Enabling Real-Time Analysis at LHCb

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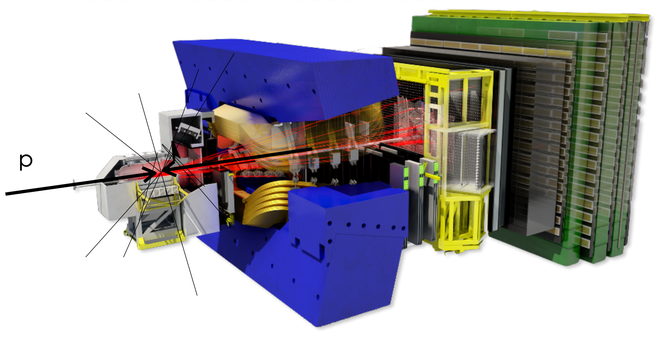
on behalf of the LHCb collaboration

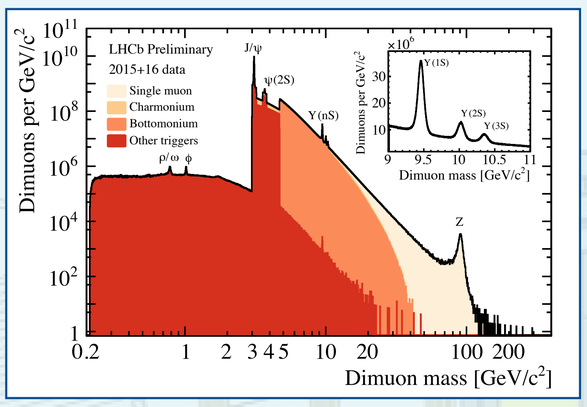
Data flow in Run 1 vs Run 2



LHCb detector overview

A single arm forward spectrometer designed for the study of heavy flavour physics

~45 kHz bb pairs
~1 MHz cc pairs
at $\sqrt{s}$ =13 TeV and
$\mathscr{L}$ = 4×10^{32} cm^{-2}s^{-1}

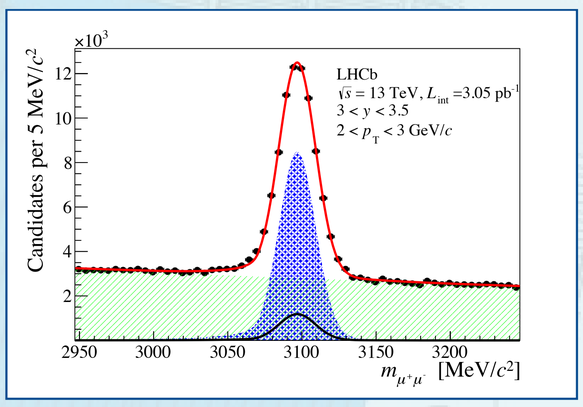


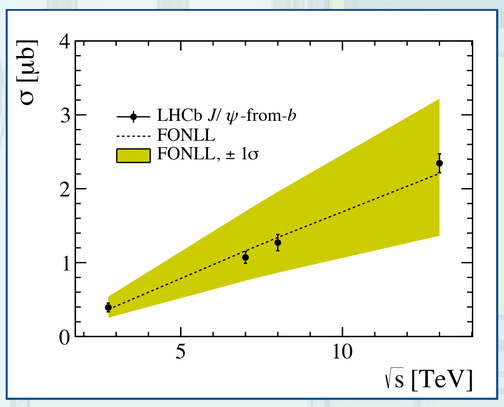
Need to isolate decays with 0.0000001% probabilities!
~10^{10} Dimuons/year and ~10 $B_s \to \mu^+\mu^-$ decays/year

Physics performance of Turbo

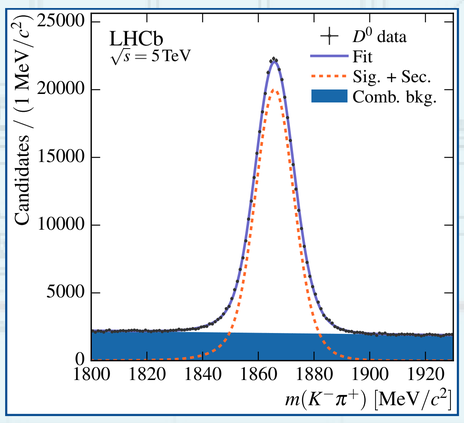
Measurement of J/ψ production cross-section at 13 TeV [1]

- Analysis finds ~ 10^6 candidates directly from the trigger
- Mass resolution 12 MeV/c^2 consistent with best previously achieved resolution
- Presented at EPS conference 18 days after data were taken



