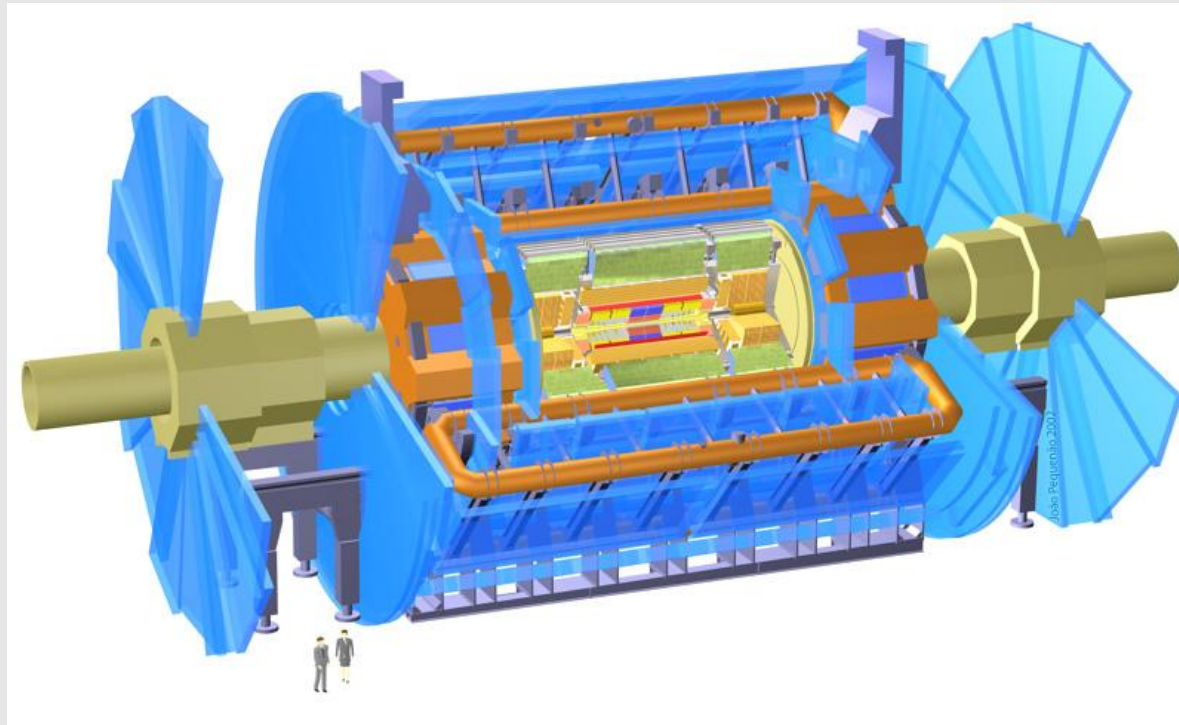
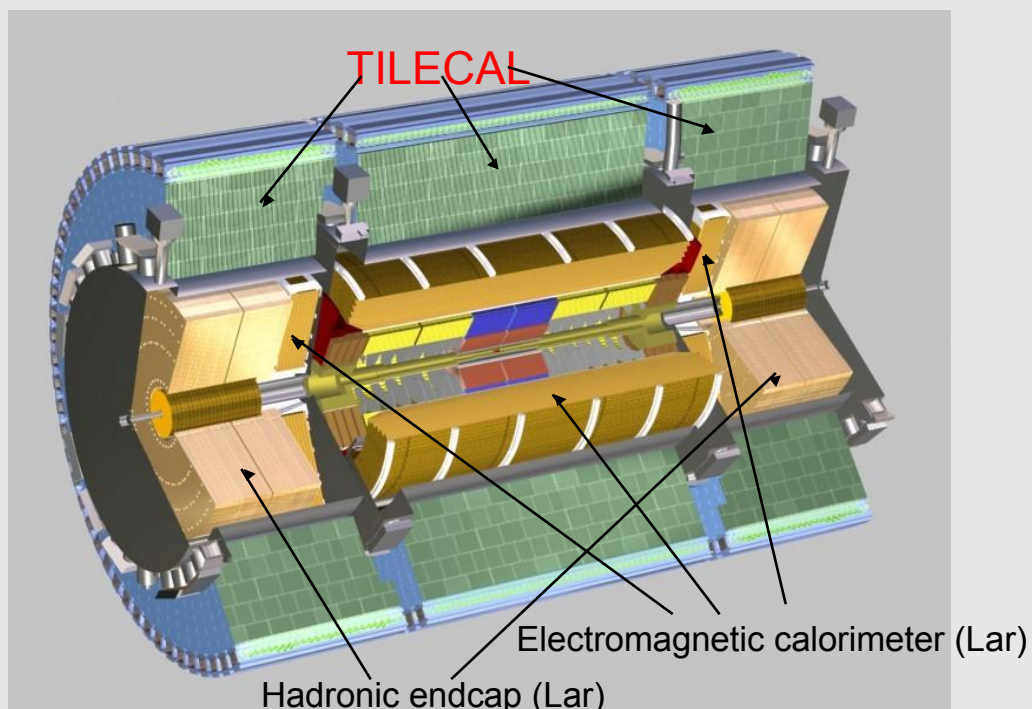


