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MEASUREMENT OF $\mathbf{R = B(t \to Wb)/B(t \to Wq)}$ AT DØ

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A measurement of the ratio of branching fractions, $R = B(t \to Wb)/B(t \to Wq)$, with q being any quark with $I_3 = -1/2$ and $Q = -1/3$, is presented. This analysis considers samples of single- and double-tagged lepton+jets events obtained with the DØ detector, corresponding to integrated luminosities of 169 pb^{-1} and 158 pb^{-1}, respectively in the e+jets and μ+jets channels. Two different lifetime taggers, CSIP and SVT, are used.

Keywords: top; CKM; Tevatron

1. Introduction

Within the SM, R can be expressed in terms of CKM matrix elements:

$$R = \frac{\mid V_{tb} \mid^2}{\mid V_{tb} \mid^2 + \mid V_{ts} \mid^2 + \mid V_{td} \mid^2} = \mid V_{tb} \mid^2 \tag{1}$$

The CKM matrix element $|V_{tb}|$ is indirectly constrained by the measurement of other CKM matrix elements, to the interval $0.9990 < |V_{tb}| < 0.9992$ at the 90% C.L.[1] However the relation between R and $|V_{tb}|$ and the prediction for R are based on the assumption of a unitary CKM matrix. Non-unitarity could for example arise from the existence of a fourth quark generation. The CDF collaboration has measured R using Run I data[2] and found it to be consistent with the SM prediction.

This note reports the result of a measurement of $B(t \to Wb)/B(t \to Wq)$ based on the data collected by the DØ detector in Run II of Tevatron. The data samples correspond to an integrated luminosity of 169 pb^{-1} in e+jets and 158 pb^{-1} in μ+jets channels. The analysis is based on the background calculation and the tagging efficiencies determined in the $t\bar{t}$ cross section measurement using lifetime tagging[3] on the same data samples and considers events with exactly one or two identified b-jets.

2. Event Preselection

The ℓ+jets events have the following signature: one high P_T isolated lepton, missing transverse energy from the undetected neutrino, two jets from hadronization of the down type quarks produced in the decays of the top quarks and two jets from W boson decay. Events are preselected by requiring, respectively, an electron ($E_T >$ 20 GeV) candidate that satisfies tight quality identification criteria or an isolated muon ($P_T > 20$ GeV). The missing transverse energy must exceed 20 GeV in the e+jets channel and 17 GeV in the μ+jets channel.

3. Event Tagging Probabilities for $t\bar{t}$ Events

The procedure to calculate the event tagging probabilities in $t\bar{t}$ events where both top quarks decay to a W boson and a b-quark is described in Ref. 3.

The assumption that top quarks decay to Wb in 100% of the cases is dropped in the present analysis. A $t\bar{t}$ event can now be of three different types:

- $t\bar{t} \to W^+b\ W^-\bar{b}$ (further will be referred to as $tt \to bb$)
- $t\bar{t} \to W^+b\ W^-\bar{q}_\ell$ or its charge conjugate (referred to as $tt \to bq_\ell$)
- $t\bar{t} \to W^+q_\ell\ W^-\bar{q}_\ell$ (referred to as $tt \to q_\ell q_\ell$),

where q_ℓ denotes either a d- or a s-quark. The $t\bar{t}$ event tagging probabilities are computed separately for the three types of $t\bar{t}$ events mentioned above using the proper b-tagging and light jet tagging probabilities.

4. Backgrounds

Details on the background calculations can be found in Ref. 3. Table 1 summarizes the number of observed ℓ+jets events before and after tagging by both taggers together with the expected number of background events. The difference between the number of observed tagged events and the predicted background is considered to be the $t\bar{t}$ contribution consisting of $tt \to bb$, $tt \to bq_\ell$ and $tt \to q_\ell q_\ell$ final states.

Table 1. Number of predicted background events and observed events.

	3 jets		≥4 jets	
Before tagging	1105		295	
	CSIP	SVT	CSIP	SVT
=1 tag	74	68	44	43
Background	49.3±1.2	38.7±0.9	14.7±0.8	11.3±0.6
≥2 tags	7	8	8	6
Background	3.41±0.09	2.90±0.10	1.24±0.06	1.00±0.11

5. Results

The value of R is calculated separately for the CSIP and SVT taggers by performing a maximum likelihood fit. The fitted value of R are:

$$CSIP : R = 0.65^{+0.34}_{-0.30}(stat)^{+0.17}_{-0.12}(syst) \tag{2}$$

$$SVT : R = 0.70^{+0.27}_{-0.24}(stat)^{+0.11}_{-0.10}(syst) \tag{3}$$

consistent with the Standard Model prediction. The 68% and 90% C.L. contours in the $\sigma_{t\bar{t}}$ versus R plane are shown for CSIP and SVT in Figure 1.

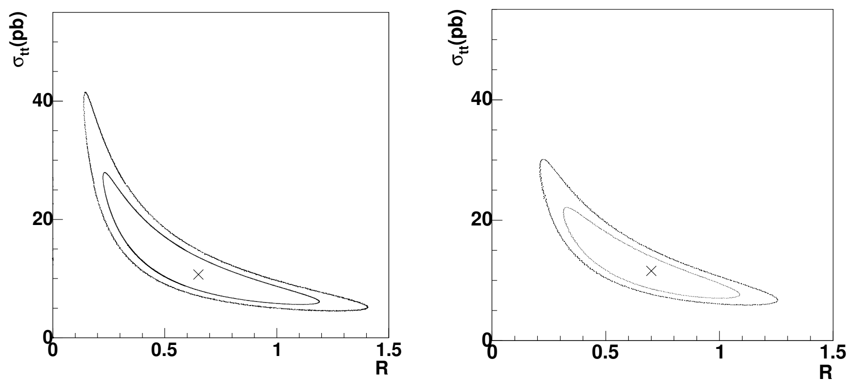

Fig. 1. The 68% and 90% C.L. contours in the plane defined by the $t\bar{t}$ cross section and R for e+jets and μ+jets combined with the CSIP tagger on the left, and the SVT tagger on the right. The maximum of the likelihood is shown by the star.

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