J/ψ and ψ' Production in d+Au Collisions

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PHENIX

Quarkonia in d+Au

Learn a lot about quarkonia from d+Au

- Production mechanism
- Cold Nuclear Matter Effects

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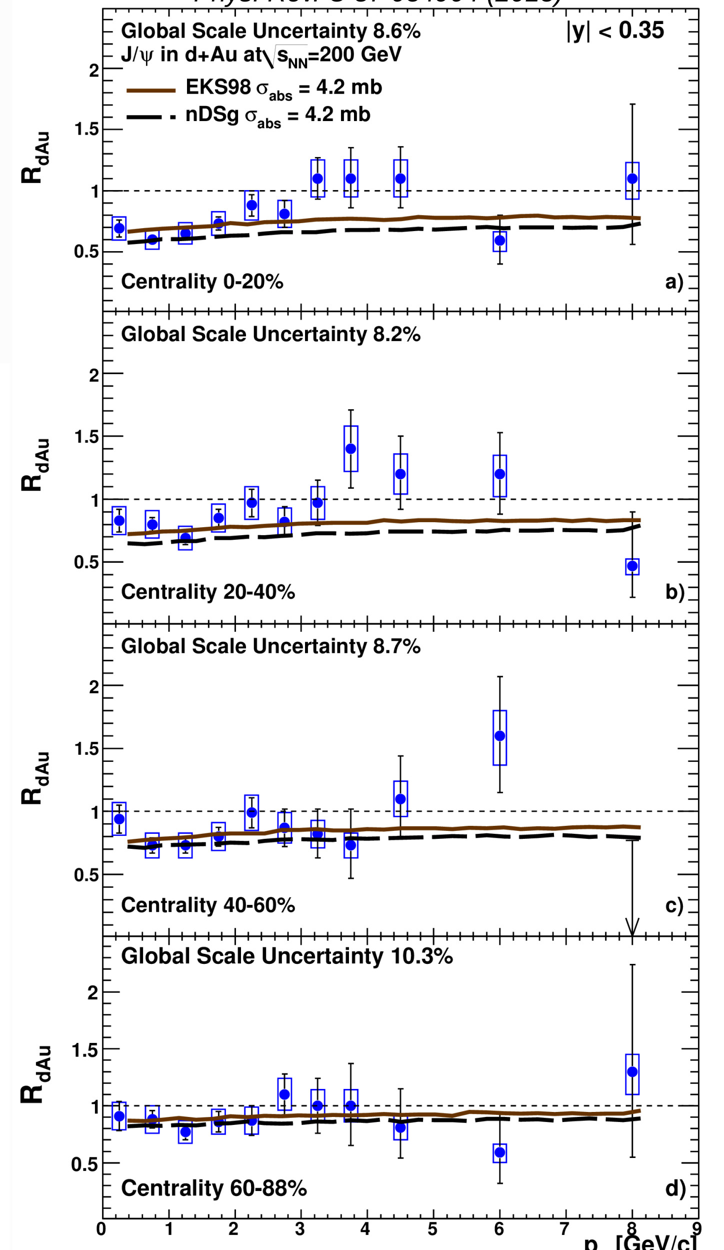
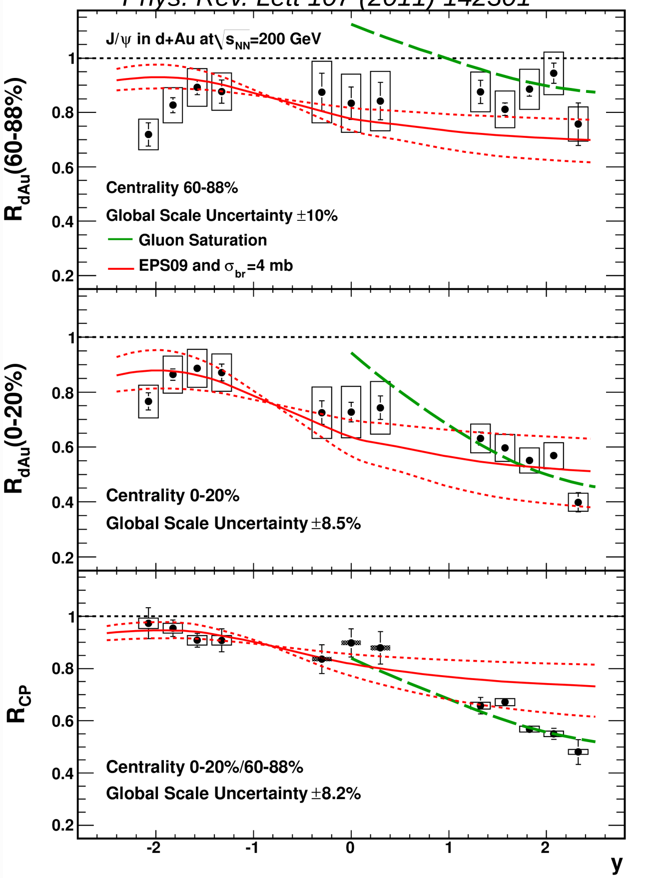
High-precision J/ψ measurements at 200 GeV

