ATLAS Liquid Argon Calorimeters Operation and Data Quality During the 2015 Proton Run

ATLAS operated at high efficiency during 2015 data taking period, recording an integrated luminosity of 3.9 fb\(^{-1}\) at \(\sqrt{s} = 13\) TeV. The Liquid Argon (LAr) Calorimeters contributed to this effort by operating with a good data quality efficiency of 99.4\%. The following poster highlights the overall status, operations, performance and data quality of the LAr Calorimeters.

Online Status & Offline Data Quality Assessment

- **LAr Calorimeters** are sampling calorimeters using liquid argon as active medium [1]
- The electromagnetic barrel (EMB) and end-caps (EMEC) are made of an innovative accordion shape, with lead plates (passive material) allowing fast readout and full azimuthal coverage
- The hadronic end-caps (HEC) are made of copper plates and cover the regions of \(|\eta|<3.2\)
- The forward calorimeters (FCal) cover very high pseudorapidity regions: \(3.1<|\eta|<4.9\) and are made of copper/lungstene matrices with liquid argon very small gaps
- Signals from LAr Calorimeters serve as input to level-1 trigger (L1Calo)

**Efficiencies [%]**

<table>
<thead>
<tr>
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<th>2012</th>
<th>2015</th>
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<tbody>
<tr>
<td>ATLAS</td>
<td>95.5</td>
<td>87.1</td>
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<tr>
<td>LAr Calorimeters</td>
<td>99.1</td>
<td>99.4</td>
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**Overall 2015 Status**

- Very stable and reliable online data acquisition (negligible data losses)
- An automated procedure to identify and mask noisy channels was implemented
- Over 99.98% of channels are operational

### Subdetector Channels Operational

- EM Calorimeter: 173 312, 100.0%
- HEC: 5632, 99.6%
- FCal: 3524, 99.8%

Timing performances

- Each Front-End Board (FEB) reads out 128 cells
- 700 pb\(^{-1}\) of data were used to tune the FEB fine delays. The implied corrections are applied since Oct 2015
- The remaining 1.6 fb\(^{-1}\) have been used to measure the FEB synchronization
- EMEC energy weighted FEB timing shown on the right [4]. One entry corresponds to the mean value of the Gaussian fit of all 128 channels of a FEB
- Most of the subdetectors exhibit well centered Gaussian distributions

- The offline timing was calibrated with W\(--\)ev data
- Time resolution was measured with independent Z\(--\)ee sample
- Time resolution vs energy fitted assuming the functional form:

\[ \sigma(E) = \frac{0.05}{E} + p_1 \]

- Correlated contribution to \(p_1\) of 200 ps attributed to beamspread
- Subtracted in quadrature, leaves 125 ps uncorrelated LAr contribution for EMB high gain \(0.4<|\eta|<0.8\)
- LAr contribution ranges from \(-65\) ps to 185 ps depending on gain and \(\eta\)

Phase-I upgrade trigger demonstrator

- In the sight of increased instantaneous luminosity up to \(2\times10^{34} \text{cm}^{-2}\text{s}^{-1}\) (~80 interactions per bunch crossing) an upgrade of the L1Calo trigger is planned in 2019 [5]
- Super cells with a granularity smaller than the currently used trigger tower, will increase the electron vs jet rejection power in dense environment
- A small scale demonstrator has been installed parasitically in 2015 to validate the design and the hardware feasibility
- The injected calibration signal was properly digitized by the new LAr Trigger Digitizer Board (LTD) and written on disk by new dedicated back end-system [6]

- The noise of LTD board prototype was measured below 1 Analog-to-Digital Converter (ADC) count
- The production of final hardware is expected to start in 2017

References