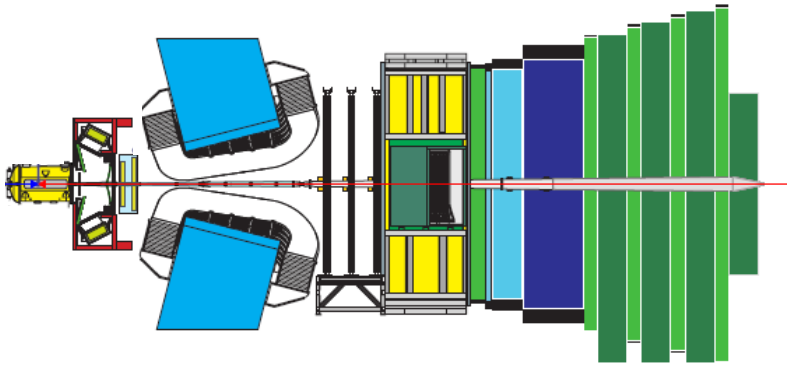
LHCb Operations in Run I:

Challenges and lessons learnt

Clara Gaspar on behalf of the LHCb Collaboration,
"Physics at the LHC and Beyond",
Quy Nhon, Vietnam, August 2014

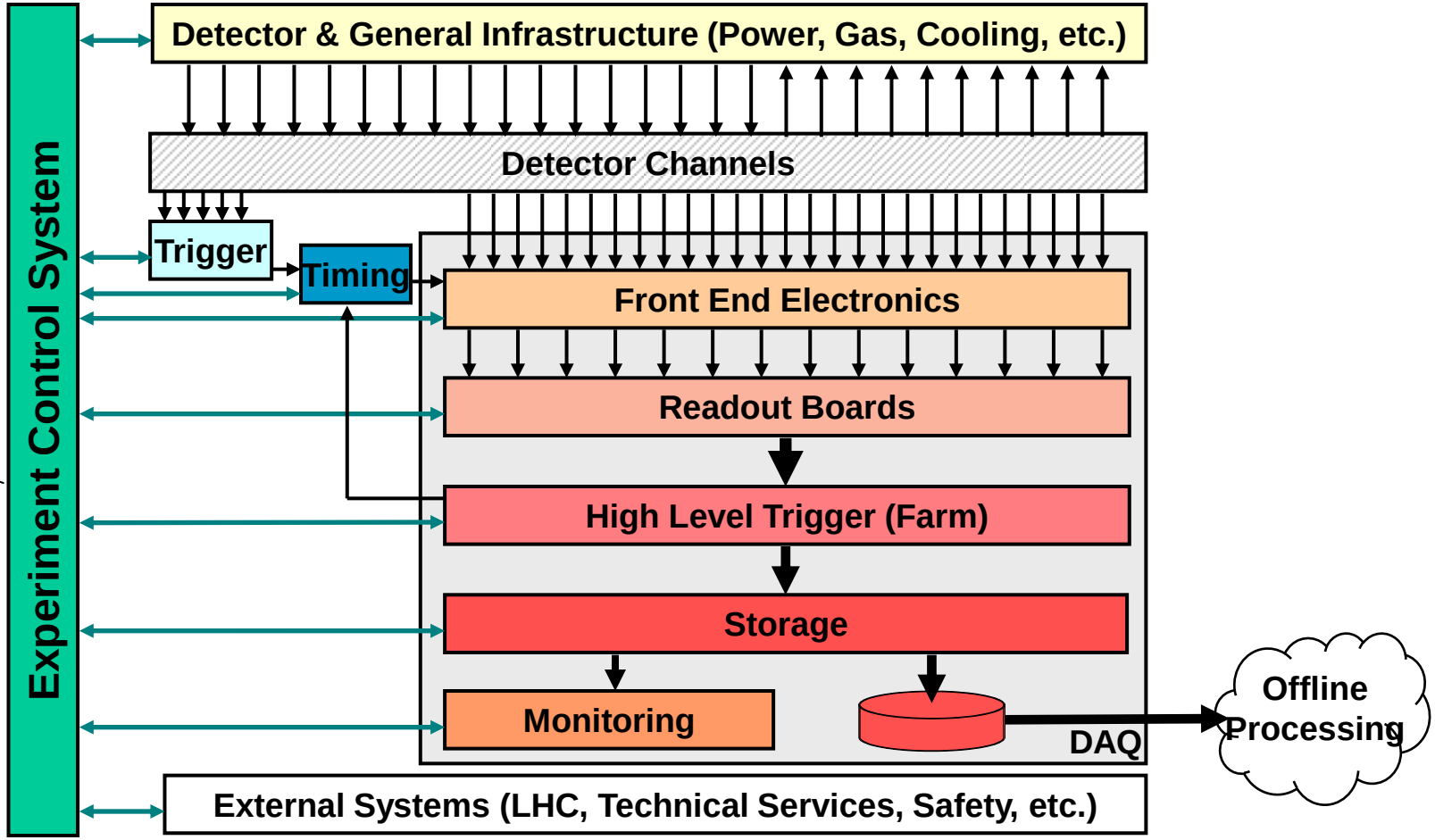
Operations



Operations Strategy

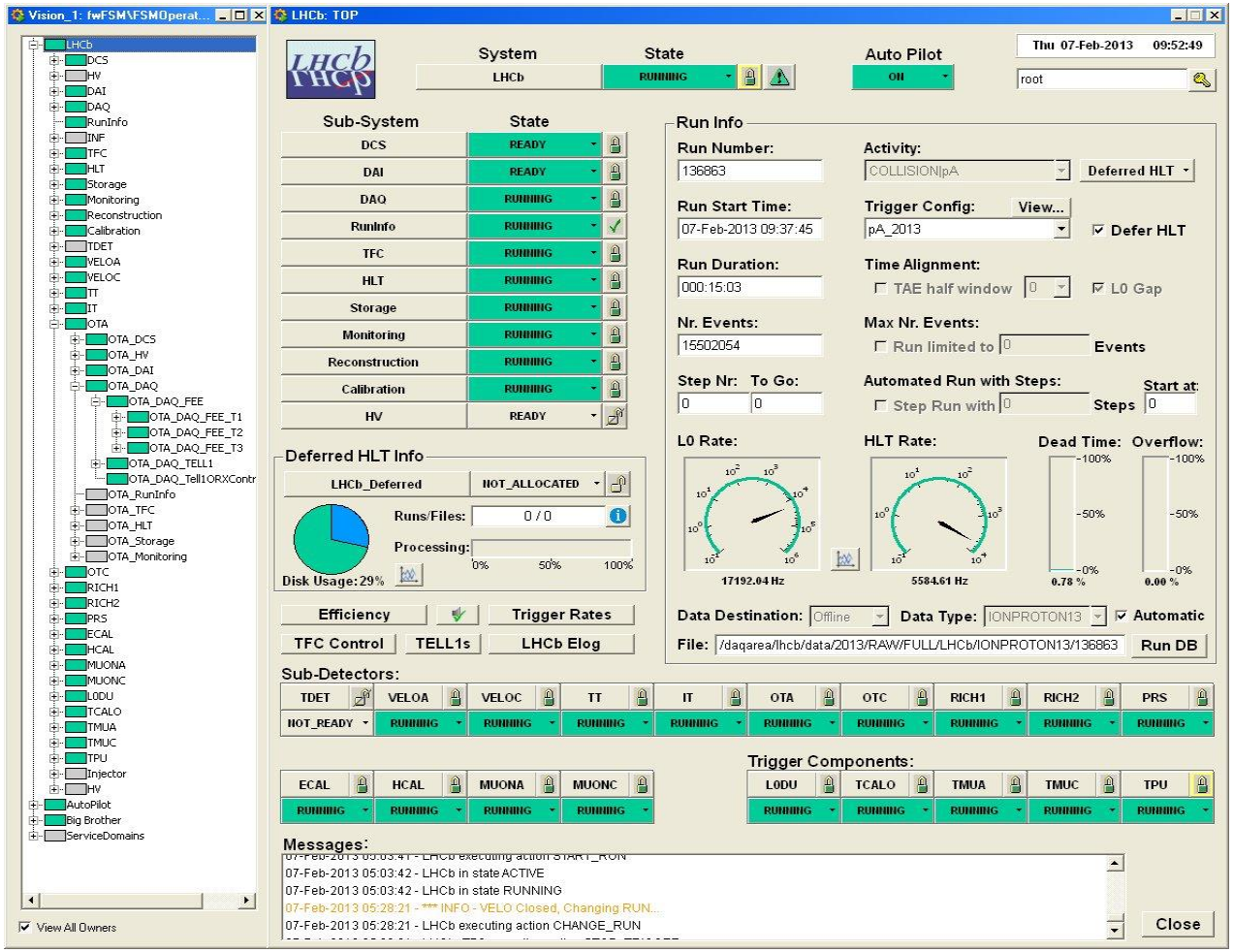
- 2 people on shift (from day one)
  - 1 Shift Leader (and main operator)
  - 1 Data Quality Manager
  - and small on-call team: ~10 people
