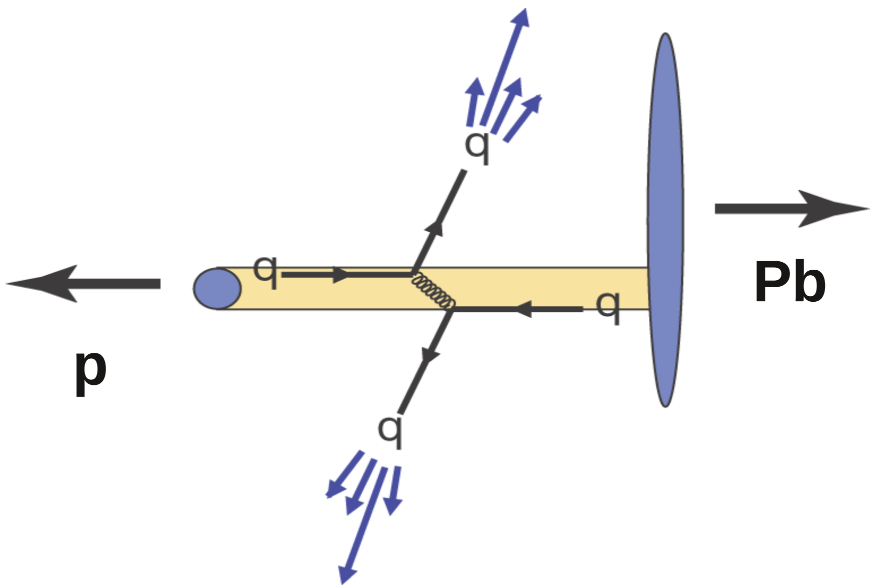
Measurement of p-Pb / Pb-p collisions with ALICE

Alberica Toia

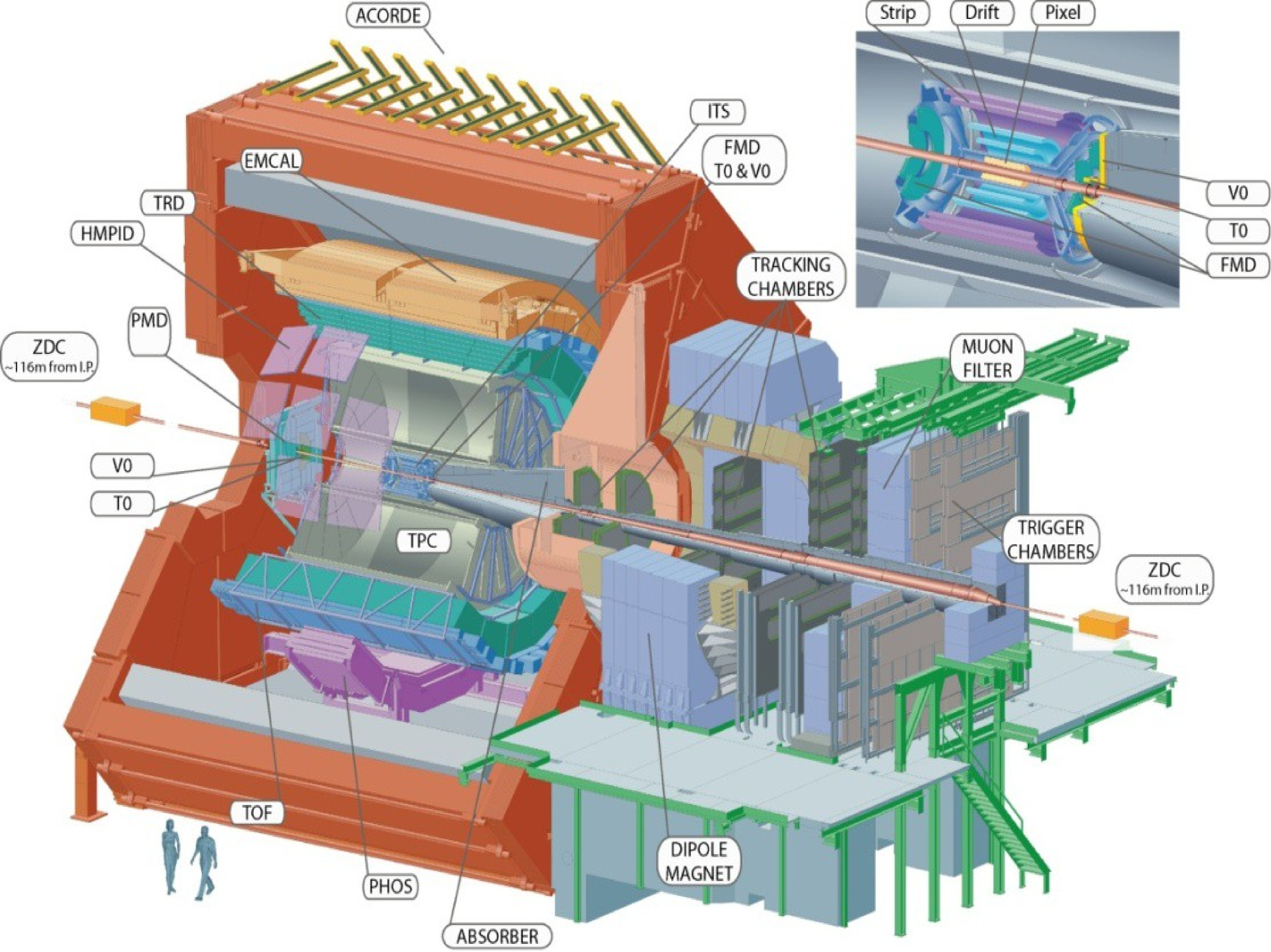
Workshop pA @ LHC
June 4th 2012



Outline

- **Detector**:
  Status and Performances
- **Benchmark** measurements for AA
  constrain cold nuclear matter effects
- **Plans** and Priorities

ALICE Detector:
Status and Performances



ACORDE
Strip
Drift
Pixel
V0
T0
FMD
ITS
FMD
T0 & V0
EMCAL
TRD
HMPID
TRACKING
CHAMBERS
PMD
ZDC
~116m from I.P.
MUON
FILTER
V0
T0
TPC
TRIGGER
CHAMBERS
ZDC
~116m from I.P.
TOF
DIPOLE
MAGNET
PHOS
ABSORBER

Detector Status

Complete since 2008:
ITS, TPC, TOF, HMPID, FMD, T0, V0, ZDC, Muon arm, Acorde, PMD, DAQ

Partial installation 2010:

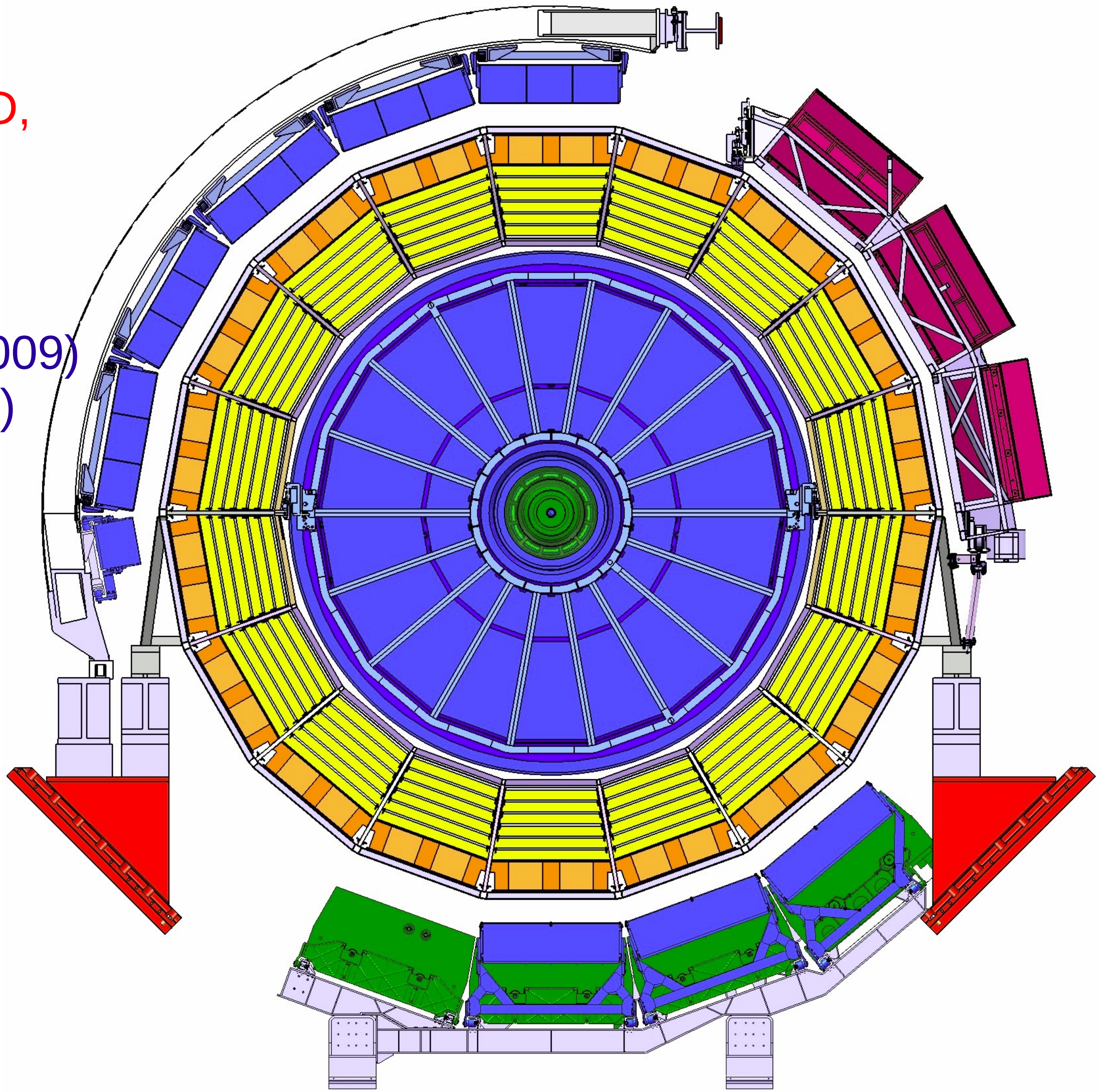
4/10 EMCAL (approved 2009)
7/18 TRD (approved 2002)
3/5 PHOS (funding)
~60% HLT

2011:

10/10 EMCAL
10/18 TRD

2012:

13/18 TRD



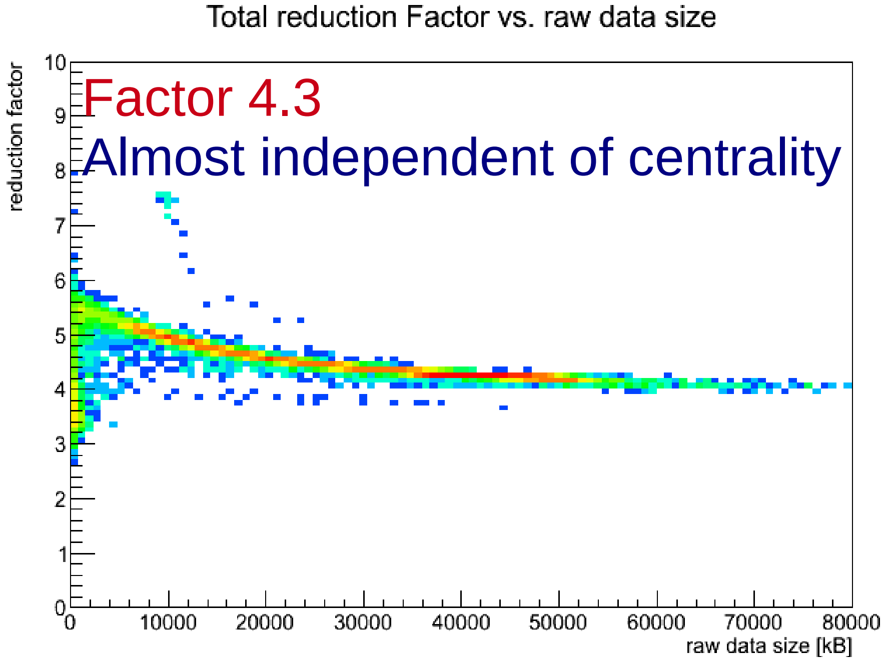
HLT in Pb-Pb run 2011

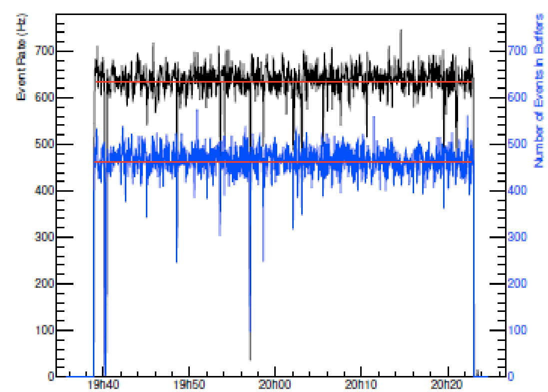
- 500-3000 Hz hadronic interaction rate
- Centrality and rare triggers
- 30% dead time

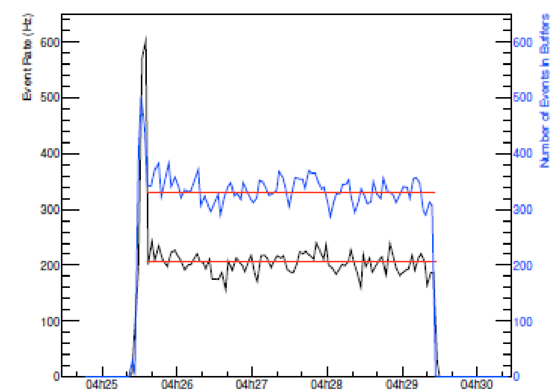
25 GB/s max data rate

Data Compression with High Level Trigger

4 GB/s max output bandwidth
10 x more statistics than 2010





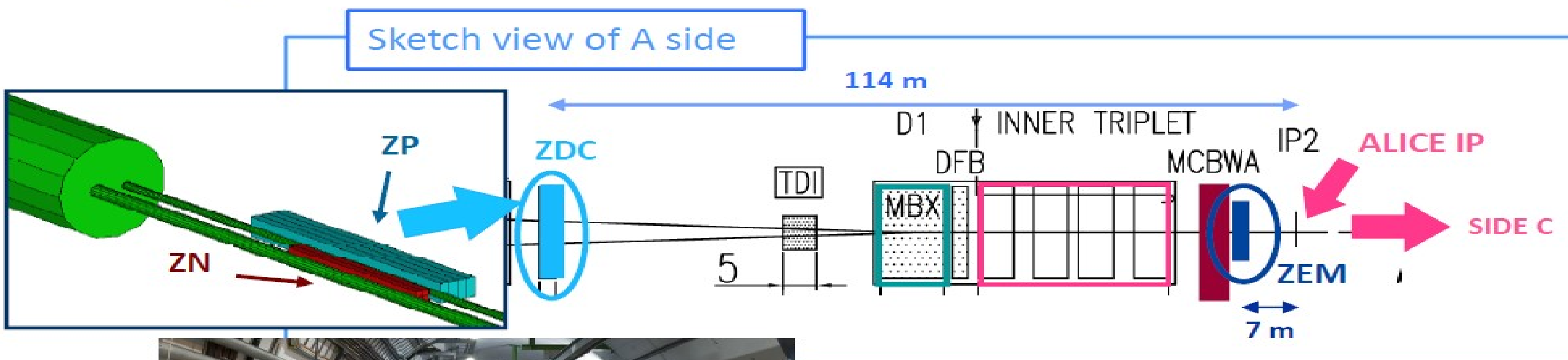


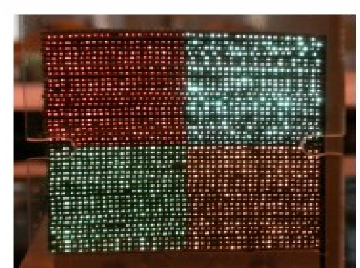
Performance parameters measured for HLT during the 2011 Pb-Pb period.

Run Type	Event Rate (Hz)	Number of Events in Buffers	Latency (s)	Data Rate (GB/s) Input	Output
Minbias	633.4 ± 2.3	464.0 ± 1.1	0.733 ± 0.003	8.0	2.1
10% Central	201.6 ± 2.8	330.0 ± 4.6	1.64 ± 0.03	9.2	2.3

ALICE ZDC Calorimeter

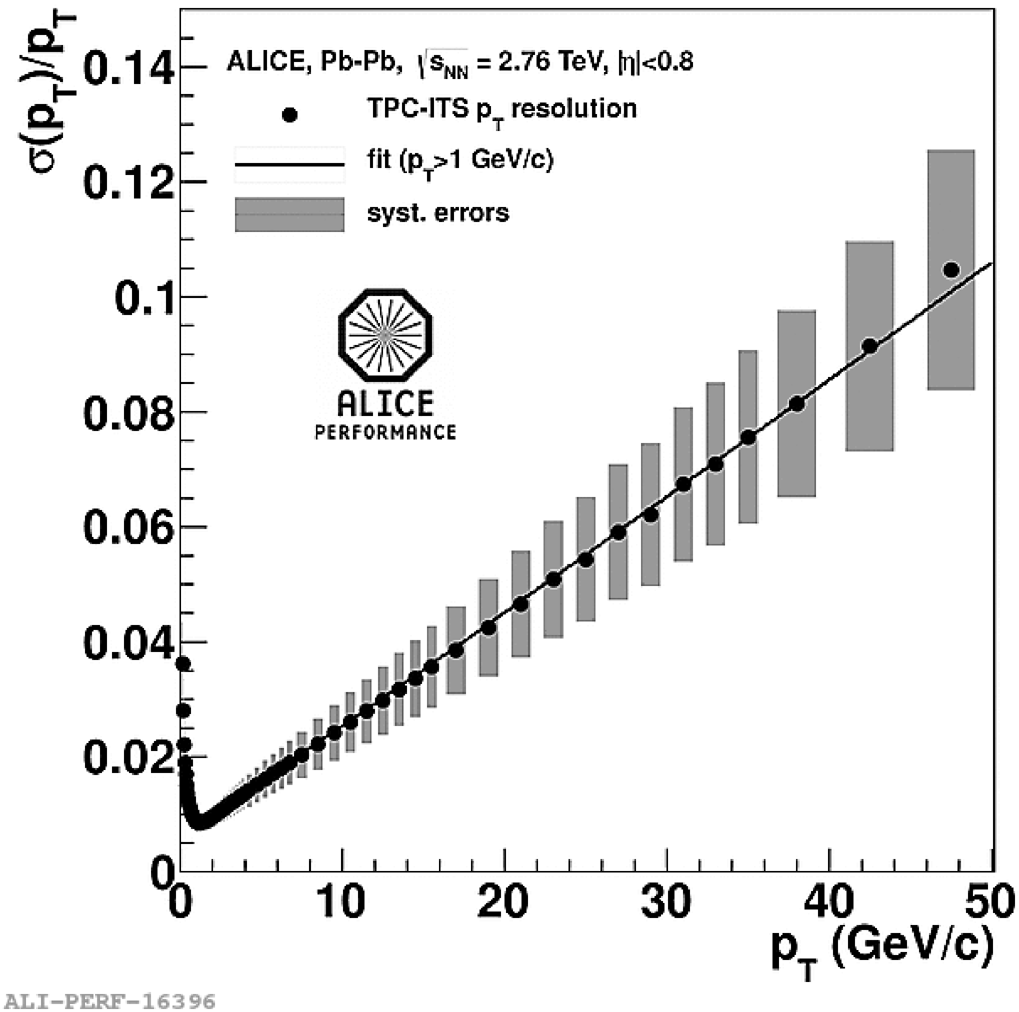
- ALICE neutron ZDCs placed at 0° w.r.t LHC axis, ~114 m far from IP on both sides (ZNC on C side, ZNA on A side), ''spaghetti'' calorimeters, dimensions (7x7x100) cm^3
- The ZDC system is completed by:
  - 2 proton calorimeters placed at ~114 m from the IP external to the beam pipe
  - 2 small (7x7x21) cm^3 EM calorimeters (ZEM1, ZEM2) placed at ~7.5 m from the IP, at ±8 cm from LHC axis, only on A side covering the range $4.8<\eta<5.7$
- ZN acceptance for neutrons emitted in EMD of Pb nuclei at $\sqrt{s}$ = 2.76 A TeV → 99 %



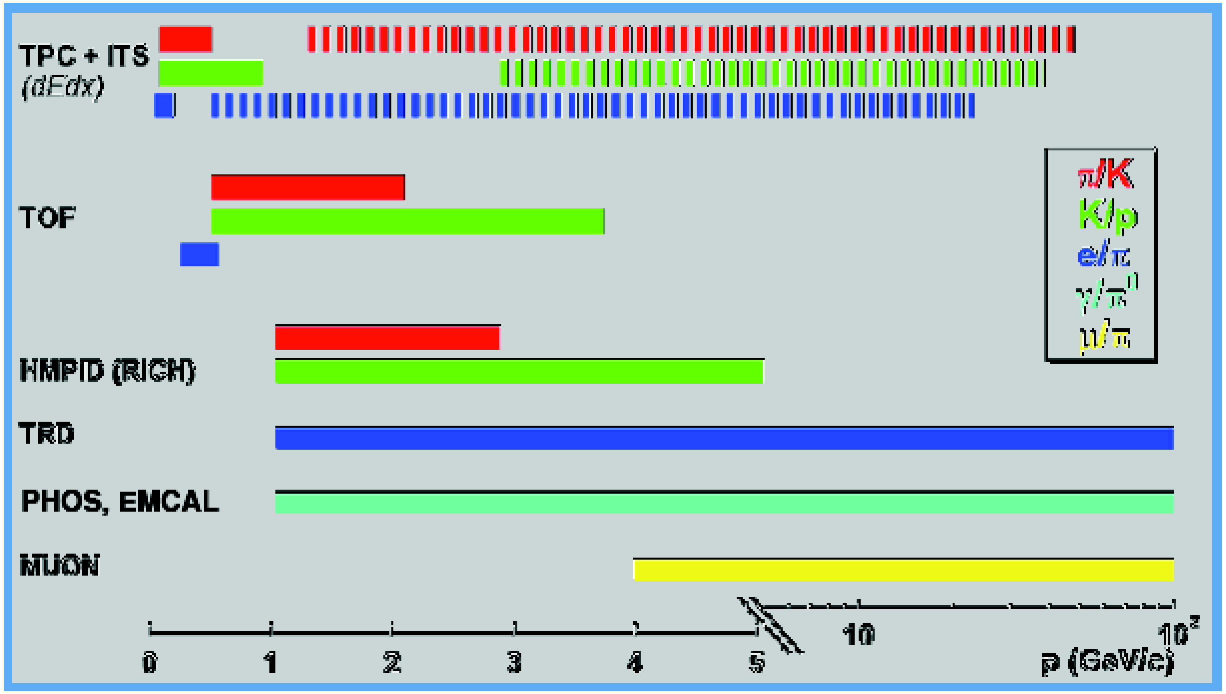


Momentum Resolution

- Combined ITS + TPC tracks
- Background/weak decays excluded via DCA cut to primary vertex
- Tracks in |η|<0.8
- Resolution determined from track residuals, verified with cosmics and reconstructed decays widths (eg K^0_s)



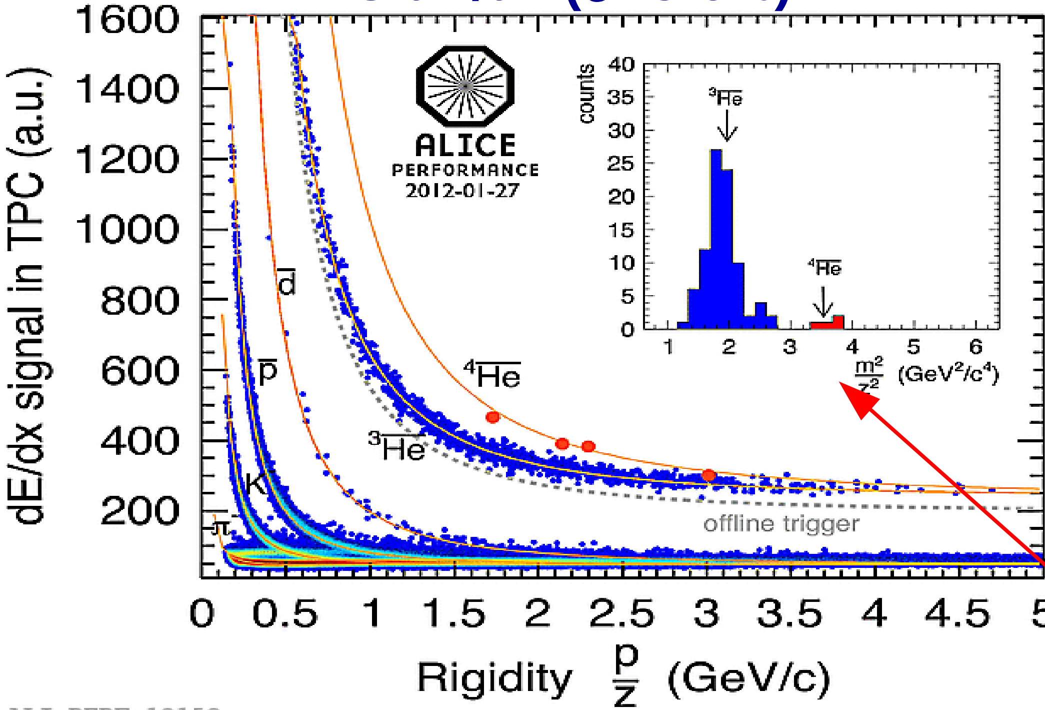
Particle Identification



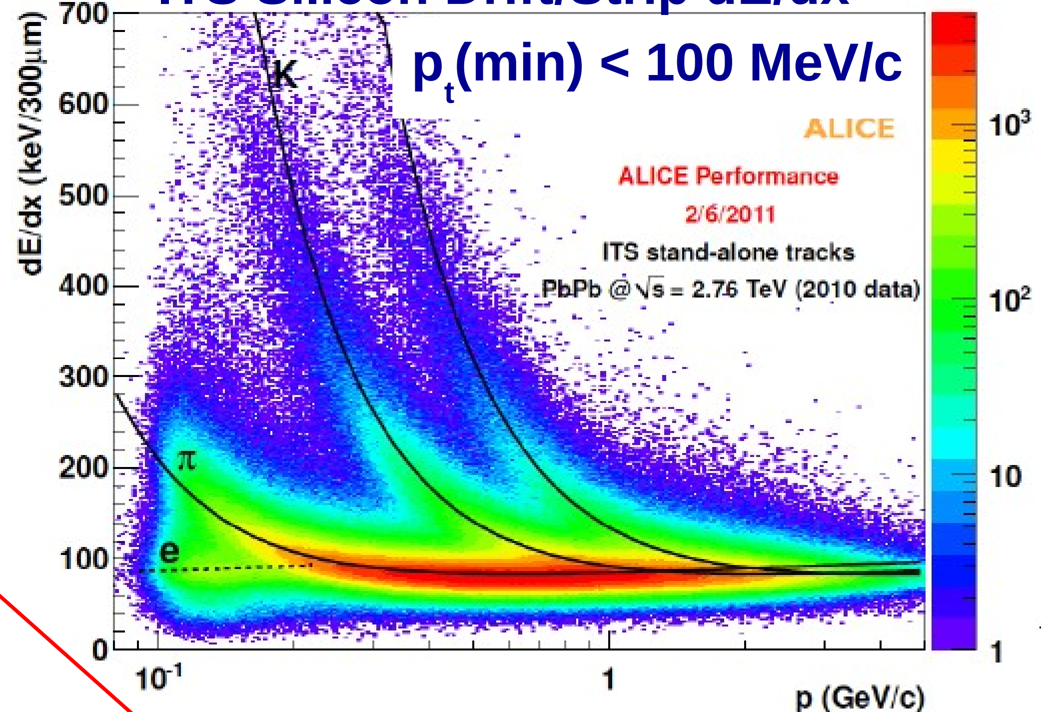
- “stable” hadrons (p,K,p): 100 MeV<p_T<5GeV
  - dE/dx in silicon (ITS) and gas (TPC) + time-of-flight (TOF) + Cherenkov (HMPID)
- Decay topologies (K,Λ,ϕ,Ξ,Ω,D)
  - K and Λ beyond 10 GeV
- Leptons (e,μ), photons ($\rightarrow$ π^0,η)
  - Electrons TRD: p_T>1GeV, muons: p_T>5Gev, π^0 in PHOS/EMCAL: 1<p_T<80 GeV

