



Baryonic B Decays at Belle

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Introduction

$B \rightarrow \Lambda \bar{\Lambda} h$

$B \rightarrow p \bar{\Lambda} \pi^+ \pi^-$

Summary



Abstract 917

EPS2009@Krakow

Introduction

- ❑ Profound baryonic decays: a unique feature of B meson
- ❑ Well established after few years of B-factory running
- ❑ $BF(2\text{-body}) < BF(3\text{-body}) (< BF(4\text{-body}))$
- ❑ **Threshold enhancement** in the baryon-antibaryon system
- ❑ Searching ground for exotic states
- ❑ May have unexpected large CP violation in charmless modes
- ❑ New results from $B \rightarrow \Lambda \bar{\Lambda} h$ and $p \bar{\Lambda} \pi^+ \pi^-$



B \rightarrow $\Lambda \bar{\Lambda} h$

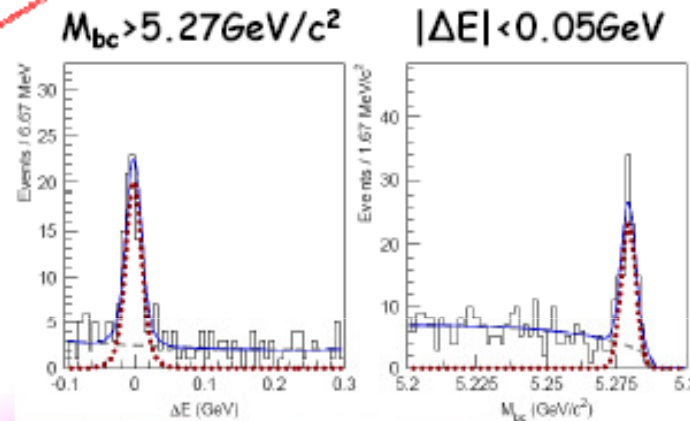
605fb⁻¹

PRD79:052006 (2009)

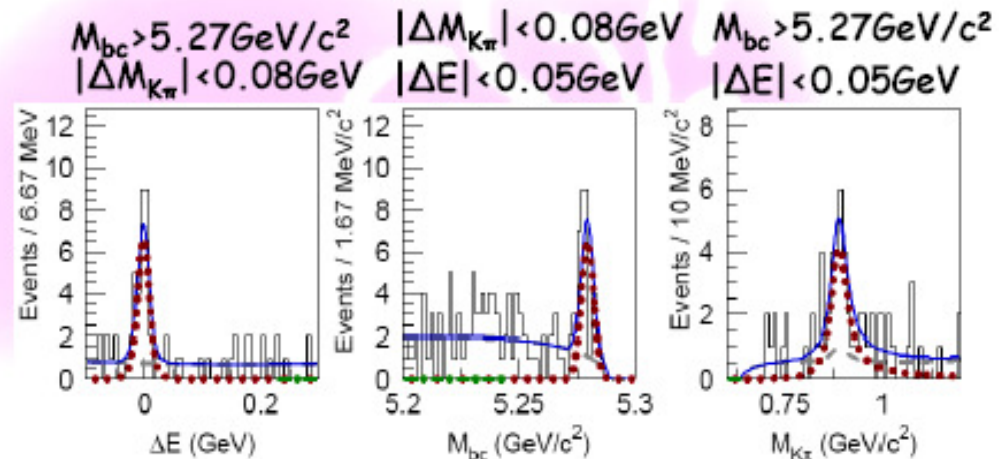
BF(B⁰ \rightarrow $\Lambda \bar{\Lambda} K^0$) =
 $(4.76^{+0.84}_{-0.68} \pm 0.61) \times 10^{-6}$
 significance : 12.5 σ

BF(B⁰ \rightarrow $\Lambda \bar{\Lambda} K^{*0}$) =
 $(2.46^{+0.87}_{-0.72} \pm 0.34) \times 10^{-6}$
 significance : 9.0 σ

First observation!



Mode	Significance
B ⁺ \rightarrow $\Lambda \Lambda K^{*+}$	3.7 σ
B ⁰ \rightarrow $\Lambda \Lambda D^0$	3.4 σ
B ⁺ \rightarrow $\Lambda \Lambda \pi^+$	2.5 σ

