DZERO Status and Prospects

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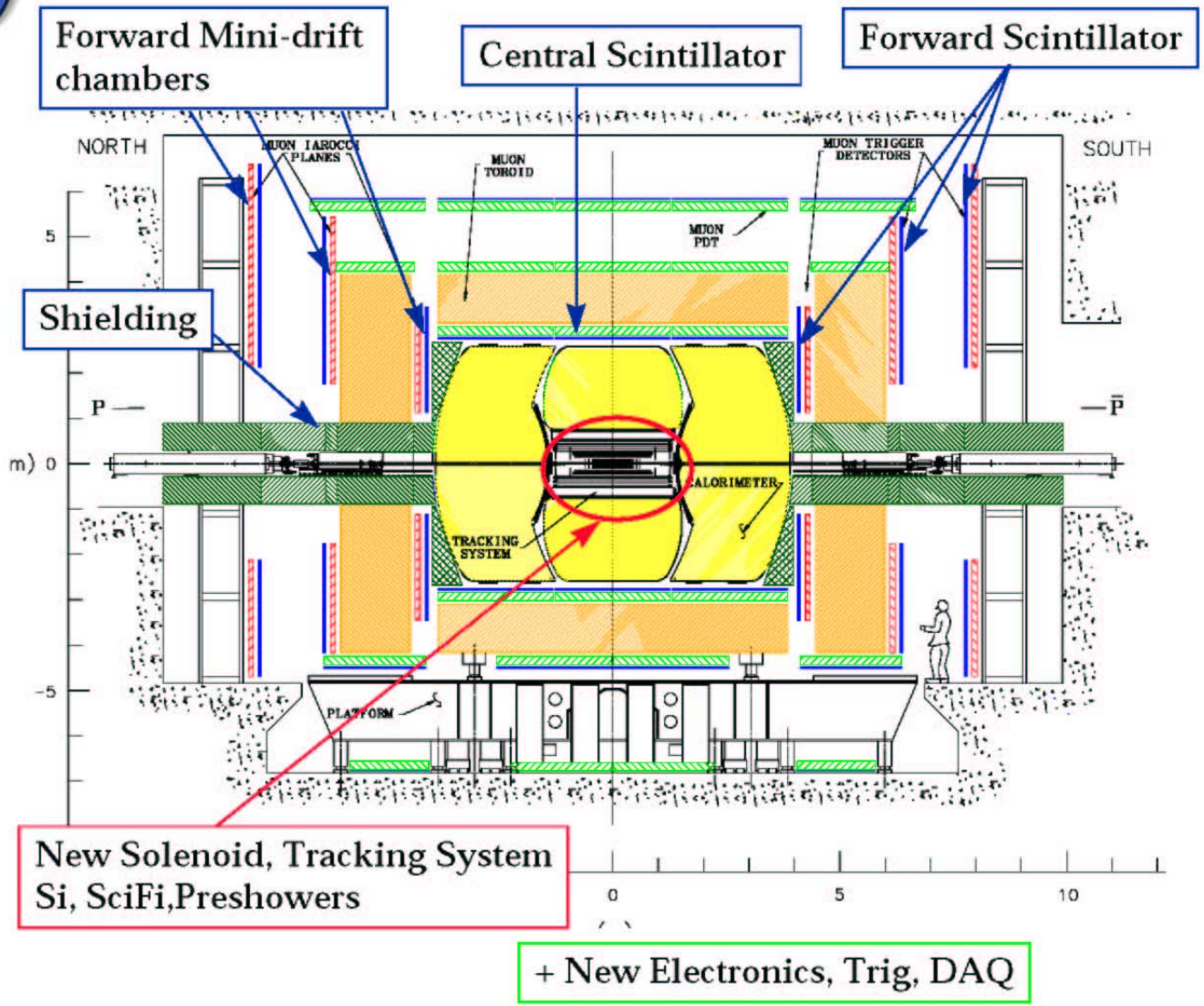
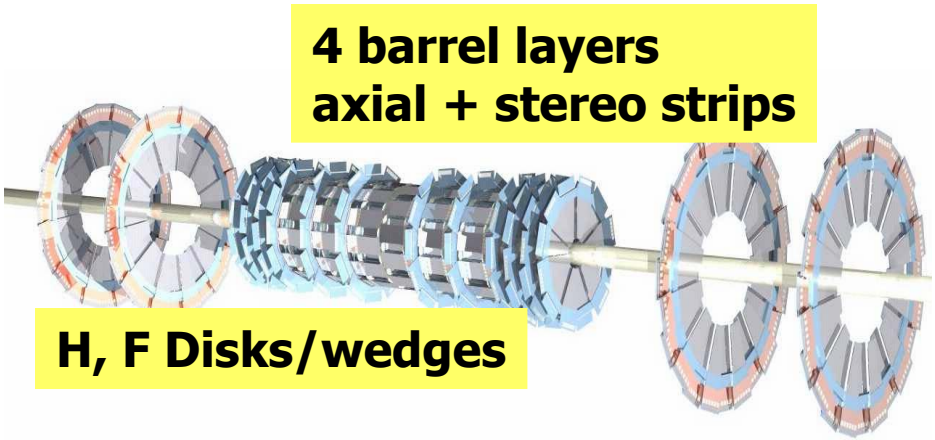
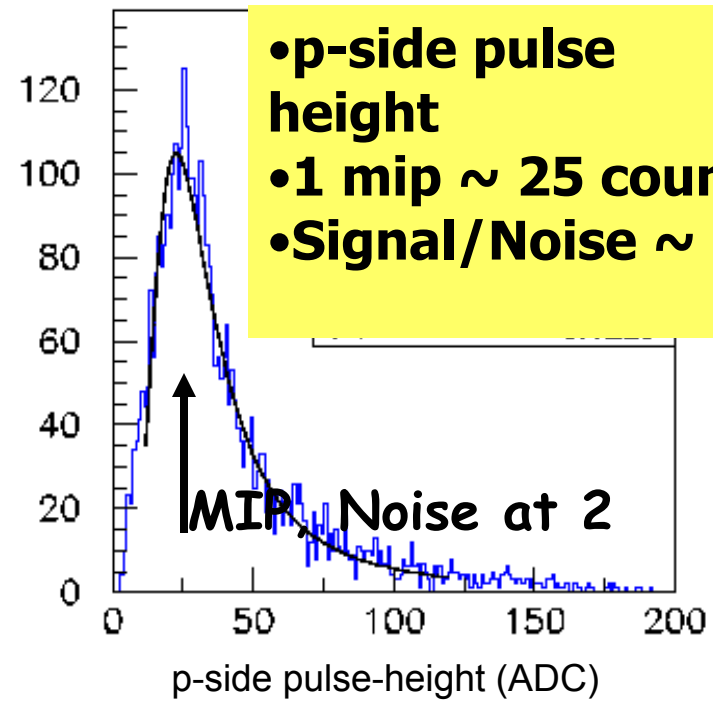
Overview

- Detector fully installed
  - Now integrating forward proton detector
  - Making increasing use of tracking triggers
  - Silicon track trigger installed this summer
- Operating stably and efficiently
- Event reconstruction <3 days
- Broad physics presentations for spring conferences and beyond

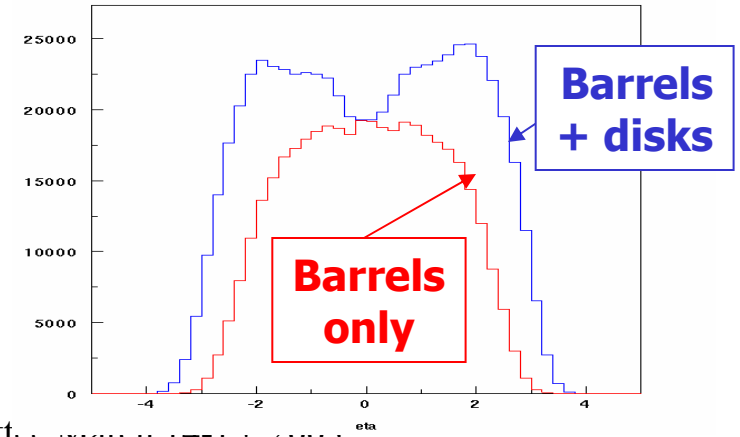

Forward Mini-drift chambers
Central Scintillator
Forward Scintillator
Shielding
NORTH
SOUTH
MUON IAROCCI PLANES
MUON TOROID
MUON TRIGGER DETECTORS
MUON PDT
CALORIMETER
TRACKING SYSTEM
PLATFORM
P
P̄
5
m) 0
-5
0
5
10
New Solenoid, Tracking System
Si, SciFi,Preshowers
+ New Electronics, Trig, DAQ

Silicon Microstrip Tracker



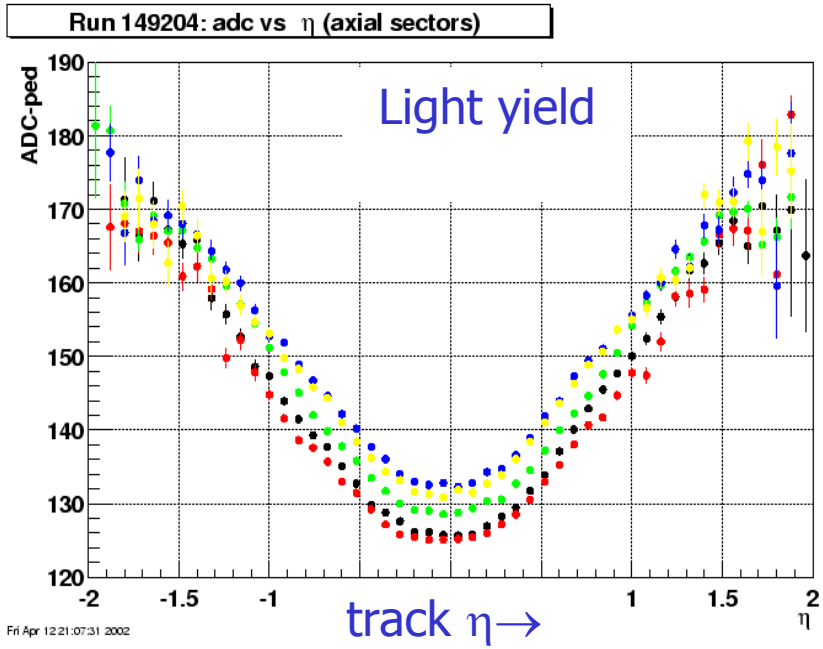


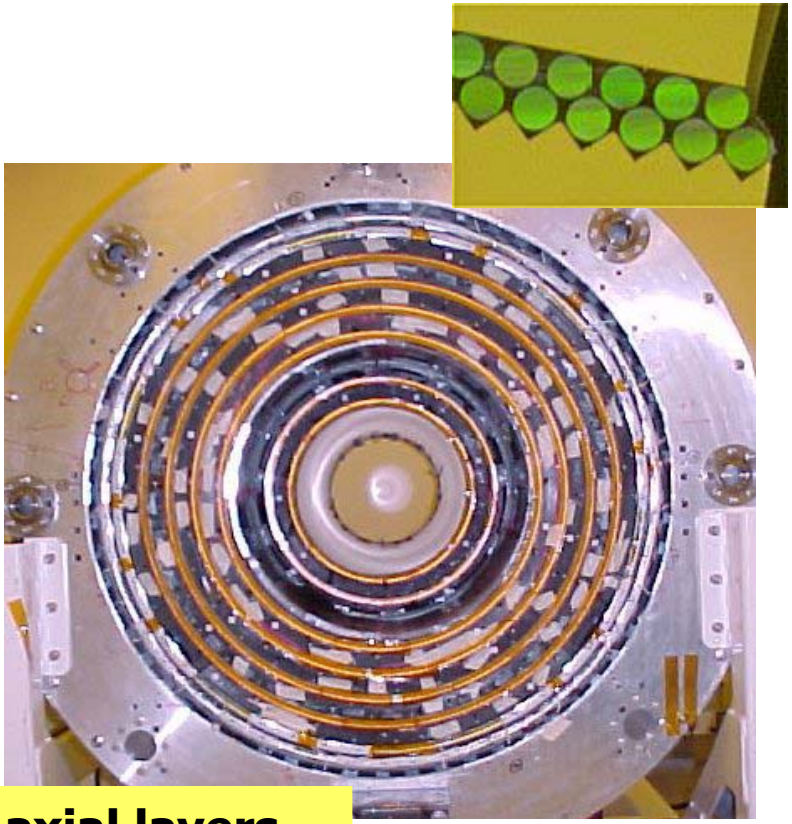
- S/Noise: > 10 all devices
- Active Channels: 91% of 1M
- Cluster Efficiency: > 97%
- No fiducial loss



