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THE v_2 FLUCTUATIONS IN NeXSPheRIO*

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Using the hydrodynamic code NeXSPheRIO, Au+Au and Cu+Cu collisions at 200 AGeV are studied. By fixing the model parameters adequately, data on pseudo-rapidity and transverse momentum distributions for charge particles are reproduced in the various centrality windows. Reasonable agreement of elliptic flow of these particles is obtained as function of pseudo-rapidity, transverse momentum and centrality. In addition, elliptic flow fluctuations are in agreement with Au+Au data.

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1. Introduction

In the past few years, we have studied several problems with our hydrodynamic code NeXSPheRIO [1–5]. In this work, we want to study elliptic flow fluctuations. Elliptic flow $\langle v_2 \rangle$ teaches us about initial conditions, thermalization, *etc.*, on an average basis. Fluctuations give information on an event-by-event basis, therefore it is a more detailed tool.

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2. The NeXSPheRIO code

NeXSPheRIO is a junction of two codes: NeXus and SPheRIO. The NeXus code [6] is used to compute the initial conditions while the code SPheRIO solves the hydrodynamical equations [7, 8]. The initial energy density of a single NeXus event has blobs of high-density matter. SPheRIO is able to compute the hydrodynamic evolution for such a geometry and predictions can be made for observables. This procedure is repeated for many collisions and in the end average observables are obtained. This should mimic the experimental conditions. In contrast, usual hydrodynamic codes assume smooth initial conditions and are run just once.

3. Adjusting the parameters of the model

Having (briefly) depicted our tool, let us now explain how we fix the parameters of the model and compute the observables of our interest.

Centrality windows are defined as often done experimentally, using participant number and not impact parameter [3]. The initial conditions are fixed so as to reproduce properly the pseudo-rapidity distributions of charged particles in each centrality window [9]. Variations of the freezeout temperature $T_{\rm fo}$ do not affect very much the pseudo-rapidity distributions [9]. To fix this quantity, the transverse-momentum spectra of charged particles are used [9].

4. Results for elliptic flow

In Fig. 1 (top), we show the pseudo-rapidity distributions of v_2 for charged particles, calculated in the three PHOBOS centrality windows for Au+Au, as well as in the centrality window of Cu+Cu. Even though Cu is a smaller system, a reasonable agreement is obtained in both cases for centrality and η dependences. Fig. 1 (bottom) shows the transverse-momentum distribution of v_2 in the mid-rapidity region again for Au+Au and Cu+Cu. While the agreement is reasonable up to large $p_{\rm t}$ for Au+Au, there is a deviation between prediction and data for somewhat smaller $p_{\rm t}$ in Cu+Cu.

Finally, we compare the results for v_2 fluctuations in Fig. 2 with STAR and PHOBOS data. There is a good agreement. In fact the correct order of magnitude for these fluctuations had been *predicted* (at $\sqrt{s} = 130\,\text{GeV}$) by NeXSPheRIO [1]. To understand the origin of these fluctuations, we also computed $\sigma_{\langle\epsilon_{\rm participant}\rangle}/\epsilon_{\rm participant}$ and found that it is fairly closed to $\sigma_{v_2}/\langle v_2\rangle$, as expected.

Recently, STAR announced [14] that their points should be interpreted as an upper limit for $\sigma_{v_2}/\langle v_2\rangle$ and that there are other reasons to expect that this upper limit will be decreased. In this case, it would create difficulty to our approach, as well as we believe various others.

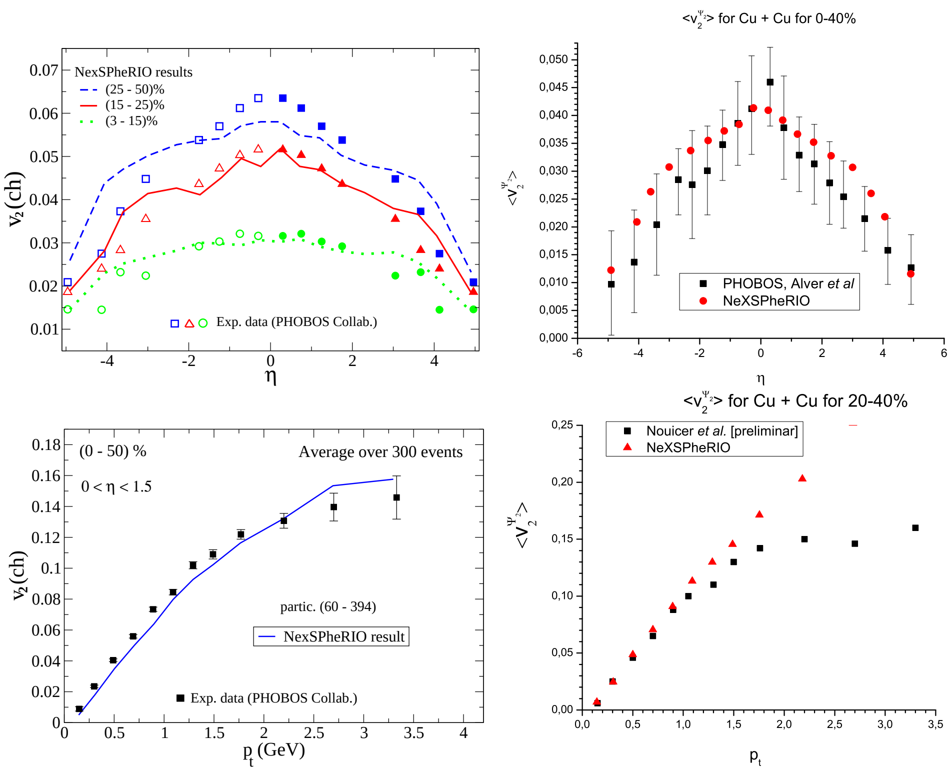

Fig. 1. NeXSPheRIO results for elliptic flow at RHIC compared with data [10]. Left: Au+Au, right: Cu+Cu.

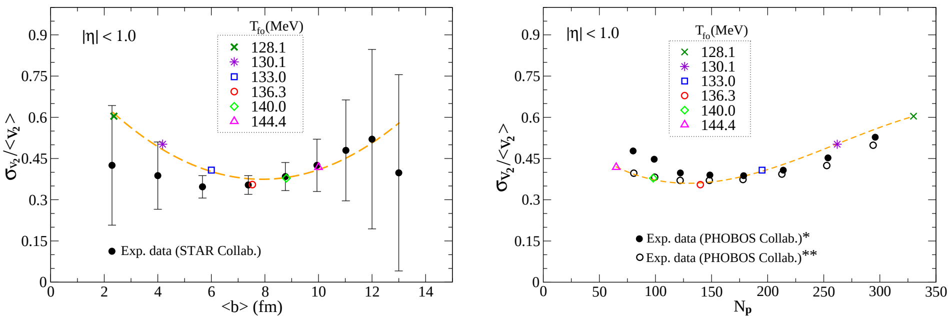

Fig. 2. NeXSPheRIO results for elliptic flow fluctuations at RHIC compared with data [11–13].

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