First results from the PHOBOS spectrometer

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Introduction

- Measured

$$\frac{\langle \pi^- \rangle}{\langle \pi^+ \rangle} \qquad \frac{\langle K^- \rangle}{\langle K^+ \rangle} \qquad \frac{\langle \bar{p} \rangle}{\langle p \rangle}$$

- Conditions

$\sqrt{s_{NN}} = 130$ GeV/c , Top 12% central

Mid – rapidity, $0.1 < p_t < 1.0$GeV/c

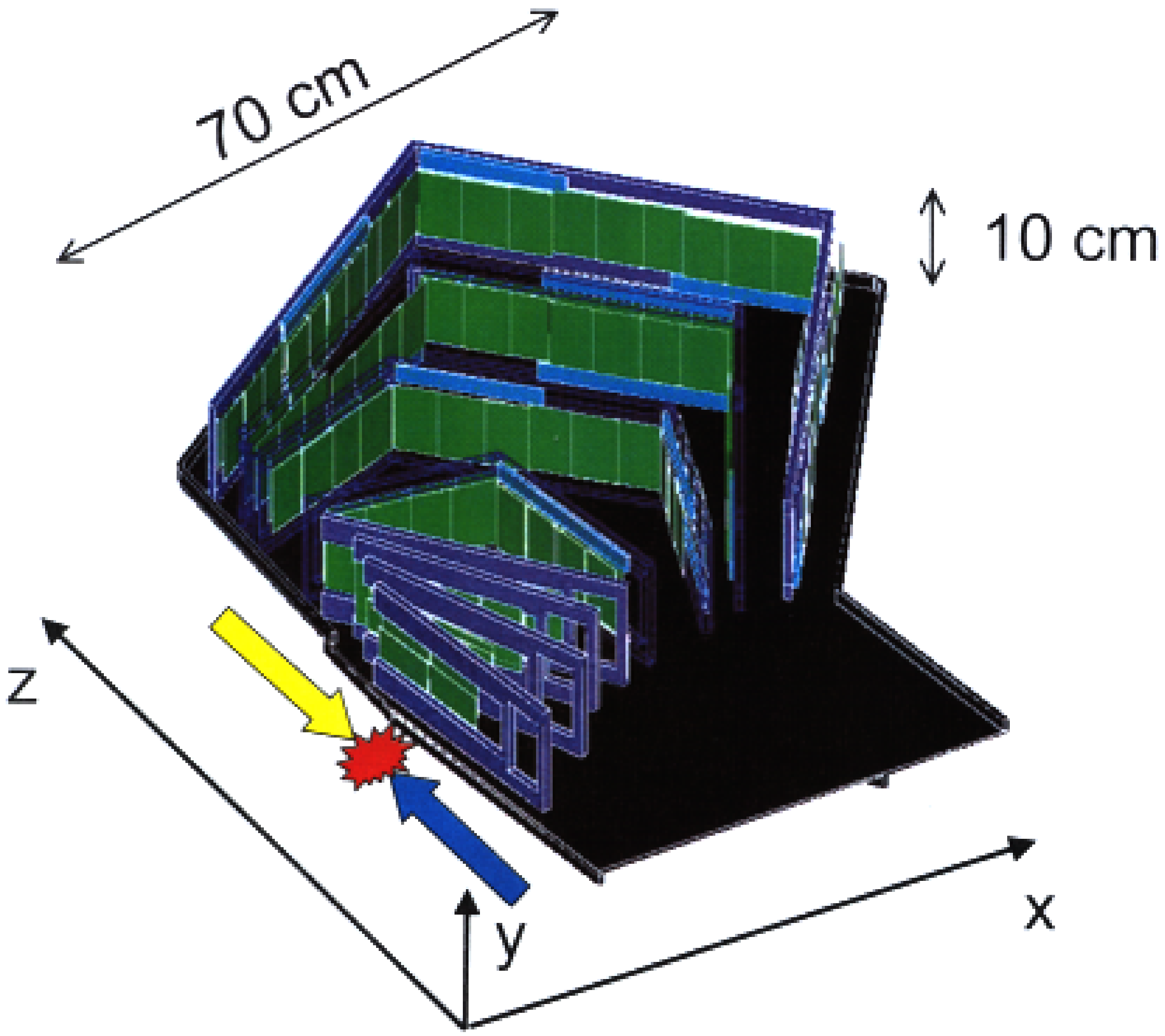
Motivation

- First look potential
  - Unexpected results?

- Baryon transport

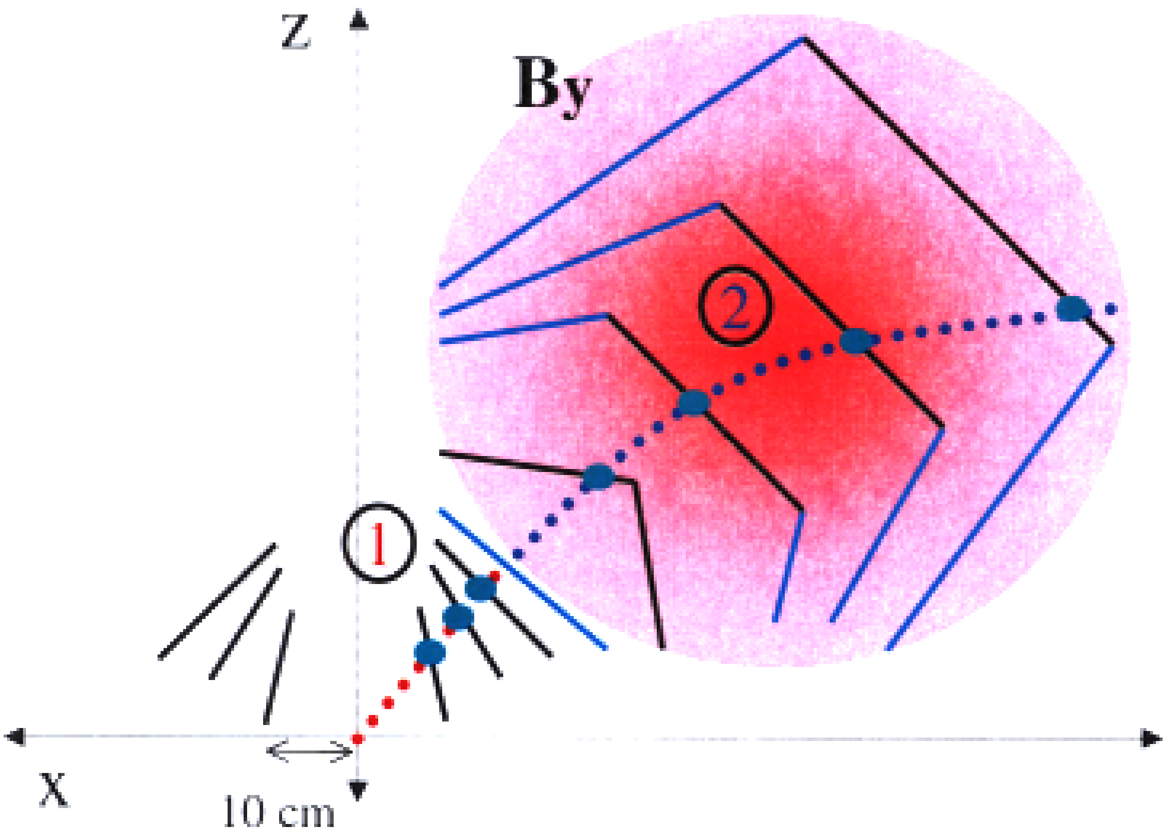
- Hadron Chemistry
  - Baryon chemical potential
  - Strange chemical potential
  - Chemical freeze-out temperature

Phobos Spectrometer



- Tracking within 10cm of interaction point
- Phi acceptance 3%

Tracking in the spectrometer



Tracking Algorithm

1 - Straight line track:

First 6 layers (θ,φ) clusters

2 - Curved track:

Last 6 layers (1/p,θ) clusters

3 - Match 1 and 2

Geometric + dE/dx

4 - Vertex matching

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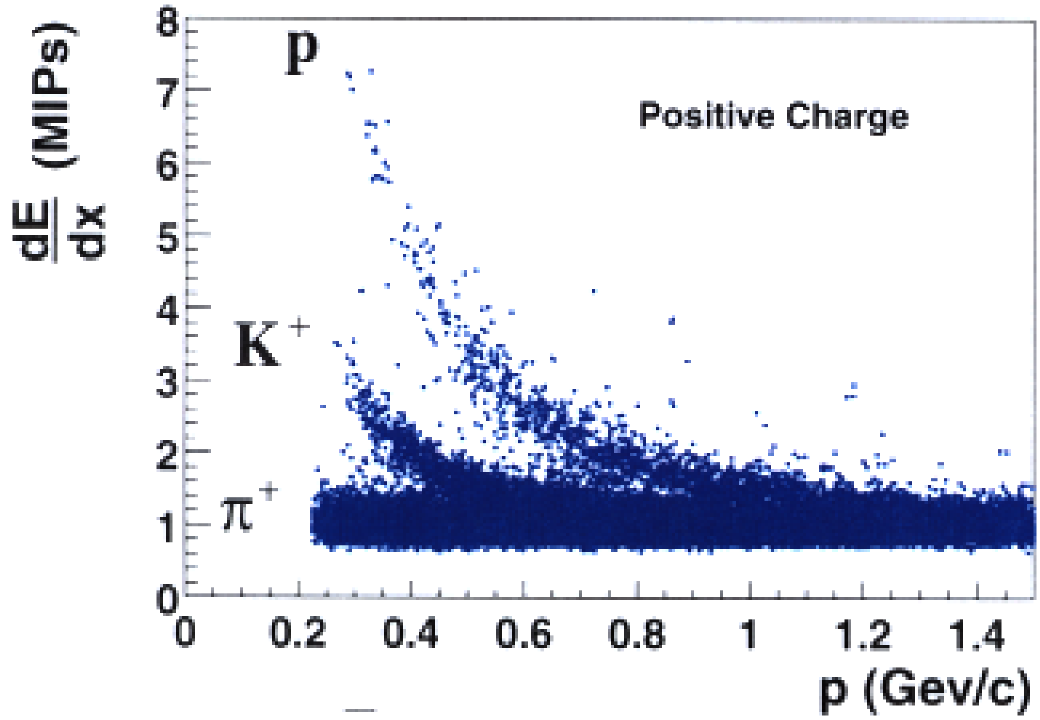
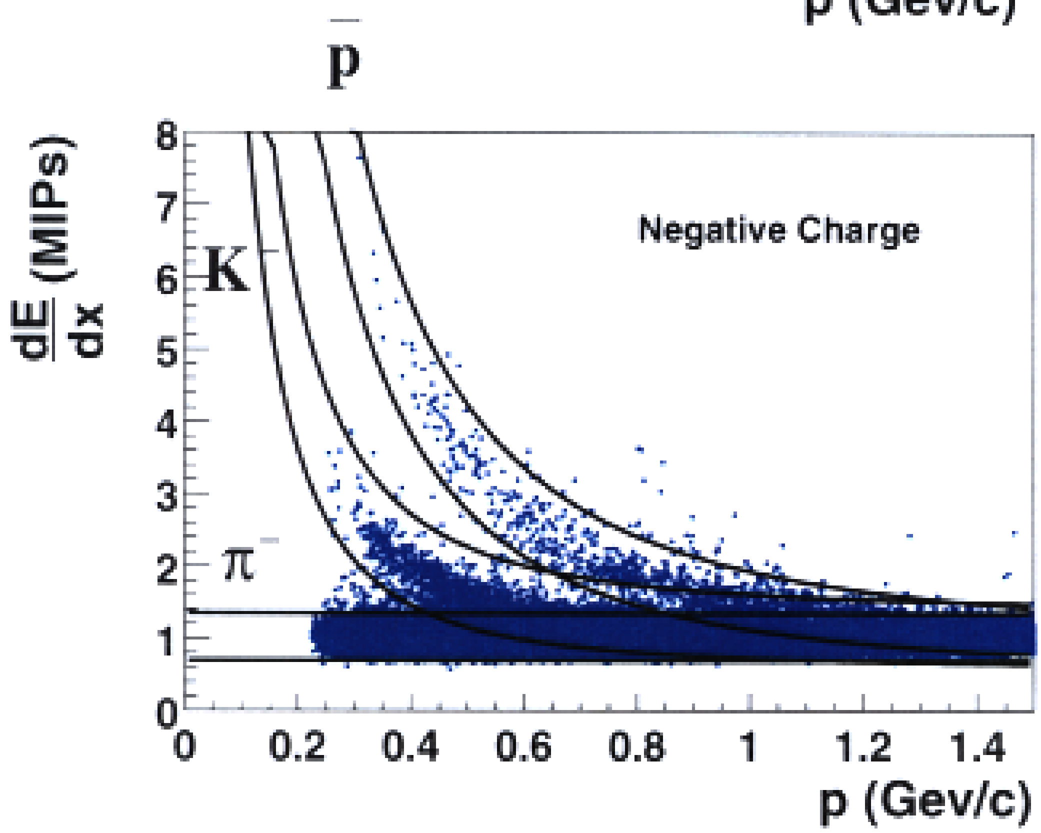
Particle Identification





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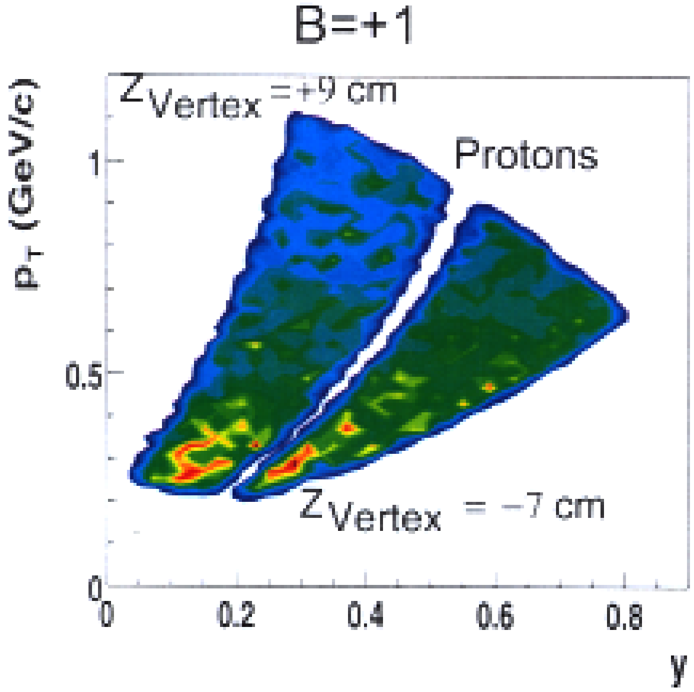
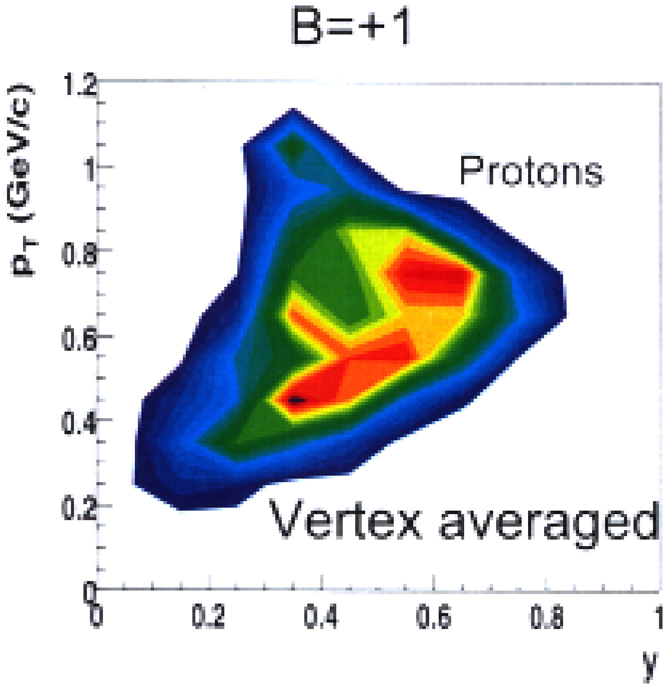
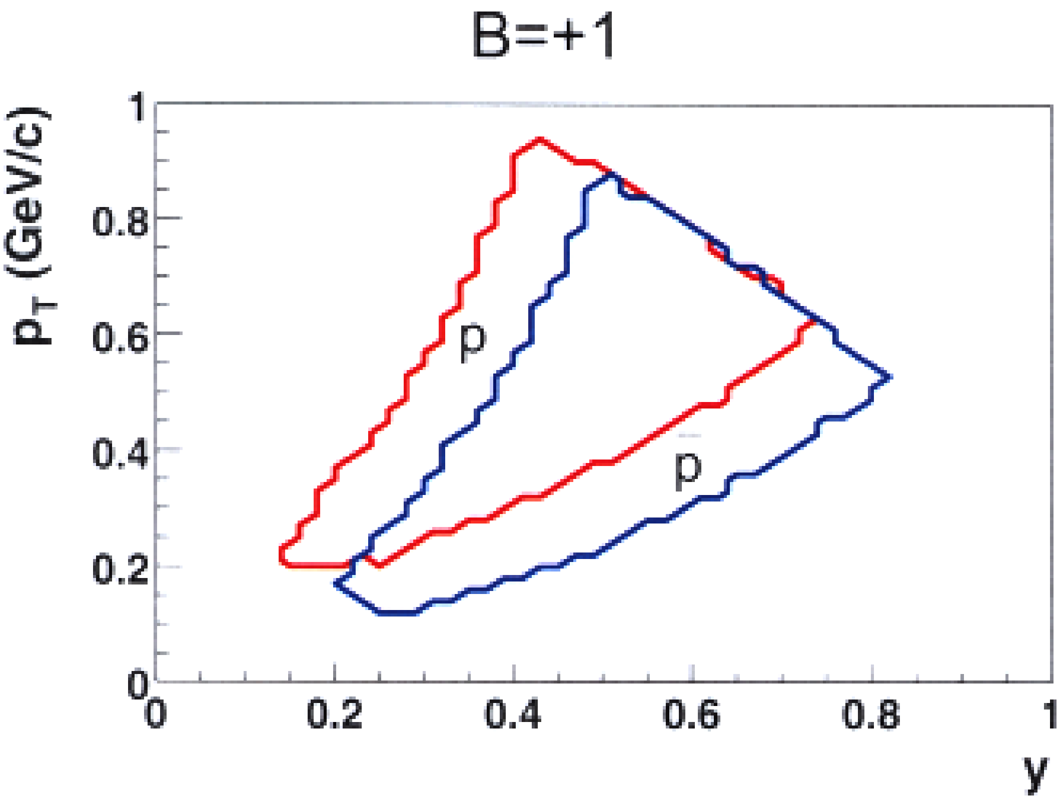
Kinematic Coverage

