On-detector powering

Low Voltage power supplies

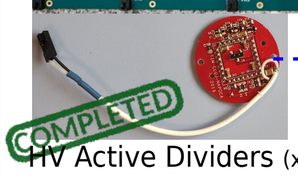
Low Voltage bricks (x2048):
- 200V->10V DC/DC converter
- most exposed component to radiation

ELMB2 motherboard (x256):
- remote control of bricks

COMPLETED

High Voltage distribution to PMTs

HVbus (x896)



HV Active Dividers (x9852):
- better PMT linearity at high current

Off-detector powering

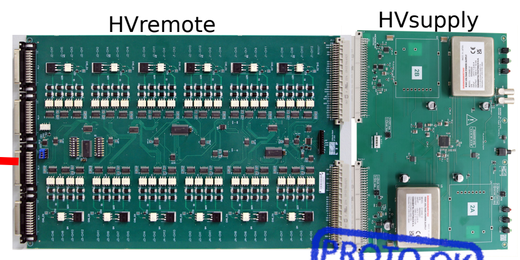
Bulk 200V DC power supplies

AuxBoards (x64): remote control

IN PROD.

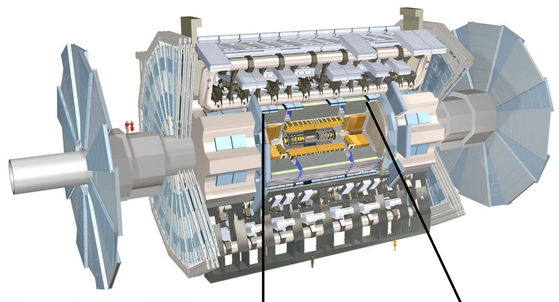
High Voltage distribution to PMTs

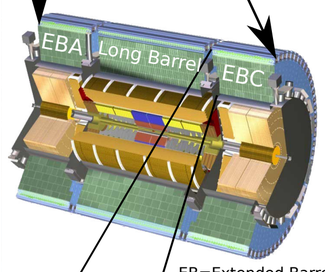
HV cables (<1kV):
- ~100m long
- 256 cables 2x24
- 128 cables 2x32



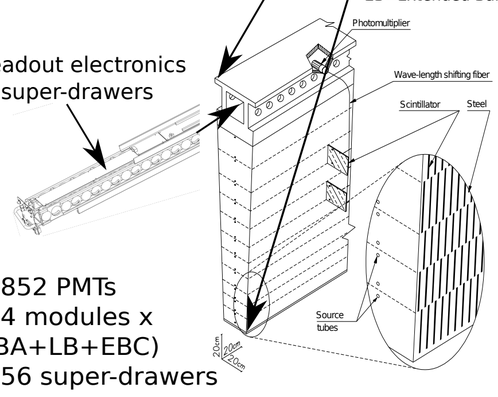
HVsupply + HVremote (x256):
- primary power supply (Hamamatsu)
- 10k regulation loops and monitoring
- hosted in 16 custom crates

ATLAS TileCal





EB=Extended Barrel



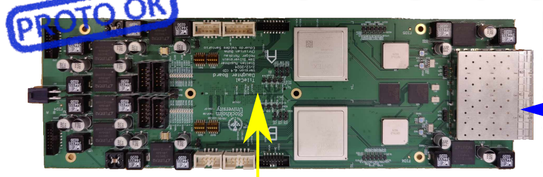
- 9852 PMTs
- 64 modules x (EBA+LB+EBC)
- 256 super-drawers

Upgrade for HL-LHC

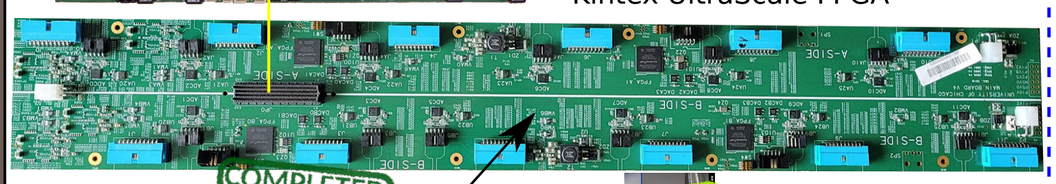
- 10% of new PMTs
- new super-drawers bodies
- new readout electronics
- new power supplies
- new back-end electronics (39 Tb/s)
- full digital trigger
- improved resistance to radiation

