[• Initial Thoughts for D + Au]

With D E Kahana

Certainly no Plasma but perhaps signs for CGC (Colour Glass Condensate)

Modeling basis Saturation of Gluon at low x

$$x \quad \frac{p_t}{\sqrt{s}} e^{?(y)}, \sqrt{A}$$

{ (1) Our modeling invokes saturation no overlap of persisting Resonances }

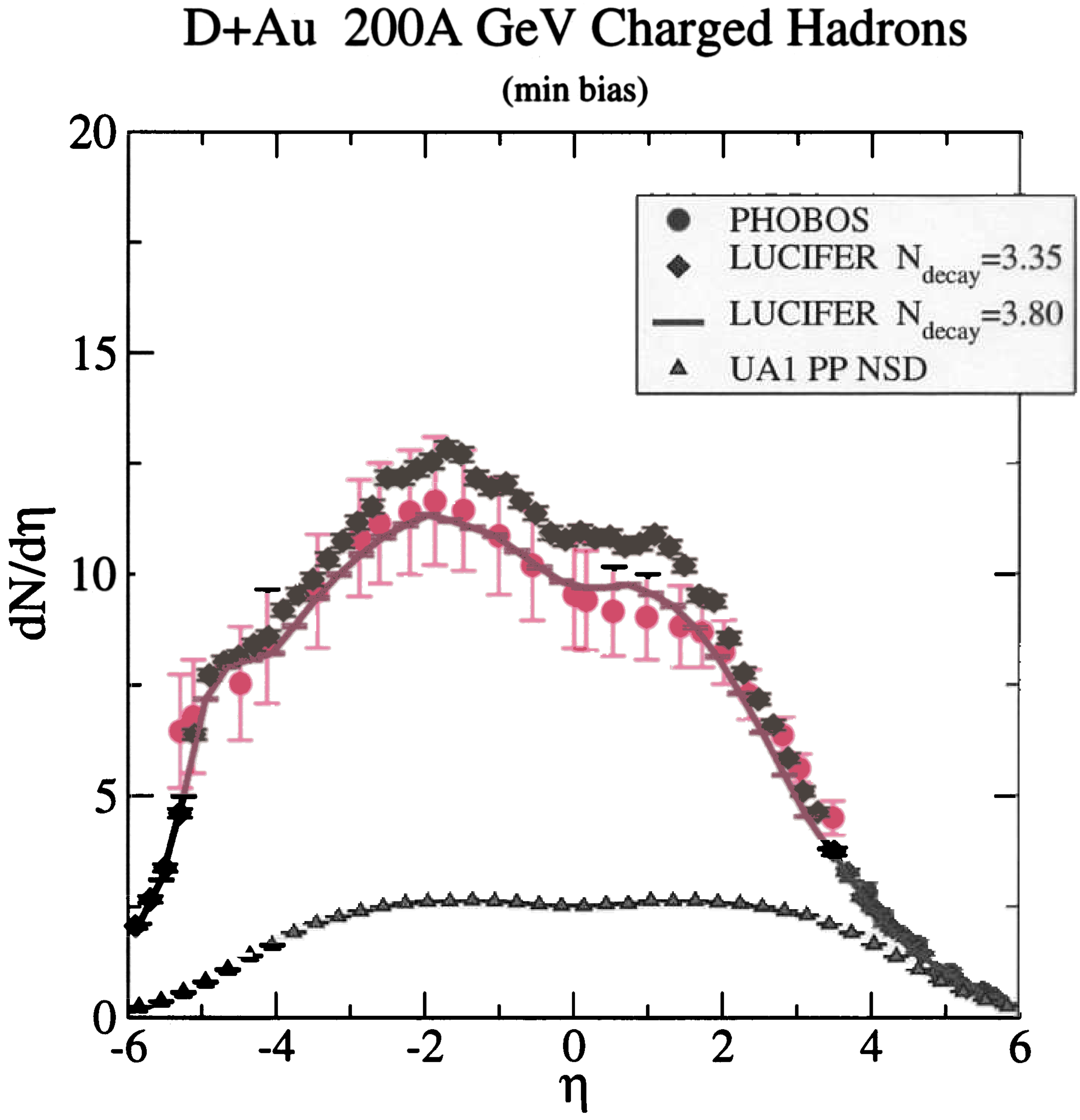
(2) Unitarity leads to gluon saturation
Long known as structure function must turn over

(3) CGC something else PQCD but for large gluon numbers
Classical Fields but perturbative
Soft Hard division at low $p_t \to 0$?

