Nuclear Induced Particle Suppression at Large-x_F at RHIC

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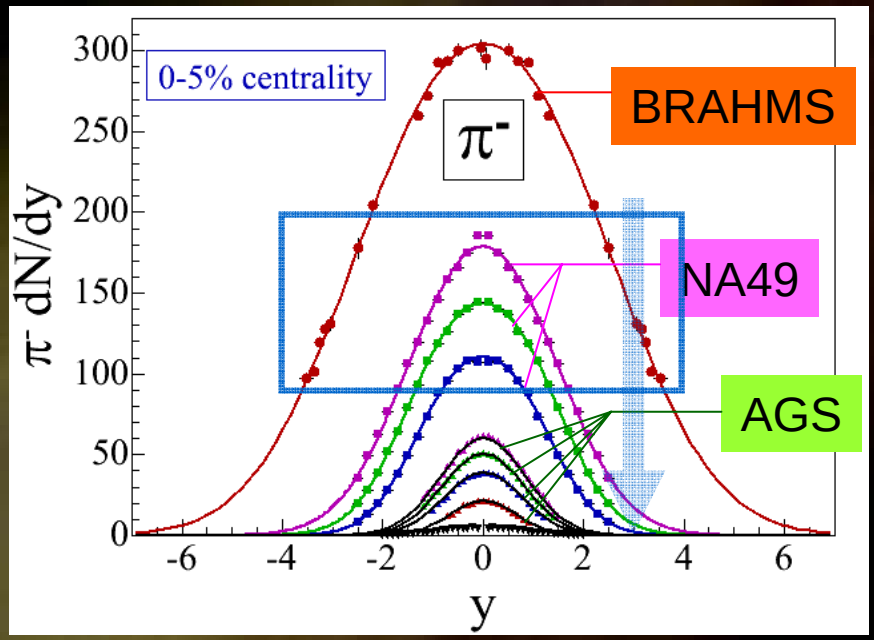
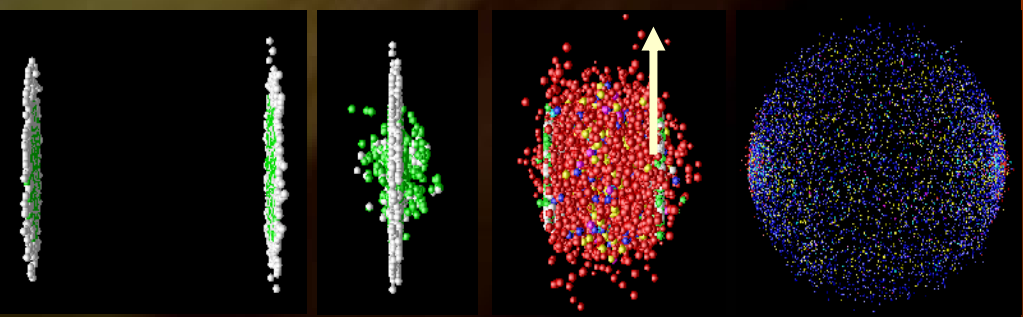
For BRAHMS Collaboration

