Production of heavy quarks in proton-proton and heavy-ion collisions with CMS

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Why heavy-flavour measurements?

- in pp collisions, they provide an important test for perturbative QCD calculations at LHC energy regimes
- in nucleus-nucleus collisions, they are effective probes to study the effects of in-medium parton energy loss
- proton-nucleus studies provide baseline for PbPb analyses and allow one to study cold nuclear matter effects (e.g. shadowing)

A focus on heavy-ion collisions:

- heavy quarks experience the full evolution of the medium
- once produced, they strongly interact with the deconfined medium via radiative and collisional processes

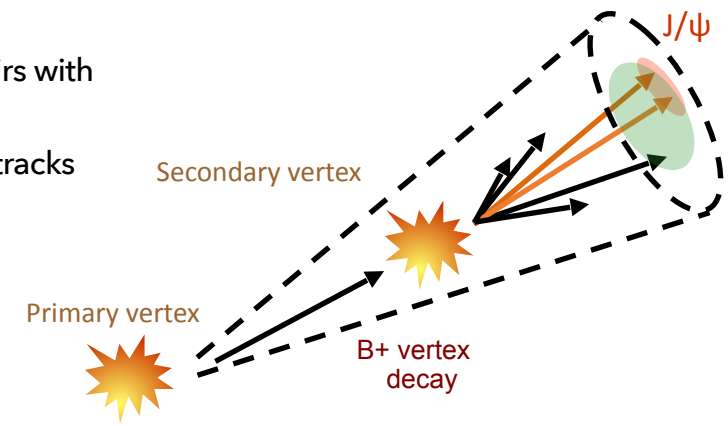
→ **Flavour-dependence of radiative energy loss:**

- larger for gluons than for quarks
- dead-cone effect: gluon radiation suppressed at small angles for massive quarks

→ $\Delta E_g > \Delta E_{u,d,s} > \Delta E_c > \Delta E_b$

B-meson reconstruction in CMS

- J/ψ reconstruction by vertexing muon pairs with opposite charges using kinematic fits
- B-meson candidates built by associating tracks to reconstructed J/ψ mesons
- Candidate selection based on multi-variate cut optimisation procedure



b-jet reconstruction in CMS

- jet reconstruction using anti-k_T algorithm with $\Delta R=0.3$
- b-jet tagging algorithm based on kinematic variables related to the long lifetime and large mass of b hadrons:

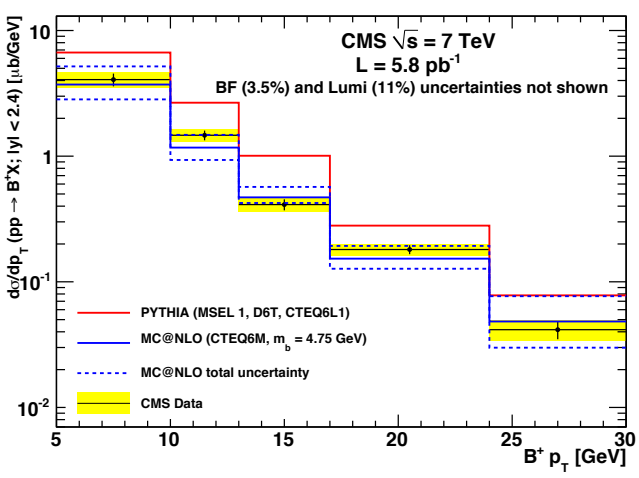
→ selection on the significance of the 3D flight distance

