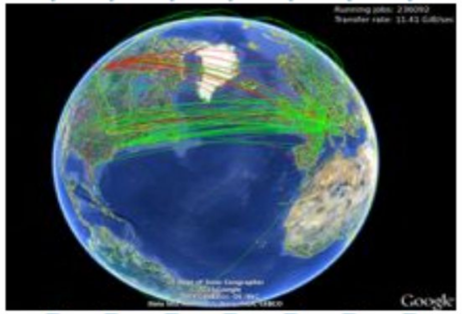
The Long Shutdown 2 is approaching its end: data in Run 3 is coming! Exciting times!

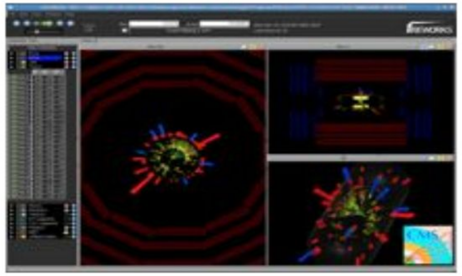


Outline of the Talk

 + 

 + 





Real Data

- From P5 to offline
  - Primary datasets
  - Reconstruction
  - Prompt-reco & prompt calibration loop at T0
  - Calibration and alignment
  - CMSSW
  - Data format, event contents & data tiers
  - Data quality monitoring
  - Data certification

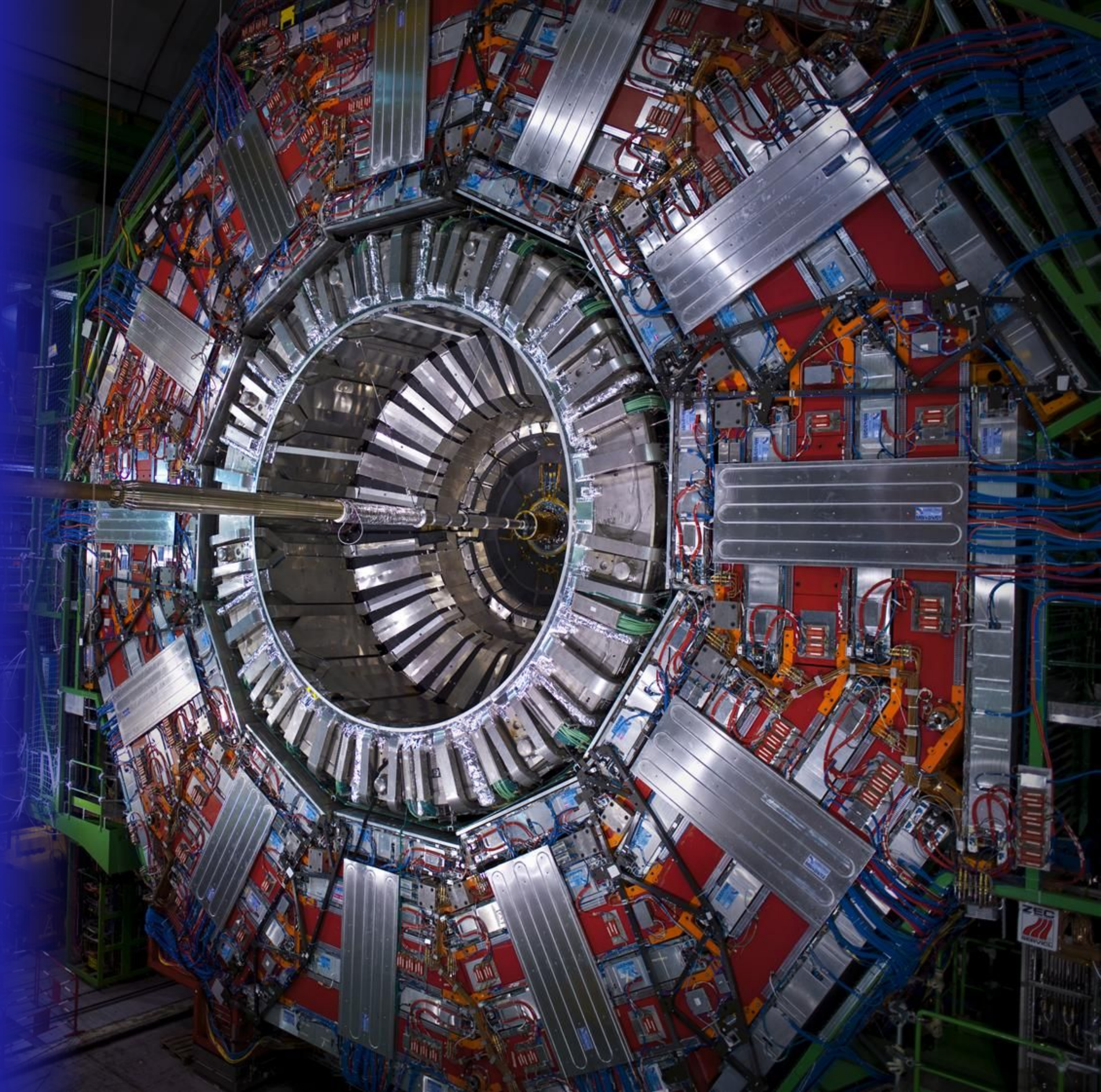
Monte Carlo

- From simulation to offline analysis
  - Simulation flow
  - Pileup

Analysis

- CMS computing model
- To start your analysis
- Exercises
- Central production
- Meetings
- TWiki, HN, … references

Software and Computing
&
Data Preparation and Processing



Coordination Areas

In this talk we focus on 2 main CMS coordination areas:

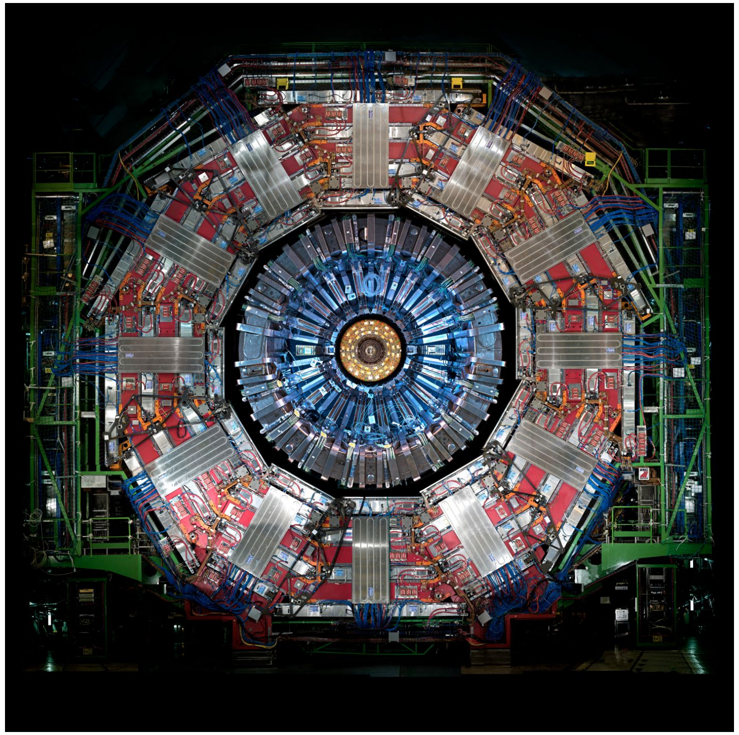
Offline & Computing (O&C)

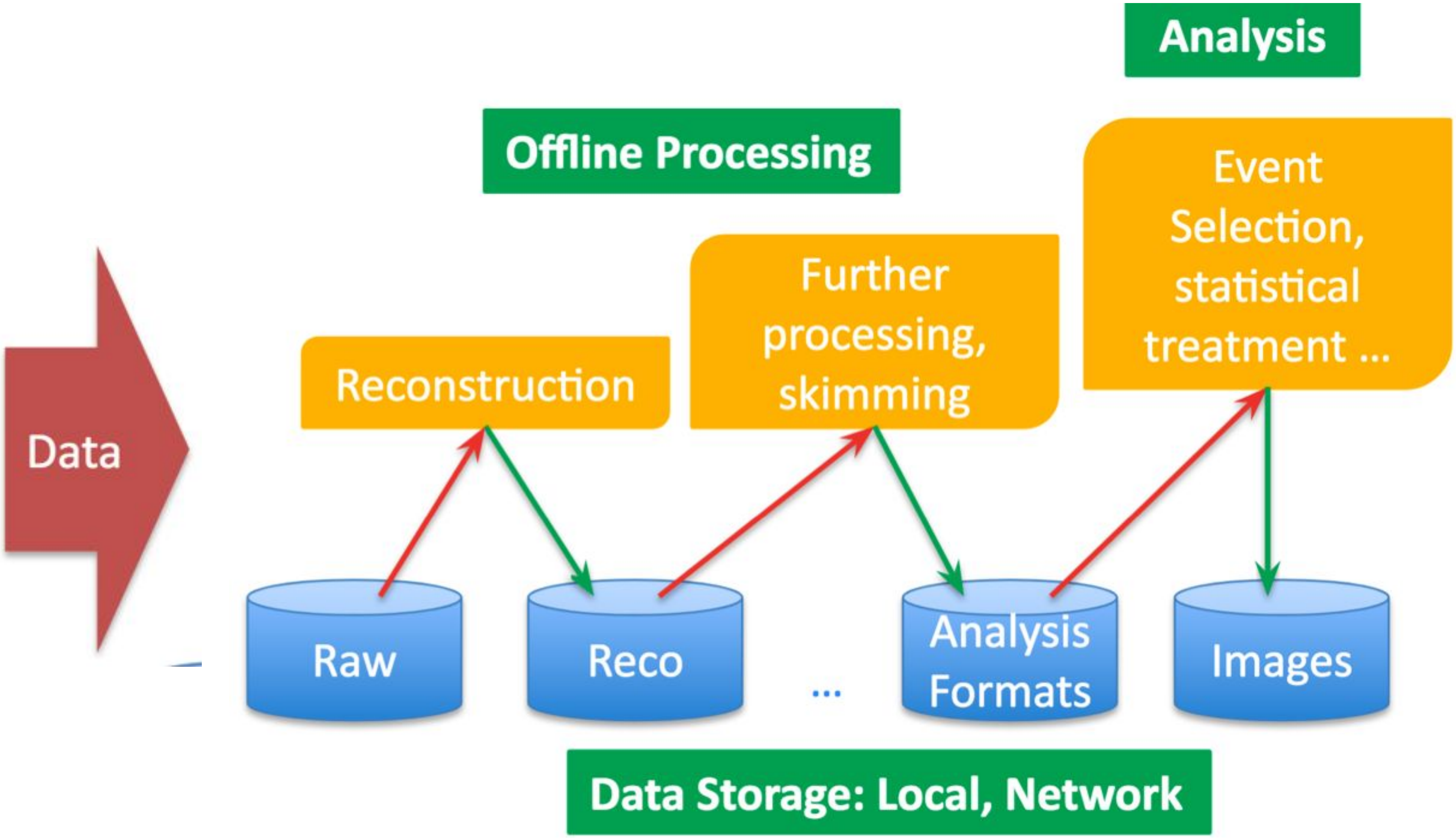
- CMSSW software development, event reconstruction and simulation
- data processing and Simulated events generation, events storage and management

Physics Performance and Dataset (PPD)

- data quality & certification
- alignment & calibrations
- software validation
- management of Monte Carlo requests
- organization and configuration of datasets and data processing

CMS Data: P5 to Offline





Event Filtering

CMS Data: P5 to Offline

Events collected by CMS reach the Tier-0 at CERN for tape archival, organization, and processing.

