Jet-Hadron Azimuthal Correlation Measurements in pp and Pb-Pb Collisions at LHC-ALICE

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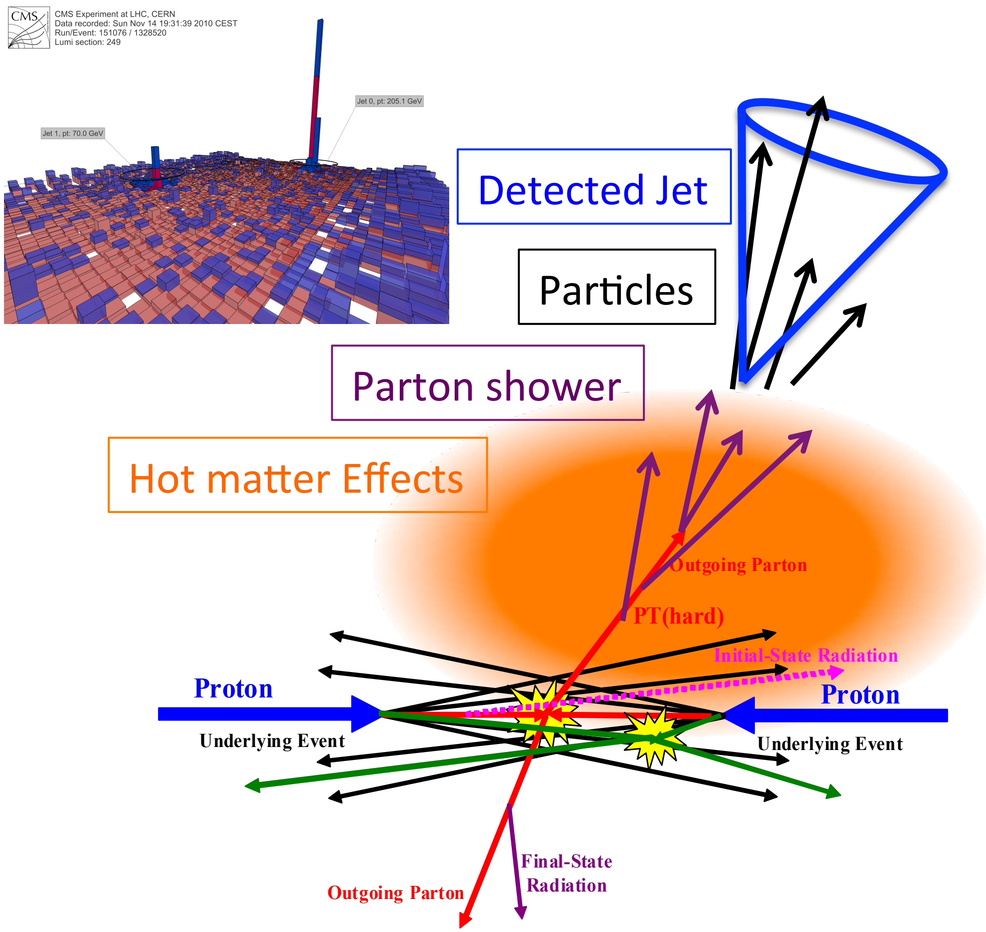
Outline

