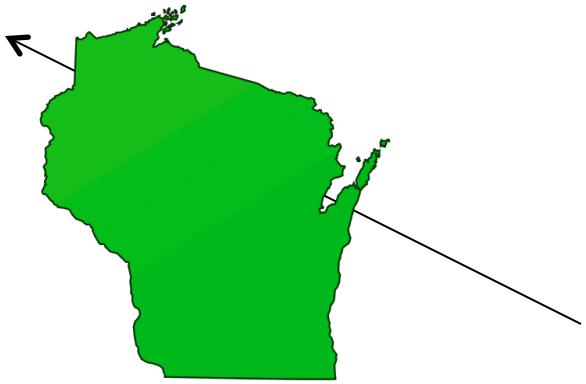
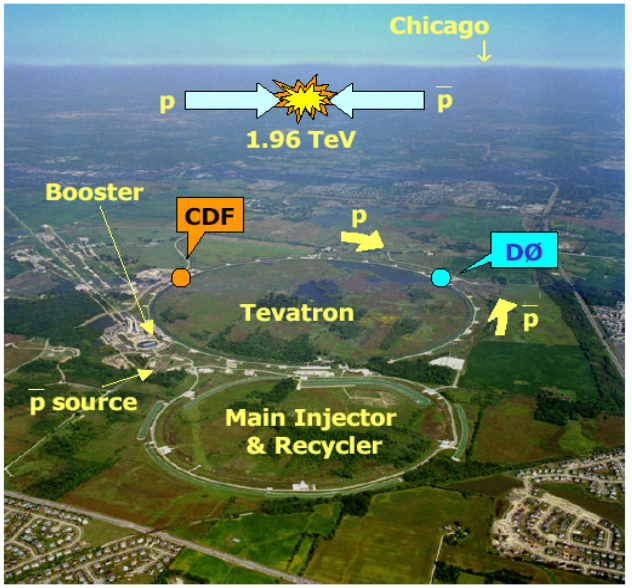
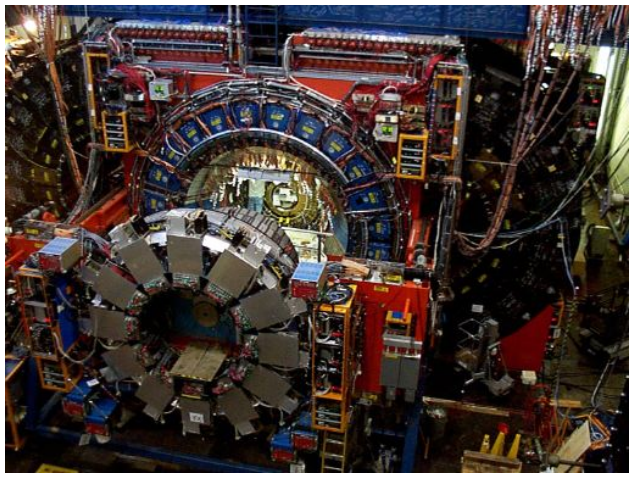
# Task E Overview






The Task CDF group is responsible for the Intermediate Muon System (IMU).

Physics studies including the search for the standard model Higgs boson, B meson rare decays and excitations, WW/WZ production, W and Z decay asymmetries, contact interactions, and multiparton interactions.

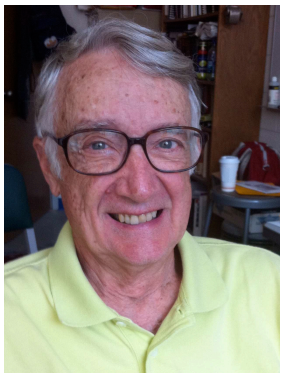


# Wisconsin Task E Group

## Faculty:

Duncan Carlsmith
Matthew Herndon
Lee Pondrom





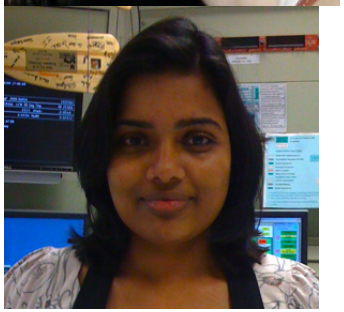
## Research Associates:

James Bellinger (50% CMS),
Woo-Hyun Chung (100% CDF),
Jennifer Pursley (Harvard Med.)



## Research Assistants:

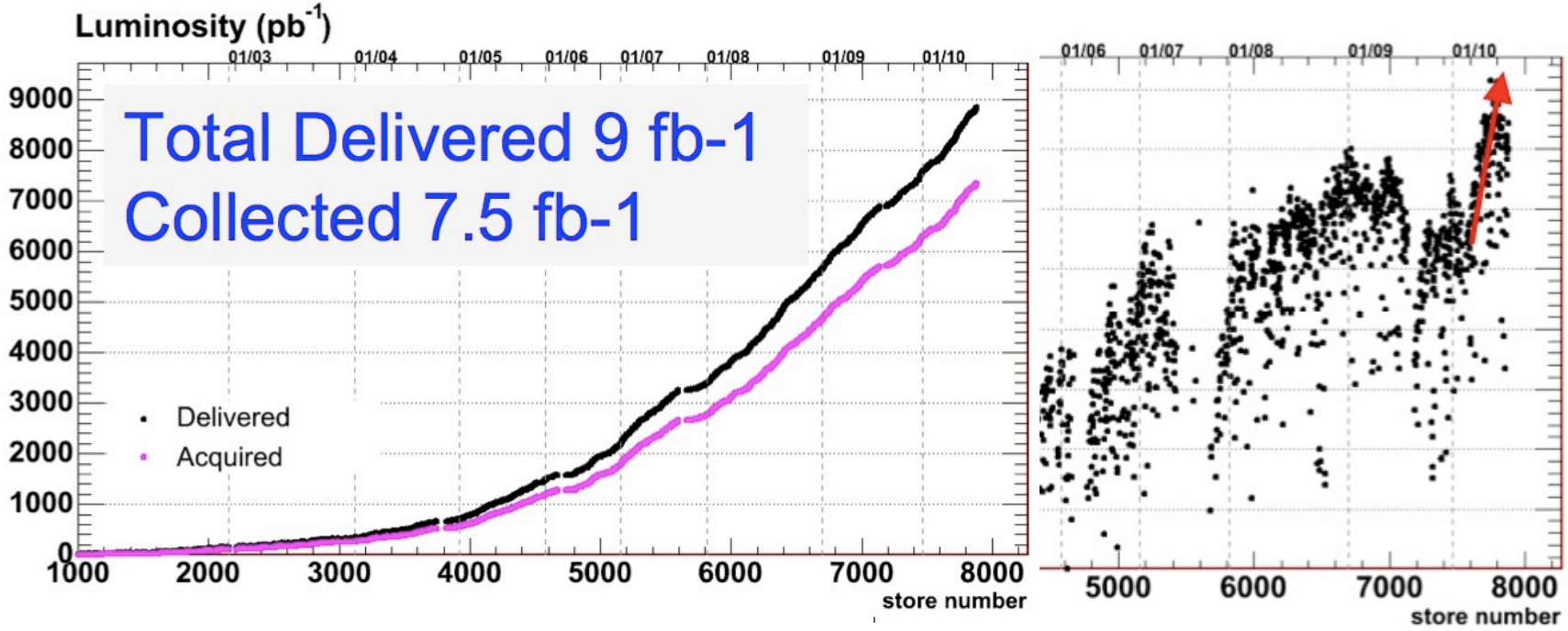
Jason Nett (Texas A&M),
Varsha Ramakrishnan (100%)



# Technical Progress Outline

- Tevatron and CDF performance
- Run III
- Intermediate Muon System
- W/Z asymmetries, multiparton interactions, contact interactions
- Service contributions
- B-physics
- EW di-boson physics
- Higgs physics

# CDF/Tevatron Performance



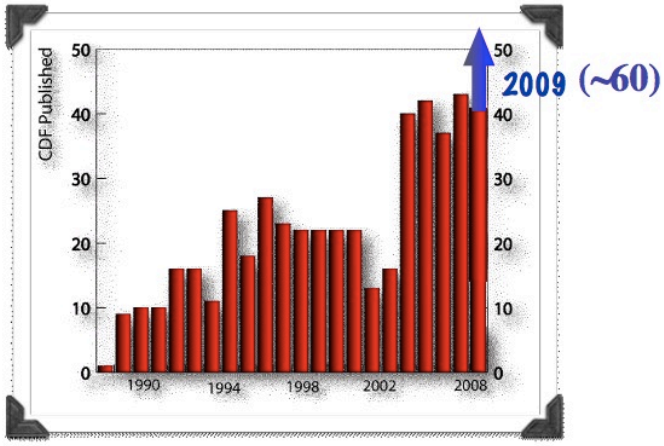

June 2010:~6.5 /fb processed

$$L = 4 \times 10^{32} \mathrm{cm}^{-1}\ \mathrm{s}^{-1}$$

# CDF Publications

Publications:
So far (June) 2010:
25 submitted

Paper Pipeline
45+ in god-parenting committee




**CDF Results for 2010 Winter Conferences**
(only new results since the 2009 Summer Conferences are listed)

The results below are grouped by physics topic, not working group.