Trigger

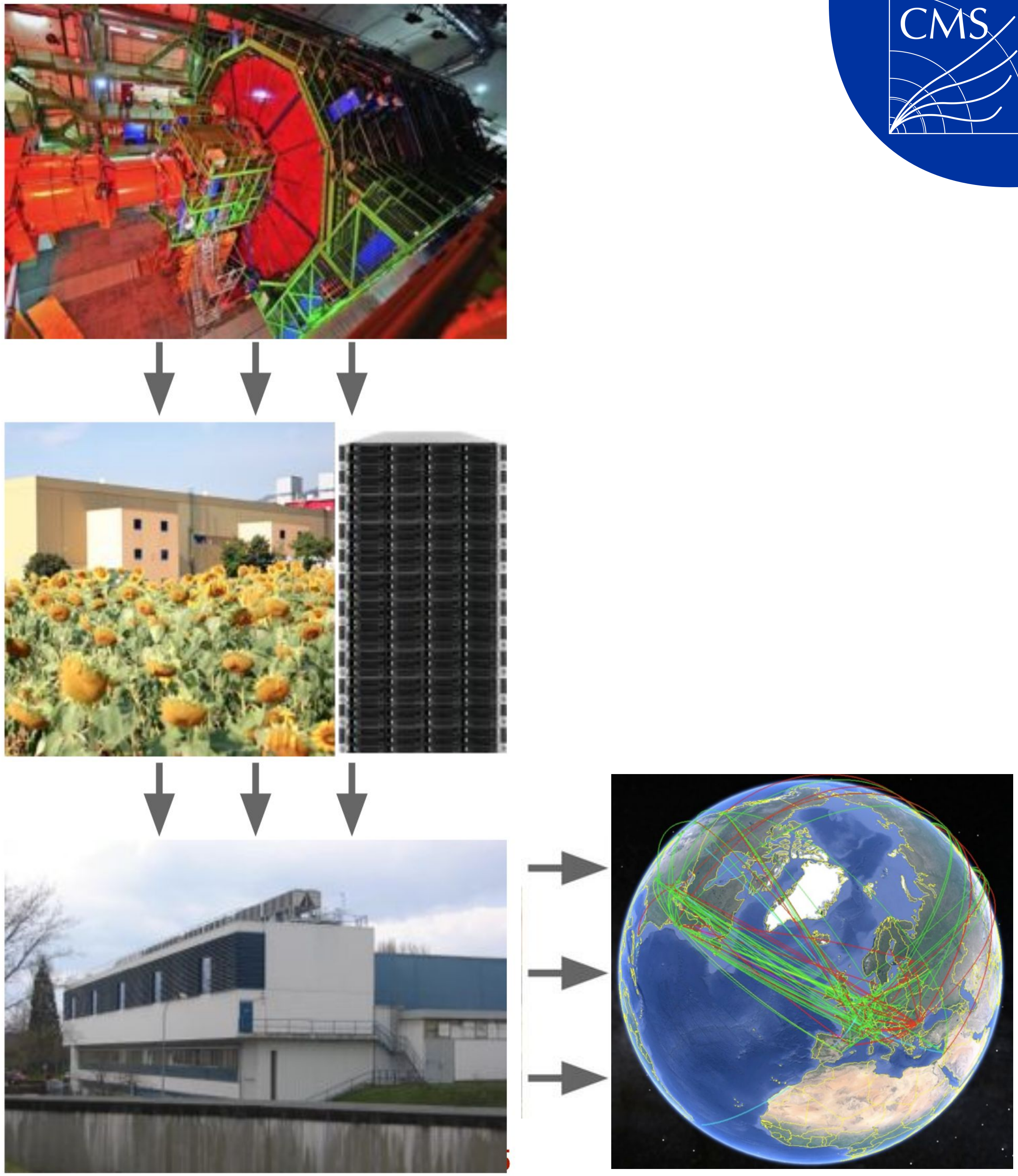
- **Level 1 T**: event selection through dedicated hardware
- **High Level T**: more refined software-based selections

Data streams

- **Express**: Generalised concept of stream which are running reconstruction before the prompt reconstruction starts. About 40 Hz bandwidth shared by Calibrations, Detector, Physics monitoring.
- **Physics**: Split into primary datasets and promptly reconstructed for physics analysis.
- **Other specialized streams**: Scouting (events w/ reduced content), Parking (not promt-reco'ed)

Data rates

- **Run I:** 300 Hz Prompt-Reco + 3-600 Hz parked
- **Run II:** 1 kHz of Prompt-Reco + high rate of scouting +parking



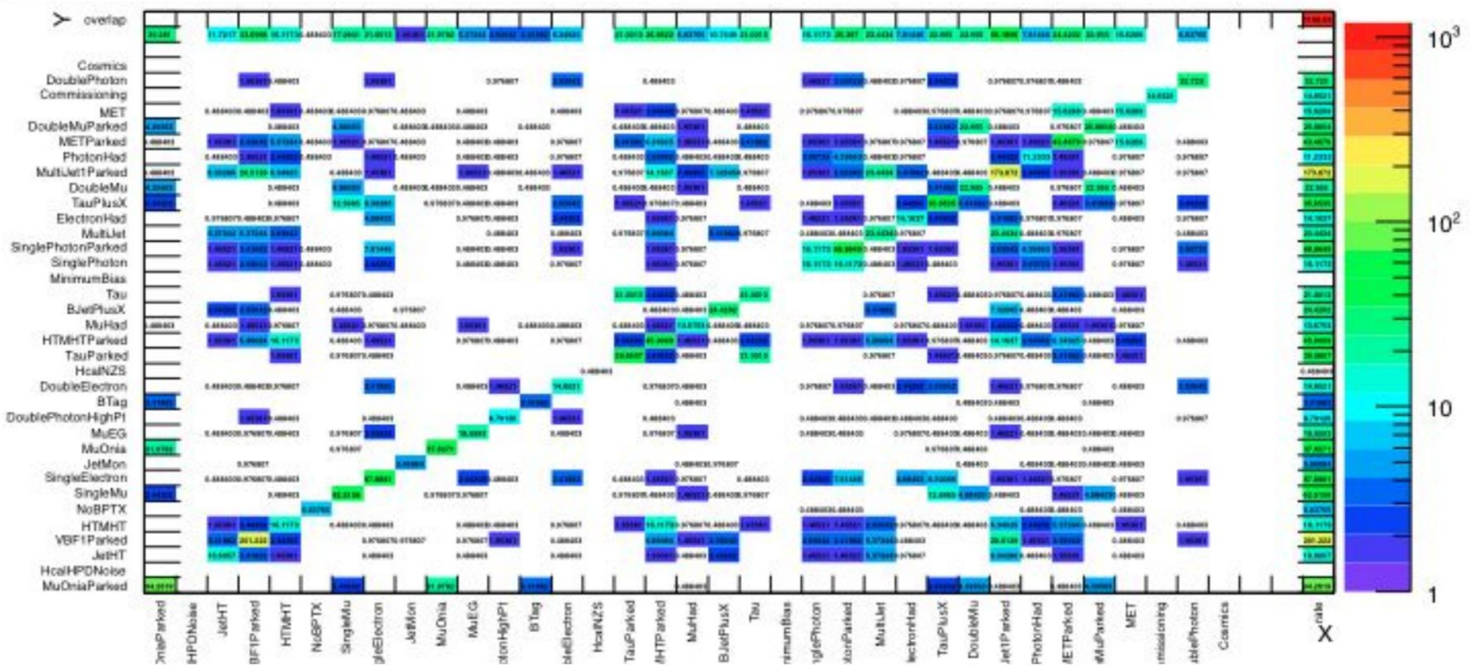
Primary Datasets (PD)

The physics steams from P5 are split to **Primary Datasets** (PD) on the basis of HLT results in order to group events with related topology and limit replication of events (PD's overlap). Constraints include

- Physics: Definition centred on physics objects (i.e. SingleElectron, JetMET)
- Processing & Handling: Proper event rates for each PD, to be able to handle by T2.

On top of the primarydatasets we can deploy "central skims" to

- customise event content,
- Reduce rate using also RECO quantities.



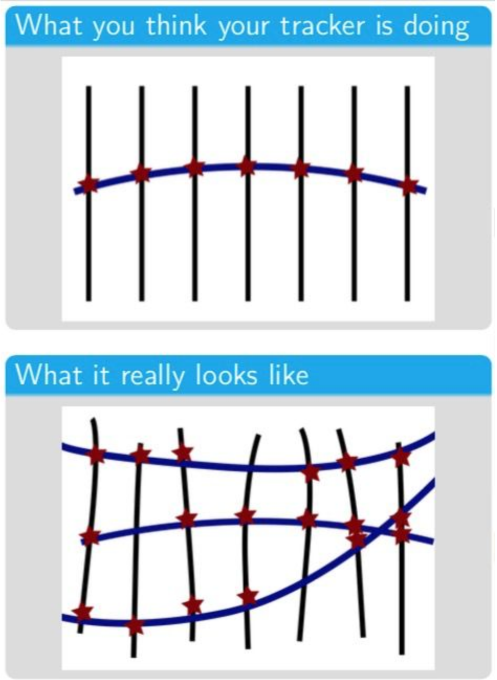
Trigger rate and overlap between PDs

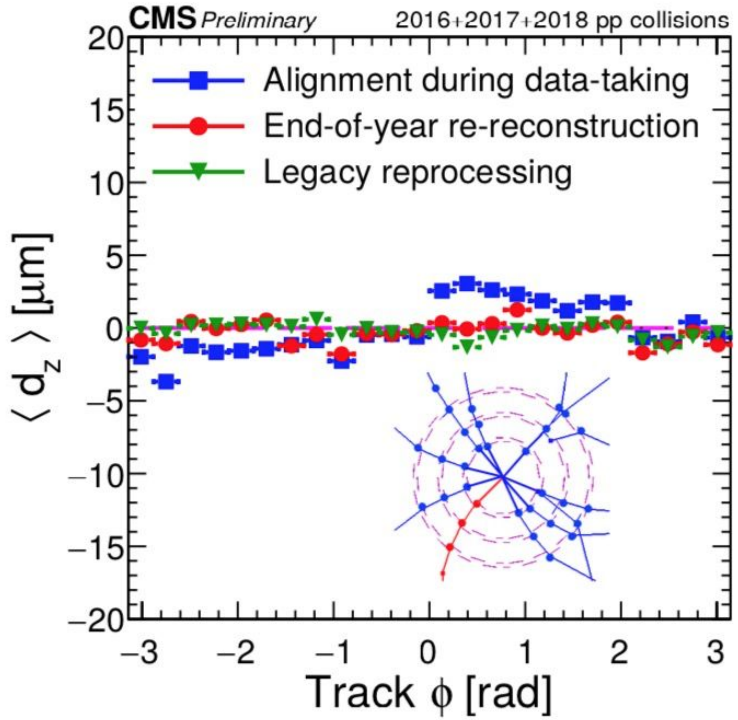
Calibration and Alignment

- Optimal calibration and alignment at all stages of the data and MC
  - major challenge involving DPGs, POGs, PPD/AlCaDb
  - vital to exploit at maximum the hardware potential for physics
- Calibrations & alignment evolve with time in real data ⟶ frequent updates needed to follow detector evolution (e.g. bad channels, ageing-induced response variation)
  - both in the reco@HLT
  - & in offline reconstruction

- CMSSW calibrations database: store history and keep track of versions
- A complete set of all calibration types (*Tag*), each with its history, needed to execute CMSSW is labelled by a *Global Tag*

Example: Tracker Alignment (taken from [P.Connor: Legacy Report: Tracker/Tracking]())



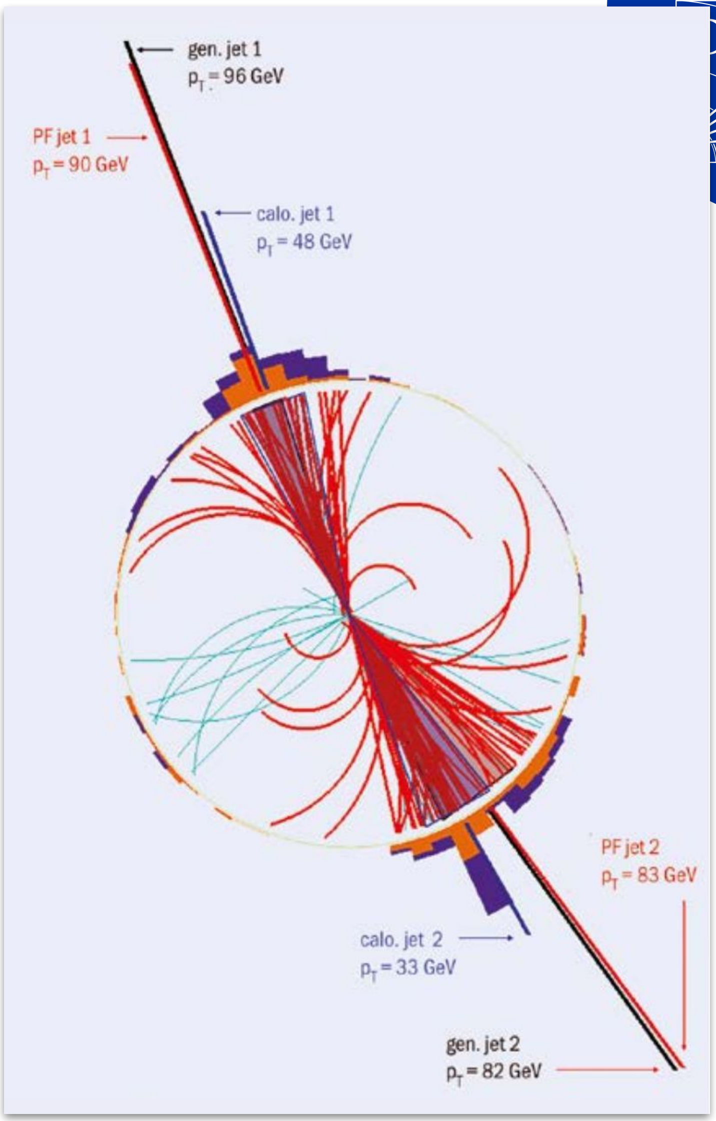


Reconstruction

- The reconstruction sequence turns the binary output event data (RAW) into sets of physics quantities ready for data analysis (e.g. positions, energies etc.)