Detector activities on Trigger and Tilecal



*Agostinho Gomes
(LIP and FCUL)
on behalf of the portuguese ATLAS team*

Tilecal - hadron calorimeter



Tilecal is the hadron calorimeter of ATLAS in the central region

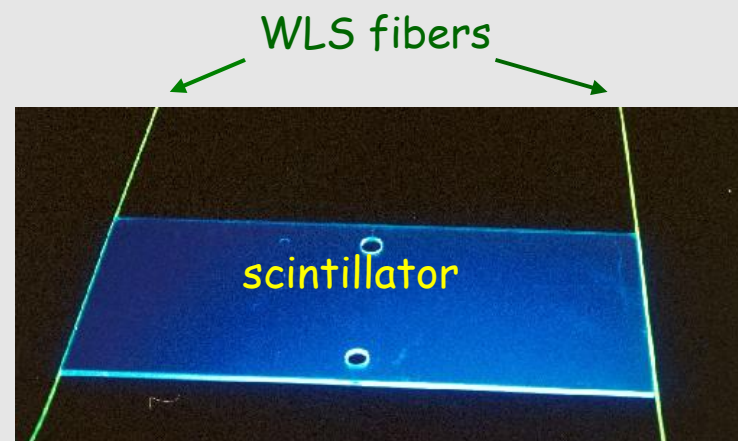
Iron plates as absorber

Active material: plastic cintillators readout by WLS fibers and PMT

Composed of 3 cylinders,
4 partitions

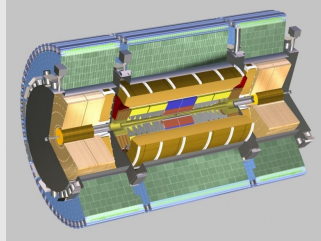
64 modules/cylinder

~10000 readout channels

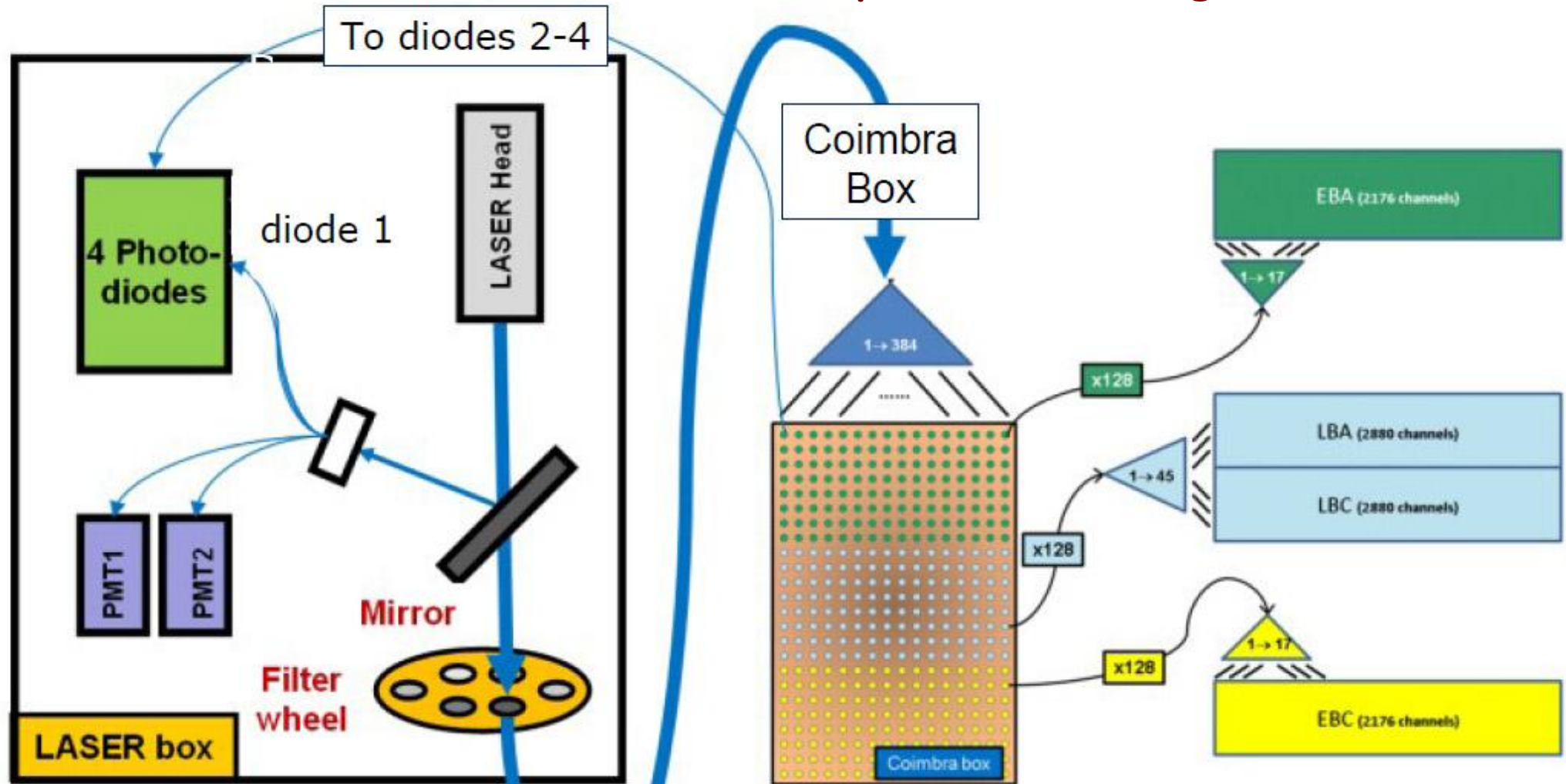


Tilecal operating smoothly - some developments in next pages

Tilecal - laser light distribution

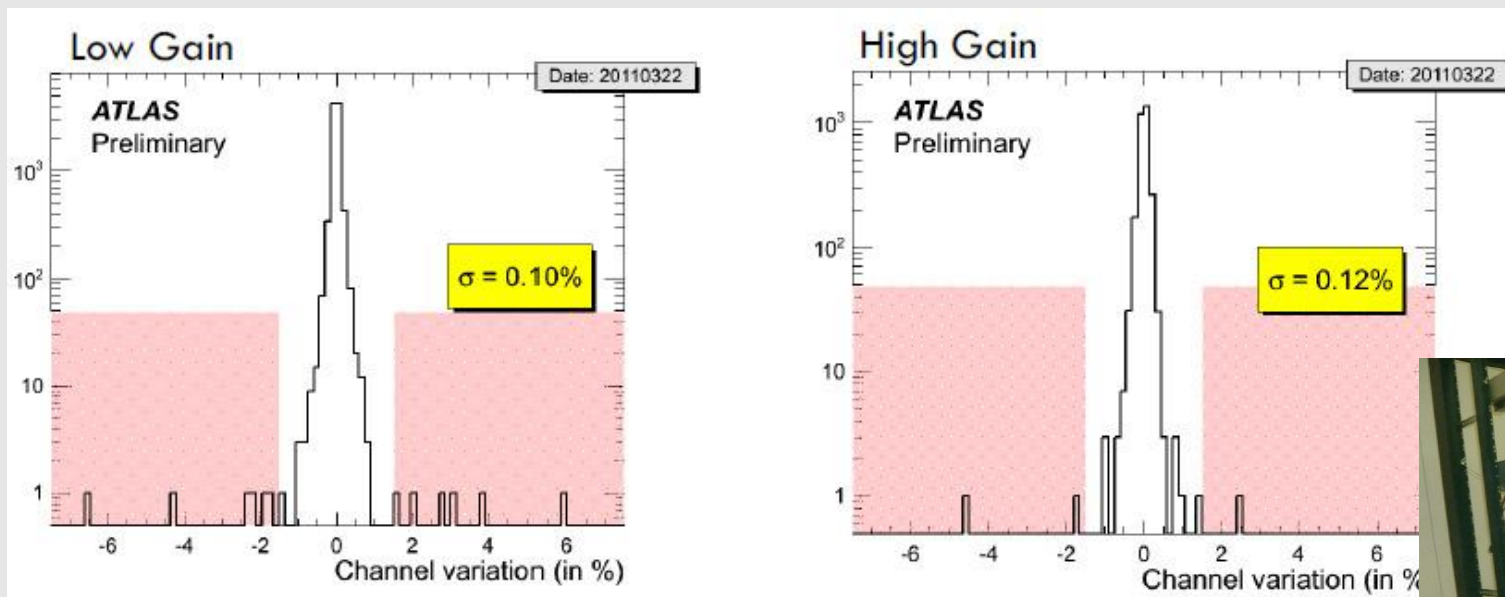
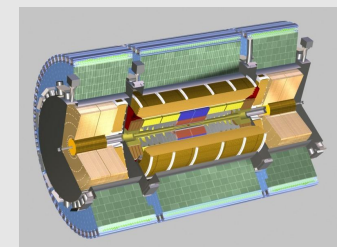


