

Upgrade of the ATLAS Tile Calorimeter High Voltage System

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- 2 Stability Testing
- 3 Calibration
- 4 Program Improvements
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ATLAS Detector

- The Hadronic Calorimeter (Tile Calorimeter, TileCal) detects the passage of particles that interact with its plastic scintillating tiles producing light;
- Light pulse is converted to electric signal by photomultipliers (PMTs);
- The gain of each PMT is highly sensitive to its power supply voltage.

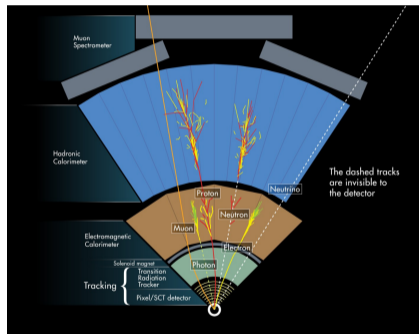
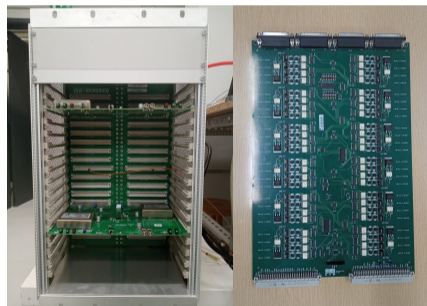


Figure 1: Schematic of the ATLAS detector

High Voltage System

- Due to the increase in luminosity for the HL-LHC, the High Voltage System (HVS) will be located outside the detector and connected to each PMT by 100m cables.
- In each Crate is possible to connect 16 sets of boards, each being able to control 48 PMTs.
- Each set has a HVSupply, with a primary voltage, connected to a HVRemote which controls and divides the input voltage for each Channel (PMT).



(a) Crate

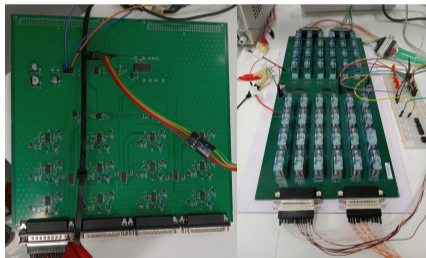
(b) HVRemote

Figure 2: Components of the HVS

Measurement System

To test the response of each Channel it was used:

- Zybo board controlling internally the voltage to each Channel and measuring it.
- External board measuring the voltage of each Channel received by cables from the HVRemote (multiplexer for a single ADC).
- Relay board also connected externally to the HVRemote (multiplexer for a single voltmeter).



