Commissioning and initial experience with the ALICE on-line

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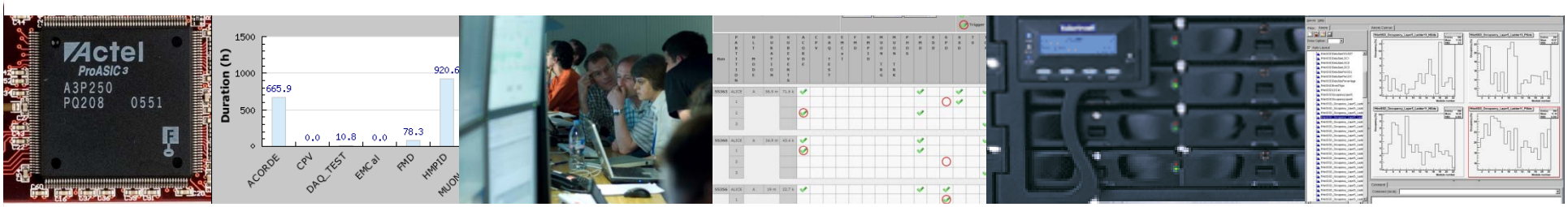
For the ALICE Collaboration



CHEP - Prague March 2009

Outline

- ALICE experiment
- ALICE online systems
- Detector Commissioning
- Global Commissioning
- Lessons from 2008
- Goals for 2009
- Conclusion

ALICE @ LHC Point 2

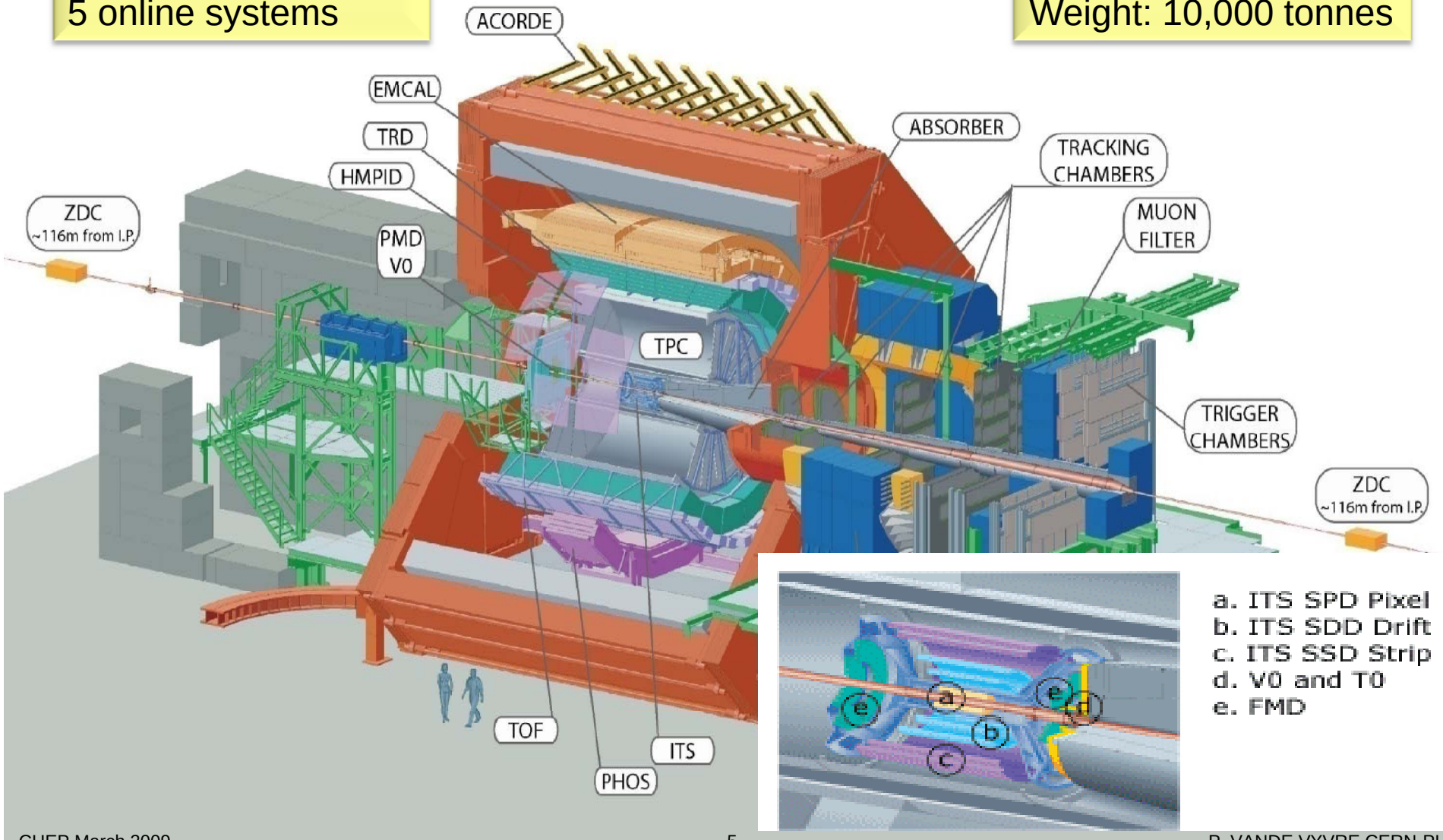
ALICE: A Large Ion Collider Experiment at CERN-LHC

- General-purpose heavy-ion detector
  - Study of strongly interacting matter and the quark-gluon plasma in nucleus-nucleus collisions at the LHC
  - Detector designed to cope with the highest particle multiplicities anticipated for Pb-Pb reactions
- Complex experiment for online systems
  - 18 detectors (last one being installed now)
  - 10 detectors providing input to the trigger
  - 2 types of beams: pp and Pb-Pb
  - 3-level hardware trigger and 1 High-Level Trigger firmware/software
  - Multiple partitions and multiple detector clusters
- Not surprisingly: complex commissioning !

