

$\bar{p}$ /p ratio of Au + Au @ 200 GeV

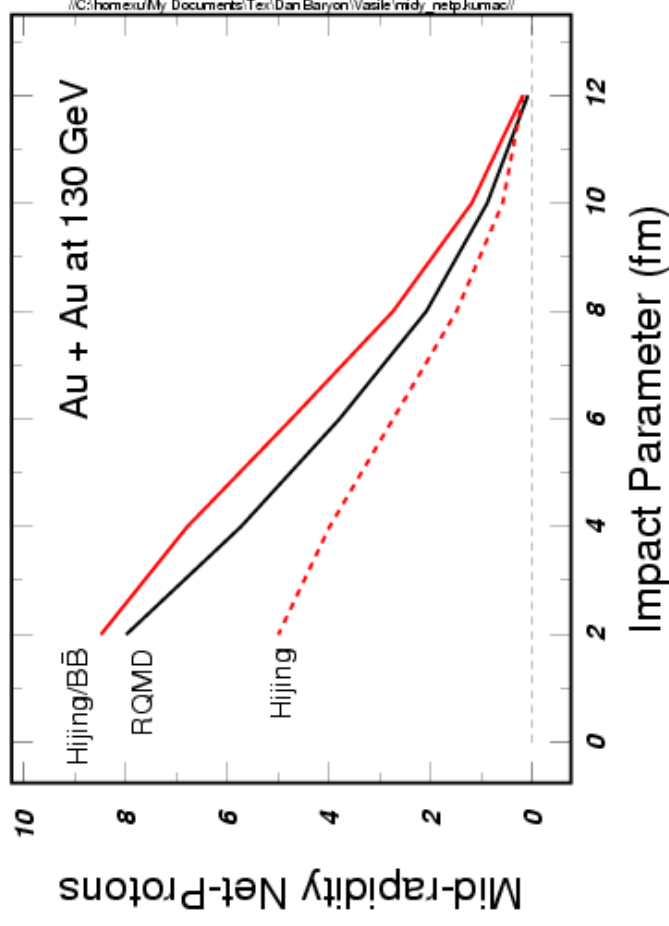
Jens Berger, Frankfurt University, STAR L3 Trigger Group
for the STAR Collaboration

- ❑ Motivation
- ❑ STAR Experiment @ RHIC
- ❑ Analysis
- ❑ $\bar{p}$ /p ratio (preliminary)
- ❑ Model comparisons
- ❑ Summary

This analysis was performed at LBL. Thanks to: RNC group, Hans Georg Ritter, Kai Schweda, Nu Xu

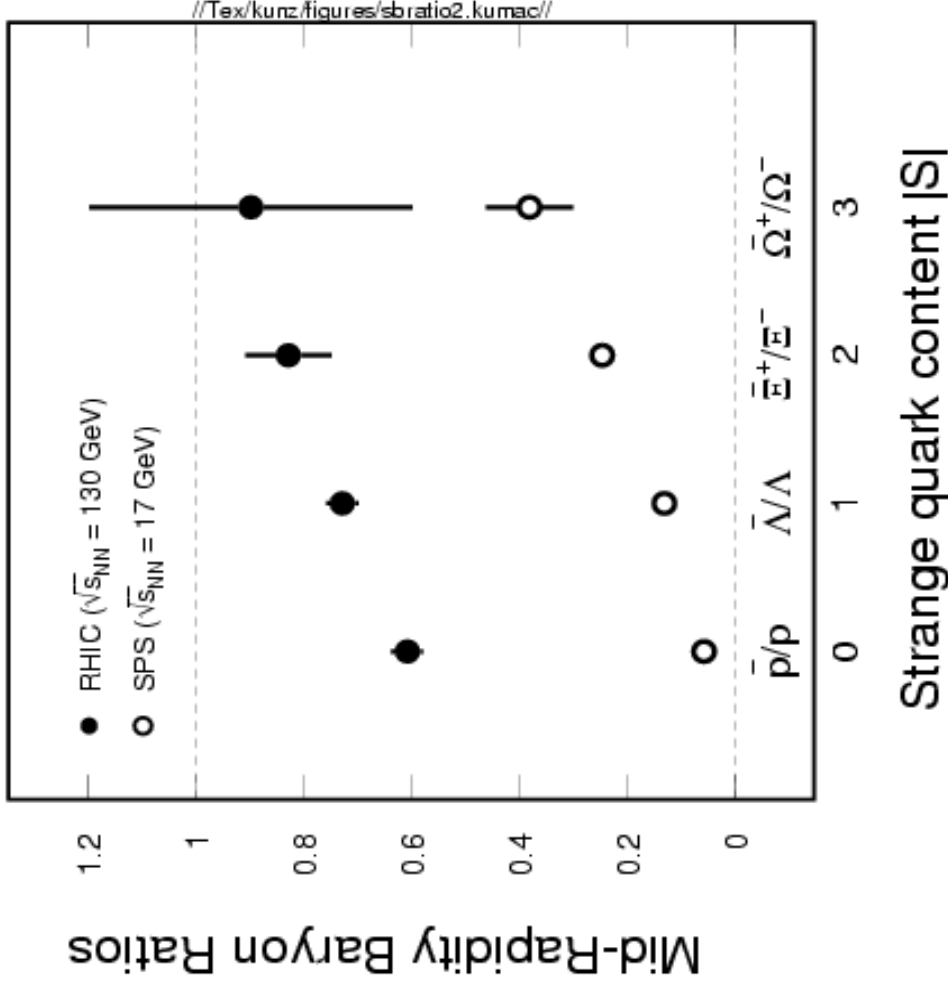
Introduction

- 1) Baryon transport is important for high energy collisions;
- 2) Baryon junction mechanism is needed for heavy ion collisions;
- 3) Net-proton + pair production => pbar/p ratios

