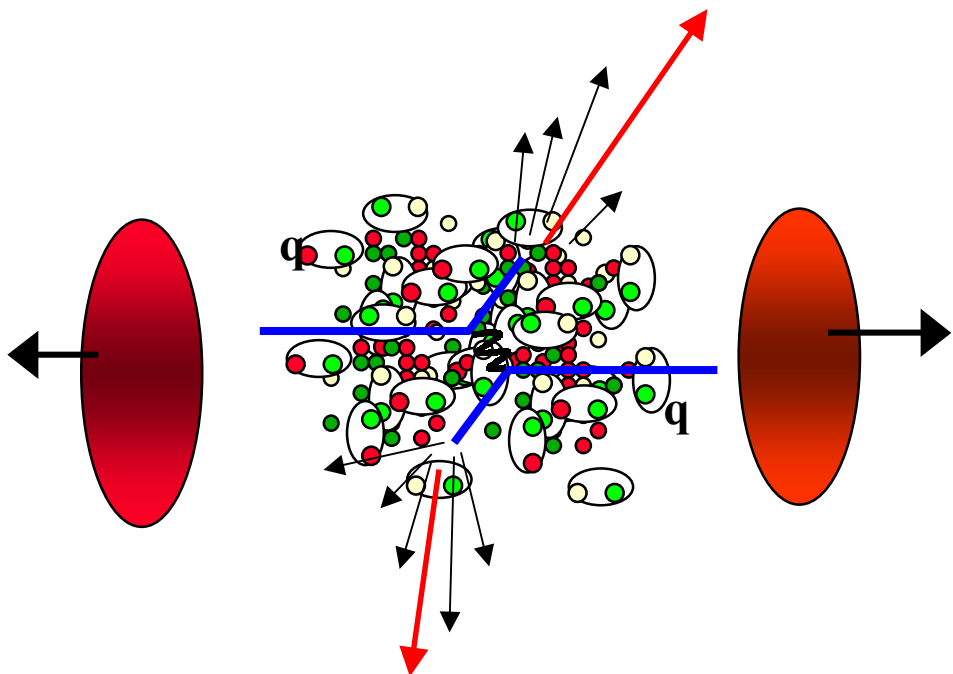# High-p_T Measurements in BRAHMS

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**For the BRAHMS Collaboration**

DNP02

Oct. 10 2002

Physics is getting "hard" at RHIC Energies: High-p_T Physics



- At the RHIC energies, hard scattering processes become important

- Partons are expected to loose energy in the dense matter

- High-p_T spectra allows studies of the medium effects in HI collisions ⟹ suppression of high p_T hadron yields?

