Baryon Stopping in Au+Au and p+p collisions at 62 and 200 GeV

- Or, a story of how baryon stopping depends on system size and collision geometry.

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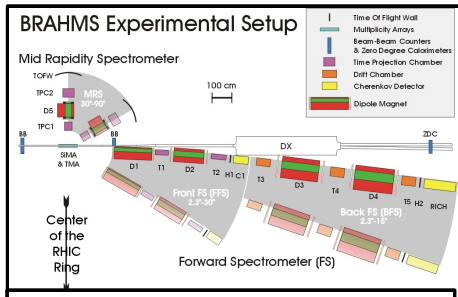
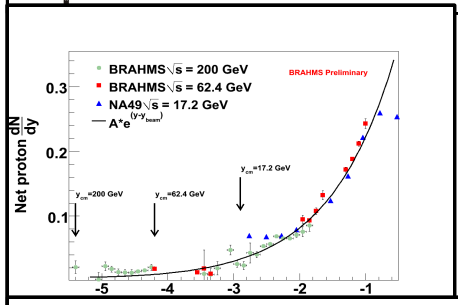
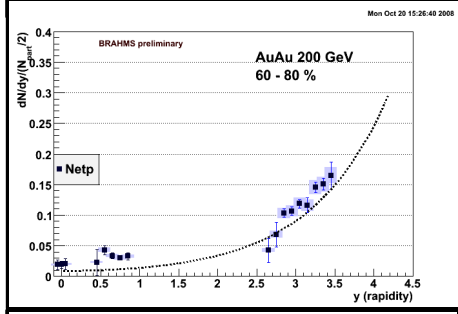
For the BRAHMS collaboration

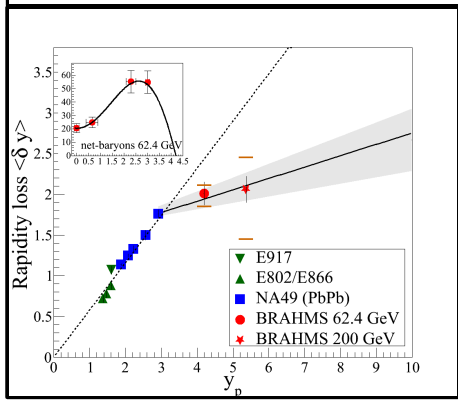
Outline

- BRAHMS experiment and analysis method....
- Scaling in p+p collisions.....
- p+p or peripheral Au+Au ? .....
- Rapidity losses and limiting fragmentation.....

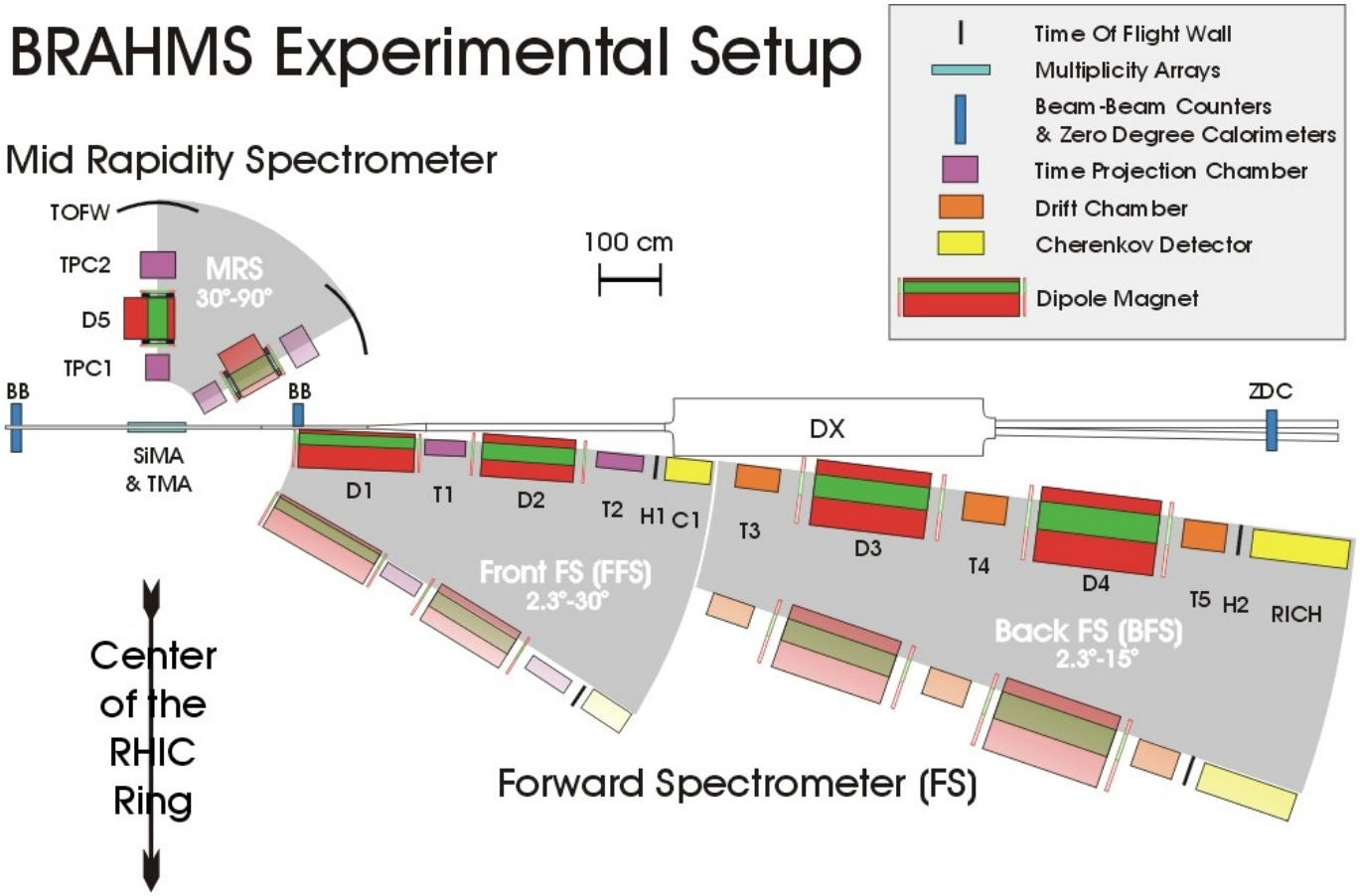








The BRAHMS experiment



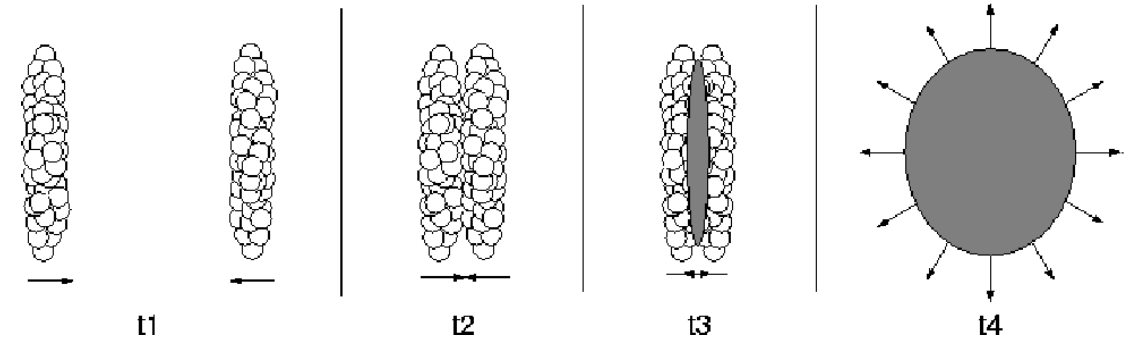
- Two spectrometers, Forward Spectrometer (FS), covering 2.3°<θ<30° and Midrapdity Spectrometer covering 30°<θ<90°.
- Both spectrometers have tracking and PID capabilities for pions, kaons and protons.
- Data presented here are from 2004 (62.4 GeV and 200 GeV Au+Au) and 2005-2006 (p+p at 62.4 and 200 GeV) RHIC runs.

