ALICE实验中带电喷注产额及核修正因子的研究

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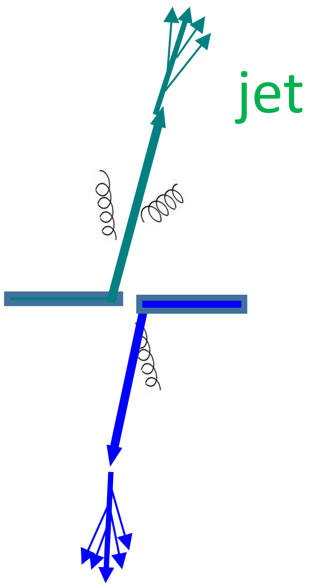
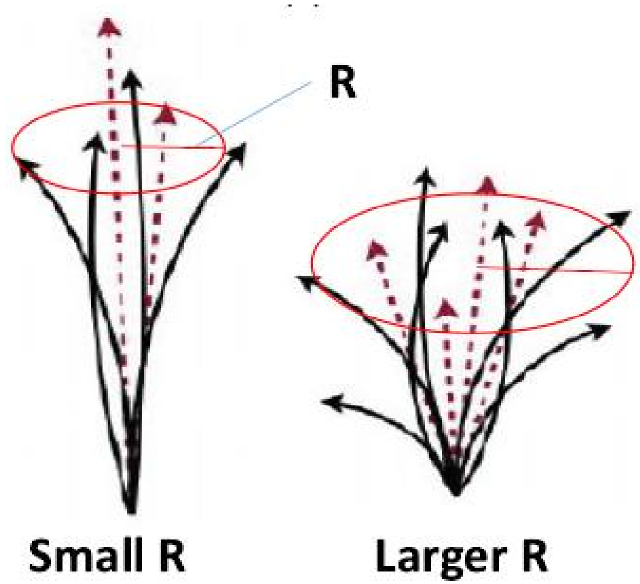
Motivation

- Jet is defined as collimated spray of particles originating from initial hard scattered partons.



- Jet cross section measurement in pp collisions provides good tests for pQCD calculation.

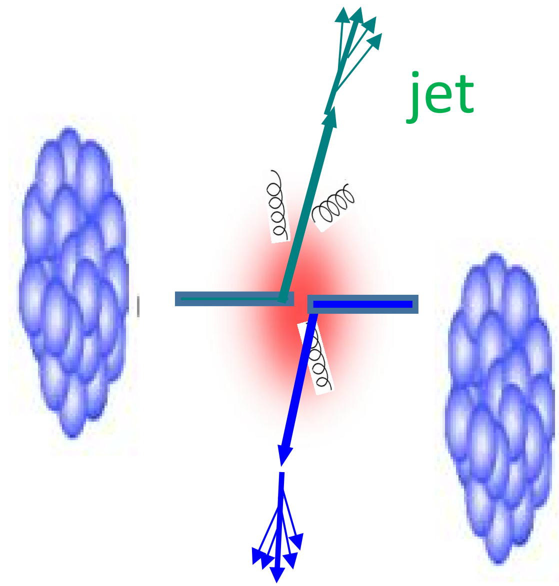
- Investigate the splitting function of parton in vacuum:close to original collimation information.

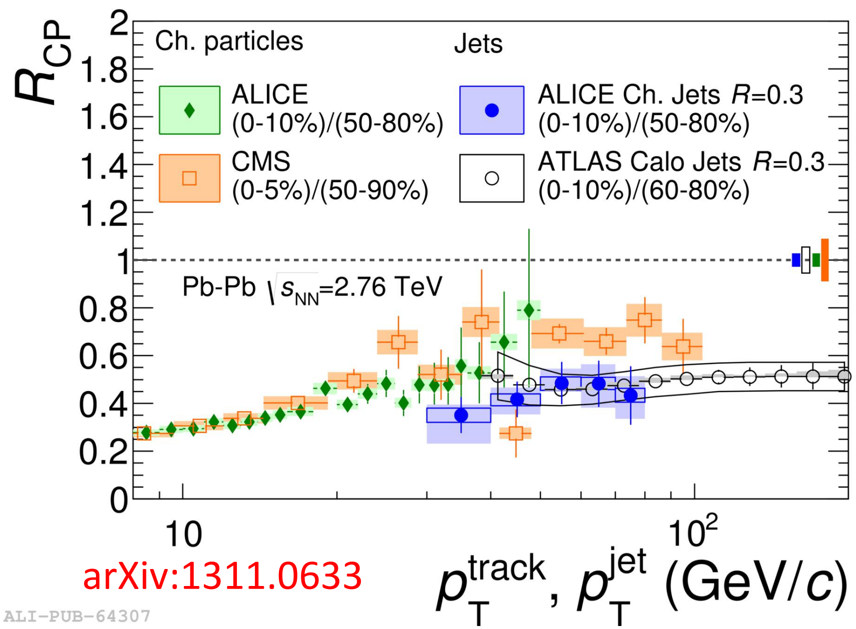


Motivation

- Jet produced in early stage of the collision will traverse the hot QGP medium created in heavy-ion collisions and will lose energy by collision and radiations → "Jet quenching"
- Jet quenching results high p_T suppression compared to pp measurements → Nuclear modification factor R_{AA}/R_{CP}

