

Weekly Report

Study of $X(3872)$ and search for $Y(4260)$ in
 $B^+ \rightarrow J/\psi \pi^+ \pi^- K^+$ decays

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Introduction

▶ Previous studies

1. BABAR [PRD 73, 011101 (2006)]

$$N_{\text{obs}}(B^+ \rightarrow X(3872)K^+) = 61.2 \pm 15.3$$

$$\mathcal{B}(B^+ \rightarrow X(3872)K^+, J/\psi\pi^+\pi^-) = (10.1 \pm 2.5 \pm 1.0) \times 10^{-6}$$

$$\mathcal{B}(B^+ \rightarrow Y(4260)K^+, Y(4260) \rightarrow J/\psi\pi^+\pi^-) < 2.9 \times 10^{-5}$$

2. Belle [PRD 84, 052004 (2011)]

$$N_{\text{obs}}(B^+ \rightarrow X(3872)K^+) = 152 \pm 15$$

$$\mathcal{B}(B^+ \rightarrow X(3872)K^+, J/\psi\pi^+\pi^-) = (8.63 \pm 0.82 \pm 0.52) \times 10^{-6}$$

3. LHCb [PRD 92, 011102(R) (2015)]

$$N_{\text{obs}}(B^+ \rightarrow X(3872)K^+) = 1011 \pm 38$$

Perform the analysis of the angular correlations in

$$B^+ \rightarrow X(3872)K^+, X(3872) \rightarrow J/\psi\pi^+\pi^- \text{ decays}$$

▶ Improve branching ratio measurement of $B^+ \rightarrow X(3872)K^+$

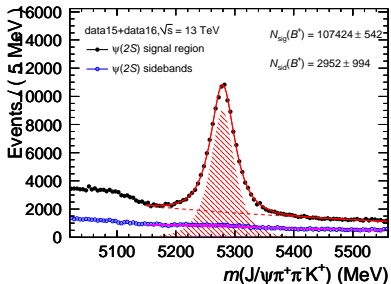
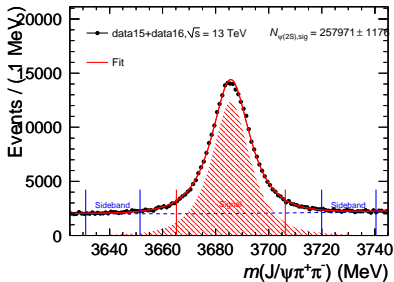
▶ Search for the $Y(4260)$ in B decays

▶ Take $B^+ \rightarrow \psi(2S)K^+$ as reference channel

Data samples

- ▶ Use $J/\psi\pi^+\pi^- + X$ events stored in BPHY5 derivation
- ▶ Following Vladimir's procedure, use Reco_BpToJpsipipiK to do private derivation
https://gitlab.cern.ch/yifang/BPhysJpsiX/tree/JpsipipiK_v1
 - ▶ Combine $J/\psi\pi^+\pi^-$ candidate with a charged track (assumed as kaon) to form B^+ candidate
 - ▶ Perform vertex fit
- ▶ Data samples:
 1. `user.yifang.data15_13TeV.JpsipipiK.ntp3.v1_DefaultOutput.root`
 2. `user.yifang.data16_13TeV.physics_BphysDelayed.JpsipipiK.ntp3.v1_DefaultOutput.root`
 3. `user.yifang.data16_13TeV.physics_Main.JpsipipiK.ntp3.v1_DefaultOutput.root`

$$B^+ \rightarrow \psi(2S)K^+$$

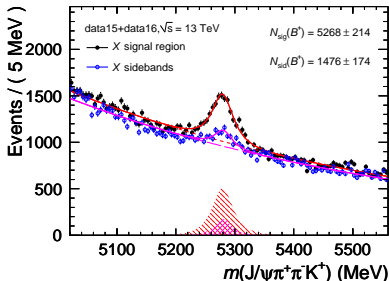
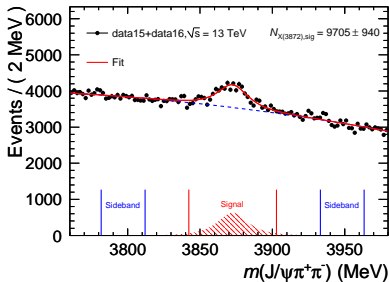


Event selection

- ▶ standard GRL
- ▶ B^+ vertex fit: $\chi^2/\text{NDF} < 3$
- ▶ $L_{xy}/\sigma(L_{xy}) > 3$
- ▶ $\tau(B^+) > 0.2$ ps
- ▶ $Q < 150$ MeV, $Q \equiv m_{J/\psi \pi^+ \pi^-} - m_{J/\psi} - m_{\pi^+ \pi^-}$

$$N_{B^+ \rightarrow \psi(2S)K^+} = 104472 \pm 1132$$

$B^+ \rightarrow X(3872)K^+$



Event selection

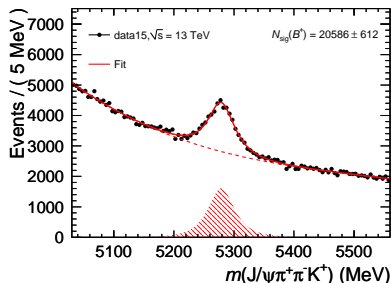
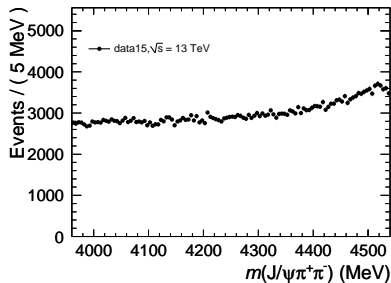
- ▶ standard GRL
- ▶ B^+ vertex fit: $\chi^2/\text{NDF} < 3$
- ▶ $L_{xy}/\sigma(L_{xy}) > 3$
- ▶ $\tau(B^+) > 0.2 \text{ ps}$
- ▶ $Q < 150 \text{ MeV}$, $Q \equiv m_{J/\psi \pi^+ \pi^-} - m_{J/\psi} - m_{\pi^+ \pi^-}$

$$N_{B^+ \rightarrow X(3872)K^+} = 3792 \pm 276$$

Ratio of yields:

$$\frac{N_{B^+ \rightarrow X(3872)K^+}}{N_{B^+ \rightarrow \psi(2S)K^+}} = 3.6\%$$

Search for $B^+ \rightarrow Y(4260)K^+$



Event selection

- ▶ standard GRL
- ▶ B^+ vertex fit: $\chi^2/\text{NDF} < 3$
- ▶ $L_{xy}/\sigma(L_{xy}) > 3$
- ▶ $\tau(B^+) > 0.2$ ps

Did not observed excess of events above background in the $J/\psi\pi^+\pi^-$ invariant mass between 4.2 and 4.4 GeV

Plan

- ▶ The BPHY5 derivation can be used for study of exclusive $B^+ \rightarrow J/\psi\pi^+\pi^-K^+$ decay
- ▶ The $B^+ \rightarrow X(3872)K^+$ signal is already there
- ▶ The $B^+ \rightarrow Y(4260)K^+$ signal is not observed
- ▶ A lot of improvements should be done, analysis is VERY preliminary
- ▶