Recent CDF Results

Aaron Dominguez
LBNL

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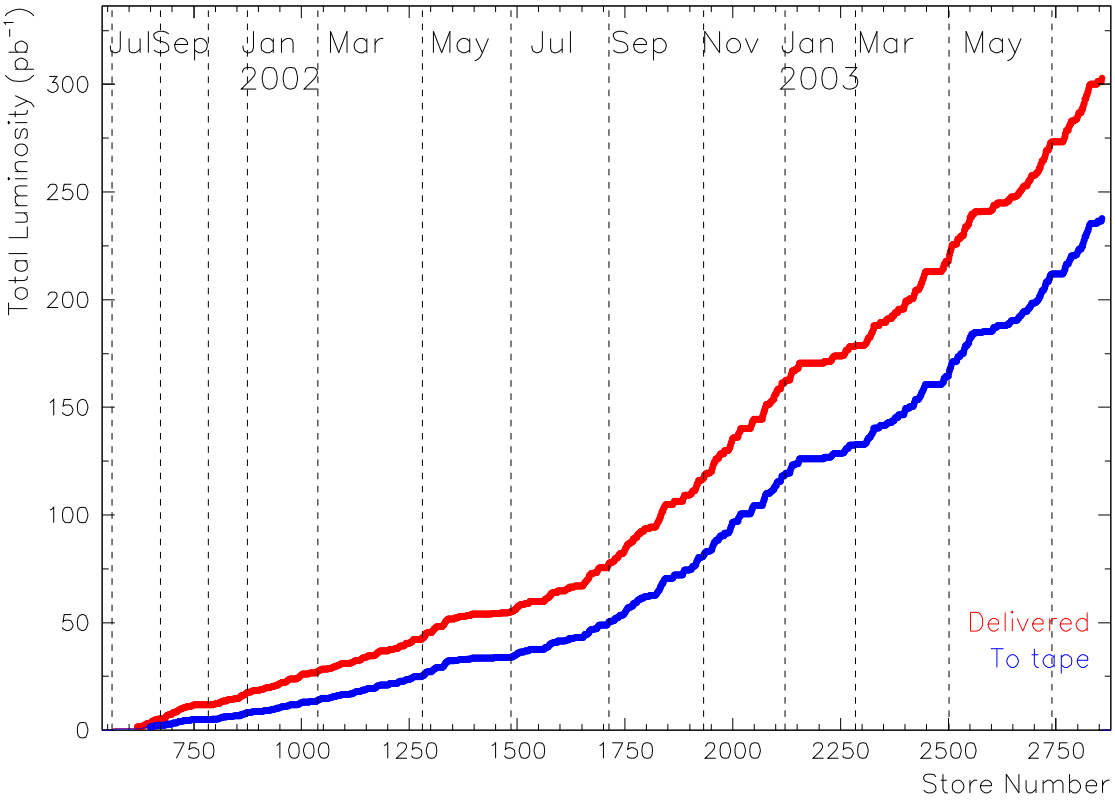
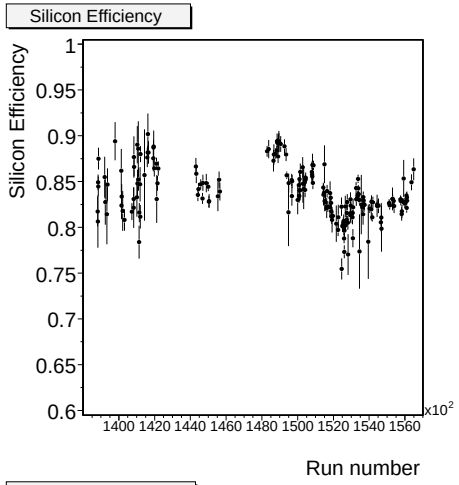
- Status and tools
- QCD
  - Inclusive Jet Cross Section
  - γ+Heavy Quark
- Electroweak
  - $W\gamma$ and $Z\gamma$ Coupling
  - WW Cross Section
- Top
  - Lepton+Jets
  - Dilepton
  - Mass
- Bottom
  - B_s and Λ_b
  - New Br, mass and lifetime measurements
- New Physics/Phenomena
  - $B_{s,d} \rightarrow \mu^+\mu^-$
  - Leptoquarks
  - Z', Graviton/Extra dimensions

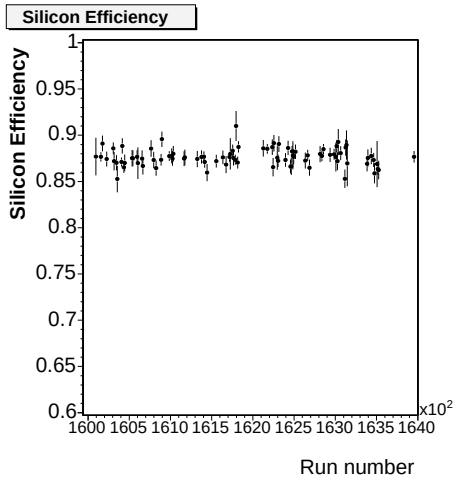
Luminosity

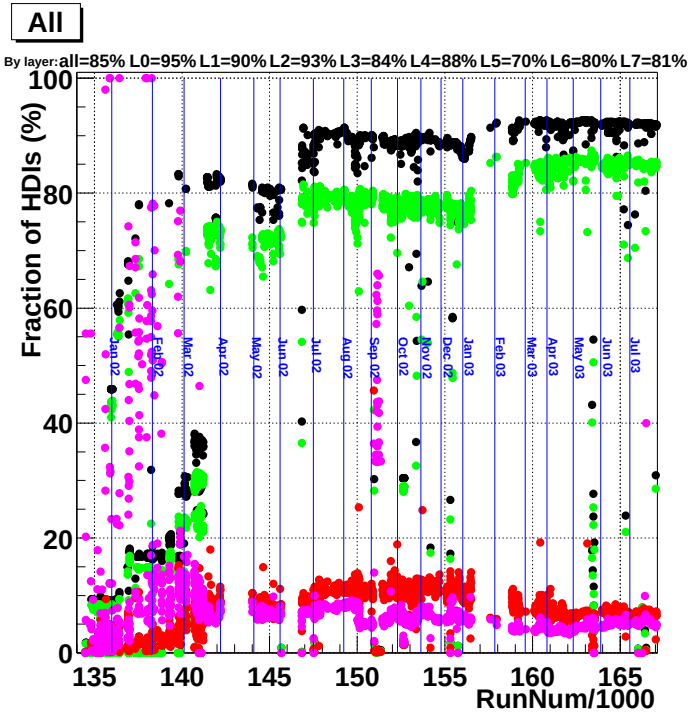


- Now have more data than RunI
- Can do precision measurements and searches
- Following are some new, recently updated or unique CDF results
- Many analyses presented use 110-170 pb^{-1}
- B-Physics results use 72 pb^{-1}

Status of Silicon Detectors

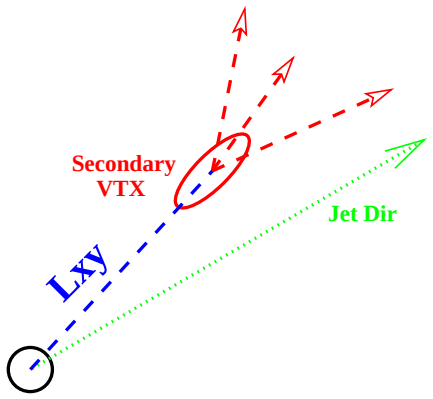




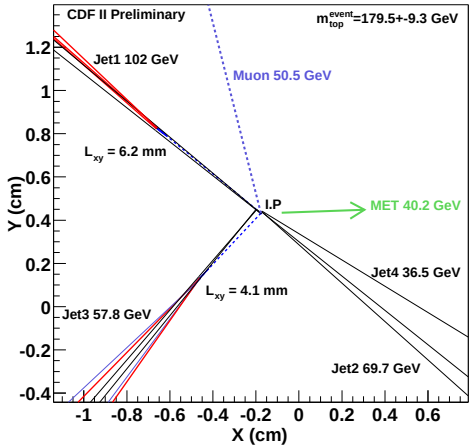


- Detector more stable, Coverage increasing from repairs
- As consequence, Si tracking eff higher, stable since shutdown
- Live SVT wedges now $\sim 95\%$