Scintillating Fiber Tracker

- Active Channels: 99% of 80k
- Light yield excellent
- Hit efficiency > 98%

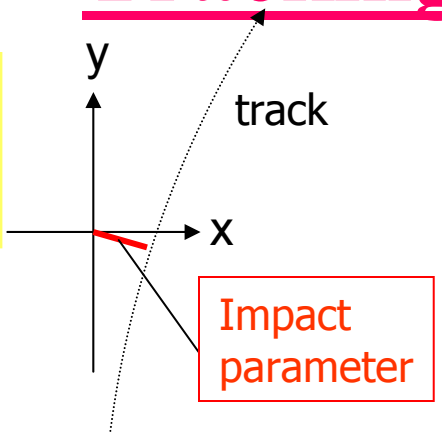




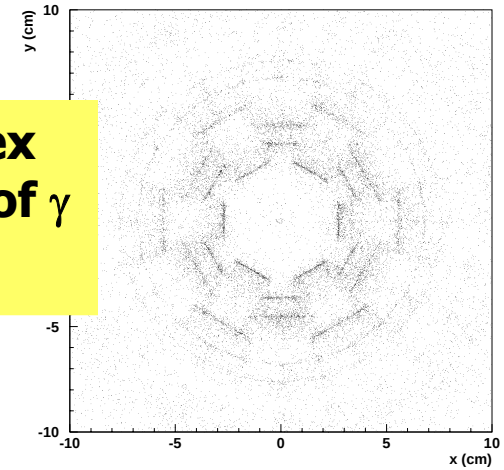
8 axial layers
8 stereo layers

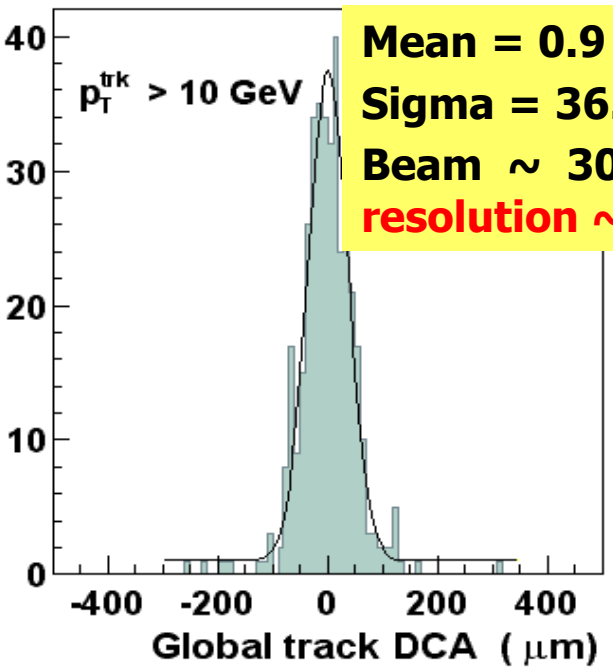
Tracking Performance

Impact Parameter Resolution

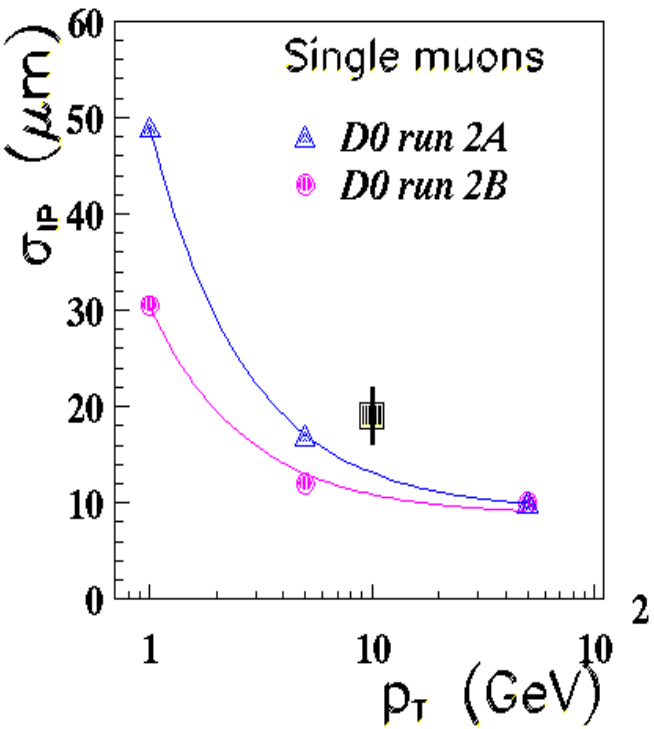


X-Y vertex location of γ to $e^+ e^-$

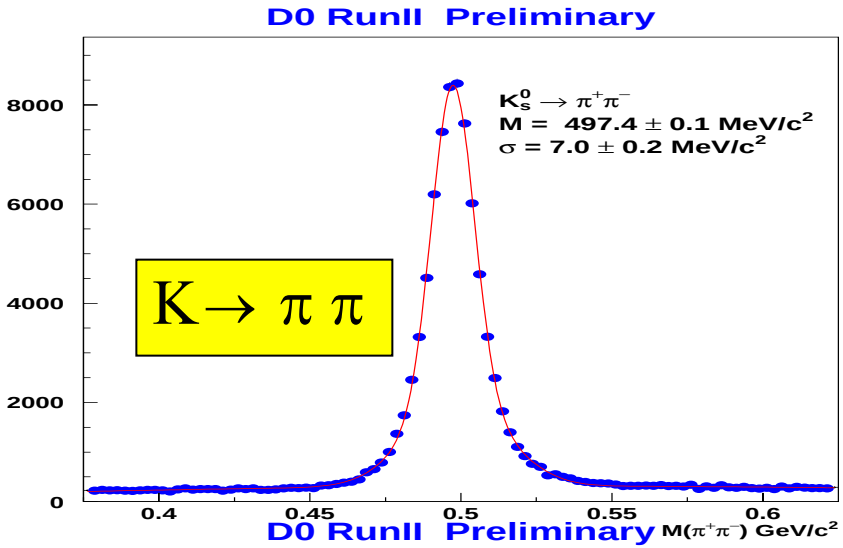


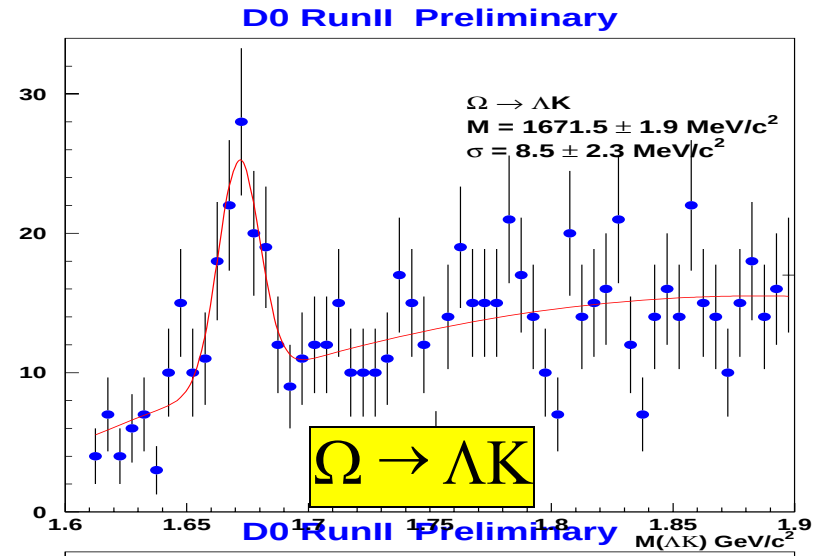


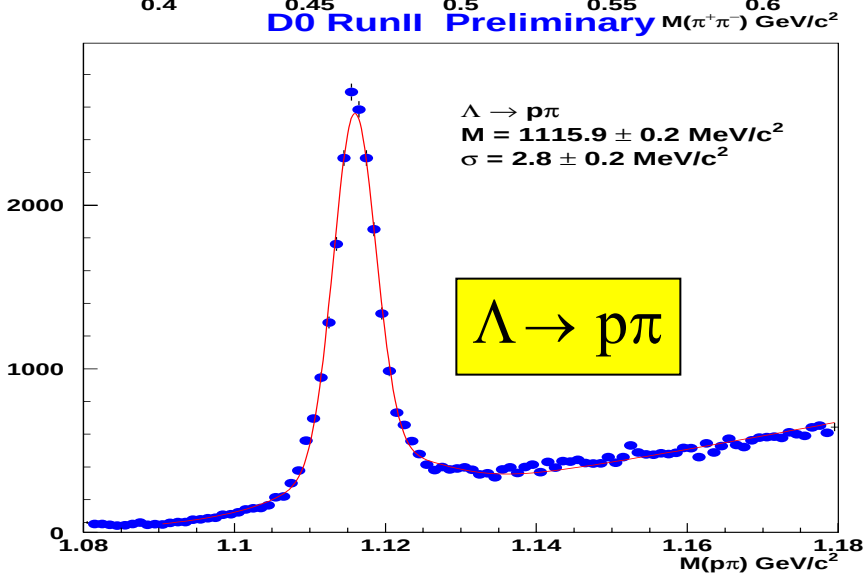
Mean = 0.9 ± 2.2 mm
Sigma = 36.3 ± 1.8 mm
Beam ~ 30 mm → IP resolution ~ 20 mm

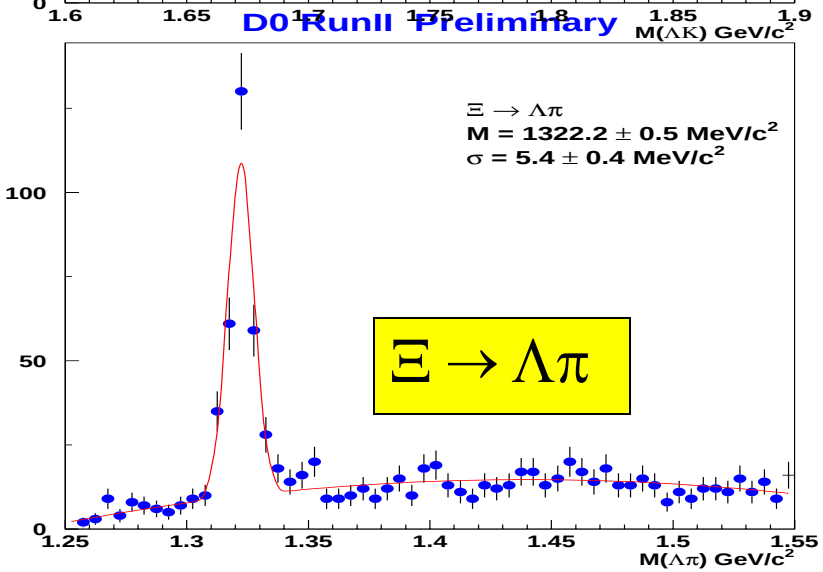


Resonances


D0 RunII Preliminary
$K^0_S \to \pi^+\pi^-$
M = 497.4 ± 0.1 MeV/c²
σ = 7.0 ± 0.2 MeV/c²
K→ π π
M(π⁺π⁻) GeV/c²

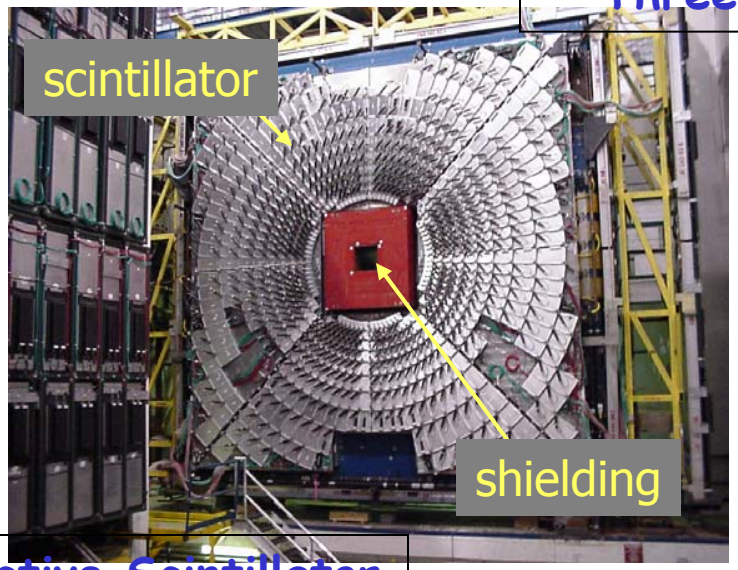

D0 RunII Preliminary
Ω → ΛK
M = 1671.5 ± 1.9 MeV/c²
σ = 8.5 ± 2.3 MeV/c²
Ω → ΛK
M(ΛK) GeV/c²


D0 RunII Preliminary
Λ → pπ
M = 1115.9 ± 0.2 MeV/c²
σ = 2.8 ± 0.2 MeV/c²
Λ→ pπ
M(pπ) GeV/c²

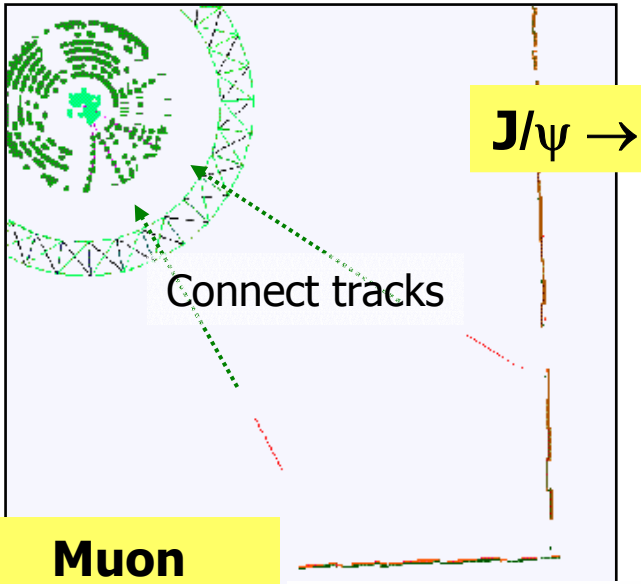

D0 RunII Preliminary
Ξ → Λπ
M = 1322.2 ± 0.5 MeV/c²
σ = 5.4 ± 0.4 MeV/c²
Ξ → Λπ
M(Λπ) GeV/c²

Muon System

- Three layers of triggering scintillator planes.
- Three layers of precise tracking drift tubes.



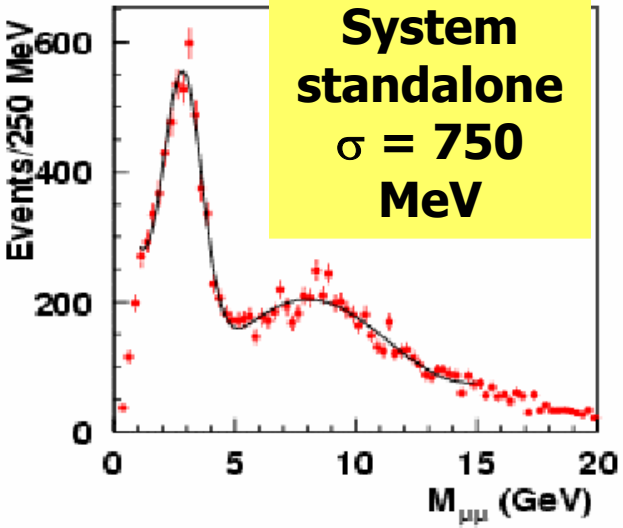
- Active Scintillator Channels: 99.9%
- Active Tracking Channels 99.5%