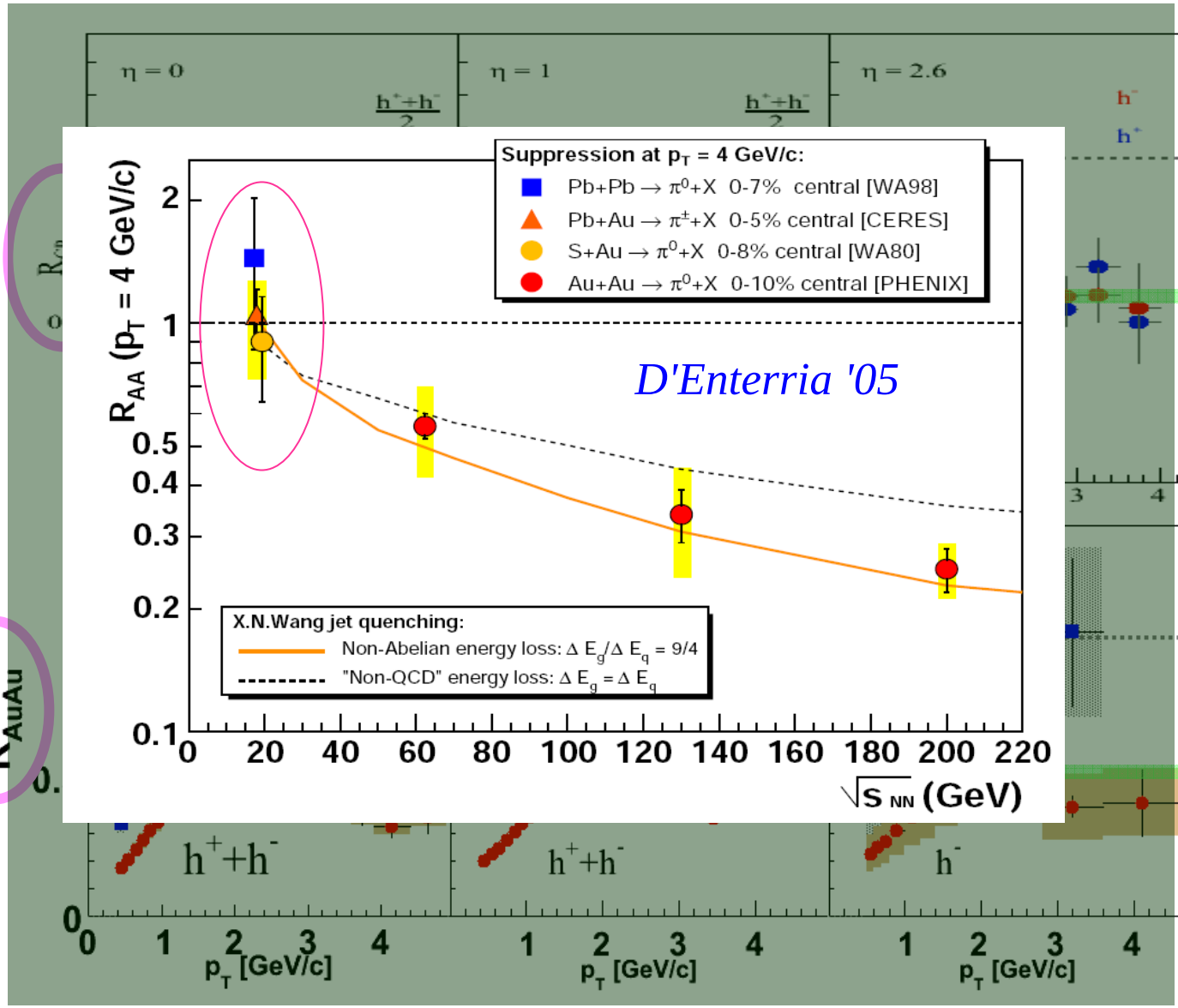
Rapidity Dependent High-p_T Measurement





- At the RHIC energies, hard scattering processes at high-p_T become important
- Partons are expected to loose energy in the dense matter
- Different rapidities provide different densities of the medium: Sensitive to the dynamics
- "Dialing" initial condition channel
- Largest medium effect at mid-rapidity ("Scale" to multiplicity)?
- Rapidity dependent high-p_T suppression factors: provide information on dynamical medium effect

R_{CP} and R_{AuAu} vs η for AuAu @200 GeV



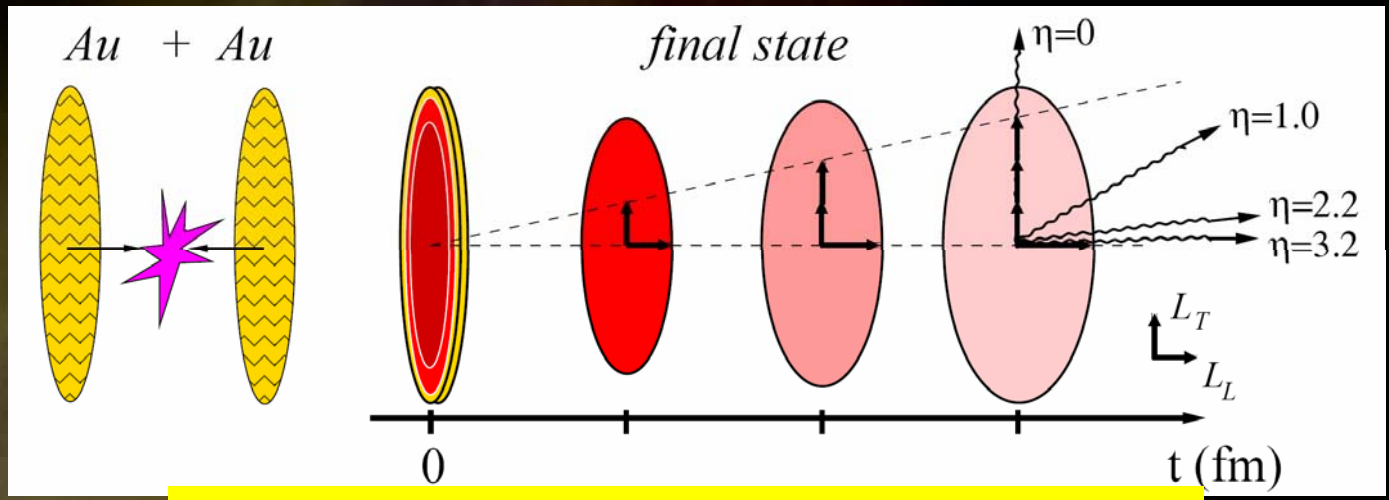
"High"-p_T Particle Suppression at Forward rapidities

- Expected forward "enhanced" physics processes:
  - Shadowing, Gluon saturation, Phase-space constraint/Energy conservation