High-P_t B-Tagging

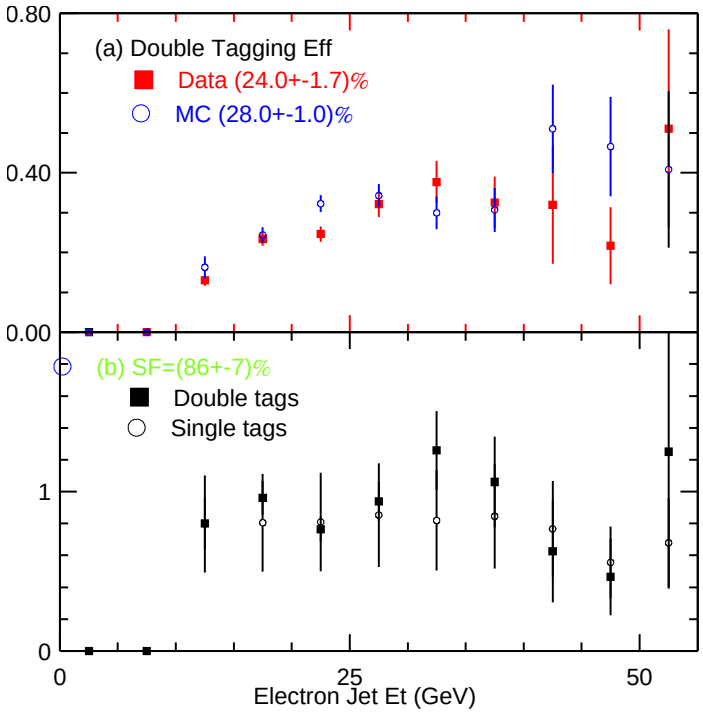


Reference VTX from beamline



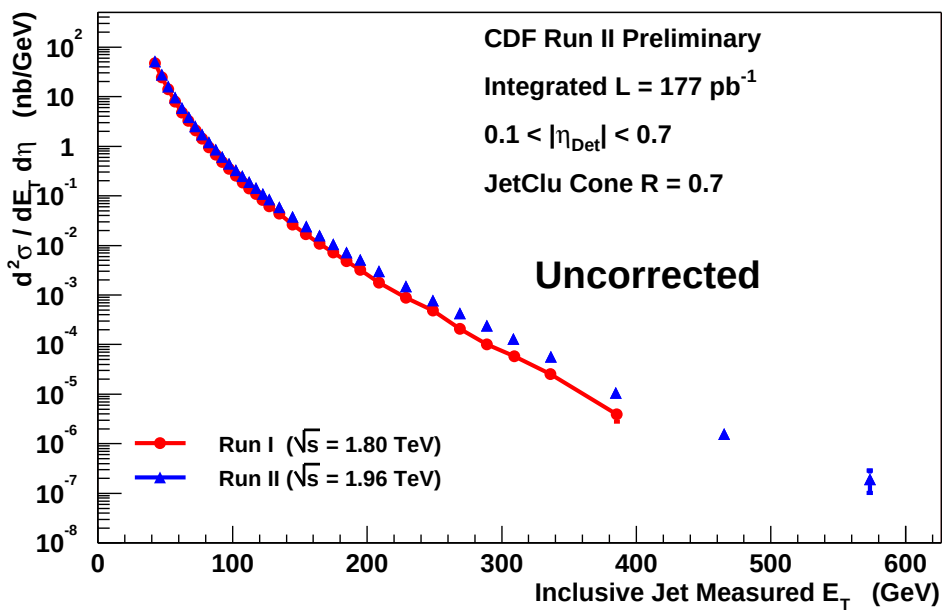
- Displaced vertexes: All combinations of at least 2 good tracks
- Jet is tagged as b-jet if $L_{xy}/\sigma_{xy} > 3$ (typical $\sigma_{xy} \sim 150\ \mu\mathrm{m}$)
- Performance/alignment/understanding of Si detectors crucial
- Measure eff and fake rate in incl lepton & generic jet data
- Tagger for high-Pt physics (QCD, top, Higgs...)

High-P_t B-Tagging Performance



- Relative difference between data/MC $86\% \pm 7\%$
- Eff to tag a $t\bar{t}$ event $55\% \pm 1\% \pm 5\%$
- Prob. for fake jet-tag for top candidates $\sim 1 - 1.5\%$

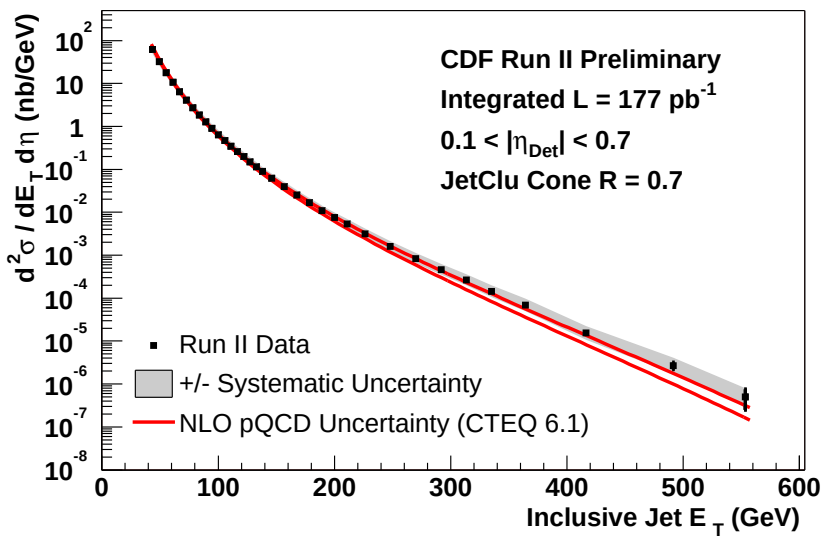
Inclusive Jet Cross Section

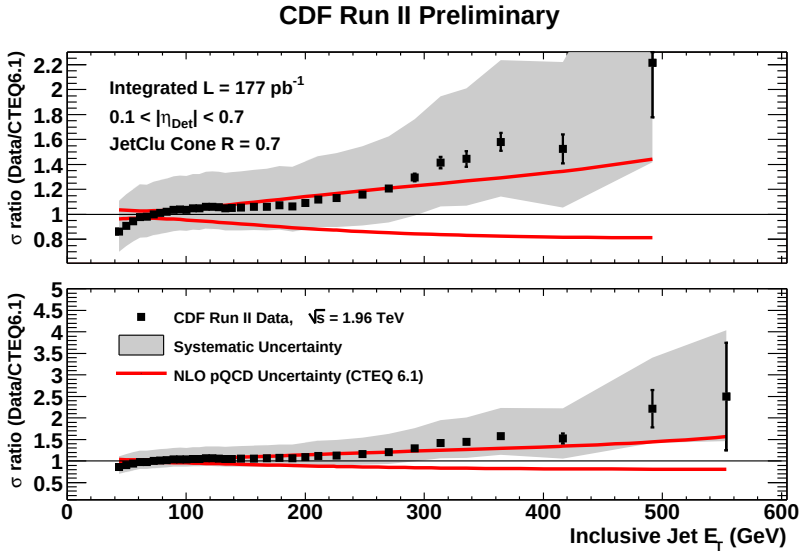


- $\int L$ of 177 pb^{-1} collected from Feb 2002 though June 2003.
- Highest E_T jets ever
- Now extending past RunI reach by almost 150 GeV
- Have reduced largest syst error from 5% to 3% since winter (jet energy)
- Can expect to reach 1% eventually

- Understanding jet cross section is cornerstone of doing physics at hadron collider

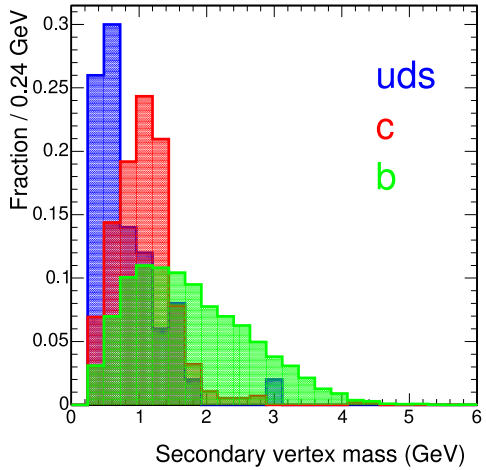
Inclusive Jet Cross Section vs NLO QCD

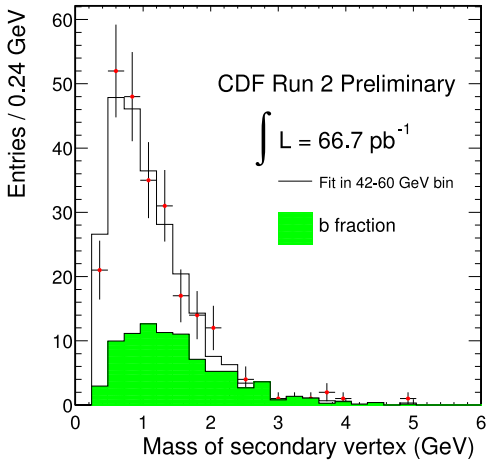




- Theoretical error dominated by PDF's (high x gluons)
- Full RunII dataset will help reduce this uncertainty
- But data currently agrees with NLO prediction within estimated errors
- Must still understand trends

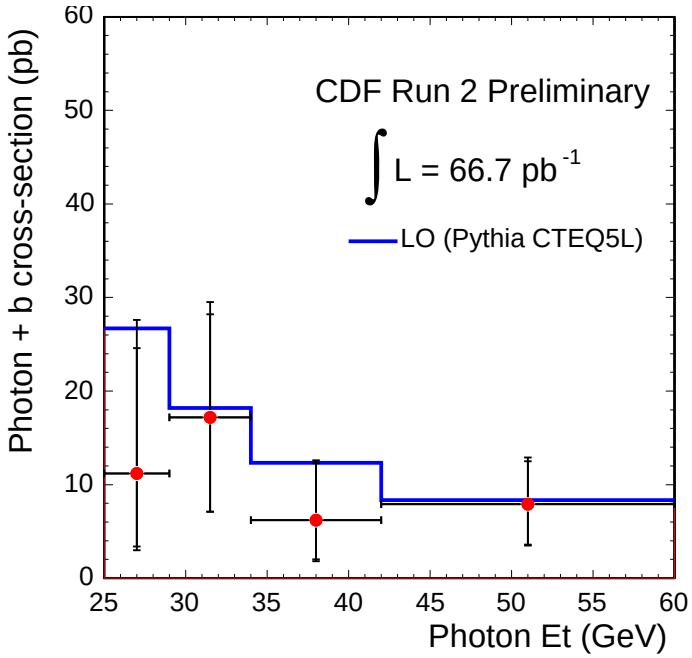
Photon+Heavy Flavor

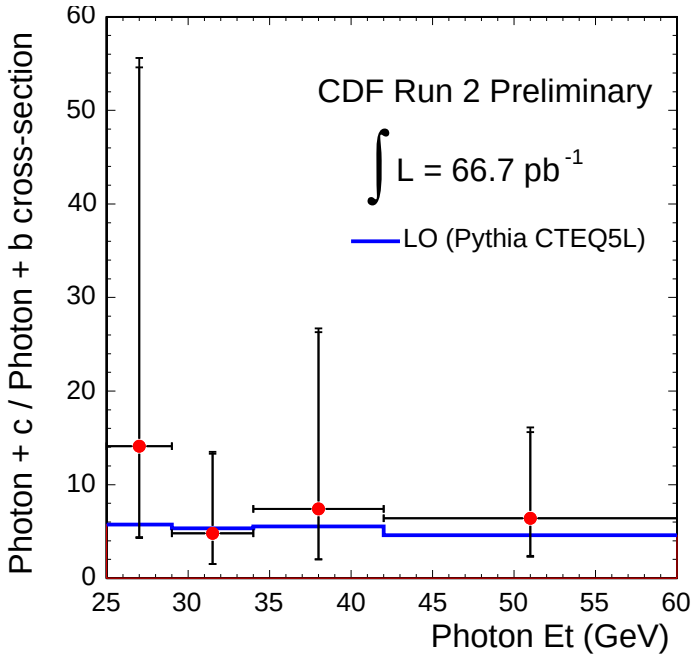




- Measure $\gamma + b, c$ cross-sections as function of photon E_T
- Test QCD predictions for $\mathrm{b\bar{b}}$ & $\mathrm{c\bar{c}}$ production at different energy scales
- Require central photon
- b-tagged jet
- Fit secondary vtx mass dist for b/c/light content
- Subtract fakes and extract production cross sections

Photon+Heavy Flavor Limits





- Extract b and c cross sections (b shown)
- Individual and ratio of b/c is in agreement with NLO predictions
- Statistics limited. Will improve with more luminosity
- Excess in $\gamma + \mathrm{b}, \mathrm{c}$, especially at high E_T, could signal new physics (light stop,...)

