# Studio della produzione di charm in collisioni pp e Pb-Pb con ALICE a LHC

Chiara Bianchin
per la Collaborazione ALICE

INFN e Università - Padova

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# Outline


1. Motivation
2. Detector and strategy
3. Expected results
4. Data from LHC
5. Conclusions

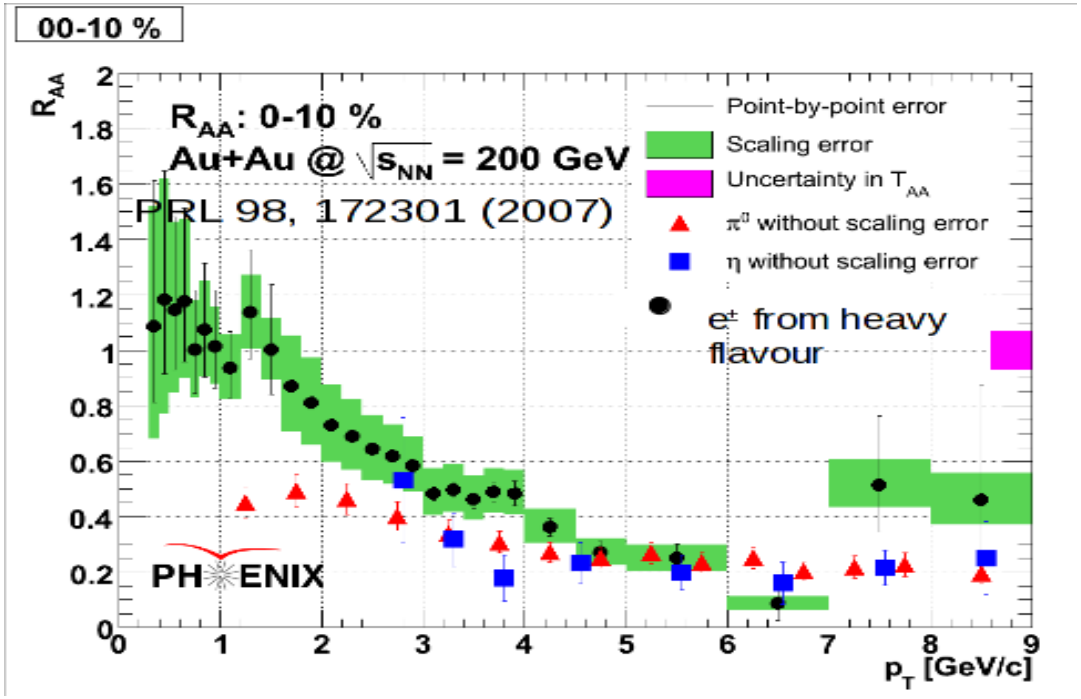
# Motivation for Heavy Flavour studies in ALICE

- The aim of the ALICE experiment is to study the properties of the deconfined medium formed in high energy heavy ion collisions, the Quark Gluon Plasma
- Hard probes such as heavy quarks are a good tool to investigate the properties of the QGP
  - At LHC energies early production of heavy quarks ($gg \rightarrow Q\bar{Q}$) (0.08 fm/c for charm) before QGP formation ($\sim$ 1 fm/c)
  - Open charmed mesons: good probes for nuclear effect on charm production, propagation and hadronization in the "hot" medium
- p-p and p-A collisions: important role in ALICE physic program to give a benchmark for Pb-Pb result and test the pQCD predictions in an unexplored energy domain

see also: Rassegna di Fisica degli ioni pesanti, Andrea DAINESE

# Results from RHIC and perspectives at LHC

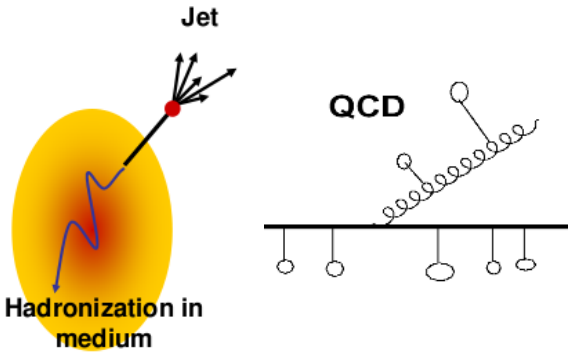
- RHIC experiments observe hadrons suppression in central collisions interpreted as energy loss
- Indirect look to open c/b performed $D/B \rightarrow e^{\pm} + X$




$$R_{AA}(p_T) = \frac{d^2N_{AA}/dp_T dy}{N_{coll} \times d^2N_{pp}/dp_T dy}$$

- At LHC, ALICE will measure charm directly thanks to the exclusive reconstruction of the hadronic decays

# In medium energy loss




- Quarks experience energy loss in the medium for instance by gluon radiation ("gluonsstrahlung")

