Contents

Chapter 1

Prospects for Neutral MSSM Higgs Search Improvement

The neutral MSSM Higgs search, described in the previous chapter, suffers strongly of poor jet reconstruction efficiency and b-tagging performance due to the particular phase space required, this bound the potential of this search, improoving b-tagging would result in a major improvement of the search sensitivity. This chapter investigates an alternative to the commonly used calorimeter jets in ATLAS, which is trackjets b-tagging. The prospects for successfully use trackjets b-tagging in the future neutral MSSM Higgs searches are reported, b-tagging on trackjets was never attempted before. Section**??** describes this and that...

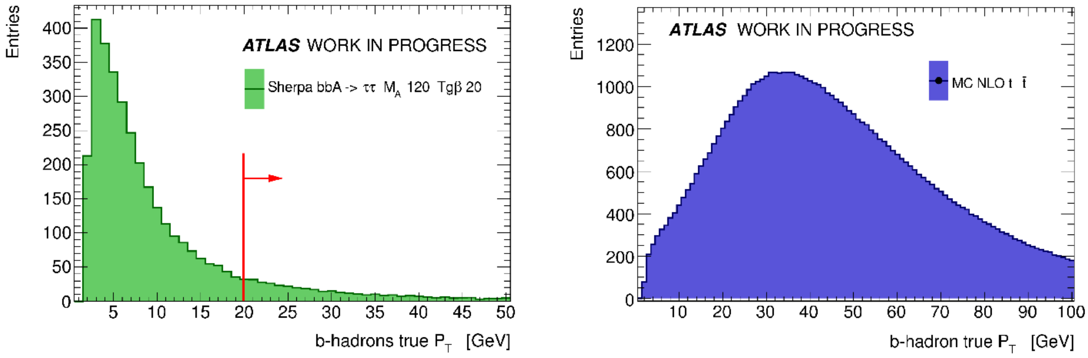

Figure 1.1: Cormparison of simulated b-hadron distribution for signal b-associated production events (left) and $t\bar{t}$ events (right). The red line in the figure shows the acceptance region due to calibrated jet p_t requirements.

1.1 Introduction to Trackjets

This problematic has two sources: - The ATLAS calorimeter is not a sampling calorimeter, this means that responses differently for Hadrons and for leptons, has different responses to electromagnetic and hadronic shower. The Calorimeter cells are calibrated in energy using response to electromagnetic showers, to know the energy of the original parton that initiated the jet there are different procedure to calibrate the Jets offline which are called in short Jet Energy Scale (JES) corrections [], which make use of MC simulation. Due to the high amount of pileup and ambient energy density in the events, jets are calibrated from 20 GeV in p_t, this means that currently is not possible with calorimeter jets to access the low transverse momentum phase space.

The neutral MSSM Higgs search, as described in chapter ??, splits the dataset in two category by means of the presence or the absence of a b-tagged jet, the b-tagged category is optimized for the b-associated production mechanism, in which the Higgs is produced in association with two b-jets. Figure 1.1 shows a comparison between p_t spectrum of simulated b-hadron in b-associated Higgs and $t\bar{t}$ events, the signal prefers b-hadron with relatively low transverse momentum, jet calibration invoqe jet $p_t > 20$ GeV removing a large fraction of possible signal candidate, many of the b-associated production signal events falls in fact in the b-veto category, making the separation not so effective. The low p_t spectrum is actually quite challenging, jet reconstruction efficiency and calibration set then a lower limit to the signal sensitivity in the b-tag category. Another challenge to this search are the poor b-tagging performance at low transverse momentum, for the a fixed tagging point of the MV1 tagger the b-tagging efficiency drops, in fact, rapidly with jet p_t reacing a minimum of 50% at 20 GeV [65, 66] (using as tagging point the 70% point).

A solution to the jet reconstruction efficiency is to use, instead of calorimetric jets (calo-jet), track-jet , which are as well anti-kt object (see chapter??) but constructed using inner detector tracks as building blocks, not calorimeter cells. Jets in the ATLAS reconstruction software are reconstructed by clustering foru vector objects (calorimeter energy cluster, tracks, truth particle, etc.) in the $\eta - \phi$ plane. In the case of clustering tracks, however, it is possible to take advantege of the longitudinal (z) impact parameter information provided by the inner detector and build track-jets in three dimensions $\eta - \phi - z$. Track-jets will then contains only tracks originating from the same interaction point (reconstructed vertex). Even thoug for calorimeter jet is possible to use the JVF, track-jets result to be more resistant to decrease in performance in the presence of pile-up, thus particolarly important in b-tagging, which depends on the determination of the jet-axis. B-tagging has been never tested before on track-jets, in the following, the first study of b-tagging over track-jets performances is reported.

1.2 Trackjet Performance

1.2.1 B-tagging Performance

1.2.2 Comparison Calo-jet Track-jet

1.2.3 Impact of Trackjet to the Analysis

1.2.4 B-Discriminant

1.3 Systematic Uncertainties on Trackjets

1.3.1 General discussion

1.3.2 Track Subtraction Method

1.3.3 Track Subtraction Validation

1.3.4 Track Subtraction Results

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