

Heavy flavour meson production in pp, pPb and PbPb collisions with the CMS detector

G.M. Innocenti, Y.-J. Lee, J. Wang, T. Wang on behalf of the CMS collaboration

Students' Poster Session, LHCC meeting, 2 Mar 2016, CERN



Why heavy-flavour measurements?

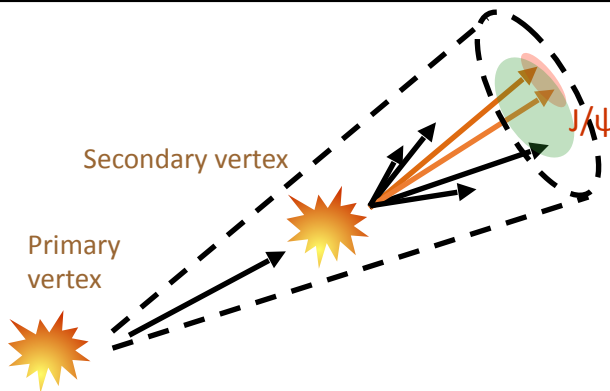
- in pp collisions, they provide an important test for perturbative QCD calculations at LHC energy regimes
- in nucleus-nucleus collisions, they are effective probes to study the effects of in-medium parton energy loss
- proton-nucleus studies provide baseline for PbPb analyses and allow one to study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

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



D-meson reconstruction

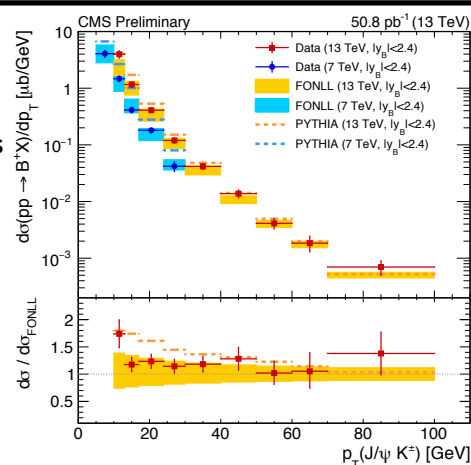
- D-meson reconstruction by vertexing displaced track pairs/triplets with proper charge combination
- Candidate selection based on multi-variate cut optimisation procedure

c/b-jet reconstruction in CMS

- jet reconstruction using anti- k_T algorithm with $\Delta R=0.3/0.4$
- c/b-jet tagging algorithm based on kinematic variables related to the long lifetime and large mass of heavy flavour hadrons
 - e.g. selection on the significance of the 3D flight distance

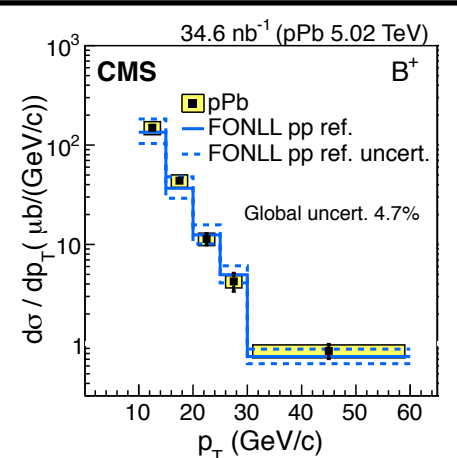
B-meson production cross sections in pp collisions at 7 and 13 TeV:

- B^+ , B^0 , B_s p_T and y -differential cross sections measured in pp collisions at 7 and 13 TeV
- Very important reference for pQCD calculations
 - well described within uncertainties by FONLL predictions at the two energies



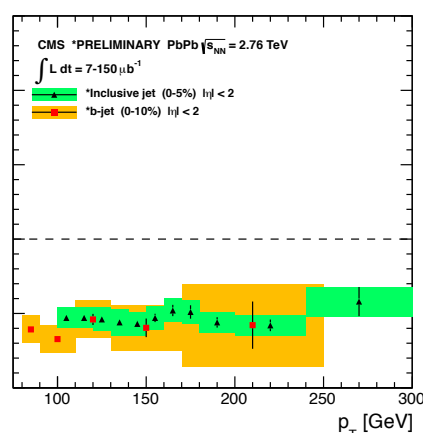
B-meson production cross section in pPb collisions at 5.02 TeV:

- measurement of B^+ , B^0 , B_s in pPb collisions at 5.02 TeV vs p_T and rapidity
- Nuclear modification factors obtained using FONLL to build the proton-proton reference
 - R_{pA}^{FONLL} consistent with unity
 - compatible with binary scaling



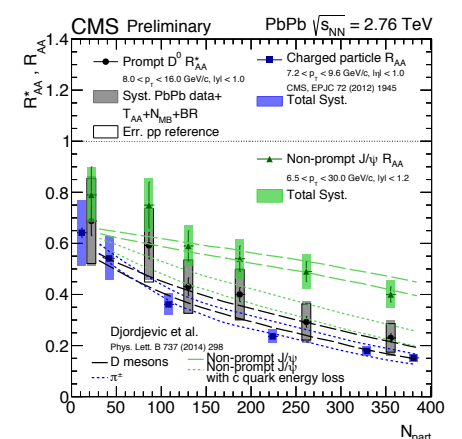
b-jet measurement in PbPb collisions at 2.76 TeV:

- Evidence of b-jet suppression in central PbPb events
- b-jet R_{AA} favours pQCD models that include strong jet-medium coupling
- no evidence of strong flavour dependence of in-medium energy loss when compared to inclusive jet R_{AA}



D^0 meson production in PbPb collisions at 2.76 TeV

- measurement of D^0 production in PbPb collisions in the central rapidity region $|y| < 1$ from 2.5 to 40 GeV/c
- Nuclear modification factor obtained using a pp reference extrapolated from ALICE measurement at 2.76 TeV
 - Comparison between D^0 and non-prompt J/ψ R_{AA} seems to indicate a possible hint of flavour dependence

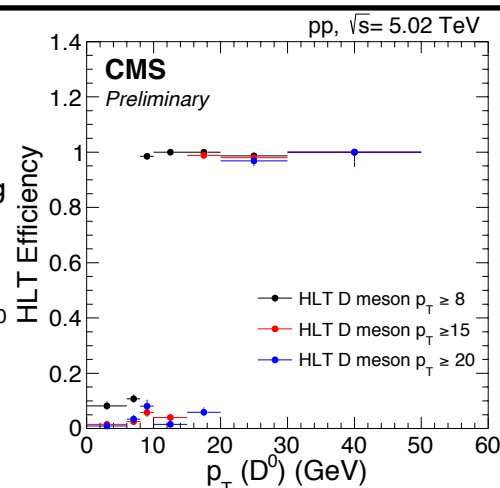


New results with the 2015 HI run:

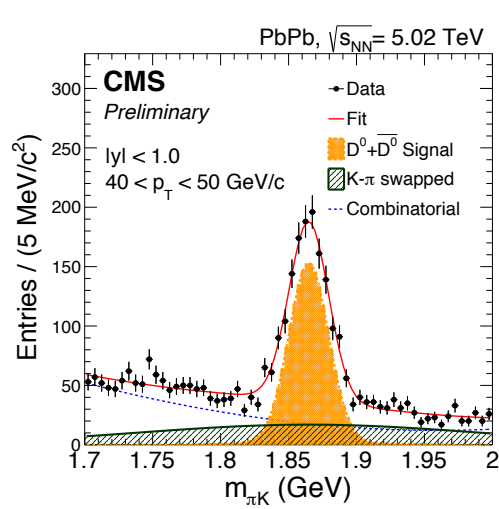
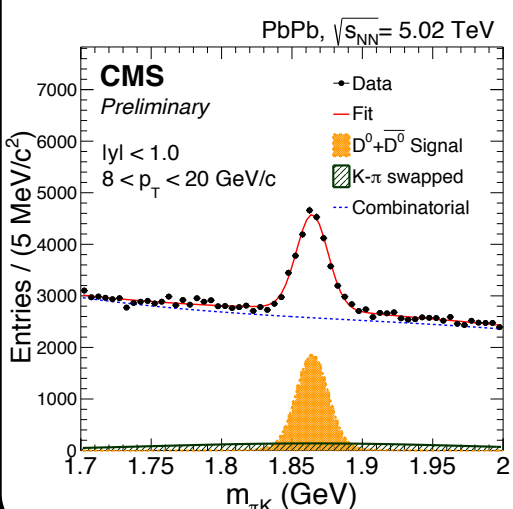
- 2015 HI runs was a big success for CMS!
- $L_{int} \sim 28/\text{pb}$ in pp collisions at 5.02 TeV
- $L_{int} \sim 0.6/\text{nb}$ in PbPb collisions at 5.02 TeV
- ~ 2.5 billions MB events collected in pp and ~ 200 millions MB events in PbPb
- **Dedicated heavy flavour HLT algorithms to trigger on D mesons and HF-jets!**

D-meson HLT algorithms in pp and PbPb

- D^0 algorithms implemented in the HLT to tag events with high p_T D^0 candidates:
 - Events selected at L1-trigger level using calorimeter-based jet seeds
 - Global tracking performed at HLT
 - Secondary vertex reconstruction and D^0 meson reconstruction and selection



- Efficiency of HLT D^0 tagging evaluated in pp collisions at 5.02 TeV using MB events
- Very sharp turn on curve vs D^0 p_T
- Efficiency in the plateau $\sim 100\%$
- **Possibility to measure D^0 meson production in pp and PbPb up to ~ 100 GeV/c**



Invariant mass plots of D and B mesons at 5.02 TeV in pp and PbPb

- (Left) Invariant mass spectra of D^0 mesons extracted in PbPb collisions using MB events in the range $8 < p_T < 20$ GeV/c and using D-triggered events in $40 < p_T < 50$ GeV/c
- (Right) Invariant mass spectrum of B^+ mesons in pp collisions at 5.02 TeV using di-muon triggered sample

