Hard Probes 2013

The 6th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions

Overview of ALICE results

Francesco Prino

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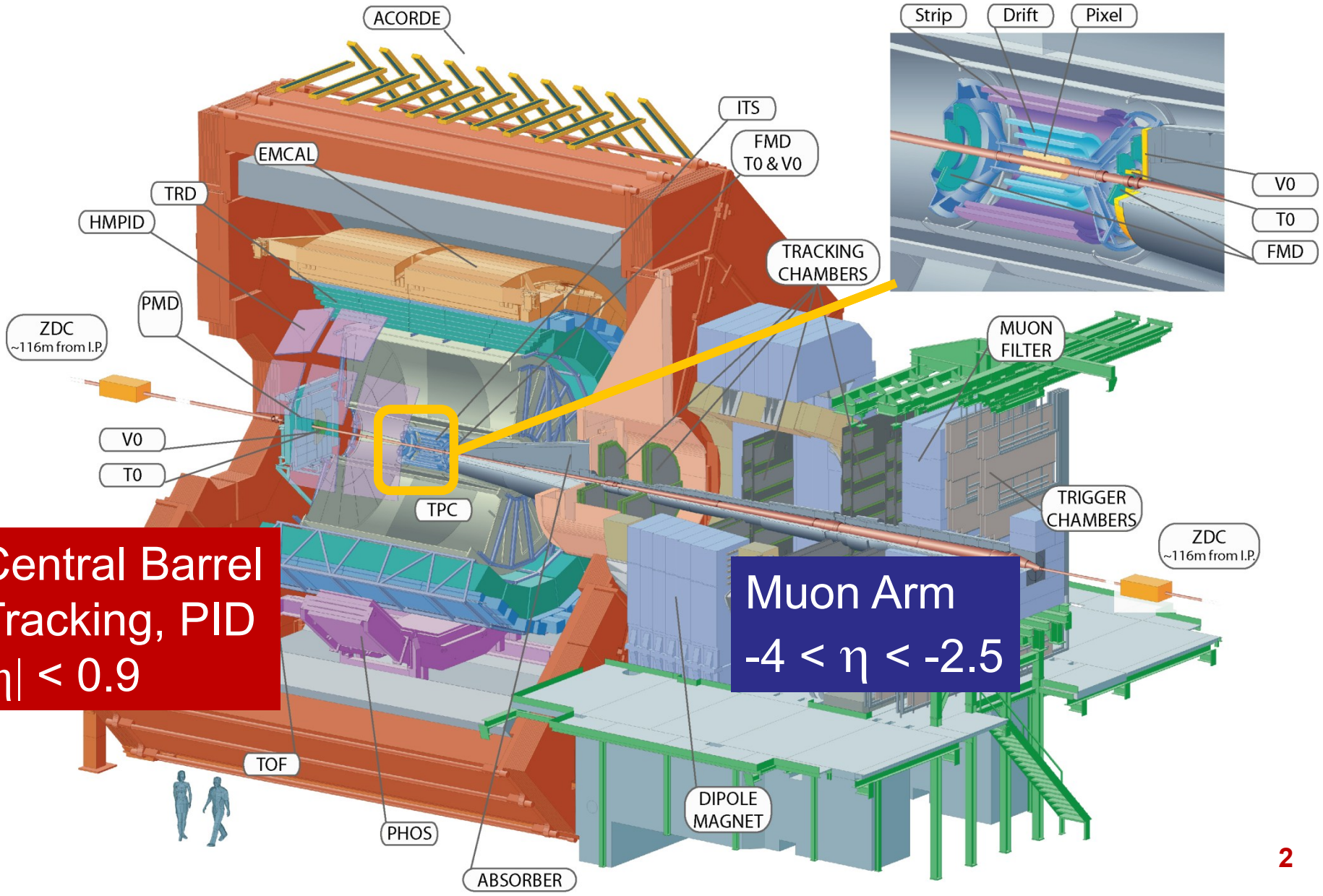
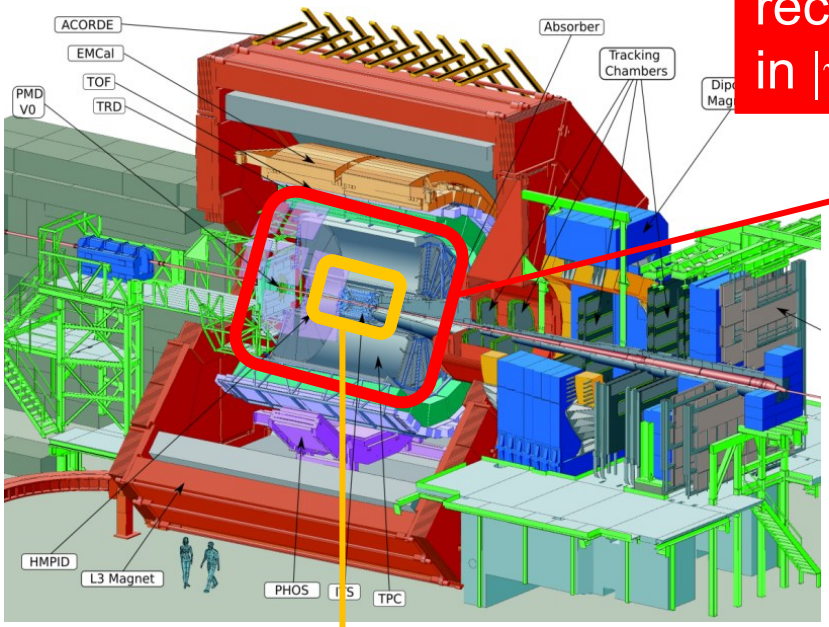
for the ALICE collaboration

ALICE at the LHC

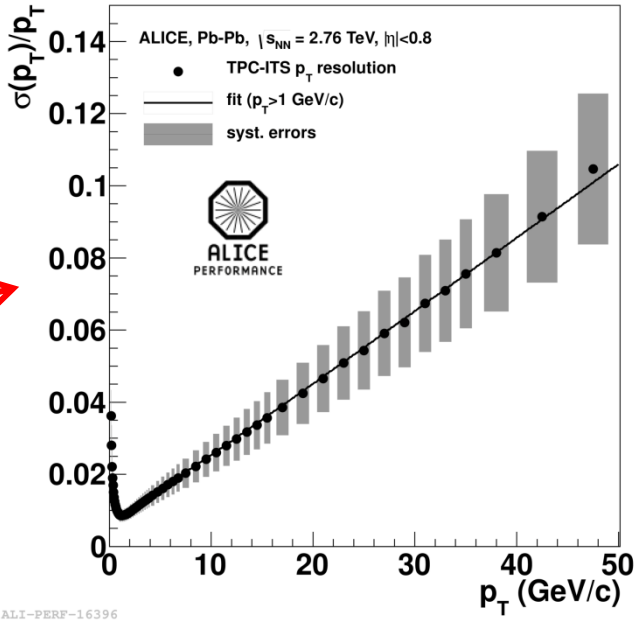


Tracking with ALICE

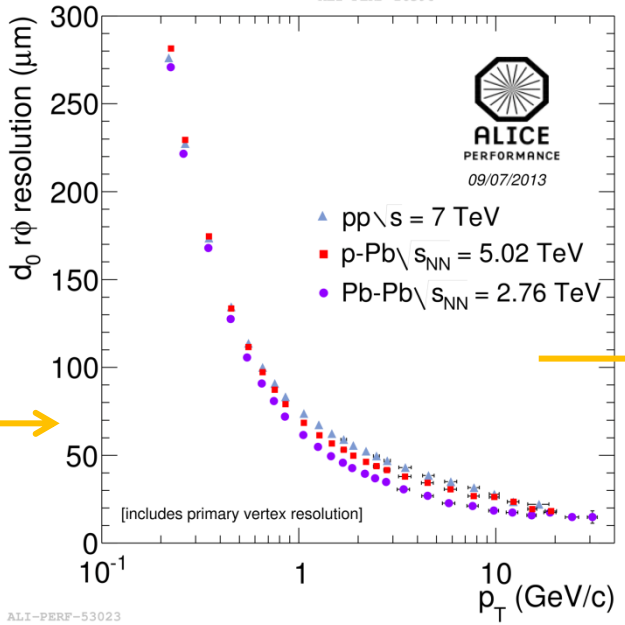
|η|<0.9



TPC+ITS: charged track reconstruction in |η| < 0.9



High precision vertexing and high resolution on track impact parameter with the ITS

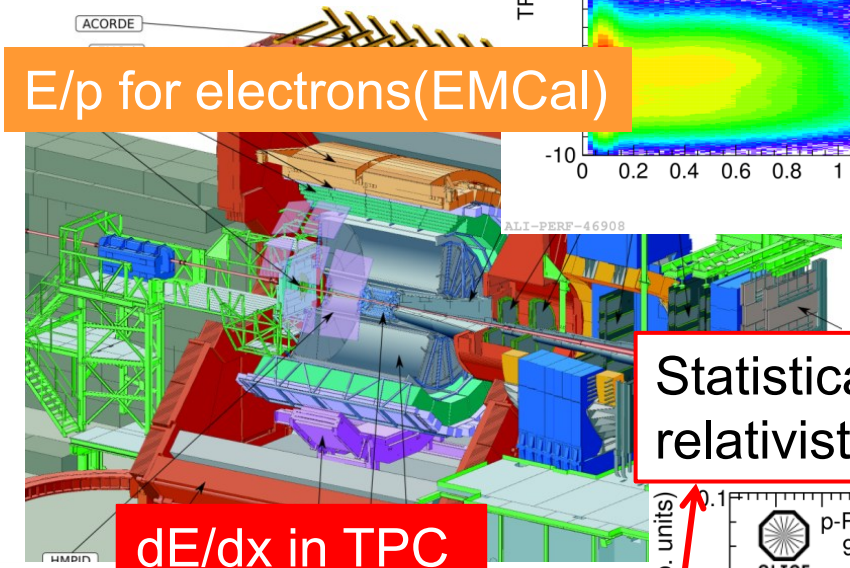


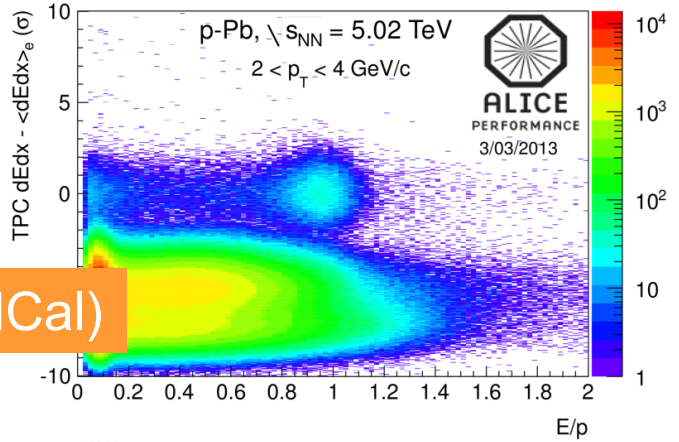
Allow one to resolve the decay vertices of charm and beauty hadrons

PID with ALICE (examples)

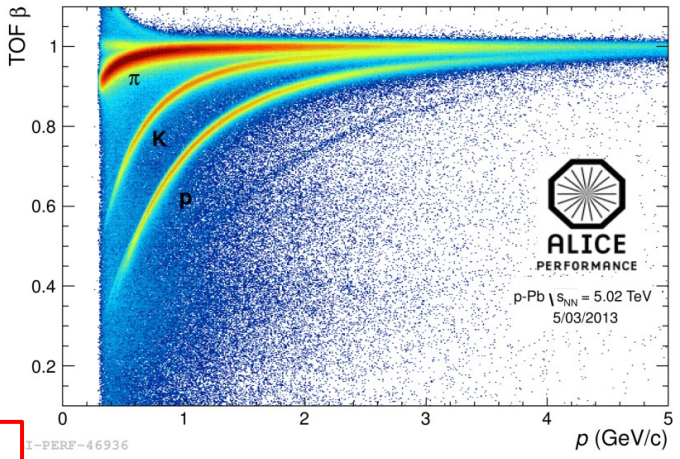
|η|<0.9

E/p for electrons(EMCal)



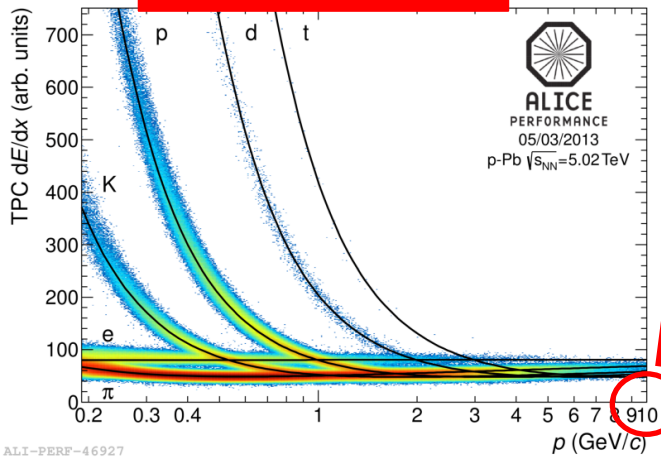


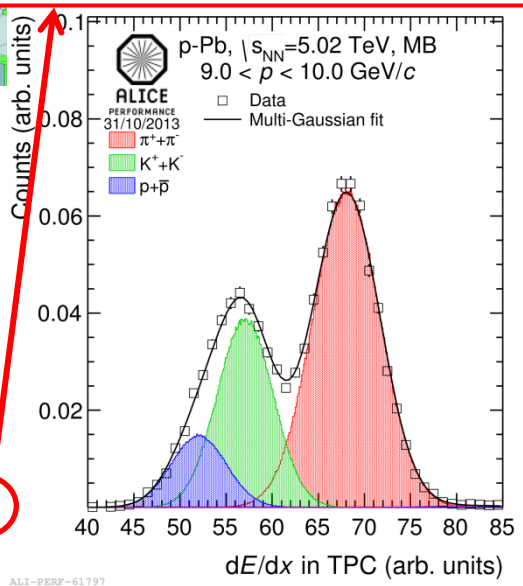
Time-of-flight from TOF



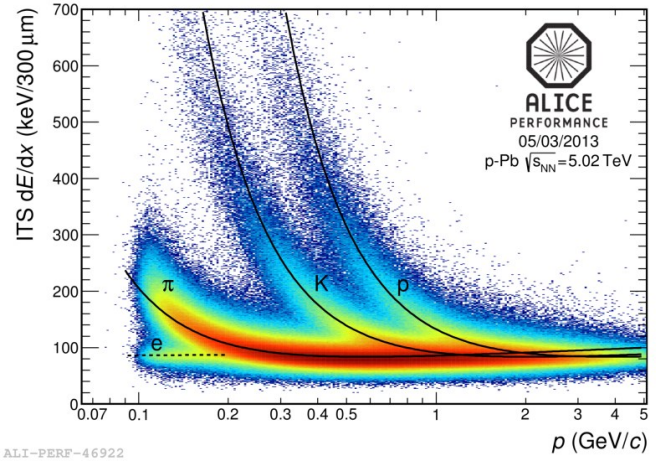
Statistical separation in relativistic rise region

dE/dx in TPC





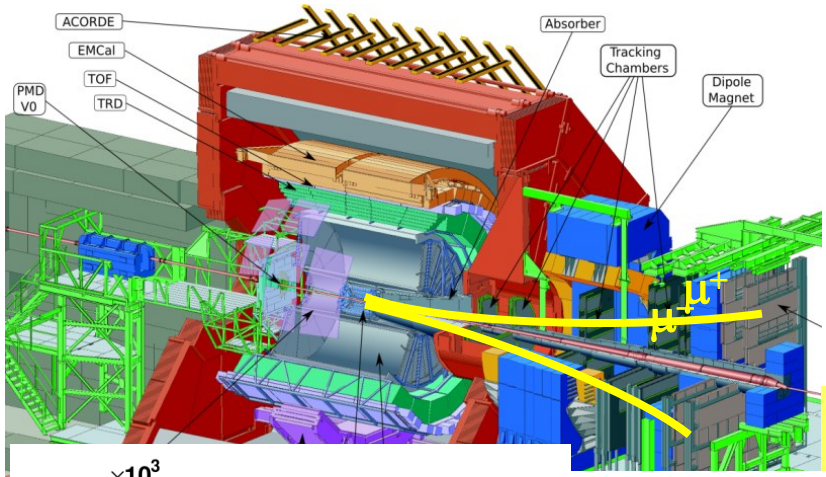
dE/dx in ITS



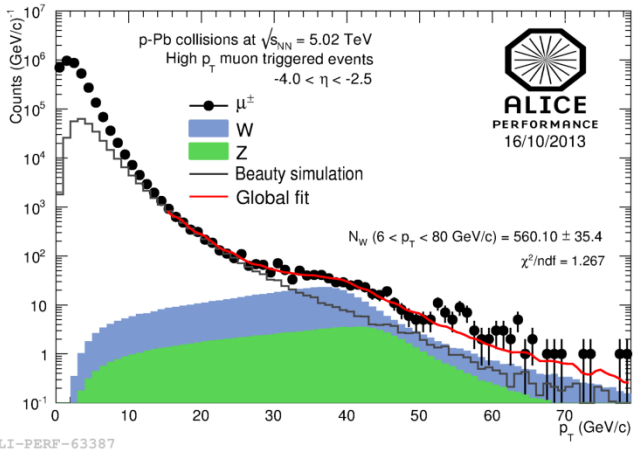
A. Ortiz, Mon 16:40

Muons with ALICE

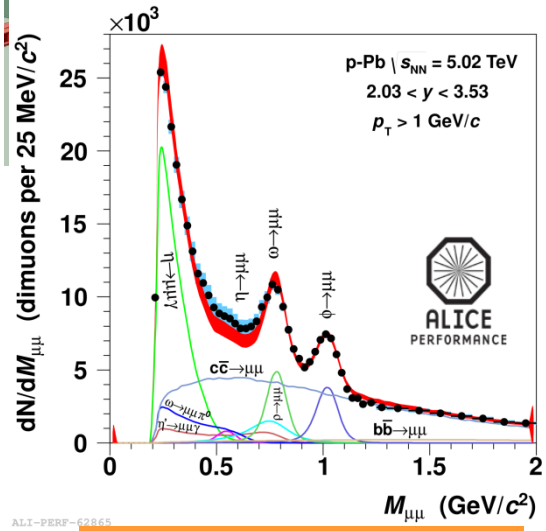
-4<η<-2.5

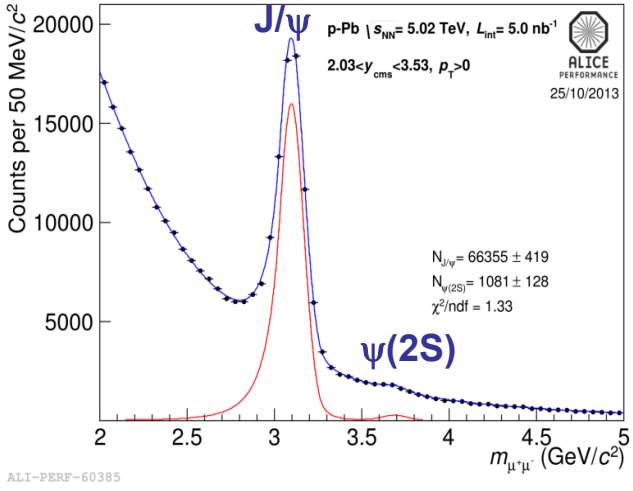


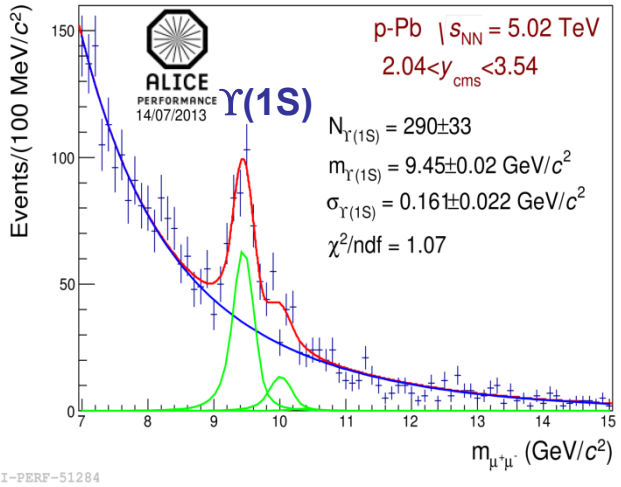
Muon p_T spectrum



Di-muon invariant mass







A. Uras, Tue 13:50

M. Winn, Thu 16:20

F. Bossù, Mon 16:20

Data samples

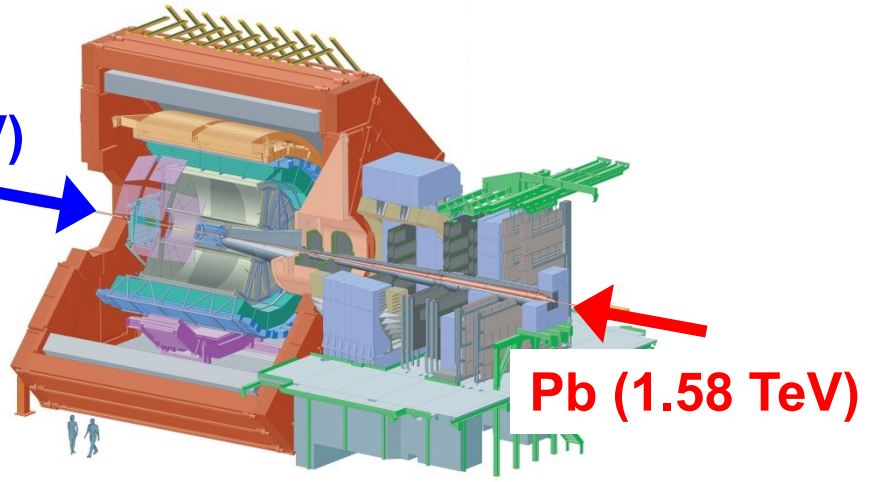
System	Energy $\sqrt{s_{NN}}$ (TeV)	Year	Integrated luminosity	Goal
Pb-Pb	2.76	2010	~10 μb^{-1}	• Study the properties of **hot and dense QCD matter**
		2011	~100 μb^{-1}	
p-Pb	5.02	2012	~0.8 μb^{-1}	• Assess **cold nuclear matter** effects • ... and much more
		2013	~15 nb^{-1} of p-Pb	
			~15 nb^{-1} of Pb-p	

In addition (not covered in this presentation)

- pp collisions at $\sqrt{s}$=0.9, 2.76, 7 and 8 TeV
  - ⇨reference for Pb-Pb (and p-Pb)
  - ⇨genuine pp physics program

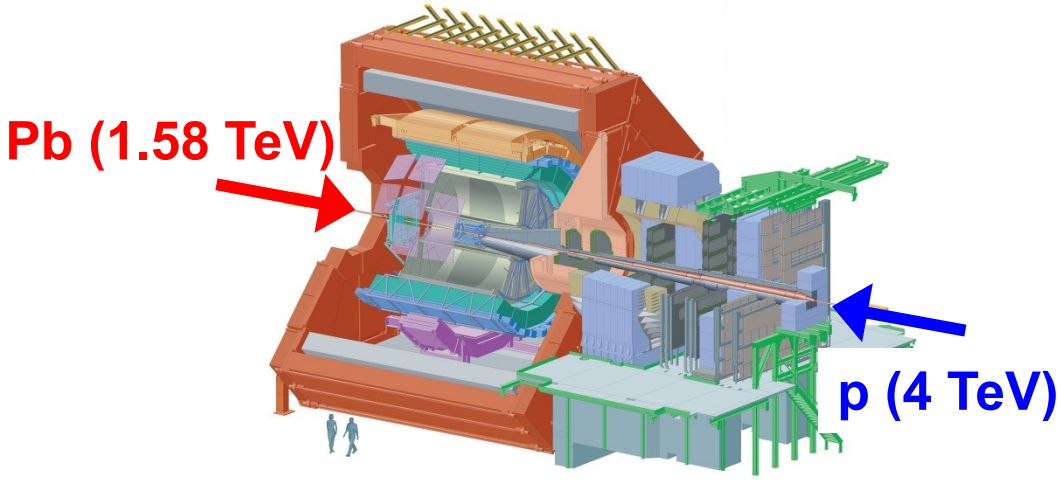
p-Pb and Pb-p samples

- p-Pb
  - ⇨proton going towards muon arm



y_{CMS} = 0.465 in the p-beam direction

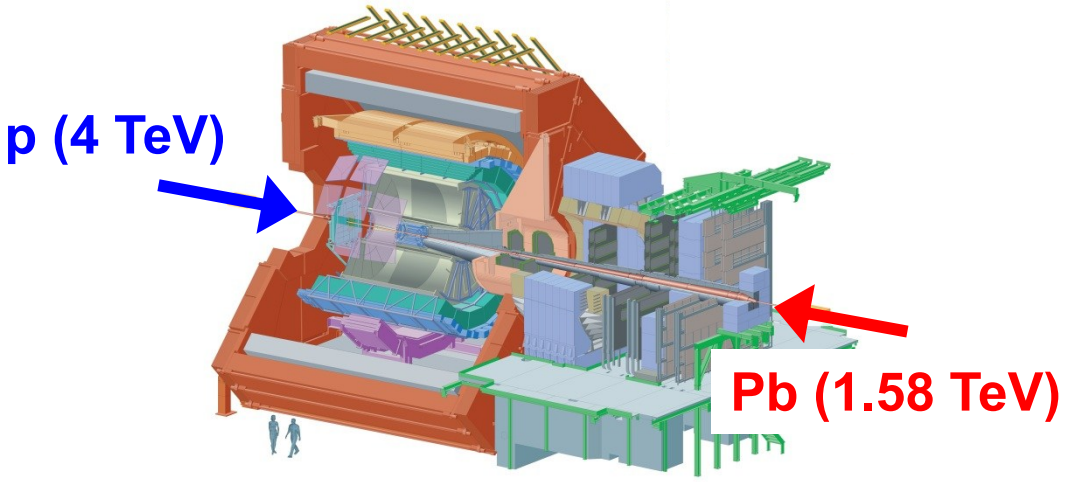
- Pb-p
  - ⇨Pb nucleus going towards muon arm



p-Pb and Pb-p samples

- p-Pb
  - ⇨proton going towards muon arm

Most of the results shown in this presentation from the p-Pb sample



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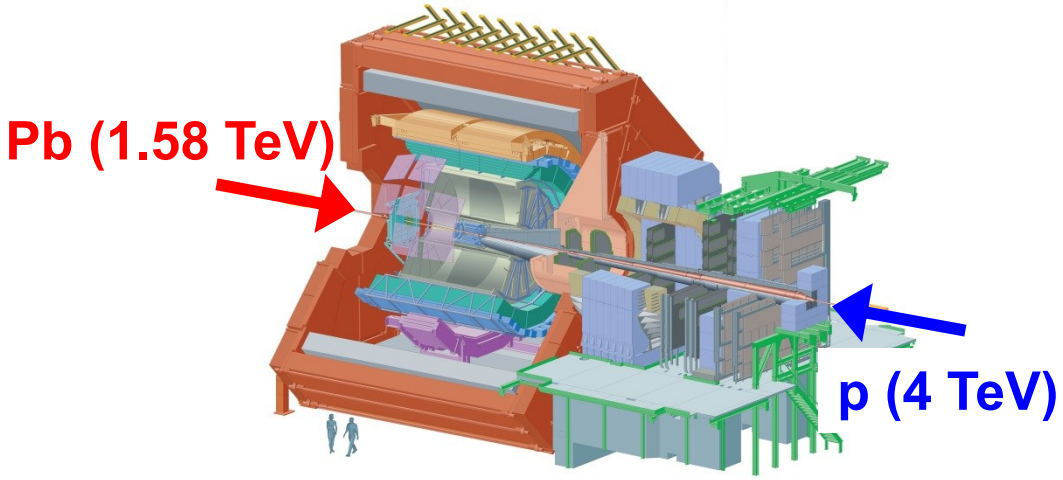
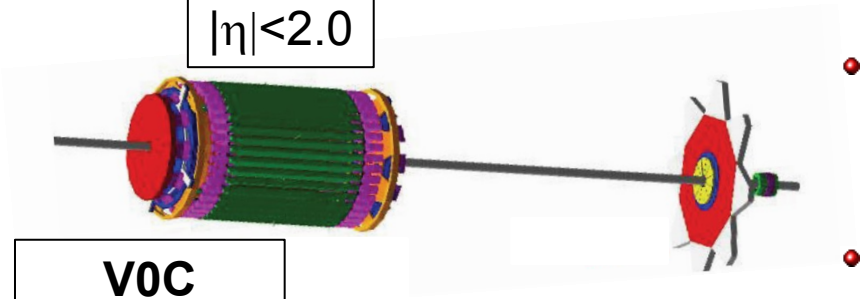
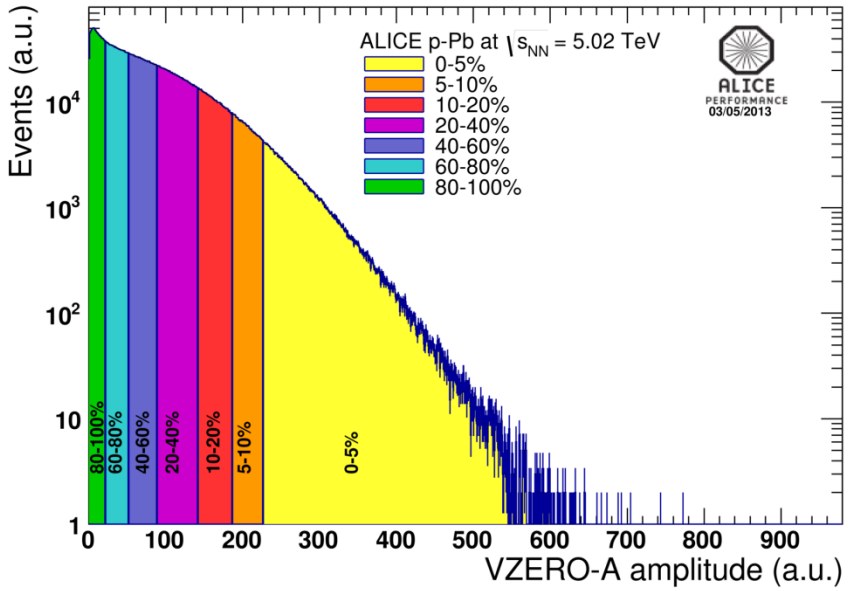


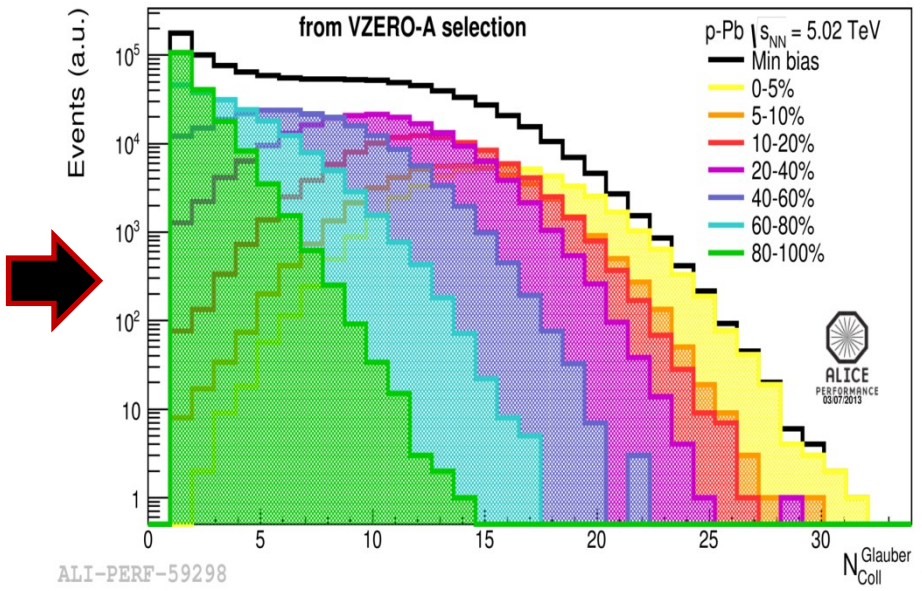
Centrality in p-Pb ?



