RAPIDITY DEPENDENT FIXED-TARGET PION SPECTRA AT $\sqrt{s_{NN}}$ = 3.0, 3.5, and 4.5 GeV FROM STAR

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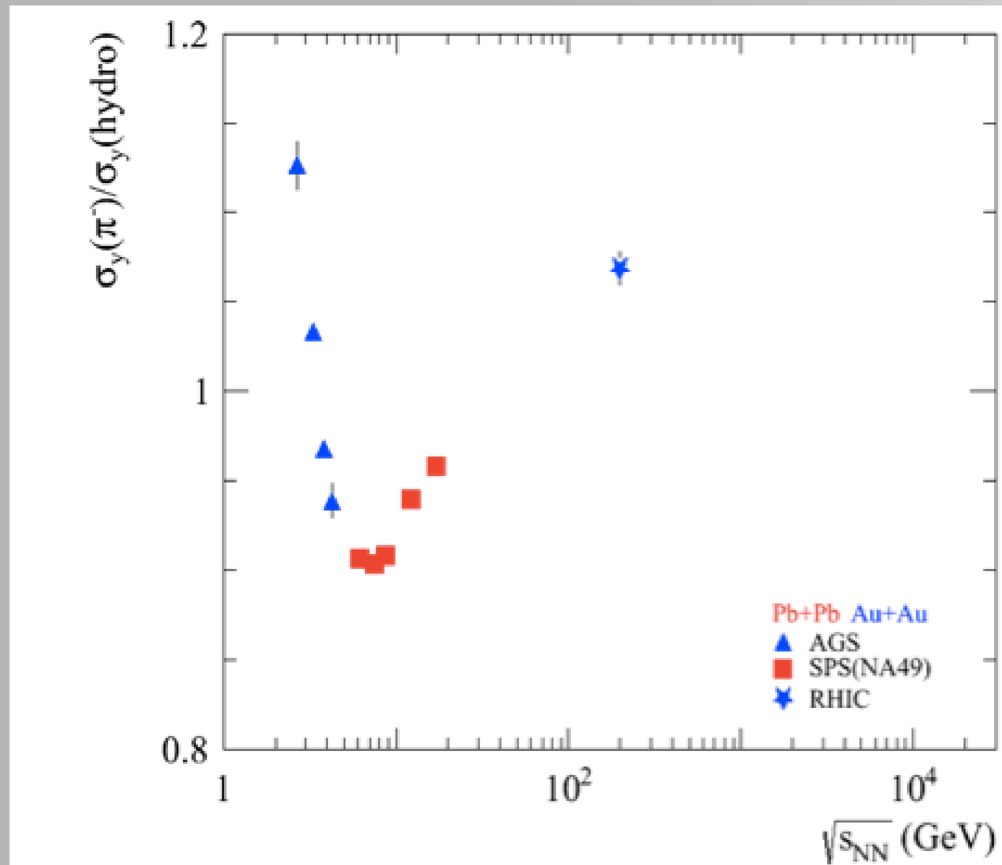
Presented at the Annual Meeting of the Division of Nuclear Physics
October 23-26, 2013
Newport News, VA

