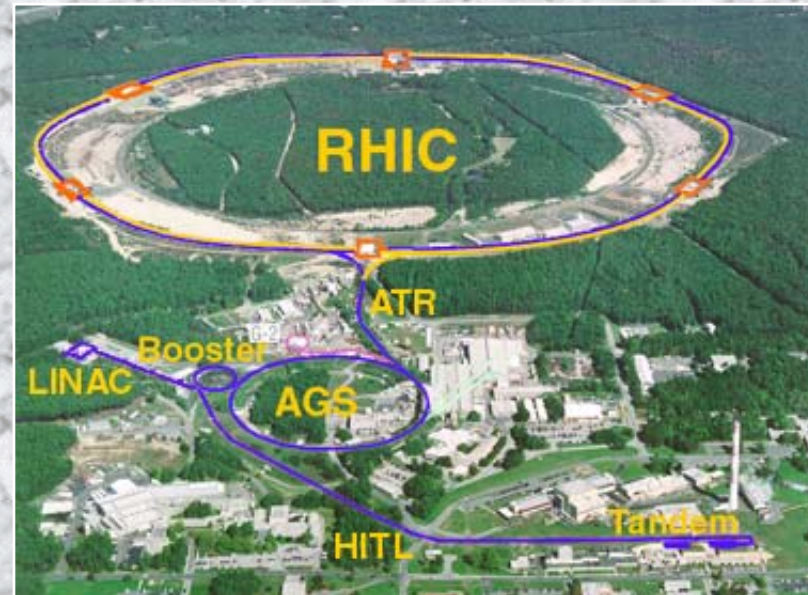


(Last results from PHENIX)

1. **RHIC**
2. **Run 1 results**
3. **PHENIX muon arms**
4. **Run 2 status**
5. **Future possibilities**

# 1. RHIC

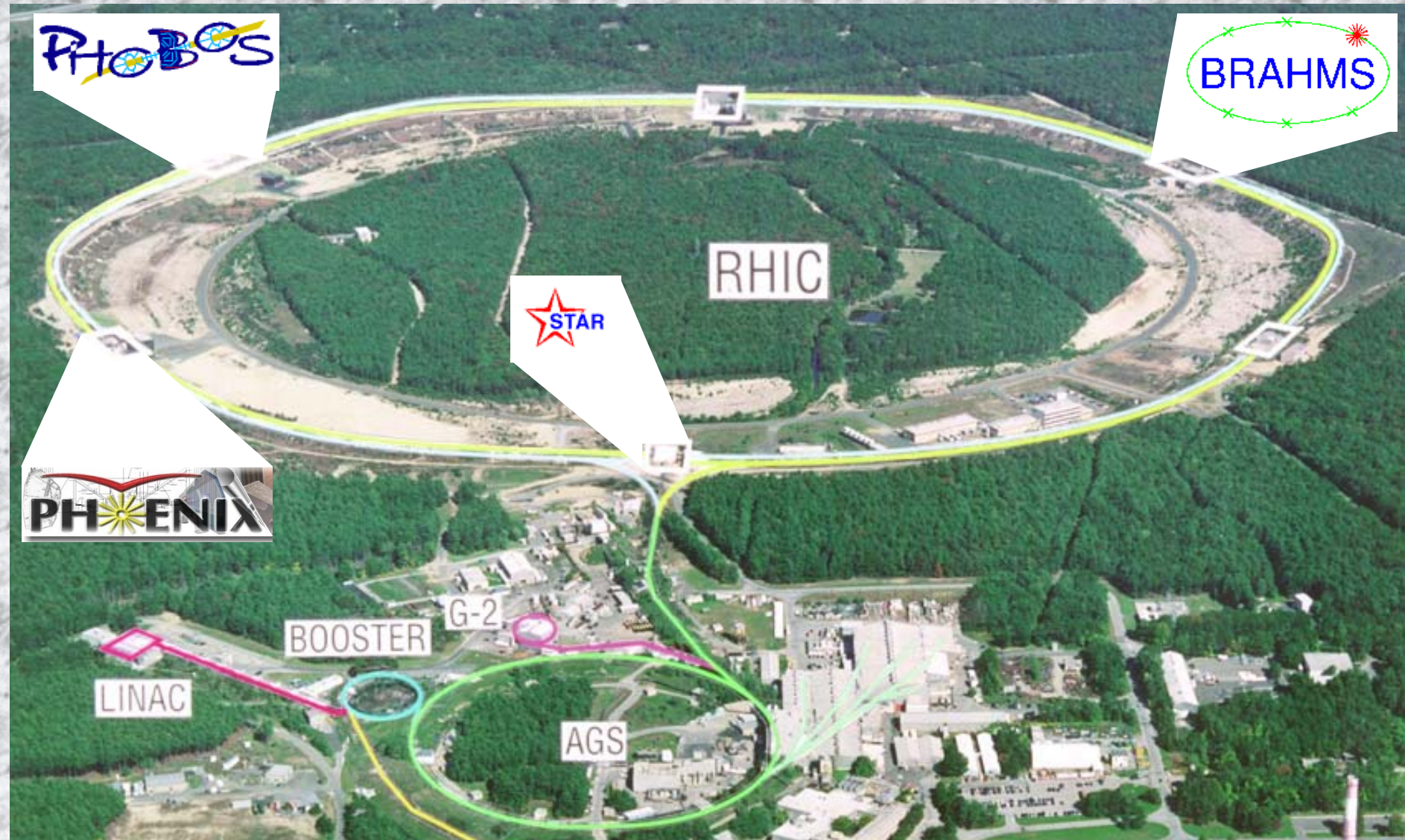


- Relativistic Heavy Ion Collider
  - 2.4 miles circumference
  - Proton + Proton (polarized)
    - $2 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$
    - 500 GeV
  - Gold + Gold
    - $2 \times 10^{26} \text{ cm}^{-2} \text{ s}^{-1}$
    - 200 GeV/nucleon
- Species in between



