STRANGE HADRON FLOW IN 2–8 AGEV SEMI–CENTRAL AU+AU COLLISIONS

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In recent experiments at the AGS, the E895 Collaboration has made detailed measurements of neutral strange particle (K_s^0 and Λ) sideward flow over the energy range 2–8 AGeV. Preliminary results indicate that the K_s^0 displays a negative sideward flow pattern, suggesting that the kaon vector potential plays an important role in kaon propagation in high-density nuclear matter. The Λ's flow in the same direction as the protons, although with smaller magnitudes. RQMD calculations underpredict the observed Λ sideward flow, showing the importance of the attractive mean field potential for Λ in-medium propagation.

1 Introduction

Strange particles have long been upheld as potential probes of the high-density nuclear matter created in relativistic heavy ion reactions. In particular, Li [1] has claimed that the flow behaviour exhibited by strange particles is sensitive to their interaction with nuclear matter. It can yield information on such fundamental issues as chiral symmetry restoration as well as neutron star dynamics [2,3,4,5]. Motivated by these suggestions, the E895 Collaboration has performed detailed measurements of neutral strange particle flow at the Alternating Gradient Synchrotron (AGS) at Brookhaven National Laboratory for Au+Au reactions at 2–8 AGeV.

2 V0 Reconstruction and Invariant Mass Spectra

The main detector used was the EOS Time Projection Chamber (TPC), located at the center of a uniform magnetic field of 3/4 T for 2AGeV beam and 1 T for 4, 6 and 8 AGeV. The TPC provides continuous 3–D tracking and identification for charged particles with $-1 \leq Z \leq 6$ [6]. Λ and K_s^0 neutral strange particles (collectively referred to as V0's) were reconstructed from their charged particle decays;

$$\Lambda \longrightarrow p + \pi^- \qquad BR \approx 64\% \;\; c\tau \approx 7.8 \text{ cm} \tag{1}$$

$$K_s^0 \longrightarrow \pi^- + \pi^+ \qquad BR \approx 69\% \;\; c\tau \approx 2.7 \text{ cm} \tag{2}$$

Each pair of p π^- (for the Λ) and $\pi^+\pi^-$ (for the K_s^0) was considered and an invariant mass calculated . Thereafter, a neural network was used to separate real V0's from combinatoric background [7,8].

Fig.1 shows invariant mass spectra for K_s^0 and Λ from 2, 4, 6 and 8 AGeV semicentral Au+Au collisions. The good peak to background ratio obtained for the mass spectra establishes the feasibility of strange hadron flow studies with the E895 data set.

3 K_s^0 Sideward Flow

A sample of $\sim$ 210,000 semi-central (b $<$ 8 fm) 6 AGeV Au+Au events, including some $\sim$ 5,500 K_s^0, at a purity of 92%, has been analysed for the K_s^0 sideward flow following the standard transverse momentum analysis technique of Danielewicz and Odyniec [9]. The reaction plane vector [10] for an event was determined and the projection of the momentum of each K_s^0 particle on the reaction plane was obtained. Averaging over all K_s^0 particles as a function of

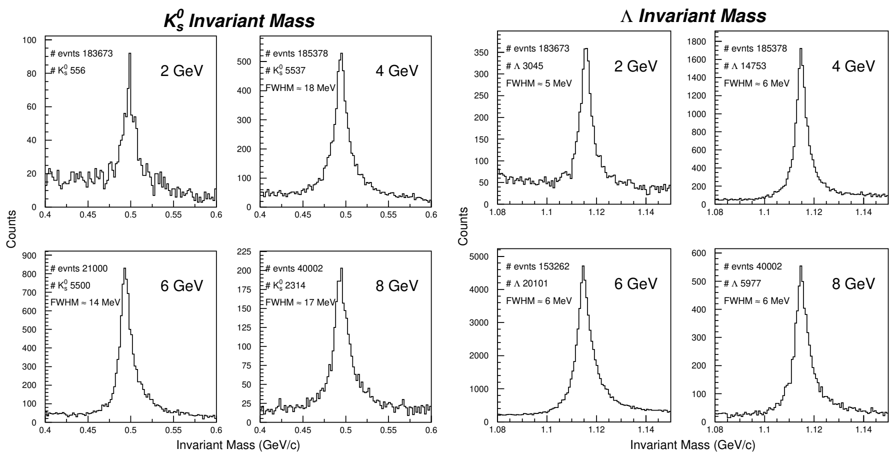

Figure 1: *Figure showing invariant mass spectra for reconstructed K_s^0 (left panel) and Λ (right panel) in 2, 4, 6 and 8 AGeV semi-central Au+Au collisions.*

