

B Physics at D0

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CINVESTAV-MEXICO

for the
D0 collaboration



Pedro Podesta, Lake Louise February 2005



Outline

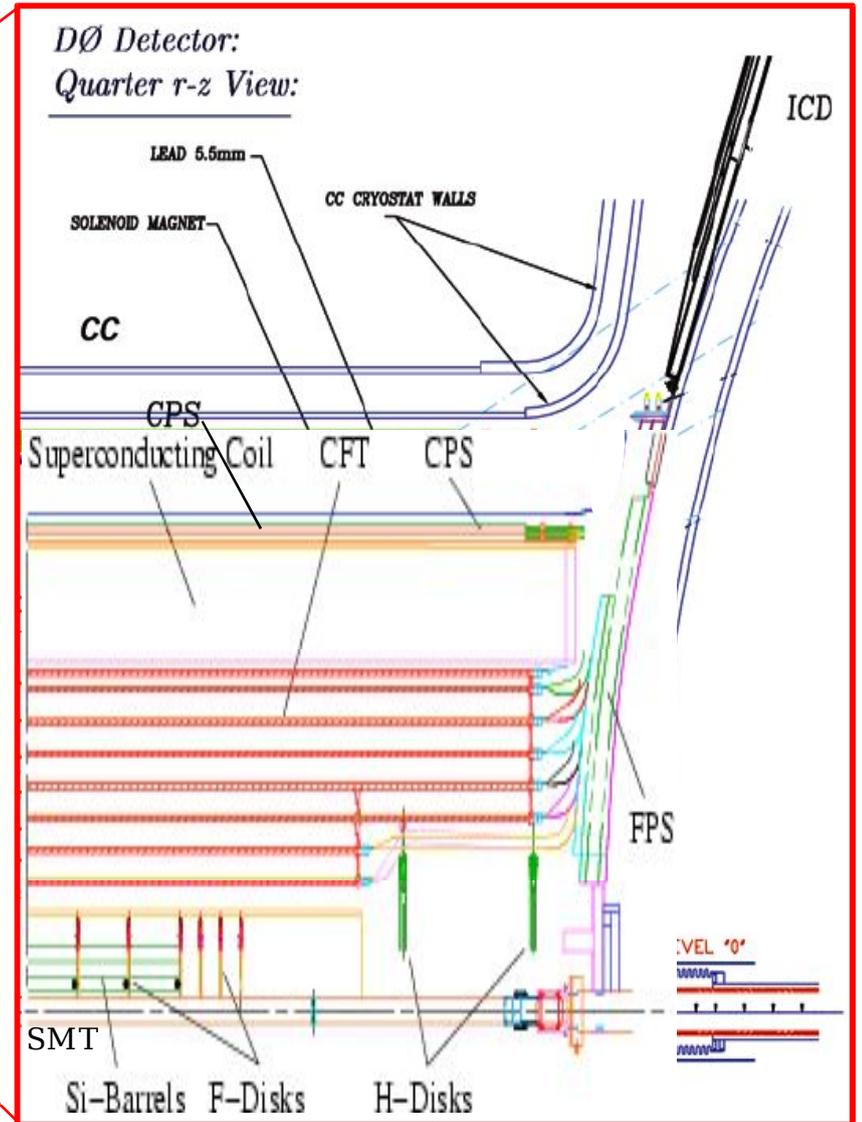
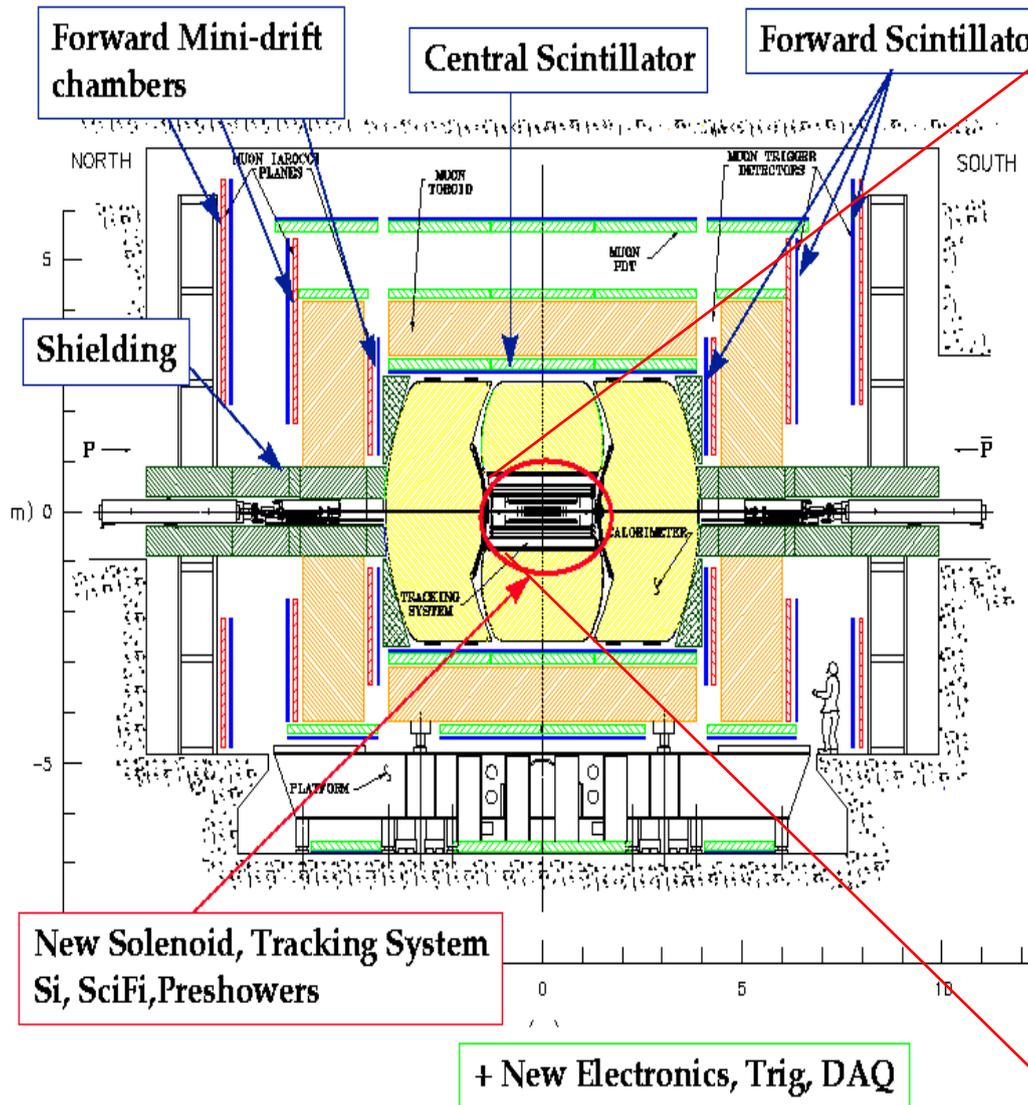
- D0 Detector
- Excited B mesons
- B_c mesons
- Lifetimes
- Rare decays
- Mixing
- Conclusions