Top, Bottom, QCD, Electroweak, Exotics, Higgs

**Top Physics**

| Analysis | Luminosity | More Informat |
|---|---|---|
| Measurement of the top quark mass using a matrix element technique | 4.8 fb$^{-1}$ | WebPage |
| Measurement of the top quark mass using lepton+jets and dilepton events | 4.8 fb$^{-1}$ | WebPage |
| Measurement of the top quark width using lepton + jet events | 4.3 fb$^{-1}$ | WebPage |
| Measurement of the t-tbar production cross section in the missing transverse energy + jets channel | 2.2 fb$^{-1}$ | WebPage |
| Measurement of the t-tbar production cross section using a neural net b-tagging algorithm | 4.3 fb$^{-1}$ | WebPage |
| Measurement of the helicity fractions and spin correlation in top quark pairs | 4.3 fb$^{-1}$ | WebPage |
| Measurement of the W-boson helicity fractions in top quark decays | 2.7 fb$^{-1}$ | WebPage |
| Search for a heavy 4th generation up-type quark in lepton + jet events | 4.6 fb$^{-1}$ | WebPage |
| Measurement of the top quark charge using soft lepton tagging | 2.7 fb$^{-1}$ | WebPage |
| Measurement of s- and t-channel single top quark production | 3.2 fb$^{-1}$ | WebPage |

**Higgs Physics**

| Analysis | Luminosity | More Information |
|---|---|---|
| Tevatron Higgs combination | 5.4 fb$^{-1}$ | WebPage |
| CDF Higgs Combination | 4.8 fb$^{-1}$ | WebPage |
| Search for WH→ l ν bb Events | 4.8 fb$^{-1}$ | WebPage |
| Search for H→ WW* and WH→ WWW* | 5.3 fb$^{-1}$ | WebPage |
| Search for WH/ZH→ qqbb Events | 4.0 fb$^{-1}$ | WebPage |
| Search for H → γγ | 5.4 fb$^{-1}$ | WebPage |

**Exotic Physics**

| Analysis | Luminosity | More Informatio |
|---|---|---|
| Search NMSSM Higgs boson in top quark decays | 2.7 fb$^{-1}$ | WebPage |
| Search for production of MSSM Higgs boson in association with b quarks | 2.5 fb$^{-1}$ | WebPage |
| Search disboson (WW/WZ) resonances in electron + 2 jets + missing transverse energy | 2.9 fb$^{-1}$ | WebPage |

**Bottom Physics**

| Analysis | Luminosity | More Information |
|---|---|---|
| Measurement of b-hadron lifetimes in decays to J/ψ final states | 4.3 fb$^{-1}$ | WebPage |
| Observation of $B_s \to \phi\mu\mu$ and measurement of $A_{fb}$ in $B \to K^{(*)}\mu\mu$ | 4.4 fb$^{-1}$ | WebPage |
| Measurement of resonant structure in $\Lambda_b \to \Lambda_c\pi^-\pi^+\pi^-$ decays | 2.4 fb$^{-1}$ | WebPage |
| Measurement Υ(1s) polarization | 2.9 fb$^{-1}$ | WebPage |
| Measurement polarization in $B_s \to \phi\phi$ decays | 2.9 fb$^{-1}$ | WebPage |

**QCD Physics**

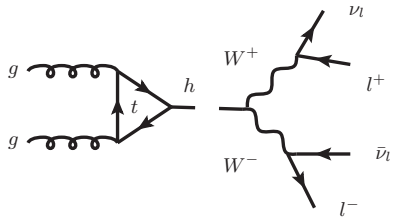
| Analysis | Luminosity | More Information |
|---|---|---|
| Measurement of the inclusive $Z/\gamma^*(\to \mu^+\mu^-)$ + jets cross section | 2.4 fb$^{-1}$ | WebPage |
| Quantifying jet energy resolution using Z+jets | 4.6 fb$^{-1}$ | WebPage |
| Measurement of the W+single charm cross section | 4.3 fb$^{-1}$ | WebPage |
| Hyperon production in minimum bias events | 3.0 fb$^{-1}$ | WebPage |
| Measurement of the W+b jet cross section | 1.9 fb$^{-1}$ | WebPage |

**Electroweak Physics**

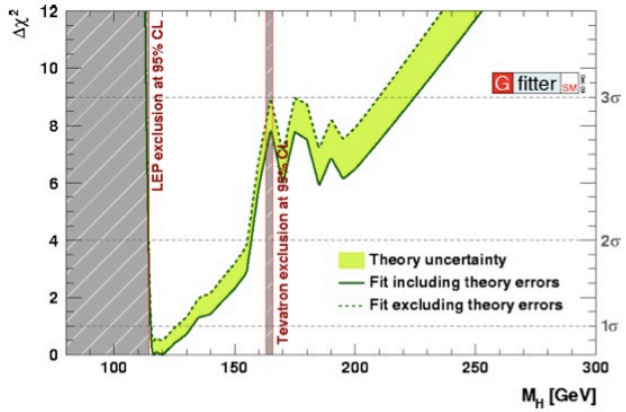
| Analysis | Luminosity | More Informatio |
|---|---|---|
| Search for the decay W → πγ | 4.3 fb$^{-1}$ | WebPage |
| Measurement of the Z forward-backward asymmetry | 4.1 fb$^{-1}$ | WebPage |
| Limits on neutral anomalous couplings from Z+γ events | 2.0 fb$^{-1}$ | WebPage |
| Observation ZZ production in the four charged lepton final state | 4.8 fb$^{-1}$ | WebPage |
| Measurement of the WW/WZ cross section in lν jj | 4.3 fb$^{-1}$ | WebPage |
| Measurement of the WW/WZ cross section in lν jj using a matrix element technique | 4.6 fb$^{-1}$ | WebPage |