(a) External Board (b) Relay Board

Figure 3: Measurement boards

① Introduction

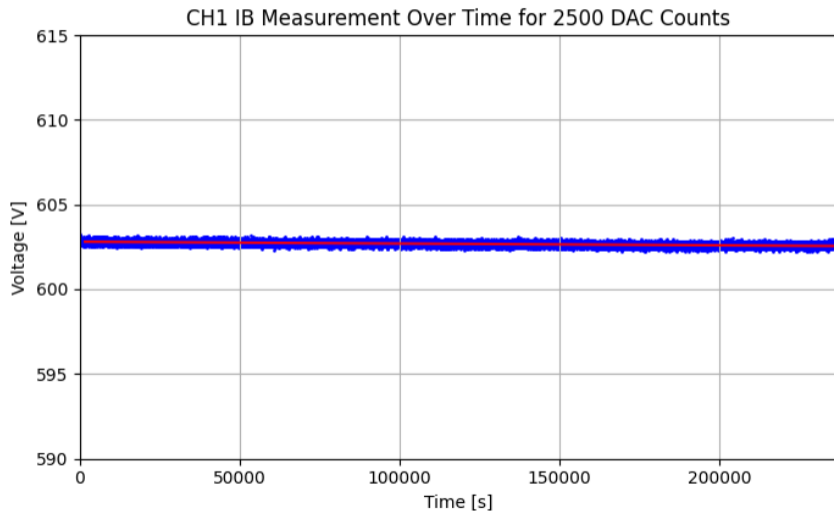
② **Stability Testing**

③ Calibration

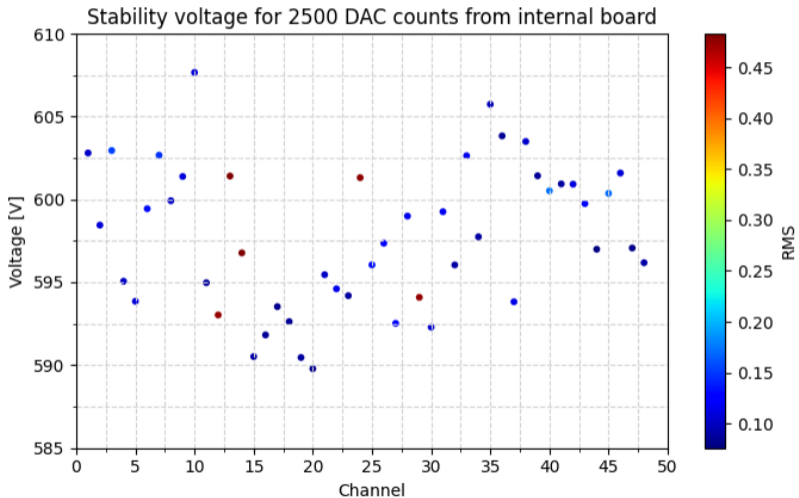
④ Program Improvements

⑤ Conclusion

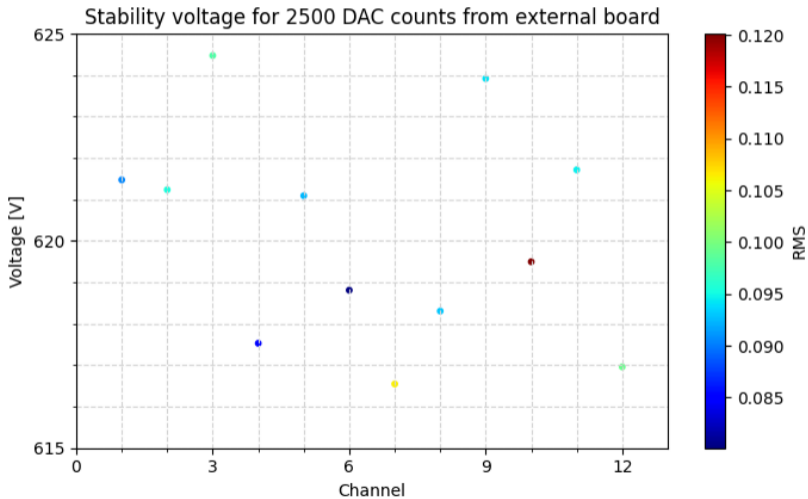
Stability Measurements



Internal Measurement

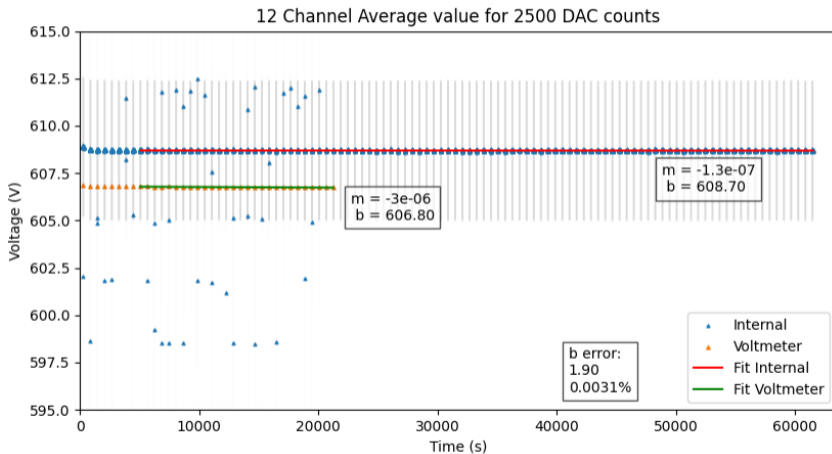


External Measurement

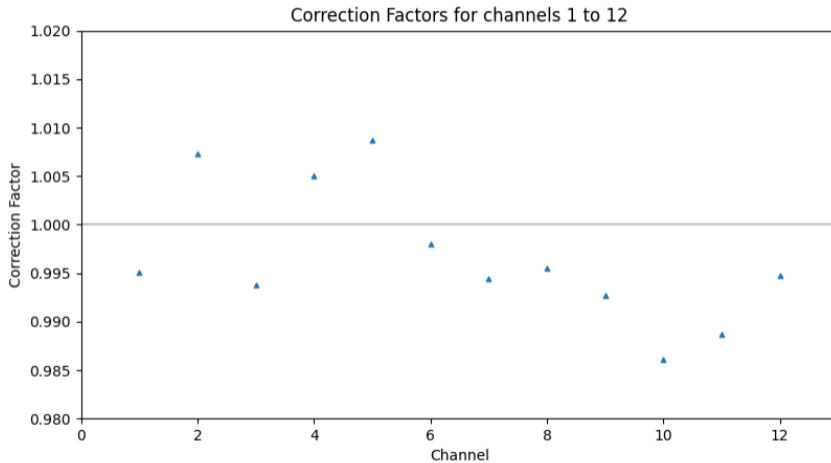


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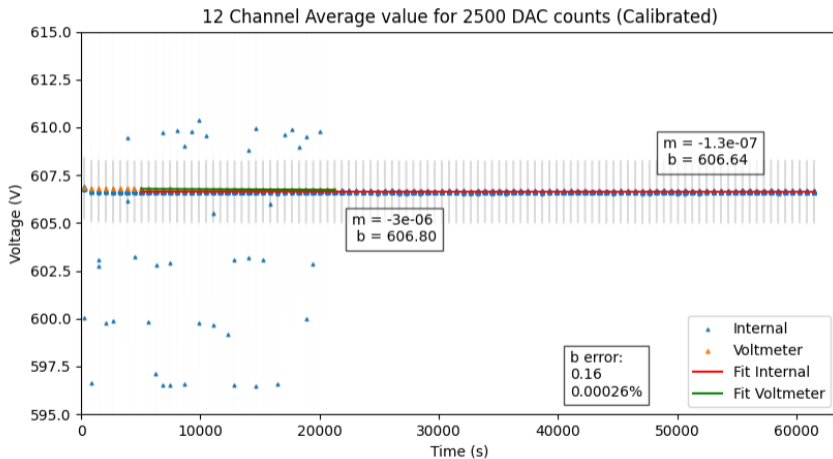
Voltmeter Measurements and Internal Measurements



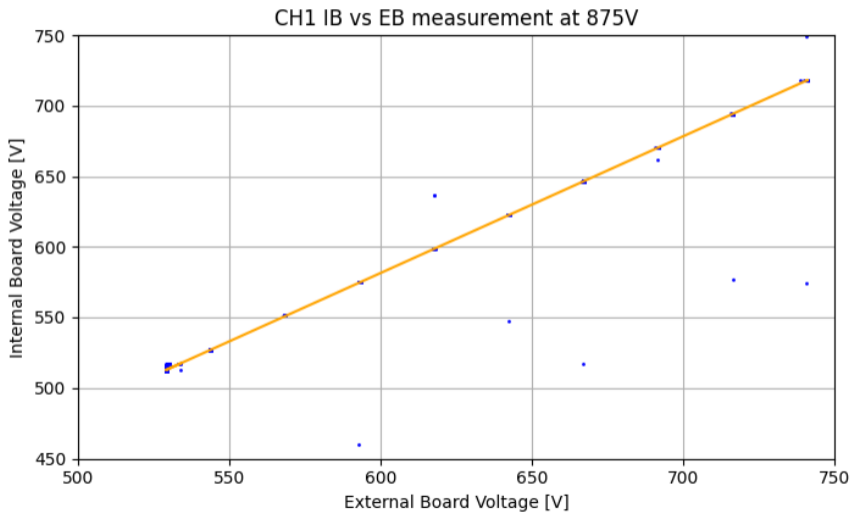
Correction Factors



Calibrated Values



Calibration's Interval of Validity



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Internal DAC Detector

Personalized programs for easy use:

- Selective information;
- Stability testing;
- Timed runs;
- Synchronization;
- Single or multi-board measurements;
- Single or multi-map measurements;
- Channel-by-channel calibration.

External DAC Detector & Digital Voltimeter Board

Personalized programs for easy use:

- Selective information;
- Stability testing;
- Timed runs;
- Synchronization.

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Conclusion

Observations:

- The system seems to have a behaviour over time compatible with the required parameters: below 0.5V RMS, when the relay system is not in use.
- Calibrations can be applied to a large range of voltage values due to its linearity.
- Programs to control and measure boards were automatized and synchronization between them is now possible.

Next steps:

- Test the system response with more boards connected to the Crate.
- Test boards that will be in production soon.