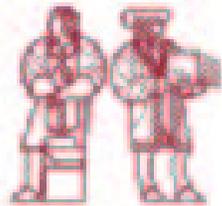


Charm and Beauty at CDF II

Christoph M.E. Paus
Massachusetts Institute of Technology

B Physics Group Co-Convener



HEPAP: September 29, 2003

The MIT Group at CDF

MIT large group on CDF

- * 4 faculty
- * 4 researchers
- * 3 postdocs
- * 12 graduates
- * 4 undergraduates
- * 1 technician



Hardware and analysis

- * Event builder (band width)
- * Level3 trigger farm
- * time of flight detector
- * B_s mixing
- * high p_T and exotics

Recent Surprise in Spectroscopy

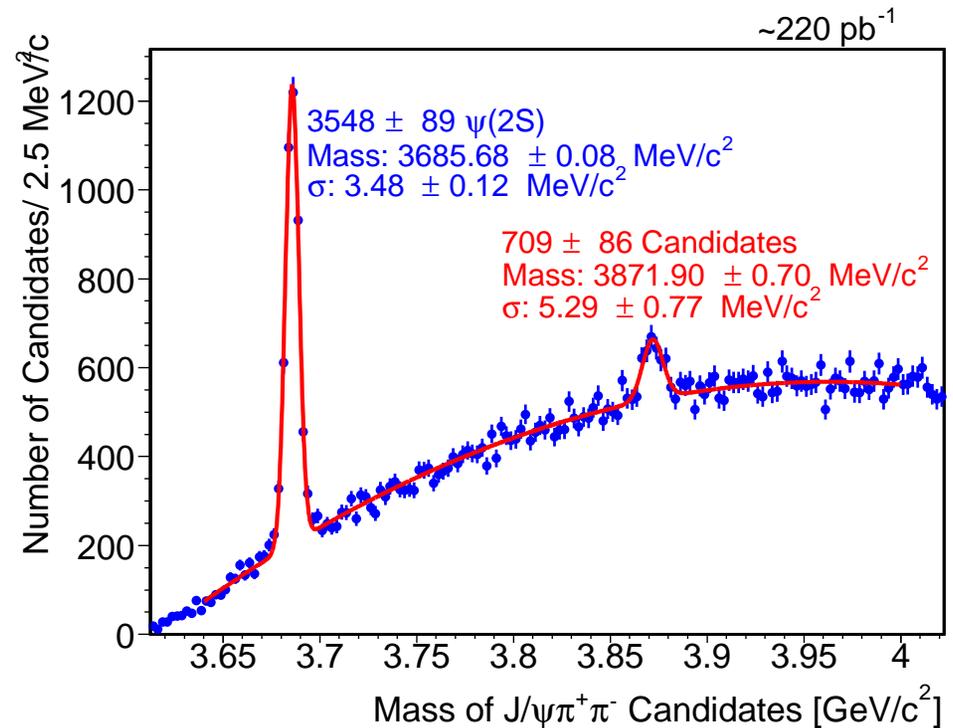
Belle observes narrow state

- * final state $J/\psi\pi^+\pi^-$
- * exclusive: $B^+ \rightarrow J/\psi\pi^+\pi^-K^+$
- * 35.7 ± 6.8 events
- * possibly charmonium
- * mass is unexpected
- * shown August 12, 2003

CDF confirms September 20

- * final state $J/\psi\pi^+\pi^-$
- * mostly prompt production
- * $\bar{p}p$ different initial state
- * 709 ± 86 events

CDF response is
very prompt
competitive
complementary



Mass measured by CDF:

$$3871.4 \pm 0.7 \pm 0.4 \text{ MeV}/c^2$$

Compares well with Belle:

$$3872.0 \pm 0.6 \pm 0.5 \text{ MeV}/c^2$$

CP Violation Puzzle: B_s Mixing

CDF Run II flagship analysis

- * B_s mixing unique at Tevatron
- * one side of unitarity triangle
- * complements B factories
- * more difficult than anticipated

