

# Jet Energy Loss at LHC

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In this work, the jet energy loss is analyzed using a monte carlo method. The data from LHC at  $\sqrt{s_{NN}} = 2.76$  TeV and 5.02 TeV is used to extract the parameters for specific energy loss of jets inside QGP. Our calculations give good discription of the nuclear modification factor and asymmetry measurements at LHC.

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## I. INTRODUCTION

## II. JET ENERGY LOSS

The Jet  $p_T$  distribution in pp collisions is measured by CMS and ATLAS experiments at LHC. We fit the jet  $p_T$  distribution with Hegedorn function.

$$f(p_T) = \frac{dn}{dy} \left(1 + \frac{p_T}{p_0}\right)^{-n} \quad (1)$$

The Jet  $p_T$  is generated from the fitted function. Now the QGP medium is assumed as a static sphere. The radius of the medium is related to the centrality of the collision as

$$R = R_A \sqrt{\frac{N_{\text{part}}}{2A_m}} \quad (2)$$

here  $R_A$  and  $A_m$  are the radius and Atomic mass of the Pb nucleus. The  $N_{\text{part}}$  is the number of participant in that particular collision class.

The cordiante  $r$  and  $\phi$  are then generated randomly. The maximum value of the cordiante  $r$  is the radius  $R$  of the system formed. We assume that both partons move back to back before fragmenting to jets.

The pathlengths  $d_1$  and  $d_2$  can be calculated as follows

$$\begin{aligned} d_1 &= \sqrt{R^2 - r^2 \sin(\phi)} - r \cos(\phi) \\ d_2 &= \sqrt{R^2 - r^2 \sin(\pi + \phi)} - r \cos(\pi + \phi) \end{aligned} \quad (3)$$

The specific energy loss (energy loss per unit length),  $dE/dx$  have following relation with the  $p_T$  of jet

$$\frac{dE}{dx} = M p_T^\alpha \quad (4)$$

Here  $M$  and  $\alpha$  are two parameters. We want to constrain these parameters with the help of LHC measurements and see their variations as a function of collision centrality and per nucleon energy.

The total energy loss for a jet then can be calculated as

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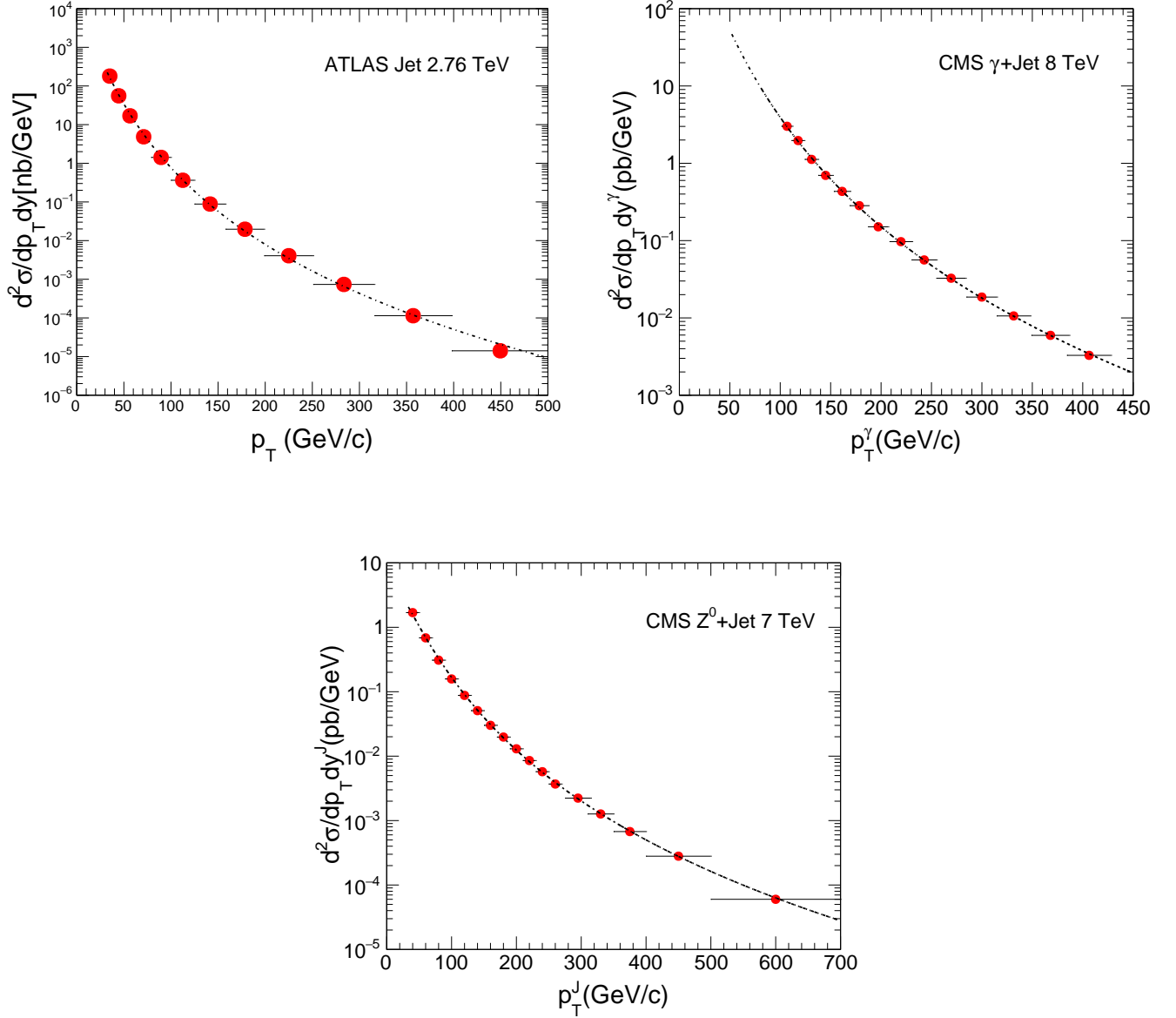