Laser is used for PMT response monitoring

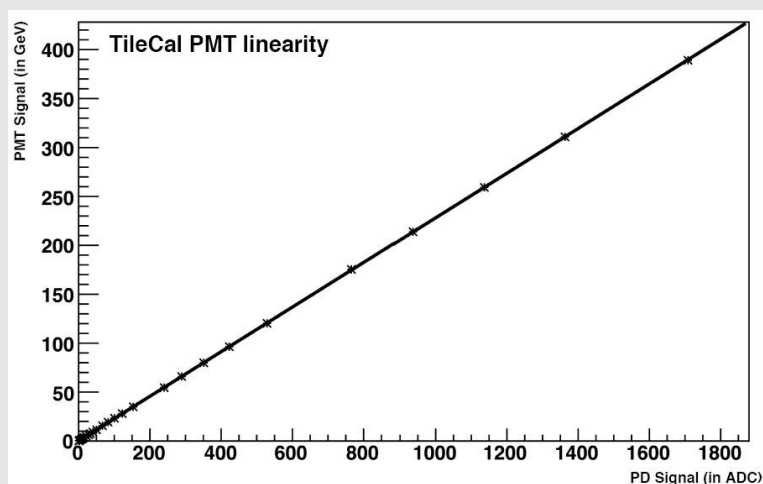
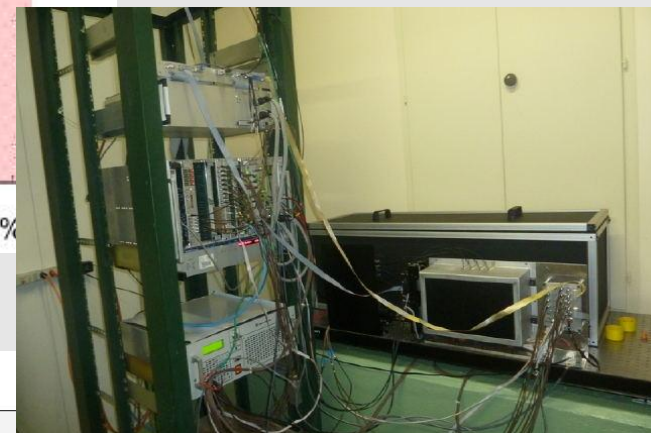


Photodiodes 2-4 used for light monitoring after patch panel (before long fibers)

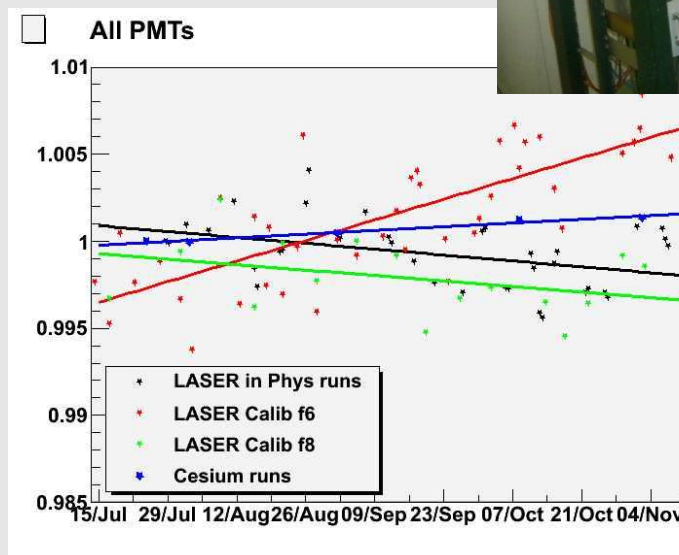
Tilecal - laser monitoring



Stability - deviations for all PMTs since previous run



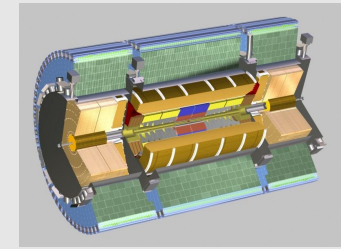
Linearity of the PMTs seen by the laser monitoring system



Signs of PMT up-drift

New laser being set-up (now is spare)

Tilecal Detector Control System



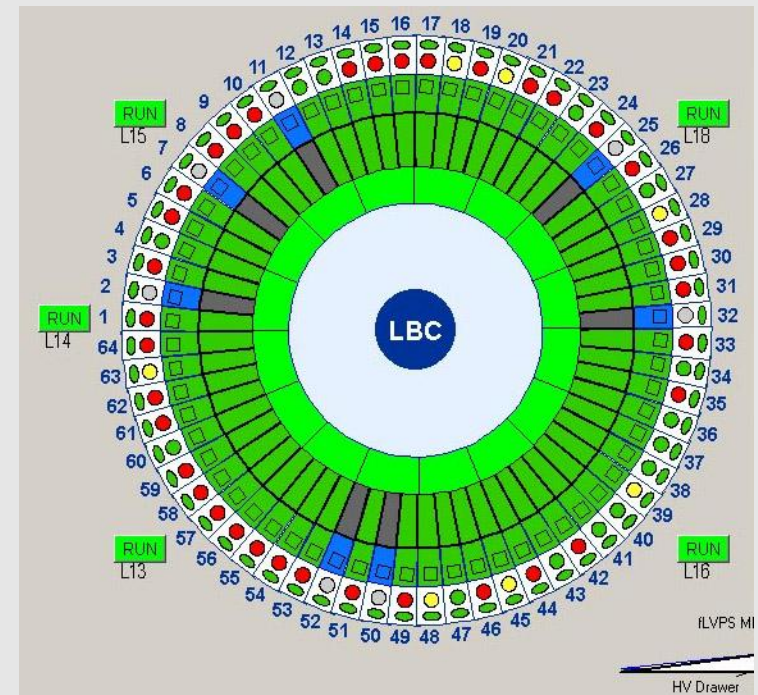
Control and monitoring of low voltages, high voltages, temperatures, etc

Low voltage power supplies located in the detector have shown a high number of trips, almost 1 trip/fb⁻¹

DCS recovers the tripped LVPS

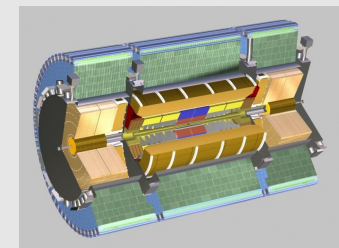
Recovery time was more than 2 minutes to ensure a safe switch on

Not a concern at low luminosity, but a problem when luminosity increased



Showing the status of one partition (cylinder) of Tilecal

Tilecal Detector Control System



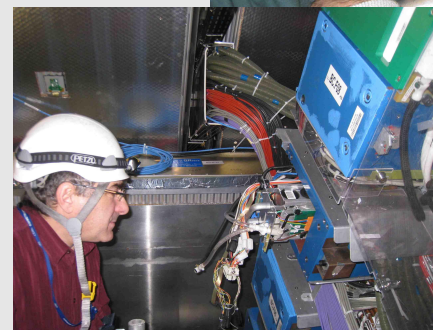
Solution 1: replace low voltage power supplies (LVPS) by new version that does not trip

