ϒ production in heavy-ion collisions at $\sqrt{s_{NN}}$ = 200 GeV with the STAR detector

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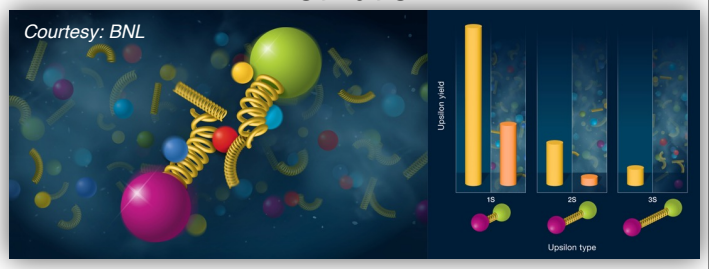
Abstract

Quarkonia play a unique role in probing the properties of the quark-gluon plasma (QGP). The dissociation of quarkonia due to the color screening was proposed as a direct signature of QGP formation. Moreover, different states of quarkonium are expected to dissociate at different temperatures depending on their binding energies. Therefore, measurement of the expected sequential suppression for the three ϒ states in heavy-ion collisions can be used to study the modification of the QCD force in the medium and the thermodynamic properties of the QGP.

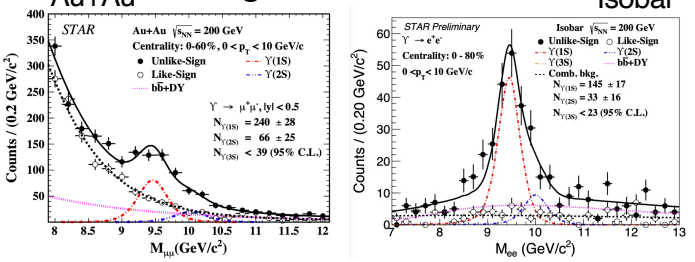
This poster presents the ϒ measurements in Au+Au and isobar (Ru+Ru and Zr+Zr) collisions at $\sqrt{s_{NN}}$ = 200 GeV with the STAR experiment at RHIC. The nuclear modification factors are presented as functions of centrality and transverse momentum. The results are compared to those at the LHC and theoretical calculations.

Motivation



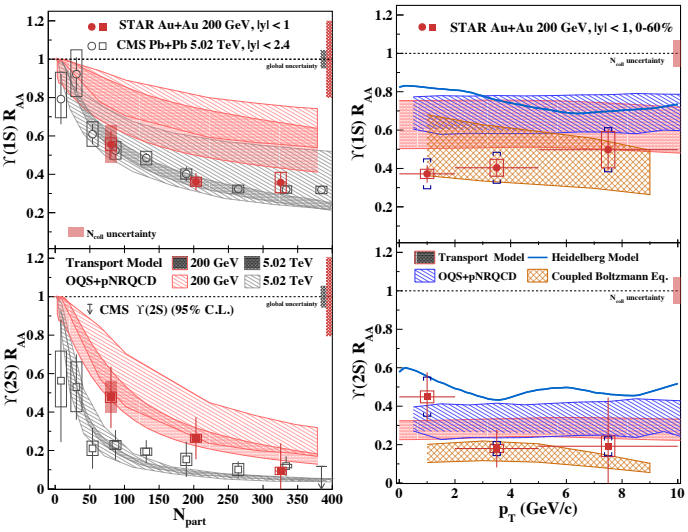
- Quarkonia suppression: a direct signature of QGP formation *[1]*
- Bottomonia provide a cleaner probe compared to charmonia *[2]*
- QGP "thermometer" *[3]*

Signal extraction



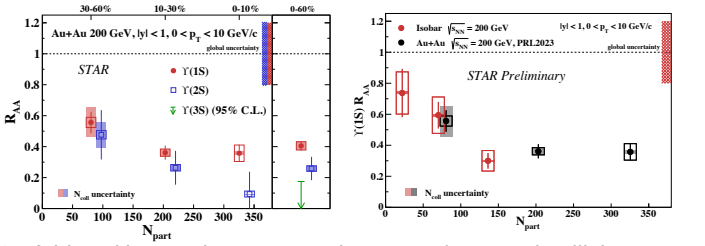
- Unbinned maximum-likelihood simultaneous fit
- Signal and residual background shapes are determined through simulation with detector effects

Comparisons of Au+Au results with LHC and theoretical calculations



- Similar magnitude of ϒ(1S) suppression at RHIC and LHC *[4, 5]*
- No significant p_T dependence at RHIC
- Theoretical calculations *[6-9]*
  - R_{AA} vs. centrality: Both models can describe RHIC and LHC data within uncertainties, though the RHIC ϒ(1S) data seems to be systematically below the model calculations.
  - R_{AA} vs. p_T: The Heidelberg model overshoots data while the other three models are consistent with data

Centrality dependence of R_{AA}



- A hint of increasing suppression towards central collisions *[4]*
- Consistent with a sequential suppression pattern
- No significant collision species dependence of the suppression at similar ⟨N_{part}⟩ in Au+Au and isobar collisions

$^{96}_{40}Zr$ $^{96}_{44}Ru$ $^{197}_{79}Au$

Summary

- ϒ(3S) is more suppressed than ϒ(1S) in $\sqrt{s_{NN}}$ = 200 GeV Au+Au collisions
- No clear p_T dependence of ϒ(1S) and ϒ(2S) suppression
- Similar magnitude of ϒ(1S) suppression at RHIC and LHC
- Model calculations are consistent with data within uncertainties

Reference

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Link to STAR presentations