- Vertex dependent

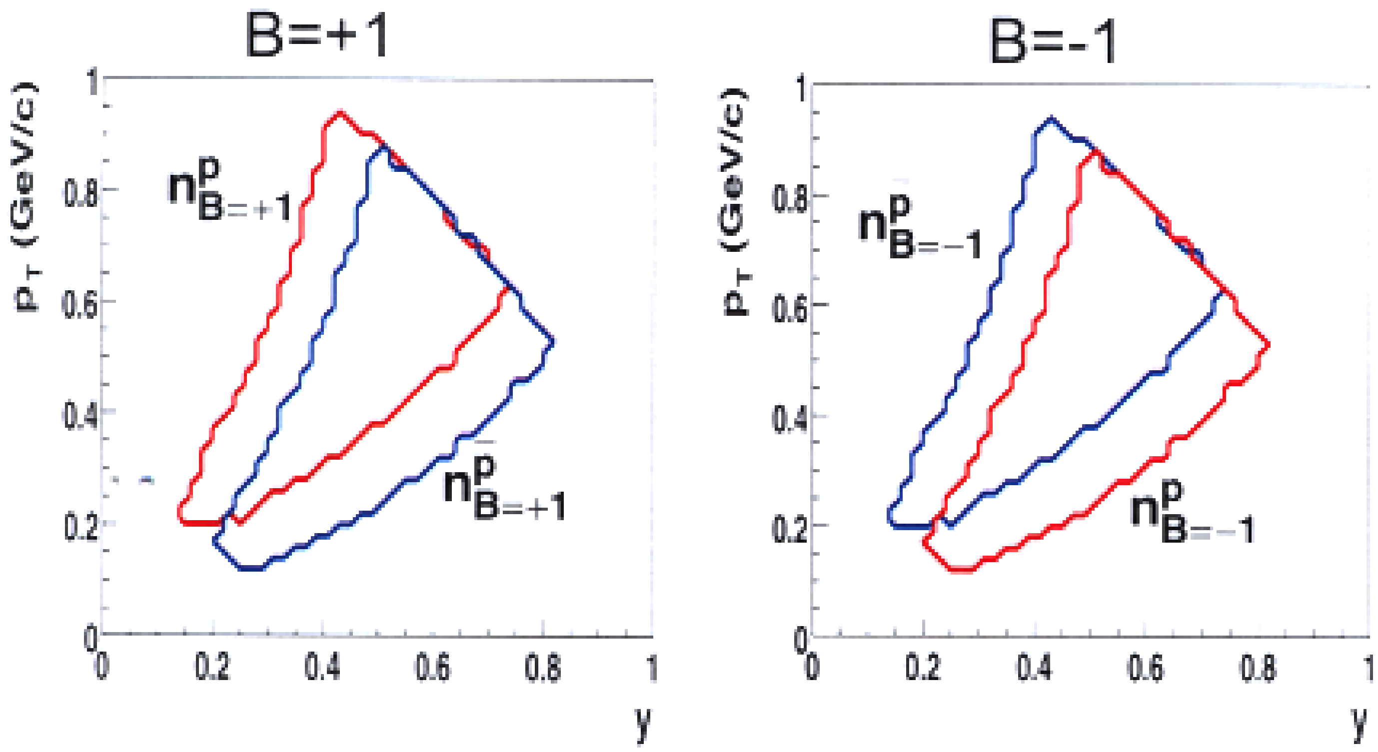




- Charge asymmetric



Particle Ratio Determination



$$\frac{\left\langle E\frac{dN}{dp^3}\right\rangle_{\bar{p}}}{\left\langle E\frac{dN}{dp^3}\right\rangle_{p}} = \frac{1}{2}\left(\frac{n^{\bar{p}}_{B=+1}}{n^{p}_{B=-1}} + \frac{n^{\bar{p}}_{B=-1}}{n^{p}_{B=+1}}\right) \underbrace{\times C_{sec.} \times C_{decay} \times C_{abs.}}_{\text{Ratio Corrections}}$$

n = number particles measured per event

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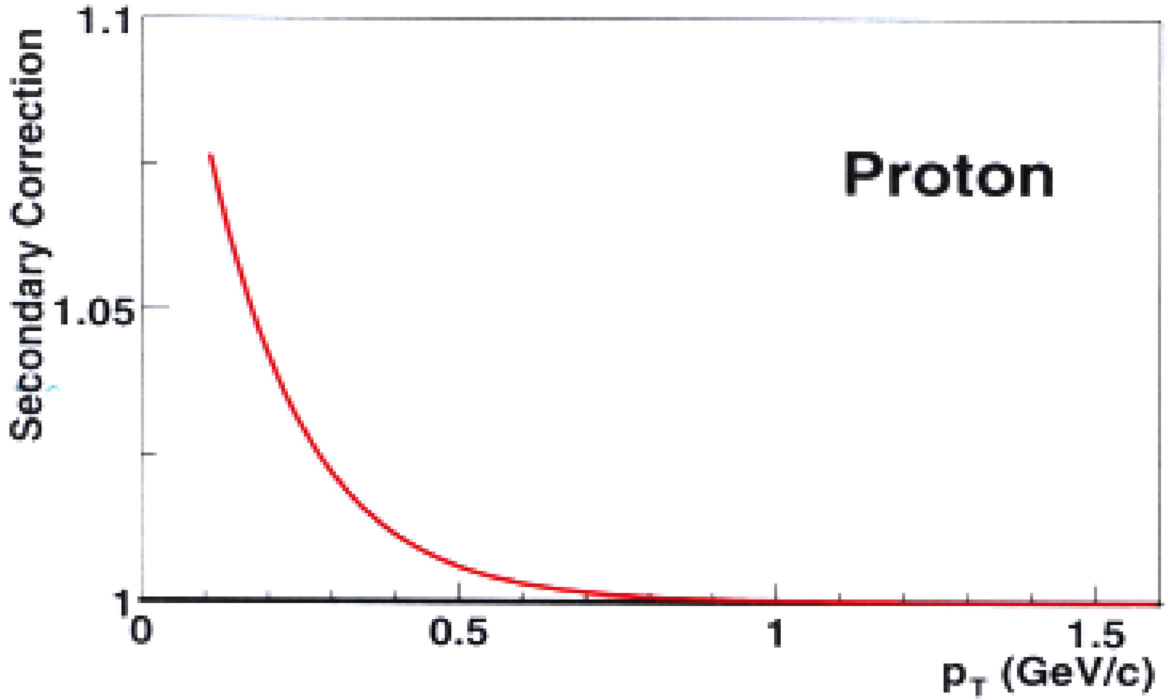
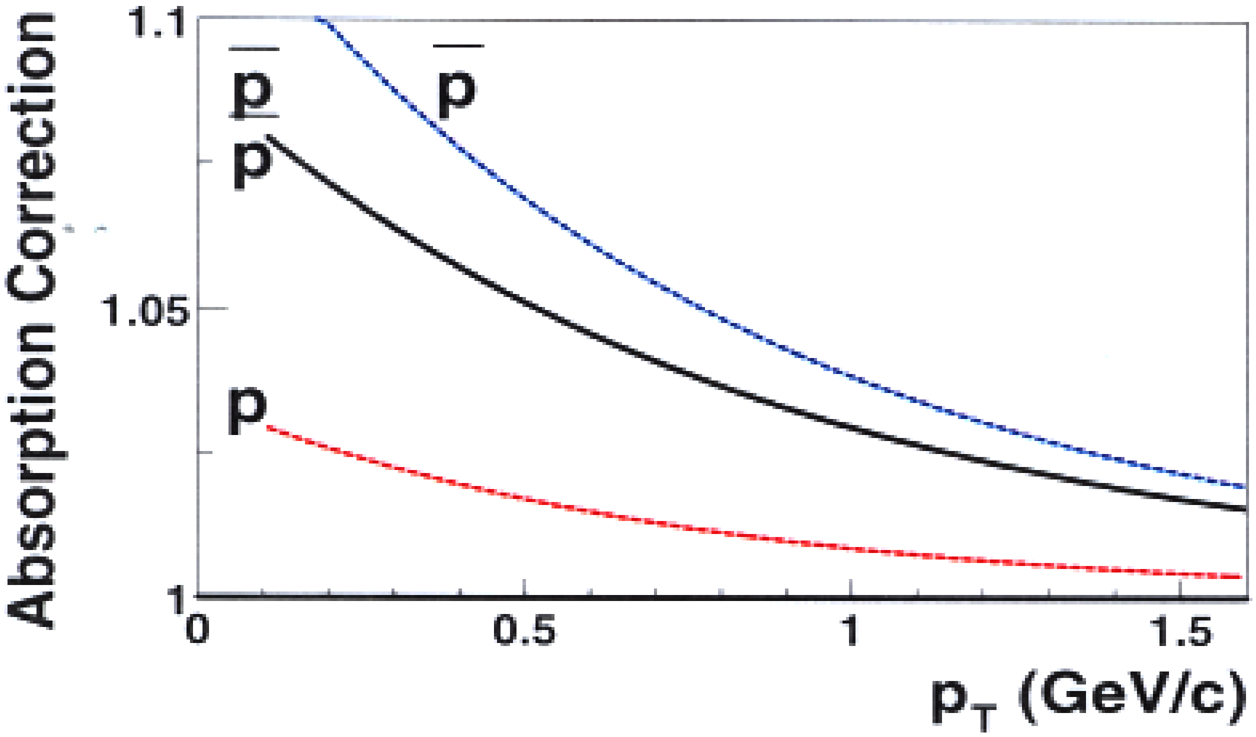
Ratio Corrections