- ➡ Integrated Control System
  - Homogeneous User Interfaces to all areas:
    - Data Acquisition (DAQ), Detector Control System (DCS), Trigger, High Level Trigger (HLT), etc.
- ➡ Full Automation
  - For standard procedures and (known) error recovery

Operations Scope



Operations Tools

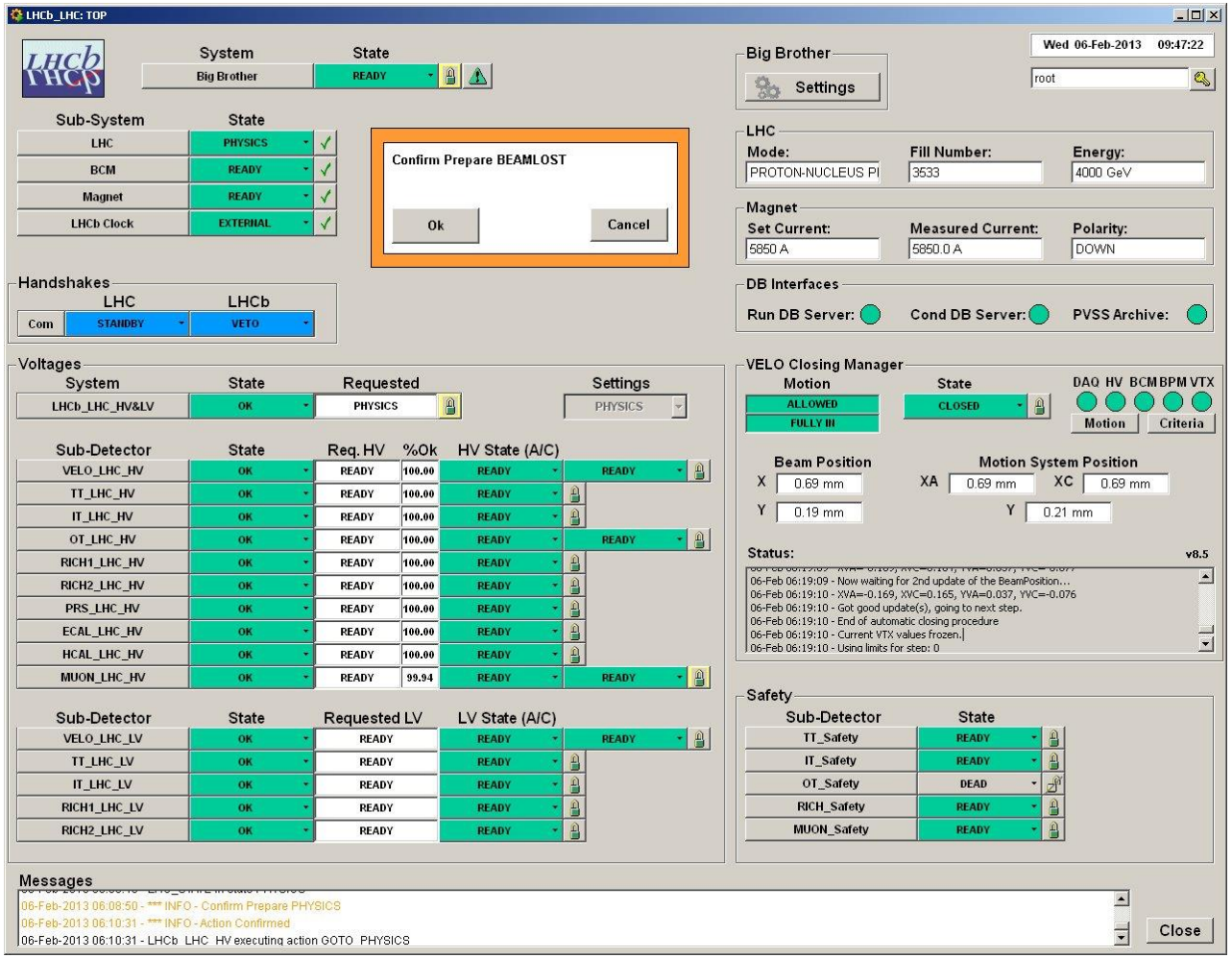
Run Control Automation: The Autopilot



- Configures, Starts and Keeps the RUN going.
  Recovers:
  - Sub-detector de-synch.
  - Misbehaving farm nodes
  - Etc.

