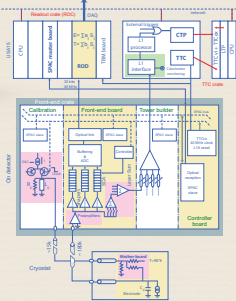# DEVELOPMENT OF THE ATLAS LIQUID ARGON CALORIMETER ELECTRONICS FOR HL-LHC
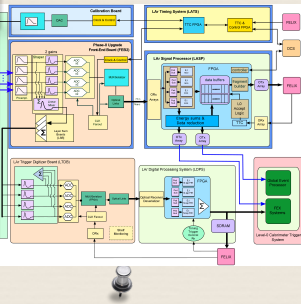
LAr CALORIMETER READ-OUT Electronics
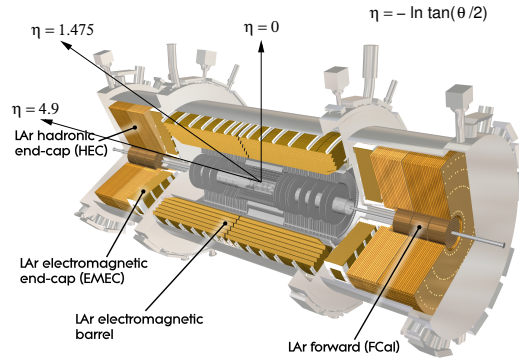
OLD

NEW

The LAr read-out electronics upgrade has to meet ATLAS Physics goals @ HL-LHC

✦ **Improved radiation tolerance needed for HL-LHC**
➡ Design LAr specific ASICs

✦ **182468 cells digitized @ 40 MHz with two gains**
➡ Wide dynamic range: 16 bits
➡ 33000 links between on / off detector

✦ **Increased trigger rate to 1 MHz will use full calorimeter granularity**
➡ Need high computing power

Main LAr Phase II upgrade:

❖ **On detector upgrade:** Calibration boards (CABANE), and Front end boards (FEB2)

❖ **Off detector upgrade:** LAr Timing System (LATOURNETT), and LAr Signal Processor (LASP)

Setup with LASP T2 prototype

MAX-PLANCK-INSTITUT FÜR PHYSIK

ATLAS LIQUID ARGON CALORIMETER

$\eta = 1.475$

$\eta = 0$

$\eta = -\ln\tan(\theta/2)$

$\eta = 4.9$

LAr hadronic end-cap (HEC)

LAr electromagnetic end-cap (EMEC)

LAr electromagnetic barrel

LAr forward (FCal)

The ATLAS Liquid Argon (LAr) Calorimeters (EMB, EMEC, HEC, FCal) are expected to operate riliably during HL-LHC and remain unchanged.

The LAr Phase-II upgrade plan for HL-LHC is to build a new read-out electronic system.

The upgrade of the LAr trigger read-out was done during the Phase-I shutdown, it is now operational

LHC / HL-LHC Plan
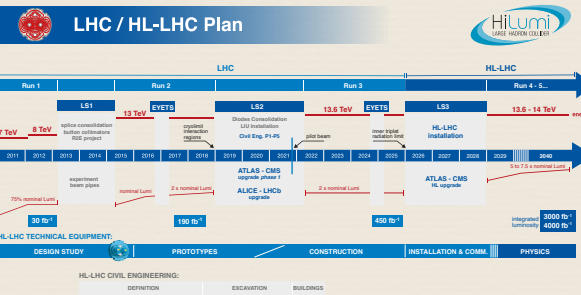
TERESA BARILLARI
MAX PLANCK INSTITUTE FOR PHYSICS
85748 GARCHING - GERMANY
ON BEHALF OF THE ATLAS LAR CALORIMETER GROUP

LAr CALORIMETER Phase II Upgrade

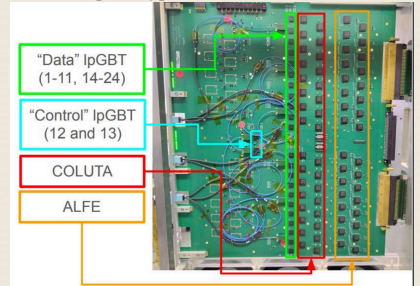**LAr calibration boards** inject calibrated signals onto calorimeter cells. Main components are:

❖ The CLAROC create the pulse

❖ The LADOC -16-bit DAC used to control the switch

❖ CABANEv1 pre-prototype board built to measure cross-talk between channels - Improved CABANEv2 prototype ongoing

CABANEv1 prototype
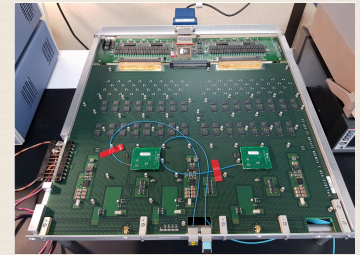
The LAr FEB2 provides input line termination, amplification, shaping, digitization and data transmission to the off-detector electronics. Main components are:
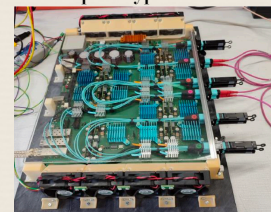
❖ The PreAmplifier/Shaper : ALFE2 (ATLAS Liquid Argon Front-End)

❖ The Analog Digital Converter: COLUTAv4

❖ Analog energy sums: LSB (Layer Sum Board)

FEB2 v2 prototype

"Data" lpGBT (1-11, 14-24)

"Control" lpGBT (12 and 13)

COLUTA

ALFE

Off detector upgrade:

❖ The LASP will receive the digitized waveforms, apply digital filtering, buffer the data until received trigger decision.

❖ LATOURNETT Distribute clock and bunch crossing information to the FEB2

LATOURNETTv1 prototype

ATLAS EXPERIMENT