Stopping: The average Rapidity Loss

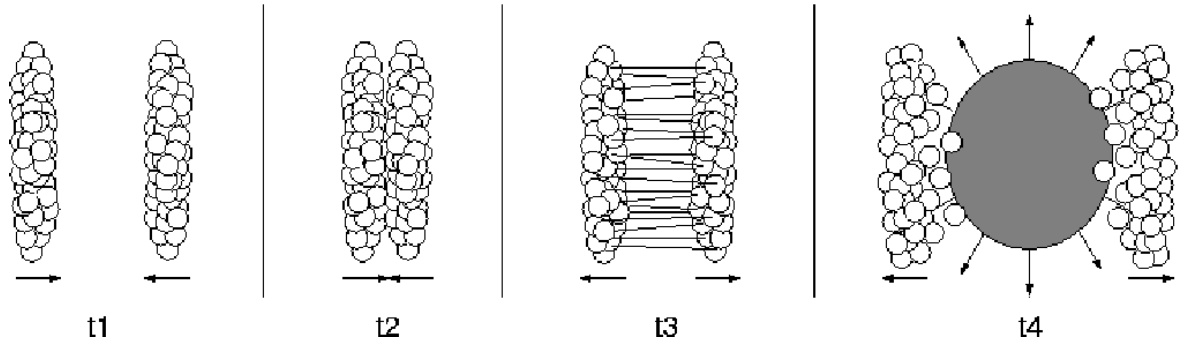
Rapidity loss :

$$\delta y = y_{beam} - \langle y \rangle = y_{beam} - \frac{2}{N_{part}} \int_0^{y_{beam}} y \frac{dN_{net-baryons}}{dy} dy$$