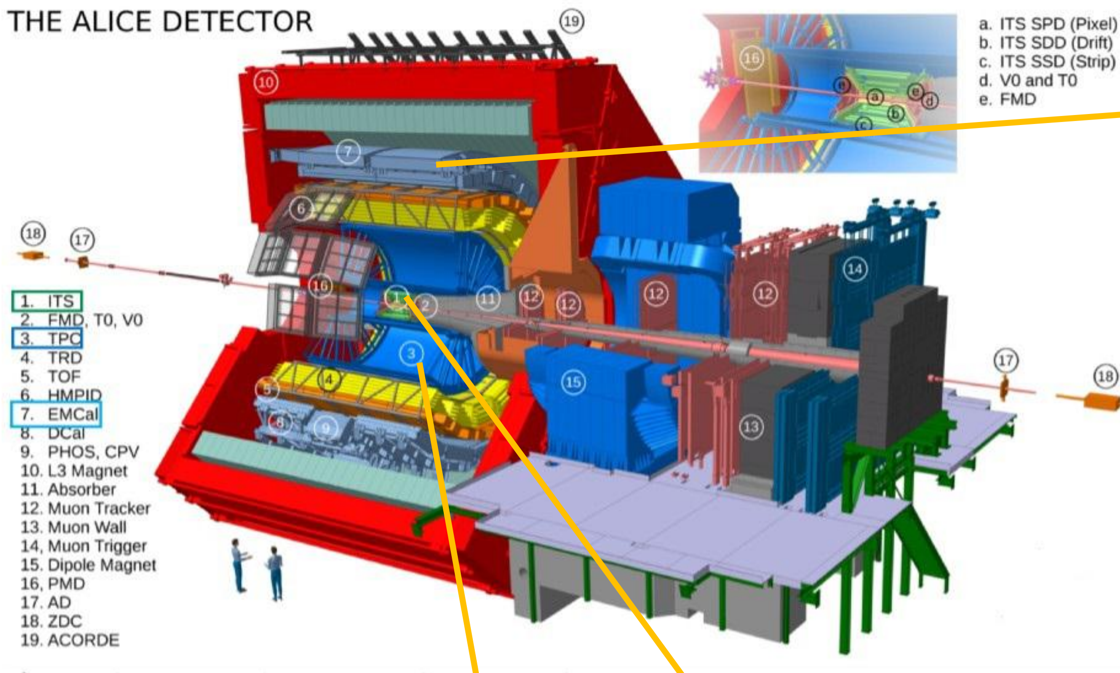
$$R_{AA} = \frac{dN^{AA}_{jets} / dp_T}{\langle N_{coll} \rangle dN^{pp}_{jets} / dp_T} = \frac{dN^{AA}_{jets} / dp_T}{\langle T_{AA} \rangle d\sigma^{pp}_{jets} / dp_T}$$





arXiv:1311.0633

Jet measurements in ALICE



EM calorimeter
Acceptance: $|\eta| < 0.7$, $80^\circ < \varphi < 188^\circ$

Remove charged particle contributions

Neutral constituents

$E_{cluster} > 0.3$ GeV

full jet

ITS(Inner tracking system)
$|\eta| < 0.9$, $0 < \varphi < 2\pi$

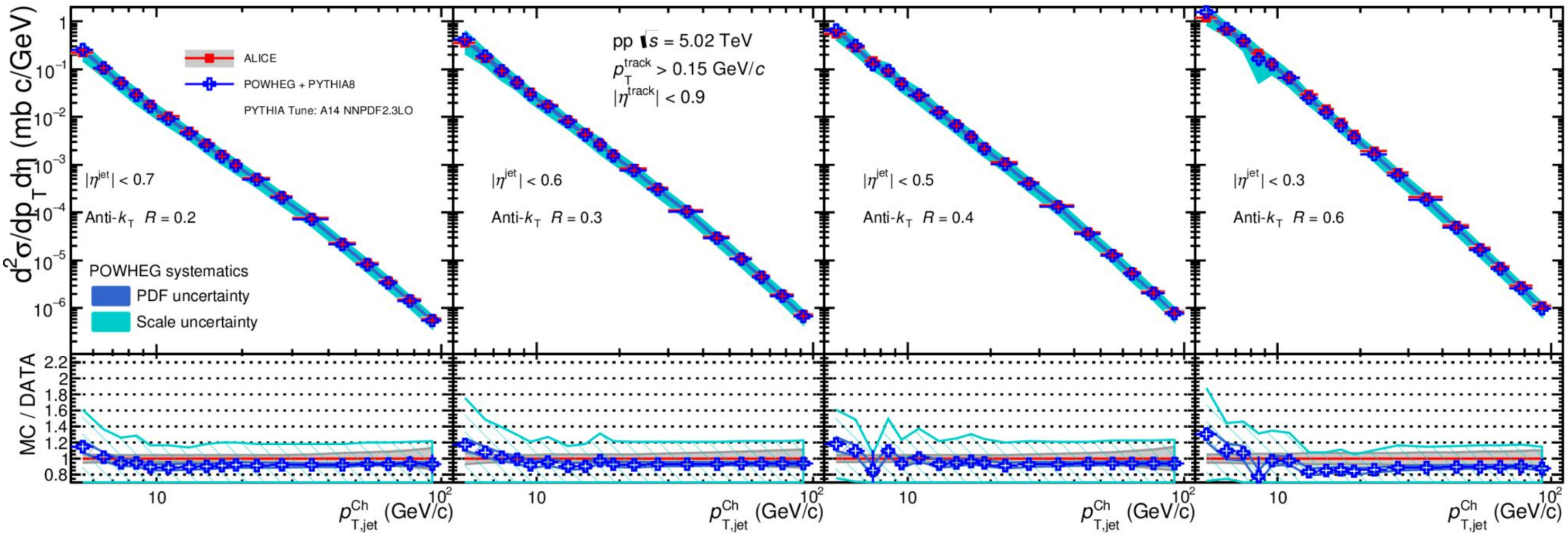
TPC(Time projection chamber)
$|\eta| < 0.9$, $0 < \varphi < 2\pi$

