ATLAS LAr Calorimeter Commissioning for LHC Run-3

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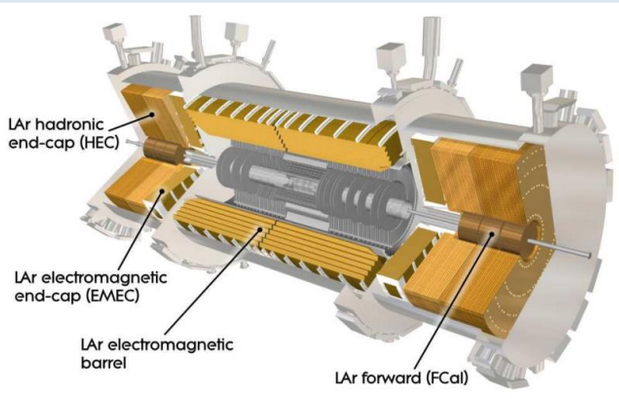
on behalf of the ATLAS Liquid Argon Collaboration

The Large Hadron Collider (LHC) has been in Long Shutdown (LS2) since the end of Run-2 in 2018. As a part of the ATLAS Phase-I Upgrade program, the Liquid Argon (LAr) Calorimeter has been equipped with new trigger readout electronics to enhance the physics reach during the upcoming Run-3 operation (2022-2025) at increased LHC luminosity. This poster provides an overview of the LAr Calorimeter Commissioning status for LHC Run-3.

The LAr Calorimeter



Electromagnetic Barrel (**EMB**):
$|\eta| < 1.475$, accordion lead plates

Electromagnetic End-Cap (**EMEC**):
$1.375 < |\eta| < 3.21$, accordion lead plates

Hadronic End-Cap (**HEC**):
$1.5 < |\eta| < 3.2$, parallel copper plates

Forward Calorimeter (**FCAL**):
$3.1 < |\eta| < 4.9$, copper & tungsten rod and tube structure

Sampling calorimeter with liquid Argon as ionizing medium. Up to 4 layers, total 182,468 channels.

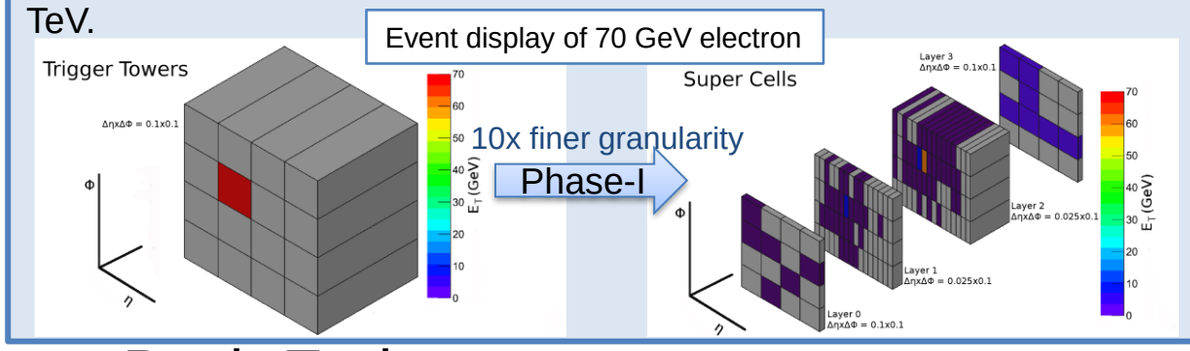
Provides input to the Level-1 trigger and precise measurement of e, γ.

Towards Run-3: Upgrade on Trigger path

A new finer granularity scheme called "**Super Cells**" (SCs), providing
- information for each of the 4 sampling layers
- finer segmentation ($\Delta\eta \times \Delta\phi = 0.025 \times 0.1$) in EM layer 1 and 2

Improves efficiency on EM objects with suppressing jets and pileup contributions under high luminosity of $\mathcal{L} = 3 \times 10^{34}\ \mathrm{cm^2 s^{-1}}$, $\sqrt{s} = 13.6$ TeV.

