LHCC Poster Session – CERN – 27 February 2019

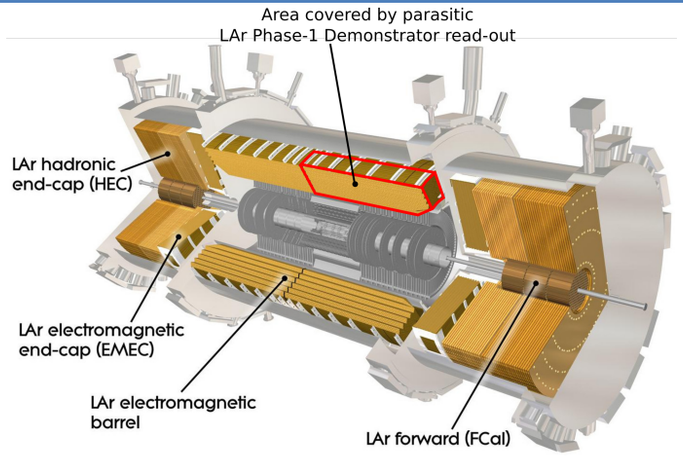
ATLAS Liquid Argon Calorimeters Operation and Data Quality During the 2018 Run Including Demonstrator Data Taking

Proton Run Uptime & Good Data Quality Efficiencies [%] [1]

	2017	2018
ATLAS	93.6	97.5
LAr	99.5	99.7

Both ATLAS and the Liquid Argon (LAr) Calorimeters operated at record efficiencies during the 2018 proton data-taking period, collecting 60.1 fb^{-1} of good physics data. The heavy ion runs were also highly successful with similarly high efficiencies. This poster outlines the function, operation, and data quality of the system during the 2018 runs. It also discusses recent results from purity stability studies and work on the demonstrator for the Phase I upgrade.

ATLAS Liquid Argon Calorimeters

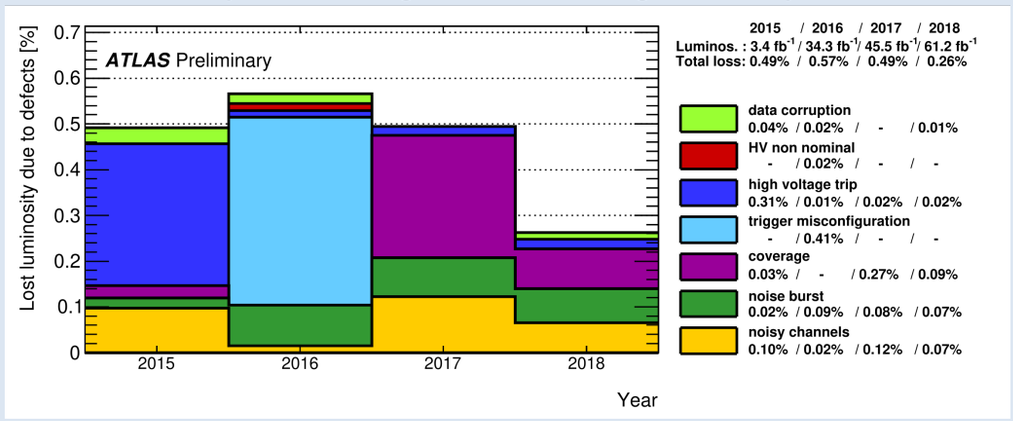


- Sampling calorimeter using cryogenically cooled liquid argon as the active medium [2]
- Electromagnetic (EM) and hadronic sections comprising ~182,000 readout channels
- EM barrel (EMB) and end-cap (EMEC) calorimeters are arranged in accordion-like structures with lead plates interspaced as the passive material, which allow for fast readout and full azimuthal coverage
- Hadronic end-cap (HEC) calorimeters use conventional parallel copper plate electrodes
- Forward calorimeters (FCal) use copper and tungsten absorbers arranged to optimize performance in the radiation-intense forward region

	Coverage in Pseudorapidity (η)
EMB	$\lvert\eta\rvert < 1.475$
EMEC	$1.375 < \lvert\eta\rvert < 3.2$
HEC	$1.5 < \lvert\eta\rvert < 3.2$
FCal	$3.1 < \lvert\eta\rvert < 4.9$