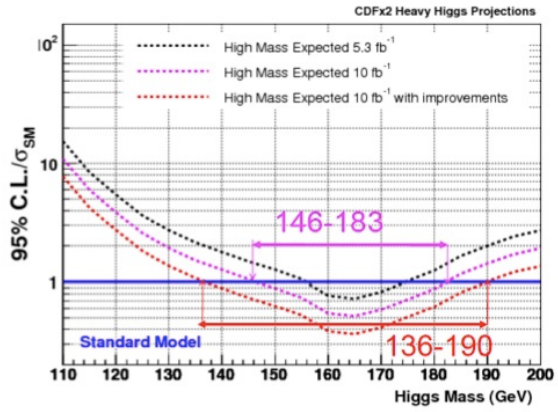
CDF continues to publish ~ 1 paper/week

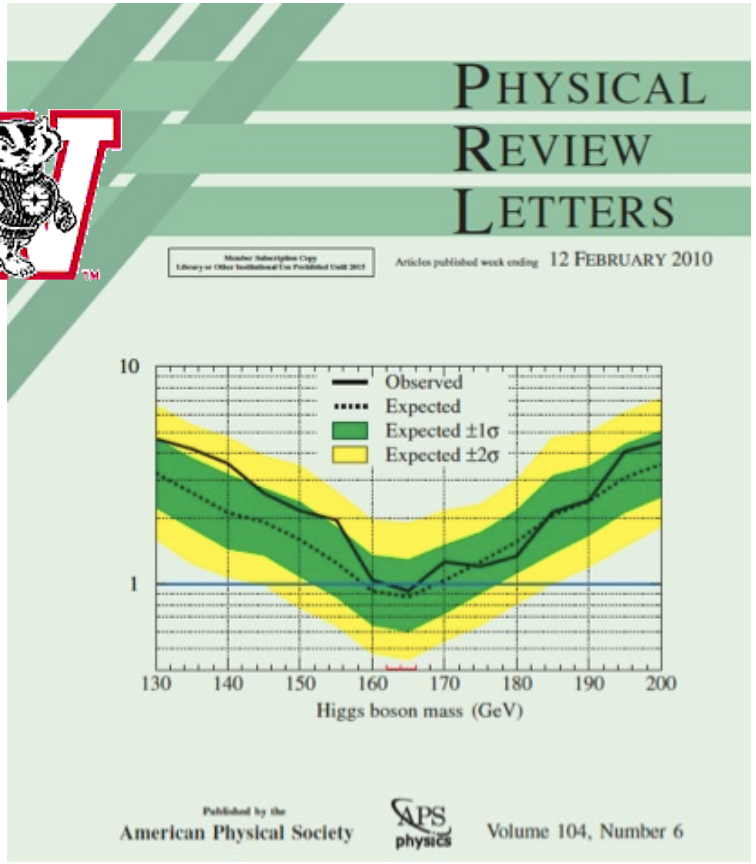
# CDF Highlights



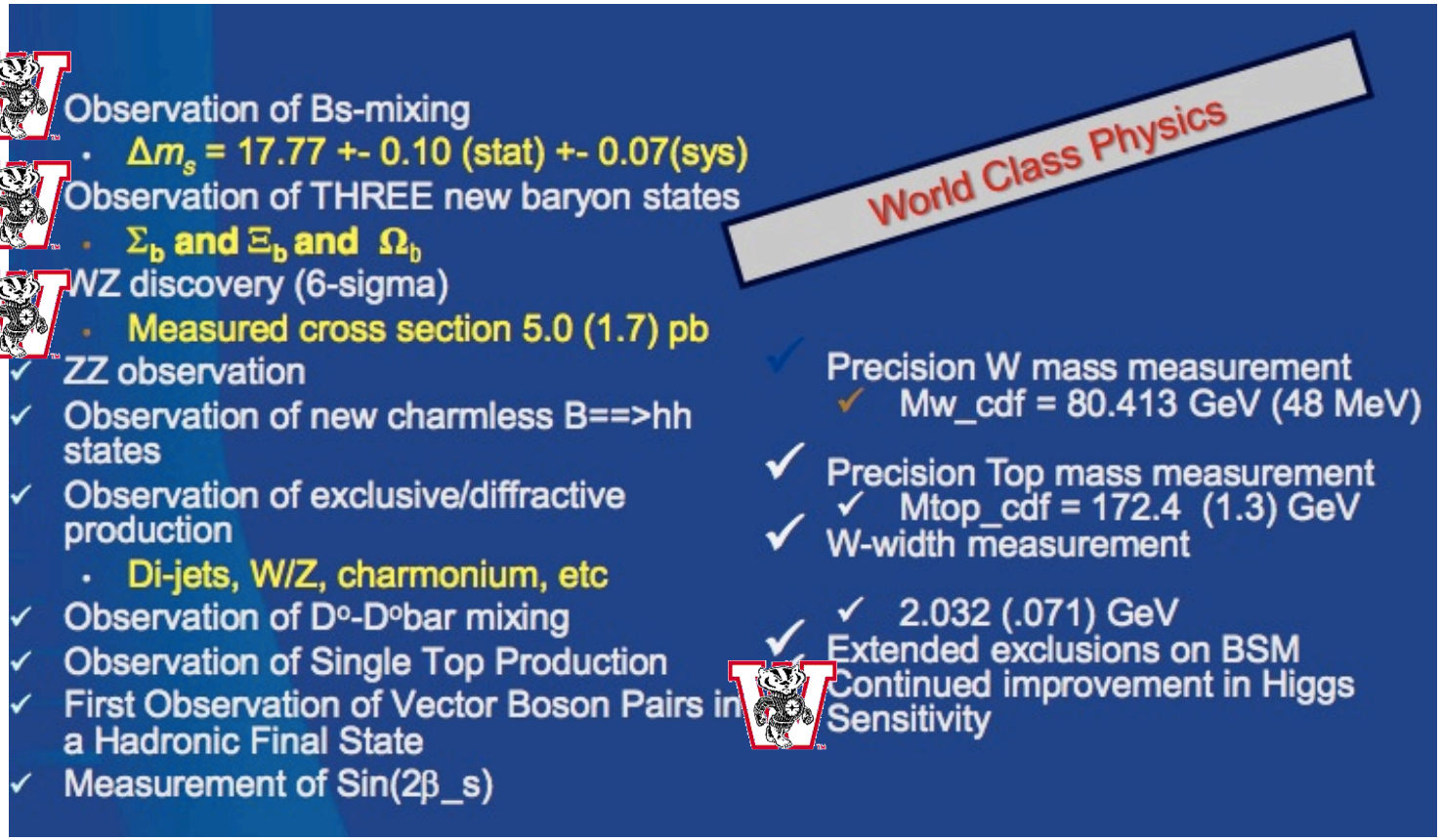

First direct limit on Higgs since LEP.
(Matt will say more about this.)



