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Experimental results on $B \to K^{(*)} l^+ l^-$ isospin asymmetries

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$B \to K^{(*)}\mu^+\mu^-$ isospin analysis

arXiv:1205.3422,
JHEP 07 (2012) 133

Can look at the isospin asymmetry in rare decays

$$A_I = \frac{\Gamma(B^0 \to K^{(*)0}\mu^+\mu^-) - \Gamma(B^+ \to K^{(*)+}\mu^+\mu^-)}{\Gamma(B^0 \to K^{(*)0}\mu^+\mu^-) + \Gamma(B^+ \to K^{(*)+}\mu^+\mu^-)}$$

$$A_I = \frac{\mathcal{B}(B^0 \to K^{(*)0}\mu^+\mu^-) - \frac{\tau_0}{\tau_+}\mathcal{B}(B^\pm \to K^{(*)\pm}\mu^+\mu^-)}{\mathcal{B}(B^0 \to K^{(*)0}\mu^+\mu^-) + \frac{\tau_0}{\tau_+}\mathcal{B}(B^\pm \to K^{(*)\pm}\mu^+\mu^-)}$$

In full 2011 data, measure individual differential branching fractions.

The ingredients

Four decay chains are reconstructed and yields extracted

$B^0 \to K^{*0}\,\mu^+\mu^-$, $K^{*0} \to K^+\pi^-$

$B^+ \to K^{*+}\,\mu^+\mu^-$, $K^{*+} \to K^0_S\pi^+$, $K^0_S \to \pi^+\pi^-$

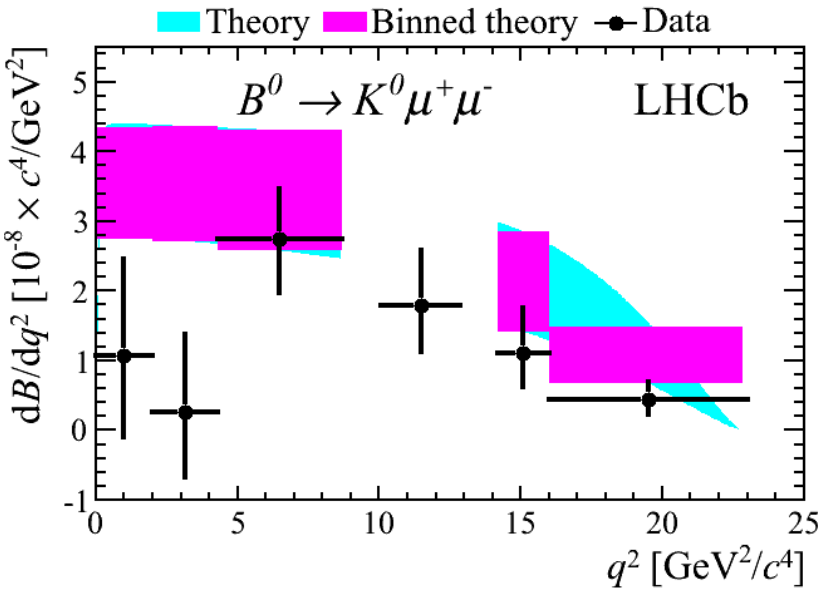
$B^0 \to K^0_S\,\mu^+\mu^-$, $K^0_S \to \pi^+\pi^-$

