ATLAS Tile Calorimeter Readout Electronics Upgrade Program for the High Luminosity LHC

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The Tile Calorimeter (TileCal) is the hadronic calorimeter covering the most central region of the ATLAS experiment at LHC. The TileCal readout consists of about 10000 channels. The ATLAS upgrade program is divided in three phases: The Phase 0 occurs during 2013-2014 and prepares the LHC to reach peak luminosities of 10^{34} cm^2s^{-1}; Phase 1, foreseen for 2018-1019, prepares the LHC for peak luminosity up to 2-3 x 10^{34} cm^2s^{-1}, corresponding to 55 to 80 interactions per bunch-crossing with 25 ns bunch interval; and Phase 2 is foreseen for 2022-2023, whereafter the peak luminosity will reach 5-7 x 10^{34} cm^2s^{-1} (HL-LHC). With luminosity leveling, the average luminosity will increase with a factor 10.

The main TileCal upgrade is focused on the HL-LHC period. 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. All new electronics must be able to cope with the increased radiation levels. An ambitious upgrade development program is pursued to study different electronics options. Three options are presently being investigated for the front-end electronic upgrade. The first option is an improved version of the present system built using commercial components, the second alternative is based on the development of a dedicated ASIC (Application Specific Integrated Circuit) and the third is the development of a new version of the "QIE" (Charge Integrator and Encoder) based on the one developed for Fermilab. All three options will use the same readout and control system using high speed (5 or 10 Gb/s) links for communication and clock synchronization. Different alternatives for designing the housing of the on-detector electronics is also being studied to simplify maintenance. For the off-detector electronics a new back-end architecture is being developed.

A demonstrator prototype read-out for a slice of the calorimeter with most of the new electronics, but still compatible with the present system, is planned to be inserted in ATLAS already in mid 2014 (at the end of the phase 0 upgrade). This work will present an overview of the TileCal readout electronics upgrade program.