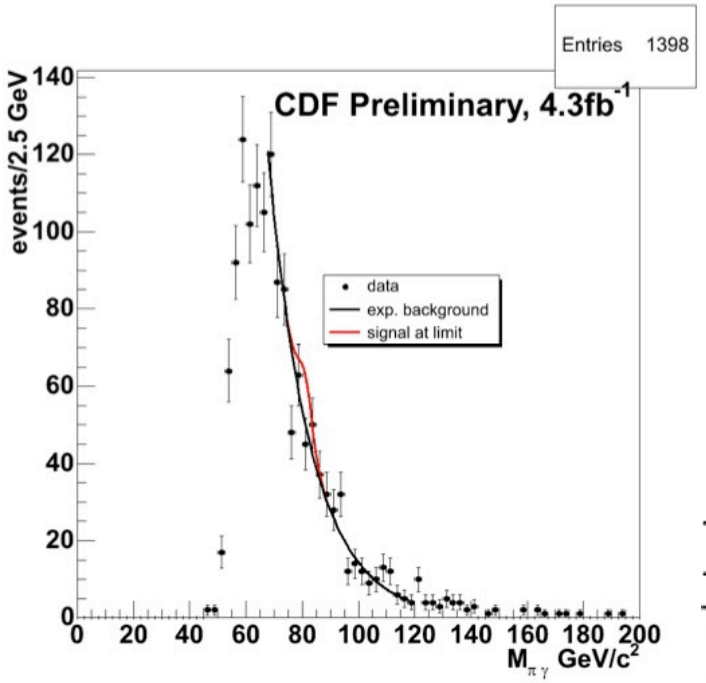



# CDF Physics



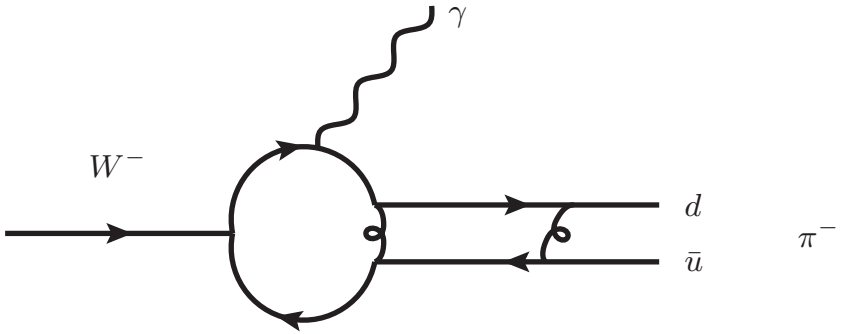

For upcoming results, see http://www-cdf.fnal.gov/physics/S10CDFResults.html

# Rare decays of W's!




BR(W->πγ)/BR(W->eν) < 6.4 x $10^{-5}$ at 95% confidence

$$W^{\pm} \rightarrow \pi^{\pm}\gamma$$

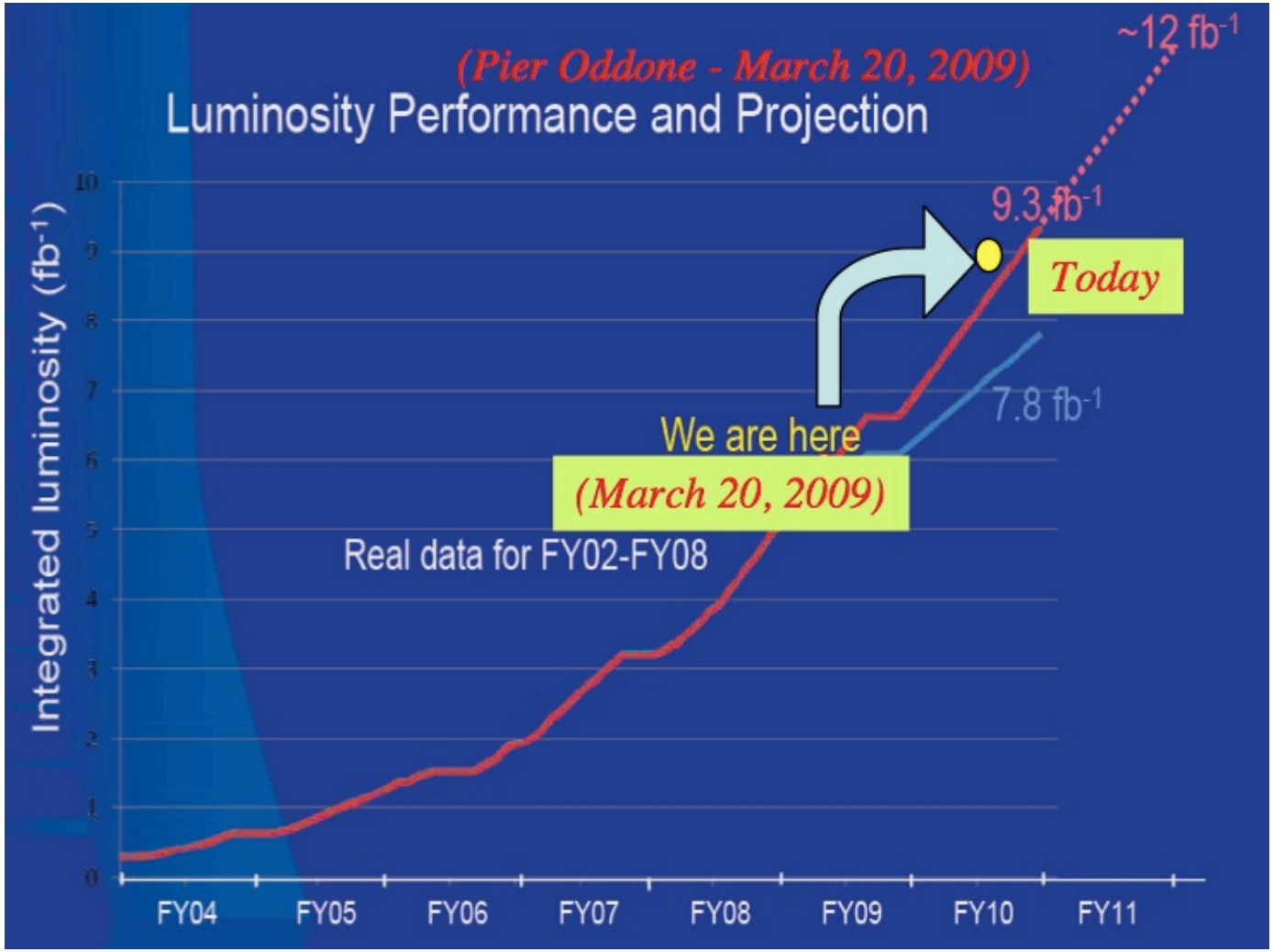



$$\frac{\Gamma_{W\rightarrow\pi\gamma}}{\Gamma_{W\rightarrow e\nu}} < 6\times10^{-5}\ (95\%\ CL)$$

$$\frac{\Gamma_{W\rightarrow\pi\gamma}}{\Gamma_{W\rightarrow e\nu}}\Big|_{SM} = 3\times10^{-8}$$

Carlsmith, godparent

# Run II Luminosity projection



# CDF Run III

Run III means
2011- 2014 and 20 /fb .


•Discover or exclude high mass standard model h

$$gg \Rightarrow t\bar{t}(loop) \rightarrow h$$

•Discover or exclude low mass Higgs

$$q\bar{q} \rightarrow W^*, Z^* \rightarrow Wh, Zh$$

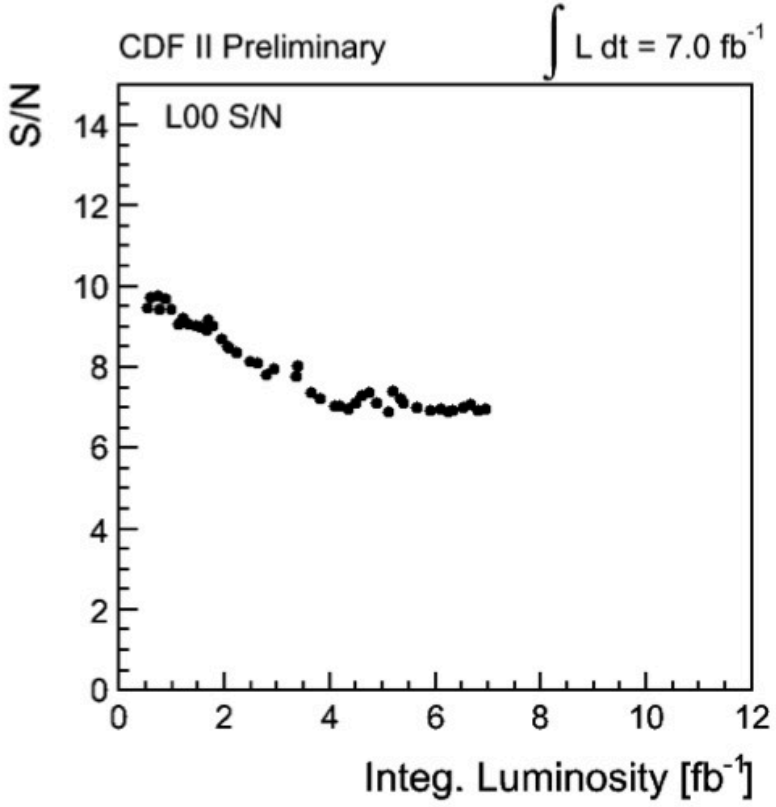
•Other physics!, e.g. t=>$H^+$+b

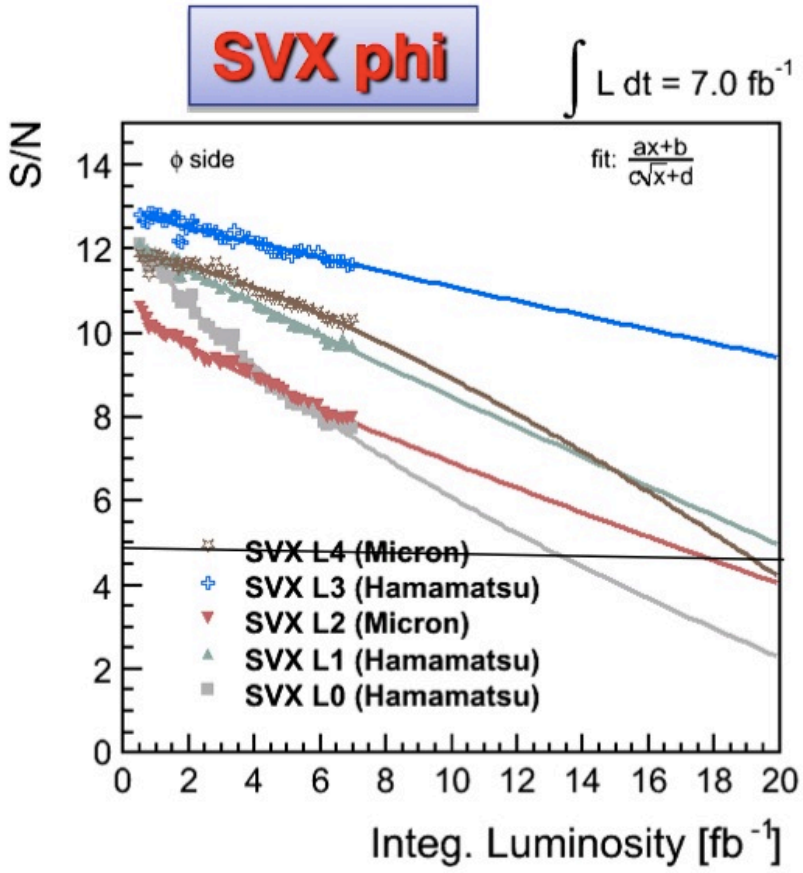
$$0.3 \text{ GeV} < \Gamma_{top} < 4.4 \text{ GeV}, \ 68\% \text{ CL} (1.3 \text{ expected})$$