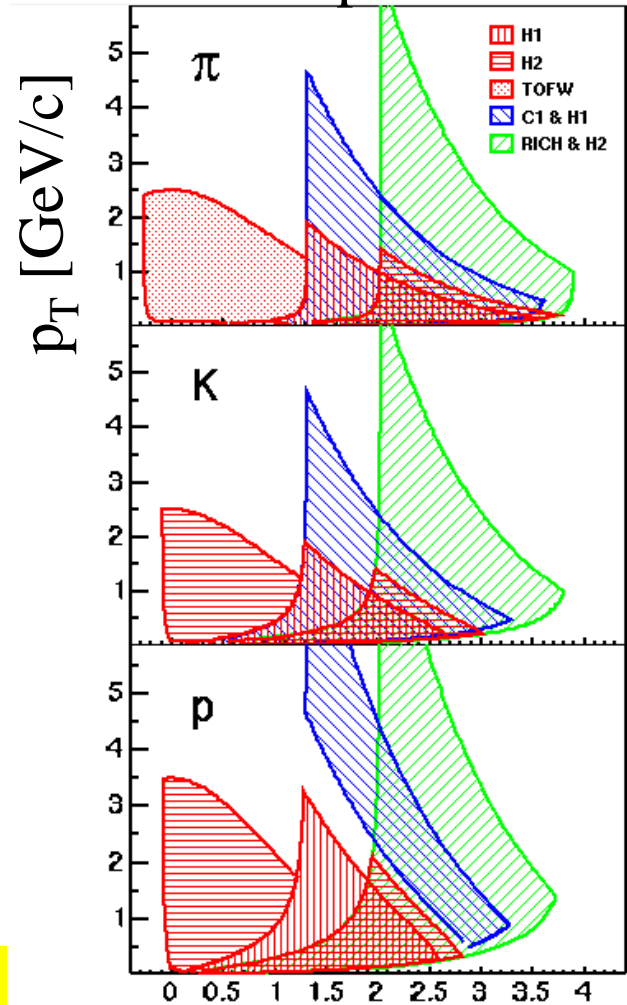# Rapidity Dependent High-p_T Measurement
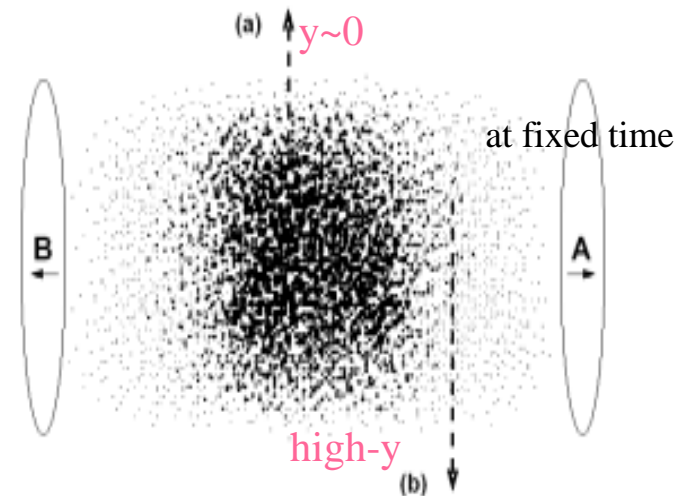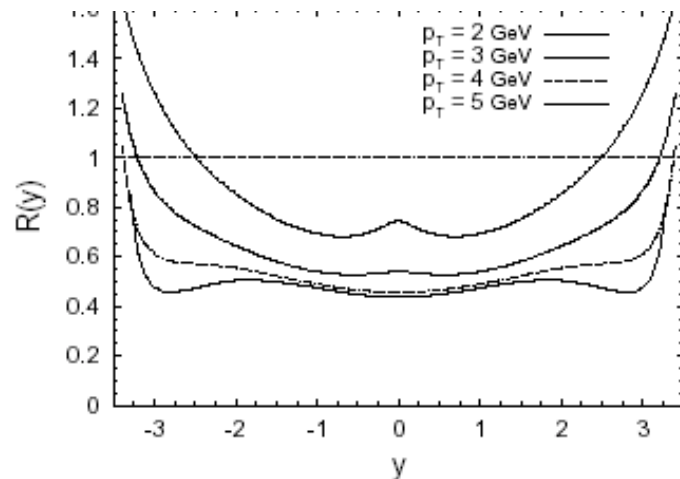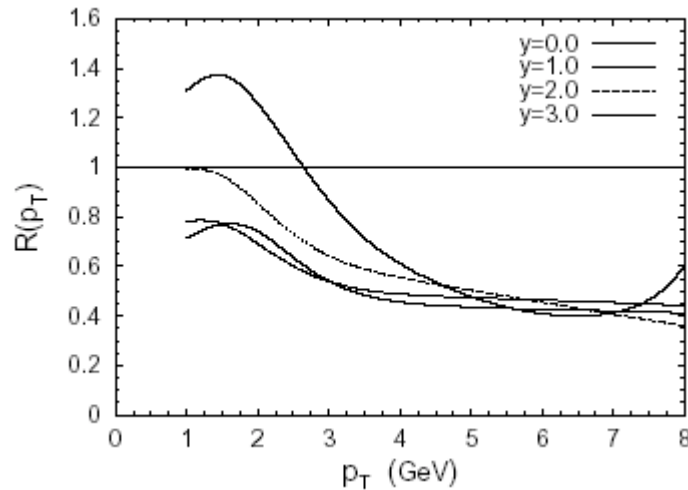
- Different rapidities provide different densities of the medium: Sensitive to the dynamics
- Largest medium effect at mid-rapidity?
- Rapidity dependent high-p_T suppression factors: provide information on dynamical medium effect

