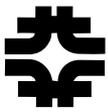


CDF Status and Tevatron Physics Results

Andy Hocker, TD/CDF
FRA Physics Visiting Committee
April 25/26 2008



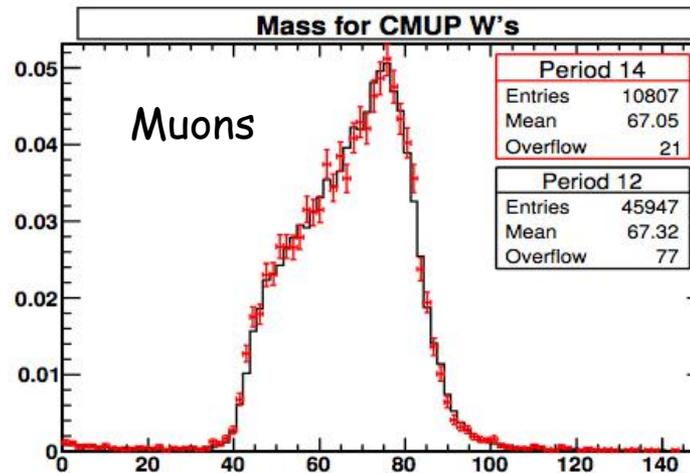
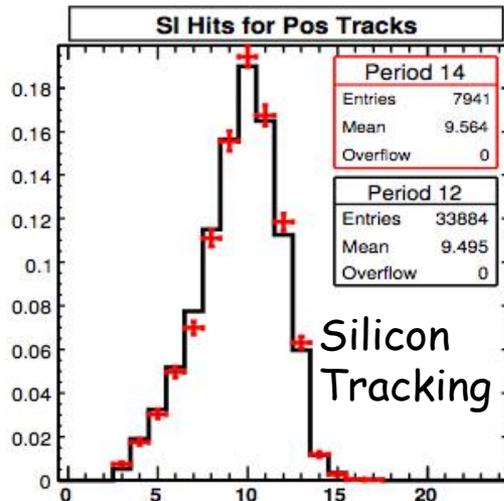
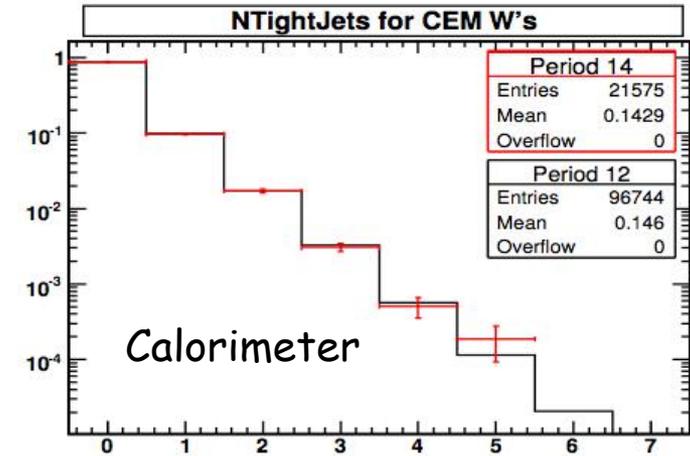
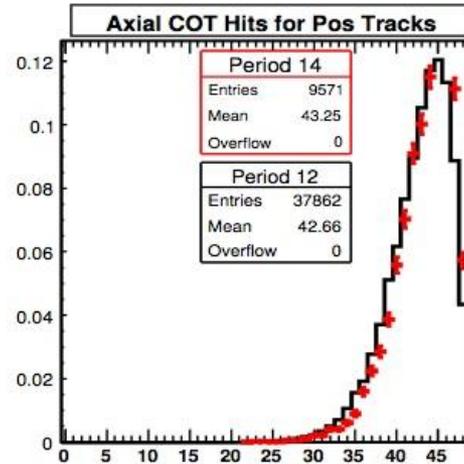
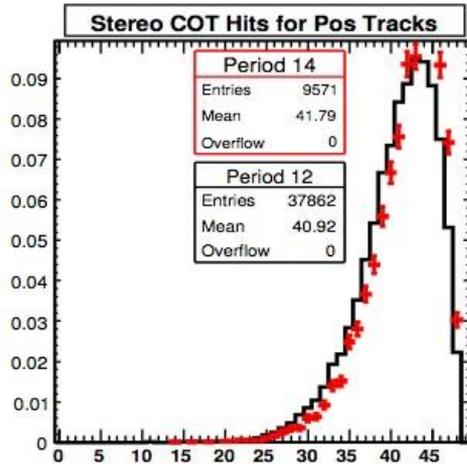
- CDF detector and operations
- Physics results tour
 - Standard Model
 - B physics
 - Electroweak physics
 - Top physics
 - Beyond the SM
 - SUSY searches
 - Model-independent new physics search
- Wade will also cover CDF's contributions to
 - CP violation in the B_s system
 - SM Higgs searches
- CDF's future