Charged constituents

$p_{T,track} > 0.15$ GeV/c

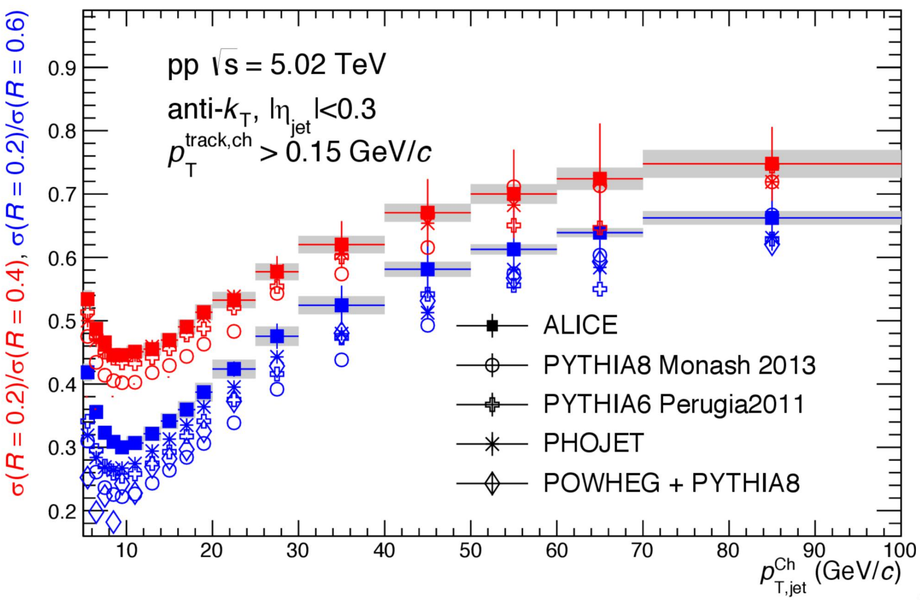
Charged jet

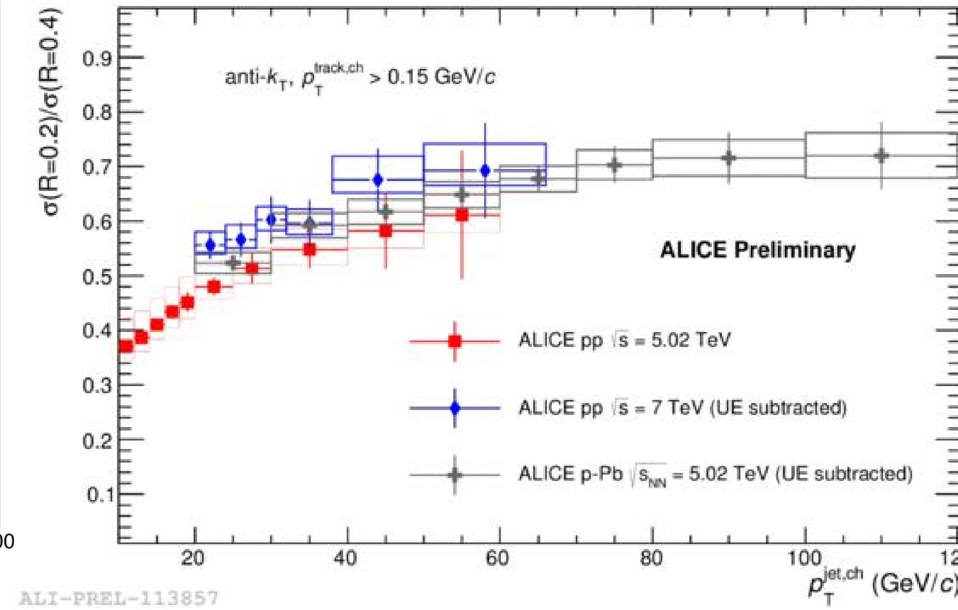
Corrected jet cross section in pp collision



- Charged jets are measured using different resolution parameters
- Jet cross section is well described by POWHEG+PYTHIA8 predictions (NLO pQCD+parton shower+hadronization) within systematic uncertainties

