Study of charmless B decays with the LHCb detector
-CHIPP SCHOOL 2012-

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Objectives

- Measure the relative rates and CP asymmetries of charmless penguin loop processes in B mesons decays, searching for deviations from SM predictions. In particular:

  - $B^{\pm} \to \phi\pi^{\pm}$

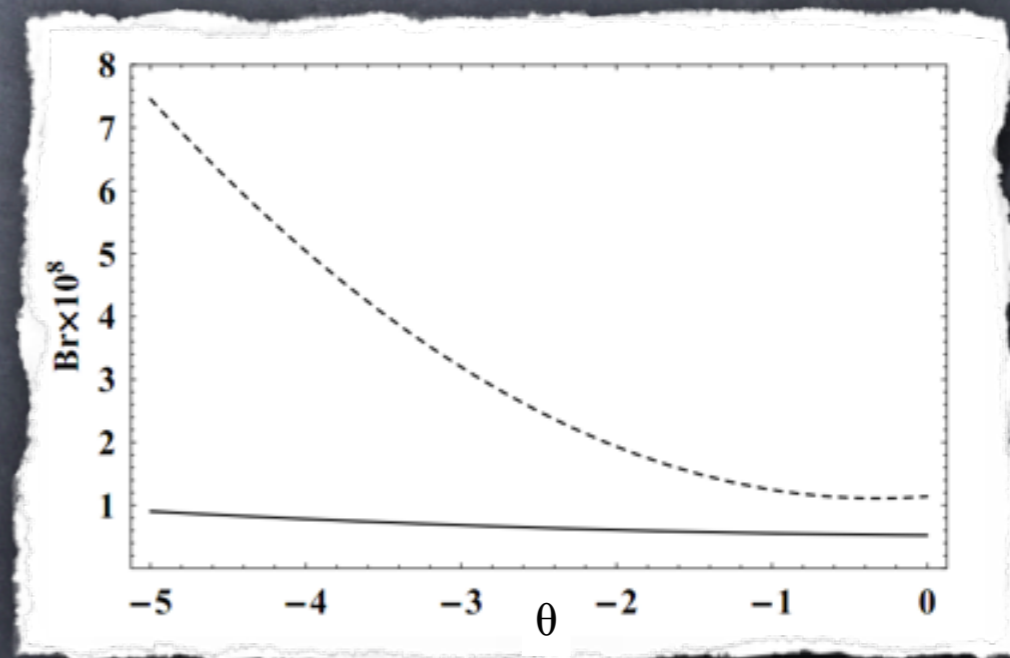 - $B^{\pm} \to \phi K^{\pm}$

$$B^+ \to \phi\pi^+$$ Not observed yet!

Currently:

- Upper limit: BR<2.4×10^{-7} at 90% CL (BABAR, PRD 74 (2006) 011102)

- SM predictions: BR between 5×10^{-9} (B. Mawlong, R. Mohanta and A. K. Giri, arXiv:0804.1231v1) and 7×10^{-8} (Ying Li, Cai-Dian Lu, Wei Wang PRD 80(2009) 014024).

Large prediction range strongly dependent on the ω-Φ mixing.

$$n\bar{n} = \frac{u\bar{u} + d\bar{d}}{\sqrt{2}}$$

$$\begin{pmatrix} \omega \\ \phi \end{pmatrix} = \begin{pmatrix} cos\theta & sin\theta \\ -sin\theta & cos\theta \end{pmatrix} \begin{pmatrix} n\bar{n} \\ s\bar{s} \end{pmatrix}$$

