A new formalism of full tracking in Dimuon High Level Trigger

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Introduction

In order to appreciate the complexities of full tracking of the Dimuon High Level Trigger, it is important to have a brief idea about High Level Trigger and Dimuon Spectrometer of ALICE.

The aim of High Level Trigger (abbreviated as"HLT") is to provide software triggers for the events of physics interest, on the basis of fast but approximate online reconstruction of events. This will reduce the data to be stored in GRID for detail Offline analysis. The online analysis of the binary data is performed on a PC farm which collects the zero-suppressed data from 1.1 million channels of the Tracking Chambers of Dimuon Spectrometer through the optical fibres called Detector Data Link (in sort "DDL"). The HLT decisions are sent back to during event building.

The Dimuon Spectrometer of ALICE consists of ten Tracking planes and four Trigger planes along with a Dipole magnet placed between the Fourth and Seventh Tacking planes. The Fifth and Sixth planes are centrally placed inside the magnet. The Spectrometer is shielded from the huge hadronic background by the Front Absorber of 10 interaction length. In addition there is a 1.2 meter thick iron wall placed between the last Tracking plane and the first Trigger planes to filter the muons with momentum greater than 4 GeV/c. The Dimuon Spectrometer is capable of handling a trigger rate of 1 kHz for Pb+Pb collisions at LHC.

The track reconstruction in Dimuon HLT is performed in 2 steps: (1) reconstruction of space-points for every detection plane using the hitreconstruction algorithm [1] which has been developed and successfully implemented by the SINP group to the PC-farm of HLT cluster; (2) a partial track reconstruction involving only the last four tracking planes, developed by Manso [2] and successfully tested by University of CapeTown group. However, the partial tracking method fails to obtain the correct p_T for the muons during the tests with detail simulations based on AliRoot. Thus this will lead to wrong HLT decision. So, a new formalism has been developed based on information from all the tracking planes which gives more accurate p_T estimation.

Formalism

In the new formalism of full tracking, the track finding is performed in four steps. In the first step, a linear extrapolation of the tracks in the last four Tracking planes, following the direction of the tracks segments found from the Muon Trigger planes. Since the level zero trigger is provided by the Trigger planes, there is no need to perform tracking without seed. In the second step, another partial tracking is carried out in first four Tracking planes using the method of Cellular Automation (reported in [3]) which does depend on the prior information of the track direction. In both the cases a track segment is formed if there are at least three hits in the four Tracking planes. In the third step of track finding, the right match between the track segments before and after the Dipole magnet is found by the chi2 test using the Kalman filter. In the last step, the transverse momentum p_T associated with the track is corrected for multiple Coulomb scattering and energy loss in the front absorber.

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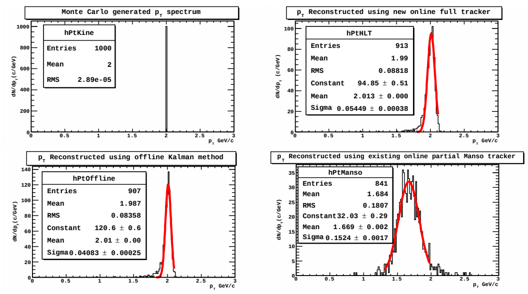

FIG. 1: Top Left : Simulated spectrum; Top Right : Reconstructed using the full online tracking method; Bottom Left : Reconstructed using the official offline Kalman Filter method; Bottom Right : Existing online tracking method following Manso algorithm

Results

The final goal of the online tracking is to filter the events based on precise p_T cuts. Thus, a set of p_T spectrum have been generated within the AliRoot framework, where each of the spectrum is produced at a fixed p_T. A window of p_T=2.5 GeV/c has been scanned at an interval of 0.5 GeV/c. This specific p_T window is chosen as the cuts on transverse momentum of muons will be 1 and 2 GeV/c to reduce the backgrounds for J/Ψ and Υ, respectively.

Fig. 1 clearly demonstrates that the resolution and the efficiency of the new tracking scheme is far better than the existing online reconstruction algorithm. In fact, the resolution of the new approach is quite close to the detail offline processing.

Another test was carried out to check the performance of the algorithm in terms of CPU processing time. A set of one thousand Υ events are generated with HIJING-8000 as background for central Pb-Pb collisions. The two muon tracks from the decay of the Υ was reconstructed with the present algorithm in a standalone mode in HLT PC-farm. It takes 4 millisecond to reconstruct a single event using the new formalism while the detail offline reconstruction takes 7 second.

It is to be noted that the present timing is slightly higher than that allowed by the trigger rate of 1 kHz. But, it should be noted that only 10-15many particles than are expected in real Pb-Pb collisions. Thus, the present timing is already within allowed time limit. However, attempts are being made to optimize the time further without sacrificing the efficiency and accuracy the track reconstruction in Dimuon HLT.

References

[1] Hit reconstruction algorithm for high level trigger of dimuon spectrometer, DAE-BRNS Nuclear Physics Symp. **50**,402(2005).

[2] A first algorithm for a dimuon High Level Trigger, F Manso and the Clermont-Fd ALICE group, ALICE Internal Note **ALICE-INT-2002-04**, 1 (2002).

[3] The first muon track in ALICE Dimuon Spectrometer, DAE-BRNS Nuclear Physics Symp. **53**, 715 (2008).