WW Production at CDF

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UCL

IOP Particle Physics 2004

April 7th
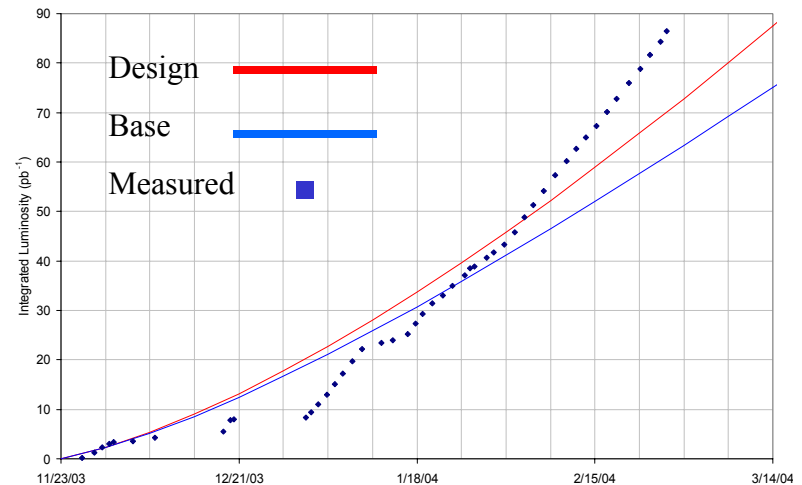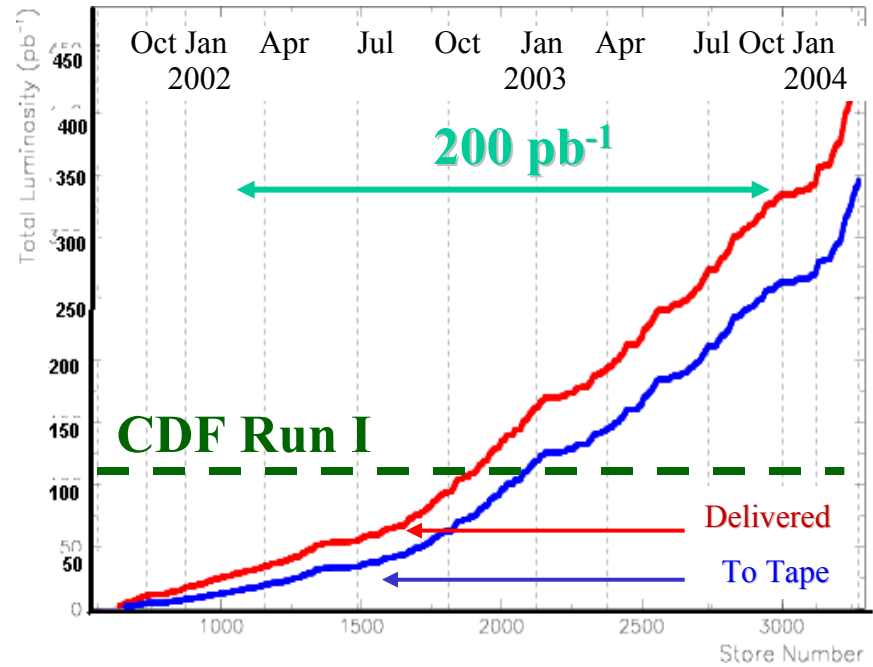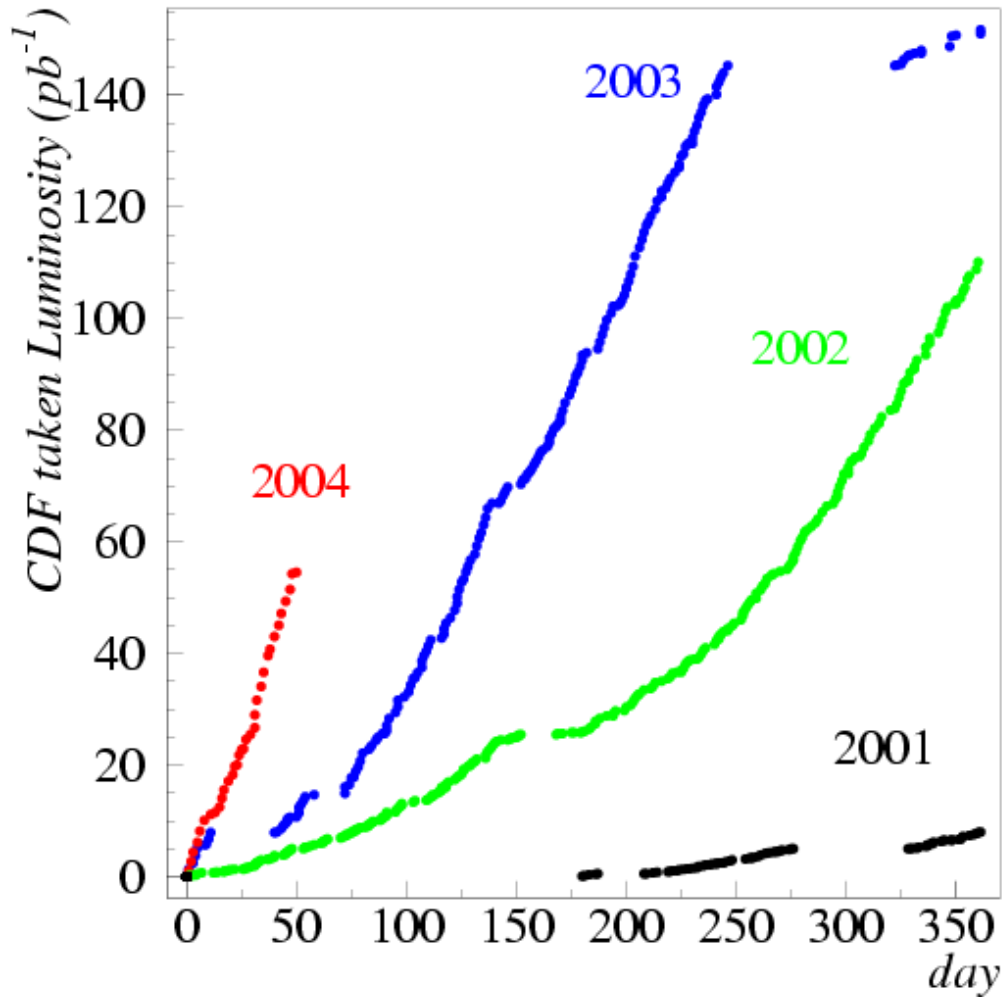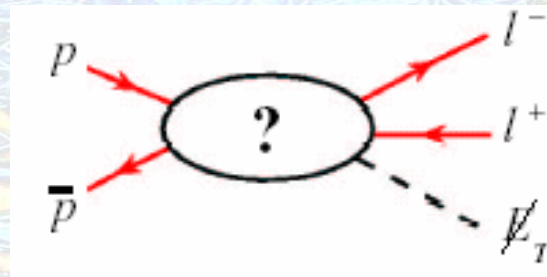
CDF and the Tevatron

