

Recent B Physics Results from CDF

Robert Harr

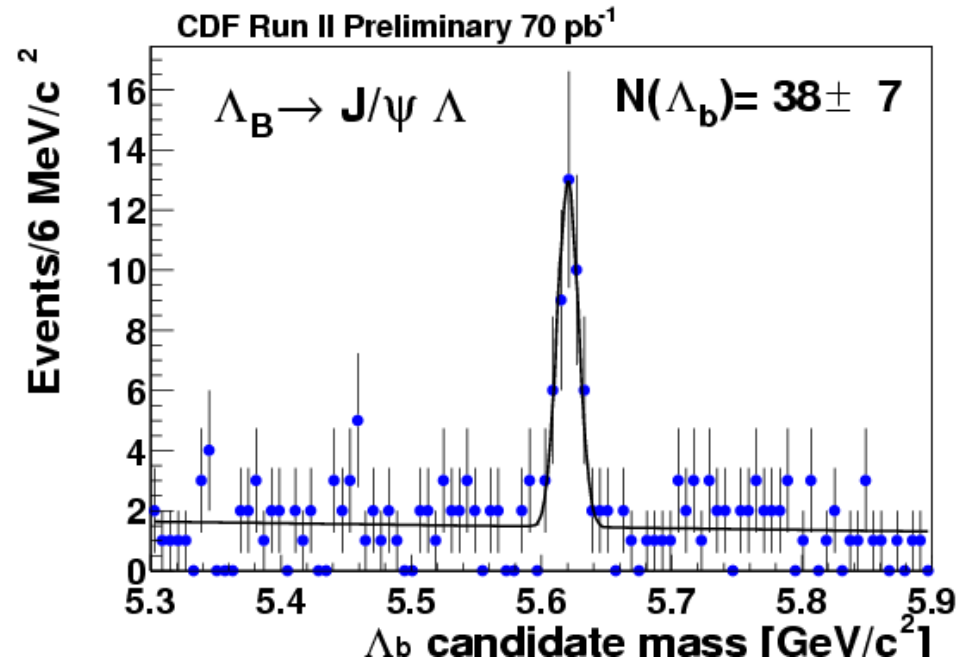
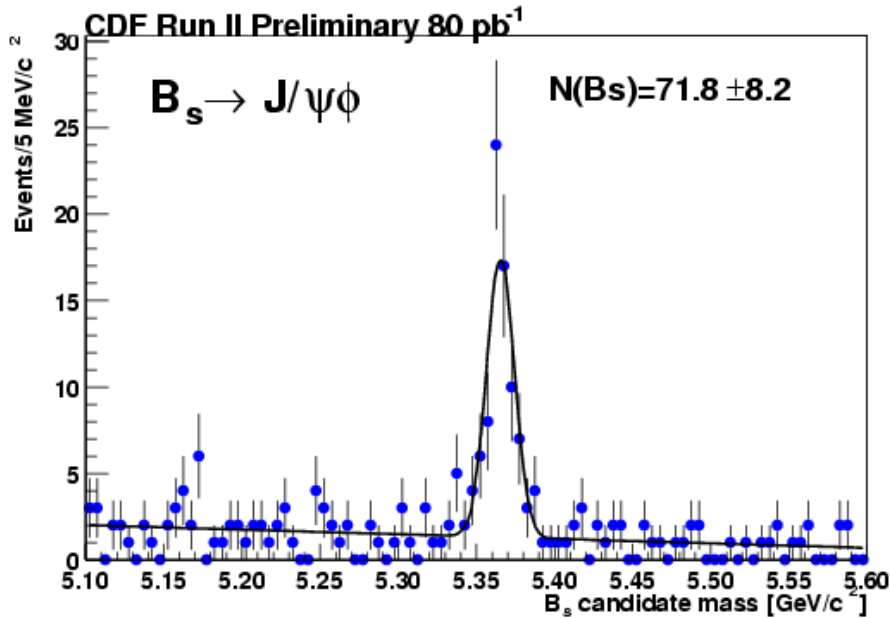
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Recent B Physics Results from CDF

Using up to 220 pb^{-1} of data

- Masses and lifetimes
 - A prelude to CP measurements
- Rare decays
- Observation of the state $X(3872)$
- Hadronic B decay final states are collected with the displaced track trigger
 - B_s mixing channel
 - Access to CP angles α and γ

