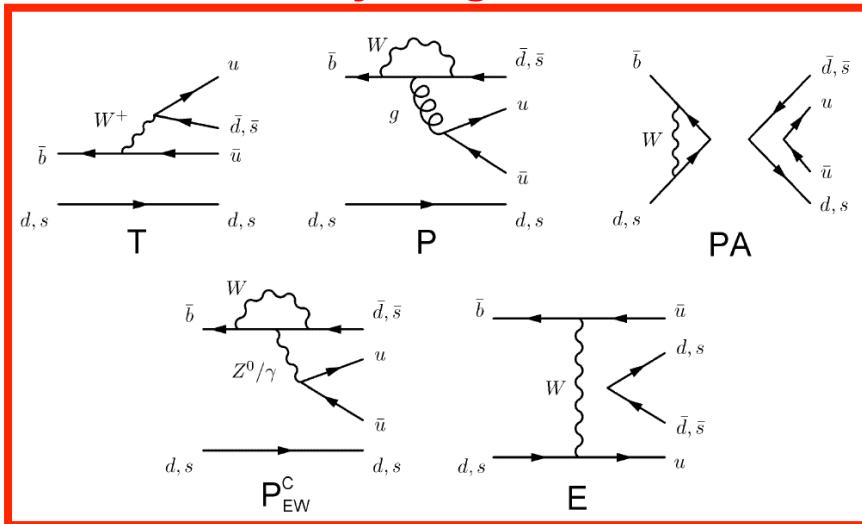


# Preliminary measurements of $A_{CP}(B^0 \rightarrow K\pi)$ and $A_{CP}(B_s \rightarrow \pi K)$ at LHCb

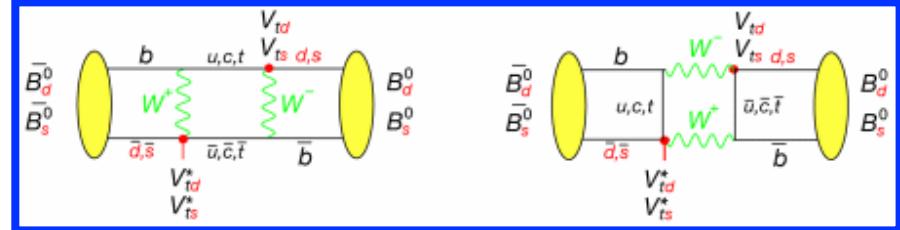
Stefano Perazzini  
On behalf of the LHCb Collaboration