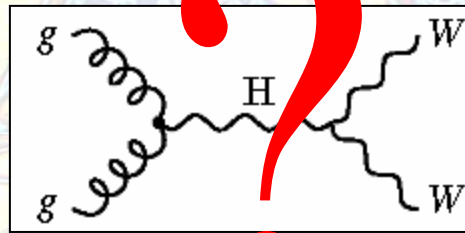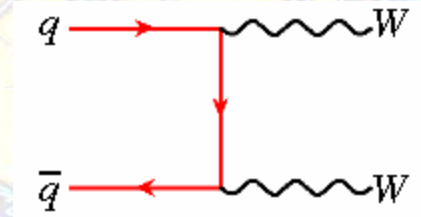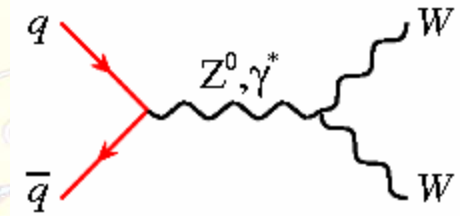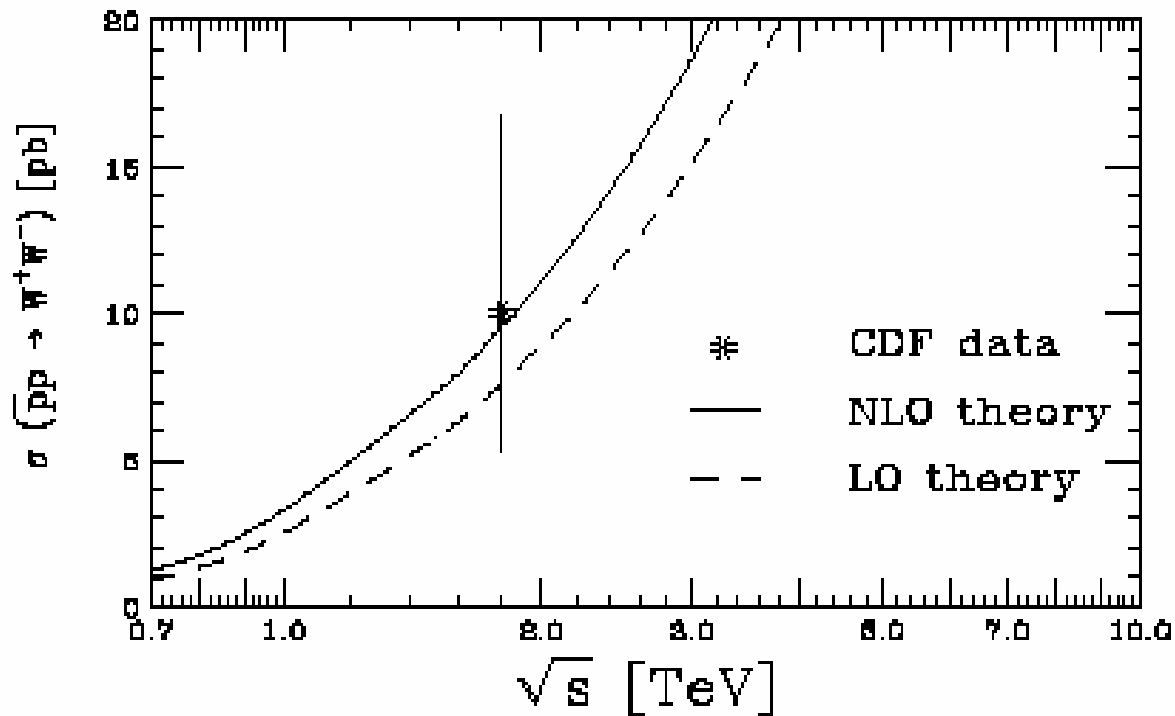2 TeV Proton Anti-Proton collider. Highest energy in the world!
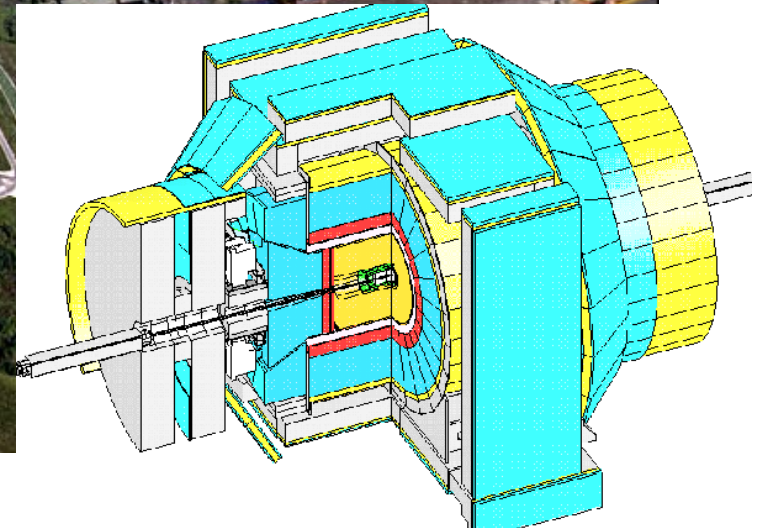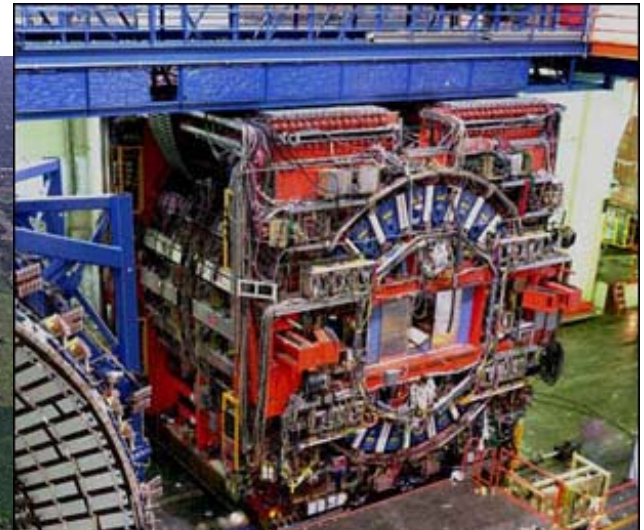
Tevatron Luminosity

