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FREEZE-OUT AT CONSTANT KNUDSEN NUMBER IN EVENT-BY-EVENT HYDRODYNAMICS*

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We employ a dynamical freeze-out criterion where freeze-out is assumed to happen when the ratio of the expansion rate to the pion scattering rate, *i.e.* the local Knudsen number, reaches a certain value in an ideal fluid hydrodynamical calculation of spectra at RHIC. We find that once the freeze-out Knudsen number is chosen to reproduce the p_{T}-spectra evaluated using freeze-out at constant temperature, the p_{T} differential momentum anisotropies, $v_2(p_{\mathrm{T}})$ and $v_3(p_{\mathrm{T}})$, are similar as well.

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1. Introduction

One of the unknowns in the fluid-dynamical description of heavy-ion collisions is when the matter no longer behaves like a fluid, but begins to behave like free-streaming particles instead. This so-called freeze-out is usually assumed to take place on a hypersurface of constant temperature or energy density, but a more physical approach is to assume that freeze-out takes place on a surface of constant Knudsen number — the ratio of microscopic-to-macroscopic scales of the system. We evaluate the Knudsen number as the ratio of the expansion rate of the system to the scattering rate of particles, and apply this criterion to an ideal-fluid event-by-event analysis of Au+Au collisions at the full RHIC energy ($\sqrt{s_{NN}} = 200$ GeV).

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2. Results

Our model and calculations have been discussed in detail in Ref. [1]. To summarise, we initialise the system using Monte-Carlo Glauber, assume chemical freeze-out at $T_{\mathrm{chem}} = 150$ MeV temperature, and use the s95p-PCE-v1 EoS. To reproduce the measured p_{T} distributions of pions and protons, we use $T_{\mathrm{f}} = 120$ MeV as the freeze-out temperature, and $K = 1.3$ as the freeze-out Knudsen number. The calculated p_{T}-differential momentum anisotropies $v_2(p_{\mathrm{T}})$ and $v_3(p_{\mathrm{T}})$ of pions and protons at 20–30% centrality are shown in Fig. 1. As can be seen, the difference due to the freeze-out criterion is negligible.

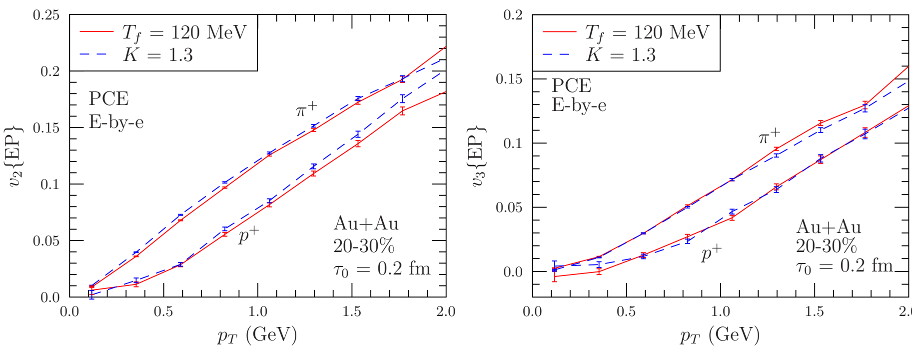

Fig. 1. (Colour on-line) Elliptic (left) and triangular (right) flow of positive pions and protons in $\sqrt{s_{NN}} = 200$ GeV 20–30% central Au+Au collisions from event-by-event hydrodynamical simulations. The solid (red) line corresponds to the results obtained using freeze-out at constant temperature and the dashed (blue) line using freeze-out at constant Knudsen number. Error bars depict estimated statistical errors.

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REFERENCES

[1] S. Ahmad, H. Holopainen, P. Huovinen, `arXiv:1608.03444 [nucl-th]`.