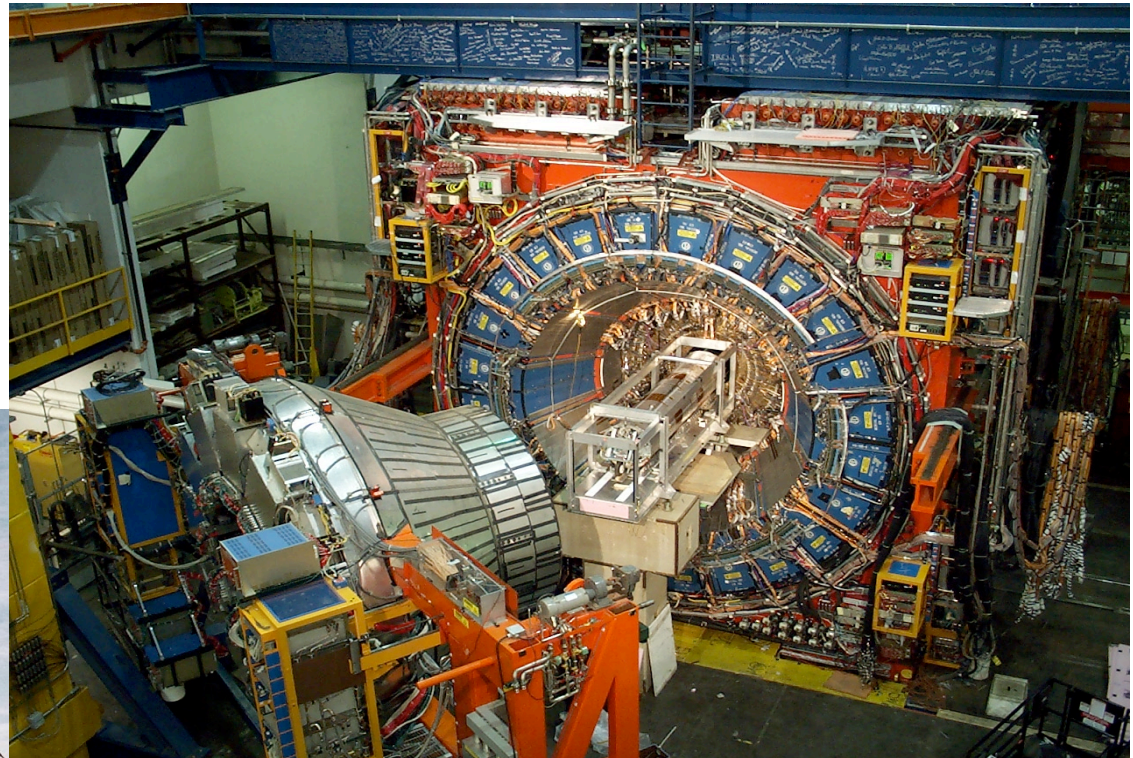


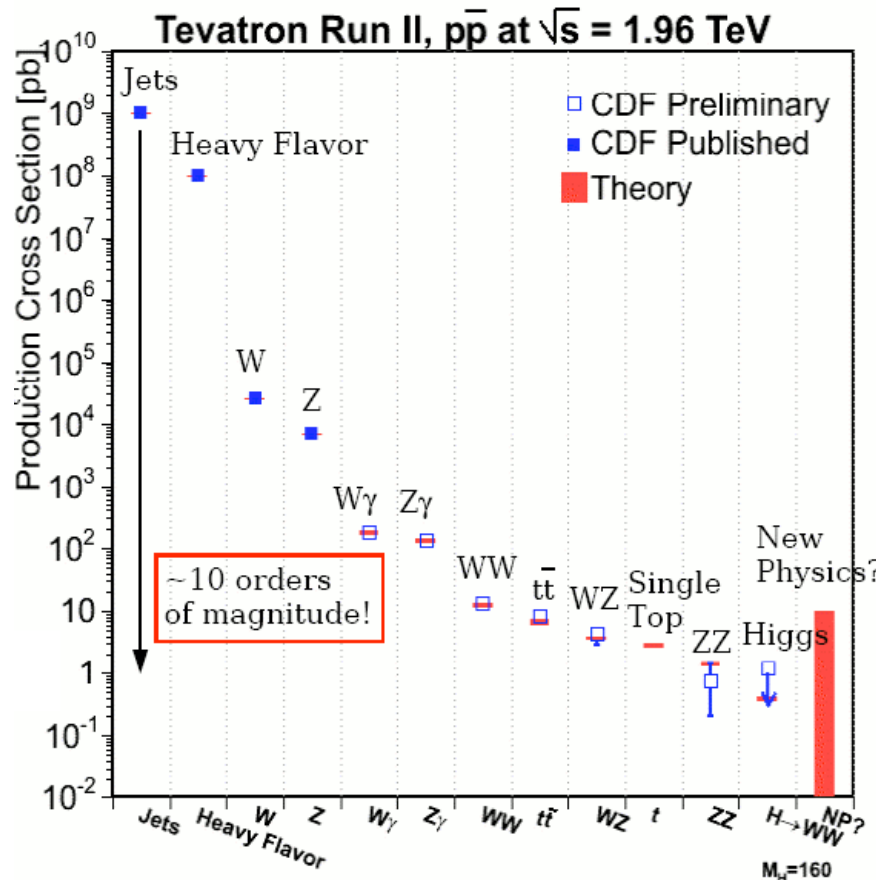
New CDF Results: a swiss perspective



Sofia Vallecorsa
University of Geneva
CHIPP Plenary Meeting - October 15-16, 2007

Overview

45 publications in calendar 2006!
 30 (and counting) in 2007!
 >50 new results since April 07!

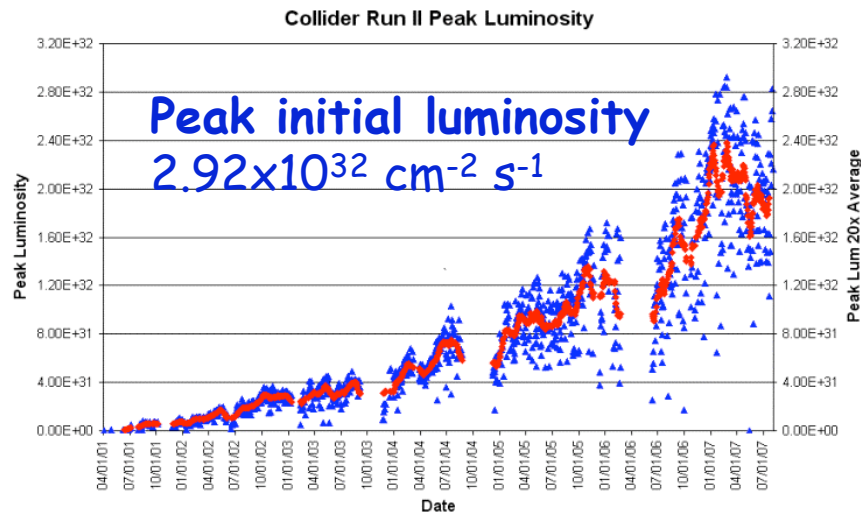


These results cover the full spectrum of CDF physics capabilities:

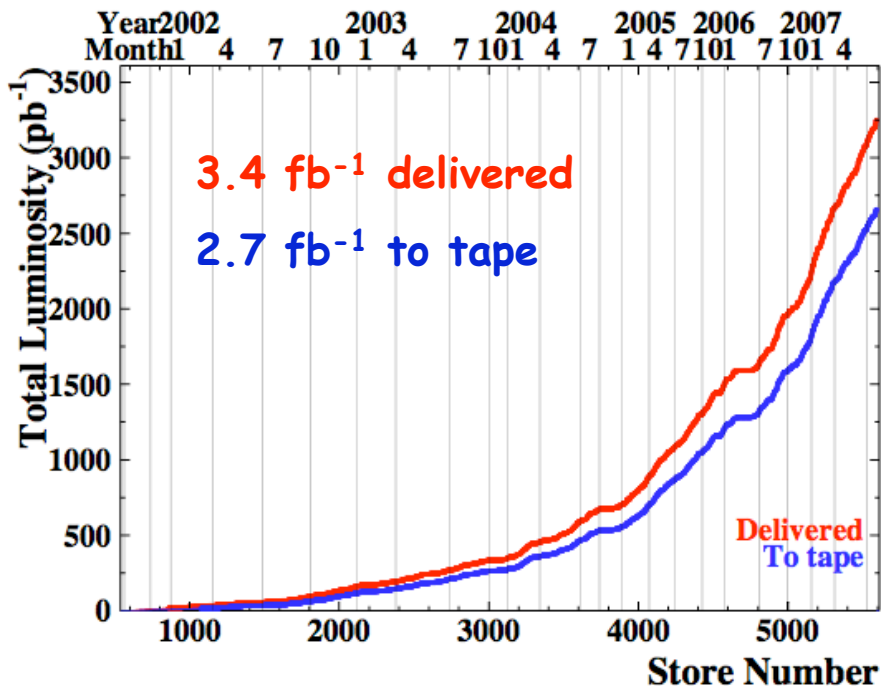
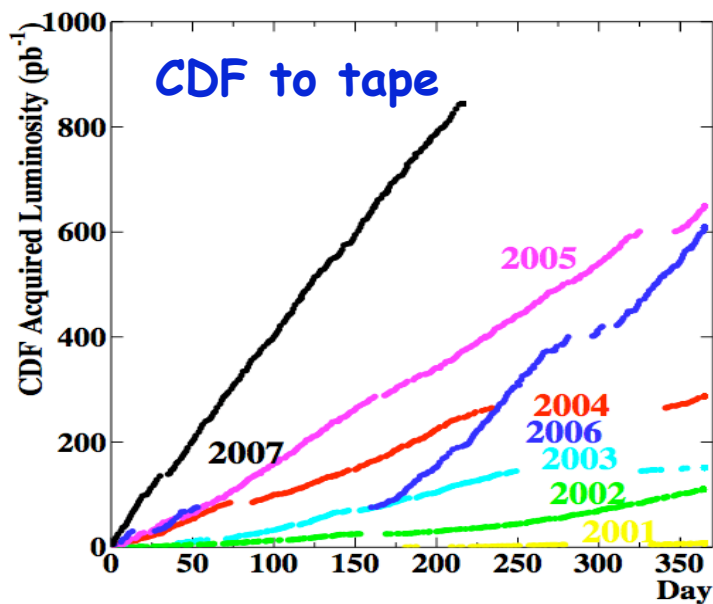
- QCD/Jets
- Heavy flavour
- Electroweak
- Top
- Higgs
- New Physics searches

This talk will show only a few recent results!

CDF Run II: luminosity

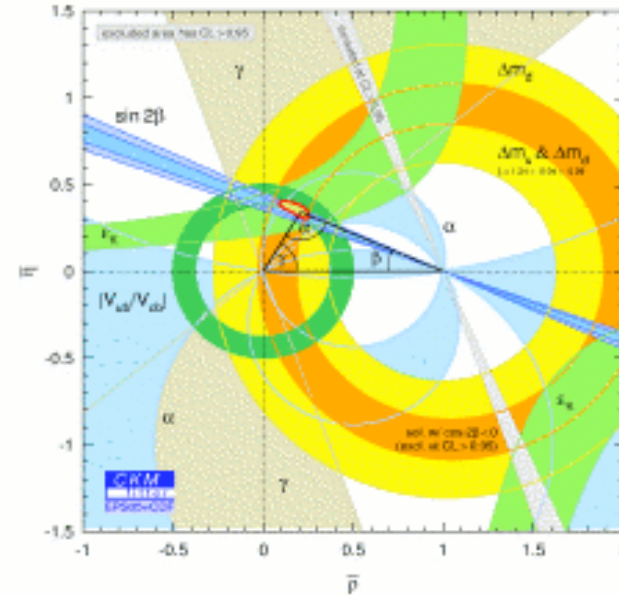


- Increased luminosity entails increased analysis complication
- key to increased integrated luminosity is lifetime and reliability
- expect 6-7 fb^{-1} by 2009



Heavy flavour physics

- **B_s oscillation**
- B baryons Ξ_b
- Lifetime measurements:
 - B^+ , B^0 , B_s and Λ_B (1fb^{-1})
 - $B_s \rightarrow KK$ lifetime (DPNC analysis)
- **$\Delta\Gamma_s$**
- D^0 mixing
- Rare decay searches:
 - $B \rightarrow hh$
 - $B^+ \rightarrow \mu^+ \mu^- K^+$, $B^0 \rightarrow \mu^+ \mu^- K^*$, $B_s \rightarrow \mu^+ \mu^- \phi$ (1fb^{-1})



Bs oscillation

After (3 σ) evidence CDF presented **observation** (>5 σ)

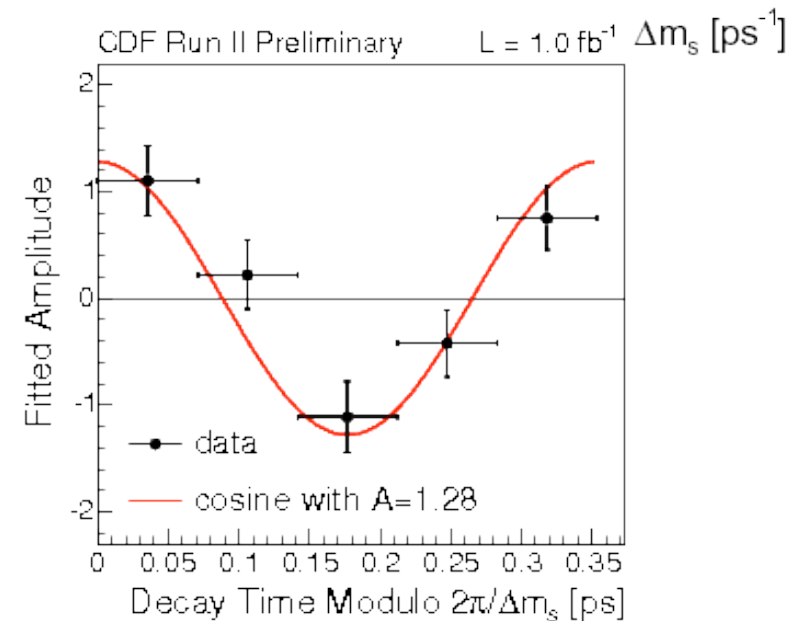
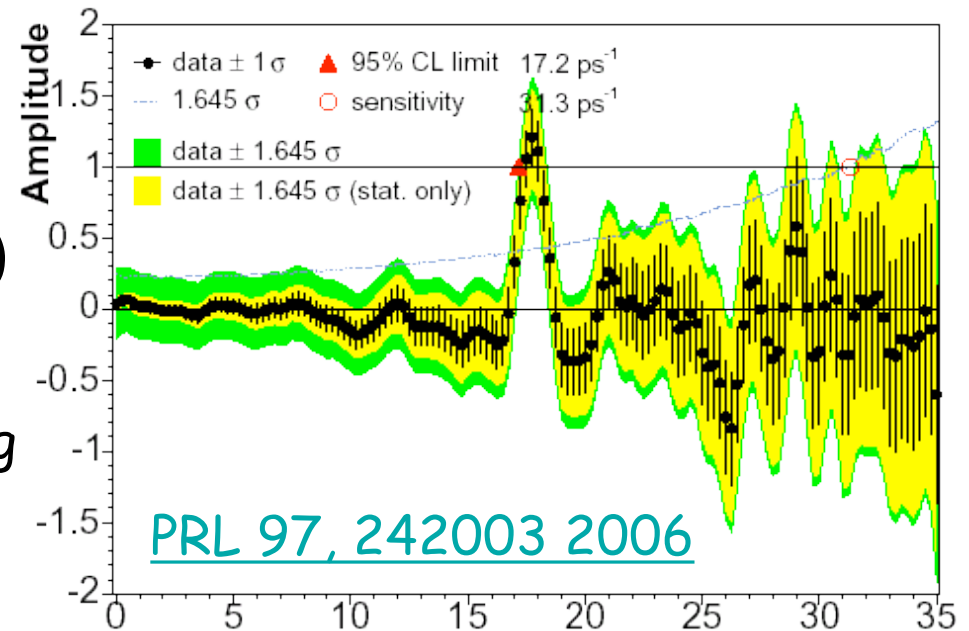
- Same dataset (1fb⁻¹)
- Use PiD and NN to improve tagging
-> x2.5 increase in stat. size

$$P_s(t, \xi, \sigma_t) \propto \frac{1 + \xi AD \cos(\Delta m t)}{1 + |\xi|} \frac{1}{\tau} e^{-t/\tau}$$

- Fit **amplitude** and fix **frequency**
- Scan through frequencies
- Fourier analysis has a max at true oscillation frequency
- Unbinned max likelihood fit:

$$\Delta m_s = 17.77 \pm 0.10 \text{ (stat)} \pm 0.07 \text{ (syst)} \text{ ps}^{-1}$$

$$|V_{td}/V_{ts}| = 0.2060 \pm 0.0007 \text{ (ex)}^{+0.0081}_{-0.0060} \text{ (the)}$$



B_s lifetime difference

Large $\Delta\Gamma_s = \Gamma_L - \Gamma_H \rightarrow$ sensitivity to mixing induced CP-violating phase ϕ_s

- Standard Model: $\Delta\Gamma_s \sim 0.096 \text{ ps}^{-1}$, $\phi_s \sim 0$
- Large $|\phi_s| \rightarrow$ new physics!

