Technical Coordination and Run Coordination in CMS

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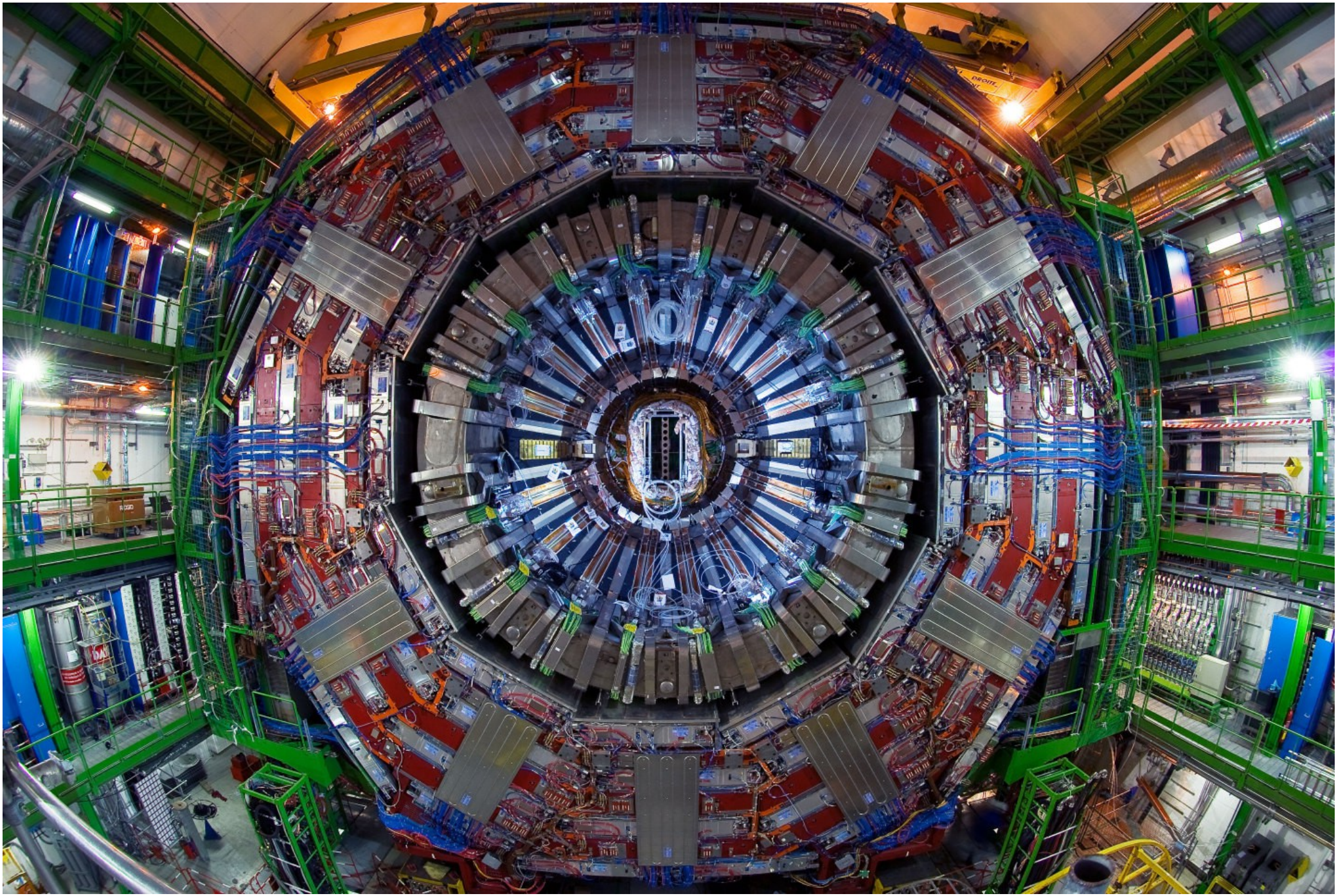
Technical coordination is the art to transform

THIS:

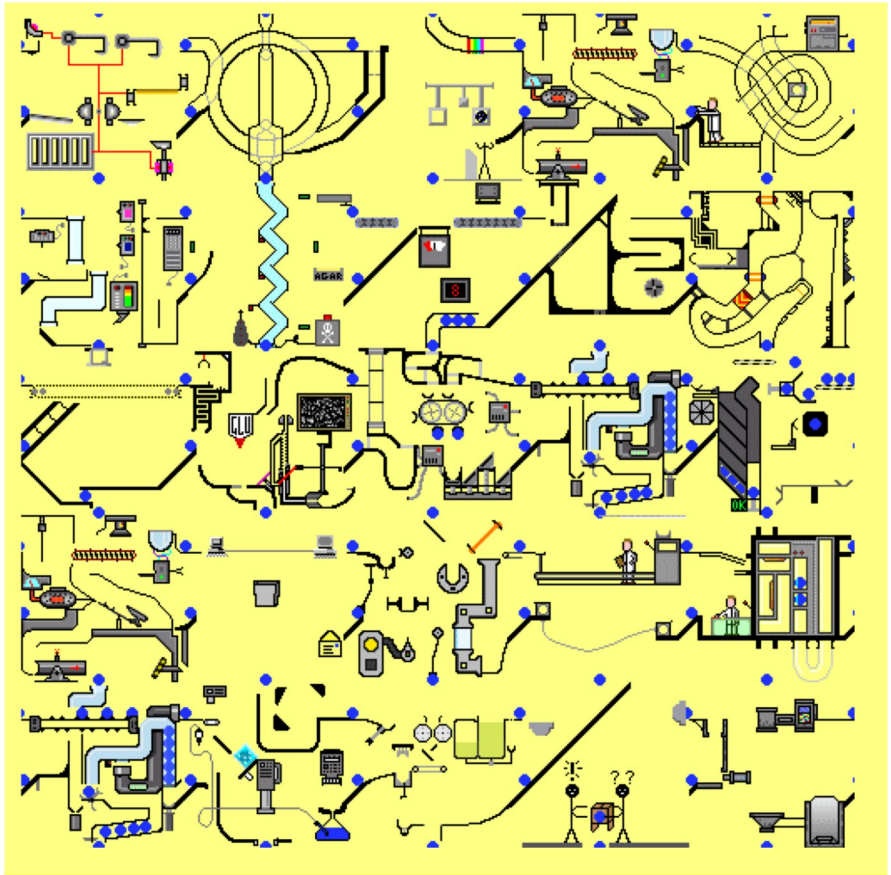

MAX 25 T.

Into

THAT:



Technical Coordination (after construction)



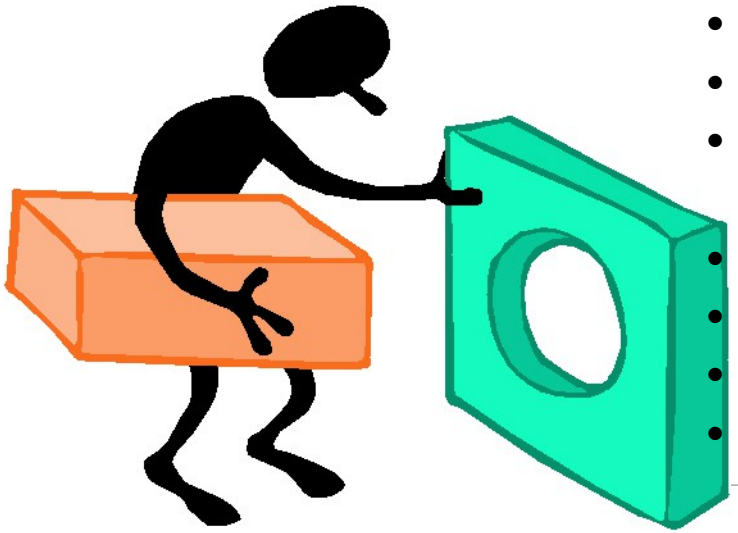
As you can see, there are a lot of **interfaces** and **inter-dependencies** to be considered...