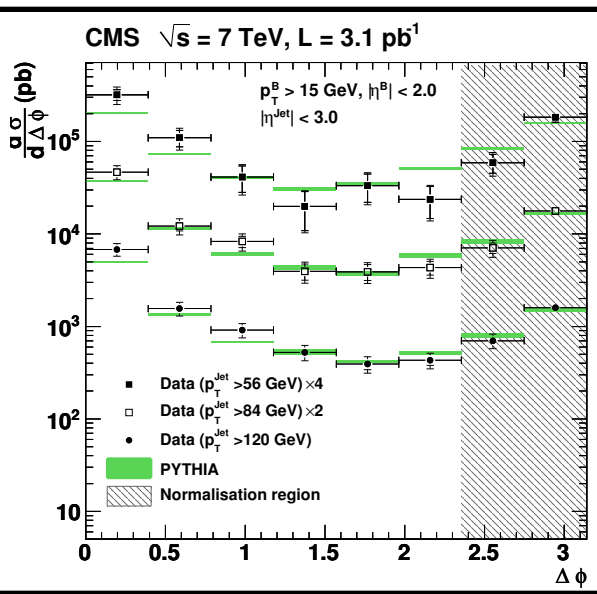
B-meson production cross sections in pp collisions:

- B^+, B^0, B_s p_T and y-differential cross sections measured in pp collisions at 7 TeV with integrated luminosity L=5.8 pb^{-1}
- CMS results well described by MC@NLO calculations and by PYTHIA

$B\bar{B}$ angular correlation in pp collisions at 7 TeV:

- in the collinear region (small $\Delta\phi$), where gluon splitting processes expected to be large, theoretical calculations do not describe CMS measurement.



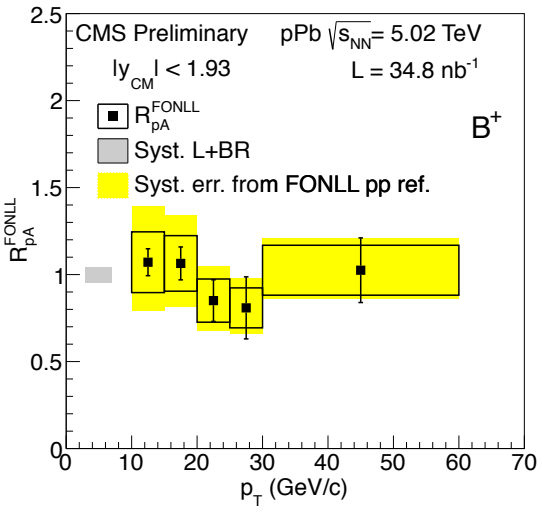


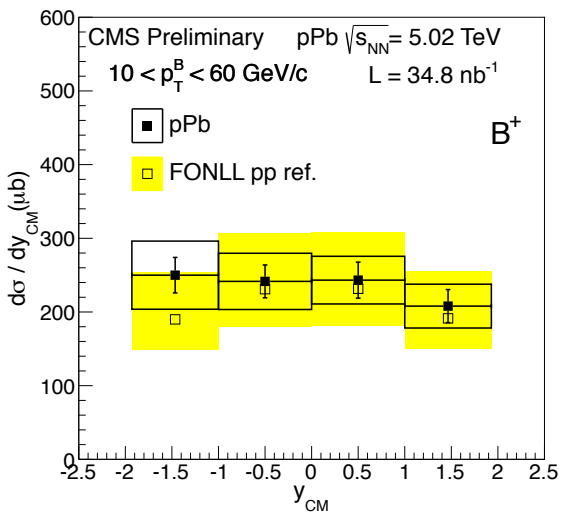
B-meson production cross section in pPb collisions:

- **First measurement of exclusive B-meson production at the LHC in heavy-ion collisions**
- p_T-differential cross section measurement of B^+, B^0, B_s and y-differential cross section of B^+ in pPb collisions at 5.02 TeV.
- Nuclear modification factors obtained using FONLL predictions to build the proton-proton reference at 5.02 TeV

→ R_{pA}^{FONLL} consistent with unity within uncertainties

→ Results compatible with binary scaling hypothesis





b-jet measurement in PbPb collisions at 2.76 TeV:

- Evidence of b-jet suppression in central PbPb events
- b-jet R_{AA} favours pQCD models that include strong jet-medium coupling
- R_{AA} of b-jets and inclusive jets compatible within the current uncertainties