40 LVPS replaced during the winter shutdown

Solution 2: Switch on procedure optimized - better evaluation of LVPS states allowed to minimize time of the critical switch on steps without compromising safety

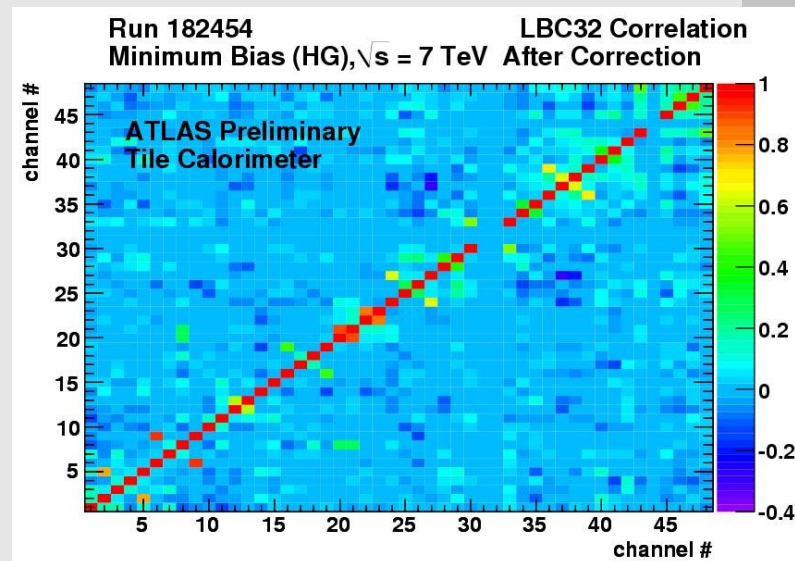
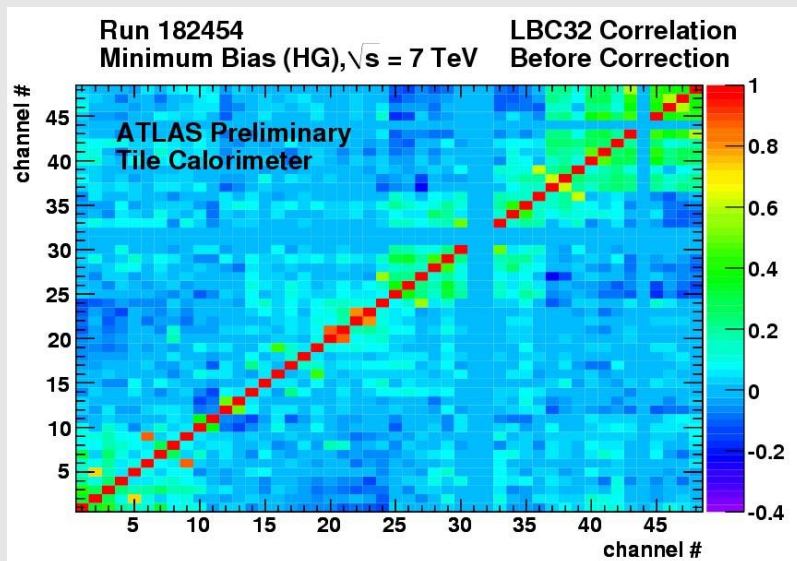
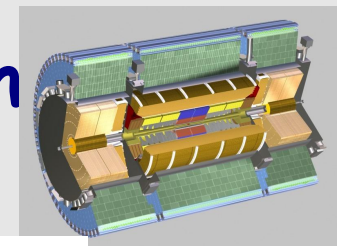
Switch on time reduced to ~1 minute

Also optimized for full partition switch on: now ~15 minutes

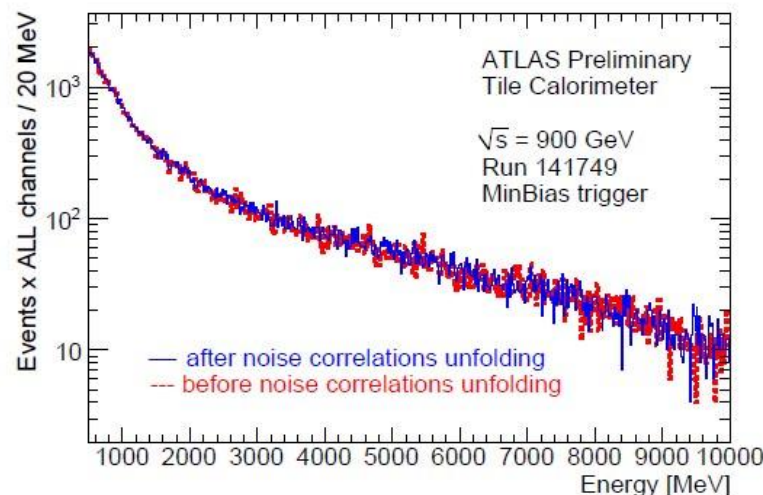
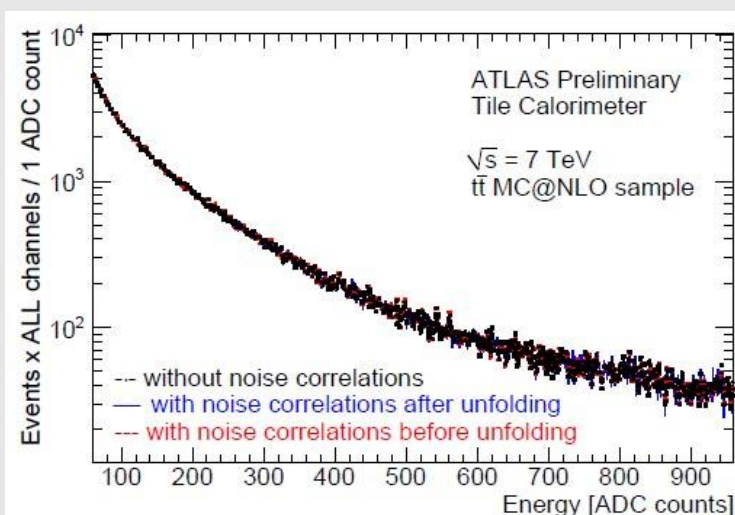


Luis Gurriana and some colleagues spent Christmas at CERN replacing LVPS and doing other repairs