- **CMS is a very complicated technical object**
  - Continuously upgraded
  - Continuous maintenance work
  - Safety (see talk of Niels)
    - Gas
    - High Voltages
    - Cryogenic installations
    - Strong magnetic fields
    - Radioactive sources, activated material, lasers...
  - Activities on this objects must be coordinated.

Upgrade projects

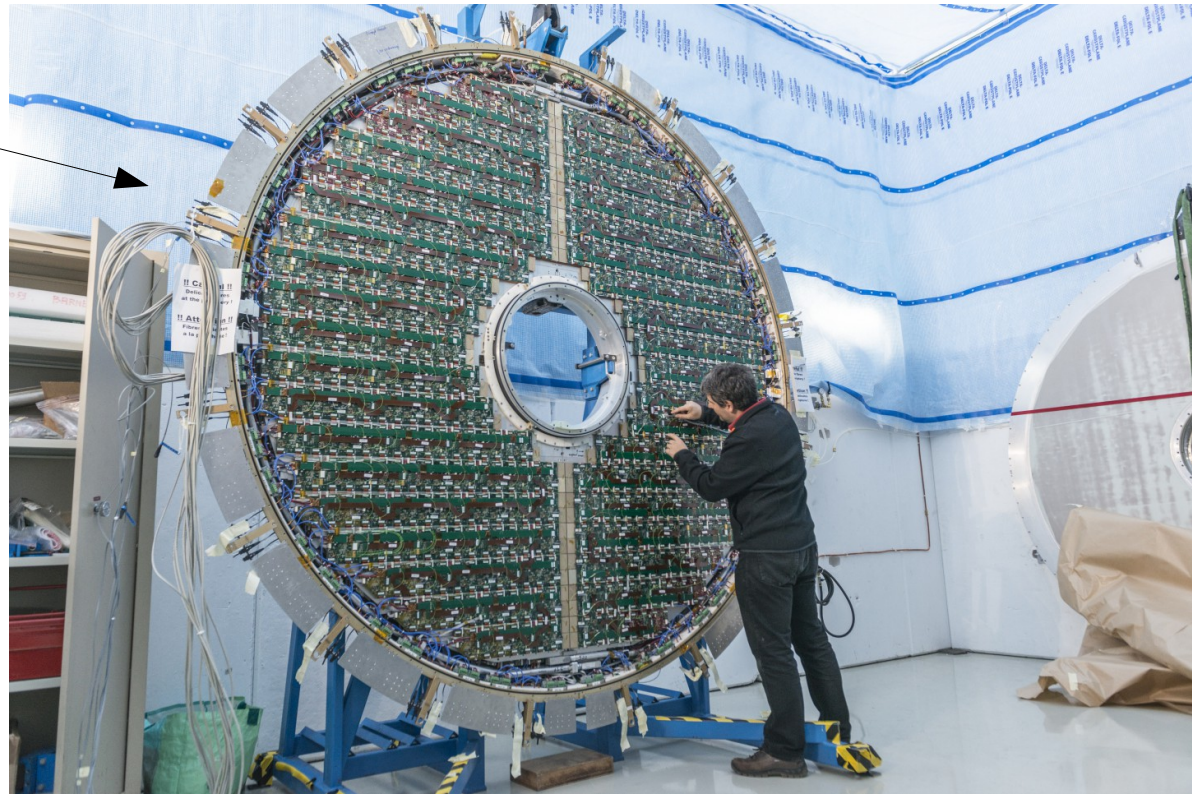
- **Technical coordination is involved in all upgrade projects for the CMS detector:**
  - Compatibility with the existing detector has to be ensured
  - Compatibility with the LHC accelerator has to be ensured
  - Performance of the entire detector has to be kept at a high level
  - A plan for integration of new components needs to be worked out
    - Involved a lot of engineering in various fields
      - Cooling, electrical eng., mechanical eng.

- **Major upgrade projects take place in Long Shutdowns (LS)**
  - We just came out of the first Long Shutdown: LS1
  - Examples of upgrades CMS has performed / is performing in LS1:
    - YE4
    - New muon RPC chambers RE4
    - New muon CSC chambers ME4/2 (CSC chambers)
    - New readout electronics with finer granularity for ME1/1
      - Inner CSC chambers at high eta, with high occupancy
    - New sensors in HCAL
    - Refurbishment of the tracker cooling
    - New DAQ system, new Trigger in preparation for 2016
    - New detectors for beam diagnostics and luminosity measurement



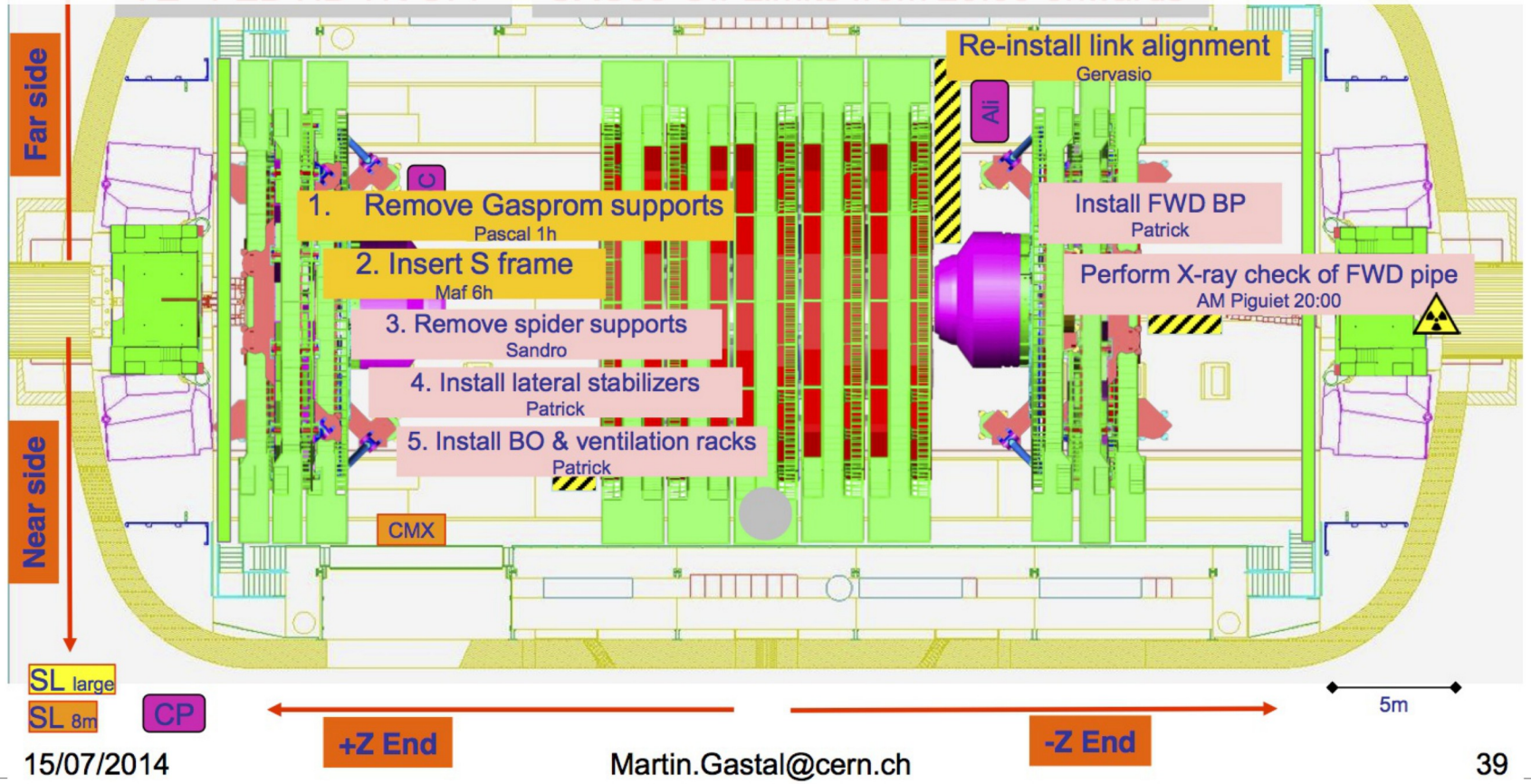
Upgrade projects

- **Upgrade work in Long Shutdowns take place at the same time as maintenance work**
  - Examples of major maintenance work in LS1:
    - Preshower disks had to be brought to the surface for repair.
    - Muon chamber electronics had to be replaced.
    - Gas leaks in the RPC chambers had to be closed.



