Commissioning of the ATLAS reconstruction software with first data

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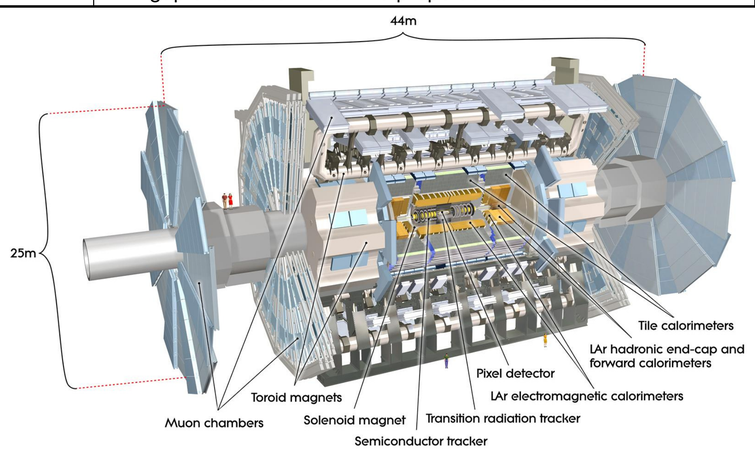
The ATLAS detector

Sub-detectors	Components	Coverage	Mag. field (average)
Inner Detector	Pixel detector: silicon pixels Semiconductor tracker (SCT): silicon micro strips Transition radiation tracker (TRT): straw tube chambers	$\|\eta\| < 2.5$	B = 2 T
Calorimeters	Electromagnetic: Pb-Liquid Ar Hadronic: Fe/scintillators, Cu/W-Liquid Ar	$\|\eta\| < 4.9$	B = 0 T
Muon Spectrometer	Monitored drift tubes: drift tube chambers Cathode strip chambers: multi-wire proportional chambers Resistive plate chambers: gaseous parallel electrode-plate detector Thin gap chambers: multi-wire proportional chambers	$\|\eta\| < 2.5$	B = 0.5 T (barrel) B = 1 T (endcap)



Schematic view of ATLAS

Commissioning

Cosmic muons

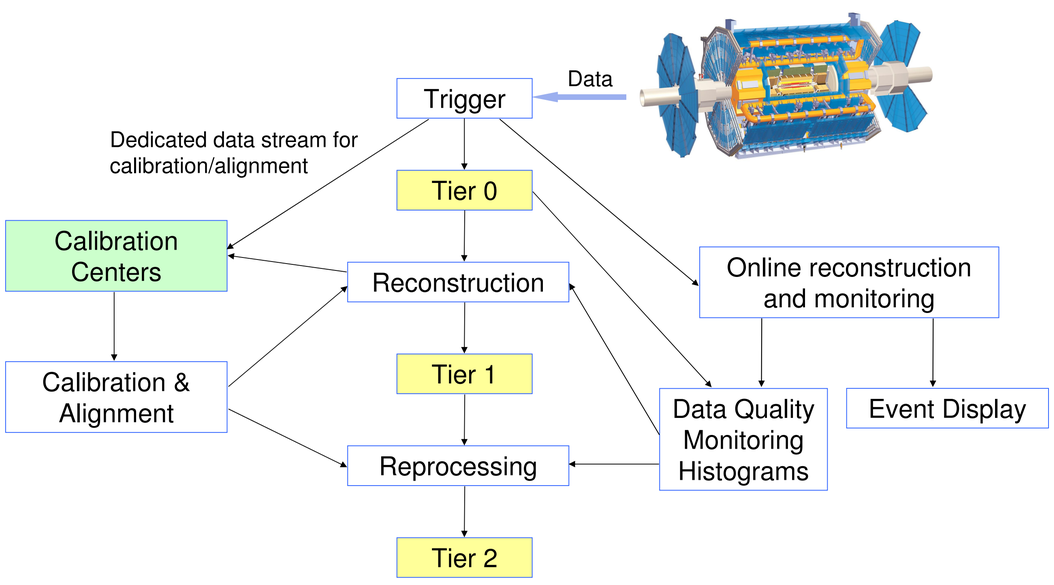
- Commissioning with cosmic rays started more than 3 years ago in parallel to the detector installation
- Main motivations
  - Gain experience on the detector operation (from trigger and data acquisition up to analysis in the grid Tier2 centers)
  - Obtain first track based alignment, calibration constants and list of bad channels
  - Understand the detector performance to achieve the physics requirements
- Cosmic rays were taken with different detector and magnet configurations as systems were ready
- In July 2008 ATLAS entered in a semi-continuous operation mode
- Simulations of cosmic muons were also available