Net-baryons =
baryons – antibaryons
Baryon conservation

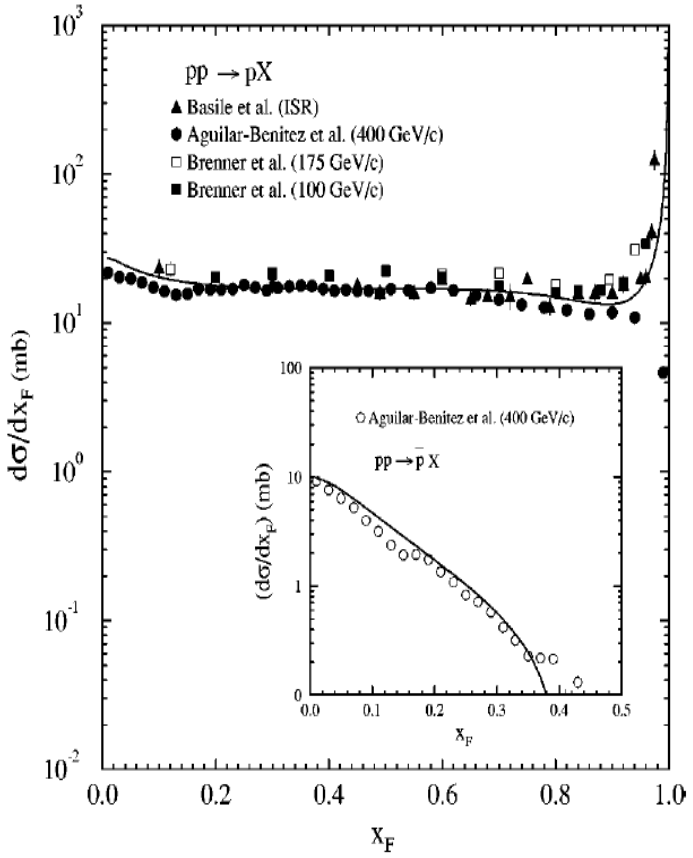


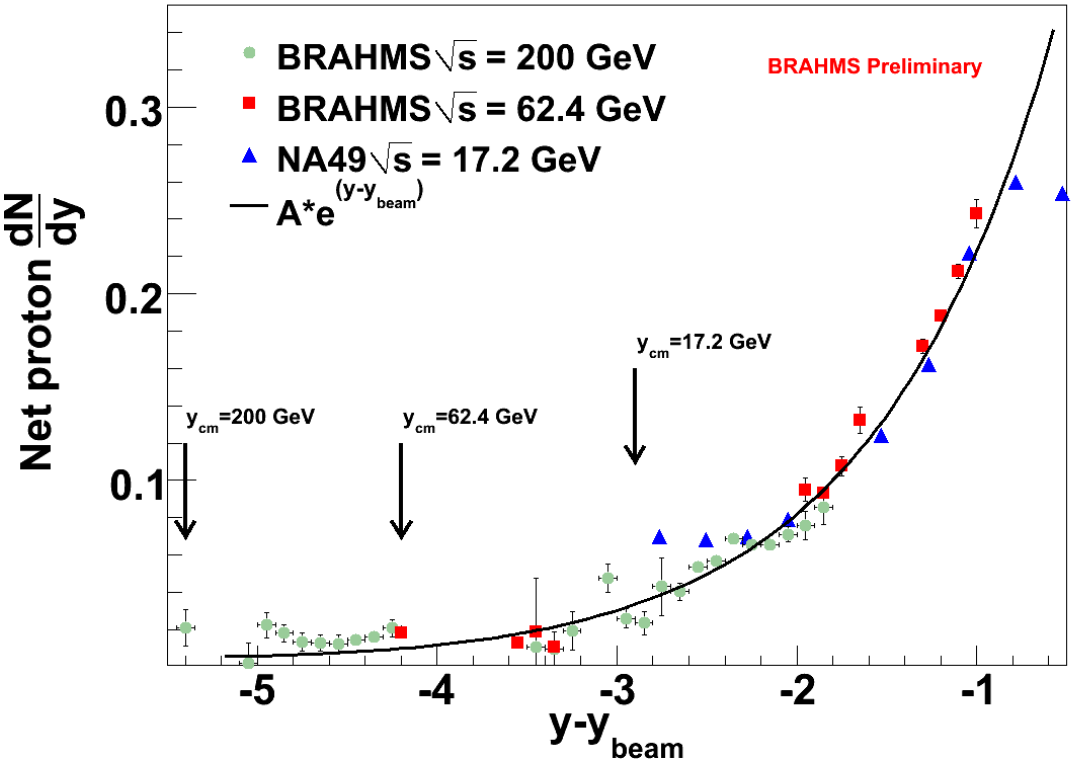
Full stopping: $\delta y = y_{beam}$



Some transparency $0 < \delta y < y_{beam}$

Scaling in p+p collisions

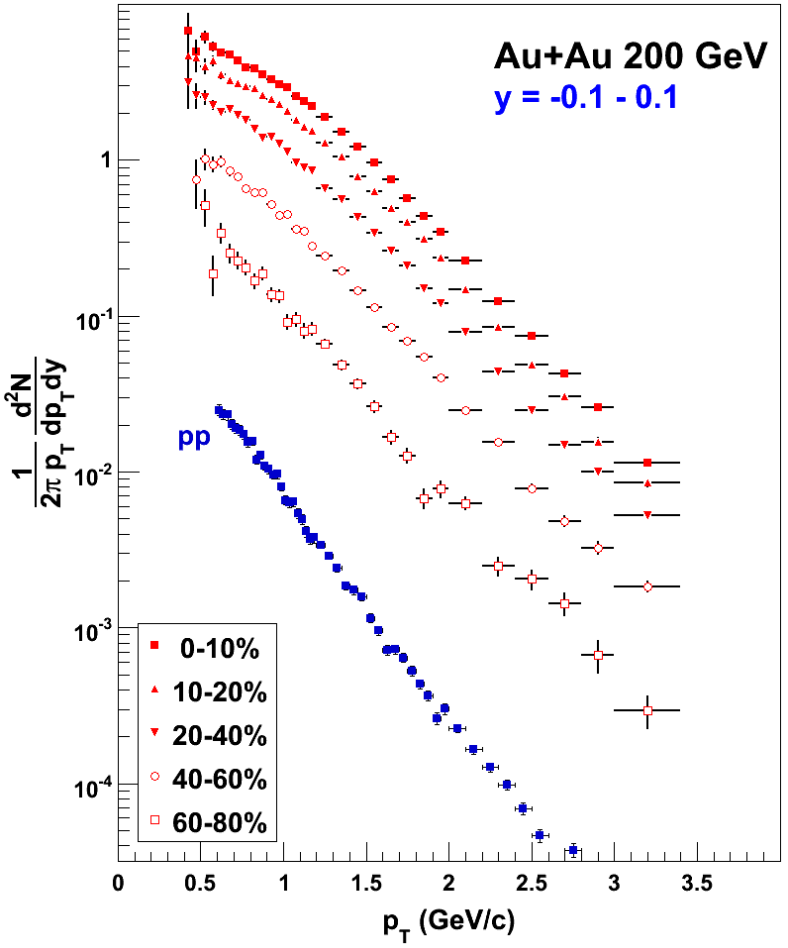




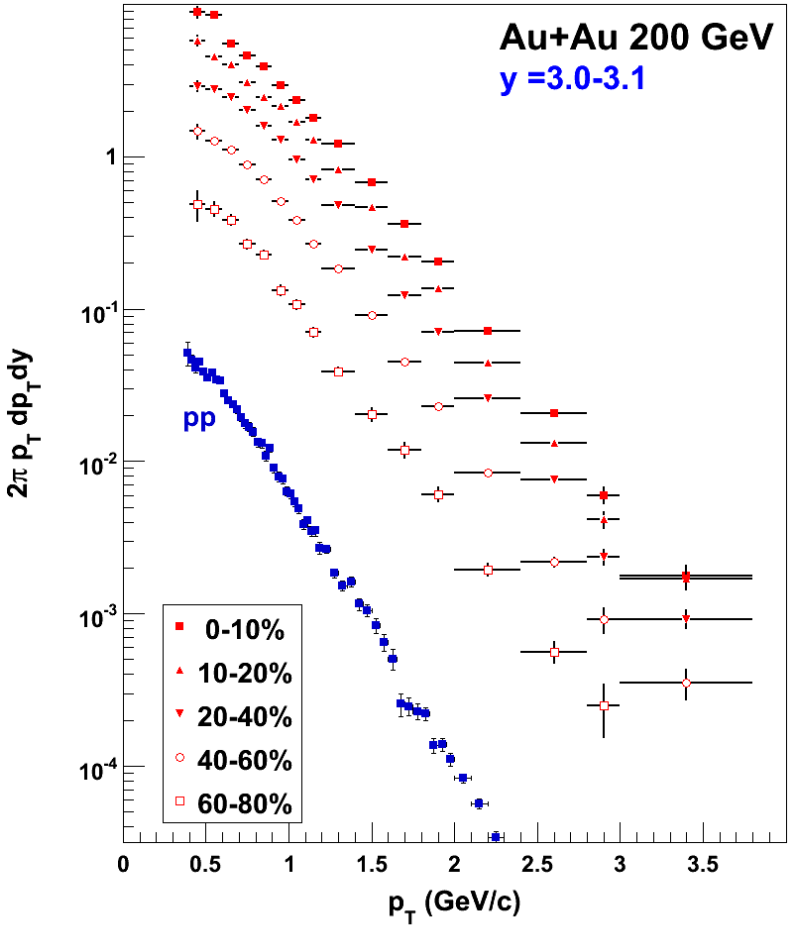
- At lower energies p+p collisions exhibits a feature where dN/dx~c with an integral of ~0.6-0.7.
- This implies for constant $<m_T>$ vs. rapidity that dN/dy~ exp(y') ~ exp(-y).
- The present data at higher energies confirms this behavior.