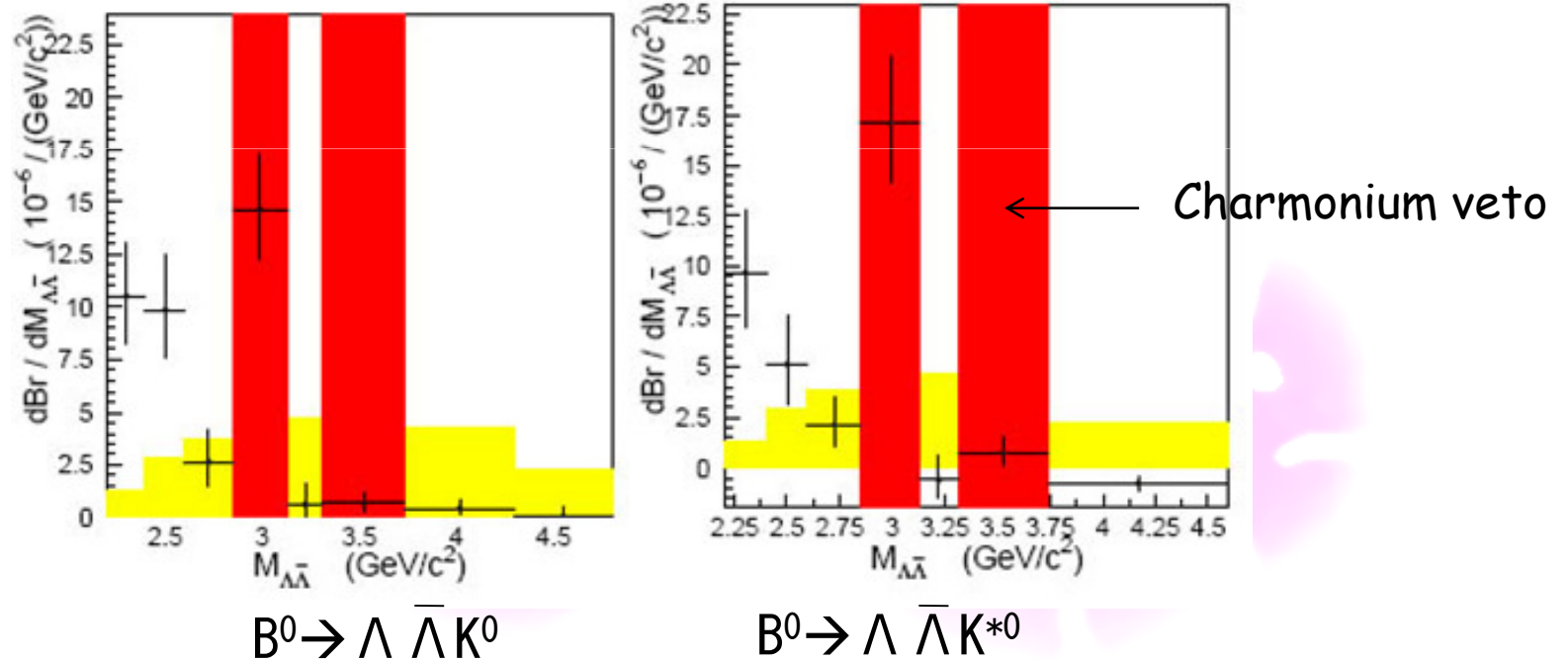




$M_{\Lambda\bar{\Lambda}}$ Distribution

- The threshold enhancement is still there for the two newly observed modes

PRD79:052006 (2009)





Comparison between $p\bar{p}h$ and $\Lambda\bar{\Lambda}h$

Branching Fractions (10^{-6})		Branching Fractions (10^{-6})	
$B^0 \rightarrow p\bar{p}K^0$	$2.51^{+0.35}_{-0.29} \pm 0.21$	$B^0 \rightarrow \Lambda\bar{\Lambda}K^0$	$4.76^{+0.84}_{-0.68} \pm 0.61$
$B^0 \rightarrow p\bar{p}K^{*0}$	$1.18^{+0.29}_{-0.25} \pm 0.11$	$B^0 \rightarrow \Lambda\bar{\Lambda}K^{*0}$	$2.46^{+0.87}_{-0.72} \pm 0.34$
$B^+ \rightarrow p\bar{p}K^+$	$5.54^{+0.27}_{-0.25} \pm 0.36$	$B^+ \rightarrow \Lambda\bar{\Lambda}K^+$	$3.38^{+0.41}_{-0.36} \pm 0.41$
$B^+ \rightarrow p\bar{p}K^{*+}$	$3.38^{+0.73}_{-0.60} \pm 0.39$	$B^+ \rightarrow \Lambda\bar{\Lambda}K^{*+}$	$2.19^{+1.13}_{-0.88} \pm 0.33$
$B^+ \rightarrow p\bar{p}\pi^+$	$1.60^{+0.22}_{-0.19} \pm 0.12$	$B^+ \rightarrow \Lambda\bar{\Lambda}\pi^+$	< 0.94

PLB659:80 (2008)

PRD79:052006 (2009)

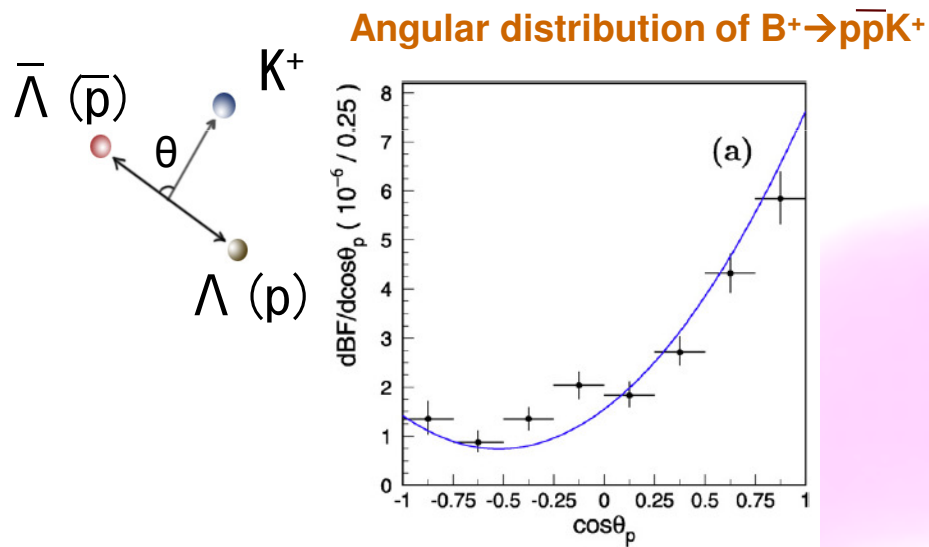
PRL100:251801 (2008)