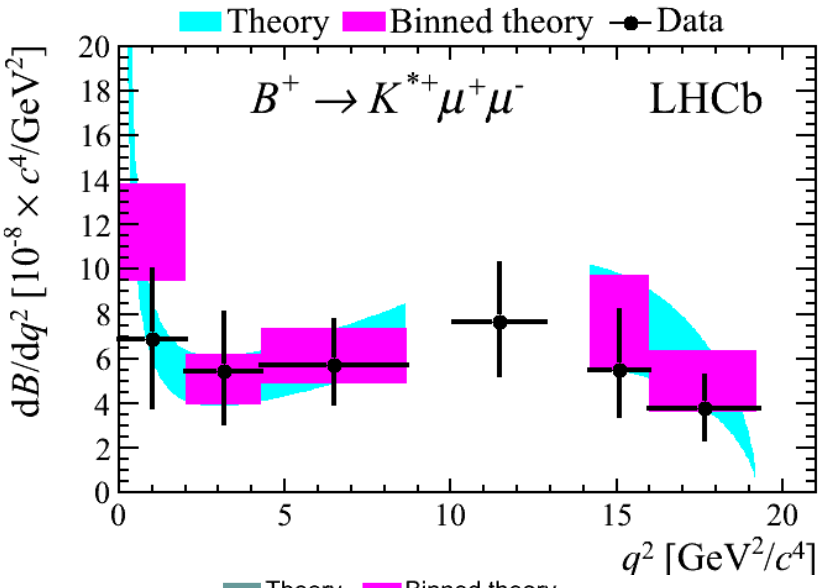
$B^+ \to K^+\,\mu^+\mu^-$

Yields are translated in branching fractions by normalising to yields in equivalent $B \to J/\psi K^{(*)}$ decay where BF is known from B-factories

Isospin measurement extracted through known B^+/B^0 lifetime ratio.

