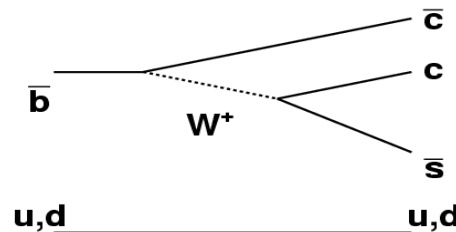




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Exclusive charmonium B decays



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Introduction



Motivation – Tests models of Hadronic B Decays

- Factorization Hypothesis – Hadronic decays sensitive to QCD

Exclusive Branching Fraction Measurements

- Factorization allowed (J/ψ , $\psi(2S)$, and χ_{c1})
- X(3872) Confirmation in Charged B Decay

Search for Charged partner of X(3872)

Factorization forbidden B Decays

- Charmonium final states - χ_{c0} , χ_{c2} and h_c

Physics beyond the Standard Model

- Rare radiative $B \rightarrow J/\psi \gamma$

**All Results are preliminary
unless otherwise stated.*



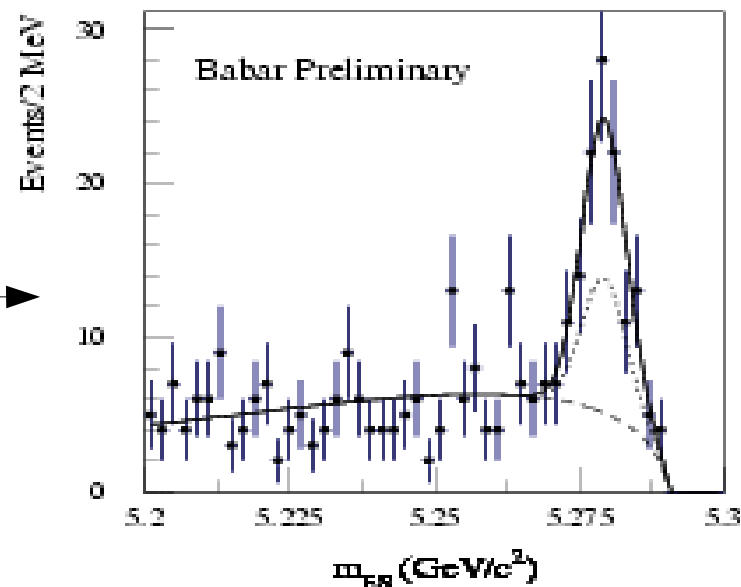
Exclusive Branching Fraction Results



Preliminary

Channel	Branching fraction ($\times 10^{-4}$)
$B^0 \rightarrow J/\psi K^{*0}$	$12.92 \pm 0.25 \pm 0.75$
$B^+ \rightarrow J/\psi K^{*+}$	$14.34 \pm 0.36 \pm 0.94$
$B^+ \rightarrow J/\psi K^+$	$10.55 \pm 0.15 \pm 0.48$
$B^0 \rightarrow J/\psi K^0$	$8.73 \pm 0.23 \pm 0.30$
$B^0 \rightarrow \psi(2S) K^{*0}$	$6.65 \pm 0.57 \pm 1.00$
$B^+ \rightarrow \psi(2S) K^{*+}$	$6.03 \pm 0.85 \pm 0.91$
$B^+ \rightarrow \psi(2S) K^+$	$6.31 \pm 0.33 \pm 0.44$
$B^0 \rightarrow \psi(2S) K^0$	$6.60 \pm 0.60 \pm 0.46$
$B^0 \rightarrow \chi_{c1} K^{*0}$	$3.19 \pm 0.37 \pm 0.64$
$B^+ \rightarrow \chi_{c1} K^{*+}$	$2.89 \pm 0.69 \pm 0.93$
$B \rightarrow \chi_{c1} K^+$	$5.72 \pm 0.24 \pm 0.64$
$B^0 \rightarrow \chi_{c1} K^0$	$4.56 \pm 0.39 \pm 0.51$

$$B^+ \rightarrow \chi_{c1} K^{*+} (K_S \pi^+)$$



- Analysis using 124M $B\bar{B}$ pairs
- Measurement of exclusive branching fractions better than or comparable to previous measurements (PDG 2004)
- First measurement of $\mathcal{B}(B^+ \rightarrow \chi_{c1} K^{*+})$



