Systematic study of small system collectivity from STAR

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How collectivity originates and evolves with collision system size is a highly debated topic in the heavy ion community. To address this, we propose the study of collision systems with decreasing system sizes: Ru+Ru/Zr+Zr > ^{3}He+Au > d+Au > p+Au > p+p > γ+Au.

We present results on the elliptic (v_2) and triangular (v_3) anisotropy on p+Au, d+Au and ^{3}He+Au collisions at 200 GeV with a comprehensive evaluation of the non-flow effects using different subtraction methods with the minimum-bias p+p collisions as a reference. We find v_3 to be weakly dependent on the system and centrality. This puts constraints on shape engineering at nucleon scale and provides strong evidence of fluctuations at the sub-nucleon scale.

In addition to the results obtained from the mid-rapidity acceptance ($|\eta|$ <1), we also use the Event Plane detector over 2.1< $|\eta|$ <5.1 to investigate the potential influence of longitudinal flow de-correlations using peripheral Ru+Ru/Zr+Zr data.

Our key addition of photo-nuclear (γ+Au) processes can push the boundaries of small systems scan at RHIC. Measurements on long-range di-hadron correlations and harmonic anisotropy coefficients in high activity γ+Au-rich events are presented to search for evidences of collectivity.