Baseline

- * 500/pb: 2σ at $\Delta m_s = 15^{-1}$ ps
- * work aggressively to improve

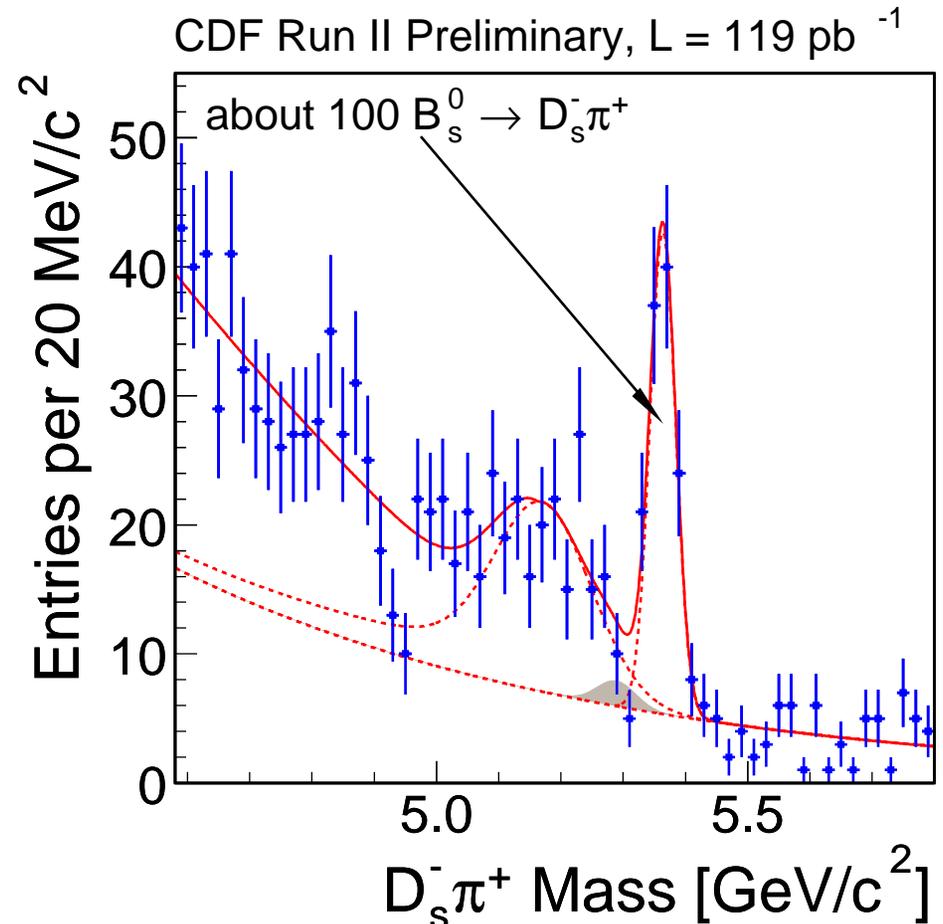
Modest improvements

- * 1.7/fb: 5σ at $\Delta m_s = 18^{-1}$ ps
- * 3.2/fb: 5σ at $\Delta m_s = 24^{-1}$ ps

Topics of studies

- * more events at a given luminosity (trigger)
- * improve vertex resolution
- * enhance flavor tagging

Need support \$\$



Ratio of branching ratios:

$$\frac{f_s Br(B_s \rightarrow D_s^- \pi^+)}{f_d Br(B^0 \rightarrow D^- \pi^+)} = 0.42 \pm 0.11 \pm 0.13$$

Unique CDF contributions

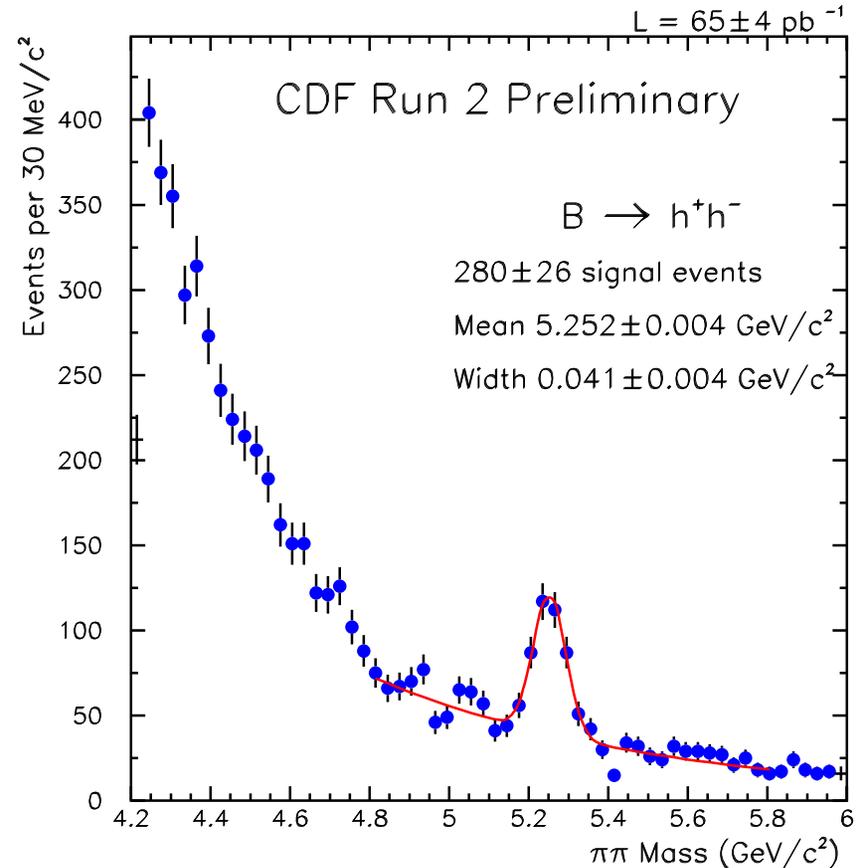
CP Violation Puzzle: Angle γ

Use $B \rightarrow hh'$

- * γ of unitarity triangle
- * decompose:
 $B_{d,s} \rightarrow K\pi$, $B_d \rightarrow \pi\pi$, $B_s \rightarrow KK$
- * determine penguin pollution
- * 'model independent' γ
- * complementary to BaBar/Belle
- * would you have believed that?

Need continued support:
bandwidth/luminosity

CDF potential
proven
competitive
complementary



Significant $B_s \rightarrow K^+K^-$ observed:

$$\frac{f_s Br(B_s \rightarrow KK)}{f_d Br(B^0 \rightarrow K\pi)} = 0.74 \pm 0.20 \pm 0.22$$

$$\text{Measure } A_{CP} = \frac{N(\bar{B} \rightarrow K^- \pi^+) - N(B \rightarrow K^+ \pi^-)}{N(\bar{B} \rightarrow K^- \pi^+) + N(B \rightarrow K^+ \pi^-)}$$

$$0.02 \pm 0.15 \pm 0.02$$

Summary

Charm and Beauty Physics well under way

- * largest analysis group in CDF (≈ 200 people)
- * many interesting topics apart from what was shown
- * 3 publications, 5 in preparation, many many following
- * good progress towards main goals

Expensive detector ready for unique, exciting physics

- * funding agencies should protect their investments

We need support to exploit the physics potential

- * support Tevatron: we need high luminosity
- * support CDF: increase bandwidth, allow for more events
- * support universities: students, postdocs, faculty to do the analysis