N.B.: Ultimately must test all h couplings!

<=New CDF collaboration prelim result!

# CDF Si-Det in Run III




Layer 00 (rad hard) will be fine.

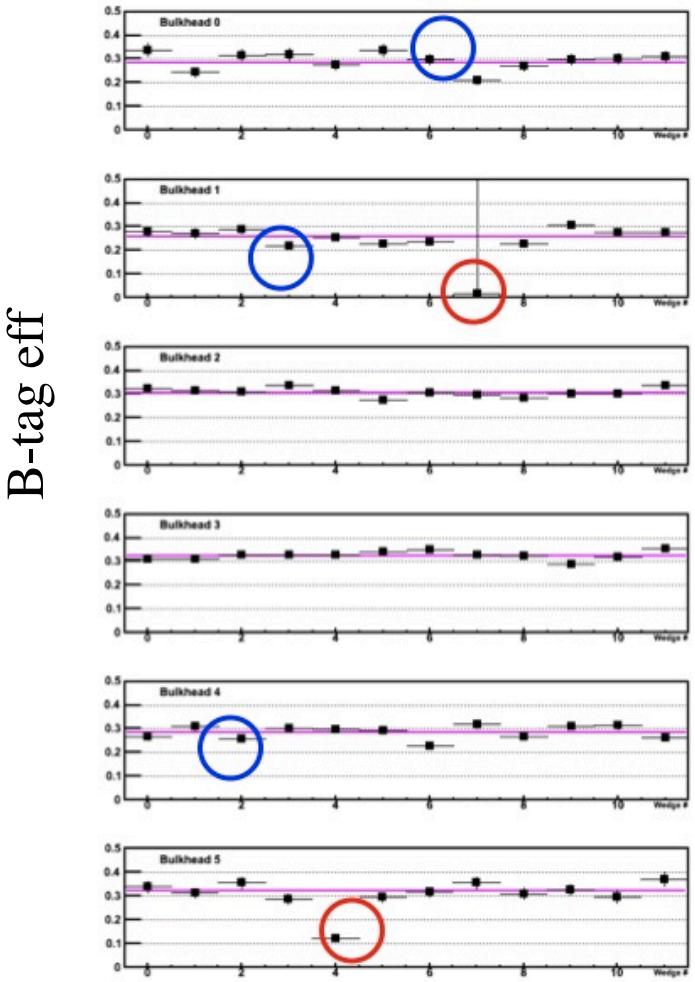
SVX-Layer0 may degrade

# CDF b-tagging OK in Run III

Low mass Higgsstrahlung (Zh=> ll bb) search requires good b-tagging.

CDF b-tagging efficiency data is <u>not appreciably degraded</u> where L0 is missing due to hardware failure. (Using present rec. algorithm, not optimized for in efficiency.)
Blue = L0 dead but eff. high
(Red = L0-4 dead, eff. low)

More studies in progress.

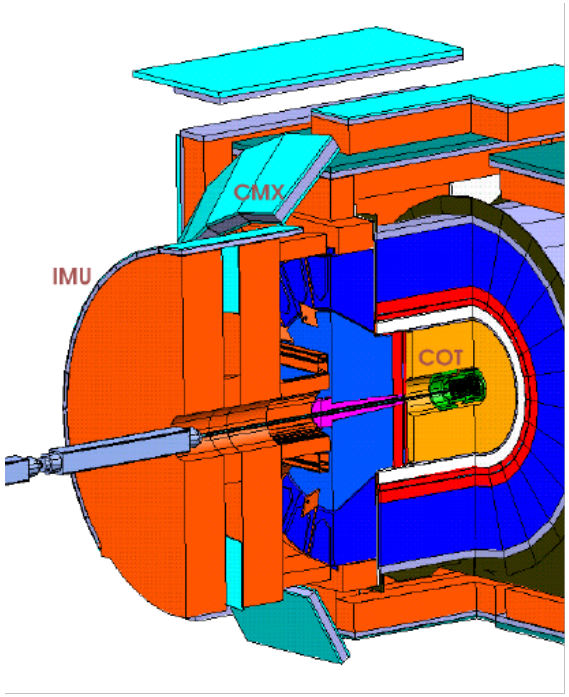



(John Freeman, 19 Aug 2010

# Intermediate Muon System

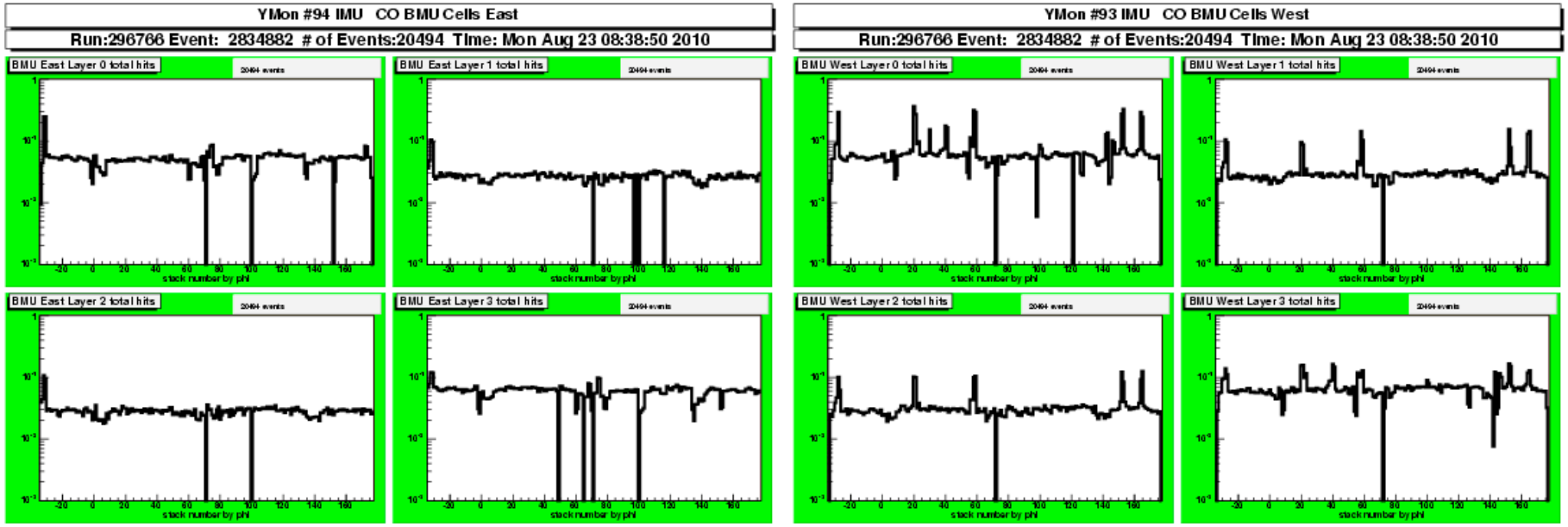
- 1728 drift tubes (BMU), 432 scintillation counter (BSU)

Detectors, preamps, amplifiers, TDCs, and trigger electronics all operate smoothly.



