DØ Experiment and BNL

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OUTLINE

- Overview of DØ experiment
- BNL-DØ personnel
- Major BNL Contributions
- Present Status
- Summary

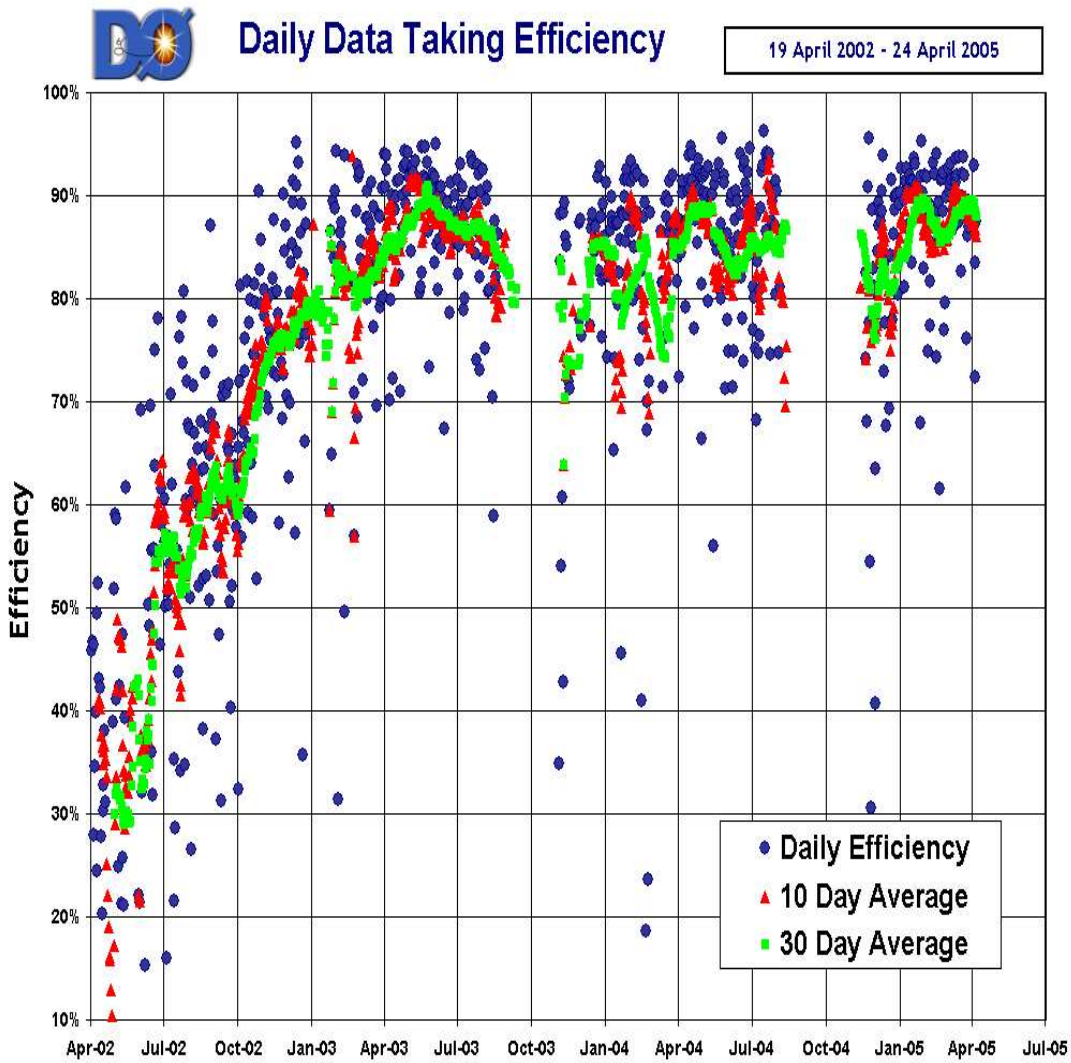
650 collaborators, 78 institutions (41 non-US), 19 countries