Phys. Rev. C 87 034904 (2013)



Phys. Rev. Lett 107 (2011) 142301



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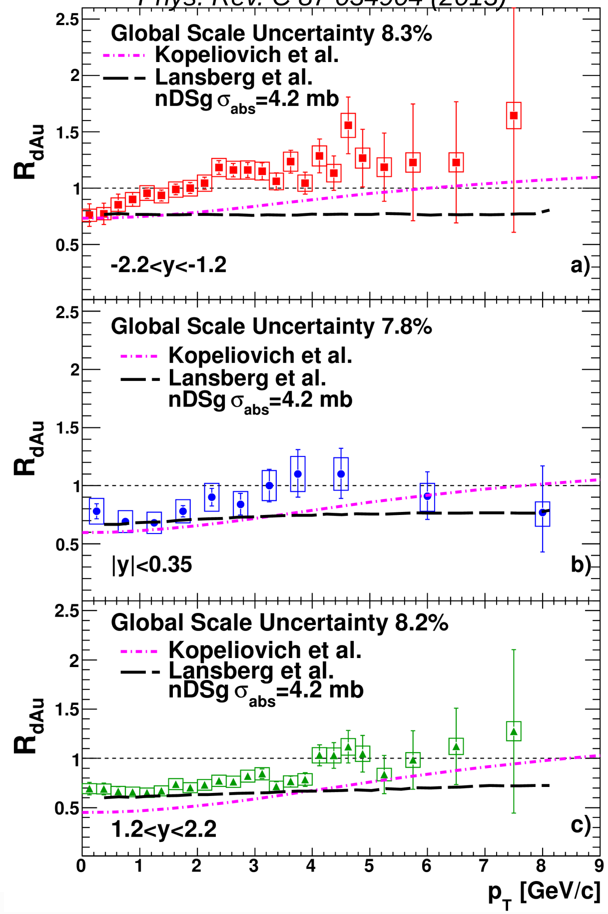
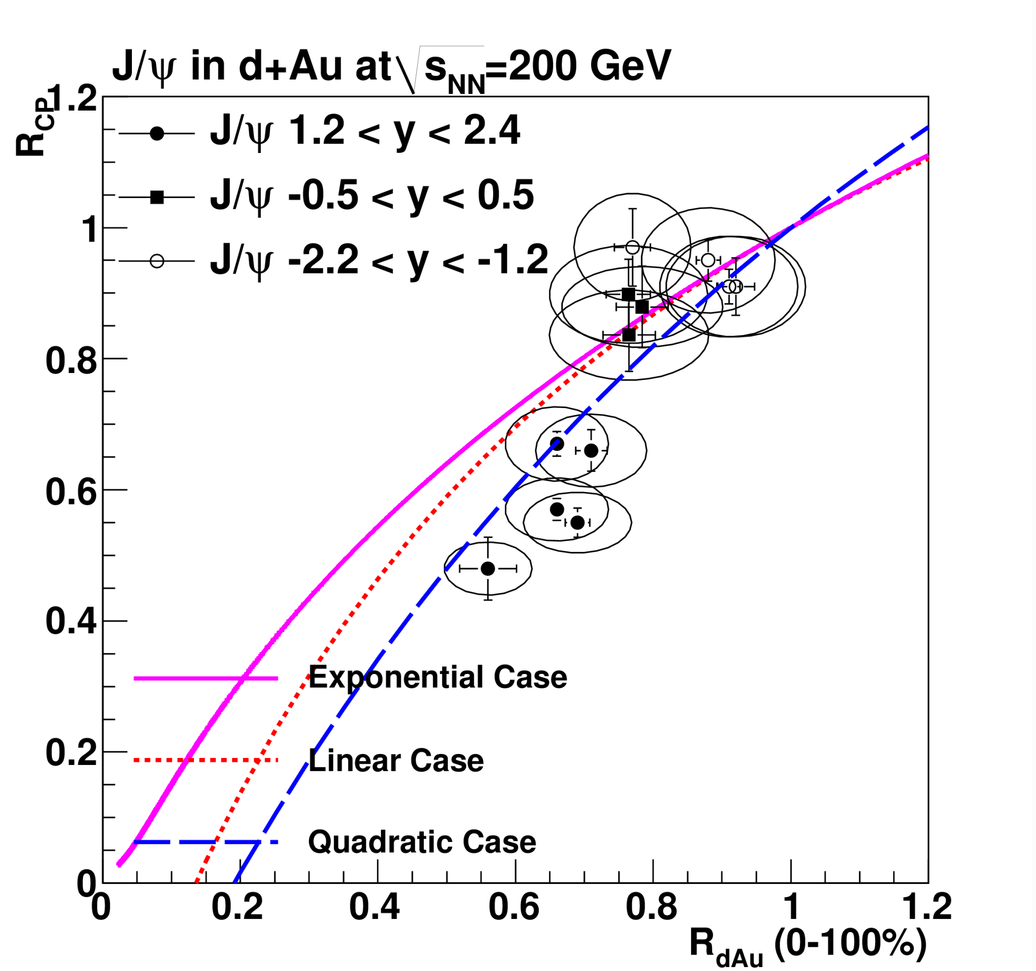


