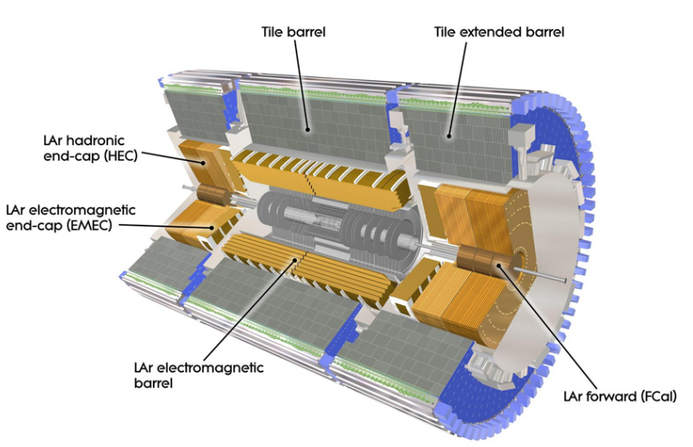
LHCC Poster Session - CERN, 5 March 2014

ATLAS calorimeters from Run 1 performance to Run 2 preparation



Run 1 ATLAS calorimeters DQ efficiency (%)			
Year	2010	2011	2012
LAr	95.0	98.7	99.1
Tile	100	99.2	99.6

ATLAS operated with an excellent efficiency during the Run 1 data taking period, recording respectively in 2011 and 2012 an integrated luminosity of 5.3 fb^{-1} at $\sqrt{s}$ = 7 TeV and 21.6 fb^{-1} at $\sqrt{s}$ = 8TeV. The Liquid Argon and Tile calorimeters contributed to this effort by operating with a good data quality (DQ) efficiency, as shown by the table on the left. This poster presents the Run 1 overall status and performance, 2013-2014 long shut down (LS1) works and preparations for Run 2.

Liquid argon calorimeter

- Sampling calorimeters segmented in 4 layer depth with LAr as active material and as passive material : Lead (EM), Cu (HEC), W/Cu (FCAL)
- ~ 180000 readout channels
- Liquid Argon ionized by charged particles
- Electrons drift to copper readout electrode thanks to high voltage applied inside the gap ~2000 V in electromagnetic barrel (EMB)
- Signal amplified, shaped and digitized in 5 samples upon level 1 trigger accept by 1524 Front End Board (FEB) each reading 128 channels

Run 1 overall status, performances and data quality

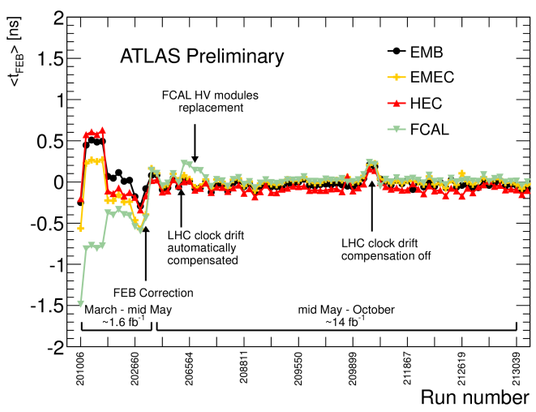
- Hardware problems during operation (all taken into account in simulation but the last one):

  - 2010: 30 FEB lost optical connection to data acquisition system → 5% acceptance loss, failing optical transmitters (including those which could potentially fail) replaced during 2011 winter break.

  - 2011: 6 FEB + 1 calibration board in EMB lost trigger clock and control signals. FEB of layer 2 fixed during the year, the rest during 2011 winter break.

