

# W' Search in the single top quark channel

Reinhard Schwienhorst  
Michigan State University

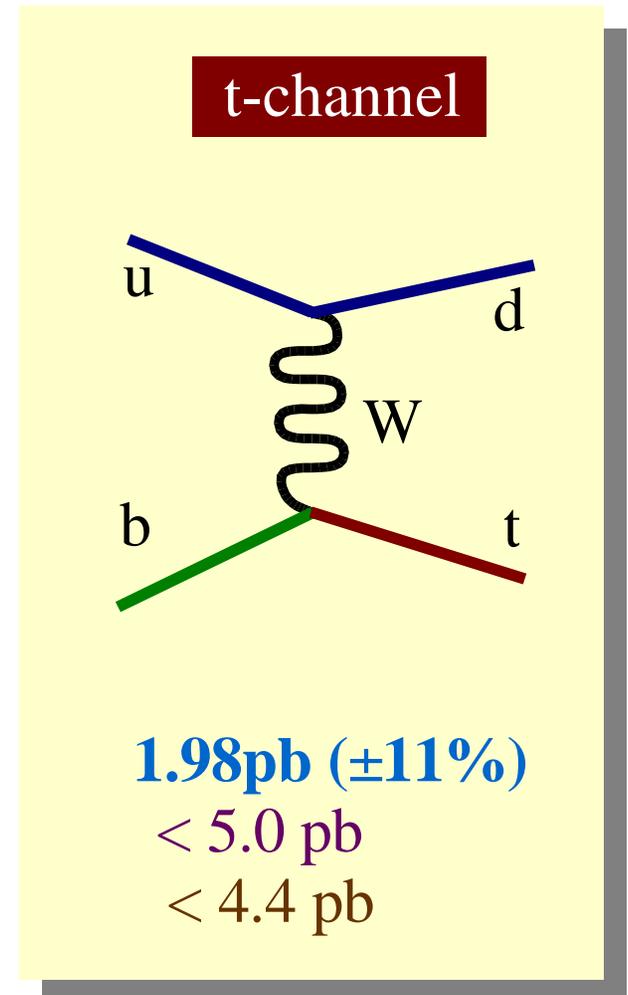
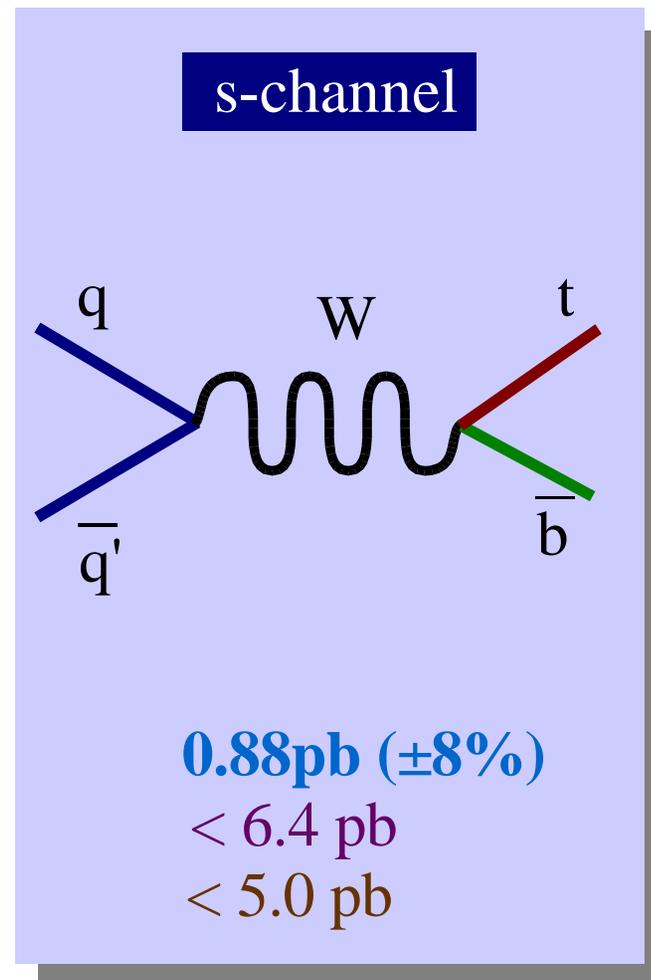
Top Group Meeting, 2/24/2005