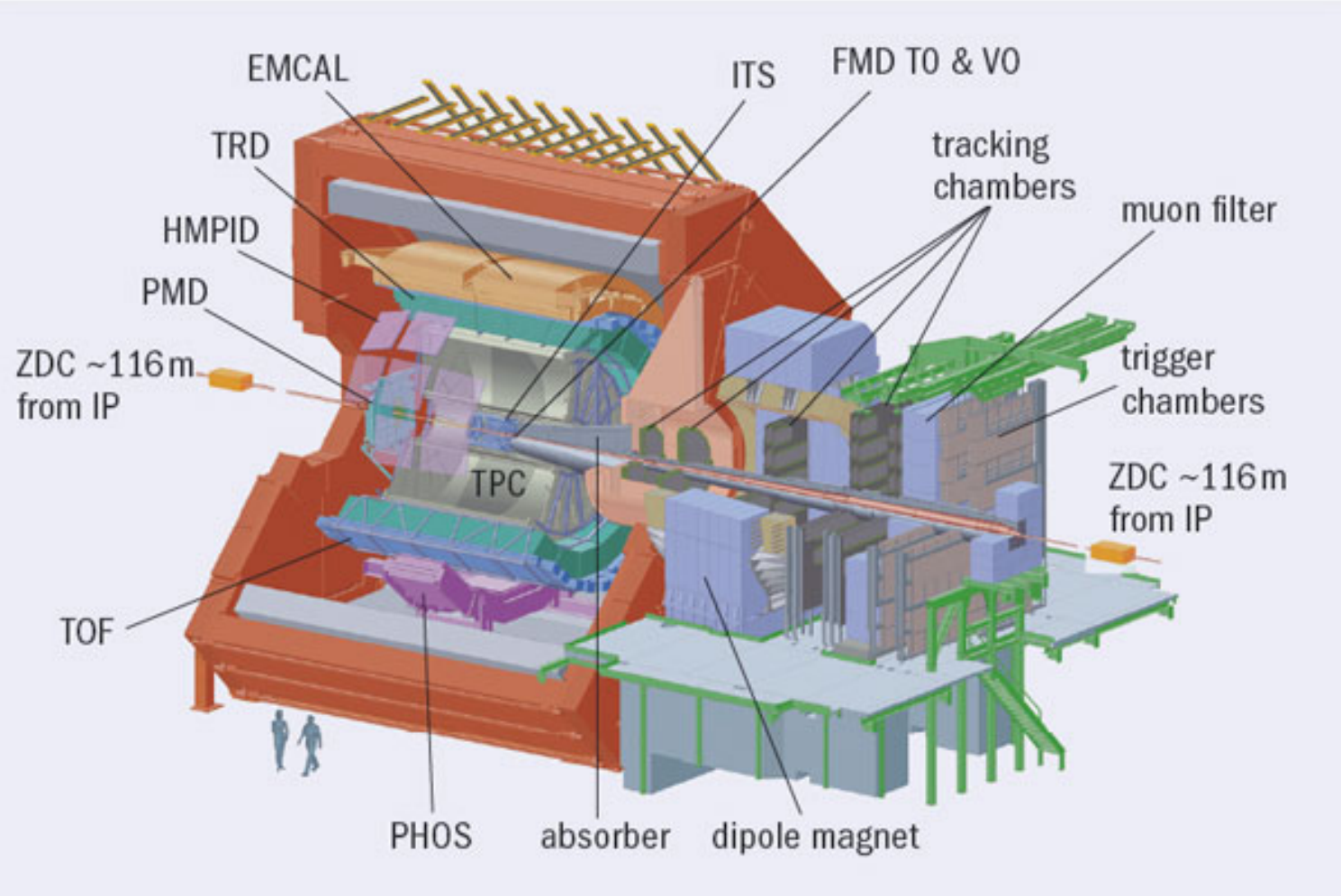
- radiative energy loss ($\langle \Delta E \rangle \propto \alpha_s C_R \hat{q} L^2$), correlated to the medium density through $\hat{q}$, depends on mass and colour charge
  - ☆ Radiation suppressed at small angles for massive partons (Dead-cone effect)

Yu.L. Dokshitzer and D.E. Kharzeev, Phys. Lett. B519 (2001) 199, arXiv:hep-ph/0106202

