Yields and elliptic flow of $d(\overline{d})$ and $^3He(\overline{^3He})$ in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV

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Ultra-relativistic heavy ion collisions are used to study the behavior of nuclear matter at extreme conditions. Previous measurements [1] indicate that high particle multiplicities and large $\overline{p}/p$ ratios prevail at RHIC. As the hot, dense system of particles cools, it expands and the mean free path increases until the particles cease interacting. At this point, light nuclei like $d(\overline{d})$ and $^3He(\overline{^3He})$ can be formed, with a probability proportional to the product of the phase space densities of their constituent nucleons [2]. Thus, the invariant yields and elliptic flow of light nuclei, compared to the protons production [1] [3] from which they coalesce, provides information about the size of the emitting system and the non-trivial correlations between coordinate- and momentum-space variables.

In Run IV at RHIC, high statistics and the participant of TOF detector allow us to study both yields and elliptic flow for $d(\overline{d})$ and $^3He(\overline{^3He})$ at STAR. In this report, we present the preliminary results of coalescence parameters B_2 and B_3 and v_2 measurements for $d + \overline{d}$ and $^3He + \overline{^3He}$. B_2 and B_3 are calculated by:

$$E_n \frac{d^3N_n}{d^3p_n}\Big|_{p_n = Ap_p} = B_A \left(E_p \frac{d^3N_p}{d^3p_p}\right)^A$$

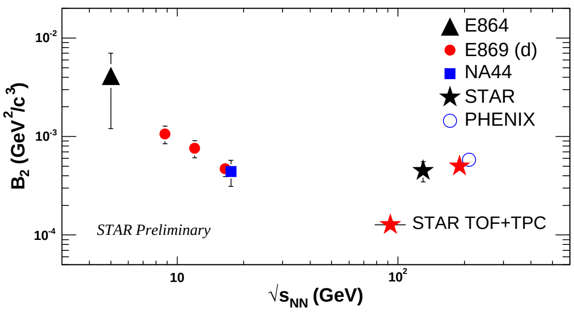

Figure 1: Comparison of the coalescence parameter B_2 for deuteron anti-deuteron with other experiments at different values of $\sqrt{s_{NN}}$.

Fig.1 shows the B_2 measurements in different $\sqrt{s}$ collision systems. As we know, $B_2 \sim V^{-1}$, we can see when $\sqrt{s} > 20\ GeV$, system freeze-out sizes show little energy dependence. Further study also indicates that B_2 and B_3 have strong centrality and p_T dependence. Fig.2 shows the $d + \overline{d}$ and $^3He + \overline{^3He}$ v_2 measurement scaled by number of nucleus (A) in minBias trigger data. For comparison, we put in the $\Lambda + \overline{\Lambda}$ results and the fitted baryon v_2 as references. The deuteron v_2 seems following the A scaling. The helium-3 v_2 is 2σ lower at $3 < p_T < 6\ GeV/c$.

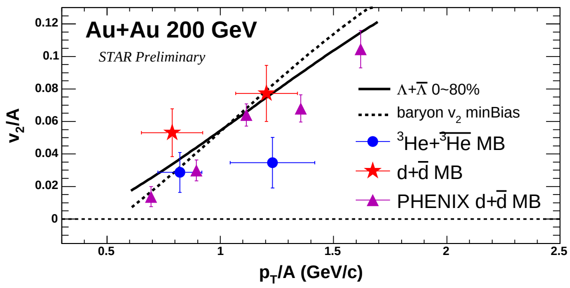

Figure 2: Number of nucleus scaled v_2 as a function of scaled p_T for $d + \overline{d}$ (filled stars) and $^3He(\overline{^3He})$ (filled circles). Scaled $\Lambda + \overline{\Lambda}$ v_2 is shown as solid line. Dashed line shows the baryon v_2 fitted by [4]. PHENIX preliminary deuteron result is shown with filled triangles.

In Summary, B_2 shows little energy dependence when $\sqrt{s} > 20\ GeV$; deuterons v_2 follows the number of nucleus scaling, this is consistent with PHENIX result; at $3 < p_T < 6\ GeV/c$, helium-3 v_2 is 2σ lower than the A scaling value.

References

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[4] X. Dong *et al.*, Phys. Lett. **B597** 328-332 (2004).