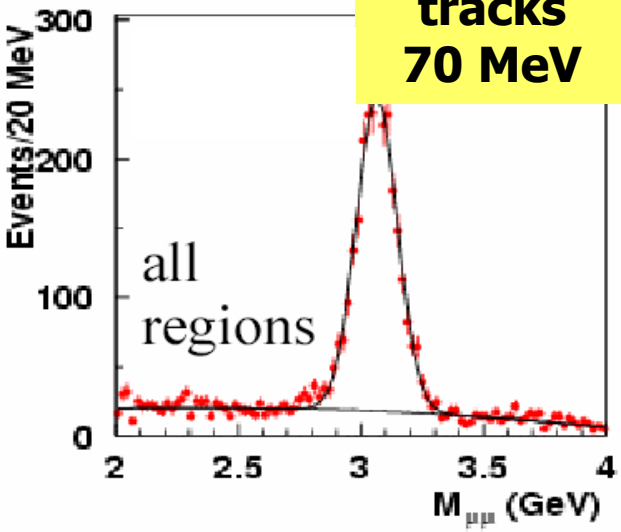


$J/\psi \rightarrow \mu^+\mu^-$

Muon System standalone σ = 750 MeV

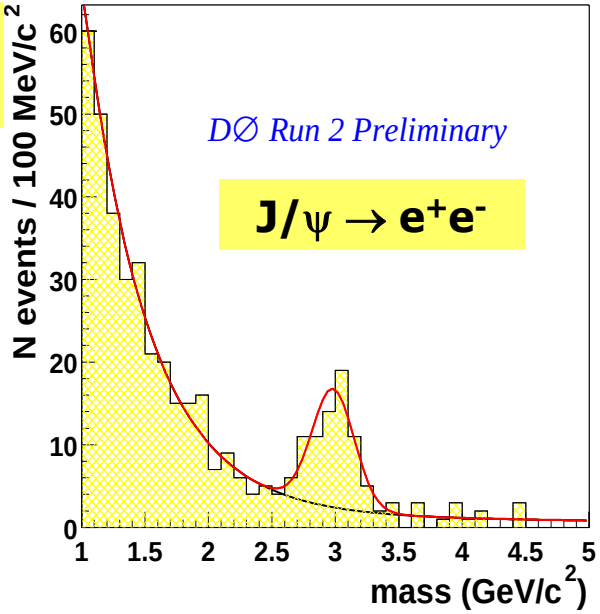
Match to CFT tracks 70 MeV



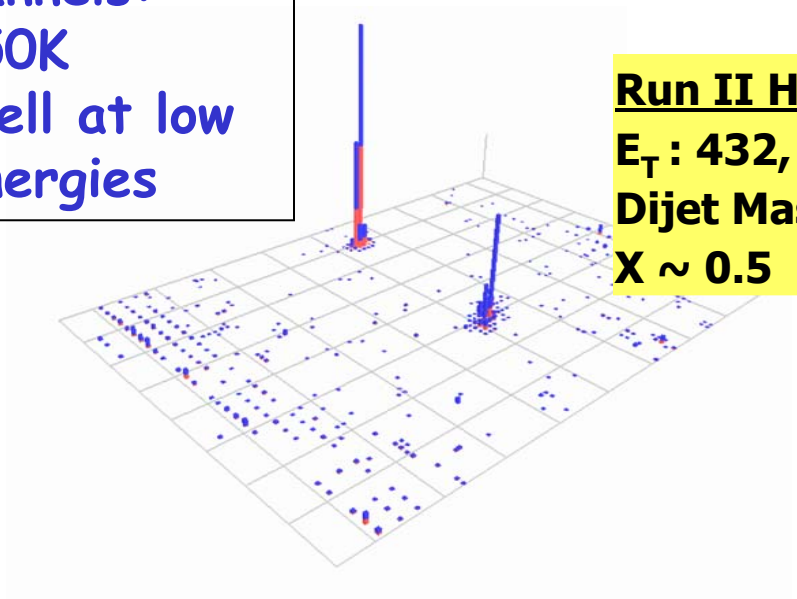


Calorimeter

Liquid argon calorimeter with uranium absorber



- Active Channels: 99.9% of 50K
- Working well at low and high energies



Run II Highest Mass DiJet Event

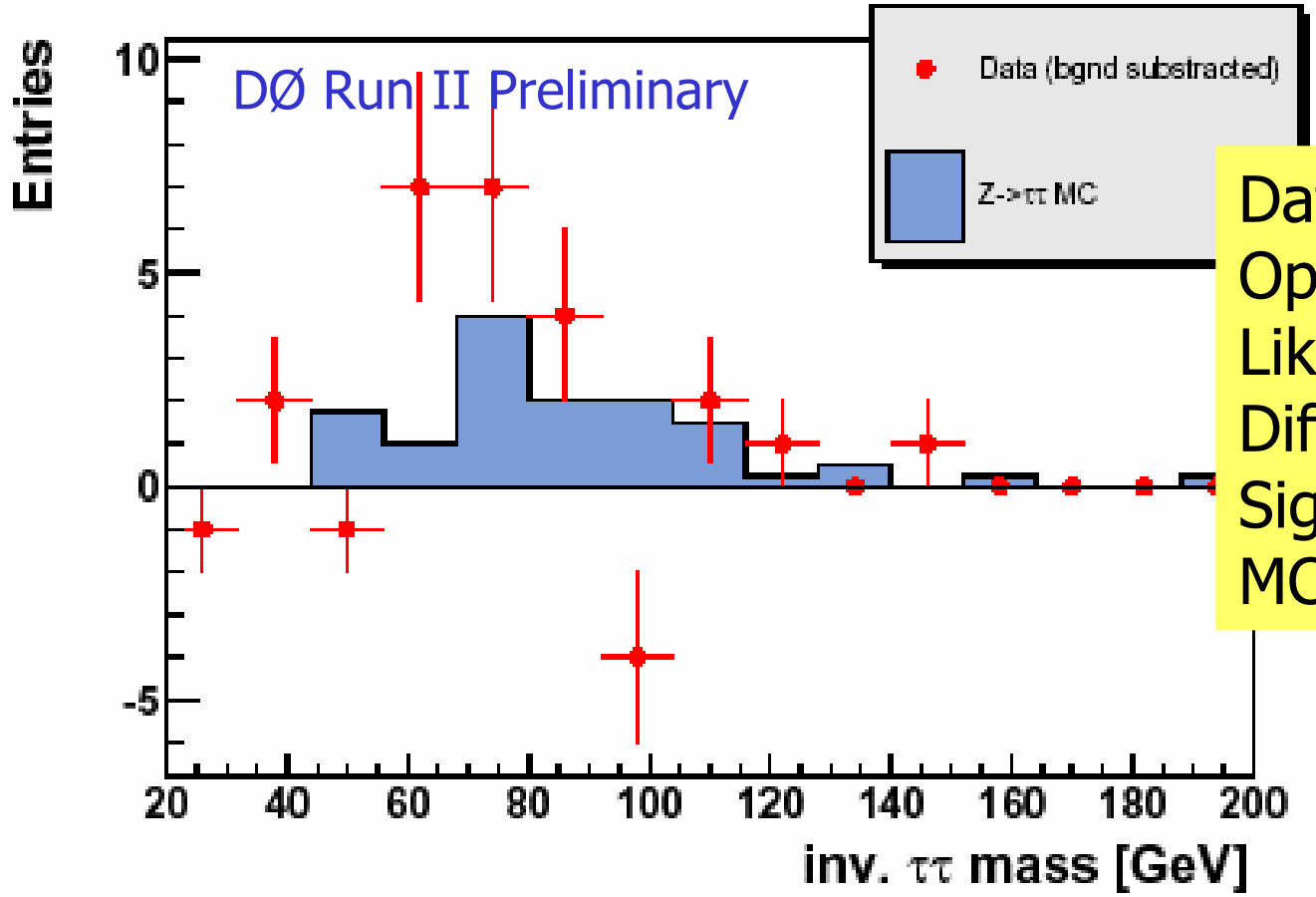
E_T : 432, 396 GeV

Dijet Mass: 838 GeV

X ~ 0.5

A new capability for DØ: $Z \rightarrow \tau^+\tau^-$

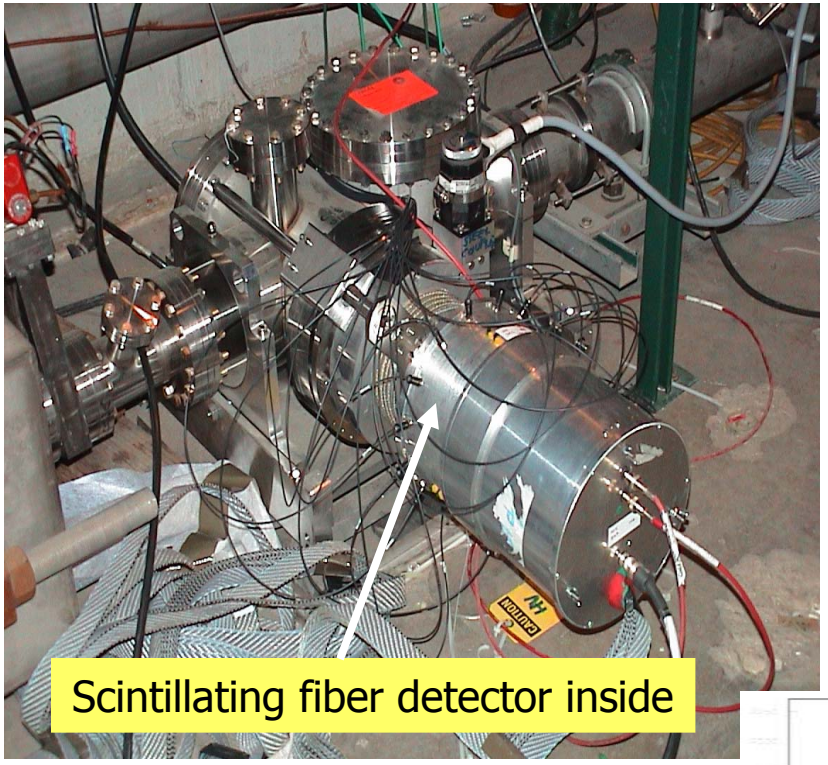
- First τ leptonic electron decay
- Second τ decay hadronic one prong decay
- Comparison of opposite to like sign → excess

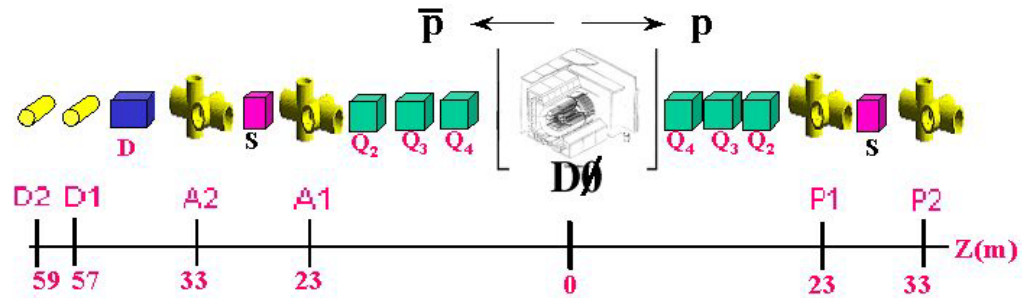


Data:
Opp sign 49 evts
Like sign 35 evts
Diff 14 ± 9
Signal: 50pb-1
MC 13 ± 4

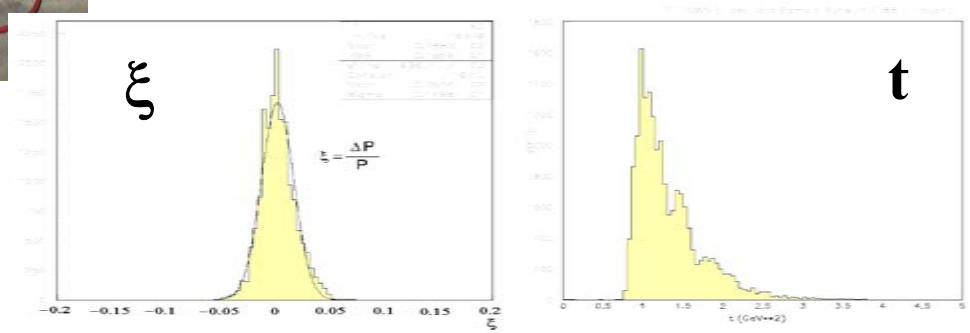
Forward Proton Detector

- Routinely and reliably insert pots in every store
- Detectors perform as designed (good efficiency, resolution)
- Have observed diffractive and elastic events
- Heretofore standalone, integrating into trigger/daq
- 10 (of 18) pots now being integrated into DAQ.

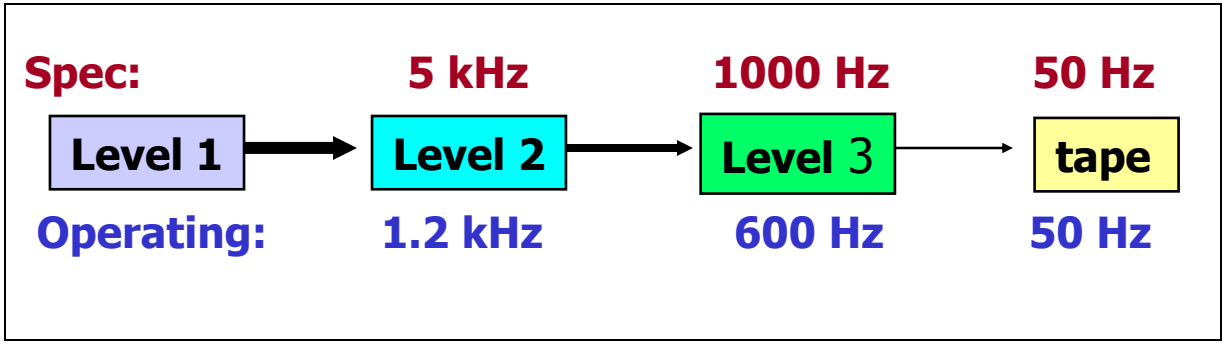




Elastic scattering data

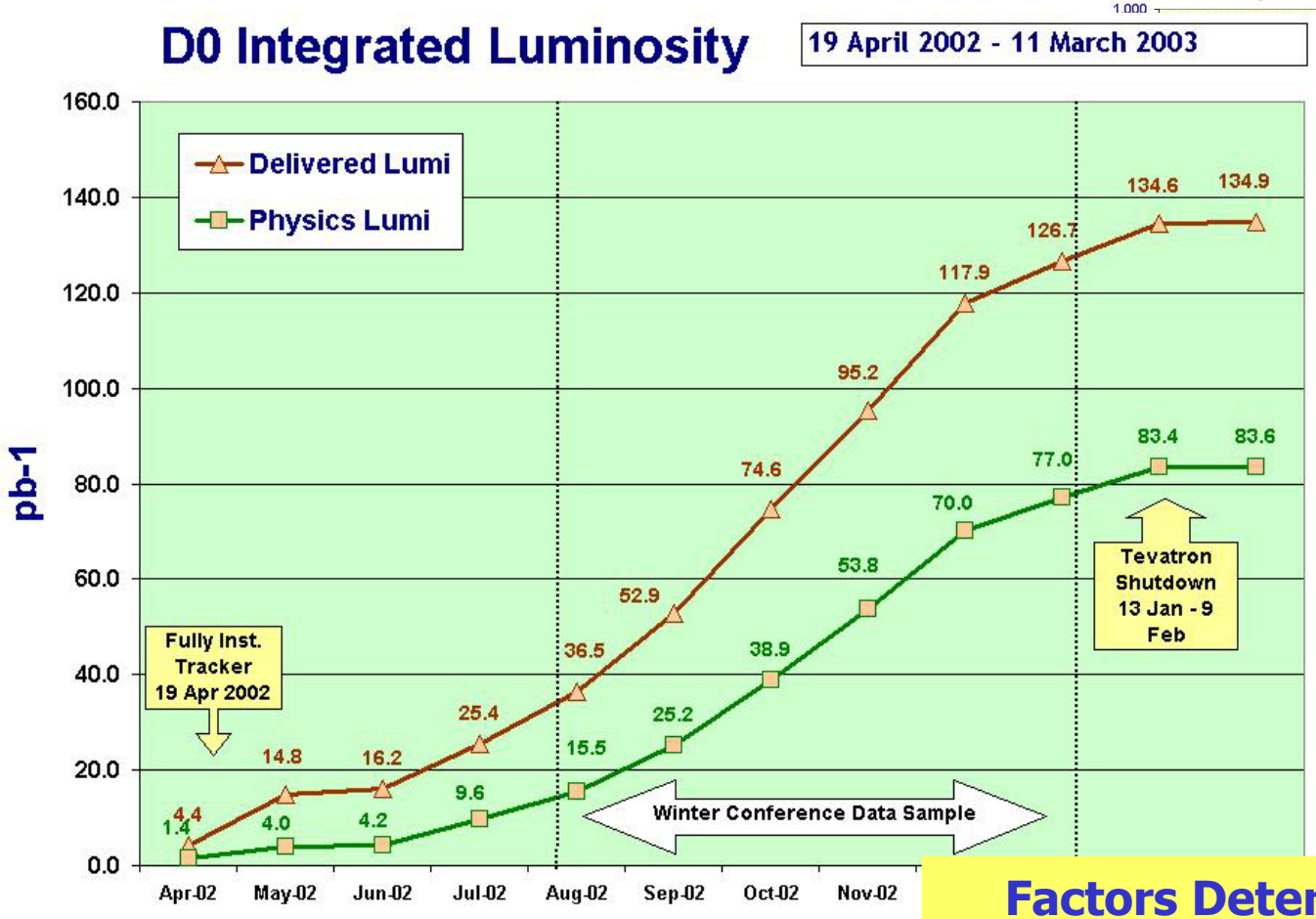


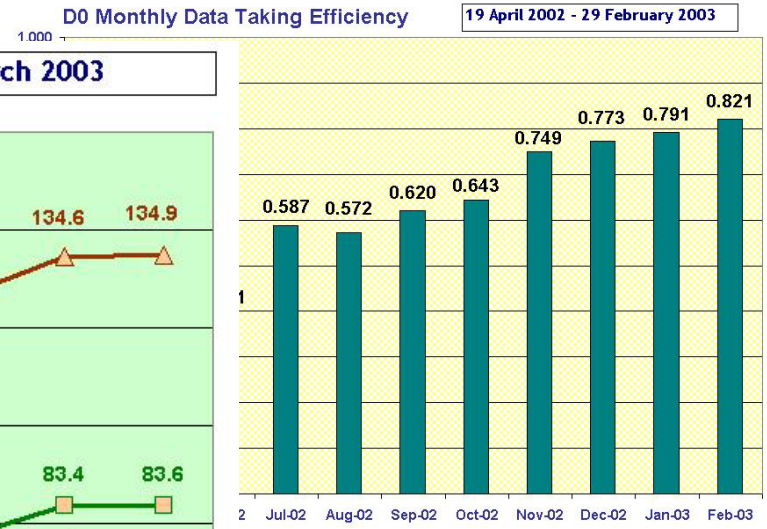
Trigger/ DAQ



- Runs comfortably up to 4E31 $cm^{-2}s^{-1}$ & will keep pace with luminosity growth as tracking triggers completed, CPUs added.
- L1 >100 independent trigger bits
  - Operating with Cal & Muon
  - CTT & PS integration underway
- L2
  - Operating with CAL, Muon, Global
  - CTT, STT integration underway
  - Input rate expansion spring w/ processor replacements
- L3 Extensive suite of filters available
- DAQ
  - Working to reduce Front End Busies.
  - All commodities solution easily meets 1 kHz L2 accept specification.