MOTIVATION

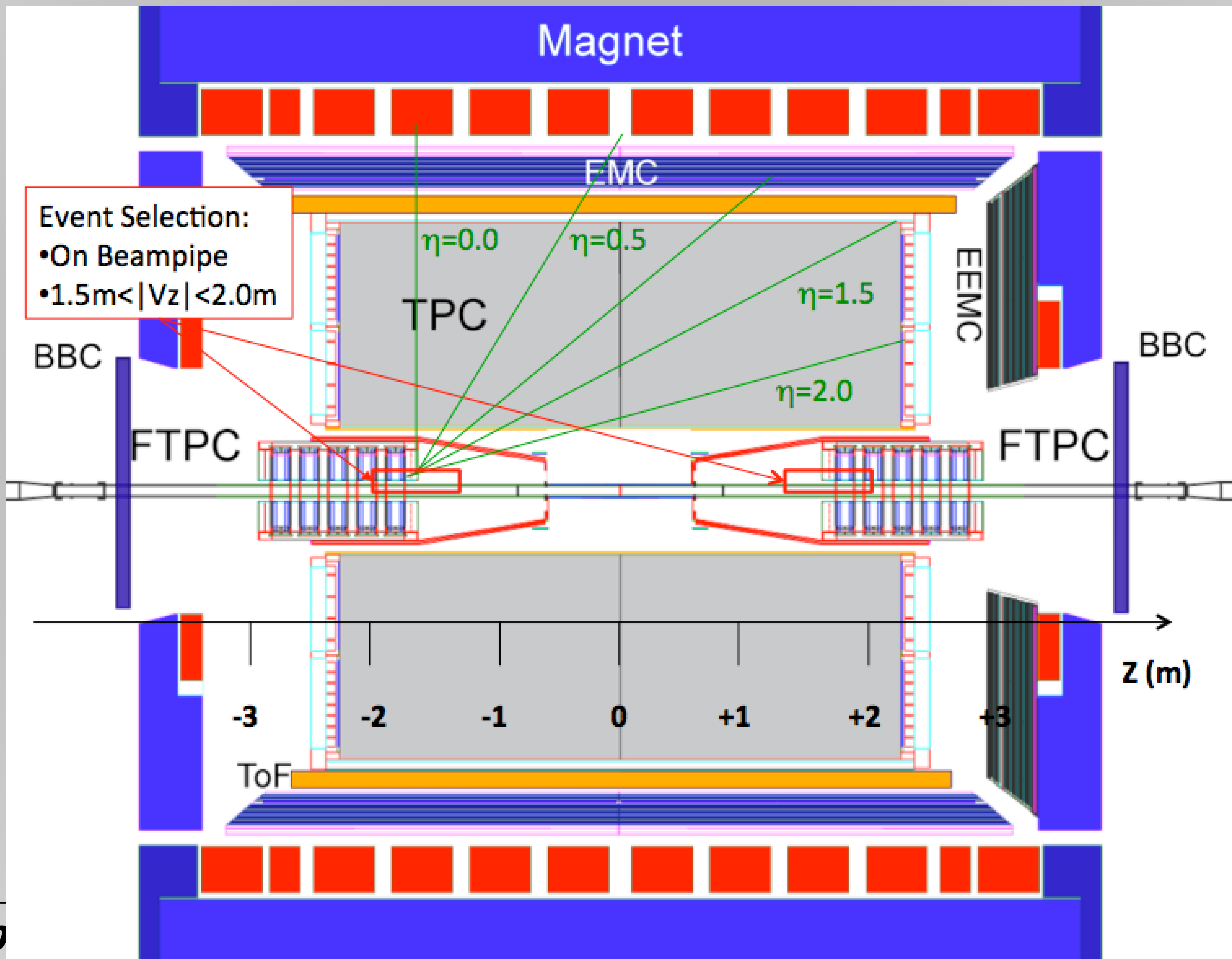
- Minimum in the width of the pion rapidity distribution, indicative of a softening of the EOS expected during first order phase transition

- The goals are then to cover a broad rapidity range at low colliding energies



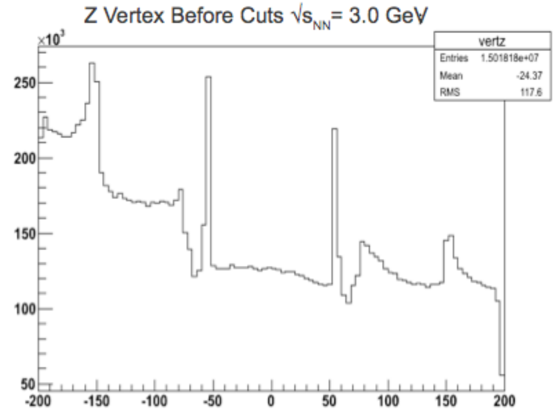
M. Bleicher hep-ph/0509314, H. Petersen nucl-th/0611001, A. Rustamov arXiv:1201:4520