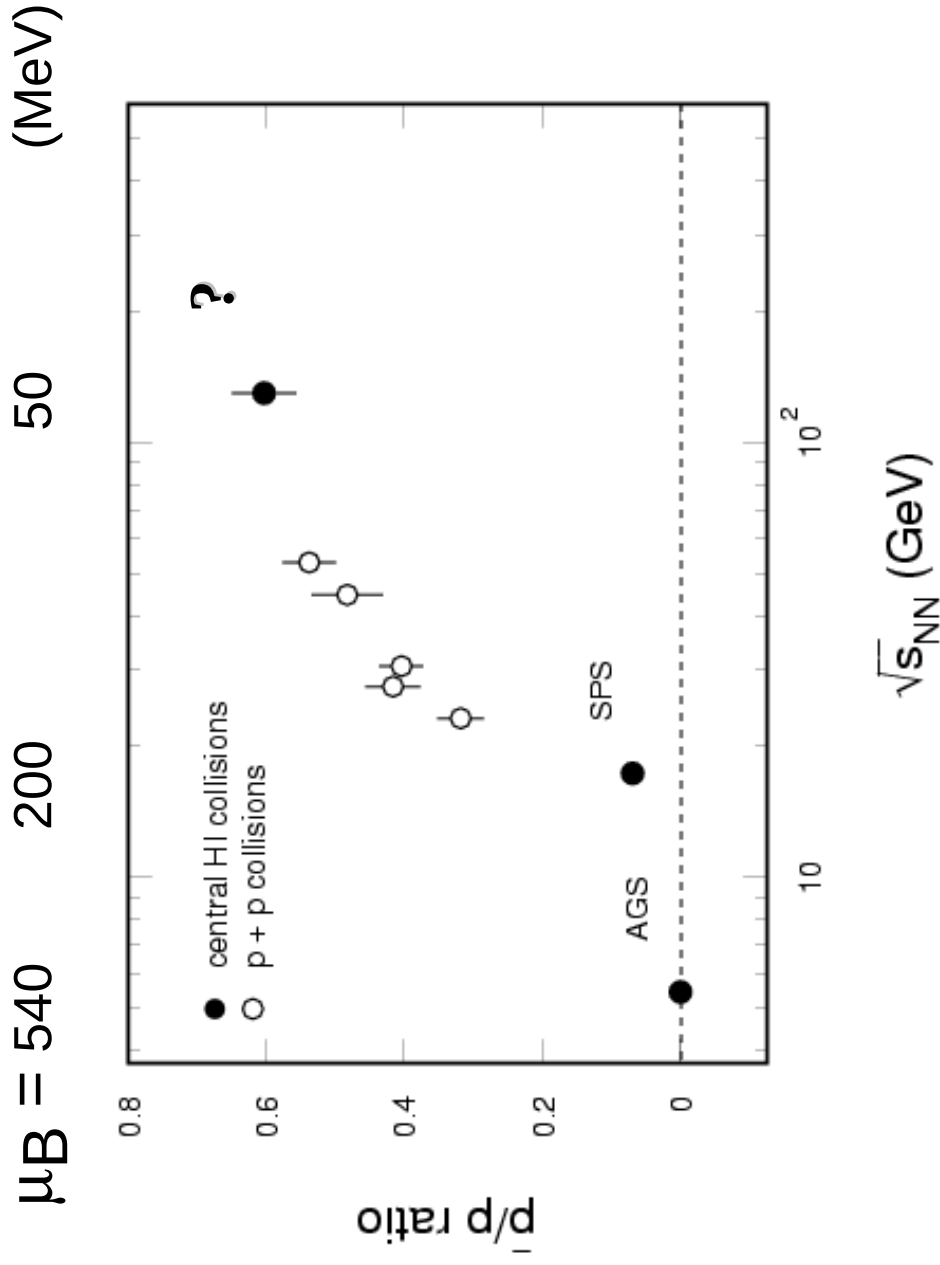


Motivation

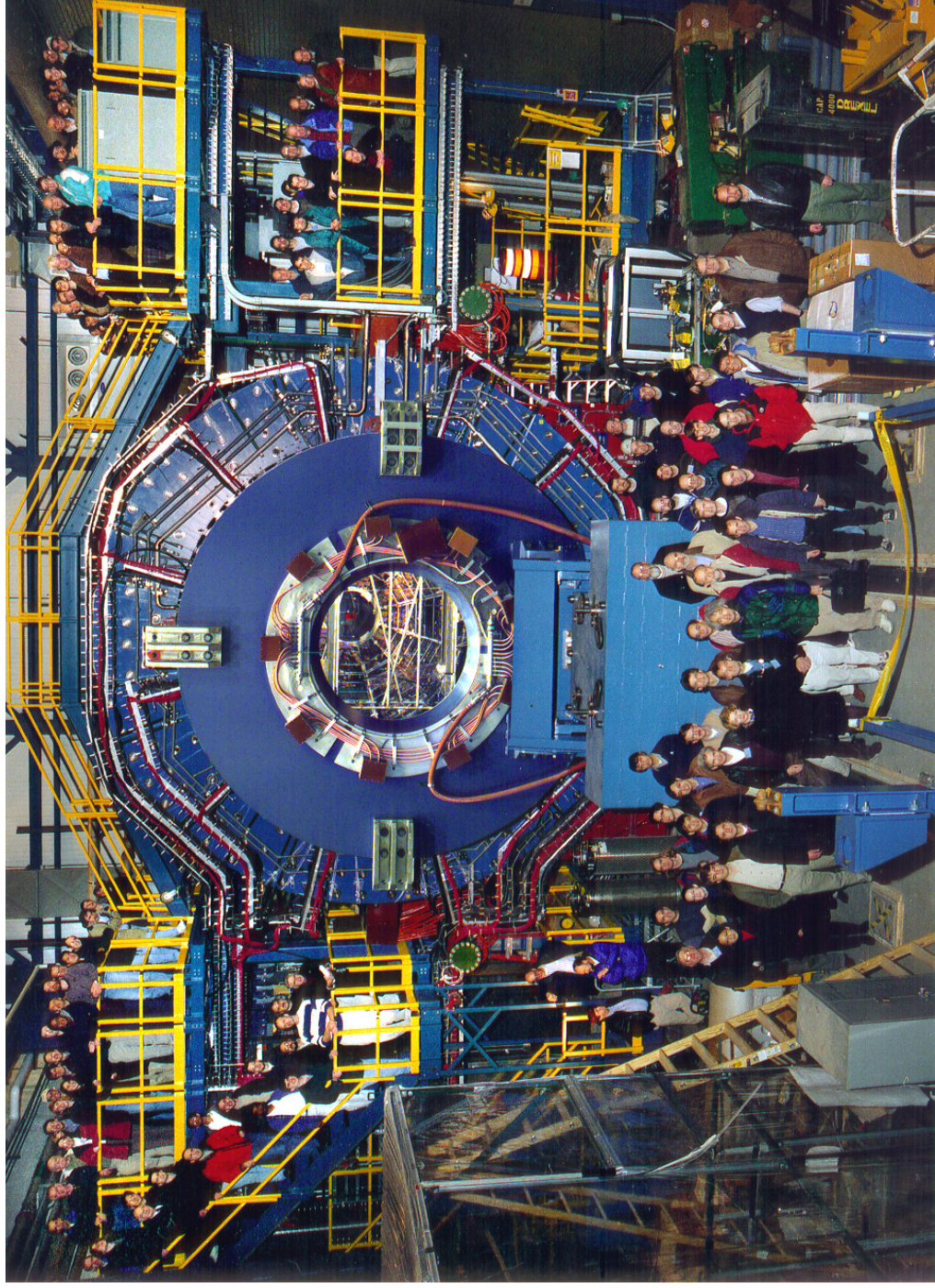
- ❑ Energy const.:
Smooth dependence of
baryon ratios on $|S|$.
- ❑ Anti -proton over
proton ratio determines
the **chemical properties**.
- ❑ With pbar/p ratio
known $\rightarrow$ other particle
ratios can be estimated.



