The B_s Semileptonic Decay Asymmetry, a^s_{sl}


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New results cast light on semileptonic B_s asymmetry

The LHCb experiment has made the most precise measurement to date of the asymmetry a^s_{sl}, which is a measure of a flavour-specific matter-antimatter asymmetry in B-mesons and a test for physics beyond the Standard Model.

In 2010, and with an update in 2011, the Fermilab DØ collaboration reported an asymmetry in the semileptonic decays of B mesons decay into muons, which they observed in the number of events containing same-sign dimuons (CERN Courier July August 2010 p6). The most recent result, using almost the full DØ data sample of 9 fb^{-1}, gives an asymmetry of about -1%, and differs by 3.9 σ from the tiny value predicted within the framework of the Standard Model (Abazov *et al.* 2011). If confirmed, it would indicate the presence of new physics.

Same-sign dimuons can be produced from the decay of pairs of neutral B mesons, which can mix between their particle and antiparticle states. Owing to the inclusive nature of the DØ measurement, the asymmetry, denoted A^b_{sl}, is a sum of contributions from the

Dimuon asymmetry in B mesons

Alessandra Borgia

Syracuse University

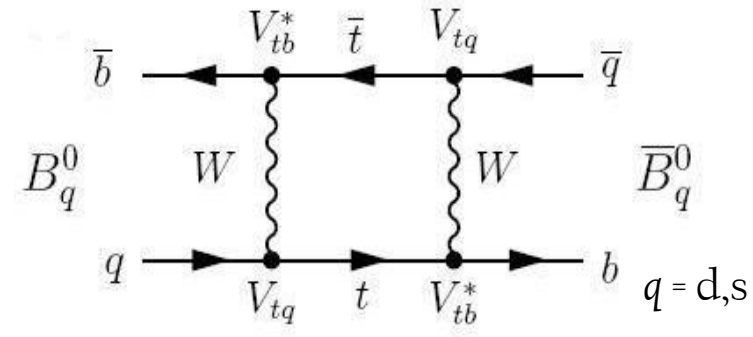
Young Physicist Lightning Round

US LHC Users Organization

FNAL, Batavia, Illinois

October 20, 2012

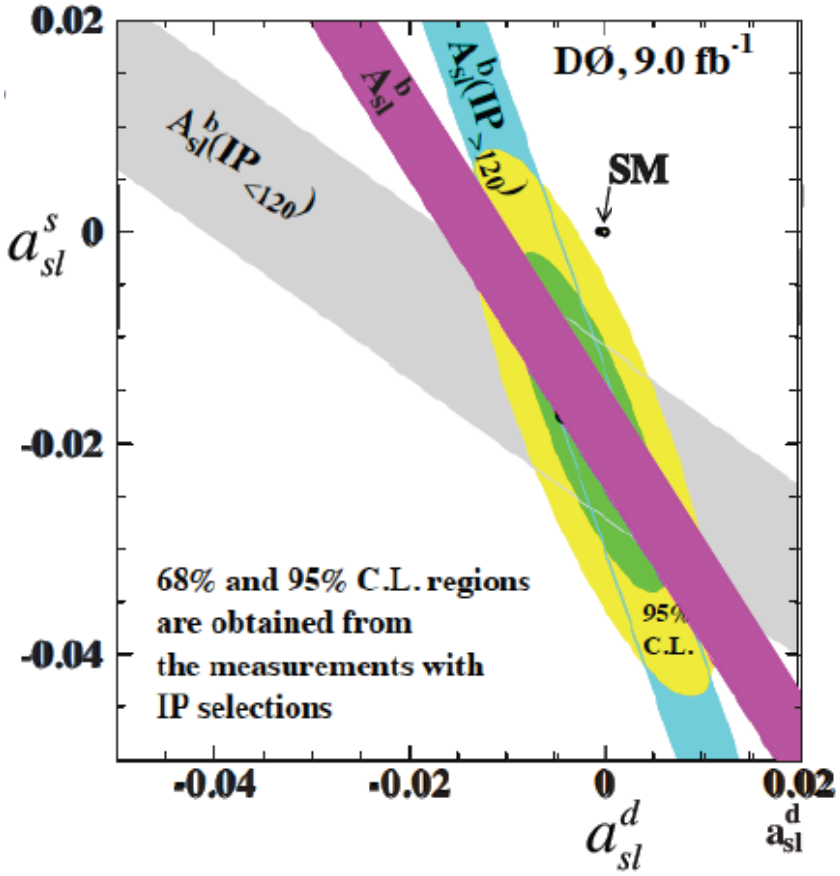
Flavor Specific CP Violating Asymmetry



q = d,s

$$a_s = 1 - \left|\frac{q}{p}\right|^2 = \mathrm{Im}\left(\frac{\Gamma_{12}^s}{M_{12}^s}\right) + O\left(\left(\mathrm{Im}\left(\frac{\Gamma_{12}^s}{M_{12}^s}\right)\right)^2\right) = \left|\frac{\Gamma_{12}^s}{M_{12}^s}\right| \sin\phi_{12}^s$$

$$\phi_{12}^s = \arg\left(-\frac{M_{12}^s}{\Gamma_{12}^s}\right)$$



DØ's result

$A^b_{sl} = (-0.787 \pm 0.172 \pm 0.093)\%$

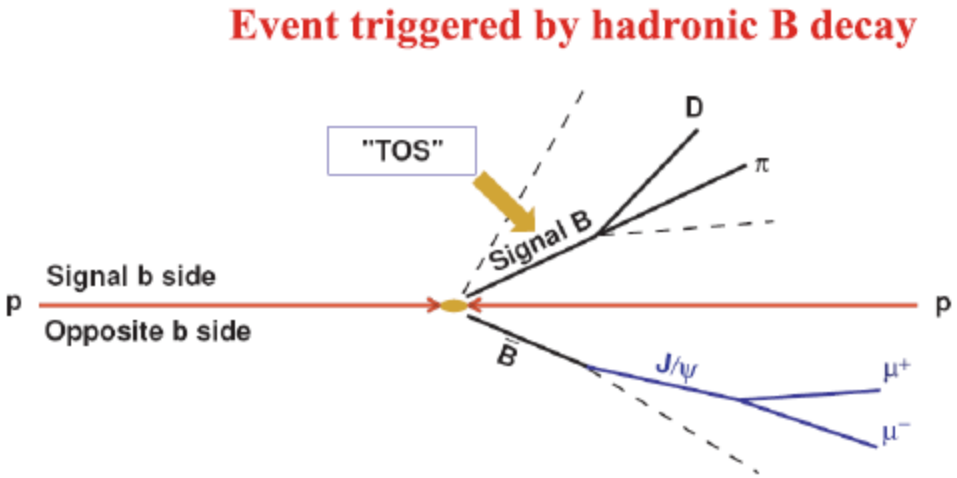
- 3.9σ from SM!