$WW \rightarrow l\nu\, l\nu$

σ measurement in dilepton channel (e or μ)

WW : Run I

Run 1

$$\sigma(p\bar{p} \rightarrow W^+W^-) = 10.2^{+6.3}_{-5.1}(stat) \pm 1.6(syst) \text{ pb}$$

Event Selection + Backgrounds

Selecting WW events:

- 2 leptons (e or μ)
- Missing $E_T > 25$ GeV

W γ

- γ fakes other lepton
- Reject with cut on σ(missing-E_T)
- And opposite sign requirement

Drell-Yan (Z $\rightarrow \mu\mu$/ee)

- Can fake large missing-E_T
- Reject with cut on σ(Missing-E_T)

QCD (W+jets)

- One jet fakes a lepton
- Reject with opposite sign requirement

W Z

- Require ONLY 2 leptons

$t\bar{t}$

- Require 0 jets

Results I

|	CDF Run II Preliminary, $200\,\mathrm{pb}^{-1}$			
Source	ee	$\mu\mu$	$e\mu$	$\ell\ell$
Drell-Yan e^+e^-	0.69 ± 0.31	0.00 ± 0.00	0.048 ± 0.039	0.74 ± 0.31
Drell-Yan $\mu^+\mu^-$	0.00 ± 0.00	0.61 ± 0.24	0.28 ± 0.12	0.89 ± 0.27
Drell-Yan $\tau^+\tau^-$	0.047 ± 0.018	0.046 ± 0.018	0.098 ± 0.037	0.19 ± 0.05
WZ	0.29 ± 0.03	0.32 ± 0.03	0.15 ± 0.02	0.76 ± 0.06
$W\gamma$	0.48 ± 0.13	0.00 ± 0.00	0.57 ± 0.13	1.05 ± 0.19
$t\bar{t}$	0.013 ± 0.008	0.008 ± 0.005	0.033 ± 0.014	0.053 ± 0.017
Fake	0.45 ± 0.20	0.15 ± 0.13	0.48 ± 0.23	1.08 ± 0.49
Total Background	1.97 ± 0.40	1.14 ± 0.28	1.66 ± 0.31	4.77 ± 0.70
$WW \rightarrow$ dileptons	2.90 ± 0.34	2.75 ± 0.32	5.69 ± 0.66	11.3 ± 1.3
Total Expectation	4.87 ± 0.55	3.89 ± 0.45	7.35 ± 0.76	16.1 ± 1.6
Run 2 Data	6	6	5	17