Planning

- **Technical Coordination needs to plan all these activities carefully**
  - On a long time scale – but being flexible in case of unforeseen issues
  - On a day by day basis
    - Daily meetings during Shutdowns and Technical Stops
  - Technical coordination together with the Spokesperson and in agreement with the Collaboration Board **prioritizes** the various tasks



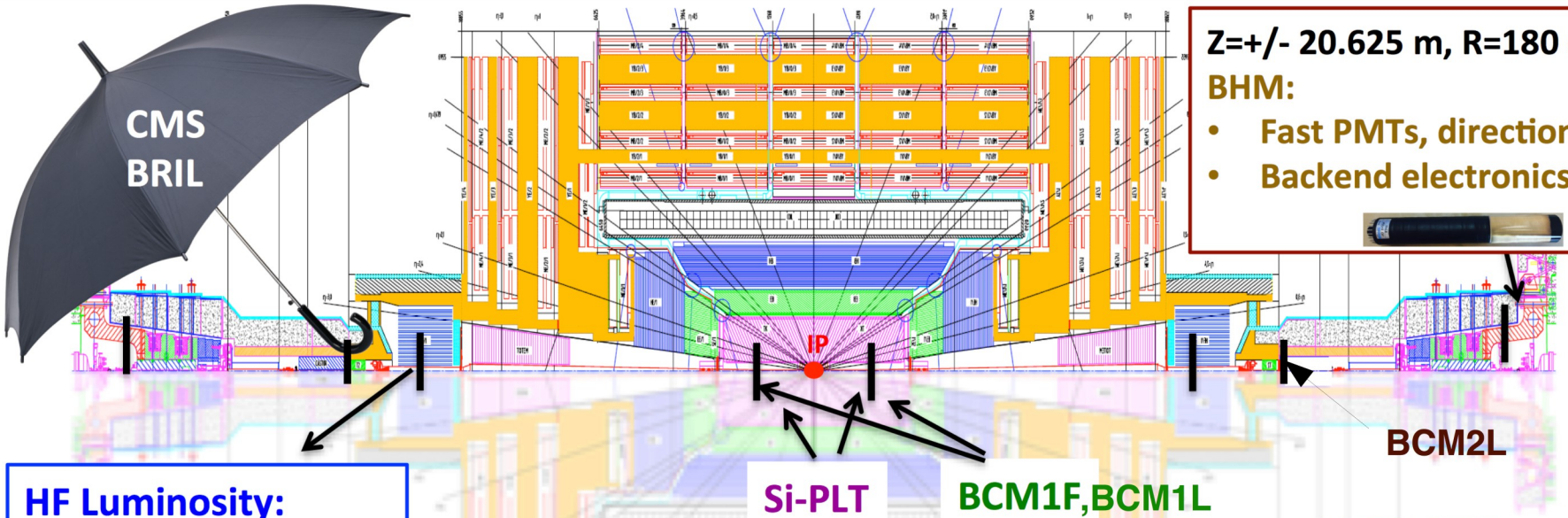
Further tools & tasks of TC

- **For the day-to-day planning:**
  - Daily meetings in point 5 during shutdown periods to discuss the plan of the day
- **Organization of reviews before any production**
  - Experts (usually internal) are invited to review projects before a major production is started
  - This minimizes the risk for a project to fail or to cause unexpected cost to completion
  - Ensures compatibility with the rest of CMS.
  - Ensures the required performance of the apparatus
- **Technical coordination is the link of CMS to CERN-services**
  - Examples are: cooling and ventilation, electrical power, gas services

Beam Instrumentation (BRIL project)

- **CMS needs to continuously monitor the background of the beam**
  - This is to guarantee safe operation of the detectors especially the pixel and the silicon strip detectors which are close to the beam.
    - A beam abort is triggered if the background reaches dangerous levels
  - The Silicon Tracker high-voltage in CMS is only switched on, if background values are below a certain threshold
  - Beam gas and beam halo interactions reflect the “quality” of the beam
  - LHC needs these values in real-time for feedback on the beam conditions
- **We have to measure luminosities: real time, integrated delivered and recorded**
  - These values are needed for physics and by the LHC as feedback
  - CMS measures luminosity with “standard sub-detectors” like HF (the “main” luminosity detector) or Pixel and with a set of dedicated detectors built and operated under the BRIL project (BCM1F, PLT)
  - The calculation of the luminosity of ALL these detectors is done under the BRIL project

Beam Condition Monitors



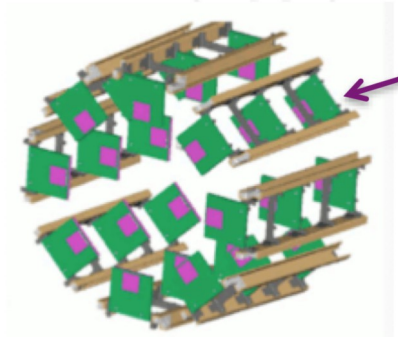
Z=+/- 20.625 m, R=180 cm

BHM:

- Fast PMTs, directionality
- Backend electronics

HF Luminosity:

- Photo-detectors
- backend electronics



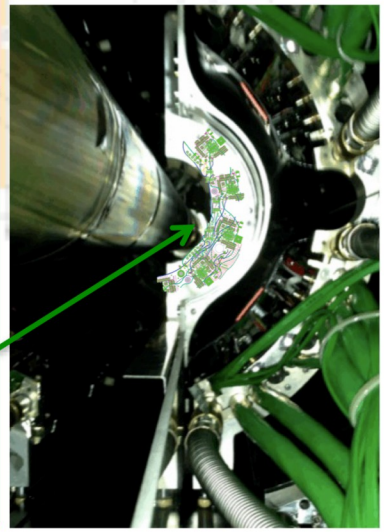
Z=+/- 1.8 m, R=5 cm

si-PLT:

- 48 si-pixel sensors
- special 40 MHz readout

BCM1F:

- 48 **single crystal diamond sensors**
- fast MIP counter, triggerless readout

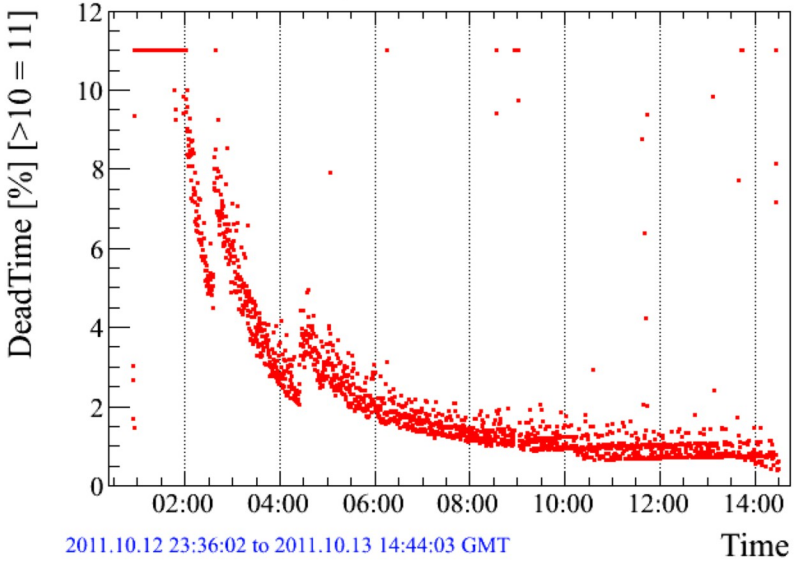


Beam Instrumentation (BRIL project)