Luminosity and Efficiency

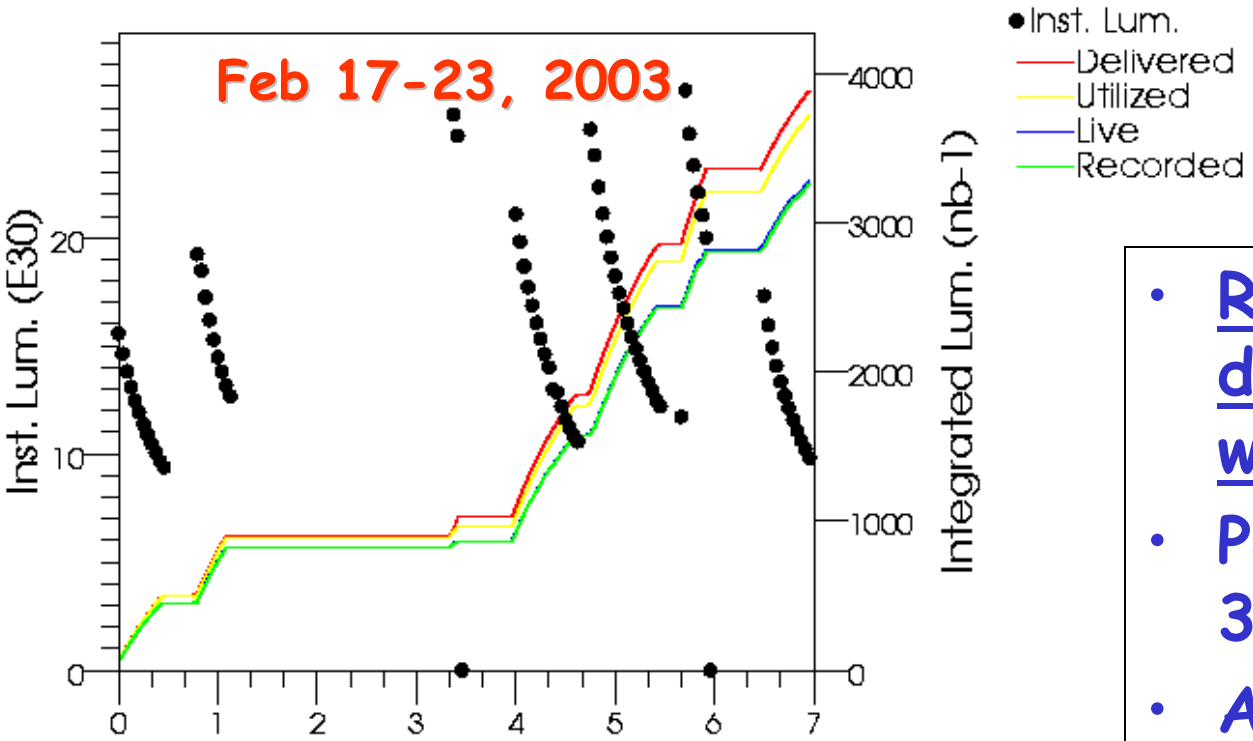




Factors Determining Inefficiency:

- **~5% front-end busy**
- **~5% are losses due to store & run transitions**
- **~5% "incidentals"**

Latest Performance



Expectations:
Typical Run Efficiency: 90%
Typical Week Efficiency: 85%

- Reconstructed data available within 72 hrs.
- Peak Rate: 3M/day
- Average Rate: 2.7M /day

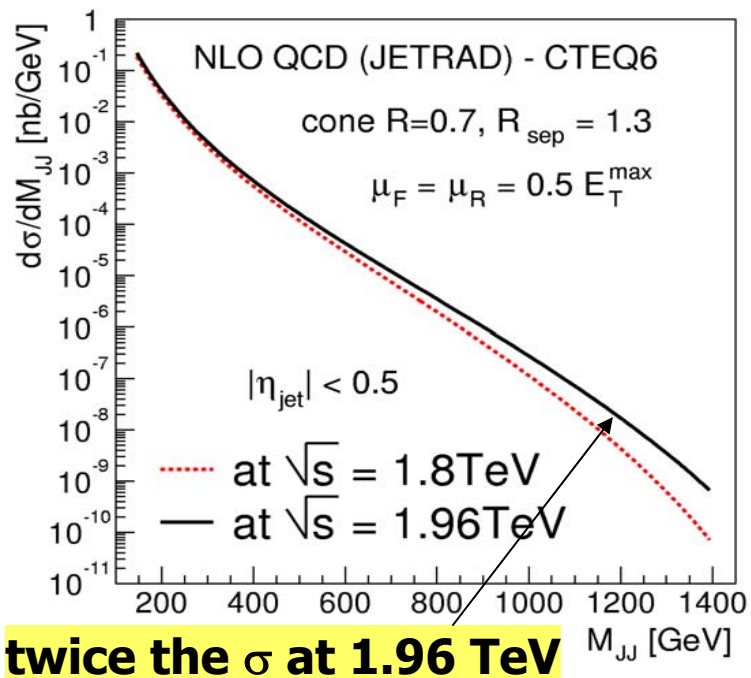
Representative Physics Analyses

- QCD: Dijet Mass
- B: Exclusive States, Lifetimes
- EW: Z to $\mu\mu$, Z' to ee
- Top: Cross Section, Run I mass
- Higgs Studies
- New Phenomena Searches

Just a note on upcoming talks: LaThuile: 5 , Moriond EW: 3, Moriond QCD: 1 + 4 shared, DPF: 15, APS: 35

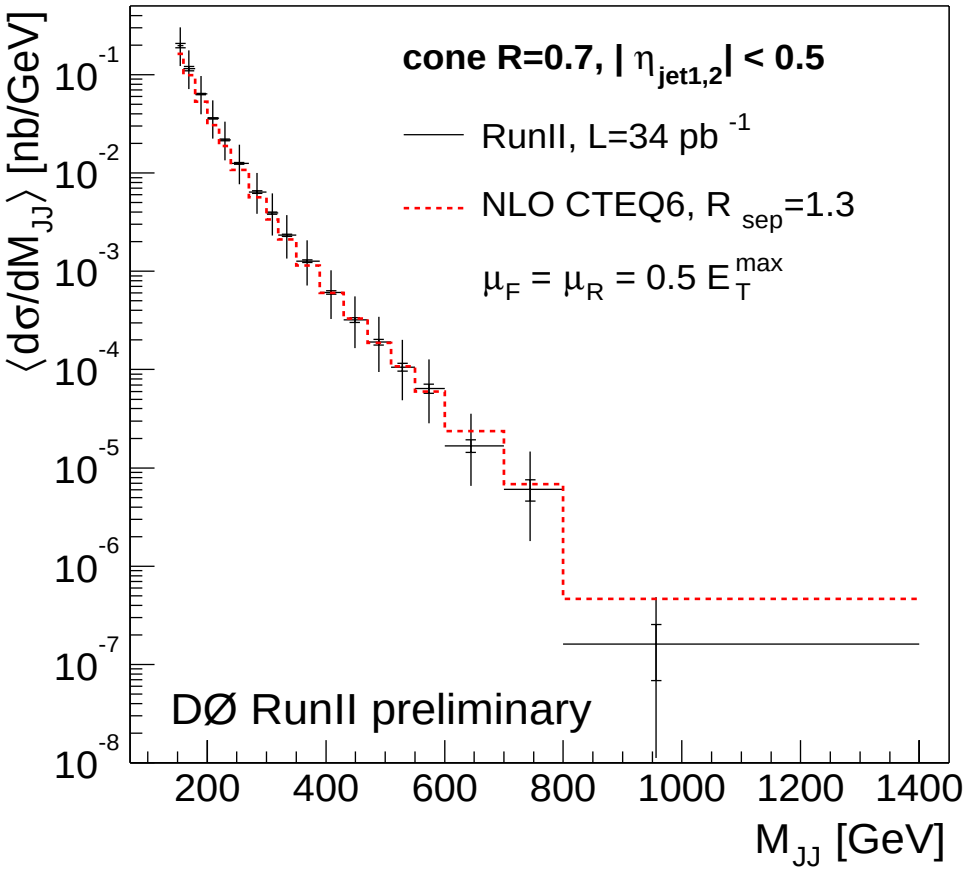
QCD: Dijet Mass Cross Section

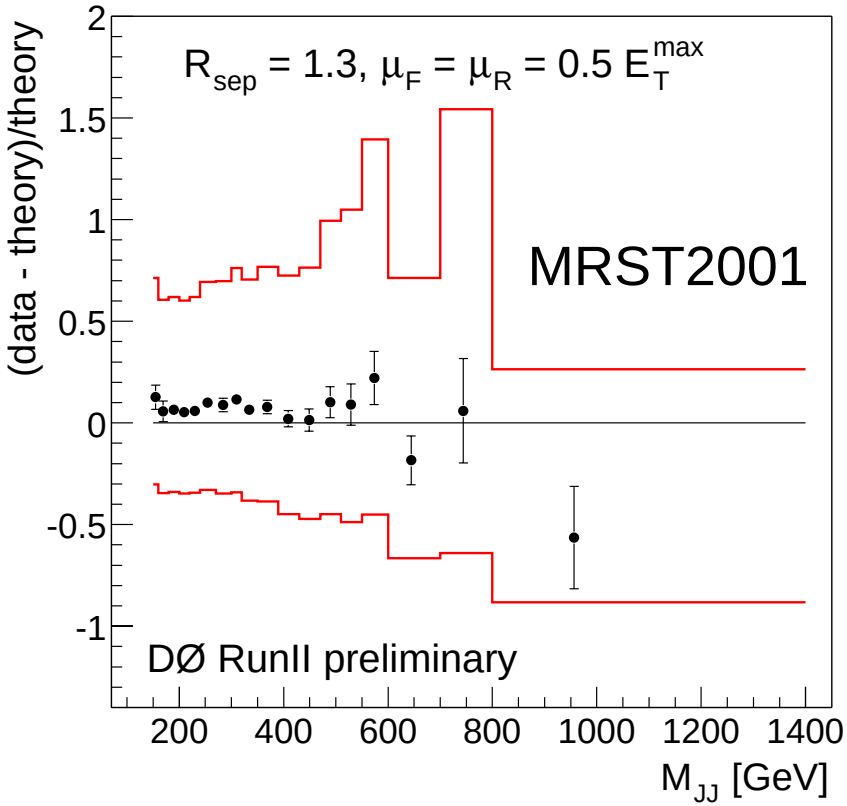
- Probe of
  - QCD
  - hunting for resonances
  - proton structure at large *x*
  - quark compositeness
- Data sample:
  - 34 pb^{-1}
  - ΔR = 0.7 cone jets
  - $|\eta_{jet}| < 0.5$



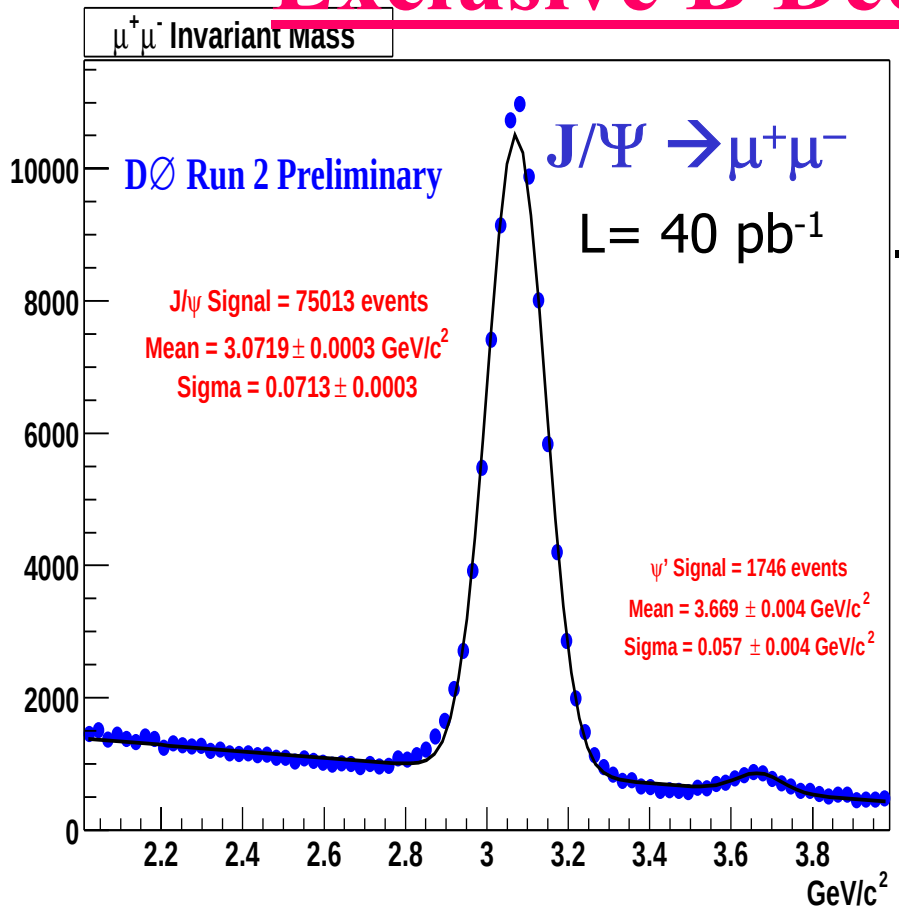
twice the σ at 1.96 TeV

Dijet mass spectrum

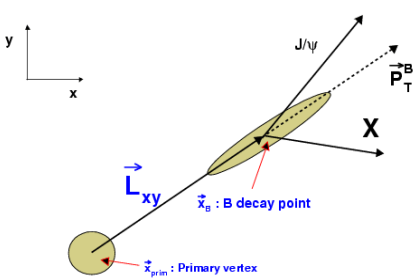


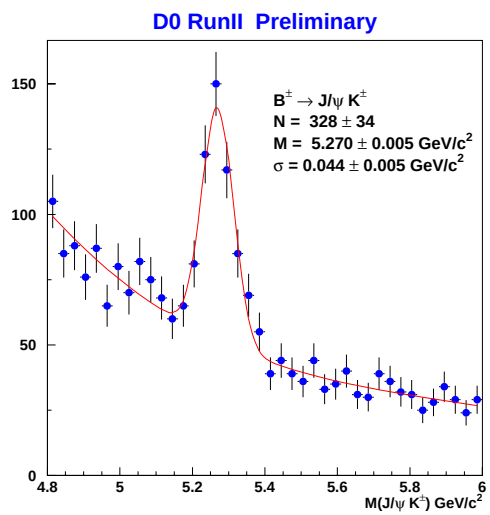


Exclusive B Decays and Lifetimes

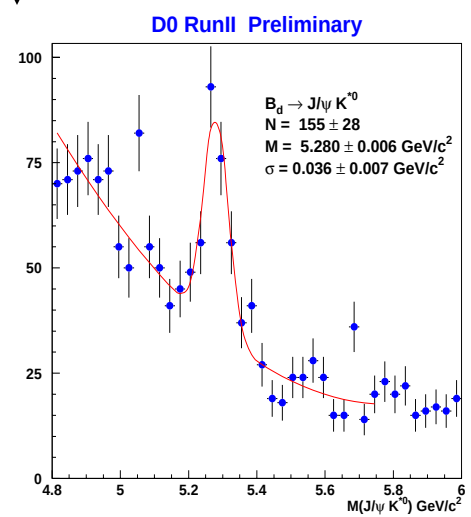


Combine J/Ψ with track or combine J/Ψ with K* and then require decay length significance>3.0