Proton spectra from 200 GeV Au+Au

Midrapidity

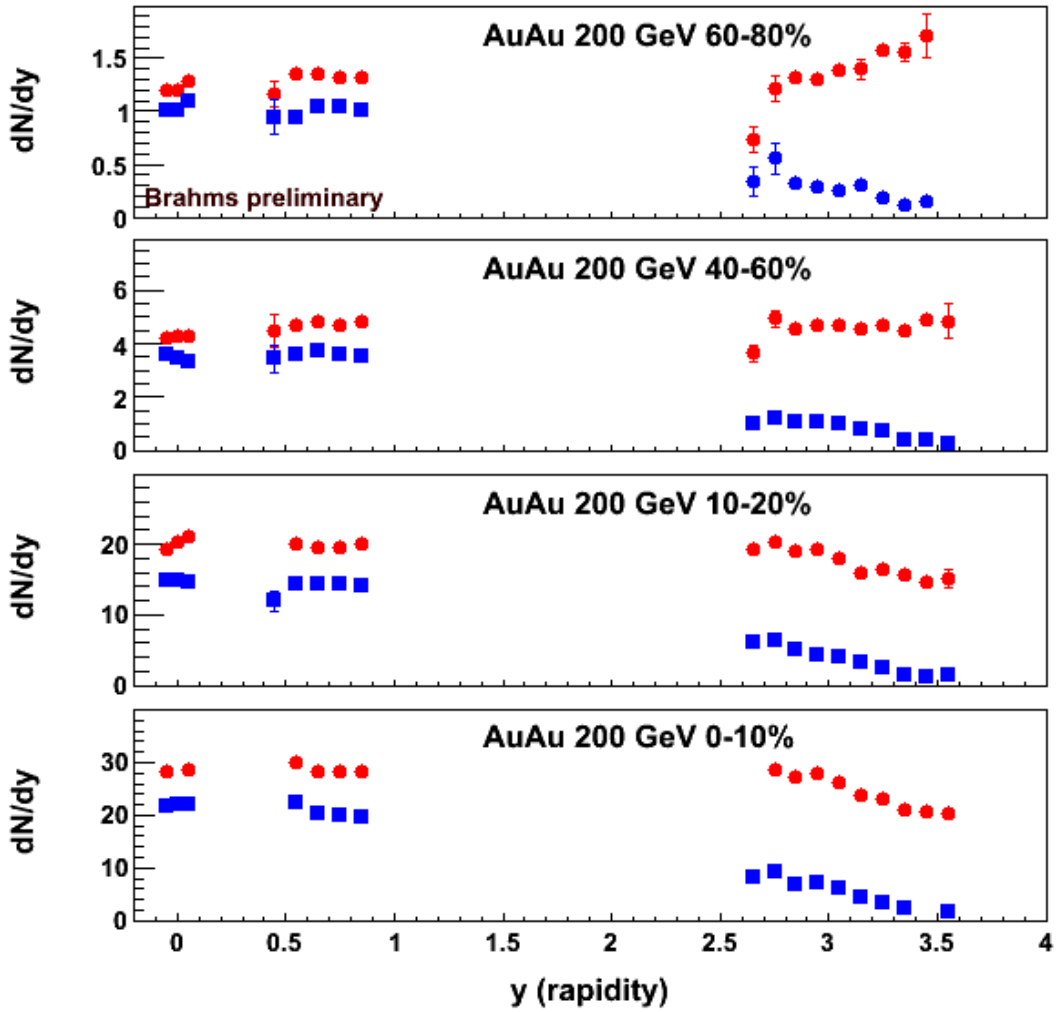


Forward rapidity



- Rapidity dependence: Softer spectra at forward rapidities.
- Centrality dependence: Lower yields, essentially unchanged slopes.