Operations Tools

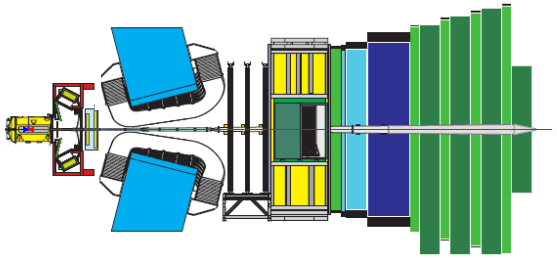
Big Brother



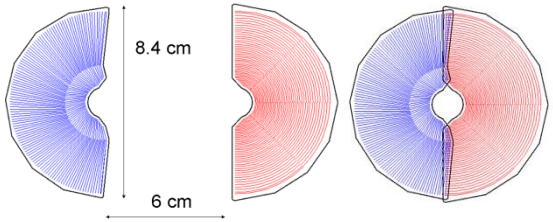
- Based on LHC state, controls:
  - Voltages
  - VELO Closure
  - Run Control
- Can sequence activities, ex.:
  - End-of-fill Calibration
- Confirmation requests and Information
  - Voice Messages

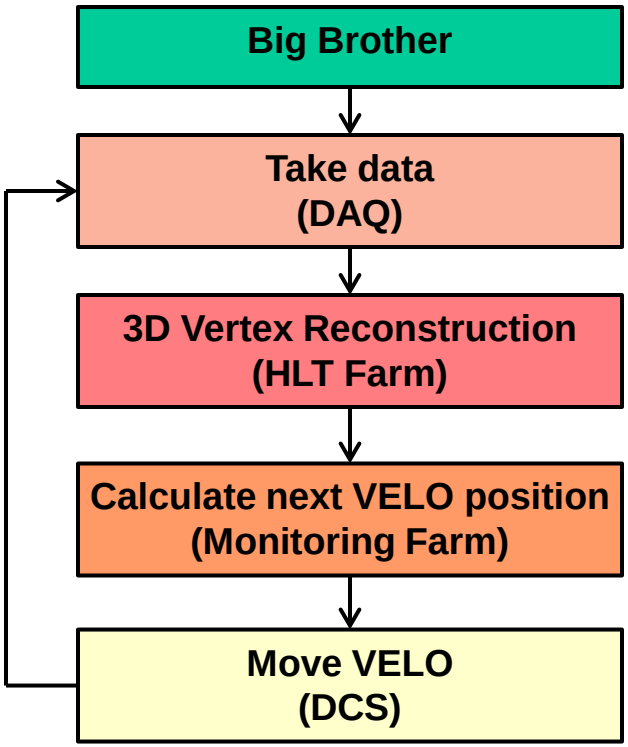
Selected Challenges…

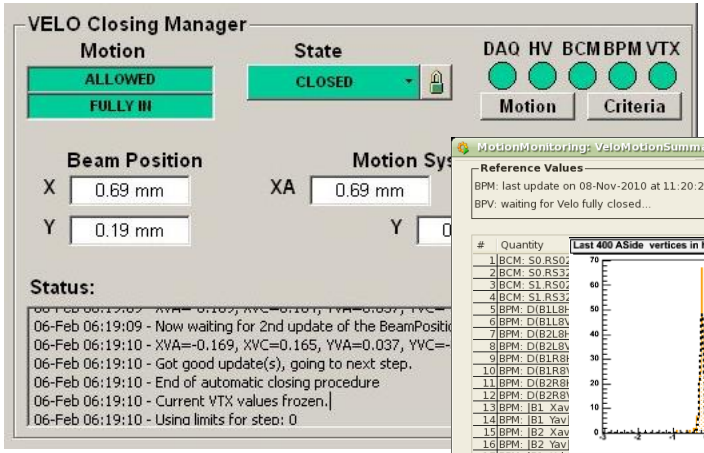
VELO Closing

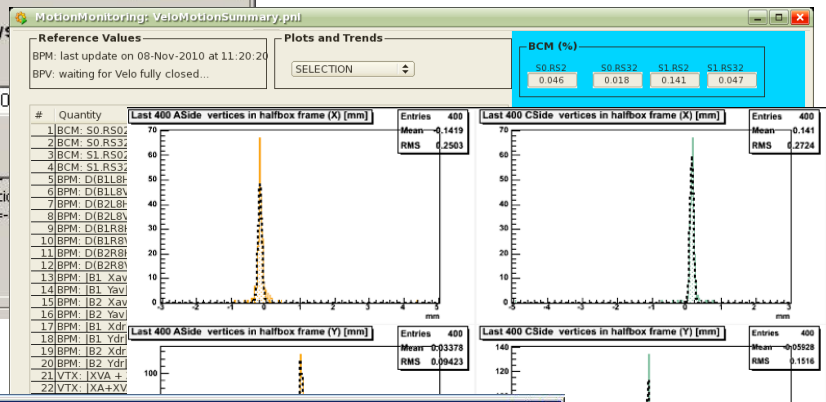


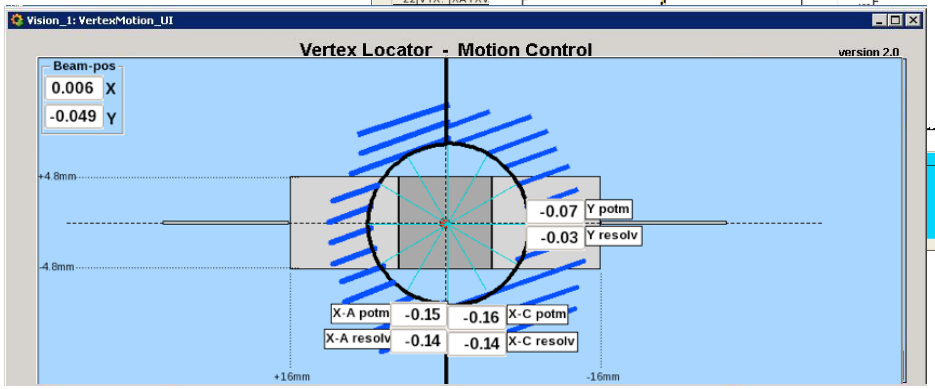
- **Safety: Many criteria to respect**
- **Procedure: Iterative "Feedback" loop**