FIG. 1: (Color online) Jet yields as a function of jet  $p_T$  measured by ATLAS and CMS experiments. These yields are used in our calculations to generate the pp spectrum.

$$\Delta E = \frac{dE}{dx} \times d \quad (5)$$

where  $d$  is the pathlength of the jet inside the medium. If  $\Delta E_1$  and  $\Delta E_2$  are the energy loss for both the jets respectively we can get the final jet energies as

$$\begin{aligned} p_{T1} &= p_T - \Delta E_1 \\ p_{T2} &= p_T - \Delta E_2 \end{aligned}$$

and the Jet asymmetry can finally be calculated as

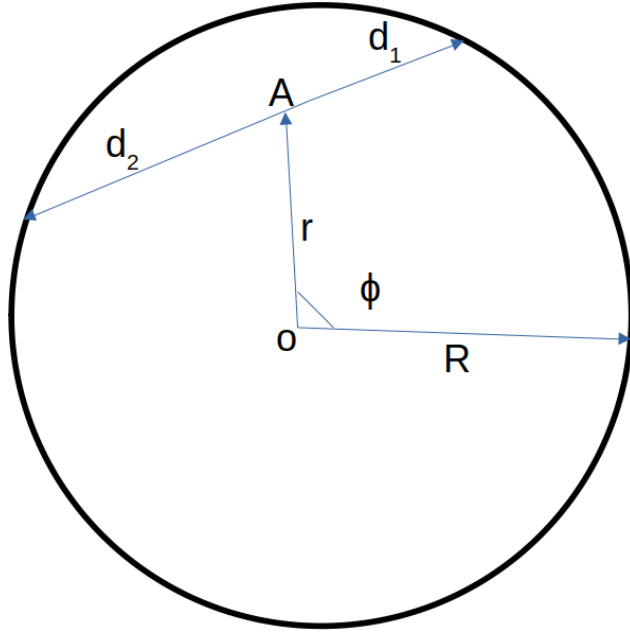


FIG. 2: (Color online) Figure showing the diagram of a diJet system.

