CMS Silicon Strip Tracker

Guido Dirkes – 02/12/2010

Tracker operation in a nutshell

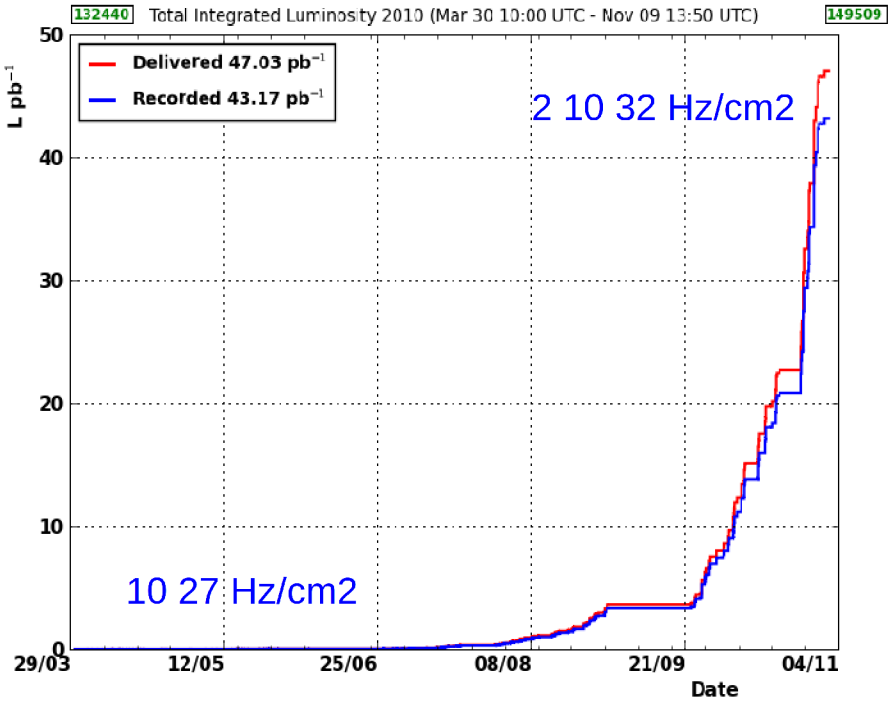
LHC delivered 47 pb^{-1}, CMS recorded 43 pb^{-1}
Overall data taking efficiency 92%
~85% with all sub-detectors in perfect conditions

Tracker uptime during stable beam (860.3h):

- Tracker **HV ON 94.9%** of stable beam time
- Tracker **DAQ running 98.8%** of HV ON time
- Tracker giving **good data 100%** of DAQ running time

Losses due to:

- Adjust/dump handshake (>3-10min)
- HV ramping at beginning of stable beam (~70secs)
- One turbine failure



Operation

Experience with Operations

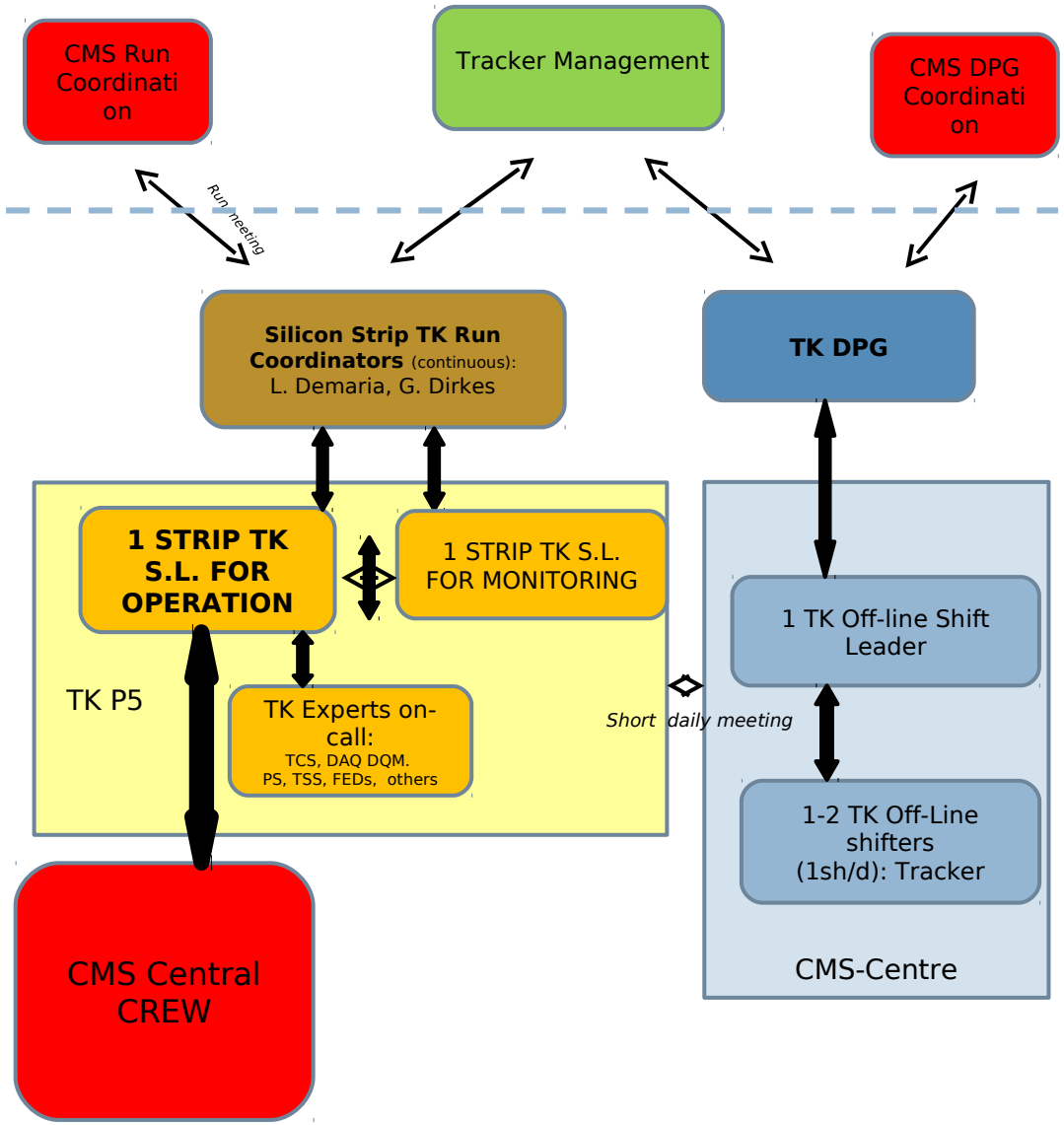
2010 operation started with 24/7 shifts at P5, which were discontinued end of June.