From MC

From Data

Results II

Run II Measured Cross-Section

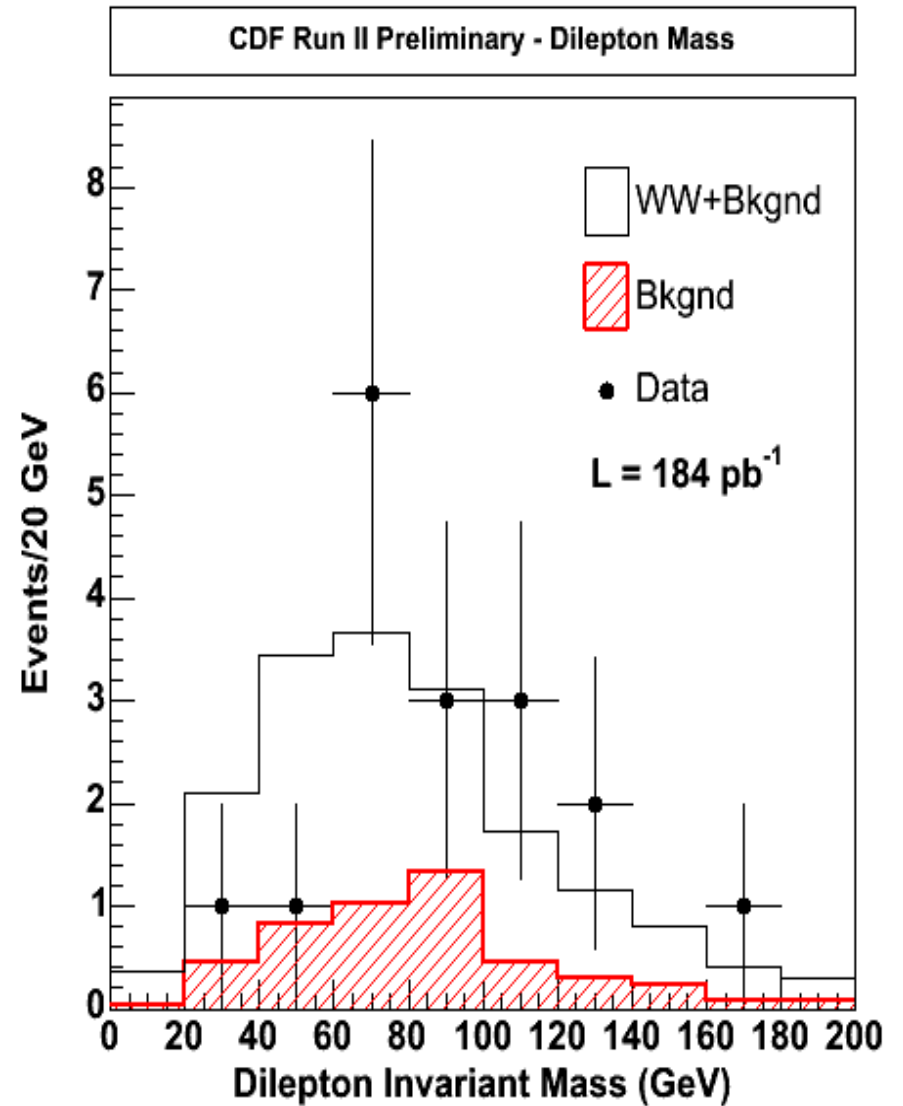$$\sigma(p\