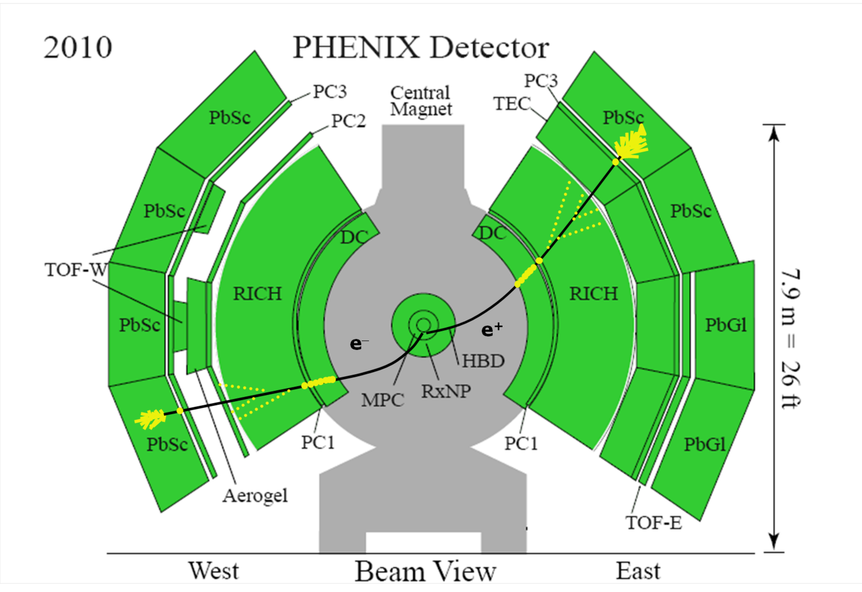
$R_{AA}(\Upsilon[1S+2S+3S])$ at Mid-Rapidity as Measured by PHENIX at $\sqrt{s_{NN}} = 200\ GeV$

By Shawn Whitaker of Iowa State University for the PHENIX Collaboration

The suppression of quarkonia in heavy ion collisions has long been thought to provide an indication of the creation of the quark gluon plasma[1]. A large sample of Au+Au collisions at $\sqrt{s_{NN}}$=200 GeV has been collected by PHENIX in 2010. The large statistical sample allows for the observation of Υ in the hot dense medium created by Au+Au collisions.In this poster I will present a preliminary measurement of $R_{AuAu}(\Upsilon)$ as observed by PHENIX at mid-rapidity in the di-electron decay channel.

The PHENIX Detector

PHENIX measures Υs decaying to di-electrons at mid-rapidity($|y| \leq 0.35$) using the central arm detectors. The detectors used in the central arms are the drift chamber for momentum reconstruction, the Ring Imaging Cherenkov detector (RICH) for electron identification and the lead glass and lead scintillators used for electromagnetic calorimetry and further electron identification using an E/p measurement.



