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Disentangling transverse single spin asymmetries for very forward neutrons in polarized p-A collisions using ultra-peripheral collisions

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We present the transverse single spin asymmetries A_N for very forward neutrons measured by the PHENIX zero-degree calorimeters (ZDCs) in high-energy polarized proton-nucleus (p-A) collisions at RHIC. First-ever p-A data taken in the RHIC-2015 run exhibit positive and remarkably large $A_N \sim 0.18$ only in p-Au collisions whereas nearly zero A_N in p-Al collisions. Comparisons of these new results with $A_N = -0.05$ from the previous PHENIX-ZDC measurement in p-p collisions raised the following question: what mechanisms do produce such a large A_N in only p-Au collisions and smaller or close to zero A_N in other collisions? One attempt is a single-Reggeon exchange model considering the interference of pion (spin flip) and a_1-Reggeon (spin nonflip). Single-Reggeon exchange well explains A_N in p-p collisions and can be extended to p-A collisions by taking into account strong nuclear absorption correction as well as nuclear breakup. However, the predicted A_N by the extended single-Reggeon exchange model is far smaller than the PHENIX data in p-Au collisions. In this talk, we will discuss an alternative and rather unknown mechanism: ultra-peripheral p-A collisions (UPCs, also known as Primakoff effects). UPCs lead to very large A_N of about 0.35 and have cross sections proportional to Z^2 of the nuclei. UPCs contribute to inclusively measured A_N modestly in p-Al collisions and significantly in p-Au collisions. To discuss quantitatively, we will show that the Monte Carlo simulations incorporating both the Reggeon exchange and UPCs, where virtual photon–polarized proton interactions follow the MAID 2007 isobar model, successfully describe the PHENIX data in p-Al and p-Au collisions simultaneously.

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