Exclusive Branching Fraction Results



- Measurement of the charged to neutral ratio at $\Upsilon(4S)$
 - Assuming isospin invariance
 - PDG 2004 Lifetimes $\tau_{B^+} / \tau_{B^0} = 1.086 \pm 0.017$

$$R^{+/0} = \frac{\Gamma(\Upsilon(4S) \rightarrow B^+ B^-)}{\Gamma(\Upsilon(4S) \rightarrow B^0 \bar{B}^0)} = 1.05 \pm 0.02 \pm 0.03$$

- Charge CP Asymmetries

$$A_{CP} = \frac{\mathcal{B}(B^+ \rightarrow (c\bar{c})K^{+(*)}) - \mathcal{B}(B^- \rightarrow (c\bar{c})K^{-(*)})}{\mathcal{B}(B^+ \rightarrow (c\bar{c})K^{+(*)}) + \mathcal{B}(B^- \rightarrow (c\bar{c})K^{-(*)})}$$

No Evidence of Direct CP Violation \longrightarrow

Preliminary

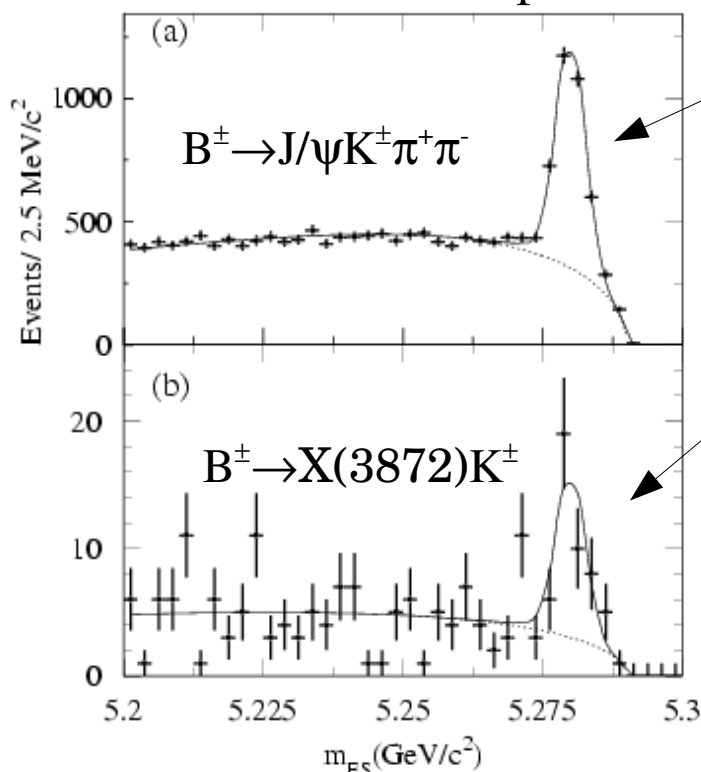
B^+ Final State	A_{CP}
$J/\psi K^+$	$-0.029 \pm 0.014 \pm 0.010$
$J/\psi K^{*+}$	$0.045 \pm 0.025 \pm 0.011$
$\psi(2S) K^+$	$0.059 \pm 0.051 \pm 0.021$
$\psi(2S) K^{*+}$	$-0.063 \pm 0.137 \pm 0.050$
$\chi_{c1} K^+$	$0.011 \pm 0.042 \pm 0.017$
$\chi_{c1} K^{*+}$	$-0.403 \pm 0.309 \pm 0.237$



$B^\pm \rightarrow J/\psi K^\pm \pi^+ \pi^-$ and the X(3872)



117 Million $B\bar{B}$ pairs



Submitted for Publication
(hep-ex/0406022)

All $B^\pm \rightarrow J/\psi K^\pm \pi^+ \pi^-$ candidates

- $BF(B^\pm \rightarrow J/\psi K^\pm \pi^+ \pi^-) = (116 \pm 7 \pm 9) \times 10^{-5}$
- Precision better by x2 w.r.t. present average

$B^- \rightarrow J/\psi K^- \pi^+ \pi^-$ candidates for X(3872)

- Mass region $3862 \text{ MeV} < m_{J/\psi \pi^+ \pi^-} < 3882 \text{ MeV}$
- $BF(B^\pm \rightarrow X(3872) K^\pm) \times BF(X(3872) \rightarrow J/\psi \pi^+ \pi^-) = (1.28 \pm 0.41) \times 10^{-5}$

Other Searches

- $B^\pm \rightarrow h_c(J/\psi \pi^+ \pi^-) K^\pm : BR < 3.4 \times 10^{-6}$
 - $B^\pm \rightarrow J/\psi D^0(K\pi) \pi^\pm : BR < 5.2 \times 10^{-5}$
- } 90% C.L.