Run I(1992-present): 131 publications

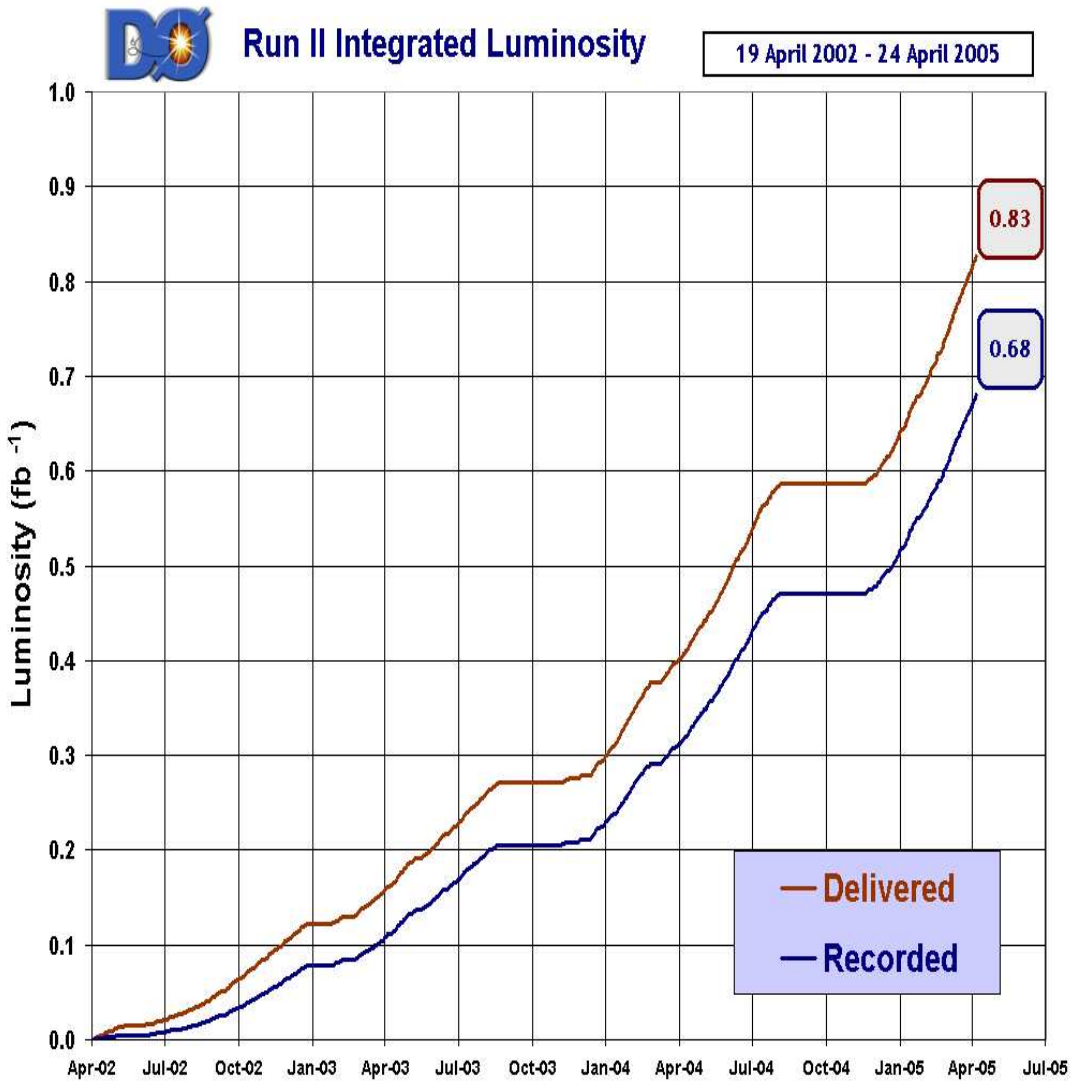
Among most recent: "An Improved Measurement of the Top Quark Mass", Nature 429, 638 2004.

Run II(2002-present): 13 publications accepted, additional 6 submitted

Most recent publication: "First measurement of $\sigma(p\bar{p} \to Z) \cdot Br(Z \to \tau\tau)$ at $\sqrt{s} = 1.96$ TeV", Phys. Rev. D 71, 072004 (2005)



Data taking efficiency $> 85\%$ since Jan.2003



Recorded 0.68 fb^{-1}
Up to 0.45 fb^{-1} used
in analyses so far.

Improved trigger
menu running stably
at high luminosities

BNL-DØ group

Current BNL-DØ members:

S. Kahn(30%), A. Patwa (100%), S. Protopopescu(90%), S. Snyder (70%), Kin Yip (30%). Total 3.2 FTE's

One resident at FNAL (A. Patwa)

Major Service Contributions:

- FPS hardware and software maintenance (A. Patwa)
- Online and offline software infrastructure (S. Snyder)
- Calorimeter software maintenance (S. Kahn)
- Data processing (K. Yip)
- τ id coordination (S. Protopopescu)
  - τ triggers (A. Patwa)
  - τ id analysis software (S. Protopopescu)

FY04 contributions:

- RunII Technical Integration Manager (J. Kotcher)
- B physics coordinator (V. Jain)
- RunIIa Triggers, Higgs Physics (A. Turcot)

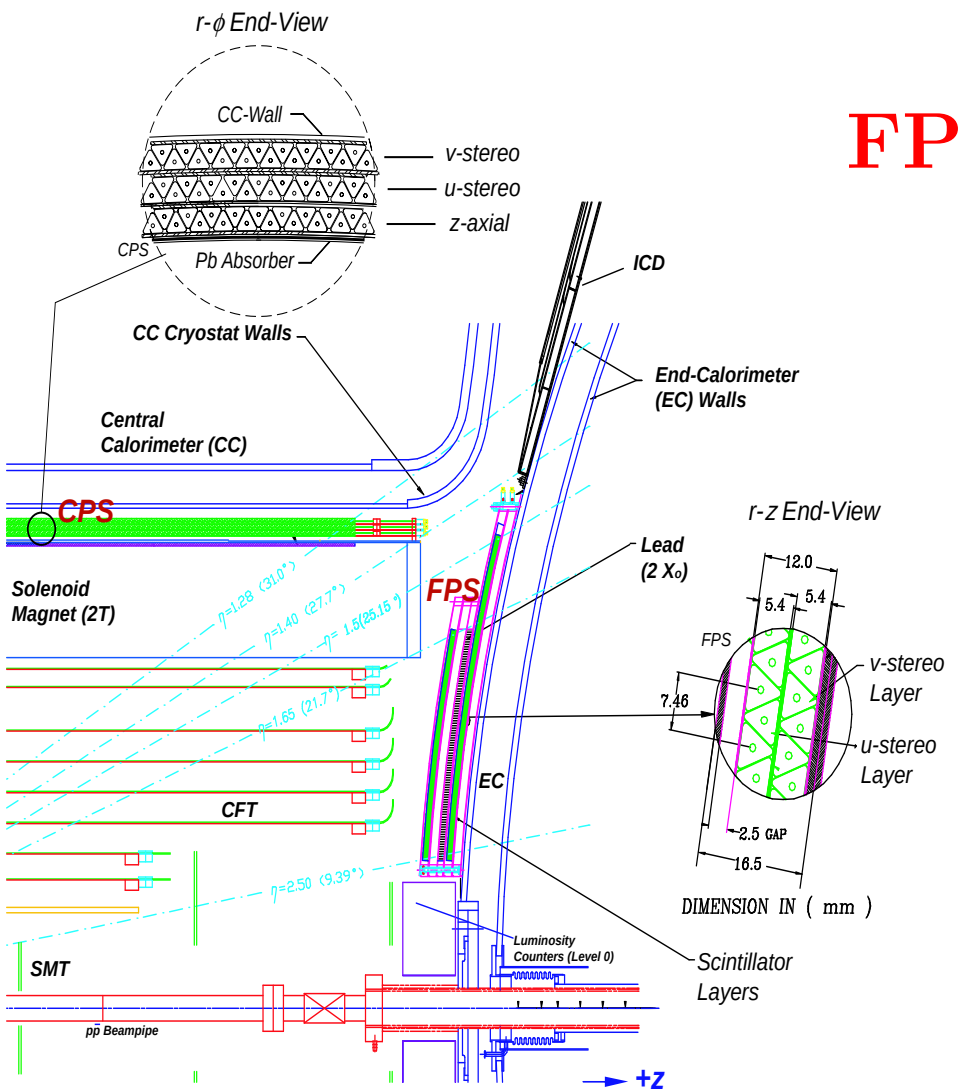
Physics Analysis:

- $Z \to \tau\tau$, $W \to \tau\nu$, SUSY-τ channels.(A. Patwa, S. Protopopescu)
- B_s mixing, lifetime studies (K. Yip).
- Top quark mass editorial board: S. Protopopescu (chair), A. Patwa, S. Snyder

Forward Pre Shower (FPS)

2 FPS detectors
North and South
2 MIP layers
(6336 u-v stereo strips)
1 lead layer (2 X_0)
2 shower layers
(8632 u-v stereo strips)

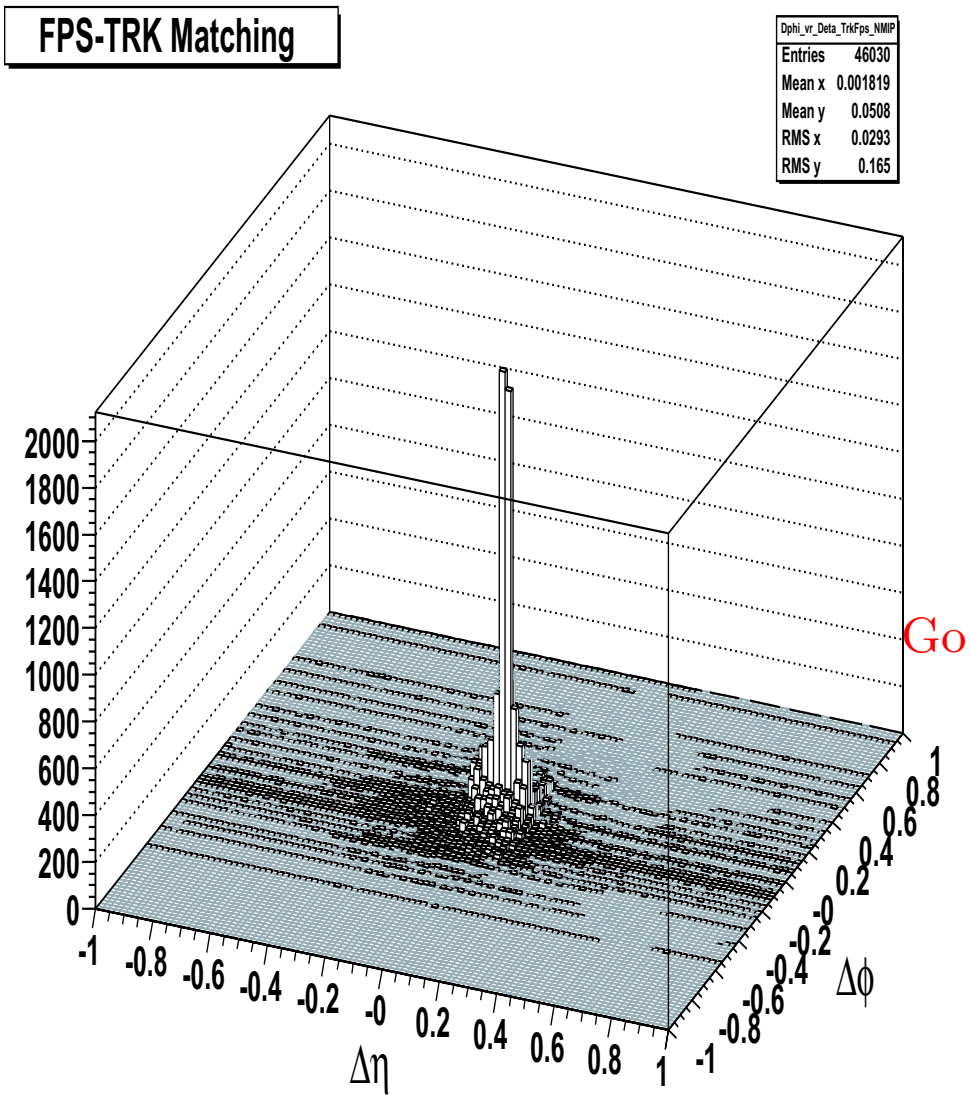
FPS II



Scintillator strips

WLS fiber readout to VLPC

14,968 readout channels



Stable operation since 2003

Enhances triggering and id of e's, γ's and τ's

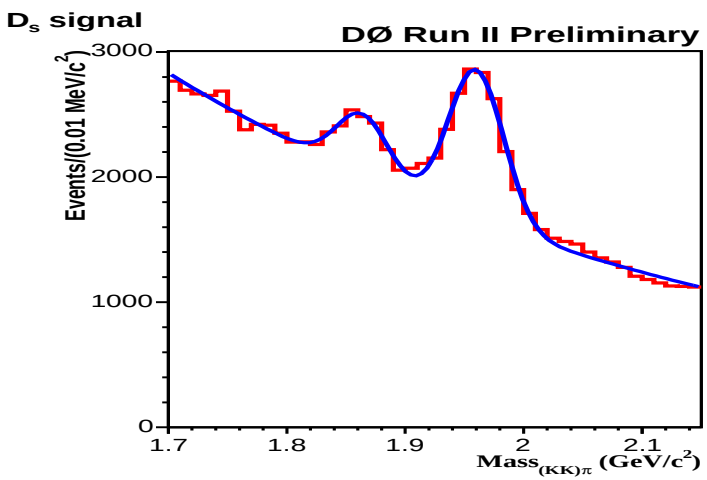