** Often assumed present BRAHMS larger η higher p_t
lists a sign (large η small x)

At Question Ratios : $R^{\eta}_{p_t}(p) = \dfrac{\left[\frac{d^2N}{p_t\, dk\, d\eta}\right]^{d+Au}}{N_{coll}\left[\frac{d^2N}{dp_t\, d\eta}\right]^{pp}}$

■ [I] $\eta = 0$ was disappointment (STAR, PHENIX)
[II] $\eta \approx 3.0$ very much accepted and welcomed from BRAHMS



D+Au 200A GeV Charged Hadrons
(min bias)
PHOBOS
LUCIFER N_decay=3.35
LUCIFER N_decay=3.80
UA1 PP NSD
dN/dη
η
0
5
10
15
20
-6
-4
-2
0
2
4
6

- Po ion of NEGATIVE η Peak (broad)

For us Related to group structure
Misplaced peak (perhaps) sign of
frame dependence

- Spill ver (from target) to $\eta \geq 0$ falls off
and contributes strongly to

$$\frac{dN}{d\eta}(\eta=0) > \frac{dN}{d\eta}(\eta=3)$$

$P\bar{P}$ much flatter

- (Good to see without Renormalisation confusion)

Attempt at "Hadronic" Picture of Soft Processes

- Applied to D+Au [A tune-up for A+B]
- Hard tail, here, and in Au+Au pasted onto NN, the basic (fitted) input.

■ LUCIFER: Two stages separated by a "production" time

- I. Initial Conditions from nucleons in A+B
- II Normal, but relatively lower energy cascade

Initialisation
- Not (strictly) a cascade
- No energy loss or transverse energy creation.

[A] Baryons

Create Group structure: defined by geometric contiguity, i.e. segmented by impact parameter
Collisions within a group treated collectively. [in parallel[?]]
To effectuate
(a) Energy loss & multiplicity: only first couple of collisions significant ⇒ $N_{participant}$ dependence

(b) Generate transverse momentum
Then n_{coll} significant: $p_t \sim \sqrt{n}\, p_{t0}$

[Could be (qqq)-like excited or resonant baryons but with relatively light mass: range M_p to 2GeV]

[B] Introduce Generic Resonances:

Associated ⟨$q\bar{q}$⟩ pairs : ρ, K^* like:
Masses $m_\pi \rightarrow$ 1.3 GeV or so

Later these rescatter and decay (widths Γ)

[Cf: Shuryak & Zahed, & Lattice calculations
QCD resonance persistence to $T \sim (1.5-2)\, T_c$
Energy density $\sim T^4$: Flow & σ-sections]

Generated in A+B, NN interactions
Share energy with Baryons.
More, excited, degrees of freedom.

[C] PP (NN) carried out with same elements, providing strong constraints since fitted to data at all energies, ie to inclusive processes.
Elastic, SD & NSD components
Multiplicities from/or with! KNO scaling
No rescattering of Resonances only decay, on average into 3 "stable" mesons.

* Implied energy dependence of KNO multiplicities drove small 13% increase (a prediction) in $\left(\frac{dN}{d\eta}\right)^{charged}$ from 130 GeV $\Rightarrow$ 200 GeV (PHOBOS)

II "Low" Energy Cascade

Position Resonances in cylinders by Group and evolve freely for formation or production time τ before allowing interaction to begin.
Very importantly τ defined in Group rest frames

Strong constraint on multiplicity in AA (and it now appears into pA or dA):
No physical overlap of Generic resonances
⇒ maximum density in cylinder.

Could perhaps all be done with strings
Particles easier to treat in interaction. Ranft, Capella etc.

Previous Efforts

NA49 + NA35 SPS application to general spectra.

