B-Quarks

Mentee: Kayla Harmon (Delaware State University)
Mentor: Jingyu Luo (Brown University)

Abstract

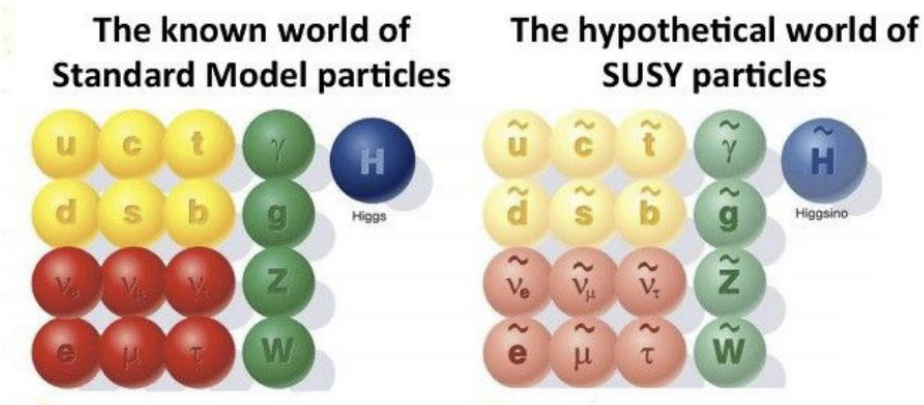
Abstract: Quarks are very important in the standard model. b quarks can deacy to lower mass quarks with relatively small rate, leading to a relatively large lifetime wich can be measured by collider detectors. When studying the Higgs boson, bottom quarks and top quarks are important because their couplings to the Higgs boson are large due to their large masses. The identification of jets arising from b quarks can be achieved by examining the properties of the charged tracks and displaced vertices. Machine learning techniques can also be utilized to improve the performance of the b-jet identification.

Overview

1. Theory
2. Goals
3. Bottom Tagging

Introduction - Theory

- Why Bottom Quarks?
  - The angle of the movement of two bottom quarks when a proton to proton collision occurs, can be used to study the nuclear force.
  - Most top quarks will decay into bottom quarks, giving information on both.
  - 59% of the time a Higgs particle will decay to an anti-bottom quark or a bottom quark



Work to do

- Bottom quarks are the second heaviest. Making these rare occurrences. However, they are slow to decay so when this happens the jets arising from bottom quarks can be identified.
- Study the properties of the tracks and secondary vertices associated with jets arising from different quarks;
- Build a machine learning algorithm to improve the performance of the jet tagging.

Method

- Techniques used to identify final state particles and their evaluation
  - Bottom Tagging -
    - measure all the tracks in a jet as accurately as possible,
    - extrapolate them back toward the original collision point, and
    - ask whether any of the extrapolated tracks miss the collision point.