Contribution ID: **98** Type: **Oral**

Precise Timing Adjustment for the ATLAS Level1 Endcap Muon Trigger System

Wednesday, 23 September 2009 12:15 (25 minutes)

The ATLAS level1 endcap muon trigger system consists of about 4000 Thin Gap Chambers (TGC) with 320,000 input electronics channels in order to find level1 trigger candidates for muons in both endcap regions. We had already adjusted channel-to-channel timing difference in overall TGC system with 1.2ns level, and found its consistency with the observation of beam halo events in the first proton circulation of LHC in September 2008. After that we have found some more correction factors to be incorporated with and eventually achieved timing adjustment in 0.9ns precision. In this presentation we also discuss an effective strategy for a parameter that can be adjusted using colliding beams.

Summary

For supplying the level1 endcap muon signals, we have installed about 4000 Thin Gap Chambers (TGC) to cover full region of both endcaps of the ATLAS detctor (1.05 < |eta| < 2.4). TGC signal processing system is divided into five stages as follows;
1. TGC and Amplifier, Discriminator and Shaper (ASD) block,
2. Patch Panel (PP) (Bunch Crossing Identification, sub-nano sec. fine delay),
3. Slave Board (Level1 buffer, derandomizer, Low pT coincidence matrix, and readout logic),
4. High pT (HpT) coincidence block, and
5. Sector Logic (wire (r) and strip (phi) coincidence logic).

The stages No.2 and No.3 are installed in the same board (PSB). The HpT board is installed in the vicinity of PSB (10 or 15m cables are used between PSB and HpT). These are all mounted just behind TGC while the stage No.5 (SL) is installed in the counting hut (USA15). The on-detector (PSB-HpT) and off-detector (SL) parts are connected with optical fibers of length 90m in average.

Since the most careful and precise timing adjustment must be made at the input of the PP stage, we have installed several facilities for this purpose in PP. We have sub-nano second delay circuit in PP to adjust timing difference of hit signals caused by differences of time of flight (TOF) of particles from the interaction point to a particular region of TGC and length of cables between ASD and PP. Another delay circuit with the same precision has been implemented to adjust BCID gate timing to absorb inherent timing fluctuation of signals generated in chamber. PP has further facility to produce test pulses (TP), which are triggered by TTCrx externally. Generation timing of TP after the trigger is adjustable with also the same precision as the delay circuits mentioned above. Since TP can be transported with the same cable connected between ASD and PP reversely into ASD, we can use this TP to simulate a hit signal made by a muon if we adjust the same timing as TOF expected for region covered by a particular ASD.

At this stage we had needed three parameters to estimate the delay timing for particular input channel, which are TOF, the cable length between ASD and PP and pulse mobile velocity in the cable. We had adjusted timing using these parameters and got reasonable results with beam halo events in the first beam circulation done in September 2008. Since then we carefully looked for other correction factors hidden in the system. We have then found the signal attenuation effect as the fourth factor for the signal delay, and also the existence of cables whose cable lengths are different from the nominal value supplied by the company. We have found this fact by measuring the delay-timing scan for all signal cables of about 10,000 using TP. By implementing these effect and correction, eventually we could achieve the timing adjustment of channel-to-channel within 0.9ns level in RMS.

We have one timing adjustment parameter left unadjusted. That is the phase difference between bunch crossing signal supplied by LHC and the clock pulse used actually in TGC system. This phase difference can be adjusted only with colliding beams. We have fixed a strategy to how to adjust this difference in 10 min. if overall TGC level1 trigger rate is 500Hz. We would like to discuss also this strategy in the presentation.

Primary author: Mr SUZUKI, Yu (KEK)

Presenter: Mr SUZUKI, Yu (KEK)

Session Classification: Parallel Session A3 - Trigger

Track Classification: Trigger