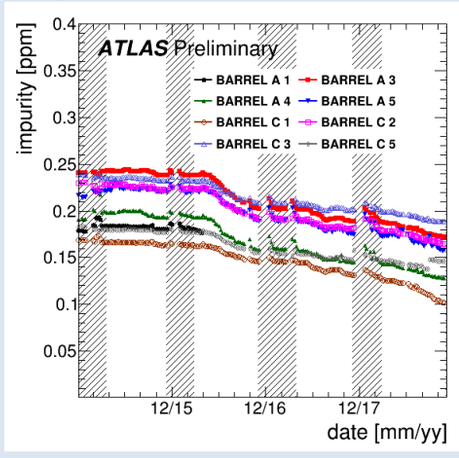
Data Quality

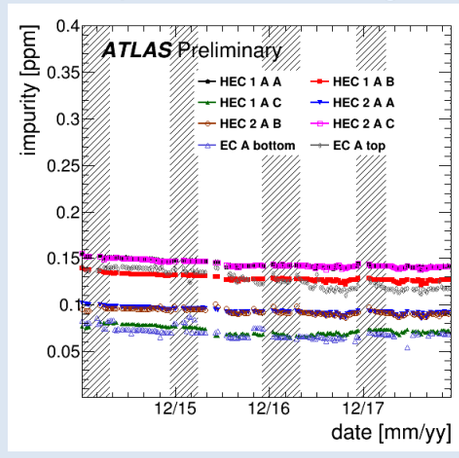
- Highest yearly data-taking efficiency for Run 2 with a data loss of 0.26% during proton data-taking [3]
- Main sources of data loss:
  - **Coverage**: an area of > 512 cells is inactive due to a single hardware failure
  - **Noise bursts**: well-known noise phenomenon affecting a large fraction of the detector for a very short time (~1 μs)
  - **Noisy channels**: individual channels masked due to detection of electronic noise from pulses incompatible with liquid argon ionization
- Front-end cooling leak in EMB appeared in October but did not cause major data loss, and the system took good data throughout the year



Purity Stability Studies

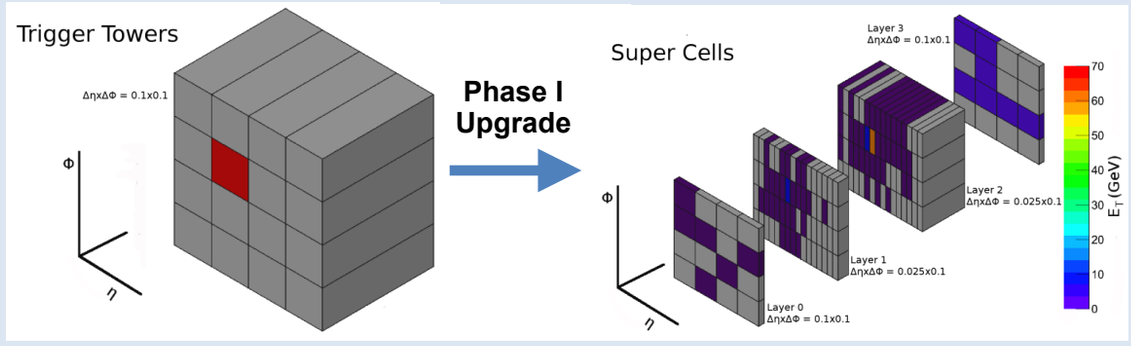
- Measured impurity in oxygen equivalent of the liquid argon [4]
  - Measurements during collisions excluded due to signals from radiation in the ionization chambers
- Impurity of cryostats during Run 2 remained stable for the end-caps and decreased for the barrel
  - Clear explanation for decrease in barrel not yet found, but change of other input parameters (e.g. temperature or high voltage of the ionization chambers) is excluded
- Charge-up effects for most monitors after time periods without high voltage





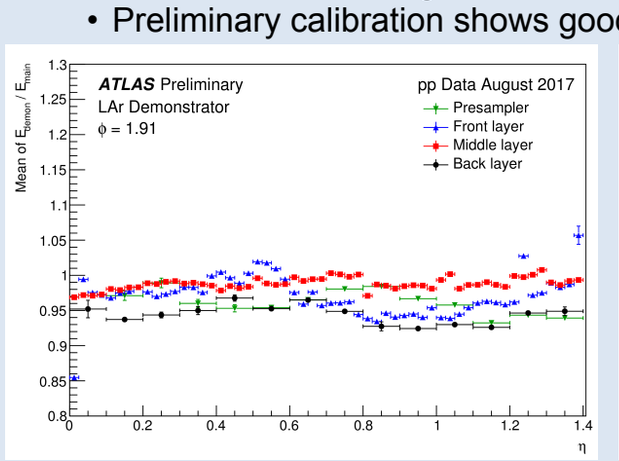
In-Situ LAr Phase I Upgrade Demonstrator

