Recent Results from the BRAHMS Collaboration - Deuteron Coalescence and Nuclear Stopping

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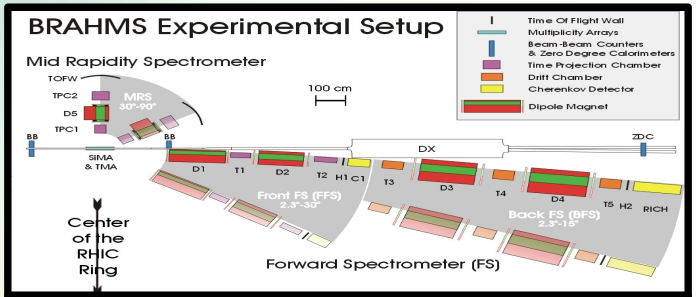
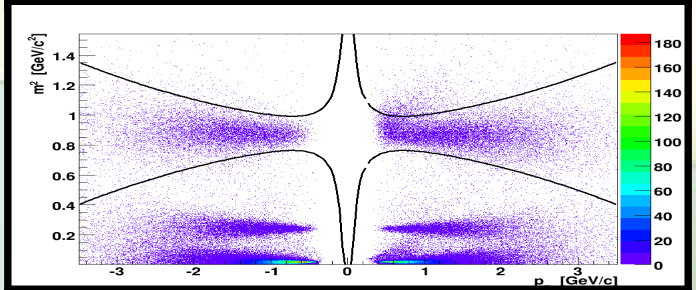
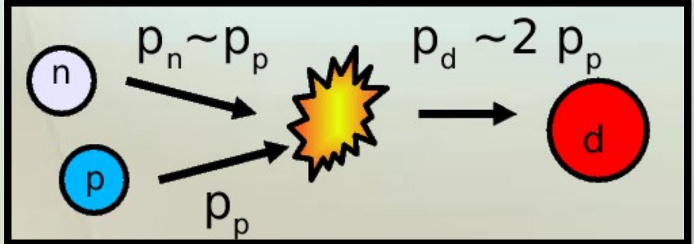
BRAHMS Collaboration

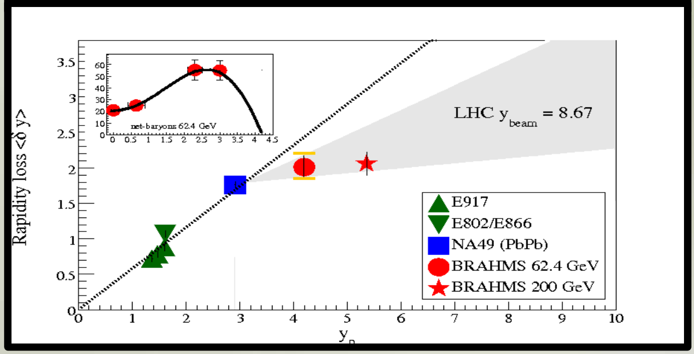
Outline

- The Brahms Experiment ....
- Analysis....................................
- Coalescence Results................
- Nuclear Stopping Results.........

