Flavor Changing Neutral Current transitions in Warped Extra Dimension

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Outline

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2. Introduction to the RS model and its variants
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5. $\Lambda_b \to \Lambda(\to p\pi^-)\mu^+\mu^-$ decay in the RS$_c$ model
6. Summary

Motivations I

- Need to go beyond the SM
- Hierarchies
  - ⋆ Gauge hierarchy problem : $M_{\text{EW}} \ll M_{\text{Pl}}$
  - ⋆ SM flavor puzzle : $m_e \ll m_t$
- The Randall-Sundrum model is among few proposals which can solve both issues.
- Interesting solutions by considering fifth dimension and a warped metric (warped extra dimension).
- Search for the Warped Extra Dimension
- Direct Search: Find KK resonances
- Indirect Search: Flavor Phenomenology of the RS model

$$\Downarrow$$

Tree level FCNCs

Motivations II

- Rare B-meson and Λ_b-baryon decays induced by FCNC transitions.
- Radiative and semi-leptonic B-meson decays in RS model.

[Burdman, 2004; Agashe *et al.*, 2005; Casagrande *et al.*, 2008; Blanke *et al.*, 2009; Bauer *et al.*, 2010; Blanke *et al.*, 2012; Biancofiore *et al.*, 2014]

- Alternative approach: Highly suppressed wrong-sign Kaon decays.

[Huitu, Lü, Singer, Zhang, Phys. Rev. Lett. 81, 4313 (1998)]

- Wrong-sign Kaon decays are $\Delta S = -1 (b \to dd\bar{s})$ and $\Delta S = +2 (b \to ss\bar{d})$ transitions in the SM which are highly suppressed compared to the Right-sign Kaon decays which are $\Delta S = 0$ and $\Delta S = +1$ transitions.
- Inclusive $b \to dd\bar{s}$ and $b \to ss\bar{d}$ decays studies in different beyond SM scenarios.

[Huitu *et al.*, 1999; Wu *et al.*, 2004; Cai *et al.*, 2004; Fajfer *et al.*, 2006]

- Exclusive doubly weak decays studies in various NP models.

[Fajfer *et al.*, 2000; Fajfer *et al.*, 2001; Chun *et al.*, 2003; Fajfer *et al.*, 2006; Pirjol *et al.*, 2010]

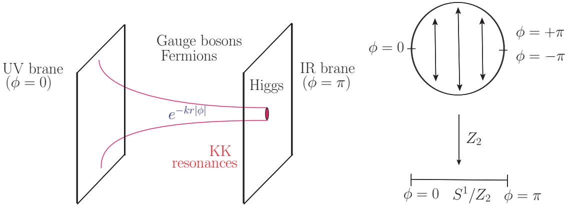
- Only three body modes are searched in the experiments. Two body exclusive decays never suggested before. Why?
- $\overline{B}^0 \to K^+\pi^-$ decay never studied before. Experimentally measureable by observing deviations in the B^0-$\overline{B}^0$ mixing oscillation curve in the study of time dependent decay of $B^0 \to K^+\pi^-$ with large experimental data.
- Impact of RS model with tree level FCNCs on the doubly weak rare hadronic B-meson decays and on semi-leptonic Λ_b-baryon decays.

Introduction to the Randall-Sundrum model

- 5D spacetime with **warped** metric

$$ds^2 = e^{-2kr|\phi|}\eta_{\mu\nu}\,dx^\mu\,dx^\nu - r^2\,d\phi^2, \qquad \phi \in [-\pi, \pi]$$

[Randall, Sundrum, Phys. Rev. Lett. 83, 3370 (1999)]



- The fundamental scale is M_{Pl}, and the effective 4D electroweak scale emerges through the warped factor

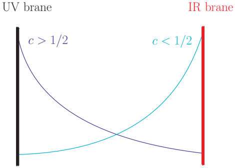
$$M_{\text{EW}} \sim e^{-kr\pi} M_{\text{Pl}} \sim \text{TeV}$$

- natural explanation of gauge hierarchy problem.
- Kaluza-Klein (KK) excitations live close to the IR brane.

Solution to the flavor problem and flavor implications

- The profiles of zero mode fermions depend heavily on bulk mass parameter c

$$f^{(0)}(y,c) \propto e^{(\frac{1}{2}-c)ky}$$



$c > 1/2$: Localized near UV brane

$c < 1/2$: Localized near IR brane

- Hierarchical structure can be naturally generated.
  - Light fermions live close to UV brane.
  - Third generation localized closest to the IR brane.

$$m_{ij} \propto v(Y^{(5D)}_{u,d})_{ij} f(c_{Q_i}) f(c_{u_j,d_j})$$

- Warped extra dimension with bulk fields have explanation for fermion masses and CKM hierarchies.
- Couplings involve overlap integrals of profiles, so different SM fermion profiles lead to flavour non-universal couplings of KK gauge bosons.
- Rotation to the fermion mass basis generates tree level FCNCs.
- New tree level FCNC effects strongly suppressed for light SM fermions by RS-GIM mechanism.

The RS model with Custodial protection

- The RS$_c$ model is based on a single warped extra dimension with the bulk gauge group

$$SU(3)_c \times SU(2)_L \times SU(2)_R \times U(1)_X \times P_{LR}$$

- The Only free parameter coming from space-time geometry

$$M_{\text{KK}} \equiv k e^{-k\pi r} \sim \mathcal{O}(\text{TeV})$$

- SM matter fields and gauge bosons are allowed to propage in the bulk while the Higgs sector is localized on the IR brane.
- Discrete P_{LR} symmetry interchanging the two $SU(2)_{L,R}$ provide the custodial protection of $Zb_L\bar{b}_L$ coupling.
- The mass of the lowest Kaluza-Klein (KK) states is $M_{g^{(1)}} \approx 2.45\ M_{\text{KK}}$.
- The mixing among zero modes and higher KK modes of neutral gauge bosons give rise to new heavy electroweak Z_H and Z' gauge bosons.

The bulk-Higgs RS model

- The bulk-Higgs RS model is based on a single warped extra dimension with the bulk gauge group

$$SU(3)_c \times SU(2)_V \times U(1)_Y$$

- All the fields in SM including matter fields, gauge bosons as well as Higgs boson are allowed to propagate in the 5D spacetime.
- We consider the summation over the contributions from the entire KK towers, with the lightest KK states having mass $M_{g^{(1)}} \approx 2.45\ M_{\text{KK}}$.
- Mixing among the Goldstone bosons $\varphi^{\pm}, \varphi^3$ and the fifth components of the gauge fields give rise to additional KK towers of physical scalars known as the extended scalar sector.

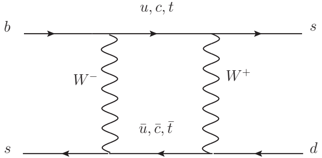
$b \to ss\bar{d}$ and $b \to dd\bar{s}$ transitions in the SM

- Local $\Delta S = 2$ SM effective Hamiltonian for $b \to ss\bar{d}$ transition

$$\mathcal{H}_{\text{eff}}^{\Delta S=2} = \frac{G_F^2 m_W^2}{4\pi^2}\left(V_{td}V_{ts}^* V_{tb}V_{ts}^* S_0\left(\frac{m_t^2}{m_W^2}\right) + V_{cd}V_{cs}^* V_{tb}V_{ts}^* S_0\left(\frac{m_c^2}{m_W^2}, \frac{m_t^2}{m_W^2}\right)\right)\left[(\bar{s}_L^i\gamma^\mu b_L^i)(\bar{s}_L^j\gamma_\mu d_L^j)\right]$$

- Local $\Delta S = -1$ SM effective Hamiltonian for $b \to dd\bar{s}$ transition $s \leftrightarrow d$

$$\mathcal{B}(b \to ss\bar{d})_{\text{SM}} = (2.19 \pm 0.38) \times 10^{-12}$$
$$\mathcal{B}(b \to dd\bar{s})_{\text{SM}} = (2.24 \pm 0.41) \times 10^{-14}$$



- $b \to ss\bar{d}$ and $b \to dd\bar{s}$ decays with very small strengths in the SM serve as a sensitive probe for new physics searches.

$$\mathcal{B}(B^+ \to K^+K^+\pi^-) < 1.1 \times 10^{-8}$$
$$\mathcal{B}(B^+ \to \pi^+\pi^+K^-) < 4.6 \times 10^{-8}$$

[R. Aaij *et al.* (LHCb), Phys. Lett. B765, 307 (2017)]

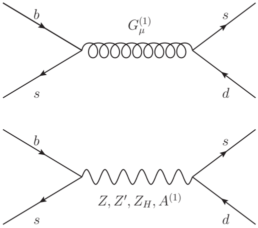
$b \to ss\bar{d}$ decay in the RS$_c$ model

- $b \to ss\bar{d}$ decay receives **tree level contributions** from the Kaluza-Klein (KK) gluons, the heavy KK photons, new heavy electroweak (EW) gauge bosons Z_H and Z', and in principle the Z boson.

