UNIVERSITÉ DE NANTES

Subatech

D-meson observables in PbPb and pPb collisions in LHC with EPOSHQ model

Vitalii Ozvenchuk,

in collaboration with

J.Aichelin, P.B.Gossiaux, B.Guiot, Iu.Karpenko, M.Nahrgang, J.Steinheimer, K.Werner

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cnrs dépasser les frontières

TOGETHER Project (Region Pays de la Loire)

Outline

- MC@sHQ+EPOS2 results
- MC@sHQ+EPOS3 results
- MC@sHQ+EPOS3 results (with HQ from EPOS3 initial conditions) = EPOSHQ results
- Summary & Outlook

MC@sHQ+EPOS2 results

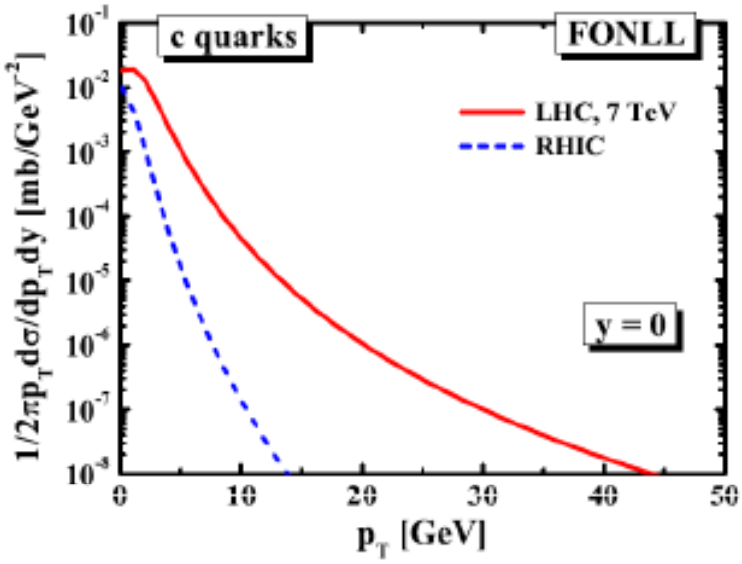
MC@sHQ+EPOS2 model

- **production** of heavy quarks at the original NN scattering points according to the **FONLL spectra**

  M.Cacciari et al., Phys. Rev. Lett. **95** (2005), JHEP **1210** (2012)

- **bulk evolution:** 3+1d ideal hydro stemming from **EPOS2** initial conditions; provides **temperature** and **velocity** fields

  K.Werner et al., Phys. Rev. C **82**, 044904 (2010)



- **evolution of HQ** in the bulk: the **Boltzmann equation**

- **interaction of HQ** in the bulk: by either **elastic** or **radiative** collisions

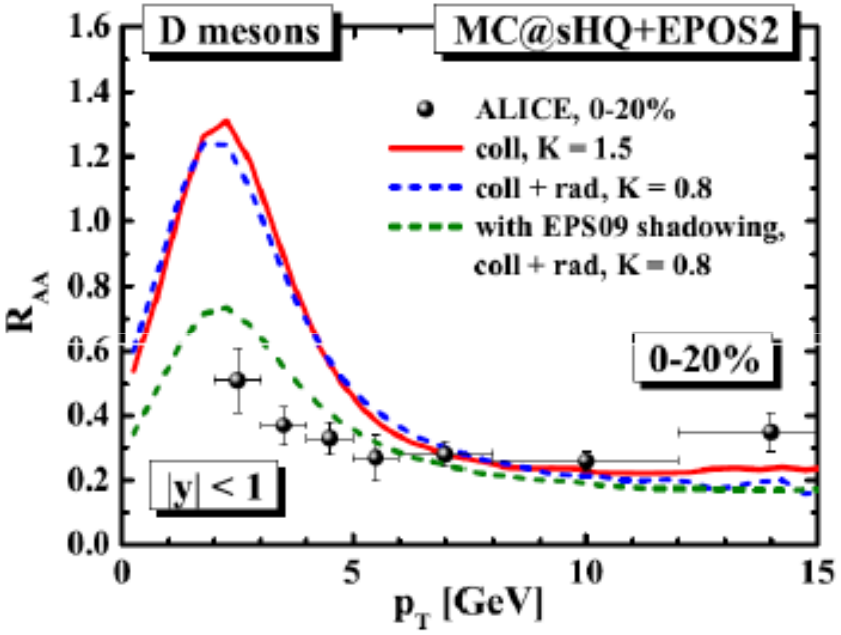
- **hadronization of HQ: coalescence** (low p_T) and **fragmentation** (high p_T)

