Investigating quantum interference in Drell-Söding process in Au+Au collisions at $\sqrt{s_{\rm NN}} = 200$ GeV at STAR

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Abstract

Relativistic heavy-ion collisions offer a unique environment for exploring quantum interference at an unprecedented femtometer scale through photon-nuclear interactions in photoproduction. In exclusive $\pi^+\pi^-$ production, the resonance and continuum $\pi^+\pi^-$ components arise from distinct production mechanisms in the γA interaction. The continuum $\pi^+\pi^-$ photoproduction is dominated by Drell-Söding process, in which a virtual π^+/π^- is diffraction-scattered on the nucleus. The $\sim$5% difference in the elastic scattering cross sections of π^-A and π^+A around a γp center-of-mass energy of approximately 12 GeV in photoproduction in 200 GeV Au+Au collisions at STAR may result in destructive interference. The Entanglement Enabled Spin Interference (EESI) in Drell-Söding process may differ from ρ^0 photoproduction due to the absence of the intermediate ρ^0 and the specific dynamics of the virtual pion-nucleus interaction.

In this talk, we will present the first measurement of the diffractive p_T spectrum and the spin interference pattern through the amplitude of the second order final state angular cosine oscillation $A_{2\Delta\phi}$ measurement for the Drell-Söding process in Au+Au collisions at $\sqrt{s_{\rm NN}} = 200$ GeV. The results indicate that Drell-Söding production is a softer process compared to ρ^0 photoproduction. We also observe $A_{2\Delta\phi}$ with no clear mass dependence for $p_T < 0.1$ GeV/c and a notably stronger interference at the same $M_{\pi^+\pi^-}$ in the Drell-Söding process compared to ρ^0 photoproduction, which provides a unique opportunity to explore the effect of production mechanism on the EESI.