- Hits in the detector are aggregated in clusters and tracks, which in turn are matched to create particle candidates: Particle-Flow, a holistic approach
  - tracks, muons, electrons, photon, jets, ...
  - Particle flow [ref1](ref1) and [ref2](ref2)

- High Level Trigger (HLT)
  - performs a 2nd stage of event selections
  - computes reconstructed quantities w/ the same software framework & algorithms as used in offline reconstruction - partly re-configured for quicker execution

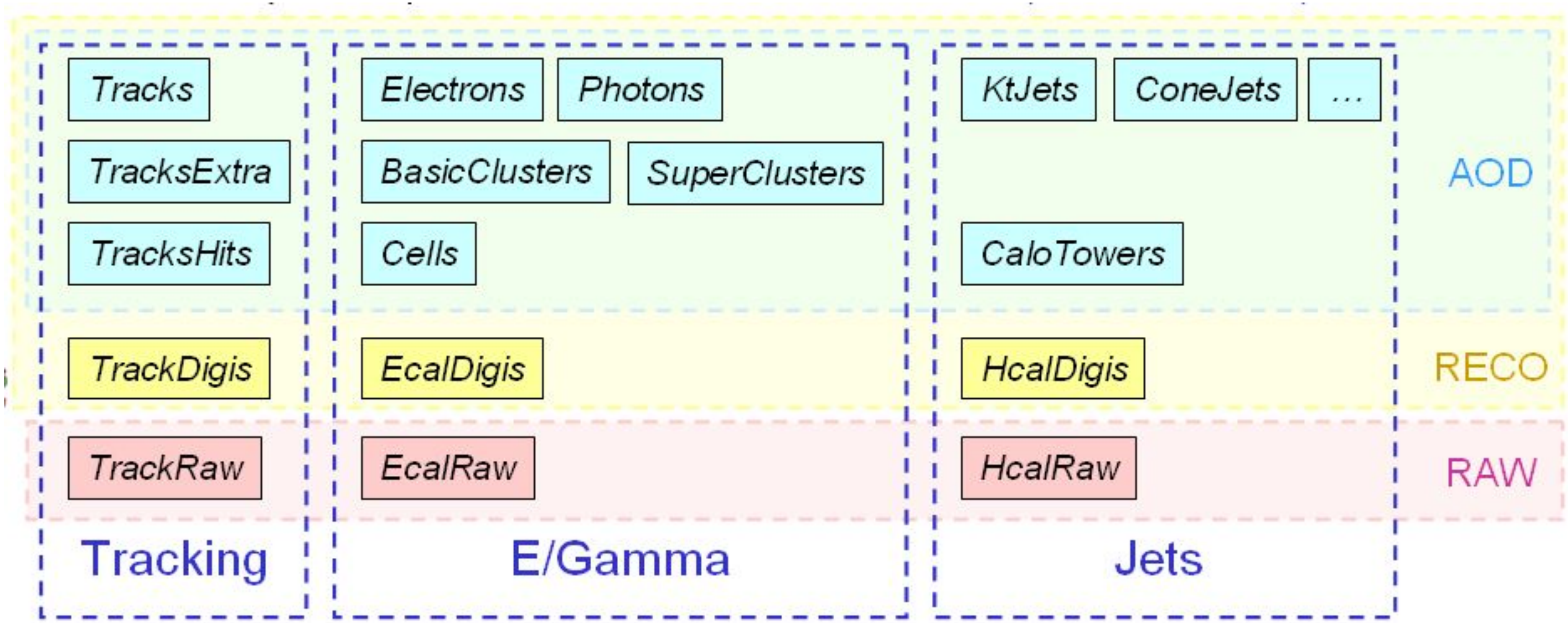


You are invited to join the Reco Meetings!

**Big opportunities in Reconstruction! Improve algorithms, code and physics performance.
You don't need to be an expert to start contributing!**

Data Formats, Event Contents, Data Tiers

- Data format: Each bit of data in an event must be written in a supported data format. A data format is essentially a C++ class, where a class defines a data structure (a data type with data members).
- Data tier: Event information from each step in the simulation and reconstruction chain is logically grouped into what we call a data tier.
- Event content: Contents of each data tier.
- Persistency achieved with ROOT

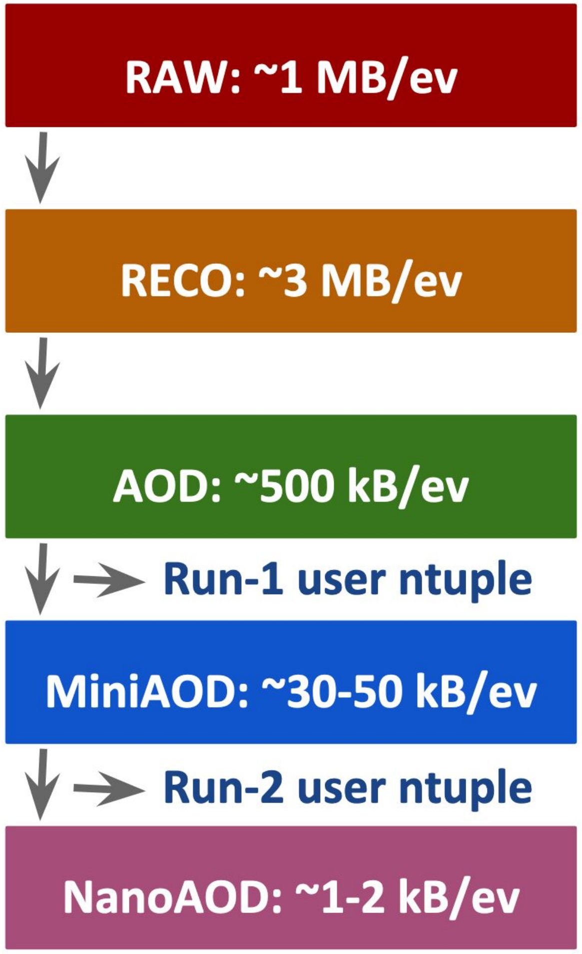


https://root/cern

For more information:
Workbook Data Formats

CMS Data Formats for Physics Analysis

- MiniAOD (30-50 kB/event)
  - working-horse CMS analysis format
  - used by essentially all analyses
- NanoAOD (1 kB/event)
  - Resembles the typical structure and size of private ntuples, with new features to make it more universal and interface it with central processing tools
  - Contents aim to support at least 50% of physics analyses
  - Continuous refinements, based on input from all physics groups



Goal: make it the main Tier for Run 3

For more information:
[WorkBookMiniAOD](), [WorkBookNanoAOD]()
Ample opportunities for contributions

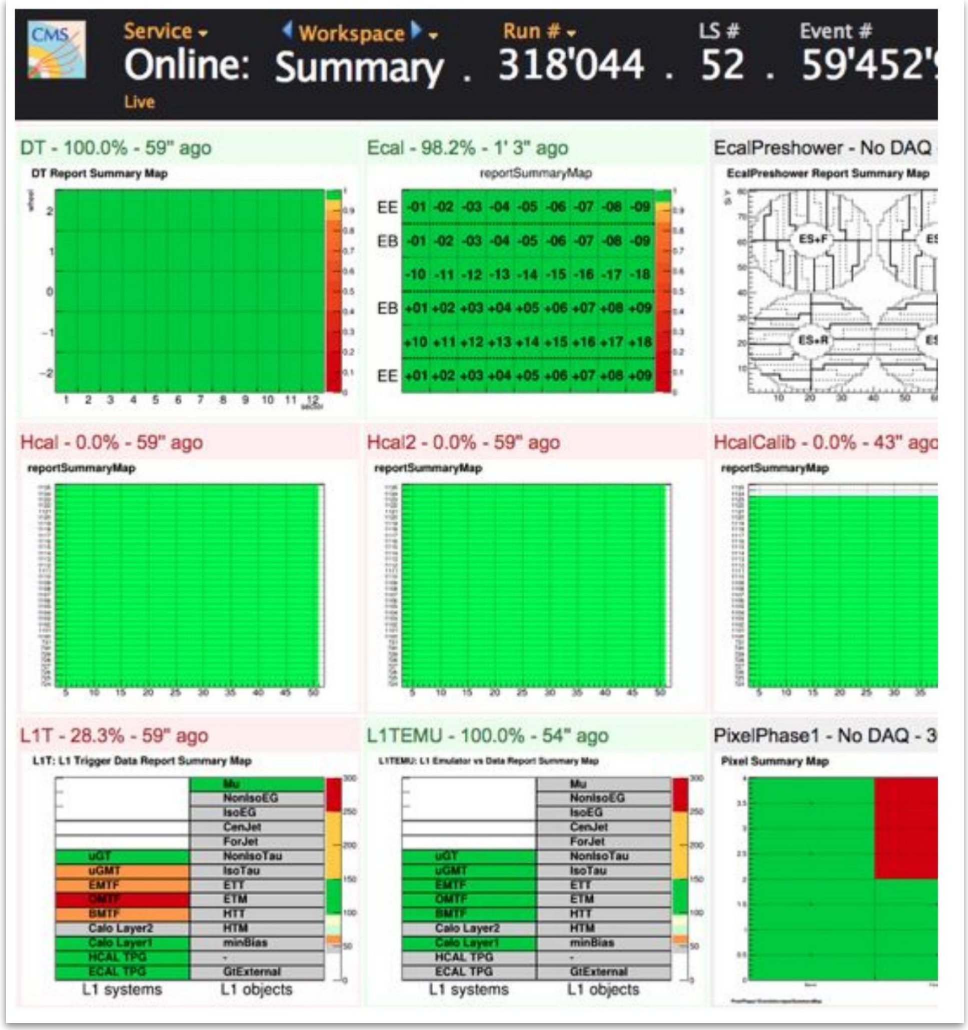
Data Quality Monitoring - DQM

Use the data to ensure detector hardware, trigger and software functionality and quality

- Online: real-time monitoring (latency ~1 min)
- Offline:
  - Short-latency (~days) diagnostics and physics performance monitoring
  - Data certification: good-run list (“JSON”)
- Release validation: data and MC distributions to monitor and validate code developments, and calibrations

Histograms with maximum sensitivity

- 24/7 DQM shifts, during data taking
- Automatic alarms using reference histograms
- Current effort: use machine-learning for DQM



https://cmsweb.cern.ch/dqm/offline

Data Certification - DC

By Run and Luminosity-section:

- 1 Lumi-section = 2^{18} revolutions of the LHC beams = 23s

Data certified as good means:

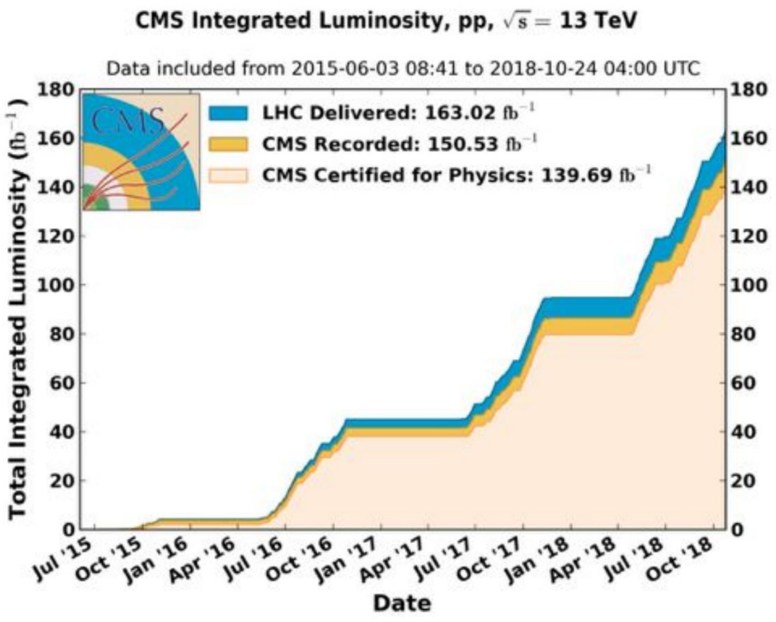
- Detector fully operational
- Reconstruction+calibration optimal

Delivered by team of experts for detector & physics objects.