Data -- the quality



Central Tracking

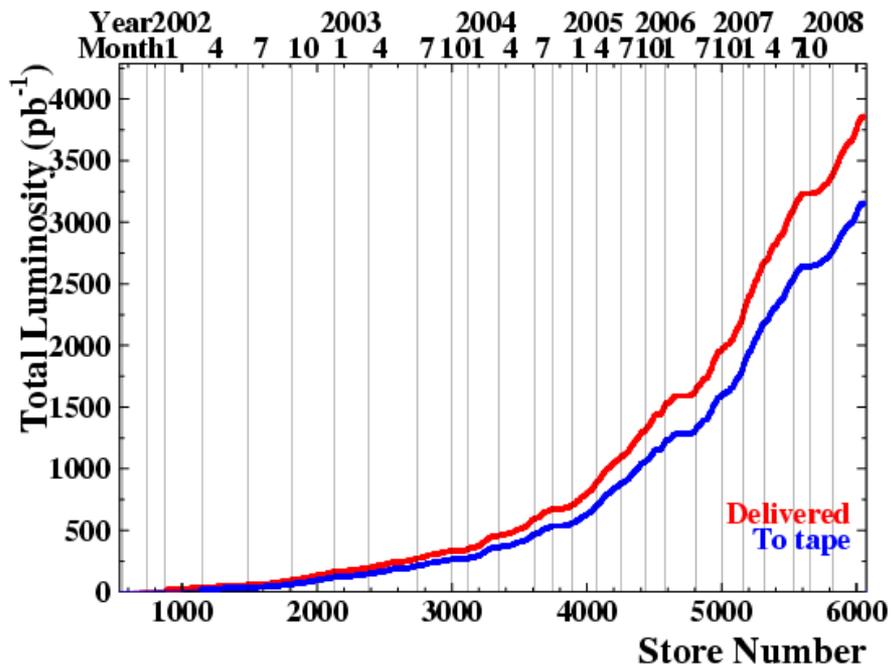
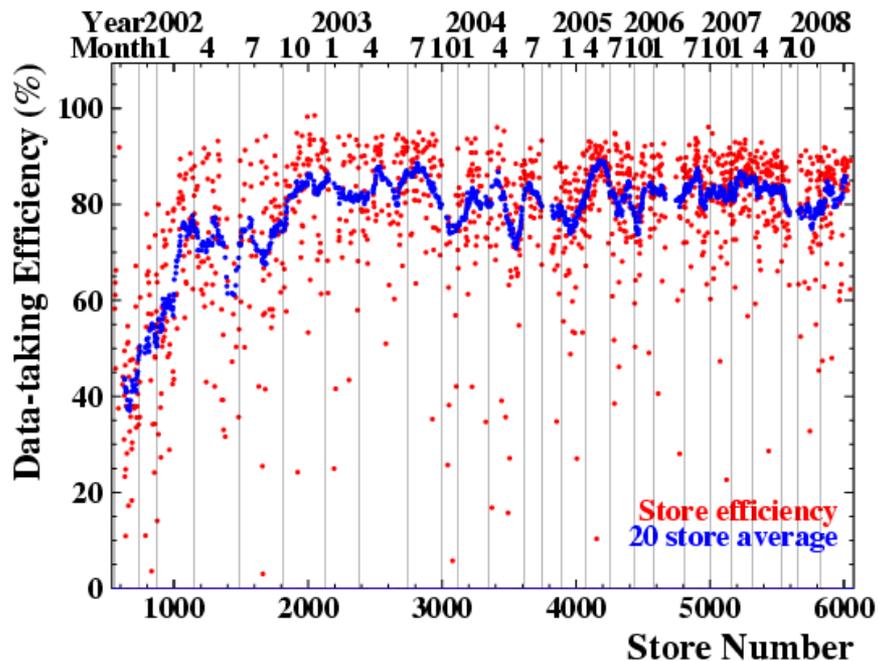


- Pre-2007 shutdown
- Post-2007 shutdown

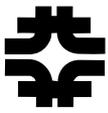
- Detectors running well
- Nothing aging prematurely



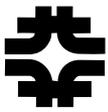
Data -- the quantity



- Operating for years with $\sim 85\%$ efficiency
 - Even with TeV's record-breaking inst. lumis
- 3.2 fb^{-1} in the can
 - Results on this dataset at summer conferences



- 16 THz of on-site CPU for data processing and user analysis
- Data calibration / reconstruction / analysis-packaging chain hums along
 - We log about 2-3 Mevts/day
 - We can process ~40 Mevts/day when needed
- Collision-to-analysis turnaround time at ~8 weeks
- Making use of GRID/offsite farms for Monte Carlo production
 - ~300 Mevts



...all of which leads to...



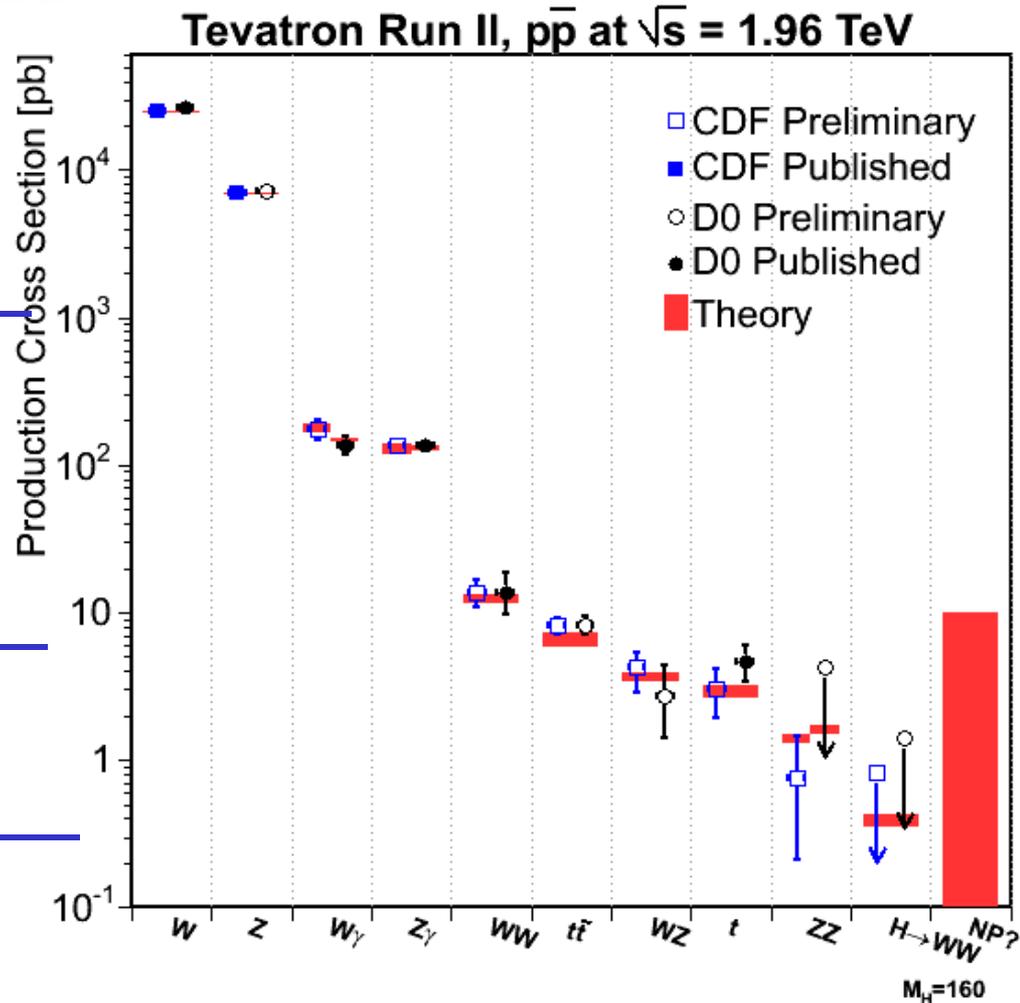
a rich tapestry of beautiful physics results

