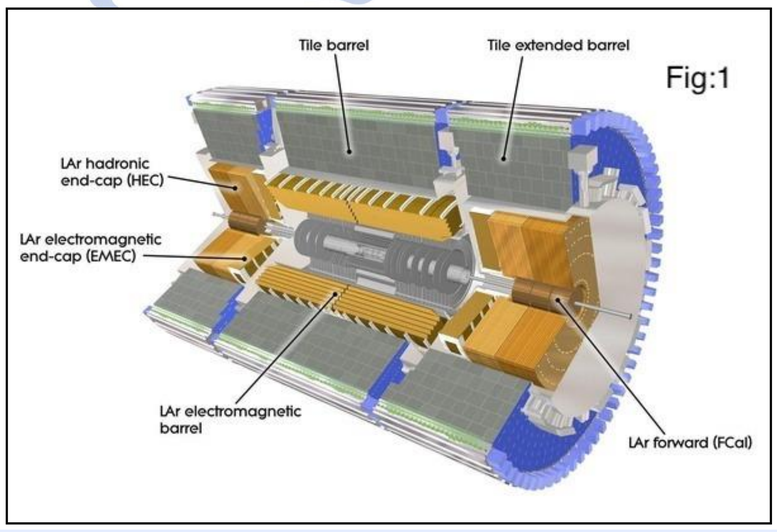
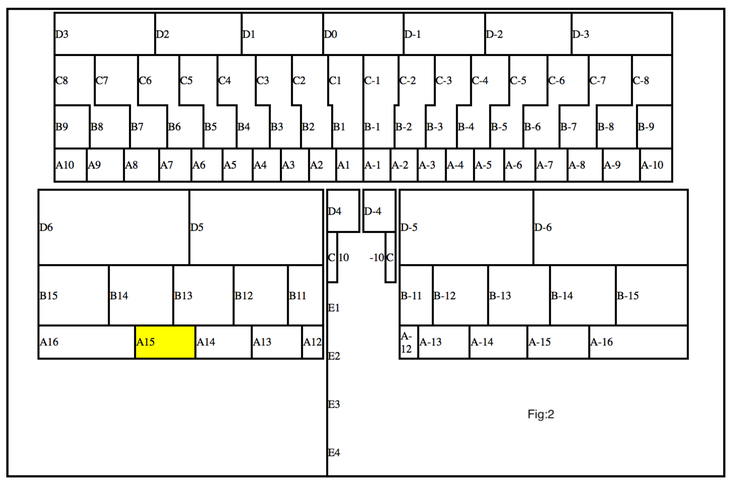
Data Quality and Conditions Assessment for the ATLAS Tile Calorimeter