B Hadron Masses



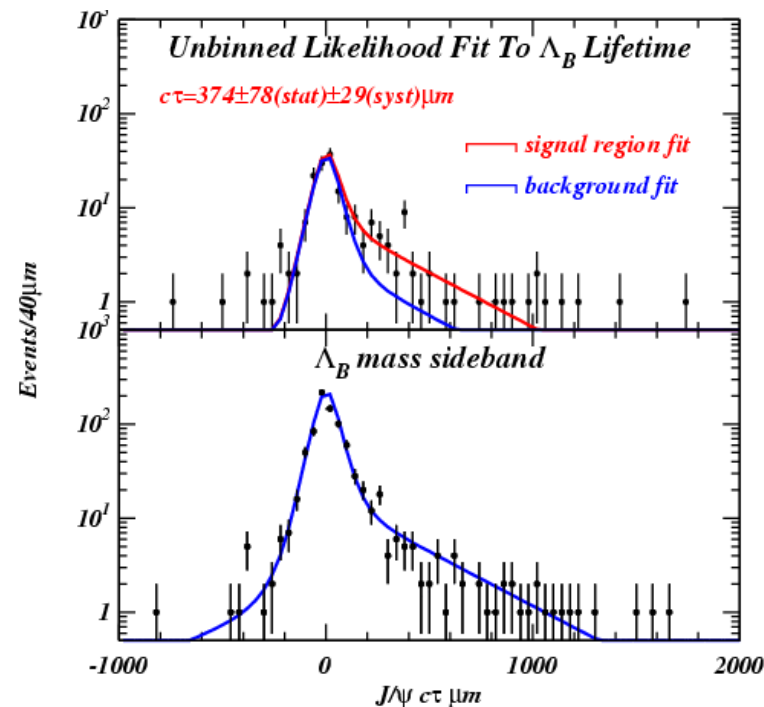
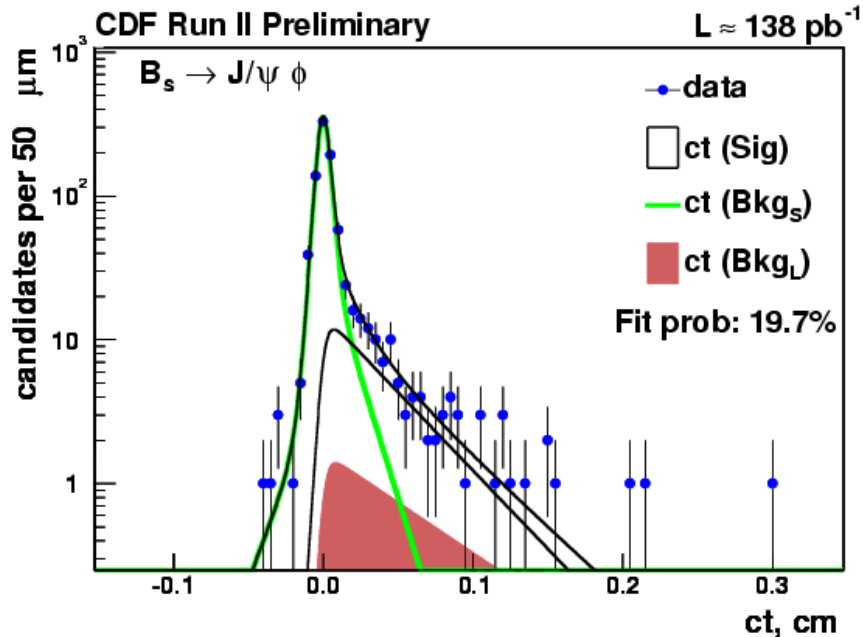
⊗ Competitive measurements for B_d and B^+ :

$M(B_d) = 5280.30 \pm 0.92 \pm 0.96$ MeV and $M(B^+) = 5279.32 \pm 0.68 \pm 0.94$ MeV

⊗ World's best measurements for B_s and Λ_B :

$M(B_s) = 5365.50 \pm 1.29 \pm 0.94$ MeV and $M(\Lambda_B) = 5620.4 \pm 1.6 \pm 1.2$ MeV

