Preliminary figures request

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Contact information

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Physics Motivation

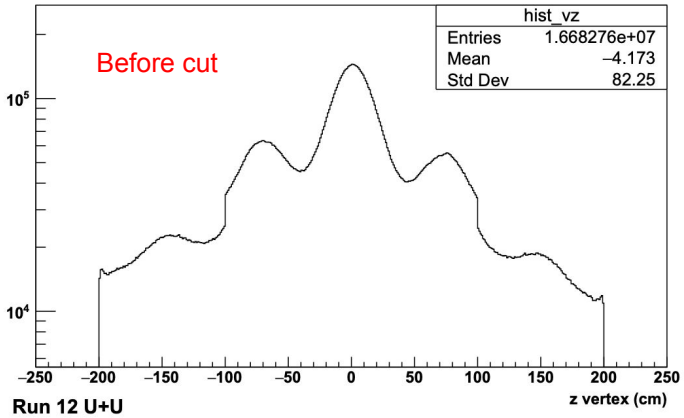
- The Breit-Wheeler process is a fundamental test of QED that depends on the field strength distributions generated by heavy ions
- It has been measured in Au+Au UPCs, but Au is a much more spherical nucleus than Uranium, so it has a more symmetric field
- The goal is to measure the Breit-Wheeler cross section in uranium data to later compare to gold to learn the effects of nuclear shape on the cross section shape, and compare with QED calculations

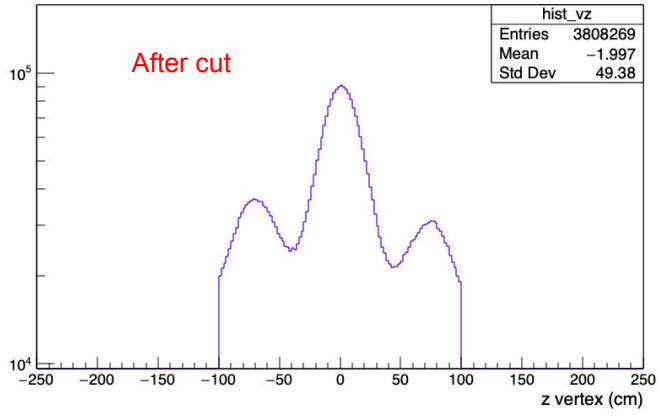
Dataset

- Dataset: Run12 U+U 193 GeV (compared to Run 10 Au+Au 200 GeV)
- Year: 2012 (and compared to 2010)
- Production tags: P12id
- Trigger used: UPC_main_protected
- No embedding