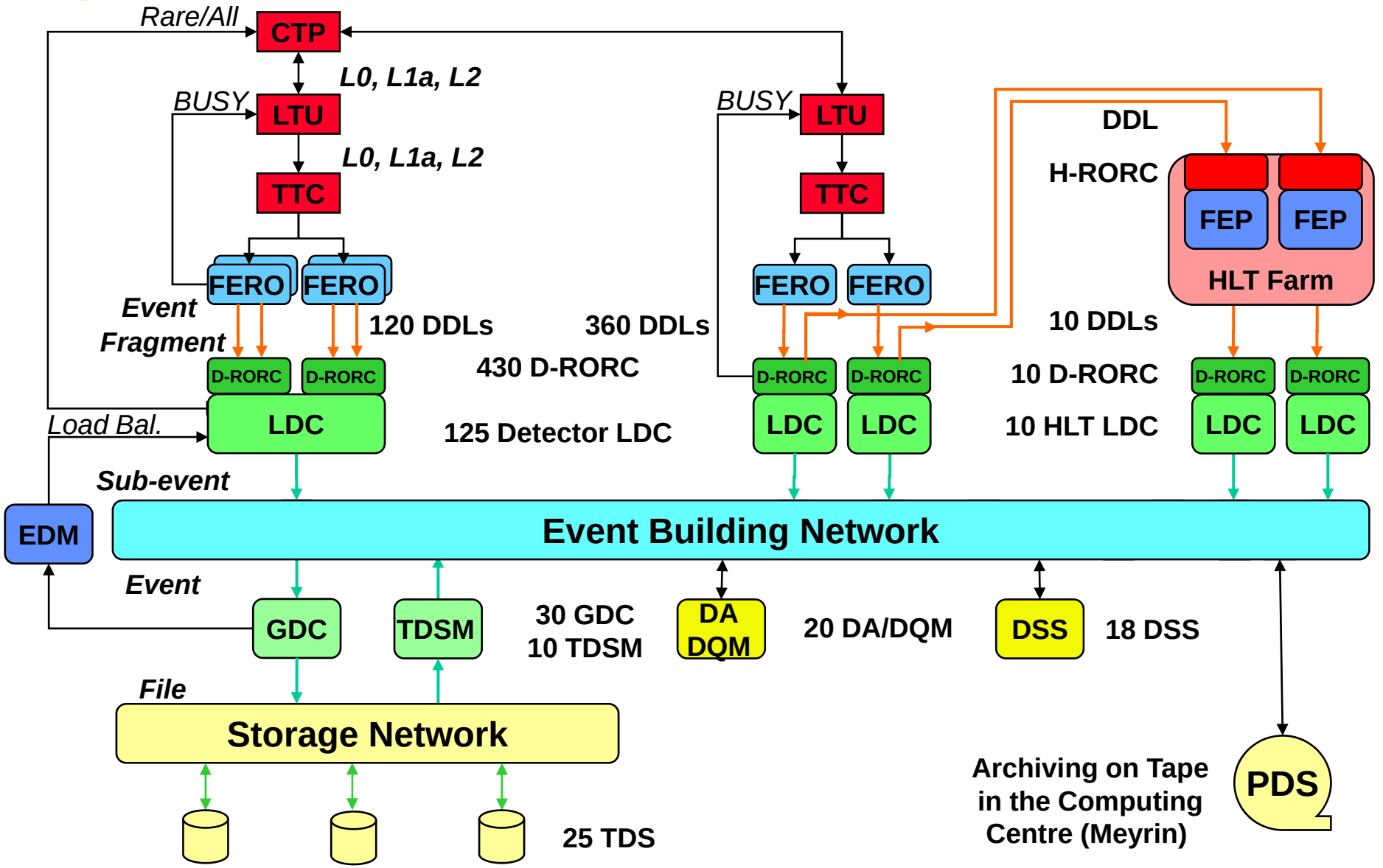
ALICE

18 detectors
5 online systems

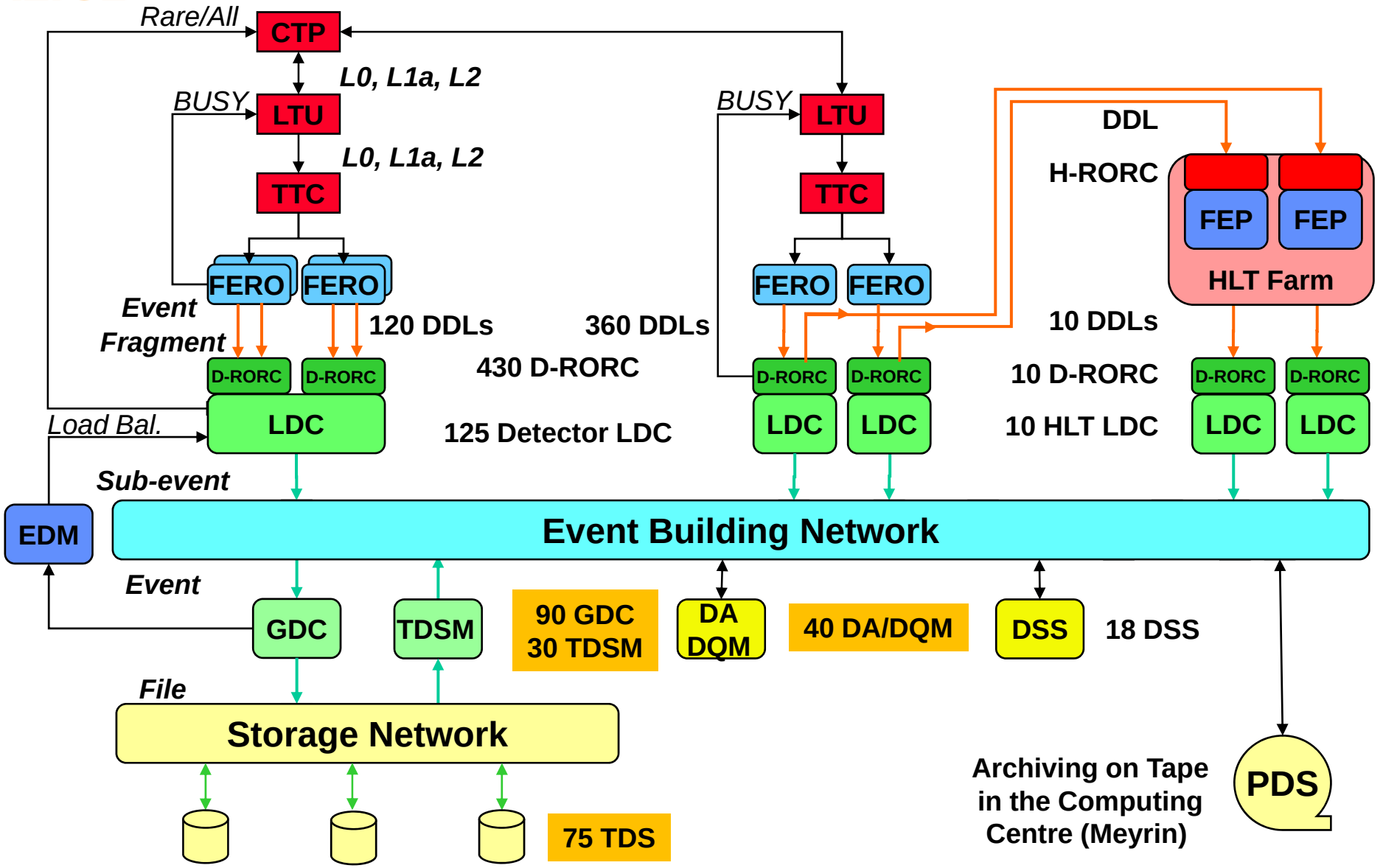
Size: 16 x 26 meters
Weight: 10,000 tonnes



Trigger – DAQ – HLT '08

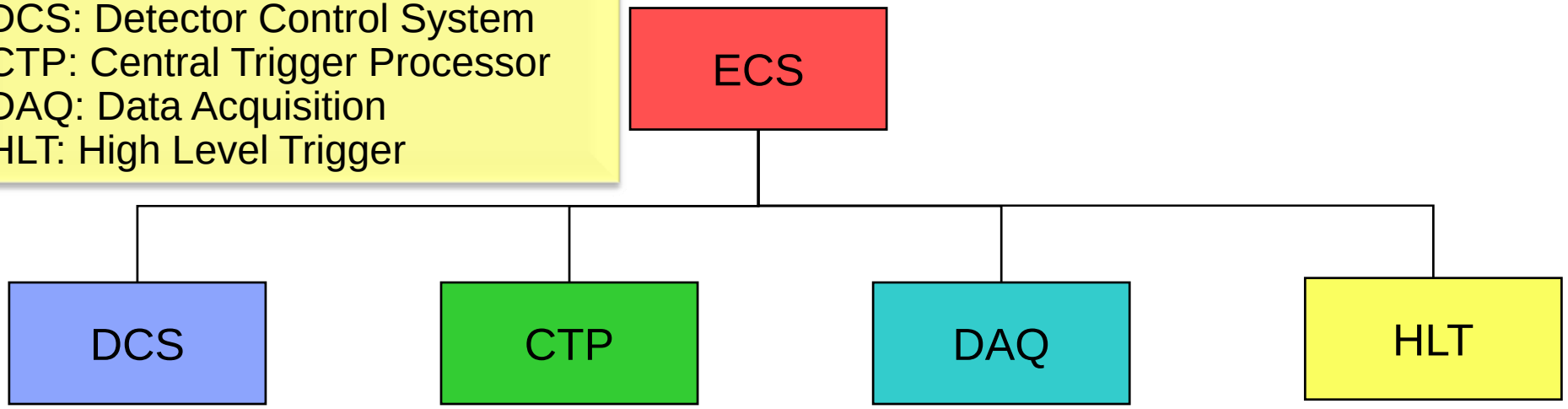


Trigger – DAQ – HLT '09



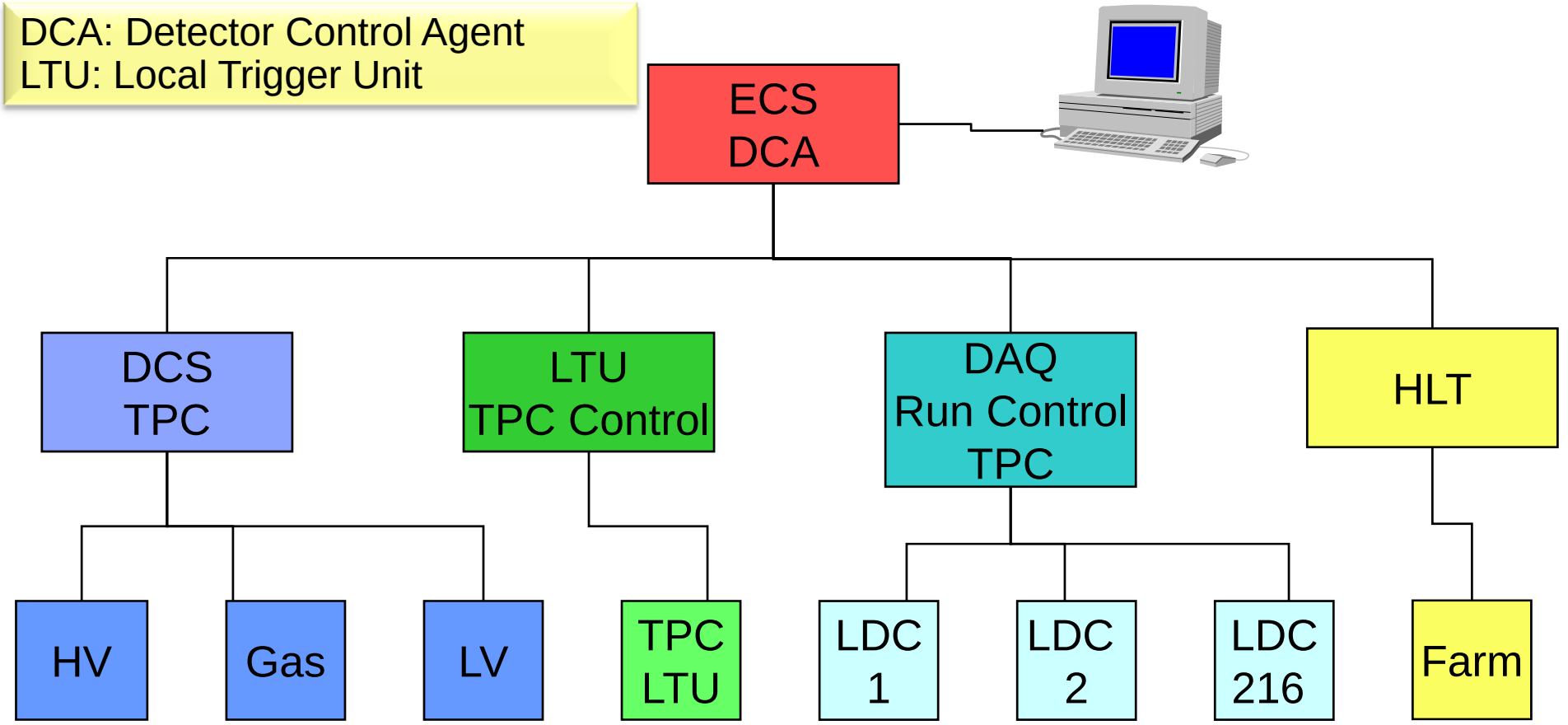
Control Logical Model

ECS: Experiment Control System
DCS: Detector Control System
CTP: Central Trigger Processor
DAQ: Data Acquisition
HLT: High Level Trigger