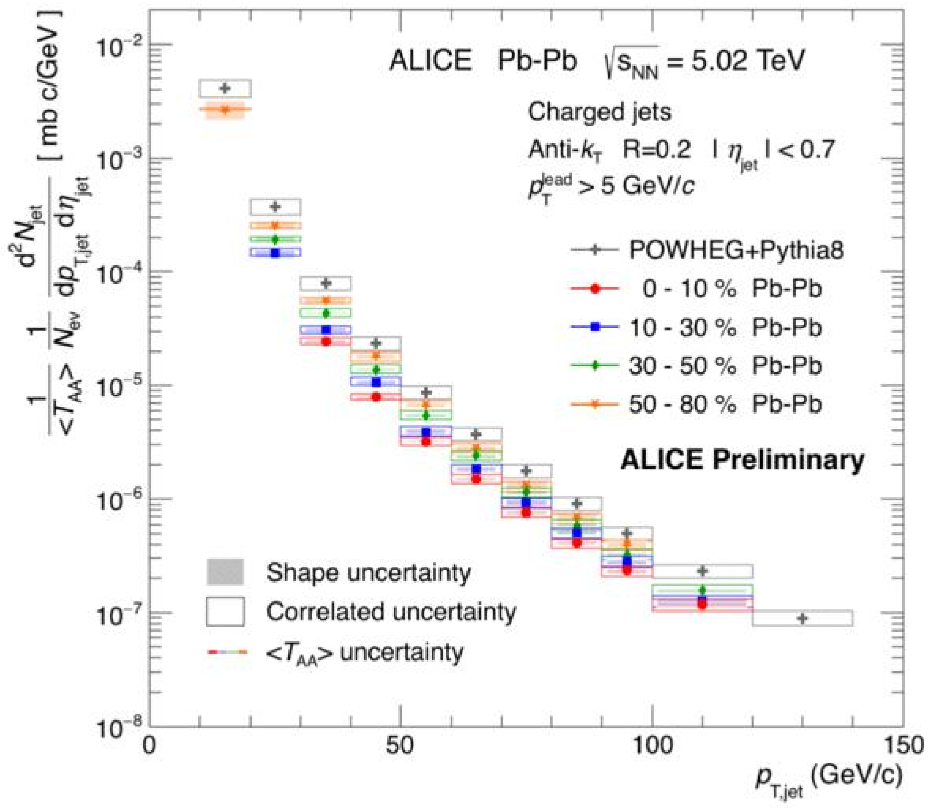
Jet cross section ratio @ pp

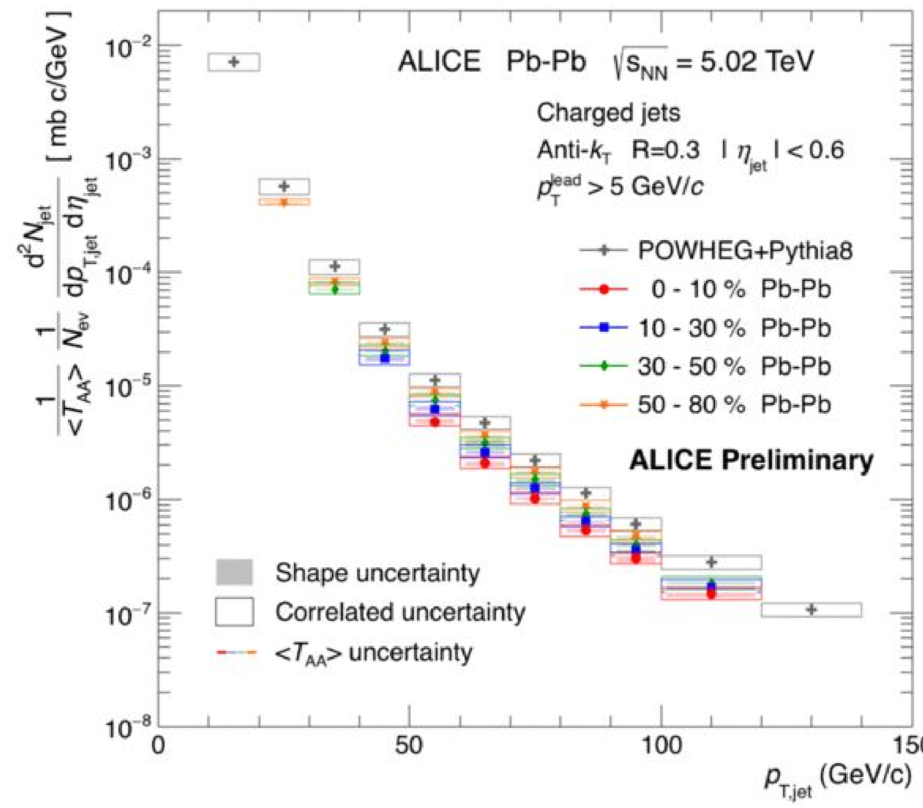




- ➢ Jet cross section ratio measurements are the reflection of jet collimation
- ➢ Different jet cross section ratio is consistent with Monte Carlo simulation
- ➢ Jet cross section ratio is consistent with different √s, slightly increasing with jet p_T