Rencontres de Moriond  
17<sup>th</sup> March 2011

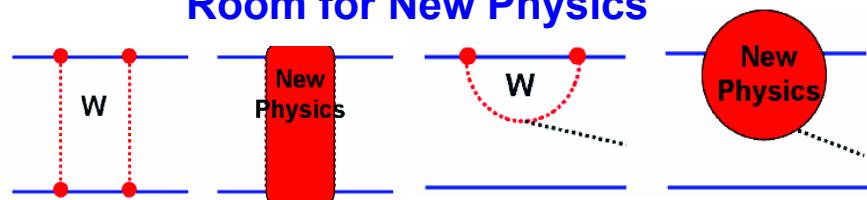
## Decay diagrams



## Mixing diagrams

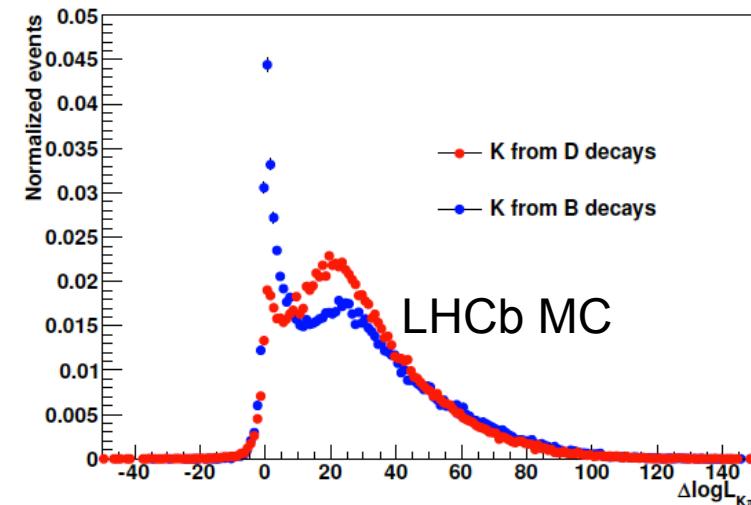
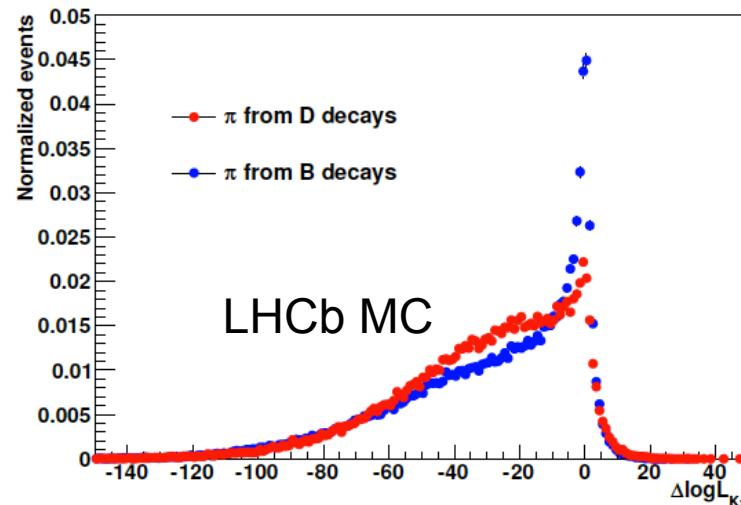


## Room for New Physics



- Many decay modes
  - $B^0 \rightarrow K\pi$ ,  $B_s \rightarrow \pi K$ ,  $B^0 \rightarrow \pi\pi$ ,  $B_s \rightarrow KK$ ,  $\Lambda_b \rightarrow pK$ ,  $\Lambda_b \rightarrow p\pi$ ,  $B^0 \rightarrow KK$ ,  $B_s \rightarrow \pi\pi$
  - both **direct** and **time-dependent CP asymmetries** can be measured
- In this talk we present preliminary measurement of **direct CP asymmetries** in  $B^0 \rightarrow K\pi$  and  $B_s \rightarrow \pi K$  decays using data collected by LHCb during 2010  $\int \mathcal{L} dt \approx 37 \text{ pb}^{-1}$
- Main steps of the analysis:
  - Calibration of particle identification
  - Determination of instrumental asymmetries
  - Measurement of B meson production asymmetry

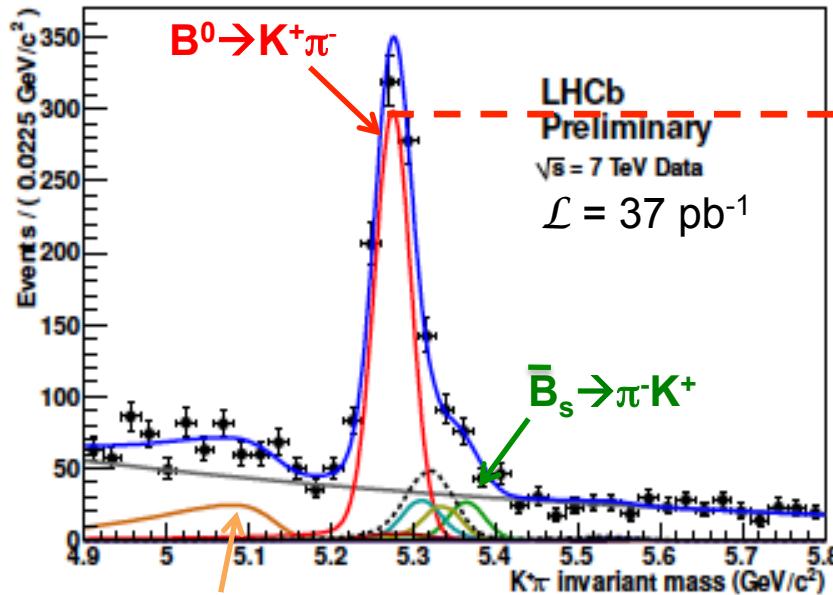
- Crucial aspect of this analysis:
  - PID needed to separate the sample into different final states
  - relative PID efficiencies needed in order to determine the yields of cross-feed backgrounds
- PID information obtained from the two RICH sub-detectors
- PID variables ( $\Delta \log \mathcal{L}$ ) distributions for true  $\pi$ , K and p can be obtained from  $D^* \rightarrow D^0(K\pi)\pi$  and  $\Lambda \rightarrow p\pi$  decays, but different phase space with respect to  $B \rightarrow hh'$