  $M_{\mathcal{G}^{(1)}} = M_{Z_H} = M_{Z'} = M_{A^{(1)}} \equiv M_{g^{(1)}} \approx 2.45\ M_{\text{KK}}$

- Custodial protection of the $Zb_L\bar{b}_L$ coupling through the discrete P_{LR} symmetry renders tree-level Z contributions negligible.

- The effective Hamiltonian for the $\Delta S = 2$ $b \to ss\bar{d}$ decay with the Wilson coefficients corresponding to $\mu = \mathcal{O}(M_{g^{(1)}})$



$$[\mathcal{H}_{\text{eff}}^{\Delta S=2}]_{\text{KK}} = \frac{1}{(M_{g^{(1)}})^2}[C_1^{VLL}\mathcal{Q}_1^{VLL} + C_1^{VRR}\mathcal{Q}_1^{VRR} + C_1^{LR}\mathcal{Q}_1^{LR} + C_2^{LR}\mathcal{Q}_2^{LR} + C_1^{RL}\mathcal{Q}_1^{RL} + C_2^{RL}\mathcal{Q}_2^{RL}].$$

$$\mathcal{Q}_1^{VLL} = (\bar{s}\gamma_\mu P_L b)(\bar{s}\gamma^\mu P_L d), \qquad \mathcal{Q}_1^{VRR} = (\bar{s}\gamma_\mu P_R b)(\bar{s}\gamma^\mu P_R d),$$
$$\mathcal{Q}_1^{LR} = (\bar{s}\gamma_\mu P_L b)(\bar{s}\gamma^\mu P_R d), \qquad \mathcal{Q}_1^{RL} = (\bar{s}\gamma_\mu P_R b)(\bar{s}\gamma^\mu P_L d),$$
$$\mathcal{Q}_2^{LR} = (\bar{s}P_L b)(\bar{s}P_R d), \qquad \mathcal{Q}_2^{RL} = (\bar{s}P_R b)(\bar{s}P_L d).$$

$b \to s s \bar{d}$ decay in the RS$_c$ model

$$
\begin{aligned}
[C_1^{VLL}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= 1/3[\Delta_L^{sb}(\mathcal{G}^{(1)})][\Delta_L^{sd}(\mathcal{G}^{(1)})],\\
[C_1^{VRR}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= 1/3[\Delta_R^{sb}(\mathcal{G}^{(1)})][\Delta_R^{sd}(\mathcal{G}^{(1)})],\\
[C_1^{LR}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= -1/6[\Delta_L^{sb}(\mathcal{G}^{(1)})][\Delta_R^{sd}(\mathcal{G}^{(1)})],\\
[C_2^{LR}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= -[\Delta_L^{sb}(\mathcal{G}^{(1)})][\Delta_R^{sd}(\mathcal{G}^{(1)})],\\
[C_1^{RL}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= -1/6[\Delta_R^{sb}(\mathcal{G}^{(1)})][\Delta_L^{sd}(\mathcal{G}^{(1)})],\\
[C_2^{RL}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= -[\Delta_R^{sb}(\mathcal{G}^{(1)})][\Delta_L^{sd}(\mathcal{G}^{(1)})],
\end{aligned}
$$

$$
\begin{aligned}
[\Delta C_1^{VLL}(M_{g^{(1)}})]^{A^{(1)}} &= [\Delta_L^{sb}(A^{(1)})][\Delta_L^{sd}(A^{(1)})],\\
[\Delta C_1^{VRR}(M_{g^{(1)}})]^{A^{(1)}} &= [\Delta_R^{sb}(A^{(1)})][\Delta_R^{sd}(A^{(1)})],\\
[\Delta C_1^{LR}(M_{g^{(1)}})]^{A^{(1)}} &= [\Delta_L^{sb}(A^{(1)})][\Delta_R^{sd}(A^{(1)})],\\
[\Delta C_1^{RL}(M_{g^{(1)}})]^{A^{(1)}} &= [\Delta_R^{sb}(A^{(1)})][\Delta_L^{sd}(A^{(1)})],
\end{aligned}
$$

$$
\begin{aligned}
[\Delta C_1^{VLL}(M_{g^{(1)}})]^{Z_H,Z'} &= [\Delta_L^{sb}(Z^{(1)})\Delta_L^{sd}(Z^{(1)}) + \Delta_L^{sb}(Z_X^{(1)})\Delta_L^{sd}(Z_X^{(1)})],\\
[\Delta C_1^{VRR}(M_{g^{(1)}})]^{Z_H,Z'} &= [\Delta_R^{sb}(Z^{(1)})\Delta_R^{sd}(Z^{(1)}) + \Delta_R^{sb}(Z_X^{(1)})\Delta_R^{sd}(Z_X^{(1)})],\\
[\Delta C_1^{LR}(M_{g^{(1)}})]^{Z_H,Z'} &= [\Delta_L^{sb}(Z^{(1)})\Delta_R^{sd}(Z^{(1)}) + \Delta_L^{sb}(Z_X^{(1)})\Delta_R^{sd}(Z_X^{(1)})],\\
[\Delta C_1^{RL}(M_{g^{(1)}})]^{Z_H,Z'} &= [\Delta_R^{sb}(Z^{(1)})\Delta_L^{sd}(Z^{(1)}) + \Delta_R^{sb}(Z_X^{(1)})\Delta_L^{sd}(Z_X^{(1)})],
\end{aligned}
$$

$b \to ss\bar{d}$ decay in the RS$_c$ model

$$C_1^{VLL}(M_{g^{(1)}}) = [0.333 + 0.01 + 0.28]\widetilde{\Delta}_L^{sb}\widetilde{\Delta}_L^{sd} = 0.623\widetilde{\Delta}_L^{sb}\widetilde{\Delta}_L^{sd},$$
$$C_1^{VRR}(M_{g^{(1)}}) = [0.333 + 0.01 + 0.49]\widetilde{\Delta}_R^{sb}\widetilde{\Delta}_R^{sd} = 0.833\widetilde{\Delta}_R^{sb}\widetilde{\Delta}_R^{sd},$$
$$C_1^{LR}(M_{g^{(1)}}) = [-0.167 + 0.01 + 0.28]\widetilde{\Delta}_L^{sb}\widetilde{\Delta}_R^{sd} = 0.123\widetilde{\Delta}_L^{sb}\widetilde{\Delta}_R^{sd},$$
$$C_1^{RL}(M_{g^{(1)}}) = [-0.167 + 0.01 + 0.28]\widetilde{\Delta}_R^{sb}\widetilde{\Delta}_L^{sd} = 0.123\widetilde{\Delta}_R^{sb}\widetilde{\Delta}_L^{sd},$$

