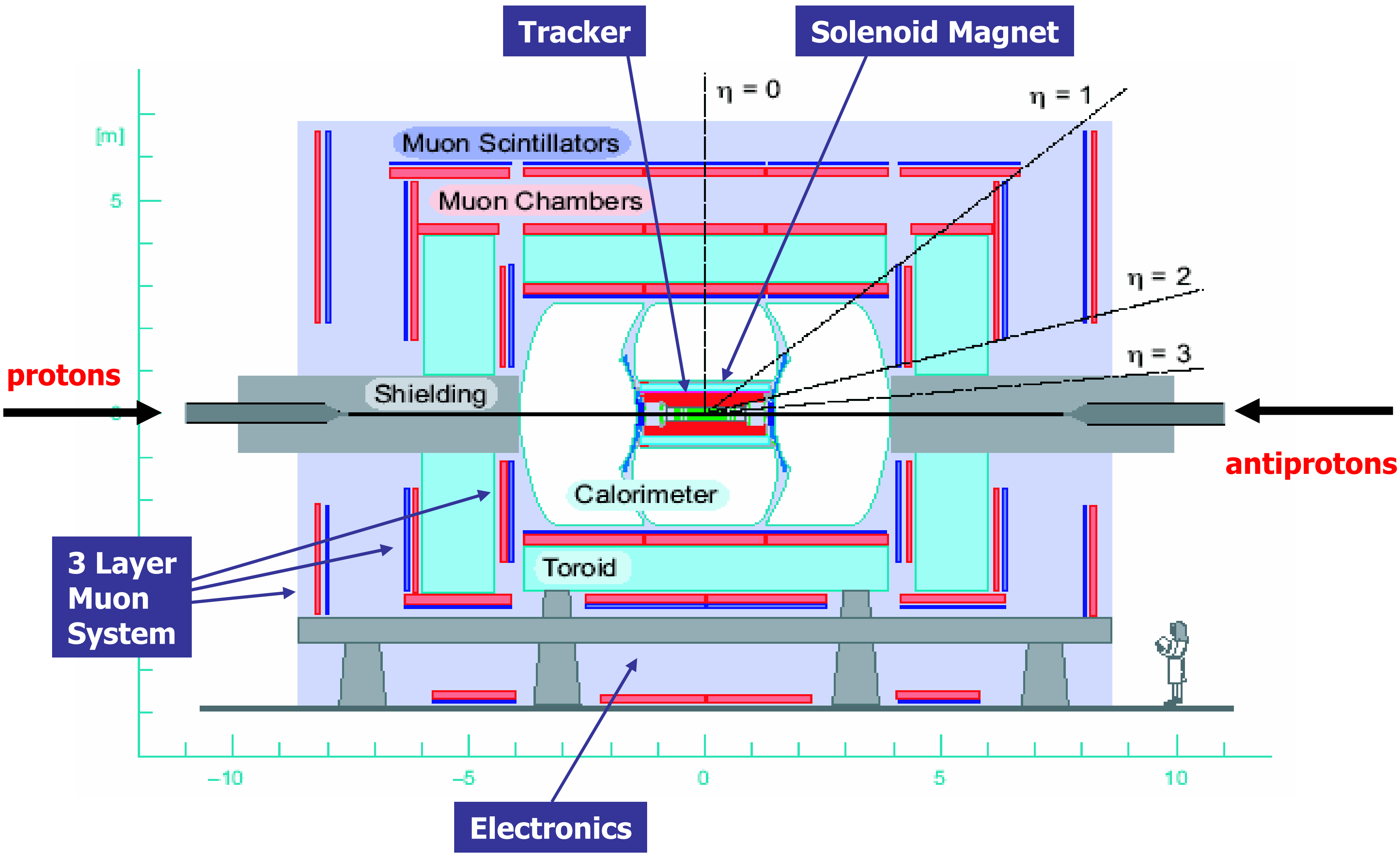
Analyses Overview

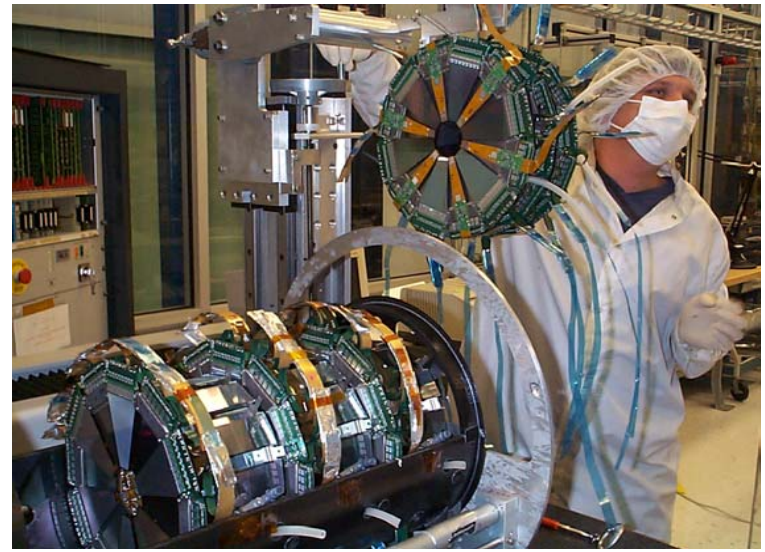
Detector Performance
Data Processing
Analysis Status and plan

Detector

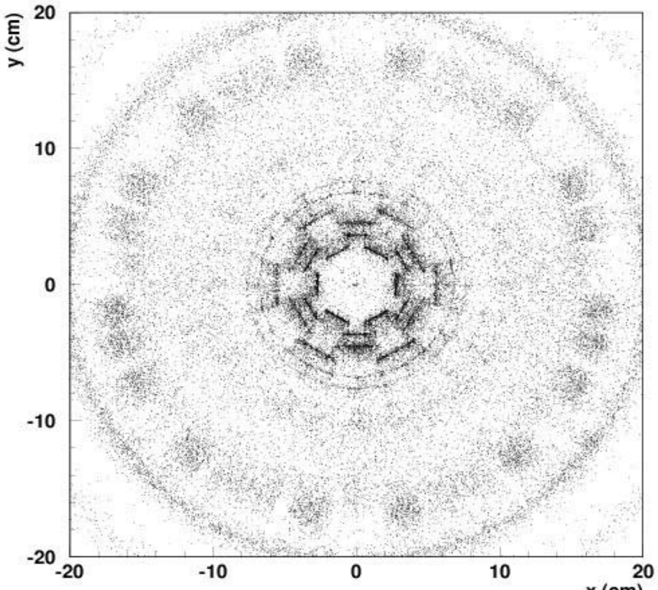


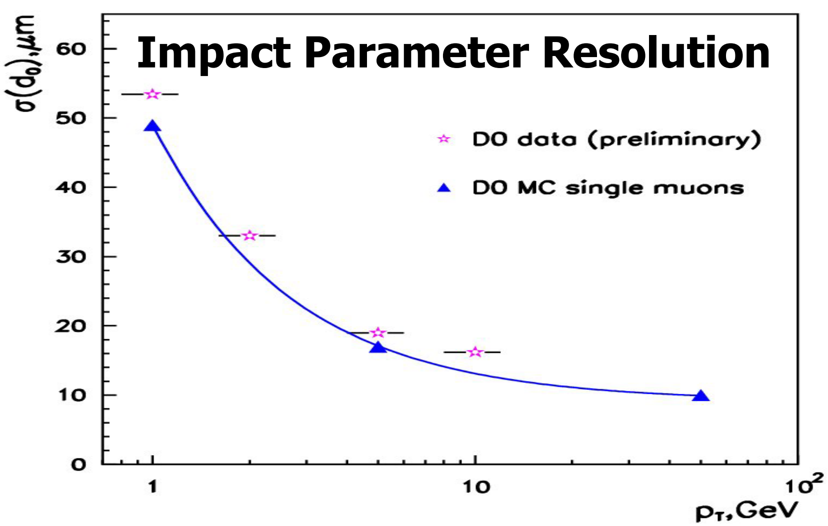
Tracker
Solenoid Magnet
η = 0
η = 1
η = 2
η = 3
[m]
5
0
Muon Scintillators
Muon Chambers
Shielding
Calorimeter
Toroid
protons
antiprotons
3 Layer Muon System
Electronics
−10
−5
0
5
10

