The LHCb Experiment and the Decay $B_d \rightarrow K^*\mu^+\mu^-$

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Outline

- The LHCb Phyics Programme
- The decay $B_d \rightarrow K^*\mu^+\mu^-$
- First Look at 2009 Data in LHCb
- Future Work

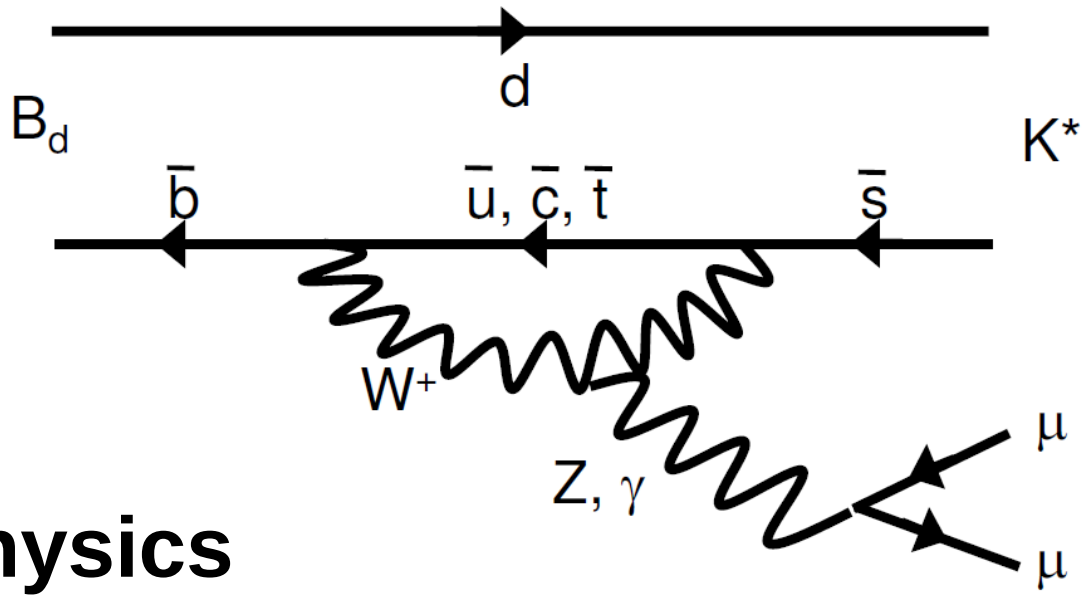
The LHCb Physics Programme

- The Standard Model
  - Consistent with vast majority of experimental data
  - Conceptual problems: CP Violation, Dark Matter, 3 quark generations...

- Search for new physics
  - Is SM picture of CPV complete (CKM) → Measurement of γ
  - Explore new physics models → **Rare Decays**

Rare Decays

- Flavour-Changing Neutral Currents proceed via loops
  - Rare
  - Virtual particles



- Sensitive to **new physics**
- Lots of loop processes studied at LHCb

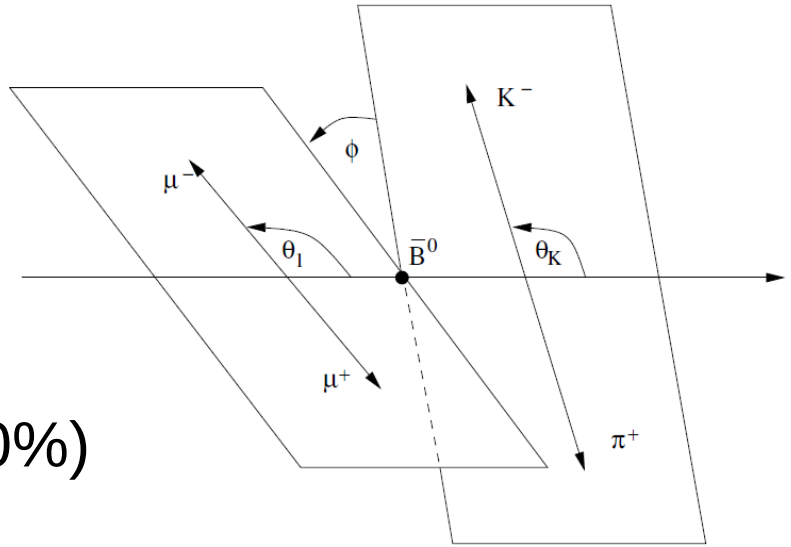
$B_s \rightarrow \mu^+\mu^-$ $B_d \rightarrow K^*\mu^+\mu^-$ $B^0 \rightarrow \pi^+\pi^-$

