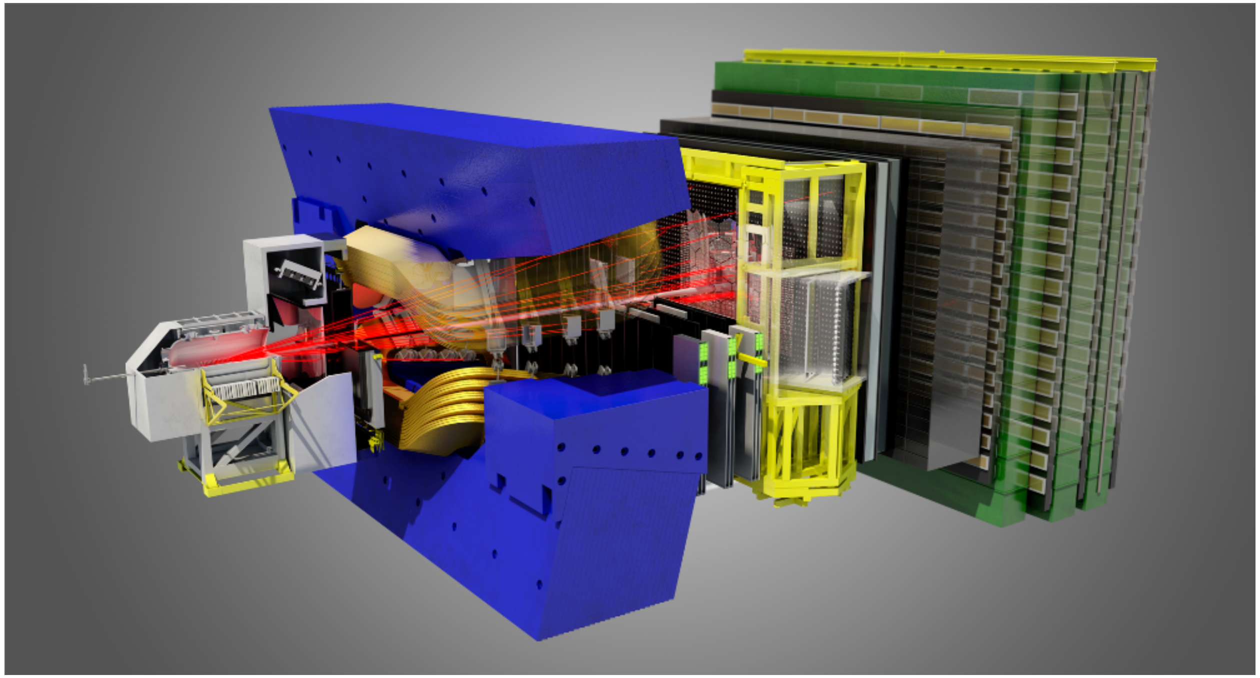
Latest rare decays results from LHCb



Moriond-Electroweak, 16th March 2014

Mitesh Patel (Imperial College London)

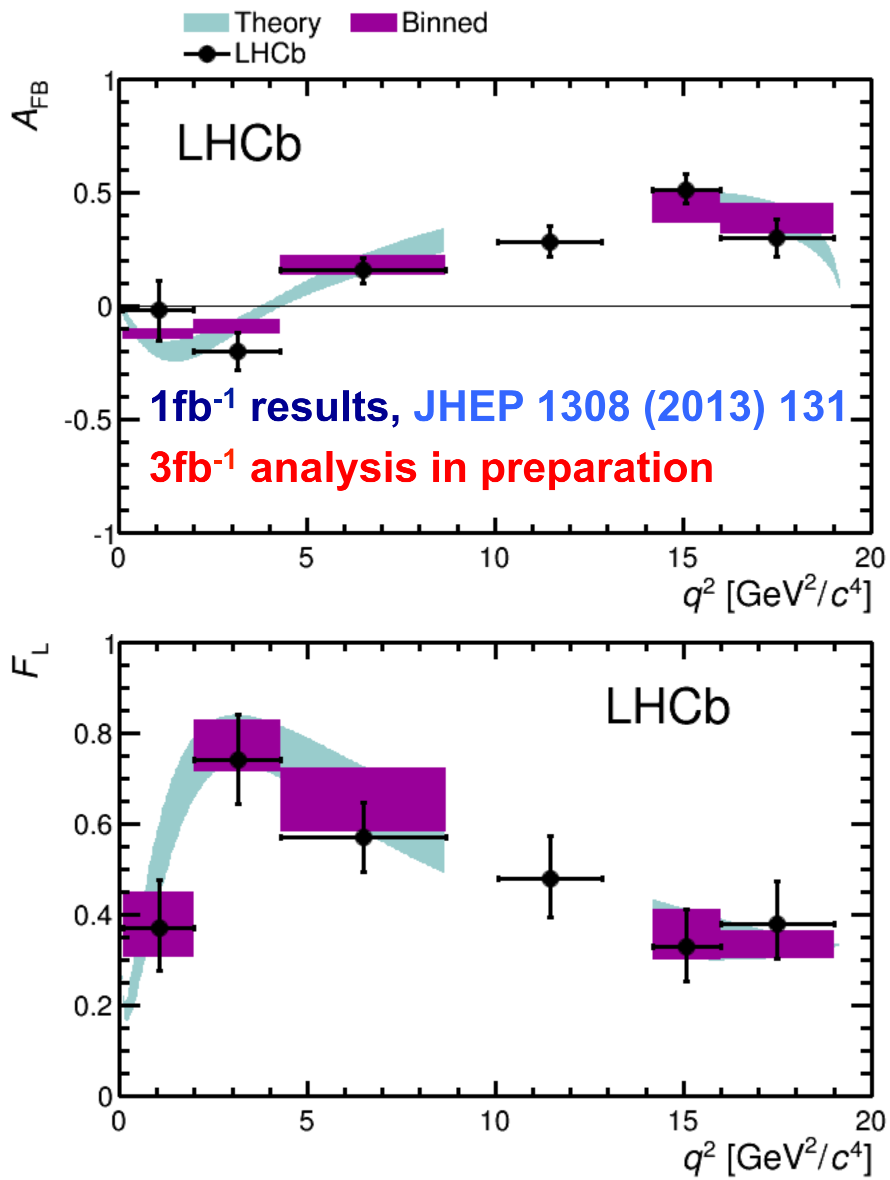
On behalf of the LHCb Collaboration

Imperial College London

LHCb

Introduction

- **b→s** transitions only occur through loop/box processes – sensitive to new physics
- Have probed **b→s** transitions in e.g. $\mathbf{B^0 \to K^{*0}\mu\mu}$ decay :
  - measurement of angular observables in addition to differential branching fraction
  - Range of measurements in excellent agreement with SM
- However, some surprises…



Introduction

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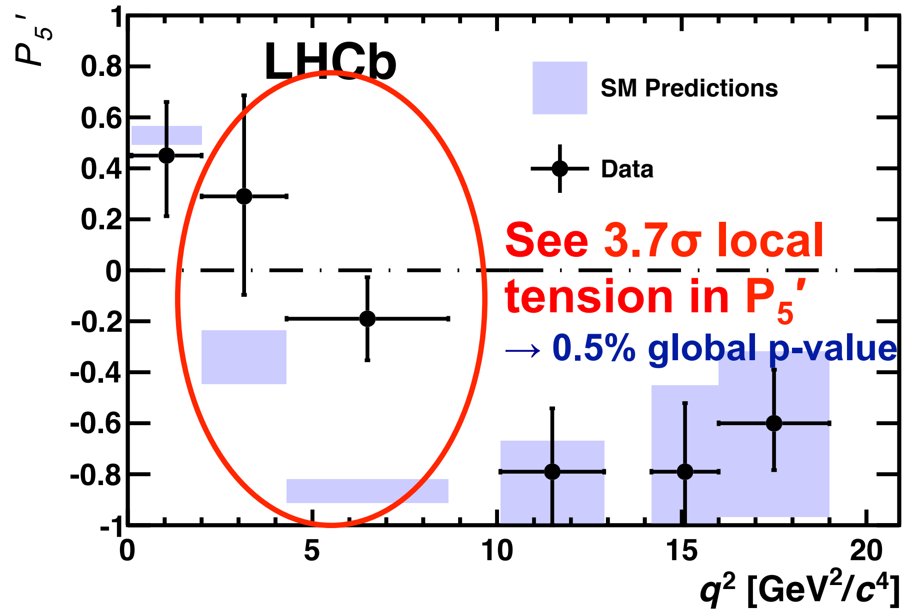


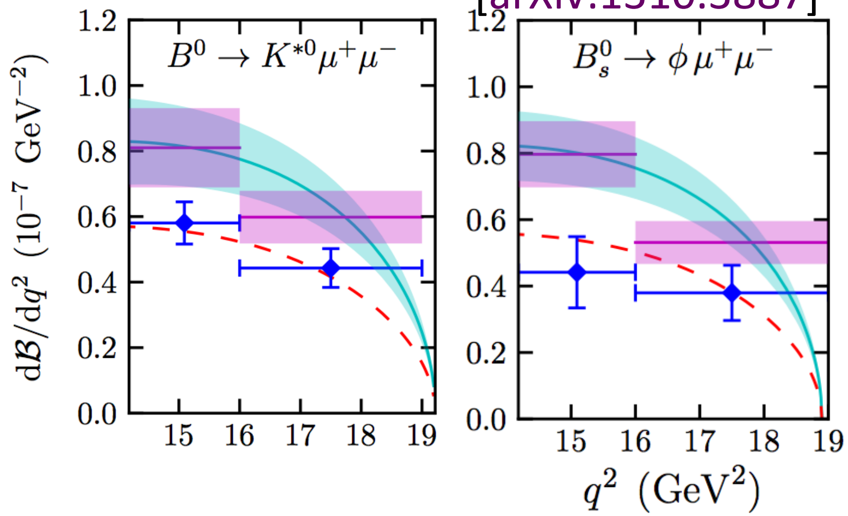
$1fb^{-1}$ results, PRL 111 (2013) 191801
$3fb^{-1}$ analysis in preparation

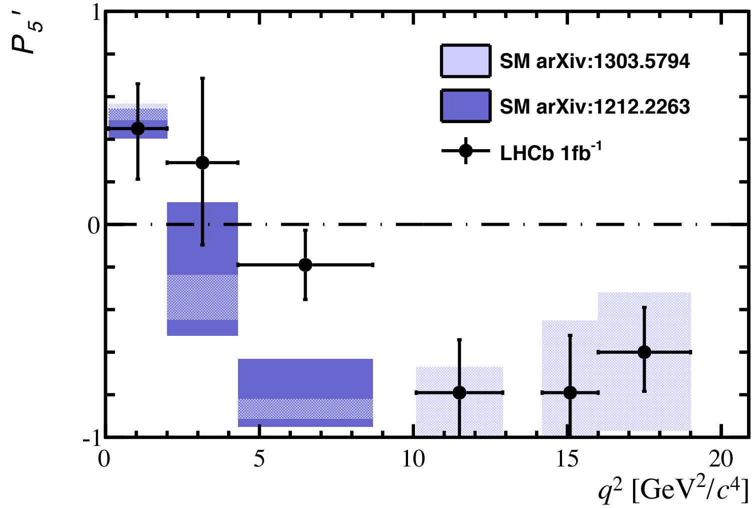
$B^0 \to K^{*0}\mu\mu$: interpretation

- Global fits → 2-4σ tension
- Views from the theory community:
  - P_5' tension correlated with other (smaller) tensions and NP explanation consistent with all measurements is possible [1,2]
  - Theory errors underestimated, tension is reduced [3]
- Difficult to explain with SUSY [1]
- Consistent with a Z' with mass ~ 7 TeV (!) [4]

→ Measure other B→Kμμ decays!

