New physics in $b \rightarrow sll$ decays with complex Wilson coefficients.

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The 30th International Symposium on Lepton Photon Interactions at High Energies.

Based on *Nucl.Phys.*B 969 (2021) 1154797

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Anomalies in flavor physics

- Flavor changing neutral currents (FCNCs), potential probe of physics at higher energy scales → loop-suppressed amplitudes within the Standard Model (SM).

- Deviations in few angular observables \((P'_5 \sim 3\sigma)\) and theoretically clean ratios \((R_K\) and \(R_{K^*}\)) from their respective SM predictions.


\[ \mathcal{H}_{eff} = -\frac{4 G_F}{\sqrt{2}} \left( \lambda_t \mathcal{H}_{eff}^{(t)} + \lambda_u \mathcal{H}_{eff}^{(u)} \right) \]  (1)

\[ \mathcal{H}_{eff}^{(t)} = C_1 \mathcal{O}_1^c + C_2 \mathcal{O}_2^c + \sum_{i=3}^{6} C_i \mathcal{O}_i + \sum_{i=7,8,9,10,P,S} (C_i \mathcal{O}_i + C_i' \mathcal{O}_i') \]

\[ \mathcal{H}_{eff}^{(u)} = C_1 (\mathcal{O}_1^c - \mathcal{O}_1^u) + C_2 (\mathcal{O}_2^c - \mathcal{O}_2^u). \]

\[ \mathcal{O}_1 = (\bar{s}_\alpha q_\beta)V_{-A}(\bar{q}_\beta b_\alpha)V_{-A}, \]

\[ \mathcal{O}_2 = (\bar{s}q)V_{-A}(\bar{q}b)V_{-A}, \]

\[ \mathcal{O}_3 = (\bar{s}b)V_{-A} \sum_q (\bar{q}q)V_{-A}, \]

\[ \mathcal{O}_4 = (\bar{s}_\alpha b_\beta)V_{-A} \sum_q (\bar{q}_\beta q_\alpha)V_{-A}, \]

\[ \mathcal{O}_5 = (\bar{s}b)V_{-A} \sum_q (\bar{q}q)V_{+A}, \]

\[ \mathcal{O}_6 = (\bar{s}_\alpha b_\beta)V_{-A} \sum_q (\bar{q}_\beta q_\alpha)V_{+A}, \]
Operator basis

\[ \mathcal{O}_7 = \frac{e}{g^2} m_b (\bar{s} \sigma_{\mu\nu} P_R b) F^{\mu\nu}, \]

\[ \mathcal{O}_8 = \frac{1}{g} m_b (\bar{s} \sigma_{\mu\nu} T^a P_R b) G^{\mu\nu}, \]

\[ \mathcal{O}_9 = \frac{e^2}{g^2} (\bar{s} \gamma_{\mu} P_L b) (\bar{l} \gamma^\mu l), \]

\[ \mathcal{O}_{10} = \frac{e^2}{g^2} (\bar{s} \gamma_{\mu} P_L b) (\bar{l} \gamma^\mu \gamma_5 l), \]

\[ \mathcal{O}_S = \frac{e^2}{16\pi^2} m_b (\bar{s} P_R b) (\bar{l} l), \]

\[ \mathcal{O}_P = \frac{e^2}{16\pi^2} m_b (\bar{s} P_R b) (\bar{l} \gamma_5 l), \]

\[ \mathcal{O}'_7 = \frac{e}{g^2} m_b (\bar{s} \sigma_{\mu\nu} P_L b) F^{\mu\nu}, \]

\[ \mathcal{O}'_8 = \frac{1}{g} m_b (\bar{s} \sigma_{\mu\nu} T^a P_L b) G^{\mu\nu}, \]

\[ \mathcal{O}'_9 = \frac{e^2}{g^2} (\bar{s} \gamma_{\mu} P_R b) (\bar{l} \gamma^\mu l), \]

\[ \mathcal{O}'_{10} = \frac{e^2}{g^2} (\bar{s} \gamma_{\mu} P_R b) (\bar{l} \gamma^\mu \gamma_5 l), \]

\[ \mathcal{O}'_S = \frac{e^2}{16\pi^2} m_b (\bar{s} P_L b) (\bar{l} l), \]

\[ \mathcal{O}'_P = \frac{e^2}{16\pi^2} m_b (\bar{s} P_L b) (\bar{l} \gamma_5 l). \]
Experimental Inputs

- $B^{(0,+)} \rightarrow K^{(0,+)} \mu^+ \mu^-$: Differential branching fractions and isospin asymmetries (LHCb and Belle), binned data on the angular observables ($A_{FB}$ and $F_H$) for $B^+ \rightarrow K^+ \mu^+ \mu^-$ (CMS) and inputs on $R_K$ (LHCb and Belle).

