(A few critical) comments on jet quenching measurements and model comparisons

Peter Jacobs

What is needed to invalidate a model? Part I

1. Quantitative prediction of *multiple observables* and their *functional dependencies*, e.g.:
    - Inclusive cross section vs pT (p+p and Au+Au)
    - Coincidence yield vs zT (p+p and Au+Au)
    - RAA vs pT
    - IAA vs zT
    - …

Comment: Predicting ratios only (RAA, IAA) is not sufficient unless

1. You have a bullet-proof reason that the main systematic uncertainties of the calculation cancel in the ratio
2. You have a bullet-proof reason why you cannot calculate absolute quantities

2. Quantitative understanding of theoretical+model uncertainties

What is needed to invalidate a model? Part II

3. Robust experimental measurements, with well-established systematic uncertainties

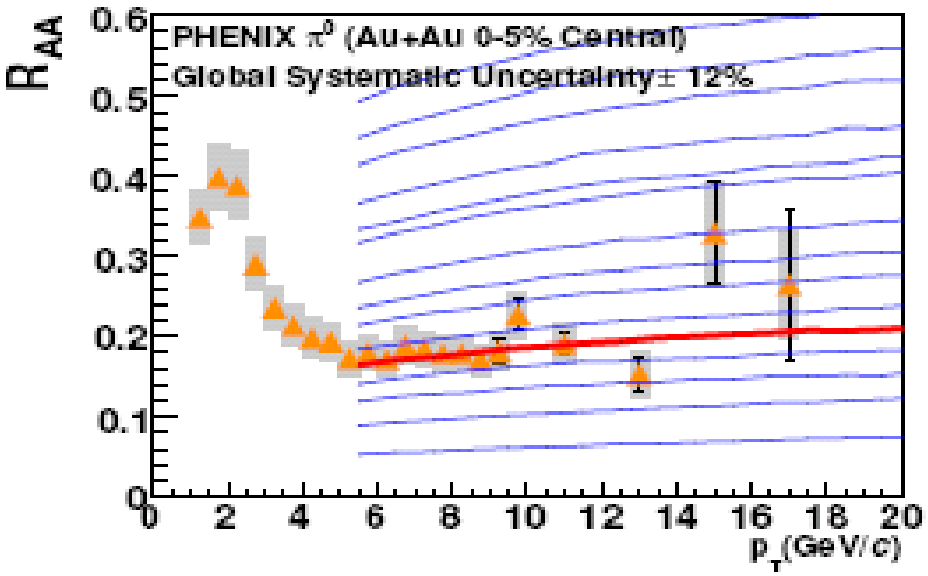
Comment: disagreement between experiments should be a cause for concern and should demote the importance of an observable for testing models

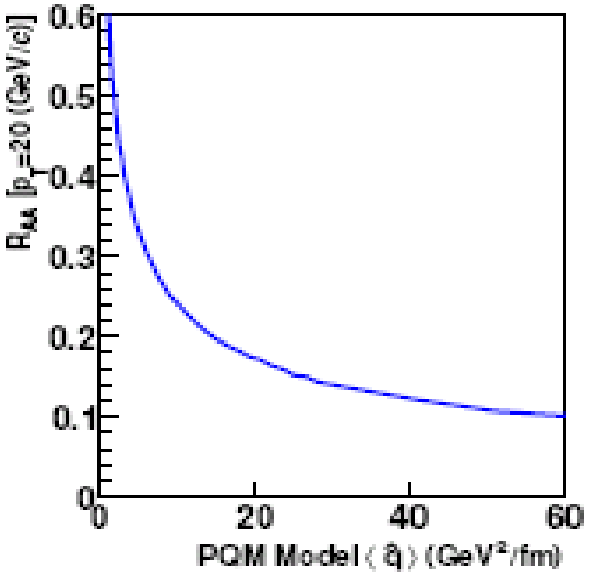
4. *Low statistical and systematic significance of global fit to multiple observables*: cannot find good, internally consistent fit of model parameters