pbar/p vs. collision energy



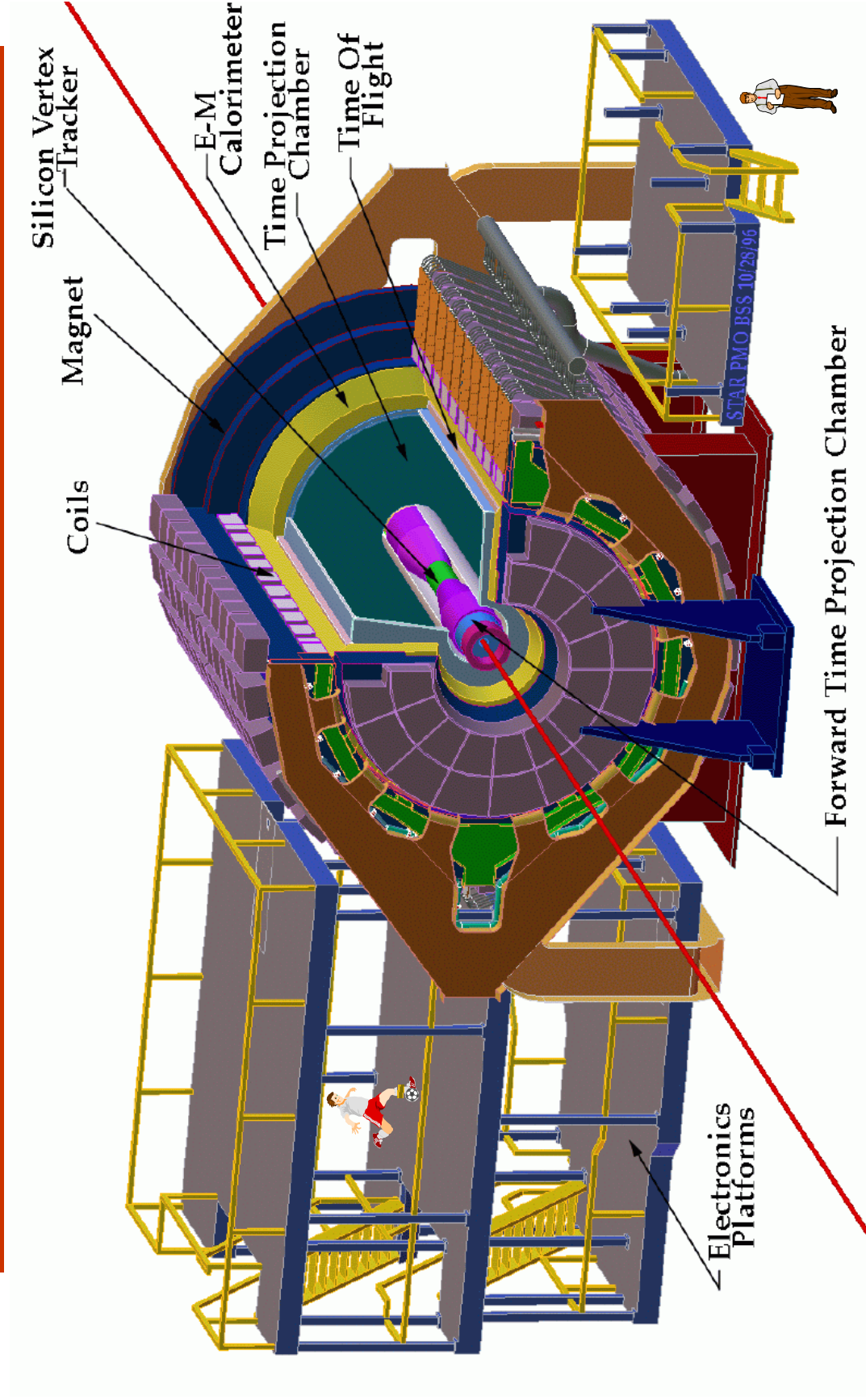
The STAR Collaboration



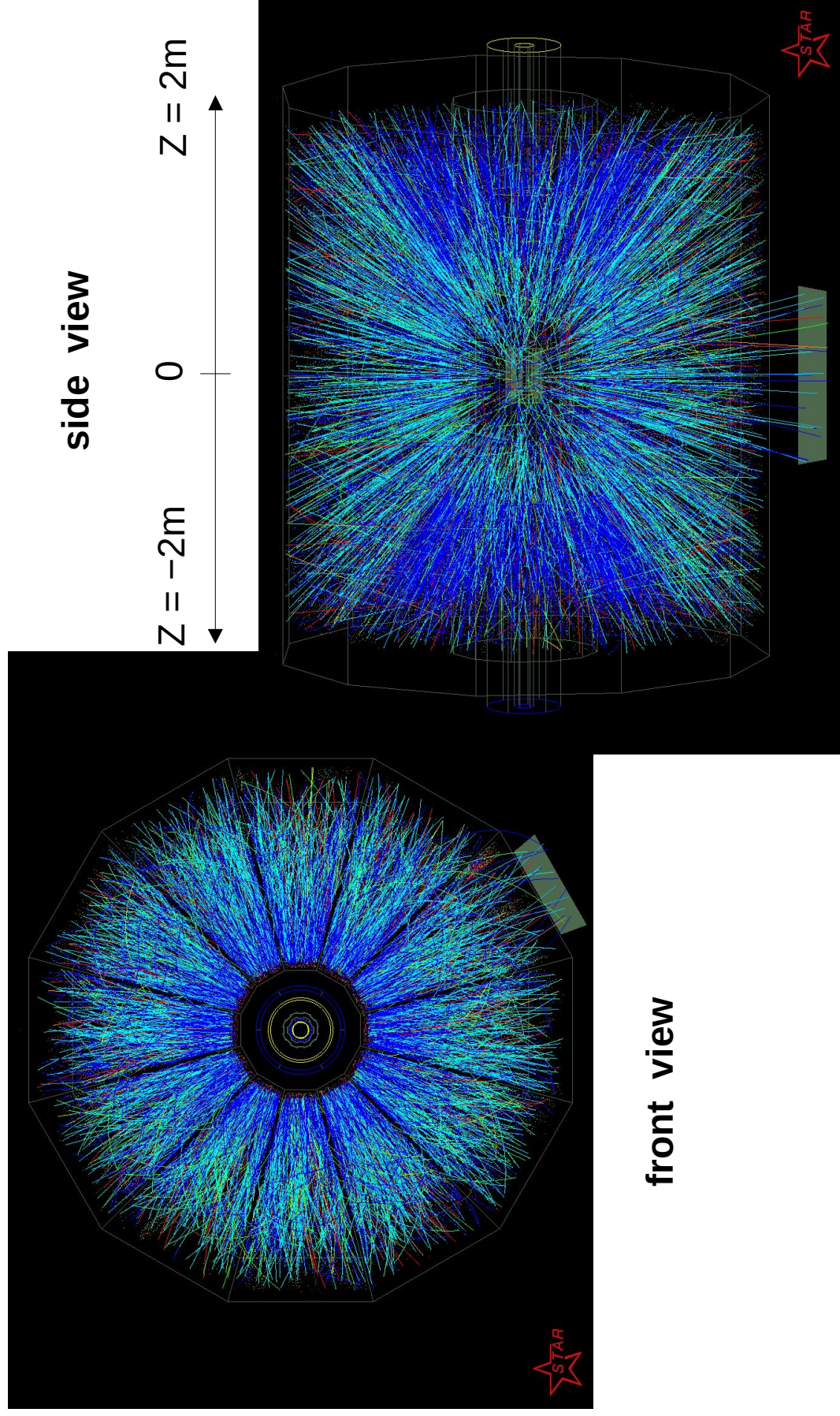
~400 collaborators, 18 institutions, 7 countries

HIT at LBNL, October 23, 2001

The STAR Detector



Central Collision rec. by STAR



STAR Trigger

- ❑ STAR uses fast trigger detectors (trigger level 0–2):
 - Central Trigger Barrel
 - Zero Degree Calorimeterto trigger on central / peripheral events based on multiplicity.
- ❑ Level 3 Trigger uses slower detectors (TPC, FTPC, SVT) to perform online analysis (cluster– / trackfinding) on those detectors.
- ❑ Results of L3 Trigger are comparable with Offline.

Level 3 Trigger Architecture

L3Architecture.ps

L3 Trigger

- ❑ STAR main detector (TPC) can be read out at ~ 100 Hz
- ❑ DAQ can write rawdata of 6 Hz to mass storage.
- ❑ L3 Trigger is a processor farm that does online analysis, (momentum determination and PID) at ~ 50 Hz.
- ❑ L3 Trigger is designed to trigger on rare events to enrich the event sample of:
 - high Pt particles pointing to the RICH.
 - heavy anti nucleus
 - $\text{Upsilon} \rightarrow e^+ e^-$, $J/\Psi \rightarrow e^+ e^-$ (2002 run)

L3 Trigger Processor Farm



STAR L3 Trigger Group:

C. Adler, J. Berger, D. Flierl, T. Dietel, S. Lange, C. Struck, P. Yepes

pbar/p Analysis

Analysis was performed with online L3 Trigger data.

- ❑ Analysis cuts
- ❑ Particle identification via dE/dx in the TPC gas.
- ❑ Proton background from secondary interactions
- ❑ Pbar absorption in detector material

Analysis cuts

L3 Online Tracking

- Reversed full field
- ~140k min bias events,

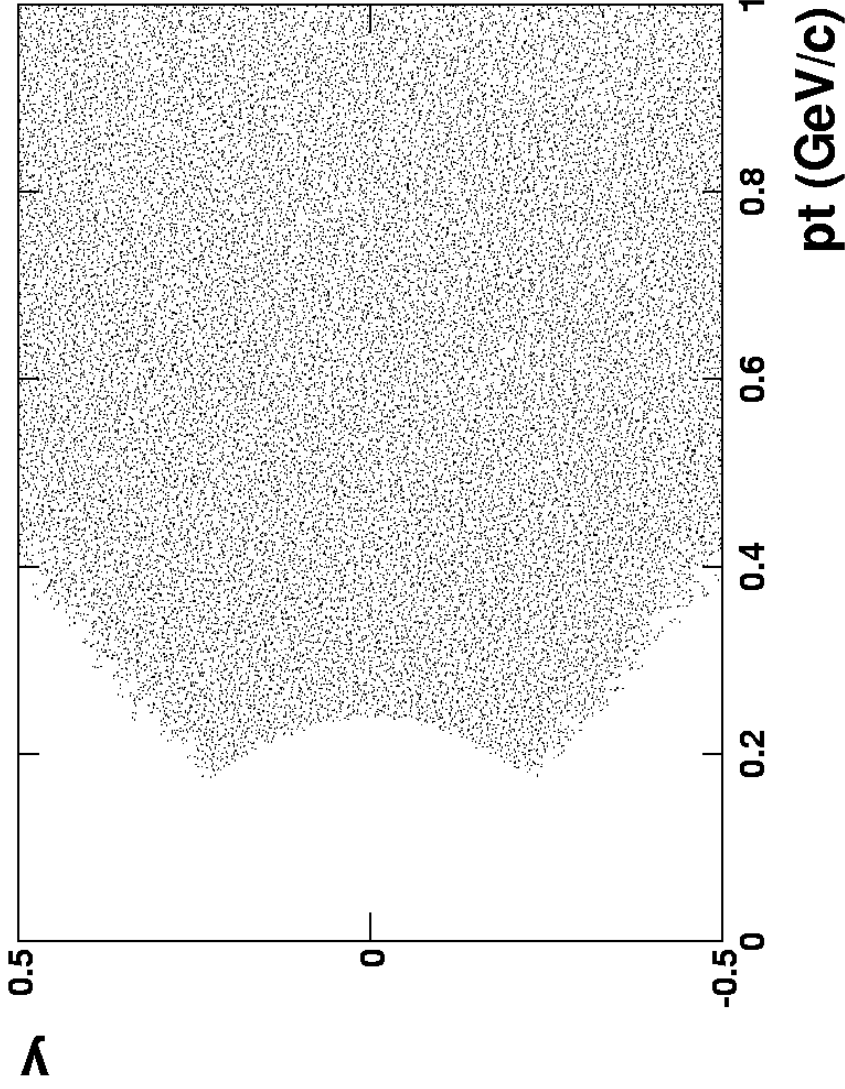
Events:

- ~104k within $|\text{Vertex } Z| < 30 \text{ cm}$

Tracks:

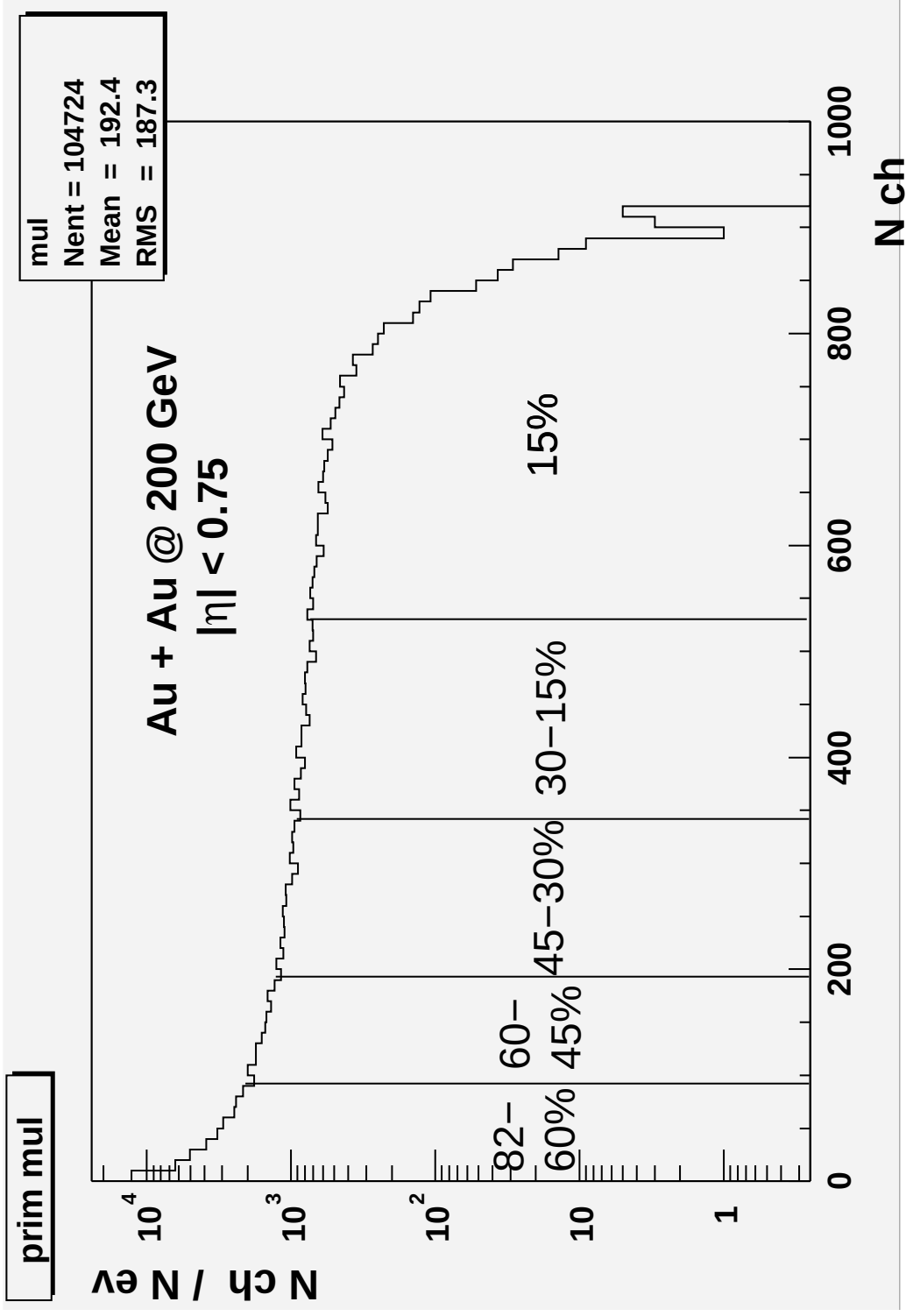
- Nhits > 22
- $-0.3 < Y_p < 0.3$
- PID via $Z = \ln(dE/dx / dE/dx_{BB})$

STAR Proton-Acceptance

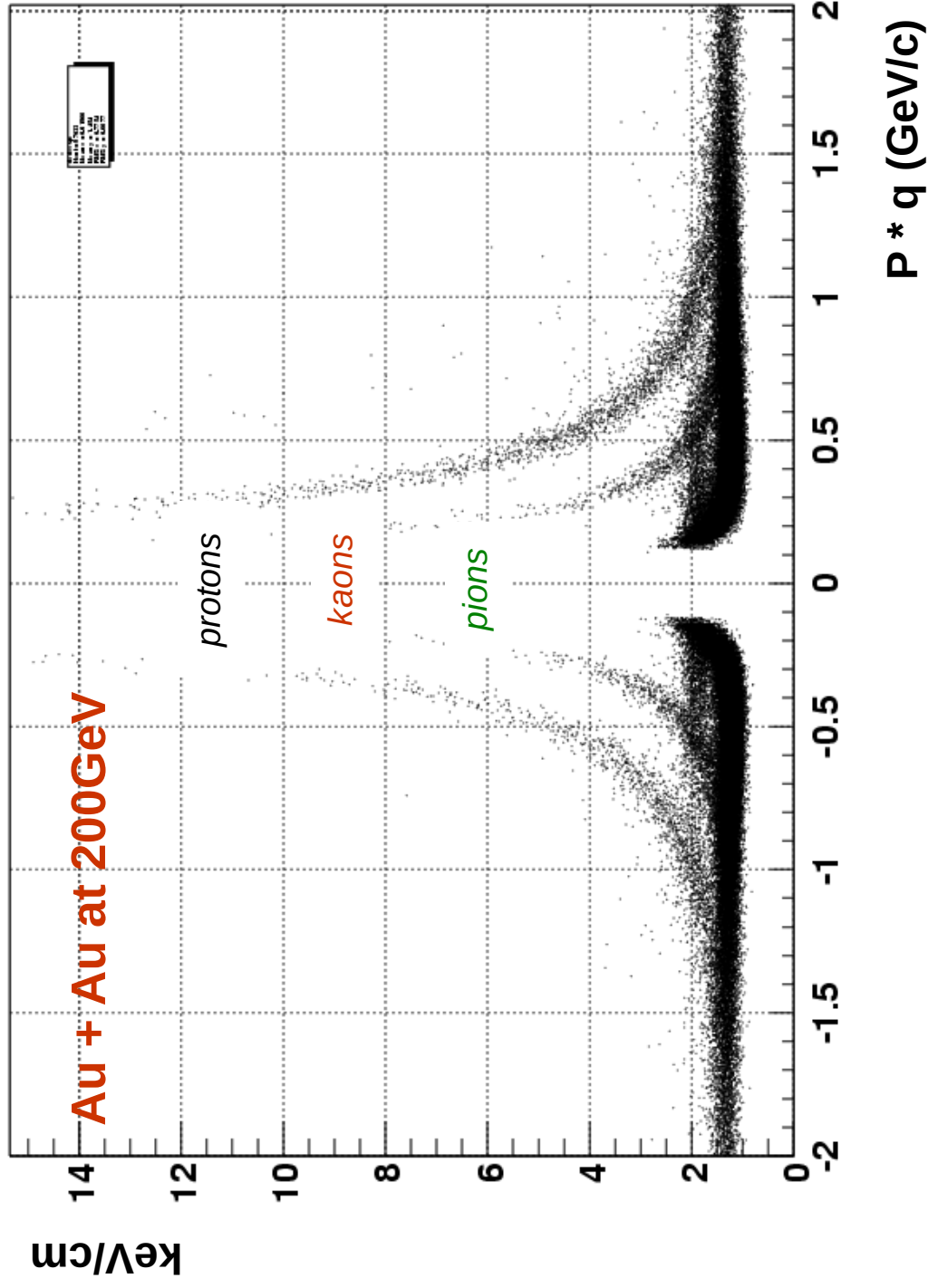


- analyze at
 $0.4 < pt < 1.0 \text{ GeV}/c$
 $-0.3 < y < 0.3$
- PID limit:
 - 1) low momentum –
 absorption in detector
 material + background protons
 - 2) large rapidity –
 particles miss TPC volume
 - 3) high momentum $> 1 \text{ GeV}$
 no separation in dE/dx from
 other particle species.