  - ☆ Casimir Factor ($C_R$) 4/3 for quarks, 3 for gluons

- Therefore it is particularly important to measure heavy quark energy loss

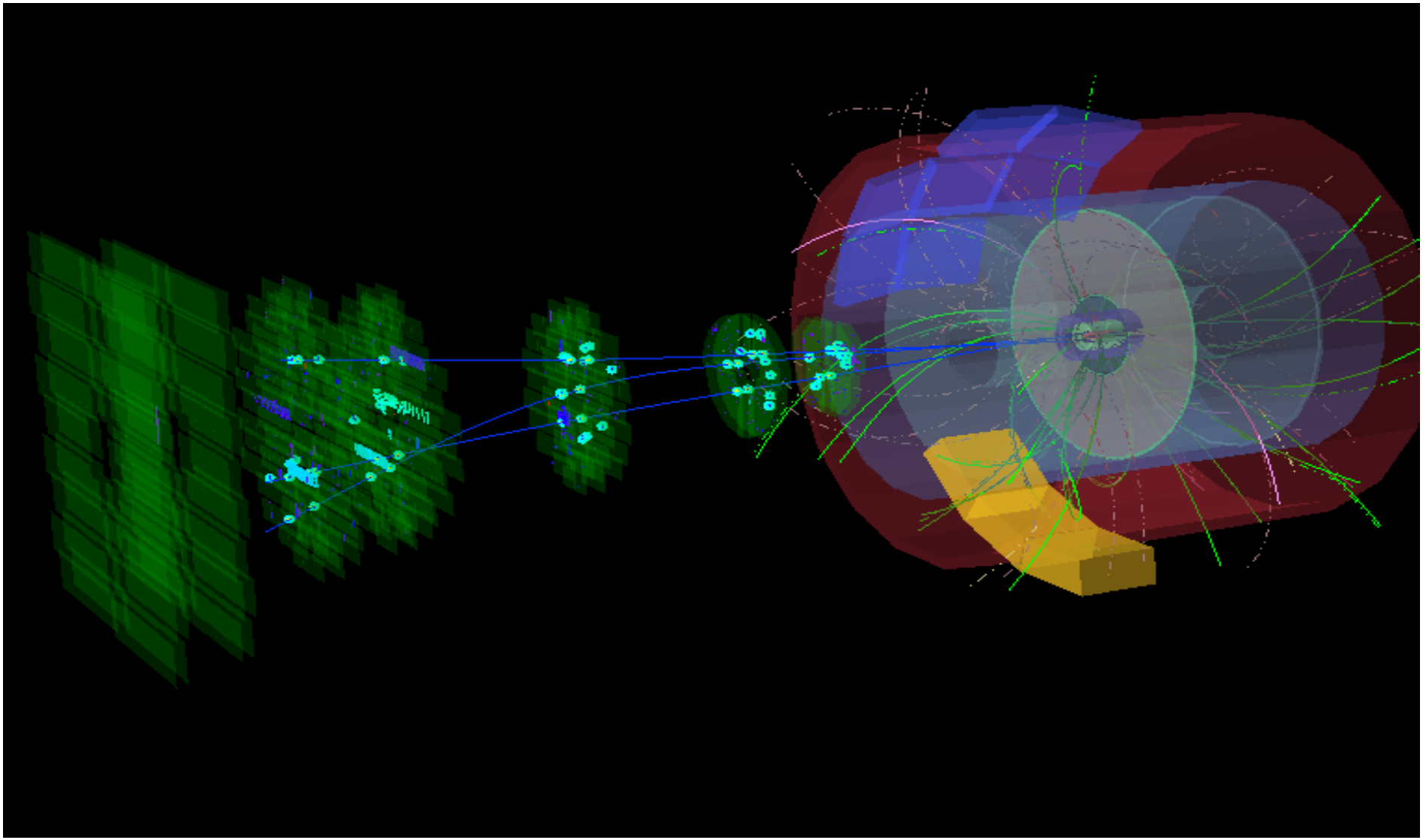
# ALICE detector and Heavy Flavours at mid-rapidity




see also: Stato di ALICE, Rosario NANIA

and: Commissioning ALICE, Stefania BEOLÈ

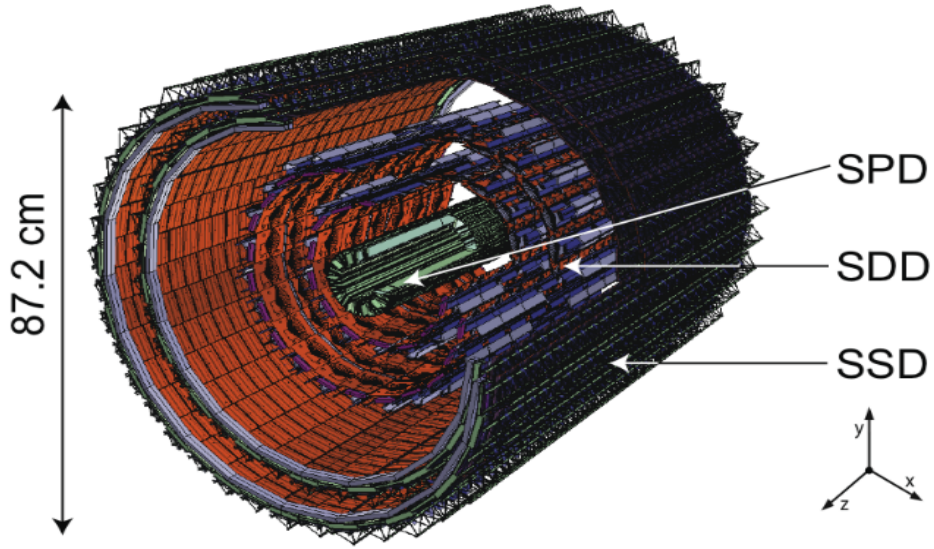
# ALICE - LHC pp@7TeV



- First collisions @7TeV 30th March 2010

# ALICE detector and Heavy Flavours at mid-rapidity

- Charm cross section and energy loss will be studied in particular with $D^0 \to K^-\pi^+$, $D^+ \to K^-\pi^+\pi^+$, $D^{*+} \to D^0\pi^+$, $D_s^+ \to K^+K^-\pi^+$, $D^0 \to 4\pi$ and – under study – $\Lambda_c \to K^-\pi^+\mathrm{p}$ ($c\tau \sim 50 \div 350\mu\mathrm{m}$)




- The vertex resolution is provided by the ITS detector (SPD+SDD+SSD) and in particular by the inner layers of pixels (SPD)

