bed

\\server\name

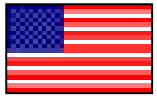
PSCRIPT Page Separator

CDF 2001-2002

Nigel Lockyer
For the CDF Collaboration
Fermilab DOE Annual Review
March 19, 2002

CDF Collaboration

North America



3 Natl. Labs
28 Universities

1 Universities

Europe

1 Research Lab
6 Universities

1 University

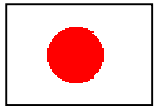
4 Universities

2 Research Labs

1 University

1 University

Asia



5 Universities
1 Research Lab

1 University

3 Universities

Totals

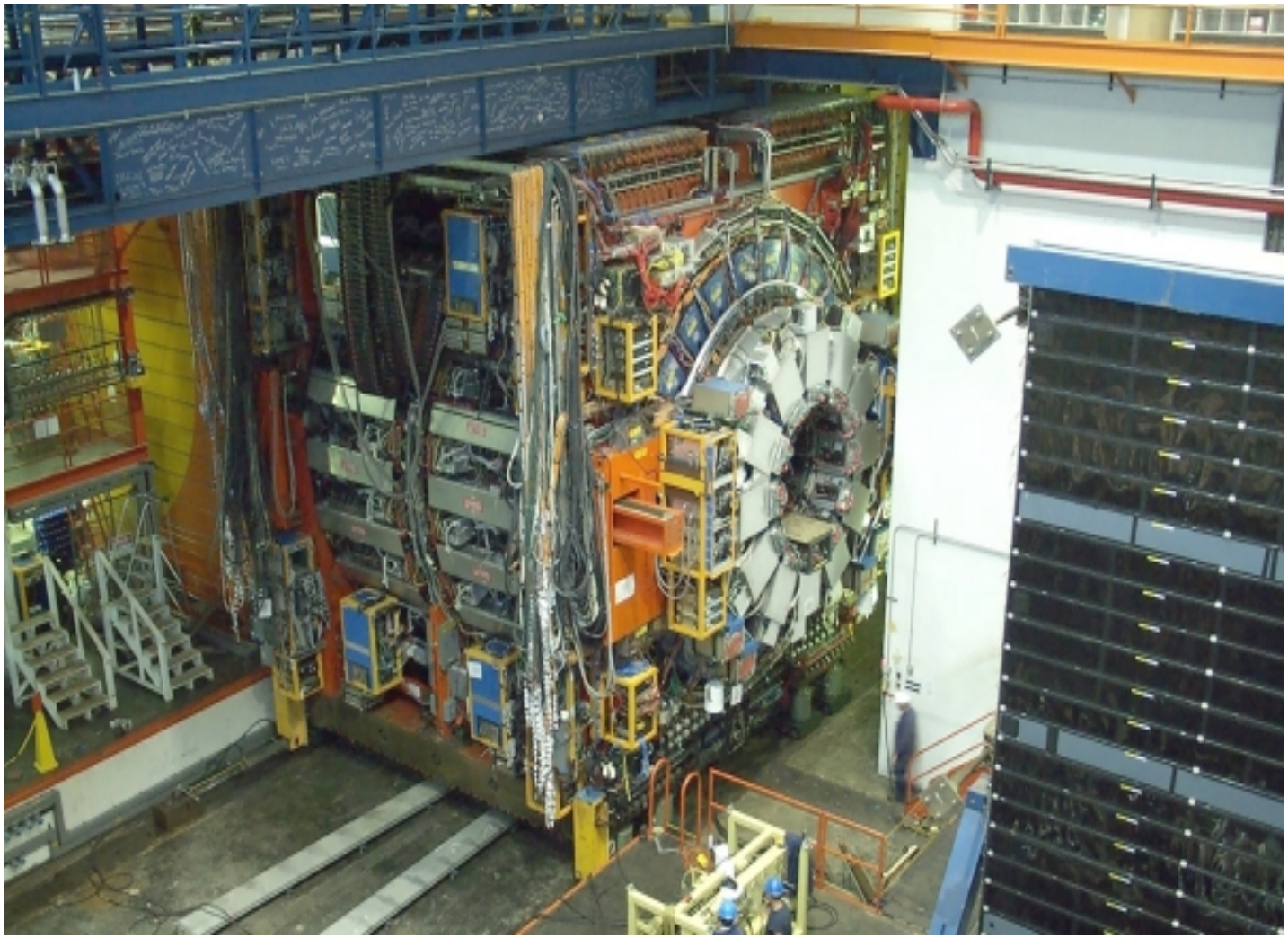
12 countries

58 institutions

581 physicists

Nigel Lockyer
University of Pennsylvania and Fermilab

Roll onto Beam Line One Year Ago



Nigel Lockyer
University of Pennsylvania and Fermilab

Outline

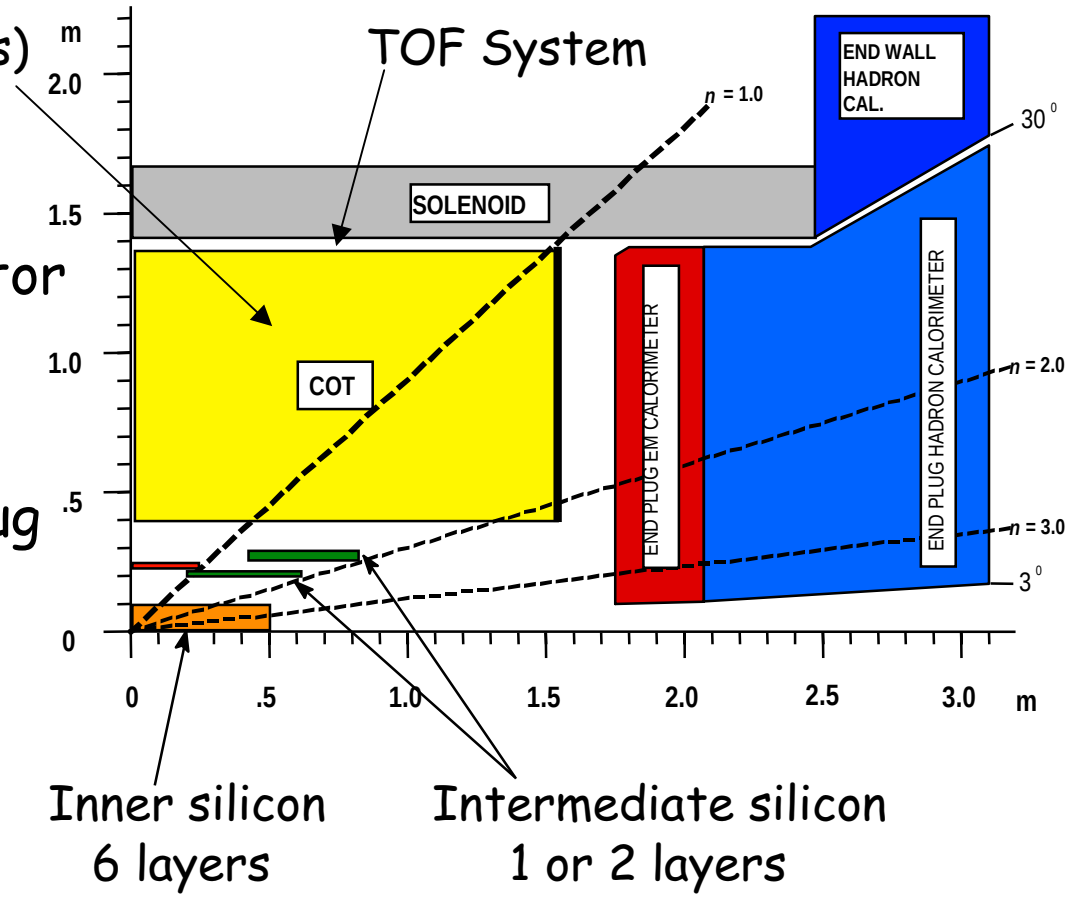
- Detector progress and status this year
- Performance plots
- Plans

Nigel Lockyer
University of Pennsylvania and Fermilab

All detectors inside the solenoid are new
Others are from Run 1 with enhancements

wire drift chamber (96 layers)

- A new 3d tracking system and vertex detector covering |η|out to 2.0.
- A new scintillating tile plug calorimeter covering |η| out to 3.6.



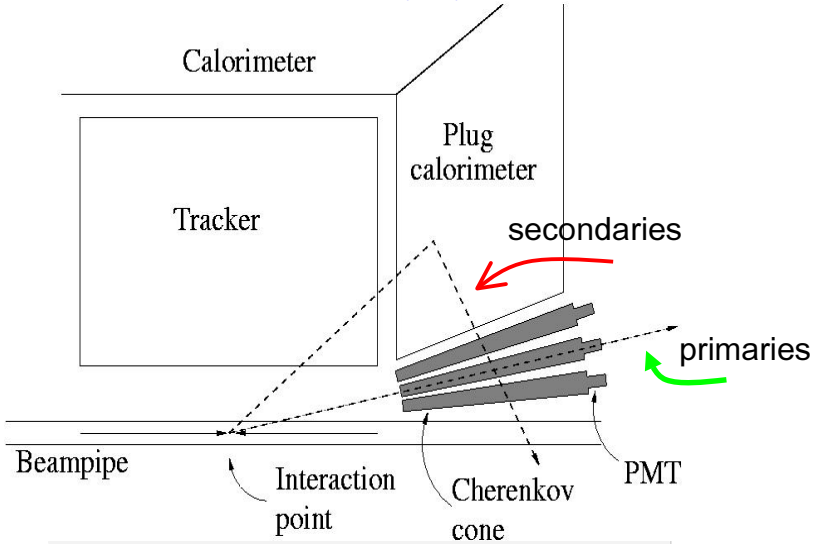
Experiment status and plans

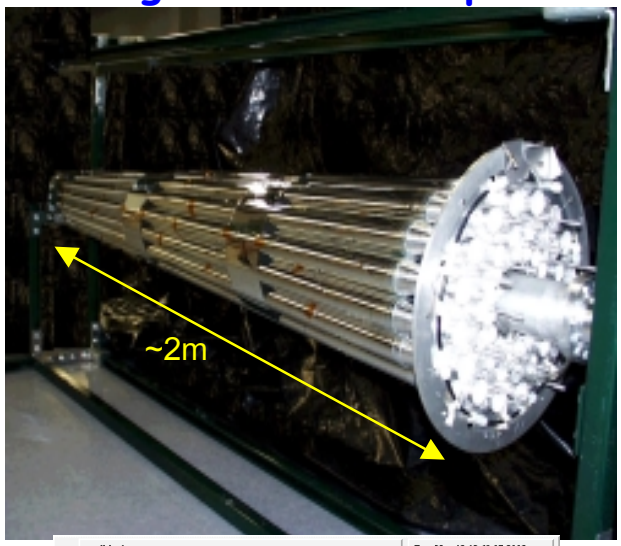
- Since operation start-up in the collision hall in March 2001, the CDF detector has been commissioned using ~ 12 pb^{-1} of data provided by the Tevatron.
- All Detector components are taking physics quality data
- Understanding detector at next level now
- Mass peaks, triggers, and data samples being used to prepare for physics

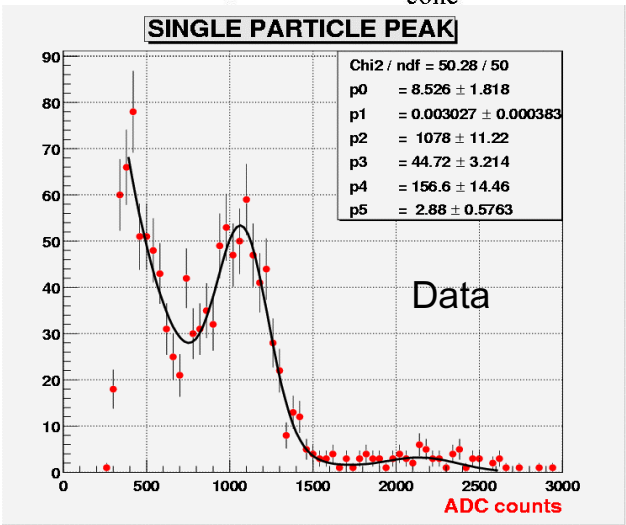
Nigel Lockyer
University of Pennsylvania and Fermilab