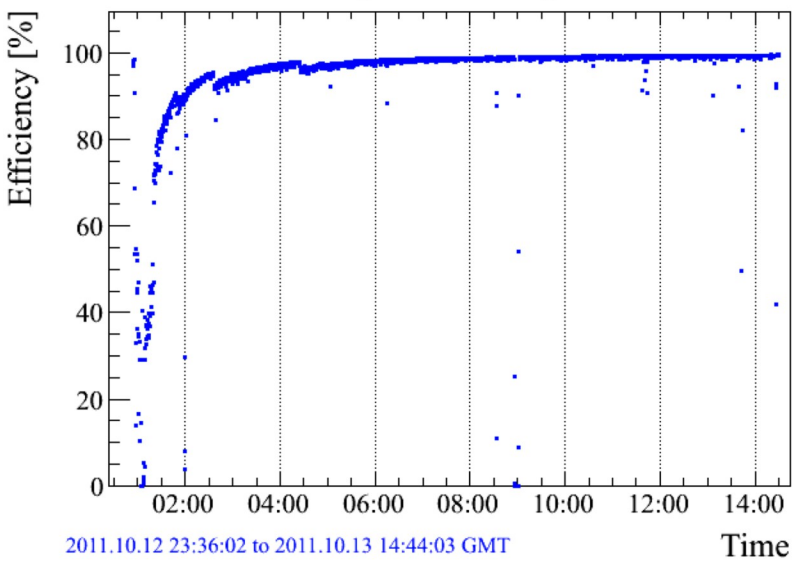
- **The BRIL project is like any other project in CMS**
  - There is an Institution Board with representatives of all participating institutes
  - The project has to raise its funding
  - The project has to find manpower
- **But the BRIL project reports directly to Technical Coordination**
  - Technical coordination is “contacted” (i.e. shouted at) in case we
    - publish wrong values for beam conditions or luminosity
    - dump the beam without obvious reason