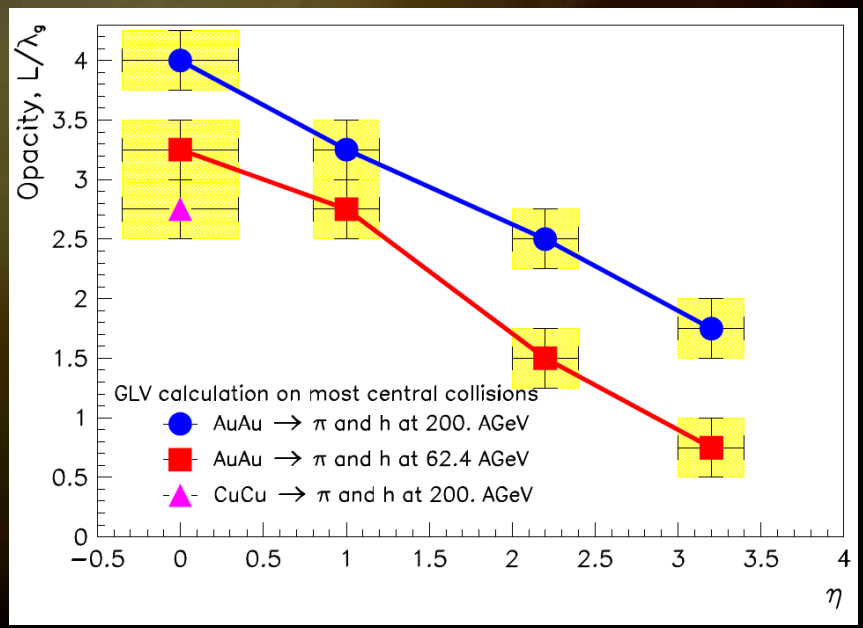
    …
- With competing physics processes:
  - Partonic energy loss, Multiple scattering, Recombination

    …

Forward Tomography: Dynamics + Geometry



G. Barnaföldi, Lévai, Papp, Fai: nucl-ph/0609023



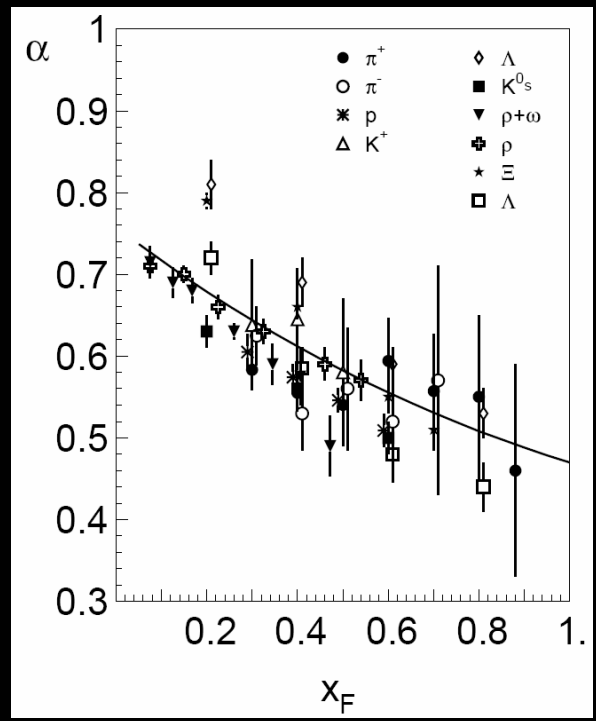
- Shadowing+MS+Energy Loss
- "Extracted" opacity indicate longitudinally traveling Protons see less colored field
- Not a prediction: Assuming rapidity independent suppression factor

Particle Suppression due to Energy Conservation at Forward Rapidities/Large-x_F

- Universal suppression mechanism at large x_F seen in data for various reactions
- Expected no particles produced as $x_F \rightarrow 1$ due to energy conservation;
- more multiple interactions (more gluon radiation) make the effect larger in nuclei

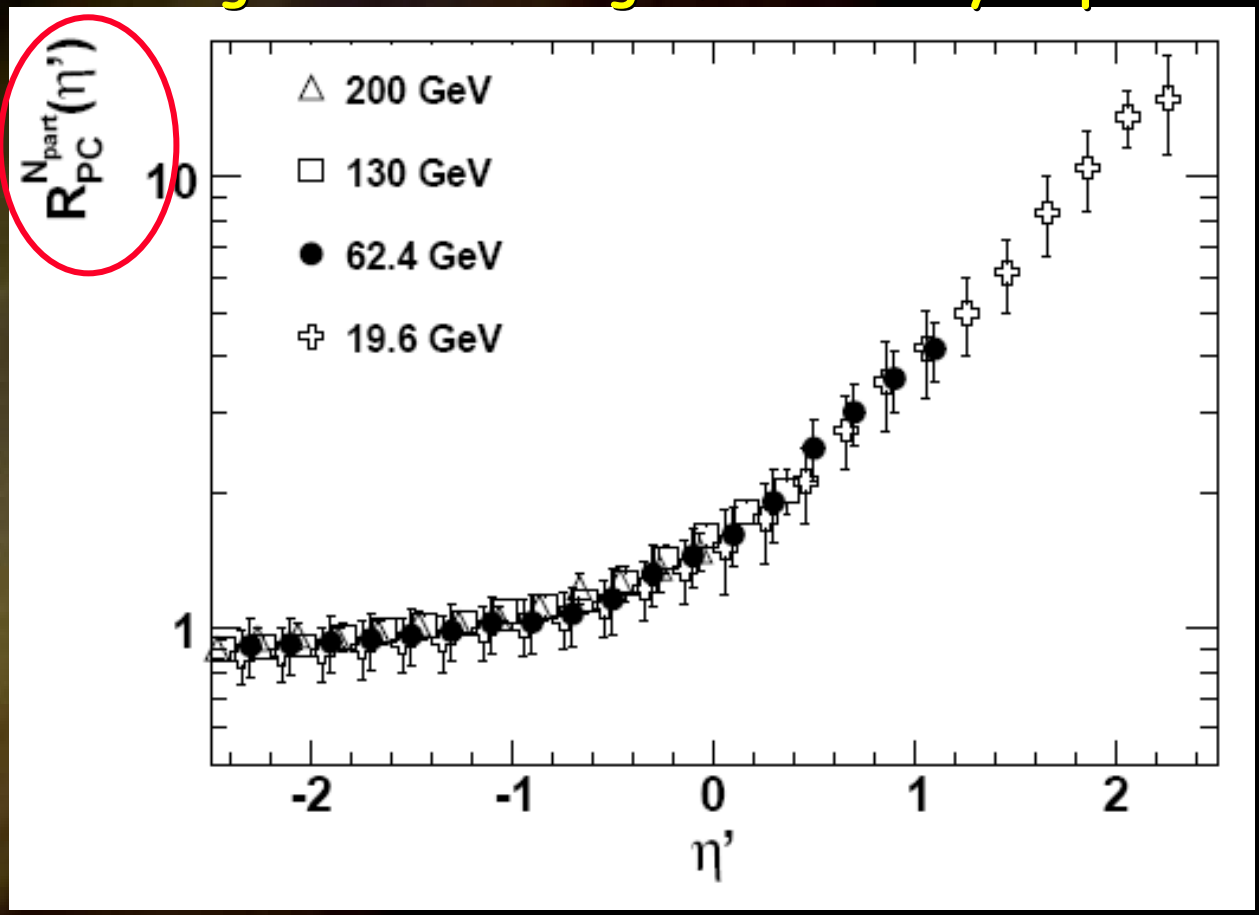
"Sudakov suppression"

