$v_n - v_m$ correlations in Xe-Xe collisions at 5.44 TeV

Saraswati Pandey[1*] and B. K. Singh[1†]
[1] *Department of Physics, Institute of Science, Banaras Hindu University, Varanasi, 221005, INDIA.*

Introduction

Anisotropic flow is an important signature of QGP that comes from the initial asymmetries in the geometry of the system produced in any noncentral collision. It plays an important role in the understanding of the collective motion and the bulk properties of the QGP. The study of anisotropic flow coefficients v_n in Xe-Xe collisions at 5.44 TeV under Monte Carlo HYDJET++ model (HYDrodynamics plus JETs) framework is presented.

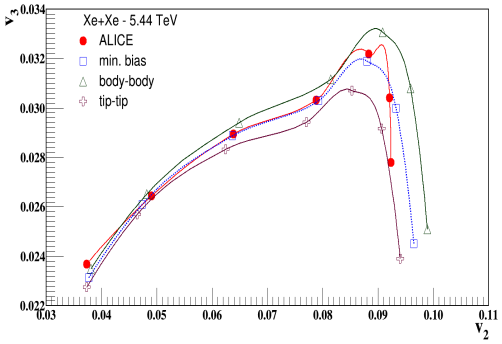

FIG. 1: Centrality dependent correlation of v_3 and v_2 for p_T <2 GeV/c and (0-60)% centrality range in Xe-Xe collisions at 5.44 TeV under HYDJET++ framework. The results have been compared with ALICE experimental data [2].

Recently, LHC carried out an 8-hr run of Xe-Xe collisions at 5.44 TeV TeV center-of-mass energy. The mass number of Xe nucleus lies in mid-between p and Pb^{208}. Thus, collisions of Xe^{129} nuclei will bridge the gap between the larger Pb-ion systems and smaller systems like p+p and p+Pb. Being deformed xenon allows us to probe a different initial condition. Therefore, we can have multiple geometrical configurations: body-body and tip-tip configurations, etc. depending upon the angle, the colliding nuclei make with the reaction plane. Hydrodynamical models predict an increase of elliptic flow (v_2) by 10% for a deformed Xe nucleus compared to the spherical Xe-nucleus in central collisions [3].

Model Description

HYDJET++ (HYDrodynamics plus JETs) is a Monte Carlo event generator with the aim of simulating relativistic heavy-ion collisions. The HYDJET++ model works by superimposing the soft hydro type state and the hard state (which results from the multiparton fragmentation) and simulataneously treating both the states independently. It gives an exhaustive approach to the soft hadroproduction (collective flow effects and resonance decays) and also to the hard parton production along with the known medium effects (jet quenching, nuclear shadowing, etc.). The in-depth details of the model and the procedure of simulation can be found in the corresponding articles [4, 5] and the references there within.

1. Results

In recent work on Xe-Xe collision systems [6, 7], tuned HYDJET++ model reproduces the LHC data on centrality and transverse momentum dependence of anisotropic flow coefficients v_n (n=2,3,4) up to p_T ~2.0 GeV/c and (0-60)% centrality range. We find suitable qualitative agreement of HYDJET++ model flow results with ALICE flow results. Flow correlations show quantitative deviation from experiment in various centralities. $v_3 - v_2$ correlations underestimate ALICE experiment in

*Electronic address: saraswati.pandey13@bhu.ac.in
†Electronic address: bksingh@bhu.ac.in

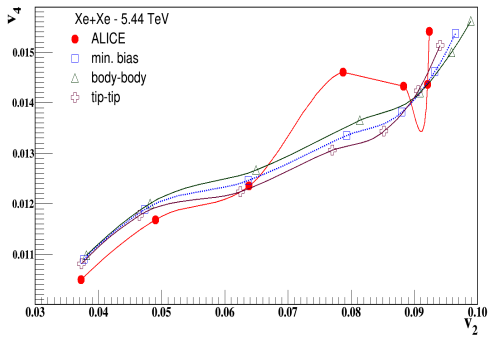

FIG. 2: Correlation between v_4 and v_2 for p_T <2 GeV/c and (0-60)% centrality range as a function of collision centrality in Xe-Xe collisions at 5.44 TeV using HYDJET++ model. The results have been compared with ALICE experimental data [2].

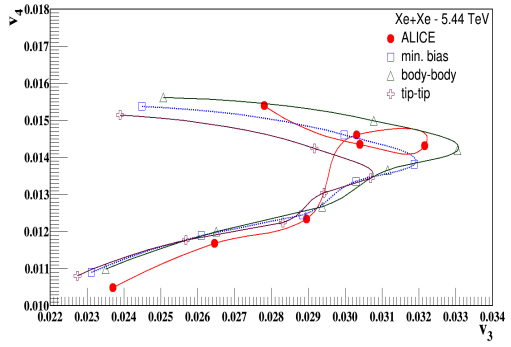

FIG. 3: Centrality dependence of $v_4 - v_3$ correlation for p_T <2 GeV/c and (0-60)% centrality range in Xe-Xe collisions at 5.44 TeV under HYDJET++ model framework. The results have been compared with ALICE experimental data [2].

most central and most peripheral collisions. A linear positive $v_3 - v_2$ correlation is observed in central collisions. In peripheral collisions, boomerang like behaviour is present. $v_4 - v_2$ correlation is non-linear positive throughout centrality. Boomerang effect observed in ALICE experiment for $v_4 - v_2$ correlation is not produced by HYDJET++ model. $v_4 - v_3$ correlation is linear positive in central collisions. In peripheral collisions, strong boomerang-like structure is predicted. Body-body and tip-tip $v_n - v_m$ correlations predict their similar respective qualitative behaviour, former being higher than latter one quantitatively.

2. Summary

Anisotropic flow of charged hadrons are centrality dependent. Strong centrality dependent correlation is observed between the flow harmonics (v_2,v_3,v_4). HYDJET++ model predicts a linear positive correlation in central collisions while boomerang-like correlation structure exists in peripheral collisions as found in ALICE experiment. We find a strong dependence of the above observables on the geometry of collision.

Acknowledgements

BKS sincerely acknowledges financial support from the Institutions of Eminence (IoE) BHU grant number-6031. SP acknowledges the financial support obtained from UGC under research fellowship scheme during the work.

References

[1] U. Heinz and R. Snellings, Annual Review of Nuclear and Particle Science 63, 123 (2013).
[2] S. Acharya, F. Acosta, D. Adamov, J. Adolfsson, M. Aggarwal, G. Aglieri Rinella, M. Agnello, N. Agrawal, Z. Ahammed, S. Ahn, et al. (ALICE), Physics Letters B 784, 82 (2018).
[3] G. Giacalone, J. Noronha-Hostler, M. Luzum, and J.Y.Ollitrault, Physical Review C 97, 034904 (2018).
[4] I. Lokhtin, L. Malinina, S. Petrushanko, A. Snigirev, I. Arsene, and K. Tywoniuk, Computer Physics Communications 180, 779 (2009).
[5] L. Bravina, I. Lokhtin, L. Malinina, S. Petrushanko, A. Snigirev, and E. Zabrodin, The European Physical Journal A 53, 219 (2017).
[6] S. Pandey, S. K. Tiwari, and B. K. Singh, Phys. Rev. C 103, 014903 (2021).
[7] S.Pandey and B. K. Singh, J. Phys. G 49 (2022) 9, 095001.