overline{p} \rightarrow W^+W^-) = 14.3^{+5.6}_{-4.9}(stat) \pm 1.6(syst) \pm 0.9(lum)\,\text{pb}$$
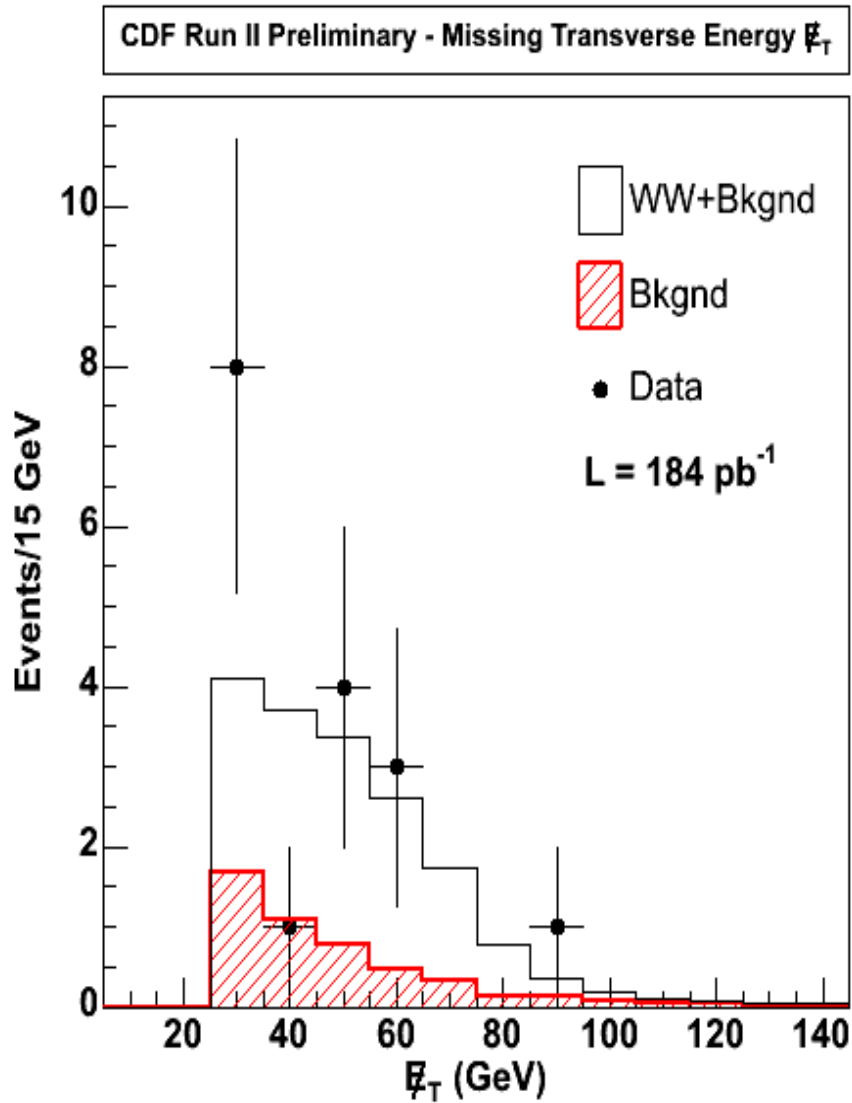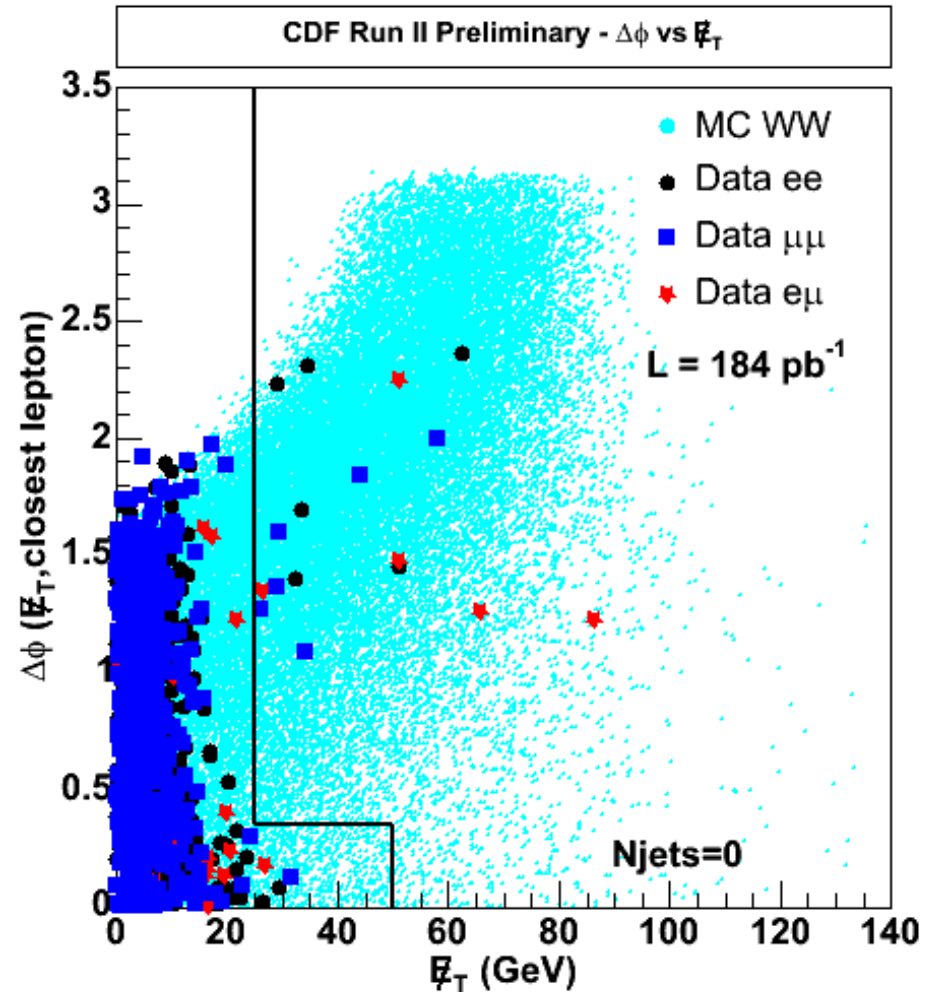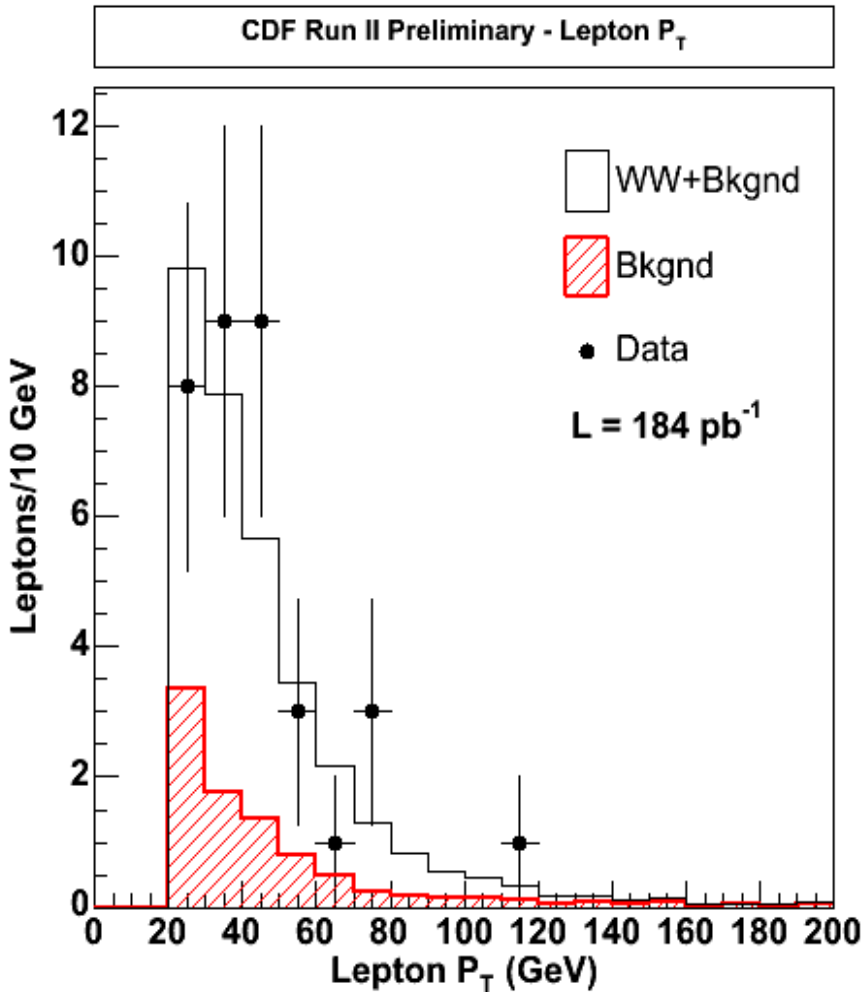
Theory