[arXiv:1310.3887]





[1] Altmannshofer et al., arXiv:1308.1501; [2] Descotes-Genon et al., Phys. Rev. D 88, 074002 (2013), Horgan et al., arXiv:1310.3887; [3] Beaujean et al., arXiv:1310.2478, Jaeger et al., arXiv:1212.2263; [4] Gauld et al., JHEP 1401 (2014) 069, Buras et al., arXiv:1311.6729

Angular analysis of $B \to K\mu^+\mu^-$ decays

[LHCb-PAPER-2014-007]

Angular analysis of $B \to K\mu^+\mu^-$ decays

- For $B^\pm \to K^\pm\mu^+\mu^-$, differential rate of B^+ (B^-) decay as a function of angle between μ^- (μ^+) and the K^+ (K^-) in the rest frame of the di-muon system given,

$$\frac{1}{\Gamma}\frac{\mathrm{d}\Gamma}{\mathrm{d}\cos\theta_l} = \frac{3}{4}(1-\boldsymbol{F_\mathrm{H}})(1-\cos^2\theta_l) + \frac{1}{2}\boldsymbol{F_\mathrm{H}} + \boldsymbol{A_\mathrm{FB}}\cos\theta_l$$

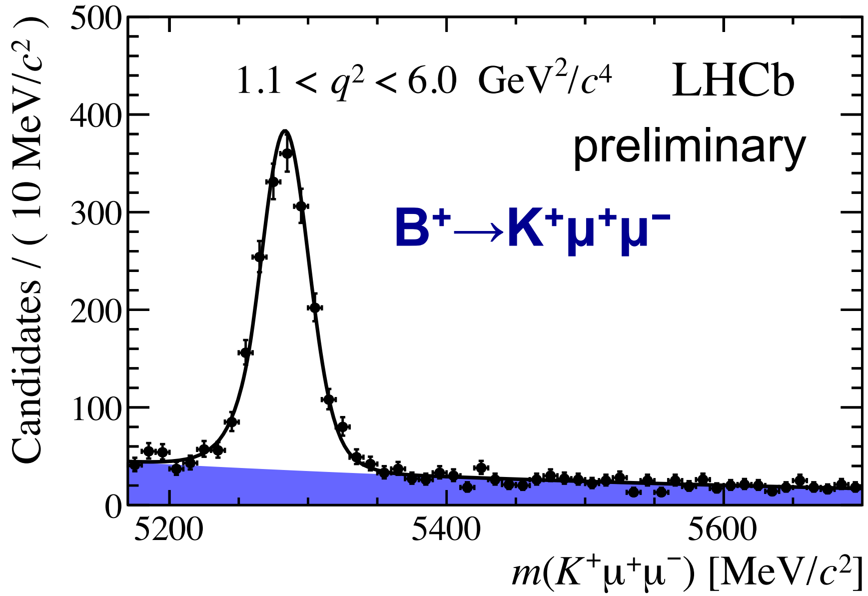
A_{FB} is the forward-backward asymmetry of the di-muon system, F_H describes constant term in $\cos\theta_l$ – expect both to be ~0 in SM but can be enhanced by new (pseudo)scalar- or tensor-couplings

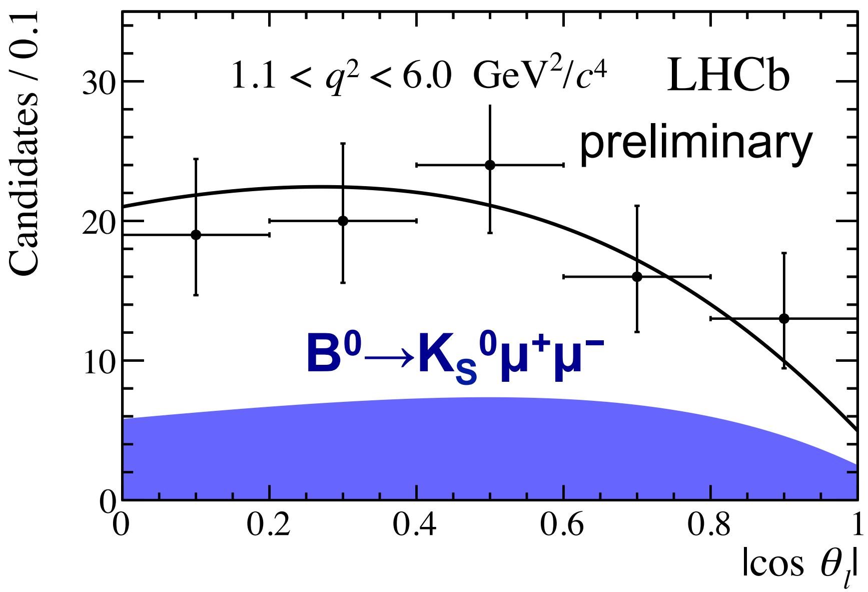
- For B^0, $\bar{B}^0 \to K_S^0\mu^+\mu^-$ decays – don't know flavour of B^0 meson – $\cos\theta_l$ defined wrt μ^+ for both B^0, $\bar{B}^0$ decays and hence measure,

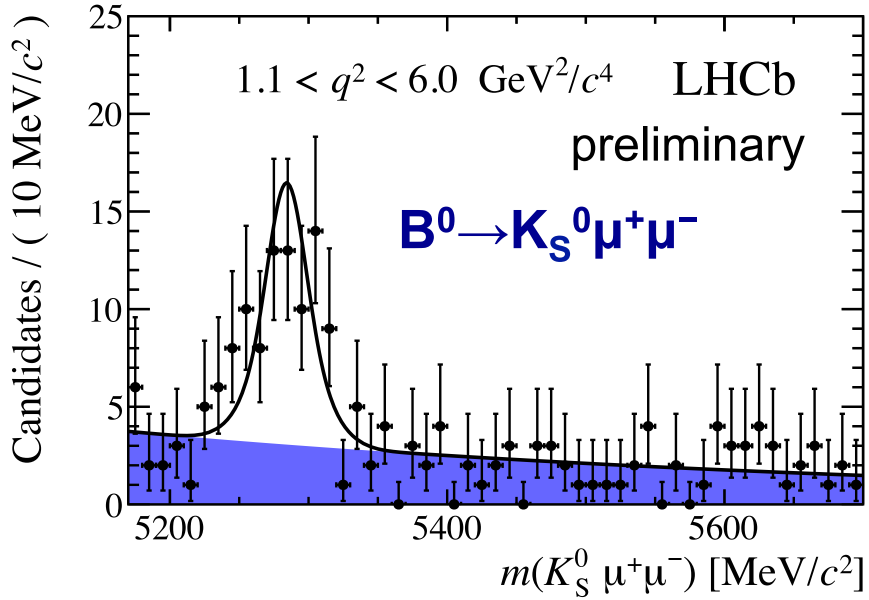
$$\frac{1}{\Gamma}\frac{\mathrm{d}\Gamma}{\mathrm{d}|\cos\theta_l|} = \frac{3}{2}(1-\boldsymbol{F_\mathrm{H}})(1-|\cos\theta_l|^2) + \boldsymbol{F_\mathrm{H}}$$

Angular analysis of $B \to K\mu^+\mu^-$ decays

- Able to isolate signal events cleanly – in full q^2,
  - 4746 ± 81 **$B^+ \to K^+\mu^+\mu^-$**
  - 176 ± 17 **$B^0 \to K_S^0\mu^+\mu^-$**
- Angular acceptance determined using simulated events
- Simultaneous 2d unbinned fit to **$m(K\mu^+\mu^-)$** and **$\cos\theta_l$**







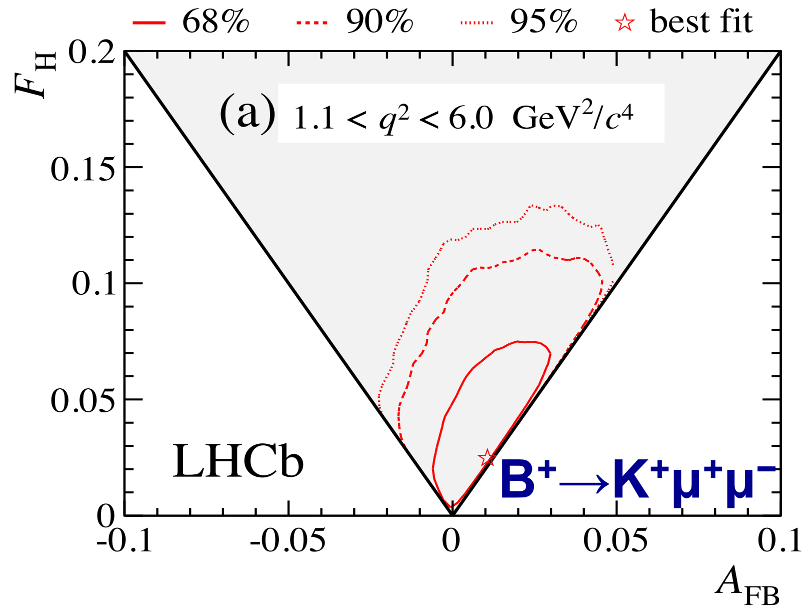
Angular analysis of $B \to K\mu^+\mu^-$ decays

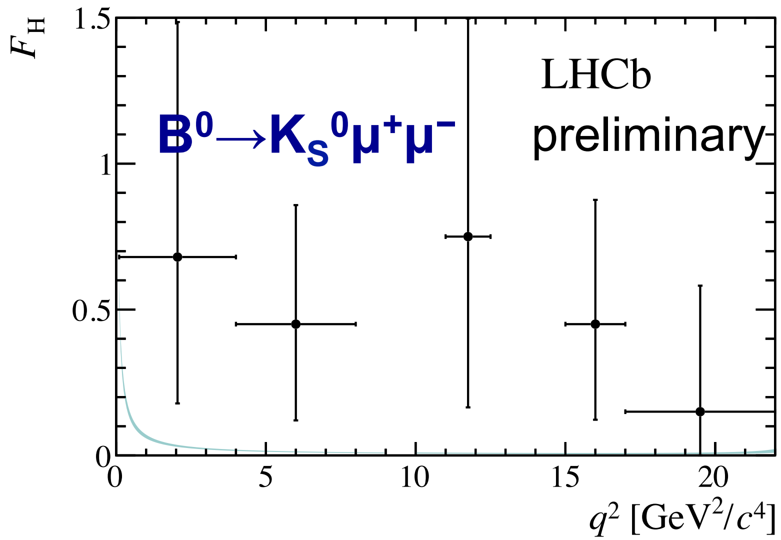
- **$B^+ \to K^+\mu^+\mu^-$**
  → (**A_{FB}, F_H**)
  → also 1d confidence intervals in which we treat A_{FB}, F_H independently

- **$B^0 \to K_S^0\mu^+\mu^-$**
  → **F_H**

- Consistent with SM predictions (**$A_{FB} \approx 0$, $F_H \approx 0$**) in every q^2 bin

- **→ No evidence new (pseudo-) scalar or tensor contributions**





Isospin asymmetry in $B \rightarrow K^{(*)}\mu^{+}\mu^{-}$

[LHCb-PAPER-2014-006]

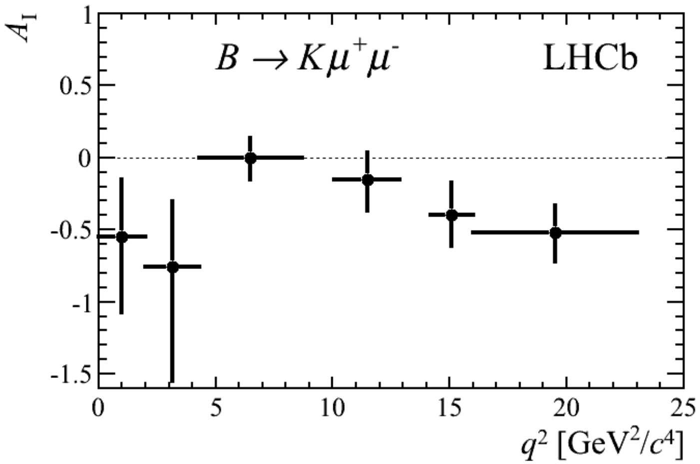
Isospin asymmetry in $B \rightarrow K^{(*)}\mu^+\mu^-$