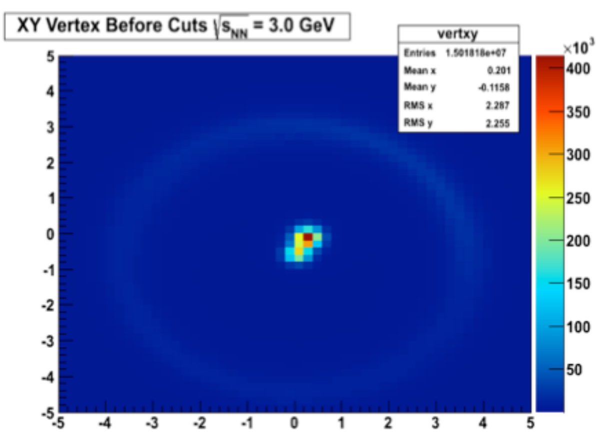
FIXED-TARGET EVENTS



EVENT SELECTION

Before Cuts





Event Cuts

- Vertex Requirements -

$-200 \leq V_z \leq -150$ cm

$2 \leq V_R \leq 5$ cm

- Momentum -

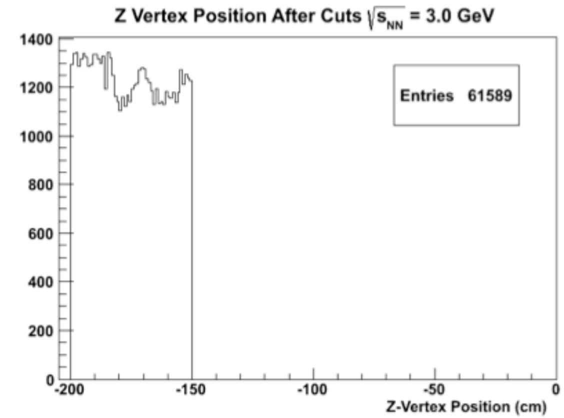
$$\sum_{Tracks} p_z > 0$$

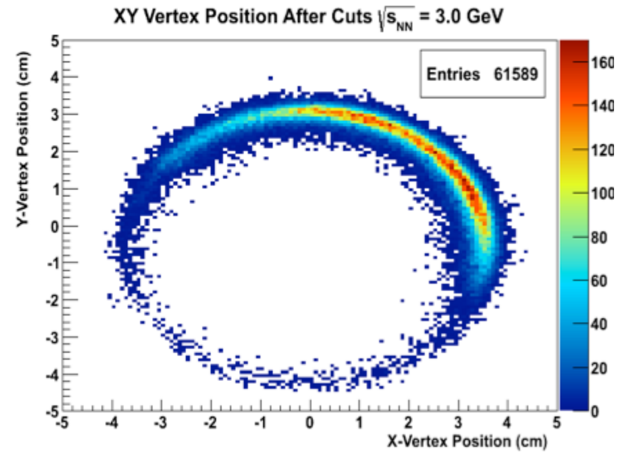
- Centrality Cut -

Top 10 %

Apply Cuts

After Cuts





KINEMATIC CALCULATIONS

Collision Energy (GeV)	Single Beam Energy	Single Beam P_z (GeV/c)	Fixed Target $\sqrt{s}$	Single Beam Rapidity	Center of Mass Rapidity
19.6 Au+Au	9.8	9.76	4.47 Au+Al	3.04	1.52
11.5 Au+Au	5.75	5.67	3.53 Au+Al	2.51	1.25
7.7 Au+Au	3.85	3.74	2.99 Au+Al	2.10	1.05