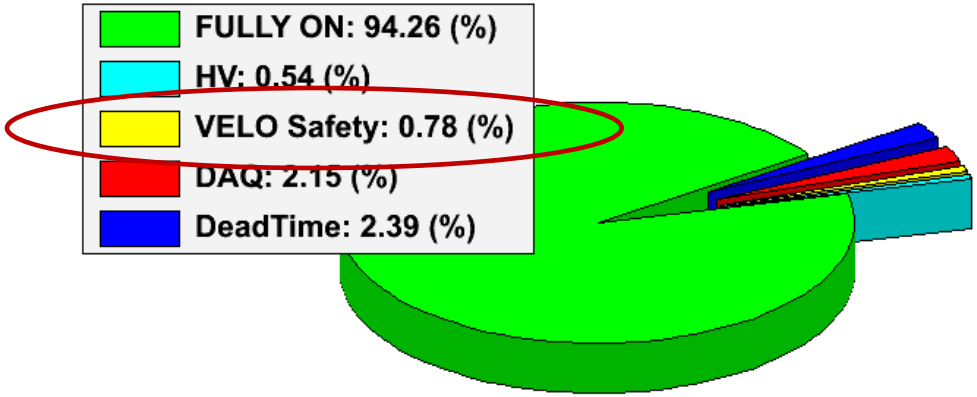






VELO Closing

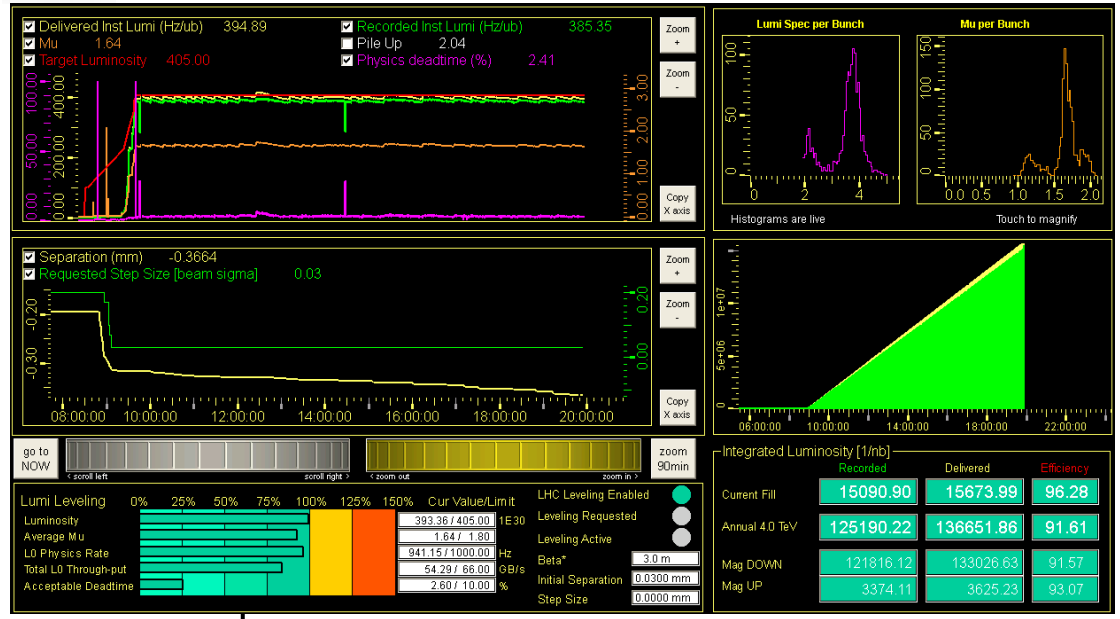
- **Manually operated in the beginning**
- **Completely automated since 2011**
  - Takes ~4 minutes at start of fill

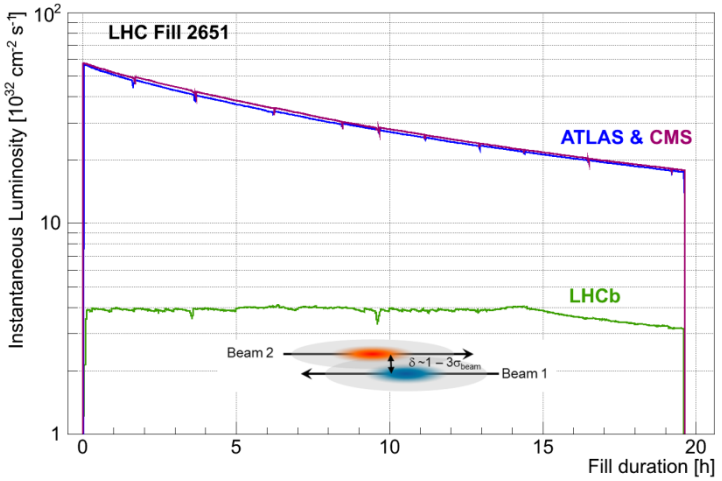


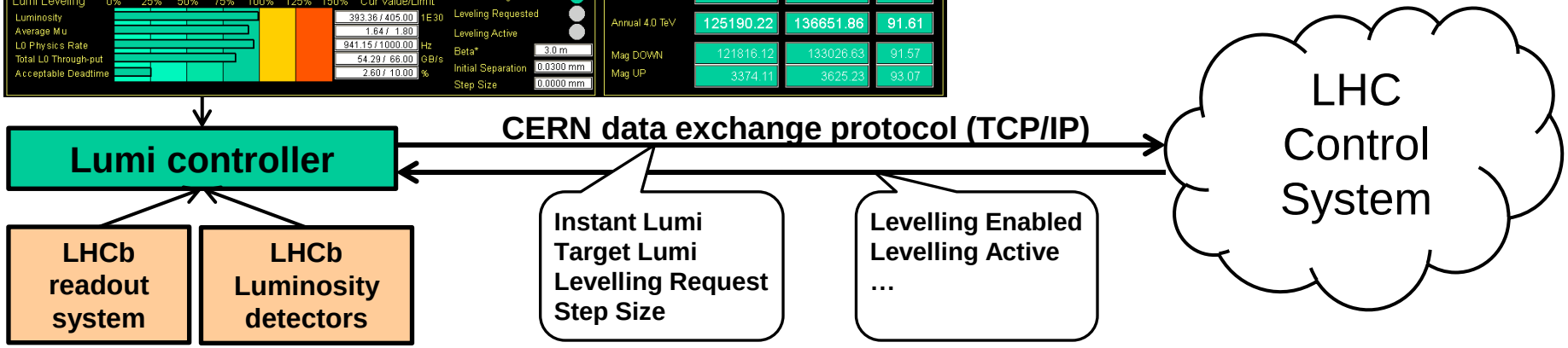
LHCb Efficiency breakdown 2012

Luminosity Levelling

- Allows running LHCb under stable optimum conditions
- Constraints: Safety and Reliability