Present scheme for **on-line at P5**:

- Tracker Expert on Call steering the operation
  - Single point contact for Strip Operations
- Second Tracker expert on call as backup and doing monitoring of the detector
- On-call experts on shift rotation: DCS, DAQ, DQM
- Experts on site: PS, DAQ-hw, TSS, Cooling,…

In addition, for **Offline**

- OffLine Tracker Shift Leader
- Offline shifter (8h at CMS-Centre, 8h at FNAL)



DAQ

Running stable without major problems (**uptime 98,8%**).

FED firmware stable but with changes related to specific items

- single bit errors (CRCs)
  - Affecting data integrity for a single front end for a single event
  - No impact on data taking stability
- extra events from single detector modules (“sync lost draining”)
  - “major” improvement of data taking stability
    - SLD recovery needed full reconfigure of 170sec

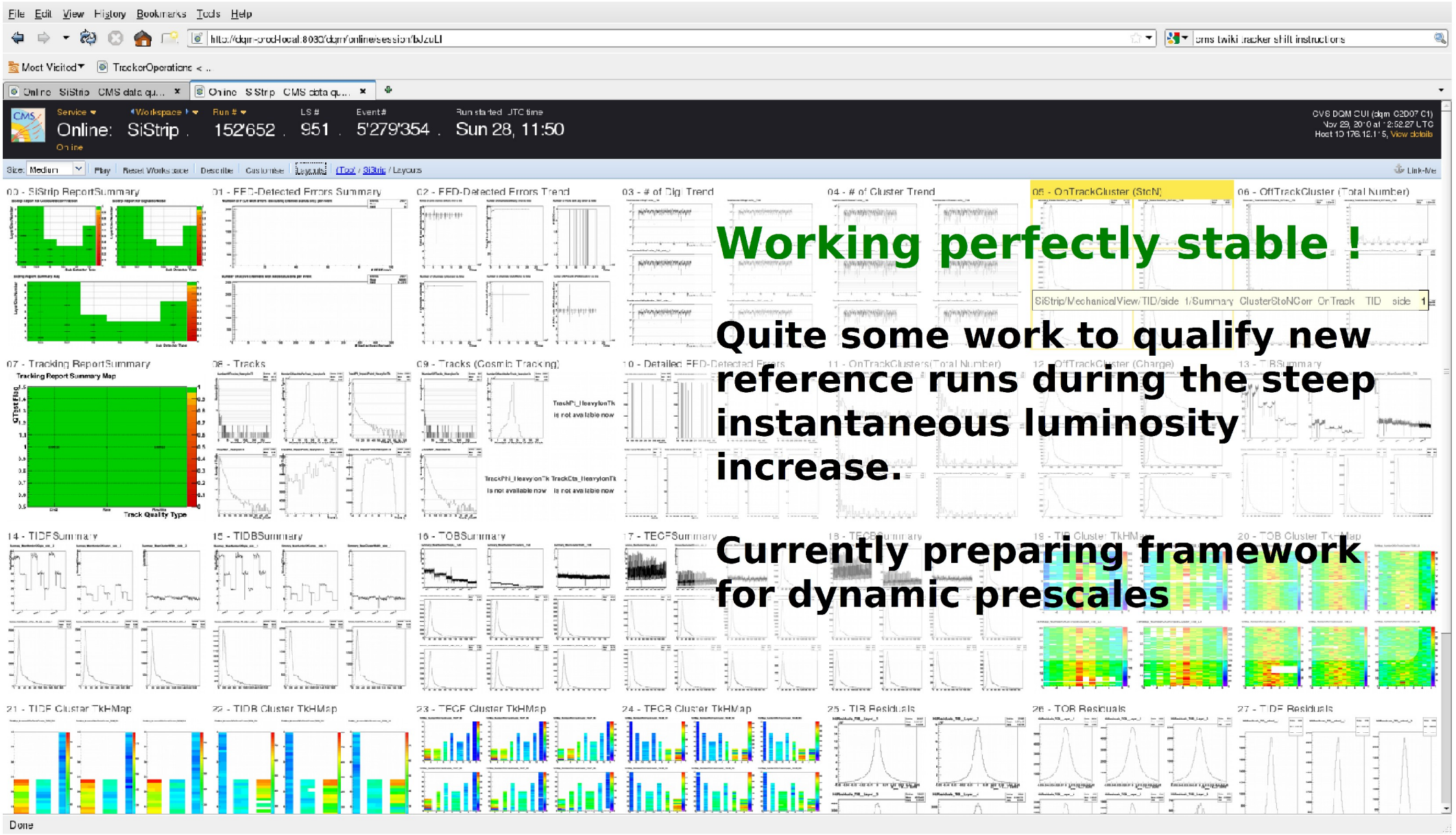
Monitoring issue

- Losing I2C communication during running (single control rings)
  - only DCU readout of affected
  - reason not yet fully understood

Central DAQ operation

- Shifter training to be improve to minimize time needed to take proper actions
  - Average down time per DAQ problem 6m35s