$\sqrt{(s_{NN})} = \sqrt{(2m^2 + 2Em)}$

$m = 0.9315\ GeV/c^2\ ;\ E = 9.8\ GeV$

$\sqrt{(s_{NN})} = 4.47\ GeV$

$p_z = \sqrt{(E^2 - m^2)} = 9.76\ GeV/c$

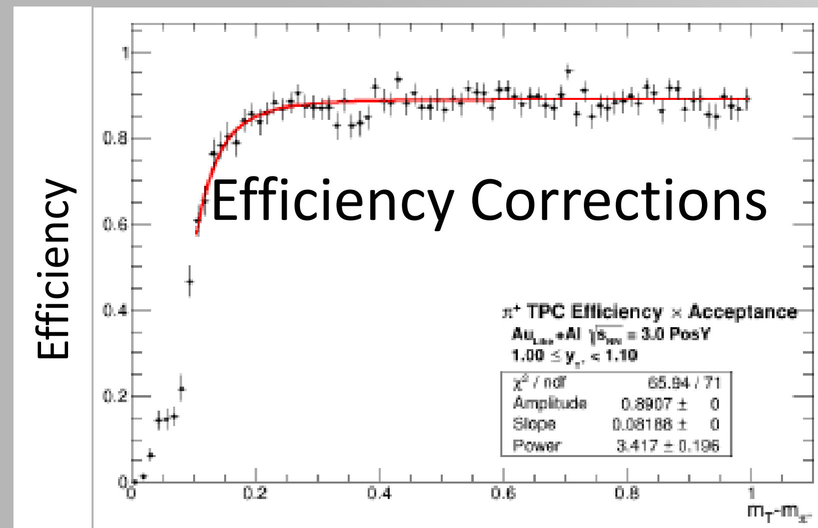
$y_{beam} = 0.5*[\ln(E + p_z)/(E - p_z)]$

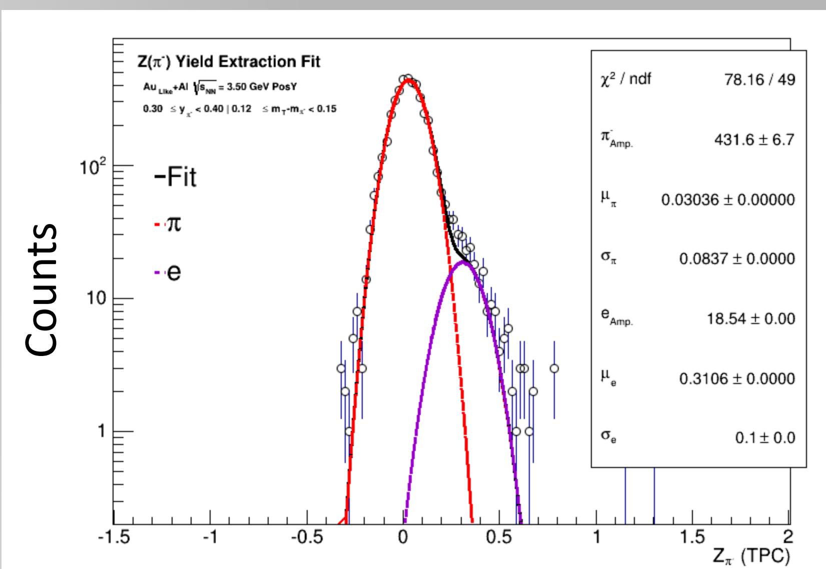
$y_{beam} = 3.0$

$y_{cm} = 1.5$

RAW YIELD EXTRACTION AND CORRECTIONS

The dE/dx distributions for negative particles were fit for defined rapidity and m_t-m_0 bins. Efficiency and other detector effects.