Example: bad beam conditions in Fill 2208

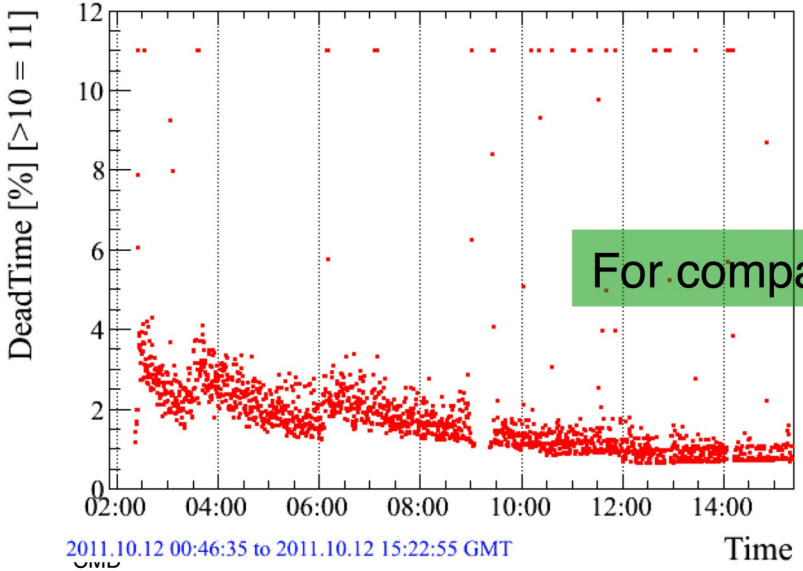
Fill 2208 Datataking Deadtime



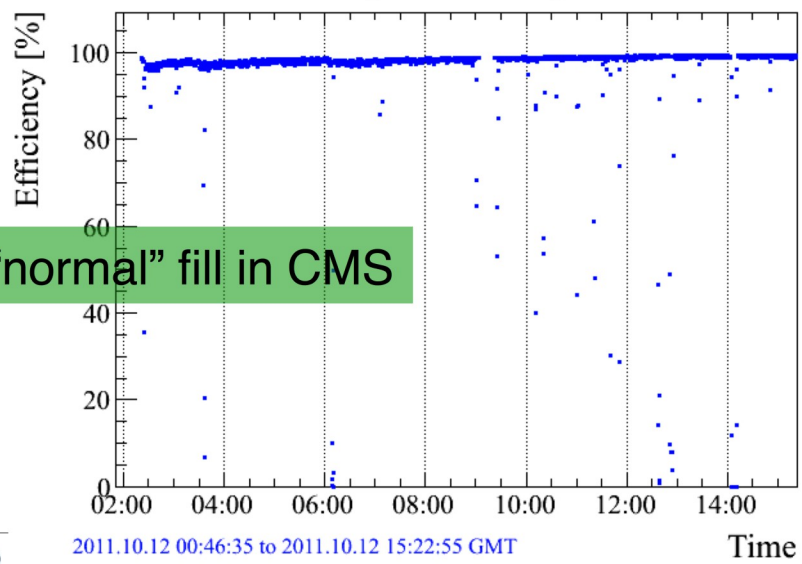
Fill 2208 Datataking Efficiency



Fill 2204 Datataking Deadtime

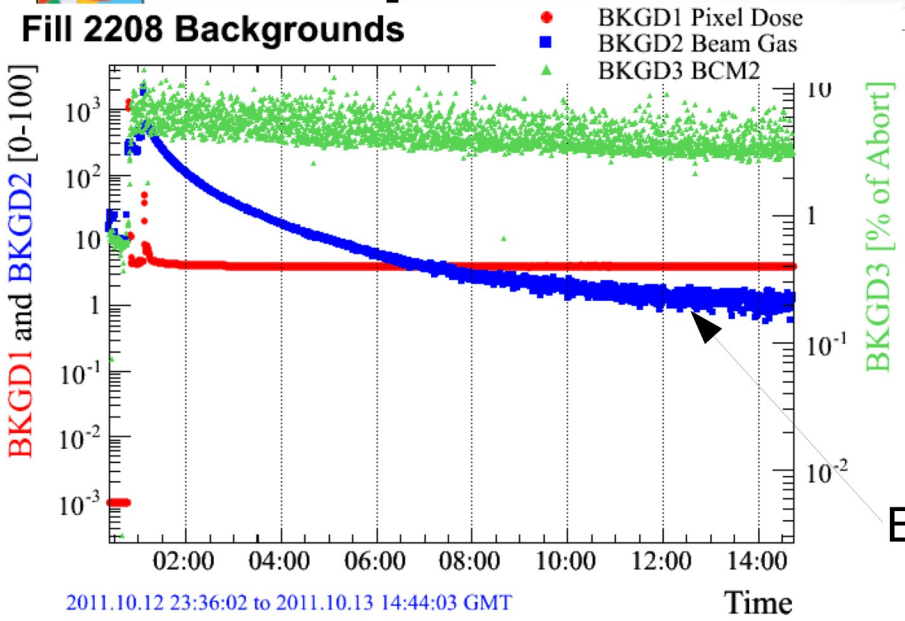


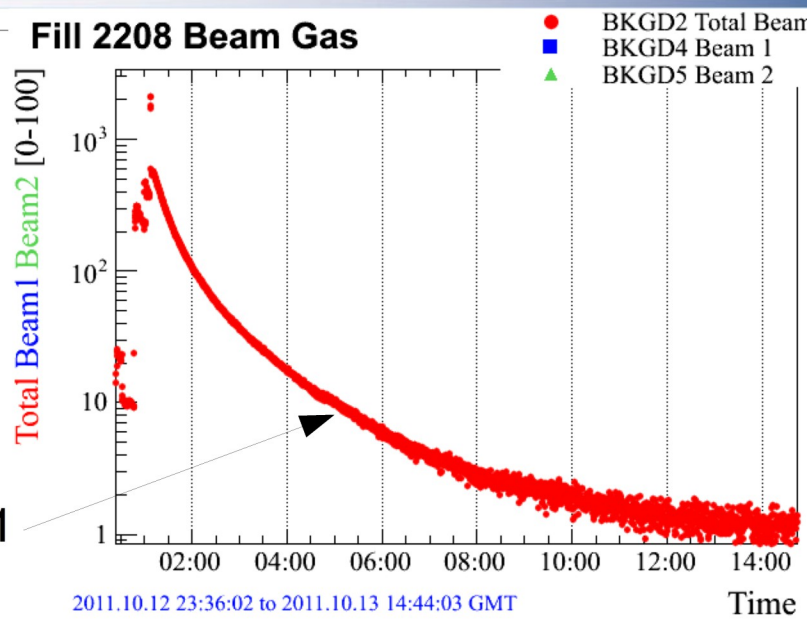
Fill 2204 Datataking Efficiency



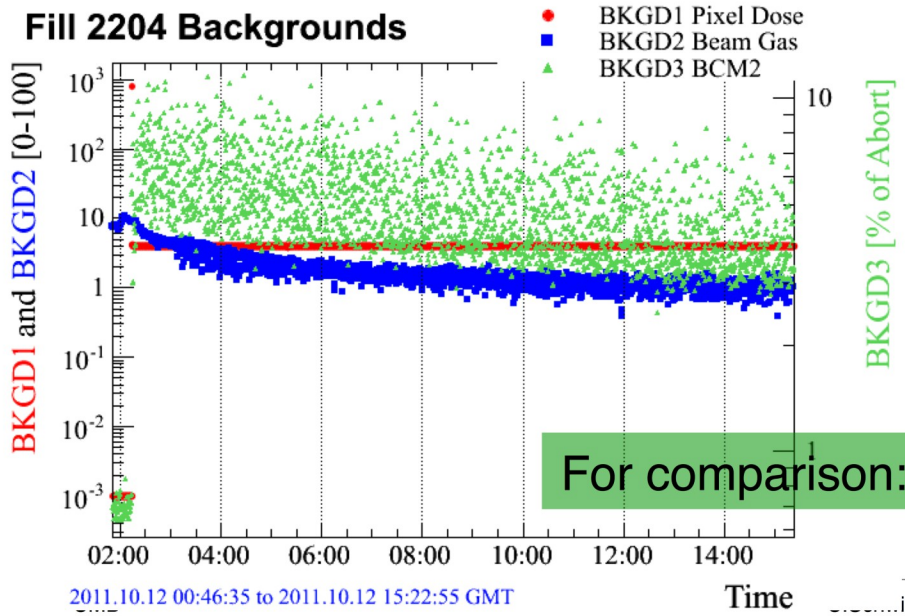
For comparison: a “normal” fill in CMS

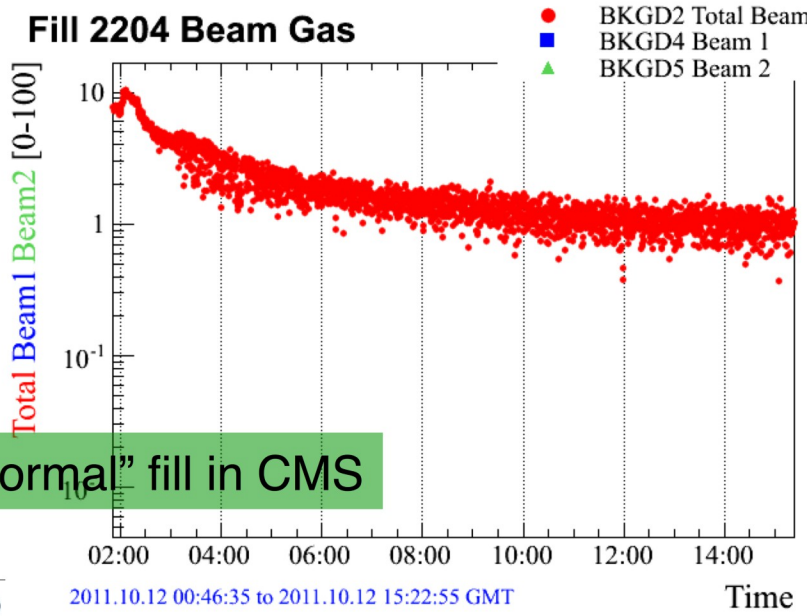
Example: bad beam conditions in Fill 2208





