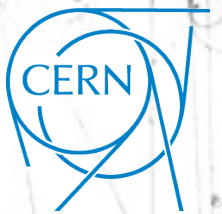
Rare decays in the beauty, charm and strange sector

Marcin Chrzaszcz



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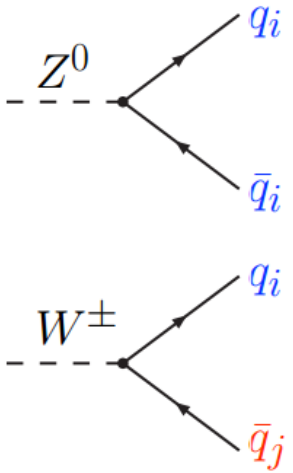
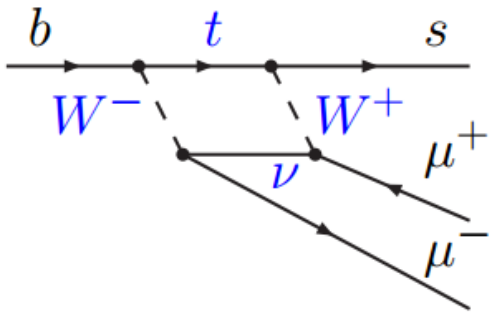
Outline

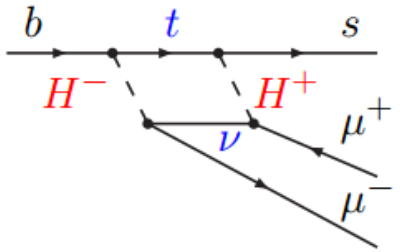
FIXME

Why rare decays?

- In the SM allows only the charged interactions to change flavour.
  - Other interactions are flavour conserving.
- One can escape this constrain and produce $b \longrightarrow s$ and $b \longrightarrow d$ at loop level.
  - This kind of processes are suppressed in the SM $\longrightarrow$ Rare decays.
  - New Physics can enter in the loops.







LHCb detector - tracking

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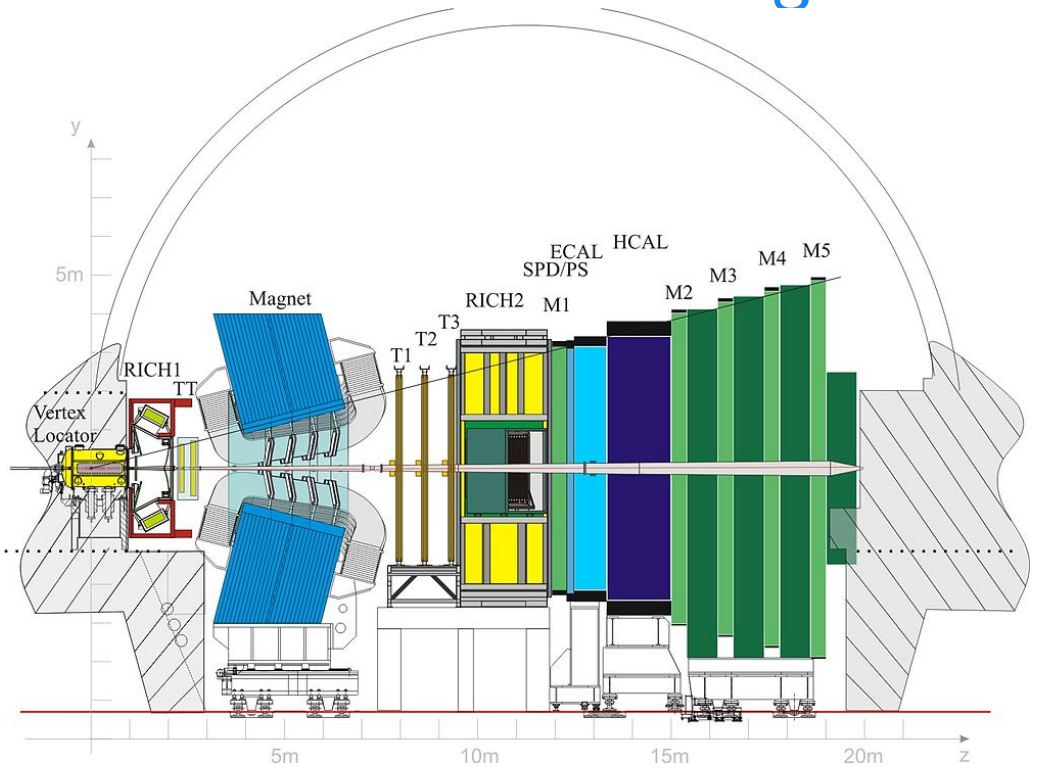