Event display of 70 GeV electron



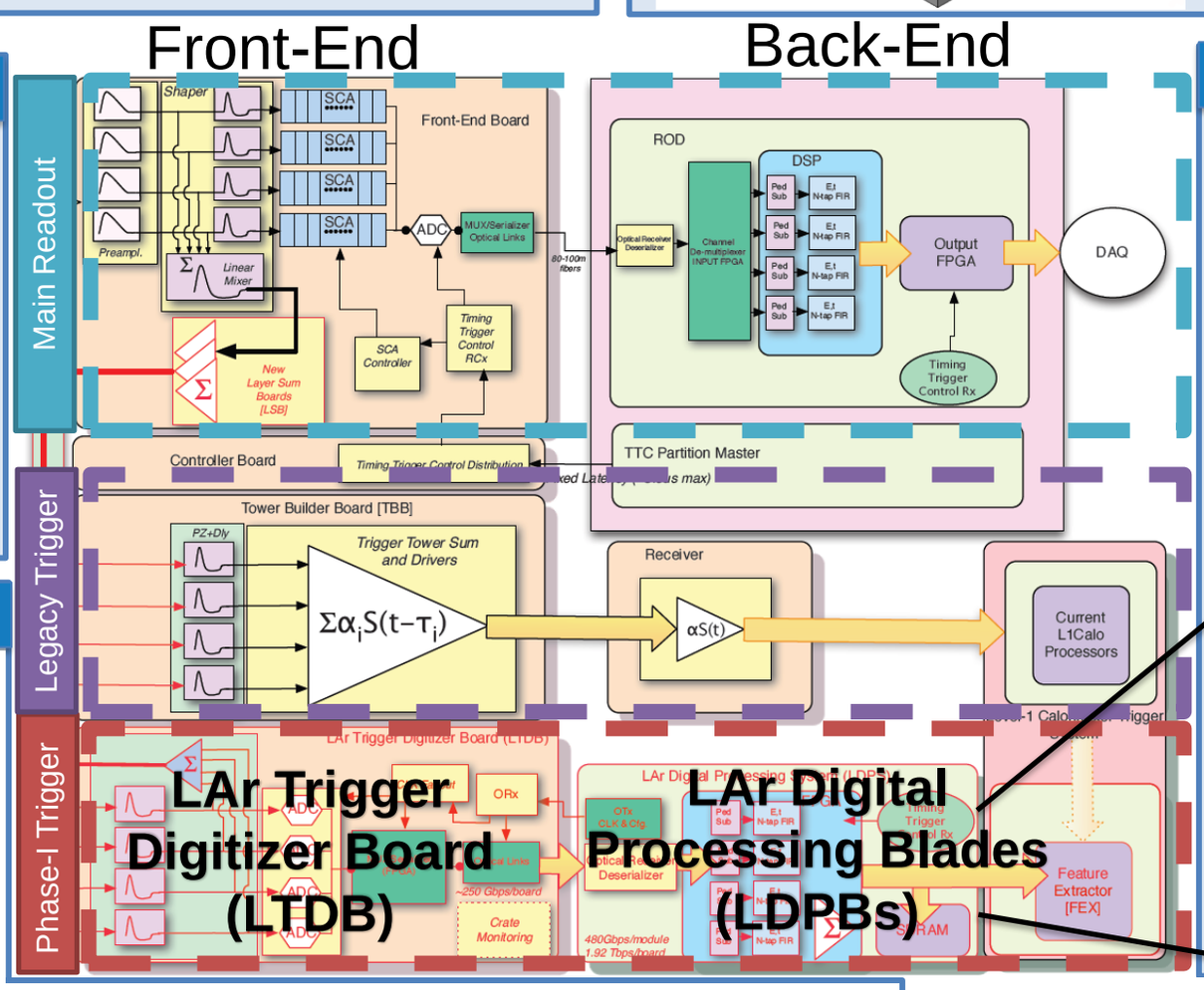
Upgrade in On-detector

Front-End (FE)

