

Tevatron Combination of Single Top Quark Production and V_{tb} Measurement



Jan Lueck (KIT) on behalf of the CDF and DØ collaborations



Physics In Collisions

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Single Top Quark Production

t -channel: $\sigma_{t, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.2 \pm 0.1 \text{ (stat)}$
 s -channel: $\sigma_{s, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.7 \text{ (stat)}$

Unfolded cross section:
 $\sigma_{t, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.46 \pm 0.18 \text{ (stat)}$ (CDF) $\sigma_{t, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.70 \text{ (stat)}$ (DØ)

Unique opportunity of first measurement of V_{tb} matrix element $|V_{tb}|^2 \approx 1$ in 5%:
 $|V_{tb}|^2 = 0.97^{+0.03}_{-0.04}$ (CDF) $|V_{tb}|^2 = 0.97^{+0.03}_{-0.04}$ (DØ)

Trigger:
One high-energy lepton (Lepton+3b) or missing trans. energy + jets (MET+3b)
Selection: 2 or 3 jets
 ≥ 1 jet with $p_{T, \text{lepton}} > 10 \text{ GeV}$
2 selection or more:
significant MET

Revised Decision Tree Analysis
Bayesian Neural Network Analysis
Matrix Element Analysis

CDF Lepton+3b Combination [14]
Revised Neural Network Analysis 2.1 & 2b

DØ Lepton+3b Combination [12]
Bayesian Neural Network Analysis 2.1 & 2b

CDF MET+3b [15]
Revised Neural Network Analysis 2.1 & 2b

Tevatron Combination [16]
all CDF Lepton+3b, CDF MET+3b, and DØ Lepton+3b Channels

High $p_{T, \text{lepton}}$ Selection:
 $\sigma_{t, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.46 \pm 0.18 \text{ (stat)}$
 $\sigma_{s, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.70 \text{ (stat)}$
 $\sigma_{t, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.46 \pm 0.18 \text{ (stat)}$
 $\sigma_{s, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.70 \text{ (stat)}$
 $\sigma_{t, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.46 \pm 0.18 \text{ (stat)}$
 $\sigma_{s, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10} = 1.70 \text{ (stat)}$

References:
[1] Phys. Rev. Lett. 94, 081801 (2005) [2] Phys. Rev. Lett. 95, 081801 (2005) [3] Phys. Rev. Lett. 95, 081801 (2005) [4] arXiv:0804.2262 [hep-ex] [5] Phys. Rev. Lett. 95, 081801 (2005) [6] arXiv:0804.2262 [hep-ex] [7] Phys. Rev. Lett. 95, 081801 (2005) [8] Phys. Rev. Lett. 95, 081801 (2005) [9] Phys. Rev. Lett. 95, 081801 (2005) [10] Phys. Rev. Lett. 95, 081801 (2005) [11] Phys. Rev. Lett. 95, 081801 (2005) [12] Phys. Rev. Lett. 95, 081801 (2005) [13] Phys. Rev. Lett. 95, 081801 (2005) [14] Phys. Rev. Lett. 95, 081801 (2005) [15] Phys. Rev. Lett. 95, 081801 (2005) [16] Phys. Rev. Lett. 95, 081801 (2005)

PHYSICAL REVIEW D

VOLUME 34, NUMBER 1

1 JULY 1986

Production of heavy quarks from W -gluon fusion

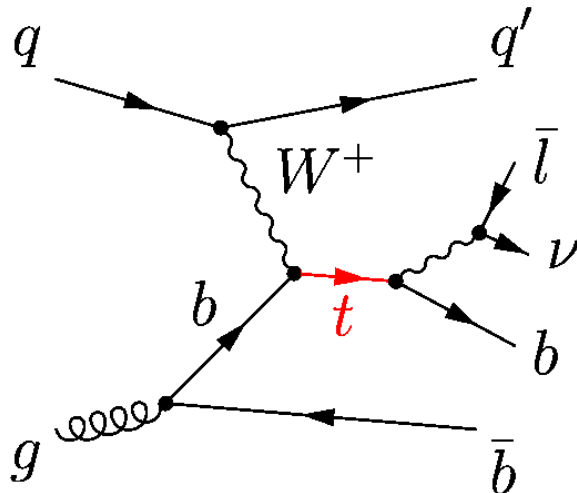
Scott S. D. Willenbrock and Duane A. Dicus