Z = (dE/dx)expected – (dE/dx)observed

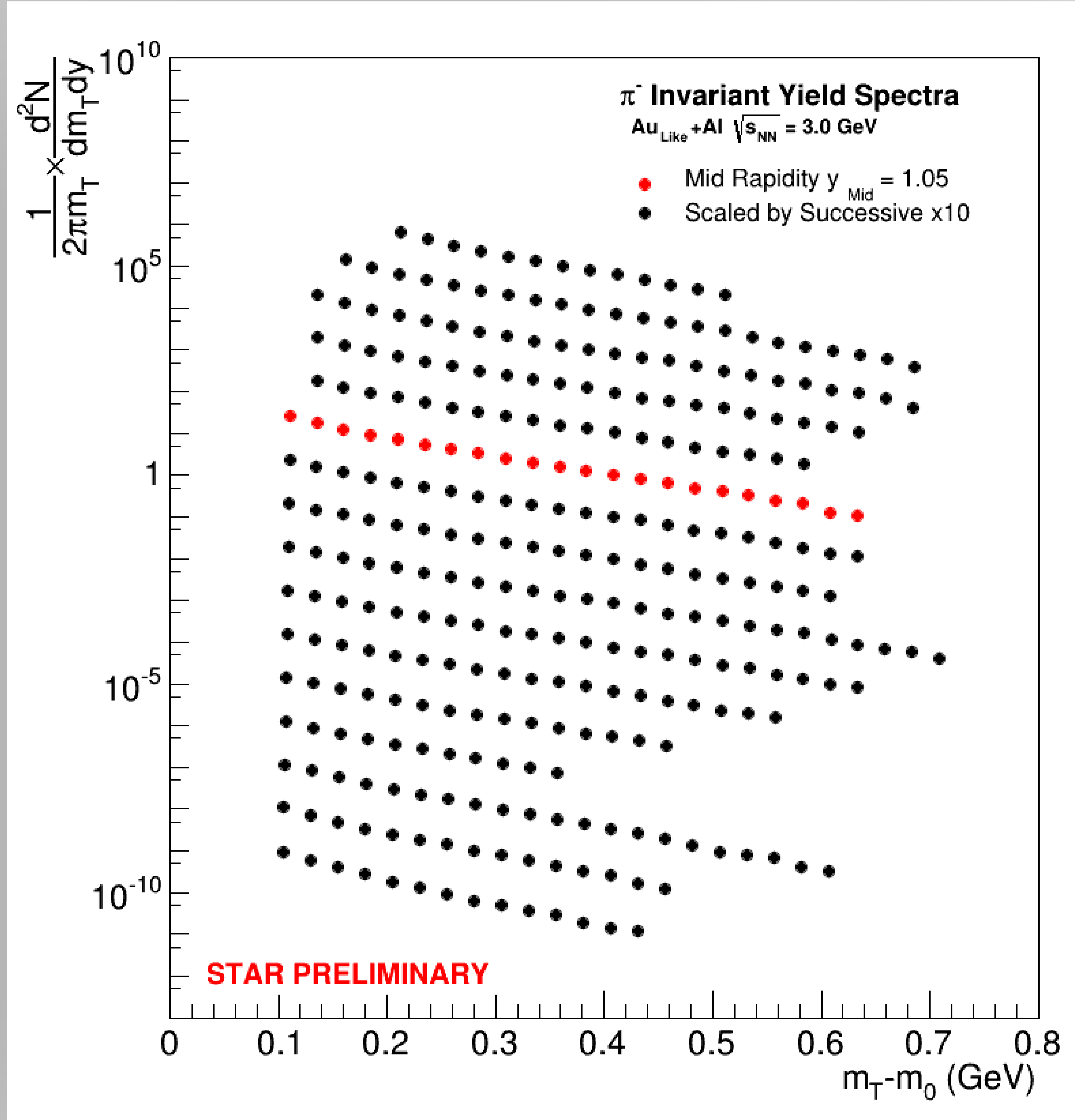
- Electrons could be easily be separated from the π^-s.
- Kaons would overlap in the forward rapidity slides, however the mid-rapidity K^-/π^- ratio is less than 2%
- even fewer anti-protons

$\sqrt{s_{NN}}$ = 3.0 GeV

•Each set of points is a different rapidity slice; bottom to top: 0.0< y < 0.1 to 1.5< y <1.6