2968 Layer Sum Boards (LSB)
- Analog sum SC signals with finer granularity.

114 Base Planes
- Routing of signals for SCs
- Maintain legacy Level-1 trigger system

124 LTDBs
- Receive, digitize and transmit digital SC signals



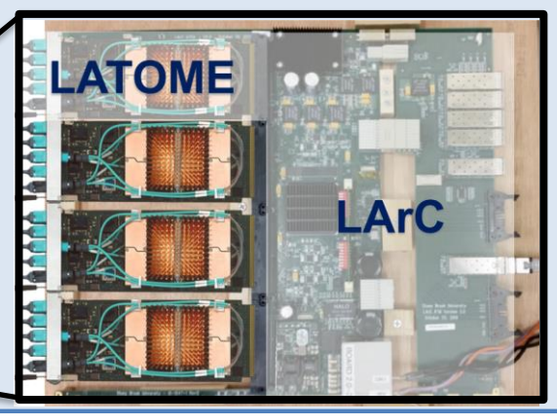
Upgrade in Off-detector

Back-End (BE)

3 ATCA shelves (Advanced Telecom Computing Architecture)

30 LDPBs
- **1** LArC (LAr Carrier)
- Up to **4** LATOMEs (LAr Trigger Processing Mezzanines)

Real-time digital processing:
- Computation of E_T
- Bunch Crossing Identification (BCID)