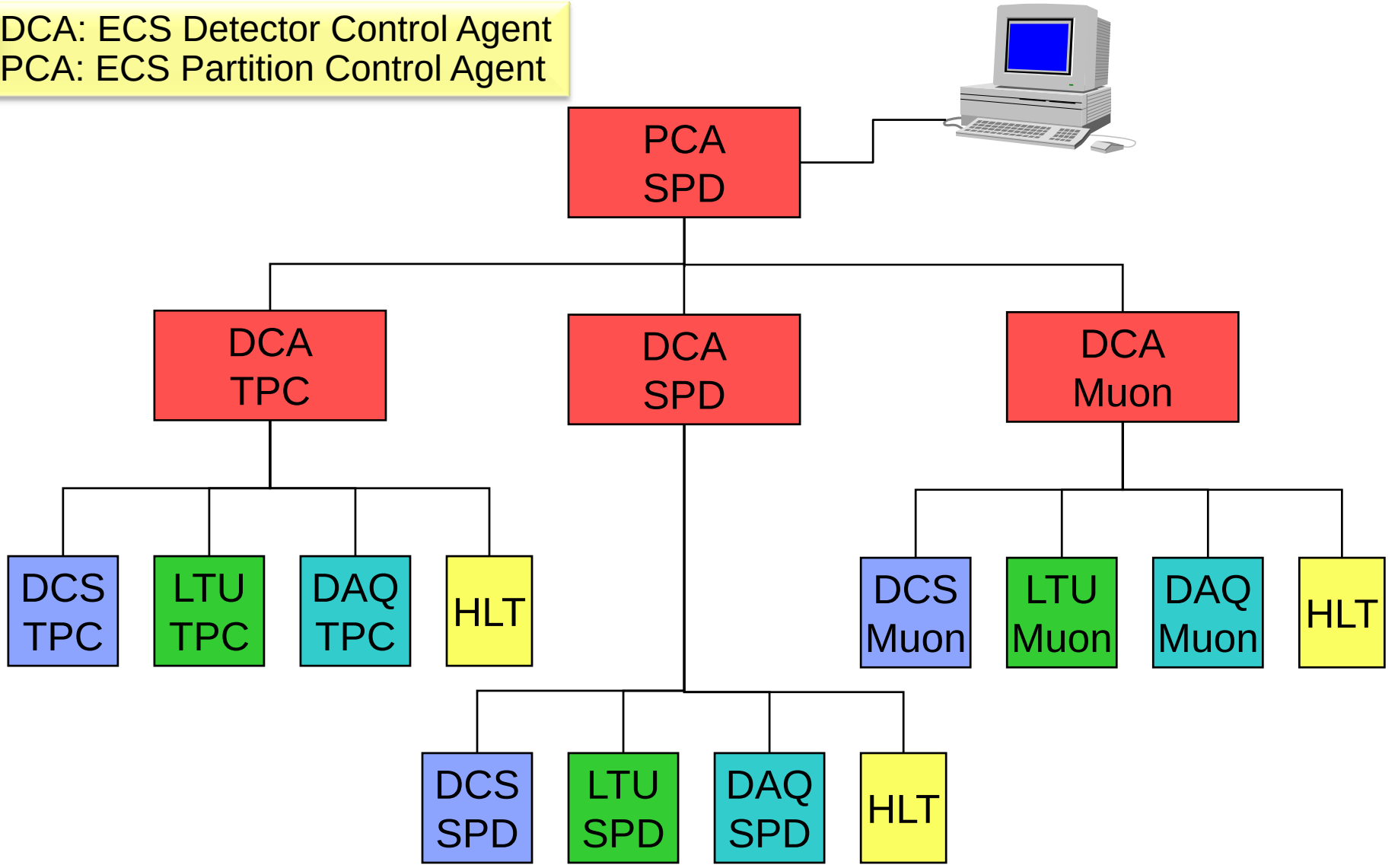
Detector in Standalone Mode

DCA: Detector Control Agent
LTU: Local Trigger Unit



Global Partition

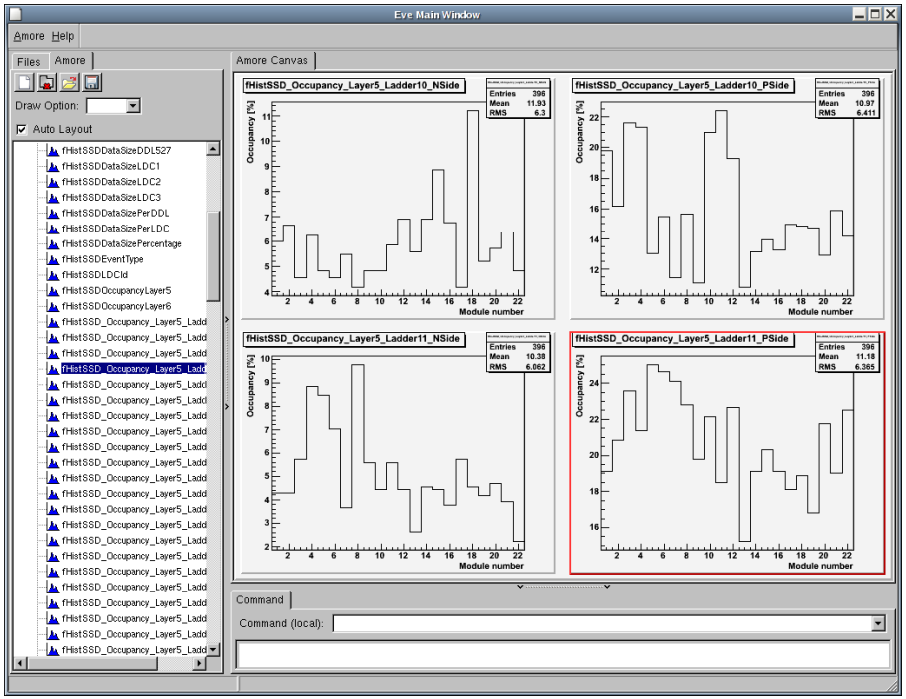
DCA: ECS Detector Control Agent
PCA: ECS Partition Control Agent

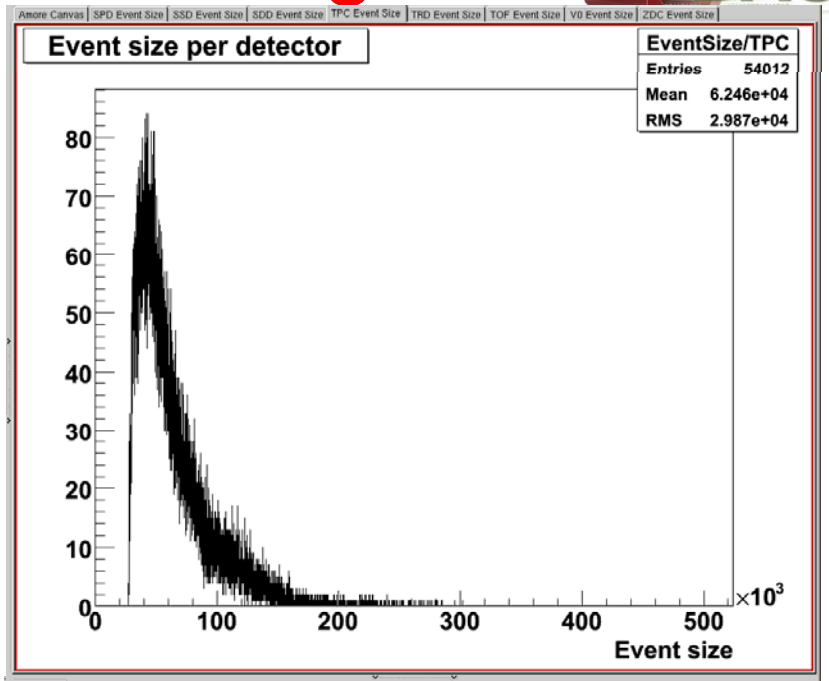


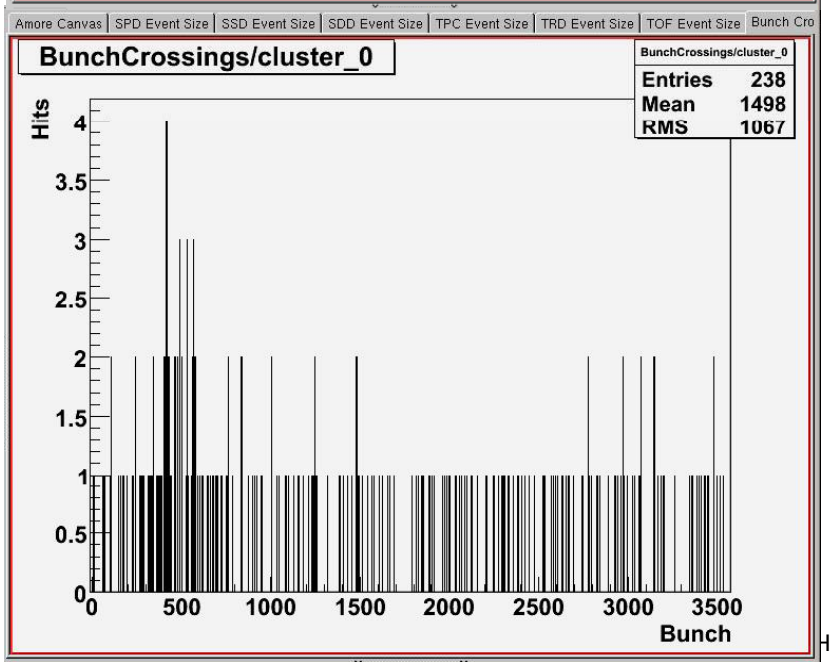
Data Quality Monitoring

DOM framework is ready.

Not yet used routinely by all detectors.