DQM

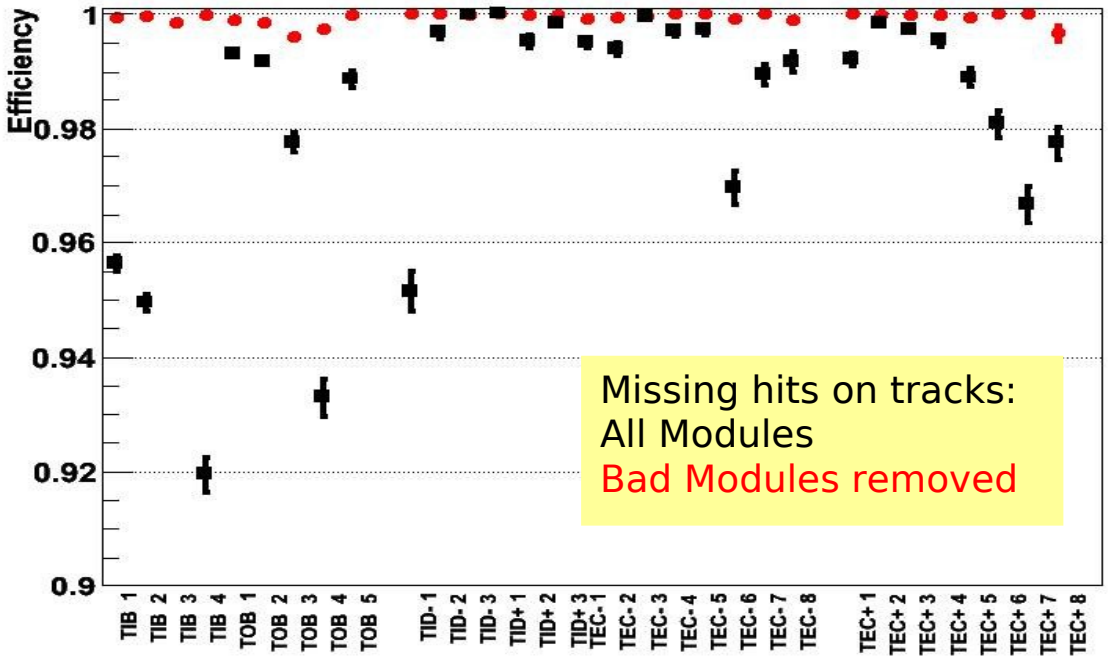

Working perfectly stable !
Quite some work to qualify new reference runs during the steep instantaneous luminosity increase.
Currently preparing framework for dynamic prescales

Tracker Basic Performance

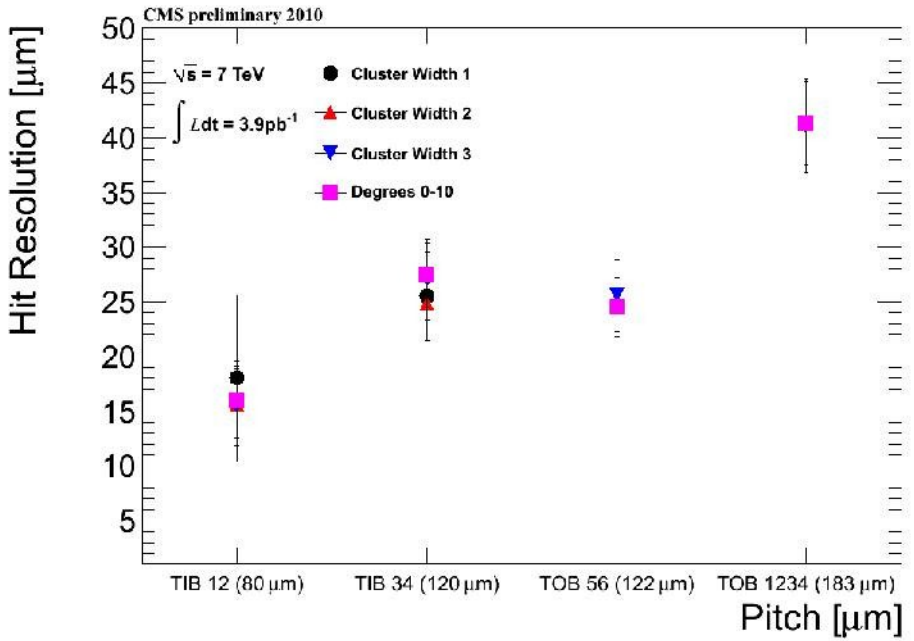
- Fraction of active detector:
  - Pixel: 98.3% Strips: 98.1%
  - high hit efficiency: >99.9%
- Reconstructed hit signals match with expectation and MC
  - Strip S/N: ~19 (thin sensors), ~23 (thick sensors)
- Estimated intrinsic hit resolutions match with MC
  - tracks in overlap: cosmics and collisions

- Offline Calibrations:
  - Lorentz Angle
  - Dead/Noisy channels
    - Efficiency
  - Analog Signal equalization