C. Oppedisano, Thu 13:30

- Estimator: V0A
  - ⇨ in p-Pb: multiplicity in Pb hemisphere
  - ⇨ in Pb-p: multiplicity in p hemisphere
- Multiplicity -> geometry (Glauber)
  - ⇨ number of binary collisions
  - ⇨ large r.m.s. -> events with same $N_{coll}^{Glauber}$ fall in different multiplicity classes
- Bias in binary scaling for multiplicity classes





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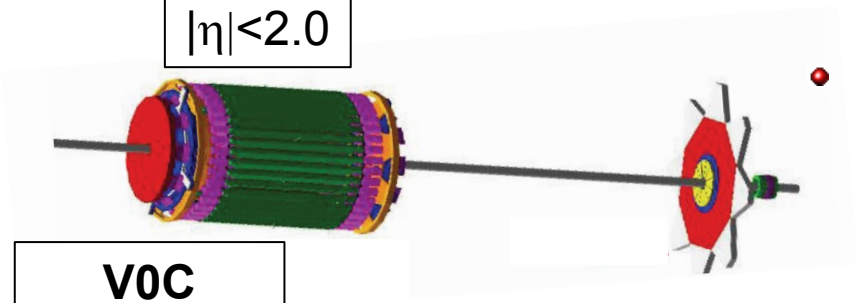
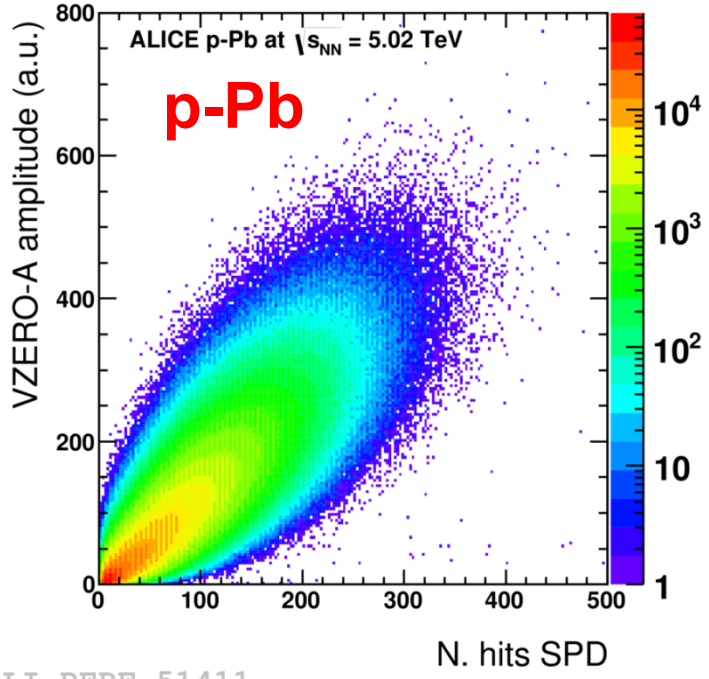
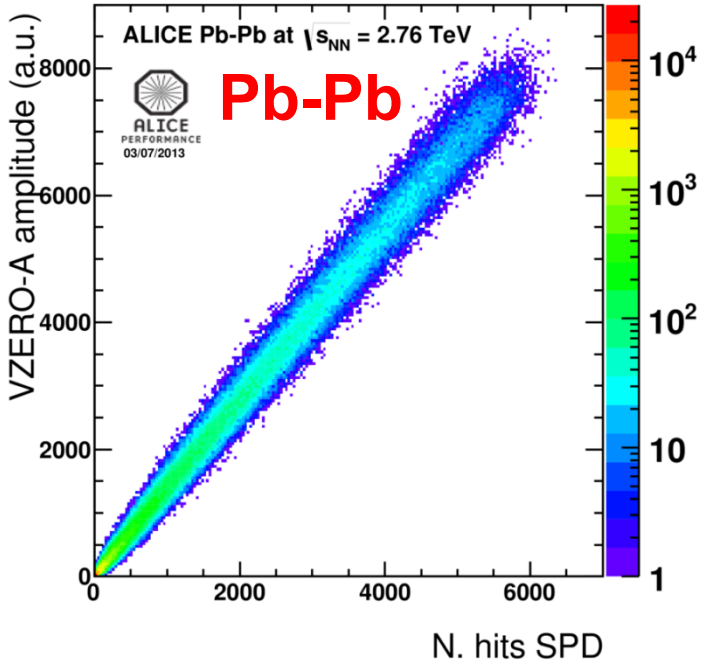
Centrality in p-Pb ?



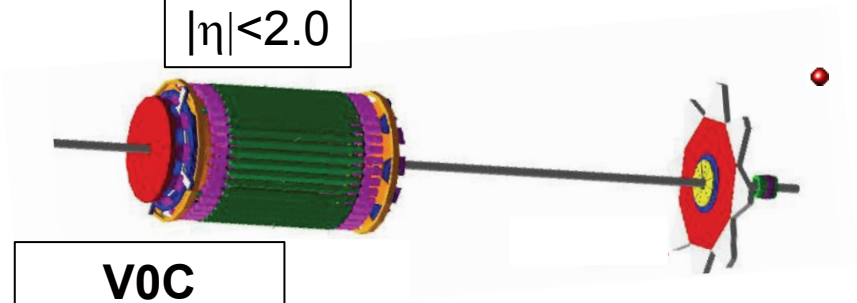
- Different bias on binary scaling for different multiplicity estimators
  - ⇨ correlations between high p_T particles in the tracker and measured multiplicity
    - ✓ *jet-veto effect at low multiplicity*
  - ⇨ bias reduced by η gap

C. Oppedisano, Thu 13:30





Centrality in p-Pb ?



Different bias on binary scaling for different multiplicity estimators

- ⇨ correlations between high p_T particles in the tracker and measured multiplicity
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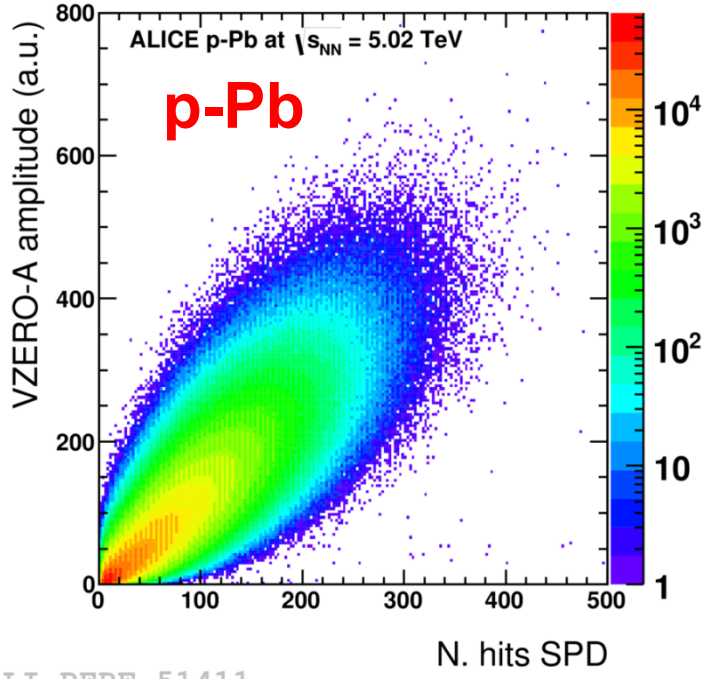
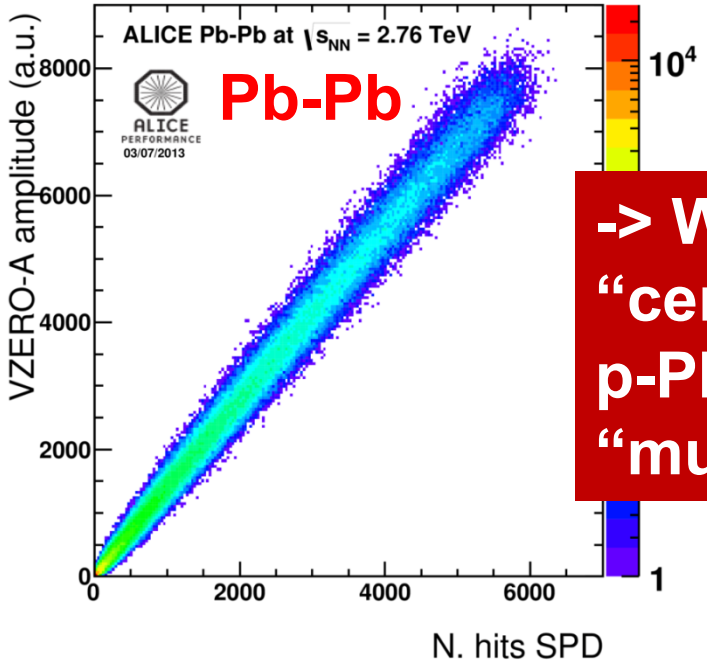
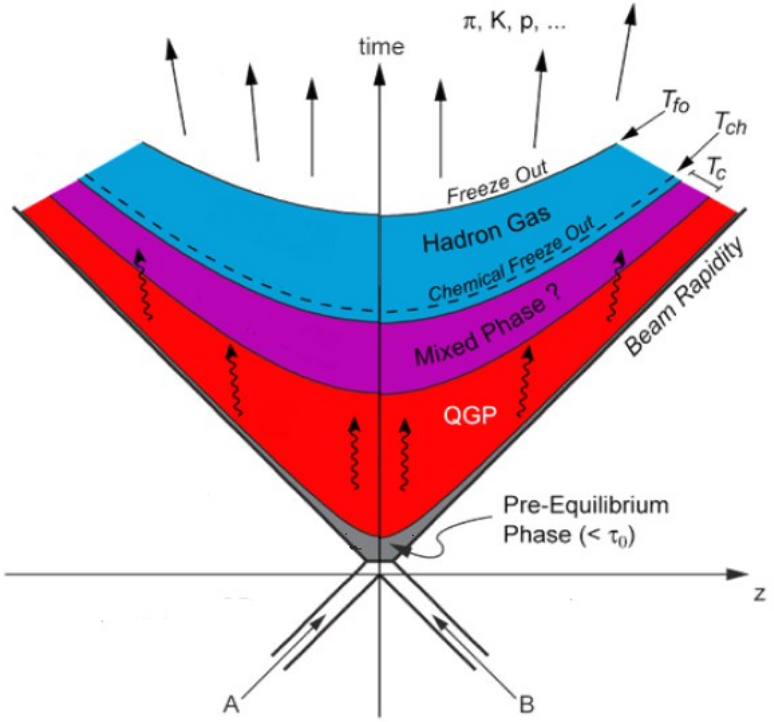
C. Oppedisano, Thu 13:30





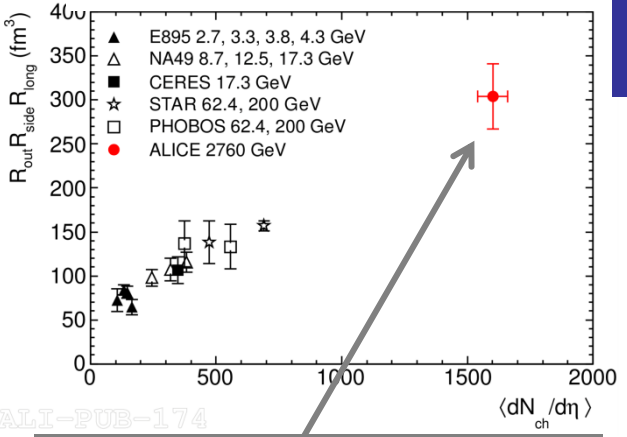
-> Won't use "centrality" in p-Pb but "multiplicity"

Global properties (the bulk)



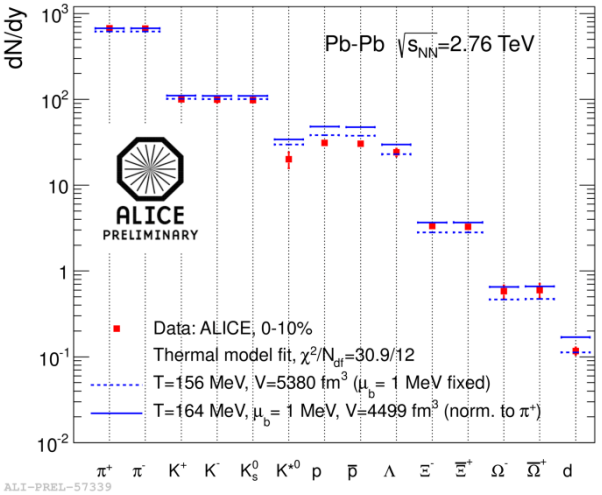
Recap: Pb-Pb global properties

ALICE, PLB696 (2011) 328

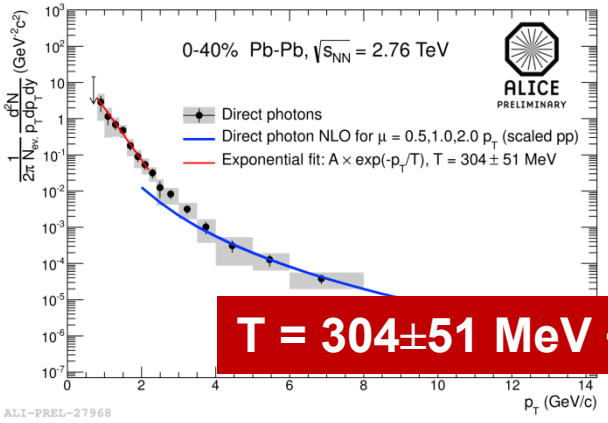


Multiplicity ~ 2 x N_{RHIC}
Energy density ~ 3 x ε_{RHIC}

Volume ~ 2 x V_{RHIC}
Lifetime ~ 20% larger than at RHIC

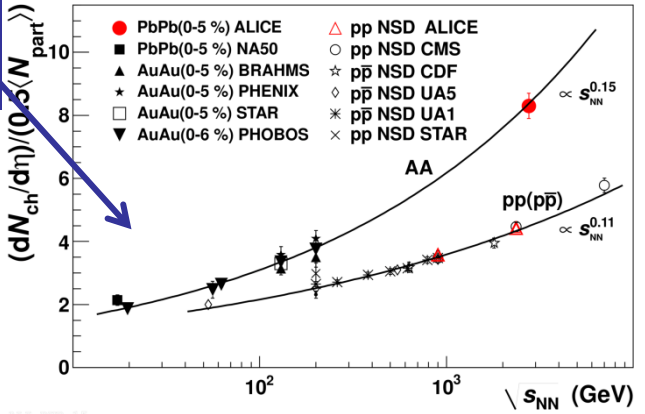


Hadron species abundances described by thermal model, but "tension" for protons

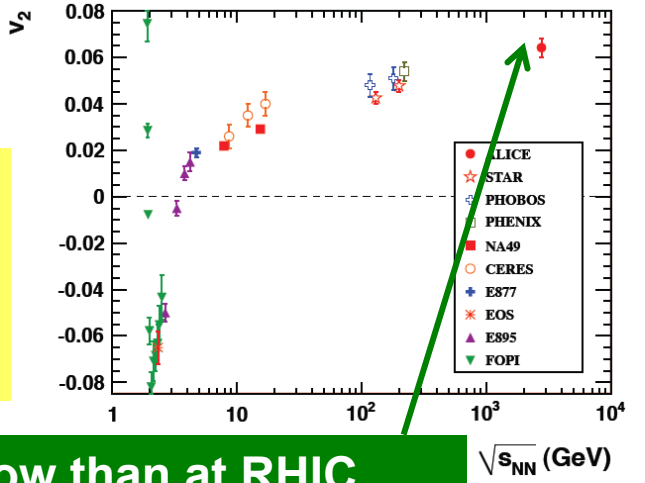


T = 304±51 MeV ~ 1.4 x T_{RHIC}

ALICE, PRL 105 (2010) 252301

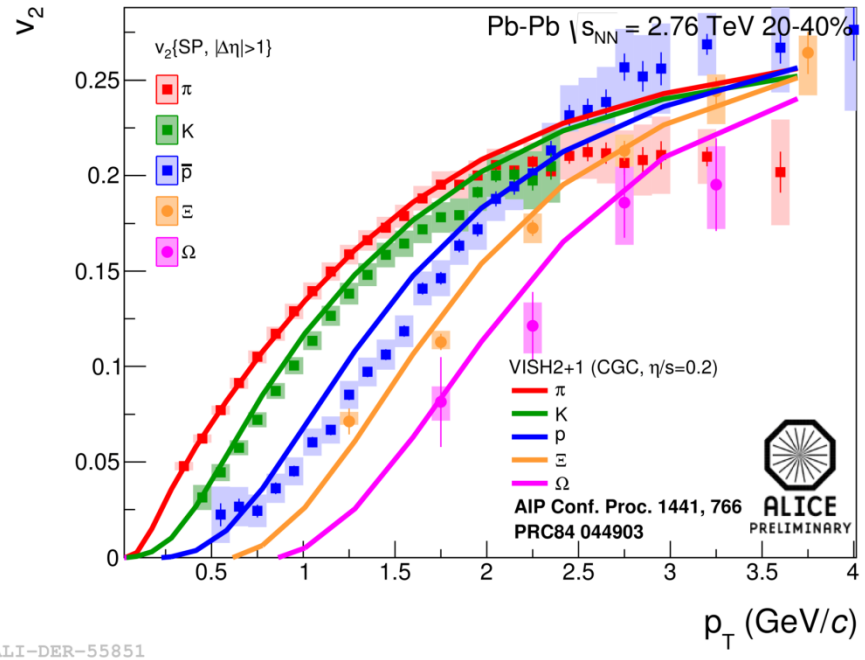


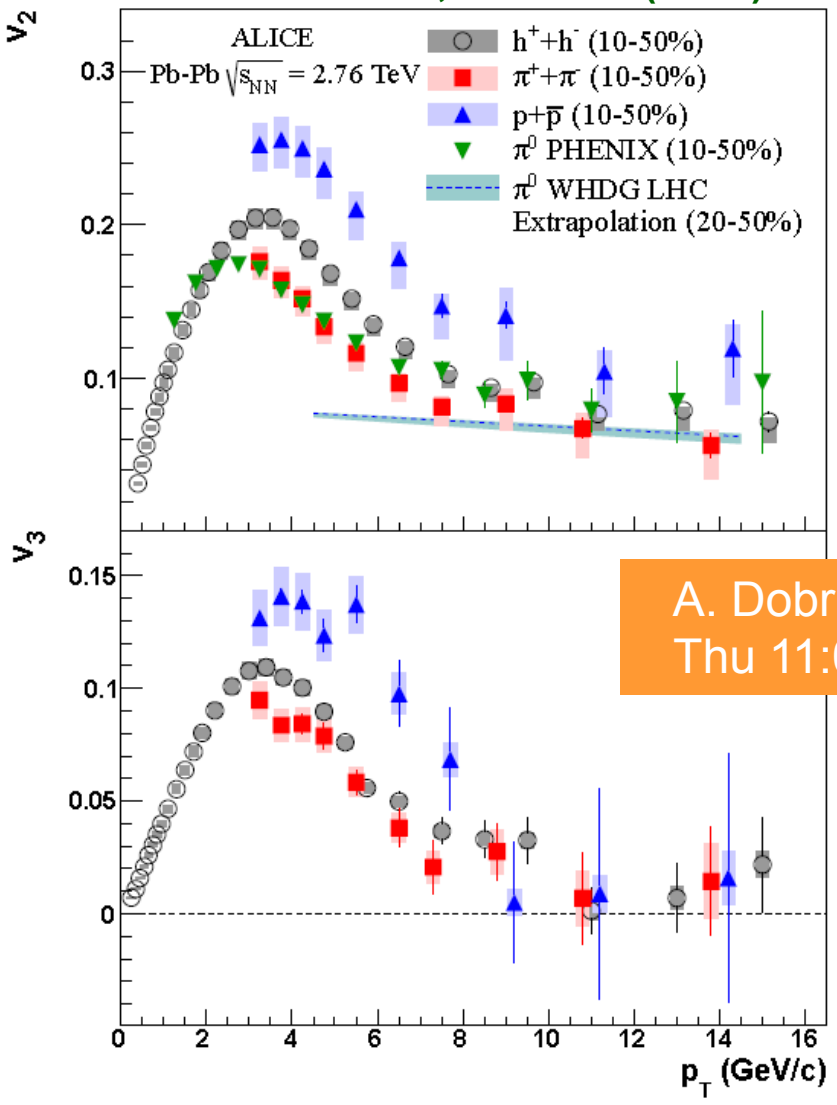
ALICE, PRL 105 (2010) 252302



Larger flow than at RHIC
- **higher p_T integrated v_2**
- **larger radial flow velocity**

Identified particle v_2 in Pb-Pb

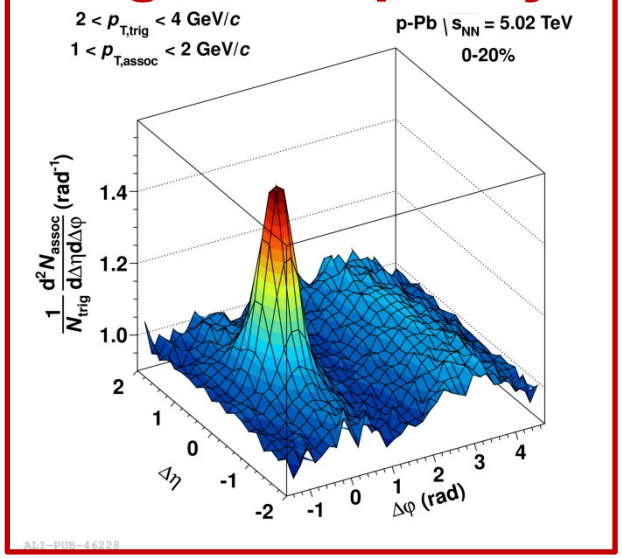




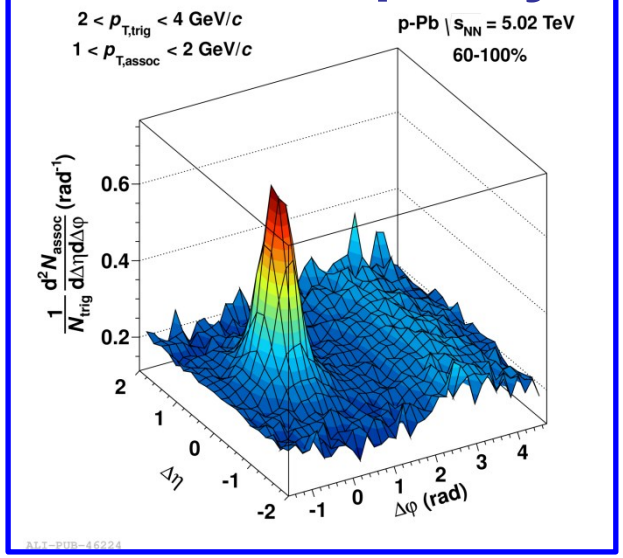
- Identified particle elliptic flow
  - ⇨ Mass ordering at low p_T described by hydrodynamics
  - ⇨ Particle species dependence persists up to $p_T \approx 8$ GeV/c

Hadron-hadron correlations in p-Pb

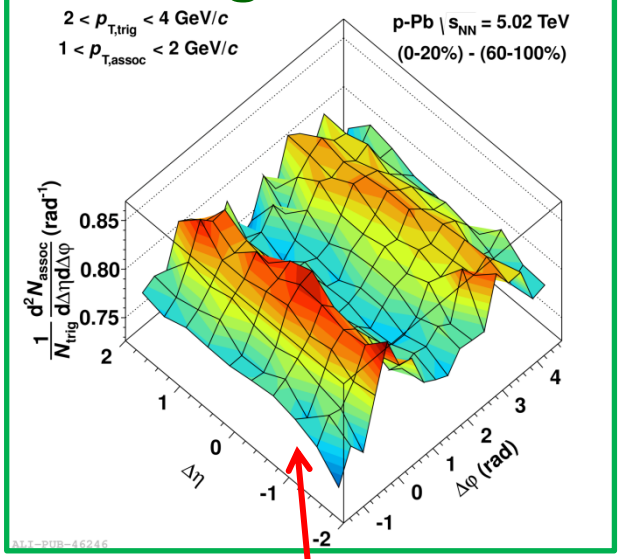
High multiplicity



Low multiplicity



High - Low

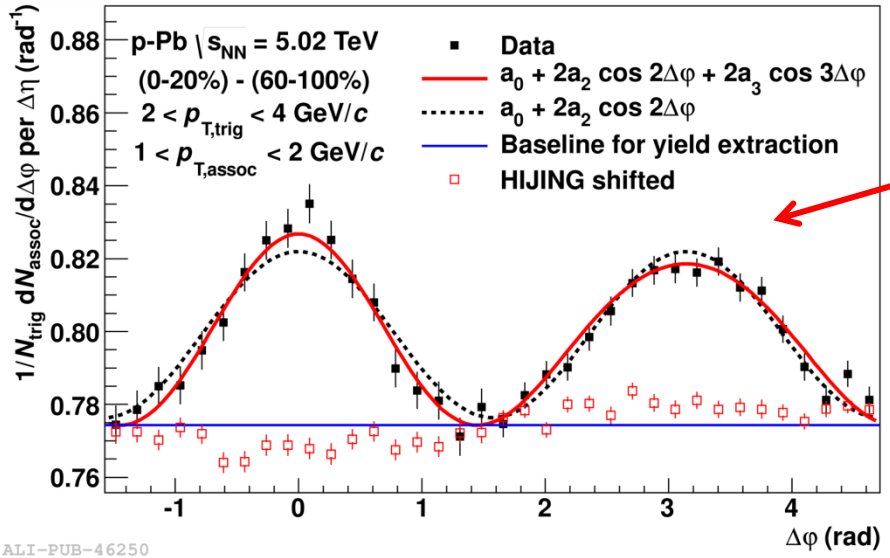


📖 ALICE, PLB719 (2013) 29

Double ridge described by both hydro and CGC

📖 Bozek et al., PLB (2013) 1557

📖 Dusling et al., PRD87 (2013) 094034



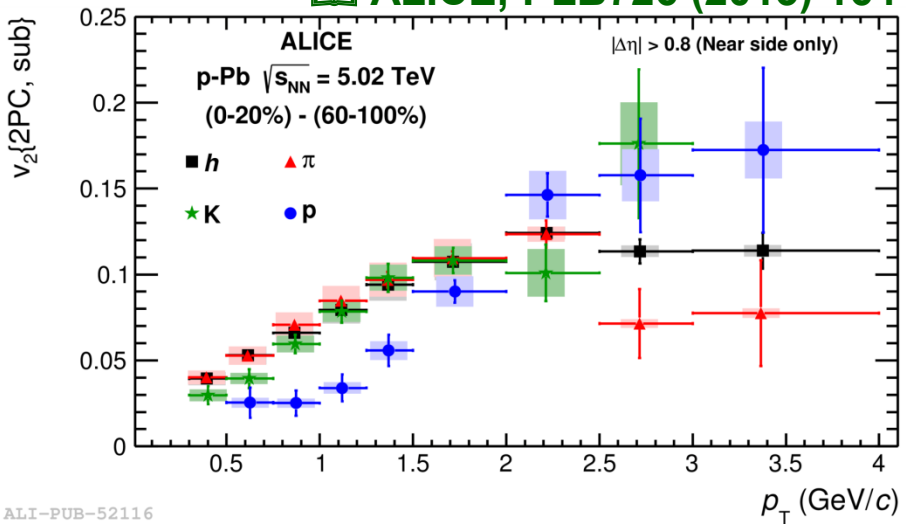
Remaining correlation: two twin long-range structures (**double ridge**)

