DØ Experiment and BNL

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OUTLINE

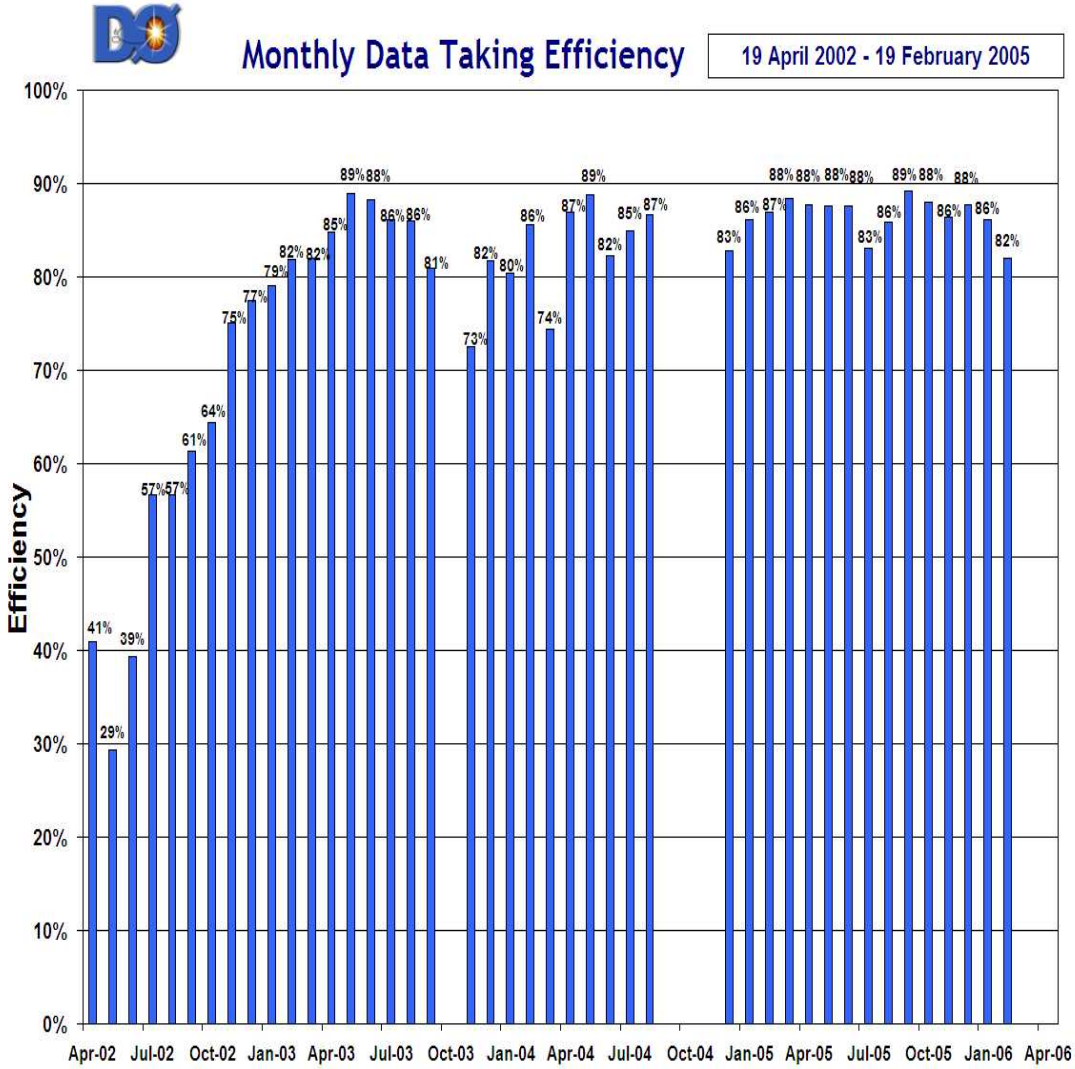
- Overview of DØ experiment
- BNL-DØ personnel
- Major BNL Contributions
- Present Status
- Summary

650 collaborators, 80 institutions (41 non-US), 19 countries

Run I(1992-present): 132 publications

Run II(2002-present): 30 publications accepted, additional 5 submitted

Most recent publication: "Search for the Higgs Boson in $H->WW^*$ Decays in $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV", Phys. Rev. Lett. 96, 011801 (2006).