BCM1





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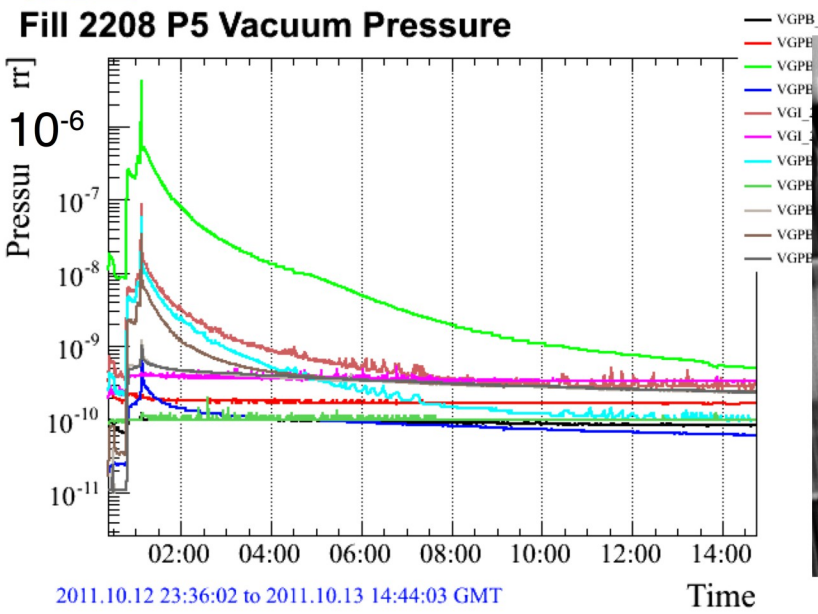
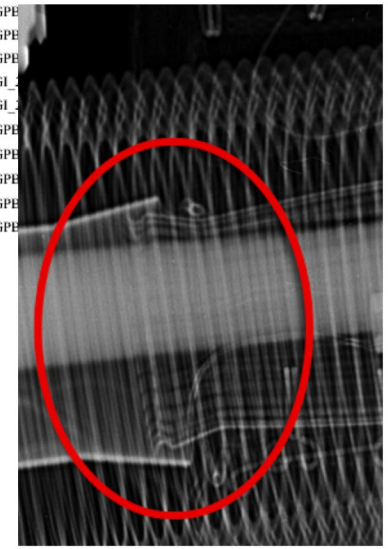
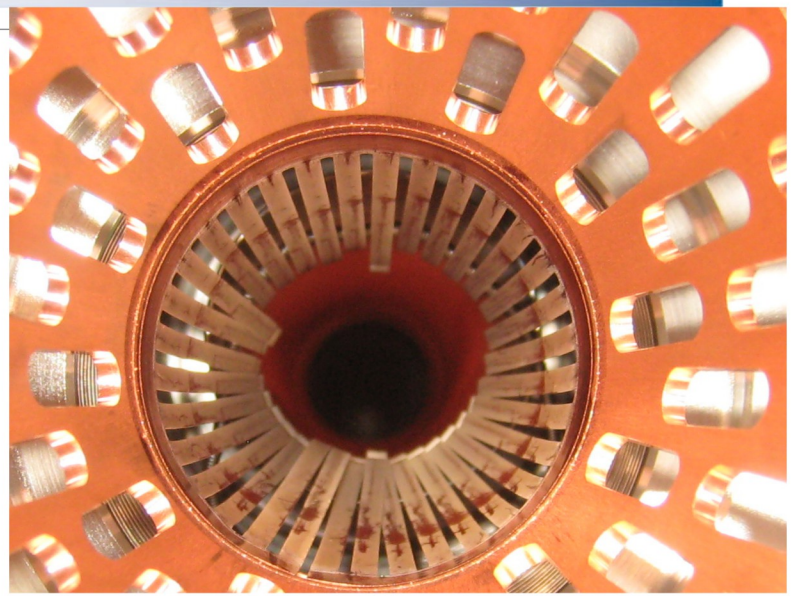
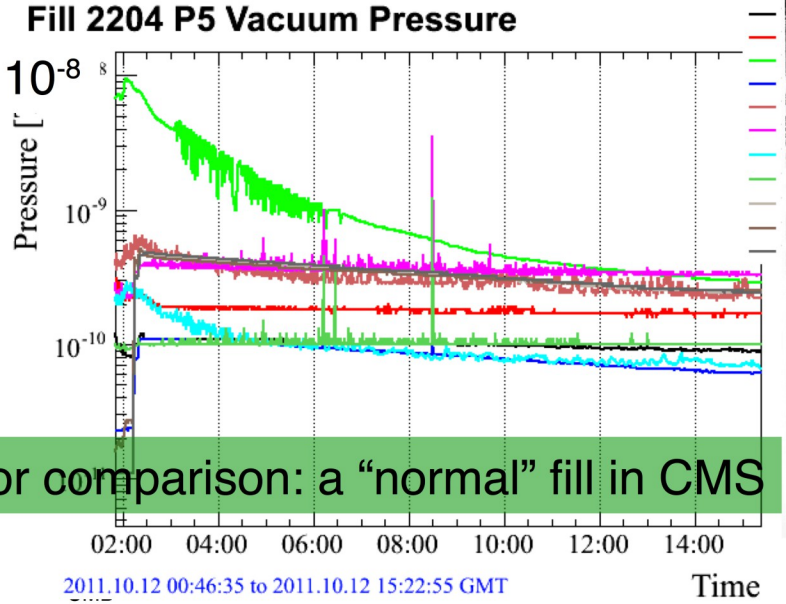
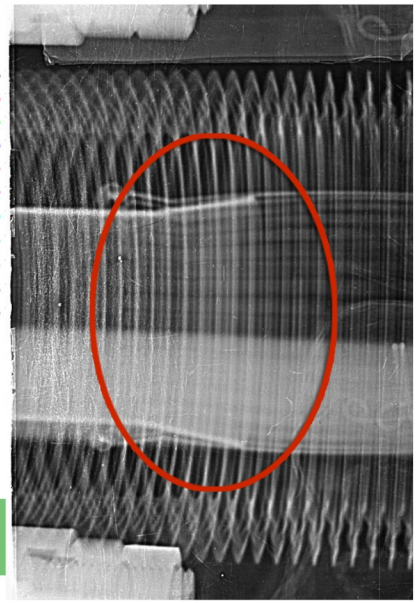
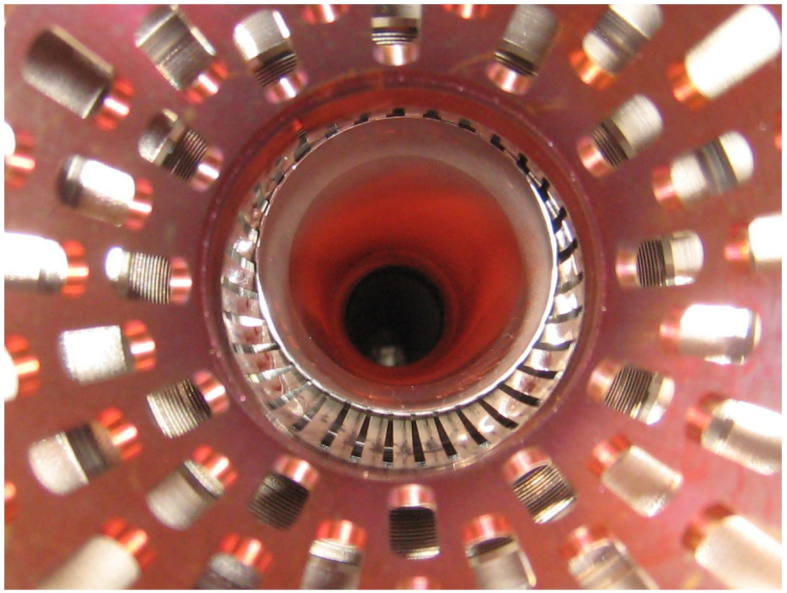












For comparison: a “normal” fill in CMS

Do we need Run Coordination?

CMS is running sooo smoothly...

Well, ...

...sometimes it makes sense to coordinate activities while running...

... especially, if you want to run faster and faster...

Run Coordination Tasks

- **Coordination of online activities at the experiment**
  - Physics data taking
    - Run Coordination establishes procedures to be followed by the shift crew.
  - Commissioning activities which require central activities
    - We call these global runs
    - They involve usually the DAQ and the Trigger and some or all sub-detectors

- **Follow and participate in the communication with LHC**
  - Sometimes we request special runs for special goals
    - Low luminosity runs with the CASTOR detector and with Totem
    - Special proton reference runs for the Heavy Ion period
    - Special runs for commissioning (e.g. Splash events)
  - Other items to discuss
    - Scheduling of Technical Stops (e.g. we want to re-insert the CASTOR detector before the Heavy Ion period)

- **Run Coordination ensures that the global running exercises are compatible with the plans of technical coordination**
  - When parts of the detectors are moved around they must be switched off.

More tasks: DPG Coordination

- **Coordination of the Detector Performance Groups (DPG)**

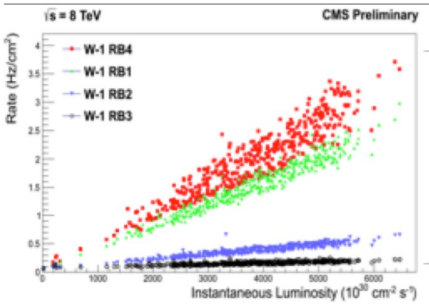
- **Detector performance groups take care of fundamental tasks, which directly relate to the physics performance of the detector:**
  - Prompt feedback and Data Quality monitoring of collected data
  - Simulation of the detector response and its performance
  - Development, maintenance and optimization of first steps of reconstruction ('local reconstruction' (from bits to hits...))
  - Validation of related software changes
  - Definition of optimal workflows for alignment and calibration

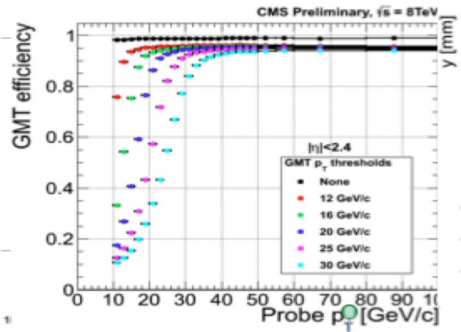
- **DPG coordination helps to organize common tasks and facilitates the information flow among DPGs and with others (like PPD/computing/offline/POGs) both for offline and during data-taking**
  - PPD: Physics Performance and Datasets
  - POG: Physics Objects Groups