LHC single beam

- The LHC beam was circulated through ATLAS during the period 10 to 12 September 2008
- The beam consisted of one bunch with $2 \cdot 10^9$ protons at 450 GeV
- Steps towards circulating beam
  1. Stop beam on collimators and get "splash" events
  2. Align with collimator center and open collimators
  3. Continue to circulate beam and get "beam halo" and "beam-gas" events

Operation chain

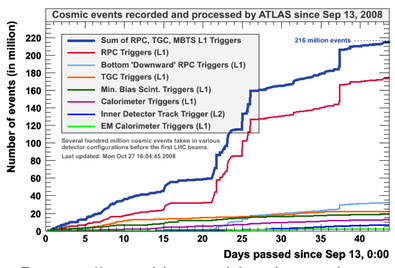
- Full chain is working for both simulated and real data
- Tier0 reconstructs all data once as soon as it is available
- Dedicated computing facilities used for calibration and alignment
- Alignment and calibration results can be used for reprocessing



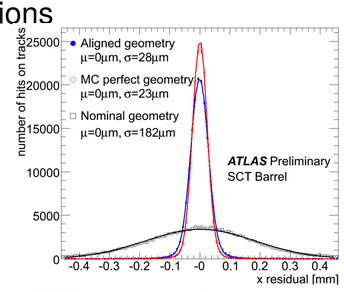
Flowchart of the ATLAS data

Data analysis

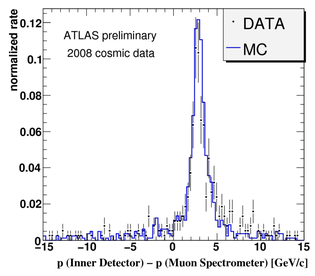
- The most useful data for analyses were collected in the autumn 2008 when almost all subdetectors participated in combined runs
- Over 200 million events were recorded
- The data are used to understand the detector performance in detail and to improve future simulations



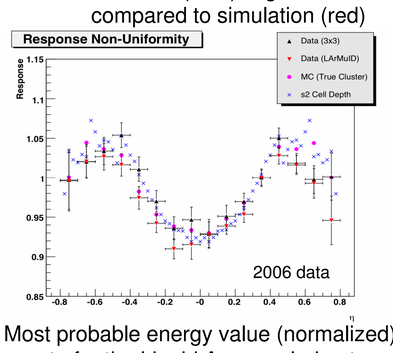
Data collected in combined cosmic runs



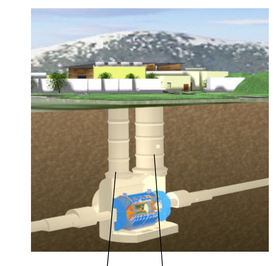
SCT residuals before (black) and after (blue) alignment compared to simulation (red)

