HADRON OBSERVABLES FROM HADRONIC TRANSPORT MODEL WITH JET PRODUCTION AT RHIC

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The hadronic transport model with jet production is applied to explore heavy ion collision at RHIC energies. Higher hadronic resonance states up to 2GeV are also included in this model to handle hadronic resonance gas system. After showing some results on SPS data, we will show the predictions at RHIC energies. It is found that pQCD like transverse momentum shape becomes exponential at $p_\perp < 4$GeV by hadronic rescattering.

1 Introduction

Relativistic heavy ion collider (RHIC) experiments at Brookhaven National Laboratory have started to explore a new form of matter. Microscopic transport models, for example, RQMD [3] or UrQMD [4] have been well tested at SPS or AGS energies. They have been recognized as a powerful tool to study relativistic heavy collisions. Those models are also used to give some predictions at RHIC [5,6], especially, observables which is considered to be related to the soft physics. Event generators based on perturbative QCD (pQCD) are proposed such as HIJING [1], VNI [2], emphasizing the importance of mini-jet productions.

In this work, the shape of the high momentum part in the transverse momentum distributions will be investigated by the transport model JAM [7]. Particle production in JAM is based on hadronic resonances or strings formation and decay and pQCD hard scattering to simulate large energy range of particle interactions (1GeV $< \sqrt{s} <$ 200GeV). We are interested in the particle spectra affected by the interactions in the hadronic resonance gas stage of the heavy ion collisions.

2 Model description

The main features included in JAM are as follows. (1) At low energies, inelastic *hh* collisions are modeled by the resonance productions based on the idea from RQMD and UrQMD. (2) Above the resonance region, soft string excitation is implemented along the lines of the HIJING model [1]. (3) Multiple

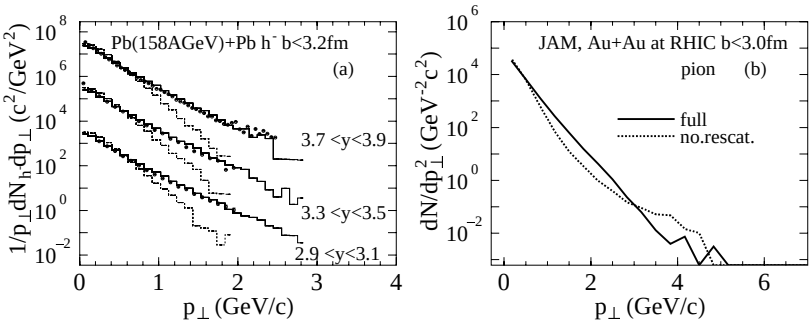

Figure 1. Fig.(a) shows transverse momentum distributions of negative particles (left) in Pb(158AGeV) + Pb, $b < 3.2$fm together with the NA49 experimental data from [10]. (b) shows transverse momentum distributions of pions in Au + Au, $\sqrt{s} = 200$AGeV, $b < 3.0$fm. Solid lines correspond to the JAM results with rescattering among hadrons, dotted lines are for without meson-baryon and meson-meson collisions.

minijet production is also included in the same way as the HIJING model in which jet cross section and the number of jet are calculated using an eikonal formalism for perturbative QCD (pQCD) and hard parton-parton scatterings with initial and final state radiation are simulated using PYTHIA [9] program. (4) Rescattering of hadrons which have original constituent quarks can occur with other hadrons assuming the additive quark cross section within a formation time.

Note that in this calculations, neither nuclear shadowing effects, nor the effect of jet quenching is not included.

3 Results

In Fig. 1(a), we compare JAM results to NA49 experimental data [10] for the central collision of Pb+Pb at 158AGeV. The calculations without meson-baryon and meson-meson interactions (dotted lines) give totally different shape, however it can be seen that the calculations with full rescattering among hadrons well reproduce experimental data. In Fig. 1(b), we give a predictions from JAM calculations on pion distributions with and without rescattering. The shape of the pion transverse momentum below $p_\perp < 3-4$GeV/c becomes exponential from the pQCD like spectrum after hadronic rescatter-

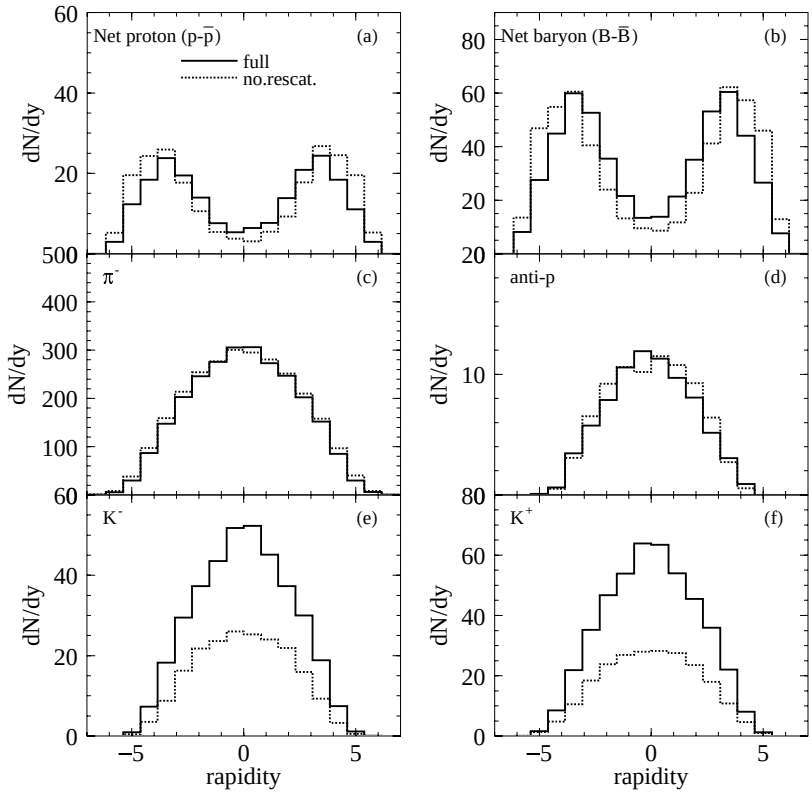

Figure 2. Solid lines denote calculations with full rescattering. Dotted lines denote calculations without any meson-baryon and meson-meson collisions. (a) Rapidity distribution of net protons. (b) Rapidity distribution of net baryons. (c) Rapidity distribution of negative pions. (d) Rapidity distribution of antiprotons. (e) Rapidity distribution of negative kaons. (d) Rapidity distribution of positive kaons.

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Figs. 2 show rapidity distributions of (a) net protons ,(b) net baryons, (c) negative pions, (d) antiprotons, (e) negative kaons, (d) positive kaons in central Au + Au collisions ($b < 3$fm) at $\sqrt{s} = 200$AGeV. Solid lines correspond to calculations with full hadronic rescattering, while dotted lines are for without

meson-baryon and meson-meson interactions. The yield of kaons are largely affected by rescattering. This is consistent with AMPT [8] and UrQMD [6] calculations. We have to care about this increase of the strangeness by hadronic interactions when we discuss about the enhancement of strangeness by QGP formation. We also see that antiproton yield is almost the same after final-state hadronic interactions consisting with AMPT ampt and UrQMD [6].

4 Conclusions

In conclusion, the JAM model has been used to study Au + Au reactions at RHIC energies to give predictions on final hadronic spectra. We saw the effect of rescattering on the transverse momentum spectra at both SPS and RHIC energies. Hadronic rescattering generally increase the slope of the transverse momentum spectra at both SPS and RHIC energies.

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