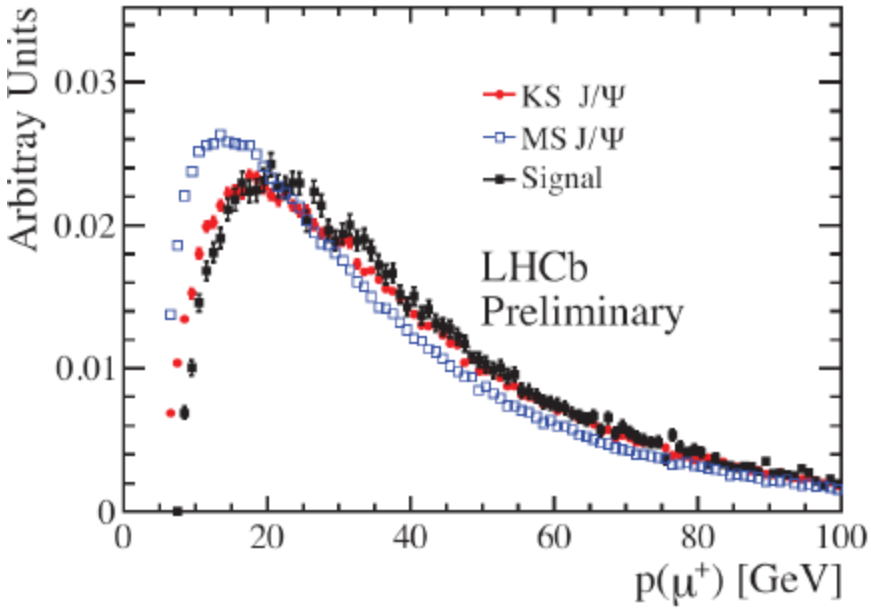
Analysis Key Points

- Choose final state with minimal uncertainties
  - $D_s^+\mu$, $D_s^+ \rightarrow \phi(1020)\pi^+$
- ...and small backgrounds
- Use data driven methods
  - All samples used are data, including trigger and identification efficiencies
- Utilize both magnet polarities and average result to assess systematic errors
- 2 separate methods used for all fits
  - Includes signal fits, efficiency corrections, etc.

Kinematic Selected Sample

$J/\psi \rightarrow \mu^+\mu^-$



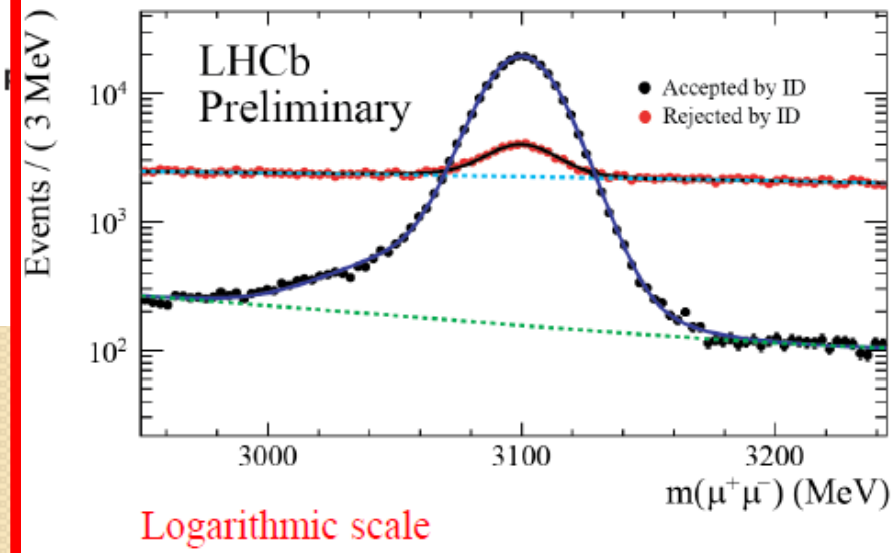


- $J/\psi \rightarrow \mu^+\mu^-$ selected in events trigger by b-hadron **not** decaying into a J/ψ, using only kinematic selections.
  - Divide sample in 50 muon p-px-py bins to reduce sensitivity to kinematic biases.
- Used to determine $\varepsilon(\mu^+)/\varepsilon(\mu^-)$ for the muon identification algorithm and muon dependent triggers.

