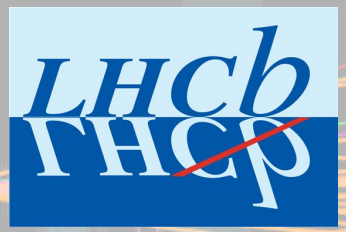
Electroweak Penguin Decays (excluding $b \to s e^+ e^-$)



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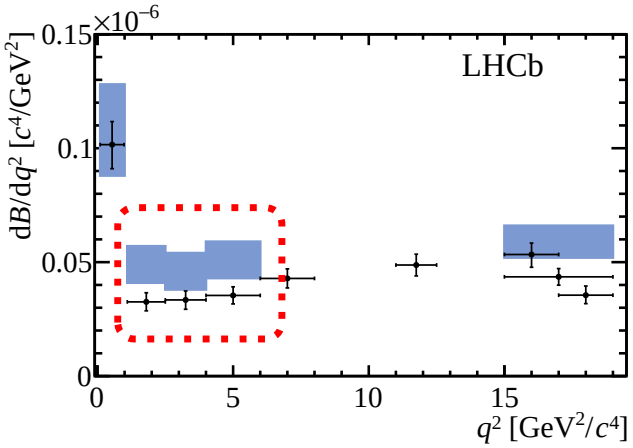
FSP 2017 Siegen, October 5, 2017

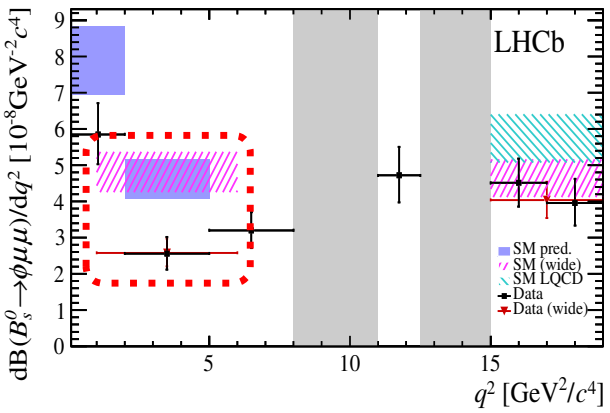
LHCb $B^0 \to K^{*0} \mu^+ \mu^-$ candidate, May 7$^{\text{th}}$ 2012, 09:32:37

Flavour anomalies I: Branching fractions

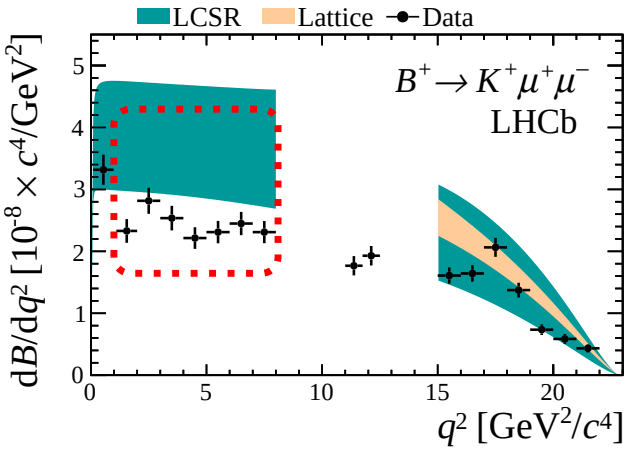
LHCb $B^0 \to K^{*0}\mu^+\mu^-$ [JHEP 11 (2016) 047]



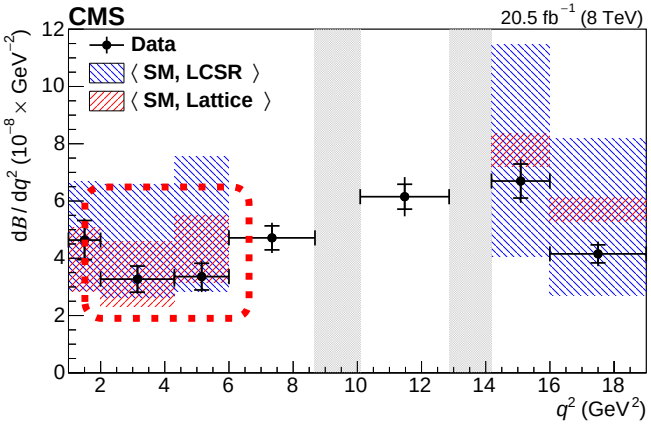
LHCb $B_s^0 \to \phi\mu^+\mu^-$ [JHEP 09 (2015) 179]