$W\gamma$ and $Z\gamma$ Couplings

$p\bar{p} \rightarrow W\gamma \rightarrow \gamma\ell\nu$

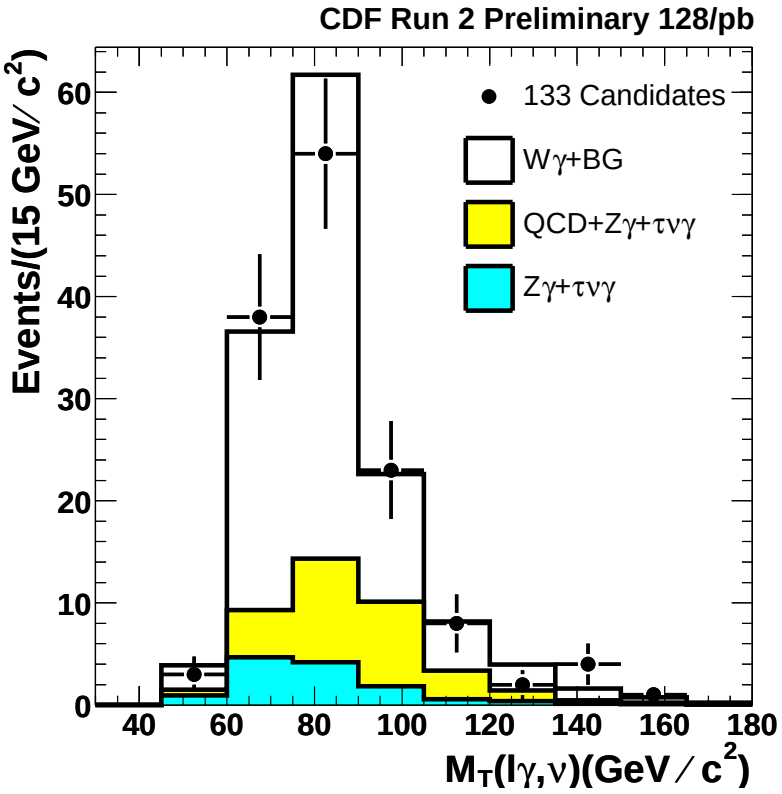
- Tests triple gauge coupling which are precisely predicted by SM
- Sensitive to anomalous couplings
- Measure cross section and kinematics
- Uses 128 pb^{-1}
- Require 1 high P_T e, μ, missing E_T and isolated photon with $E_T > 7$ GeV

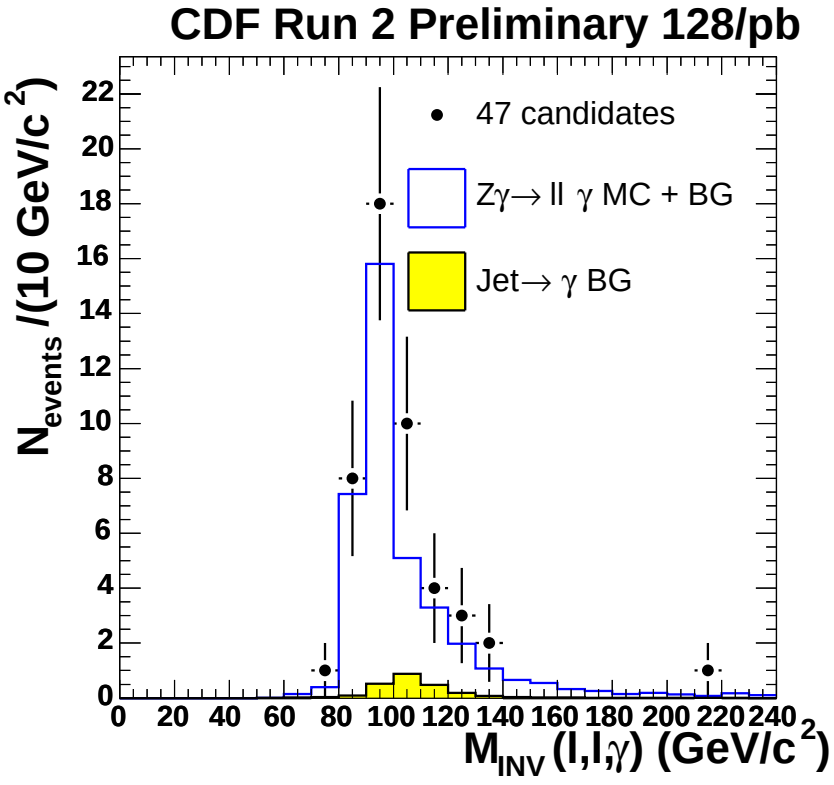
$p\bar{p} \rightarrow Z\gamma \rightarrow \gamma\ell^+\ell^-$

- Similar to $W\gamma$, but no s-channel
- Now extended acceptance by including plug calorimeter for $Z\gamma$ plug-central candidates
- Instead of missing E_T, 2 opp sign high P_T leptons
- Have reduced systematic error on photon ID

	Events	S/B	Meas $\sigma(\mathrm{pb})$	SM $\sigma(\mathrm{pb})$
$W\gamma \rightarrow \gamma\ell\nu$	133	2.4	$17.2 \pm 1.8 \pm 2.2 \pm 1.0$	18.6 ± 1.3
$Z\gamma \rightarrow \gamma\ell^+\ell^-$	47	15	$5.8 \pm 1.0 \pm 0.4 \pm 0.4$	5.3 ± 0.4

$W\gamma$ and $Z\gamma$ Couplings

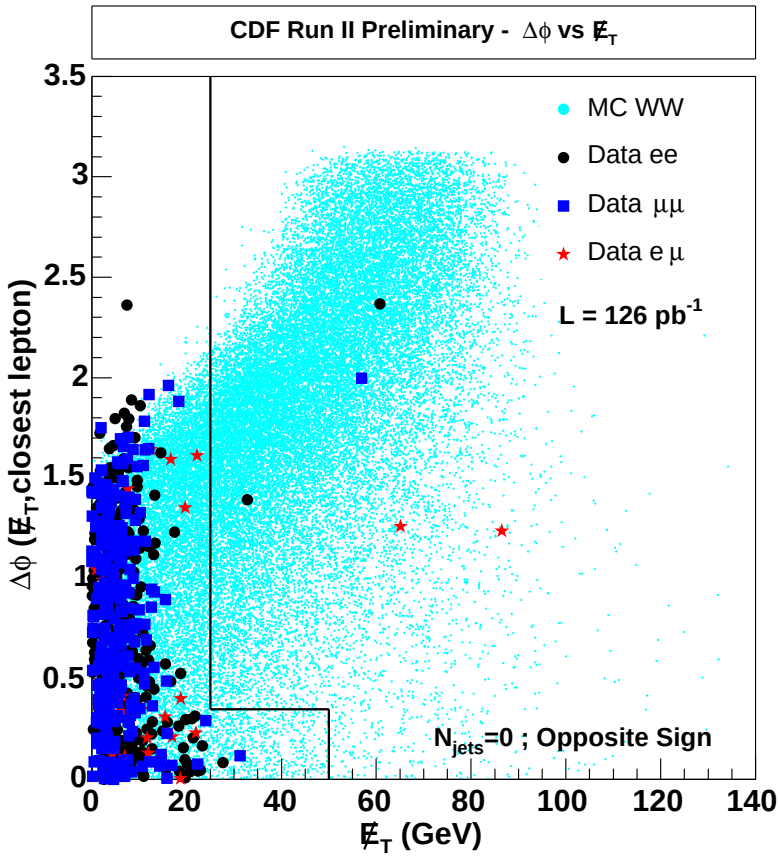




Cross sections and mass spectra currently consistent with SM

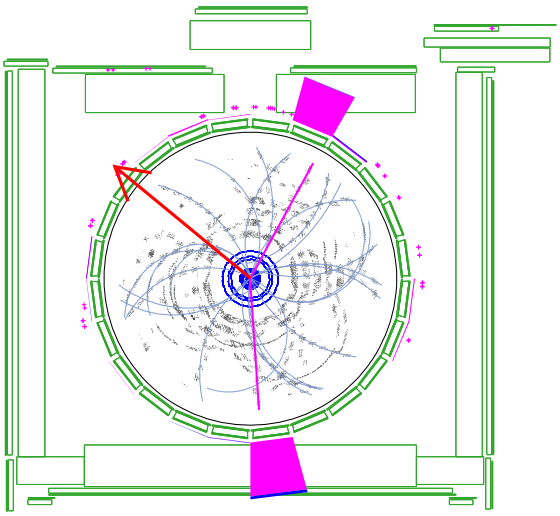
Will extract anomalous couplings limits

WW Cross Section



- $\mathrm{p\bar{p}} \rightarrow WW \rightarrow \ell\ell'\nu\nu'$ $(\ell = e, mu)$
- Important SM process, kinematically similar $H \rightarrow WW$ events, bkg for top
- Uses 126 pb^{-1}
- Requires
  - 2 high P_T isolated central, opp charge leptons
  - Large missing E_T
  - Veto Z and jets