Kinematic Selected Sample

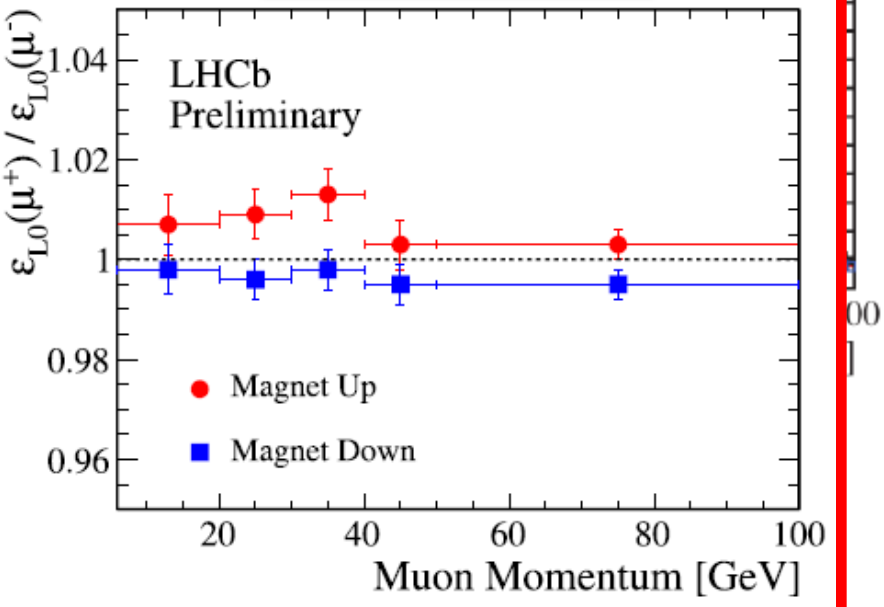
$J/\psi \rightarrow \mu^+\mu^-$

Muon identification
Magnet up data



Logarithmic scale

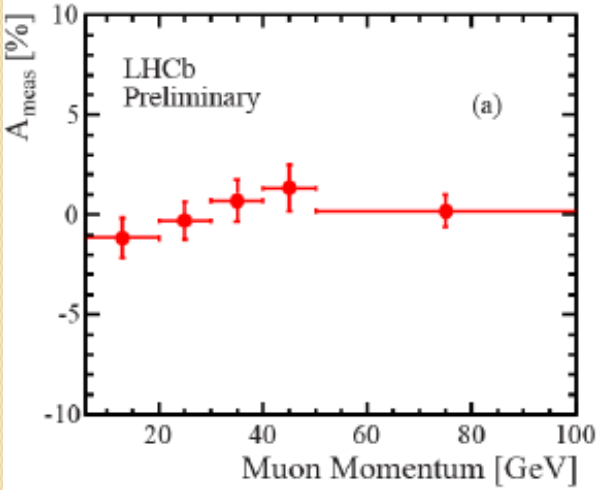
Efficiency ratio for
μ hardware trigger



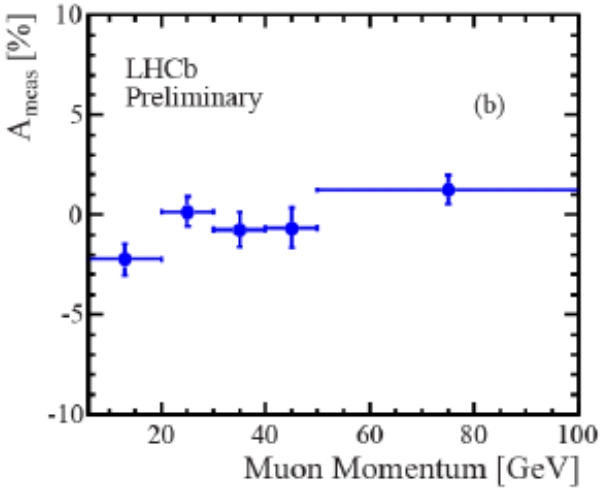
- Used to determine $\varepsilon(\mu^+)/\varepsilon(\mu^-)$ for the muon identification algorithm and muon dependent triggers.