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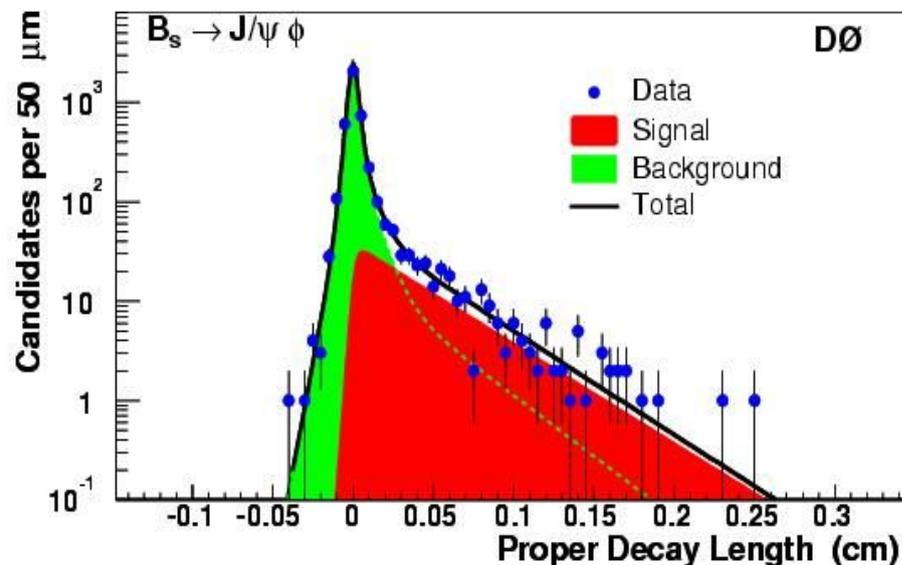
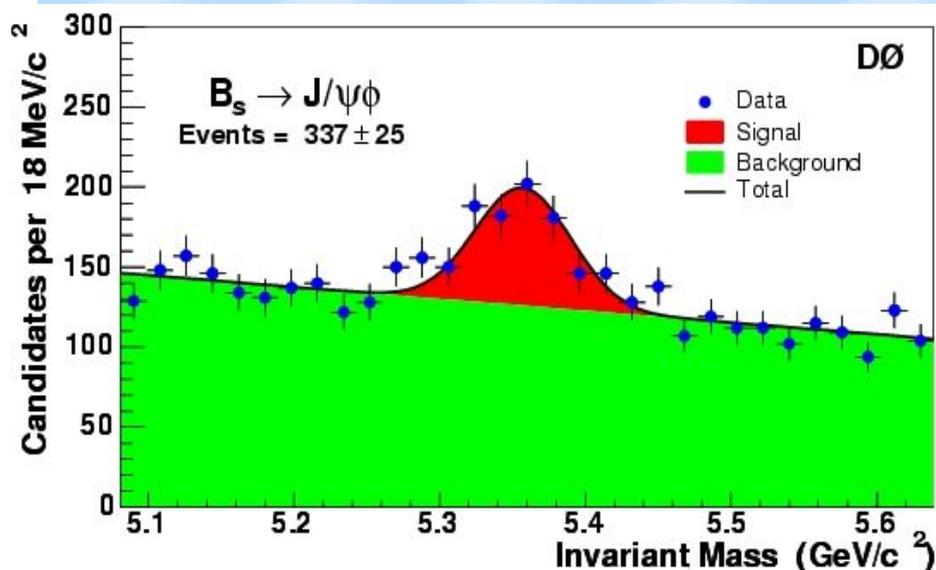
D0 Detector



