Identified Particle Dependence of Nuclear Modification Factors in d+Au Collisions at RHIC.

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For the STAR Collaboration

Outline

- Motivation for d+Au measurements
  - Previous p+A results
  - Au+Au results
- STAR setup for d+Au run
- Nuclear modification factors in d+Au
- Implications for Au+Au interpretation
- Forward rapidity region
- Summary and outlook

Motivation

- Species dependent Cronin effect at *lower* energies.
  - Cronin effect decreasing with increasing $\sqrt{s}$.
  - Still existing at $\sqrt{s}$ = 200 GeV?
- Final state explanation for high p_T suppression and disappearance of back-to-back correlations in Au+Au but…
  - What about particle dependence of nuclear modification factors in Au+Au at intermediate p_T?
- RHIC provided d+Au rather than p+Au collisions purely for technical reasons.

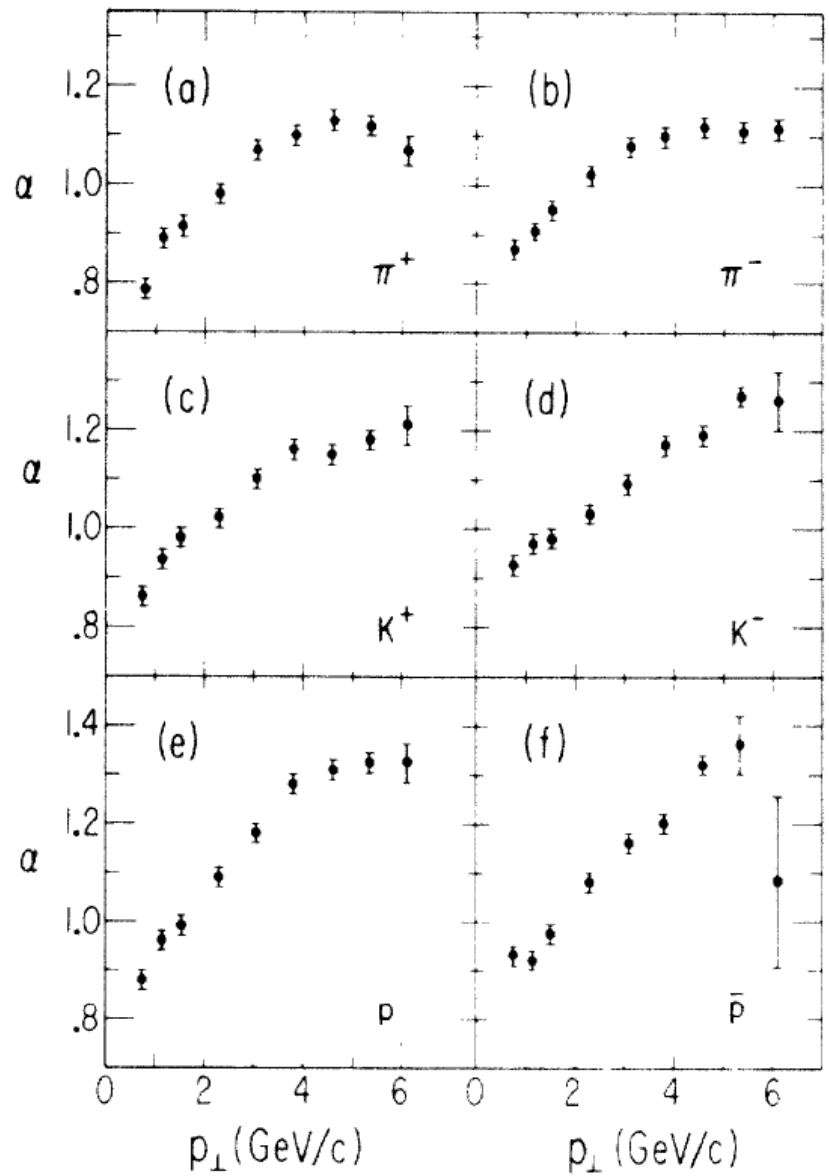
Lower energy p+A measurements

PRD 11, 3105 (1975) Cronin *et. al*

$$I(p_T, A) = I(p_T, 1) A^{\alpha(p_T)}$$

Enhancement growing with p_T
Larger enhancement with heavier particle:

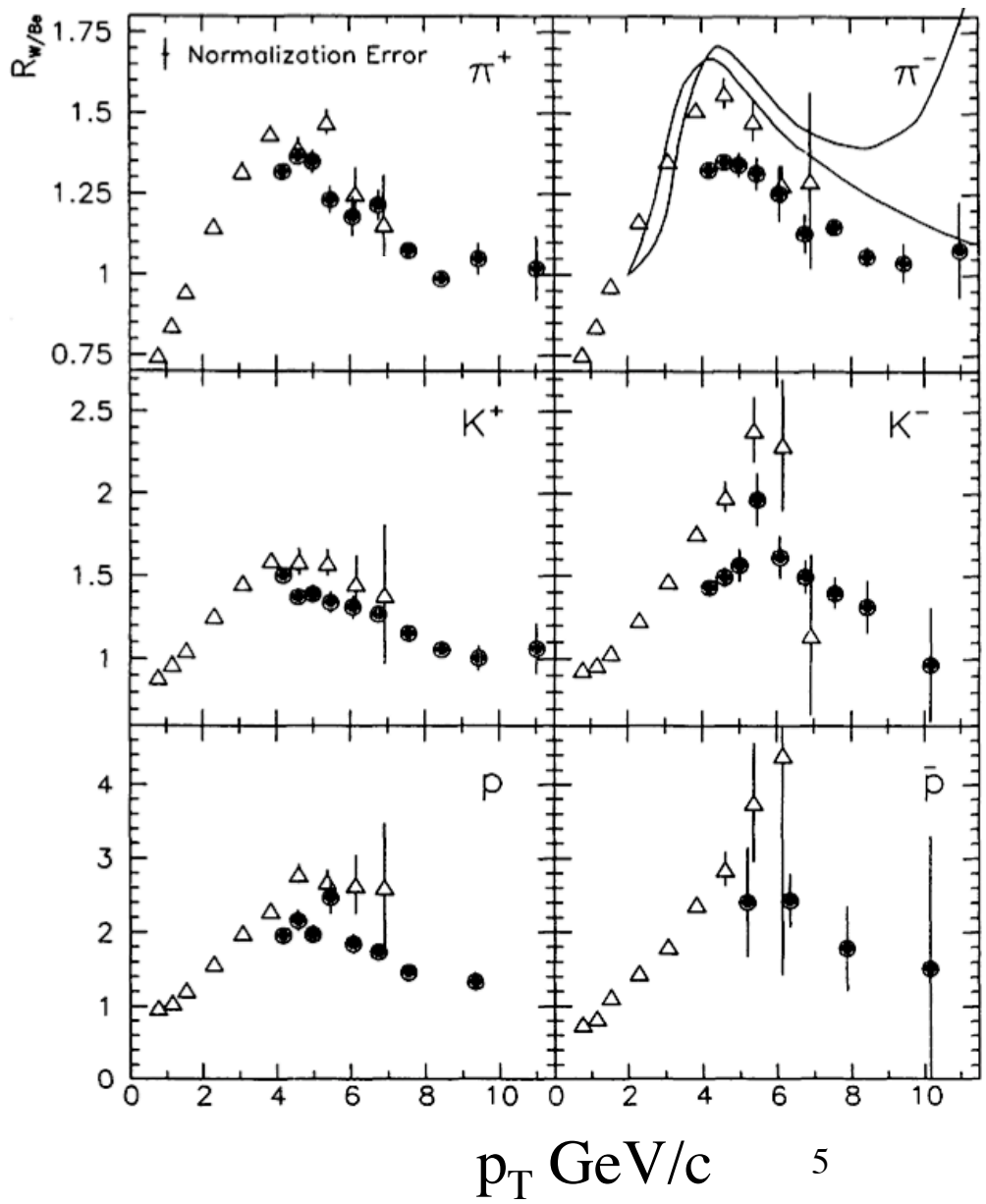
$\alpha_\pi < \alpha_K < \alpha_{proton}$



Lower Energy Cronin effect data

- Ratio of per nucleon cross sections for p+W and p+Be collisions at $\sqrt{s}$=38.8 GeV
  - Enhancement varies with p_T and with particle species