WW Cross Section

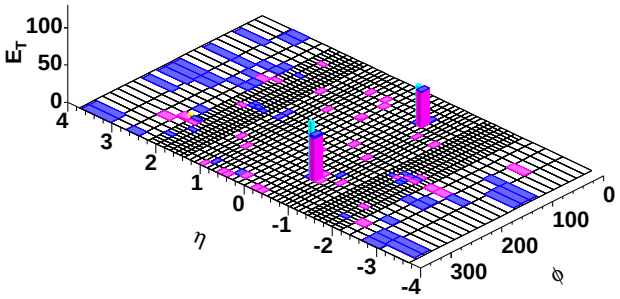


Run 161678 Event 5620107 : $WW \to e^+\nu_e e^-\bar{\nu}_e$ Candidate

$p_T(e^+) = 61.4$ GeV/c; $p_T(e^-) = 49.6$ GeV/c, $M_{e^+e^-} = 106.0$ GeV

$\not\!\!E_T = 33.2$ GeV; $\Phi(\not\!\!E_T) = 2.5$

$\Delta\Phi(\not\!\!E_T, \text{lepton}) = 1.4$; $\Delta\Phi(e^+, e^-) = 2.6$; Opening-Angle$(e^+, e^-)$=2.0

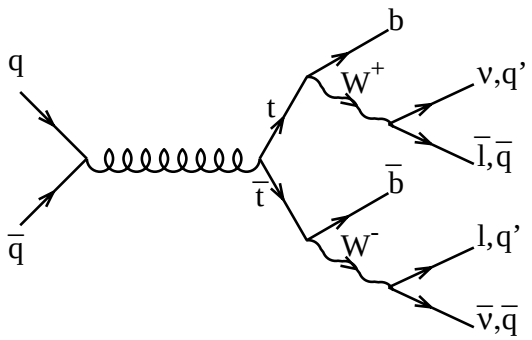


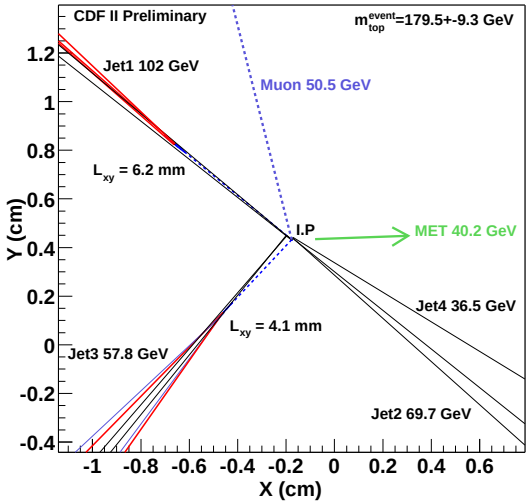
	CDF Run II Summer 2003 Preliminary			
Source	ee	$\mu\mu$	$e\mu$	$\ell\ell$
Drell-Yan e^+e^-	0.40 ± 0.19	0. ± 0.	0.051 ± 0.053	0.45 ± 0.19
Drell-Yan $\mu^+\mu^-$	0. ± 0.	0.49 ± 0.22	0.35 ± 0.17	0.84 ± 0.28
Drell-Yan $\tau^+\tau^-$	0.024 ± 0.010	0.022 ± 0.009	0.066 ± 0.025	0.11 ± 0.03
WZ	0.030 ± 0.004	0.057 ± 0.007	0.11 ± 0.01	0.19 ± 0.02
Fake	0.16 ± 0.04	0.16 ± 0.09	0.40 ± 0.11	0.72 ± 0.15
$t\bar{t}$	0.0039 ± 0.0030	0.0054 ± 0.0035	0.020 ± 0.009	0.029 ± 0.010
Total Bkg	0.61 ± 0.19	0.74 ± 0.24	1.00 ± 0.21	2.34 ± 0.38
$WW \to \ell^+\ell^-$	1.61 ± 0.37	1.36 ± 0.31	3.92 ± 0.89	6.89 ± 1.53
Run 2 Data	2	1	2	5

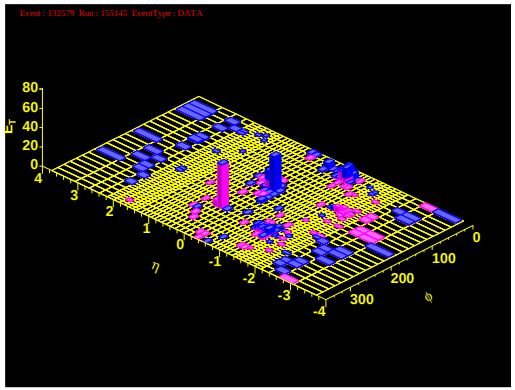
$$\sigma(WW) = 5.1^{+5.4}_{-3.6}(\text{stat}) \pm 1.3(\text{syst}) \pm 0.3(\text{lumi}) \text{ pb}$$

$$\sigma(WW)_{\text{NLO}} = 13.3 \pm 0.3 \text{ pb}$$ (Campbell, Ellis)

Top Physics Studies



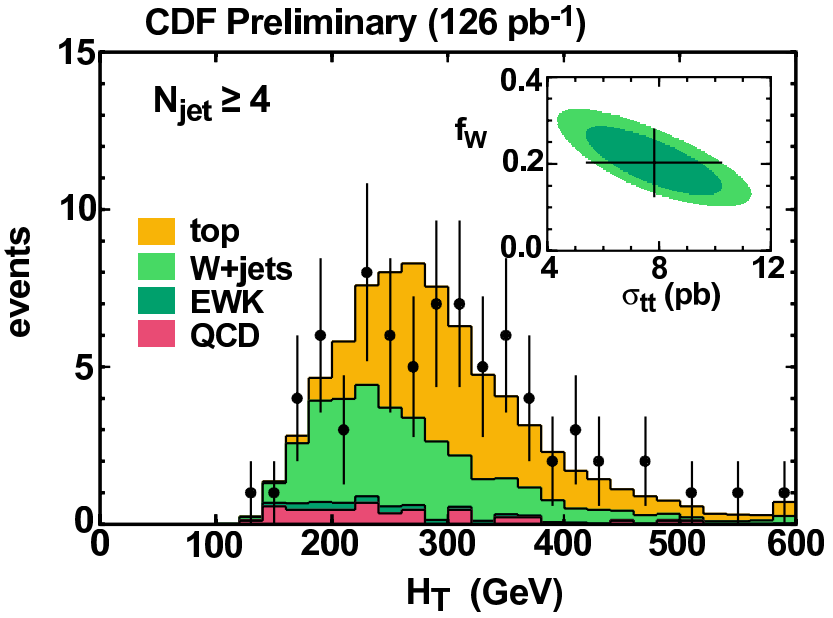




- Final states (2 B-jets & W's)
  - Dilepton ($2\ \mathrm{W} \rightarrow \mathrm{l}\nu$)
  - Lepton+jets ($\mathrm{W} \rightarrow \mathrm{l}\nu$, $\mathrm{W} \rightarrow \mathrm{q}\bar{\mathrm{q}}'$)
  - All hadronic ($2\ \mathrm{W} \rightarrow \mathrm{q}\bar{\mathrm{q}}'$)
- Lepton+jets
  - Higher stats than dilepton chan
  - Less bkg than all hadronic chan
- Dilepton
  - 2 well id'd leptons: high S/B
  - 1 well id'd lepton + iso track: higher stats

Top: Lepton+Jets Cross Section

- Signature:
  - One high-P_t isolated lepton
  - Veto Z's, cosmics and conversions
  - Large missing E_t
  - At least 4 or more high E_t jets

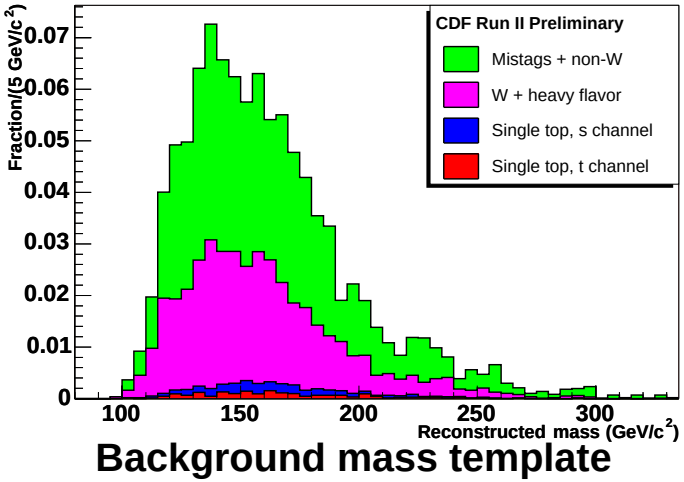


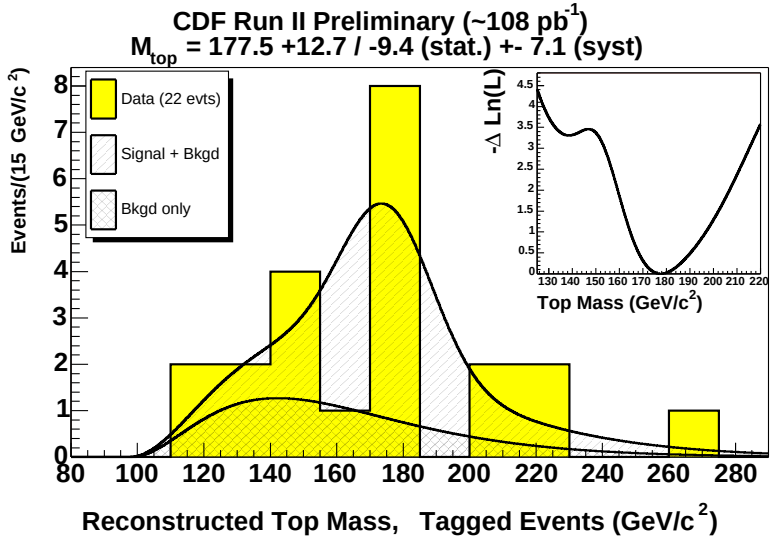
- Extract cross-section with fit to shape of H_T