•Curves are offset by powers of ten

• The nucleon-nucleon center-of-mass rapidity slice is indicated in red

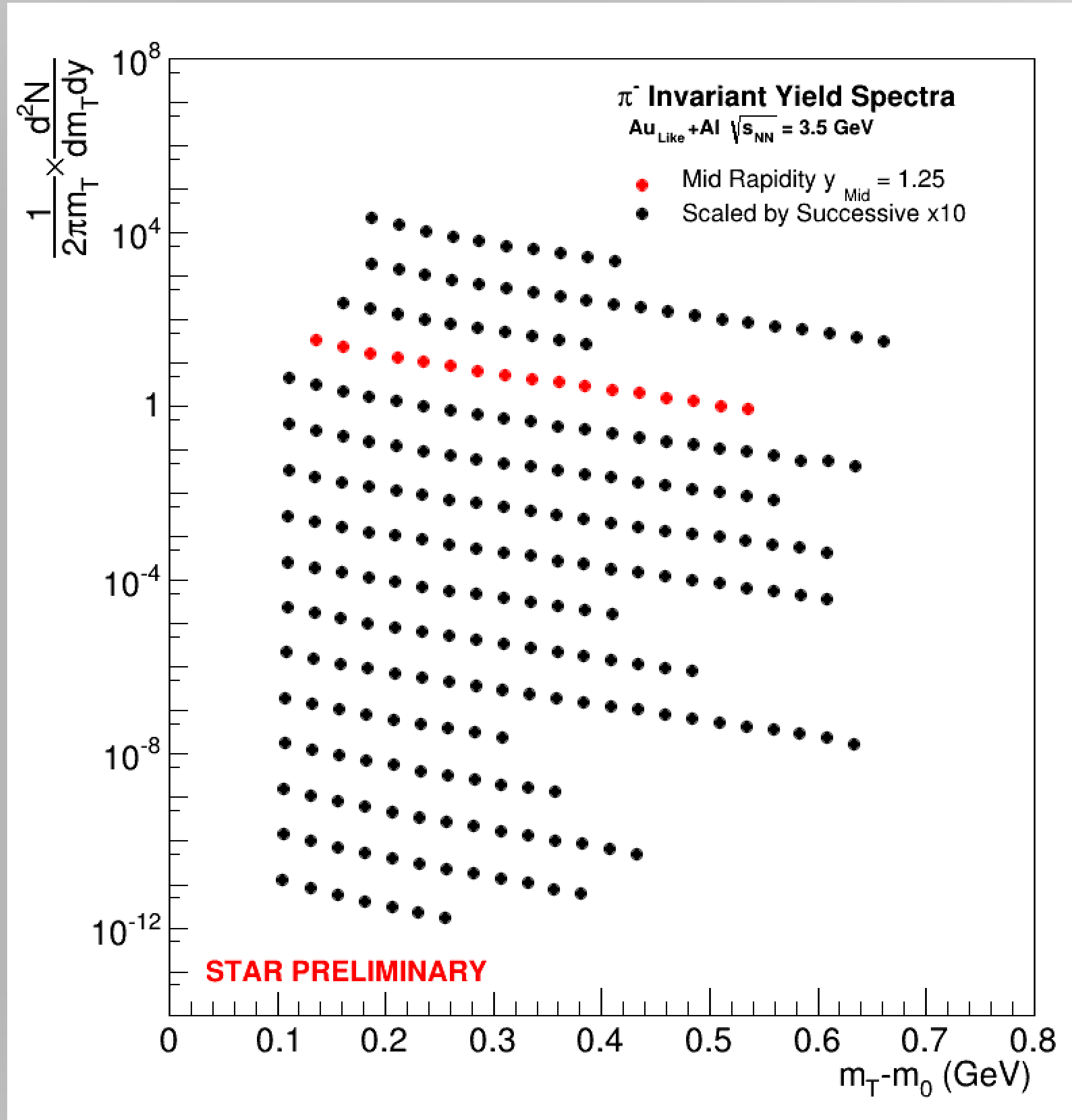


$\sqrt{s_{NN}}$ = 3.5 GeV

•Each set of points is a different rapidity slice; bottom to top: 0.0< y < 0.1 to 1.5< y <1.6