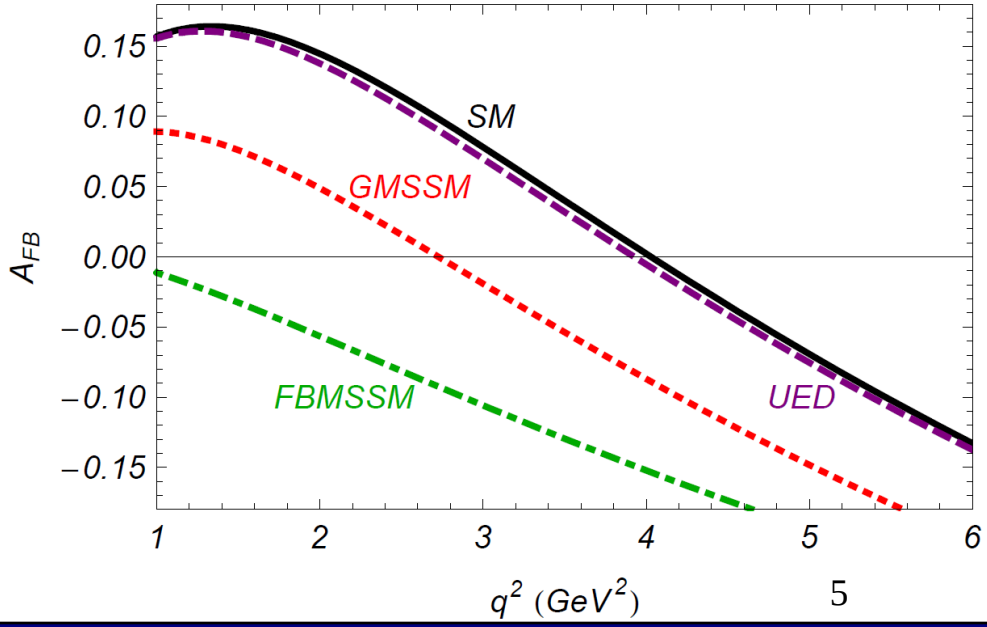
The Decay $B_d \rightarrow K^*\mu^+\mu^-$

- FCNC rare decay
- Described by θ_L, θ_K,φ,q^2
- Theoretically well-calculable in region $1 < q^2 < 6$ GeV^2

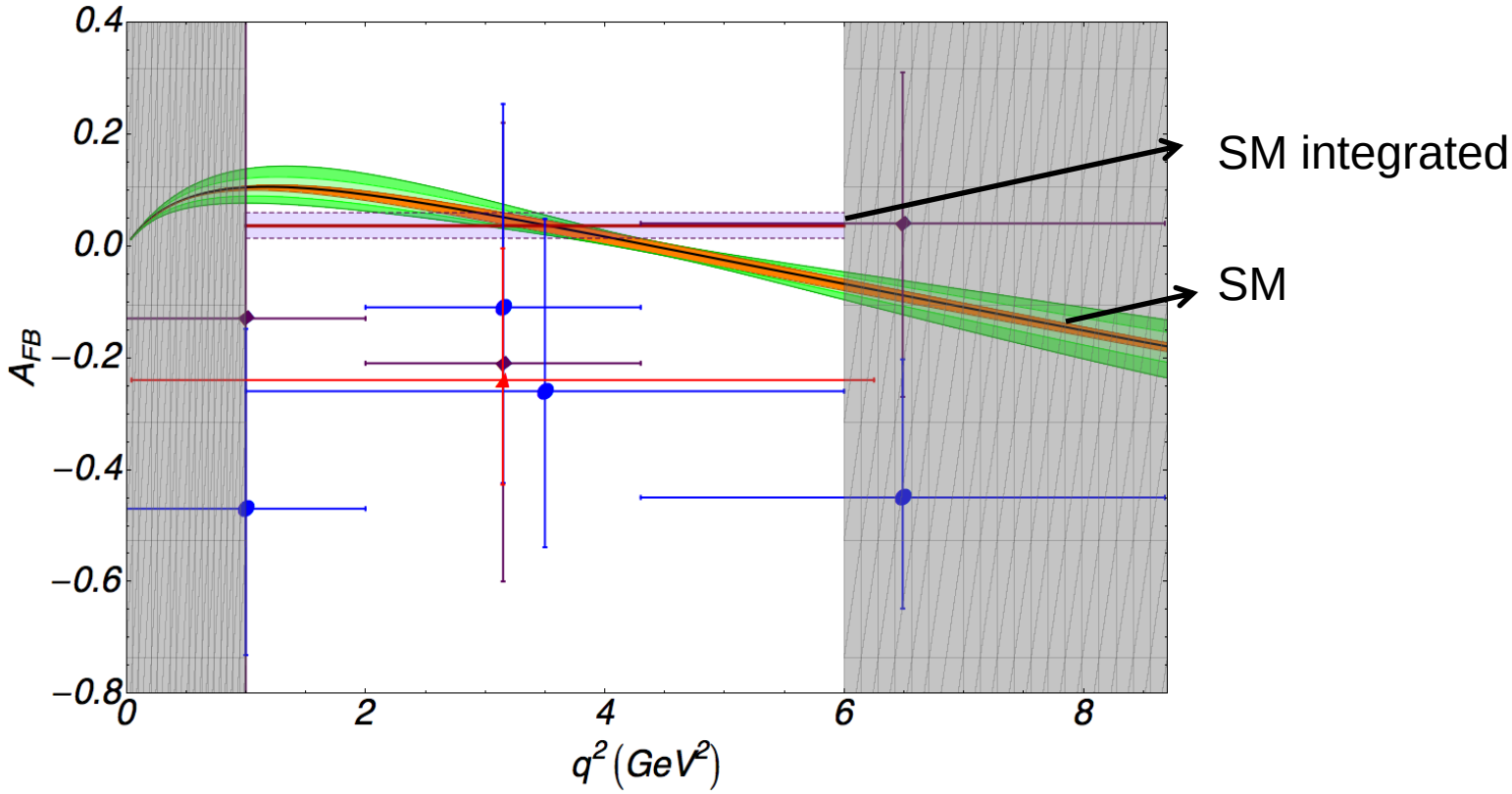
(theory errors ~ 10%)