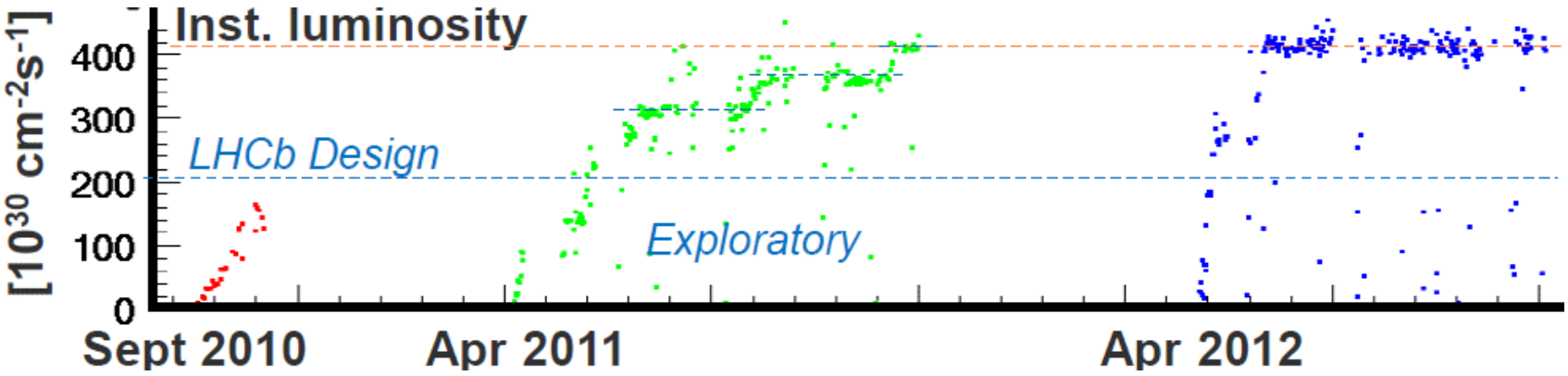






Luminosity Levelling

- In operation since 2011
- 95 % of integrated luminosity recorded within 3% of desired luminosity

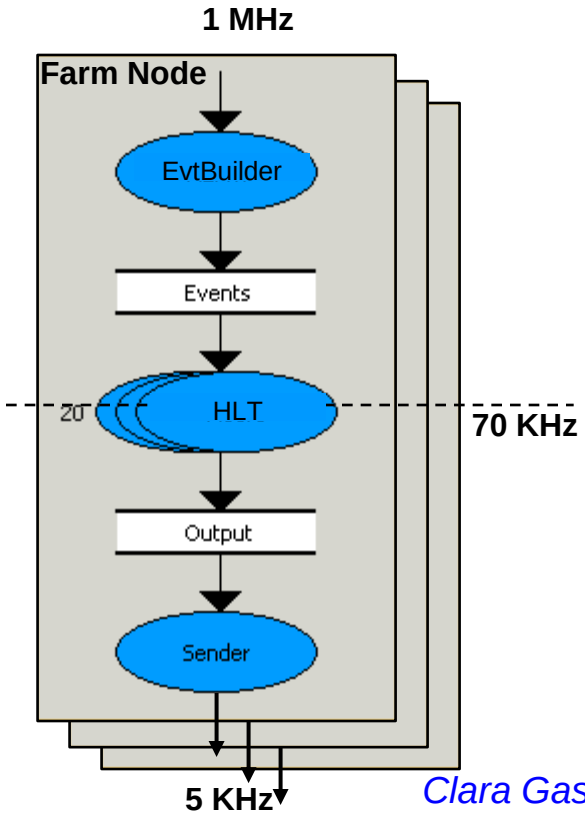


- Thanks to the LHC experts and operators

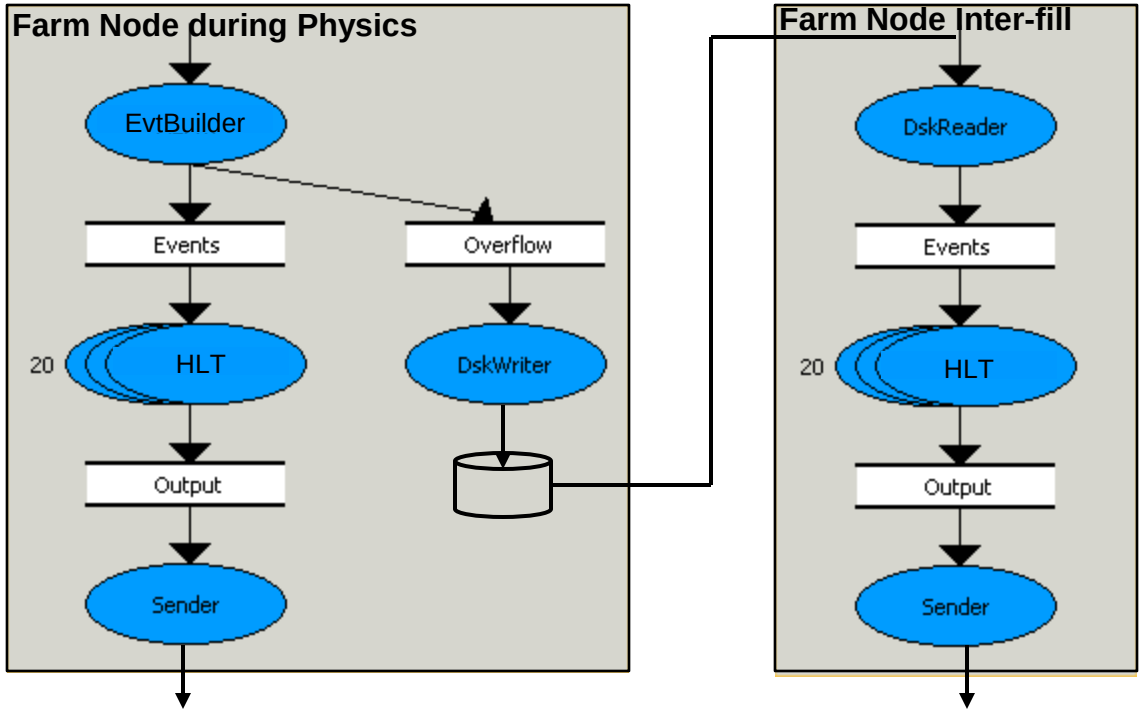
HLT Farm Usage

- **Resource Optimization -> Deferred HLT**
  - Idea: Buffer data to disk when HLT busy / Process in inter-fill gap
  - Change of “paradigm”: A run can “last” days…