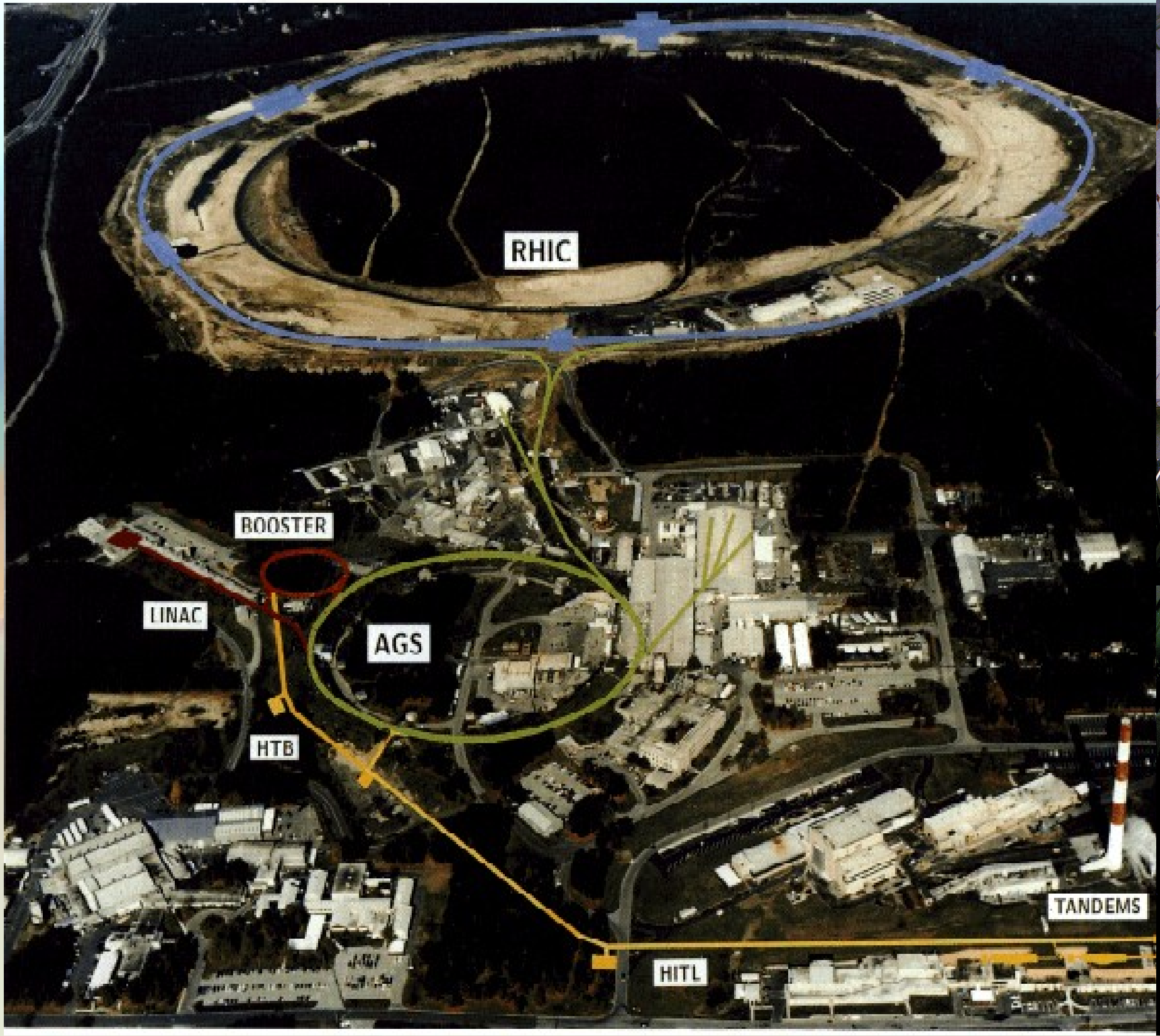


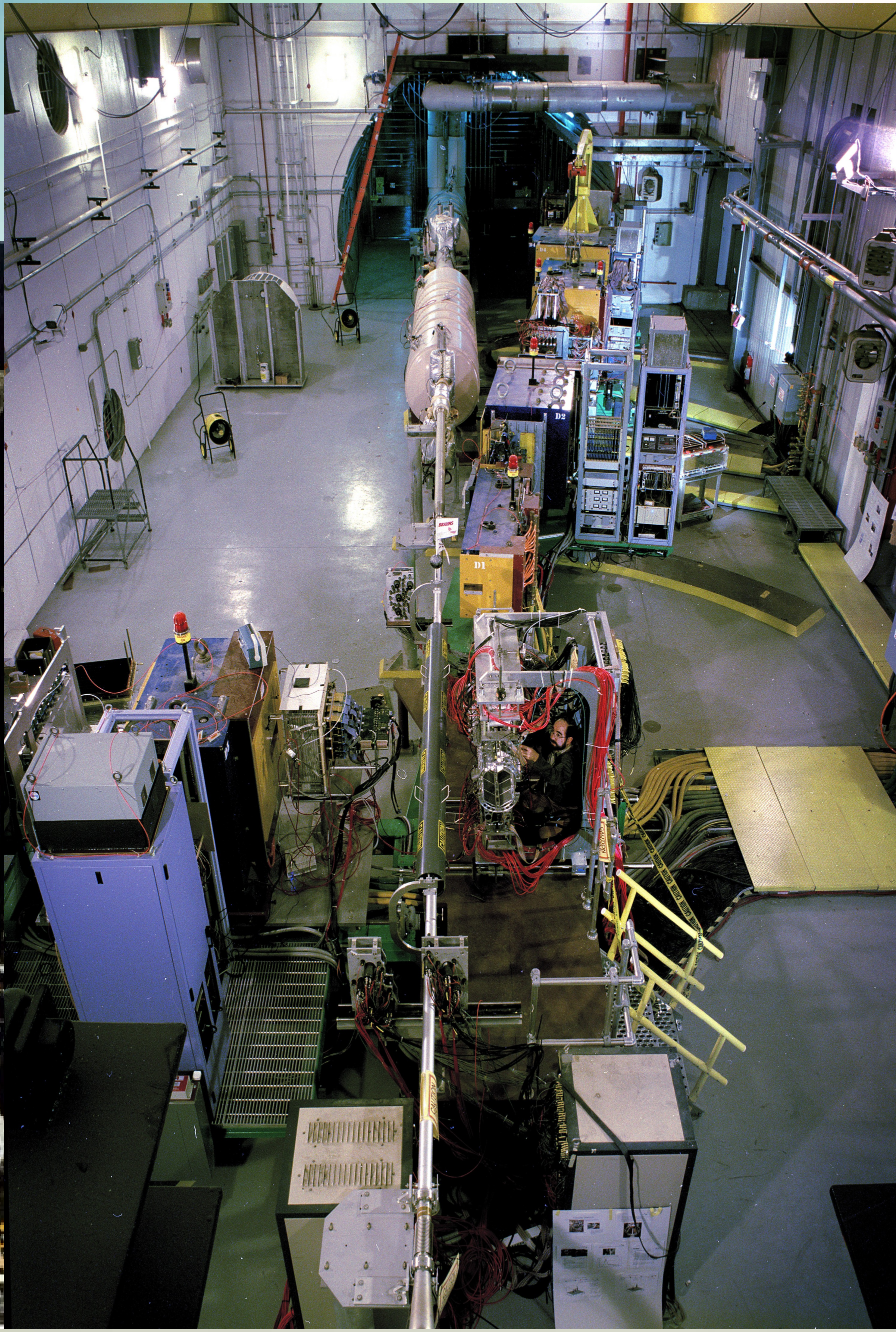




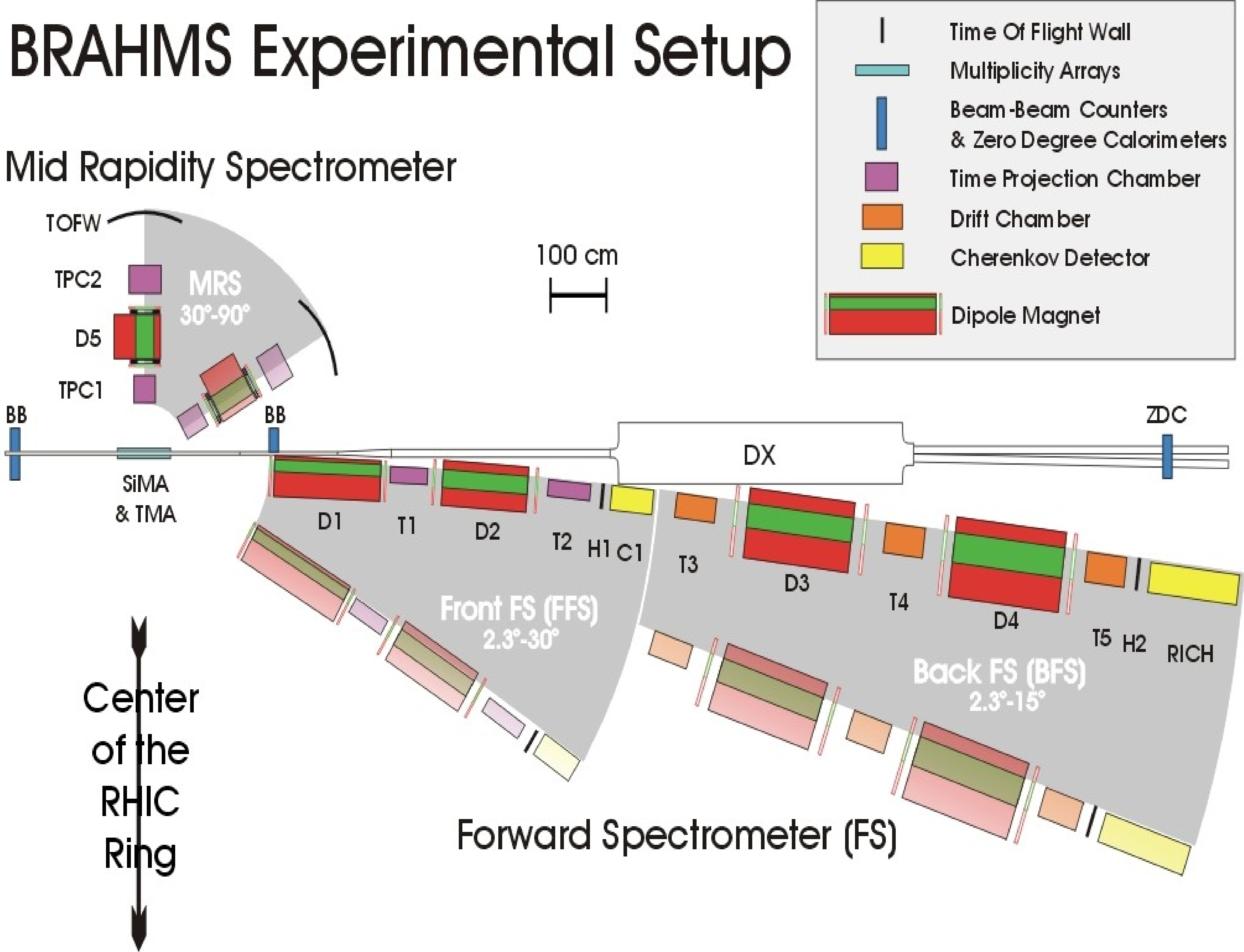


BRAHMS @ RHIC

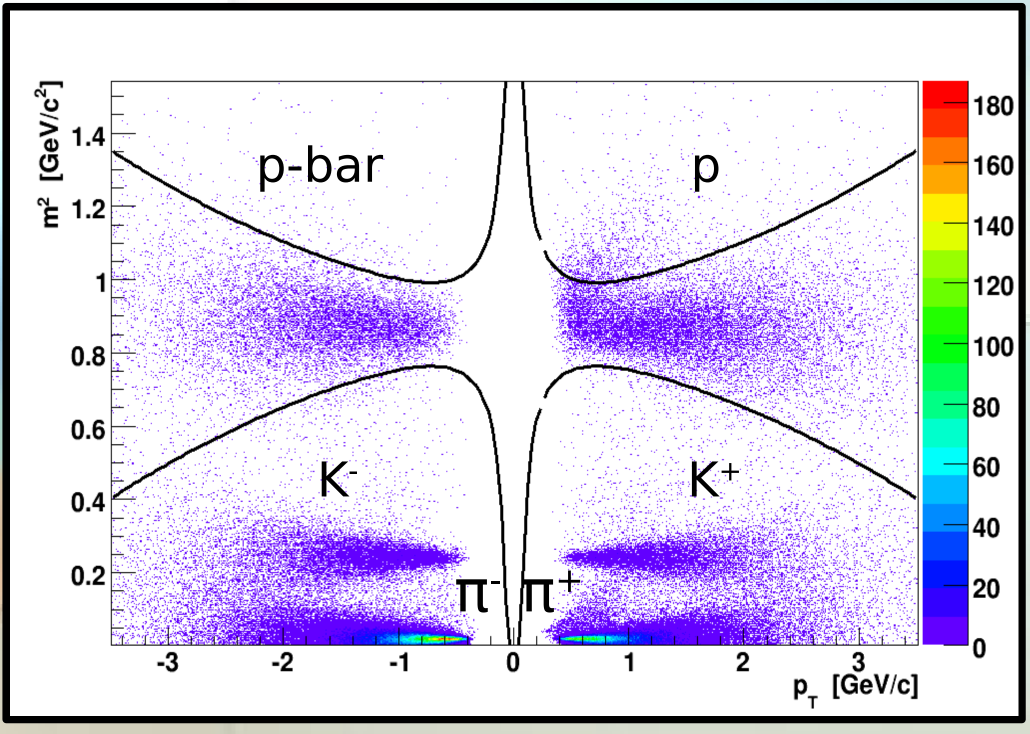




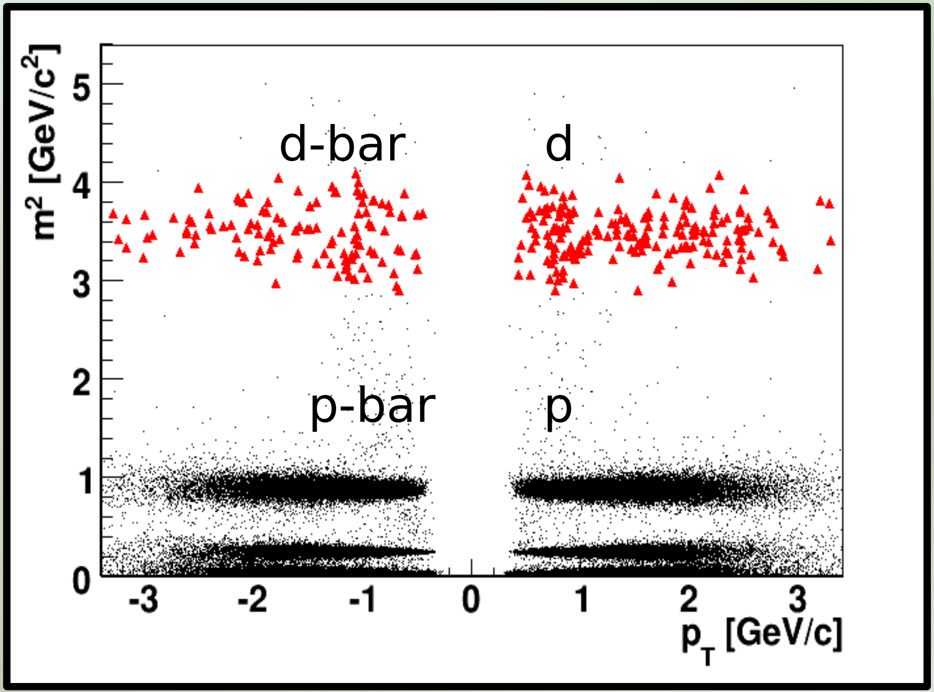
BRAHMS Experimental Setup



TOF PID



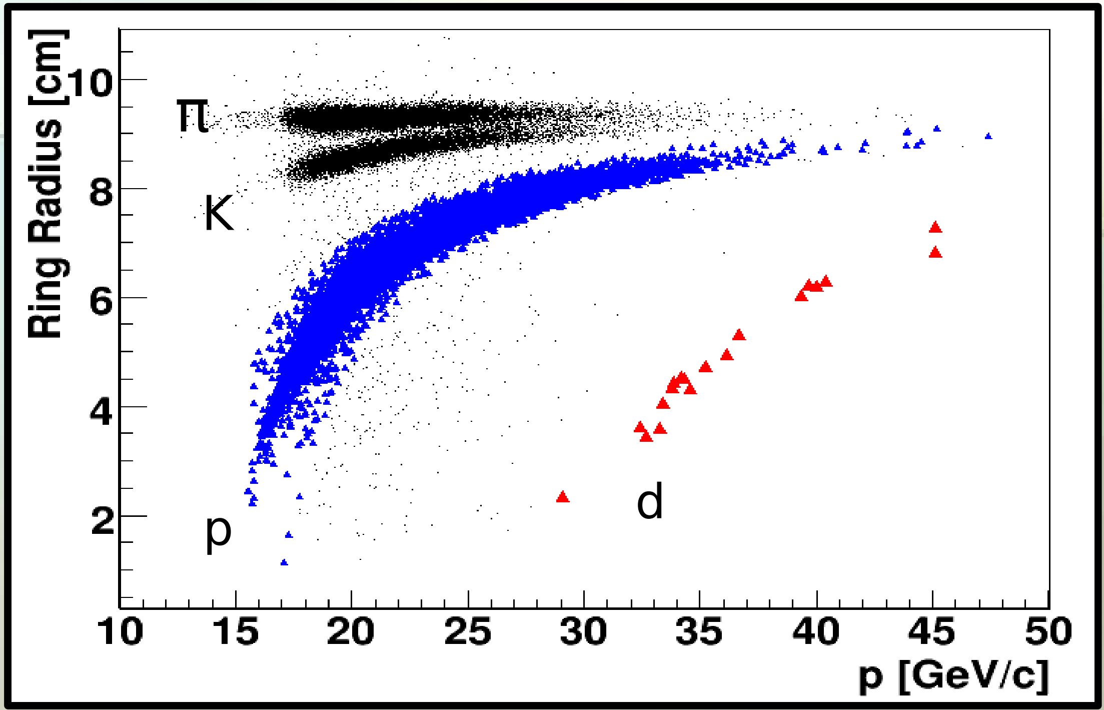
- Proton PID done by fitting the m^2 vs. p_T distribution.
- Deuteron PID done by a gaussian fit in the m^2 distribution.



- TOF PID used in the MRS and at y~2.

RICH PID

- Proton PID
  - Direct: From p~15 GeV/c, the Cherenkov ring radius is used