eLogBook

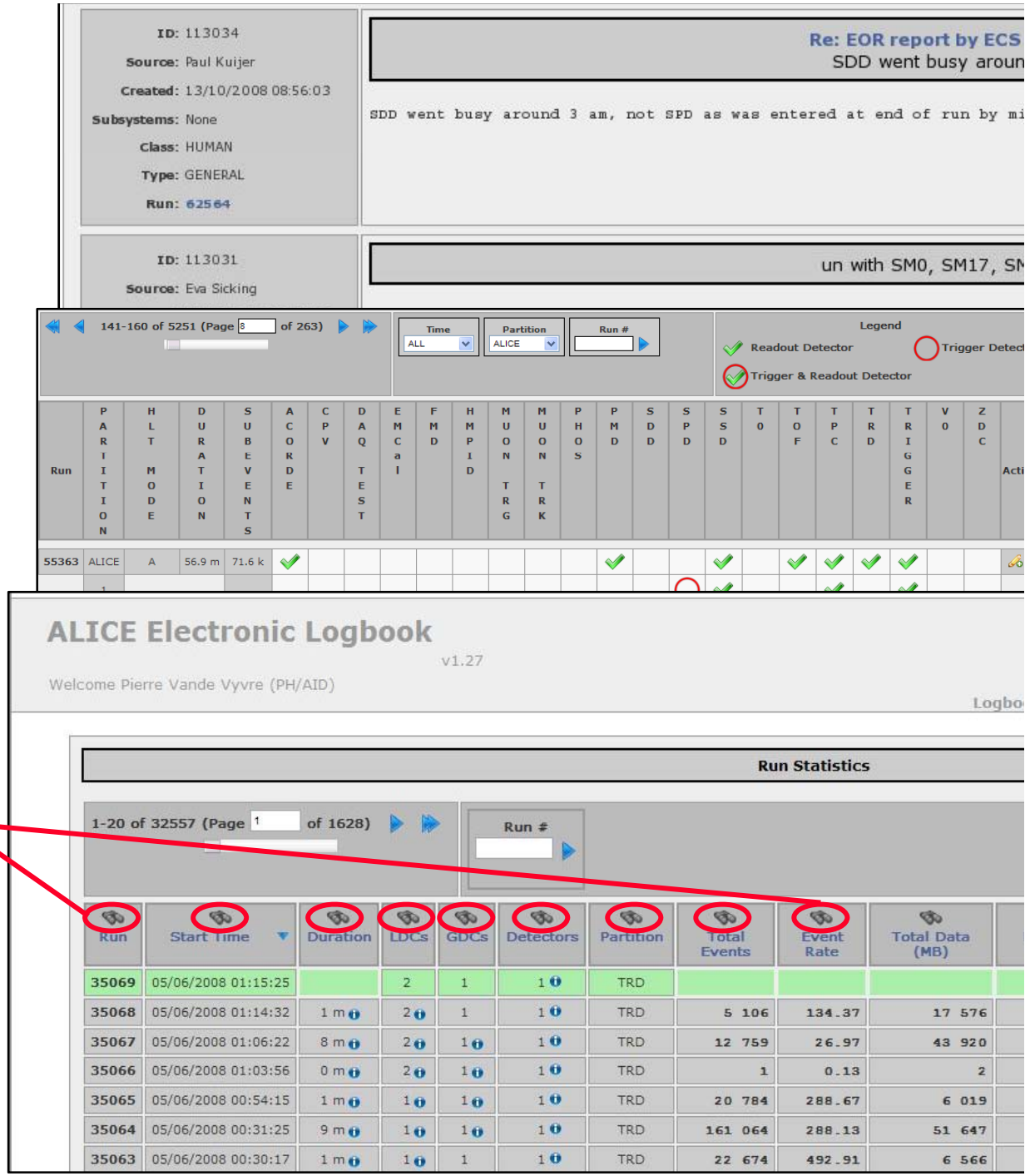
Electronics Logbook

Online status display of TRG and DAQ running conditions

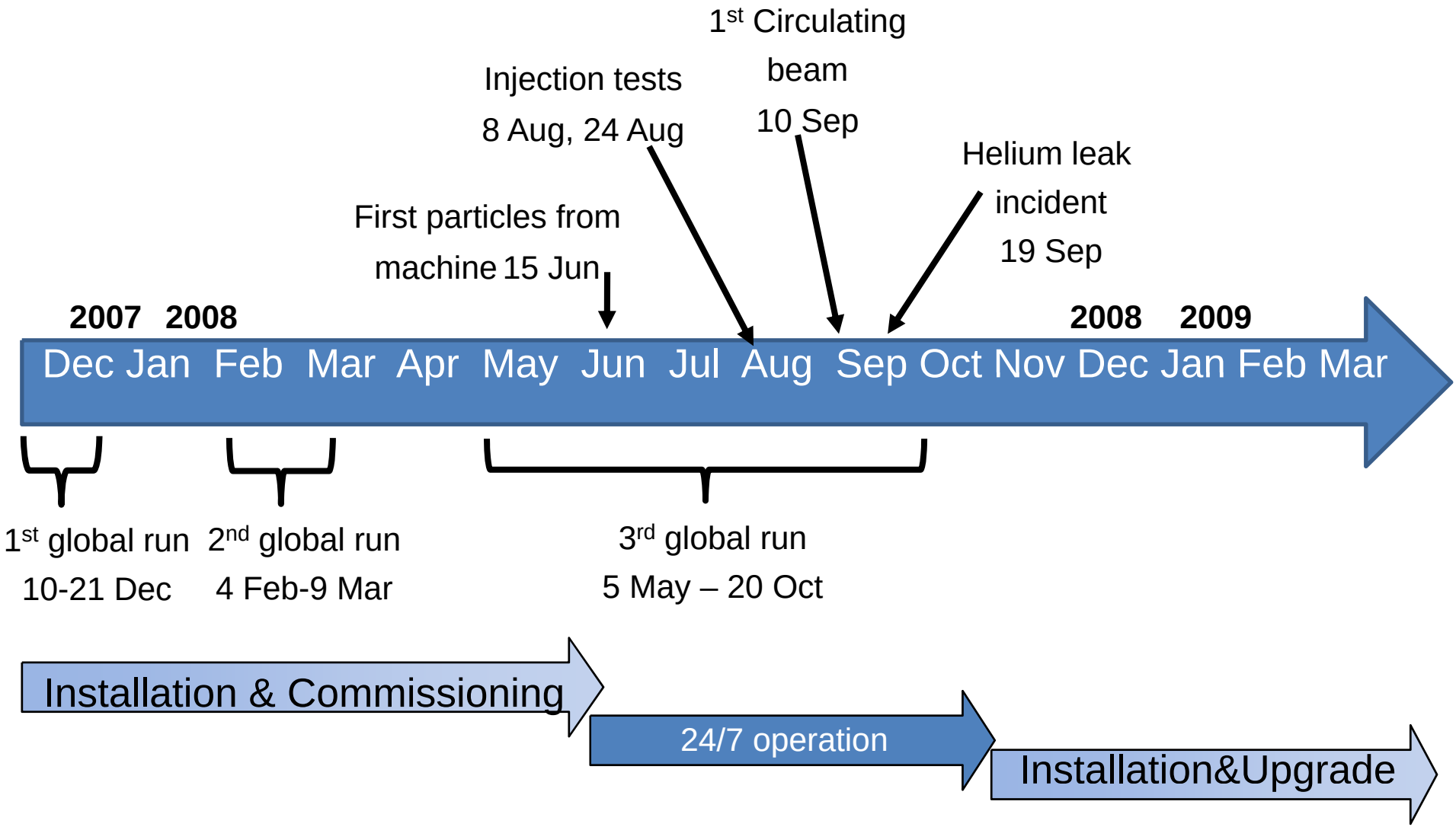
Run statistics with filter on all fields

eLogBook:

From replacing the paper logbook to a powerfull data mining tool



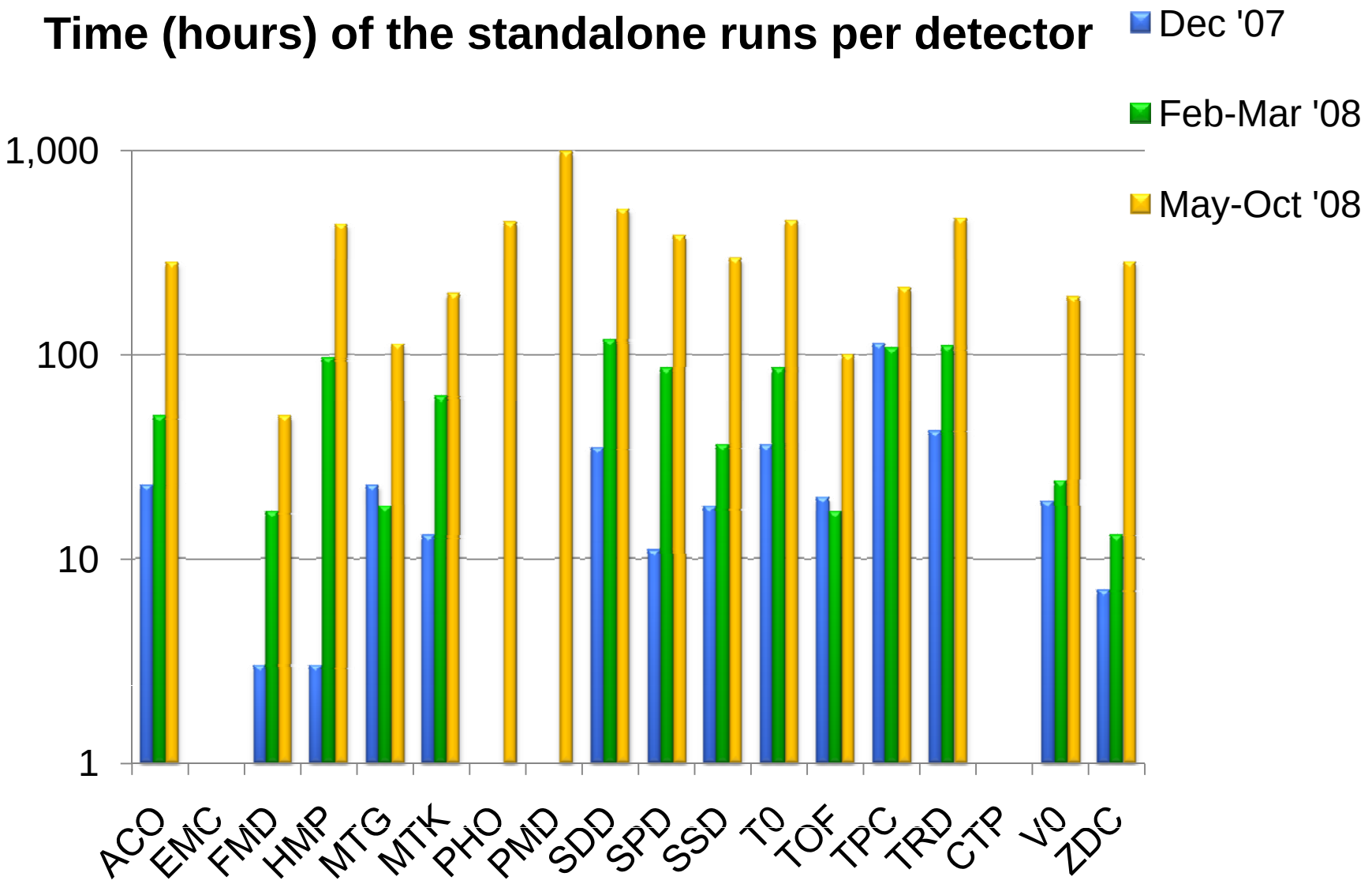
ALICE Commissioning 2007-09



Detector Commissioning

- Standalone commissioning
  - Services: cabling, cooling, power supplies, etc
  - Detector hardware, firmware, software
  - Interfaces to online systems
- Online commissioning process
  - Control procedure up to the state “Ready for Data Taking”
  - Exposed to variety of trigger (cosmic, pulser up to 40 MHz, random)
  - Data taking stability tests
  - Calibration procedure
- Integration to global partition

Detector Commissioning



Global Commissioning

- Exercise stability
  - Detectors
  - Services
  - Online systems
  - 23 systems (18 detectors and 5 online systems) $\Rightarrow 0.97^{23} < 0.5$!
- Measure performance
  - Detector readout time and event size
  - Online systems
- Take data
  - Cosmic data for detector alignment
  - Detector calibration (E.g.: TPC calibration with krypton or laser)
- Organize operation