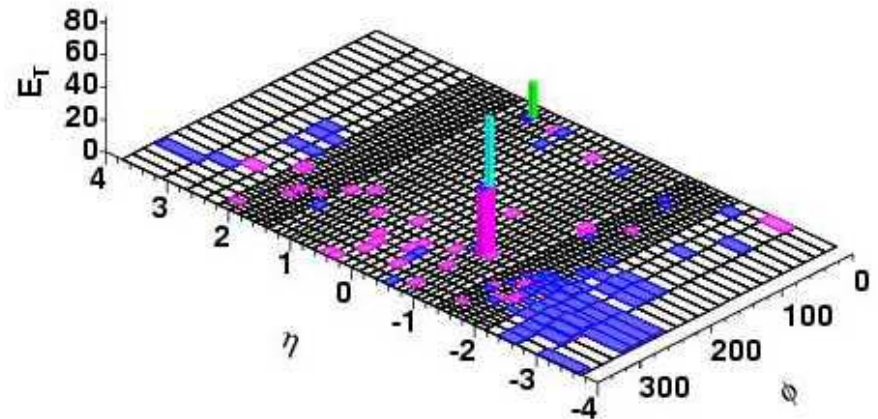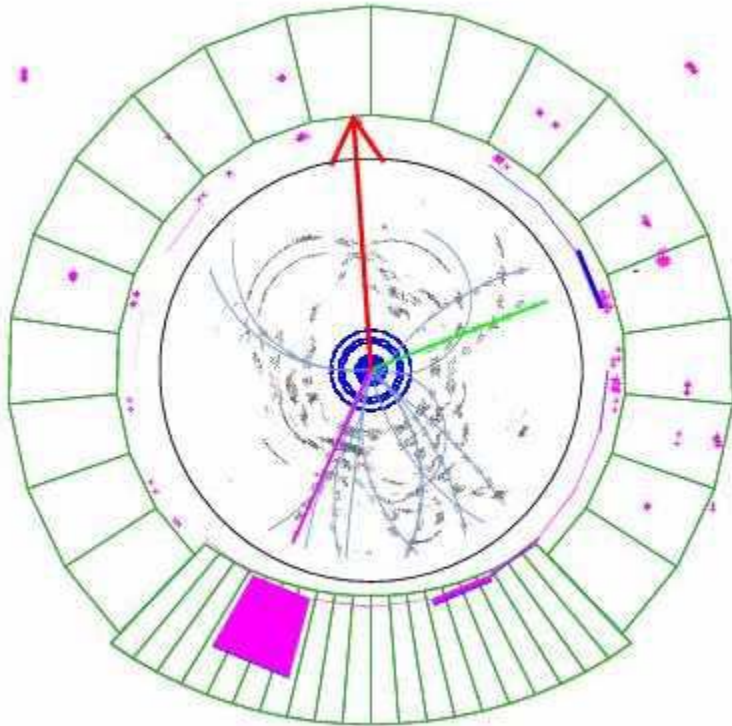$$\sigma^{WW}_{NLO} = 12.5 \pm 0.8\,pb$$
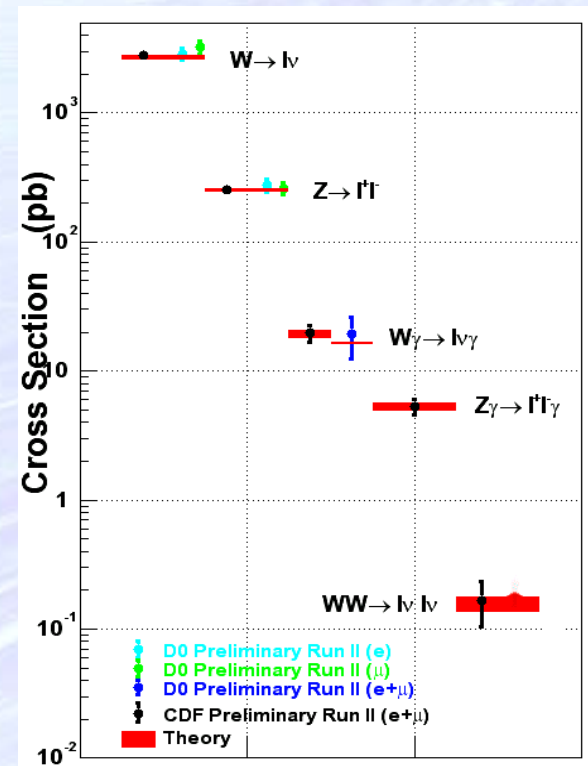
Results III