Validation plots

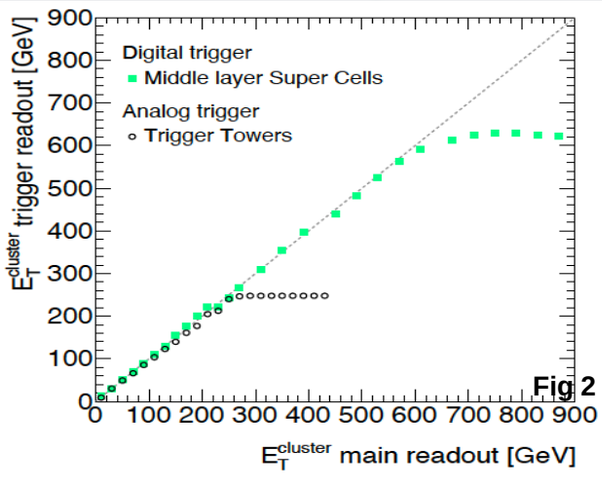


Fig 2

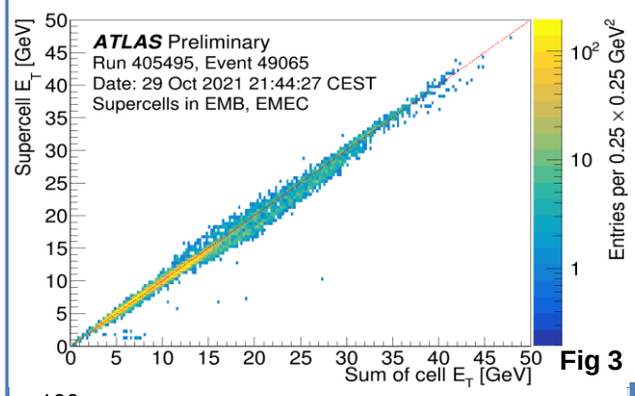


Fig 3

Measured E_T per ADC count from calibration

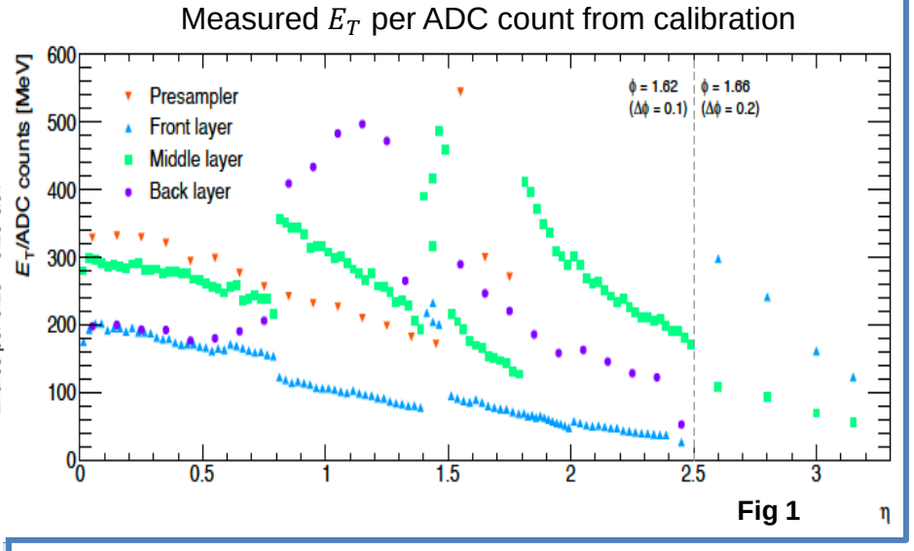
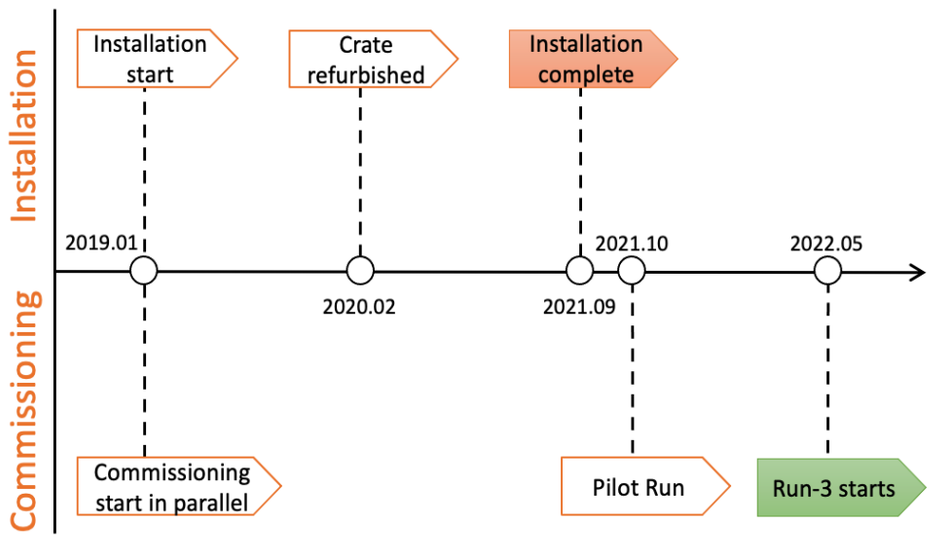


Fig 1



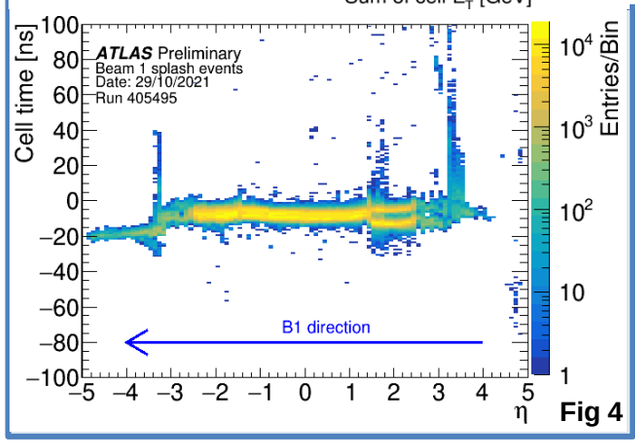


Fig 4

Calibration, tuning & validations for Phase-I Upgrade

Calibration runs for the new Phase-I hardware, reading out Super Cells data (Fig 1, Fig 2)
- Connectivity checks, SCs mapping, calibration constants, energy, BCID adjustments, noise…
- Automatic processing of data & threshold values/criteria

Pilot runs in Oct 2021, Apr 2022, collecting splashes and test collisions (Fig 3, Fig 4)
- Consistent SCs energy with legacy readout, uniform timing, good LAr cells coverage…

⇒ LAr Calorimeter Phase-I Upgrade has been completed, **ready for Run-3 data taking!** ✓

References

ATLAS Collaboration, ATLAS Liquid Argon Calorimeter Phase-I Upgrade Technical Design Report, CERN-LHCC-2013-017, ATLAS-TDR-022
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ATLAS Collaboration, Approved Liquid-Argon Calorimeter Plots, https://twiki.cern.ch/twiki/bin/view/AtlasPublic/LArCaloPublicPilotBeam2021

15th Pisa Meeting on Advanced Detectors
La Biodola, Isola d'Elba, May 22-28, 2022