The branching fractions indicate that there is no one to one correspondence

Dibaryon angular distribution

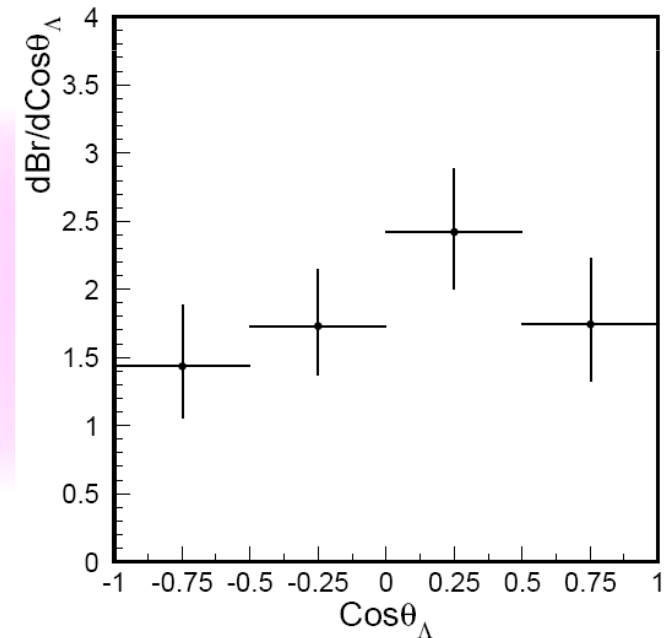
- Fit results in bins of $\cos \theta_{\Lambda}$ with $M_{\Lambda\bar{\Lambda}} < 2.85 \text{ GeV}/c^2$

PRD79:052006 (2009)



Phys. Lett. B659, 80-86 (2008)

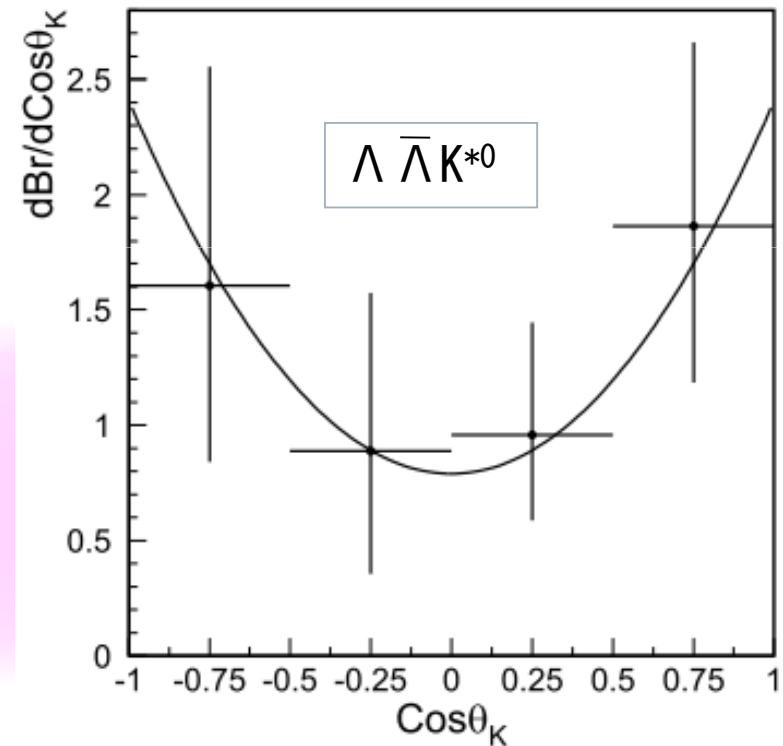
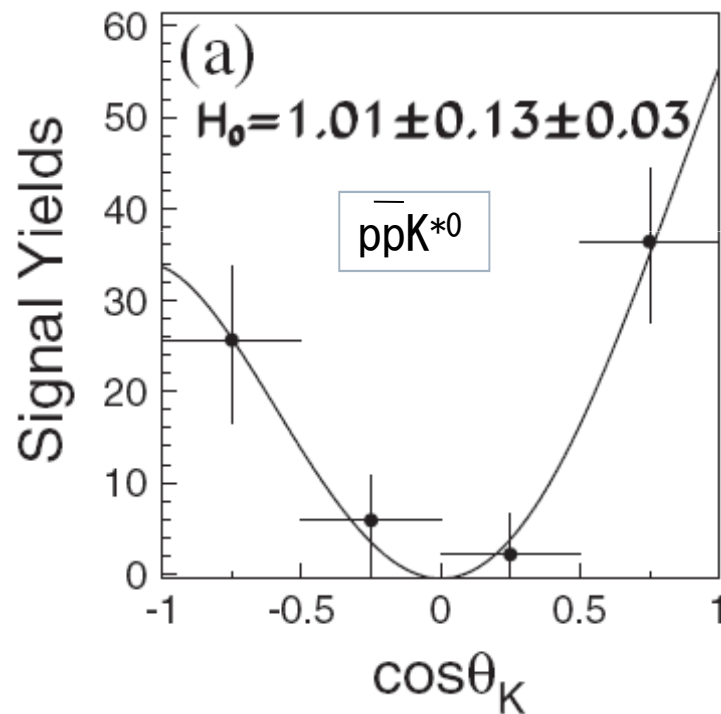
Angular distribution of $B^+ \rightarrow \Lambda \bar{\Lambda} K^+$