# Drift tubes: BMU

## Occupancies 23 Aug. 2010

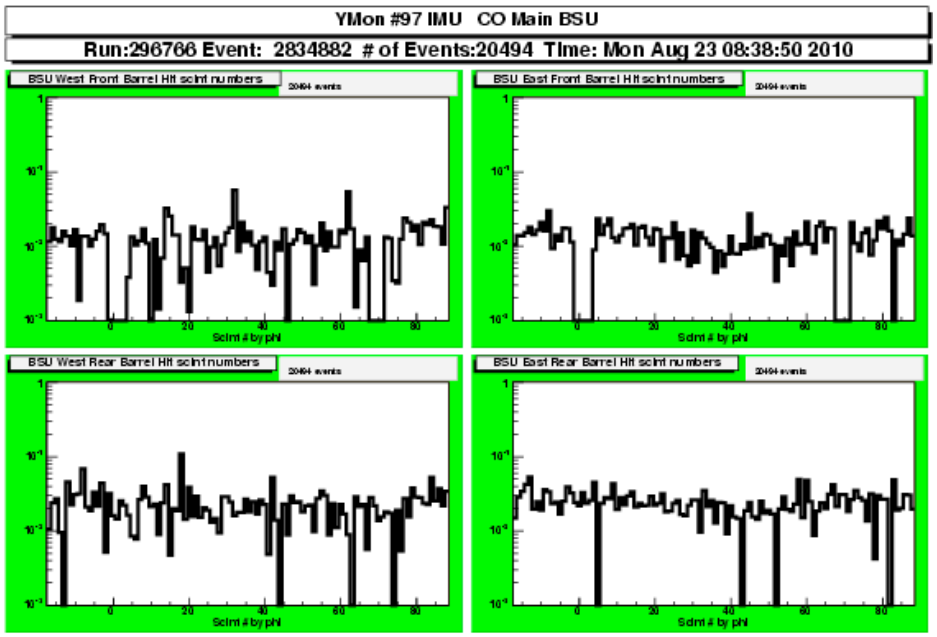


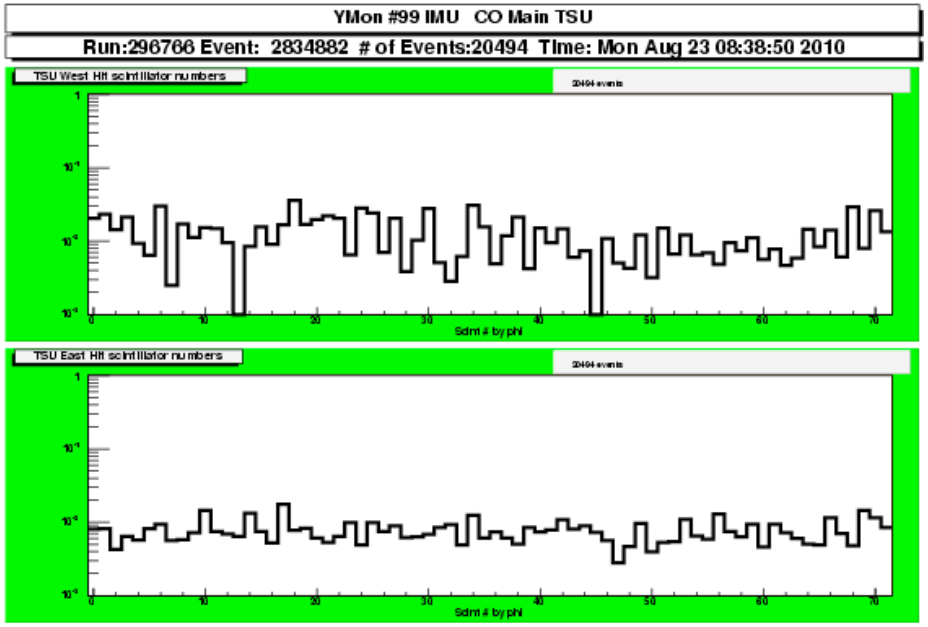

East West

Four concentric layers per end

# Scintillators (BSU, TSU)

## Occupancies 23 Aug. 2010




BSU (outside BMU)

TSU (within the steel)

# Scientific Linux 5

Thanks to Jim Bellinger's leadership,

Leading team including help from Ray Culbertson, Lynn Garren,Sasha Golossanov, Stephan Lammel, Marc Mengel, Aiden Robson, Simona Rolli, Rick Snider, Rick St.Denis, Oksana Tadevosyan, Costas Vellidis and others,

CDF code has been migrated to Scientific Linux 5. The release is out on CDFGrid, and in good shape. This was a major and necessary upgrade dictated by security/ Fermilab policy.

TODO list:

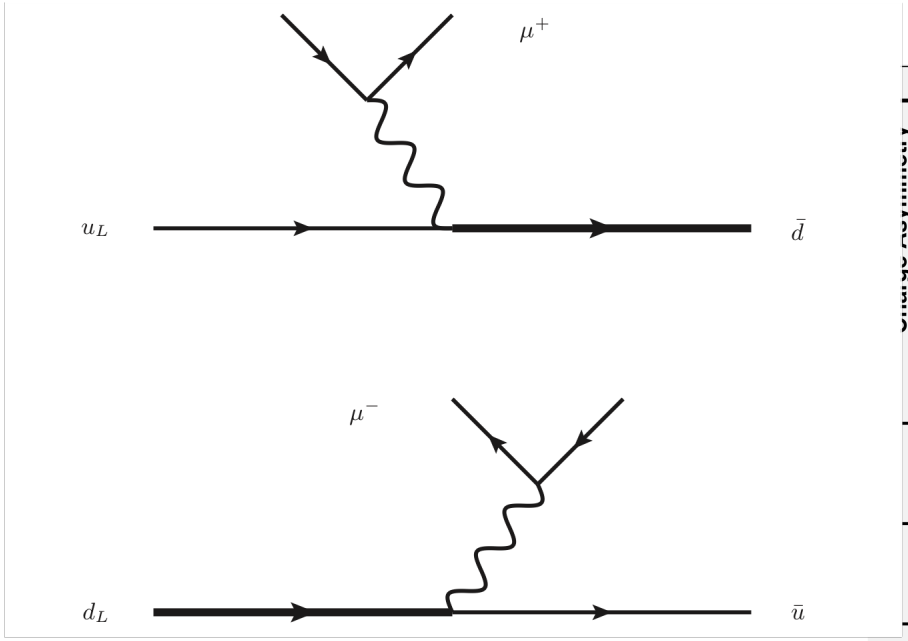
a) Make CDF code robust enough to be usable for five years past the end of data taking.

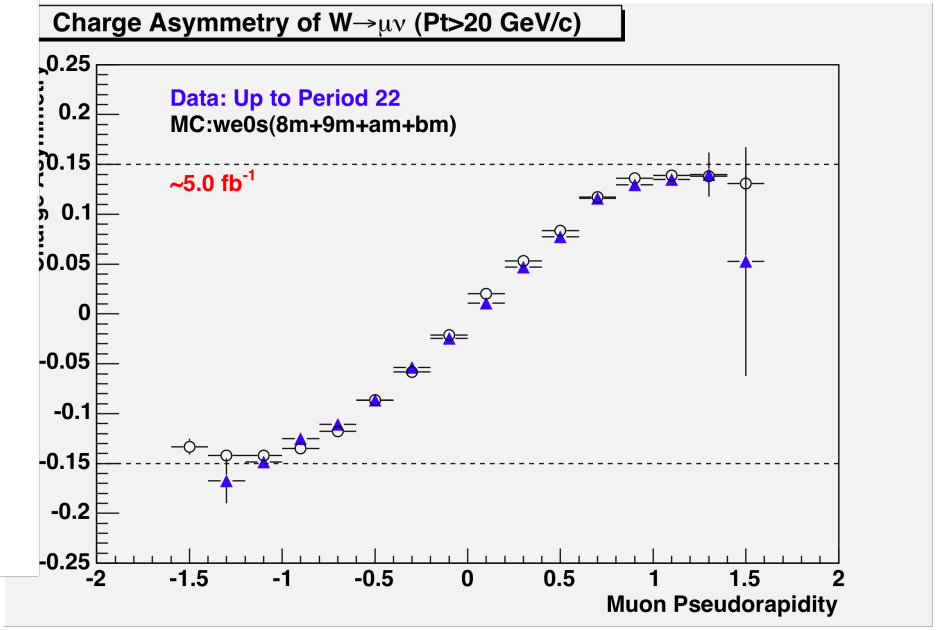
b) Speed up CDF reconstruction and ntupling code.

c) Integrate the Monte Carlos, and create an integrated release for long term use.