Data taking eff. > 85% since Jan.2003

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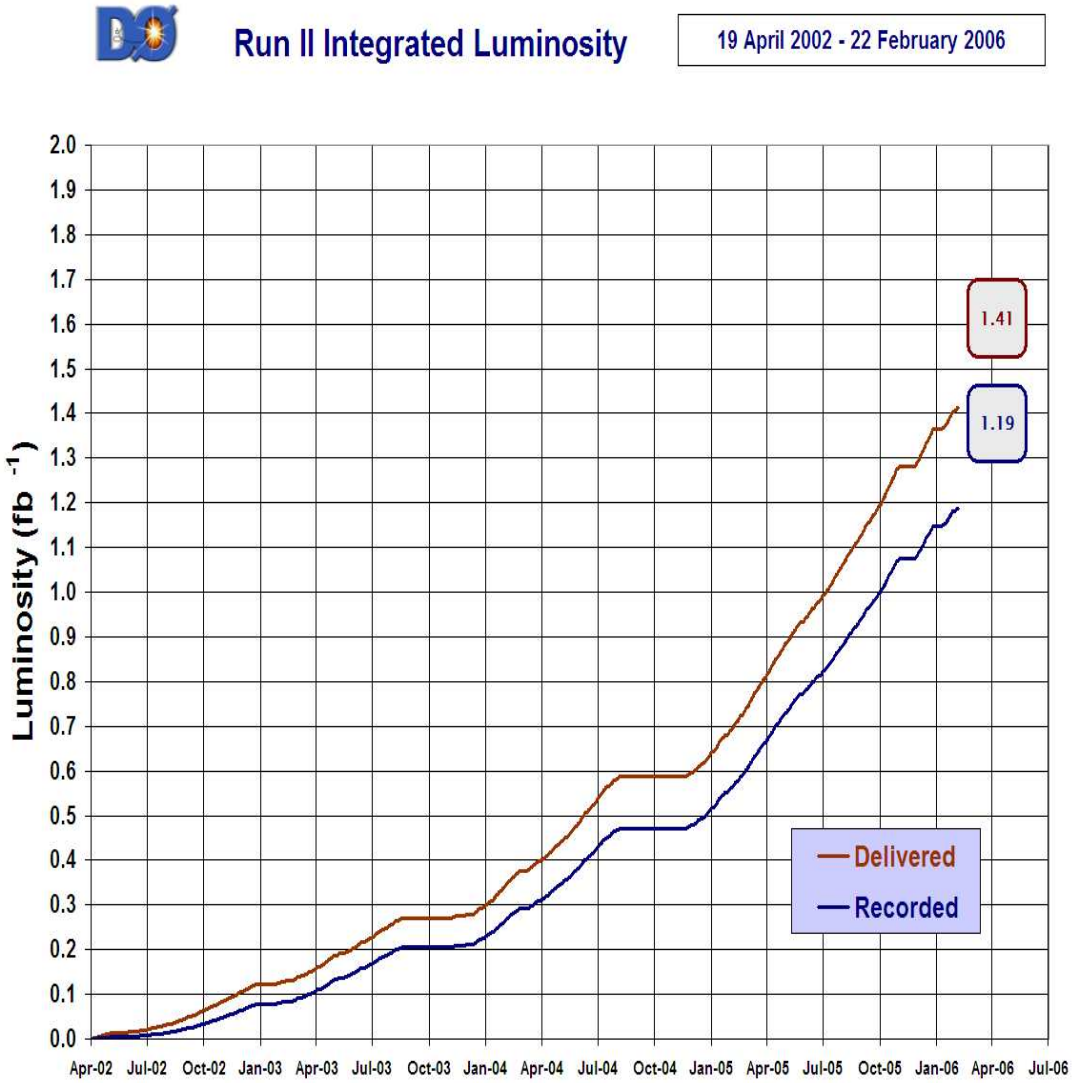

Recorded 1.2 fb^{-1}
Up to 1 fb^{-1} used in analyses so far.

RunIIa ended Feb. 19, 2006

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1 fb^{-1} Results at Winter conferences

- First direct 2-sided bound on the B_s^0 oscillation frequency
- Measurement of BR($B_s \to D_s D_s$)
- Measurement of the Lifetime Difference in the B_s System
- First Measurement of Br($B_s^0 \to D_{s1}^-(1536)\mu^+\nu X$)
- Search for Flavor Changing Neutral Current Decays $D \to \pi + \mu^+\mu^-$

1 fb^{-1} Results at Winter conf. (cont'd)

- B_d Mixing Measurement
- Study of Excited B Mesons
- First Direct Observation of the $B^0_{s2}*$ Meson
- Limit on $Higgs \rightarrow WW^*$ production
- Search for Gauge Mediated SUSY in $\gamma\gamma$ events with Large $\not{E}_T$

BNL-DØ group

Current BNL-DØ members:

A. Patwa (100%), S. Protopopescu(100%), S. Snyder (50%), Kin Yip (30%). Total 2.8 FTE's

1 resident at FNAL (A. Patwa). 1 additional post-doc soon.

Major Service Contributions:

- **FPS hardware and software maintenance (A. Patwa)**
- **Online and offline software maintenance (S. Snyder, S. Protopopescu)**
- **Data processing (K. Yip)**
- **τ id coordination (S. Protopopescu, A. Patwa)**

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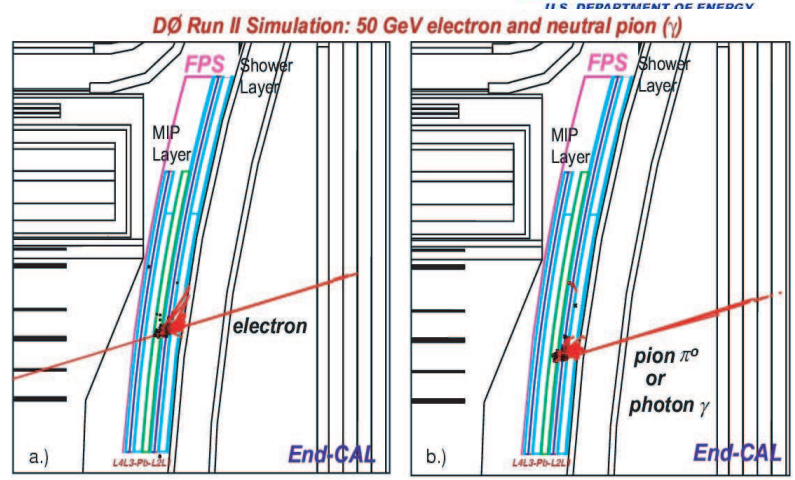
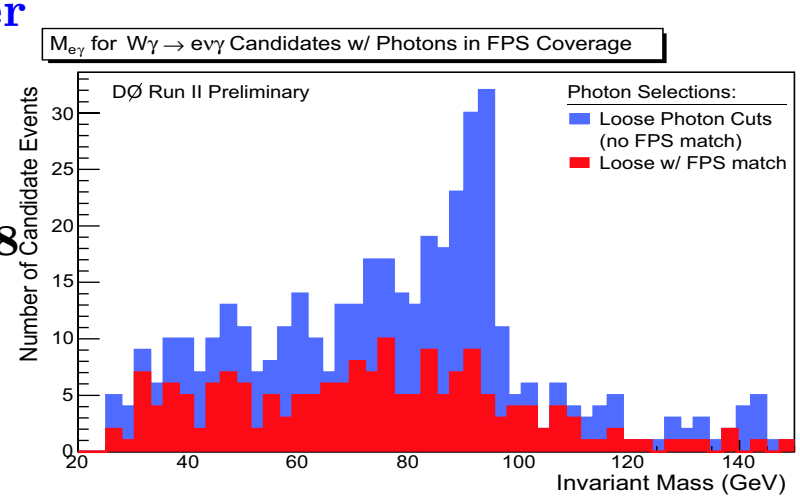
Physics Analysis:

- **Measurement of the Lifetime Difference in the B_s System**
  (K. Yip)
- **Studies of $Z \to \tau\tau$, $W \to \tau\nu$, $H \to \tau\tau$, SUSY-τ channels**
  (A. Patwa, S. Protopopescu)
- **Top Mass Editorial Board**
  (A. Patwa, S. Protopopescu (*chair*), S. Snyder)

Forward Preshower Detector

- covers $1.5 < |\eta| < 2.5$
- MIP and Shower layers separated by $2X_0$ Pb absorber
- help discriminate e, γ match MIP hit to EM cluster
  - $\mathbf{FPS_{MIP}}$-EM: dR< 0.1
  - $\mathbf{FPS_{Shwr}}$-EM: dR< 0.1
  - $\mathbf{FPS_{MIP}}$-$\mathbf{FPS_{Shwr}}$: dR< 0.08
- Remove $Z \to ee$ bckg from $W\gamma \to e\nu_e\gamma$

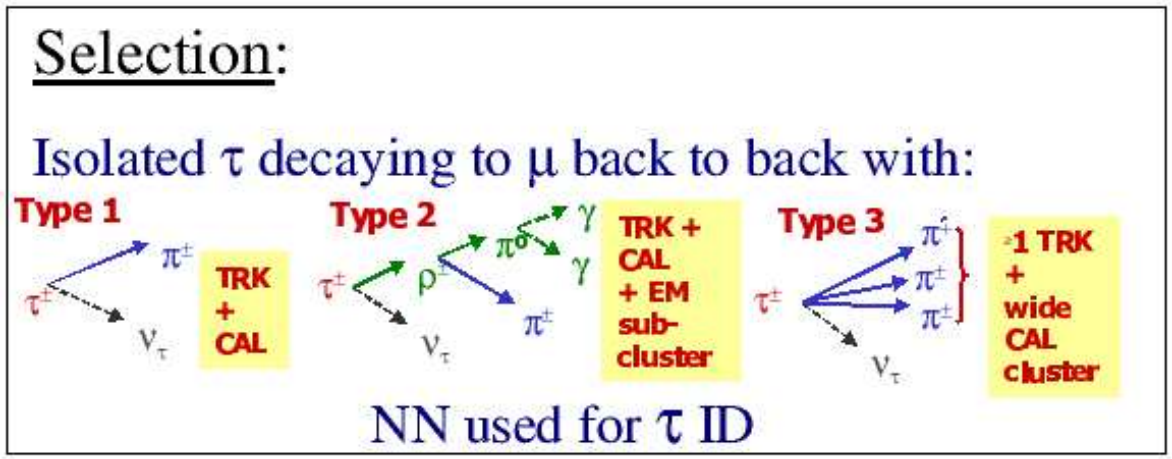




Physics with τ's

$Z \to \tau\tau$ Cross Section

Use channel $\tau_1 \to \mu + \tau_2 \to$ had or e



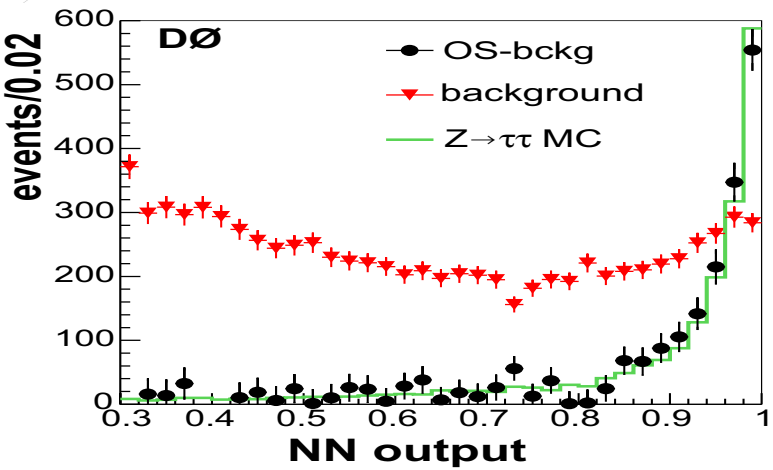
$p_T^\mu > 12$ GeV, $|\eta_\mu| < 2.0$
$p_T^\tau > 10(5)$ GeV, $|\eta_\tau| < 3.0$
Select back-to-back μ, τ ($|\phi_\mu - \phi_\tau| > 2.5$)

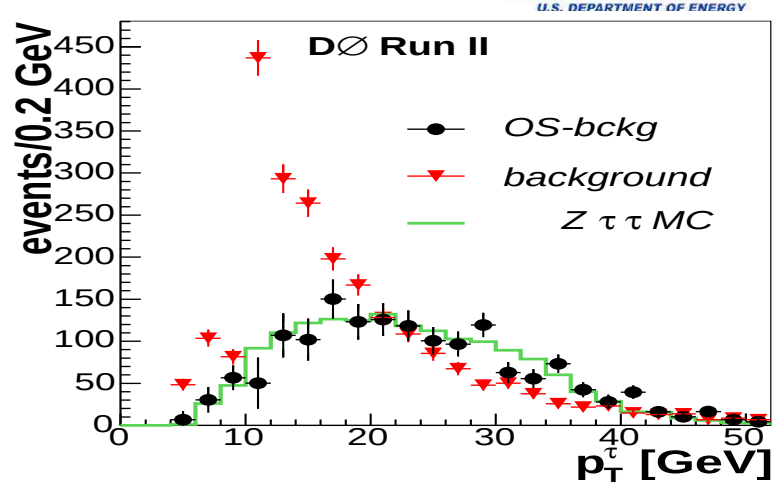
split sample into opposite sign (OS) μ, τ
and same sign (SS) μ, τ (estimate background)

$$\sigma(Z \to \tau\tau) = 237 \pm 15_{stat} \pm 18_{sys} \pm 15_{lum} \text{ pb}$$