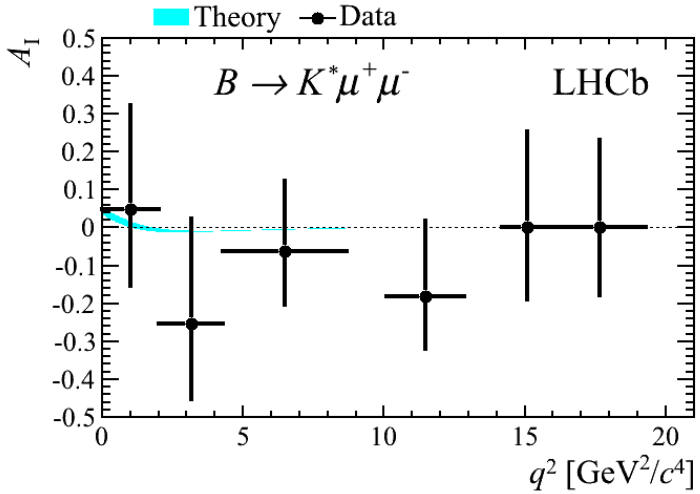
- The isospin asymmetry of $B \rightarrow K^{(*)}\mu^+\mu^-$, A_I is defined as:

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

can be more precisely predicted than the branching fractions

- A_I is expected to be very close to zero in the SM



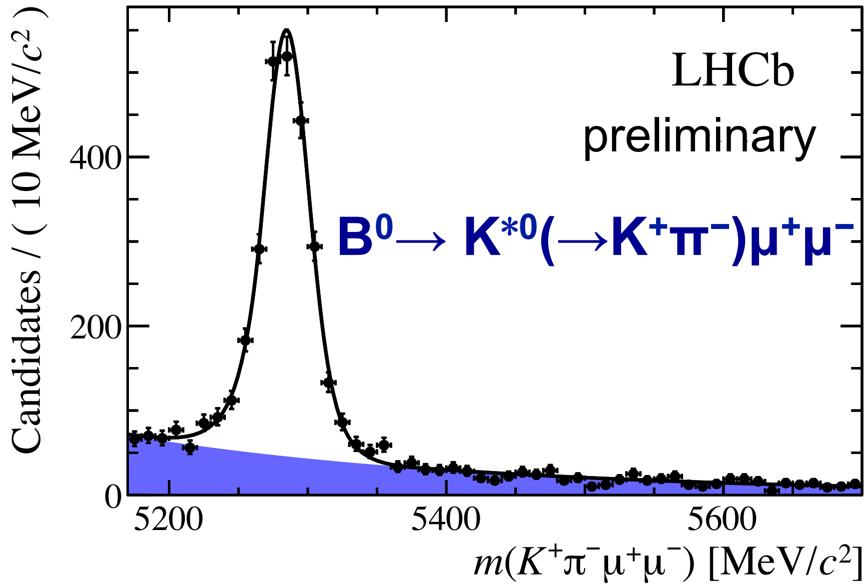


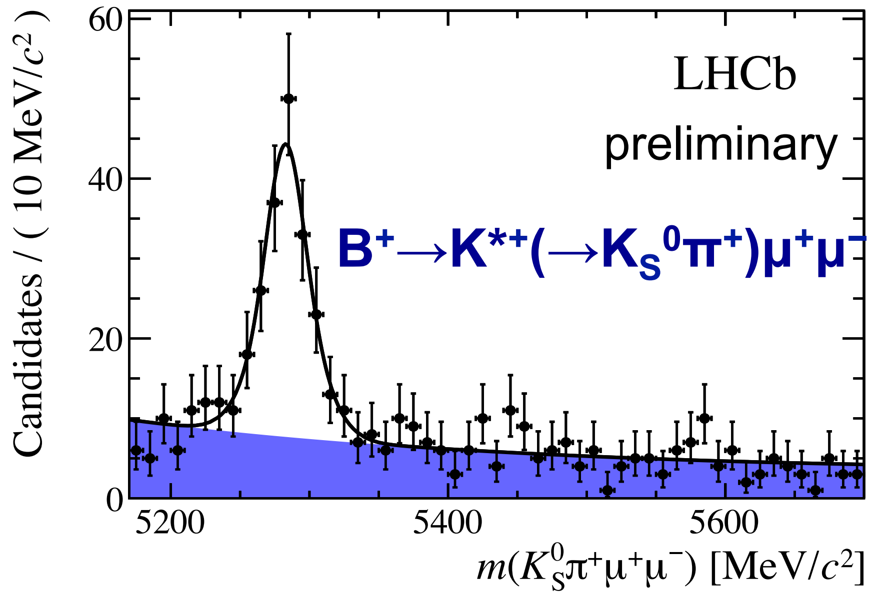
- Analysis of 1fb^{-1} data from 2011: A_I K* modes consistent with zero, for **K** modes, find A_I 4.4σ from zero! [JHEP 07 (2012) 133]

Measuring A_I

- Update A_I measurement to $3fb^{-1}$
- Extract A_I by measuring four decay modes :
  $B^+ \to K^+\mu^+\mu^-$, $B^0 \to K_S{}^0\mu^+\mu^-$,
  $B^+ \to K^{*+}(\to K_S{}^0\pi^+)\mu^+\mu^-$,
  $B^0 \to K^{*0}(\to K^+\pi^-)\mu^+\mu^-$
- Fit the $K^{(*)}\mu^+\mu^-$ mass in q^2 bins
- Total yields :

$B^+ \to K^+\mu^+\mu^-$	4746 ± 81
$B^0 \to K_S{}^0\mu^+\mu^-$	176 ± 17
$B^+ \to K^{*+}(\to K_S{}^0\pi^+)\mu^+\mu^-$	162 ± 16
$B^0 \to K^{*0}(\to K^+\pi^-)\mu^+\mu^-$	2361 ± 56



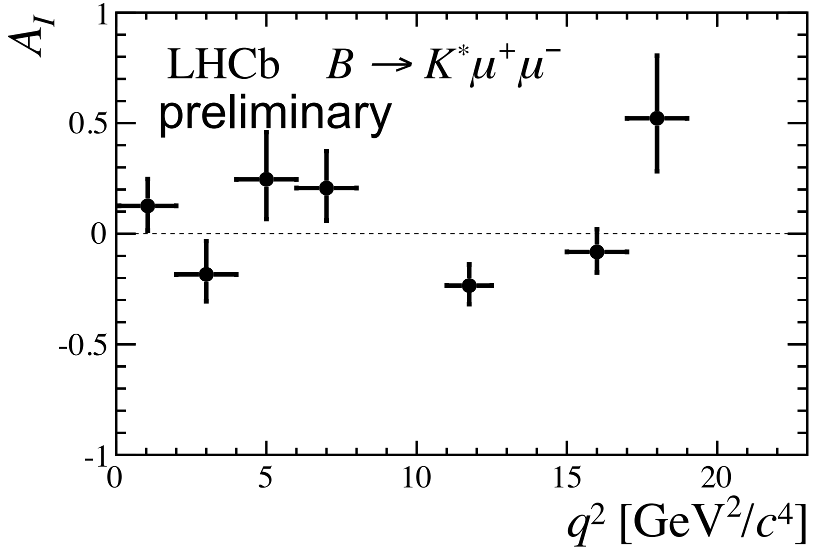


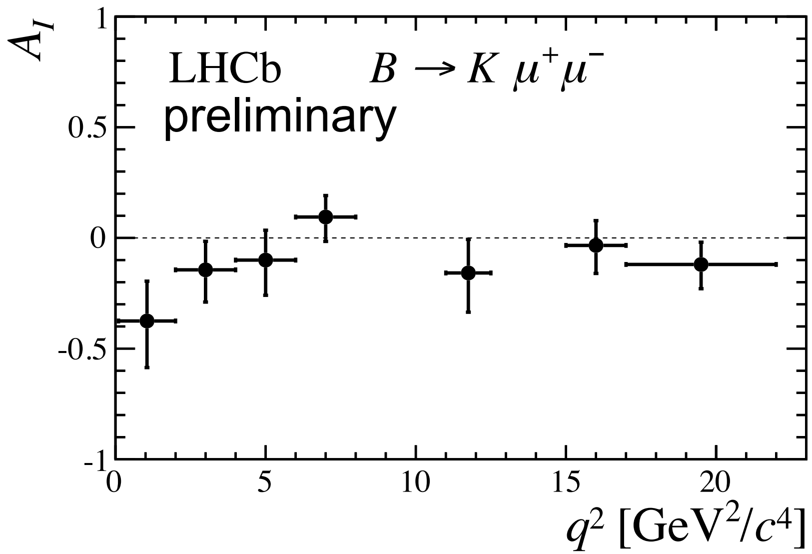
Isospin asymmetry results

- Assume A_I of **B→J/ψK(*)** decays = 0
  - Uncertainties related to measurements of absolute branching fraction cancel

- Estimate p-value for difference from zero by assuming data have a constant non-zero A_I value
  → 11% (1.5σ) p-value for **A_I $B \to K\mu^+\mu^-$**

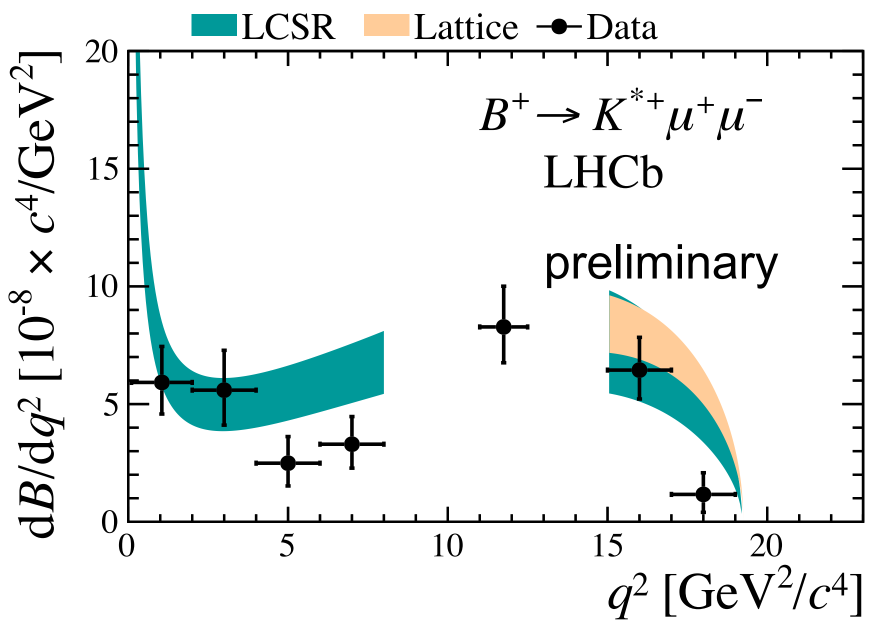
→ **$3fb^{-1}$ A_I results consistent with SM**





Differential branching fractions

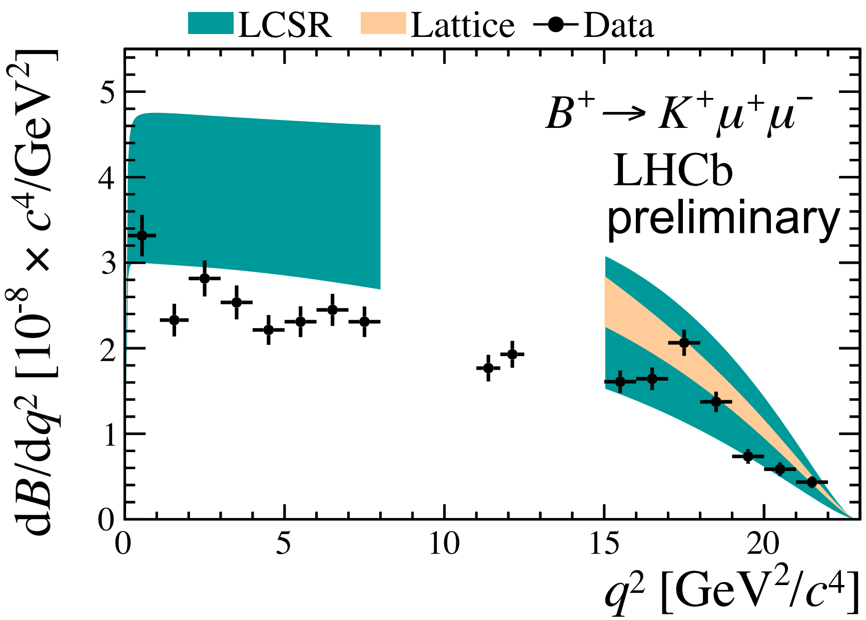
- Normalise wrt corresponding **B→J/ψK(*)** decay
  - Again assume **A_I J/ψ modes=0**
  - Relative efficiency as function of **q^2** from simulation
  - Dominant systematic: branching fractions of **J/ψ** modes