  - 2012: 4 FEB turned off in end cap due to a cooling leak → 1.2%(4.5%) of EM(HEC) channels affecting 300 pb^{-1}(2.9 fb^{-1}) of data

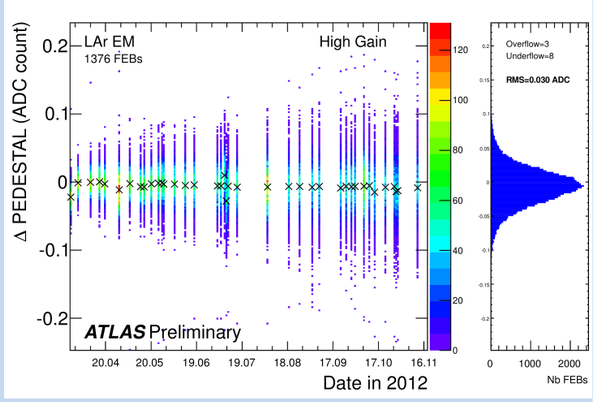
- No problem with detector itself or cryogenic system during the whole Run1 data taking
- Good stability and precision of FEB timing as shown in the plot bellow (the timing resolution is ~ 300ps in 2012)



- Excellent stability of calibration constant over time:

  - electronic baseline (pedestal): 0.02 – 0.03 ADC counts,

  - relative gain: 0.05 – 0.30 per mill



- LAr data quality procedure constantly improved during the whole Run1:

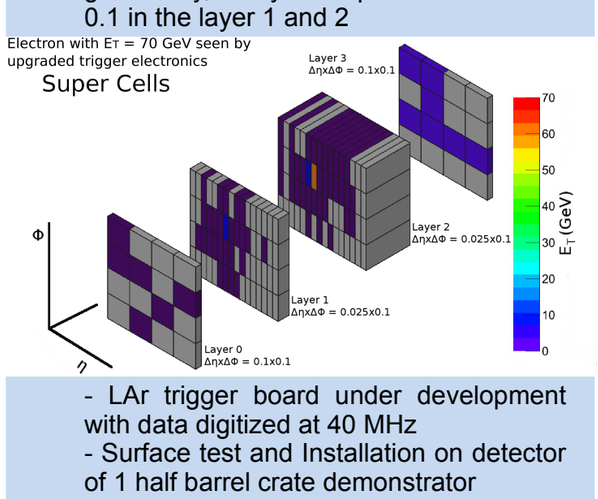
  - Data rejection due to High Voltage (HV) trips almost divided by 2 from 2011 (0.96%) to 2012 (0.46%) → installation of HV modules with independent current control (no trips) in the most affected regions.

  - Huge improvement to tag and treat coherent noise burst (< 5µs) affecting 1.46%(0.26%) of the data in 2011(2012).

- Contribute to good performance on the physics objects (electron, photon, jet…) → see performance poster

LS1 work and phase I upgrade

- Activities mainly focused on maintenance and consolidation of the LAr system:
  - 58 front end crate low voltage power supplies changed (more robust modules),
  - change of 52 HV modules for current control ones for part of EMEC and FCAL (continuation of ongoing improvement started during Run1),
  - Repair / replacement of ~ 20 FEB to reduce the number of bad channels even further (<0.1% of bad channels during Run 1),
  - Install spare long optical readout cables to replace damaged cable
- Online software update to the improved data acquisition software. Tune calibration system to speed up.
- LAr upgrade scheduled in 2019:
  - The existing level 1 trigger granularity is Δη x ΔΦ = 0.1 x 0.1 with no longitudinal granularity
  - Upgrade proposal to keep low trigger rate for increased peak luminosity: new granularity, 4 layers Δη x ΔΦ = 0.025 x 0.1 in the layer 1 and 2



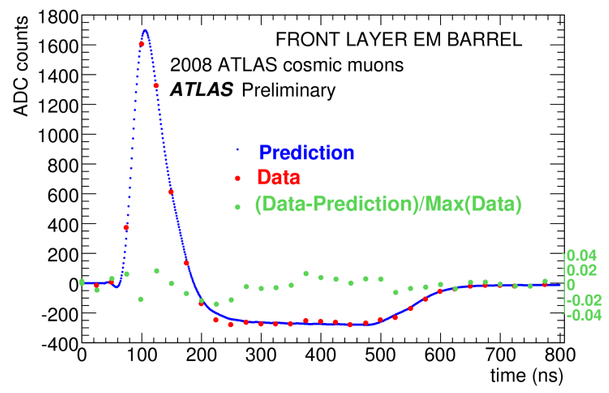
- LAr trigger board under development with data digitized at 40 MHz
- Surface test and Installation on detector of 1 half barrel crate demonstrator