System size dependence of proton dN/dy



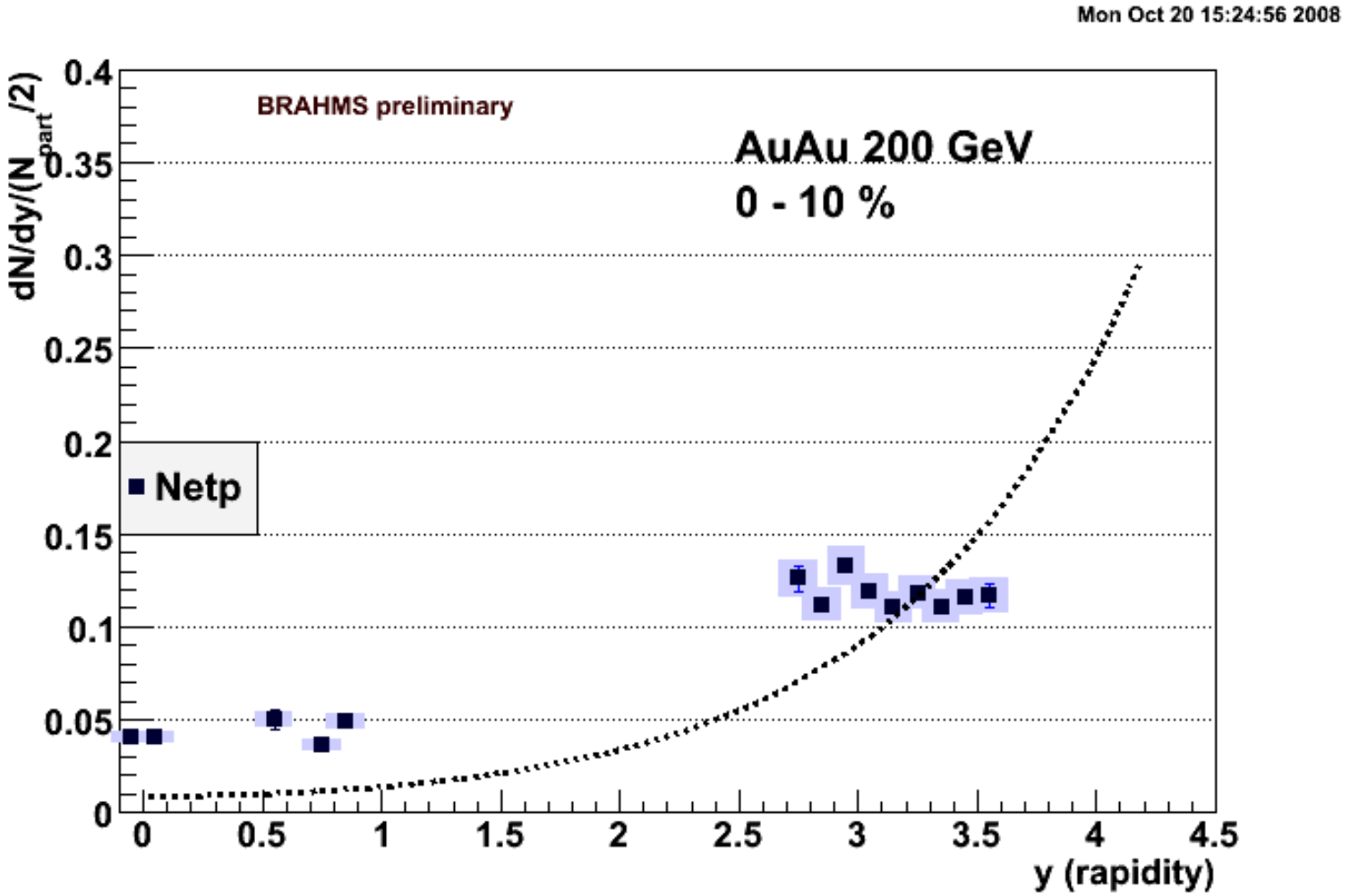
Peripheral

Proton
Antiproton

Central

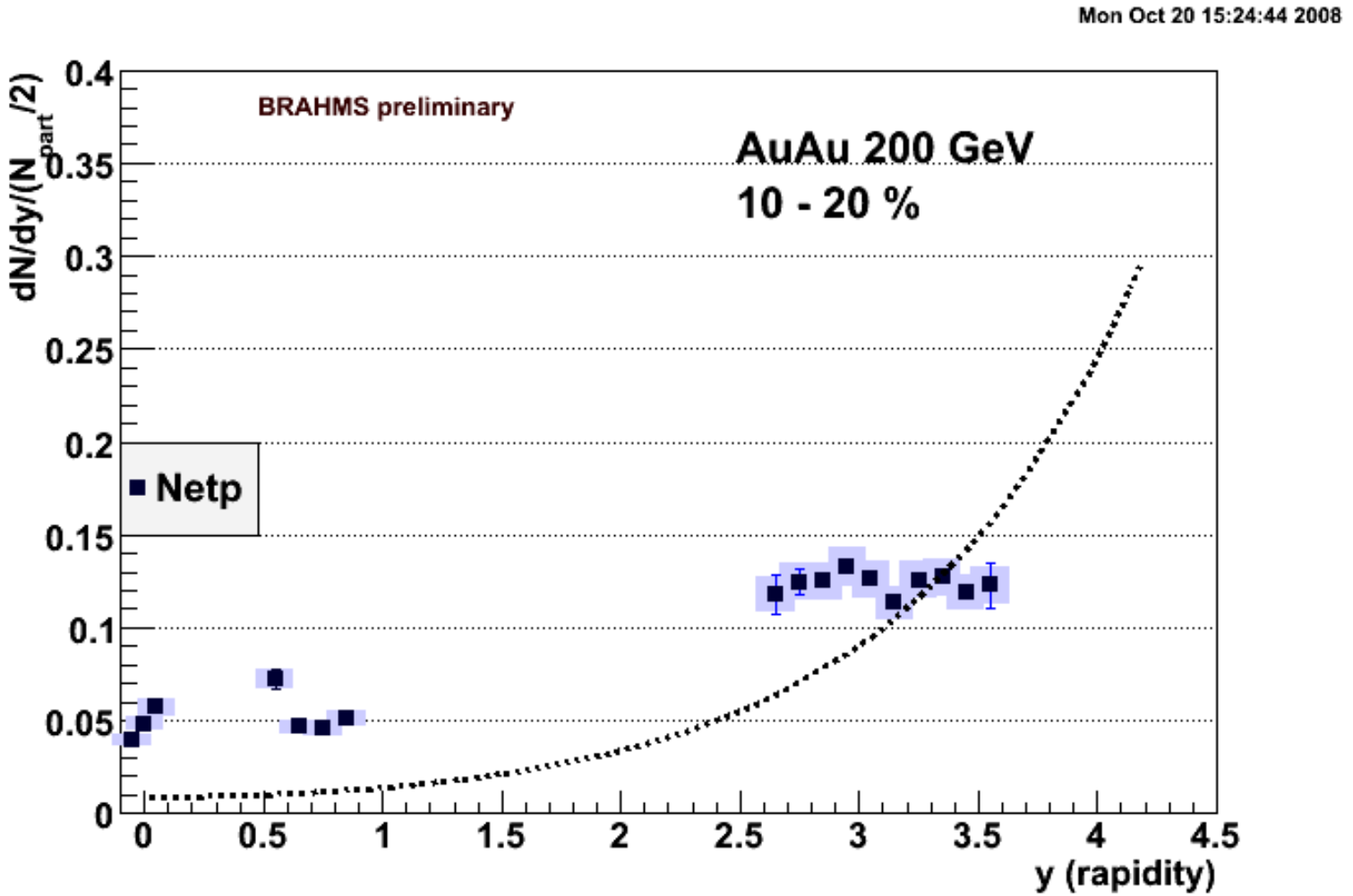
- The shape of dN/dy for peripheral Au+Au collisions is similar to that of p+p collisions.

From central Au+Au to p+p



- Peripheral Au+Au collisions exhibit same scaling as p+p collisions (dotted line).

From central Au+Au to p+p



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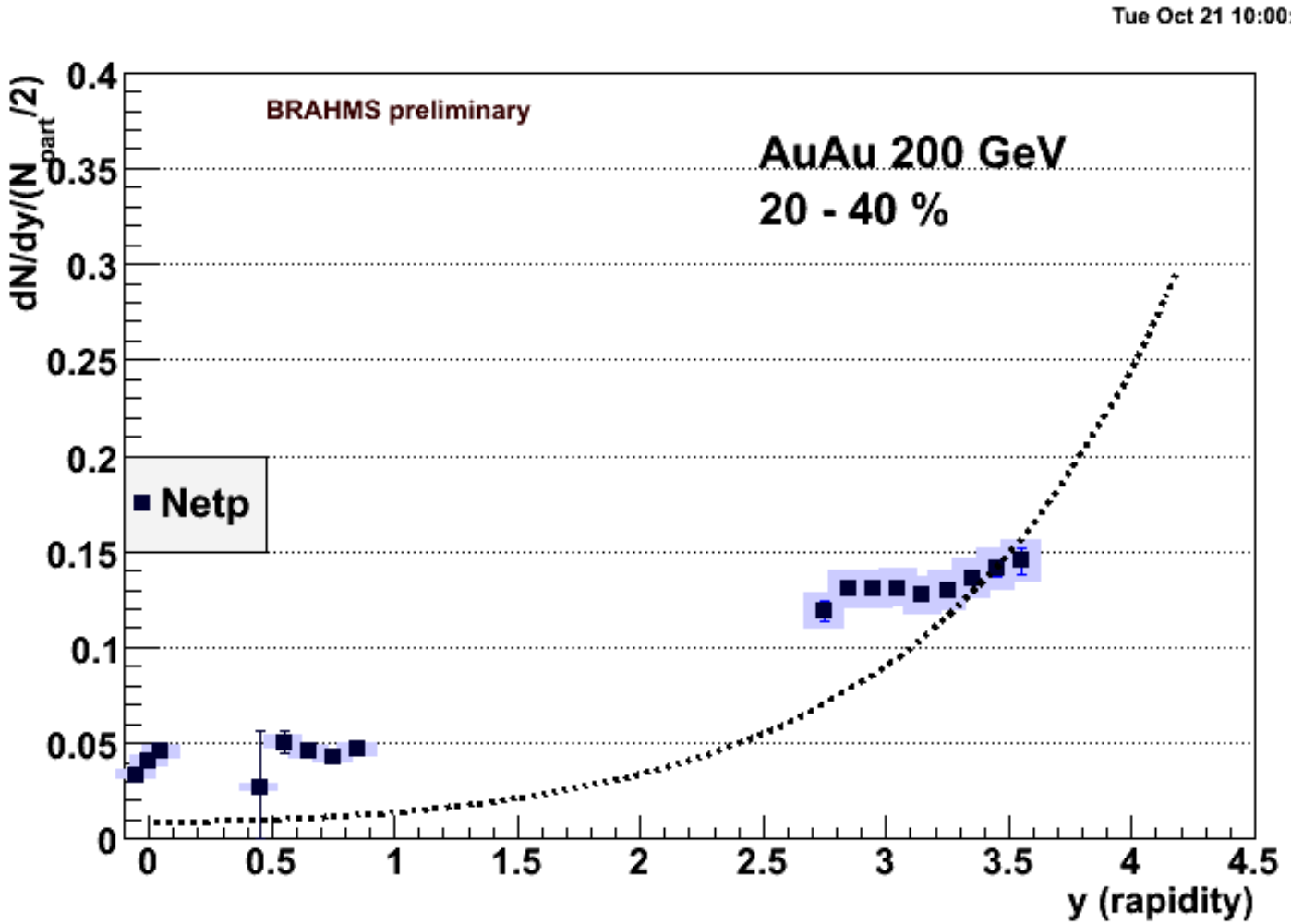
From central Au+Au to p+p