QCD, B physics - - -

EW physics

Top physics

Higgs and the unknown

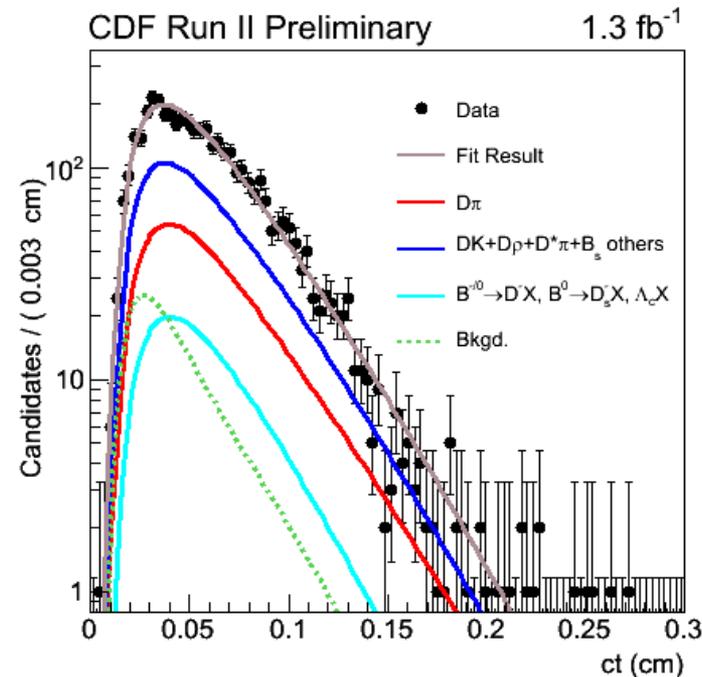
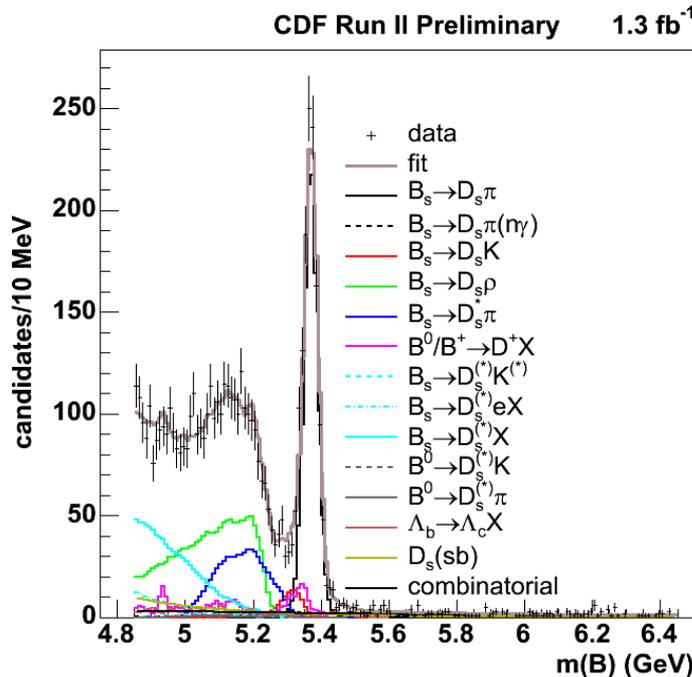




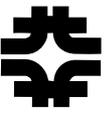
Precision B_s lifetime



- Tevatron has a rich B-physics program
 - And B_s is our exclusive playground
- CDF's secondary vertex trigger gives large samples of hadronic B_s decays



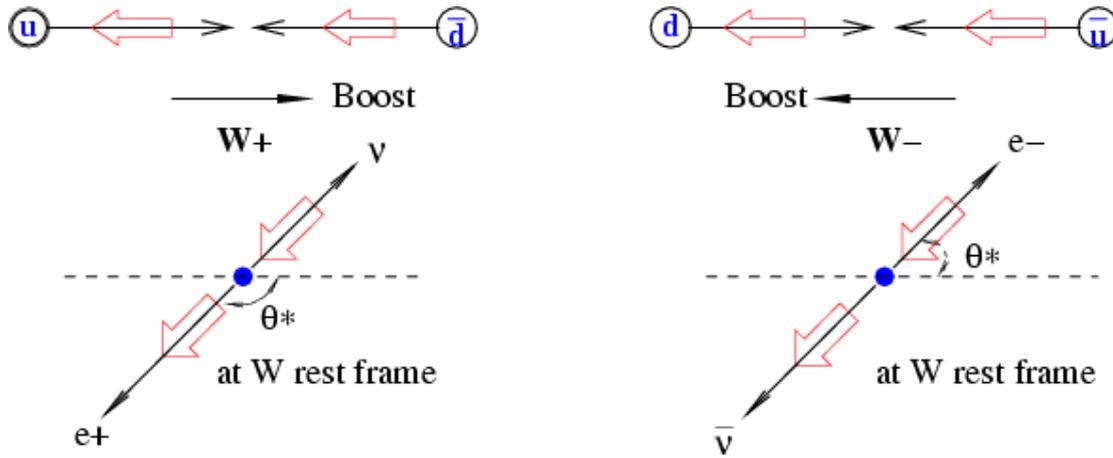
- Fit fully/partially reconstr'd $B_s \rightarrow D_s^- \pi^+ X$ decays
 - $\tau_{B_s} = 1.518 \pm 0.041$ (stat) ± 0.025 (syst) ps
- Confirms $\tau_{B_s}/\tau_{B_0} : 0.99 \pm 0.03$ (single most precise)
 - Previously $\sim 3\sigma$ discrepancy



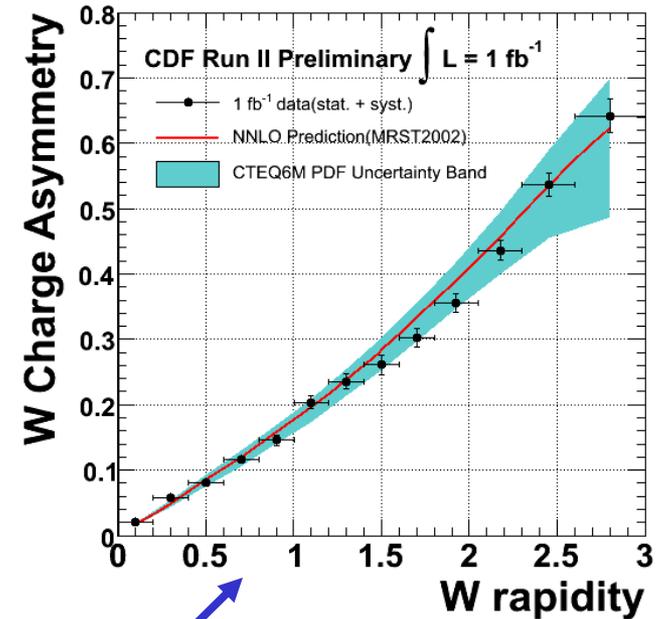
W production charge asymmetry



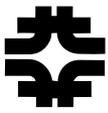
- Copious vector boson production at Tevatron
 - An effective tool for a broad range of physics
- Ex: W production as a window to proton structure