- After renormalization group running of the Wilson coefficients to a low energy scale μ_b = 4.6 GeV, the decay width in the RS$_c$ model

$$\Gamma_{\text{RS}_c} = \frac{m_b^5}{3072(2\pi)^3(M_{g^{(1)}})^4}[16(|C_1^{VLL}(\mu_b)|^2 + |C_1^{VRR}(\mu_b)|^2)$$
$$+ 12(|C_1^{LR}(\mu_b)|^2 + |C_1^{RL}(\mu_b)|^2) + 3(|C_2^{LR}(\mu_b)|^2 + |C_2^{RL}(\mu_b)|^2)$$
$$- 2\mathcal{R}e(C_1^{LR}(\mu_b)C_2^{*LR}(\mu_b) + C_2^{LR}(\mu_b)C_1^{*LR}(\mu_b)$$
$$+ C_1^{RL}(\mu_b)C_2^{*RL}(\mu_b) + C_2^{RL}(\mu_b)C_1^{*RL}(\mu_b))].$$

$b \to s s \bar{d}$ decay in the bulk-Higgs RS model

- We start with the effective Hamiltonian

$$[\mathcal{H}_{\text{eff}}^{\Delta S=2}]_{\text{KK}} = \sum_{n=1}^{5} [C_n \mathcal{O}_n + \widetilde{C}_n \widetilde{\mathcal{O}}_n],$$

$$\mathcal{O}_1 = (\bar{s}_L \gamma_\mu b_L)(\bar{s}_L \gamma^\mu d_L),$$
$$\mathcal{O}_2 = (\bar{s}_R b_L)(\bar{s}_R d_L),$$
$$\mathcal{O}_3 = (\bar{s}_R^\alpha b_L^\beta)(\bar{s}_R^\beta d_L^\alpha),$$
$$\mathcal{O}_4 = (\bar{s}_R b_L)(\bar{s}_L d_R),$$
$$\mathcal{O}_5 = (\bar{s}_R^\alpha b_L^\beta)(\bar{s}_L^\beta d_R^\alpha).$$

$$C_1 = \frac{4\pi L}{M_{\text{KK}}^2} (\widetilde{\Delta}_D)_{23} \otimes (\widetilde{\Delta}_D)_{21} [\frac{\alpha_s}{2}(1 - \frac{1}{N_c}) + \alpha Q_d^2 + \frac{\alpha}{s_w^2 c_w^2}(T_3^d - Q_d s_w^2)^2],$$
$$\widetilde{C}_1 = \frac{4\pi L}{M_{\text{KK}}^2} (\widetilde{\Delta}_d)_{23} \otimes (\widetilde{\Delta}_d)_{21} [\frac{\alpha_s}{2}(1 - \frac{1}{N_c}) + \alpha Q_d^2 + \frac{\alpha}{s_w^2 c_w^2}(-Q_d s_w^2)^2],$$
$$C_4 = -\frac{4\pi L \alpha_s}{M_{\text{KK}}^2} (\widetilde{\Delta}_D)_{23} \otimes (\widetilde{\Delta}_d)_{21} - \frac{L}{\pi \beta M_{\text{KK}}^2} (\widetilde{\Omega}_d)_{23} \otimes (\widetilde{\Omega}_D)_{21},$$
$$\widetilde{C}_4 = -\frac{4\pi L \alpha_s}{M_{\text{KK}}^2} (\widetilde{\Delta}_d)_{23} \otimes (\widetilde{\Delta}_D)_{21} - \frac{L}{\pi \beta M_{\text{KK}}^2} (\widetilde{\Omega}_D)_{23} \otimes (\widetilde{\Omega}_d)_{21},$$
$$C_5 = \frac{4\pi L}{M_{\text{KK}}^2} (\widetilde{\Delta}_D)_{23} \otimes (\widetilde{\Delta}_d)_{21} [\frac{\alpha_s}{N_c} - 2\alpha Q_d^2 + \frac{2\alpha}{s_w^2 c_w^2}(T_3^d - Q_d s_w^2)(Q_d s_w^2)],$$
$$\widetilde{C}_5 = \frac{4\pi L}{M_{\text{KK}}^2} (\widetilde{\Delta}_d)_{23} \otimes (\widetilde{\Delta}_D)_{21} [\frac{\alpha_s}{N_c} - 2\alpha Q_d^2 + \frac{2\alpha}{s_w^2 c_w^2}(T_3^d - Q_d s_w^2)(Q_d s_w^2)].$$

$b \to s s \bar{d}$ decay in the bulk-Higgs RS model

$$(\widetilde{\Delta}_D)_{23} \otimes (\widetilde{\Delta}_d)_{21} \to (U_d^\dagger)_{2i}(U_d)_{i3}(\widetilde{\Delta}_{Dd})_{ij}(W_d^\dagger)_{2j}(W_d)_{j1},$$

$$(\widetilde{\Delta}_{Dd})_{ij} = \frac{F^2(c_{Q_i})}{3+2c_{Q_i}} \frac{3+c_{Q_i}+c_{d_j}}{2(2+c_{Q_i}+c_{d_j})} \frac{F^2(c_{d_j})}{3+2c_{d_j}},$$

$$(\widetilde{\Omega}_D)_{23} \otimes (\widetilde{\Omega}_d)_{21} \to (U_d^\dagger)_{2i}(W_d)_{j3}(\widetilde{\Omega}_{Dd})_{ijkl}(W_d^\dagger)_{2k}(U_d)_{l1},$$

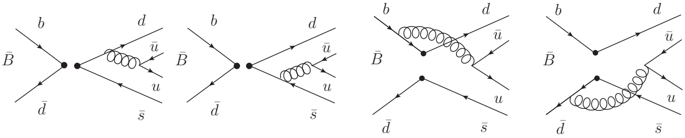
$$(\widetilde{\Omega}_{Dd})_{ijkl} = \frac{\pi(1+\beta)}{4L} \frac{F(c_{Q_i})F(c_{d_j})}{2+\beta+c_{Q_i}+c_{d_j}} \frac{(Y_d)_{ij}(Y_d^\dagger)_{kl}}{1} \times \frac{(4+2\beta+c_{Q_i}+c_{d_j}+c_{d_k}+c_{Q_l})}{4+c_{Q_i}+c_{d_j}+c_{d_k}+c_{Q_l}} \frac{F(c_{d_k})F(c_{Q_l})}{2+\beta+c_{d_k}+c_{Q_l}}.$$

- The decay width in the bulk-Higgs RS model

$$\Gamma_{\text{KK}} = \frac{m_b^5}{3072(2\pi)^3}[64(|C_1(\mu_b)|^2 + |\widetilde{C}_1(\mu_b)|^2) + 12(|C_4(\mu_b)|^2 + |\widetilde{C}_4(\mu_b)|^2 + |C_5(\mu_b)|^2 + |\widetilde{C}_5(\mu_b)|^2) + 4\mathcal{R}e(C_4(\mu_b)C_5^*(\mu_b) + C_4^*(\mu_b)C_5(\mu_b) + \widetilde{C}_4(\mu_b)\widetilde{C}_5^*(\mu_b) + \widetilde{C}_4^*(\mu_b)\widetilde{C}_5(\mu_b))].$$

$\overline{B}^0 \to K^+\pi^-$ decay in the Standard Model

$$\mathcal{H}^{\mathsf{SM}} = C^{\mathsf{SM}}[(\bar{d}^{\alpha}_L \gamma^{\mu} b^{\alpha}_L)(\bar{d}^{\beta}_L \gamma_{\mu} s^{\beta}_L)],$$



$$\mathcal{A}^{\mathsf{SM}} = F_{a1}[\tfrac{4}{3}C^{\mathsf{SM}}] + \mathcal{M}_{a1}[C^{\mathsf{SM}}],$$