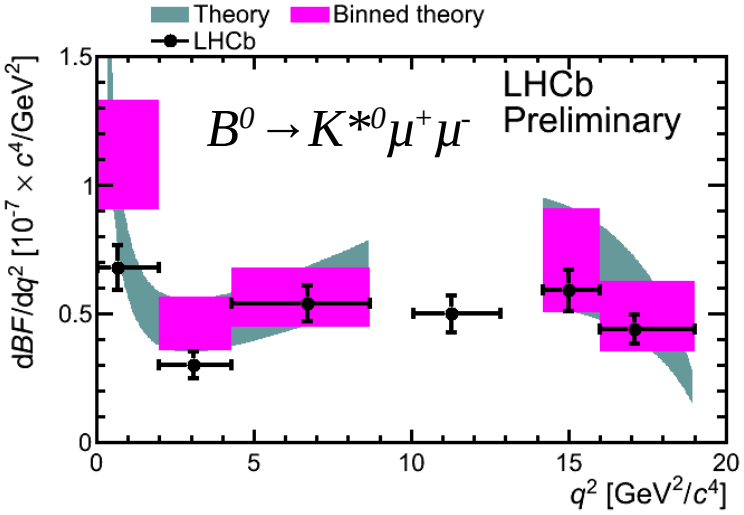
The differential branching fractions





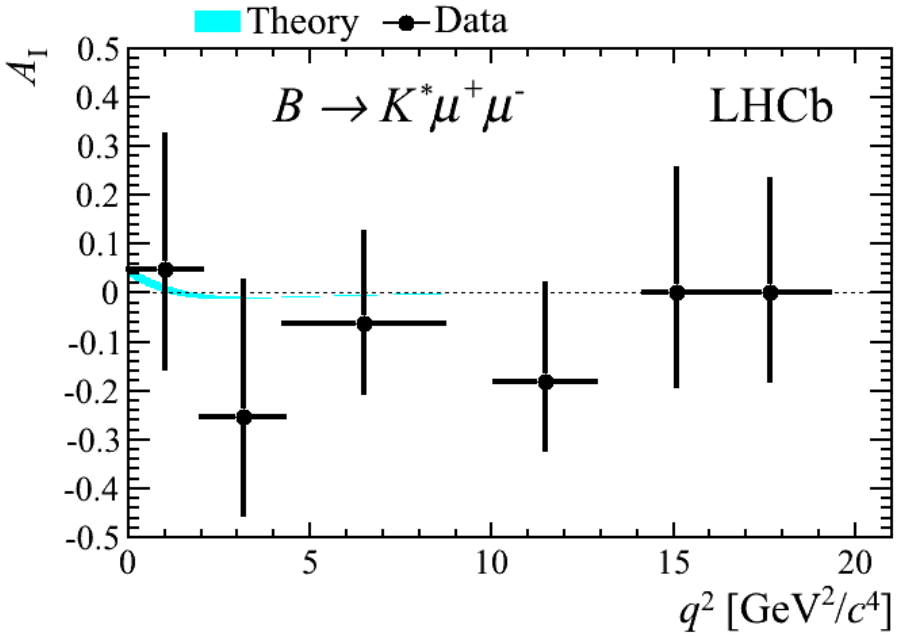
$B^+ \to K^+\mu^+\mu^-$

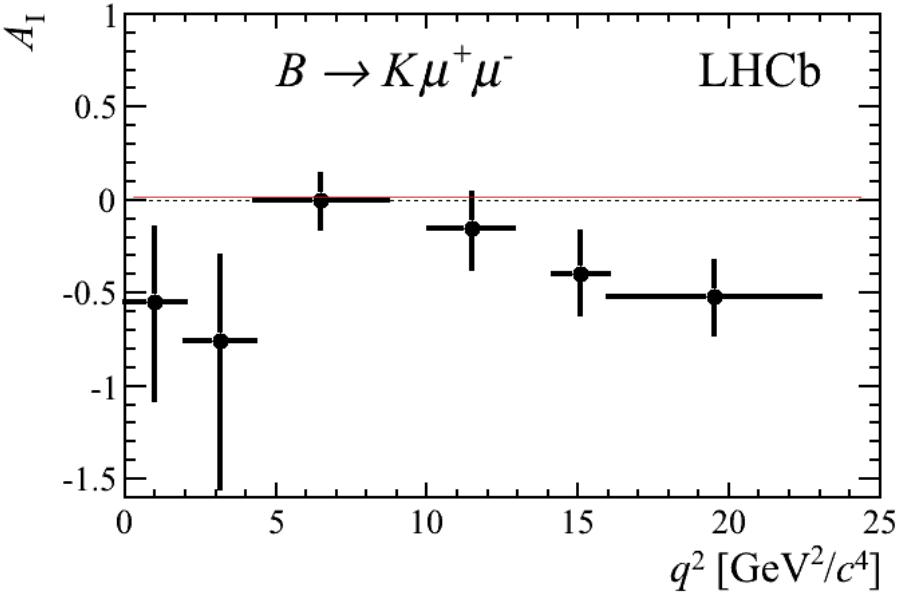
Coming very soon



$B \to K^{(*)}\mu^+\mu^-$ isospin analysis