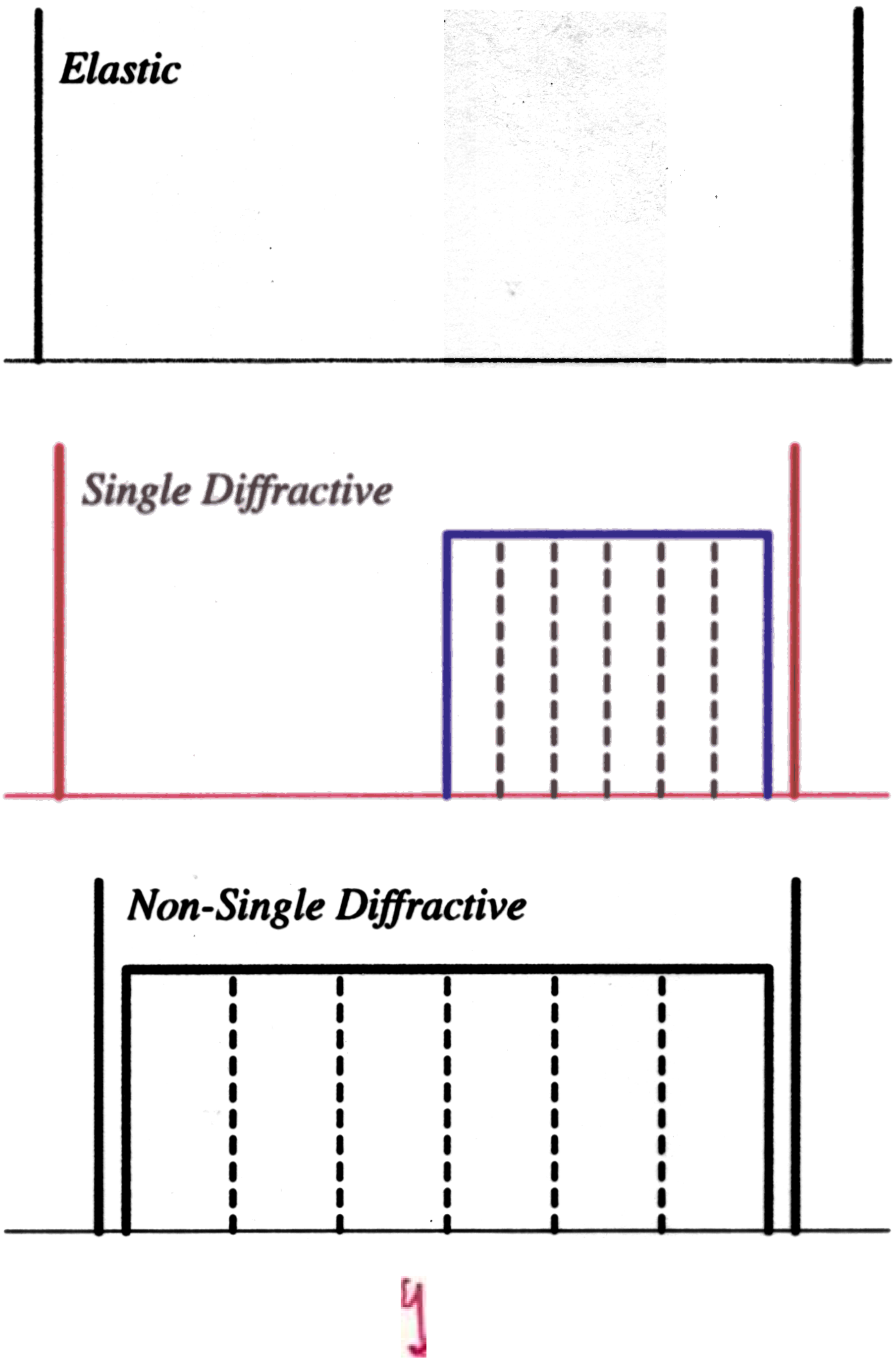
NA50 : J/ψ suppression

"right"

RHIC 56, 130, 200 $\left(\frac{dN}{d\eta}\right)^{ch}$

RHIC Centrality Dependence + E_T generation
: appreciable (40%) generation in phase II