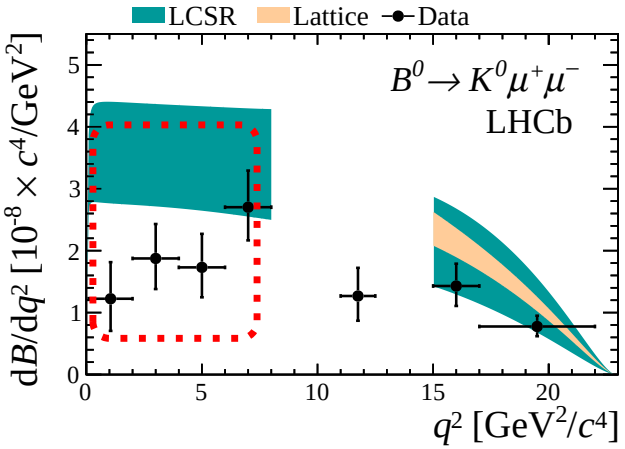
LHCb $B^+ \to K^+\mu^+\mu^-$ [JHEP 06 (2014) 133]



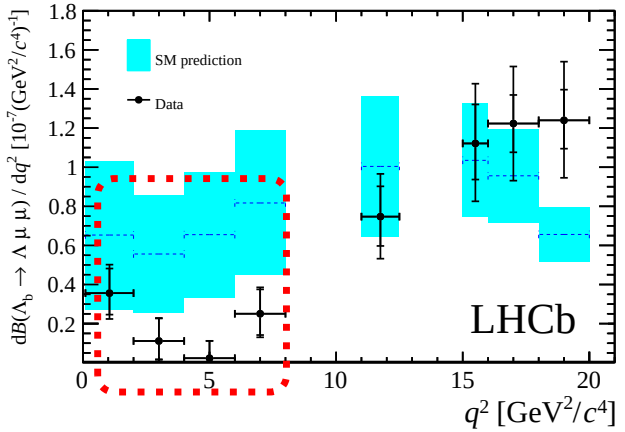
CMS $B^0 \to K^{*0}\mu^+\mu^-$ [PLB 753 (2016) 424]



LHCb $B^0 \to K^0\mu^+\mu^-$ [JHEP 06 (2014) 133]