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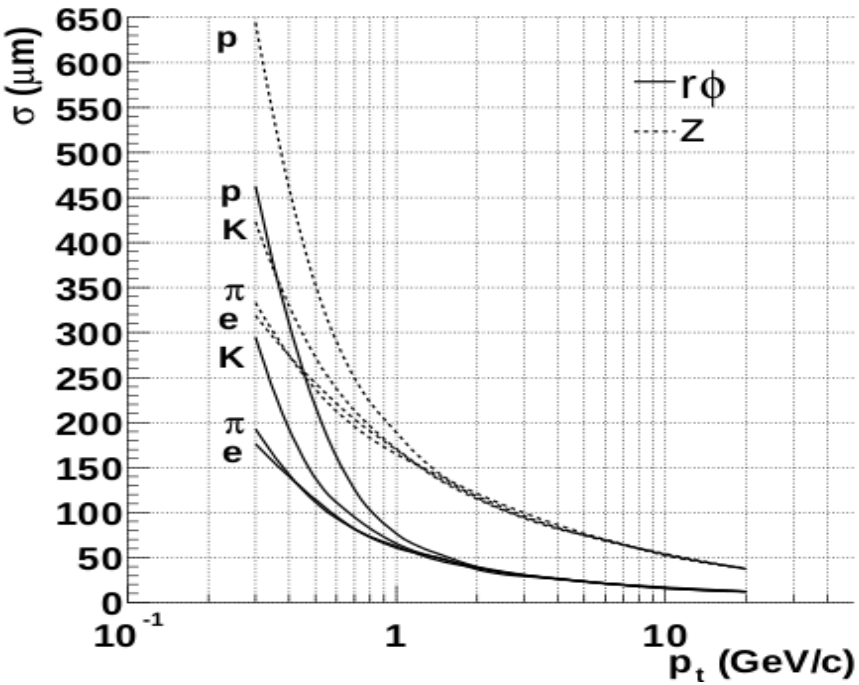
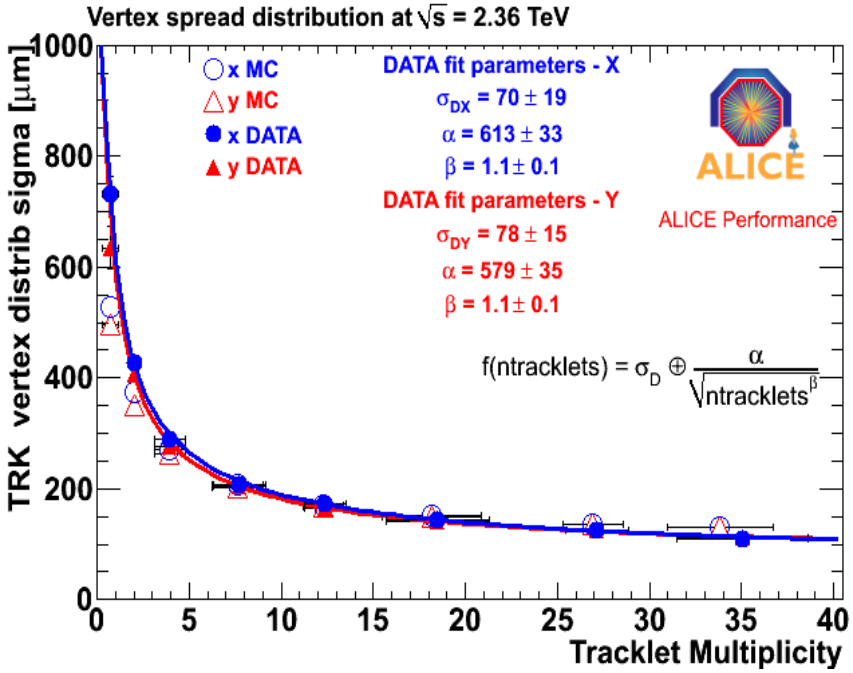
Simulated Impact parameter resolution Pb-Pb central