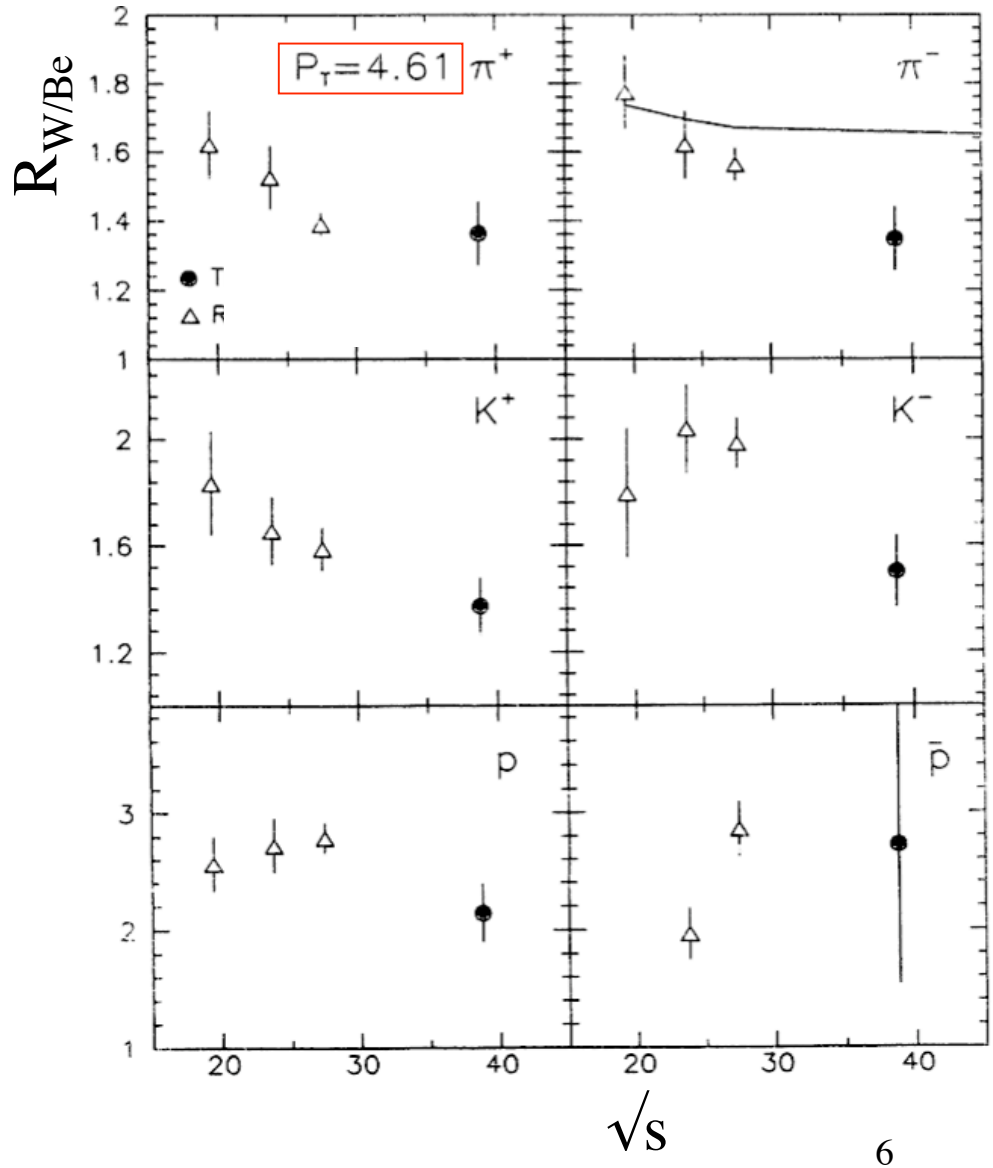
PRL 68, 452 (1992) Straub *et al.*



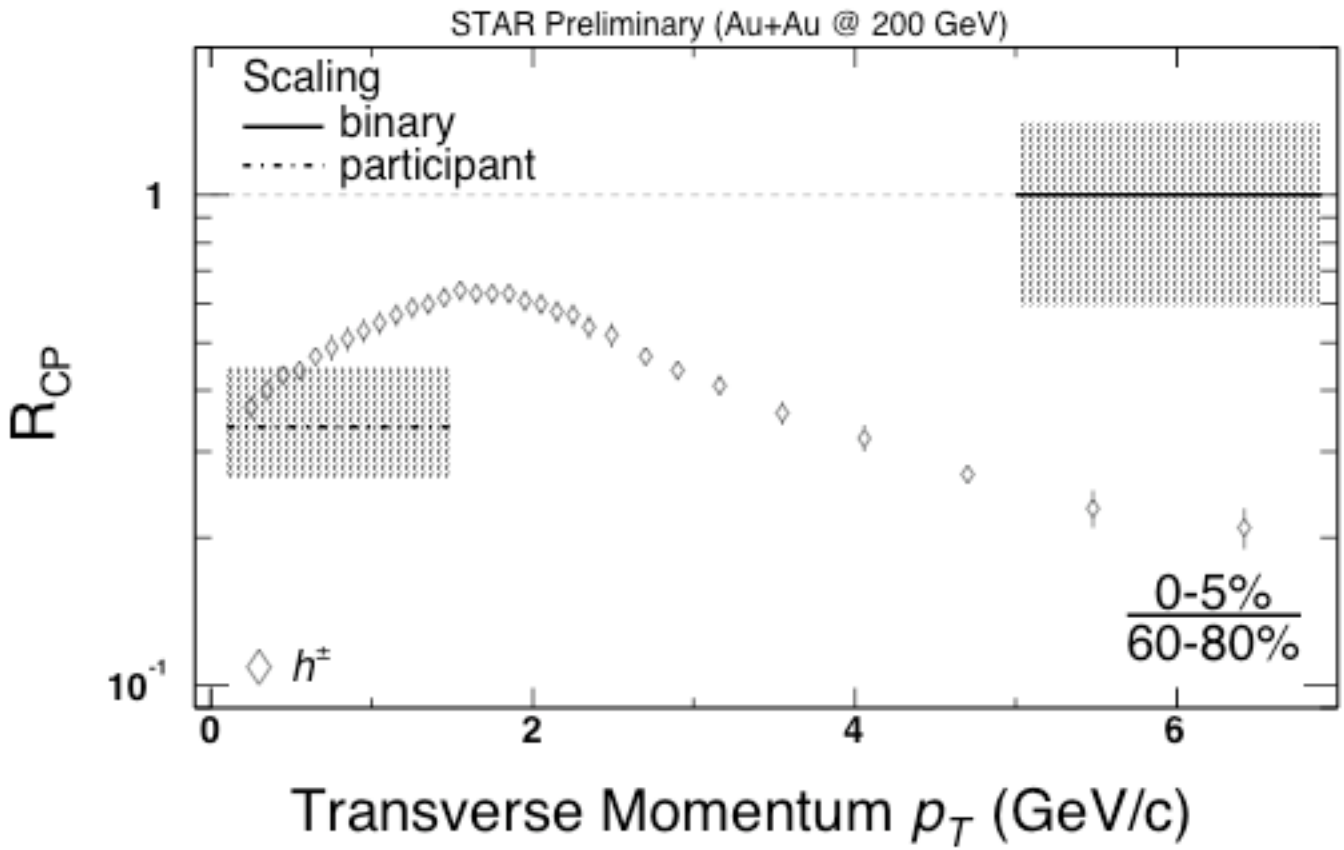
PRL 68, 452 (1992) Straub *et al*.

Lower Energy Cronin data (II)

- Cronin enhancement decreasing with increasing √s
  - Certainly for π, K
  - Trend less clear for proton?
- Larger magnitude effect for p