B Hadron Lifetimes

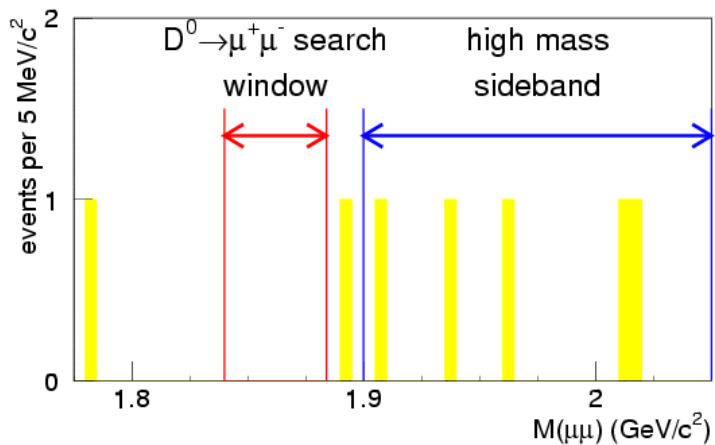
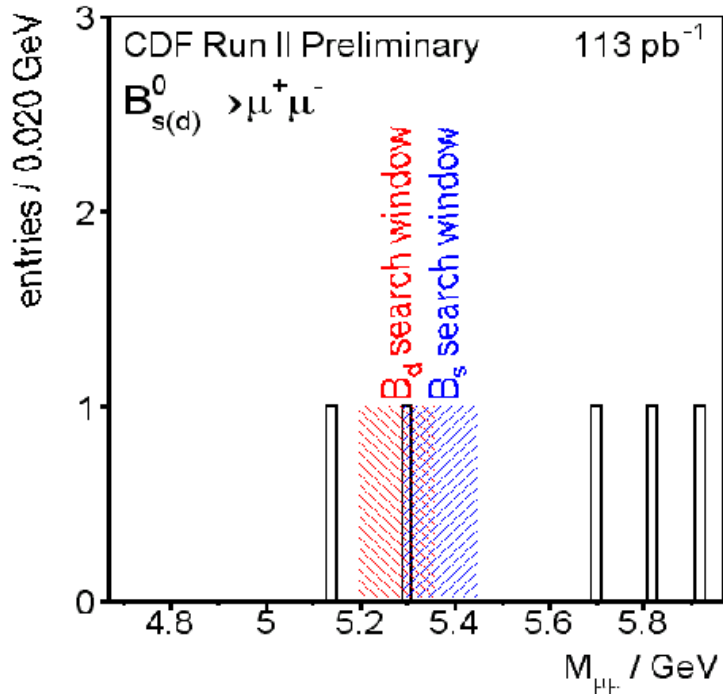


- Check B_d and B^+ lifetimes against BaBar/Belle measurements.

$$\tau(B_s) = 1.33 \pm 0.14 \pm 0.02 \text{ ps and } \tau(\Lambda_B) = 1.25 \pm 0.26 \pm 0.10 \text{ ps}$$

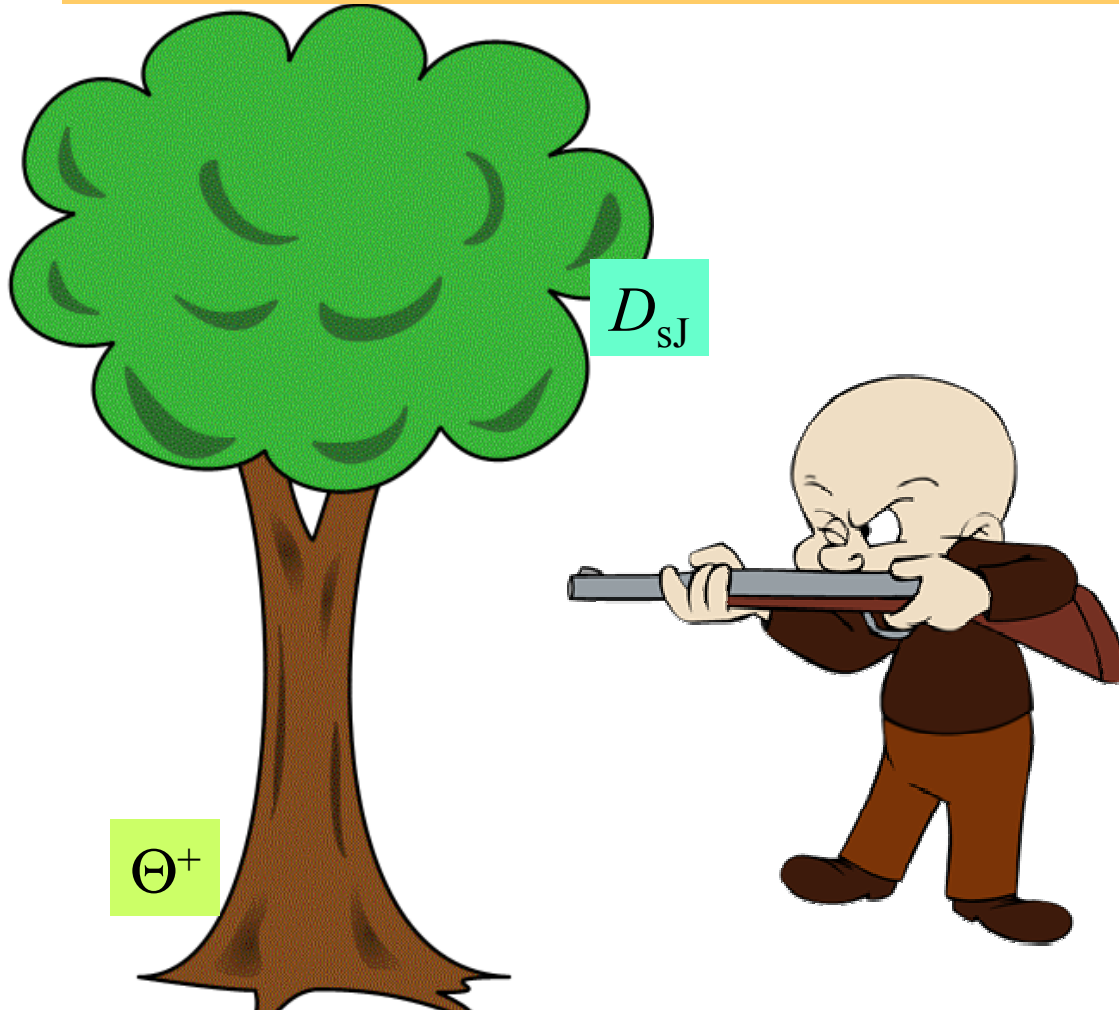
- ◆ Competitive with LEP results. Will improve with statistics.
- ◆ See talk by Daria Zieminska.