Secondaries



Absorption

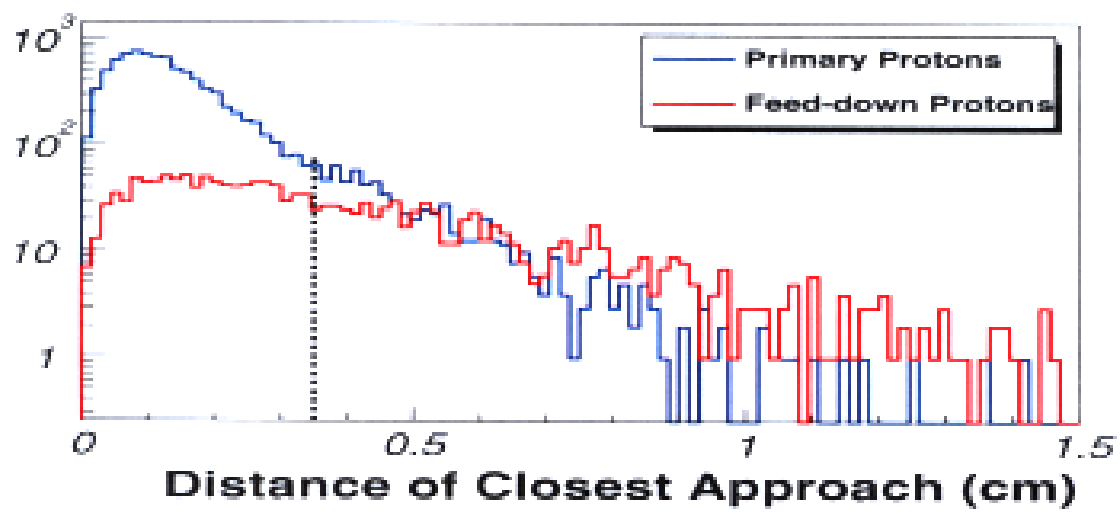


Feed-down Corrections

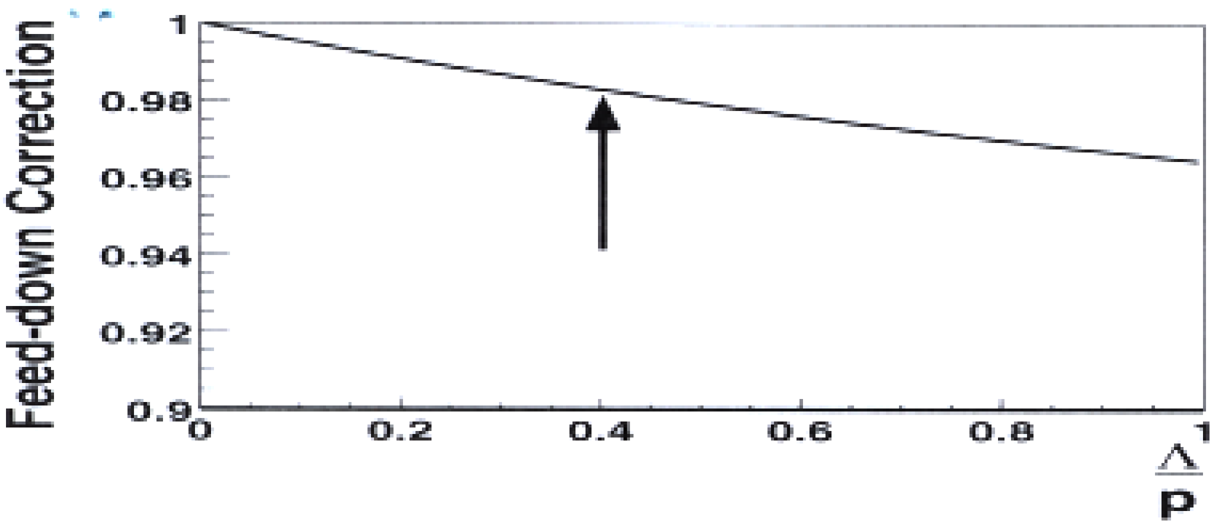
- Feed-down channels

$\Lambda \rightarrow p\pi^-$ $\Sigma^0 \rightarrow \Lambda\gamma$ $\bar{\Lambda} \rightarrow \bar{p}\pi^+$ $\bar{\Sigma}^0 \rightarrow \bar{\Lambda}\gamma$