clear MIP peaks after calibration

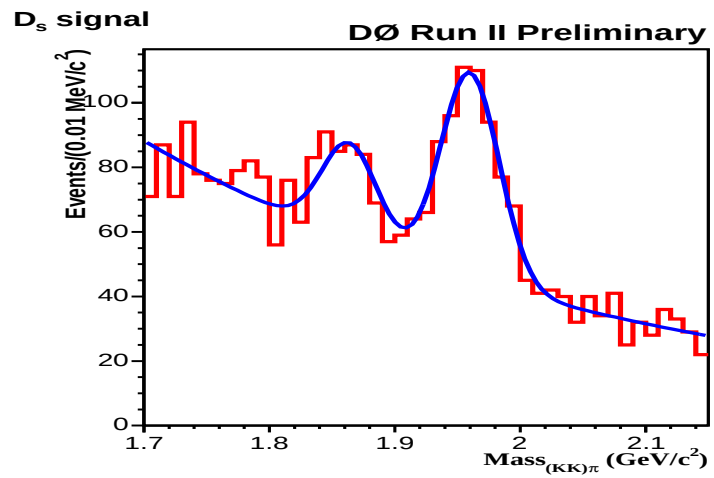
Good track-fps cluster matching:

$\sigma_r = 0.4\ mm$, $\sigma_\phi = 2.6\ mrad$

B physics

B_s mixing:





Use events with $B_s \to \mu\nu + D_s \to \phi\pi$.

13,000 events, 376 tagged with an additional μ.

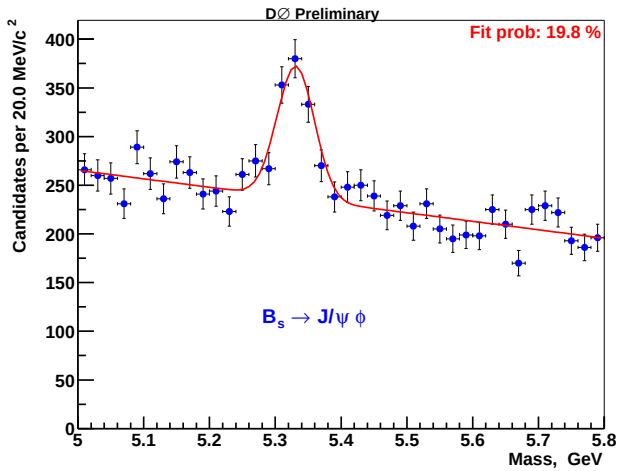
Use asymmetry between opposite and equal sign tags to measure Δm_s, only possible at Tevatron.

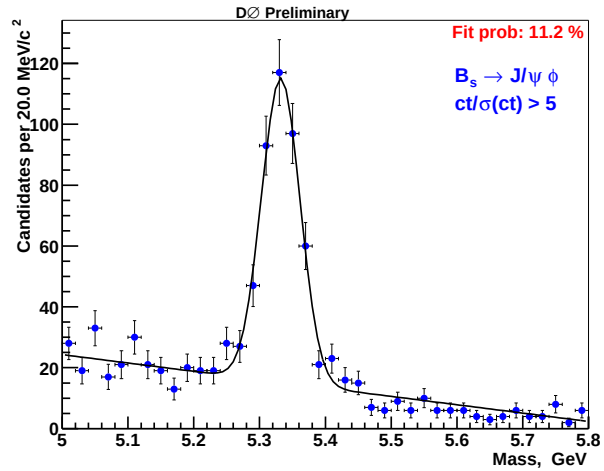
Check method by measuring B_d oscillation:

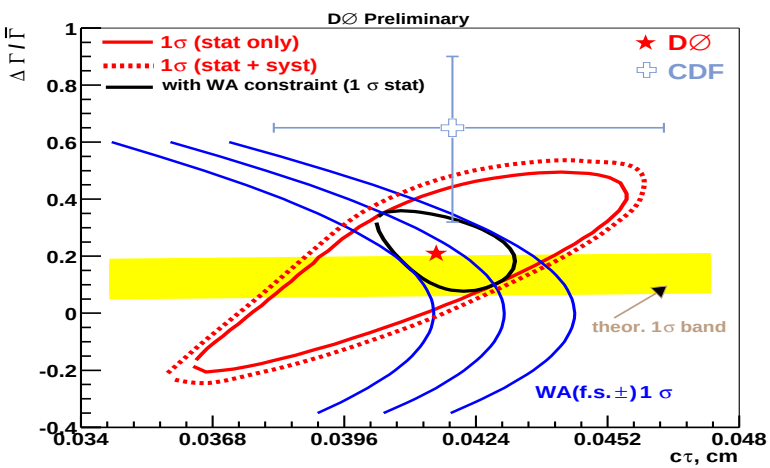
$\Delta m_d = 0.558 \pm 0.048$ ps^{-1} (World Av.$= 0.502 \pm 0.007$ ps^{-1})

