THE LHCB TRACKS RECONSTRUCTION IN RUN 2: STRATEGY AND PERFORMANCE

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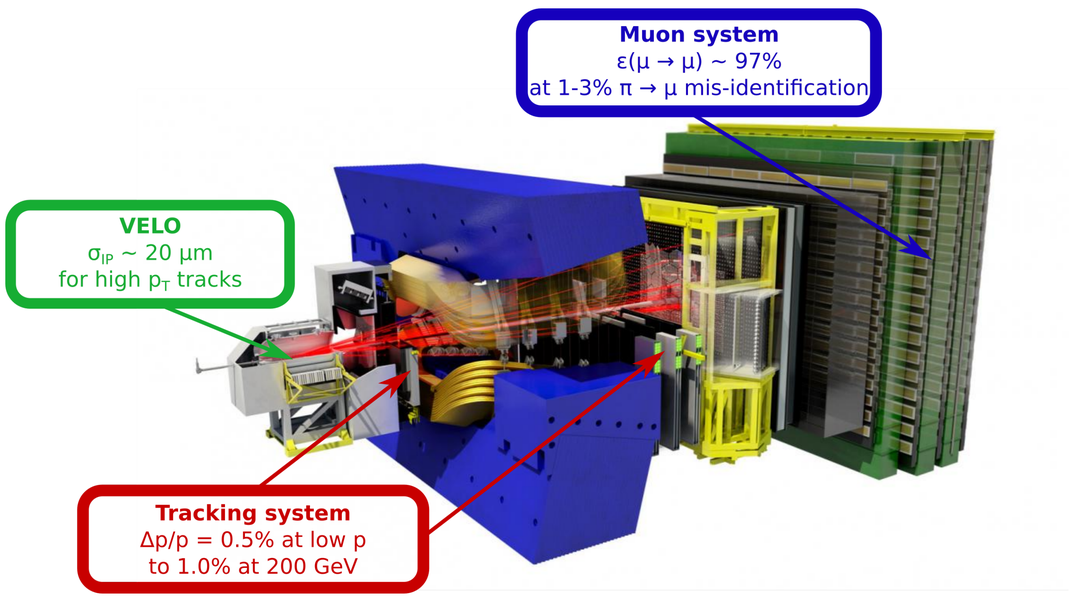
LHCB DETECTOR

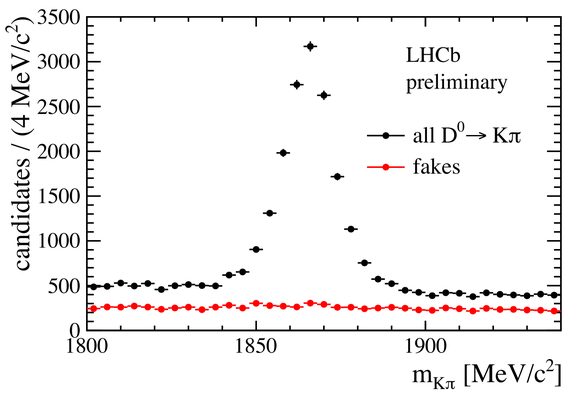
[1] [2]

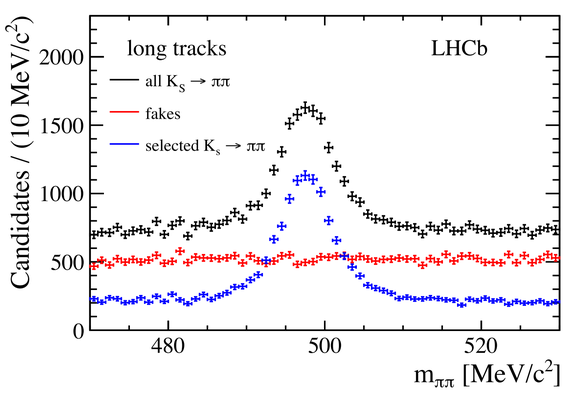


RECONSTRUCTION IMPROVEMENTS IN RUN 2

- Major improvements in the pattern recognition algorithms
- Factor of 2 speed-up, without loss in performance
- Extensive use of machine-learning techniques
- Example: Improved fake-track reduction
  - Fake tracks: not corresponding to a real particle's trajectory
  - Sped up by $\mathcal{O}(90\%)$: allow the use in the online event selection
  - Ghost rate in online event selection reduced from 22% to 14%

[4]