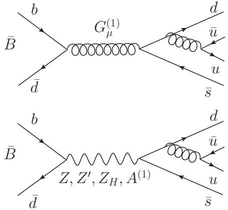
$$\begin{aligned}
F_{a1} &= 4\pi C_F m_B^2 f_B \int_0^1 dx_2\, dx_3 \int_0^{\infty} b_2\, db_2\, b_3\, db_3 \Big[\Big\{ x_3 \phi_K^A(x_2)\phi_\pi^A(x_3) + 2r_\pi r_K \phi_K^P(x_2) \Big[\Big(\phi_\pi^P(x_3) - \phi_\pi^T(x_3)\Big) \\
&+ x_3 \Big(\phi_\pi^P(x_3) + \phi_\pi^T(x_3)\Big) \Big] \Big\} E_a(t_a) h_a(x_2, x_3, b_2, b_3) S_t(x_3) - \Big\{ (1-x_2)\phi_K^A(x_2)\phi_\pi^A(x_3) + 4r_\pi r_K \phi_K^P(x_2)\phi_\pi^P(x_3) \\
&- 2r_\pi r_K x_2 \phi_\pi^P(x_3) \Big(\phi_K^P(x_2) - \phi_K^T(x_2)\Big) \Big\} E_a(t_b) h_b(x_2, x_3, b_2, b_3) S_t(x_2) \Big],
\end{aligned}$$

$$\begin{aligned}
\mathcal{M}_{a1} &= 8\pi C_F \frac{\sqrt{2N_c}}{N_c} m_B^2 \int_0^1 dx_1\, dx_2\, dx_3 \int_0^{\infty} b_1\, db_1\, b_3\, db_3 \phi_B \Big[\Big\{ (1-x_2)\phi_K^A(x_2)\phi_\pi^A(x_3) + r_\pi r_K \Big[(1-x_2)(\phi_K^P(x_2) - \phi_K^T(x_2)) \\
&\times (\phi_\pi^P(x_3) + \phi_\pi^T(x_3)) + x_3(\phi_K^P(x_2) + \phi_K^T(x_2))(\phi_\pi^P(x_3) - \phi_\pi^T(x_3)) \Big] \Big\} E'_a(t_c) h_c(x_1, x_2, x_3, b_1, b_3) \\
&- \Big\{ x_3 \phi_K^A(x_2)\phi_\pi^A(x_3) + r_\pi r_K \Big[4\phi_K^P(x_2)\phi_\pi^P(x_3) - (1-x_3)(\phi_K^P(x_2) - \phi_K^T(x_2))(\phi_\pi^P(x_3) + \phi_\pi^T(x_3)) \\
&- x_2(\phi_K^P(x_2) + \phi_K^T(x_2))(\phi_\pi^P(x_3) - \phi_\pi^T(x_3)) \Big] \Big\} E'_a(t_d) h_d(x_1, x_2, x_3, b_1, b_3) \Big],
\end{aligned}$$

$$\mathcal{B}(\overline{B}^0 \to K^+\pi^-)^{\mathsf{SM}} = 1.0 \times 10^{-19}$$

$\overline{B}^0 \to K^+\pi^-$ decay in the RS$_c$ model

$$[\mathcal{H}_{\text{eff}}]_{\text{RS}_c} = \frac{1}{[M_{g^{(1)}}]^2}[C_1^{VLL}\mathcal{O}_1 + C_1^{VRR}\widetilde{\mathcal{O}}_1 + C_4^{LR}\mathcal{O}_4 + C_4^{RL}\widetilde{\mathcal{O}}_4 + C_5^{LR}\mathcal{O}_5 + C_5^{RL}\widetilde{\mathcal{O}}_5].$$



$$\mathcal{O}_1 = (\bar{d}_L\gamma_\mu b_L)(\bar{d}_L\gamma^\mu s_L),$$
$$\mathcal{O}_4 = (\bar{d}_R b_L)(\bar{d}_L s_R),$$
$$\mathcal{O}_5 = (\bar{d}_R^\alpha b_L^\beta)(\bar{d}_L^\beta s_R^\alpha).$$

$$\begin{aligned}
[C_1^{VLL}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= 1/3 p_{\text{UV}}{}^2 \Delta_L^{db}\Delta_L^{ds},\\
[C_1^{VRR}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= 1/3 p_{\text{UV}}{}^2 \Delta_R^{db}\Delta_R^{ds},\\
[C_4^{LR}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= -p_{\text{UV}}{}^2 \Delta_L^{db}\Delta_R^{ds},\\
[C_4^{RL}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= -p_{\text{UV}}{}^2 \Delta_R^{db}\Delta_L^{ds},\\
[C_5^{LR}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= 1/3 p_{\text{UV}}{}^2 \Delta_L^{db}\Delta_R^{ds},\\
[C_5^{RL}(M_{g^{(1)}})]^{\mathcal{G}^{(1)}} &= 1/3 p_{\text{UV}}{}^2 \Delta_R^{db}\Delta_L^{ds},
\end{aligned}$$

$$\begin{aligned}
[\Delta C_1^{VLL}(M_{g^{(1)}})]^{A^{(1)}} &= [\Delta_L^{db}(A^{(1)})][\Delta_L^{ds}(A^{(1)})],\\
[\Delta C_1^{VRR}(M_{g^{(1)}})]^{A^{(1)}} &= [\Delta_R^{db}(A^{(1)})][\Delta_R^{ds}(A^{(1)})],\\
[\Delta C_5^{LR}(M_{g^{(1)}})]^{A^{(1)}} &= -2[\Delta_L^{db}(A^{(1)})][\Delta_R^{ds}(A^{(1)})],\\
[\Delta C_5^{RL}(M_{g^{(1)}})]^{A^{(1)}} &= -2[\Delta_R^{db}(A^{(1)})][\Delta_L^{ds}(A^{(1)})].
\end{aligned}$$

$$\begin{aligned}
[\Delta C_1^{VLL}(M_{g^{(1)}})]^{Z_H,Z'} &= [\Delta_L^{db}(Z^{(1)})\Delta_L^{ds}(Z^{(1)}) + \Delta_L^{db}(Z_X^{(1)})\Delta_L^{ds}(Z_X^{(1)})],\\
[\Delta C_1^{VRR}(M_{g^{(1)}})]^{Z_H,Z'} &= [\Delta_R^{db}(Z^{(1)})\Delta_R^{ds}(Z^{(1)}) + \Delta_R^{db}(Z_X^{(1)})\Delta_R^{ds}(Z_X^{(1)})],\\
[\Delta C_5^{LR}(M_{g^{(1)}})]^{Z_H,Z'} &= -2[\Delta_L^{db}(Z^{(1)})\Delta_R^{ds}(Z^{(1)}) + \Delta_L^{db}(Z_X^{(1)})\Delta_R^{ds}(Z_X^{(1)})],\\
[\Delta C_5^{RL}(M_{g^{(1)}})]^{Z_H,Z'} &= -2[\Delta_R^{db}(Z^{(1)})\Delta_L^{ds}(Z^{(1)}) + \Delta_R^{db}(Z_X^{(1)})\Delta_L^{ds}(Z_X^{(1)})],
\end{aligned}$$

$$\mathcal{A} = \frac{1}{[M_{g^{(1)}}]^2}\Big[F_{a1}\Big[\frac{4}{3}(C_1^{VLL} + C_1^{VRR})\Big] + F_{a4}\Big[\frac{4}{3}(C_4^{LR} + C_4^{RL})\Big] + F_{a5}\Big[\frac{4}{3}(C_5^{LR} + C_5^{RL})\Big] + \mathcal{M}_{a1}\Big[C_1^{VLL} - C_1^{VRR}\Big] + \mathcal{M}_{a4}\Big[C_4^{LR} - C_4^{RL}\Big] + \mathcal{M}_{a5}\Big[C_5^{LR} - C_5^{RL}\Big]\Big].$$