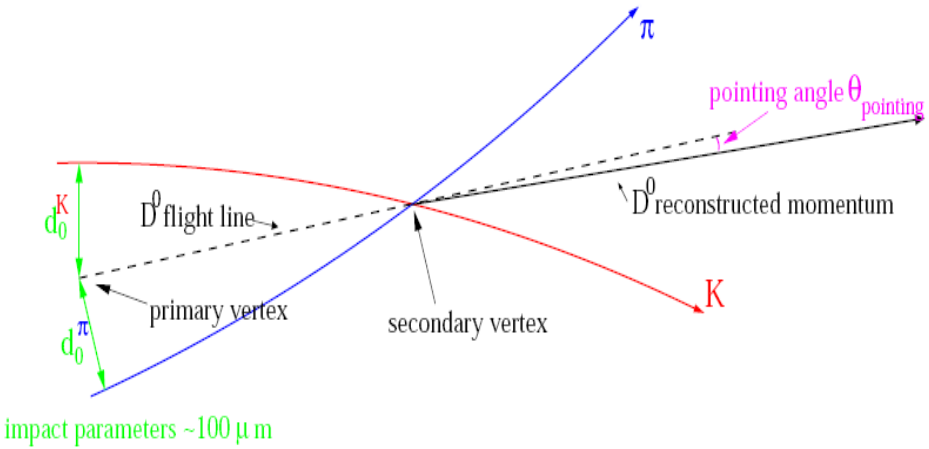

Data Vertex resolution $\sqrt{s} = 2.36$ TeV with B = 0.5 T

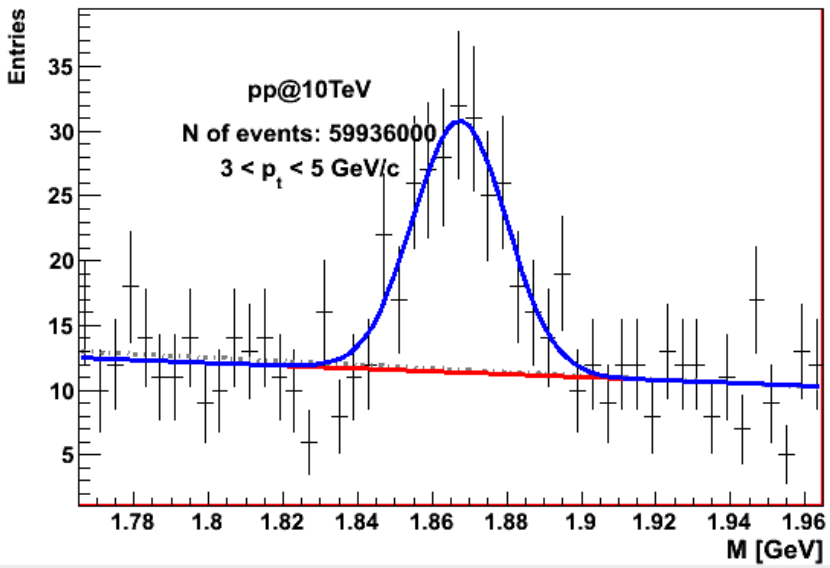


# Invariant mass analysis - MC pp@10TeV

- Invariant mass analysis:
  - Topological cuts to select displaced secondary vertices (significance maximization)
  - Subtraction of remaining background (fit, like-sign, rotation and mixing technique)
