Measurement of $D_s^\pm$ Production Asymmetry at LHCb

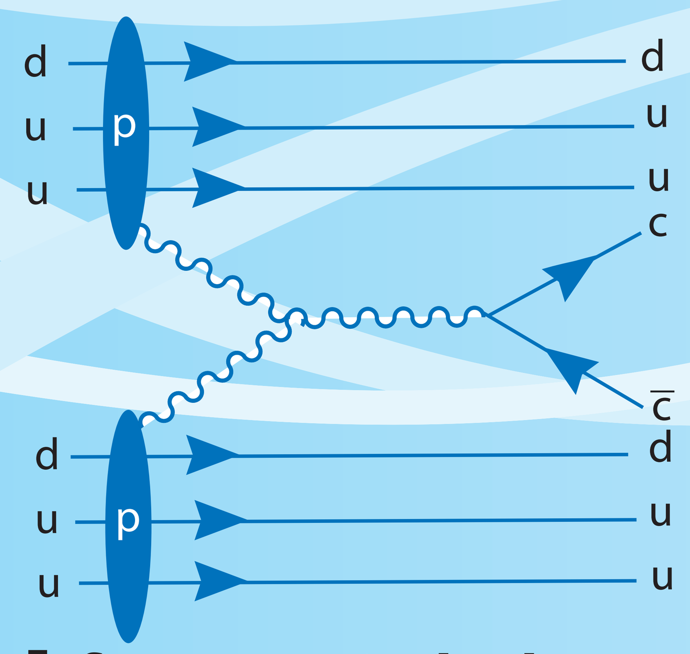
Zhou Xing
on behalf of the LHCb collaboration

Email: zhxing@syr.edu
Syracuse University, NY 13244, USA

LHCb-PAPER-2012-009

Motivation

Production of charm and beauty hadrons at LHC in 7 TeV pp collisions is quite prolific. In pp collisions the production of charm particles need not be the same as anti-charm particles. While production diagrams are flavour symmetric, the hadronization process may prefer anti-particles to particles or vice versa.



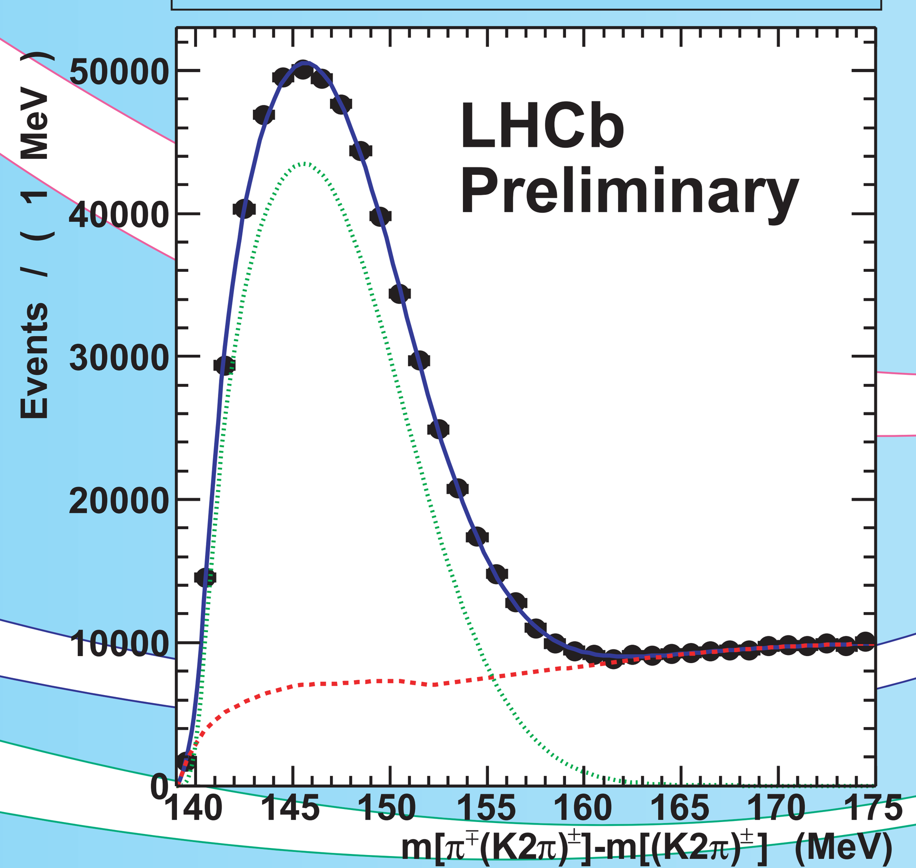
$$A_P = \frac{\sigma(D_s^+) - \sigma(D_s^-)}{\sigma(D_s^+) + \sigma(D_s^-)}$$

