$\tau \rightarrow 3\mu$ @ LHCb

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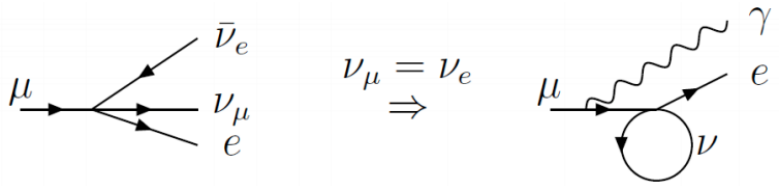
Lepton Flavour/Number Violation

Lepton Flavour Violation(LFV):
After μ^- was discovered it was natural to think of it as an excited e^-.

- Expected: $B(\mu \to e\gamma) \approx 10^{-4}$
- Unless another ν, in intermediate vector boson loop, cancels.



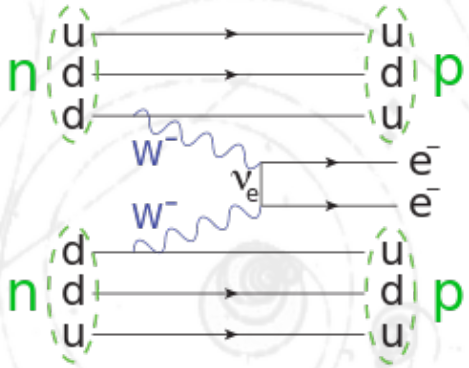
I.I.Rabi:

"Who ordered that?"

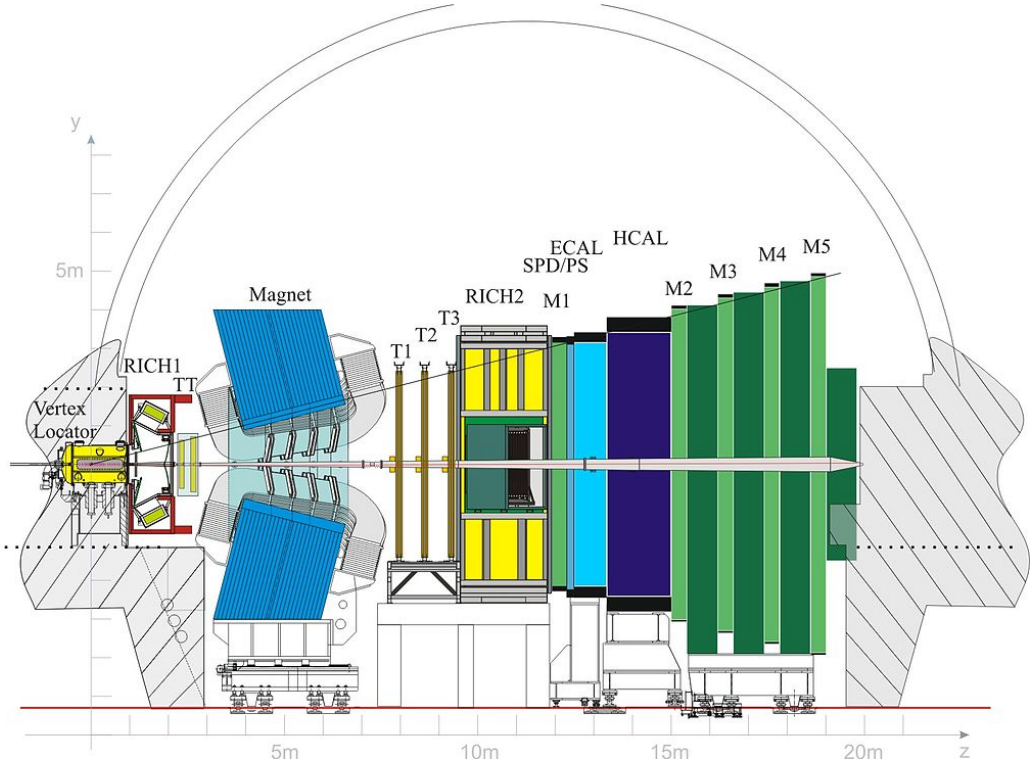
- Up to this day charged LFV is being searched for in various decay modes.
- LFV was already found in neutrino sector (oscillations).