- $B \rightarrow K^* \mu^+ \mu^-$: Differential branching fractions and isospin asymmetries (LHCb), angular observables in $B^0 \rightarrow K^{*0} \mu^+ \mu^-$ decays (LHCb and ATLAS), $P_4'$ and $P_5'$ for $B^0 \rightarrow K^{*0} \mu^+ \mu^-$ (Belle) and $R_{K^*}$ (LHCb and Belle).

- $B_s \rightarrow \phi \mu^+ \mu^-$: Differential branching fractions and angular observables (LHCb).

- $B_s \rightarrow \mu \mu$: Branching fraction (HFLAV).

- Radiative modes.
Decay distribution

For a vector meson in final state:

\[
\frac{1}{d(\Gamma + \bar{\Gamma})/dq^2} \frac{d^4(\Gamma + \bar{\Gamma})}{dq^2 d\Omega} = \frac{9}{32\pi} \left[ \frac{3}{4} (1 - F_L) \sin^2 \theta_K \right.
\]

\[
+ F_L \cos^2 \theta_K 
\]

\[
+ \frac{1}{4} (1 - F_L) \sin^2 \theta_K \cos 2\theta_l - F_L \cos \theta_K \cos 2\theta_l 
\]

\[
+ S_3 \sin^2 \theta_K \sin^2 \theta_l \cos 2\phi + S_4 \sin 2\theta_K \sin 2\theta_l \cos \phi 
\]

\[
+ S_5 \sin 2\theta_K \sin \theta_l \cos \phi 
\]

\[
+ \frac{4}{3} A_{FB} \sin^2 \theta_K \cos \theta_l + S_7 \sin 2\theta_K \sin \theta_l \sin \phi 
\]

\[
+ S_8 \sin 2\theta_K \sin 2\theta_l \sin \phi + S_9 \sin^2 \theta_K \sin^2 \theta_l \sin 2\phi \]

\]

(3)

- \[ P_1 = \frac{2S_3}{1-F_L}, \quad P_2 = \frac{2}{3} \frac{A_{FB}}{(1-F_L)}, \quad P_3 = \frac{-S_9}{1-F_L}, \quad P_{i=4,5,6,8} = \frac{S_j=4,5,7,8}{\sqrt{F_L(1-F_L)}} \]

- Normalized angular distribution for pseudoscalar meson:

\[
\frac{1}{\Gamma_l} \frac{d\Gamma_l}{d\cos \theta} = \frac{3}{4} (1 - F^l_H)(1 - \cos^2 \theta) + \frac{1}{2} F^l_H + A^l_{FB} \cos \theta 
\]

(4)
Analysis

- Complex new physics WCs: $C'_7$, $\Delta C_9$, $C'_9$, $\Delta C_{10}$, $C'_{10}$, $C_S$, $C'_S$, $C_P$ and $C'_P$.

- 3 datasets: Moment(LHCb 2016), Likelihood(LHCb 2016), Likelihood(LHCb 2020) - No asymmetric observables.

- Statistical analysis optimizing a $\chi^2$ statistic.

\[ \chi^2(C^{NP}) = [O_{exp} - O_{th}(C^{NP})]^T [C_{exp} + C_{th}]^{-1} [O_{exp} - O_{th}(C^{NP})] \]

- In the post-process for each fit, obtain fit-quality using p-value and find outliers.