Rare Decays



- ⊙ New limit for B.R. of $B_s \rightarrow \mu^+ \mu^-$:
 $< 9.5 \times 10^{-7}$ @ 90% CL
 $< 1.2 \times 10^{-6}$ @ 95% CL
- ⊙ Limit on B.R. of $B_d \rightarrow \mu^+ \mu^-$
 about a factor of 2 worse than BaBar and Belle.
- ⊙ New limit for B.R. of $D^0 \rightarrow \mu^+ \mu^-$:
 $< 2.5 \times 10^{-6}$ @ 90% CL
- ⊙ See talk by Cheng-Ju Lin.

Hunting For New States



- Sssshhhh.....

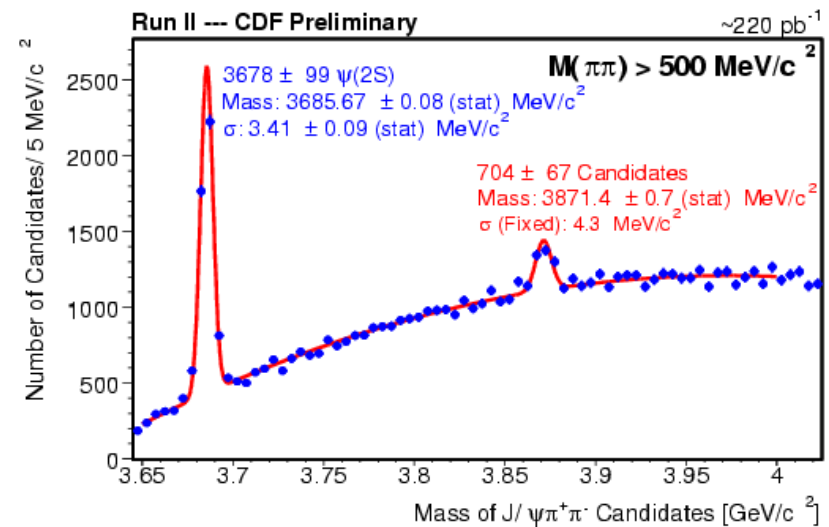
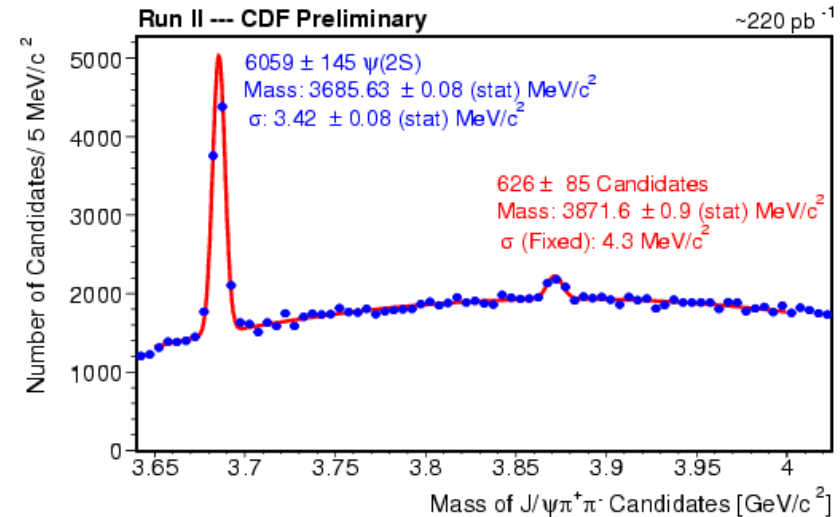
Hunting For New States