Tilecal - noise correlation suppression



Correcting the noise correlation in the presence of pile-up



MC and data results showing that the noise correction does not add any bias



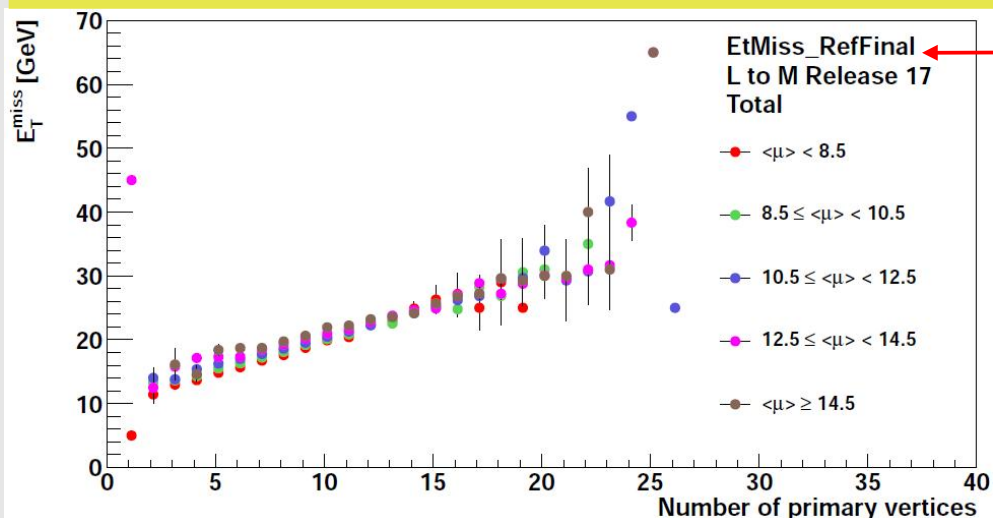
Missing ET- object based reconstruction

2010 - MET performance in data was as expected.
Late 2011 - the increasing pile-up deteriorated it.
Many studies are under development in order to restore the performance as it was w/o pile-up.

$$E_{x(y)}^{\text{miss,calo}} = E_{x(y)}^{\text{miss,e}} + E_{x(y)}^{\text{miss,\gamma}} + E_{x(y)}^{\text{miss,\tau}} + E_{x(y)}^{\text{miss,jets}} + E_{x(y)}^{\text{miss,softjets}} + E_{x(y)}^{\text{miss,calo,\mu}} + E_{x(y)}^{\text{miss,CellOut}}$$

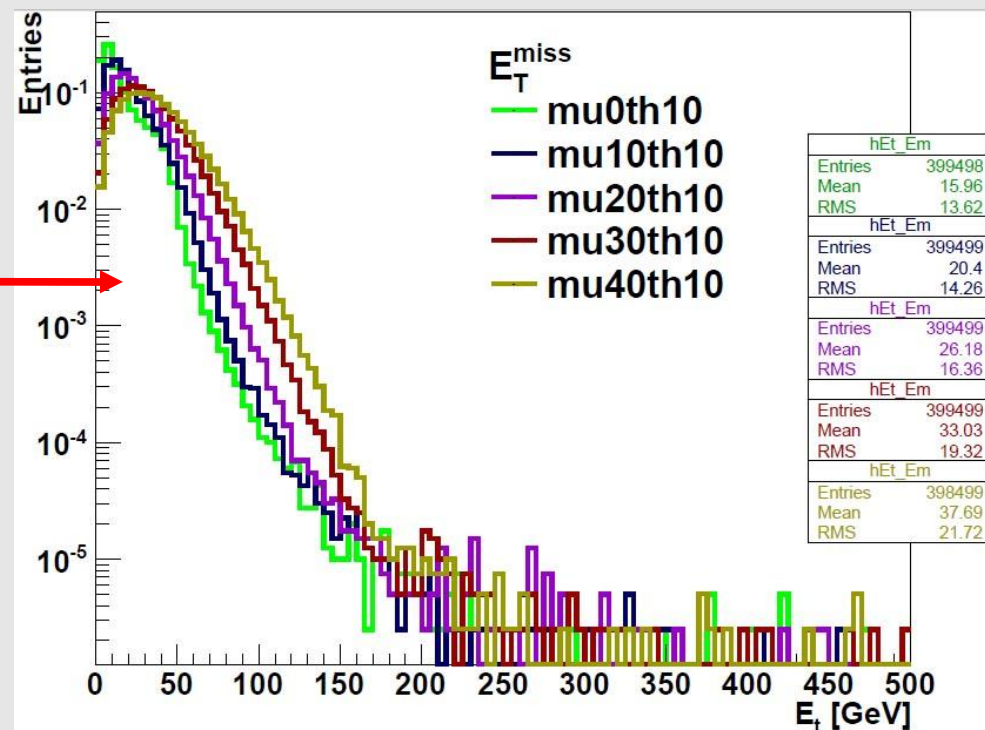
Following MET performance with increasing pileup in 2011 data

- **mu** expected collisions per bunch crossing
- MET vs Npv in pp Data (end of 2011)
- MET mean and resolution increase linearly with Npv



Preparing for pileup increase in 2012 (MC)

- Jets are build out of topological clusters, using calorimeter cells in a way that leads to noise suppression
- The cell energy is compared to a threshold (th) that includes electronic noise and pile-up.
- The question is: Which is the best threshold for pile-up for 2012?

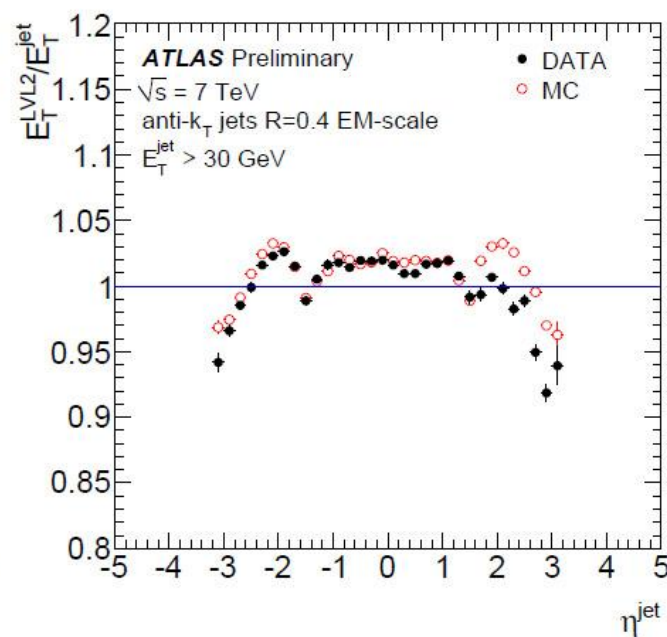
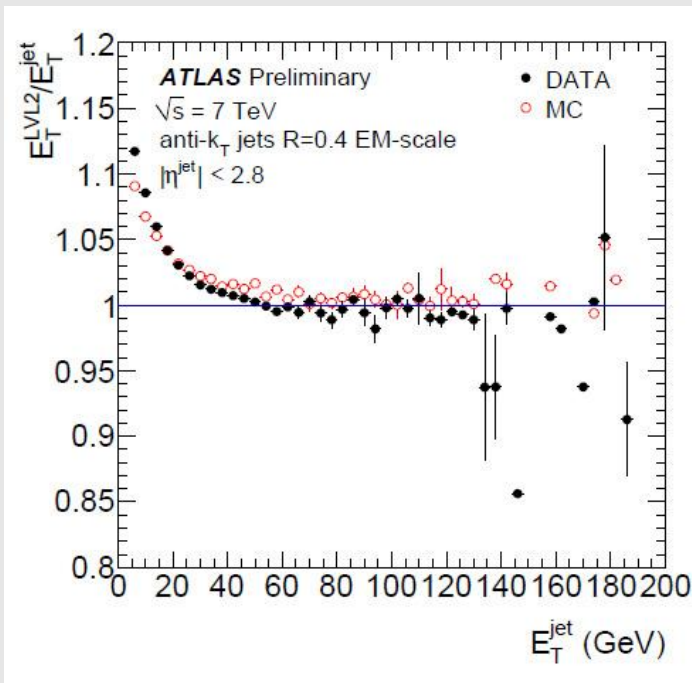
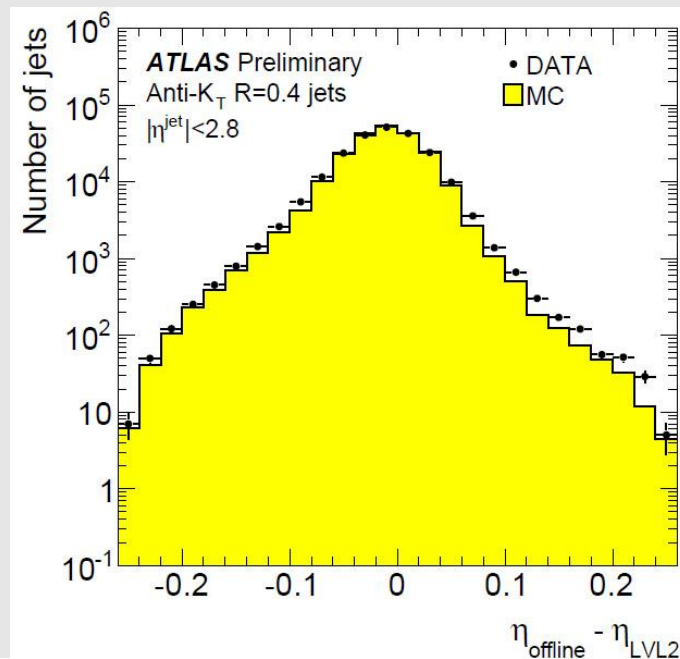