Polarization study of K^{*0}

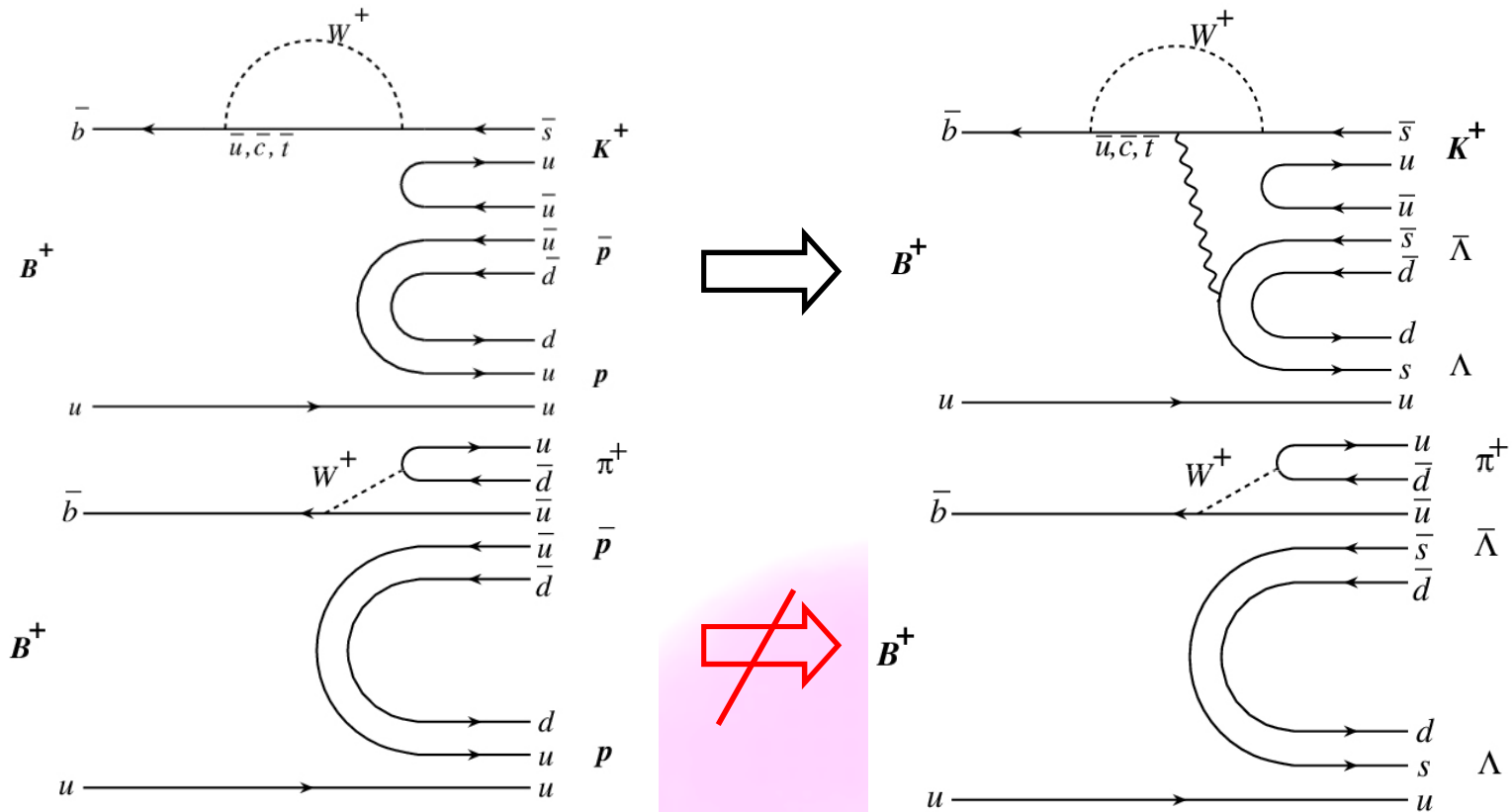
- The K^{*0} meson is found to have a fraction of $(60 \pm 22 \pm 8)\%$ in the helicity zero state.

PRD79:052006 (2009)



Phys. Rev. Lett. 100, 251801 (2008)