- Key Observable:
  - **Forward-Backward Asymmetry (A_{FB})**
  - Constructed from θ_L
- **Allows discrimination between SM & NP models**





Current Status of A_{FB} Measurement



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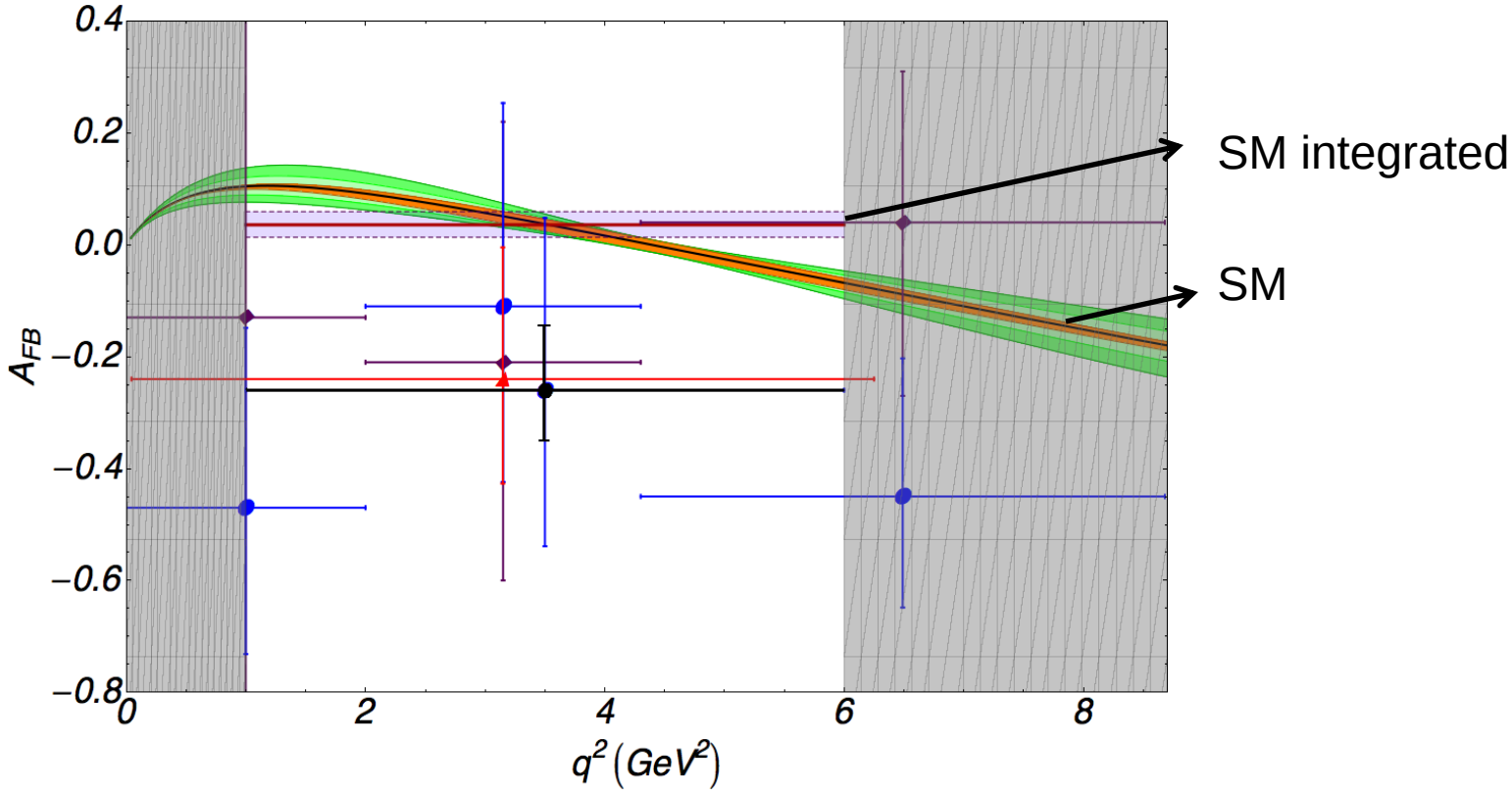