Kopeliovich et al: PRC72 (2005)



$x_F = 2p_z/\sqrt{s}$

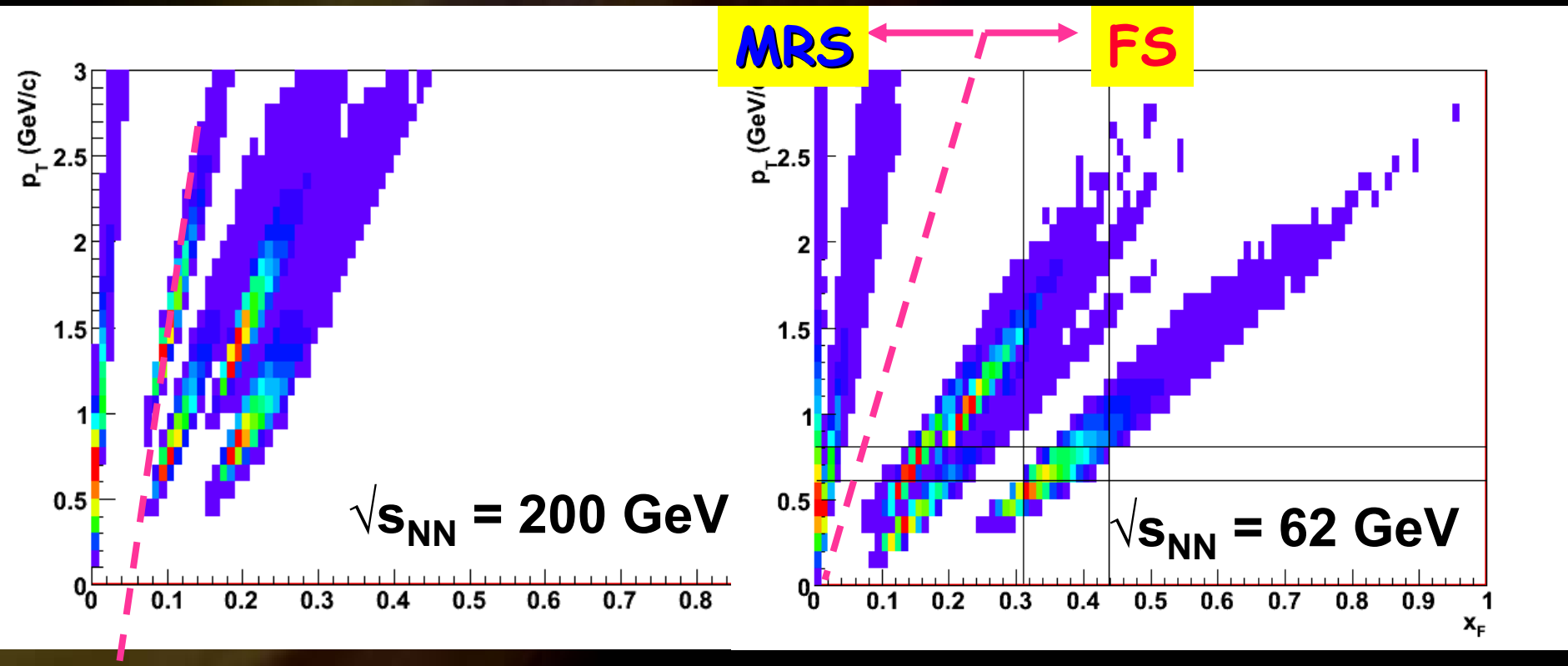
"Extended" Longitudinal Scaling of Centrality dependence: R_{CP}^{Npart}