Biased comments:

- fitting to one featureless distribution (RAA) is not very discriminating (many models can do this)
- centrality dependence is a weak systematic test (most models interpolate ~smoothly from central to peripheral)

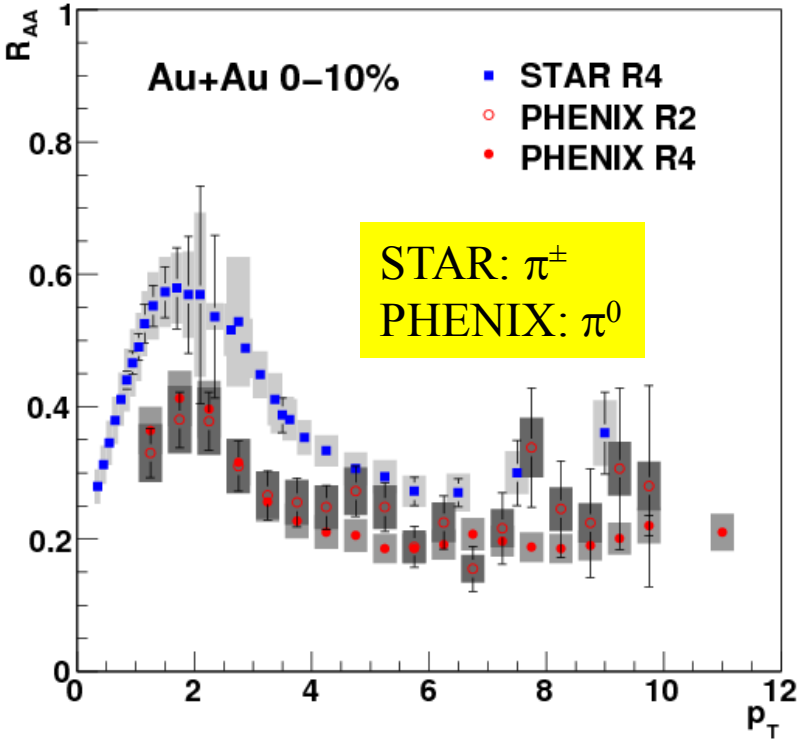