Search for X(3872) Charged Partner

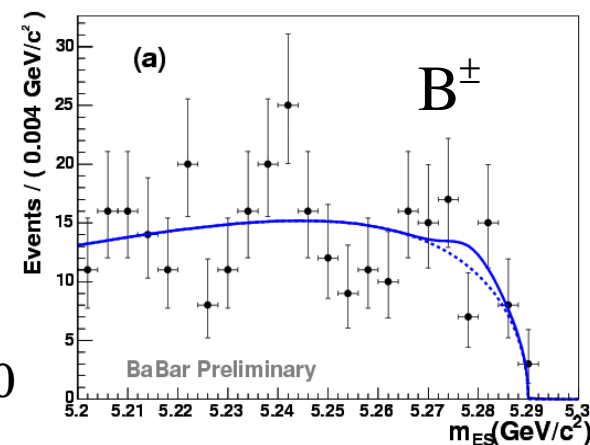
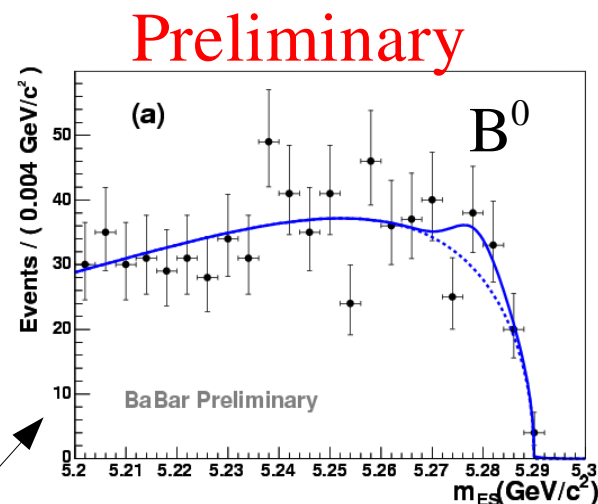


Possible Decay of $X(3872) \rightarrow J/\psi \rho^0 (\pi^+ \pi^-)$

- If pions are from ρ^0 then charged partner $X^\pm(3872) \rightarrow J/\psi \rho^\pm$ may exist
- Assuming isospin conservation and X^\pm is a member of an isotriplet $\Rightarrow \Gamma(B \rightarrow X^\pm K) = 2 \cdot \Gamma(B \rightarrow X^0 K)$

Analysis on 213 million $B\bar{B}$ events

- Fits Consistent with Peaking Background
- $BR(B^0 \rightarrow J/\psi \pi^+ \pi^0 K^\mp) < 5.8 \times 10^{-6}$
- $BR(B^\pm \rightarrow J/\psi \pi^+ \pi^0 K_s^0) < 11 \times 10^{-6}$ } 90% C.L.
- Results do not support isovector hypothesis
- Probability isovector hypothesis is correct $< 1:600$