Trigger - jet calibration

Responsible for LVL2 jet calibration and validation

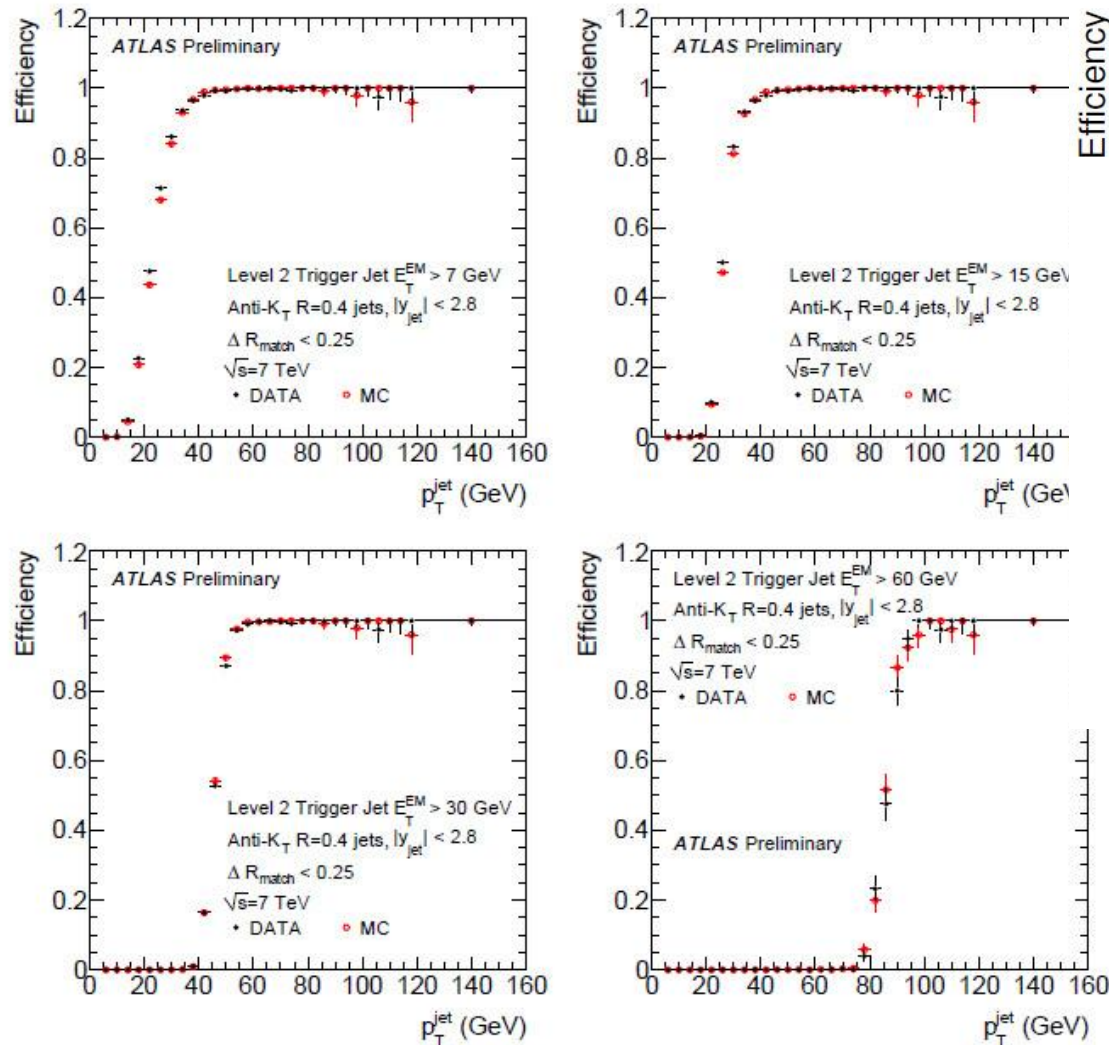
Validation of the LVL2 jet calibration has been one of the major tasks since 2009