Silicon Detector

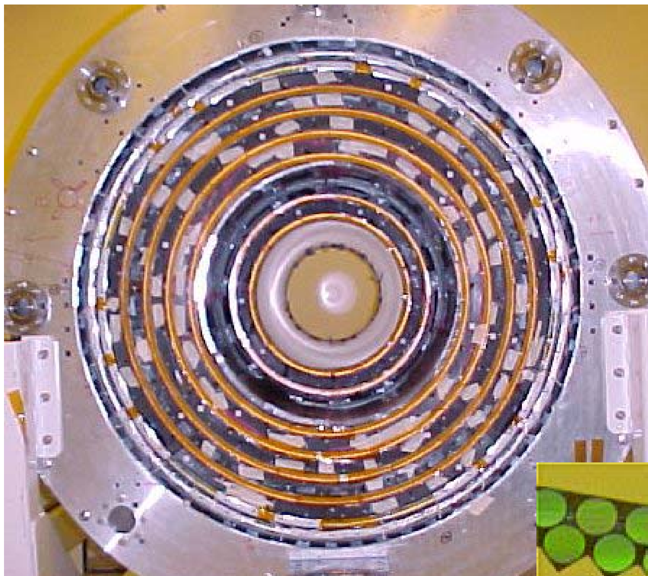


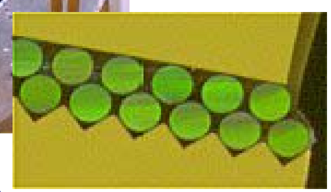
$\gamma \rightarrow e^+e^-$ vertex





Fiber Tracker

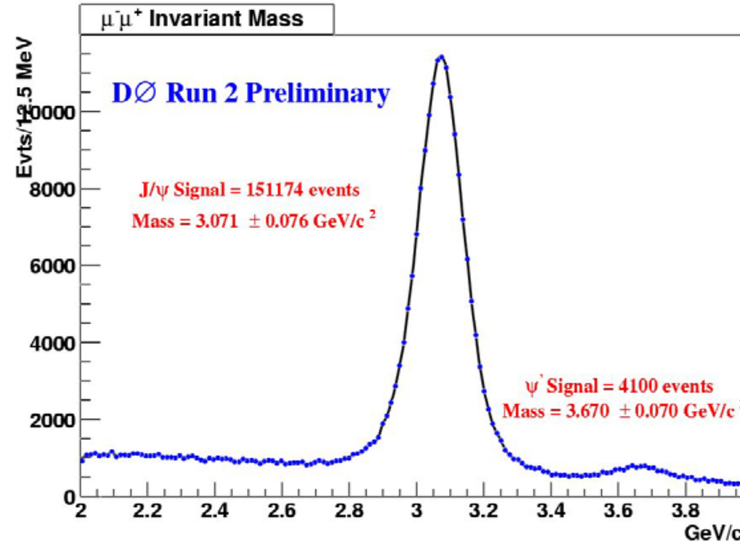


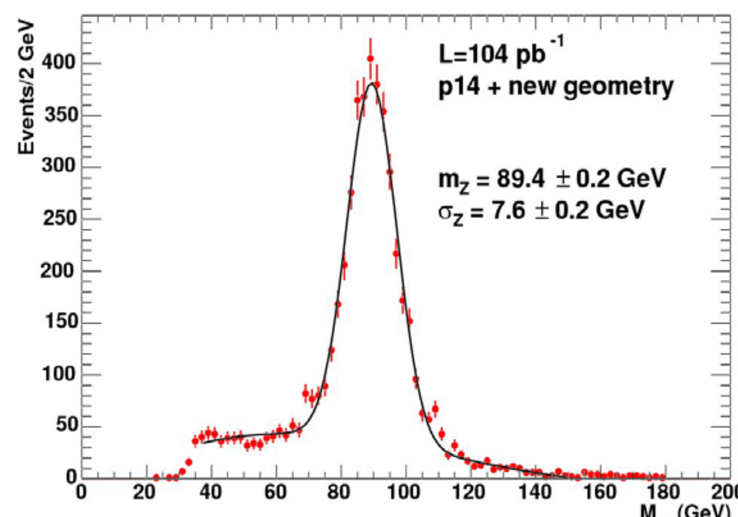


~ 99% channels live

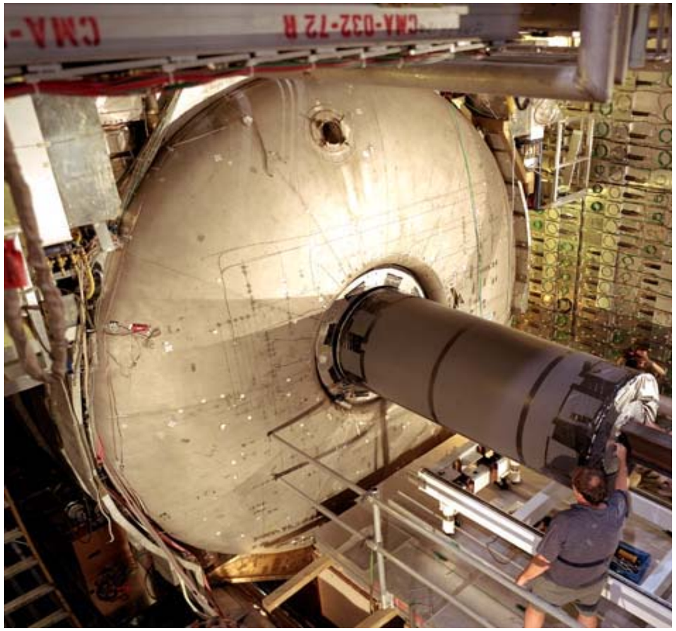
8 super layers of scintillating fibers, each layer with one axial and one stereo doublet

