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

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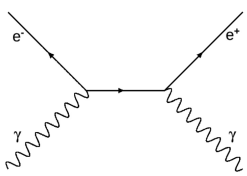
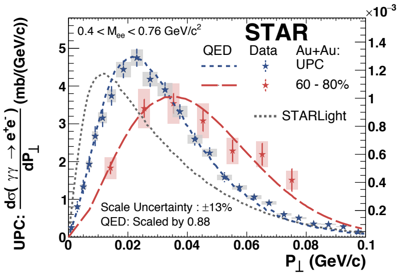
Physics Motivation

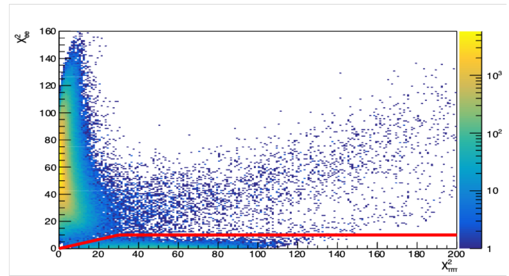
- The Breit-Wheeler process [2] is a fundamental test of QED that depends on the field distributions from the sourcing heavy ions
- It has been measured and published in Au+Au collisions at STAR (see figure) [1], but Au is a more spherical nucleus than uranium
- Future comparisons between uranium and gold cross sections will allow a new method of constraining the nuclear shape





Signal Selection and Analysis Procedure

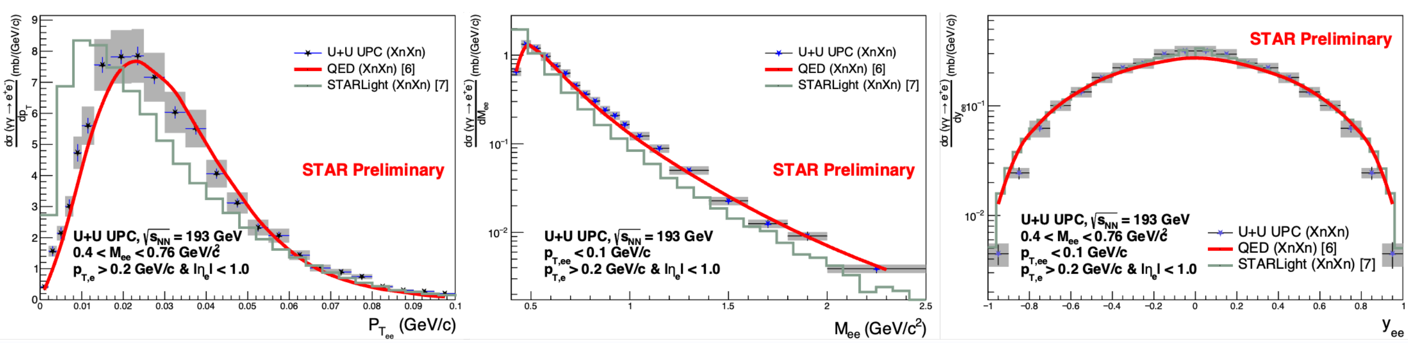
- Select electron-positron pairs corresponding to the Breit-Wheeler process using $\chi_{ee}^2 = n\sigma_{e1}^2 + n\sigma_{e2}^2$, where $n\sigma_e = \log(\frac{dE}{dx} / B_e)/\sigma_e$, B_e is the expected energy loss value for electrons, and σ_e is the standard deviation of the energy loss distribution for electrons
- Simulation is used to calculate kinematic-dependent efficiency corrections



Cross Sections

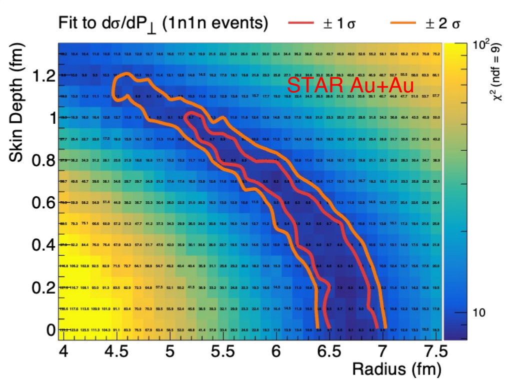
- Efficiency corrections and luminosity goes into converting a Breit-Wheeler pair yield into a differential cross section
- Results show good agreement with QED in pair transverse momentum, mass, and rapidity when we allow for any neutron multiplicity in the QED calculations (XnXn) and use a 2-D deformed form factor [6]
- STARLight uses a hard sphere approximation for the nucleus and does not describe the data well

$$\frac{d\sigma}{dm} = \frac{N^{e^+e^-}(m)}{dm \times \mathcal{L} \times \varepsilon}$$



Conclusions and Next Steps

- QED calculations predict that the absolute scale of the Breit-Wheeler cross section should scale as Z^4
- Comparison with the published Au+Au cross section (above) shows agreement with this prediction at low transverse momentum
- Our cross sections show agreement in almost all bins with QED calculations [6]
- Next steps: look at the cross section ratios between Au and U to constrain shape effects and also create the plot to the right [5] for uranium using a properly deformed form factor for uranium



References

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Thank You!

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