rapidity gives the flow pattern of K_s^0 shown in Fig.2. The effect of the 8% combinatoric background under the mass peak was removed by a weighted subtraction procedure. The Figure shows that the K_s^0 displays a distinct anti-flow signal compared to protons [11]. One also sees that the RQMD mean field prediction for the K^0 flow fails to reproduce the experimental observation. This points to the fact that rescattering effects, which are present in RQMD, cannot account for the anti-flow signal. Rather, it is more suggestive of the need for a repulsive vector potential to explain kaon propagation inside the nuclear medium. Similar results have been obtained for K_s^0 in 4AGeV Au+Au collisions, although the flow is smaller at the lower energy.

4 Λ Sideward Flow

The same flow analysis procedure was performed for the Λ particles in a sample of $\sim$ 153,000 semi-central (b $<$ 6fm) 6 AGeV Au+Au events. The sample contained $\sim$ 20,000 Λ's at a purity of 93%. Fig.3 shows the flow pattern obtained from this sample. The effect of the 7% combinatoric background has again been removed via the same weighted subtraction procedure used for K_s^0. One sees qualitatively that the Λ's flow in the same direction as the protons (see Fig.3). This is hardly surprising: as RQMD mean field calculations show, rescattering effects are enough to produce a positive flow for the Λ's. However, one also notes that quantitatively, RQMD predicts a smaller flow value (taken

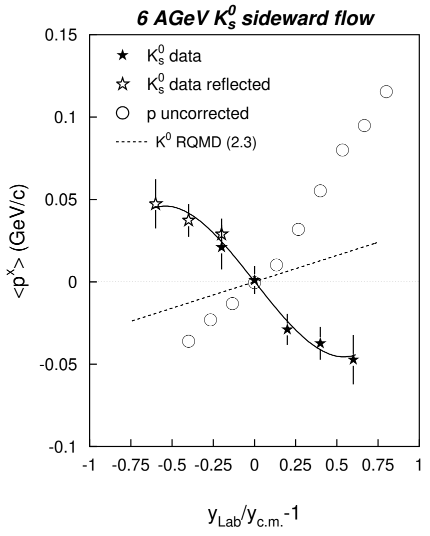

Figure 2: *Figure showing the $< p^x >$ vs normalised centre-of-mass rapidity for K_s^0(stars) (preliminary) and protons (circles) at 6 AGeV. The solid curve is drawn to guide the eye. The proton flow result is not corrected for acceptance losses and contaminations arising from ambiguous particle identification.*

to be the slope at mid-rapidity). The same observation is made for the Λ flow from 2, 4 and 8 AGeV Au+Au collisions. This is very reminiscent of the calculations of Li and Brown [12] which show that the presence of an attractive mean field potential for the Λ's increases the flow of Λ's beyond what can be obtained from rescattering only. Thus, the increased flow of the Λ's, relative to RQMD predictions, might be attributed to the propagation of the Λ's in an attractive in-medium mean field potential.

5 Summary

The E895 Collaboration has measured neutral strange particles flow at AGS energies. The transverse momentum flow analysis shows that K_s^0's display an anti–flow pattern relative to protons. This observation is consistent with the K^0's being subjected to a repulsive vector potential. On the other hand, the Λ's flow with the protons with a magnitude which suggests that they experience an attractive in-medium potential.

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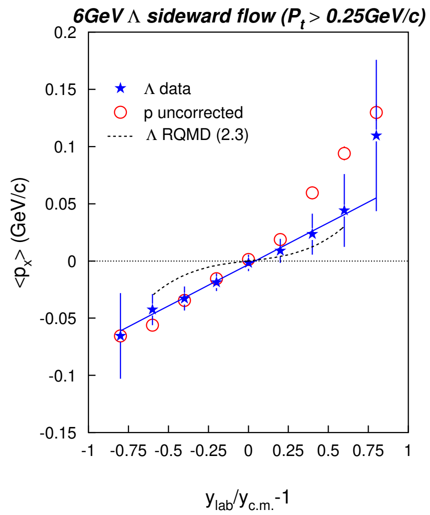

Figure 3: *Figure showing* $< p^x >$ *vs normalised cm rapidity for 6 AGeV* Λ *(stars) (preliminary) and protons (circles) in the same events. the solid curve is drawn to guide the eye. The proton flow result is not corrected for acceptance losses and contaminations arising from ambiguous particle identification.*

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