  - Indirect: 12>p>17 GeV/c
- Deuteron PID
  - Direct: From p~30 GeV/c
- Used for PID at y~3.



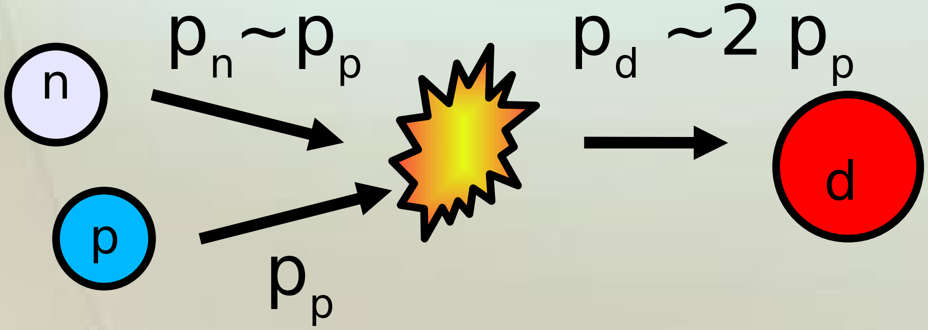
Spectra

- The invariant spectra have been corrected for:
  - Acceptance
  - Tracking efficiency
  - Multiple scattering, absorption and weak decay for (anti)-protons by GEANT
  - GEANT does not handle anti-deuterons, and does not handle hadronic interactions for deuterons.
  - Deuteron correction approximated to: $\mathrm{Eff}(p_d)_{d/dbar}=\mathrm{Eff}(p_d)_{GEANT(d)}*(\mathrm{Eff}(p_d/2)_{GEANT:hadronic(p/pbar)})^2$