- Weekly for PromptReco
- After each major reprocessing
- The format of the good-run list is JSON

Types of “JSON files”:

- “Golden”: require all sub-detectors/POGs to be “GOOD”
- Muon-only: no requirements on calorimeters
- DCS-only: require detector components to be powered up



{"273158": [[1, 1279]], "273302": [[1, 45
"273408": [[1, 6]], "273409": [[1, 309]],
113], [115, 412]], "273448": [[1, 391]],
"273493": [[1, 233]], "273494": [[1, 192]
[[1, 173]], "273725": [[83, 252], [254, 2
"274159": [[1, 43]], "274160": [[1, 207]]
"274240": [[1, 40], [42, 82]], "274241":

Run Range of lumisection

https://cms-service-dqm.web.cern.ch/cms-service-dqm/CAF/certification/ https://twiki.cern.ch/twiki/bin/viewauth/CMS/DataQuality

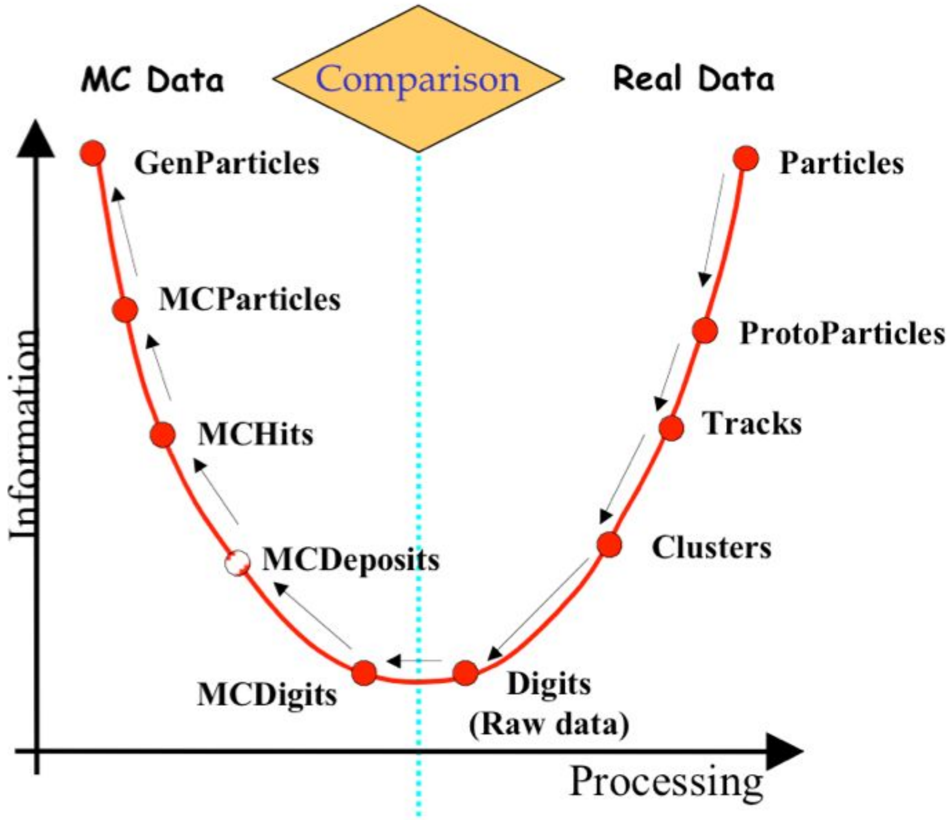
Monte Carlo Simulation

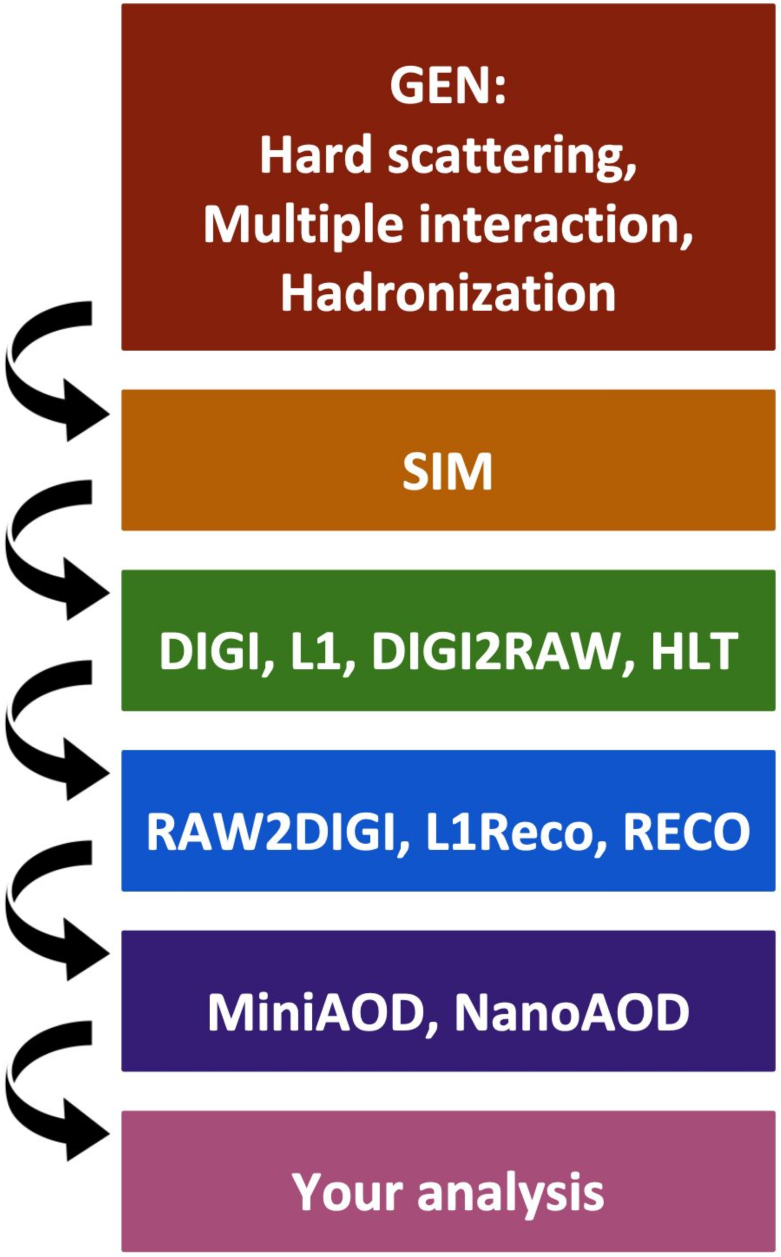
Monte-Carlo Simulations

MC method: efficient statistical method to calculate multi-dimensional folding integrals (reflecting e.g. detector resolution, noise, biases etc.)

Monte Carlo
Simulation follows the evolution of physics processes from collision to digital signals

Reconstruction "goes back in time" from digital signals to the original particles produced in the collision





"Full" and "Fast" Simulation

- Full Simulation: follow the evolution of all individual particles, their trajectory through the detector material, including their decay or interaction with matter:
  - based on Geant4 https://geant4.web.cern.ch/
  - **high fidelity: 10s of seconds / event**
  - currently used for most signal (SM and BSM), and SM backgrounds

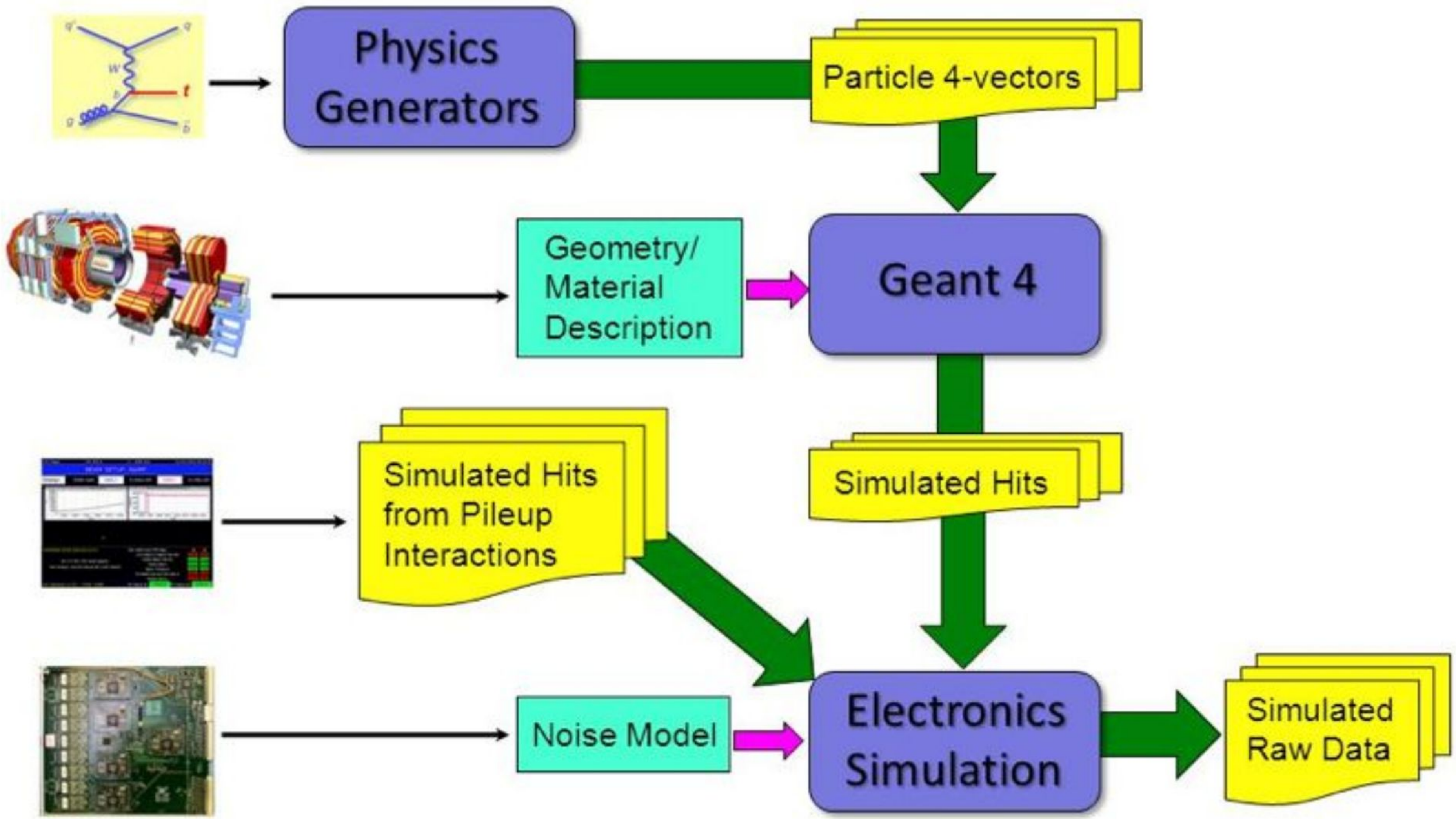
- Fast Simulation: parameterise as much as possible (N.B. fast "simulation" is a misnomer, e.g. it's a fast simulation and reconstruction tool)
  - based on an in-house approach
  - **good fidelity: seconds / event**
  - So far mostly used for scans of SUSY signals

  Use fastsim/fullsim scale factors for differences in response

You are invited to join the simulation meetings!

Great opportunities to further improve precision of physics processes, and code performance: You don't need to be an expert to start contributing!