Centrality Definition

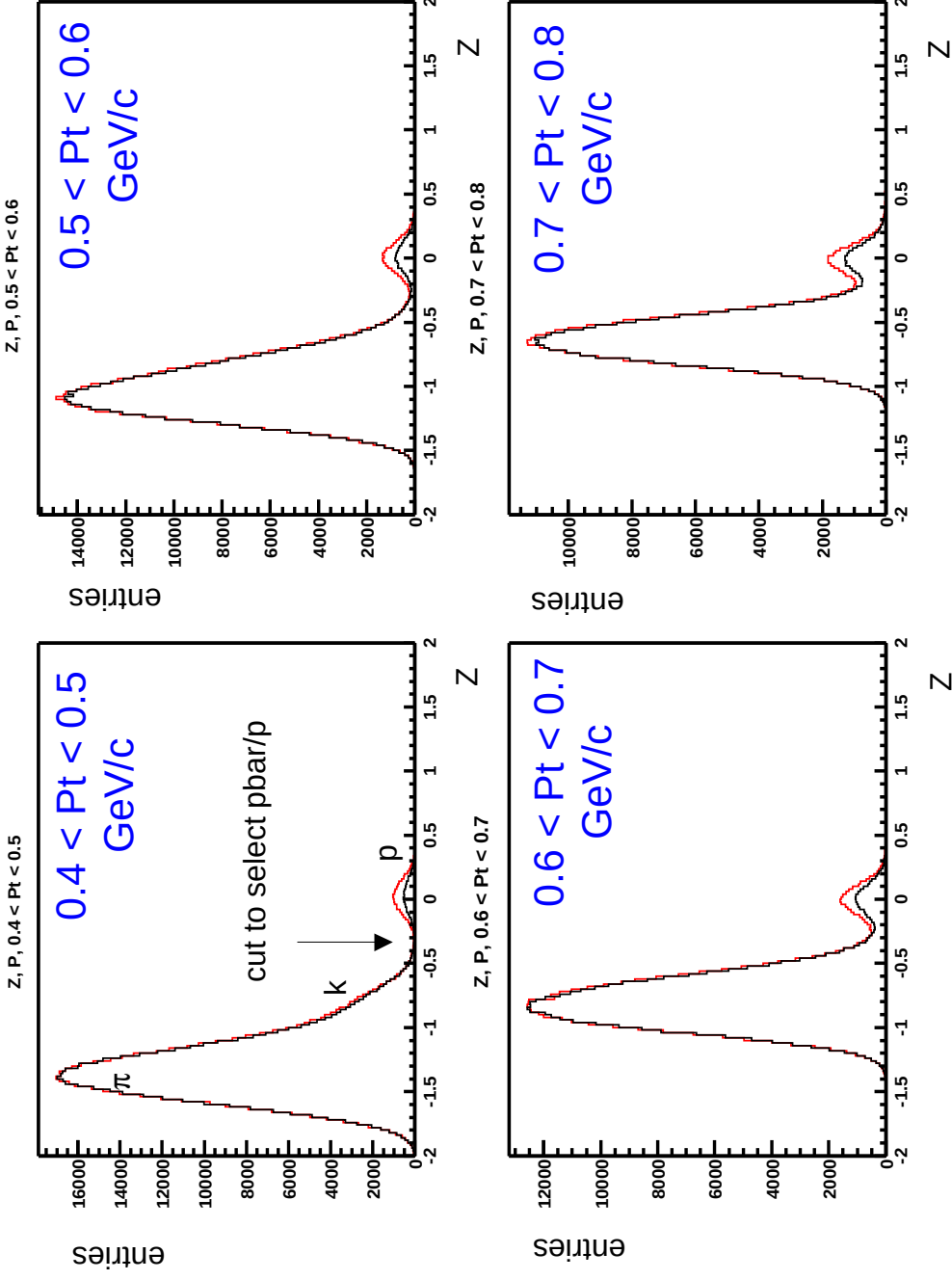


dE/dx Particle Identification



red = pos.
black = neg.

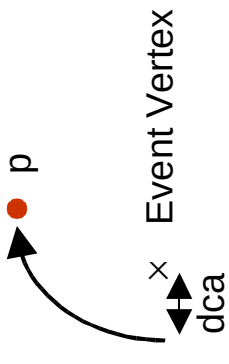
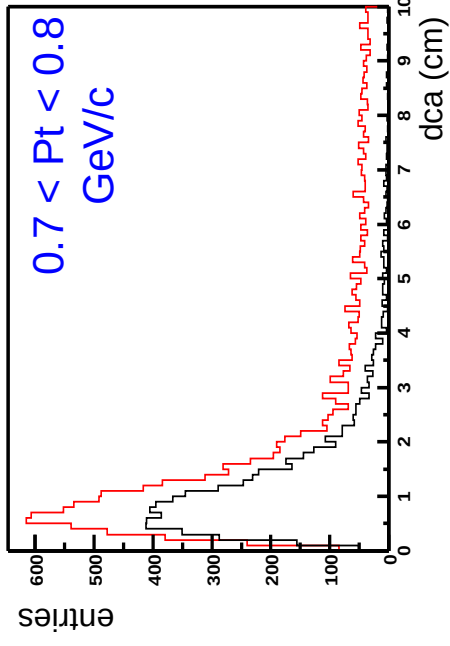
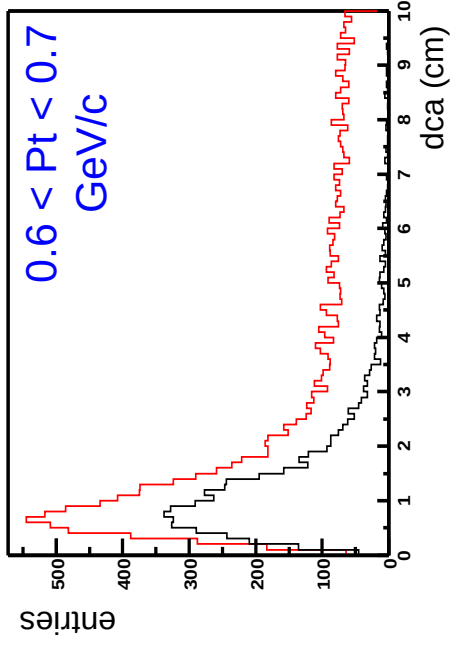
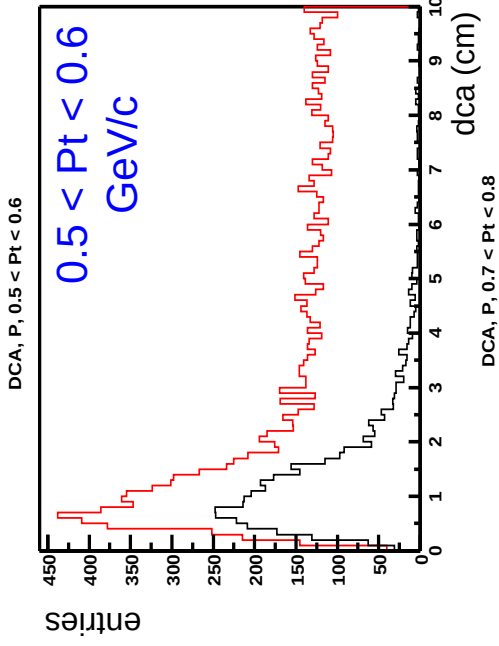
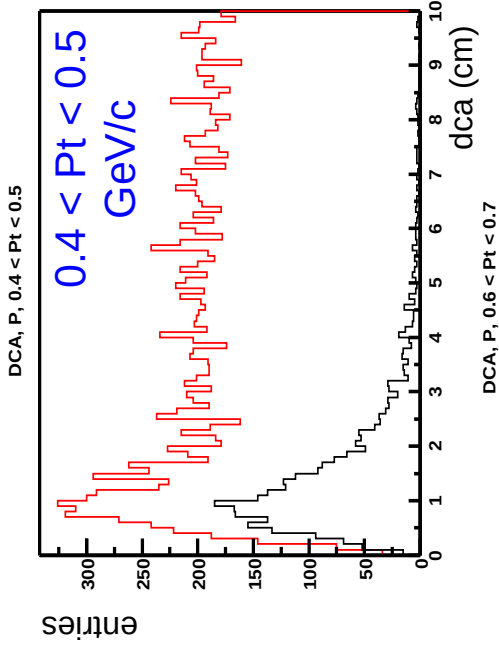
Z distributions



Top 15% mult. cut, $|Z| < 30$ cm, $N_{hit} > 22$, $Z = \ln(dE/dx / dE/dx_{BB})$

dca distributions

red = pos.
black = neg.