$\overline{B}^0 \to K^+\pi^-$ decay in the bulk-Higgs RS model

- We start with the effective Hamiltonian

$$[\mathcal{H}_{\text{eff}}^{\Delta S=-1}]_{\text{KK}} = \sum_{n=1}^{5}[C_n\mathcal{O}_n + \widetilde{C}_n\widetilde{\mathcal{O}}_n],$$

$$\mathcal{O}_1 = (\bar{d}_L\gamma_\mu b_L)(\bar{d}_L\gamma^\mu s_L), \quad \mathcal{O}_2 = (\bar{d}_R b_L)(\bar{d}_R s_L), \quad \mathcal{O}_3 = (\bar{d}_R^\alpha b_L^\beta)(\bar{d}_R^\beta s_L^\alpha),$$

$$\mathcal{O}_4 = (\bar{d}_R b_L)(\bar{d}_L s_R), \quad \mathcal{O}_5 = (\bar{d}_R^\alpha b_L^\beta)(\bar{d}_L^\beta s_R^\alpha).$$

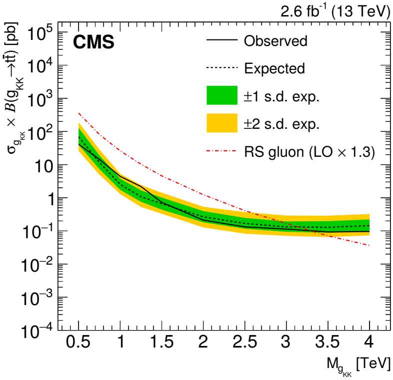
$$\mathcal{A} = F_{a1}\Big[\frac{4}{3}(C_1+\widetilde{C}_1)\Big] + F_{a4}\Big[\frac{4}{3}(C_4+\widetilde{C}_4)\Big] + F_{a5}\Big[\frac{4}{3}(C_5+\widetilde{C}_5)\Big] + \mathcal{M}_{a1}\Big[C_1-\widetilde{C}_1\Big] + \mathcal{M}_{a4}\Big[C_4-\widetilde{C}_4\Big] + \mathcal{M}_{a5}\Big[C_5-\widetilde{C}_5\Big],$$

$$\Gamma = \frac{m_B^3}{64\pi}\,|\mathcal{A}|^2\,.$$

Constraints on the RS Parameter space

- Direct Searches

[A. M. Sirunyan *et al.* (CMS), JHEP 07 (2017) 001]



$$M_{g^{(1)}} > 3.3 \text{ TeV} \qquad (95\% \text{ CL}).$$

More Constraints

- The RS_c model
  - Constraint from tree-level analysis of the S and T parameters

[Malm, Neubert, Novotny, Schmell, JHEP 01 (2014) 173]

$$M_{g^{(1)}} > 4.8 \text{ TeV} \qquad (95\% \text{ CL}).$$

- The bulk-Higgs RS model

$$S = \frac{2\pi v^2}{M_{\text{KK}}^2}\left(1 - \frac{1}{(2+\beta)^2} - \frac{1}{2L}\right)$$

$$T = \frac{\pi v^2}{2c_W^2 M_{\text{KK}}^2}\,\frac{2L(1+\beta)^2}{(2+\beta)(3+2\beta)}$$

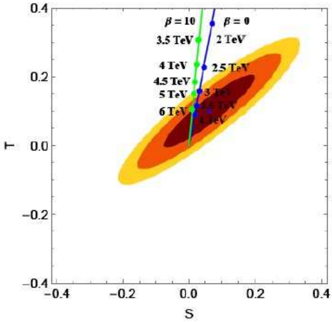
$$U = 0.$$

[M. Baak *et al.* (Gfitter), Eur. Phys. J. C74 (2014) 3046]

$$S = 0.06 \pm 0.09$$

$$T = 0.10 \pm 0.07$$

$$U = 0.$$

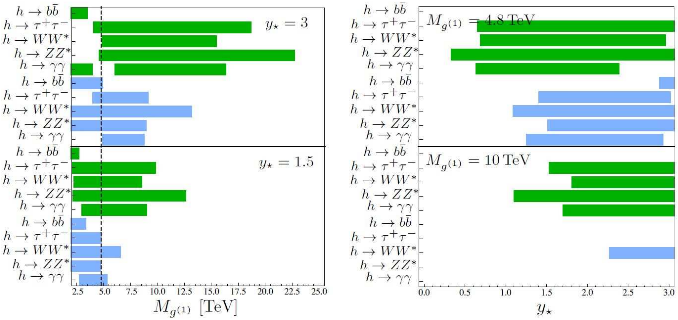


$$M_{\text{KK}} > 5 \text{ TeV}, \quad \text{with} \quad \beta = 10$$

$$M_{\text{KK}} > 3 \text{ TeV}, \quad \text{with} \quad \beta = 0$$

More Constraints

- The RS$_c$ model



[Malm, Neubert, Schmell, JHEP 02 (2015) 008]

- Stringent bounds emerge from the signal rates for $pp \to h \to ZZ^*, WW^*$, at 95% CL

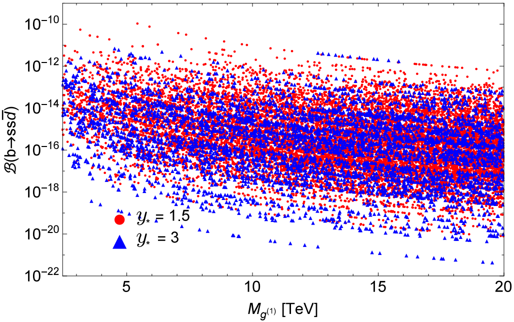
$$M_{g^{(1)}}\Big|_{\text{brane-Higgs}}^{\text{custodial RS}} > 22.7 \text{ TeV} \times \left(\frac{y_\star}{3}\right), \quad M_{g^{(1)}}\Big|_{\text{narrow bulk-Higgs}}^{\text{custodial RS}} > 13.2 \text{ TeV} \times \left(\frac{y_\star}{3}\right)$$

Branching ratio of $b \to ss\bar{d}$ in the RS$_c$ model

ΔM_K, ϵ_K and ΔM_{B_s} constraints

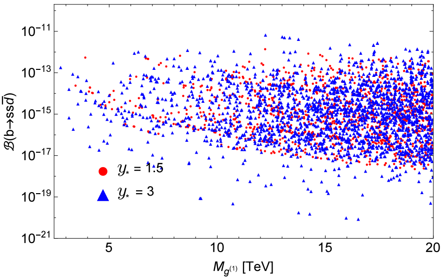
KK gluons dominant

Comparable Z_H and Z' contributions



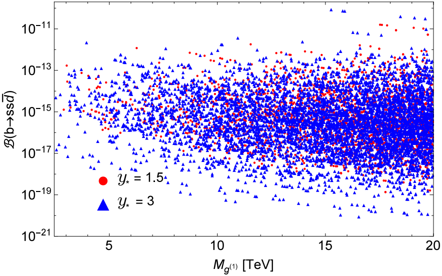
Branching ratio of $b \to ss\bar{d}$ in the bulk-Higgs RS model

broad Higgs profile



$\beta = 1$

narrow Higgs profile

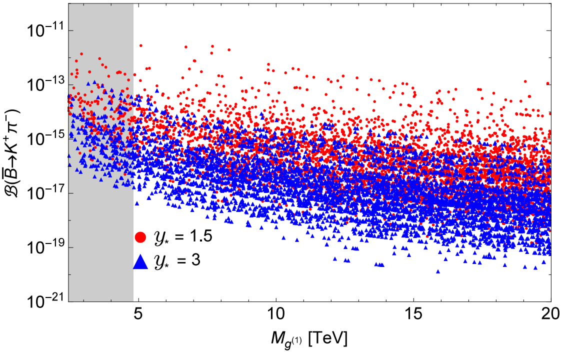


$\beta = 10$

Branching ratio of $\overline{B}^0 \to K^+\pi^-$ decay in the RS$_c$ model

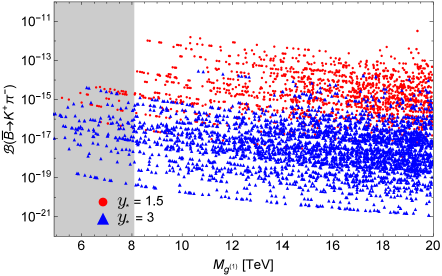
ΔM_K, ϵ_K and ΔM_{B_d} constraints

KK gluons dominant



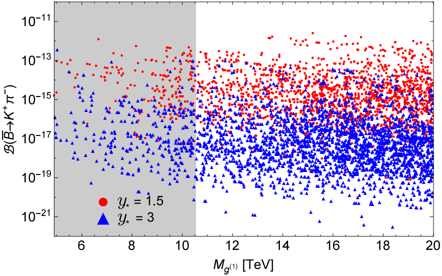
Branching ratio in the bulk-Higgs RS model