Result $\Delta m_s > 5.0$ ps^{-1} (Expected $\Delta m_s = 18.3 \pm 1.7$ ps^{-1})

Lifetime Difference in B_s system



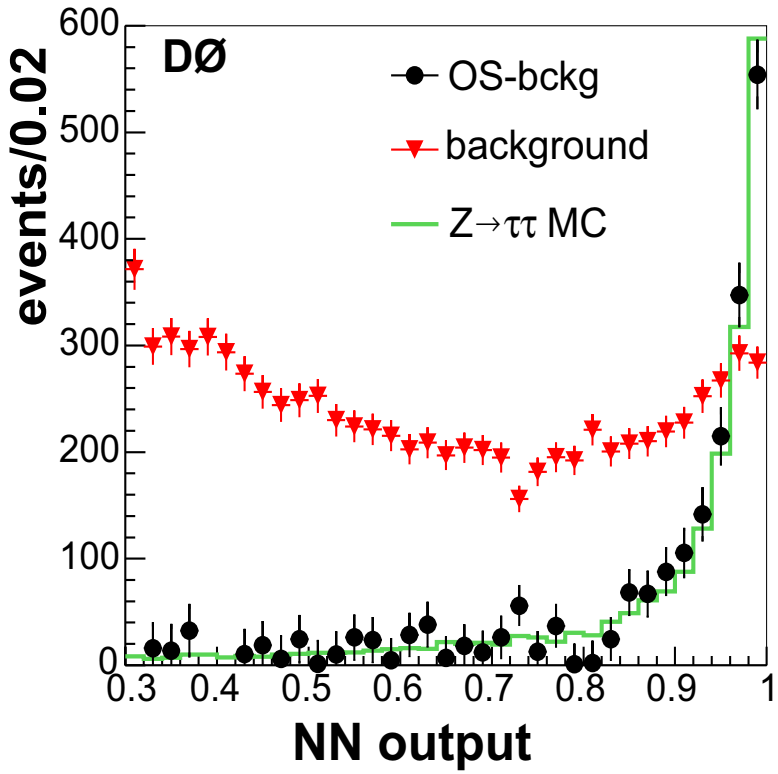




Extract lifetime difference between CP-even and CP-odd B_s states by simultaneous fit to mass, proper decay length and angular decay dist. of $B_s \to J/\psi\phi$ events

Physics with τ's

Measurement of $\sigma(p\bar{p} \to Z) \cdot Br(Z \to \tau\tau)$:



Developed (NN) algorithms to identify τ's.

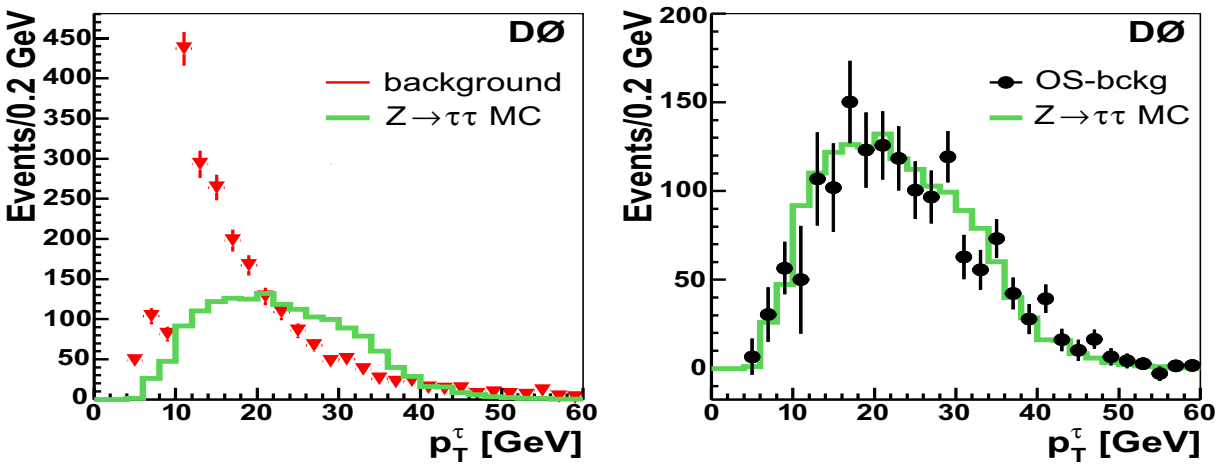
Used succesfully for first observation of $p\bar{p} \to \tau\tau$ events

