Top Summary and Plans

Cecilia Gerber, *University of Illinois at Chicago*

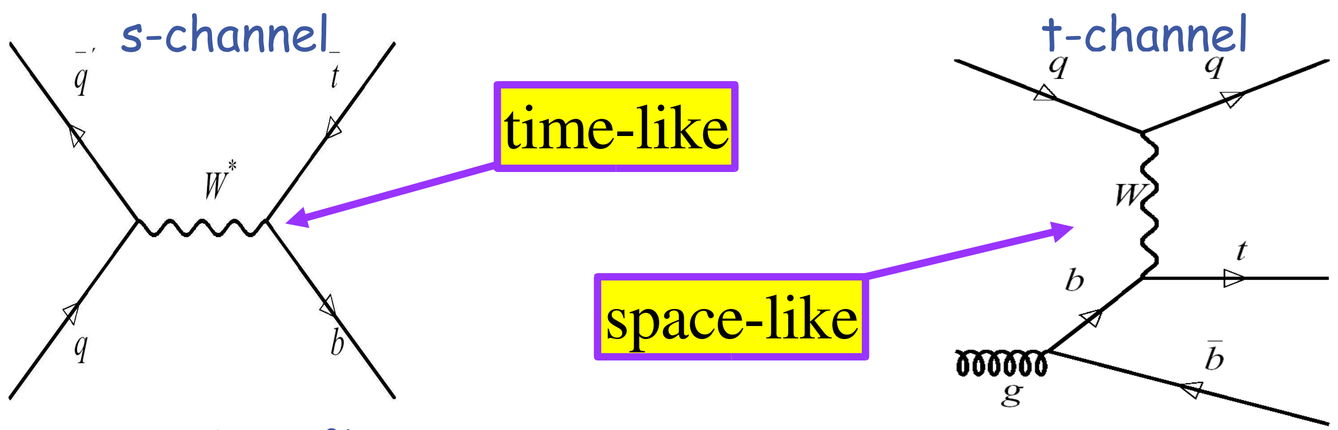
Reinhard Schwienhorst, *Michigan State University*

Summary

- Focus on Single Top
  - Single Top Production (Steve Ellis)
  - Single Top at the Tevatron (Gordon Watts)
  - Discussion

Tevatron Experience might be relevant to Higgs searches during the early days of the LHC

Electroweak top production at the Tevatron



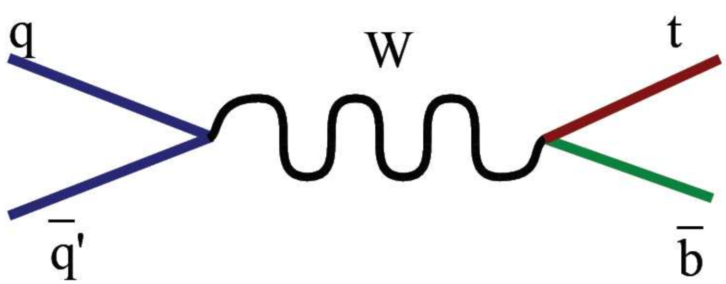
σ_{NLO} = 0.88pb ± 8%

σ_{NLO} = 1.98pb ± 11%

- Leads to measurement of V_{tb}
- Background to other searches (Higgs, etc.)
- Also: Potential for new physics discovery
  - New bosons, extra quark generations or couplings

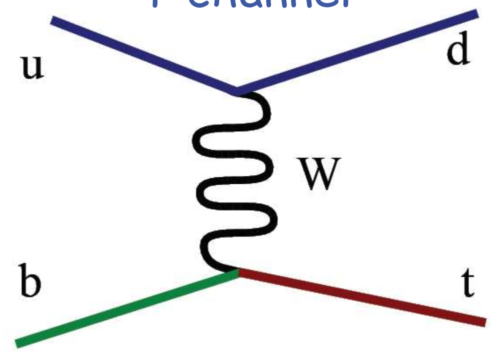
Experimental status of the search for single top production at the Tevatron