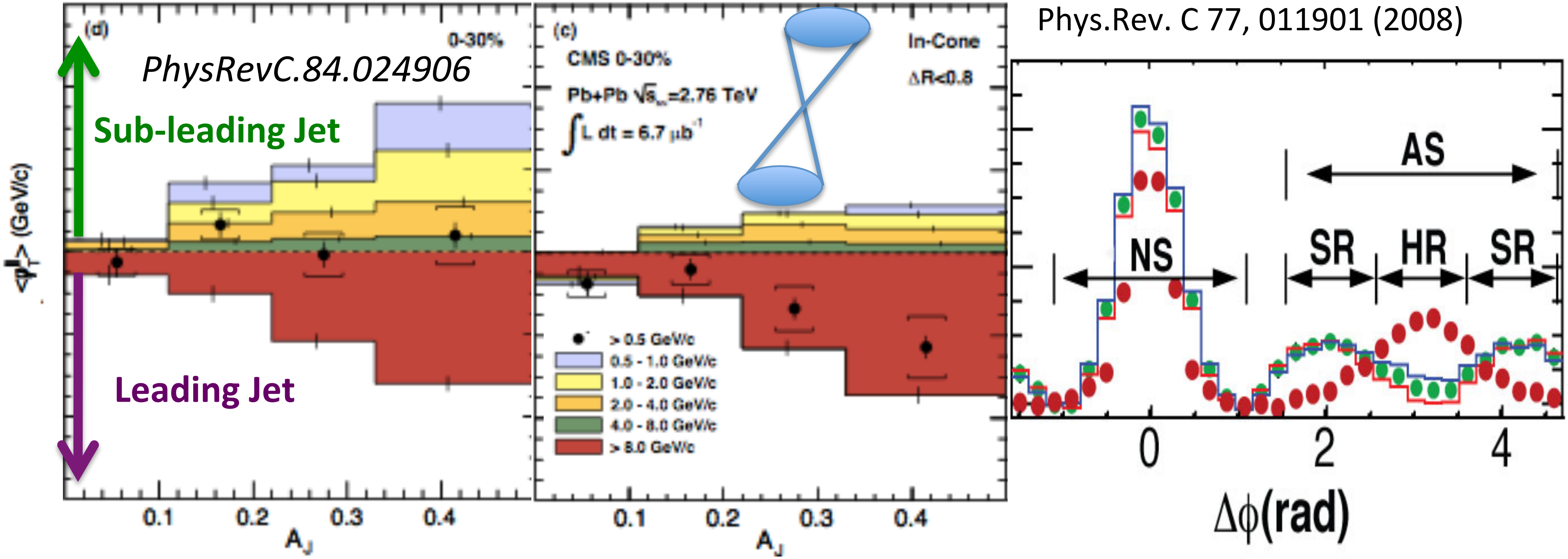
- Introduction
- Event Information
- Leading-Jet Reconstruction
- Momentum distribution w.r.t Jet axis in pp
- Background Subtraction
- Momentum distribution w.r.t Jet axis in PbPb
- Summary and Outlook

Jet Physics in in Heavy Ion Collisions



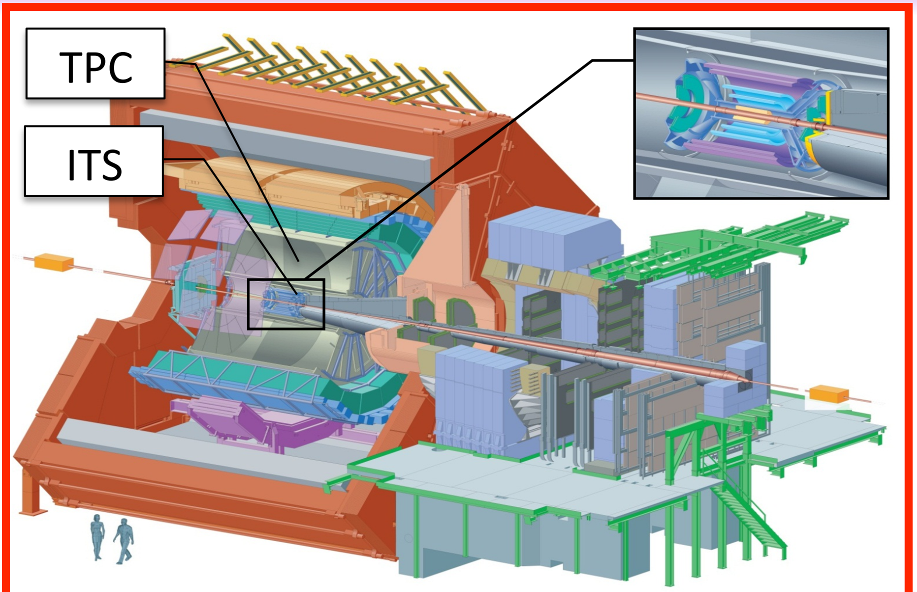
- Jet could be clear probe to investigate hot and dense matter effects.
  - Collisional energy loss
  - Radiative energy loss
  - Other effects???

Why "Jet-Hadron Correlation"?



- Jet-energy flow into medium.
- Make sure origin of double peak in away side.
  - v3? , "Mach Cone"?
- Jet-hadron correlation let us know constituent particles, shape ,BKG.