  - Feed-down from B
  - Yield correction with efficiencies
  - Calculation of exclusive charm cross section

Example from MC



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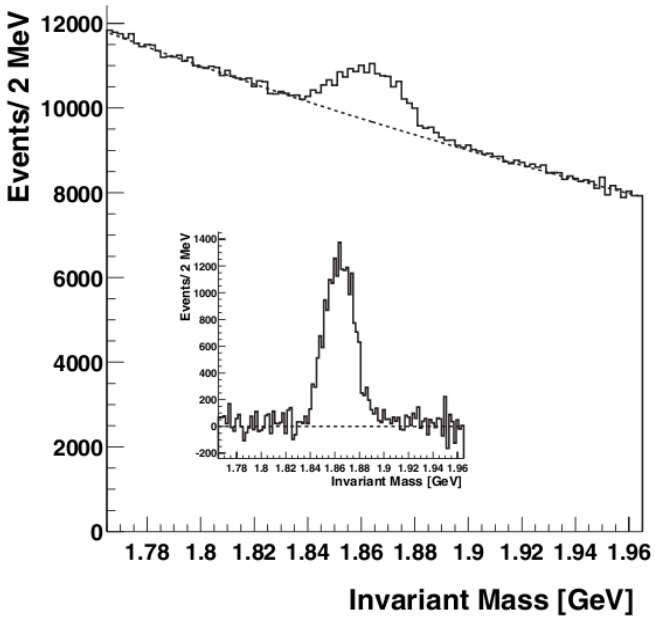
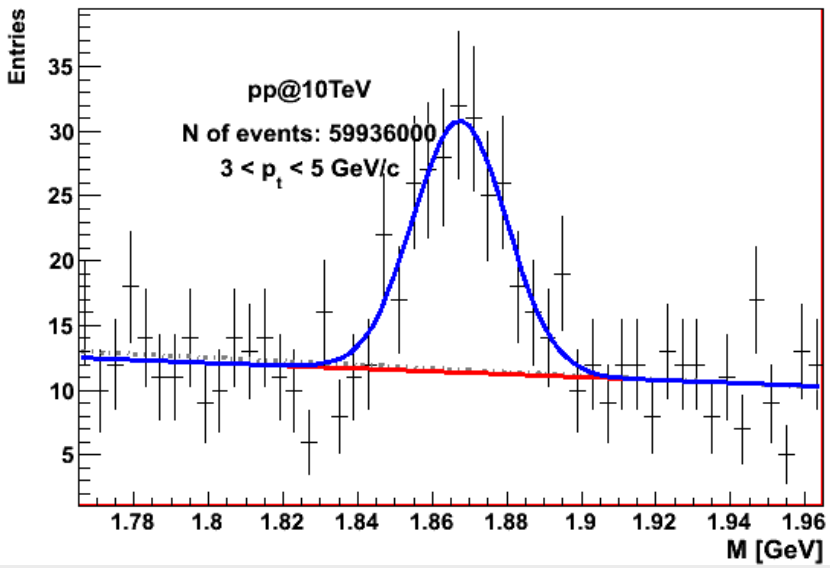
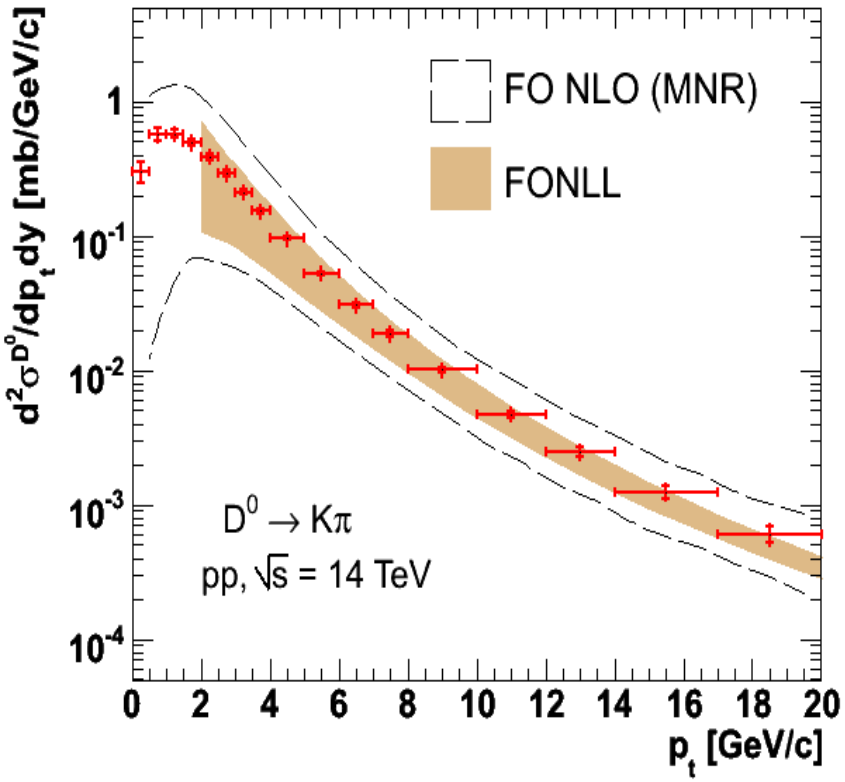
$10^7$ Pb-Pb central events @5.5TeV