- Electron direction has some sensitivity to W asymmetry
 - Diluted by decay kinematics
- Developed techniques to get at W rapidity directly



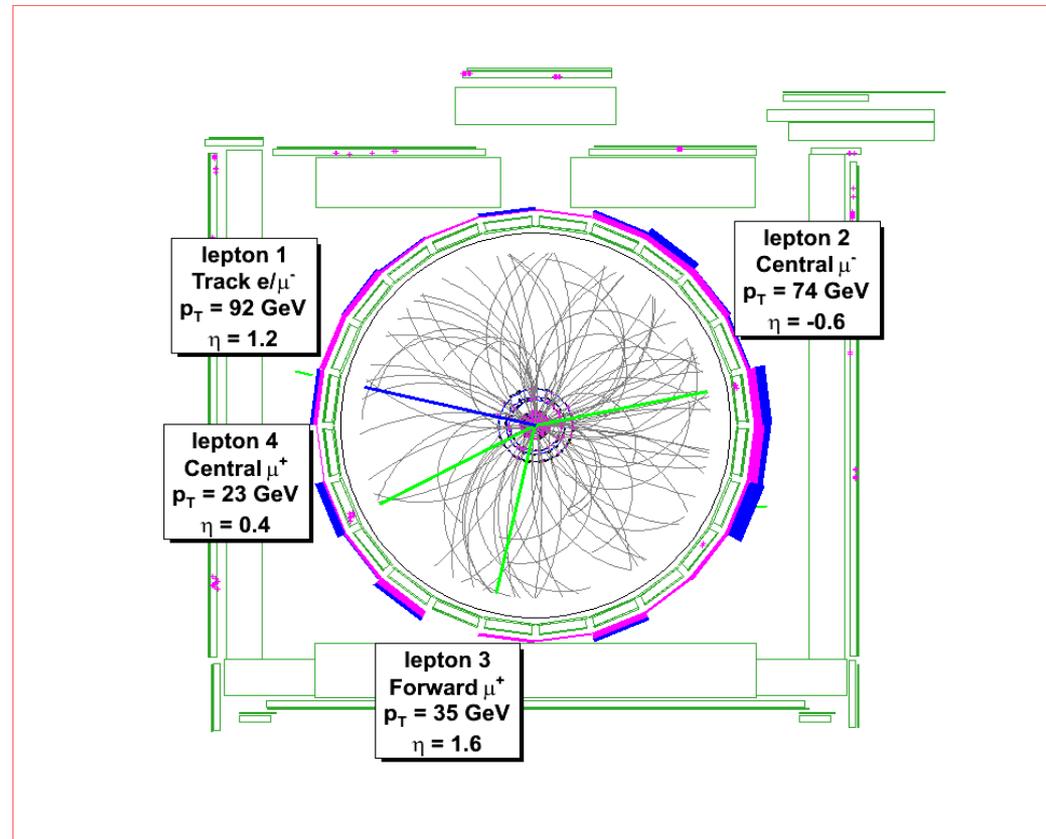
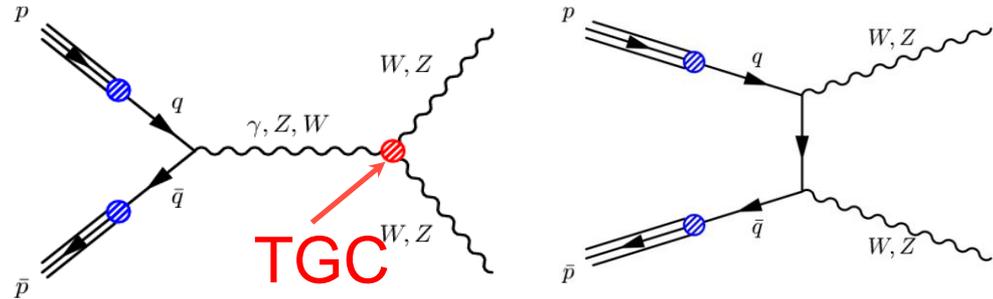
- Asymmetry constrains PDFs at $Q^2 \sim M_W^2$
 - Important input data for LHC



Diboson production



- EW interaction as a hunting ground for new physics
 - SM nails down triple gauge vertex; anomalies will be unambiguous
- Xsecs are small, but 2 fb^{-1} results on anomalous TGC's already competitive w/ LEP2
 - Complementarity too, e.g. resolving γWW and ZWW
- $W\gamma$, $Z\gamma$, WW , and WZ well established, latest foray is ZZ production
 - 4.4σ obsv., $\sigma = 1.4^{+0.7}_{-0.6} \text{ pb}$

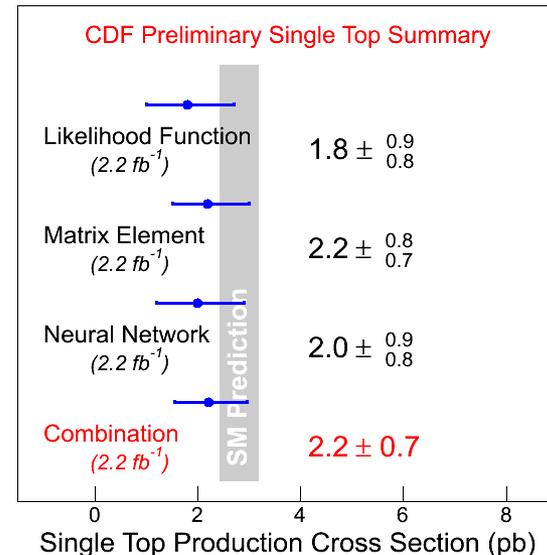
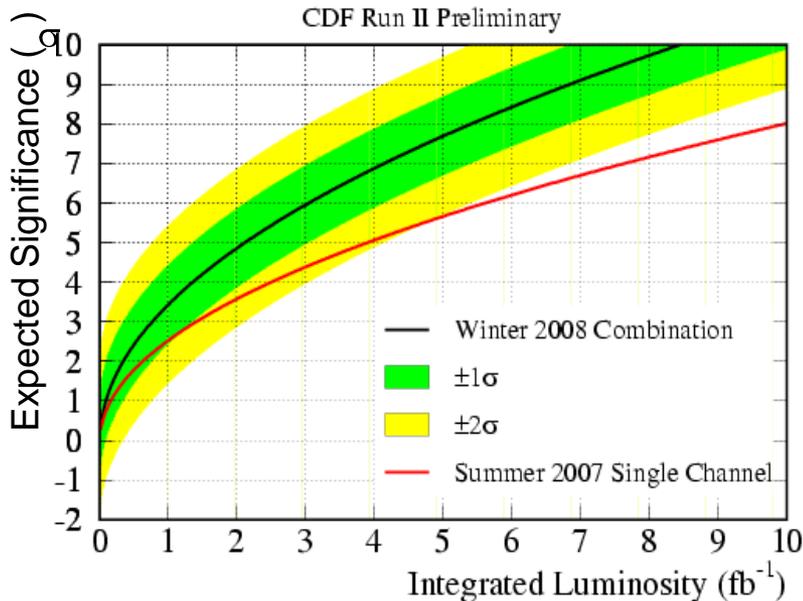