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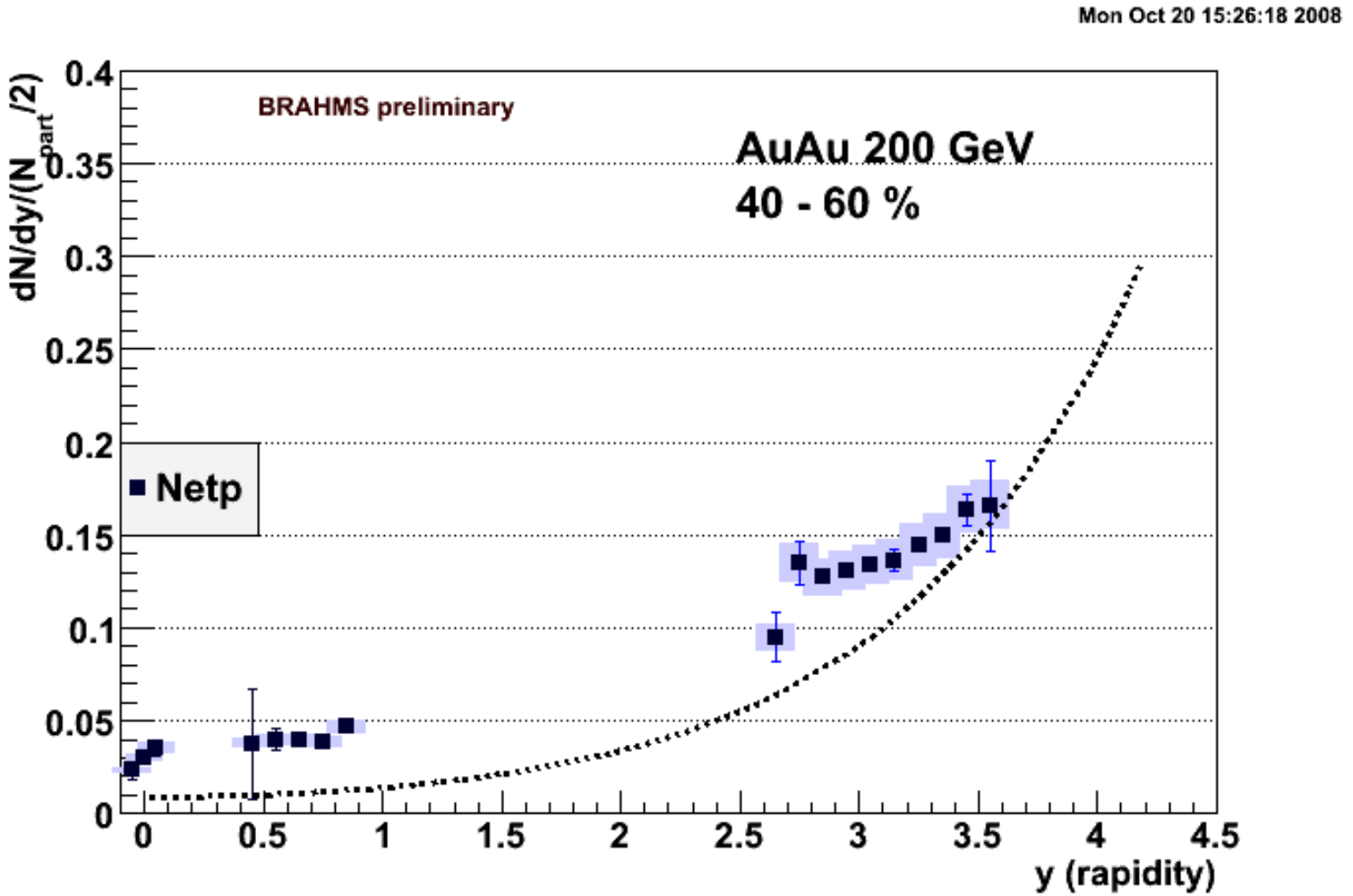
From central Au+Au to p+p



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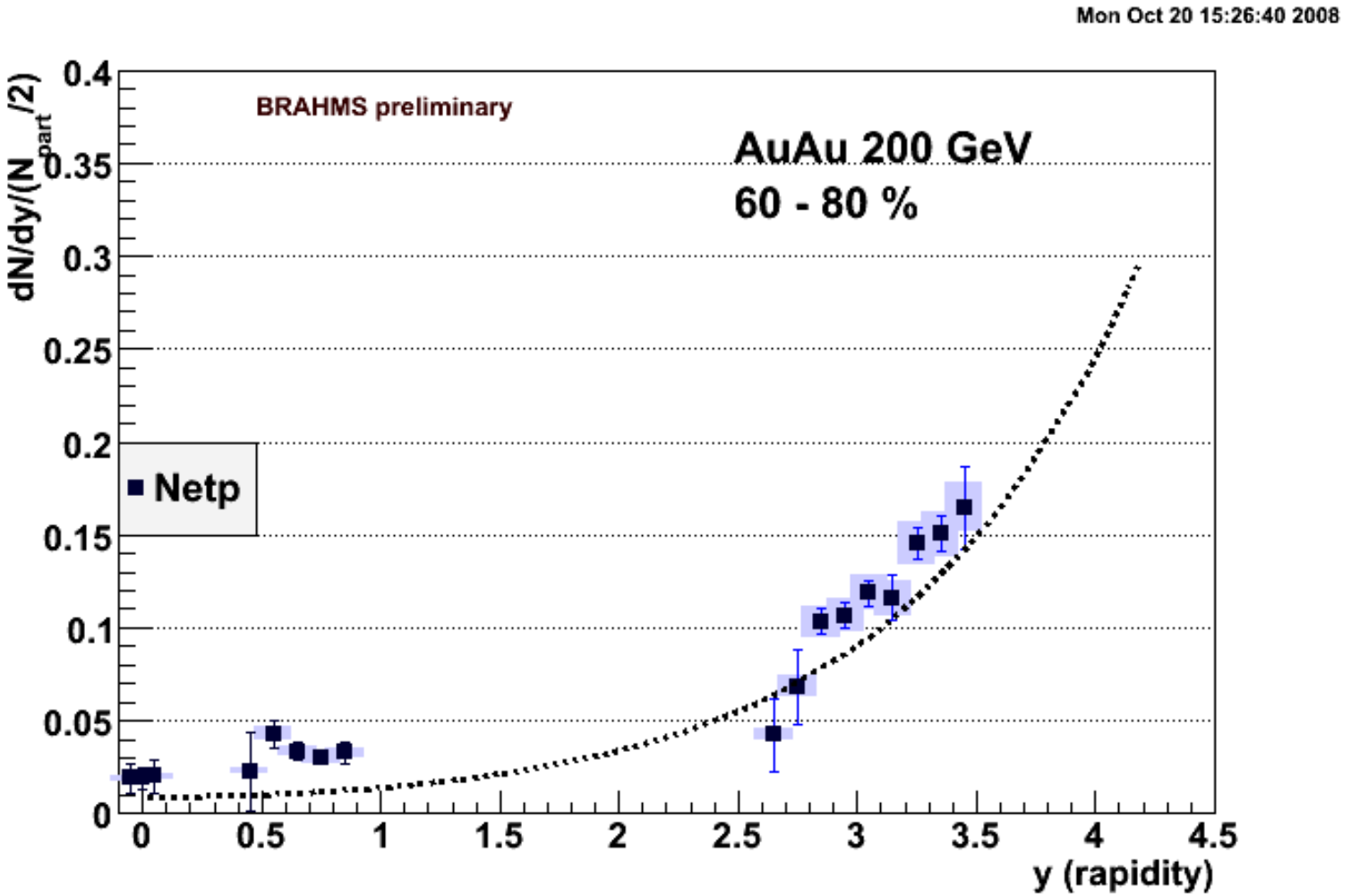
From central Au+Au to p+p