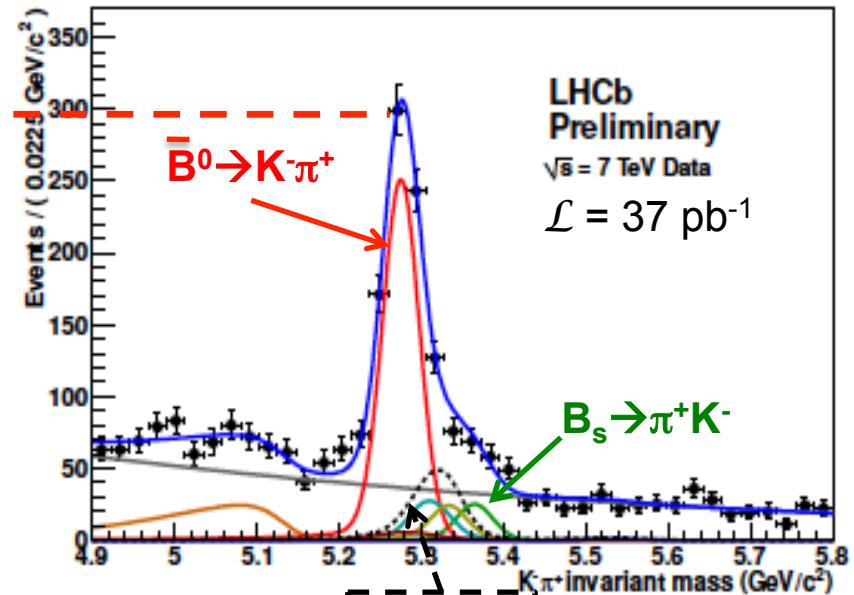
- $\Delta \log \mathcal{L}$  distributions from calibration sample have been reweighted considering the different phase spaces

$$A_{CP} = (N_{\bar{B} \rightarrow \bar{f}} - N_{B \rightarrow f}) / (N_{\bar{B} \rightarrow \bar{f}} + N_{B \rightarrow f})$$