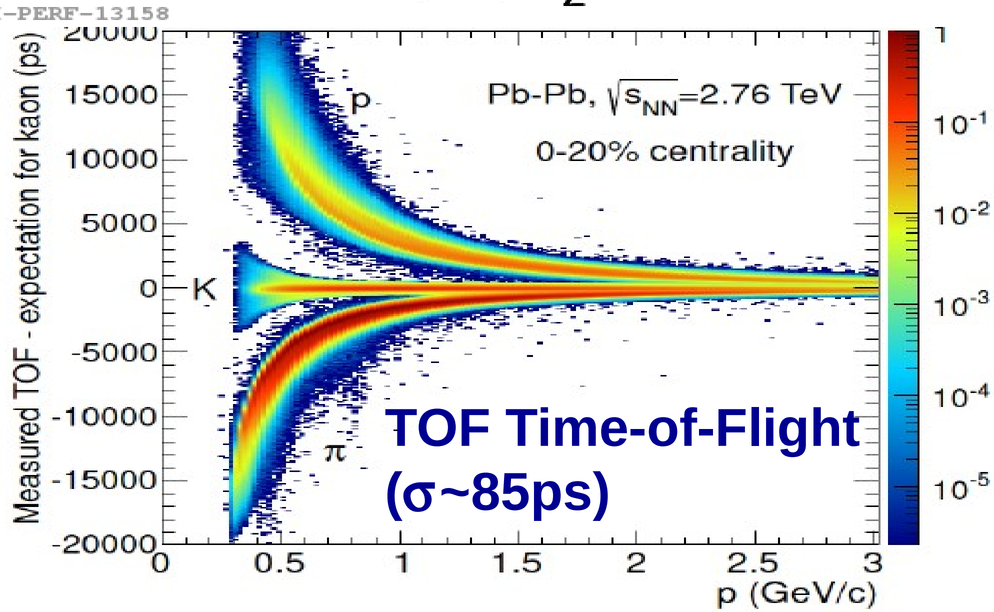
Particle Identification

TPC dE/dx (σ~5-6%)



ITS Silicon Drift/Strip dE/dx



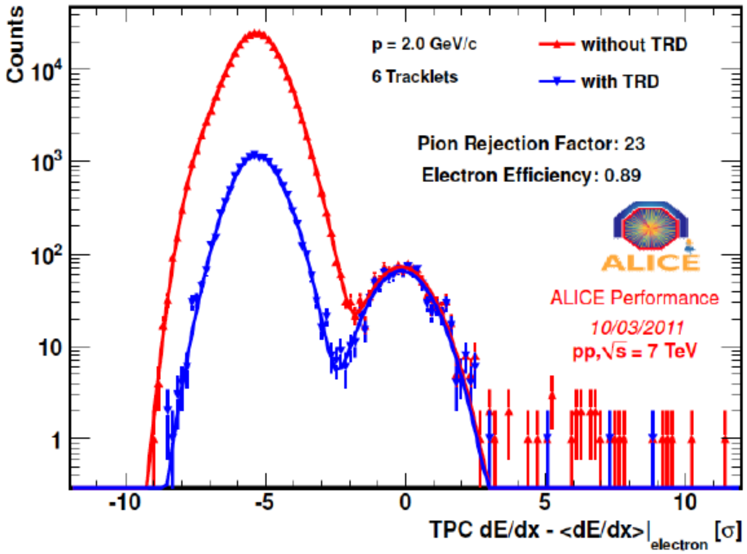


4 anti-alpha candidates in 16M Pb-Pb events
Confirmed by TOF analysis (time-of-flight sensitive to m/z ratio)

$$m = \frac{z \cdot R}{\sqrt{\gamma^2 - 1}}$$

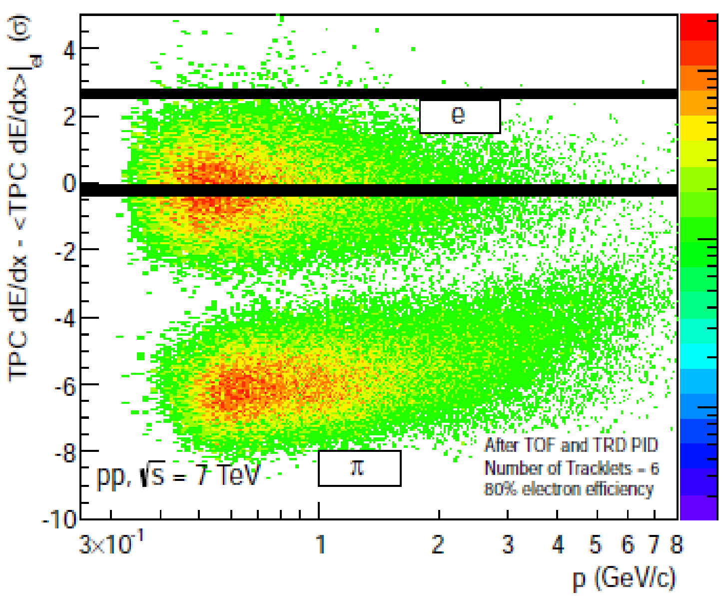
Electron identification

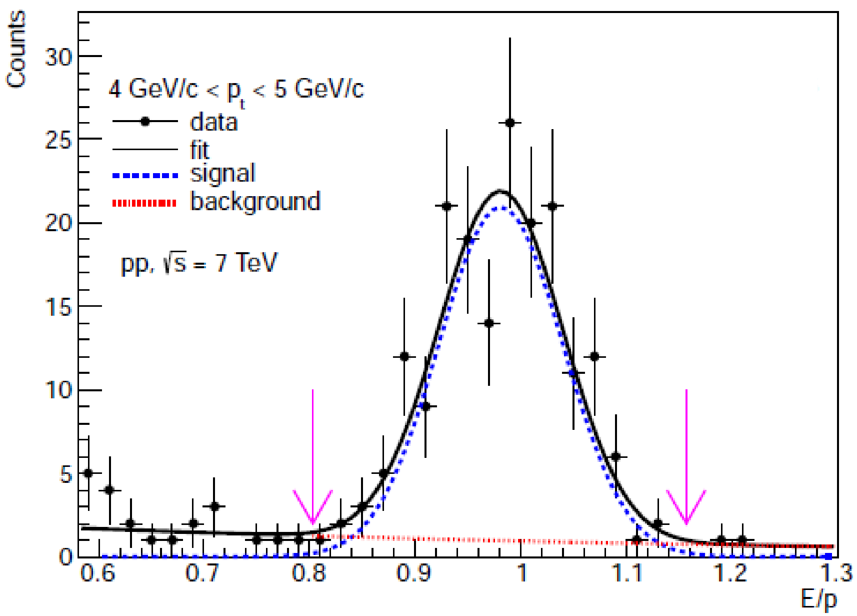
Transition Radiation Detector
e/π separation



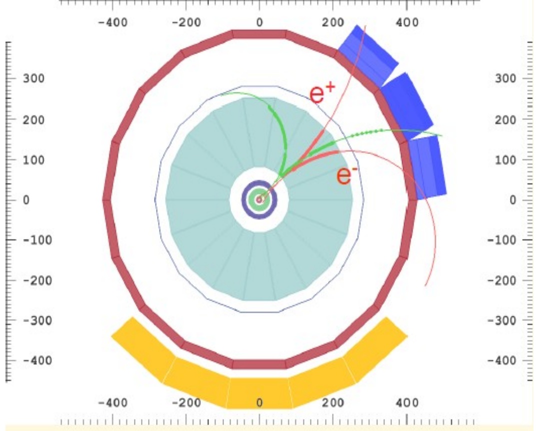
Electromagnetic Calorimeter
combined with TPC dE/dx
E/p ~ 1

TOF
(± 3σ_e)

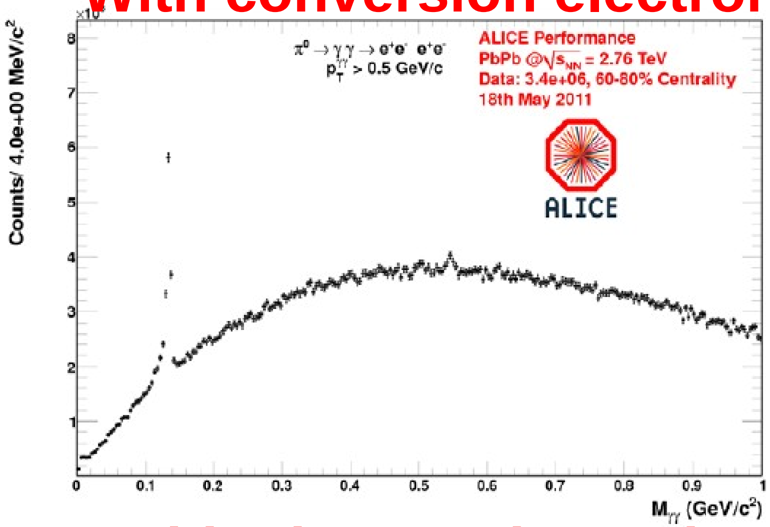




π^0, η reconstruction



With conversion electrons



- 3 independent measurements
  - Conversion, PHOS, EMCAL

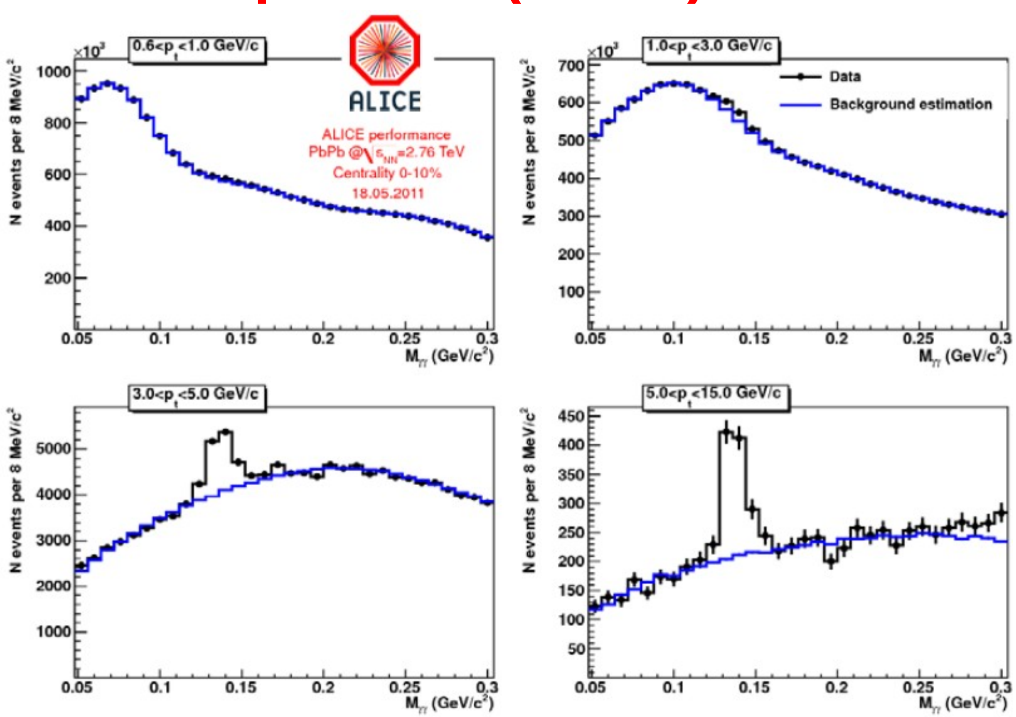
- pp $\to \pi^0 + X \to \gamma\gamma + X \to e^+e^-e^+e^- + X$

$m(\pi^0) = 0.135\text{GeV/c}^2$, BR=0.988

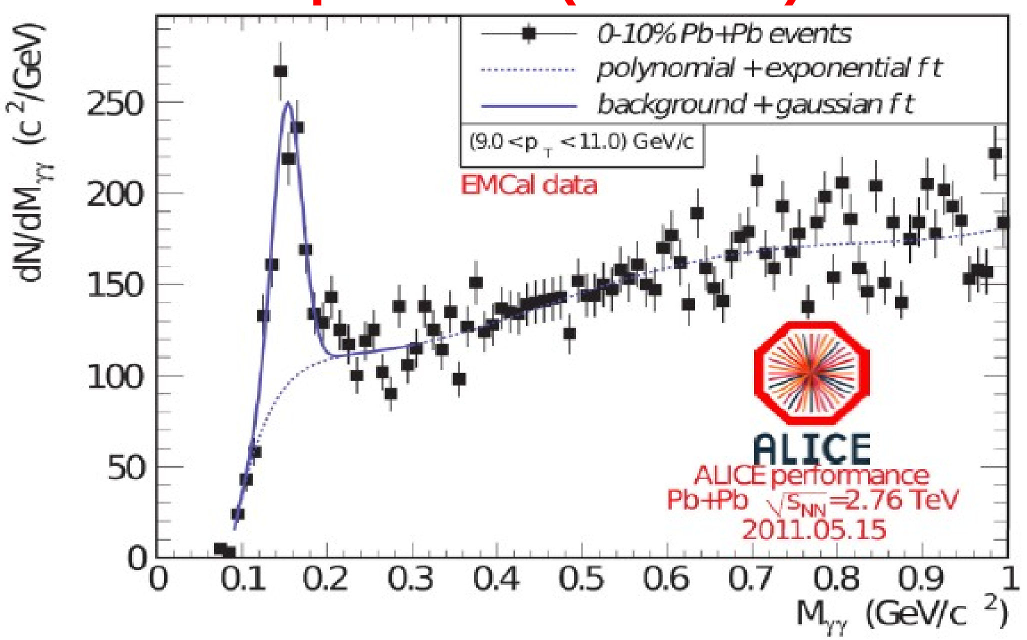
- pp $\to \eta + X \to \gamma\gamma + X \to e^+e^-e^+e^- + X$

$m(\eta) = 0.548\text{GeV/c}^2$, BR=0.393

With photons (PHOS)

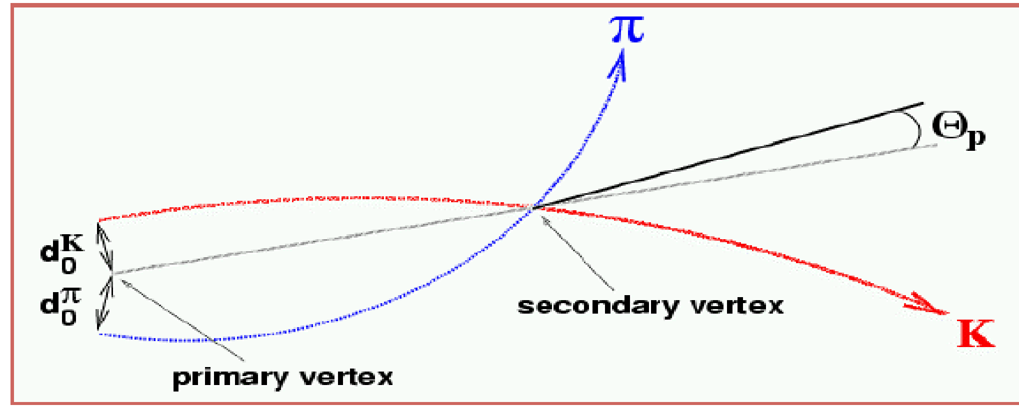


With photons (EMCAL)

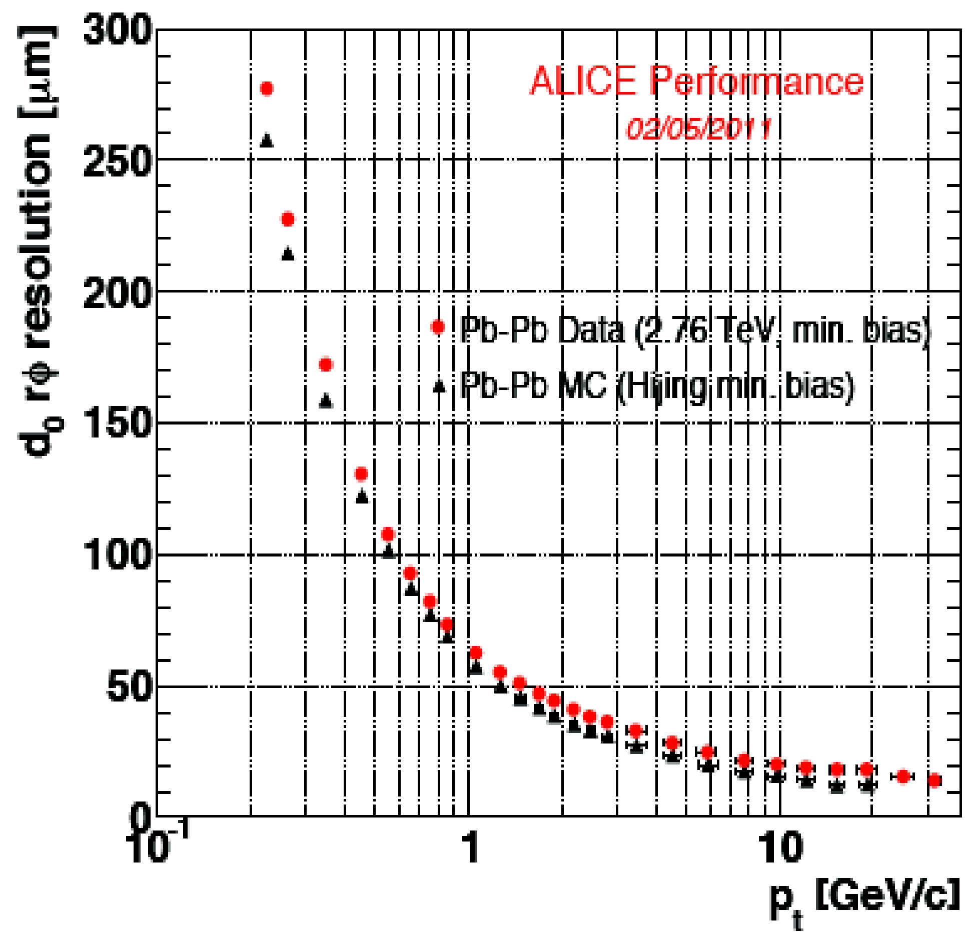


Impact Parameter Resolution

- Main selection for weak decays: displaced vertex topology
- Tracking and vertexing precision is crucial
  → Resolution of d_0



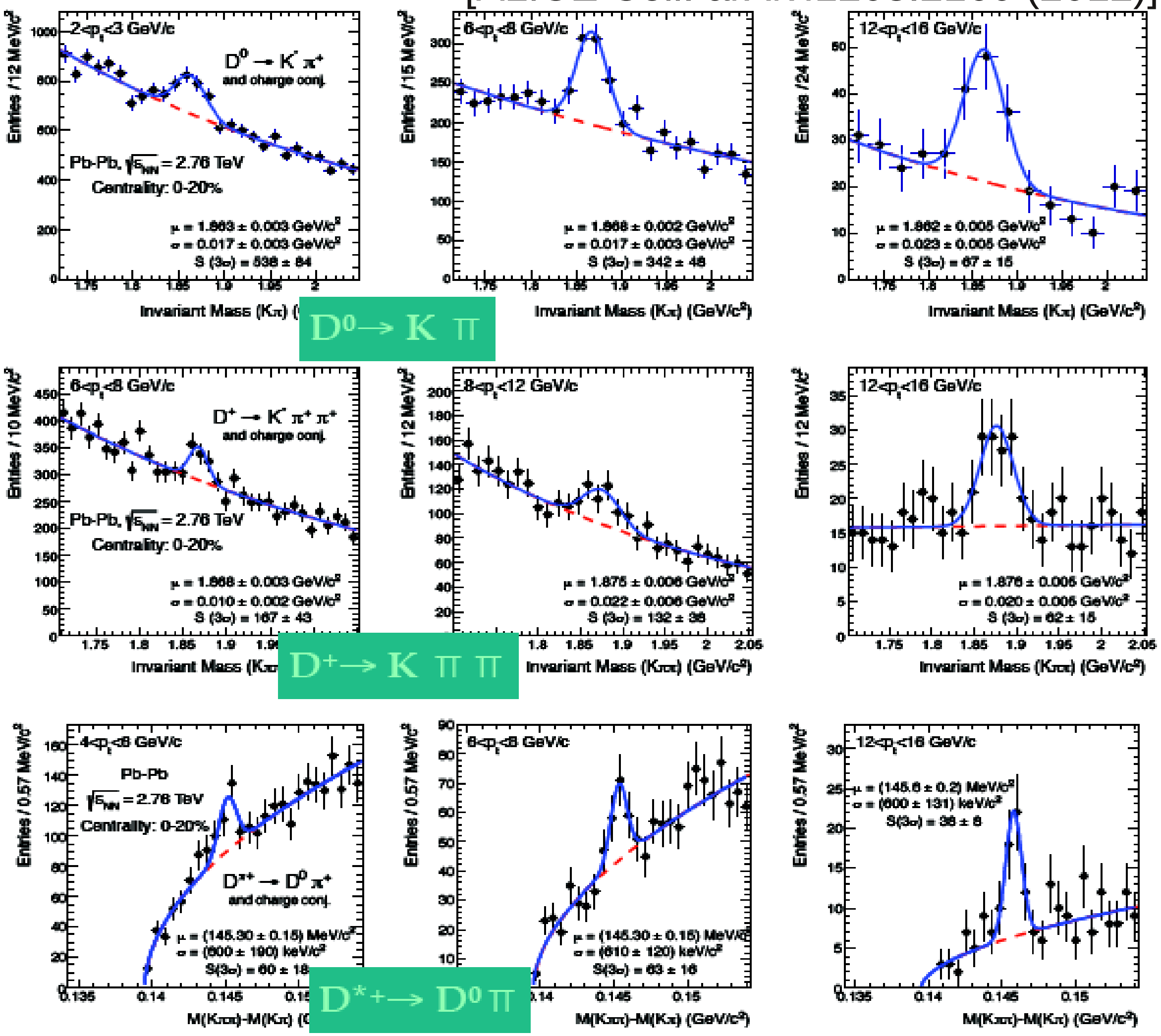
- Inner Tracking System (ITS) with 6 layers
  - Two pixel layers at 3.9 (closest barrel layer at LHC!) and 7 cm
- ITS alignment with cosmics and collisions
  - Current resolution ~ nominal

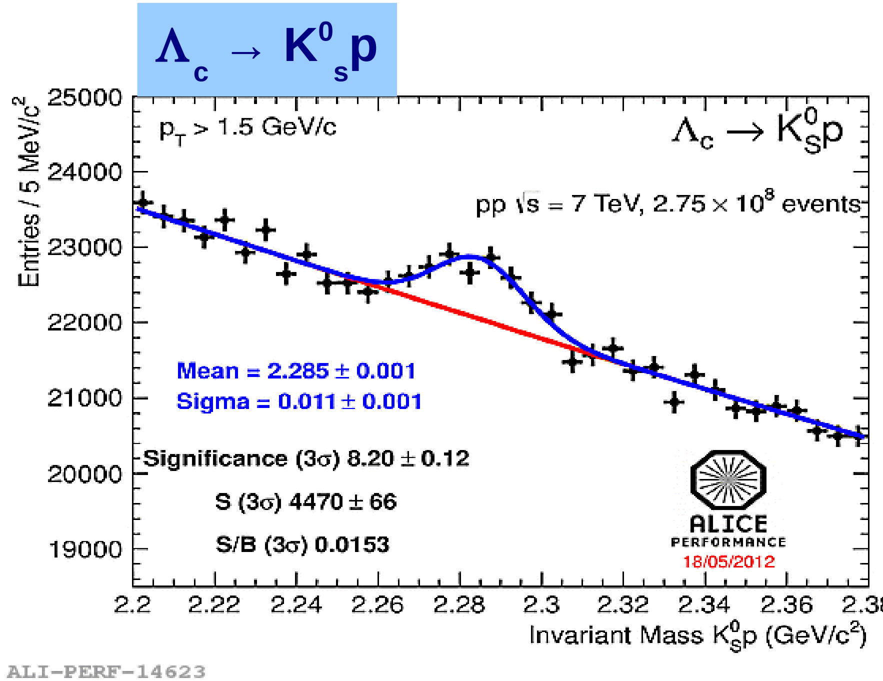


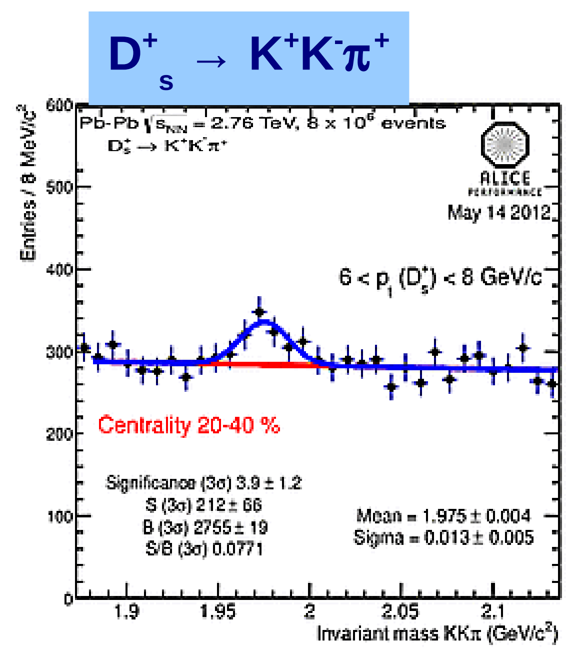
• D^0	→ Kπ (Kπππ)	cτ ~ 122.9 μm	
• D^+	→ Kππ	cτ ~ 311.8 μm	
• D^{*+}	→ $D^0\pi$		
• D_s	→ KKπ	cτ ~ 149.9 μm	
• Λ_c	→ Kpπ, K^0_sp	cτ ~ 59.9 μm	

Charm hadron reconstruction

[ALICE Coll. arXiv:1203.2160 (2012)]