LHCC 2018, CERN, Geneva, Switzerland, 28th February 2018



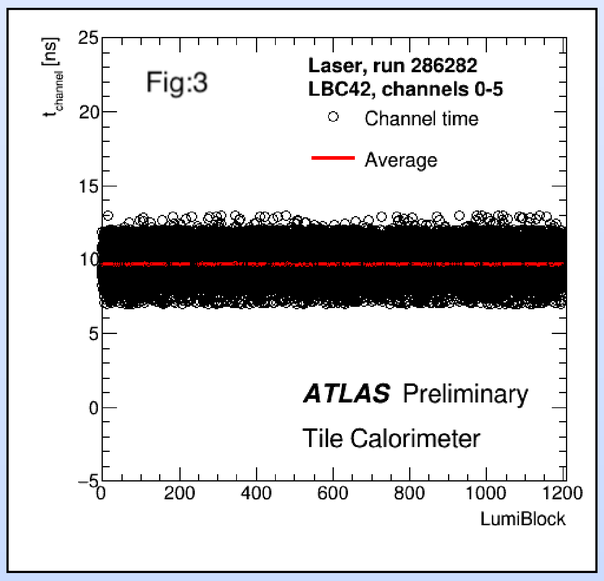
Tile Calorimeter

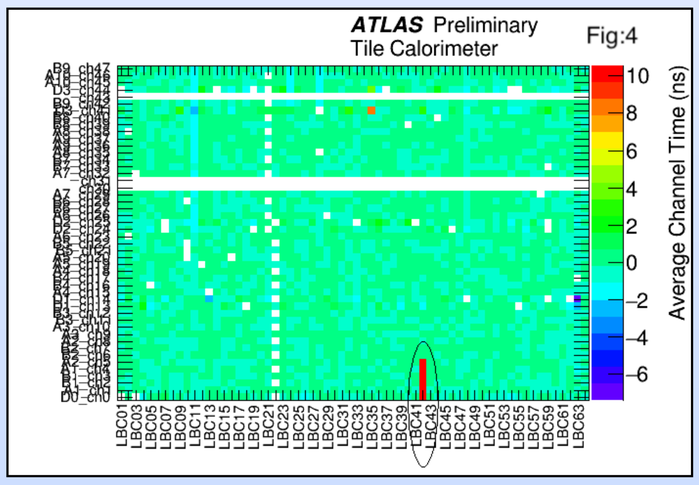
The ATLAS Tile calorimeter (TileCal, Fig: 1) is a steel-scintillator sampling hadronic calorimeter covering the central part of the detector (|η|<1.7). TileCal is a key detector for the measurement of hadrons, jets, taus, missing transverse energy and it also provides input signal to L1 Calo Trigger. Numerous particles produced in collisions in the LHC produce light in scintillator tiles, generating analog pulses in photomultiplier tubes. The amplitude of the analog pulse is proportional to the energy deposited in the active medium. The TileCal is divided in four sections along *Z* : the long barrel (LB) and extended barrel (EB) on either side (A and C) of the interaction point. Each of the TileCal's four partitions is comprised of 64 modules in Φ, each with three radial layers (A, BC, D). In total, there are 5198 scintillators "cells" (Fig:2), each read out with two PMTs. Additionally, the gap and crack regions are instrumented with special C10 cell and E cells, which have one PMT. Each module has 48 channels, some of which are not read out.



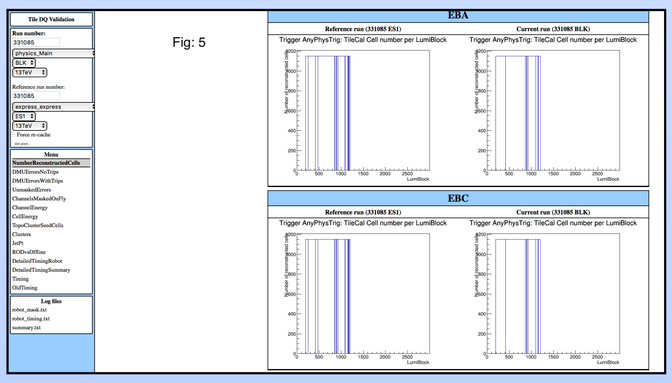
TileCal Data Quality Monitoring

Data recorded by the TileCal is constantly monitored online in the control room. Afterwards, 10% of the data is processed for first offline assessment. Quantities monitored include energy occupancy in cells and channels, timing, data corruption and cell noise.





Since 2016, reconstructed time in TileCal channel has been monitored during physics runs using laser (Fig: 3) and jet collision data (Fig: 4). Sudden shifts in timing can be detected in both streams and corrected in Conditions Database (CondDB) during the calibration loop (CL). Once a CL is completed, the CondDB is locked and full processing of data starts.



In cell occupancy, we look for severe hot and cold spots caused by electronic noise. Corrupted data are automatically masked on the fly so it does not affect over all data quality (DQ). Diagnostic plots are monitored by the DQ shifter using the DQvalid web interface (Fig: 5).

During data taking, the express stream is certified by the DQ Leader and DQ Validator, while the DQ co-ordinator certifies the bulk processing and reports weekly on Tile DQ. Luminosity blocks found to contain data defective beyond tolerable limits are excluded from the Good Run List (GRL). Tolerable defects are logged. In 2017 TileCal took data with an efficiency of 99.4 %.