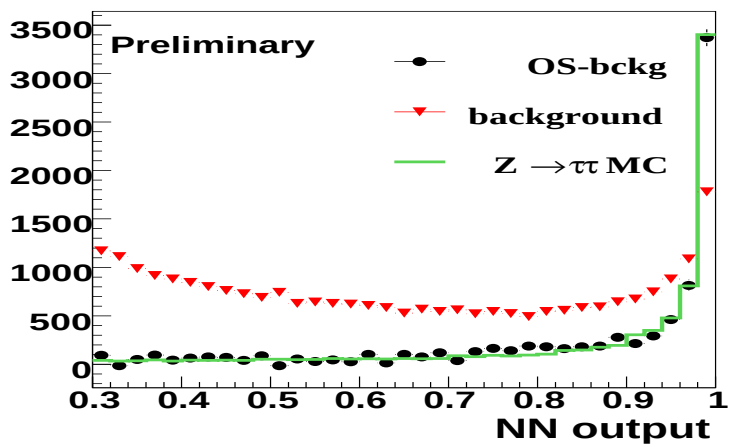
PRD 71, 072004 (2005) ($\int L dt$ =220 pb^{-1})

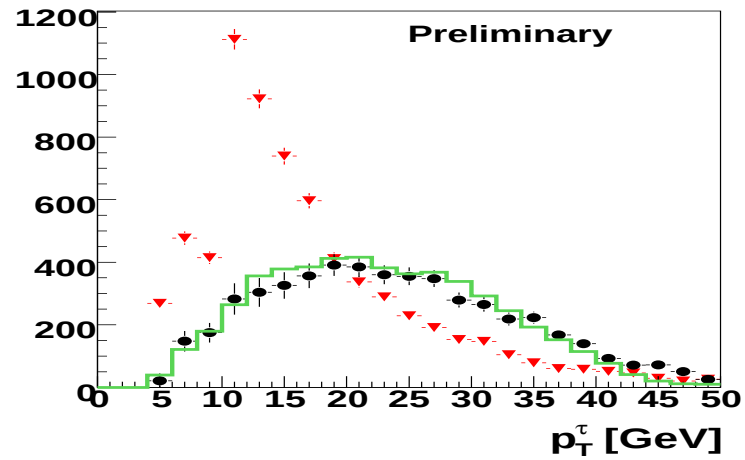
$\int L dt = 220\ \mathrm{pb}^{-1} \approx 1400\ \tau\text{'s}(\rightarrow had,\ e)$