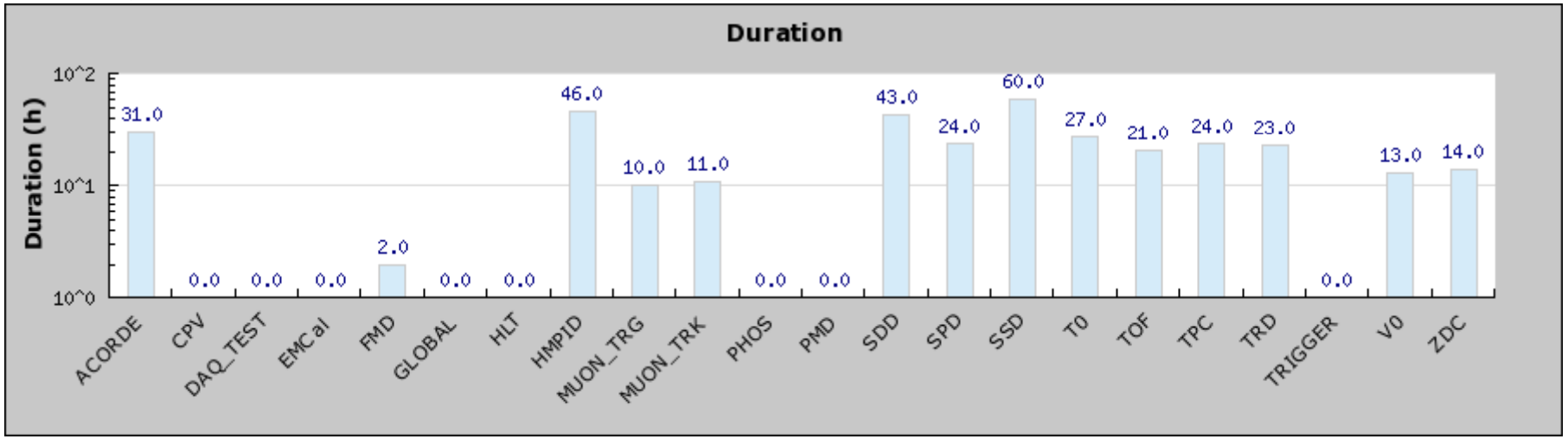
ALICE Control Room

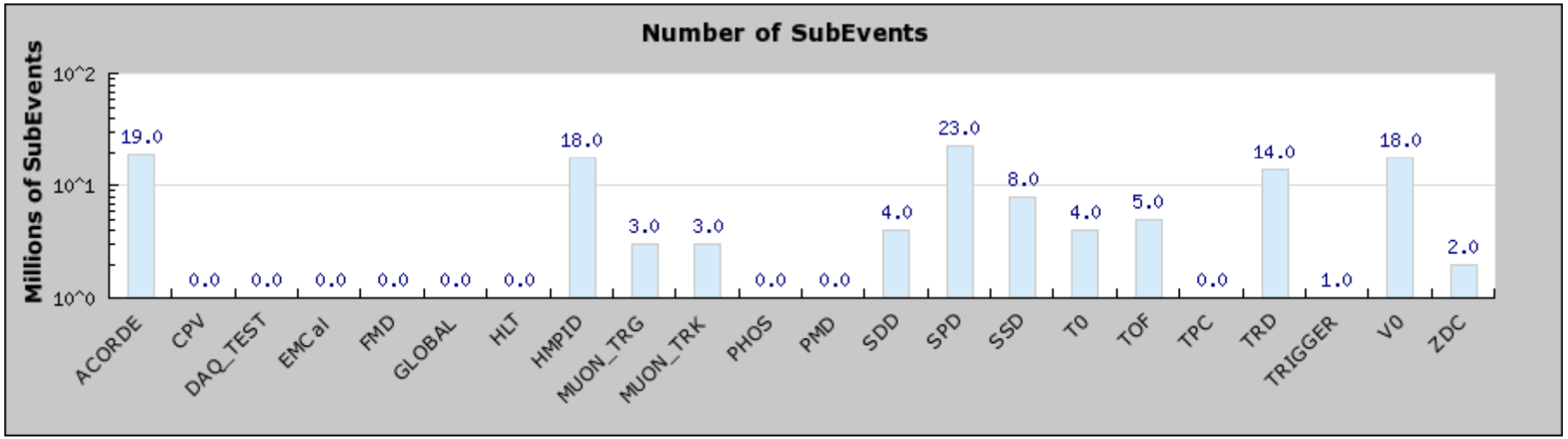
Cosmic Run I (Dec '07)

Global runs in 2 weeks

14 detectors participating

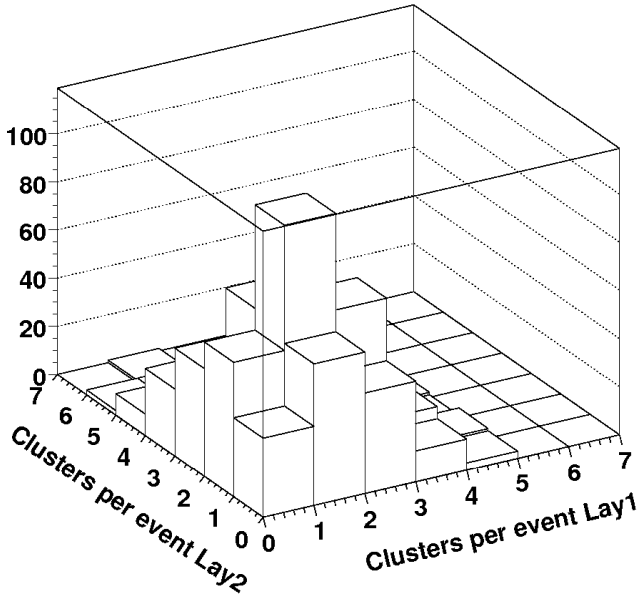
10-60 hours of data taking – 1-20 x 10^6 triggers

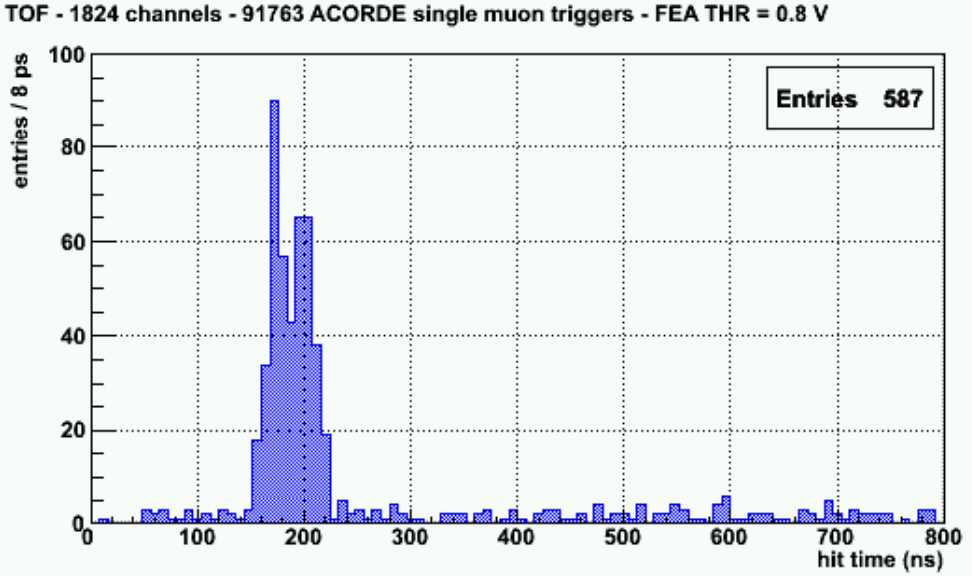


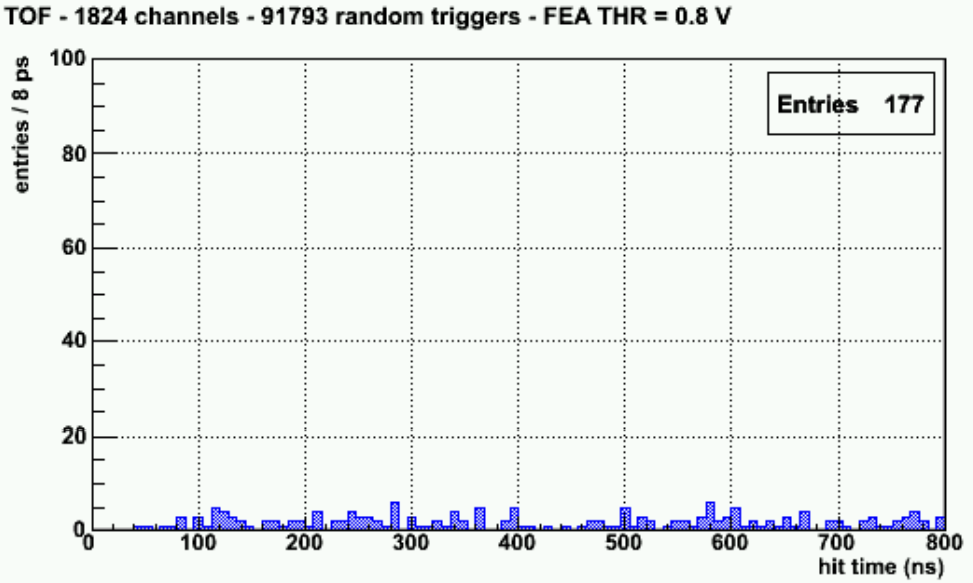


Cosmic Run I

- TOF
  - Comparison of hit time distribution in ACORDE and random triggers
- SPD
  - Comparison of number of clusters per event in the 2 SPD layers