Theory Group and Center for Particle Theory, University of Texas, Austin, Texas 78712

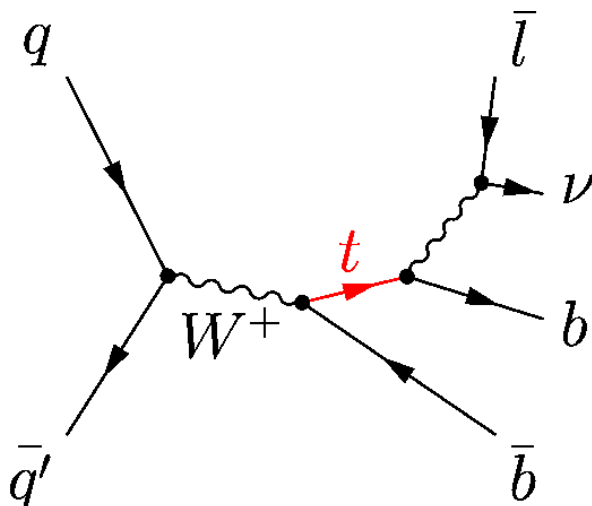
(Received 3 February 1986)

We show that heavy-quark production via W -gluon fusion in high-energy pp and $\bar{p}p$ collisions is an important source of the heavier member of an $SU(2)_c$ doublet of quarks if the mass splitting within the doublet is large. W -gluon fusion exceeds the strong production of heavy quarks for mass splittings greater than 300–350 GeV at $\sqrt{s} = 10$ TeV and 400–450 GeV at $\sqrt{s} = 40$ TeV. An al-

Scott Willenbrock, Duane Dicus, Phys. Rev. **D34**, 155 (1986).