s-channel



σ_{NLO} = 0.88pb ± 8%

t-channel



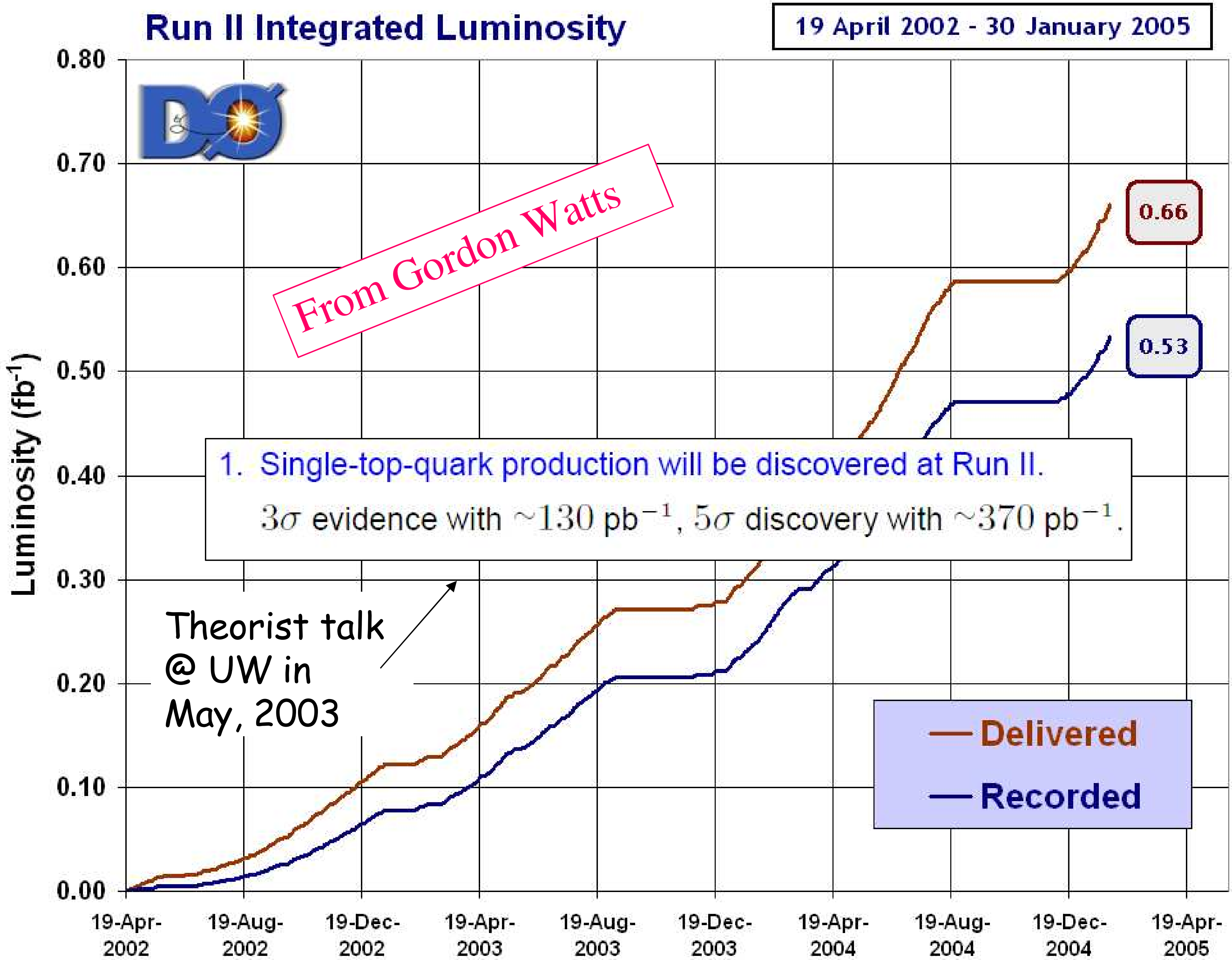
σ_{NLO} = 1.98pb ± 11%

Signature: Lepton + Missing E_T + Jets ➡ Harder Signal To Find than $t\bar{t}$

DØ and CDF have set limits on single top production using ~ 160pb^{-1} of Run II data.

95% C.L. limits Observed (Expected)

Channel	CDF (pb)	DØ (pb)
s+t	<17.8 (13.6)	<23 (20)
t	<10.1 (11.2)	<25 (23)
s	<13.6 (12.1)	<19 (16)



Run II Integrated Luminosity
19 April 2002 - 30 January 2005
Luminosity (fb^{-1})
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
19-Apr-2002
19-Aug-2002
19-Dec-2002
19-Apr-2003
19-Aug-2003
19-Dec-2003
19-Apr-2004
19-Aug-2004
19-Dec-2004
19-Apr-2005
0.66
0.53
From Gordon Watts
1. Single-top-quark production will be discovered at Run II.
3σ evidence with ~ 130 pb^{-1}, 5σ discovery with ~ 370 pb^{-1}.
Theorist talk @ UW in May, 2003
Delivered
Recorded