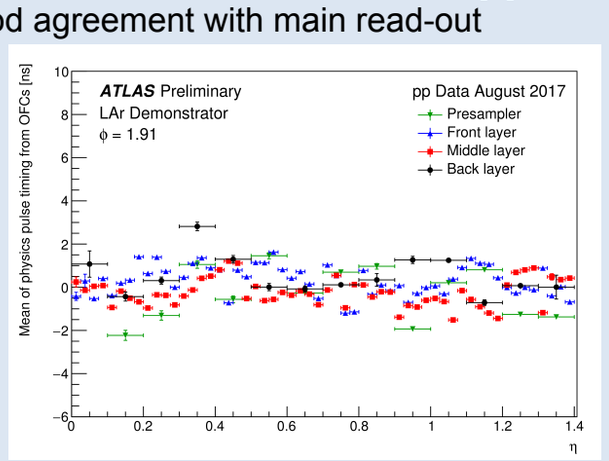
- Upgrade of Level-1 trigger read-out system [5]
  - To be installed during LS2 (2019-2020)
  - Uses super cells with higher granularity to cope with increase in instantaneous luminosity
- Two demonstrator systems were installed
  - 1st generation: 2015-2017 (pre-prototype hardware)
  - 2nd generation: 2018 (pre-production hardware)
- Successful data-taking throughout Run 2
- Dedicated trigger items to select energy deposits within coverage



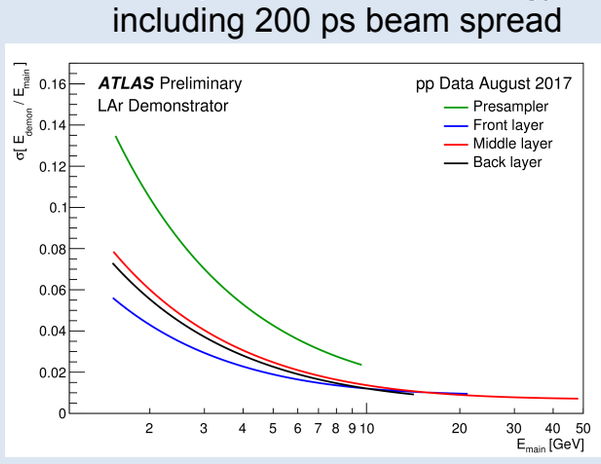
Demonstrator Data Analysis Results

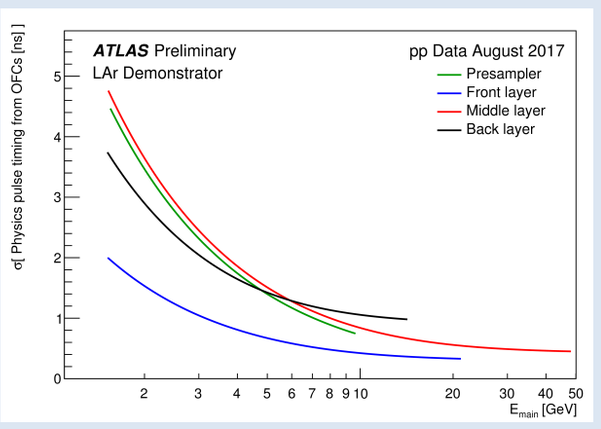
- Various studies done using demonstrator calibration and collision data [6]
  - Preliminary calibration shows good agreement with main read-out





- Further studies: pulse shapes, event displays and more complex variables
  - Examples below show energy comparison and timing resolution including 200 ps beam spread





References

[1] ATLAS Collaboration, Data Quality Information for Data, https://twiki.cern.ch/twiki/bin/view/AtlasPublic/RunStatsPublicResults2010
[2] ATLAS Collaboration, The ATLAS experiment at the CERN Large Hadron Collider, JINST 3 (2008) S08003
[3] ATLAS Collaboration, LArCaloPublicResults2015, https://twiki.cern.ch/twiki/bin/view/AtlasPublic/LArCaloPublicResults2015
[4] ATLAS Collaboration, Liquid-Argon Calorimeter Plots on Detector Status, https://twiki.cern.ch/twiki/bin/view/AtlasPublic/LArCaloPublicResultsDetStatus
[5] ATLAS Collaboration, ATLAS Liquid Argon Calorimeter Phase-I Upgrade Technical Design Report, CERN LHCC-2013-017, ATLAS-TDR-02
[6] ATLAS Collaboration, Liquid-Argon Calorimeter Plots on Upgrade, https://twiki.cern.ch/twiki/bin/view/AtlasPublic/LArCaloPublicResultsUpgrade

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