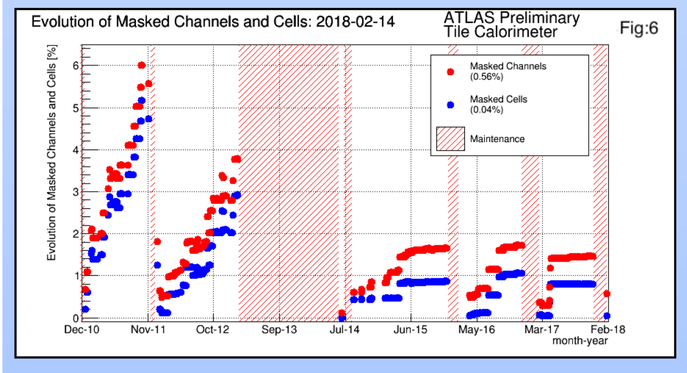
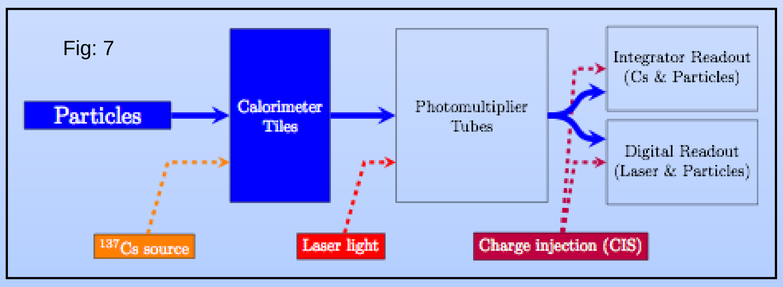


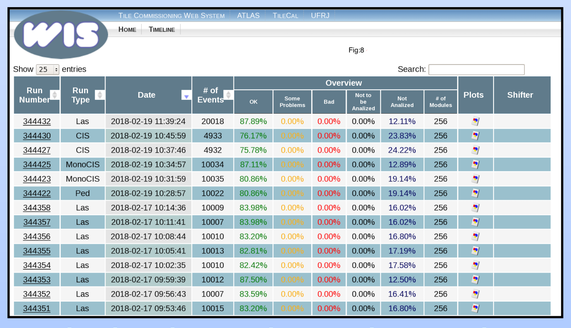
Fig:6 shows the evolution of masked channels and cells from 2010.This is generated by DQ leader every month to keep track on fraction of channels/cells masked in TileCal.

TileCal Calibration Systems

Tile Calibration system (Fig:7) is important to adjust energy on channel-by-channel basis and to figure out hardware problems. The cell energy is computed using calibration constants:

$E[GeV] = A[ADC].C_{ADC\rightarrow pc}.C_{laser}.C_{Cs}.C_{pc\rightarrow GeV}$, Where A[ADC] is the pulse amplitude in ADC.



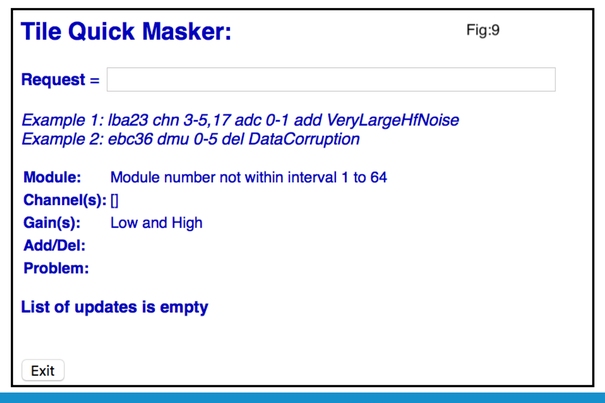


Calibration runs (laser, charge injection, Cs) are recorded when there is no beam in the machine. Once the runs are fully processed the validator performs an assessment of the DQ based on the plots available on WIS (Fig: 8) and submits an e-log report for each run.

TileCal Conditions DataBase (CondDB)

The CondDB stores conditions data for online data-taking, offline data processing and Monte Carlo simulation separately. For each type of calibration runs, separate folders are used to store constants with specific interval of validity (IOV). Once the run is out of the CL, the database can not be updated until the end-of-run reprocessing campaign.

Routine updates to the CondDB are done using a ROBOT interface (Fig:9), major updates are manually done by the DB co-ordinator.



Puja Saha, Northern Illinois University, On behalf of the ATLAS Collaboration

Reference: Calibration and Performance of Tile Calorimeter. Bernardo Sotto-Mairo Peralva https://arxiv.org/pdf/1305.0550.pdf,

Tile Public plots: https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ApprovedPlotsTileDetectorStatus