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B_s Lifetime



Using unbinned Likelihood fit

$$B_s \rightarrow J/\psi(\mu^+\mu^-) \phi(K^+K^-)$$

$$B_d \rightarrow J/\psi(\mu^+\mu^-) K^*(K^+\pi^-)$$

$$\tau(B_s) = 1.444^{+0.098}_{-0.090} \text{ (stat)} \pm 0.020 \text{ (syst) ps.}$$

$$\tau(B_d) = 1.473^{+0.052}_{-0.050} \text{ (stat)} \pm 0.023 \text{ (syst) ps.}$$

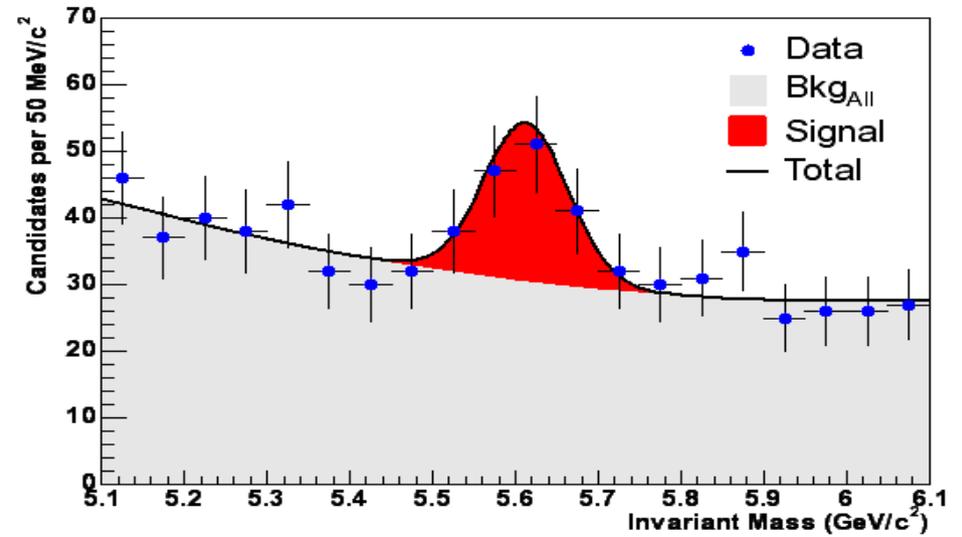
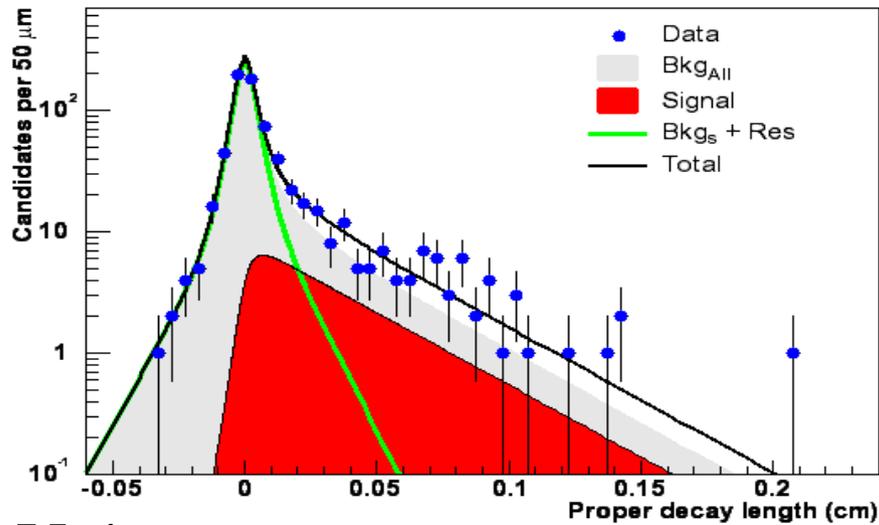
$$\tau(B_s)/\tau(B_d) = 0.980^{+0.076}_{-0.070} \text{ (stat)} \pm 0.003 \text{ syst}$$



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Λ_b Lifetime



Using:

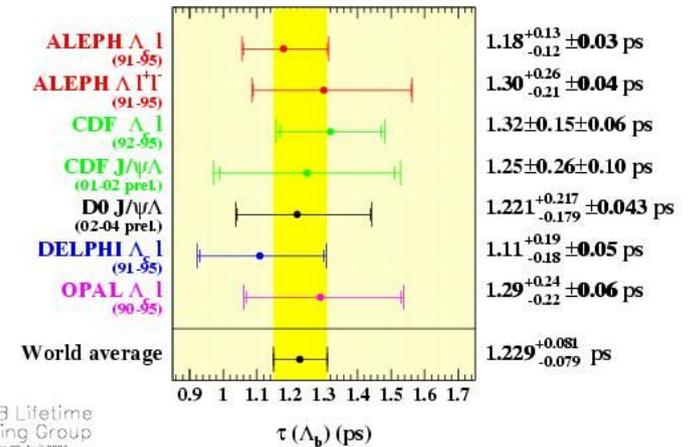
$$\Lambda_b \rightarrow J/\psi(\mu^+\mu^-) \Lambda(p\pi^+)$$

$$B^0 \rightarrow J/\psi(\mu^+\mu^-) K_s(\pi^-\pi^+)$$

$$\tau(\Lambda_b) = 1.221^{+0.217}_{-0.179} (stat) \pm 0.043 (syst) ps$$

$$\tau(B^0) = 1.397^{+0.107}_{-0.098} (stat) \pm 0.031 (syst) ps$$

$$\frac{\tau(\Lambda_b)}{\tau(B^0)} = 0.874^{+0.169}_{-0.142} (stat) \pm 0.028 (syst)$$



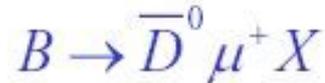
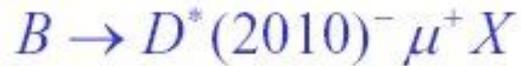
LEP B Lifetime Working Group
Private Note 00, April 2004



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B⁺/B⁰ Lifetime Ratio



Measure directly ratio of lifetimes
instead of measuring absolute
lifetimes

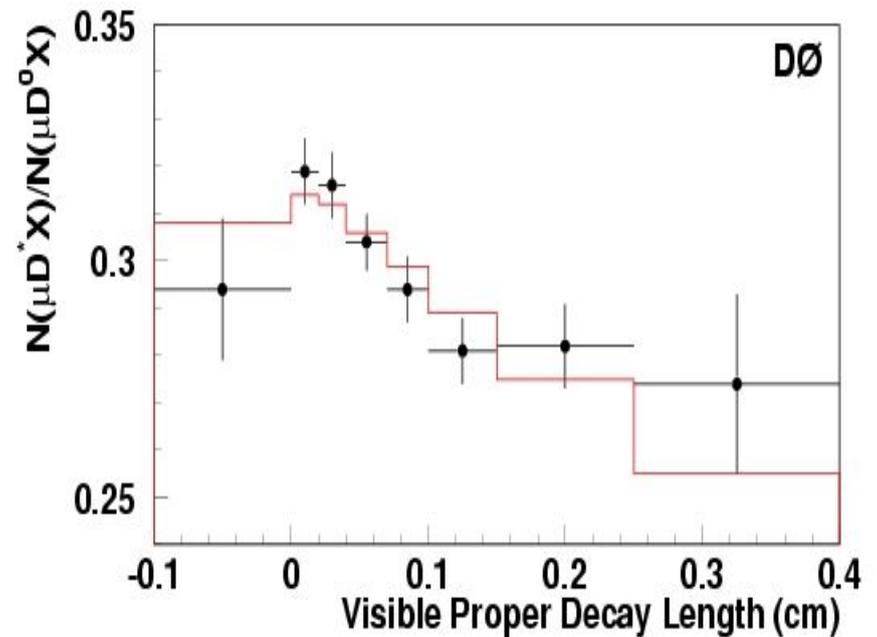
Group events into 8 bins of Visible
Proper Decay Length (VPDL):

$$VPDL = L_T / p_T(\mu, D^0) \cdot M_B$$

Measure $r = N(\mu D^*)/N(\mu D^0)$ in
each bin

- In both cases fit D⁰ signal to
extract N(μ D)

$$\tau(B^+)/\tau(B^0) = 1.080 \pm 0.016 \pm 0.014$$

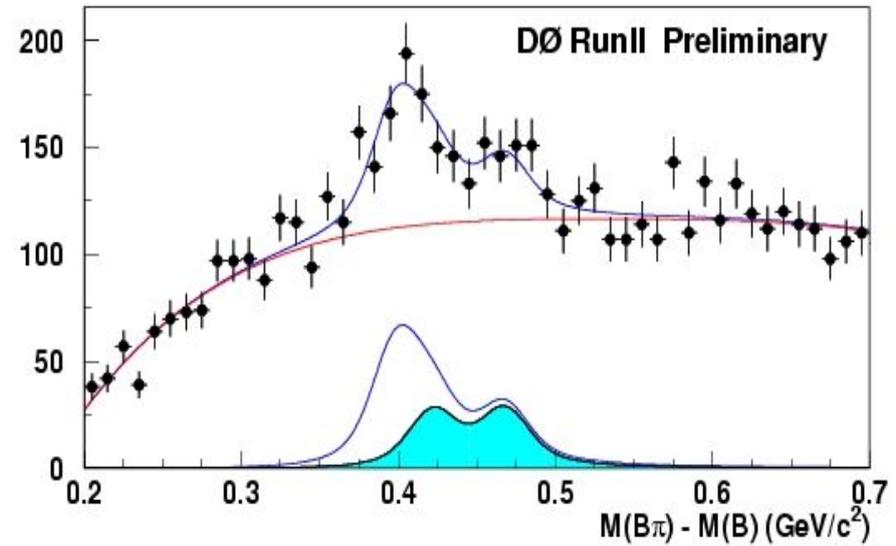


Excited B mesons

Using:



Add one track ()



$$M(B^1) = 5724 \pm 4 \text{ MeV}/c^2$$

$$M(B^{2*}) - m(B^1) = 23.6 \pm 7.7 \text{ MeV}/c^2$$



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B_c Meson

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

$B_c^+ \rightarrow J/\psi \mu X$

231 candidates

$95 \pm 12 \pm 11$ events

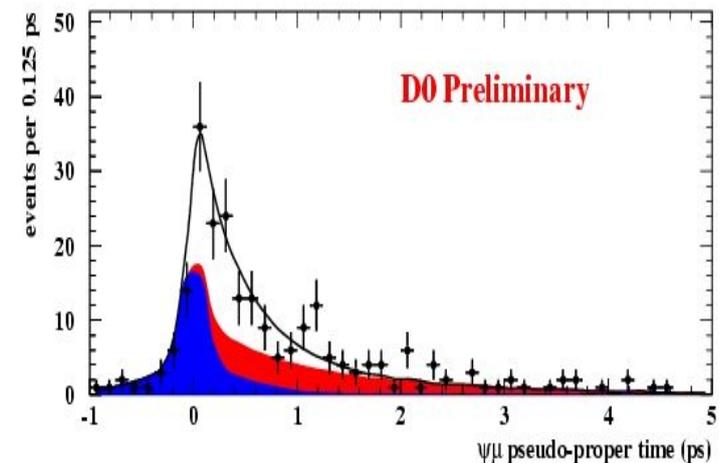
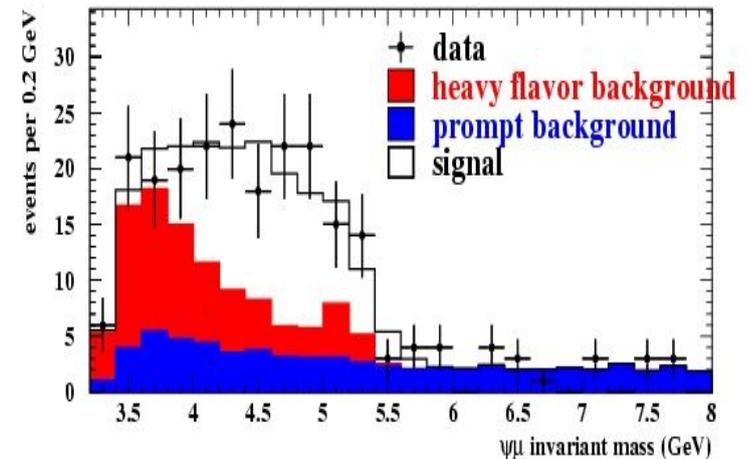
With a mass:

$m = 5.95 \pm 0.14 \pm 0.34 \text{ GeV}/c^2$

Using correction factor

$\tau = 0.448 +0.123/-0.096 \pm 0.121 \text{ ps}$

210 pb⁻¹



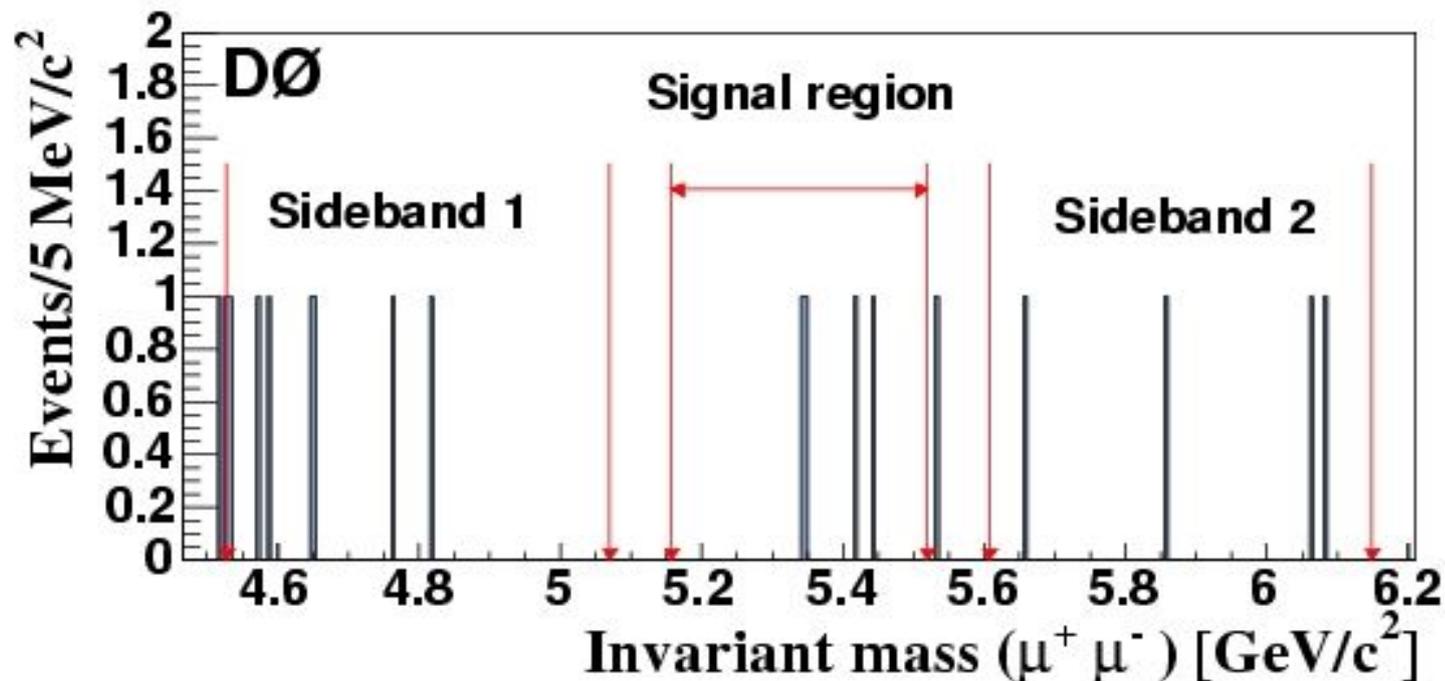
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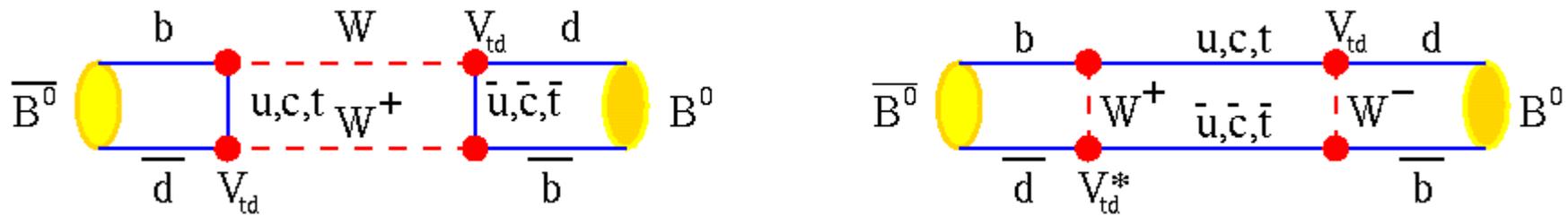
Rare decays: $B_s \rightarrow \mu^+ \mu^-$

Normalize the number of events in the signal region to the number of reconstructed $J/\psi K^+$

$$\mathcal{B}(B_s \rightarrow \mu^+ \mu^-) < 5 \times 10^{-07} \text{ at 95\% C.L.}$$



