Results from the BRAHMS experiment at RHIC

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Results from the BRAHMS collaboration for Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV are presented, focussing on the measurement of the net-proton rapidity distribution, the determination of the pseudorapidity distribution of charged particles and on the rapidity distributions of pions and kaons.

1. The BRAHMS experiment

The BRAHMS detector system [1] consists of two independent magnetic spectrometers that can be positioned over an angular range from 2.3° to 30° (forward spectrometer, FS) and from 30° to 90° (midrapidity spectrometer, MRS) with respect to the beam line. The spectrometers are used to fully identify charged particle over a large range in rapidity y, and transverse momentum p_t. Due to the small solid angle of each spectrometer (6 msr and 0.5 msr, respectively) the acceptance must be explored through numerous combinations of angular and field settings.

The BRAHMS experiment has four different global detector systems. The Beam-Beam Counters (BB) measure charged hadrons in the pseudorapidity range of $2.1 < |\eta| < 4.7$. The Zero Degree Calorimeters (ZDC) measure non-interacting neutrons from the collisions. The time difference between the two ZDC signals allows a determination of the collision vertex with a precision of $\approx$ 2.5 cm. A scintillator tile multiplicity array (TMA) measures charged particle emission in the central pseudorapidity region ($-2.0 < \eta < +2.0$) and is used for centrality selection and determination of the multiplicity of charged particles as a function of pseudorapidity. A silicon multiplicity array (SiMA) ($-2.2 < \eta < +2.2$) provides additional information on charged particle multiplicity in the central region. Due to the spread in collision vertices these two arrays provide charged particle multiplicity information for $-3 < \eta < +3$; combined with the beam-beam information the three arrays cover the range $-4.7 < \eta < +4.7$.

2. Stopping

Stopping, the slowing down of incoming nucleons, is a measure of the conversion of the incoming longitudinal energy of a projectile and target into transverse degrees of freedom. BRAHMS is well suited to study the mechanism underlying the stopping of the baryons of the colliding nuclei due to its ability to identify particles over a broad range in rapidity. Fig. 1 shows the measurement [8] of the net-proton distribution at RHIC energies. The rapidity density is about 8 at midrapidity, stays constant for approximately $\pm$ 2 units of rapidity and increases to about 17 at $y = 3$, a value close to midrapidity densities at the SPS. The data point at $y = 3$ is derived from an extrapolation in m_T; a p_T extrapolation would give a 25% higher yield.

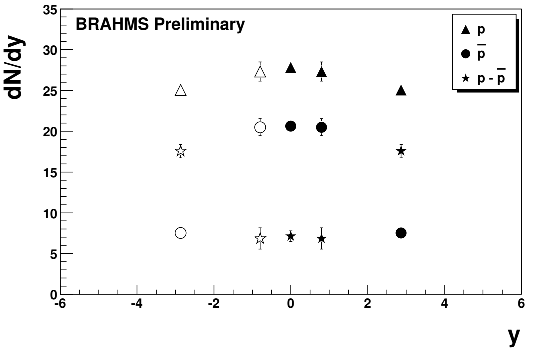

Figure 1. Rapidity distribution of net protons (p - $\bar{p}$) for central (10%) Au+Au collisions at RHIC.

3. Pseudorapidity densities of charged particles

Fig. 2 shows the pseudorapidity density distributions for different collision centralities for $100AGeV + 100AGeV$ Au+Au collisions. In fig. 3

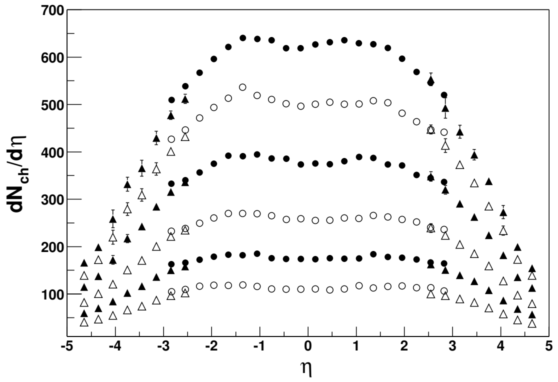

Figure 2. Distributions of $dN_{ch}/d\eta$ vs η for centrality ranges of, top to bottom, 0-5%, 5-10%, 10-20%, 20-30%, 30-40%, and 40-50% at $\sqrt{s_{NN}}$ = 200 GeV. Statistical uncertainties are shown where larger than the symbol size.