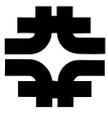
Single top production



- So far, Tevatron top physics done with $t\bar{t}$ pairs (QCD prod)
- EW single top production: lots of good physics to be done
 - tWb vertex and direct access to $|V_{tb}|$
 - Top spin
 - Lots of experimental overlap with the Higgs
- Combination of 3 complex analyses gave CDF 5.1σ sensitivity with 2 fb^{-1}
 - 3.7σ observed, but should be 5σ by summer conferences



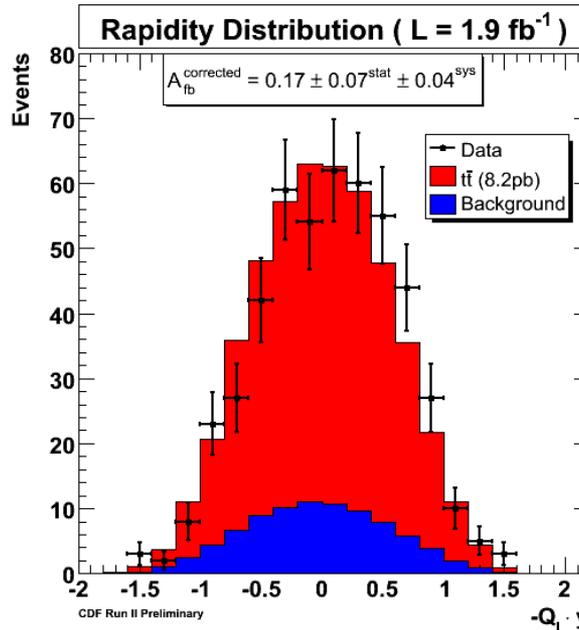
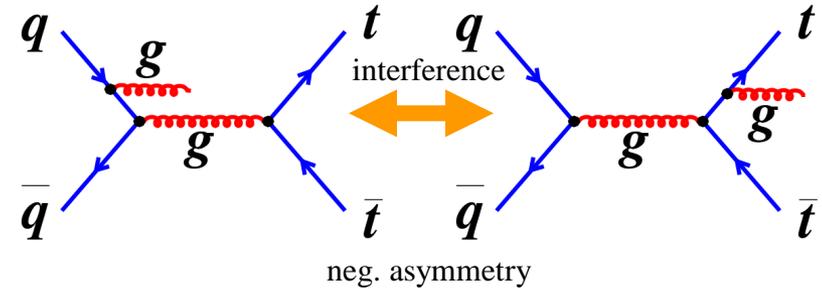
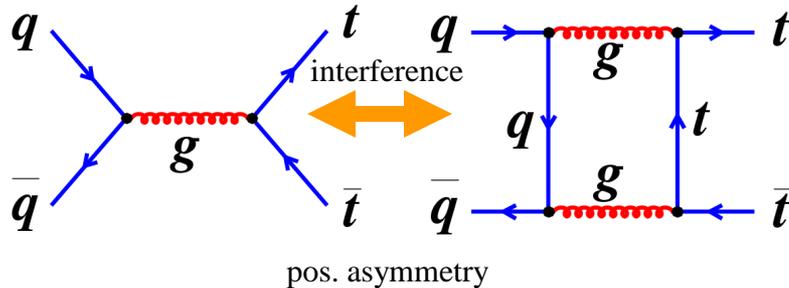
- $|V_{tb}| = 0.88 \pm 0.14 (\text{exp}) \pm 0.07 (\text{theo})$



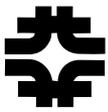
A_{FB} in $t\bar{t}$ production



- Tevatron's exclusive top physics program is extensive
 - Ever more detailed top properties studied as the data piles up
- A_{FB} : Zero at LO, 4-5% at NLO



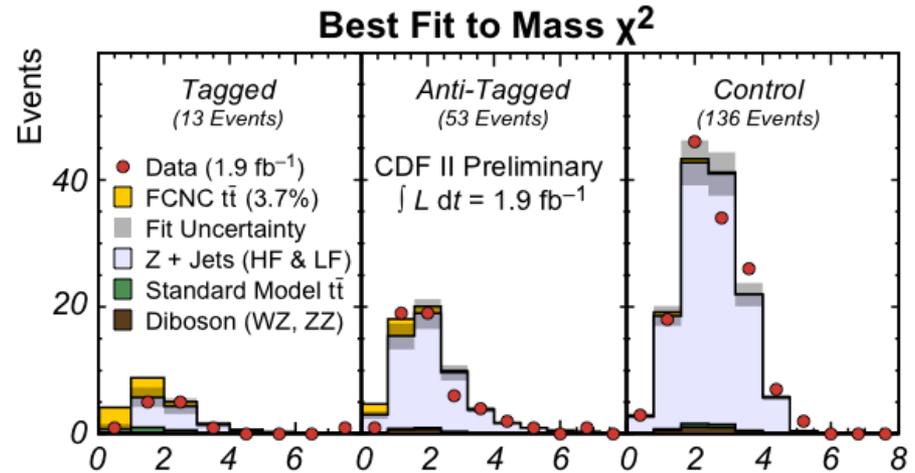
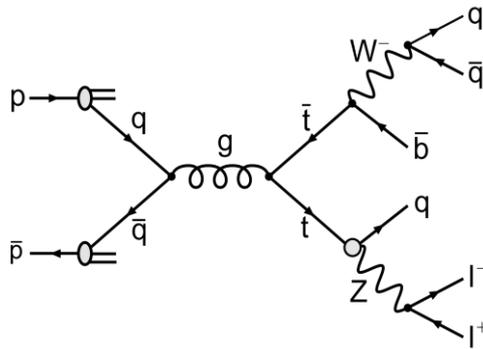
- $A_{FB} = 0.17 \pm 0.07 \pm 0.04$
- Potentially sensitive to non-SM production mechanism (Z' , etc)