Front-end electronics

PROTO OK



DaughterBoard (x896):
- communication with back-end (GBT 2 Rx@4.8 Gb/s+4 Tx@9.6 Gb/s)
- clock distribution to MainBoard
- Kintex UltraScale FPGA



COMPLETED

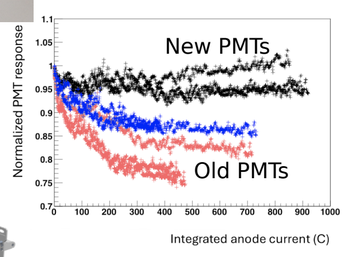
MainBoard (x896):
- power conversion from input 10V
- digitization of FENICS outputs
  2x12-bit/40MHz +16-bit (integrator)
- configuration control for FENICS

IN PROD.

FENICS (x9852):
- PMT pulse shaping
- bi-gain amplification
- current integration

IN PROD.

New PMTs (x1000):
- Hamamatsu R11187
- Q.E. >15%



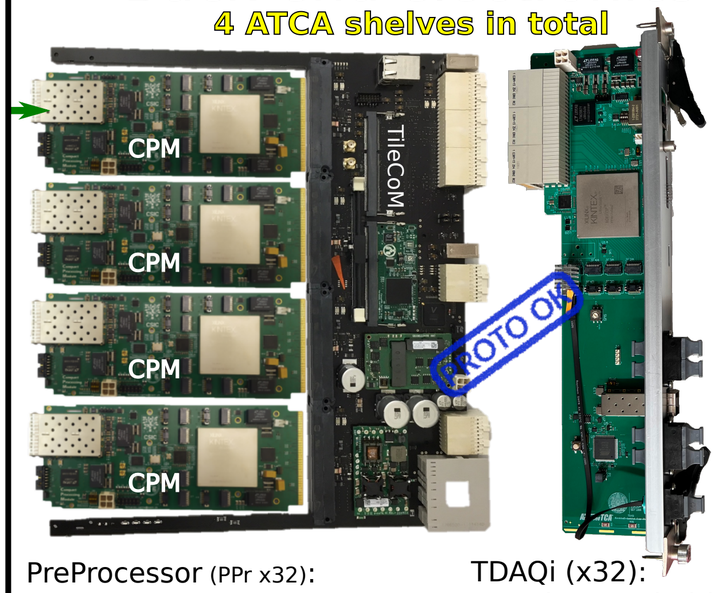
Aluminum bodies
- 896 mini-drawers
- 256 micro-drawers

COMPLETED

256 readout units (super-dr.) -> 896 readout units (mini-dr.)

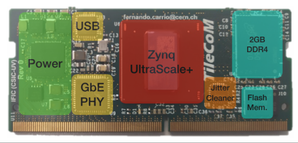
Back-end electronics

4 ATCA shelves in total



PreProcessor (PPr x32):
- comm. with front-end
- comm. with ATLAS DAQ
- signal reconstruction
- ATCA Carrier Board (x32):
  - power distribution (up to 400W)
  - comm. between CPM and TDAQi
  - hosts TileCoM and GbE switch
- CPM (4/PPr -> x128):
  - Kintex UltraScale 115
  - Samtec FireFly
  - GBT 16 Tx@4.8Gb/s+32 Rx@9.6Gb/s
  - +8 Tx@9.6 Gb/s+1 Rx@9.6 Gb/s
- TileCoM (x32):
  - interface with ATLAS DCS
  - Zynq UltraScale+ SoC

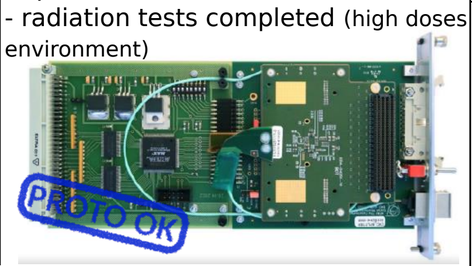
TDAQi (x32):
- produces primitives for ATLAS L0 triggers:
  - L0Muon: 6x9.6 Gb/s
  - L0Calo: 26x11.2 Gb/s
  - L0Global: 8x11.2 Gb/s
- ATCA Rear Transition Module
- Kintex UltraScale+
- Samtec FireFly