Event level cuts

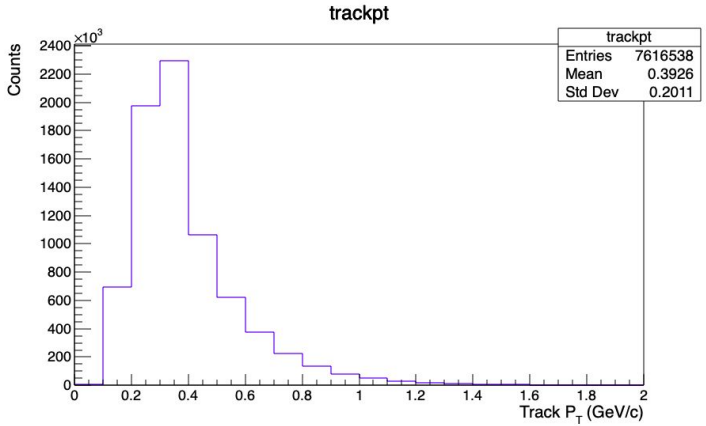
- |ZVertex| < 100 cm
- gRefMult <=4

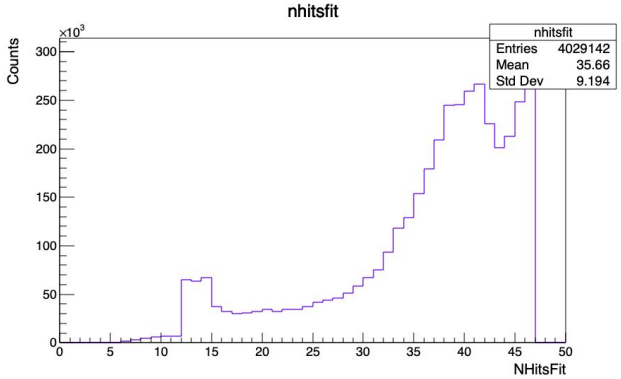


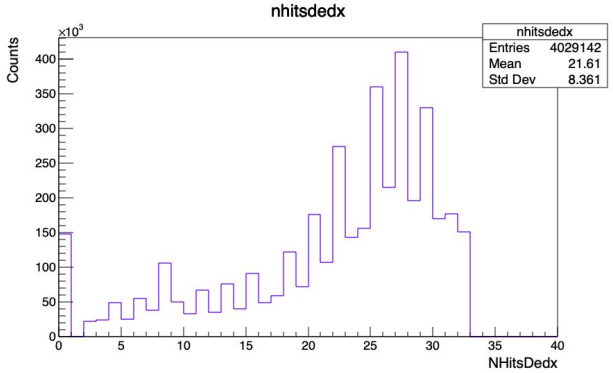


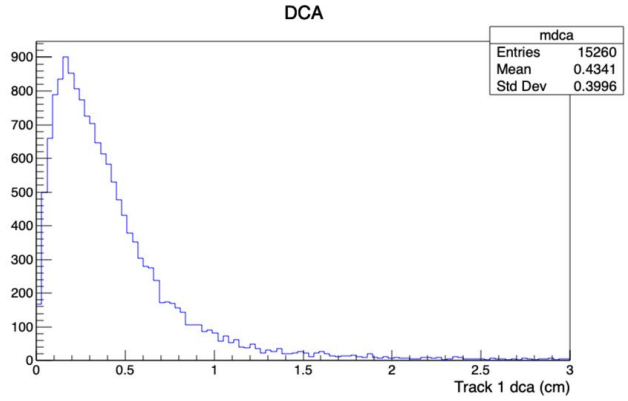
Track Cuts

- Track P_T > 0.2 GeV
- NHitsDedx > 15 & NHitsFit > 10 for each track
- DCA < 1 for each track









Other Cuts

- Track $|\eta| < 1$
- $|y_{ee}| < 1$
- Require a TOFMatch in both tracks
- Chargesum = 0
- $\square_{ee}^{2} < 10$ & $3*\square_{ee}^{2} < \square_{\pi\pi}^{2}$
- $|\Delta\Delta TOF| < 0.5$ ns
- For P_T cross section, $0.4 < M_{ee} < 0.76$ GeV
- For M_{ee} cross section, $P_{T,ee} < 0.1$ GeV
- For rapidity cross section, both kinematic cuts are applied

Analysis Procedure

- After using the above cuts to select on data, we get a pair yield as a function of various kinematic variables
- Efficiency corrections are multi-faceted, with some flat efficiencies, and some kinematic dependent corrections applied
  - A flat number is used for purity and efficiencies for PID and TOF cuts
  - Luminosity fraction is calculated from the Zvertex cut
  - Standalone simulation is used for the TOFMatch efficiencies and tracking efficiencies
    - STARLight→Starsim→BFC reconstruction gives reconstructed and MC distributions, which includes all tracking and track-quality related efficiencies
  - Some flat efficiency corrections are reused from JDB's analysis on this including bbc efficiency and event selection efficiency, and TPC efficiency, though TPC efficiency is modified due to the fixed TPC sector for run 12 as compared to run 10, so 84% per track is used
- Total efficiency, bin width, and luminosity are applied in the usual way to get from yield to cross section

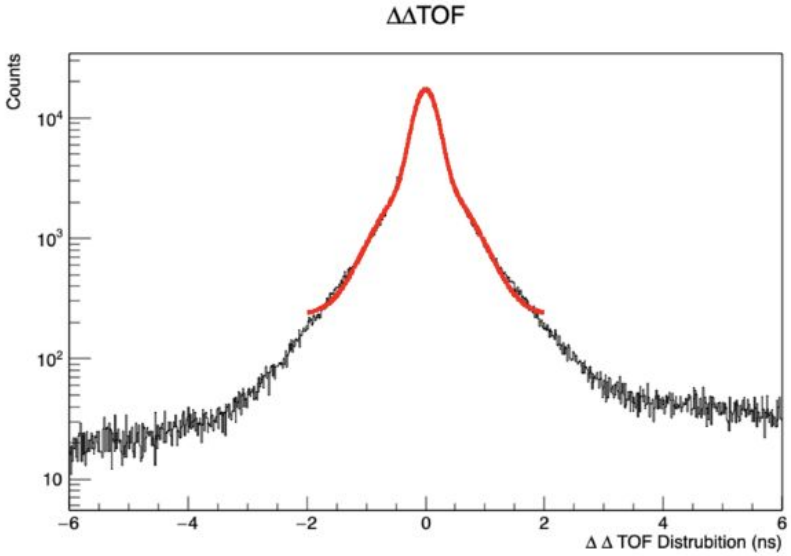
$$\frac{d\sigma}{dm} = \frac{N^{e^+e^-}(m)}{dm \times \mathcal{L} \times \varepsilon}$$