Nucl-th/0108056 Polleri and Yuan

BRAHMS (Broad RAnge Hadron Magnetic Spectrometers)
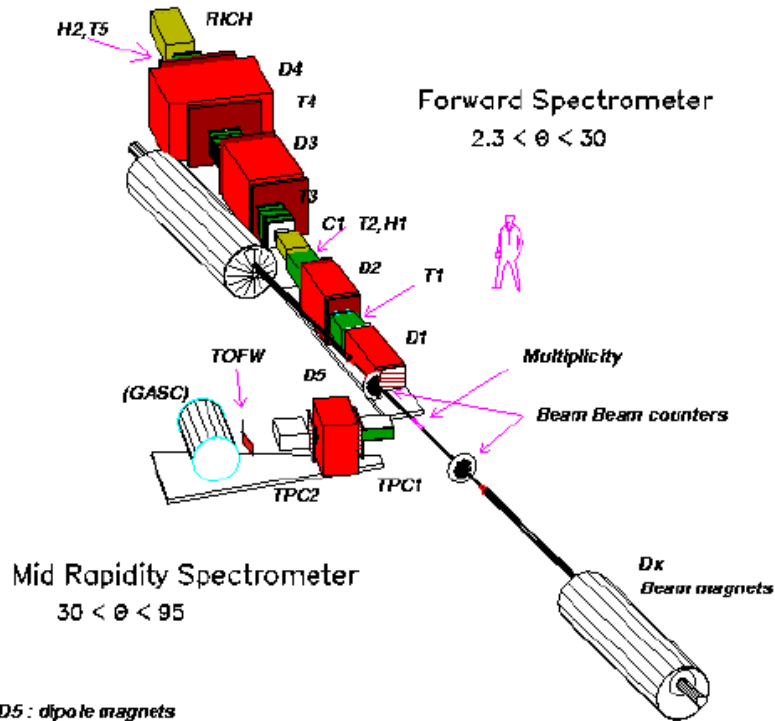
Acceptance
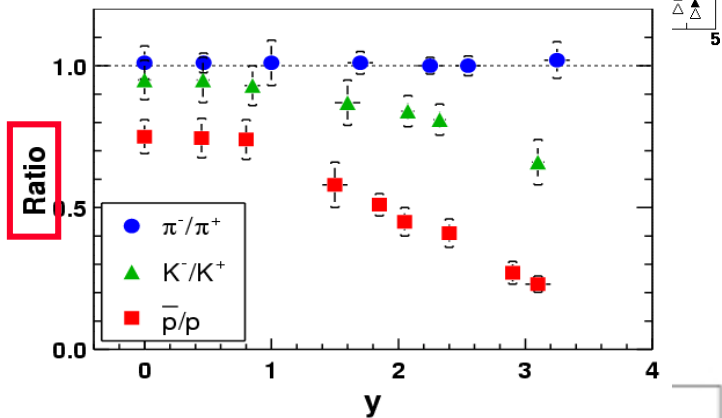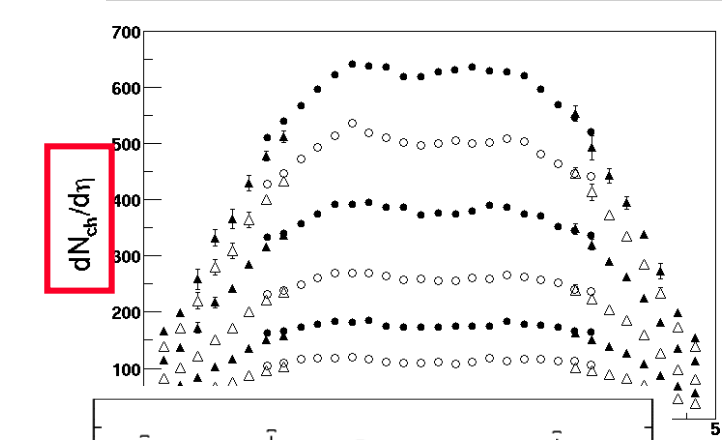

Small solid angle, but broad y-pt coverage with high resolution

$\sqrt{S_{NN}}$=200GeV

And

More...

At y=0: Hadron Spectra and Nuclear Modification Factor

$$R_{AA} = \frac{d^2N/dp_T d\eta}{\left(\langle N_{bin}\rangle / \sigma_{inel}^{NN}\right) d^2\sigma^{NN}/dp_T d\eta}$$