Strip hit efficiency

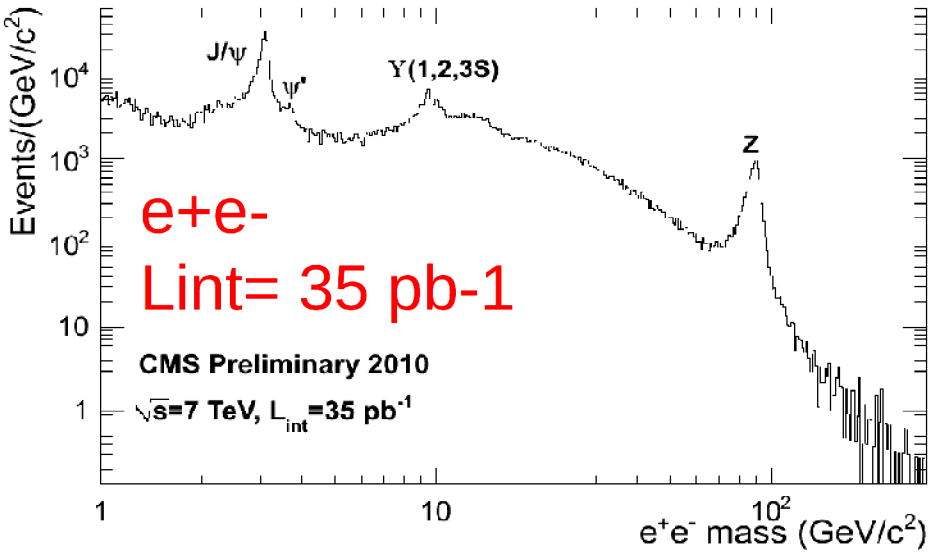


Strip hit resolution



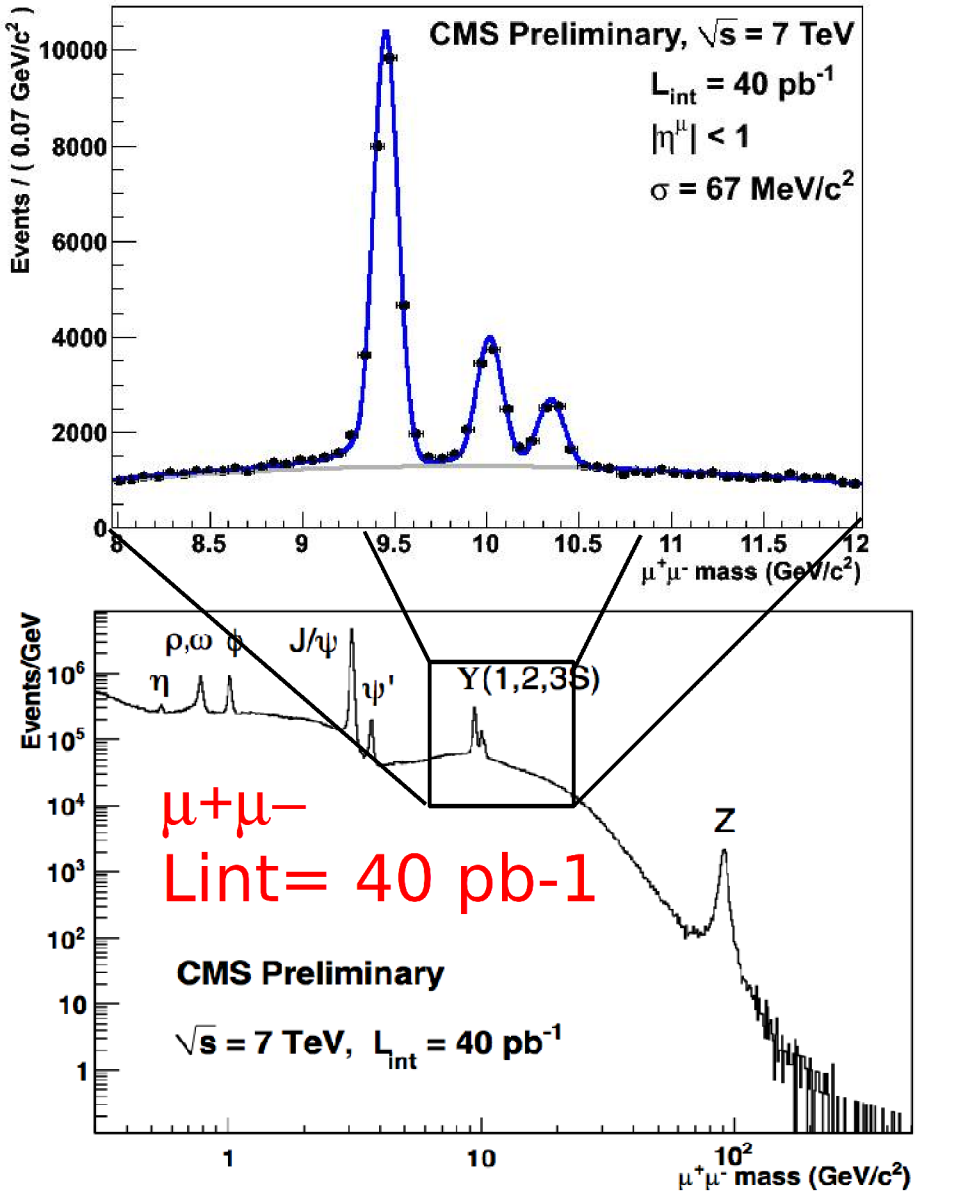
Invariant mass distributions

A tribute to Level1 and HLT trigger capability and flexibility



e+e- widths:
J/Ψ 52 MeV