From Physics Generator to Simulated Raw Data



Datatiers

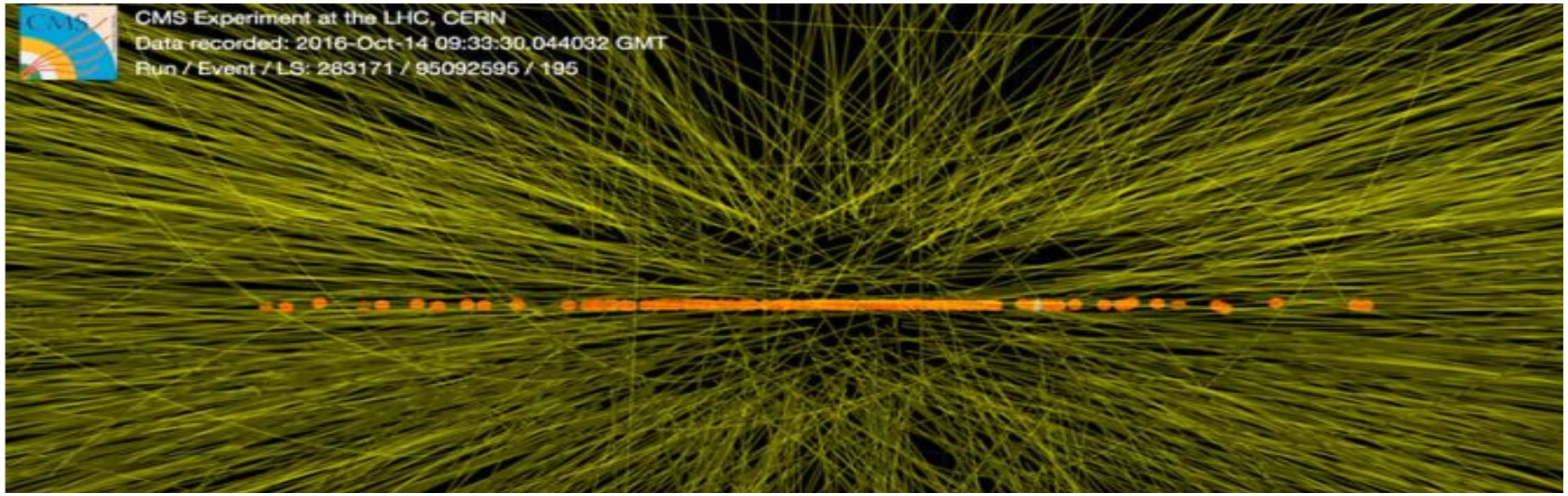
LHE, GEN

GEN-SIM

GEN-SIM-RAW

Pileup Simulation

- Multiple pp collisions in each bunch-crossing (almost all “soft”, i.e. small transverse mom.)
- Pileup collisions add to multiplicity of charged particles, complexity in the tracking and - need for CPU



CMS has two approaches to deal with PU simulation

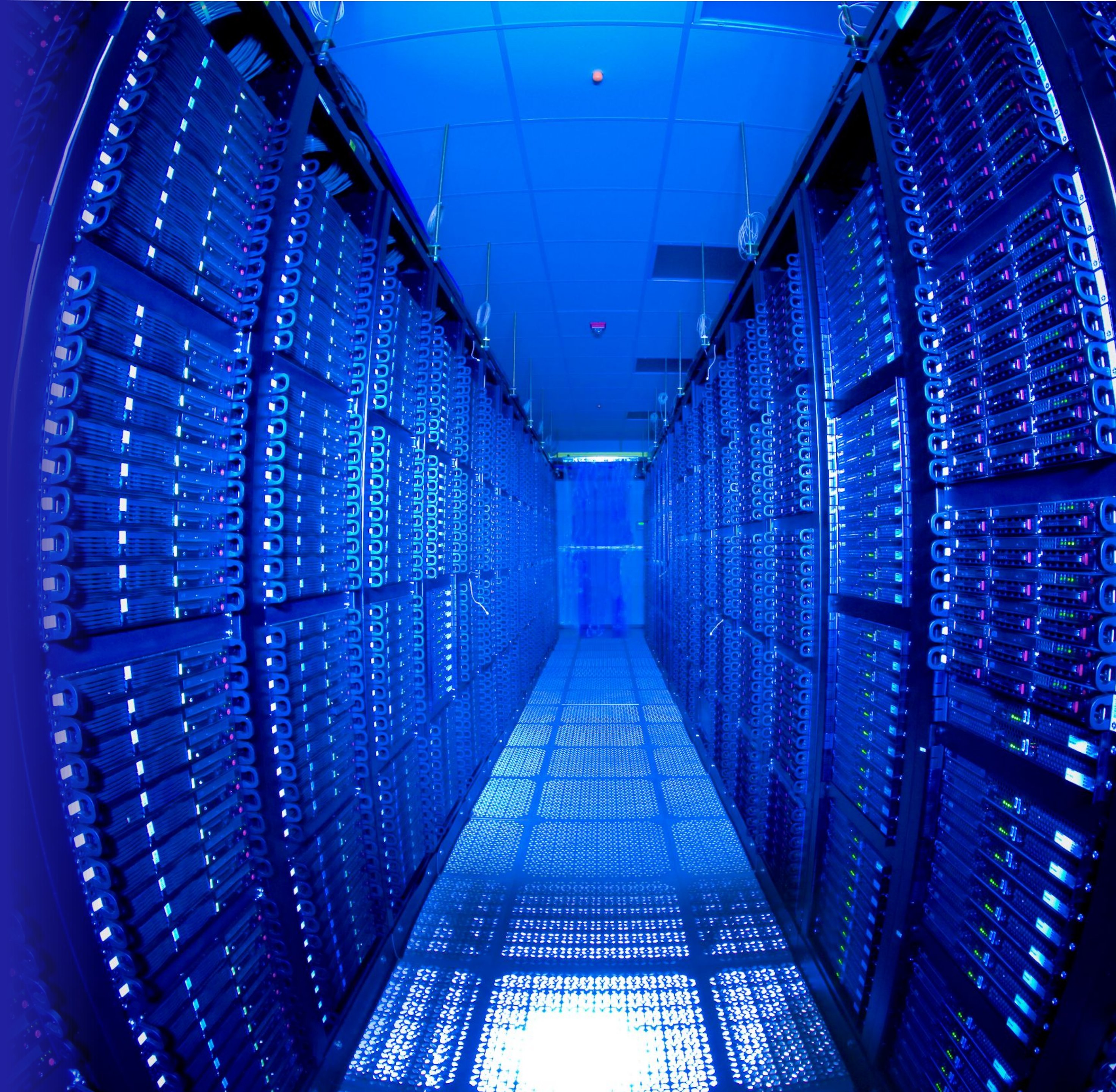
“Classical” mixing

- GENSIM MinBias events of chosen pileup distribution are overlaid one-by-one on hard scatter event

“Pre-mixing” (for standard MC production):

- MinBias events (RAWSIM) are premixed according to PU distribution, resulting RAW data is stored.
- PreMix events are overlaid on hard scatter events in one go (RawToDigi is done on-the-fly)

Starting Your Analysis



When You Start Your Analysis

For more information: PdmV

Several questions will come to you:

- Which datasets you are using?
  - How many fb-1 of data you are using?
  - Are you sure that you use all available data? How?
- Do you need Monte-Carlo samples for your analysis?
  - Are they produced centrally, all of them?
  - Are they currently producing? How can you monitor them.
  - How to produce it privately? (For learning, not suggestion for private production)
- Version of CMSSW, Global tag, Particle ID, …..

[link]

Run-2 UltraLegacy Datasets for Analysis

MiniAOD and NanoAOD Versions

Two versions of UL datasets are available for analysis

- MiniAODv1 and NanoAODv8. Please see the table at the bottom for information about rele
  Click on the table to access the gdoc containing the active links.
- MiniAODv2 (data, mc) and NanoAODv9 (data, mc).
- Global Tags:
  - Data: 106X_dataRun2_v35
  - MC 2016APV: 106X_mcRun2_asymptotic_preVFP_v11
  - MC 2016: 106X_mcRun2_asymptotic_v17
  - MC 2017: 106X_mc2017_realistic_v9
  - MC 2018: 106X_upgrade2018_realistic_v16_L1v1

Data Samples

Documentation of the Primary Datasets in data, including dataset and era-specific details is availa

- 2016 data (6 + 3 eras: "B_ver1", "B_ver2", C, D, E, "F(HIPM)", "F(no HIPM)", G, H).
- 2017 data (5 (+2) eras: B, C, D, E, F, (+G (5 TeV) and H (lowPU)))
- 2018 data (4 eras: A, B, C, D).

The production status in full technical detail is available in this daily updated page.

Monte Carlo Samples

The production status and history for the Monte Carlo samples is here:

- MiniAODv1 (RunIISummer20ULMiniAOD) PMP.
- MiniAODv2 (RunIISummer20ULMiniAODv2) PMP.
- NanoAODv8 (RunIISummer20ULNanoAODv2 (sic!)) PMP.
- NanoAODv9 (RunIISummer20ULNanoAODv9) PMP.

CMS Data Analysis Schools

- CMS Data Analysis Schools (CMSDAS) and Physics Object Schools (CMSPOS) are regularly organized (every 6 months or so)

- Exercises include tutorials and instructions for end-to-end physics analyses. How to find / determine / produce
  - datasets, software release
  - calibrations, configurations, conditions
  - cmsdrivers, global tags
  - gridpacks

- Tools
  - DAS for dataset navigation
  - Brilcalc for luminosity calculation
  - MCM and PMP (tutorial)
  - cmsDBBrowser

Previous CMS Schools:

- CMSDAS FNAL
- CMSPOS Aachen
- CMSDAS PISA
- vCMSDAS CERN

Watch out for the CMS DAS!: https://indico.cern.ch/category/371/

Dataset search and transfer

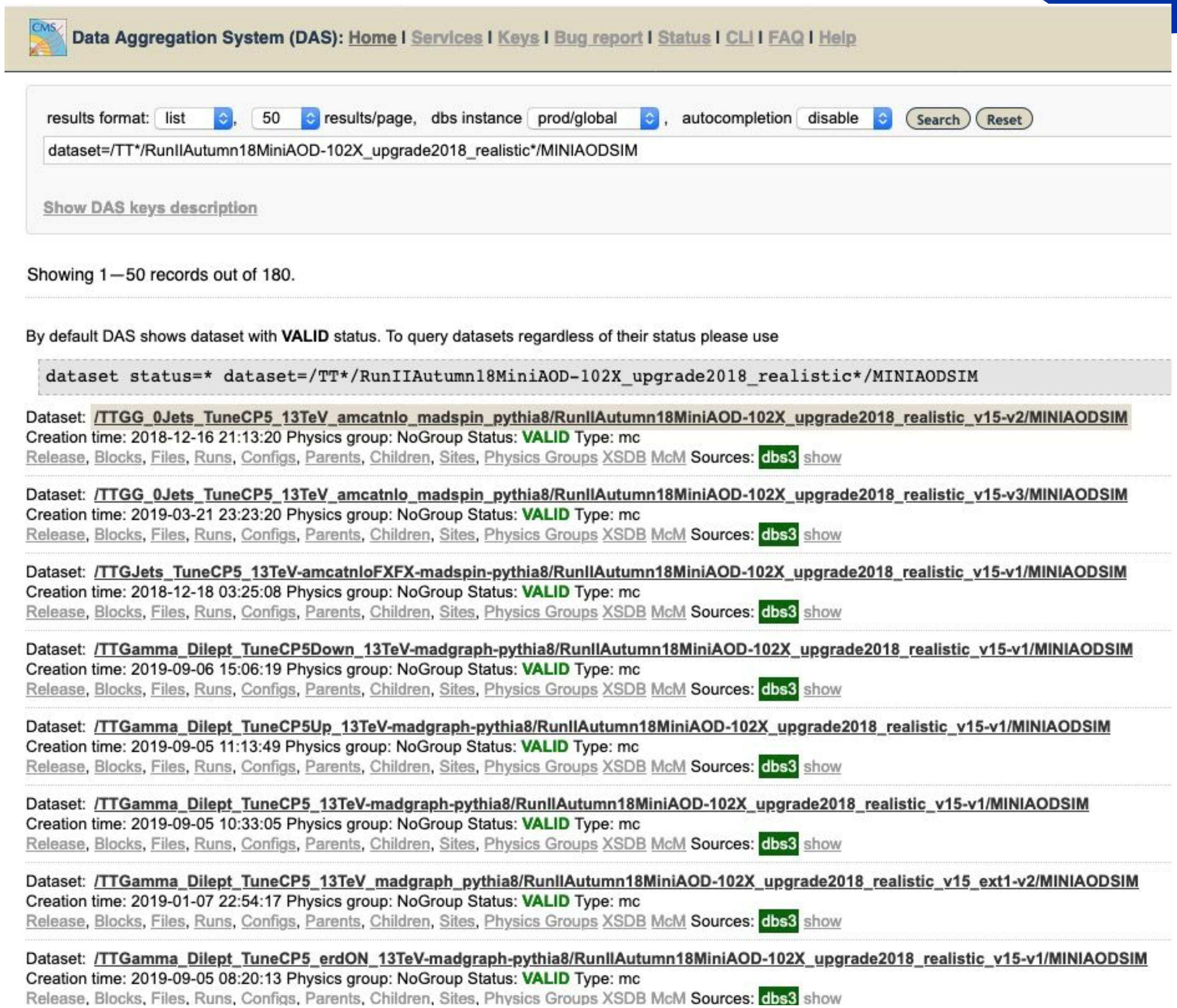
Data Aggregation Service (DAS)

- datasets and their properties (requestID, sites, run # and LS #....) + information from various services.
- requires a certificate in the browser (CERN, or mapping to CERN account) [link]

CMS Rucio

- is a tool to transfer datasets between sites (you may not need it for your analysis)
- MiniAOD and NanoAOD will always be on disk somewhere
- if transfer is needed (i.e. AOD), CRAB will help you (see next slide)

Example DAS link to MiniAOD for ttbar MC for 2018



Data Aggregation System (DAS): Home | Services | Keys | Bug report | Status | CLI | FAQ | Help

results format: list , 50 results/page, dbs instance prod/global , autocompletion disable Search Reset

dataset=/TT*/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic*/MINIAODSIM

Show DAS keys description

Showing 1—50 records out of 180.