# Outline

- Single top status
- $W'$  introduction
- Analysis procedure
- Outlook/Conclusions

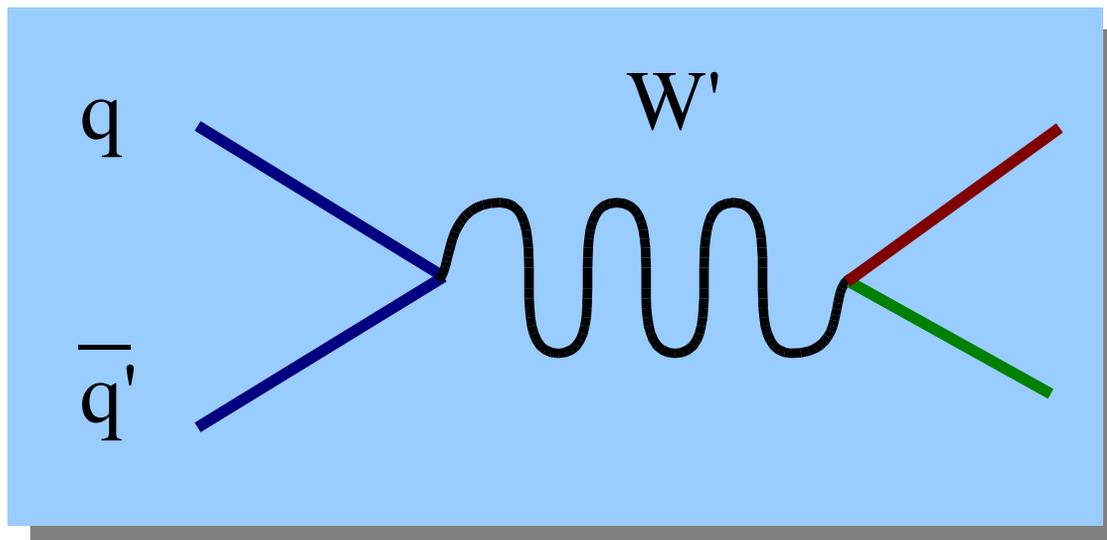
# Single top status

- Neural Network analysis with  $230 \text{ pb}^{-1}$  published
- Likelihood-based analysis with  $360 \text{ pb}^{-1}$  at conferences



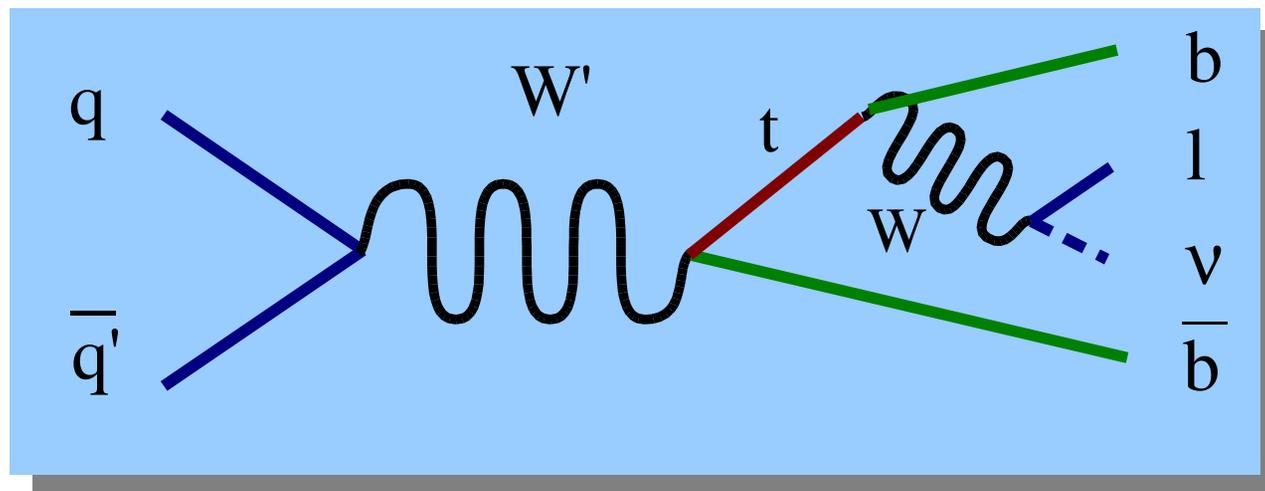
# Introduction

- Many extensions of the SM involve heavy gauge bosons
  - Typically called  $W'$  and  $Z'$
  - From larger, extra gauge symmetry groups
  - Could interact differently with leptons and quarks
- Current limits:  $M(W' \rightarrow \text{anything}) > 786 \text{ GeV}$

