

Tracking Optimization for the ATLAS b-Jet Trigger

Overview of the project

The trigger system is a fundamental part of the ATLAS detector. The several 100 million collisions per second needs to be reduced to a rate at which, in a sustainable way, the data from the detector can be stored to disk.

In order to do this without losing interesting events the ATLAS trigger system adopts a 3-tiered structure, with each level having more time to process and analyze each event and access to higher granularity of the detector information. In ATLAS the first level trigger (LVL1) is a hardware based trigger using coarse information from the calorimeters and the muon system. Events deemed interesting is passed on to the so-called High Level Trigger (HLT) which is a software based trigger running on farms of commercial computers. The HLT has access to the full detector granularity and reduces the rate in two steps from about 75kHz to a few hundred Hz after which events are written to disk for further study.

Many of the main physics goals at the LHC includes collisions which results in the production of bottom quarks. This includes decays of the hitherto unseen Higgs boson and Supersymmetric particles but also from important Standard Model process such as decays of top quarks.

The analysis and possible discovery of such processes depends on that the trigger system is able to identify those events efficiently and often several different strategies are used. One of the promising techniques for future improvements in the ability of the trigger system to select such events is the possibility of bottom quark identification already at the trigger level.

The bottom quarks are special. When produced in the collision, they quickly hadronize into bottom hadrons that has a relatively long lifetime and are thus able to travel several millimeter before decaying. In addition to the long lifetime the large mass of the bottom hadrons gives it's decay products a relatively large momentum relative to the hadrons direction. By using information from the inner-most tracking detectors in ATLAS one can use those properties to distinguish bottom hadrons from other type of particles.

Goal

The goal of this rotation project is to characterize, compare and improve the performance of the ATLAS tracking at the HLT. There is strong indications that the tracking performance used in the B hadron identification algorithms at the trigger level can be improved but studies and comparisons at the HLT and offline tracking level is needed.

Impact

The results of this project will have direct impact on the performance of analyses using the b-jet trigger and potentially all trigger using HLT tracking. This includes searches for Higgs and Supersymmetry or top quark analyses.

What you will learn

The project involves learning about the inner tracking detectors and in particular how charged particle tracks are reconstructed. You will gain experience with programming in C++ and Python, use of the ATLAS software framework and learning how to use the GRID. ROOT is extensively used to analyze data and display results.