

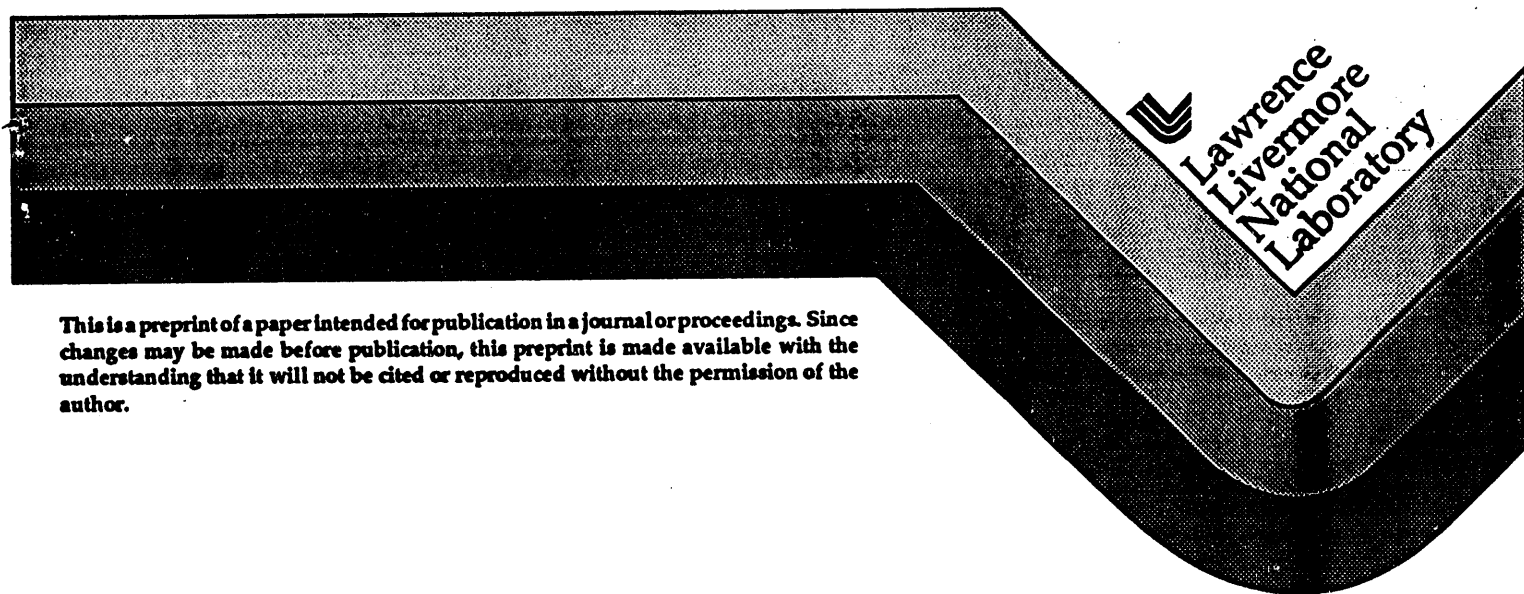
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Backward Emission of Protons in Au+Au Collisions at 11.7 A.GeV/c

Presented by M.N. Namboodiri (LLNL) for the E802 Collaboration

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We present preliminary results for the emission of target rapidity protons in minimum bias and central 11.7 A.GeV/c Au+Au collisions. The data span the pseudo-rapidity range $|\eta| \leq 0.76$ and proton kinetic energy range of $50 \leq E \leq 200$ MeV. The slopes of the kinetic energy spectra and $dN/d\eta$ values for central and minimum bias collisions are strikingly similar. Comparison of the results to results for Si+Au and p+A shows that the shape of the $dN/d\eta$ distribution is independent of the reaction system or centrality suggesting that the spectator matter does not play a decisive role in determining the shape of the proton distributions at back angles for these systems at AGS energies.