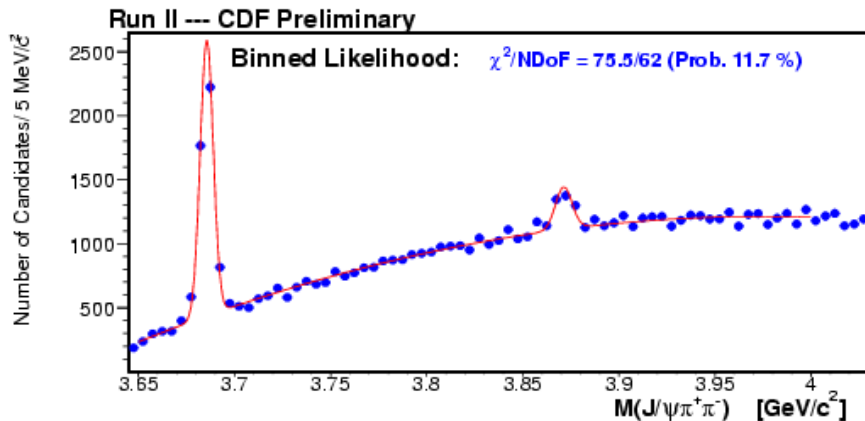
- Sssshhhh.....Wabbit hunting.

X(3872)

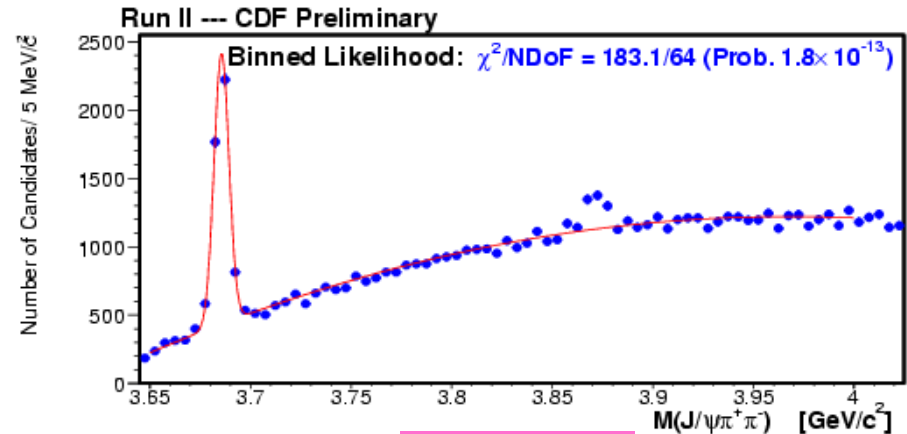
- ◆ New state observed by Belle in $B \rightarrow XK \rightarrow J/\psi \pi^+ \pi^- K$ final state of narrow width.
- ◆ Tevatron: this state produced directly, or via B decays.
- ◆ CDF observes this state at the same mass.
- ◆ Belle reports that $M(\pi \pi)$ distribution suggests a ρ resonance.
- ◆ CDF sees a preference for $M(\pi \pi) > 500 \text{ MeV} \Rightarrow$ needs to be finalized!



X(3872) Signal Significance



with



without

- ⊙ Fit with and without a Gaussian for the X(3872) yields a significance of more than 10σ .
- ⊙ Note relatively large cross section (times branching fraction) compared to the $\psi(2s)$.

What is $X(3872)$?

