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Upgrading the ATLAS Tile Calorimeter electronics

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The Tile Calorimeter (TileCal) is the hadronic calorimeter covering the central region of the ATLAS experiment at LHC. The TileCal readout consists of about 10000 channels. Its main upgrade will occur for the High Luminosity LHC phase (phase 2) where the peak luminosity will increase 5-fold compared to the design luminosity (10exp34 cm−2s−1) but with maintained energy (i.e. 7+7 TeV). An additional increase of the average luminosity with a factor of 2 can be achieved by luminosity leveling. This upgrade will probably happen around 2023.

The upgrade aims at replacing the majority of the on- and off-detector electronics so that all calorimeter signals are directly digitized and sent to the off-detector electronics in the counting room. To achieve the required reliability, redundancy has been introduced at different levels. The smallest independent on-detector electronics module has been reduced from 45 channels to 6, greatly reducing the consequences of a failure in the on-detector electronics. The size of the smallest mechanical module has been reduced by a factor 4 to facilitate maintenance. This will mostly be accomplished by module replacement to reduce radiation exposure to maintenance personnel, which will be an increasingly important issue.

Three different options are presently being investigated for the front-end electronic upgrade. Which one to use will be decided after extensive test beam studies. 10 Gbps optical links are used to read out all digitized data to the counting room while 5 Gbps down-links are used for synchronization, configuration and detector control. For the off-detector electronics a pre-processor is being developed, which takes care of the initial trigger processing while temporarily storing the main data flow in pipeline and de-randomizer memories.

One demonstrator prototype module with the new calorimeter module electronics, but still compatible with the present system, is planned to be inserted in ATLAS this year i.e. mid 2014 (at the end of the phase 0 upgrade).

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