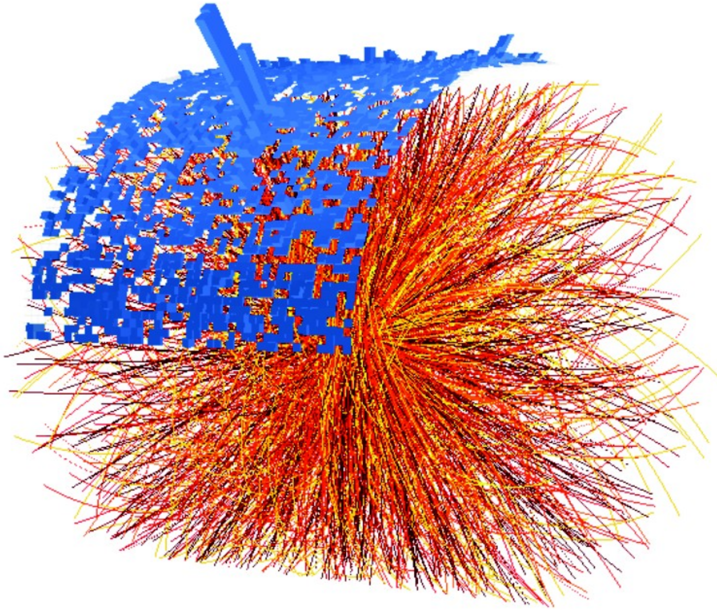
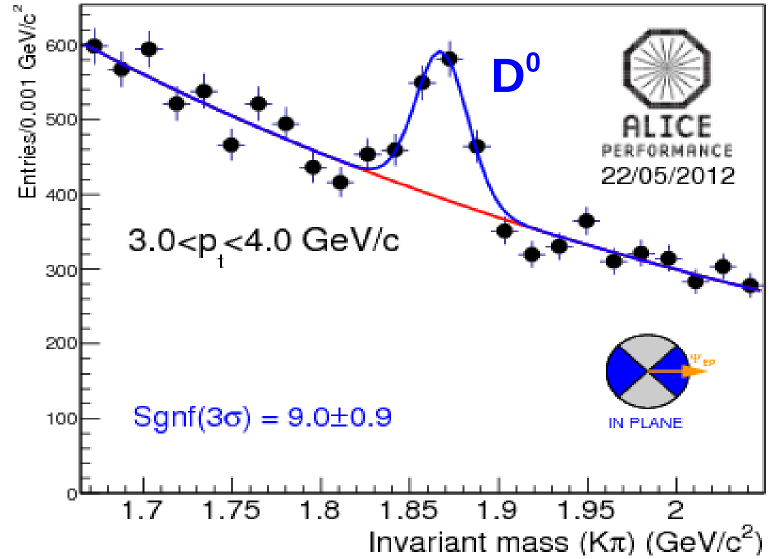




ALICE Status Report

110th LHCC Meeting – Open Session
June 13, 2012

Andreas Morsch
on behalf of the ALICE Collaboration

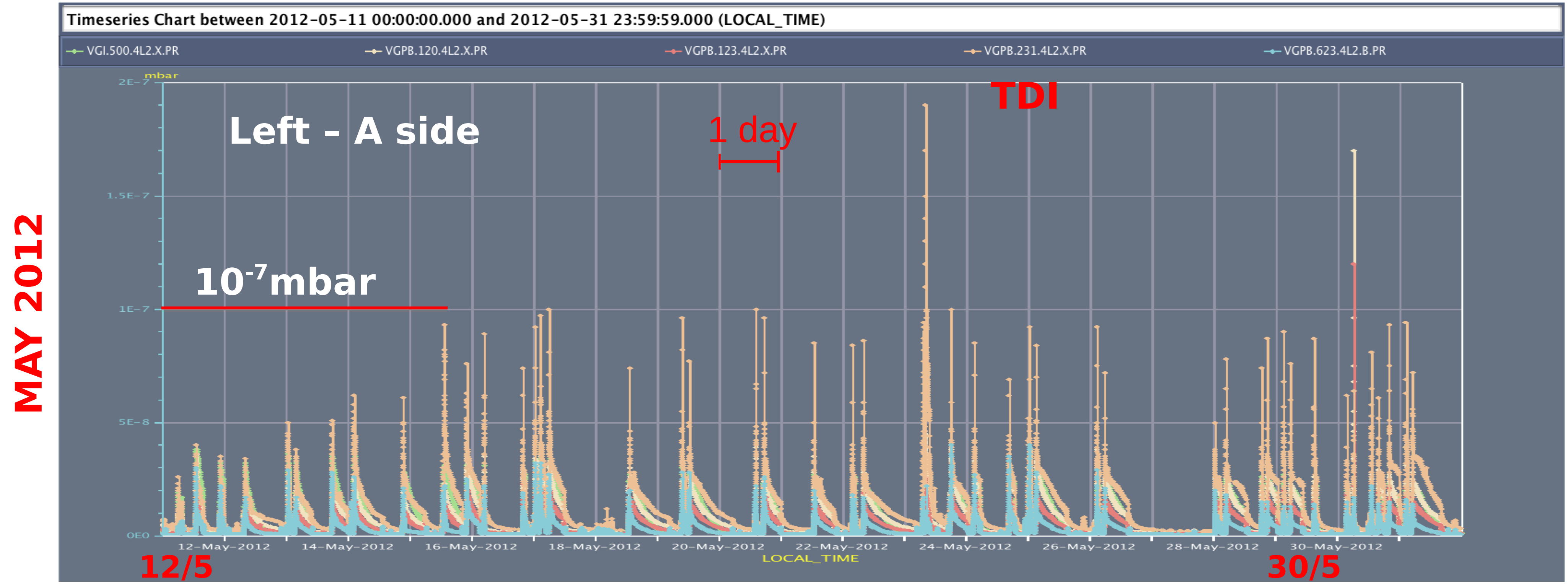
Outline

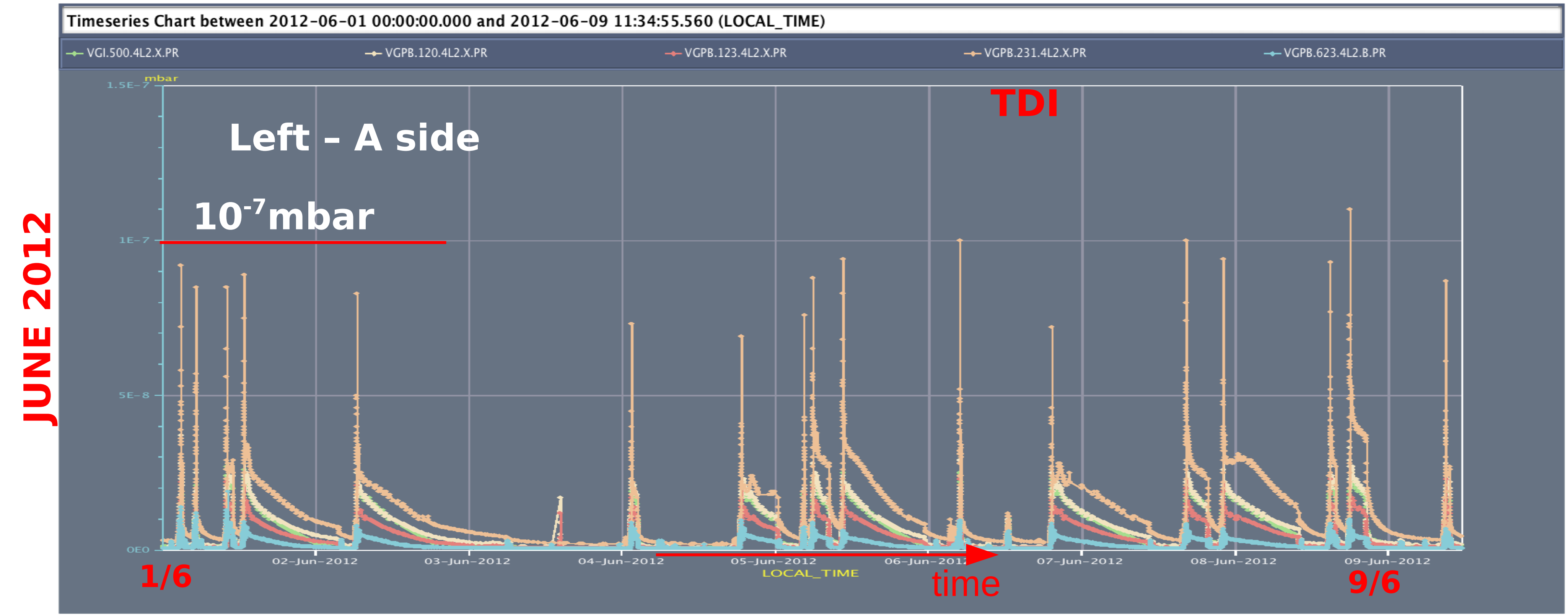
- 2012 pp Data Taking
- New Physics Results
  - Pb-Pb
    - Probing the medium with high p_T partons
    - De-confinement and the J/ψ
  - Highlights in pp

2012 pp @ $\sqrt{s}$ = 8 TeV Data Taking

LHC Vacuum problems strongly deteriorate ALICE data taking

- ALICE is heavily affected by background from high vacuum pressure in the Long Straight Sections.
  - The beam-gas collisions result in a background event rate which is typically a factor 5 larger than the pp collision rate
    - L=2 10^{30} cm^{-2} s^{-1} with main-satellite collisions
  - The vacuum situation is dominated by the high pressure in the Injection Beam Stopper (TDI) and the 800 cm vacuum chambers.
    - distance to the IP about 100 m
  - Due to the 'particle load' on the detector we can turn on and start data taking only 5-6 hours after declaration of stable beam.
  - The vacuum situation is unchanged since many weeks.


MAY 2012
Timeseries Chart between 2012-05-11 00:00:00.000 and 2012-05-31 23:59:59.000 (LOCAL_TIME)
VGI.500.4L2.X.PR
VGPB.120.4L2.X.PR
VGPB.123.4L2.X.PR
VGPB.231.4L2.X.PR
VGPB.623.4L2.B.PR
mbar
2E-7
1.5E-7
1E-7
5E-8
0E0
Left – A side
1 day
TDI
10^{-7}mbar
12-May-2012
14-May-2012
16-May-2012
18-May-2012
20-May-2012
22-May-2012
24-May-2012
26-May-2012
28-May-2012
30-May-2012
LOCAL_TIME
12/5
30/5


JUNE 2012
Timeseries Chart between 2012-06-01 00:00:00.000 and 2012-06-09 11:34:55.560 (LOCAL_TIME)
VGI.500.4L2.X.PR
VGPB.120.4L2.X.PR
VGPB.123.4L2.X.PR
VGPB.231.4L2.X.PR
VGPB.623.4L2.B.PR
mbar
1.5E-7
1E-7
5E-8
0E0
Left – A side
TDI
10^{-7}mbar
02-Jun-2012
03-Jun-2012
04-Jun-2012
05-Jun-2012
06-Jun-2012
07-Jun-2012
08-Jun-2012
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LOCAL_TIME
time
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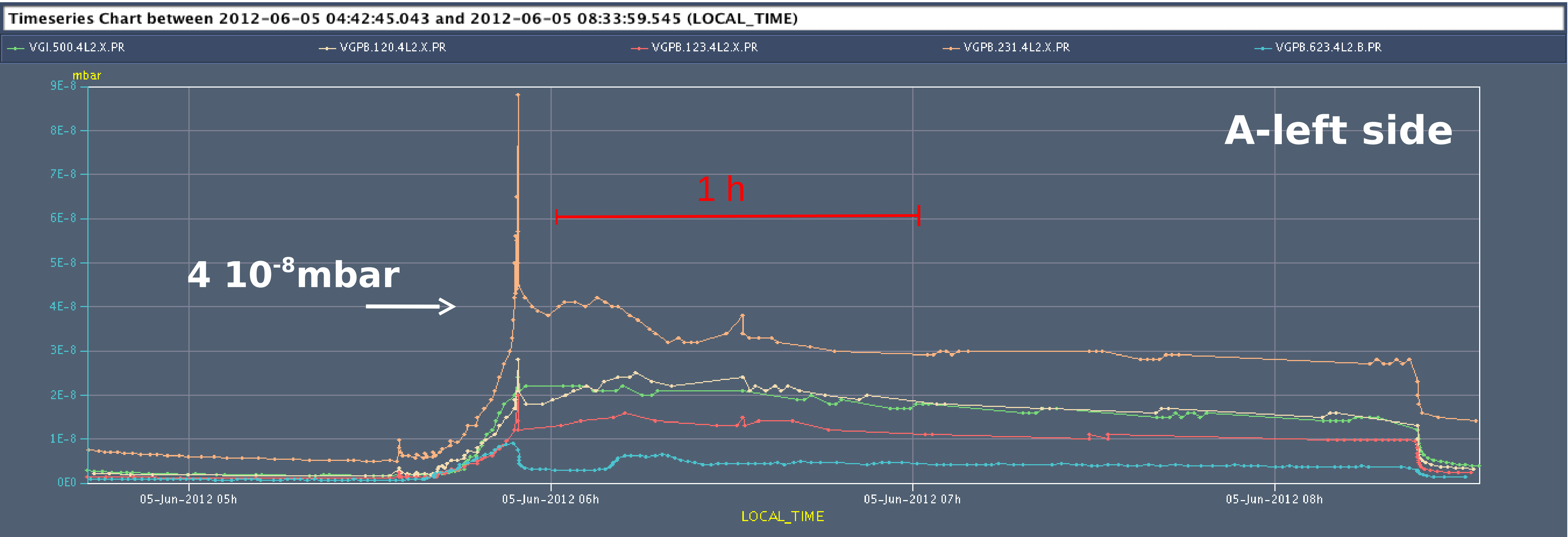
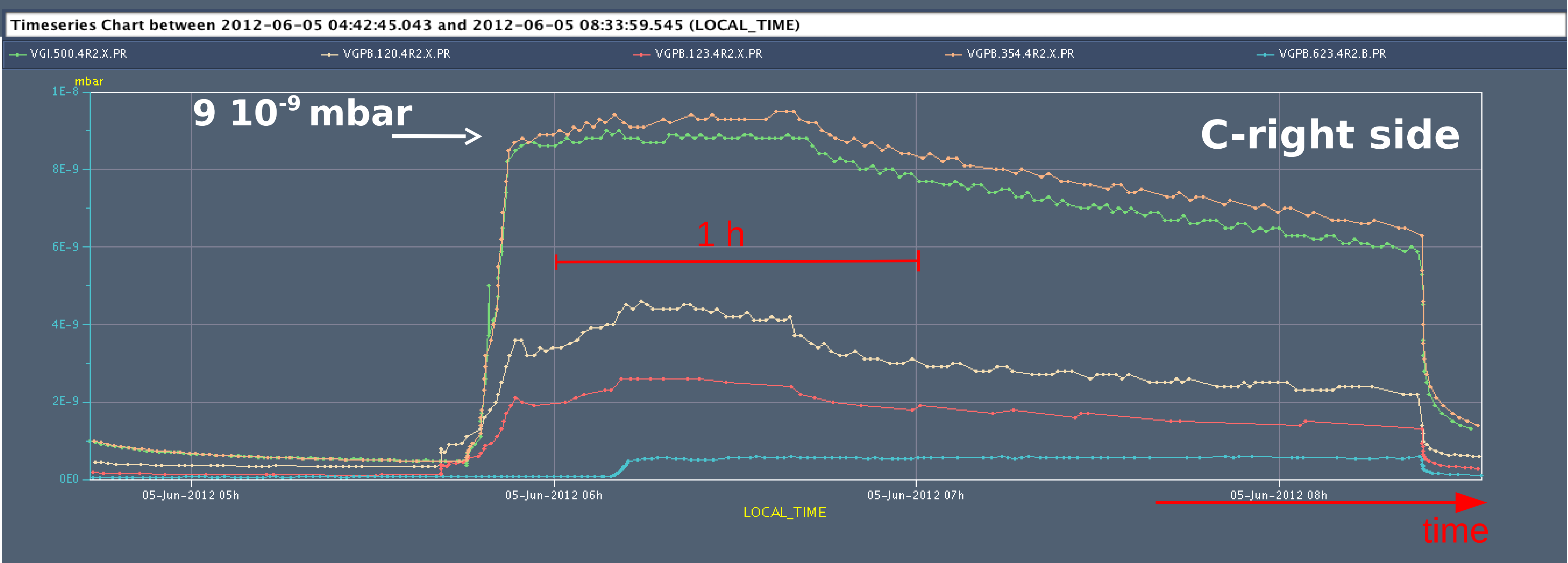
9/6

An example: fill 2700





Triggers and sample sizes

	Plan	Target sample size	achieved today
Minimum bias	30 days $6x10^5$ s	360M events	**131 M events**
Rare triggers @ 100 kHz (1.85 mb^{-1}/s) 80% life-time	115 days $2.3x10^6$ s	3.4 pb^{-1}	**Barrel: 40 nb^{-1}** **Muon: 80 nb^{-1}**

- Rare triggers include
  - EMCal high p_T jets and photons
  - PHOS high-p_T gamma
  - di-muon
  - high-multiplicity triggers

= 3-5% of planned,
if situation does not improve !

7 new Publications since last LHCC meetings

arXiv.org

- Transverse sphericity of primary charged particles in minimum bias proton-proton collisions at $\sqrt{s}$ = 0.9, 2.76 and 7 TeV (arXiv:1205.3963)
- Measurement of charm production at central rapidity in proton-proton collisions at $\sqrt{s}$ = 2.76 TeV (arXiv:1205.4007)
- Measurement of electrons from semileptonic heavy-flavour hadron decays in pp collisions at $\sqrt{s}$ = 7 TeV (arXiv:1205.5423)
- Neutral pion and η meson production in proton-proton collisions at $\sqrt{s}$ = 0.9 TeV and $\sqrt{s}$ = 7 TeV (arXiv:1205.5724)
- Anisotropic flow of charged hadrons, pions and (anti-)protons measured at high transverse momentum in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV (arXiv:1205.5761)
- Measurement of prompt and non-prompt J/ψ production cross sections at midrapidity in pp collisions at $\sqrt{s}$ =7 TeV (arXiv:1205.5880)
- Production of muons from heavy flavour decays at forward rapidity in pp and Pb–Pb collisions at $\sqrt{s}$ = 2.76 TeV (arXiv:1205.6443)

5 Plenary Talks

- High p_T identified particle production in ALICE (P. Christiansen)
- Hadron correlations in ALICE (J.F. Grosse-Oetringhaus)
- Heavy flavour production in ALICE at the LHC (S. Masciocchi)
- Quarkonia production in ALICE (Ch. Suire)
- Characterizing energy loss in ALICE (P. Jacobs)

Hard Probes 2012 (14 contributed)

- Production anisotropy of $h^{\pm}$, $\pi^{\pm}$ and protons at high-p_T in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV (J. Rak)
- Jet-like near-side peak shapes in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV TeV with ALICE (A. Morsch)
- p/π ratio in jet and bulk region in heavy ion collisions (M. Veldhoen)
- D mesons suppression in Pb--Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV measured by ALICE (Z. Conesa del Valle)
- Open-charm meson elliptic flow measurement in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV with ALICE at the LHC (G. Ortona)
- Measurement of heavy-flavour decay muon production at forward rapidity in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV with the ALICE experiment (D. Stocco)
- Open Heavy-Flavour and J/ψ production in proton-proton collisions measured with the ALICE experiment at LHC (C. Geuna)
- Measurement of the nuclear modification factor of electrons from heavy-flavour decays in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV with ALICE (M. Kweon)

Hard Probes 2012 (contributed)

- Nuclear modification of J/ψ production in Pb--Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV (J. Wiechula)
- J/psi elliptic flow measurement in Pb-Pb collisions at forward rapidity in the ALICE experiment (L. Massacrier)
- Neutral meson production in pp and Pb-Pb collisions at LHC (Y. Kharlov)
- Charged particle production in Pb-Pb collisions at the LHC with the ALICE detector (M. Floris)
- Measurement of inclusive jet cross section and jet fragmentation in pp collisions with ALICE experiment at the LHC (R. Ma)
- Measurement of jet spectra in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV with the ALICE detector at the LHC (M. Verweij)

Hard Probes 2012 (11 Posters)

- Inclusive jet measurements and unfolding studies in proton-proton collisions at $\sqrt{s}$ = 2.76 TeV and 7 TeV with the ALICE experiment (M. Vajzer)
- Transverse Momentum Spectra of Unidentified Charged Particles in pp Collisions at the ALICE experiment (P. Lüttig)
- Light vector meson productions at the LHC with the ALICE detector (E. Incani)
- Quarkonium measurements in pPb collisions at the LHC with the ALICE experiment (C. Hadjidakis)
- Measurement of B meson production in pp collisions at $\sqrt{s}$ = 7 TeV via displaced electrons in ALICE (M. Heide)
- Study of the nuclear modification factor of electrons from B meson decays at mid-rapidity in Pb-Pb collisions $\sqrt{s_{NN}}$= 2.76 TeV with ALICE (M. Voelkl)
- Reconstruction of the charmed baryon Λ_c in pp collisions at $\sqrt{s}$ = 7 TeV with ALICE (P. Pagano)
- Azimuthal angular correlations between heavy flavor decay electrons and charged hadrons in pp collisions at $\sqrt{s}$ = 2.76 TeV in ALICE (D. Thomas)
- Azimuthal angular correlations between D* mesons and charged hadrons in 7 TeV proton-proton collisions in ALICE (S. Bjelogrlic)
- Measurement of charm suppression and charm flow in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV via $D^0 \to K^- \pi^+$ reconstruction in ALICE (D. Caffarri)
- D^+_s production in pp collisions at $\sqrt{s}$ = 7 TeV and prospects for the Pb-Pb analysis with the ALICE detector (G.M. Innocenti)

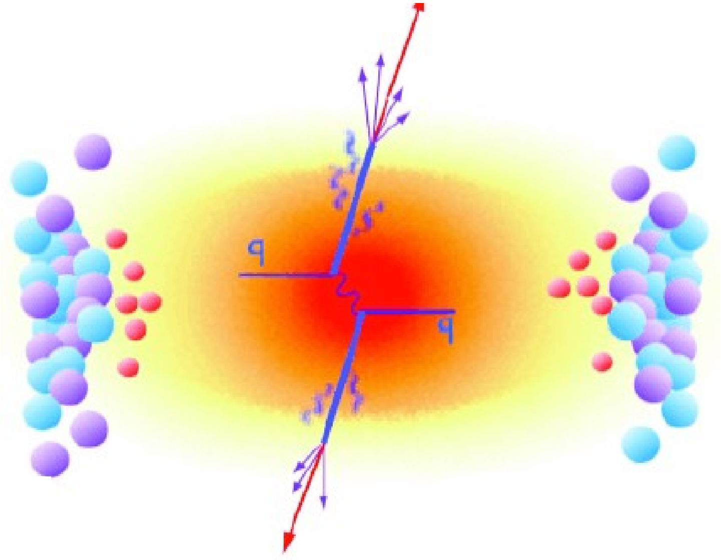
New Results Pb-Pb at $\sqrt{s_{NN}}$ = 2.76 TeV

Part I
Probing the medium with high-p_T partons

Probing the medium with high-p_T partons

- Parton energy loss is related to a rich phenomenology
  - Particle yields are suppressed depending on their
    - Origin
      - gluon or quark fragmentation
    - Direction of emission rel. to event plane
  - Jet yield is reduced and there can be broadening due to
    - Medium induced radiation
    - Interaction with the flowing bulk
  - Modifications of the particle compositions of fragments.
- Study
  - Single particles, di-hadron correlations, jets …
  - From intermediate to high p_T
  - Pathlength dependence from elliptic flow v_2
  - Light hadrons (dominantly form gluon fragmentation) vs heavy flavors (quarks)

Energy loss by radiation and elastic scattering



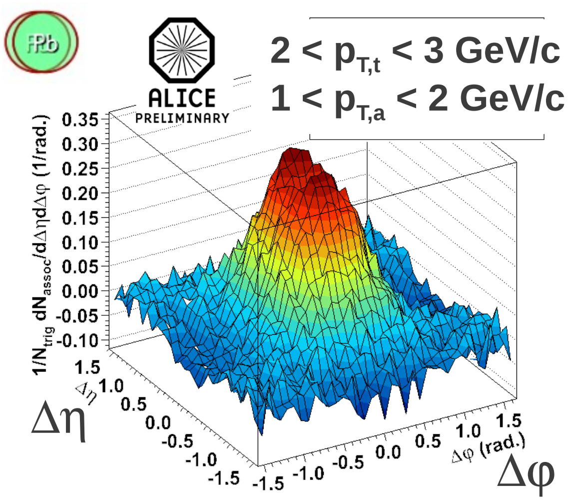
Di-Hadron correlations

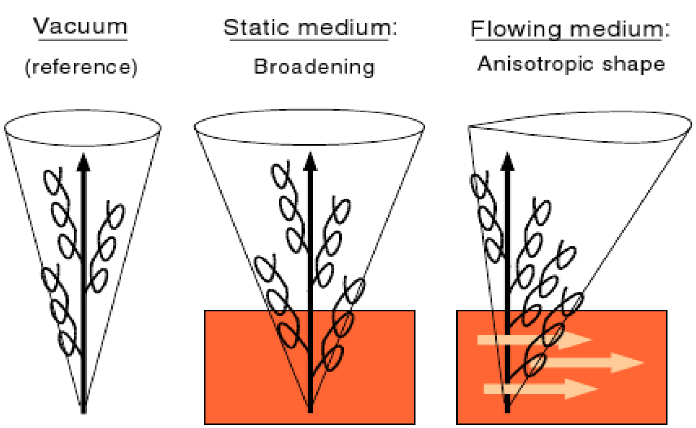
Assess jet properties in the low-p_T region where event by event jet reconstruction is not possible because of underlying event fluctuations.

Study angular correlations ($\Delta\varphi$, $\Delta\eta$) between trigger particles and all associated particles.