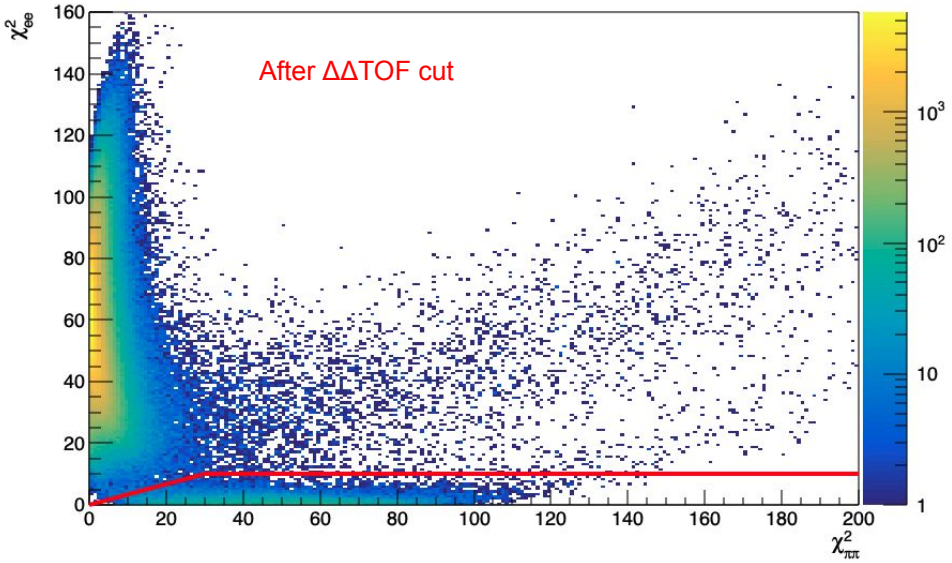
Systematic uncertainties

- Systematic uncertainties considered are as follows
  - PID cut uncertainty (~2%)
  - TOF selection uncertainty (~2%)
  - Pair distribution shape uncertainty from efficiency correction (~4%)
- For the first two, nominal analysis cuts are varied in small amounts each direction, relevant efficiencies recalculated, and the cross section recalculated to examine the bin-by-bin variation. The systematic uncertainty is taken to be the maximum variation across the bins with some rounding and is approximately 5% when added in quadrature
- For the last, this is accounting for the shape change in the differentials caused by the tracking efficiencies
- It is worth mentioning that the systematic uncertainties are significantly smaller than the overall scale uncertainty due primarily to the luminosity uncertainty (10%)
- I plan to compute further uncertainties related to the single track cuts, vertex cut and event-level cuts, which will go into the overall scale uncertainty

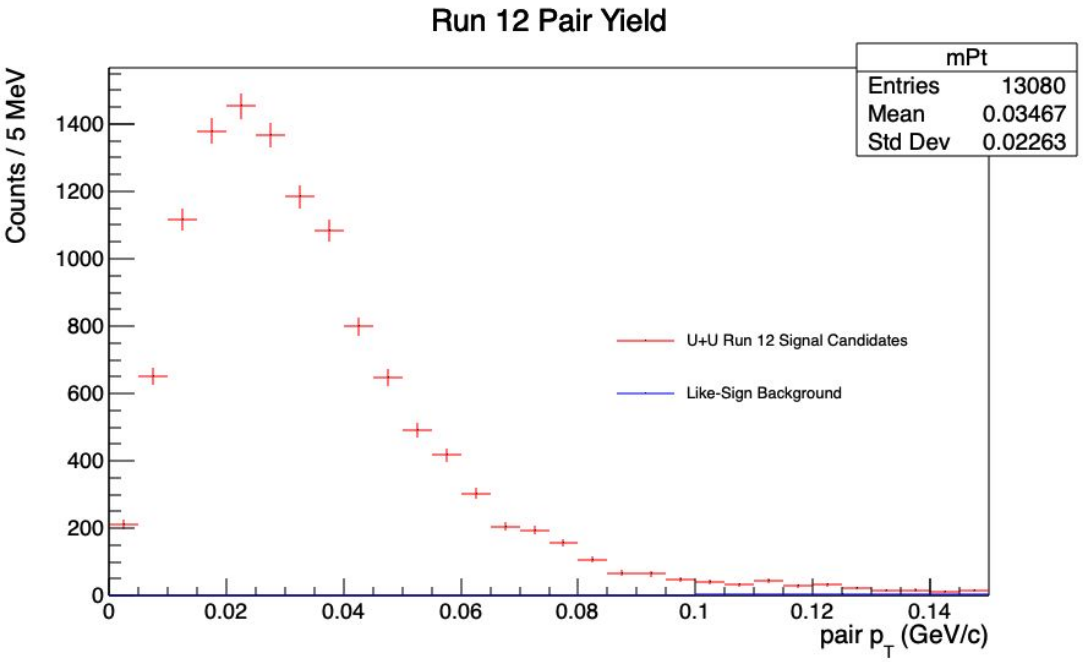
PID technical plots - not requesting preliminary