T. Schuster, Thu 14:50

More on the double ridge

h - π,K,p correlations

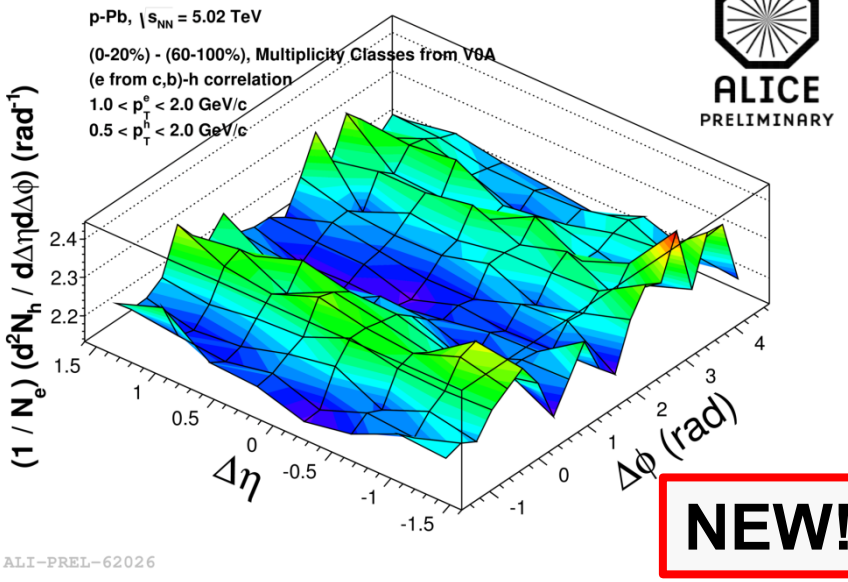
📖 ALICE, PLB726 (2013) 164



- v_2 extracted from two-particle correlations
  - ⇨ Mass ordering at low p_T
  - ⇨ Crossing at $p_T \approx 2$ GeV/c
  - ⇨ Qualitatively similar to Pb-Pb

T. Schuster, Thu 14:50

HF decay e± - h correlations

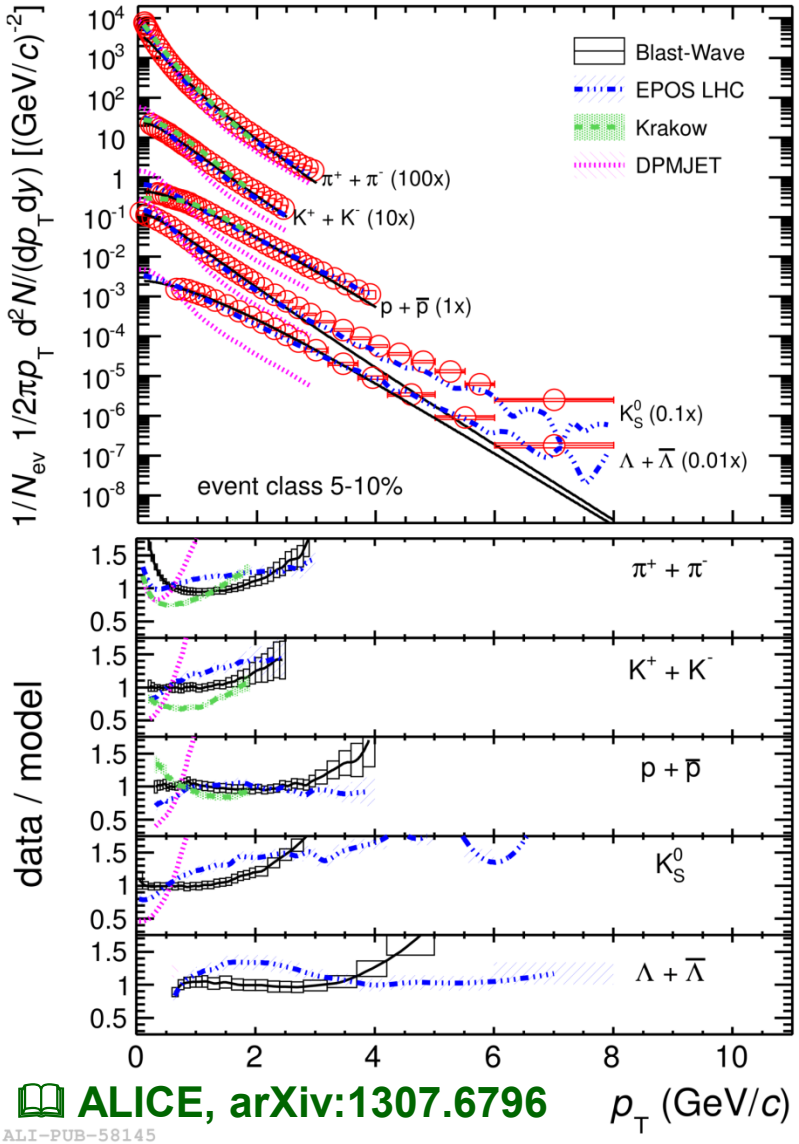


NEW!

- Double ridge seen also in the correlation of heavy-flavour decay electrons with hadrons
  - ⇨ Suggests that the mechanism generating the double ridge is at work also for heavy flavours

E. Pereira, Tue 14:30

Identified particles in high multiplicity p-Pb

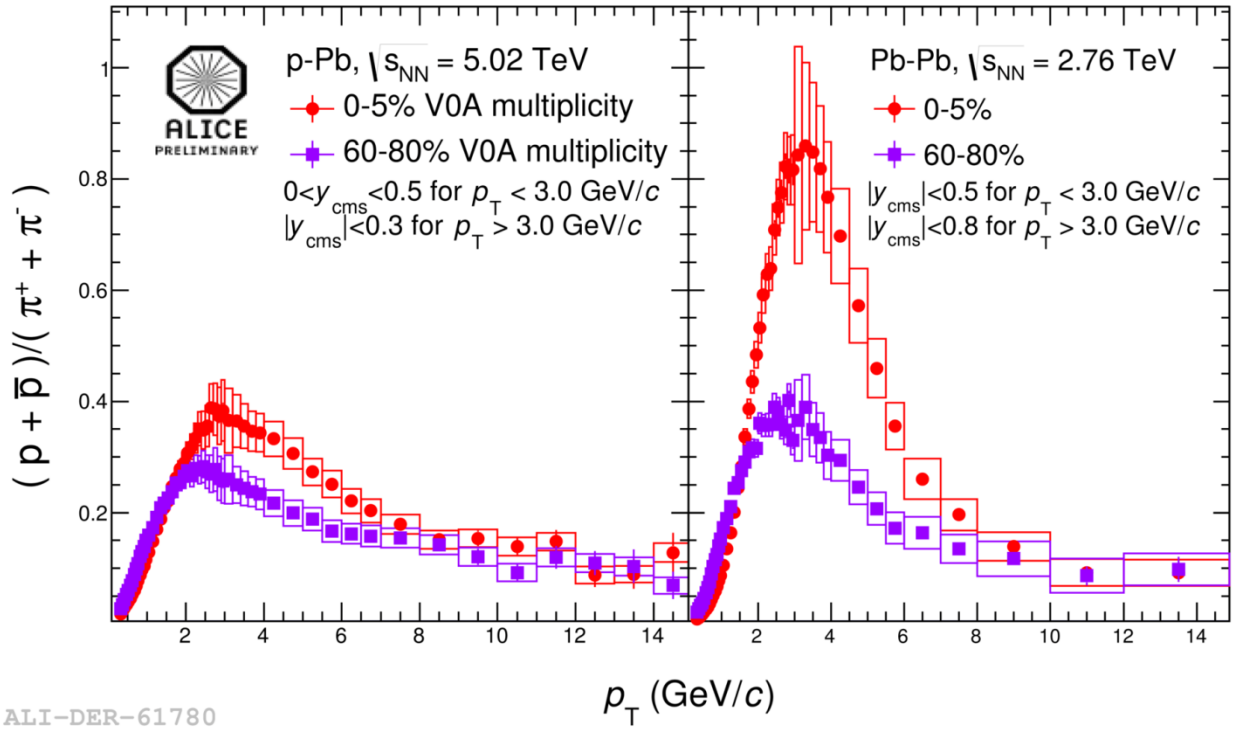


ALICE, arXiv:1307.6796

- Models:
  - ⇨ Blast-wave fit = locally thermalized medium expanding with collective flow velocity
  - ⇨ EPOS LHC = full event generator including hydrodynamical evolution
  - ⇨ Krakow = 3+1 viscous hydrodynamics (expected to work at low p_T)
  - ⇨ DPMJET = PHOJET pp +nuclei via Glauber-Grybov approach
- Models including hydrodynamics give a better description of the spectra

A. Ortiz, Mon 16:40

Baryon/meson ratios



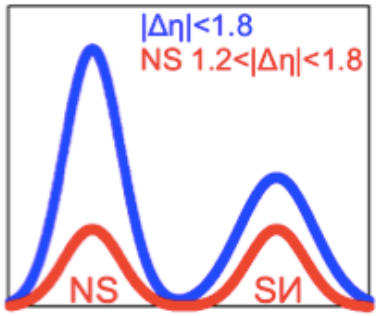
J. Otwinowski, Tue 12:00

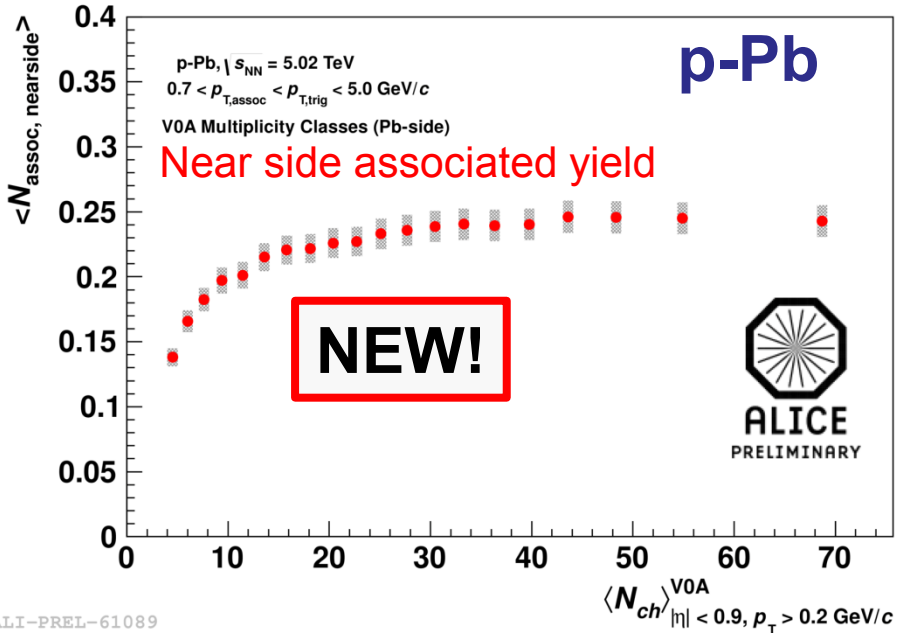
A. Ortiz, Mon 16:40

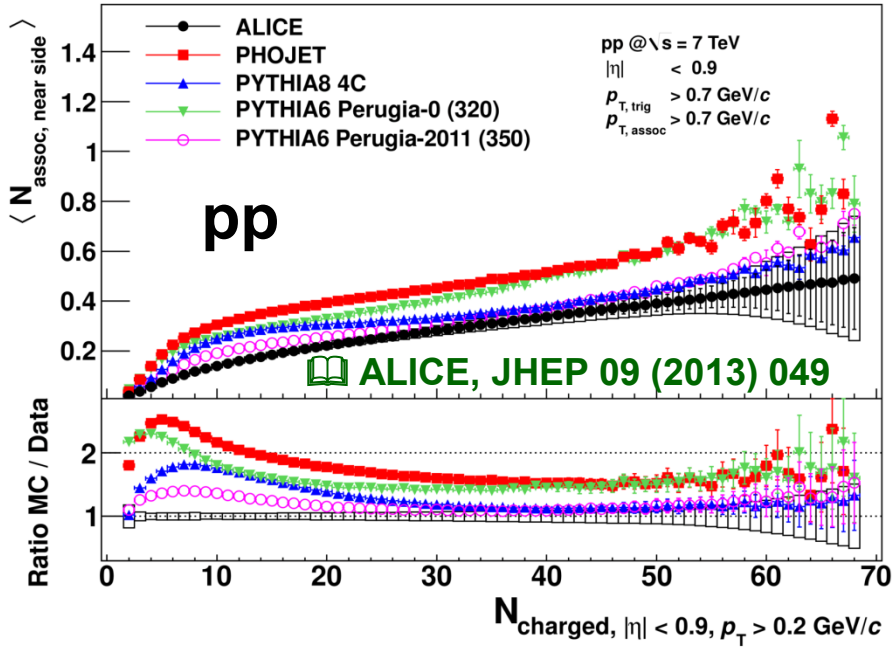
- Similar evolution of baryon/meson ratios vs. p_T with multiplicity in Pb-Pb and p-Pb collisions
  - ⇨ Enhancement at intermediate p_T
  - ⇨ Pb-Pb results commonly understood in terms of collective radial expansion and hadronization via quark recombination
  - ⇨ Magnitude of the effect significantly different in p-Pb and Pb-Pb

Mini-jets in p-Pb

- **Mini-jets**: bundles of particles from semi-hard partonic scatterings
- **How**: from associated yield in near and away sides
  - ⇨ Subtract the double ridge in p-Pb to remove the non-jet-related yield







- High multiplicity p-Pb events not built by a higher number of associated particles in the jet peaks
  - ⇨ Different from what observed in pp

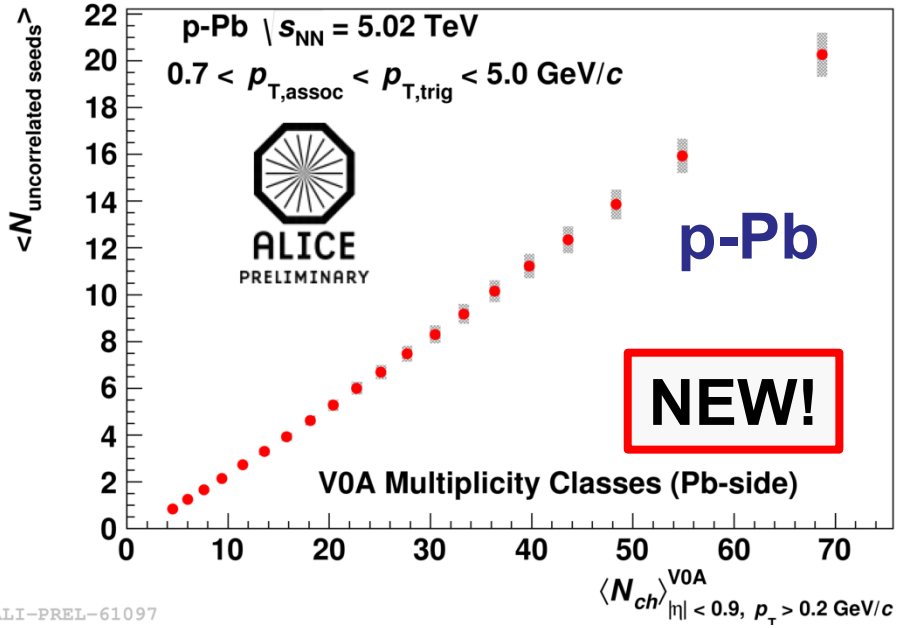
E. Leogrande, Thu 14:10

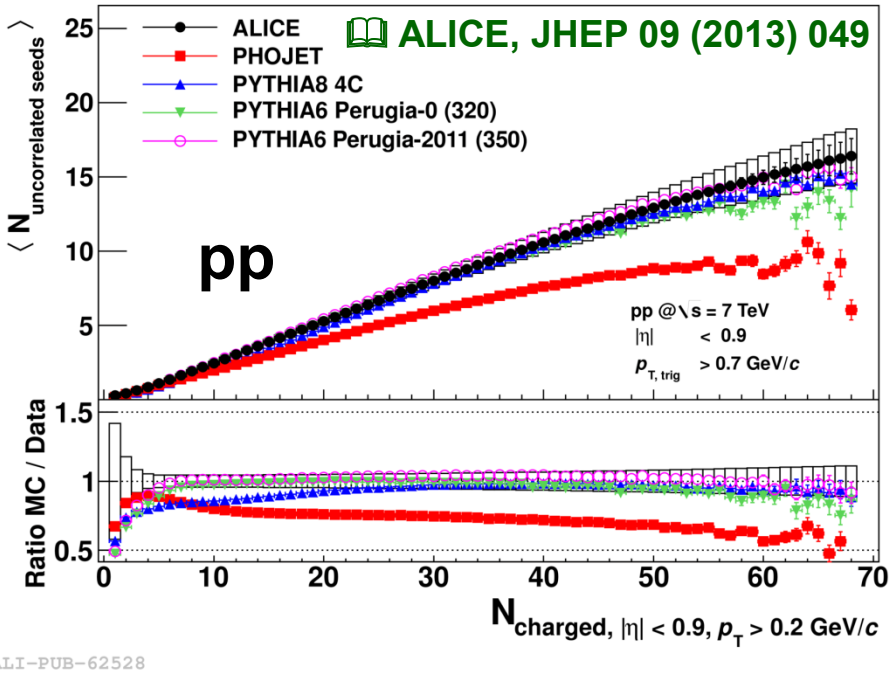
Mini-jets and MPIs

- Uncorrelated seeds = number of independent sources of particle production

$$< N_{\text{uncorrelated seeds}} >= \frac{< N_{\text{trigger}} >}{< 1 + N_{\text{assoc, near+away}} >}$$

⇨ In PYTHIA strongly correlated with number of MPIs



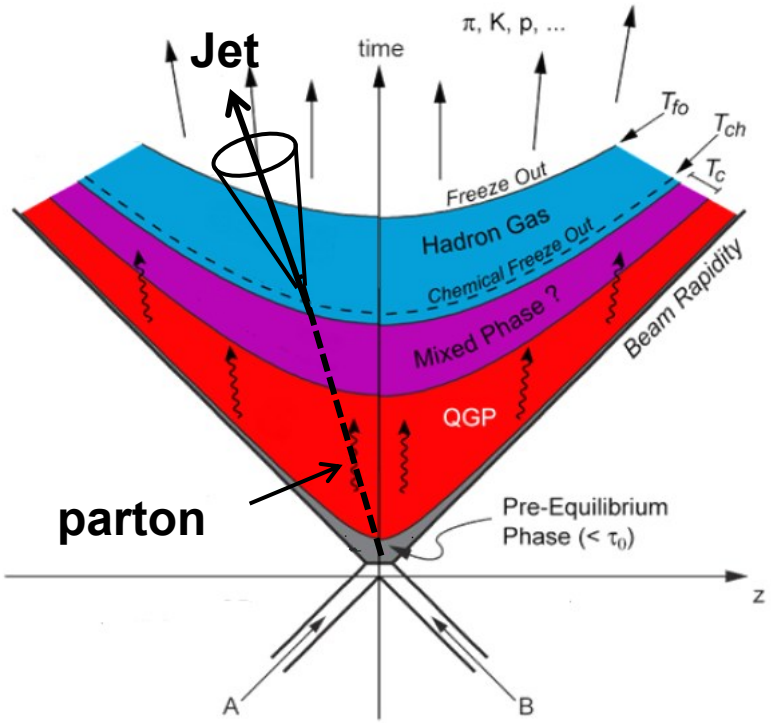


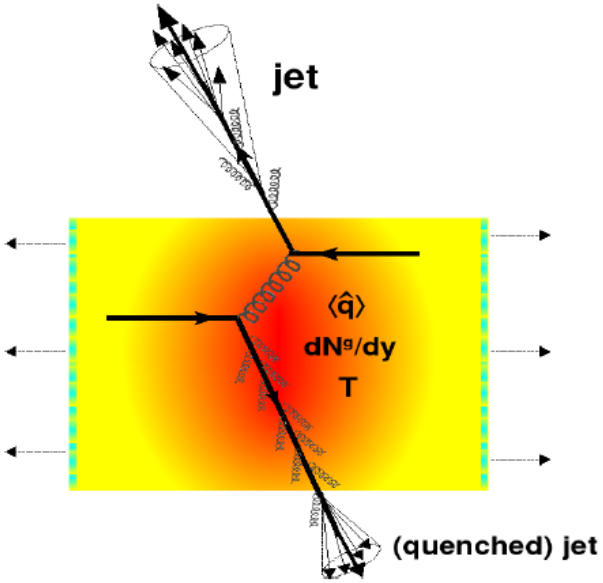
- Number of MPIs and multiplicity scale linearly in p-Pb

⇨ Different from what observed in pp

E. Leogrande, Thu 14:10

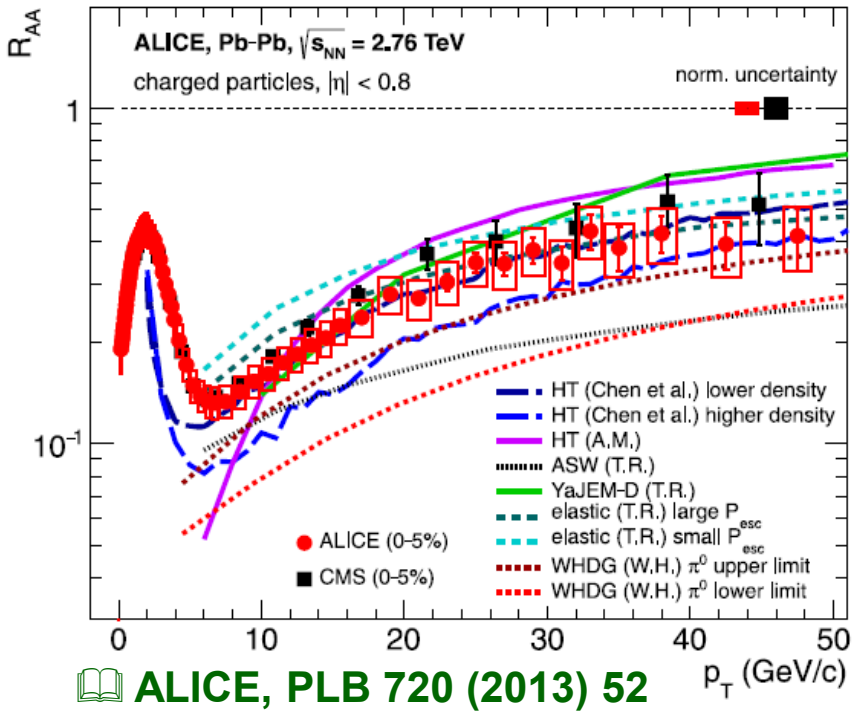
Jet quenching





Nuclear modification factor

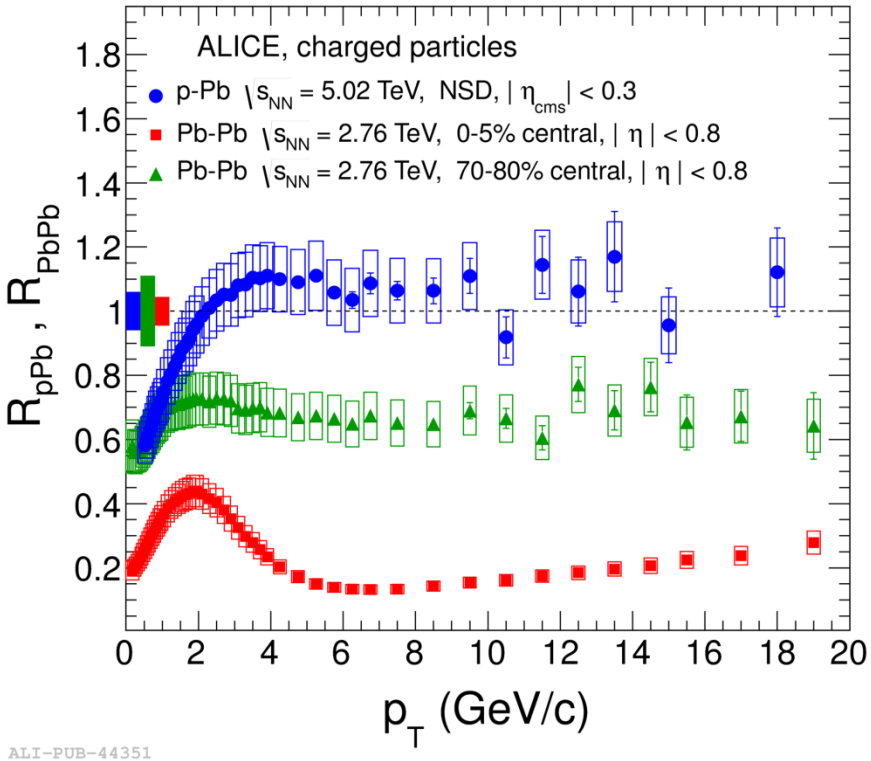
$$R_{AA}(p_T) = \frac{1}{\langle N_{coll} \rangle} \frac{dN_{AA}/dp_T}{dN_{pp}/dp_T}$$



📖 ALICE, PLB 720 (2013) 52

📖 CMS, EPJ C 72 (2012) 1945

📖 ALICE, PRL 110 (2013) 082302



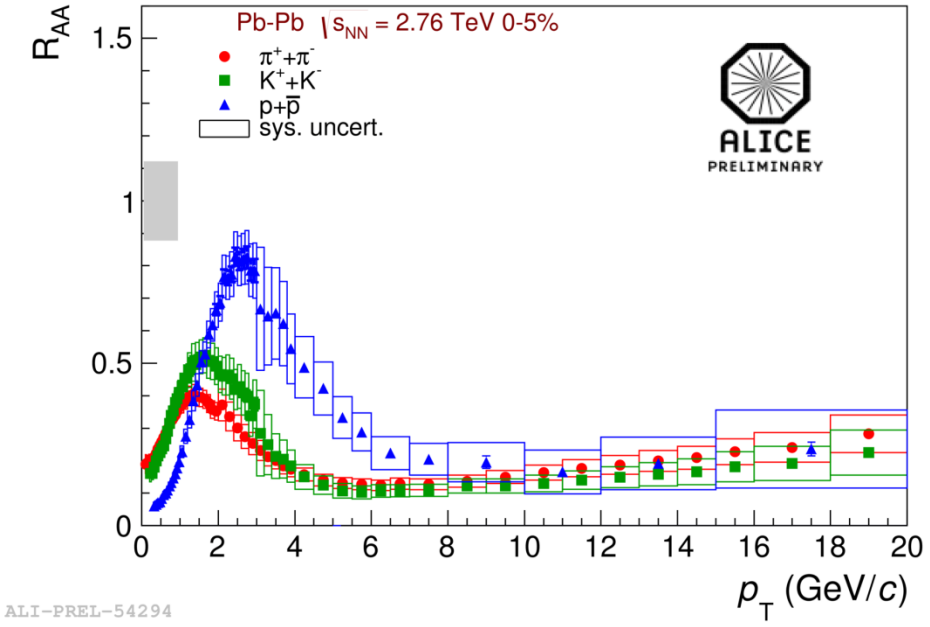
ALI-PUB-44351

- Charged particle spectra strongly modified in Pb-Pb w.r.t. pp
- p-Pb results confirm that jet quenching is a final state effect