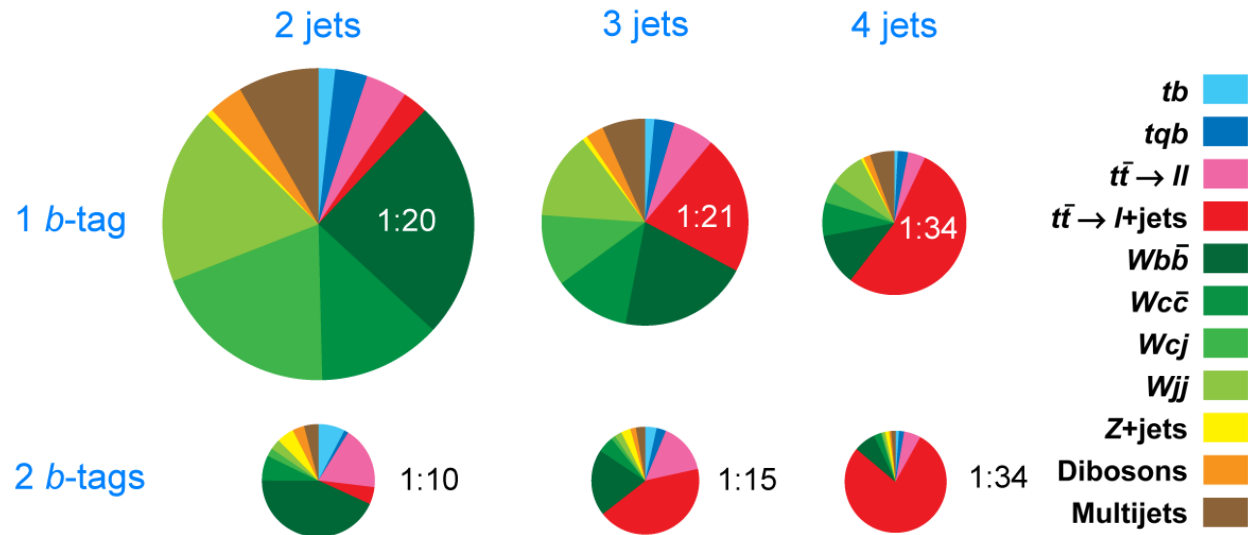
t-channel



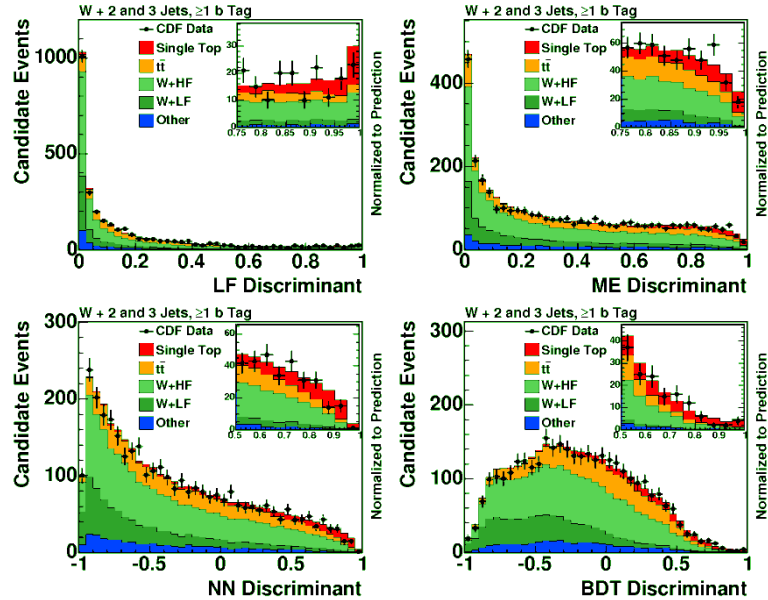
s-channel

- Test of SM, s vs. t sensitive to BSM
- Direct Measurement of $|V_{tb}|^2$
- Same techniques as in WH Searches
- Milestone for WH Searches at the Tevatron
- Test of b quark PDF, top polarization

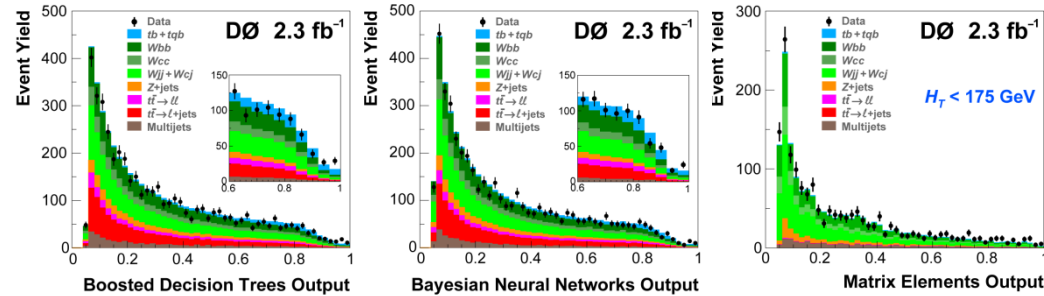
DØ Single Top 2.3 fb⁻¹ Signals and Backgrounds



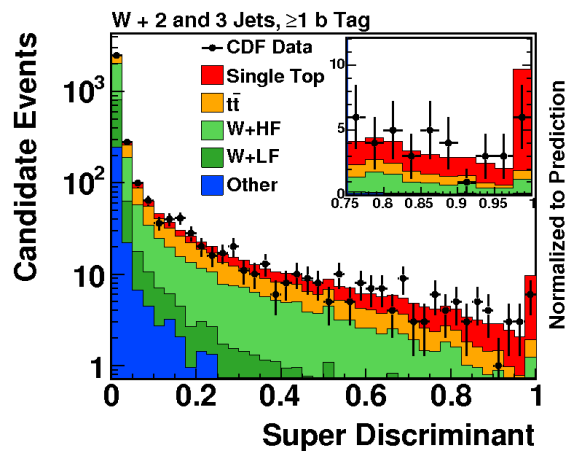
DØ further splits dataset into e, μ and Run IIa, IIb: 24 channels
 CDF splits into (non-)triggered leptons, but no 4 jets: 8 channels
 CDF further uses 3 channels in MET+jets data (with lepton veto)