- Tracking within 10 cm of interaction point
  => Good decay product rejection



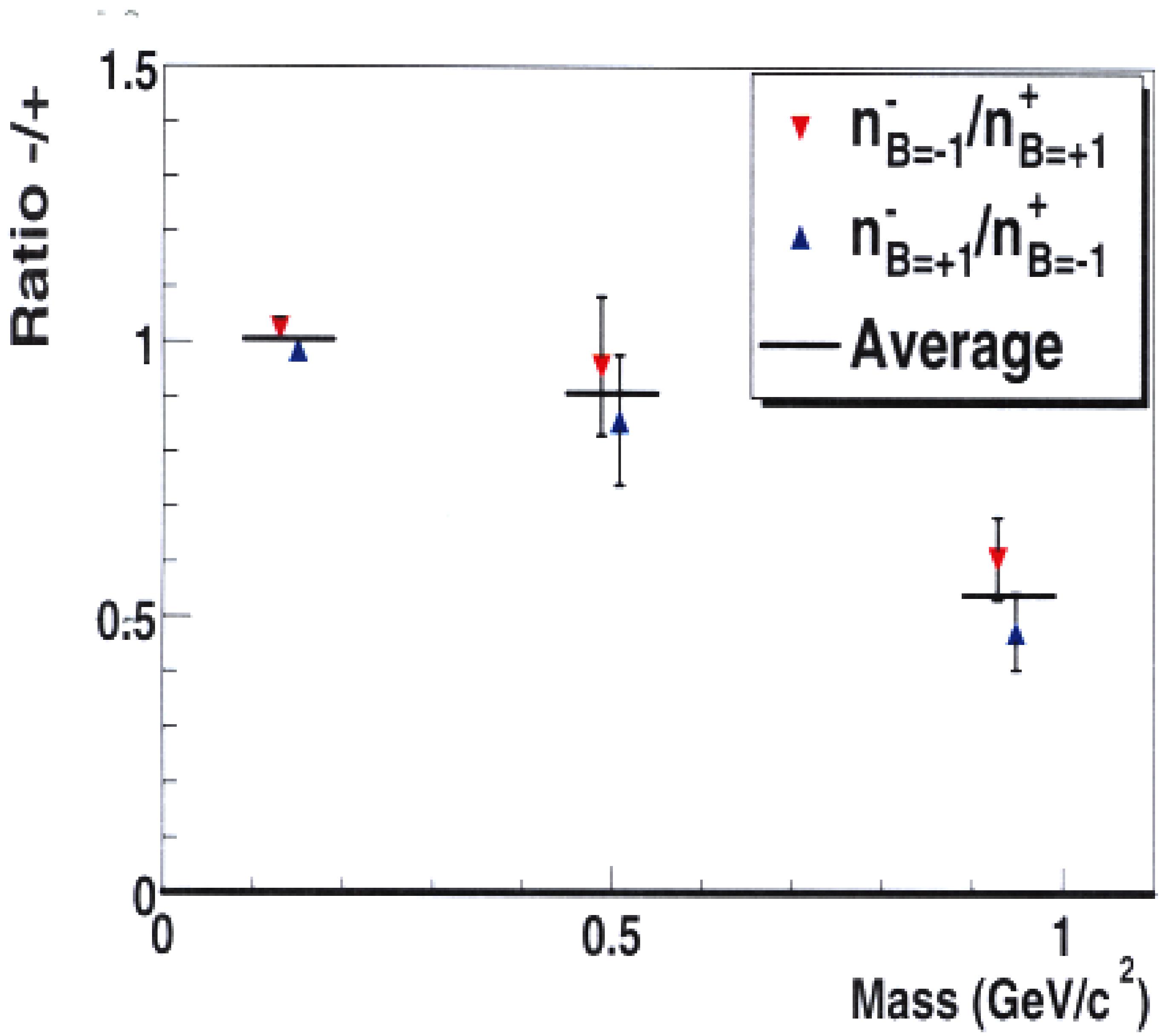
- Correction to $\bar{p}/p$ depends on Λ/p