# W=>mu,nu asymmetry

$$W^+ \rightarrow \mu^+ \nu_\mu$$



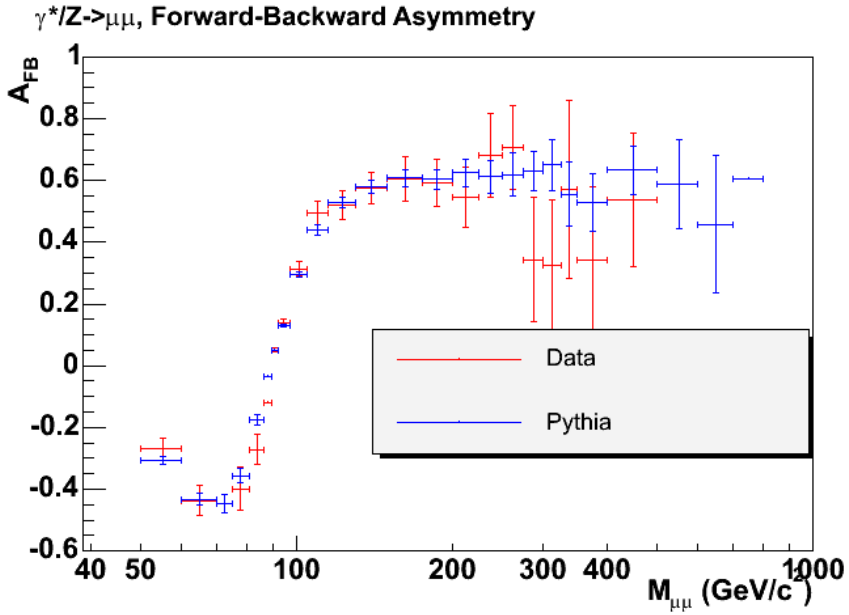

$$W^- \rightarrow \mu^- \bar{\nu}_\mu$$

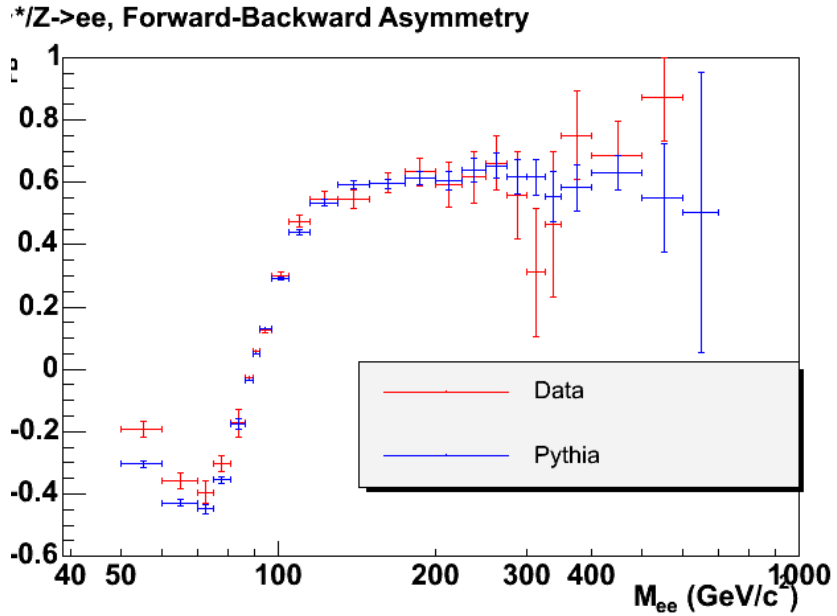
Includes BMU.

# $Z=l^+l^-$ asymmetry

Preliminary

Z'? More data please!

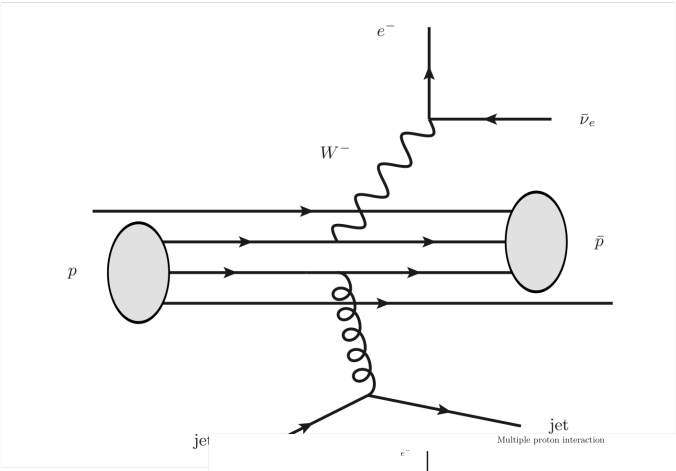


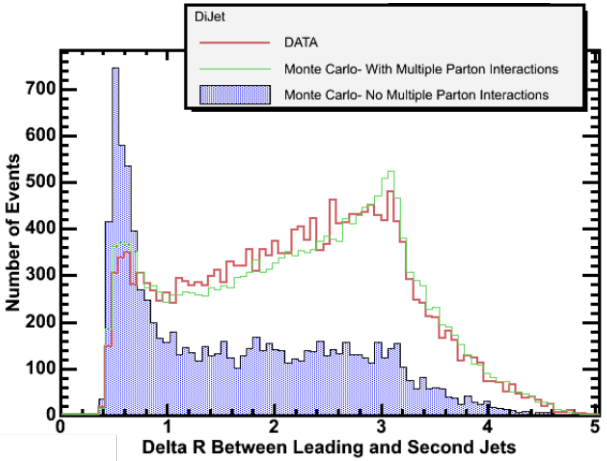



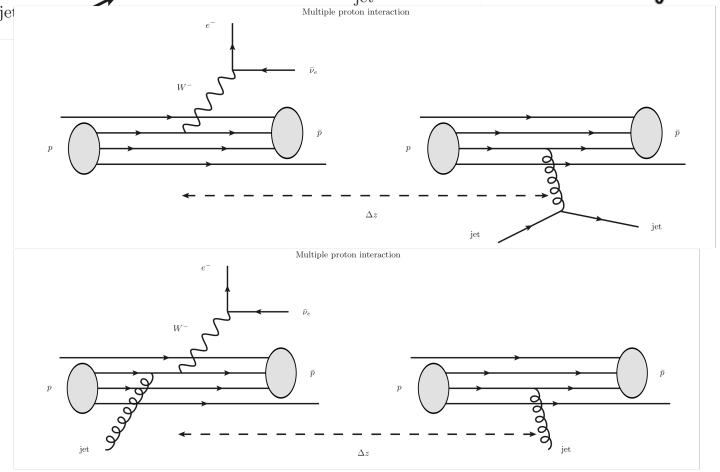

$$Z \rightarrow \mu^+\mu^- \qquad Z \rightarrow e^+e^-$$

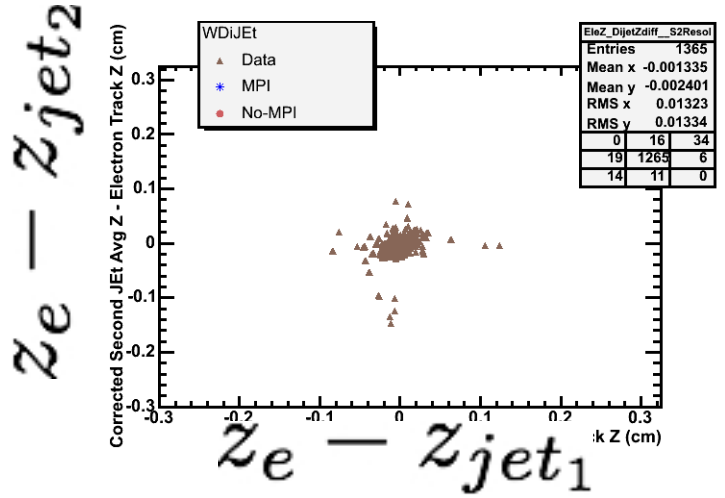
On-going work combining muon and electron data with U. Rochester.