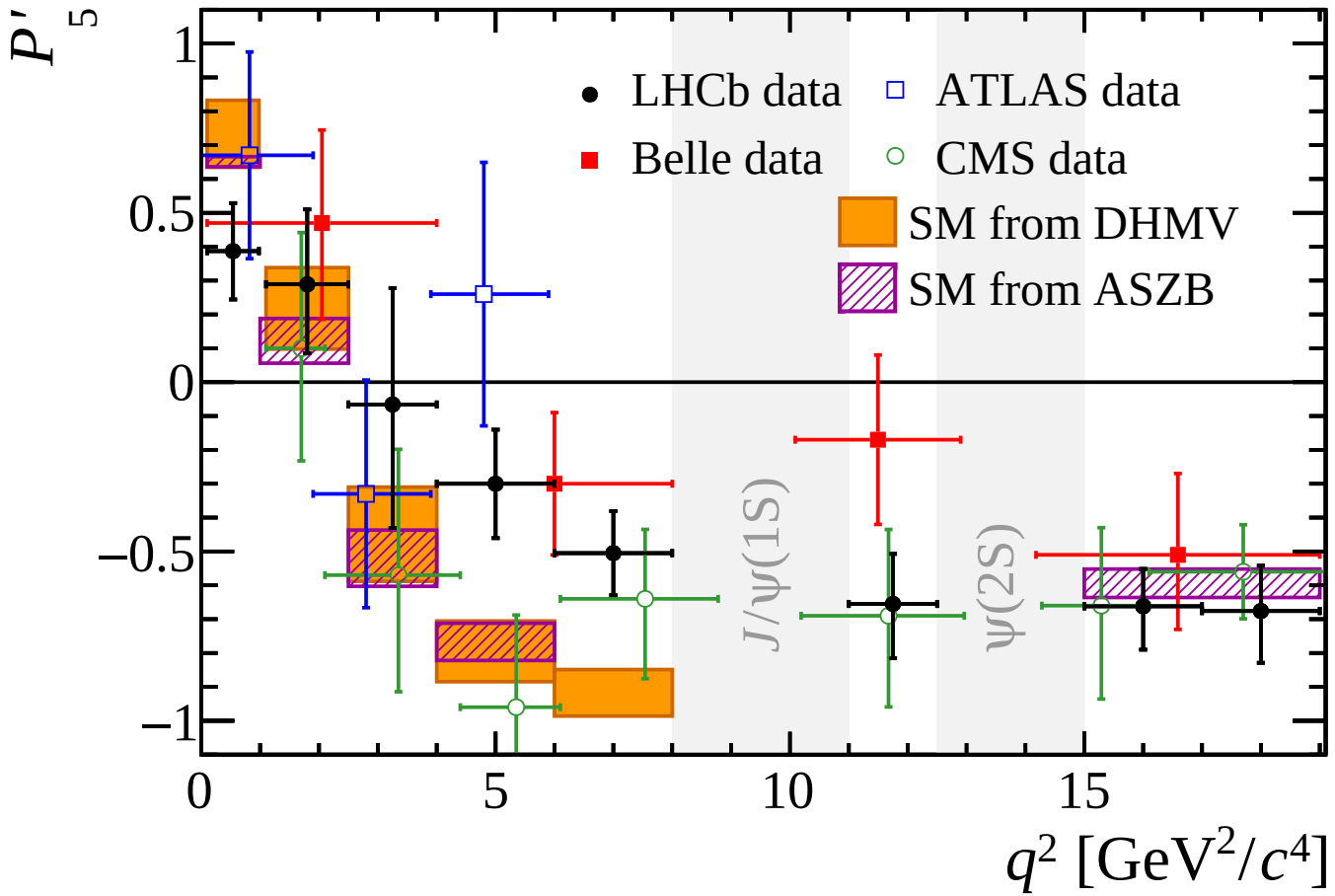


LHCb $\Lambda_b^0 \to \Lambda\mu^+\mu^-$ [JHEP 06 (2015) 115]



- Data consistently below SM predictions (particularly at low q^2)

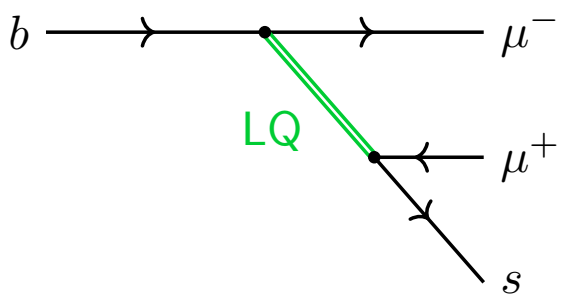
Flavour anomalies II: P_5' angular obervable



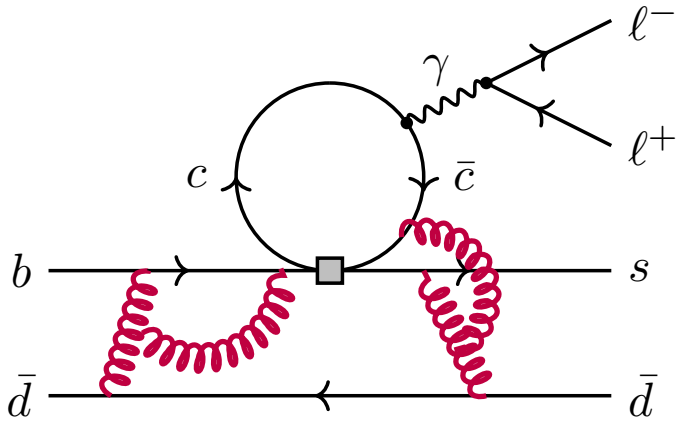
- LHCb finds local deviations of $2.8\,\sigma$ and $3.0\,\sigma$
- [JHEP 02 (2016) 104] [ATLAS-CONF-2017-023] [CMS-PAS-BPH-15-008] [PRL 118 (2017) 111801]