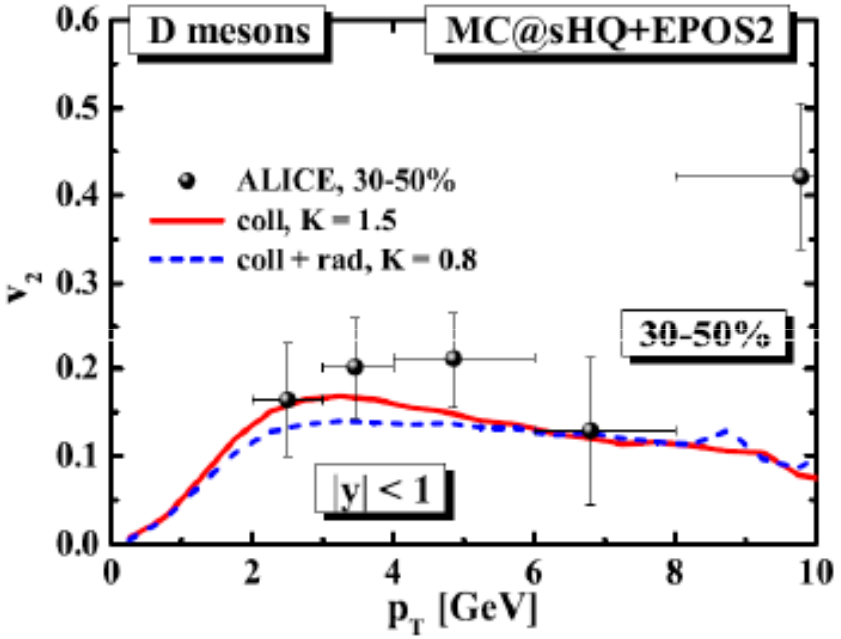
$$T_c = 155 \text{ MeV}$$

MC@sHQ+EPOS2 results (R_{AA} and v_2 at LHC)

- we generate **10000 MC** events for **1 EPOS** event

MC@sHQ+EPOS2 results: M.Nahrgang *et al*, Phys. Rev. **C89**, 014905 (2014)





- **reasonable agreement** for the R_{AA} of D mesons at **p_T > 5 GeV**;
- at **low p_T**: sensitive to the medium – **good agreement** with **EPS09 shadowing**;
- **reasonable agreement** for the v_2 of D mesons.

MC@sHQ+EPOS3 results

EPOS2 vs. EPOS3

Slide from Marlene's talk

MC@sHQ - heavy flavor

- Evolution by the Boltzmann transport equation.
- Elastic cross sections from the pQCD Born approximation with HTL+semi-hard propagators.
- Including a running coupling ⇒ selfconsistently determined Debye mass.
- Radiative energy loss including suppression due to coherent radiation.

consistent coupling

M.Nahrgang *et al*, Phys. Rev. **C89**, 014905 (2014)

EPOS2 - light flavor

- Initial conditions from a flux tube approach to multiple scattering events.
- 3 + 1 d ideal fluid dynamics with viscous effects being mimicked.
- Including a parametrization of the equation of state from lattice QCD.
- Finite initial velocities.
- Event-by-event fluctuating initial conditions.

K.Werner *et al*, Phys. Rev. **C89**, 064903 (2014)

- 3d+1 **viscous** hydrodynamical evolution, **eta/s = 0.08**;
- **more sophisticated** treatment of nonlinear effects in the parton evolution by considering **individual (per Pomeron) saturation scales**;
- **changes** in **core-corona** procedure

MC@sHQ+EPOS3 results (R_{AA} and v_2 at LHC)

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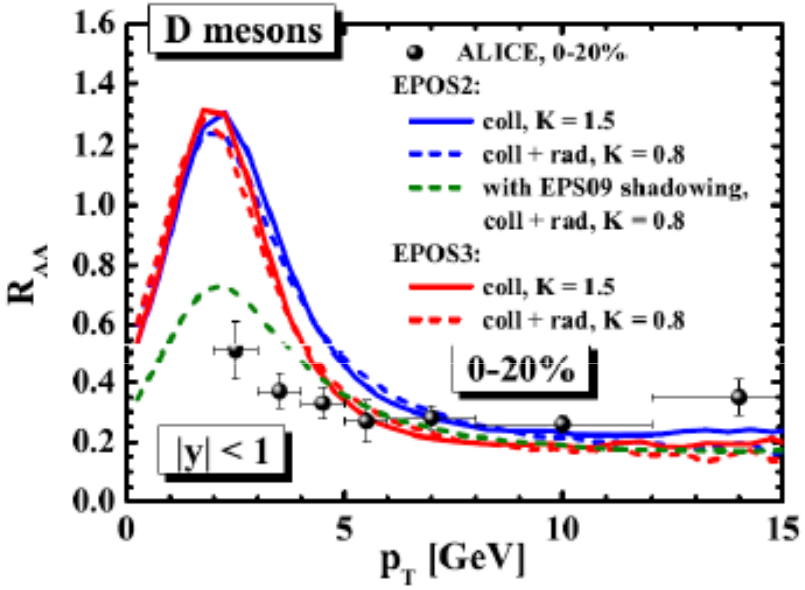
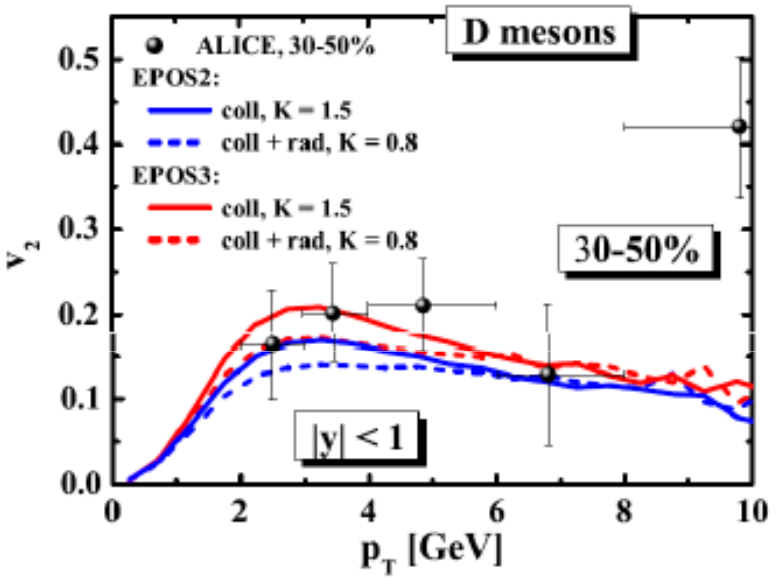
MC@sHQ+EPOS2 results: M.Nahrgang *et al*, Phys. Rev. **C89**, 014905 (2014)





