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ATLAS LAr Calorimeter Commissioning for LHC Run-3

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The Liquid Argon Calorimeters are employed by ATLAS for all electromagnetic calorimetry in the pseudo-rapidity region $|\eta| < 3.2$, and for hadronic and forward calorimetry in the region from $|\eta| = 1.5$ to $|\eta| = 4.9$. It also provides inputs to the first level of the ATLAS trigger. After successful period of data taking during the LHC Run-2 between 2015 and 2018 the ATLAS detector entered into a long period of shutdown. In 2022 the LHC should restart and the Run-3 period should see an increase of luminosity and pile-up of up to 80 interactions per bunch crossing.

To cope with these harsher conditions, a new trigger readout path have been installed during the long shutdown. This new path should improve significantly the triggering performance on electromagnetic objects. This is achieved by increasing by a factor of ten the number of available units of readout at the trigger level.

The installation of this new trigger readout chain required the update of the legacy system to cope with the new components. It is more than 1500 boards of the precision readout that have been extracted from the ATLAS pit, refurbished and re-installed. The legacy analogue trigger readout that will remain during the LHC Run-3 as a backup of the new digital trigger system has also been updated.

For the new system it is 124 new on-detector boards that have been added. Those boards are able to digitize the calorimeter signal for every collision, i.e. at 40MHz, in a radiative environment. The digital signal is then processed online to provide the measured energy value for each unit of readout and for each bunch crossing. In total this is up to 31Tbps that are analyzed by the processing system and more than 62Tbps that are generated for downstream reconstruction. To minimize the triggering latency the processing system had to be installed underground. There the limited space available imposes the need of a very compact hardware structure. To achieve a compact system, large FPGAs with high throughput have been mounted on ATCA mezzanines cards. In total 3 ATCA shelves are used to process the signal of approximately 34k channels. Given that modern technologies have been used compared to the previous system, all the monitoring and control infrastructure had to be adapted and commissioned as well.

This contribution should present the challenges of such installation, what have been achieved so far and what are the milestones still to be done toward the full operation of both the legacy and the new readout paths for the LHC Run-3. It will also include the first results of the calibration and operation of the new system.

Submitted on behalf of a Collaboration?

Yes

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