Separation of B_{sL} (CP even) and B_{sH} (CP odd) by angular analysis on $B_s \rightarrow J/\psi \phi$
 \rightarrow Mass, angle and lifetime fit

Assuming no CP violation:

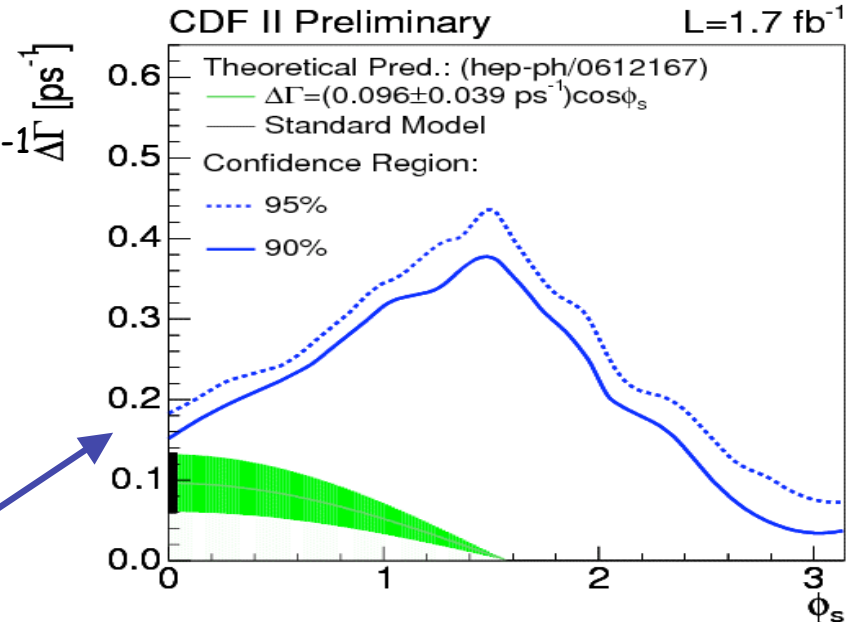
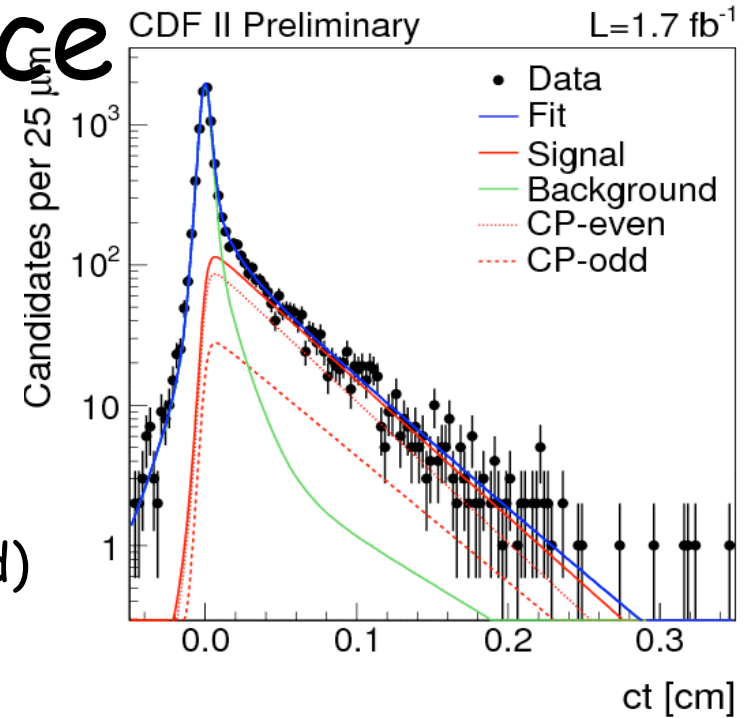
$$\Delta\Gamma_s = 0.076_{-0.063}^{+0.059}(\text{stat}) \pm 0.006(\text{syst}) \text{ ps}^{-1}$$

$$c\tau = 456 \pm 13(\text{stat}) \pm 7(\text{syst}) \mu\text{m}$$

$\Delta\Gamma_s$ agrees well with SM and D0 result

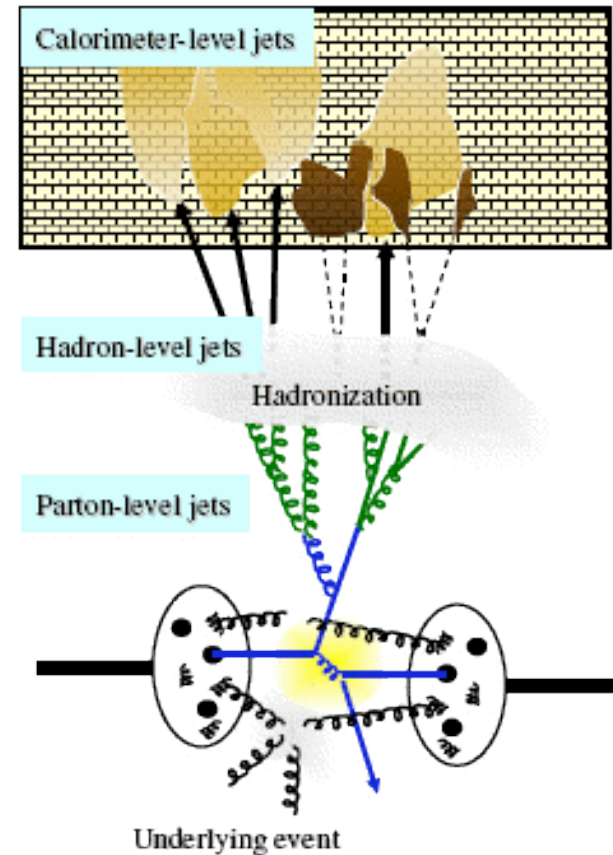
Allowing CP violation:

- Bias for $\Delta\Gamma_s$ and ϕ_s observed in toy MC
- Quote p-value and confidence region



QCD

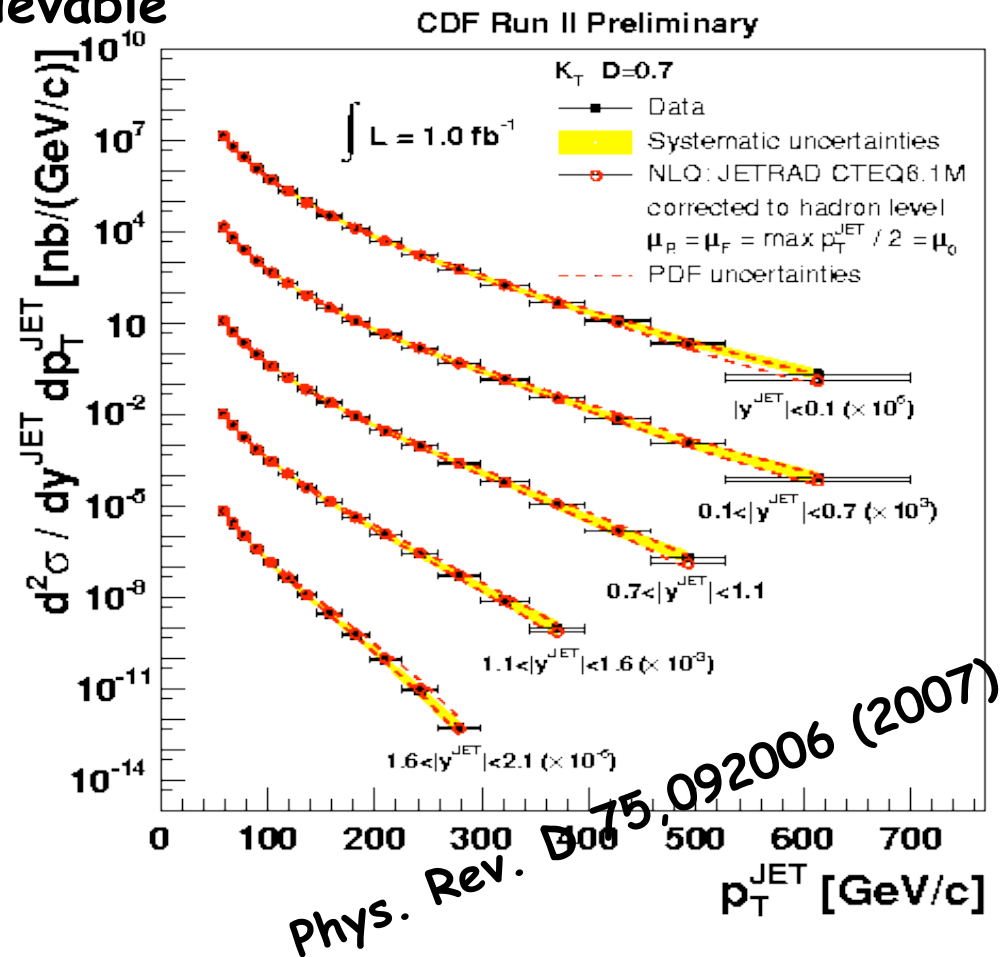
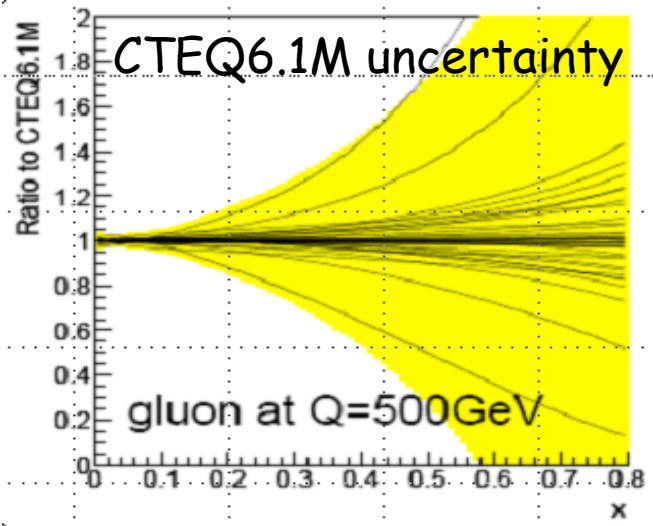
- Inclusive jet production
- Di-jet production
- Z/W+jets cross sections
- Inclusive b-jet cross section
(DPNC analysis)
- b-bbar dijet production
(DPNC analysis)
- Z/ γ + b-jets
(DPNC analysis)
- W + b-jets
- W + c-jets
- Diffractive di-jet production
- b-jet shapes