If the $c\bar{c}$ fragments independently equal amount of D and $\bar{D}$ mesons will be produced, if, however, they combine with valence quarks in beam protons the $\bar{c}$ quark can form a meson, typically $\bar{D}^0$ or D^-_s, while c quark can form a charmed baryon. Therefore we might expect a small excess of D^-_s over D^+_s.

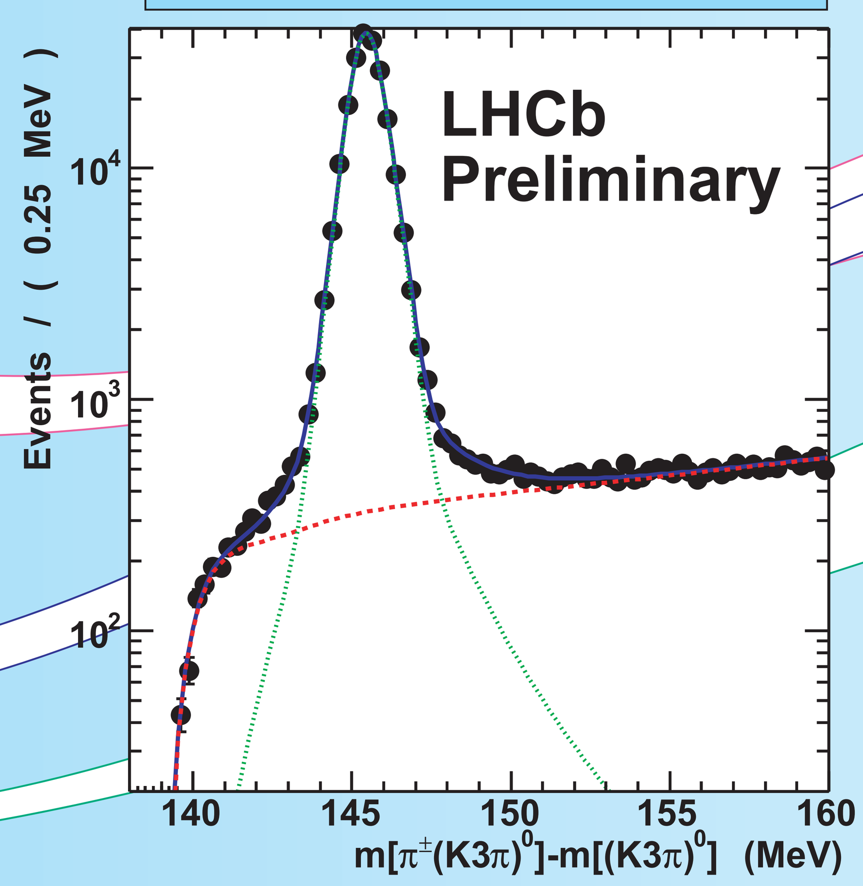
Measurement of relative pion detection efficiency

There are sufficient kinematic constraints to detect the decay $D^{*+} \to D^0(K^-\pi^+\pi^-\pi^+)\pi_s^+$ even if one pion is missed.