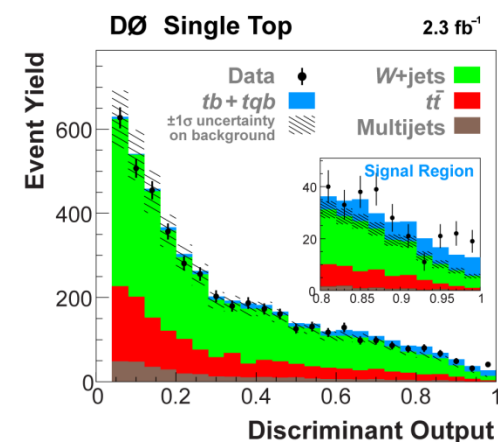
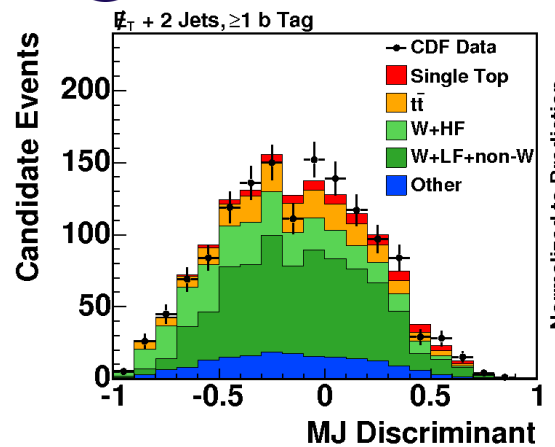
4 parallel analyses