$\sqrt{S_{NN}}=200\,\text{GeV}$

BRAHMS preliminary

0-5%
5-10% /10
10-20% /30
≈ 40-60% /40

$\frac{H^+ + H^-}{2}$

p+p̄

BRAHMS preliminary

0-5% 5-10%

10-20% ≈40-60%

PHENIX 130 GeV

Au+Au √s_NN= 130 GeV
central 0-10%

(h⁺+h⁻)/2
π⁰

α+α CERN-ISR
π⁰

Pb+Pb(Au) CERN-SPS

binary scaling
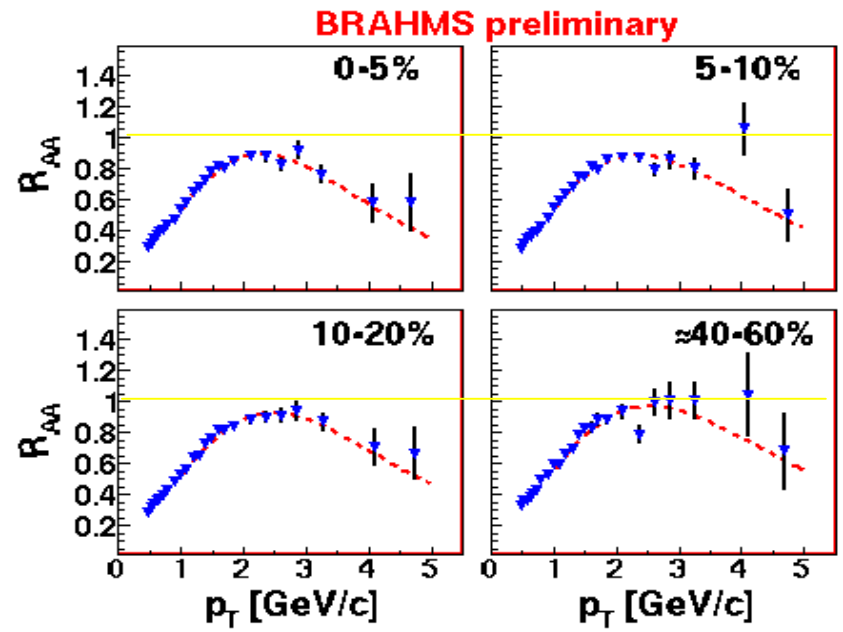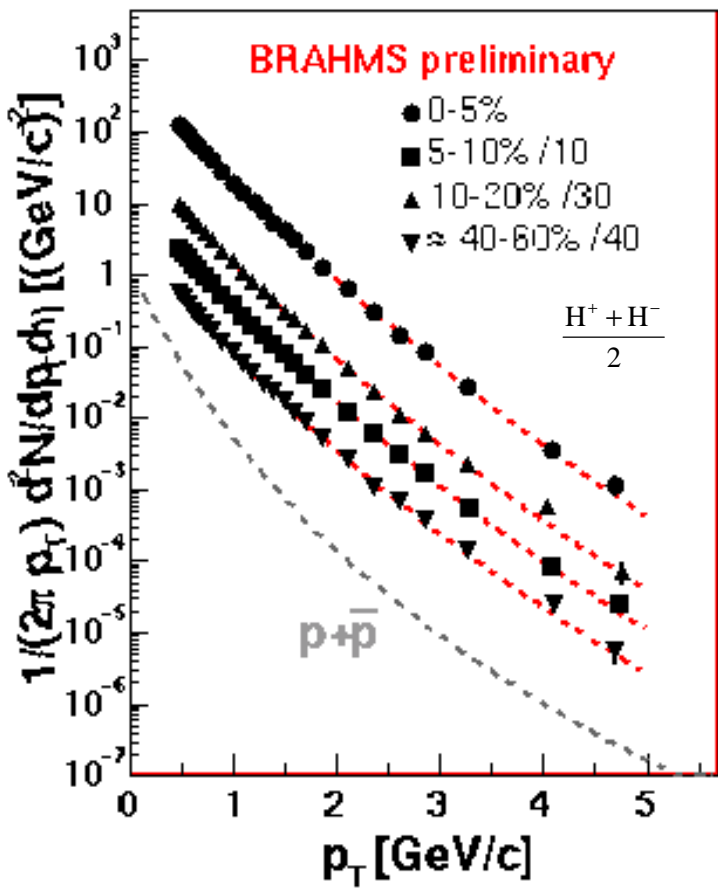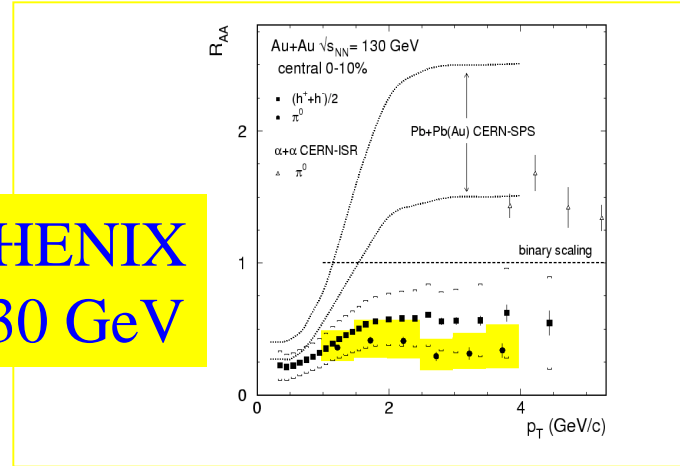
Ay y~0: Central/Peripheral

$\sqrt{S_{NN}}$=200GeV

y~0

BRAHMS preliminary
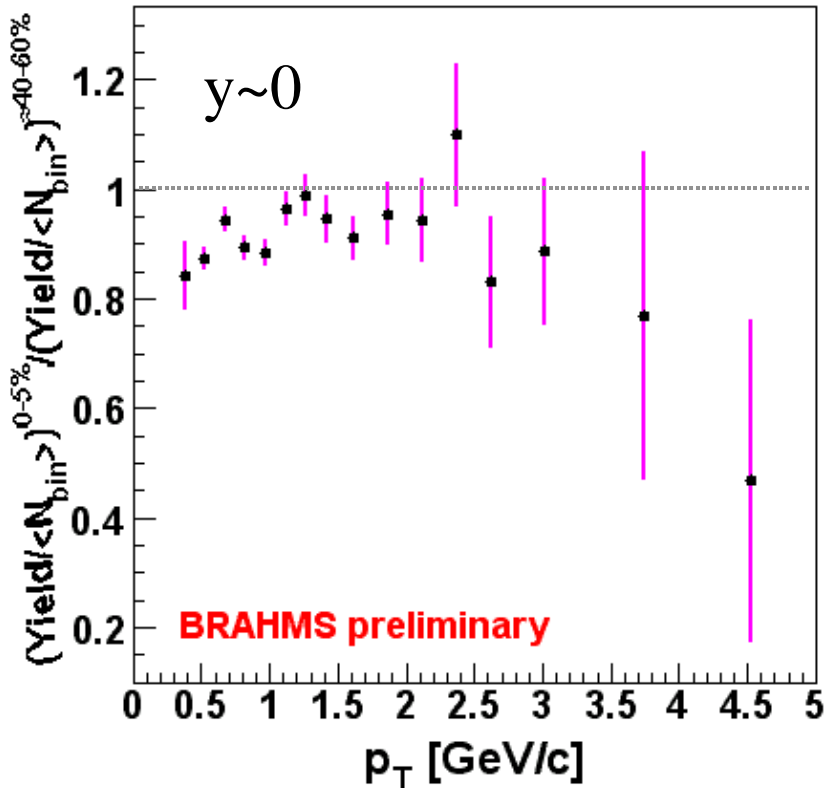
- Scaled by number of binary collisions
- Some systematics cancel out
- Central/Peripheral Ratios:
  - increases up to~2GeV
    :Cronin Effect+…
  - Saturates at R ~< 1
  - decrease at high-p_T

