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# Technical challenges and performance of the new ATLAS LAr Calorimeter Trigger

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To cope with the increase of the LHC instantaneous luminosity, new trigger readout electronics were installed on the ATLAS Liquid Argon Calorimeters.

On the detector, new electronic boards digitise 10 times more signals than the legacy system. Downstream, large FPGAs are processing up to 20 Tbps of data to compute the deposited energies. Moreover, a new control and monitoring infrastructure was developed.

This contribution will present the challenges of the commissioning, the first steps in operation, and the milestones to be completed towards the full operation of the legacy and the new trigger readout for the LHC Run-3.

## 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 $|\eta| = 4.9$. They also provide inputs to the first level of the ATLAS trigger. In 2022 the LHC started its Run-3 period with an increase in luminosity and pile-up of up to 60 interactions per bunch crossing.

To cope with these harsher conditions, a new trigger readout path has been installed. This new path significantly improved the triggering performances on electromagnetic objects with lower pT thresholds, but also lower rates. This was achieved by increasing the granularity of the objects available at trigger level by up to a factor of ten.

The installation of this new trigger readout chain also required the update of the legacy system. More than 1500 boards of the precision readout have been extracted from the ATLAS cavern, refurbished and re-installed. The legacy analog 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, 124 new on-detector boards have been added. Those boards that are operating in a radiative environment are digitizing the calorimeter trigger signals at 40MHz. The digital signal is sent to the off-detector system and processed online to provide the measured energy value for each unit of readout. In total up to 31Tbps are analyzed by the processing system and more than 62Tbps are generated for downstream reconstruction. To minimize the triggering latency the processing system had to be installed underground. The limited available space imposed a very compact hardware structure. To achieve a compact system, large FPGAs with high throughput have been mounted on ATCA mezzanine cards. In total no more than 3 ATCA shelves are used to process the signal from approximately 34000 channels.

Given that modern technologies have been used compared to the previous system, all the monitoring and control infrastructure is being adapted and commissioned as well.

This contribution will present the challenges of the commissioning and operation, the performance and the milestones still to be achieved towards the full operation of the new digital trigger system.

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