By default DAS shows dataset with **VALID** status. To query datasets regardless of their status please use

```
dataset status=* dataset=/TT*/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic*/MINIAODSIM
```

Dataset: /TTGG_0Jets_TuneCP5_13TeV_amcatnlo_madspin_pythia8/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic_v15-v2/MINIAODSIM
Creation time: 2018-12-16 21:13:20 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

Dataset: /TTGG_0Jets_TuneCP5_13TeV_amcatnlo_madspin_pythia8/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic_v15-v3/MINIAODSIM
Creation time: 2019-03-21 23:23:20 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

Dataset: /TTGJets_TuneCP5_13TeV-amcatnloFXFX-madspin-pythia8/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic_v15-v1/MINIAODSIM
Creation time: 2018-12-18 03:25:08 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

Dataset: /TTGamma_Dilept_TuneCP5Down_13TeV-madgraph-pythia8/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic_v15-v1/MINIAODSIM
Creation time: 2019-09-06 15:06:19 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

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Creation time: 2019-09-05 11:13:49 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

Dataset: /TTGamma_Dilept_TuneCP5_13TeV-madgraph-pythia8/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic_v15-v1/MINIAODSIM
Creation time: 2019-09-05 10:33:05 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

Dataset: /TTGamma_Dilept_TuneCP5_13TeV_madgraph_pythia8/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic_v15_ext1-v2/MINIAODSIM
Creation time: 2019-01-07 22:54:17 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

Dataset: /TTGamma_Dilept_TuneCP5_erdON_13TeV-madgraph-pythia8/RunIIAutumn18MiniAOD-102X_upgrade2018_realistic_v15-v1/MINIAODSIM
Creation time: 2019-09-05 08:20:13 Physics group: NoGroup Status: **VALID** Type: mc
Release, Blocks, Files, Runs, Configs, Parents, Children, Sites, Physics Groups XSDB McM Sources: dbs3 show

CMS Remote Analysis Builder

CRAB
Cms Remote Analysis Builder

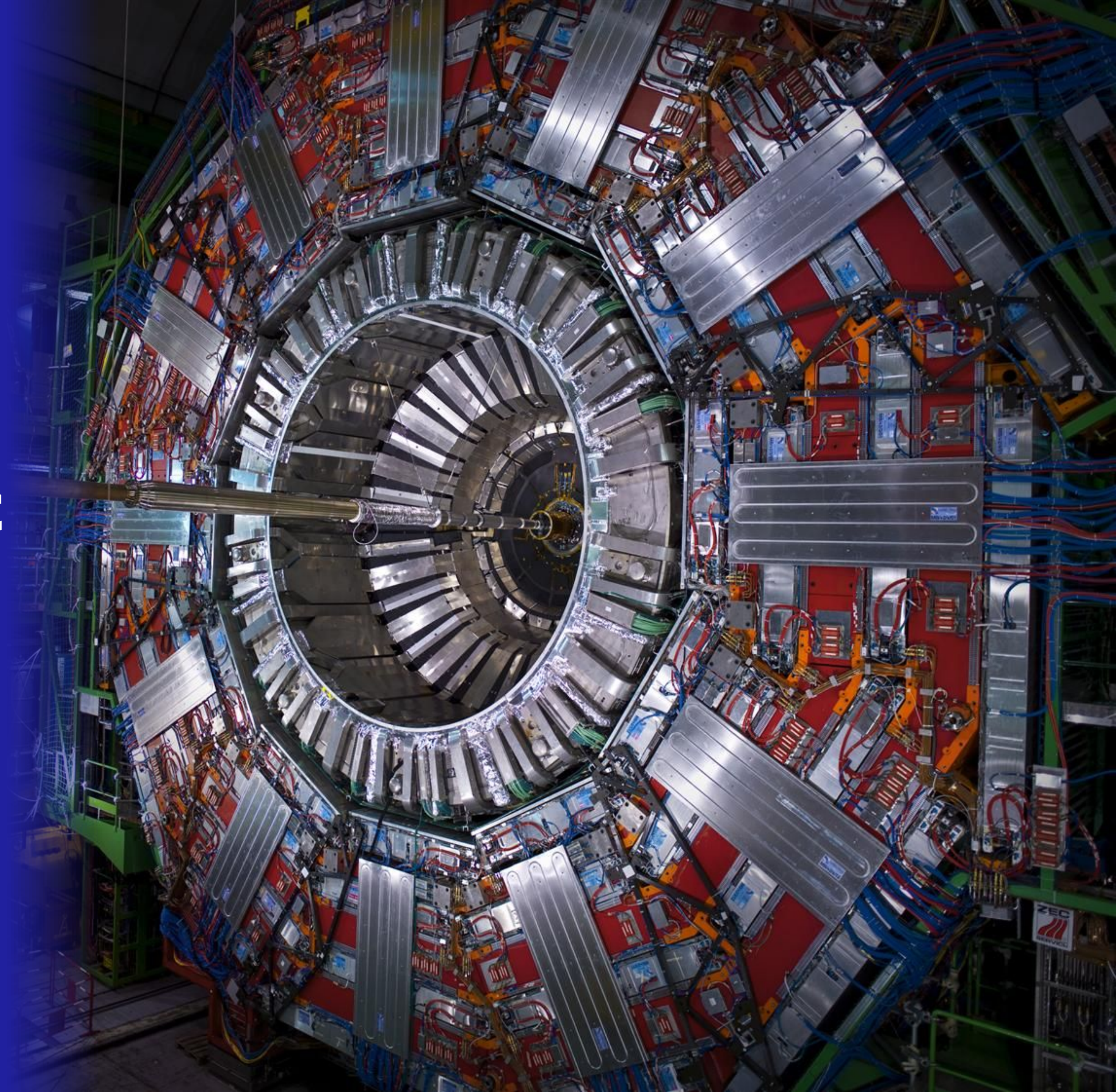
- CRAB is a utility to submit jobs to distributed computing resources for both CMSSW and user scripts

- By using CRAB you will be able to:
  - Access CMS data and Monte-Carlo which are distributed to CMS aligned centres worldwide.
  - Exploit CPU and storage resources at CMS centres.
  - Datasets not on disk will be transferred from tape to disk for you automatically
  - Before starting: you need to have a grid certificate.

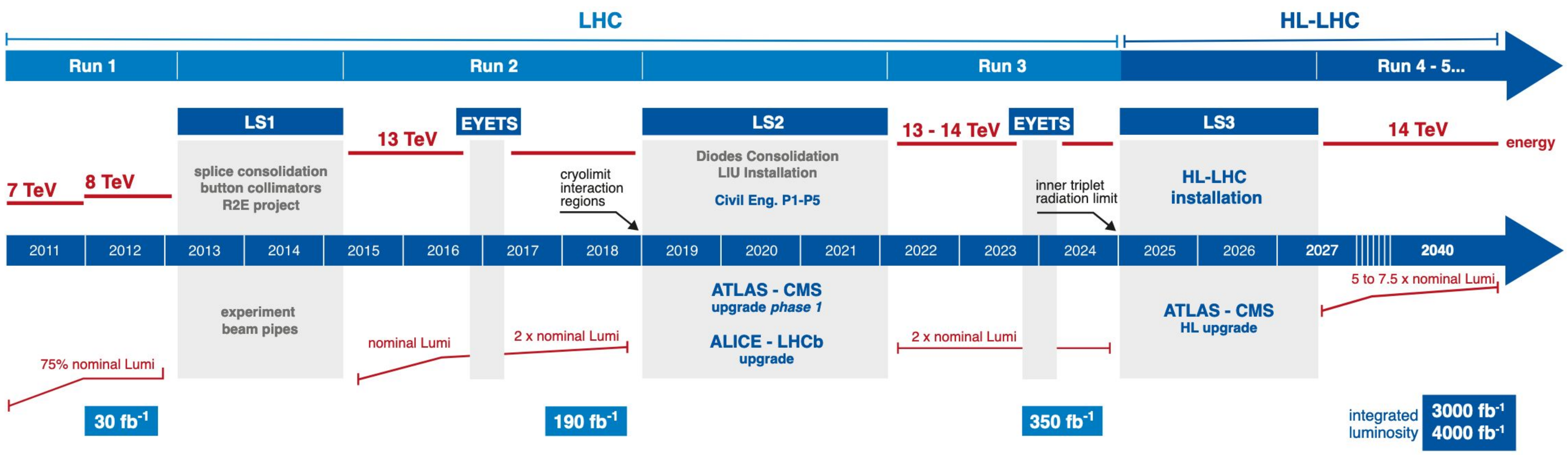
CRAB: the Swiss Army knife of Job Submission Plenty of Opportunities for curious developers: core, interface, documentation, trainings, community building!

You are invited to join the CRAB Meetings!

The (Near) Future: HL-LHC and Phase2



Will Software and Computing scale to Phase-2?



https://hilumilhc.web.cern.ch/sites/hilumilhc.web.cern.ch/files/images/HL-LHC-plan-2021-1.pdf

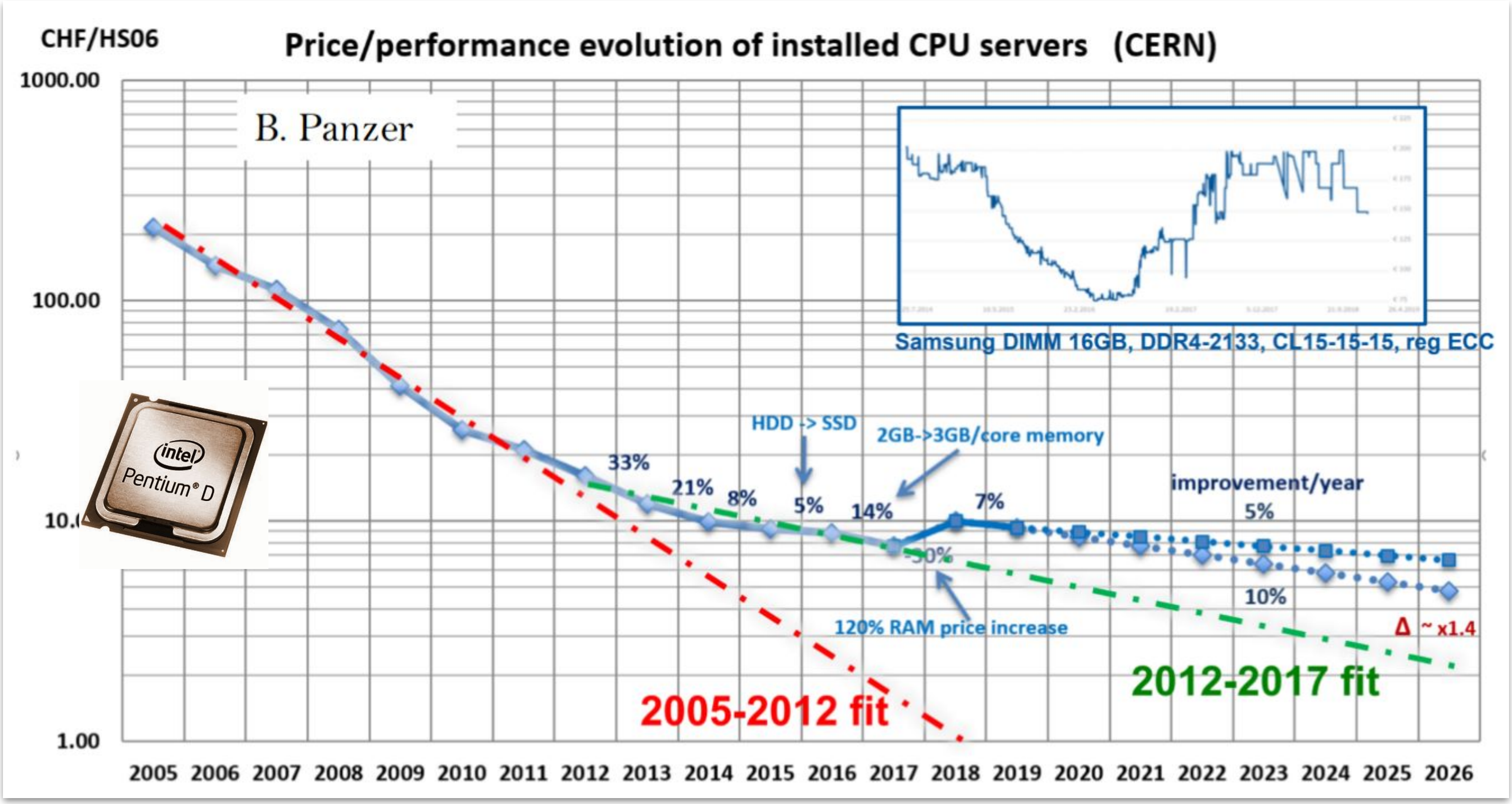
- Not only **an unprecedented accelerator upgrade…**
- **… but also an ambitious CMS detector upgrade**
- Much more data, much more complex!