PHOBOS: nucl-ex/0509034

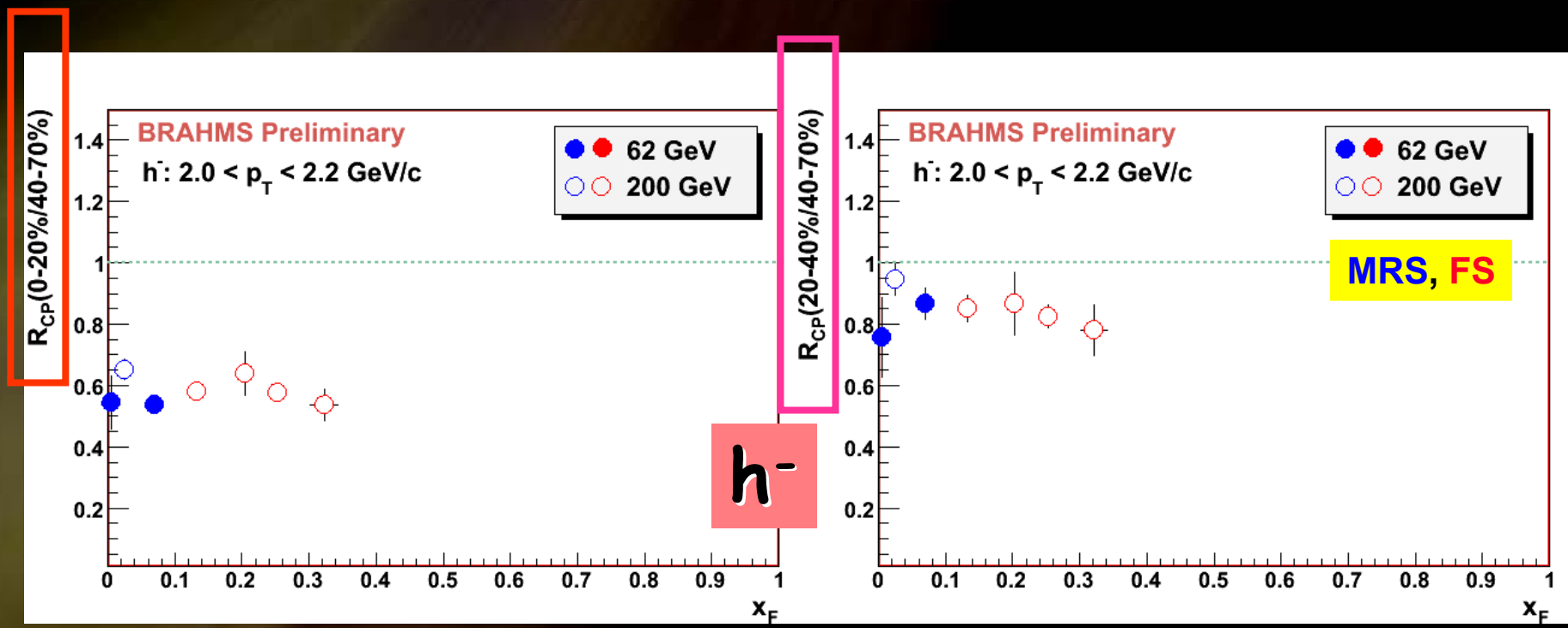
- Extended range of limiting fragmentation behavior on centrality dependence of particle production: Factorization of Centrality and Energy dependence

BRAHMS Data/Acceptance: p_T vs x_F at $\sqrt{s_{NN}}$ = 200 and 62 GeV



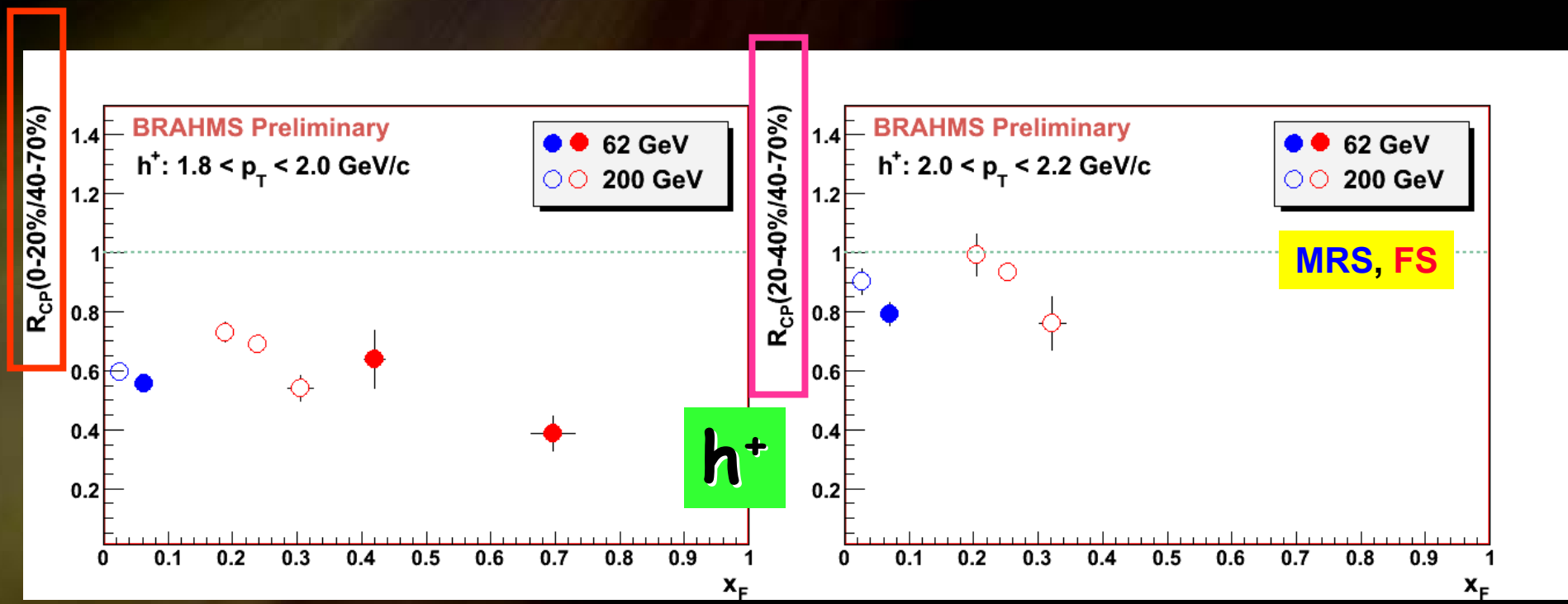
- Strong p_T-x_F correlation due to limited spectrometer solid angle acceptance
- Measurements from BRAHMS Mid-Rapidity Spectrometer (MRS) and Forward Spectrometer (FS)
- "Dynamic" x_F binning in p_T 0.2 GeV/c
- R_{CP} for centrality dependence in p_T-x_F: R_{CP}(0-20/40-70%),(20-40/40-70%)

