Measurement of J/ψ polarization in Ru+Ru and Zr+Zr collisions at $\sqrt{s_{\rm NN}} = 200$ GeV at STAR

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Abstract

The large scale set by the charm mass means the heavy quark pairs are produced early in heavy-ion collisions and experience the full evolution of the quark-gluon plasma (QGP) created in these collisions. Because of this, J/ψ serves as one of the important probes to study the properties of the QGP. In Ru+Ru and Zr+Zr collisions at $\sqrt{s_{\rm NN}} = 200$ GeV recorded by the STAR experiment, it has been observed that the J/ψ yield is strongly suppressed and its elliptic flow is consistent with zero indicating the J/ψ's strong coupling with the medium and its potentially small regeneration contribution, respectively. Besides those observable, the J/ψ polarization can shed new light on the QGP properties and the J/ψ production mechanism in heavy-ion collisions. For example, it has been hypothesized that the J/ψ polarization can be observed due to the spin-orbit coupling between J/ψ and the QGP's large angular momentum in non-central heavy-ion collisions. The early production of J/ψ also makes its polarization potentially sensitive to the strong magnetic field at the early stage.

In this talk, we will present the first measurement of J/ψ polarization in heavy-ion collisions at RHIC. The study is carried out by reconstructing the J/ψ through its di-electron decay channel in the mid-rapidity ($|y| < 1$) and the J/ψ transverse momentum range of $0.2 < p_T < 10$ GeV/c. The J/ψ polarization parameters are measured in the Helicity frame, Collins-Soper frame and with respect to the event plane. We conclude by presenting the physics implications of this measurement.