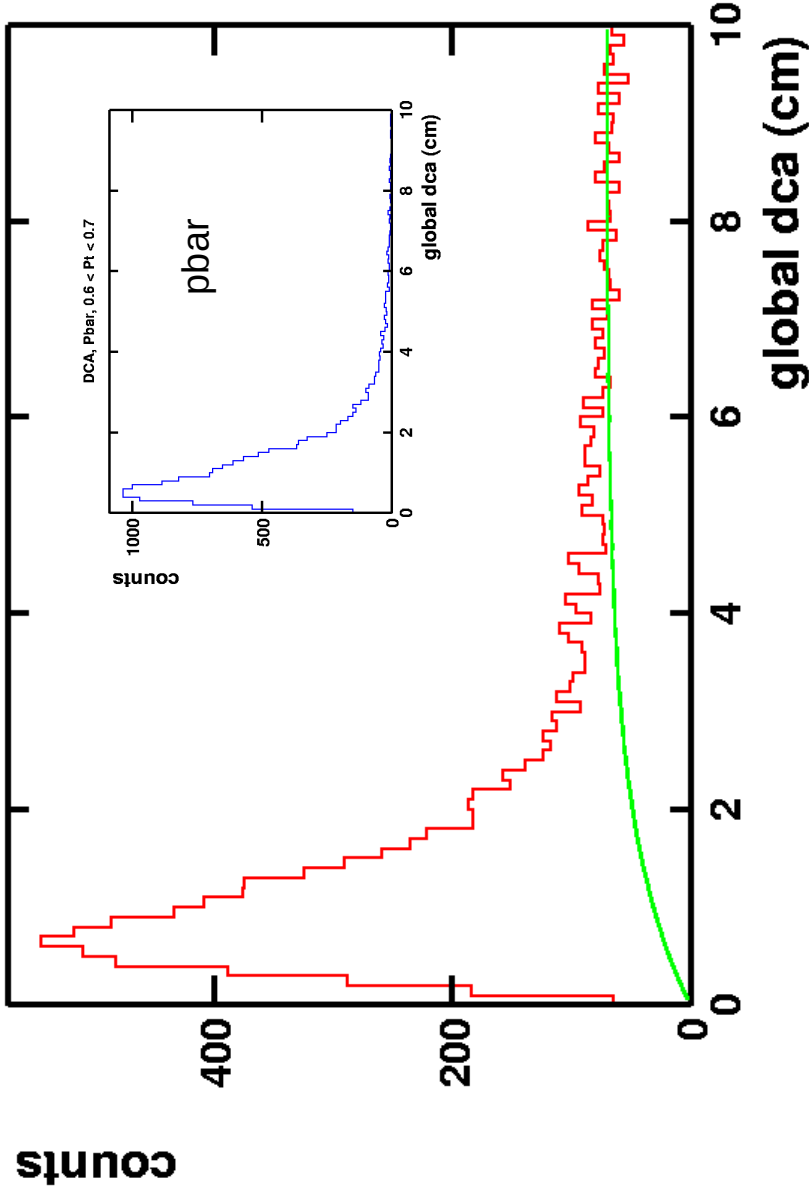


- Primary particles interact with detector material generate background protons $\rightarrow$ secondaries
- Large background at $pt \approx 400 \text{ MeV/c}$
- Steeply decreasing at higher pt

Top 15% mult. Cut, $|\text{Vertex } Z| < 30 \text{ cm}$, $N_{hit} > 22$

Proton background

DCA, P, $0.6 < P_t < 0.7$

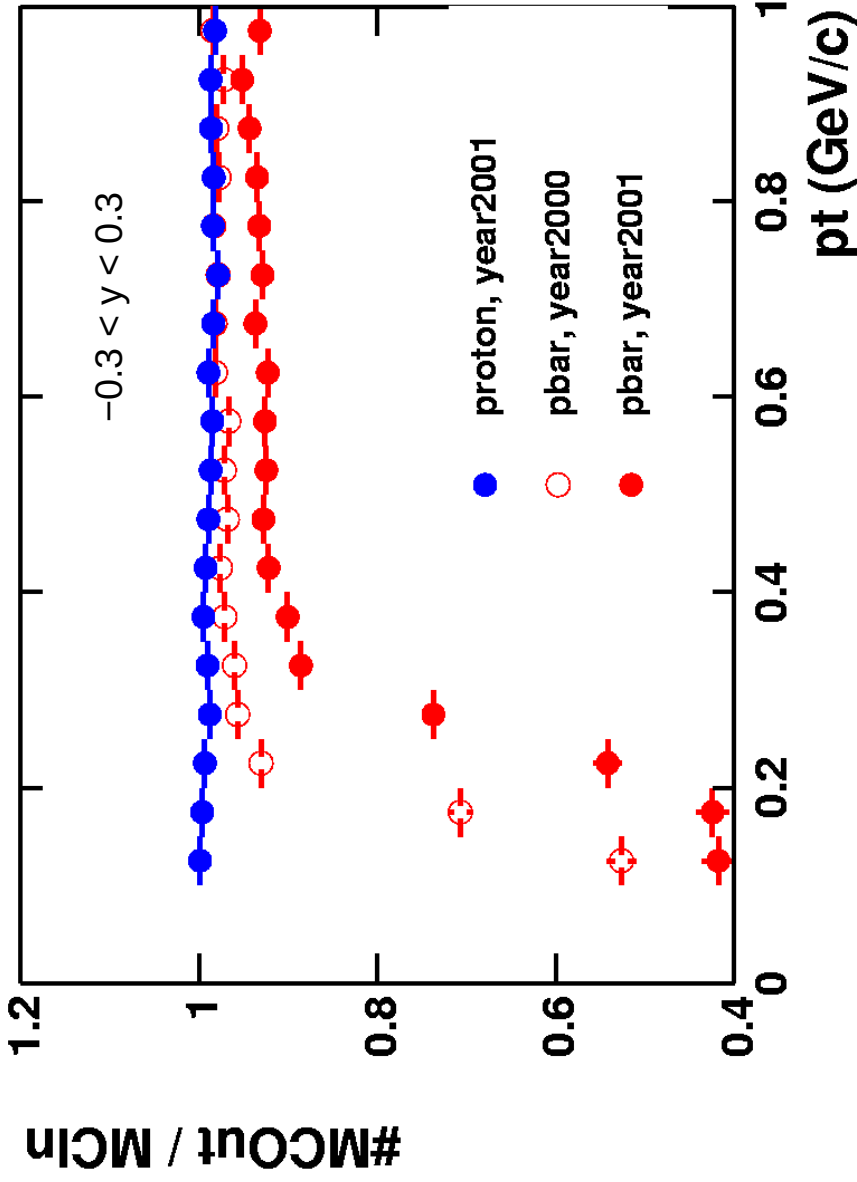


- Proton background from secondary interactions
- Assume:

$$dca_P = C * dca_{pba} + dca_{back}$$

$$f_{back}(x) = A * (1 - \exp(-x / k))$$

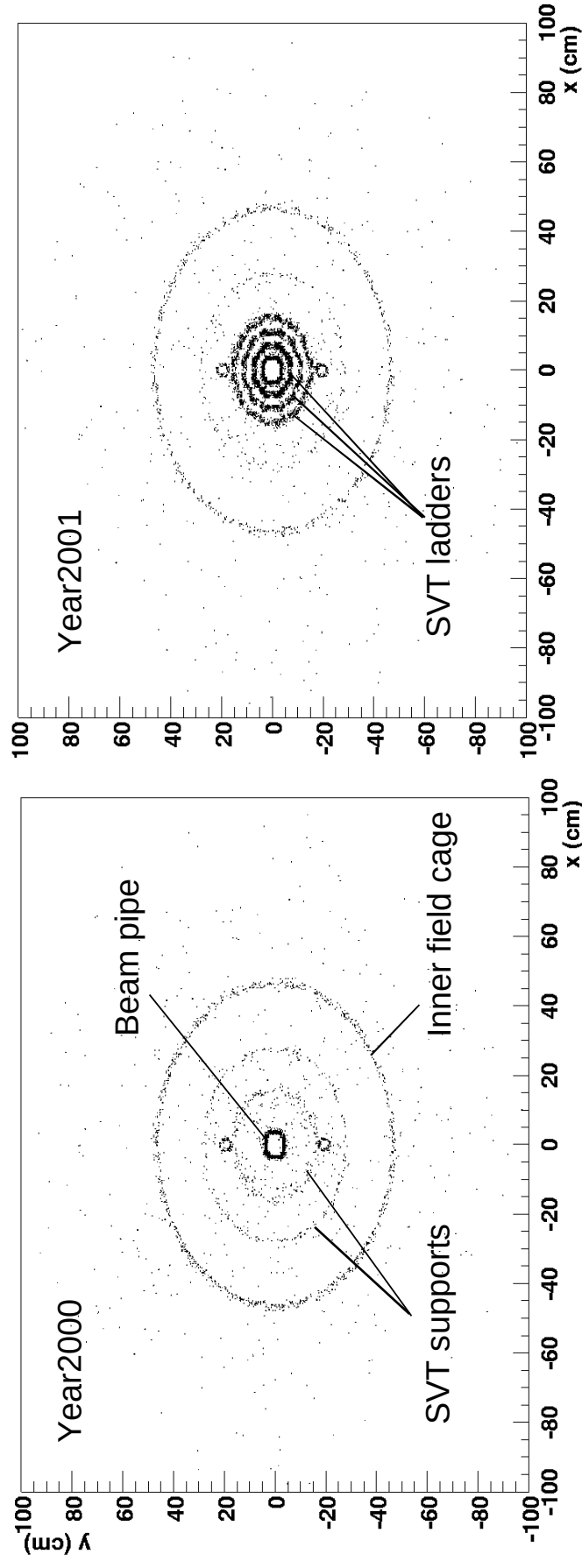
pbar-absorption correction



absorption of pbar at
 $0.45 < pt < 0.65$ GeV/c:

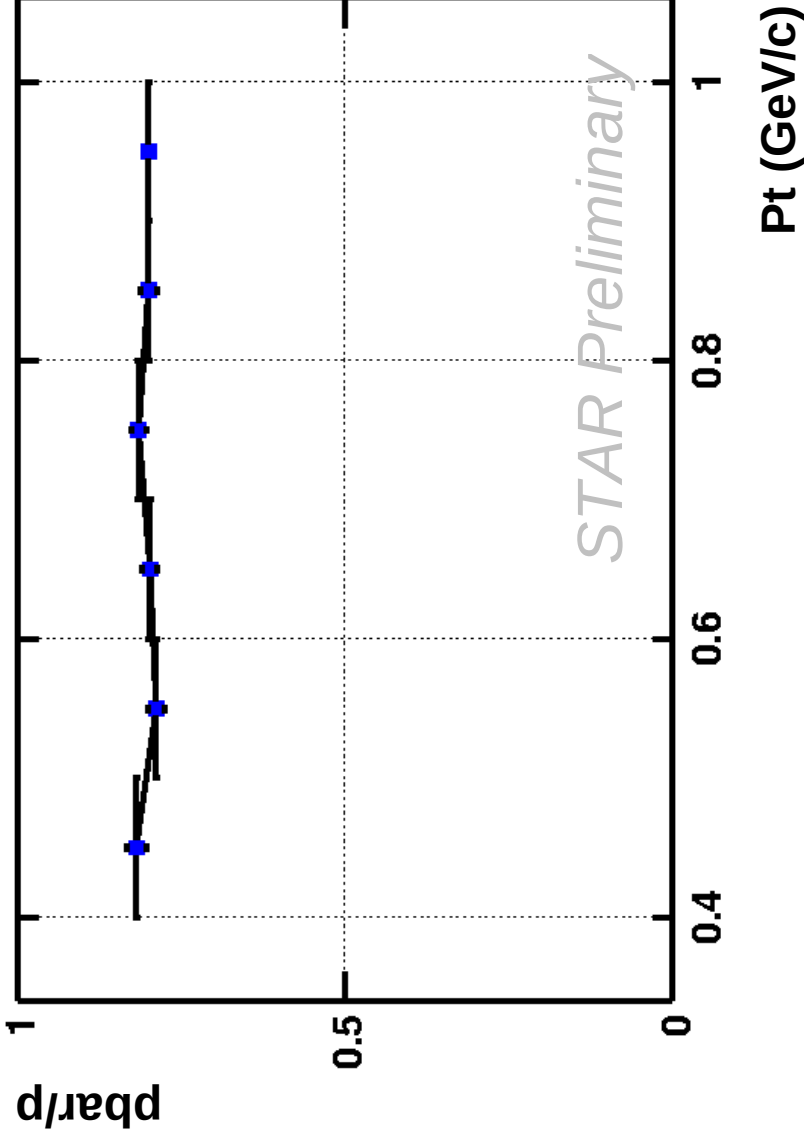
- 1) Pbar2000: 0.970
- 2) Pbar2001: 0.925
- 3) Proton2001: 0.990

Where are particles absorbed?



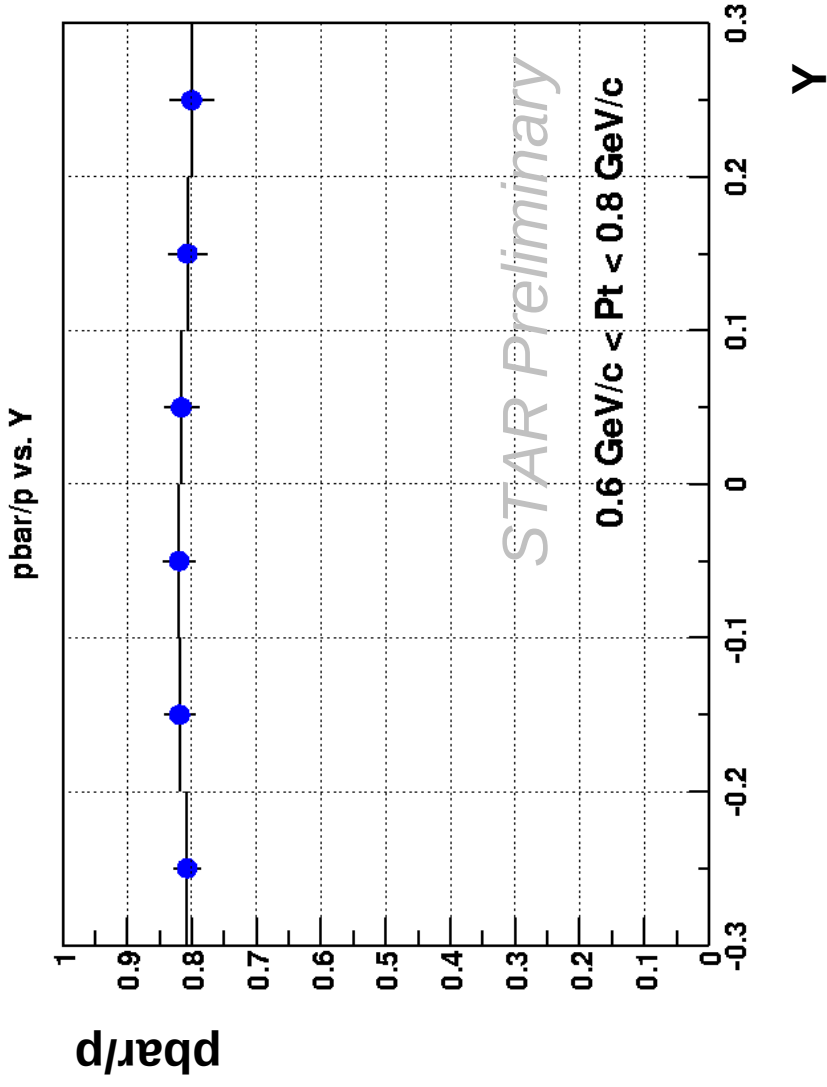
- year2000: Beam Pipe
Inner field cage
SVT supports
- Year2001: + 3SVT ladders

pbar/p ratio @ 200GeV vs. pt



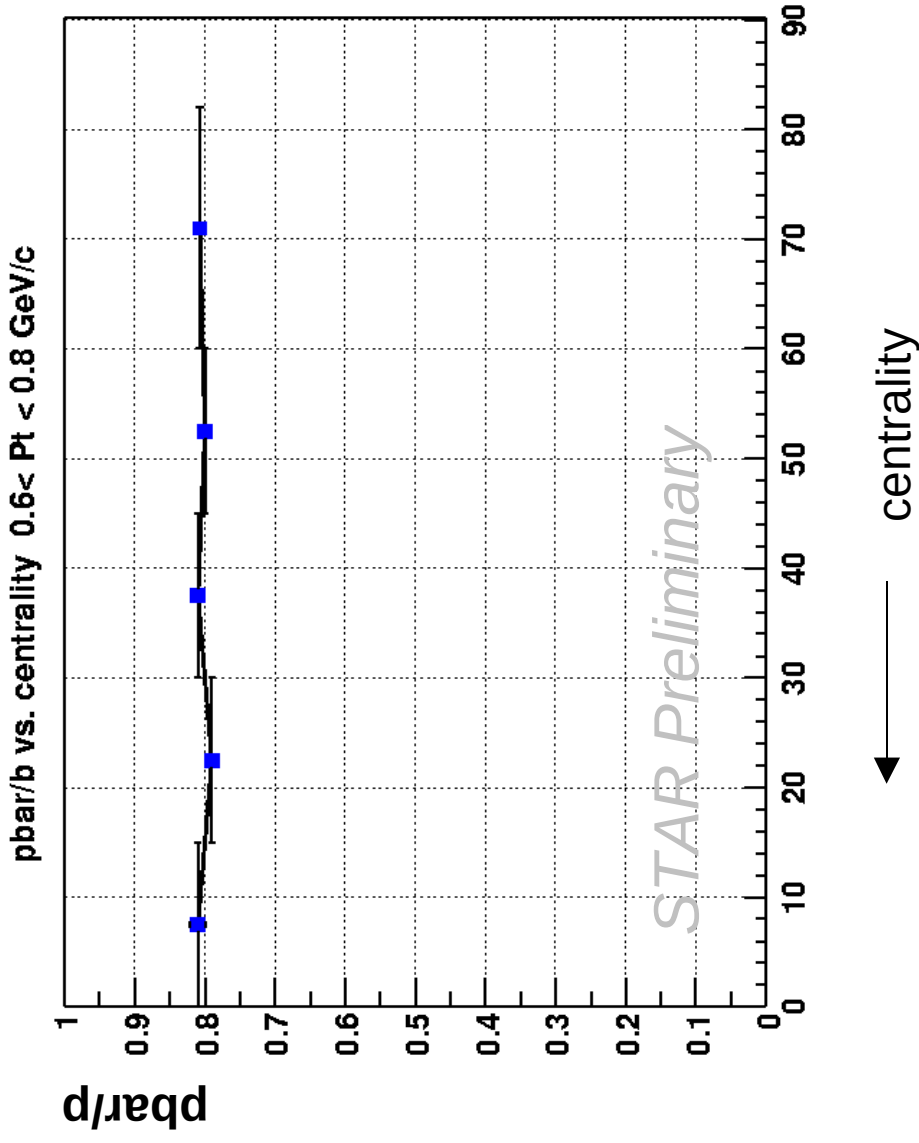
- 15% most central
- $-0.3 < Y < 0.3$
- Only statistical errors shown
- $p_{\text{bar}}/p = 0.80 \pm 0.02$
- Lowest momentum bin has 35% background $\rightarrow$ large systematic error
- No strong dependence on Pt