We have recently reported preliminary results, from Experiment 859 at the AGS, on the emission of target rapidity protons in Si+Au collisions at 14.6A GeV/c^{1,2}. In

Preliminary E866 Au+Au Proton Spectra

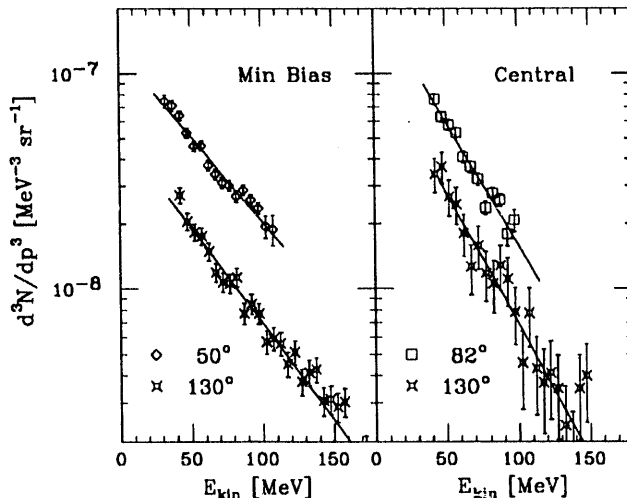


Fig. 1: Proton kinetic energy spectra from Au+Au central and minimum bias collisions.

this paper we present preliminary results for target rapidity protons in minimum bias and central Au+Au collisions at 11.7 A.GeV/c. These measurements, which cover a pseudorapidity range $|\eta| \leq 0.76$, were made using the E859/866 Phoswich array at the AGS. Since emission of protons at $\theta > 90$ degrees cannot arise from simple free nucleon-nucleon collisions, our results serve to constrain and quantify multiparticle processes such as rescattering of protons in the target spectator matter.

The Phoswich array consists of 42 ΔE -E scintillator telescopes. A detailed description of the array and its performance has been published elsewhere³. The modules, mounted approximately 65 cm from the target, subtend a polar angular range of 50–130 degrees and an azimuthal range of 24 degrees. The ΔE -E and time-of-flight information allow the separation of “neutrals” (gammas and neutrons), charged pions, protons, deuterons and tritons over a broad range of kinetic energy (up to 220 MeV for protons). The lower energy threshold for proton detection (25–45 MeV) is mainly determined by the energy loss in the target (944 mg/cm² Au). Unambiguous determination of the proton energy is possible for energies up to 110–220 MeV, depending upon the angle.

Fig. ?? shows the proton momentum density distribution, d^3N/dp^3 , at fixed laboratory angles as a function the proton of kinetic energy for central and minimum bias Au+Au collisions. Central collisions were selected by requiring that the kinetic energy of projectile spectators recorded in the Zero-Degree Calorimeter⁴ not exceed a preset value corresponding to about 4 percent of the interaction cross section. The cross sections were normalized per event (systematic scale uncertainty $\leq \pm 15\%$) and have been corrected for energy loss, target-out contributions, proton identification efficiency, and geometrical acceptance. Corrections for background have also been made as a function of angle and kinetic energy. We have fit the spectra to exponentials in the proton kinetic energy for $E_{kin} \geq 50$ MeV as shown by the solid lines in Fig. 1. The inverse slopes, shown in Fig. 2a, vary from 35 to 60 MeV, the values for minimum bias collisions being slightly

Preliminary E859/E866 Results

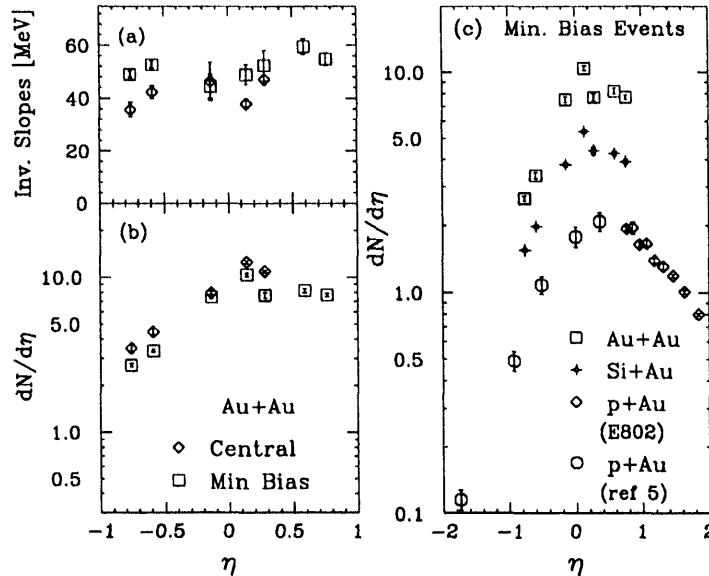


Fig. 2: (a) Inverse slopes for protons from Au+Au at 11.7 GeV/c; (b) Proton pseudorapidity density distributions for Au+Au; (c) Comparison of pseudorapidity distributions for minimum bias events from different systems.