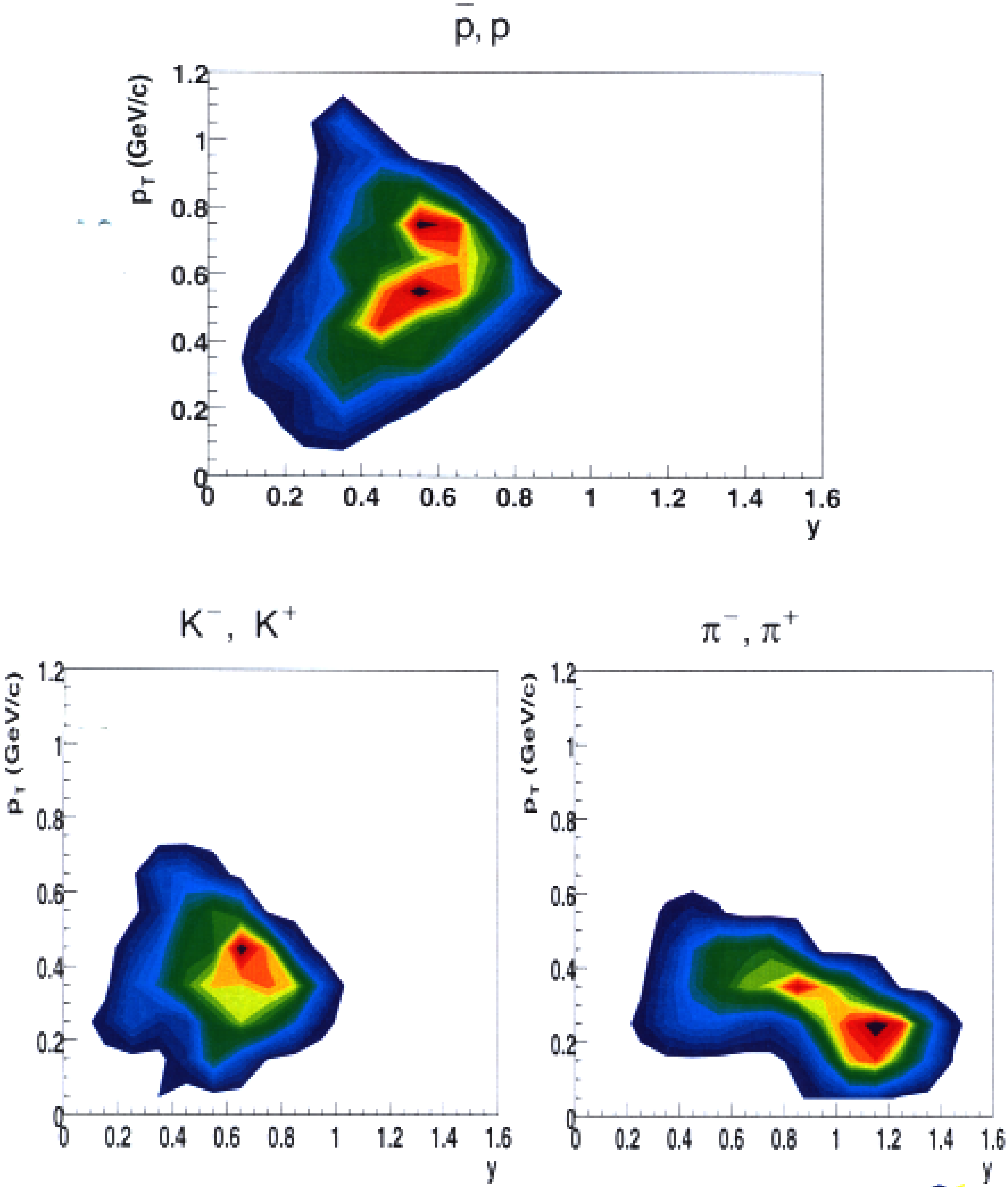
Evidence of canceling efficiencies

- Equality of particle ratios

Non-canceling effects would drive ratios in opposite directions



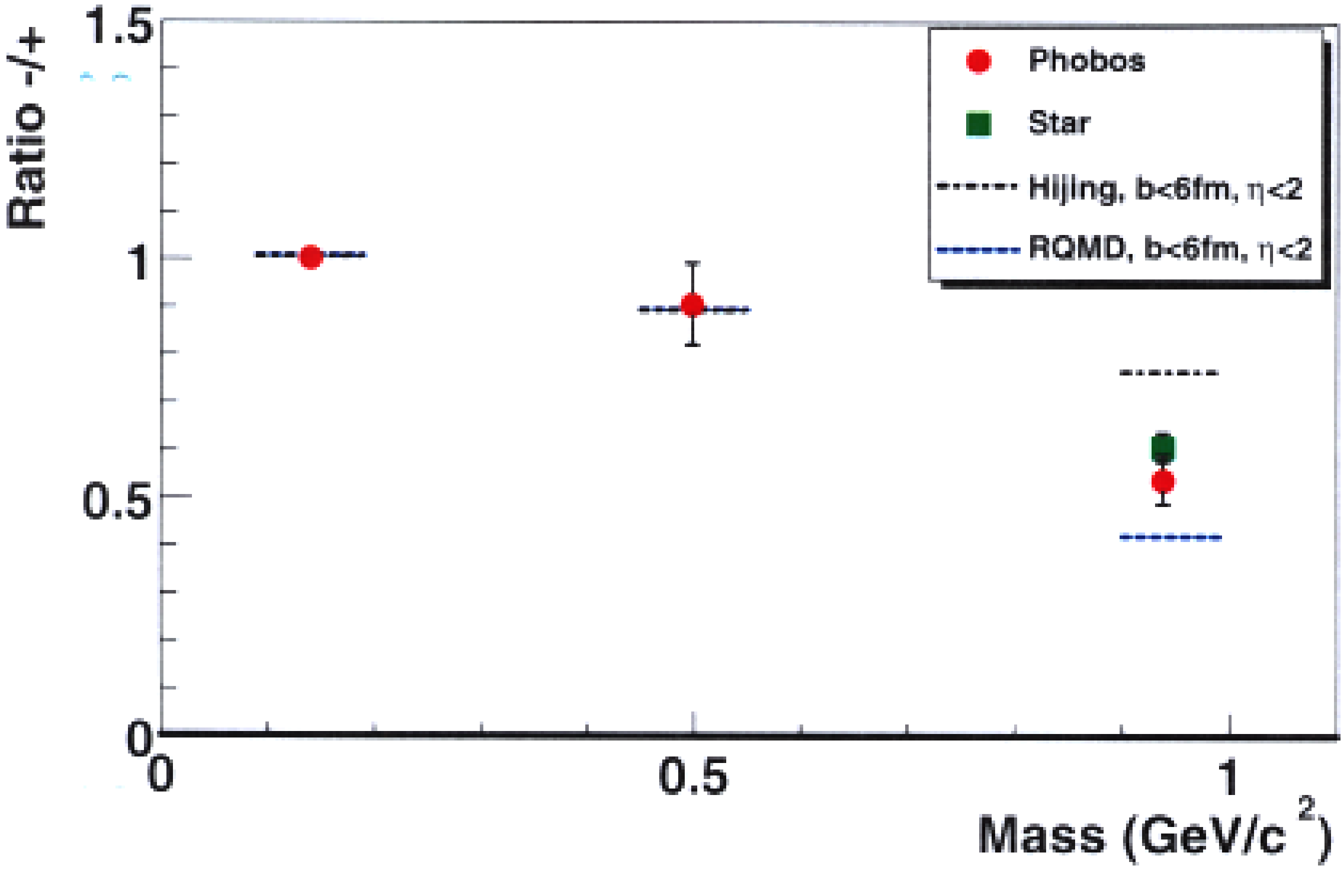
Average Kinematic Coverage



Results

Average Values

Centrality =12 %



$$\frac{\langle \pi^- \rangle}{\langle \pi^+ \rangle} = 1.01 \pm 0.01(\textbf{stat.}) \pm 0.05(\textbf{syst.})$$

$$\frac{\langle K^- \rangle}{\langle K^+ \rangle} = 0.91 \pm 0.09(\textbf{stat.}) \pm 0.1(\textbf{syst.})$$

$$\frac{\langle \bar{p} \rangle}{\langle p \rangle} = 0.54 \pm 0.05(\textbf{stat.}) \pm 0.1(\textbf{syst.})$$

Preliminary

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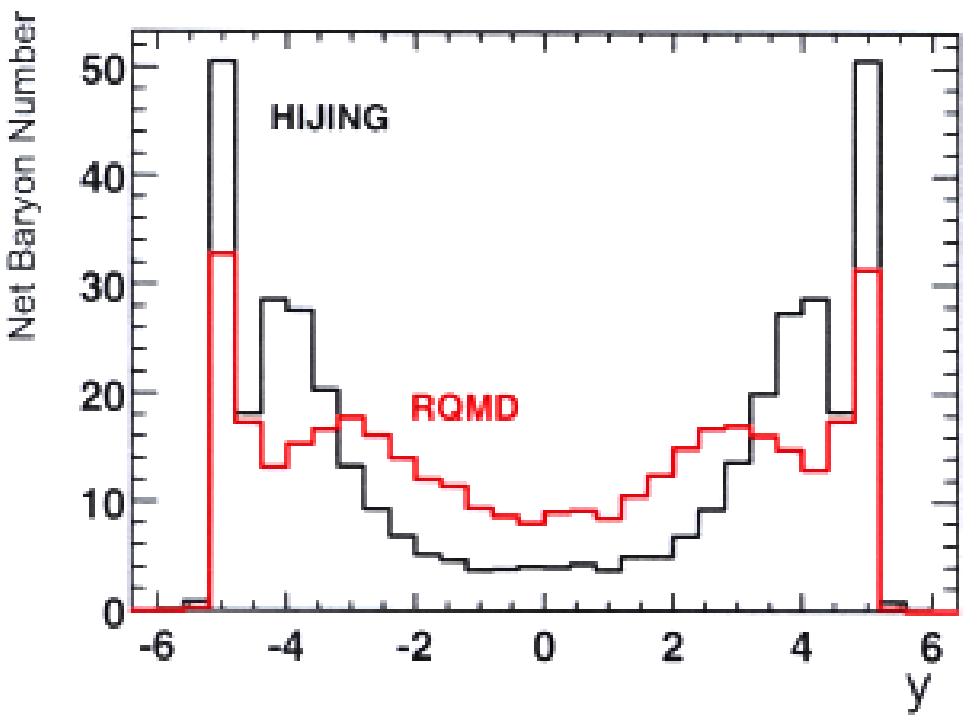
Baryon Transport

$$\left.\frac{\langle \bar{p} \rangle}{\langle p \rangle}\right|_{y\approx 0} = 0.54 \pm 0.05 \neq 1$$

$$\frac{\bar{\Lambda}}{\Lambda} \approx \frac{K^+}{K^-}\frac{\bar{p}}{p} = 1.1\frac{\bar{p}}{p}$$

=>Mid-rapidity region NOT baryon free

- Measured $\bar{p}/p$ between RQMD and Hijing. Each has different baryon stopping.



Hijing- Version 1.35 -b<6fm
RQMD- Version 2.4 –b<6fm

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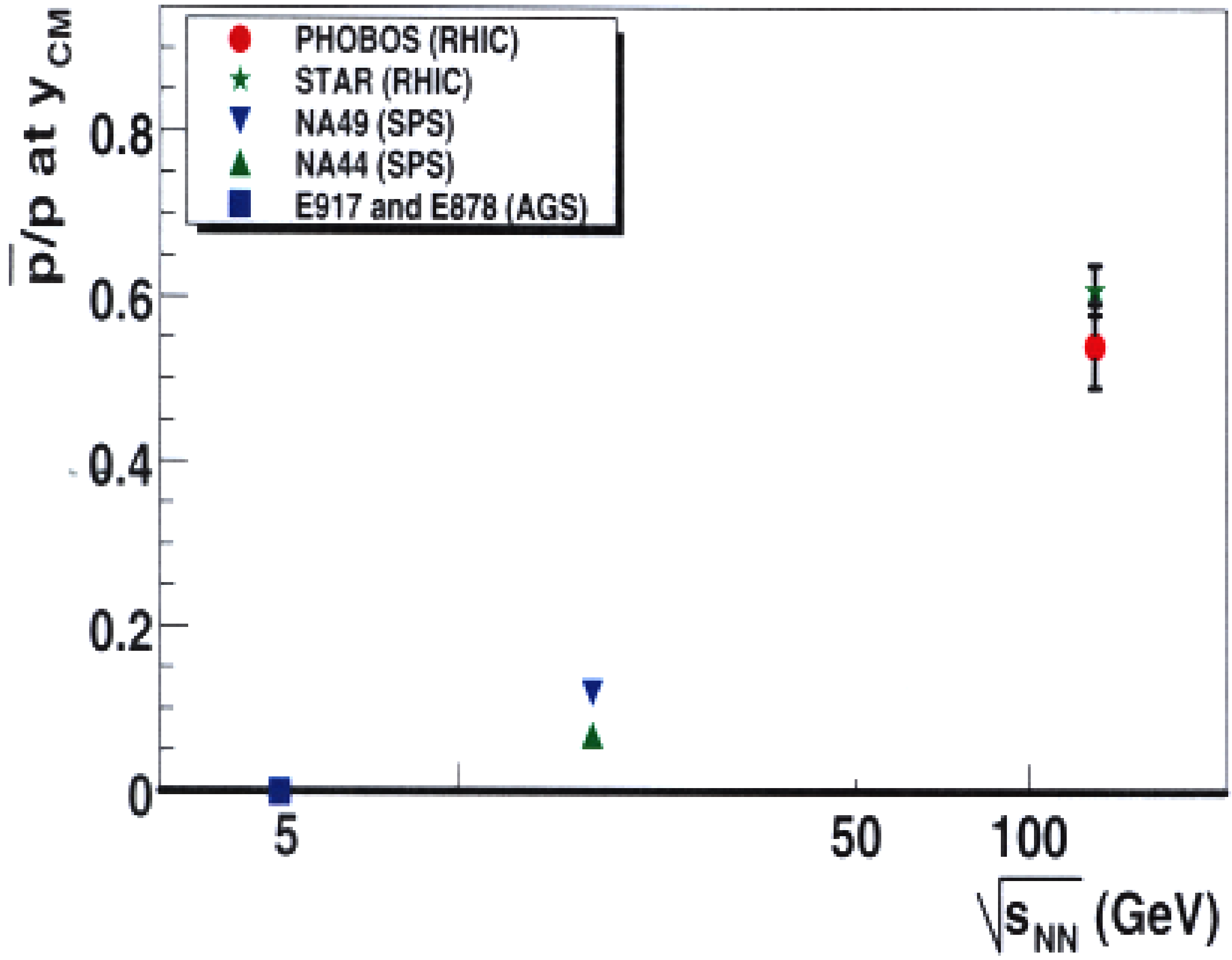
Systematics