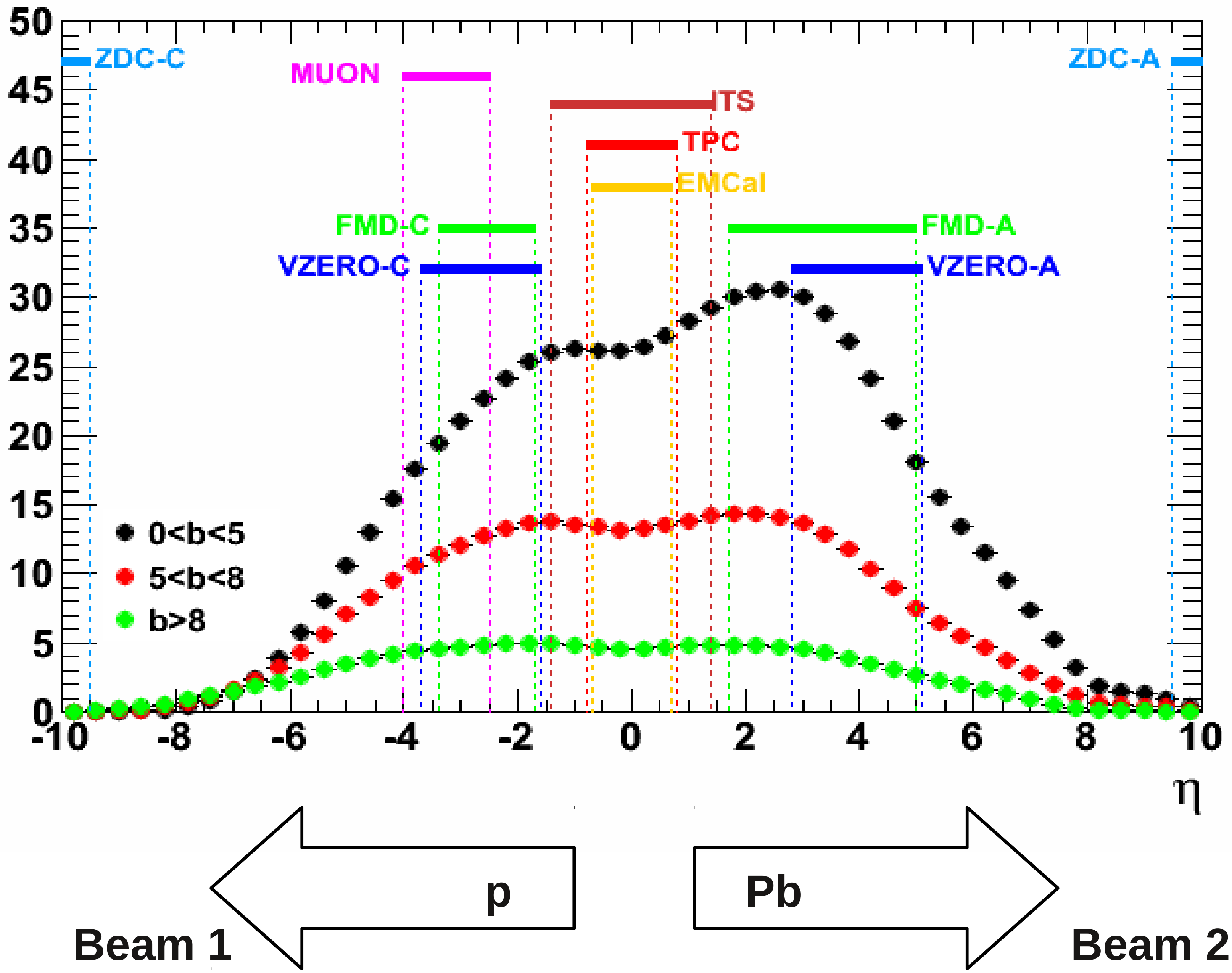


- Selection strategy, topological cuts: displaced vertexes
  - Impact parameter of the tracks,
  - Angle between the meson flight line and the particle p
- Particle identification: TPC + TOF (K,p identification)

ALICE in pA

ALICE
p-Pb

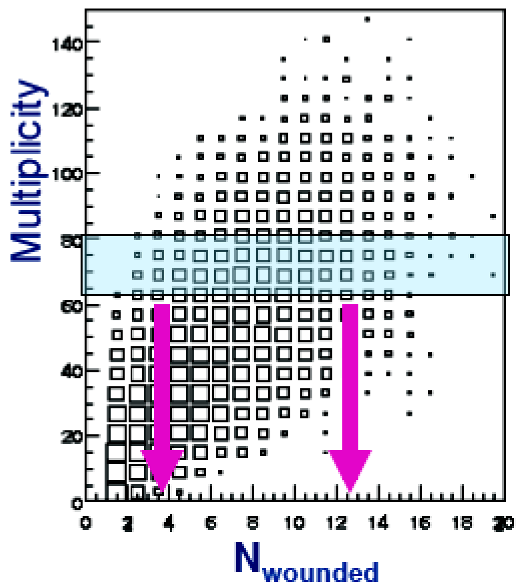
Rapidity distribution

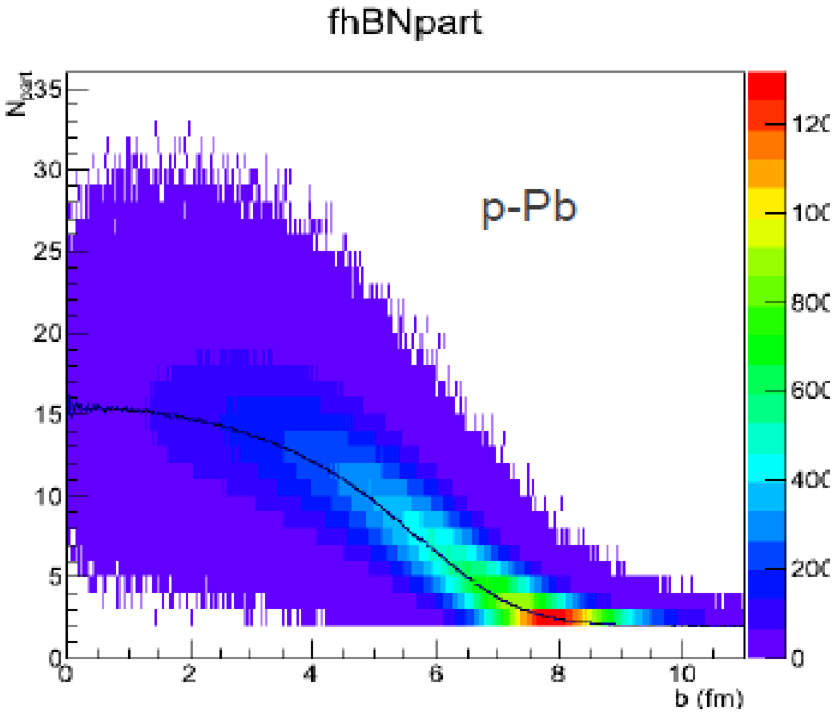


HIJING
Primary charged particles
p_T > 150 MeV

How to determine centrality in pA

- Physics used for centrality independent from the physics signal
- dN_{ch} poorly correlated with N_{coll}
- In earlier fixed target pA experiments, one often categorized "centrality" via gray tracks (lower momentum particles from the nucleus fragmenting)





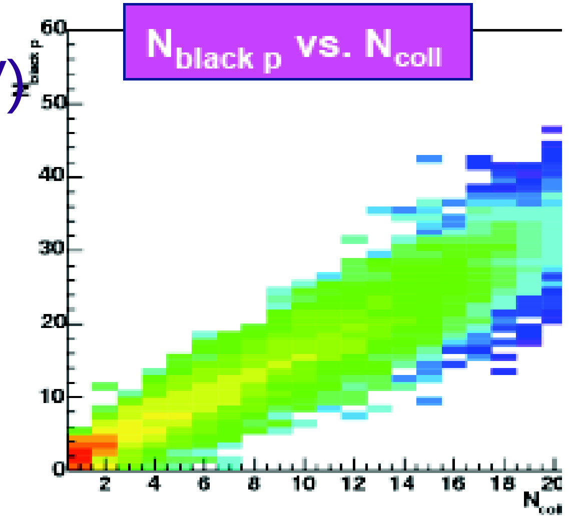
- Looking at recoil nucleons from Pb: possible observable
  - ZDC: detect slow nucleons
  - VZERO: detect high p_T particles from the nucleus breaking up

Alberica Toia

Centrality Discussion Tuesday 14-15:30

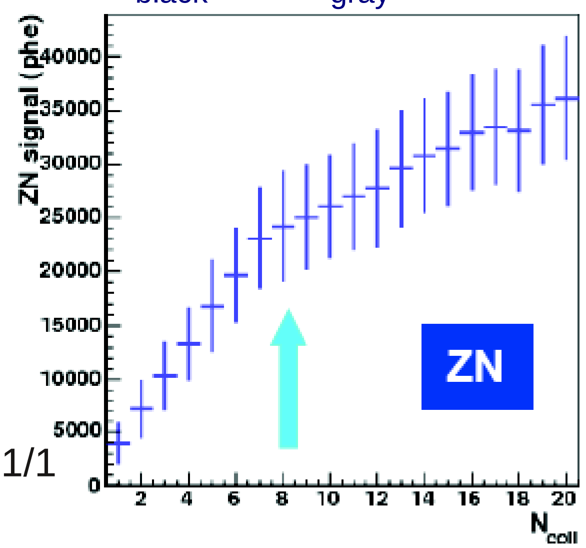
Centrality with ZDC

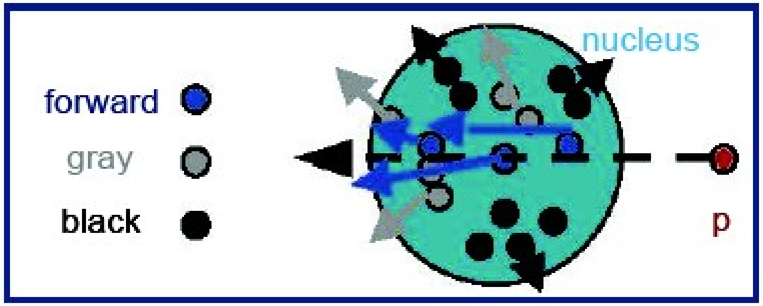
- Features of N_{ch} ~ independent of $E_{projectile}$ (1GeV → 1 TeV)



- **Slow nucleons** emission dictated by collision geometry
  → Maxwell-Boltzmann distributions
  (independent statistical emission)
- Glauber model: distribution of N_{coll} from impact parameter
- N_{coll} → N_{gray} (wounded nucleons knocked out in initial interaction)
  probability distribution from geometric model:
  $\mathbf{N_{gray} \sim 1.2\ A^{1/3} \sim 2\ N_{coll}}$
- N_{coll} → N_{black} (emitted during nucleus de-excitation)
  emission from equilibrated nucleus connected
  to target excitation: $\mathbf{N_{black} \sim 0.08\ A \sim 4 N_{coll}}$

Problem:
saturation in
N_{black} vs N_{gray}

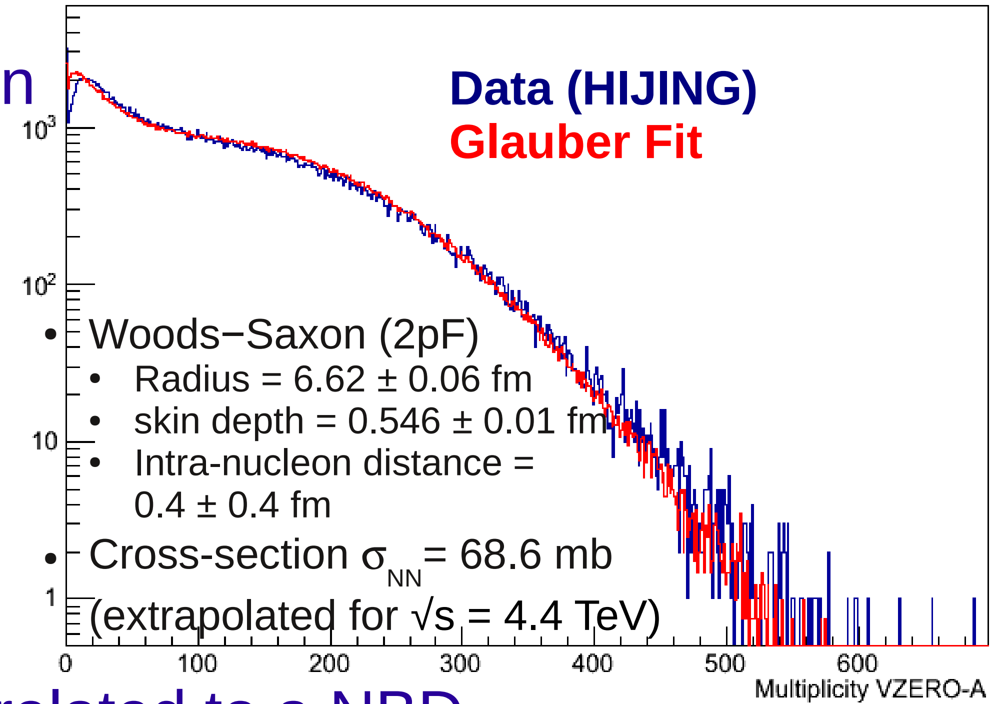




C.Oppedisano
https://edms.cern.ch/document/682801/1

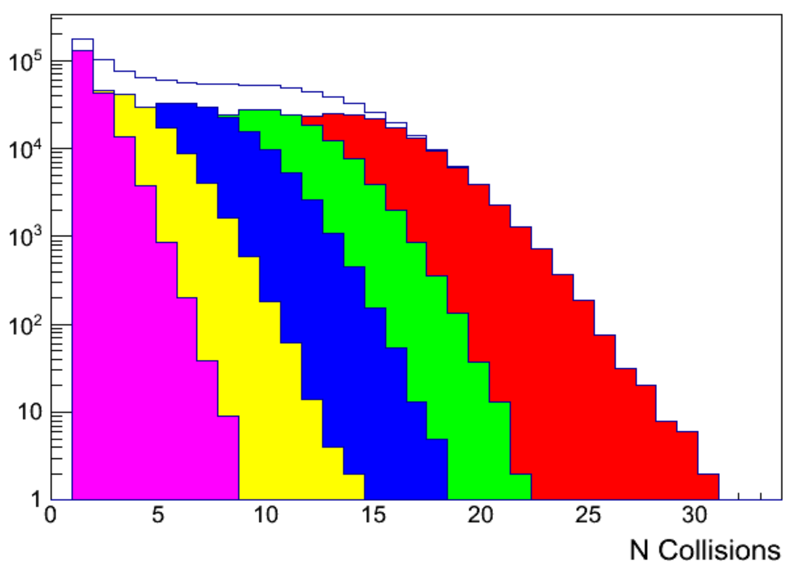
Centrality with VZERO

- Recoil nucleons in Pb-going direction
  - possible observable for gray tracks.
  - High p particles from nucleus breaking up (not really nuclear fragments at this η).



- $N_{ch} \sim N_{coll}$

→ Glauber fit: For each N_{coll} , N_{ch} is related to a NBD



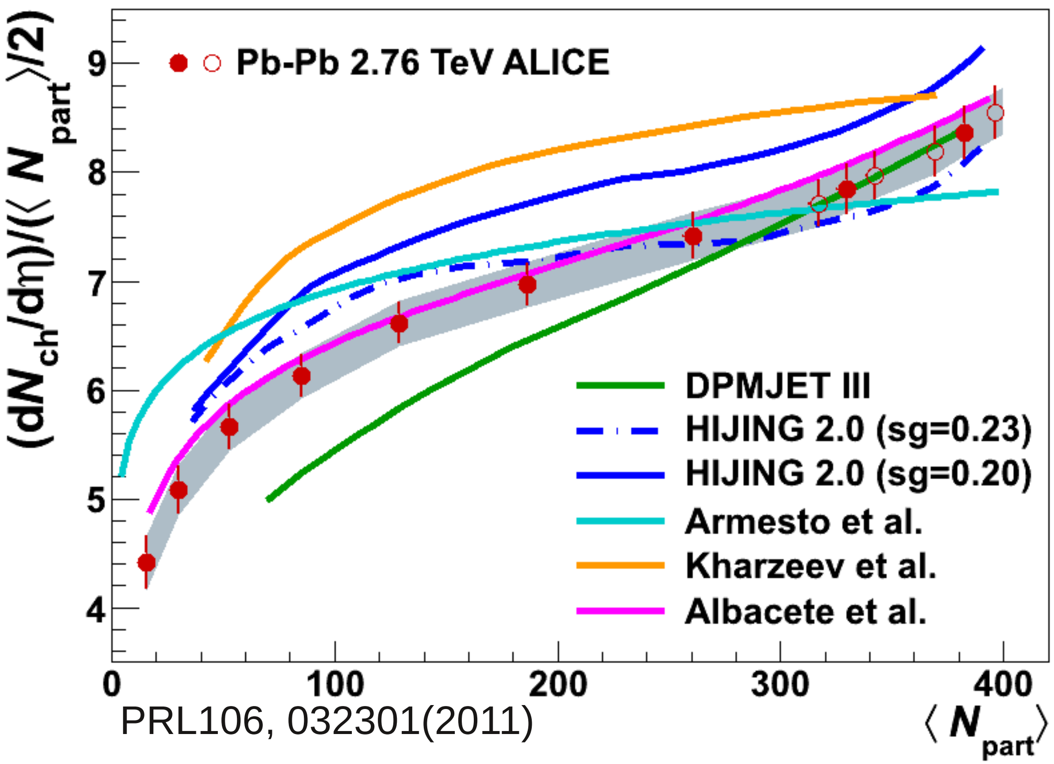
Cent	Ncoll	RMS
00-20:	13.7	3.2
20-40:	9.6	2.7
40-60	6.1	2.7
60-80:	3.1	1.6
80-100:	1.4	0.8

Careful with
- EM background
- Trigger bias
- Centrality bin shift

Benchmark measurements for AA

Bulk Physics

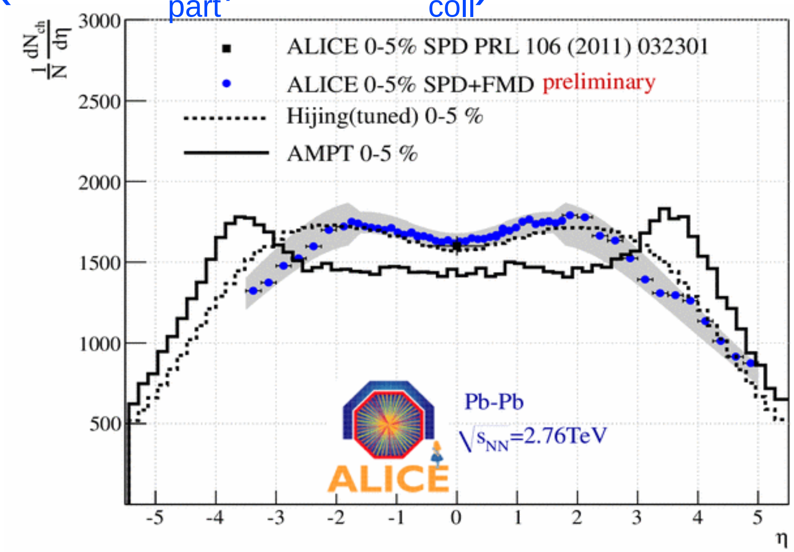
- Multiplicity and energy flow on a wide pseudo-rapidity range
  Important input for saturation physics (few hundred thousands events)



PRL106, 032301(2011)

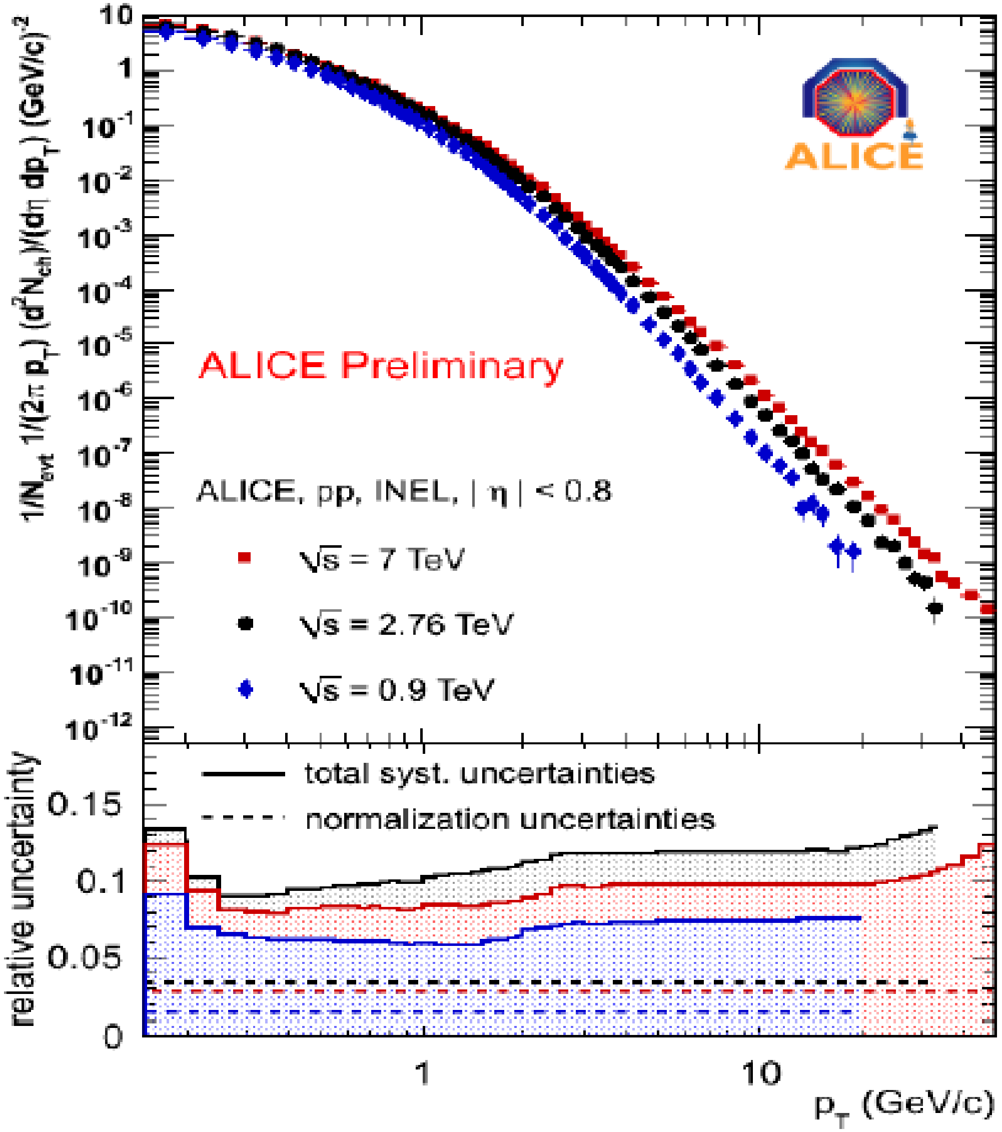
No growing influence of hard scattering (N_{coll}) from 0.2 to 2.76 TeV ?

- pQCD-inspired models (HIJING, DPMJET, AMPT, ...)
  - strong centrality dependence
  - moderated by gluon shadowing → 2-component (soft~N_{part}, hard~N_{coll})



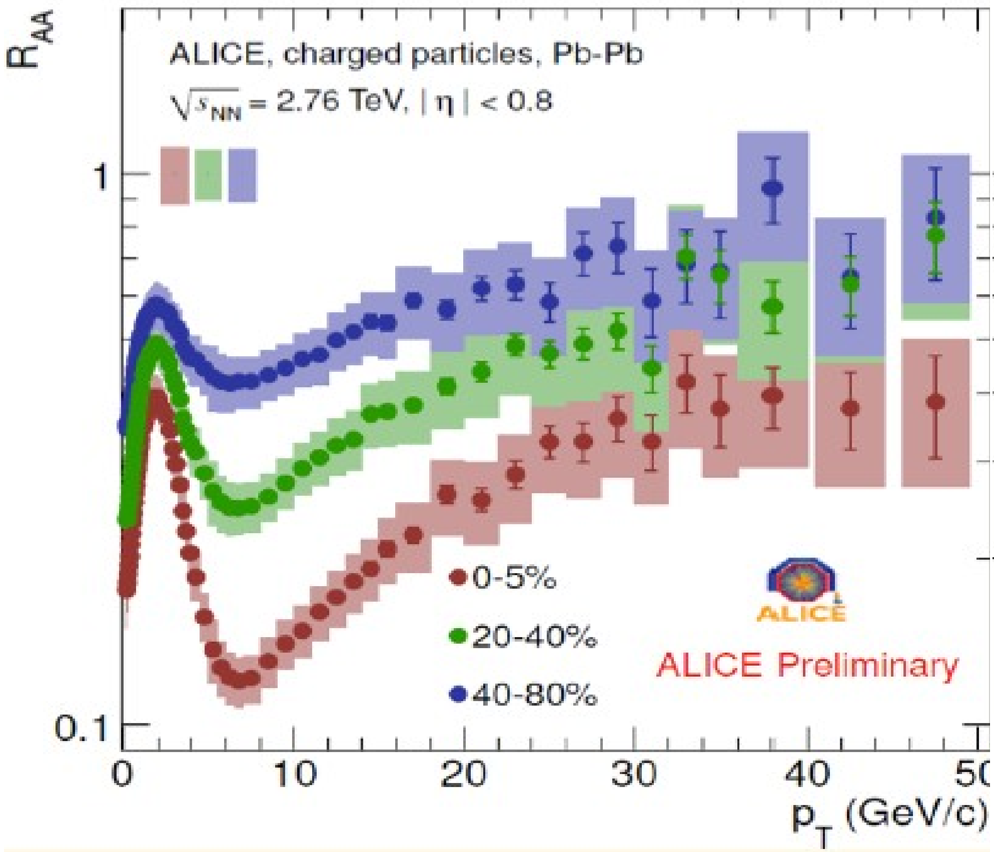
- Saturation models (CGC, EKRT, ...)
  - At fixed scale parton phase space density saturates → limits parton production
  - Factorization of N_{ch}

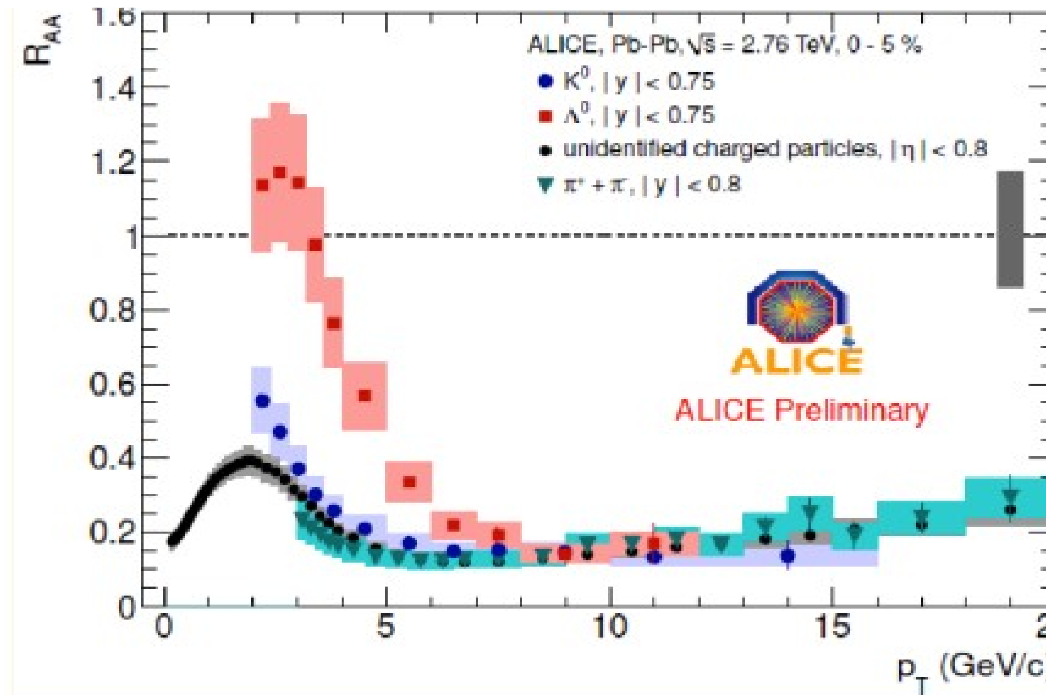
Charged hadrons



- p_T spectra measured in pp at 0.9 / 2.76 / 7 TeV
- Good p_T resolution $\sigma(p_T)/p_T \sim 10\%$ at 50 GeV/c
- Several approaches to construct pp reference for R_{AA}
  - 2.76 TeV data (extrapolated for p_T>30 GeV/c using modified Hagedorn or power-law functions)
  - Interpolation between 0.9 and 7 TeV data using power-law function
  - Scaling of 0.9, 7 TeV to 2.76 TeV using factors from NLO calculations