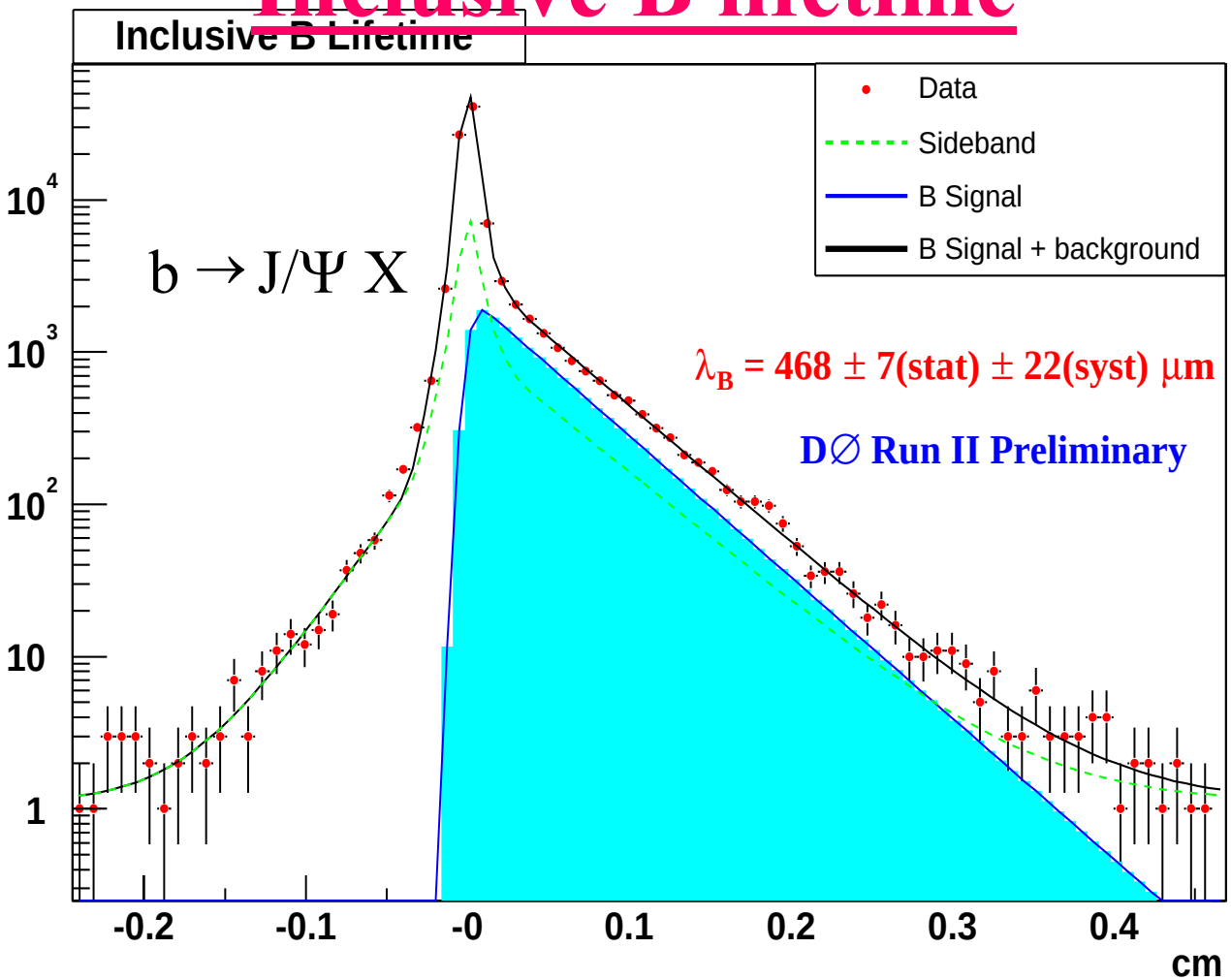


$B^+ \rightarrow J/\Psi\ K^+$



$B_d \rightarrow J/\Psi\ K'^o$

Inclusive B lifetime

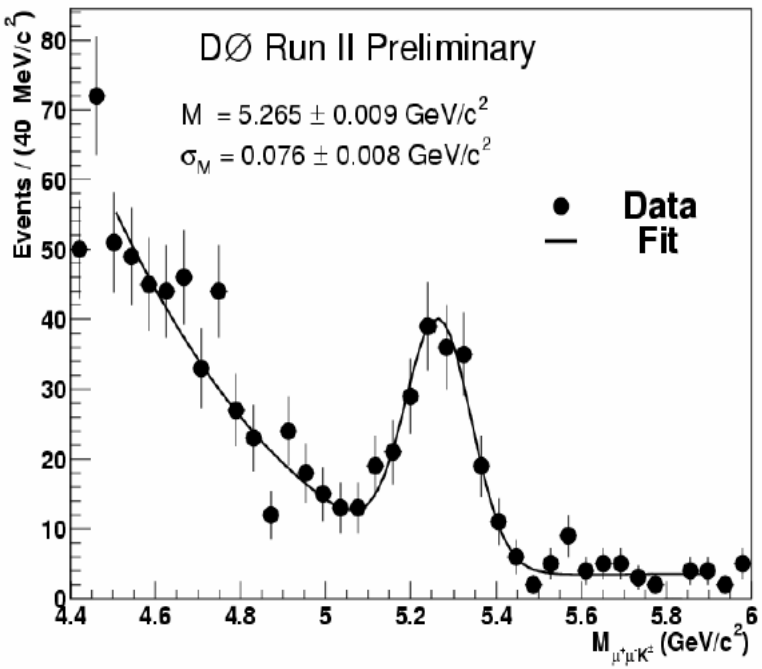


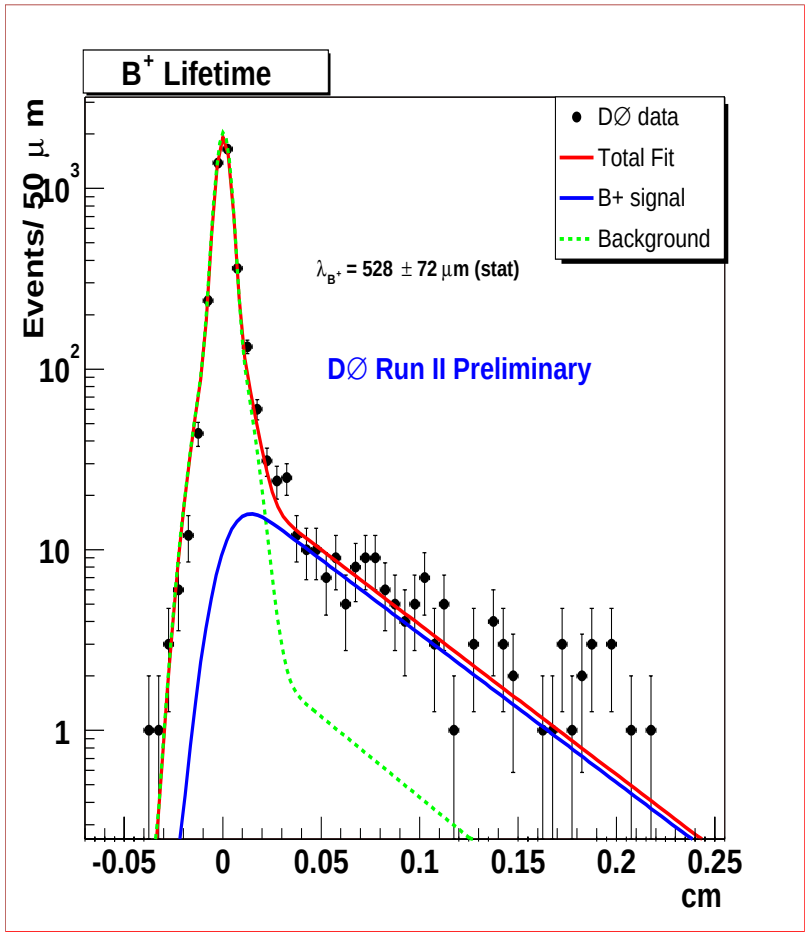
$\langle \tau \rangle = 1.561 \pm 0.024$ (stat) ± 0.074 (sys) ps

$\langle \tau \rangle = 1.564 \pm 0.014$ ps (PDG)

Charged B & Lifetime

$B^{+-} \rightarrow J/Psi\ K^{+-}$



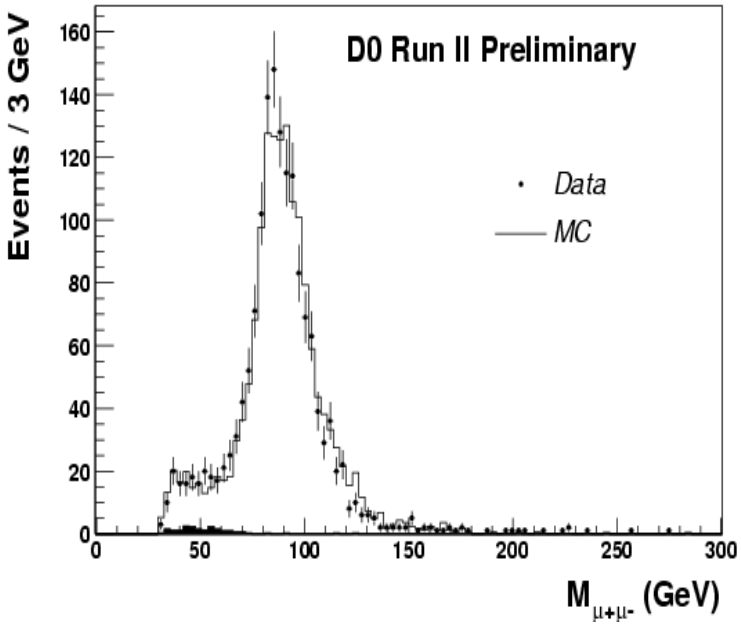


$\langle\tau\rangle = 1.76 \pm 0.24$ ps (stat)

$\langle\tau\rangle = 1.674 \pm 0.018$ ps (PDG)

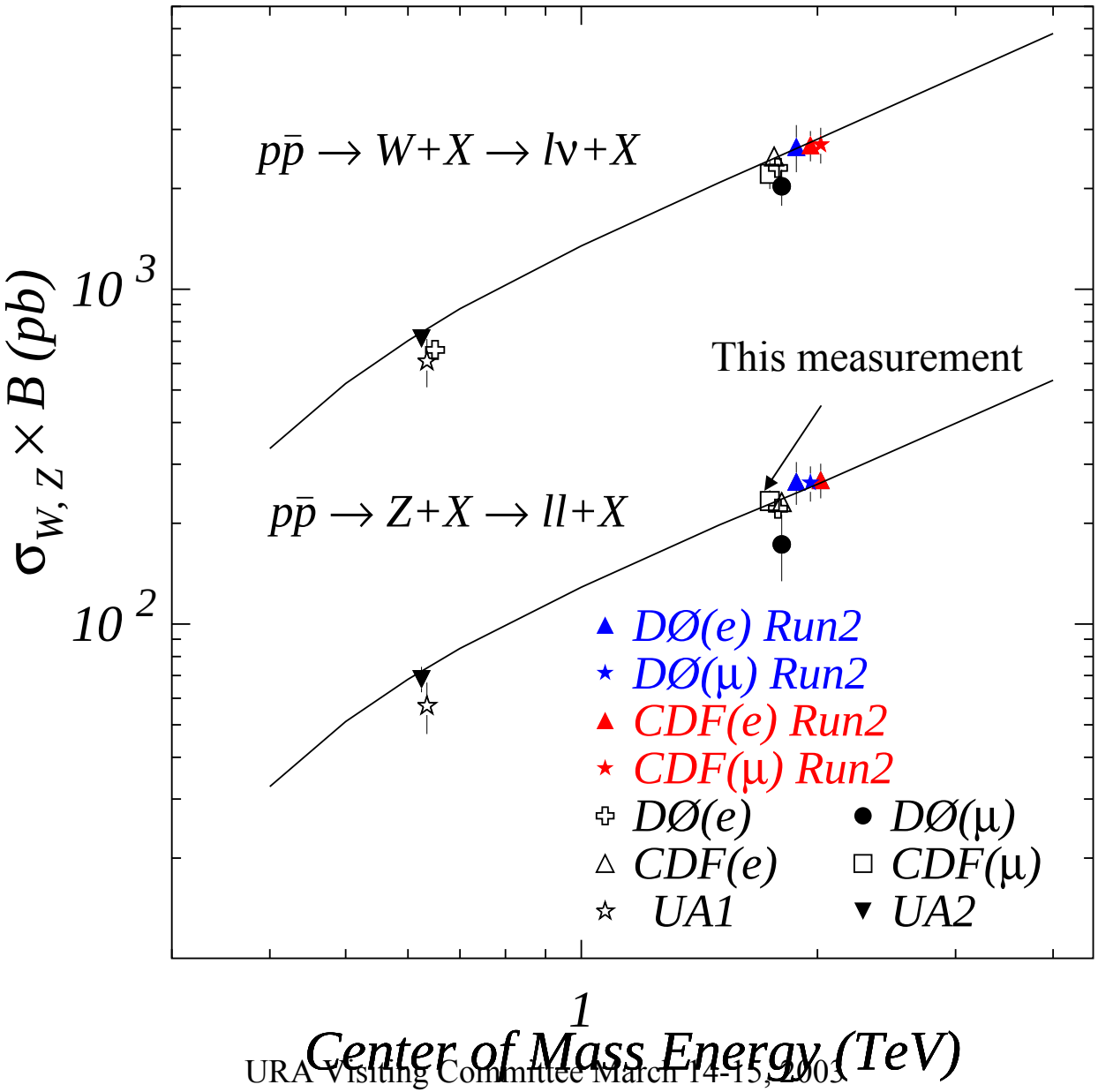
Electroweak: $Z \rightarrow \mu\mu$

- Data sample: 32 pb^{-1}
- Selection
  - $|\eta^{\mu}| < 1.8$
  - pair of oppositely charged muon
    - $P_T > 15$ GeV
    - $\sqrt{\Delta\eta^2 + \Delta\phi^2} > 2.0$
    - Isolation
    - timing cut removes cosmics
- 1585 events pass cuts



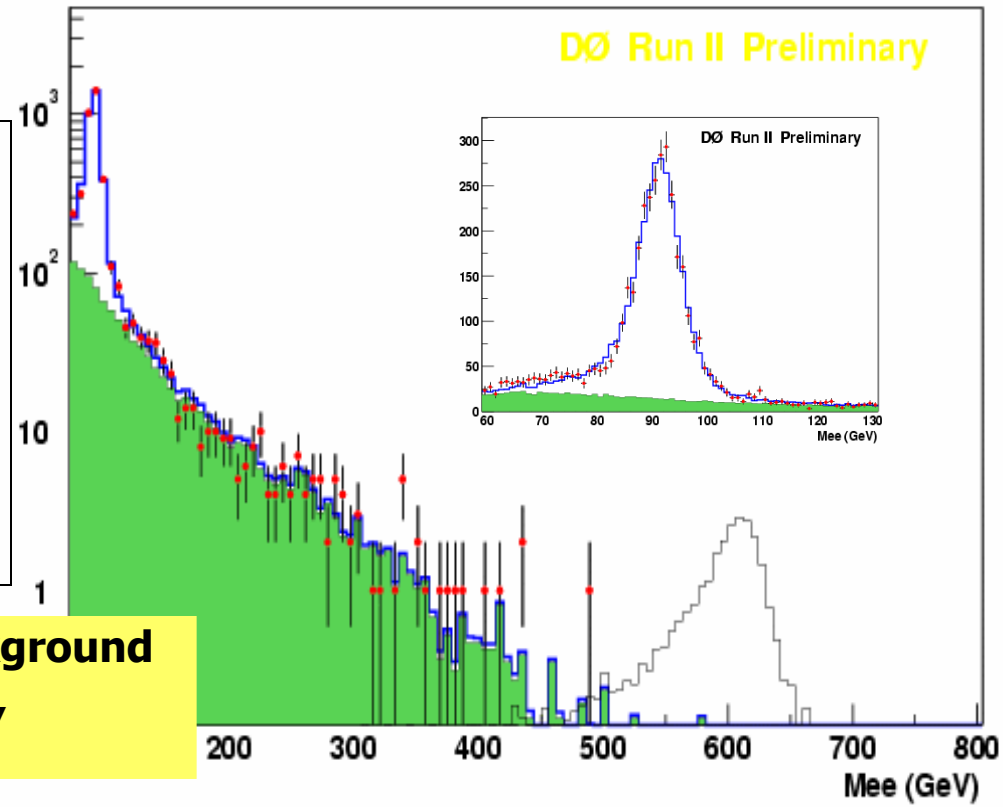
$$\sigma * Br = 263.8 \pm 6.6\ (stat) \pm 17.3\ (sys) \pm 26.4\ (lum)\ pb$$