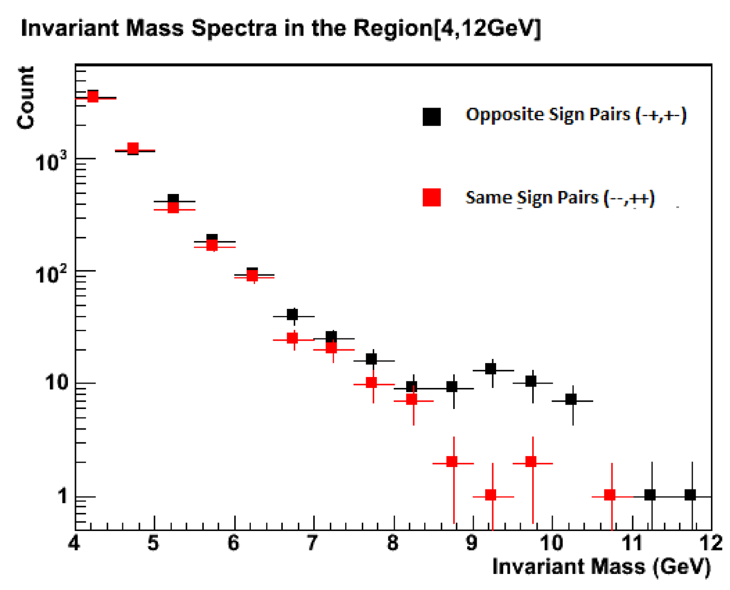
Using Relative Yields

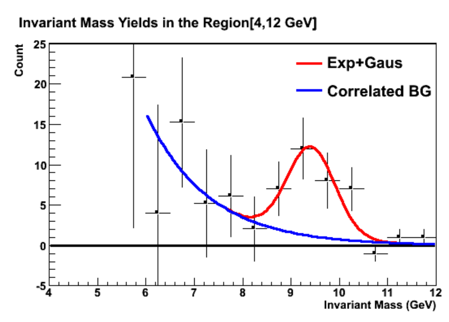
The $R_{AuAu}(\Upsilon)$ was found by using a relative yield method where the ratio of Υ to J/ψ was found in both p+p and Au+Au collisions correcting for the known suppression of J/ψ in Au+Au with a previous PHENIX $R_{AuAu}(J/\psi)$ measurement[3].

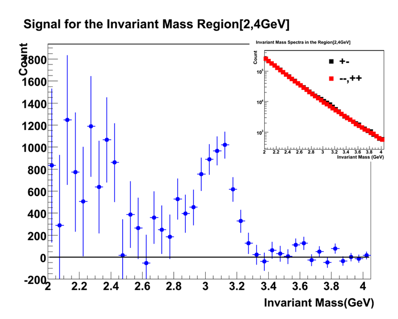
$$R_{AuAu}(\Upsilon) = \frac{[N(\Upsilon)/N(J/\psi)]_{AuAu}}{[N(\Upsilon)/N(J/\psi)]_{pp}} \times R_{AuAu}(J/\psi) \quad (1)$$

Determining Yields

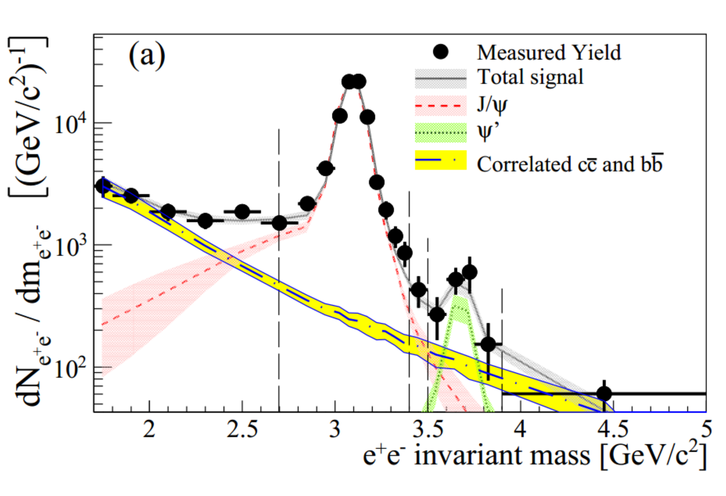
1. Υ candidates were selected from di-electrons with an invariant mass between 8.5 GeV and 11.5 GeV.
2. There are two sources of backgrounds: combinatorial background from the random association of di-leptons, and correlated backgrounds from physical processes such as Drell-Yan and the semi-leptonic decays of open charm and open bottom.
3. The combinatorial background was removed by using the like sign subtraction method.
4. The correlated backgrounds were estimated by fitting the subtracted distribution with an exponential plus Gaussian function. Where the exponential portion of the fit characterized the correlated background.
5. The Υ yields were then determined by counting the number of entries in the mass range from 8.5 GeV to 11.5 GeV and subtracting the integral of the exponential portion of the fit in the same mass range.
6. This was repeated for the J/ψ in the region between 2.8 GeV and 3.4 GeV.