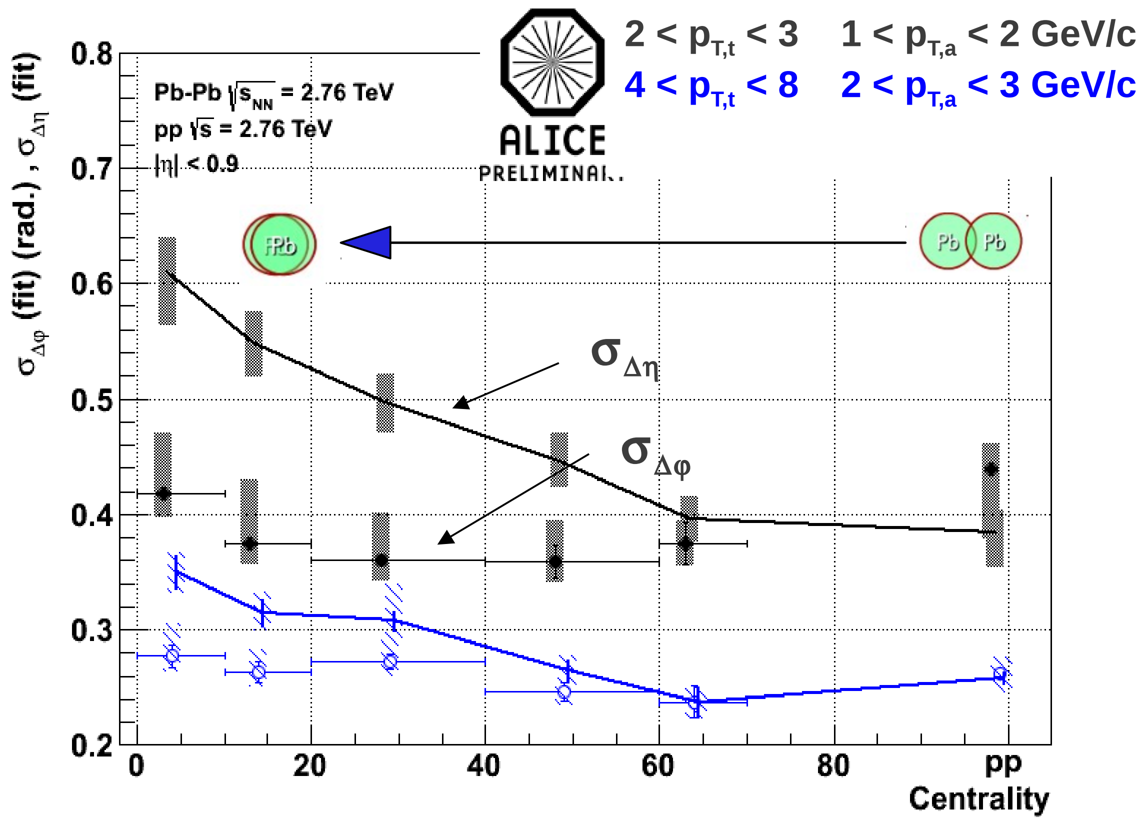
Jet-like near-side peak shapes

Long-range $\Delta\eta$ correlations subtracted
Near-side "jet" peak





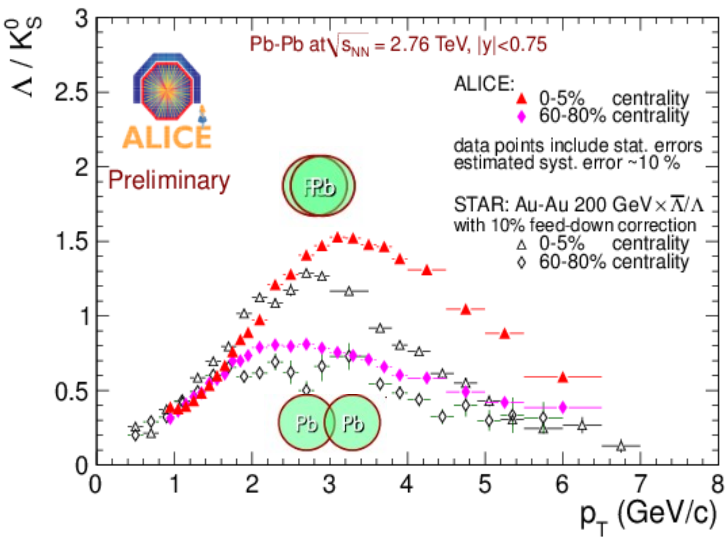
N. Armesto et al., PRL 93,242301 (2004)

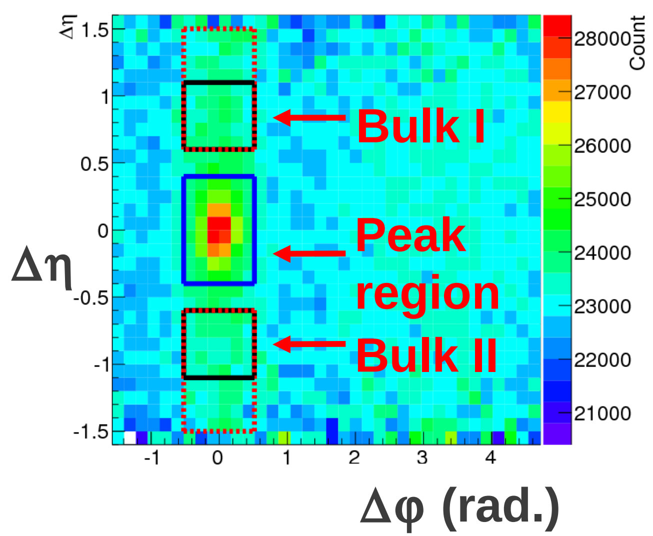


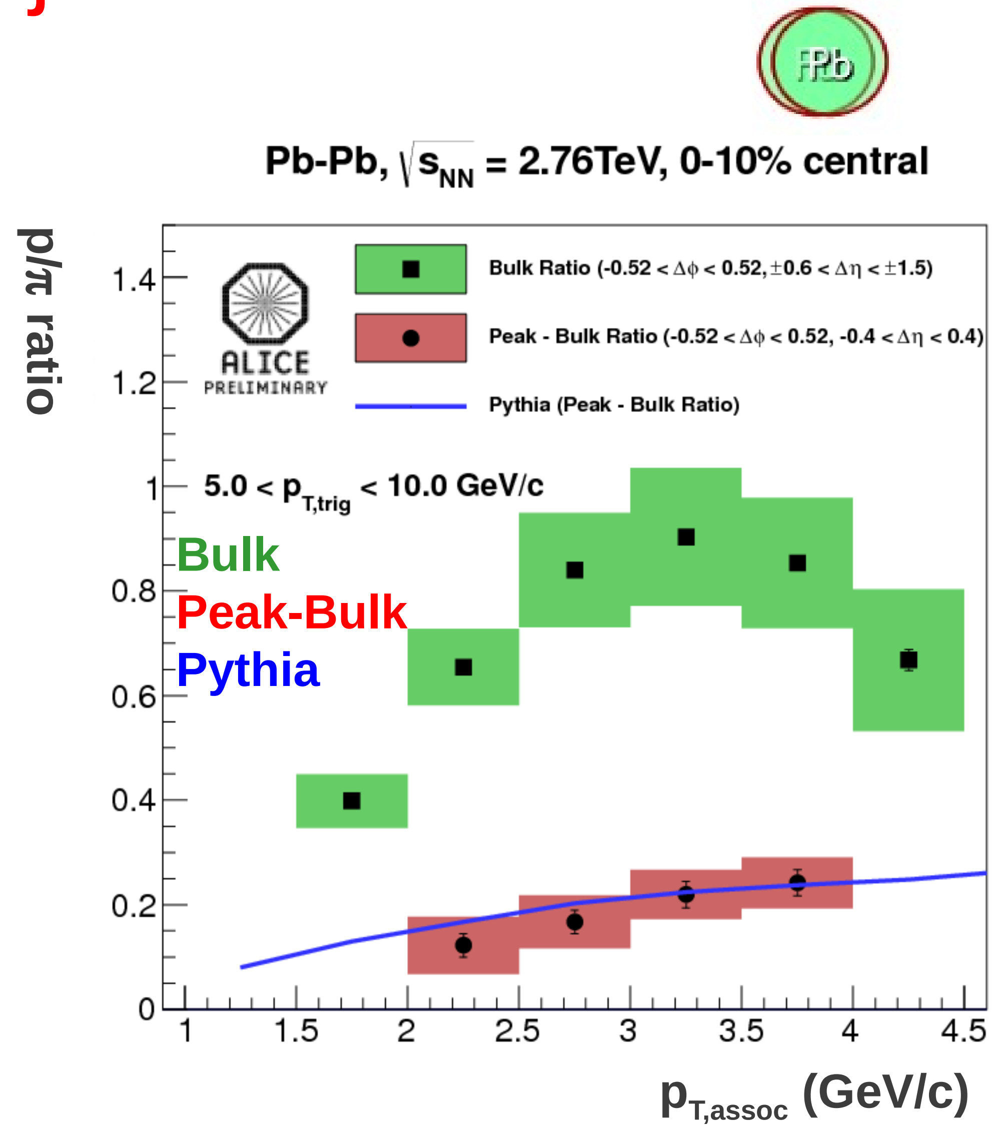
Centrality | 100 = pp

$\sigma_{\Delta\varphi}$ constant whereas $\sigma_{\Delta\eta}$ increases with centrality.

p/π Ratio in jets and bulk







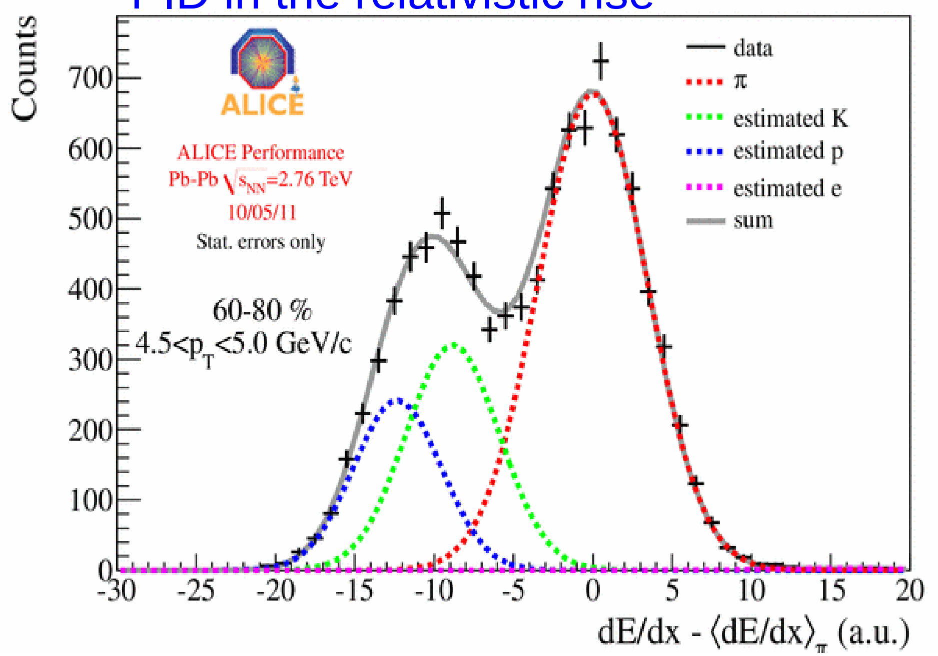
p/π ratio in the bulk is consistent with inclusive p/π ratio

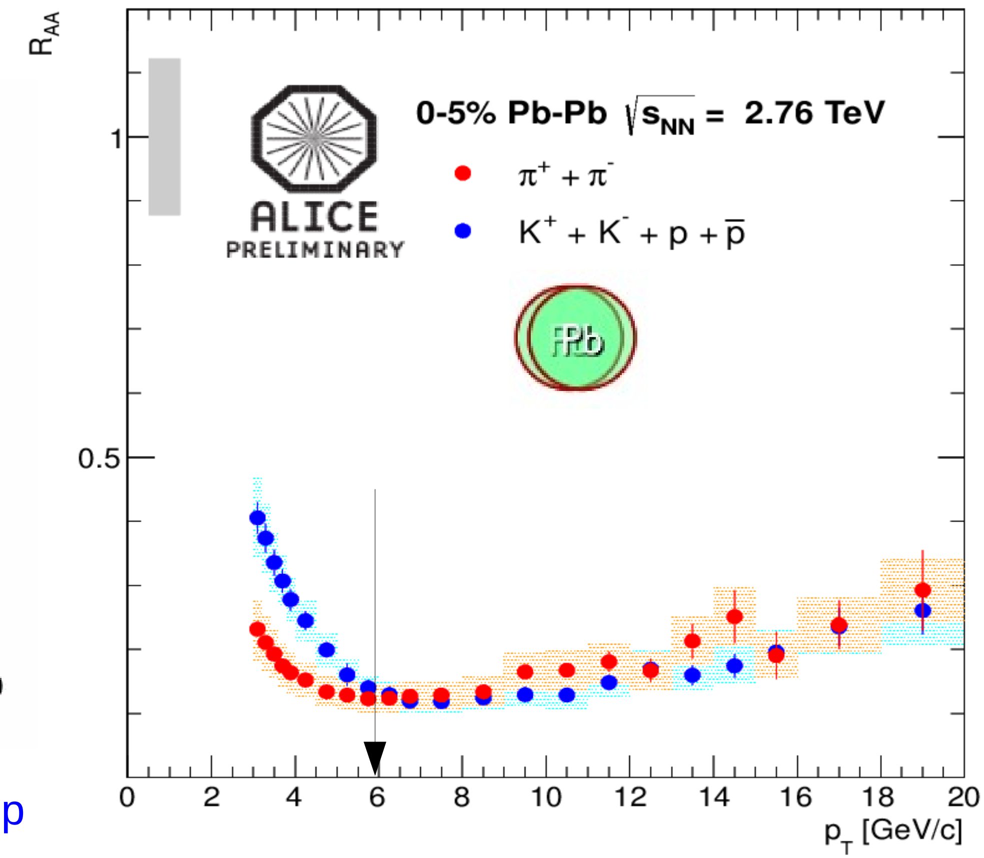
p/π ratio in peak-bulk is significantly smaller

No evidence for medium-induced modification of jet fragmentation in this p_T regime

Charged pion compared to (K+p) R_{AA}

PID in the relativistic rise





For the moment only separation of π from K+p

Later: π,K,p separation

No difference in transverse momentum region where jet fragmentation dominates.

Flow at High p_T

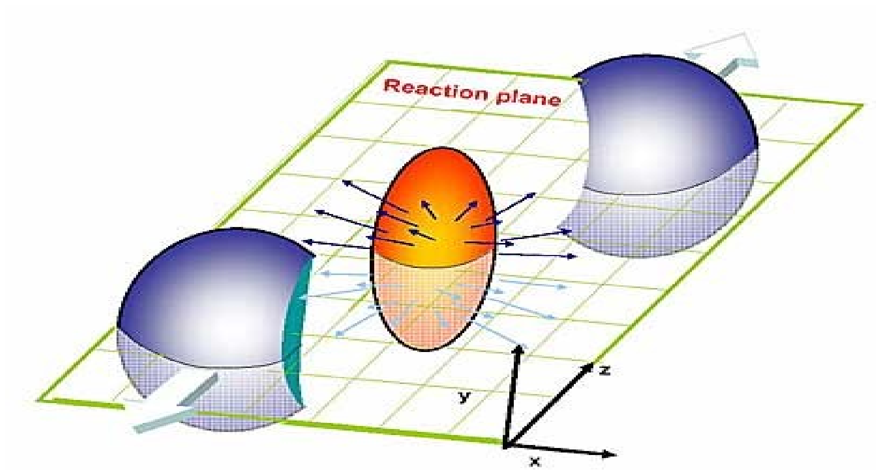
Path length dependence of partonic energy loss

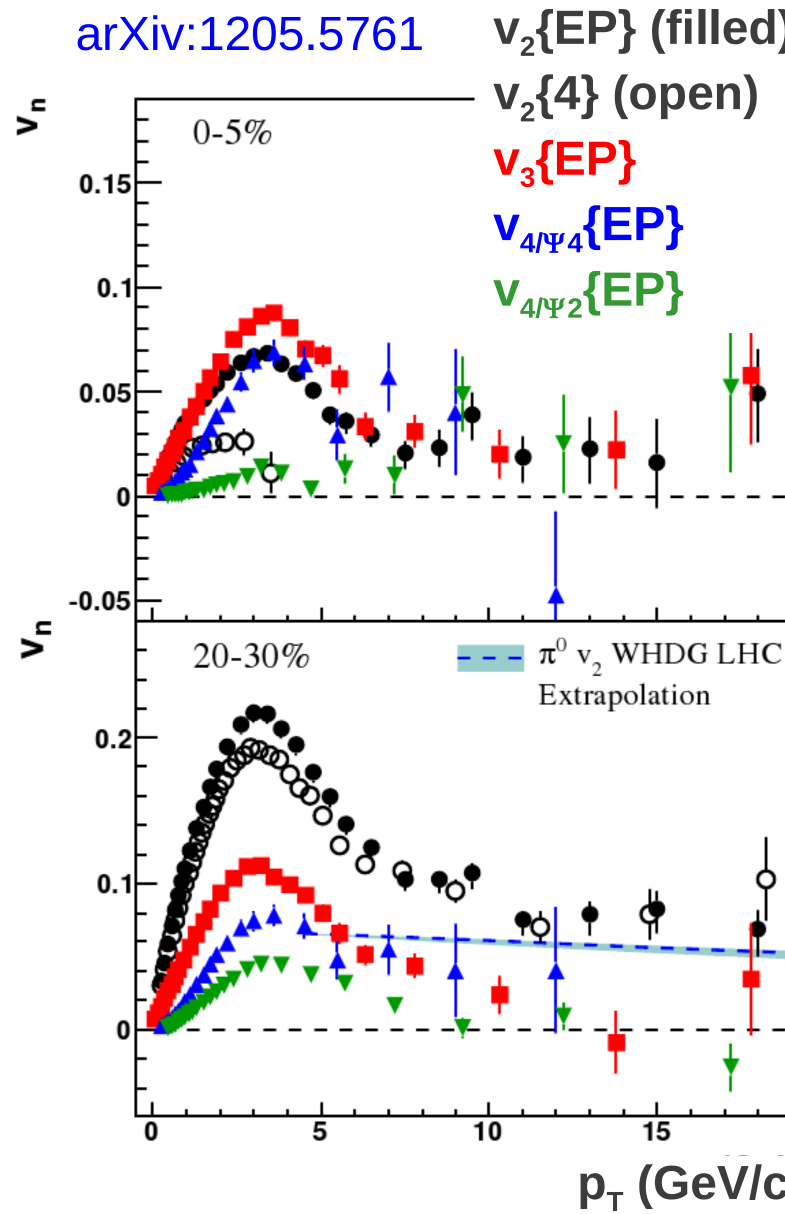
Flow at high p_T

arXiv:1205.5761

- v_2, v_3, v_4 have been measured to 20 GeV/c in 6 centrality classes

  (0-5% to 40-50%)
- v_2 flattens at high p_T, stays positive and increases towards mid-centrality
  - Path-length dependent quenching



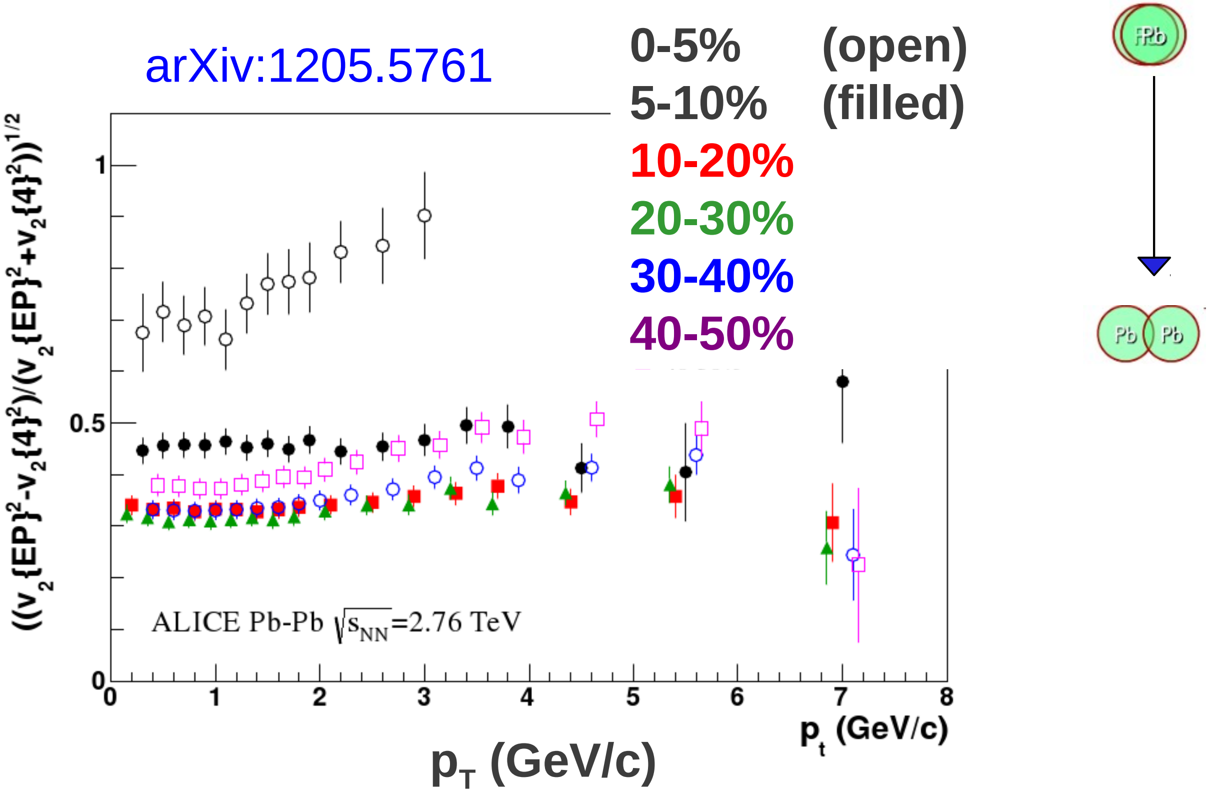


Collectivity (hydro)

Quenching

p_T

Flow fluctuations



Relative v_2 fluctuations only weakly dependent on p_T

Two very different effects, however, common origin of flow fluctuations ?

Heavy Flavor

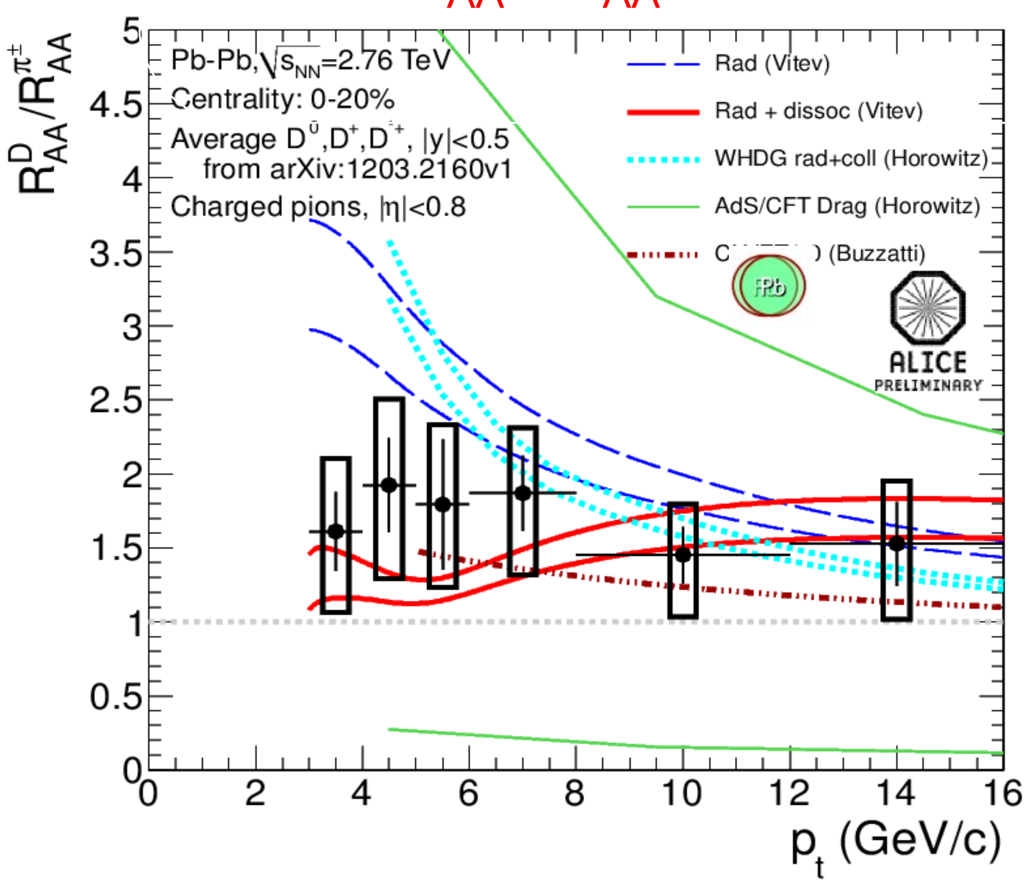
First measurement of R^{D}_{AA}/R^{π}_{AA}

Expectation:

$\Delta E_{gluon} > \Delta E_{quark}$ (Casimir factor)

$\Delta E_{light\ quark} > \Delta E_{massive\ quark}$ ('dead cone')

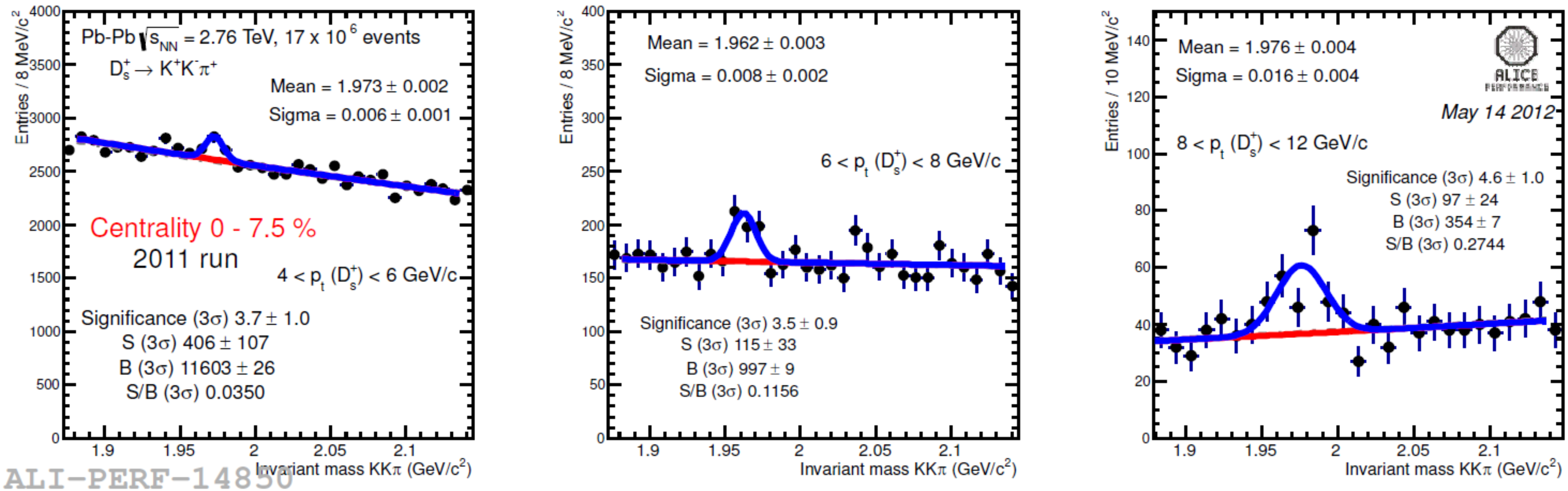
$R^{D}_{AA}/R^{\pi}_{AA} > 1$ (?)