Υ 149 MeV

μ+μ- widths:
J/Ψ 30 MeV
Υ 67 MeV



Services

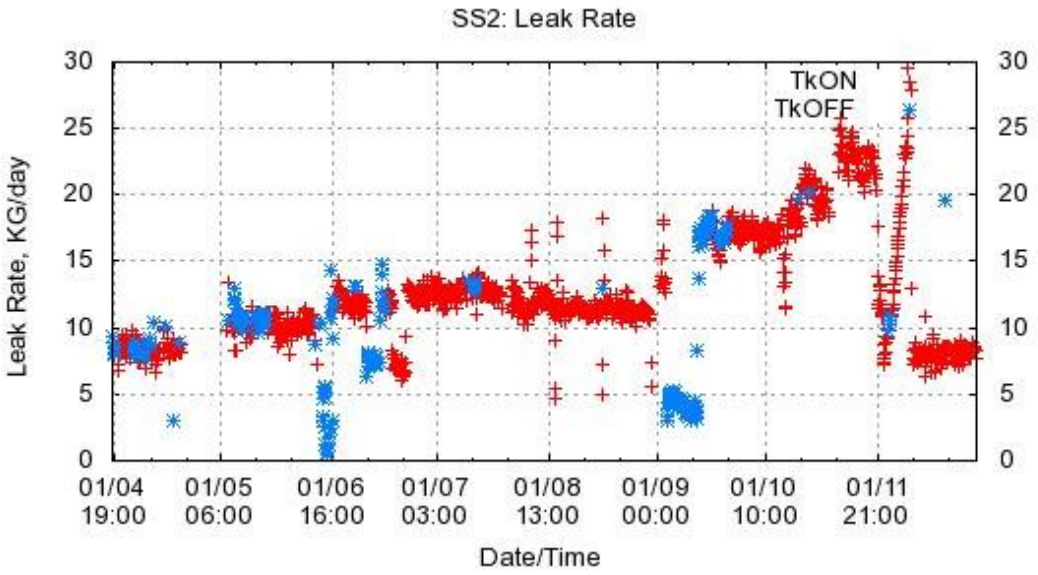
Cooling performance

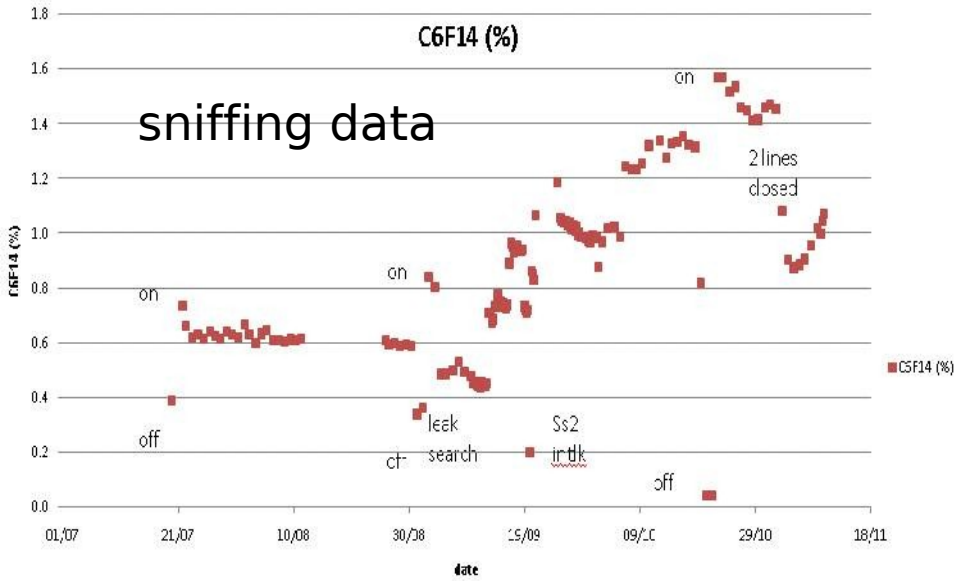
Stable and **reliable** operation

- only one unintended stop in 2010 (no data losses)