# Multiparton interactions



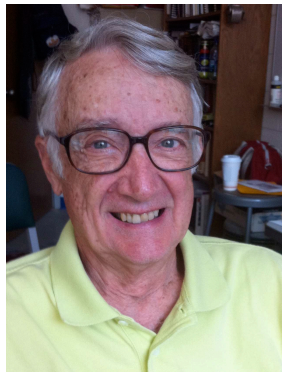




SiDet distinguishes multiparton from multiproton interactions.

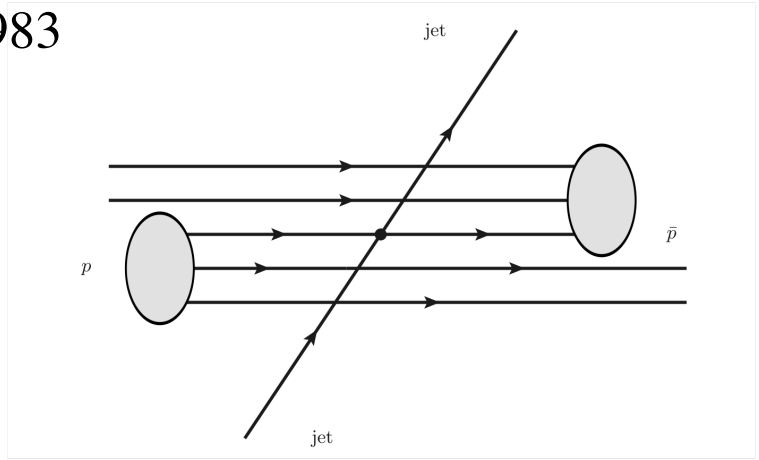
# Contact interactions



E Eichten, K Lane, M Peskin, 1983

$$L = \frac{g^2}{2\Lambda^2}\bar{\psi}_L\gamma\psi_L\bar{\psi}_L\gamma\psi_L$$

$$\frac{g^2}{4\pi} \equiv 1$$




A limit Lambda> 2.4 TeV 95% confidence was reported in 2008. Subsequently a godparent committee has been formed to prepare the paper for publication by the collaboration in Phys. Rev. D. .

NLOjet++ has been run on the UW Condor cluster and compared to Pythia to check the sensitivity to hard scale.

# Service Work/Operations

•Woo-Hyun Chung (NAL part-time)- IMU expert (pager), online monitor (YMON), offline monitoring, data production and analysis, consumer operator and ACE

•James Bellinger - software maintenance and computer system manager, consumer operator, SVTMON author, CDF software user support, SL5 migration team leader

•Jen Pursley – CDF Operations Manager(!).
•Matt Herndon– continued work on Si tracking improvements

•Duncan Carlsmith, Lee Pondrom, Matt Herndon - scientific coordinators (all serve annual shifts). Godparenting.

# Research Assistant Contributions

Students play an active role in hardware support and data analysis.


Jason Nett, CDF ACE 2008-9, forward tracking studies, Higgs trigger studies, passed prelim '07, advisor Herndon, graduated June 2010! Thesis: Search for SM h=> WW, WZ in tri-lepton events.

Varsha Ramakrishnan, NAL resident, CDF ACE summer 06, IMU pager, responsible for BMU reconstruction efficiency dbase, passed prelim June '06 , advisor Carlsmith, Thesis: Multiple parton interactions in Wjj events

Support for additional student overlapping with present students is requested to exploit CDF through 2011 and beyond!

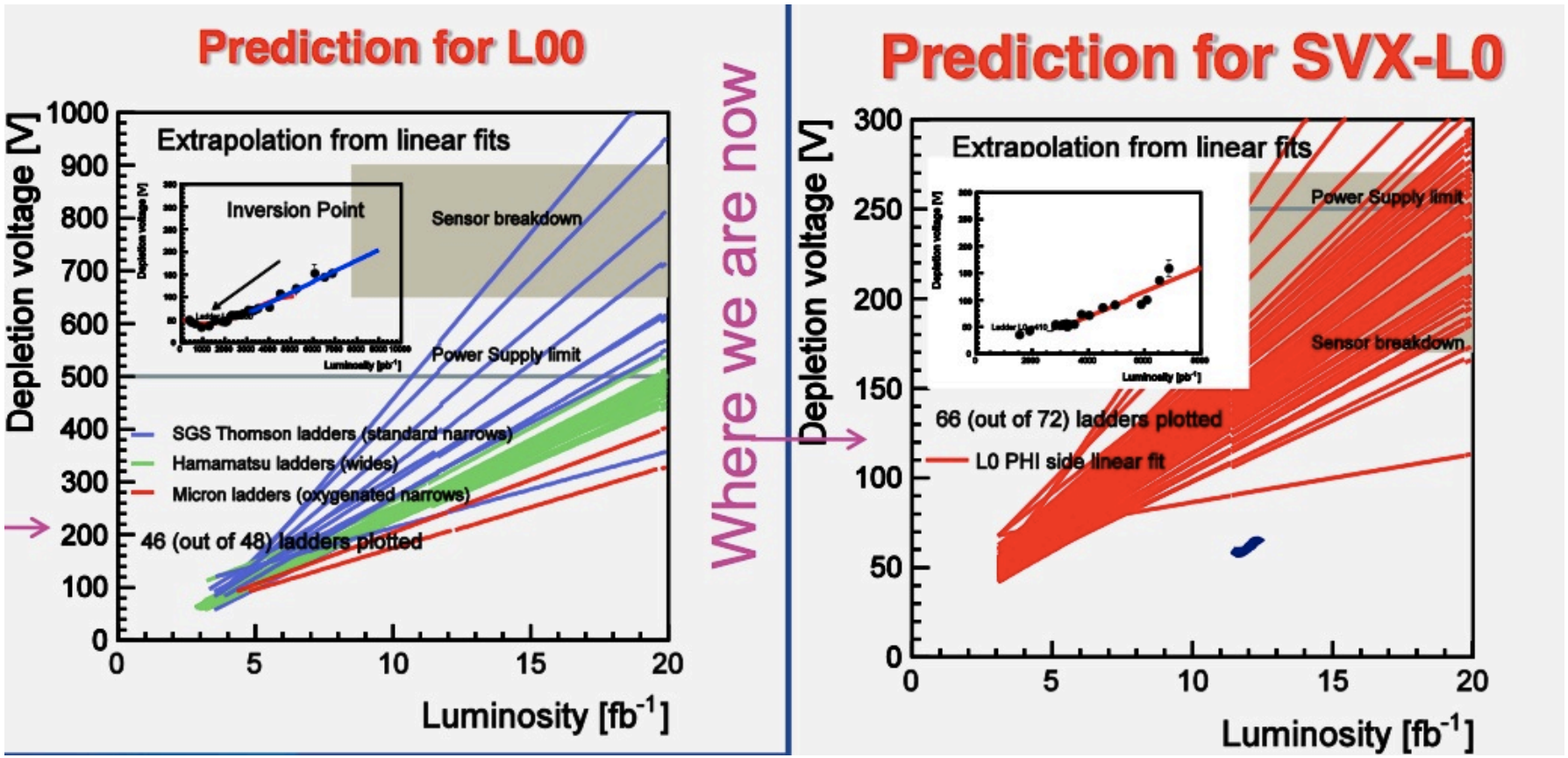
# Summary

The Fermilab Tevatron and the CDF II Detector run brilliantly.

The Wisconsin group supports the IMU system, CDF operations and computing, and participates in a variety of physics studies.

Wisconsin supports continued operation of the Tevatron through the end of Run II (2011) and beyond to Run III.

# Backup:CDF Si-Det voltages




L00 looks fine

SVX-L0 may degrade