Inclusive jet cross section

Jets are a key probe: Fundamental in measuring top mass, search for new physics, test of the SM..

- Highest q^2 scale currently achievable
 - Wide p_T range
 - 5 rapidity regions:
 - sensitivity to pdf over a broad kinematic range
 - measurement at large x
- > **constraints gluon pdfs**



b jets at the Tevatron

THE STUDY OF b PRODUCTION PROPERTIES IS AN IMPORTANT TEST TO pQCD

$$\frac{d\sigma(p\bar{p} \rightarrow BX)}{d p_T(B)} = \frac{d\sigma(q\bar{q} / gg / qg \rightarrow bX)}{d p_T(b)} \otimes F^{p\bar{p}} \otimes D^{b \rightarrow B}$$

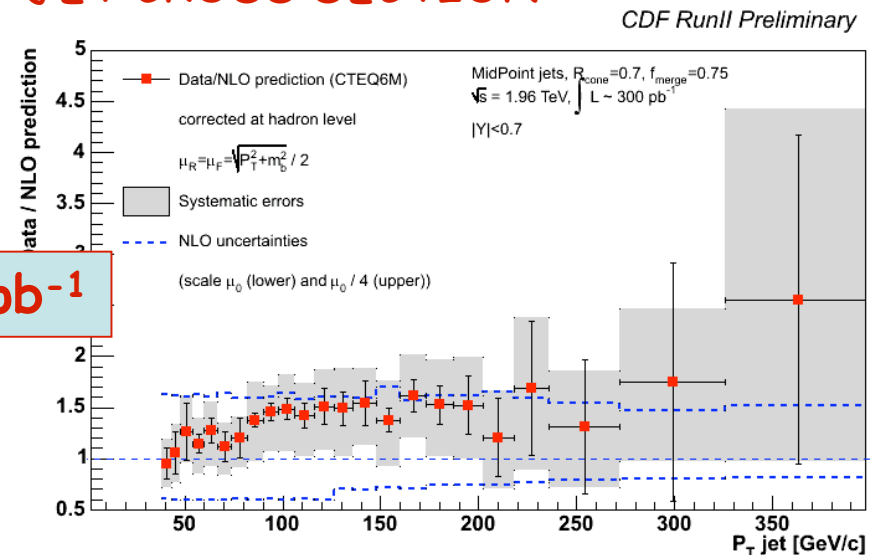
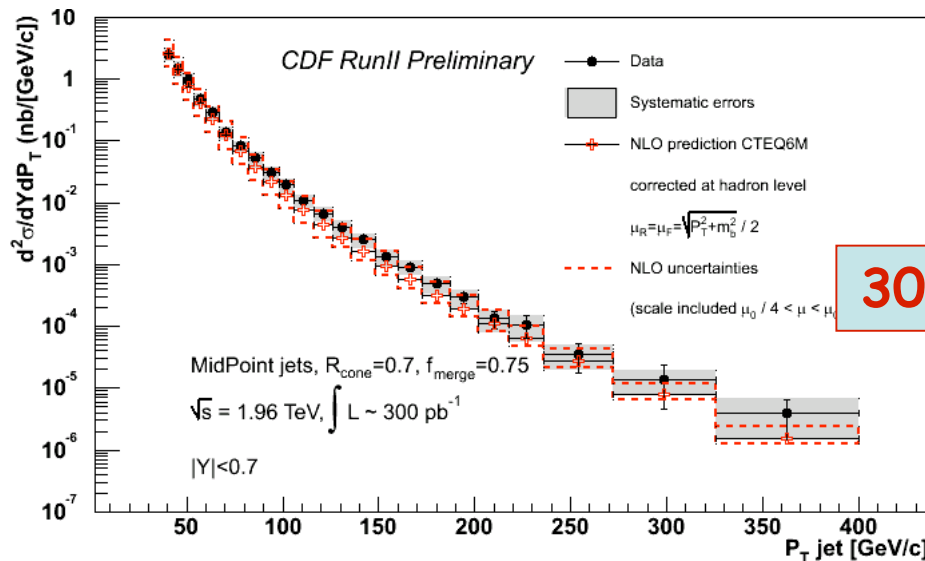
Proton structure
↑
↓

NLO QCD
Fragmentation

b-jets as experimental input:

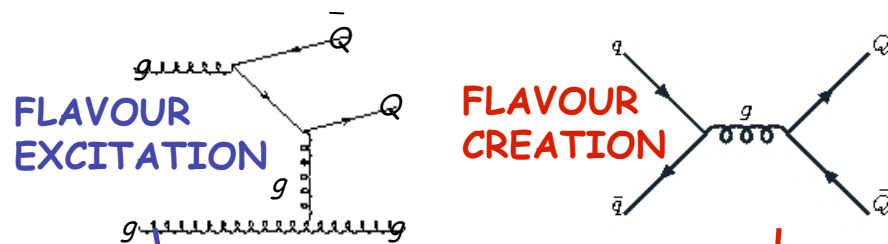
- include most of quark fragmentation remnants
- small dependence on fragmentation**
- wide P_T spectrum