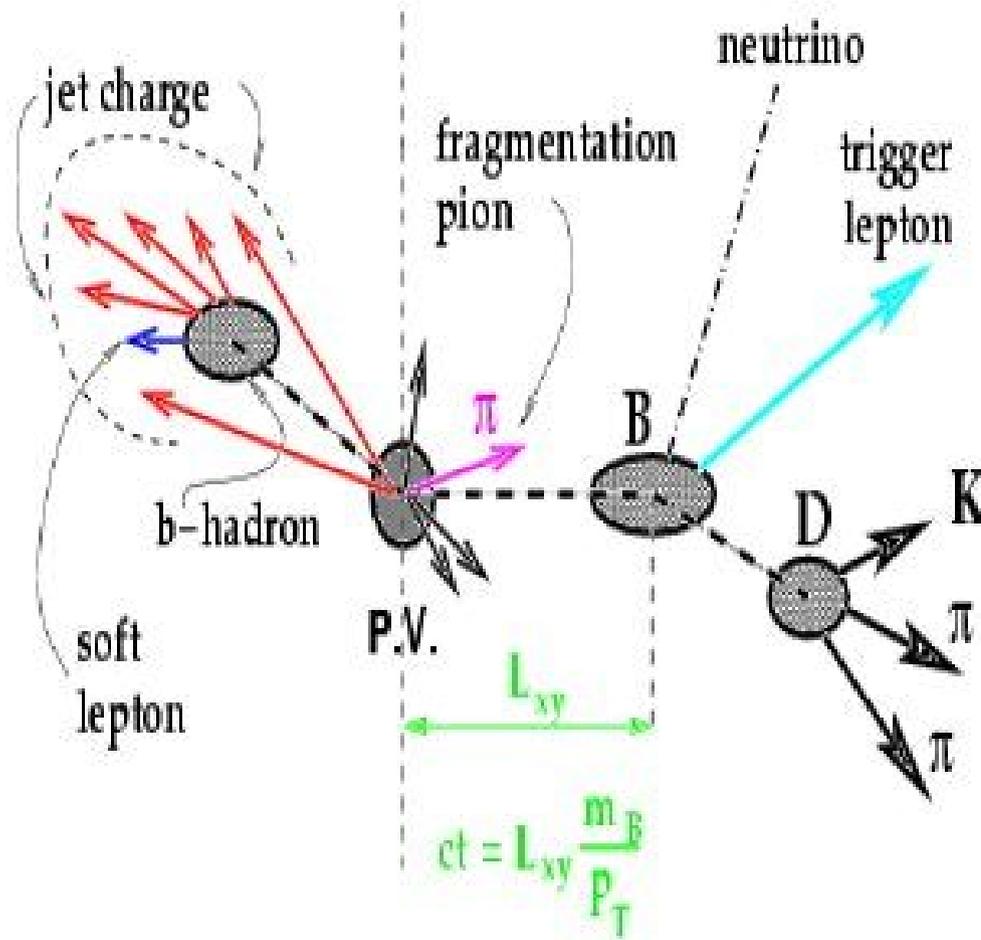
B^0 mixing



- In SM B_d mixing is explained by box diagrams
 - ◆ Constrains V_{td} CKM matrix element
 - Mixing frequency Δm_d has been measured with high precision at B factories ($0.502 \pm 0.007 \text{ ps}^{-1}$)
- We use our large sample of semileptonic B_d decays to measure Δm_d
 - ◆ Benchmark the initial state flavour tagging for later use in B_s and Δm_s measurements
 - ◆ Can also constrain more exotic models of b production at hadron colliders



Different Tagging methods



Soft Lepton tagging (SLT)
 $\epsilon = 5.0 \pm 0.2 \%$

Jet charge tagging (JetQ)

Same side tagging (SST)

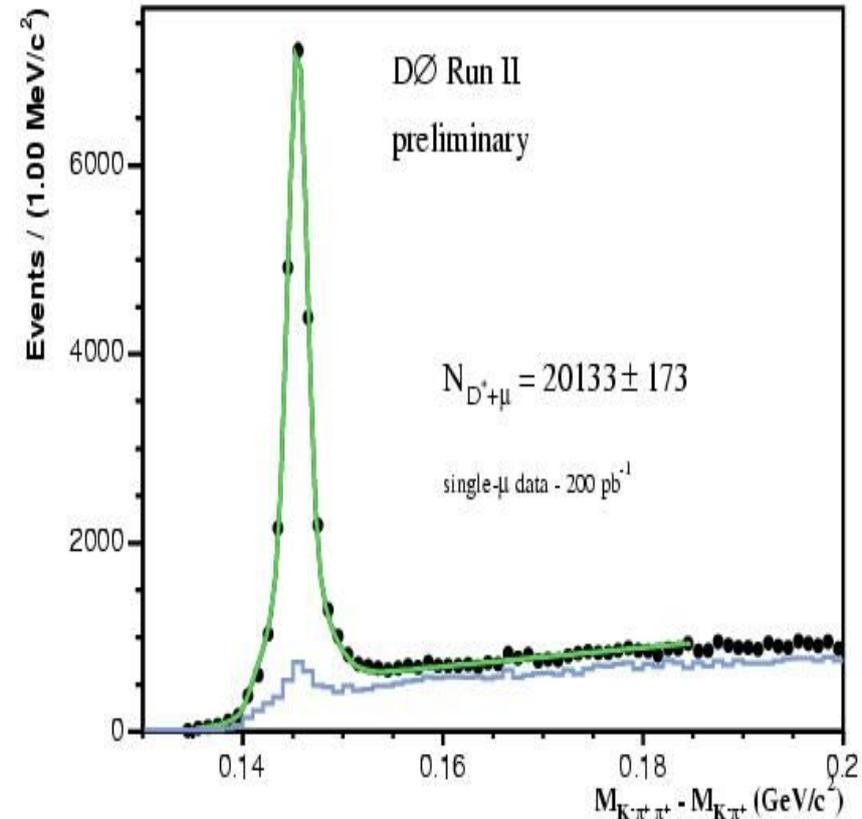
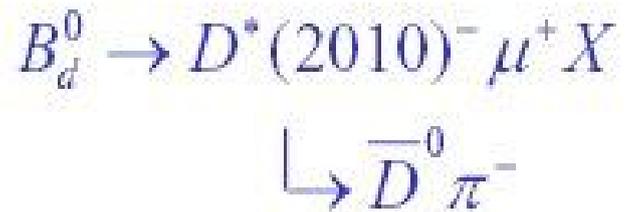
Combined tagging to improve dilution:
 JetQ-SST
 $\epsilon = 68.3 \pm 0.9 \%$