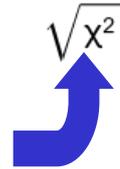
Rare top decays



- SM $BR(t \rightarrow Zq) \sim 10^{-14}$ in SM (FCNC)
- New physics (SUSY, 2HDM, etc.) \rightarrow large enhancements
 - Smoking gun



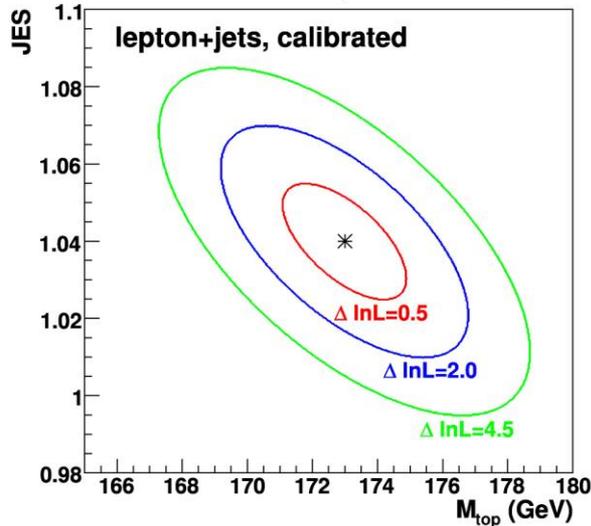
- Fit Z+jets events to $t\bar{t}$ kinematic hypothesis
- $BR(t \rightarrow Zq) < 3.7\% @ 95\% CL$





M_t and M_W

DØ Run IIb Preliminary, $L=1.2 \text{ fb}^{-1}$ (combined w/ Run IIa)

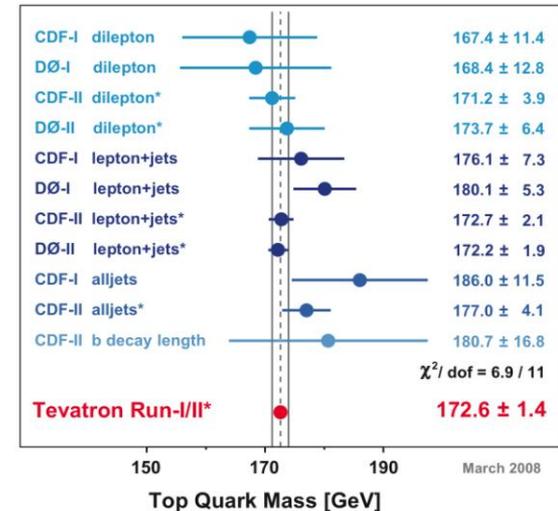


Tevatron combo



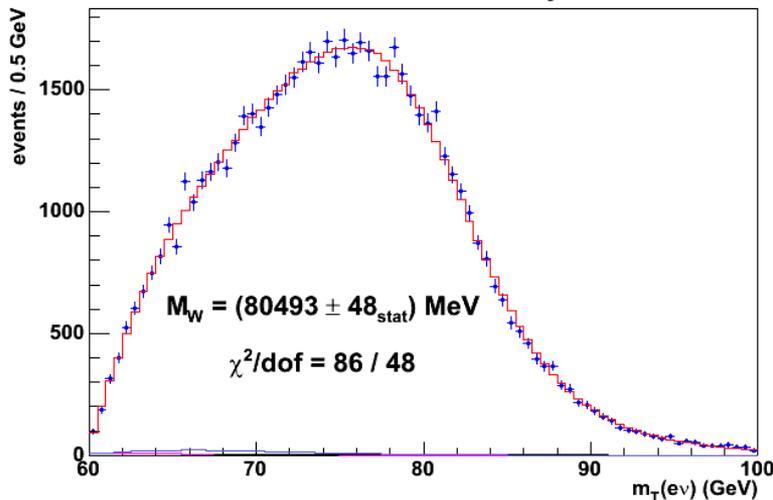
0.8% rel. uncertainty

Best Independent Measurements of the Mass of the Top Quark (*=Preliminary)