Major effort on validation was in 2010, redone in 2011 and in 2012

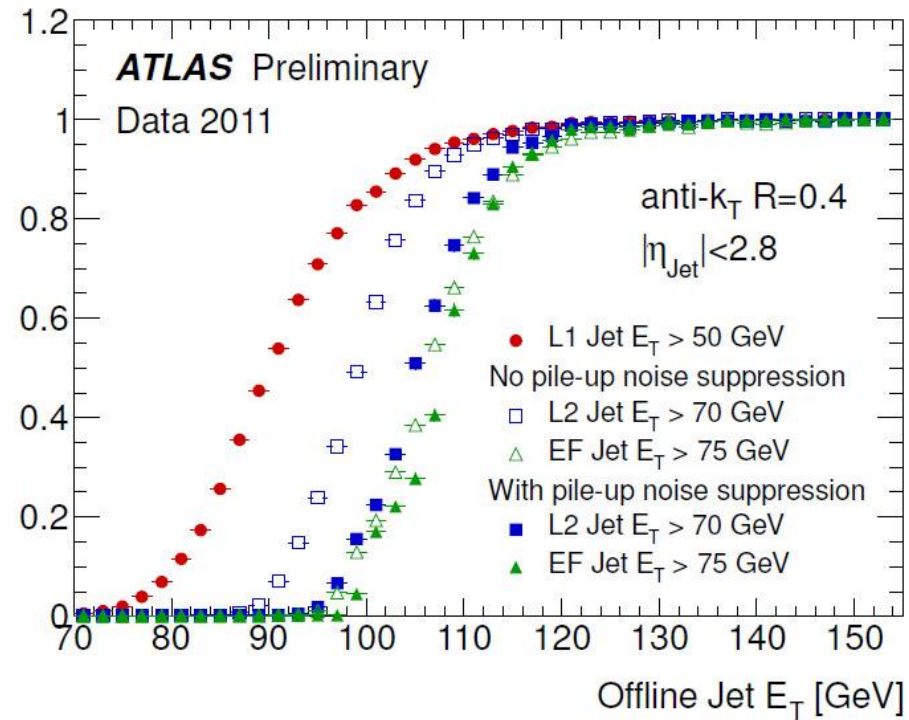


Ratios of transverse momenta of jets at L2 and offline vs E_T and η

Trigger - jet calibration



Efficiency for LVL2 for 7, 15, 30 and 60GeV thresholds in 2010



Pile-up noise suppression in 2011

Future improvements:
Numerical inversion in layers
to further improve resolution

Trigger - E/p

Motivation for E/p Analysis

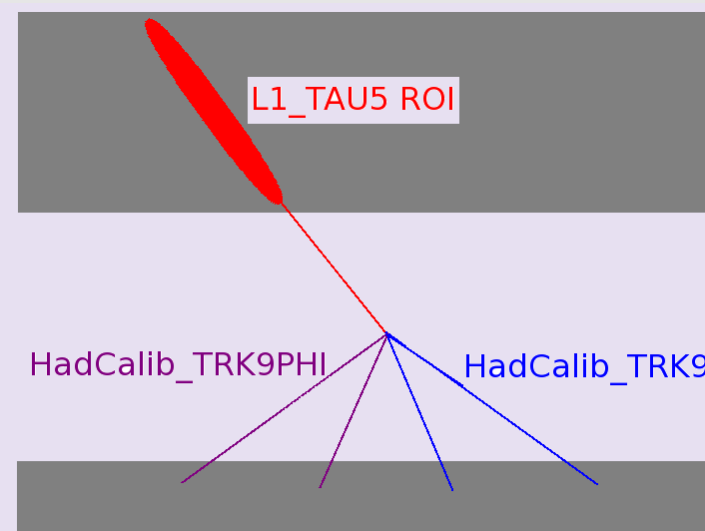
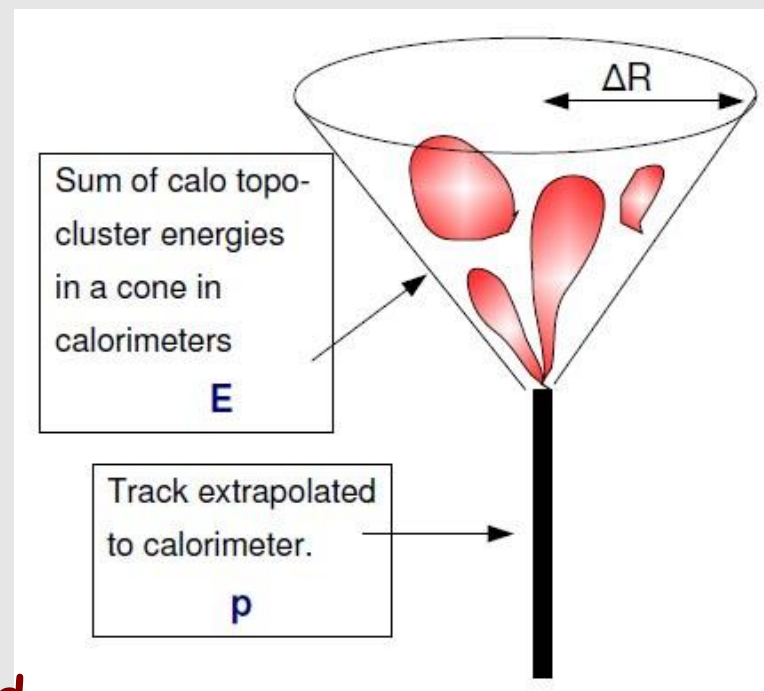
Check of the hadronic energy scale (E) against the inner detector momentum (p), which should be known to a much higher accuracy.

The presence of a track allows to identify clusters as having belonged to a hadron of a particular energy.

This can help to improve jet reconstruction and test uncertainty in JES

Using minimum bias trigger, lack of events at high momentum

Need for dedicated E/p trigger to access higher momentum



Trigger designed and implemented, being tested

Upgrade for the future

The LHC is going to be upgraded

- to reach nominal energy (14 TeV) ~2014
- to reach nominal luminosity ~2019
- to reach higher luminosity ($5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$) ~2023

Higgs boson

- Assuming it is found, determine its properties, primarily its couplings to fermions and bosons.
- If it is excluded, WW scattering measurements will become essential to unveil the electroweak symmetry breaking mechanism.

Direct motivation to work on ATLAS Forward Proton detectors (220 m far from IP)

Beyond the SM

- Extend search for SUSY squark/gluino
- new couplings and their gauge bosons (e.g. Z' , W')
- quark and lepton substructure
- dark matter candidate
- ?

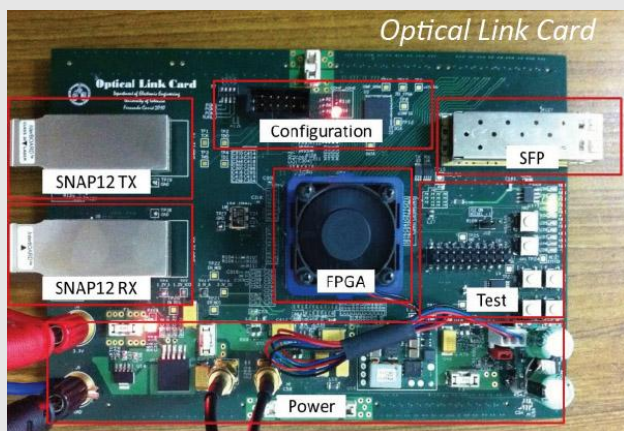
For this, high statistics are fundamental and the detector needs to be able to run in very demanding radiation environment, and performance needs to be at least comparable to current ATLAS (b-tagging, forward jet reconstruction, trigger)