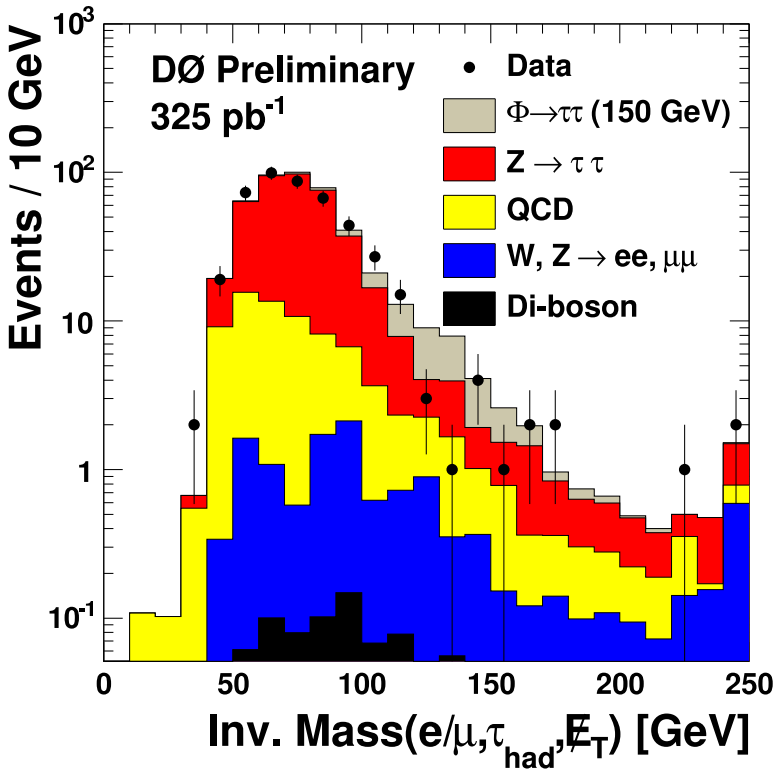


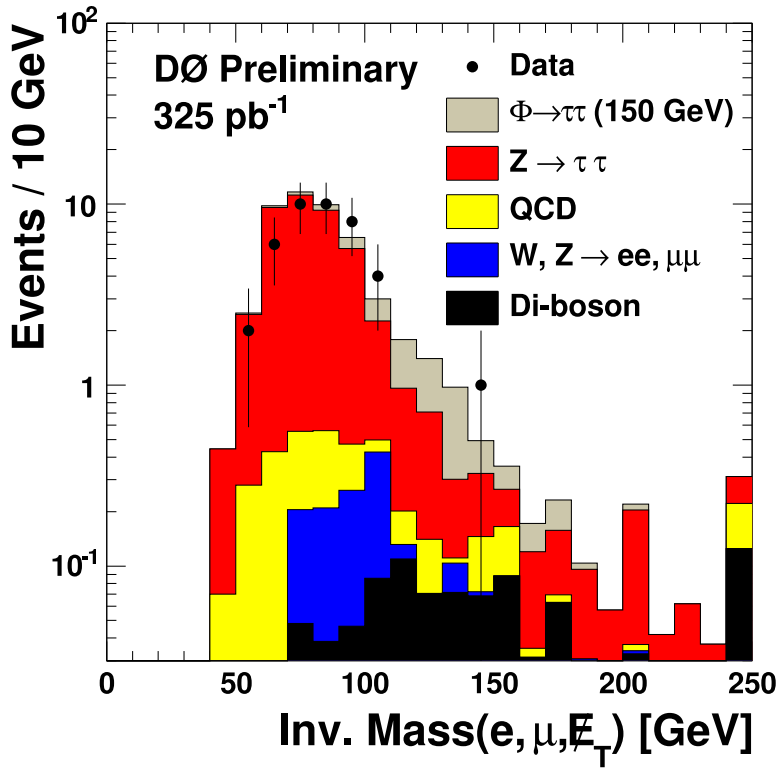
$\int L dt = 700\ \mathrm{pb}^{-1} \approx 5000\ \tau\text{'s}(\rightarrow had,\ e)$

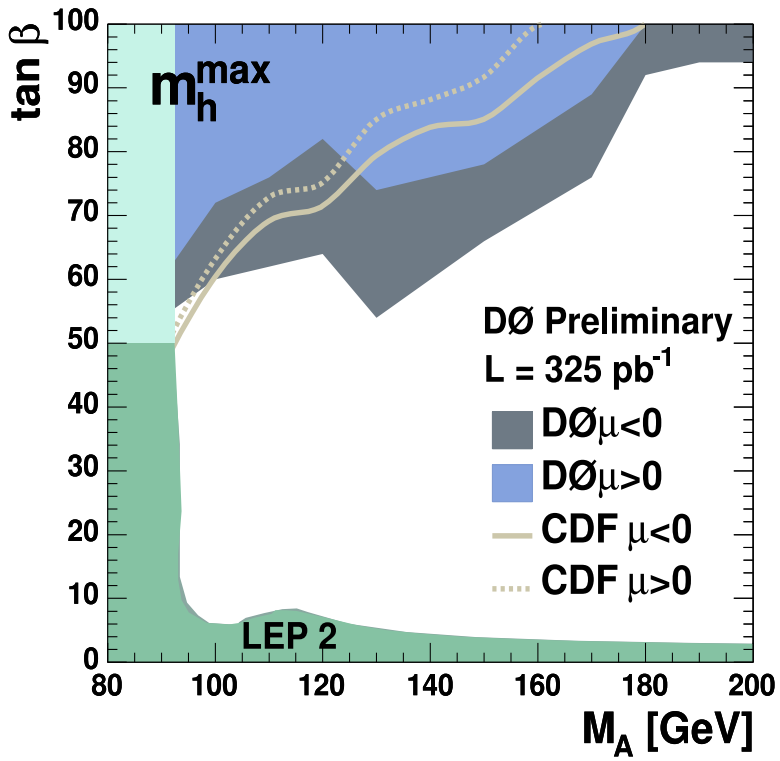




MSSM Higgs$\rightarrow \tau\tau$ Search ($\int L dt$ =350 pb^{-1})





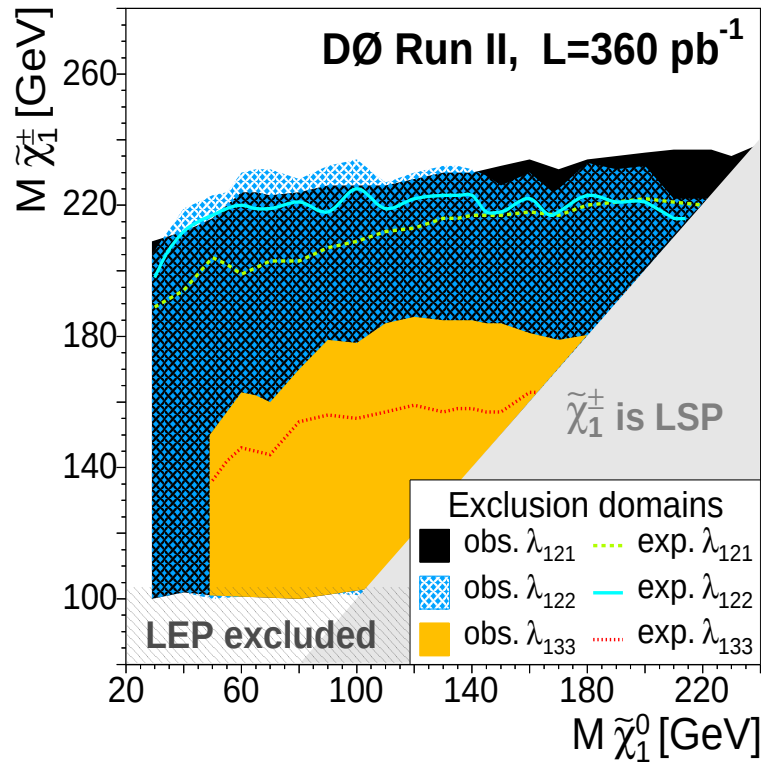


Limits from fits to $M(e\mu, \tau, \not{E}_T)$ distributions

Rules out MSSM Higgs for some M_A, $tan\beta$ regions

SUSY searches in 3 lepton final states

R-parity violating limits assuming $\lambda_{121} = \lambda_{122} = 0.01$, $\lambda_{133} = 0.003$