Raw  $A_{CP}(B^0 \rightarrow K\pi) = -0.086 \pm 0.033$



3-body B decays



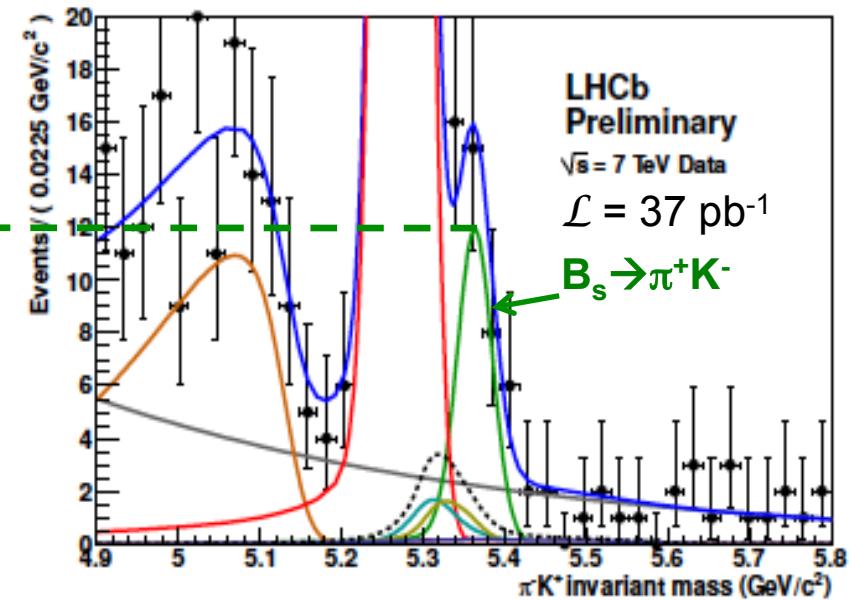
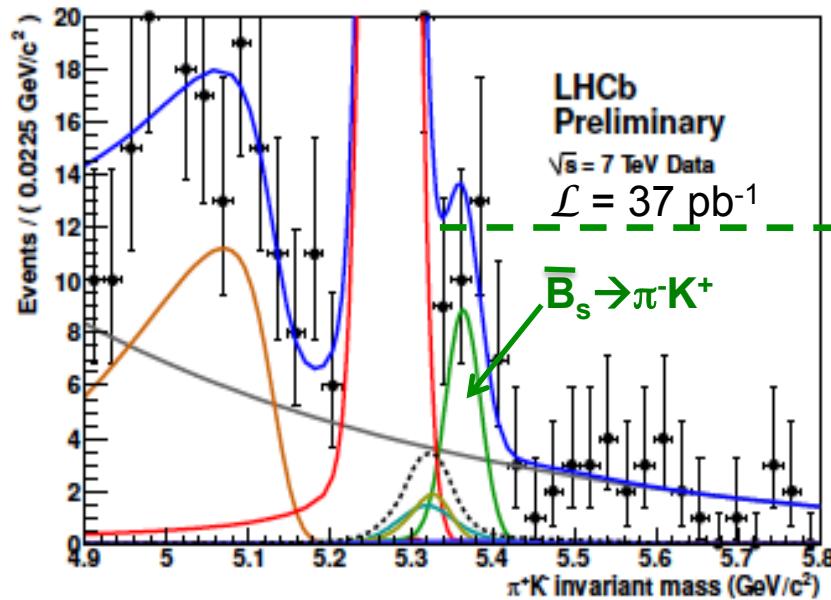
$B^0 \rightarrow \pi^+ \pi^-$   
 $B_s \rightarrow K^+ K^-$   
 $B^0 \rightarrow \pi^- K^+$

Selection optimized for  $A_{CP}(B^0 \rightarrow K\pi)$

$B^0 \rightarrow K\pi$  yield  
 $1447 \pm 50$  events

$$A_{CP} = (N_{\bar{B} \rightarrow \bar{f}} - N_{B \rightarrow f}) / (N_{\bar{B} \rightarrow \bar{f}} + N_{B \rightarrow f})$$

