Nuclear Modification factor in deformed Xe-Xe collisions at 5.44 TeV

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I. INTRODUCTION

High transverse momentum quarks and gluons (jets), created from early stage hard scatterings are very useful probes of such highly excited nuclear matter [1]. These hard partonic jets lose energy as they interact with the medium ingredients while propagating through the QGP medium before fragmenting into hadrons. So, the associated observables are modified.

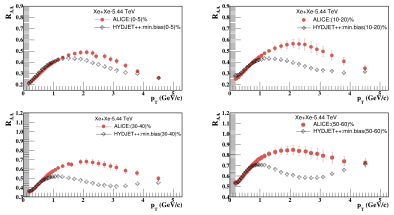

FIG. 1. Nuclear Modification Factor R_{AA} of charged hadrons with respect to p_T for minimum bias, body-body and tip-tip collisions over centrality along with ALICE experimental data for comparison [2]. Here we have used $|\eta| < 0.8$ pseudorapidity cut.

Xe-Xe collisions will provide a unique opportunity to explore QGP and its properties using intermediate-size collision system at LHC energies. Also, deformed shape brings multiple geometrical configurations in accordance to the way nuclei collide with each other such as body-body, body-tip, tip-tip, etc. Here we will focus on body-body and tip-tip configurations.

II. MODEL DESCRIPTION

HYDJET++ (hydrodynamics plus jets) is an event generator developed to study heavy-ion collisions at RHIC as well as LHC energies, performing simulation by superimposing soft state and the hard state simultaneously and independently. It meticulously treats soft hadroproduction as well as hard parton production, also examining the known medium effects. Incorporated physics and the corresponding simulation procedure can be found in the articles [3].

III. RESULTS

The suppression of particle spectra in A+A collisions is measured by the nuclear modification factor R_{AA} . For a given centrality bin Δc, R_{AA} is defined as follows [4]:-

$$R_{AA} = \frac{d^2N_{AA}/d^2p_T dy}{\langle N_{coll}\rangle_{\Delta c} d^2N_{pp}/d^2p_T dy}, \qquad (1)$$

where, $\langle N_{coll}\rangle_{\Delta c}$ is the number of binary collisions for centrality class Δc.

Here, we have taken p+p from ALICE experiment. Measured R_{AA} if smaller than 1 indicates strong suppression of jets. The resulting R_{AA} is studied as a function of transverse momentum and collision centrality (in figure 1) from most-central to most-peripheral

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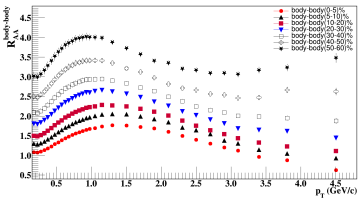

FIG. 2. Nuclear modification factor R_{AA} of charged hadrons with respect to p_T in body-body configuration over seven classes of centralities.

class of collisions and compared to ALICE experimental data [2], showing a suitable match with ALICE experimental results upto $\sim$ 1.0 GeV/c. The suppression increases at low p_T, reaches maximum at around $p_T \simeq 2$ GeV/c. This is caused by the interplay of soft and hard processes. In the range $2 \leq p_T \leq 5$ GeV/c, R_{AA} falls reaching minimum.

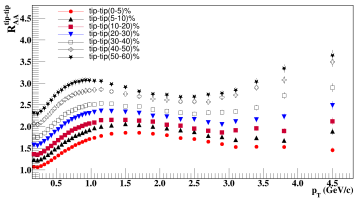

FIG. 3. Nuclear modification factor R_{AA} of charged hadrons with respect to p_T in tip-tip configuration over seven classes of centralities.

Centrality dependence of nuclear modification factor R_{AA} in body-body and tip-tip geometrical configurations can be clearly seen in figures 2 and 3. Each distribution of R_{AA} at a particular centrality shows a zenith at $\sim$1.5 GeV/c in most-central collisions which shifts to $\sim$1.0 GeV/c as we reach to most-peripheral collisions. The nuclear modification factor is higher in body-body collisions being $\approx$1.32 times higher than tip-tip collisions. The peak value rises almost 2.22 times for body-body and 1.77 times for tip-tip geometrical configurations as we move from most central to most peripheral collisions. In our study, we have not calculated p_T-spectra for p+p collisions at 5.44 TeV using HYDJET++ model due to physical restrictions of the model [5]. Therefore, the suppression is studied in terms of R_{CP} which is defined as the ratio of the modification in charged particle p_T-spectra at a given collision centrality to the modification in p_T-spectra in peripheral collisions. Using this technique we have estimated R_{CP} in figure 4. As a function of transverse momentum, the relative suppression R_{CP} increases from low p_T, finds a maximum at $\sim$2.25 GeV/c and decreases moving towards higher p_T.

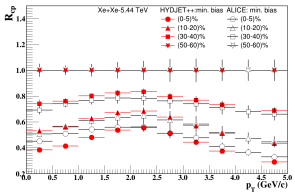

FIG. 4. Suppression in terms of R_{CP} of charged hadrons with respect to p_T in minimum bias collisions over various classes of centralities.

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