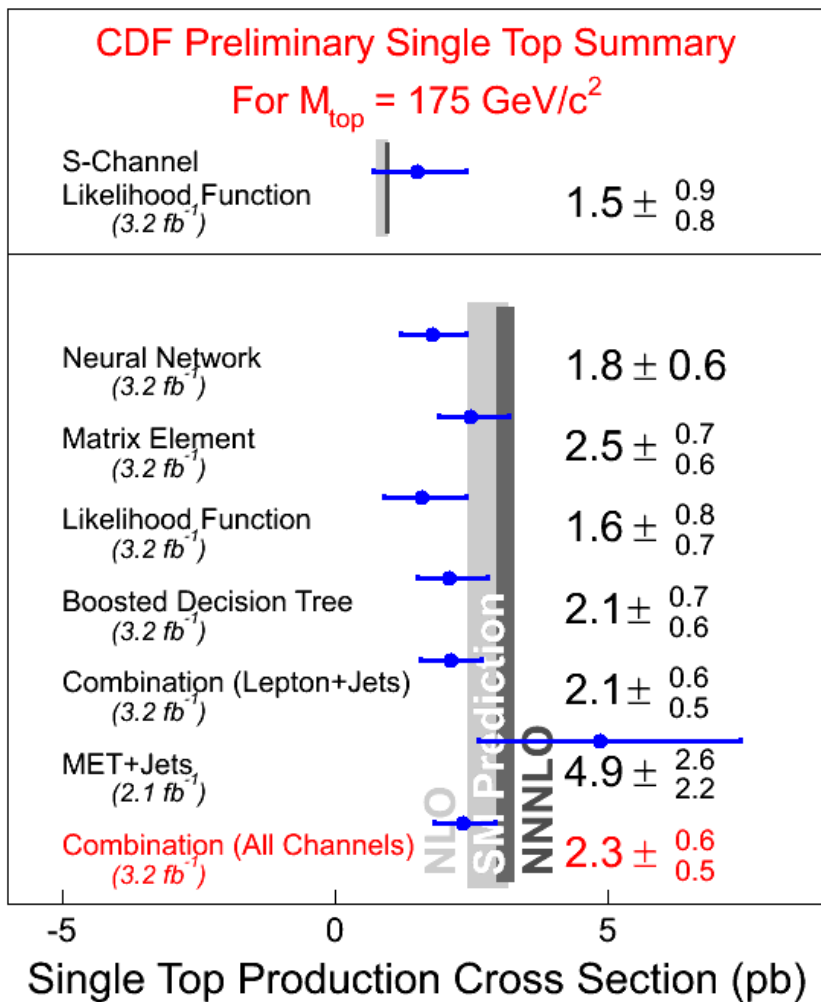


3 parallel analyses



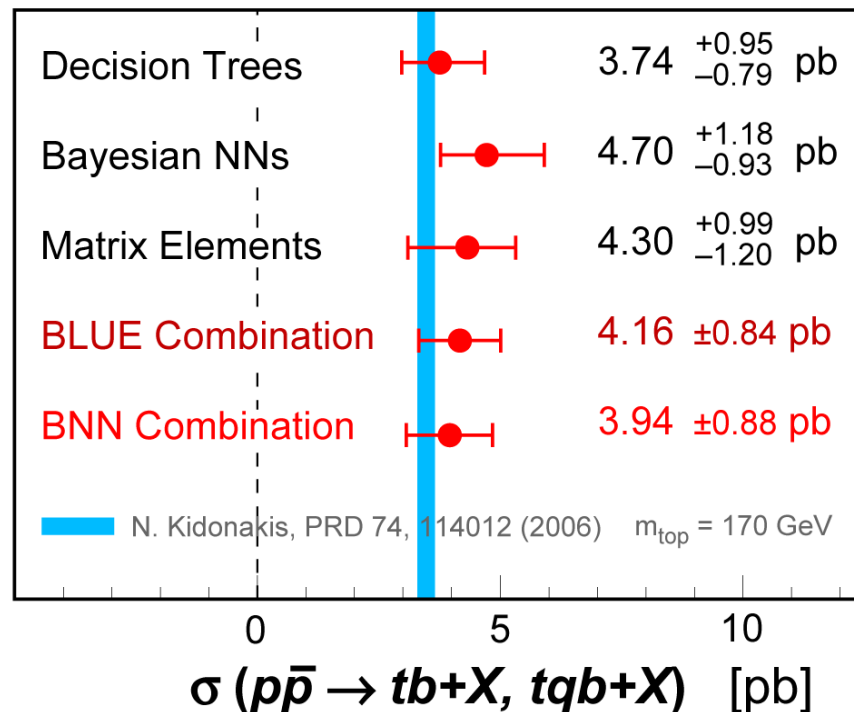