Charged hadron R_{AA}

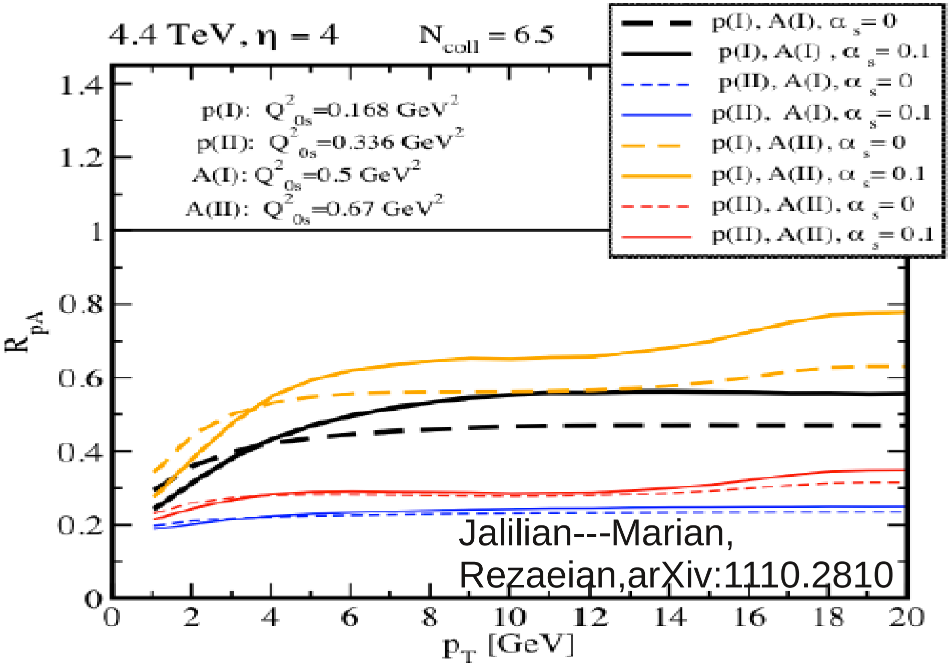




PID out to ~ 40-50 GeV

- Change of slope beyond p_T>40 GeV
- Decreasing dependence on centrality and p_T with increasing p_T
- Up to 20 GeV compatible to RHIC

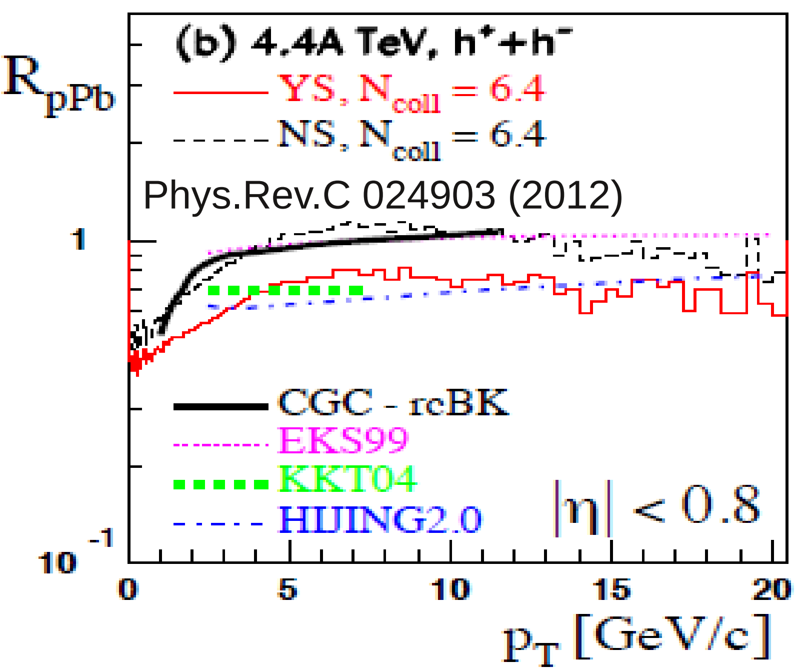
pA prediction: charged hadron R_{pA}



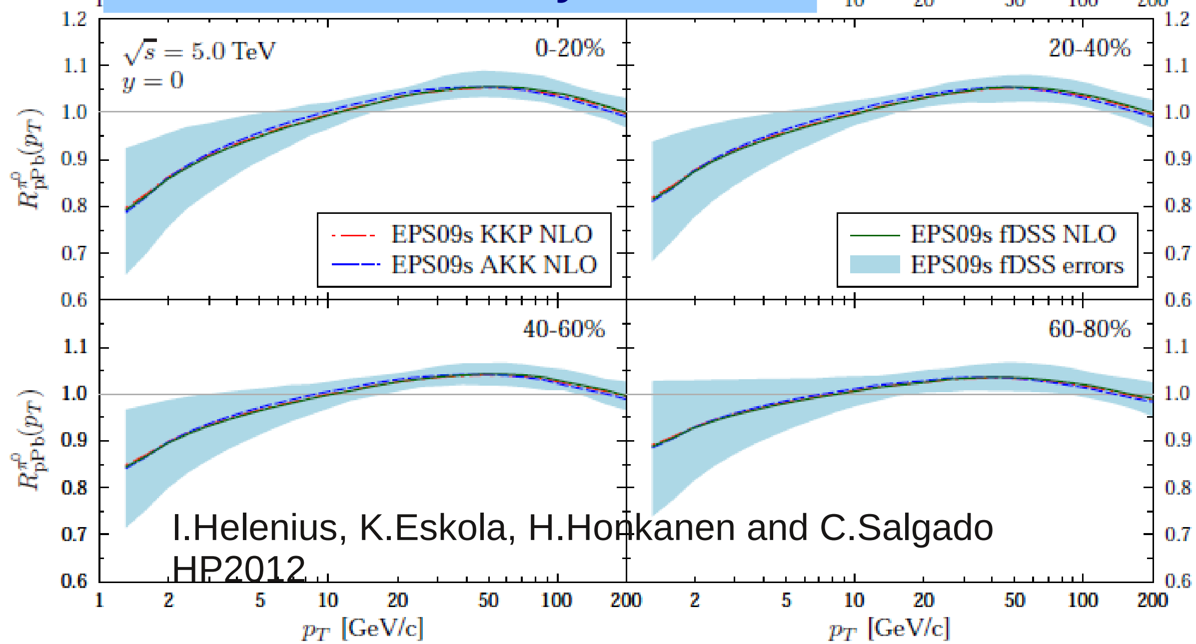
- Significant differences predicted for different saturation scales and elastic and inelastic scattering

  → Handle on saturation scale and small-x evolution dynamics

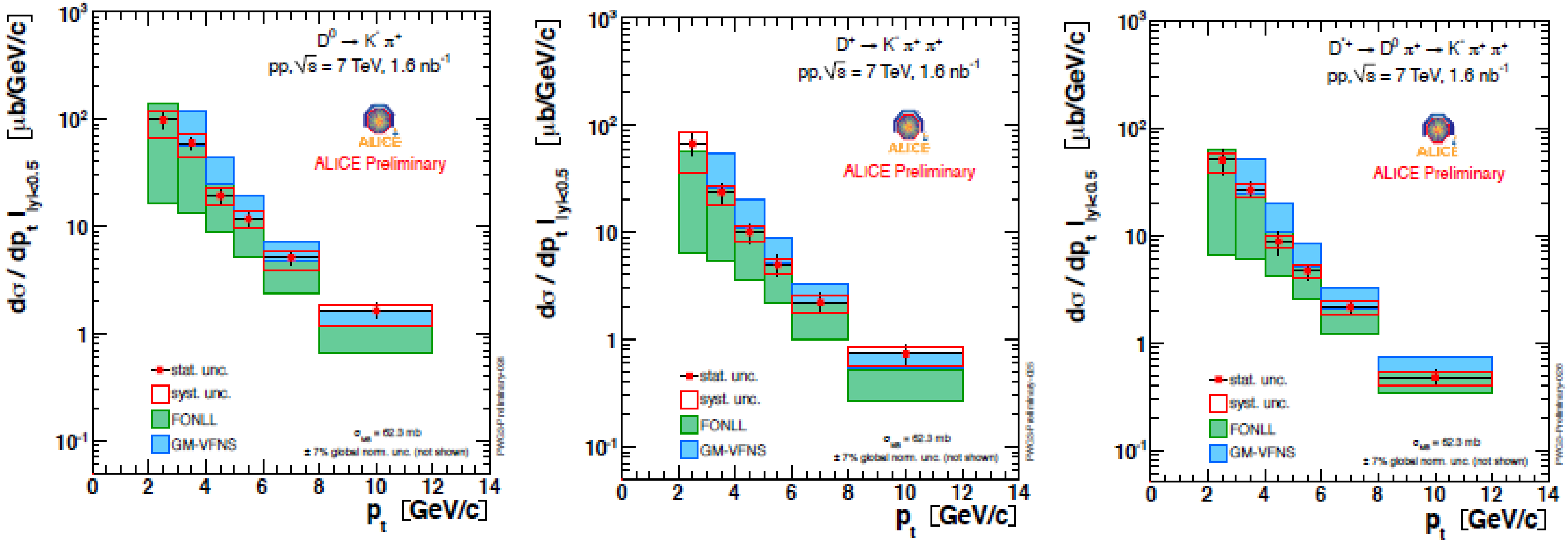
- Need to measure **pA data**



nPFD in centrality classes



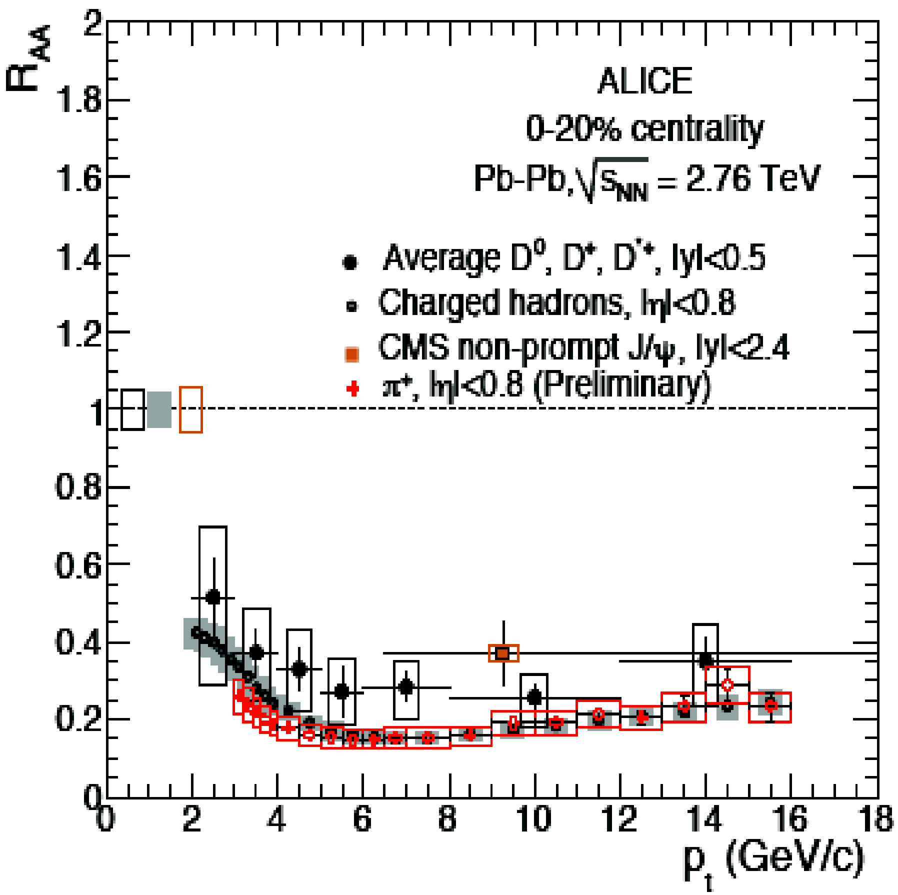
D mesons cross section



FONLL: Cacciari et al., private comm.
GM-VFNS: Kniehl et al., private comm.

- $2 < p_T < 12$ GeV with 1.6 nb^{-1} (20% of 2010 statistics)
- y acceptance is p_T dependent
- pQCD predictions (FONLL and GM-VFNS) compatible with our data

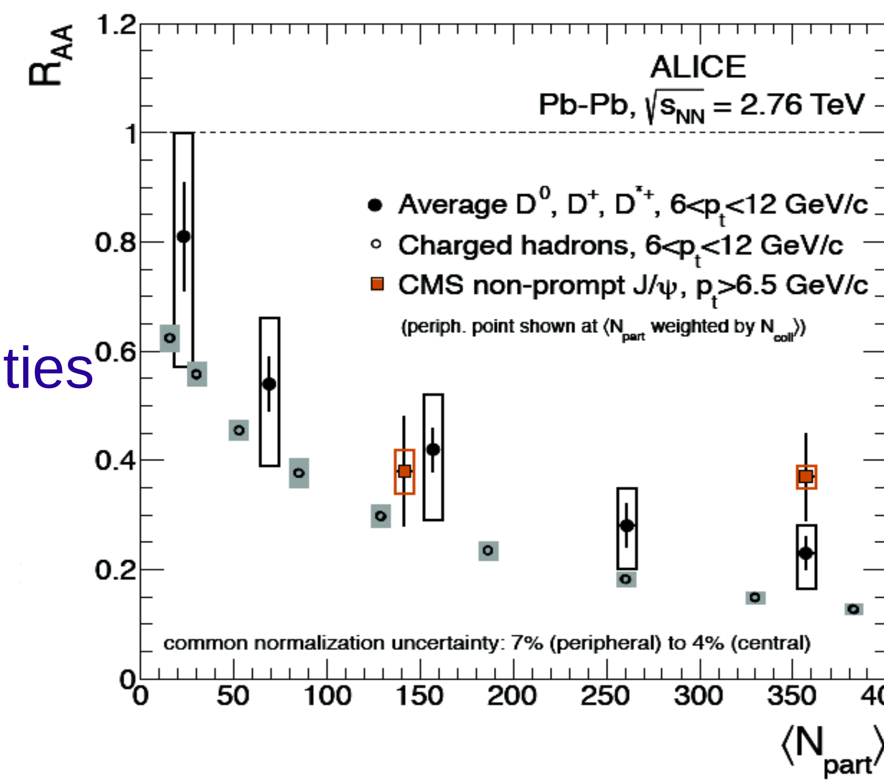
D mesons R_{AA}



- R_{AA} (D)~R_{AA} (N_{ch}) ~R_{AA} (π±) but central values are systematically larger
- Non-prompt J/ψ (B → J/ψ) from CMS also larger than N_{ch}

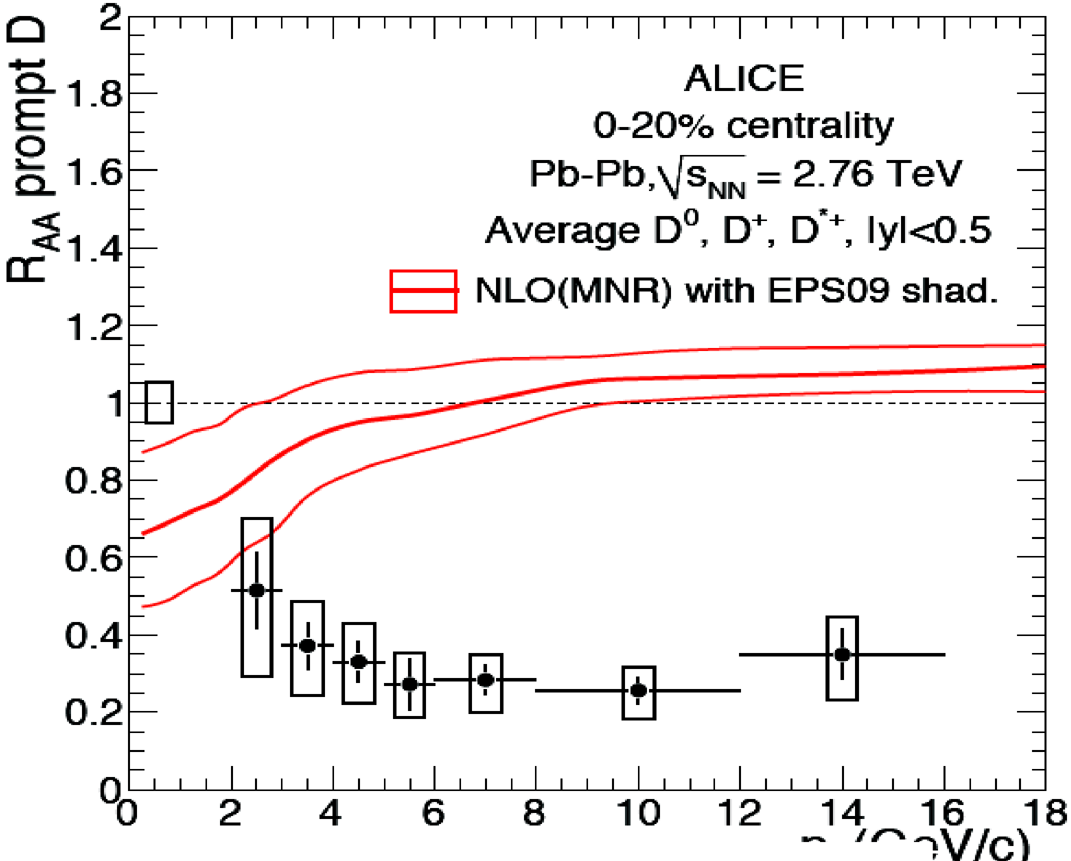
→ **hint for hierarchy?**

- Need precise measurements and **pA data**



- D^0, D$^+$, D^{*+} R_{AA} compatible within uncertainties
  - 0-20% suppressed 3-4 (p_T>5 GeV/c)
  - 40-80% suppressed 1-3 (p_T>5 GeV/c)

pA prediction: D mesons R_{pA}

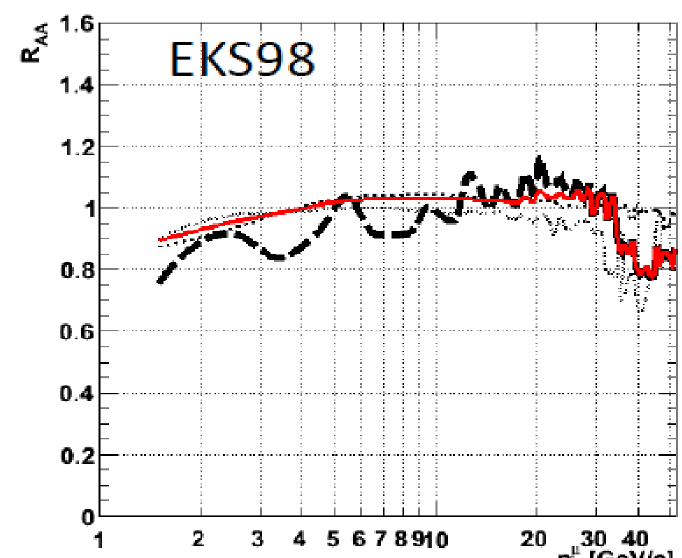


- Average D meson R_{AA} using the statistical errors as weights
- suppression in the 0-20% for p_T > 4 GeV/c
- Difficult to explain only with shadowing

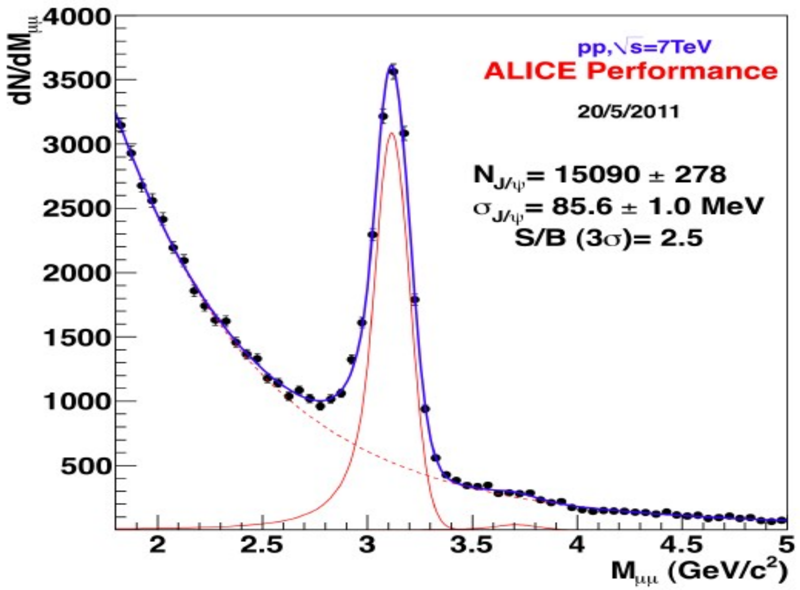
→ need **pA data**

Forward muons: very little effect expected from shadowing (both AA and pA)
EKS98 for Pb-Pb 5.5 TeV:
~5% deviations from R_{AA}=1

- Will be smaller in pA
- A bit larger with EPS09



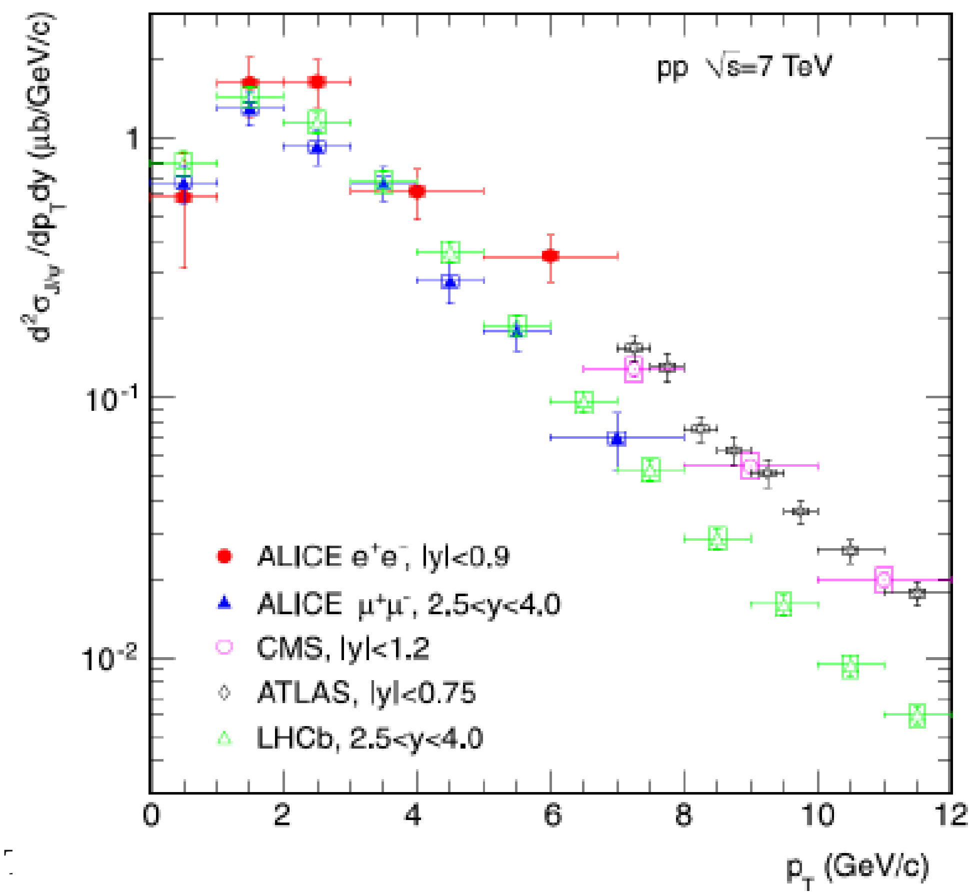
J/ψ in pp



- NRQCD calculation describes the measured p_T dependence at both 7 and 2.76 TeV
- pp @ 2.76 TeV reference for the nuclear modification factor R_{AA} in Pb-Pb collisions
- the pp reference is the main source of systematic uncertainty in the R_{AA} computation

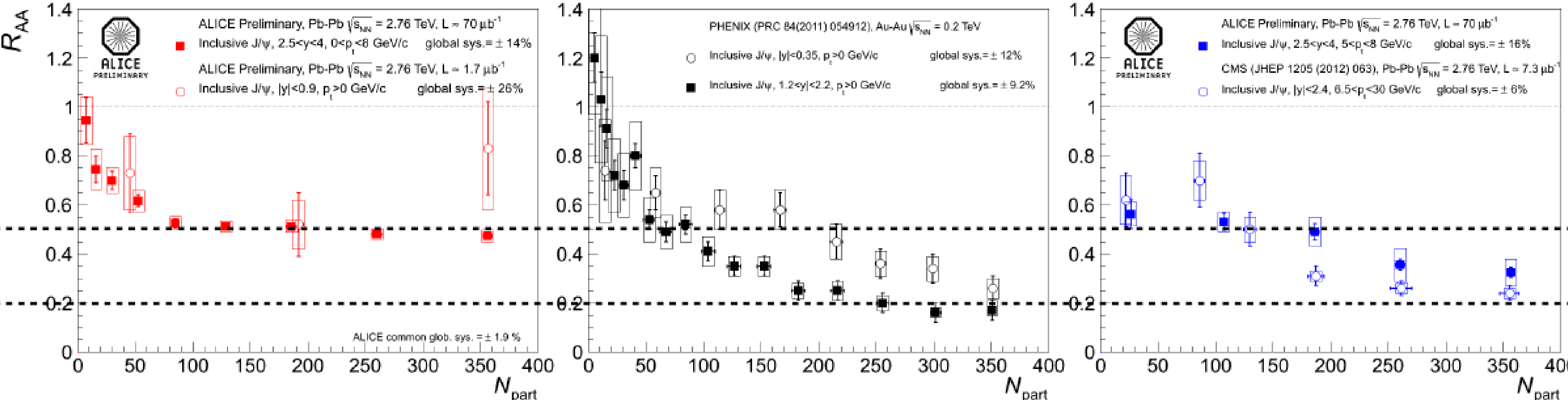
•in pp collisions, ALICE has measured charmonia

- in μ+μ- at y (4 - 2.5) and e+e- channels y (-0.9 - 0.9)
- down to p_T = 0
- differentially in p_T, y
- at $\sqrt{s_{NN}}$ = 2.76 and 7 TeV
- as a function of $dN_{ch}/d\eta$
- Polarization
- from B decay