one can see the charged particle densities normalized to the number of participant pairs $N_{part}/2$ for the two RHIC energies. Data are plotted as a function of pseudorapidity and shifted by the beam rapidity. Data from 9.4% central Pb+Pb reactions at CERN-SPS are also shown [4]. The figure illustrates that the particle production is practically identical at rapidities closer to the beam rapidity. This supports the notion of a limiting behavior of particle production in the fragmentation region [2,3].

4. Rapidity dependence of ratios and yields of identified particles

Fig. 4 shows the rapidity dependence of various antiparticle/particle ratios [6]. The $N(\bar{p})/N(p)$ ratio drops when going to forward rapidities, the $N(K^-)/N(K^+)$ ratio follows this trend while the $N(\pi^-)/N(\pi^+)$ ratio stays constant. Fig. 5 shows the rapidity spectra of charged pions and kaons [7,9]. All peak at midrapidity, and the K$^-$ distribution is narrower than that of K$^+$.

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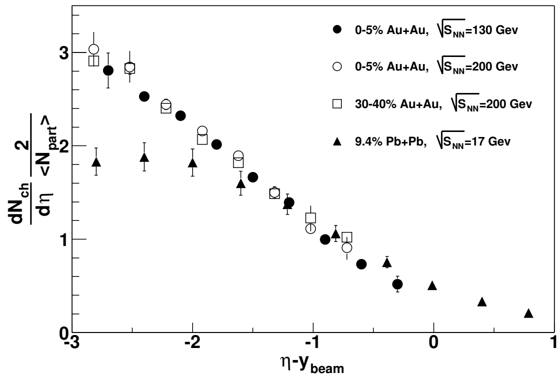

Figure 3. Distribution of $dN_{ch}/d\eta$ divided by the number of pairs of participant baryons plotted as a function of pseudorapidity minus beam rapidity for BRAHMS data at $\sqrt{s_{NN}} = 130$, 200 GeV and SPS data.

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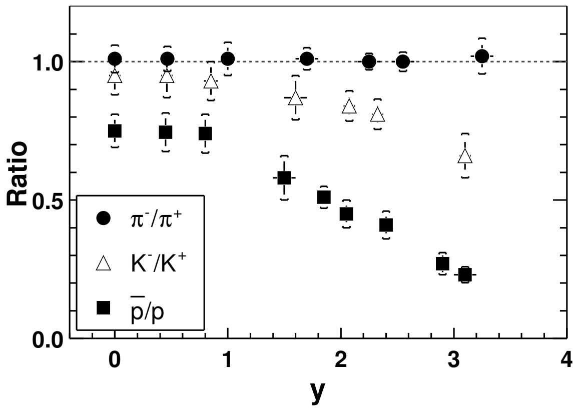

Figure 4. Rapidity dependence of the $N(\bar{p})/N(p)$, $N(K^-)/N(K^+)$ and $N(\pi^-)/N(\pi^+)$ ratios for central (20%) Au+Au collisions.

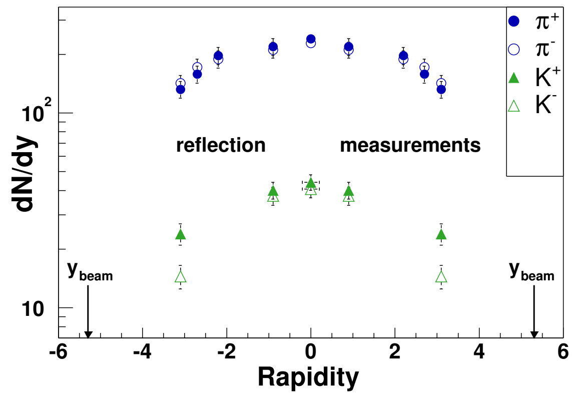

Figure 5. Preliminiary rapidity spectra of charged pions and kaons for central (10%) Au+Au collisions.