Quarkonia measurements in heavy ion collisions with the sPHENIX experiment

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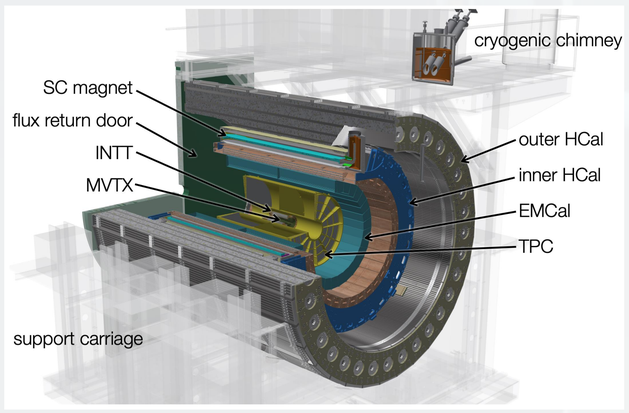
Abstract

Quarkonia measurements in heavy-ion collisions are important for understanding both initial-state effects on heavy-quark production and final-state interactions between heavy quarks and the hot and dense nuclear matter created in high-energy heavy-ion collisions.

The sPHENIX experiment at RHIC started detector commissioning and first Au+Au data-taking run in 2023, and plans to measure the production of Upsilons and high p_T J/ψ's in the di-electron channel in this data set as well as in future p+p, p+Au and Au+Au running. The status of the relevant detectors and their performance for di-electron measurements will be presented and compared to what is expected from a Monte Carlo simulations. Analysis prospects and future plans will also be discussed.

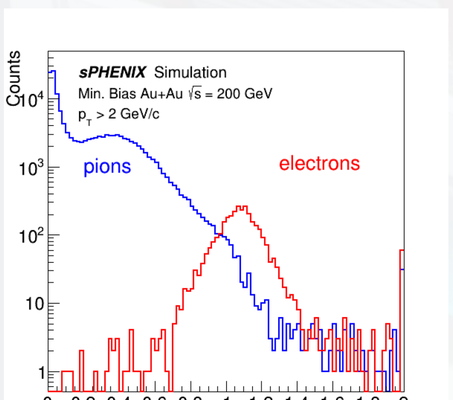
sPHENIX Detector

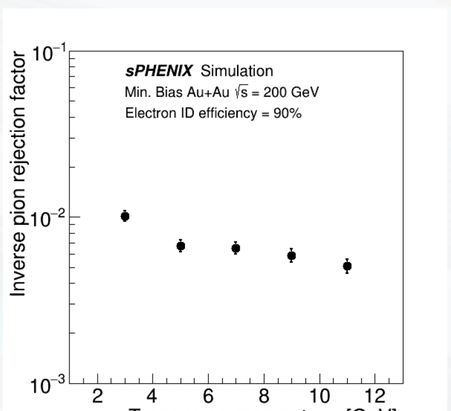


- Upsilons are reconstructed in di-electron channel
- Electron tracks found by TPC
- Hadrons rejected using EMCal and both HCal's
- 2 GeV/c electron p_T cut used to reduce combinatorial background

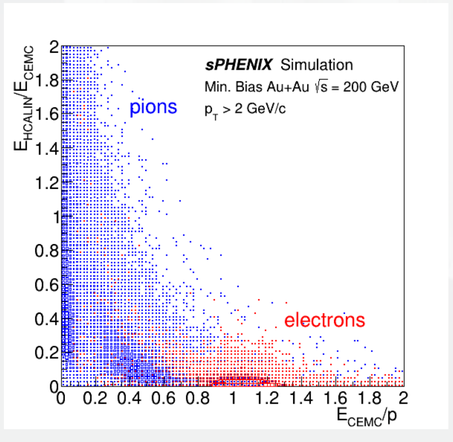
Hadron rejection

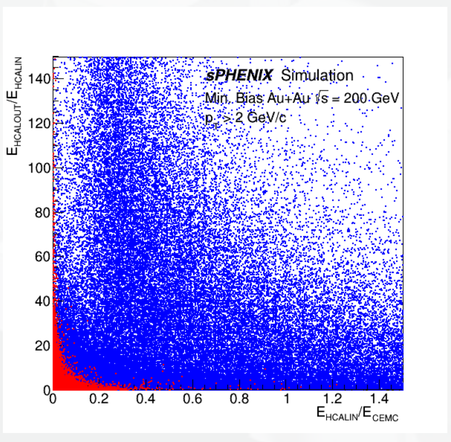
- E/p cut is the main tool for hadron rejection
- Better than 100 pion rejection achieved at 90% electron id efficiency in Au+Au collisions





Using Inner and Outer HCal's to improve hadron rejection

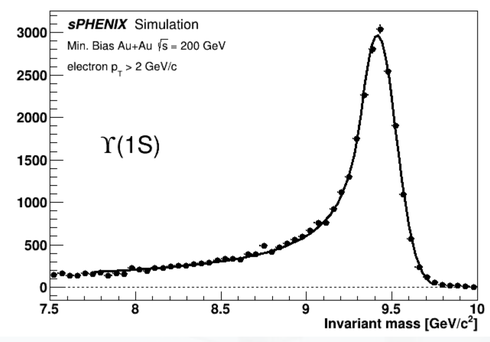




- Using $E_{HCALOUT}/E_{HCALIN}$ vs. E_{HCALIN}/E_{CEMC} cut (right plot) gives hadron rejection of ~70 at 70% electron id efficiency, although there is a significant overlap with the E/p rejection. Work in progress.