First indication of color-charge effects ?

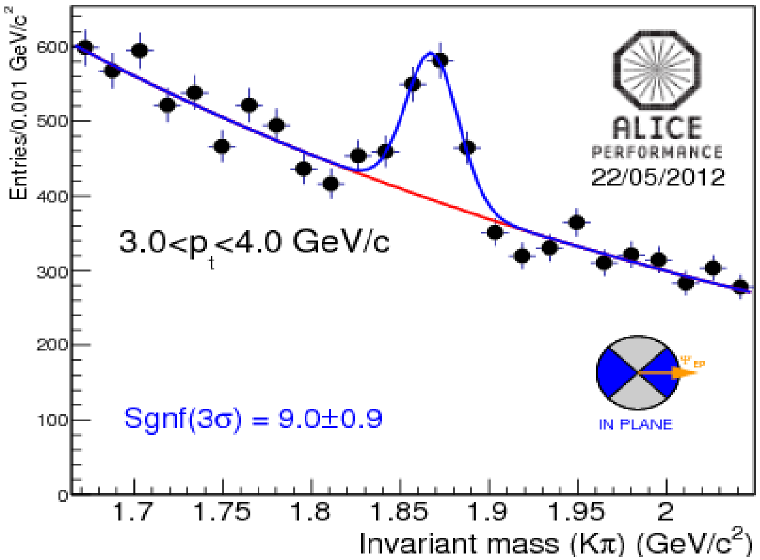
More to come from 2011 PbPb

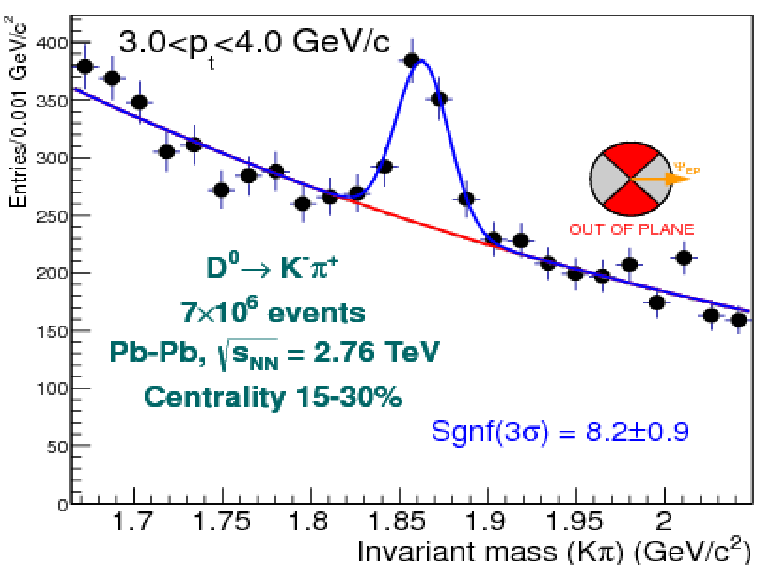
D_s

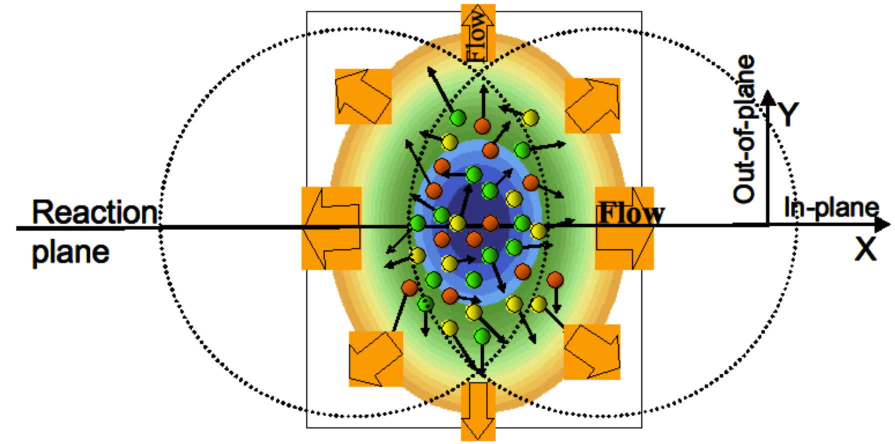


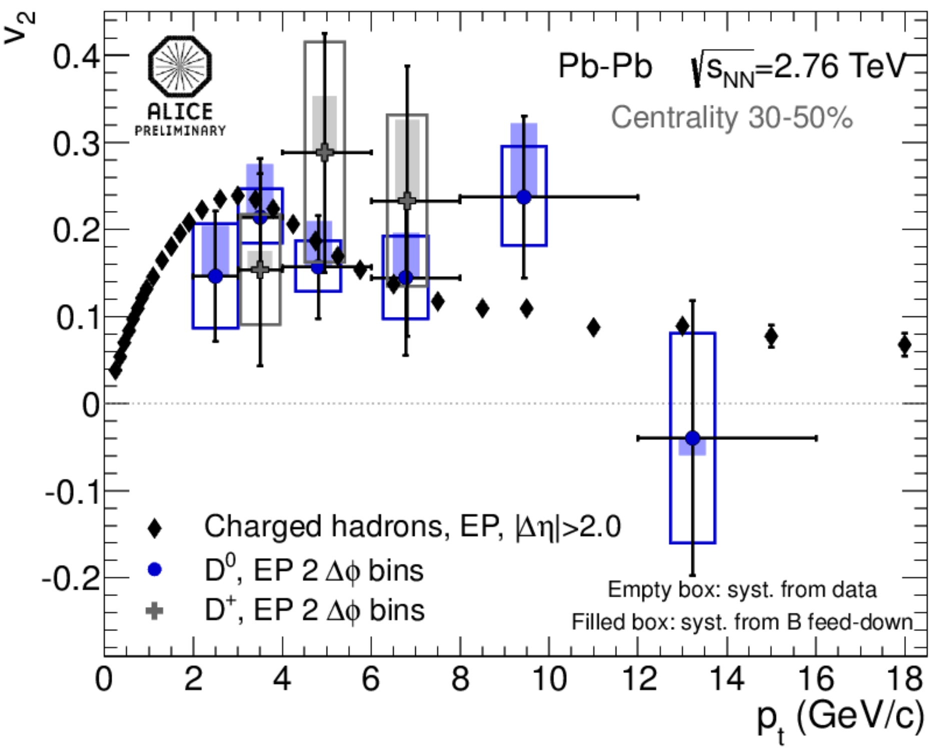
Elliptic flow in D mesons

Total 2011 Statistics







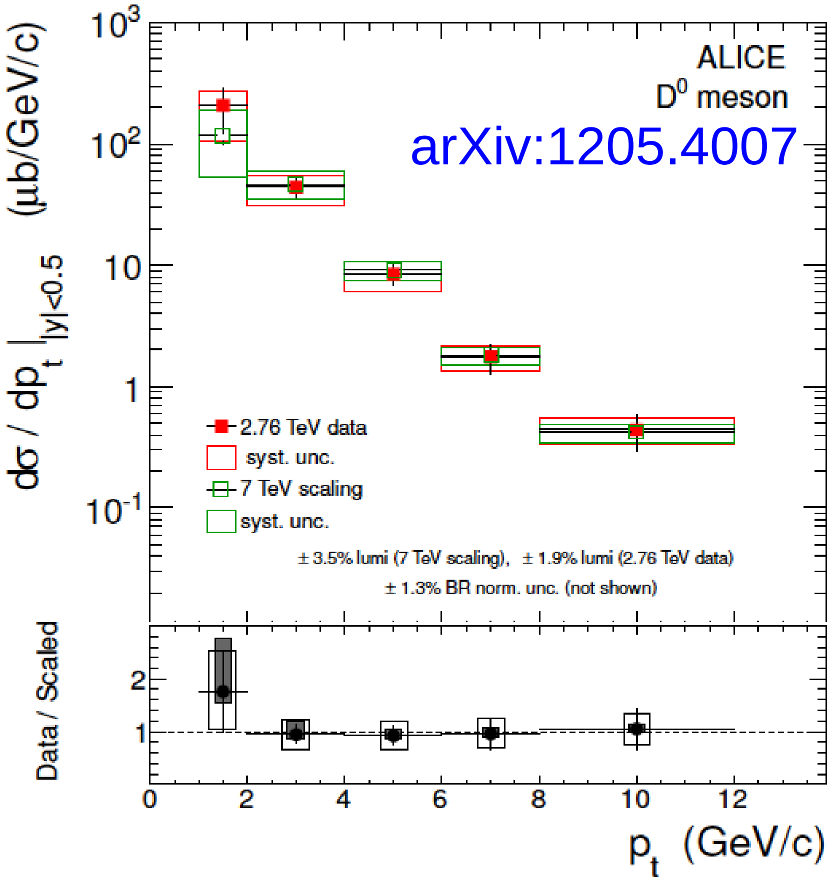


The D flows ! Thermalization at low p_T ?

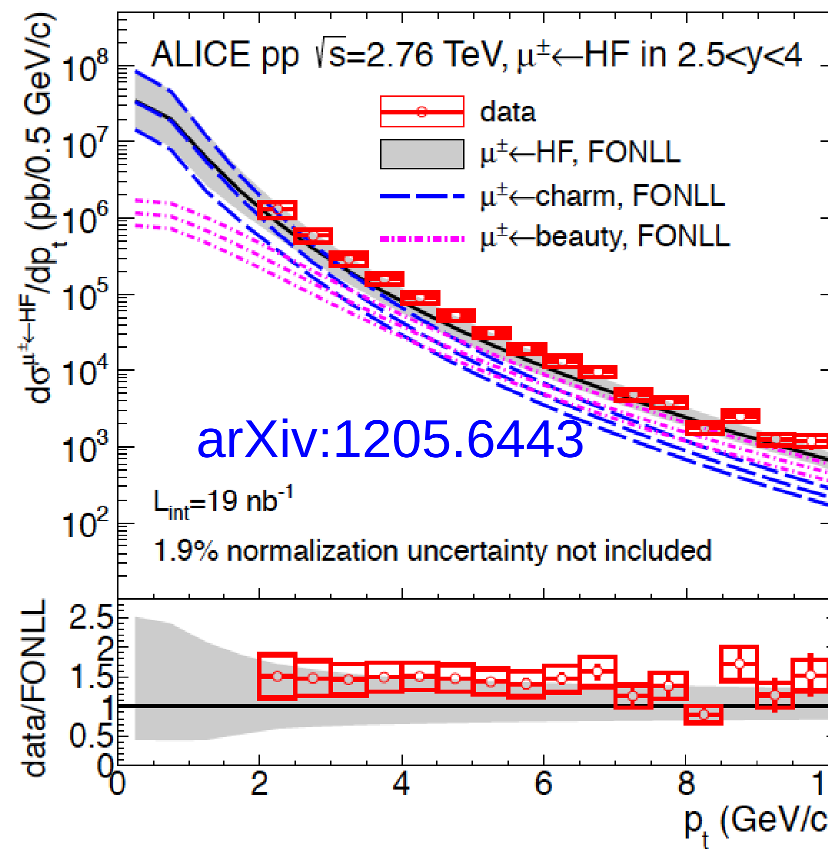
Interlude

pp at √s = 2.76 TeV references

$D^0 \rightarrow K^- \pi^+$



forward single muons

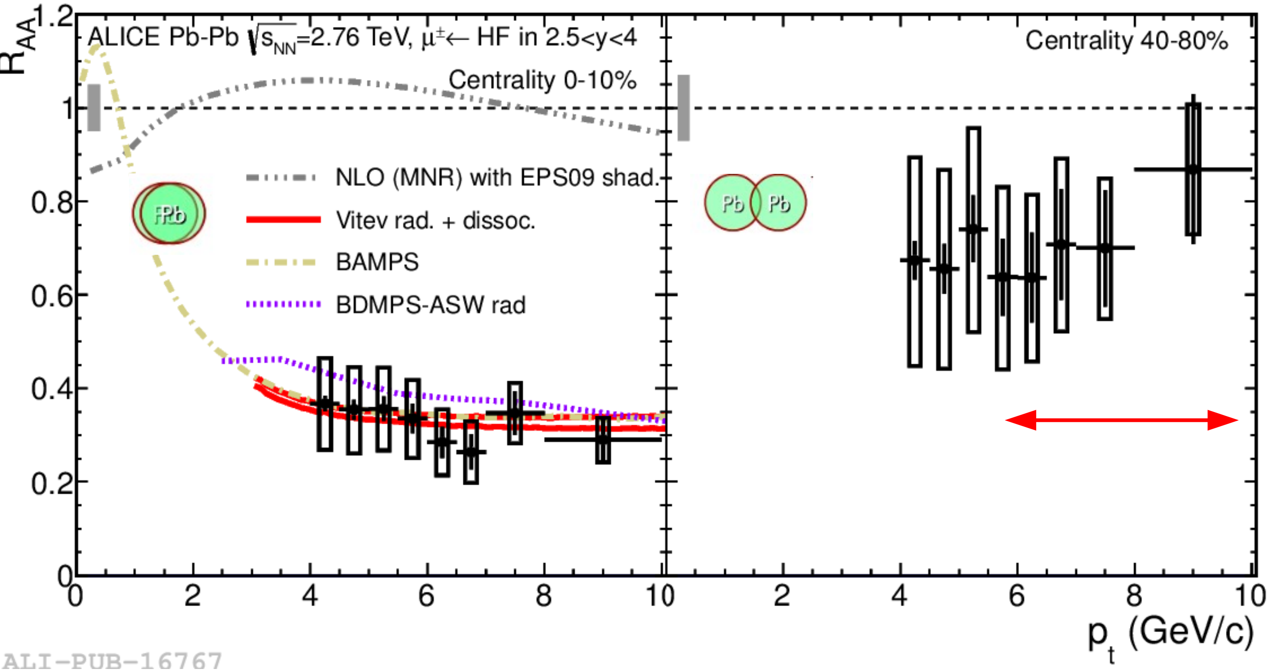


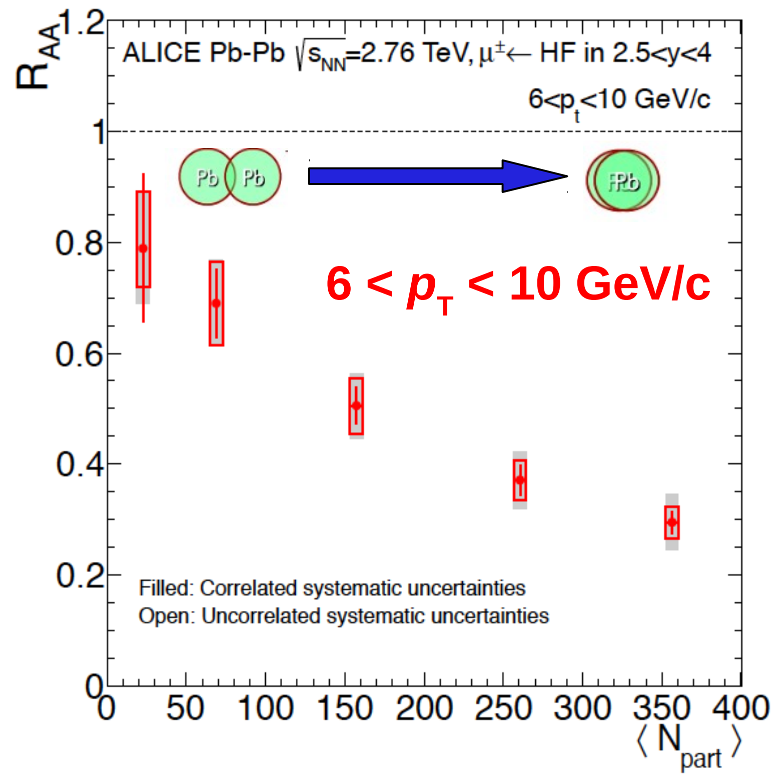
Important cross-check for spectra extrapolated from 7 TeV to 2.76 TeV using FONLL

High p_T (8-10 GeV/c) dominated by b-decays according (FONLL)

PbPb
single muon R_{AA} 2.5 < y < 4

arXiv:1205.6443

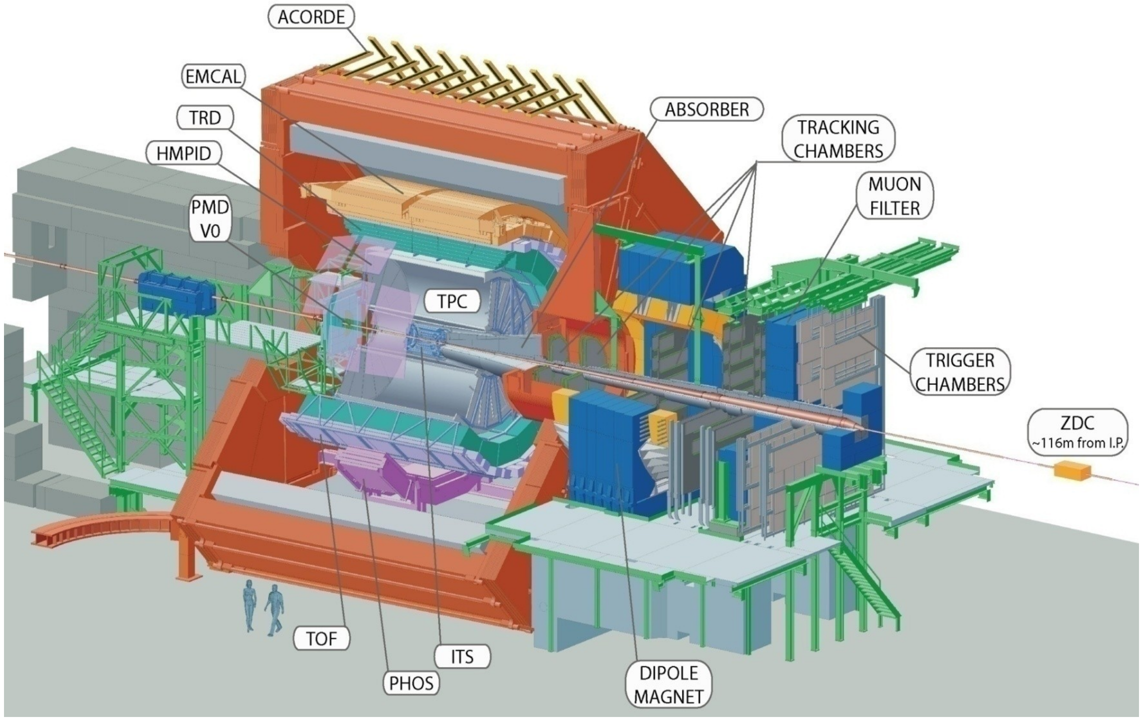


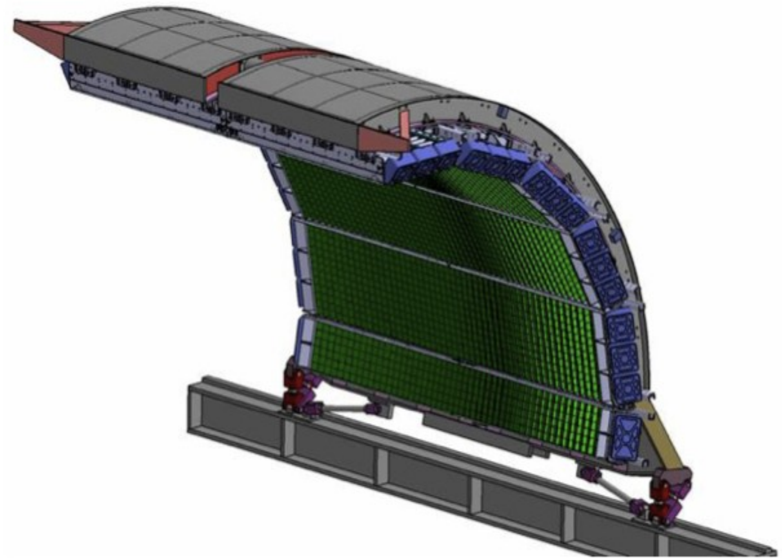


No p_T dependence within errors consistent with R_{CP} measured by ATLAS

Strong centrality dependence

Jets





EMCal: Pb-scintillator sampling calorimeter which covers:

$|\eta|<0.7$, $80°<\varphi<180°$

- 11520 towers with each covers $\Delta\eta \times \Delta\phi \sim 0.014 \times 0.014$