CDF HAS MEASURED THE **INCLUSIVE B-JET CROSS SECTION**

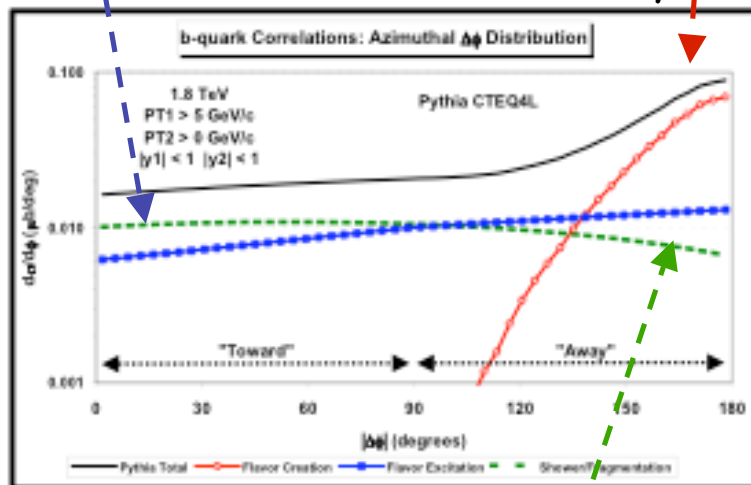


$b\bar{b}$ di-jet production

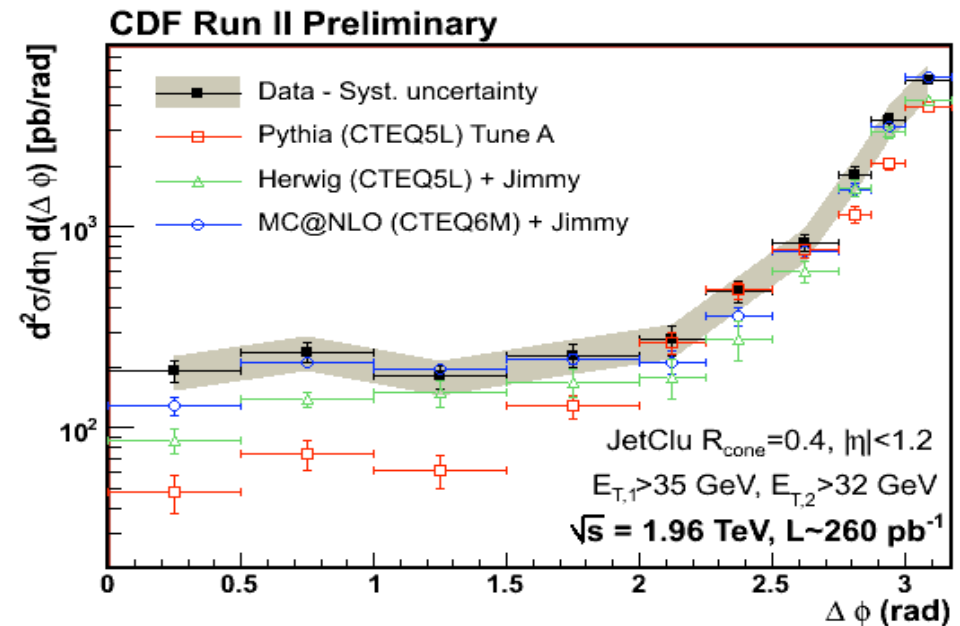
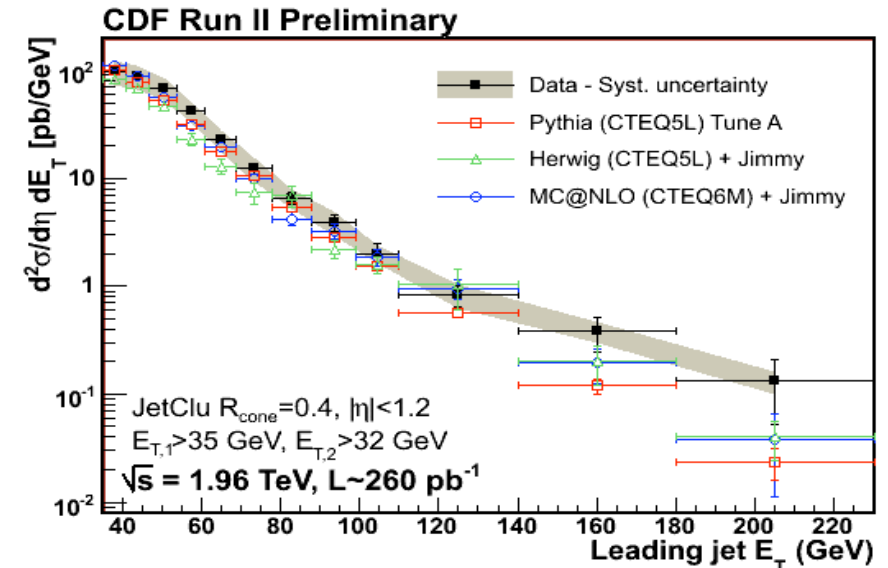
- $b\bar{b}$ cross section and correlation gives info on production mechanism
- good test to nlo vs lo predictions



Run I LO Monte Carlo study

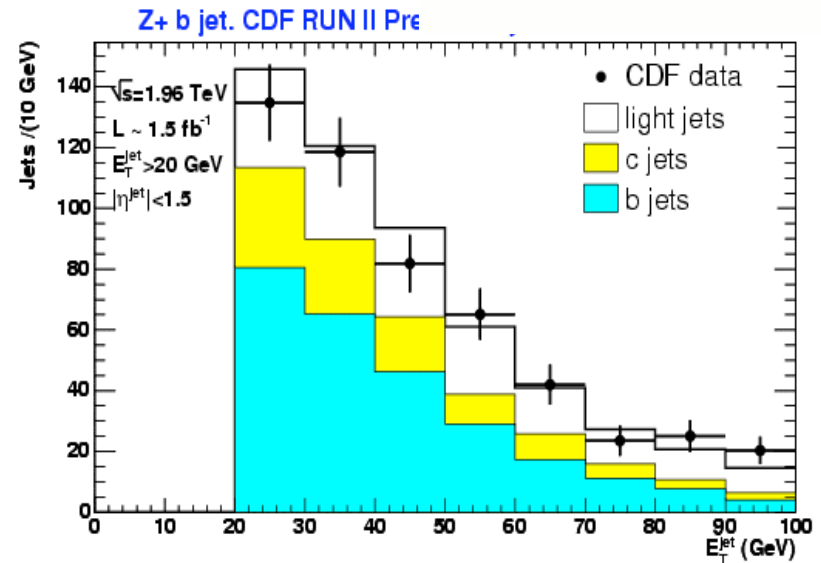
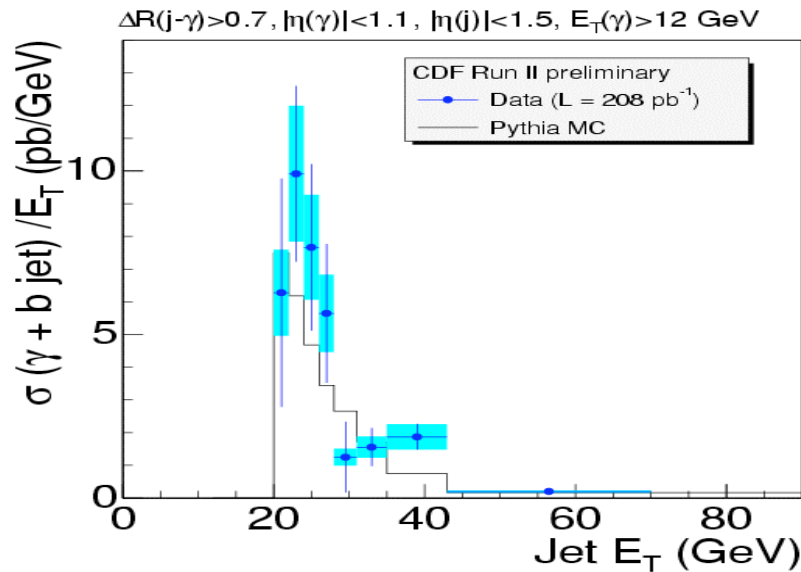
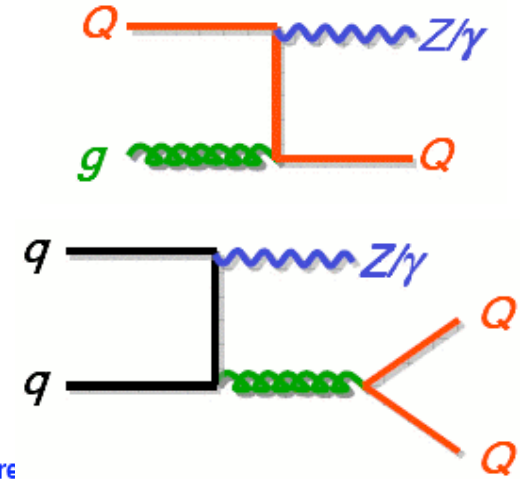


SHOWERING



Z/ γ + b-jets

SENSITIVE TO **b** CONTENT IN THE **p** PDF
 MAJOR BKGD FOR **SM HIGGS** (e.g. ZH, H \rightarrow b \bar{b})

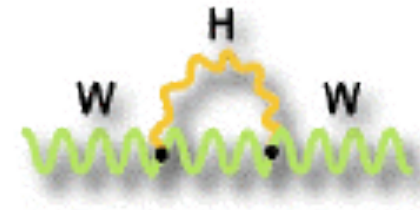
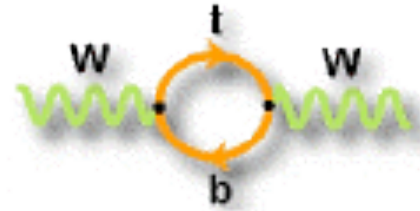


$E_T^{\text{jet}} > 20 \text{ GeV}$, $ \eta^{\text{jet}} < 1.5$ $R_{\text{jet}} = 0.7$	CDF Run II Preliminary measurement	PYTHIA	MCFM NLO	MCFM NLO + UE + hadr.
$\sigma(Z+b\text{-jet})/\sigma(Z)$	$0.369 \pm 0.057 \pm 0.055 \%$	0.35 %	0.21 %	0.23 %
$\sigma(Z+b\text{-jet})$	$0.94 \pm 0.15 \pm 0.15 \text{ pb}$	n.a.	0.51 pb	0.56 pb
$\sigma(Z+b\text{-jet})/\sigma(Z+\text{jet})$	$2.35 \pm 0.36 \pm 0.45 \%$	2.18 %	1.88 %	1.77 %