Preparation for Run 2

- LAr getting prepared to increased instantaneous luminosity of Run2:

  - Coherent noise burst frequency increase with the instantaneous luminosity. All events passing Level 1 trigger will pass through a dedicated algorithm to keep high data quality efficiency,

  - Run 1 condition of 5 digitized samples transmitted from readout (seen signal plot bellow) limit level 1 trigger rate at bellow 90 kHz. Going to 4 samples readout will allow for 100kHz. Performance impact currently under study.



- Operational plans for the future months:

  - Restart regular operation with LAr + L1 Calo standalone,

  - Integrate LAr in the ATLAS data taking recommissioning with and without HV on.

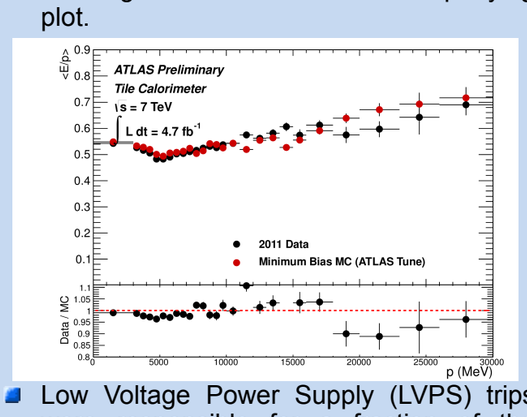
  - ATLAS combined data taking with cosmics + random trigger for December 2014

Tile calorimeter

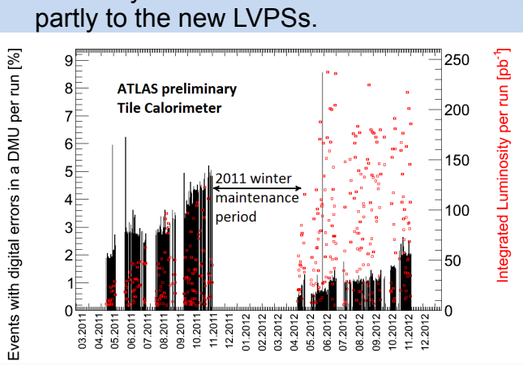
- 4 partitions: Long Barrel and Extended Barrel, A / C sides (LBA, LBC, EBA, EBC).
- 64 modules (phi regions) per partition, with a total of 9852 PMTs.
- Light from the 3mm thick scintillating tiles is amplified by the PMTs and the signal is digitized for readout.

Run 1 performance

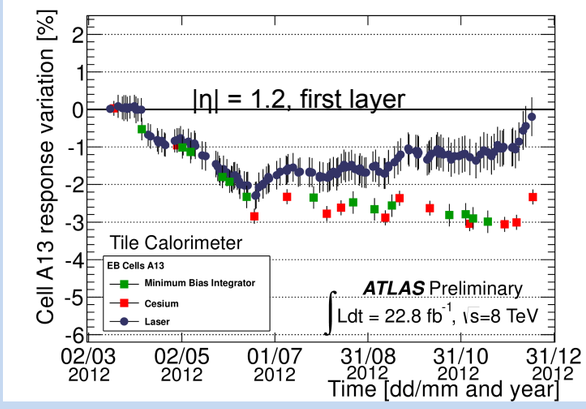
- The Tile Calorimeter performed well during the Run 1 data taking periods, operating at an overall efficiency of 99.5%.
- Tile response during Run 1 was found to be accurately modeled by MC, as shown for single hadrons in the accompanying plot.



- Low Voltage Power Supply (LVPS) trips were responsible for a fraction of the inefficiency in Tile Cal during Run 1. Upgraded LVPSs (more stable and with reduced, Gaussian noise) were installed in 40 of the 256 phi-regions (modules) over the 2011 winter maintenance period. The efficiency increase in 2012 is attributed partly to the new LVPSs.



