Initial electromagnetic field dependence of photon-induced production in isobaric collisions at STAR

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Abstract

Strong electromagnetic field, arising from the Lorentz contraction and a large number of charges (Z) in the colliding nuclei at ultrarelativistic speeds, can generate a large flux of quasi-real photons. Consequent photon-induced interactions could reasonably explain the observed enhancements of J/ψ and e^+e^- pair production at very low transverse momenta (p_T) in peripheral high-energy heavy-ion collisions, via photonuclear ($\propto Z^2$) and photon-photon ($\propto Z^4$) processes. The STAR experiment has collected a large sample of $^{96}_{44}$Ru+$^{96}_{44}$Ru and $^{96}_{40}$Zr+$^{96}_{40}$Zr collisions at $\sqrt{s_{\rm NN}}$ = 200 GeV in 2018. The isobaric collisions, with different number of charges and same number of nucleons in the colliding nuclei, provide a unique opportunity to study the electromagnetic field dependence of photon-induced production.

In this presentation, we will present the first measurement of the electromagnetic field dependence of J/ψ and e^+e^- pair production at very low p_T, via comparisons between the new measurements in isobaric collisions and the published results in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 200 GeV. Furthermore, the angular modulation of dielectron pairs in isobaric collisions, which is related to vacuum birefringence, will also be presented. Physics implications of these results will be discussed.