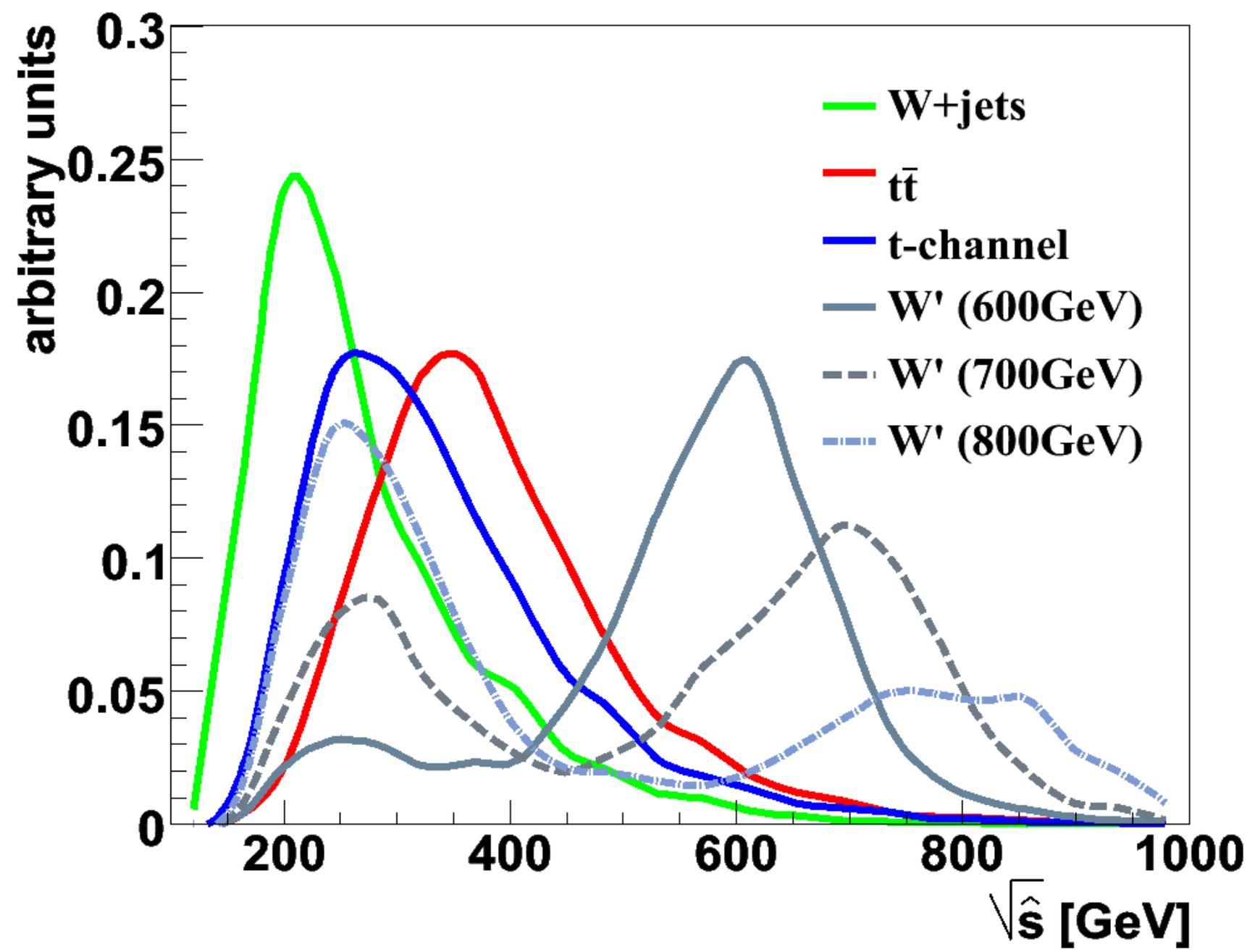


# W' in the single top quark channel

- Single top quark production is the ideal place to search for hadronic decays of a W'
  - W' searches in the light quark decay channels are swamped by multijet background
  - Current limits:  $M(W' \rightarrow qq') > 800 \text{ GeV}$
- W' model used here:  $W' \rightarrow tb$  with SM-like couplings
  - Include interference with SM W boson in event generation