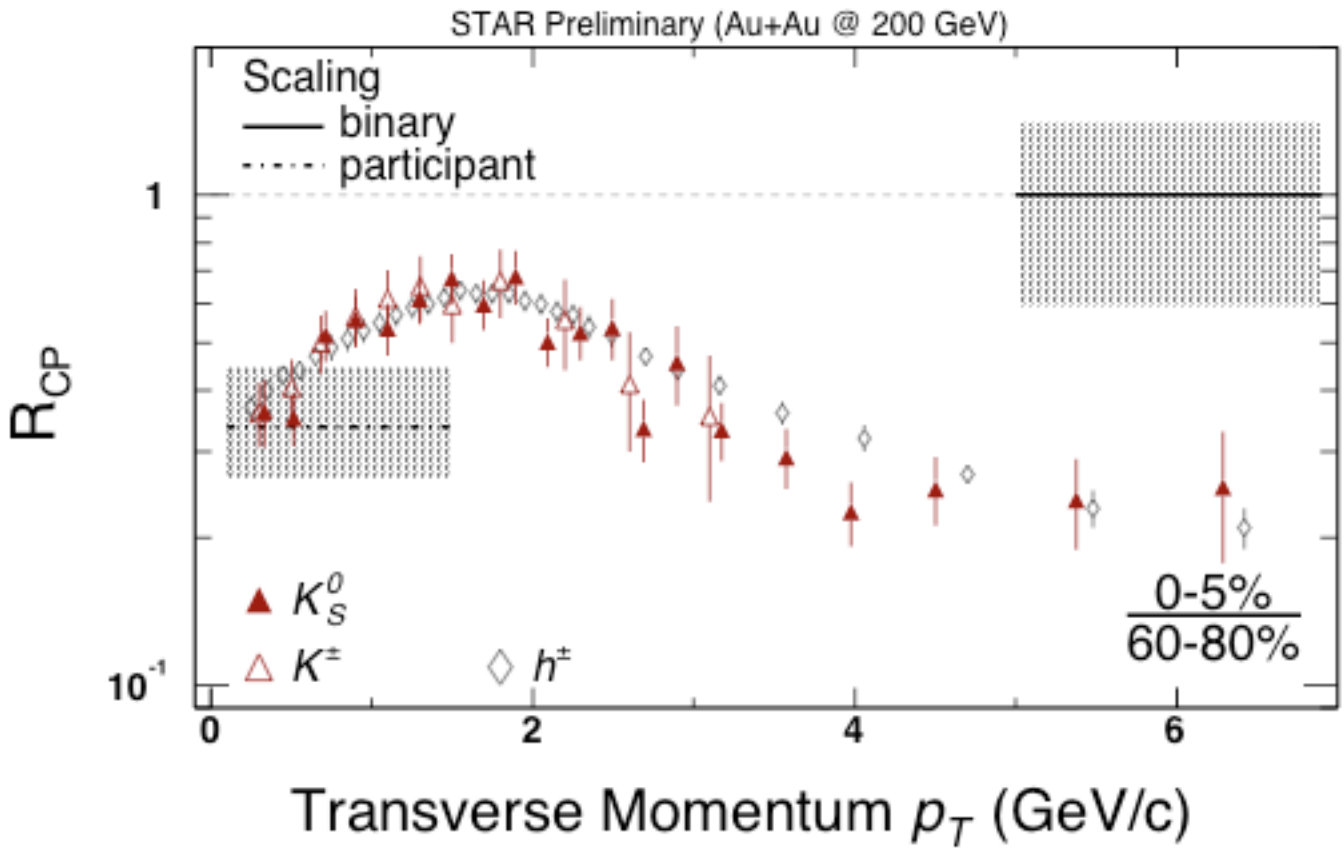


Au+Au Nuclear Modification



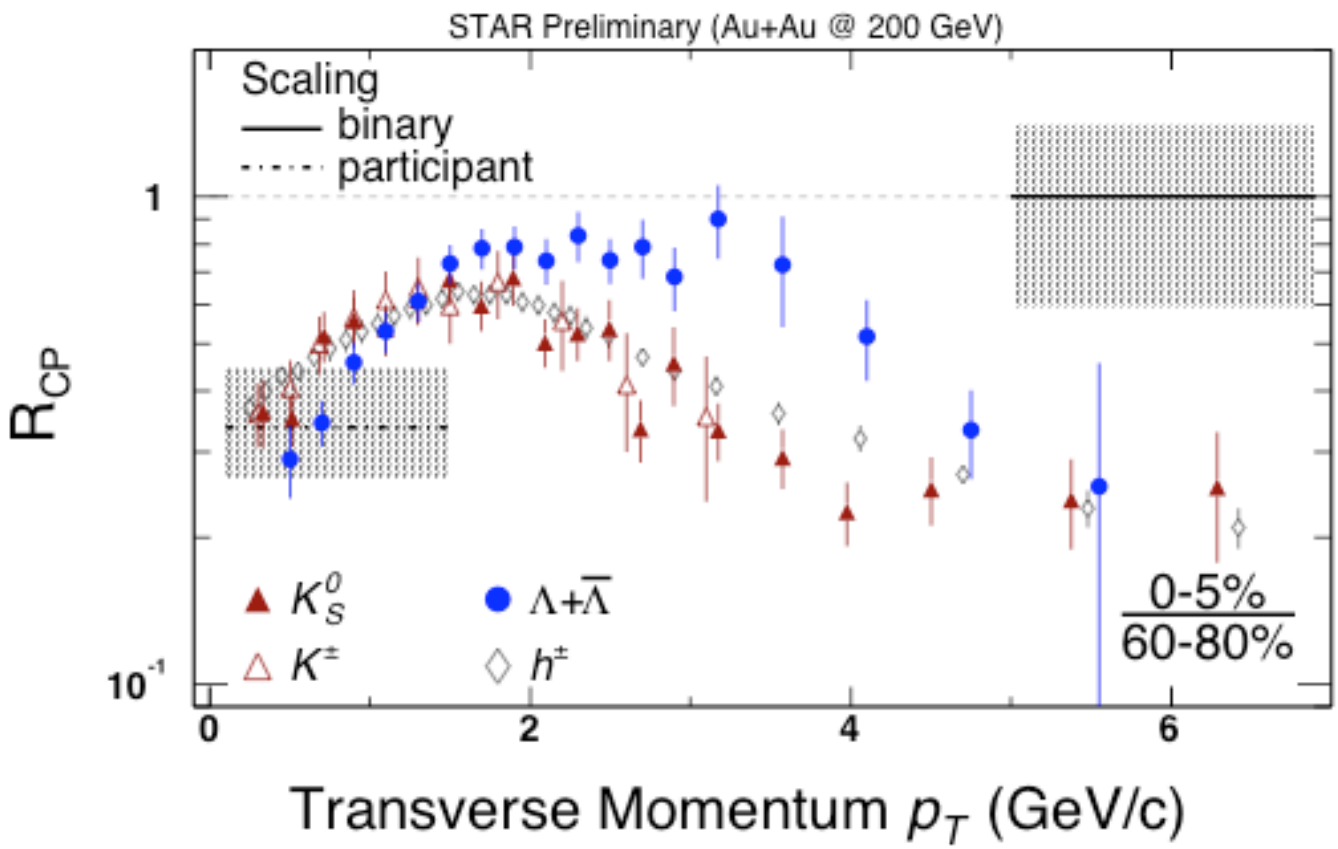
PRL 91, 072302 (2003) STAR

Au+Au Nuclear Modification



PRL 91, 072302 (2003) STAR

Au+Au Nuclear Modification

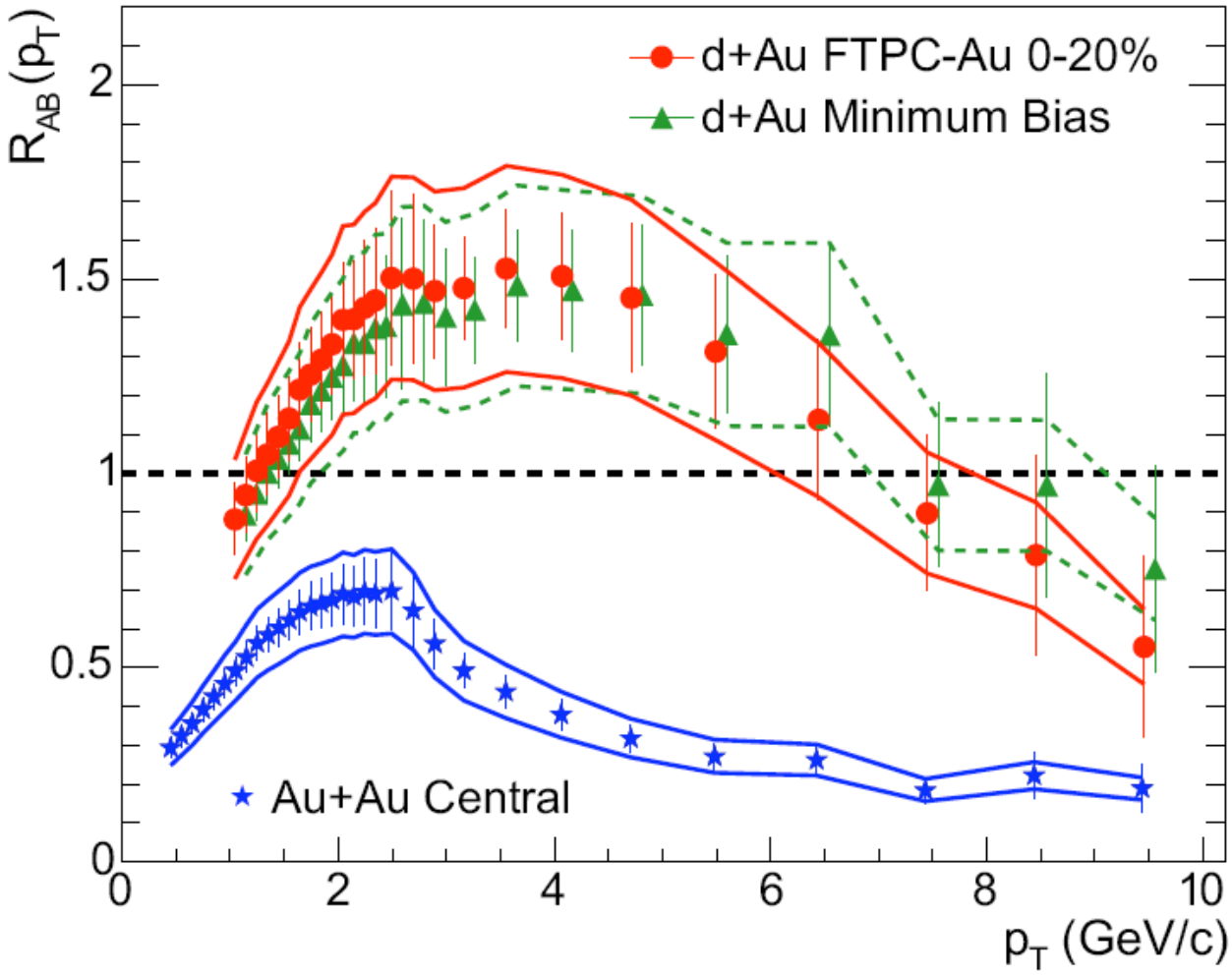


Different behaviour for Λ and K^0 in p_T 2-4 GeV range.