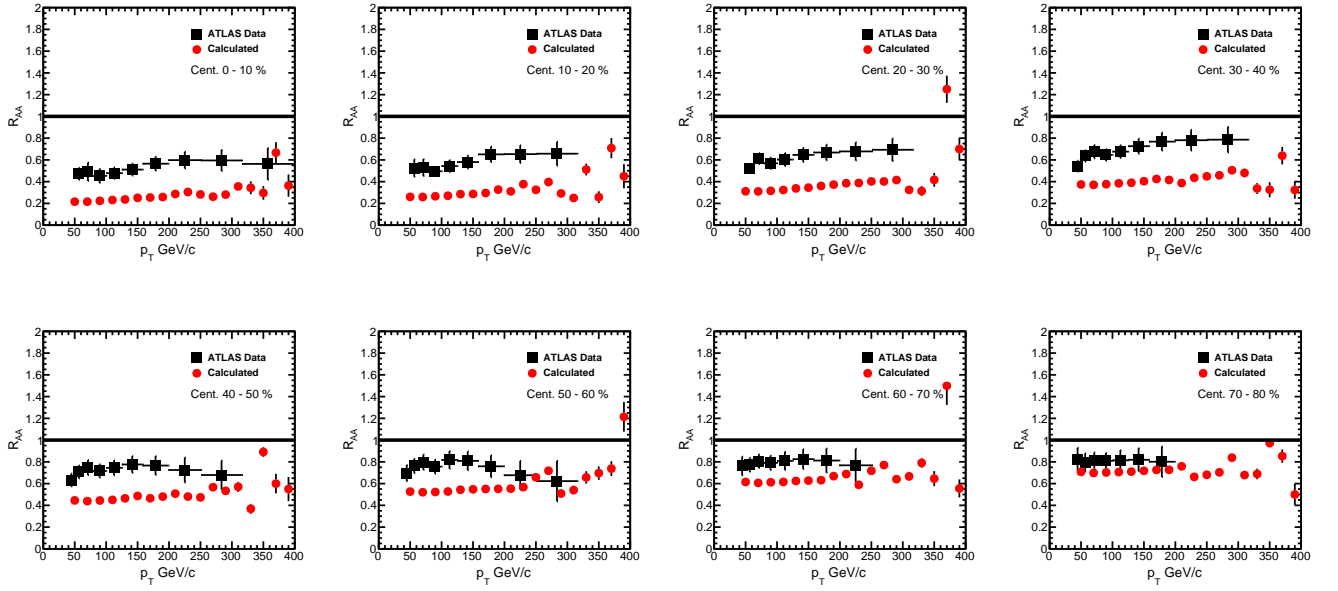


FIG. 3: (Color online) Jet  $R_{AA}$  as a function of jet  $p_T$  in several collision centrality bins measured by the ATLAS experiment. The measurement is compared with our model calculations.

