The Phase-1 Upgrade of the ATLAS Level-1 Calorimeter Trigger

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On behalf of the ATLAS collaboration

Motivation

- Challenging pileup environment
- New LAr electronics: 10x higher granularity with super-cells
- Improved L1Calo algorithms benefit from higher granularity, higher resolution and shower shape information resulting in better performance

Simulation Studies

- jet Feature Extractor (jFEX)
- electron Feature Extractor (eFEX)
- global Feature Extractor (gFEX)

New L1Calo Hardware and Infrastructure

- 24 modules in 2 ATCA shelves
- Identifies electrons, photons & taus
- Production & installation in progress

Installation & Commissioning

- Fully equipped test-rig at CERN
- ATCA shelves for eFEX, jFEX, gFEX, L1Topo, LAr & L1Muon
- VME crate for PPM, TREX & TTC
- Full DAQ infrastructure available

- Successful combined slice tests with all modules
- Synchronous readout & event building
- Transmission through all modules

Surface Test Facility (STF)

- gFEX (1/3), jFEX (6/6) & L1Topo (3/3) fully installed
- 1 eFEX (12/24) shelf fully populated
- Remaining boards in production (to come soon)
- Hub & ROD (5/7) installed
- 2 remaining boards will be installed with eFEX modules for the second eFEX crate
- All TREX (32/32) modules installed
- FOX boxes installed & connected
- Topo-FOX box installed & connected

Commissioning in ATLAS

- Installed Phase-1 systems successfully integrated in ATLAS run control software
- Successful integration with Calorimeters
- Fiber mapping, connectivity and bit-error rate checks
- Parasitic tests with FEXes during special runs (splashes, pilot beam, etc)
- TREX running stably in ATLAS up to 100 kHz readout
- Re-commissioning of legacy system in parallel

Reference:
[3] https://cds.cern.ch/record/1513945
[4] https://twiki.cern.ch/twiki/bin/view/AtlasPublic/L1CaloTriggerPublicResults

The ATLAS Level-1 Calorimeter Trigger (L1Calo) in Run3

The ATLAS Level-1 Calorimeter Trigger (L1Calo) is a hardware-based system that identifies events containing calorimeter-based physics objects, including electrons, photons, taus, jets, and missing transverse energy. In preparation for Run 3, when the LHC will run at higher energy and instantaneous luminosity, L1Calo is currently implementing a significant programme of planned upgrades. The existing hardware will be replaced by a new system of FPGA-based feature extractor (FEX) modules.

- 3 new feature identification systems:
  - electron Feature Extractor (eFEX)
  - jet Feature Extractor (jFEX)
  - global Feature Extractor (gFEX)
- Upgraded Level-1 Topological (L1Topo) processor
- New readout interfaces: L1Calo ReadOut Driver (ROD) & Front-End Link eXchange (FELIX)
- Tile Rear Extension (TREX) module
- Fiber-Optic eXchange (FOX)
- Run 2 legacy L1Calo system will run in parallel with Phase-1 system at the beginning of Run 3

Installation status in ATLAS

- STF
- FOX installation
- TREX VME crate
- L1Calo in USA
- Hub & ROD
- Commission

Installation of ATLAS

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