String-Like Model for Hadron-Hadron Scattering

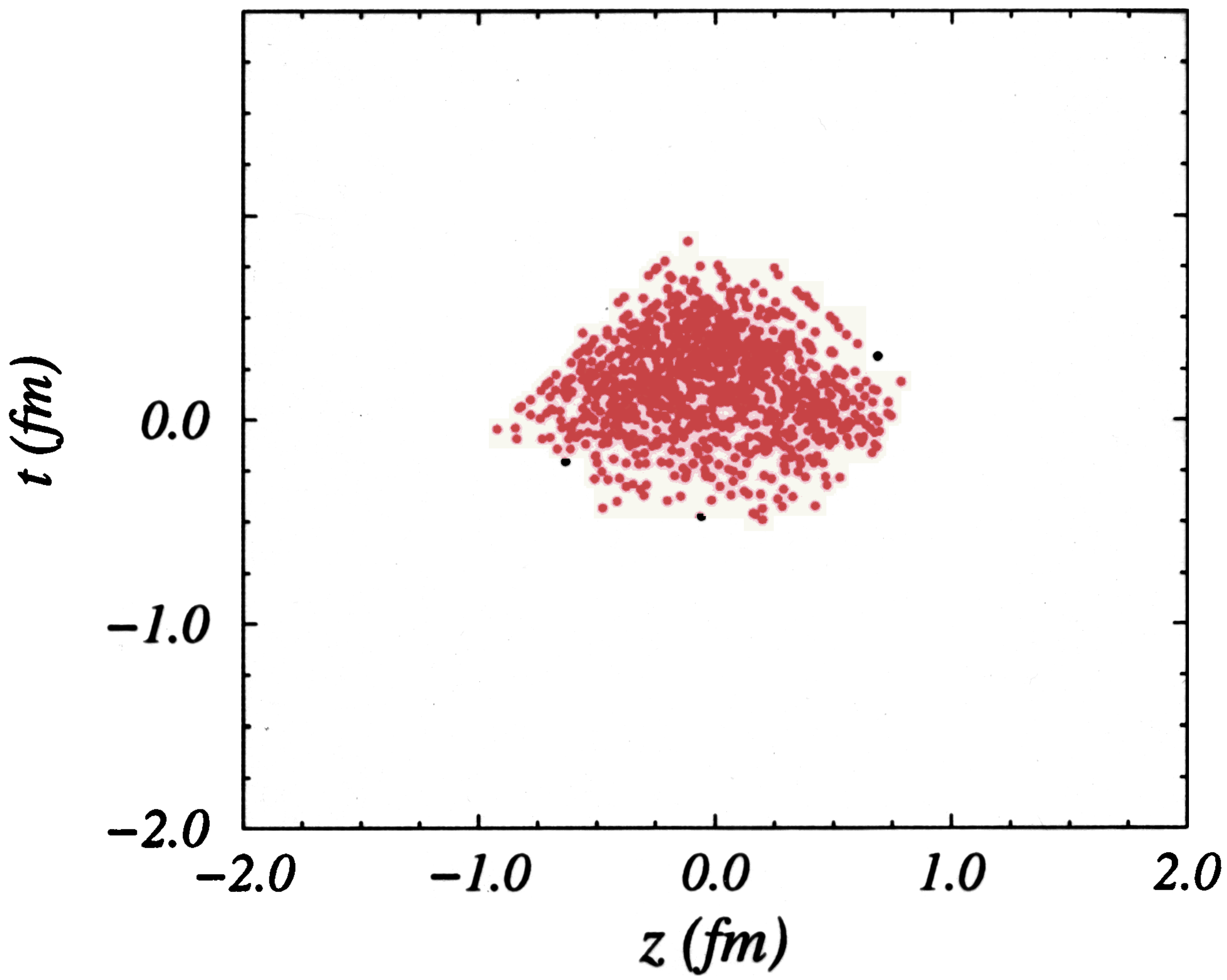


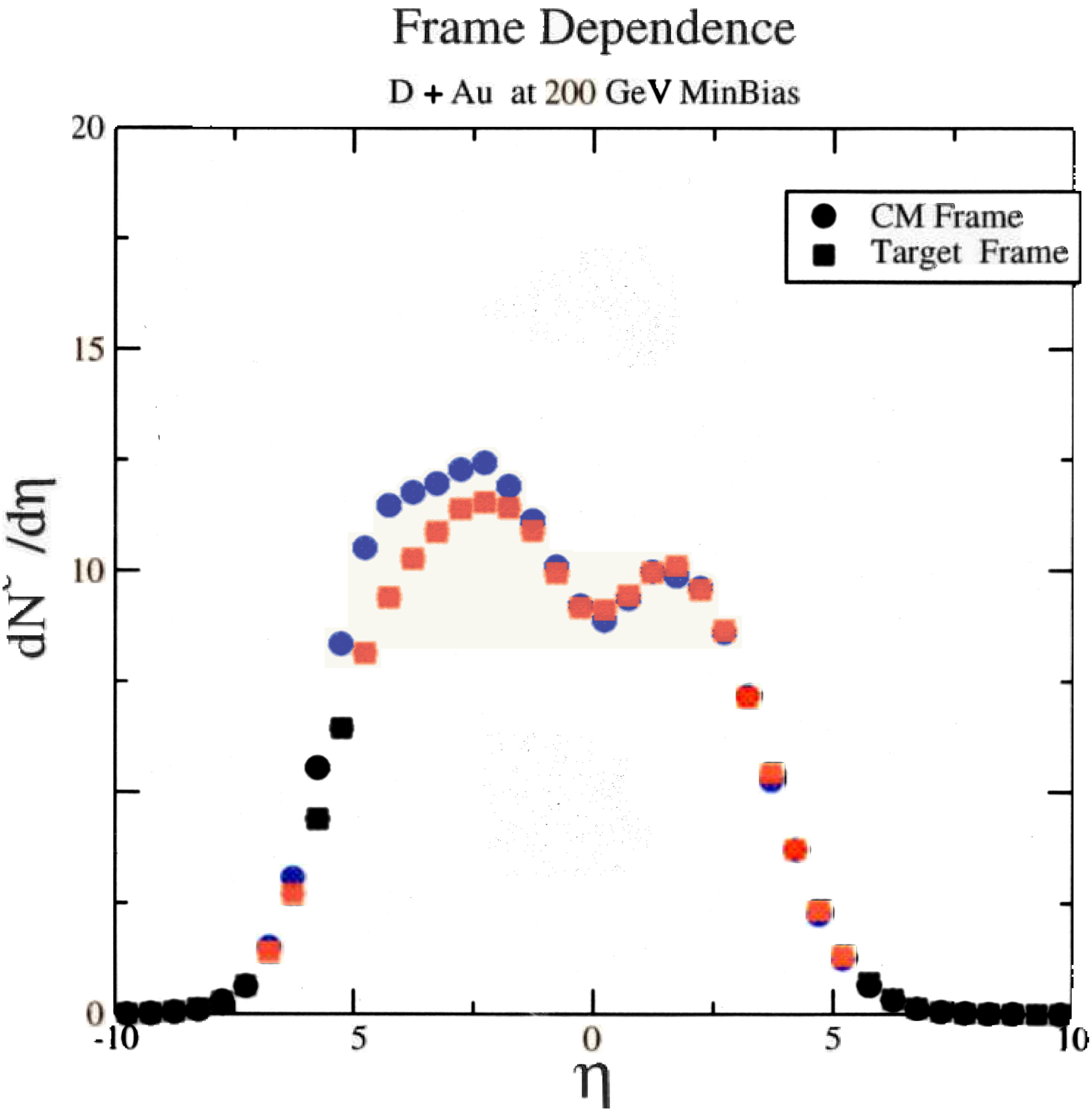
UNIVERSALITY BB ~ NN MB ~ πN

DECAY (PQ) M → 2 3 π s

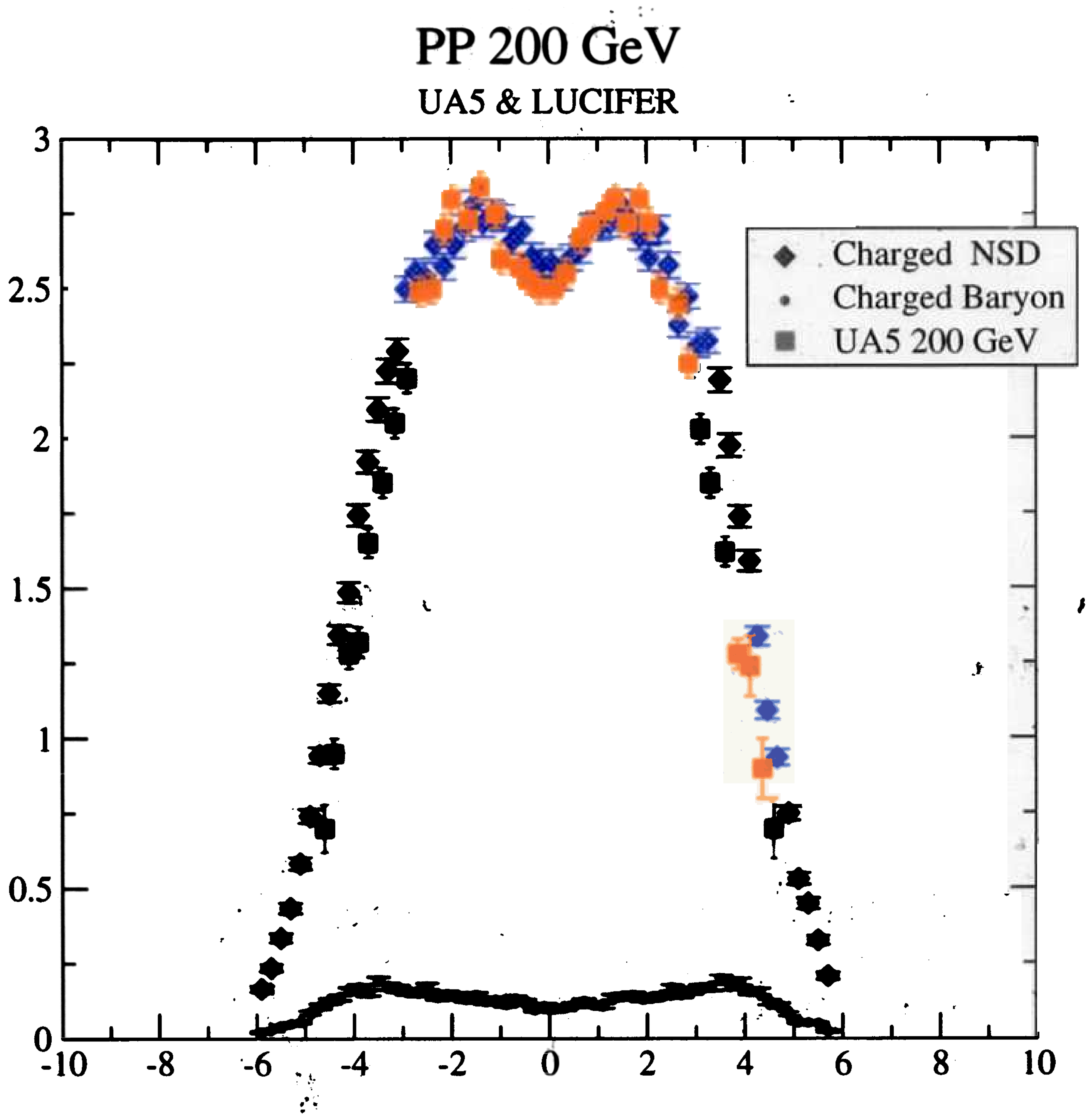
Baryon Final Positions

after first stage cascade I




Frame Dependence
D + Au at 200 GeV MinBias
CM Frame
Target Frame
dN˜ /dη
η
20
15
10
0
-10
5
0
5
10

NN fitted [input]



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• Final Thoughts

- For CGC picture to be valid require all soft mesons to be produced in hard collisions

  Hard to avoid softer interpretation

  Fill in of $\frac{dN}{d\eta}$ near $\eta \approx 0$ from spill over of target processes hence η fall off