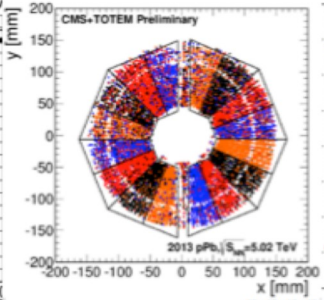
More DPG coordination tasks

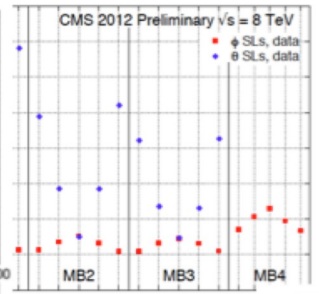
- **Approval of Detector Performance Plots**
  - Every plot shown in public needs prior approval in the collaboration
  - Plots related to the Detector Performance are approved in several steps:
    - Inside the related DPG
    - By DPG-/Run-coordination in a public meeting
    - By the CMS community in the General meeting on Wednesday
  - This procedure guarantees the quality of the plots according to some guidelines, the consistency of the results with other publications and tries to ensure the correctness of the shown material.
  - Procedure documented here: https://twiki.cern.ch/twiki/bin/view/CMS/Internal/DPSnotePreparation
  - Approved plots can be found in public twikis: https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResults
  - And corresponding notes in iCMS: http://cms.cern.ch/iCMS/jsp/iCMS.jsp?block=publications&mode=single

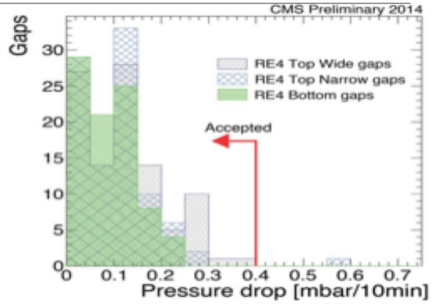
Some examples of approved plots in 2014

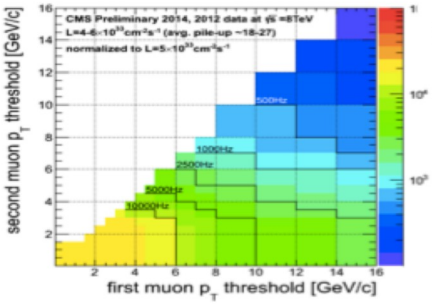


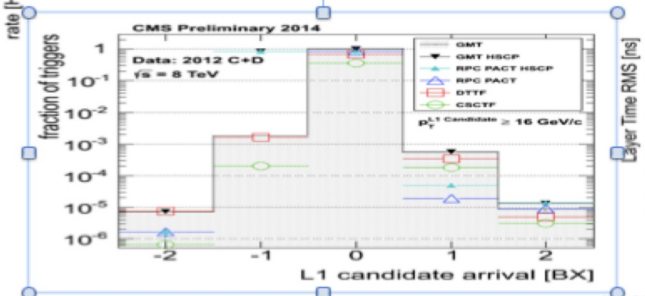


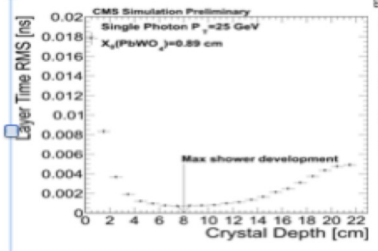


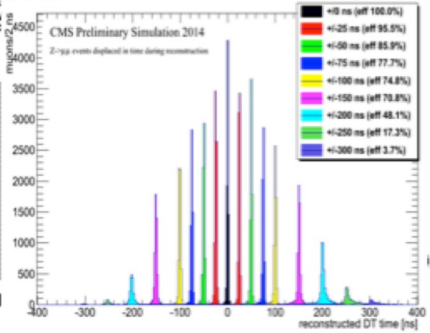


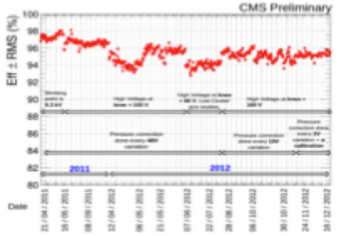


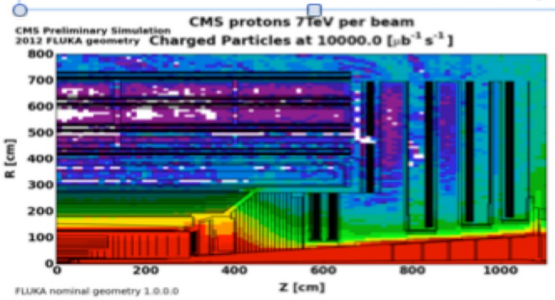


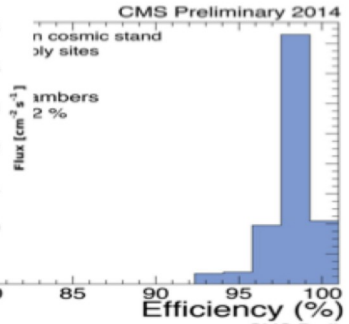


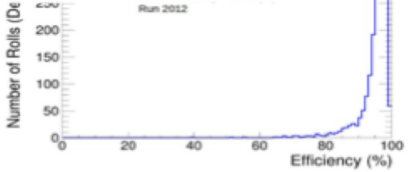


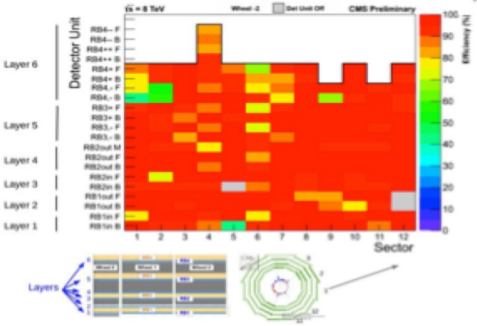


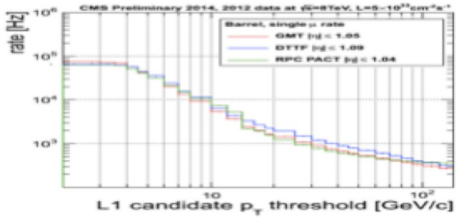


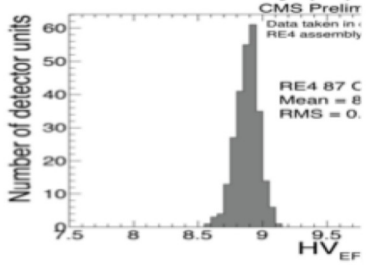


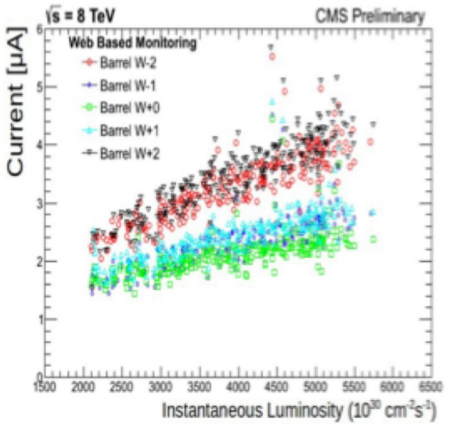












Operation in Point 5

CMS operation at Point 5

Nominated for 2 years by CMS management

Run Coordination
3 persons

Long term coordination and planning
Interface to CMS management (XEB, MB)
Interface to LHC

In charge for three weeks. Need to have experience in online operation

Run Field Managers
2 persons

Implementing the long term plans
Interface to the shift crew
Follow up of problems

Shifters: assigned on weekly basis

Shift Leader

Responsible for safety during operation
Coordination of activities in Control room
Implementation of daily plan

DAQ shifter

- Responsible for successful data taking
- Heavily involved in debugging of problems
- Needs a sound understanding of Data Flow and Computing in general

Trigger shifter

- Responsible for correct functioning of the L1 trigger
- Heavily involved in debugging of problems
- Needs a sound understanding of the L1 Trigger architecture

