Contribution ID: **55** Type: **Oral**

Evolution of the TRT backend and the new TRT-TTC board

Thursday 15 September 2005 16:50 (25 minutes)

The Transition Radiation Tracker, made of 370'000 cylindrical straws, is a combined tracking and electron identification detector, part of the ATLAS Inner Detector at CERN's LHC. The back-end electronics, which are in charge of the communication with the front-end boards mounted all around the detector, are made up of two types of 9U VME boards. One type is the ROD boards, collecting, compressing and synchronising data from the front-end electronics. The second type is the TRT-TTC boards, transmitting the timing, trigger and control signals to the on-detector electronics using a special protocol. The current back-end of the TRT and its evolution will be presented, as well as the new TRT-TTC board.

Summary

The Transition Radiation Tracker, made of 370000 cylindrical straws, is a combined tracking and electron identification detector, which is part of the ATLAS Inner Detector at the CERN LHC. The TRT on-detector electronics is made of 2 types of custom asics, handling the analogue signals from the straws, providing a ternary encoded output (ASDBLR), binning the incoming tracking discriminator signal into 3.25ns bins and storing up to 6 microseconds of level 1 storage (DTMROC). This on-detector electronics is joined to the off-detector electronics via patch-panels in charge of data distribution.

The off-detector is comprised of three types of modules: the Timing,Trigger and Control (TTC) module, the ReadOut Driver (ROD) and the ReadOut Buffer (ROB). The ROD is a VME 9U module responsible for compressing the data and checking the synchronisation of the data coming from 240 DTMROCs. After processing the signals, the data is sent out to the ROB via SLINK transmitters.

The TRT-TTC is a VME 9U board responsible for the transmission of the timing and trigger signals (LHC bunch clock, Bunch Crossing Reset, Level1 Accept trigger, Event Counter Reset, test pulse for calibration) to ROD and on-detector electronics. It is also responsible for the communication with the front-end boards (register configuration, regular check of the registers contents). This is done using a special serial protocol, transmitted over up to 100 meters of cables via LVDS drivers and a special equalisation scheme. Each link between the TRT-TTC and the front-end communicates with up to 15 DTMROCs, and each TRT-TTC controls 40 links. One TRT-TTC is associated with two RODs in the same subrack, and controls 4/32 of one side of the TRT Barrel, or 2/32 of one end-cap.

To ensure complete coverage of the TRT detector, 50 TRT-TTC boards and 100 RODs will be produced.

The system must be modular to allow different partitions of the TRT to operate autonomously during the commissioning or the debugging phase of the experiment.

The TRT back-end electronics has recently been re-specified to conform to the above description and ensure that the volume taken up by the electronics is halved. This redesign consisted in overhauling the transmission schemes and the technologies of the system (use of optics, transmission of I2C signals over 100m of cables, $\cdots$). Some of the interesting challenges that were identified during this phase will be discussed.

The new scheme of the TRT back end and its evolution will be presented, as will the new TRT-TTC board.

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Session Classification: Parallel session A6