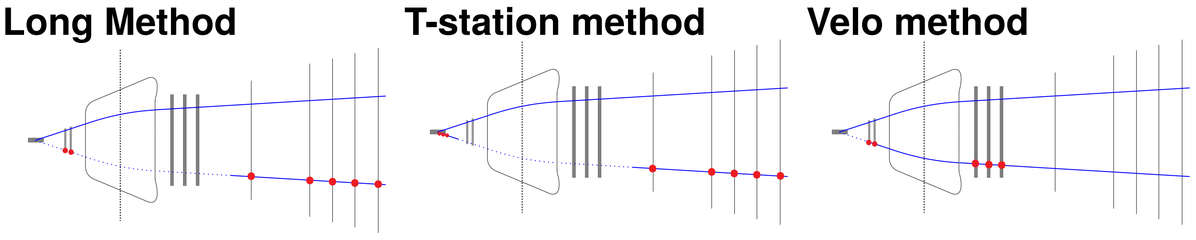
MEASUREMENT OF TRACKING EFFICIENCY

- All data selected and stored in software trigger: **"TurCal"** [5]
  - Offline-quality event reconstruction available online
  - Detector calibration ran online: offline-quality data
  - Data immediately available for analyses
- Efficiency from data using tag-and-probe method
  - Track parameter inference independent of standard track reconstruction
  - Exploit two-particle decays
  - First track from the decay is fully reconstructed (tag track)
  - Second track is reconstructed excluding the probed subdetector (probe track)
- Tracking efficiencies easily accessible using **"TrackCalib"** tool
  - Transparent and easy efficiency estimation
  - User-defined track-quality cuts, binning and variables
  - Available for all users

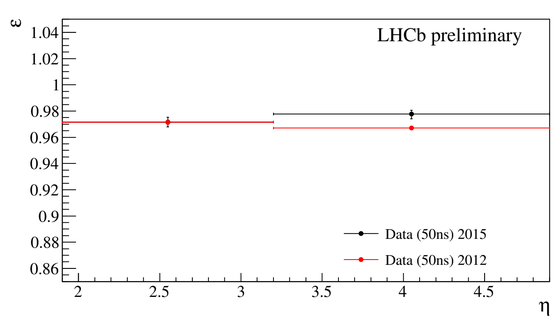
MUON TRACKING EFFICIENCY

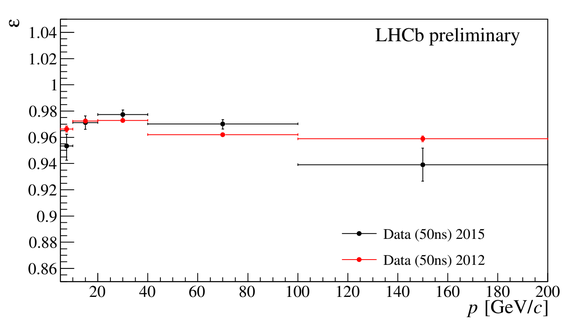
- $J/\psi \longrightarrow \mu^+\mu^-$ decay is used [3]
  - $\mu\mu$ pair ideal to probe the whole tracking system
  - J/ψ gives a clear signal in the detector
- J/ψ coming from $B^+ \longrightarrow J/\psi X$ (data) and $B^+ \longrightarrow J/\psi K$ (MC)
  - Detached J/ψ for clean signal
  - Unbiased selection by dedicated trigger

Long Method **T-station method** **Velo method**



Final method = Long method + (VELO method ⊕ T-station method)





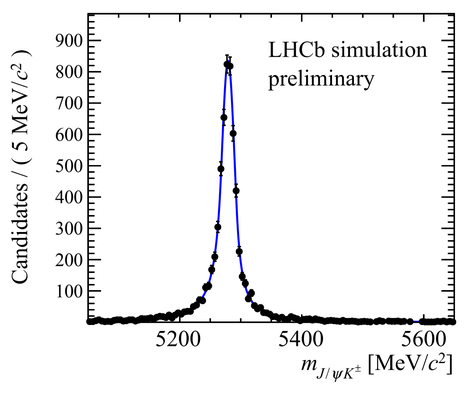
ELECTRON TRACKING EFFICIENCY

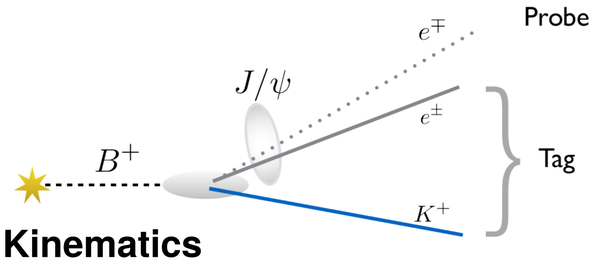
Electrons have a considerably different behaviour compared to muons

- Significant energy loss (**bremsstrahlung**) along trajectory
- Decreases reconstruction efficiency downstream of VELO

New method for measuring reconstruction efficiencies for electrons:
Kinematically constrained VELO tracks originating from
$B^+ \longrightarrow J/\psi(\longrightarrow e^+e^-)K^+$

- Efficient VELO reconstruction (≈98%)
- Applicable also to muons & hadrons





Kinematics

- Direction inferred from VELO segment
- Probe momentum inferred from J/ψ mass constraint
- Use B^+ mass with J/ψ mass constraint to distinguish between signal and background

REFERENCES

[1] A. A. Alves Jr. *et al.* [LHCb collaboration], JINST 3 (2008) S08005
[2] R. Aaij *et al.* [LHCb collaboration], Int. J. Mod. Phys. A30 (2015) 1530022
[3] R. Aaij *et al.* [LHCb Collaboration], JINST **10**, no. 02, P02007 (2015)
[4] M. De Cian *et al.*, LHCb-PUB-2017-011 (2017)
[5] S. Benson *et al.*, J. Phys.: Conf. Ser. 664 (2015) 082004