Elliptic Flow of K_S^0 and Λ in Au + Au Collisions at 200 GeV

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The goal of ultra-relativistic heavy ion collisions is to create a new form of the matter, which is believed to exist at early universe. The momentum space anisotropy of produced particles converted from initial spatial anisotropy may shed light on the early stage information of the system. The azimuthal anisotropy in momentum space is quantified by the coefficients of the Fourier decomposition of the azimuthal particle distribution with respect to the reaction plane. The second harmonic coefficient v_2 is called elliptic flow. Due to self quenching effect, elliptic flow is sensitive to the early stage of dense system created in ultra-relativistic heavy ion collisions [1]. Elliptic flow of (multi-)strange particles may be possible to provide unique insight into partonic stage due to their small hadronic cross sections different from non-strange particles [2]. Recent measurements at RHIC observe mass ordering at low p_T, which is predicted by hydrodynamic model [3] and Number-of-Quark scaling at intermediate p_T [4], which many theoretical models try to explain [5].

Using the STAR TPC tracks at RHIC, K_S^0 and Λ are reconstructed via their decay topology $K_S^0 \to \pi^+ + \pi^-$ and $\Lambda \to p + \pi^-$. Cuts on geometry, kinematics and particle identification via specific ionization are applied to reduce combinatorial background. The reaction-plane angle is estimated from the azimuthal distribution of primary tracks, which is from the collision vertex [6] with $0.1 < p_T < 2.0$ GeV/c and $|\eta| < 1.0$, where η is the pseudorapidity. To avoid autocorrelations, tracks associated with a K_S^0, Λ decay vertex are excluded from the calculation of reaction plane. In this analysis, we use 11 million 0-80% events from high statistics Run IV.

Panel (a) in Figure 1 shows elliptic flow v_2 as a function of (m_T – mass) for K_S^0 (red circles) and Λ (blue squares) for minimum bias in Au + Au collisions at 200 GeV. v_2 is plotted in (m_T – mass) scale instead of usual p_T scale. We can see at low (m_T – mass) region (< ~ 0.5 GeV/c^2), v_2 of K_S^0 and Λ follow the same line while mass ordering in p_T scale disappears. This feature strongly refers to the picture in which all particles co-move with the same velocity (collectivity). Hydrodynamic calculation also indicates this behavior. At intermediate (m_T – mass) region (~ 0.5 – 3.0 GeV/c^2) , Λ exhibits larger v_2 than K_S^0. At high (m_T – mass) (> ~ 3.0 GeV/c^2), both K_S^0 and Λ v_2 tend to saturate(or decrease). Both v_2 and (m_T – mass) scaled by Number-of-Quark are shown in Panel (b) of Figure 1. NQ is equal to 2 and 3 for K_S^0 and Λ, respectively. At intermediate (m_T – mass), NQ scaling is observed

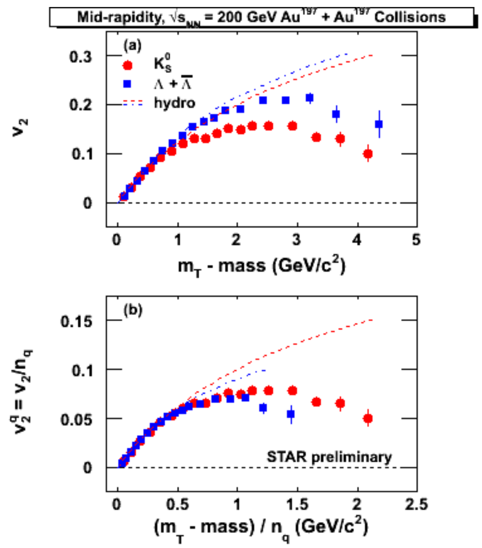

Figure 1, panel (a) shows v_2 as a function of (m_T – mass) for K_S^0 (red circles) and Λ (blue squares) in mid rapidity from 200 GeV Au + Au minimum bias collisions. Panel (b) shows Number-of-Quark scaling. Only statistical uncertainty is included in errors.

as it is observed at intermediate p_T. Recently, string-hadron transport model challenges the coalescence/recombination interpretation of observed NQ scaling [5].

In summary, m_T-scaling is observed for K_S^0 and Λ at low (m_T – mass) region as indicated by hydrodynamic calculation. NQ scaling at intermediate (m_T – mass) is similar to that at intermediate p_T.

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