We also call this scenario *Phase-2*

Market Trends of CPUs

HL-LHC computing will not rely on CPUs alone, also on GPU - being prepared already for Run-3

impossible-to-predict developments, *fierce* competition (AMD, Intel, IBM, ARM, ...): keeping our eyes open



Summit Supercomputer: 4608 nodes. **Per node, 2 IBM POWER9™ CPUs, 6 NVIDIA V100 GPUs.**

https://en.wikipedia.org/wiki/Summit_(supercomputer)

A Taste of Phase-2 Challenges for Software & Computing

The CPU computing power / price affects CMS (and other experiments). If one considers for CMS:

- The current Grid computing approach
- A **flat budget** to finance its computing resources
- **No change in its computing model and data processing software**

Factor order of 10, for storage and CPU still missing to successfully trigger, process and analyse Phase-2 data

Comprehensive R&D effort to facilitate optimal use of the vast HL-LHC physics potential

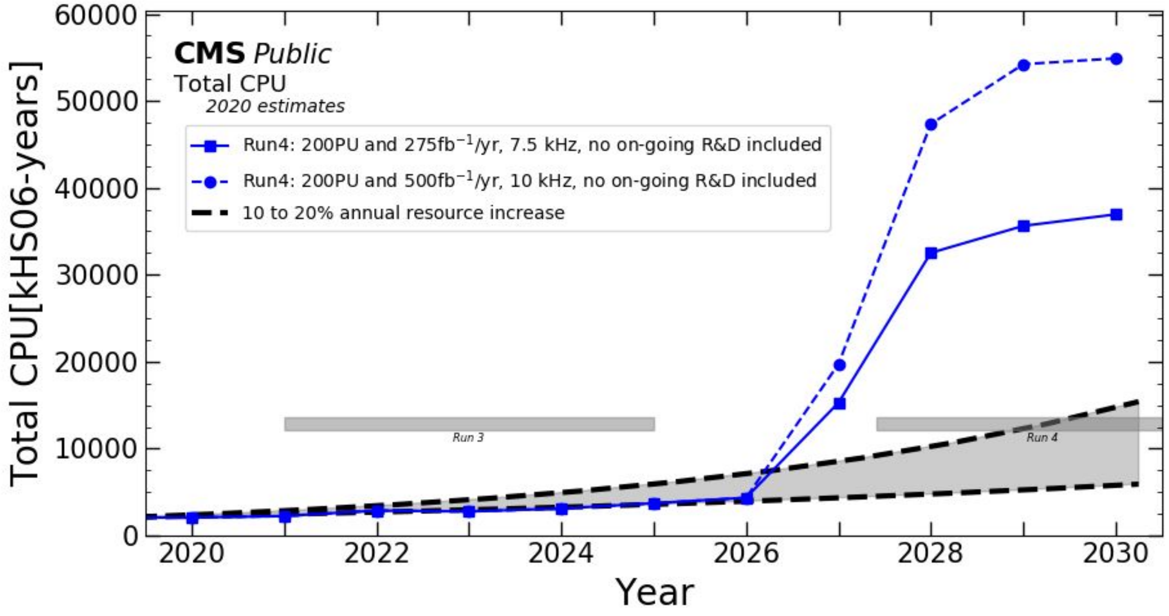
- Smarter algorithms, smaller data formats
  - e.g. “scouting” (aka trigger-level analysis, i.e. high rate but small event contents)
- Reduced data formats (e.g. NanoAOD)
- Faster event simulations
  - Invent new approaches
  - optimise the traditional ones
- Increase usage of HPCs
- Better (faster!) algorithms and data structures
- Effectively exploit heterogeneous architectures

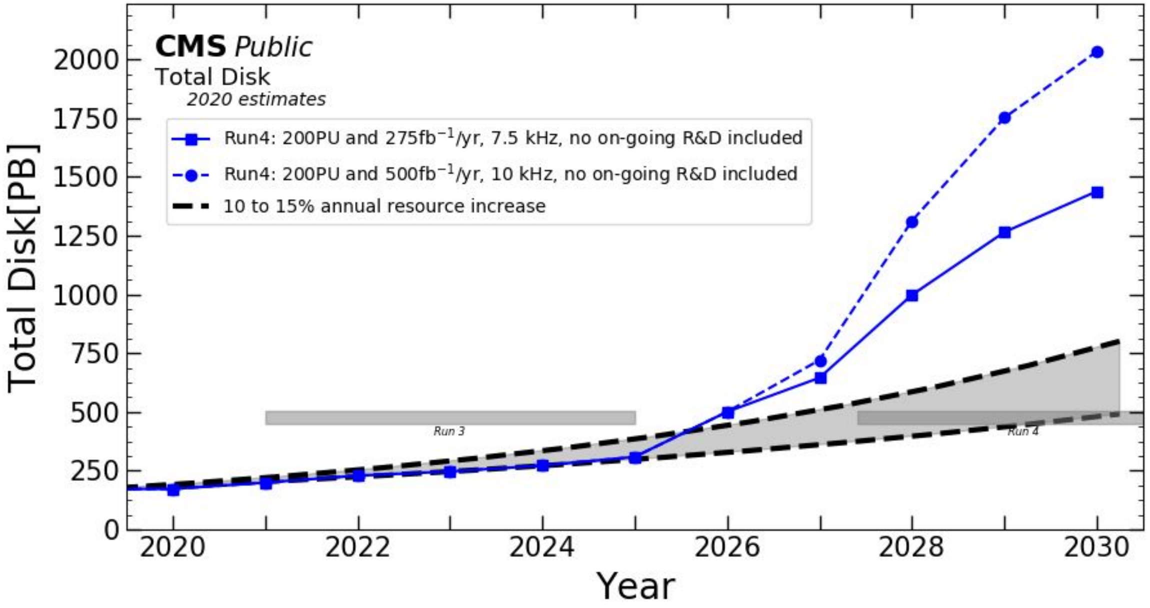
Focus on these two very entangled aspects in this talk

Scientific software expertise can reduce the costs of computation

The Computing Power and Disk Space Gap

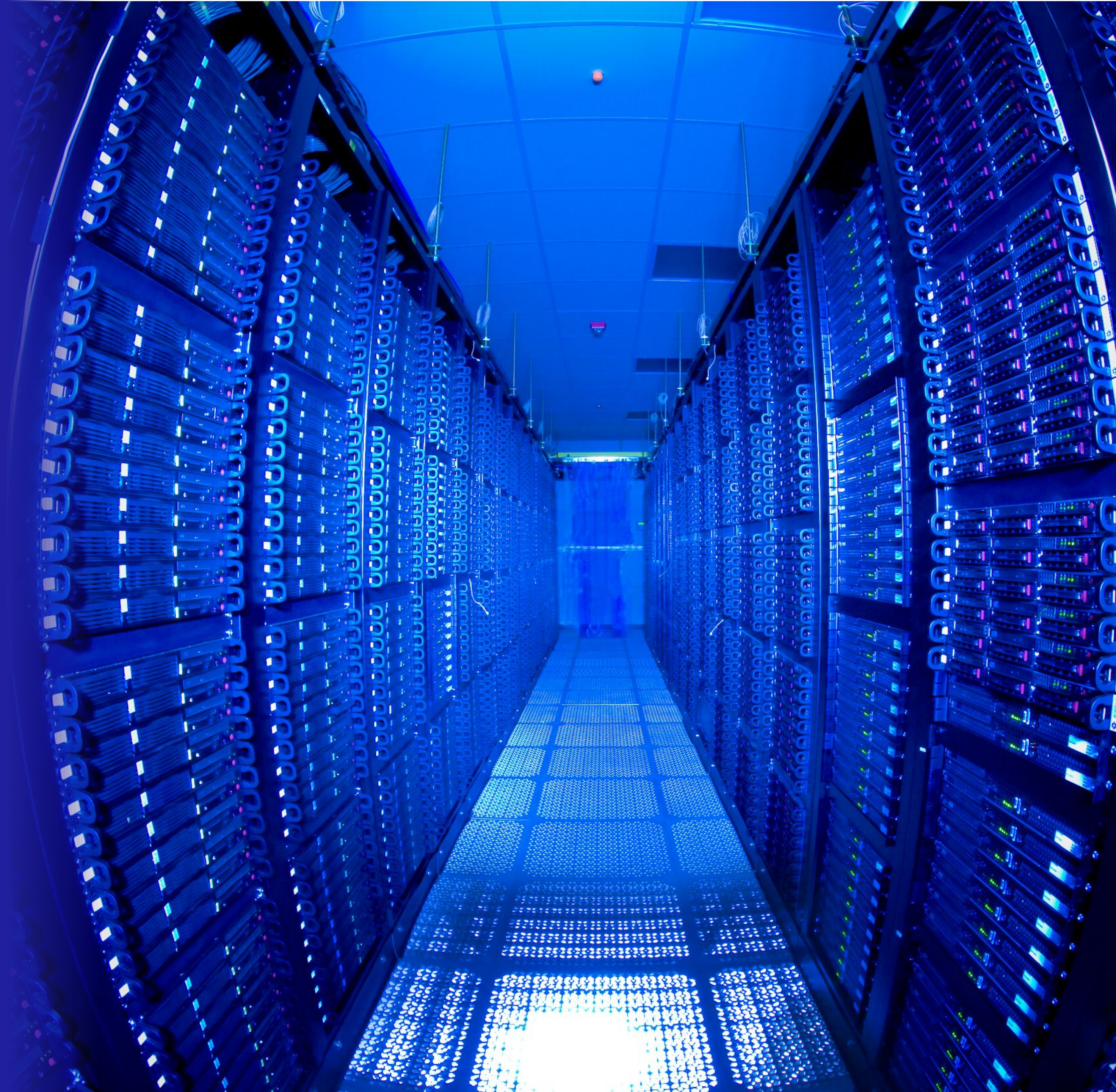
This is the kind of challenges we want to tackle!





One motivate person can make the difference! Exciting times for curious physicists-developers!