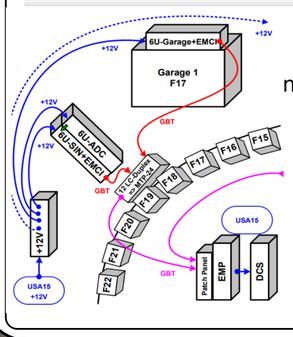


Calibration systems

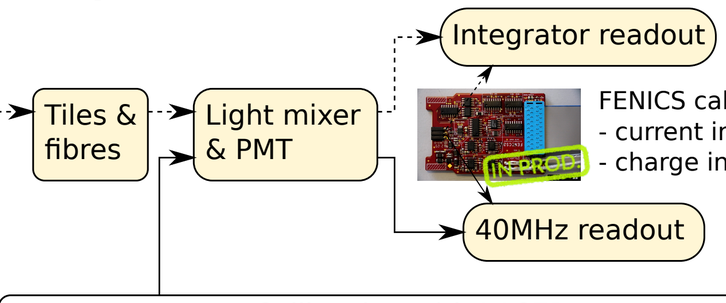
Calibration with Cesium

New on- and off-detector electronics:
- optical links readout
- radiation tests completed (high doses environment)





New hydraulics system (source movement) under study, with increased segmentation and reduced pressure to reduce risk of leaks



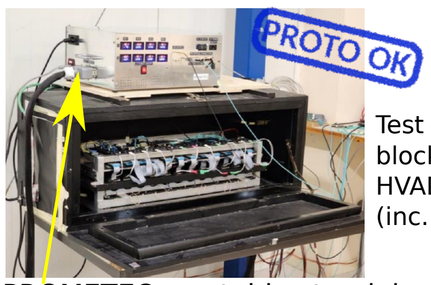
FENICS calibration:
- current injection
- charge injection

Calibration with LASER

New integrating sphere for mixing LASER light and light from new LED matrix to simulate pile-up

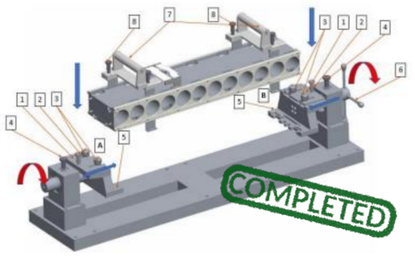
ILANA:
- interface LASER/ATLAS
- 2x9.6 Gb/s optical links
- Arria 10 SoC + TileCoM

Assembly and tests



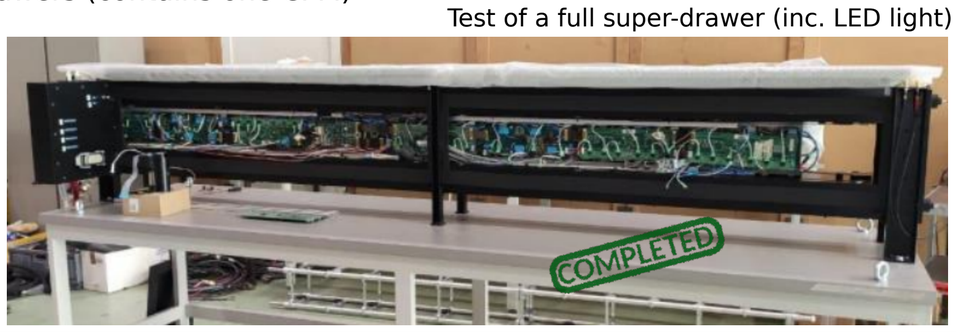
Test of 12 PMT blocks = PMT + HVAD + FENICS (inc. LED light)

PROMETEO: portable standalone test system for up to four mini-drawers (contains one CPM)