DØ and CDF Run2 Preliminary

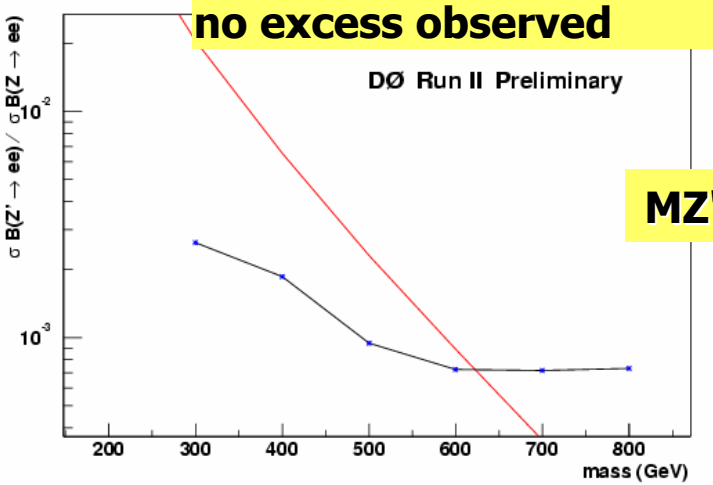


Z' → ee Search

- Expected in left-right symmetric models
- Data sample
  - 50 pb^{-1}
  - single electron
  - $|\eta| < 2.5$
  - $E_T > 25$ GeV



Data and expected background agree well at high mass, no excess observed



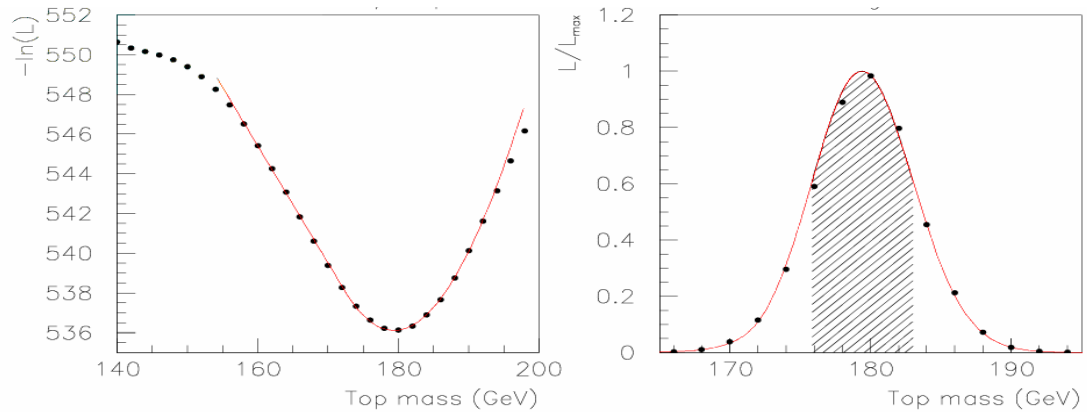
MZ' > 620 GeV @ 95% c.l.

Run I Top Mass Measurement in the Lepton+Jets Channels

- Likelihood method using most available information
- Uses DØ Run I statistics (125 pb^{-1}) & selection → 91 events
- Additional cuts for this analysis:

4 Jets exclusively: 71 events

P_b: 22 events (pure samp



$$m_{top} = 179.9 \pm 3.6 \quad (stat)\, GeV/c^2$$

(5.6 GeV from 1998 PRD)

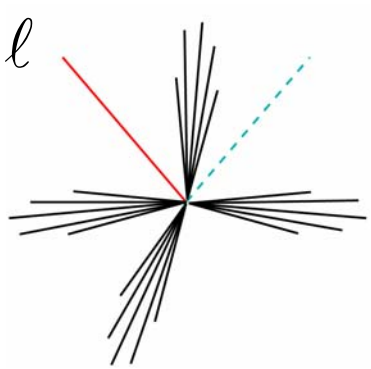
Improvement equivalent to a 2.4 increase in statistics

Details to be presented at an upcoming Wine and Cheese seminar

Top

- First cross section measurement at 1.96 TeV
- Cross section predictions between 6.7 – 7.5 pb (30% higher than Run I)
- Six analysis channels ($t\bar{t} \rightarrow W^- W^+ b\bar{b}$)

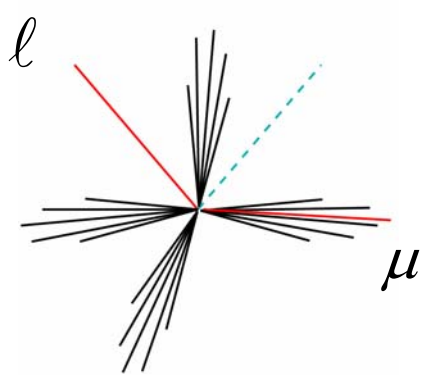
Lepton+jets
(topological)



e+jets, μ+jets

Br = 14.7%

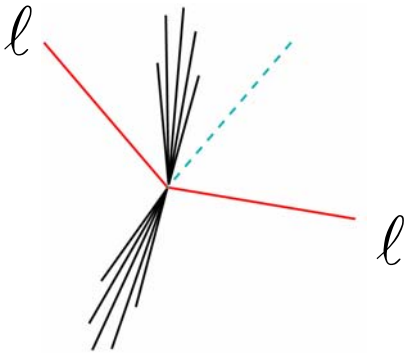
Lepton+jets
(soft muon tag)



e+jets/μ, μ+jets/μ

Br = 14.7%

Dileptons



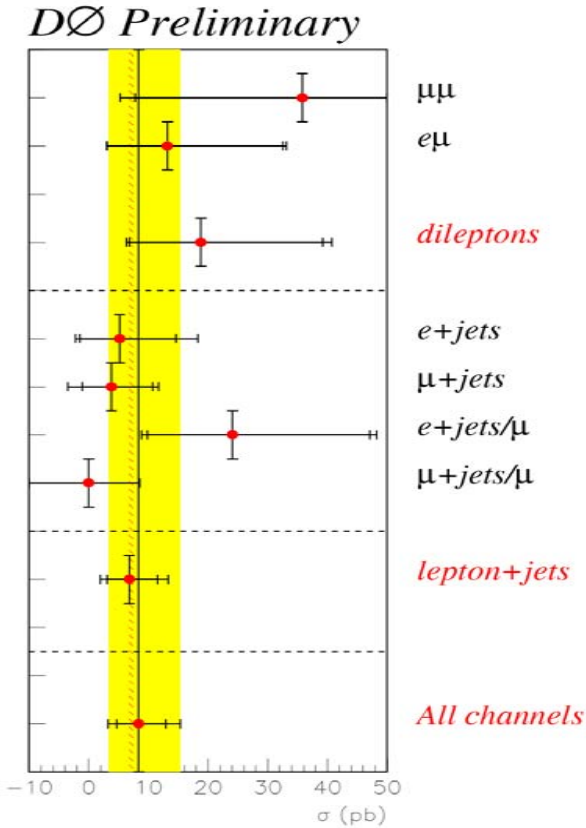
eμ and μμ

Br = 2.5 and 1.2%

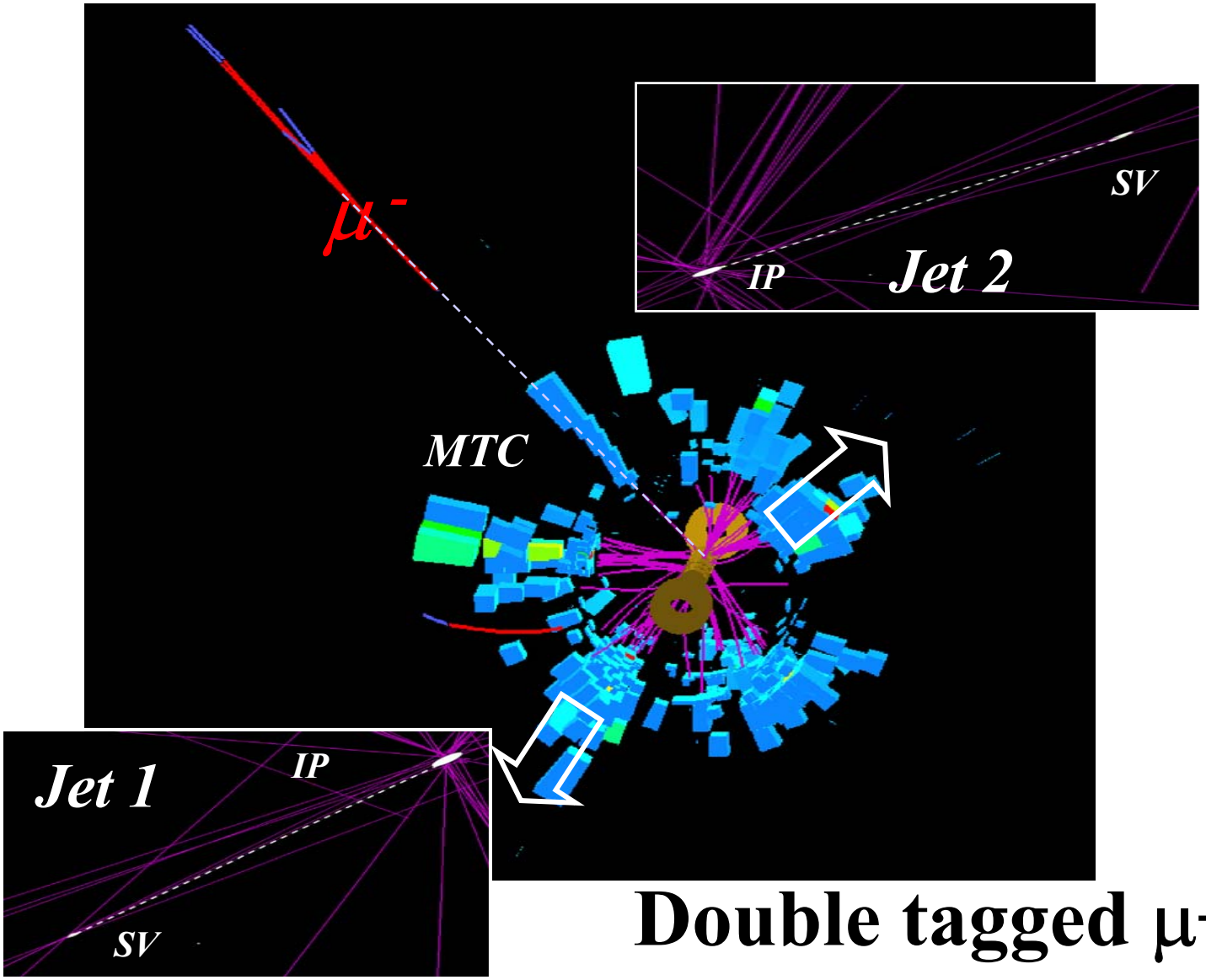
Results

- Jets: 0.5 cone Improved Legacy Algorithm with JES corrections
- Electrons: Central only, Selected based on simple cone, shower shape, EM fraction, Match with track (ϕ, η and E/p)
- Muons: Tracks in muon system, Tracks in central tracker
- Missing Et: From calorimeter with JES corrections and muon correction

Channel	Lum(pb^{-1})	Expected Background	Expected Signal	Obs.
e+jet	50	2.7+/-0.6	1.8	4
μ+jet	40	2.7+/-1.1	2.4	4
e+jet/μ	50	0.2+/-0.1	0.5	2
μ+jet/μ	40	0.6+/-0.3	0.4	0
$\mu\mu$	43	0.60+/-0.30	0.30+/0.04	2
eμ	33	0.07+/-0.01	0.50+/0.01	1



$$\sigma = 8.4\ ^{+4.5}_{-3.7}\ (\text{stat})\ ^{+5.3}_{-3.5}\ (\text{syst})\ \pm\ 0.8\,(\text{lumi})\ \text{pb}$$



Double tagged μ+jets Candidate Event

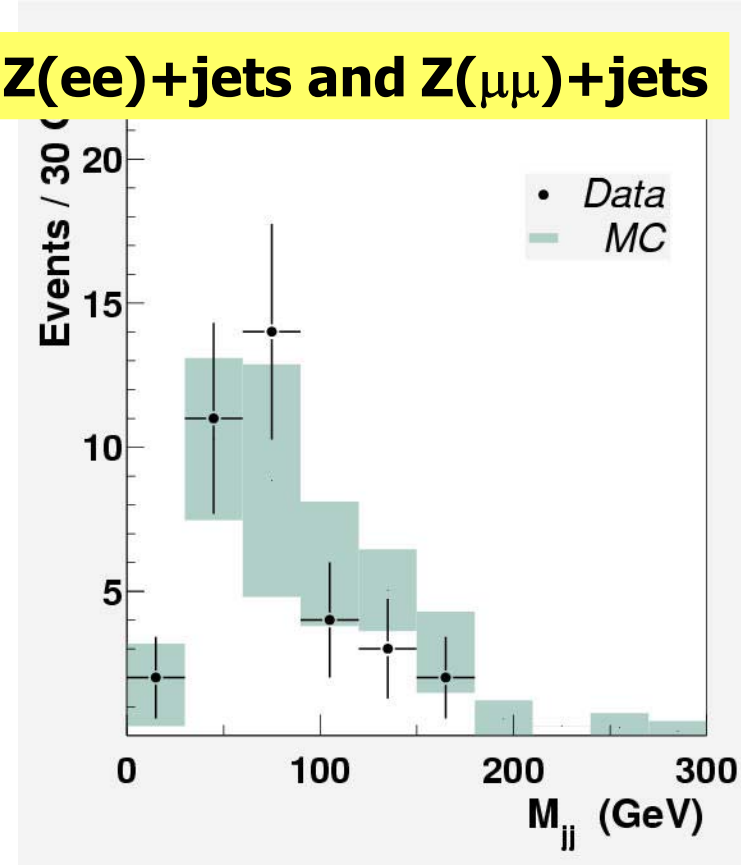
Higgs Activities

- In collaboration with CDF, undertaken a joint Higgs Sensitivity Study.
  - CDF will study HW, D0 HZ channels.
  - Preliminary discussions by June.
- Concentrating on study of the background from W/Z($\rightarrow$lepton) + jets production
  - First step towards W/Z ($\rightarrow$leptons) +H ($\rightarrow$bb) measurement
  - The W/Z + b-jets distributions related to W/Z+ jets distributions
- $H \rightarrow WW^*$ ($\rightarrow$ ee$\nu\nu$,e$\mu\nu\nu$) decays (observed number of events consistent with expected number of background)