$B \bullet \ell^2 \sim 0.5\ \mathrm{Tm}^2$ ⇒ **Compact**





Calorimeter



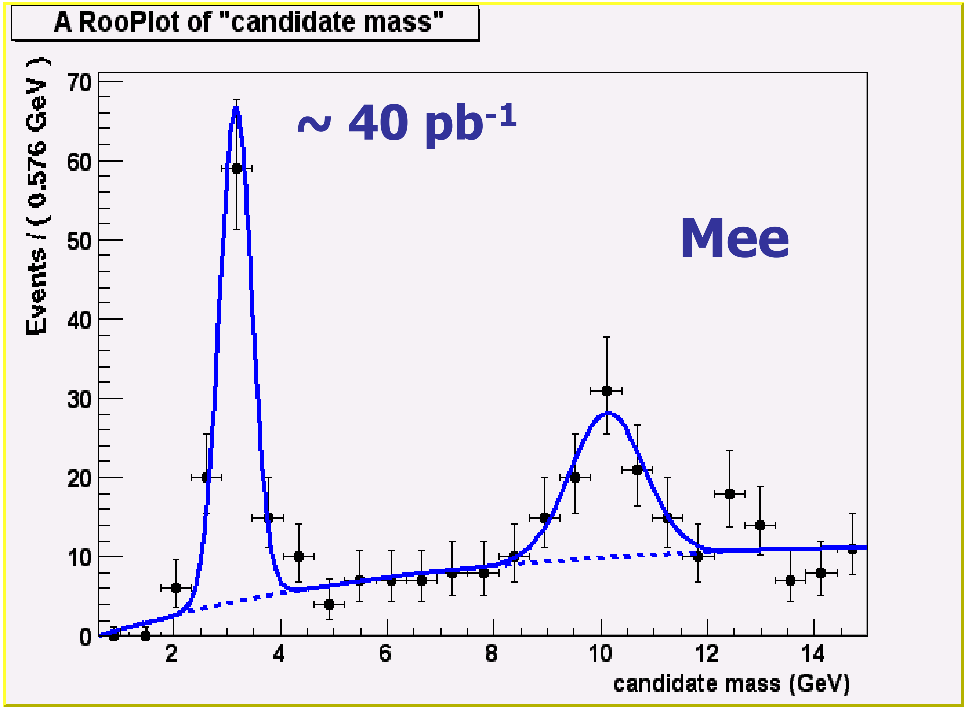
~99% channels live

Most issues are understood and fixed in hardware

Software fixes developed for the data affected

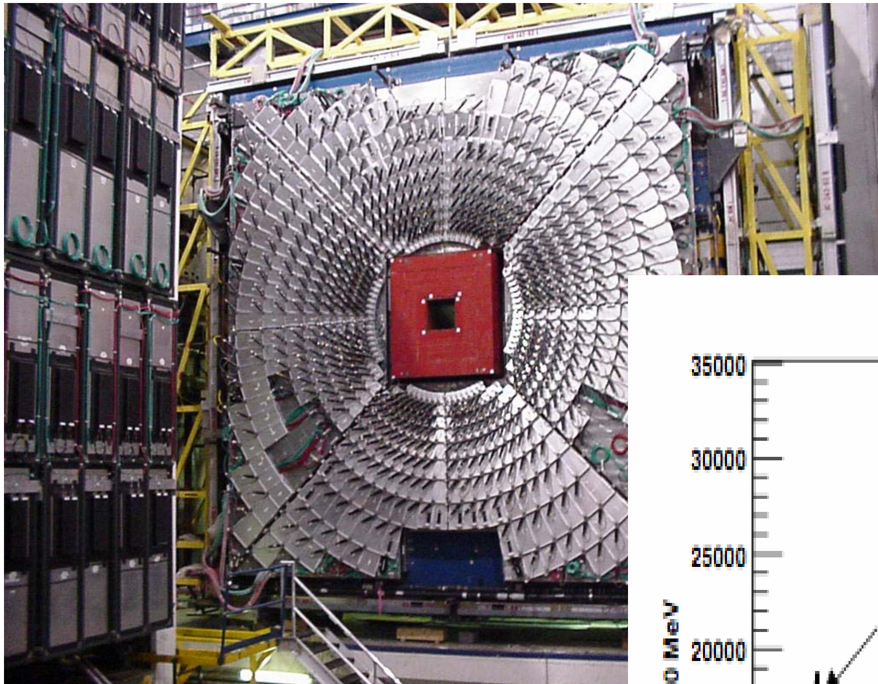
Same detector, new electronics

Worked during the shutdown to reduce noise sensitivity:
grounding, isolation, …



"Old" calorimeter with a new tracker = new possibilities

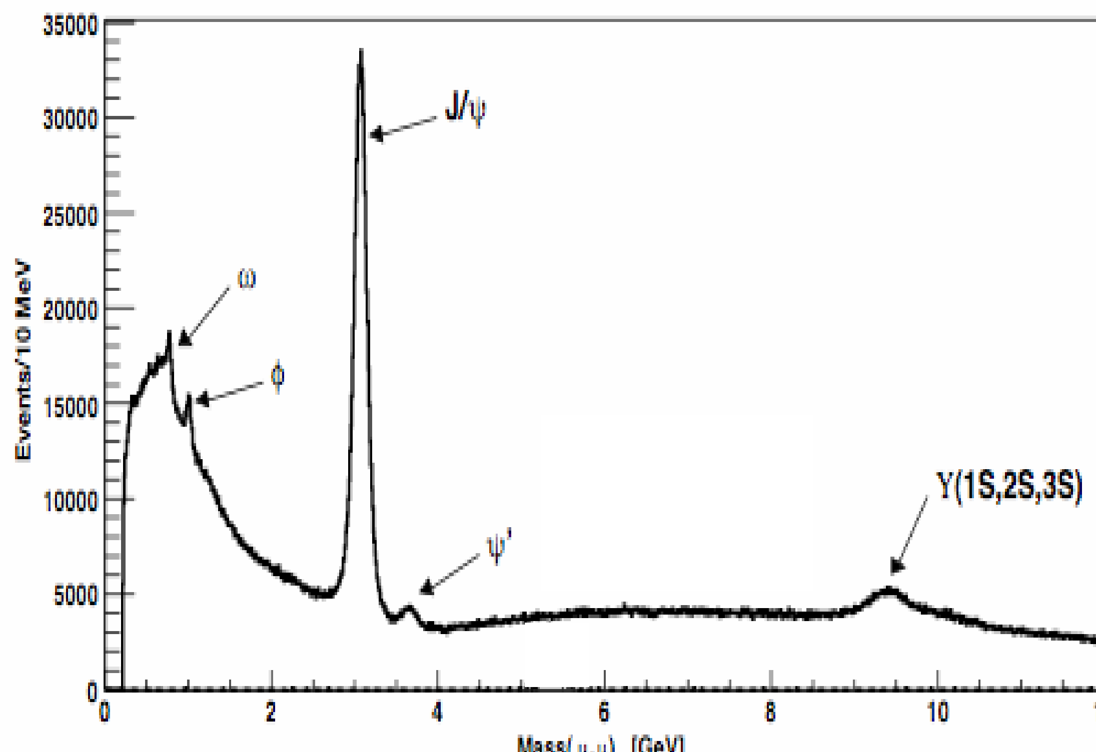
Muon



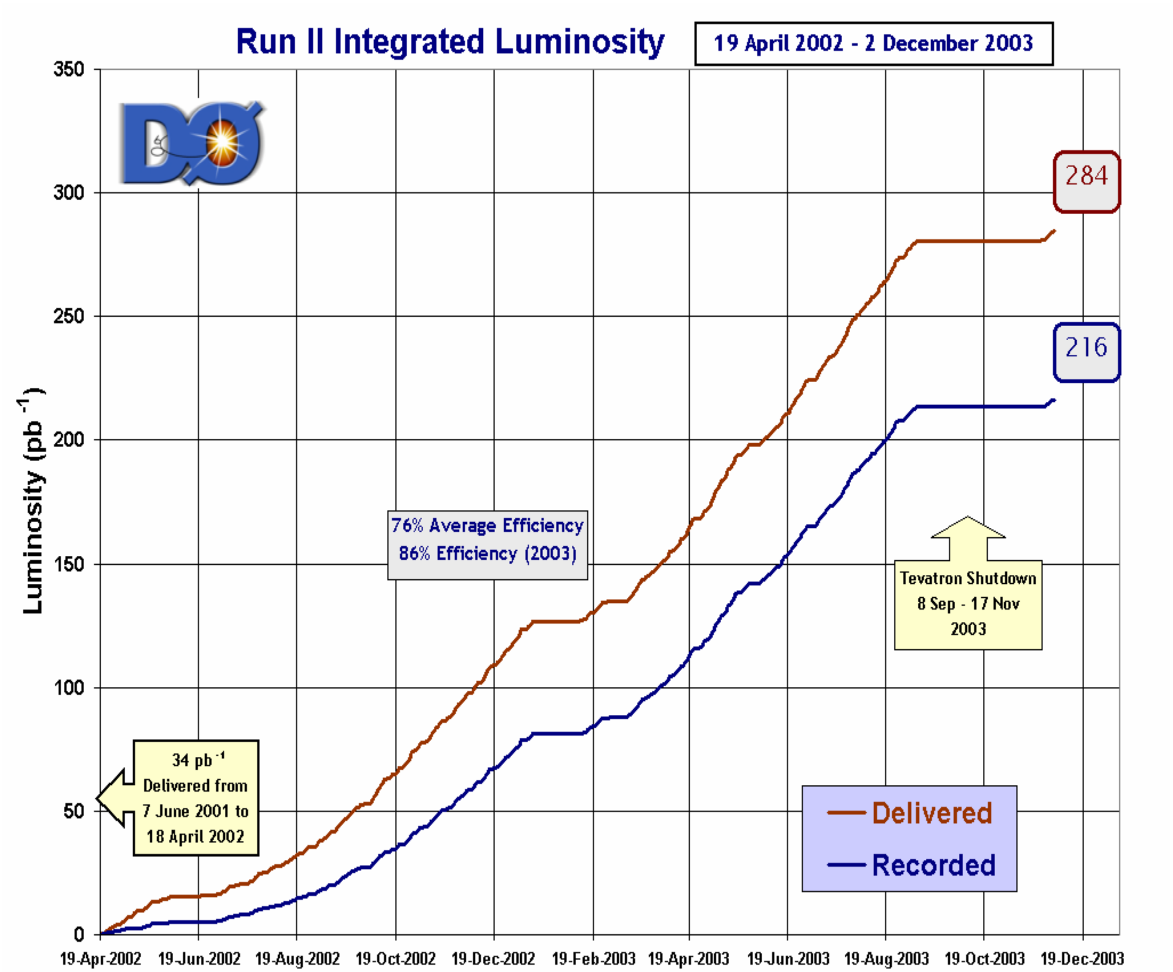
Run I central muon detector, New forward muon detector and many scintillator counters…

99+% channels live

The biggest upgrade of DØ muon detection is its magnetic central tracker…



Integrated Luminosity



~210 pb^{-1} on tape $\Rightarrow$ an overall 76% efficiency

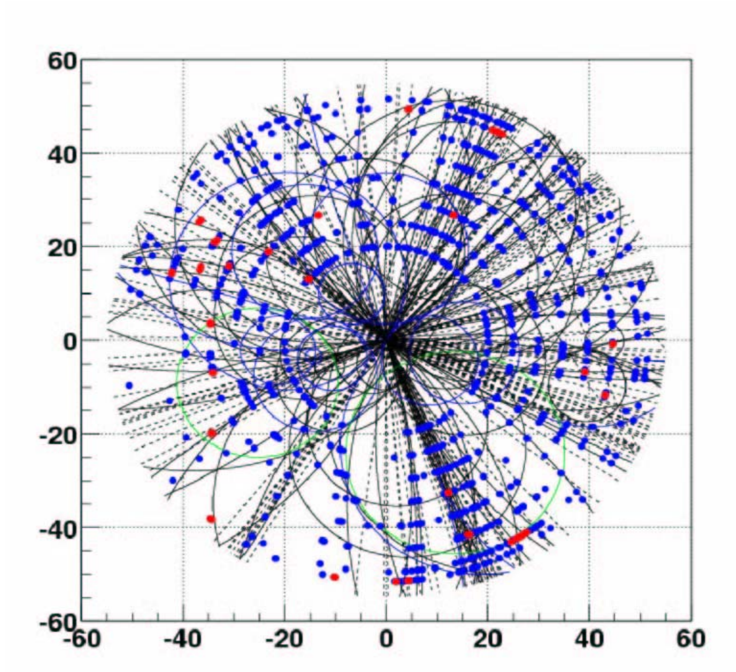
DAQ steadily improved during the run and routinely run at 85% efficiency before the shutdown

~8 pb^{-1} taken since the shutdown, the high DAQ efficiency continues…

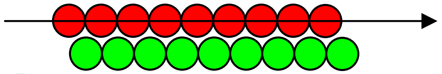
RECO Improvement

Tracking speed was a concern

high occupancy coupled with a small number of measurements makes pattern recognition difficult



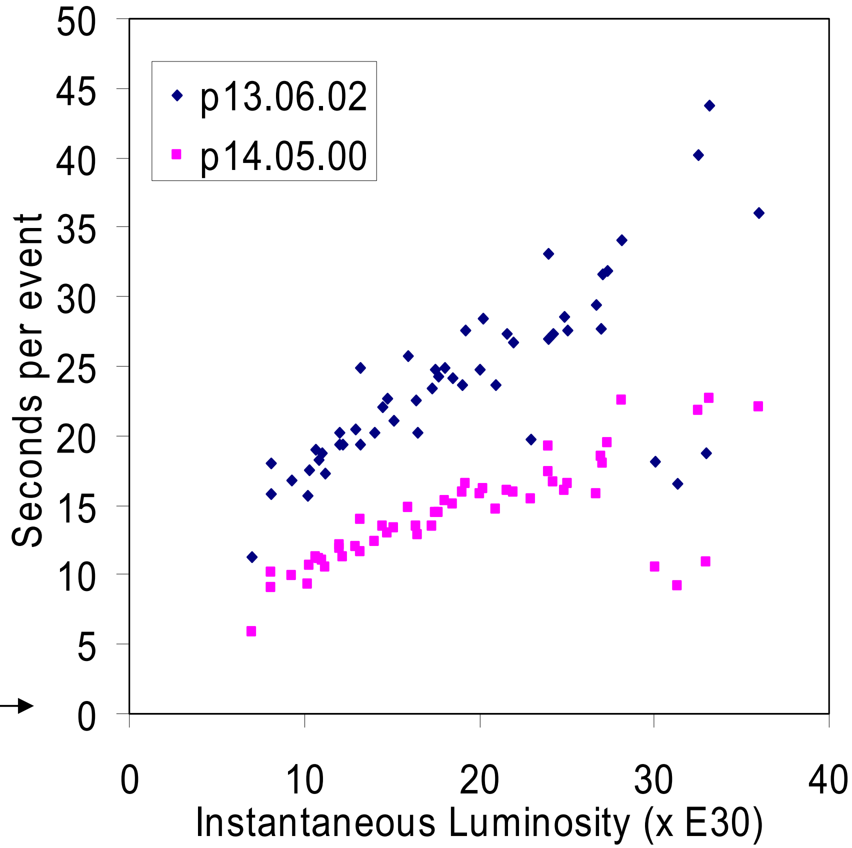
Low pT "loopers"



- **increases combination**
- **eats up memory**

Removing clusters from loopers…

Speed up the reconstruction, improve operation efficiency and "no" effect on tracking eff.



Reprocessing Plan

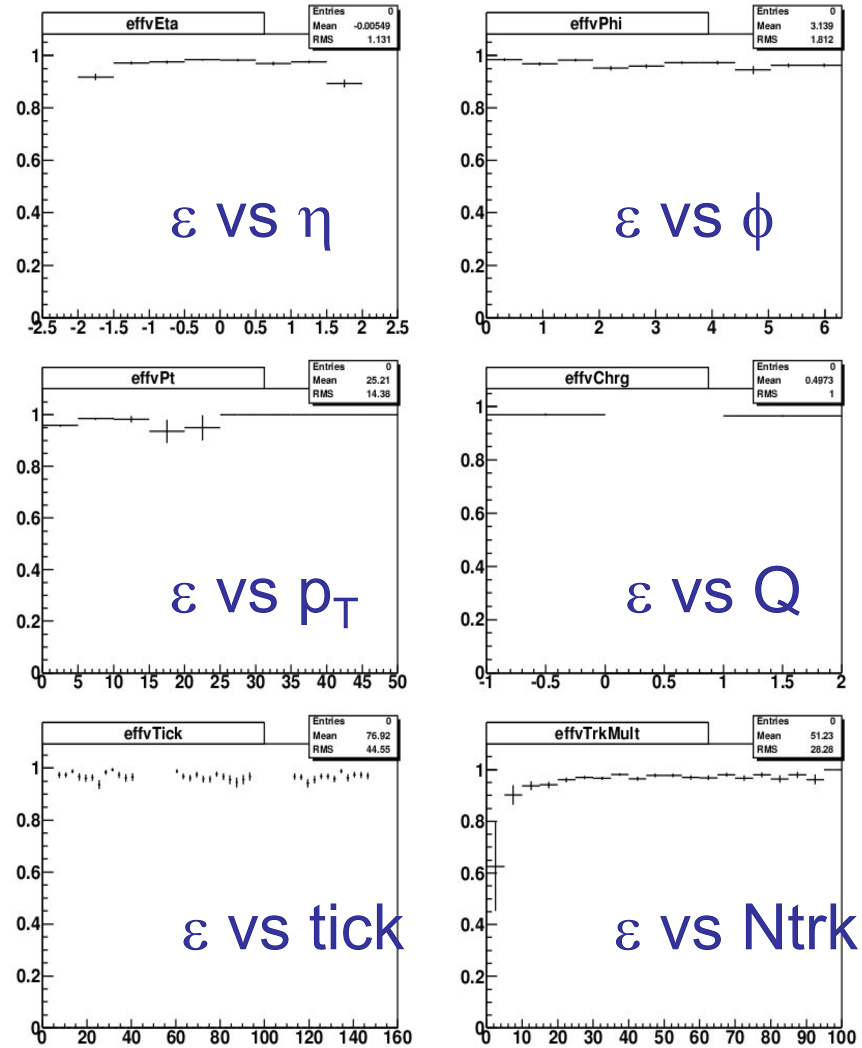
New algorithm significantly improves the tracking efficiency

