Inclusive jet measurements in Heavy Ion collisions at CMS

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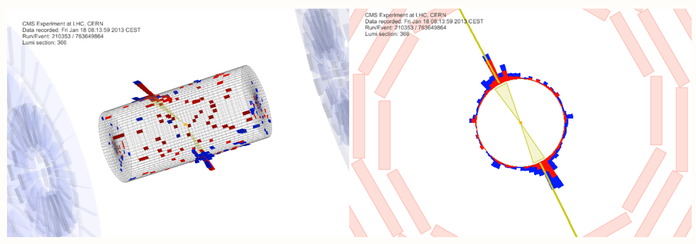
Introduction

Proton-nucleus (pA) collisions serve as baseline measurements for the study of nucleus-nucleus (AA) collisions. Understanding the signatures of QCD matter created in heavy ion collisions relies on an understanding of elementary collisions, where final-state medium effects are expected to be largely absent.

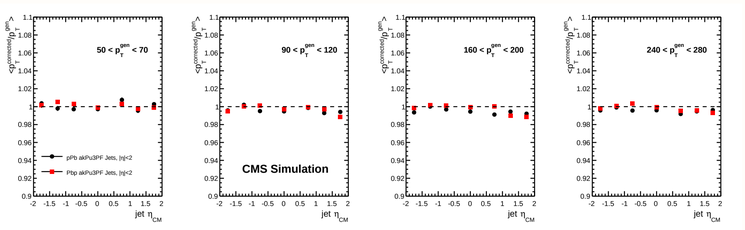


- anti-$\mathrm{k_T}$ jet algorithm with a distance parameter of $\mathrm{R} = 0.3$ (FastJet framework [1]).
- iterative "noise/pedestal subtraction" technique for background subtraction [2].
- Particle Flow (PF) objects that are reconstructed by combining information from various sub-detectors [3].

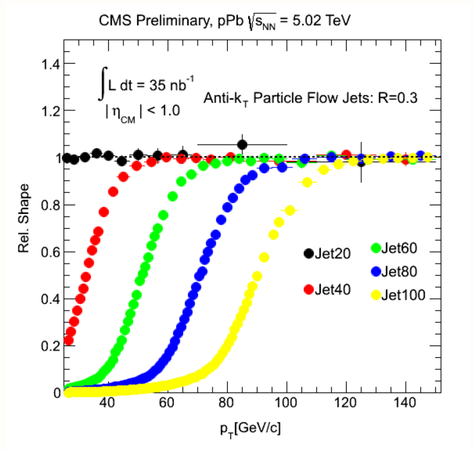
Methods - Jet Reconstruction

Jet Transverse Momentum Corrections

The ratio of the corrected (reco) jet transverse momentum ($\mathrm{p_T}$) with the generator (gen) truth $\mathrm{p_T}$ for several gen $\mathrm{p_T}$ ranges are shown below after the jet $\mathrm{p_T}$ corrections using different direction of boosted PYTHIA [5] embedded into HIJING [6] (MC) samples representing the pPb and Pbp data respectively. The ratios are found to be within 2-3% for all the η_{CM} (center of mass) ranges used in this analysis.



Trigger Combination

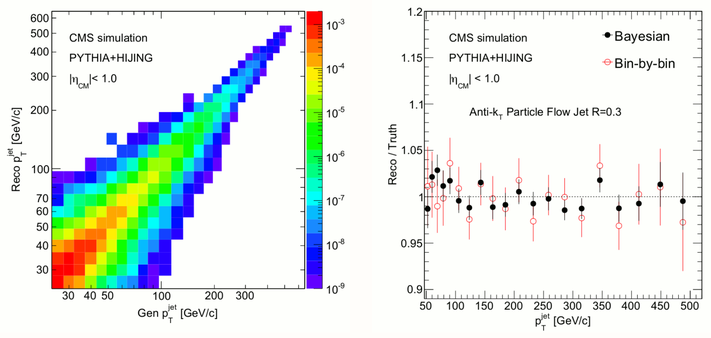


The data jet samples were collected using 5 different High level trigger (HLT) paths and categorized into five groups based on its trigger $\mathrm{p_T}$ [7].

- $\mathrm{A} <= \mathrm{MAX(trig p_T)} < \mathrm{B} = \mathrm{n_A} \times \mathrm{PS_A}$

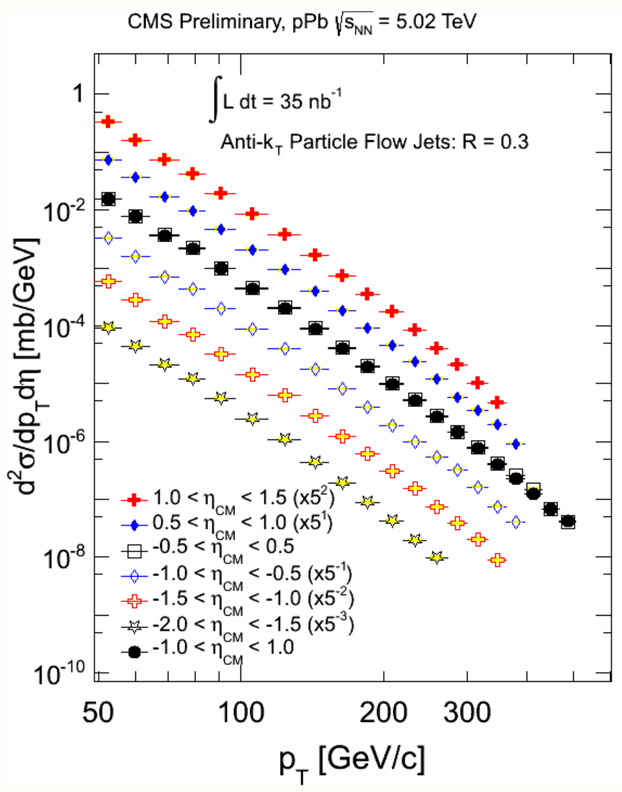
Where A and B are $\mathrm{p_T}$ thresholds, corresponding to the HLT used and $\mathrm{MAX(trig p_T)}$ refers to the maximum value of the online $\mathrm{p_T}$ observed by the trigger and used to calculate the trigger decisions. The weights applied to each sample are simply the pre-scale factor ($\mathrm{PS_\#}$) of the particular trigger.