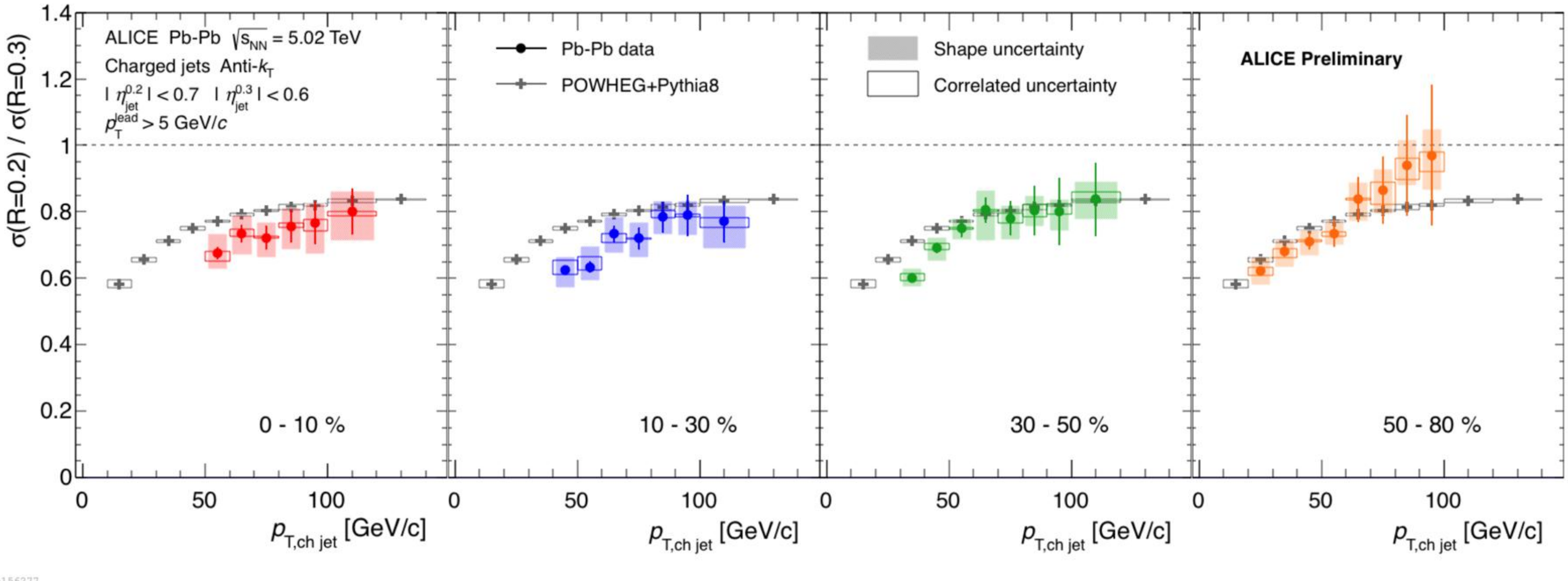
Charged jet production @ Pb-Pb





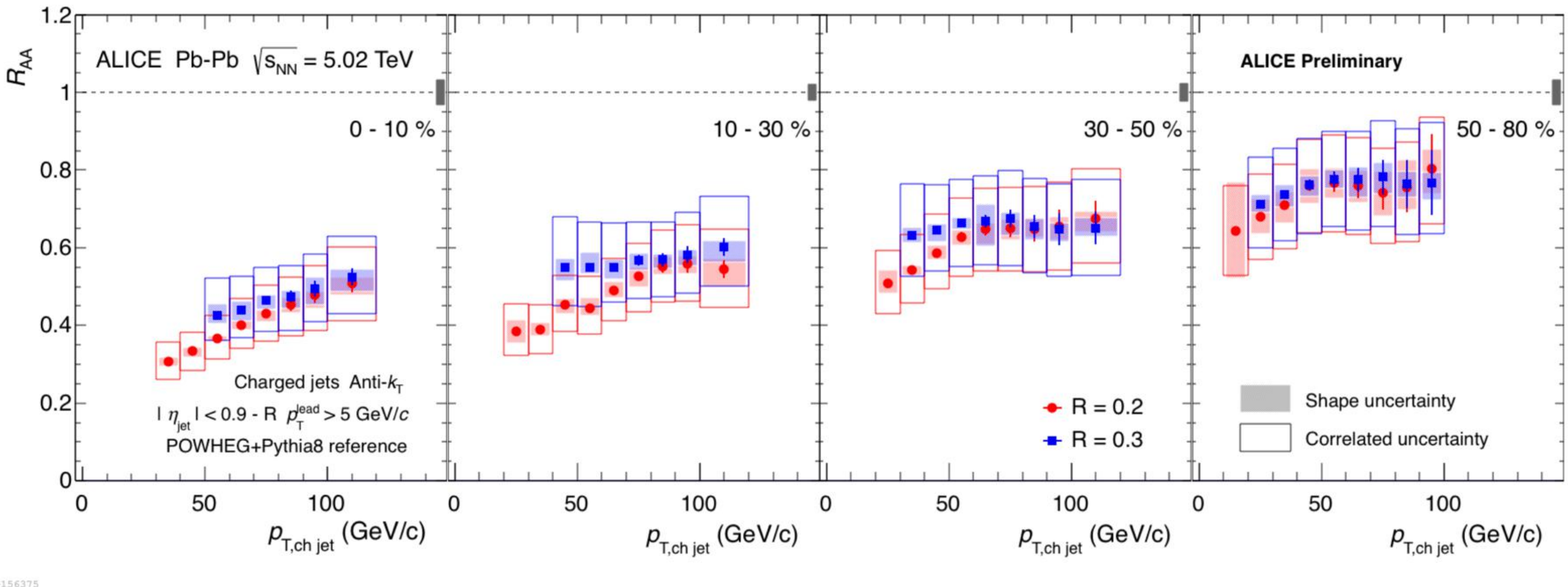
- Charged jet spectra in different centrality bins are measured in Pb-Pb collision with different jet radii
- Jet production yield are scaled by T_{AA} and using POWEG+Pythia for pp reference

Jet cross section ratio @ Pb-Pb



- ➢ Ratio of charged jet cross section between R=0.2 and R=0.3 are measured for different centrality intervals
- ➢ No significant difference compared to ratio in vacuum (POWHEG+PYTHIA8 reference)
  - ➢ Small difference at low p_T in central collisions → Hints for stronger broadening at low p_T

