Other B Decays at Belle

Outline

• $B^{-} \rightarrow \bar{p}\Lambda D^{(*)0}$
• $B^{0} \rightarrow J/\Psi\eta(')$
• Summary

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on behalf of the Belle Collaboration
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A test for generalized factorization

Three-body baryonic B decays with a $D^{(*)}$ meson

Under generalized factorization:
- Current type
- Transition type
- Hybrid type

Understand $b \rightarrow c$ in order to disentangle $b \rightarrow u$ & $b \rightarrow s$ in $B^+ \rightarrow p\bar{p}K^+$ decays

Prediction:
\[
B(B^- \rightarrow \bar{p}\Lambda D^0) = 1.14 \pm 0.26 \times 10^{-5}
\]
\[
B(B^- \rightarrow \bar{p}\Lambda D^{*0}) = 3.23 \pm 0.32 \times 10^{-5}
\]

C.-H. Chen, H.-Y. Cheng
C.Q. Geng and Y.K. Hsiao
PRD 78:054016(2008)
Check B yield from $D^0$ side band with good $\Lambda$ tag

Yield $= 9.37 \pm 5.20$

Under signal region $|M_{K\pi} - 1.863| < 10$ MeV
Yield $= 1.17 \pm 0.65$

Sideband definition:
$1.765 < M_{K\pi} < 1.965$ GeV
excluding $D^0$ signal region
$|M_{K\pi} - 1.863| < 20$ MeV
Result for $B^- \rightarrow \bar{\rho} \Lambda D^0$

Consistent with prediction!

$B(B^s \rightarrow \bar{\rho} \Lambda D^0) = 1.14 \pm 0.26 \times 10^{-5}$
Comparison with similar modes

Threshold enhancement in the baryon-antibaryon invariant mass

$B^+ \to \bar{p}\Lambda D^0$

$B(B^+ \to \bar{p}\Lambda D^0) = (1.18 \pm 0.15 \pm 0.16) \times 10^{-4}$

$B^0 \to p\bar{\Lambda}\pi^-$

$B(B^0 \to p\bar{\Lambda}\pi^-) = (3.23 \pm 0.33 \pm 0.29) \times 10^{-6}$

M.-Z. Wang et al.,
PRD, 76, 052004 (2007)

K. Abe. et al
PRL. 89, 151802 (2002)
Dominant background in $B^- \rightarrow \bar{\rho} \Lambda D^{*0}; D^{*0} \rightarrow D^0 \pi^0$

$B^0 \rightarrow \bar{\rho} \Lambda D^{*+}; D^{*+} \rightarrow D^0 \pi^+$

Missed the slow $\pi^+$ ($\pi^0$) from $D^{*+}$ ($D^{*0}$) and form a $\pi^0$ candidate from two random photons to reconstruct the $D^{*0}$

We denote these as CF (cross-feed) events

\[ \Delta M \equiv M_{D^{*0}} - M_{D^0} \text{(GeV/c}^2\text{)} \]
B^− \rightarrow \bar{\rho}ΛD^{*0} CF signal extraction

- Estimate CF from ΔM sideband region
- Fix the contribution of CF in ΔM signal region in order to extract true signal yield
- Fraction of CF in ΔM signal/sideband region is 0.26 ± 0.01

ΔM:[0.139,0.145] GeV/c^2 => Signal region
ΔM:[0.150,0.170] GeV/c^2 => Sideband region

(preliminary)
Result for $B^- \rightarrow \bar{p}\Lambda D^{*0}$

$\Delta M$ sideband region

$\Delta M$ signal region

$N_{CF} = 11.6 \pm 5.4$

Scaled by the factor 0.26 into signal region
Fix $N_{CF'} = 3.0 \pm 1.4$ for signal extraction

<table>
<thead>
<tr>
<th>Modes</th>
<th>$N_{signal}$</th>
<th>$S$</th>
<th>$\epsilon(%)$</th>
<th>$B(\times 10^{-5})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B^- \rightarrow \bar{p}\Lambda D^{*0}$</td>
<td>$4.3_{-2.4}^{+3.2}$</td>
<td>2.1</td>
<td>2.8</td>
<td>$1.53_{-0.85}^{+1.12} \pm 0.47$</td>
</tr>
</tbody>
</table>

$B(B^- \rightarrow \bar{p}\Lambda D^{*0}) < 4.6 \times 10^{-5}$ at 90% C.L
UL obtained using the Pole package prediction: $B(B^- \rightarrow \bar{p}\Lambda D^{*0}) = (3.23 \pm 0.32) \times 10^{-5}$
Motivation to study $B^0 \rightarrow J/\psi \eta^{(')}$ 

It is Cabibbo-suppressed and color-suppressed

From $\eta-\eta^{'}$ mixing, it is possible to estimate the $B^0 \rightarrow J/\psi \eta^{'}$ branching fraction

$$\begin{pmatrix} \eta \\ \eta' \end{pmatrix} = \begin{pmatrix} \cos \phi & -\sin \phi \\ \sin \phi & \cos \phi \end{pmatrix} \begin{pmatrix} \eta_q \\ \eta_s \end{pmatrix}$$

Effectively $\eta_q = 1 \ \eta_s = 0$

$$\frac{Br(B^0 \rightarrow J/\psi \eta^{'})}{Br(B^0 \rightarrow J/\psi \eta)} = \frac{\sin^2 \phi}{\cos^2 \phi} = \tan^2 \phi = \tan^2 40.4^\circ \sim 0.724$$
Clean J/ψ tagging

\[ J/\psi(e^+e^-) \]  \[ J/\psi(\mu^+\mu^-) \]

Signal MC \[ \eta(\gamma\gamma) \] \[ \eta(\pi^+\pi^-\pi^0) \]
Simultaneous 1d ∆E fits for different sub-decay processes

Updated Branching fraction = \((12.2 \pm 1.7 \pm 0.9) \times 10^{-6}\)

Consistent with previous measurement
\((9.5 \pm 1.7 \pm 0.8) \times 10^{-6}\) M.-C. Chang et al. Phys. Rev. Lett. 98:131803(2007)
A search for $B^0 \to J/\psi \eta'$

- No significant signal
- Upper limit set at 90% C.L. $< 1.1 \times 10^{-5}$
Summary

- With the world’s largest Y(4S) data set in hand, Belle has started updating measurements of many known rare B decay modes and continues its search for new physics.
- First observation of $B^- \rightarrow p\Lambda D^0$.
- Upper limit set for $B^- \rightarrow p\Lambda D^{*0}$ & $B^0 \rightarrow J/\psi \eta'$.
- Many other decays will be shown in the near future with better statistics and reduced systematic uncertainties.