- Find 75 candidate events in 107.9 pb^{-1}
- Fit $51\% \pm 16\%$ to be top events
- $\sigma_{\mathrm{t\bar{t}}}(\mathrm{NLO}) = 6.7^{+0.71}_{-0.88}$ pb (Mangano et al)

$$\sigma(\mathrm{t\bar{t}}) = 7.1 \pm 2.4(\mathrm{stat}) \pm 3.0(\mathrm{sys})\ \mathrm{pb}$$

Top: Mass in Lepton+Jets Events





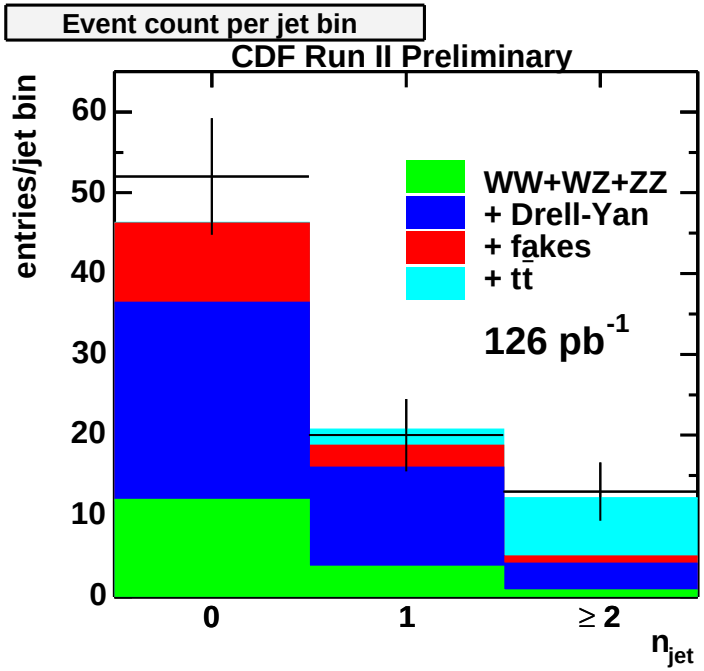
- Same sample as for cross section
- Require ≥ 4 jets
- Measure $m_{\rm t}$ with ≥ 1 b-tag
- Find 22 candidate events with b-tag

- Expect 5.9 ± 2.1 bkg events
- Make 2C mass fit of each event
- Extract $m_{\rm t}$ using likelihood fit to simulated mass templates for signal & bkg

$$m_t = 177.5^{+12.7}_{-9.4}(\text{stat}) \pm 7.1(\text{syst})\ \text{GeV}$$

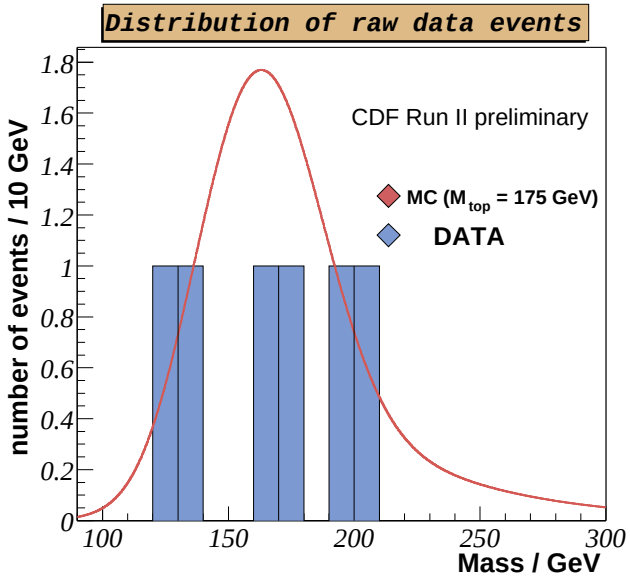
Top: Lepton+Track Cross Section

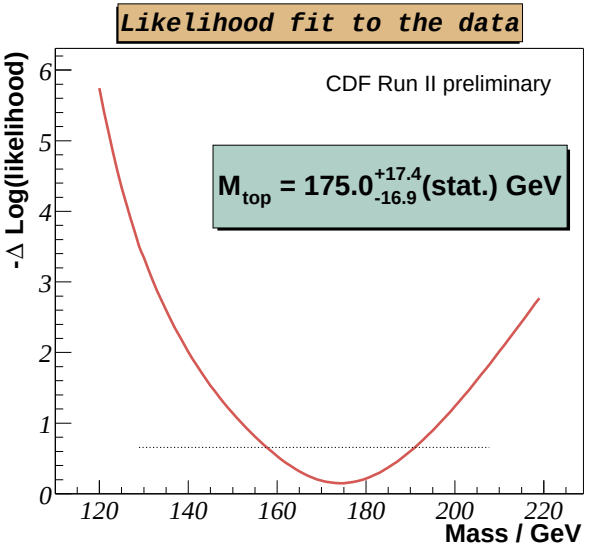
- Dilepton is clean, but low stats channel $\Rightarrow$ open acceptance with looser requirements
- Require 1 tight lepton and 1 isolated track
  - 1 e or μ in central detectors
  - 1 isolated track with $P_T > 15$ GeV, $|\eta| < 1$
- Has significant (25%) sensitivity to τ-channel
- Missing $E_T > 25$ GeV (corrected for lepton and track
- ≥ 2 jets with $E_T > 15$ GeV



$$\sigma(\mathrm{t\bar{t}}) = 7.3 \pm 3.4(\mathrm{stat}) \pm 1.7(\mathrm{syst})\ \mathrm{pb}$$

Top: Mass in Dilepton Events





- Traditional tight-tight dilepton analysis
- 2 well identified & isolated leptons, $E_T > 20$ GeV, opp charge
- Veto m_Z and large missing E_T, cosmics
- Large $H_T > 200$ GeV
- Event-by-event kinematic fit

$$m_t = 175.0^{+17.4}_{-16.9} \pm 7.9 \text{ GeV}$$

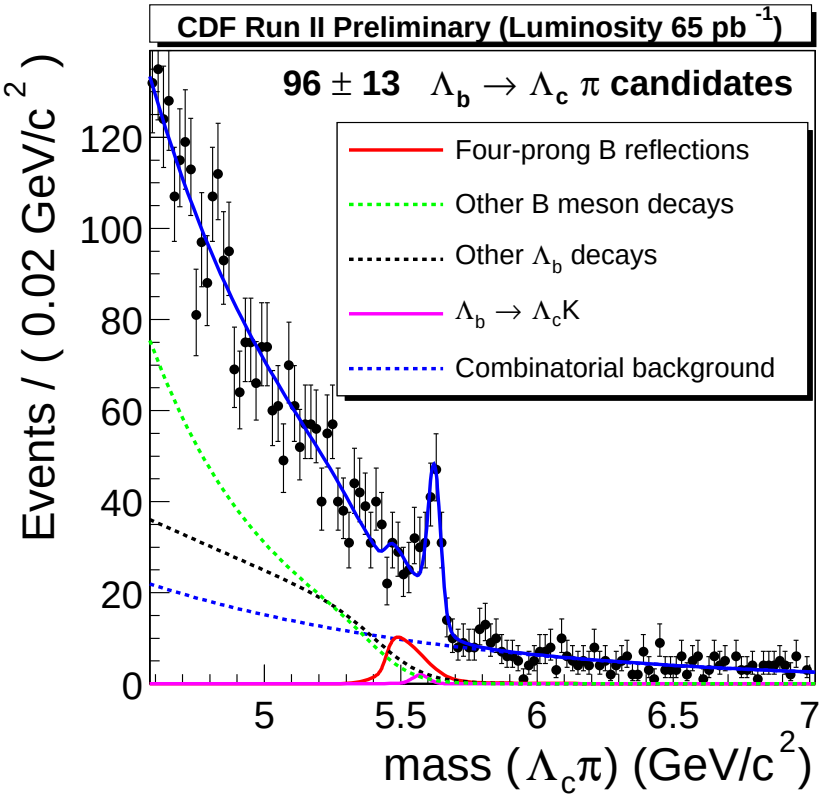
Bottom: B_s and Λ_b

B_s^0 DECAYMODES		Fraction(Γ_i/Γ)	Confidence level	(MeV/c)
D_s^- anything		(94 ±30) %		–
$D_s^- \ell^+ \nu_\ell$ anything	[iii]	(7.9 ± 2.4) %		–
$D_s^- \pi^+$		< 13 %		2321
$D_s^{(*)+} D_s^{(*)-}$		(23 $^{+21}_{-13}$) %		–
$J/\psi(1S)\phi$		(9.3 ± 3.3) $\times 10^{-4}$		1590
$J/\psi(1S)\pi^0$		< 1.2 $\times 10^{-3}$	90%	1788
$J/\psi(1S)\eta$		< 3.8 $\times 10^{-3}$	90%	1735
$\psi(2S)\phi$		seen		1122
$\pi^+\pi^-$		< 1.7 $\times 10^{-4}$	90%	2681
$\pi^0\pi^0$		< 2.1 $\times 10^{-4}$	90%	2681
$\eta\pi^0$		< 1.0 $\times 10^{-3}$	90%	2655
$\eta\eta$		< 1.5 $\times 10^{-3}$	90%	2628
$\rho^0\rho^0$		< 3.20 $\times 10^{-4}$	90%	–
$\phi\rho^0$		< 6.17 $\times 10^{-4}$	90%	–
$\phi\phi$		< 1.183 $\times 10^{-3}$	90%	–
$\pi^+ K^-$		< 2.1 $\times 10^{-4}$	90%	2660
K^+K^-		< 5.9 $\times 10^{-5}$	90%	2639
$\overline{K}^*(892)^0\rho^0$		< 7.67 $\times 10^{-4}$	90%	–
$\overline{K}^*(892)^0 K^*(892)^0$		< 1.681 $\times 10^{-3}$	90%	–
$\phi K^*(892)^0$		< 1.013 $\times 10^{-3}$	90%	–
$p\overline{p}$		< 5.9 $\times 10^{-5}$	90%	2515
$\gamma\gamma$		< 1.48 $\times 10^{-4}$	90%	2685
$\phi\gamma$		< 7 $\times 10^{-4}$	90%	2588
Lepton Family number (LF) violating modes or $\Delta B = 1$ weak neutral current ($B1$) modes				
$\mu^+\mu^-$	$B1$	< 2.0 $\times 10^{-6}$	90%	2682
e^+e^-	$B1$	< 5.4 $\times 10^{-5}$	90%	2864
$e^\pm\mu^\mp$	LF [ff]	< 6.1 $\times 10^{-6}$	90%	2864
$\phi\nu\overline{\nu}$	$B1$	< 5.4 $\times 10^{-3}$	90%	–

