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A Measurement of Bottom Quark Production in Z Boson Hadronic Decays*

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A MEASUREMENT OF BOTTOM QUARK PRODUCTION IN Z BOSON HADRONIC DECAYS

by

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B.S., Boston University, 1992

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A MEASUREMENT OF BOTTOM QUARK PRODUCTION IN Z BOSON HADRONIC DECAYS

(Order No.)

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Boston University Graduate School of Arts and Sciences, 2000

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ABSTRACT

A precise measurement of R_b, the fraction of hadronic decays of the Z^0 boson into bottom quark pairs, will test the Standard Model of particle physics. By measuring R_b, the coupling between the Z^0 boson and bottom quarks can be investigated. The strength of this coupling is sensitive to the top quark mass and to physics which lies outside the Standard Model. This thesis presents a measurement of R_b made at the Stanford Linear Accelerator Center with the SLD experiment. Approximately 196,000 hadronic events are used in the measurement. The data set was obtained during the 1997–98 SLD physics run. The selection of B hadrons for identifying $Z^0 \to b\bar{b}$ events is based on the invariant mass of topologically reconstructed vertices separated from the primary vertex for the event. This reconstruction method identifies B hadrons with a high efficiency (49.9%) and high purity (98.0%). Each candidate $Z^0 \to b\bar{b}$ event is split into two separate hemispheres which are analyzed independently. The efficiency for tagging B hadrons is extracted from the data, reducing the dependence on the Monte Carlo simulation for B hadron and b quark systematic errors. A measured result of $R_b = 0.2185 \pm 0.0013_{(stat)} \pm 0.0022_{(syst)}$ is reported. This value is consistent within measurement errors with the Standard Model prediction of 0.2158. The significance of this measurement is discussed.

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