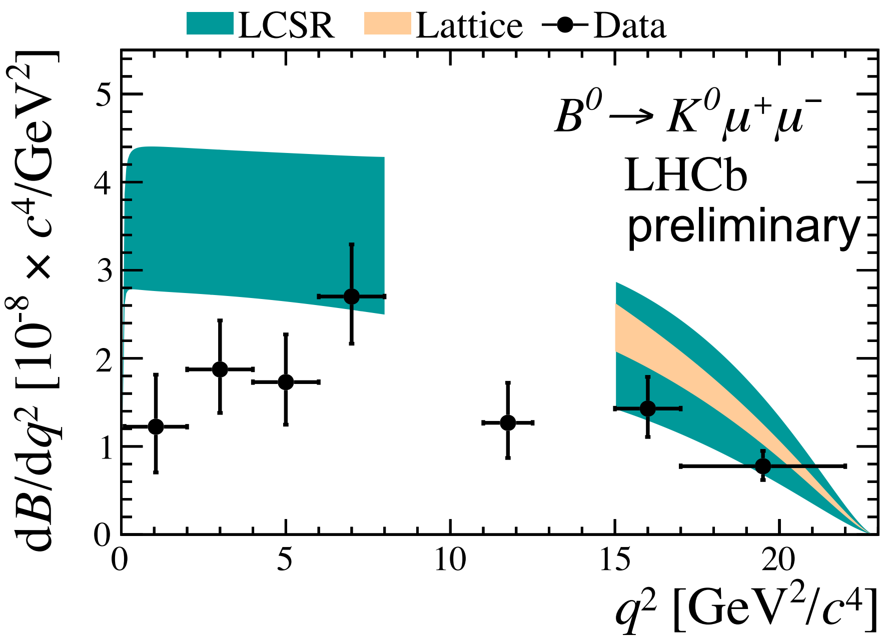


- Although consistent with SM, branching fraction tends to sit below theory predictions

- **Theory predictions**: [Ball, Zwicky Phys. Rev. D71 (2005) 014029; A. Khodjamirian et al., JHEP 09 (2010) 089, M. Beneke et al., Nucl. Phys. B612 (2001) 25, Eur. Phys. J. C41 (2005) 173; C. Bobeth et al., JHEP 12 (2007) 040, B. Grinstein and D. Pirjol, Phys. Rev. D70 (2004) 114005, U. Egede et al., JHEP 11 (2008) 032]
- **Lattice predictions :** [C. Bouchard et al., Phys. Rev. D88 (2013) 054509; R. R. Horgan et al., arXiv: 1310.3722]

Differential branching fractions

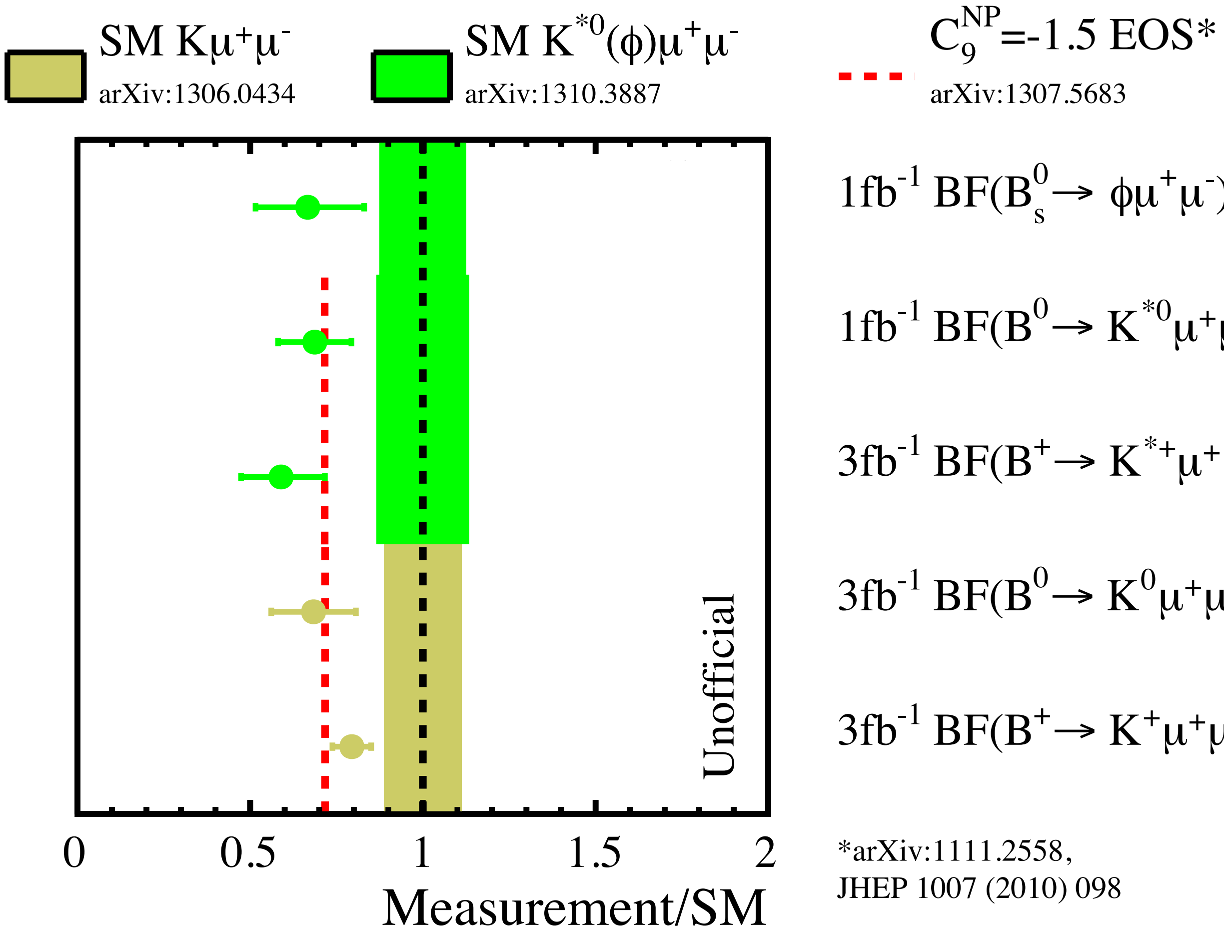




- **$B^+ \to K^+ \mu^+ \mu^-$** and **$B^0 \to K^0 \mu^+ \mu^-$** decays also consistent with SM but tend to sit below the theoretical predictions

- Extrapolate underneath the charmonium resonances assuming the **q^2** distribution from [Ali et al., Phys. Rev. D61 (2000) 074024]
  - $B(B^+ \to K^+ \mu^+ \mu^-) = (4.29 \pm 0.07(\text{stat}) \pm 0.21(\text{syst})) \times 10^{-7}$
  - $B(B^0 \to K^0 \mu^+ \mu^-) = (3.27 \pm 0.34(\text{stat}) \pm 0.17(\text{syst})) \times 10^{-7}$
  - $B(B^+ \to K^{*+} \mu^+ \mu^-) = (9.24 \pm 0.93(\text{stat}) \pm 0.67(\text{syst})) \times 10^{-7}$

High-q^2 diff. branching fractions



- **High q^2** branching fraction measurements are below the latest SM (lattice) predictions
- Better consistency with C_9^{NP}=-1.5 suggested by (**low q^2**) anomalous angular data

Conclusions

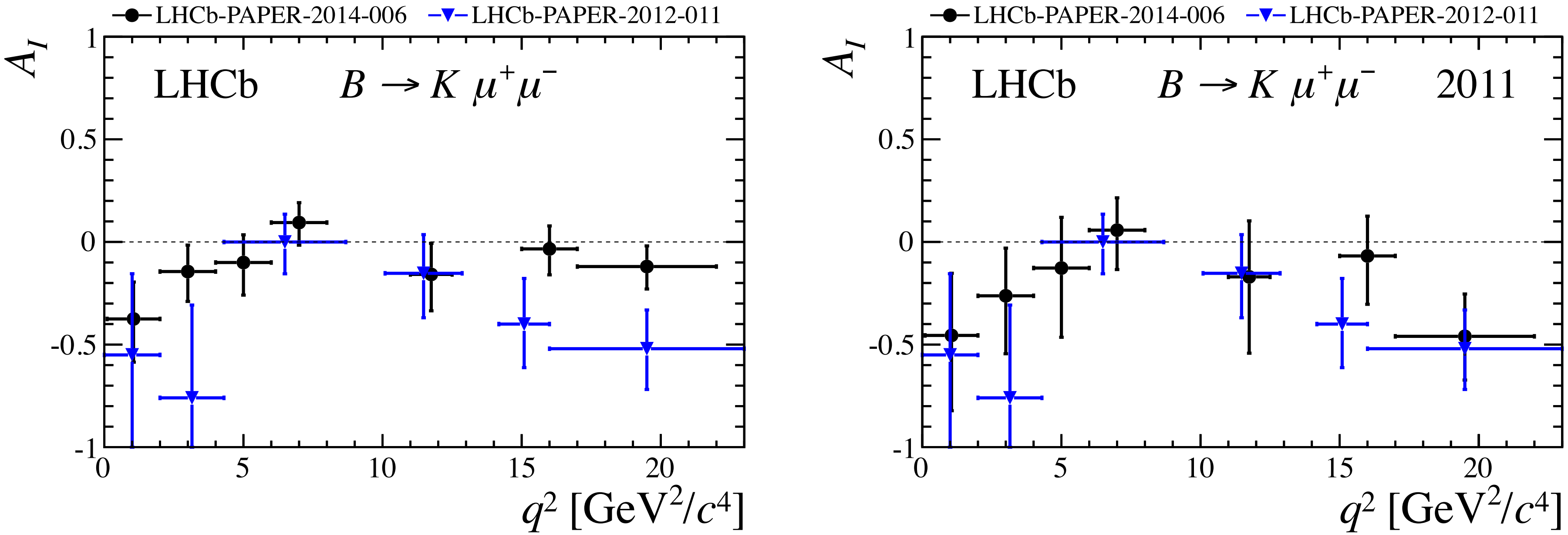
- **$B^+ \to K^+\mu^+\mu^-$, $B^0 \to K^0_S\mu^+\mu^-$** angular analysis gives results consistent with SM – no evidence for new (pseudo-)scalar or tensor couplings
- **A_I** in **$B \to K\mu^+\mu^-$** and **$B \to K^*\mu^+\mu^-$** decays consistent with SM
- At high-**q^2,** differential branching fractions of **$B^+ \to K^+\mu^+\mu^-$**, **$B^+ \to K^{+*}\mu^+\mu^-$** and **$B^0 \to K^0_S\mu^+\mu^-$** below lattice predictions ($3fb^{-1}$)
- Same trend observed in **$B^0 \to K^{*0}\mu^+\mu^-$** and **$B^0_s \to \phi\mu^+\mu^-$** decays ($1fb^{-1}$)
  - consistent with anomalous **$B^0 \to K^{*0}\mu^+\mu^-$** angular ana. results… ?
  - indicative of a theory problem… ?
- LHCb will update **$B^0 \to K^{*0}\mu^+\mu^-$**, **$B^0_s \to \phi\mu^+\mu^-$** angular analysis and branching fractions with $3fb^{-1}$ data in-hand

Backup

Reconciling the A_I significances

- A_I results for $B \to K\mu^+\mu^-$ are negative in all but one q^2 bin
- Results are more consistent with the SM cf previous analysis which had **4.4σ** significance from zero [JHEP 07 (2012) 133]
- Reduction in significance comes from several effects:
  - change of the test statistic (prior to unblinding) – previously used product of p-values of each individual q^2 bin **4.4σ→3.5σ**
  - assumption that $A_I(B \to J/\psi K)=0$ (increases A_I in each bin by ~4% cf using $B(B \to J/\psi K^{(*)})$) **3.5σ→3.2σ**
  - re-analysis of 2011 data /inclusion of 2012 data **3.2σ→1.5σ**
    - previous and new 2011 analyses compatible at 90% level -
    - results from the 2012 data more compatible with A_I =0