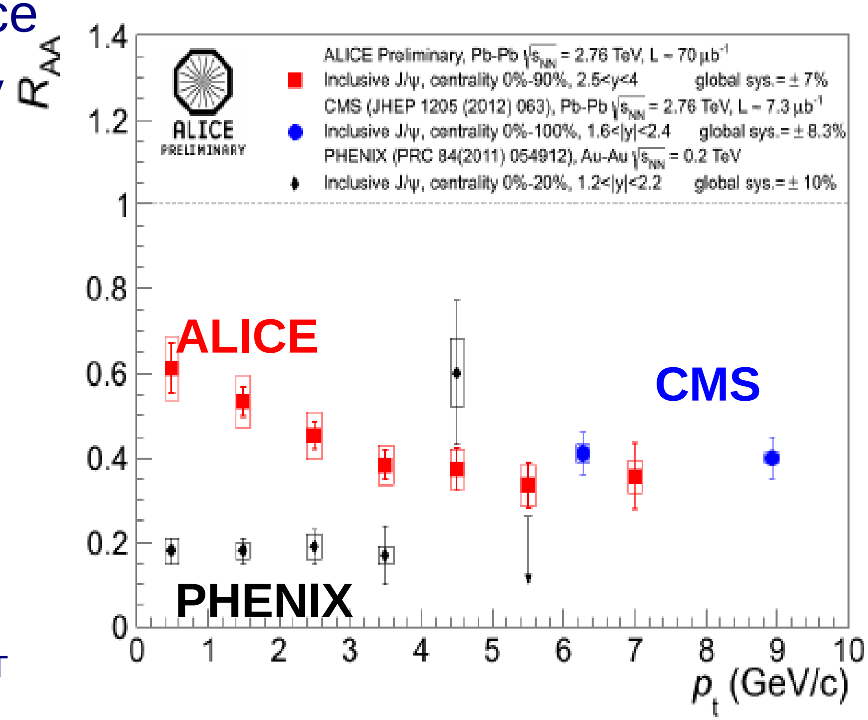


J/ψ suppression

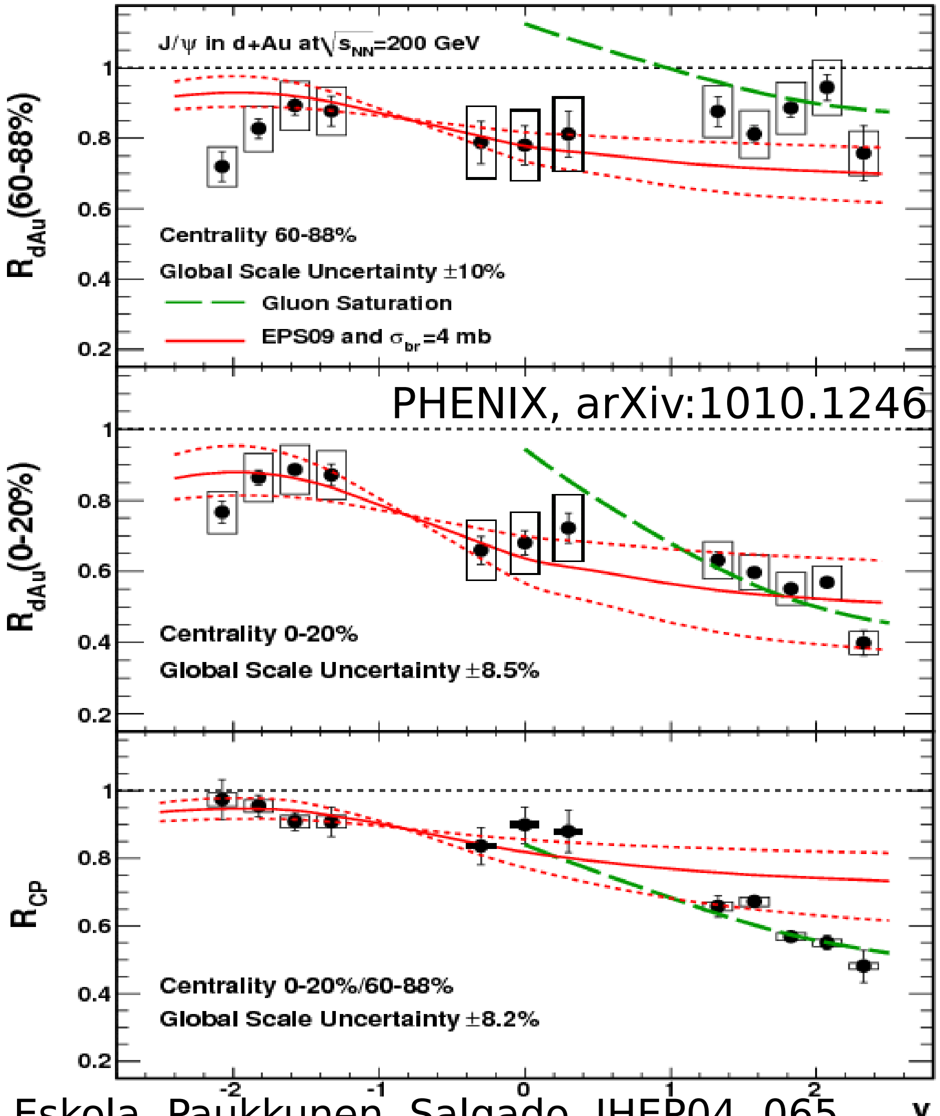
ALICE $p_t > 0$ PHENIX $p_t > 0$ ALICE/CMS high p_t



- **Low-p_T**: ALICE $R_{AA} \geq 0.5$, no centrality dependence ≠ PHENIX (larger suppression and strong centrality dependence)
- **High-p_T**: larger suppression (ALICE and CMS) ~ behavior at low energy
- R_{AA} ~ 0.6 (low-p_T) → R_{AA} ~ 0.35 (high-p_T)
  → **Suppression is p_T-dependent** (increases with increasing p_T)
  - In agreement with CMS
  - PHENIX measured larger suppression at low p_T



J/ψ in CNM at RHIC and SPS

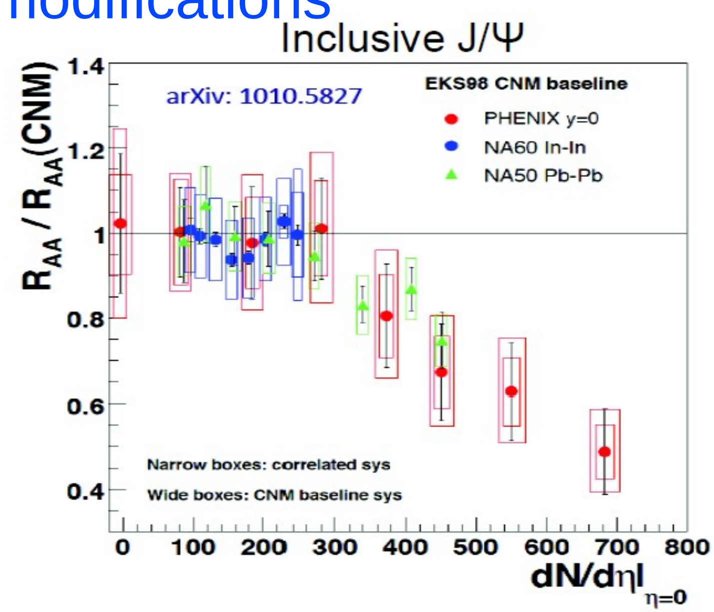


Eskola, Paukkunen, Salgado, JHEP04, 065
Vogt, PRC71, 054902
Kharzeev, Tuchin, NPA770, 40; NPA735, 248

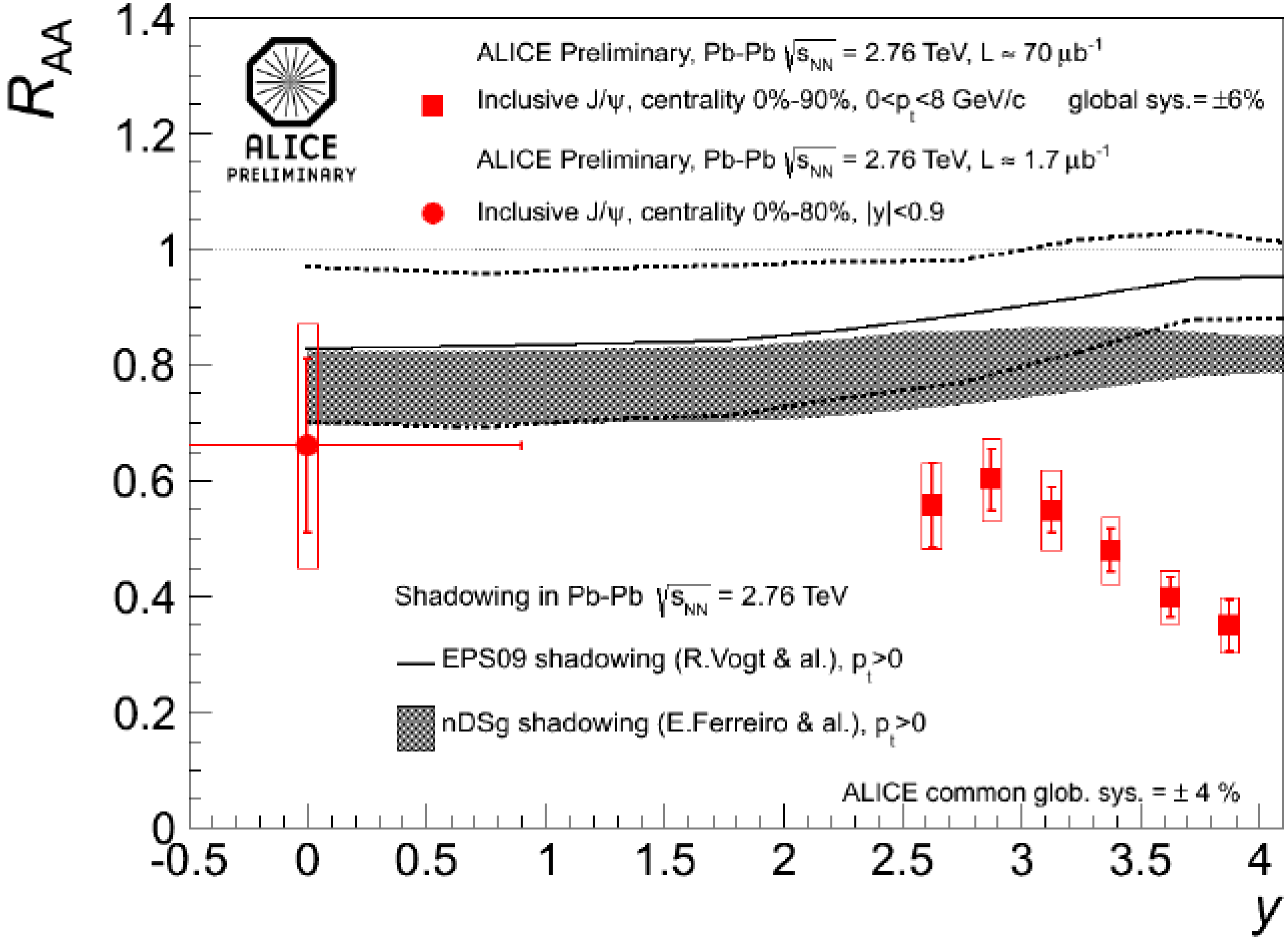
- EPS09 shadowing with linear dependence on nuclear thickness matches for central collisions
- Over-predicts suppression for peripheral collisions

→ R_{CP} shows this clearly

- **Thickness (impact parameter) dependence of shadowing is non-linear**!
- **pA data** → Cold Nuclear Matter effect:
  - Nuclear absorption
  - Gluon PDF modifications

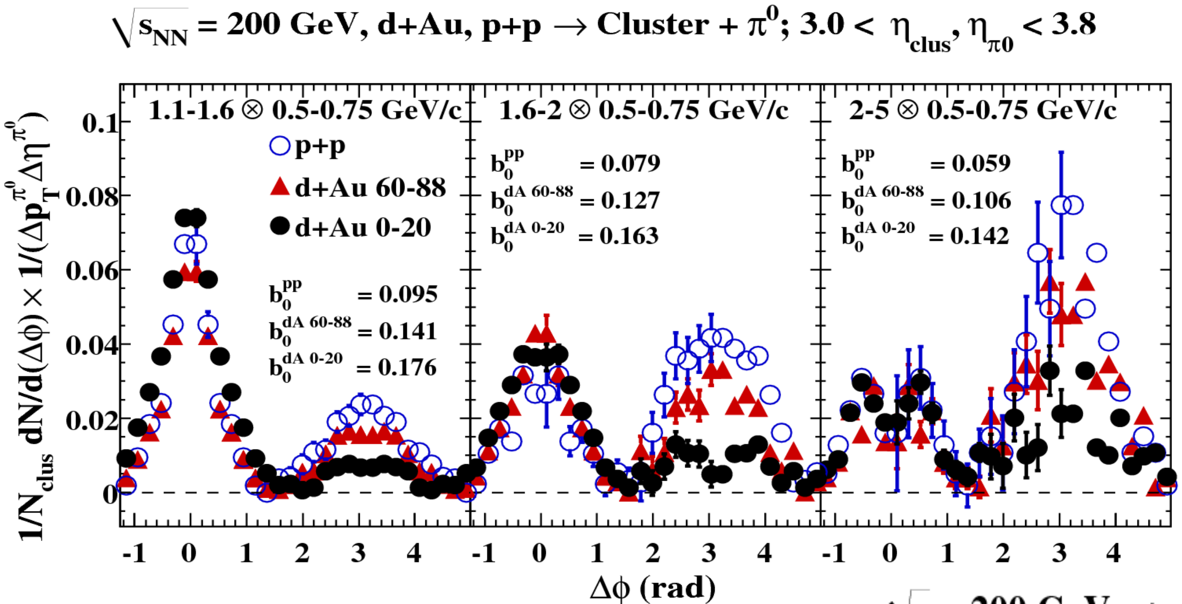


pA prediction: shadowing in J/ψ R_{AA}



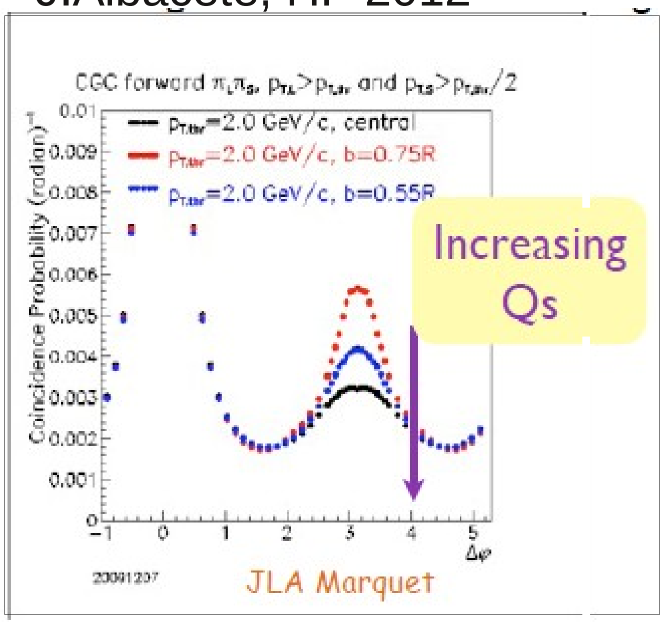
- Inclusive J/ψ measured in ALICE at both mid and forward rapidity.
- R_{AA} decrease by 40% from y=2.5 to y=4.
- Possible flat dependence toward mid rapidity.
- Suppression beyond the current estimate of shadowing
- Importance to measure cold nuclear matter effects → need **pA data**

Forward di-hadron correlations

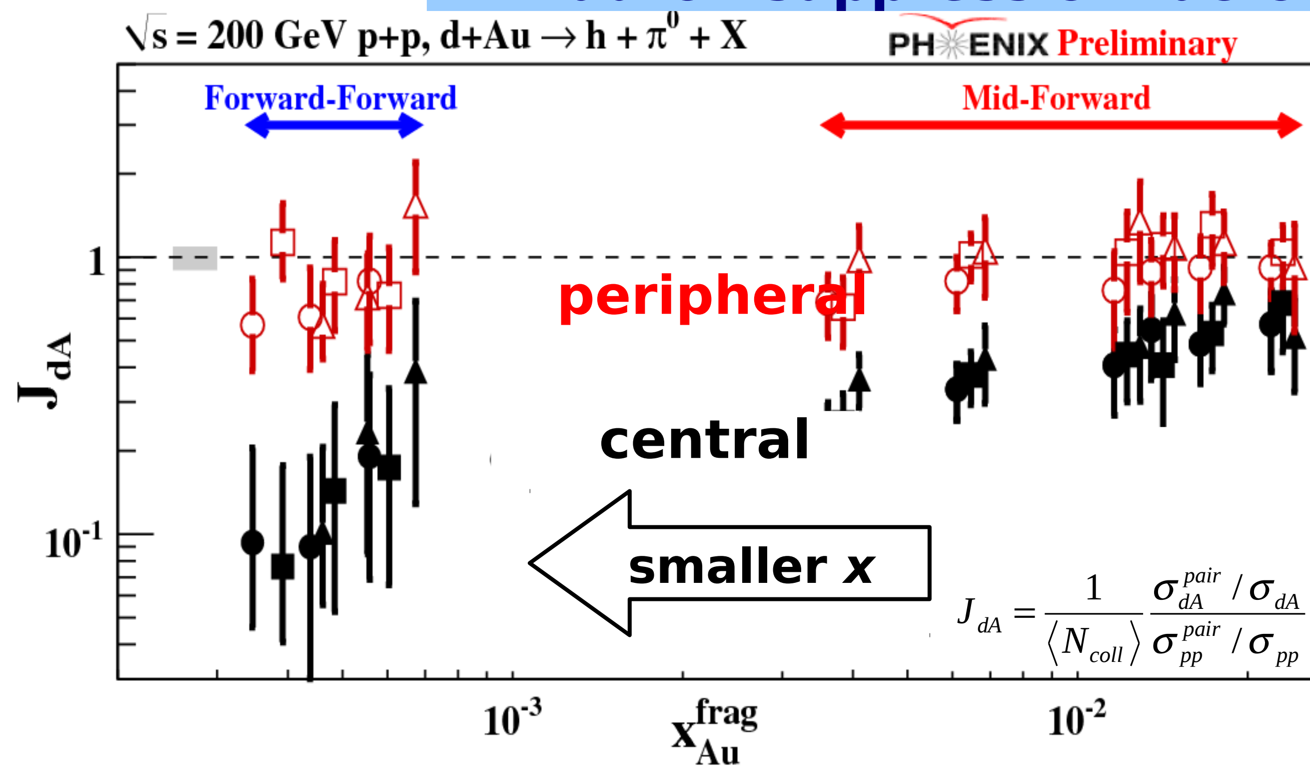


- Di-hadrons suppressed at low-x → initial state low-x gluon suppression? (Color Glass Condensate)
- p_T-y scan of di-hadrons in pA:
  - Constrains on CGC evolution
  - Information on b-dependence of saturation scale

J.Albacete, HP 2012



Di-hadron suppression factor



ALICE Plans & Wishes

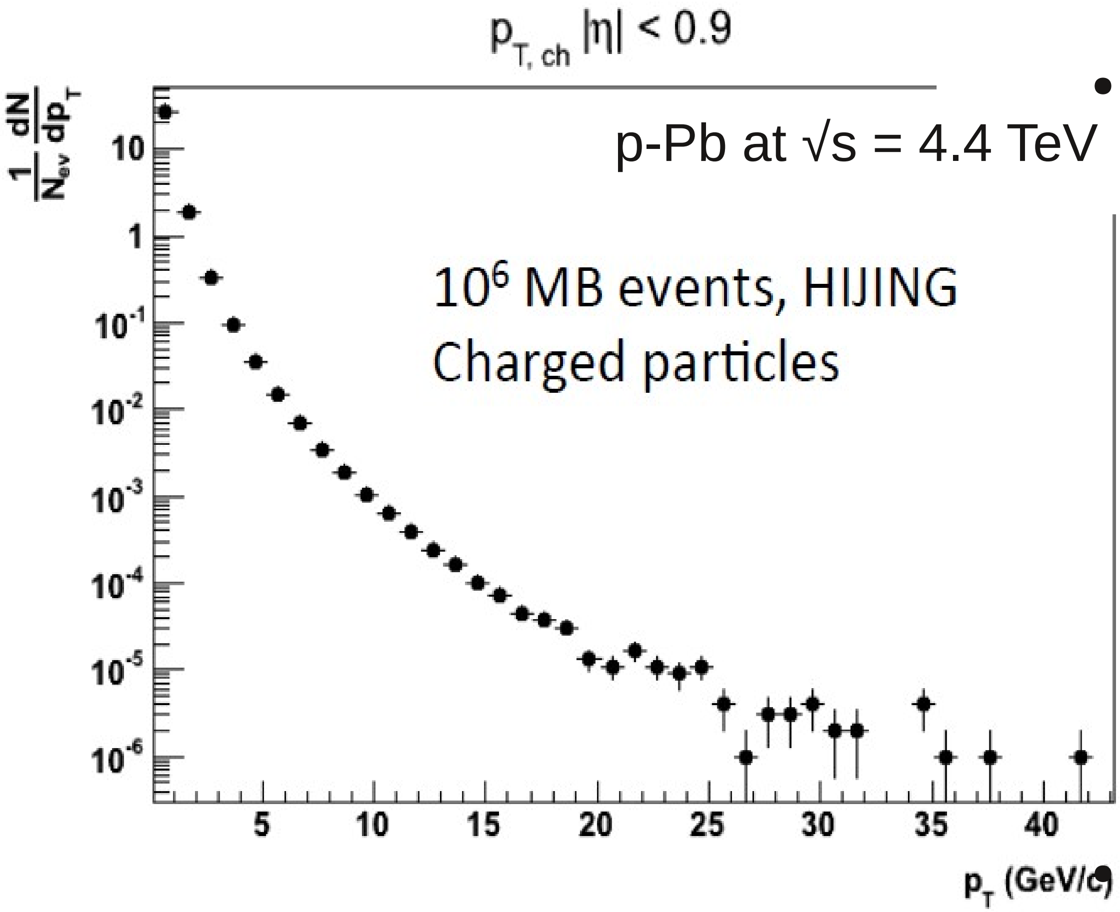
Running conditions

- Initial luminosity: $L_0 = 10^{28}$-10^{29} $cm^{-2}\ s^{-1}$
  → rates: 20-200 kHz
- σ(p-Pb) ~ 2 barn
- 22-24 operating days
  → Integrated luminosity: L_{int}= 15-25 nb^{-1}

J.Jowett (Chamonix, Feb 2012)

- ALICE can take ~ 1kHz MB triggers and can inspect most (80%) of the events at L0 with a rate to tape of ~ 200 Hz
  → Admixture of MB (1kHz) + rare triggers (~200 Hz)
  - Centrality
    Muons
    PHOS/EMCAL → photons, electrons, jets
    (TRD) → electrons, jets
  - MB: 1kHz x 2×10^4 (sec/day) = 2×10^7 events/day
  - Rare: 200 Hz x 2×10^4 (sec/days) = 4×10^6 events/day
    5 x $10^{28}$$cm^{-2}s^{-1}$ x 0.8 (lifetime) x 2×10^4 (sec/days) = $0.8\times10^{33}$$cm^{-2}s^{-1}$/day = 0.8 nb^{-1}/day

Light Flavors

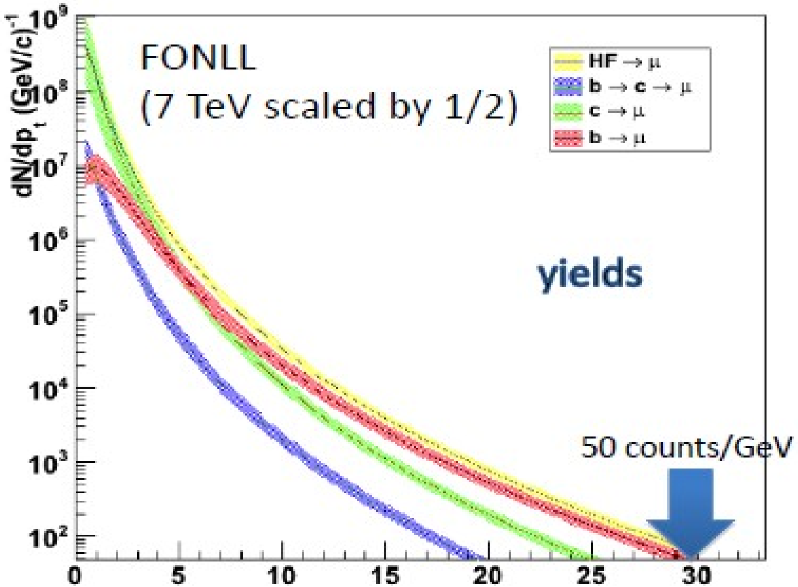


- **ALL-CHARGED HADRONS**
  p_T reach: ~ 50 GeV/c
  → 3 centrality intervals:
  - Few 10^7 MB event
  - EMCAL trigger events to extend p_T reach

- π, K±, p to the p_T limit of their PID
- Λ: up to p_T= 8 GeV/c
- K^0_S: up to p_T= 10 GeV/c
- Σ,Ξ,Ω: up to p_T= 5 GeV/c

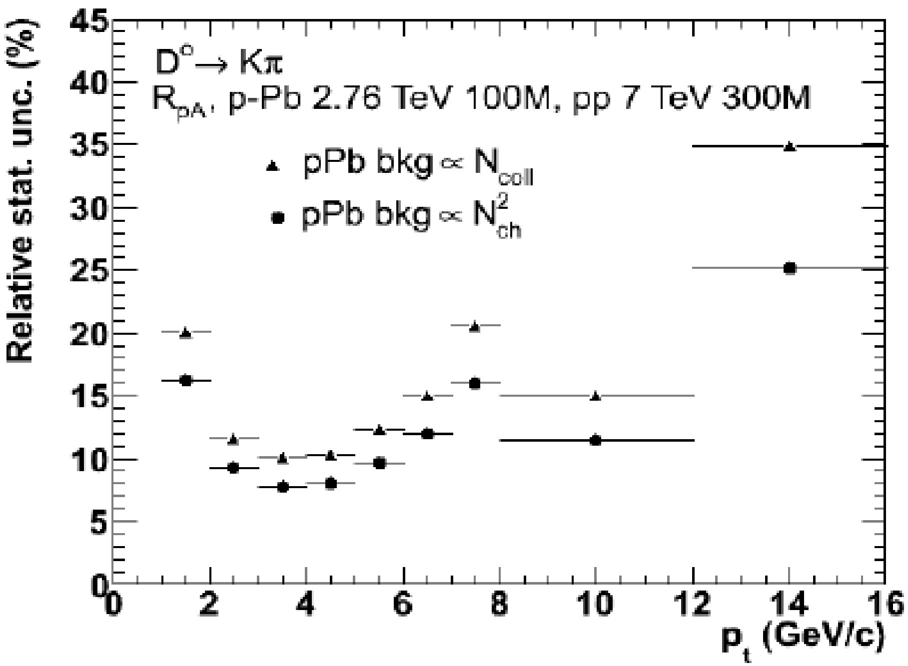
RESONANCES
With 100M MB p-Pb sample, equivalent to ~400M pp collisions, we can do everything that is being done for 7 TeV pp