- **reasonable agreement** for the R_{AA} of D mesons at **p_T > 5 GeV**;
- **larger suppression** for MC@sHQ+EPOS3 results at **intermediate p_T**;
- at **low p_T**: sensitive to the medium – **good agreement** with **EPS09 shadowing**;

MC@sHQ+EPOS3 results (R_{AA} and v_2 at LHC)

- we generate **10000 MC** events for **1 EPOS** event

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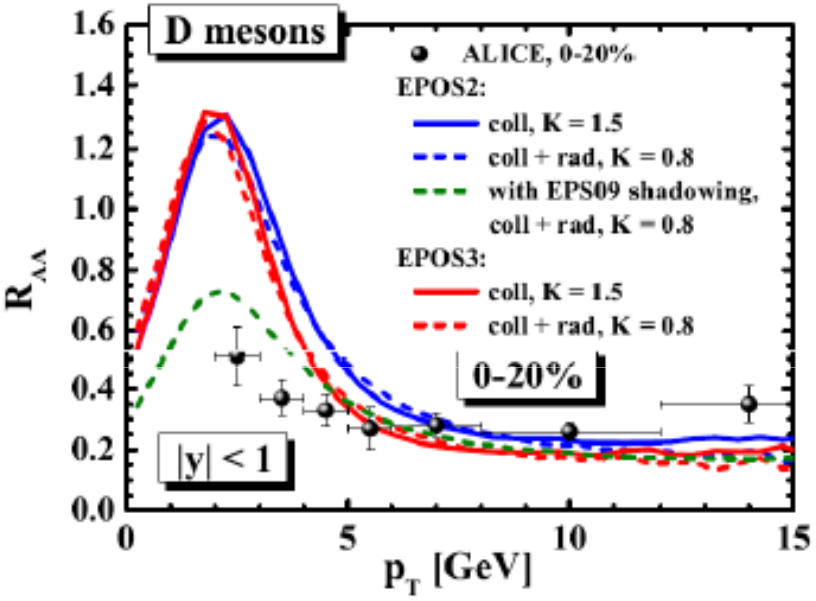
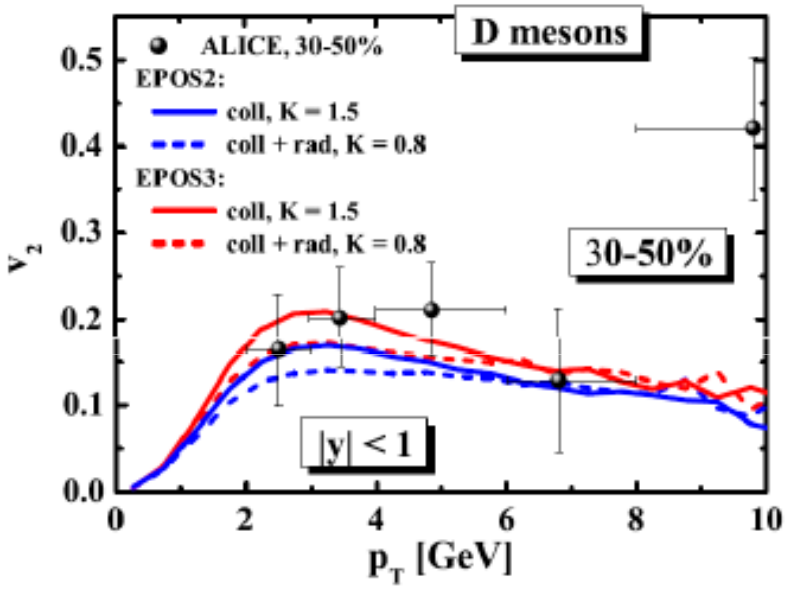