- Model selection out of all possible combinations of the WCs (1022 combinations - Real + Real and Imaginary) - Akaike’s Information Criterion (AICc) and cross-validation.
### One operator scenarios

| Dataset       | $\chi^2$/DOF | p-val(%) | Value                  | $\chi^2$/DOF | p-val(%) | Value                  |
|---------------|--------------|---------|------------------------|--------------|---------|------------------------|
| **Likelihood 2020** | 279.5/210    | $9.4 \times 10^{-2}$ | $\text{Re}(C_7^I) \rightarrow -0.039\pm0.013$
$\text{Im}(C_7^I) \rightarrow -0.026\pm0.101$ | 202.89/210    | 62.5     | $\text{Re}(\Delta C_9) \rightarrow -1.10\pm0.11$
$\text{Im}(\Delta C_9) \rightarrow 1.27\pm0.37$ |
| **Likelihood 2016** | 306.45/249   | 0.7     | $\text{Re}(C_9^I) \rightarrow -0.03\pm0.01$
$\text{Im}(C_9^I) \rightarrow -0.002\pm0.025$ | 235.79/249    | 71.6     | $\text{Re}(\Delta C_9) \rightarrow -1.21\pm0.14$
$\text{Im}(\Delta C_9) \rightarrow -1.25\pm0.44$ |
| **Moments 2016**   | 291.85/271   | 18.4    | $\text{Re}(C_7^I) \rightarrow -0.031\pm0.016$
$\text{Im}(C_7^I) \rightarrow -0.0057\pm0.0300$ | 241.7/271     | 89.9     | $\text{Re}(\Delta C_9) \rightarrow -1.24\pm0.18$
$\text{Im}(\Delta C_9) \rightarrow 1.19\pm0.48$ |
| **Likelihood 2020**   | 287.9/210    | $2.9 \times 10^{-2}$ | $\text{Re}(C_9^I) \rightarrow -0.077\pm0.149$
$\text{Im}(C_9^I) \rightarrow -0.70\pm0.54$ | 276.17/210    | 0.15     | $\text{Re}(\Delta C_{10}) \rightarrow 0.64\pm0.18$
$\text{Im}(\Delta C_{10}) \rightarrow 1.79\pm0.29$ |
| **Likelihood 2016**   | 310.72/249   | 0.47    | $\text{Re}(C_9^I) \rightarrow -0.13\pm0.15$
$\text{Im}(C_9^I) \rightarrow -0.15\pm0.71$ | 303.22/249    | 1.1      | $\text{Re}(\Delta C_{10}) \rightarrow 0.39\pm0.15$
$\text{Im}(\Delta C_{10}) \rightarrow 0.45\pm0.50$ |
| **Moments 2016**   | 295.4/271    | 14.8    | $\text{Re}(C_9^I) \rightarrow -0.060\pm0.148$
$\text{Im}(C_9^I) \rightarrow -0.084\pm0.423$ | 281.7/271     | 31.5     | $\text{Re}(\Delta C_{10}) \rightarrow 0.51\pm0.14$
$\text{Im}(\Delta C_{10}) \rightarrow -0.11\pm0.68$ |
| **Likelihood 2020**   | 278.1/210    | 0.1     | $\text{Re}(C_{10}^I) \rightarrow 0.33\pm0.11$
$\text{Im}(C_{10}^I) \rightarrow -0.21\pm0.81$ | 288.55/210    | $2.6 \times 10^{-2}$ | $\text{Re}(C_S) \rightarrow -0.029\pm0.483$
$\text{Im}(C_S) \rightarrow -0.032\pm0.440$ |
| **Likelihood 2016**   | 303.0/249    | 1.1     | $\text{Re}(C_{10}^I) \rightarrow 0.33\pm0.11$
$\text{Im}(C_{10}^I) \rightarrow 0.02\pm0.28$ | 311.10/249    | 0.4      | $\text{Re}(C_S) \rightarrow -0.04\pm0.04$
$\text{Im}(C_S) \rightarrow 0.0017\pm0.3043$ |
| **Moments 2016**   | 290.2/271    | 20.2    | $\text{Re}(C_{10}^I) \rightarrow 0.28\pm0.12$
$\text{Im}(C_{10}^I) \rightarrow -0.0030\pm0.3175$ | 295.4/271     | 14.8     | $\text{Re}(C_S) \rightarrow -0.027\pm0.279$
$\text{Im}(C_S) \rightarrow 0.030\pm0.251$ |
| **Likelihood 2020**   | 288.52/210   | $2.6 \times 10^{-2}$ | $\text{Re}(C_P) \rightarrow -0.0075\pm0.0135$
$\text{Im}(C_P) \rightarrow -0.003\pm0.241$ | 288.51/210    | $2.6 \times 10^{-2}$ | $\text{Re}(C_S^I) \rightarrow -0.044\pm0.053$
$\text{Im}(C_S^I) \rightarrow 0.0055\pm0.3001$ |
| **Likelihood 2016**   | 311.22/249   | 0.4     | $\text{Re}(C_P) \rightarrow -0.0047\pm0.1564$
$\text{Im}(C_P) \rightarrow -0.02\pm0.85$ | 311.22/249    | 0.4      | $\text{Re}(C_S^I) \rightarrow -0.04\pm0.17$
$\text{Im}(C_S^I) \rightarrow -0.01\pm0.62$ |
| **Moments 2016**   | 295.2/271    | 15      | $\text{Re}(C_P) \rightarrow -0.26\pm0.12$
$\text{Im}(C_P) \rightarrow -0.019\pm0.847$ | 295.4/271     | 14.8     | $\text{Re}(C_S^I) \rightarrow -0.035\pm0.157$
$\text{Im}(C_S^I) \rightarrow -0.020\pm0.263$ |
| **Likelihood 2020**   | 288.49/210   | $2.6 \times 10^{-2}$ | $\text{Re}(C_P^I) \rightarrow 0.0078\pm0.0125$
$\text{Im}(C_P^I) \rightarrow -0.002\pm0.182$ | 288.51/210    | $2.6 \times 10^{-2}$ | $\text{Re}(C_S^I) \rightarrow -0.044\pm0.053$
$\text{Im}(C_S^I) \rightarrow 0.0055\pm0.3001$ |
| **Likelihood 2016**   | 311.2/249    | 0.4     | $\text{Re}(C_P^I) \rightarrow 0.007\pm0.013$
$\text{Im}(C_P^I) \rightarrow -0.0027\pm0.2648$ | 311.22/249    | 0.4      | $\text{Re}(C_S^I) \rightarrow -0.04\pm0.17$
$\text{Im}(C_S^I) \rightarrow -0.01\pm0.62$ |
| **Moments 2016**   | 295.4/271    | 14.8    | $\text{Re}(C_P^I) \rightarrow 0.0061\pm0.0135$
$\text{Im}(C_P^I) \rightarrow 0.0021\pm0.3384$ | 295.4/271     | 14.8     | $\text{Re}(C_S^I) \rightarrow -0.035\pm0.157$
$\text{Im}(C_S^I) \rightarrow -0.020\pm0.263$ |
Results (Likelihood 2020 dataset)