See poster by P. Sorensen (STAR)

d+Au Nuclear Modification $h^{\pm}$

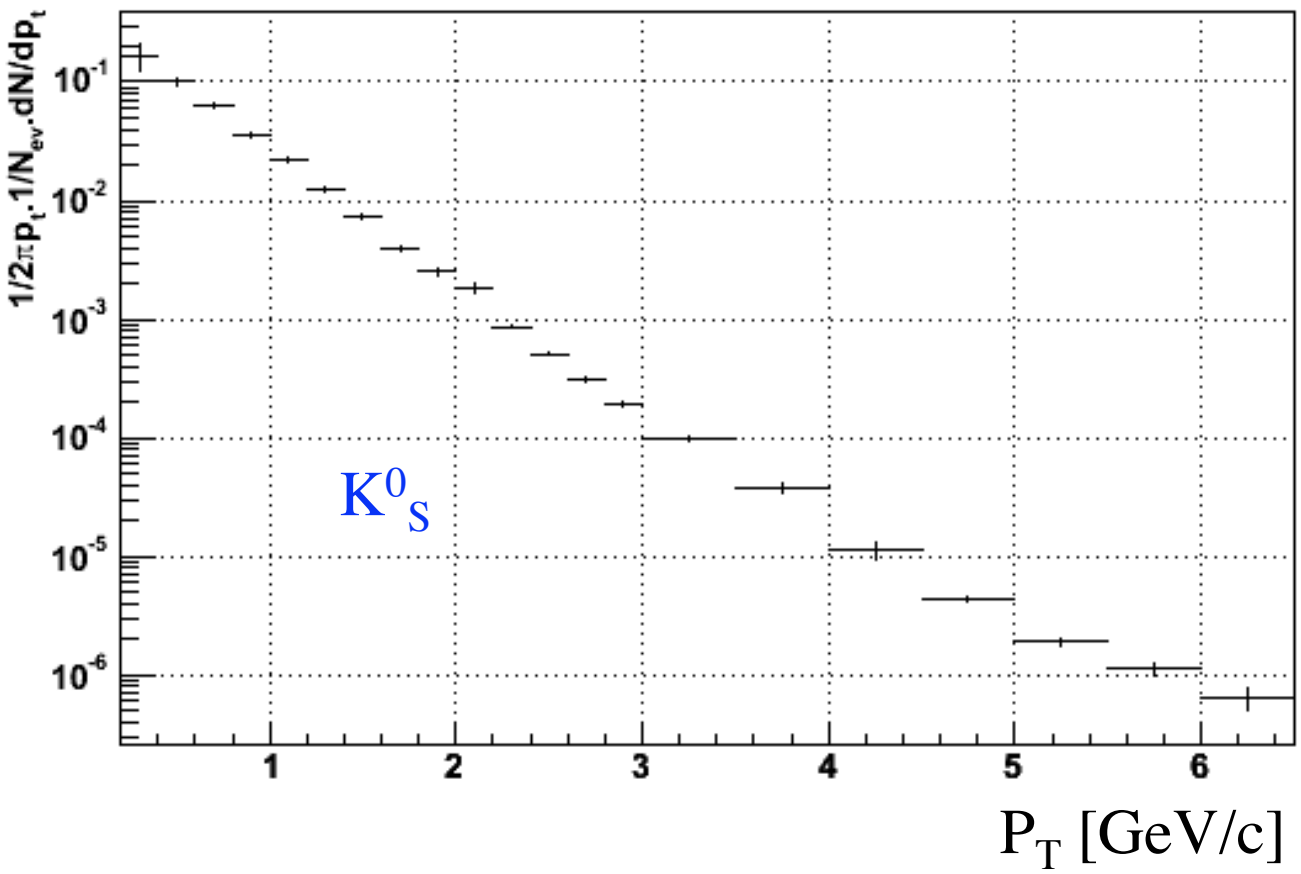
STAR, PRL 91 (2003) 072304



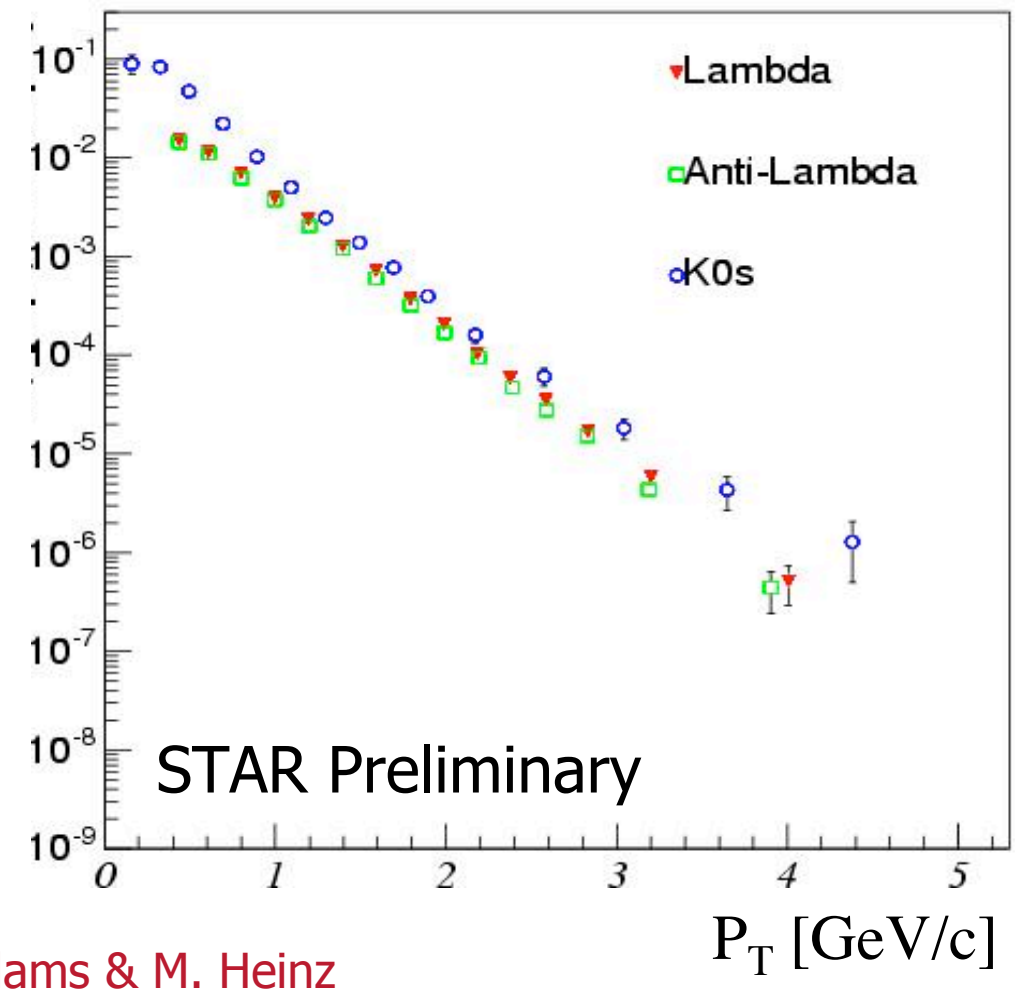
STAR Setup

- 10 M minimum bias d+Au events used.
- Main TPC at mid-rapidity measures charged tracks
  - Reconstruct "V0s" $\Lambda \rightarrow p\pi^-$ and $K^0_s \rightarrow \pi^-\pi^+$
  - And "kinks" $K^\pm \rightarrow \mu^\pm\nu$, $K^\pm \rightarrow \pi^\pm\pi^0$ See poster C.Mironov
- TOF at mid-rapidity identifies π, K, p
- FTPC reconstructs charged tracks at forward rapidity ($\eta \sim 3$)
  - Used in centrality classification