Upgrade for the future

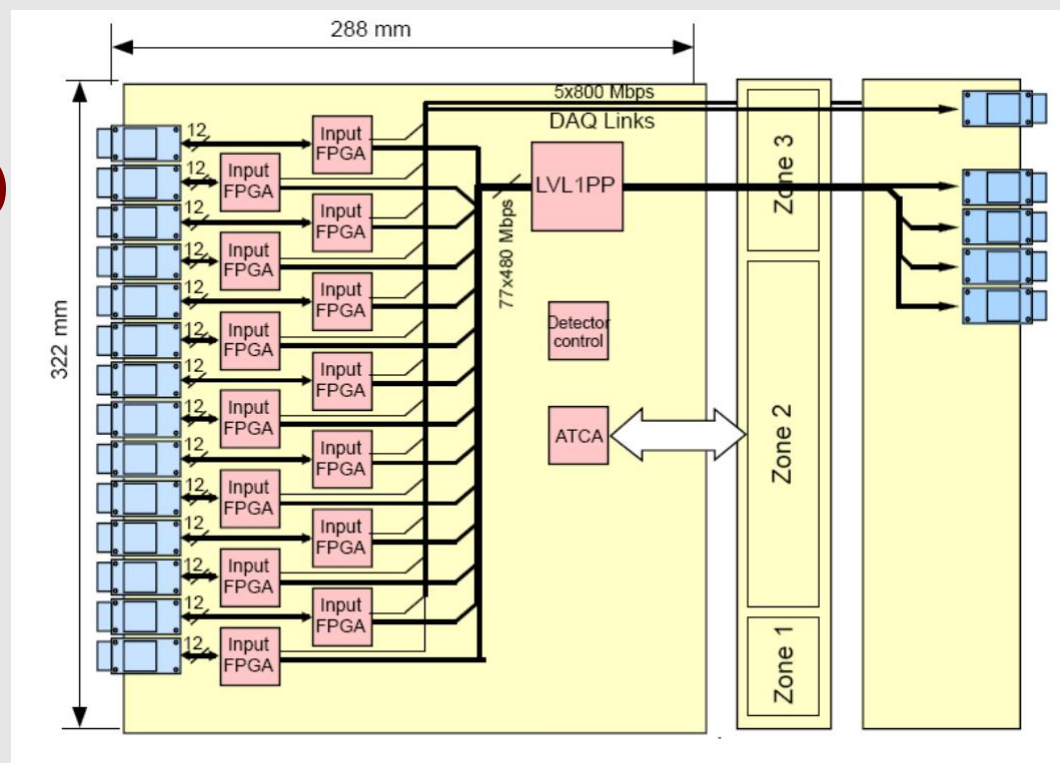
Testing optical links to be used to transfer the full amount of data to off-detector

Also transfer Detector Control System data/commands
Development of new LVPS and HV system will require new DCS

Work in close collaboration with Valencia (developer of the sROD)



Optical link card

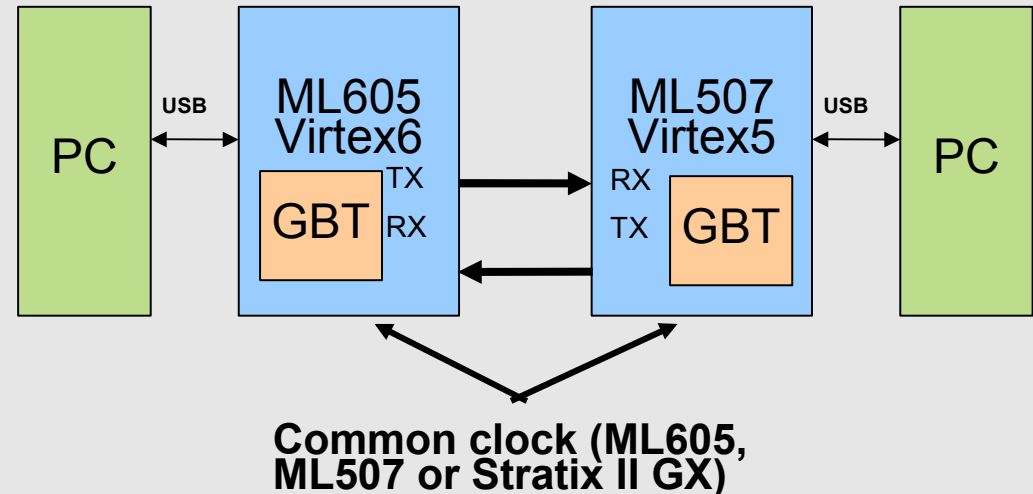
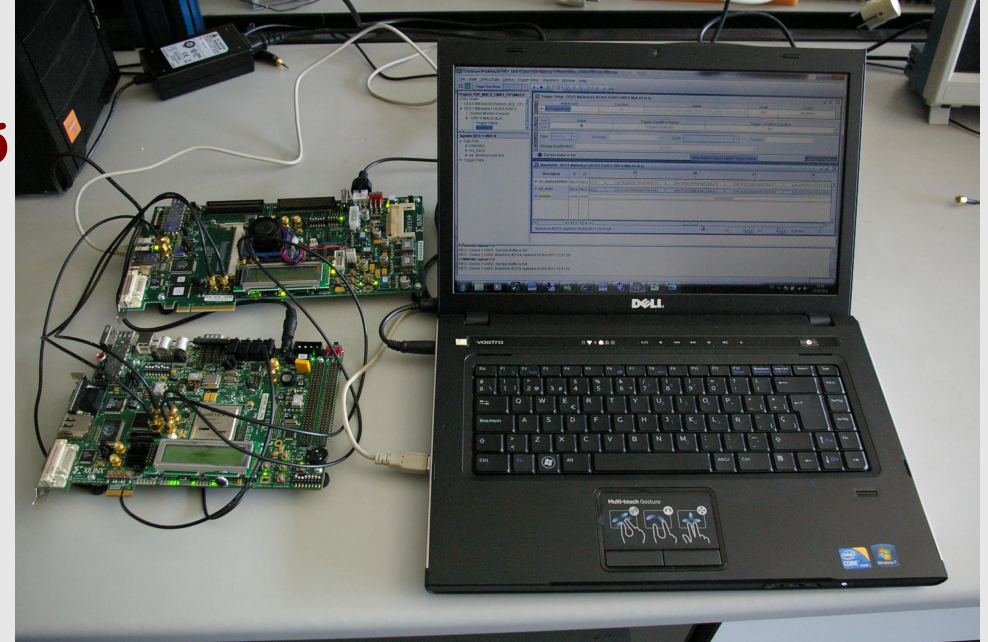


sROD sketch

GBT communication tests with high performance FPGAs

ML605-Virtex-6 and ML507-Virtex-5 working full-duplex with no errors (two cross TX-RX simultaneously, common clock from either board or from external Stratix II GX)

Loopback GBT TX-RX implementation in Virtex-6 (up to 12 GBT links)



Summary

A lot of work required to operate detector and improve its performance and operational conditions

New laser available. Still addressing long term stability.

Tilecal LVPS replaced partially. DCS improved for faster auto-recovery after trips.

Missing ET object based reconstruction tried to restore MET performance under current level of pile-up

Trigger LVL2 jet calibration validated

New E/p trigger being tested

Preparing for the upgrades