▲ BaBar ● Belle ◆ CDF

With ~300 pb^{-1} (end of 2010)

LHCb gets world-best measurement

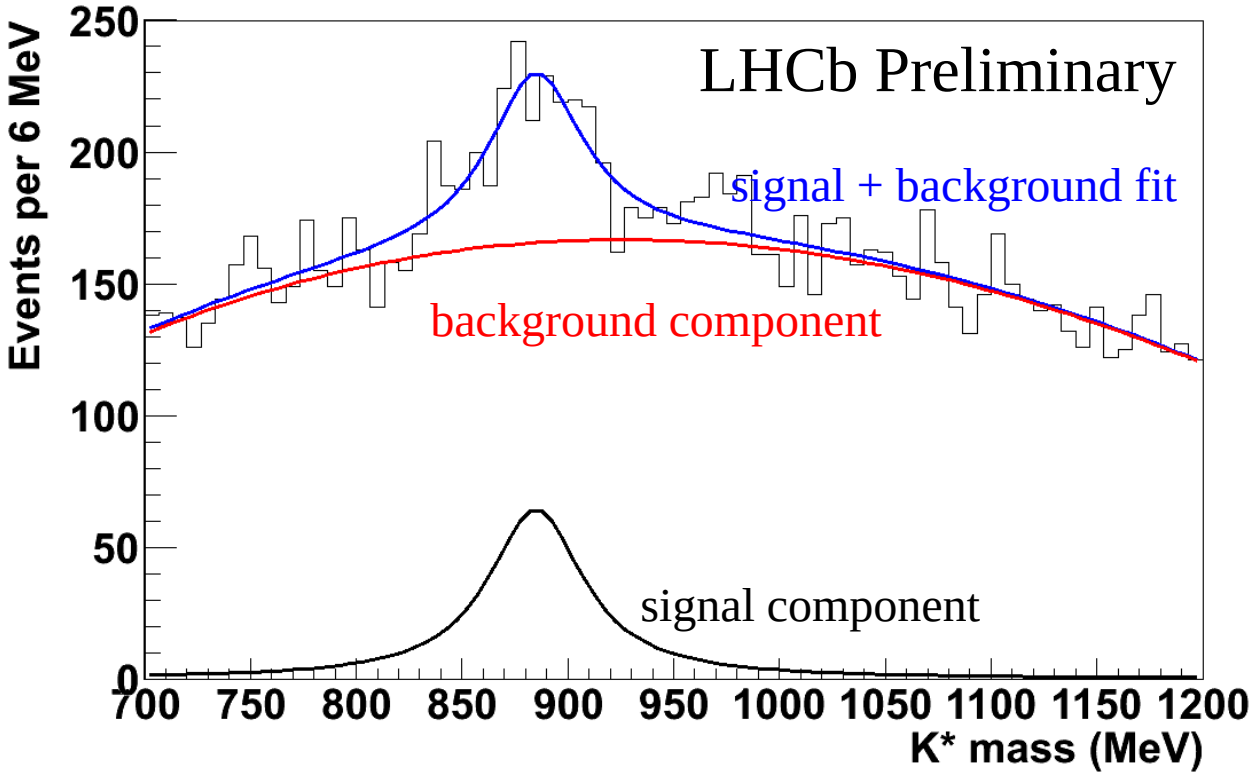
$B_d \rightarrow K^*\mu^+\mu^-$ Analysis