At y~1 (Mid-Rapidity Spectrometer at 40,45 degrees)

BRAHMS Preliminary

$y \approx 1$

h^+ (at $40°$, $45°$): ○ △
h^- (at $40°$, $45°$): □ ◇

y-axis: 0-10% / 40-50% (arbitrary scale)
x-axis: p_T (GeV/c)
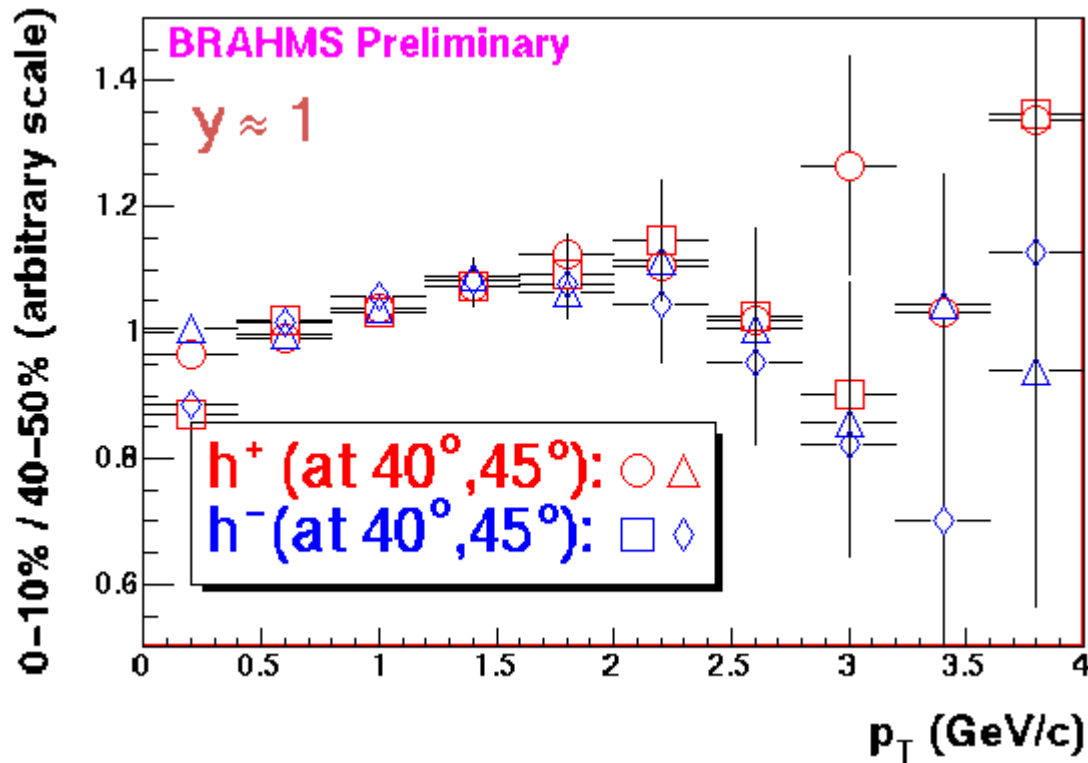
- Normalization: N_{trk}(Central)/N_{trk}(Peripheral) =1
- No difference between h^+ and h^-

