Reconstructing Mass of Bosons and Mesons Using CMS Data from LHC

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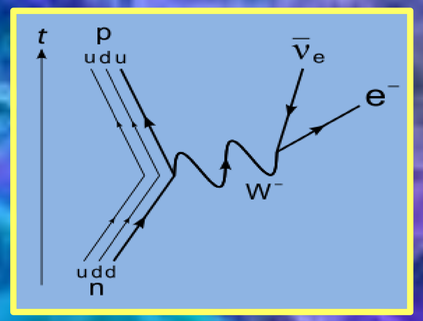
Abstract

•The purpose of this study was to reconstruct the mass of Z and W Bosons and J/psi Mesons using CMS data from LHC and to understand how the CMS machine detects the different particles.

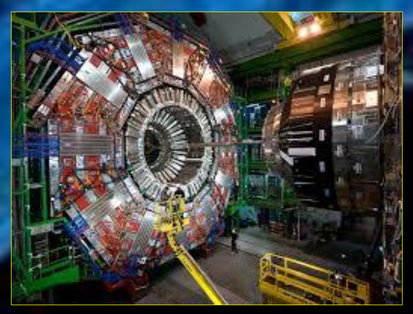
CMS at LHC

•CMS was designed to see wide range of particles and phenomena produced in LHS collisions. Located 330 feet underground in Cessy, France , CMS has approximately a 3000 member collaboration from 39 countries.

•Contains tracking devices to record tiny electrical signals that particles trigger, Calorimeter to measure energy a particle looses as it passes through ,and particle-identification detectors that detect radiation emitted by the charge particles.

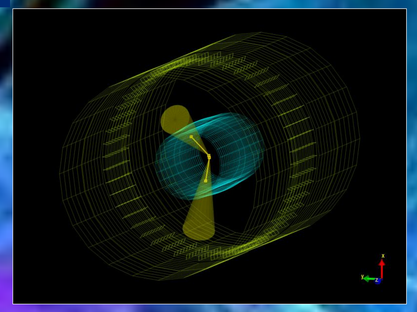


•Feynman diagram shows a W- boson mediate a beta decay into electron and antineutrino.

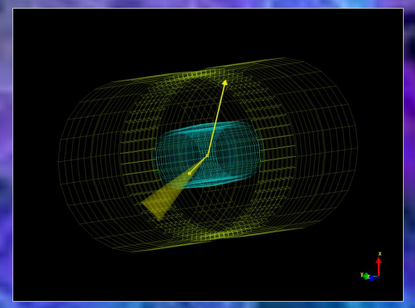


•CMS machine, 13,800 tons, 52 feet in diameter, 70 feet long, 100 million different detection elements.

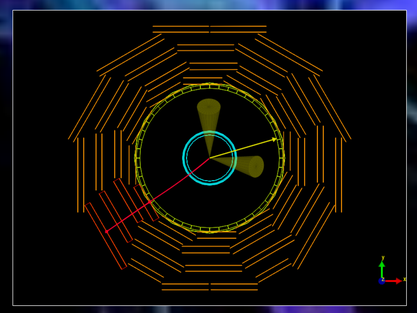
CMS Event Displays



•Z boson decays into electron and positron



•W boson decays into electron and neutrino, neutrino displayed as missing energy .



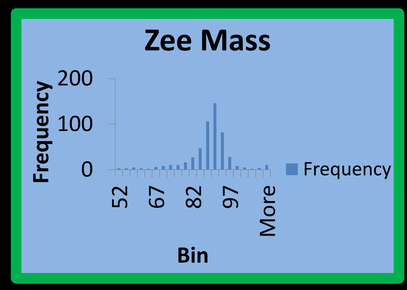
•W boson decays into muon and neutrino.

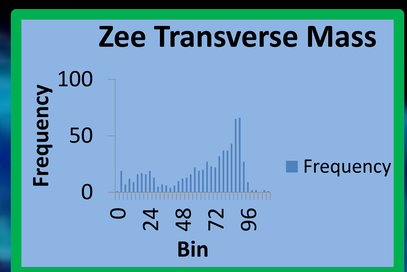
Finding the Mass

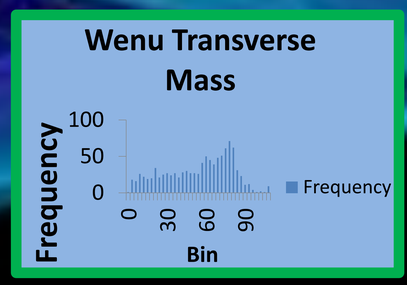
•In Zee decay (Z Boson decays into electron and positron) histogram we can see peak at approximately 91.0 GeV (Actual mass value of 91.2 GeV).

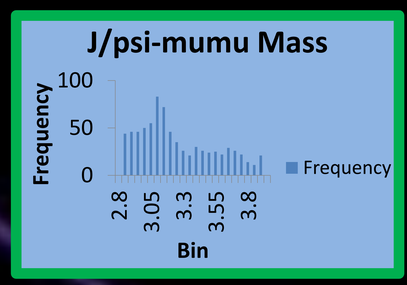
•When finding the mass of a W boson you are limited to using the transverse mass because of the missing energy carried by the neutrino. So for us to more accurately measure the mass of a W boson we must compare its transverse mass histogram to the transverse mass histogram of a Z boson decay. In the transverse mass histogram of the Z boson we can see a drop off at its true mass. When we do this to the transverse mass of W boson we see mass of approximately 80.0 GeV (Actual mass value of 80.4GeV).

•In J/psi-mumu decay (J/psi decays into muon and antimuon) histogram we can see peak at 3.1 GeV (Actual mass value of 3.1 GeV).









Resources

Rubbia, Carlo: EXPERIMENTAL OBSERVATION OF THE INTERMEDIATE VECTOR BOSONS W +, W- and Z0, *Rev. Mod. Phys*. 57, 699 – Published 1 July 1985. Switzerland.

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Ting, Samuel: THE DISCOVERY OF THE J PARTICLE, Rev. Mod. Phys. 49, 235 – Published 1 April 1977. Massachusetts.