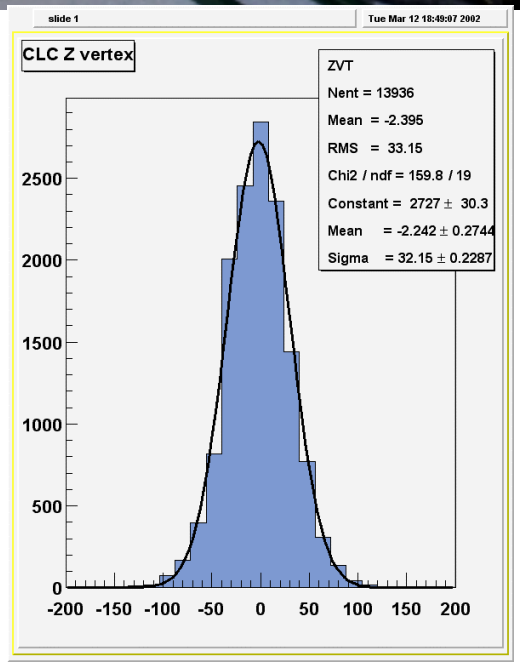
Cherenkov Luminosity Monitor

Measure the number of p-pbar interactions directly by counting <number> of particles



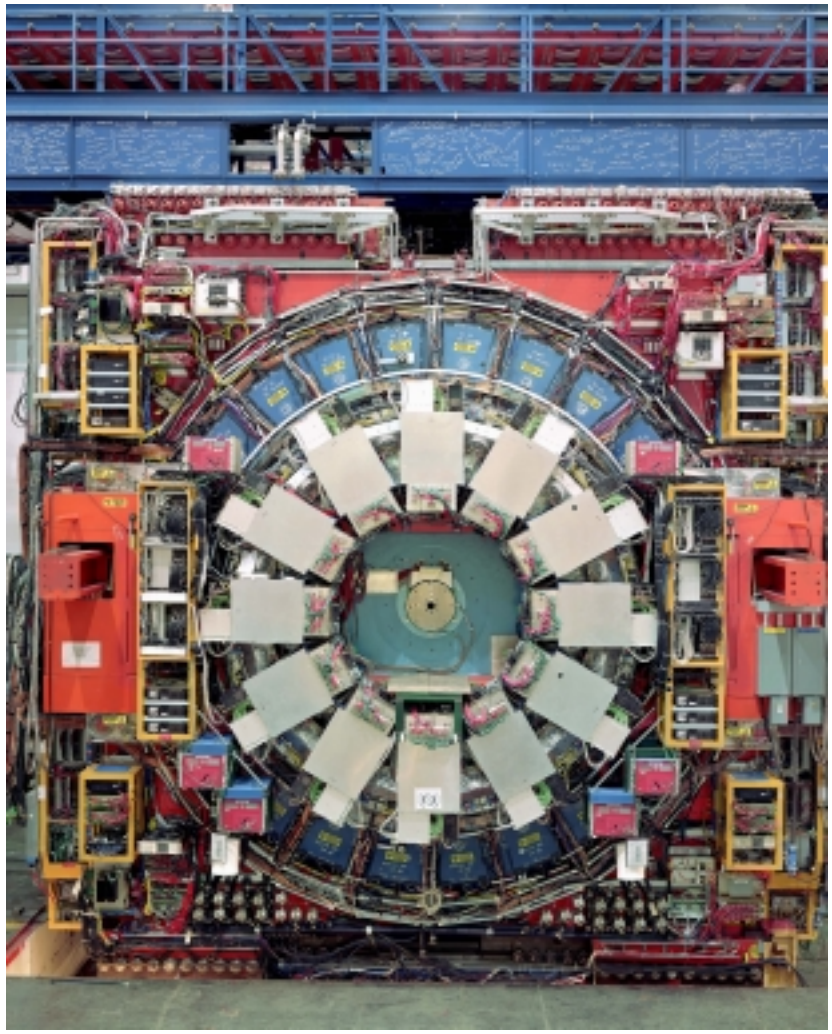


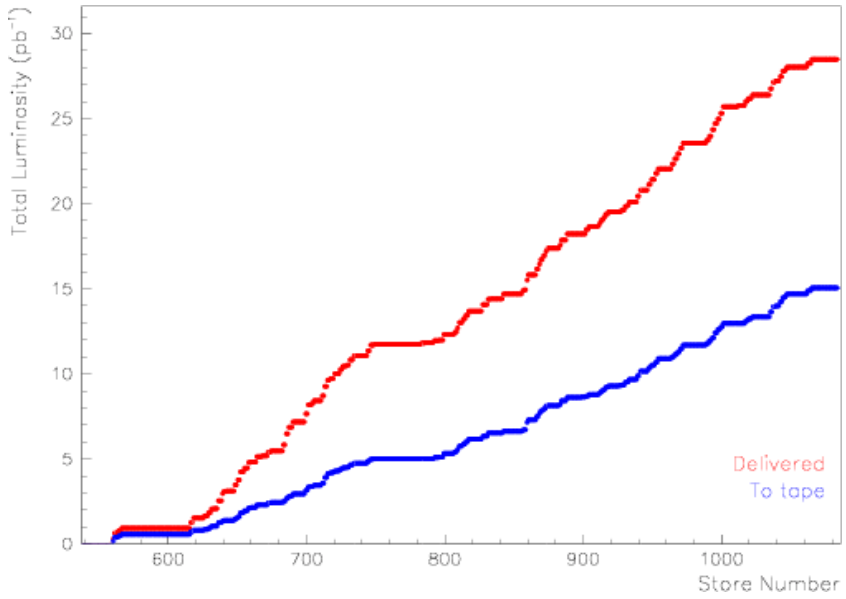




Nigel Lockyer
University of Pennsylvania and Fermilab

Cherenkov Luminosity Monitor

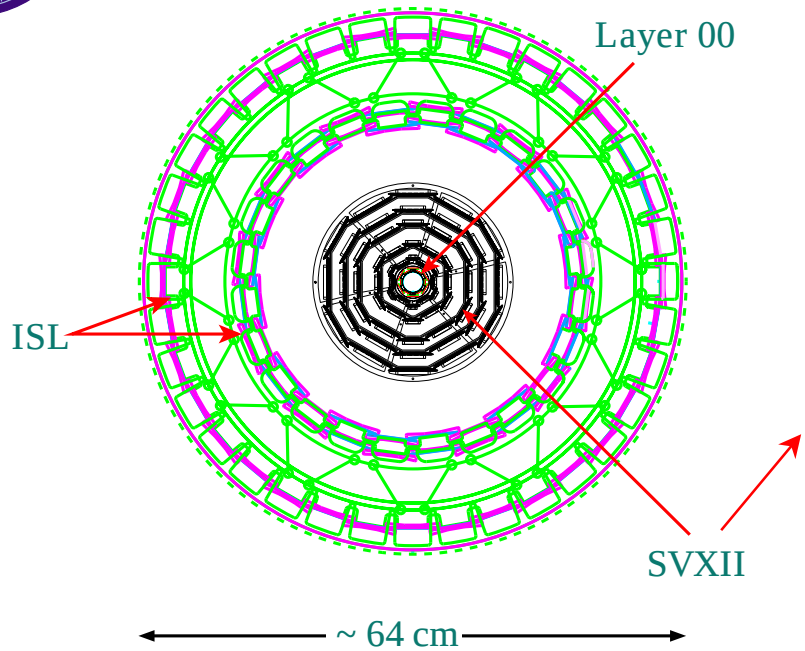


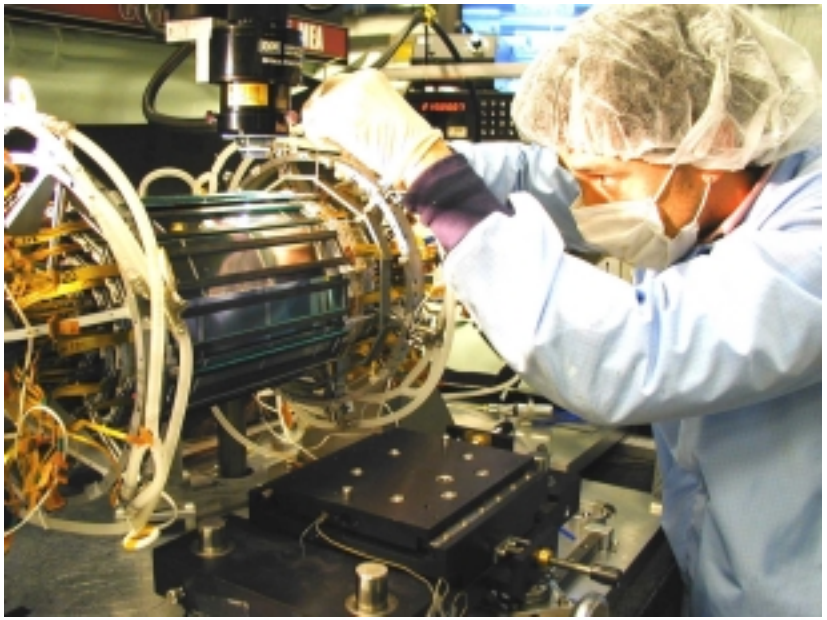


Integrated Luminosity

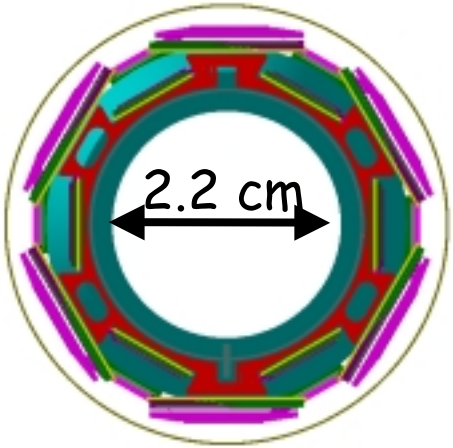
Nigel Lockyer
University of Pennsylvania and Fermilab