- Main analysis issues
  - Need to understand detector efficiencies
    - Recall Alex's talk
  - **Background control**

- First look for genuine $K^* \rightarrow K\pi$ combinations in data
- Then use 2009 data for first look at background
  - VELO open $\rightarrow$ σ_{Vertex} , $\sigma_{ImpactParameter}$ resolution worsened
  - RICH not fully calibrated $\rightarrow$ K – π separation impaired
  - No B/D decays $\rightarrow$ All $K\pi$ from primary-vertex
    - **From Primary Vertex & Ghosts**

K* → Kπ Search

- Search for genuine K*
- Look for Kπ FROM PV
  - Good quality vertex
  - Mass ~ M_{K^*}
  - Flight Distance (FD) small
  - Good quality tracks
  - Impact parameter small
  - Kaon probability large/small



Indication of genuine K* in 2009 data!

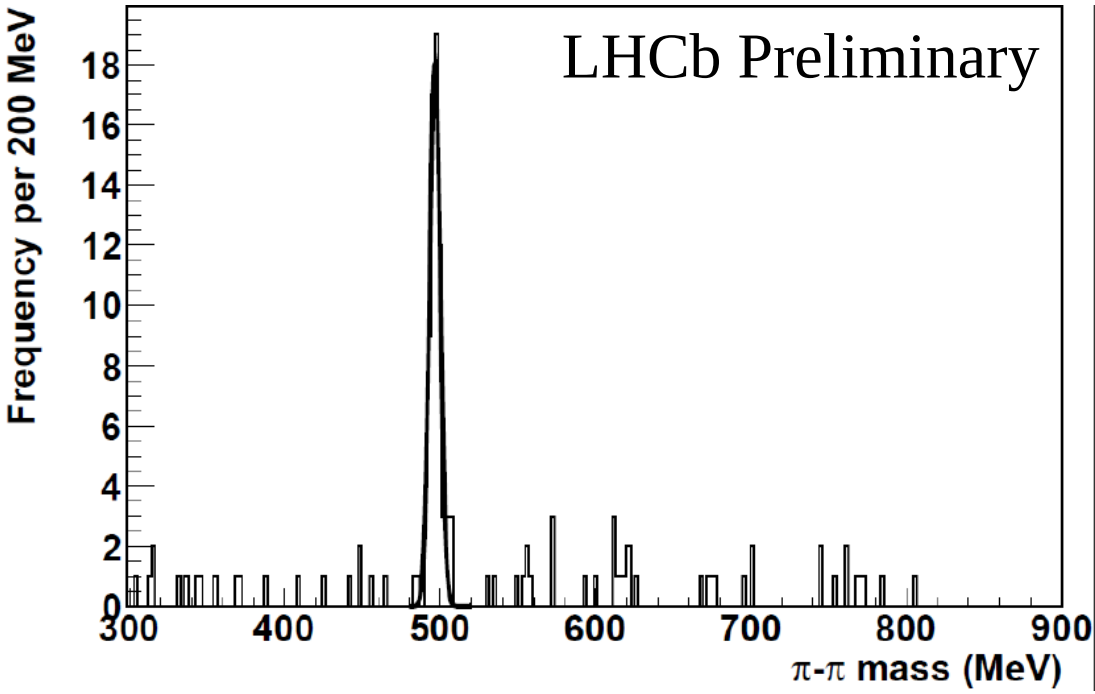
K* as background to $B_d \rightarrow K^*\mu^+\mu^-$

- No B/D particles therefore look for Kπ NOT FROM PV
  - Cut hard on: Flight Distance χ^2 & Impact Parameter χ^2
- Applied full $B_d \rightarrow K^*\mu^+\mu$ selection criteria to K* candidates in 2009 data

- **129 candidates survive**

- Switch $K \rightarrow \pi$ to check
  $K_S \rightarrow \pi^+\pi^-$
  - **Majority are K_S**

- K – π mis-identification
  - **Require VELO & PID !**



Conclusions & Future work

- **K* backgrounds**
  - Some evidence for genuine K* above combinatorial background
  - First look at background sources for $B_d \rightarrow K^*\mu^+\mu^-$
- **New data**
  - VELO closed
  - Better calibrated RICH
  - Give resolution in discriminating quantities
- **$B_d \rightarrow K^*\mu^+\mu^-$**
  - Establish control of background
- **RICH**
  - Alignment
  - Shifts
- **Find new physics!**