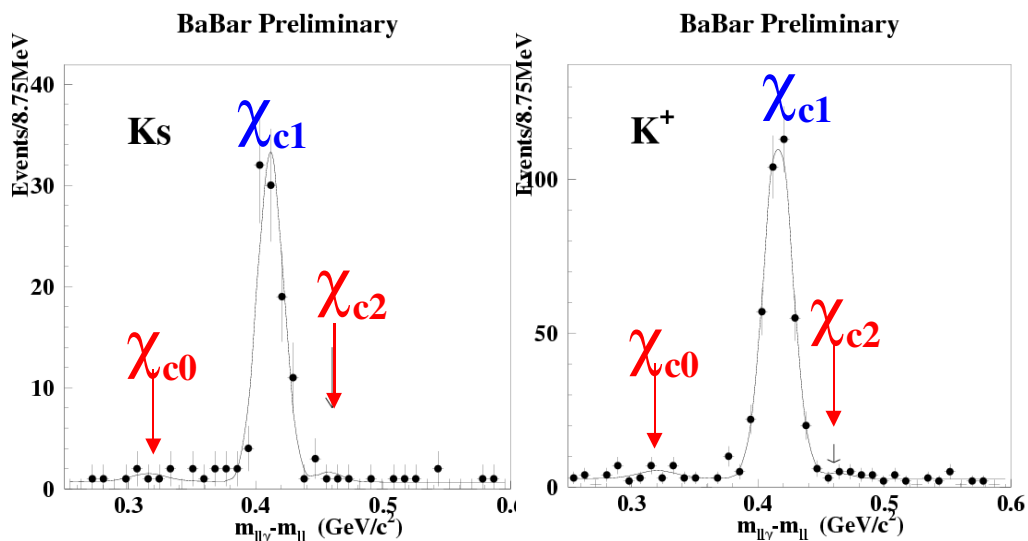
Factorization Suppressed Decays



$BF(B \rightarrow \chi_{c0} K)$ comparable to factorization allowed

- Seen on Belle and BaBar in $\chi_{c0} \rightarrow \pi\pi, KK$
- Analysis presented here: $\chi \rightarrow J/\psi\gamma$
- 124M $B\bar{B}$ events

$B(\chi_{c0} \rightarrow J/\psi\gamma)$	$(1.18 \pm 0.14)\%$
$B(\chi_{c1} \rightarrow J/\psi\gamma)$	$(31.6 \pm 3.3)\%$
$B(\chi_{c2} \rightarrow J/\psi\gamma)$	$(20.2 \pm 1.7)\%$



Upper limits in χ_{c2} are an order of magnitude smaller than factorization allowed decays

$B(10^{-4})$ Limits @ 90% C.L.		
	χ_{c2}	χ_{c0}
K^{*0}	<0.22	<8.0
K^{*+}	<0.14	<45
K^+	<0.36	<12
K^0	<0.44	<13

Preliminary



Tests of the Standard Model

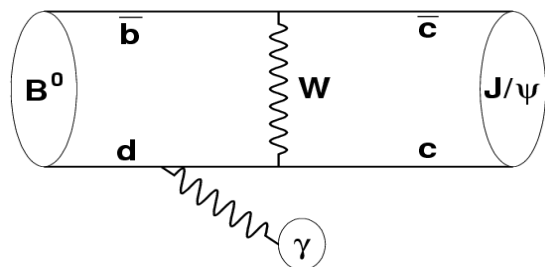


Preliminary

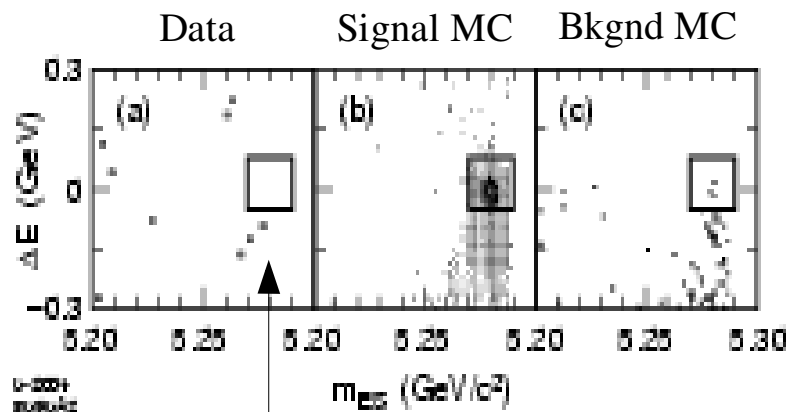
$B^0 \rightarrow J/\psi \gamma$ – Possible probe of physics beyond the SM

- Right handed charged current
- Non-spectator intrinsic charm in the B^0 meson

SM estimate $BR(B^0 \rightarrow J/\psi \gamma) = 7.65 \times 10^{-9}$



Blind Analysis on 123M $B\bar{B}$
(hep-ex/0408018)



No signal events found in data
 $BR(B^0 \rightarrow J/\psi \gamma) < 1.6 \times 10^{-6}$ @ 90% C.L.



Summary of Results



Factorization allowed (J/ψ , $\psi(2S)$, and χ_{c1})

- Improved branching fraction precision

Factorization forbidden B decays

- Limits for χ_{c2} Order of Magnitude below Allowed
- No evidence seen in $h_c \rightarrow J/\psi \pi^+ \pi^-$

X(3872) Charmonium-like resonance

- Confirmation and BF measurement in Charged B Decay

Charged partner of X(3872)

- Excluded isovector hypothesis

Rare radiative $B \rightarrow J/\psi \gamma$

- No deviations from the SM prediction