Example 1: pion RAA



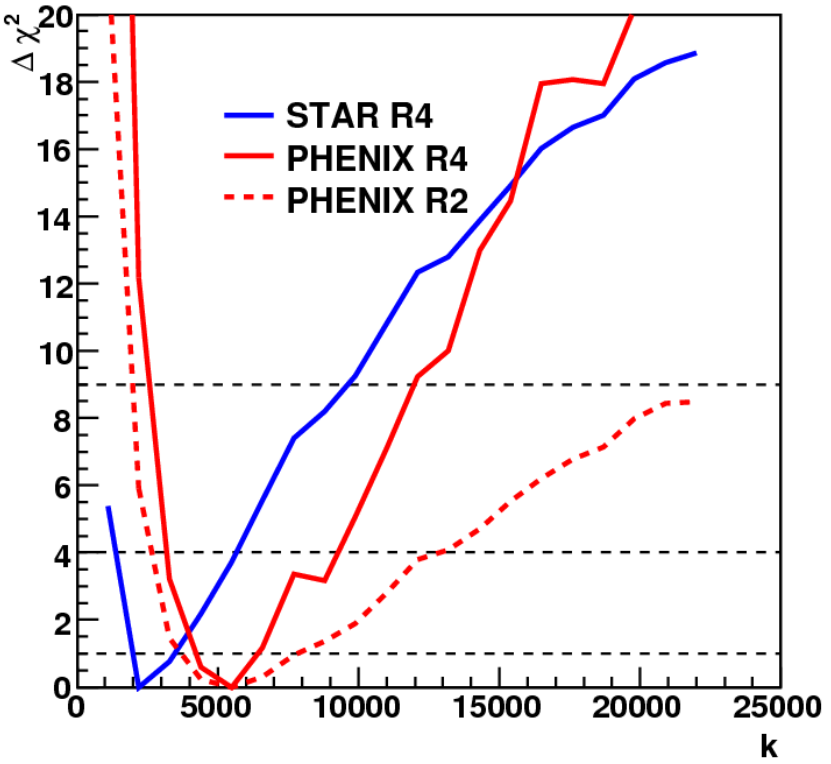


Example 1: pion RAA

M. Van Leeuwen

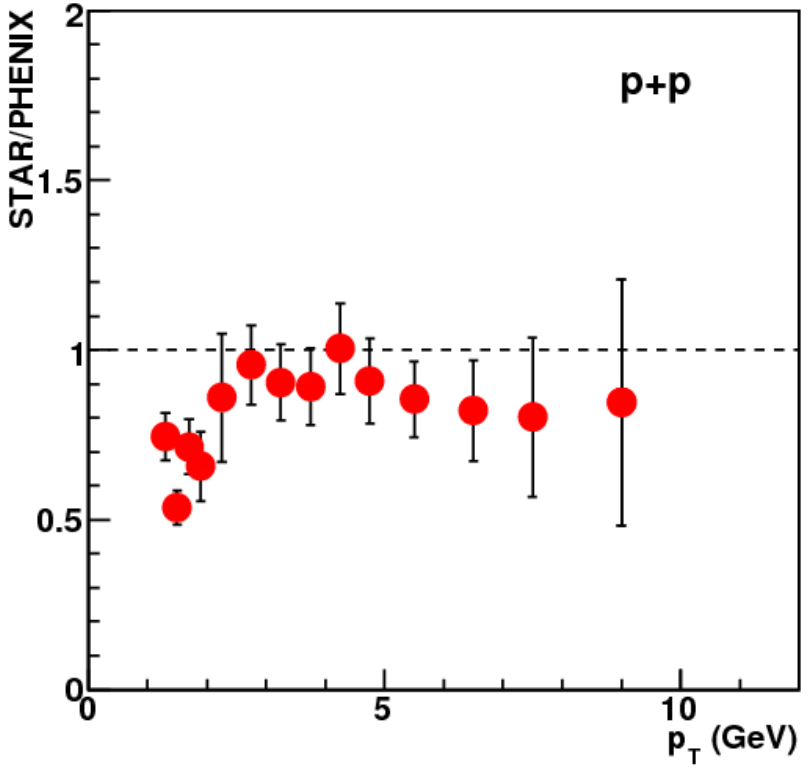


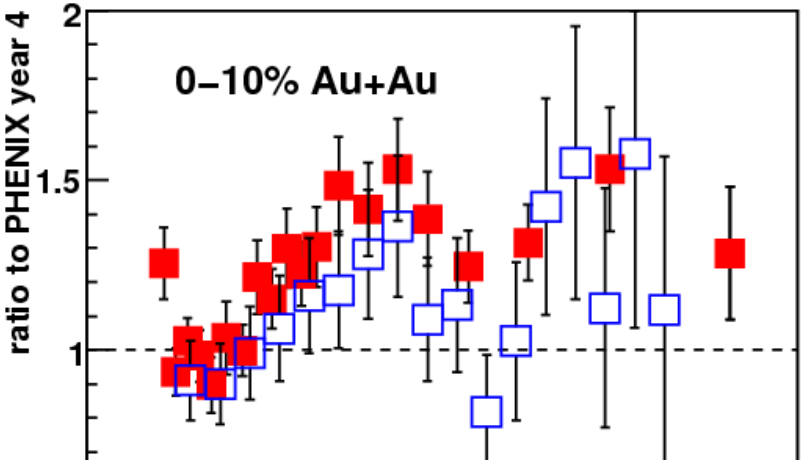
Sizable differences between STAR, PHENIX R_{AA}

