The High Luminosity Large Hadron Collider (HL-LHC) will deliver five times the LHC nominal instantaneous luminosity, after a series of upgrades that will take place during the shutdown of 2024-2026. The ATLAS Hadronic Calorimeter (TileCal) will require the complete replacement of the readout electronics in order to accommodate its acquisition system to the increased radiation levels, trigger rates, and high pile-up conditions during the HL-LHC era. The upgraded readout electronics will digitize the PMT signals from every TileCal cell for every bunch crossing and will transmit them directly to the off-detector electronics. In the counting rooms, the off-detector electronics will store the calorimeter signals in pipelined buffers while transmitting reconstructed trigger objects to the first level of trigger at 40 MHz. The Demonstrator module has been assembled and is being operated and read out using a prototype of Tile PreProcessor (TilePPr) which also permits integrating the Demonstrator module into the present ATLAS TDAQ system. This contribution presents the status and performance of the Demonstrator module in the ATLAS experiment.

### Demonstrator status and test results

- For accurate cell energy reconstruction, the Demonstrator was used together with the entire TileCal for taking calibration and data quality runs. The main objectives for Demonstrator data analysis are: (i) pedestal stability over long periods (Figure 3), (ii) stability of the noise, (iii) stability of the timing in Laser runs and (iv) PMT Response variation.

- **Pedestal tests** showed slightly lower noise in the demonstrator for April run 2021 (Figure 4).

- The **Demonstrator readout** was fully integrated in the TDAQ software with very stable links. (Figure 5)

- Correlations for pedestal measurements in-between all 12 channels within mini-drawers MD1, MD2, MD3 a Reduced correlation coefficients show that no linear association exists between pedestal measurements and MD4 were performed (Figure 6) for mini-detector channels sharing the same electronics.

### Conclusion

Replacement of MBs and fixing noisy channels was completed for the Tile demonstrator module and is now fully integrated with the TileCal TDAQ system. The Demonstrator timing was adjusted by CIS and laser, and the integrator pedestals tests with L1Cal showed no noisy towers. The Demonstrator data acquisition runs which included a new optimized TilePPr firmware have taken place without data losses. The pedestal analysis showed better performances compared with the legacy system.

### References