Reprocessing the entire dataset (210 pb^{-1}, 550 mln events) at
- Fermilab farm from raw data
- Offsite farms from DST data

About 400 mln events are done
Completion by January 15, 2004

Most analyses plan to use the reprocessed data $\Rightarrow$ reprocessing dictates our analysis schedule

We have learnt a great deal about reprocessing and are planning a major reprocessing next year



Tracking (Efficiency)

Ongoing Analyses

Electroweak

W/Z cross sections, dibosons and anomalous couplings, charge and rapidity asymmetry, …

Top Quark

top quark pair production cross section measurements, top quark mass and decay properties, searches for single top quark production, …

New phenomena searches

Higgs bosons, supersymmetry, leptoquark, large extra dimensions, Z′, …

Full Run II menu, Expect to evolve as luminosity increases

Heavy flavor

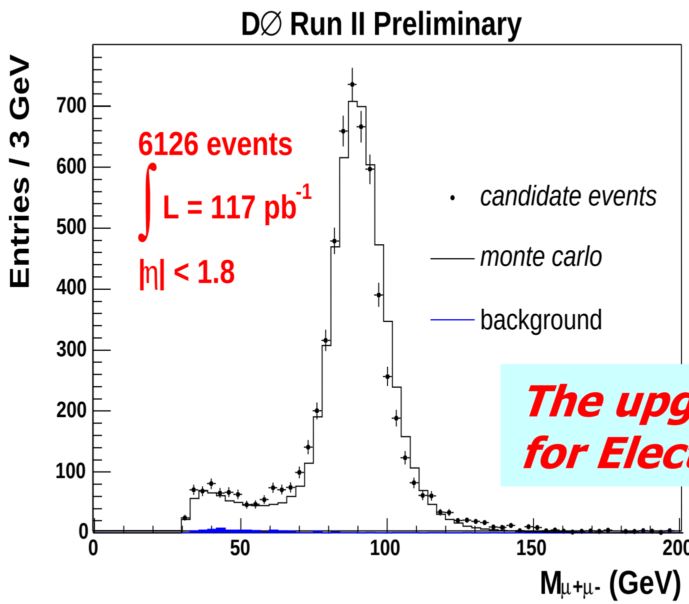
resonance reconstructions, masses, lifetimes, branching fractions, rare decays, Bs mixing, …

QCD

inclusive jet cross section, dijet mass and angular distributions, diffraction, …

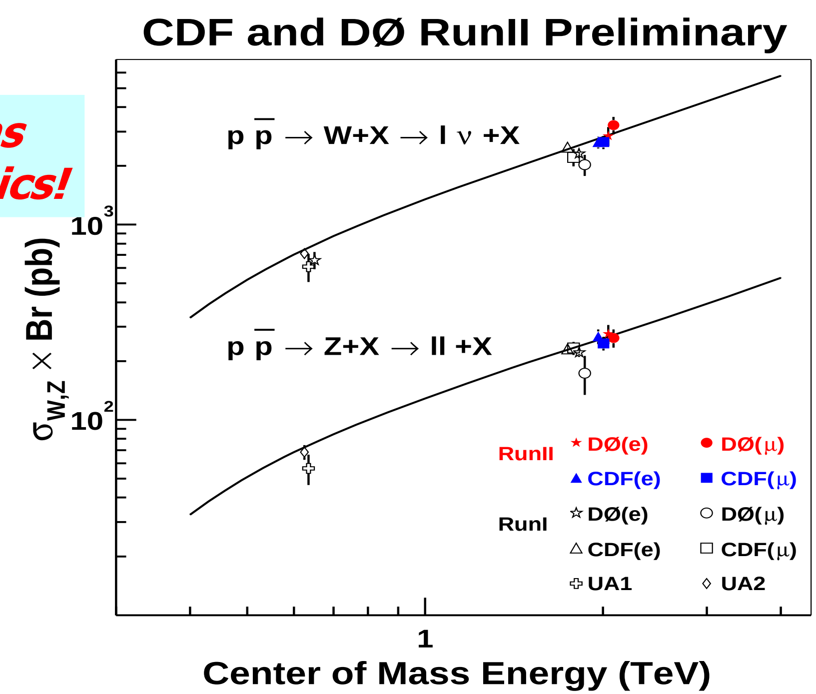
Electroweak Physics

Leptonic decays of W/Z are standard candles of hadron collider physics, ideal for detector calibration and understanding precision measurements



W/Z production cross sections
Diboson cross sections and anomalous couplings
Charge/rapidity asymmetries
W boson mass (starting)

The upgrade ⇒ muons for Electroweak physics!



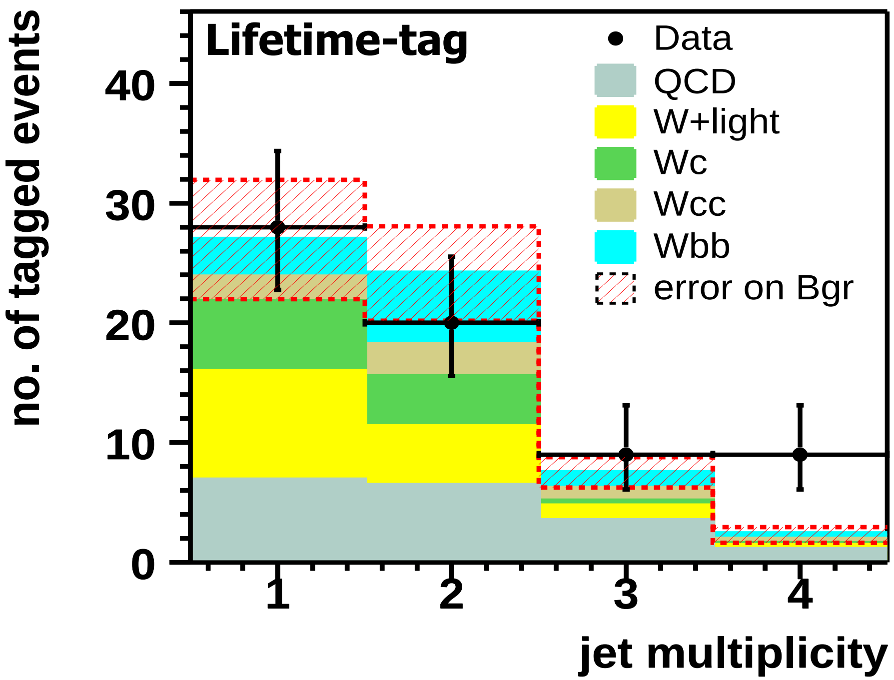
We will use the same inelastic cross section used by CDF to calculate our luminosities to avoid the Run I problem

Expect to have updated W/Z cross sections in e/μ channels, new results in Wγ, WZ, and possible charge asymmetry measurements

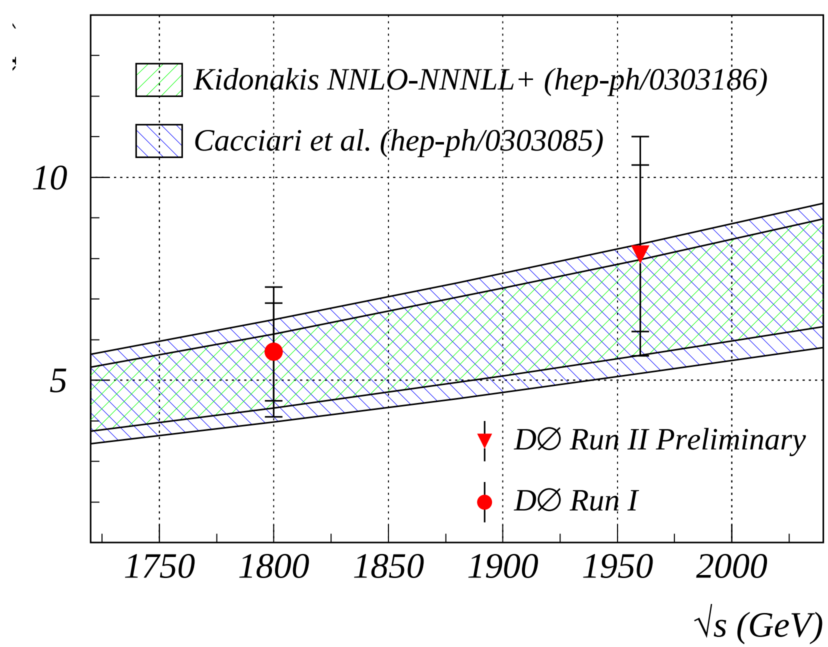
Top Quark Physics

For summer conferences, only cross section measurements are shown

- **~100 pb^{-1} for topological and soft-muon-tagged analyses**
- **~45 pb^{-1} for b lifetime-tagged analyses**



$$\sigma_{t\bar{t}} = 8.1^{+2.2}_{-2.0}(\text{stat})^{+1.6}_{-1.4}(\text{syst}) \pm 0.8(\text{lum})\ \text{pb}$$

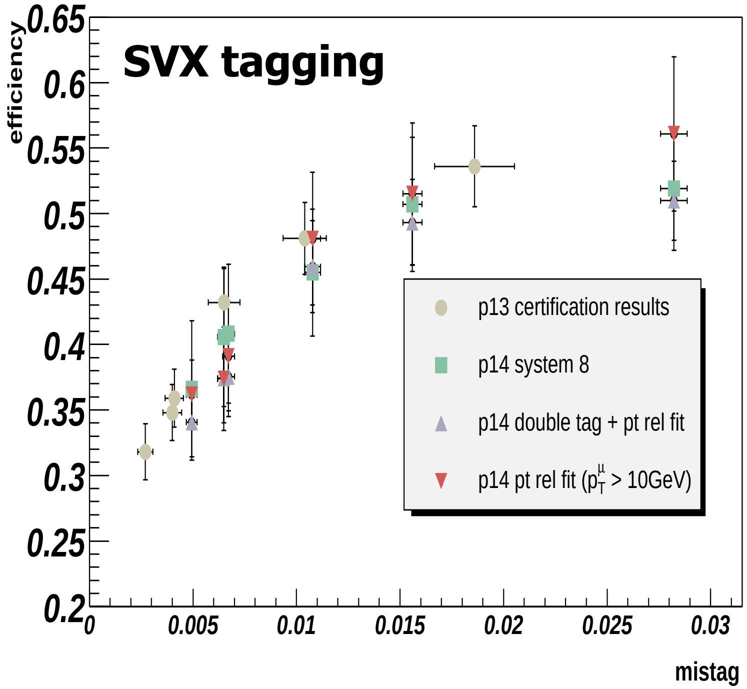


Many analyses on production cross section, mass and decay properties, and single top searches. Expect to have cross section and mass measurements for winter conferences.