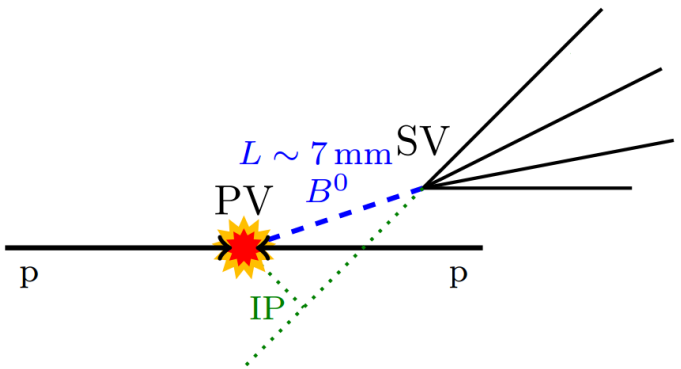
Lepton Number Violation (LNV)

- Even with LFV, lepton number can be a conserved quantity.
- Many NP models predict it violation(Majorana neutrinos)
- Searched in so called Neutrinoless double β decays.



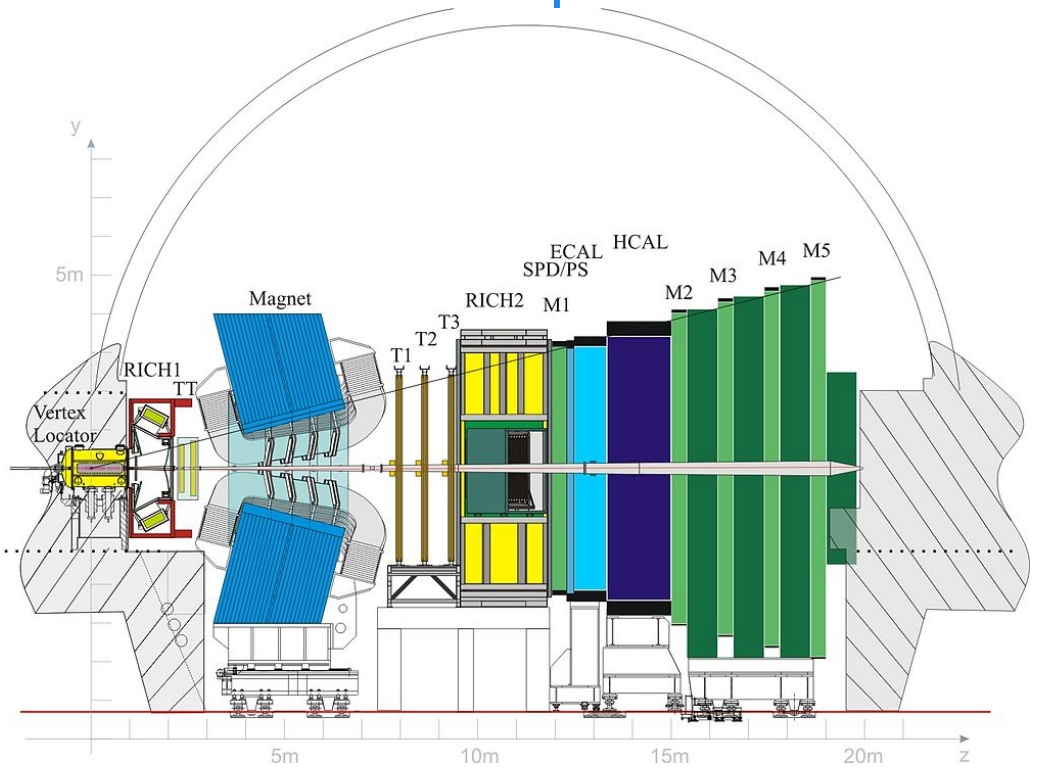
LHCb detector - tracking

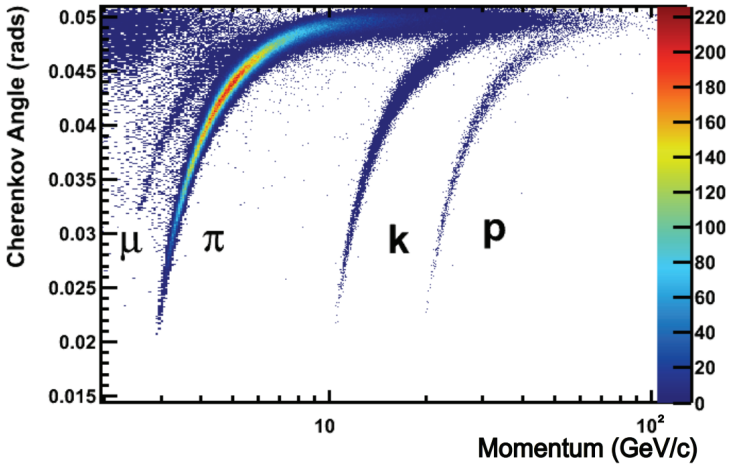




- Excellent Impact Parameter (IP) resolution ($20\ \mu\mathrm{m}$).
  $\Rightarrow$ Identify secondary vertices from heavy flavour decays
- Proper time resolution $\sim\ 40\ \mathrm{fs}$.
  $\Rightarrow$ Good separation of primary and secondary vertices.