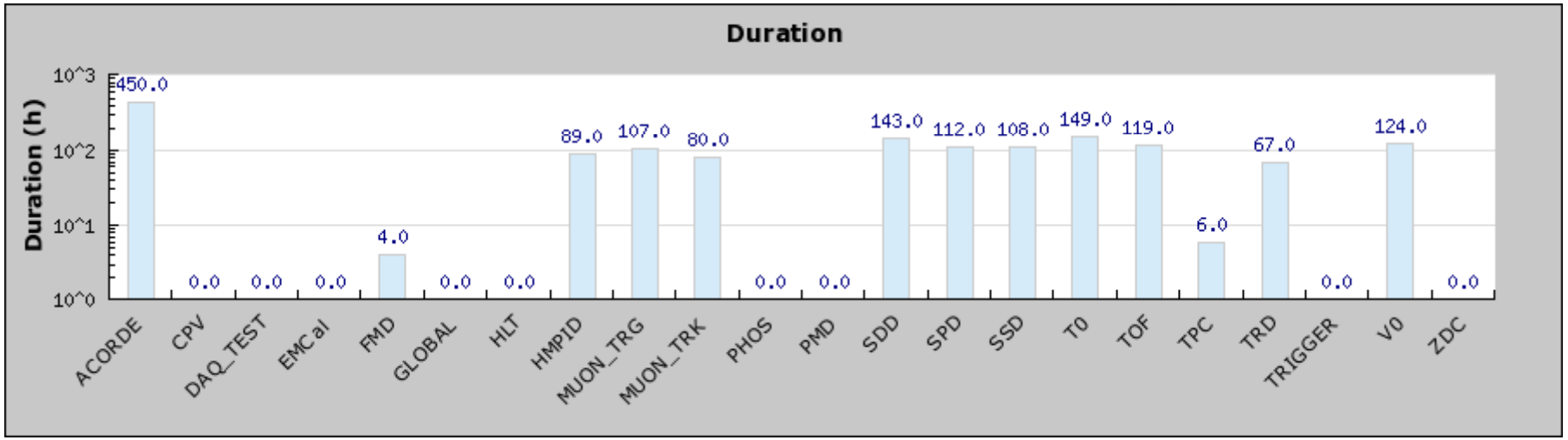


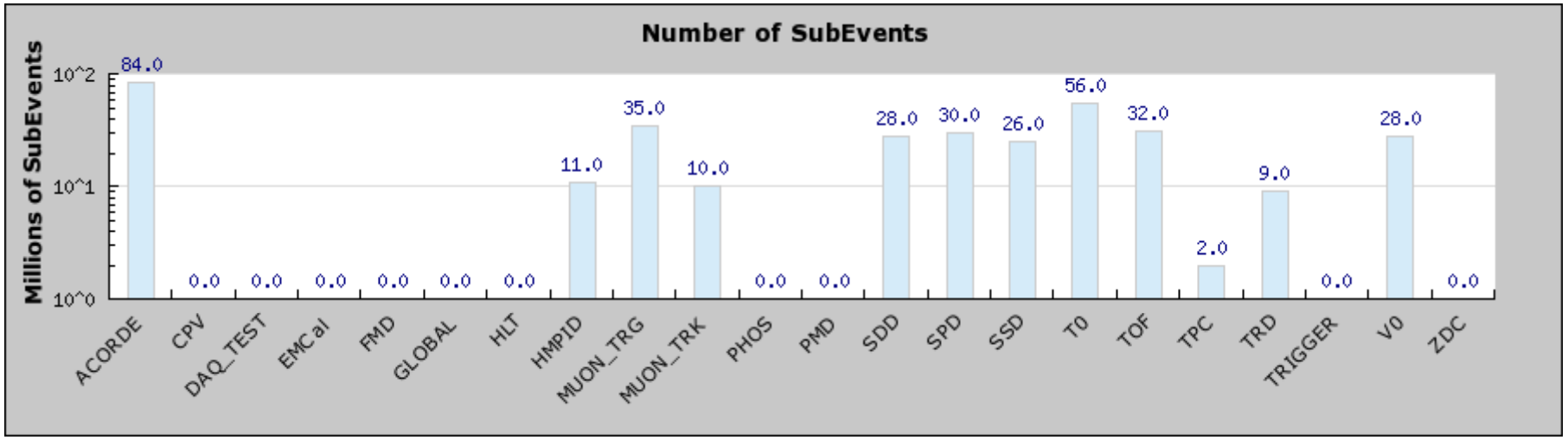
Cosmic Run II (Feb-Mar '08)

Global runs in 5 weeks

13 detectors participating

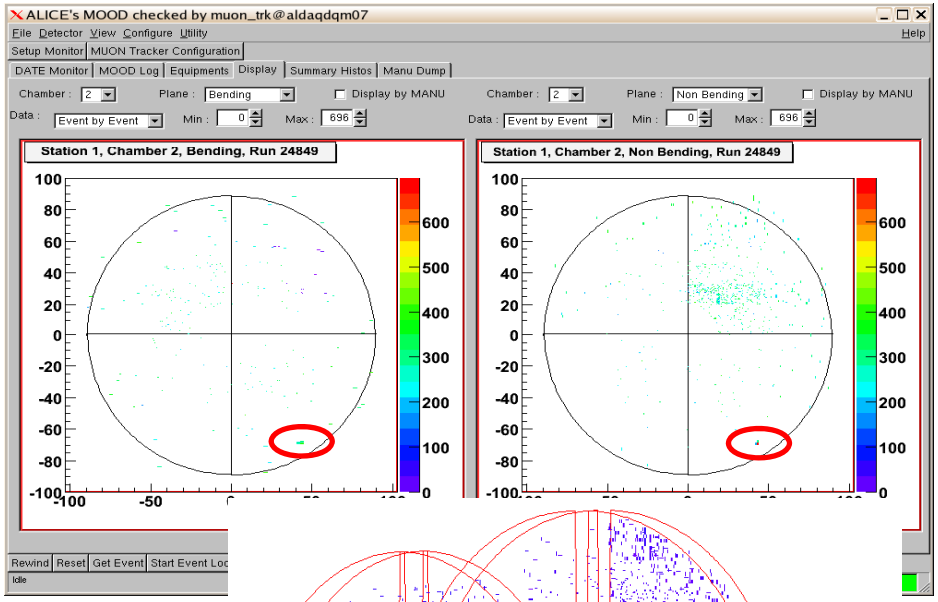
60-150 hours of data taking – 2-50 x 10^6 triggers

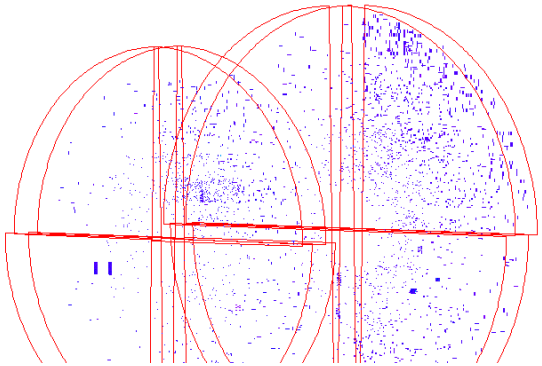


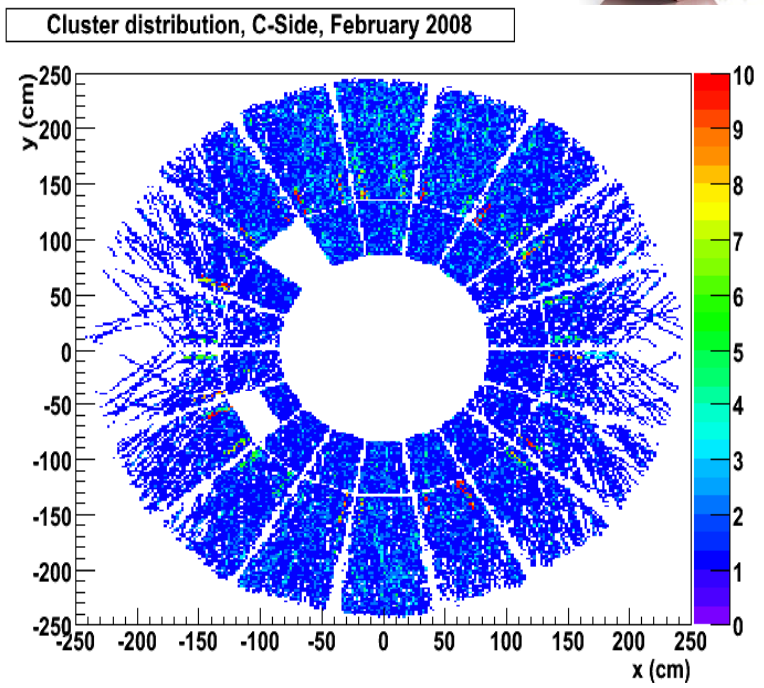


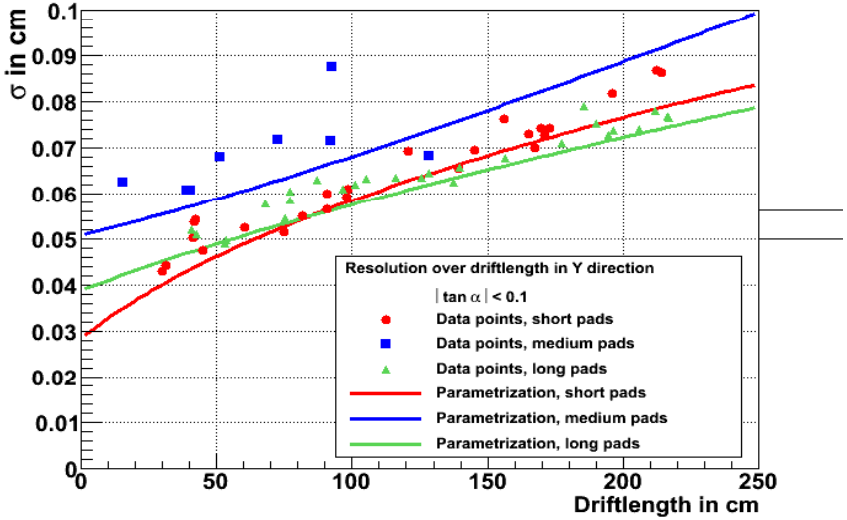
Cosmic Run II

- TPC
  - Cluster distribution
  - Resolution over drift length
- Muon Tracking
  - Online data monitoring vs offline analysis