B_d Mixing

Luminosity $\sim 200 \text{ pb}^{-1}$

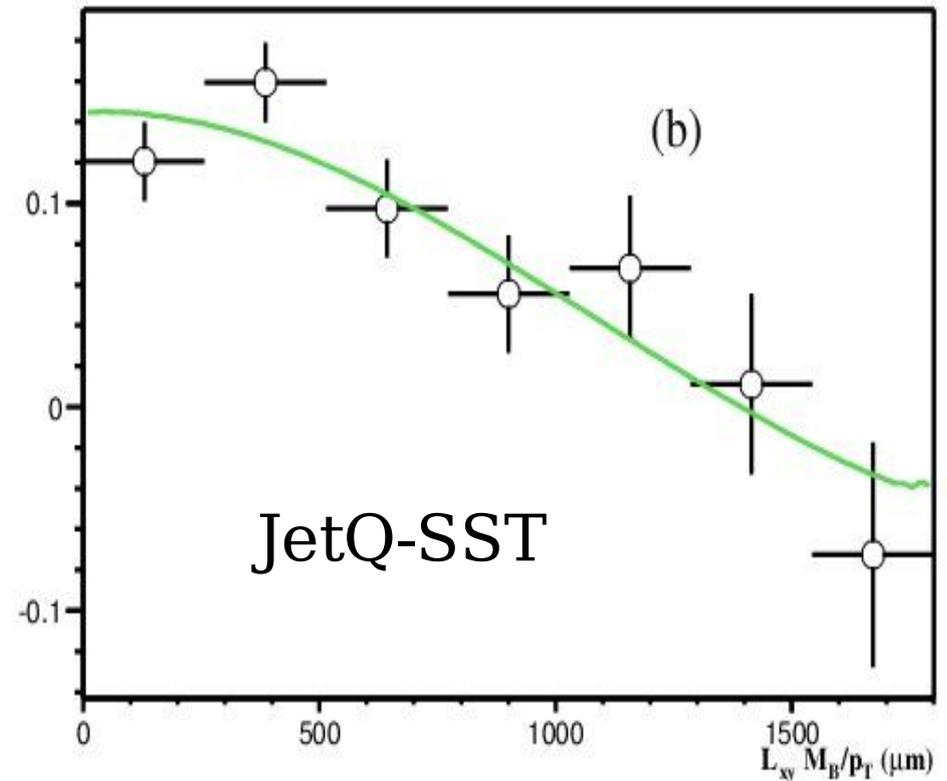
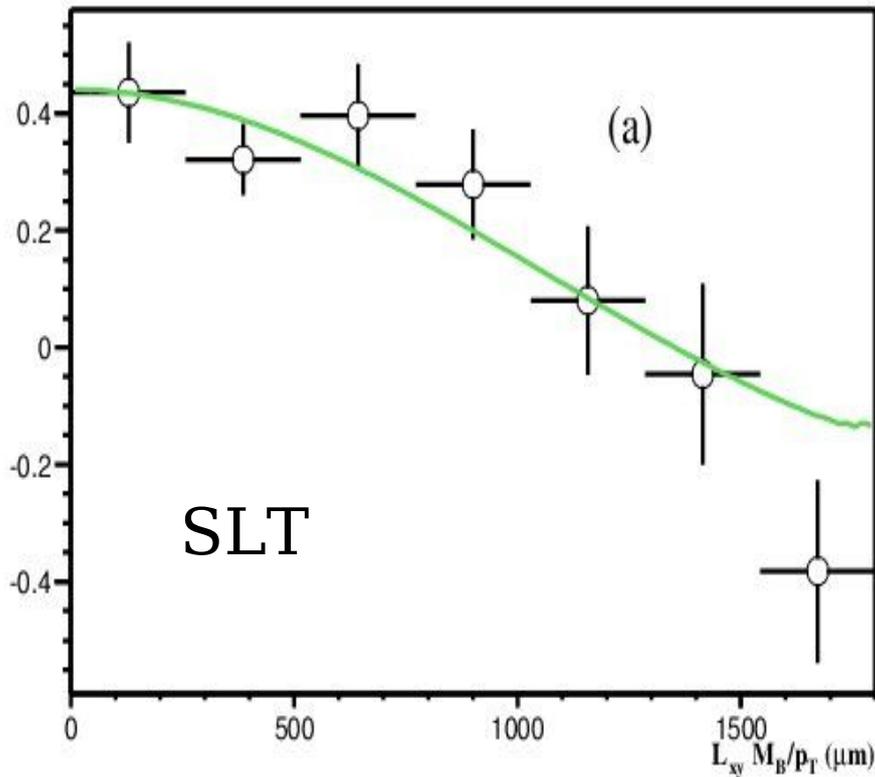
Use SLT in event where
is possible if not use
JetQ-SST



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B_d Mixing



Preliminary results:

$$\Delta m_d = 0.456 \pm 0.034(\text{stat}) \pm 0.025(\text{syst}) \text{ ps}^{-1}$$



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Conclusions

- B physics at D0 is competitive.
- Results are complementary to b-factories
- Very interesting results are feasible:
 - Bs Lifetime in semileptonic.
 - Bs Mixing
 - DeltaGamma in Bs
 - More rare decays, etc.

