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ATLAS LAr Calorimeter Commissioning for LHC Run-3

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Liquid argon (LAr) sampling 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 $|\eta| = 4.9$. Phase-I detector upgrades began after the end of ATLAS Run-2. New trigger readout electronics of the LAr Calorimeter have been developed. Installation began at the start of the LHC shut down in 2019 and is expected to be completed in 2021.This contribution will give an overview of the new trigger readout commissioning, as well as the preparations for Run-3 detector

Summary (500 words)

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 the 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 up to 80 interaction per bunch crossing.

To cope with this harsher conditions, a new trigger readout path have been installed on the during the long shutdown. This new path should improve significantly the triggering performances on electromagnetic objects. This will be 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 analogic 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 collisions i.e. at 40MHz and in radiative environment. The digital signal is then processed online to provide the measured energy value for each unit of readout an 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 imposed the needs of a very compact hardware structure. To achieve a good enough compacity larges FPGAs with high throughput have been mounted on ATCA mezzanines cards. In total no more than 3 ATCA shelves are used to process the signal of approximately 40k 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.

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