☉ Two leading candidates:

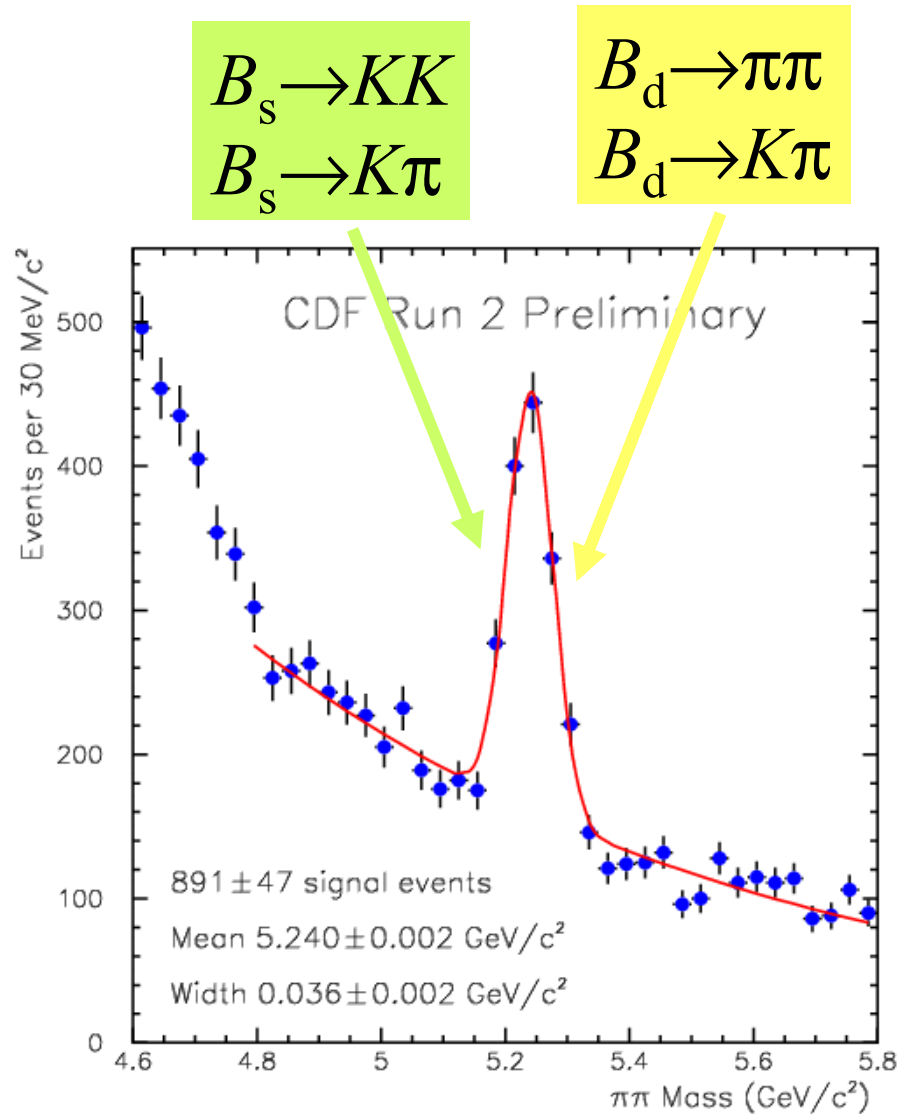
1. A $c\bar{c}$ state \Rightarrow like the 1^3D_2 state
2. D^*D molecule (suggested by Belle)
 - ◆ Observed mass is a few MeV below threshold
 - ◆ $X \rightarrow \chi_c \gamma$ is not yet observed by Belle
 - ◆ $X \rightarrow J/\psi \rho$ forbidden for 3D_2 state

☉ Additional measurements to pin down the quantum numbers:

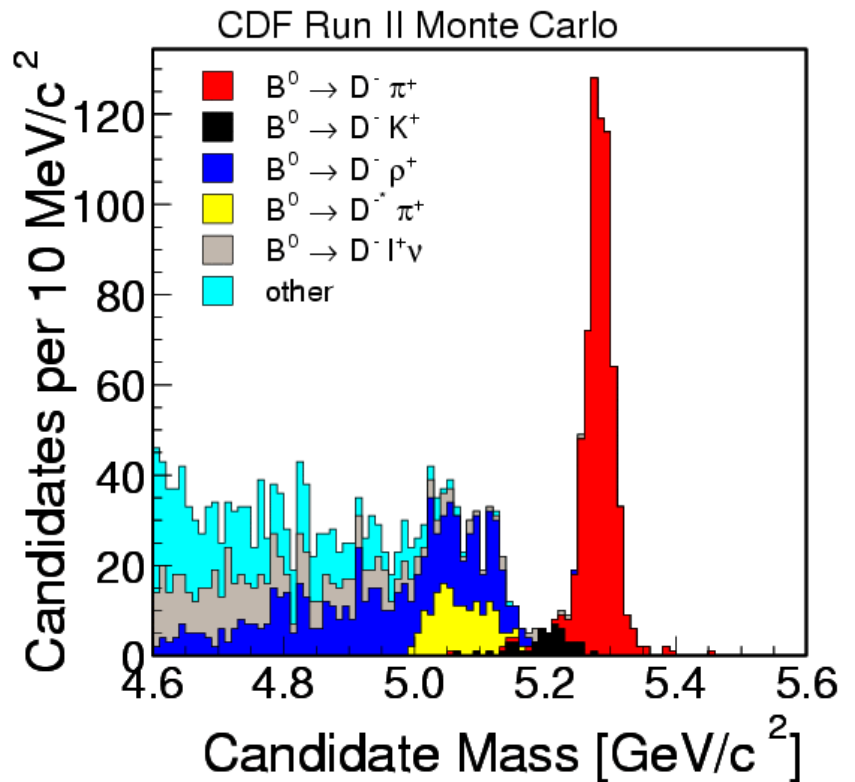
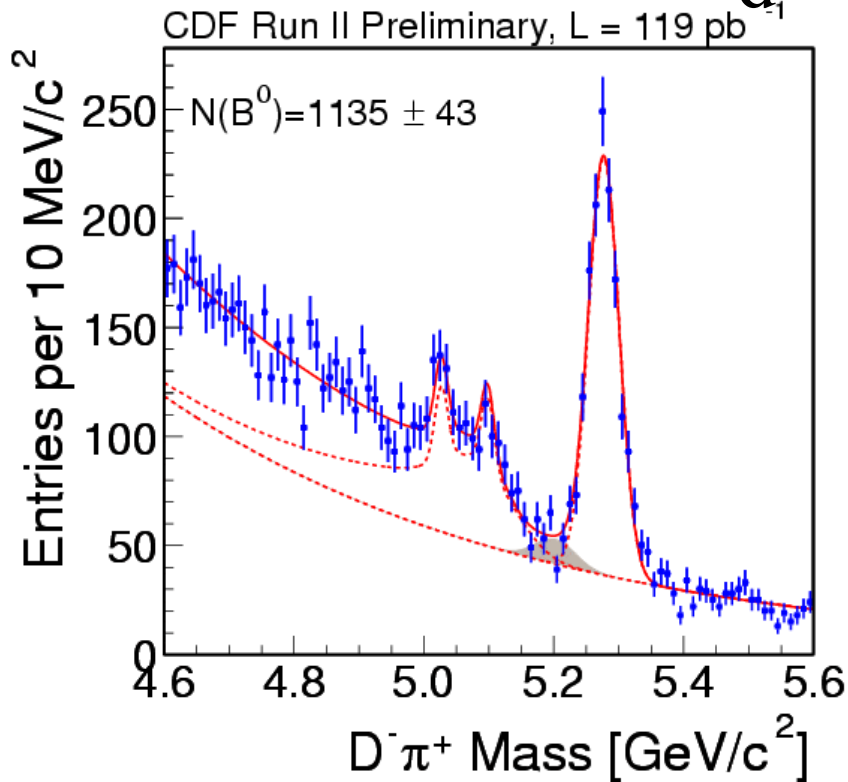
- Helicity angles
- $M_{\pi\pi}$ distribution (resonance structure)

$B \rightarrow h^+ h'^-$ Decays

- ⊗ $B_d \rightarrow \pi\pi$ and $B_s \rightarrow KK$ modes are sensitive to CP angle γ .
- ⊗ $B_{(d,s)} \rightarrow K\pi$ and above modes are separated statistically by kinematics and particle ID.
- ⊗ $\mathcal{B}(B_d \rightarrow \pi\pi) / \mathcal{B}(B_d \rightarrow K\pi) = 0.26 \pm 0.11 \pm 0.055$.
- ⊗ First observation of $B_s \rightarrow K^+ K^-$.