BR(B+->ϕπ+) = 3.2×10^{-8} with θ = -(3.0±1.0)°

Dependence of the BR on the mixing angle θ. The dot-dashed and solid lines correspond to charged and neutral channel, respectively.
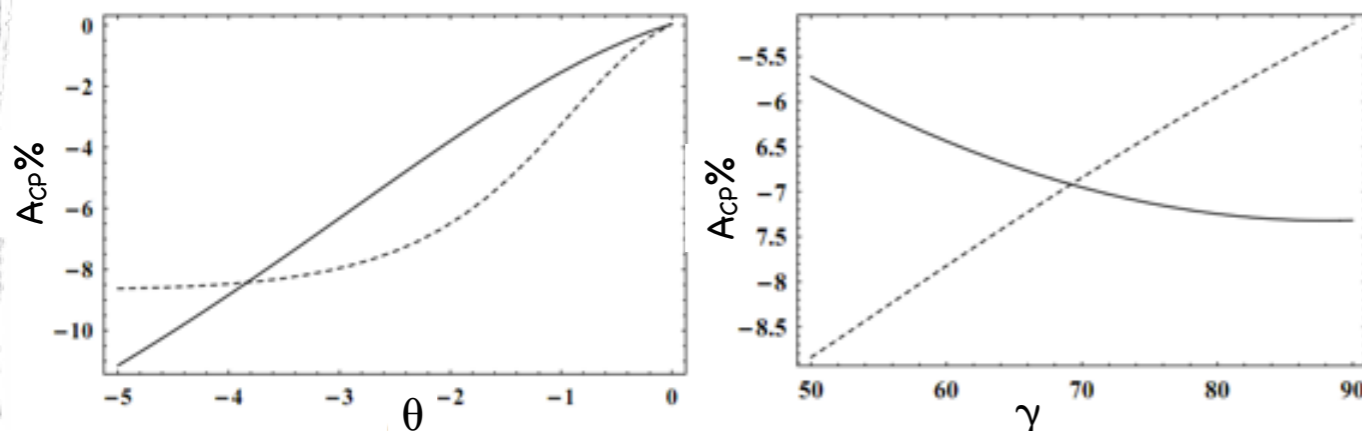
Why is this channel interesting?

- channel sensitive to New Physics (Penguin decay with small Branching Ratio)

- direct CP observable (also sensitive to NP)
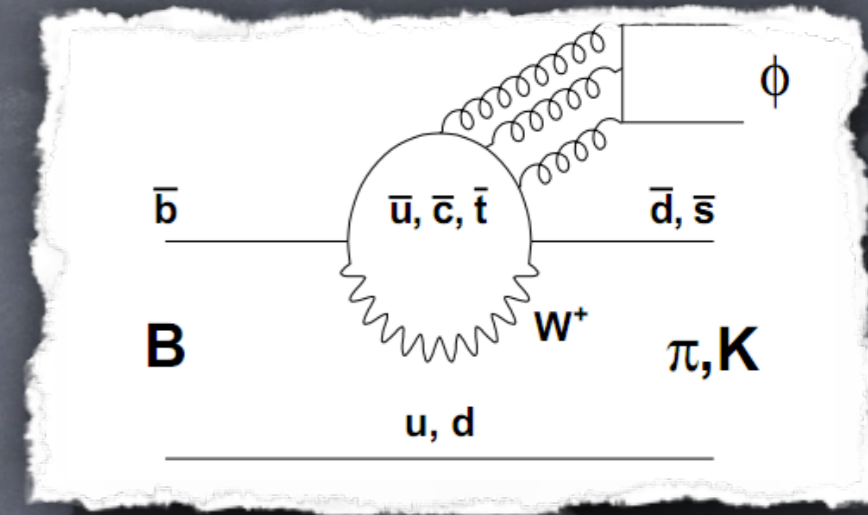
$$A_{CP} = \frac{BR(B^- \to \phi\pi^-) - BR(B^+ \to \phi\pi^+)}{BR(B^- \to \phi\pi^-) + BR(B^+ \to \phi\pi^+)}$$

SM prediction: $\quad A_{CP} = (-8.0^{+0.9+1.5}_{-1.0-0.1})\%$

with: $\quad \gamma = (58.6 \pm 10)° \qquad \theta = -(3.0 \pm 1.0)° \quad$ [PRD 80 (2009) 014024]

Dependence of the direct CP asymmetries (in units of %) on the mixing angle θ (left panel) and the CKM phase angle γ (right panel), where dot-dashed lines and the solid lines correspond to charged channel and neutral channel respectively.