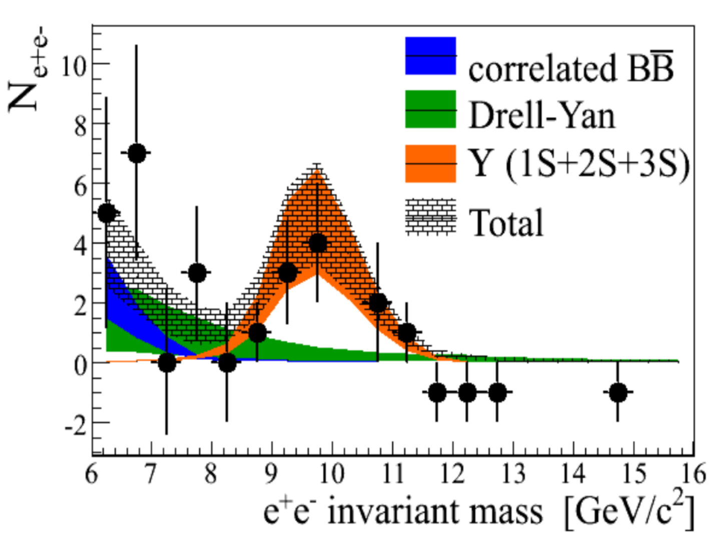


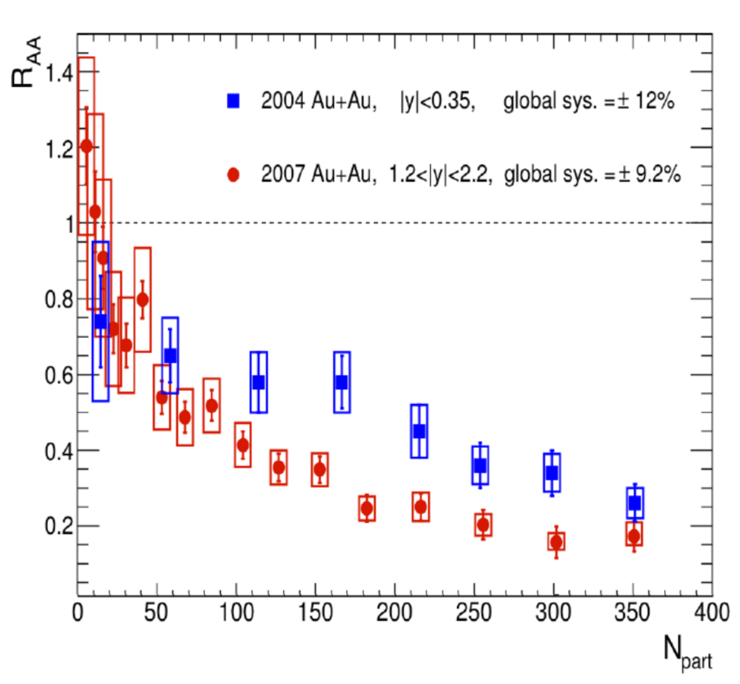


Previous PHENIX Results



[2]