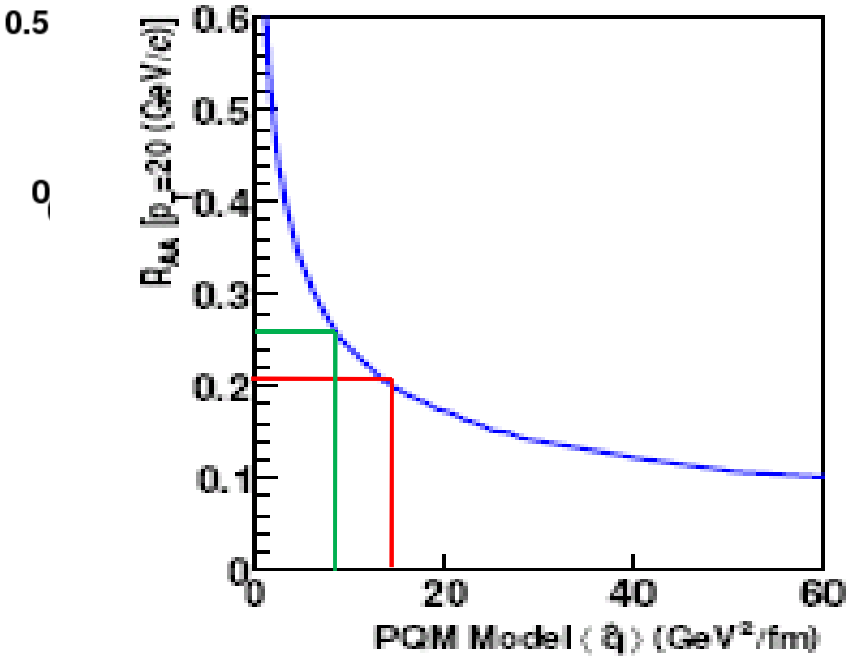


Taking stat+sys together, deviation is ~2 sigma for $5.25 < p_T < 20$

STAR/PHENIX RAA cont'd