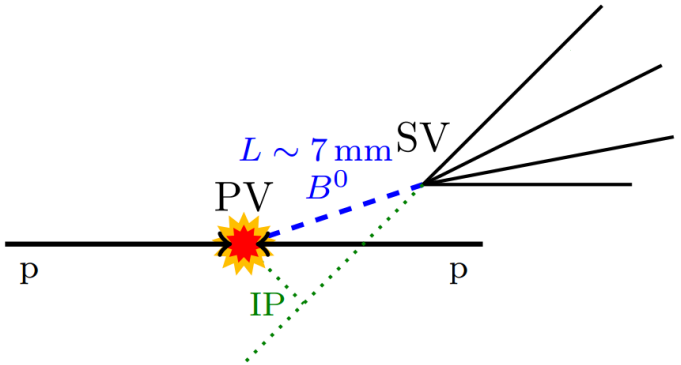

- Excellent Impact Parameter (IP) resolution ($20\ \mu\mathrm{m}$).
  $\Rightarrow$ Identify secondary vertices from heavy flavour decays
- Proper time resolution $\sim\ 40 - 50$ fs.
  $\Rightarrow$ Good separation of primary and secondary vertices.
- Excellent momentum ($\delta p/p \sim 0.5 - 1.0\%$) and inv. mass resolution.
  $\Rightarrow$ Low combinatorial background.

LHCb detector - PID

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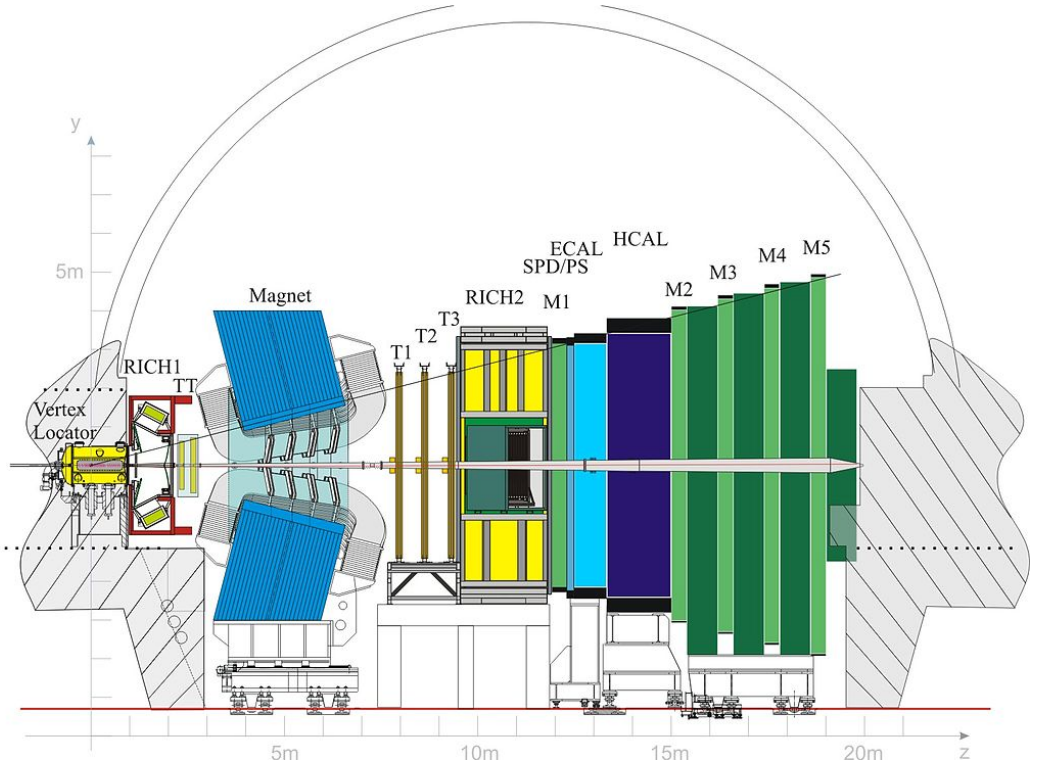
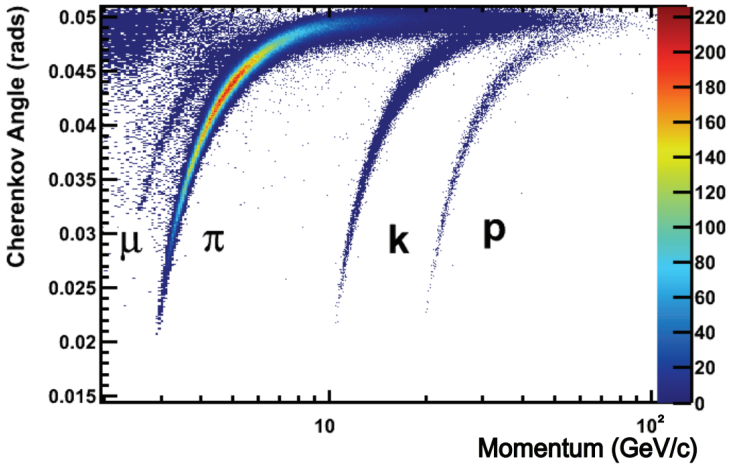