How About p_L at y~1 ?
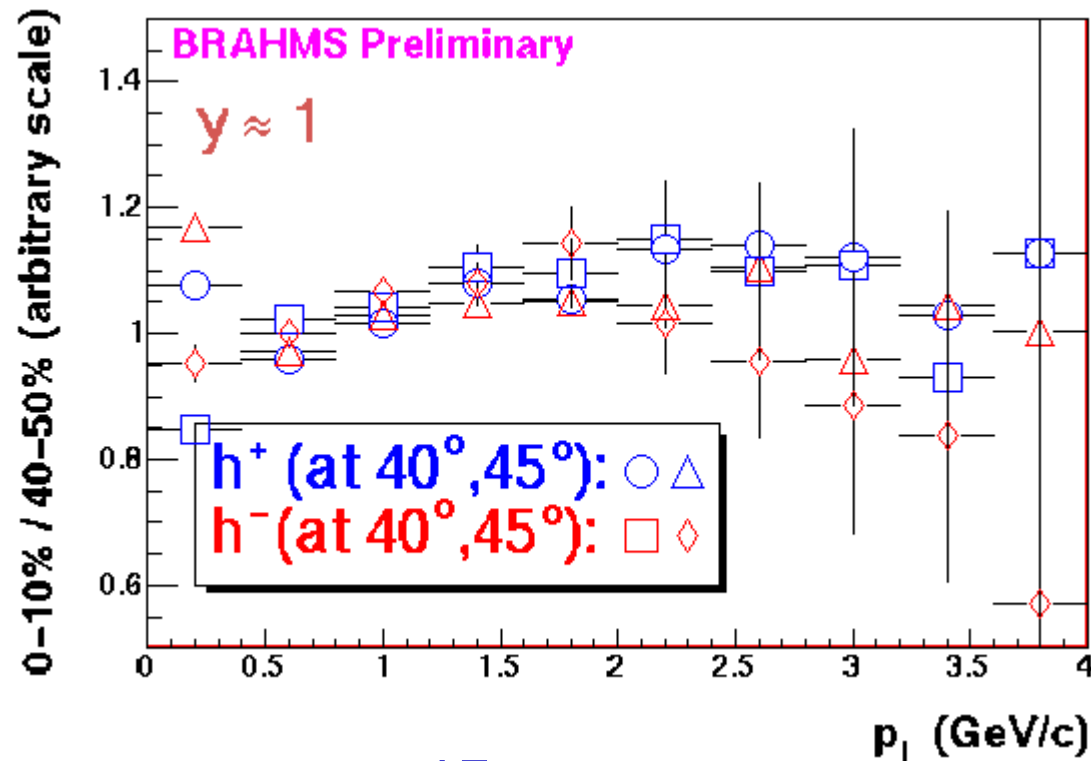
- $p_T = p_L$ at 45°
- $R(p_T) = R(p_L)$?

y ~ 2 (Forward Spectrometer at 12 degree)

p~17 GeV/c

BRAHMS 200GeV preliminary

π⁻

y≈2.2
10% cent.

BRAHMS Preliminary

y ≈ 2

0-10% / 40-50% (arbitrary scale)

h⁺

h⁻

π

12 deg.
(2001 data)

2/3 field (BFS)
1/2 field
1/4 field
1/4 field (FFS)
1/8 field

Rapidity Dependent High-pt Suppressions?

BRAHMS Preliminary: $(h^+ + h^-)/2$

Legend:
- $y \approx 0$ (green square)
- $y \approx 1$ (red triangle)
- $y \approx 2$ (blue star)