pbar/p ratio @ 200GeV vs. rapidity



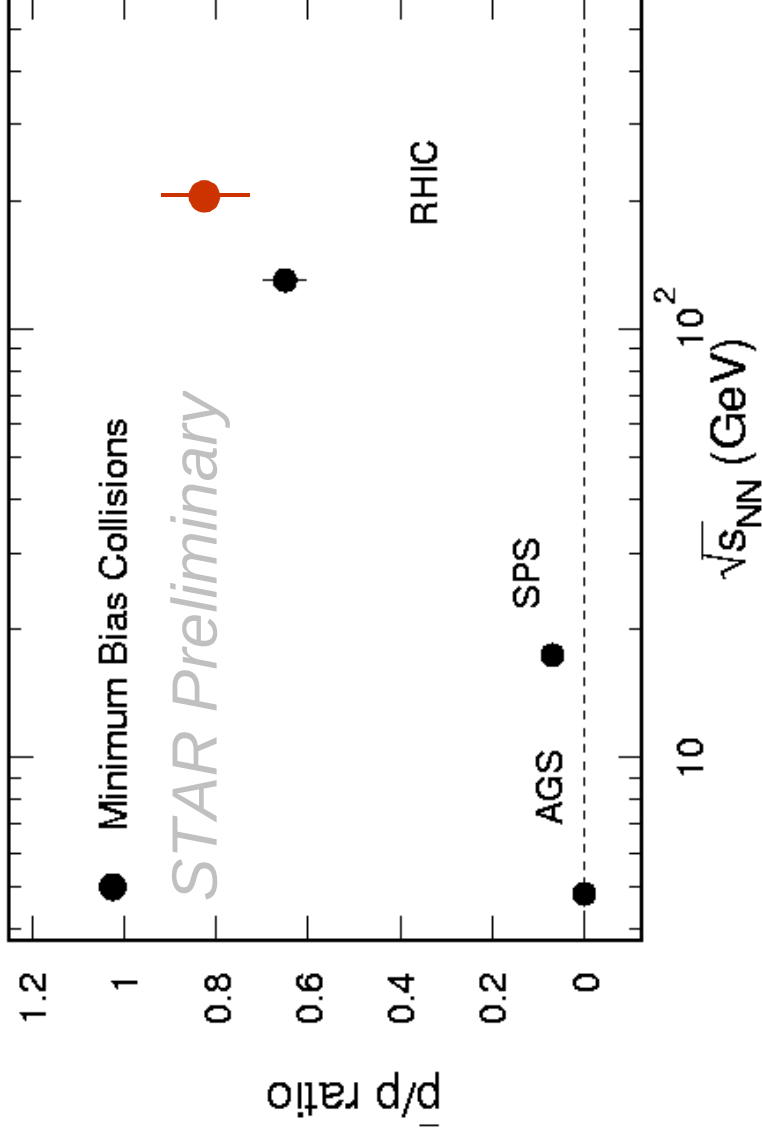
- minbias
- Only statistical errors shown
- $\text{pbar/p} = 0.82 \pm 0.02$
- No strong dependence on rapidity

pbar/p ratio @ 200GeV vs centrality



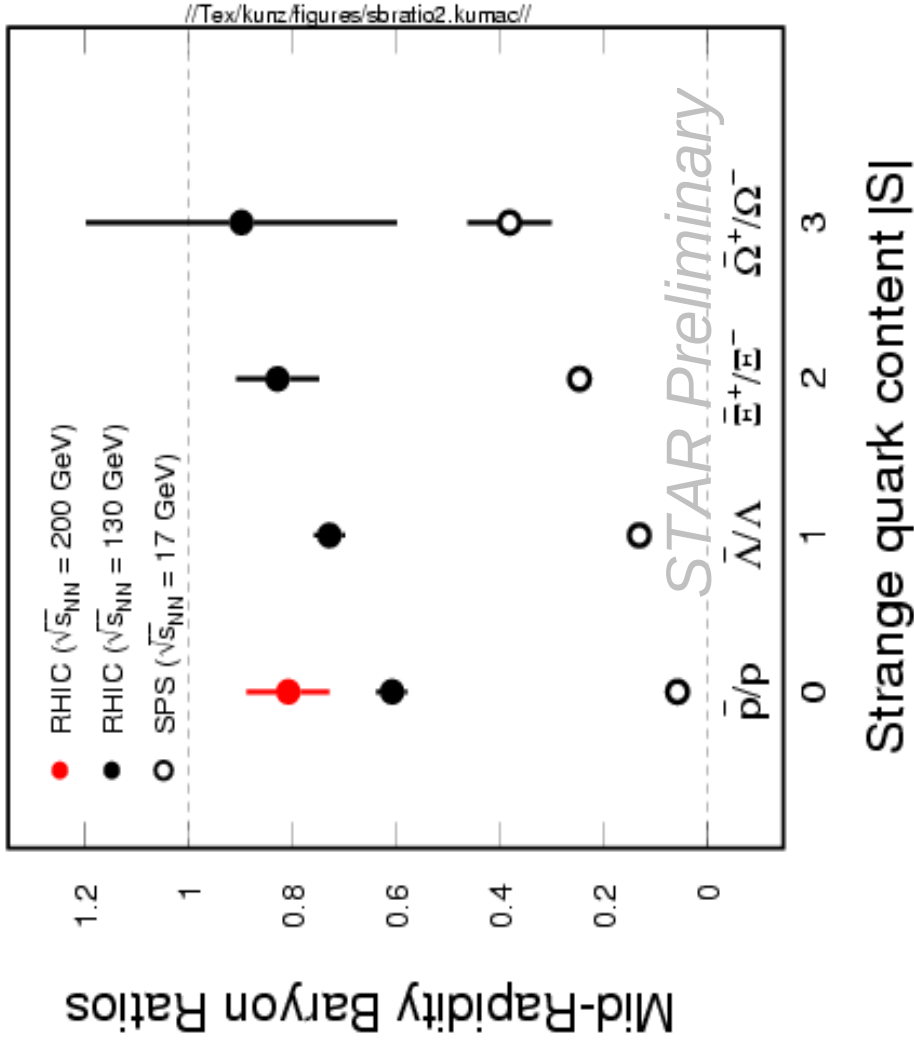
- only statistical errors shown
- $-0.3 < Y < 0.3$
- no strong dependence on centrality

pbar/p ratio @ 200GeV



- pbar/p-ratio = $0.82 \pm 0.02(\text{stat.}) \pm 0.1(\text{syst.})$
- not baryon-free at RHIC

pbar/p



- pbar/p-ratio = $0.82 \pm 0.02(\text{stat.}) \pm 0.1(\text{syst.})$
- not baryon-free at RHIC

Conclusions

- 1) anti-proton over proton ratio measured at the RHIC top energy
 $r = 0.82 \pm 0.02 \text{ (stat.)} \pm 0.1 \text{ (syst.)}$

 $\Rightarrow$ significant increase from 130 GeV collisions
 $r = 0.65 \pm 0.01 \text{ (stat.)} \pm 0.07 \text{ (syst.)}$
- 2) No strong dependence on transverse momentum, rapidity and centrality in the ratio.
- 3) Hijing model predicts the ratio : 0.8
RQMD model predicts the ratio : 0.55
- 4) Still large systematic errors $\Rightarrow$ comparison with STAR offline analysis.
- 5) To understand the baryon physics, proton (anti-proton) transverse momentum and rapidity distributions are needed.