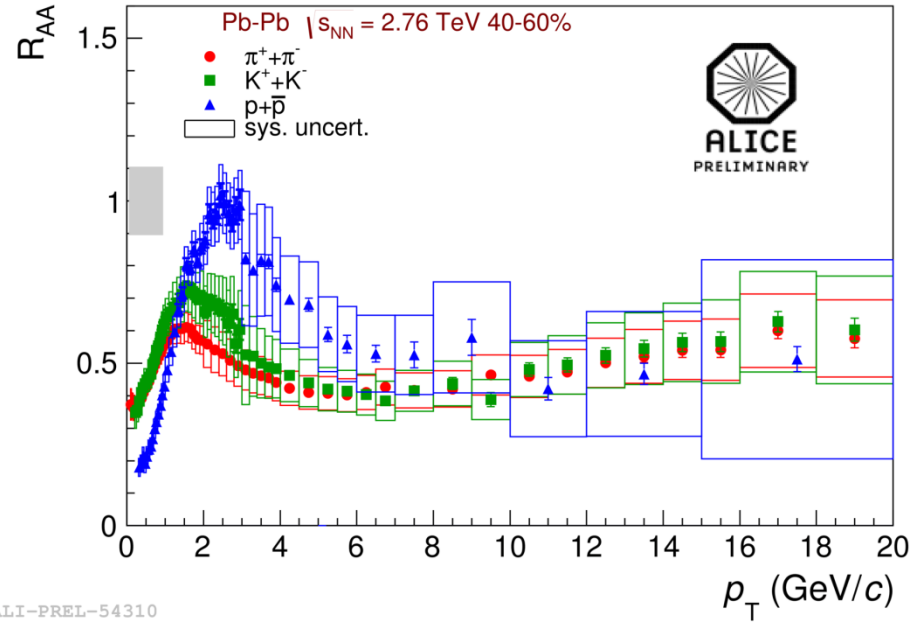
J. Otwinowski, Tue 12:00

Identified particle R_{AA}

Centrality: 0-5%



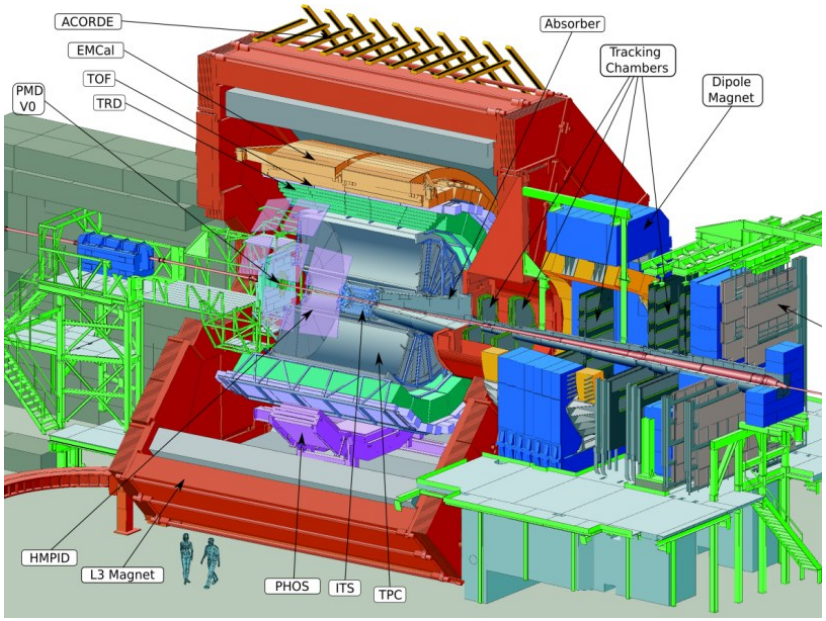
Centrality: 40-60%

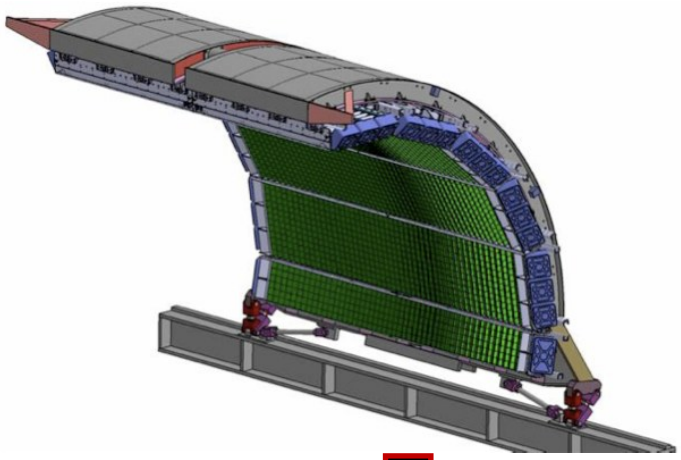


- For p_T>8 GeV/c pions, kaons and protons are equally suppressed within uncertainties
  - ⇨ Particle composition at high-p_T not affected by the medium

J. Otwinowski, Tue 12:00

Jet reconstruction



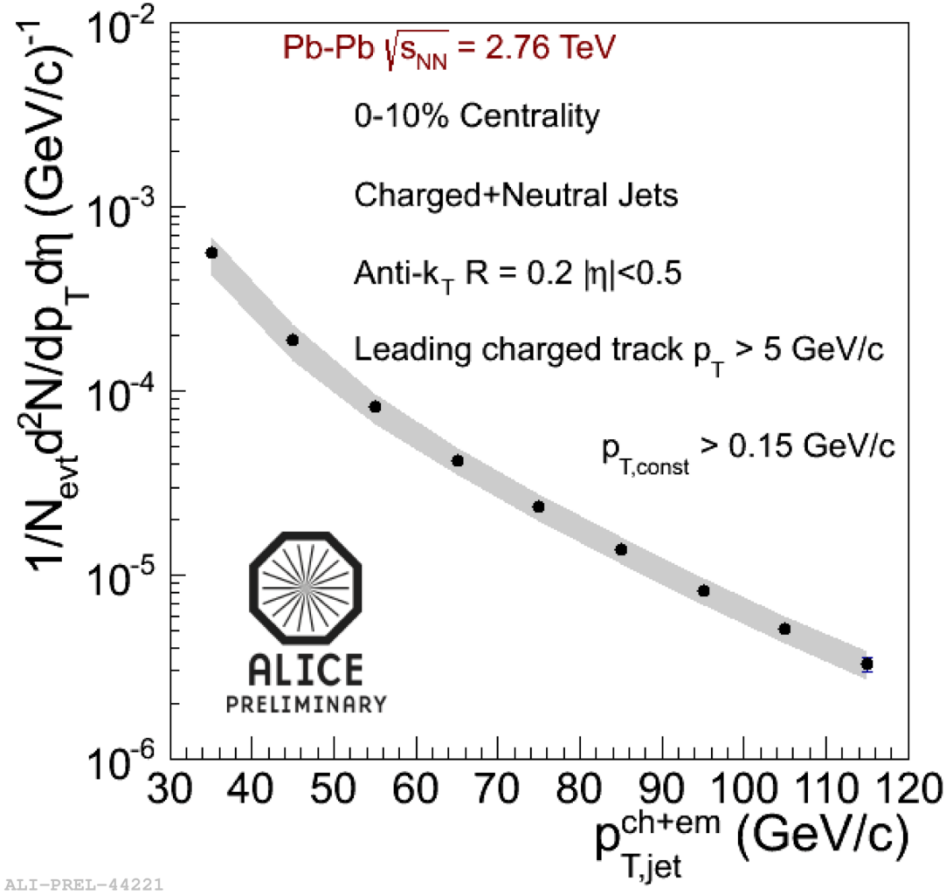


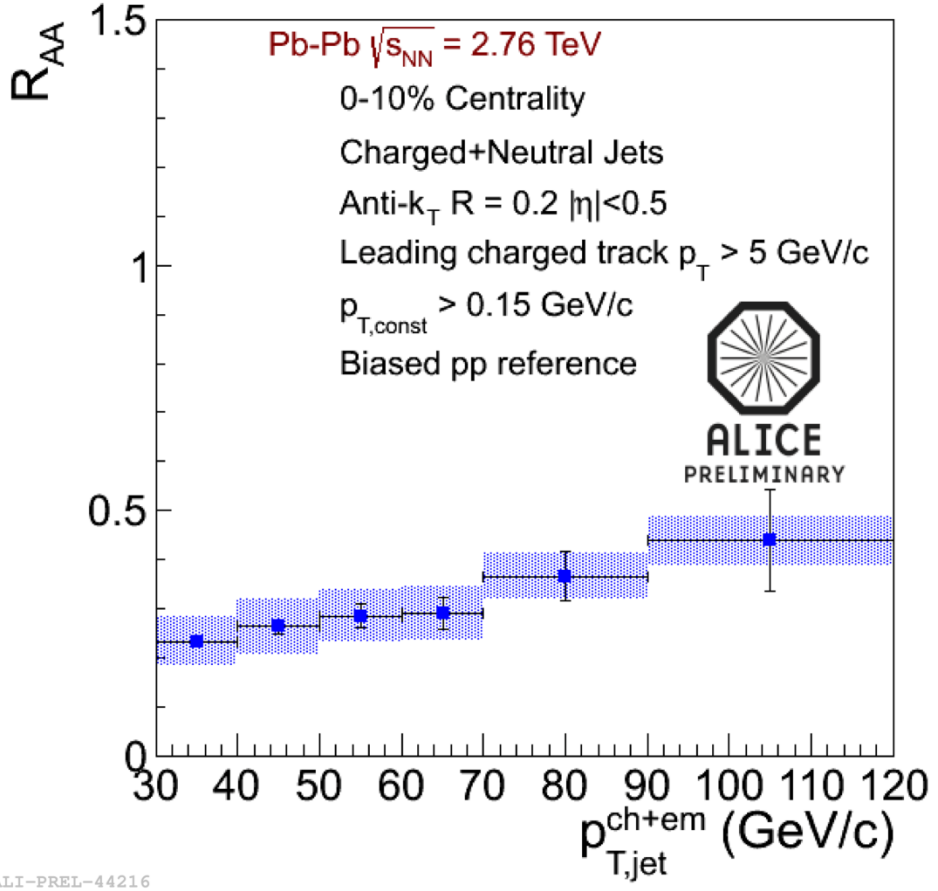
Tracking in TPC + ITS

Energy in EMCal
(corrected for energy of charged particles)

Charged constituents → **JETS** ← Neutral constituents

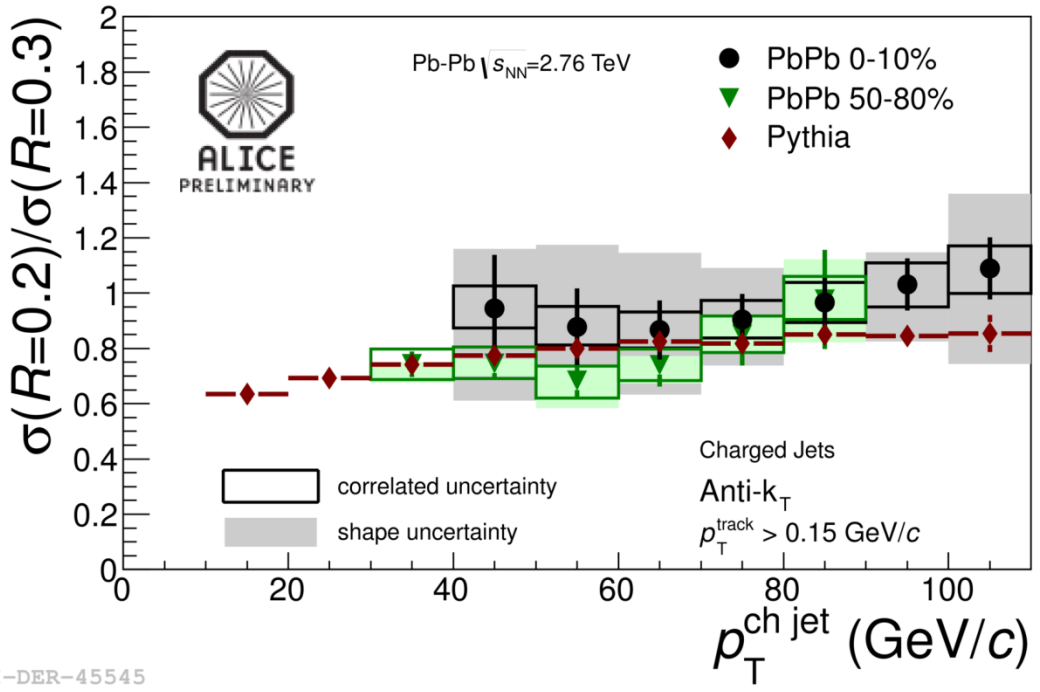
Jet cross section in Pb-Pb

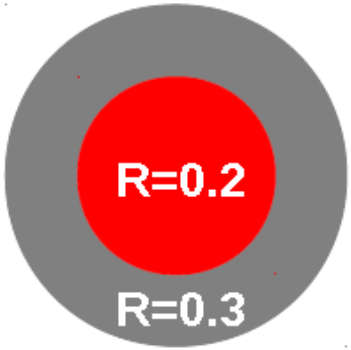




- Strong suppression of jet yield in most central Pb-Pb collisions
  - ⇨ Moderate increase of R_{AA} with increasing p_T

Jet structure in Pb-Pb



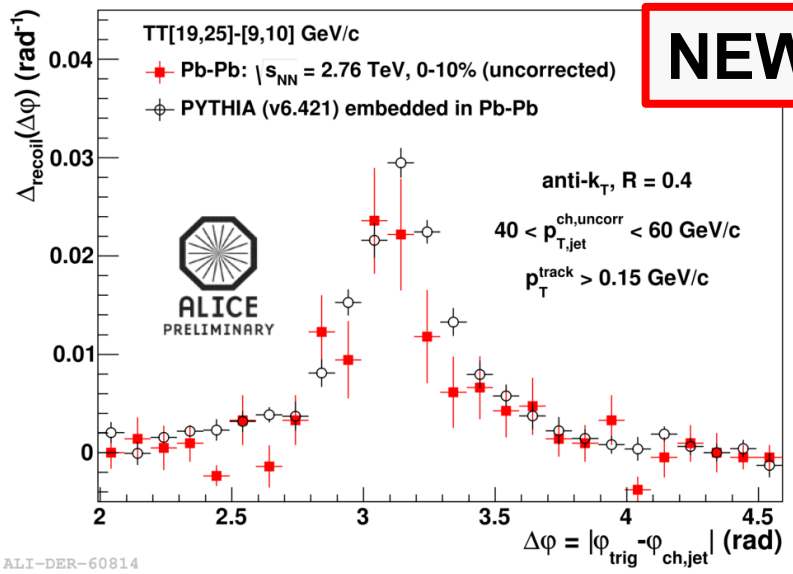


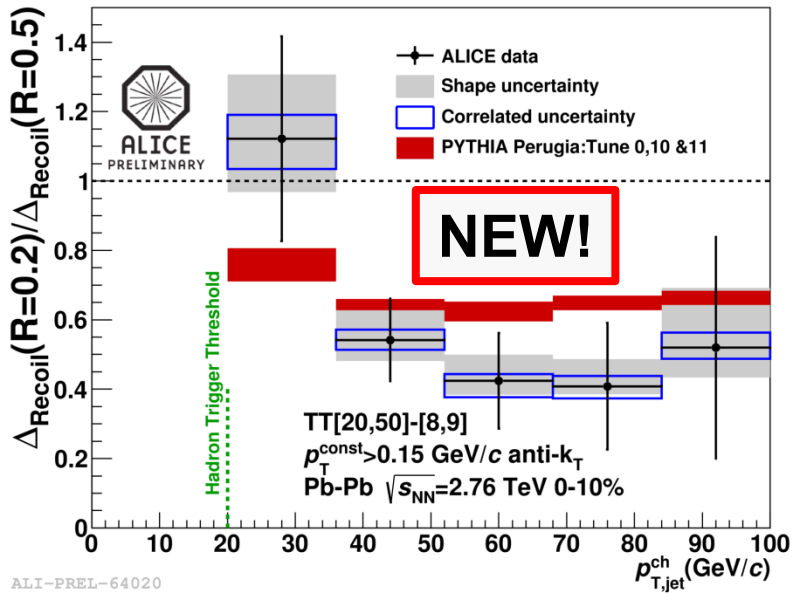
- Ratio $\sigma(R=0.2)/\sigma(R=0.3)$ of jet cross sections in Pb-Pb compatible with fragmentation in vacuum (PYTHIA)
  - ⇨Sensitive to the profile of the jet energy density
  - ⇨No evidence of jet shape modification in jet core

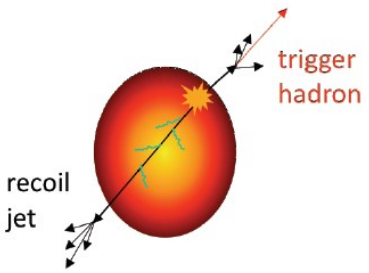
R. Reed, Tue 9:30

Hadron-Jet correlations in Pb-Pb

- Trigger on high p_T hadron and look at recoil jet







- Hadron-recoil jet $\Delta\varphi$ consistent with PYTHIA
  - ⇨ No indication for medium-induced acoplanarity, also at low p_T

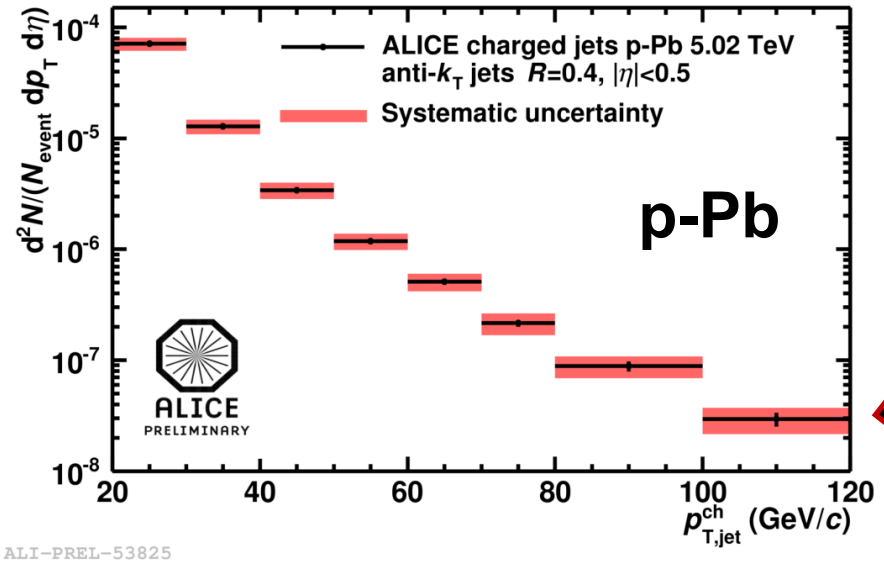
- Δ_{recoil} = difference of recoil jet spectra for two intervals of trigger hadron p_T

$$\Delta_{recoil} = \left(\frac{1}{N_{trig}}\frac{dN}{dp_{T,trigger}}\right)_{TT[20-50]} - \left(\frac{1}{N_{trig}}\frac{dN}{dp_{T,trigger}}\right)_{TT[8-9]}$$

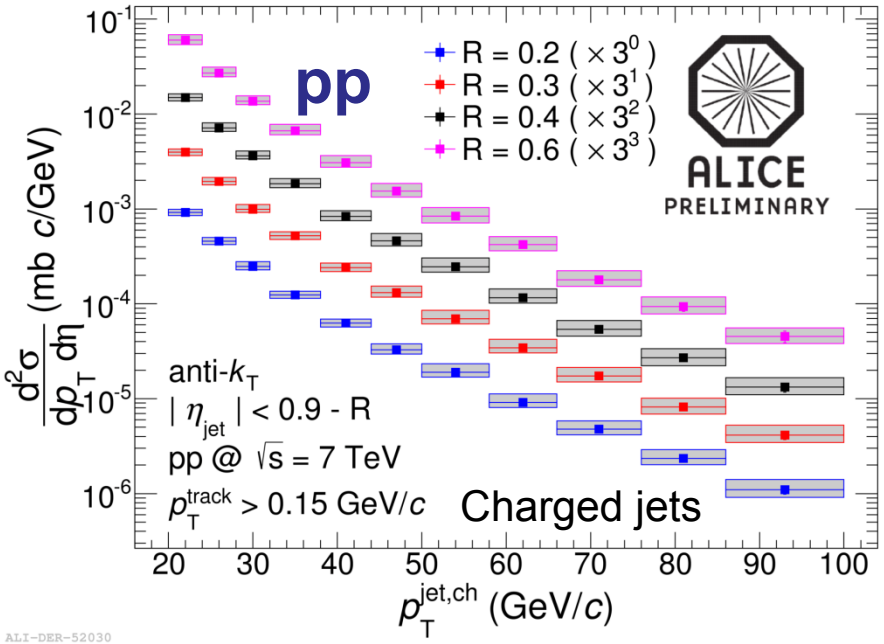
- Δ_{recoil} ratio consistent with PYTHIA
  - ⇨ No significant energy redistribution within R=0.5

L. Cunqueiro, Thu 13:50

Jet cross section in p-Pb

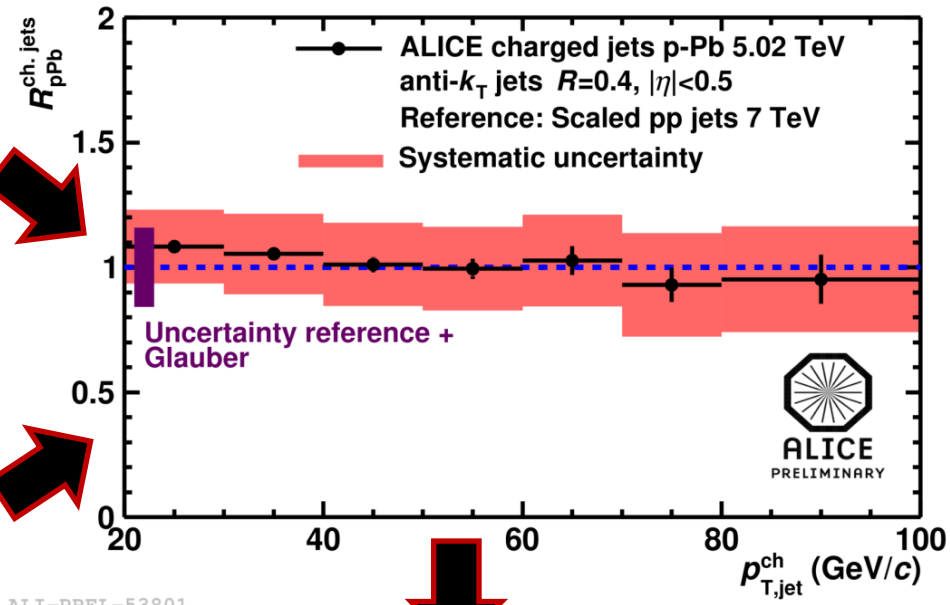


ALI-PREL-53825



ALI-DER-52030

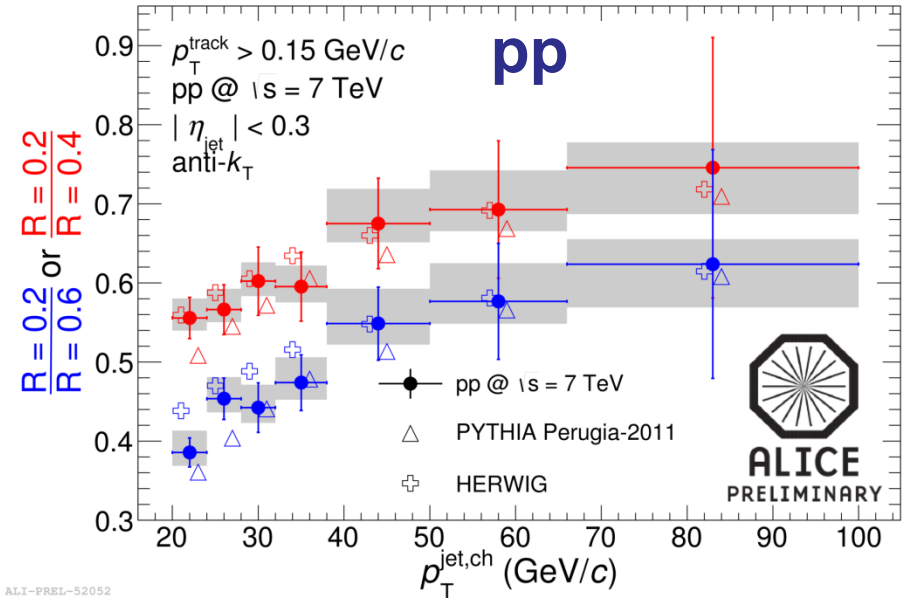
$$R_{pPb}(p_T) = \frac{1}{\langle N_{coll} \rangle} \frac{dN_{pPb}/dp_T}{dN_{pp}/dp_T}$$

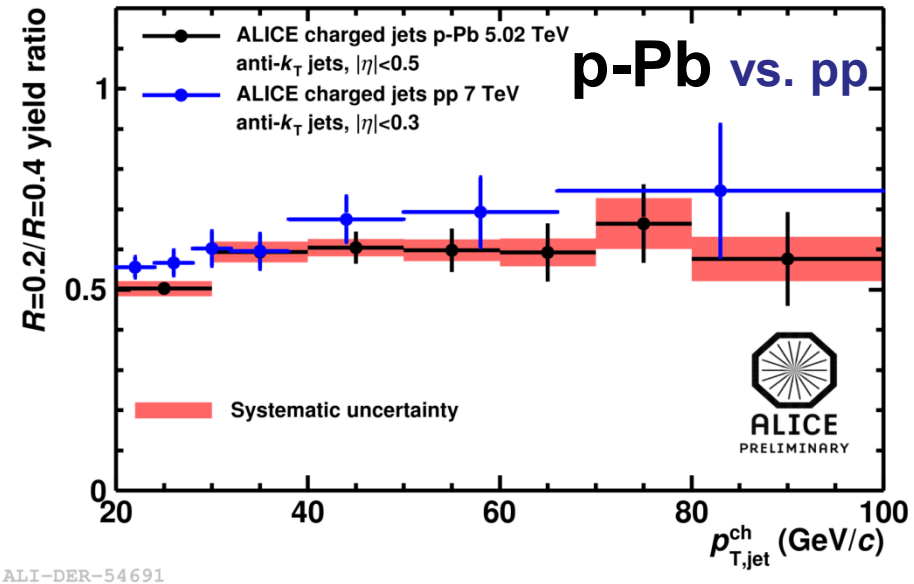


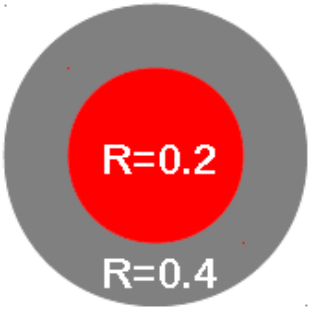
ALI-PREL-53801

- No modification of jet cross section in p-Pb relative to pp
  - ⇨Binary scaling holds

Jet structure in pp and p-Pb





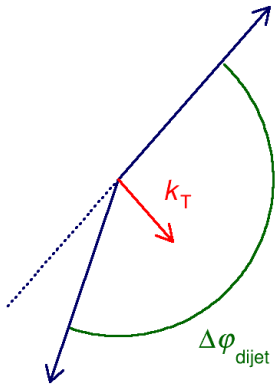


- Ratio $\sigma(R=0.2)/\sigma(R=0.4)$
  - ⇨ Sensitive to the profile of the jet energy density
  - ⇨ Compatible in p-Pb and pp (and PYTHIA)
    - ✓ ***NOTE: comparison between different √s***
  - ⇨ No indication of jet structure modification due to CNM effects

M. Verweij, Thu 14:30

Di-jets: k_T in p-Pb

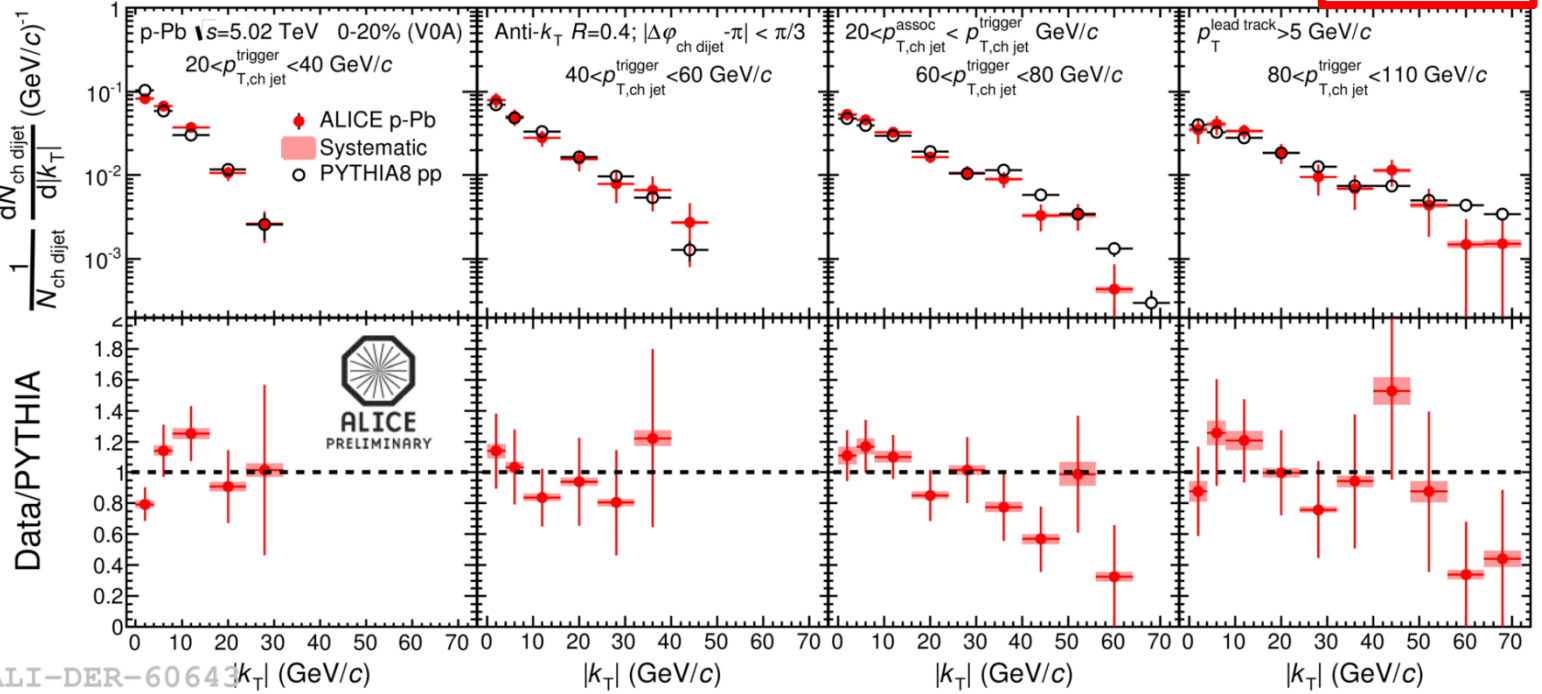
$$k_T = p_{T,\text{trigger}} \sin(\Delta\varphi_{\text{dijet}})$$



M. Verweij, Thu 14:30

increasing $p_{T,\text{trigger}}$

NEW!