Goals:

- Measure the BR and A_{CP} for $B^+ \to \phi K^+$

PDG values: $$BR(B^+ \to \phi K^+) = (8.3 \pm 0.7) \times 10^{-6}$$

$$A_{CP}(B^+ \to \phi K^+) = (-0.01 \pm 0.06)\%$$

- Measure the ratio of the two Branching Ratios : $R = \dfrac{BR(B^+ \to \phi \pi^+)}{BR(B^+ \to \phi K^+)}$

From $B^+ \to \phi \pi^+$ theoretical predictions: $R = 0.6\text{-}8.3 \times 10^{-3}$
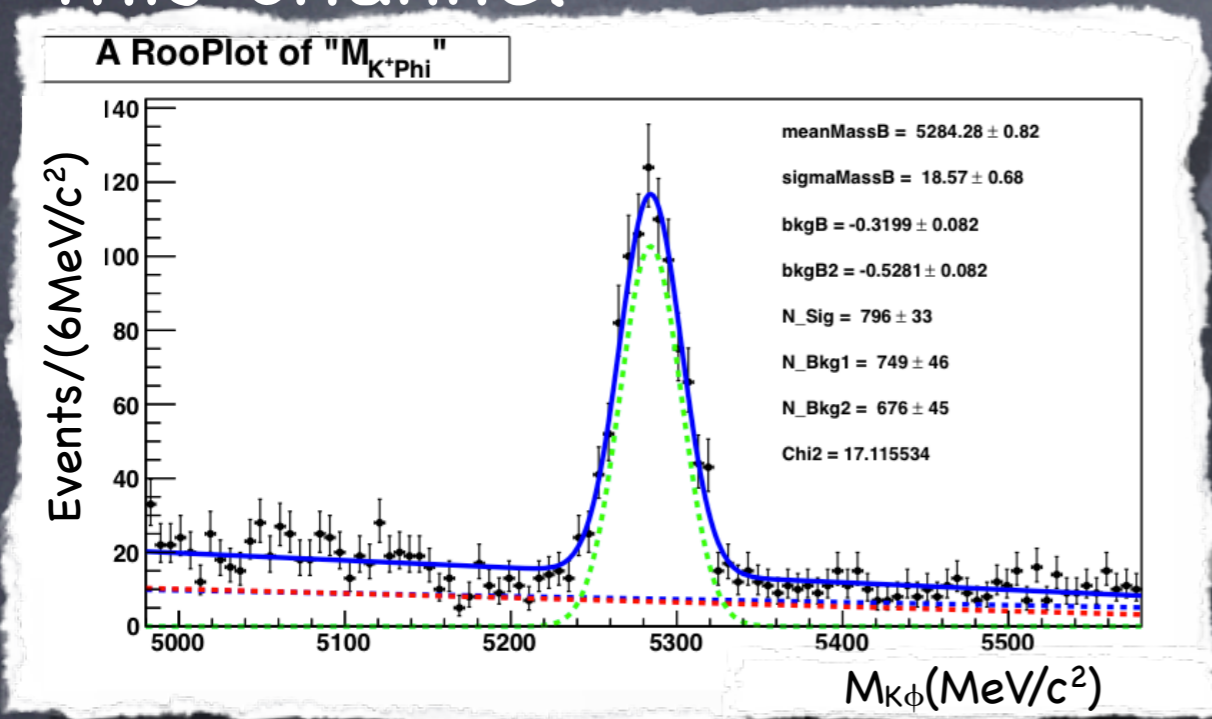
Assuming (naively) the same efficiencies for both mode, between 2000 and 20000 events are needed in the $B^+ \to \phi K^+$ channel to observe ~ 10 events $B^+ \to \phi \pi^+$