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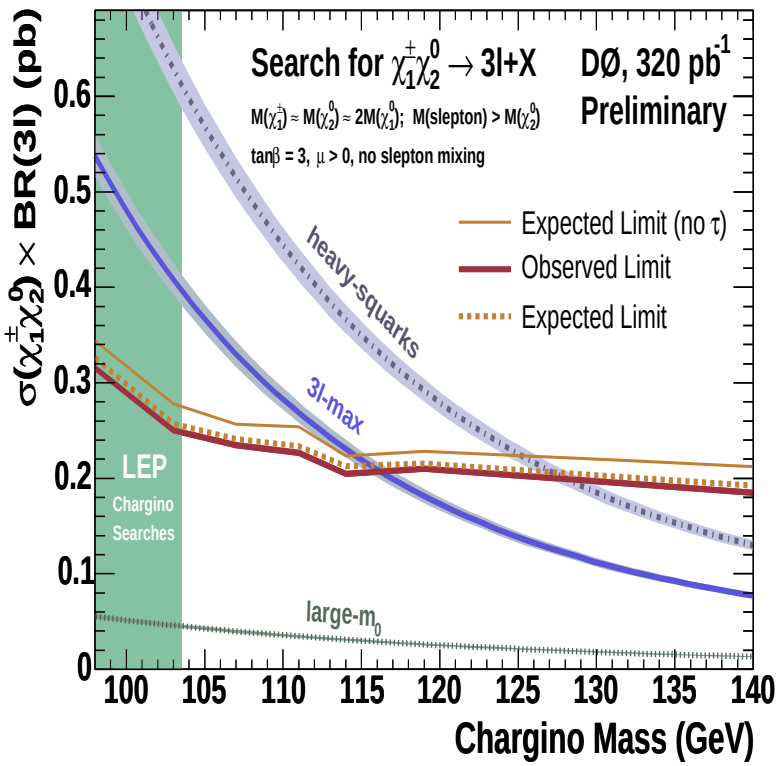
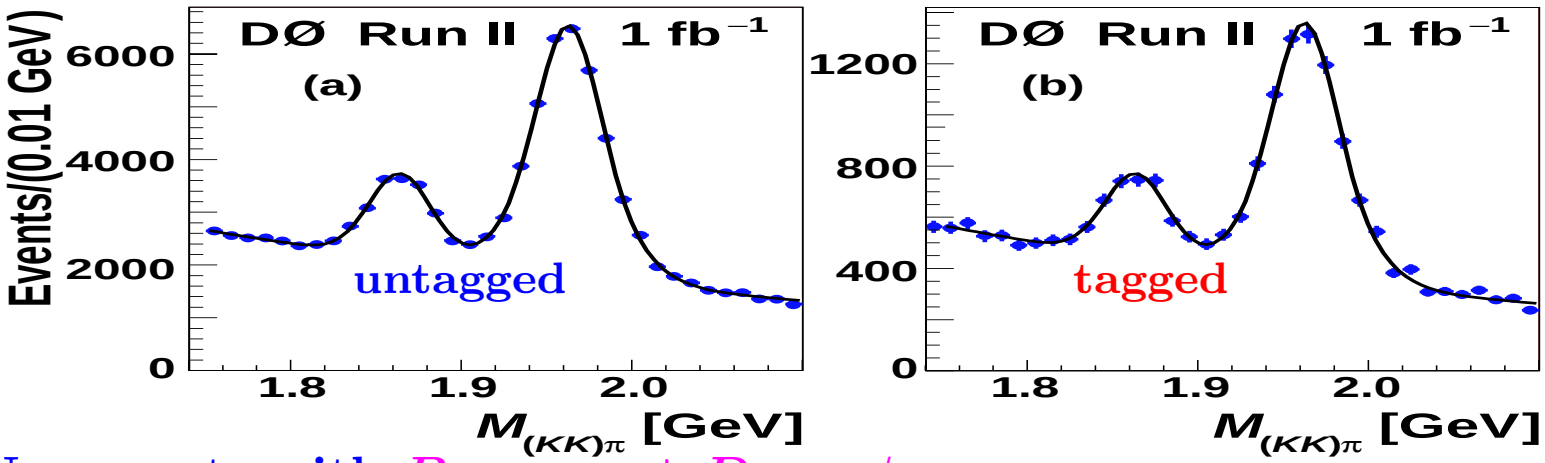
R-parity conserving limits assuming $tan\beta = 3$, $\mu > 0$
$M(\chi_1^{\pm})=2M(\chi_1^0)$
no slepton mixing

Improvement on LEPII for some regions of SUSY parameter space.



B physics

B_s mixing:



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

27,000 events, 5600 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:

$\Delta m_d = 0.506 \pm 0.026$ ps^{-1} (World Av.$= 0.506 \pm 0.004$ ps^{-1})