•Curves are offset by powers of ten

• The nucleon-nucleon center-of-mass rapidity slice is indicated in red

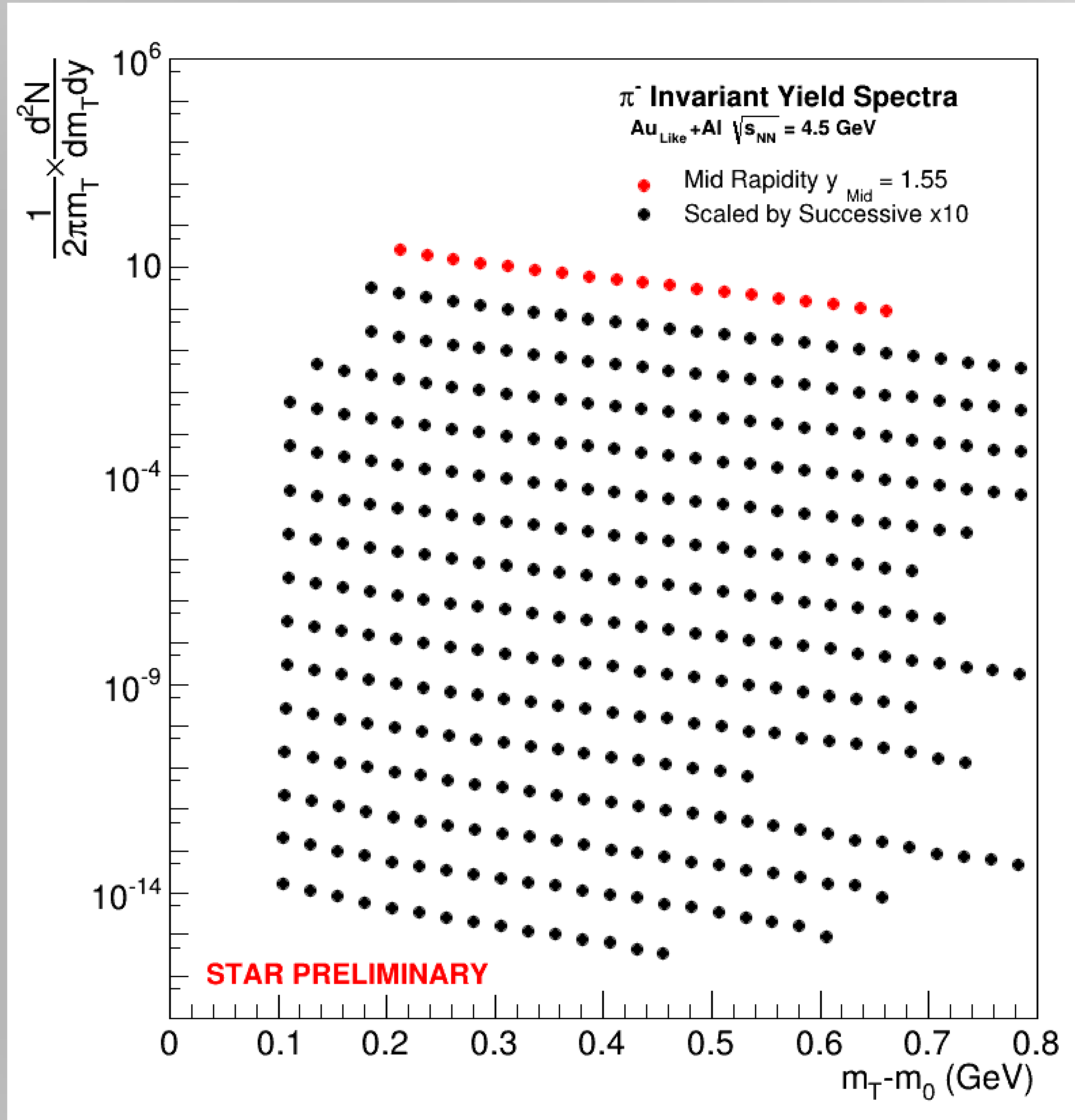


$\sqrt{s_{NN}}$ = 4.5 GeV

•Each set of points is a different rapidity slice; bottom to top: 0.0< y < 0.1 to 1.5< y <1.6