broad Higgs profile



$$\beta = 1$$

narrow Higgs profile



$$\beta = 10$$

Model Independent Analysis of $\overline{B}^0 \to K^+\pi^-$ decay

- Assuming new physics contribution only to local operator $\mathcal{O}_1$

$$[\mathcal{H}_{\text{eff}}^{\Delta S=-1}] = C_1^{dd\bar{s}}(\bar{d}_L\gamma_\mu b_L)(\bar{d}_L\gamma^\mu s_L),$$
$$[\mathcal{H}_{\text{eff}}^{\Delta S=2}] = C_1^{K}(\bar{d}_L\gamma_\mu s_L)(\bar{d}_L\gamma^\mu s_L), \qquad C_1^{dd\bar{s}} \sim \sqrt{C_1^K C_1^{B_d}}$$
$$[\mathcal{H}_{\text{eff}}^{\Delta B=2}] = C_1^{B_d}(\bar{d}_L\gamma_\mu b_L)(\bar{d}_L\gamma^\mu b_L).$$

- Assuming NP contributions come from non standard model chiralities

$$\mathcal{A}_j(\overline{B}^0 \to K^+\pi^-) = F_{aj}\left[\tfrac{4}{3}C_j^{dd\bar{s}}\right] + \mathcal{M}_{aj}\left[C_j^{dd\bar{s}}\right]$$
$$\widetilde{\mathcal{A}}_j(\overline{B}^0 \to K^+\pi^-) = F_{aj}\left[\tfrac{4}{3}\widetilde{C}_j^{dd\bar{s}}\right] + \mathcal{M}_{aj}\left[-\widetilde{C}_j^{dd\bar{s}}\right]$$

$$R \equiv \frac{\mathcal{B}(\overline{B}^0 \to K^+\pi^-)}{\mathcal{B}(\overline{B}^0 \to K^-\pi^+)}$$

- For an experimental precision of $R < 0.001$

Parameter	Allowed range (GeV^{-2})	Parameter	Allowed range (GeV^{-2})
		$\widetilde{C}_1$	$< 1.1 \times 10^{-7}$
C_2	$< 6.3 \times 10^{-9}$	$\widetilde{C}_2$	$< 6.8 \times 10^{-9}$
C_3	$< 5.1 \times 10^{-8}$	$\widetilde{C}_3$	$< 5.3 \times 10^{-8}$
C_4	$< 4.9 \times 10^{-9}$	$\widetilde{C}_4$	$< 4.2 \times 10^{-9}$
C_5	$< 1.6 \times 10^{-6}$	$\widetilde{C}_5$	$< 7.3 \times 10^{-7}$

New Physics with Conserved Charge

- NP Lagrangian of a generic form

$$\mathcal{L}_{\text{flavor}} = g_{b\to d}(\bar{d}\Gamma b)X + g_{d\to b}(\bar{b}\Gamma d)X + g_{s\to d}(\bar{d}\Gamma s)X + g_{d\to s}(\bar{s}\Gamma d)X + \text{h.c.},$$

$$\mathcal{L}_{\text{eff}} = \frac{1}{M_X^2}\Big[g_{s\to d}g^*_{d\to s}(\bar{d}\Gamma s)(\bar{d}\bar{\Gamma} s) + g_{b\to d}g^*_{d\to b}(\bar{d}\Gamma b)(\bar{d}\bar{\Gamma} b)$$
$$+ g_{b\to d}g^*_{d\to s}(\bar{d}\Gamma b)(\bar{d}\bar{\Gamma} s) + g_{s\to d}g^*_{d\to b}(\bar{d}\bar{\Gamma} b)(\bar{d}\Gamma s)\Big].$$

- $K^0 - \overline{K}^0$ and $B^0 - \overline{B}^0$ mixing bounds

$$\frac{|g_{s\to d}g^*_{d\to s}|}{M_X^2} < \frac{1}{(\Lambda_j^K)^2}, \qquad \frac{|g_{b\to d}g^*_{d\to b}|}{M_X^2} < \frac{1}{(\Lambda_j^{B_d})^2}.$$

Scenarios	R_X				R_{SM}
	M_X (TeV)	Case-I	M_X (TeV)	Case-II	
S1	1.0	0.085	10	8.5×10^{-6}	6.8×10^{-15}
S2		0.074		7.3×10^{-6}	
S3		55		0.005	
S4		0.002		1.9×10^{-7}	

$\Lambda_b \to \Lambda(\to p\pi^-)\mu^+\mu^-$ decay in the RS$_c$ model

- The effective weak Hamiltonian for $b \to s\mu^+\mu^-$ transition in the RS$_c$ model

$$H_{\text{eff}}^{\text{RS}_c} = -\frac{4G_F}{\sqrt{2}} V_{tb} V_{ts}^* \left[C_7^{\text{RS}_c} O_7 + C_7^{\prime\text{RS}_c} O_7' + C_9^{\text{RS}_c} O_9 + C_9^{\prime\text{RS}_c} O_9' + C_{10}^{\text{RS}_c} O_{10} + C_{10}^{\prime\text{RS}_c} O_{10}' \right],$$

$$O_7 = \frac{e}{16\pi^2} m_b (\bar{s}_{L\alpha} \sigma^{\mu\nu} b_{R\alpha}) F_{\mu\nu}, \qquad O_7' = \frac{e}{16\pi^2} m_b (\bar{s}_{R\alpha} \sigma^{\mu\nu} b_{L\alpha}) F_{\mu\nu},$$

$$O_9 = \frac{e^2}{16\pi^2} (\bar{s}_{L\alpha} \gamma^\mu b_{L\alpha}) \bar{\mu} \gamma_\mu \mu, \qquad O_9' = \frac{e^2}{16\pi^2} (\bar{s}_{R\alpha} \gamma^\mu b_{R\alpha}) \bar{\mu} \gamma_\mu \mu,$$

$$O_{10} = \frac{e^2}{16\pi^2} (\bar{s}_{L\alpha} \gamma^\mu b_{L\alpha}) \bar{\mu} \gamma_\mu \gamma_5 \mu, \qquad O_{10}' = \frac{e^2}{16\pi^2} (\bar{s}_{R\alpha} \gamma^\mu b_{R\alpha}) \bar{\mu} \gamma_\mu \gamma_5 \mu.$$

$$C_i^{(\prime)\text{RS}_c} = C_i^{(\prime)\text{SM}} + \Delta C_i^{(\prime)},$$

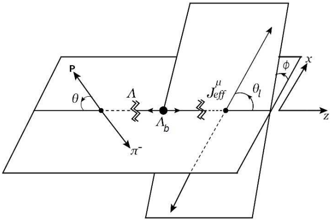
$$\Delta C_9 = \frac{\Delta Y_s}{\sin^2\theta_W} - 4\Delta Z_s, \quad \Delta Y_s = -\frac{1}{V_{tb} V_{ts}^*} \sum_X \frac{\Delta_L^{\mu\mu}(X) - \Delta_R^{\mu\mu}(X)}{4M_X^2 g_{SM}^2} \Delta_L^{bs}(X),$$

$$\Delta C_9' = \frac{\Delta Y_s'}{\sin^2\theta_W} - 4\Delta Z_s', \quad \Delta Y_s' = -\frac{1}{V_{tb} V_{ts}^*} \sum_X \frac{\Delta_L^{\mu\mu}(X) - \Delta_R^{\mu\mu}(X)}{4M_X^2 g_{SM}^2} \Delta_R^{bs}(X),$$

$$\Delta C_{10} = -\frac{\Delta Y_s}{\sin^2\theta_W}, \qquad \Delta Z_s = \frac{1}{V_{tb} V_{ts}^*} \sum_X \frac{\Delta_R^{\mu\mu}(X)}{8M_X^2 g_{SM}^2 \sin^2\theta_W} \Delta_L^{bs}(X),$$

$$\Delta C_{10}' = \frac{\Delta Y_s'}{\sin^2\theta_W}, \qquad \Delta Z_s' = \frac{1}{V_{tb} V_{ts}^*} \sum_X \frac{\Delta_R^{\mu\mu}(X)}{8M_X^2 g_{SM}^2 \sin^2\theta_W} \Delta_R^{bs}(X).$$