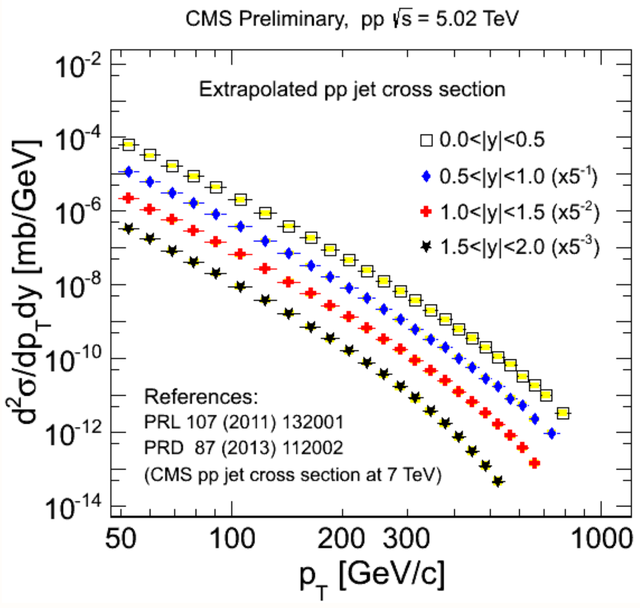
Unfolding Methods on Data



The unfolding procedures uses a response matrix from MC simulation, and reconstructs the true jet distribution from the measured distribution. The event generator was tuned with the Z2 [4] tune at center of mass energy of $\sqrt{s} = 5.02\ \mathrm{TeV}$. Above we have shown the response matrix on the left and on the right the ratios of the unfolded MC with the generator truth for Bayesian [8] and bin-by-bin methods which show consistent results.

pPb *and* pp *jet cross sections*





Our final pPb cross section with integrated luminosity $\mathrm{L} = 35\mathrm{nb}^{-1}$ is shown as the first plot in the preceding couple of plots. The values for the cross sections for the different η bins are also overlaid on top of each other after appropriate scaling.
The pp reference at $\sqrt{s} = 5.02\ \mathrm{TeV}$ (below the pPb plot) is extrapolated from the published jet cross section measurement in pp collisions at $\sqrt{s} = 7\ \mathrm{TeV}$ [9] by using the scaling factors calculated based on PYTHIA Z2 simulation.

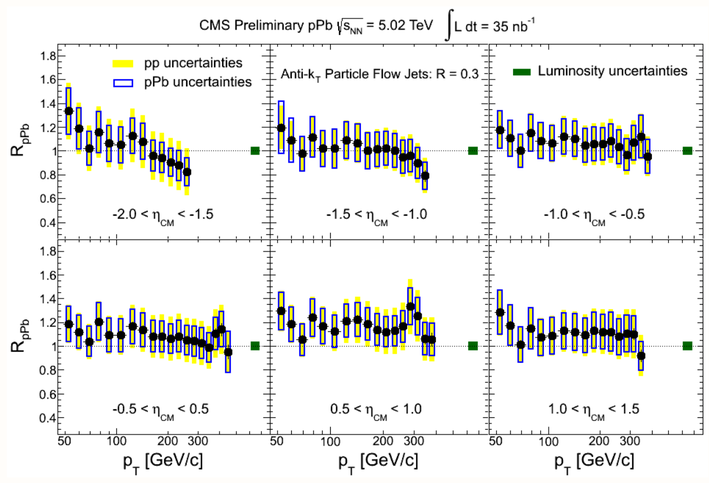
Inclusive Jet $\mathrm{R_{pPb}}$

The inclusive jet nuclear modification factor as a function of jet $\mathrm{p_T}$ is shown below for six center of mass pseudorapidity bins.

- Slight jet $\mathrm{p_T}$ dependence $\tilde{1}$ at large $\mathrm{p_T}$ ranges for mid-rapidity.
- Separation of the $\mathrm{R_{pPb}}$ between forward and backward ranges
- $\mathrm{R_{pPb}}$ from the proton beam direction is slightly larger than of the Pb beam direction.

$$\mathrm{R_{pPb}} = \frac{\mathrm{d^2\sigma^{pPb}_{jet}/dp_T d\eta}}{\mathrm{L \cdot A \cdot d^2\sigma^{pp}_{jet}/dp_T d\eta}}$$

where $\mathrm{L} = 35\ \mathrm{nb}^{-1}$ is the recorded luminosity in pPb collisions and A is the nucleon number (208 for pPb).



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This Analysis: CMS Collaboration, Jet nuclear modification factor in pPb collisions, CMS PAS HIN-14-001

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