Discussion based on quark diagrams

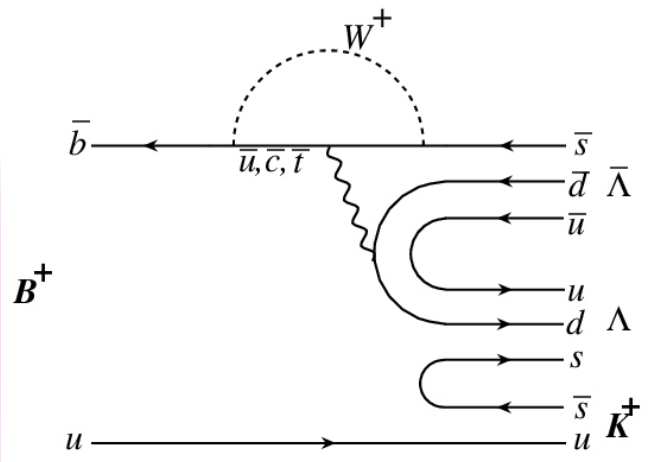
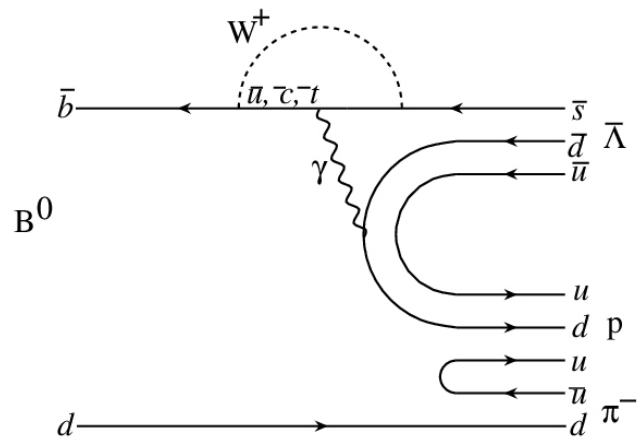
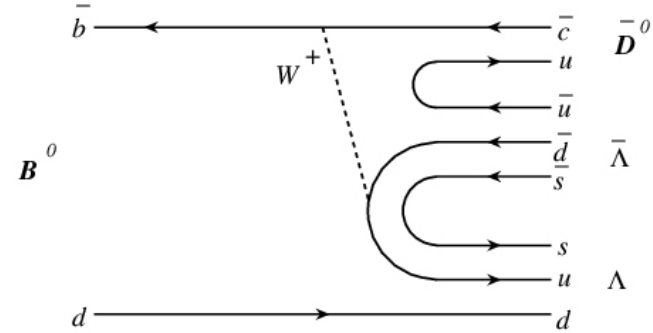
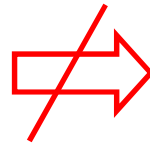
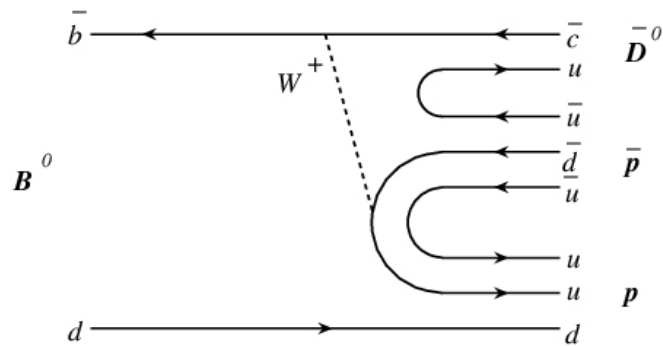


comparably smaller $BF(B^+ \rightarrow \Lambda \bar{\Lambda} \pi^+)$

considerably larger $BF(B^0 \rightarrow \Lambda \bar{\Lambda} \bar{K}^0)$

lack of peaking feature in $\cos\theta_\Lambda$ distribution for $B^+ \rightarrow \Lambda \bar{\Lambda} K^+$

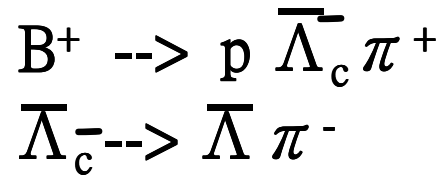
$\rightarrow B \rightarrow \Lambda \bar{\Lambda} h \neq B \rightarrow p \bar{p} h$?



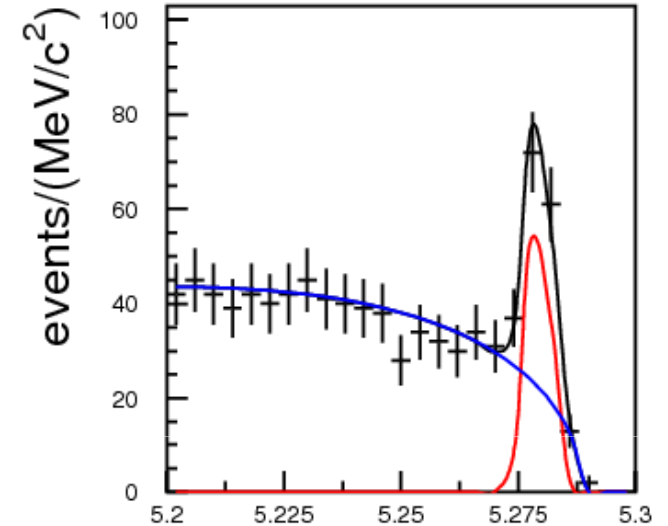
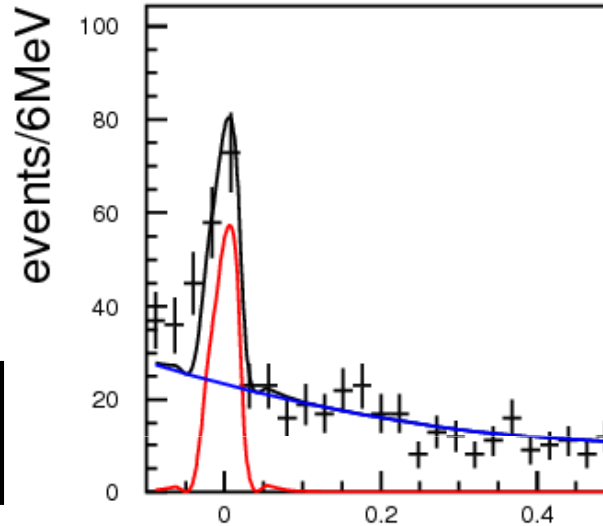
■ B to $\Lambda\bar{\Lambda}K$ mode might behave like B to $p\bar{\Lambda}\pi$ mode?



