Measurement of dielectron production in Au+Au and U+U ultraperipheral collisions at STAR

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Dielectron production can occur in ultra-peripheral heavy ion collisions via the Breit-Wheeler process, in which the linearly polarized photons from the heavy ion fields interact to produce low transverse momentum dielectron pairs. This production is sensitive to the electromagnetic field distributions from the heavily Lorentz-contracted nuclei, which are directly dependent on the charge radius and shape of the atomic nucleus sourcing the photons. This can result in a non-isotropic azimuthal production, as well as shifts in the momentum-dependent production cross sections between different sourcing nuclei. Additionally, Sudakov radiation can result in an azimuthal modulation at higher pair momentum, so nuclear shape effects and constraints on the angular effects of soft photon radiation can both be measured for the first time.

In this talk, results will be presented of the first Breit-Wheeler measurement in U+U ultraperipheral collisions (UPCs) at $\sqrt{s_{NN}} = 193$ GeV, with comparisons to Au+Au at $\sqrt{s_{NN}} = 200$ GeV, to explore both nuclear shape effects on the cross sections, and the effects of both nuclear shape and Sudakov radiation on the azimuthal modulation strengths. Comparisons between gold and uranium show a sensitivity to nuclear shape differences at pair p_T less than 60 MeV/c in both the cross sections and the angular modulations. Similarly, by measuring these modulations at pair p_T above 60 MeV/c, qualitative results are observed that are in agreement with theory predictions for the effects of Sudakov radiation (Shao, et al. 2023).