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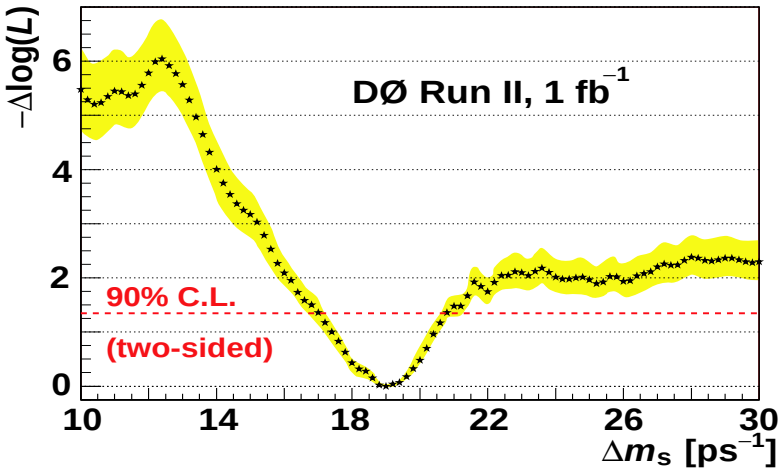
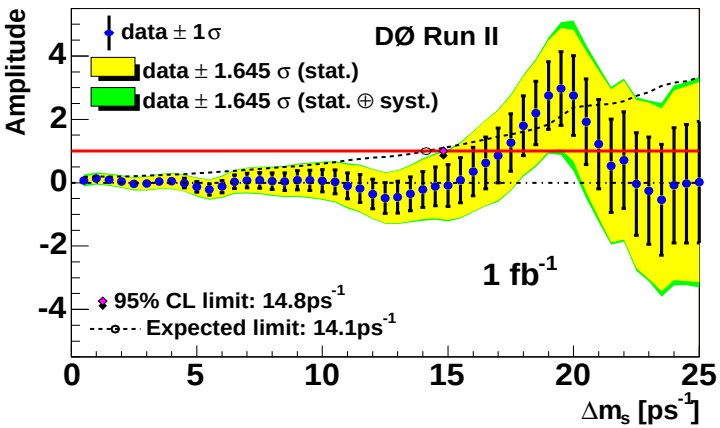
B_s mixing (cont'd):





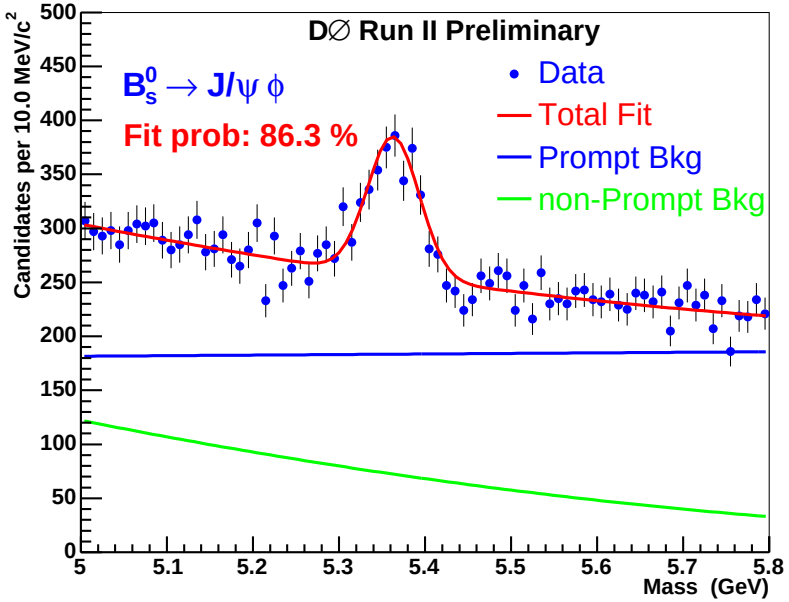
Observe 1% probability that

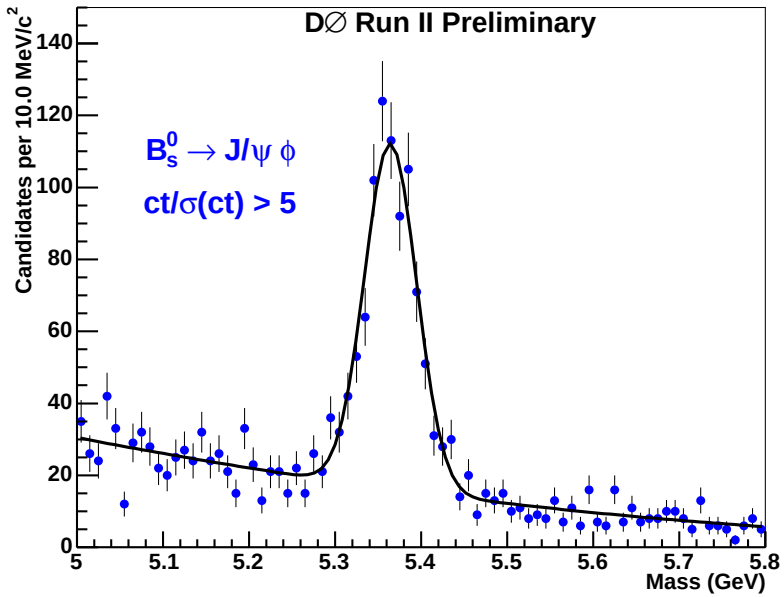
$\Delta m_s > 26$ ps^{-1} (2.5 σ).

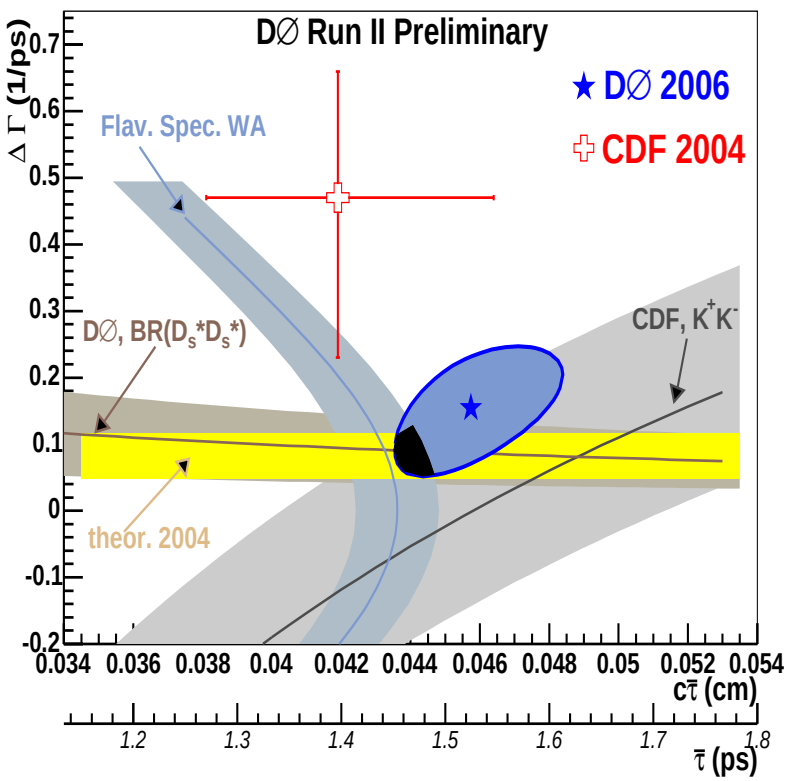
$$\boxed{17 < \Delta m_s < 21 \text{ ps}^{-1} \text{ at } 90\% \text{ CL}}$$