CDF Silicon Tracker

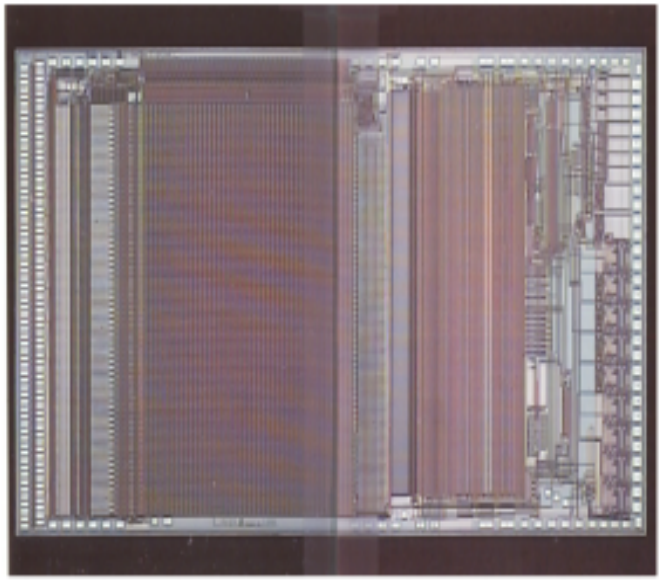




L00

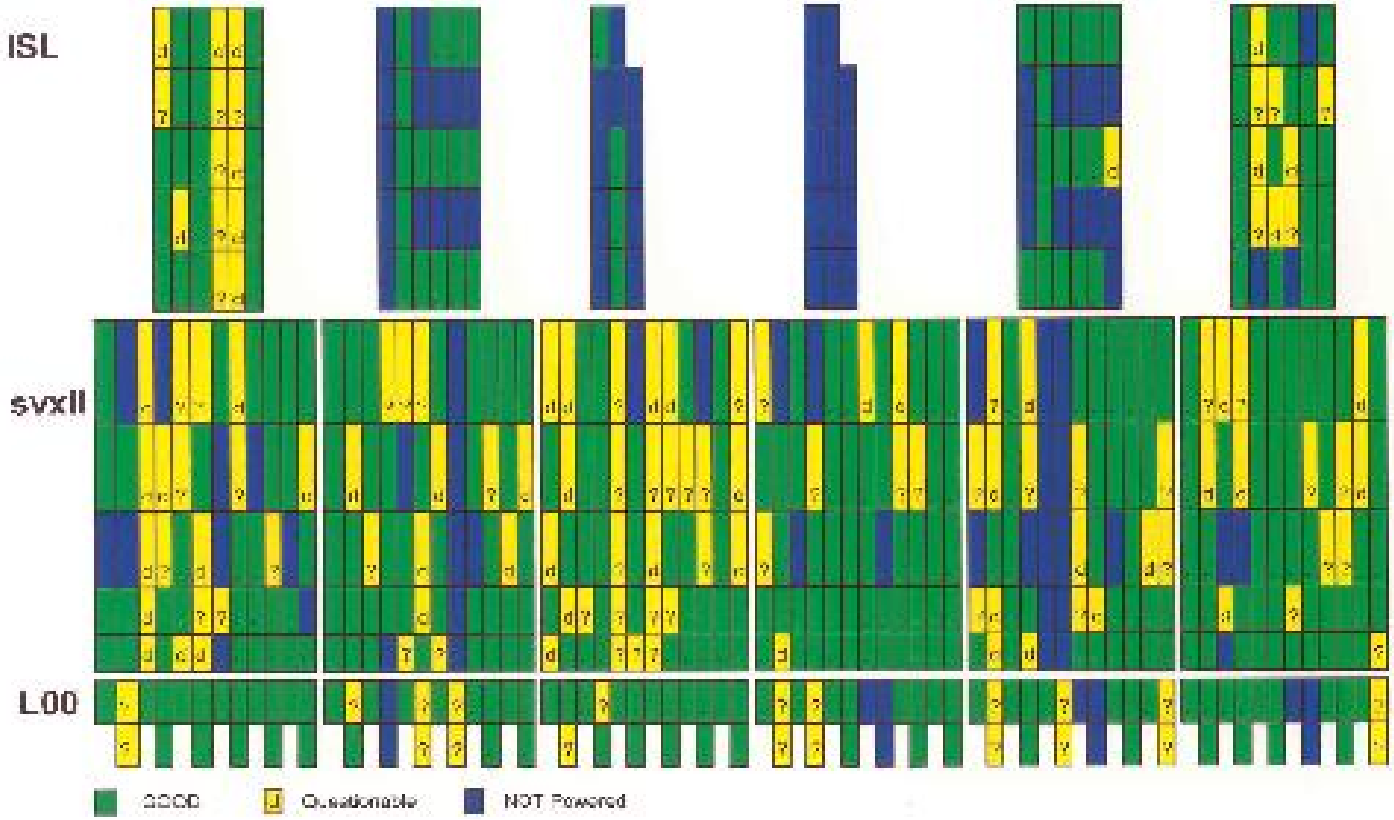


SVX3 chip



Nigel Lockyer
University of Pennsylvania and Fermilab

Silicon Status



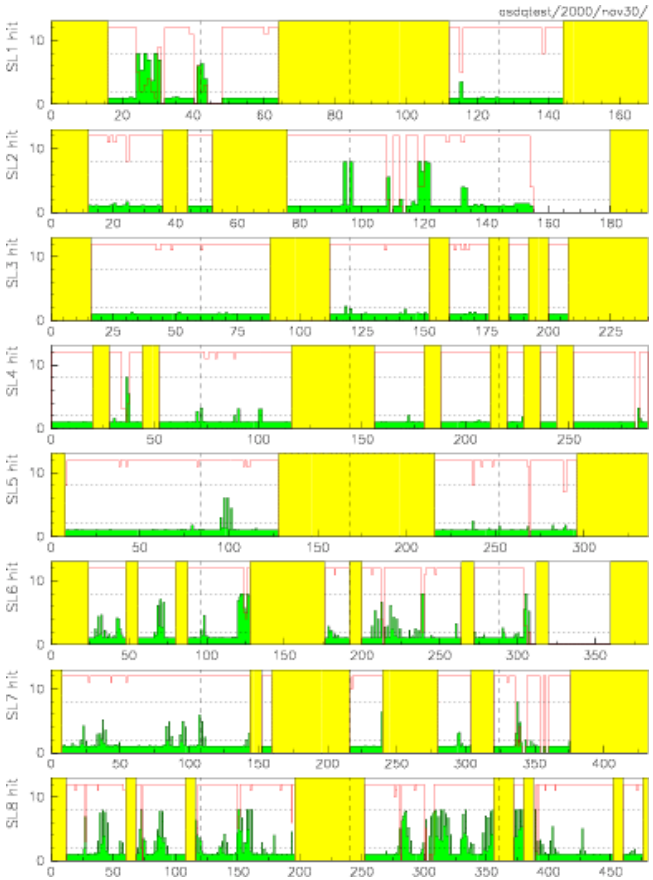
Silicon Summary

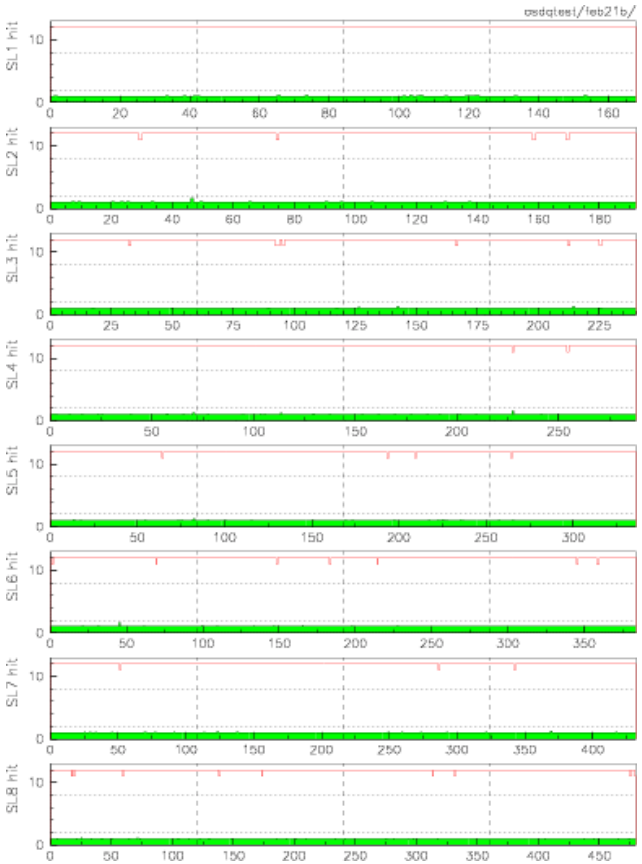
	Total	No Power	Some Issues	Good
ISL	148	66	23	59
SVXII	360	41	97	222
L00	108	11	21	76

Nigel Lockyer
University of Pennsylvania and Fermilab

COT Good Channels

Fall 2000





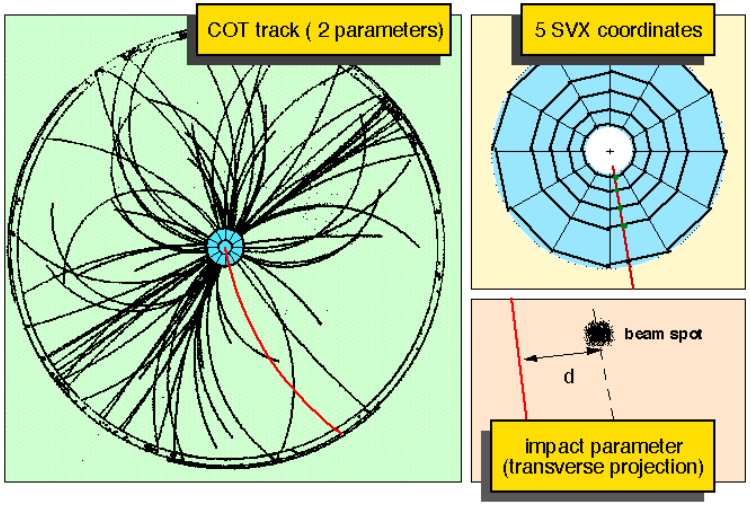
Now

Nigel Lockyer
University of Pennsylvania and Fermilab

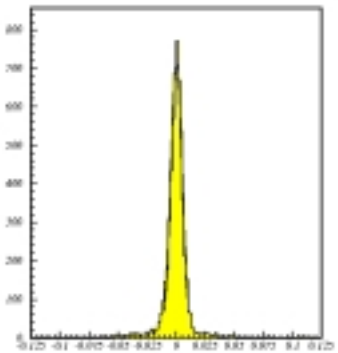
COT and SVX Trigger Status

COT defines
track momentum
cut at level 1
(XFT)

SVX measures
impact parameter
cut at level 2
(SVT)



σ= 48 μm
including beam
spot spread

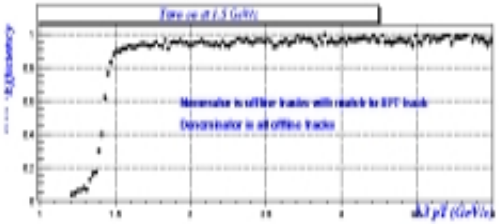


σ=30 μ

d_o (cm)

from beam

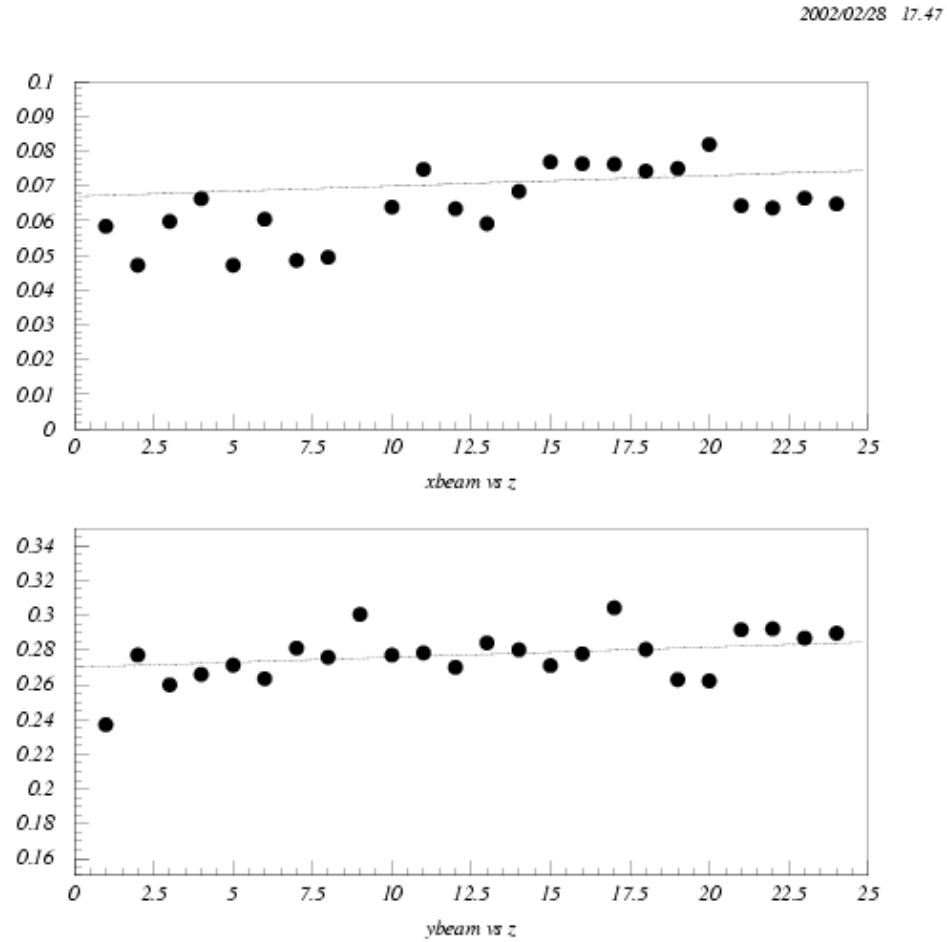
SVT impact
parameter



XFT cut at
P_T = 1.5 GeV/c

Beam Position vs Z

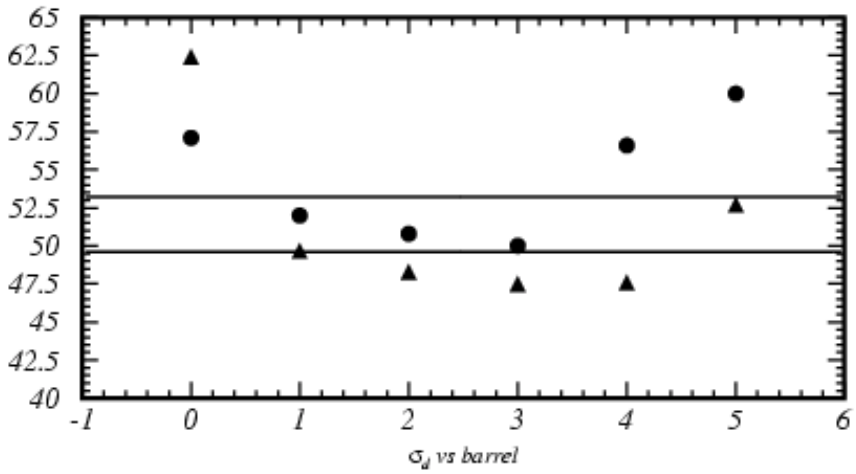
Each SVX barrel is divided into 4 bins. The beam position is given in cm for min bias tracks. The fitted slopes are 0.08 mrad in x and 0.15 mrad in y.