**Raw  $A_{CP}(B_s \rightarrow \pi K) = -0.15 \pm 0.19$**



**Selection optimized for  $A_{CP}(B_s \rightarrow \pi K)$**

$B_s \rightarrow \pi K$  yield  
 $52 \pm 10$  events

Raw asymmetry  
measured in data

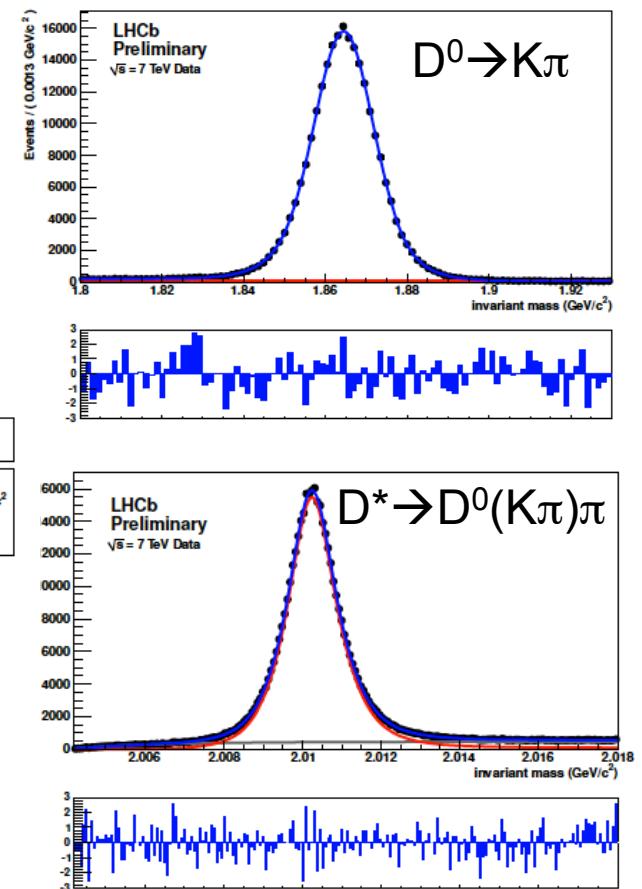
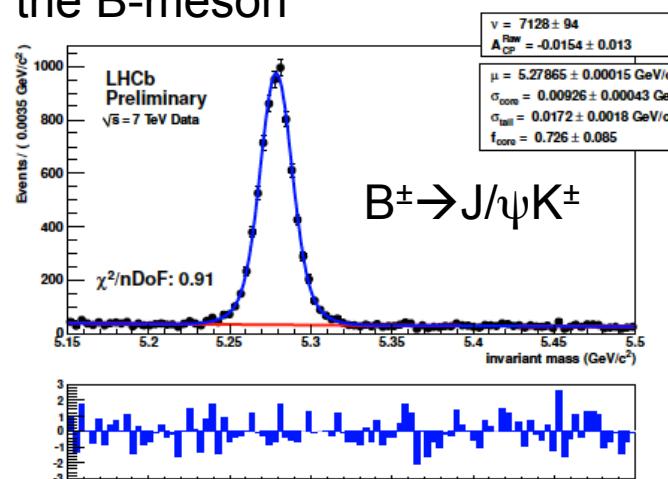
$$A_{CP} = A_{CP}^{RAW} - A_D(K\pi) - \kappa A_P$$

Instrumental charge  
asymmetry

Neutral B-meson  
production asymmetry

- $A_D(K\pi) = -0.004 \pm 0.004$  (stat.)
  - Determined using  $D^* \rightarrow D^0(K\pi)\pi$ ,  $D^* \rightarrow D^0(KK)\pi$ ,  $D^* \rightarrow D^0(\pi\pi)\pi$  and untagged  $D^0 \rightarrow K\pi$  decays
- $A_P = -0.025 \pm 0.014$  (stat.)  $\pm 0.010$  (syst.)
  - Determined using  $B^\pm \rightarrow J/\psi K^\pm$  decays
  - $\kappa$  factor depends on the selection and on the time-evolution of the B-meson

Channel	$\kappa$
$B^0 \rightarrow K^+\pi^-$	0.33
$B_s^0 \rightarrow \pi^+K^-$	0.015



- Using data collected during 2010 we provide a preliminary measurement of the direct CP asymmetries  $A_{CP}(B^0 \rightarrow K\pi)$  and  $A_{CP}(B_s \rightarrow \pi K)$