Y-axis: 0-10% / 40-50% (arbitrary scale)
X-axis: p_T (GeV/c)
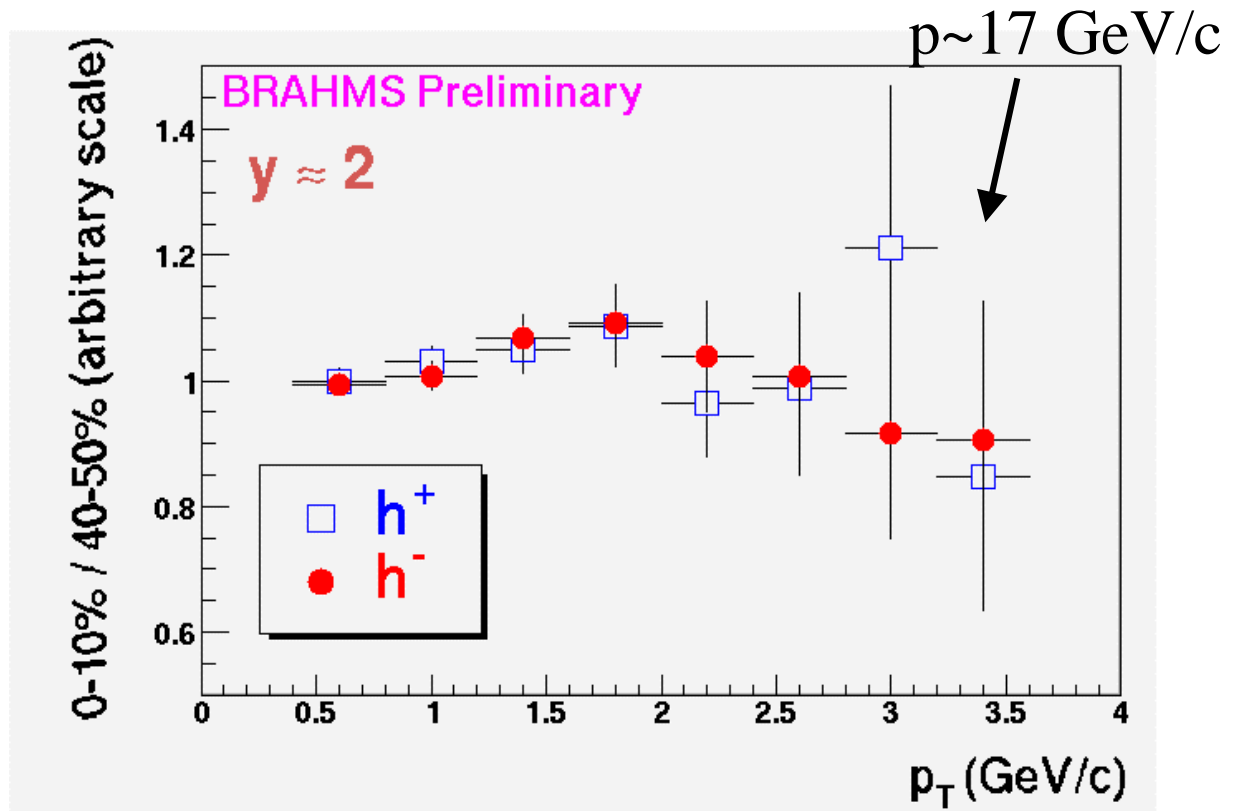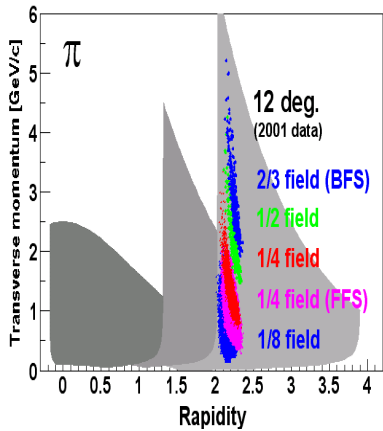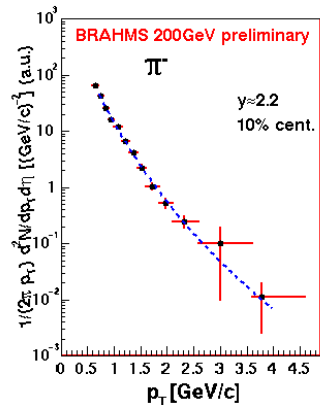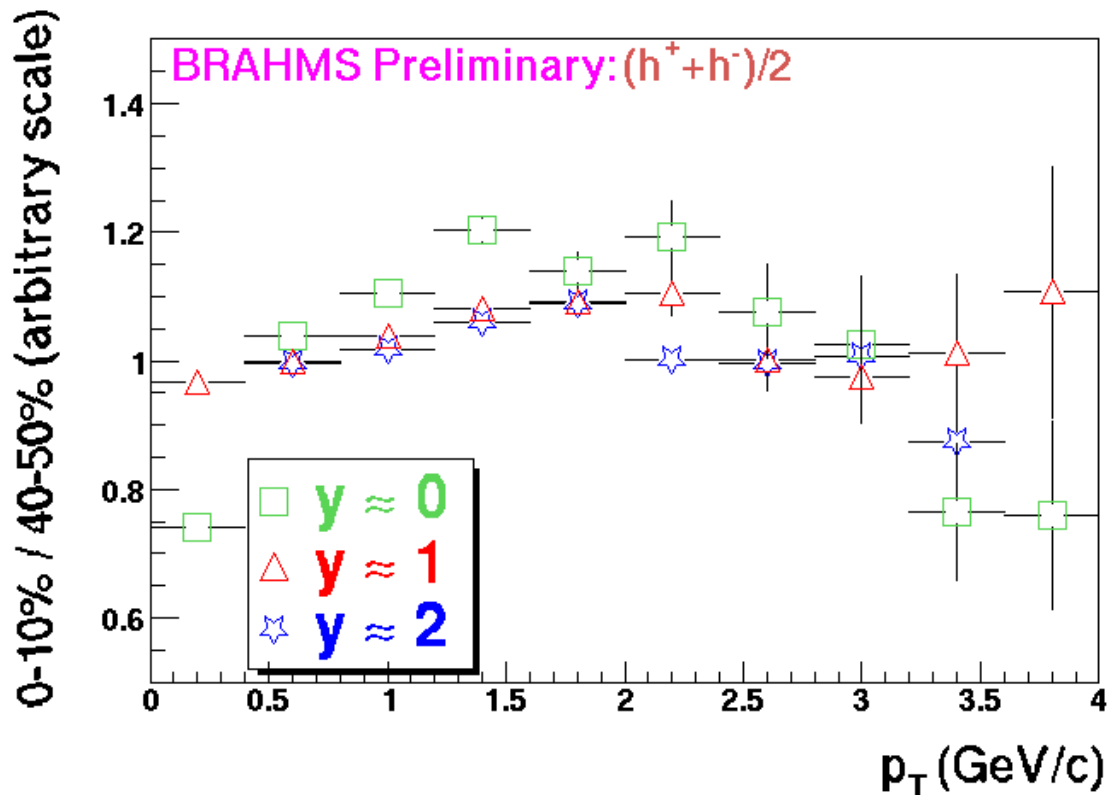
- High-p_T suppressed at $0 < y < 2$
- Systematic Error ~ 15 - 25%
- No significant rapidity-dependence within systematics