- Excellent momentum ($\delta p/p \sim 0.4 - 0.6\%$) and inv. mass resolution.
  $\Rightarrow$ Low combinatorial background.

LHCb detector - particle identification





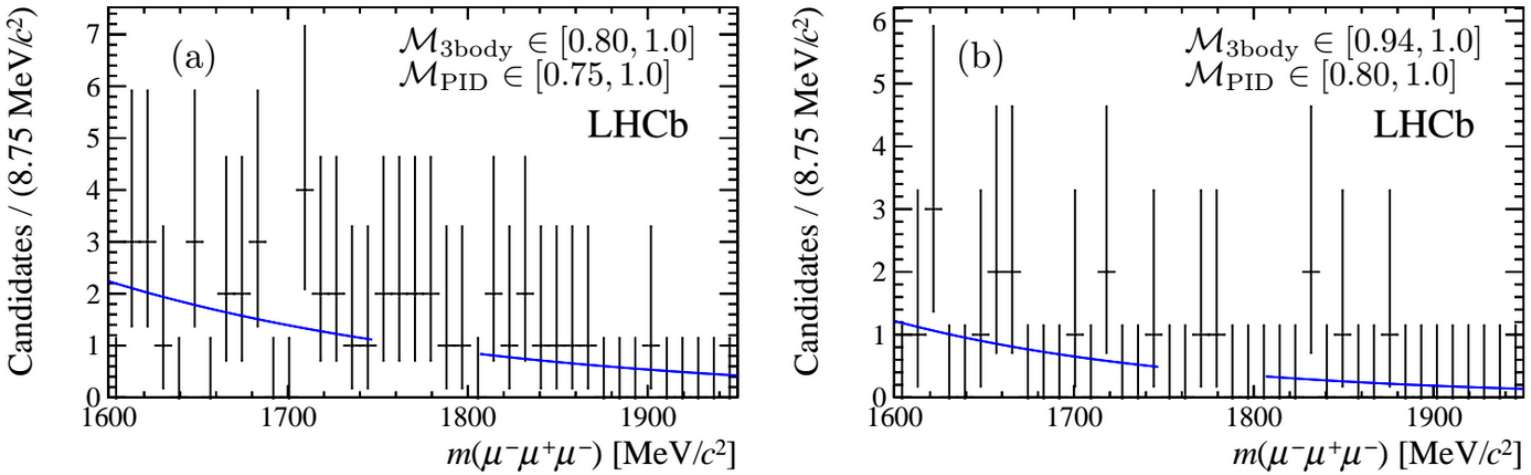
- Excellent Muon identification $\epsilon_{\mu\to\mu} \sim 97\%$, $\epsilon_{\pi\to\mu} \sim 1-3\%$
- Good $K-\pi$ separation via RICH detectors, $\epsilon_{K\to K} \sim 95\%$, $\epsilon_{\pi\to K}\ m5\%$.
  $\Rightarrow$ Reject peaking backgrounds.
- High trigger efficiencies, low momentum thresholds. Muons:
  $p_T > 1.76\mathrm{GeV}$ at L0, $p_T > 1.0\mathrm{GeV}$ at HLT1,
  $B \to J/\psi X$: Trigger $\sim 90\%$.