orthogonal analysis



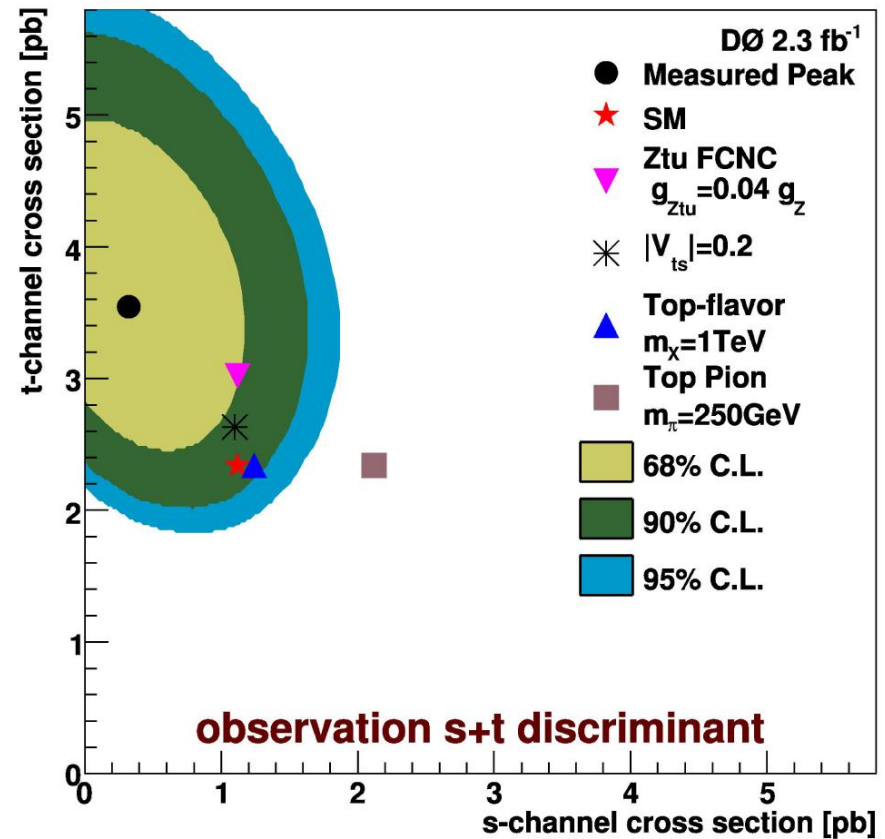
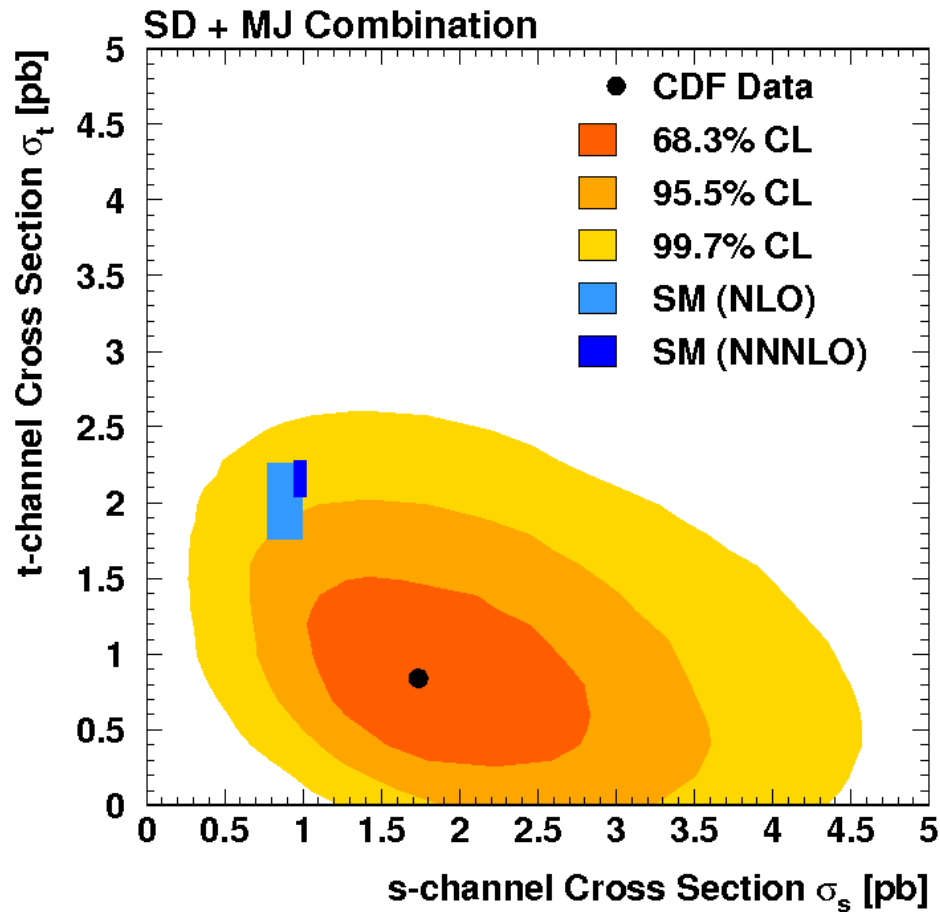