$$A_J = \frac{p_{T1} - p_{T2}}{p_{T1} + p_{T2}} \quad (6)$$

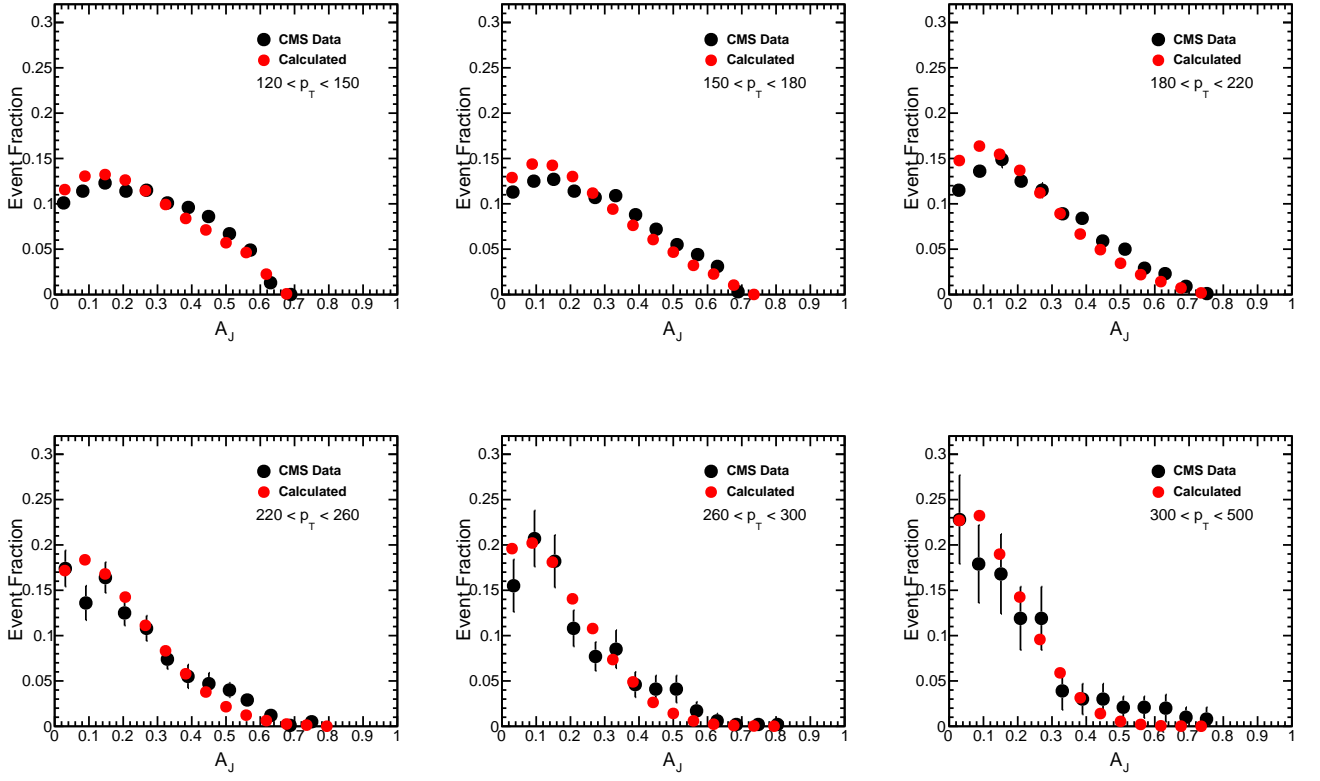


FIG. 4: (Color online) DiJet asymmetry as a function of jet  $p_T$  measured by CMS experiment compared with our calculations.

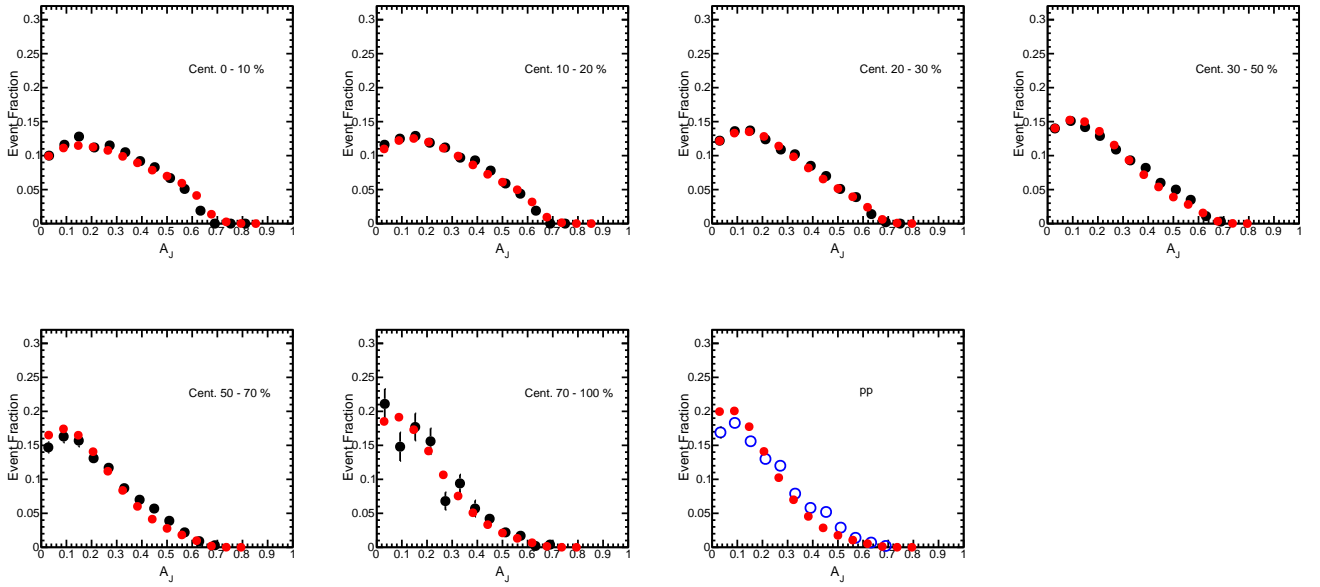


FIG. 5: (Color online) DiJet asymmetry as a function of collision centrality measured by CMS compared with our calculations.