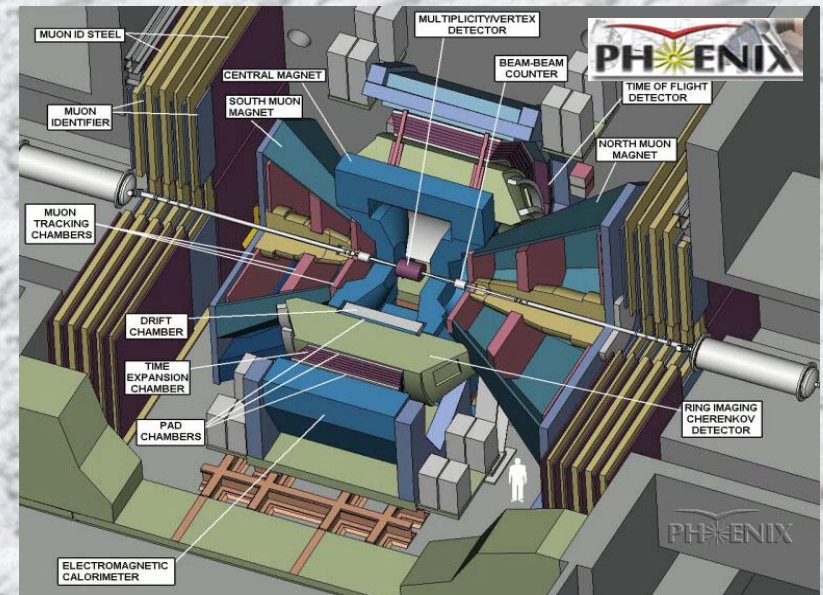
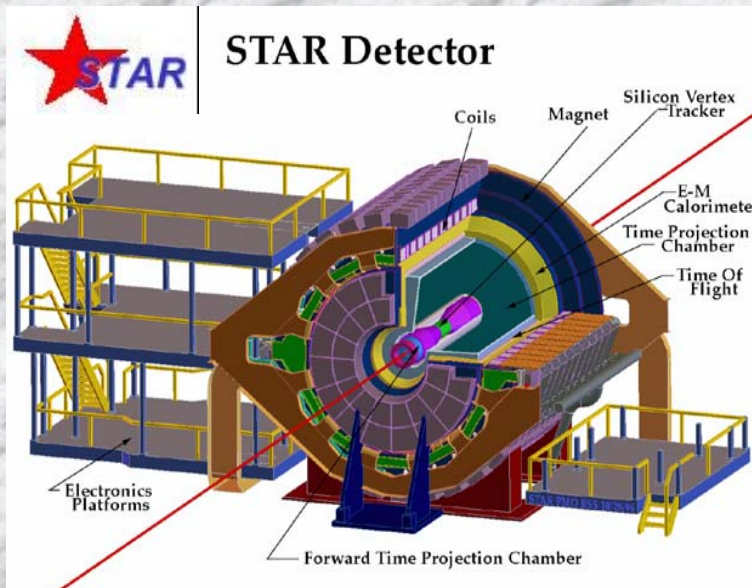
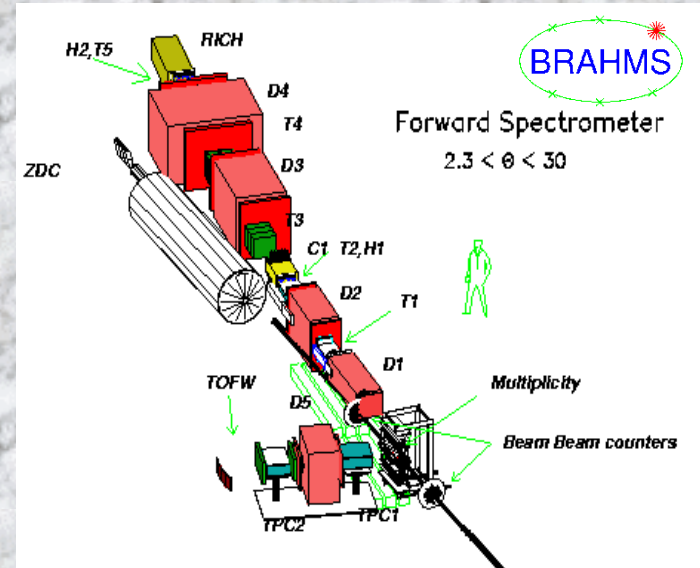
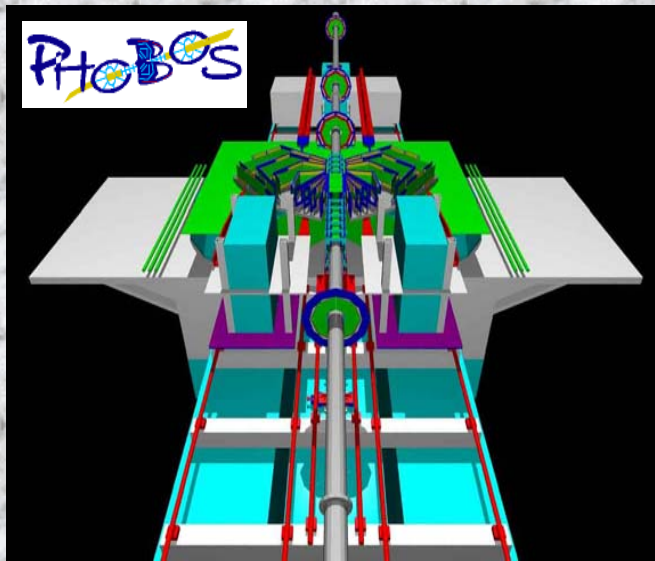