Partial Reconstruction

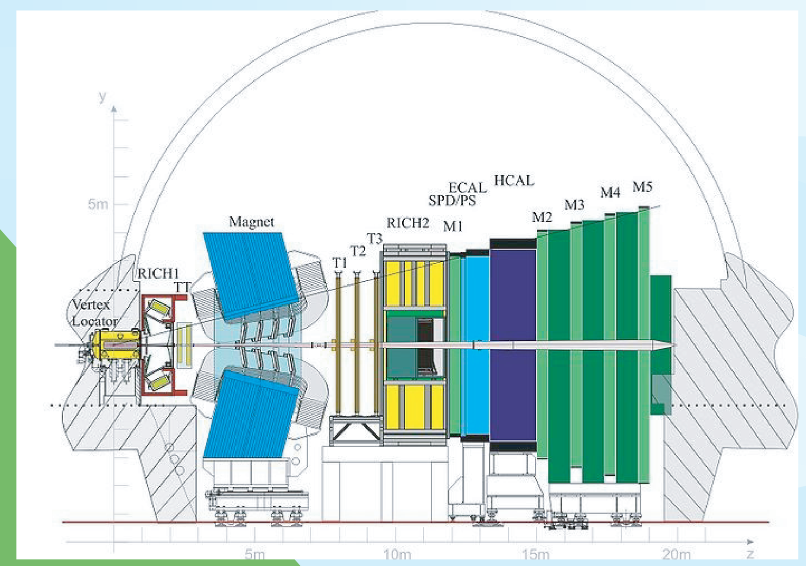


Full Reconstruction



Analysis Strategy

The LHCb Experiment - Forward Spectrometer



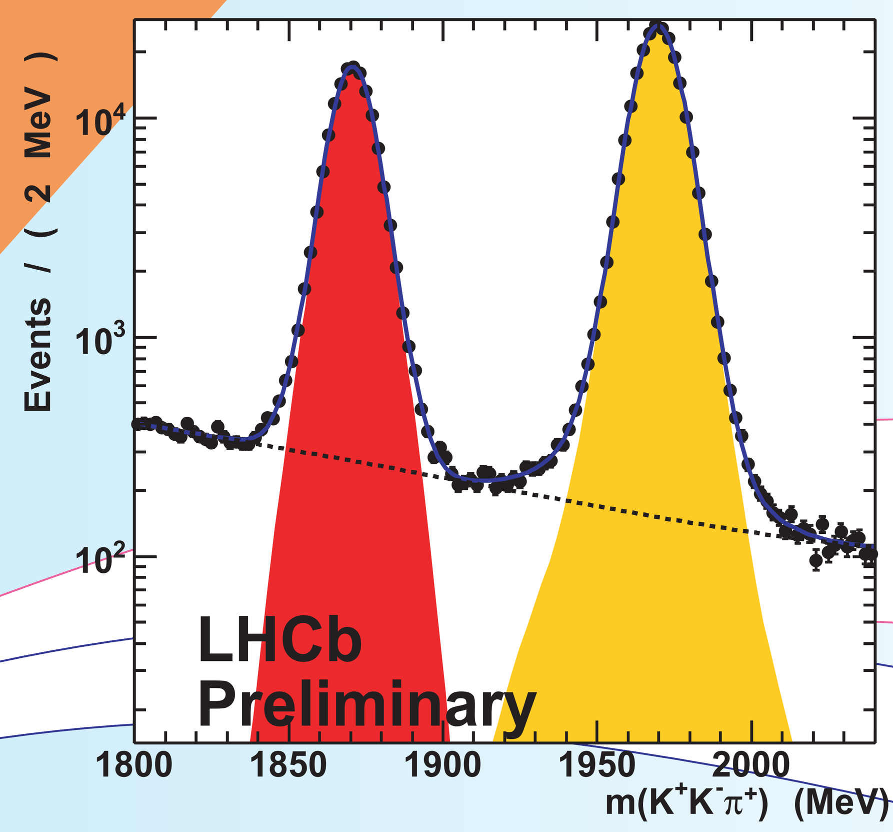
Major components:
–>Vertex Locator
–>Tracking System
–>Magnet (3.7 Tm)
–>RICH
–>Calorimeter
–>Muon Chamber

Introduction

We utilize the decay $D^+_s \to \phi(K^+K^-)\pi^+$ and its charge conjugate which are symmetric in kaon productions to measure the production asymmetry. Since it is Cabbibo allowed no significant CP asymmetries are expected, however, we need to measure the relative π^+ and π^- detection efficiencies.