A Large Ion Collider Experiment [ALICE]



ALICE Experiment is optimized to study hot and dense QCD matter created in HI collisions

Central detectors |η|<0.9

ITS,**TPC**,TRD,TOF,EMCAL,PHOS,HMPID

Forward detectors

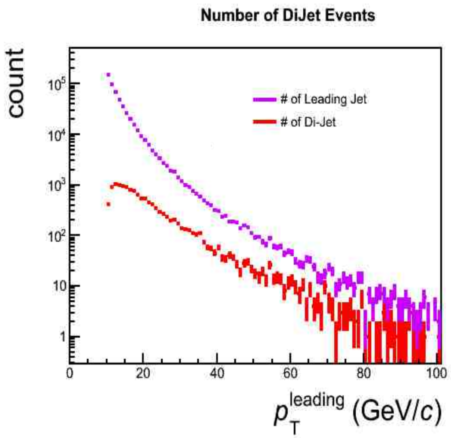
FMD,V0,T0,ZDC,PMD,Muon Chamber

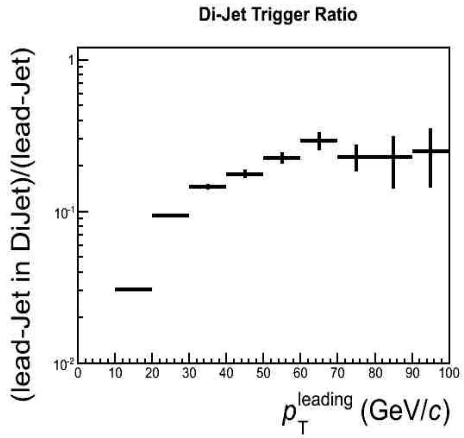
Event Selection

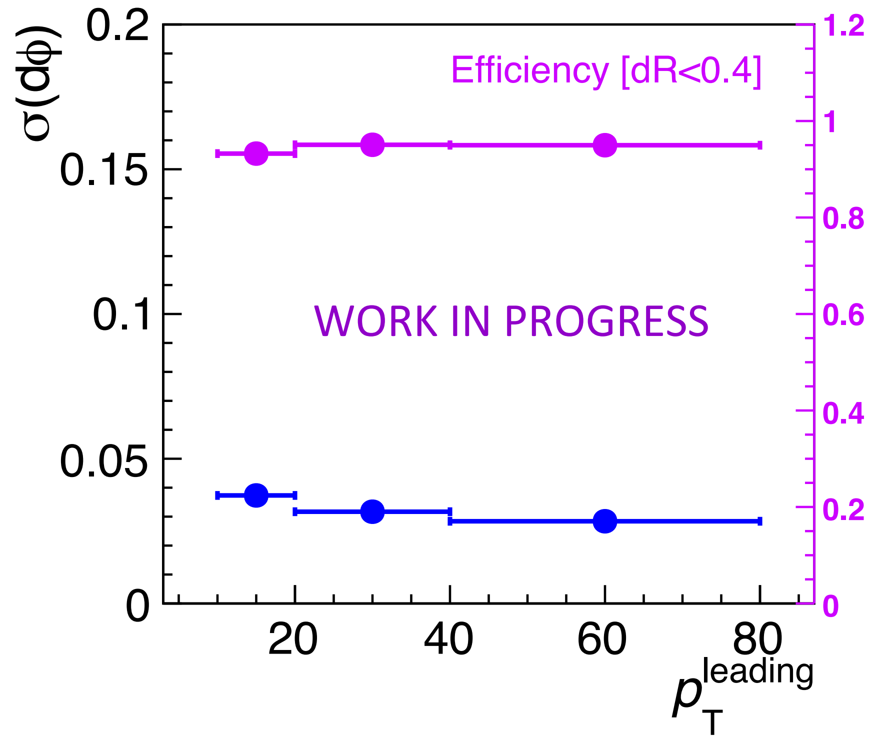
- Data :pp 2.76TeV (61M MB events) , 7TeV (31M MB events)
  Pb-Pb 2.76TeV (2M MB events)
- Tracks : TPC+ITS , $|\eta|<0.9$, $p_T^{track} > 0.15$ GeV/c
- Jets : anti-k_T R=0.4 , $|\eta|<0.5$
- Di-Jet Event Selection
  - Leading Jet : $p_T^{lead} > 10$ GeV/c
  - Sub-Leading Jet : $p_T^{sub} > 10$ GeV/c
  - $\cos(\phi^{lead} - \phi^{sub}) < -1/2$ (120deg.<dϕ<240deg.)