From Fermilab TeV4LHC summary talk

Experimental Reality

- Current analyses would need several fb^{-1} for observation
  - Particle ID, b-tagging not as efficient as predicted
  - Large systematic uncertainties from background modelling and detector understanding
  - Analyses methods need optimization to make and observation soon
- Work in progress
  - Ever improving particle ID and understanding of detector effects
  - Accurate models for signal and background benefits from recent NLO calculations
  - Working on multivariate analysis techniques (NN, Matrix Element, ...)
- Need to work with theorists to identify variables that give good signal-background separation – not just at parton level, but for experimental observables.

More Realistic Phenomenology

Define Event Samples for Counting E...riment

From Steve Ellis hep-ph/0412223

Studies done with Madgraph + Pythia + PGS Detector S...
normalized to NLO (including choice of μ) where possible;
For 3 fb^{-1}, sum over $\mu^{\pm}$ and $e^{\pm}$ (top and anti-top)

PGS jets, R_{cone} =0.4; ΔR(lepton,jet) > 0.4

Advanced Cuts: "m_{top}" = invariant mass of (blν)

$H_T = P_{Tlepton}$+MET+ $\Sigma_{all\ jets}$ (jet P_T)
(all jets P_T > 20 GeV, |η| < 3.5)

b-Tags: "real b" ~ 0.5 tanh(P_T/36 GeV) [P_T = jet P_T]

"real c" ~ 0.15 tanh(PT/42 GeV)

mistag ~ 0.01 tanh(PT/80 GeV)

More realistic b-tagging

Result for 3 sets of cuts

From Steve Ellis

Events in 3 fb^{-1}

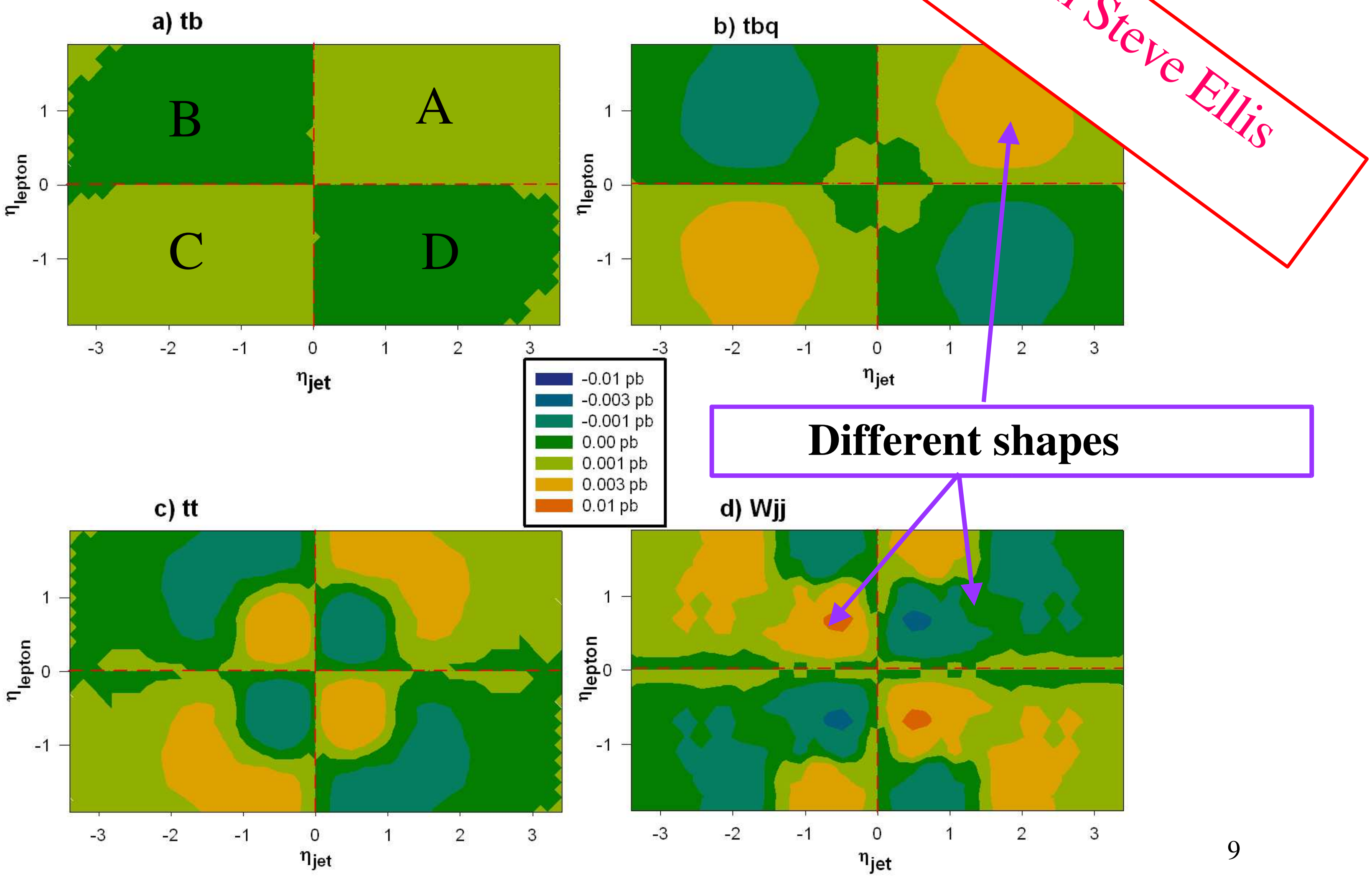
Channels	Basic	Intermed	Hard	Sy
t-channel	298	67	30	>10%
s-channel	145	27	13	>10%
W+jj	6816	550	152	>10%
$t\bar{t}$	2623	140	57	>10%
Sig/Bkg	1/21	1/7	1/5	