# 4 experiments





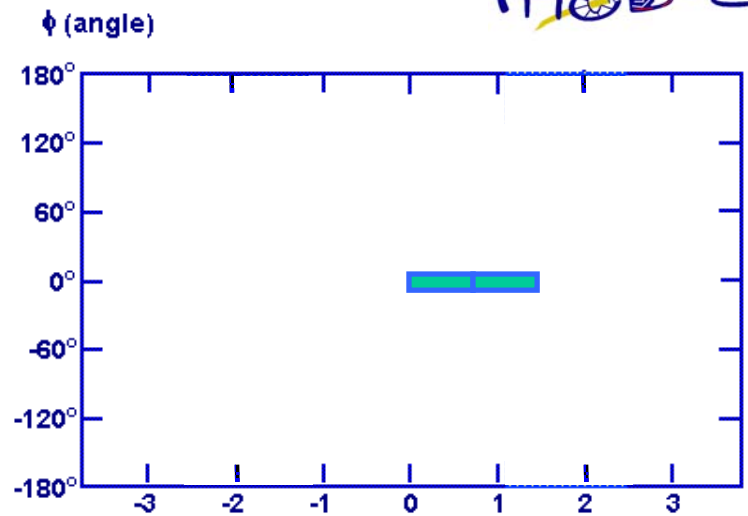
# 4 experiments



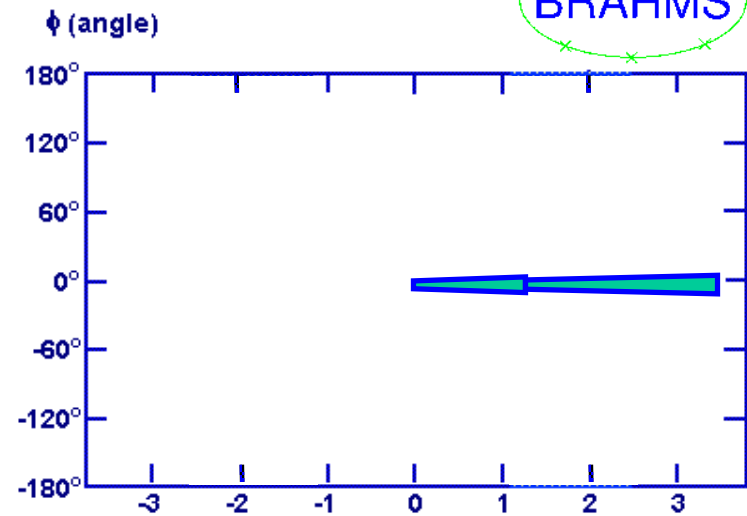
# Identified particle acceptances



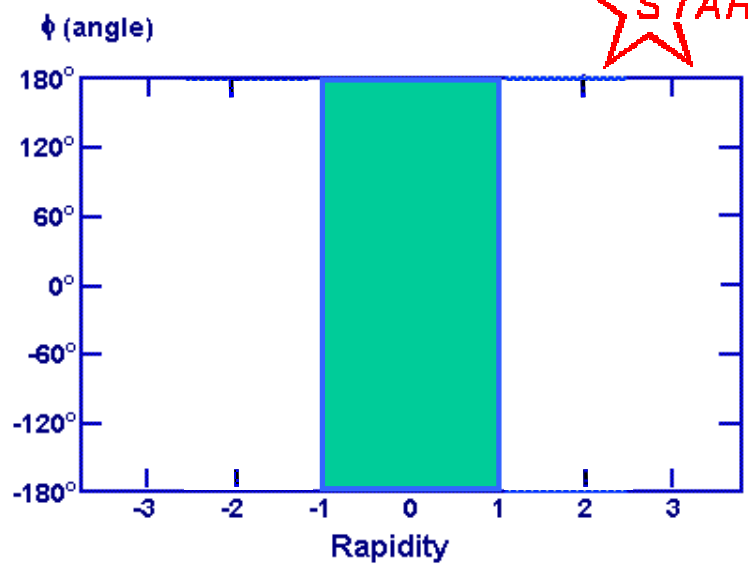
**PHOBOS**



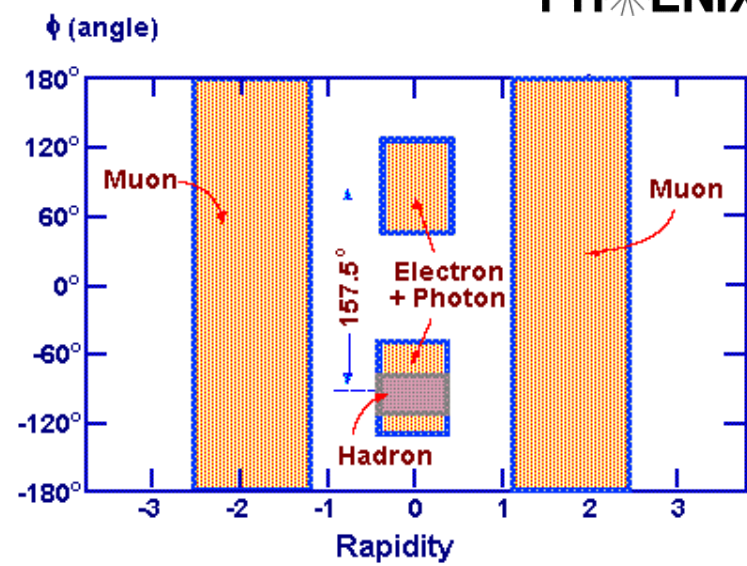
**BRAHMS**



**STAR**

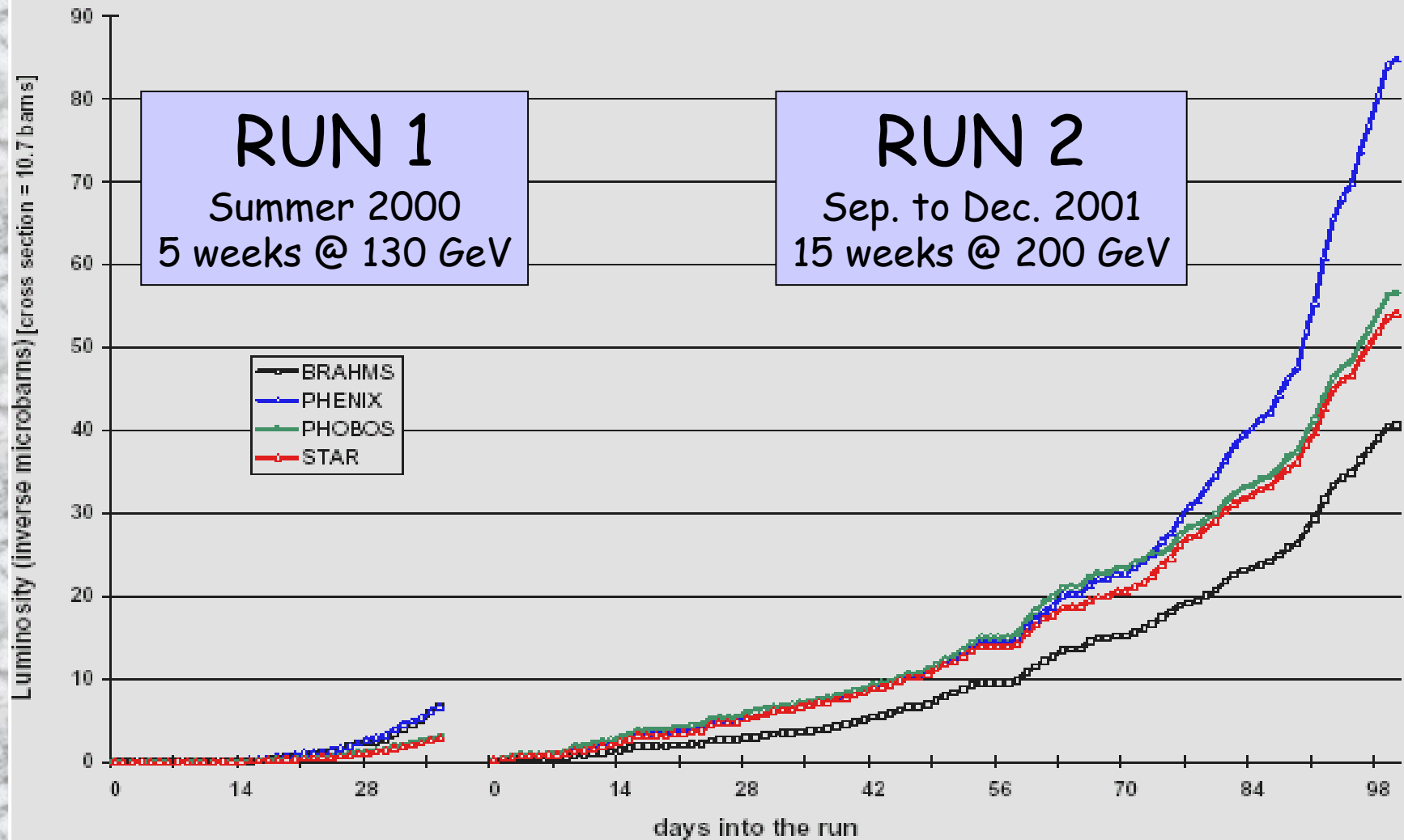


**PHENIX**





RHIC Experiment Integrated Luminosity – Gold Ion Operations  
fy'00, & fy01-02



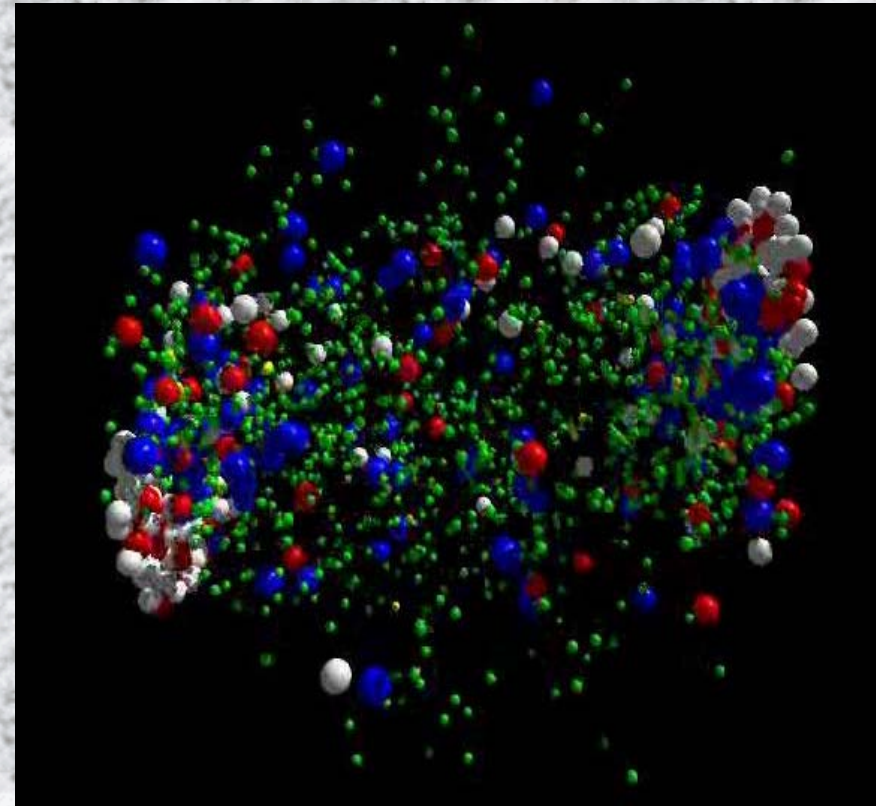
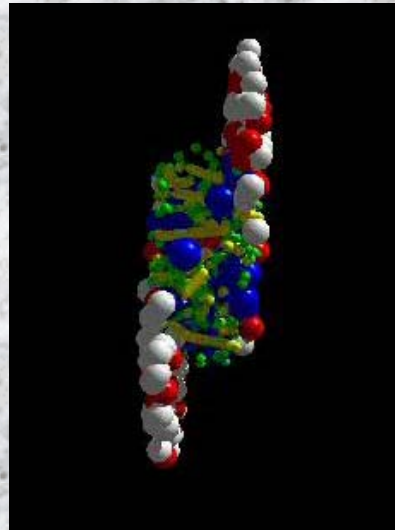
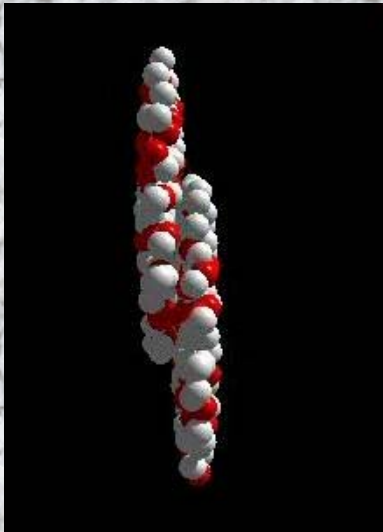
### ➤ Selection of results from run 1

- First Gold-Gold run
- Int. Luminosity  $\sim 8 \mu\text{b}^{-1}$
- Energy = 130 GeV / nucleon
- > 20 preprints, others in preparation
- No dimuons, PHENIX not yet equipped