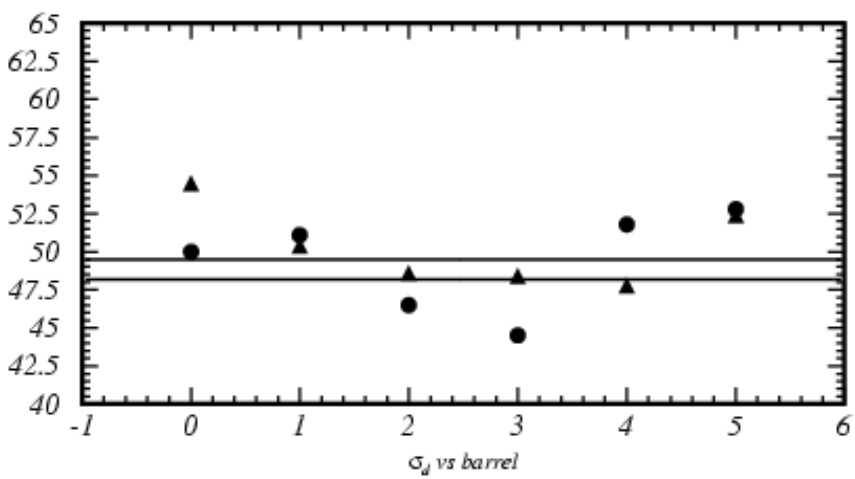
Nigel Lockyer
University of Pennsylvania and Fermilab

SVT Resolution vs Barrel

Resolution is about 50 microns in each half barrel



Online

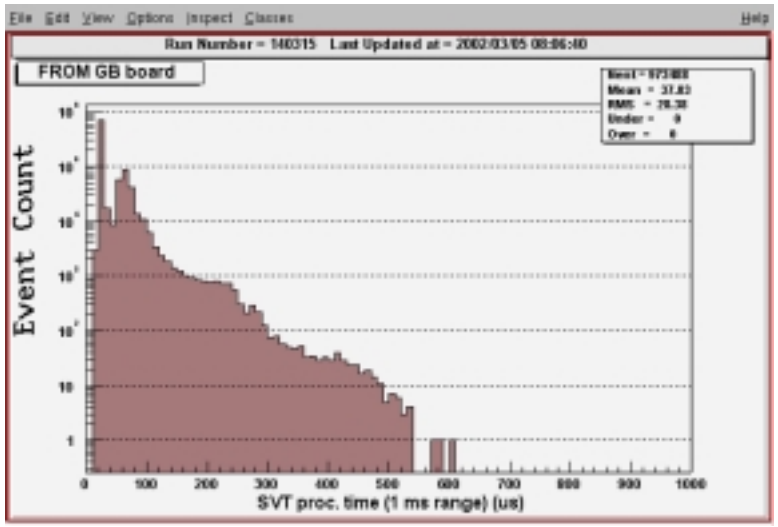


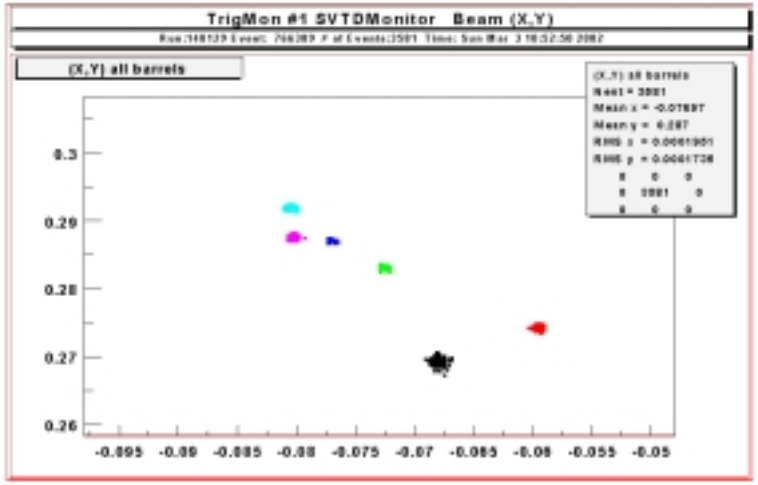
Offline

Nigel Lockyer
University of Pennsylvania and Fermilab

SVT: work in progress

- Understanding execution time
  - new tools in development
- Barrel to barrel alignment
  - Needed for 3D online beamline fit





Nigel Lockyer
University of Pennsylvania and Fermilab

SVT Trigger Rates OK

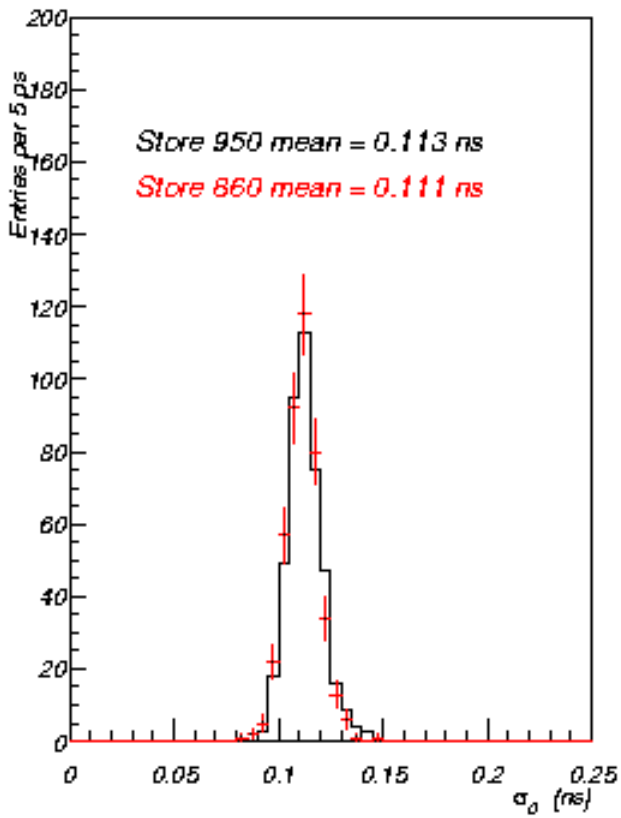
- Two SVT L2 triggers are defined in internal trigger guide
  - B_pipi: 360 nb
    - 2x (d > 100 um), Delta-phi > 20^0, Lxy > 0, d_B < 140 um
  - B_charm: 394 nb (200 nb overlap)
    - 2x (d > 120 um), 2^0 < Delta-phi < 90^0, Lxy > 0
- Simple requirement of two tracks with d > 100 um is currently used at L2
  - L2_TWO_TRK2_D100: 3200 nb
- L2 cuts are simulated offline on data from a L3 auto-accept prescaled path

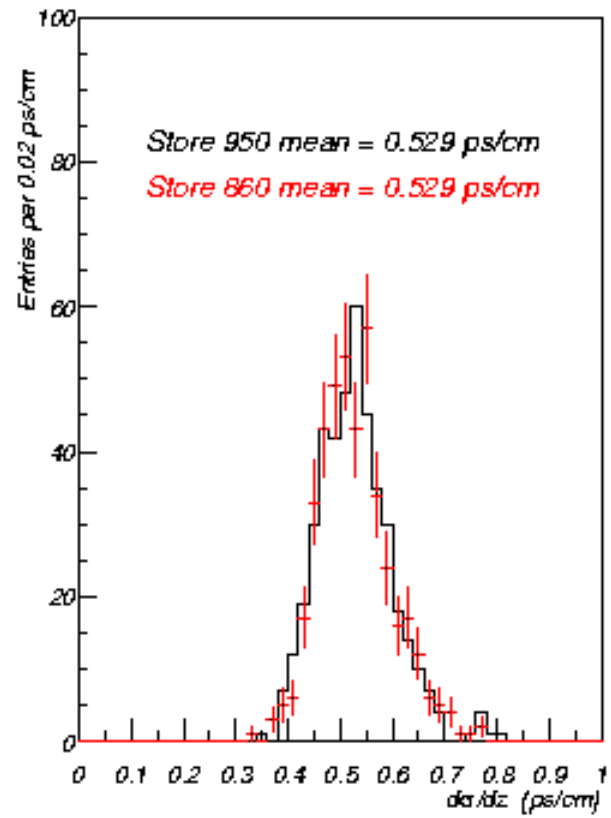
	All	simulate	x $(72/56)^2$	Expected
B_pipi	3200 nb	287 nb	474 nb	360 nb
B_charm	3200 nb	391 nb	646 nb	394 nb

Nigel Lockyer
University of Pennsylvania and Fermilab

TOF Timing Resolution

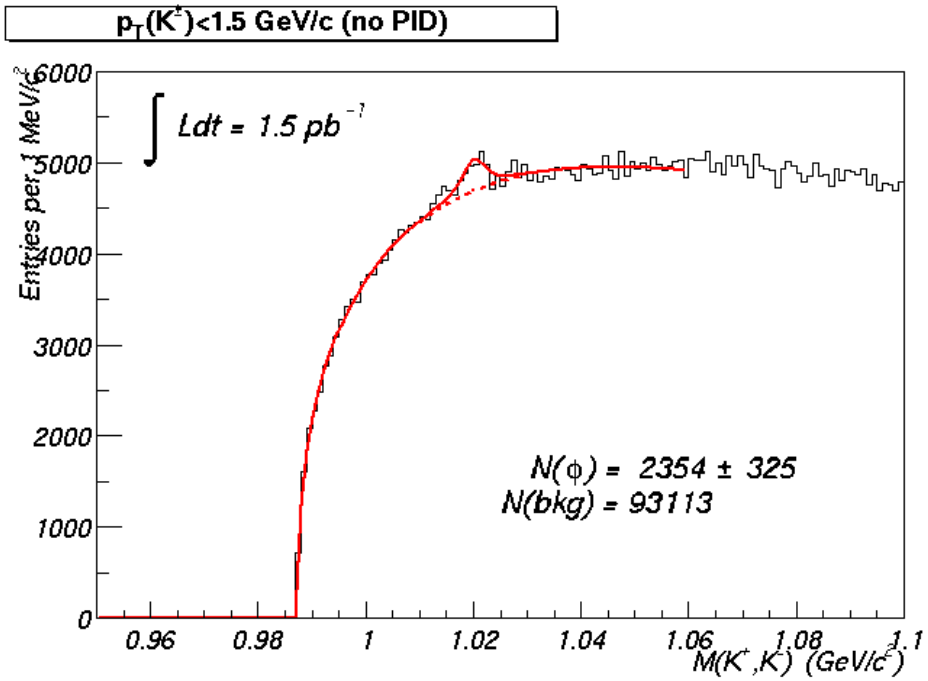
Resolution is measured close to PMT and as a function of Z along the bar

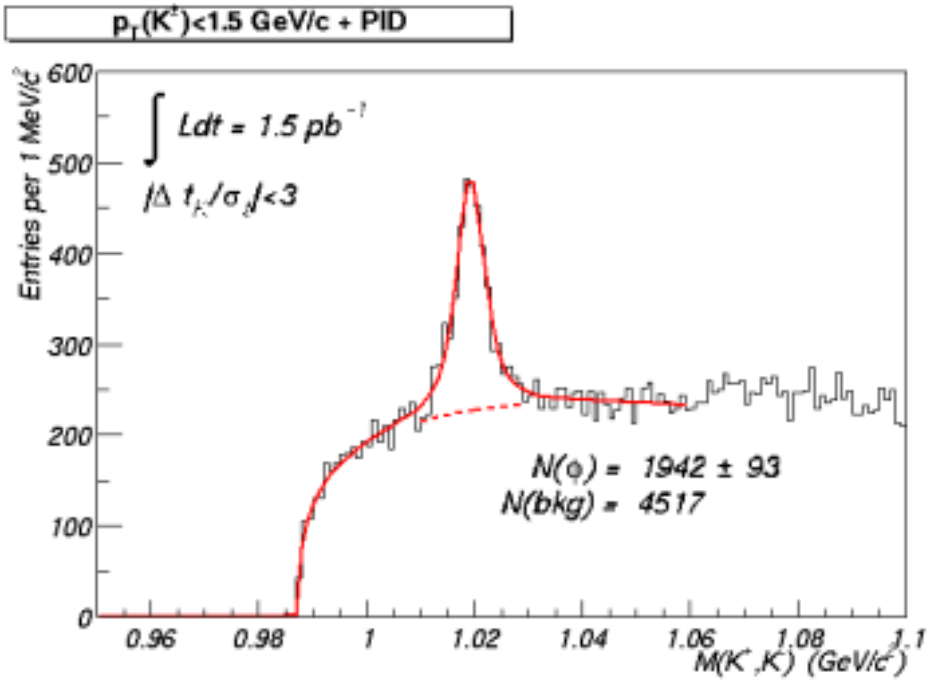




Nigel Lockyer
University of Pennsylvania and Fermilab

Time-of-Flight ID





Nigel Lockyer
University of Pennsylvania and Fermilab

B Physics in Run II

The CDF detector is <u>MUCH</u> improved

- Improved silicon coverage + stereo silicon
- L00 improves resolution
- Silicon Vertex Trigger (SVT)
- High-rate trigger and DAQ system
- Time-of-flight (TOF) system