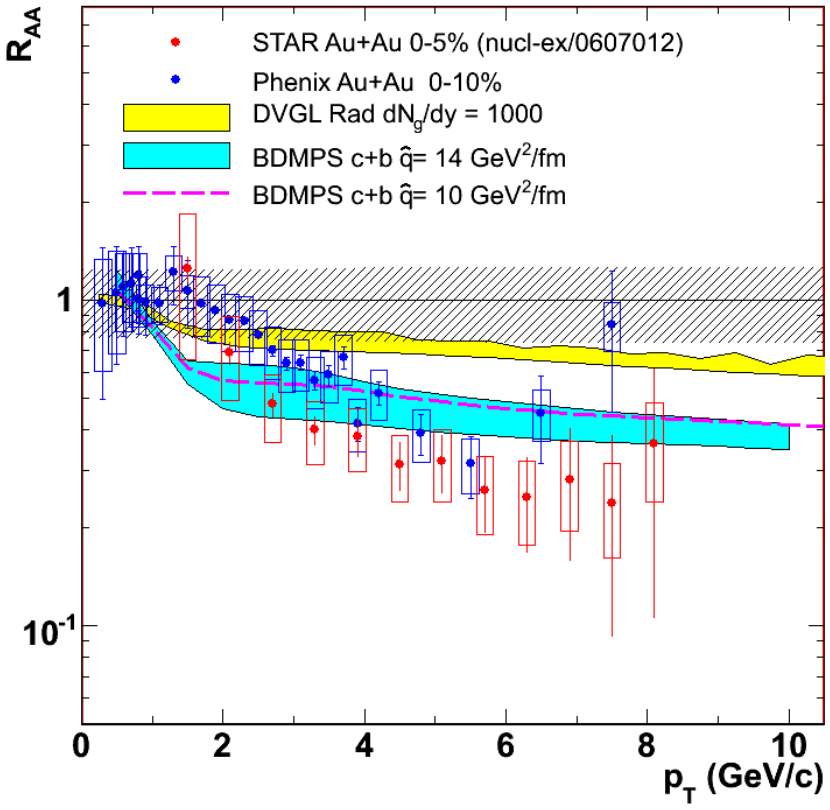


Difference sits in Au+Au result…

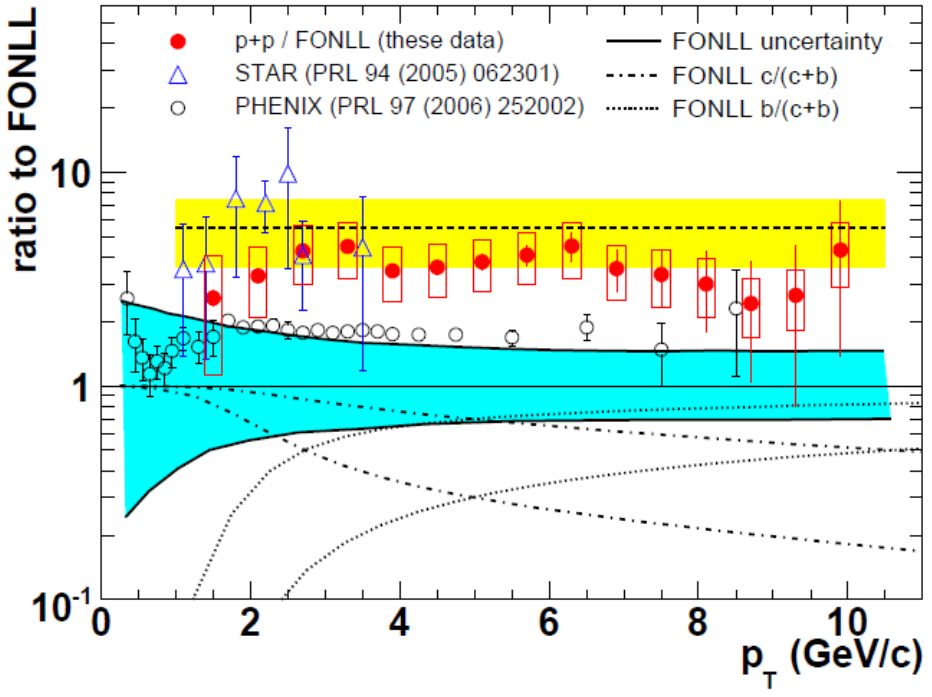
What are consequences for extracting qhat?