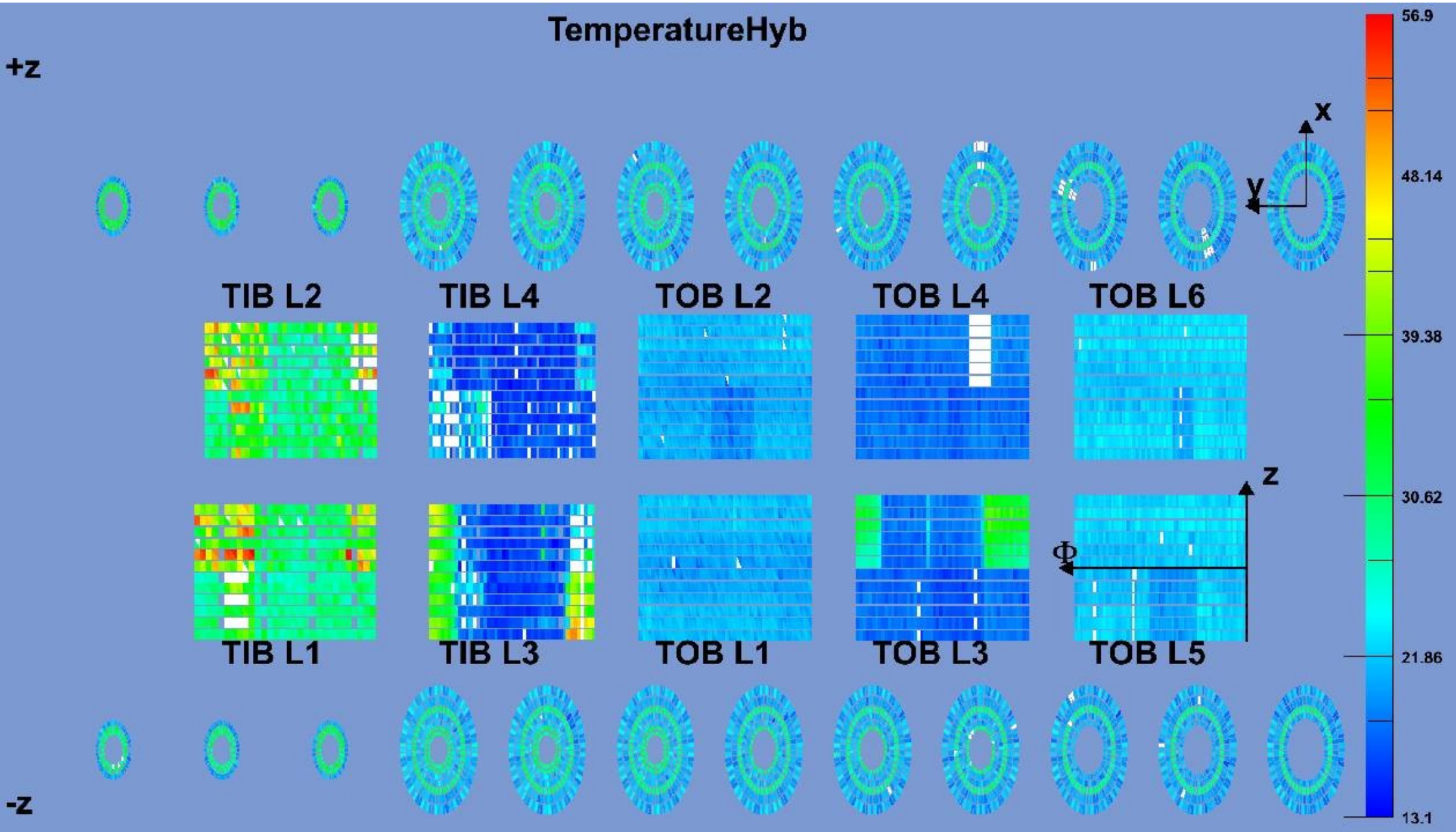
but

- SS2 leak rate problem
  - Sniffing data shows main part of the leaks are inside the detector
  - Closed two more lines in end of October (4/180)
  - Affected detector parts were re-commissioned for warmer operation
- SS1 pump ventilation fan broken → pump exchanged





