

# Implication of the LHCb results in the anomalous $tsW$ couplings

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# Introduction

- Top quark couplings will be directly tested and nondiagonal couplings may be observed at LHC.
- Study of  $B_s$  system probes the  $tsW$  couplings.
- LHCb begins studying CP violation in the  $B_s$  system.
- Anomalous  $tsW$  couplings are worth examining at present.
- Anomalous  $tsW$  coupling can explain the present experimental data, but a tension exists.

## Effective Lagrangian

$$\mathcal{L} = -\frac{g}{\sqrt{2}} \sum_{q=d,s,b} V_{tq}^{\text{eff}} \bar{t} \gamma^\mu (P_L + \xi_q P_R) q W_\mu^+ + \text{H.c.},$$

$V_{tq}^{\text{eff}}$  : measures SM-like left-handed couplings

$\xi_q$  : measures right-handed couplings

New particles, neutral current interactions are ignored.

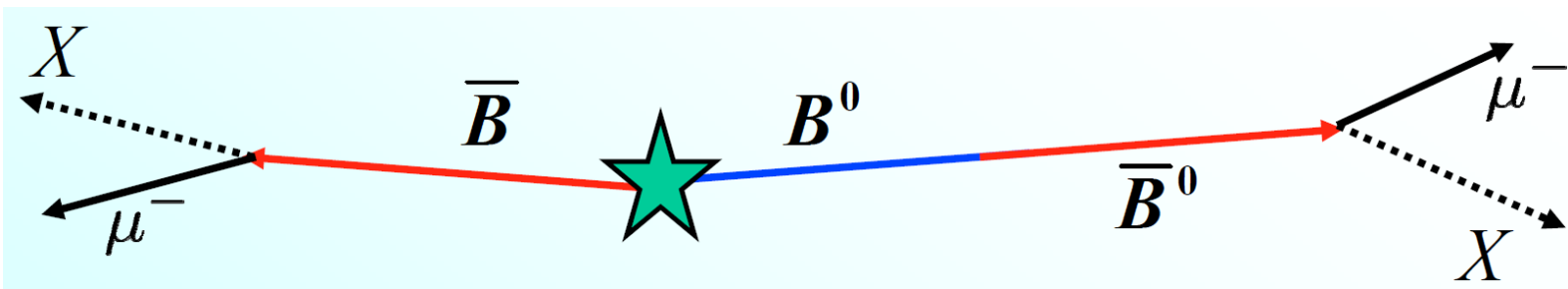
## Possible underlying new physics

- Effective electroweak chiral Lagrangian
- General Left-Right model ( $V_L^{\text{CKM}} \neq V_R^{\text{CKM}}$ )
- Etc.



# Like-sign dimuon charge asymmetry

$b\bar{b}$  production at Tevatron



The dimuon charge asymmetry

$$A_{sl}^b \equiv \frac{N_b^{++} - N_b^{--}}{N_b^{++} + N_b^{--}}$$

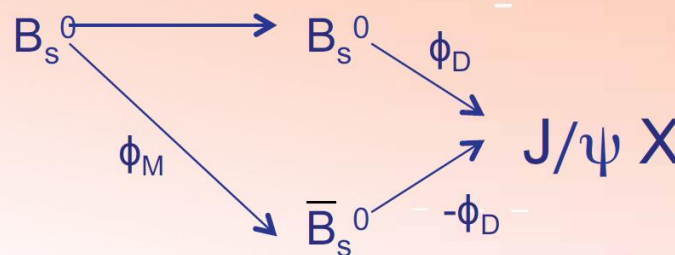
$$A_{sl}^b = (-2.3_{-0.6}^{+0.5}) \times 10^{-4}$$

The SM prediction

$$A_{sl}^b = (-0.957 \pm 0.172 \text{ (stat.)} \pm 0.093 \text{ (syst.)})\% \quad \text{D0 result}$$

# $B_S \rightarrow J/\psi \Phi$ decays at the LHCb

- Measure relative phase difference<sup>1</sup>  
 $\phi_s = \phi_M - 2\phi_D$  between two “legs”



In the SM,  
penguin contribution is ignored.

$$\phi_D \sim 0$$

$$\phi_s^{SM} \sim \phi_M$$

The CP violating phase is dominated  
by new physics contribution.

$$\phi_s = \phi_s^{SM} + \phi_s^{NP}$$

Note that  $\phi_s = -2\theta_{ts}^{\text{eff}}$

$B \rightarrow X_s \gamma$  +  $B_s$  mixing + dimuon asymmetry +  $B \rightarrow \Phi K$

$$14^\circ < \theta_{t,s}^{\text{eff}} < 22^\circ$$

LHCb fit in  $B_s \rightarrow J/\psi \Phi$  decays

$$-15.48^\circ < \theta_{ts}^{\text{eff}} < 6.88^\circ \quad \text{at 95\% C.L.}$$

There is a tension between  $B_s \rightarrow J/\psi \Phi$  decays by LHCb and the dimuon asymmetry by D0.