### ➤ First results from run 2

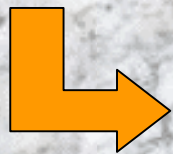
- Multiplicities from Brahms & Phobos





## Initial conditions

- Energy density
- Charge multiplicity
- Baryonic transparency



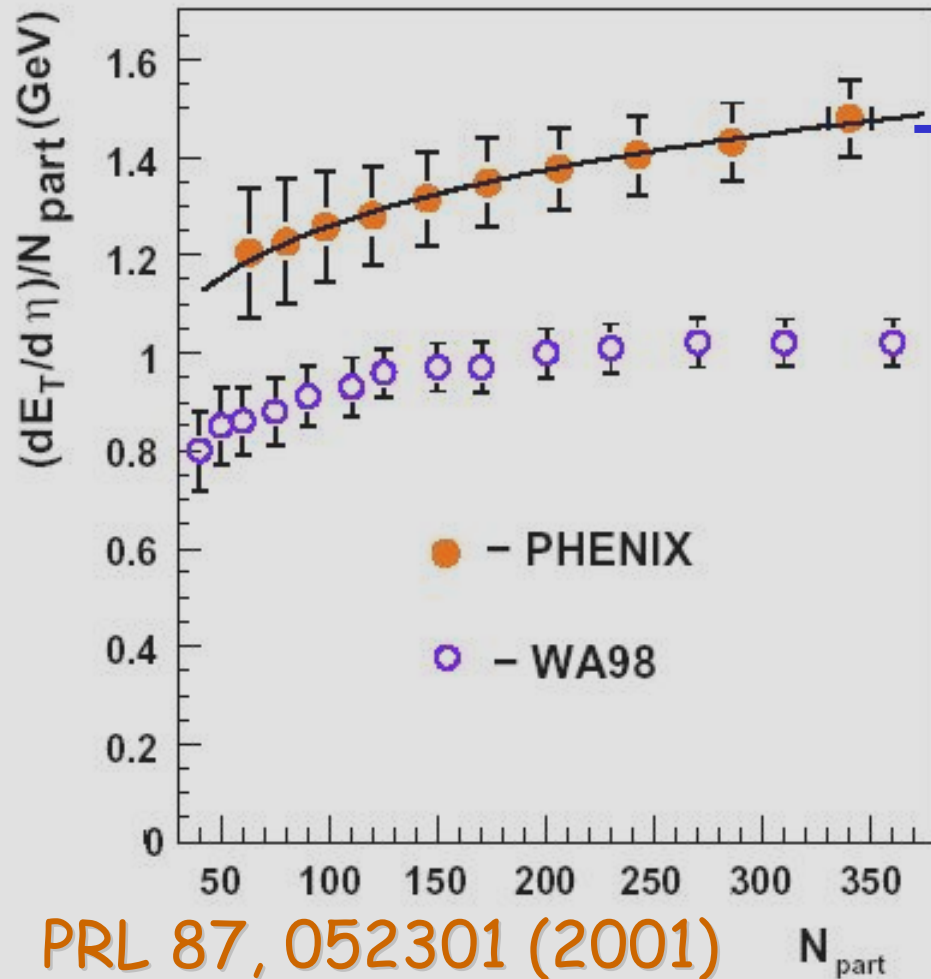
## First moments

- Jet quenching ?
- Elliptic flow



## Cooling and hadronisation





$dE_T/dy)_{y=0}$   
Bjorken  
energy density  
(2% most central events)