Coalescence

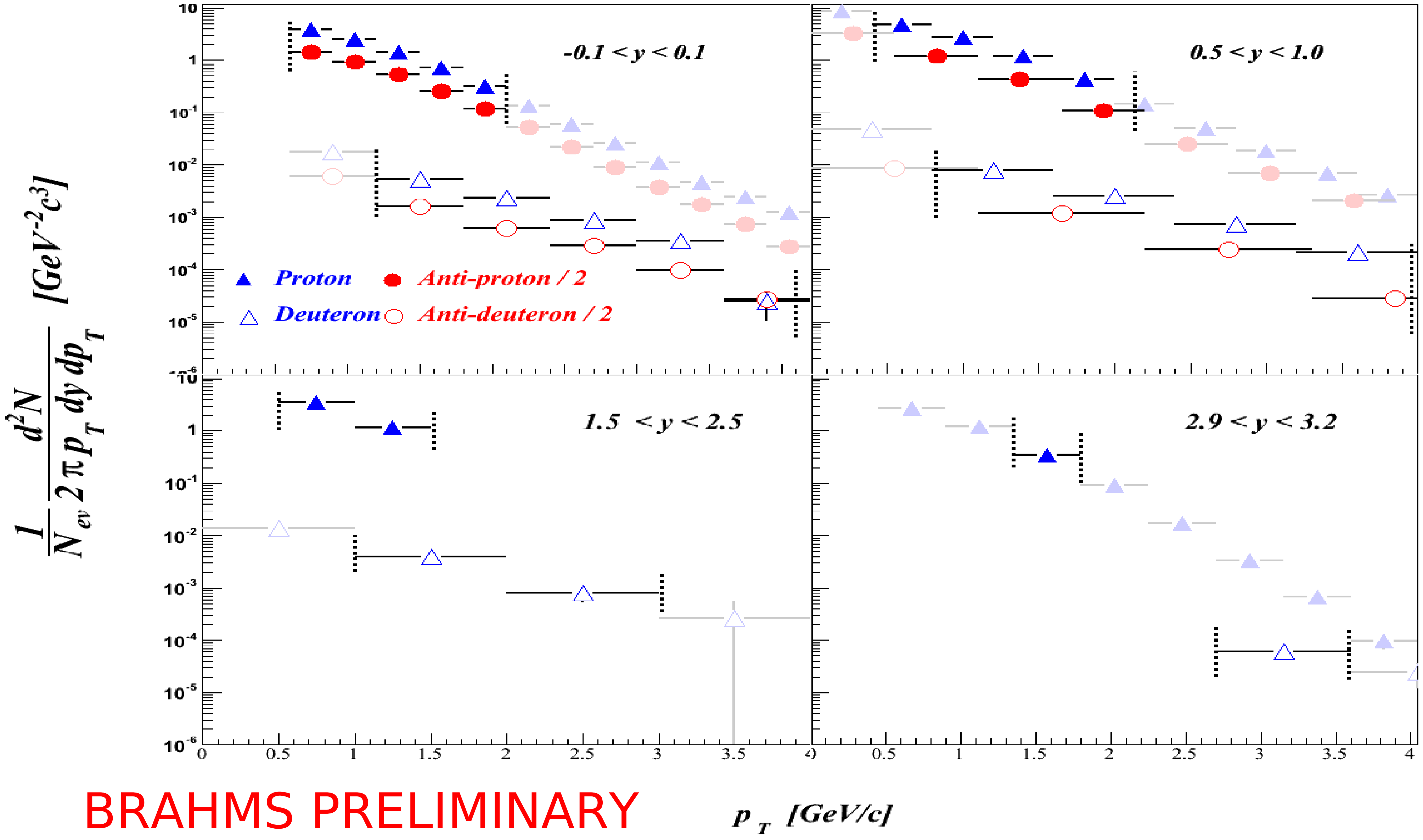
- Deuteron coalescence is the creation of a deuteron, from a proton and a neutron.
- Due to the very low binding energy of the deuteron (2.22 MeV) , Coalescence probes the collision at the timescale of the freeze-out.
- Coalescence parameter given by:

$$B_2 = \frac{E_d \cdot \left(\frac{d^3 N_d}{dp_d^3} \right)}{\left(\frac{E_p \cdot d^3 N_p}{dp_p^3} \right)^2}$$



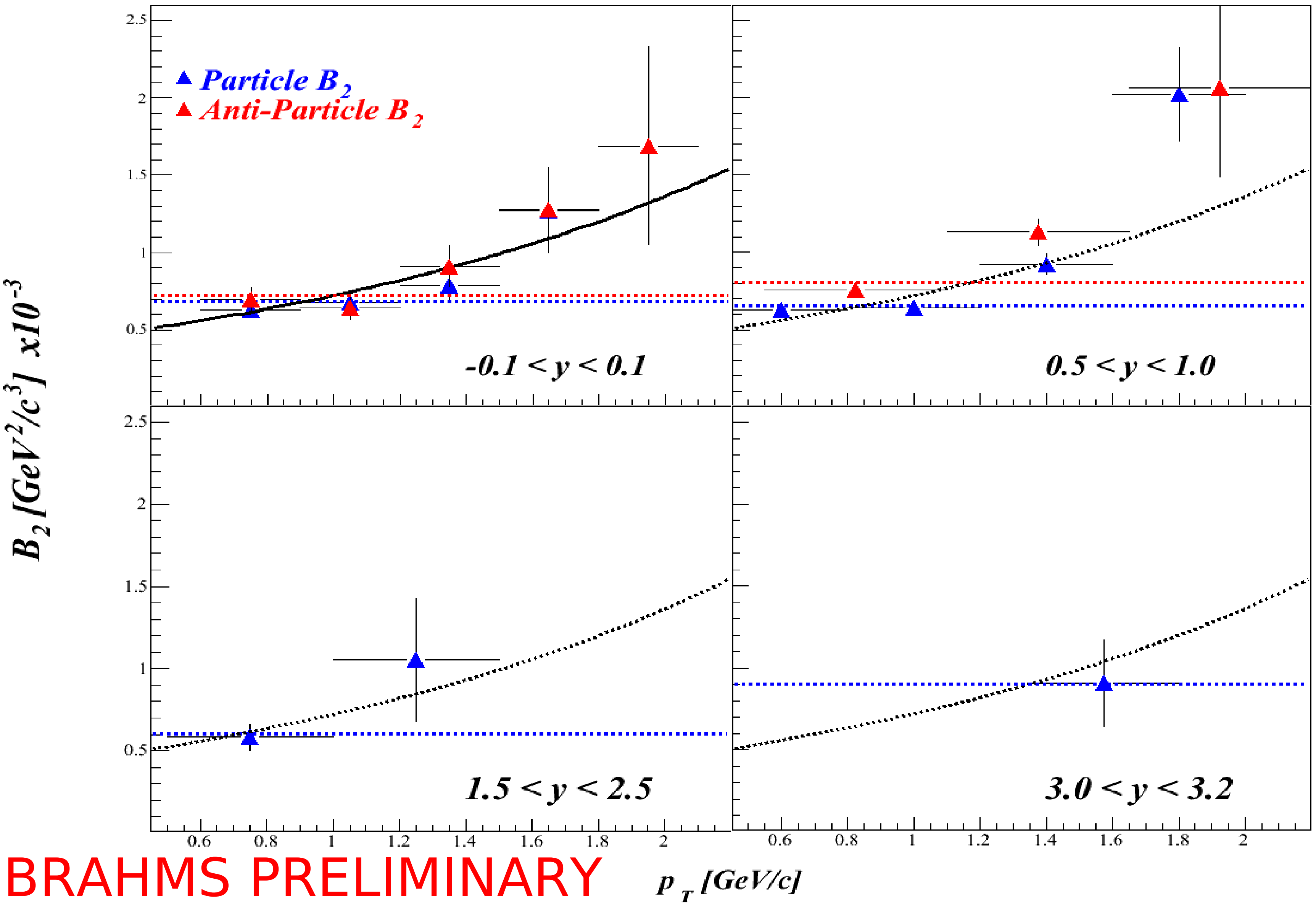
- B_2 is inversely proportional to the collision volume according to various models. [Pearson]

Spectra (0-20% central Au-Au@200GeV)