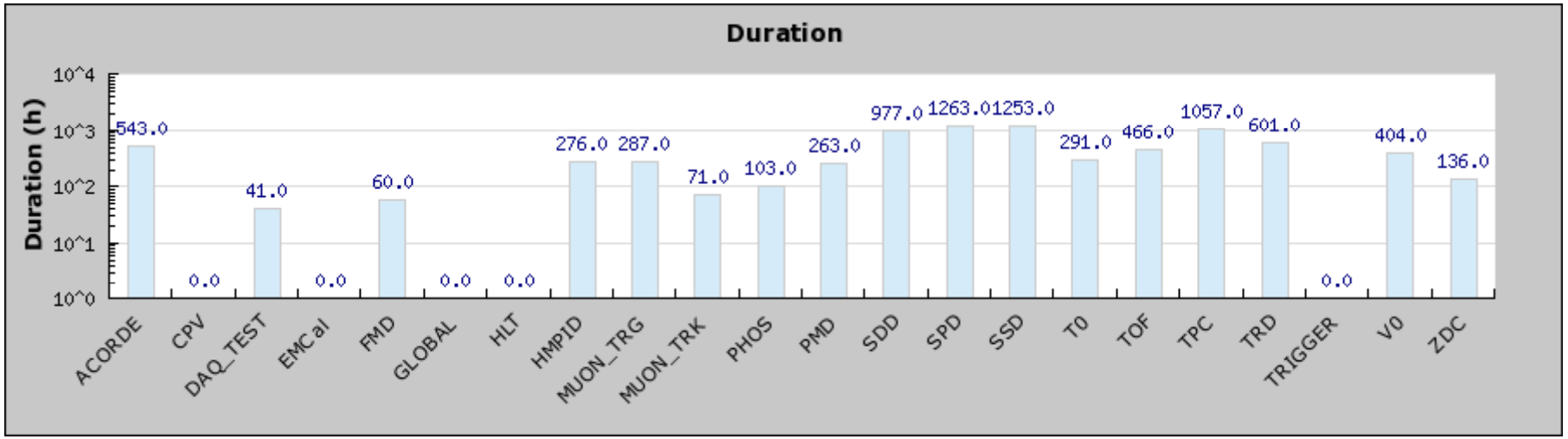


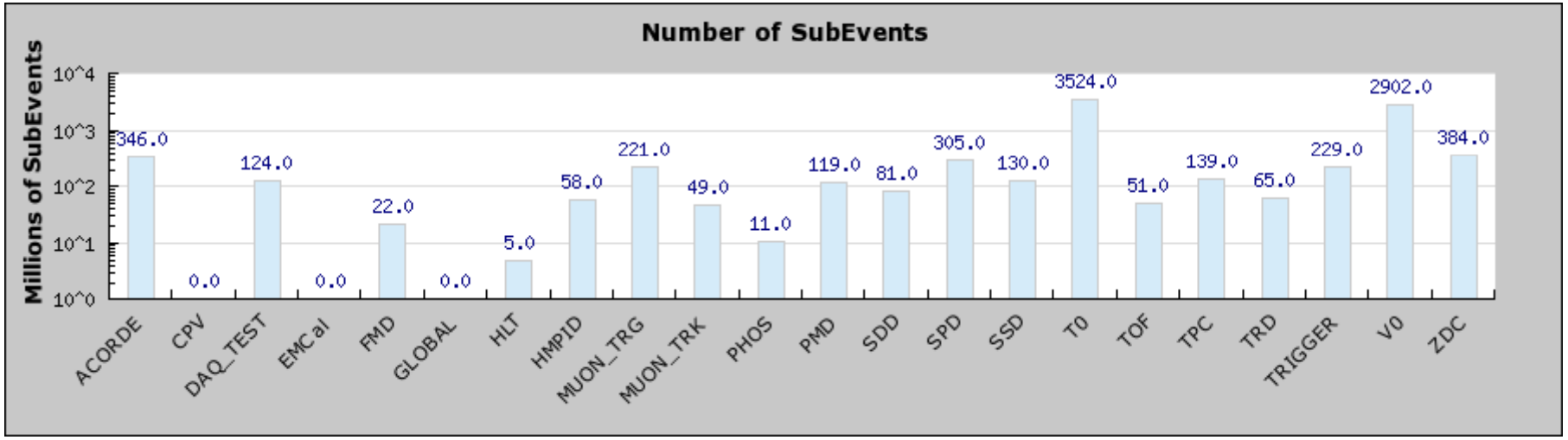
Cosmic Run III (May-Oct '08)

Global runs in 23 weeks

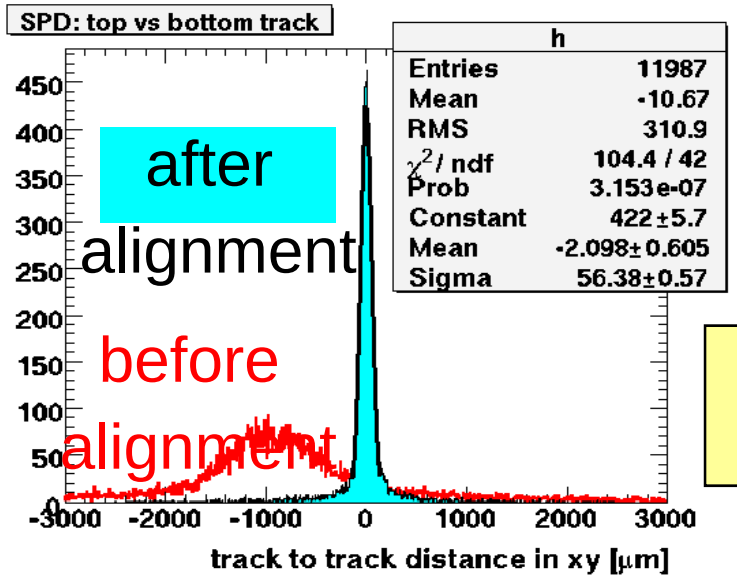
16 detectors participating

60-1250 hours of data taking – 5-3500 x 10^6 triggers

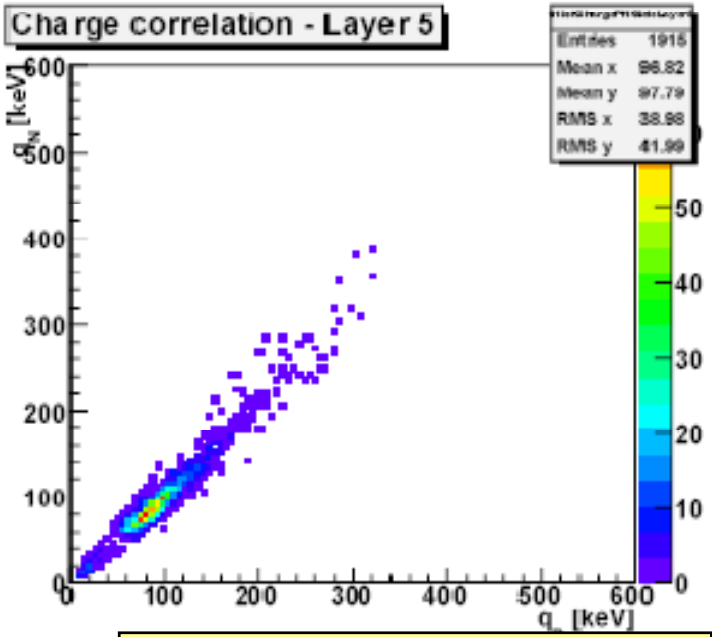




Cosmic Run III

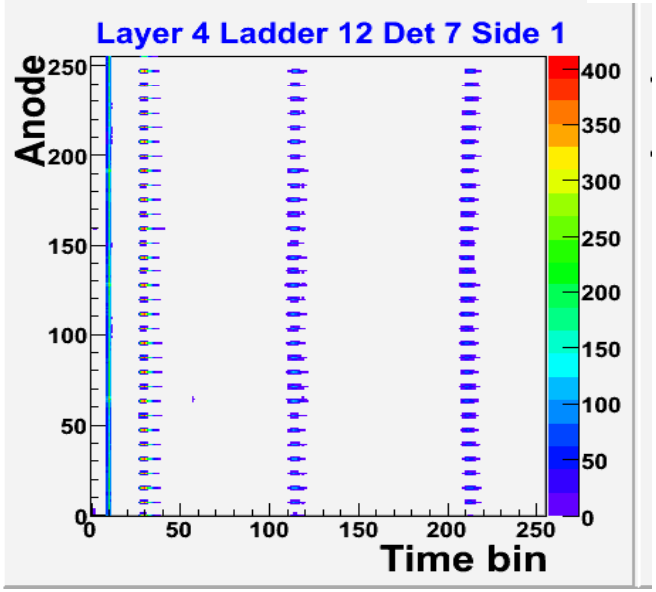


SPD Alignment:



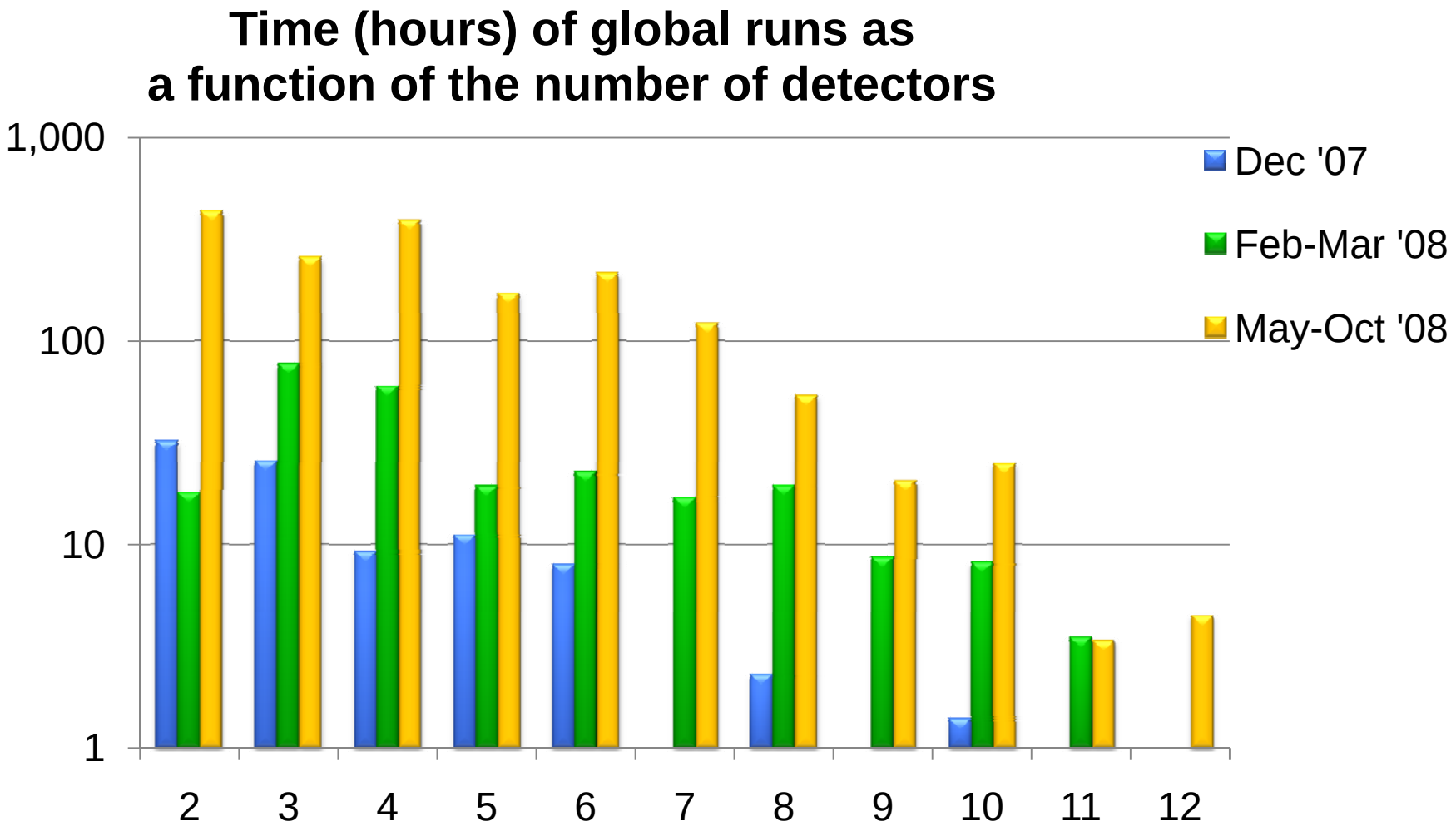
SSD: p-n charge correlation

SDD: Drift speed calibration vs position



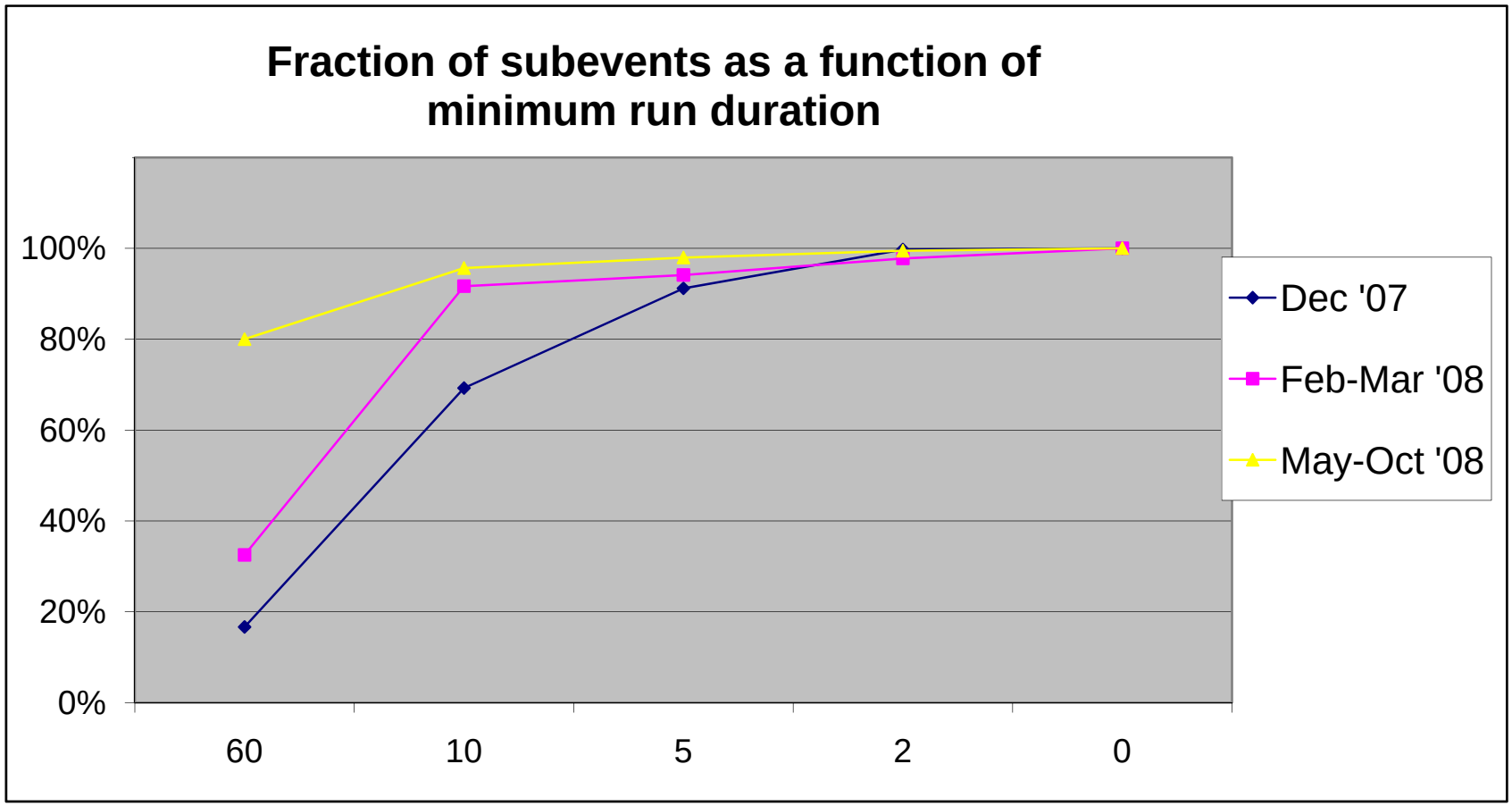
Global runs

Global runs with all detectors are still difficult to achieve



System Stability

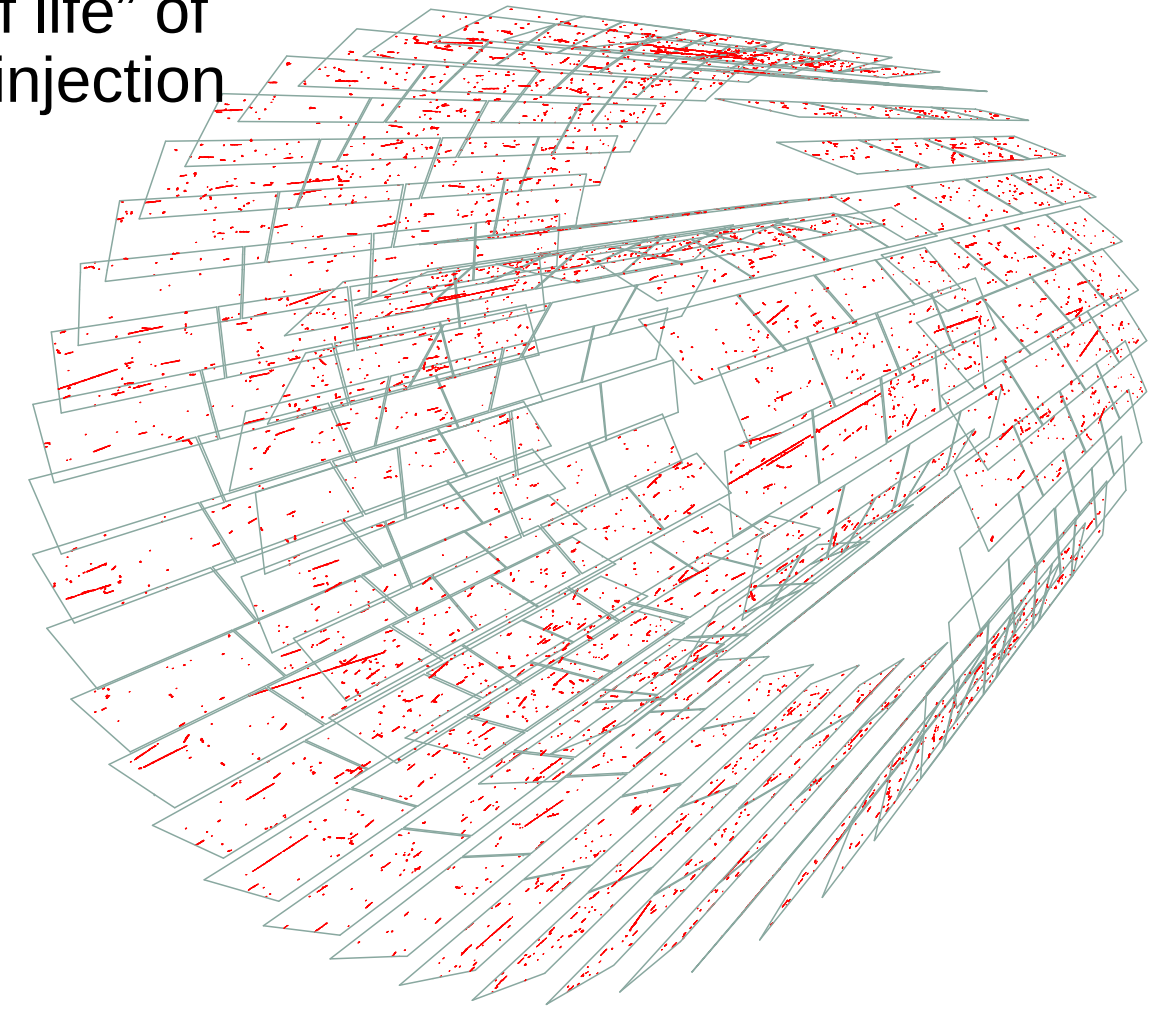
Stability of global runs has improved substantially during the cosmic runs



ALICE SPD: the first LHC “event”

On 15 June 2008 the ALICE SPD in self-triggering mode (L0) sees one of the first “sign of life” of LHC during the beam injection test in TI2

Run 38795
Time 18:10



Lessons from 2008

- Services
- Detectors:
  - Work in progress for firmware and software ⇒ readout time and zero suppression (event size)
  - Noise and grounding
- Online systems:
  - Control scalability: some systems isolated and load distributed
  - CPU needed for data formatting: late decision to format data into reconstruction ready format CPU needed higher than anticipated Price to pay for allowing single pass offline analysis
  - Spurious triggers : fixed during cosmic run
  - Global sequences of detector control still in the phase of being defined ⇒ Not yet fully automated
- But a successful commissioning of the whole experiment and ready for startup in September ‘08

Goals for 2009… and after

- Ready for a nominal data taking year
  10 months pp + 1 month HI
  - Full deployment of the DAQ system: 40 ⇒ 100 % performance
  - Increase of HLT CPU power
- Improve feedback to shift crew (DQM deployment)
- Reduce the size of shift crews
  - Group of detectors
  - Automation of atomic operations (configuration, calibration)
  - Automation of global planning
- Central system for the configuration/archiving of all the trigger detectors and the corresponding trigger processors

Conclusion

- ALICE became reality after almost 15 years of design and installation
- Commissioning of detectors and online systems lasted from Dec ‘07 to Sep ’08. Work intensive !
- Online systems contributed to the detector commissioning, alignment, and calibration
- Experiment ready to start with beam in September ‘08
- Will be ready again in September ’09 !