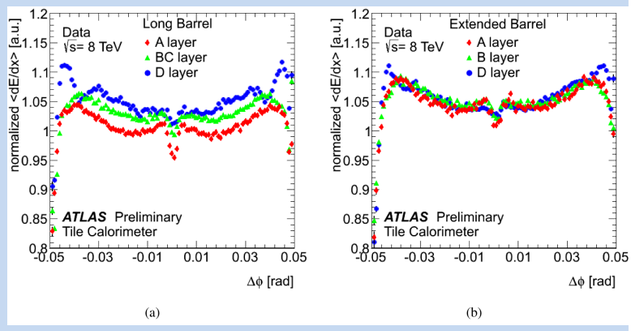
- There was a corresponding decrease in the number of cells which needed to be masked. This reached as high as 5.2% in 2011, but remained below 3% in 2012.
- Tile Calibration systems performed well during Run 1. At the end of data taking, Laser and Cesium calibrations were in agreement to within 0.4%.
- In the cell most exposed to radiation, the maximum drift was 3%, attributed in equal parts to PMT drift and scintillator aging.



- Cell noise was modeled with separate contributions from pileup and electronics. Electronic noise has a significant non-Gaussian component. A double-Gaussian model was used to model this in Run 1. Noise correlation between components was monitored during Pedestal calibration runs and corrected for.
- Energy scale resolution was within 3% based on cosmic muons, with additional studies planned to improve modeling of the energy scale uncertainty.

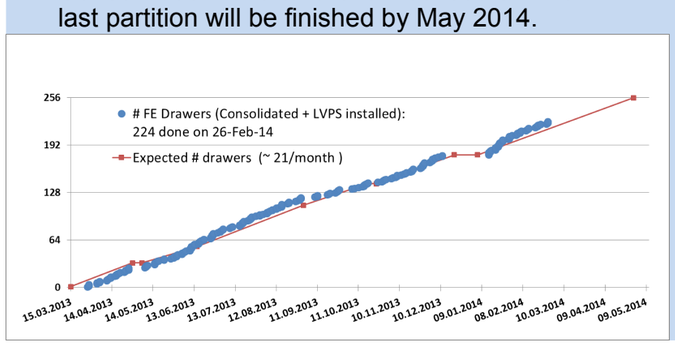
Run 2 preparation

- The Laser calibration system being upgraded, and calibration frequency during data runs is being increased for Run 2.
- Improvements to calibration software, for example time offset shift detection.
- Improvements to Tile Monitoring and Data Quality software. Expanded use of automated Data Quality testing during calibration runs provides a significant reduction in shifter work load. More effective signaling of detected problems reduces the possibility of human error.
- A new web interface is under ongoing development, which will provide a full overview of TileCal, with access to DCS, calibration and conditions, and DQ monitoring functionality.
- Replacement of Minimum Bias Trigger Scintillator (MBTS), with preliminary test showing a more uniform response and reduced cross-talk at the trigger level.
- Ongoing performance studies, including realistic modeling of the signal response along a cell, implemented in the MC for Run 2.



LS1 consolidation and improvements

- To address issues that will lead to better data taking conditions for Run 2, there is a significant ongoing maintenance and consolidation effort within Tile Cal.
- New Low Voltage Power Supplies have been installed in all modules.
- Recabling was performed prevent adjacent modules from being unpowered at the same time during a power supply trip.
- Consolidation efforts are on schedule. The last partition will be finished by May 2014.



- The general hardware consolidation includes:
  - Reinforcement of connectors for power and data transmission
  - Thorough test of component functionality
  - Repair of dead or unstable channels
- Additional actions are taken during consolidation of the extended barrel:
  - Installation of missing crack and gap scintillators (8 on each side).
  - Optimization of the readout for crack and gap scintillators and the new MBTS
  - Preparation for using the tile last layer at LV1 muon trigger for 1.0 < |η| < 1.3 to reduce rates

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