DØ 2.3 fb^{-1}

March 2009

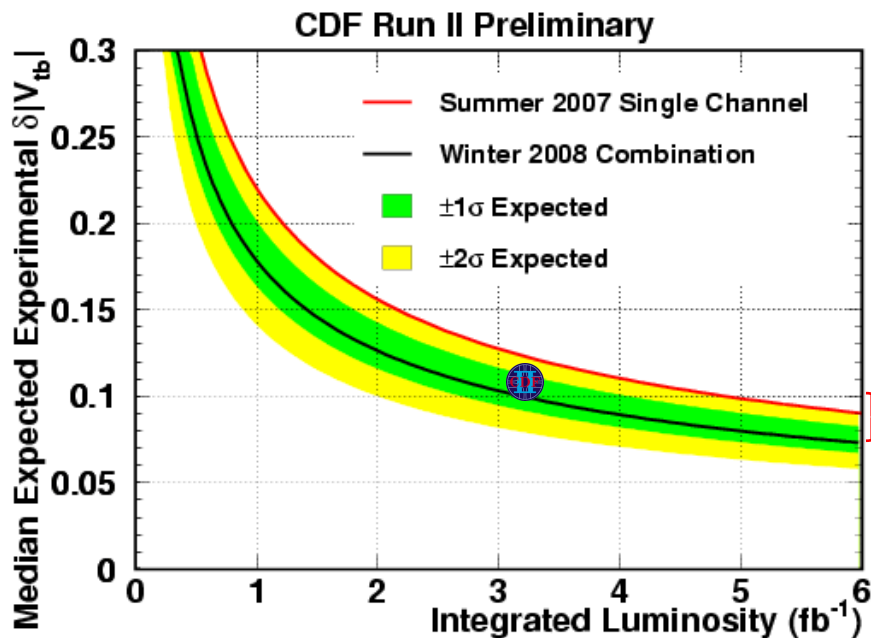


Combination result see poster



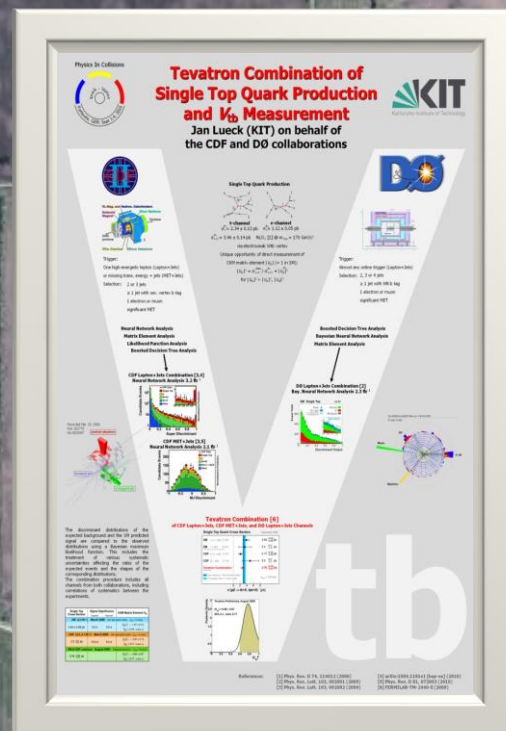
Not part of the combination

CDF and DØ will look at a \sim doubled Data Set for s+t and s vs. t measurements in the coming month



$\sim 25\%$ gain expected per experiment

You are invited to come to my poster to learn ...





Physics in Collaboration

Tevatron Combination of Single Top Quark Production and V_b Measurement
 Jan Luick (KIT) on behalf of the CDF and D0 collaborations

CDF **D0** **KIT**

Single Top Quark Production
 Theory: $q\bar{q} \rightarrow t\bar{b}$
 Experimental: $q\bar{q} \rightarrow t\bar{b}$ at $\sqrt{s} = 1.96$ TeV
 Signature: $t \rightarrow W^+ b$, $\bar{b} \rightarrow \bar{c} + \ell + \nu$
 Cross-section: $\sigma \approx 1.5 \text{ fb}$
 Discovery: 3σ at $\sqrt{s} = 1.96$ TeV

Neutral Bottom Quark Anomalous Magnetic Moment
 Theory: a_b
 Experimental: a_b from $B \rightarrow X \ell \nu$
 Signature: $B \rightarrow X \ell \nu$
 Cross-section: $\sigma \approx 1.5 \text{ fb}$
 Discovery: 3σ at $\sqrt{s} = 1.96$ TeV

Neutral Bottom Quark Anomalous Magnetic Moment
 Theory: a_b
 Experimental: a_b from $B \rightarrow X \ell \nu$
 Signature: $B \rightarrow X \ell \nu$
 Cross-section: $\sigma \approx 1.5 \text{ fb}$
 Discovery: 3σ at $\sqrt{s} = 1.96$ TeV

Tevatron Combination [1]
 CDF, D0, CDF+D0, and D0+Luminosity Channels
 Summary of Results:
 - Single Top Quark Production: $\sigma = 1.5 \pm 0.1 \text{ fb}$
 - Neutral Bottom Quark Anomalous Magnetic Moment: $a_b = 4.2 \pm 0.2$
 - V_b Measurement: $V_b = 0.99 \pm 0.01$

References: [1] Phys. Rev. D, 78, 113002 (2008); [2] Phys. Rev. D, 78, 113003 (2008); [3] Phys. Rev. Lett., 93, 081801 (2004); [4] Phys. Rev. Lett., 93, 081802 (2004); [5] Phys. Rev. Lett., 93, 081803 (2004)

... why the Tevatron will remain No1 for another year