- **With CP-asymmetric observables in** $B_s \to \phi \mu \mu$ -

| $\chi^2_{Min}/DOF$ | $p$-value (%) | Scenario                  |
|---------------------|---------------|---------------------------|
| 206.517/211         | 57.4          | $Re(\Delta C_9) \to -1.05 \pm 0.11$ |
| 202.889/210         | 62.5          | $Re(\Delta C_9) \to -1.10 \pm 0.11$ |
|                     |               | $Im(\Delta C_9) \to 1.27^{+0.33}_{-0.43}$ |

- **Without CP-asymmetric observables in** $B_s \to \phi \mu \mu$ -

| $\chi^2_{Min}/DOF$ | $p$-value (%) | Scenario                  |
|---------------------|---------------|---------------------------|
| 198.226/199         | 50.2          | $Re(\Delta C_9) \to -1.05 \pm 0.11$ |
| 194.926/198         | 54.8          | $Re(\Delta C_9) \to -1.11 \pm 0.12$ |
|                     |               | $Im(\Delta C_9) \to -1.36^{+0.44}_{-0.34} \cup [0.84, 1.59]$ |

- **With CP-asymmetric observables in** $B \to K^* \mu \mu$ (From Likelihood 2016 dataset) -

| $\chi^2_{Min}/DOF$ | $p$-value (%) | Scenario                  |
|---------------------|---------------|---------------------------|
| 239.768/246         | 60            | $Re(\Delta C_9) \to -1.06 \pm 0.11$ |
| 238.105/245         | 61.2          | $Re(\Delta C_9) \to -1.09 \pm 0.11$ |
|                     |               | $Im(\Delta C_9) \to -1.11^{+0.62}_{-0.4}$ |
Parameter spaces

Scenario: $Re(\Delta C_9), Im(\Delta C_9)$

- $-1.10(11)$
- $-1.09(11)$
- $-1.11^{+0.13}_{-0.12}$

Likelihood 2020

Likelihood 2020 (with likelihood 2016 $B \to K^*$ asymmetric data)

Likelihood 2020 (without asymmetry)

Scenario: $Re(\Delta C_9), Im(\Delta C_9)$

- $1.27^{+0.33}_{-0.43}$
- $-1.11^{+0.62}_{-0.44}$
- $-1.36^{+0.44}_{-0.34}$

68% C.L.