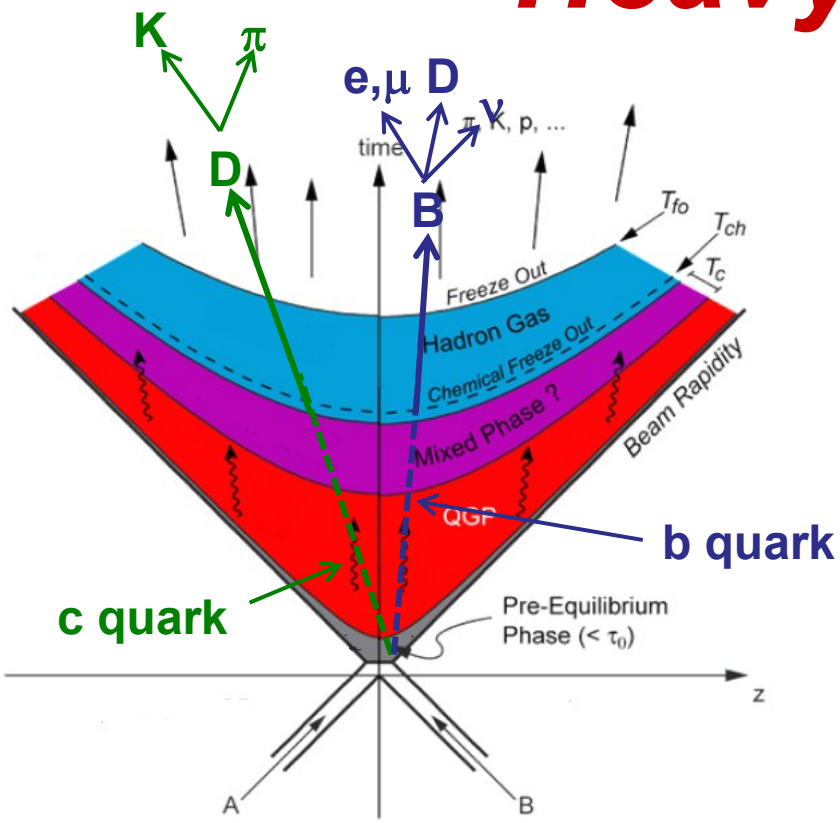


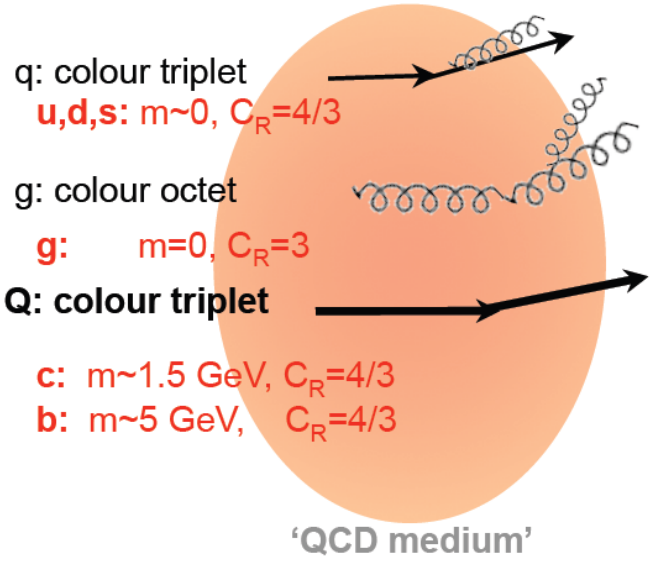
ALI-DER-60643

- Good agreement between data and PYTHIA8 (tune 4C)
  - ⇨ No indication for additional k_T in p-Pb collisions

-> No significant cold nuclear matter effects observed in jet measurements in p-Pb

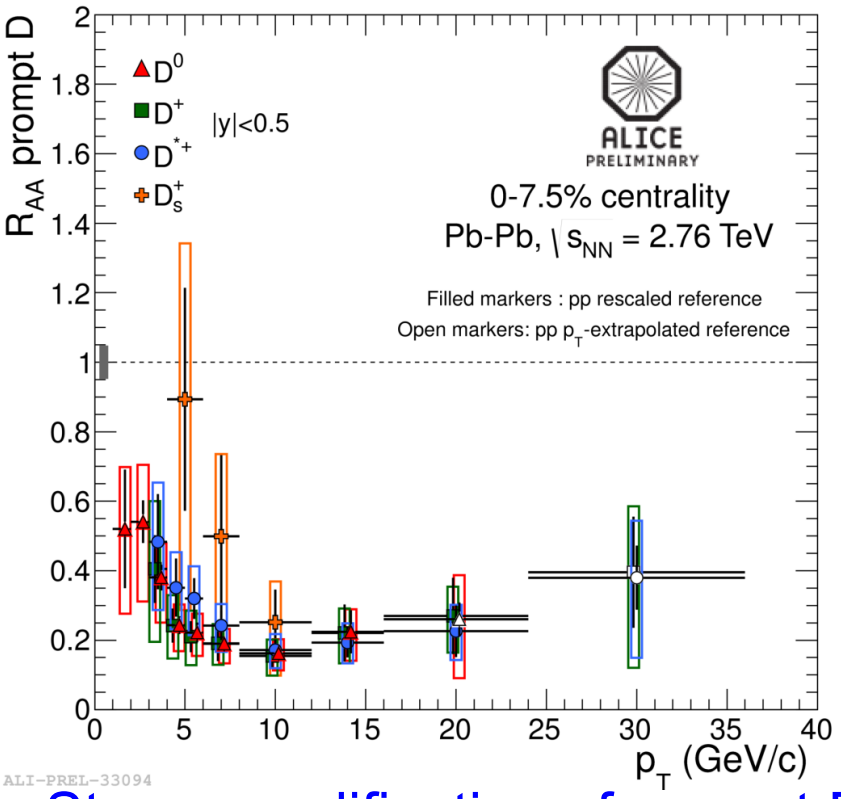
Heavy flavours

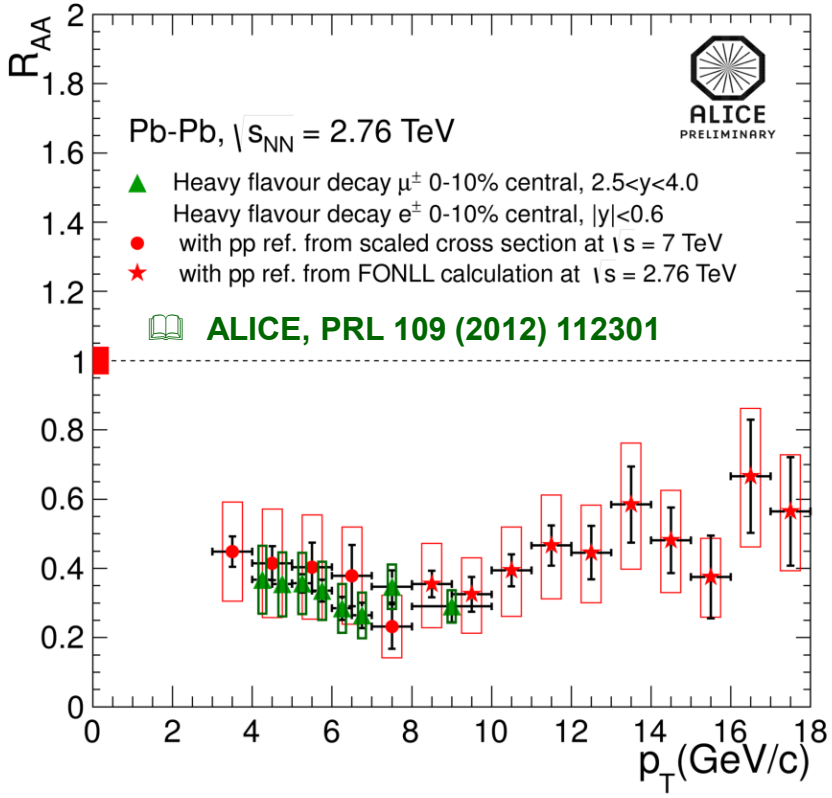




📖 Dokshitzer and Kharzeev, PLB 519 (2001) 199

Heavy-flavours: R_{AA}





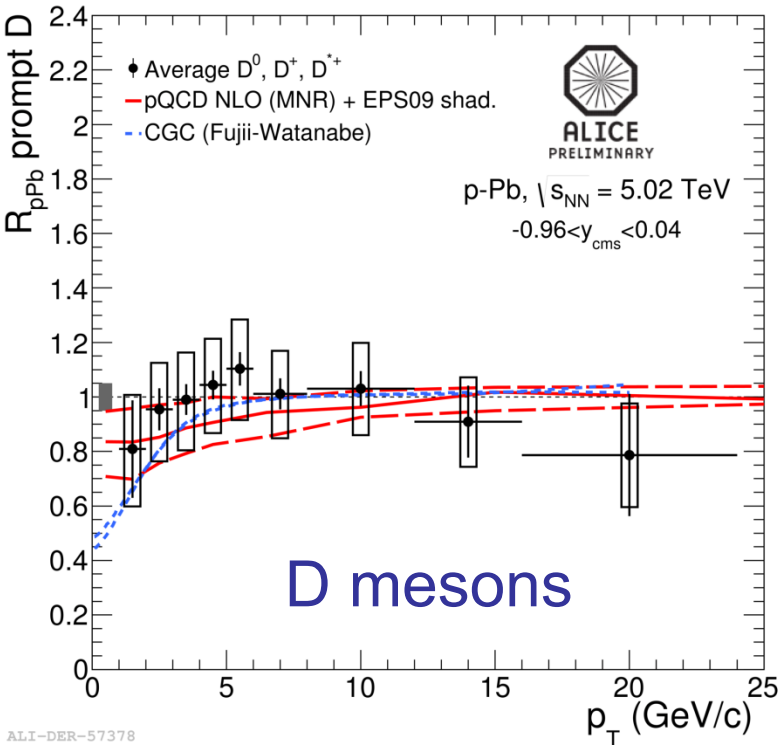
- Strong modification of prompt D meson yield
- Cannot conclude on expected enhancement of D_s/D at low/intermediate p_T

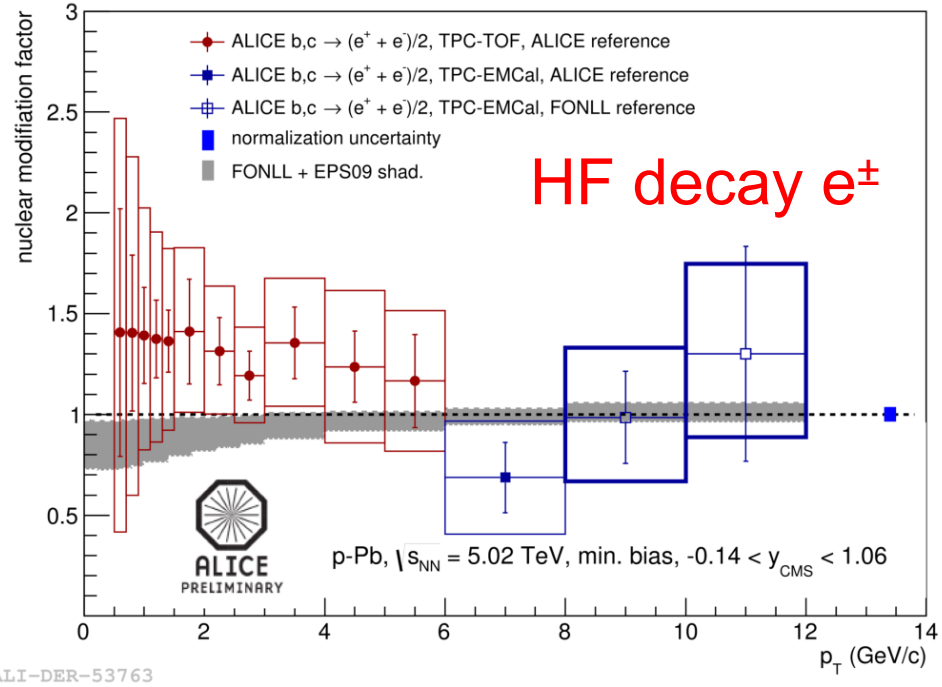
- HF decay lepton yield suppressed in $3<p_T<18$ GeV/c
- Similar R_{AA} for heavy-flavour decay electrons (|y|<0.6) and muons (2.5<y<4)

Kuznetsova, Rafelski, EPJ C 51 (2007) 113
He, Fries, Rapp, arXiv:1204.4442

S. Li, Mon 13:30

Heavy-flavours in p-Pb



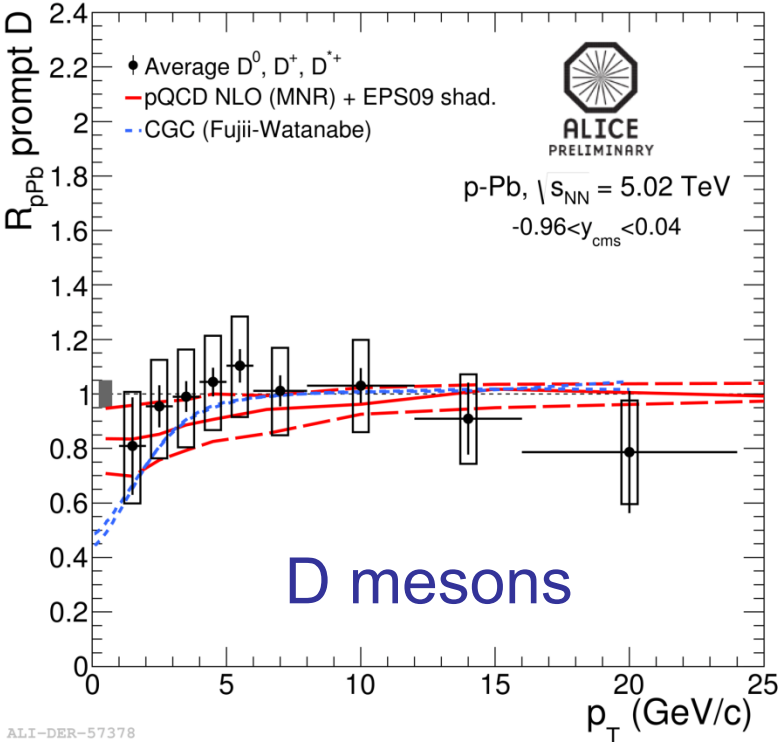


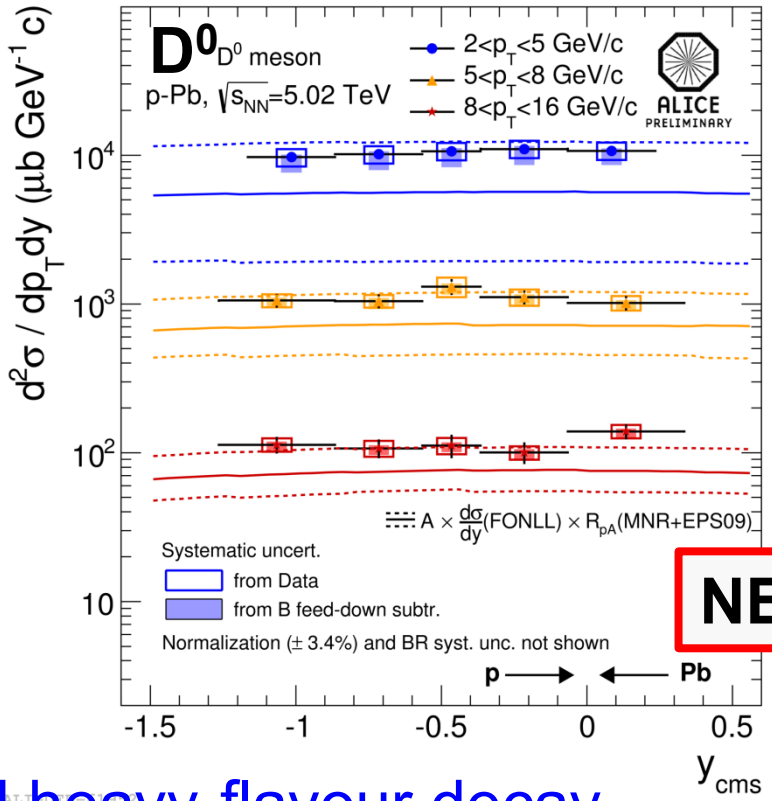
- R_{pPb} of prompt D mesons and heavy-flavour decay electrons compatible with unity in the measured p_T range
  - ⇨ Data described both by EPS09 parameterization of nuclear PDFs and by Color-Glass-Condensate approach

E. Pereira, Tue 14:30

📖 FONLL: M. Cacciari et al, JHEP0407 (2004) 033
📖 EPS09: K. J. Eskola et al., JHEP 0904 (2009) 065
📖 CGC: H. Fujii, K. Watanabe, arXiv: 1308.1258

Heavy-flavours in p-Pb





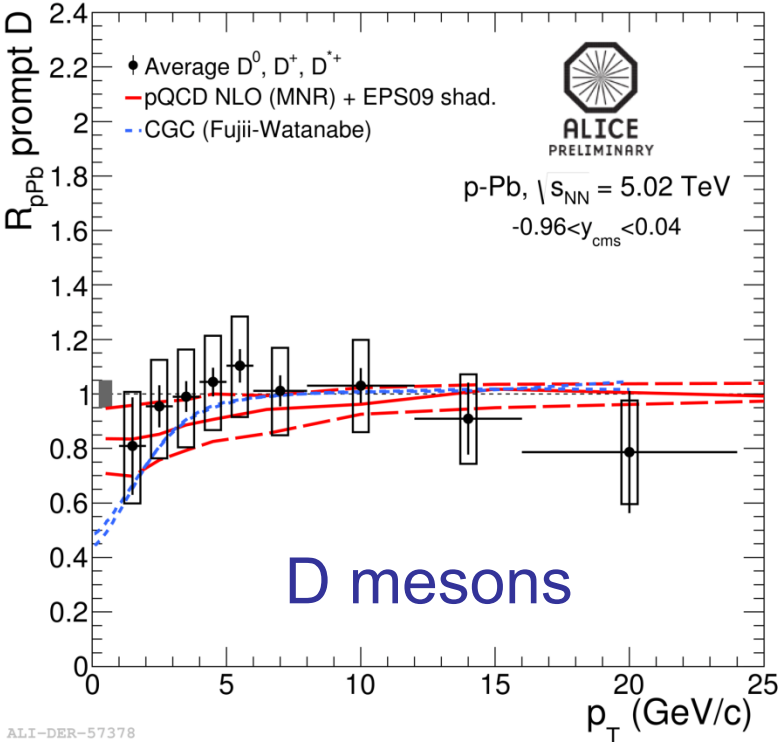
NEW!

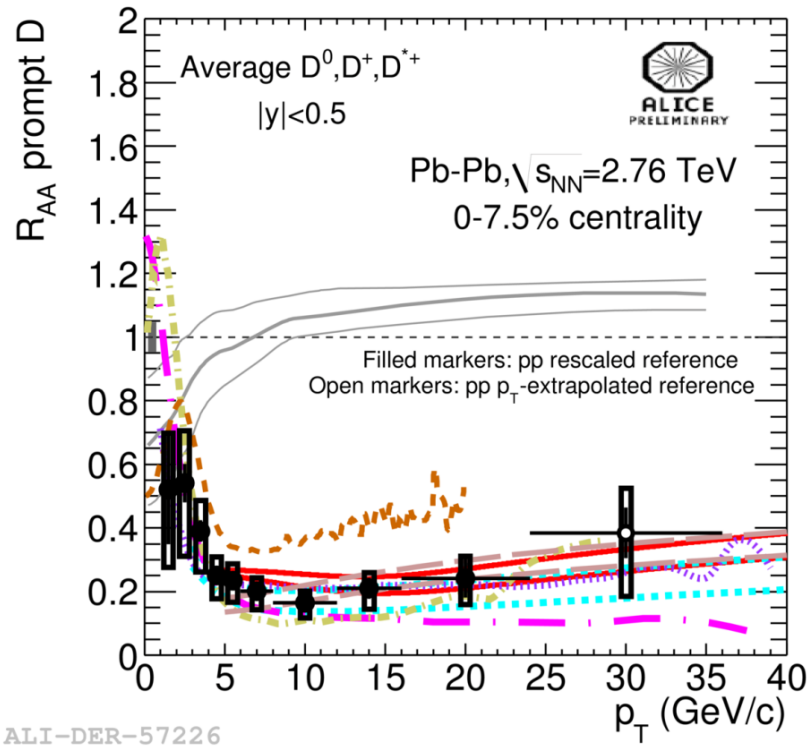
- R_{pPb} of prompt D mesons and heavy-flavour decay electrons compatible with unity in the measured p_T range
  - ⇨ Data described both by EPS09 parameterization of nuclear PDFs and by Color-Glass-Condensate approach

A. Rossi, Mon 14:50

📖 FONLL: M. Cacciari et al, JHEP0407 (2004) 033
📖 EPS09: K. J. Eskola et al., JHEP 0904 (2009) 065
📖 CGC: H. Fujii, K. Watanabe, arXiv: 1308.1258

D mesons: p-Pb and Pb-Pb





-> the suppression observed in Pb-Pb is a **final state effect**

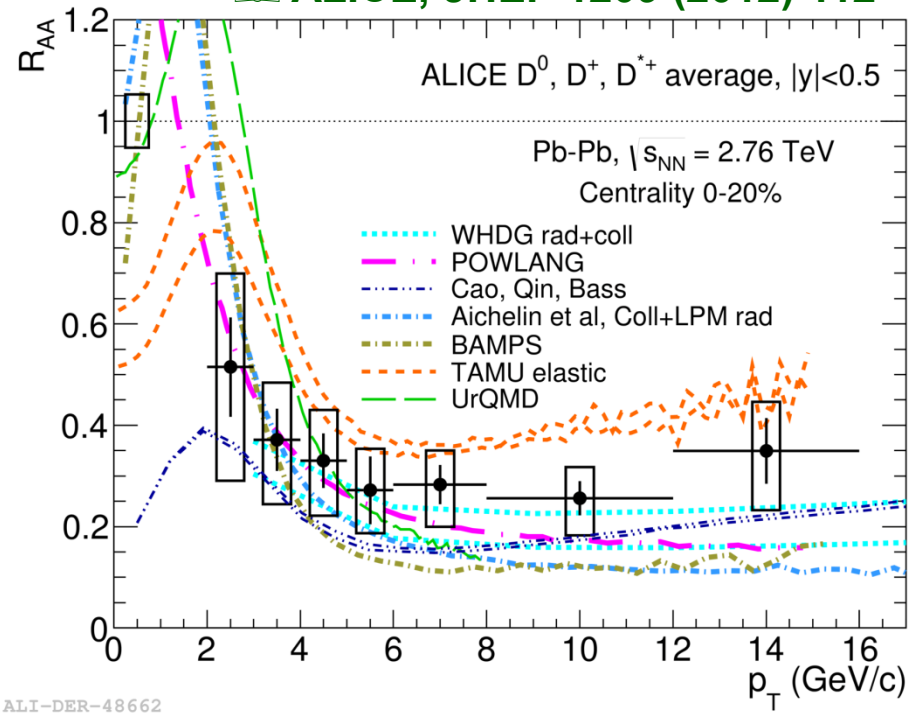
- FONLL: M. Cacciari et al, JHEP0407 (2004) 033
- EPS09: K. J. Eskola et al., JHEP 0904 (2009) 065
- CGC: H. Fujii, K. Watanabe, arXiv: 1308.1258
- Vitev et al.: PLB 713 (2012) 224
- WHDG: Horowitz et al., J Phys. G38 (2011) 124114
- POWLANG: Alberico et al., EPJ C71 (2011) 1666
- BAMPS: Fochler et al., J. Phys. G38 (2011) 124152
- BDMPS: Armesto et al. PRD71 (2005) 054027
- TAMU: Rapp, He et al., PRC 86 (2012) 014903
- Djordjevic et al.: arXiv:1307.4098

NLO(MNR) with EPS09 shad.
Rad+dissoc (0-20%)
WHDG rad+coll
POWLANG (Beraudo et al.)
BAMPS
BDMPS-ASW rad $\hat{q}$=25
Rapp et al.
Djordjevic

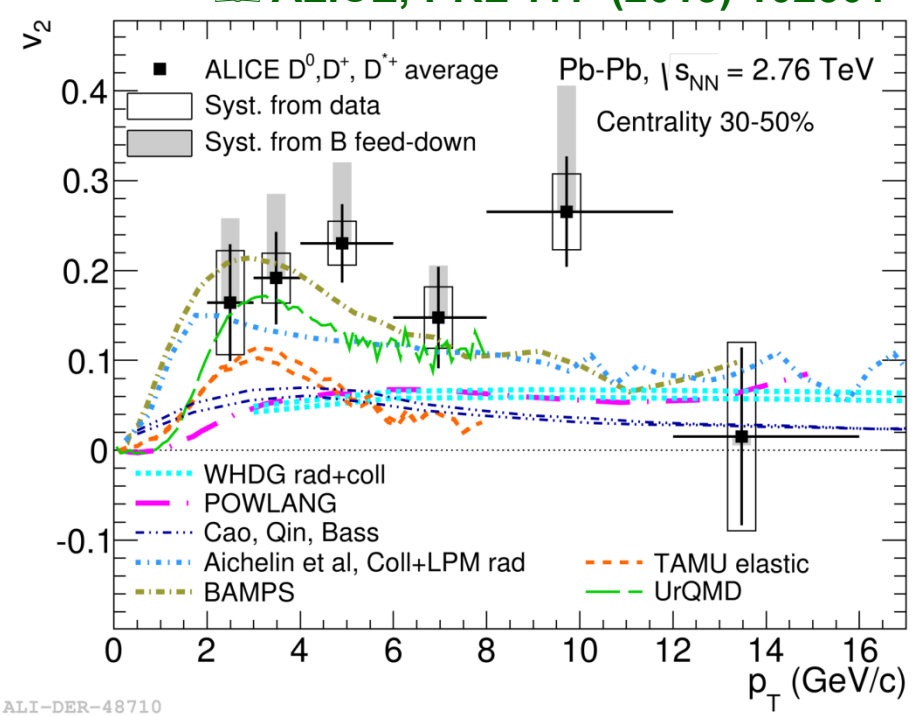
Open charm R_{AA} and v_2

- Simultaneous description of open charm R_{AA} and v_2 is a challenge for theoretical models

📖 ALICE, JHEP 1209 (2012) 112



📖 ALICE, PRL 111 (2013) 102301

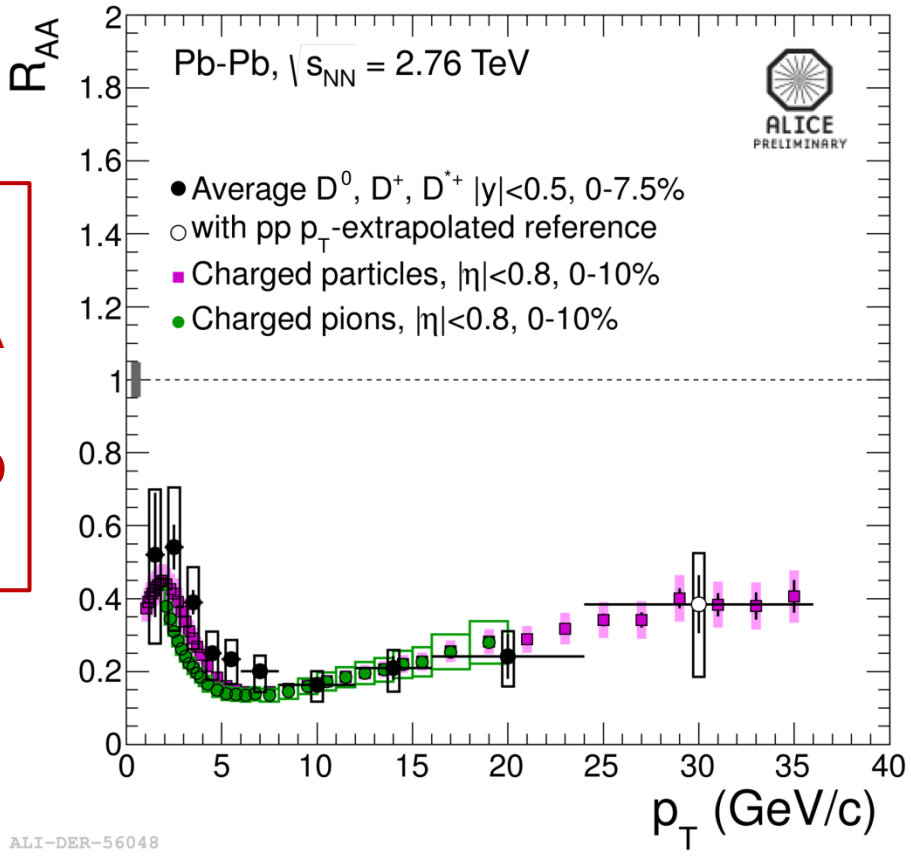


📖 WHDG: Horowitz et al., J Phys. G38 (2011) 124114
📖 POWLANG: Alberico et al., EPJ C71 (2011) 1666
📖 Cao, Qin, Bass, arXiv:1308.0617
📖 Aichelin et al.:PRC79 (2009) 044906, J. Phys. G37 (2010) 094019
📖 BAMPS: Fochler et al., J. Phys. G38 (2011) 124152
📖 TAMU: Rapp, He et al., PRC 86 (2012) 014903
📖 UrQMD: Lang et al, arXiv:1211.6912, arXiv:1212.0696

Hierarchy in energy loss?

