

# System size dependence of particle production and collectivity from the STAR experiment at RHIC

Tong Liu, Yang Li, Shengli Huang, Prithwish Tribedy

1 The medium modification to particle spectra and the origin of collectivity  
2 in small collision systems are widely debated topics in our community. To  
3 address these open questions we propose the study of particle production and  
4 collectivity for varying system sizes, presented in decreasing order (Au+Au  
5 > Ru+Ru/Zr+Zr > <sup>3</sup>He+Au > d+Au > p+Au > p+p >  $\gamma$ +Au), available  
6 at RHIC using the STAR detector.

7 We present the first measurements of charged hadron yields in isobar  
8 (Ru+Ru and Zr+Zr) collisions. We perform measurements of identified par-  
9 ticle spectra at low transverse momenta ( $p_T$ ) as a function of rapidity and  
10 event centrality. We also perform the centrality dependent measurements  
11 of nuclear modification factors ( $R_{AA}$ ) at high  $p_T$ . Combined with the exist-  
12 ing results in smaller systems (p/d+Au), these results provide an additional  
13 handle in studying system size and collision geometry dependences of the  
14 medium modification to particle production.

15 We also revisit the measurements of elliptic ( $v_2$ ) and triangular ( $v_3$ )  
16 anisotropies in p+Au, d+Au and <sup>3</sup>He+Au collisions at 200 GeV including a  
17 comprehensive evaluation of the non-flow effects using different subtraction  
18 methods. In addition to the results obtained from the mid-rapidity ( $|\eta| < 1$ ),  
19 we also use the Event Plane Detectors that span over  $2.1 < |\eta| < 5.1$  to in-  
20 vestigate the potential influence of longitudinal flow de-correlations in  $v_n$   
21 measurements using peripheral Ru+Ru and Zr+Zr collisions.

22 Our study of photonuclear ( $\gamma$ +Au) processes using ultra-peripheral Au+Au  
23 data can push the boundaries of small system scan at RHIC. We lastly present  
24 measurements on particle production and long-range di-hadron correlations  
25 in inclusive  $\gamma$ +Au-rich events that are not dominated by hadronic interac-  
26 tions.