Angular distributions



- $\theta = \theta_\Lambda$: angle of emission between Λ and p in di-meson rest frame
- $\theta_l = \theta_\mu$: angle of emission between μ^- and z-axis in di-muon rest frame
- ϕ : angle between the two planes
- $q^2 = s$: di-muon invariant mass squared

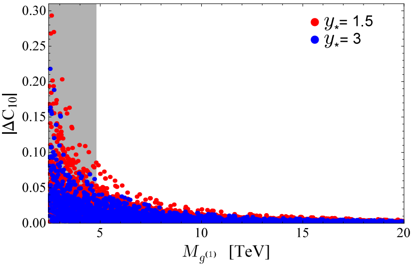
- The angular decay distribution of the four-fold decay $\Lambda_b \to \Lambda(\to p\pi)\mu^+\mu^-$

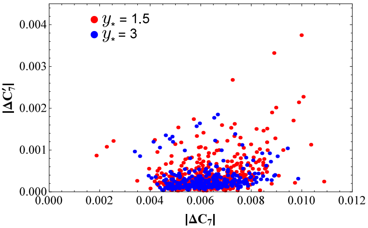
$$\frac{d^4\Gamma}{ds\ d\cos\theta_\Lambda\ d\cos\theta_l\ d\phi} = \frac{3}{8\pi}\Big[K_{1ss}\sin^2\theta_l + K_{1cc}\cos^2\theta_l + K_{1c}\cos\theta_l + (K_{2ss}\sin^2\theta_l + K_{2cc}\cos^2\theta_l + K_{2c}\cos\theta_l)\cos\theta_\Lambda + (K_{3sc}\sin\theta_l\cos\theta_l + K_{3s}\sin\theta_l)\sin\theta_\Lambda\sin\phi + (K_{4sc}\sin\theta_l\cos\theta_l + K_{4s}\sin\theta_l)\sin\theta_\Lambda\cos\phi\Big].$$

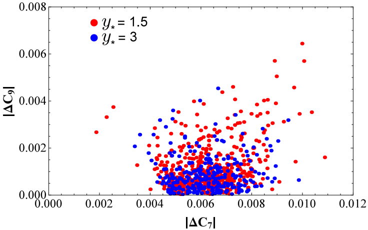
$$\frac{d\Gamma}{ds} = 2K_{1ss} + K_{1cc}, \qquad F_L = \frac{2K_{1ss} - K_{1cc}}{2K_{1ss} + K_{1cc}}, \qquad A^l_{FB} = \frac{3K_{1c}}{4K_{1ss} + 2K_{1cc}},$$

$$A^\Lambda_{FB} = \frac{2K_{2ss} + K_{2cc}}{4K_{1ss} + 2K_{1cc}}, \qquad A^{l\Lambda}_{FB} = \frac{3K_{2c}}{8K_{1ss} + 4K_{1cc}}.$$

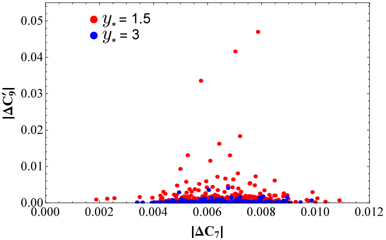
Wilson coefficients

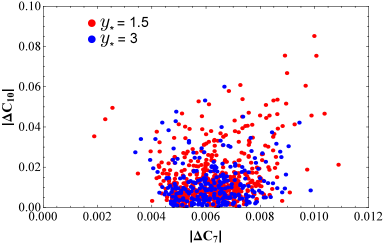


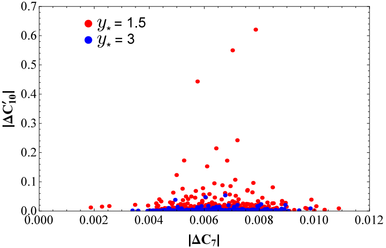


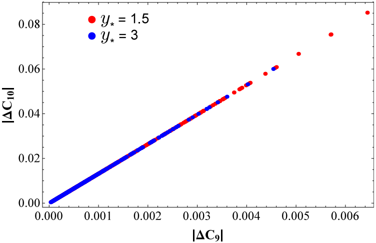


Correlations plots between the Wilson coefficients









Numerical Results

		$\left\langle \frac{d\mathcal{B}}{ds} \times 10^{-7} \right\rangle$	$\langle F_L \rangle$	$\left\langle A_{FB}^{\ell} \right\rangle$	$\left\langle A_{FB}^{\Lambda} \right\rangle$	$\left\langle A_{FB}^{l\Lambda} \right\rangle$
$[0.1, 2]$	SM	$0.238^{+0.230}_{-0.230}$	$0.535^{+0.065}_{-0.078}$	$0.097^{+0.006}_{-0.007}$	$-0.310^{+0.015}_{-0.008}$	$-0.031^{+0.003}_{-0.002}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.219^{+0.218}_{-0.217}$	$0.552^{+0.069}_{-0.084}$	$0.093^{+0.005}_{-0.006}$	$-0.313^{+0.013}_{-0.004}$	$-0.030^{+0.003}_{-0.002}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.233^{+0.228}_{-0.225}$	$0.539^{+0.066}_{-0.080}$	$0.096^{+0.006}_{-0.007}$	$-0.311^{+0.015}_{-0.007}$	$-0.031^{+0.003}_{-0.002}$
	LHCb	$0.36^{+0.122}_{-0.112}$	$0.56^{+0.244}_{-0.566}$	$0.37^{+0.371}_{-0.481}$	$-0.12^{+0.344}_{-0.318}$	$-$
$[2, 4]$	SM	$0.180^{+0.123}_{-0.123}$	$0.855^{+0.008}_{-0.012}$	$0.054^{+0.037}_{-0.030}$	$-0.306^{+0.022}_{-0.012}$	$-0.016^{+0.008}_{-0.009}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.171^{+0.118}_{-0.117}$	$0.860^{+0.008}_{-0.006}$	$0.040^{+0.035}_{-0.026}$	$-0.311^{+0.016}_{-0.005}$	$-0.013^{+0.009}_{-0.010}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.177^{+0.120}_{-0.120}$	$0.857^{+0.008}_{-0.011}$	$0.051^{+0.037}_{-0.030}$	$-0.309^{+0.021}_{-0.010}$	$-0.016^{+0.008}_{-0.009}$
	LHCb	$0.11^{+0.120}_{-0.091}$	$-$	$-$	$-$	$-$
$[4, 6]$	SM	$0.232^{+0.110}_{-0.110}$	$0.807^{+0.018}_{-0.012}$	$-0.063^{+0.038}_{-0.026}$	$-0.311^{+0.014}_{-0.008}$	$0.021^{+0.007}_{-0.009}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.224^{+0.108}_{-0.108}$	$0.806^{+0.021}_{-0.016}$	$-0.078^{+0.034}_{-0.021}$	$-0.314^{+0.008}_{-0.002}$	$0.024^{+0.008}_{-0.009}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.230^{+0.110}_{-0.110}$	$0.807^{+0.019}_{-0.013}$	$-0.067^{+0.037}_{-0.025}$	$-0.313^{+0.013}_{-0.006}$	$0.022^{+0.007}_{-0.009}$
	LHCb	$0.02^{+0.091}_{-0.010}$	$-$	$-$	$-$	$-$
$[6, 8]$	SM	$0.312^{+0.094}_{-0.094}$	$0.724^{+0.025}_{-0.014}$	$-0.162^{+0.025}_{-0.017}$	$-0.317^{+0.007}_{-0.004}$	$0.052^{+0.005}_{-0.007}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.306^{+0.094}_{-0.093}$	$0.720^{+0.026}_{-0.016}$	$-0.174^{+0.021}_{-0.013}$	$-0.314^{+0.002}_{-0.001}$	$0.054^{+0.005}_{-0.007}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.310^{+0.094}_{-0.094}$	$0.723^{+0.025}_{-0.014}$	$-0.165^{+0.024}_{-0.016}$	$-0.317^{+0.006}_{-0.003}$	$0.053^{+0.006}_{-0.007}$
	LHCb	$0.25^{+0.120}_{-0.111}$	$-$	$-$	$-$	$-$
$[1.1, 6]$	SM	$0.199^{+0.120}_{-0.120}$	$0.818^{+0.011}_{-0.011}$	$0.009^{+0.027}_{-0.018}$	$-0.309^{+0.018}_{-0.010}$	$-0.002^{+0.004}_{-0.005}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.190^{+0.120}_{-0.119}$	$0.824^{+0.010}_{-0.007}$	$-0.005^{+0.025}_{-0.014}$	$-0.312^{+0.012}_{-0.004}$	$0.001^{+0.005}_{-0.006}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.197^{+0.120}_{-0.120}$	$0.819^{+0.011}_{-0.011}$	$0.006^{+0.026}_{-0.017}$	$-0.311^{+0.017}_{-0.008}$	$-0.001^{+0.004}_{-0.005}$
	LHCb	$0.09^{+0.061}_{-0.051}$	$-$	$-$	$-$	$-$

