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Particle production at very low and intermediate transverse momenta in d+Au and Au+Au collisions

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The transverse momentum (p_T) spectra of identified charged particles have been measured at very low and intermediate transverse momenta in Au+Au collisions at $\sqrt{s_{NN}}$ = 62.4 GeV and d+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV using the PHOBOS detector at RHIC. New results on charged particle production at very low p_T in central Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in the centrality intervals 0-6% and 6-15% are presented. A comparison of the PHOBOS low-p_T data with predictions of a recent optical model is shown. The shapes of m_T spectra for d+Au and Au+Au collisions are compared.

1. INTRODUCTION

In nucleus-nucleus collisions, an enhanced production of low-p_T particles could signal new long-wavelength physics phenomena [1,2]. It is also expected that yields of particles with higher masses, like protons and antiprotons can be modified due to collective transverse expansion of the system [3,4]. Measurements at very low p_T can also provide a critical test for models predicting a pronounced modification of the low-p_T particle emission pattern, see e.g. [5].

The PHOBOS experiment has the unique capability to measure charged particles at transverse momenta as low as 30, 90 and 140 MeV/c for charged pions, kaons and for protons and antiprotons, respectively, using a multi-layer, magnetic spectrometer. Yields at very low transverse momenta are determined using a reconstruction procedure developed to look for particles which range out in the fifth silicon layer of the PHOBOS spectrometer. A description of the "stopping algorithm" is presented in [6]. At intermediate p_T, particle momentum and charge are obtained from the curvature of particle trajectories in a 2T magnetic field and particle identification is provided by the specific energy loss (dE/dx) in the spectrometer and by Time-of-Flight detectors. Details on tracking, particle identification, event selection and centrality determination in the PHOBOS detector can be found in [7].

2. p_T SPECTRA IN Au+Au COLLISIONS AT $\sqrt{s_{NN}}$ = 62.4 GeV

The preliminary particle yields for $\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$ are presented in Fig. 1 for three centrality intervals: 0-15%, 15-30% and 30-50%. The data are corrected for detector effects (acceptance, efficiency, momentum resolution) and background particles including feed-down from weak decays and secondary particles produced in the beam pipe and detector material. The rapidity coverage of measured yields extends from about 0.4 to 1.4 for $\pi^{\pm}$, from 0.2 to 1.2 for $K^{\pm}$ and

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from 0.2 to 1.1 for p and $\bar{p}$. The preliminary results on antiparticle to particle ratios have been obtained for the 15% most central collisions. The results of 0.84 $\pm$ 0.02 (stat.) $\pm$ 0.08 (syst.) for K^-/K^+ and 0.37 $\pm$ 0.01 (stat.) $\pm$ 0.06 (syst.) for $\bar{p}/p$ fit smoothly into the energy evolution of antiparticle to particle ratios from the AGS up to the highest RHIC energy.

Low-p_T yields of (π^++π^-), (K^++K^-) and (p+$\bar{p}$) near mid-rapidity in Au+Au collisions at $\sqrt{s_{NN}}$ = 62.4 GeV, corrected for detector effects and background particles, are shown in Fig. 2 in the same centrality bins. One can see that (K^++K^-) and (p+$\bar{p}$) yields are quite consistent with extrapolations of blast wave functions (BWF) [4] fitted to the spectra at higher transverse momenta. Some disagreement between the measured yield of pions and BWF at low p_T could be attributed to a contribution from resonances which is not included in the model. A similar behavior was observed for p_T yields measured in the 15% most central Au + Au collisions at $\sqrt{s_{NN}}$ = 200 GeV [6], indicating that at both energies no significant enhancement of particle production is observed at very low p_T. Also, a flattening of the (p+$\bar{p}$) spectra down to very low transverse momentum is observed. This could be a consequence of collective transverse expansion of the medium created in heavy ion collisions at RHIC.

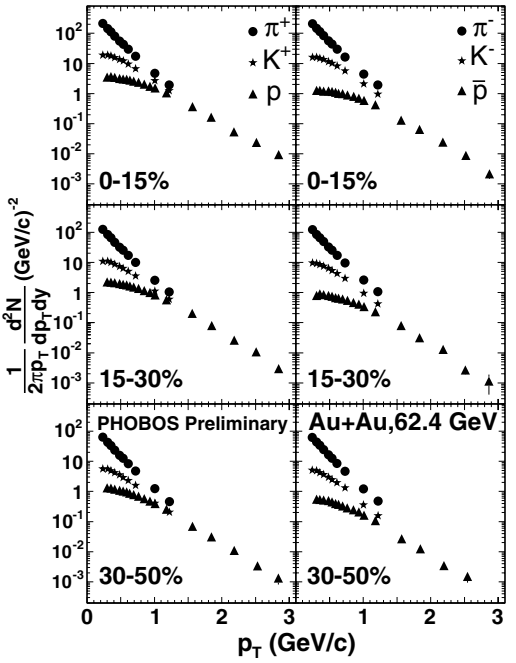

Figure 1. p_T spectra of $\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$ near mid-rapidity in Au+Au collisions at $\sqrt{s_{NN}}$ = 62.4 GeV.

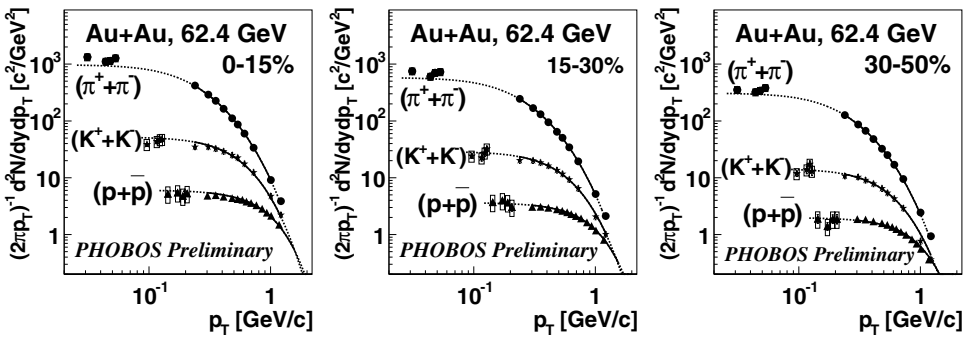

Figure 2. (π^++π^-), (K^++K^-) and (p+$\bar{p}$) yields at very low p_T in Au+Au collisions at $\sqrt{s_{NN}}$ = 62.4 GeV. Blast wave fits to the intermediate p_T data (solid lines) are extrapolated to low p_T (dashed lines).