DQM shifter

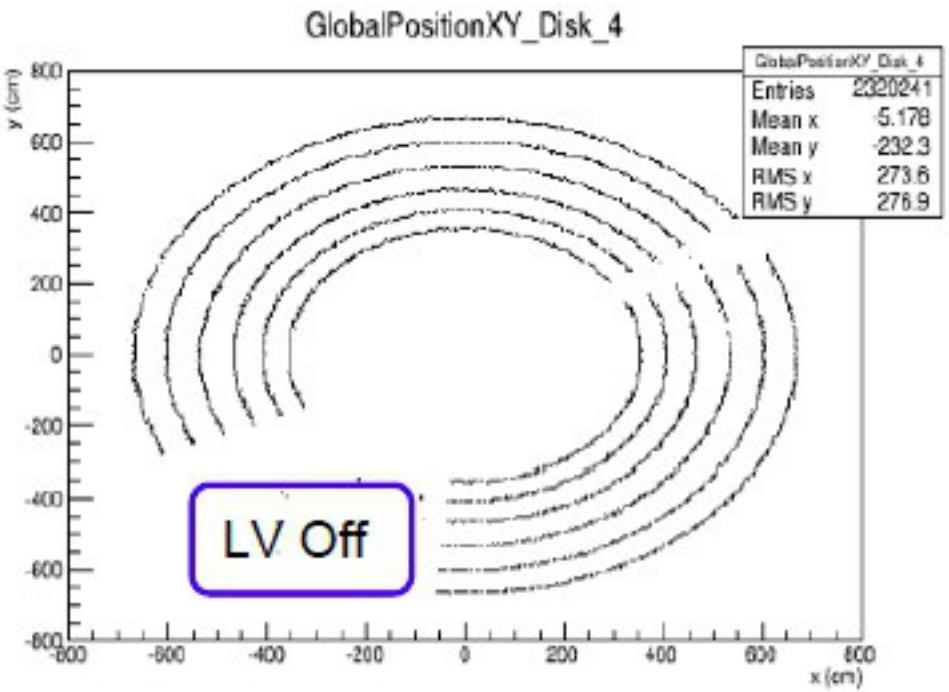
- Responsible for quality of the data taken by CMS
- The first person to spot problems in the data
- Needs a sound understanding of all sub-detectors of CMS

DCS shifter

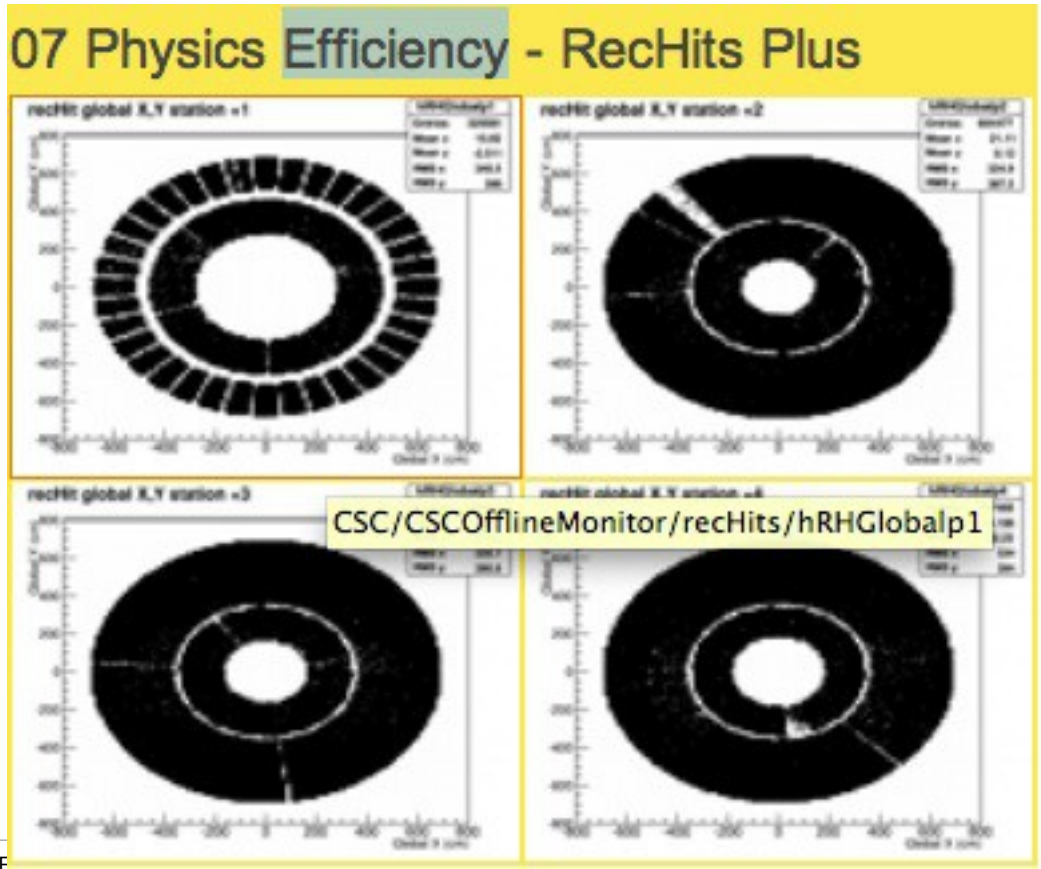
- Co-responsible for safety in CMD and for the data quality.
- The first person to spot problems in the infrastructure (HV/LV, gas, cooling,...)
- Needs a sound understanding CMS architecture and infra-structure

Example: DQM shift

RPC hits in Disk 4:
the “holes” indicate regions where
The Low Voltage for the electronics
fad been off.



CSC hits maps in 4 disks on the positive side:
Holes indicate problematic zones and are
easily visible by the shifter in these hit-maps



Shifts in CMS

- **CMS shifters are the main stake holders for successful data taking**
  - They “run the show” in CMS
  - They are the first to spot problems
  - Their efficiency is directly correlated to the data taking efficiency of the experiment.

- **Shifters in CMS get extensive training**
  - You need to have a thorough knowledge of the experiment to act correctly in normal operation or in case of problems.

- **Doing shifts is useful for your physics analysis**
  - You know where your data comes from.
  - You know what can go wrong.
  - You will be able to understand better the various problems you might encounter in the data

- **Last but not least: Shifting is fun:**

  It is cool to run the show in one of the most complex experiments of the world!!!
- **Do not hesitate to ask the Run Coordinators in case you want to have more detailed information about shifts**

Online operation of CMS

Regular meetings where Run Coordination is involved during data taking:

- Daily 8h30 in the CCC (LHC control room): One Run Coordinator participates in the LHC daily operations meeting. Accelerator related problems and plans for the next day are discussed there.

- Daily 9h30 at point 5: Run Coordination holds the daily run meeting at point 5.
  - Experts from all components participate
  - Debriefing of the last 24h
  - Noting down on new problems and deciding on actions to take.
  - Following up on known problems
  - Establishing a plan of the next day which is implemented by the Run Field Managers and the Shift Crew.

- Weekly: Run Coordination meeting to summarize the week, and to plan the activities for the coming week.

Interested in more info ???

- **Pages on CMS-Twiki**
  - CMS online workbook: Links to pages relevant for online operation
    https://twiki.cern.ch/twiki/bin/viewauth/CMS/OnlineWB
  - Run Coordination: Commissioning for Run 2
    - Overview over global run exercises
    - Collection of commissioning needs for sub-systems
    - ...

    https://twiki.cern.ch/twiki/bin/view/CMS/Run2CMScommissioning
  - Online Web Based Monitoring: Monitoring information about the data taken during the various runs
    https://cmswbm.web.cern.ch/cmswbm/
  - Entry point to various online services like the online logbook, shift-lists, overviews for DAQ, DCS, DSS status and others
    http://cmsonline.cern.ch/

Some Contacts

- **Technical Coordination/BRIL/DCS**
  - Austin Ball, Wolfram Zeuner (Technical coordinator & deputy)
  - Christoph Schaefer , Nils Dupont (Safety)
  - David Stickland, Anne Dabrowski (Beam instrumentation: BRIL-project)
  - Frank Glege (Detector Control System: DCS)
- **Run Coordination**
  - Greg Rakness, Christoph Schwick (Run coordinator & deputy)
  - Silvia Goy Lopez (DPG coordinator)

Organization