Control sample study for $B^+ \rightarrow p \bar{\Lambda} \pi^+ \pi^-$



— $B^- \rightarrow p \bar{\Lambda}_c^- \pi^-$
— Continuum



ΔE (GeV)

M_{bc} (GeV/c^2)

Eff. = 5.1%

BF = $(2.4 \pm 0.5 \text{ (stat.)}) \times 10^{-6}$

PDG value = $(2.25 \pm 0.87) \times 10^{-6}$

$B^- \rightarrow p \bar{\Lambda}_c^- \pi^-$; $\Lambda_c^- \rightarrow \Lambda \pi^-$

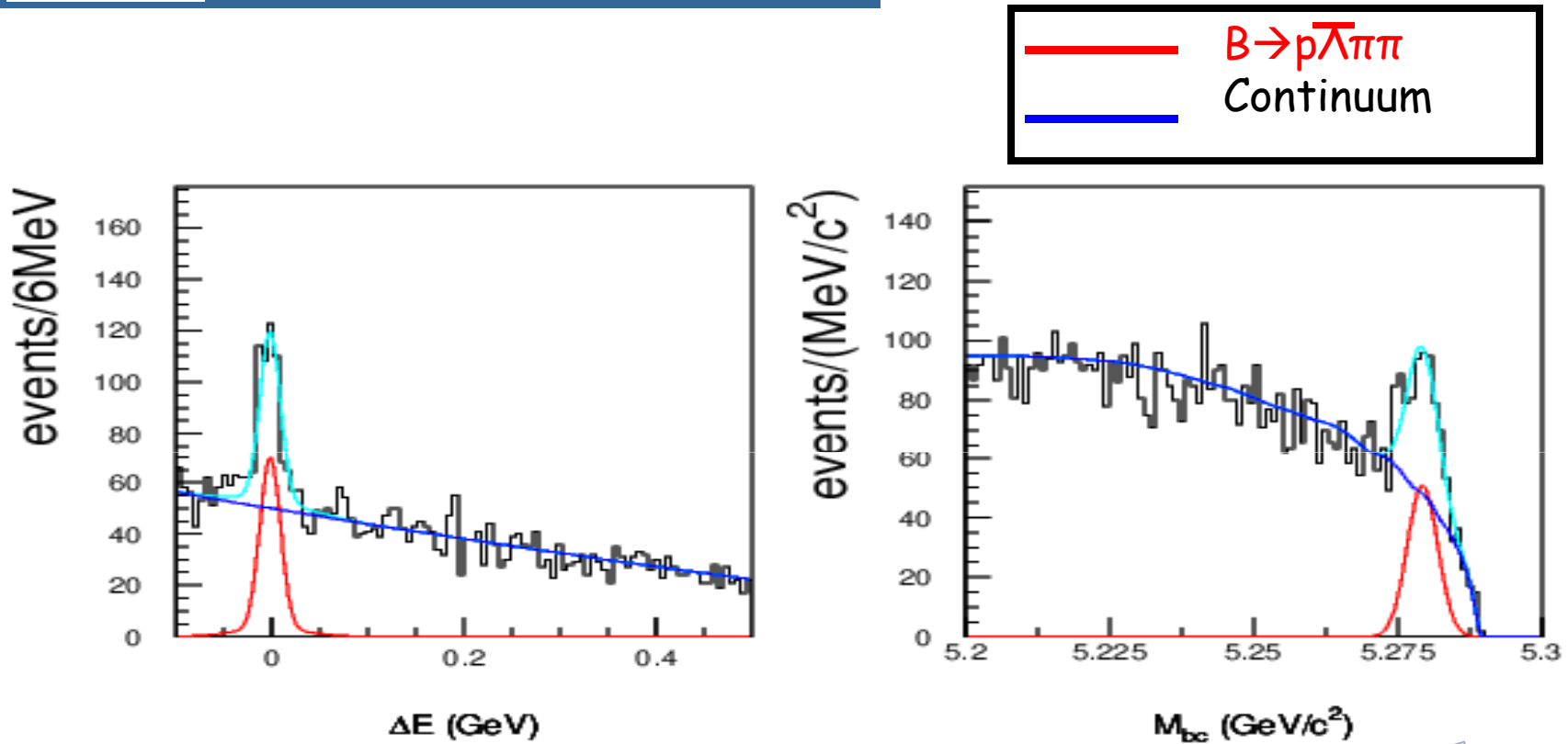
