Measurement of nuclear deformation in relativistic heavy-ion collisions at STAR

Chunjian Zhang[1], for the STAR Collaboration

[1] *Department of Chemistry, Stony Brook University, Stony Brook, NY 11794, USA*

Contact e-mail: chun-jian.zhang@stonybrook.edu

The isobar ^{96}Ru+^{96}Ru and ^{96}Zr+^{96}Zr collisions, arguably, the most unique colliding mode so far in high energy experiments, provide a valuable experimental test of nuclear structure. In this talk, we will present the precision measurements of bulk observables such as flow coefficients v_n, mean transverse momentum $[p_T]$ fluctuations (mean, variance, skewness, and kurtosis), and their Pearson correlation coefficients $\rho(v_n^2, [p_T])$ from large systems ^{238}U+^{238}U and ^{196}Au+^{196}Au to isobaric systems ^{96}Ru+^{96}Ru and ^{96}Zr+^{96}Zr collisions at $\sqrt{s_{NN}} = 200$ GeV. We will discuss how the significant deviations of the ratios of v_2 and v_3 in Ru+Ru collisions over Zr+Zr collisions from unity are indicative of large quadrupole, octuple deformations, and neutron surface diffuseness in Ru and Zr nuclei, respectively [1]. We will also discuss how the relative enhancement of $[p_T]$-skewness, sign-change of $[p_T]$-kurtosis, and the suppression of $\rho(v_n^2, [p_T])$ in U+U relative to Au+Au collisions are consistent with large prolate deformation of the uranium nuclei. Furthermore, we will discuss how the comparison of such data with state-of-the-art hydrodynamic models infers the shape of the colliding nuclei and quantitatively constrains the nuclear structure parameters.

1. M. Abdallah et al. (STAR Collaboration), Phys. Rev. C 105, 014901 (2022).