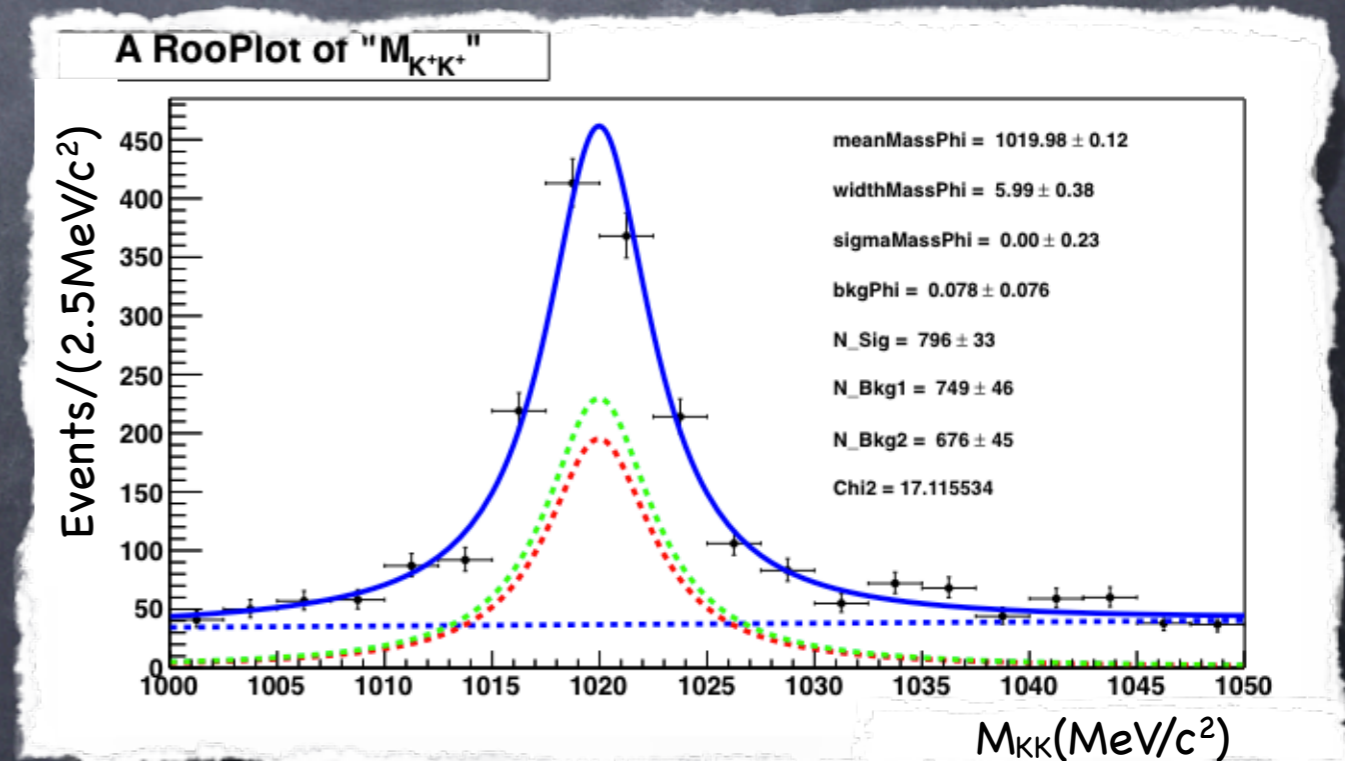- Depending on the size of the observed signal, measure A_{CP} for $B^+ \to \phi \pi^+$

First results - B⁺->φK⁺

Preliminary study of $B^+ \to \phi K^+$ using a specific selection for this channel

Two dimensional fit of B Mass and φ Mass

Data taken with Down polarity of the magnet:
796 signal events with 165 pb⁻¹ of data

Conclusion

- Number of expected events with the full 2011 data sample (1.05 fb^{-1}): 5.1- 5.2k events.

- From preliminary results $B^+ -> \phi\pi^+$ analysis seems to be feasible.

- $B -> \phi\pi^+$ and $B -> \phi K^+$ analysis will be performed in 2011-2012 with the 1 fb^{-1} of data collected in 2011.