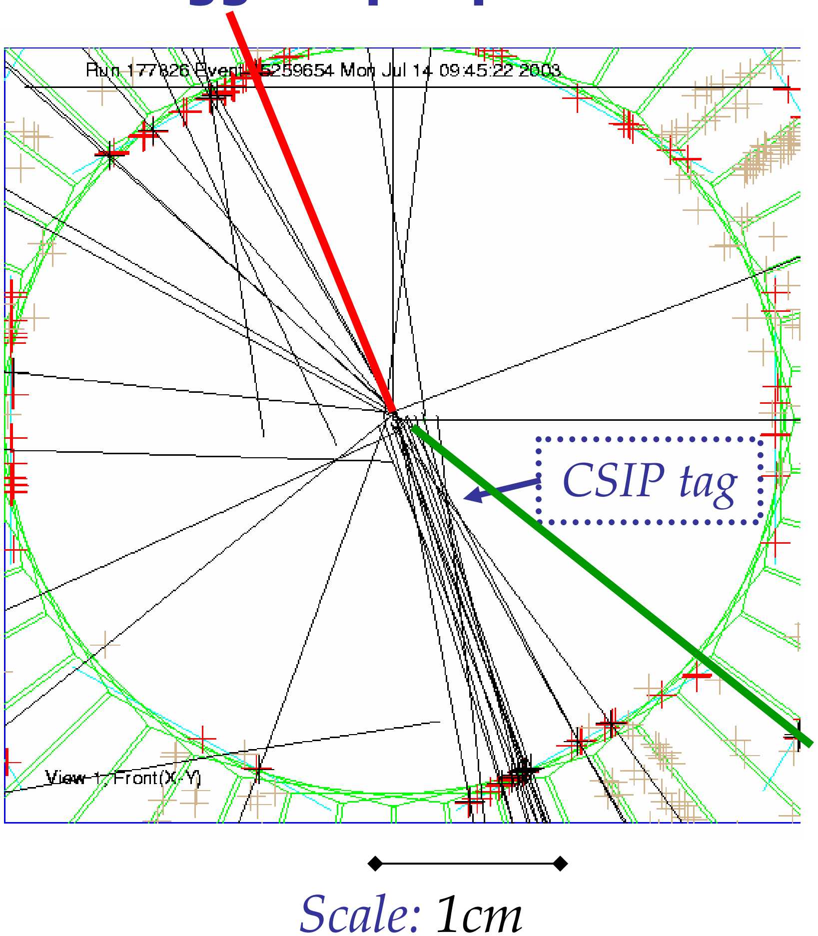
Lifetime b-tagging

Three different tagging algorithms
- **One based on secondary vertices**
- **Two based on tracks with large IPs**

Multiple methods to measure efficiencies and fake rates



A tagged eμ top candidate



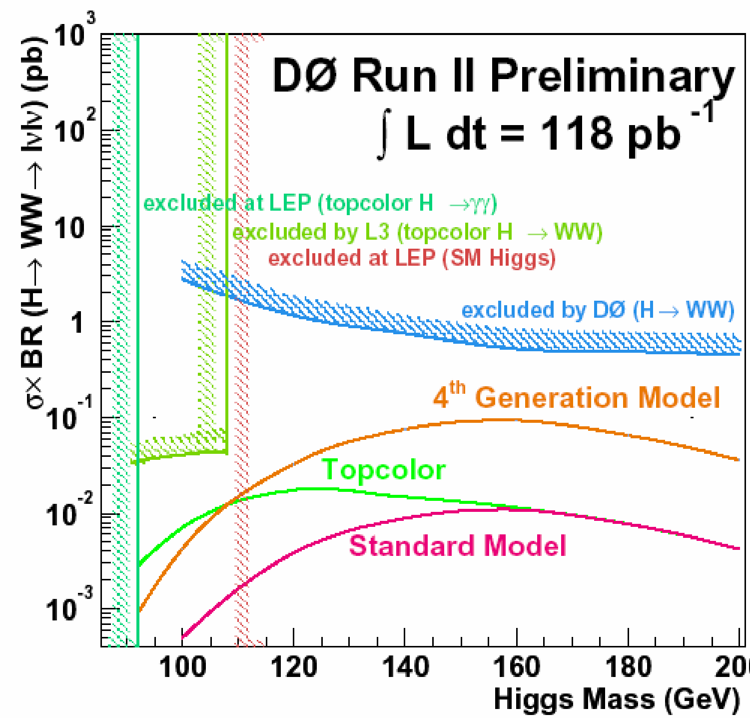
~50% jet-tagging efficiency at a fake rate of 1% compared with ~60+% efficiency in MC. Improvements can be made by tuning the algorithms.

Higgs Searches

Look for unexpected, understand our data and develop tools

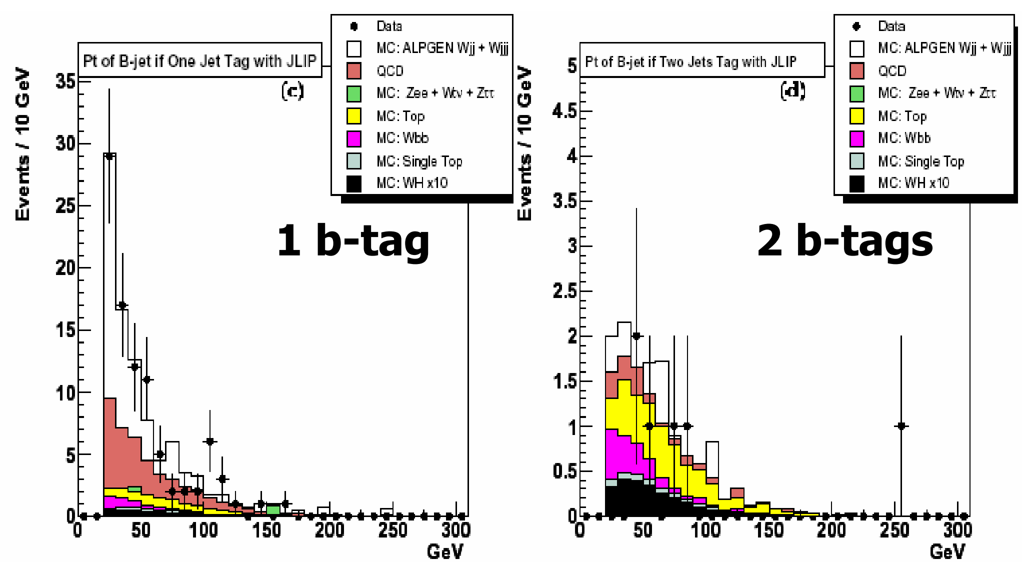
- Within the SM: WH and ZH with $H \rightarrow bb$; $gg \rightarrow H \rightarrow WW^*$
- Supersymmetry: $Hb \rightarrow bbb$, $Hbb \rightarrow bbbb$ (enhanced at large $\tan\beta$)
- More exotic: $H^{++} \rightarrow \mu\mu$, $H \rightarrow \gamma\gamma$

$$H \rightarrow WW^* \rightarrow \ell\ell'$$



WH→ebb:

so far focused on understanding Wbb production



Supersymmetry

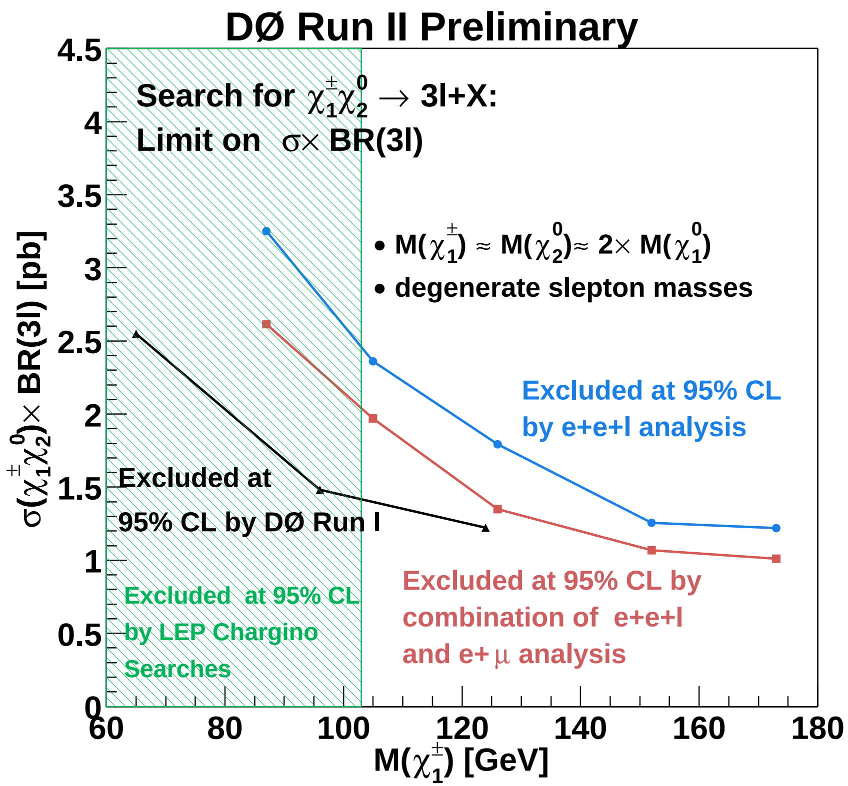
A large number of analyses searching for supersymmetry

Experimentally (covering most conceivable topologies)

- di and tri-leptons,
- diphoton,
- tau,
- jets w/o b-tagging

Theoretically

- R-parity conservation
- R-parity violation
- gravity-mediation
- gauge-mediation
- different LSPs



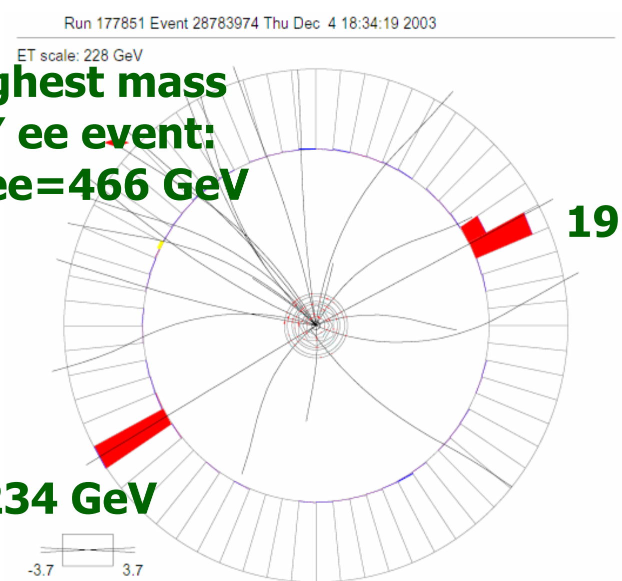
Many analyses have reached or exceeded Run I sensitivities