Summary

- Suppression of high p_T (>2GeV/c) hadrons at mid-rapidity in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV
- No Strong rapidity dependence in suppression (0<y<2)
- Analysis in progress: Understanding systematics+More data
- Data from RUN4 will provide more detailed information on pt/rapidity/centrality/(reaction plane) dependent suppression

- BRAHMS + PID Upgrade + high luminosity will provide unique high-p_T measurements of identified hadrons over a broad y range in RHIC RUN3 and RUN4...
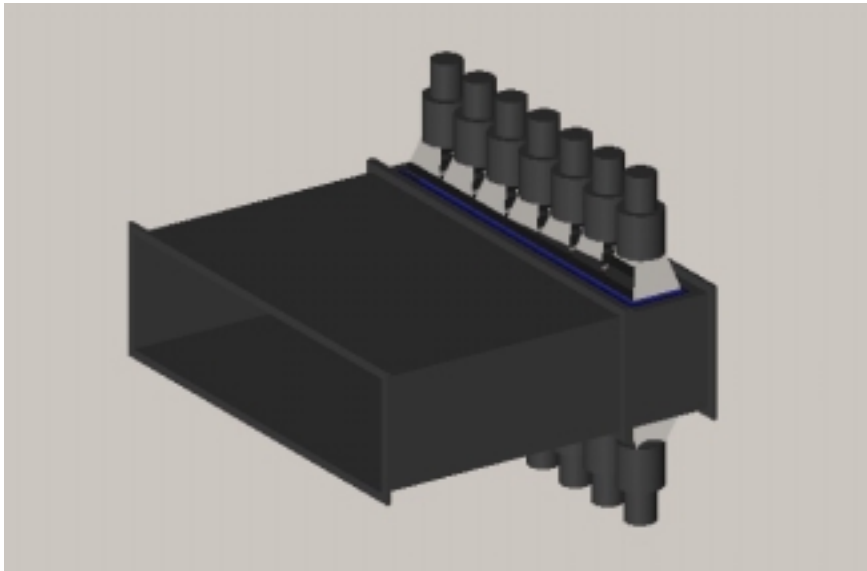- High-p_T and High-y (low-x) measurements with BRAHMS detectors in d-A (Run3) will probe low-x ($\sim 5 \times 10^{-4}$) to study Saturation (CGC): (R. Debbe on Saturday Symposium on Saturation)
- Good reference spectra will be available from RUN3: p+p and d+A: (Study Cold Nuclear effect)

Extended PID for High pt measurements
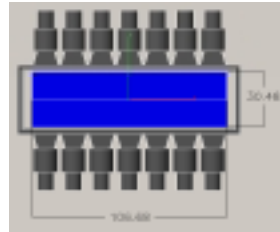
- New Cherenkov detector C4: Addition to TOFW at Mid-Rapidity Spectrometer

- π/K identification up to p = 8 GeV/c (Forward Spectrometer PID up to p = 25 GeV/c)

- "high-pt" pion measurement up to 5 GeV at y ~ 0 (luminosity limited)

- Will be installed for Run3 (2002-3)
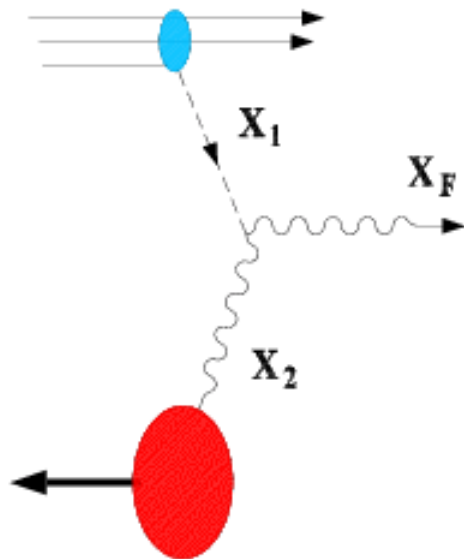
Production of high rapidity (large x_F) charged hadrons can be described with this diagram; the momentum fraction of each parton is written as:

$$x_{1,2} = (p_t/\sqrt{s})e^{\pm y}$$

p_t and y are the transverse mom and rapidity of the measured hadron.

A proton of 30 GeV/c measured at 3° would probe x_2 ~5 X 10^{-4}

BRAHMS ability to work at high rapidity (~4) opens a window to study the presence of a Color Glass Condensate in the initial conditions of d-A collisions

$$x_1 - x_2 = x_F$$

$$x_1 x_2 = p_T^2/s$$

$$0 < x_{1,2} < 1 \quad -1 < x_F < 1$$

The BRAHMS Collaboration

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