Tracking: $|\eta|<0.9$, $0<\varphi<360°$
TPC: gas detector
ITS: silicon detector

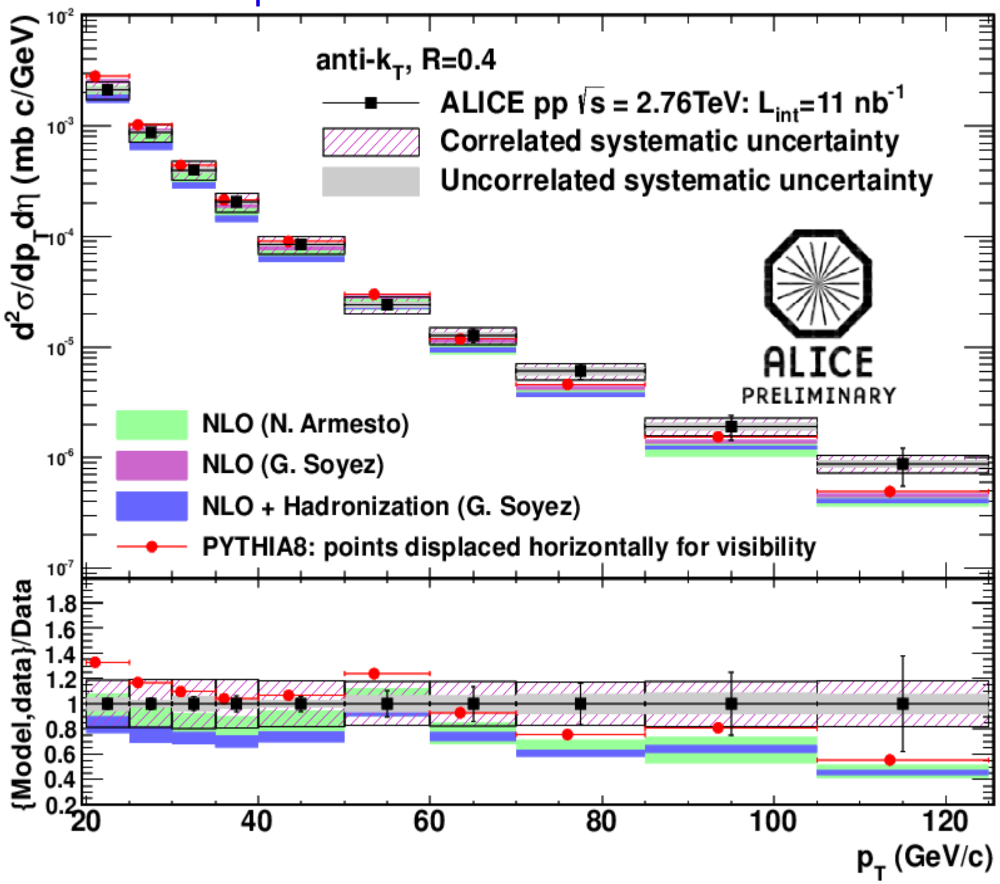
Charged constituents

Neutral constituents

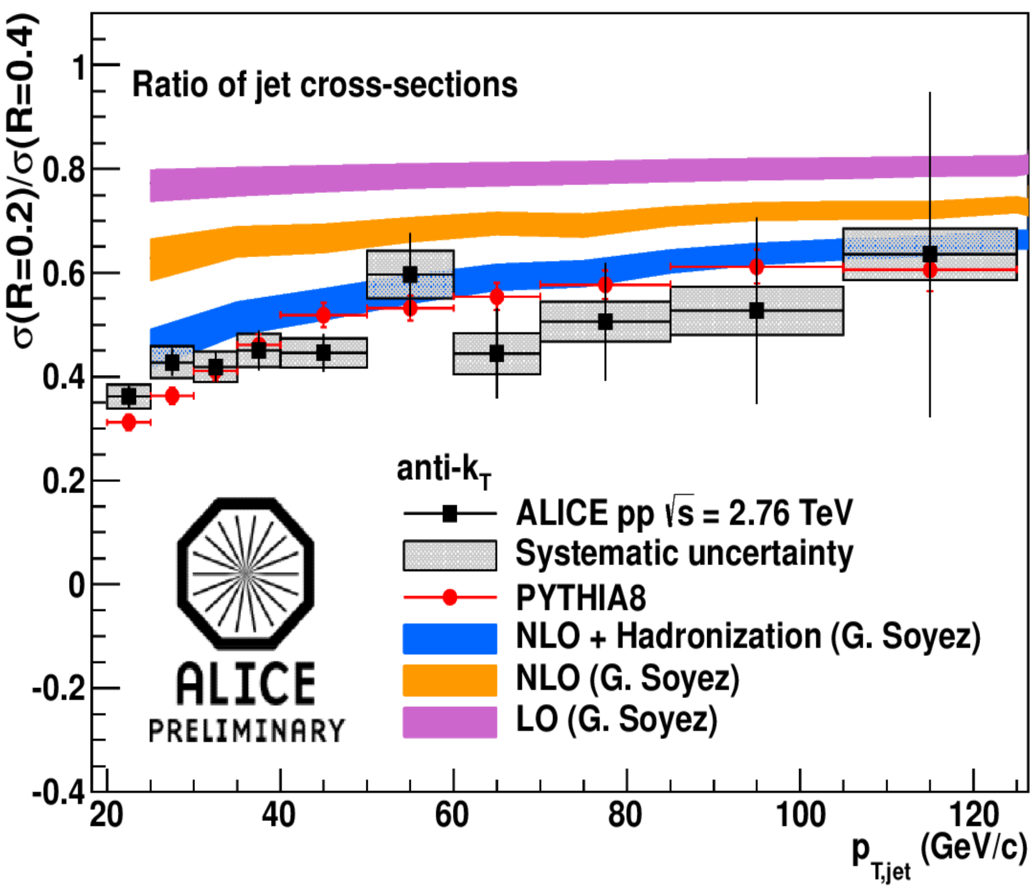
JET

Fully reconstructed jets
pp at √s = 2.76 TeV

anti k_T R = 0.4

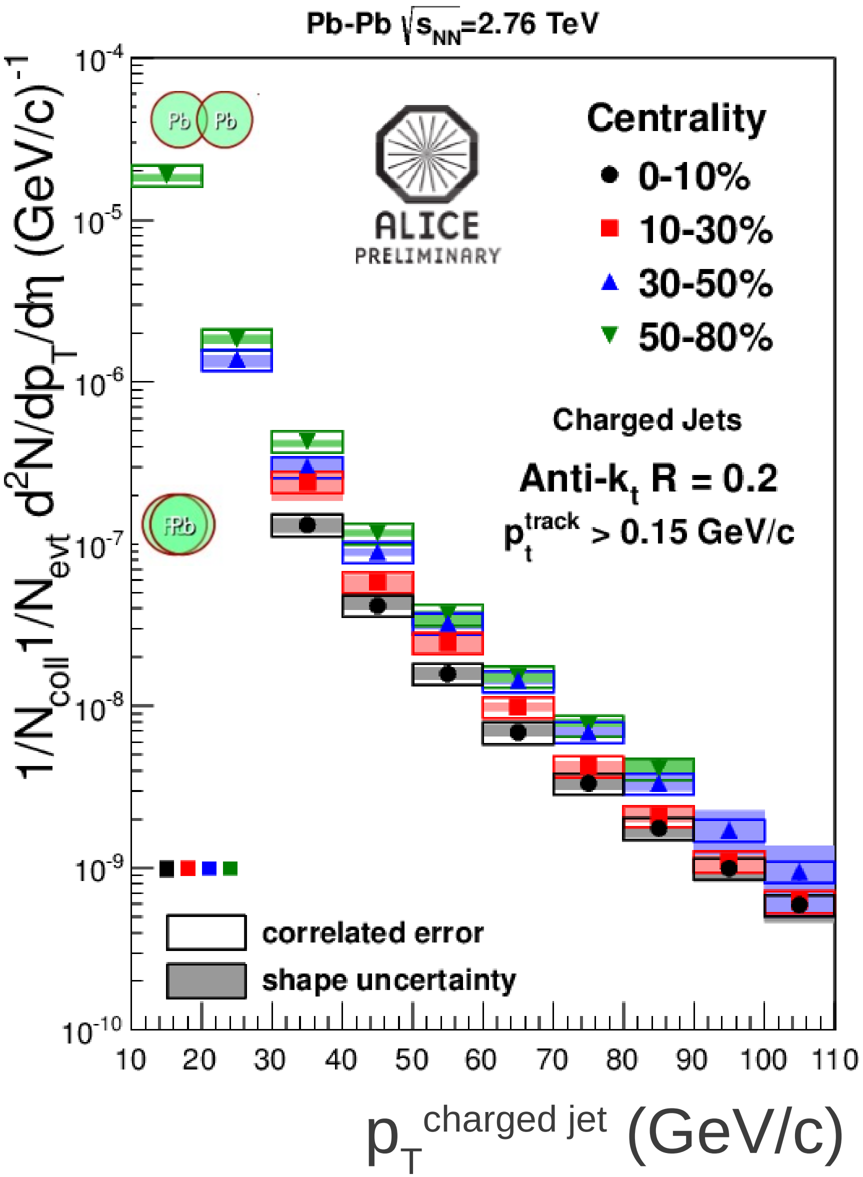


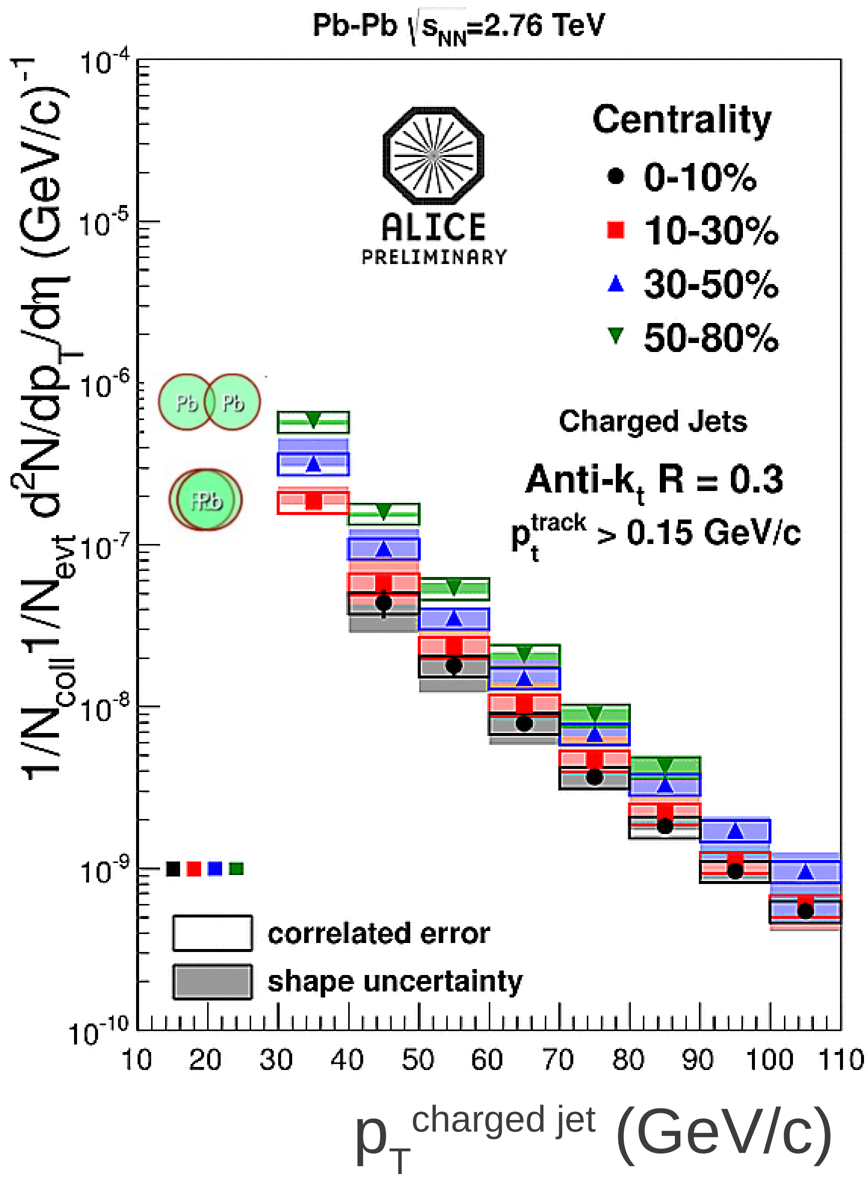
Jet shape by varying R



Good agreement with NLO and Pythia8

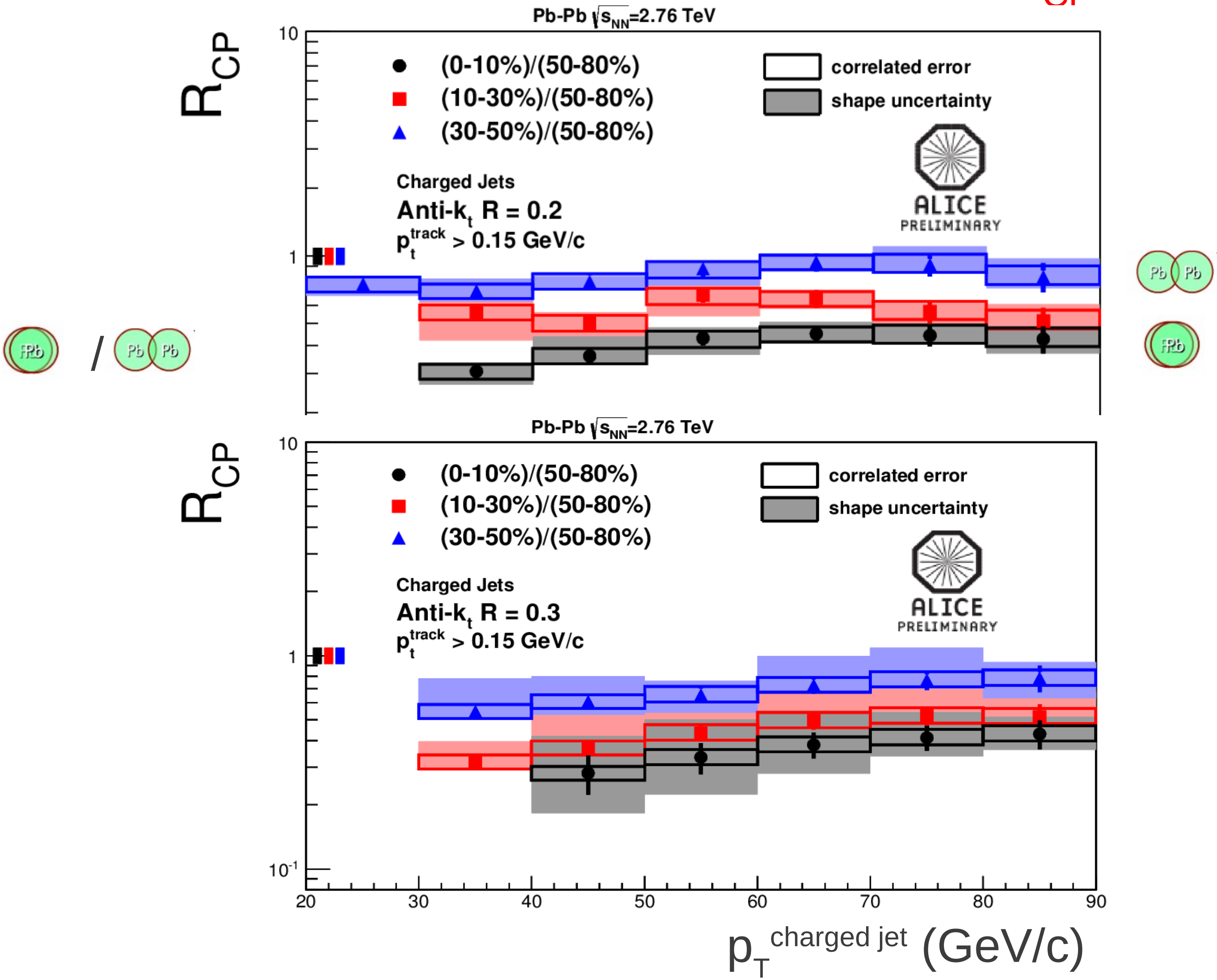
Charged jet spectra in PbPb





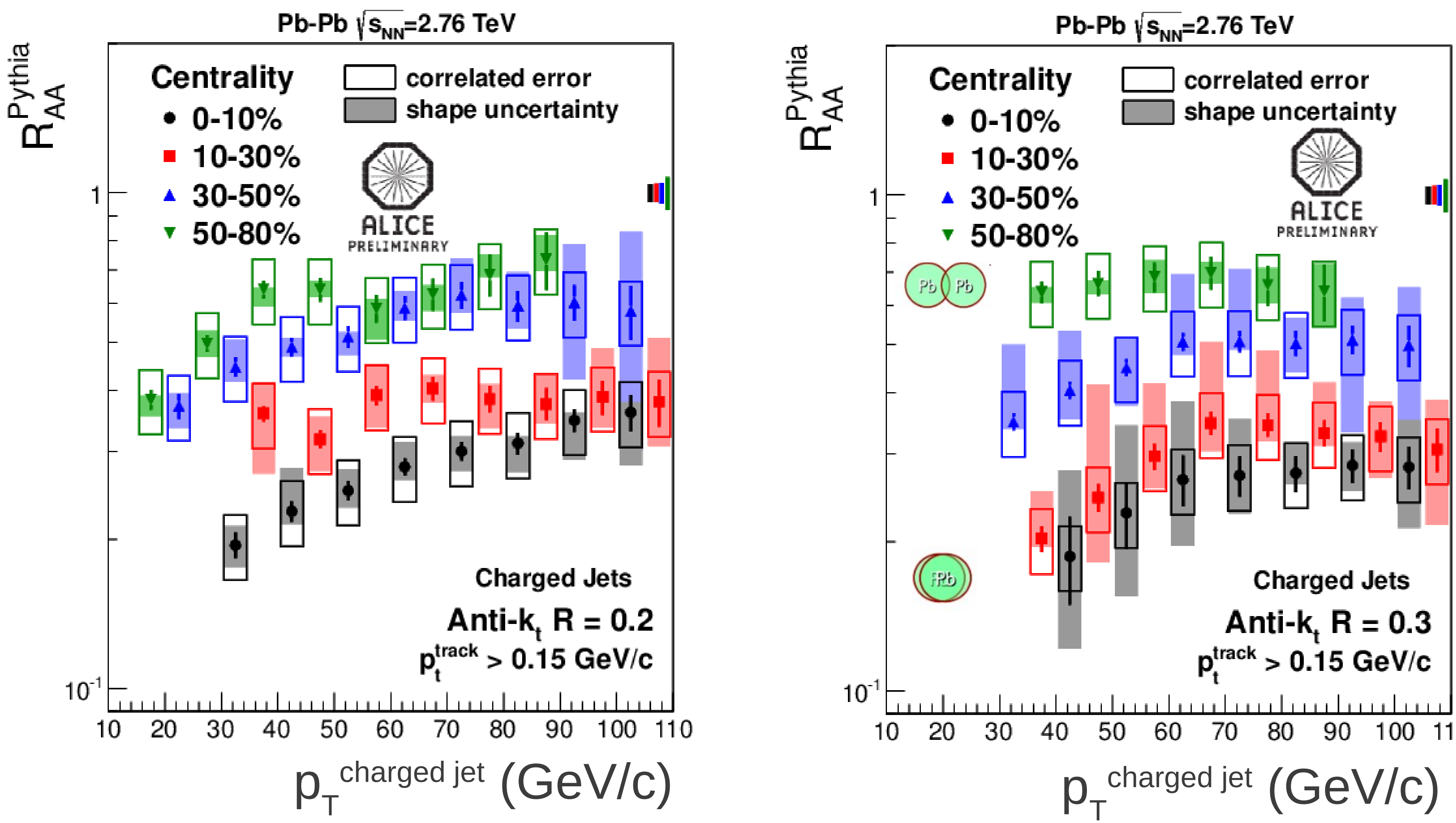
Yield scaled by the number of binary collisions shows suppression increasing with centrality.

Nuclear modification R_{CP}



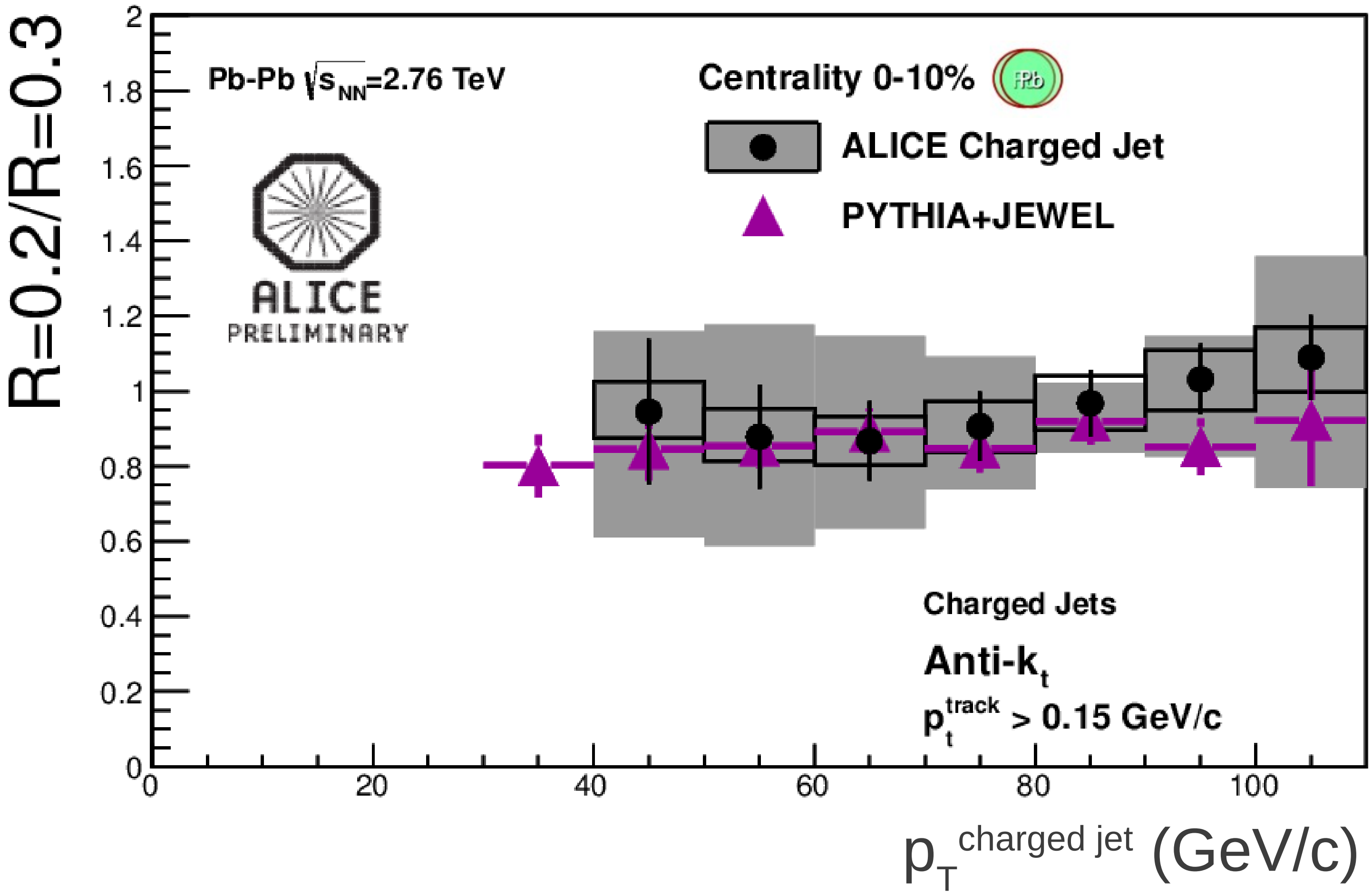
Significant jet yield suppression in central and mid-central Pb-Pb collisions

Nuclear modification R_{AA}



Jet suppression in central events close to inclusive particle R_{AA} !

Jet shape via variations of *R*



Very weak *R* dependence => no significant modification of the remnant jet shape.
Consistent with ATLAS and CMS measurements.

New Results Pb-Pb at $\sqrt{s_{NN}}$ = 2.76 TeV

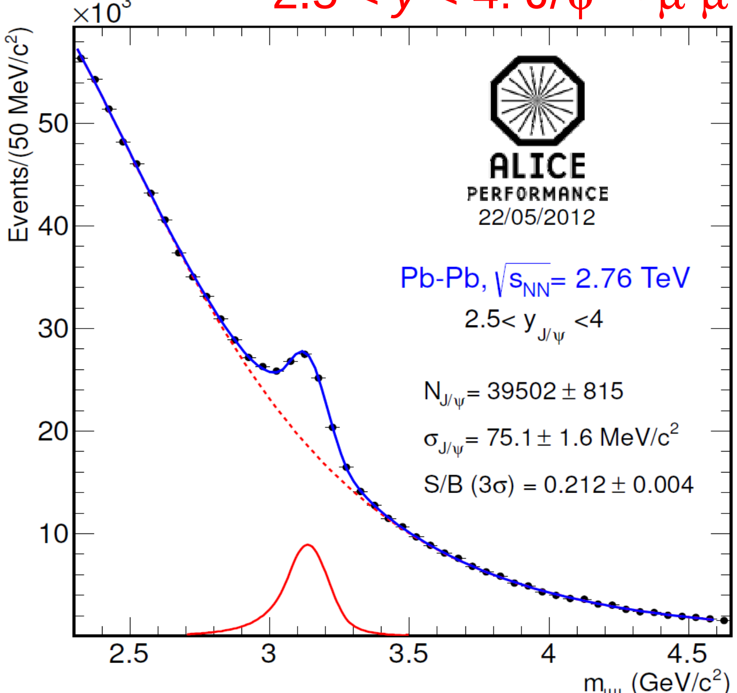
Part II
De-confinement and the J/ψ

J/ψ

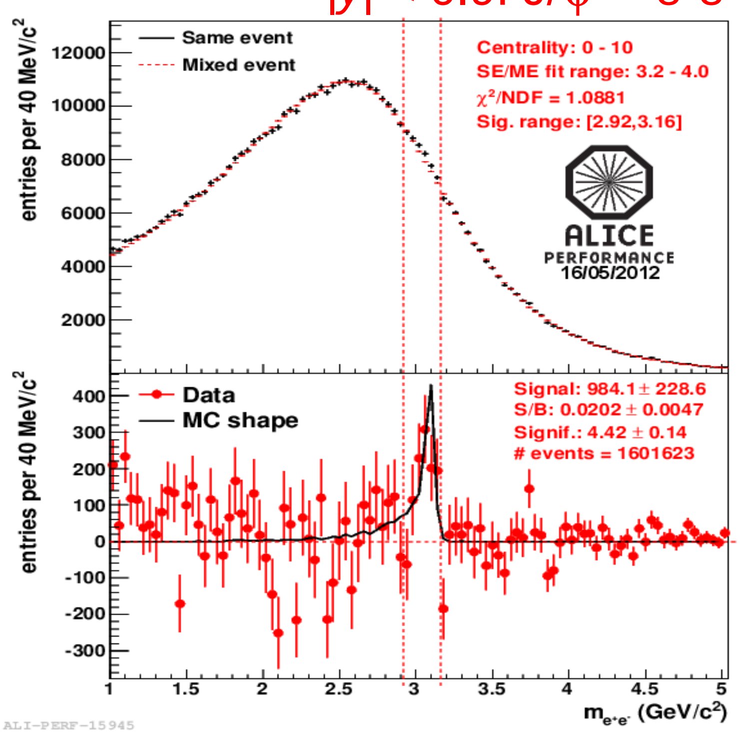
- Yield modifications due to de-confinement
  = interplay between