Meetings and Links



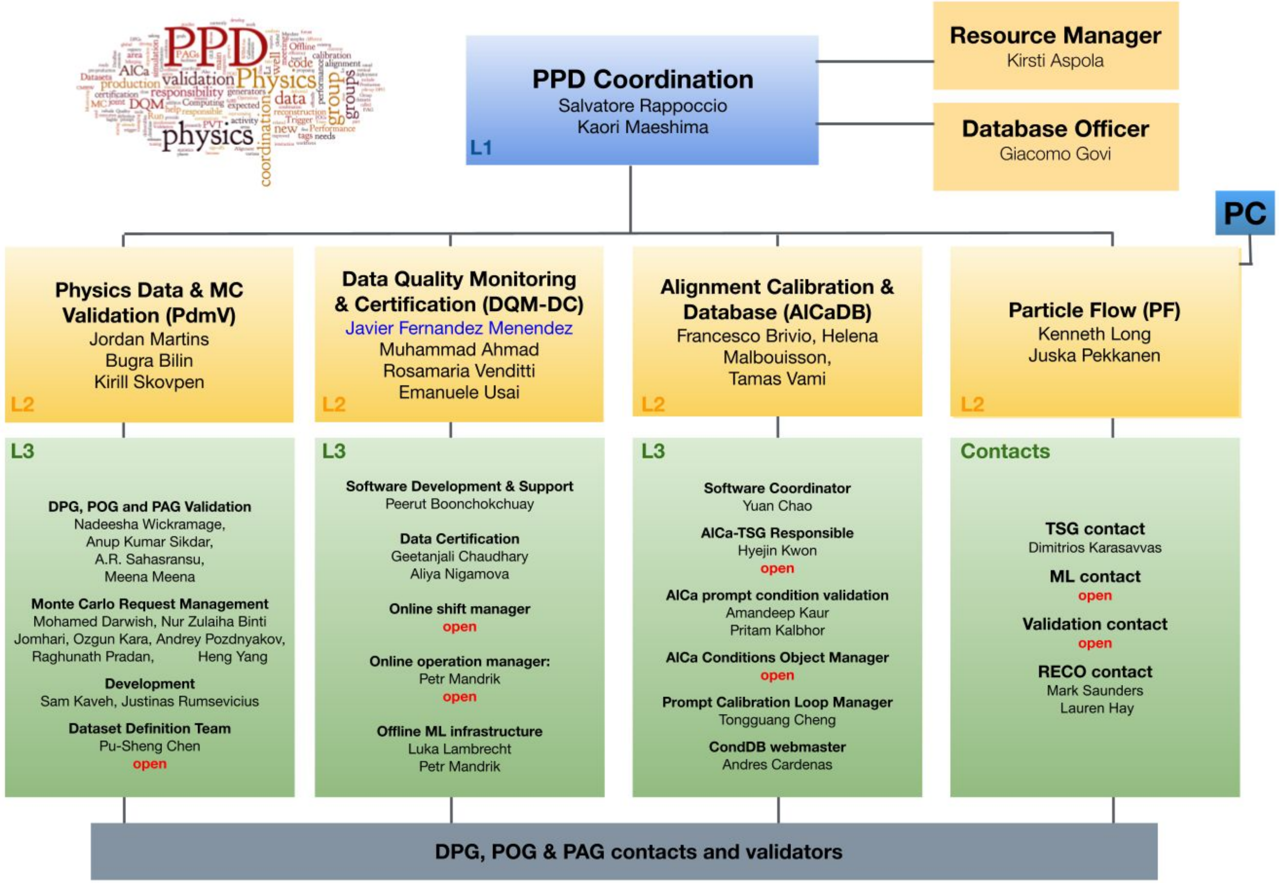
Reach Out to the Physics Performance and Dataset Area!

PPD [Webpage]

- **PdmV (Physics data & MC validation)**
  - Detector and physics performance reviews
  - Code Validation (Relval)
  - MC request management
- **AlcaDB (Alignment/Calibration & DB)**
  - Review of detector conditions
  - Database administration
- **DQM (Data Quality Monitoring)**
  - Data quality monitoring (online and offline)
  - Data certification
- **PF (Particle Flow)**
  - Optimal combination of physics objects (tracks and clusters)
  - Developments for Run-3 and Phase-2

Great opportunities to contribute to physics performance reviews, data monitoring and preparation and to tools developments for Run-3

Physics Performance & Datasets (PPD) Organisation as of 08/21



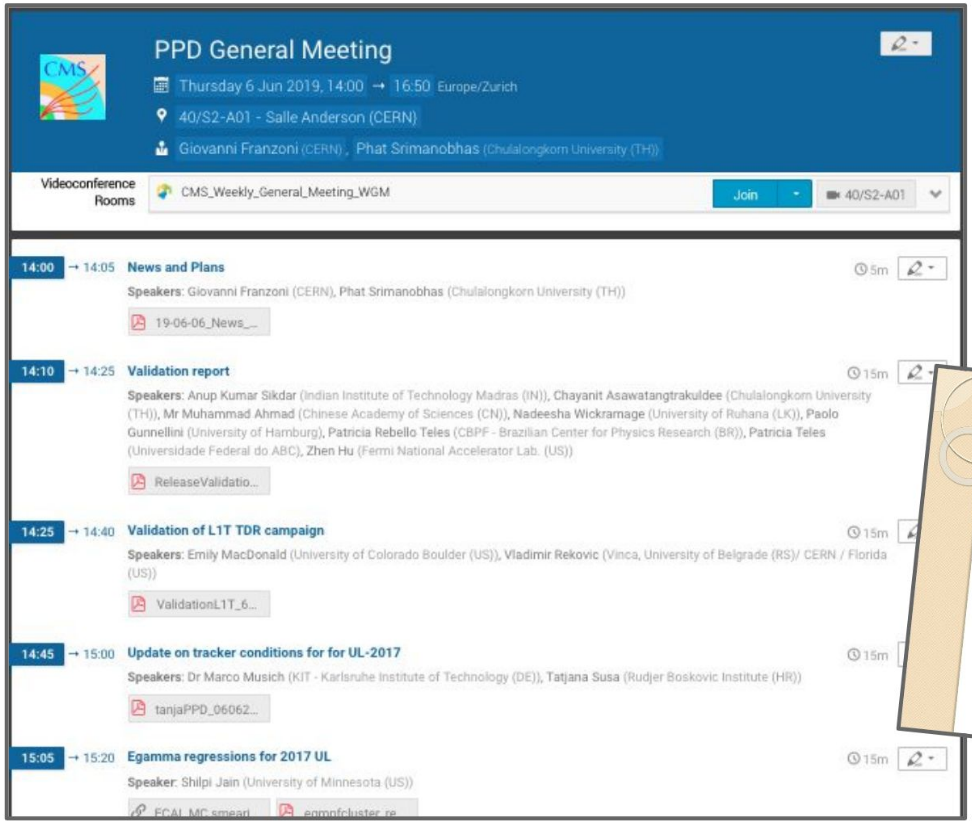
PPD General Meeting

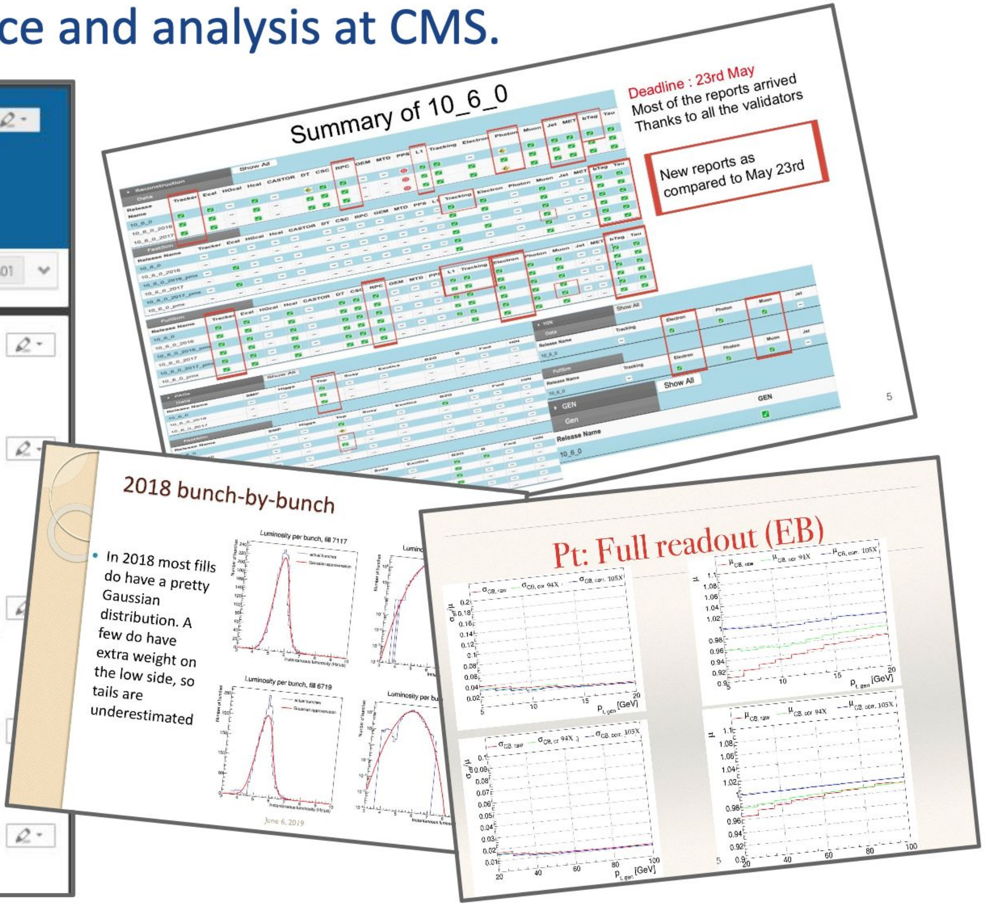
PPD general meeting is a plenary forum for performance discussion for

- Detector Performance Groups (DPG)
- Physics Object Groups (POG)
- Physics Analysis Groups (PAG)

This means "**everyone**" doing performance and analysis at CMS.

Join the [PPD General Meetings](#)
Plenary every Thursday: 14-16h





Reach Out to the Offline Software and Computing Area!

Coordinators
D. Piparo, J. Letts

Visit the O&C website!

Core Software
S. Muzaffar, M. Kortelainen

Computing Operations
C. Paus, N. Smith

Dyn. Res. Provisioning
D. Spiga, C. Wissing

Facility Services
G. Bagliesi, S. Lammel

Simulation
V. Ivantchenko, S. Bein

Workload/Data Mgt Devel
K. Lannon, K. Ellis

Reconstruction
S. Krutelyov, J. Pata

Resource Management
J. Flix, D. Lange

Monitoring & Analytics
B. K. Jashal, F. Legger

Offline Release Planning
A. Perrotta, Q. Li

Upgrade Software
P. Srimanobhas, A. Di Florio

Submission Infra
A. Perez-Calero, M. Mascheroni

Analysis Infra & Support
S. Belforte, S. Malik, M. Tonjes

Upgrade R&D and TDR
M. Girone, D. Elvira

Web Services & Security
A. Pfeiffer, P. Paparrigopoulos

Generators *
S. Bhattacharya, G. Chahal

L1 Software **
V. Rekovic, C. Caillol

DPOA ***
K. Lassila-Perini, E. Carrera

Machine Learning *
J.R. Vlimant, G. Kasieczka

Computing Resources Board
J. Hernandez, K. Bloom

O&C General Meetings
Wednesday: 15:00 - 16:00

* Joint with Physics
** Joint with TSG
*** Joint with CB
Mandates here

Summary

A lot of information, but hopefully:

- A taste of data processing and preparation for physics analysis
- Overview of the paths and procedures to bring the data from the detector to the final analysis
- Useful links and an overall view of what is O&C and PPD are busy with
- Join us! You can make the difference!

O&C keywords

Done at https://www.wordclouds.com

Important Twikis, Chats and Mailing Lists

- Mattermost Channel: https://mattermost.web.cern.ch/cms-exp
- Analysis recipe, Re-Processing information, JSON:

  https://twiki.cern.ch/twiki/bin/viewauth/CMS/PdmV
- Information of data recorded by CMS: https://cmswbm.cern.ch/
- Offline Workbook: https://twiki.cern.ch/twiki/bin/view/CMSPublic/WorkBook
- Questions on datasets, processing: hn-cms-physics-validation@cern.ch
- Questions on Monte Carlo production: hn-cms-prep-ops@cern.ch
- Questions on CRAB, computing tools: hn-cms-computing-tools@cern.ch

More Mailing Lists and Documentation

Contacts	Documentation
cms-ppd-coordinator@cern.ch, cms-offcomp-coordinator@cern.ch	PPD Main Twiki, Offline Main Twiki, Computing Main Twiki
hn-cms-dataset-definition@cern.ch	DDT Twiki
hn-cms-computing-tools@cern.ch	DAS
hn-cms-prep-ops@cern.ch	PdmV Twiki, McM
	Computing Model Workbook
hn-cms-offlineAnnounce@cern.ch hn-cms-relAnnounce@cern.ch	Offline Workbook SW Guide
hn-cms-physTools@cern.ch	MiniAOD Workbook
hn-cms-phedex@cern.ch	XROOTD doc, Phedex - Phedex Workbook
hn-cms-relval@cern.ch hn-cms-physics-validation@cern.ch	PdmV Twiki
hn-cms-evfdqmannounce@cern.ch	DQM Twiki
hn-cms-data-certification@cern.ch	DQM-DC Twiki, JSON File Twiki, RunRegistry
hn-cms-luminosity@cern.ch, cms-pog-conveners-lum@cern.ch	brilcalc Doc, lumi pog
hn-cms-alca@cern.ch	AlCaDB Twiki, GlobalTag Twiki