- Excellent Muon identification $\epsilon_{\mu\to\mu} \sim 97\%$, $\epsilon_{\pi\to\mu} \sim 1-3\%$
- Good $K-\pi$ separation via RICH detectors, $\epsilon_{K\to K} \sim 95\%$, $\epsilon_{\pi\to K} \sim 5\%$.
  $\Rightarrow$ Reject peaking backgrounds.
- High trigger efficiencies, low momentum thresholds.
  $B \to J/\psi X$: Trigger $\sim 90\%$.

Rare beauty decays

$b \to s\ell\ell$ family

- $B \to K^* \mu\mu$
- $B_s^0 \to \phi\mu\mu$
- $\Lambda_b \to pK\mu\mu$
- LUV: R_K, R_{K^*}

$b \to s\gamma$ family

- $B \to J/\psi\gamma$
- $B \to K\pi\pi\gamma$

$b \to d\ell\ell$ family

- $B \to \pi\pi\mu\mu$
- $\bar{B}_s^0 \to K^* \mu\mu$
- $\Lambda_b \to p\pi\mu\mu$

$\Rightarrow$ To many results to be covered in one talk! Please see A. Campos talk for more!

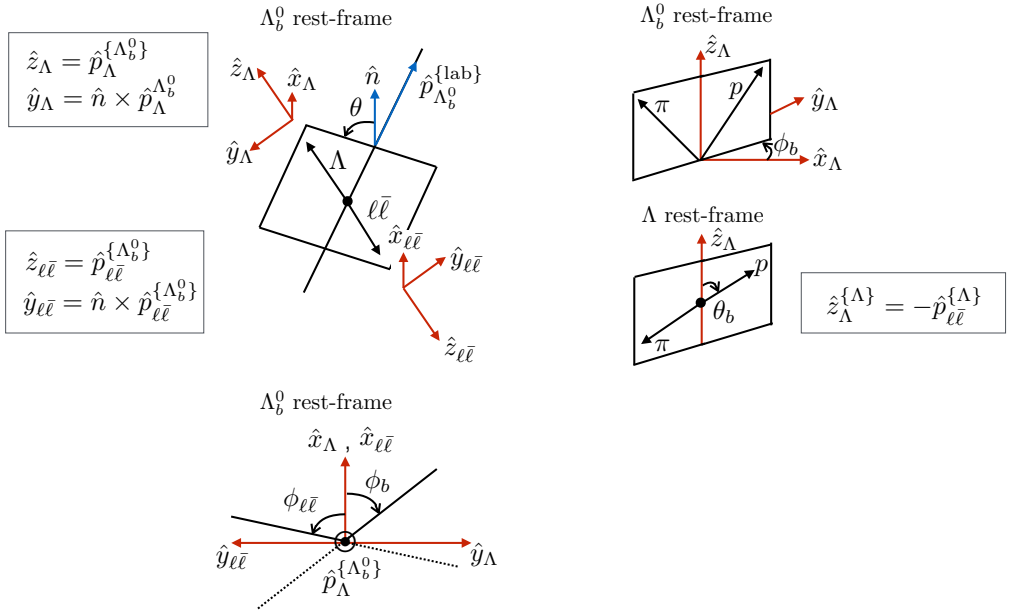
Purelly leptonic familly

- $B \to \ell\ell$
- LFV: $B \to \ell\ell'$
- LFV in τ

⇛ $b \longrightarrow s\mu\mu$ in baryon sector.