–color screening — suppression
–charm recombination — regeneration

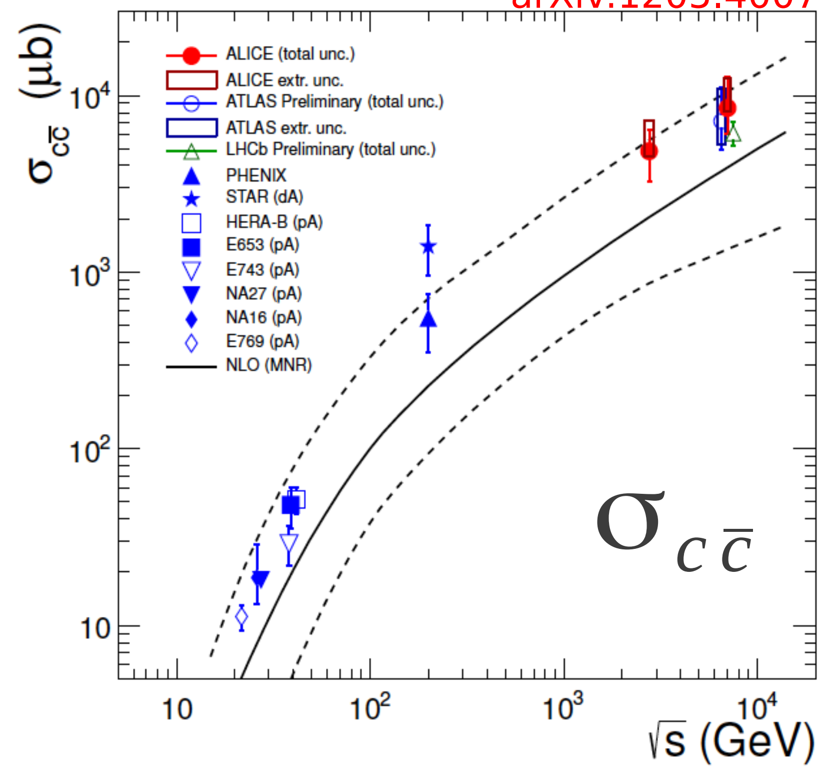
2.5 < y < 4: $J/\psi \rightarrow \mu^+\mu^-$



|y| < 0.9: $J/\psi \rightarrow e^+e^-$

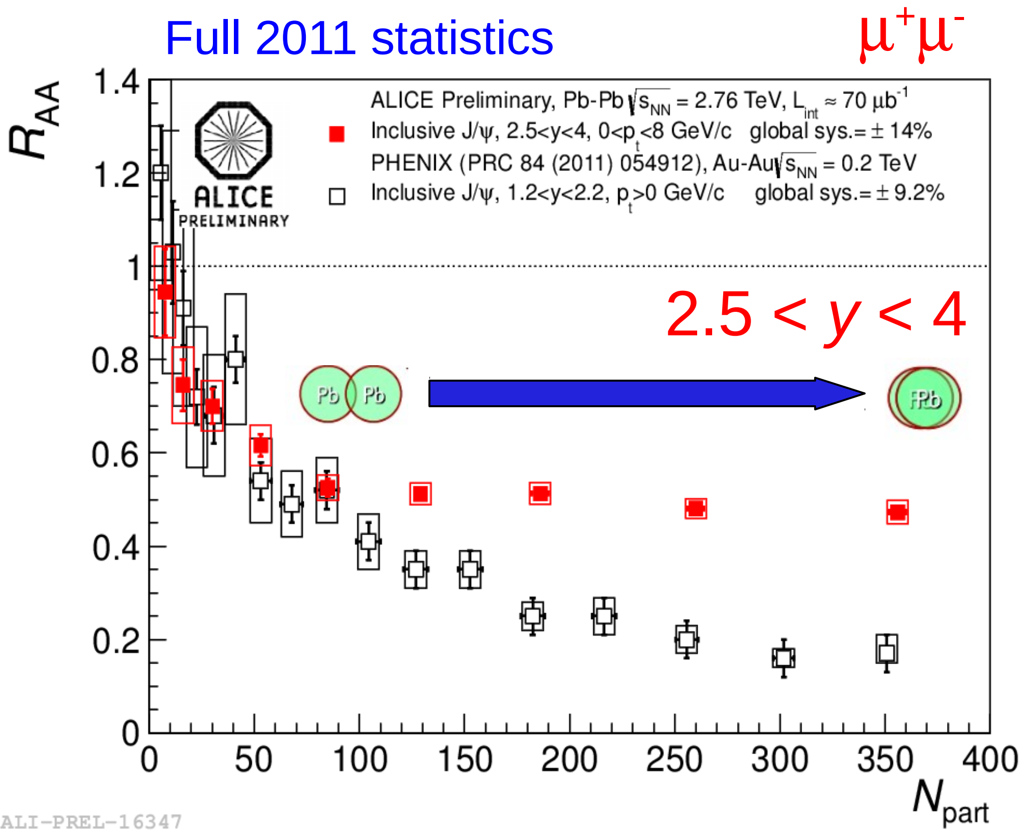


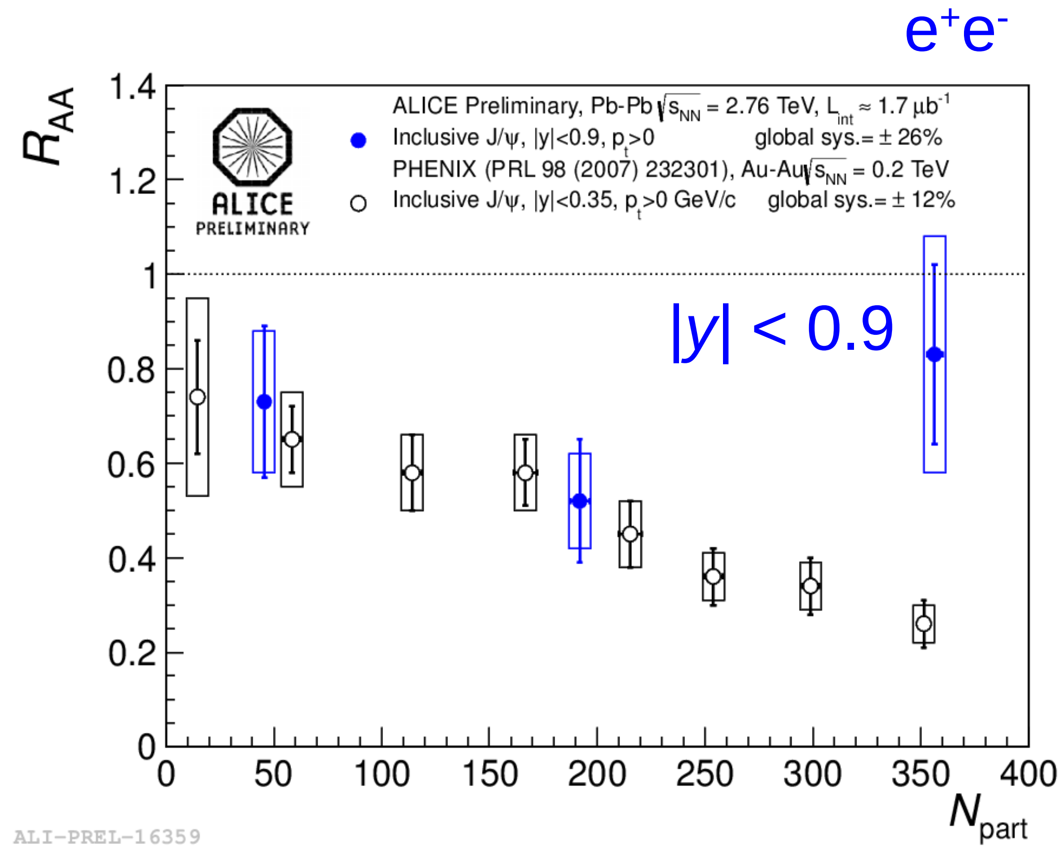
arXiv:1205.4007



≈ 60 $c\bar{c}$ in central Pb-Pb

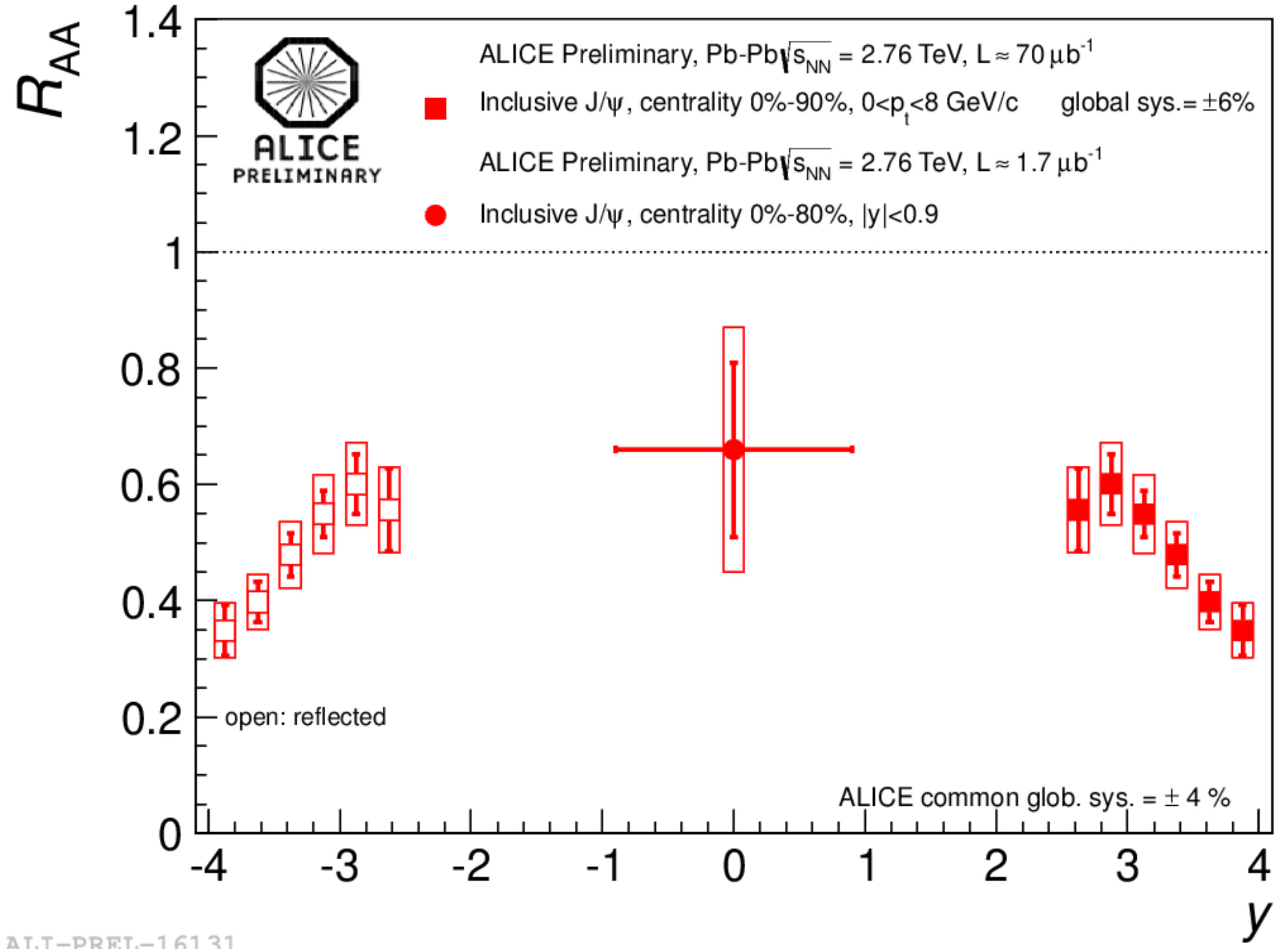
J/ψ Suppression as function of centrality





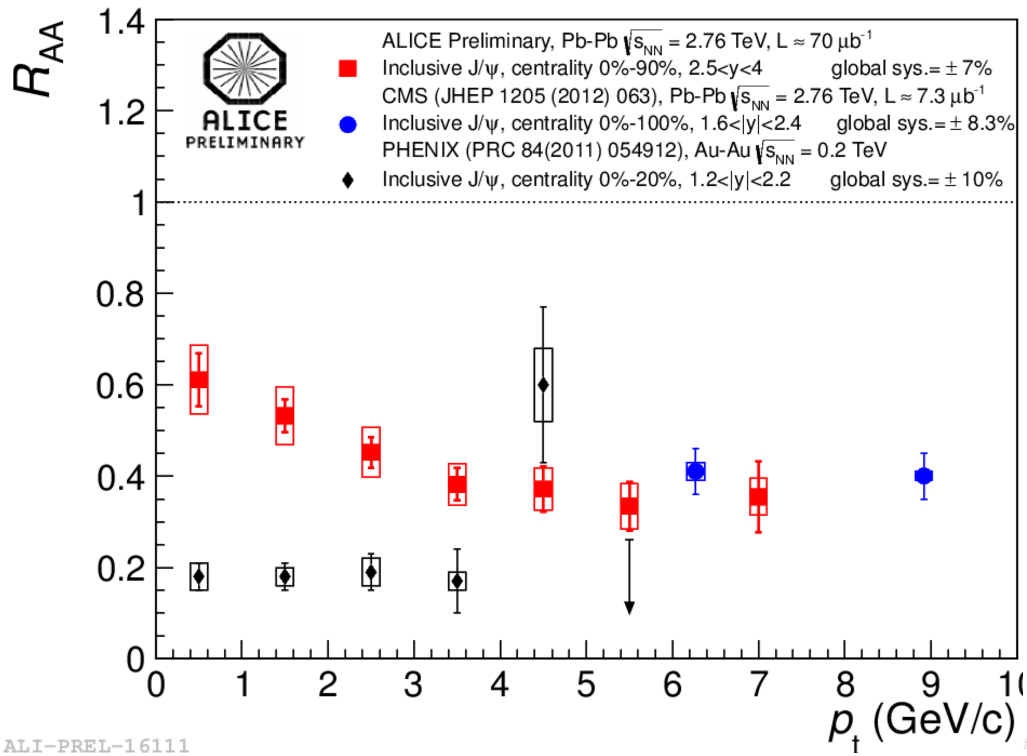
- No centrality dependence for N_{part} > 50 in contrast to RHIC results in a similar kinematic region.
- Regeneration when charm density becomes high ?
  - large centrality
  - central rapidity
  - low p_T.

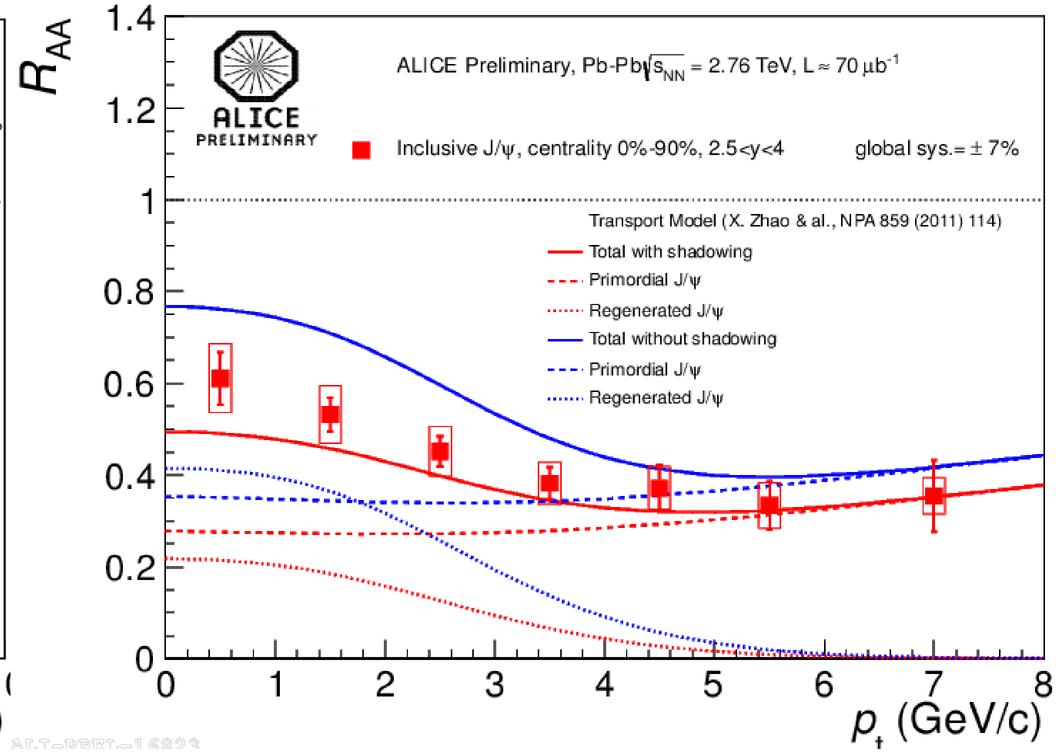
Rapidity dependence of suppression



Stronger suppression at high rapidity

p_T -Depedence of suppression

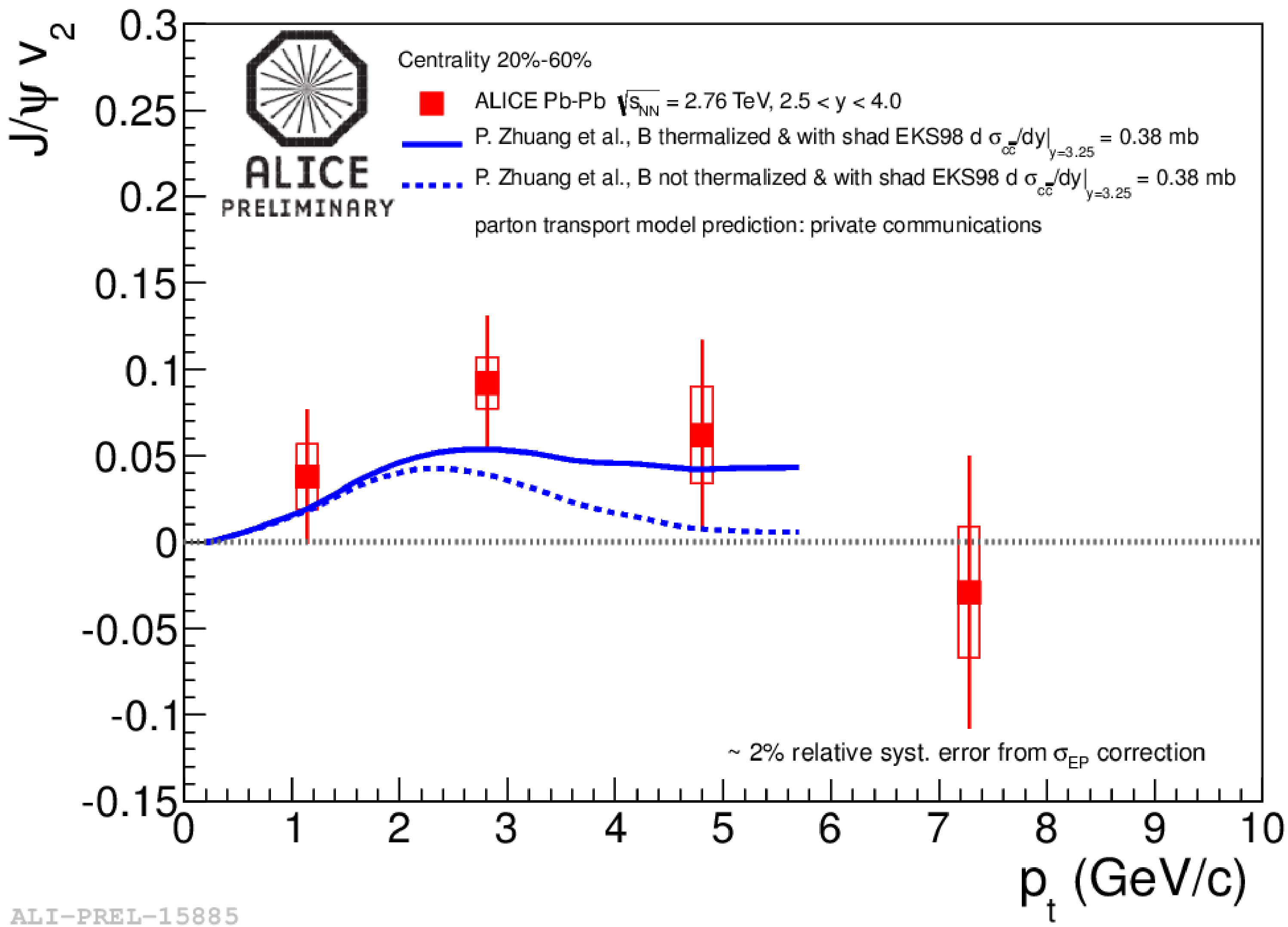




Strong p_T dependence observed, in agreement with models including regeneration.

These models also predict a non-zero elliptic flow (v_2)

J/ψ Elliptic Flow



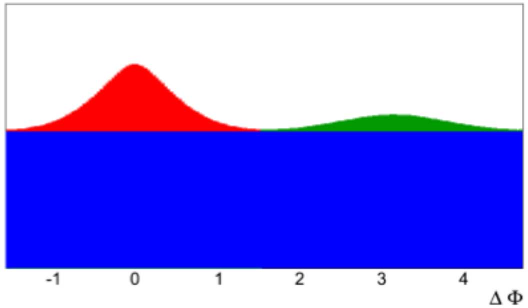
Indications for non-0 elliptic flow (2.2σ effect)

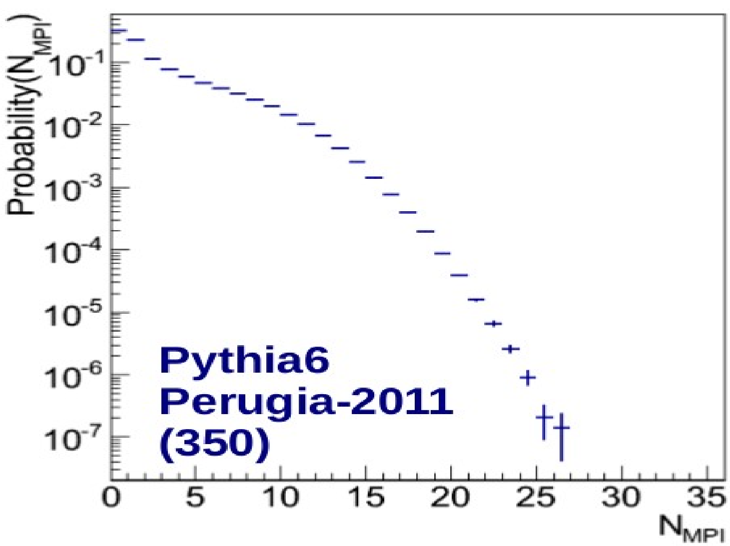
Part III

pp Highlights

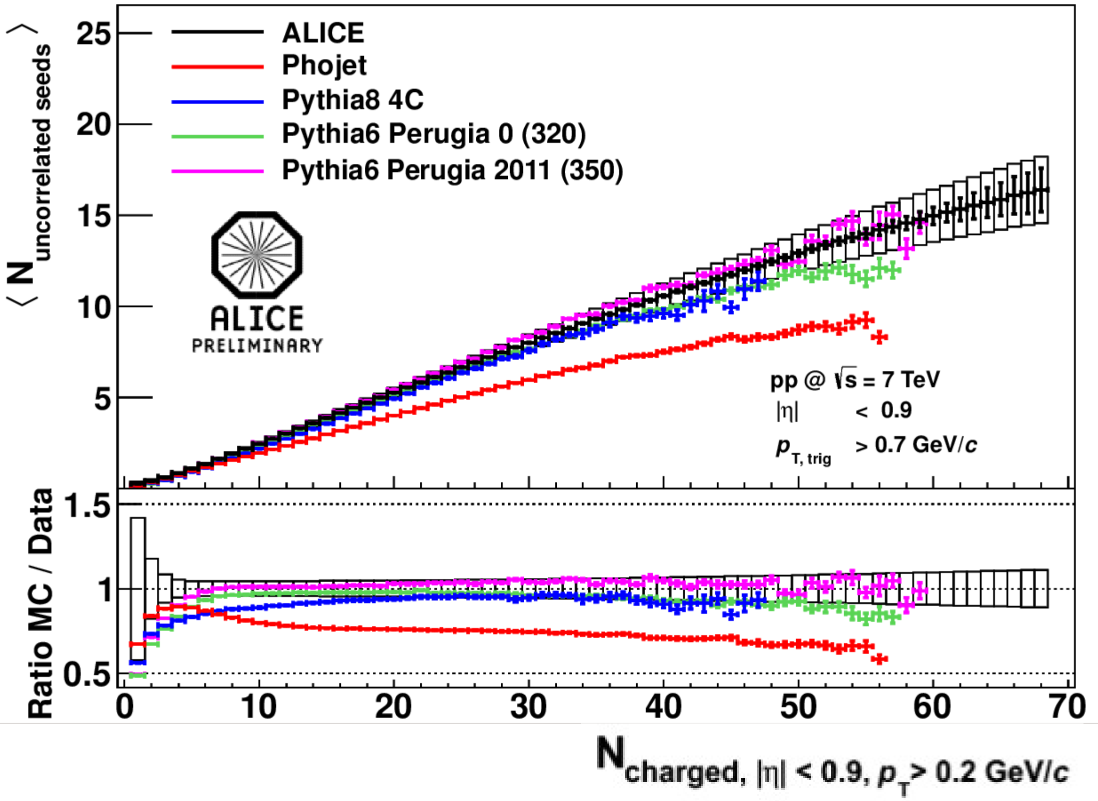
Di-Hadron correlations in pp as a function of multiplicity

Per trigger yield of:
combinatorial background,
per-trigger "near side" yield,
per-trigger "away side" yield





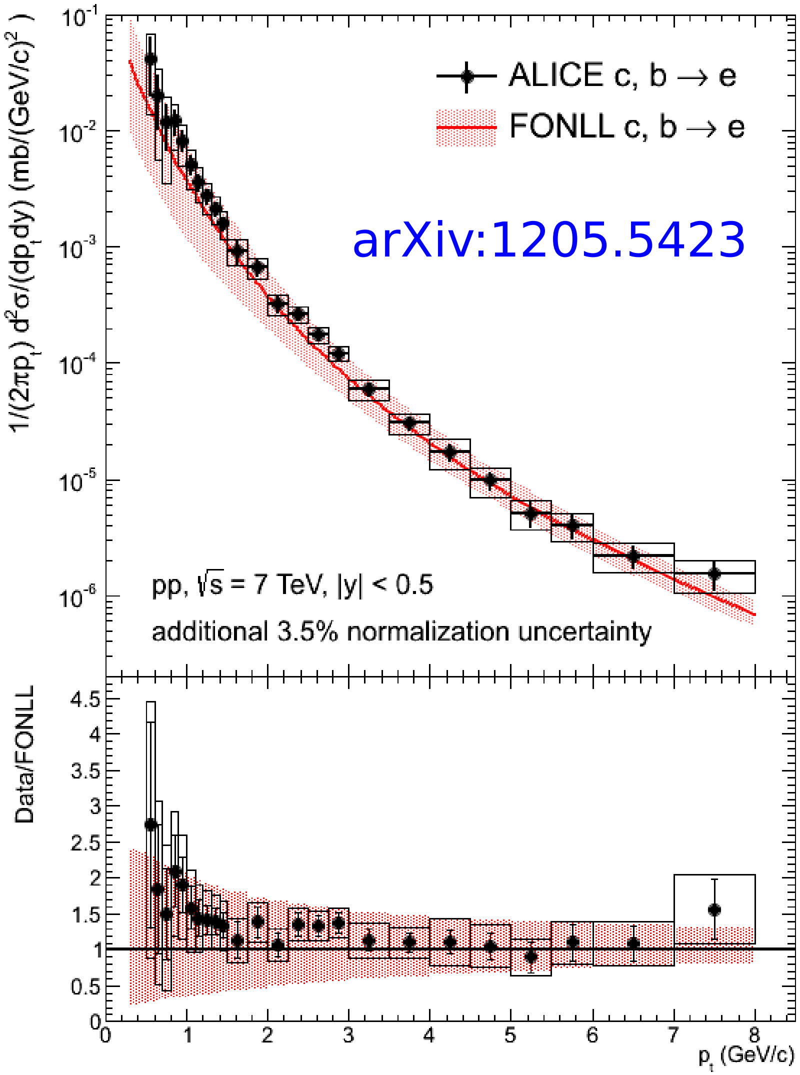
$$\langle N_{uncorrelated\ seeds} \rangle = \frac{\langle N_{trig} \rangle}{\langle 1 + N_{assoc,\, near+away,\, p_T > p_{T,trig}} \rangle}$$



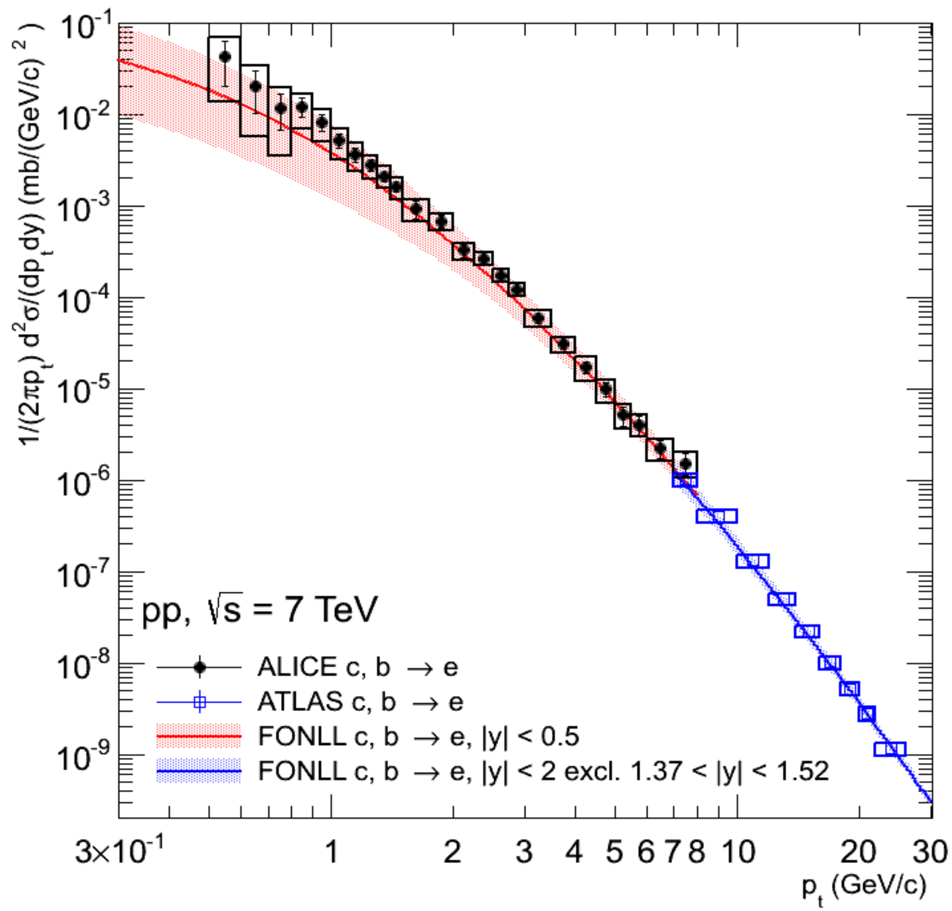
Onset of Multi Parton Interaction threshold effect ?