Spectra √s=200 GeV d+Au collisions

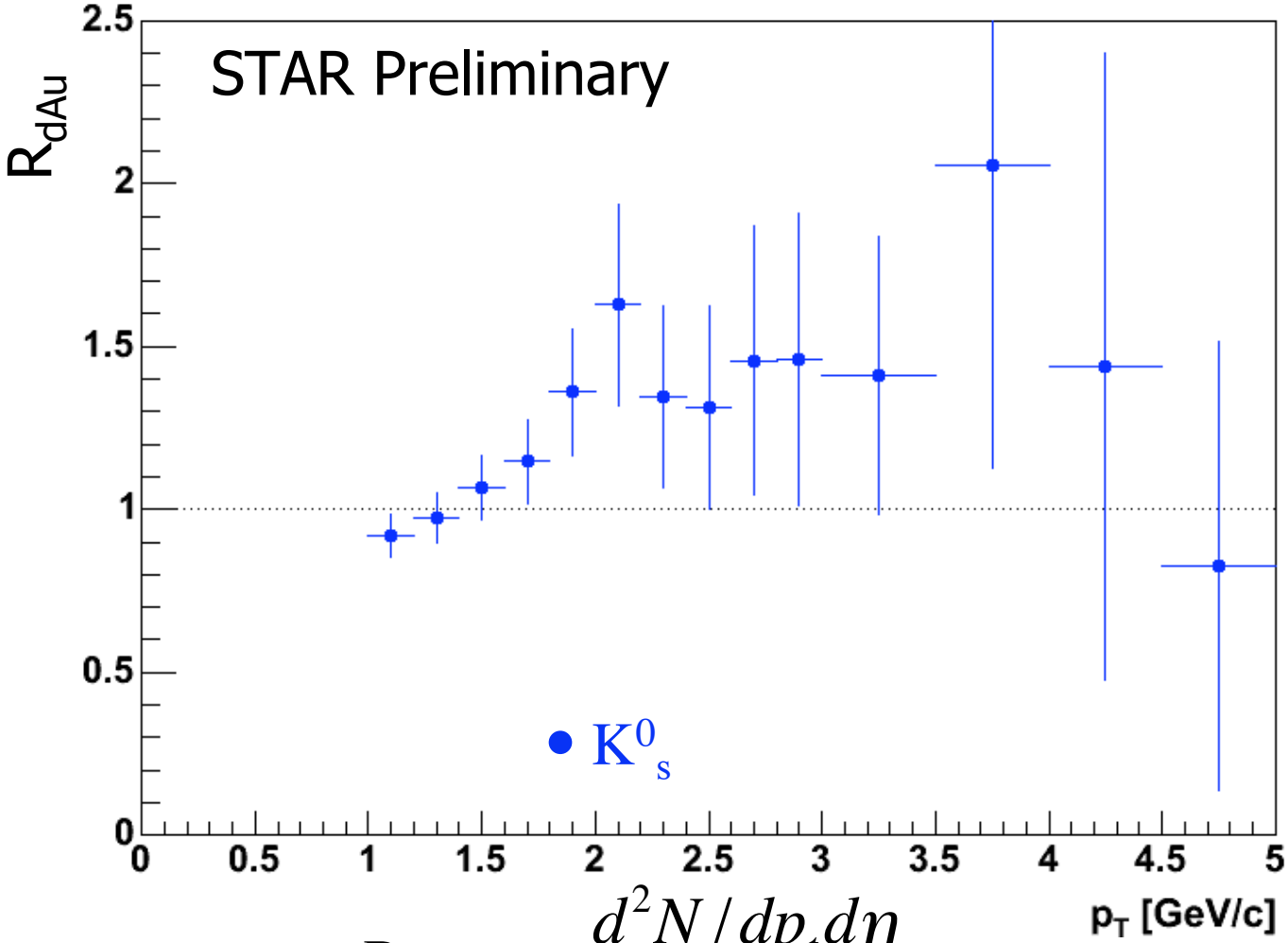


Spectra √s=200 GeV p+p collisions



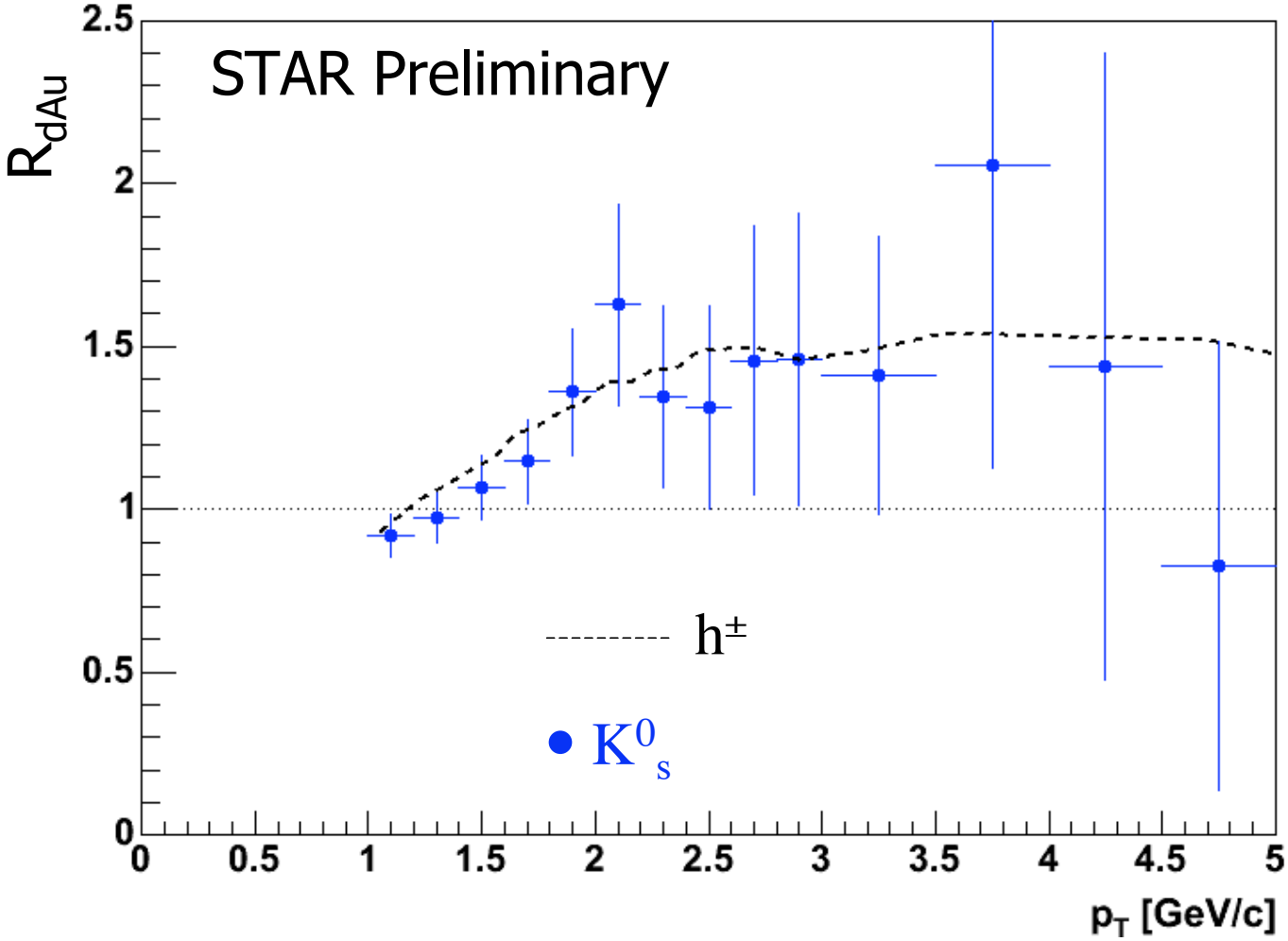
See poster J. Adams & M. Heinz

Nuclear modification factors



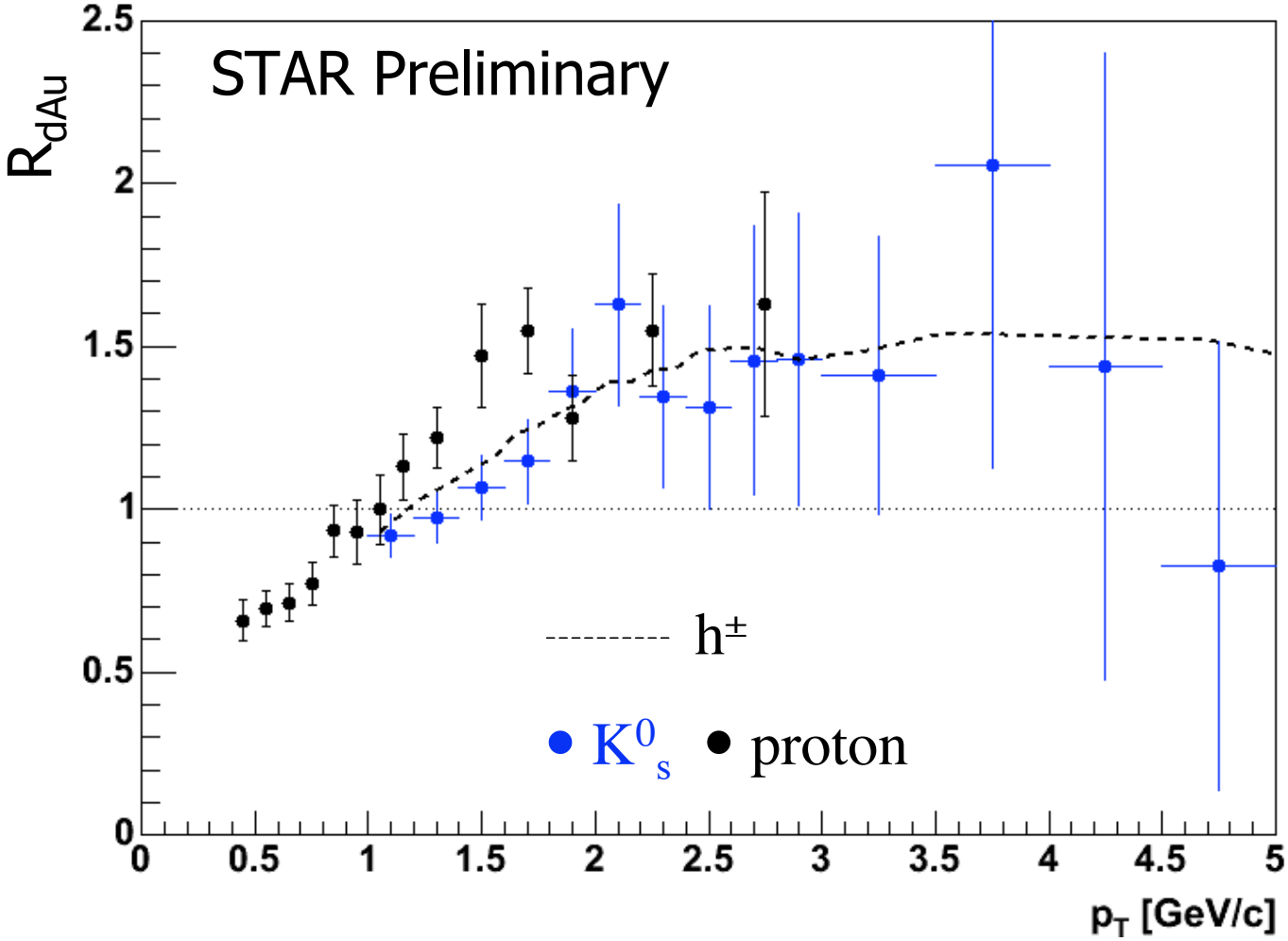
$$R_{AB} = \frac{d^2N / dp_t d\eta}{T_{AB} d^2\sigma^{pp} / dp_t d\eta}$$