Nigel Lockyer
University of Pennsylvania and Fermilab

CDF B Physics Plan

View CDF Running in 2002-03 with three phases:

- Phase 1: first 50 pb^{-1} of data
  - refine trigger algorithms
  - study & improve *B* reconstruction and tagging techniques
- Phase 2: next 50 pb^{-1} of data (100 pb^{-1} total)
  - first attempt to B_s mixing (or set new limit)
    - ***unique to the Tevatron***
- Phase 3: next 200-300 pb^{-1} of data and beyond
  - many new measurements involving B_s, B_c and Λ_b hadrons
  - Two-body B_d sample large
    - ***complementary to*** **e^+e^- B** ***factories***

Nigel Lockyer
University of Pennsylvania and Fermilab

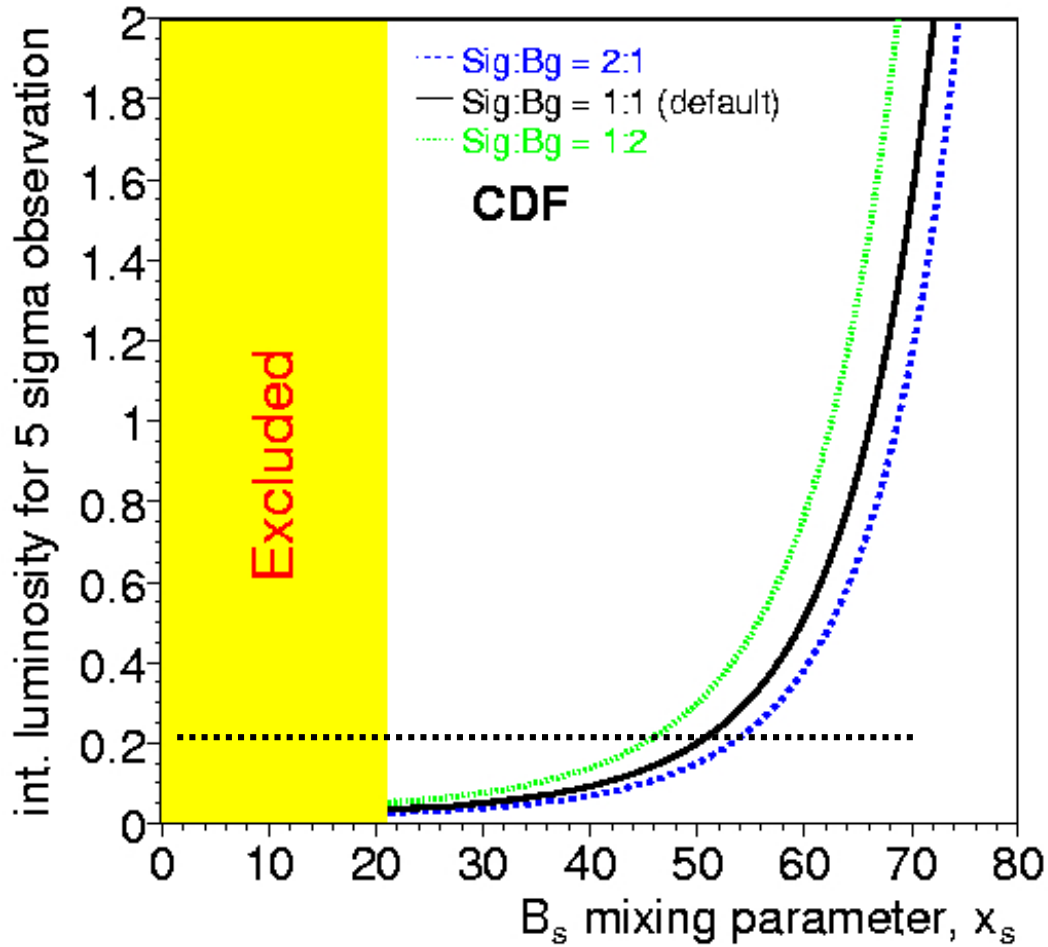
Prospects for B_s Mixing

Plot shows that with ~100-200 pb^{-1} of data, we can begin to cover expected region for B_s mixing

Important point: *Plot assumes we have achieved:*

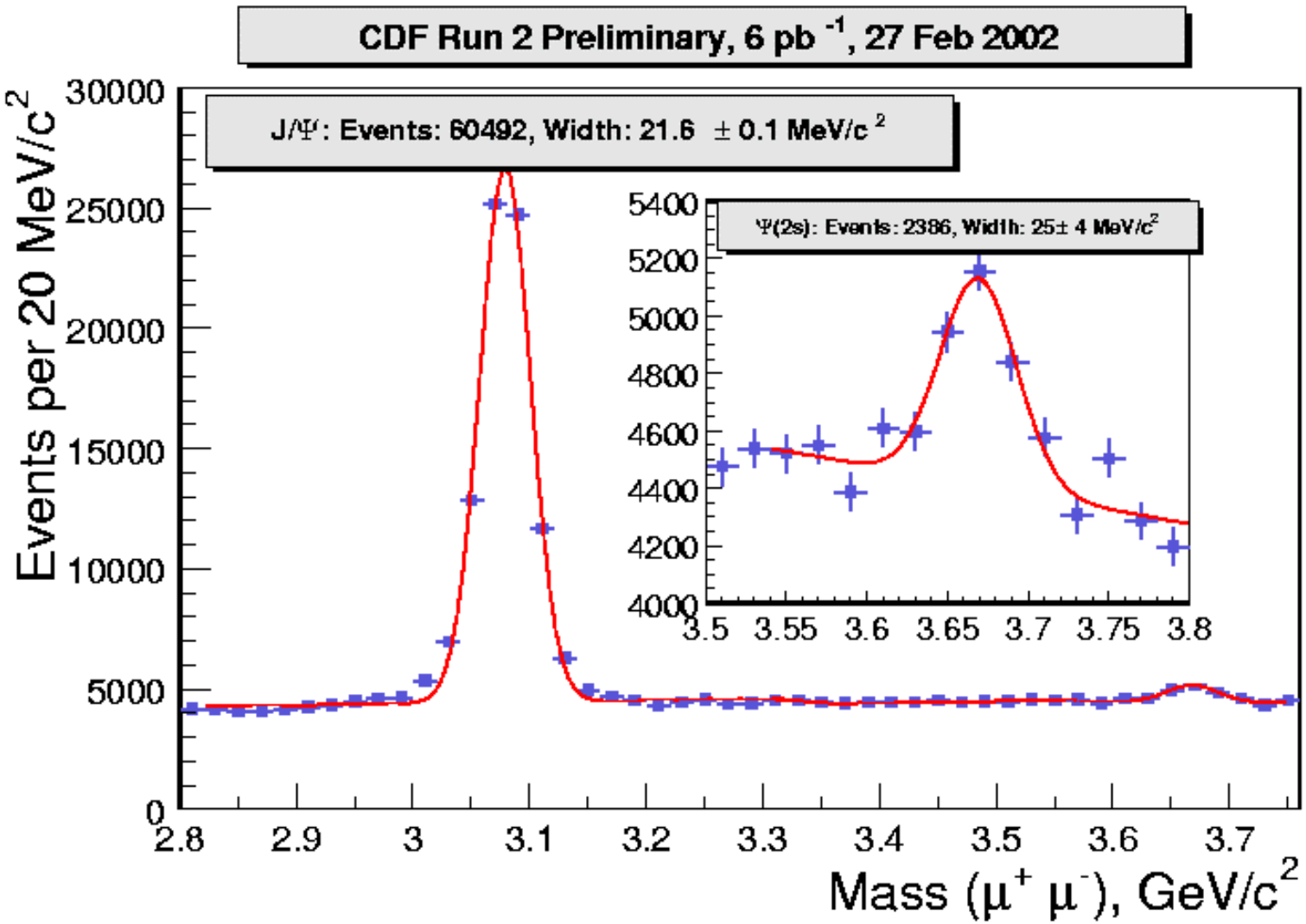
1. ***Excellent*** *trigger & reconstruction efficiency*
2. ***Excellent*** *proper time resolution*

   -L00
3. ***Excellent*** *flavor tagging efficiency*



Nigel Lockyer
University of Pennsylvania and Fermilab

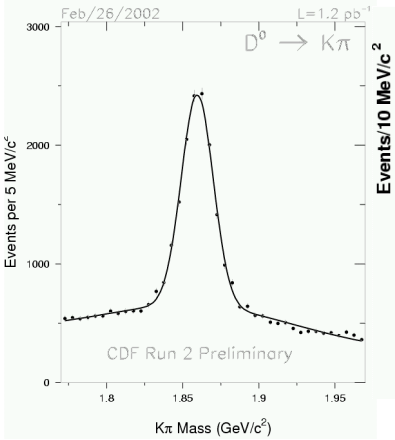
$J/\Psi \rightarrow \mu\mu$

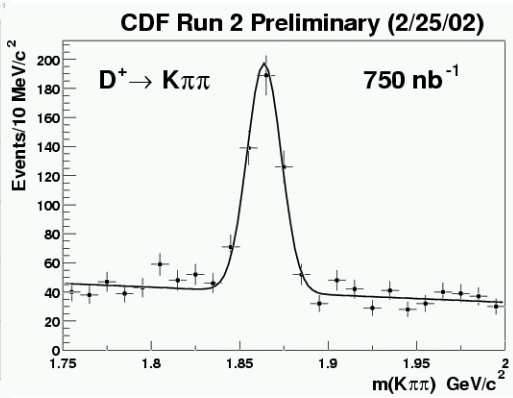


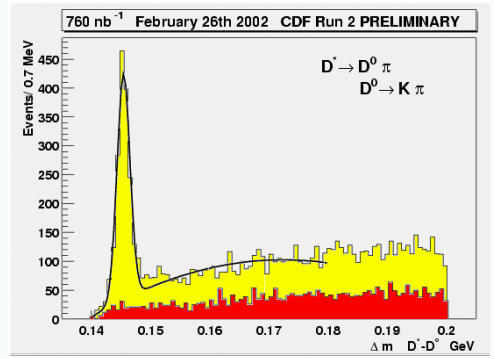
Nigel Lockyer
University of Pennsylvania and Fermilab

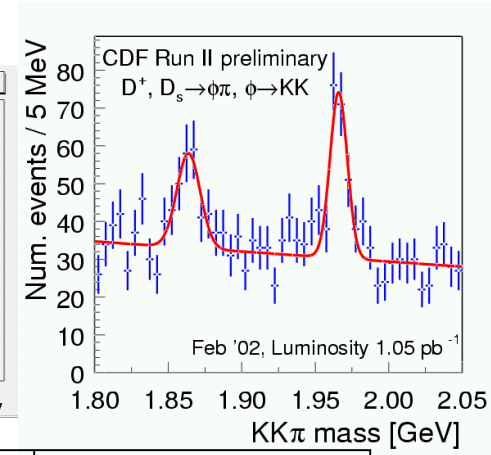
Charm Physics at CDF

From first pb^{-1} with the SVT:









$D^0 \to K^-\pi^+$ yields:

50 pb^{-1}	2 fb^{-1}	E791	FOCUS	Υ(4S)/100 fb^{-1}
500K	20M	40K	120K	1M

Large yield, but poor PID, biased trigger, prompt & secondary charm.

