Elliptic and triangular flows of reconstructed jets in Pb+Pb collisions at $\sqrt{S_{NN}}=2.76$TeV in a multiphase transport model

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Introduction

The recent studies of higher orders of harmonic flow, especially for triangular flow $v_3$, have deepened our understanding of many aspects of high energy heavy-ion collisions. It would be interesting to study the third order of anisotropy $v_3$ of reconstructed jets, as it serves as the jet response to the initial geometry triangle which could provide a greater constraint on jet quenching models.

In this poster, the elliptic anisotropy $v_2$ and triangular anisotropy $v_3$ of reconstructed jets are investigated in Pb+Pb collisions at $\sqrt{S_{NN}}=2.76$TeV within a multiphase transport (AMPT) model. We observe that the jet energy loss fraction is dependent on the azimuthal angle with respect to the different orders of event plane. We further propose azimuthal anisotropies of a reconstructed jet as a good probe to study the initial spatial fluctuations, and expect that jet $v_3$ provides constraints on the path-length dependence of jet quenching models.

The AMPT Model

The AMPT model with string melting scenario is utilized in this work. It consists of four main stages of high-energy heavy-ion collisions: the initial condition, parton cascade, hadronization, and hadronic rescatterings. In order to increase the simulation efficiency of jets with $p_T>45$GeV/c, a dijet of $p_T>40$GeV/c is triggered in the initial condition based on the HIJING model.

Jet reconstruction

To reconstruct jets, the kinematic cuts are chosen to be the same as in the ATLAS experiment. An anti-$k_T$ algorithm from the standard FastJet package is used to reconstruct full jets, in which the jet cone size $R$ is set to be 0.2.

A pseudorapidity strip of width $\Delta\eta=1.0$ centered on the jet position, with two highest-energy jets excluded, is used to estimate the background (“average energy per jet area”), which is subtracted from the reconstructed jet energy in Pb+Pb collisions. Only jets within a pseudorapidity range of $|\eta|<2$ are considered in this analysis.

Results and Discussions

To calculate the n-th Fourier coefficient $v_n$, the n-th event plane $\Psi_n^\text{jet}$ can be defined as:

$$\Psi_n^\text{jet} = \frac{1}{2\pi} \arctan \left( \frac{r \sin(n\phi)}{r \cos(n\phi)} + \pi \right)$$

where $r$ and $\phi$ are the coordinate position and azimuthal angle of each parton in the AMPT initial condition, and the average of $(-\pi)$ denotes density weighting. Then the n-th harmonic coefficient of jets $v_n^\text{jet}$, can be obtained by the following equation

$$v_n^\text{jet} = \left( \cos \left( n(\phi^\text{jet} - \Psi_n^\text{jet}) \right) \right)$$

Figs. 2(a) and (b) display the jet $v_3$ is nearly zero in the initial state. However, jet $v_3$ arises from the process of parton cascade, which indicates jet $v_3$ is generated owing to the strong interactions between jet and the paronic medium.

Conclusions

- $v_3$ of a reconstructed jet, which has a smaller magnitude than its $v_2$.
- The dynamical stage evolution of reconstructed jet discloses that jet $v_3$ mostly arises from a strong parton cascade process with little effect from the final stages.
- The ratio $v_3^\text{jet}/v_2^\text{jet}$ increases with $N_{\text{part}}$ in non-central Pb+Pb collisions; furthermore, jet $v_3$ increases with the initial spatial asymmetry $c_3$ for a given centrality bin.
- These behaviors indicate that jet $v_3$ is produced by the strong interactions between jet and the partonic medium with different initial asymmetrical geometry shapes.
- The azimuthal anisotropies of reconstructed jet can be utilized as a good probe to study the initial spatial asymmetry, and imposes constraints on the path-length dependence of jet quenching models.

*more details see Phys. Rev. C 90, 014907(2014)