•Curves are offset by powers of ten

• The nucleon-nucleon center-of-mass rapidity slice is indicated in red

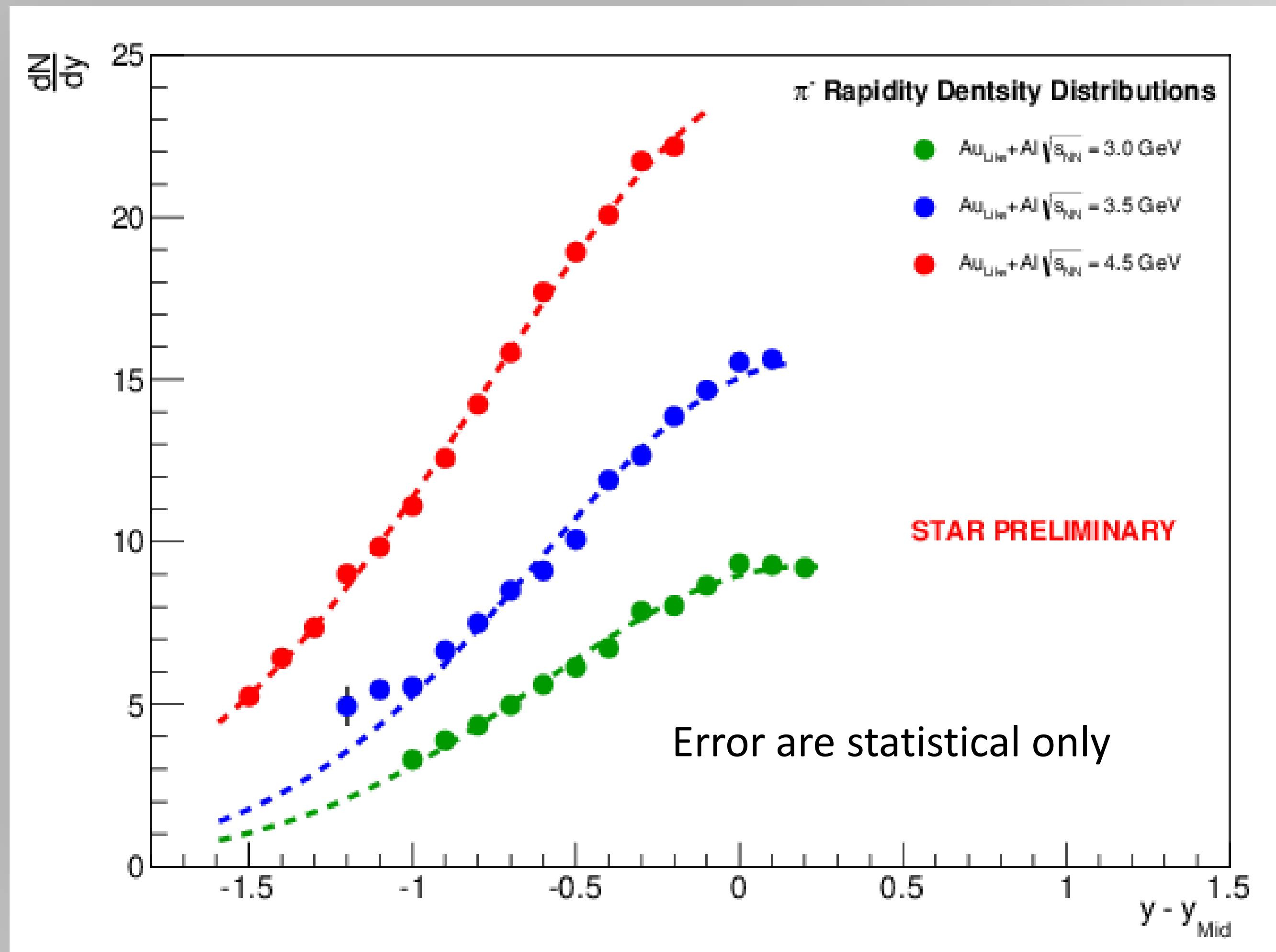


Rapidity Density Distributions

- The rapidity density distributions have been measured from target rapidity to the nucleon-nucleon center-of-mass rapidity.

- The distributions are fit with Gaussians.

- dN/dy distributions for Au_{Like}+Al may not peak at zero.



CONCLUSIONS AND OUTLOOK

• We have made the first measurement of broad rapidity dependence of spectra in STAR

• This proof of principle study demonstrates we ***can make the dale*** measurement, which is an important measurement indicative of the softening of the equation of state and a first-order phase transition

• We are looking forward to fixed target run as we are primed to make the dale measurement with Au+Au collisions and dedicated trigger (currently in development)

• STAR is an excellent detector, still doing important physics as we push its capabilities beyond expectations