Nuclear modification factors



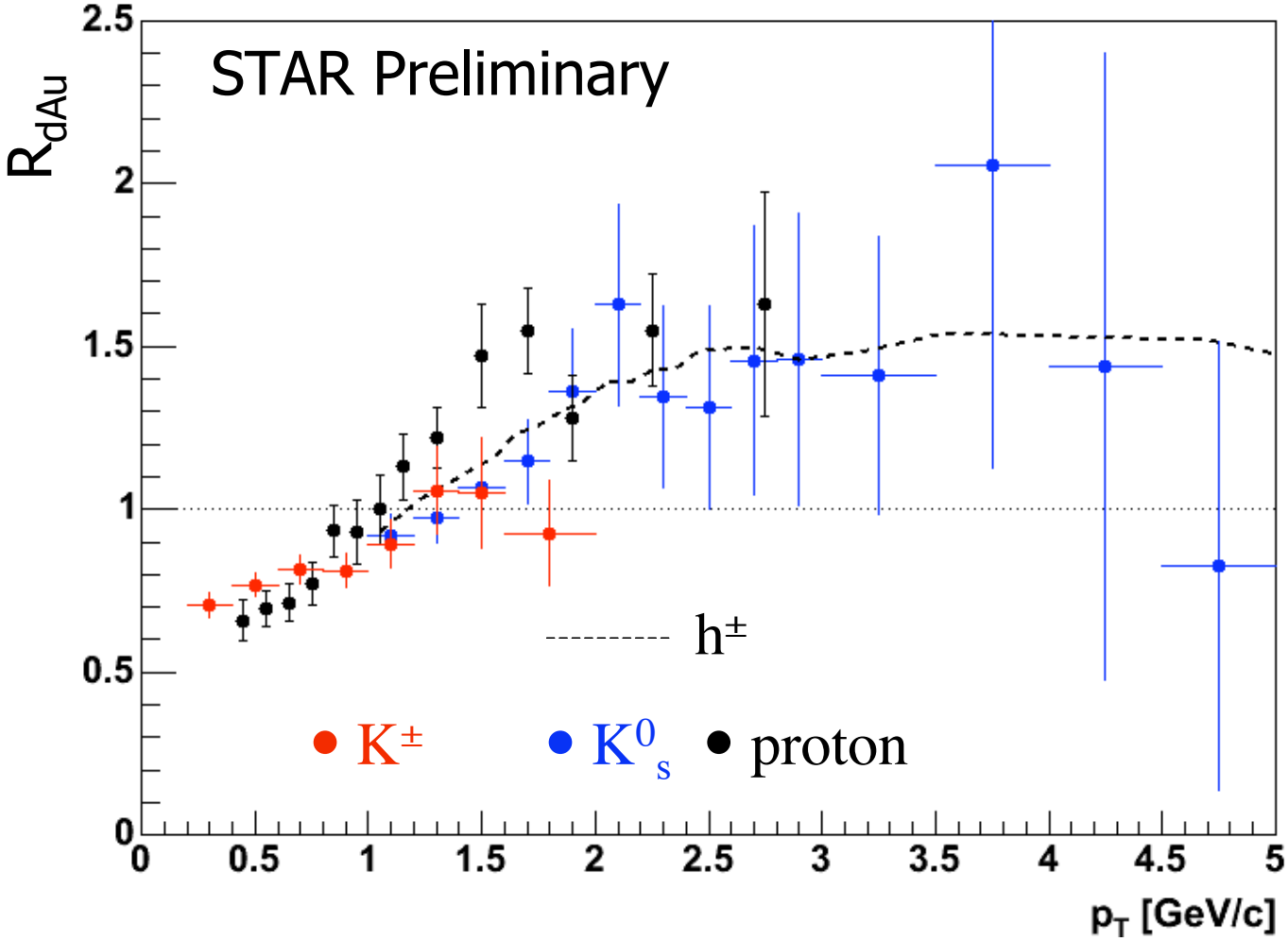
$h^{\pm}$ data PRL 91 (2003) 072304

Nuclear modification factors



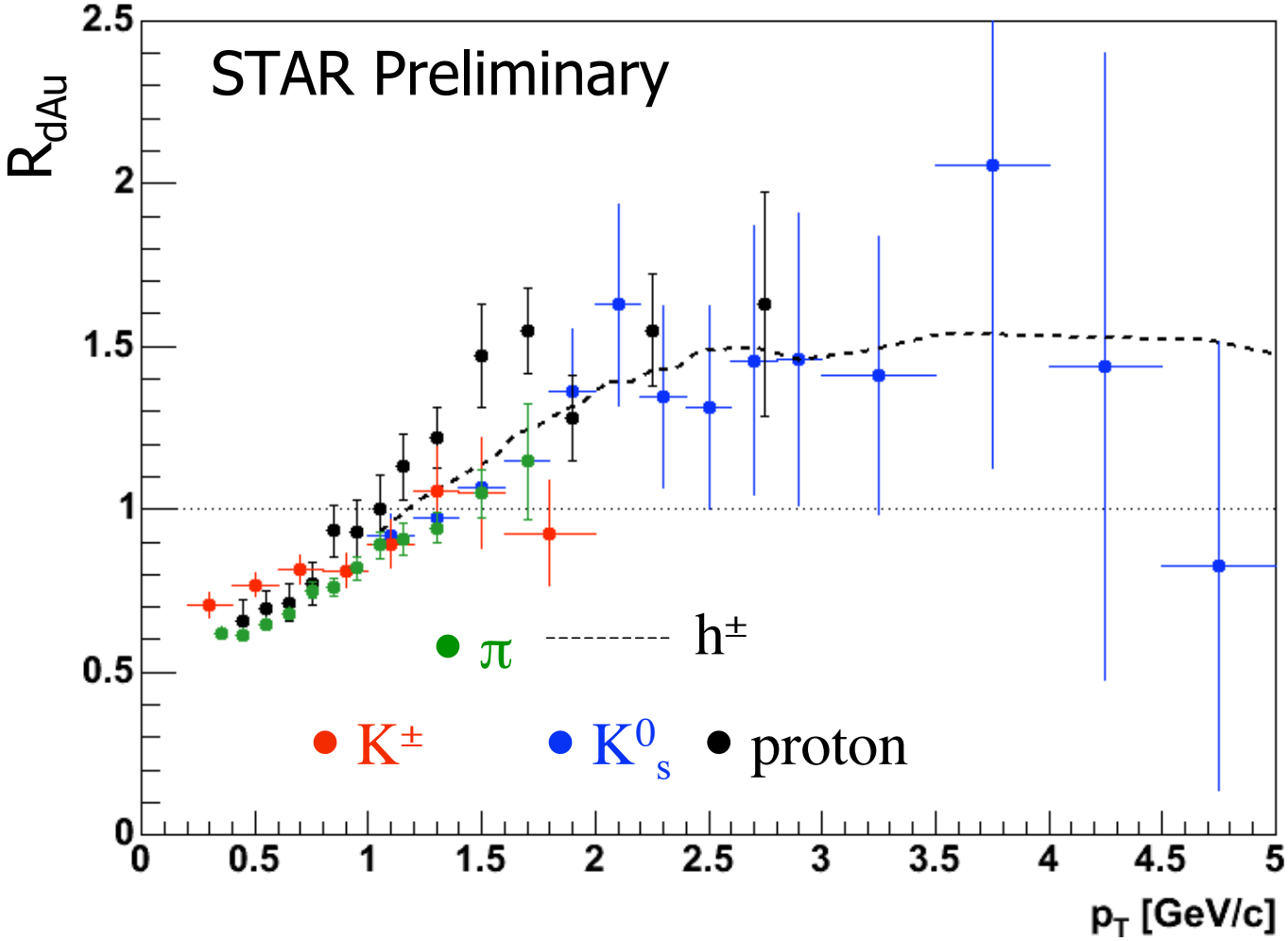
STAR TOF data nucl-ex/0309012

Nuclear modification factors



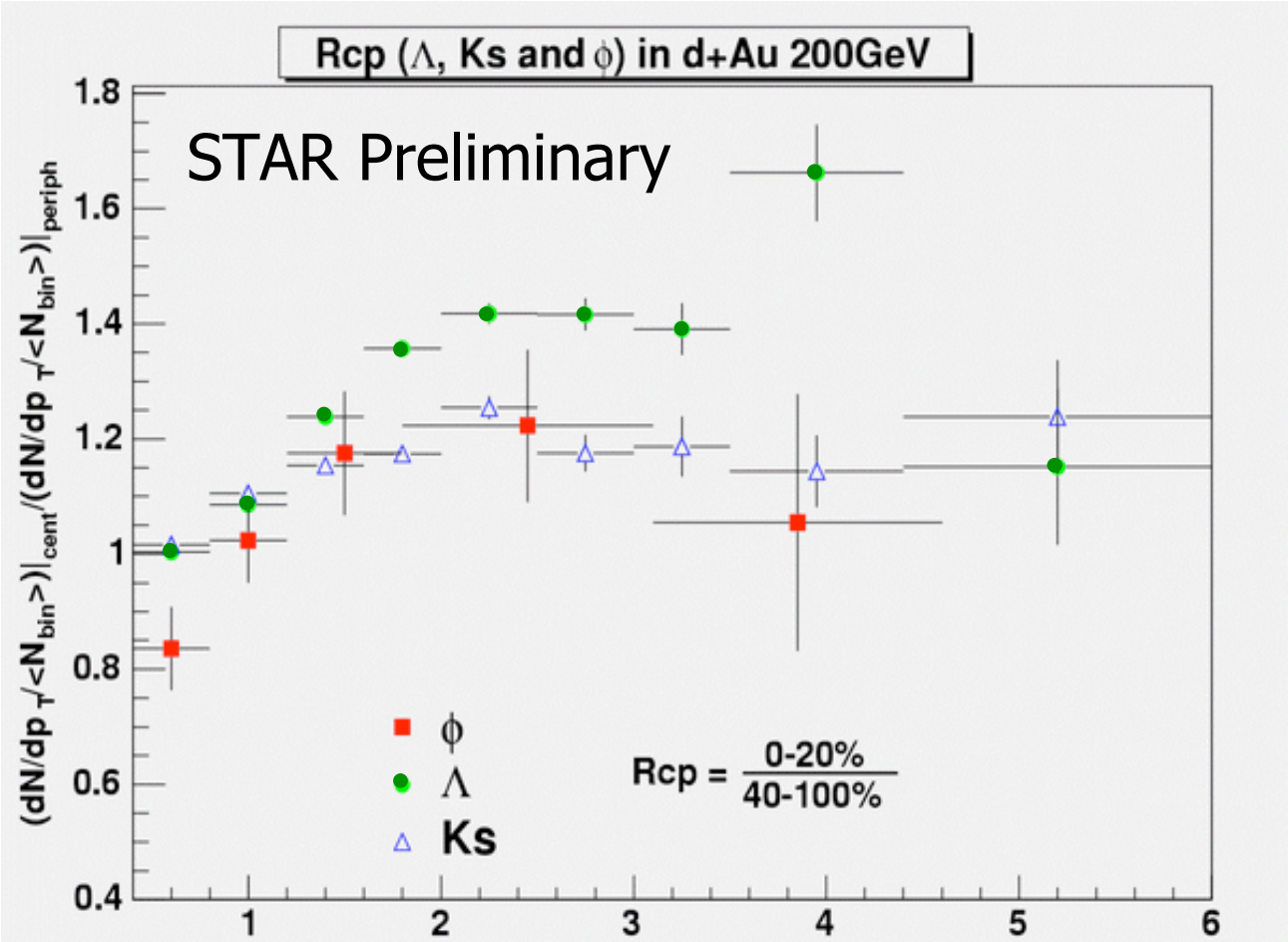
STAR TOF data nucl-ex/0309012

Nuclear modification factors