Expected $\Delta m_s = 18.3 \pm 1.7$ ps^{-1}

Lifetime Difference in B_s system

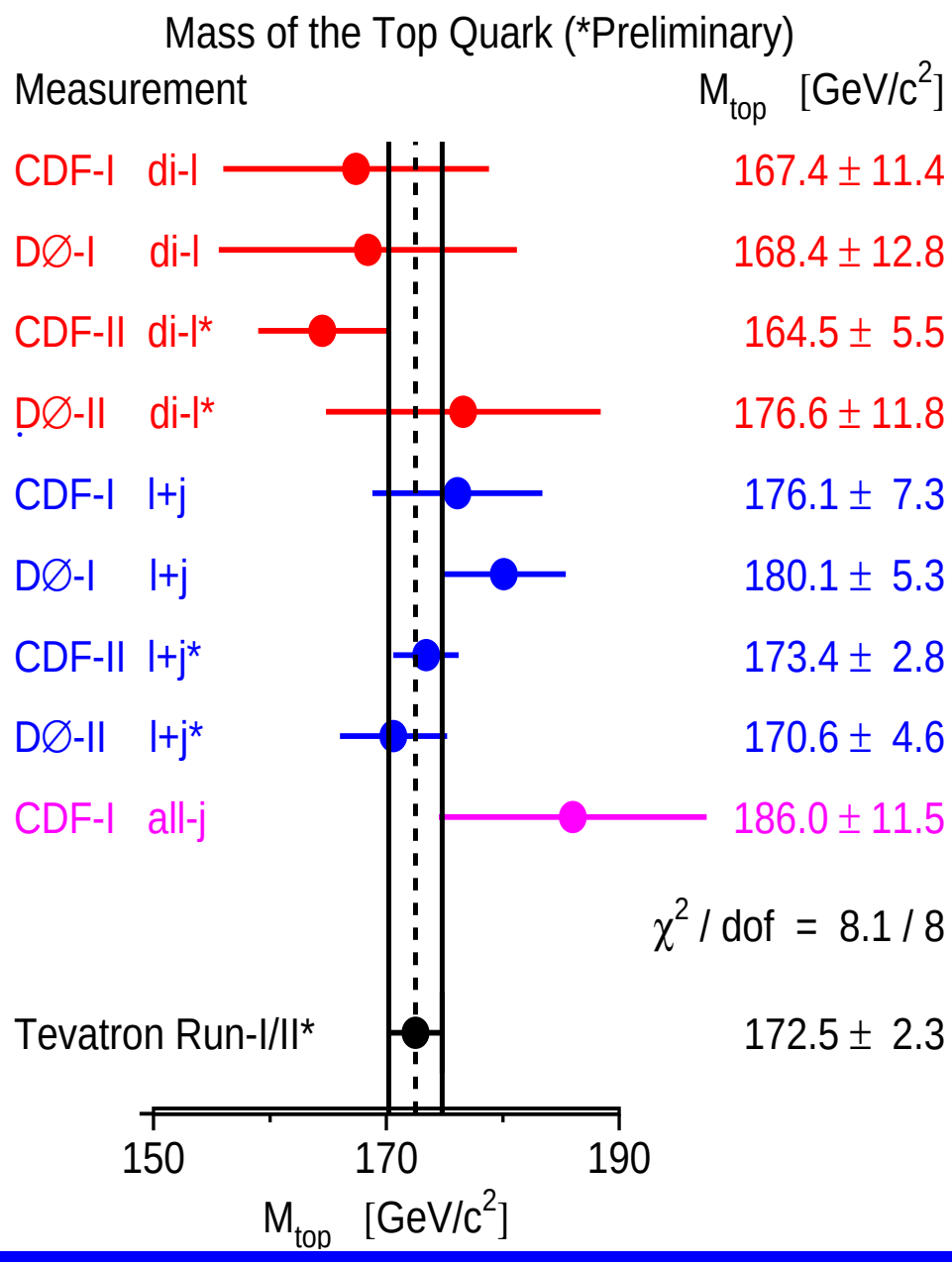






Extract lifetime difference between CP-even and CP-odd B_s states by simultaneous fit to mass, proper decay length and angular decay dist. of $B_s \to J/\psi\phi$ events

CP-violating $\delta\phi = -0.9 \pm 0.7$



Matrix element method with b-tagged events$^{(*)}$

CDF 600 pb^{-1} sample

DØ 350 pb^{-1} sample

Other Recent Results

- Limits on leptoquark masses ($>$ 240 GeV 1st & 2nd gen., $>$ 213 GeV 3rd gen.)
- Limits on extra dimensions
- Top cross section measurements
- Measurement of W helicity in top decays
- Limits on $\tilde{t}\bar{\tilde{t}}$ production
- Searches for long lived neutral and charged heavy particles
- Search for excited muons

Summary

- Tevatron and DØ detector performing very well
  1.2 fb^{-1} recorded in Run IIa
- Expect to accumulate > 1 fb^{-1}/year in Run IIb
- First RunII published results in 2004, submitted 3 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.