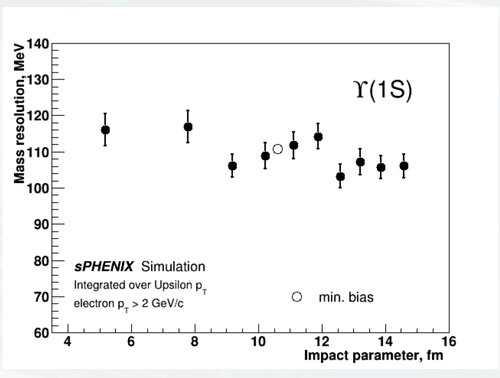
Expected Upsilon mass resolution

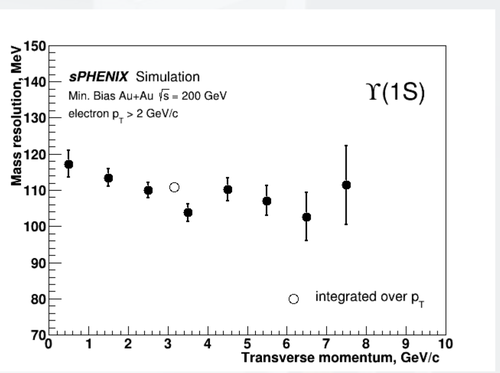
Good mass resolution is important for resolving the three Upsilon states and reducing background under the peak.



- Y(1S) embedded in min. bias Au+Au events, processed through full sPHENIX GEANT simulation and reconstructed.
- Same sign background subtracted
- Fit with double Crystal Ball function

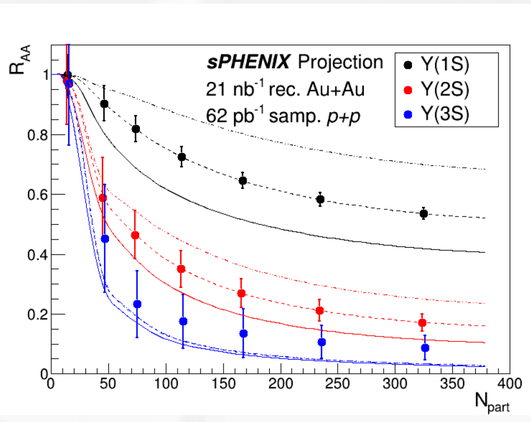
Mass resolution vs centrality and transverse momentum

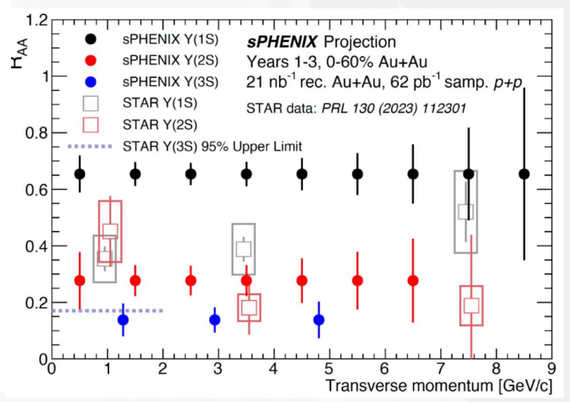




Expected statistical accuracy of R_{AA}

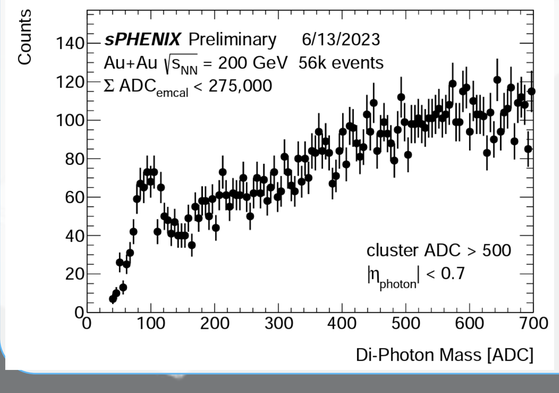
- Three year running plan assumed for the plots
- Realistic background simulation used for uncertainty estimate
- Y(3S) projection based on Y(3S) suppression reported by CMS at LHC

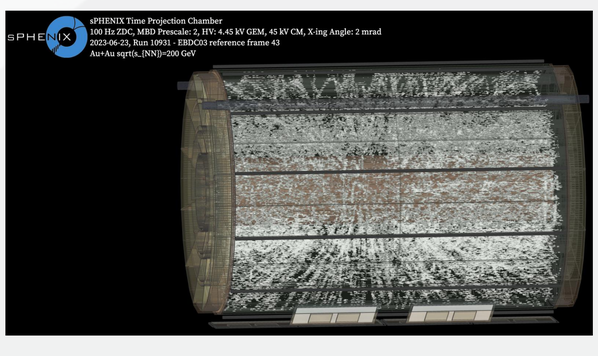




Detector performance

sPHENIX detector commissioning started in May 2023. Significant progress achieved during RHIC Run23 despite the early termination of the run with collision data observed by each of the detector subsystem. Commissioning effort continues into Run24.





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