STAR TOF data nucl-ex/0309012

Central to peripheral



P_T [GeV/c]

Au+Au interpretation

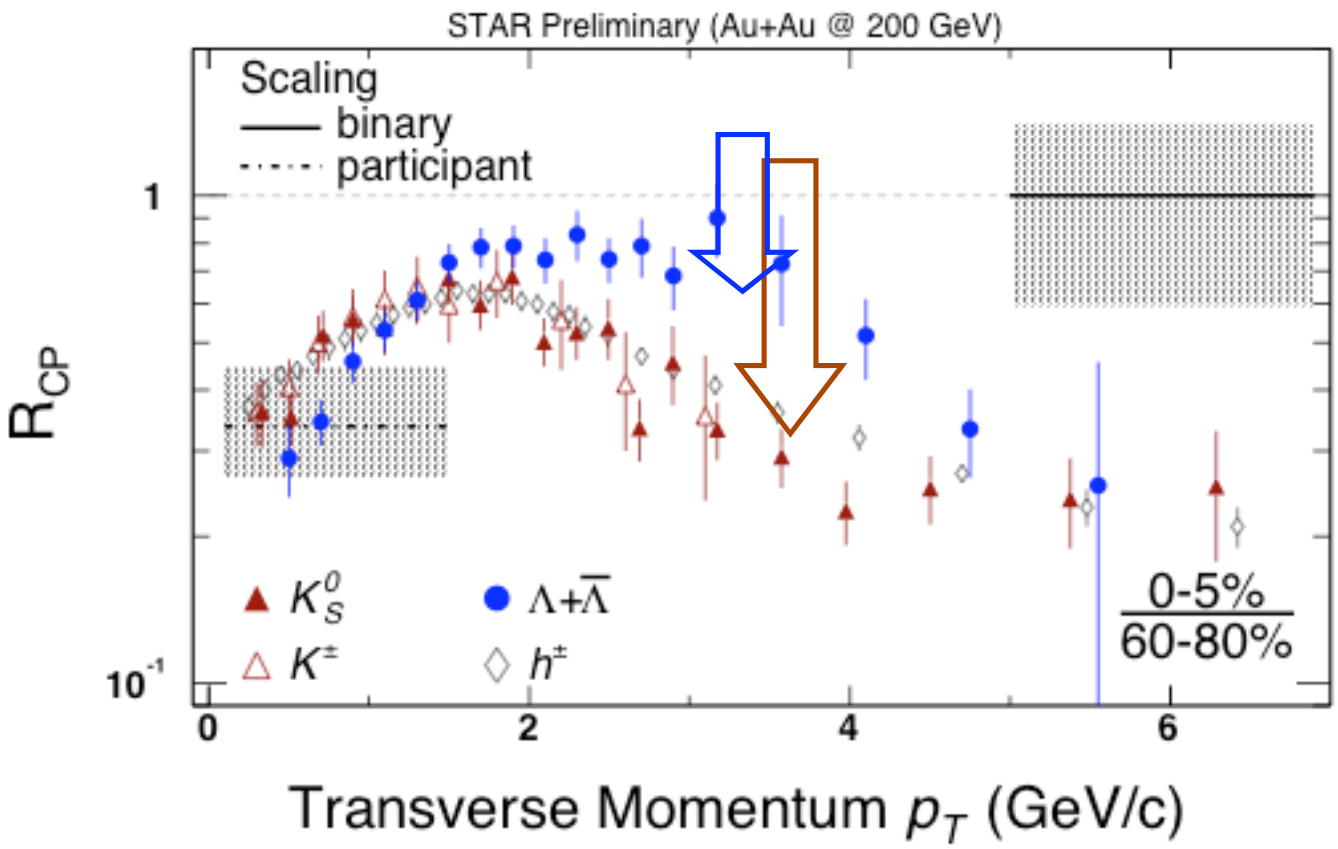
Difference between identified particle nuclear modification factors also seen in d+Au collisions. However they are smaller and unlikely to explain difference in R_{CP} at intermediate p_T

- Order 20% not a factor 2.