Geometric Dependence

- $\mathbf{R_{cp}}$ – Change in suppression over the Au nucleus.
- $\mathbf{R_{dAu}}$**(0-100%)** - Average suppression over the Au nucleus.
- $\mathbf{R_{cp}}$ **vs** $\mathbf{R_{dAu}}$**(0-100%)** - gives information about the geometric dependence of the nuclear modification.
- Any $\Lambda(r_T)$ dependence implies relationship between R_{cp} and R_{dAu}(0-100%)
- Data at forward rapidity requires modification greater than quadratic!

$$\Lambda(r_T) = \frac{1}{\rho_0} \int dz\, \rho(z, r_T)$$



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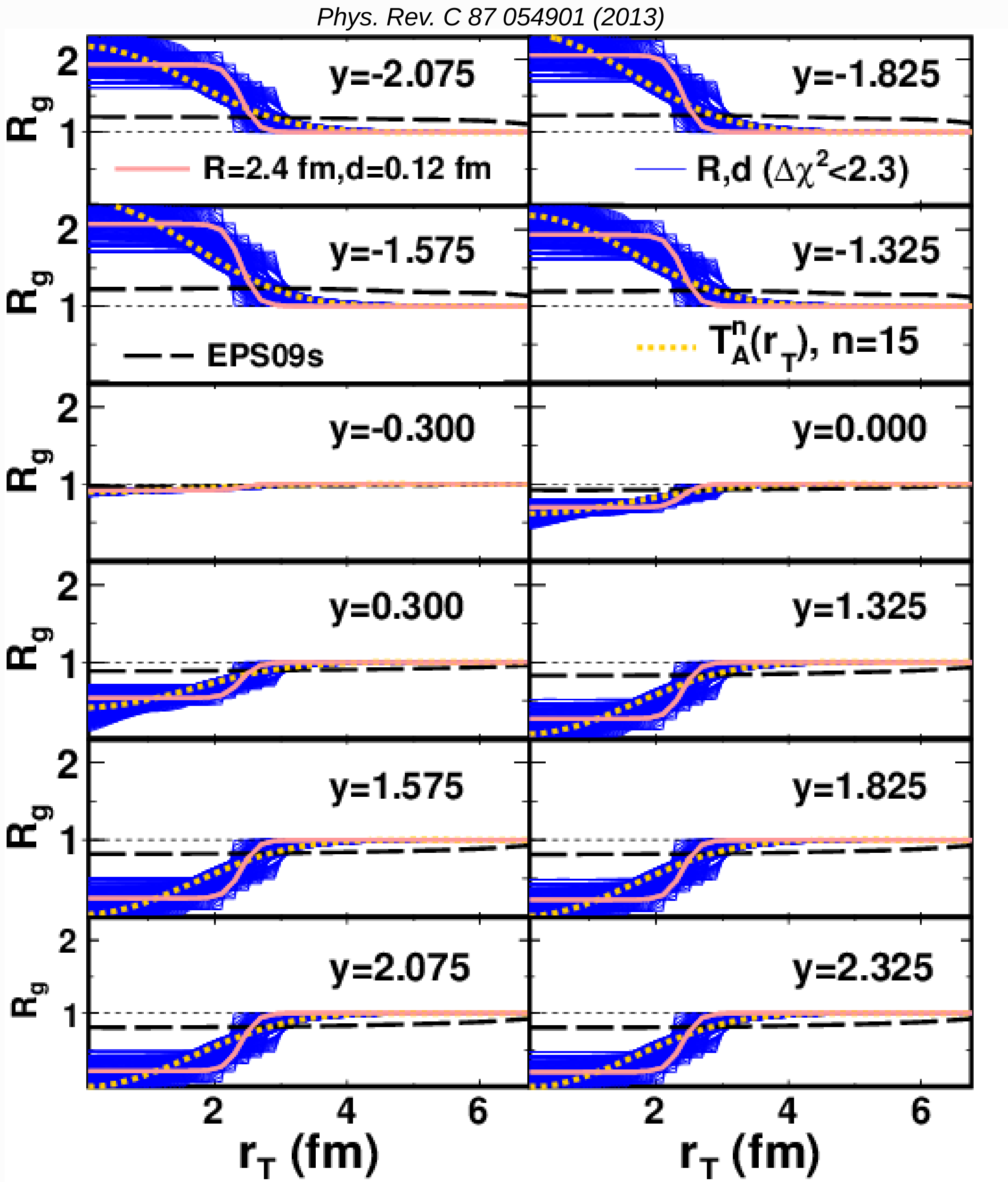
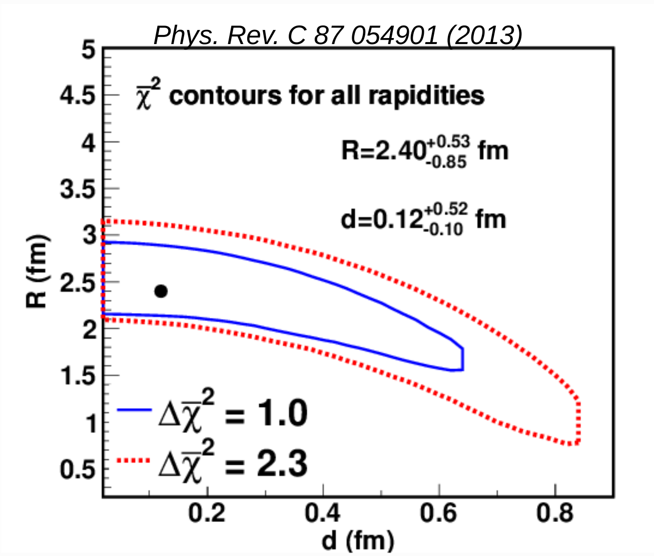
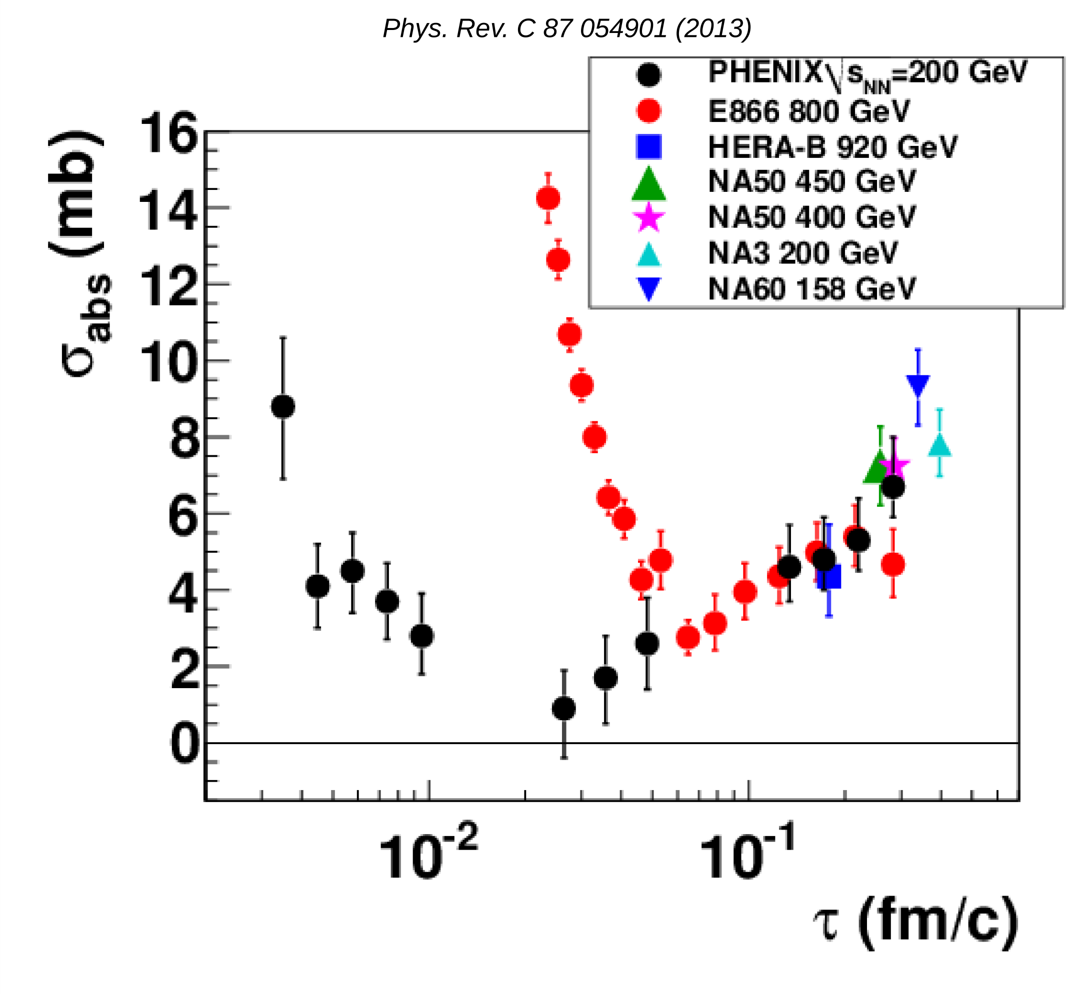
Determining Geometric Dependence