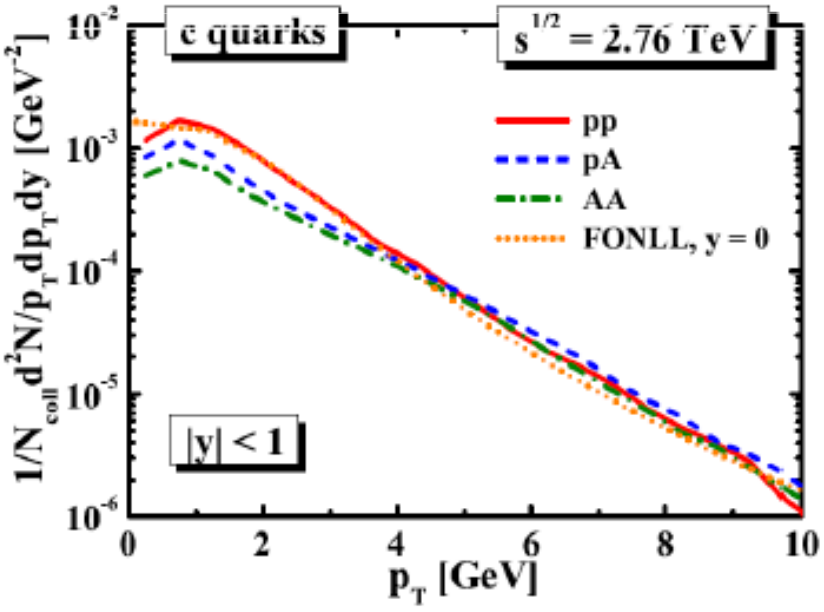


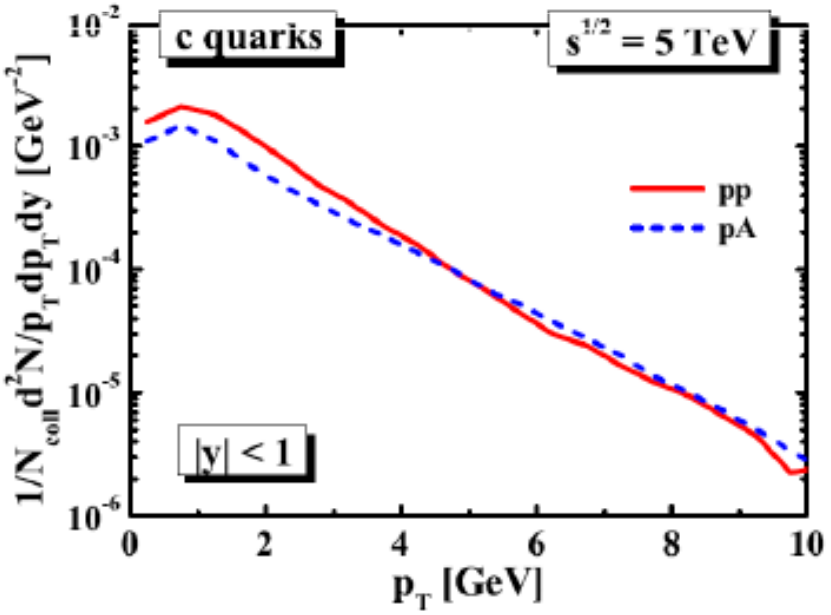
- **reasonable agreement** for v_2 of D mesons;
- **enhancement** for MC@sHQ+EPOS3 results at **intermediate p_T**;
- need to include **hadronic contribution** *(work in progress…)*

