Stony Brook University
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Doctoral Defense Announcement

Abstract

A Precision Measurement of the *W* Boson Mass

By

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In the Standard Model, the *W* boson mass is a key parameter which, in conjunction with the top quark mass, constrains the predicted Higgs boson mass. For equal contribution to the Higgs mass constraint, we need $\Delta M_W \approx 0.006\ \Delta M_t$. Currently the top quark mass is known with an uncertainty of 1.3 GeV. That requires $\Delta M_W \approx 8$ MeV. However, the current world average of *W* boson mass uncertainty is 25 MeV. So the *W* mass uncertainty is really the limiting factor in constraining the Higgs mass.

D0 group measured the *W* boson mass in $W\text{->}e\nu$ decays using 1 fb^{-1} data collected between 2002 and 2006 in $W\text{->}e\nu$ decays. One of the $W\text{->}e\nu$ decay products neutrino escapes the detection and the longitudinal momentum is unknown. So we cannot reconstruct the invariant mass of the *W* boson. We use a fast simulation to model the whole process including the physical process, detector effect and the offline selection. It takes the *W* boson mass as the input. We compare the prediction of the fast simulation with the corresponding distribution from collider data to extract the *W* mass that gives the best agreement with the data. Three kinematic observables are used to extract the *W* mass: *W* transverse mass (M_T), electron transverse momentum ($p_T(e)$) and the missing transverse momentum(MET).

The *W* boson mass was measured at D0 with a precision of 0.05%. It is the most precise measurement of the *W* boson mass from one single experiment to date.

Date: August 10th, 2009
Time: 10:00 AM
Place: Physics, D-122

Program: Physics
Dissertation Advisor: Robert L. McCarthy