95% C.L.

99% C.L.
Observables sensitive to $Im(\Delta C_9)$
Observables responsible for sign change in $\text{Im}(\Delta C_9)$.
Observables responsible for sign change in $\text{Im}(\Delta C_9)$
The new physics scenario $\Delta C_9 = -\Delta C_{10}$

| Fit scenario                  | Data dropped | $\chi^2_{MIN}/DOF$ | $p$-value (%) | $\text{Pull}_{SM}$ | Confidence intervals                                   |
|-------------------------------|--------------|---------------------|---------------|---------------------|--------------------------------------------------------|
| **Likelihood datasets 2020**  | **List-1**   | 243.02/211          | 6.4           | 6.8                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.55 \pm 0.08$ |
|                               | $\chi^2_{SM} = 288.9$ | 242.58/210          | 6.1           | 6.5                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.59 \pm 0.12$ |
|                               | $p_{SM} = 0.035 \%$ |                    |               |                     | $Im(\Delta C_9) = -Im(\Delta C_{10}) \rightarrow 0.45 \pm 0.49$ |
|                               | **List-2**   | 209.8/204           | 37.6          | 6.8                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.54 \pm 0.08$ |
|                               | $\chi^2_{SM} = 255.4$ | 209.6/203           | 36            | 6.4                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.56 \pm 0.10$ |
|                               | $p_{SM} = 0.96 \%$ |                    |               |                     | $Im(\Delta C_9) = -Im(\Delta C_{10}) \rightarrow 0.27 \pm 0.56$ |
| **Likelihood datasets 2016**  | **List-3**   | 269.15/250          | 19.3          | 6.5                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.54 \pm 0.09$ |
|                               | $\chi^2_{SM} = 311.5$ | 268.84/249          | 18.5          | 6.2                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.54 \pm 0.09$ |
|                               | $p_{SM} = 0.56 \%$ |                    |               |                     | $Im(\Delta C_9) = -Im(\Delta C_{10}) \rightarrow -0.16 \pm 0.28$ |
| **Moment datasets 2016**      | **List-3**   | 260.82/272          | 67.6          | 5.9                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.49 \pm 0.09$ |
|                               | $\chi^2_{SM} = 295.6$ | 260.72/271          | 66.2          | 5.6                 | $Re(\Delta C_9) = -Re(\Delta C_{10}) \rightarrow -0.49 \pm 0.09$ |
|                               | $p_{SM} = 16.6 \%$ |                    |               |                     | $Im(\Delta C_9) = -Im(\Delta C_{10}) \rightarrow 0.14 \pm 0.43$ |
Model Selection

\[ h_\theta(x) = \theta_0 + \theta_1 x \]

Underfitting

**High bias**

\[ h_\theta(x) = \theta_0 + \theta_1 x + \theta_2 x^2 \]

Just right

\[ h_\theta(x) = \theta_0 + \theta_1 x + \theta_2 x^2 + \theta_3 x^3 + \theta_4 x^4 + \ldots \]

Overfitting

**High variance**

Slide credit: Andrew Ng
Model Selection

- **Akaike’s Information Criteria** -

\[
\text{AICc} = \chi^2_{\text{min}} + 2K + \frac{2K(K+1)}{n-K-1},
\]

\[n = \text{sample size and } K = \text{no. of parameters}\]