MC@sHQ+EPOS3 results
(with HQ from EPOS3 initial conditions)
= EPOSHQ results

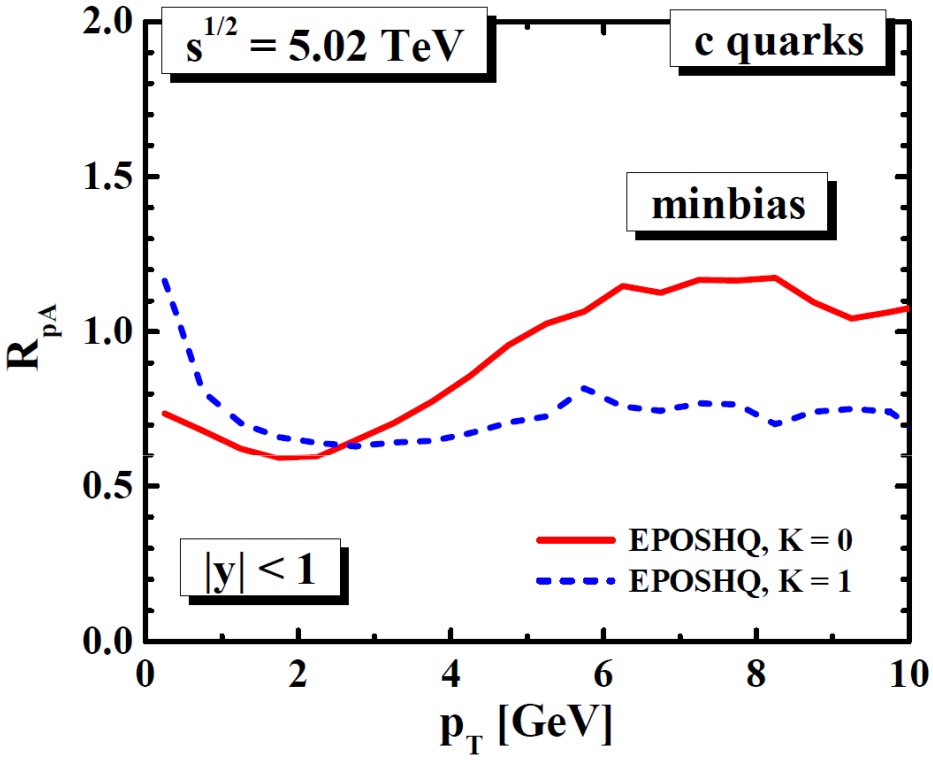
Heavy quarks from EPOS3

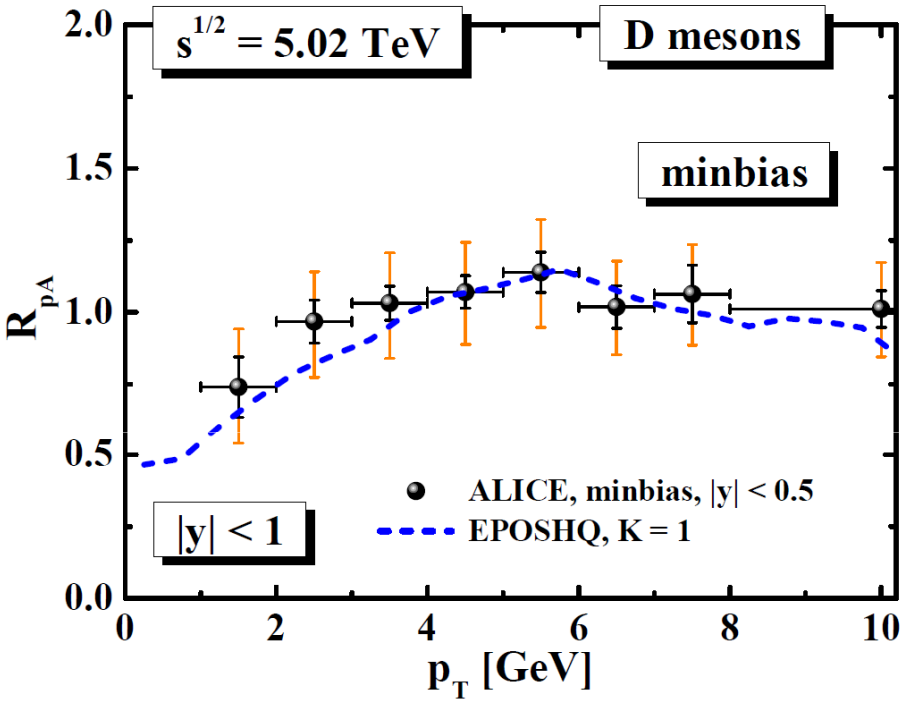
- we implement the **heavy quarks** from **EPOS3** model
- the **heavy quarks** in **EPOS3** can be produced during:
  - spacelike cascade;
  - Born process;
  - partonic shower





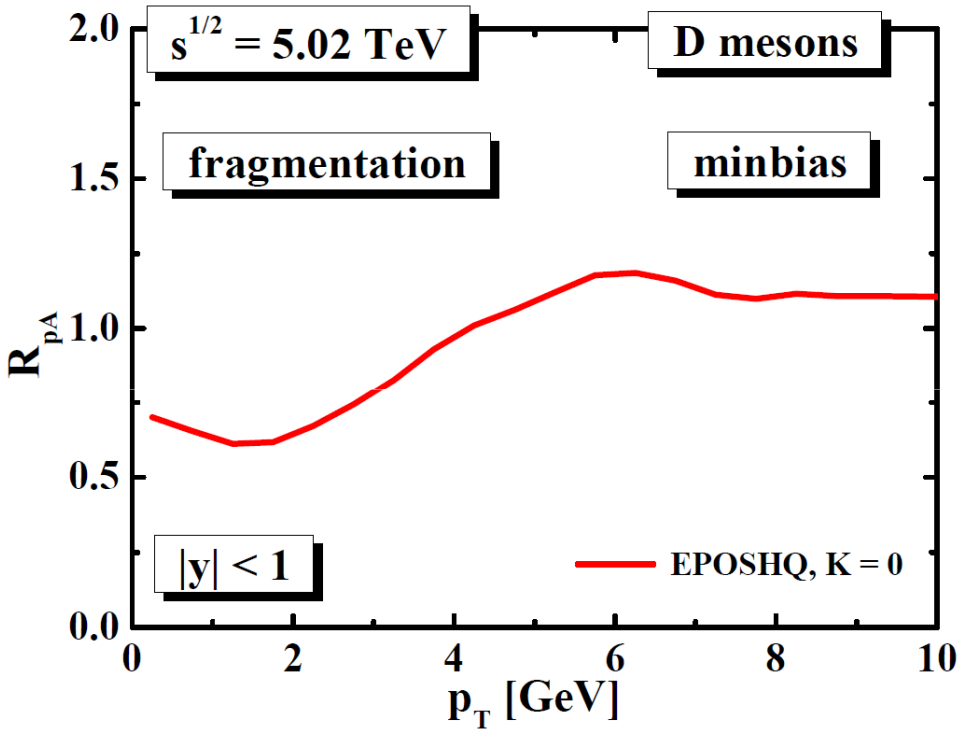
RpA of D meson in pPb@5.02TeV





- **suppression of c-quark yield** at low pT for K=0 (no interactions) shows the presence of **shadowing** initially
- **good agreement** for R_{pA} of D mesons for **whole range of pT**