- Expectation from radiative energy loss: $\Delta E_g > \Delta E_{u,d,s} > \Delta E_c > \Delta E_b$
- Could be reflected in an hierarchy of R_{AA}: $R_{AA}(B) > R_{AA}(D) > R_{AA}(\pi)$

D meson and **pion** R_{AA} vs. p_T in central Pb-Pb collisions



-> RAA(D) and RAA(π) found to be compatible within uncertainties

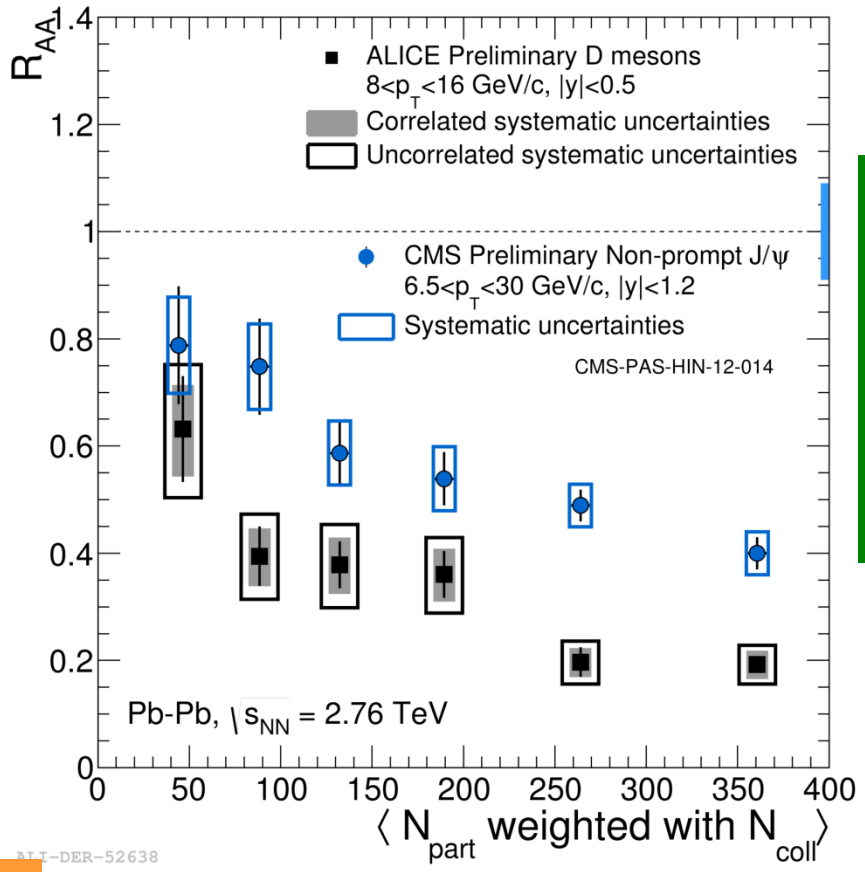
-> measurement not yet conclusive

⇨ NOTE: comparison of D and π R_{AA} complicated by different fragmentation, different p_T spectra, and by soft π production (scaling with N_{part}) at low p_T

Hierarchy in energy loss?

- Expectation from radiative energy loss: $\Delta E_g > \Delta E_{u,d,s} > \Delta E_c > \Delta E_b$
- Could be reflected in an hierarchy of R_{AA}: $R_{AA}(B) > R_{AA}(D) > R_{AA}(\pi)$

D meson and **J/ψ←B** (from CMS) R_{AA} vs. centrality in p_T ranges tuned to have $\langle p_T(D) \rangle \approx \langle p_T(B) \rangle$



-> clear indication for $R_{AA}(B) > R_{AA}(D)$

->consistent with the expectation $\Delta E_c > \Delta E_b$

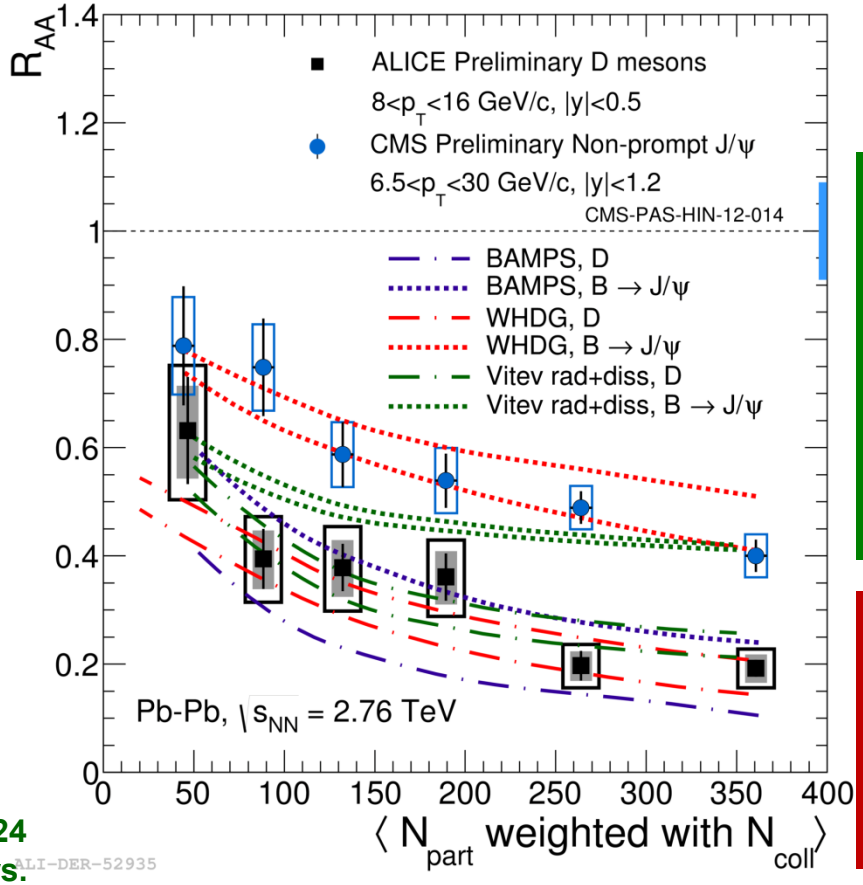
📖 **CMS-PAS-HIN-12-014**

D. Caffarri, Wed 9:00
A. Rossi, Mon 14:50

Hierarchy in energy loss?

- Expectation from radiative energy loss: $\Delta E_g > \Delta E_{u,d,s} > \Delta E_c > \Delta E_b$
- Could be reflected in an hierarchy of R_{AA}: $R_{AA}(B) > R_{AA}(D) > R_{AA}(\pi)$

D meson and **J/ψ←B** (from CMS) R_{AA} vs. centrality in p_T ranges tuned to have $\langle p_T(D) \rangle \approx \langle p_T(B) \rangle$



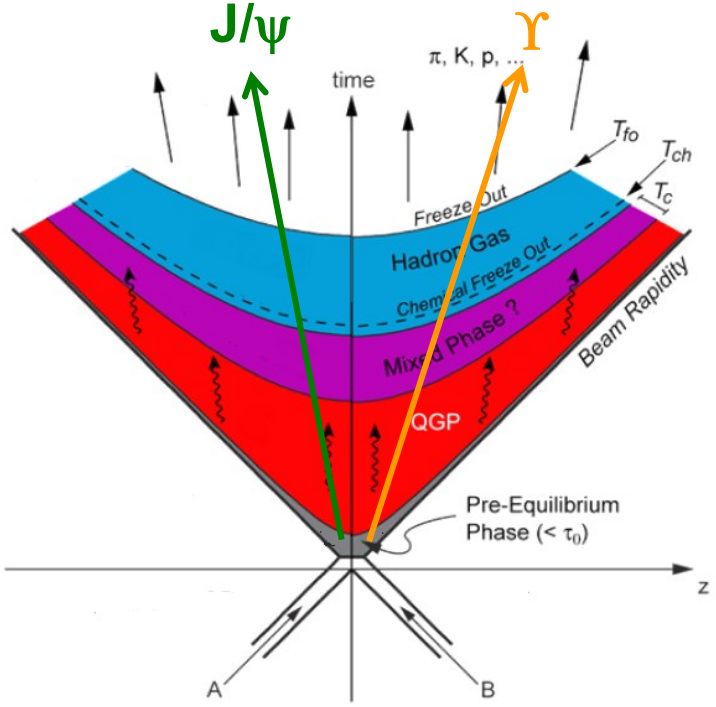
-> clear indication for $R_{AA}(B) > R_{AA}(D)$

->consistent with the expectation $\Delta E_c > \Delta E_b$

-> first clear indication of a dependence on heavy quark mass

- Vitev et al.: PLB 713 (2012) 224
- WHDG: Horowitz et al., J Phys. G38 (2011) 124114
- BAMPS: Fochler et al., J. Phys. G38 (2011) 124152

Quarkonia



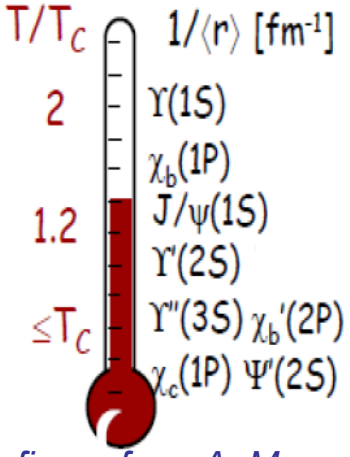
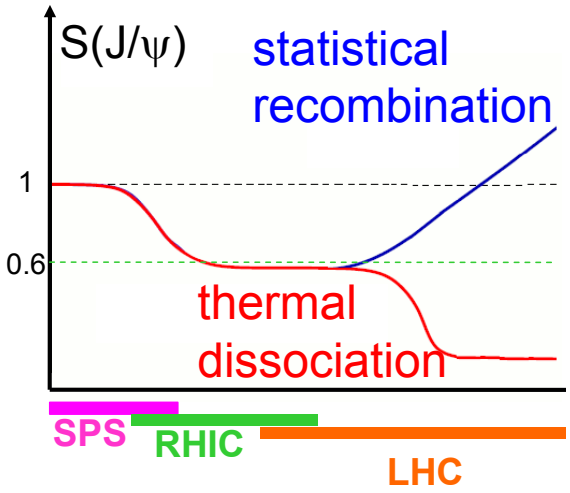
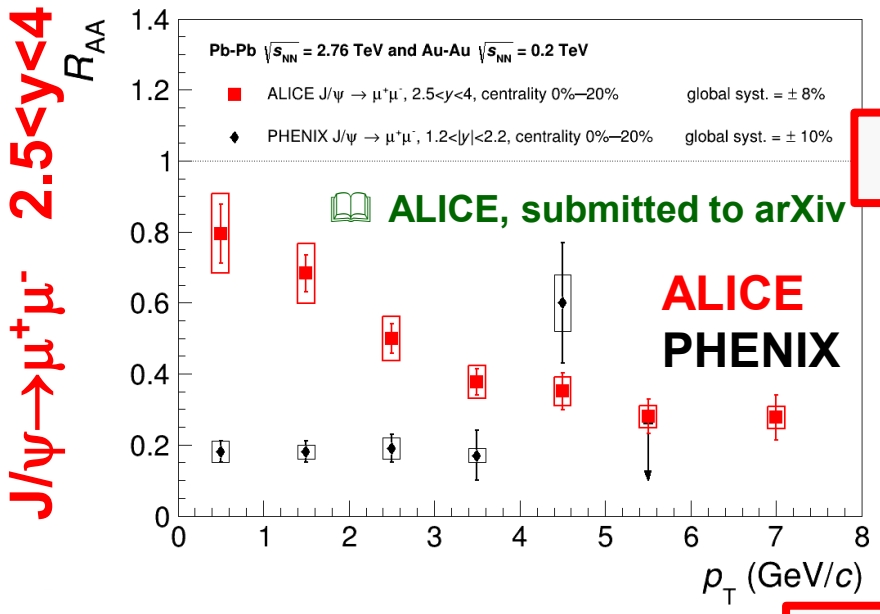


figure from A. Mocsy

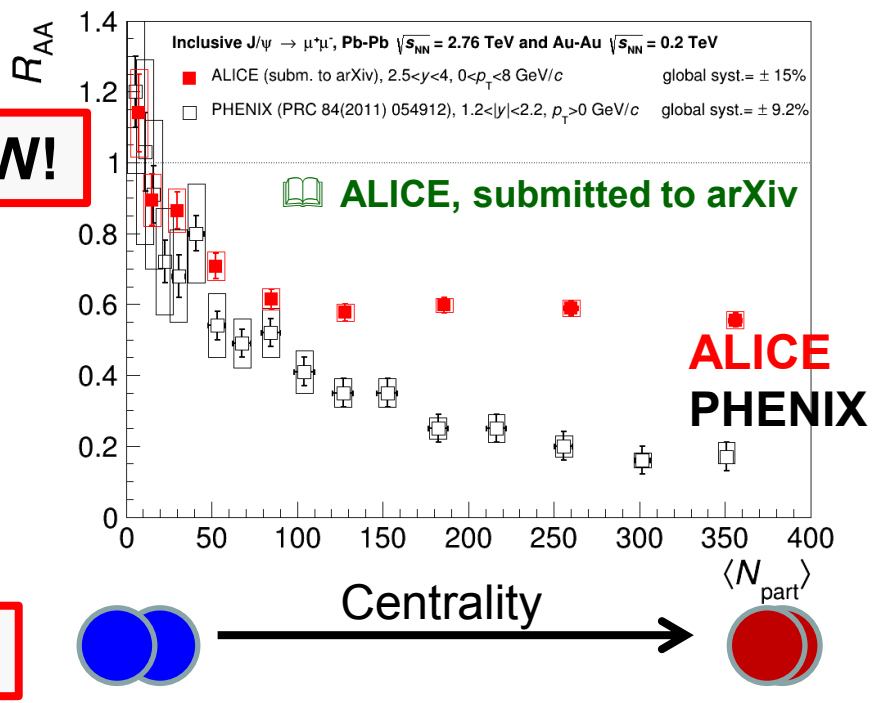


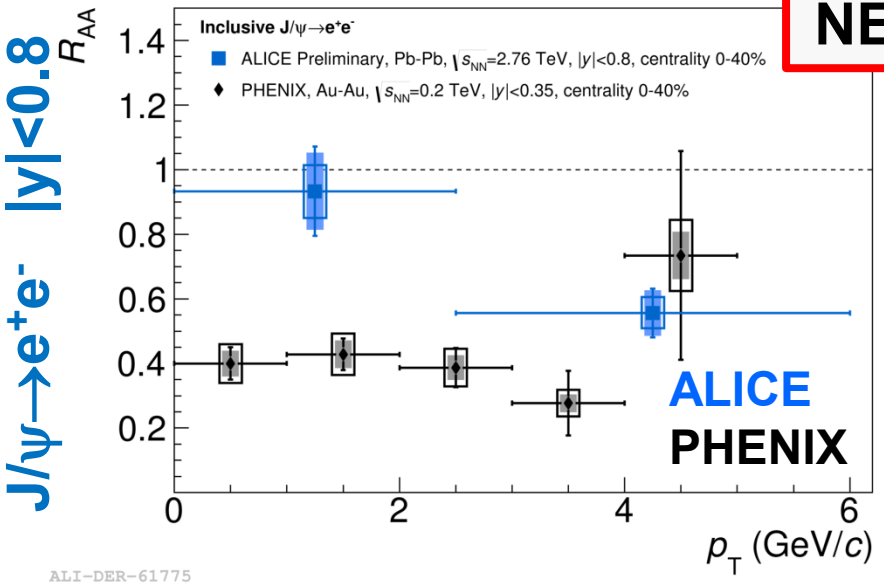
- Matsui, Satz, PLB178 (1986) 416
- Digal et al., PRD64 (2001) 094015
- Braun-Munzinger, Stachel, PLB 490 (2000) 196

J/ψ production in Pb-Pb



NEW!





NEW!

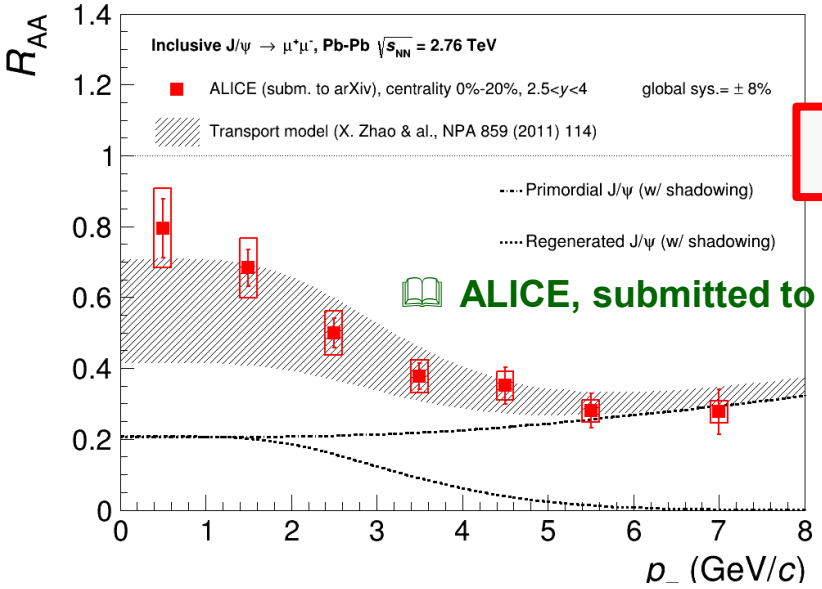
- J/ψ less suppressed at low p_T than at high p_T
- Different p_T and centrality dependence of J/ψ R_{AA} at RHIC and LHC

-> new regime for J/ψ production!

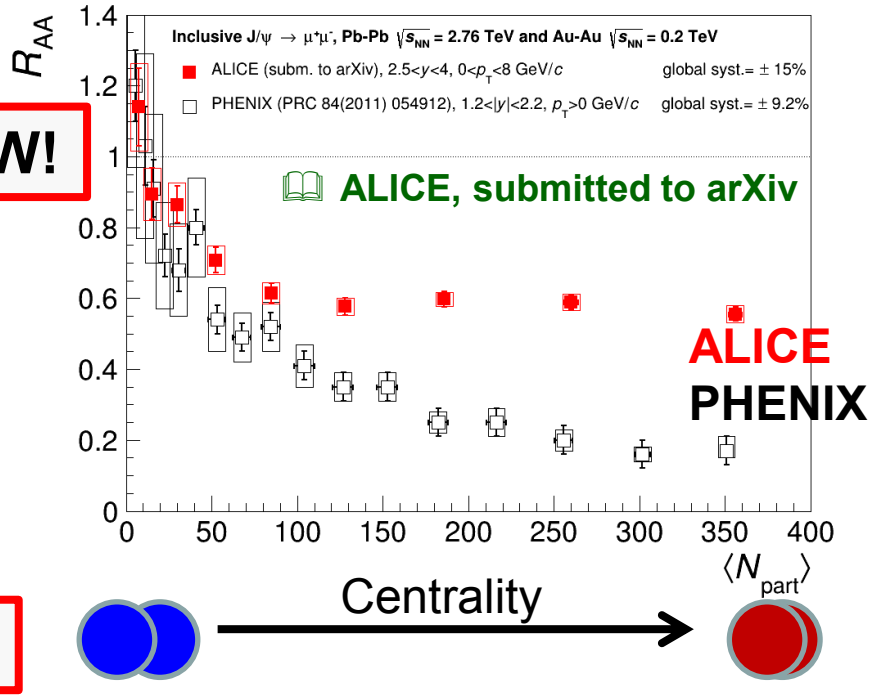
C. Hadjidakis, Fri 11:30

J/ψ production in Pb-Pb

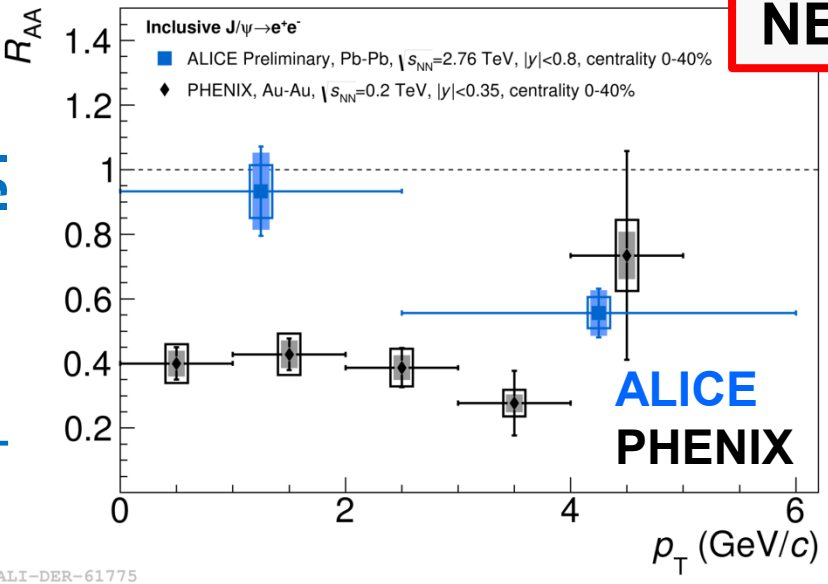
J/ψ→μ⁺μ⁻ 2.5<y<4



NEW!



J/ψ→e⁺e⁻ |y|<0.8

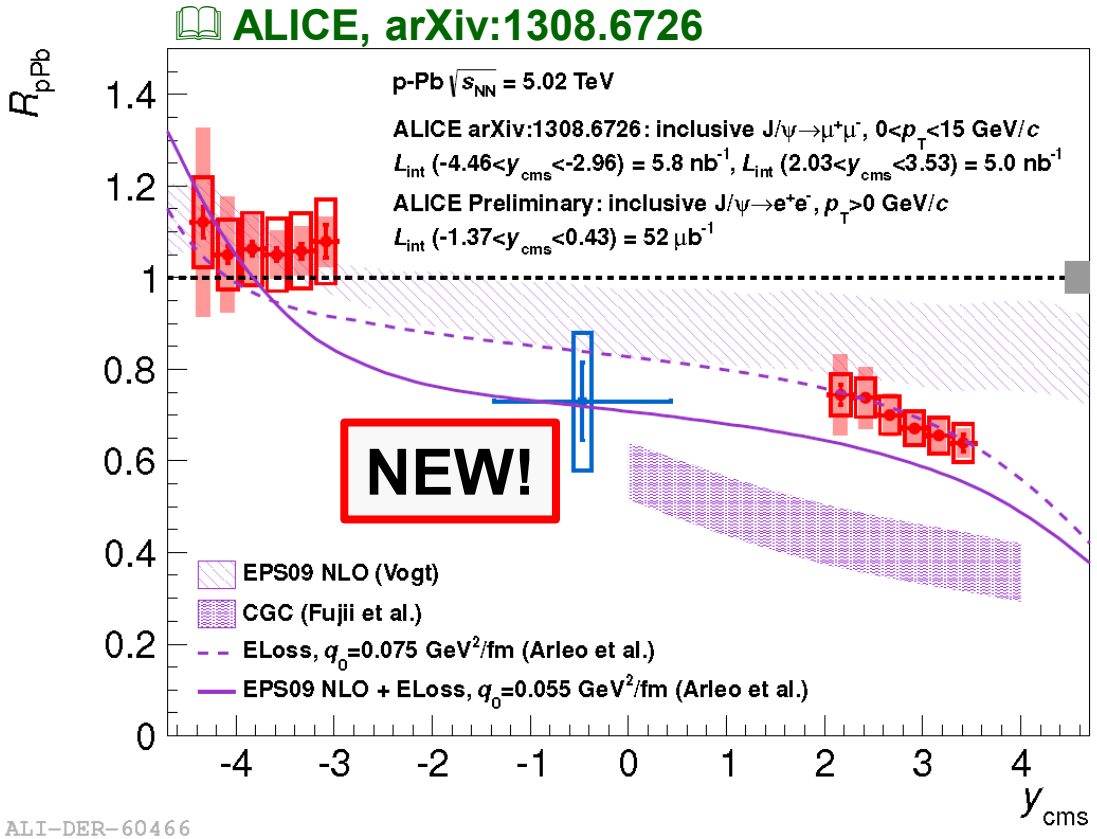


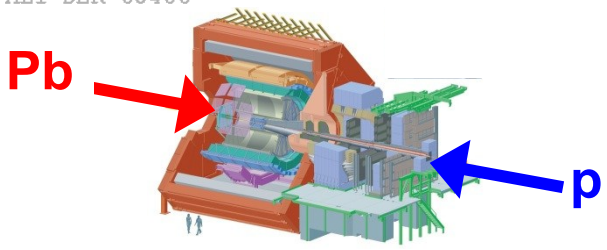
NEW!