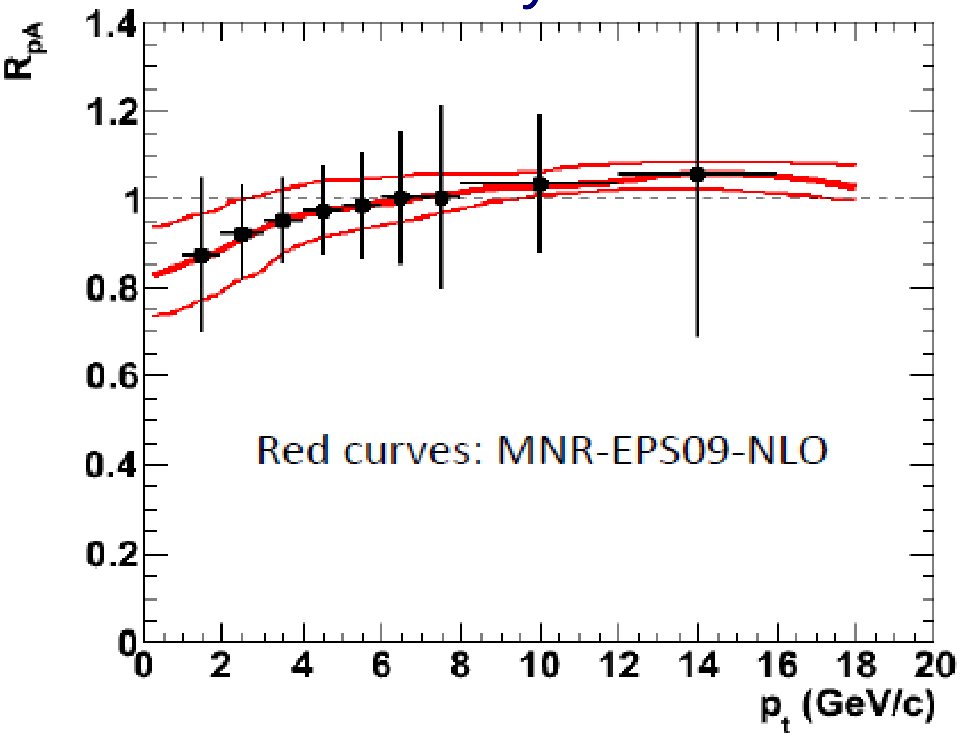
Heavy Flavors



- **HEAVY FLAVOR MUONS**
  30 nb^{-1} p-Pb at 5 TeV
  (muon trigger: effi=100%)
  p_T reach 25-30 GeV/c
- **D MESONS**

10^8 MB p-Pb events at 2.76 TeV
Cross section ~2 x higher at 5 TeV
→ stat. err. smaller by 30-50%

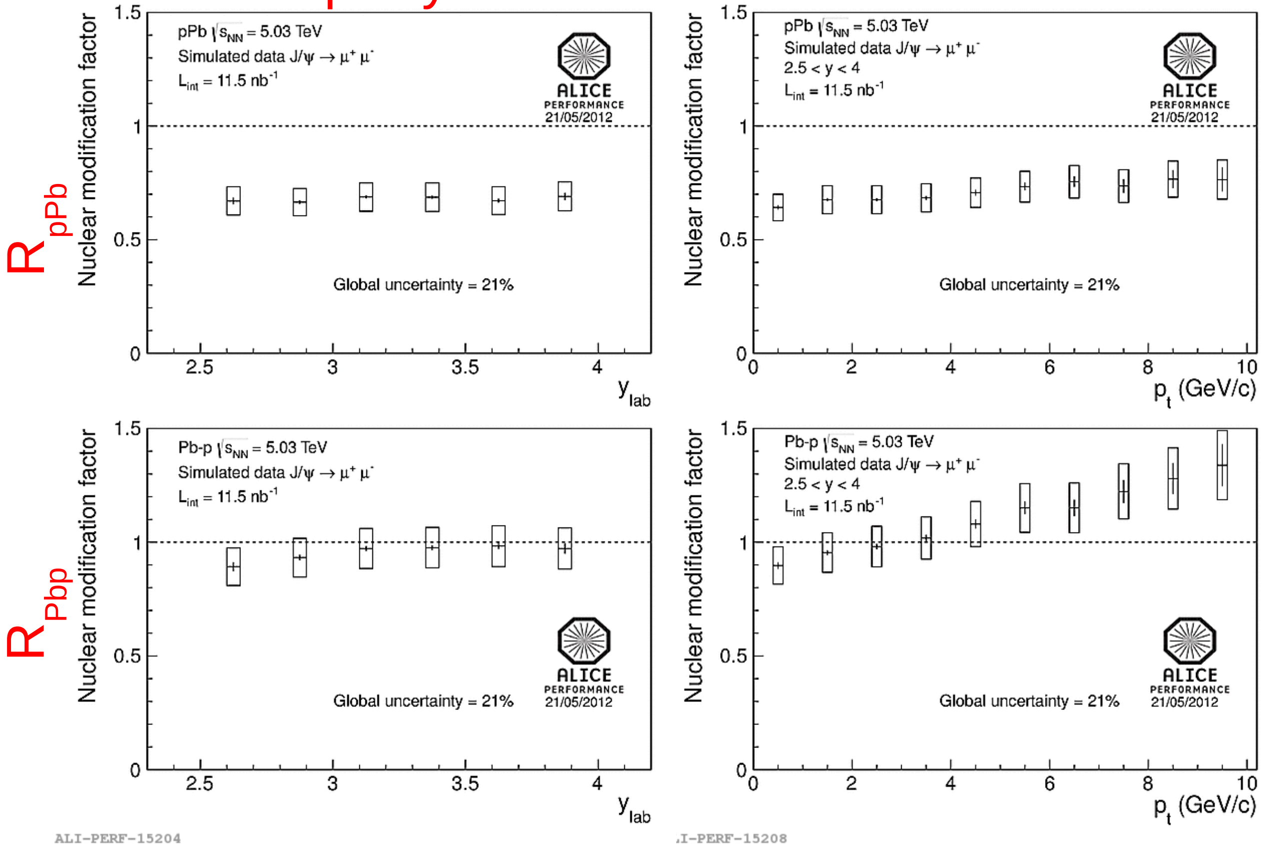




J/ψ and quarkonia

Need Pb-p

rapidity — Transverse momentum



- **QUARKONIA**

Essential to measure both p-Pb and Pb-p to understand cold nuclear matter effects

10 nb^{-1} p-Pb and Pb-p at 5 TeV (muon trigger: effi=100%)

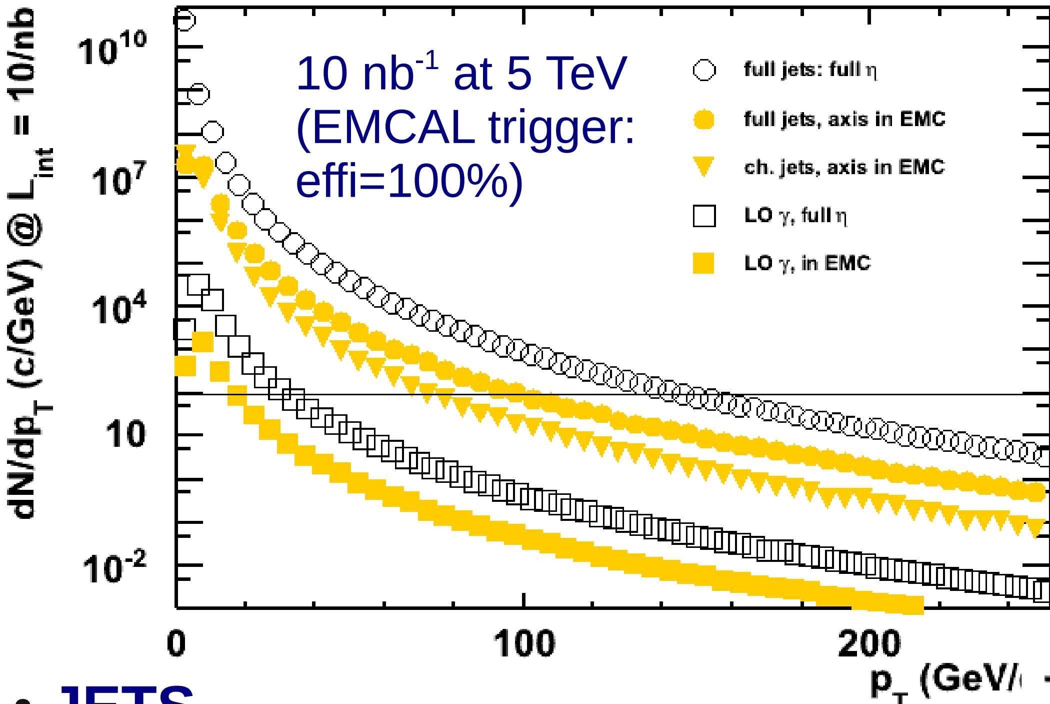
Double ratio

In order to reduce the systematics and better constrain the models, one can define:

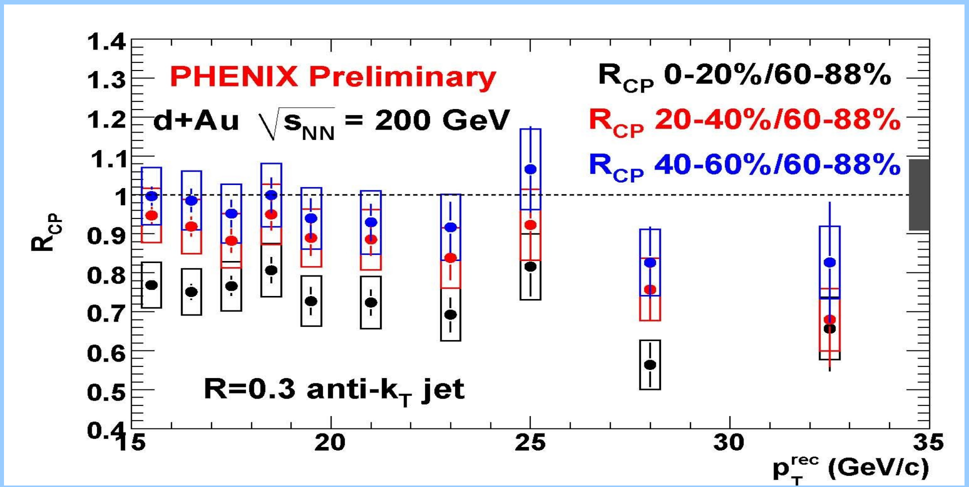
$R_{p\text{-}Pb} / R_{Pb\text{-}p} = \sigma_{p\text{-}Pb} / \sigma_{Pb\text{-}p}$

	L_{int} (nb^{-1})	J/ψ	ψ′	Υ	Υ′	Υ″	x_{Pb} (J/ψ pt=0)
pPb @ 5 TeV	11.5	111k	1920	612	153	77	$[1.8–8.1]\cdot 10^{-5}$
Pb–p @ 5 TeV	11.5	116k	2006	556	139	70	$[1.2–5.4]\cdot 10^{-2}$

Jets

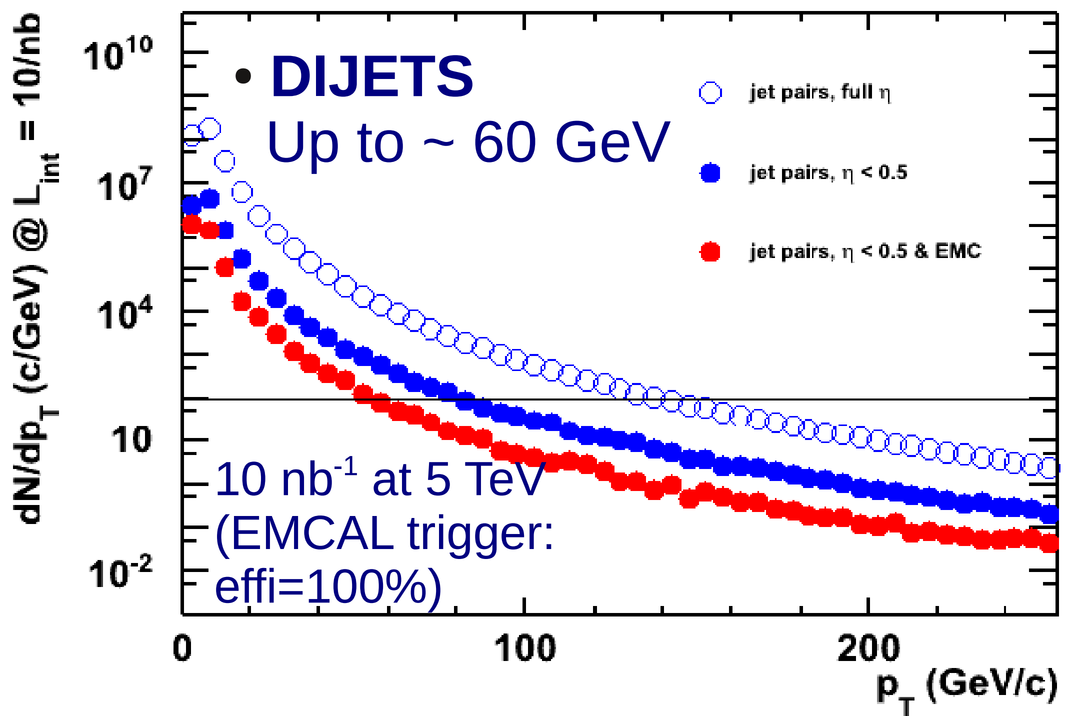


@ RHIC:
Jet R_{CP} modified in central d+Au



- **JETS**
  - 100 single jets @ 100 GeV
  - Charged jets out to 80 GeV
  - R_{CP}: 100 jets in peripheral
    - 60 GeV for full jets
    - 50 GeV for charged
  - Direct γ (basis for γ-Jet) up to ~ 20 GeV
    - γ-Jet down by factor 5-3

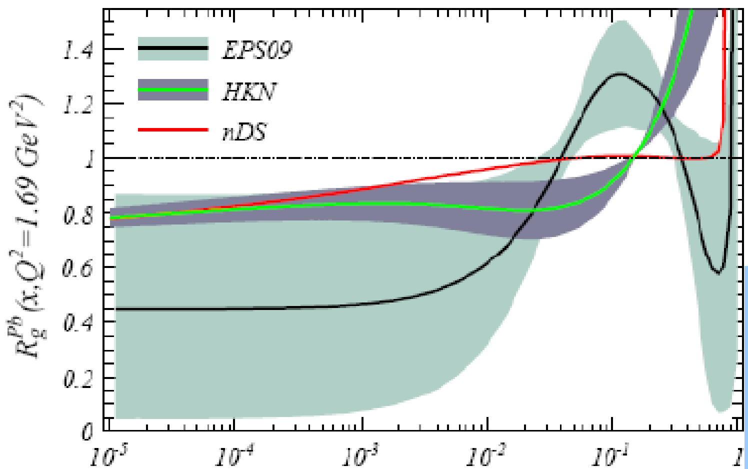
- **DIJETS**
  Up to ~ 60 GeV



Photoproduction in UPC

Need Pb-p

Nuclear Parton Distribution Function (nPDF) for the gluon



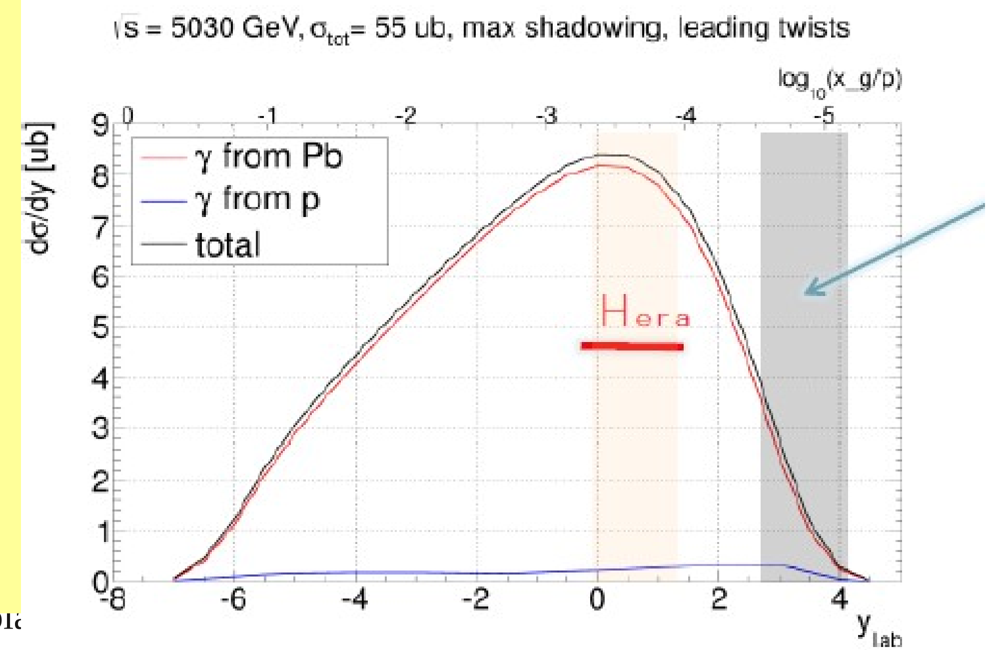
- Gluon density distributions in p at small x, studied at HERA up to $x\sim10^{-4}$
- Gluon shadowing in Pb at small x. No experimental information for $x<10^{-2}$

p-Pb: proton → muon arm: **low-x gluons from Pb**
→ nuclear gluon shadowing accessible with p_T cut
- σ_{tot} (4.4 TeV) = 6-49 μb – no big changes for 5 TeV (depending upon shadowing and p_T cut)

Pb-p: Pb → muon arm:
low-x gluons from p
high-x gluons from Pb
- Advantage: high photon flux ($Z^2/A^{2/3}$ compared to proton case: factor ~100)
- σ_{tot} (5 TeV) = 55 μb

L_{int}=30 nb^{-1}
~ 300 J/Ψ in p-Pb
~ 1000 J/Ψ in Pb-p

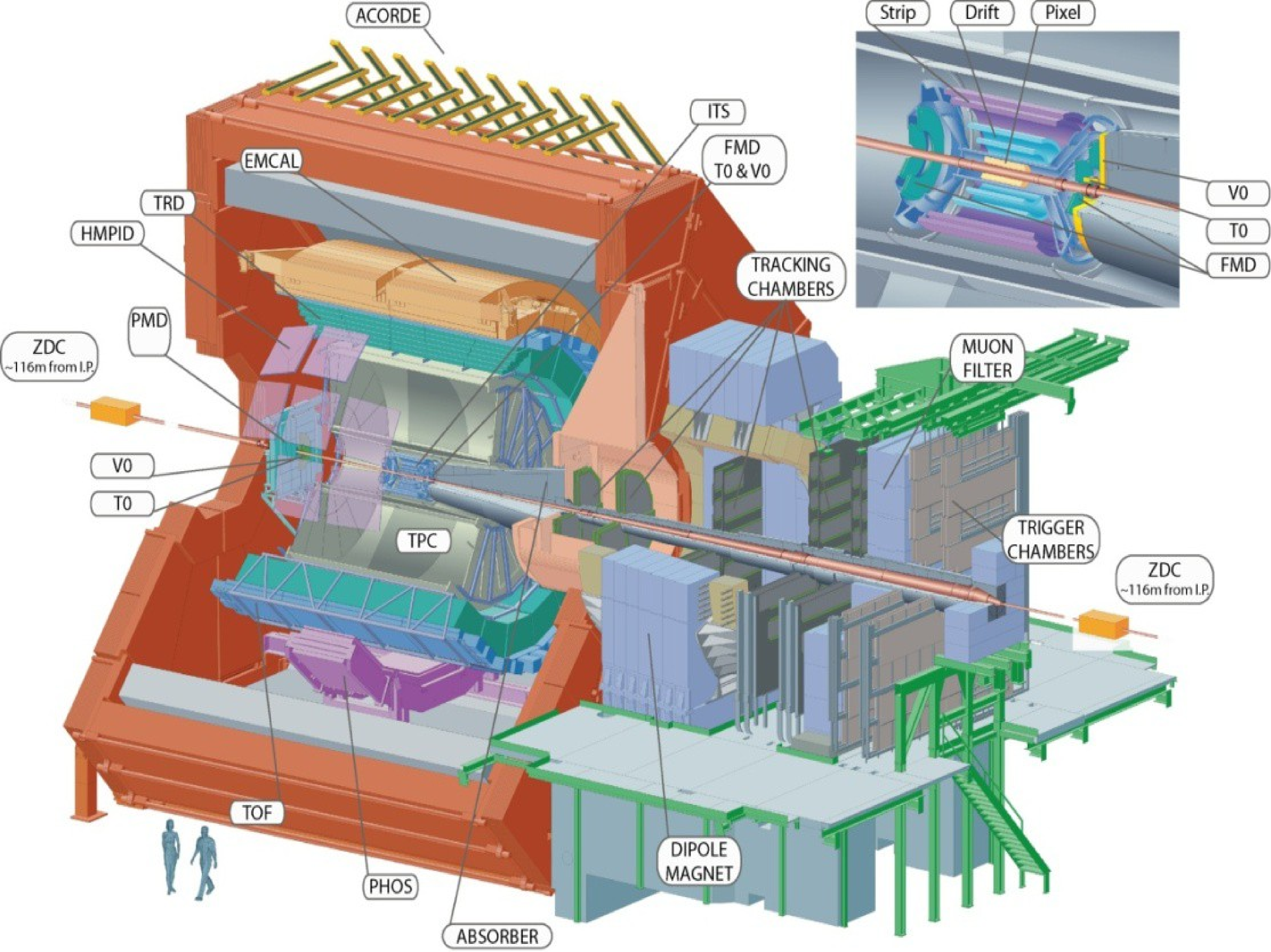
Barrel sensitive to $x\sim10^{-3}$ (studied by HERA)



Conclusions

- The ALICE detector is in good shape and performs according to the expectations
- The AA physics program is rich but full of open questions
  - Many require constrains of cold nuclear matter effects
  - Detector asymmetry with reverse polarity (p-Pb and Pb-p) allows to probe backward/forward region
- We look forward to a harvest of valuable results for the pA physics program
  - Open questions and issues: look forward to fruitful discussions with theorists and experimental colleagues!

Backup



ACORDE
Strip
Drift
Pixel
ITS
FMD
T0 & V0
EMCAL
TRD
HMPID
V0
T0
FMD
TRACKING
CHAMBERS
PMD
ZDC
~116m from I.P.
MUON
FILTER
V0
T0
TRIGGER
CHAMBERS
TPC
ZDC
~116m from I.P.
TOF
DIPOLE
MAGNET
PHOS
ABSORBER

Detector Status

Complete since 2008:

ITS,TPC,TOF,HMPID,FMD,T0,V0,ZDC,Muon arm, Acorde, PMD,DAQ

Partial installation 2010:

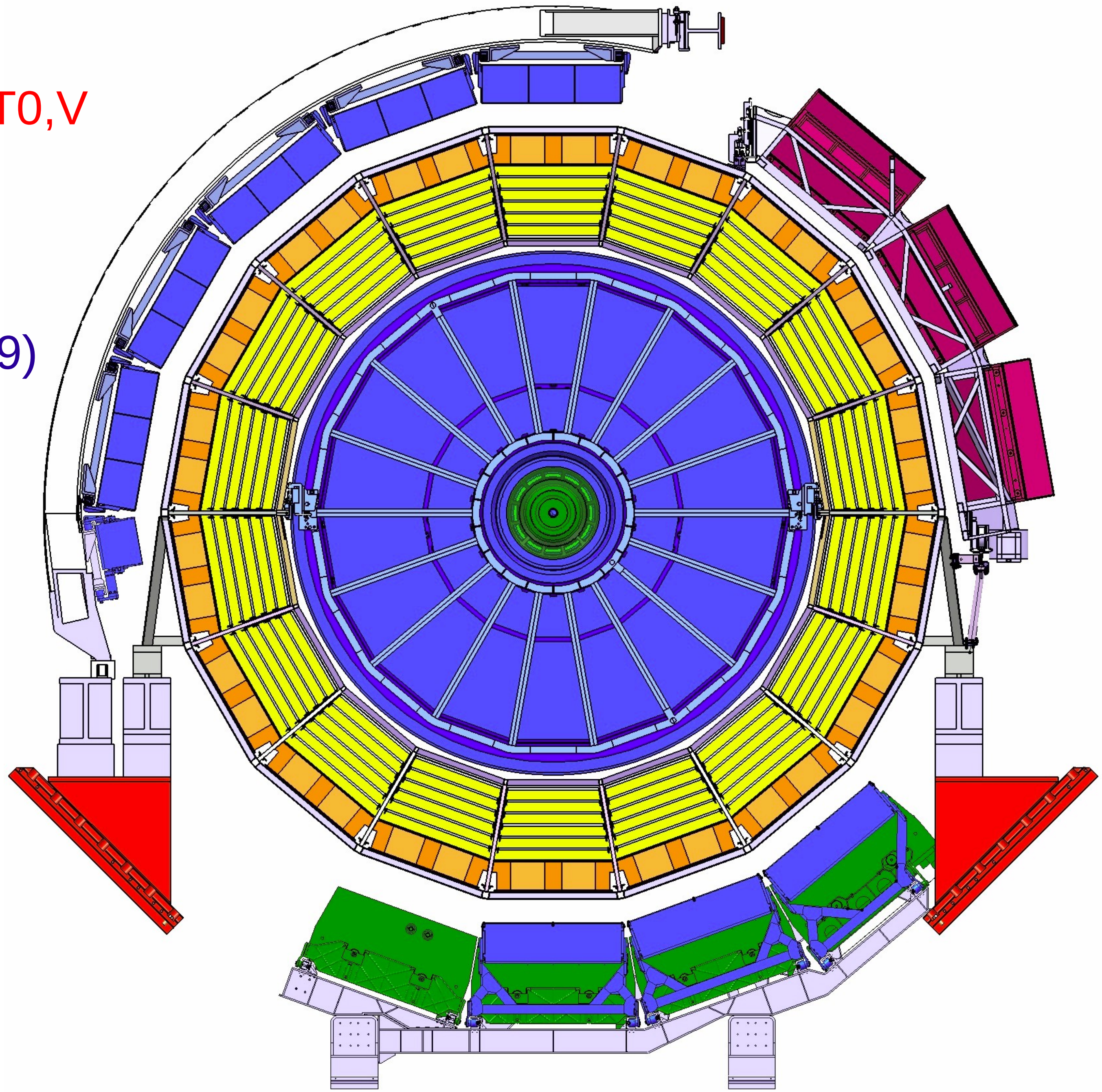
4/10 EMCAL (approved 2009)
7/18 TRD (approved 2002)
3/5 PHOS (funding)
~60% HLT

2011:

10/10 EMCAL
10/18 TRD

2012:

13/18 TRD



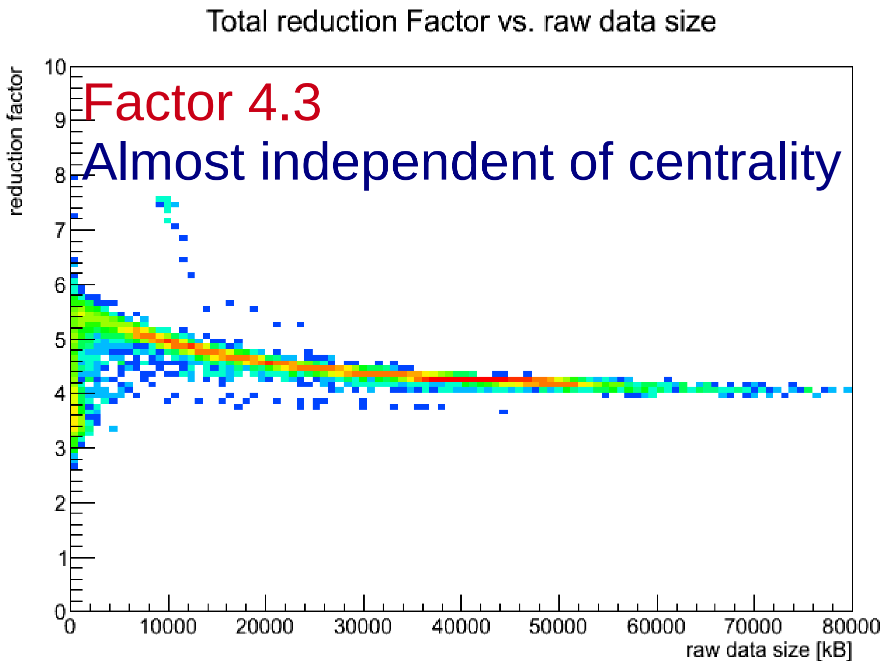
HLT in Pb-Pb run 2011

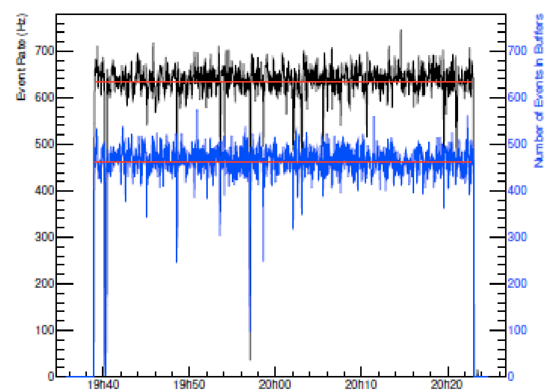
- 500-3000 Hz hadronic interaction rate
- Centrality and rare triggers
- 30% dead time

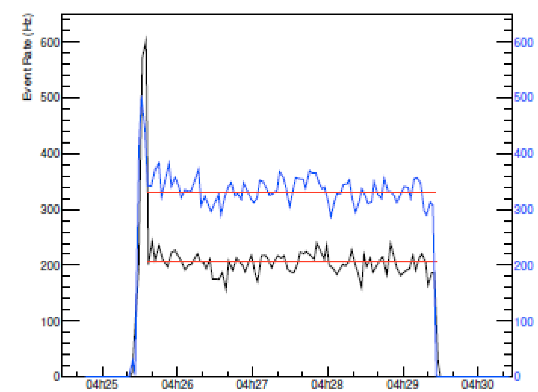
25 GB/s max data rate

Data Compression with High Level Trigger

4 GB/s max output bandwidth
10 x more statistics than 2010





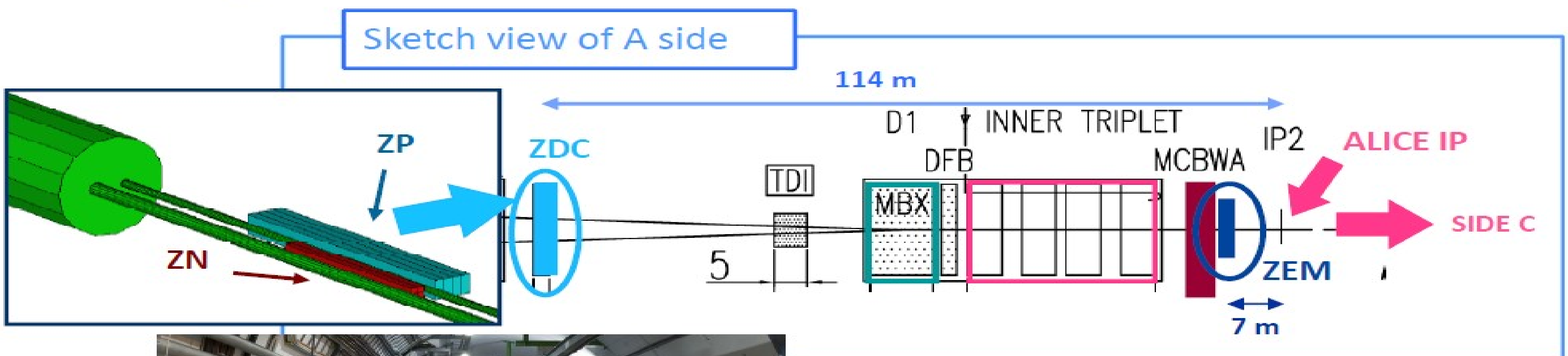


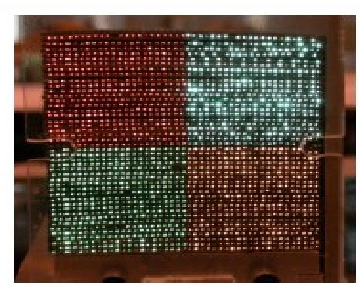
Performance parameters measured for HLT during the 2011 Pb-Pb period.

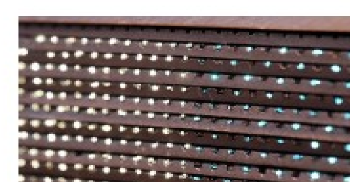
Run Type	Event Rate (Hz)	Number of Events in Buffers	Latency (s)	Data Rate (GB/s) Input	Output
Minbias	633.4 ± 2.3	464.0 ± 1.1	0.733 ± 0.003	8.0	2.1
10% Central	201.6 ± 2.8	330.0 ± 4.6	1.64 ± 0.03	9.2	2.3

ALICE ZDC Calorimeter

- ALICE neutron ZDCs placed at 0° w.r.t LHC axis, ~114 m far from IP on both sides (ZNC on C side, ZNA on A side), ''spaghetti'' calorimeters, dimensions (7x7x100) cm^3
- The ZDC system is completed by:
  - 2 proton calorimeters placed at ~114 m from the IP external to the beam pipe
  - 2 small (7x7x21) cm^3 EM calorimeters (ZEM1, ZEM2) placed at ~7.5 m from the IP, at ±8 cm from LHC axis, only on A side covering the range $4.8<\eta<5.7$
- ZN acceptance for neutrons emitted in EMD of Pb nuclei at $\sqrt{s}$ = 2.76 A TeV → 99 %



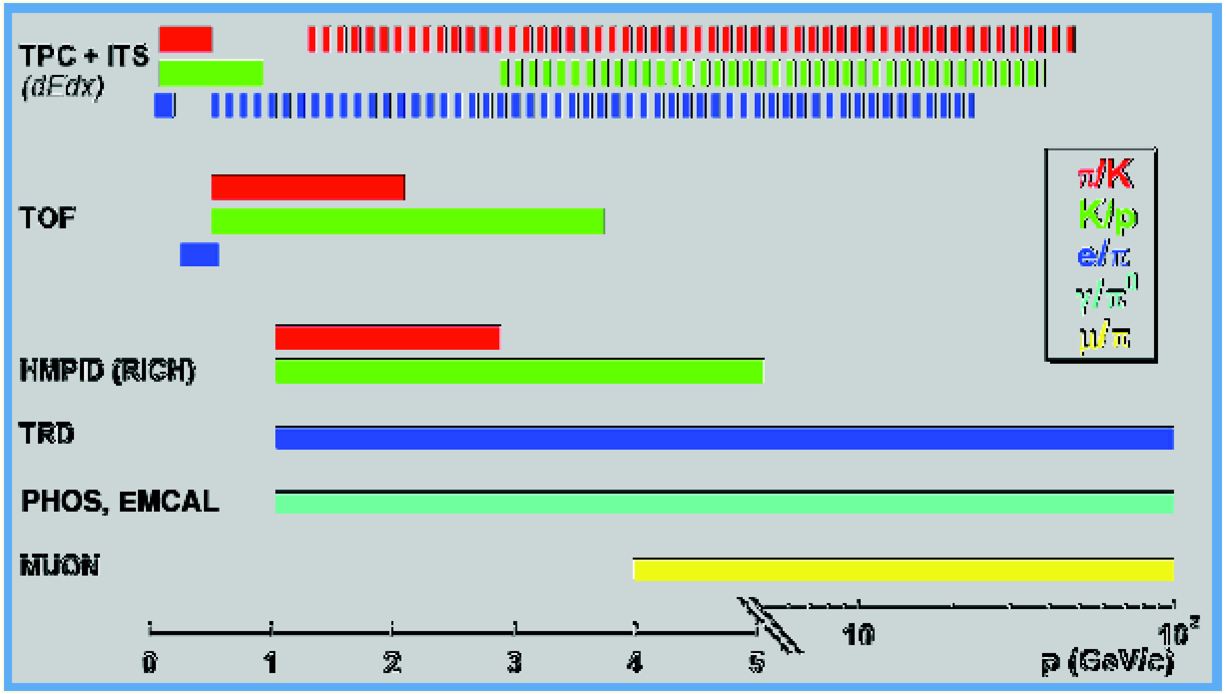




Momentum Resolution

- Combined ITS + TPC tracks
- Background/weak decays excluded via DCA cut to primary vertex
- Tracks in $|\eta|<0.8$
- Resolution determined from track residuals, verified with cosmics and reconstructed decays widths (eg K^0_s)

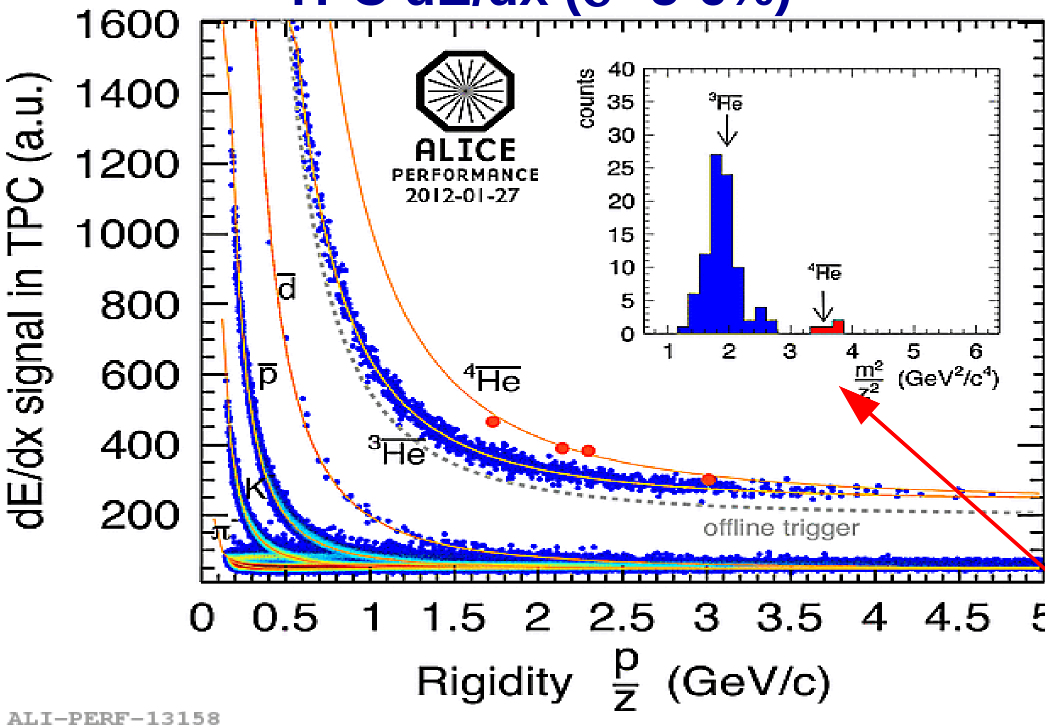
Particle Identification



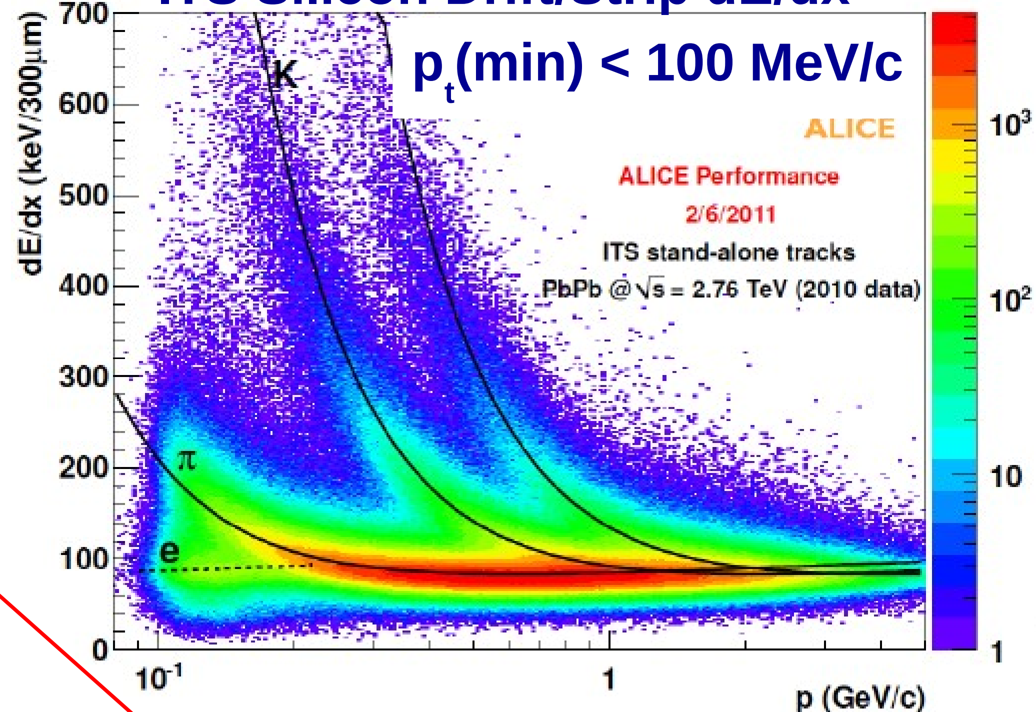
- “stable” hadrons (p,K,p): 100 MeV<p_T<5GeV
  - dE/dx in silicon (ITS) and gas (TPC) + time-of-flight (TOF) + Cherenkov (HMPID)
- Decay topologies (K,Λ,ϕ,Ξ,Ω,D)
  - K and Λ beyond 10 GeV
- Leptons (e,μ), photons (→ π^0,η)
  - Electrons TRD: p_T>1GeV, muons: p_T>5Gev, π^0 in PHOS/EMCAL: 1<p_T<80 GeV

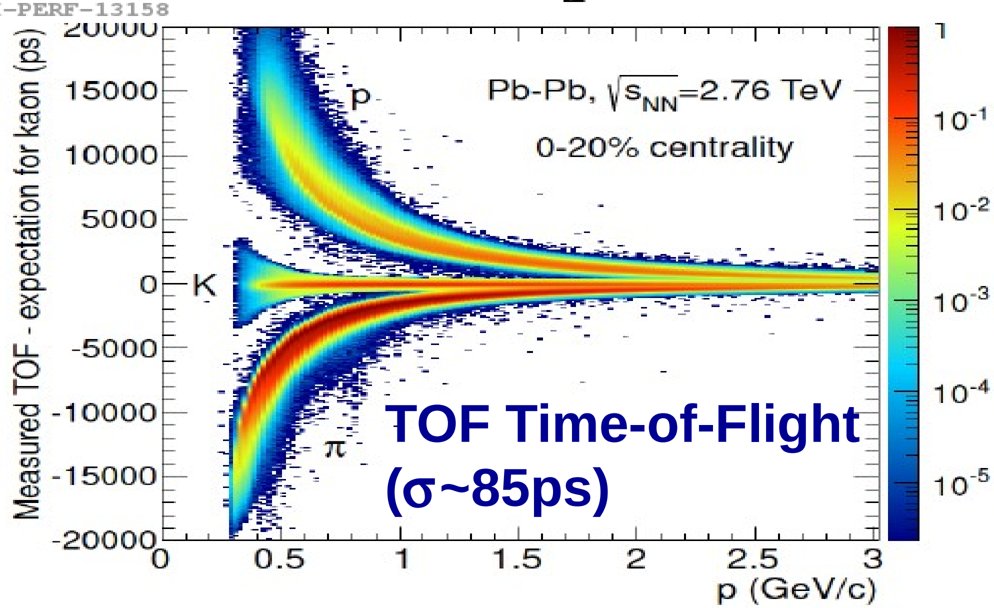
Particle Identification

TPC dE/dx (σ~5-6%)



ITS Silicon Drift/Strip dE/dx



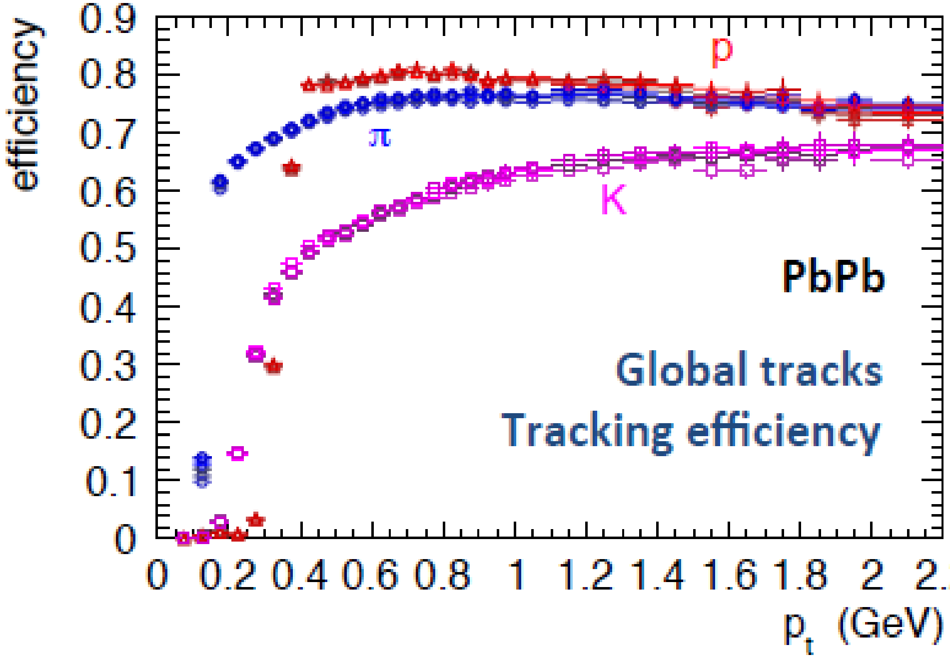


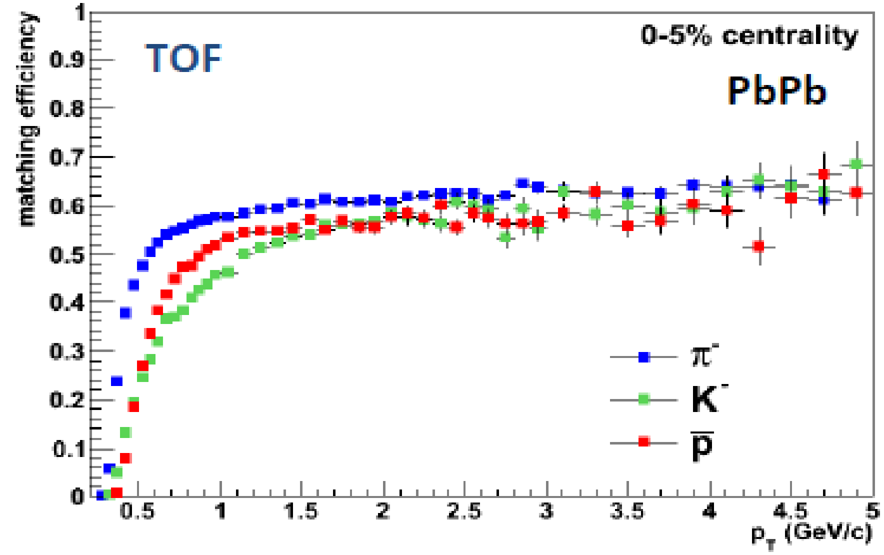
TOF Time-of-Flight (σ~85ps)

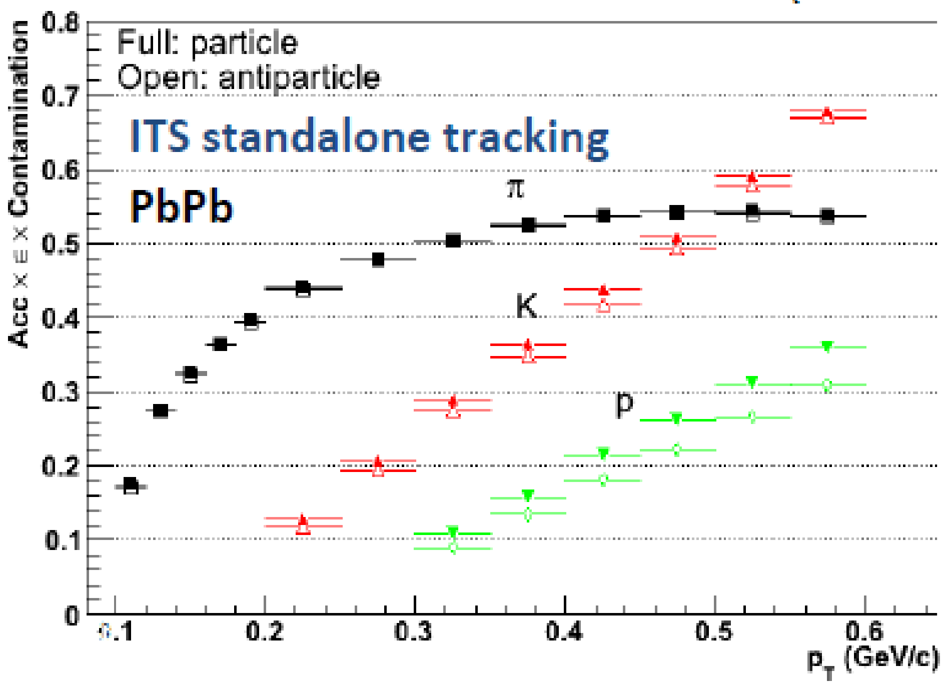
4 anti-alpha candidates in 16M Pb-Pb events
Confirmed by TOF analysis (time-of-flight sensitive to m/z ratio)

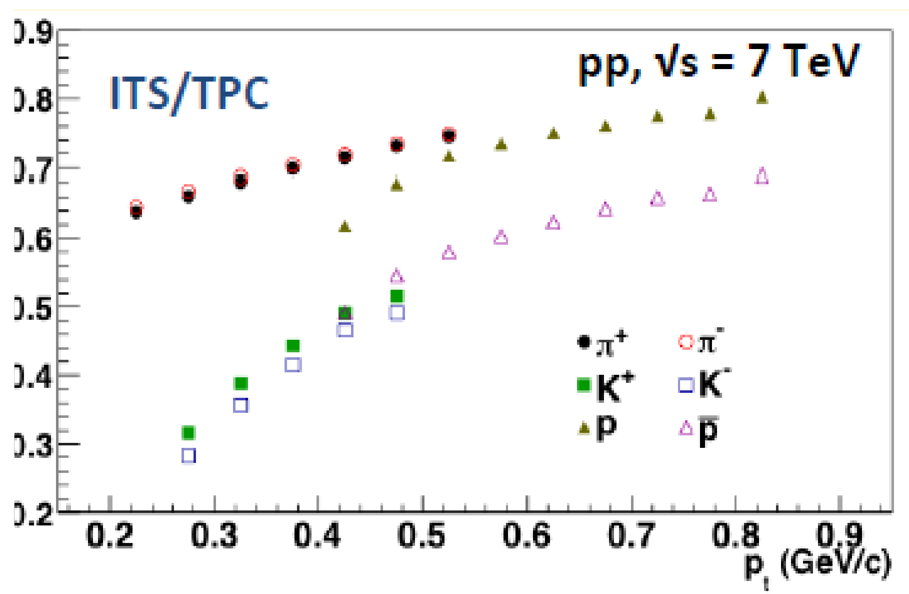
$$m = \frac{z \cdot R}{\sqrt{\gamma^2 - 1}}$$

Efficiencies for π,k,p





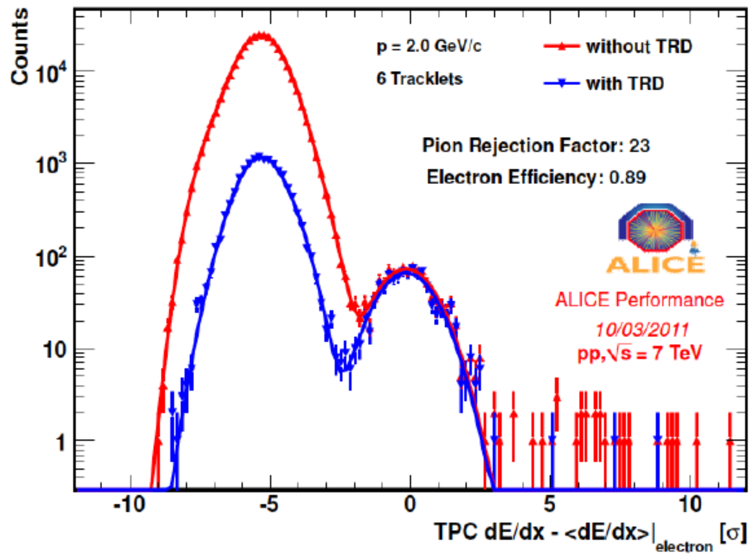




Electron identification

Transition Radiation Detector

e/π separation



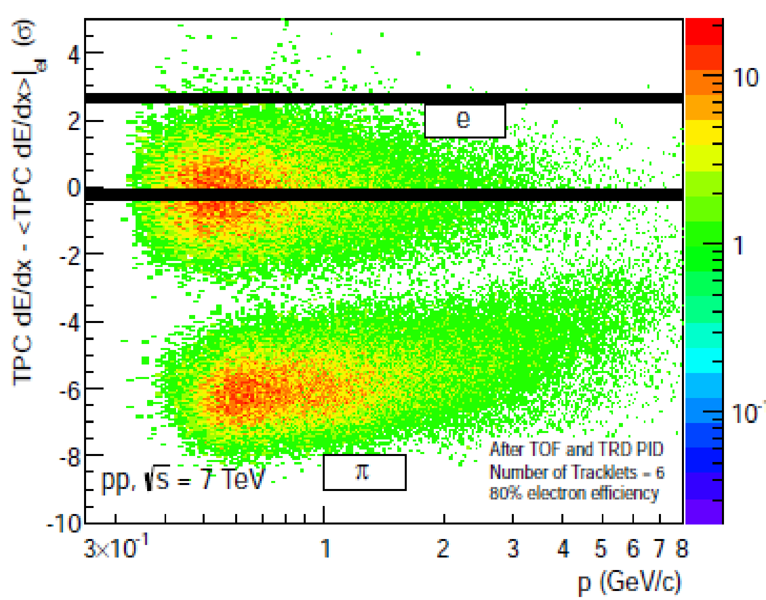
Electromagnetic Calorimeter

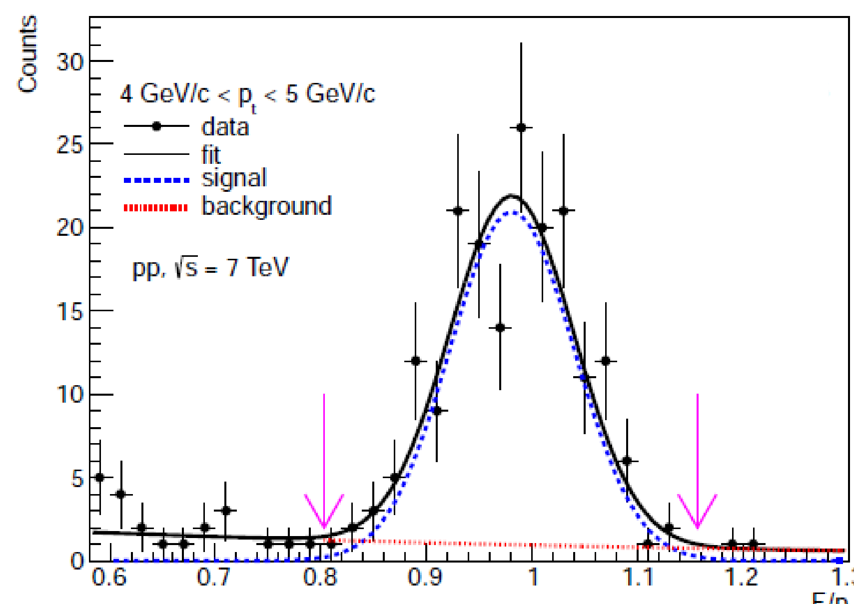
combined with TPC dE/dx

E/p ~ 1

TOF

(± 3σ_e)