D^0 mixing: Lifetime difference between $D^0 \to K^-\pi^+$ and $D^0 \to K^-K^+$

Time-dependent analysis of wrong sign decay $D^0 \to K^+\pi^-$

CP violation: CP asymmetry in $D^0 \to K^-K^+$ $D^0 \to \pi^-\pi^+$ $D^+ \to K^-K^+\pi^+$

from tree-penguin interference in $c \to uq\bar{q}$ transition

Nigel Lockyer
University of Pennsylvania and Fermilab

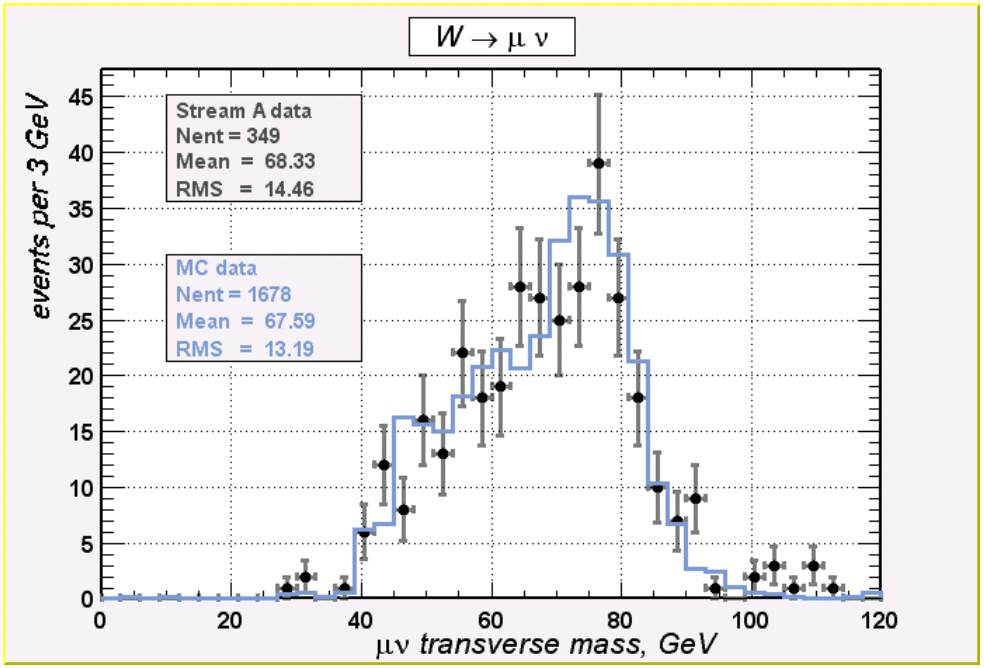
Trigger Status

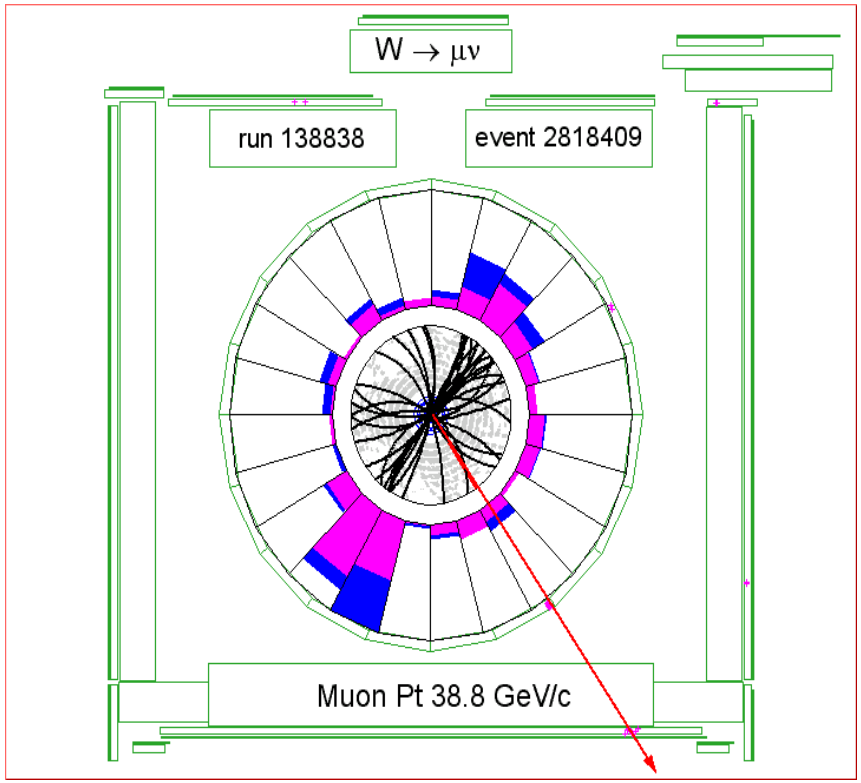
- We are currently running with
  - ~ 1700 nb on tape since Feb 18
  - L1A: 340 ub ⇨ 3.4 kHz @ 10^{31}
  - L2A: 22 ub ⇨ 220 Hz @ 10^{31}
  - L3A: 2.5 ub ⇨ 25 Hz @ 10^{31}
- A new trigger table is being prepared.

  Main changes are:
  - New paths: Z->bb, inclusive b jet, b + gamma, rare B decays
  - Add soft central shower max electrons to level 2
  - Add D^0 path to fast production line (express)
- Currently limited mainly by L2 accept rate and execution time
  - Work is in progress to understand and improve both
  - Substantial gain expected from better L2 algorithms
    - See e.g. SVT L2 triggers

