Probing the neutron skin and symmetry energy with isobar collisions at $\sqrt{s_{\rm NN}} = 200$ GeV by STAR

Haojie Xu
(For the STAR Collaboration)
Huzhou University
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Neutron skin thickness $\Delta r_{\rm np}$ of nuclei and the inferred nuclear symmetry energy are of critical importance to the equation of state of dense nuclear matter in neutron stars and heavy-ion collisions. The $\Delta r_{\rm np}$ has traditionally been measured by low-energy hadron-nucleus and nucleus-nucleus scatterings over decades. The recent PREX-II measurement using parity-violating electroweak interactions has yielded a large neutron skin thickness of Pb nucleus, at tension with the world-wide data established in hadronic collisions. More recent studies indicate that the neutron skin can also be measured, unconventionally and possibly with better precisions than traditional methods, by colliding isobar nuclei at relativistic energies [1]. The idea is to compare the produced hadron multiplicities ($N_{\rm ch}$) [1], the mean transverse momenta ($\langle p_T \rangle$) [2], and the net charge multiplicities (ΔQ) [3] to trace back the nuclear structure differences between the isobar nuclei. In this talk, we will present results on the $N_{\rm ch}$, $\langle p_T \rangle$, and ΔQ ratios between isobar ($^{96}_{44}$Ru+$^{96}_{44}$Ru and $^{96}_{40}$Zr+$^{96}_{40}$Zr) collisions at $\sqrt{s_{\rm NN}} = 200$ GeV by STAR. We extract the neutron skin thickness and the symmetry energy slope parameter from these data, and discuss our results in the context of the global data on symmetry energy and the tension with the PREX-II data. We also comment on the implication of our results on the baseline for the chiral magnetic effect search in isobar collisions [4, 5].

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