$\tau_1 \to \mu\nu_\mu\nu_\tau$, $\tau_2 \to h\nu_\tau$ or $e\nu_e\nu_\tau$

$p_T^\mu > 12$ GeV, $E_T^{h,e} > 10$ GeV

$|\phi_\mu - \phi_{h,e}| > 2.5$, OS $\tau_1\tau_2$ pairs

Bckg. estimated from SS $\tau_1\tau_2$ pairs



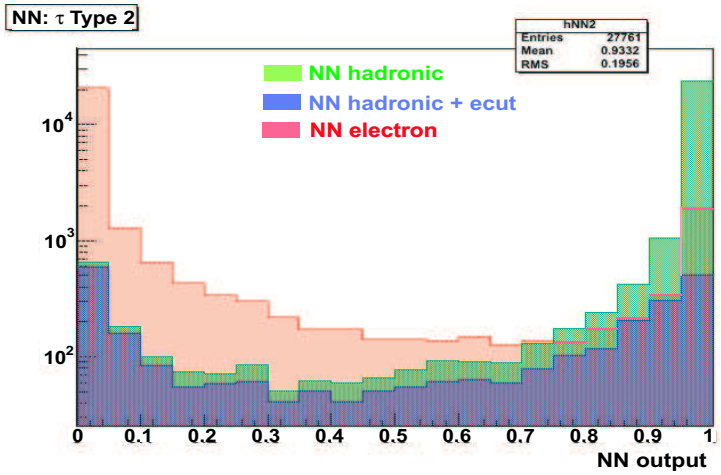
Measured $\sigma(Z \to \tau\tau)$ with 10% precision (based on 226 pb^{-1} data sample):

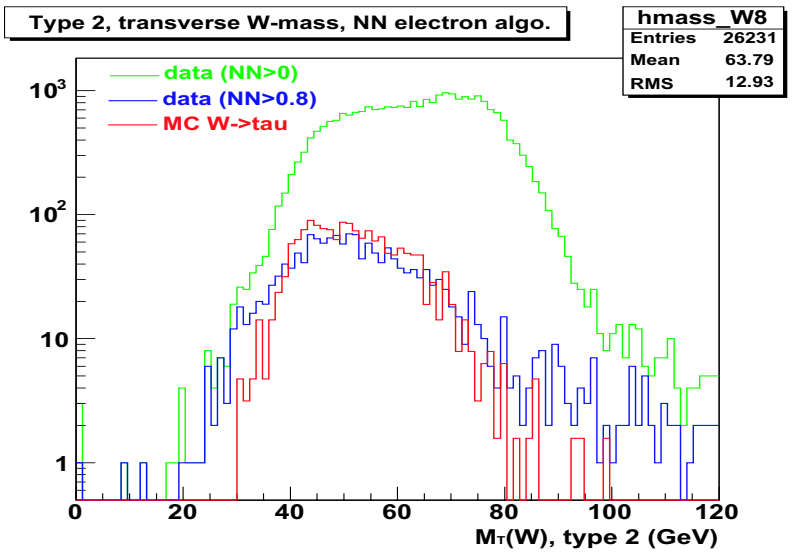
$$237 \pm 15(stat) \pm 18(sys) \pm 15(lum) \text{ pb}$$

Expected from SM 242 ± 9 pb.

Analysis being extended to $H \to \tau\tau$ and other di-τ states.

$W \to \tau\nu_\tau$ channel: 100 pb^{-1} sample





Select events with:

only 1 jet

$\not{E}_T > 20$ GeV

1-track τ-candidates

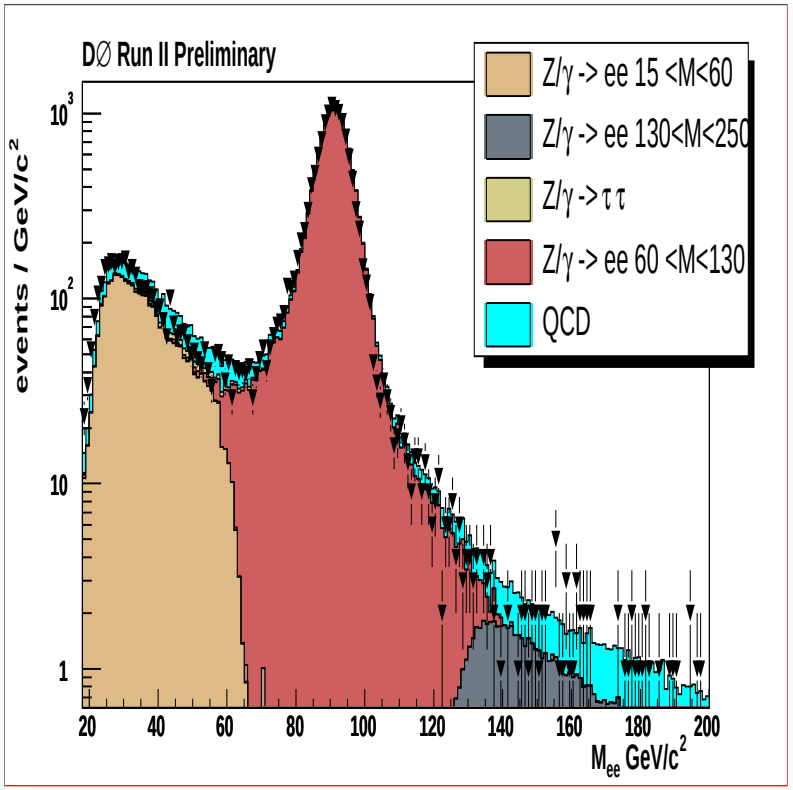
Biggest bckg: $W \to e\nu_e$

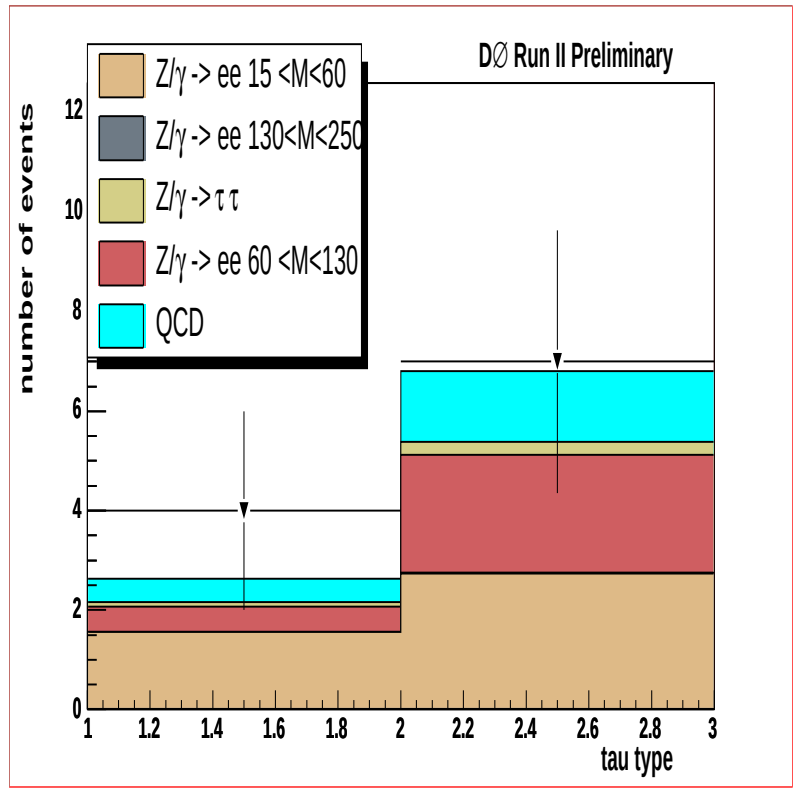
$NN_{elec} > 0.8$ removes e's

$NN_{had} > 0.8$ removes jets

$\sigma(W \to \tau\nu_\tau)$ measurement soon.

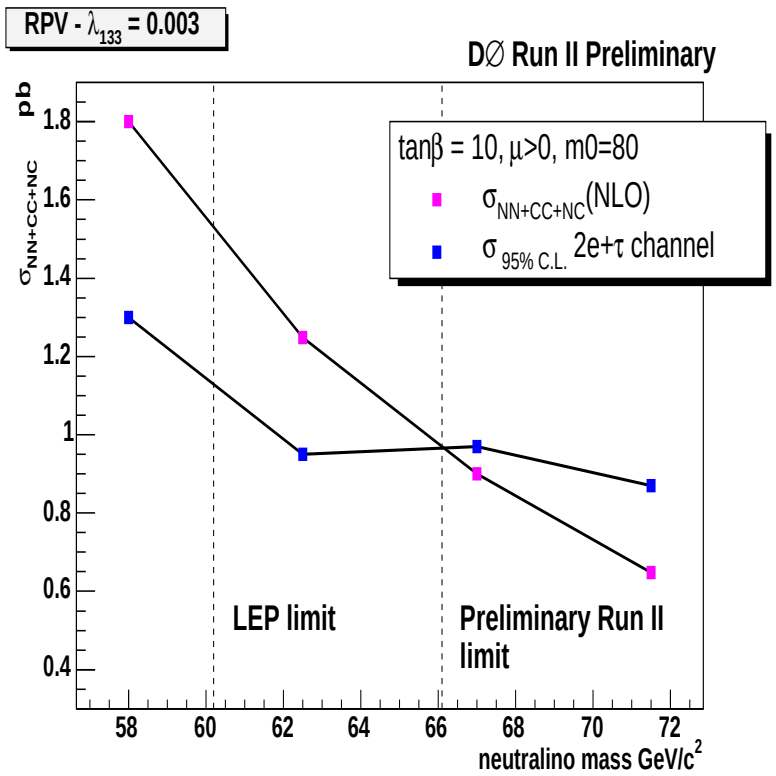
Search for R-parity violated SUSY ($ee\tau$ channel):

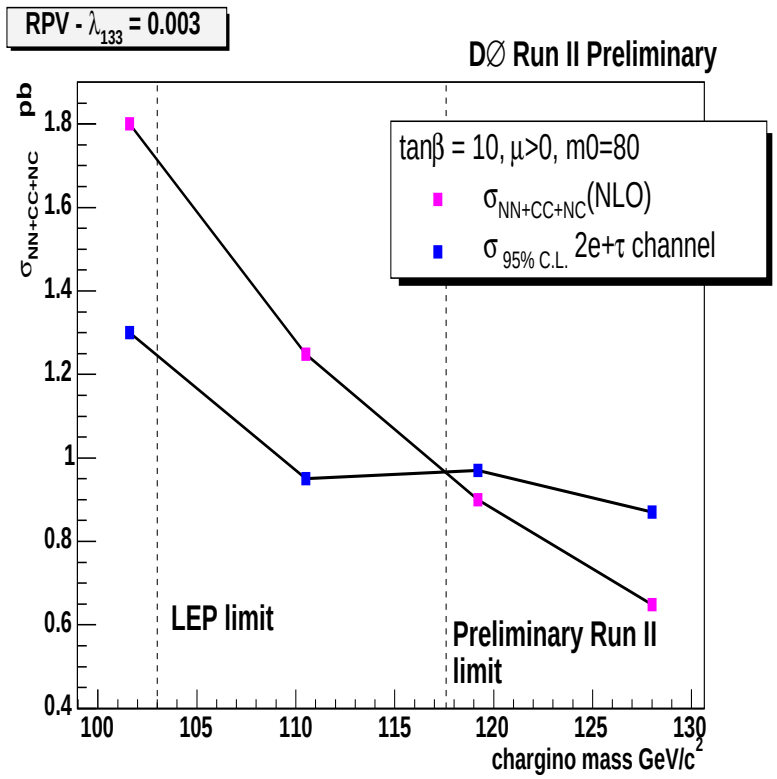




After requiring "τ" with $NN > 0.9$ plus $M_{ee} < 60$ cut, 6 events remain.