> 4,6 GeV/fm<sup>3</sup>

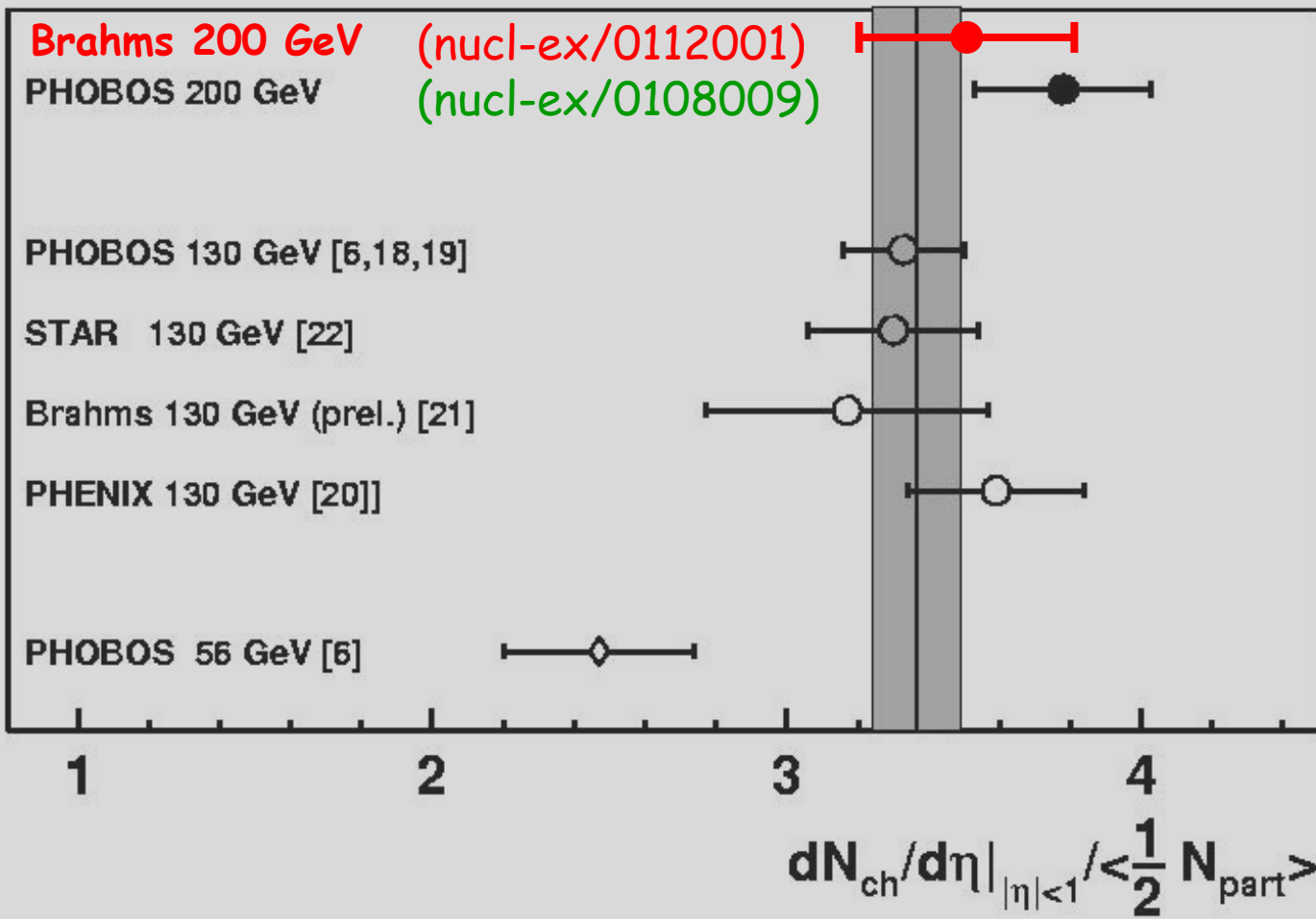
@ RHIC

2,9 GeV/fm<sup>3</sup>

@ SPS

+ 60 %

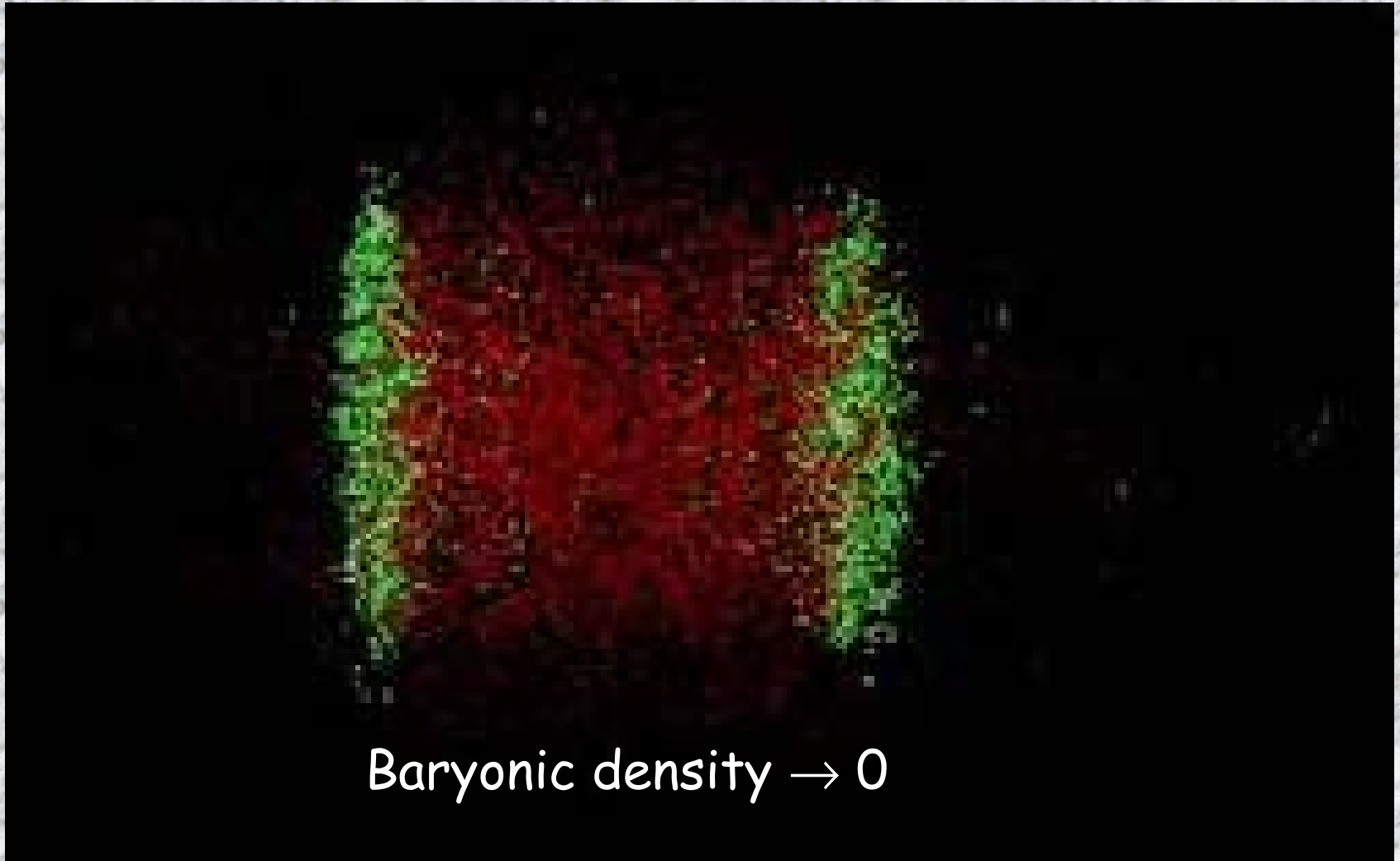
$dN_{ch}/d\eta$  @  $\eta=0$  for 56, 130 and 200 GeV (5% most central)