The LHCb result

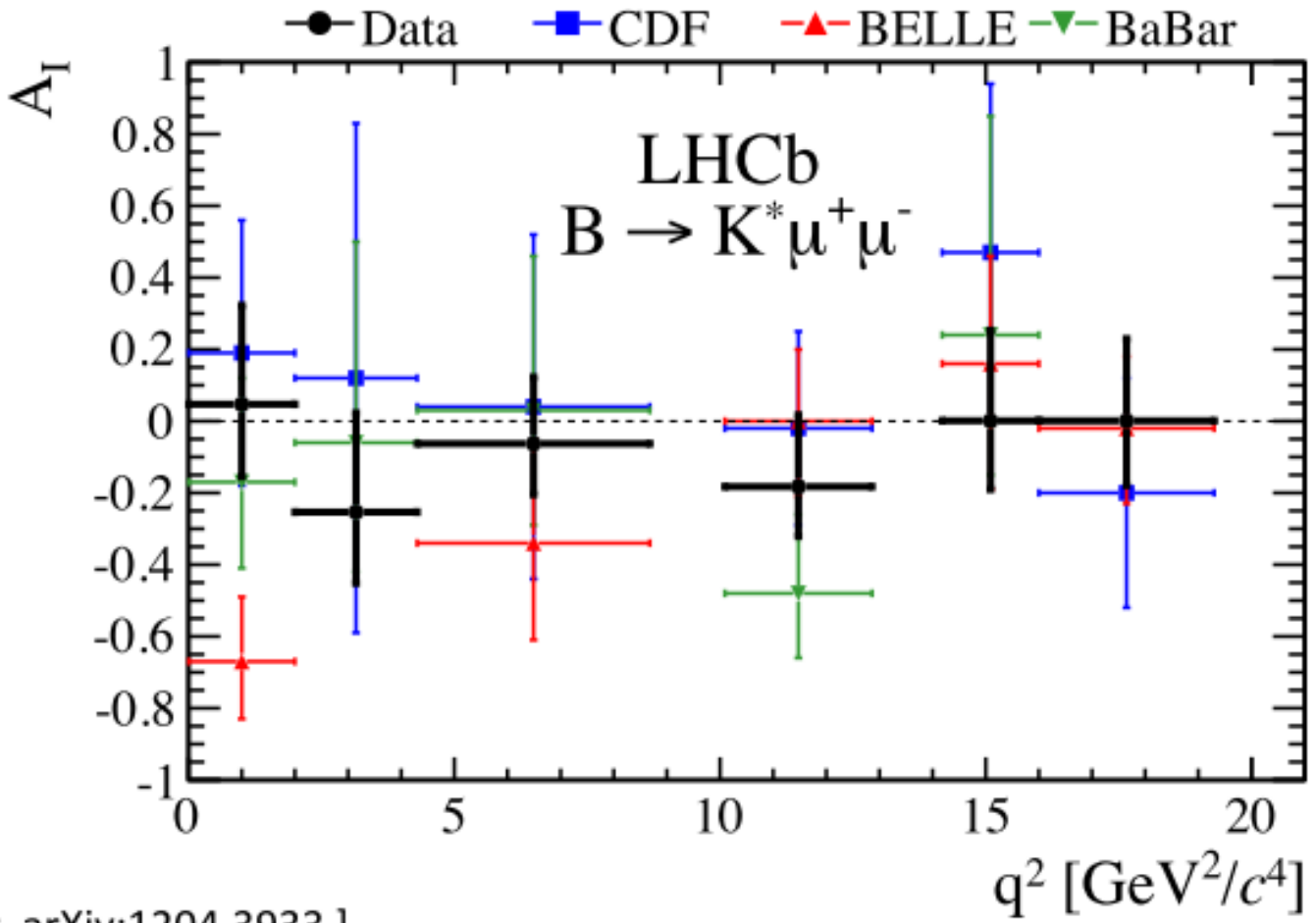




Result for $B \to K^*\mu^+\mu^-$ in agreement with SM theory

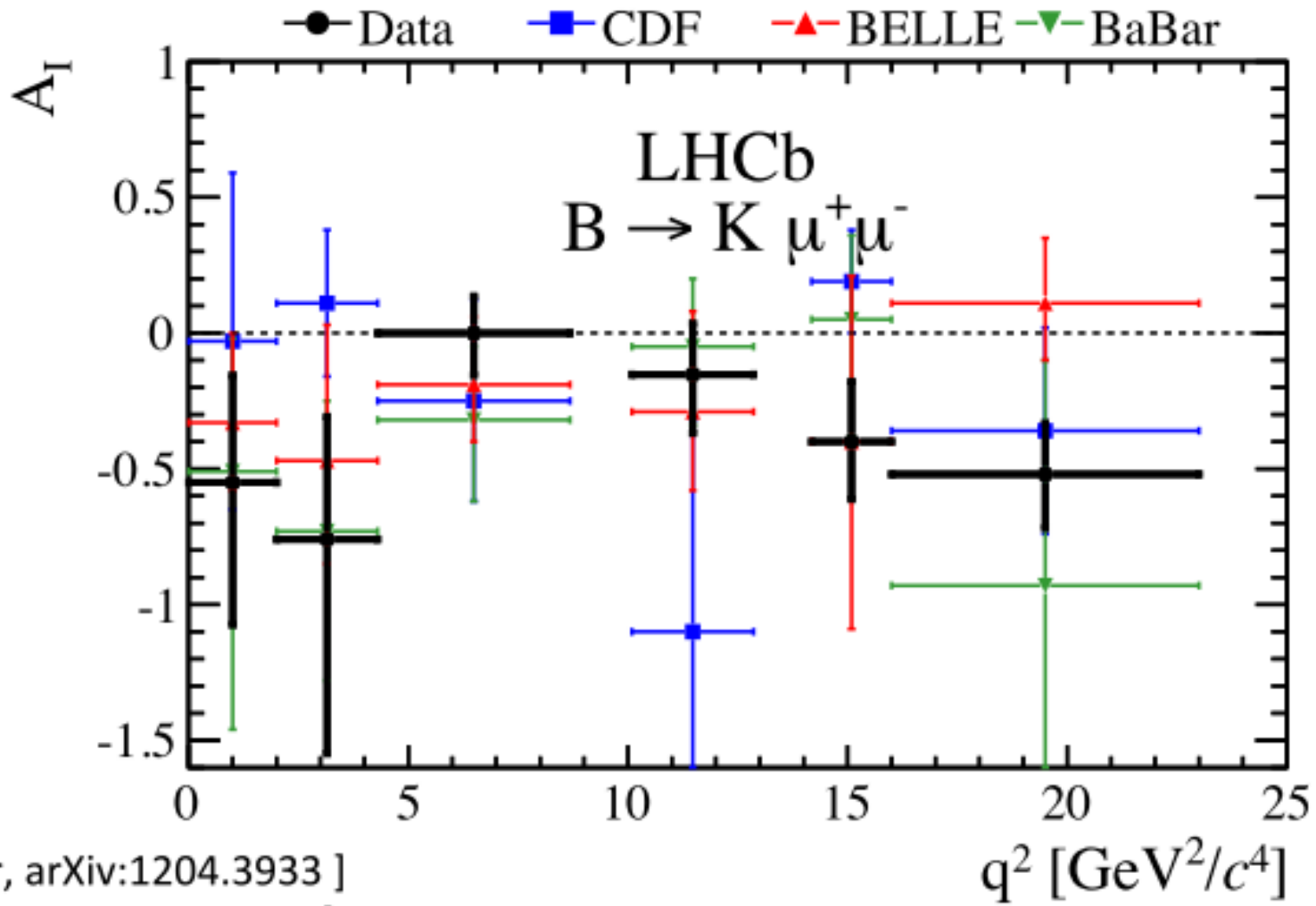
But $B \to K\mu^+\mu^-$ differs from naive zero expectation of above 4σ