RpA of D meson in pPb@5.02TeV



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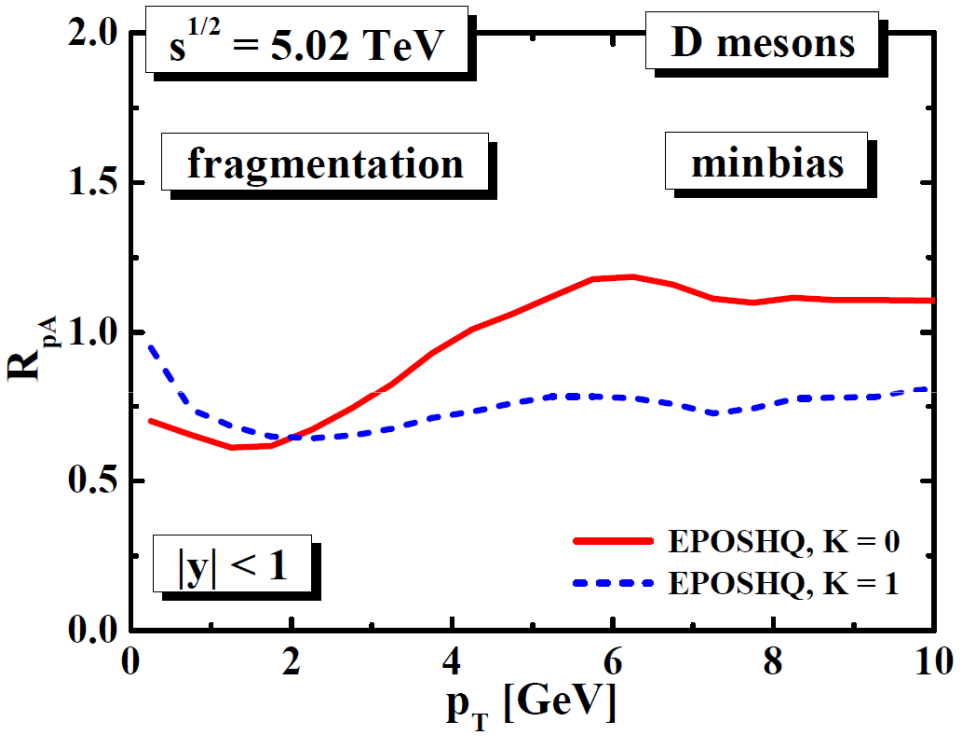