$$A_{raw} = A_{cp} + A_D(\pi) + A_P + A_D(K^+K^-)$$

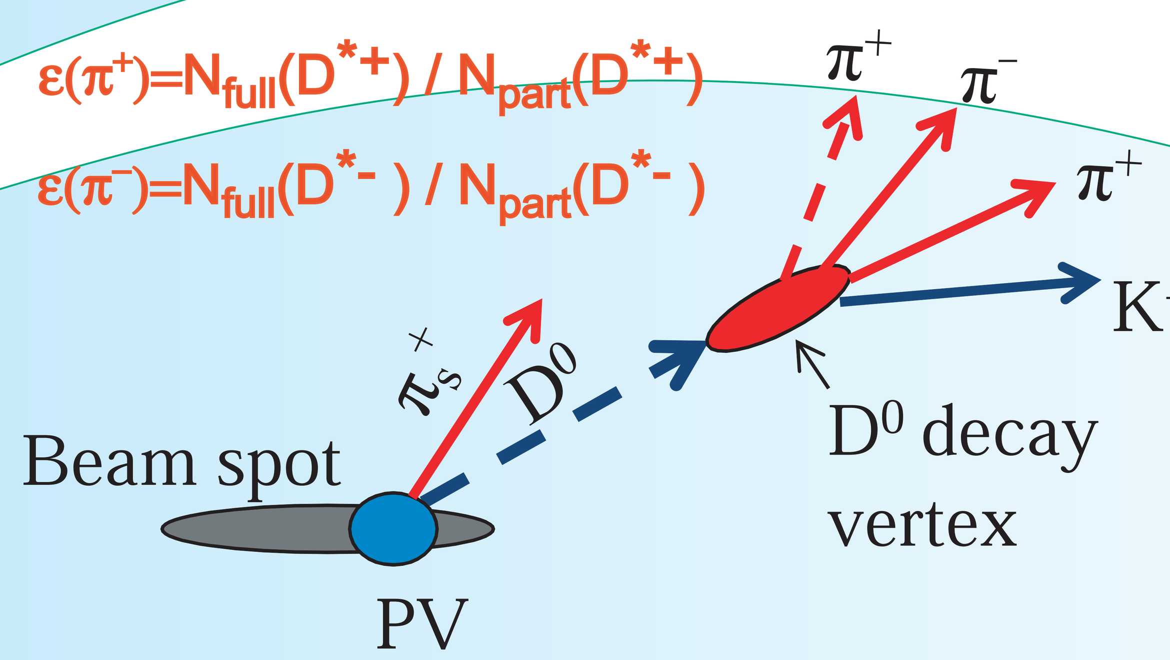
Measurement of raw $D_s^\pm$ asymmetry



- Invariant mass of K^+K^- within 20 Mev of the ϕ mass

Binned maximum likelihood fit

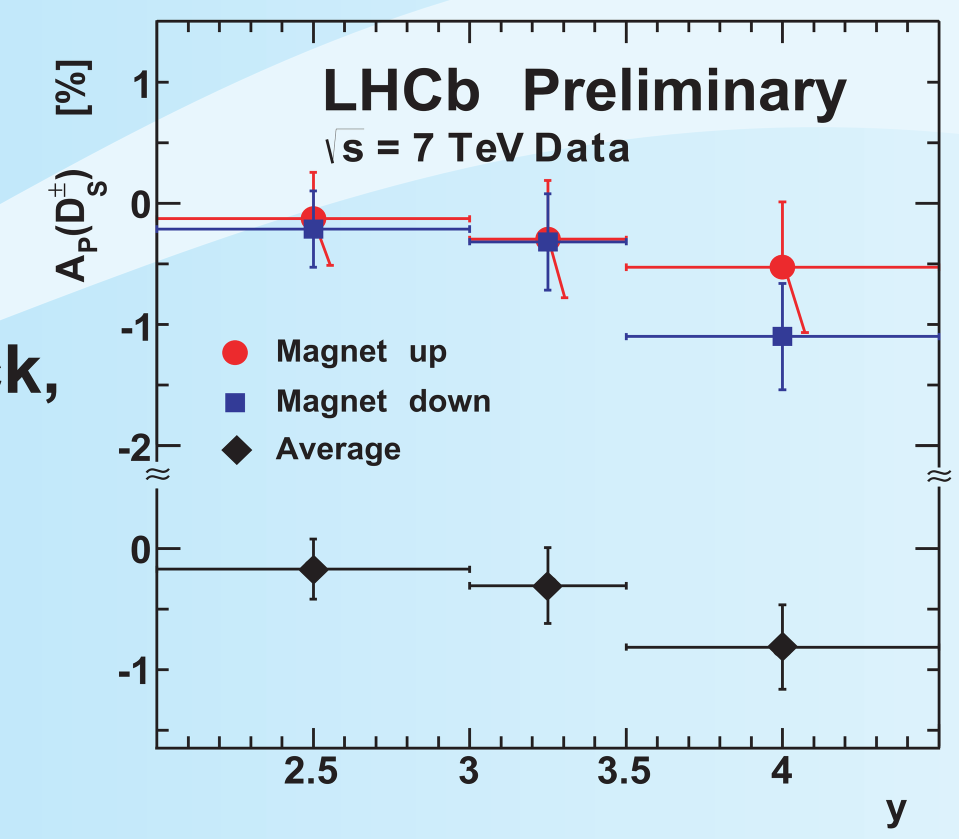
$$\varepsilon(\pi^+) = N_{full}(D^{*+}) / N_{part}(D^{*+})$$
$$\varepsilon(\pi^-) = N_{full}(D^{*-}) / N_{part}(D^{*-})$$