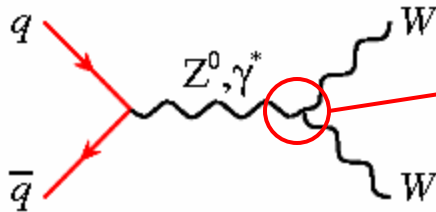# Results IV

Results V

Missing-E_T = 64.9 GeV

$P_T(e)$ = 42.0 GeV $P_T(\mu)$ = 20.0 GeV
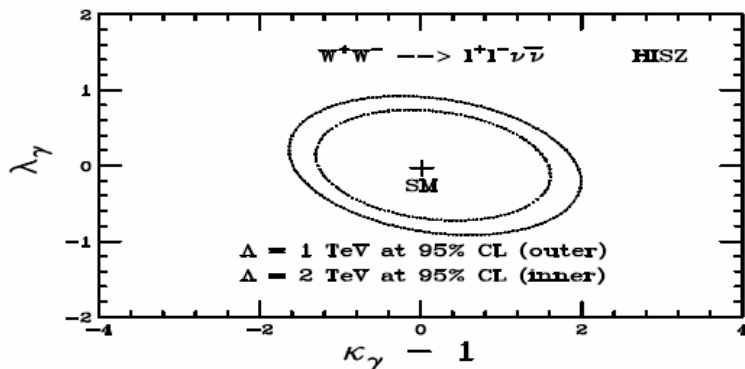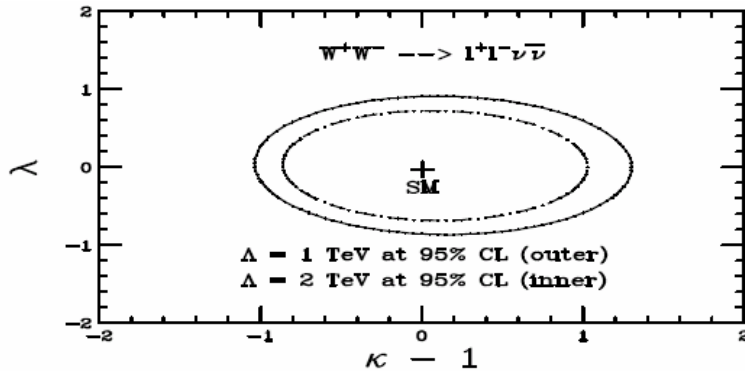
$M_{e\mu}$=81GeV

Next Step: Anomalous Couplings

Test SM description of boson interactions
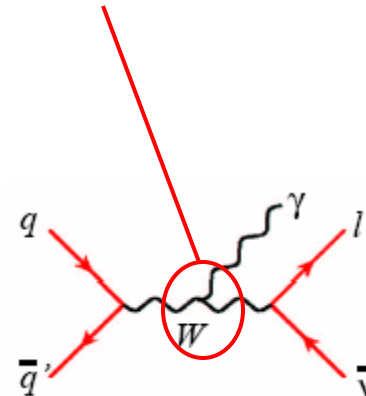
Non-SM interactions Give different cross-section and different kinematics

Run I Anomalous Coupling Limits

Complimentary to Wγ analysis

Need to use both measurements to understand all the couplings, WWZ, WWγ etc

Summary

Established the WW dilepton signal in Run II data

Measured Cross-Section in good agreement with SM

Publication on the way (summer)

Then anomalous couplings….

Backup slides

CDF efficiency