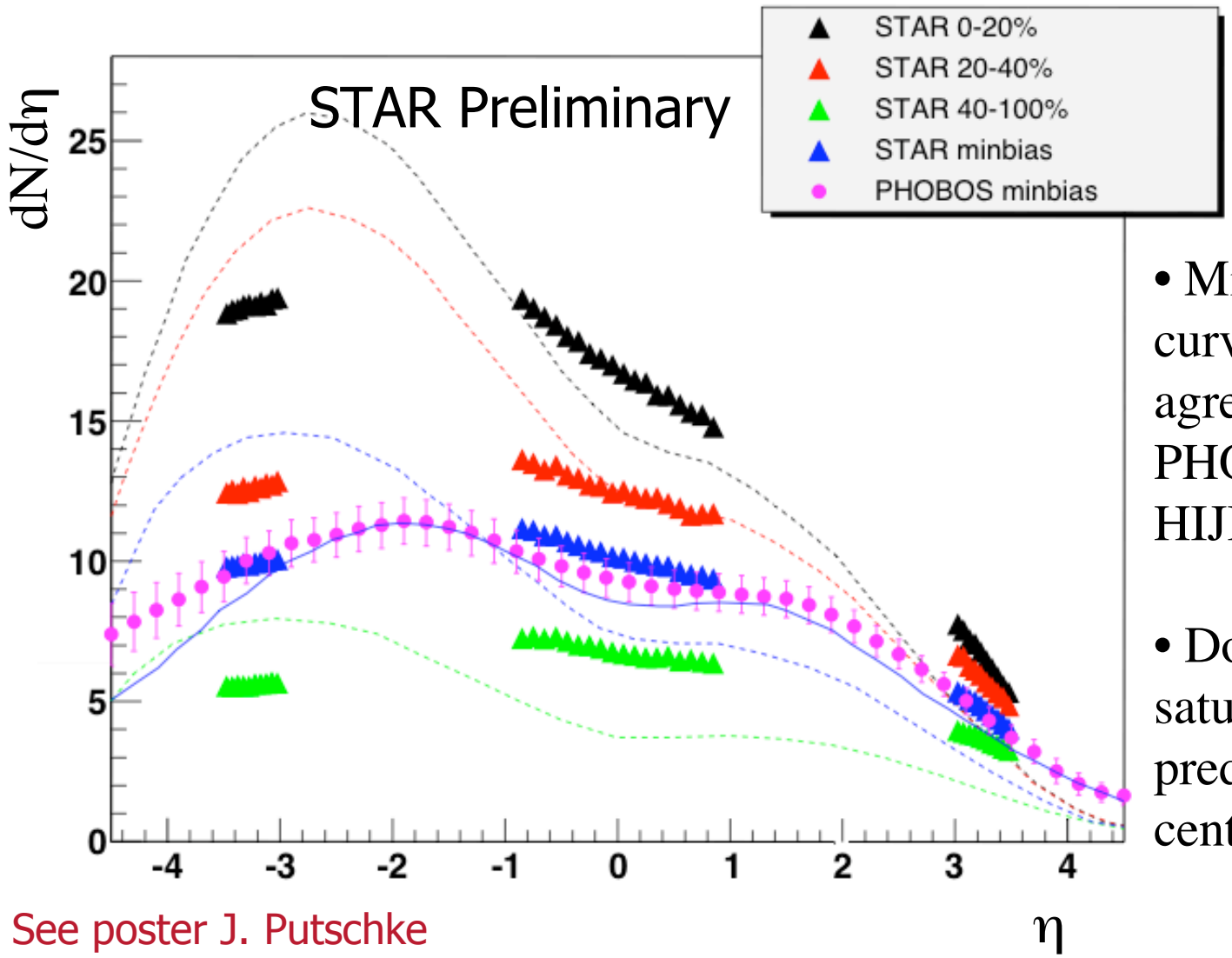
Baseline for suppression in central Au+Au is actually is close to N_{binary} scaling

- Depends on details of convoluting d+Au collisions

Au+Au Nuclear Modification



Spectra at forward rapidities

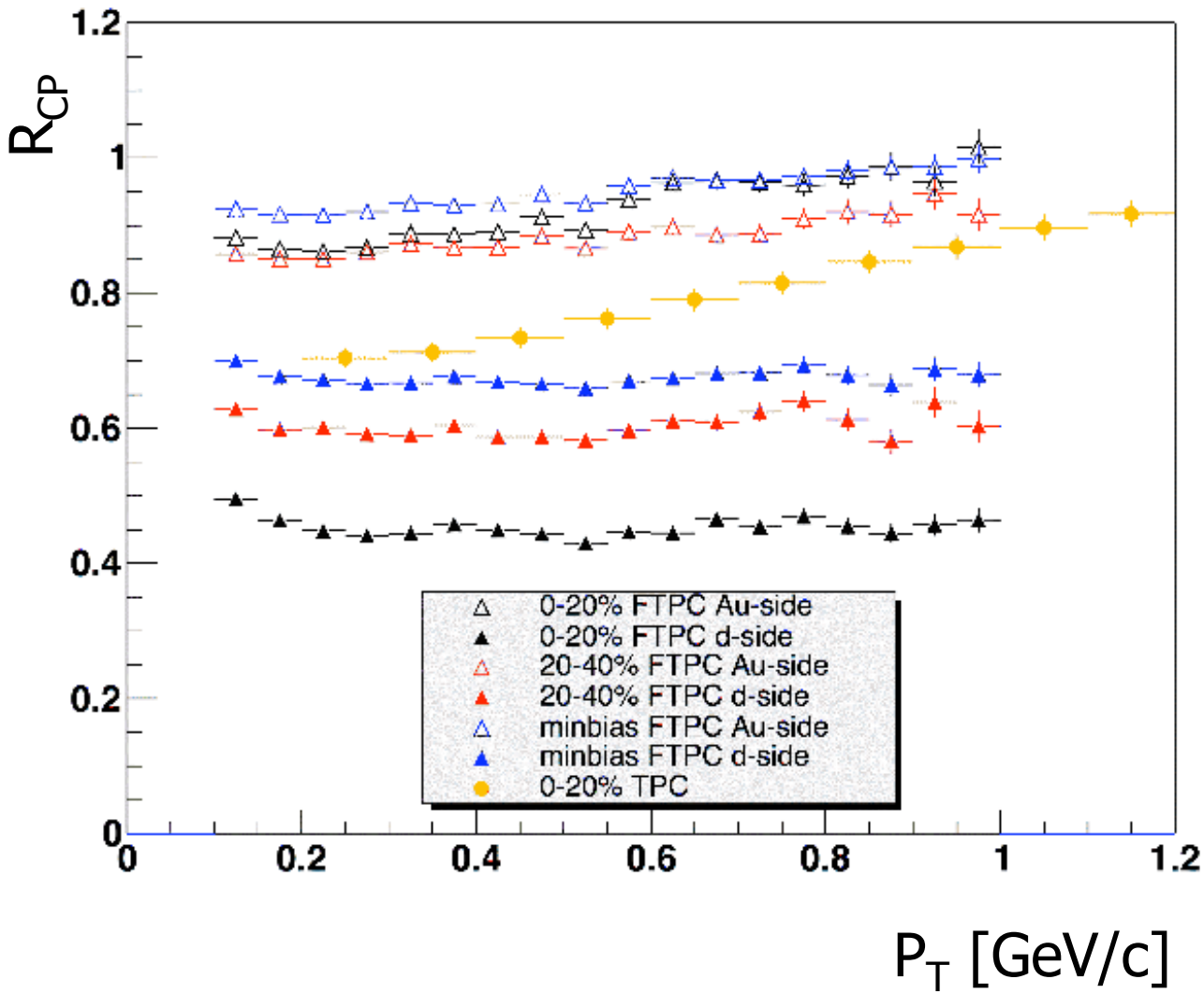


- Minimum bias curve shows agreement with PHOBOS and with HIJING model

- Dotted lines are saturation model predictions for centrality selections

See poster J. Putschke

d+Au R_{CP} at forward rapidities



- Au-Side R_{CP} shows almost no variation with centrality
- d-side is interesting: more central is more suppressed

Summary and Outlook

- Particle dependence of nuclear modification factors in d+Au of order 20% unlikely to explain R_{CP} differences in d+Au.
- More conspicuous differences at forward rapidity on d-side.
- More p+p data required to go further in p_T and improve precision of R_{dAu} measurement.