Large Extra Dimensions

The mediation by the Kaluza-Klein gravitons will lead to modification of both dilepton and diphoton event topology

$$\frac{d^2\sigma}{dMd\cos\theta^*} = f_{SM}(M,\cos\theta^*) + f_{int}(M,\cos\theta^*)\eta + f_{KK}(M,\cos\theta^*)\eta^2$$

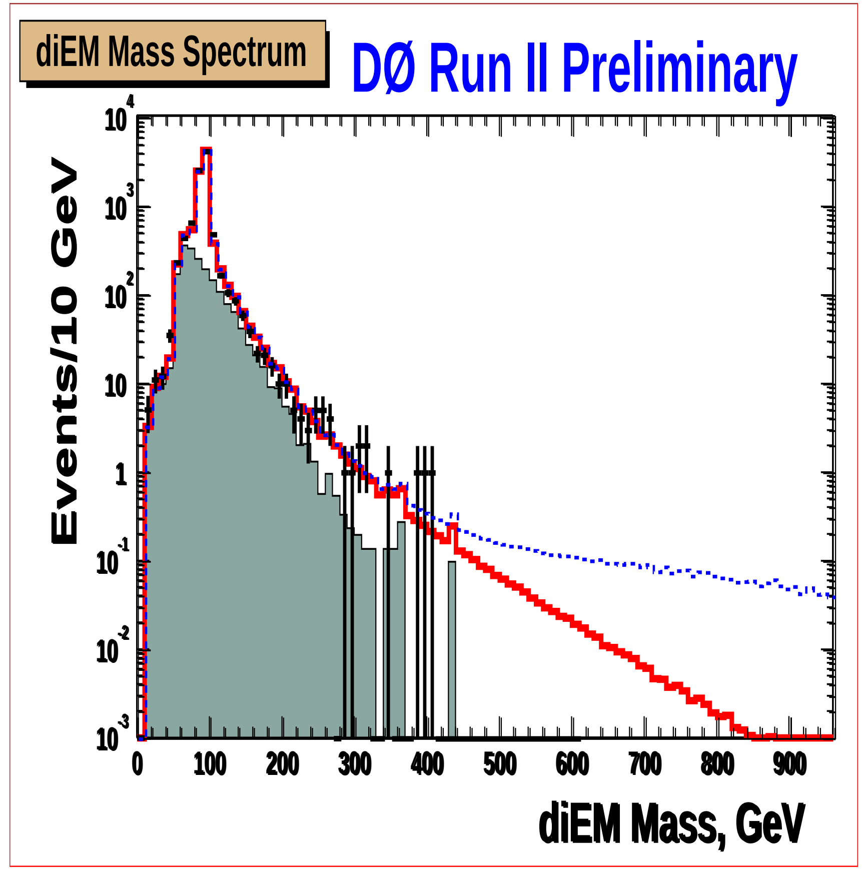
where $\eta = \frac{F}{M_S^4}$



highest mass DY ee event: Mee=466 GeV

191 GeV

234 GeV

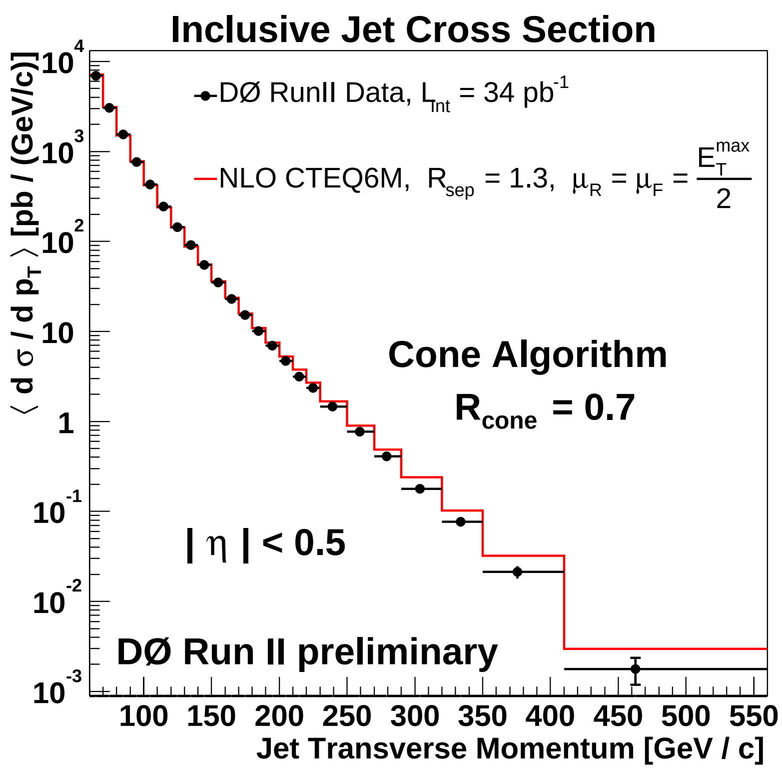


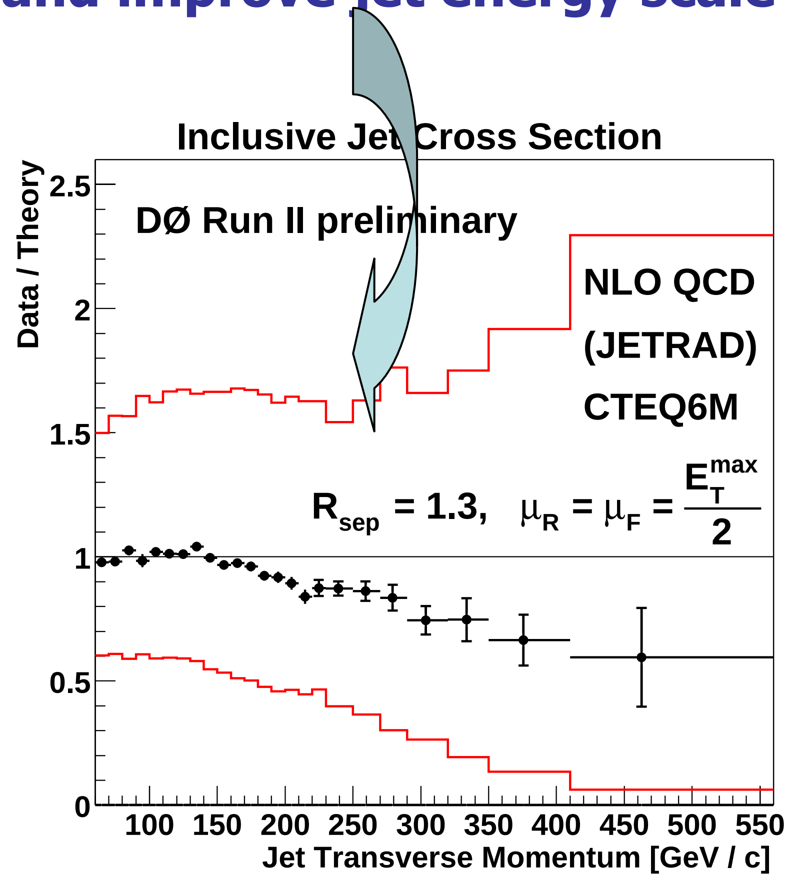
Ms > 1.28 TeV at 95% CL

(GRW, from ~130 pb^{-1} diEM)

Inclusive Jet Production

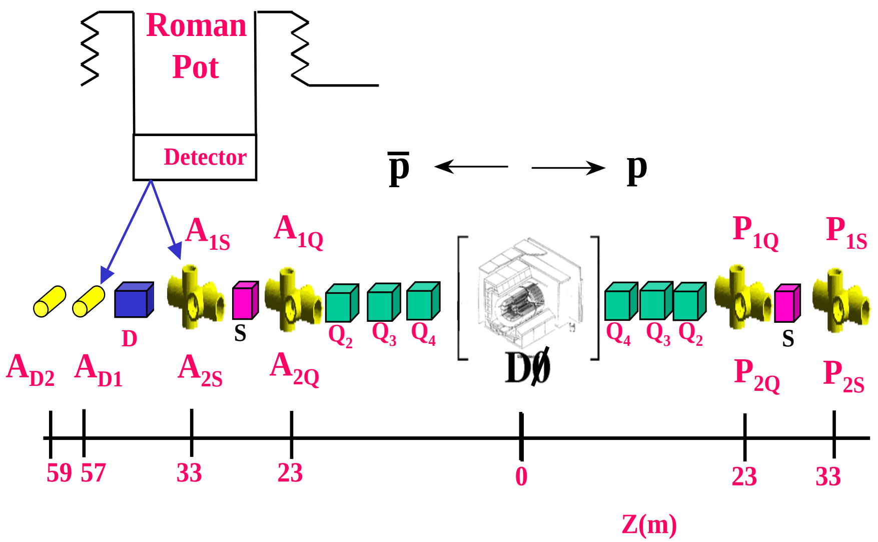
Presented preliminary results for winter'03 conferences,
Current focus is to understand and improve jet energy scale

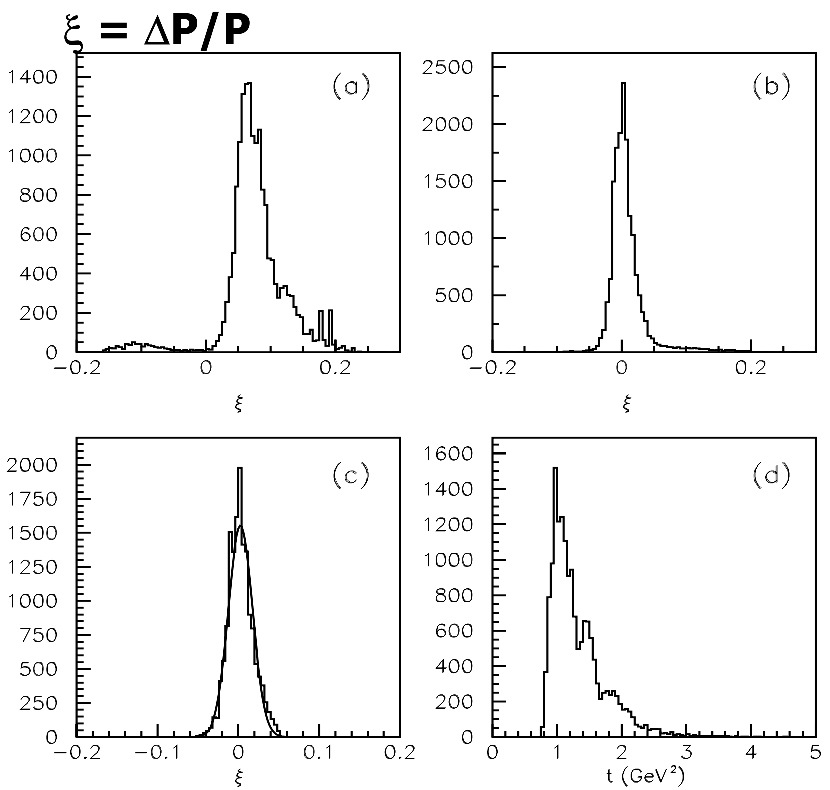




Diffractive Physics

will significantly benefit from the newly installed forward proton detector.