$R_{CP}(h^-)$ vs x_F in Au+Au at $\sqrt{s_{NN}}$ = 200 and 62 GeV

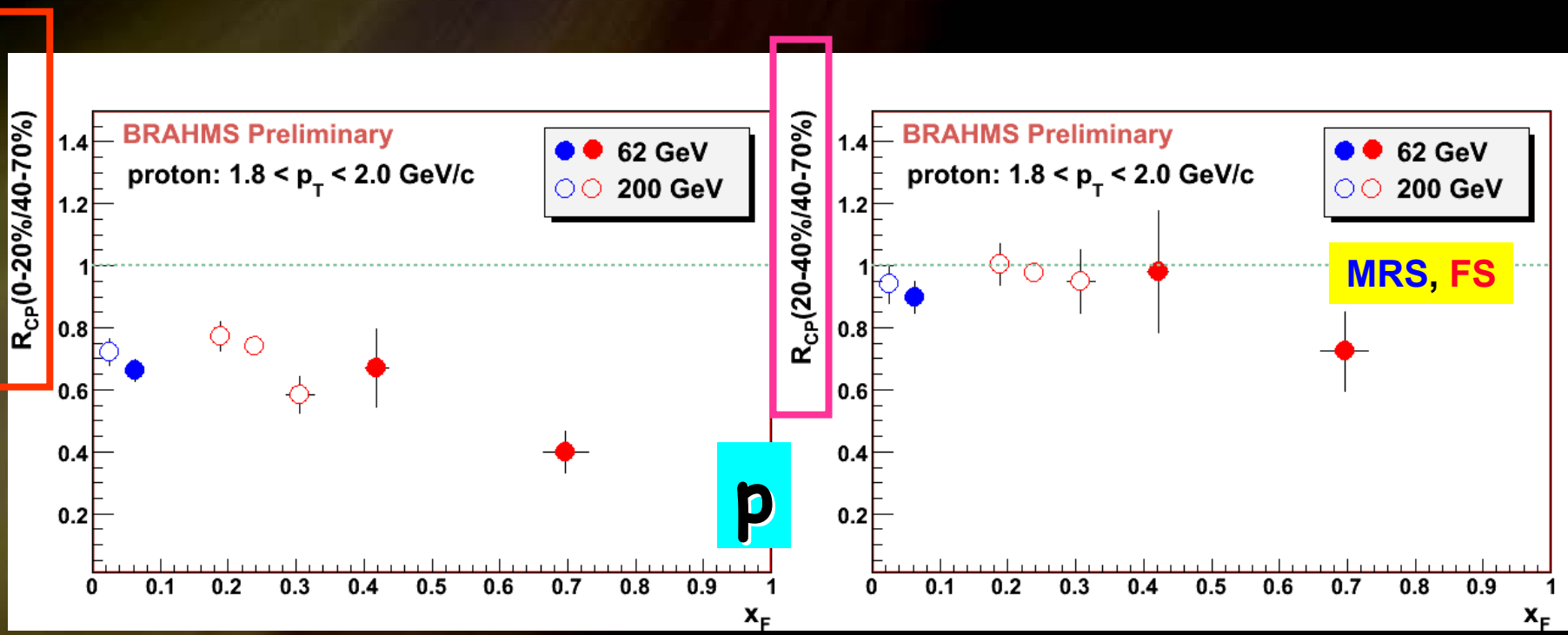


- Rcp (0-20%) < Rcp (20-40%): Centrality dependent suppression in x_F<0.6
- More suppression as x_F increases at fixed p_T (0.3 ~ 2.2 GeV/c)
- For the soft Rcp increase and maximize at p_T ~ 1 GeV/c
- Statistical errors only shown
- Systematic Uncertainties: 10% (p-to-p) + 10% (normalization)

$R_{CP}(h^+)$ vs x_F in Au+Au at $\sqrt{s_{NN}}$ = 200 and 62 GeV



R_{CP}(proton) vs x_F in Au+Au at $\sqrt{s_{NN}}$ = 200 and 62 GeV



- protons at high-x_F at the kinematic range dominates form initial protons
- Yet similar behavior with h^-