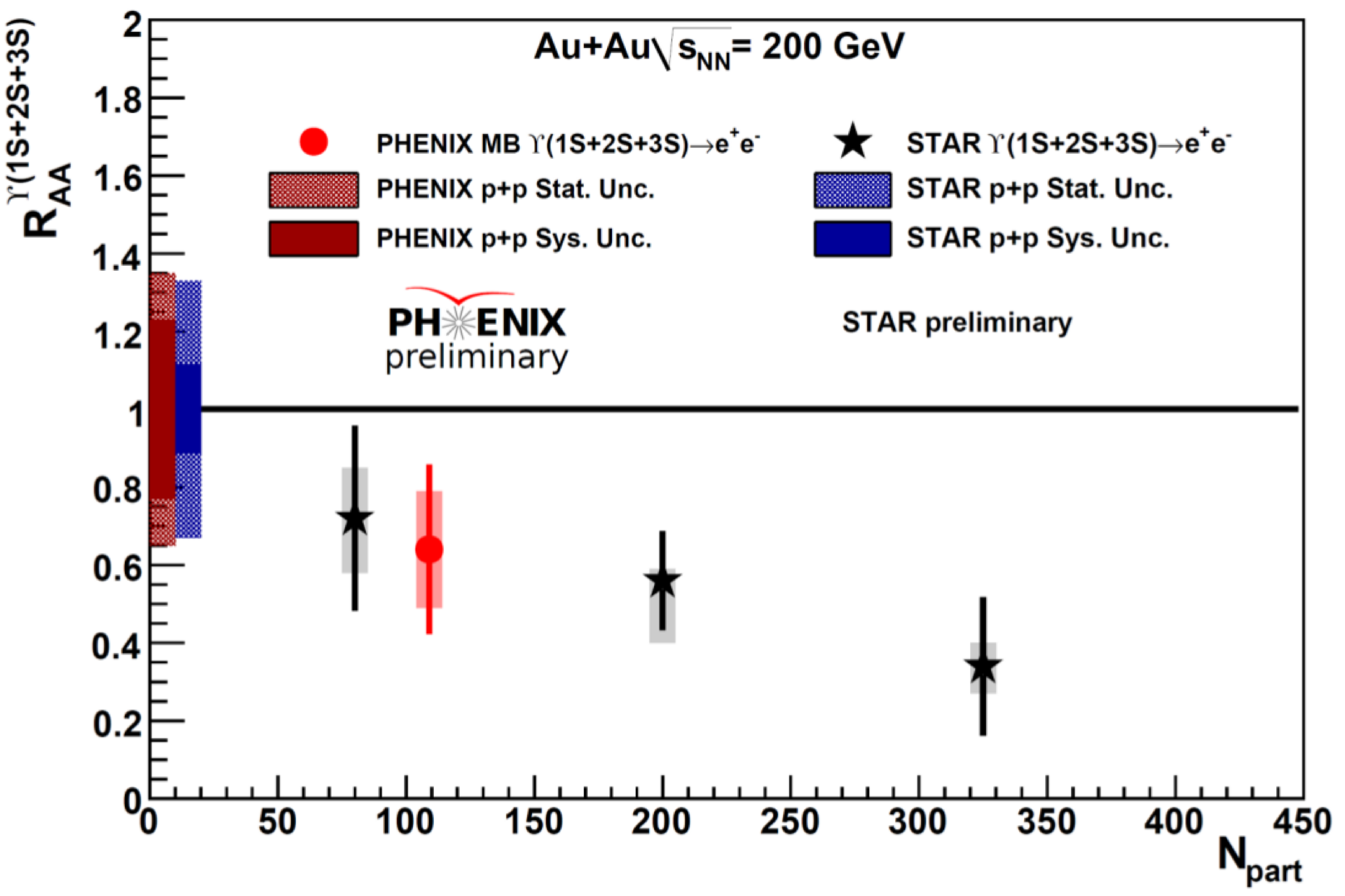




[3]

Previous PHENIX results were used as input into Eqn 1 to get the $R_{AuAu}(\Upsilon)$. The J/ψ and Υ signals from 2006 p+p data are shown above with the mid-rapidity $R_{AuAu}(J/\psi)$ shown in blue to the left.

$R_{AuAu}(\Upsilon)$



[4]

Conclusions

Using the naive assumption that there are no cold nuclear matter effects and that the Υ(2S+3S) states melt completely in the QGP formed at RHIC the measured $R_{AuAu}(\Upsilon)$ would be expected to be 0.64. If the χ_b state also melts $R_{AuAu}(\Upsilon)$ would be expected to be 0.37.

The $R_{AuAu}(\Upsilon)$ as measured by PHENIX is consistent with the $\Upsilon(2S+3S)$ states melting and the result shown by STAR at Quark Matter 2011[4].

References

[1] Matsui T and Satz H 1986 Phys. Lett. B 178 416

[2] arXiv:1105.1966v1

[3] Phys. Rev. Lett. 98, 232301 (2007)

[4] Reed R 2011 J. Phys. G: Nucl. Part. Phys. 38 124185