18 Roman pots are installed and integration is underway.

Ongoing analyses:

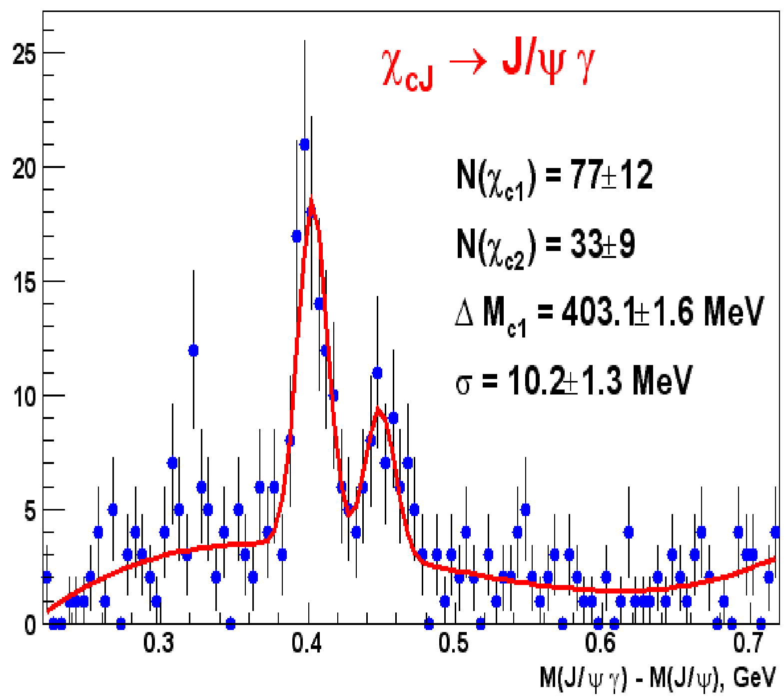
- Elastic dN/dt measurements
- Diffractive and non-diffractive jet cross section ratio
- Diffractive W and Z production
- Double pomeron exchange using FPD

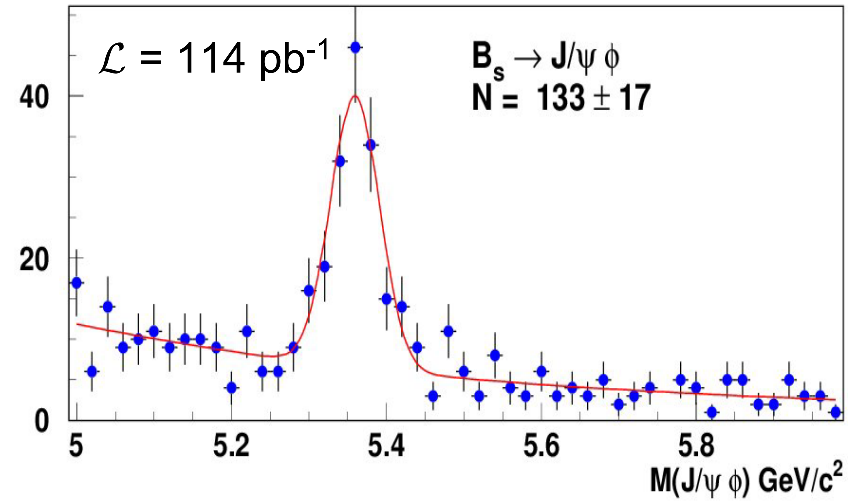
Charm and Beauty

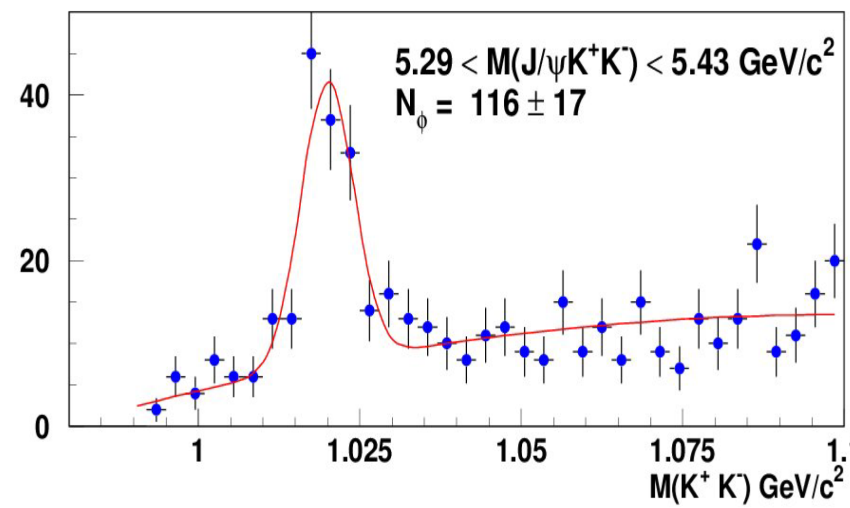
The magnetic central tracker opens numerous opportunities…