UE + Hadr
 obtained
 from Pythia

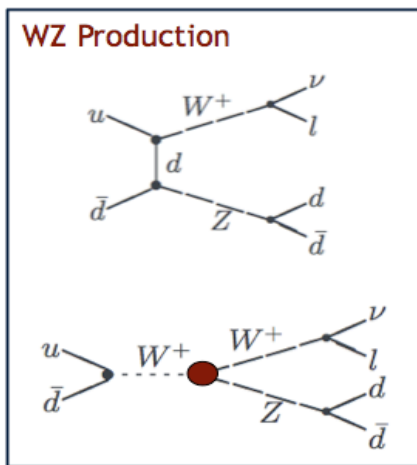
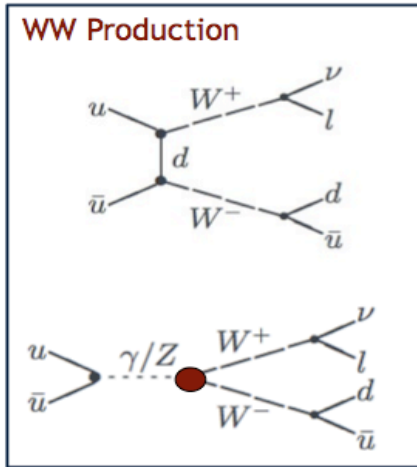
EWK gauge boson physics

- WW/WZ production
 - Leptonic
 - **Leptons + jets** (DPNC analysis)
- Evidence of ZZ production
- **W mass**
- W width
- WWZ couplings
- W charge asymmetry



WW/WZ semileptonic search

Sensitive to Triple Gauge Coupling and non-standard $ZZ\gamma$
 LARGE branching ratio with respect to leptonic channels



Signal:

- 1 central e/μ
- $Met > 25 \text{ GeV}$
- $> 1 \text{ jet } (P_T > 15 \text{ GeV})$

$$\sigma_{WW}^{\text{th}} \times \text{BR} = 1.81 \text{ pb}$$

$$\sigma_{WZ}^{\text{th}} \times \text{BR} = 0.28 \text{ pb}$$

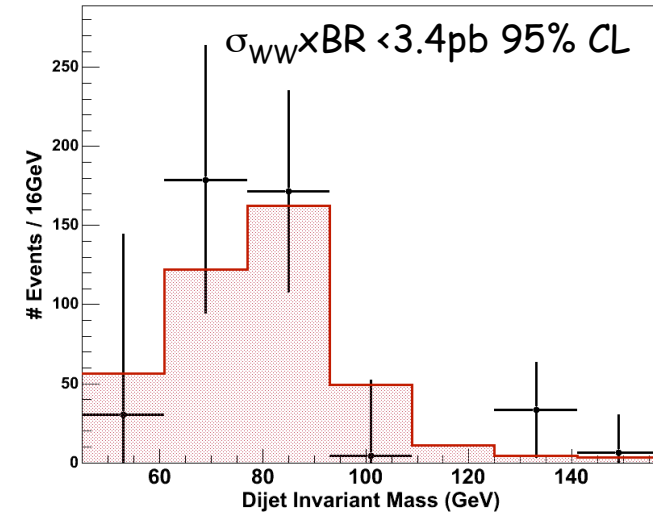
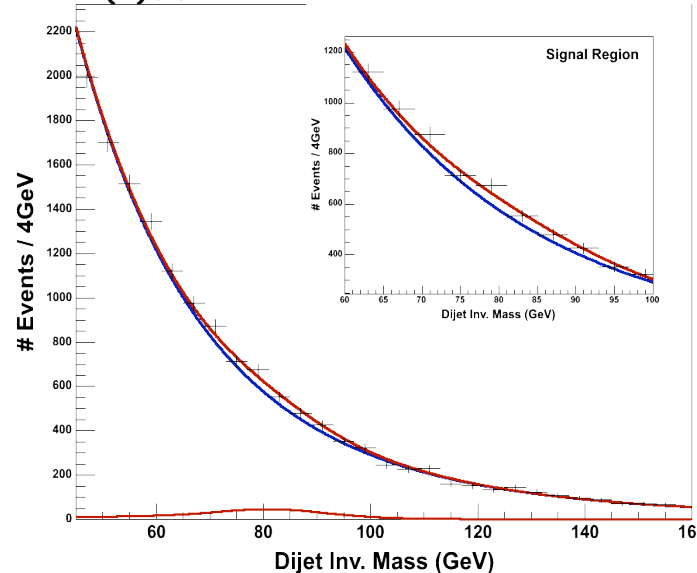
$$\sigma_{W(e)JJ}^{\text{th}} = 320.4 \text{ pb}$$

Background:

- $W(\text{left}) + \text{jets}$
- $Z(\text{left}) + \text{jets}$
- QCD, t - \bar{t}



Use NN to discriminate



Top + Higgs + ...

- Top
 - Top mass in all-jets channel
 - FCNF $t \rightarrow Zq$
 - Search for single top
 - Top Production
 - Top Charge
 - W helicity (DPNC analysis)
 - V_{tb}

- Higgs (fb^{-1})
 - $H \rightarrow \tau\tau$ SUSY Higgs
 - $H \rightarrow WW$ ME-based analysis
 - $ZH \rightarrow llbb$ 2D-NN and MET fitter analysis
 - CDF limit

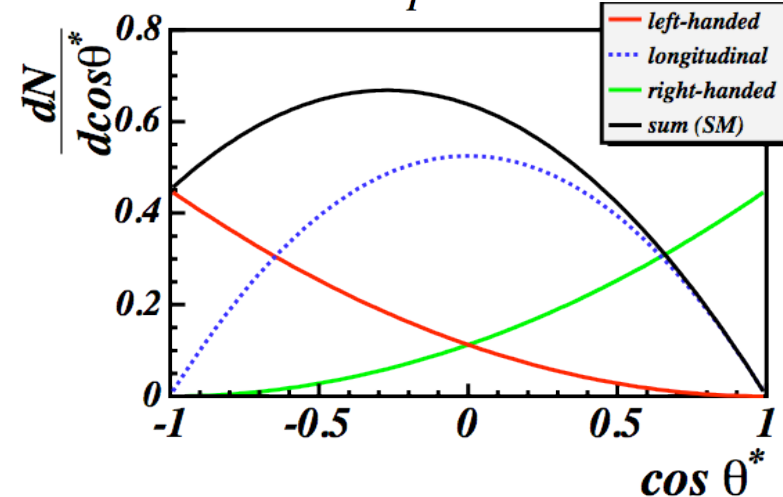
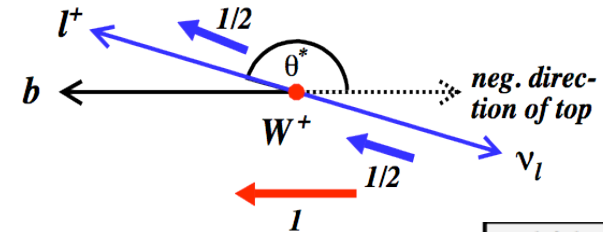
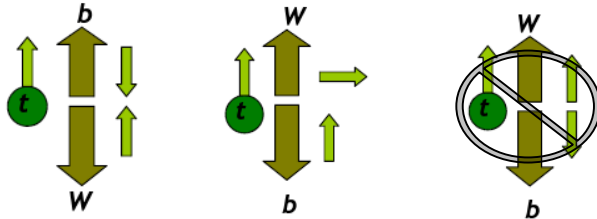
- New Phenomena
 - Search for New Particles Coupling to Z +jets ($b' \rightarrow Z+b$) in 1.1 fb^{-1}
 - SUSY trilepton combined limit - 0.7 to 1 fb^{-1}
 - High-mass dielectron (Z' search) - 1.3 fb^{-1}

W helicity in t decays

1.7fb⁻¹

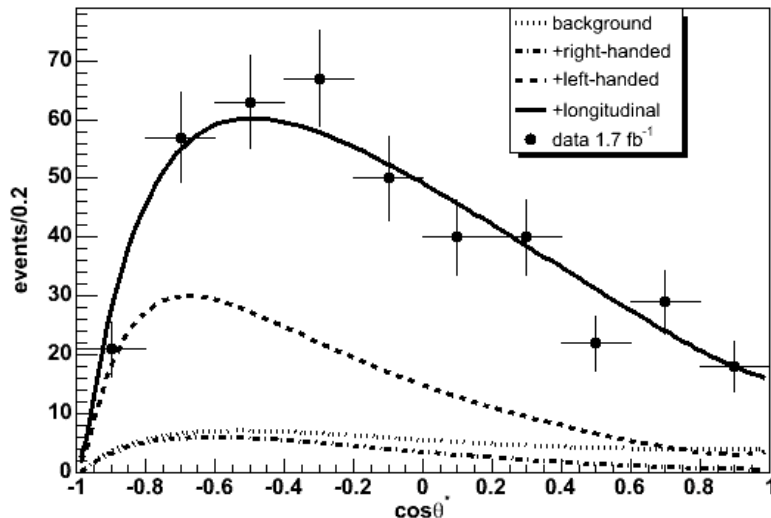
W helicity in t-decay fixed by m_t , m_W , V-A structure of tWb vertex