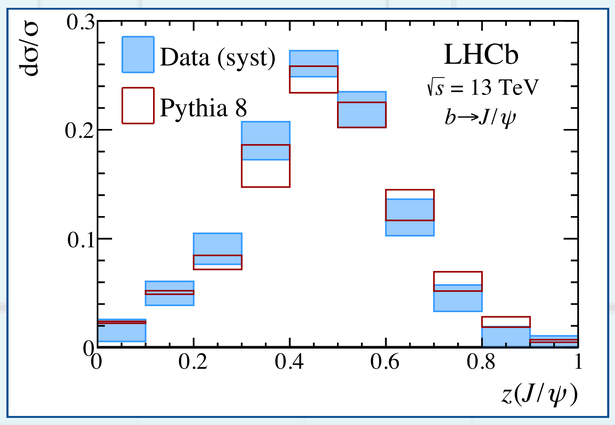


Measurement of prompt charm production at 5 TeV [2]



Study of J/ψ production in jets [3]

Performed with Turbo++



[1] LHCb collaboration, Measurements of forward J/ψ production cross-sections in pp collisions at √s = 13 TeV, JHEP 10 (2015) 172.

[2] LHCb collaboration, Measurements of prompt charm production cross-sections in pp collisions at √s = 5 TeV, arXiv:1610.02230

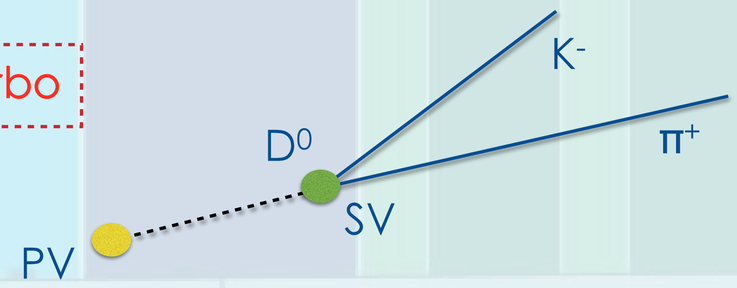
[3] LHCb collaboration, Study of J/ψ production in jets, arXiv:1701.05116

[4] R. Aaij et al., Tesla : an application for real-time data analysis in High Energy Physics, Comput.Phys.Commun. 208 (2016)

Turbo evolution

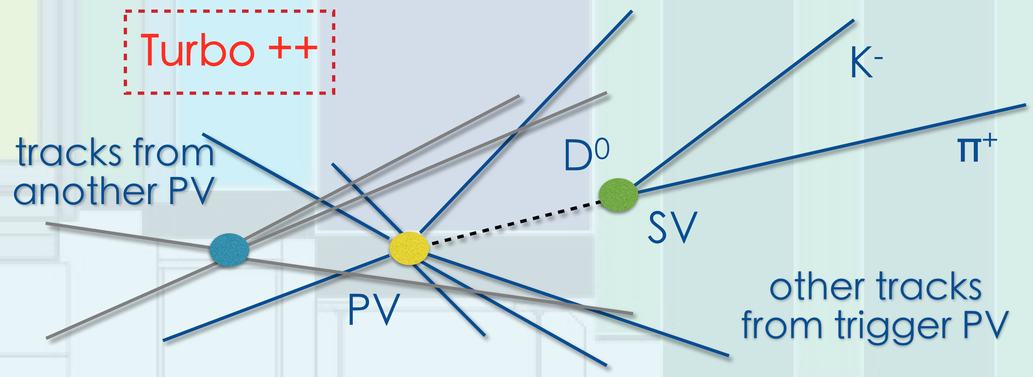
Turbo stream [4]

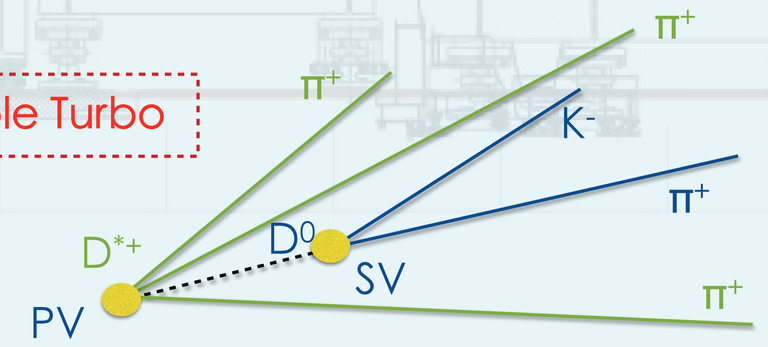
- Store HLT candidate information. No further reconstruction! All necessary information is persisted from the trigger
- Remove most of detector raw data
- Space required is reduced by >90%



Turbo++

- New in 2016
- Allow to persist HLT candidate + all reconstructed objects
- Enables analyses which need the full or partial event information, like the flavour tagging, on the trigger output
- But requires a lot of storage space



Flexible Turbo

- Coming in 2017
- Middle-ground between Turbo and Turbo++
- Allows for selective persistence of raw and reconstructed data