Energy flow from 5 TeV pPb collisions in CMS



Michael Murray, University of Kansas

CMS

Forward Physics & Instrumentation, Stonybrook, 17-19 October 2018

Outline

- CMS capabilities for measuring E_T
- Relevance to cosmic rays
- Minimum bias distributions and comparison to pPb
- Question of deceleration of nucleons.
- Centrality dependence in different η regions
- Pushing the event generators
 - Can the capture the correlations in the data



For $|\eta| < 2.4$ use particle flow for E_T



At forward rapidity use only calorimeter objects for E_T











CCMS The second second





$dE_T/d\eta$ near $\eta=0$ vs $\sqrt{s_{NN}}$





Nuclear stopping power in PbPb



For AA deceleration of nucleons, δy , flattens out above 30 GeV It would be good to measure this in pA



Three regions to measure centrality







HF Double

HF Single







E_T vs centrality for 3 different definitions



Centrality dependence vs n



Reducing systematics

Many systematics depend only weakly on centrality. Therefore look at the ratio of peripheral to central events versus centrality to cancel common uncertainties.

$$S_{\text{PC}}(\eta) = \frac{\frac{dE_{\text{T}}}{d\eta}(\text{peripheral},\eta)}{\frac{dE_{\text{T}}}{d\eta}(\text{central},\eta)}$$



Peripheral to central ratio vs n



Peripheral to central ratio vs n



 $pPb \sqrt{s_{NN}} = 5.02 \text{ TeV} (1.14 \text{ nb}^{-1})$



Peripheral to central ratio vs η



Models do not do a good job of capturing the correlations induced by the centrality definition



Summary

- For pPb collisions the energy density comparable to peripheral PbPb and sufficient for a small QGP
- The peak of $dE_T/d\eta$ is 1.4 units behind the nucleon-nucleon center of mass for both 5TeV pPb and 20 GeV pPt.
- $dE_T/d\eta$ grows as a power law of the energy. This growth is faster for AA than for pA
- Centrality dependence depends strongly on η region used to define centrality.
- Modern generators are not able to reproduce correlations induced by centrality definition.