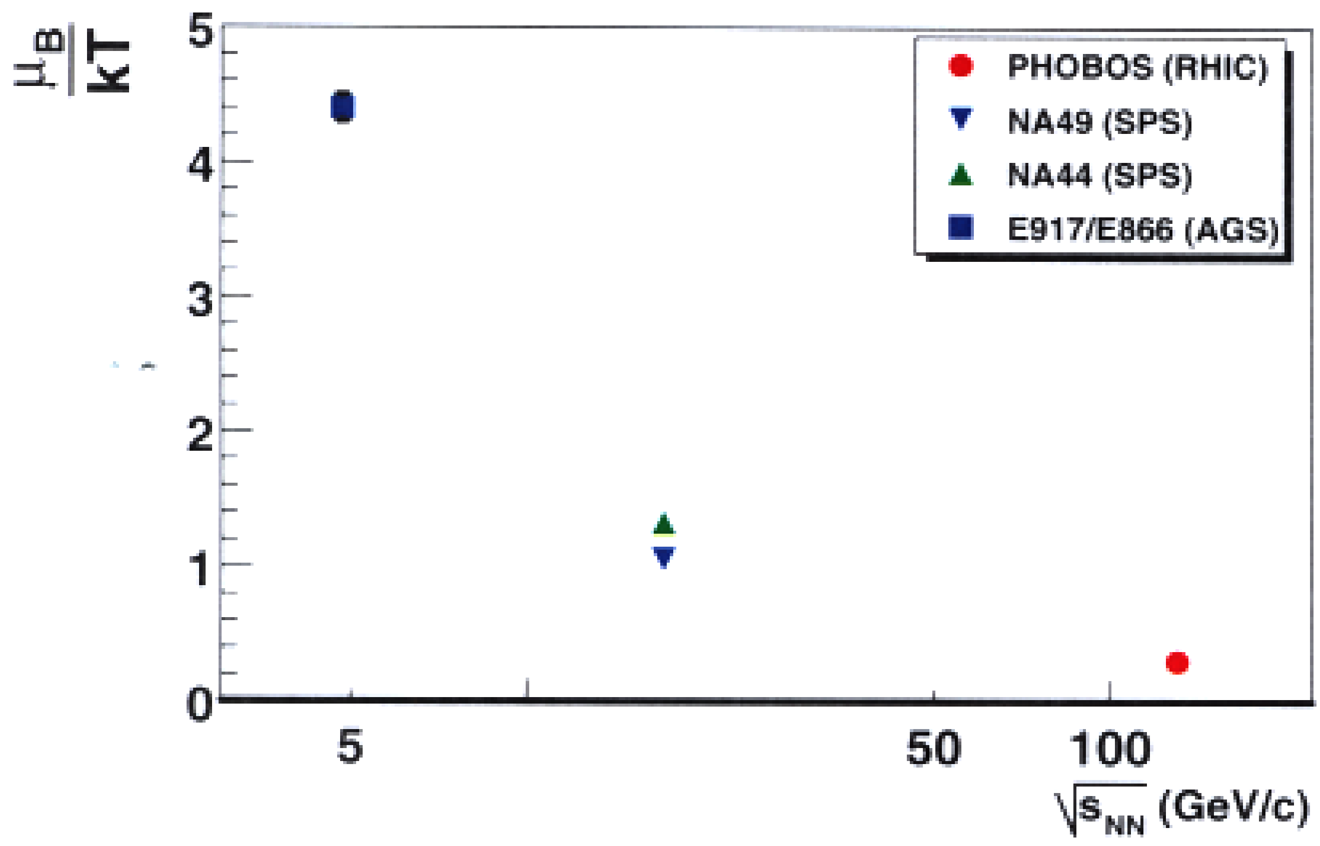
Proton Ratio Energy Dependence



Thermal Model Interpretation

$$\left.\frac{dN}{dp^3}\right|_{\bar{p}} \bigg/ \left.\frac{dN}{dp^3}\right|_{p} = \exp\left(\frac{2\mu_B}{kT}\right)$$

$$\frac{\mu_B}{kT} = 0.31 \pm 0.05(\text{stat.})$$



- Extract μ_B for typical temperatures

T(MeV)	μ_B (MeV)
200	~60
150	~45

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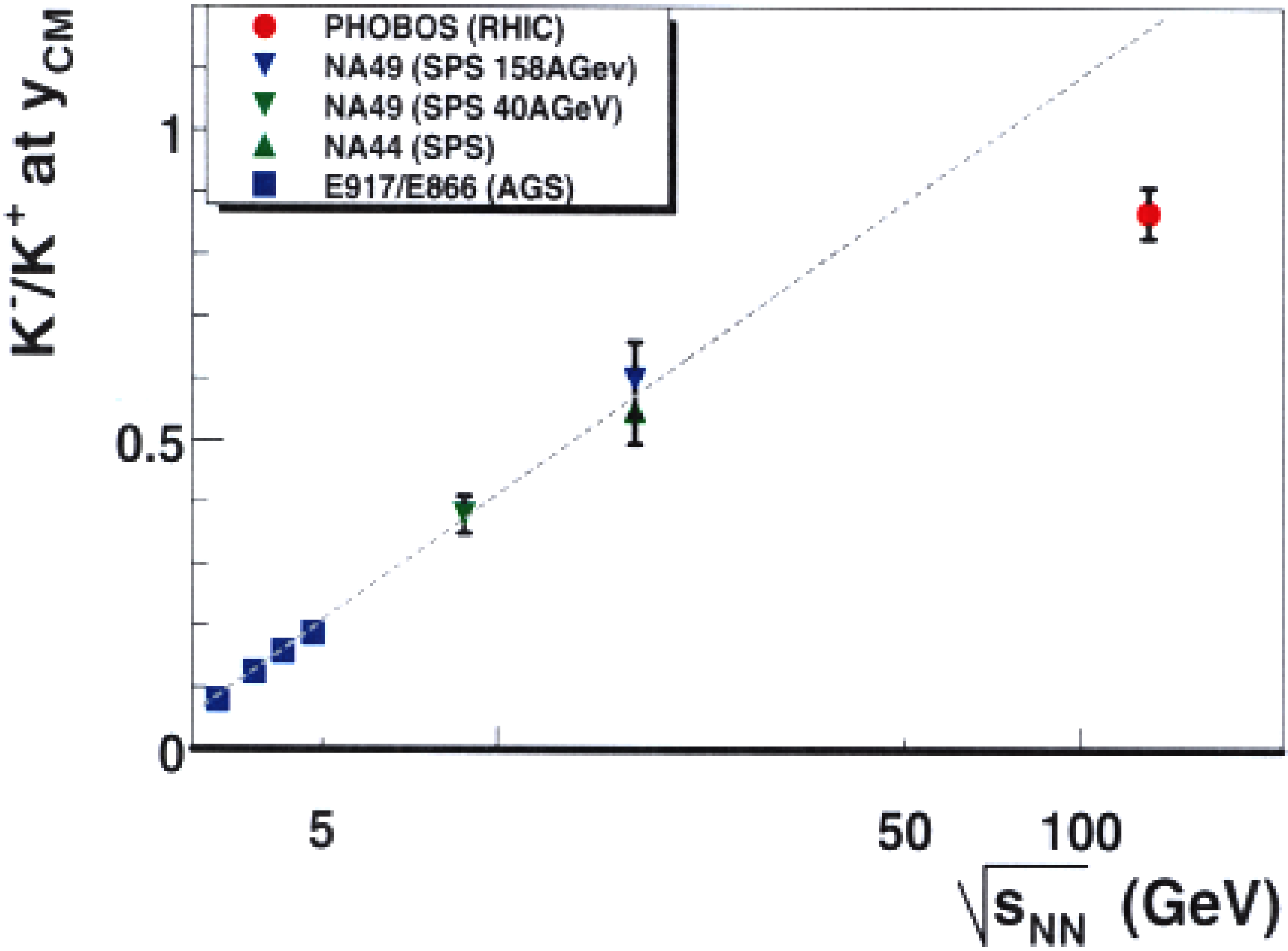
Systematics

