

Kinetic freeze-out at RHIC

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At RHIC, particle transverse momentum (p_T) distributions have been measured in $^{197}\text{Au}+^{197}\text{Au}$ collisions at $\sqrt{s_{NN}} = 130$ GeV for a vast variety of particle species. This allows a systematic study of the transverse collective expansion at an so far unprecedented energy region in heavy-ion collisions.

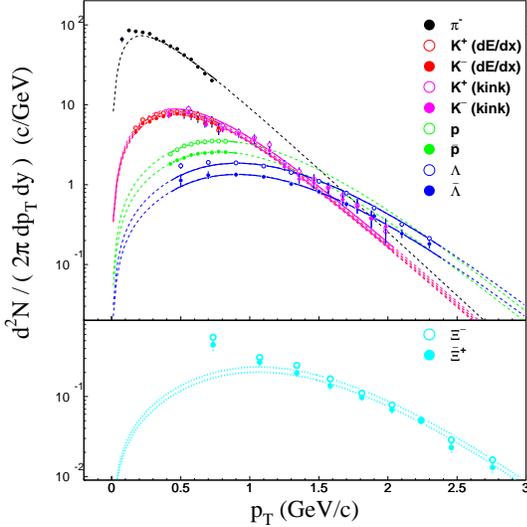


Figure 1: STAR preliminary transverse momentum distributions of π^- , K^\pm , p , \bar{p} , Λ , $\bar{\Lambda}$ (upper panel) and Ξ^- , Ξ^+ (lower panel). The lines show results from hydrodynamically motivated fits.

Figure 1 shows the measured p_T distributions for π^- , K^\pm , p , \bar{p} , Λ , $\bar{\Lambda}$ (upper panel) and Ξ^- and Ξ^+ (lower panel). In a simple hydrodynamic picture¹, the transverse momentum distribution for each particle species can be characterized by a thermal temperature T_{fo} and a collective transverse expansion β_t . The lines in Fig. 1 show fit results to the experimental data in the framework of such a model. As one can clearly see, with one set of parameters ($T_{fo}=110$ MeV, $\langle\beta_t\rangle=0.55 c$), the p_T distributions of π^- , K^\pm , p , \bar{p} , Λ and $\bar{\Lambda}$ are well described (upper

Footnotes and References

¹S. Esumi, S. Chapman, H. van Hecke, and N.Xu, Phys. Rev. **C55**, R2163(1997); E. Schnedermann, J. Sollfrank, and U. Heinz, Phys. Rev. **C48**, 2462(1993).

panel). This indicates a collective motion among those particles. However, the fit results for double strange baryons (Ξ^- and Ξ^+) deviate from the experimental data (lower panel).

The extracted mean transverse momentum $\langle p_t \rangle$ as a function of particle mass is shown in Fig.2. The solid lines show the fit results with/without collective expansion. Some of the feature one see here are similar to what has been observed at SPS energy heavy ion collisions².

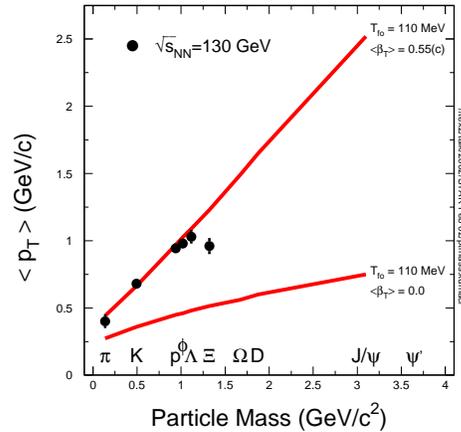


Figure 2: Measured mean transverse momentum $\langle p_t \rangle$ as a function of particle mass (data points).

Comments: (i) The effect of radial flow is somewhat stronger at this RHIC energy than those from CERN SPS energies; (ii) The freeze-out temperature parameters are similar for both RHIC and SPS collisions; (iii) Multi-strange baryons show a clear deviation from the collective line indicating they freeze-out relative earlier than other lighter hadrons. Multi-strange baryons and charmed particles are, therefore, carrying dynamical information at relatively early stage of the heavy ion collision.

Footnotes and References

²I. Bearden *et al.* (NA44 Collaboration), Phys. Rev. Lett. **78**, 2080 (1997); H. van Hecke, H. Sorge, and N. Xu, Phys. Rev. Lett. **81**,5764 (1998).