Nigel Lockyer
University of Pennsylvania and Fermilab

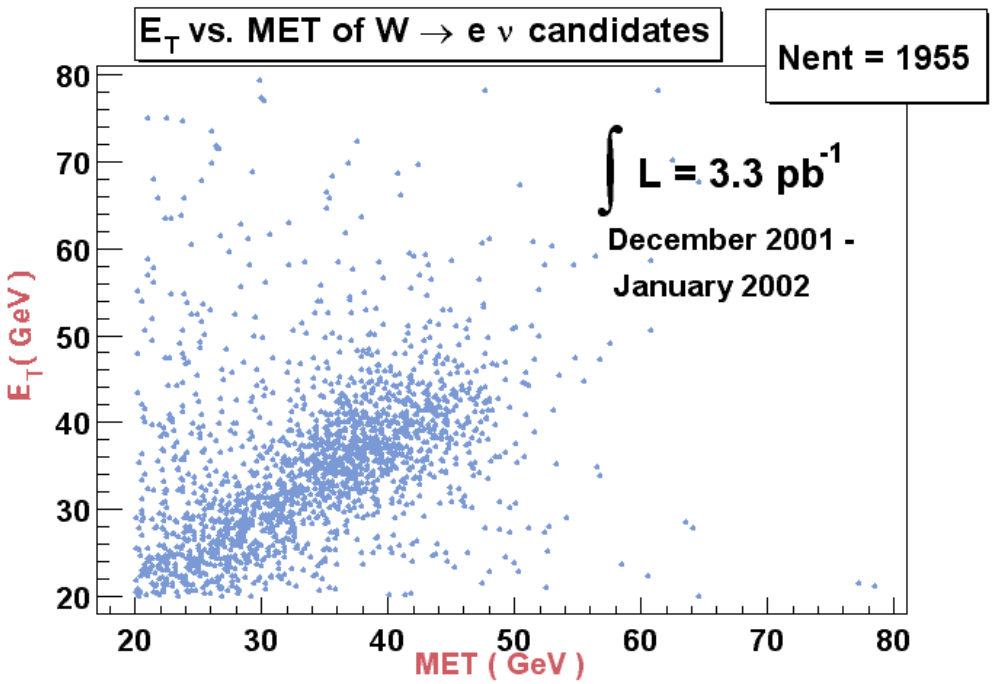
$W \rightarrow \mu\nu$

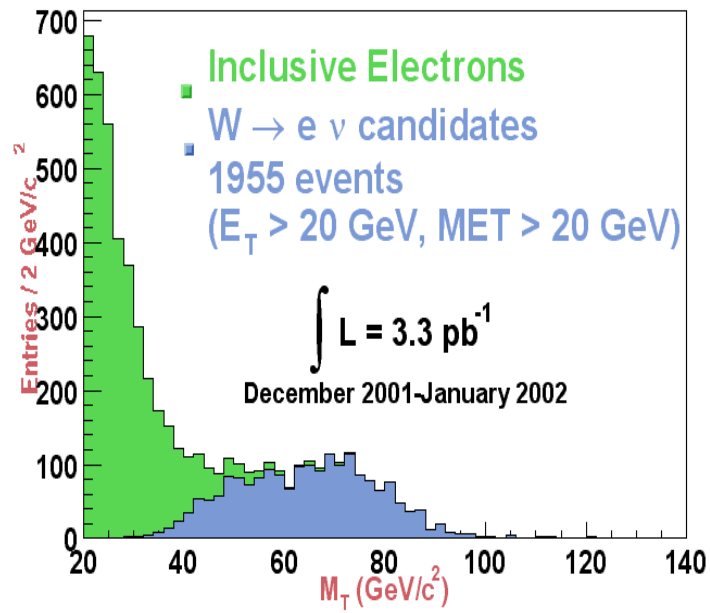


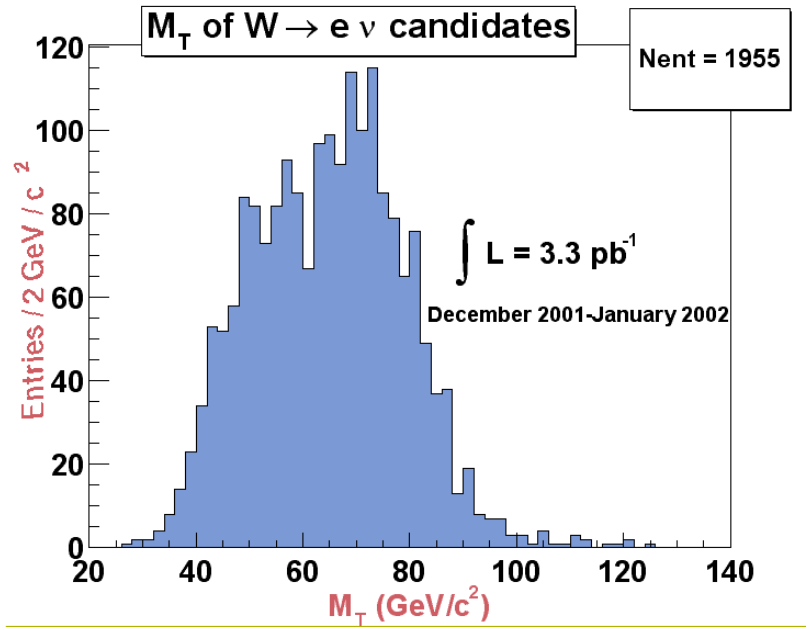


Nigel Lockyer
University of Pennsylvania and Fermilab

$W \rightarrow e\nu$

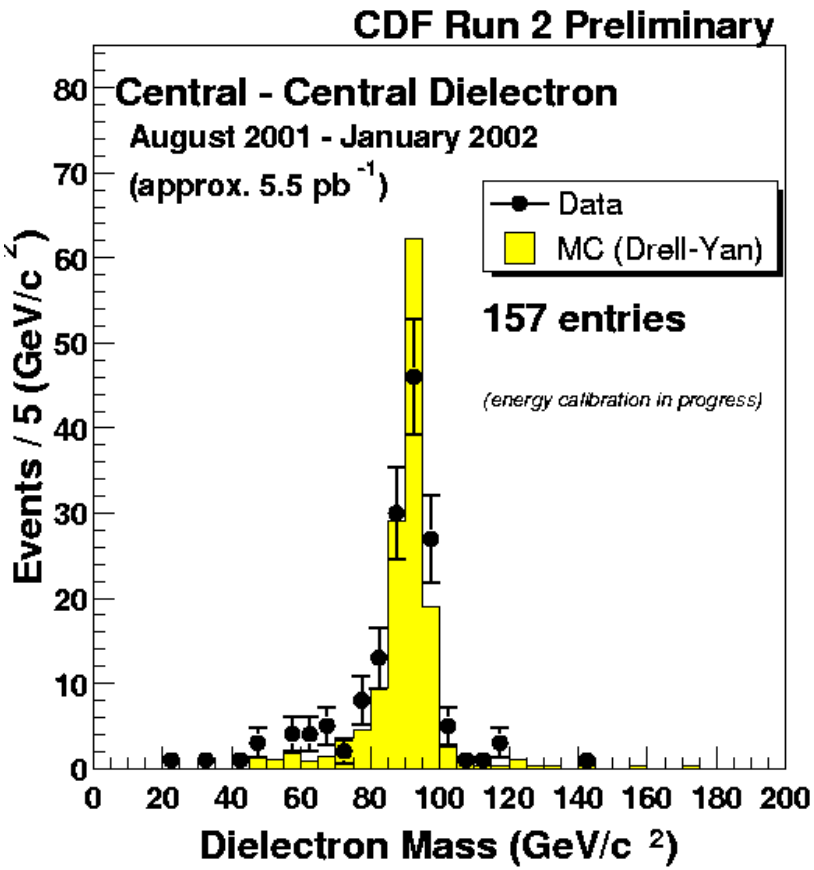


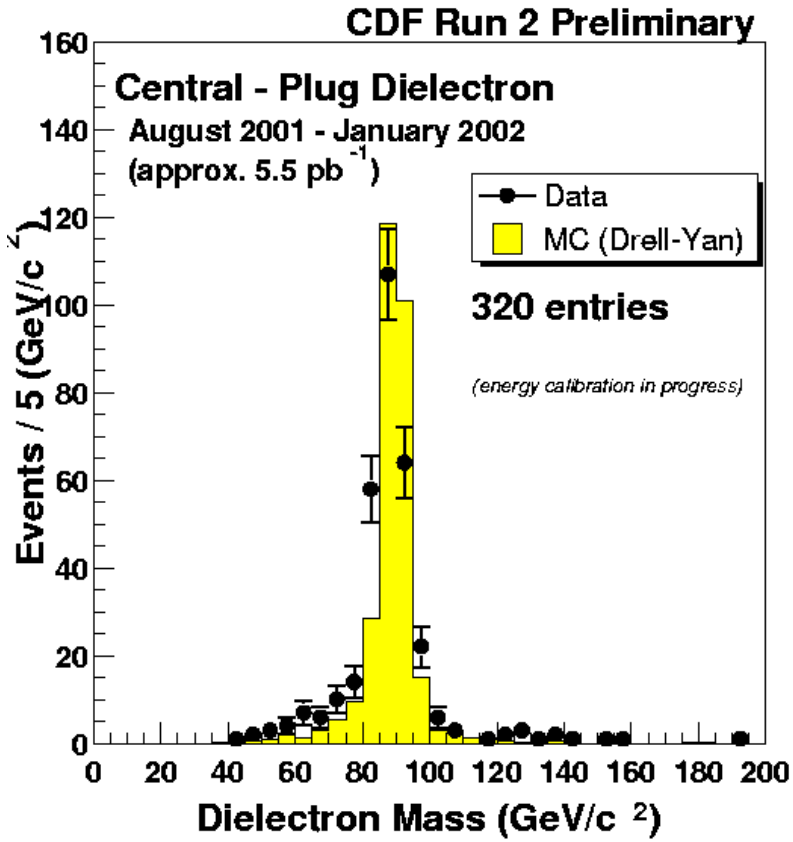




Nigel Lockyer
University of Pennsylvania and Fermilab

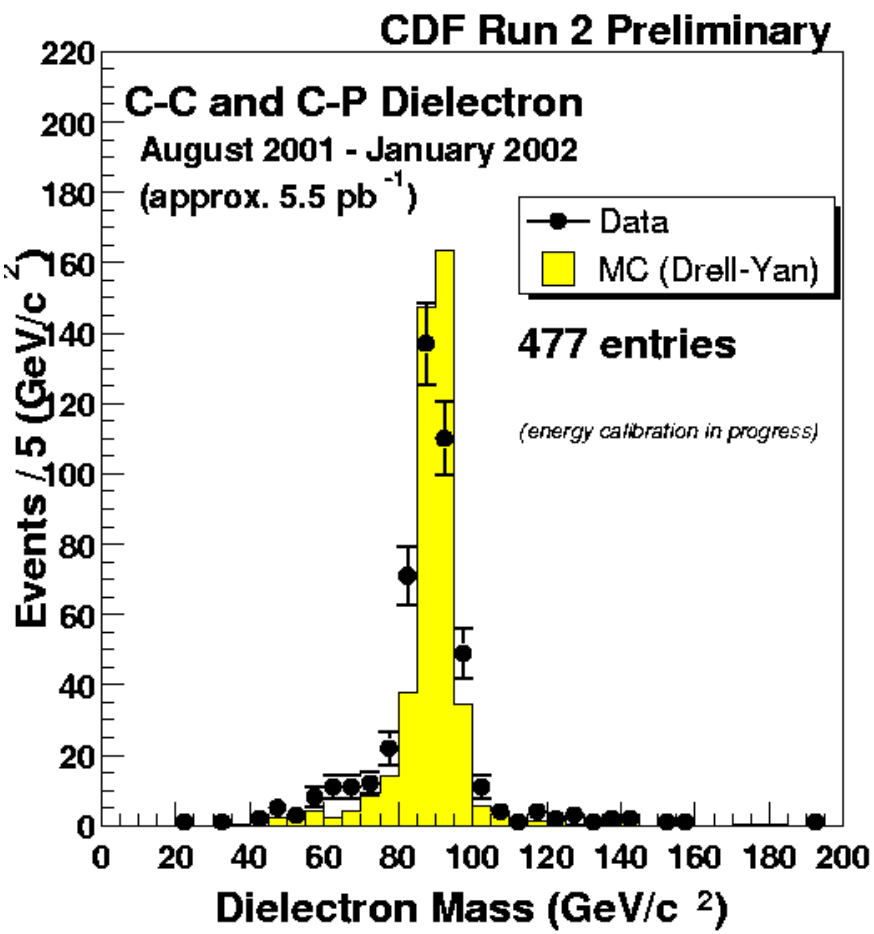
$Z \rightarrow ee$

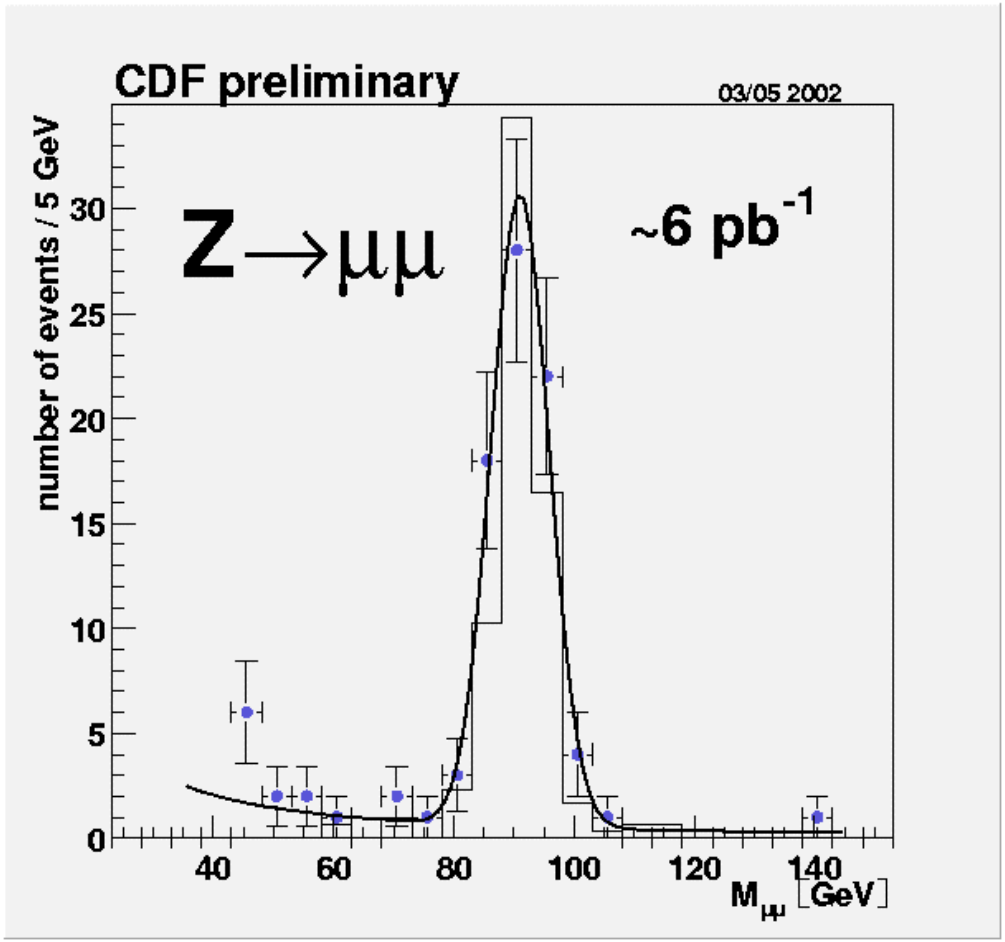




Nigel Lockyer
University of Pennsylvania and Fermilab

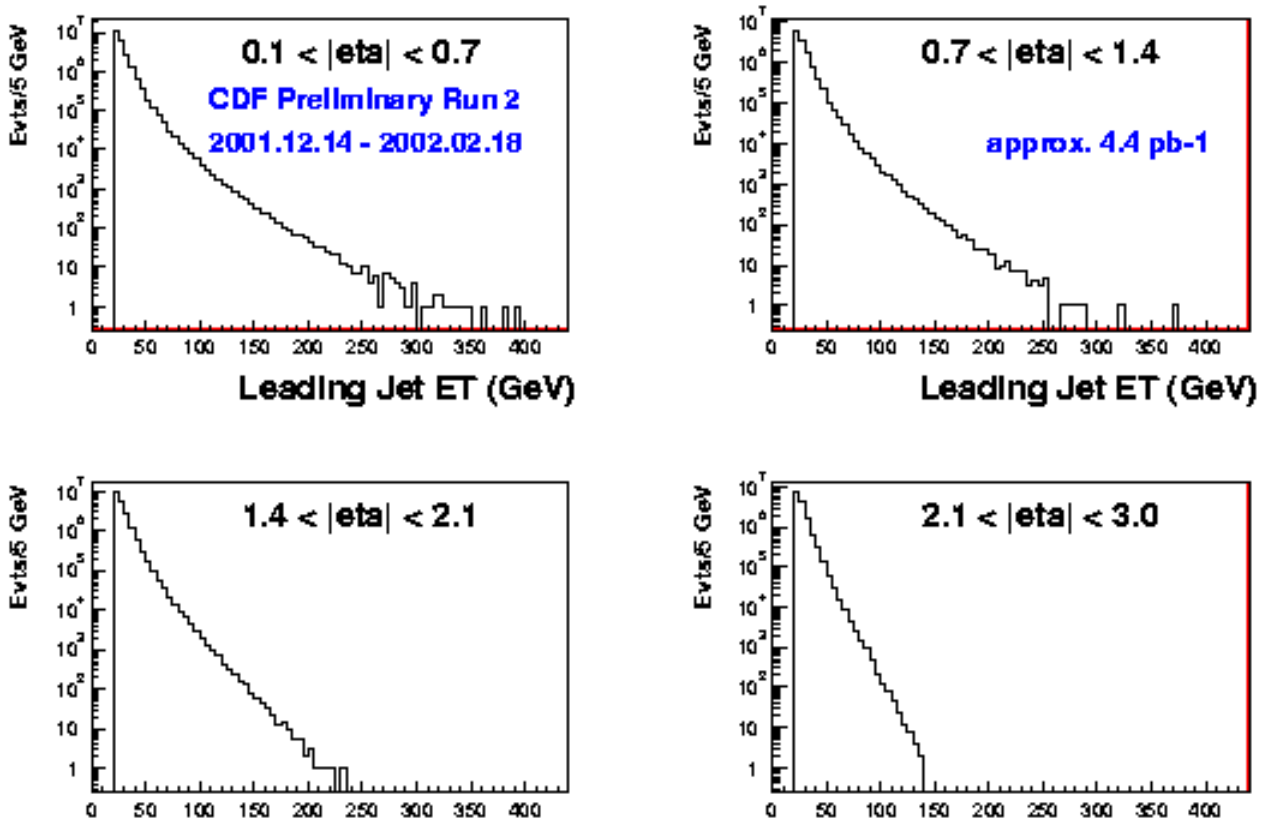
$Z \rightarrow ee$ and $Z \rightarrow \mu\mu$