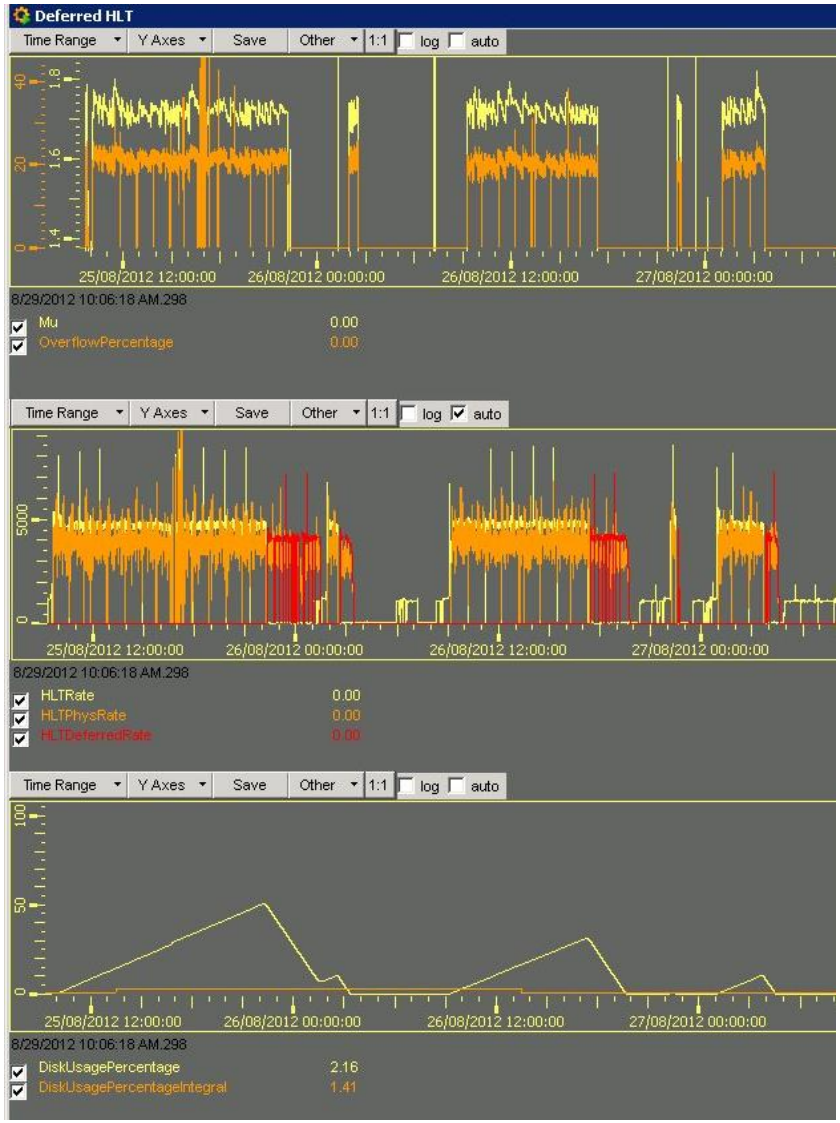
Standard HLT

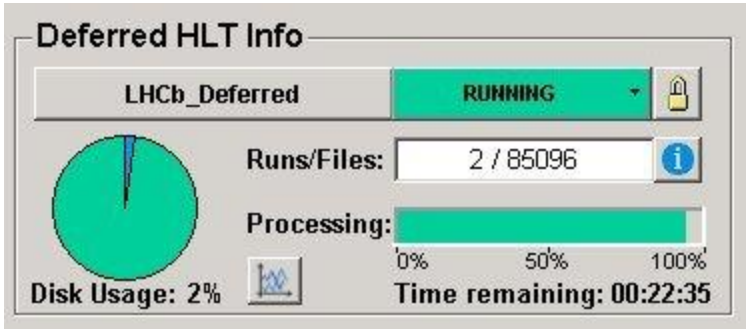


Deferred HLT



Deferred HLT

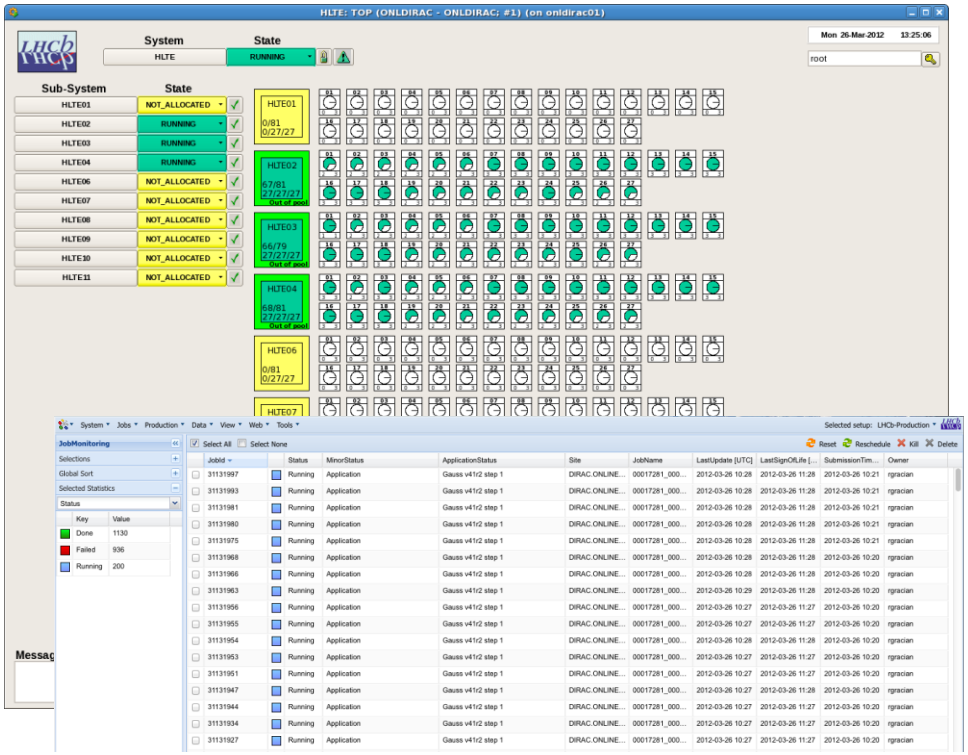




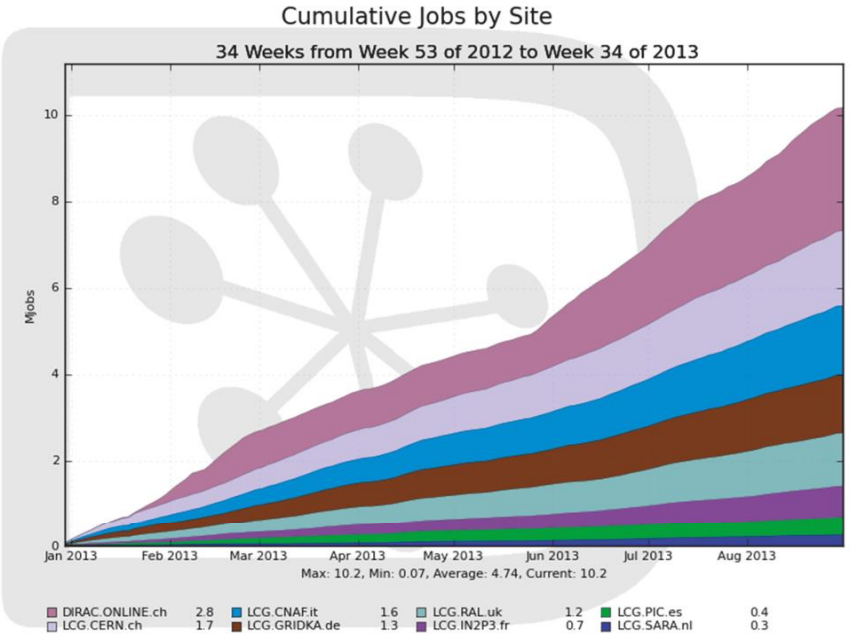
- **Major Success**
  - In place since 2012
  - ~20% resource gain for HLT
    - ➡ Better Trigger
  - Cushion for central DAQ/Storage hiccups

HLT Farm Usage

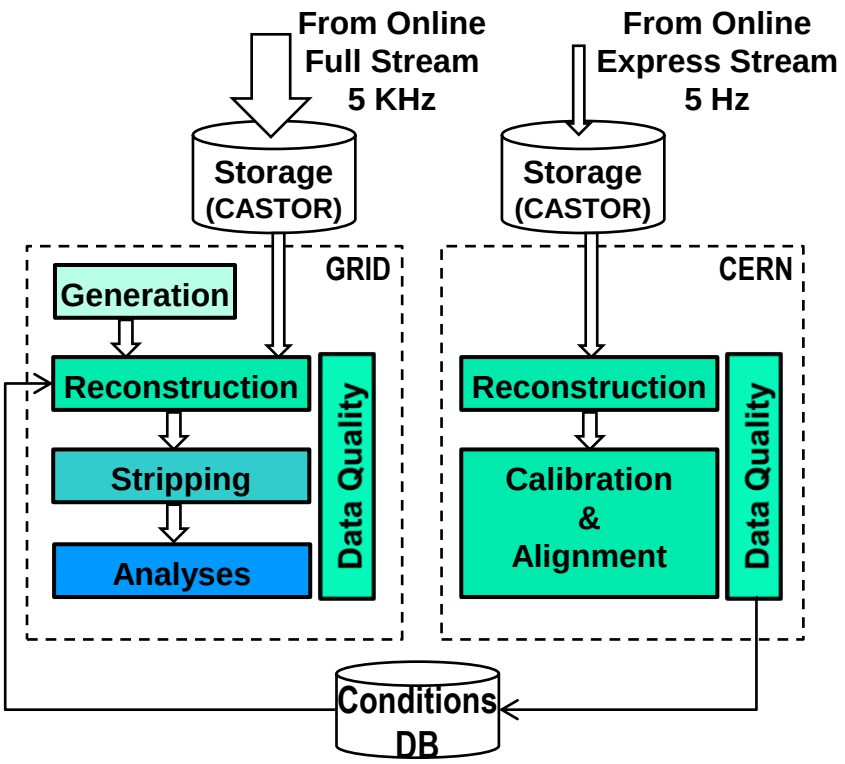