- Quarkonia reconstruction
- Lifetime measurements
- Bd and Bs mixing

DØ Run II Preliminary

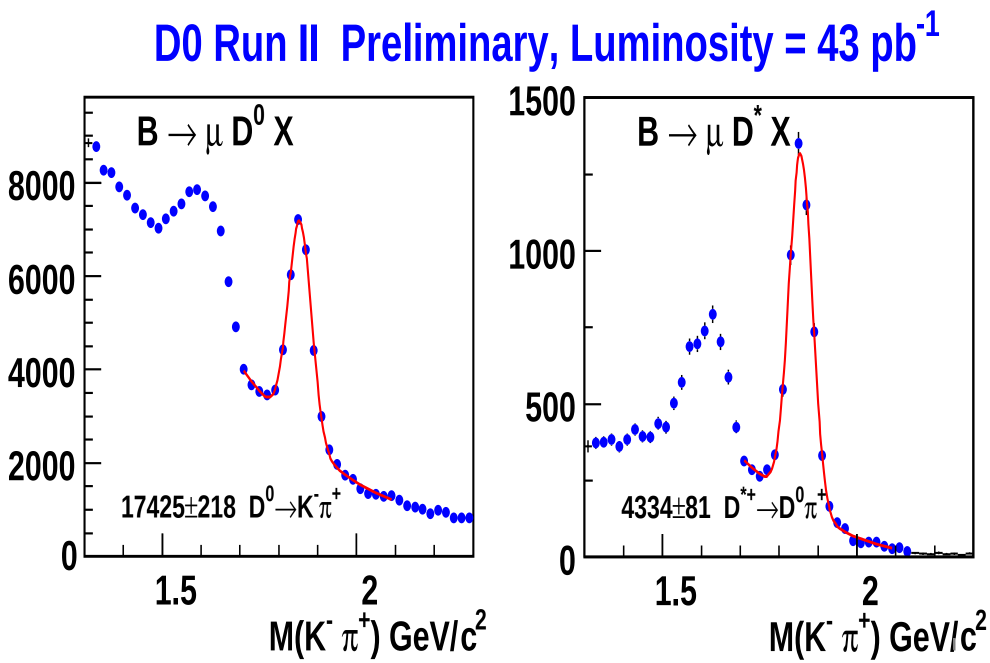




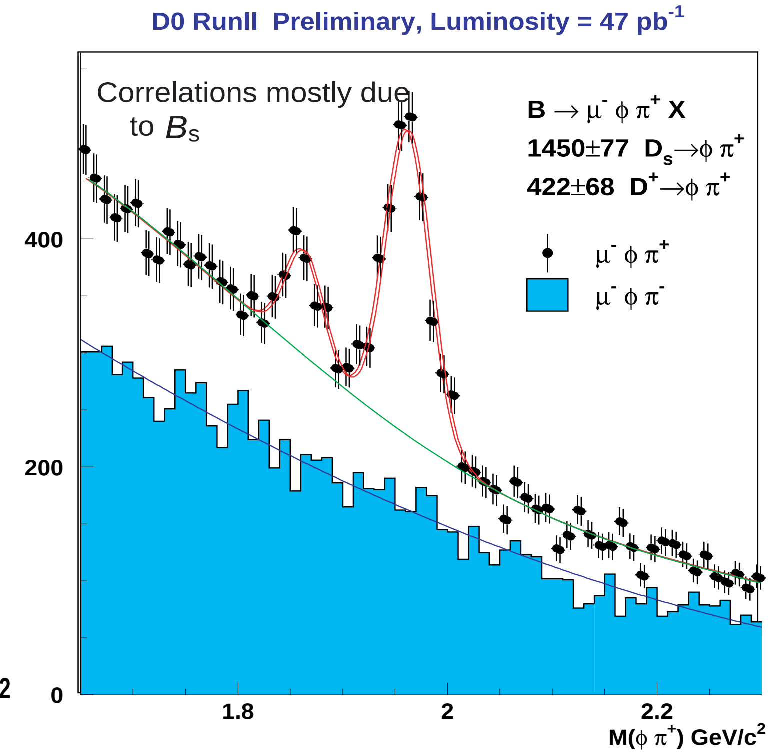


Bs Mixing

Excellent Bd yield, ideal control sample for Bs mixing studies



Bs → μ Ds x

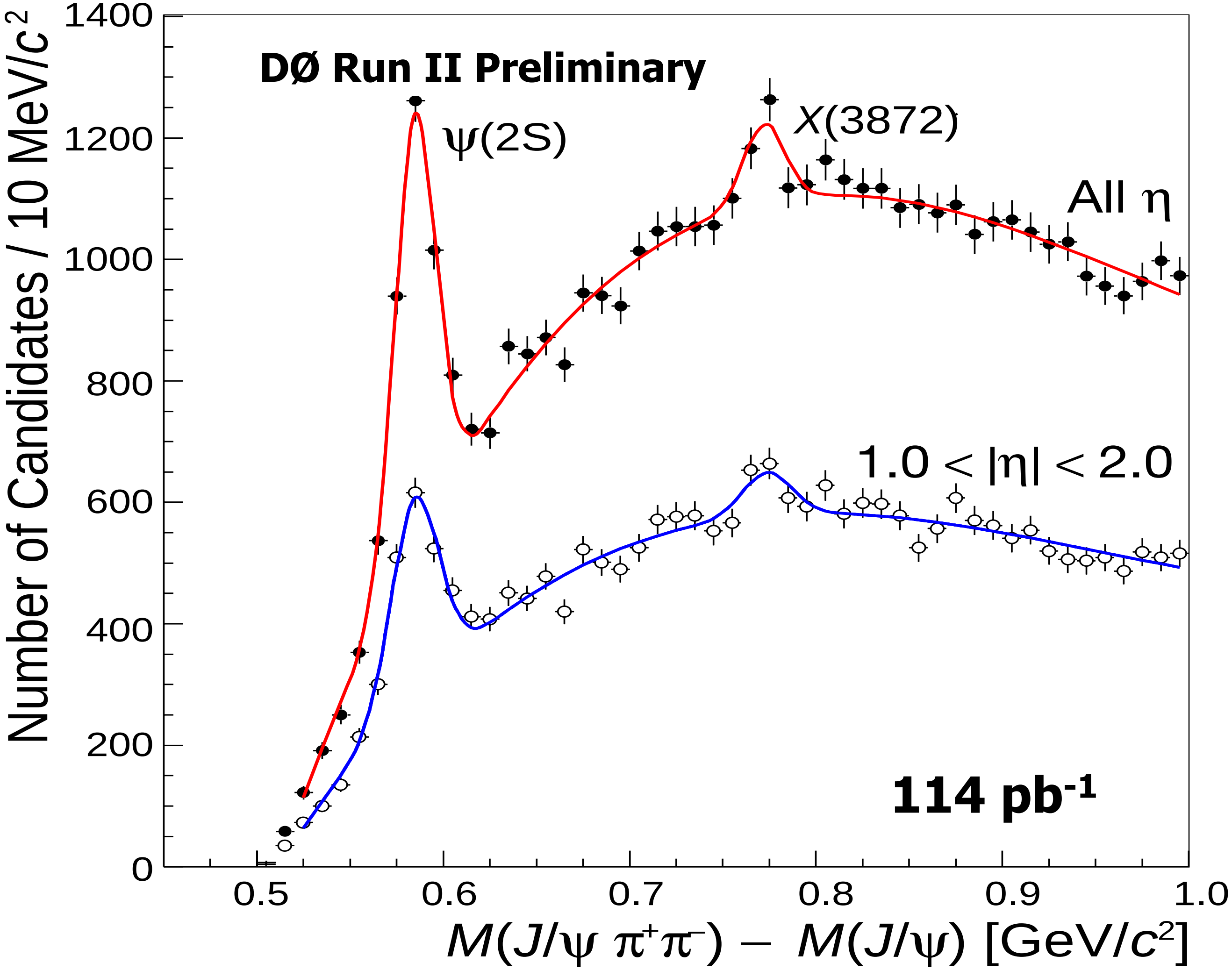


Tagging power estimated from $B^{\pm} \to J/\psi\, K^{\pm}$

- **Opposite side jet charge εD^2=3.3±1.8%**
- **Opposite side soft muon εD^2= 1.6±0.6%**
- **Same side track εD^2= 5±2%**

We have observed Bd mixing signal and are working to optimize the analysis.

Observation of X(3872)



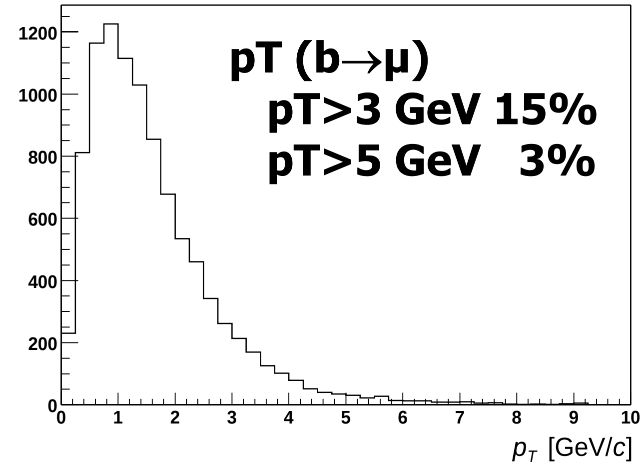
$\Delta M(\pi\pi)>500$ MeV
$\Delta R(X,\pi)<0.6$

Bandwidth Issues

Our heavy flavor physics program has shown great potential. However, its potential is currently limited by computing resources available.

We administratively limit the rate to tape at 50 Hz ⇒ low pT single muon triggers heavily prescaled and effectively turned off at luminosities above 40E30. Dimuon triggers are prescaled too.

Luminosity (cm-1 s-1)	Trigger Rate (prescale factor) pT > 5 GeV	pT > 3 GeV
20E30	8 Hz (2)	27 Hz
40E30	15 Hz (61)	52 Hz
60E30	23 Hz (off)	80 Hz



To fully explore the potential, we need to increase our rate to tape:

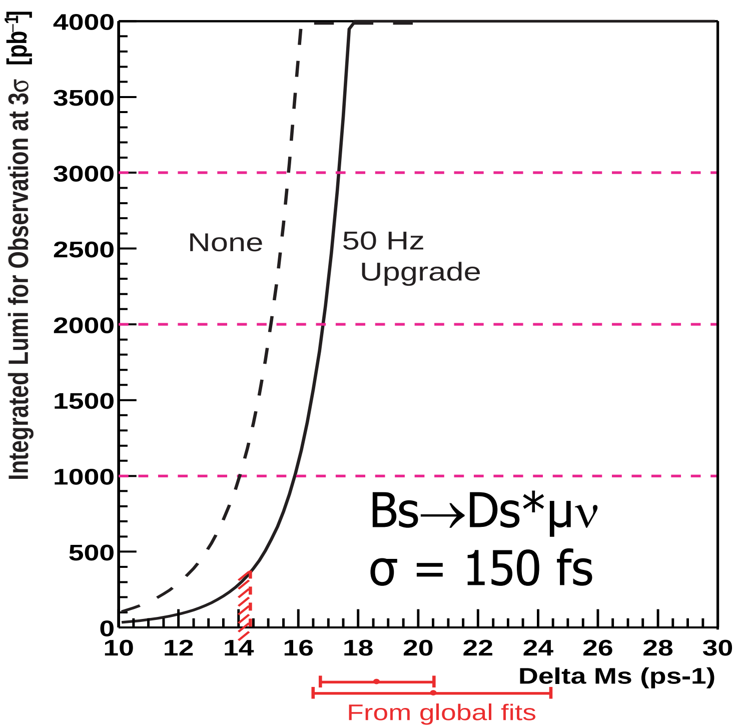
- **Not a problem with the trigger system (prescale at Level 3).**
- **Planned Run IIb upgrade will enable our DAQ to run at 100 Hz.**
- **The problem: storage, drive, reconstruction and analysis CPUs.**
- **The solution: increase our capacity at Fermilab, expand offsite processing resources, speed up reconstruction program.**

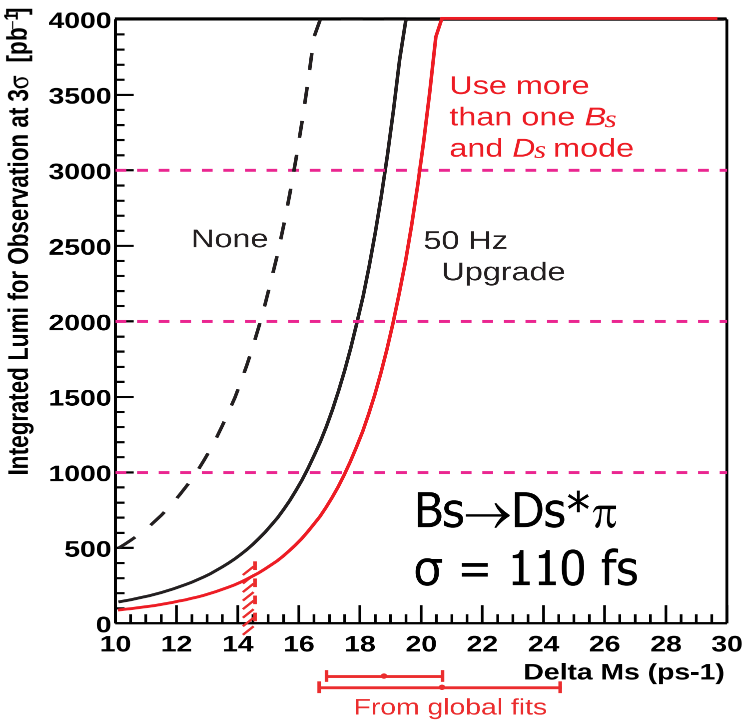
Reach in Bs Mixing

The upgrade will increase Bs yield by a factor of 3 at low luminosities to more than 5 at high luminosities. Thus it will extend the reach well into "interesting region" from the global fits.

$$\mathrm{Sig}(\Delta m_s) = \sqrt{\frac{N\varepsilon D^2}{2}}\ \mathrm{Exp}\{-\frac{(\Delta m_s \sigma_\tau)^2}{2}\}\ \sqrt{\frac{S}{S+B}}$$

Current knowledge:
Δms > 14.9 ps^{-1}



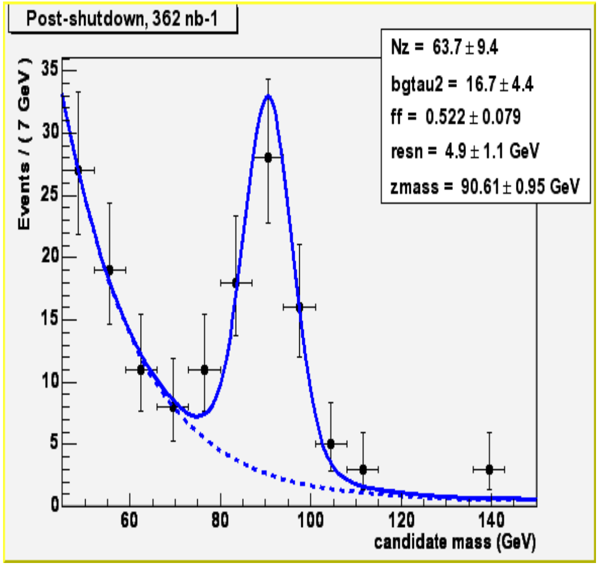


Jianming Qian, University of Michigan

Summary

The upgraded detector is performing well and we continue to develop new triggers to improve our physics output. *We have completely recovered from the shutdown and are on standby.*

Post-shutdown data



We have a large Run II dataset (~ x2 Run I). However, our physics reach is well beyond the luminosity increase, thanks to the upgrade:

> Preliminary results are very encouraging, the new central magnetic tracker greatly extends our physics capability.

We are reprocessing the entire dataset and expect to have many new results for winter conferences and for publications in the spring.

Our heavy flavor physics program is promising, but only if we can take the data. We will continue to explore the option to effectively double our offline resources.