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Research and Development for a Free-Running Readout System for the ATLAS LAr Calorimeters at the High Luminosity LHC

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The ATLAS Liquid Argon (LAr) Calorimeters were designed and built to measure electromagnetic and hadronic energy in proton-proton collisions produced at the LHC at centre-of-mass energies up to 14 TeV and instantaneous luminosities up to $10^{34} / \text{cm}^2 / \text{s}$. The High Luminosity LHC (HL-LHC) programme is now developed for up to 5-7 times the design luminosity, with the goal of accumulating an integrated luminosity of 3000 fb^{-1} .

In the HL-LHC phase, the increased radiation levels require a replacement of the front-end electronics of the LAr Calorimeters. Furthermore, the ATLAS trigger system is foreseen to increase the trigger accept rate by a factor 10 to 1 MHz and the trigger latency by a factor of 20 which requires a larger data volume to be buffered. Therefore, the LAr Calorimeter read-out will be exchanged with a new front-end and a high bandwidth back-end system for receiving data from all 186.000 channels at 40 MHz LHC bunch-crossing frequency and for off-detector buffering. The talk will give an overview of the development of radiation tolerant components like low-noise pre-amplifier and shapers, 10-14 bit and 40-80 MHz analog-to-digital converters (ADCs) with low power and latency, integrated serializer and optical transceivers, as well as a 140 Tb/s digital processing system based on high-performance FPGAs. Results from research and development of individual components and their radiation qualification as well as the overall system design will be presented.

Collaboration

ATLAS Liquid Argon Calorimeter Group

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