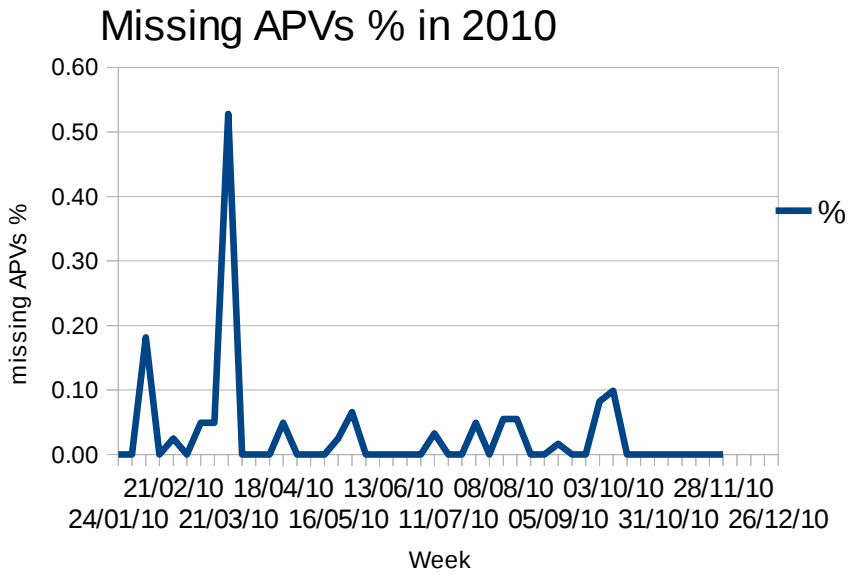
Cooling performance

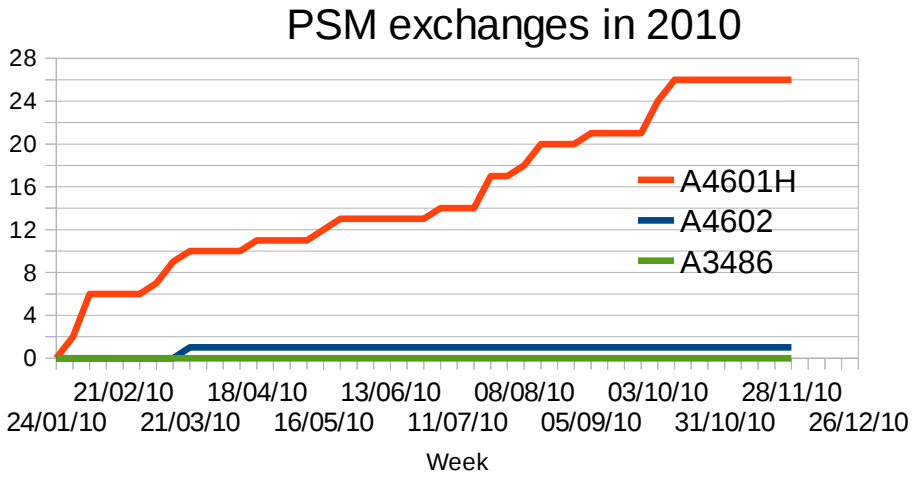


Power system

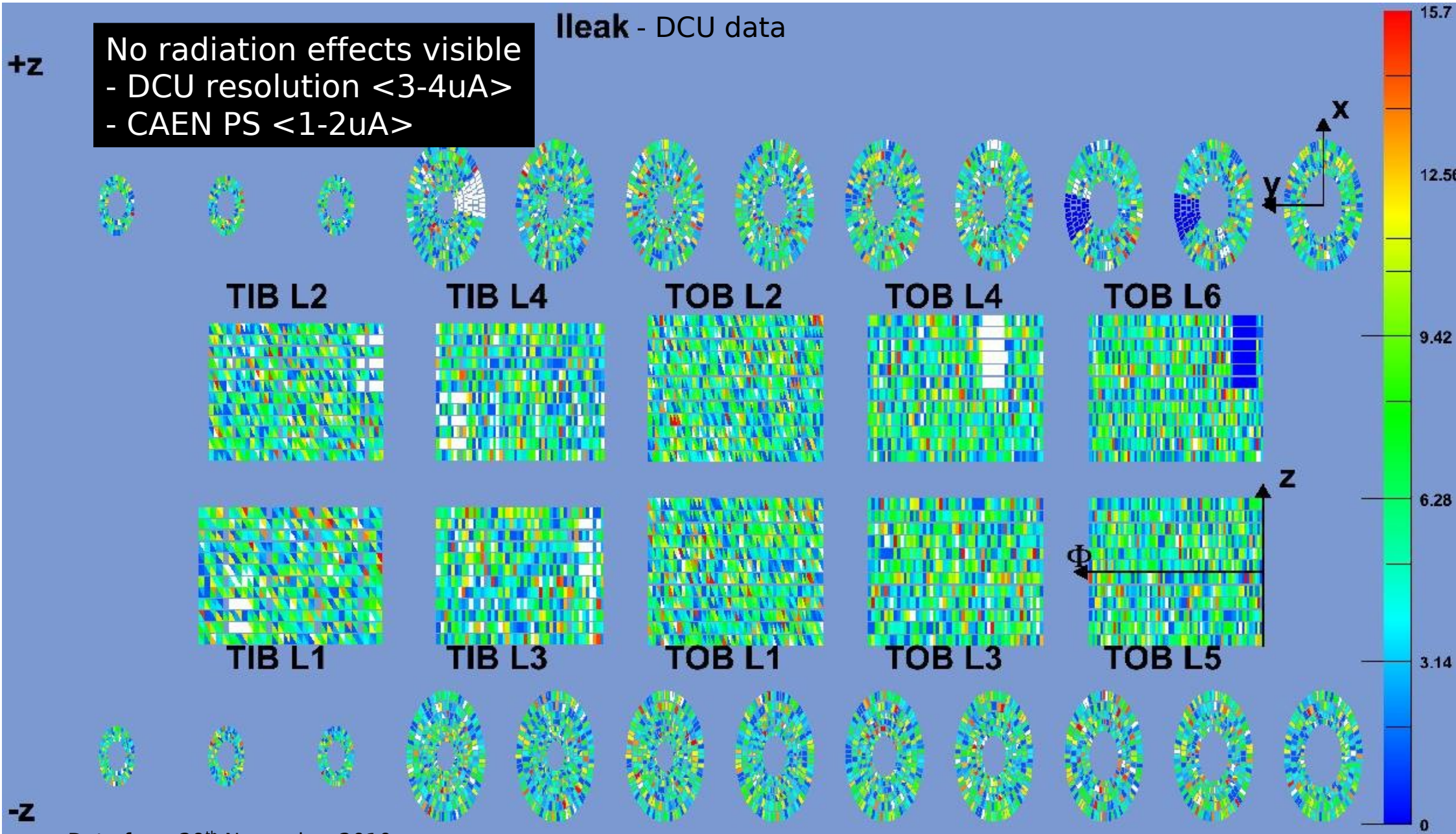
Working **perfectly stable**:

- Expect ~20/8270 channels giving problems per year
  - Negligible impact on tracking performance
    - Even with TS access only
- Spares for >2 years in hands