Λ_b^0 DECAYMODES		Fraction(Γ_i/Γ)	Confidence level	(MeV/c)
$J/\psi(1S)\Lambda$		(4.7±2.8) $\times 10^{-4}$		1744
$\Lambda_c^+\pi^-$		seen		2345
$\Lambda_c^+ a_1(1260)^-$		seen		2156
$\Lambda_c^+ \ell^- \overline{\nu}_\ell$ anything	[s]	(7.7±1.8) %		–
$p\pi^-$		< 5.0 $\times 10^{-5}$	90%	2732
pK^-		< 5.0 $\times 10^{-5}$	90%	2711

- Unique program of B_s and Λ_b physics making an impact: Yellow are recent results, green are new results compared to PDG02/03
- B_s is currently poorly measured particle
  - Measured Br's
  - Rare decays
  - Also have new results for mass & lifetime
- Largest sample of identified Λ_b^0
  - Measured Br's
  - Also have new results for mass & lifetime

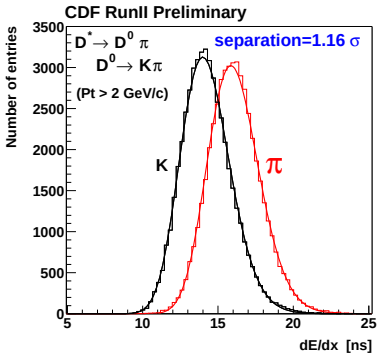
Bottom: $\Lambda_b^0 \to \Lambda_c^+ \pi^-$ Observation & Branching Fraction

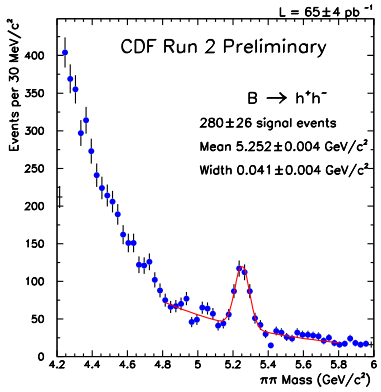


- Uses hadronic displaced track trigger (SVT)
- Use decay mode $\Lambda_c^+ \to p^+ K^- \pi^+$
- $P_T(p) > 2$ GeV
- $P_T(\pi \text{ from } \Lambda_b) > 2$ GeV
- $P_T(\Lambda_c^{\pm}) > 7.5$ GeV
- $c\tau(\Lambda_c \text{ from } \Lambda_b) > -65\ \mu$m
- Impact par of $\Lambda_b < 85\ \mu$m
- $2.269 \text{ GeV} < m_{\Lambda_c} < 2.302$ GeV
- Measure branching relative to well known $\bar{B}^0 \to D^+ \pi^-$
- Use f_{baryon}/f_d from PDG as input

$$\frac{\text{Br}(\Lambda_b \to \Lambda_c^+ \pi^-)}{\text{Br}(\bar{B}^0 \to D^+ \pi^-)} = 2.2 \pm 0.4(\text{stat}) \pm 0.3(\text{sys}) \pm 0.7(Br + Fr)$$

Bottom: $B_s^0 \to K^\mp K^\pm$ Observation



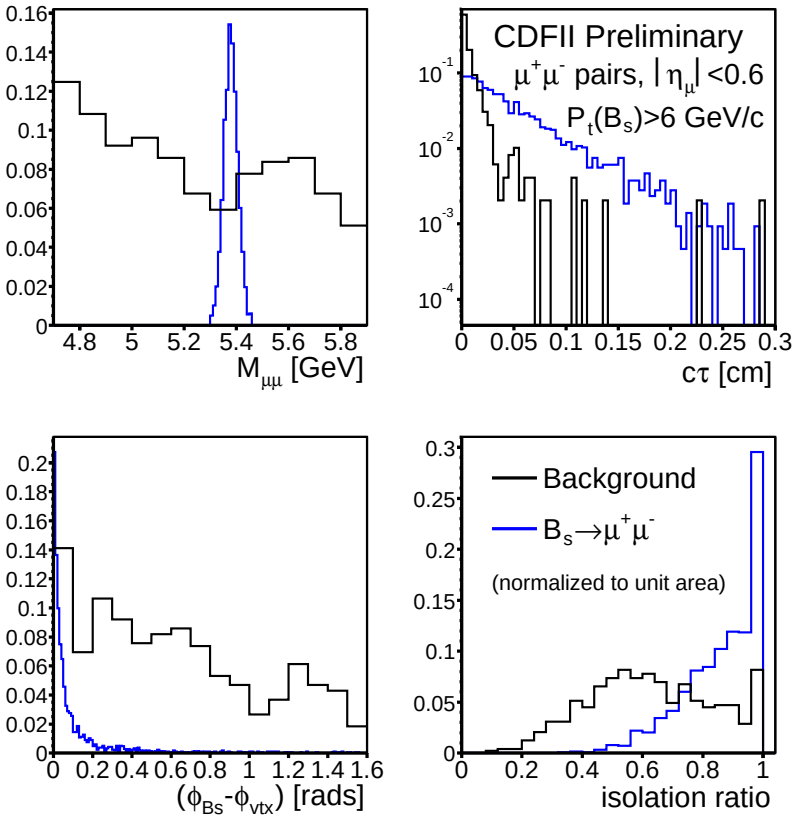


- Uses SVT
- Melange of 4 hadronic modes: $B_d \to \pi\pi$, $B_d \to K\pi$, $B_s \to K\pi$, $B_s \to KK$
- Statistically disentangle using invariant mass ($M_{\pi\pi}$) and relative momentum ($(1 - p_1/p_2)q_1$))
- Require 2 tracks with impact par $> 150\ \mu$m
- $L_{xy}(B) > 300\ \mu$m, but impact par $< 80\ \mu$m
- Use PID for K and π
- Perform Log-Like fit to 2D $M_{\pi\pi}, \alpha$ dist including PID
- Can extract, A_{CP}, relative Br and rel. Br of $B_s \to KK$

$$B_s \to KK = 90 \pm 17(\text{stat}) \pm 17(\text{sys}) \text{ events}$$

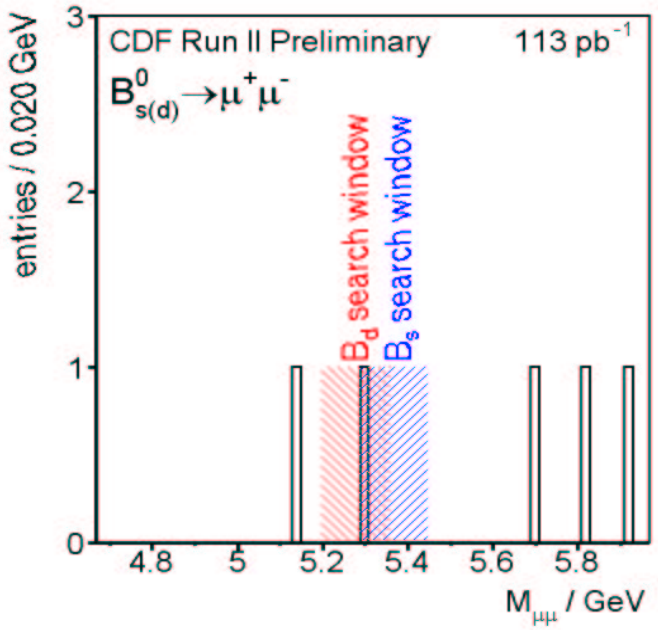
$$\frac{f_s \cdot \text{Br}(B_s \to K^\pm K^\mp)}{f_d \cdot \text{Br}(B_d \to K^\pm \pi^\mp)} = 0.75 \pm 0.20 \pm 0.22$$

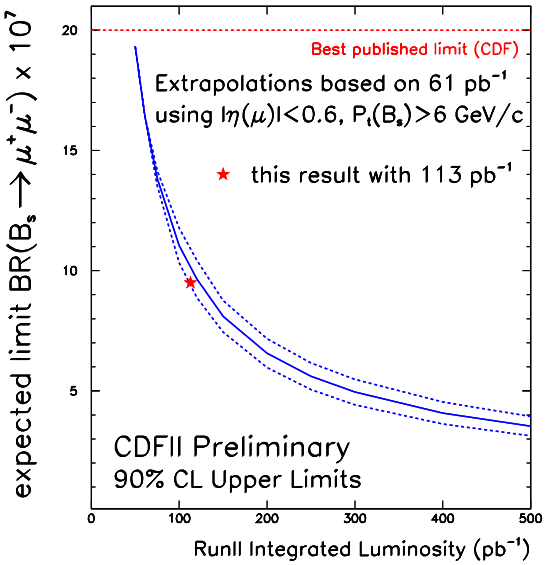
Exotics: $B^0_{s,d} \to \mu^+\mu^-$ Search



- B_s can also be used to search for new physics with FCNC $B_s \to \mu^+\mu^-$
- SM $Br \sim 3.8 \times 10^{-9}$, but SUSY predict enhancements by 1-3 orders of mag
- Recent interest due to predicted deviations of $(g-2)_\mu$ from SUSY lie in par-space with large $B_s \to \mu^+\mu^-$ (hep-ph/0207026 and hep-ph/0203069)
- Signal is pair of opp. sign muons with inv. mass consistent with B_s
- Use rare-B dimuon trigger and discriminating variables
- Mass windows of $\pm 3\sigma$ for B_s and B_d
- Interpolate bkg from sidebands
- Use measured $\sigma(B_s)$ for denominator