Interpretation of anomalies

1. New Physics



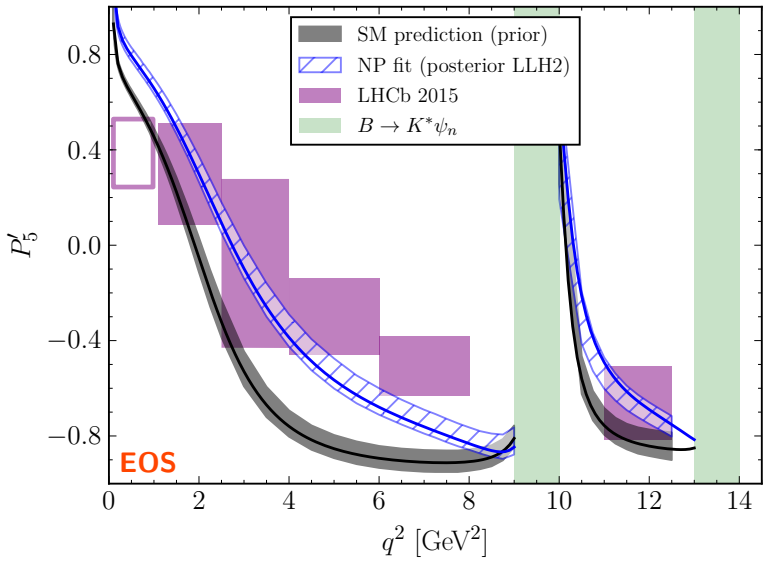
2. SM $c\bar{c}$ loop

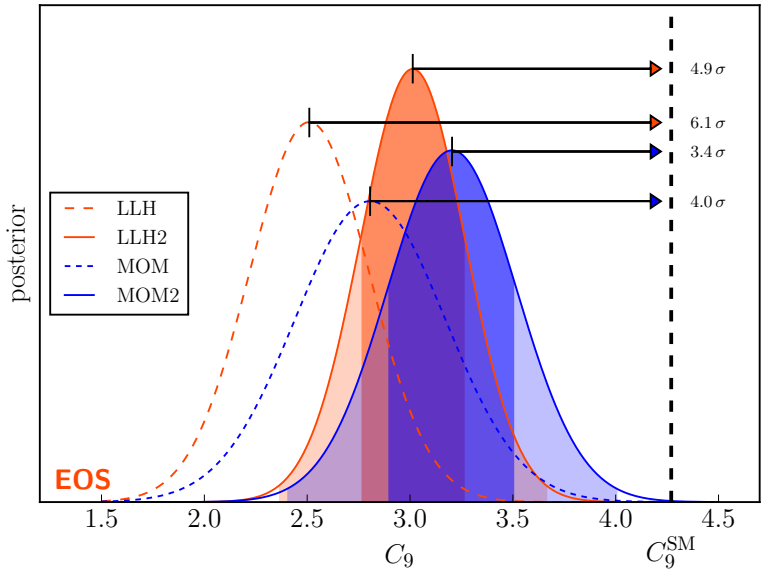


3. Fluctuation

- Experimental precision: LHCb Run 2 data on tape already $+3\,\text{fb}^{-1}$
  $\rightarrow$ Statistics tripled
- Study of q^2-dependence: NP would be q^2-independent
- Expect increase in precision of FF predictions from lattice

Recent developements in phenomenology





- Model-ind. $c\bar{c}$-loop parameterisation from analyticity [arxiv:1707.07305]
- Seems to allow us to use data to fit the charm-loop contributions
- Uses information from the $c\bar{c}$ resonances and the inter-resonance bin
- See also
  - Parameterise $c\bar{c}$-loop contribution with BWs [arXiv:1709.03921]
  - Increase stat. precision with q^2-unbinned approach [arxiv:1708.04474]

Other interesting observables

- Clean $B^0 \to K^{*0}\mu^+\mu^-$ angular observables available:
  T-odd CP asymmetries A_7, A_8, A_9, and S_3 unaffected by charm-loop
- Cancellation in ratios:
  CP asymmetries $\mathcal{A}_{\rm CP} = \frac{\Gamma(\bar{B}\to\bar{K}^{(*)}\mu^+\mu^-)-\Gamma(B\to K^{(*)}\mu^+\mu^-)}{\Gamma(\bar{B}\to\bar{K}^{(*)}\mu^+\mu^-)+\Gamma(B\to K^{(*)}\mu^+\mu^-)}$
  Isospin asymmetries $\mathcal{A}_I = \frac{\Gamma(B^0\to K^{(*)0}\mu^+\mu^-)-\Gamma(B^+\to K^{(*)+}\mu^+\mu^-)}{\Gamma(B^0\to K^{(*)0}\mu^+\mu^-)+\Gamma(B^+\to K^{(*)+}\mu^+\mu^-)}$
- Tests of MFV via $B^+ \to \pi^+\mu^+\mu^-$ *vs.* $B^+ \to K^+\mu^+\mu^-$
  and $B^0 \to \rho^0\mu^+\mu^-$ *vs.* $B^+ \to K^{*0}\mu^+\mu^-$
- Higher resonances *e.g.* $B_s^0 \to f_2(1525)\mu^+\mu^-$
- Further study of rare Λ_b^0 decays
- Rare B_c^+ decays $B_c^+ \to D_s^+\mu^+\mu^-$
- Endpoint relations (?)

  [JHEP 03 (2014) 042] [Phys. Rev. D 95, 114006 (2017)] [EPJC 77 (2017) 16]
- Semi-inclusive/Sum of exclusives measurements (?)
- For clean LFU (angular) tests see Johannes talk