# W' Signal final state invariant mass

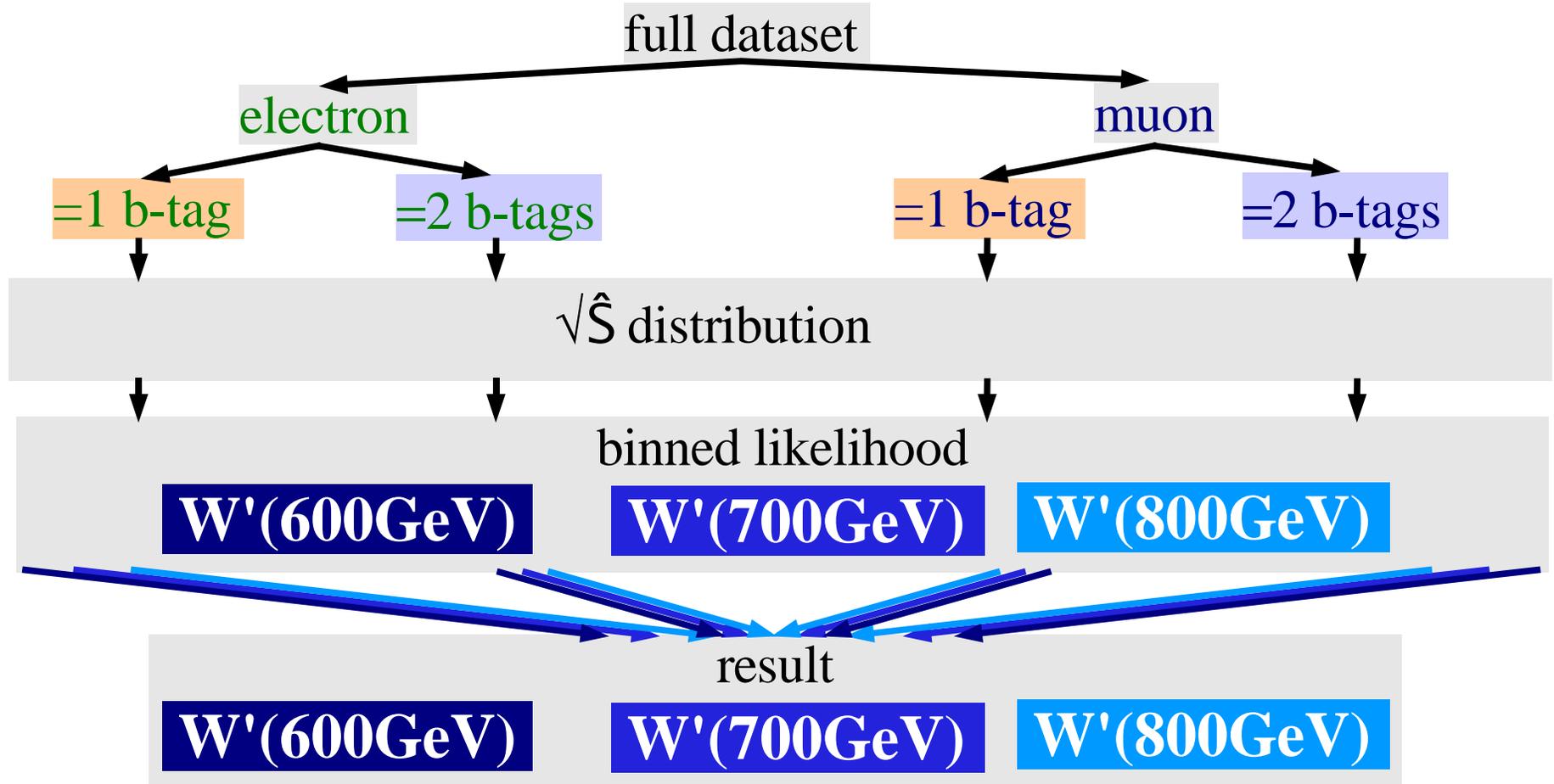


# Analysis procedure

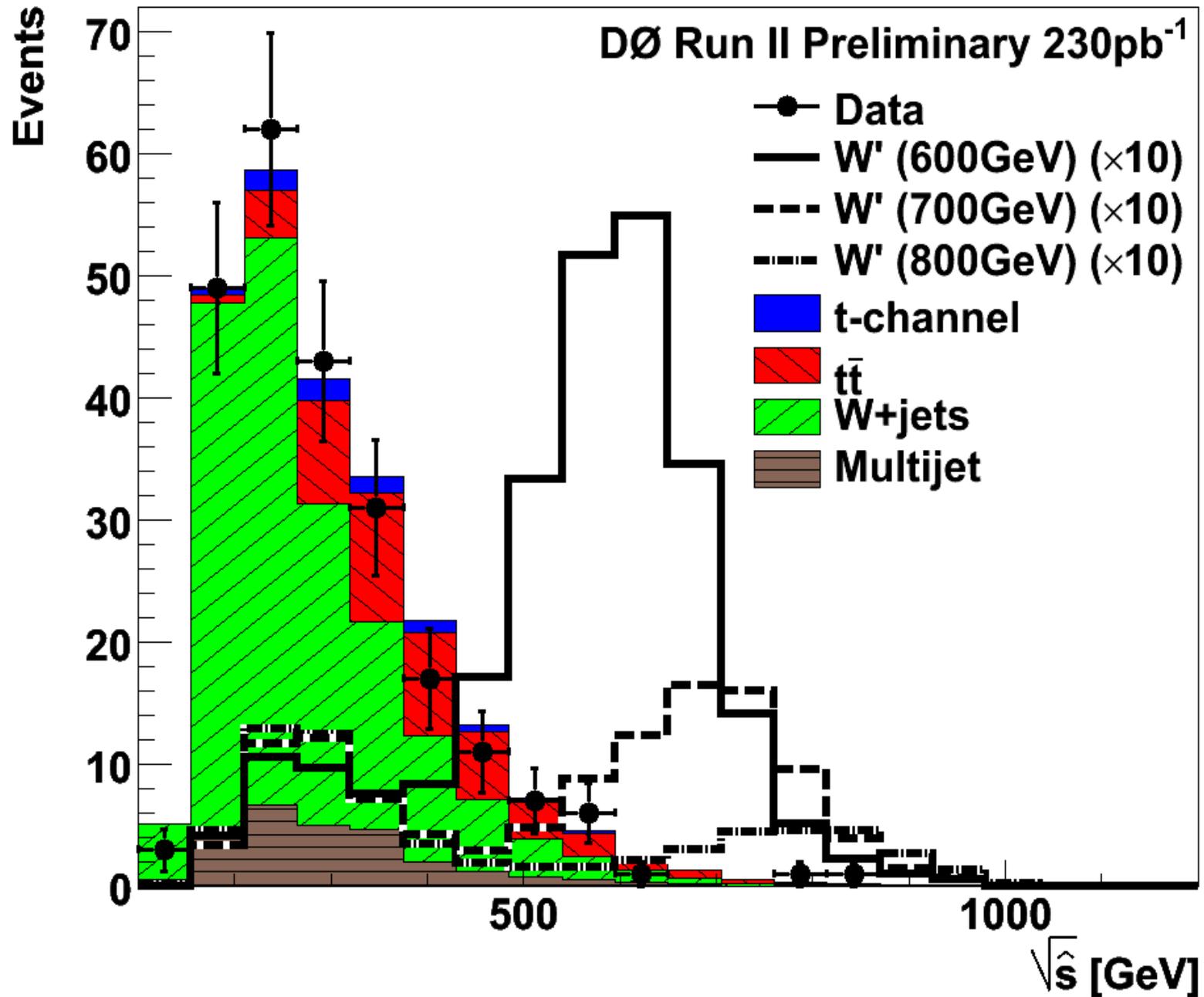
- Follow procedure used in  $D\bar{0}$  single top publication
  - 230  $\text{pb}^{-1}$  dataset
  - Stradivarius top\_analyze samples
  - Same background estimation methods, scale factors, efficiencies, smearing, ...
- Apply s-channel single top selection cuts
  - Lepton  $p_T > 15\text{GeV}$ , MET  $> 15\text{GeV}$ , jet  $p_T > 15\text{GeV}$
  - Tighter jet selection:  $2 \leq n_{\text{jets}} \leq 3$ 
    - Remove top pair background
- Then form binned likelihood using invariant mass distribution
  - No NN, DT, LH, ...



