Performance of reconstruction and identification of τ leptons decaying to hadrons and ντ in pp (proton-proton) collision

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Overview

Overview

1. Introduction
2. The CMS Detector
3. Data and Simulated Events
4. Event reconstruction
5. Measurement of the τh identification efficiency
6. Measurement of the misidentification probability
7. Conclusion

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Abstract

Abstract

Abstract: The algorithm developed by the CMS Collaboration to reconstruct and identify τ leptons produced in proton-proton collisions, via their decays to hadrons and a neutrino, has been significantly improved. The changes include a revised reconstruction of π 0 (pi null) candidates, and improvements in multivariate discriminants to separate τ leptons from jets and electrons. The algorithm is extended to reconstruct τ leptons in highly Lorentz-boosted pair production, and in the high-level trigger. The performance of the algorithm is studied using proton-proton collisions recorded during 2016. The performance is evaluated in terms of the efficiency for a genuine τ lepton to pass the identification criteria and of the probabilities for jets, electrons, and muons to be misidentified as τ leptons.

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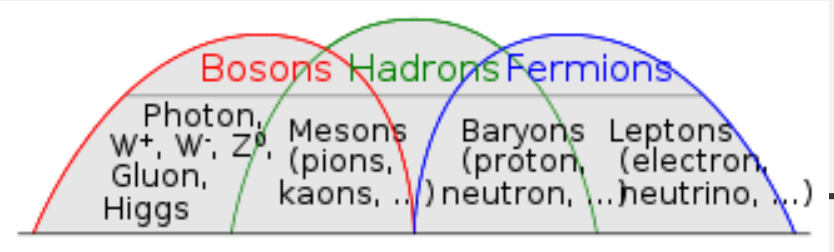
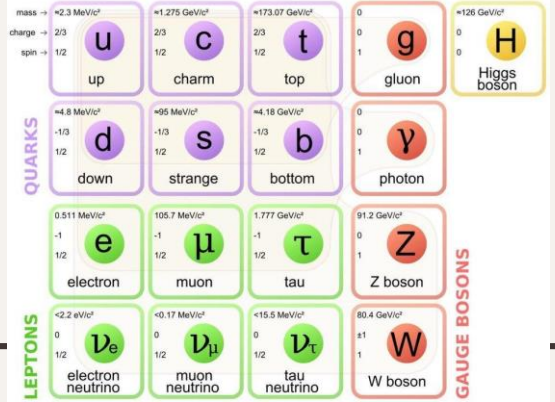
Introduction

Introduction

- Higgs Bosons
  - W and Z
  - Excitation of the Higgs field
  - Very short ½ half-life
  - By measuring collision prooeties we can learn more about the bossons
- Particle Decay
  - Decay of Higgs Bosons to two τ leptons which creates a unique channel of Higgs Bosons coupling to fermions
  - Higgs Bosons decay to fermion pairs





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Work To Do

Work to Do

- Detection of τ leptons into hadrons and neutrinos partners is difficult as they are simultaneously produced with quark and gluon jets, which are also produced in pp collisions.
- Using the recorded proton-proton collisions recorded in 2016 we are able to analyze these events and by utilizing the Tag and Probe approach we are able to reconstruct the identification algorithm.
- In this work we look to have an high efficiency algorithm which identifies the τ leptons into hadrons and neutrinos corresponding with the Standard Model

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Methods

Methods

- **CMS Detector**
  - The decay of τ leptons into hadrons and neutrinos are identified using the hadrons-plus-strips (HPS) algorithm
  - The detector improves the HPS algorithms detection by combining information from the trajectory of the decays produced by the proton-proton collisions

1. Modification of the strip reconstruction algorithm to collect the tau decay products and data more efficiently
2. Improvement to the multivariable based discriminant that reduces the false detection of jets by combining all gathered information regarding the decaying τ leptons
3. Improvements to the MVA-based discriminant - this ensures lower misidentification of τ leptons into hadrons and neutrinos

Methods

- **Root Files**
- **Tag and Probe**
  - Reference particle (tag)
  - Measured particle (probe)
  - Discriminant information
  - Discriminate between 0 and 1 which assess the level of tau identification
  - “Training” sample which learns the behaviors of various particle specific collisions
  - Measuring using real and simulated energy
- **Challenges**
  - Distinguish these objects from quark and gluon jets, which are also produced in pp collisions.

Thank You!