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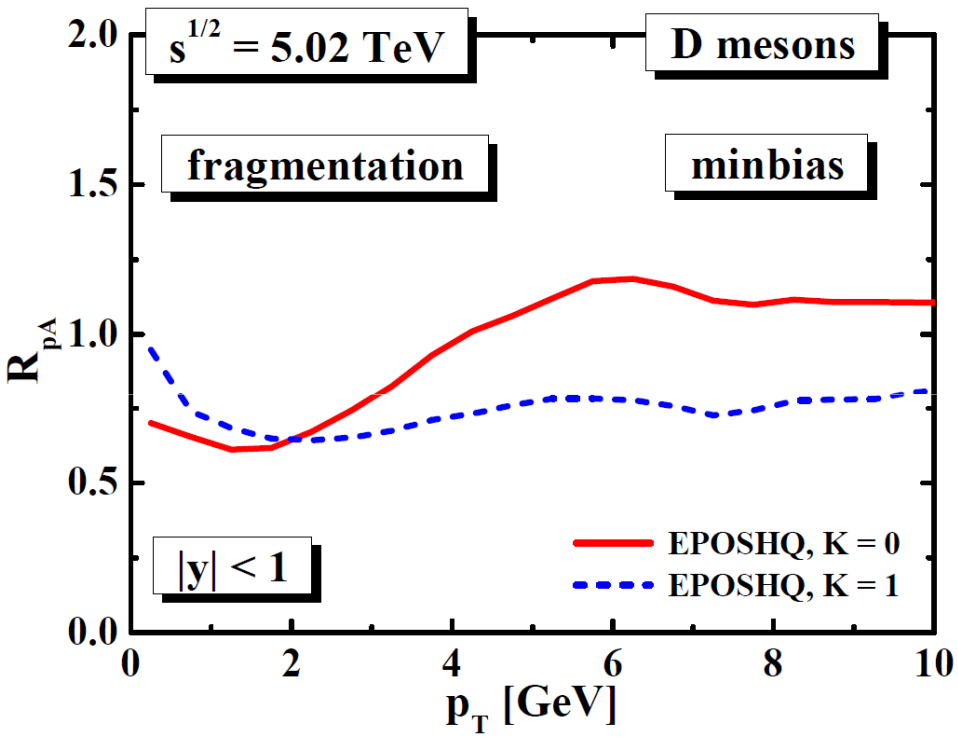
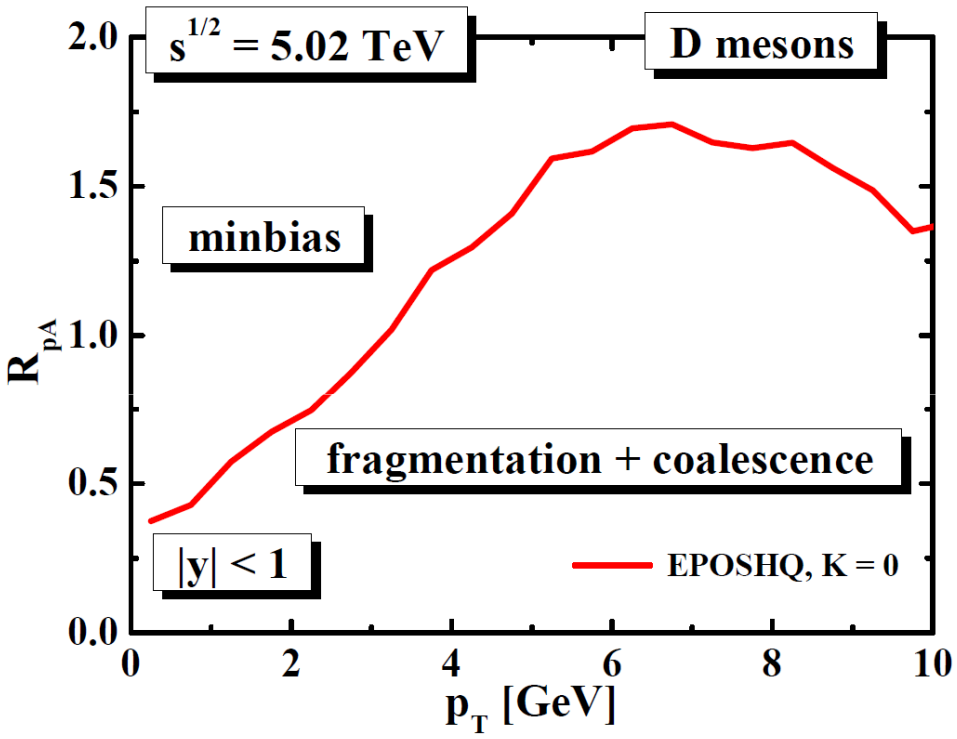
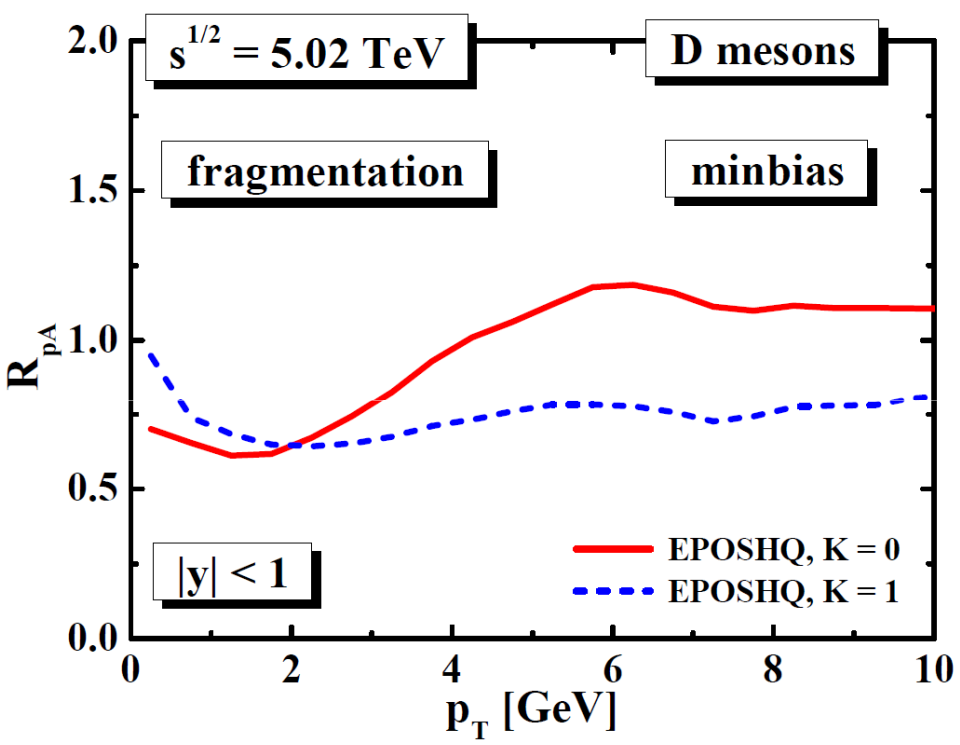
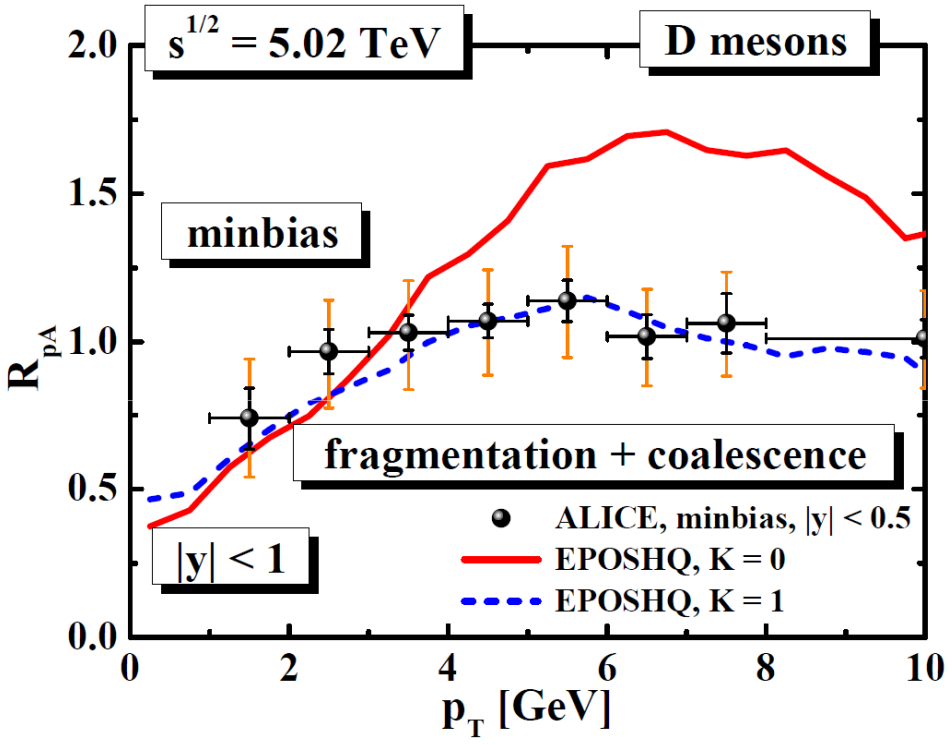