Reconciling the A_l significances



- Comparison of 2011 and 2012 A_l results for $B\to K\mu^+\mu^-$ (left)
- Comparison of just 2011 A_l results for $B\to K\mu^+\mu^-$ (right)
- Latest results look consistently above $1fb^{-1}$ analysis but if split into long and downstream categories for K_S^0 see there is no overall trend

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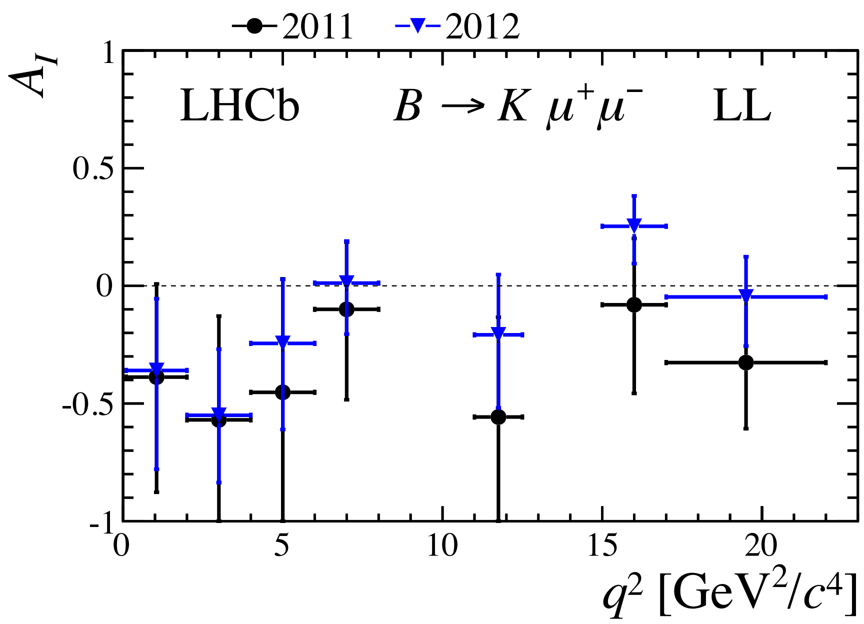
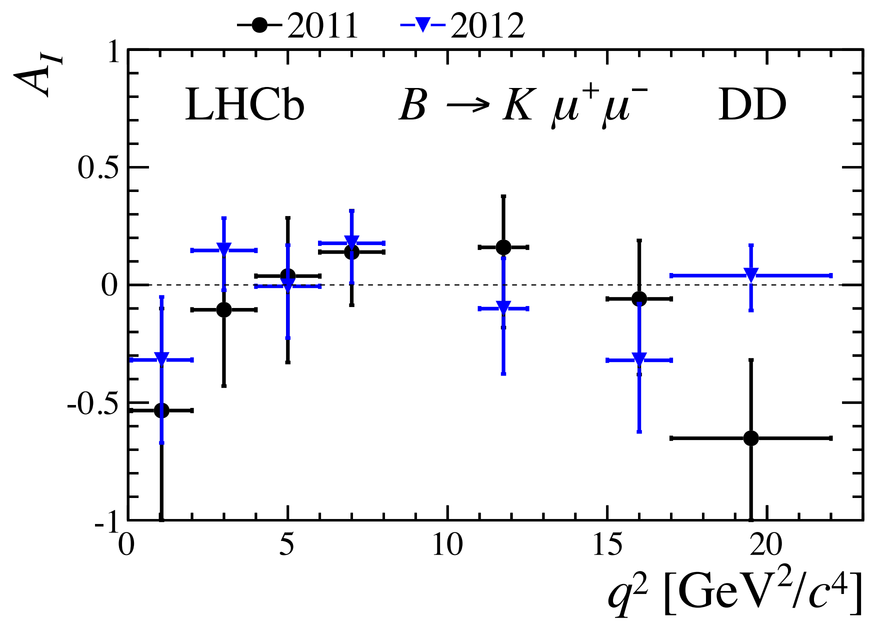




- Comparison of 2011 and 2012 A_I results for $B \to K\mu^+\mu^-$ (left)
- Comparison of just 2011 A_I results for $B \to K\mu^+\mu^-$ (right)
- Latest results look consistently above $1 fb^{-1}$ analysis but if split into long and downstream categories for K_S^0 see there is no overall trend

Table 2: Differential branching fraction results for $B^+ \to K^+\mu^+\mu^-$.

	Differential branching fraction ($\times 10^{-9}$)		
q^2 range (GeV^2/c^4)	central value	stat error	syst error
$0.1 < q^2 < 0.98$	33.2	1.8	1.7
$1.1 < q^2 < 2.0$	23.3	1.5	1.2
$2.0 < q^2 < 3.0$	28.2	1.6	1.4
$3.0 < q^2 < 4.0$	25.4	1.5	1.3
$4.0 < q^2 < 5.0$	22.1	1.4	1.1
$5.0 < q^2 < 6.0$	23.1	1.4	1.2
$6.0 < q^2 < 7.0$	24.5	1.4	1.2
$7.0 < q^2 < 8.0$	23.1	1.4	1.2
$11.0 < q^2 < 11.8$	17.7	1.3	0.9
$11.8 < q^2 < 12.5$	19.3	1.2	1.0
$15.0 < q^2 < 16.0$	16.1	1.0	0.8
$16.0 < q^2 < 17.0$	16.4	1.0	0.8
$17.0 < q^2 < 18.0$	20.6	1.1	1.0
$18.0 < q^2 < 19.0$	13.7	1.0	0.7
$19.0 < q^2 < 20.0$	7.4	0.8	0.4
$20.0 < q^2 < 21.0$	5.9	0.7	0.3
$21.0 < q^2 < 22.0$	4.3	0.7	0.2
$1.1 < q^2 < 6.0$	24.2	0.7	1.2
$15.0 < q^2 < 22.0$	12.1	0.4	0.6

Table 3: Differential branching fraction results for $B^0 \to K^0\mu^+\mu^-$.

	Differential branching fraction ($\times 10^{-9}$)		
q^2 range (GeV^2/c^4)	central value	stat error	syst error
$0.1 < q^2 < 2.0$	12.2	$^{+5.9}_{-5.2}$	0.6
$2.0 < q^2 < 4.0$	18.7	$^{+5.5}_{-4.9}$	0.9
$4.0 < q^2 < 6.0$	17.3	$^{+5.3}_{-4.8}$	0.9
$6.0 < q^2 < 8.0$	27.0	$^{+5.8}_{-5.3}$	1.4
$11.0 < q^2 < 12.5$	12.7	$^{+4.5}_{-4.0}$	0.6
$15.0 < q^2 < 17.0$	14.3	$^{+3.5}_{-3.2}$	0.7
$17.0 < q^2 < 22.0$	7.8	$^{+1.7}_{-1.5}$	0.4
$1.1 < q^2 < 6.0$	18.7	$^{+3.5}_{-3.2}$	0.9
$15.0 < q^2 < 22.0$	9.5	$^{+1.6}_{-1.5}$	0.5

Table 4: Differential branching fraction results for $B^+ \to K^{*+}\mu^+\mu^-$

	Differential branching fraction ($\times 10^{-9}$)		
q^2 range (GeV^2/c^4)	central value	stat error	syst error
$0.1 < q^2 < 2.0$	59.2	$^{+14.4}_{-13.0}$	4.0
$2.0 < q^2 < 4.0$	55.9	$^{+15.9}_{-14.4}$	3.8
$4.0 < q^2 < 6.0$	24.9	$^{+11.0}_{-9.6}$	1.7
$6.0 < q^2 < 8.0$	33.0	$^{+11.3}_{-10.0}$	2.3
$11.0 < q^2 < 12.5$	82.8	$^{+15.8}_{-14.1}$	5.6
$15.0 < q^2 < 17.0$	64.4	$^{+12.9}_{-11.5}$	4.4
$17.0 < q^2 < 19.0$	11.6	$^{+9.1}_{-7.6}$	0.8
$1.1 < q^2 < 6.0$	36.6	$^{+8.3}_{-7.6}$	2.6
$15 < q^2 < 19.0$	39.5	$^{+8.0}_{-7.3}$	2.8

Table 5: Isospin asymmetry results for $B \to K\mu^+\mu^-$

	Isospin asymmetry.		
q^2 range (GeV^2/c^4)	central value	stat error	syst error
$0.1 < q^2 < 2.0$	-0.37	$^{+0.18}_{-0.21}$	0.02
$2.0 < q^2 < 4.0$	-0.15	$^{+0.13}_{-0.15}$	0.02
$4.0 < q^2 < 6.0$	-0.10	$^{+0.13}_{-0.16}$	0.02
$6.0 < q^2 < 8.0$	0.09	$^{+0.10}_{-0.11}$	0.02
$11.0 < q^2 < 12.5$	-0.16	$^{+0.15}_{-0.18}$	0.03
$15.0 < q^2 < 17.0$	-0.04	$^{+0.11}_{-0.13}$	0.02
$17.0 < q^2 < 22.0$	-0.12	$^{+0.10}_{-0.11}$	0.02
$1.1 < q^2 < 6.0$	-0.10	$^{+0.08}_{-0.09}$	0.02
$15.0 < q^2 < 22.0$	-0.09	$^{+0.08}_{-0.08}$	0.02

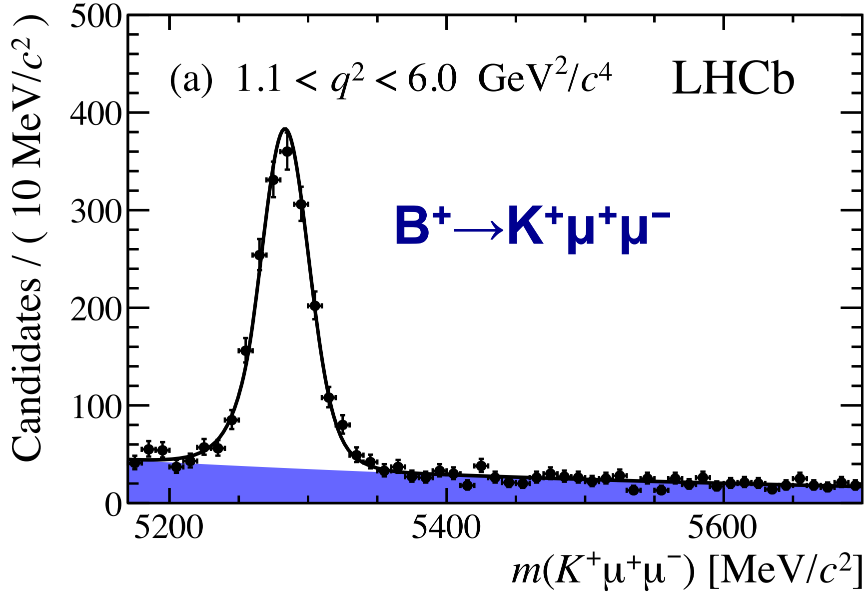
Table 6: Isospin asymmetry results for $B \to K^* \mu^+ \mu^-$.

