

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

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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 $\pi^+\pi^-\pi^+\pi^-$ photonuclear production in ultraperipheral Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. The data were collected in 2014 by the STAR experiment. The $\pi^+\pi^-\pi^+\pi^-$ 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 ~ 1370 and ~ 1610 MeV/ c^2 with widths of 200 and 330 MeV/ c^2 , likely corresponding to $\rho(1450)$ and $\rho(1700)$. Furthermore, a peak corresponding to $\rho(2150)$ is observed. We also observe corresponding peaks 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 further present the ratios of $\rho(1450)$, $\rho(1700)$, and $\rho(2150)$ to $\rho_0(770)$ coherent production cross sections.