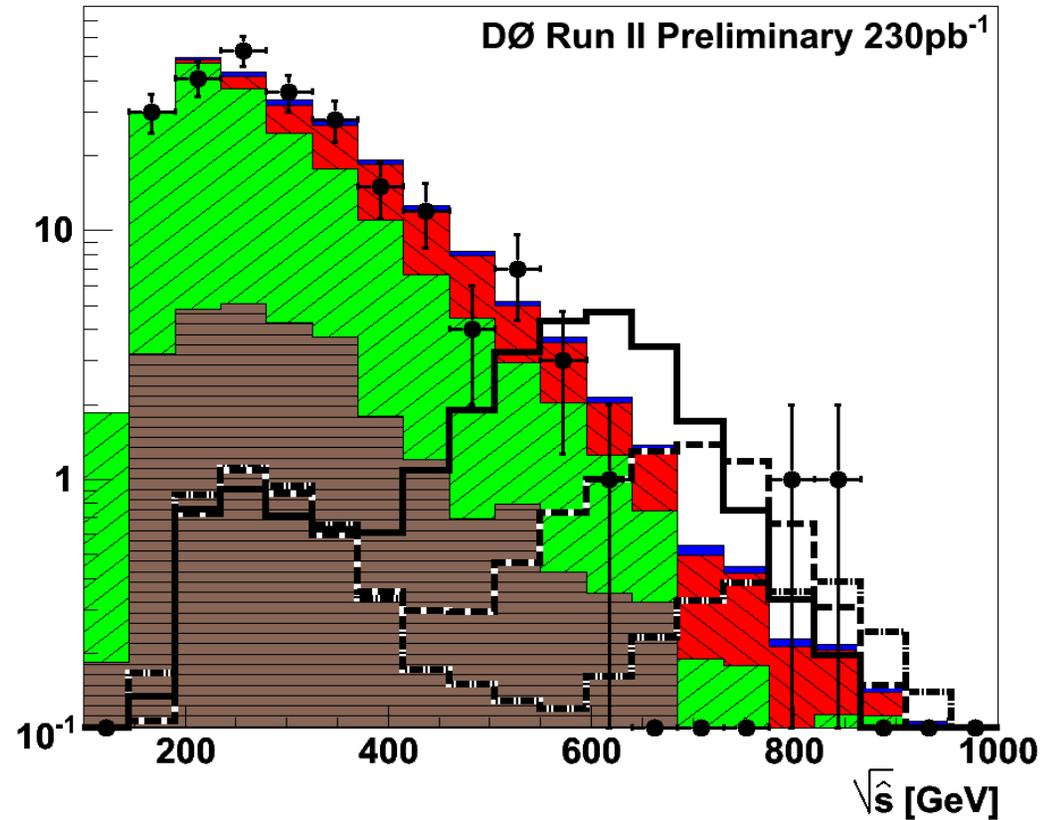
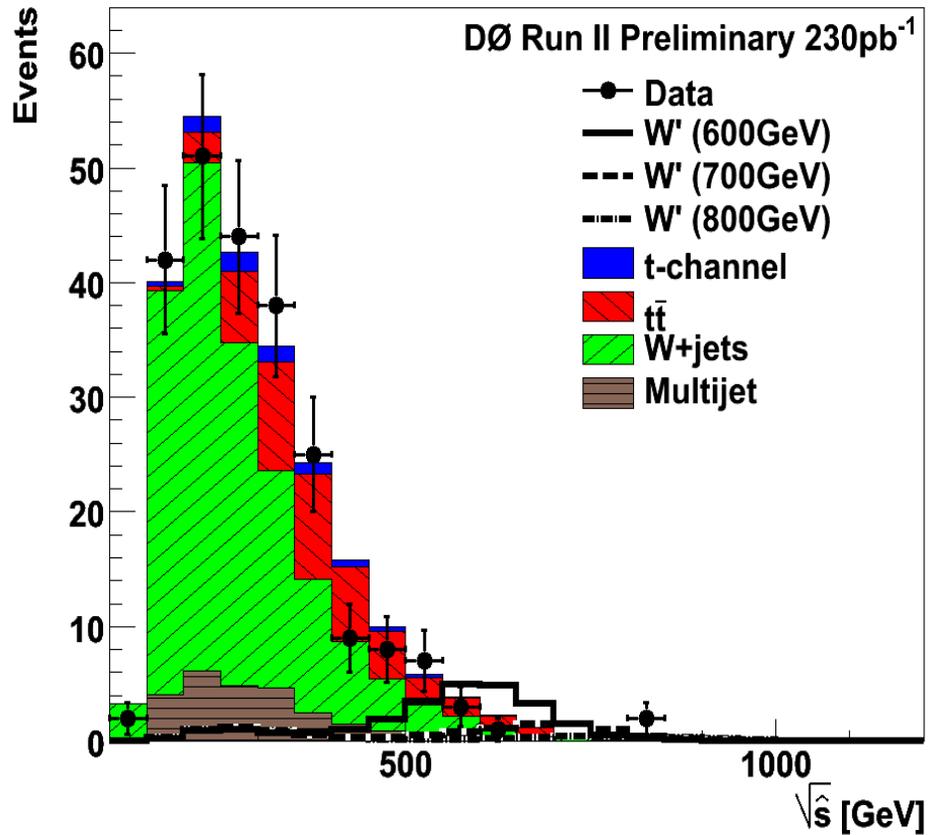
# Analysis Strategy