- I want to add these to my QM poster, but as they are technical plots, I am not requesting preliminary unless it is needed





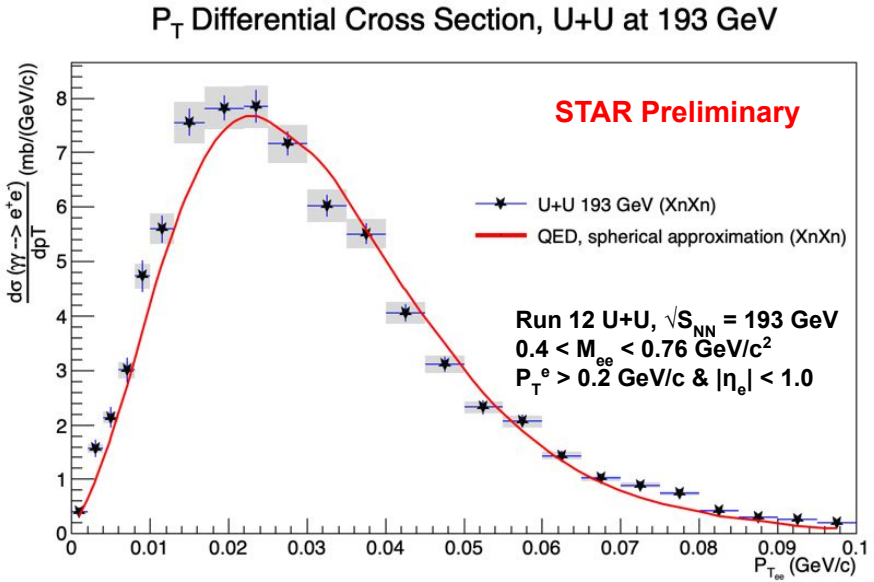
Yield – not requesting preliminary

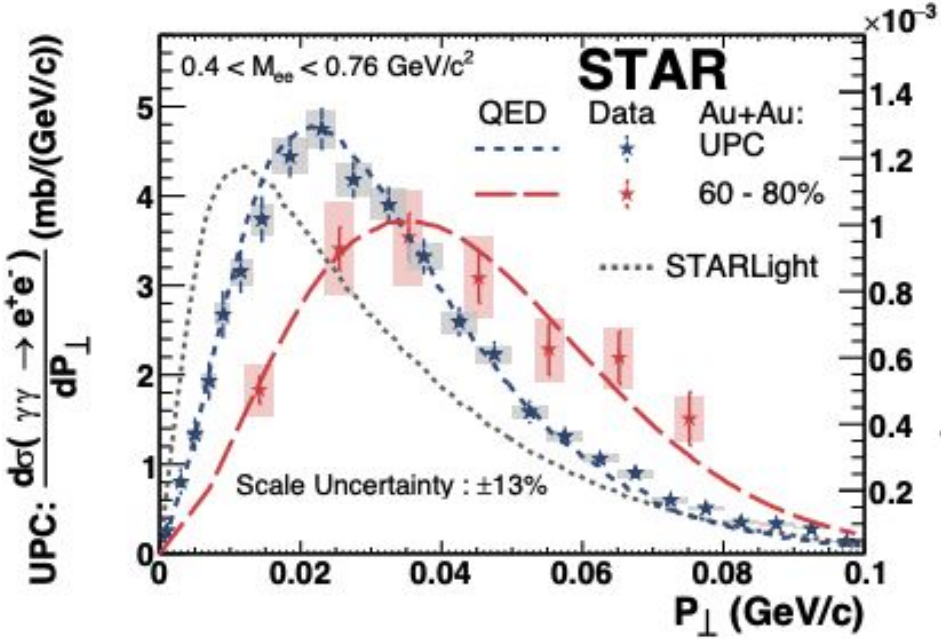


This is with no efficiency corrections applied, and is obtained after all event, track and PID cuts mentioned in the previous slides. Combinatorial background is negligible as shown.