- $f_- = f_{LH} \sim 30\%$, $f_0 = f_{long} \sim 70\%$,
 $f_+ = f_{RH} \sim 0.036\%$ in SM
- fully reconstruct (lepton+jet events)
measure $\cos\theta^*$
- fit with unbinned likelihood



CDF Run II Preliminary

Entries 407



1D fit: (fixed f_0 or f_+)

$$f_0 = 0.57 \pm 0.11(\text{stat}) \pm 0.04(\text{sys})$$

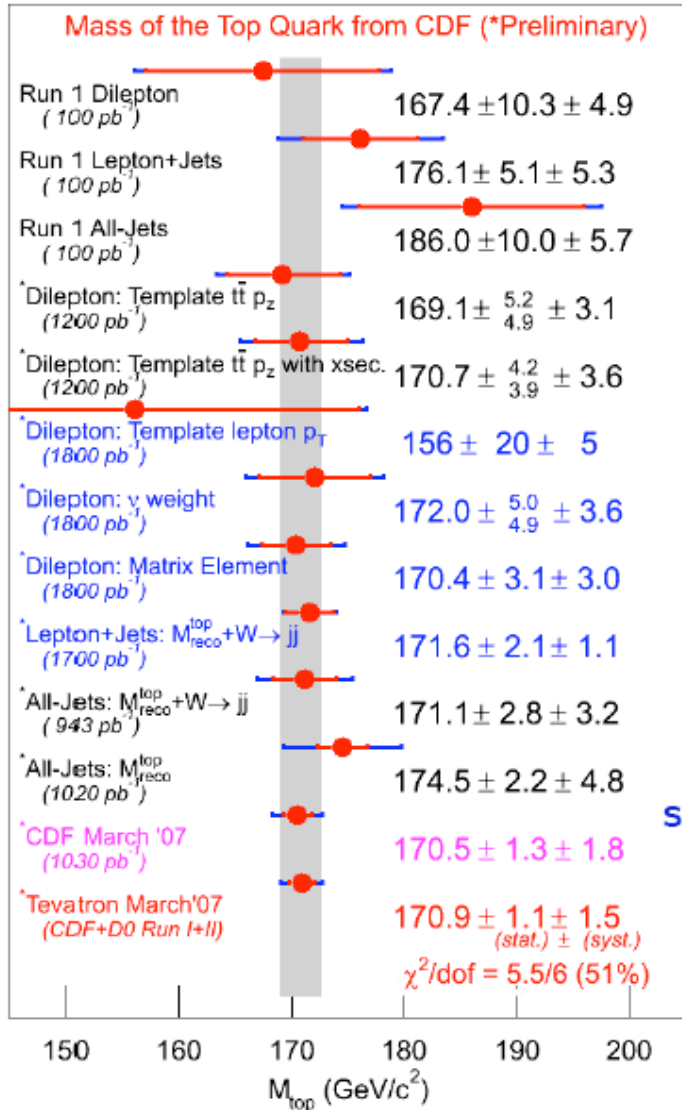
$$f_+ < 0.07 \text{ (95\% CL)}$$

2D fit:

$$f_0 = 0.61 \pm 0.20(\text{stat}) \pm 0.03(\text{sys})$$

$$f_+ = -0.02 \pm 0.08(\text{stat}) \pm 0.03(\text{sys})$$

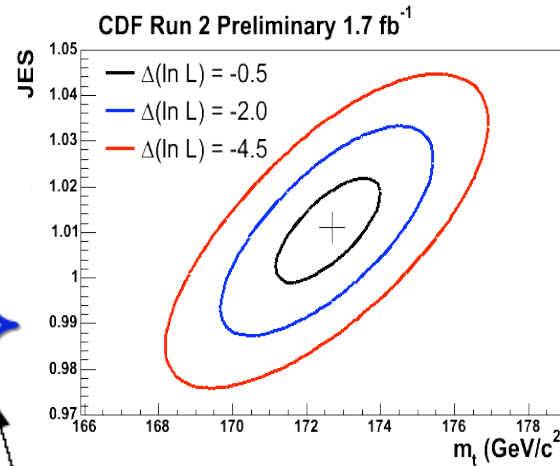
t-quark mass



Most precise measurement: lepton + jets channel

• ME Method: (new!! Sept07)

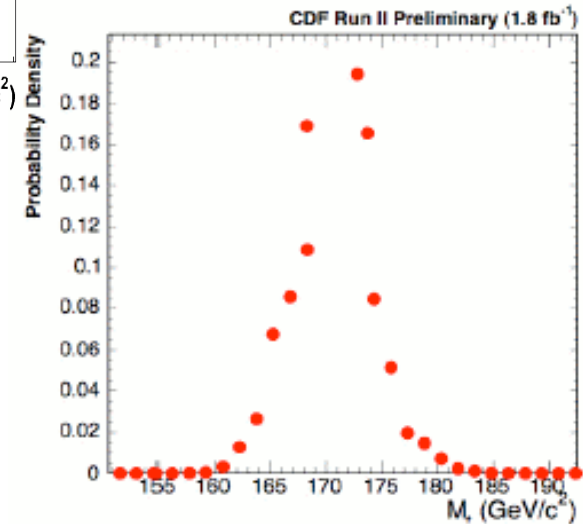
$$M_{\text{top}} = 172.7 \pm 2.1 \text{ (stat+syst) GeV}/c^2$$



New for summer 2007!

Most precise dilepton channel: ME analysis

$$M_{\text{top}} = 170.4 \pm 3.1 \text{ (stat)} \pm 3.0 \text{ (syst) GeV}/c^2$$

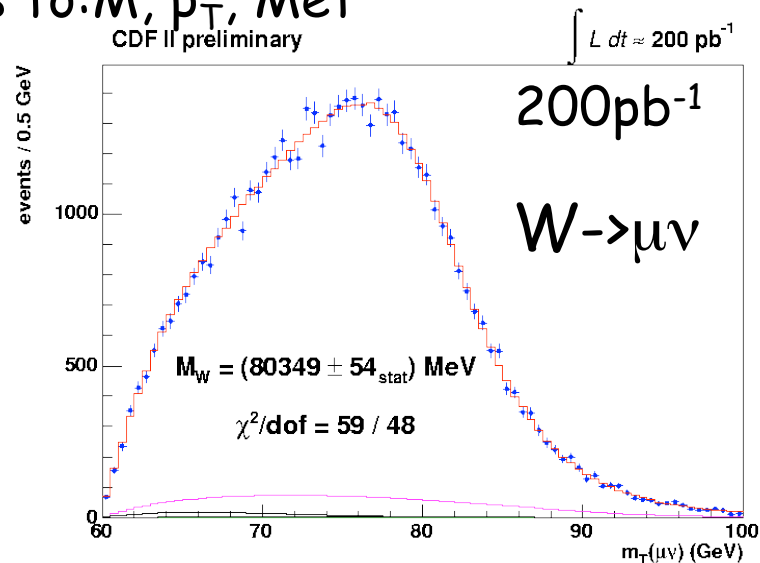


M_W & SM Higgs expectation

- Radiative corrections dominated by top and Higgs loop
- > allows a constraint on the Higgs mass