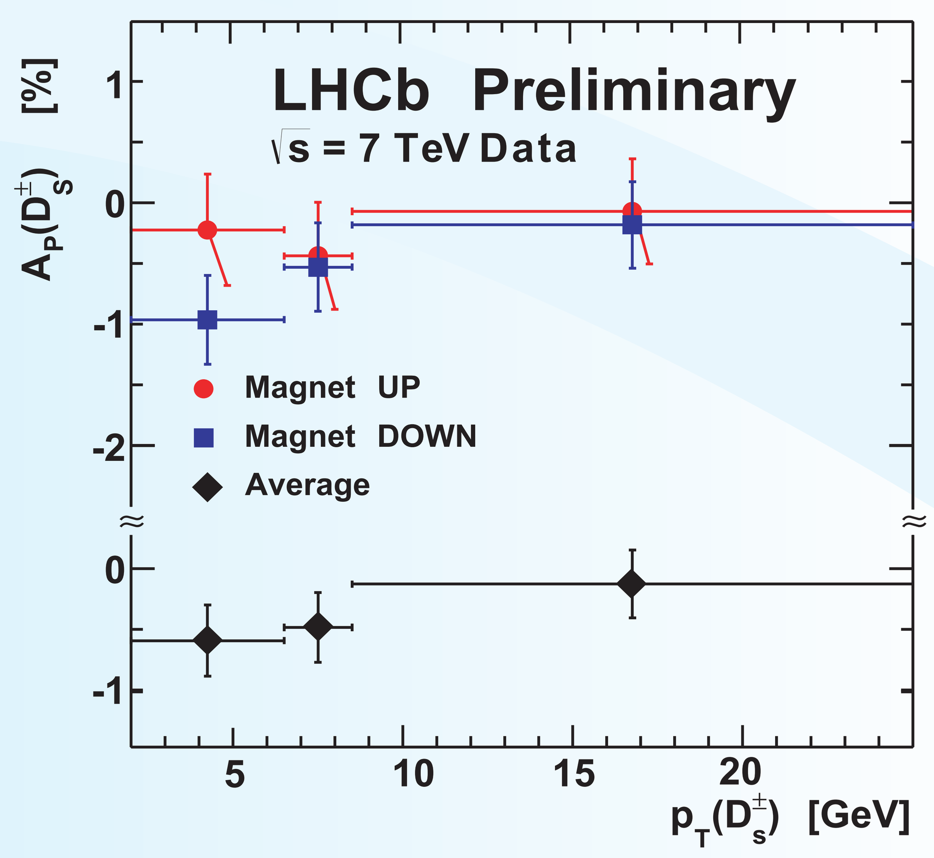


- Kinematic fitting used to infer the "missing" pion's momentum vector in partial reconstruction

Results

Relative pion efficiency corrections are applied as a function of pion track azimuthal angle in two momentum intervals.
Magnet up and down data are treated separately for both signal and control samples as cross check, compatible results are obtained at permil-level precision.





Conclusions

We have developped a method using partially and fully reconstructed $D^{*\pm}$ decays to measure the relative pion detection efficiency. Appying this method to directly produced $D_s^\pm \to \phi(K^+K^-)\pi^\pm$ decays we measure the overall production asymmetry in the rapidity region 2 to 4.5 , and p_T > 2GeV as:

$$A_P(D_s^\pm) = \frac{\sigma(D_s^+) - \sigma(D_s^-)}{\sigma(D_s^+) + \sigma(D_s^-)} = (-0.39 \pm 0.22 \pm 0.08)\%$$

LHCC poster session 2012