Summary

- Nuclear modification factor Rcp for charges hadrons and proton for $\sqrt{s_{NN}}$ = 200 and 62 GeV:

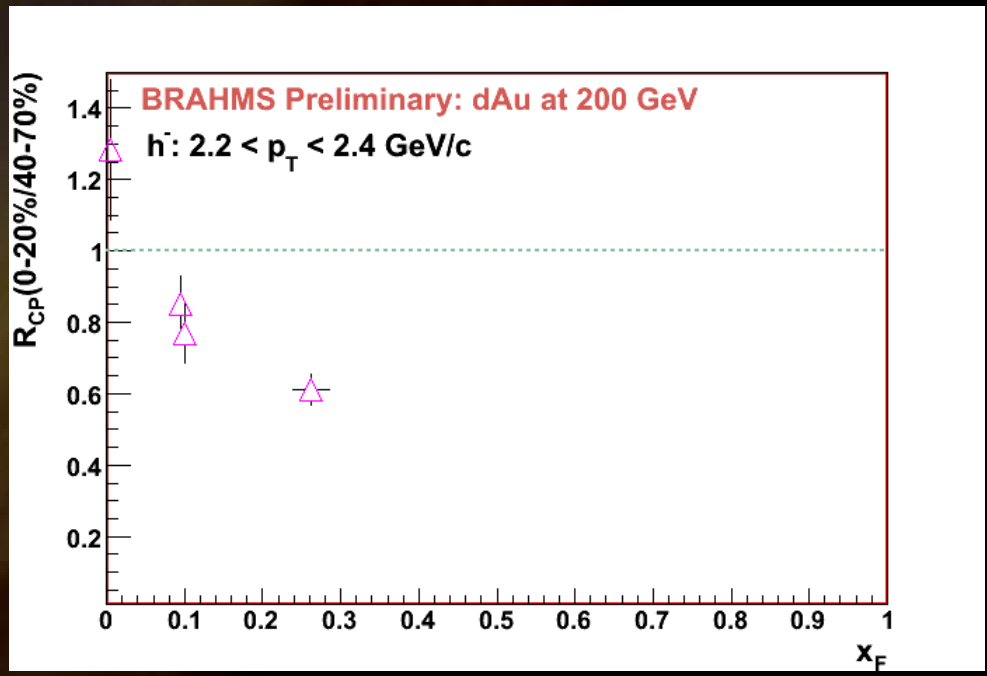
  -Rcp decrease with x_F at given p_T

  -Scaling-like behavior with x_F indicating Energy conservation might play a significant role in addition to dynamical suppression mechanism at forward region

- Constraint/input for more coherent/complete theoretical understanding on dynamics of particle suppression/production at RHIC