Electrons from heavy flavor in |*y*| < 0.5

c,b semi-electronic decays |y|<0.5



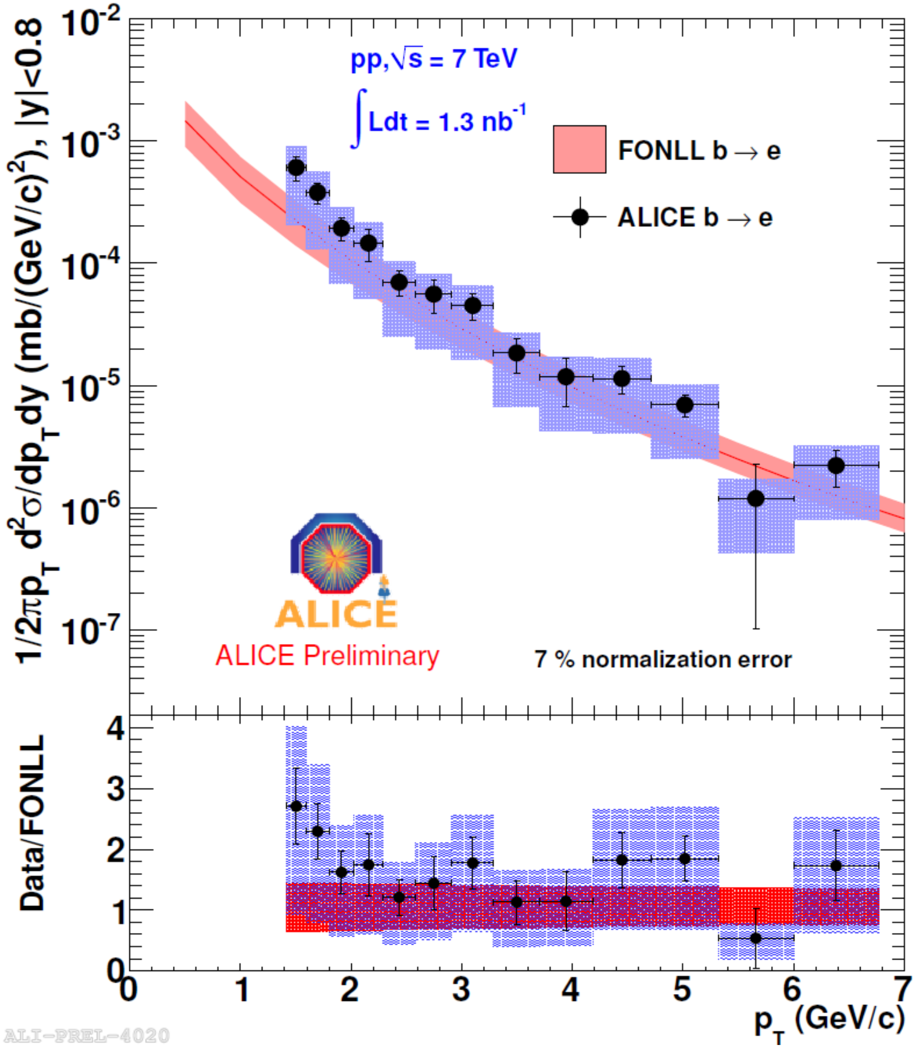
ATLAS: PLB707 (2012) 438
FONLL: Cacciari et al.
arXiv:1205.6344



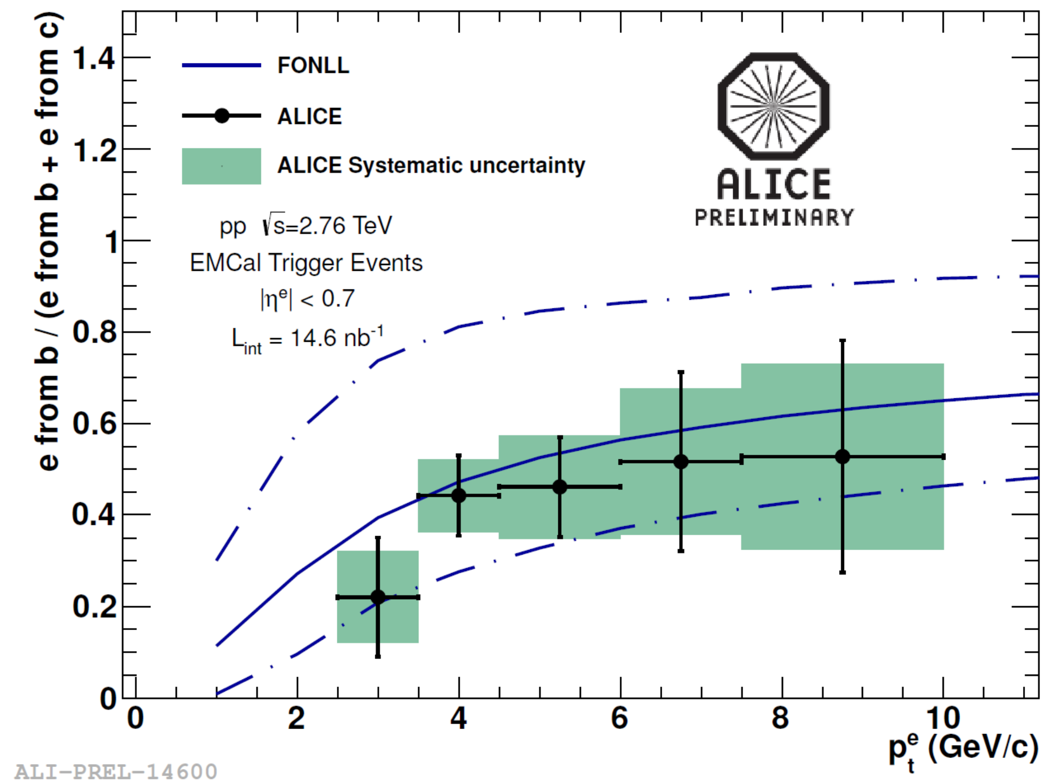
Good agreement with FONLL and ATLAS

Beauty measurement with electrons
pp @ √s = 7 TeV

Beauty separation using impact parameter cut

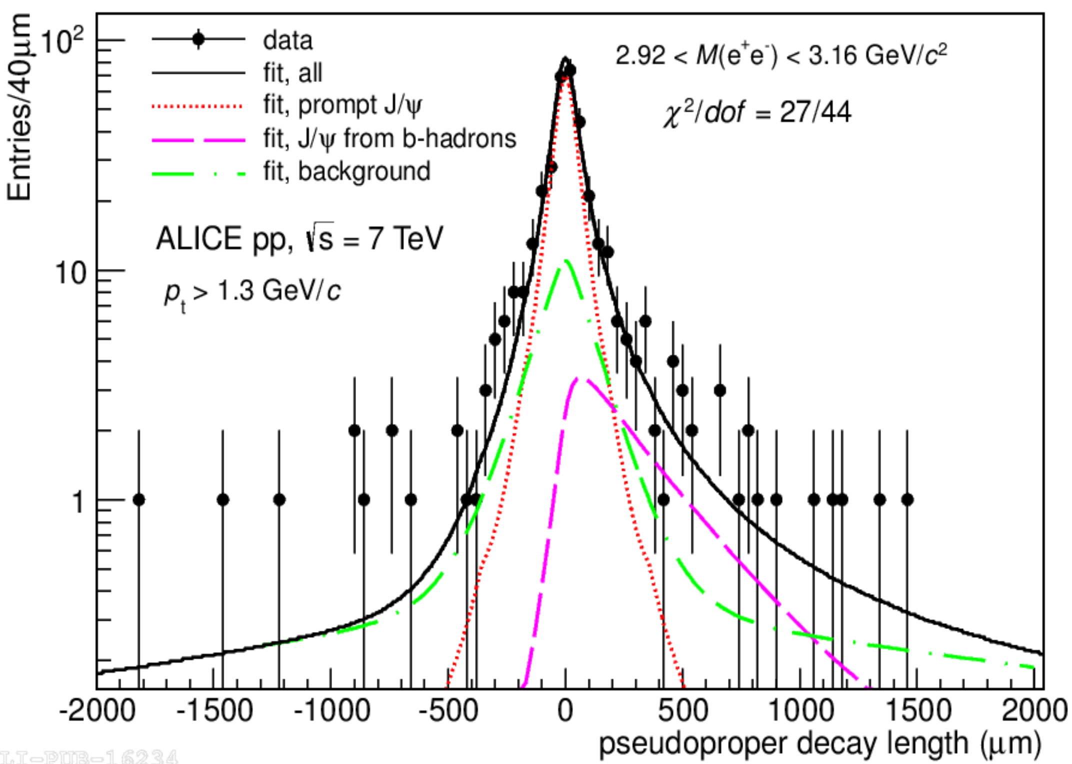


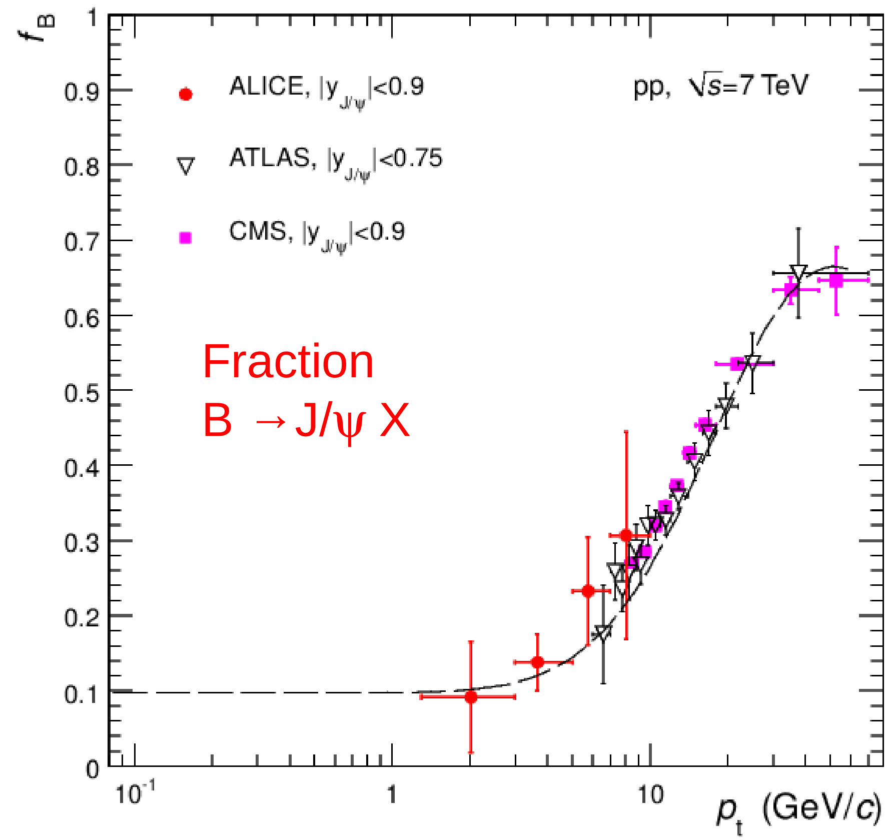
Relative beauty contribution to the heavy flavour electron yield from electron-hadron correlations.



Good agreement with FONLL

Prompt and non-prompt J/ψ in pp at √s = 7 TeV



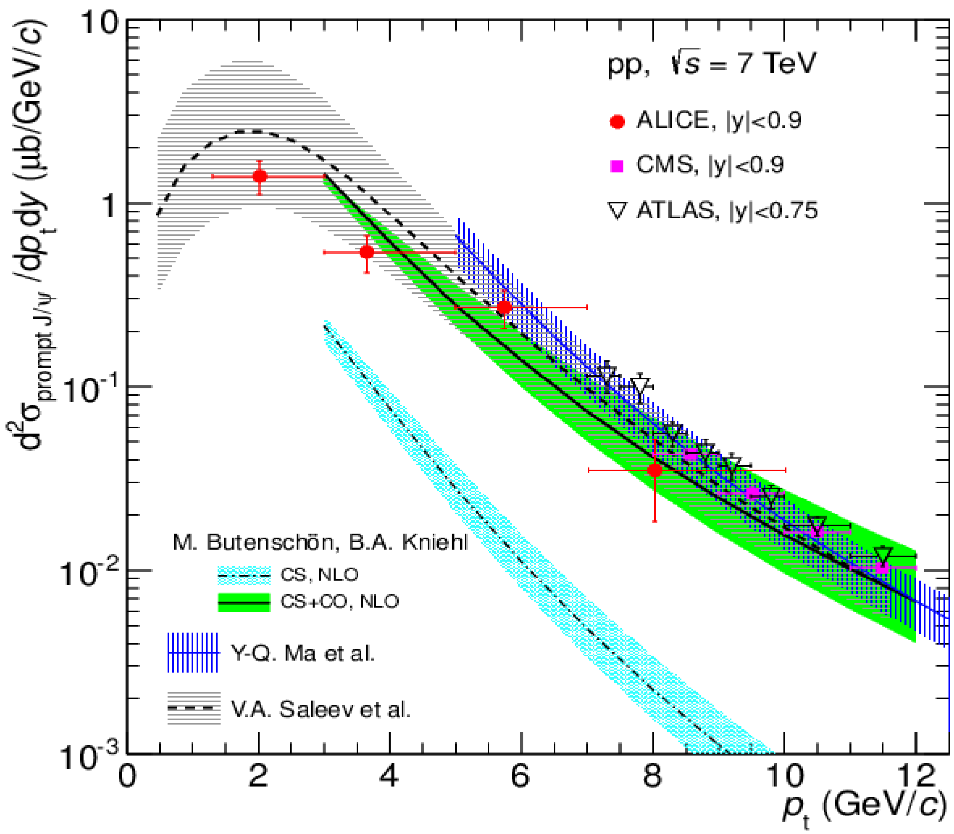


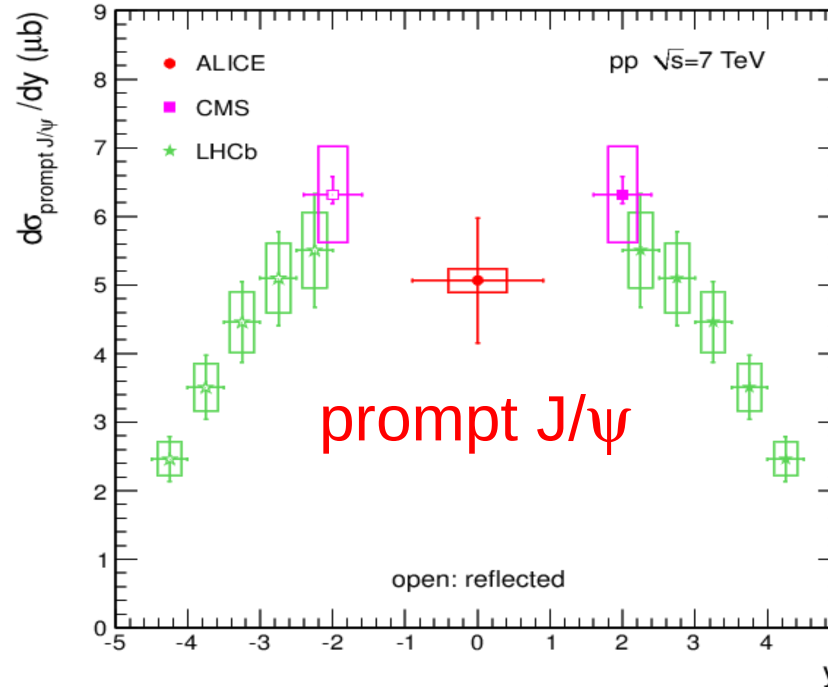
ALICE extends this measurement to low p_T