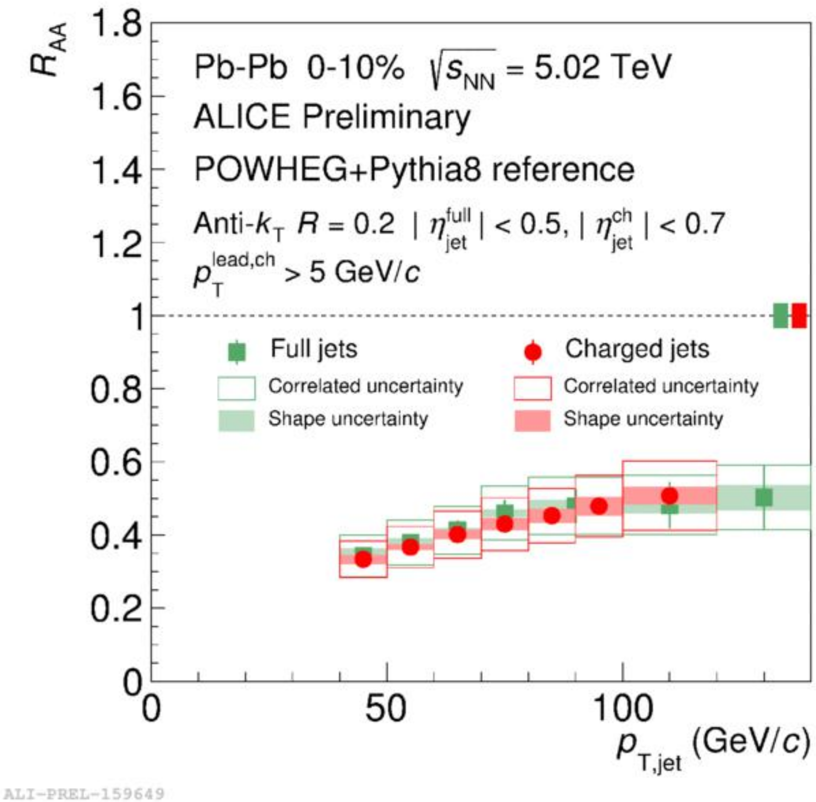
Jet nuclear modification factor R_{AA}

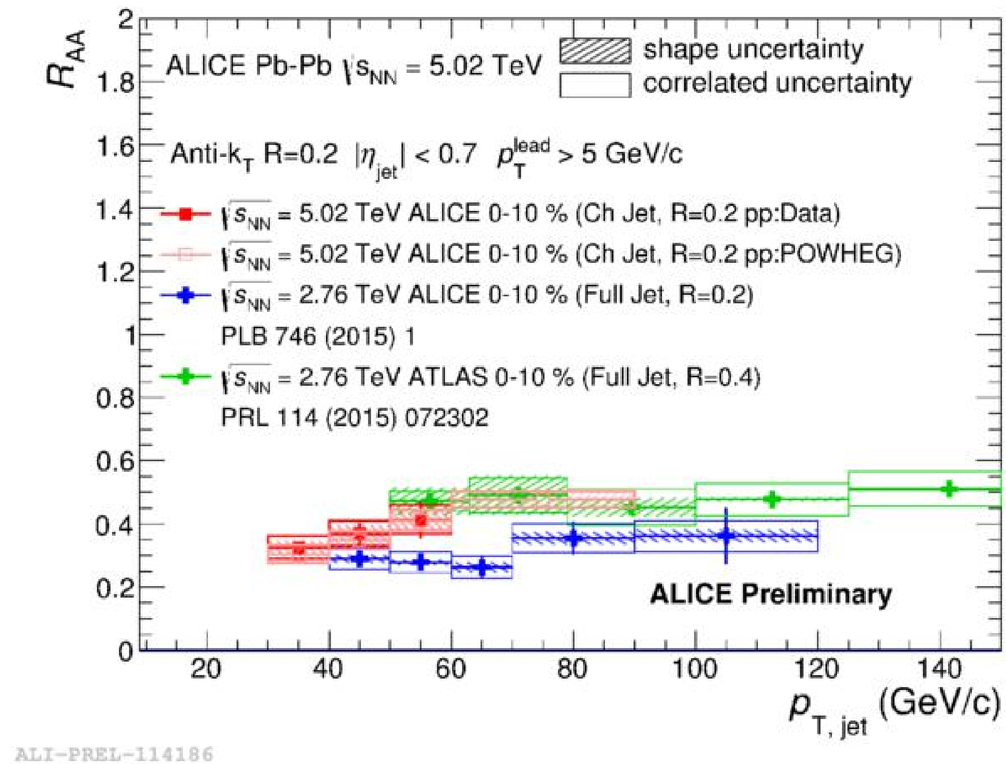


$$R_{AA} = \frac{dN_{jets}^{AA} / dp_T}{\langle T_{AA} \rangle d\sigma_{jets}^{pp} / dp_T}$$

- Strong suppression is observed in central Pb-Pb collisions
- Less suppression for peripheral events
- R_{AA} of different radius jets are similar with systematic errors
- POWHEG+PYTHIA8 is used as pp reference to enlarge to higher jet p_T range

Comparison between charged & full jets





- Full jets and charged jets R_{AA} is consistent
- R_{AA} at 5.02 TeV similar to 2.76 TeV
  - It indicates effect of flattening of the spectrum in higher collision energy is compensated by stronger jet suppression
- All measurements are consistent within errors

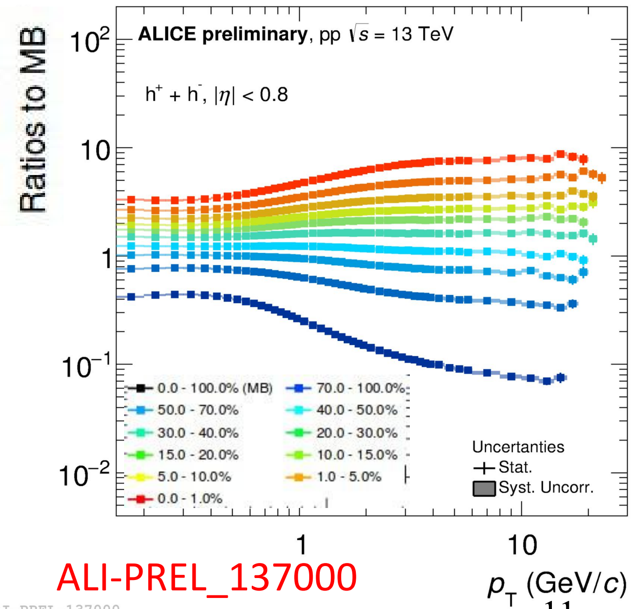
Summary and outlook

- Charged jet cross section in pp and Pb-Pb collisions at 5.02 TeV for different jet radius are measured
- Jet cross section ratio are studied in both pp and Pb-Pb collisions
  - No significant difference with measurements in Pb-Pb compared to the one in vacuum
- Nuclear modification factor (R_{AA}) has been measured
  - Strong jet suppression is observed in central Pb-Pb collisions
  - Centrality dependence is observed
  - Full jets and charged jets R_{AA} is consistent

Outlook

- Study of jet production in different multiplicity intervals on going
  - Similar trend as high p_T charged particle results anticipated

➔Please stay tuned!