Nigel Lockyer
University of Pennsylvania and Fermilab

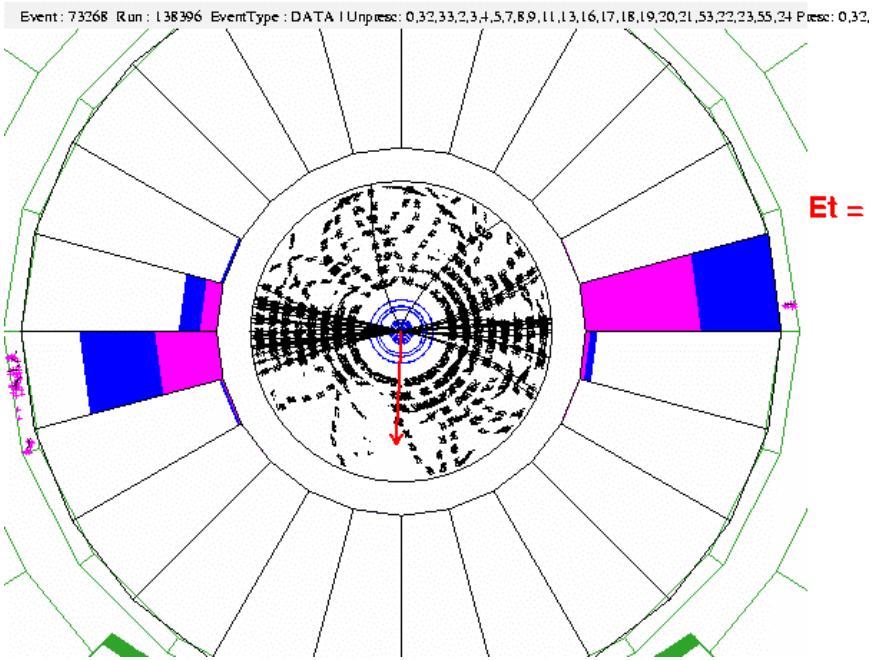
Leading Jet Et

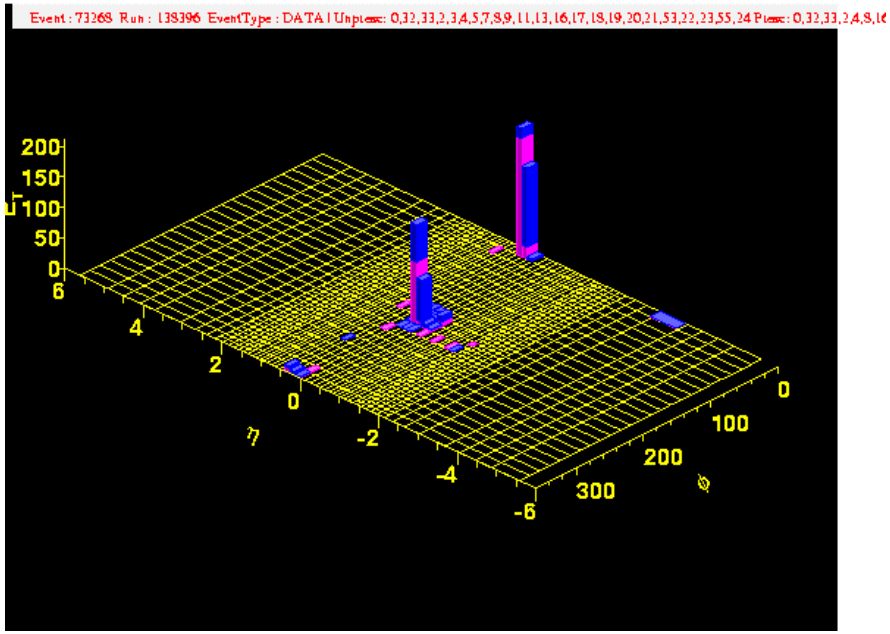


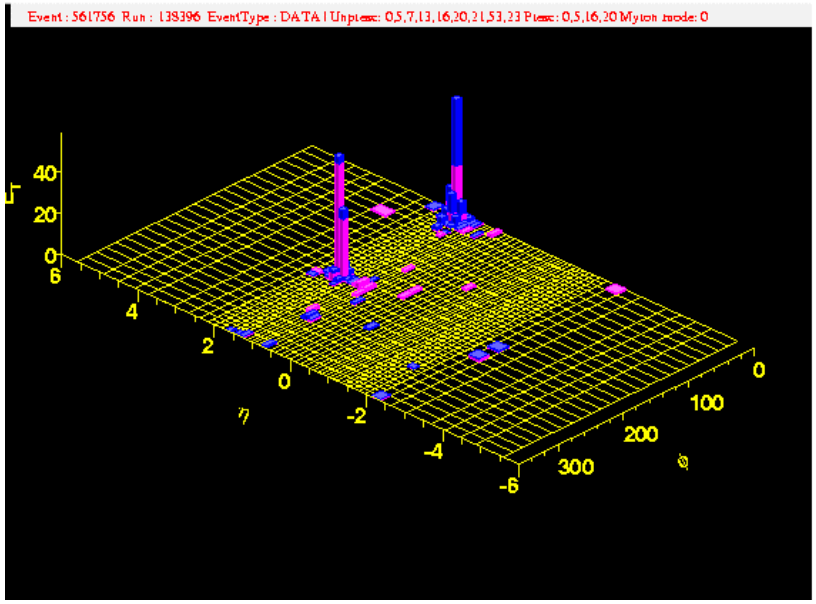
Different η Regions

Nigel Lockyer
University of Pennsylvania and Fermilab

Jets







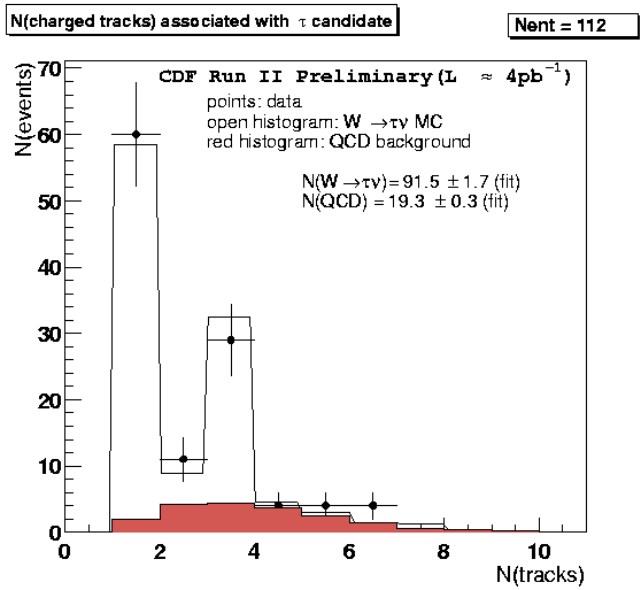
High Et jets > 400 GeV

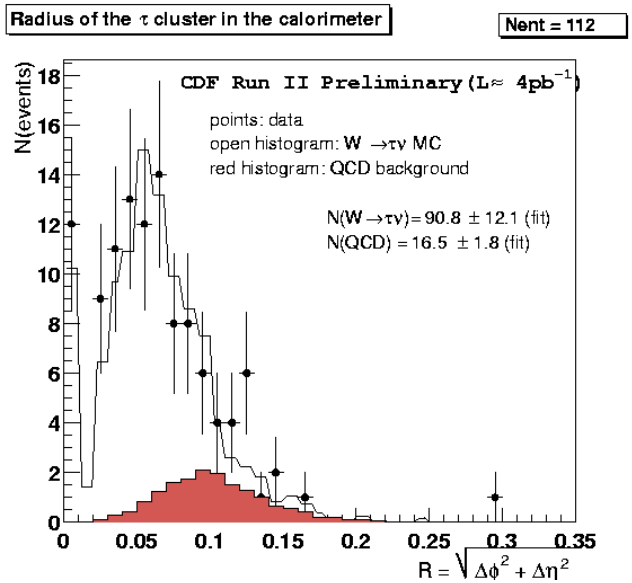
Forward jets

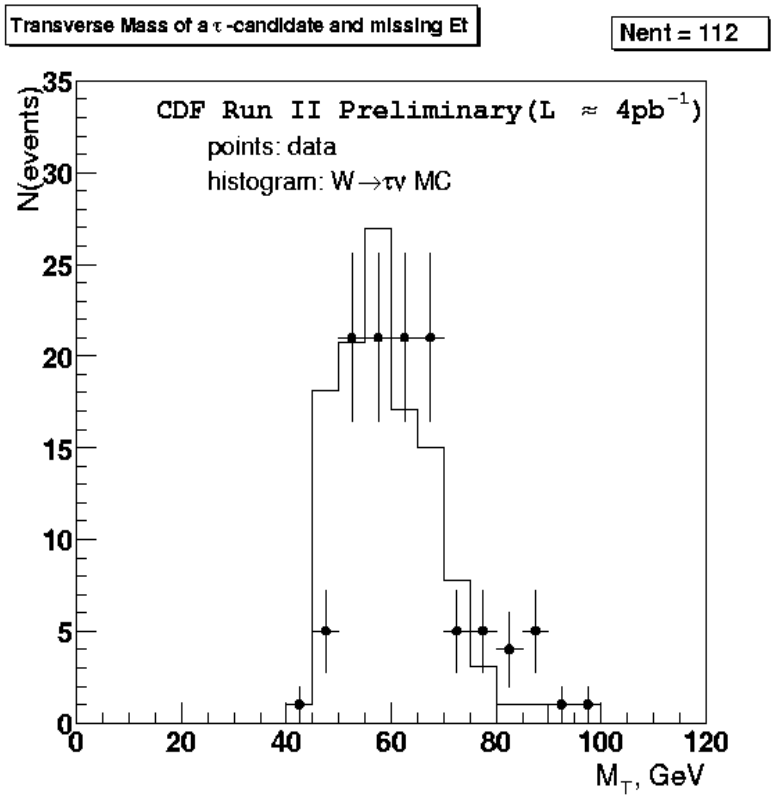
Probe small x region

Nigel Lockyer
University of Pennsylvania and Fermilab

$W \rightarrow \tau\nu$





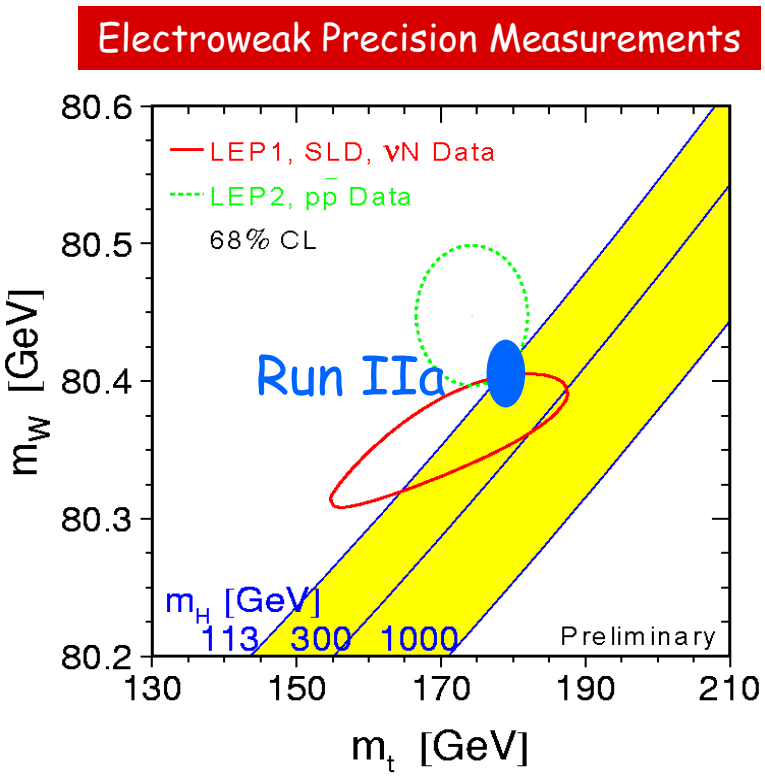


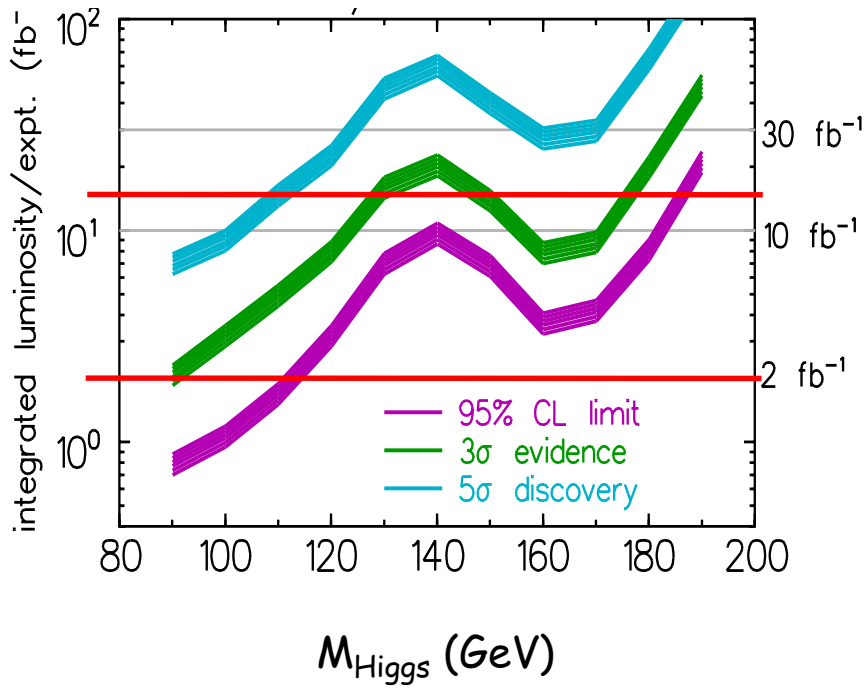
Nigel Lockyer
University of Pennsylvania and Fermilab

Run II HIGGS

Favors light Higgs : M_{Higg} <165 GeV at 95%CL
LEP II Searches : M_{Higg} > 113 GeV at 95%CL
LEP II Hint at M_{Higg}= 115 GeV

Higgs Reach





Nigel Lockyer
University of Pennsylvania and Fermilab

Summary

- CDF detector is working well
- Collab in process of understanding data
- Physics plots used to evaluate detector
- Higgs, SUSY, Bs mixing, and lots more

Nigel Lockyer
University of Pennsylvania and Fermilab