Numerical Results

		$\left\langle \frac{d\beta}{ds} \times 10^{-7} \right\rangle$	$\langle F_L \rangle$	$\left\langle A_{FB}^{\ell} \right\rangle$	$\left\langle A_{FB}^{\Lambda} \right\rangle$	$\left\langle A_{FB}^{l\Lambda} \right\rangle$
$[15, 16]$	SM	$0.798^{+0.073}_{-0.073}$	$0.454^{+0.032}_{-0.017}$	$-0.382^{+0.017}_{-0.008}$	$-0.307^{+0.002}_{-0.004}$	$0.131^{+0.004}_{-0.008}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.832^{+0.073}_{-0.073}$	$0.447^{+0.033}_{-0.017}$	$-0.365^{+0.014}_{-0.006}$	$-0.287^{+0.003}_{-0.005}$	$0.132^{+0.004}_{-0.008}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.804^{+0.074}_{-0.074}$	$0.452^{+0.032}_{-0.017}$	$-0.378^{+0.016}_{-0.008}$	$-0.304^{+0.002}_{-0.004}$	$0.132^{+0.004}_{-0.008}$
	LHCb	$1.12^{+0.197}_{-0.187}$	$0.49^{+0.304}_{-0.304}$	$-0.10^{+0.183}_{-0.163}$	$-0.19^{+0.143}_{-0.163}$	$-$
$[16, 18]$	SM	$0.825^{+0.075}_{-0.075}$	$0.418^{+0.033}_{-0.017}$	$-0.381^{+0.013}_{-0.006}$	$-0.289^{+0.005}_{-0.006}$	$0.141^{+0.004}_{-0.008}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.877^{+0.075}_{-0.075}$	$0.411^{+0.033}_{-0.017}$	$-0.356^{+0.010}_{-0.004}$	$-0.265^{+0.005}_{-0.006}$	$0.140^{+0.004}_{-0.009}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.835^{+0.075}_{-0.075}$	$0.416^{+0.033}_{-0.017}$	$-0.376^{+0.012}_{-0.006}$	$-0.284^{+0.005}_{-0.006}$	$0.141^{+0.004}_{-0.008}$
	LHCb	$1.22^{+0.143}_{-0.152}$	$0.68^{+0.158}_{-0.216}$	$-0.07^{+0.136}_{-0.127}$	$-0.44^{+0.104}_{-0.058}$	$-$
$[18, 20]$	SM	$0.658^{+0.066}_{-0.066}$	$0.371^{+0.034}_{-0.019}$	$-0.317^{+0.010}_{-0.010}$	$-0.227^{+0.011}_{-0.011}$	$0.153^{+0.005}_{-0.009}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.726^{+0.066}_{-0.066}$	$0.367^{+0.034}_{-0.020}$	$-0.286^{+0.010}_{-0.010}$	$-0.201^{+0.010}_{-0.010}$	$0.151^{+0.005}_{-0.009}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.672^{+0.066}_{-0.066}$	$0.370^{+0.034}_{-0.019}$	$-0.309^{+0.010}_{-0.010}$	$-0.221^{+0.011}_{-0.011}$	$0.153^{+0.005}_{-0.009}$
	LHCb	$1.24^{+0.152}_{-0.149}$	$0.62^{+0.243}_{-0.273}$	$0.01^{+0.155}_{-0.146}$	$-0.13^{+0.095}_{-0.124}$	$-$
$[15, 20]$	SM	$0.753^{+0.069}_{-0.069}$	$0.409^{+0.033}_{-0.018}$	$-0.358^{+0.012}_{-0.007}$	$-0.271^{+0.011}_{-0.011}$	$0.143^{+0.005}_{-0.008}$
	RS$_c\|_{M_{g^{(1)}}} = 4.8$	$0.807^{+0.069}_{-0.069}$	$0.403^{+0.034}_{-0.019}$	$-0.332^{+0.008}_{-0.009}$	$-0.247^{+0.011}_{-0.011}$	$0.142^{+0.005}_{-0.009}$
	RS$_c\|_{M_{g^{(1)}}} = 10$	$0.764^{+0.069}_{-0.069}$	$0.407^{+0.033}_{-0.019}$	$-0.353^{+0.011}_{-0.007}$	$-0.266^{+0.011}_{-0.011}$	$0.143^{+0.005}_{-0.008}$
	LHCb	$1.20^{+0.092}_{-0.099}$	$0.61^{+0.114}_{-0.143}$	$-0.05^{+0.095}_{-0.095}$	$-0.29^{+0.076}_{-0.081}$	$-$

Summary

- In both models, main contributions to the branching ratios of the inclusive $b \to ss\bar{d}$, $b \to dd\bar{s}$ and the exclusive $\overline{B}^0 \to K^+\pi^-$ decay come from the KK gluons exchange.
- For the inclusive $b \to ss\bar{d}$ and $b \to dd\bar{s}$ decays in the RS$_c$ model, contributions of EW gauge bosons Z_H and Z' are equally important to that of the KK gluons.
- The RS$_c$ model enhances the branching ratio, such that compared to the SM result, a maximum enhancement of two and six orders of magnitude for $b \to ss\bar{d}$ and $\overline{B}^0 \to K^+\pi^-$ decay, respectively is possible for few points in the parameter space with $y_\star = 1.5$ case.
- In the bulk-Higgs RS model, branching ratio of the $b \to ss\bar{d}$ gets a maximum increase of one order of magnitude for $y_\star = 1.5$ value with $\beta = 10$ scenario, while for the exclusive $\overline{B}^0 \to K^+\pi^-$ decay, maximum possible enhancement of five to six orders of magnitude is probable for both cases of $y_\star$ within broad and narrow Higgs profile cases.
- In the model independent analysis of $\overline{B}^0 \to K^+\pi^-$ decay, it is possible to constrain the Wilson coefficients of different dimension-6 operators for a specific experimental precision for the observable R.
- The current constraints on the parameters of RS$_c$ model are too strict to explain the discrepancies in various observables predicted by LHCb measurements in Λ_b decays.

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