# Final state invariant mass



# Data-Background comparison



# Limit Setting Procedure

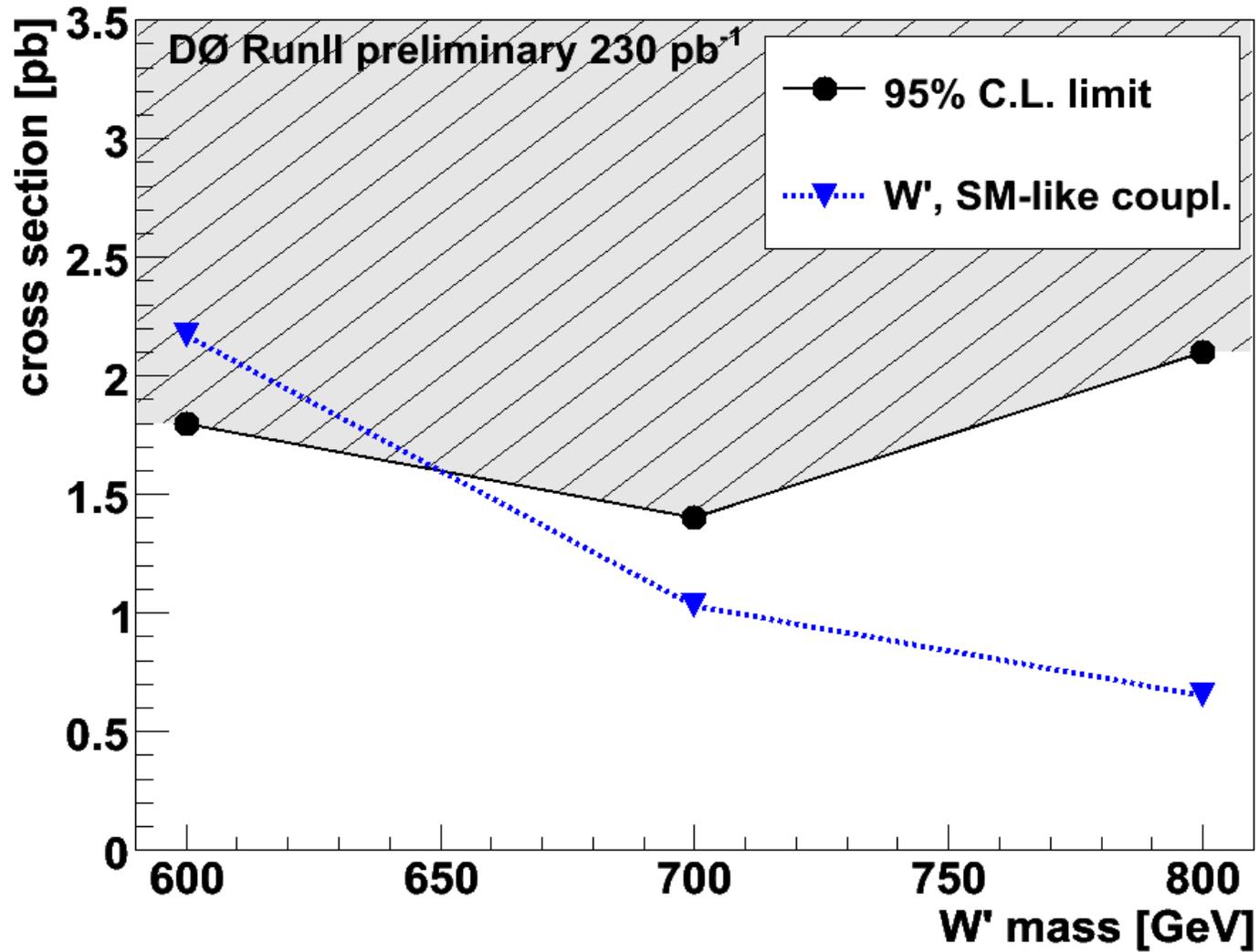
- Use  $\sqrt{\hat{S}}$  distribution to set limits
  - In window  $400\text{GeV} \leq \sqrt{\hat{S}} \leq 1000\text{GeV}$
- Including all systematic uncertainties