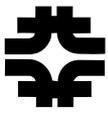


CDF II preliminary

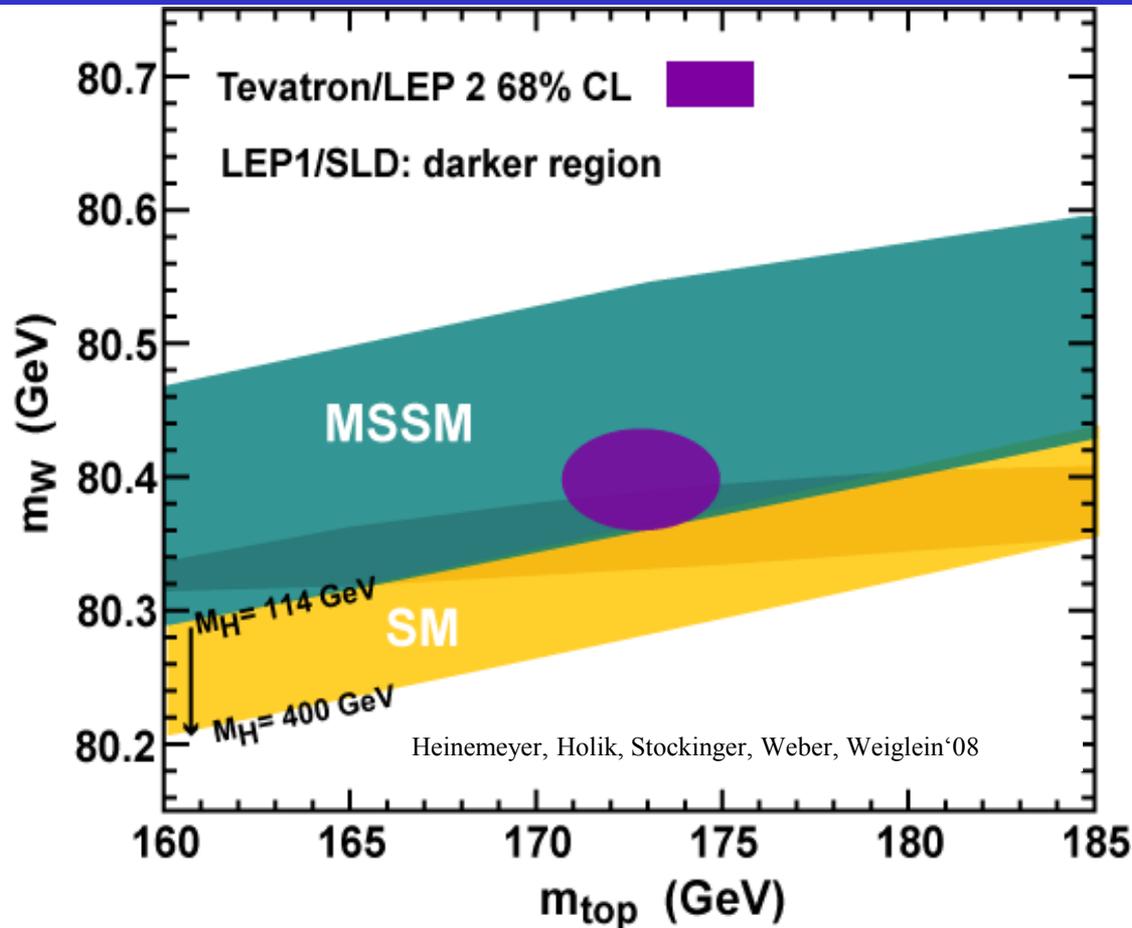
$\int L dt \approx 200 \text{ pb}^{-1}$



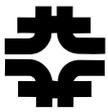
- $M_W = 80413 \pm 48 \text{ MeV}/c^2$
- Expect 25 MeV/c^2 for ICHEP08 (2 fb^{-1})



M_t/M_W implications



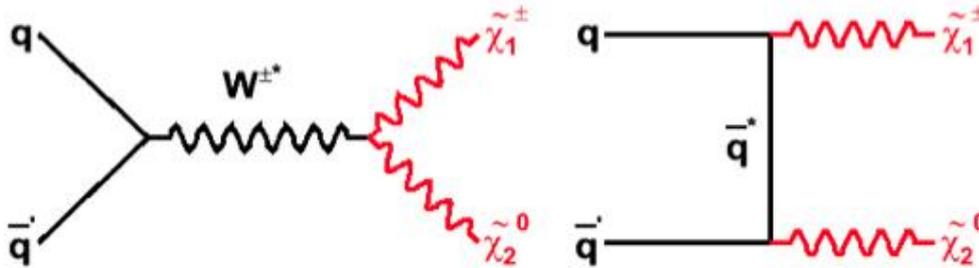
- Favors a light Higgs --- where the Tevatron has a shot and the LHC has their work cut out for them



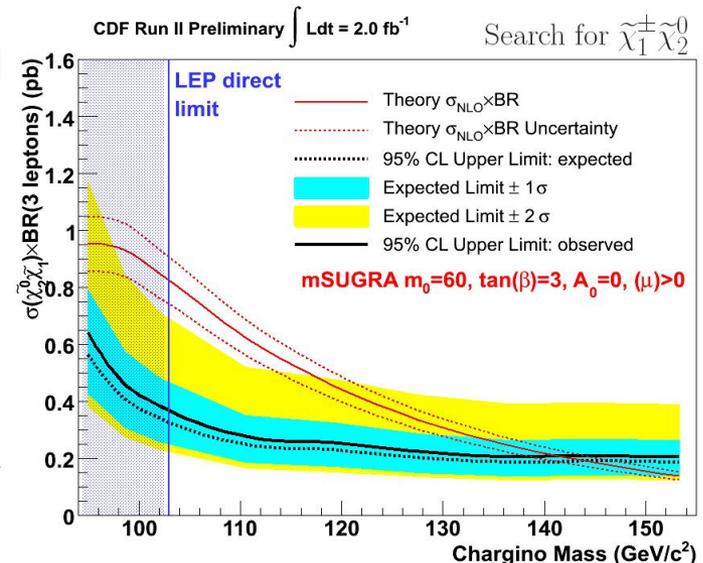
Searches: SUSY charginos/neutralinos

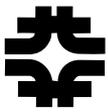


- SUSY just one of many new physics models searched for at Tevatron
- Zoo of superpartners predicted with observable prod. rates
 - Consequent zoo of final states where SUSY could appear
- Example: charginos and neutralinos
 - Trilepton signatures = sore thumbs



- Well-understood detector has allowed a loosening of lepton ID and larger signal acceptance
- No signals seen, allowing us to significantly constrain the SUSY parameter space

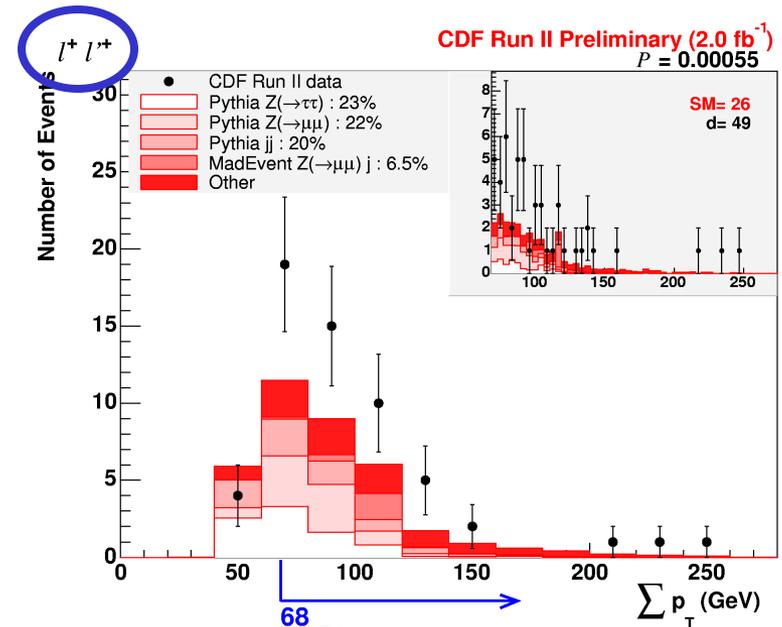




Searches: model-independent

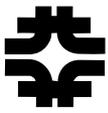


- Lots of new physics models under study, but...
 - Who knows if any of them are even right?
- Perform systematic search of entire high- p_T dataset
 - Cast a wide net to complement the searches targeted at specific models and final states
 - Look for excess at large p_T
 - Fight about what it is later