higher than those for central collisions. The $dN/d\eta$ distribution of protons is determined by integrating the kinetic energy spectra, assuming that each proton spectrum is a single exponential from zero to infinite kinetic energy with a slope given by the fit over the measured portion of the spectrum. The results are given in Fig. ??(b). The systematic uncertainty in the $dN/d\eta$ from the extrapolation is estimated to be $\leq 25\%$.

It is seen that the absolute yield of protons per collision is very similar for central and minimum bias collisions. This is in contrast to the case of Si+Au collisions, where the $dN/d\eta$ values in central collisions are about three times higher than in minimum bias collisions^{1,2}.

In Fig. 2c, the minimum bias $dN/d\eta$ distribution for Au+Au from the present experiment is compared with the preliminary results for Si+Au obtained in E859. The shape of the $dN/d\eta$ distribution does not depend significantly on the target projectile combination. It is also interesting to compare the present results with those for p+A collisions. Abbot *et al.*⁵ have reported results for p+A at 14.5 GeV obtained using the E802 spectrometer at forward angles. We replot their data in terms of $dN/d\eta$ values in Fig. 2c for $|\eta| \geq 0.76$. Experimental results on backward protons from p+A collisions at the AGS energies are scanty. However, it has been shown that the shapes and magnitudes of proton spectra at back angles depend only weakly on target mass and incident projectile momentum⁶. Bayukov *et al.*⁶ have reported proton spectra from the reactions of 400 GeV protons on targets ranging from Li to Ta under minimum bias conditions. They show that the proton spectra (expressed as invariant cross section per nucleon) at 160 deg. from p+C and p+Cu at 8 and 400 GeV were indistinguishable in shape and magnitude. Fitting their proton spectra from p+A at 400 GeV⁶ in the same manner as the data from Si+Au and using the smooth target dependence of the resulting $dN/d\eta$ values, the

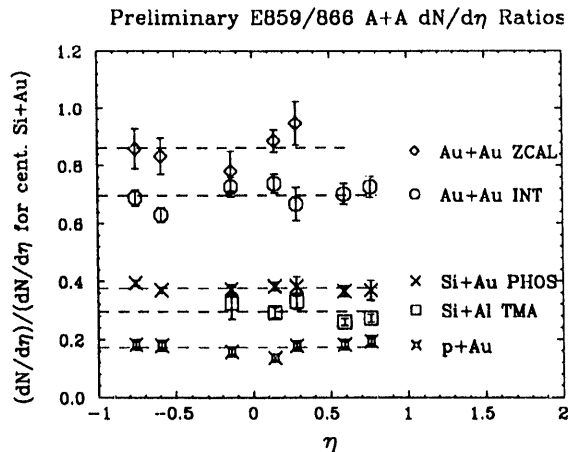


Fig. 3: Ratio of $dN/d\eta$ for different target projectile combinations to the $dN/d\eta$ for central Si+Au collisions plotted as a function of η . ZCAL and TMA are central triggers and INT is minimum bias.

$dN/d\eta$ for p+Au reaction can be obtained by extrapolation. These results are also shown in Fig. 2c. They match the forward angle data from E802 quite well. The p+Au $dN/d\eta$ distribution at back angles has the same shape as the distributions for Si+Au. The similarity in the shapes of the distributions is underscored by the comparison given in Fig. ??, which shows the ratio of $dN/d\eta$ distributions for different systems to that for Si+Au central collisions. Preliminary results from E859 on central Si+Al are also included. It is seen that the ratio for each system is essentially independent of angle. The shape of the pseudorapidity distributions is independent of the reaction system or centrality. This insensitivity suggests that the spectator matter does not play a decisive role in determining the shape of proton distributions at back angles for these reaction systems at AGS energies.

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