Data

Preliminary



$B \rightarrow \rho \bar{\Lambda} \pi \pi$ yield extraction

605 fb^{-1}



B yield = 348.03 ± 25.37

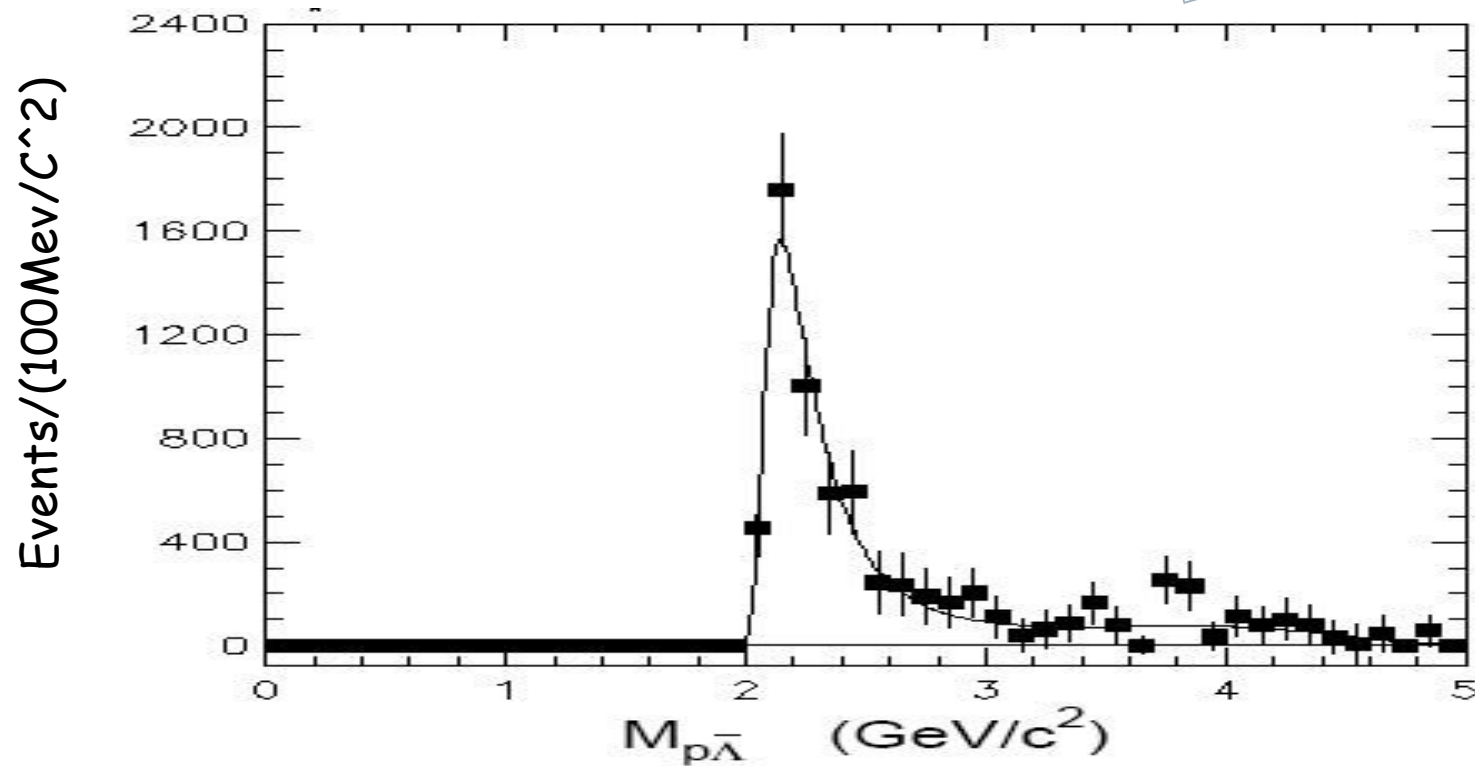
Preliminary



Threshold enhancement

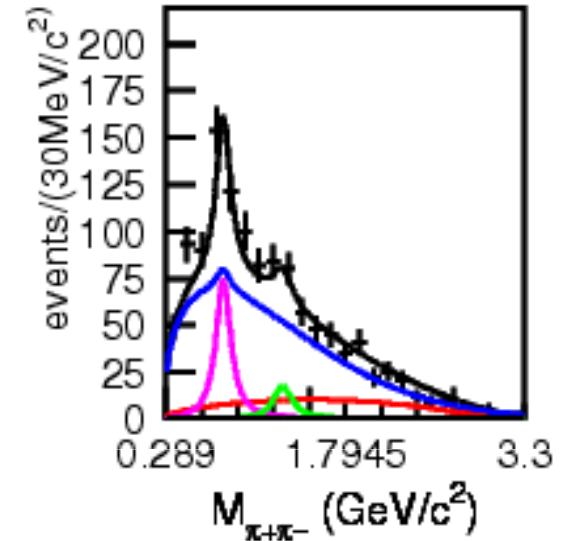
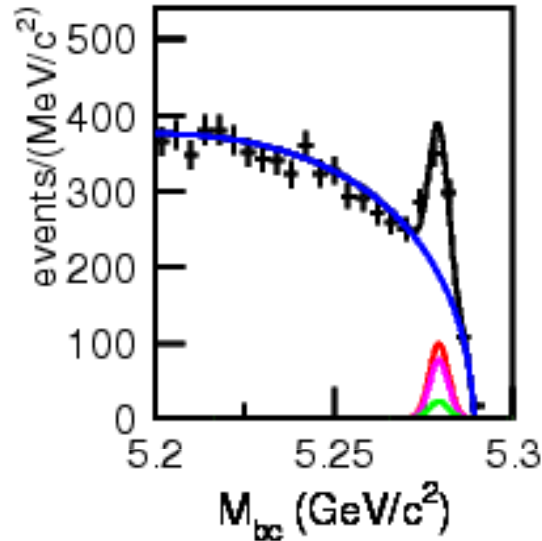
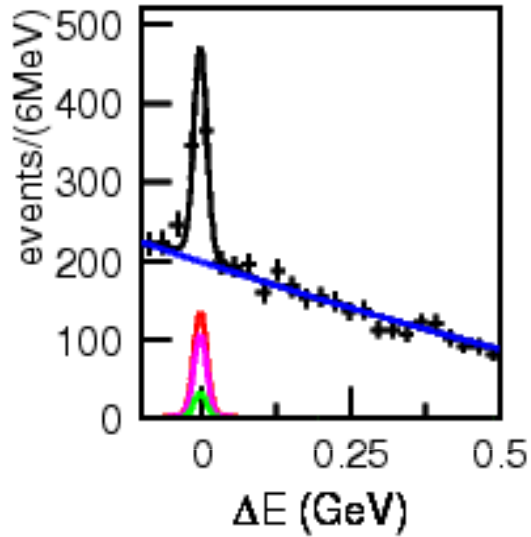
of B/eff. in $M_{p\bar{\Lambda}}$ spectrum
Fit with threshold function