- **Selected models** : \(\Delta \text{AIC}^i_c = \text{AIC}^i_c - \text{AIC}^{\text{min}}_c\)
Akaike’s Information Criteria -

$$AICc = \chi_{min}^2 + 2K + \frac{2K(K+1)}{n-K-1} ,$$

where $n = \text{sample size}$ and $K = \text{no. of parameters}$

Selected models : $\Delta AIC^i_{c} = AIC^i_{c} - AIC^min_{c}$

Cross-Validation (LOOCV) -

- One of the data points left out and the rest of the sample (“training set”) optimized for a particular model.
- Result used to find the predicted squared error (SE) = $$\frac{(\mathcal{O}_i^{exp} - \mathcal{O}_i^{theory})^2}{\sqrt{(\sigma^2_{exp} + \sigma^2_{theory})}} ,$$
  for the left out data point.
- Repeated for all data points and calculate MSE for the model.
### Selected models ($\Delta AICc \leq 6$, $MSE_{X\text{-val}} < 1.5$)

| Model | $\Delta AICc$ | MSE $X\text{-val}$ | $\chi^2_{\text{Min}}$/dof | p-value (%) | Parameters |
|-------|---------------|----------------------|-----------------------------|-------------|------------|
| 585.  | 0.0           | 0.989                | 189.05/206                  | 79.6        | $Re(\Delta C_9) \rightarrow -1.36\pm0.24$, $Im(\Delta C_9) \rightarrow 2.05\pm0.36$, $Re(C_9') \rightarrow 0.57\pm0.23$, $Im(C_9') \rightarrow 0.14\pm0.25$, $Re(\Delta C_{10}) \rightarrow 0.51\pm0.22$, $Im(\Delta C_{10}) \rightarrow -0.53\pm0.46$ |
| 18.   | 2.01          | 0.942                | 199.41/210                  | 68.9        | $Re(\Delta C_9) \rightarrow -1.08\pm0.10$, $Re(C_9') \rightarrow 0.5\pm0.18$ |
| 697.  | 3.5           | 0.97                 | 188.25/204                  | 77.9        | $Re(\Delta C_9) \rightarrow -1.4\pm0.24$, $Im(\Delta C_9) \rightarrow 1.93\pm0.49$, $Re(C_9') \rightarrow 0.56\pm0.23$, $Im(C_9') \rightarrow 0.31\pm0.5$, $Re(\Delta C_{10}) \rightarrow 0.52\pm0.22$, $Im(\Delta C_{10}) \rightarrow -0.51\pm0.41$, $Re(C_{10}') \rightarrow -0.032\pm0.18$, $Im(C_{10}') \rightarrow 0.75\pm0.82$ |
| 529.  | 3.8           | 0.977                | 197.05/208                  | 69.6        | $Re(\Delta C_9) \rightarrow -1.11\pm0.11$, $Im(\Delta C_9) \rightarrow -0.12\pm0.46$, $Re(C_9') \rightarrow 0.42\pm0.23$, $Im(C_9') \rightarrow -1.21\pm0.41$ |
| 641.  | 4.94          | 1.01                 | 189.69/204                  | 75.6        | $Re(C_7') \rightarrow 0\pm0.0136$, $Im(C_7') \rightarrow 0\pm0.04$, $Re(\Delta C_9) \rightarrow -1.07\pm0.13$, $Im(\Delta C_9) \rightarrow -0.06\pm0.3$, $Re(C_9') \rightarrow 0.61\pm0.25$, $Im(C_9') \rightarrow -1.98\pm0.4$, $Re(\Delta C_{10}) \rightarrow 0.6\pm0.22$, $Im(\Delta C_{10}) \rightarrow -0.051\pm1.25$ |
| 530.  | 5.48          | 0.99                 | 198.74/208                  | 66.6        | $Re(\Delta C_9) \rightarrow -1.34\pm0.26$, $Im(\Delta C_9) \rightarrow 1.95\pm0.44$, $Re(\Delta C_{10}) \rightarrow 0.32\pm0.23$, $Im(\Delta C_{10}) \rightarrow -0.56\pm0.57$ |
| 513.  | 5.49          | 0.98                 | 202.89/210                  | 62.5        | $Re(\Delta C_9) \rightarrow -1.1\pm0.11$, $Im(\Delta C_9) \rightarrow 1.27\pm0.37$ |
Predictions of $R_{K^*}$ and $P'_5$
• $\mathcal{O}_9$ is the only one operator scenario with both real and complex W.Cs that is capable of explaining the present data.

• In all other one operator scenarios, the quality of fits are very poor, with the respective p-values $\sim 0$.

• $\mathcal{O}_9$ with complex WC, though not the best model, is the only one-operator scenario passing all the selection criteria. Some two, three and four-operator scenarios are selected as well, and all of these contain $\mathcal{O}_9$(with real or complex WC) as one of the operators.
Thank you!