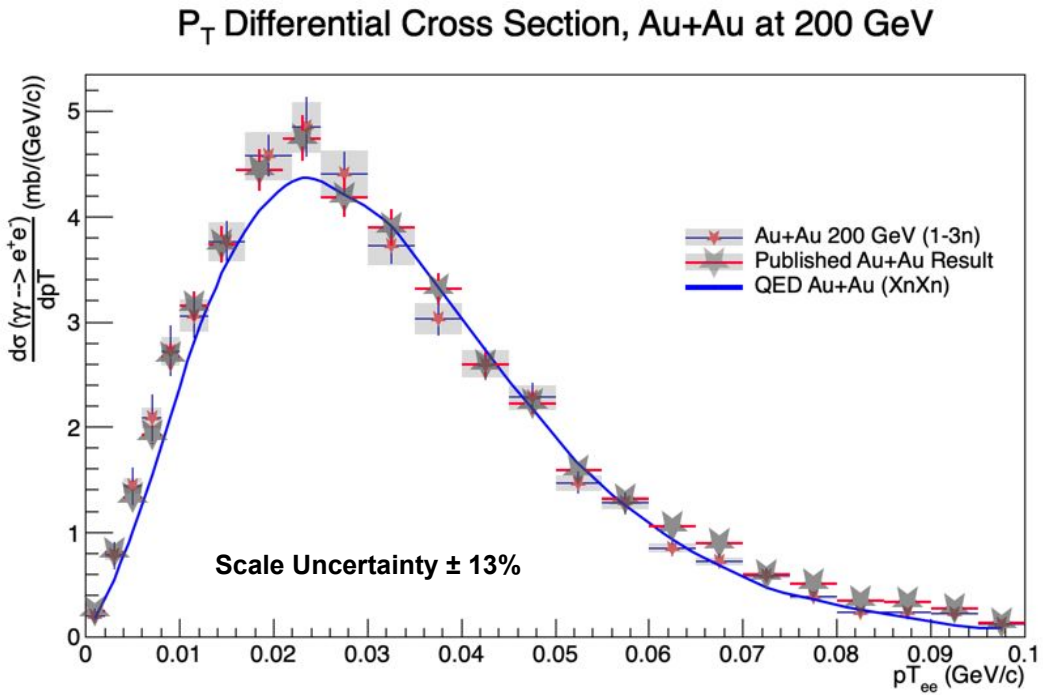
Published Run 10 vs. my Run 12

- Requesting preliminary for the left plot
- On the poster I will show uranium and gold (published results), see next slide for comparison between my Au+Au and published