**RUN 2**

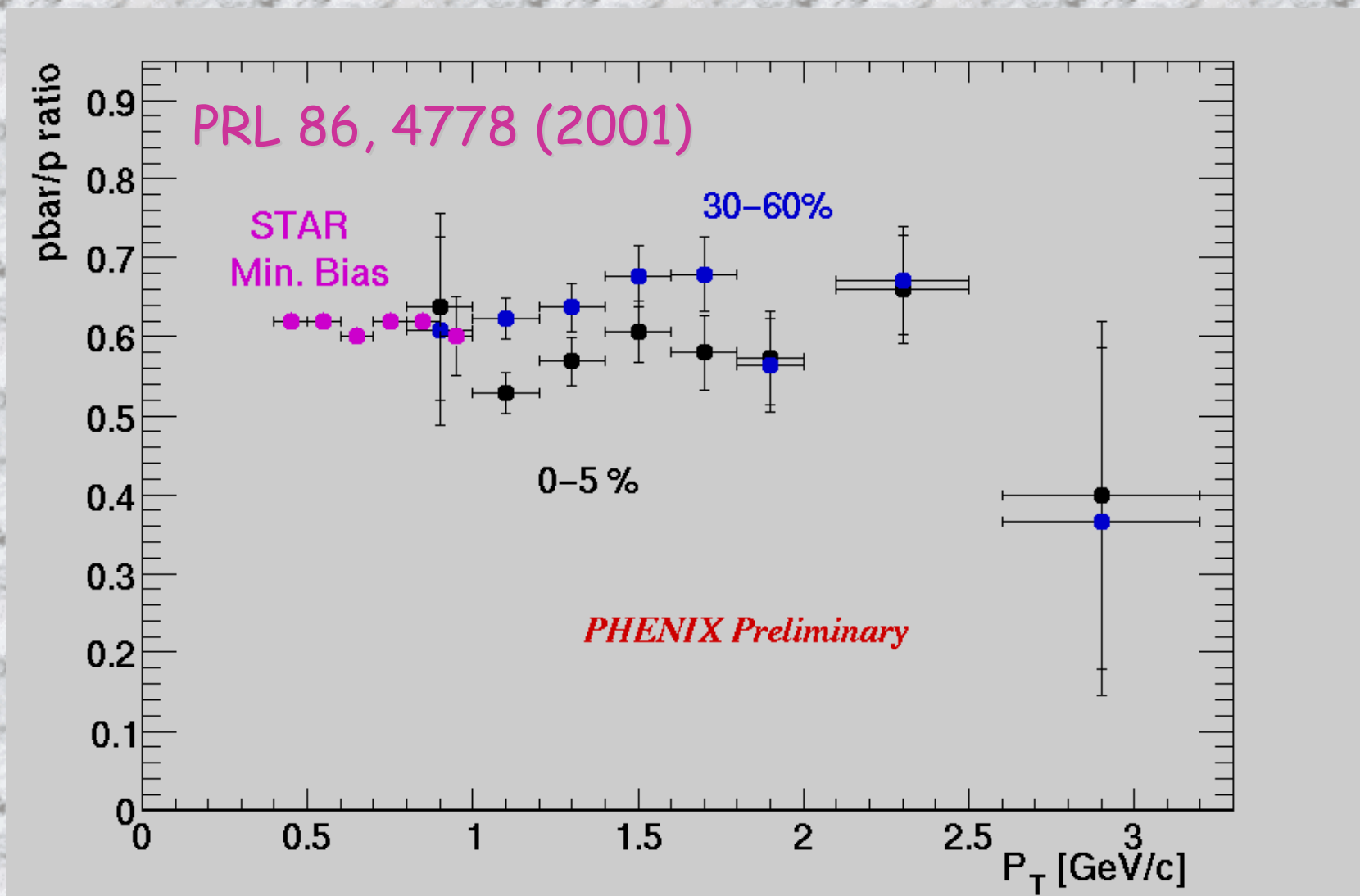
**+ 14 %  
from 130  
to 200 GeV**





Baryonic density  $\rightarrow 0$

Probed through antiparticle/particle ratio

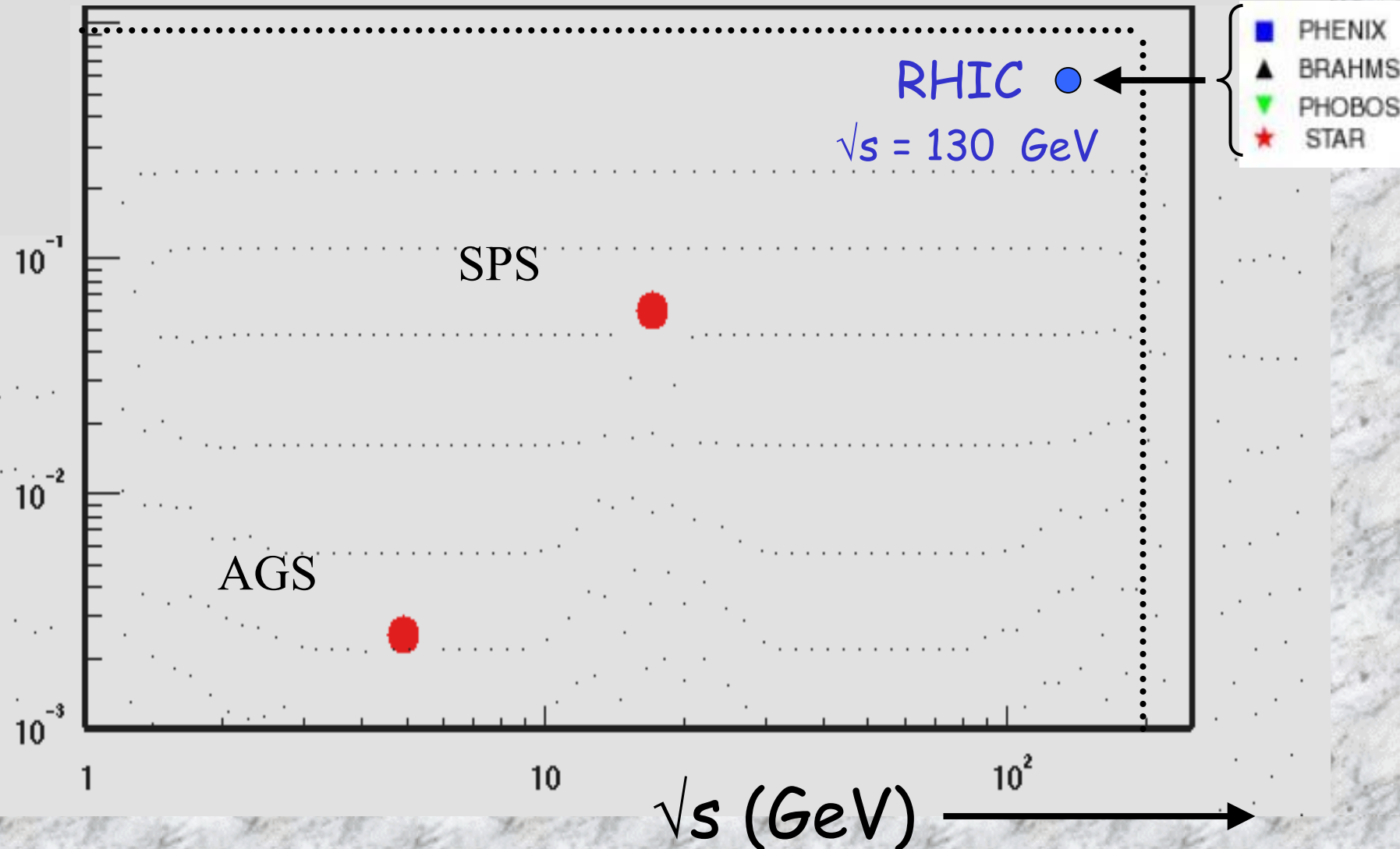


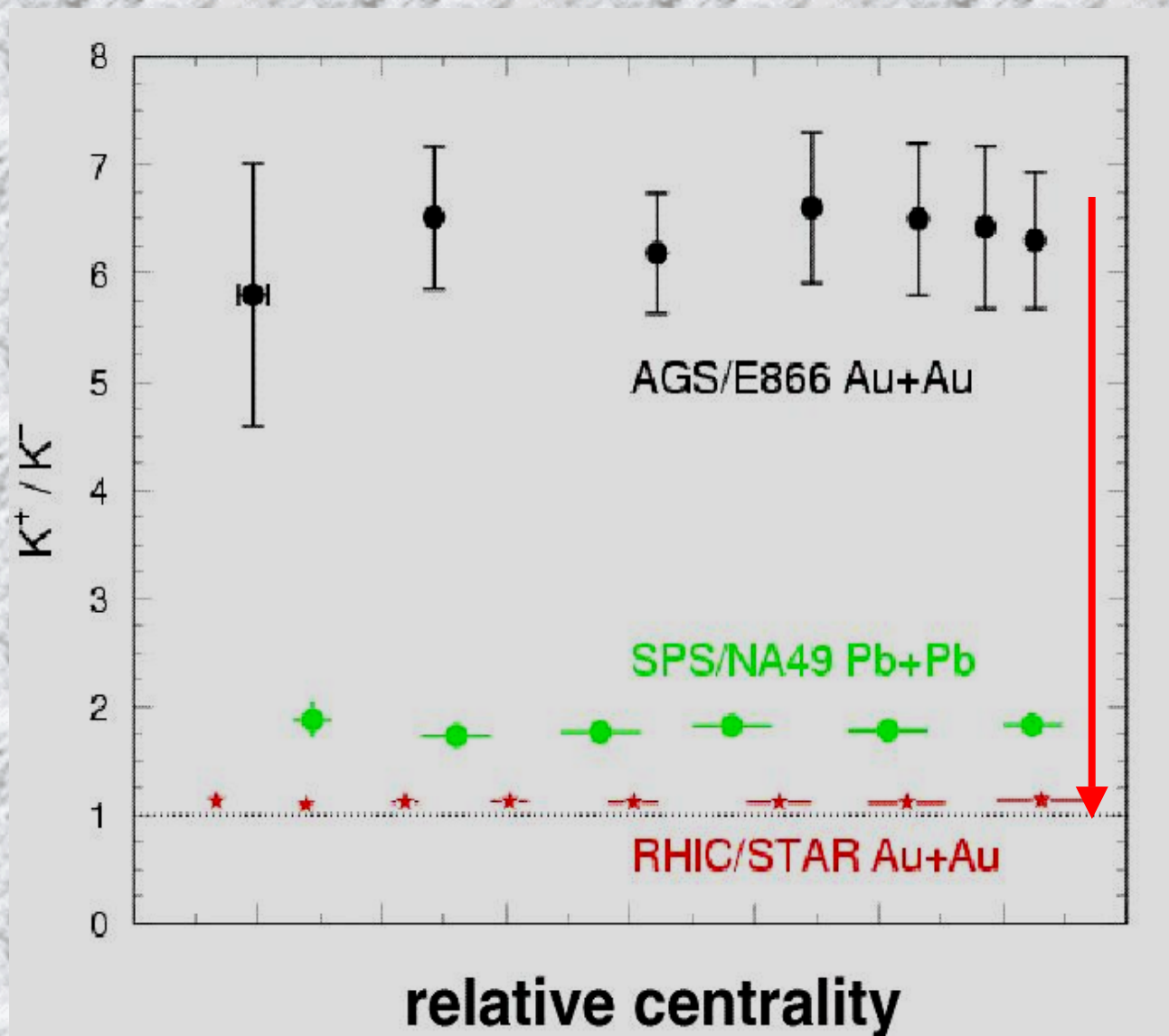


# Antiproton/proton vs energy



We should be very close to transparency @ 200 GeV





$K^+ / K^- = 1,12 \pm 0,06$

$K^+ / K^- \rightarrow 1$

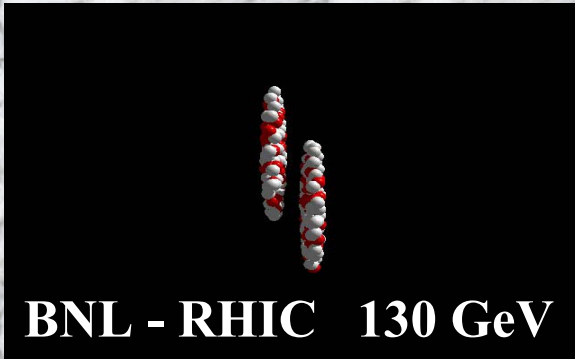
