

Observation of $\pi^+\pi^-\pi^+\pi^-$ and $\pi^+\pi^-$ final state photoproduction in ultraperipheral heavy-ion collisions at $\sqrt{s_{NN}} = 200$ GeV at the STAR detector

David Thusty (for the STAR Collaboration)

Creighton University, Omaha, NE USA

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Abstract

One of the most pressing questions in both hot and cold QCD communities is what the physics mechanism responsible for modified parton densities in heavy nuclei is. One promising channel to address this question is the photoproduction of vector mesons, which is considered a clean probe to the nuclear parton structures. We present a measurement of $\pi^+\pi^-\pi^+\pi^-$ and $\pi^+\pi^-$ photonuclear production in ultraperipheral Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. The data were collected in 2014 by the STAR experiment. The $\pi^+\pi^-\pi^+\pi^-$ and $\pi^+\pi^-$ final states, accompanied by mutual excitation of projectile and target, are observed to be greatly enhanced at low transverse momentum, which is consistent with coherent photoproduction. The $\pi^+\pi^-\pi^+\pi^-$ invariant mass spectrum in coherent events exhibits a two-resonance structure around ~ 1.5 and ~ 1.7 GeV/ c^2 with widths of around 0.50 and 0.45 GeV/ c^2 , likely corresponding to $\rho(1450)$ and $\rho(1700)$. Furthermore, a peak corresponding to $\rho(2150)$ is observed. We also observe peaks corresponding to $\rho(1450)$ and $\rho(1700)$ in the $\pi^+\pi^-$ final state and report the ratio of the branching fractions of the $\rho(1450)$, $\rho(1700)$ to $\pi^+\pi^-$ and $\pi^+\pi^-\pi^+\pi^-$. We also present the ratios of $\rho(1450)$, $\rho(1700)$, and $\rho(2150)$ to $\rho_0(770)$ coherent production cross sections. Further, we present the status on the analysis of $\pi^+\pi^-\pi^+\pi^-$ polarization.