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Backup

Analysis stragegy

Event selection
↓
Track selection
↓
Jet reconstruction
↓
UE subtraction
↓
Detector & UE fluctuation effect correction
↓
Corrected jet spectra

$$p_{T,jet}^{corr} = p_{T,jet}^{raw} - \rho . A_{jet}$$

$$\rho = median\left\{ \frac{p_{T,jet}^{kt}}{A_{jet}} \right\}$$

A_{jet} : Jet_area

- Minimum bias events (V0 and trigger)
  - $|Z_{y\ Primary\ vertex}| < 10$ cm
- The charged tracks measured by ITS + TPC
  - $|\eta_{track}| < 0.9$, $p_{T,track} > 0.15$ GeV/c
- Neutral components measured by EMCAL
  - $|\eta_{cluster}| < 0.7$, $E_{T,cluster} > 0.3$ GeV/c
- Signai: Anti-k_T algorithm, background: k_T algorithm
  - Utilizing FastJet package
  - Jet cone radii R=0.2, 0.3
- $|\eta_{jet,Ch}| < 0.9$-R , $p_{T,leading} > 5$ GeV/c
- Raw spectra are corrected by SVD unfolding method
  - Utilizing RooUnfold package (arXiv:1105.1160)
  - Detector responses are evaluated by Pythia8+Geant3 full MC detector simulation
  - Background fluctuations are evaluated by random cone method for charged jets and are evaluated by embedding Pythia8 events into Pb-Pb data

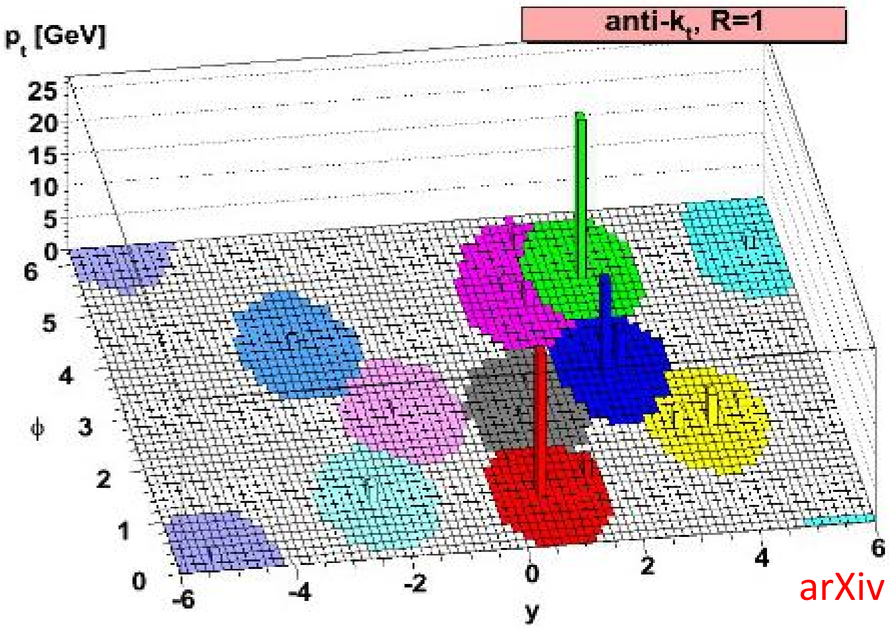
Data and event selection

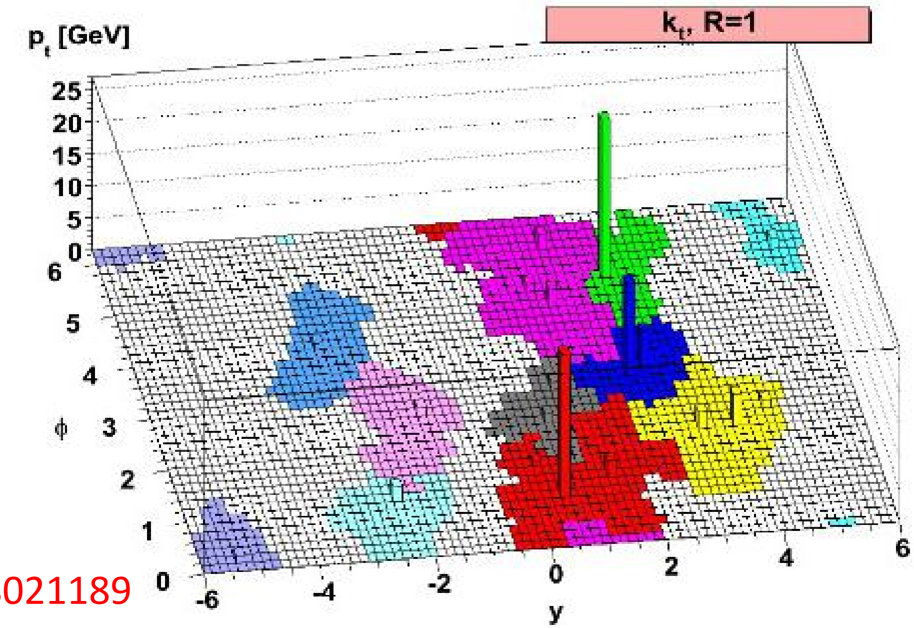
- Raw jet spectra
  - Event samples: 68 M(Charged jets, 0-80%)

    Minimum bias events of Pb-Pb at s_{NN} = 5.02 TeV
  - Reconstructed by anti-k_T algorithm, R=0.2 and 0.3, k_T-scheme
  - Combinatorial backgrounds are suppressed by leading charged track requirement (p_T > 5 GeV/c)
- Background subtraction
  - Event-by-event background density estimation and subtraction
- Measured spectra are corrected by SVD unfolding method
  - Charged jets
    - Detector response : Pythia8+Geant3 full MC detector simulation
    - Background fluctuation : Random cone method