- **Resource Optimization -> Offline Processing**
  - Idea: Run standard Offline Simulation outside data taking periods
  - Online Control System turns HLT Farm into Offline site
  - In Operations since end 2012

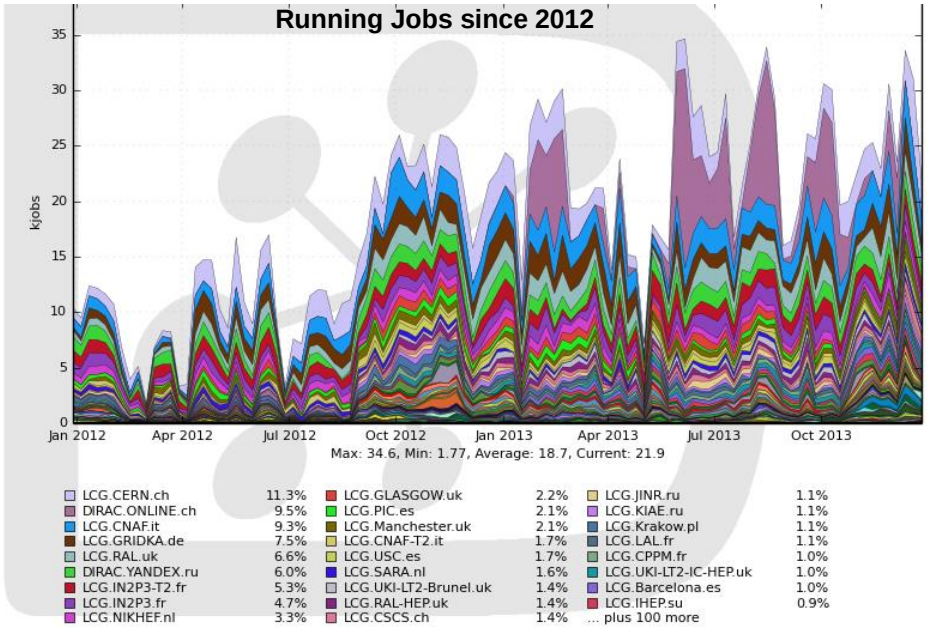


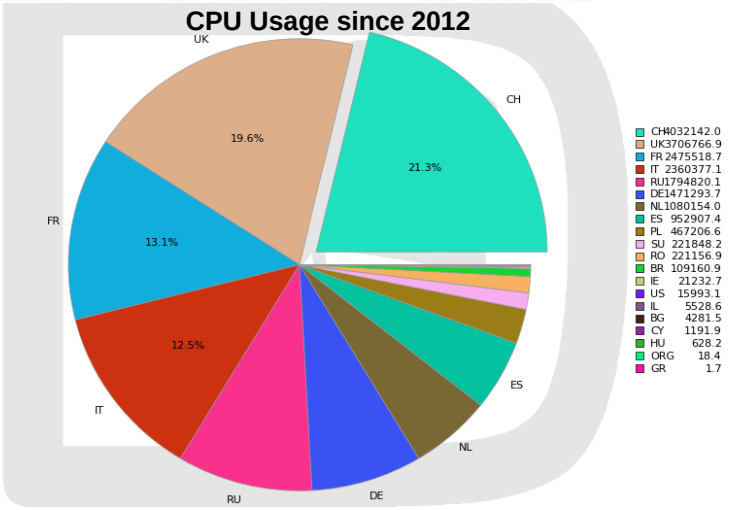
- **Also a big Success:**
  - ~25K jobs simultaneously
  - Largest LHCb producer