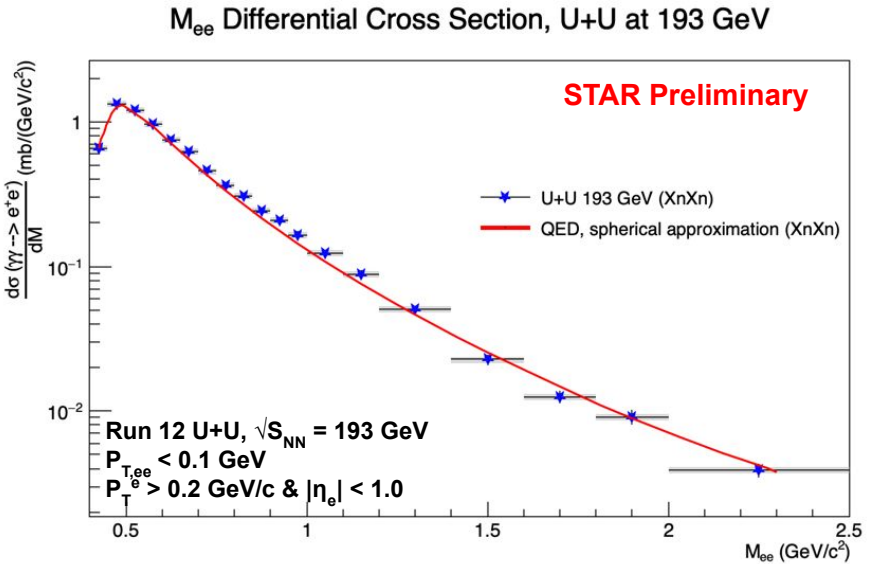
My Run 10 vs. Published

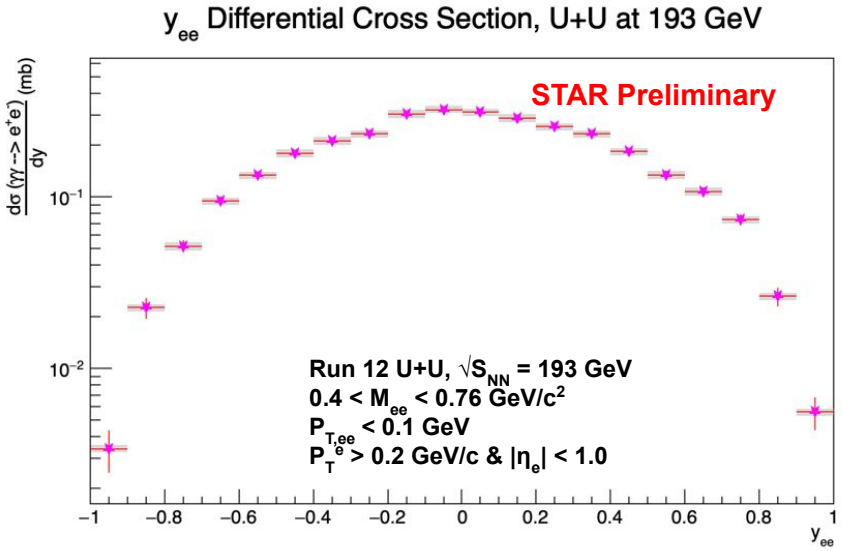


Given the scale uncertainty, it is apparent that my result for Run 10 Au+Au is consistent with the published result, justifying my use of the same procedure in the uranium dataset

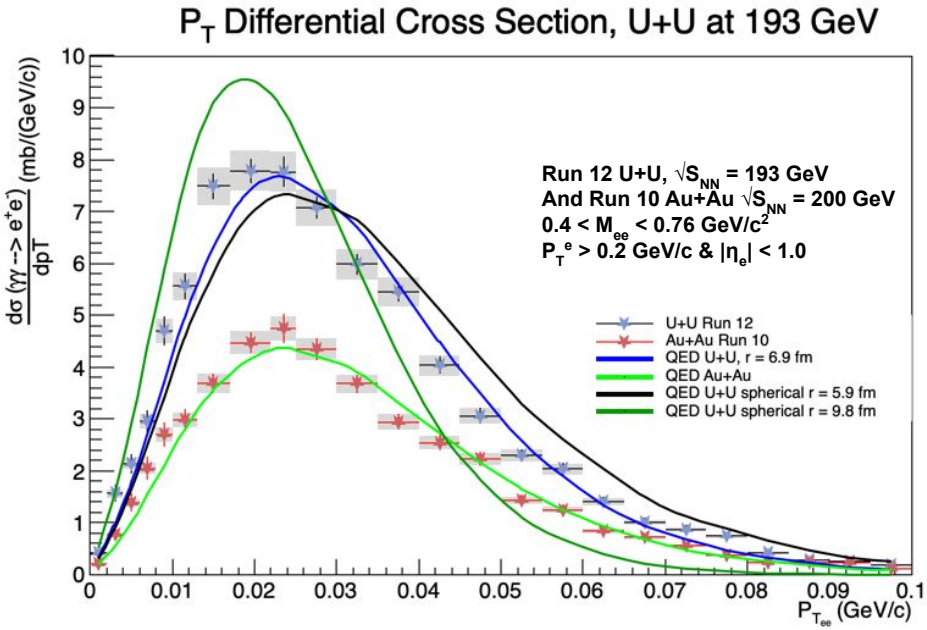
Mass and Rapidity Cross sections

- Requesting preliminary for both
- QED curve for mass is normalized to match the cross section of the QED P_T curve in the correct mass range





QED comparisons



Not requesting preliminary for this, but this is U+U and Au+Au cross sections compared with QED calculations approximating uranium with various radii in spherical approximations