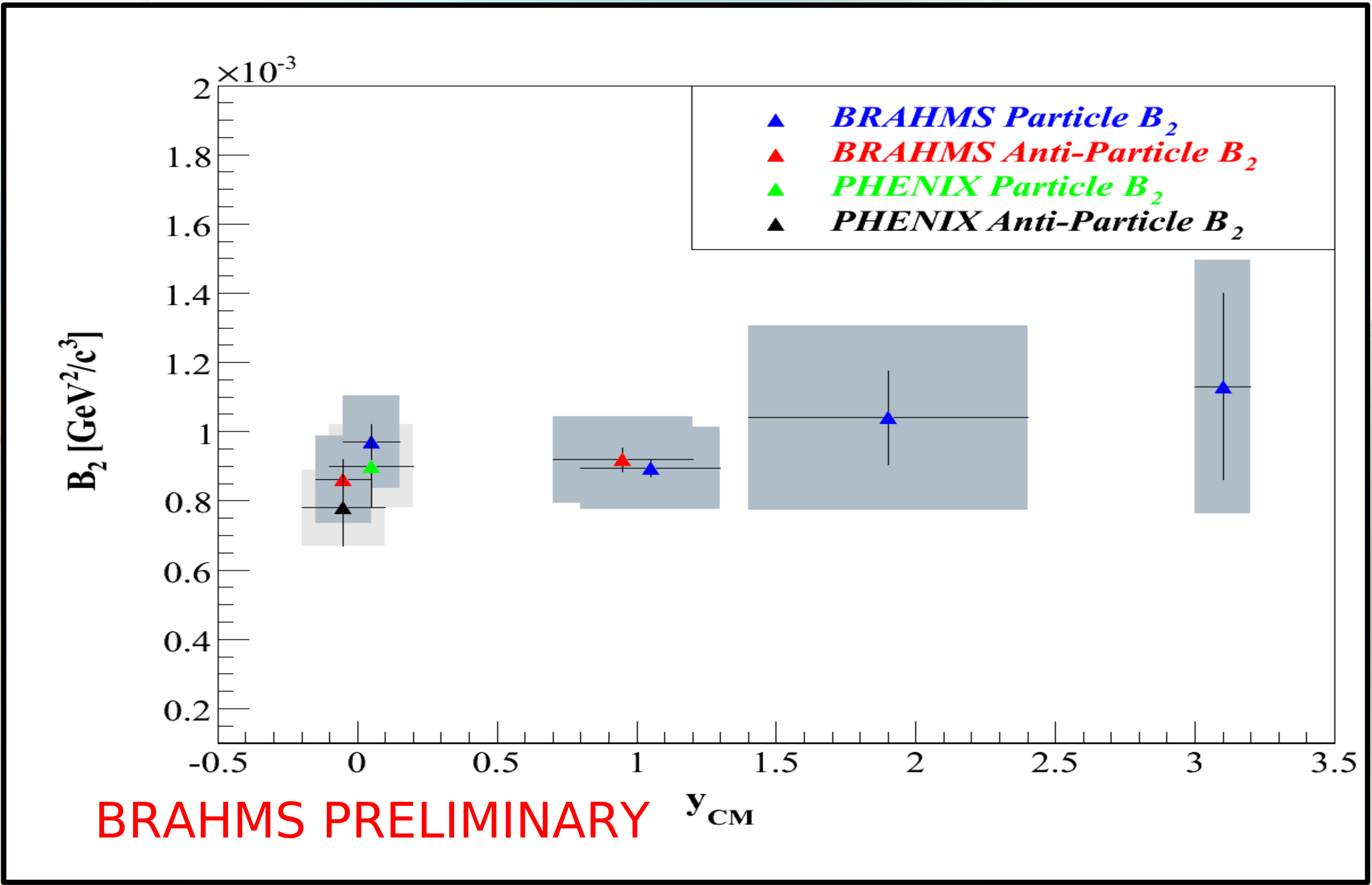
BRAHMS PRELIMINARY

B_2 vs. p_T



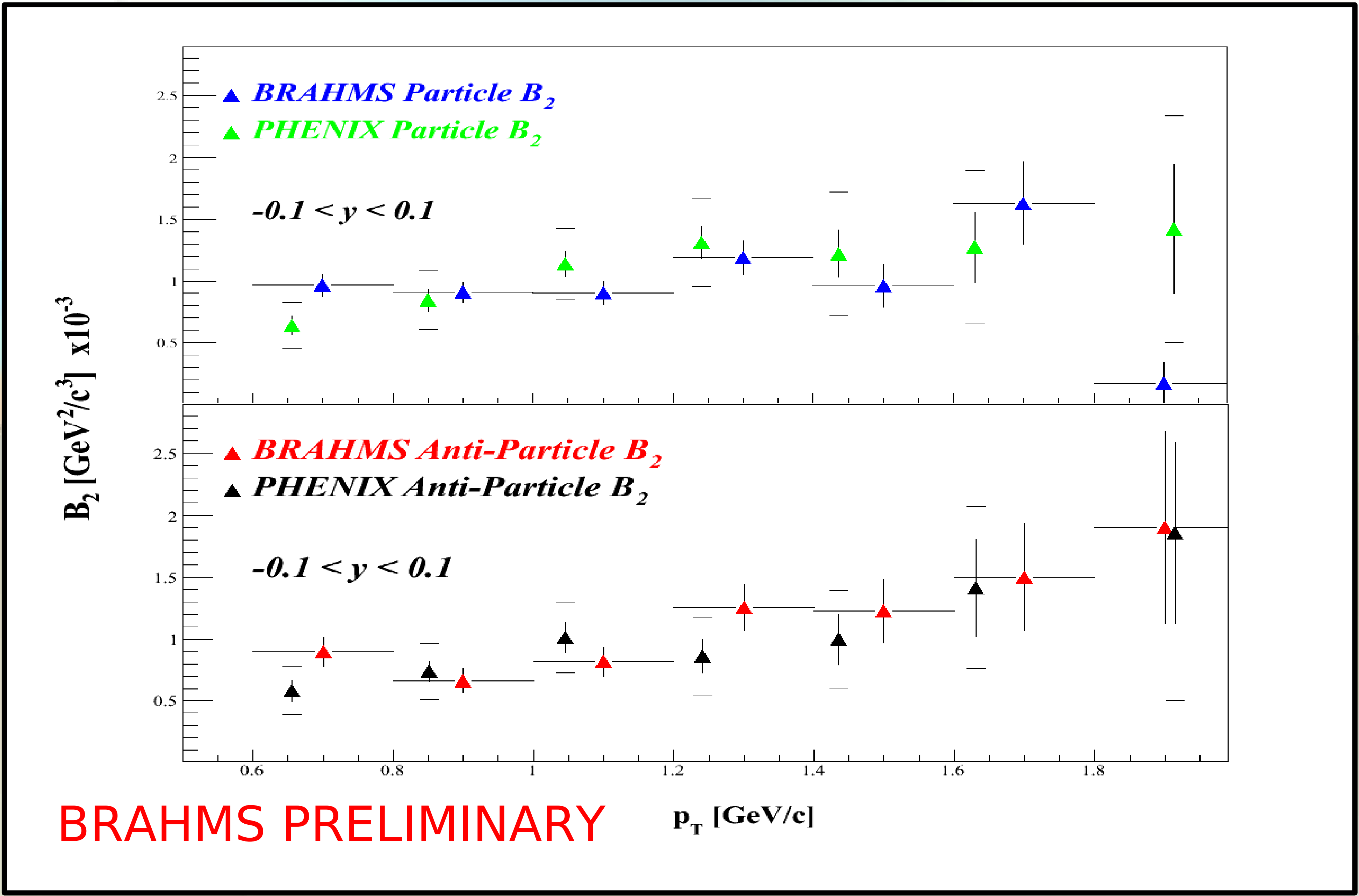
BRAHMS PRELIMINARY

B_2 vs. y

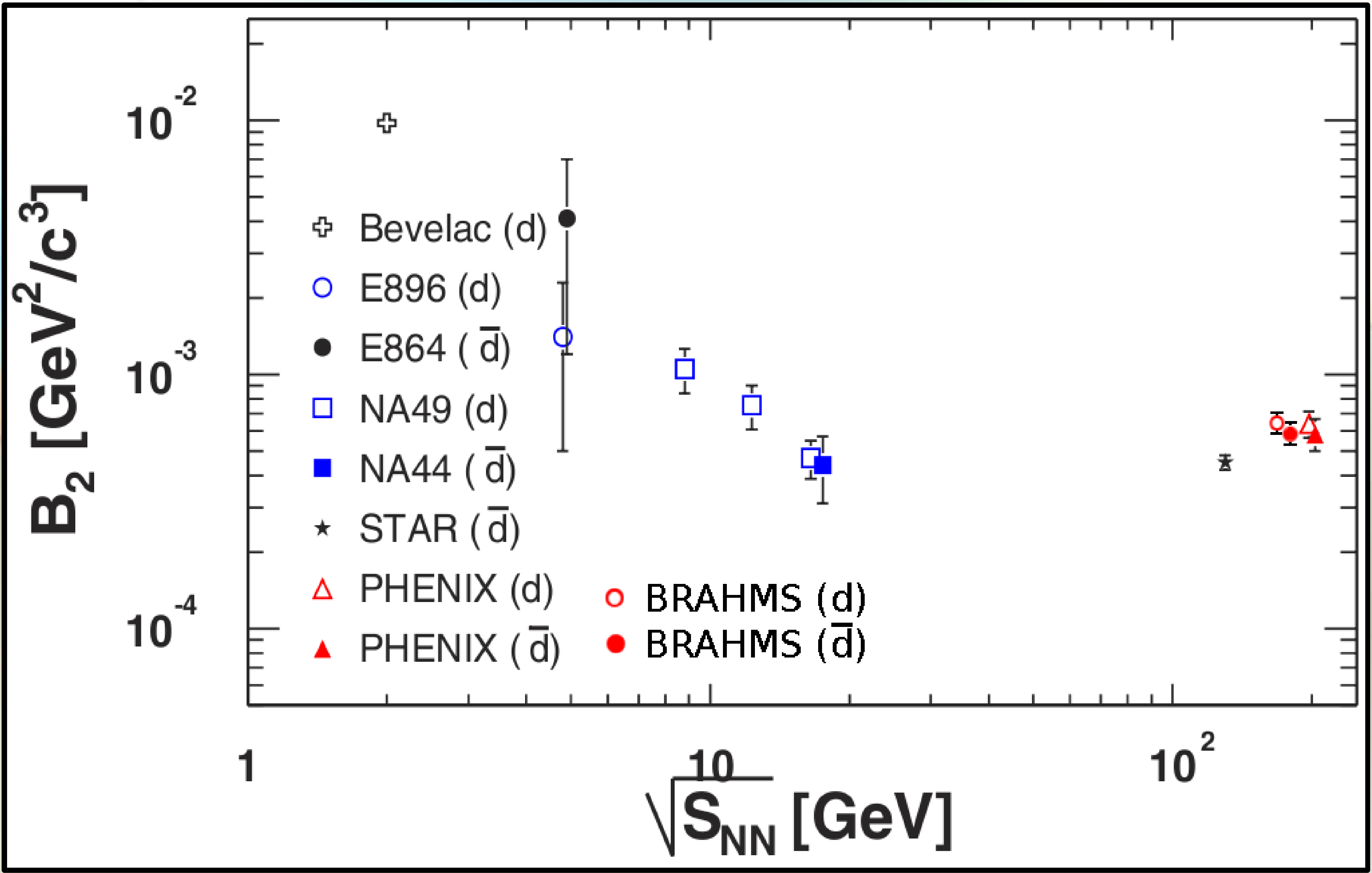


BRAHMS PRELIMINARY

B_2 comparison to PHENIX



Energy dependency

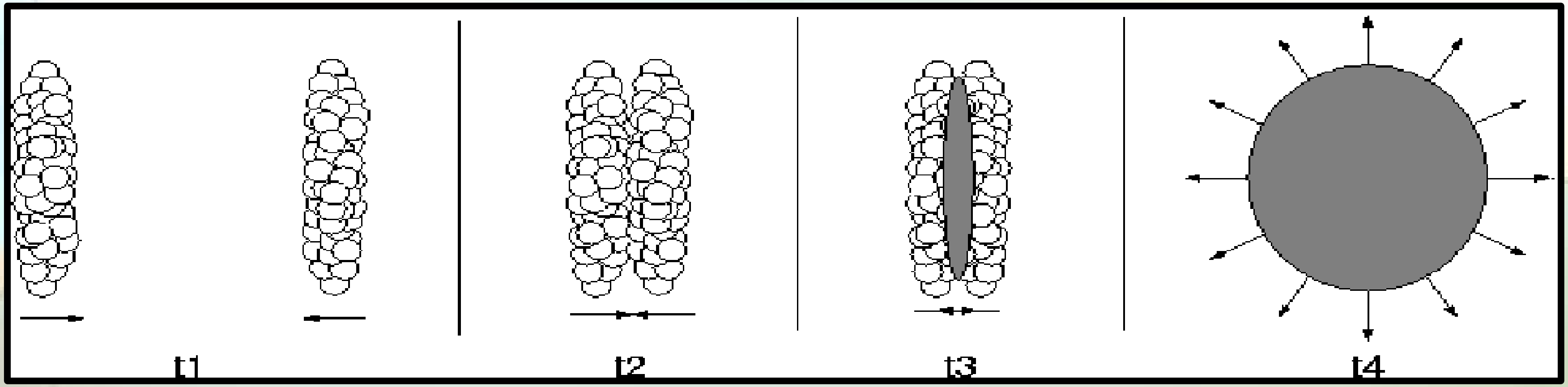


Coalescence Summary

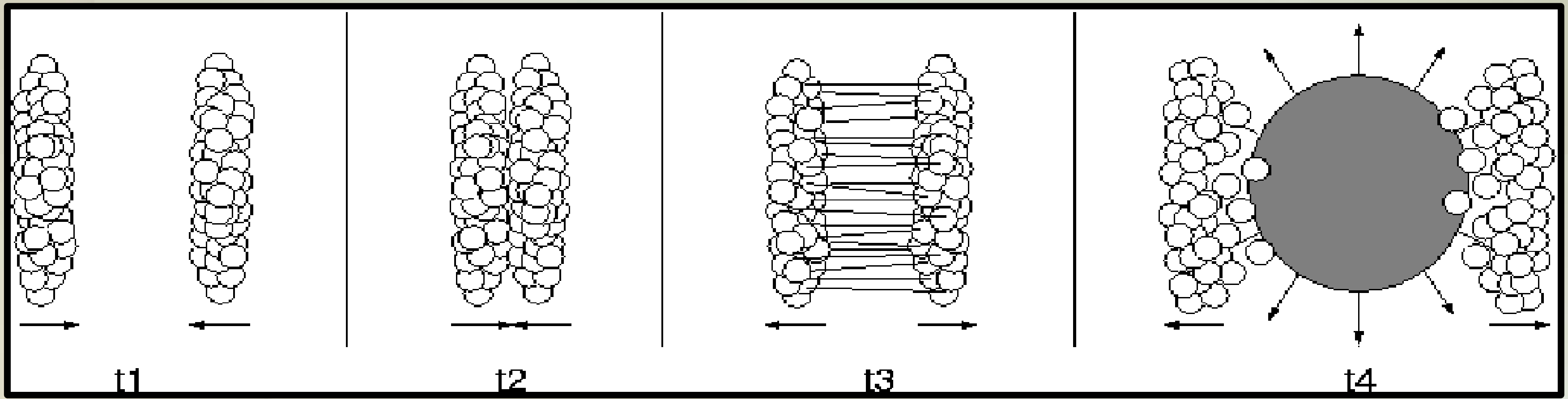
- B_2 increases as a function of p_T at y~0 and y~1.
- B_2 is constant within errors in the rapidity range y~[0; 3] , indicating that source sizes are comparable at these rapidities.
- The decrease of B_2 as a function of collision energy is not observed at post RHIC energies.
- These results are due to being submitted for publication early 2009

Nuclear stopping I

- Collision scenarios:
  - Landau: Full stopping. Many baryons at midrapidity.