Conclude that Life is Hard!!!

Simple cuts are not enough, also need to use shapes

Shape variables using $p\bar{p}$ CP symmetry

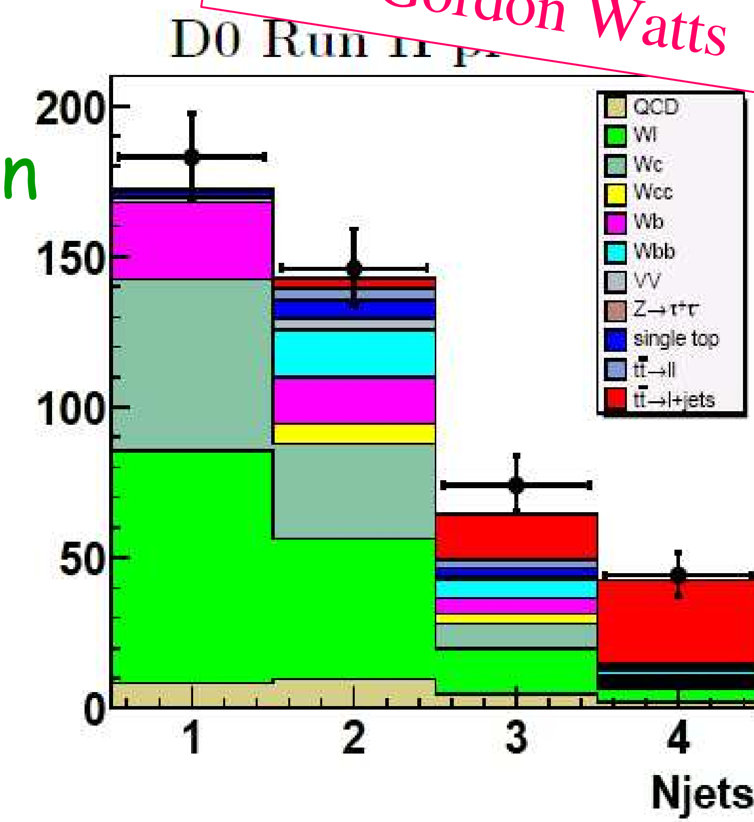
$$F_+\left(\hat{\eta}_l, \hat{\eta}_j\right) = \sigma_A + \sigma_C - \sigma_B - \sigma_D$$



The W+jets Problem

- Might get sufficient S-B separation in 3fb^{-1}
- But need to understand background systematics
  - W+jets flavor composition
    - Different flavors can have different shapes
    - Understand both b and c contributions

From Gordon Watts



Summary & Plans

- Important to have realistic phenomenology
- Important to understand W+jets contribution
  - Experiment: study flavor fractions in data
    - Project: flavor fraction in b-tagged sample using jet mass
  - Phenomenology: study shape variables for different flavors
    - Compare LO to NLO

Thanks to all contributors!