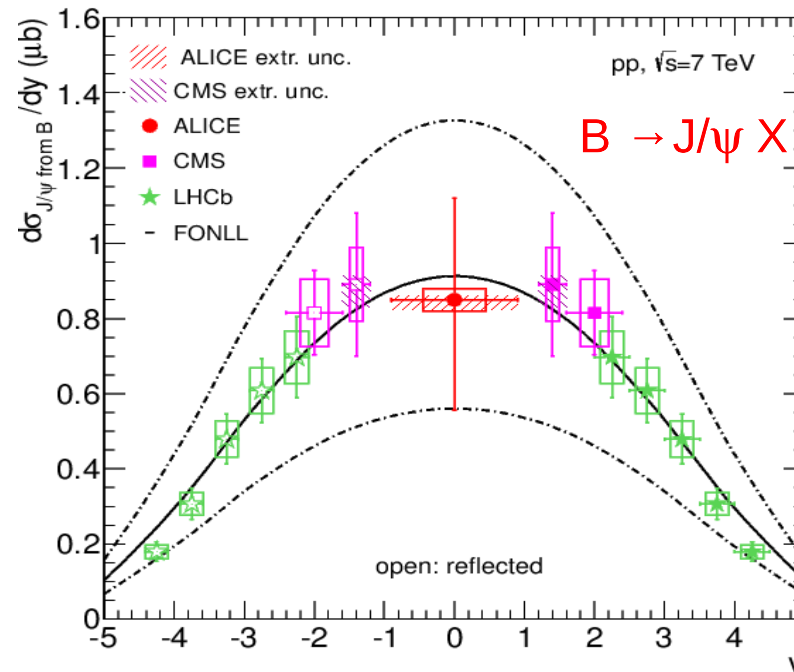
arXiv:1205.5880

arXiv:1205.5880

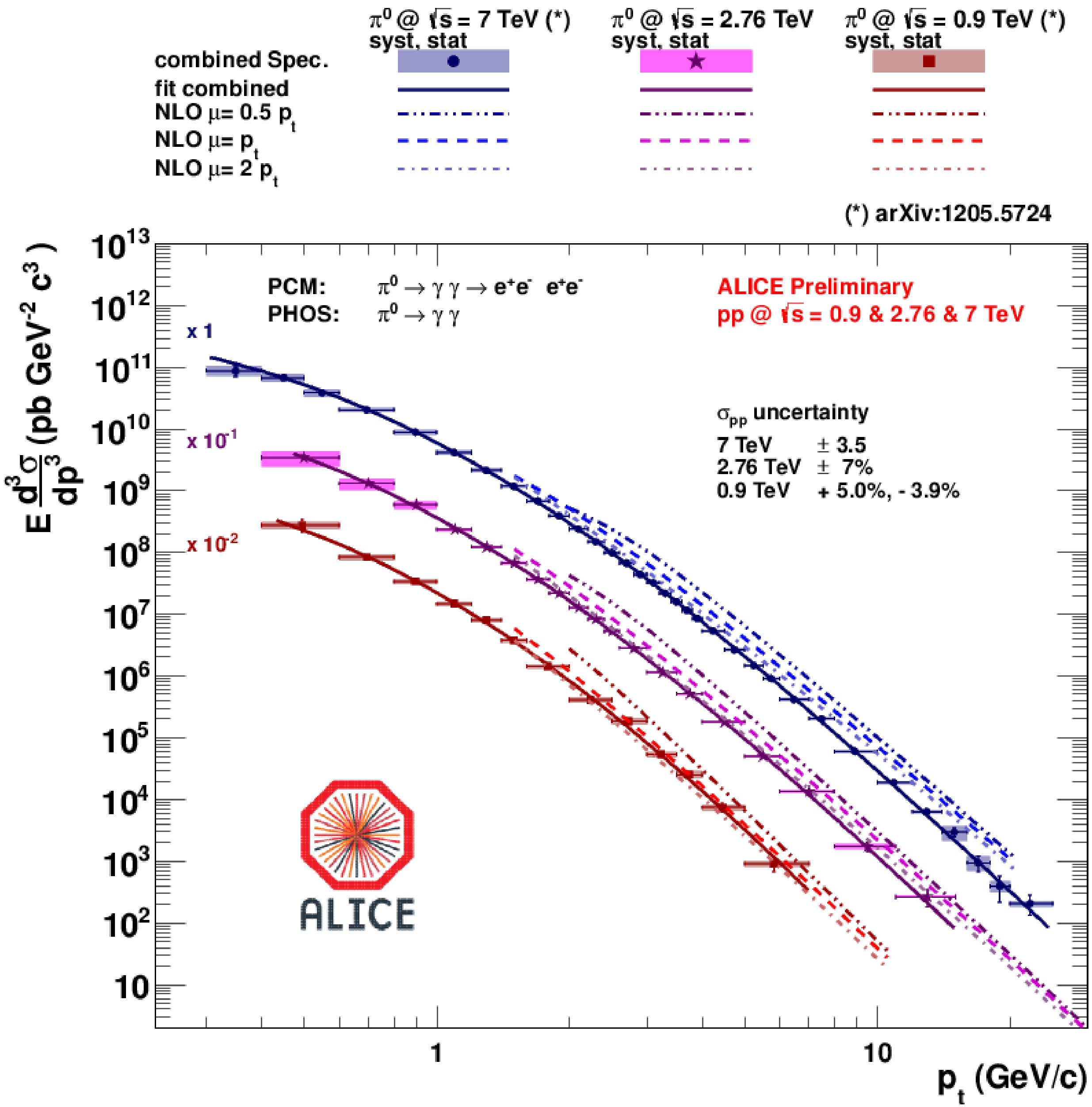
prompt J/ψ





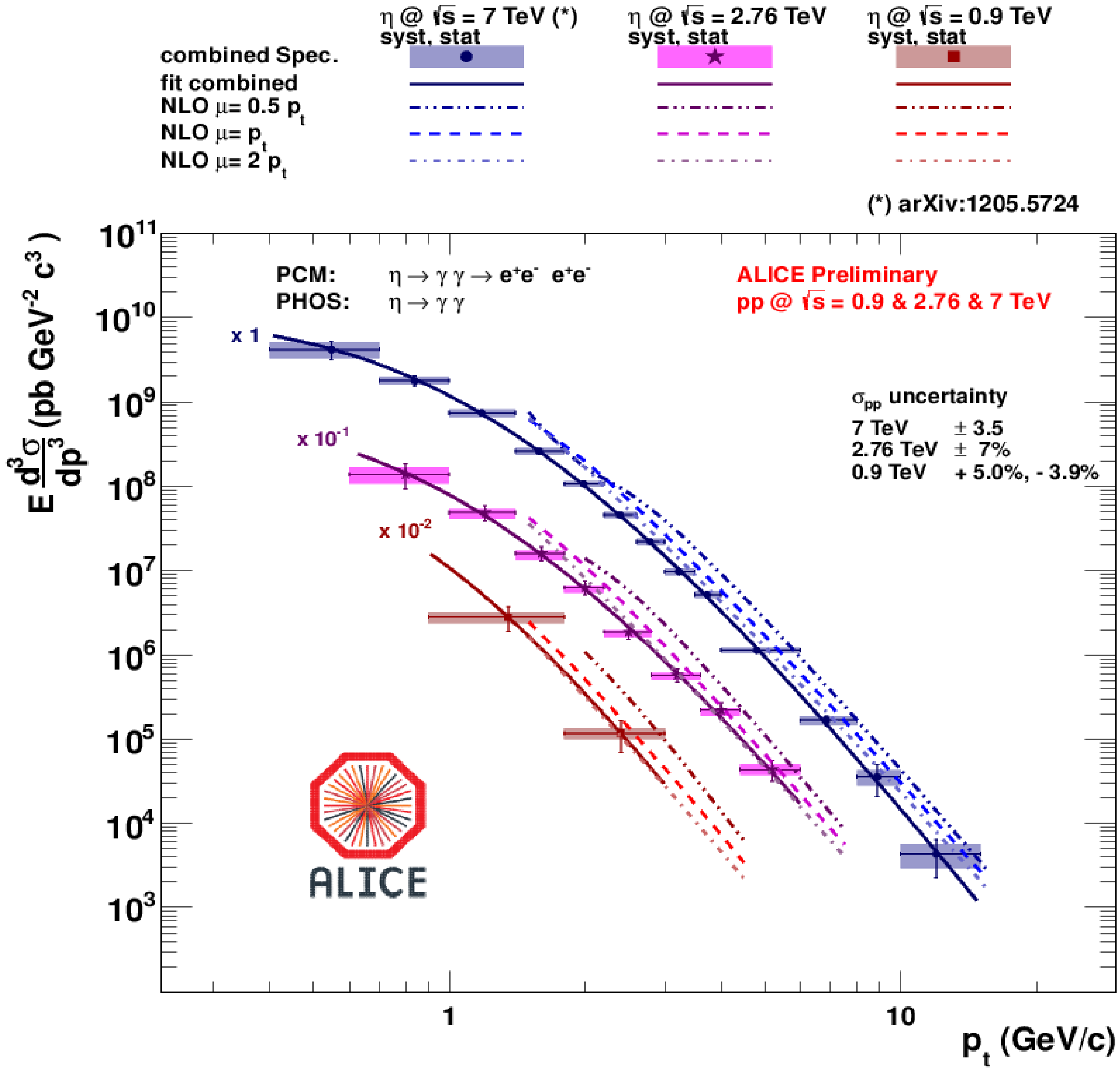


π^0 Production in pp



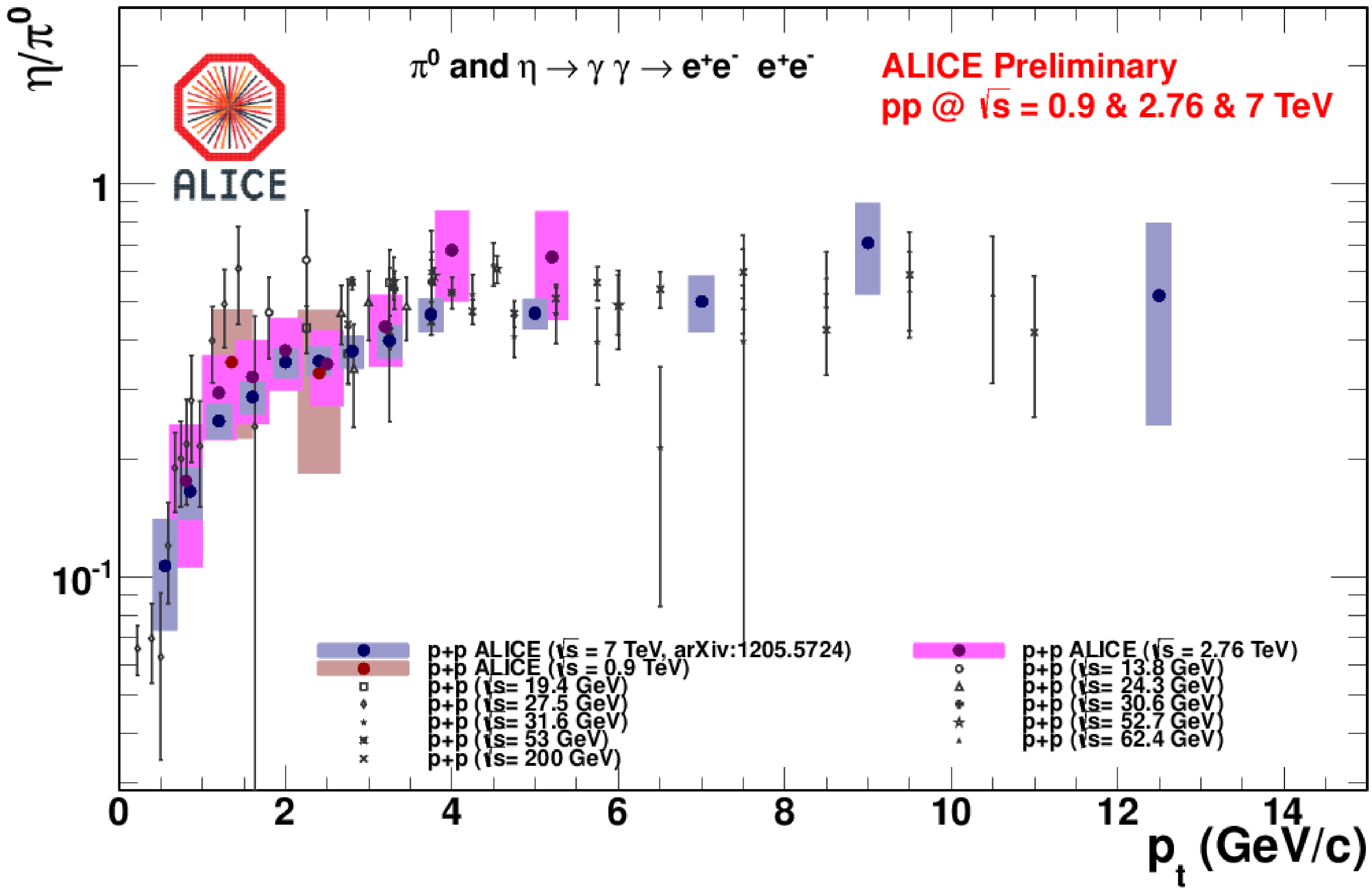
Data at the lower bound of NLO predictions

η Production in pp



Data at the lower bound of NLO predictions

η/π^0 Ratio



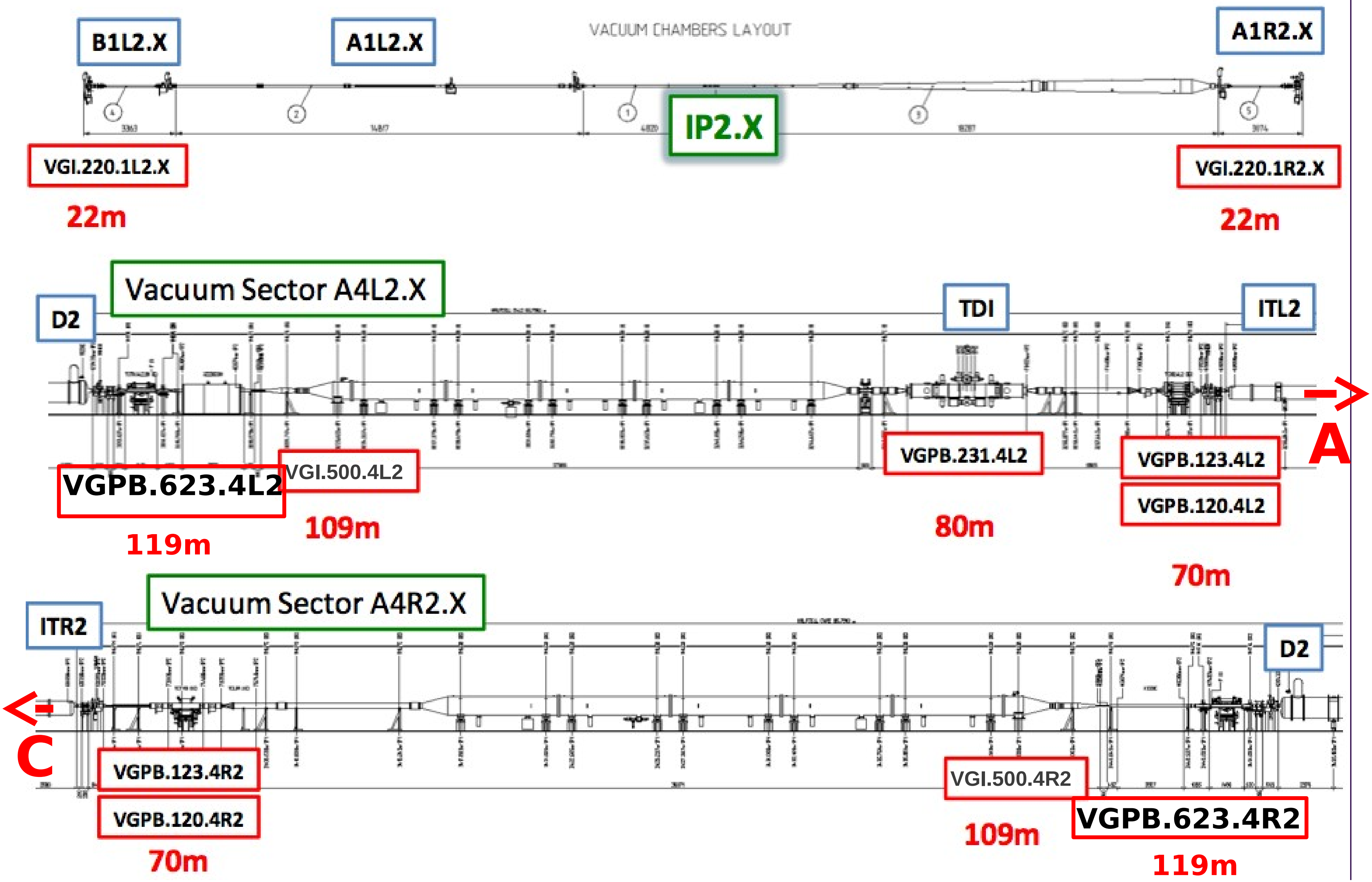
In agreement with measurements at lower center of mass energies.

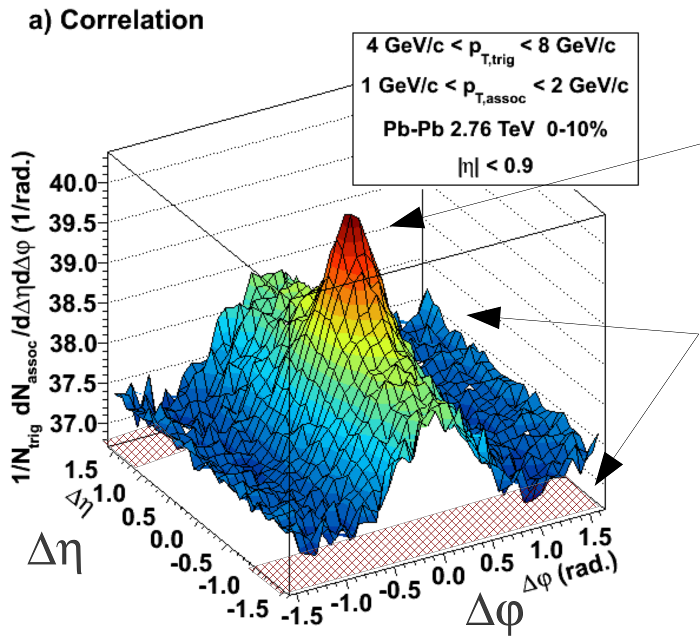
Highlights

- We studied interplay between hard and soft with di-hadron correlations
  - Observe jet shape modifications in central Pb-Pb collisions but no modification of the p/π ratio.
- We measured the elliptic flow of D-mesons
  - Sign of thermalization at low-p_T ?
- J/ψ Suppression Measurements
  - Color screening and charm recombination needed to explain the experimental data on centrality, rapidity and transverse momentum dependence of J/ψ suppression.
- First event-by-event reconstructed jets from ALICE

Backup

ALICE Vacuum Layout

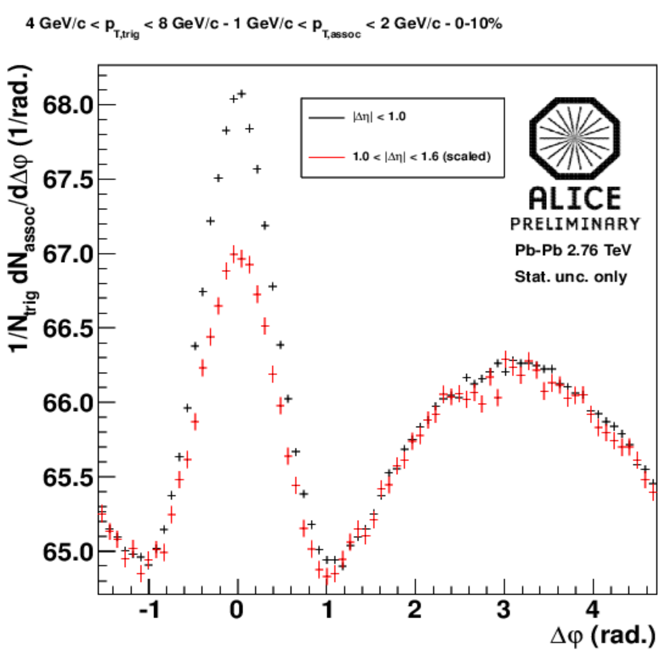


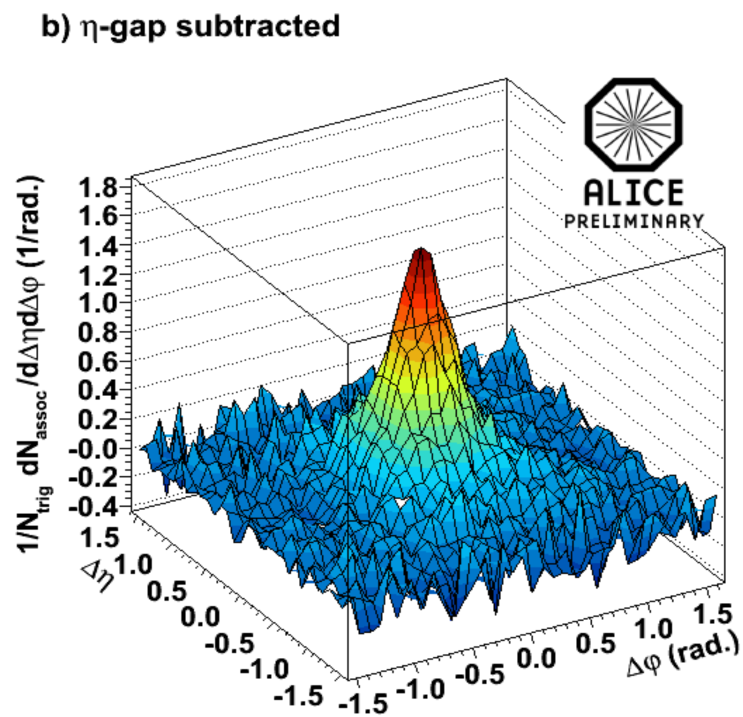


- Near-side peak centered at ($\Delta\varphi = 0$, $\Delta\eta = 0$)

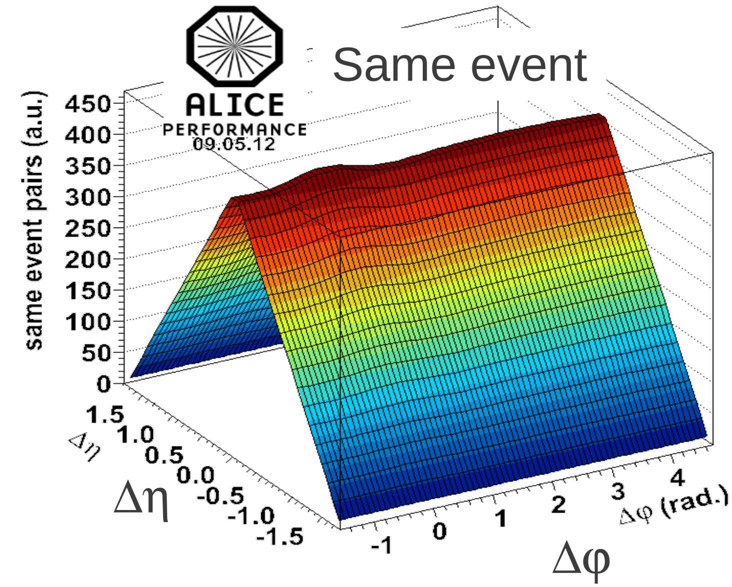
- $\Delta\eta$ independent (long range) correlations (mainly flow near-side + flow+jet away-side) plus uncorrelated background.

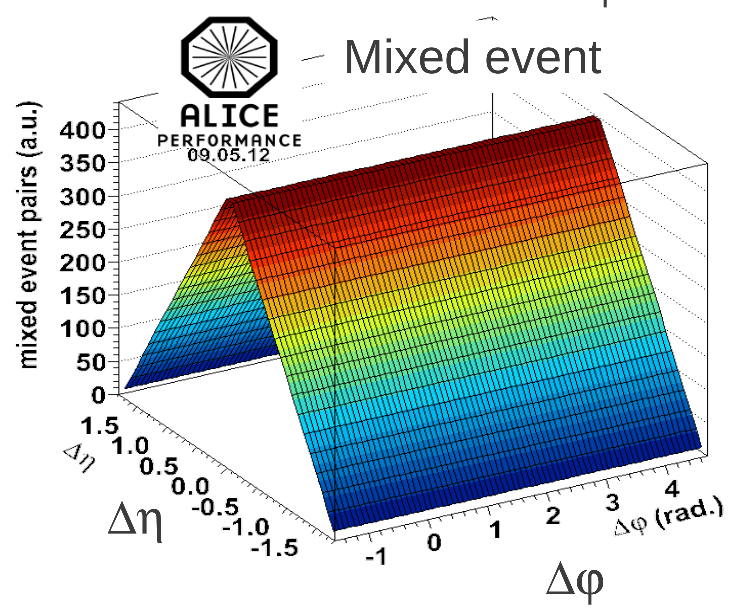
- Signal Extraction: Subtract side bands $1 < \Delta\eta < 1.6$
- Study near-side peak (away side peak is removed by this procedure)





Two-Track Acceptance Correction





- Event Mixing performed in bins of
  - Long. vertex position (z, Δz = 2 cm)
  - Centrality: 1% steps from 0-5%; then 5-10% followed by 10% steps.
  - For each z-bin calculate the ratio:

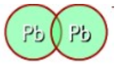
$$\frac{d^2 N^{raw}}{d\Delta\varphi\, d\Delta\eta}(\Delta\varphi,\Delta\eta,z)=\frac{1}{N_{trig}(z)}\frac{N_{pair}^{same}(\Delta\varphi,\Delta\eta,z)}{N_{pair}^{mixed}(\Delta\varphi,\Delta\eta,z)}\beta$$

  – β chosen such that correction interpolated to $\Delta\varphi=\Delta\eta=0$ is 1.

  - Calculate weighted average of ratios

$$\frac{d^2 N^{raw}}{d\Delta\varphi\, d\Delta\eta}(\Delta\varphi,\Delta\eta)=\frac{1}{\sum_z N_{trig}(z)}\sum_z N_{trig}(z)\frac{d^2 N^{raw}}{d\Delta\varphi\, d\Delta\eta}(\Delta\varphi,\Delta\eta,z)$$