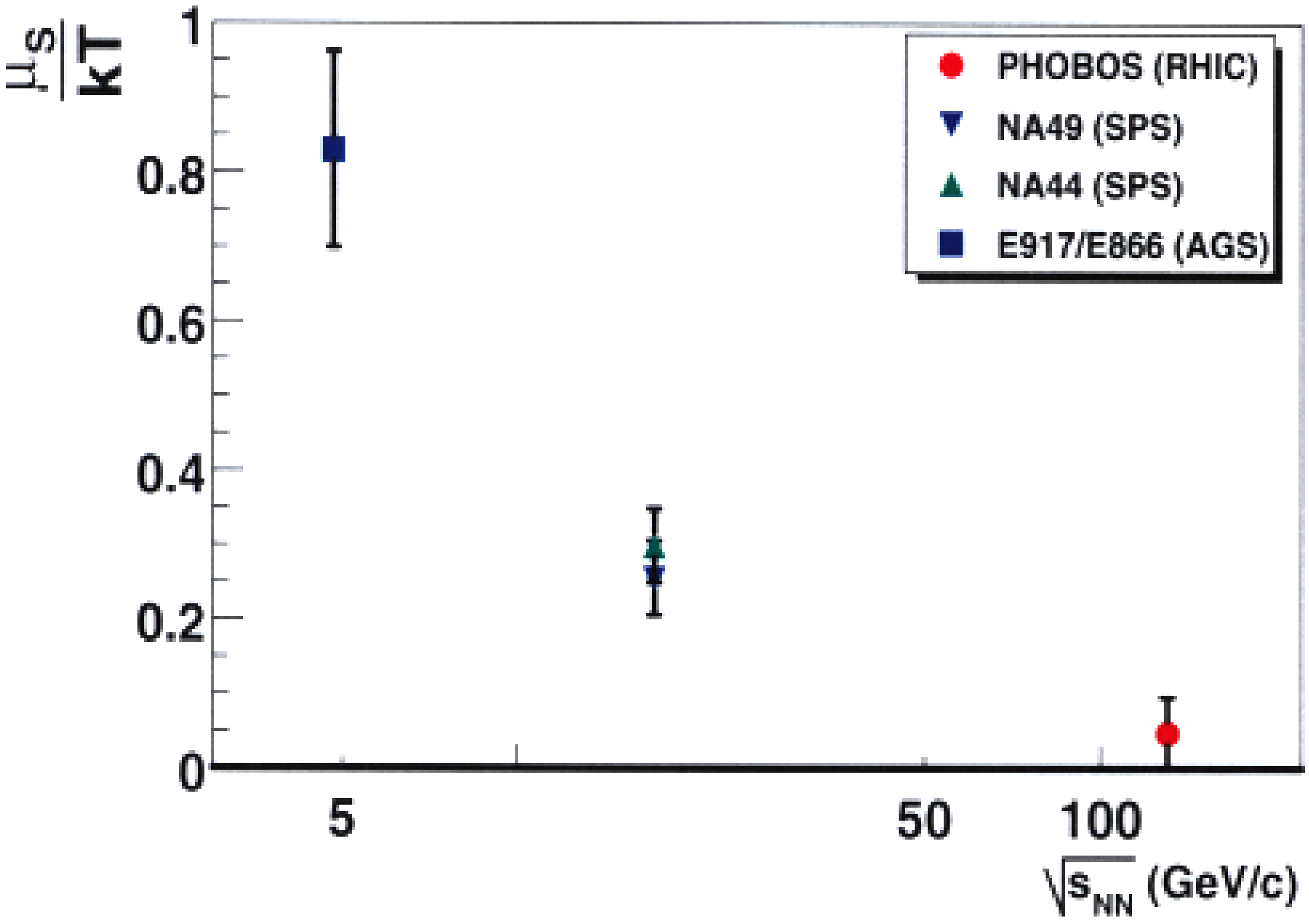
Kaon Ratio Energy Dependence



Thermal Model Interpretation

$$\left.\frac{dN}{dp^3}\right|_{K^+} \Big/ \left.\frac{dN}{dp^3}\right|_{K^-} = \exp\left(\frac{2\mu_S}{kT}\right)$$

- μ_S/kT very small



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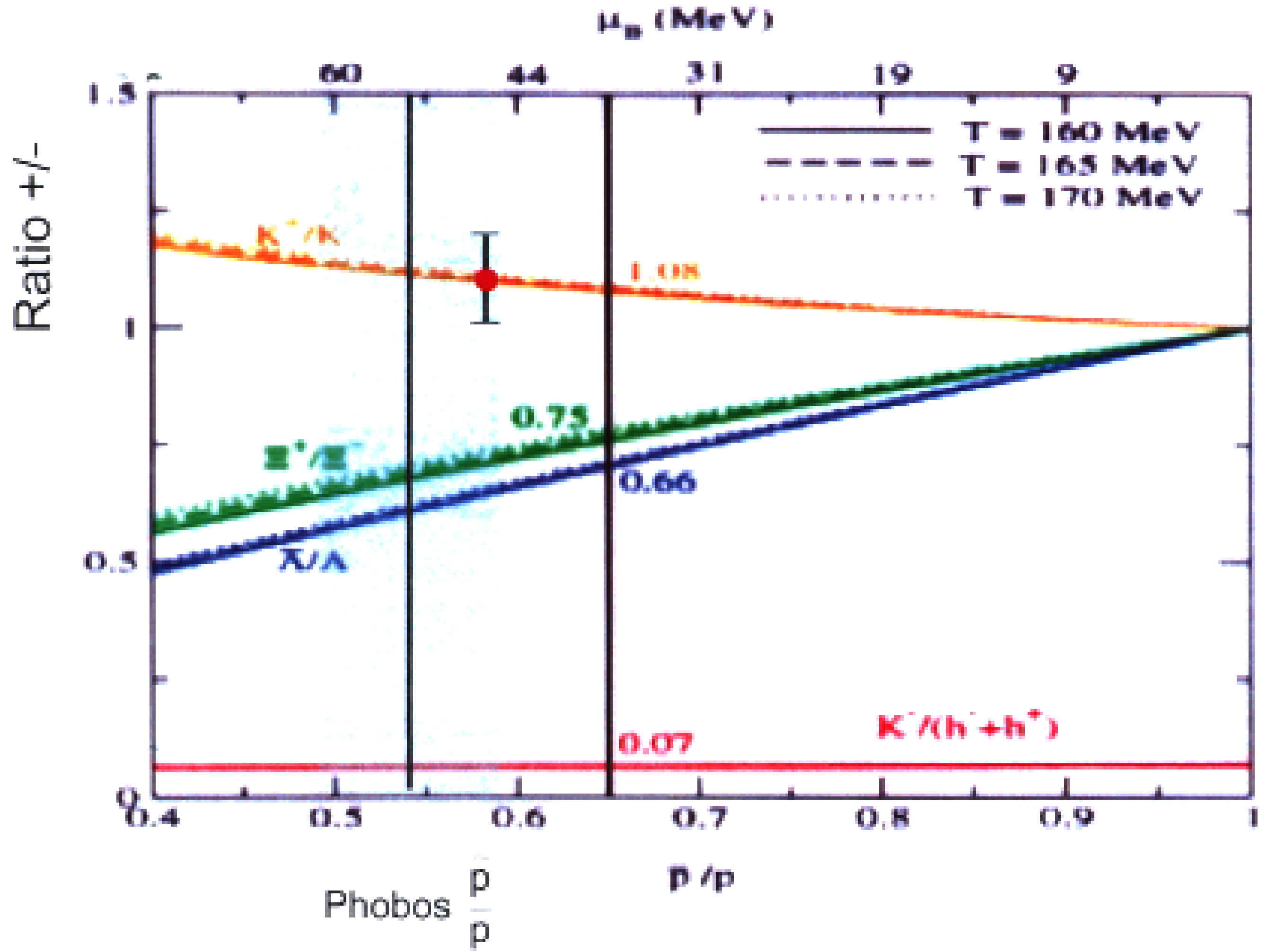
Thermal Model Comparison

- Thermal model presented by K. Redlich on Tuesday

F.Becattini, J. Cleymans, A.Keraneh, E. Suhonen,K. Redlish



Conclusions

- New energy regime,

  Preliminary Phobos ratio results

$$\frac{\langle \pi^- \rangle}{\langle \pi^+ \rangle} = 1.01 \pm 0.01(\textbf{stat.}) \pm 0.05(\textbf{syst.})$$

$$\frac{\langle K^- \rangle}{\langle K^+ \rangle} = 0.91 \pm 0.09(\textbf{stat.}) \pm 0.1(\textbf{syst.})$$

$$\frac{\langle \bar{p} \rangle}{\langle p \rangle} = 0.54 \pm 0.05(\textbf{stat.}) \pm 0.1(\textbf{syst.})$$

  ~Ycm, 12% most central

- Baryon Transport

  pbar/p ratio consistent with non-zero net baryon density at mid-rapidity

- Hadron Chemistry

  μ_B~50 MeV for typical T=150-200MeV