Back-up Slides

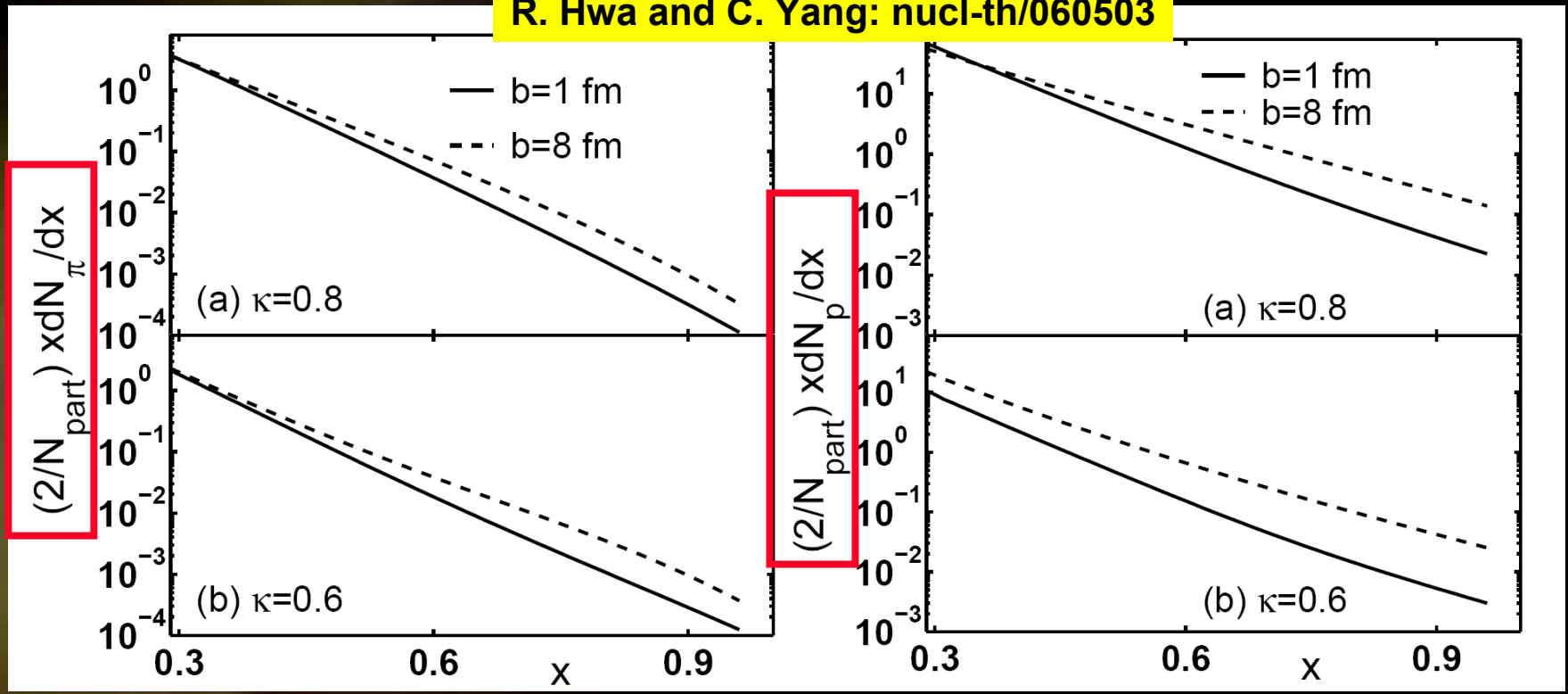
R_{CP} (h^-) in dAu



- Stronger dependence of R_{CP} on x_F
- R_{CP} continuously increase with p_T

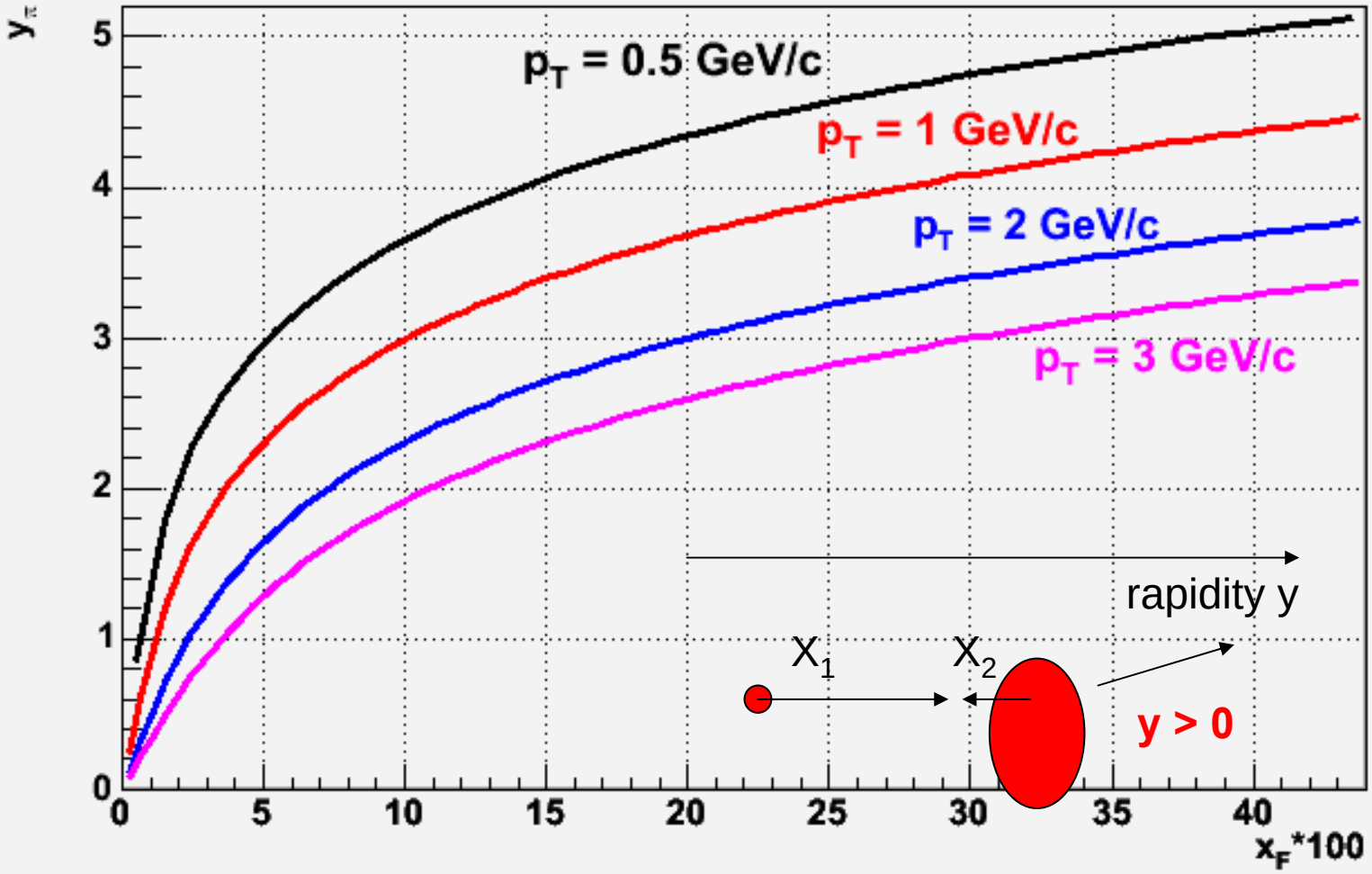
Recombination model at high-x_F in AuAu at 62 GeV

R. Hwa and C. Yang: nucl-th/060503



- Parton recombination without shower parton dominates forward particle production
- Loosening up kinematic limit and enhance particle production at high-x_F for peripheral collisions
- Protons are more efficiently produced at large-xF (valence quark dominance)

y vs x_F


y_π
p_T = 0.5 GeV/c
p_T = 1 GeV/c
p_T = 2 GeV/c
p_T = 3 GeV/c
rapidity y
X_1
X_2
y > 0
x_F*100