Identification of boosted Higgs bosons for searches of new physics and improvement of the ATLAS tracker for the high luminosity phase of the LHC

Yajun HE
Under guidance of
Giovanni Calderini, Reina Camacho Toro

Laboratoire de Physiques Nucléaires et de Haute Energie (LPNHE)
Universite Paris-Diderot

The Standard Model (SM) of the particle physics is the theory describing three of the four known fundamental interactions in the Universe, as well as classifying all known elementary particles. So far now, it has been proven a great success with experiments. However, there are some of phenomena which can not be explained by SM, like dark matter, asymmetry of matter and antimatter etc. Physicists are motivated to explore physics beyond SM, called also New Physics (NP). The indirect way to NP is studying properties of SM particles and comparing with SM predictions. Higgs Boson, one of the most important particles in SM could be a leading door to NP.

ATLAS is one of the experiment recording the products of proton-proton collisions created by the Large Hadron Collider (LHC). The analysis of data collected in 2010-2012 allowed ATLAS and CMS collaborations to discover a Higgs boson with mass of about 125 GeV. One part of my work is to develop new tagging algorithms for boosted Higgs bosons, using $H \to b\bar{b}$ process. The new tools are expected to have a good discrimination between signal and QCD background. Some preliminary studies for mass decorrelated identification tools has been done.

Since W/Z/Higgs boson tagging algorithms developed, optimised and evaluated using Monte Carlo simulations, we can not expect simulations to describe all effects (like modelling, detector, etc.) that impact the performance of tagging algorithms accurately. Scale factor is defined as data-to-simulation correction factor. The work of scale factor measurement has started first on boosted $V \to b\bar{b}$ final states and extrapolate to $H \to b\bar{b}$ final state.

It is important to mention that LHC will start data-taking with unprecedented collision rates in the coming years, LHC and HL-LHC phase. Inner tracker (ITk), pixel silicon detectors of the ATLAS tracking and vertexing system for HL-LHC, is being developed to cope with the increase in event rate and in pile-up events, and harsh radiation condition. One part of my work is measuring electrical and physical properties of pixel sensors developed in the laboratory LPNHE. Several measurements and data takings have been done.