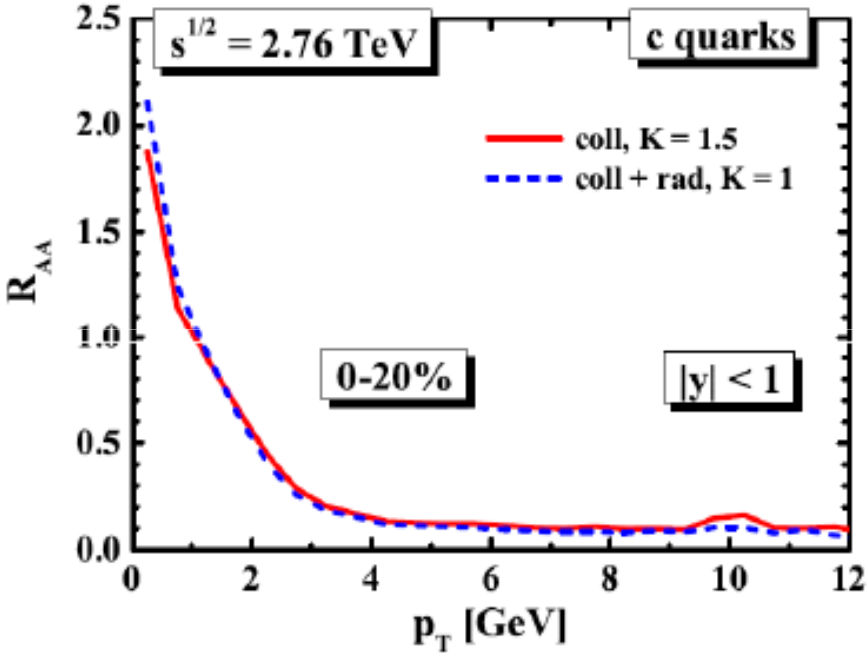


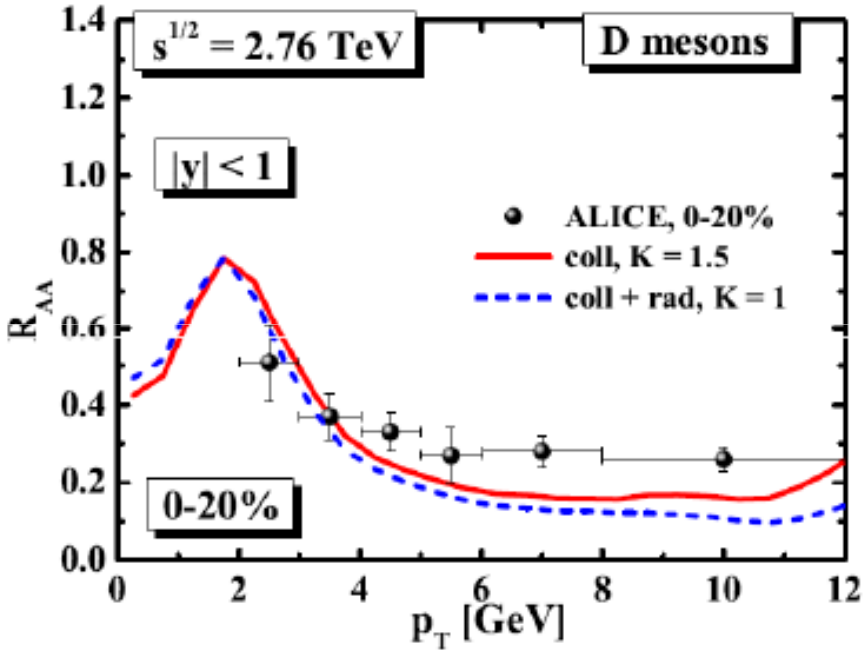
RpA of D meson in pPb@5.02TeV





R_{AA} of D meson in PbPb@2.76 TeV





- **reasonable agreement** for R_{AA} of D mesons for **whole range of p_T**
- almost the **same behavior** for two sets of parameters

Summary & Outlook

- **EPOSHQ model is a powerful tool** to study HQ and HF mesons in **pA** and **AA** collisions
- Our model **well describes** the **D-meson nuclear modification factor** in pPb collisions at LHC
- The introduction of **HQ** from **EPOS3 IC** to a model leads to the **better description** of the experimental data for the **R_{AA}** of D mesons at **low p_T** in PbPb collisions at LHC

- **to define** the **centrality classes** for pPb collisions
- **to calculate** the **elliptic flow** of D mesons both for PbPb and pPb collisions at LHC within EPOSHQ model
- **to include** the **hadronic rescatterings** to our model (to couple with UrQMD)

Thank you!

Acknowledgments:
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