- Use model which includes nuclear shadowing (EPS09) and nuclear absorption.
- Fits to the d+Au data suggest forms with a sharp cutoff at ~3 fm.
- Using step function, can determine radius (R) and diffuseness (d).



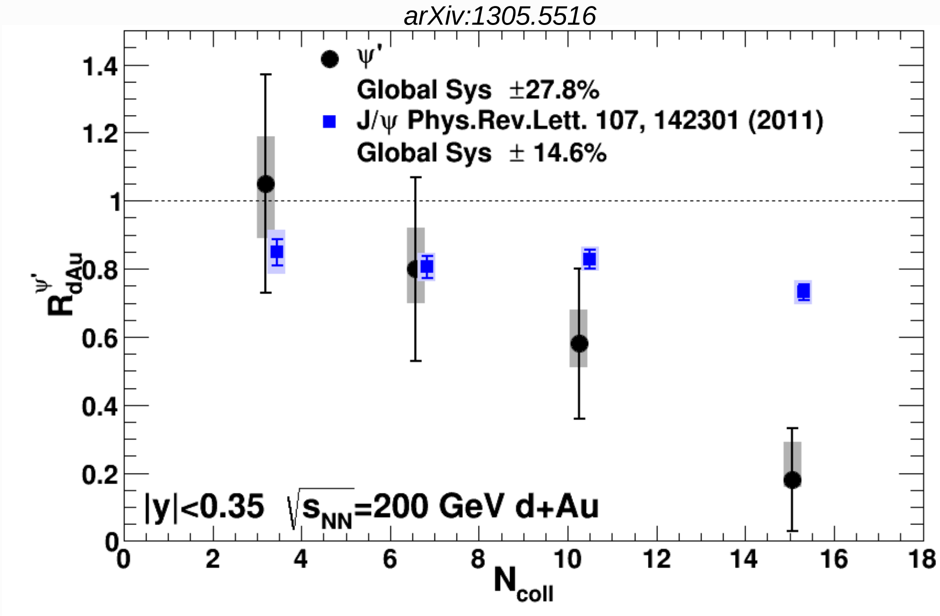


Nuclear Absorption



- Extract nuclear absorption cross section from previous model.
- Compare with results from lower energies.
- For $\tau > 0.05$ fm/c, results are consistent!
  - Likely due to expansion of ccbar pair.
- Both E866 & PHENIX show increase in σ_{abs} at low τ.

ψ' in d+Au

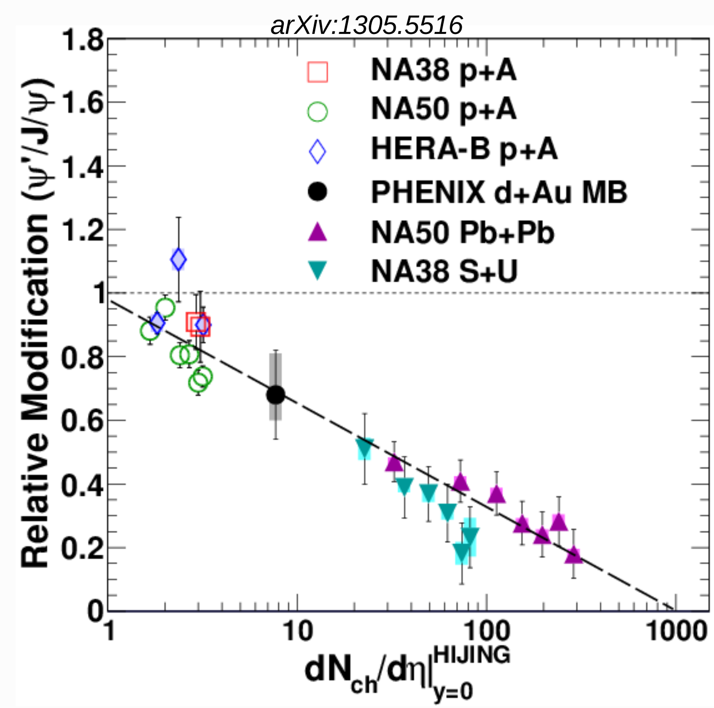


Stronger modification of ψ' compared to J/ψ in d+Au!

Not predicted by nuclear shadowing or nuclear absorption.

Relative modification seems to scale with multiplicity.

May indicate initial state effects. Co-movers?



Conclusions

- Precision measurements of J/ψ production in d+Au have led to many interesting results and questions.
- J/ψ modification suggests a non-linear geometric dependence.
  - Fits suggest a modification which is weak for $r_T > 3$ fm and strong for $r_T < 3$ fm, with a sharp transition.
- For time scales greater than the ccbar formation time, absorption cross section scales with time in the nucleus over a large range in energies
  - consistent with nuclear absorption of an expanding ccbar pair.
- ψ' modification is larger than expected.
  - Not predicted by shadowing or nuclear absorption.
  - Indicates new physics at short time scale.
- I've only briefly touched on a few of the many interesting things we've learned.

Thank you!