Leading-Jet Reconstruction

Data: pp 7TeV







Reconstructed di-Jet events

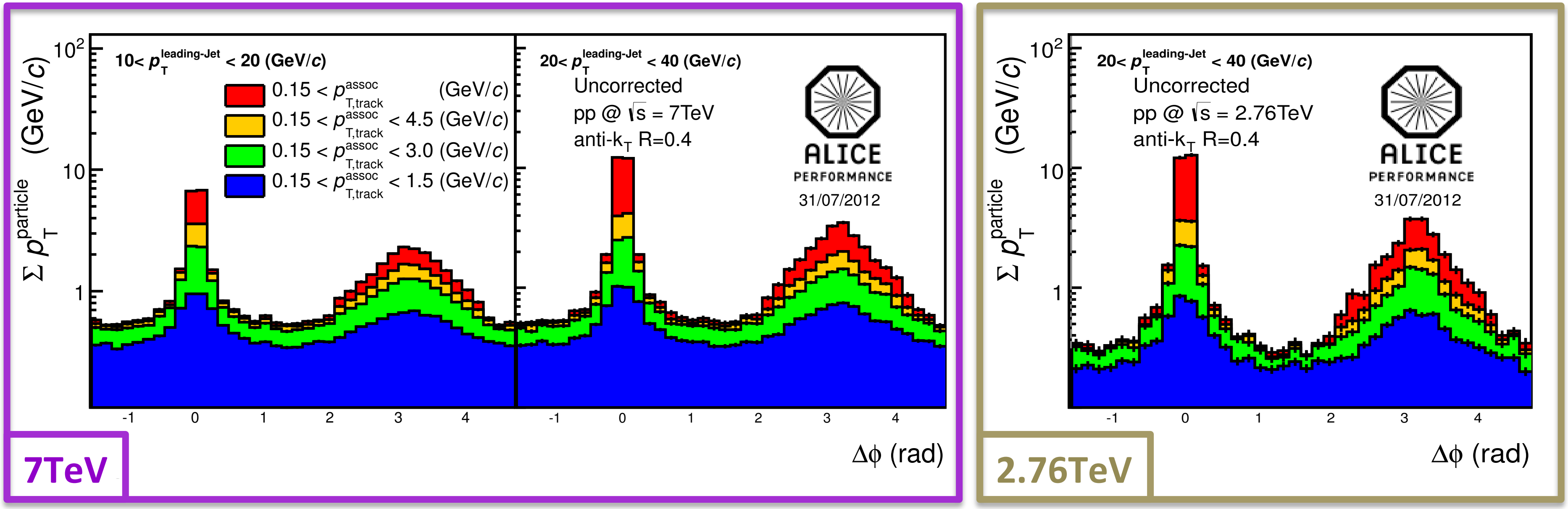
7TeV : 13k events

2.76TeV : 10k events

- Within the acceptance,

  almost leading jets are reconstructed as leading jets.

Momentum Distribution w.r.t Jet Axis

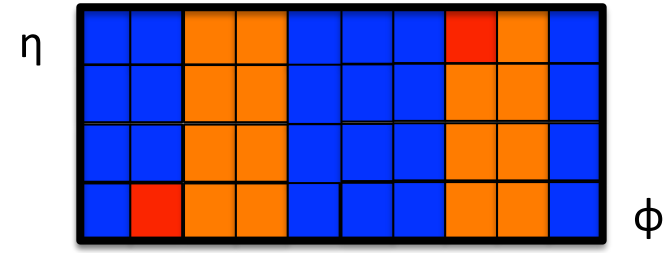


- Peak width and height depend on trigger jet momentum.
- Underlying momentum depend on center mass energy.

Flow BKG Subtraction Method

ψ_2 are reconstructed by forward detector called V0

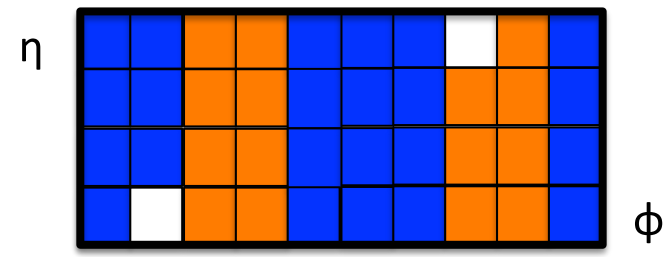
- Fill particles with p_T into 2D histogram
- Fit for p_T weighted v2
- Subtract BKG (flat+v2)
- Remove close cells to jet
- Fit again for v2
- Subtract BKG again



$A+B*\cos(2\phi)$

$p_T^{v2subed} = p_T^{RAW} - Area^{Jet}*\rho - |v2|/d\phi d\eta*Area^{Jet}*\cos(2\Delta\phi)$

If($p_T^{v2subed}$>20) remove cells in dR<0.4



$A+B*\cos(2\phi)$

$p_T^{v2subed} = p_T^{RAW} - Area^{Jet}*\rho - |v2|/d\phi d\eta*Area^{Jet}*\cos(2\Delta\phi)$

p_T^{Jet} vs Δϕ(Jet-EP)

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centrality	0-5%	5-20%	20-50%	50-90%

Jet Momentum p_T (GeV/c)

Subtract FLAT Background

Subtract FLAT+v2 Background

Jet axis with respected to event plane Δϕ (rad)

Back Ground Distribution

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Flat BKG strength ($p_T/d\eta d\phi$)

centrality

Flow BKG strength ($p_T/d\eta d\phi$)

centrality

# of Jets

5<centrality<30

p_T

- Fitting looks working.
- Minimized BKG from Flow.