Same for

- $\bar{p} / p$
- $\bar{\Xi} / \Xi$
- $\bar{\Lambda} / \Lambda$



Quasitransparency





Energy density

Transparency

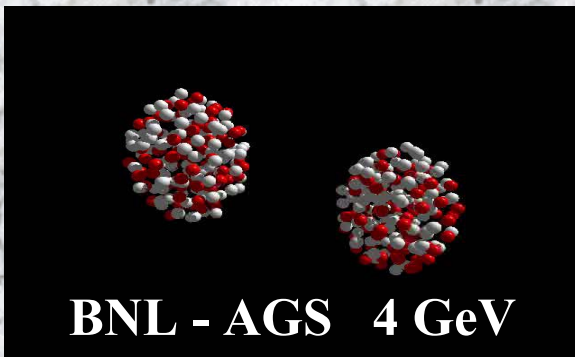
4.6

yes



2.9

little

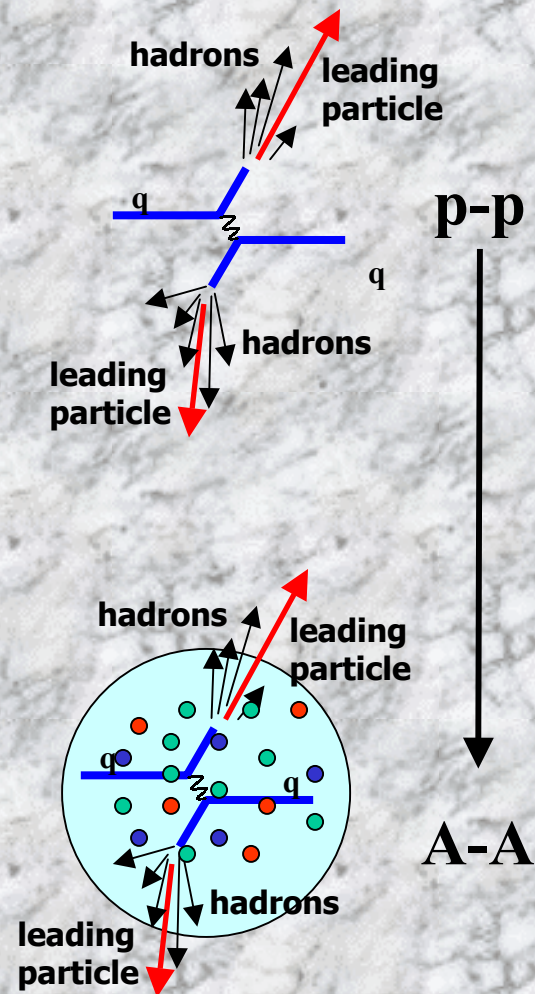


1.4

no

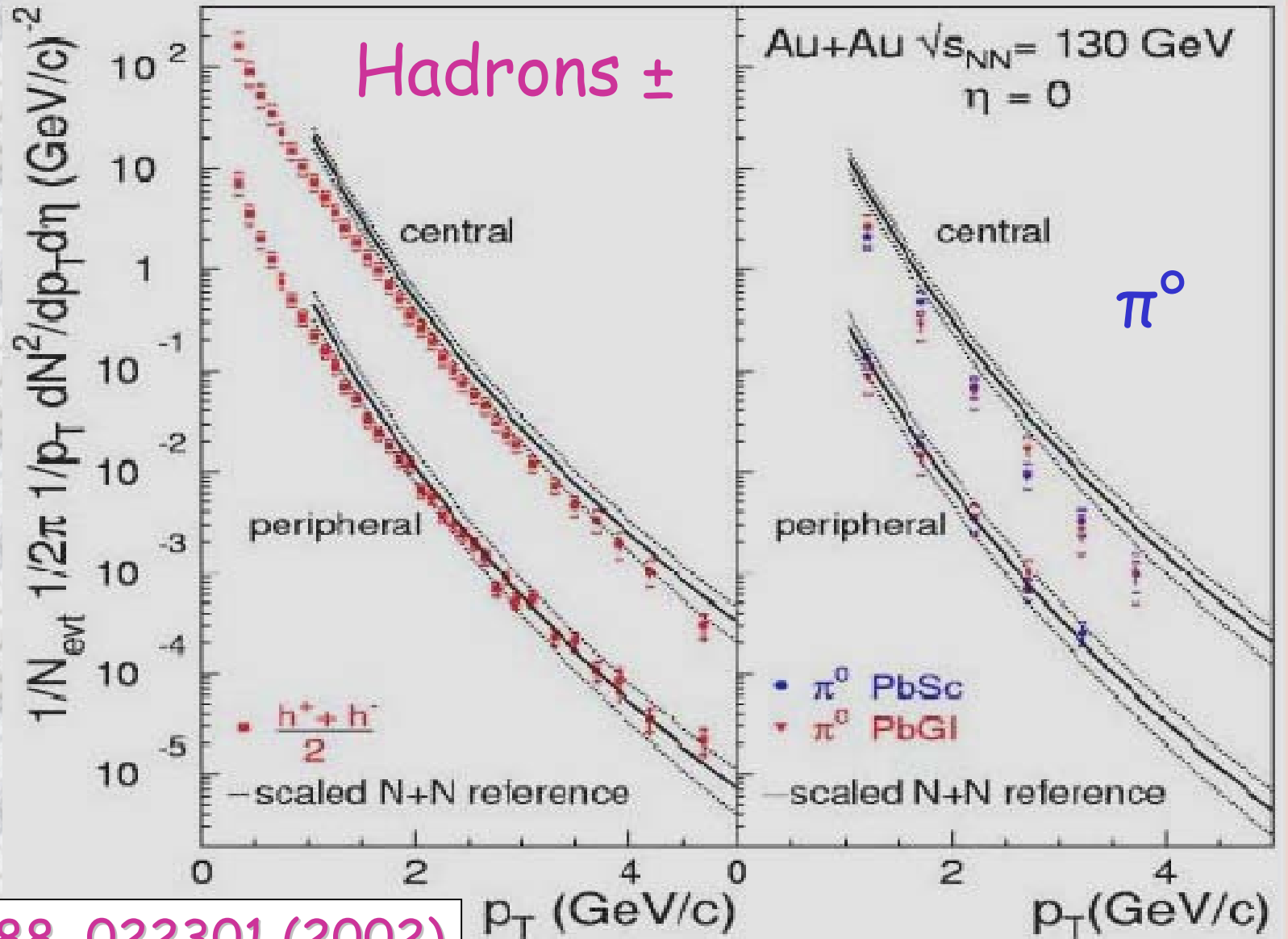
- **Jet Quenching ?**

- Partons are expected to lose energy traversing a quark gluon plasma
- Leading particles (high  $p_T$ ) should be suppressed

