Opportunities and interplay beyond $b \to s\, l\, l$

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Mitesh Patel
(Imperial College London)

- B_s lifetime difference
  - The lifetime difference in the B_s system has an impact on the expected $B(B_s \to \mu\mu)$:

    $(3.2 \pm 0.2) \times 10^{-9}$ [arXiv:1012.1447] → $(3.5 \pm 0.2) \times 10^{-9}$ [arXiv:1204.1737]
  - Exactly this lifetime difference in used in the proposed $B_s \to \phi\gamma$ analysis [arXiv:0912.4179] to get sensitivity to right-handed photon contributions without requiring knowledge of the B flavour (experimentally, this measurement is extremely tough)
  - Are there ways of exploiting this difference in other measurements?
  - Does this lifetime difference have bearing on the $B_s \to \phi\mu\mu$ analysis where LHCb should have the statistics to do an angular analysis?
  - Are there other radiative measurements LHCb should look at? [signatures with a single γ, π^0, K_S can be isolated experimentally]

- What can we learn from $B_s \to \tau\tau$? Should this be a priority?

- Is $B_s \to K^{+(*)}\mu\nu$ the measurement to get V_{ub}? Or double ratio method?

- Is the contribution from “exchange” diagrams insignificant for all B^0 decays?
  - arXiv:1106.2711 predicts a large exchange contribution to B($B^0 \to D^0 \mu\mu$) [and an very large B (~10^{-5}) that LHCb should be able to test]

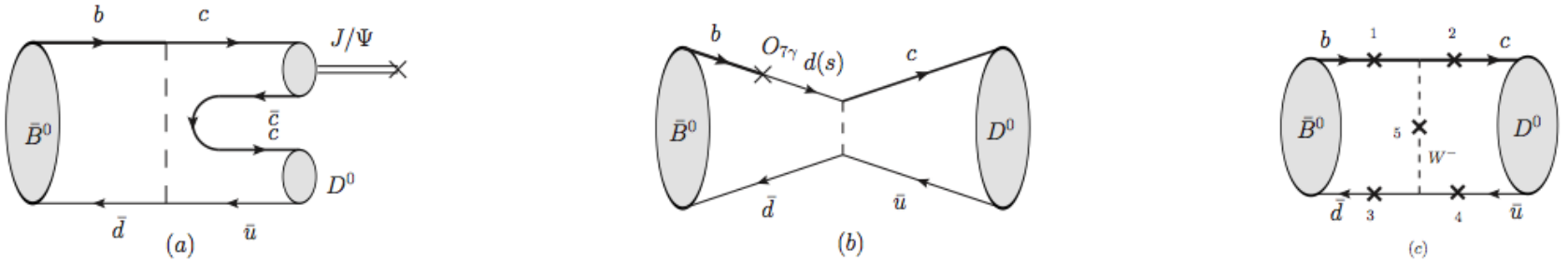

Figure 1: The possible diagrams for $B^0 \to D^0 \ell^+ \ell^-$, where the crosses stand for a virtual photon.

  - Paper claims that “the weak annihilation contributions are usually ignored since they are regarded to be suppressed by $O(\Lambda_{QCD}/m_B)$”
  - A similar “exchange” process must contribute to $B^0 \to \pi^0 \mu\mu$ → significant difference cf. naïve expectation from B ($B^+ \to \pi^+ \mu\mu$) ?
  - (While LHCb might just be able to see the $\pi^0 \mu\mu$ mode, perhaps an upgraded experiment could measure the isospin asymmetry in π^+, π^0 $\mu\mu$ as in $B \to K \mu\mu$ decays)

- Are there other ancillary measurements to help us with theory issues elsewhere
  - masses? matrix elements?

- Is $B_s \to K^{*0}\mu\mu / B^0 \to K^{*0}\mu\mu$ of interest for V_{td}/V_{ts} determination?
  - Same form factor
  - f_d/f_s now known very well

- Other than $B^0 \to \mu\mu$, what would shopping list for $b \to d$ transitions be?

- B_c-decays
  - LHCb sees 400 $B_c \to J/\psi\pi$ decays which have effective BF ($B(B_c \to J/\psi\pi) \times B(b \to B_c)$) ~10^{-4} [arXiv:1204.0079]
  - Given low $b \to B_c$ probability, unlikely any penguin decays will be visible with current phase of LHCb but are there other decays that are interesting?

    e.g. B_c analogue of $B^0 \to D^{(*)}\tau\nu$ / $B^0 \to D^{(*)}\mu\nu$ (where BaBar recently measured 2.7σ discrepancy arXiv:1205.5442v1) : $B_c \to J/\psi\tau\nu$ / $B_c \to J/\psi\mu\nu$
    Does have spectator c-quark make things different from the theory-side?