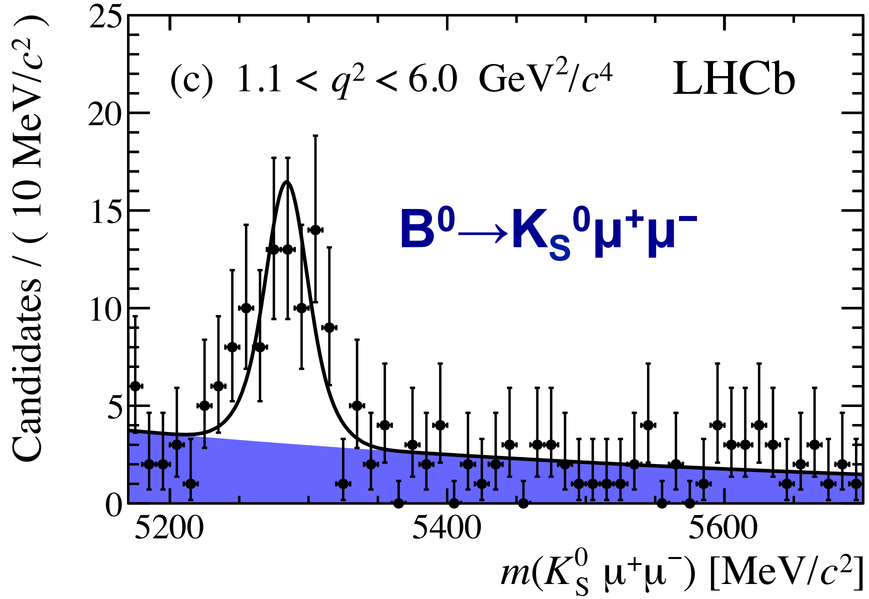
	Isospin asymmetry		
q^2 range (GeV^2/c^4)	central value	stat error	syst error
$0.1 < q^2 < 2.0$	0.11	$^{+0.12}_{-0.11}$	0.02
$2.0 < q^2 < 4.0$	-0.20	$^{+0.15}_{-0.12}$	0.03
$4.0 < q^2 < 6.0$	0.23	$^{+0.21}_{-0.18}$	0.02
$6.0 < q^2 < 8.0$	0.19	$^{+0.17}_{-0.15}$	0.02
$11.0 < q^2 < 12.5$	-0.25	$^{+0.09}_{-0.08}$	0.03
$15.0 < q^2 < 17.0$	-0.10	$^{+0.10}_{-0.09}$	0.03
$17.0 < q^2 < 19.0$	0.51	$^{+0.29}_{-0.24}$	0.02
$1.1 < q^2 < 6.0$	0.00	$^{+0.12}_{-0.10}$	0.02
$15.0 < q^2 < 19.0$	0.06	$^{+0.10}_{-0.09}$	0.02

Selection

- $K_S^0 \to \pi^+\pi^-$ with first hits:
  - in the vertex detector around interaction point (**long**)
  - in the downstream silicon-strip detector (**downstream**)
- Multivariate selection removes 94% (99%) of combinatorial bkgrd, retains 89% (66%) of **$B^+ \to K^+\mu^+\mu^-$, ($B^0 \to K_S^0\mu^+\mu^-$, long)**
- Exclusive bkgrds:
  - $B \to KJ/\psi$ and $B \to K\psi(2S)$ rejected by removing $m(\mu^+\mu^-)$ windows
  - $B^- \to D^0\pi^-$, $D^0 \to K^-\pi^+$ rejected using requirement on $K^-\mu^+$ mass

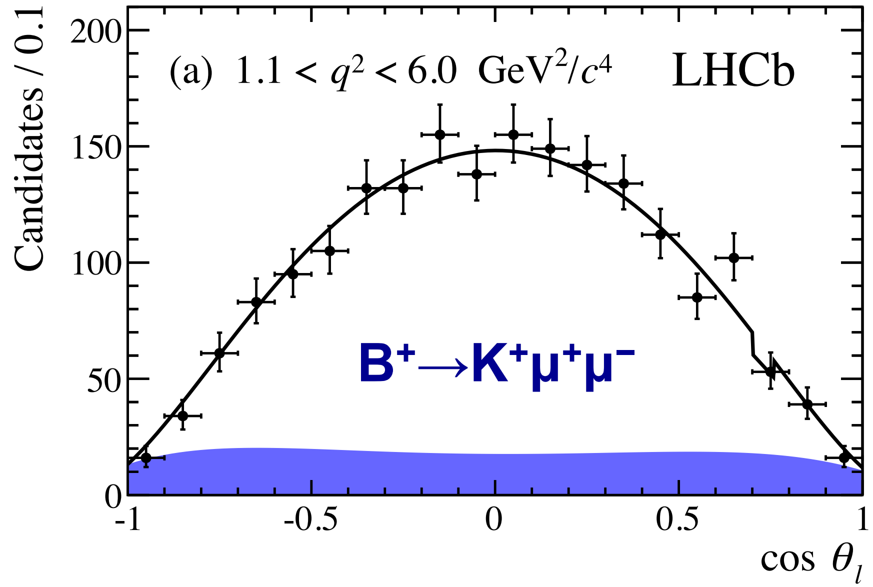
→ Exclusive bkgrds ~O(0.1%) of sig.

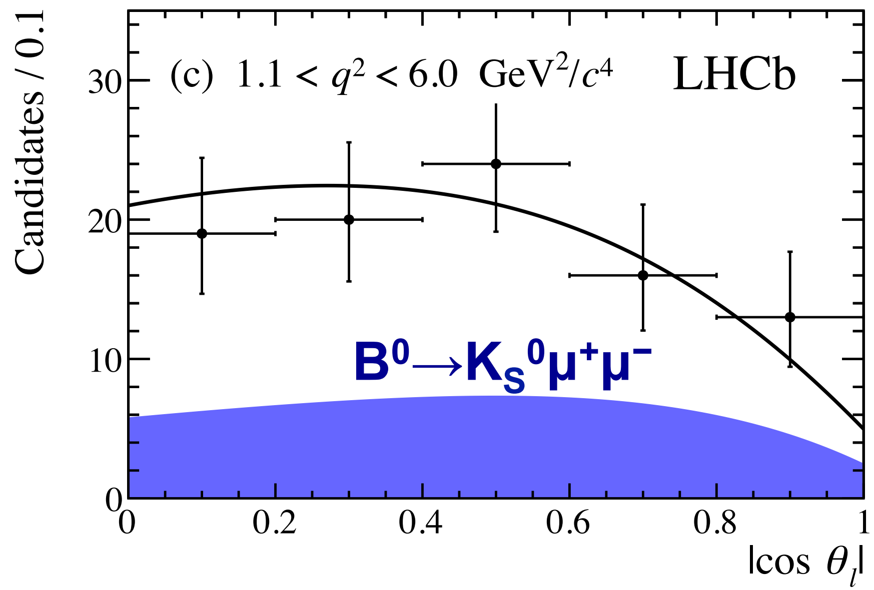




Angular analysis results

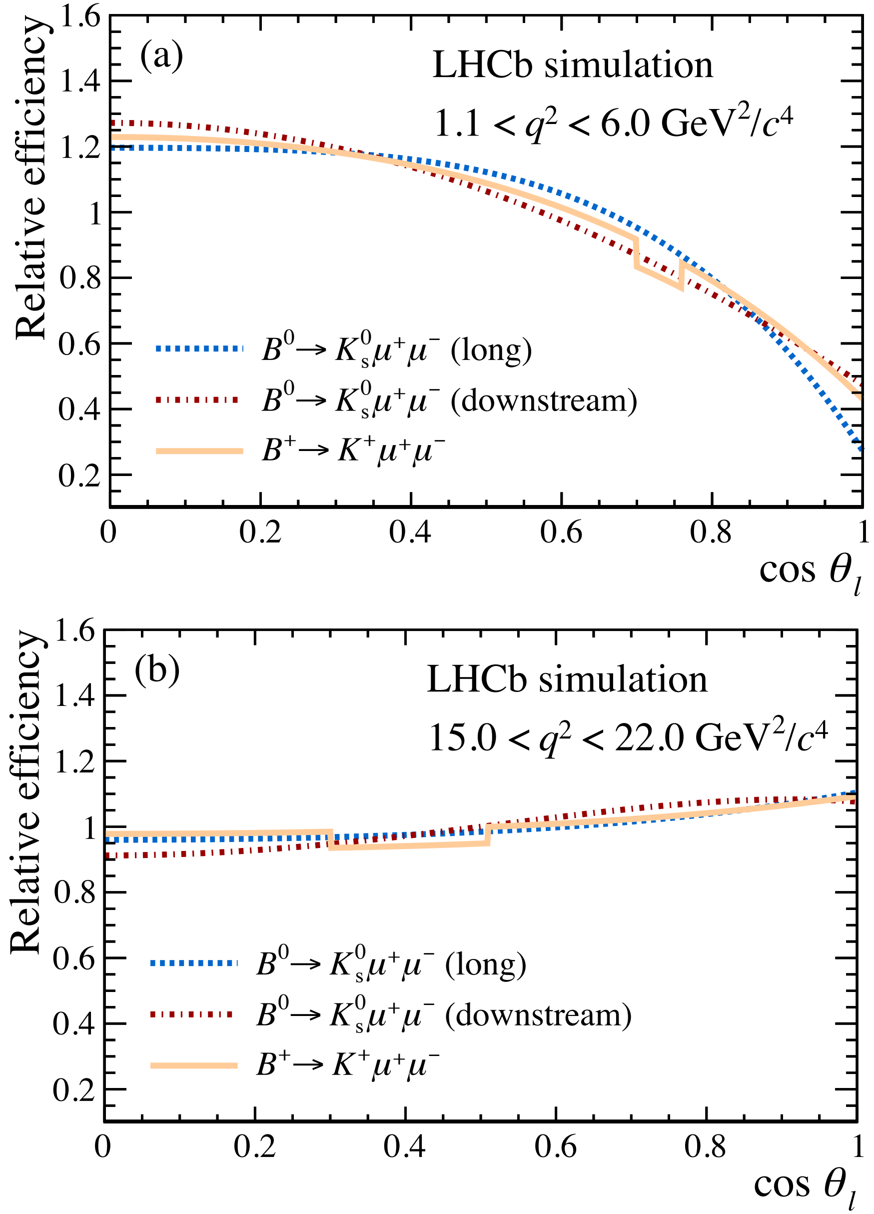
- Angular acceptance determined using simulated events
- Simultaneous 2d unbinned fit to **$m(K\mu^+\mu^-)$** and **$\cos\theta_l$**
- **$B^+ \to K^+\mu^+\mu^-$**
  $\to$ (**A_{FB}, F_H**)
  $\to$ also 1d confidence intervals in which treat A_{FB}, F_H independently
- **$B^0 \to K_S^0\mu^+\mu^-$**
  $\to$ **F_H**
- Consistent with SM predictions (**$A_{FB} \approx 0$, $F_H \approx 0$**) in every q^2 bin