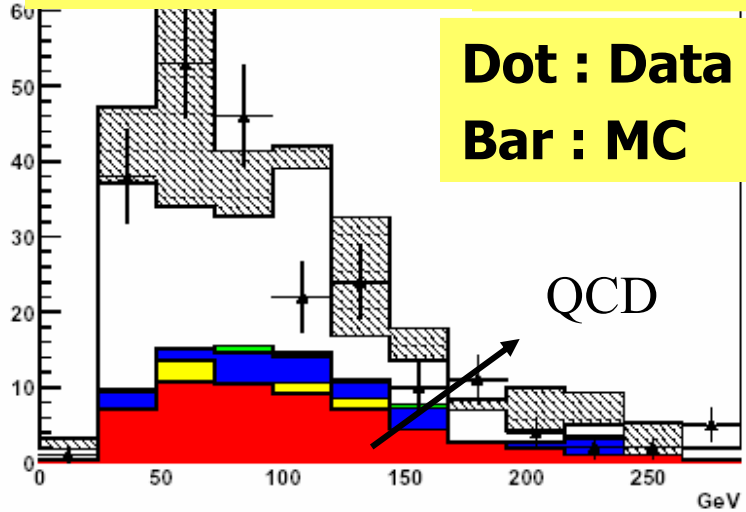
Some Data/Background Comparisons

- Selection 35pb^{-1}
- Pythia/Data Good Agreement

Di-jet Mass **Combined Z(ee)+jets and Z(μμ)+jets**



Di-jet Mass **W(eν)+jets**

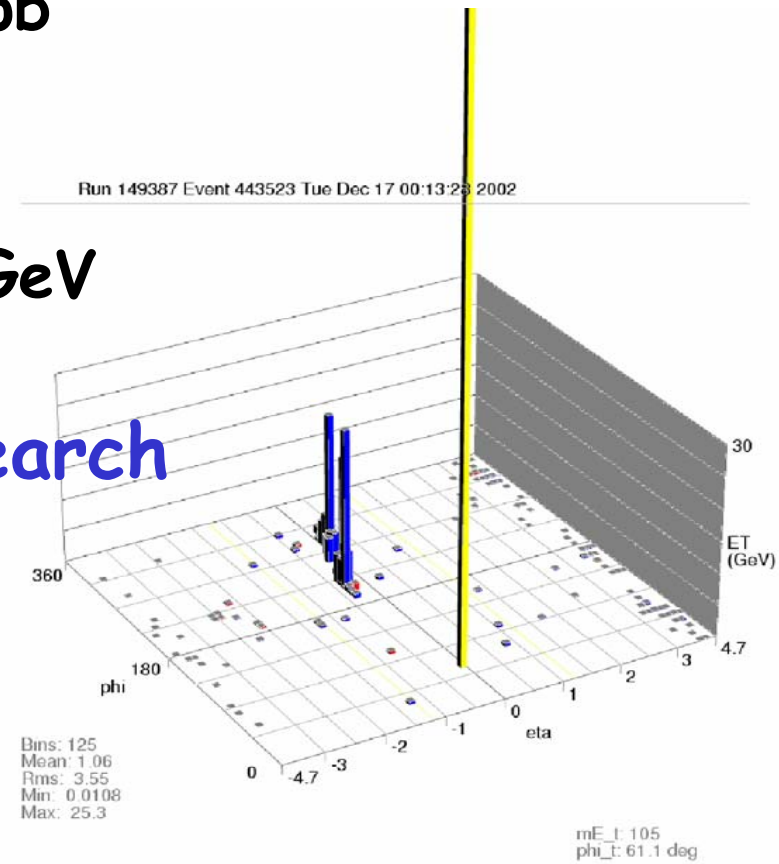


Dot : Data

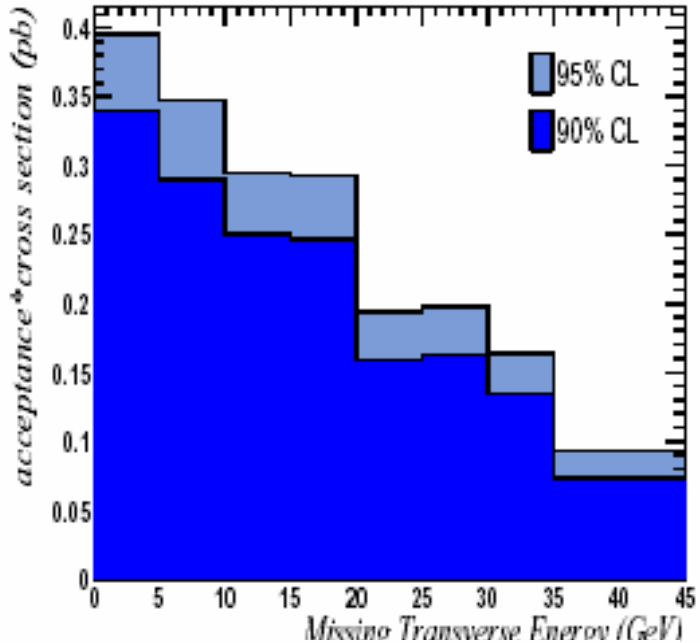
Bar : MC

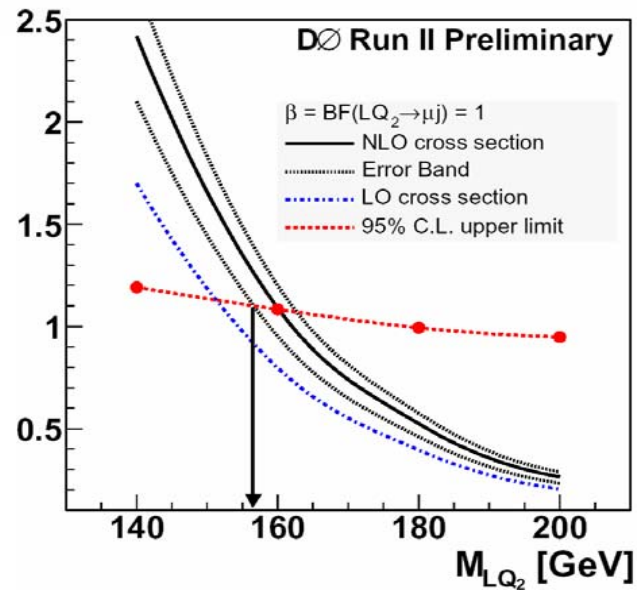
New, New Phenomena Results

- mSUGRA Chargino/Neutralino Search
  - Tri-lepton mode
  - excludes σxBR = 3.5-2.2 pb
- GMSB SUSY LSP Search
  - $2\gamma + mE_T$
  - 95% CLimit m (LSP) = 66 GeV
  - close to Run I
- SUGRA neutralino LSP Search
  - Jets + mE_T
  - Sets model-ind cross section limit as a function of mE_T,



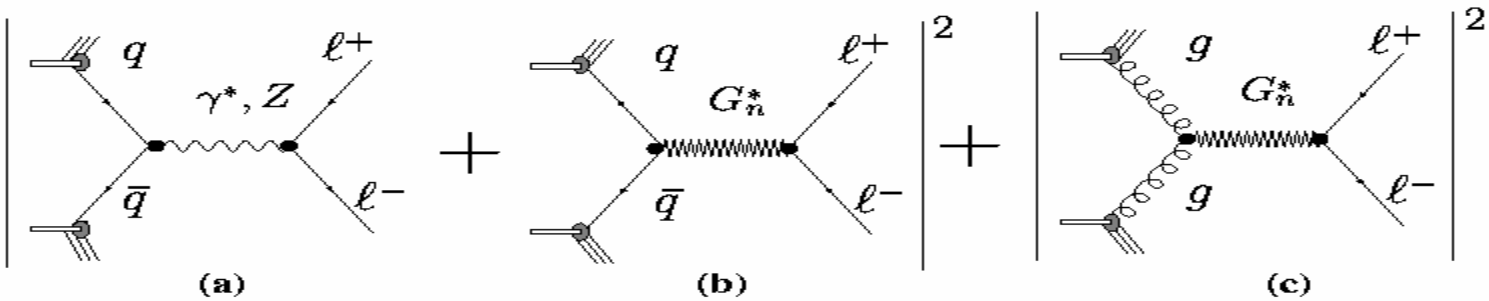
- Limits on New Physics in an e-μ Search
  - Sets limit on cross section as a function of mE_T
- Search for 2nd Gen LQ
  - 2 μ + 2 jets
  - MLQ > 157 GeV





Large Extra Dimensions Search

- Model framework: string theory w/ SM restricted to D3-brane, gravity propagating in extra dim's. Virtual graviton diagrams contributing to dilepton and diboson production.

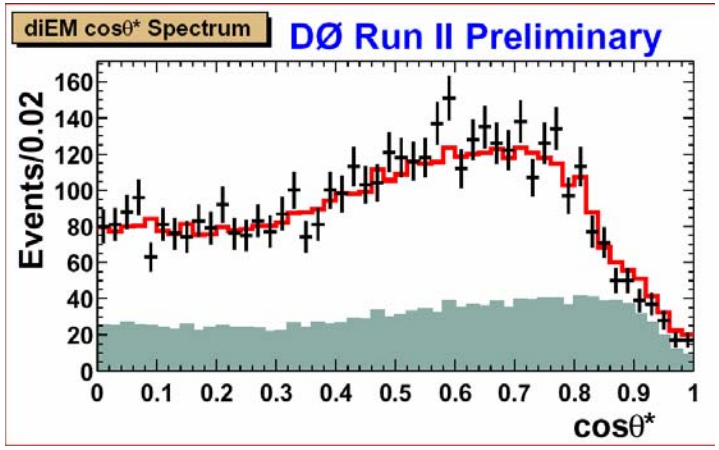


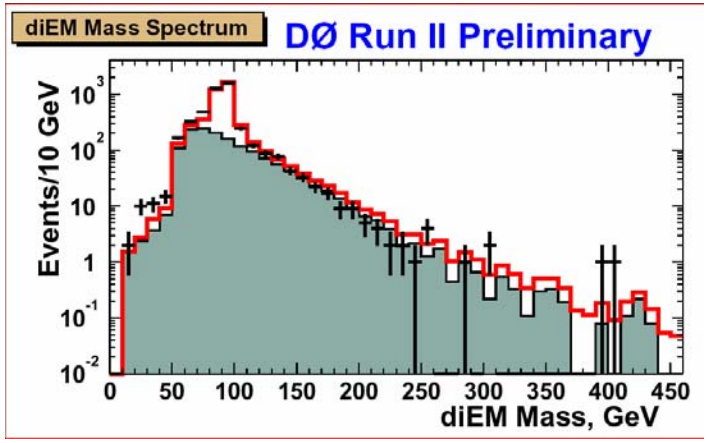
- 50pb^{-1} ee and $\gamma\gamma$ channels and 30pb^{-1} $\mu\mu$ channel
- Combined dodel dependent 95% CL lower limit on Planck scale M_S in TeV

	GRW	HLZ for n: 2	7	Hewett $\lambda = +1$
diEM	1.12	1.16	0.89	1.00
diMU	0.79	0.68	0.63	0.71

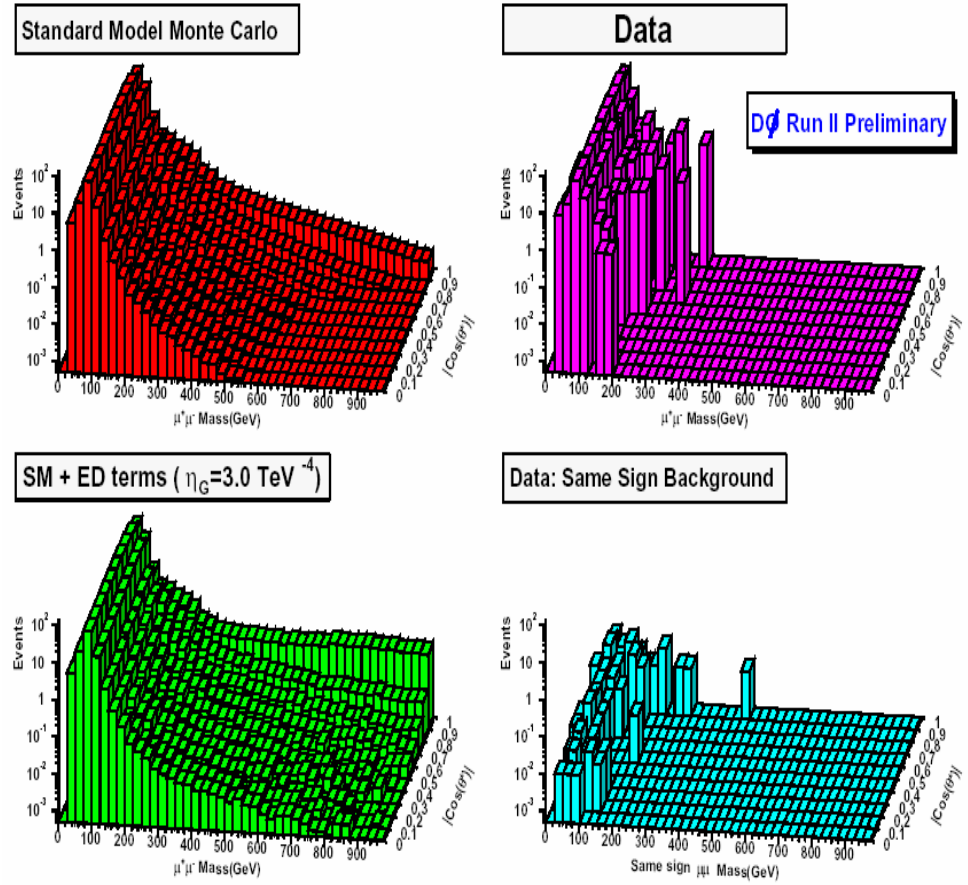
Signal/Theory

ee Channel



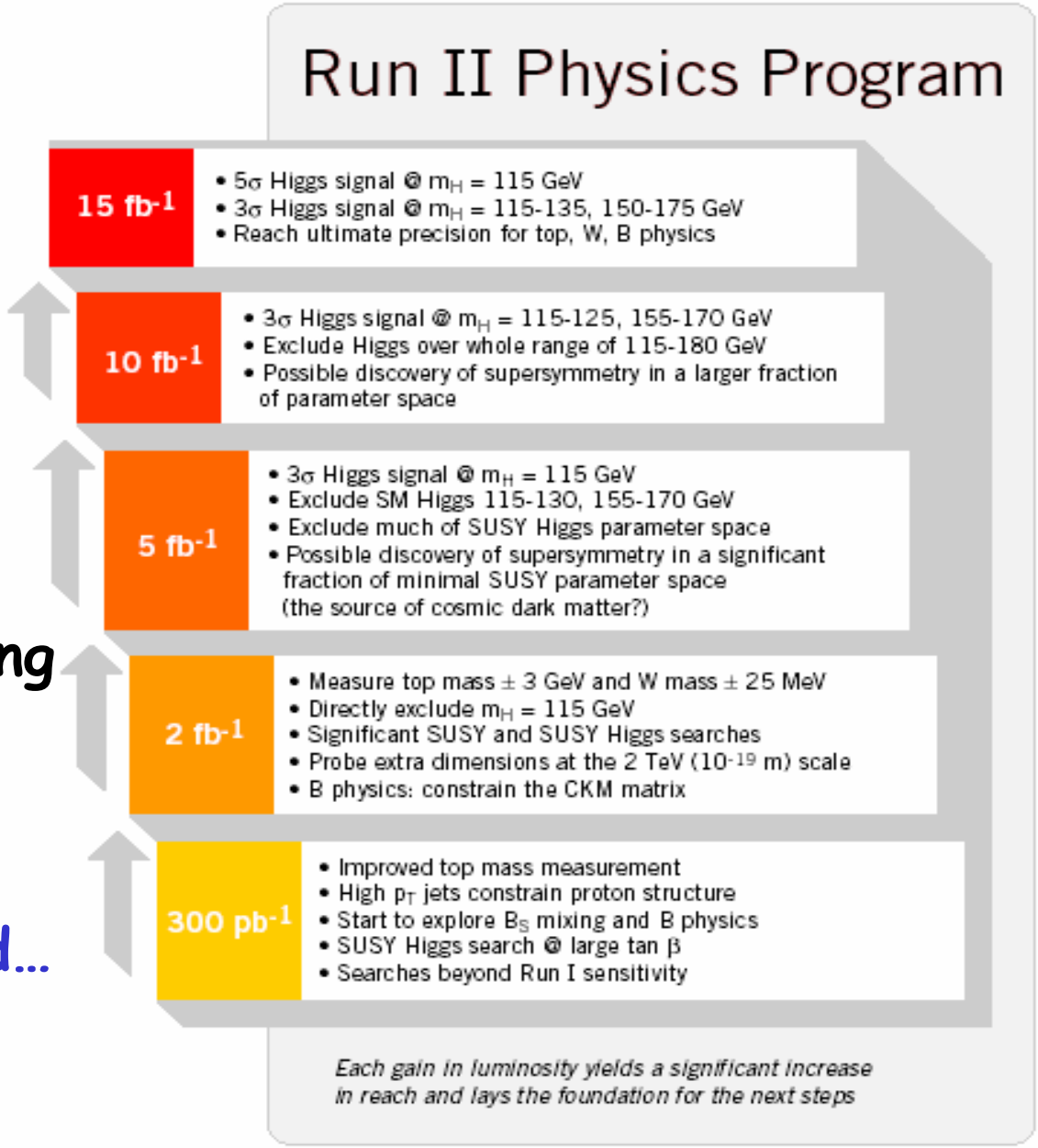


μμ a New Channel!