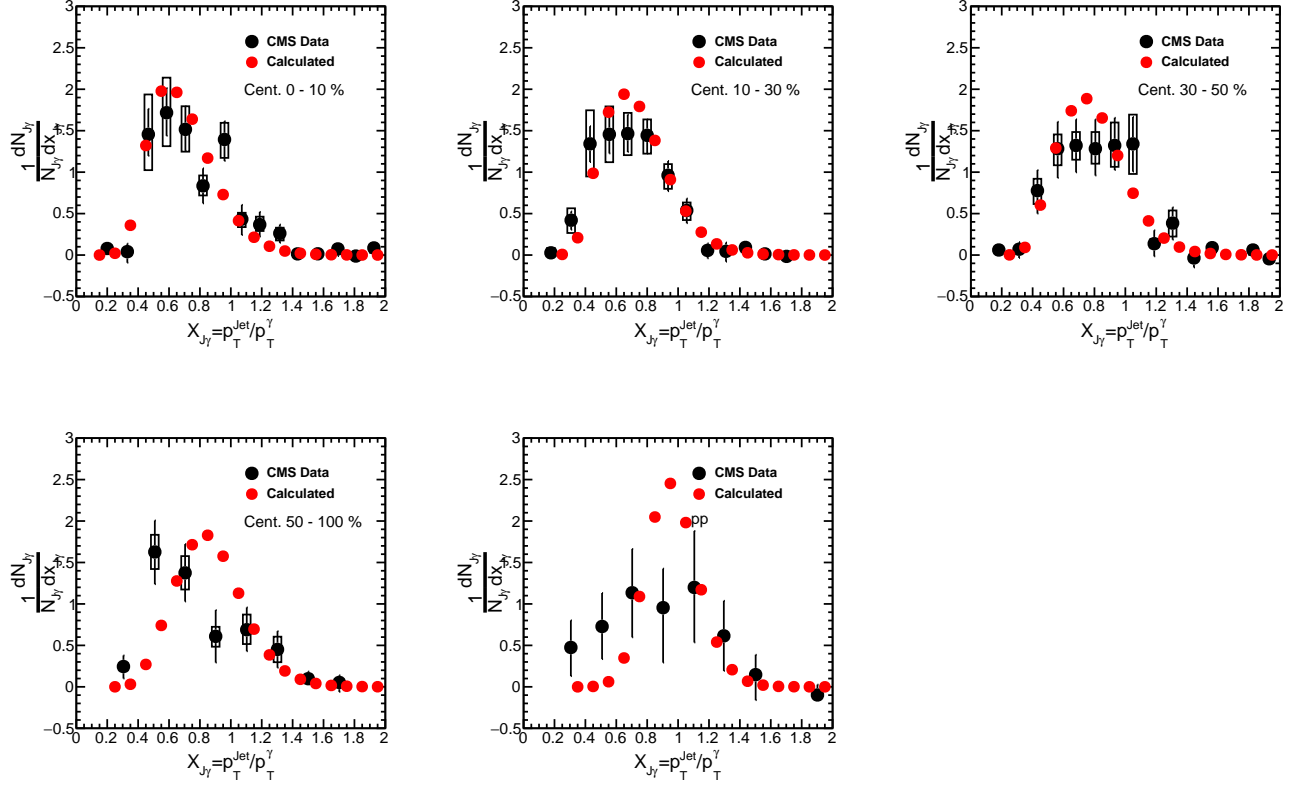


FIG. 6: (Color online) Jet asymmetry as a function of collision centrality in  $\gamma + \text{Jet}$  events as measured by CMS experiment. The data is compared with our calculations.

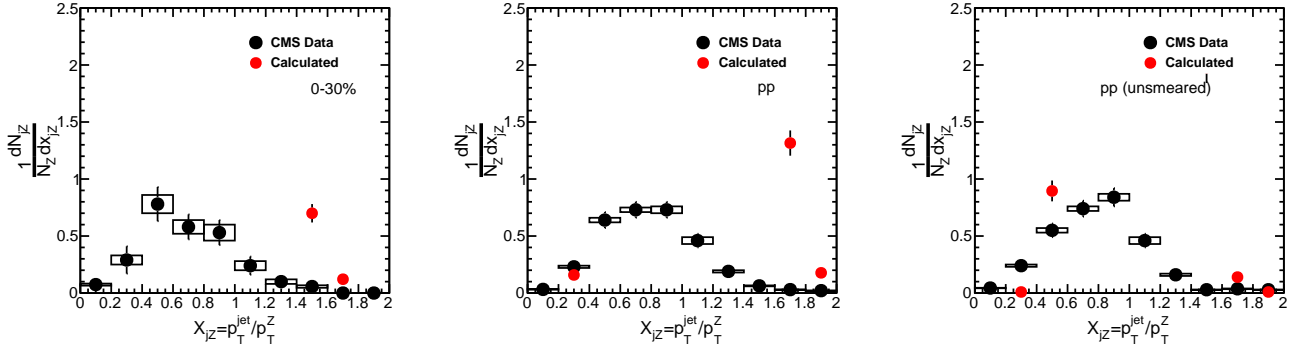


FIG. 7: (Color online) Jet asymmetry as a function of collision centrality in  $Z^0 + \text{Jet}$  events as measured by CMS experiment. The data is compared with our calculations.

### III. RESULTS AND DISCUSSIONS

### IV. SUMMARY

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