Example of analysis

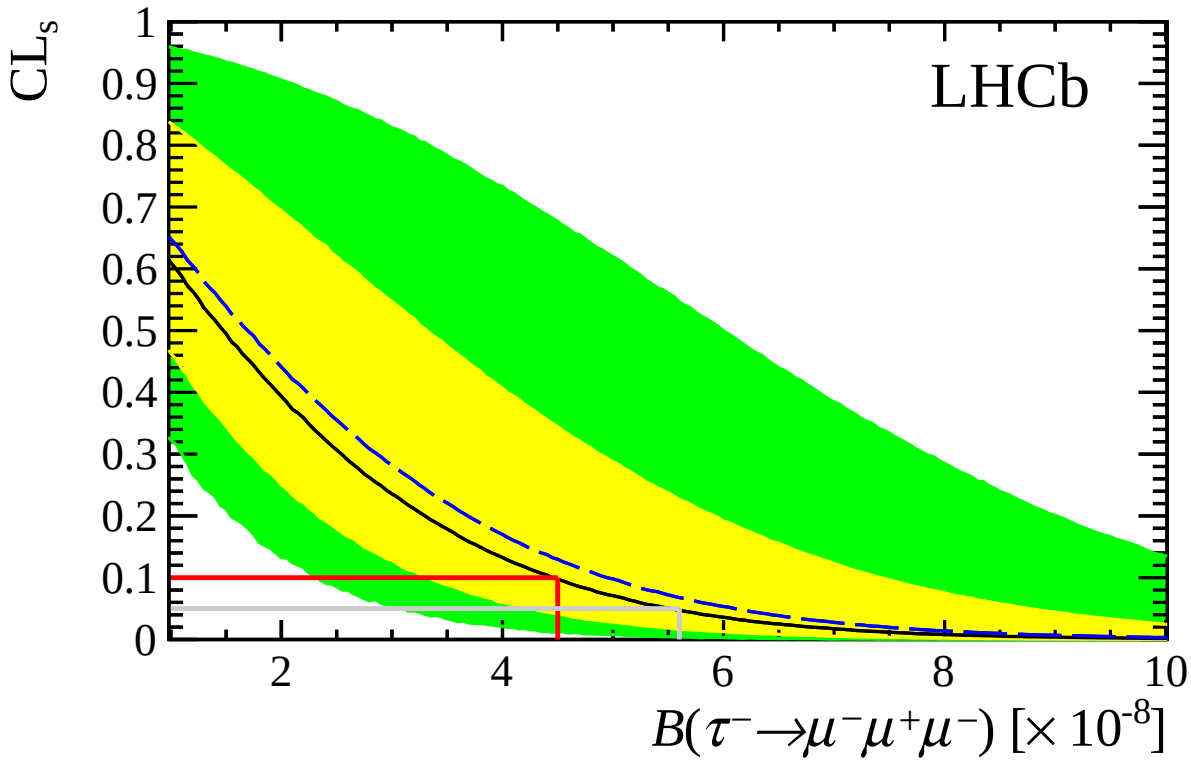
- Fit exponential to invariant mass spectrum in each likelihood bin.
- Don't use blinded region ($\pm 30 MeV$).

$\rightarrow$ Compatible results blinding only $\pm 20 MeV$

Example of most sensitive regions in 2011 and 2012



Run1 Results



Limits(PHSP):

Observed(Expected)

$4.6\ (5.0) \times 10^{-8}$ at 90% CL

$5.6\ (6.1) \times 10^{-8}$ at 95% CL

Dalitz distribution	x10^{-8}
$\varrho_V^{(LL)(LL)}$	4.2 (4.7)
$\varrho_V^{(LL)(RR)}$	4.1 (4.6)
$\varrho_{rad}^{(LR)}$	6.8 (7.6)
$\varrho_{mix}^{(LL)(LL)}$	4.4 (5.1)
$\varrho_{mix}^{(LL)(RR)}$	4.6 (5.0)

Backup