Collectivity in heavy ion collisions from RHIC - STAR BESII

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In heavy-ion collisions, directed flow (v_1) and elliptic flow (v_2) represent the first and second harmonic coefficients in the Fourier expansion of the final-state particle azimuthal distribution. These coefficients are sensitive to the equation of state (EoS) and the degrees of freedom in the produced medium. Measuring v_1 and v_2 of identified particles provides a powerful tool for investigating the properties of nuclear matter created in heavy-ion collisions.

With the enhanced statistical datasets from the second phase of the RHIC Beam Energy Scan (BES-II) program at STAR, we will present measurements of v_1 and v_2 for a range of hadrons, including $\pi^{\pm}$, $K^{\pm}$, K^0s, p, $\bar{p}$, ϕ, Λ, $\bar{\Lambda}$, $\Xi^{\pm}$, and $\Omega^{\pm}$ at $\sqrt{sNN}$ = 3.0 - 19.6 GeV.

Additionally, we will present the scaling of the Number of Constituent Quarks (NCQ) for both particles and anti-particles. The NCQ-scaled v_2 ratios of π^+/K^+, p/K^+, π^-/K^-, $\bar{p}/K^-$, ϕ/K^-, Λ/K^0s, and $\bar{\Lambda}/K^0s$ will also be discussed over the range of $\sqrt{s_{NN}}$ = 3.0 - 19.6 GeV.

Furthermore, negative v_1 slopes for kaons are observed in the low p_T region ($p_T < 0.6$ GeV/c). A comparison with JAM model calculations, both with and without spectators, suggests that the observed kaon anti-flow at low p_T can be explained by the shadowing effect of spectators in non-central collisions within the high baryon density region.

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