Preliminary





Intermediate 3-body decay study



605 fb ⁻¹					
Decay	BF (10 ⁻⁶)	Stat. Err.	Sys. Err.	Eff.(%)	Significance
$\rho\Lambda\pi\pi$	5.84	+0.87 -0.80	± 0.82	4.32	9.1
$\rho\Lambda\rho$	4.14	+0.58 -0.55	± 0.65	4.22	9.5
$\rho\Lambda f_2$	1.11	+0.44 -0.41	± 0.21	5.20	3.0

— $B \rightarrow \rho\Lambda\pi\pi$
— $B \rightarrow \rho\Lambda\rho$
— $B \rightarrow \rho\Lambda f_2$
— Continuum

Preliminary

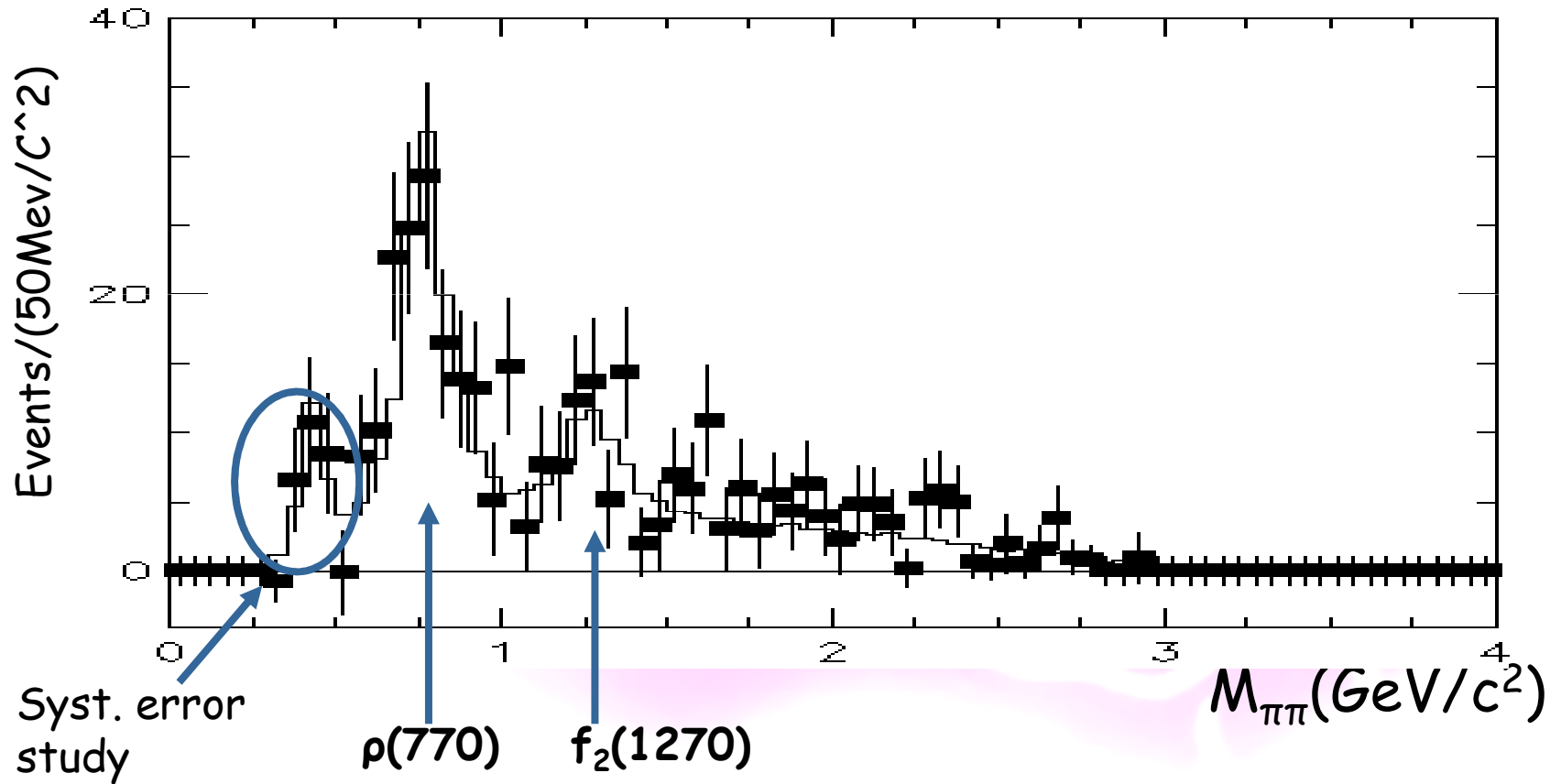


B yields in $M_{\pi\pi}$

Preliminary

Cross: B yield from the $M_{bc} - dE$ fit

Histogram: MC simulation for $\pi\pi$ and resonances



Summary

- More baryonic modes have been found in B meson decays
- Comparisons between $p\bar{p}h$ and $\Lambda\bar{\Lambda}h$ show that the underlying dominant decay diagrams may be different
- First 4-body charmless baryonic decay has been observed in $B \rightarrow p\bar{\Lambda}\pi\pi$
- Threshold enhancement is the key to understand baryonic B decays