Measurement of ψ(2S) production in Ru+Ru and Zr+Zr collisions at $\sqrt{s_{\rm NN}} = 200$ GeV by the STAR experiment

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Abstract

Charmonia are important probes to study the properties of the quark-gluon plasma (QGP) created in heavy-ion collisions. Measurements from SPS, RHIC, and the LHC experiments show that charmonium production in heavy-ion collisions is affected by the interplay of several effects, including dissociation and regeneration in QGP and cold nuclear matter effects. All these effects strongly depend on the binding energy of the charmonium state. The two charmonium states, J/ψ and ψ(2S), have binding energies that differ by almost a factor 10, providing a great opportunity to study the properties of the QGP through measuring their relative suppression in heavy-ion collisions. In 2018, the STAR experiment recorded about 4 billion isobar collisions ($^{96}_{44}Ru$ + $^{96}_{44}Ru$ and $^{96}_{40}Zr$ + $^{96}_{40}Zr$) at $\sqrt{s_{\rm NN}} = 200$ GeV, a golden dataset for carrying out such measurements.

In this contribution, the first measurement of ψ(2S) production in heavy-ion collisions at RHIC will be presented. J/ψ and ψ(2S) are reconstructed in isobaric collisions via the e^+e^- decay channel with machine learning techniques. Centrality and transverse momentum dependence of the ψ(2S)-to-J/ψ yield ratio will be shown and physics implications will be discussed.