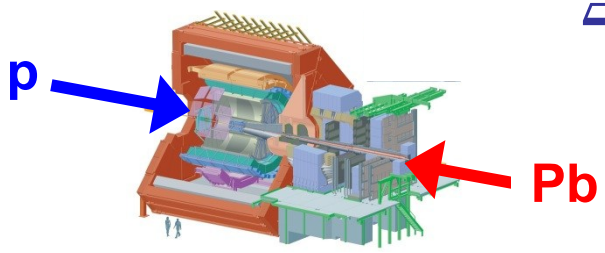
- As expected in a scenario with $c\bar{c}$ (re)combination
  - ⇨ (Re)generation contribution important at low p_T

Liu, Qiu, Xu and Zhuang, PLB678(2009) 72
Zhao, Rapp, NPA859(2011) 114
Andronic et al., arXiv:1210.7724

J/ψ production in p-Pb vs. y







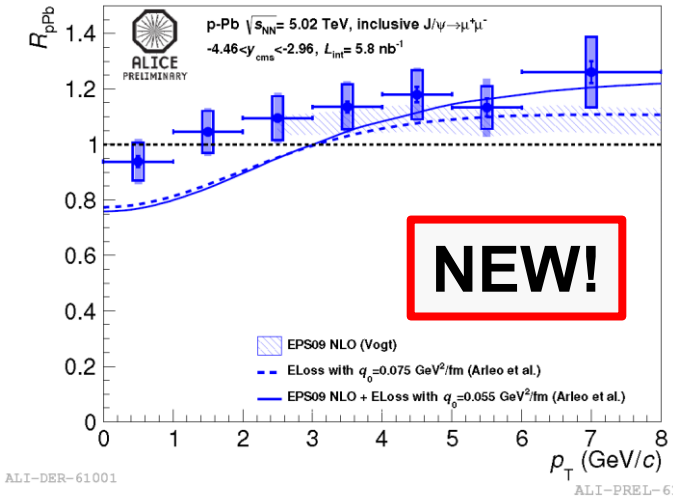
- R_{pPb} close to unity at backward rapidity
- Suppression at mid- and forward rapidity
- Models of CNM effects
  - ⇨ CEM(NLO)+EPS09: describes well the backward rapidity, strong shadowing favoured by data at forward rapidity
  - ⇨ Coherent energy loss: reproduces well the y dependence
  - ⇨ CGC-based calculations disfavoured by the data

📖 Vogt, arXiv:1301.3395
📖 Arleo et al., arXiv:1212.0434
📖 Fuji et al., arXiv:1304.2221

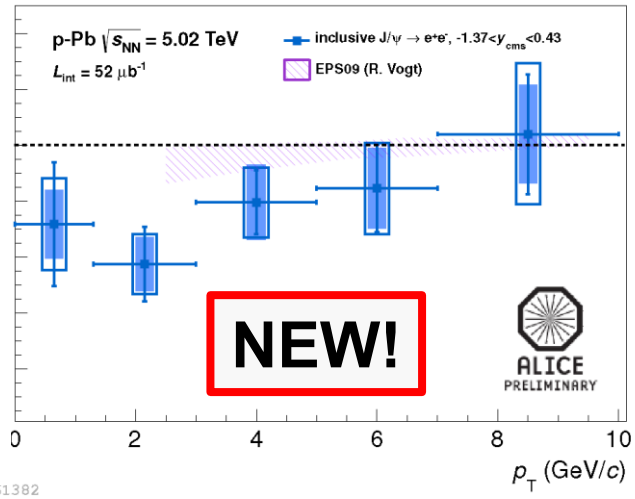
M. Winn, Thu 16:20

J/ψ production in p-Pb vs. p_T

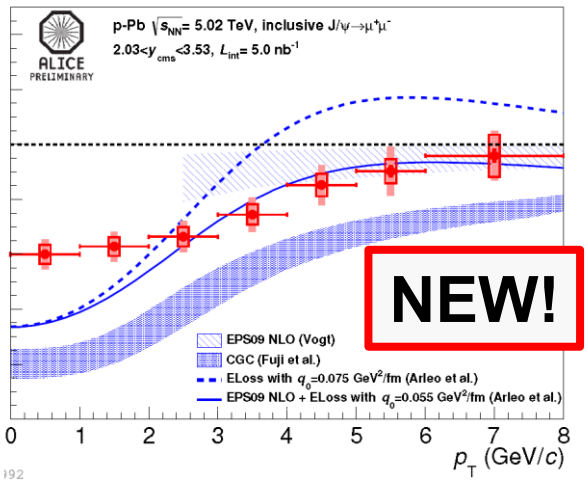
Backward rapidity



Mid-rapidity



Forward rapidity

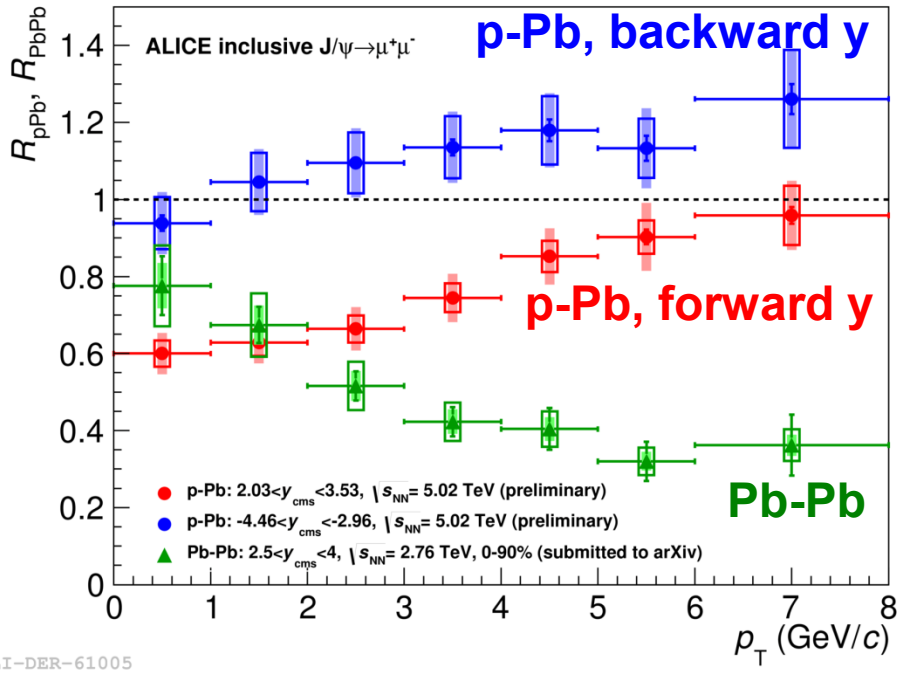


- **Backward rapidity (Pb-going side):**
  - ⇨ R_{pPb} close to unity, small p_T dependence
- **Mid-rapidity:**
  - ⇨ R_{pPb} lower than unity, more precision needed for clear p_T dependence
- **Forward rapidity (p-going side)**
  - ⇨ More significant p_T dependence, R_{pPb} lower than unity at low p_T
  - ⇨ Data tend to favour strong shadowing, CGC-based model disfavoured

📖 Vogt, arXiv:1301.3395
📖 Arleo et al., arXiv:1212.0434
📖 Fuji et al., arXiv:1304.2221

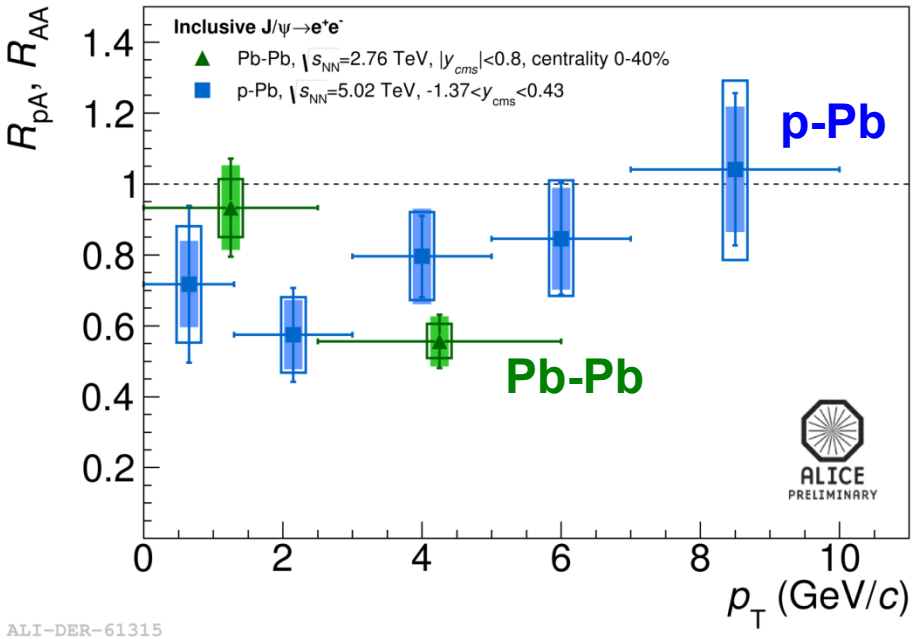
p-Pb and Pb-Pb

J/ψ→μ⁺μ⁻ forward/backward y



ALI-DER-61005

J/ψ→e⁺e⁻ mid-rapidity



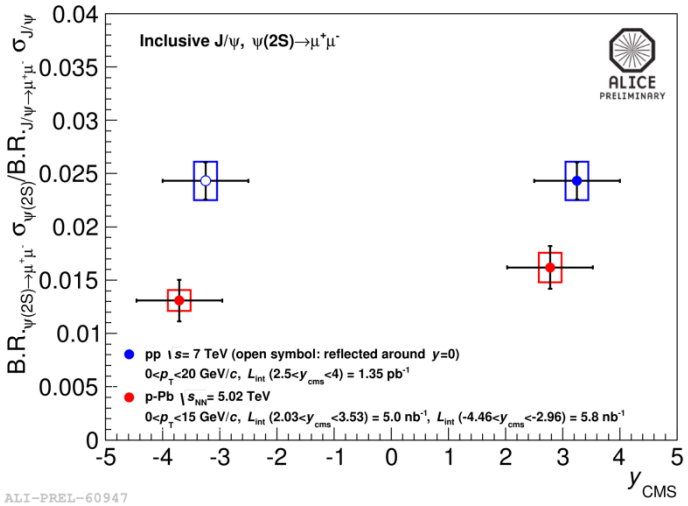
ALI-DER-61315

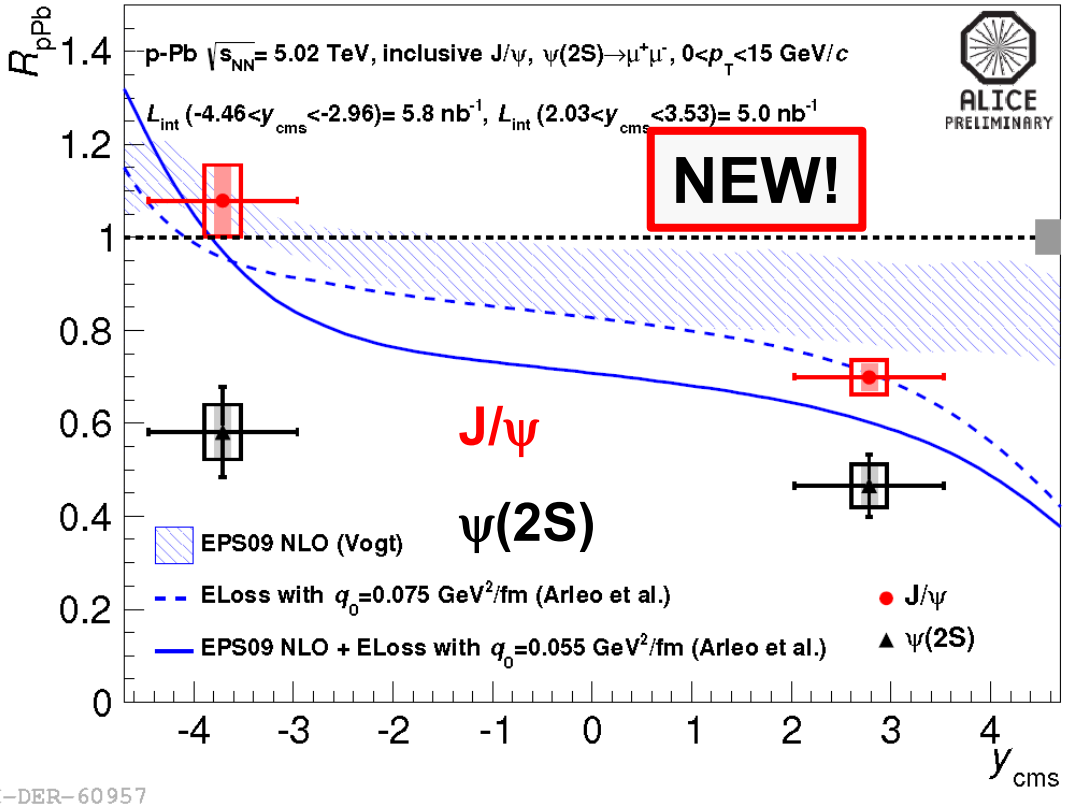
- In a 2→1 kinematics, assuming that shadowing factorizes:
  - ⇨ Compare R_{AA} in Pb-Pb with $R_{pPb}(y>0) \times R_{pPb}(y<0)$
- Small CNM effects at high p_T (> 4-6 GeV/c)
- At low p_T: similar (or lower) suppression in Pb-Pb relative to shadowing expectation

C. Hadjidakis, Fri 11:30
M. Winn, Thu 16:20

ψ(2S) production in p-Pb

$$R_{\mathrm{pPb}}^{\psi(2S)} = R_{\mathrm{pPb}}^{\mathrm{J/\psi}} \frac{\sigma_{\mathrm{pPb}}^{\psi(2S)}}{\sigma_{\mathrm{pPb}}^{\mathrm{J/\psi}}} \frac{\sigma_{\mathrm{pp}}^{\mathrm{J/\psi}}}{\sigma_{\mathrm{pp}}^{\psi(2S)}}$$

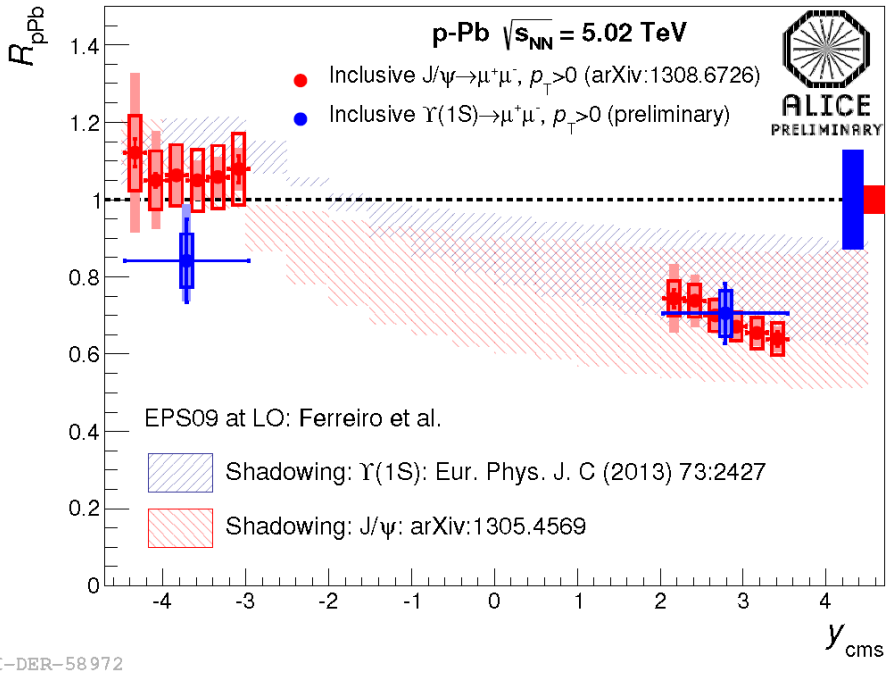




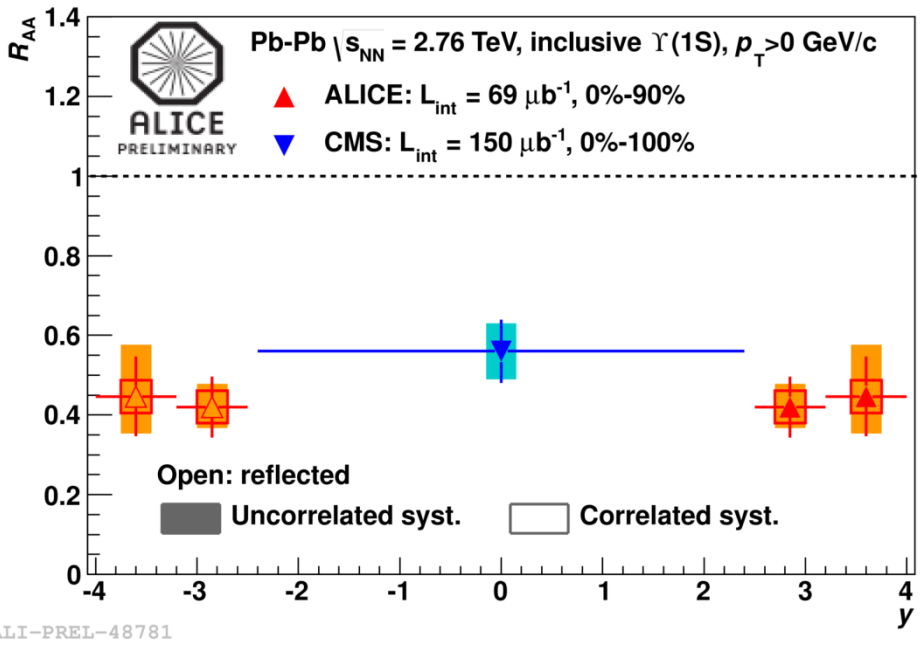
- Stronger suppression of ψ(2S) in p-Pb relative to J/ψ
  - ⇨ Not described by initial state CNM effect and coherent energy loss
  - ⇨ Similar observation by PHENIX in d-Au at $\sqrt{s_{NN}}$ = 200 GeV
  - ⇨ Final state effects?

📖 **PHENIX, arXiv1305.5516**

Υ(1S) production



ALI-DER-58972



ALI-PREL-48781

- p-Pb:
  - ⇨Similar R_{pPb} of J/ψ and Υ
  - ⇨EPS09 shadowing in fair agreement with both J/ψ and Υ within uncertainties

- Pb-Pb:
  - ⇨Υ (1S) yield suppressed relative to binary-scaled pp
  - ⇨Similar suppression at mid (CMS) and forward rapidity

F. Bossù, Mon 16:20

Conclusions

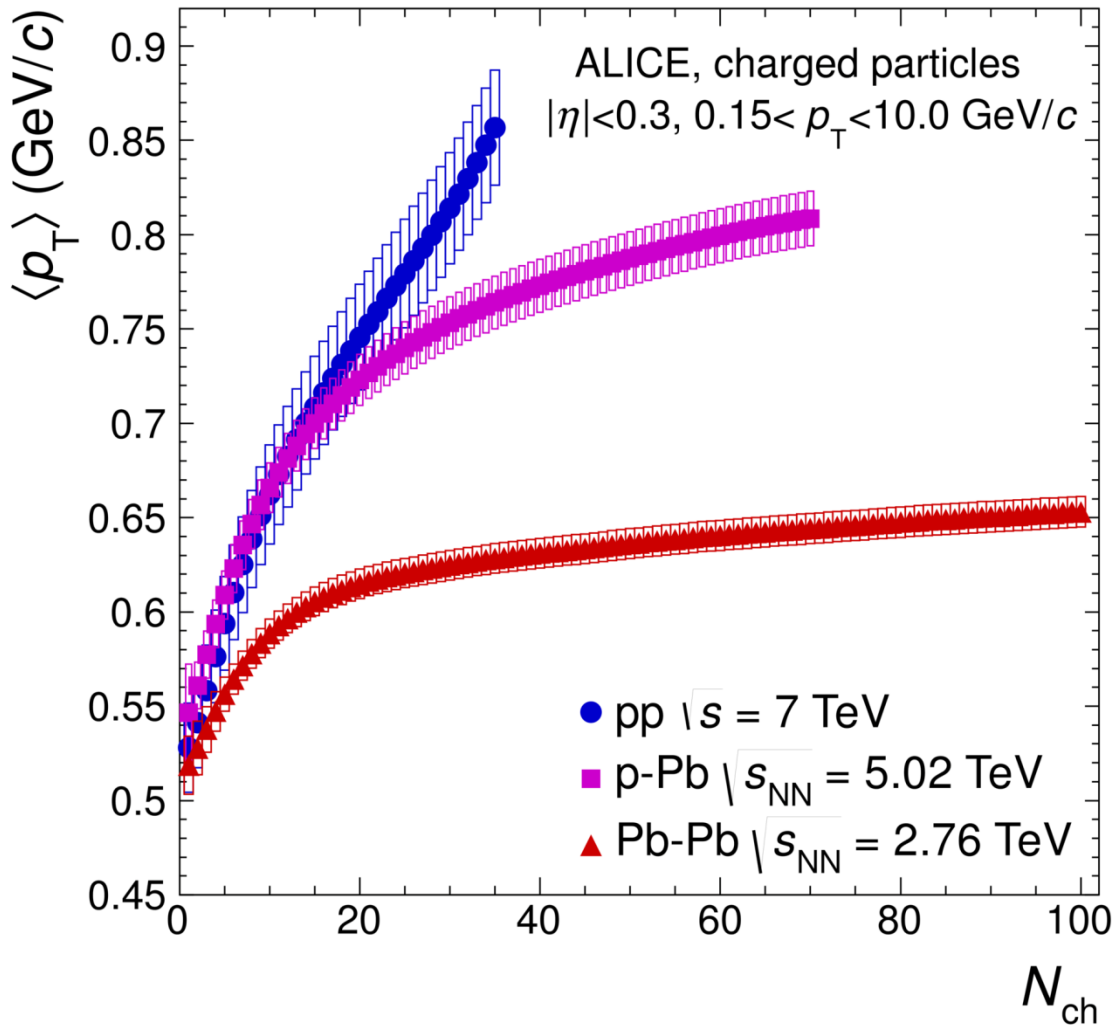
- p-Pb:
  - ⇨More than just a control experiment
  - ⇨Quantify Cold Nuclear Matter Effects, constrain shadowing/saturation at low x
  - ⇨Intriguing results from high multiplicity events, ψ(2S)
- Pb-Pb
  - ⇨Significant progress in the studies of the properties of the hot and dense medium formed in the collision
  - ⇨Decisive role of hard probes: jets, heavy flavour and quarkonia crucial to quantify the density, transport properties and the temperature of the medium

ALICE at HP2013

- ALICE plenary talks:
  - ⇨ R. Reed: Jets — **Tue 9:30**
  - ⇨ J. Otwinowski: Light flavours — **Tue 12:00**
  - ⇨ D. Caffarri: Heavy flavours — **Wed 9:00**
  - ⇨ A. Dobrin: Azimuthal correlations — **Thu 11:00**
  - ⇨ C. Hadjidakis: Quarkonia — **Fri 11:30**
- ALICE parallel talks:
  - ⇨ C. Oppedisano: particle production and centrality — **Thu 13:30**
  - ⇨ A. Ortiz: Identified particle production — **Mon 16:40**
  - ⇨ S. Li: Muons from heavy-flavour decays — **Mon 13:30**
  - ⇨ A. Rossi: D mesons in pp, p-Pb and Pb-Pb — **Mon 14:50**
  - ⇨ E. Pereira: Electrons from heavy-flavour decays — **Tue 14:30**
  - ⇨ L. Cunqueiro: Hadron-jets in Pb-Pb — **Thu 13:50**
  - ⇨ M. Verweij: Di-jets in p-Pb — **Thu 14:30**
  - ⇨ E. Leogrande: Minijets in p-Pb — **Thu 14:10**
  - ⇨ T. Schuster: Two-particle correlations — **Thu 14:50**
  - ⇨ A. Uras: Low mass dileptons — **Tue 13:50**
  - ⇨ M. Winn: J/ψ and ψ(2S) in p-Pb — **Thu 16:20**
  - ⇨ F. Bossù: Υ production in pp, p-Pb and Pb-Pb — **Mon 16:20**
- ... and also 8 ALICE posters

Backup

Mean p_T in pp, p-Pb and Pb-Pb



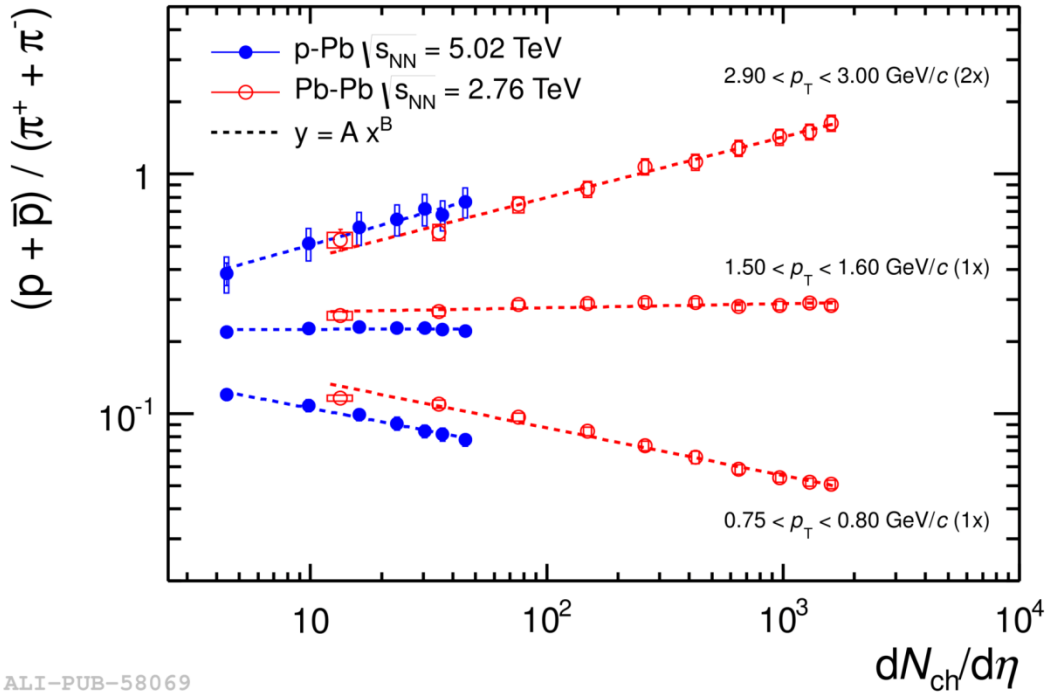
ALI-PUB-55941

- Three different √s for pp, p-Pb and Pb-Pb
  - ⇨ but √s dependence expected to be weak
- Much stronger increase of $\langle p_T \rangle$ in p-Pb than in Pb-Pb
- p-Pb follows pp up to N_{ch}~14-15
- N_{ch}>14 corresponds to
  - ⇨ ~10% of pp x-section:
    - ✓ ***pp already highly biased***
  - ⇨ 50% of p-Pb x-section
    - ✓ ***only centrality bias***

Baryon/meson vs. multiplcity

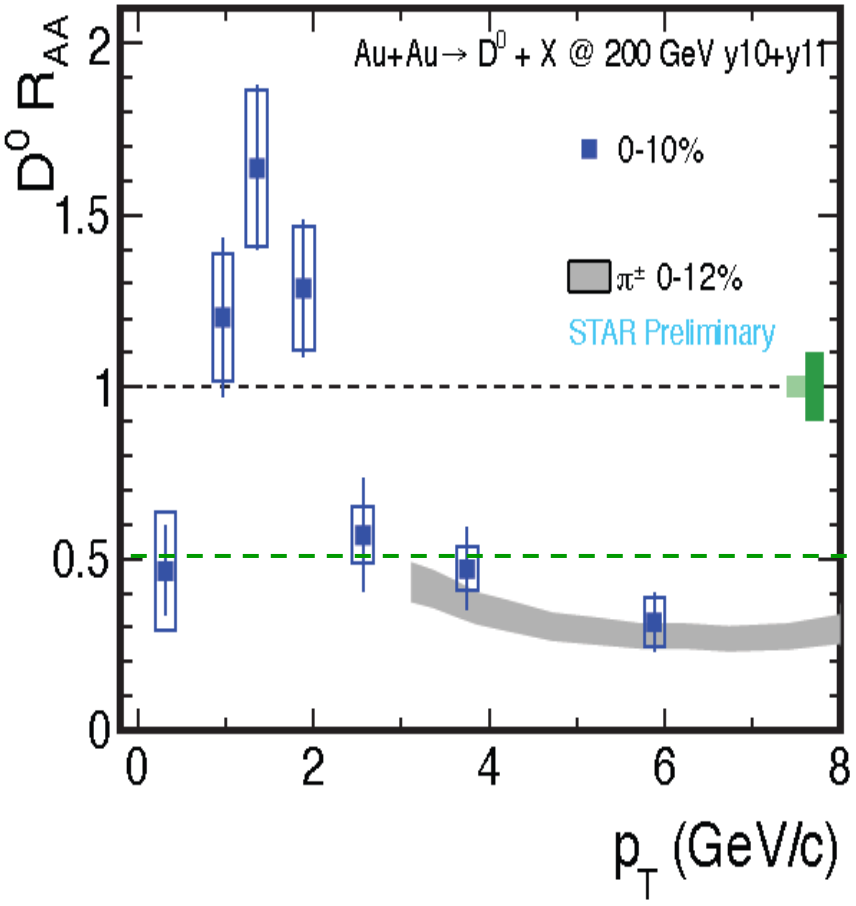
ALICE

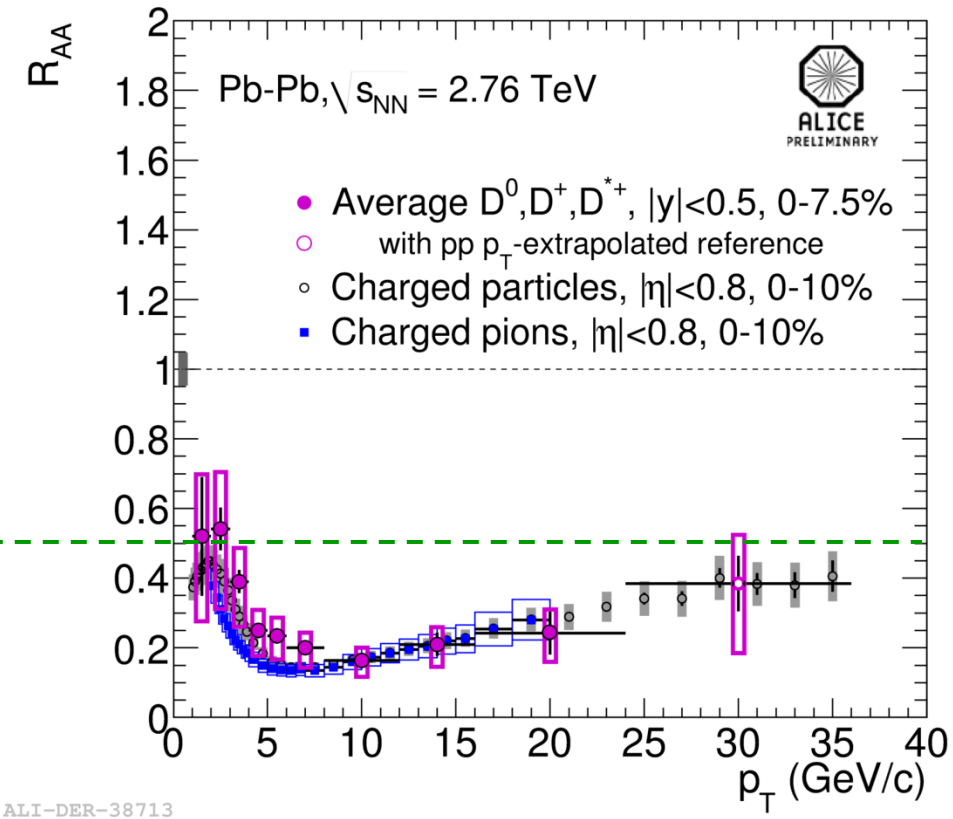
📖 ALICE, arXiv:1307.6796



- In a given p_T bin, the ratio p/π as a function of dNch/dh follows a power-law behavior
  - ⇨ Same power-law scaling eponent in p-Pb and Pb-Pb collisions
- Same feature observed also in the K/K^0_s ratio