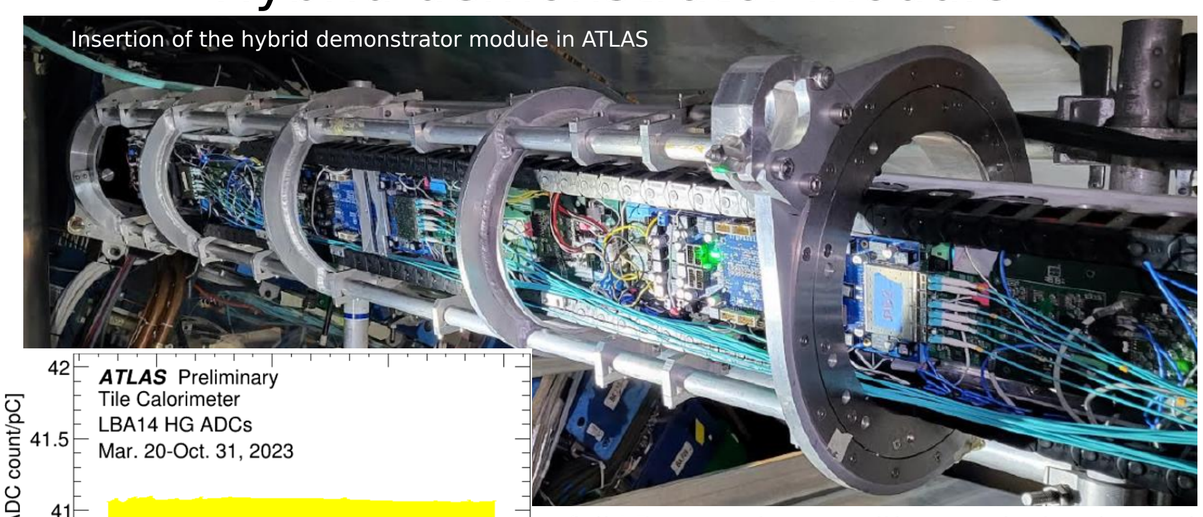


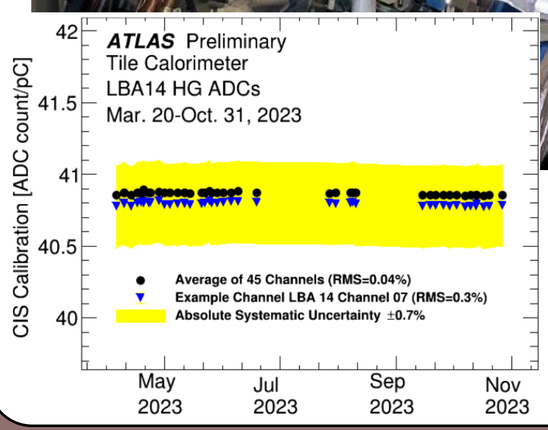
Assembly of a mini-drawer (896 to be done in 32 weeks)

Test of a full super-drawer (inc. LED light)



Hybrid demonstrator module

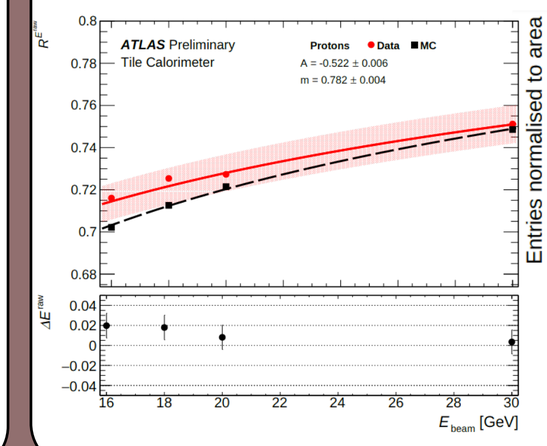


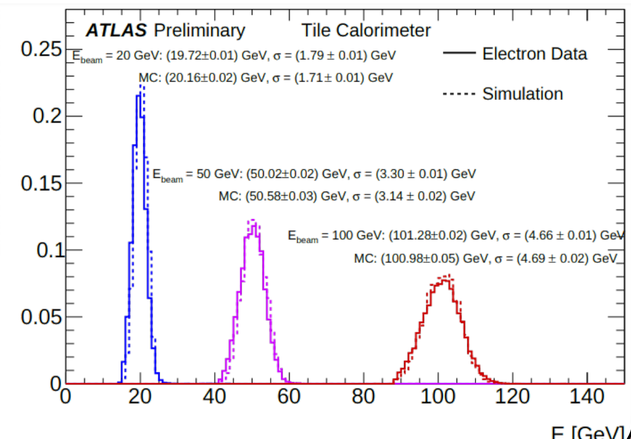


- full LB super-drawer with new electronics and analog trigger (backward compatible)
- new back-end electronics interfaced to legacy
- takes data in ATLAS since 2020
- updated every year with most recent versions
- usefull experience with real operation
- good stability and in-situ performance

Beam tests

Extensive tests with particle beams at CERN:
- test campaign every year
- updated every year with most up-to-date versions of electronics
- 1 LB + 1 EB new super-drawers
- new back-end electronics
- new powering systems





David Calvet (Université Clermont Auvergne, CNRS/IN2P3) on behalf of the ATLAS Collaboration. 16th Pisa Meeting on Advanced Detectors, May 26 - June 1st, 2024, La Biodola, Isola d'Elba, Italy.