The Measured Result

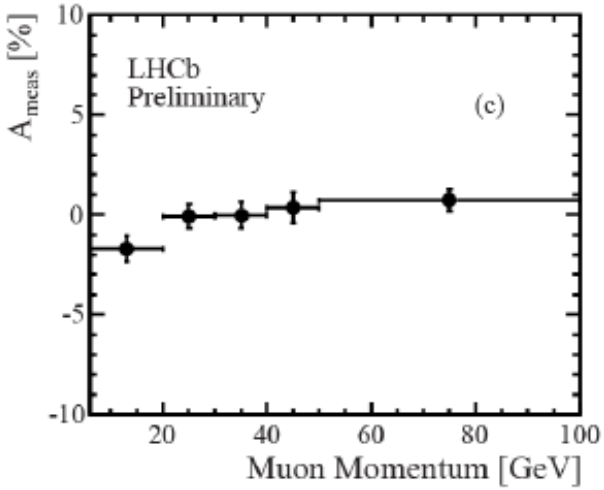
Magnet Up
Preliminary
A_{meas} = (0.10±0.41±0.15)%



Magnet Down
Preliminary
A_{meas} = (-0.34±0.35±0.13)%



Average
Preliminary
A_{meas} = (-0.12±0.27±0.10)%



Preliminary Results

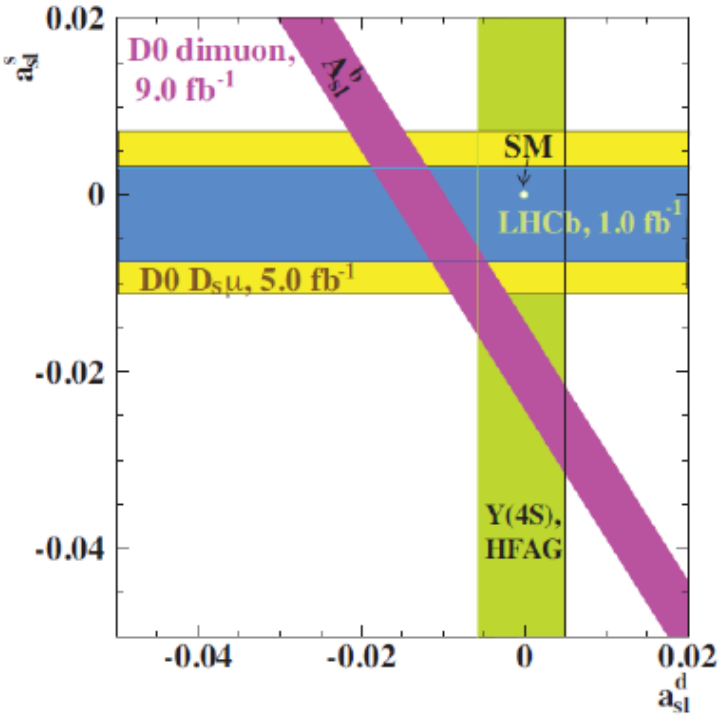
$a^s_{sl} = 2A_{meas}$

$a^s_{sl} = (-0.24 \pm 0.54 \pm 0.33)\%$

- Most precise measurement of a^s_{sl}

- In agreement with Standard Model's prediction (Lenz, arXiv:1205.1444)

$a^s_{sl} = (0.0019 \pm 0.0003)\%$
$a^d_{sl} = (-0.041 \pm 0.0006)\%$



LHCb-conf-2012-022

DØ's result: $a^s_{sl} = (-0.108 \pm 0.72 \pm 0.17)\%$
$a^d_{sl} = (0.93 \pm 0.45 \pm 0.14)\%$

Conclusions

- LHCb reports preliminary result:

$$a_{sl}^{s} = (-0.24 \pm 0.54 \pm 0.33)\%$$

- a^{s}_{sl} measured is consistent with Standard Model (or 0).
- Most precise measurement.
- Data sample to increase and more final states to be included.

THANK YOU!