  - Bjorken: Transparency. No baryons at midrapidity



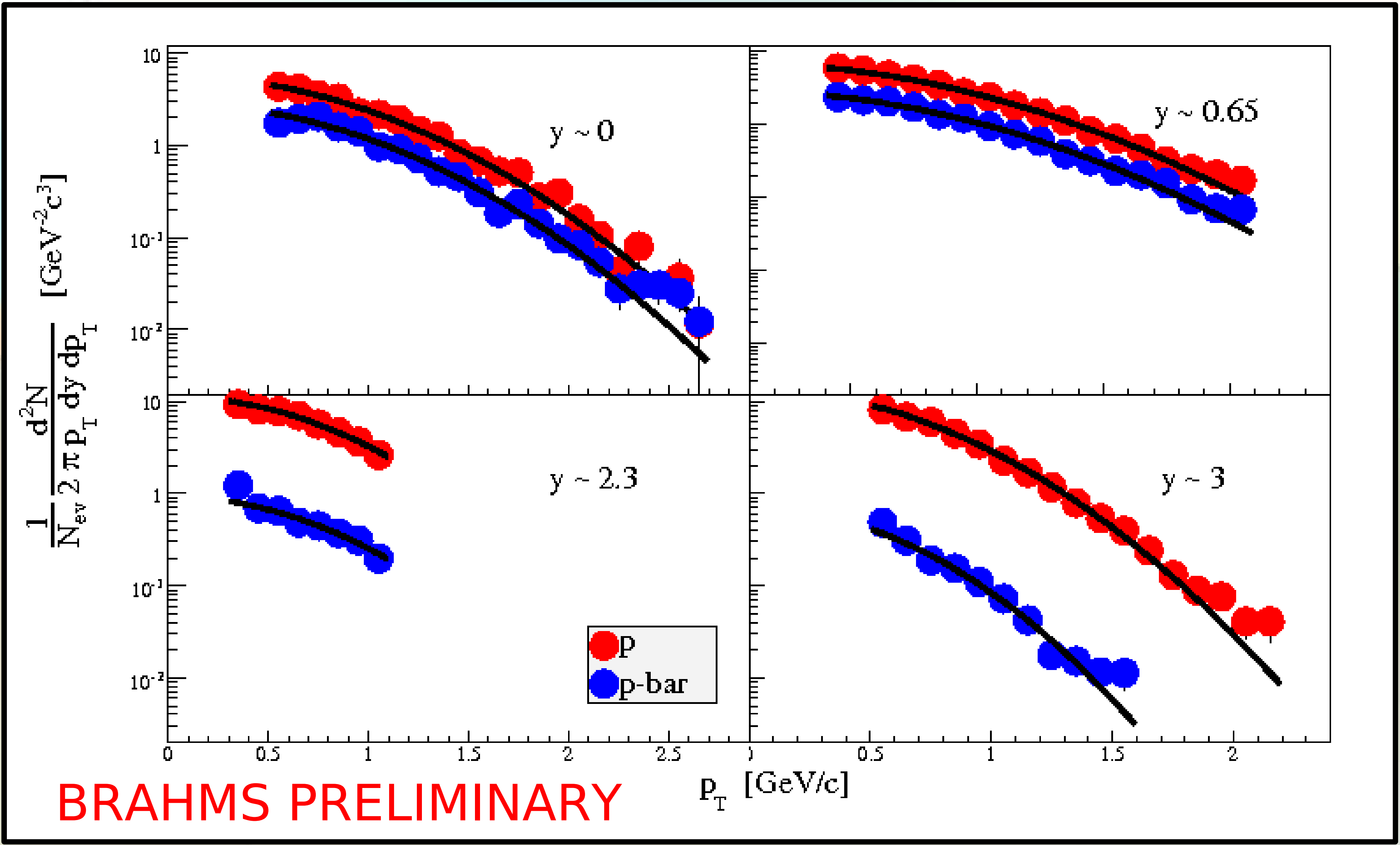
Nuclear Stopping II

- Quantify stopping by the rapidity loss:

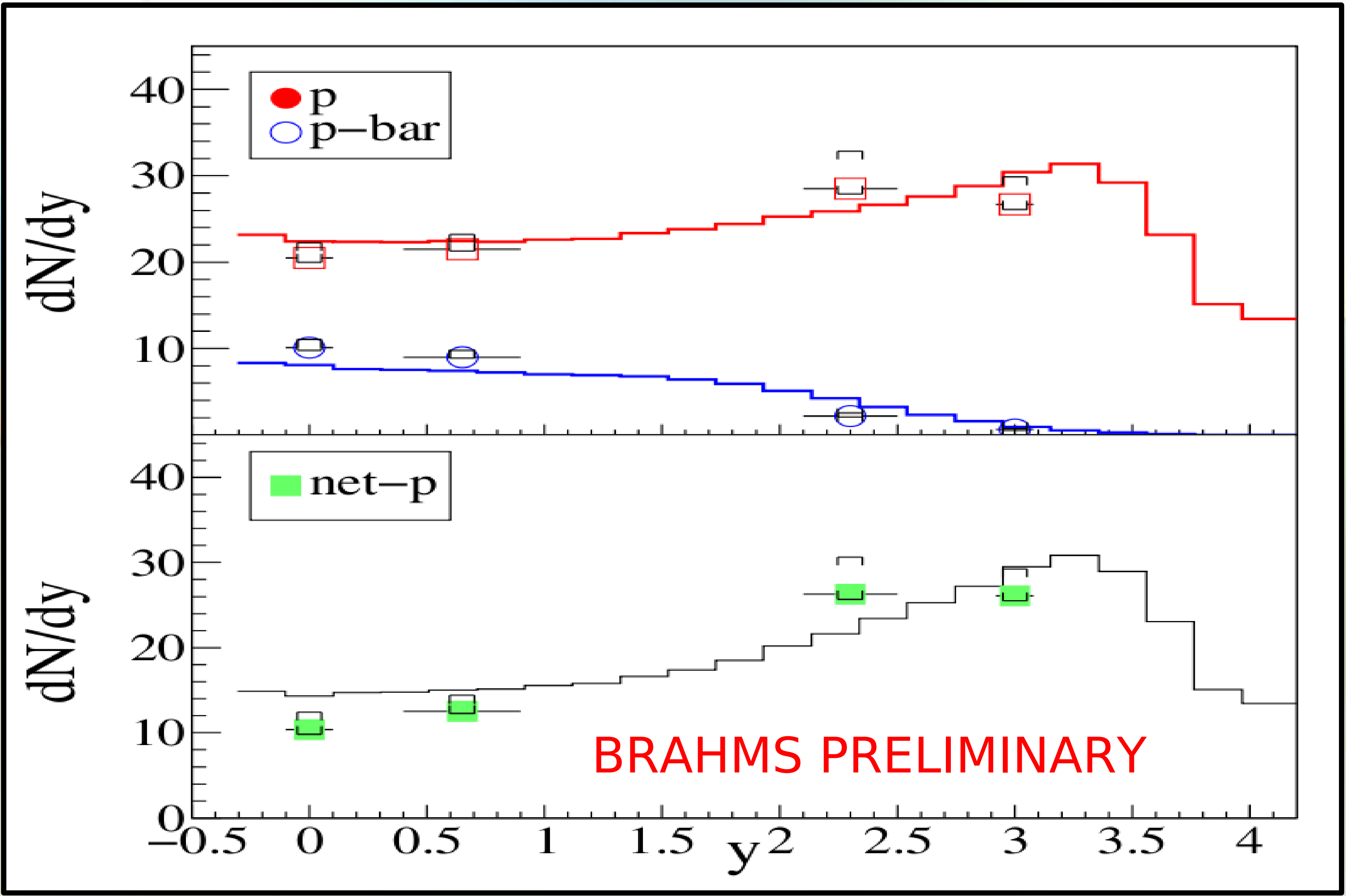
$$\delta y = y_{beam} - \langle y \rangle = y_{beam} - \frac{2}{N_{part}} \int_0^{y_{beam}} y \frac{dN_{net-baryons}}{dy} dy$$

- BRAHMS measures only charged hadrons, hence a conversion to baryons must be done.
- Baryon conservation is an important constraint.