A_I for $B \to K^*\mu\mu$



[Babar, arXiv:1204.3933]
[BELLE, arXiv:0804.4770]
[CDF, arXiv:1204.3933]

A_I for $B \to K\mu\mu$



[Babar, arXiv:1204.3933]
[BELLE, arXiv:0804.4770]
[CDF, arXiv:1204.3933]

Assumptions made

- We only reconstruct K^0_S
  - Assume exactly the same amount of K^0_L
- We do not perform any flavour tagging
  - Assume equal amounts of B^+/B^- and B^0/B^0-bar respectively
    - Assumption good at the 1% level
- Have not looked for any CP violation in same decays
  - Direct CPV measurement in $B^0 \rightarrow K^{*0}\,\mu^+\mu^-$, $K^{*0} \rightarrow K^+\pi^-$ and in $B^+ \rightarrow K^+\,\mu^+\mu^-$ on the way
  - Time dependent CPV in $B^0 \rightarrow K^0_S\,\mu^+\mu^-$, $K^0_S \rightarrow \pi^+\pi^-$ will be very hard with meaningful precision.

Assumptions made

- No angular analysis is performed
- As efficiencies are calculated in simulation assuming SM angular distribution this in principle matters
  - Some rather extreme alternative angular distributions applied and difference to default used as systematic error
  - Effect is negligible with current statistical errors

What will the future bring

The 2011+2012 LHCb dataset will bring

- Factor 3 in luminosity
- Increased B cross section for 2012 data (7-8 TeV)
- Higher efficiency for K^0_S channels
- Re-optimisation of selection to increase efficiency
- Inclusion of $K^{*+} \to K^+\pi^0$ final state

We feel confident that we before summer 2013 will have a result with errors reduced by more than factor 2.

- Should lead to a very clear result

Connections to other observables

- The isospin asymmetry in $B \to K^* \gamma$ is measured as slightly positive
  - Fits well with prediction and with the $B \to K^* ll$ measurement
- For the $B \to Kll$ isospin asymmetry we do not have the same cross check
  - Anything else we can measure to add information into this?
  - For LHCb, we can forget $B \to K^0_L \mu\mu$, but maybe at a B-factory?