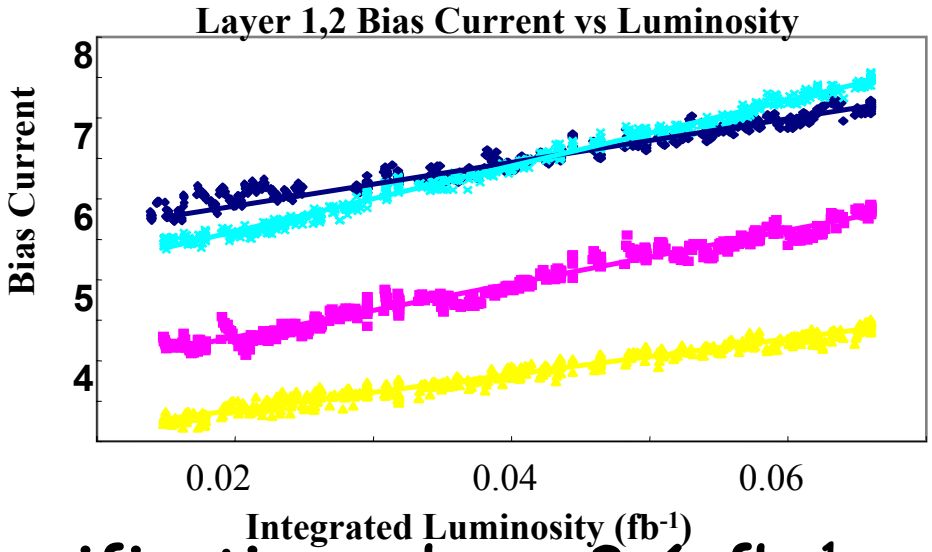


Fit to 2-D distributions to extract SM, interference, and direct gravity terms; use topologies w/ at least 1 EM obj in central calorimeter

- Detector operating well.
- Producing lots of interesting physics
  - QCD, B, W&Z, Top,
  - Limits approaching Run I sensitivity
- Looking forward to new physics this summer and beyond…



Silicon Status



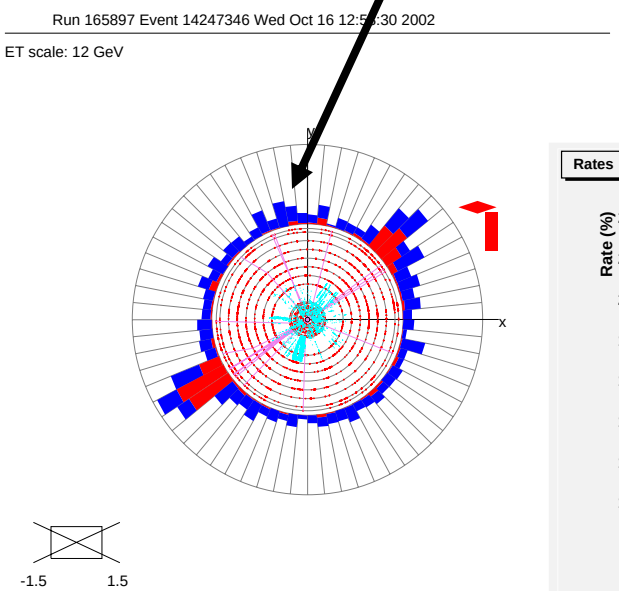
- Radiation
  - Increase of bias current measured and consistent with expectations
  - Infers depletion voltage exceeds specifications above 3.6 fb^{-1}
  - 100% loss inner layer by 4.9fb^{-1}
  - 50% Uncertainty

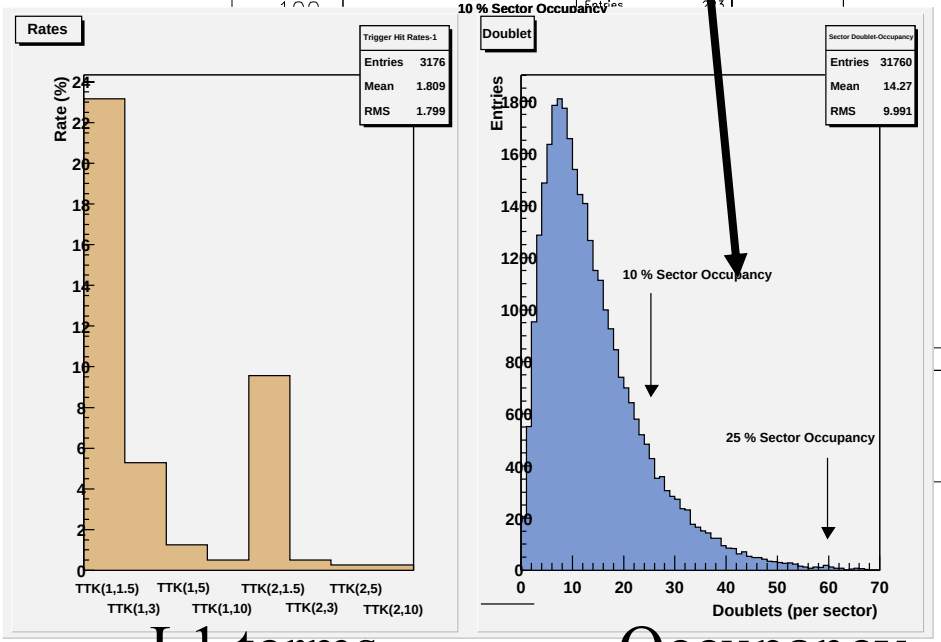
- Active Ladders/Wedges

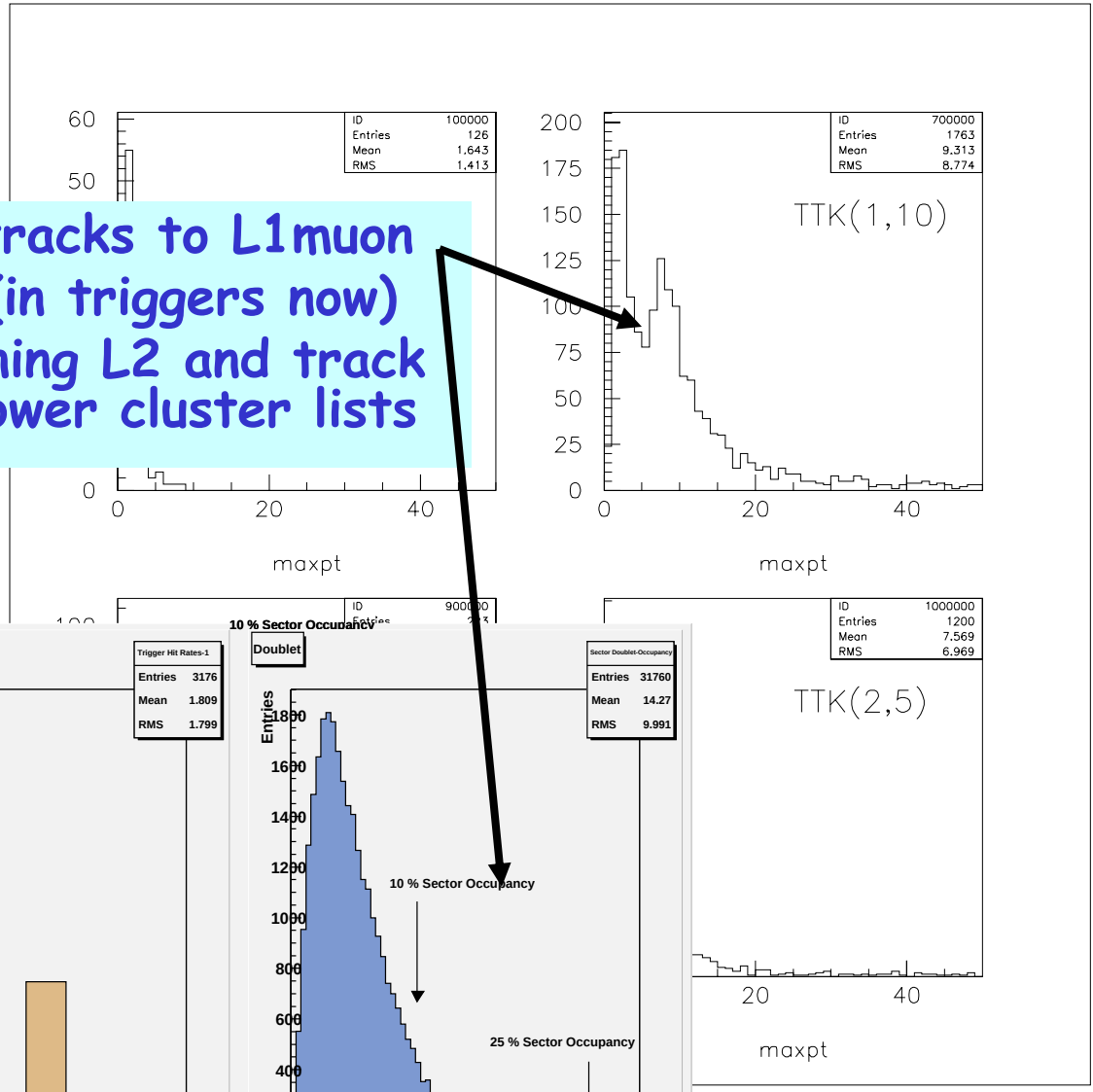
Device	Oct 01	Feb03	Mar 03
Ladders:	93.4%	93.1%	88.4%
F-wedges:	92.7	91.5	91.3
H-wedges:	86.0	86.0	85.4

L1CTT

- Providing tracks to L1muon
- L1 terms (in triggers now)
- Commissioning L2 and track and preshower cluster lists



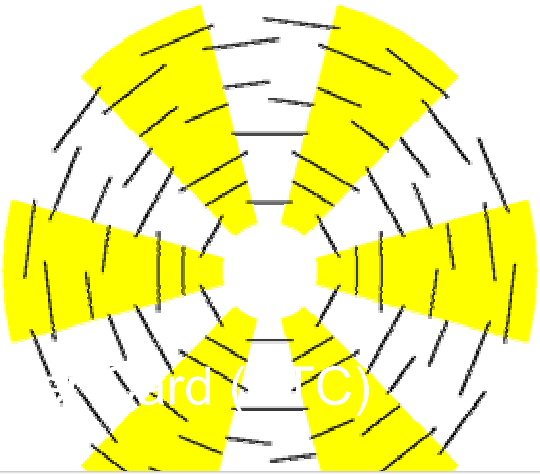


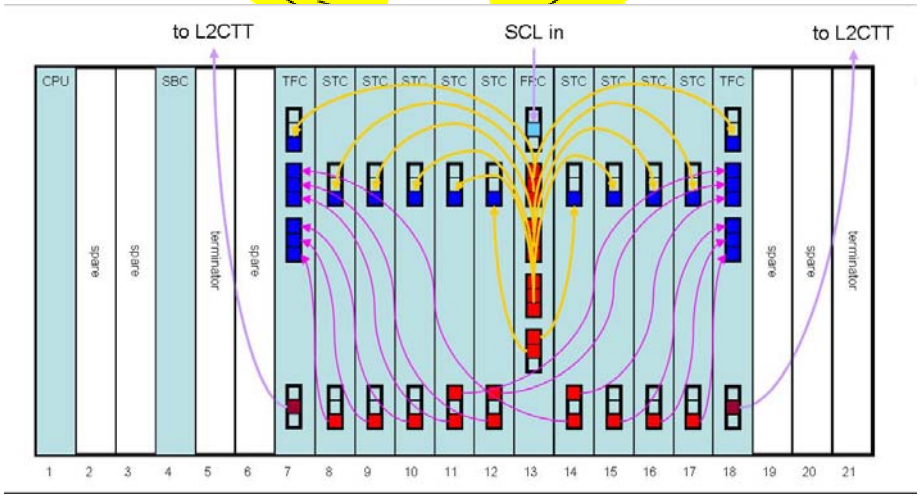


L1 terms Occupancy

STT

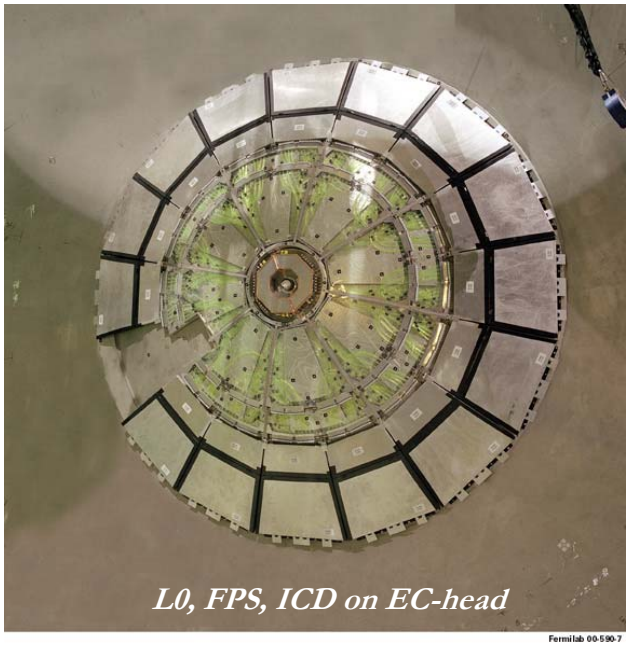
- 30° azimuthal units, 6 crates
- Common Motherboard w/ PCI communication
- Huge progress last calendear year, from prototypes to complete production
- Commissioning 1st sector at DØ
  - Firmware debugging
  - Interface with DØ systems
- Operational Spring 2003

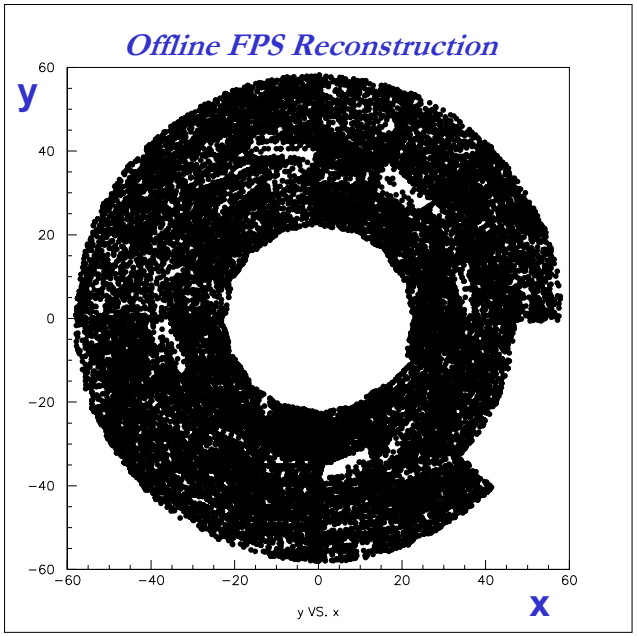




Forward Preshower Detector

- Extensive forward coverage: $1.5 \leq |\eta| \leq 2.5$
- u,v Stereo Layers with $2X_0$ Lead Absorber
- 14,988 channels: 99% active.





- System instrumented June 2002
- Offline reconstruction using matched u, v clusters and energy correlation requirement