Flat sub. (inplane)

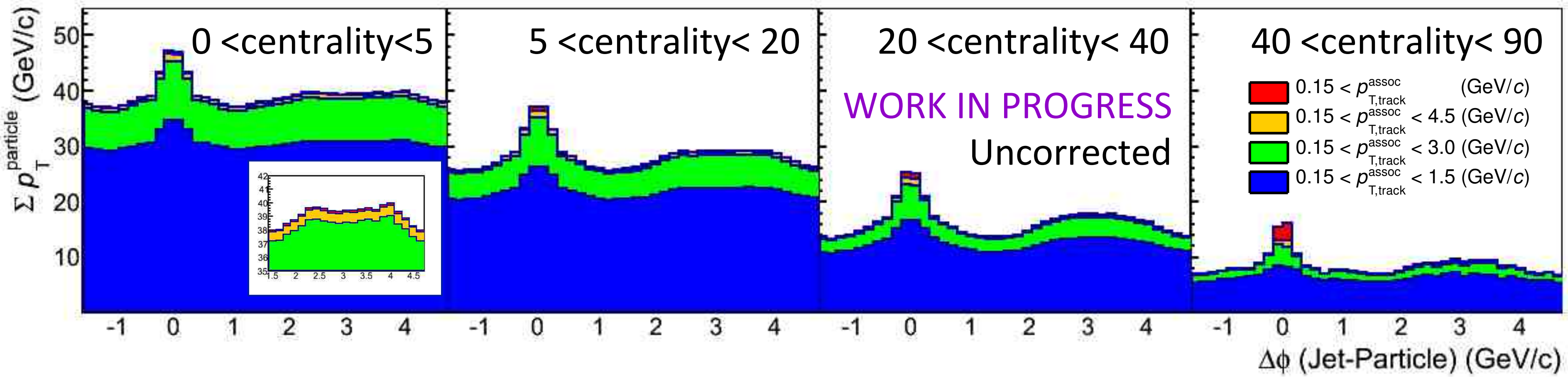
Flat sub. (outplane)

Flat+v2 sub. (inplane)

Flat+v2 sub. (outplane)

Momentum Distribution w.r.t Jet Axis

$20 < p_T^{leading} < 40$ GeV/c



- Underlying momentum depend on centrality
- Near-side jets are shaper with the increasing centrality.
- Double peak in away side on central.

BKG subtraction from asso. particles

- Fill particle momentum to 2D histogram(η,ϕ).
- Fit using following function to each asso. particle momentum region event by event.

$$F = A+B*\cos(2*(x-\psi_2))$$

- Calculate momentum density of Flat and v2 components. e.g) $\rho^{flat}=A/d\eta d\phi$
- Calculate area of a bin of 2D histogram.
- Subtract BKG bin by bin.

Momentum Dis. (Flat BKG subtracted)

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Centrality 0-5 5-30 30-60 60-90

- Over flat BKG estimation.
  - We have to consider v2,v3 effects in asso. particles
- Away-side peak is sharper in peripheral
- Still have double peak in away-side in central

$10 < p_T^{lead} < 20$ GeV/c
$10 < p_T^{sub\text{-}lead}$ GeV/c

$0.15 < p_{T,track}^{assoc}$ (GeV/c)
$0.15 < p_{T,track}^{assoc} < 4.5$ (GeV/c)
$0.15 < p_{T,track}^{assoc} < 3.0$ (GeV/c)
$0.15 < p_{T,track}^{assoc} < 1.5$ (GeV/c)

Summary & Outlook

Jet-Particle Correlation in pp

- Peak and width depending on triggered jet momentum.
- Underlying momentum depend on center mass energy.

Jet-Particle Correlation in Pb-Pb

- Underlying momentum depending on centrality
- Near-side jets are shaper with the increasing centrality.
- Double peak in away side on central.

Outlook

- Subtract v2 and v3 effect from associate particles.
- Event Plane dependence, Compare with pp results.