Detector leakage currents

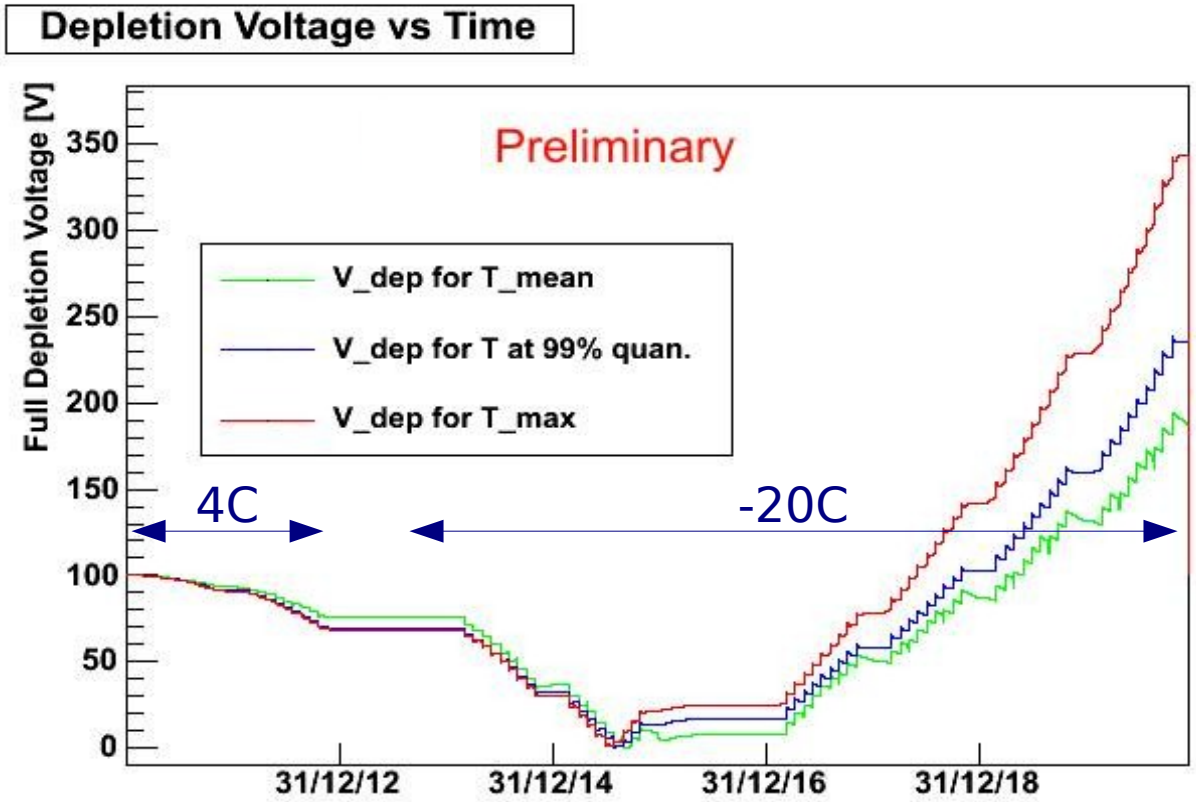


Outlook 2011 / 2012

Evolution of depletion voltage

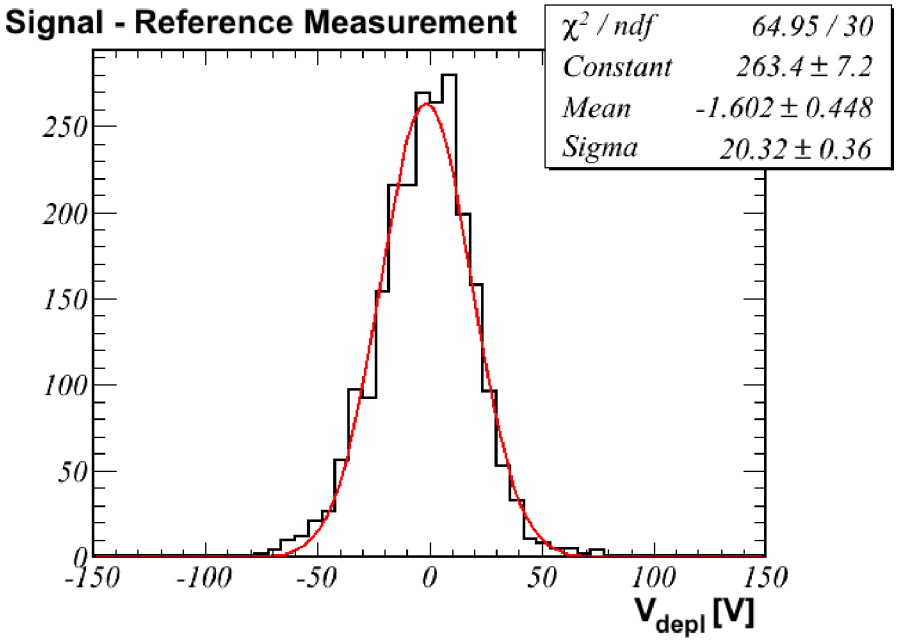
TIB layer 1 scenario:

- **335 fbarn-1 total dose**
  - _ Default LHC scenario with 2011& 201 modification
- Cooling set points
  - _ 2010-2012: 4C
  - _ 2013-2020: -20C
  - _ 3 d/quarter warm (15C)
  - _ 4 d/quarter OFF
- Shutdowns 2013, 2016
  - _ 1 m warm (20C)
  - _ 1 m warm (15C / cavern dew point)
  - _ Rest cold
- 8 weeks winter technical stop
  - _ 1 m/y on thermal screen
  - _ 1 m/y OFF



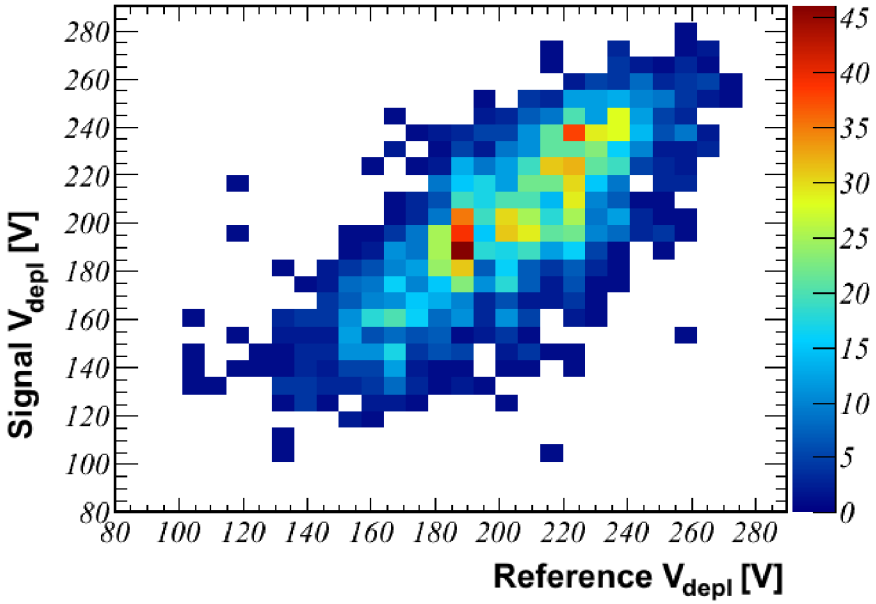
→ No urgent measure needed to reduce temperature for the upcoming two years

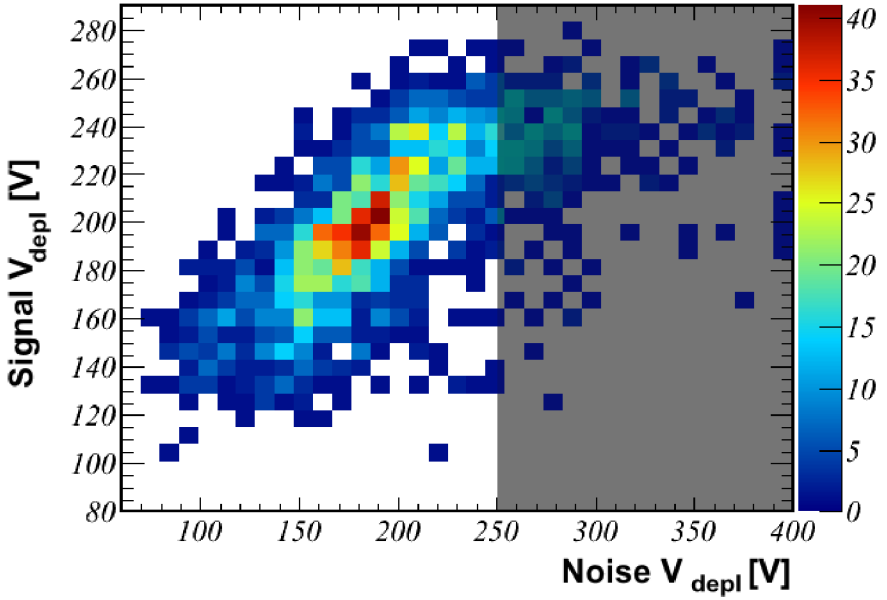
Full depletion voltage



Two methods to measure Vdepl:

- Signal vs voltage
  - Needs beam time (2h)
- Noise vs voltage
  - Fitting harder for higher Vdelp
- Both methods agree with reference from production





Summary

CMS strip tracker runs extremely well

- Superb tracking performance
- Excellent stability
  - Last 4 week with only 0.25% down time
- No issues for the 2011 & 2012 runs