Elliptic Flow of Strange-hadron K_S^0 and Λ in Au + Au Collisions at 200 GeV — high statistics Run IV

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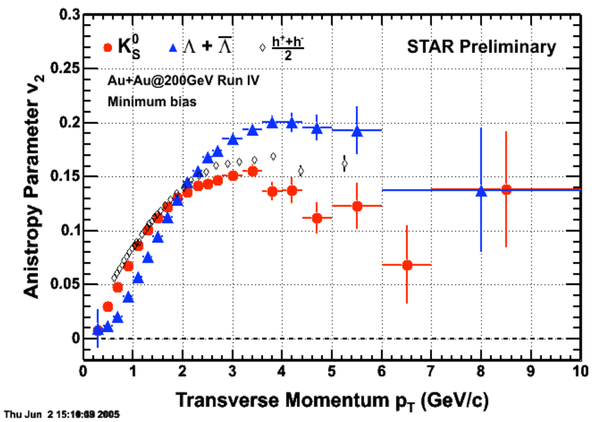

Figure 1: v2 as a function of transverse momentum p_T for K_S^0 (filled circles) and Λ (filled triangles) from 200 GeV Au + Au minimum bias collisions. The charged hadron v_2 is from [4]. Only statistical uncertainty is included in the errors.

Elliptic flow, due to its self quenching nature, is sensitive to the early stage of the dense system created in ultra-relativistic heavy ion collisions [1]. Because (multi-) strange hadrons have smaller hadronic cross-sections than non-strange hadrons [2], the flavor dependence of elliptic flow can provide insight into the partonic stage of heavy ion collisions. Recent work established that at low p_T v_2 depends on particle mass while at intermediate p_T it saturates and appears to depend on the number of constituent quarks [3, 5, 6]. A scaling law is naturally expected from coalescence or recombination models. Above $p_T \sim 5$ GeV/*c*, with large error, v_2 of K_S^0 and Λ seems to take on a value supported by R_{CP} of K_S^0 and Λ close to that of charged hadrons [3].

Using the STAR TPC at RHIC, K_S^0 and Λ are reconstructed via their decay topology $K_S^0 \rightarrow \pi^+ + \pi^-$ and $\Lambda \rightarrow p + \pi^-$. Cuts on geometry, kinematics and particle identification via specific ionization are applied to reduce combinatorial background. The remaining background is counted for in our analysis procedure. We calculate the elliptic flow parameter v_2 from the particle momentum-space azimuthal angle with respect to the reaction plane. The basic idea of this method is that 1. v_2 of real and background particles is averaged by real particle v_2 and background v_2 according to following equation:

$$v_2^{REAL+BG}(m) = v_2^{REAL} \times \tfrac{REAL}{REAL+BG}(m) + v_2^{BG}(m) \times \tfrac{BG}{REAL+BG}(m)$$

2. v_2 of background is smoothly changing with invariant mass. By measuring the ratio of real and background counts vs. invariant mass and v_2 vs. invariant mass, we can extract v_2 for the real counts. For this analysis, about 11 million minimum bias events are used from Au + Au collisions at 200 GeV.

Figure 1 shows elliptic flow v_2 as a function of p_T for charged hadrons (open diamonds), K_S^0 (filled circles) and Λ (filled triangles) for the minimum bias data set. v_2 of charged hadrons, K_S^0 and Λ first increases with transverse momentum and then saturates or decreases. Up to 6 GeV/*c*, there is a clear particle type dependence. At low p_T, smaller v_2 of Λ than that of K_S^0 is consistent with mass ordering as predicted by the hydrodynamic model [7], which assume local thermal equilibrium. At $p_T \sim 2$ GeV/*c* v_2 of K_S^0 and Λ cross over and continue to increase. v_2 of K_S^0 starts to decrease at $p_T \sim 3.6$ GeV/*c* while v_2 of Λ stays large up to 6 GeV/*c*. At intermediate p_T the K_S^0 and Λ measurements seem to indicate that v_2 doesn't depend on particle mass at this region. These more precise measurements supports the previously suggested baryon to meson dependence which is qualitatively consistent with quark coalescence or recombination models of hadronization. Above $p_T \sim 3.6$ GeV/*c*, K_S^0 v_2 decreases with increasing p_T. Λ v_2 increases with p_T until it reaches its maximum measured value at $p_T \sim 4$ GeV/*c*. The K_S^0 and Λ v_2 may merge for $p_T > 6$ GeV/*c* but with the current statistical errors the measurements remain inconclusive.

REFERENCES

[1] J.-Y. Ollitrault, Phys. Rev. D 46, 229 (1992); H. Sorge, Phys. Rev. Lett. 82, 2048 (1999).

[2] H. van Hecke, H. Sorge, and N. Xu, Phys. Rev. Lett. 81, 5764 (1998).

[3] J. Adams *et al*., arXiv:nucl-ex/0306007.

[4] J. Adams *et al*., arXiv:nucl-ex/0409033.

[5] STAR Collaboration, C. Adler *et al.*, Phys. Rev. Lett. 87, 182301 (2001).

[6] STAR Collaboration, C. Adler *et al.*, Phys. Rev. Lett. 89, 132301 (2002).

[7] D. Teaney, J. Lauret, and E. V. Shuryak, Phys. Rev. Lett. 86, 4783 (2001).