

# 20th International Conference on Computing in High Energy and Nuclear Physics (CHEP2013)



## Abstracts book

# Table of contents

Review of the LHCb Higher Level Trigger operations and performance during 2010-2012 .....	1
The LHCb Trigger Architecture beyond LS1 .....	2
Upgrade of the LHCb Trigger system .....	3

Abstract ID : 124

# Review of the LHCb Higher Level Trigger operations and performance during 2010-2012

## Content :

The LHCb experiment is a spectrometer dedicated to the study of heavy flavor at the LHC. The rate of proton-proton collisions at the LHC is 15 MHz, but resource limitations imply that only 5 kHz can be written to storage for offline analysis. For this reason the LHCb data acquisition system -- trigger -- plays a key role in selecting signal events and rejecting background. In contrast to previous experiments at hadron colliders like for example CDF or D0, the bulk of the LHCb trigger is implemented in software and deployed on a farm of 20k parallel processing nodes. This system, called the High Level Trigger (HLT) is responsible for reducing the rate from the maximum at which the detector can be read out, 1.1 MHz, to the 5 kHz which can be processed offline, and has 20 ms in which to process and accept/reject each event. In order to minimize systematic uncertainties, the HLT was designed from the outset to reuse the offline reconstruction and selection code. This contribution describes the design, implementation, performance and evolution of the HLT from the initial commissioning to its present status.

**Primary authors** : RAVEN, Gerhard (NIKHEF (NL)) ; GLIGOROV, Vladimir (CERN) ; ALBRECHT, Johannes (Technische Universitaet Dortmund (DE))

## Co-authors :

Presenter : RAVEN, Gerhard (NIKHEF (NL))

Track classification : Data acquisition, trigger and controls

Contribution type : Oral presentation to parallel session

Submitted by : RAVEN, Gerhard

Submitted on Wednesday 27 March 2013

Last modified on : Wednesday 27 March 2013

Comments :

Abstract ID : 125

# The LHCb Trigger Architecture beyond LS1

## Content :

The LHCb experiment is a spectrometer dedicated to the study of heavy flavor at the LHC. The rate of proton-proton collisions at the LHC is 15 MHz, but resource limitations mean that only 5 kHz can be written to storage for offline analysis. For this reason the LHCb data acquisition system -- trigger -- plays a key role in selecting signal events and rejecting background. In contrast to previous experiments at hadron colliders like for example CDF or D0, the bulk of the LHCb trigger is implemented in software and deployed on a farm of 20k parallel processing nodes. This system, called the High Level Trigger (HLT) is responsible for reducing the rate from the maximum at which the detector can be read out, 1.1 MHz, to the 5 kHz which can be processed offline, and has 20 ms in which to process and accept/reject each event. In order to minimize systematic uncertainties, the HLT was designed from the outset to reuse the offline reconstruction and selection code. During the long shutdown it is proposed to extend this principle and enable the HLT to access offline quality detector alignment and calibration, by buffering events on the HLT nodes for long enough for this alignment and calibration to be performed and fed into the HLT algorithms. This will in turn allow the HLT selections to be tightened and hence will significantly increase the purity of the data being written for offline analysis. This contribution describes the proposed architecture of the HLT beyond LS1 and the technical challenges of implementing a real-time detector alignment and calibration in the LHC environment.

**Primary authors** : GLIGOROV, Vladimir (CERN) ; ALBRECHT, Johannes (Technische Universitaet Dortmund (DE)) ; RAVEN, Gerhard (NIKHEF (NL))

## Co-authors :

Presenter : GLIGOROV, Vladimir (CERN)

Track classification : Data acquisition, trigger and controls

Contribution type : --not specified--

Submitted by : RAVEN, Gerhard

Submitted on Wednesday 27 March 2013

Last modified on : Wednesday 27 March 2013

Comments :

Abstract ID : 126

# Upgrade of the LHCb Trigger system

## Content :

The current LHCb trigger system consists of a hardware level, which reduces the bunch crossing frequency of 40 MHz to 1 MHz, at which the entire detector is read out. In a second level, implemented in a farm of 20k parallel-processing CPUs, the event rate is reduced to about 5 kHz. The major bottleneck in LHCb's trigger efficiencies for hadronic heavy flavour decays is the hardware trigger. The LHCb experiment plans a major upgrade of the detector and DAQ system in the LHC shutdown of 2018. In this upgrade, a trigger-less DAQ and a purely software based trigger system are being developed.

This upgraded software trigger will have to process more than 10 MHz of events. We demonstrate that the current architecture will be able to meet this challenge, particularly in the context of running stability and long term reproducibility of the trigger decisions.

We also discuss the expected efficiencies and signal yields per unit luminosity in several key channels for the LHCb upgrade.

**Primary authors** : ALBRECHT, Johannes (Technische Universitaet Dortmund (DE)) ; RAVEN, Gerhard (NIKHEF (NL)) ; GLIGOROV, Vladimir (CERN)

## Co-authors :

Presenter : ALBRECHT, Johannes (Technische Universitaet Dortmund (DE))

Track classification : Data acquisition, trigger and controls

Contribution type : Oral presentation to parallel session

Submitted by : RAVEN, Gerhard

Submitted on Wednesday 27 March 2013

Last modified on : Wednesday 27 March 2013

Comments :