π^0, η reconstruction

- 3 independent measurements
  - Conversion, PHOS, EMCAL
- pp $\rightarrow \pi^0$ + X

  $\gamma\gamma$

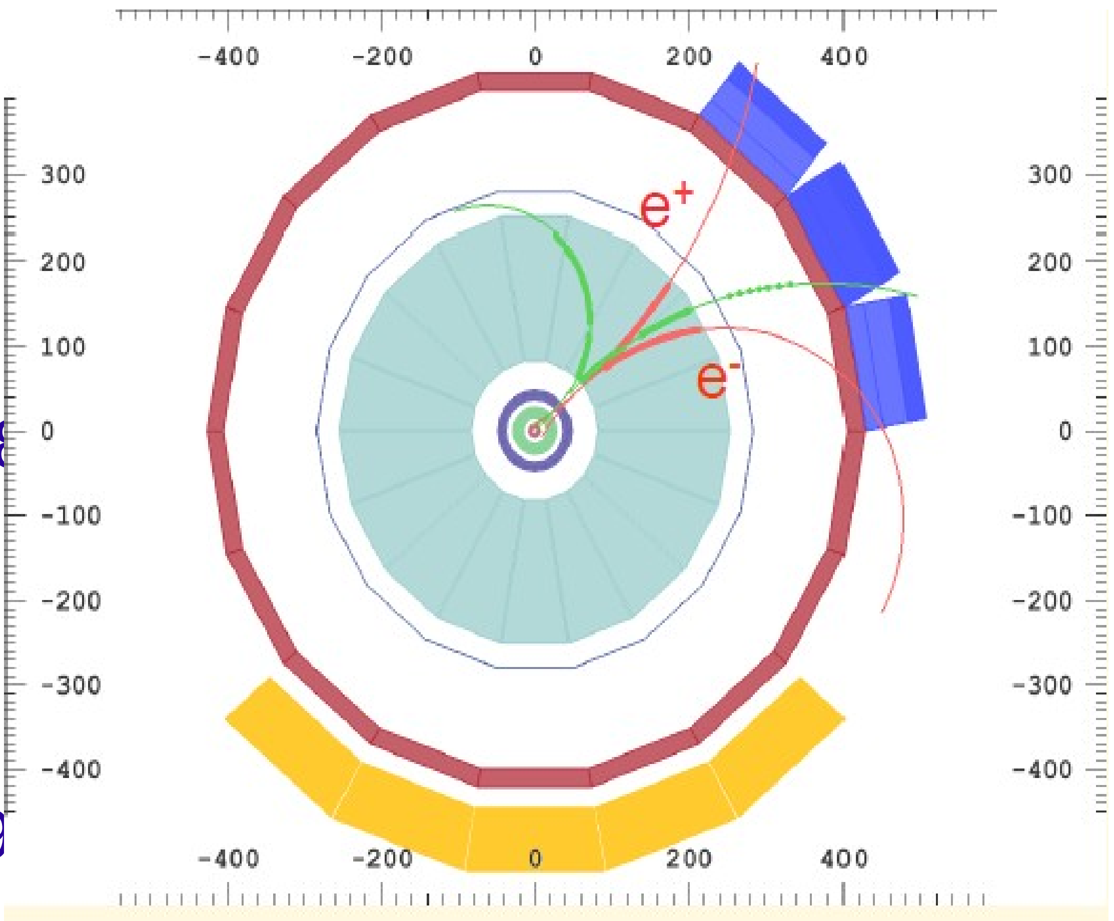
  $e^+e^-e^+e^-$

  $m(\pi^0) = 0.135 GeV/c^2$, BR=0.98
- pp $\rightarrow \eta$ + X

  $\gamma\gamma$

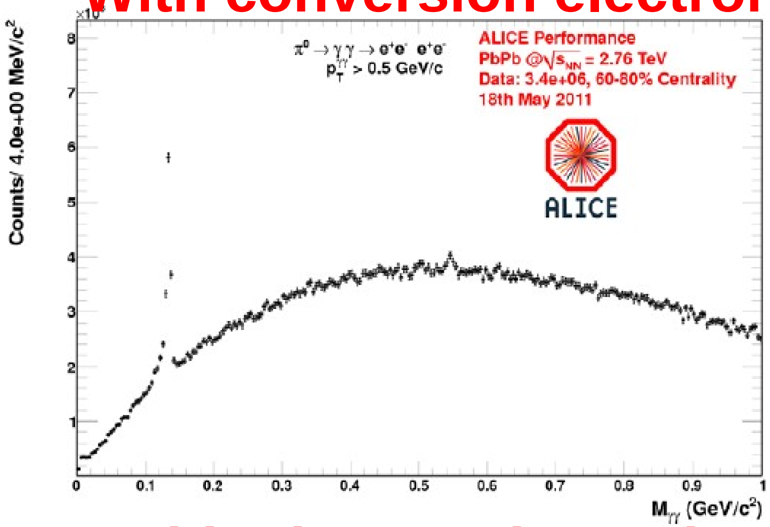
  $e^+e^-e^+e^-$

  $m(\eta) = 0.548 GeV/c^2$, BR=0.39

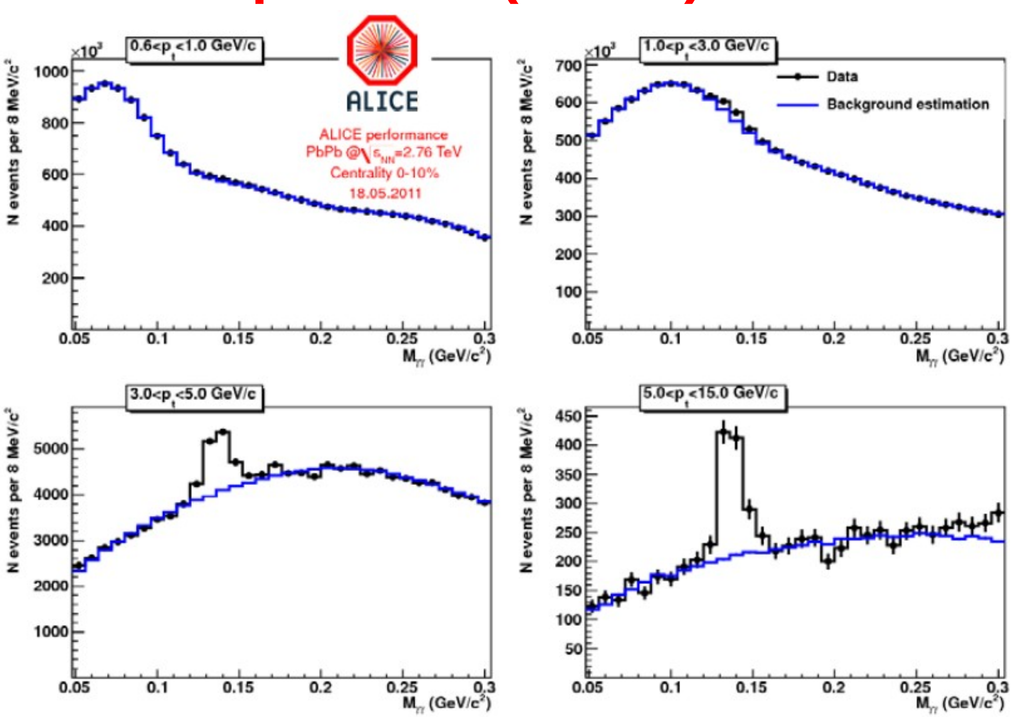


π^0, η reconstruction

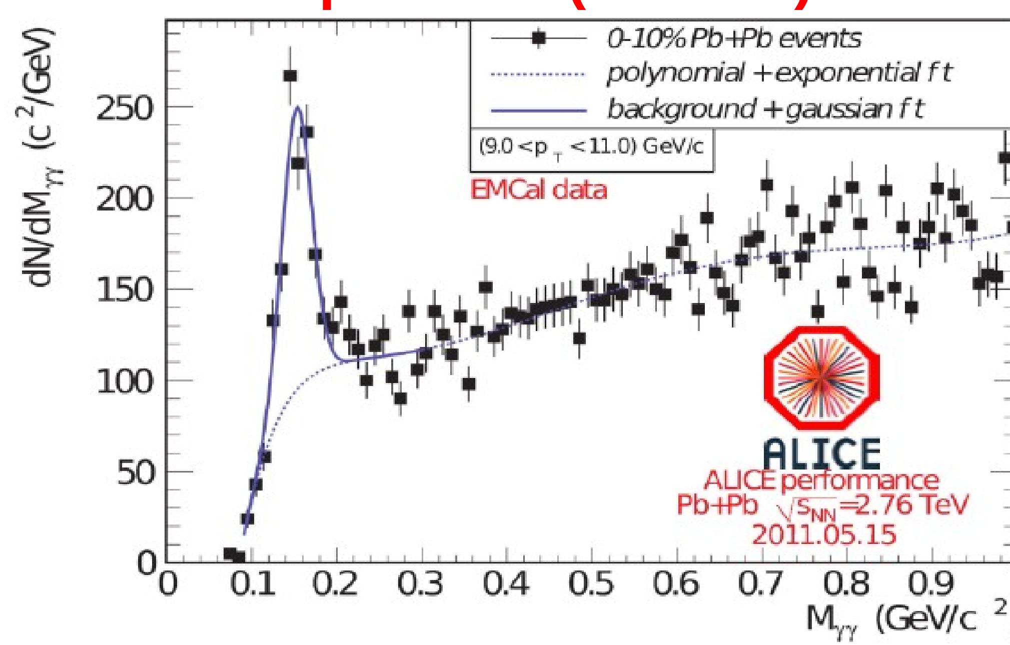
With conversion electrons



With photons (PHOS)

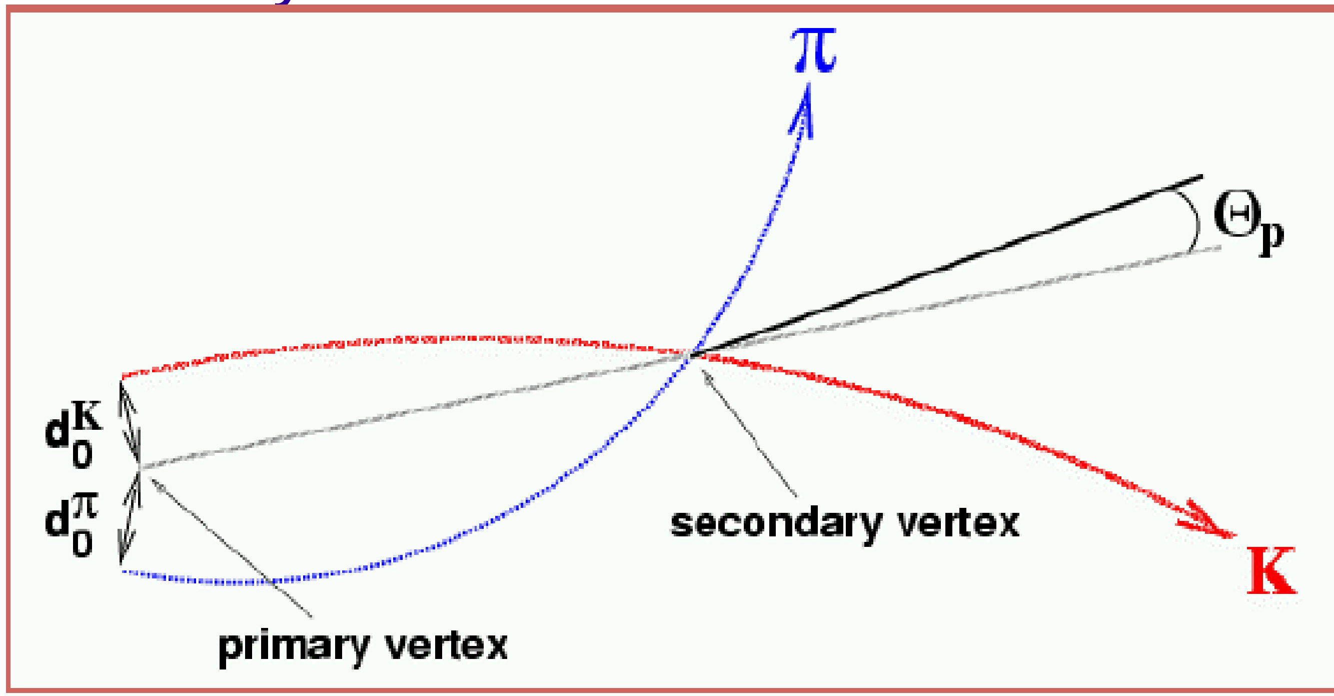


With photons (EMCAL)



Reconstruction of weak decays

- Resolution of d_0 (impact parameter) is the key parameter for the reconstruction of weak decays of D-mesons



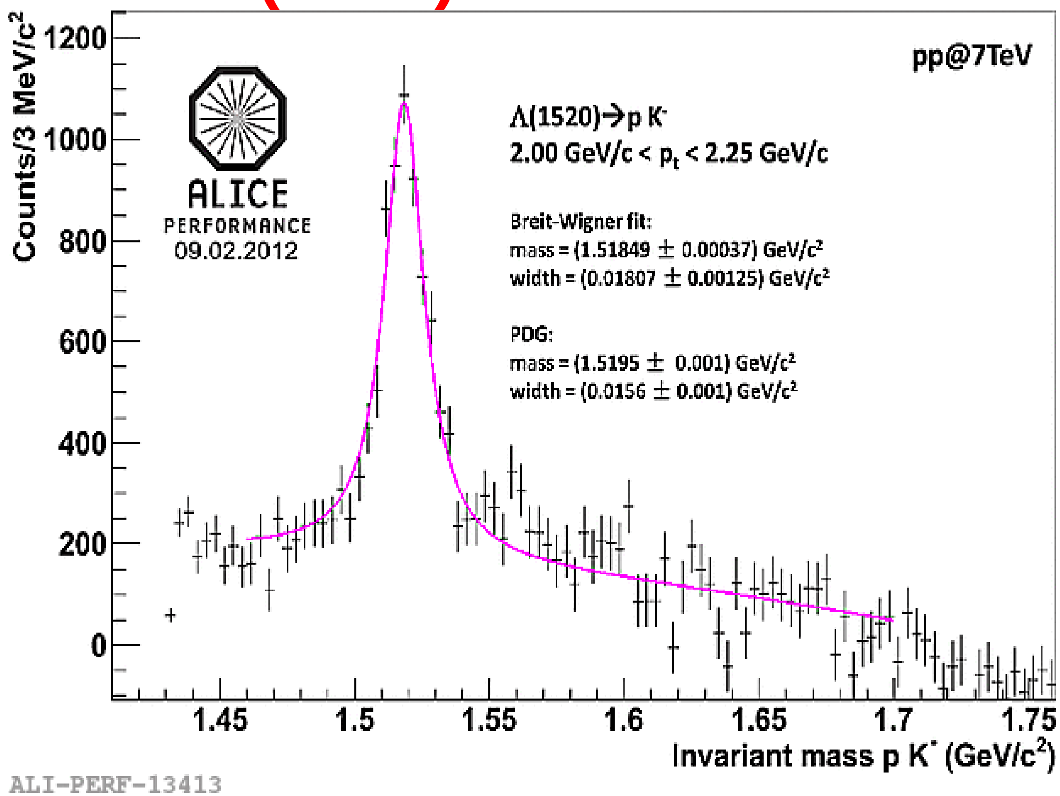
• D^0	→	$K\pi$ ($K\pi\pi\pi$)	$c\tau \sim 122.9\ \mu m$
• D^+	→	$K\pi\pi$	$c\tau \sim 311.8\ \mu m$
• D^{*+}	→	$D^0\pi$	
• D_s	→	$KK\pi$	$c\tau \sim 149.9\ \mu m$
• Λ_c	→	$Kp\pi$, $K^0_s p$	$c\tau \sim 59.9\ \mu m$

Impact Parameter Resolution

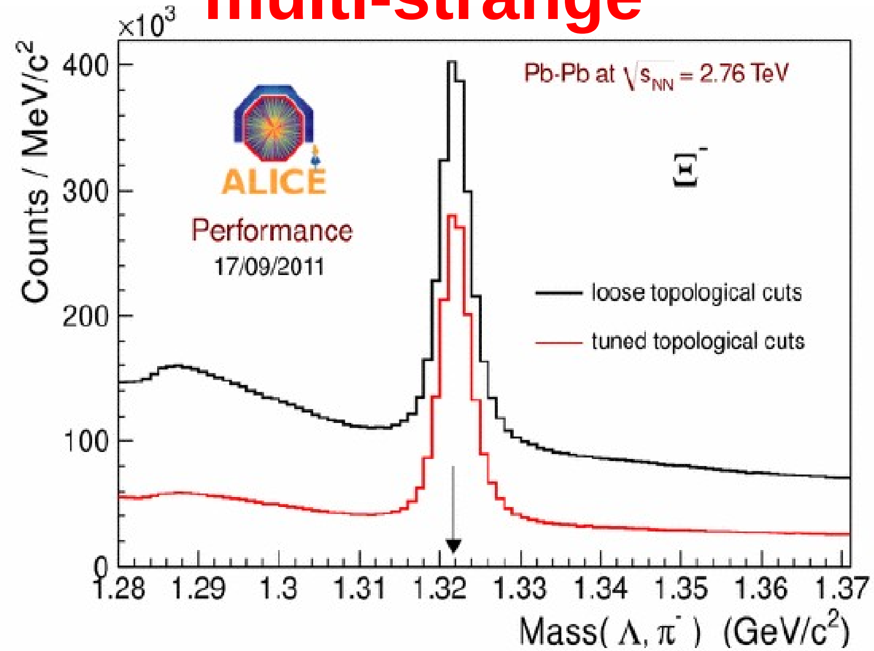
- Main selection: displaced vertex topology
- Tracking and vertexing precision is crucial
- Inner Tracking System (ITS) with 6 layers
  - Two pixel layers at 3.9 (closest barrel layer at LHC!) and 7 cm
- ITS alignment with cosmics and collisions
  - Current resolution: very close to nominal one

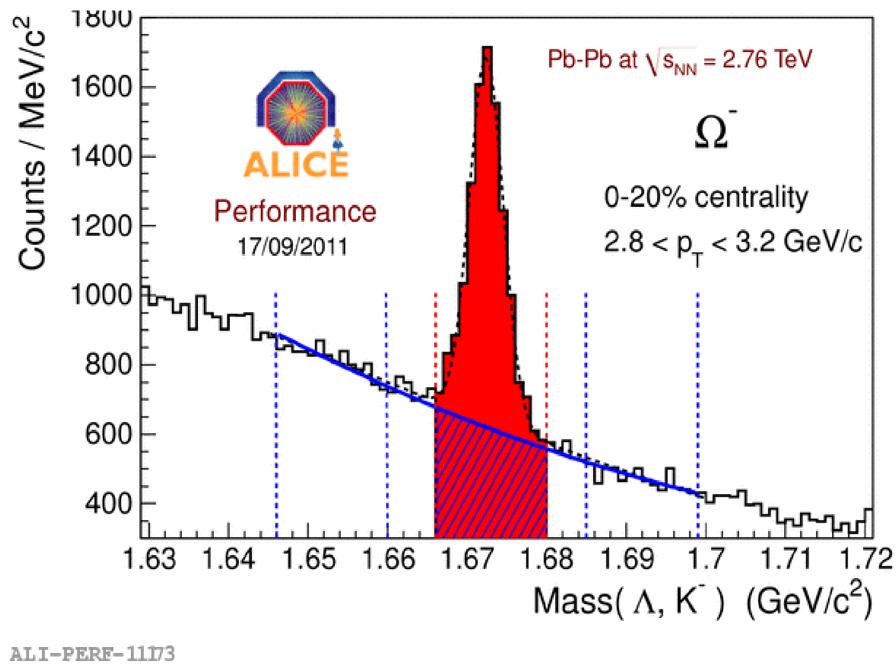
Light hadron reconstruction

Λ(1520)



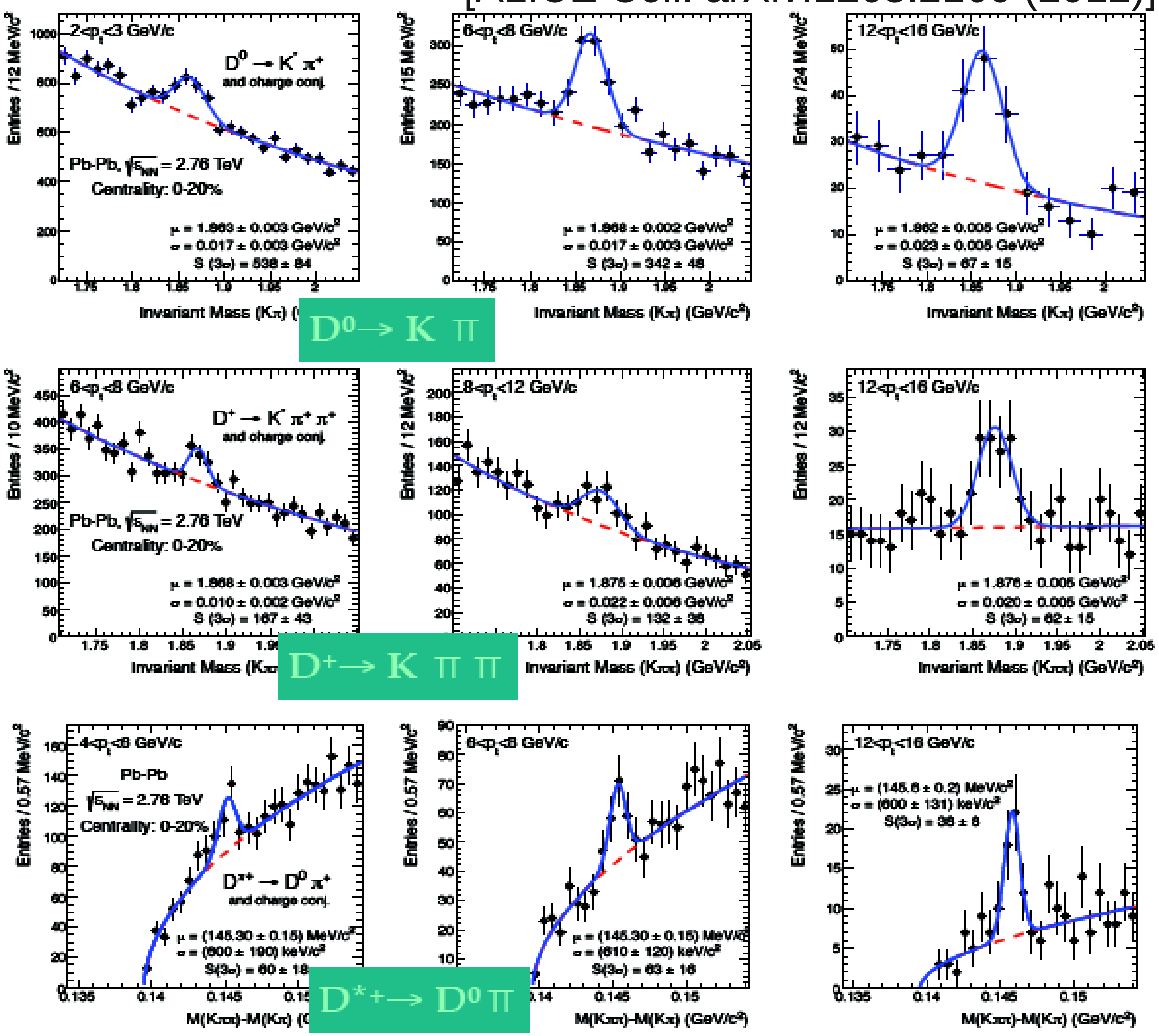
multi-strange



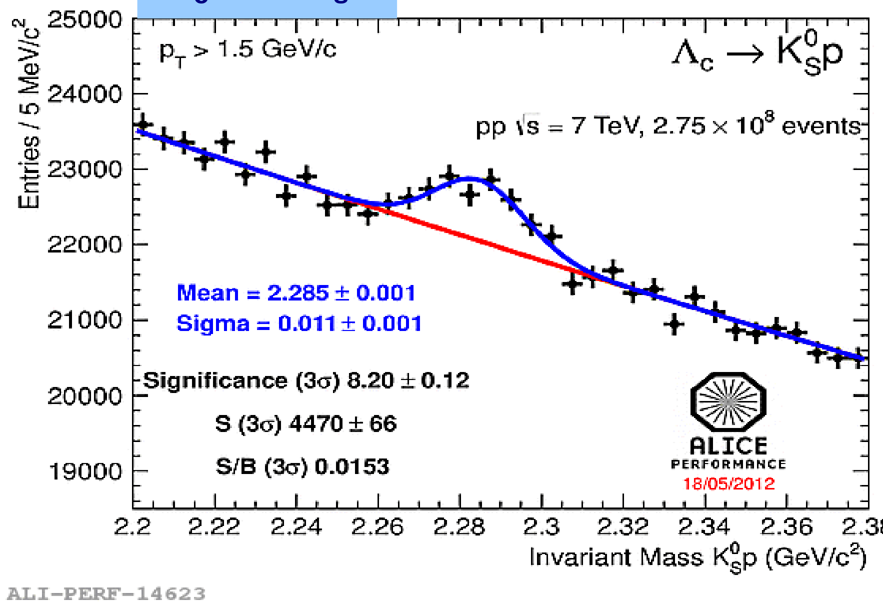


Charm hadron reconstruction

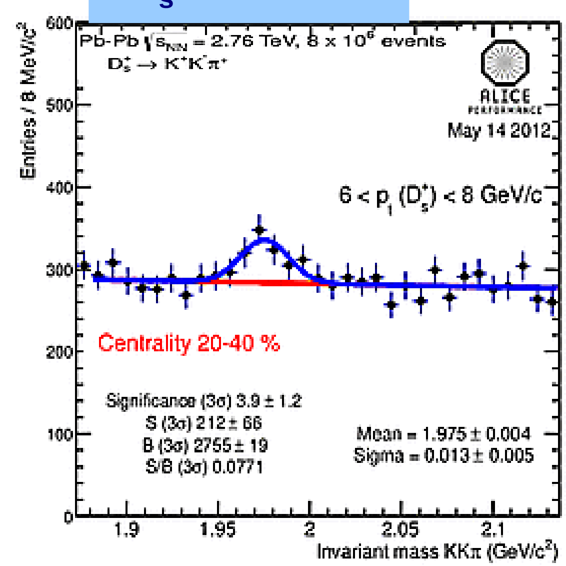
[ALICE Coll. arXiv:1203.2160 (2012)]



$\Lambda_c \to K^0{}_s p$



$D^+_s \to K^+K^-\pi^+$



- Selection strategy, topological cuts: displaced vertexes
  - Impact parameter of the tracks,
  - Angle between the meson flight line and the particle p
- Particle identification: TPC + TOF (K,p identification)