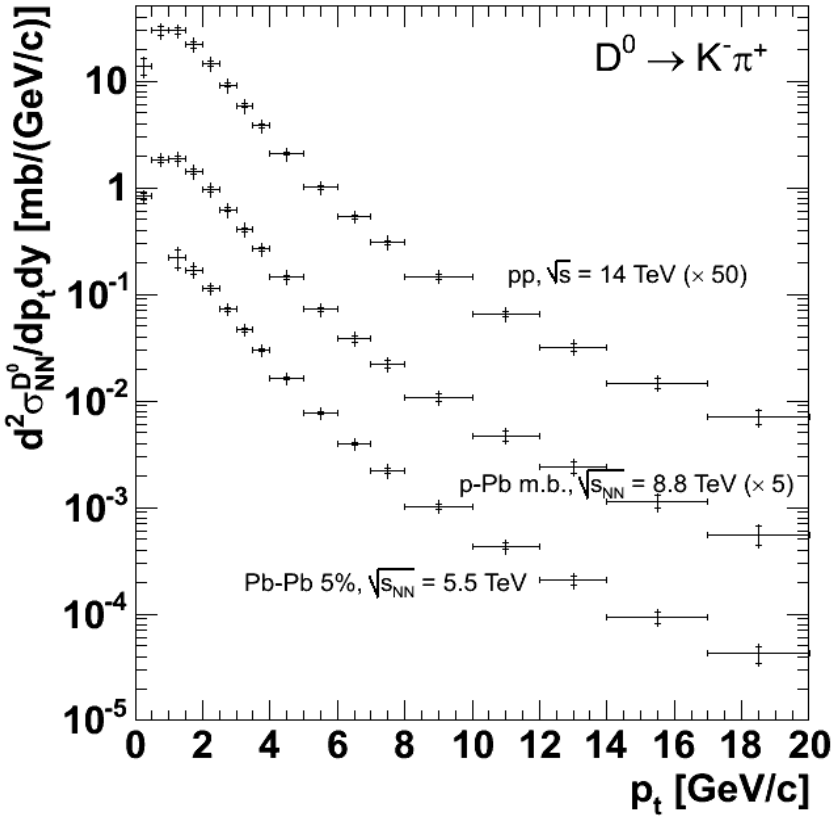



Example from MC



# Expected performance for $D^0$ $d\sigma/dp_t$ from MC

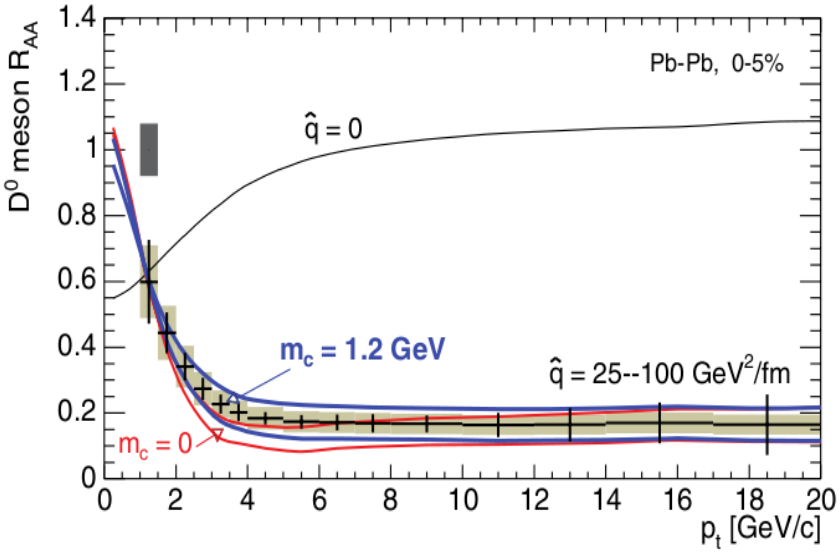


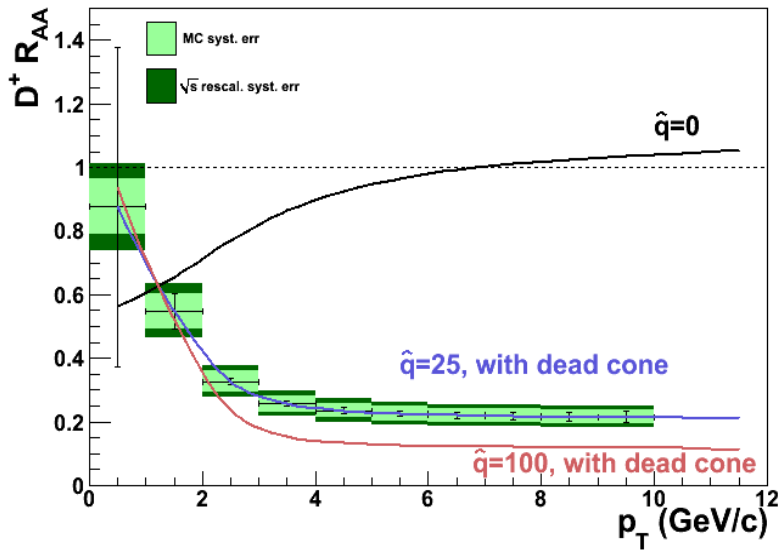

- Expected $D^0$ production for different systems and compared to theory for pp

# Expected distributions from MC

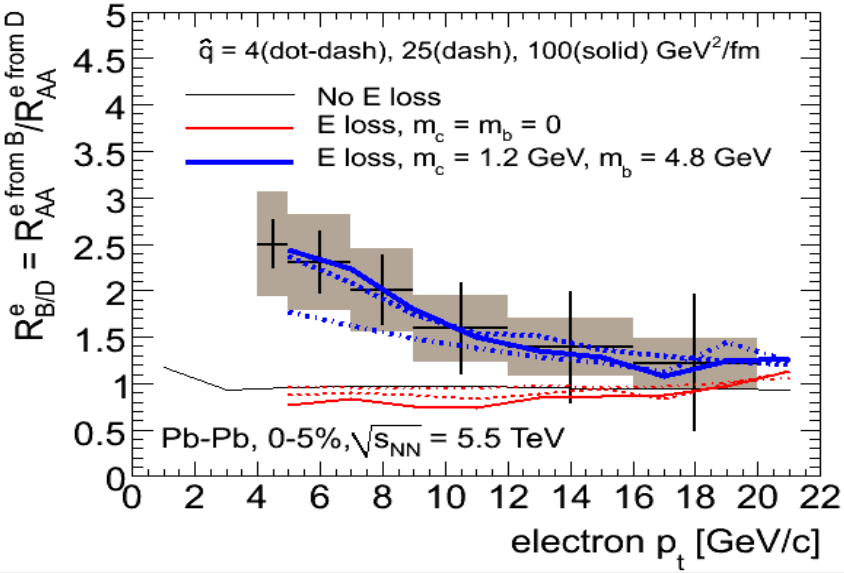
$D^0$



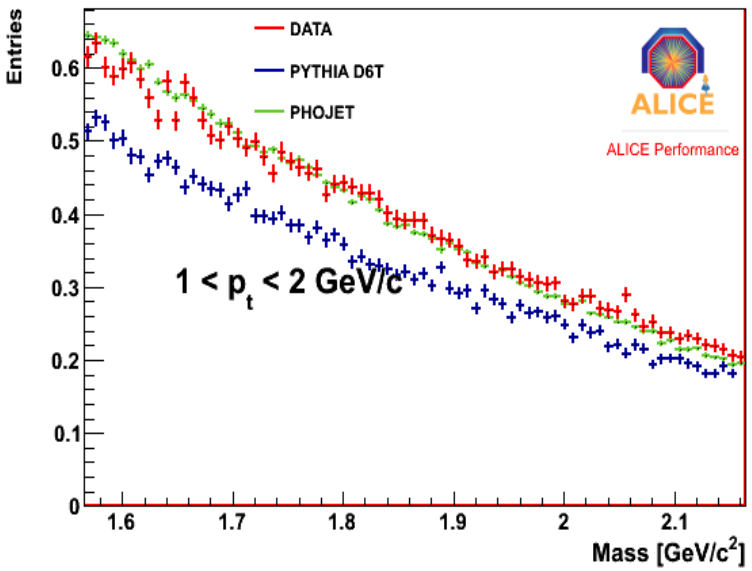

$D^+$

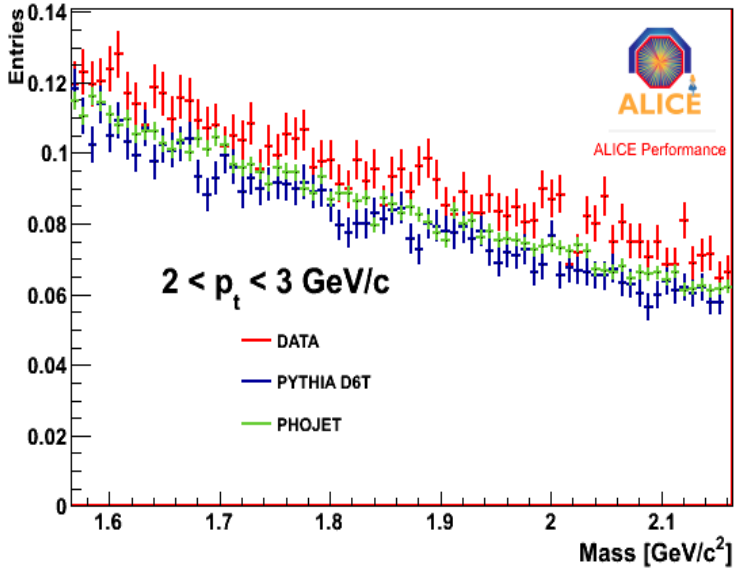



- The $R^e_{B/D}$ is the ratio between the $R_{AA}$ of B and D mesons dacaying in $e^- + X$



# pp@900 GeV Data of December 2009 vs MC



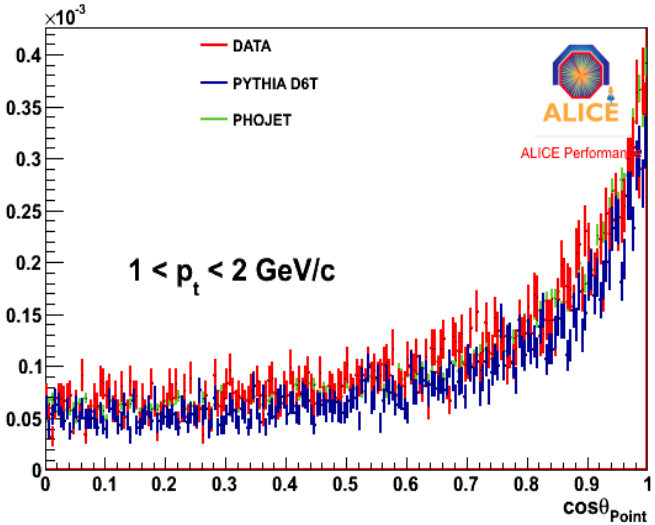



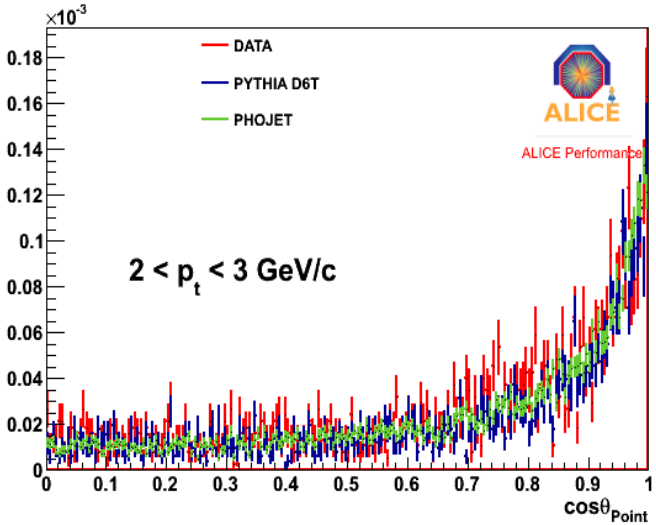

Mass:
low reco
& sel
cuts
cosmic
align

exp

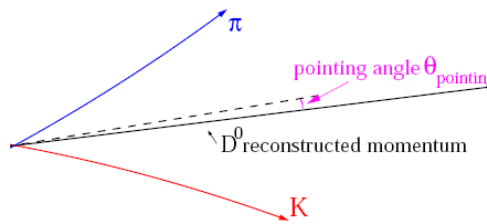
$D^0 < 1$

$\cos\theta_{Point}$




⇨ Data: 367936 events



# Conclusions

- The aim of the ALICE experiment is to study the properties of the deconfined medium formed in high energy heavy ion collisions
- Heavy flavoured mesons are good probes as they experience the whole deconfined phase
- Necessary tools to detect D(B)-mesons are good vertexer and tracker
- Heavy flavour measurements in pp are integral part of ALICE program
- Detector and analysis chain are ready: first look at background in LHC data shows agreement with MC
- Already 7M of pp events @7TeV collected from March the 30th and expected Pb-Pb in autumn