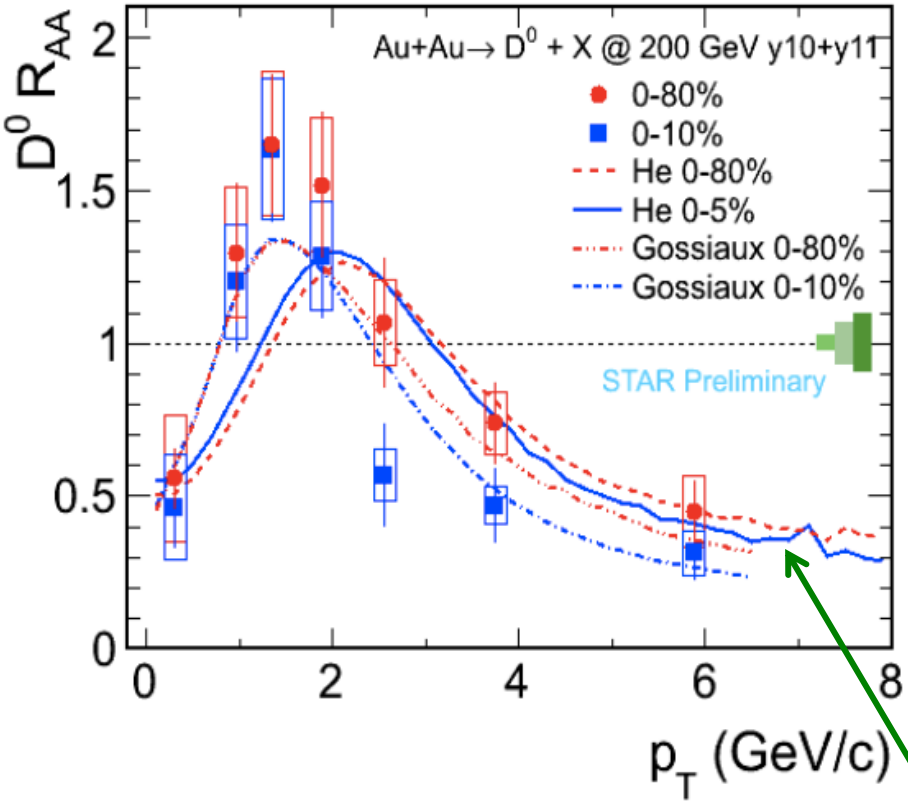
D meson R_{AA}: LHC vs RHIC

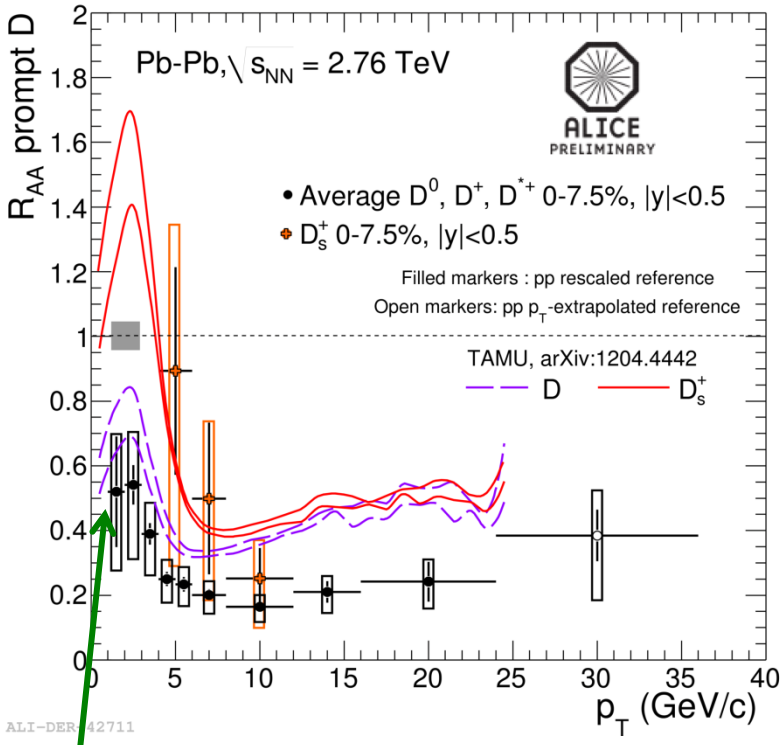




ALI-DER-38713

D meson R_{AA}: LHC vs RHIC

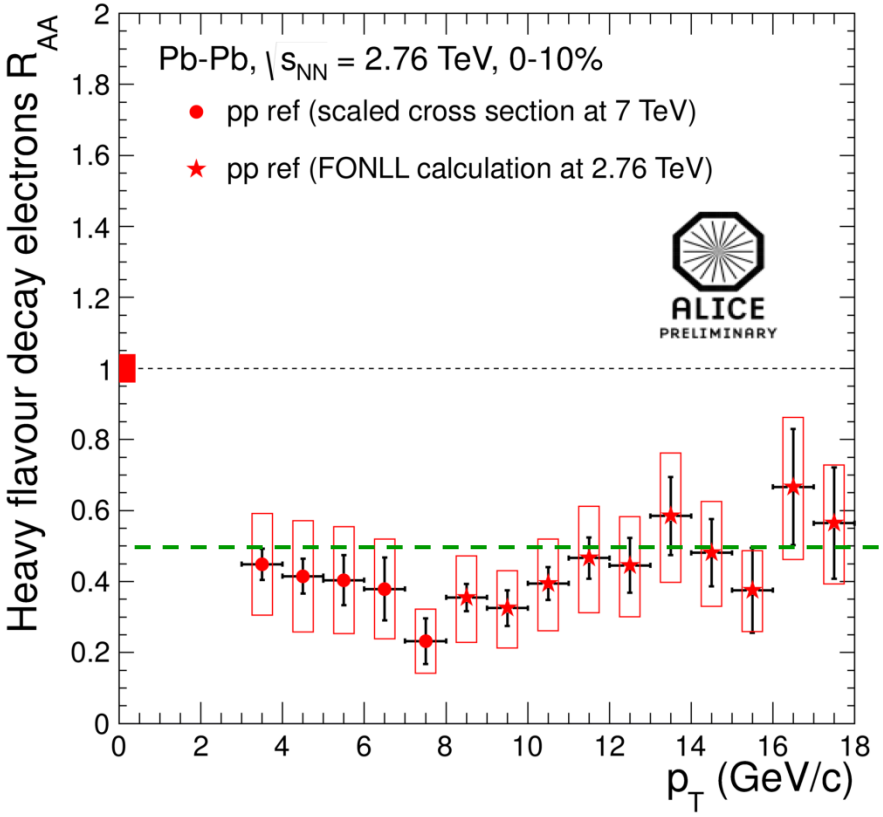


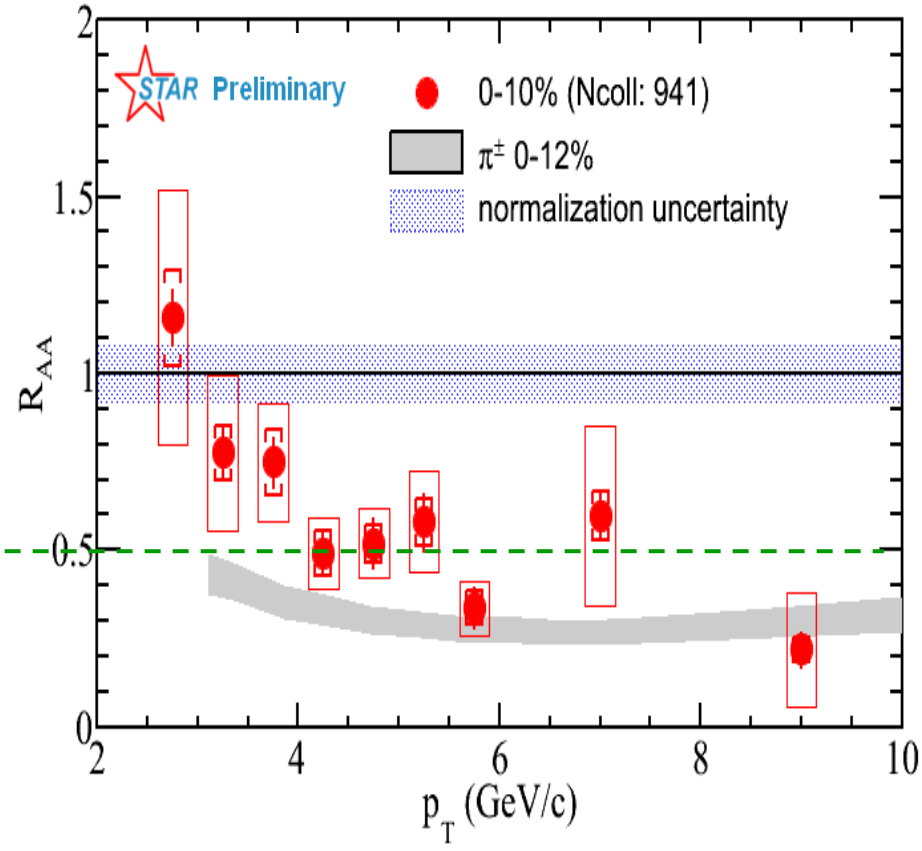


same theoretical model

- D meson R_{AA} quite different for $1<p_T<2$ GeV/c
  - ⇨Recombination + radial flow?
    - ✓ ***Stronger effect at RHIC because of steeper dN/dp_T?***
  - ⇨Different role of shadowing at low p_T at the two energies?

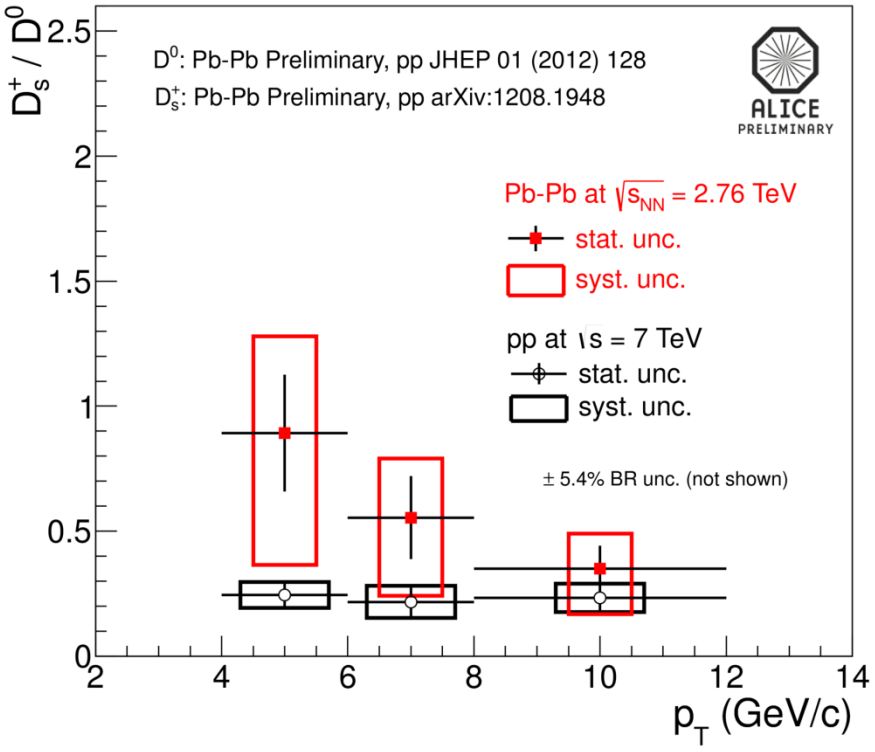
Heavy Flavour decay electrons: LHC vs RHIC



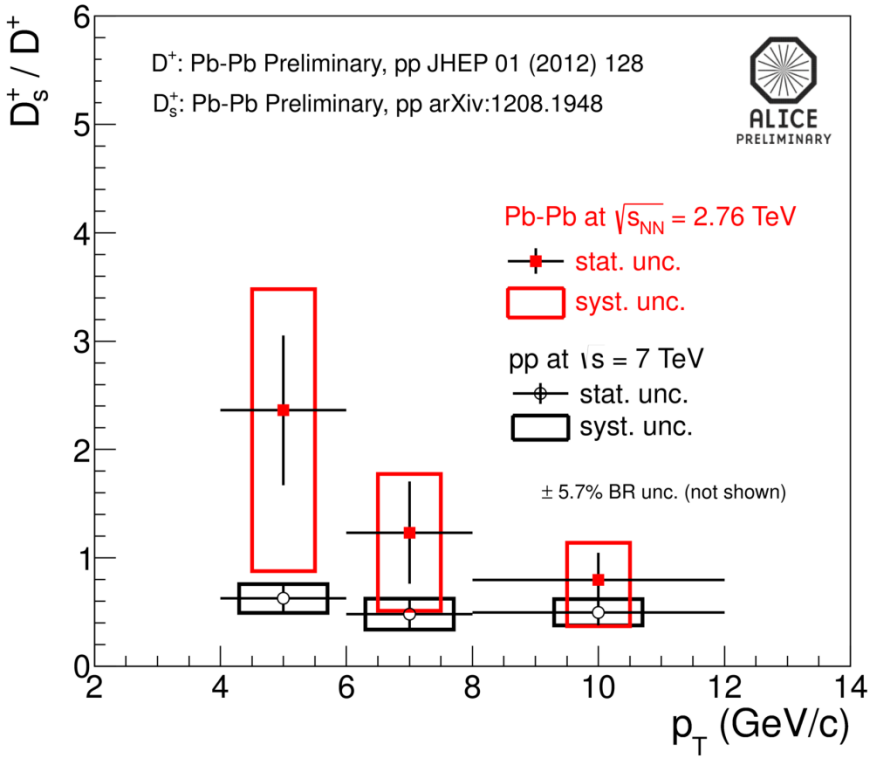


ALI-PREL-31917

D_s/D^0 and D_s/D^+



ALI-DER-44038



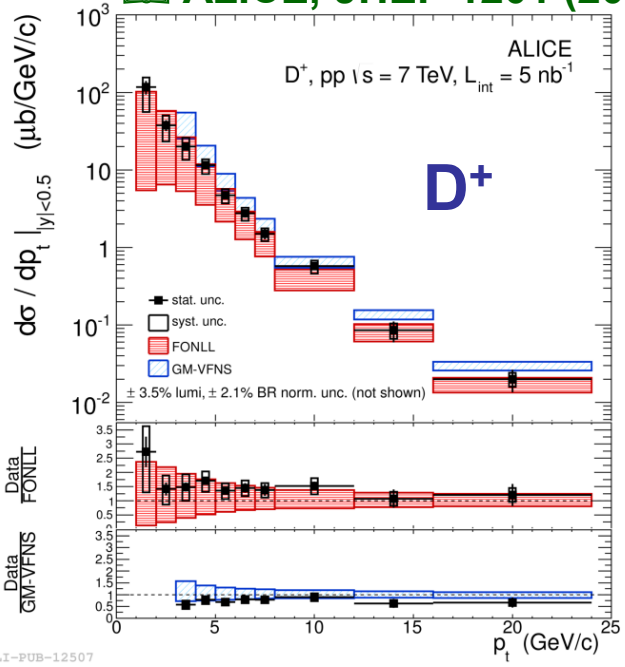
ALI-DER-44042

Heavy flavours in pp

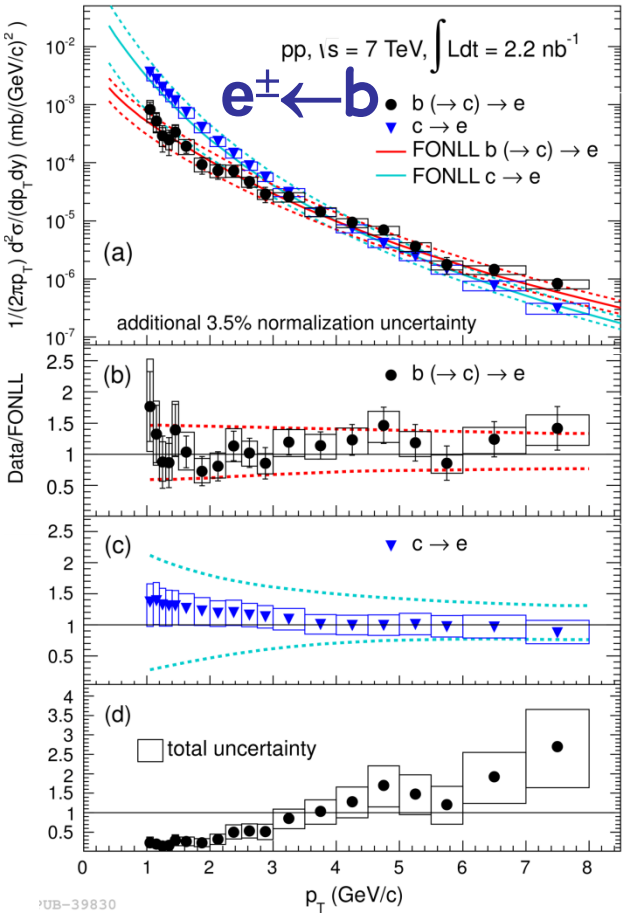
Heavy flavour p_T-differential cross sections well described by pQCD calculations

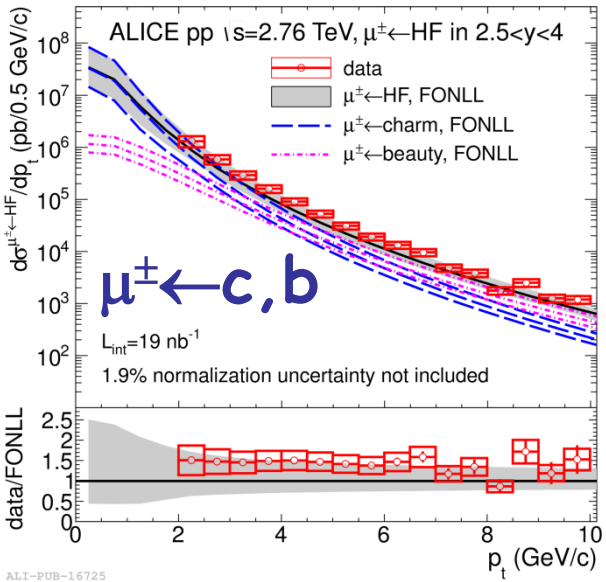
Charm cross section on the upper side of the FONLL uncertainty band, as at lower $\sqrt{s}$

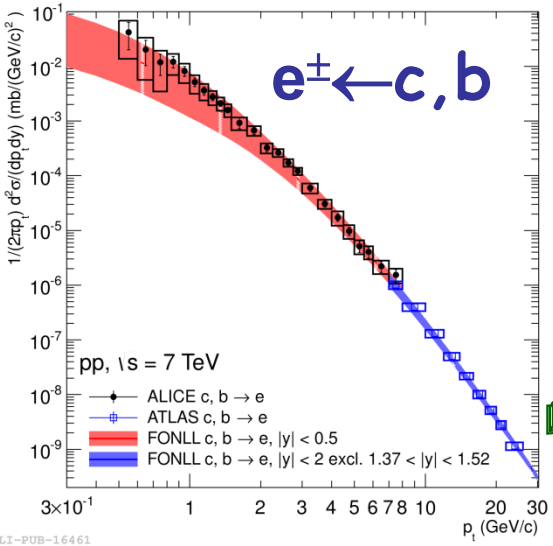
📖 ALICE, JHEP 1201 (2012)



📖 ALICE, PLB721 (2013) 13







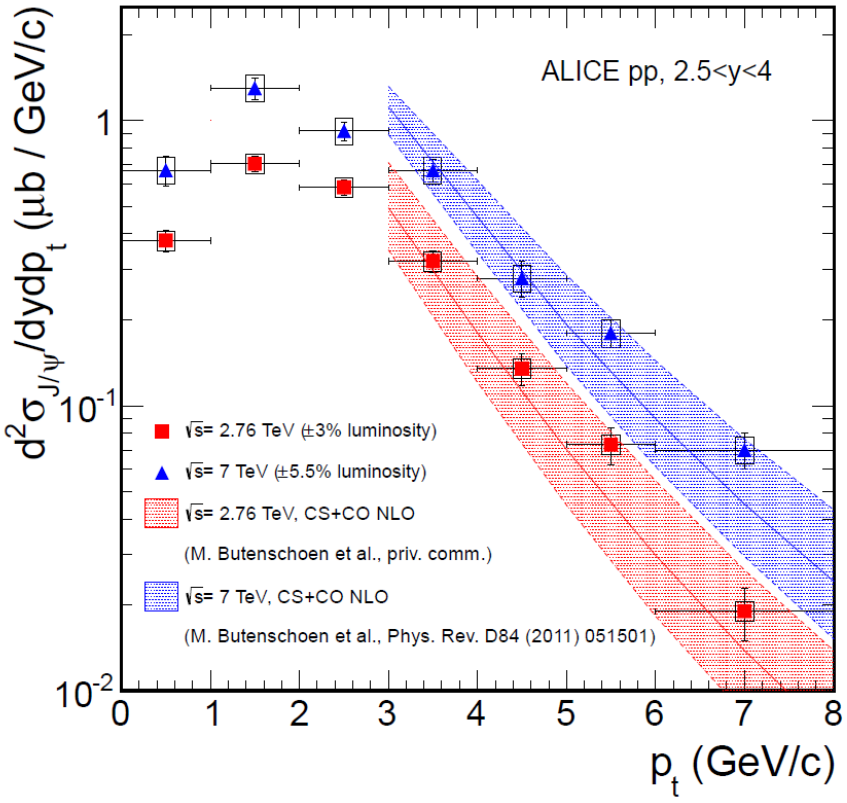
📖 ALICE, PRD 86 (2012) 112007

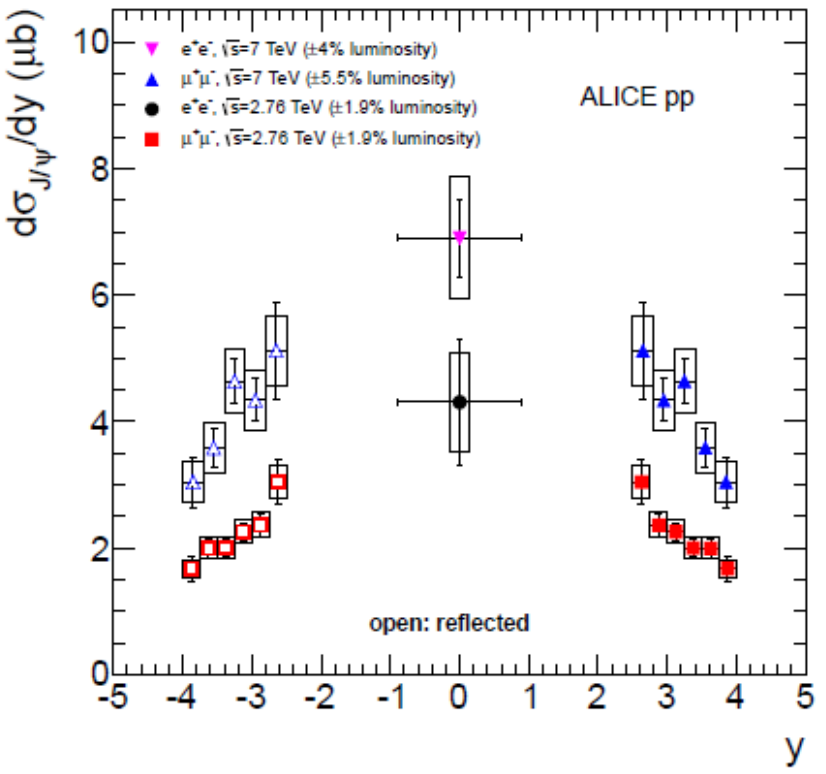
📖 ALICE, PRL 109 (2012) 112301

J/ψ production in pp

- Inclusive J/ψ production cross-section measured in pp at √s of 7 and 2.76 TeV

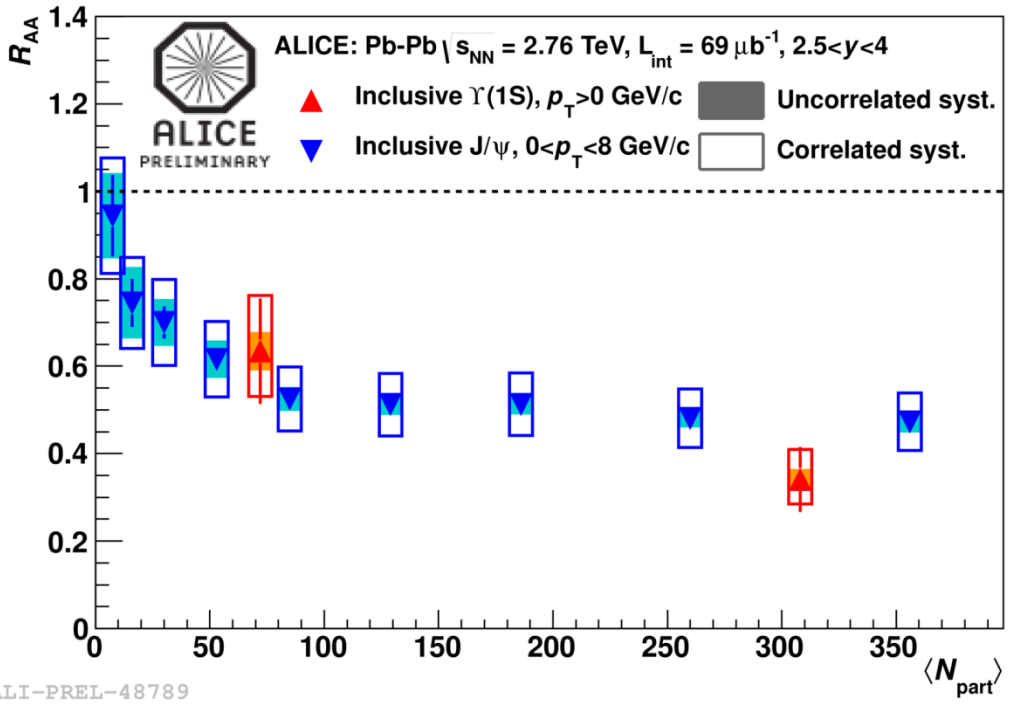
📖 **ALICE, Phys.Lett. B718 (2012) 295**





- Results in agreement with NLO NRQCD calculations

Υ(1S) vs. J/ψ R_{AA}



- No straightforward interpretation:
  - ⇨ different contribution of (re-)generation for charmonia and bottomonia
  - ⇨ different feed-down from higher mass-states for J/ψ and Υ(1S)