Distributed Computing







Running Fine

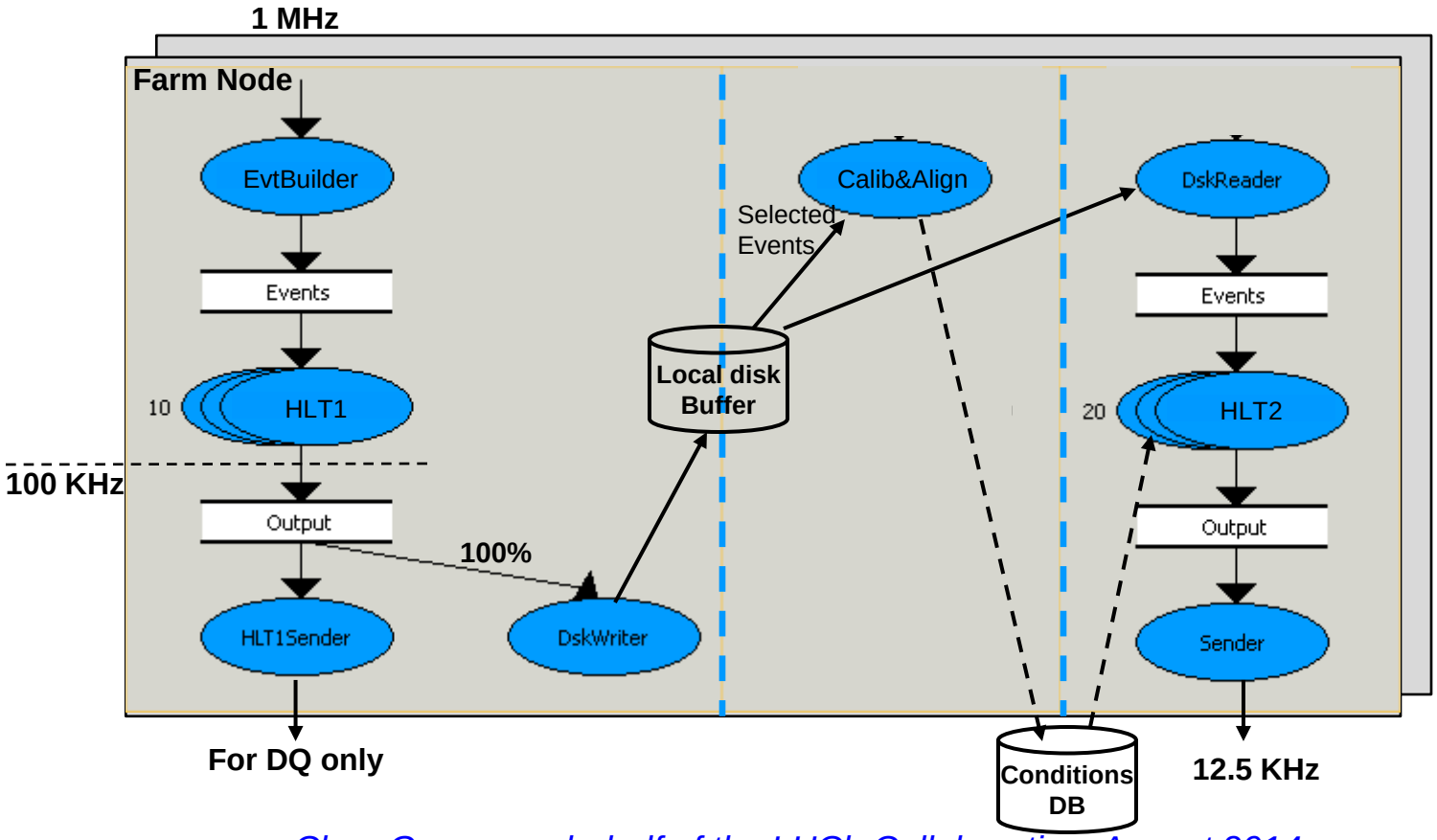
- 126 sites in 20 countries
- 2 Shifters (daytime only)

Lessons Learnt…

HLT Farm Usage in RUN II

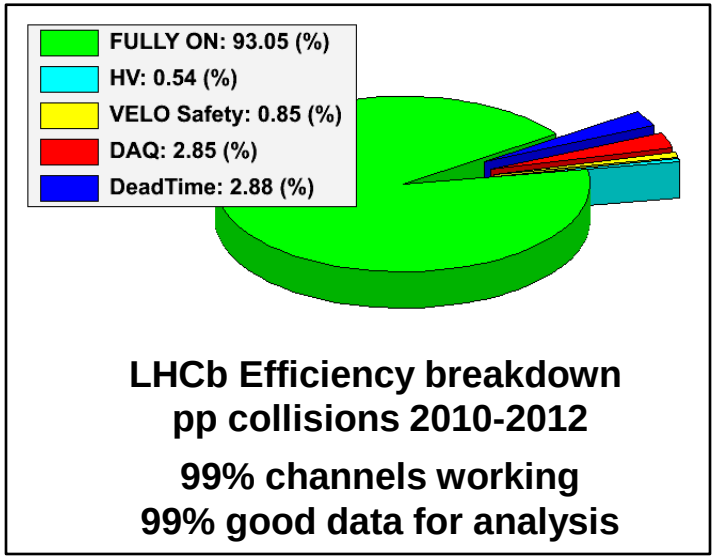
Even better Resource Optimization -> Split HLT

- Idea: Buffer ALL data to disk after HLT1 / Perform Calibration & Alignment / Run HLT2 permanently in background



Summary

- **LHCb Operations very successful**
- **The strategy was good**
  - One operator is enough
  - Integration & Homogeneity
    - Allows complex feedback mechanisms
      - Ex.: Re-synch or Reset a Sub-detector from Data Monitoring information
  - Automated Operations
    - Saves time and avoids mistakes
    - But requires experience and learning…
  - Further improve HLT Farm usage
    - Better Trigger and Online processing closer to Offline



LHCb Efficiency breakdown
pp collisions 2010-2012

99% channels working
99% good data for analysis

- **Related talks:**
  - **LHCb Run I Performance: Giacomo Graziani, Monday morning**
  - **LHCb Run II Challenges: Karol Hennessy, Friday afternoon**
  - **LHCb Upgrades: Olaf Steinkamp, Friday afternoon**