Exotics: $B^0_{s,d} \to \mu^+\mu^-$ Limit





- Optimized cuts on discriminating vars: $c\tau > 200\ \mu\mathrm{m}$, $\Delta\Phi < 100$ mrad, Iso> 0.65
- Total B_s signal eff of 1.89% with bkg of 0.0048 ± 0.0018 pb. Similar for B_d.
- One shared candidate
- World's best limit: $\mathrm{Br}(B^0_s \to \mu^+\mu^-) < 9.5 \times 10^{-7}$ @ 95% CL
- B_d will be competitive with more lumi: $\mathrm{Br}(B^0_d \to \mu^+\mu^-) < 2.5 \times 10^{-7}$ @ 95%CL

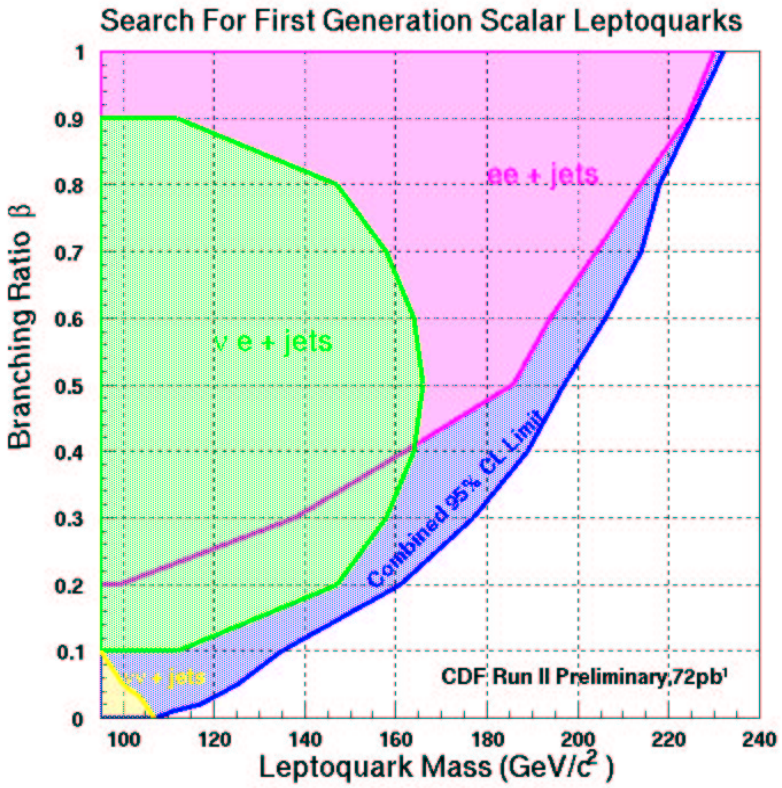
Exotics: 1st Generation Leptoquarks

- Leptoquarks (LQ): Predicted by several extensions to SM (GUTS, SUSY w/RP-violation, Technicolor...)
- Carry lepton & baryon quantum numbers
- LQ pair produced by gg-fusion & $\mathrm{q\bar{q}}$-annihilation
- To avoid FCNC's, assume LQ couple to lepton/quark of same generation
- Search as function of $\beta \equiv$ branching into chg leptons:

Channel	SM Events Expected	Observed
$\nu_e\bar{\nu}_e\mathrm{u\bar{u}}$	$42.5 \pm 7.6 \pm 7.5$	42
$\mathrm{e^+e^-u\bar{u}}$	3.39 ± 3.15	0
$e\nu_e\mathrm{u\bar{u}}$	1.73 ± 1.47	2

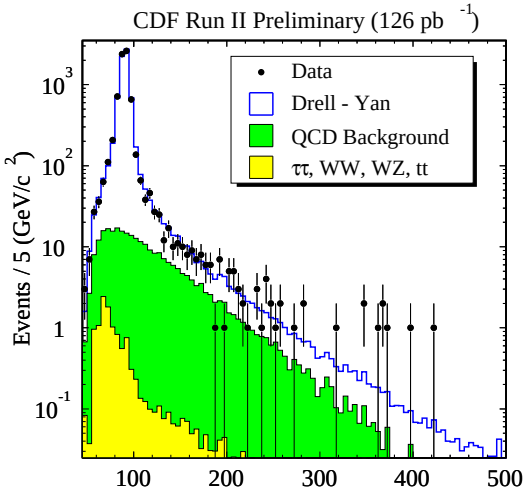
- $\nu_e\bar{\nu}_e\mathrm{u\bar{u}}$ channel
  - Trigger on missing $E_T > 45$ GeV
  - Reduce QCD multijets with large opening angle cuts and missing $E_T > 55$ GeV
  - Reject W/Z+jets with lepton veto, $N_{\mathrm{trk}}^{\mathrm{jet}} \geq 4$
  - $W \rightarrow \tau\nu$ + 2 jets and $Z \rightarrow \nu\bar{\nu}$ + 2 jets largest bkg
- $\mathrm{e^+e^-u\bar{u}}$ channel
  - High P_T electron trigger
  - Require 2 well id'd central electrons with $E_T > 25$ GeV, $P_T > 10$ GeV
  - At least 1 electron well isolated
  - Largest bkg from $\gamma/Z \rightarrow \mathrm{e^+e^-}$ + jets
  - Veto m_Z region
- $e\nu_e\mathrm{u\bar{u}}$ channel
  - High P_T electron and missing E_T
  - Combo of previous two analyses

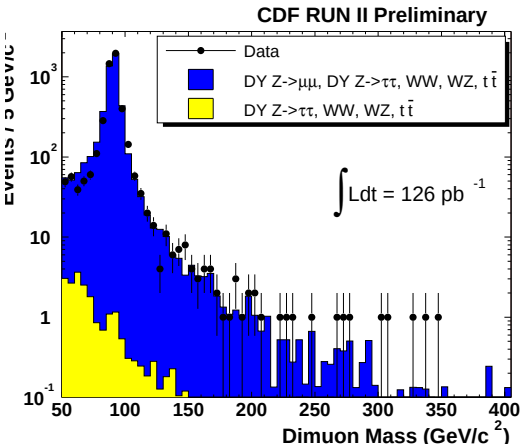
Exotics: 1st Generation Leptoquarks Limits



- Combine 3 channels to set mass limits for various β
- Accounts for small cross-eff between $\mathrm{e^+e^-u\bar{u}}$ events appearing in $e\nu_e \mathrm{u\bar{u}}$ channel
- $m_{\mathrm{LQ}} > 107$ GeV at 95% CL independent of β

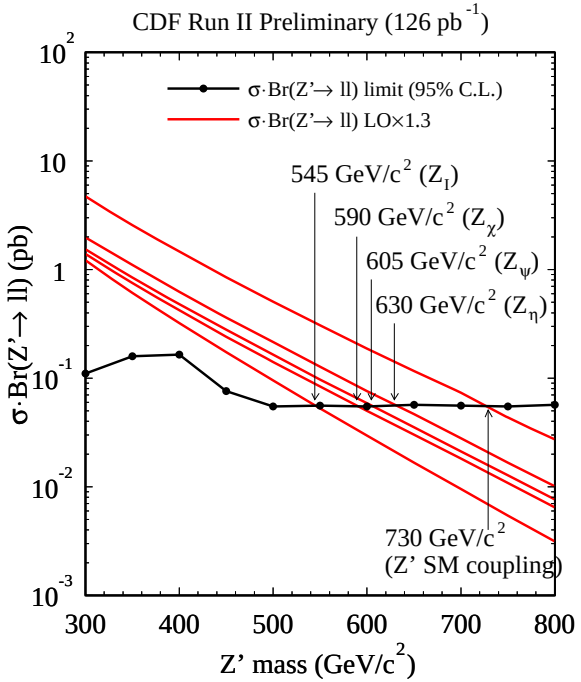
Exotics: Z' and RS Gravitons

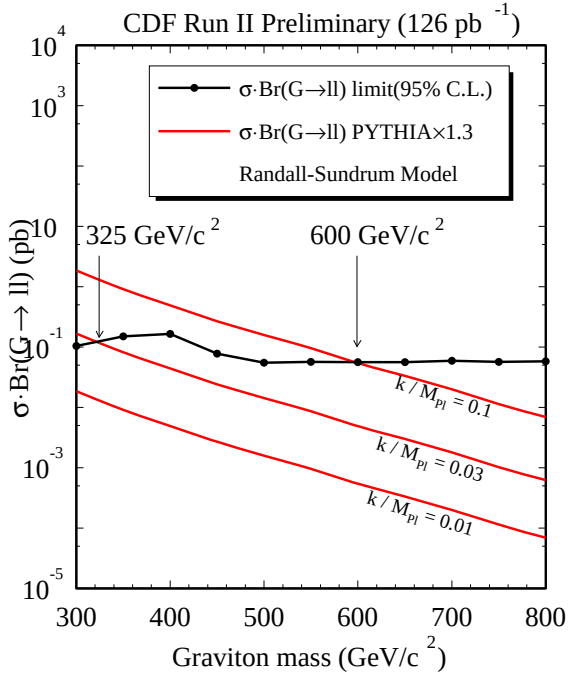




- Search for high mass opp. sign dilepton pairs ($e^{\pm}$ or $\mu^{\pm}$)
  - Assume a narrow resonance such as
    - $\mathrm{q\bar{q}} \rightarrow \mathrm{Z'} \rightarrow \ell^+\ell^-$ (Extra gauge bosons)
    - $\mathrm{q\bar{q}}, gg \rightarrow G \rightarrow \ell^+\ell^-$ (RS Gravitons)
- Backgrounds from
  - Drell-Yan, QCD, diboson, $\mathrm{t\bar{t}}$, $\mathrm{b\bar{b}}$
  - Cosmics large, but easy to id
- $\mathrm{e^+e^-}$
  - 1 good central e with $E_T > 25$ GeV
  - 2^{nd} good central or plug e $E_T > 25$ GeV
  - $(\text{missing } E_T)/\sqrt{\sum E_T} < 2.5$
  - Mass window of 3σ for each mass pt
- $\mu^+\mu^-$
  - 2 good muons
  - Cosmics rejected by COT timing & IP cuts
  - Fixed mass cut of $M_{\mu\mu} > 250$ GeV

Exotics: Z' and RS Graviton Mass Limits





	Mass (GeV)	SM Expected	Observed
e^+e^-	250 ± 20	13.9	15
$\mu^+\mu^-$	> 250	5.35	8

Other Recent CDF Analyses

- Only showed a fraction of all CDF results, much less all the new results
- Many analyses moving towards publication:
  - A_{fb}
  - $D^0 \to \mu^+\mu^-$, $\mathrm{Br}(D^0)$, $(m_{D_s^+} - m_{D^+})$ and CP Asymm
  - Charm cross section (submitted to PRL), luminosity
- *Many* B-Physics results conference-ready
  - Masses and lifetimes of Λ_b, B_s, B^+, B^0
  - Also charm results extremely competitive
- New top measurements: single top search, cross section with b-tag
- Many SUSY/Exotics searches
  - CHAMPS
  - Higgs
  - Traditional SUSY
- Look forward to many new results and publications with luminosity to be delivered until summer shutdown.