Spectra (0-10% central Au-Au@62.4 GeV)

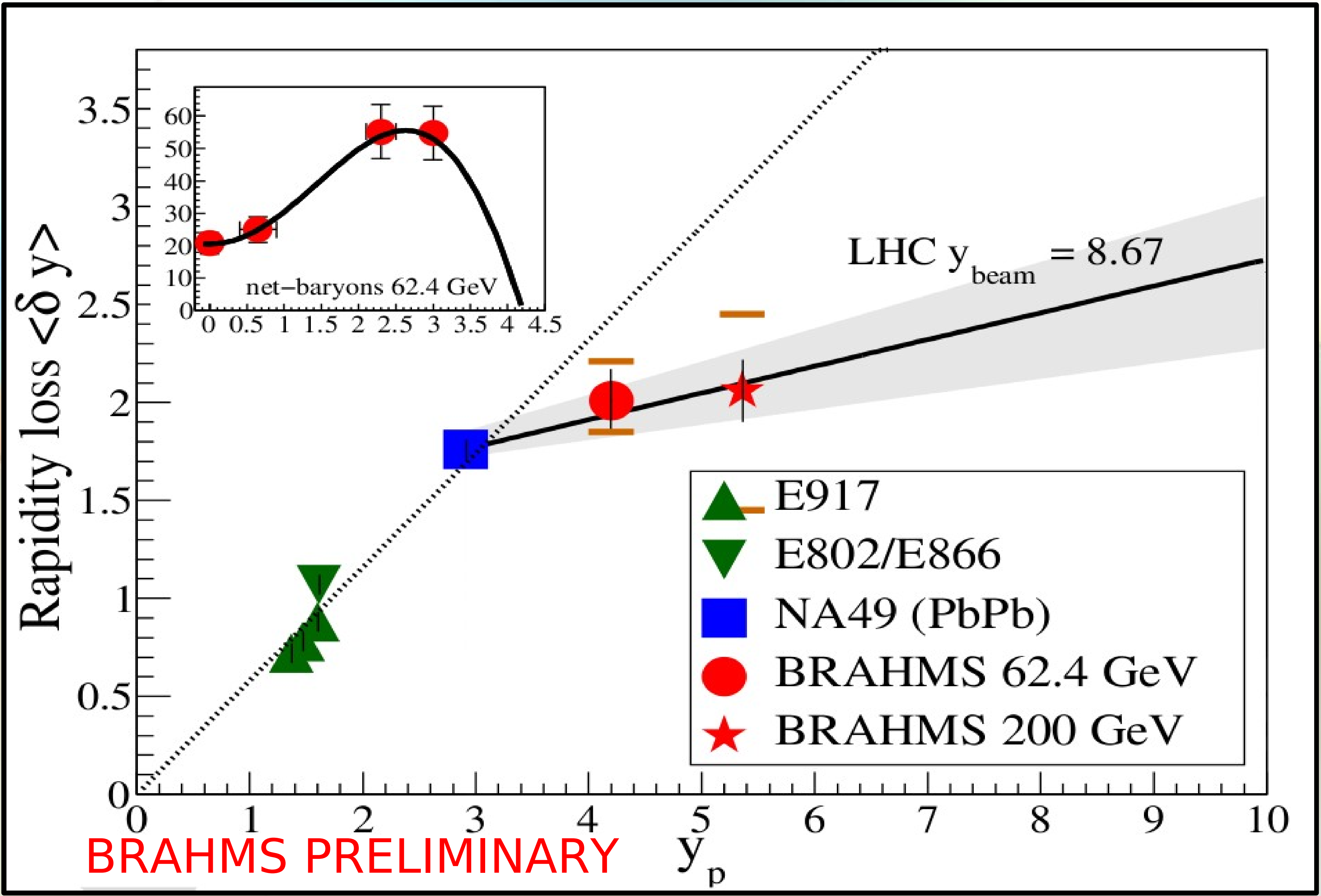


Yields - dN/dy

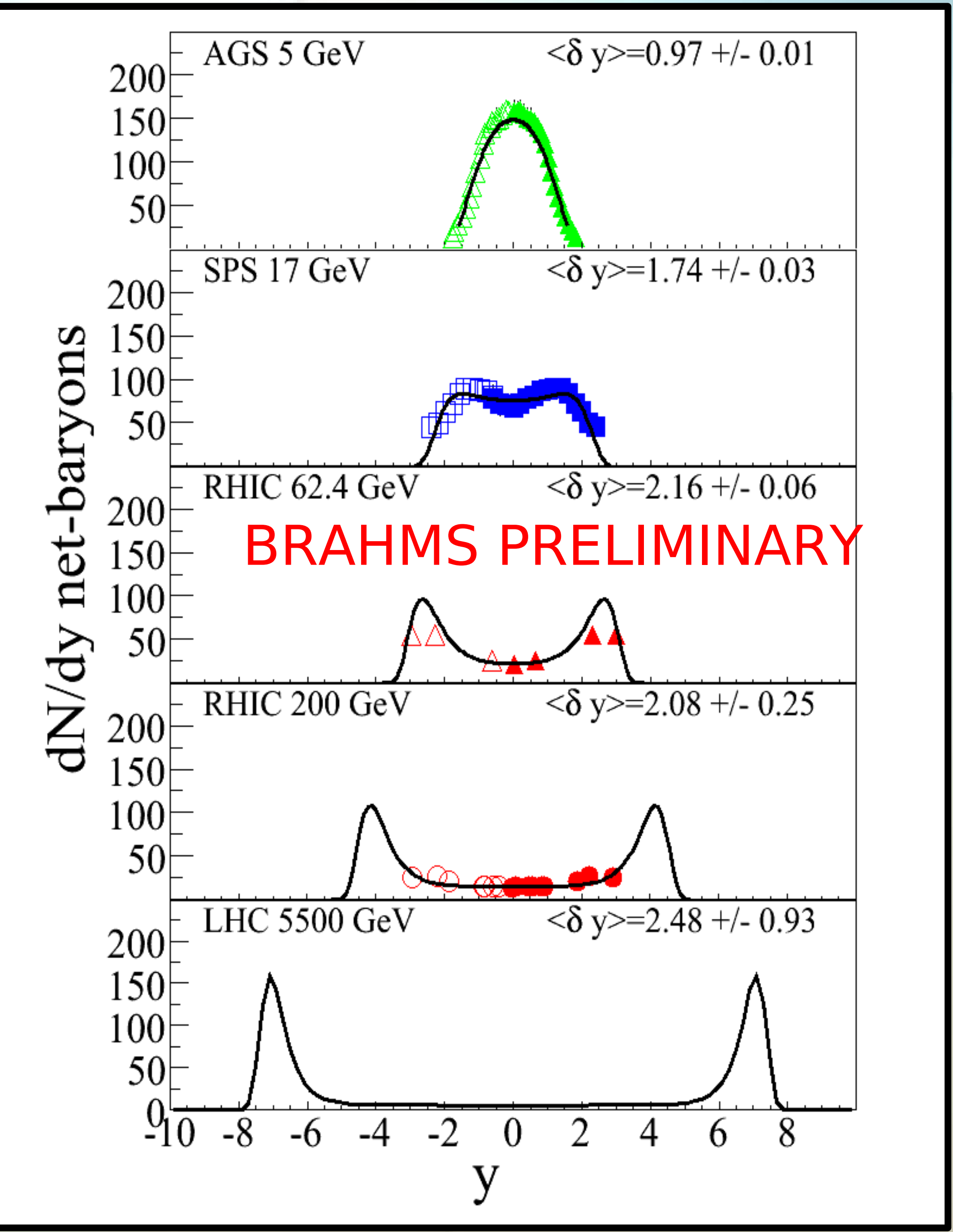


40
30
20
10
dN/dy
● p
○ p−bar
40
30
20
10
0
dN/dy
net−p
BRAHMS PRELIMINARY
−0.5
0
0.5
1
1.5
y
2
2.5
3
3.5
4

Rapidity loss



Net-baryons



- Fit: Bjorken inspired double gaussian in $p_z = m_T \sinh(y)$
- Baryon conversion factor:
  - $N_{net\text{-}B} \sim 2.5\ N_{net\text{-}p}$ at AGS, SPS
  - $N_{net\text{-}B} \sim 2.1\ N_{net\text{-}p}$ at RHIC, LHC
- Extrapolation to LHC done using simple straight line fits to μ,σ .

Nuclear Stopping Summary

- Stopping systematics might be used to predict LHC results or at least set limits.
- The linear scaling of rapidity loss is broken already at 62.4 Gev.
- This analysis is being submitted for publication before christmas 2008.

BRAHMS Collaboration

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