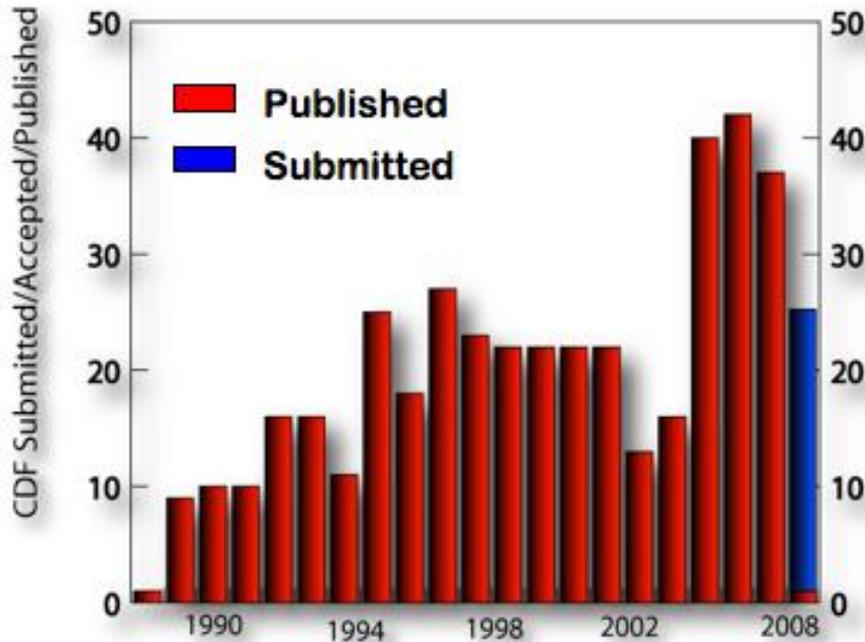


$\tilde{P} = 0.08$
after taking into account "trials factor"
(87 final states searched)

...more data please!



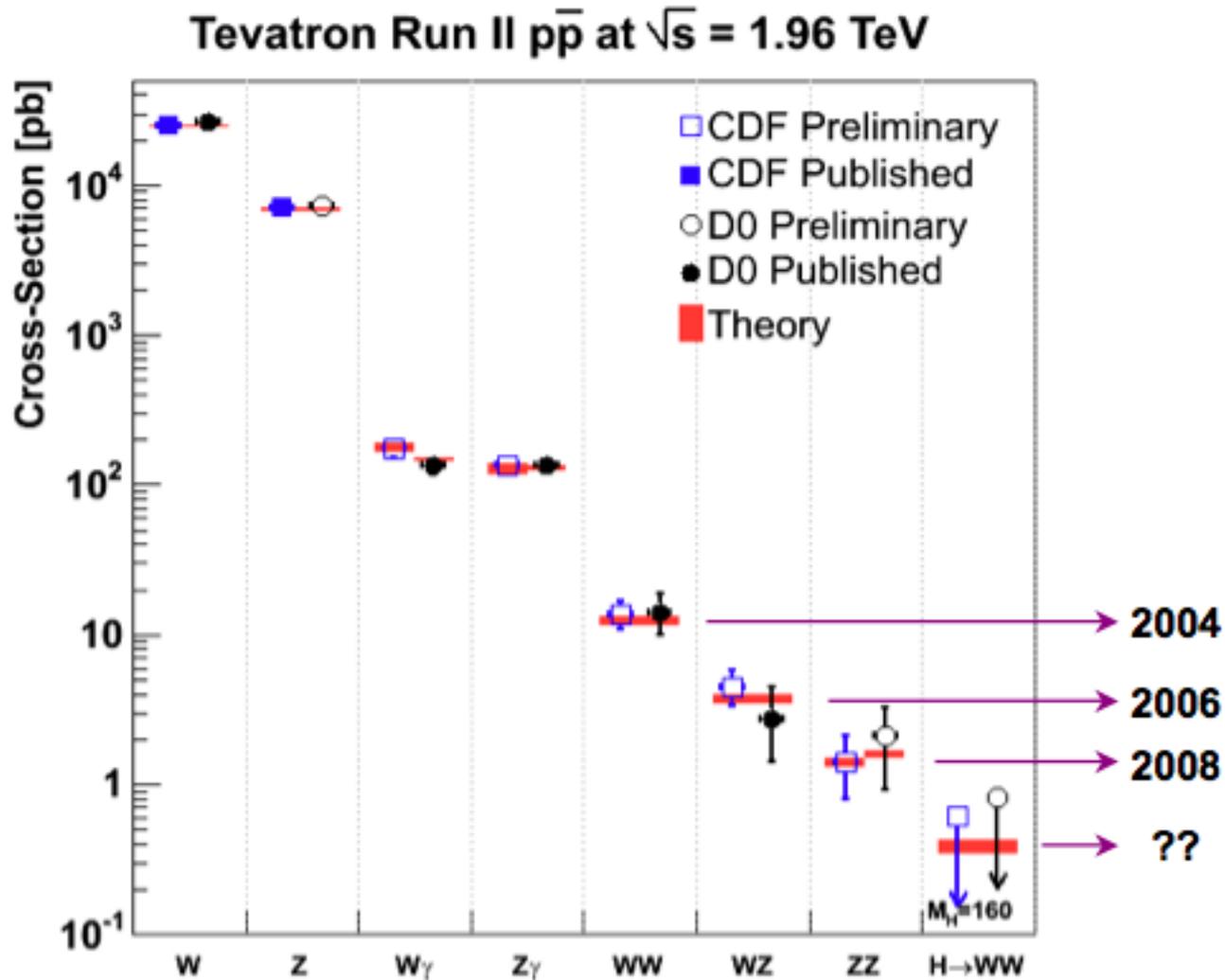
...and so much more



- CDF producing publications at a steady clip
 - 145 in Run 2
 - 38 last year
- 26 publications submitted so far this year
 - 50+ under internal review

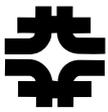


CDF's future





- CDF/D0, the lab, DOE all share goal of running through 2010
 - Most measurements are statistics limited
 - 8 fb^{-1} could mean the difference between "tantalizing hints" and "discovery"
- Do we have what it takes to do this?
 - YES
 - Tevatron can deliver the luminosity
 - CDF detector is in good shape
 - We have the manpower

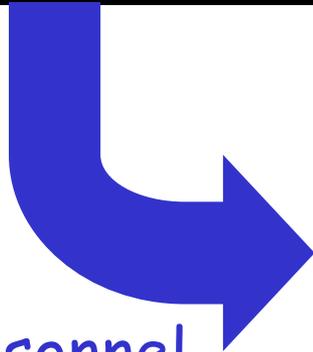


Resources for 2009/2010



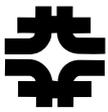
- Called everyone up in February to discuss commitments

FTE	2009	2010
Needed (ops+offline+Calibrations)	95	~85
Available	253	196



- Ample personnel to keep CDF running AND do the physics

FTE	2009	2010
Students	88	60
Post Docs	65	45
Faculty	100	91
Total	253	196



- CDF detector and offline computing performing well
 - No significant concerns at this time, although vigilance and constant effort required

- CDF has a broad and very productive physics program addressing important questions
 - We produced over 100 new results over the last 12 months
 - We average a publication or dissertation every 4.5 days

- CDF remains a strong collaboration and has ample personnel to run in FY2010 and accomplish important physics goals
 - Given the uncertainties in where NP may lie and LHC challenges, it's important to plan to extend Run2