Jet jet reconstruction

- Hybrid Track : $P_T^{Track} > 0.15\text{GeV/c}$ $\quad |\eta| < 0.9$
- Charged Jet reconstruction: anti-k_T algorithm $\quad P_T^{Jet} > 1\text{GeV/c}$ $\quad |\eta_{jet}| < 0.9 - R$
- Underlying event: k_T algorithm





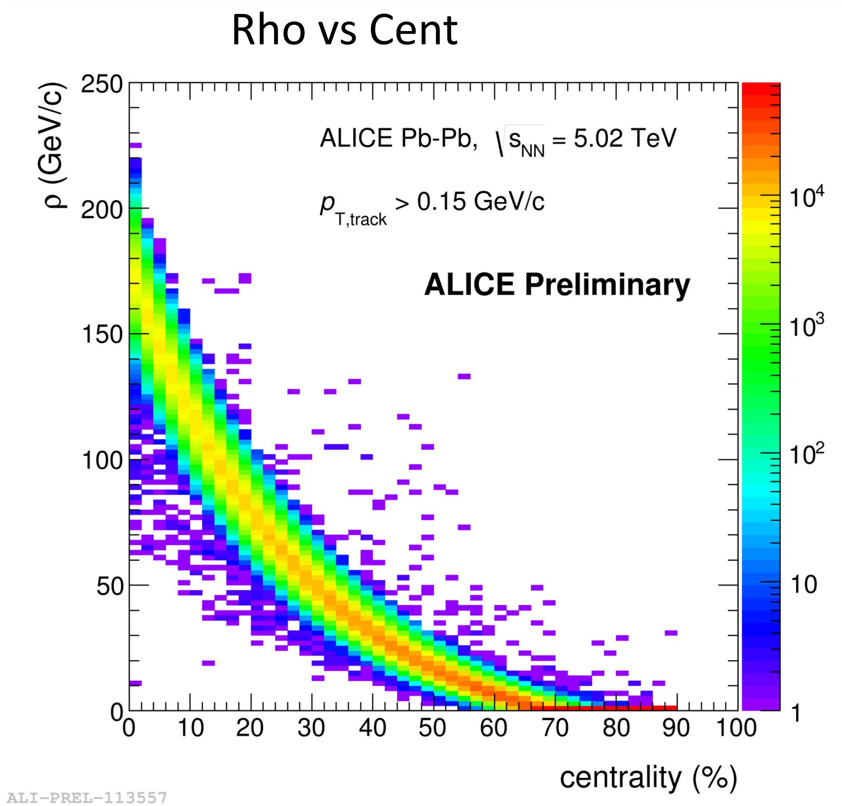
arXiv:08021189

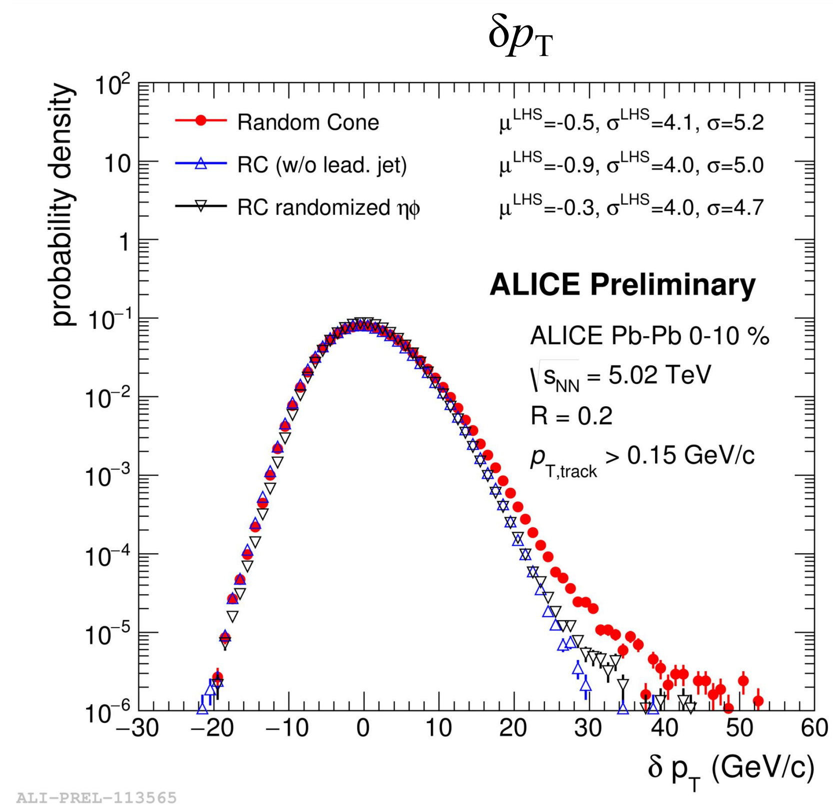
- For each pair of particles, i and j,calculate:

$$d_{ij} = \min\{p_{T,i}^{2n}, p_{T,j}^{2n}\}\frac{(\eta_i - \eta_j)^2 + (\varphi_i - \varphi_j)^2}{R} \quad \begin{cases} n=1 & k_T \text{ algorithm} \\ n=-1 & \text{anti-}k_T \text{ algorithm} \end{cases}$$

- R is resolution parameter which is one of the inputs of the jet finder

Jet background subtraction @Pb-Pb





- Background density ρ as function of centrality
- δp_T from different type of rigid random cones with R=0.2 and centrality 0-10%. The left -hand-side has been fitted with a gaussian