Example 2: non-photonic electrons

RAA: rough STAR/PHENIX agreement

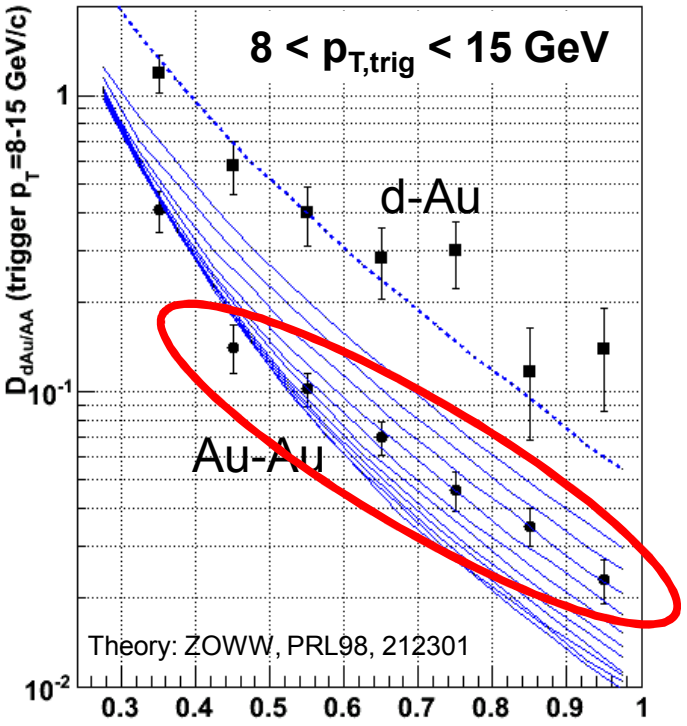


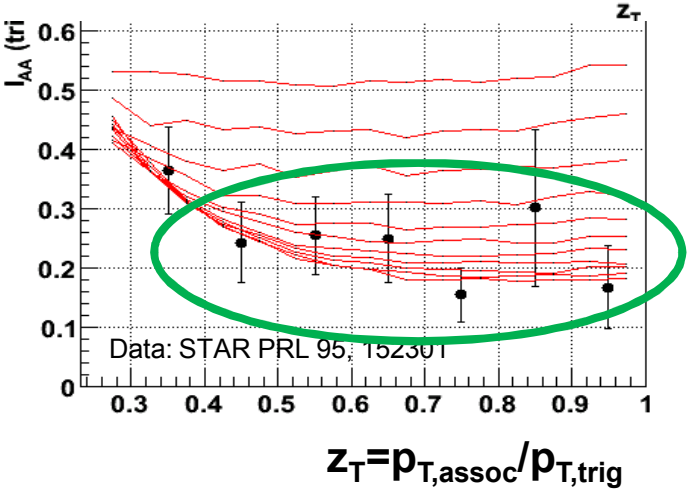
p+p spectrum: large STAR/PHENIX disagreement !



Can we trust the ratio if we can't trust its components?