A $\not{E}_T/\sqrt{\Sigma E_T} > 1.5$ cut leaves 0 events (200 pb^{-1} sample).

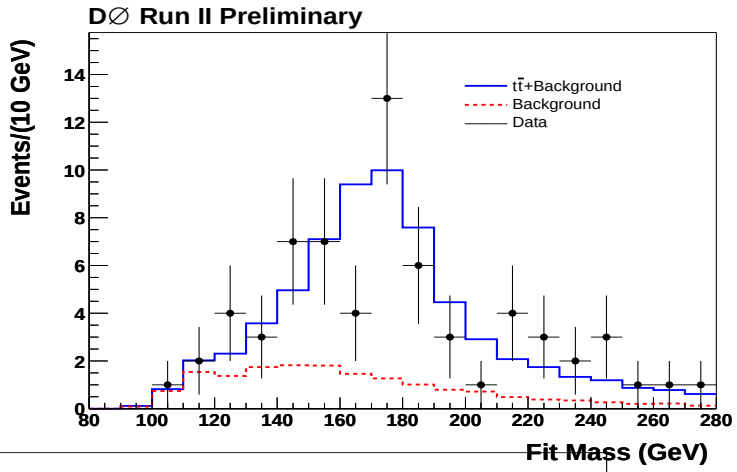


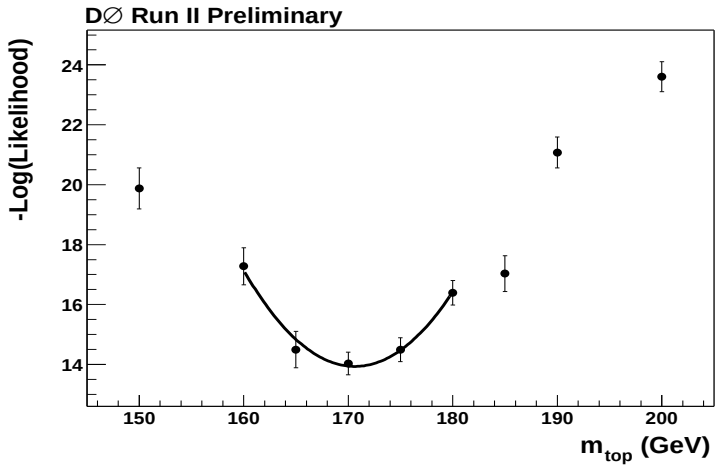


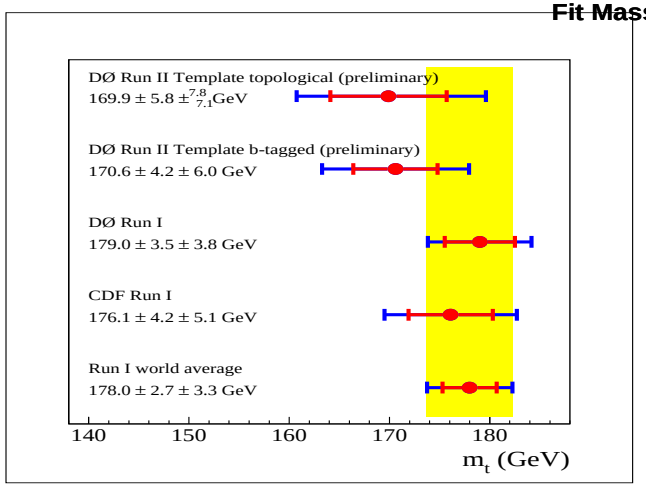
Improvement on LEPII limits for some regions of SUSY parameter space.

Top Quark Mass

Template method analysis with b-tagged events (140 pb^{-1} sample).







Analysis of 400 pb^{-1} sample with Matrix Element method in final stages

uncertainty

$\pm 3.0(stat) \pm 2.6(sys)$

Some Additional Recent Results

- $\sigma(p\bar{p} \to WW)$ =13.8 ± 4.5 pb
- $\sigma(p\bar{p} \to WZ)$ =$4.5^{+3.8}_{-2.6}$ pb
- $\sigma(p\bar{p} \to t\bar{t})$ =8.2 ± 2.3 pb
- Most precise measurements of B_s lifetime= 1.42 ± 0.071 ps
- Most precise measurement of $\tau(B^+)/\tau(B^0)$ =1.08 ± 0.021 ps
- Upper limit on $B_s \to \mu^+\mu^-$ branching ratio $< 3.7 \cdot 10^{-7}$
- Observation of $X(3872) \to J/\psi\pi^+\pi^-$
- Limits on gaugino masses from tri-lepton final states.
- Limits on leptoquark masses ($>$ 240 GeV)
- Limits on extra dimensions

Summary

- Tevatron and DØ detector performing very well.
- Expect to accumulate > 1 fb^{-1} by end of 2005
- First RunII published results in 2004, submitted 4-5 papers/month since January 2005.
- BNL will continue to play an important role in:
  - Maintenance of software infrastructure
  - Development of analysis software
  - Development of τ-triggers
  - physics analyses of channels with τ's.