Available on CMS information server

CMS NOTE 2005/000

The Compact Muon Solenoid Experiment

CMS Note

Mailing address: CMS CERN, CH-1211 GENEVA 23, Switzerland

24 July 2000

Study of the CMS L1 and L2 Trigger in single and di-muons topologies

A. Author, B. Author, C. Author[a)]

CERN, Geneva, Switzerland

D. Author, E. Author[b)], F. Author

Institute of Experimental Physics, Hepcity, Wonderland

Abstract

The performance of the Muon L1 trigger of the CMS experiment is studied in single muon and di-muon topologies expected from inhelastic *p-p* scattering at the LHC collider, at the design luminosity of $10^{34} cm^{-2} s^{-1}$. L1-filtered data from the muon detectors and the hadron and electromagnetic calorimeters are processed through the first stage of the High-Level-Trigger processor, L2, to improve the background rejection capability before the full event buffer is required. It is shown that a background rejection factor of... is achieved with respect to the L1 output rate in the full acceptance region ($\eta < 2.4$) covered by the muon detectors.

Submitted to *NIM (?)* ....

Preliminary version

a) On leave from prison

b) Now at the Moon

1 Introduction

The CMS experiment at the LHC *p-p* collider is designed to detect the very rare processes expected from the current theories describing High Energy Physics (the Standard Model (SM) and its supersymmetric extensions), in the hard environment characterized by the very high QCD background foreseen for the inhelastic *p-p* interactions at the collider center of mass energy $\sqrt(s) = 14\, TeV$. At the design machine luminosity of $10^{34} cm^{-2} s^{-1}$, the involved cross-sections imply an interaction rate as high as 600 MHz in the apparatus, delivering on average as much as 15 interactions at each bunch crossing (the bunch crossing rate being of 40 MHz).

The ”Level 1” (L1) trigger processors, based on dedicated hardware, will filter the events delivering an output rate of 25 KHz by selecting characteristics signatures based on the presence of high transverse momentum lepton(s), energetic hadronic jets and missing transverse energy. This will keep a safety margin of a factor 3 in the system, foreseen to work up to 75 KHz, to cope with the current theoretical uncertainty on the expected event rates. After this L1 filtering on analog data, digitized data will be analyzed and further filtered by the High Level Trigger (HLT) software processors, to rich a final output rate of 100 Hz for the events to be written on the mass storage for the off-line analysis. It is then of crucial importance for the design of the final Trigger and DAQ system to have a detailed simulation of the detector response and of the trigger processors.

This work is devoted specifically to the muonic triggers based on single and di-muons topologies. In Section 1 the event generation and the datasets used in this study are described. Details of the detector simulation are given in Section 2. Sections 3 and 4 report on the simulation of the L1 trigger processors and the L2 reconstruction algorithms respectively. The results on the expected rates accepted by the two trigger levels are reported in Section 5.

2 Event generation and dataset definition

3 Detector simulation

4 L1 trigger simulation

The L1 Muon Trigger of the CMS detector is a complex and redundant system, based on three independent detectors: the Drift Tube (DT) chambers in the barrel region ($\eta < 1.15$), the Cathod Strip Chambers (CSC) in the endcap region and the Resistive Plate Chambers (RPC) in the whole acceptance region of the muon detector ($\eta < 2.40$). The Trigger layout is shown in Fig.... ect.....

4.1 DT L1 trigger

4.2 RPC L1 trigger

4.3 CSC L1 trigger

4.4 Global Muon Trigger

5 L2 reconstruction from digitized data

6 Results

6.1 Single muon topology

6.2 Di-muons topology

7 Conclusions