**LHCb preliminary**

$$A_{CP}(B^0 \rightarrow K^+ \pi^-) = -0.074 \pm 0.033 \pm 0.008$$

$$A_{CP}(B_s^0 \rightarrow \pi^+ K^-) = 0.15 \pm 0.19 \pm 0.02$$

**HFAG averages**

$$A_{CP}(B^0 \rightarrow K^+ \pi^-) = -0.098^{+0.012}_{-0.011}$$

$$A_{CP}(B_s^0 \rightarrow \pi^+ K^-) = 0.39 \pm 0.17$$

**Measurements already competitive with only 37 pb<sup>-1</sup> of integrated luminosity**

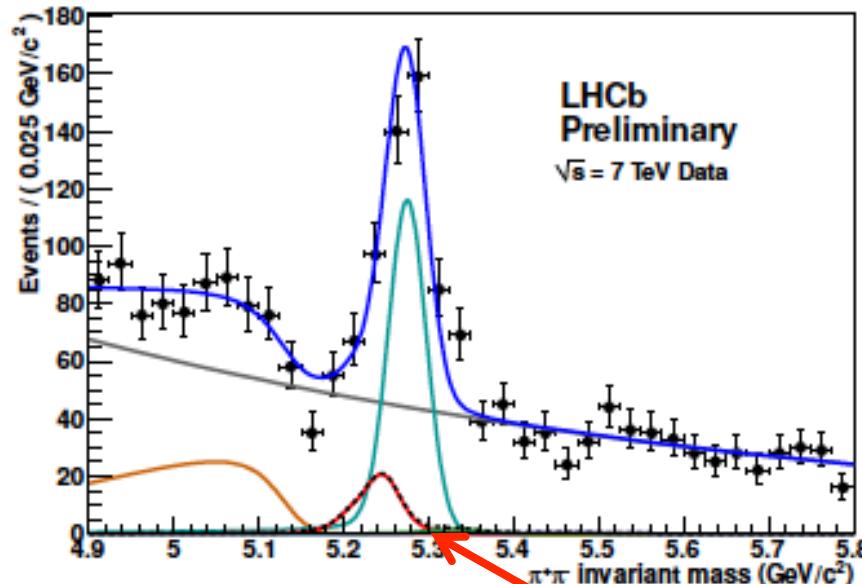
**LHCb is expected to significantly contribute  
to the world average by 2011**

- Other measurements to come in 2011
  - relative branching fractions of all decay modes
  - direct CP asymmetries in  $\Lambda_b \rightarrow pK$  and  $\Lambda_b \rightarrow p\pi$  decays
  - time-dependent CP asymmetries of  $B^0 \rightarrow \pi^+ \pi^-$  and  $B_s \rightarrow K^+ K^-$

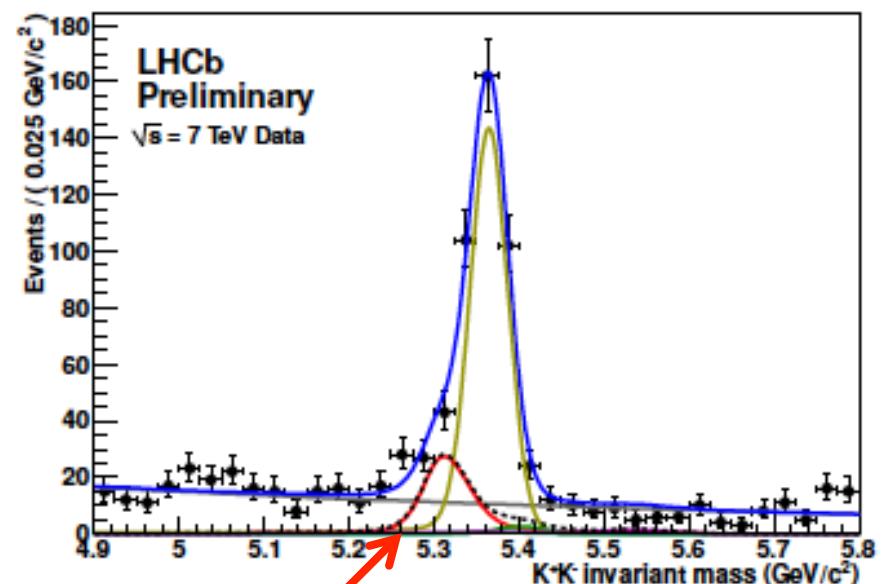
# Backup

Selection optimized for  $A_{CP}(B^0 \rightarrow K\pi)$

$B^0 \rightarrow \pi^+ \pi^-$  yield:  $275 \pm 24$



$B_s \rightarrow K^+ K^-$  yield:  $333 \pm 21$



Cross feed backgrounds  
dominated by  $B^0 \rightarrow K\pi$  decays

**Selection optimized for  $A_{CP}(B^0 \rightarrow K\pi)$**  $\Lambda_b \rightarrow pK$  yield:  $76 \pm 12$  $\Lambda_b \rightarrow p\pi$  yield:  $41 \pm 10$ 