Leptons channel: $W \rightarrow e\nu, W \rightarrow \mu\nu$

Fits to: M, p_T, M_{et}



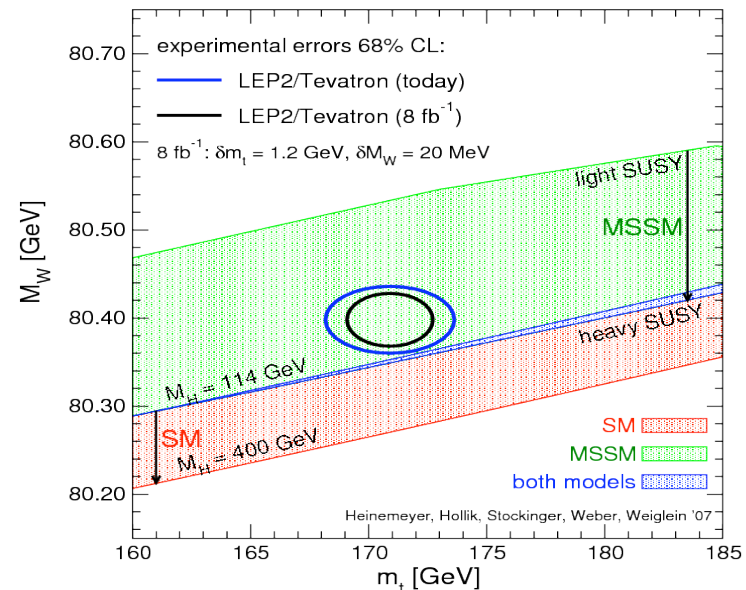
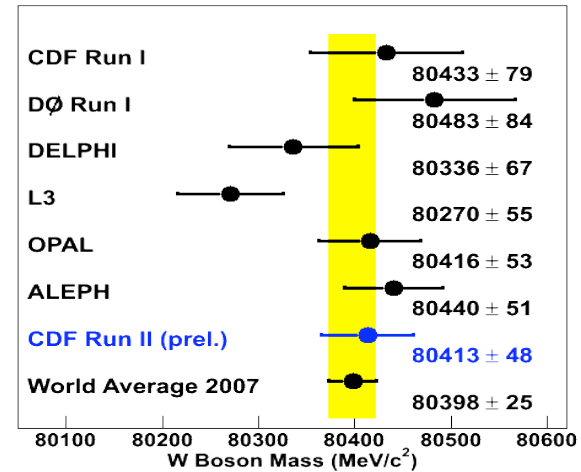
$$M_W = 80413 \pm 34(\text{stat}) \pm 34(\text{syst})$$

Preliminary SM Higgs fit:
(with new Tevatron top mass)

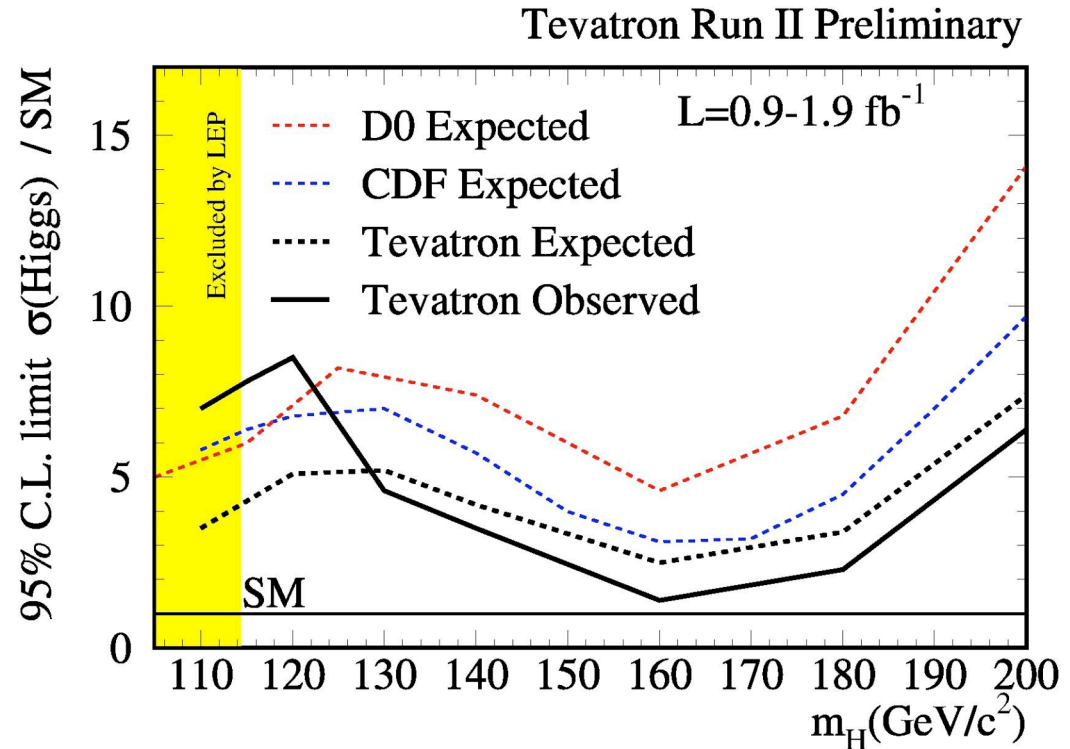
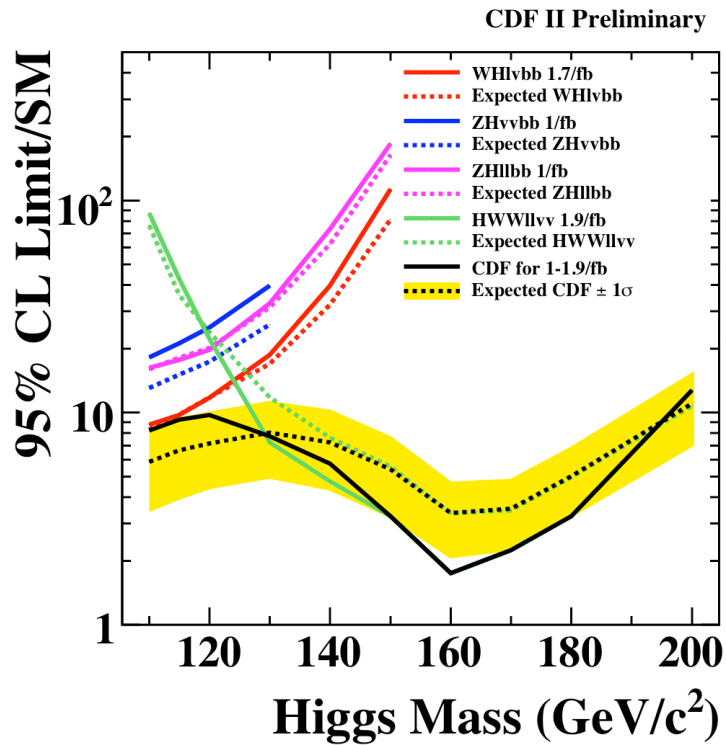
$$M_H = 76^{+33}_{-24} \text{ GeV}$$

$$M_H < 144 \text{ GeV (95\% CL)}$$

$$M_H < 182 \text{ GeV (95\% CL) LEP II exclusion}$$



SM Higgs search summary

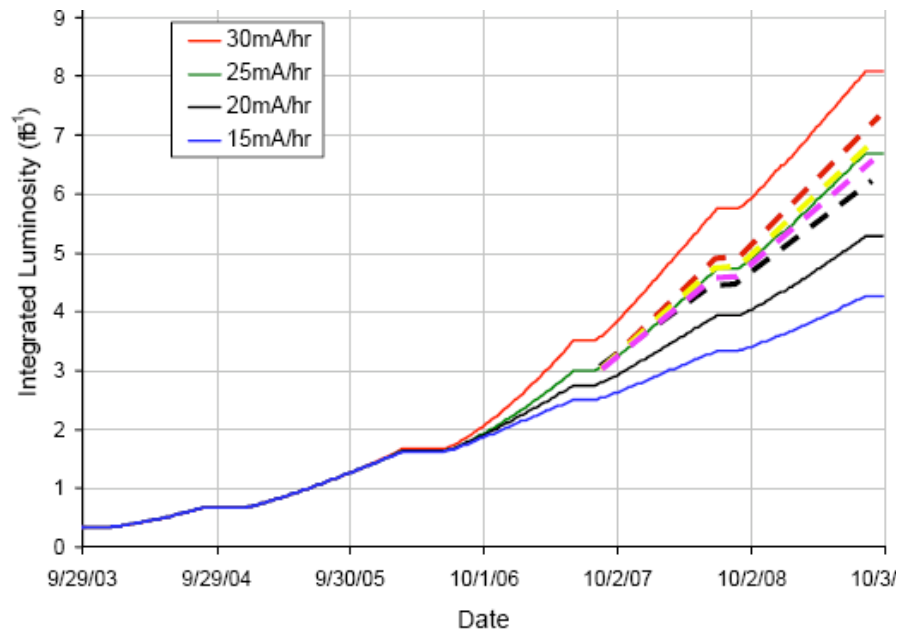


New 1.9 fb^{-1} search for
 $ZH \rightarrow \nu\nu b\bar{b}$ not yet included

The results shown are 95% CL limits for the SM Higgs.
 In case of (e.g.) MSSM or SUGRA Higgs or similar,
 results no longer apply

Summary and perspectives

- The accelerator complex is working well
 - More data is now collected in one week than what was used to gather evidence for top
- In the fb region many interesting processes at the boundary of the Standard Model
 - CDF is performing well to study physics in this region



Expect 6-7 fb⁻¹ by 2009

Given good perspectives CDF is discussing the possibility to run in 2010