Near-side peak: shape evolution

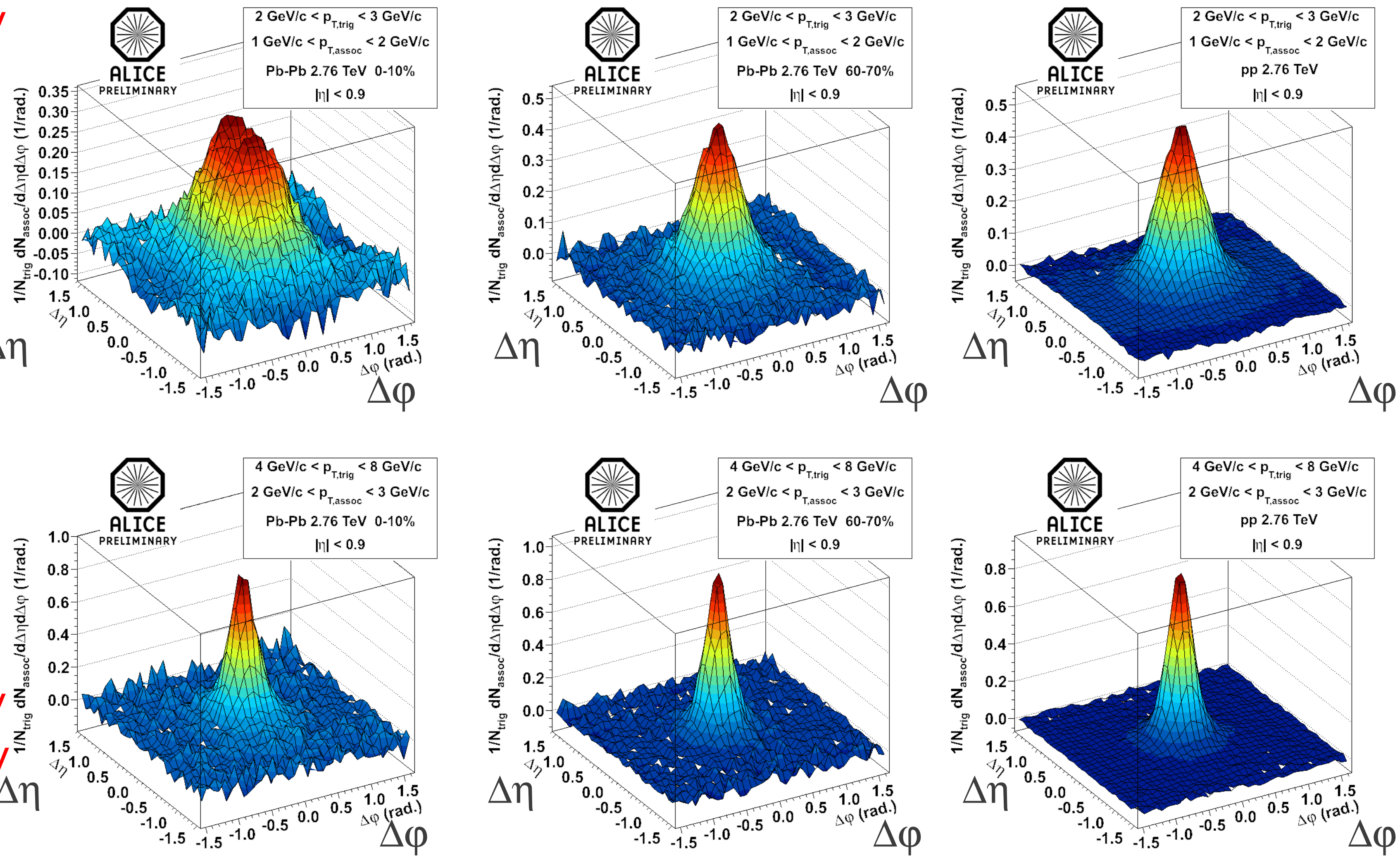


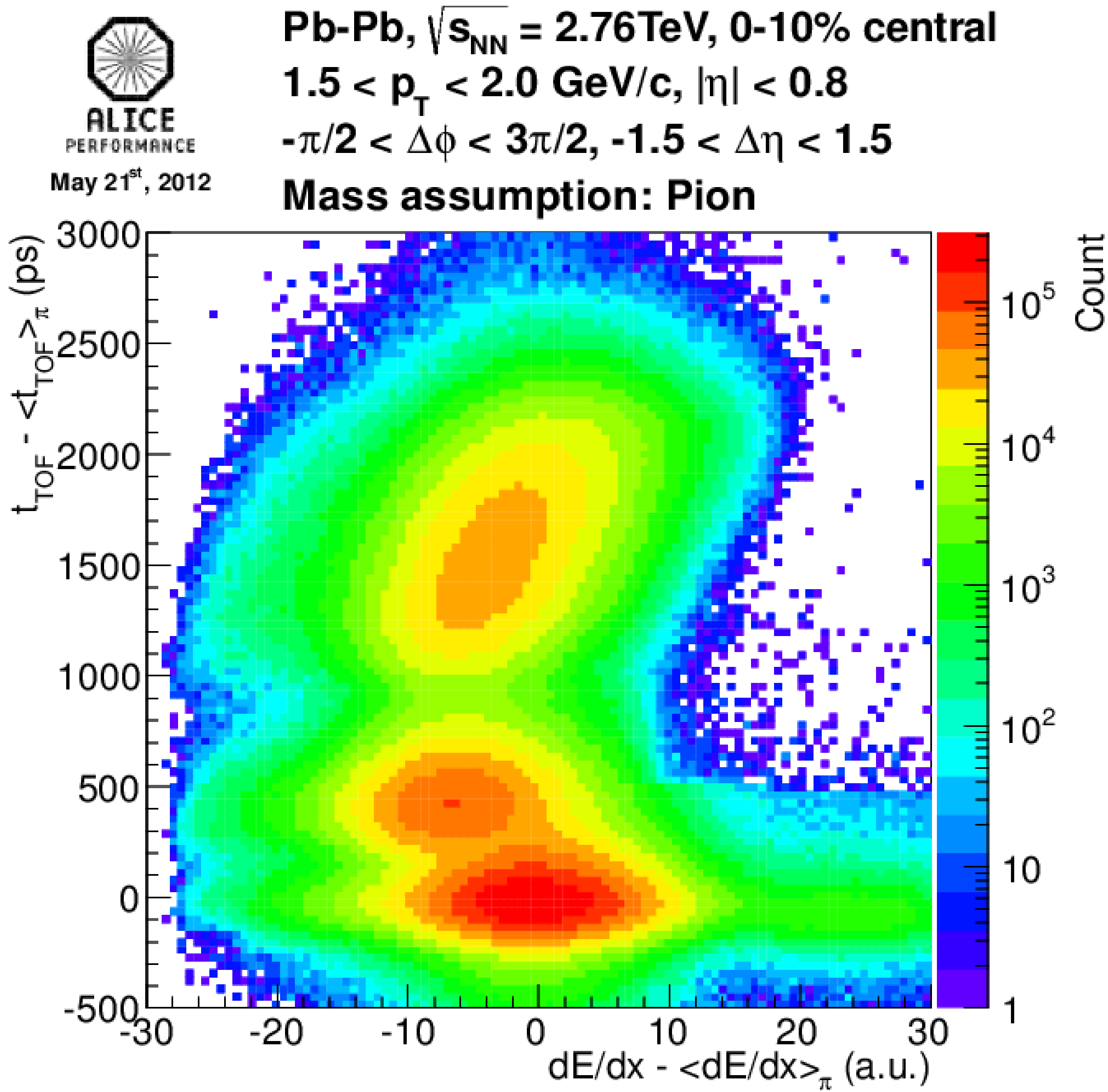
0-10% ← 60-70% ← pp

$2 < p_{T,trig} < 3$ GeV
$1 < p_{T,assoc} < 2$ GeV

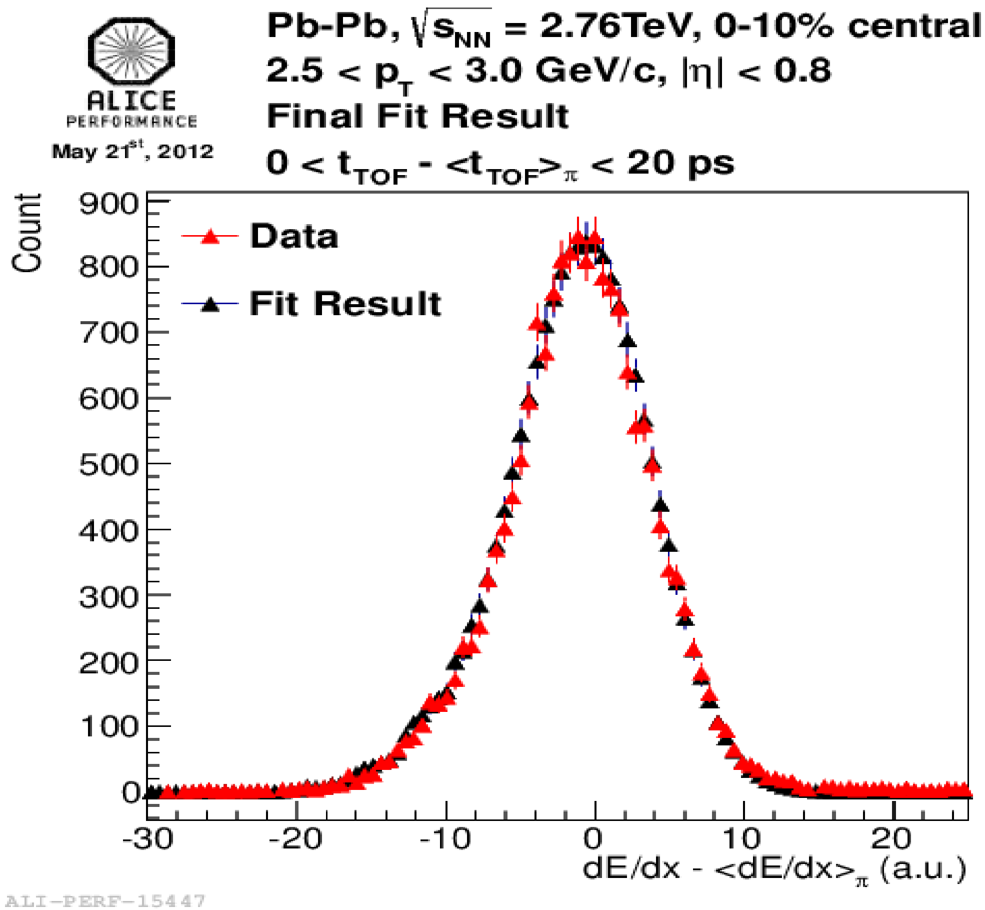
p_T ↑

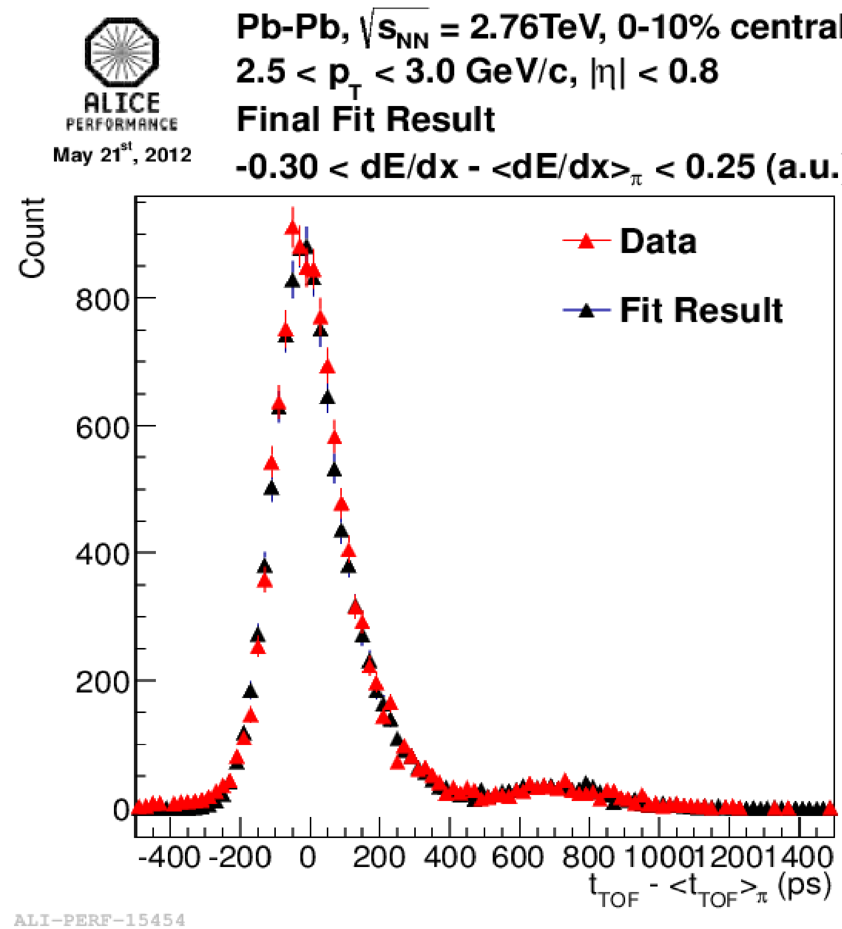
$4 < p_{T,trig} < 8$ GeV
$2 < p_{T,assoc} < 3$ GeV

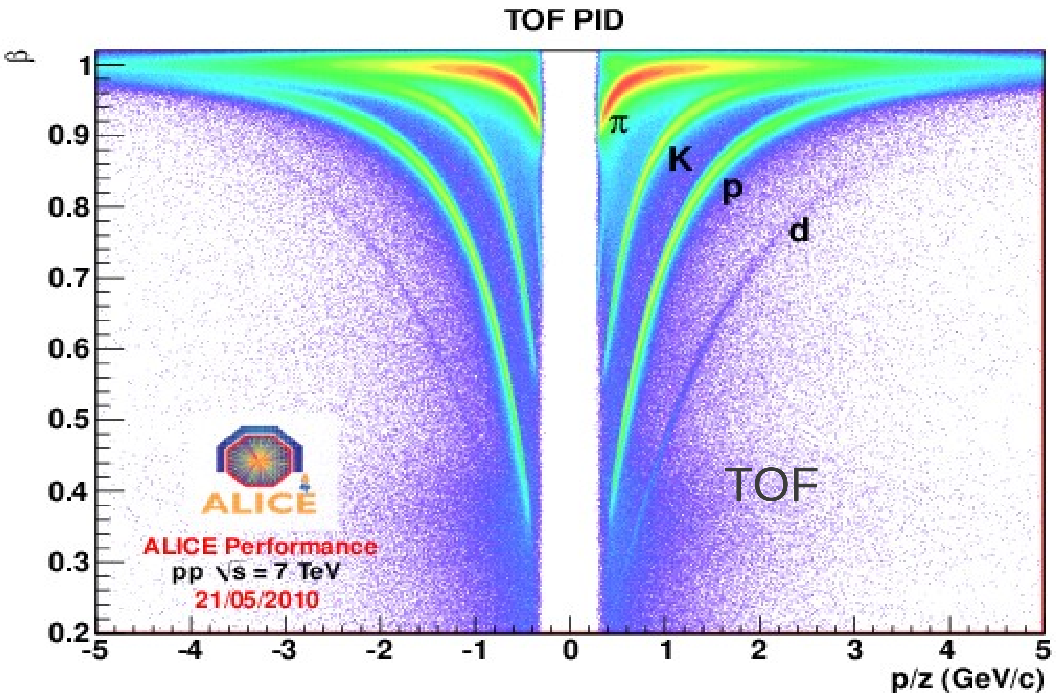


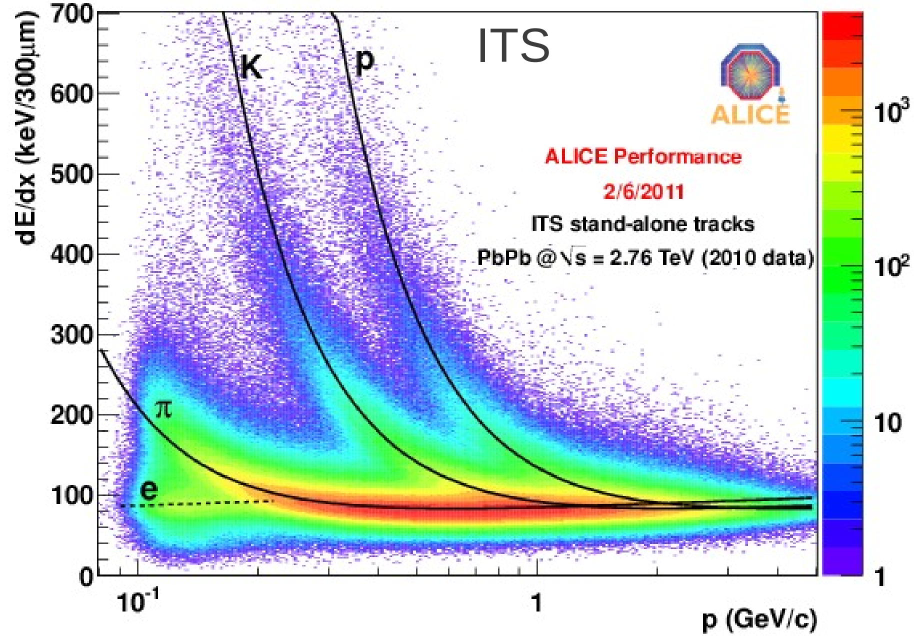


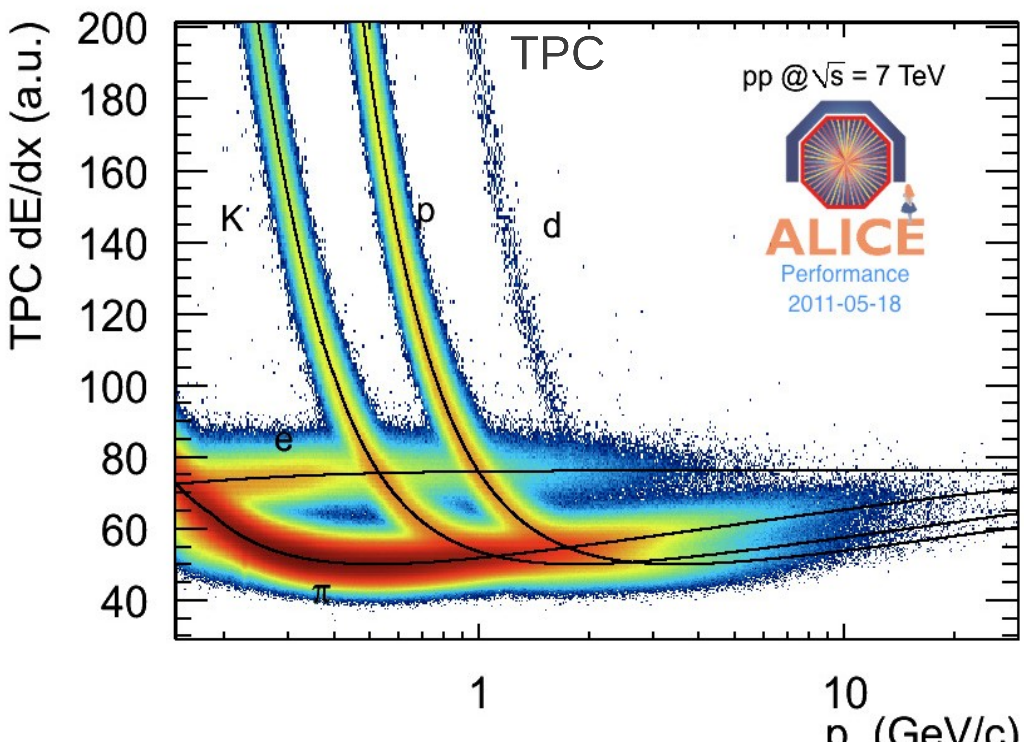
ALICE
PERFORMANCE
May 21st, 2012
Pb-Pb, $\sqrt{s_{NN}}$ = 2.76TeV, 0-10% central
1.5 < p_T < 2.0 GeV/c, |η| < 0.8
-π/2 < Δφ < 3π/2, -1.5 < Δη < 1.5
Mass assumption: Pion
$t_{TOF} - \langle t_{TOF} \rangle_\pi$ (ps)
3000
2500
2000
1500
1000
500
0
-500
-30
-20
-10
0
10
20
30
dE/dx - <dE/dx>$_\pi$ (a.u.)
Count
10^5
10^4
10^3
10^2
10
1

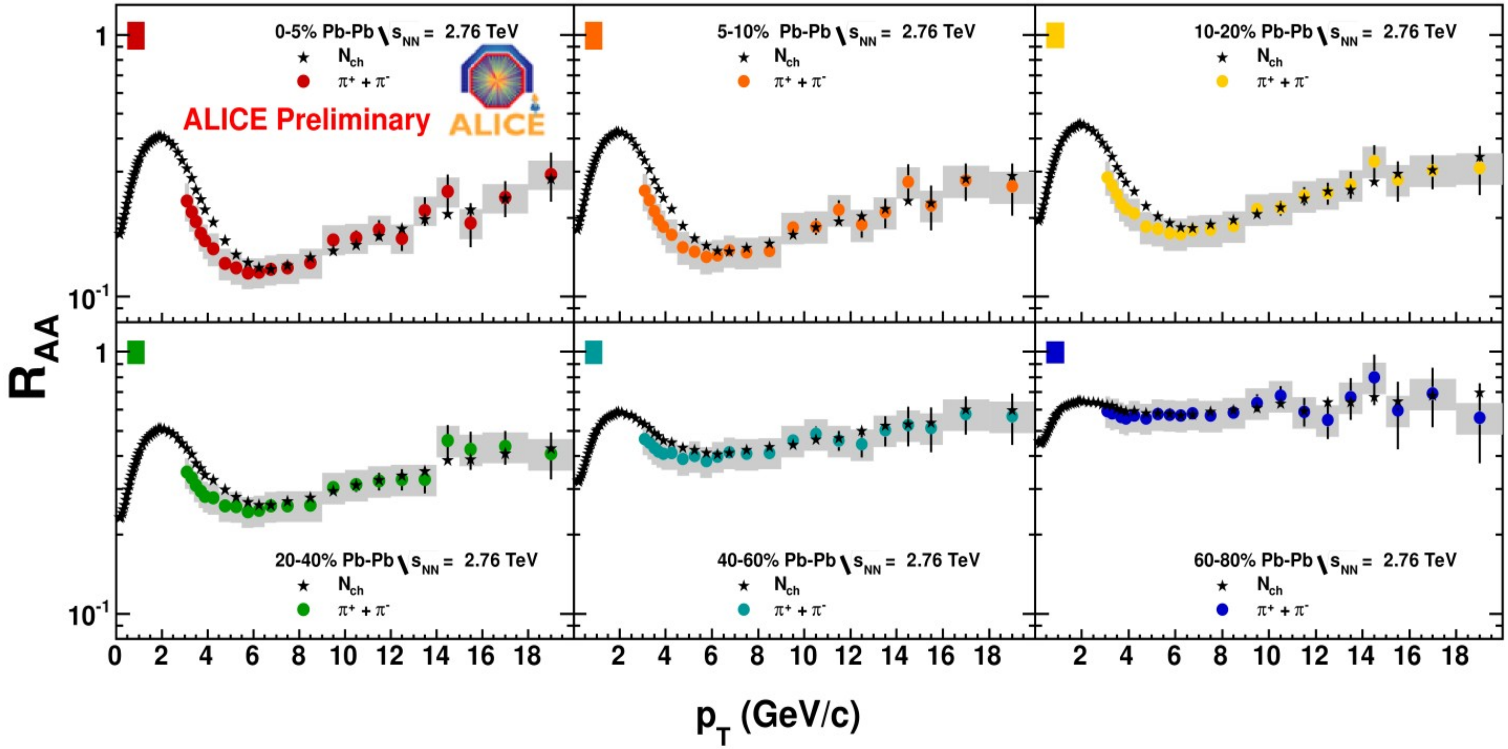

ALICE Performance
May 21st, 2012
Pb-Pb, $\sqrt{s_{NN}}$ = 2.76TeV, 0-10% central
2.5 < p_T < 3.0 GeV/c, |η| < 0.8
Final Fit Result
0 < t_{TOF} - $<t_{TOF}>_\pi$ < 20 ps
Count
Data
Fit Result
dE/dx - $<dE/dx>_\pi$ (a.u.)
ALI-PERF-15447

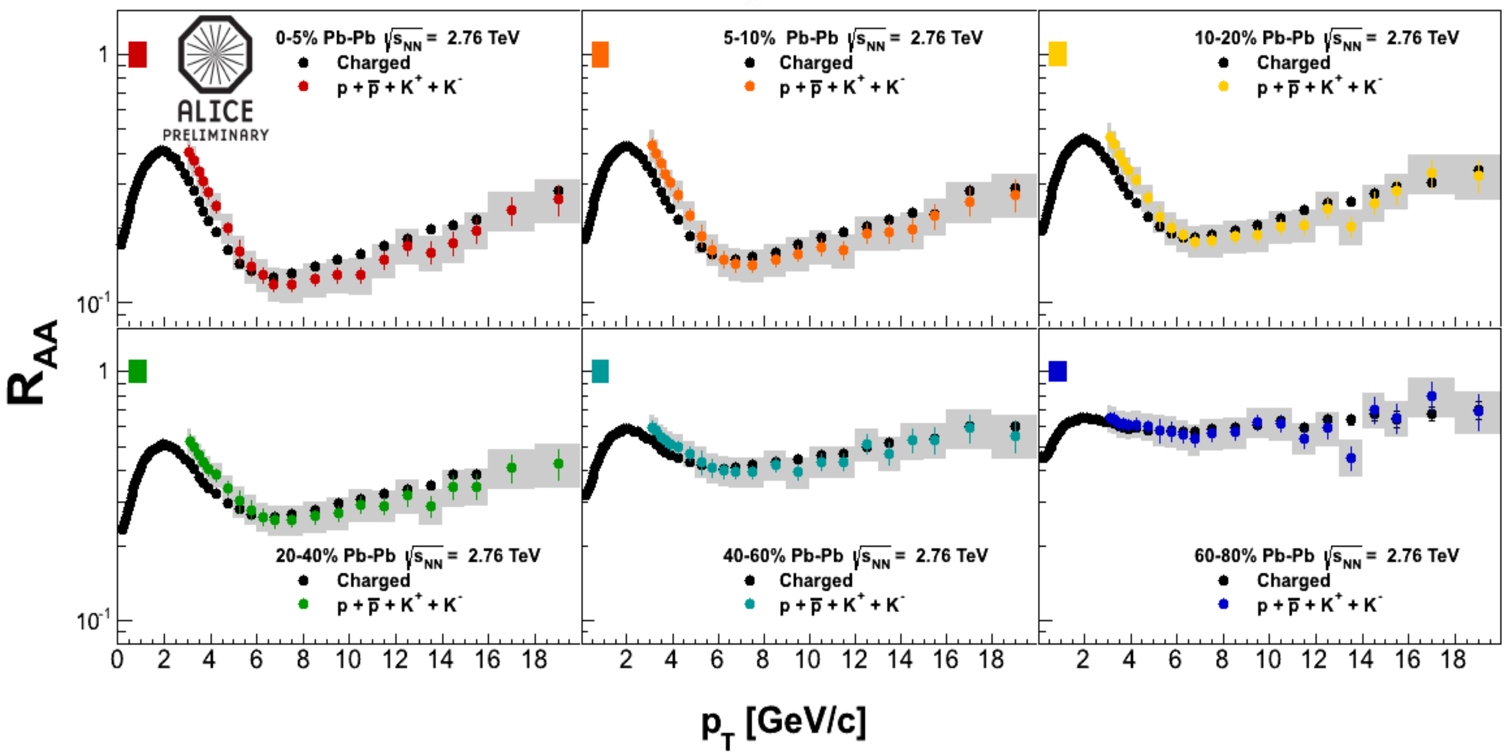

ALICE Performance
May 21st, 2012
Pb-Pb, $\sqrt{s_{NN}}$ = 2.76TeV, 0-10% central
2.5 < p_T < 3.0 GeV/c, |η| < 0.8
Final Fit Result
-0.30 < dE/dx - $<dE/dx>_\pi$ < 0.25 (a.u.)
Count
Data
Fit Result
t_{TOF} - $<t_{TOF}>_\pi$ (ps)
ALI-PERF-15454


TOF PID
β
π
K
p
d
TOF
ALICE
ALICE Performance
pp √s = 7 TeV
21/05/2010
p/z (GeV/c)


ITS
dE/dx (keV/300μm)
K
p
π
e
ALICE
ALICE Performance
2/6/2011
ITS stand-alone tracks
PbPb @ √s = 2.76 TeV (2010 data)
p (GeV/c)

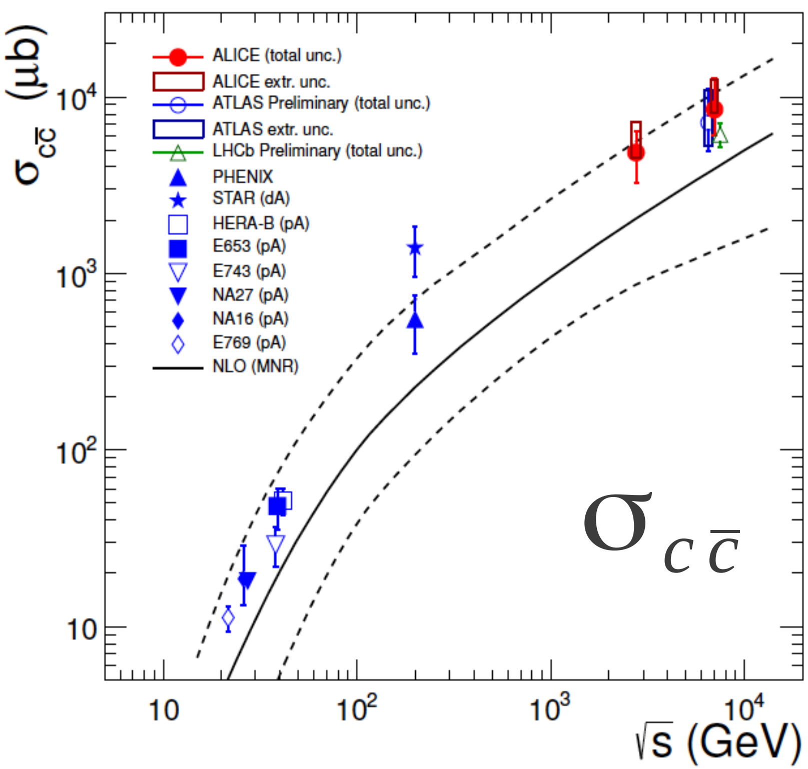

TPC
TPC dE/dx (a.u.)
pp @ √s = 7 TeV
K
p
d
e
π
ALICE
Performance
2011-05-18
p (GeV/c)


ALICE Preliminary
0-5% Pb-Pb √sNN = 2.76 TeV
5-10% Pb-Pb √sNN = 2.76 TeV
10-20% Pb-Pb √sNN = 2.76 TeV
20-40% Pb-Pb √sNN = 2.76 TeV
40-60% Pb-Pb √sNN = 2.76 TeV
60-80% Pb-Pb √sNN = 2.76 TeV
Nch
π+ + π-
RAA
pT (GeV/c)


ALICE
PRELIMINARY
0-5% Pb-Pb √sNN = 2.76 TeV
5-10% Pb-Pb √sNN = 2.76 TeV
10-20% Pb-Pb √sNN = 2.76 TeV
20-40% Pb-Pb √sNN = 2.76 TeV
40-60% Pb-Pb √sNN = 2.76 TeV
60-80% Pb-Pb √sNN = 2.76 TeV
Charged
p + p̄ + K+ + K-
RAA
pT [GeV/c]

Heavy Flavor Production Cross-Sections
pp at √s = 2.76 TeV

arXiv:1205.4007



arXiv:1205.5423