- Flow (not considered here) seems to need large (hadron like) x sections

• Plasma

Implications for jet suppression in Au+Au

Another subject but D+Au is a tune-up

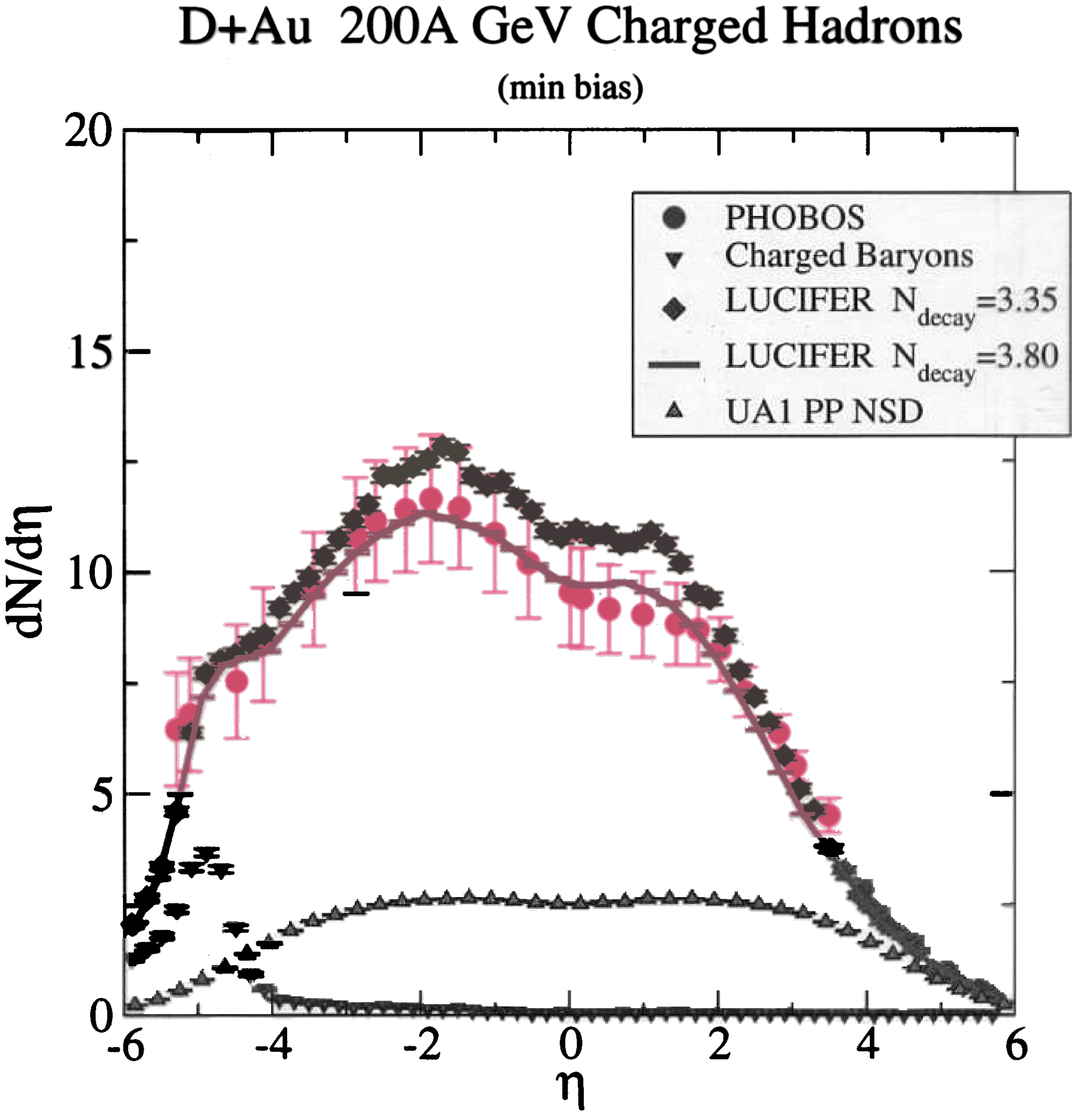
Now 50–70% suppression at least from II

Can one tell the difference parton parton parton+Res

(Duality?)

Wait for LHC (Atlas, Alice)

Everything moving → jets
So many gluons can't avoid each other ⇒ Thermali
(as water drop)