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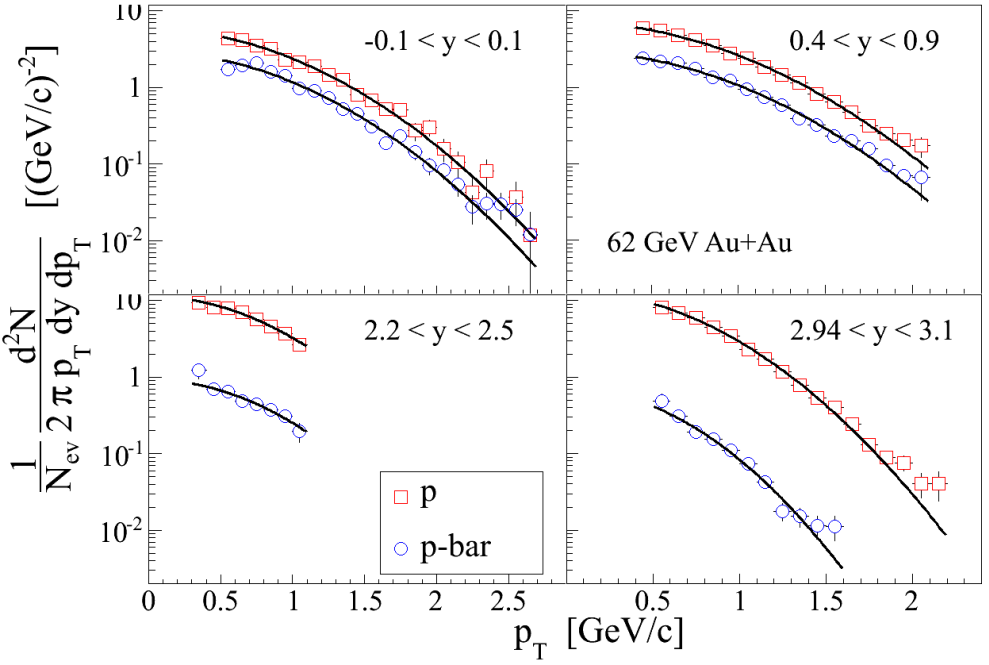
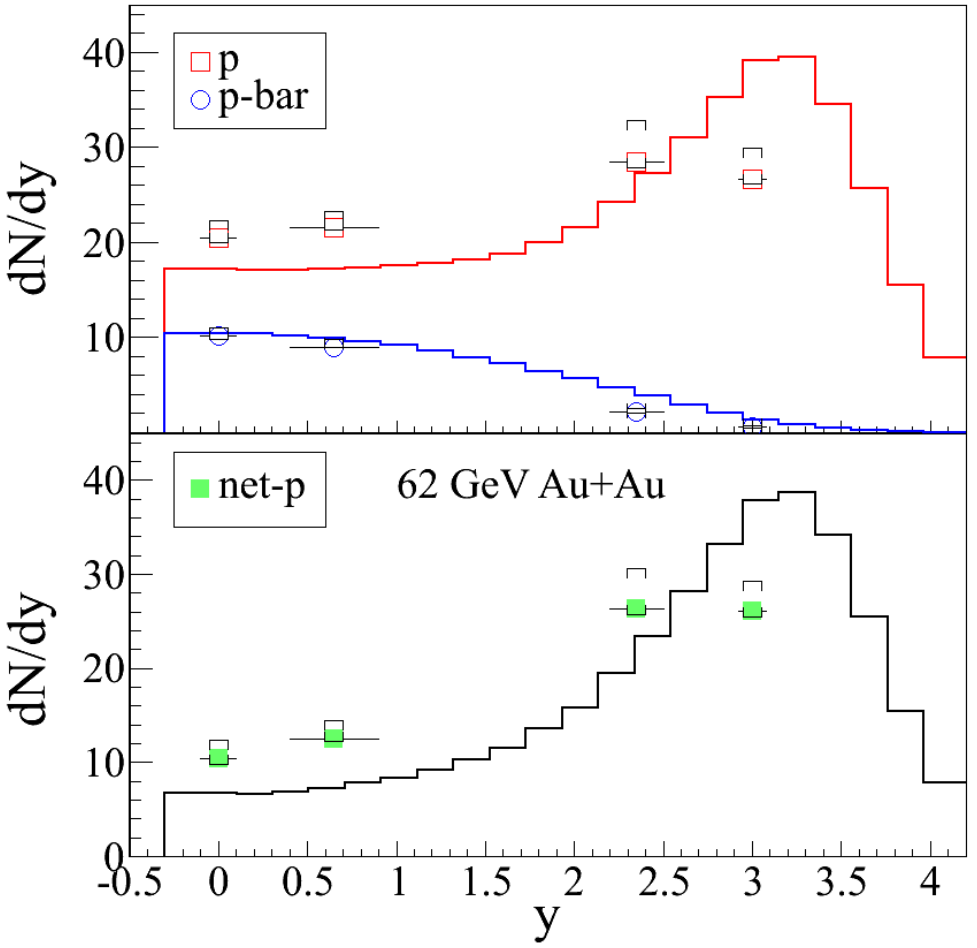
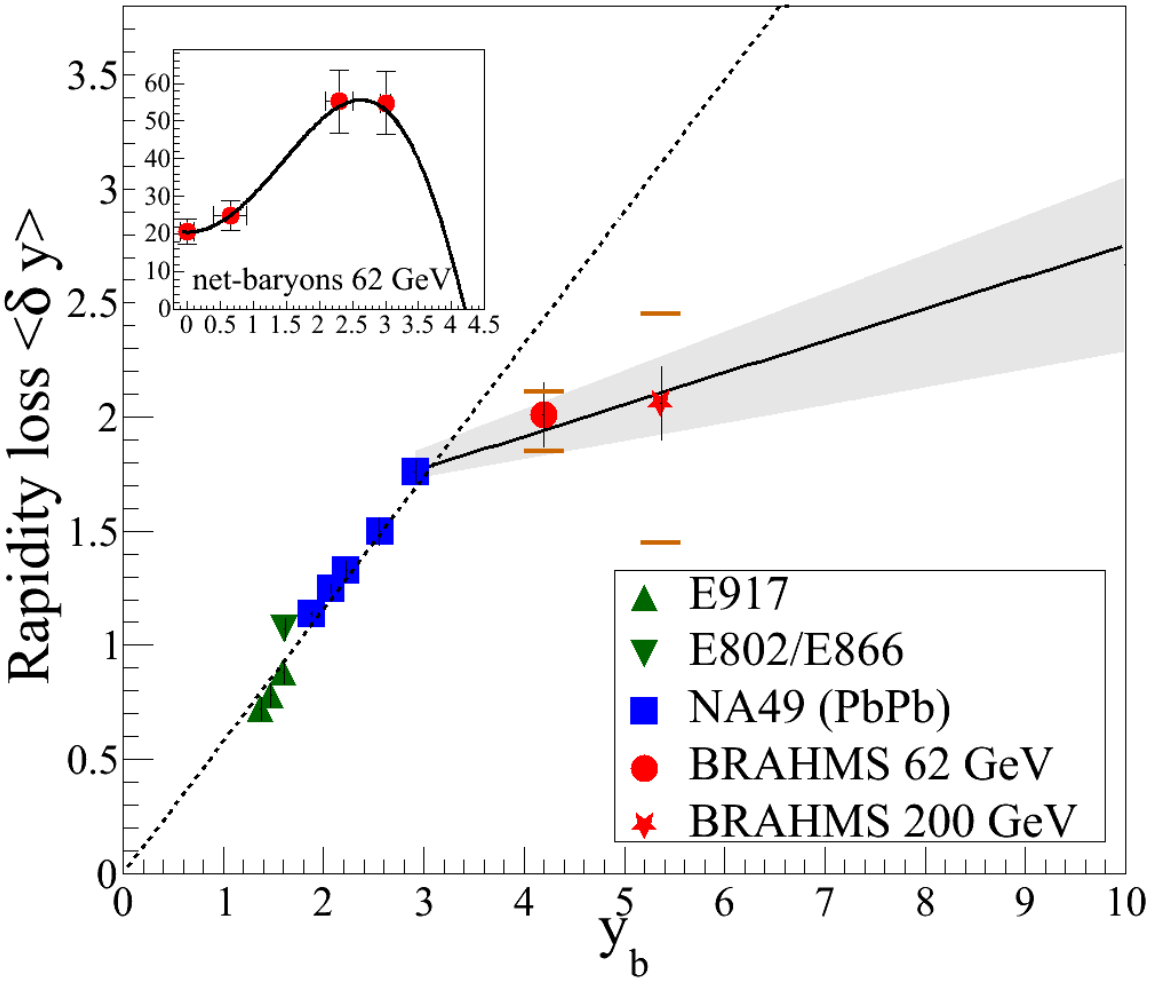
62.4 GeV Au+Au analysis