Example 3: di-hadrons





Coincidence yield:
functional form is wrong

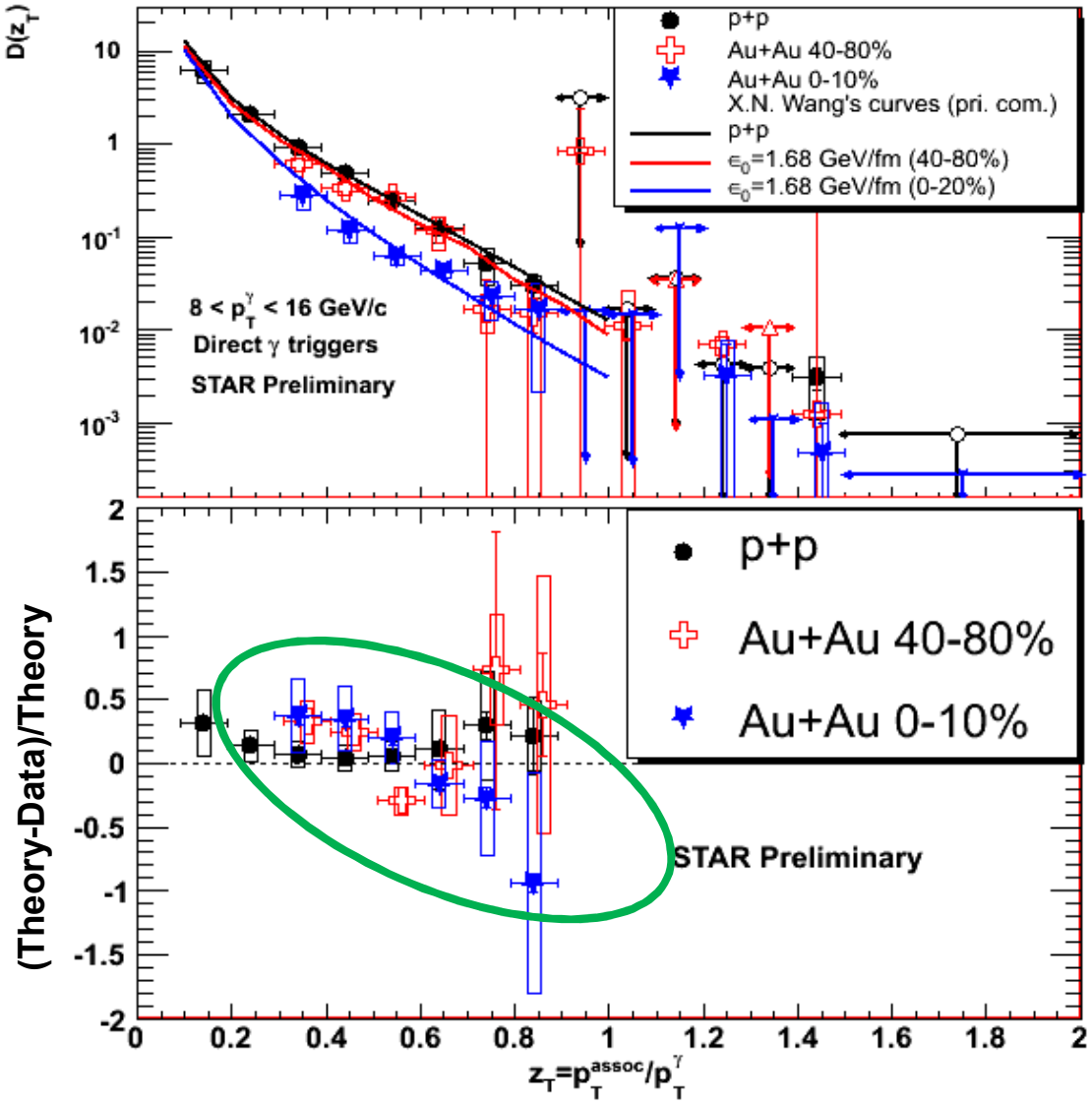
IAA: functional form OK

Can we trust the ratio if we can't trust the components…?