⇛ Because of spin $1/2$ nature of the baryon there the system has to be described by 5 angles: 1710.00746

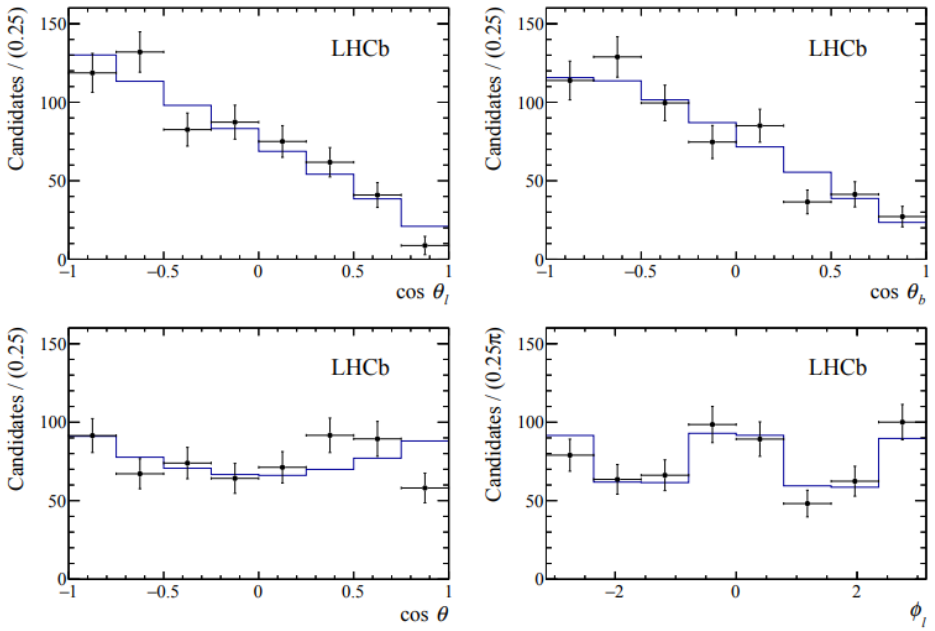
⇛ Impossible to perform a likelihood fit. Need to use moments:

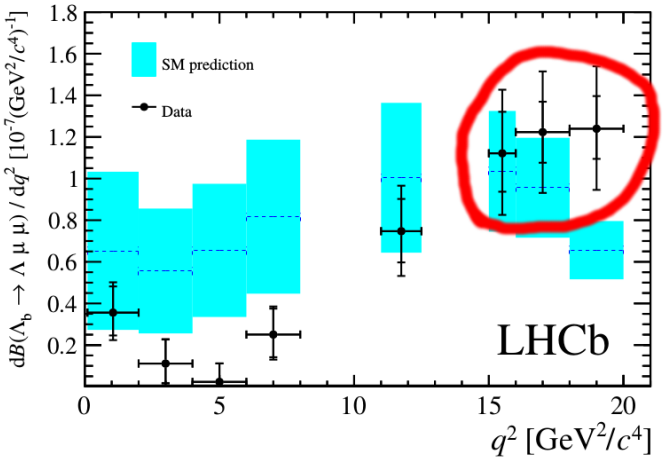


$$M_i = \frac{3}{32\pi^2} \int \sum_{i=1}^{34} K_i(q^2) f(\overrightarrow{\Omega}) d\overrightarrow{\Omega}$$

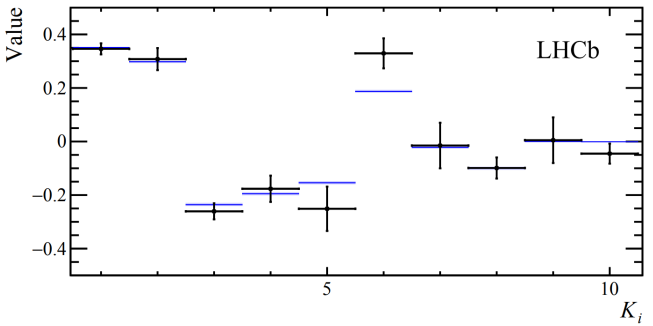
⇛ In total we have 34 observables!

- Update with $5\ \mathrm{fb}^{-1}$.
- 610 events observed in the high q^2.
- Angular efficiency modelled in 6D.





- The results:



$\bar{B}_s^0 \longrightarrow K^* \mu\mu$

wq

qwe

$\bar{B}_s^0 \longrightarrow K^* \mu\mu$

weq

qwe

$B \to e\mu$

qewqeq

$B \to e\mu$

qewqeq

$\Lambda_c \to p\mu\mu$

qewqeq

$\Lambda_c \to p\mu\mu$

qewqeq

$D \to hh\mu\mu$

qewqeq

$D \to hh\mu\mu$

qewqeq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$K_S^0 \to \mu\mu$

qewqeq

$K_S^0 \to \mu\mu$

qewqeq

$\Sigma \to p\mu\mu$

qewqeq

$\Sigma \to p\mu\mu$

qewqeq

Backup