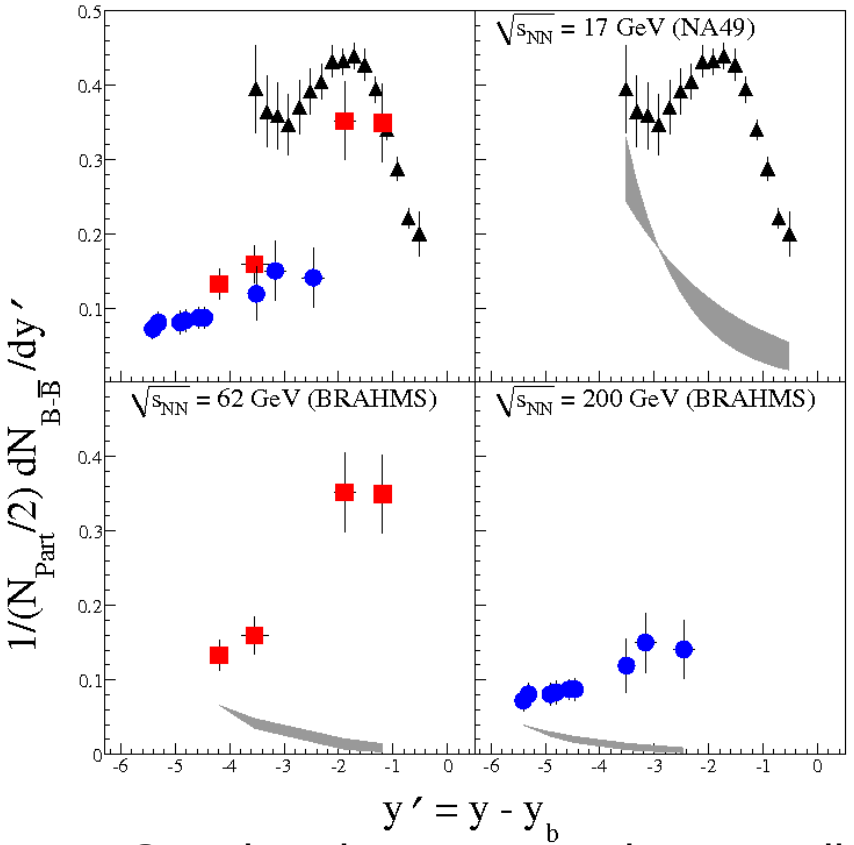
- Results submitted to PLB: *arXiv:0901.0872v1 [nucl-ex]*.
- Comparison to HIJING/BB(v2.1).
- HIJING shows more transparency and does not reproduce the 62.4 GeV data.

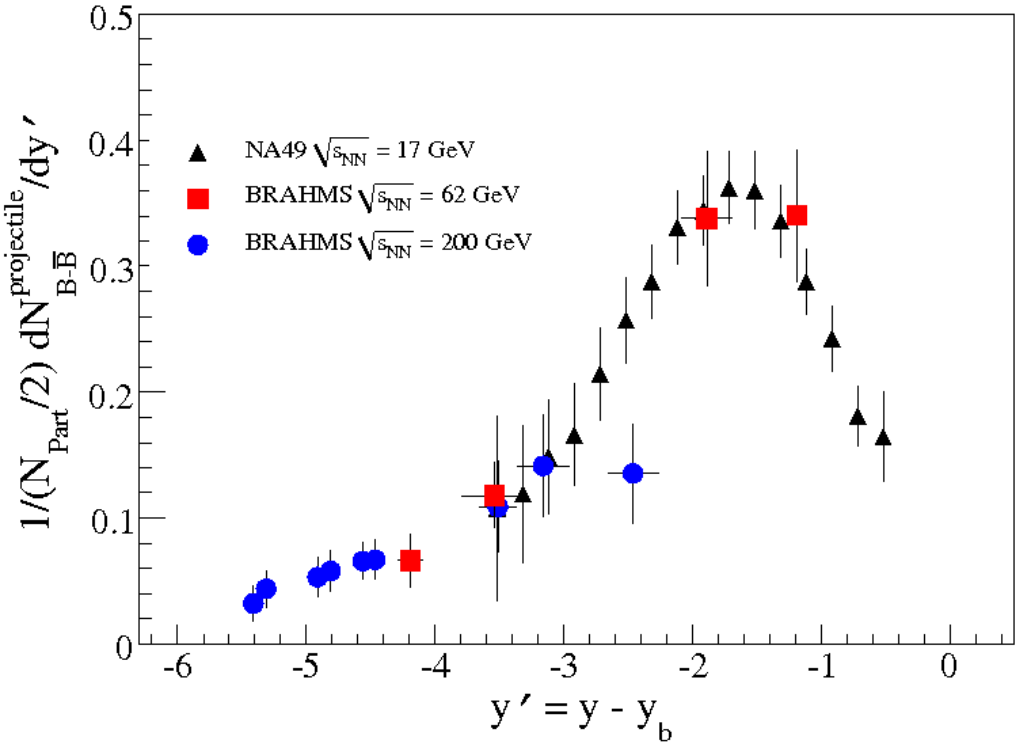
Rapidity losses



- Linear scaling as proposed by Videbaek and Hansen (Phys. Rev.C 52 (1995) 2684) broken already at 62 GeV.
- 'Saturation' behaviour from SPS energies.
- Simple linear extrapolation to LHC beam rapidity (Pb+Pb), y=8.67 gives $2.4 < \delta y_{LHC} < 2.8$.

Limiting fragmentation





- Grey bands are 'target' baryons distributions taken from W. Busza, A.S. Goldhaber, Phys. Lett.B 139 (1984) 235 and B. Z. Kopeliovich and B. G. Zakharov, Z. Phys.C 43, (1989) 241.
- Limiting fragmentation behaviour suggests universal scaling of projectile baryons from SPS to RHIC energies.

Conclusions

- Scaling in p+p collisions as expected from dσ/dx behaviour.
- Peripheral Au+Au collisions exhibit same scaling.
- 200 Gev Au+Au spectra show softening at forward rapidities.
- No significant changes with centrality.
- 62 GeV Au+Au data bridge the gap between SPS and RHIC and show that the linear model breaks down already at y ~ 4.2.
- Limiting fragmentation from SPS to RHIC suggests universal scaling of projectile baryons.

The BRAHMS collaboration

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