	signal	backgrounds
• b-tag modeling	4 – 16%	5 – 20%
• Jet energy calibration	1 – 2%	15 – 30%
• Others (trigger, ID, ...)	1 – 5%	1 – 5%

- Set limits separately for 600 GeV, 700 GeV, 800GeV

	$\sigma_{600 \text{ GeV}}$	$\sigma_{700 \text{ GeV}}$	$\sigma_{800 \text{ GeV}}$
Expected limit:	< 1.8 pb	< 1.6 pb	< 2.1 pb
Measured limit:	< <b>1.7 pb</b>	< <b>1.4 pb</b>	< 2.1 pb

# Result



# Conclusions/Outlook

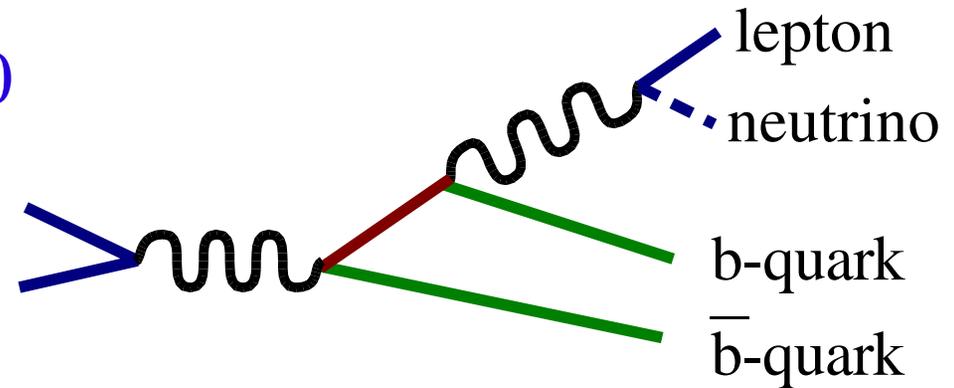
- First search for  $W'$  boson production in top quark decay channel
- No evidence for a  $W'$  boson in  $230\text{pb}^{-1}$  of data
- Mass limit:  $M(W') > 650 \text{ GeV}$ 
  - For a  $W'$  boson with SM-like coupling to SM fermions

# Additional Material



# Event Selection

- Trigger:
  - Electron +  $\geq 1$  jets, muon +  $\geq 1$  jets
- Lepton:
  - 1 electron:  $p_T > 15\text{GeV}$ ,  $|\eta^{\text{det}}| < 1.1$
  - 1 muon:  $p_T > 15\text{GeV}$ ,  $|\eta^{\text{det}}| < 2.0$
- Neutrino:  $E_T > 15\text{GeV}$
- Jets:
  - $p_T > 15\text{GeV}$ ,  $|\eta^{\text{det}}| < 3.4$ ,  $p_T(\text{jet } 1) > 25\text{GeV}$   
 $|\eta^{\text{det}}(\text{jet } 1)| < 2.5$
  - $2 \leq n_{\text{jets}} \leq 3$
  - $\geq 1$  b-tagged jet
- Reject mis-reconstructed events



# Background Modeling

- Based on data as much as possible
- W/Z+jets production
  - Estimated from MC/data
    - Distributions from MC
    - Normalization from pre-tagged sample
    - Flavor fractions from NLO
- Multijet events (misidentified lepton)
  - Estimated from data
- Top pair production
  - Estimated from MC
- Diboson (WZ, WW)
  - Estimated from MC