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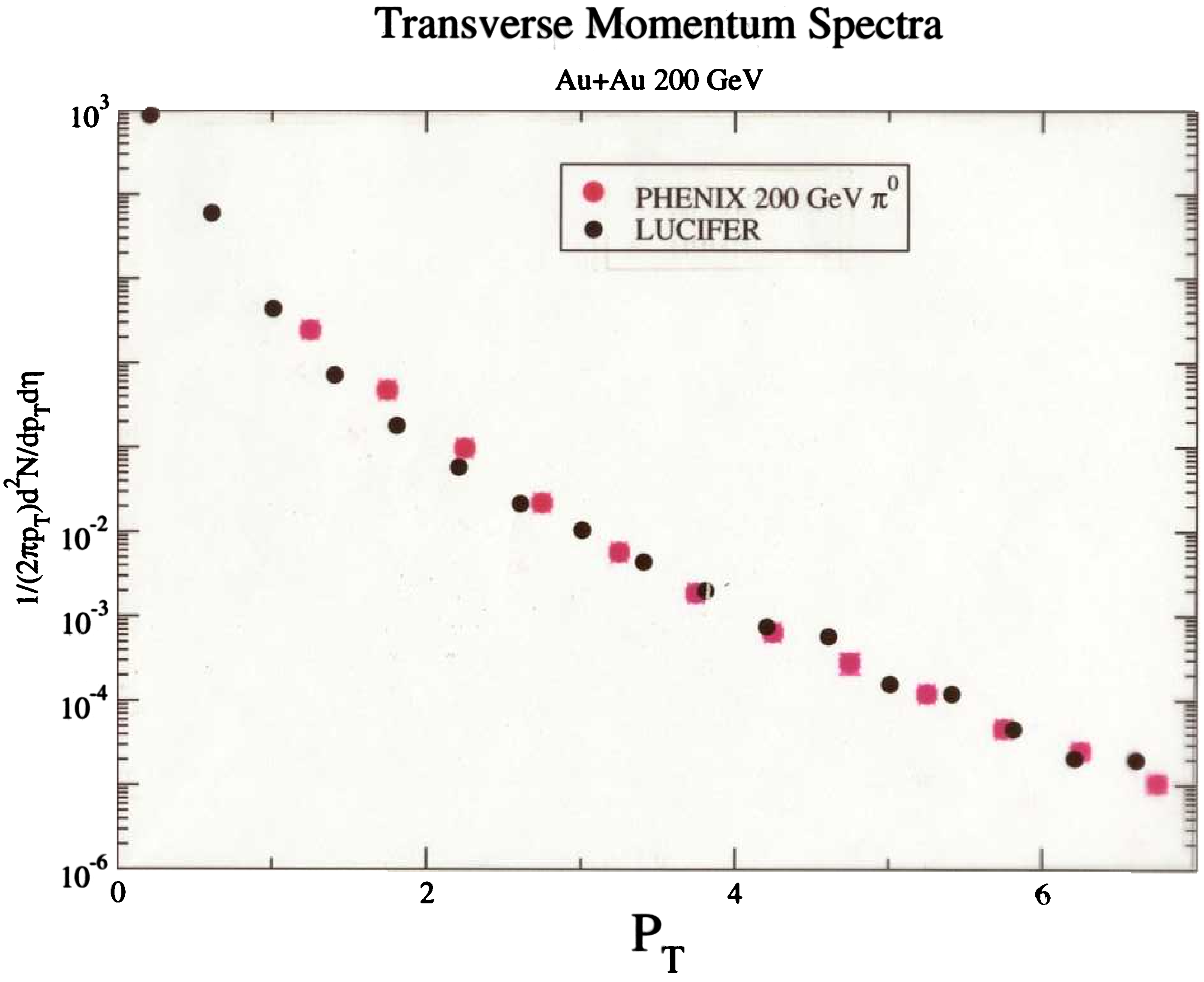
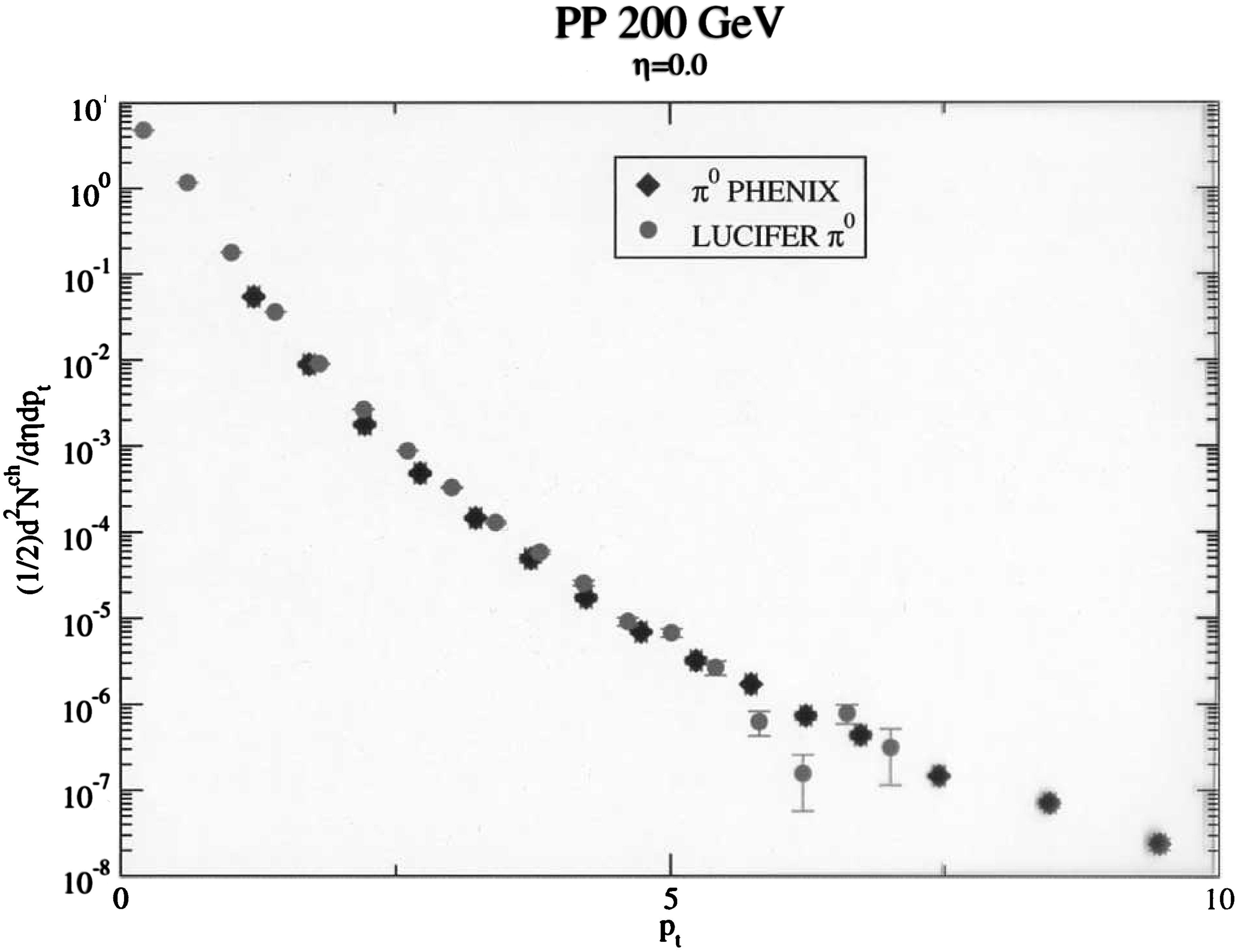


Transverse Momentum Spectra
Au+Au 200 GeV
PHENIX 200 GeV π0
LUCIFER
1/(2πpT)d2N/dpTdη
10^3
10^-2
10^-3
10^-4
10^-6
0
2
4
6
PT



PP 200 GeV
η=0.0
π0 PHENIX
LUCIFER π0
(1/2)d2Nch/dηdpt
pt
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
0
5
10