Conclusions

- Have highest E_T jets observed by CDF
- New top and EW measurements
- Have first observations of:
  - $\Lambda_b \to \Lambda_c^+ \pi^-$
  - $B_s^0 \to K^\mp K^\pm$
  - $B_s^0 \to D_s^\mp \pi^\pm$
- World's best limits on new phenomena:
  - $B_s \to \mu^+ \mu^-$
  - Direct search mass limits on Z'

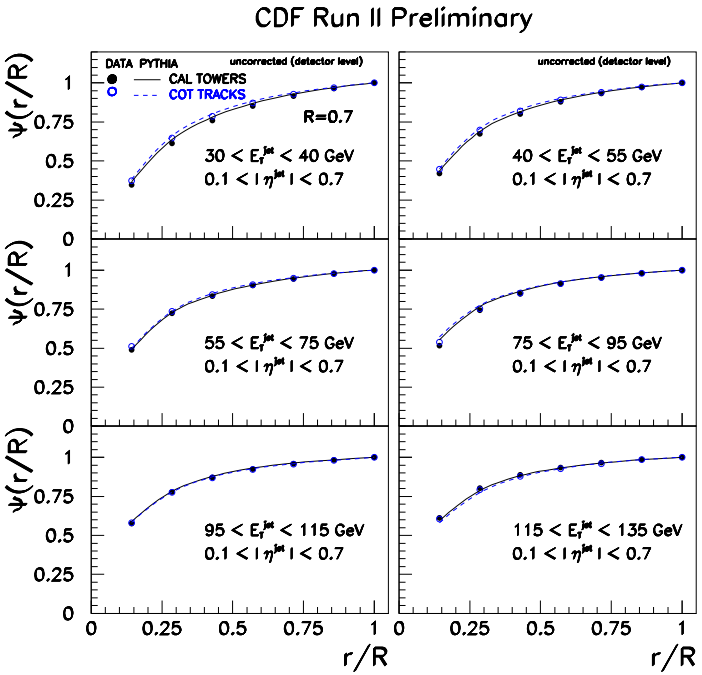
Thank You

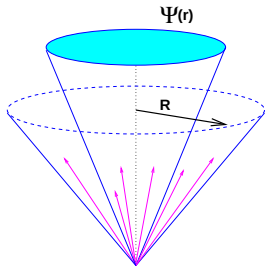
On behalf of CDF and myself,

I would like to thank the beams division
for their hard work and successful operation
of the accelerator, making world-class
physics possible at the Tevatron.

Backup Slides and Additional Material follow

Additional Material: Energy Flow Inside Jets

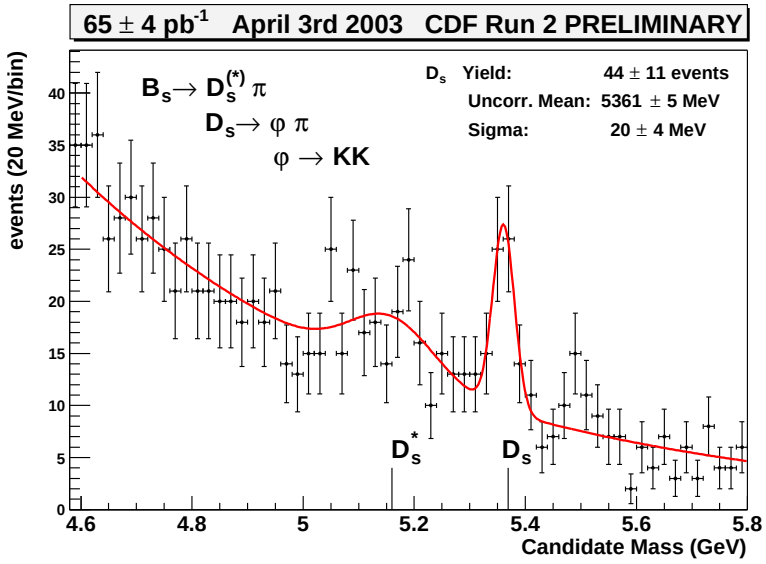




$$\psi(r/R) = \frac{1}{N_{\rm jet}} \sum_{\rm jet} \frac{E_T(0,r)}{E_T^{\rm jet}(0,R)}$$

- Jet Shape: fractional energy flow inside jets
- In central region can do with both tracks and cal
- Shapes nearly identical, data MC agree well
- Many High E_T analyses depend on well understood jet properties

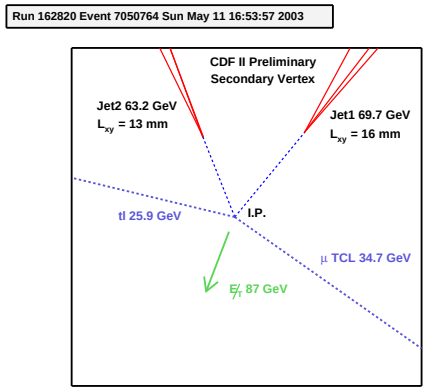
Additional Material: $B_s^0 \to D_s^{\mp}\pi^{\pm}$ Observation & Branching Fraction

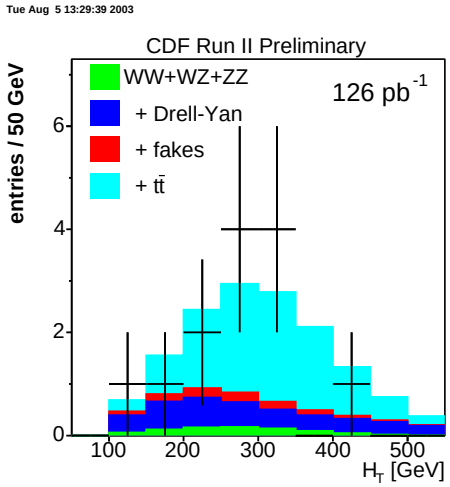


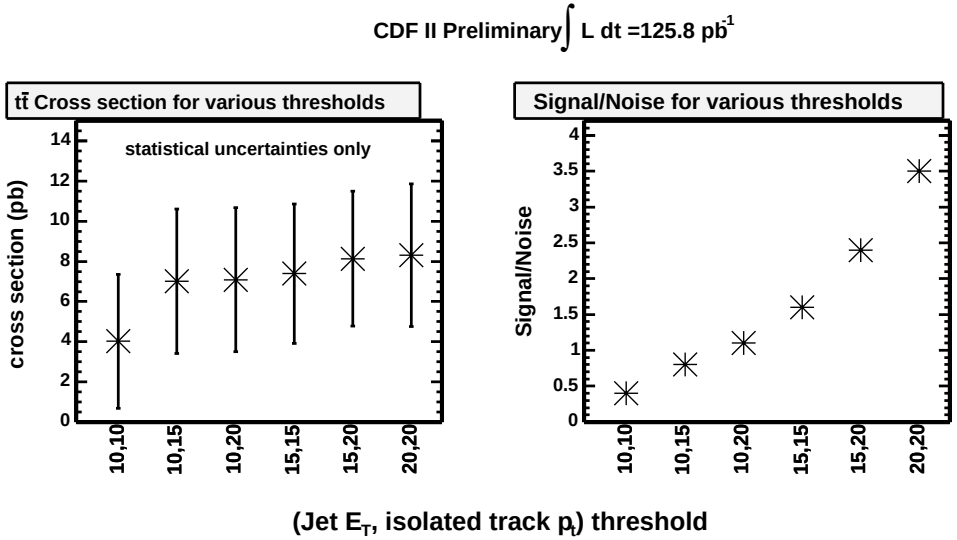
- Uses SVT
- Use decay mode $D_s \to \phi\pi$ with $\phi \to K^+K^-$
- $1.013\ \text{GeV} < m_{KK} < 1.028\ \text{GeV}$
- $m_{D_s} = 1968.5\ \text{MeV}$ from PDG
- $P_T(D_s) > 4\ \text{GeV}$
- $P_T(B_s) > 4\ \text{GeV}$
- $L_{xy}(D_s) > 400\ \mu\text{m}$
- $L_{xy}(B_s) > 100\ \mu\text{m}$
- Impact par of $B_s < 100\ \mu\text{m}$
- Measure branching relative to well known $B_d^0 \to D^{\mp}\pi^{\pm}$
- Use f_s/f_d from PDG as input

extract $\frac{\text{Br}(B_s \to D_s\pi)}{\text{Br}(B_d \to D\pi)} = 1.61 \pm 0.40(\text{stat}) \pm 0.40(Br) \pm 0.26(\text{sys}) \pm 0.20(Fr)$

Backup: Lepton+Track Cross Section







- No anomalies in H_T
- Cross section stable as function of E_T, P_T