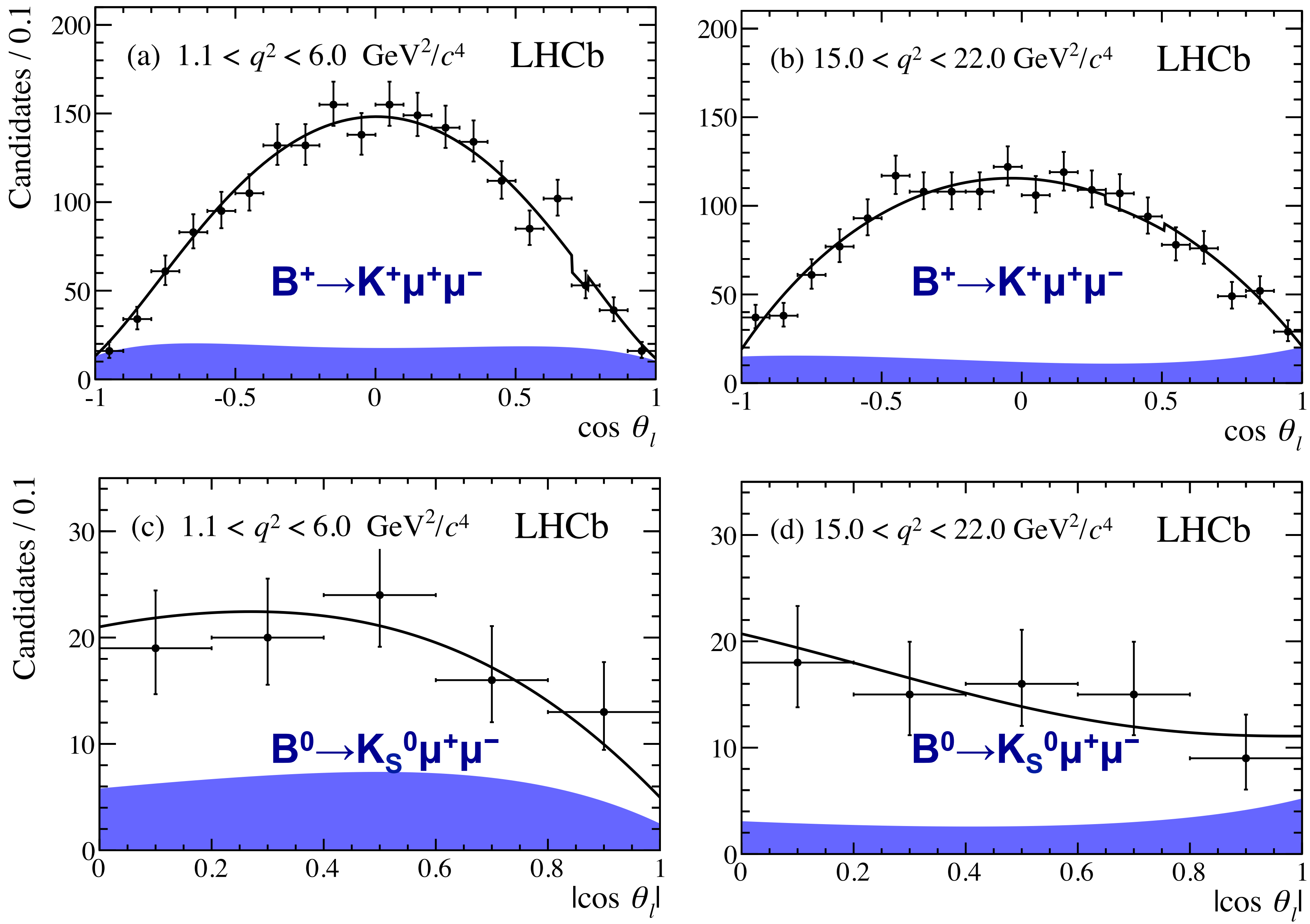




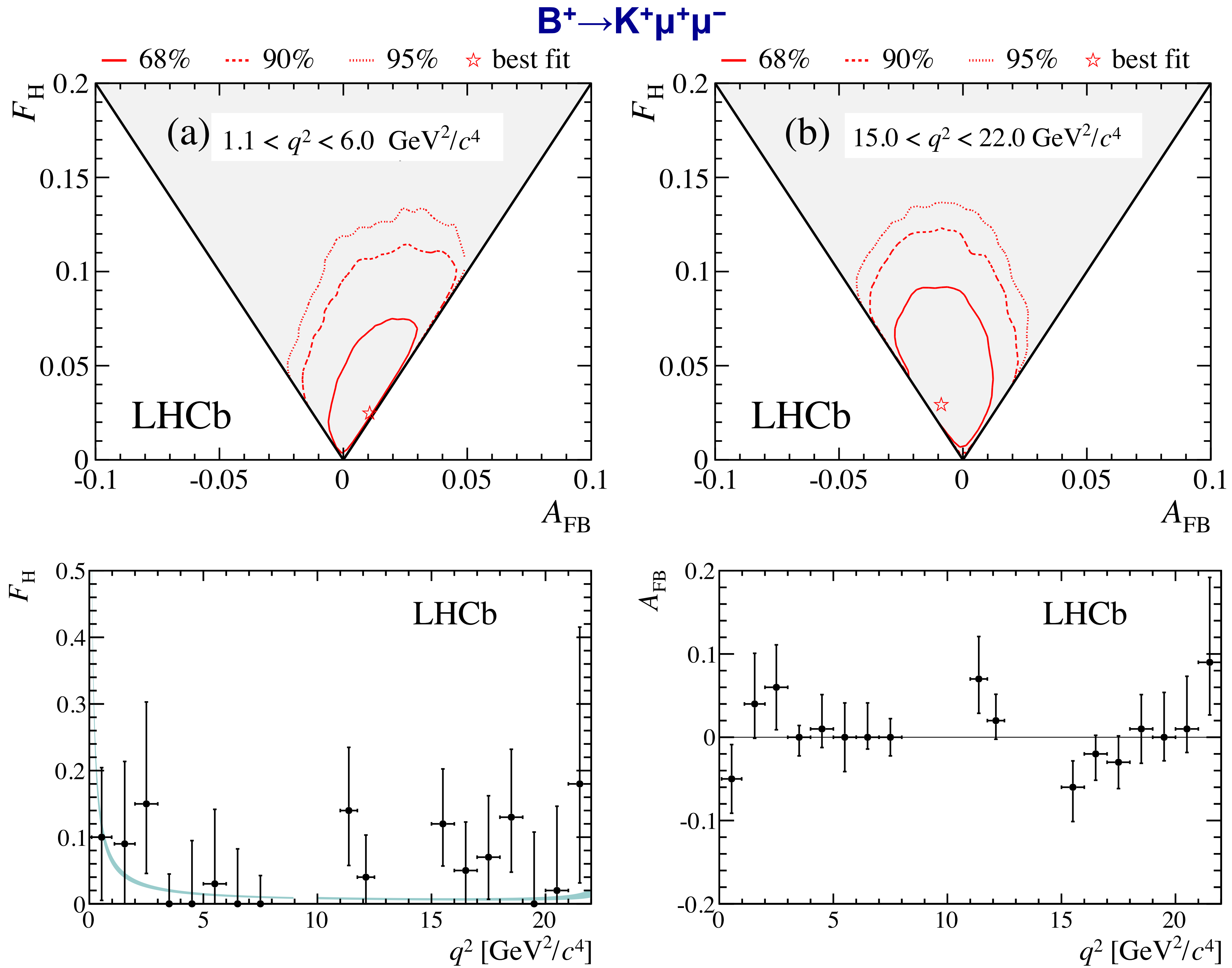
Angular acceptance

- Geometric acceptance of detector and selection bias angular distribution
- Determine angular acceptance using simulated signal events in relevant q^2 bins
- Muons need p>3GeV/c to reach LHCb muon system → large distortion of angular distribution at low q^2
  - Can see distortion from D0-veto at **cos θ_l**~0.75





Candidates / 0.1
(a) 1.1 < q² < 6.0 GeV²/c⁴
LHCb
B⁺→K⁺μ⁺μ⁻
cos θl
(b) 15.0 < q² < 22.0 GeV²/c⁴
LHCb
B⁺→K⁺μ⁺μ⁻
cos θl
Candidates / 0.1
(c) 1.1 < q² < 6.0 GeV²/c⁴
LHCb
B⁰→KS⁰μ⁺μ⁻
|cos θl|
(d) 15.0 < q² < 22.0 GeV²/c⁴
LHCb
B⁰→KS⁰μ⁺μ⁻
|cos θl|



B⁺→K⁺μ⁺μ⁻
68%
90%
95%
best fit
(a) $1.1 < q^2 < 6.0$ GeV²/c⁴
(b) $15.0 < q^2 < 22.0$ GeV²/c⁴
LHCb
F_H
A_{FB}
q^2 [GeV²/c⁴]

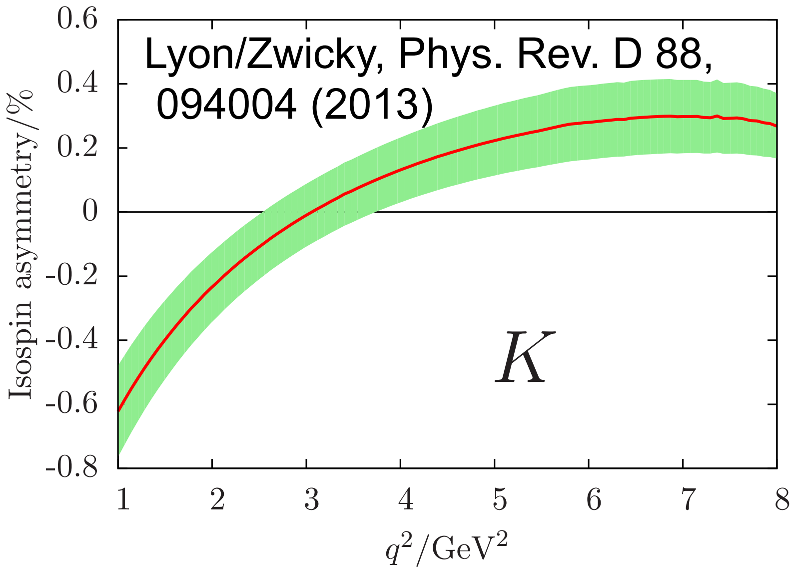
Isospin asymmetry in $B \to K^{(*)}\mu^+\mu^-$

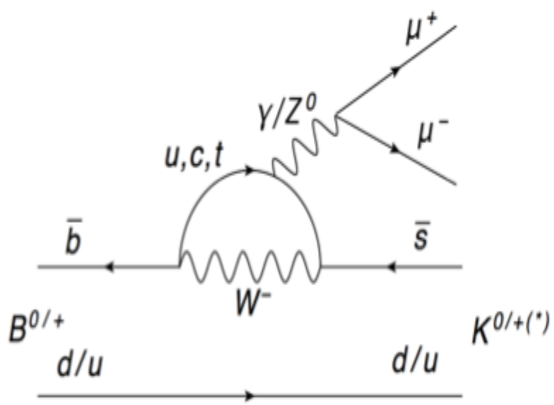
- The isospin asymmetry of $B \to K^{(*)}\mu^+\mu^-$, A_I is defined as:

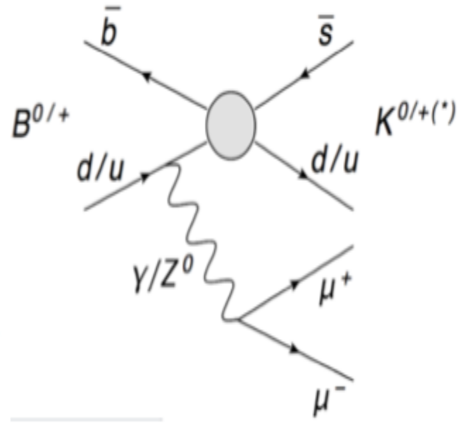
$$A_I = \frac{\mathcal{B}(B^0 \to K^{(*)0}\mu^+\mu^-) - \frac{\tau_0}{\tau_+}\mathcal{B}(B^\pm \to K^{(*)\pm}\mu^+\mu^-)}{\mathcal{B}(B^0 \to K^{(*)0}\mu^+\mu^-) + \frac{\tau_0}{\tau_+}\mathcal{B}(B^\pm \to K^{(*)\pm}\mu^+\mu^-)}$$

can be more precisely predicted than the branching fractions

- A_I is expected to be very close to zero in the SM e.g. for $B \to K\mu^+\mu^-$:





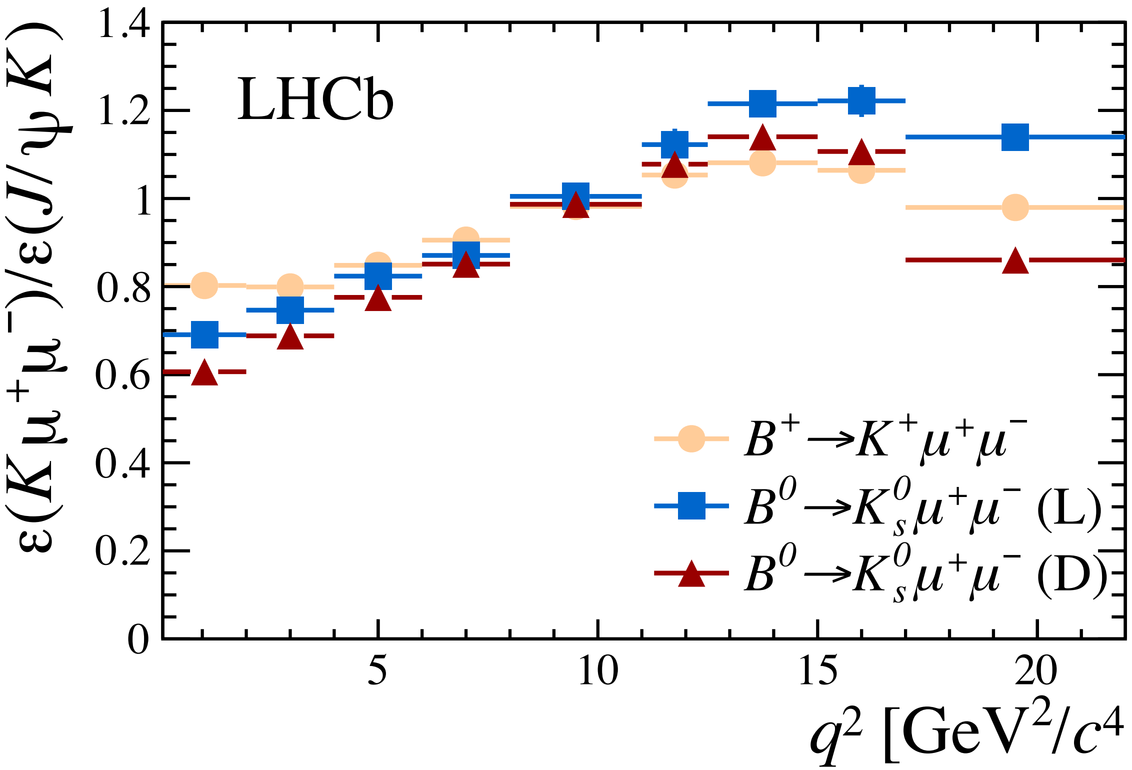


Normalisation

- Each signal mode is normalised with respect to its corresponding $B \to J/\psi K(*)$ channel
  - BFs from B-factories, implicitly assume B^+ and B^0 mesons are produced with equal proportions at the Y(4S)
  - Alternatively, assume isospin symmetry between J/ψ modes, assign difference in BFs to a production asymmetry between the B^+ and B^0 - gives different J/ψ branching fractions

- Relative efficiency taken from simulation as function of q^2
- The momentum distributions of the K_S^0 in $B^0 \to J/\psi K_S^0$ and $B^+ \to J/\psi (K^{*+} \to K_S^0 \pi^+)$ decays in data and simulation for both K_S^0 categories are in good agreement
- Assign systematic or the imperfect knowledge of the q^2 spectrum in the simulation

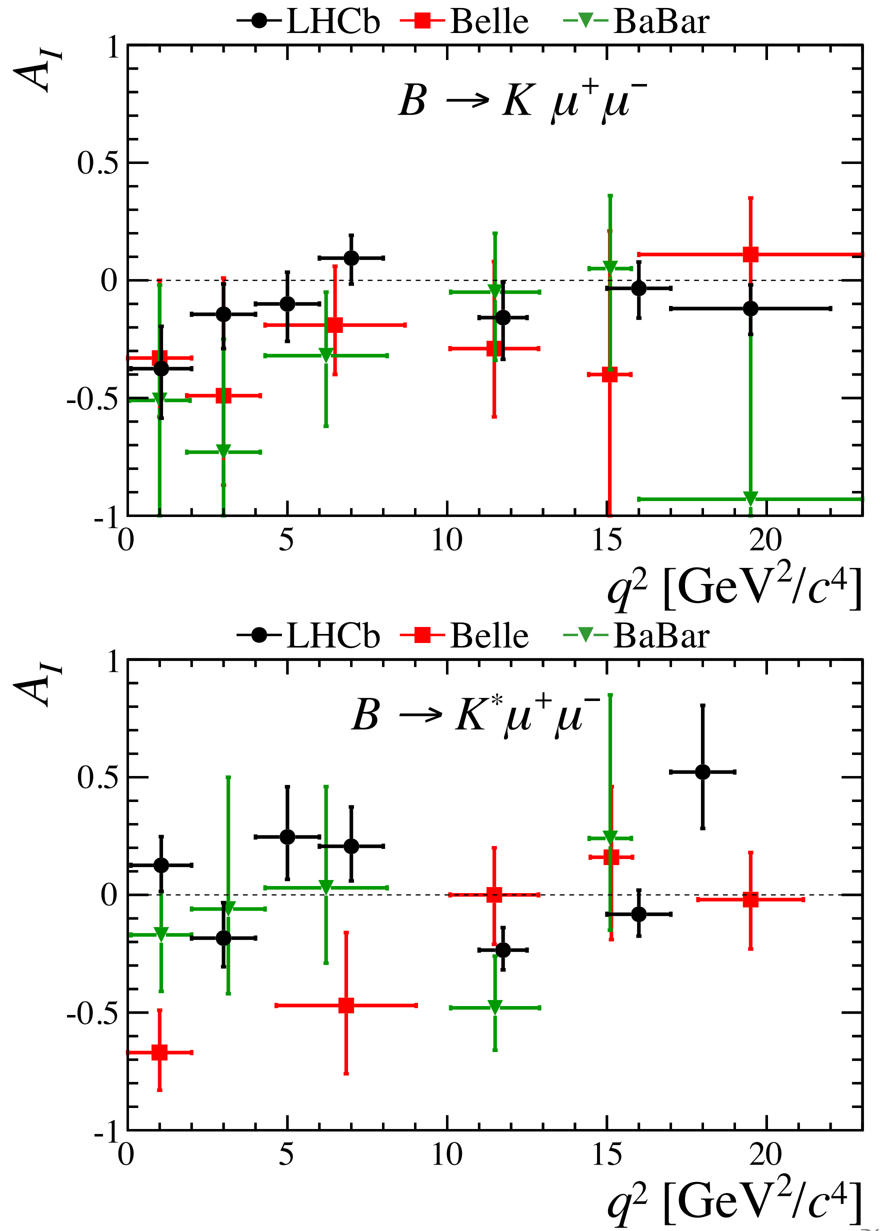
Relative Efficiency



- dominant effect from trigger: at high q^2, muons have high p_T → higher trigger efficiency
- Requiring decay products do not point back to primary pp vertex removes events at high q^2 where hadron almost at rest in B rest frame
- K_S^0 mesons more likely to be reconstructed in the long category if they have low momentum i.e. at high q^2

A_I Consistency with B-factories

- Results look consistent with previous measurements from babar/ belle



Theory Predictions

- **Theory predictions** : form factor calculations from Light Cone Sum Rules (LCSR) [Ball, Zwicky Phys. Rev. D71 (2005) 014029; A. Khodjamirian et al., JHEP 09 (2010) 089]
  - In the low q^2 region, rely on QCD factorisation which loses accuracy as approach J/ψ mass [M. Beneke et al., Nucl. Phys. B612 (2001) 25, Eur. Phys. J. C41 (2005) 173; C. Bobeth et al., JHEP 12 (2007) 040]
  - In the high q^2 region, an operator product expansion in the inverse b-quark mass, $1/m_b$ and in $1/\sqrt{q^2}$ is used [B. Grinstein and D. Pirjol, Phys. Rev. D70 (2004) 114005] - only valid above the open charm. Dimensional estimate is made of the uncertainty from expansion corrections [U. Egede et al., JHEP 11 (2008) 032]
- **Lattice predictions** : [C. Bouchard et al., Phys. Rev. D88 (2013) 054509; R. R. Horgan et al., arXiv:1310.3722]

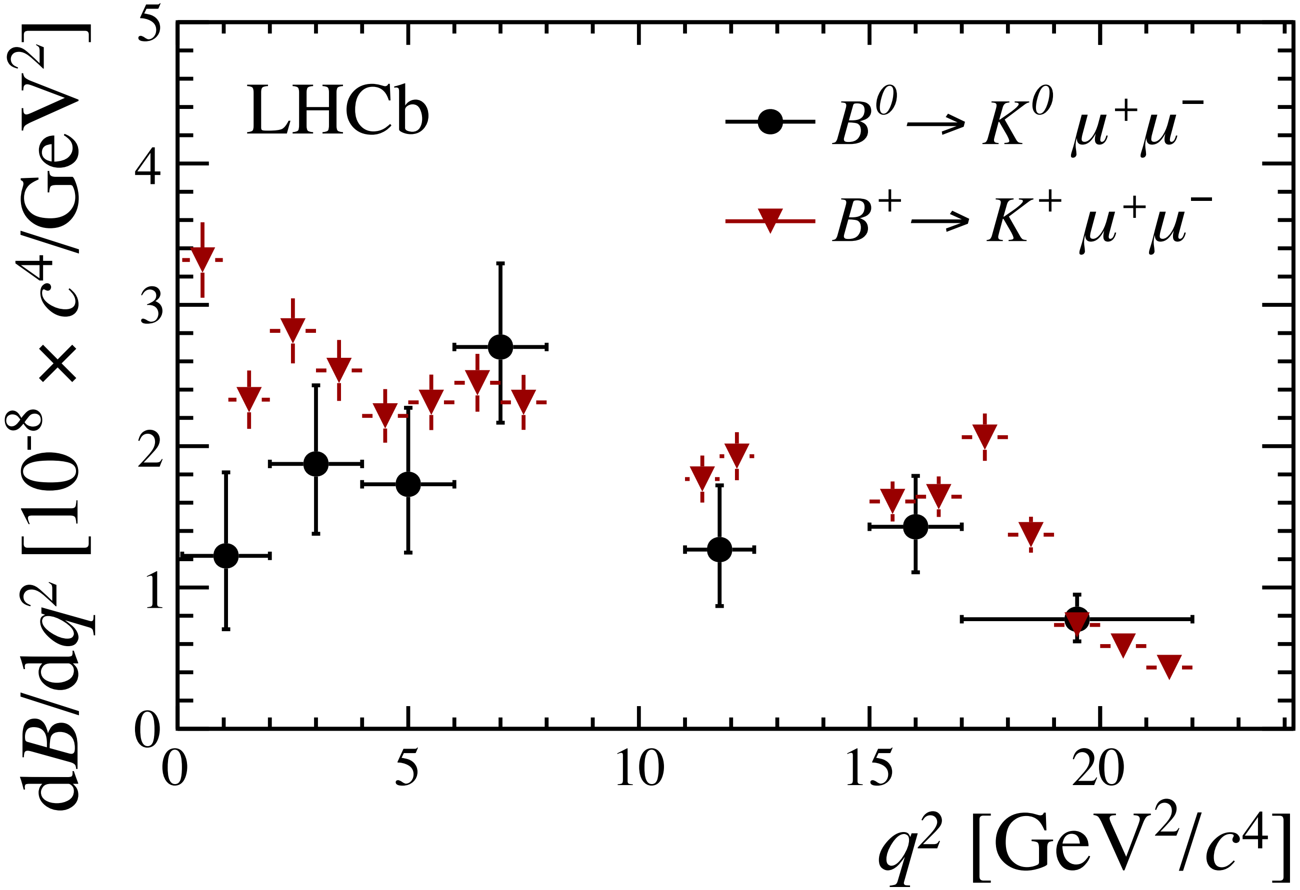
Selection

- Trigger:
  - (hardware) μ p_T > 1.48 (1.76) GeV in 2011 (2012)
  - (software) one of the final state particles is required to have both p_T > 1.0 GeV/c, IP >100 μm wrt all primary pp vertices; multivariate algorithm used to find secondary vertices consistent with the decay of a b hadron

- After preselection, multivariate selection used to isolate candidates: reduces combinatorial backgrounds by 95% (99)% while rejecting 90% (60%) of backgrounds for K^+,K^{*+}, K^{*0} (K_S^0) decays

- Peaking backgrounds:
  - $B\to K^{(*)}J/\psi$ and $B\to K^{(*)}\psi(2S)$ rejected by removing (2946 < $m(\mu^+\mu^-)$ < 3176 MeV/c^2, 3586 < $m(\mu^+\mu^-)$ < 3776 MeV/c^2
  - Use combination of mass and particle identification requirements to remove exclusive backgrounds from e.g. $\Lambda^0_b \to \Lambda^{0(*)}\mu^+\mu^-$, $B_s^0\to\phi\mu^+\mu^-$

→ exclusive backgrounds reduced to < 1% of the level of the signal



LHCb
$B^0 \to K^0 \mu^+\mu^-$
$B^+ \to K^+ \mu^+\mu^-$
$\mathrm{d}\mathcal{B}/\mathrm{d}q^2$ [$10^{-8} \times c^4/\mathrm{GeV}^2$]
q^2 [GeV^2/c^4]
0
1
2
3
4
5
0
5
10
15
20