# Stony Brook University
# The Graduate School

Doctoral Defense Announcement

## Abstract

Measurements of the $W$ Boson Mass with the D0 Detector

By

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We give a detailed description of a measurement of the $W$ boson mass using the D0 Central Calorimeter. The measurement uses 1.68 x $10^6$ candidates from $W \rightarrow e\nu$ decays, corresponding to 4.3 $fb^{-1}$ of integrated luminosity collected from 2006 to 2009. We measure the mass using the transverse mass, electron transverse momentum, and missing transverse energy distributions. The transverse mass and electron transverse momentum measurements are the most precise and are combined to give $M_W$ = 80.367 ± 0.013 (stat) ± 0.023 (syst) GeV = 80.367 ± 0.026 GeV. This is combined with an earlier D0 result determined using an independent 1 $fb^{-1}$ data sample, also with central electrons only, to give $M_W$ = 80.375 ± 0.023 GeV. The uncertainty in the measurement is dominated by the determination of the calorimeter electron energy scale, the $W$ sample size, and the knowledge of the parton distribution function.

We then discuss methods of reducing the dominant uncertainties in the $W$ boson mass measurement. We show that introducing electrons detected in the End Calorimeters greatly reduce the measurement systematic uncertainty, especially that arising from the parton distribution functions. We describe a precise calibration of the End Calorimeters using $Z \rightarrow ee$ events corresponding to 4.3 $fb^{-1}$ of integrated luminosity. We present parametrized models that describe the response of the End Calorimeters to electron and hadronic showers, giving special attention to the specific challenges of a measurement in the forward region: the inhomogeneity of the uninstrumented materials, the large hadronic energy flow in the calorimeter and the presence of misidentified jets.

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