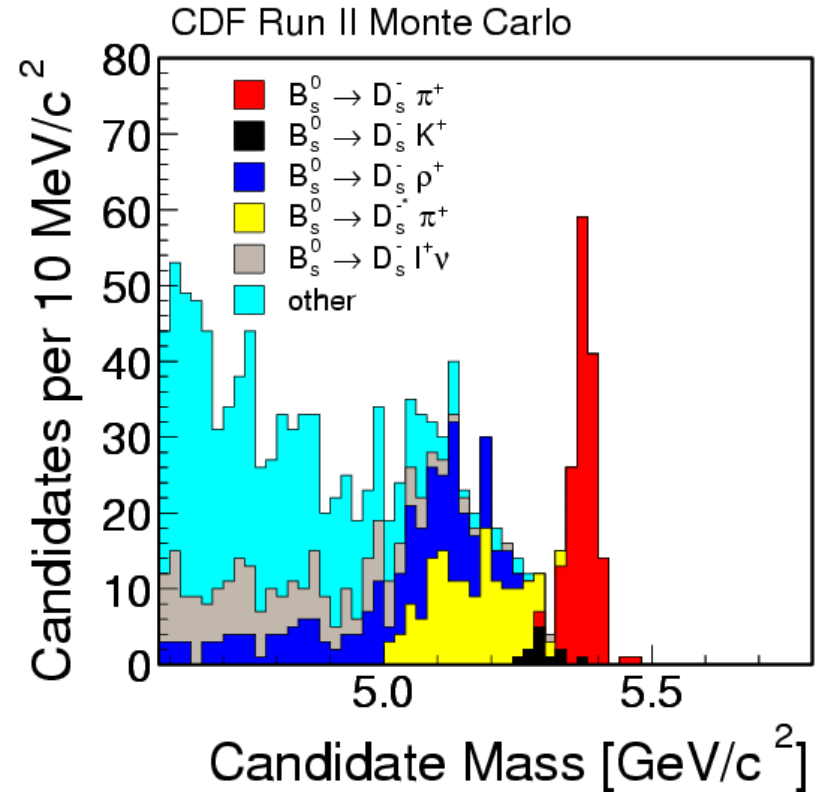
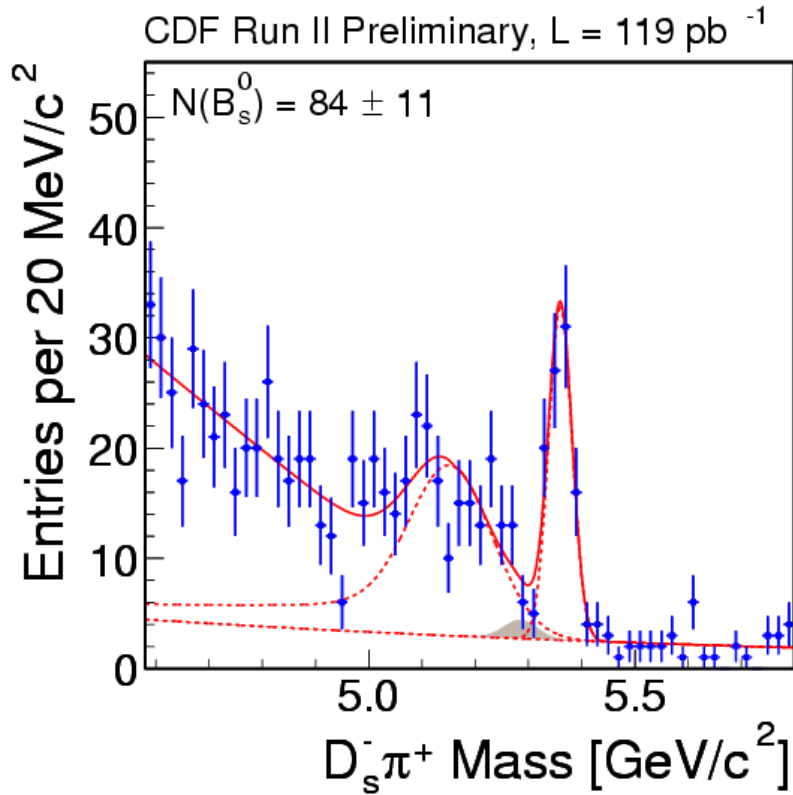


$B_d^- \rightarrow D^- \pi^+$



- ⊗ MC templates used to fit mass spectrum.
- ⊗ $B \rightarrow DK$ is another mode of interest for CP analysis.

$B_s \rightarrow D_s^- \pi^+$



- ⊗ $B_s \rightarrow D_s^- \pi^+$ is a potential mode for measuring x_s .
- ⊗ Fully reconstructed mode for minimal uncertainty in the boost of the B_s .

Summary

- ⊙ Progress with CDF Run2 analyses:
 - ◆ Traditional: masses, lifetimes, rare decays.
 - ◆ CDF has observed the X(3872).
 - ◆ New topics enabled by the displaced track trigger are being explored: hadronic CP modes, and hadronic modes for B_s mixing.
- ⊙ New charm and bottom production cross sections \Rightarrow Chunhui Chen.
- ⊙ Tagging studies \Rightarrow Ting Miao.
- ⊙ Future prospects \Rightarrow Petar Maksimovic.