Maybe it's the data and not the calculation…

γ+hadron coincidences

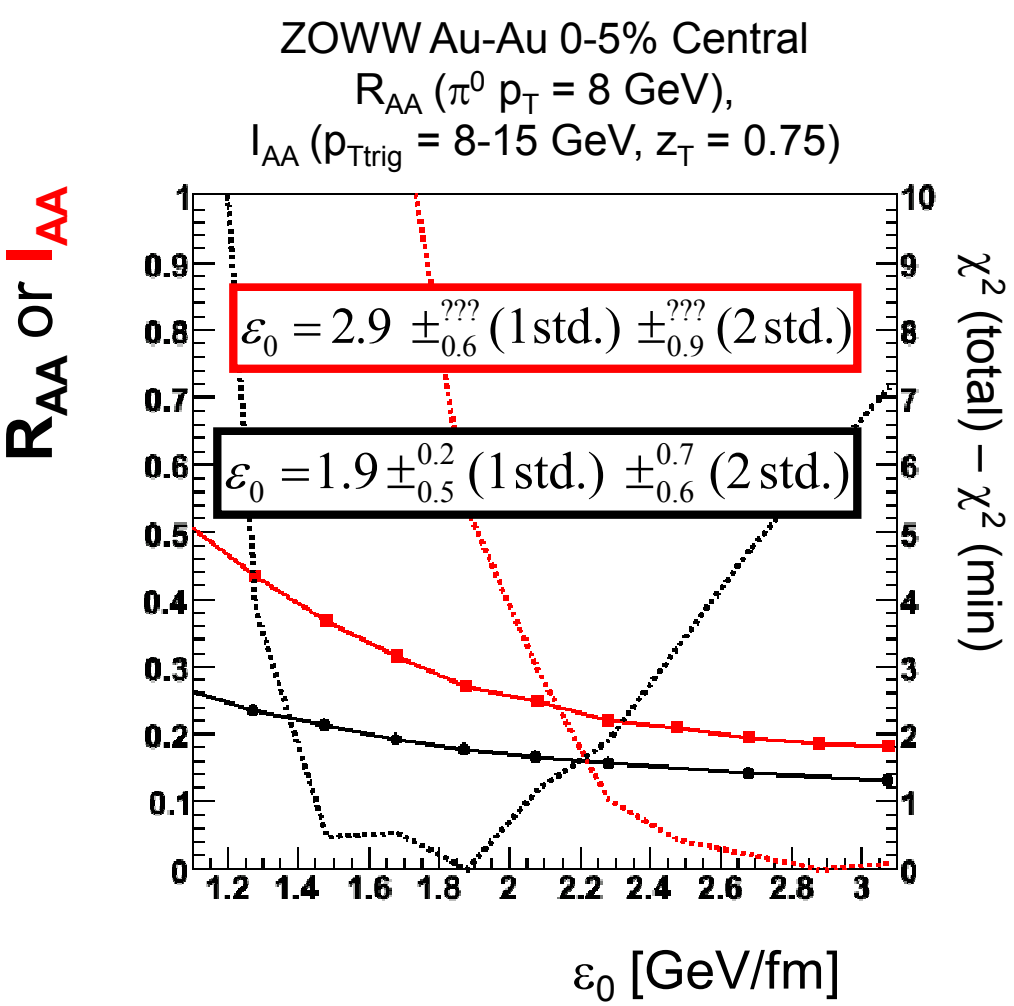
A. Hamed, QM09



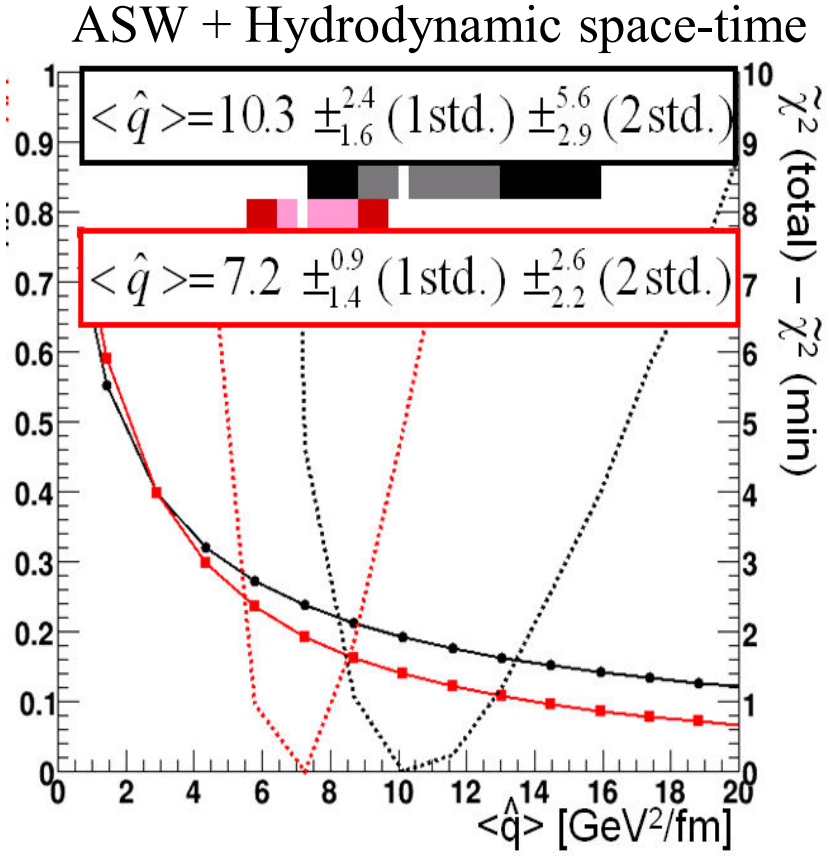
Functional form wrong here too…

Is this important or not?

We need to resolve such systematic issues before we can meaningfully do this ….



J. Nagle QM09



But this is good:

Thorsten R., yesterday:

> As a theorist, I am somewhat dismayed by the fact that trying to make the model more realistic leads to less agreement with the data. As a phenomenologist however, I am excited by the fact that there's something to learn here!

Bottom line:

- we have a rich set of measurements with the potential to provide deep insight into hot QCD matter
- but we need to take their precision and accuracy seriously: "qualitative agreement" is of limited value

These issues are central to TECHQM – should become a regular part of the discussion