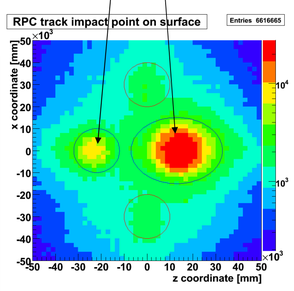


Difference in momentum measured in the Inner Detector and Muon Spectrometer



Most probable energy value (normalized) vs. eta for the Liquid Argon calorimeter





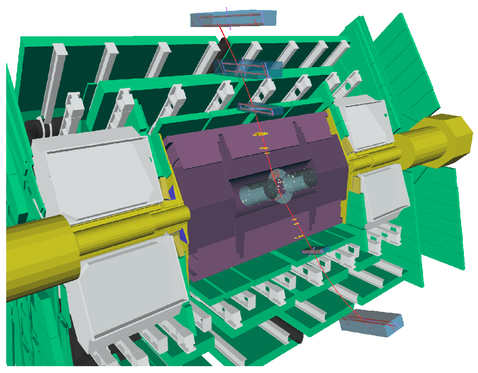
Cosmic muon map reconstructed by Resistive Plate Chambers and projected on the Earth surface

Reprocessing

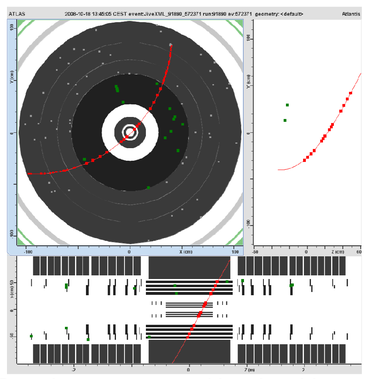
- The reprocessing is a rerunning of the event reconstruction
- More than 280 million events were reprocessed during past Christmas holidays at seven Tier1 centers
- The aim of this run was to
  - Test the Tier1 reprocessing chain and software with large event statistics
  - Use new calibration and alignment constants and noisy/bad channels maps
- Improvements w.r.t. Tier0 reconstruction
  - Inner Detector
    - New alignment corrections and new TRT and Pixel calibration constants
    - Use of Pixel and SCT noisy channel maps
    - Additional tracking algorithm
  - Calorimeters
    - New calibration constants
    - Updated bad channels list
    - Corrections from improved noise level measurements from random events
    - Specific tracking for single beam runs to deal with horizontal tracks
  - Muon Spectrometer
    - New time offset (T0) and space-time relation (R-T) calibration constants
    - New optical alignment constants
  - Combined reconstruction
    - Improvements in soft electron, jet, tau and missing transverse energy reconstruction
- Output data were produced in all ATLAS supported formats
  - Dedicated data streams were made for the commissioning of each subdetector
- Another reprocessing campaign is ongoing

ATLAS software is able to reconstruct cosmic muons, and it was ready for the first beam. Looking forward to LHC collisions in 2009!

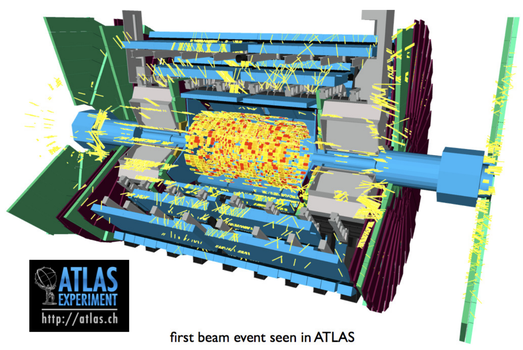
Examples of events



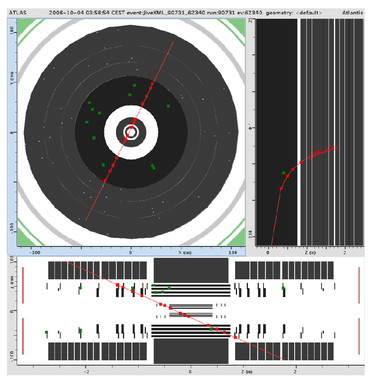
Cosmic muon event with solenoid and toroid magnets ON (run 90272, ev. 3494207)



Cosmic muon event with solenoid magnet ON (run 90270, ev. 572371)



Collimator "splash" event with huge energy deposition (run 87764, event 40050)



Cosmic muon event with solenoid magnet OFF (run 90731, ev. 62340)

Poster ID 239 – contact: arshak.tonoyan@cern.ch