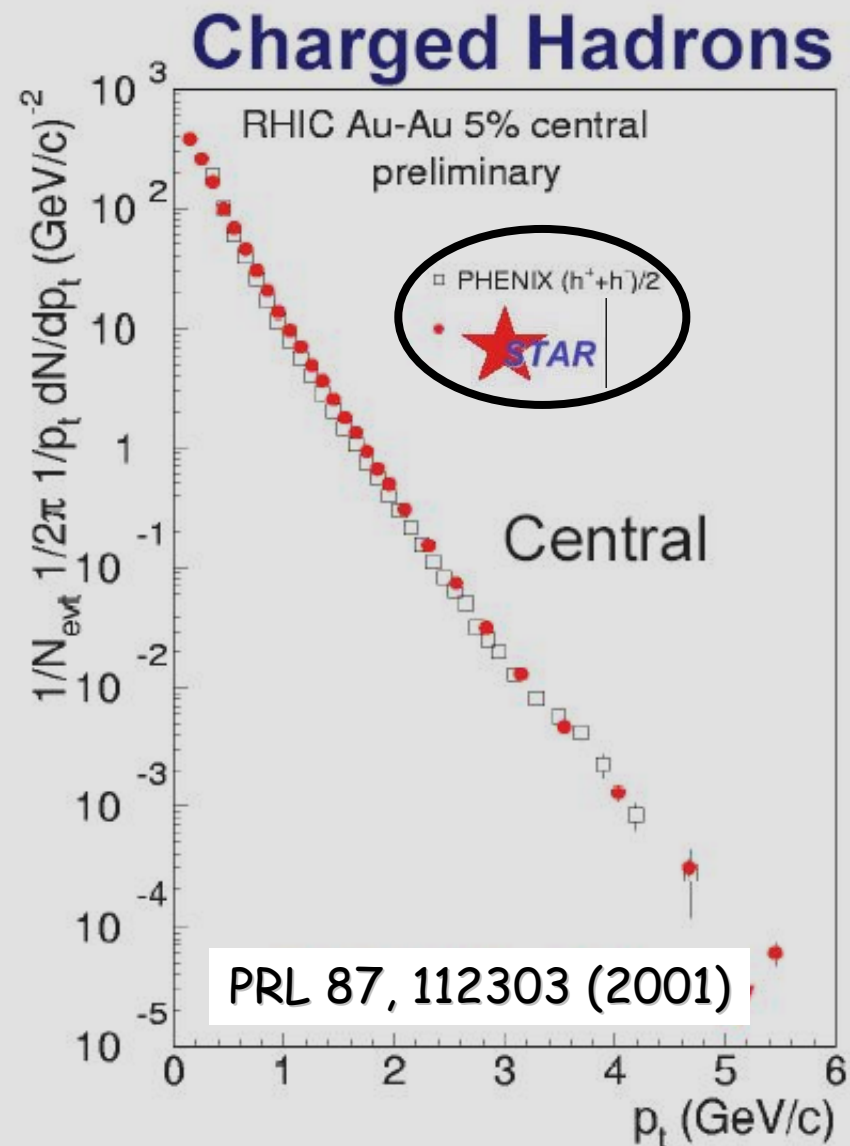




# Jet Quenching ???



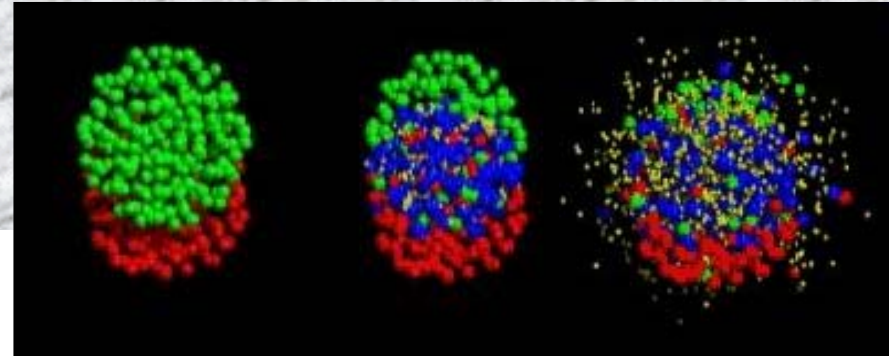
PRL 88, 022301 (2002)



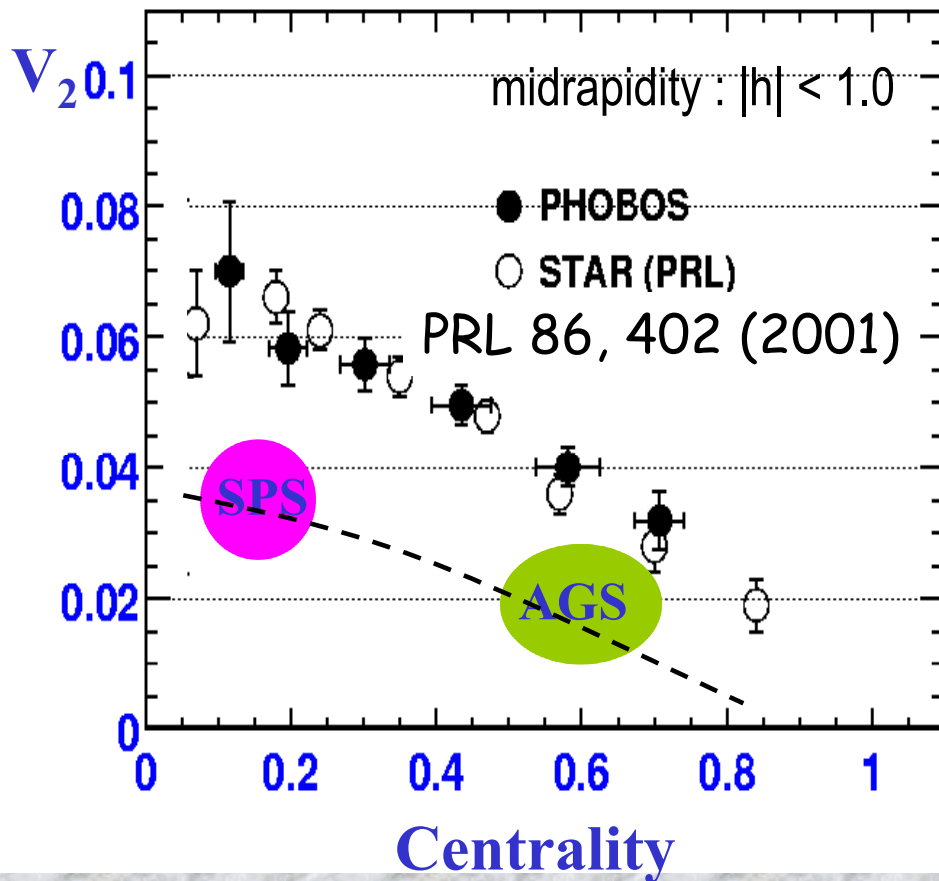
- **High  $p_T$  drop for**
  - Neutral pions
  - Charged hadrons
- **Consistent with parton energy loss**  
( $\sim 0.25 \text{ GeV}/\text{fm}$ )
- **Need more study !!!**
  - Test Cronin effect with p+p run
  - Measure gluon shadowing with p+A
  - Reach higher  $p_T$  (RUN2)



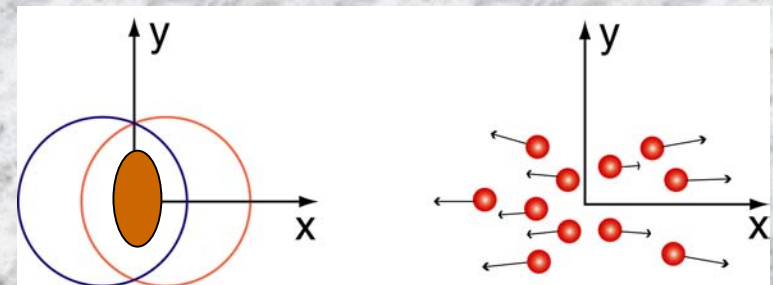
# First moments : elliptic flow



## Centrality Dependence



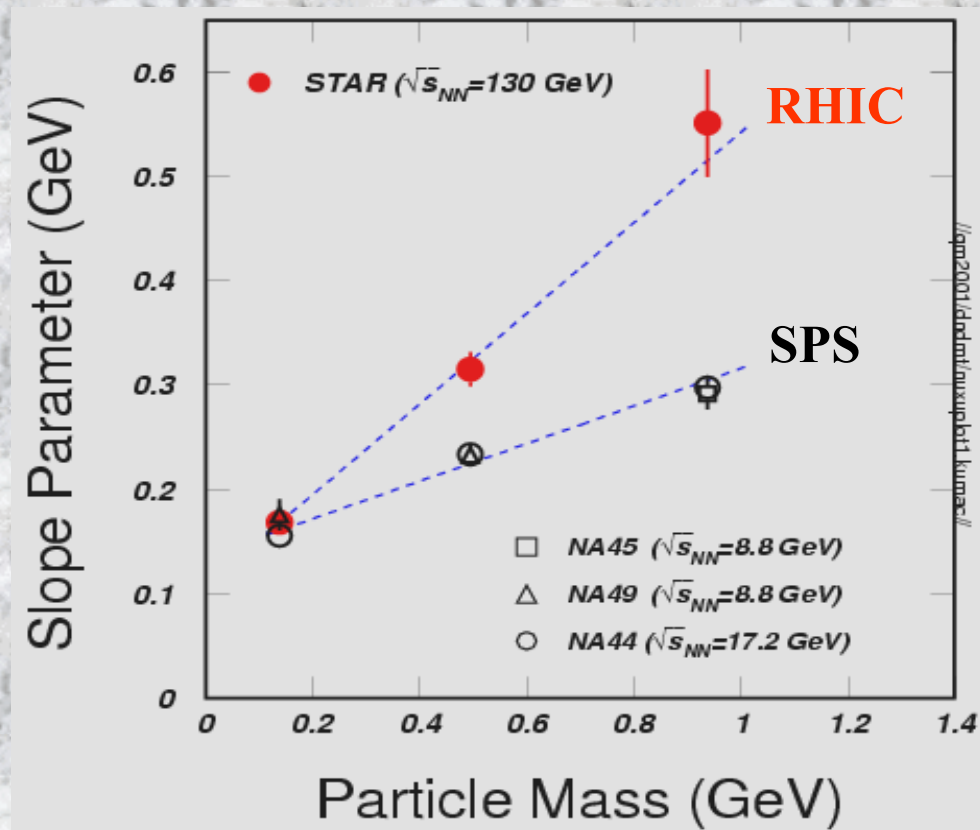
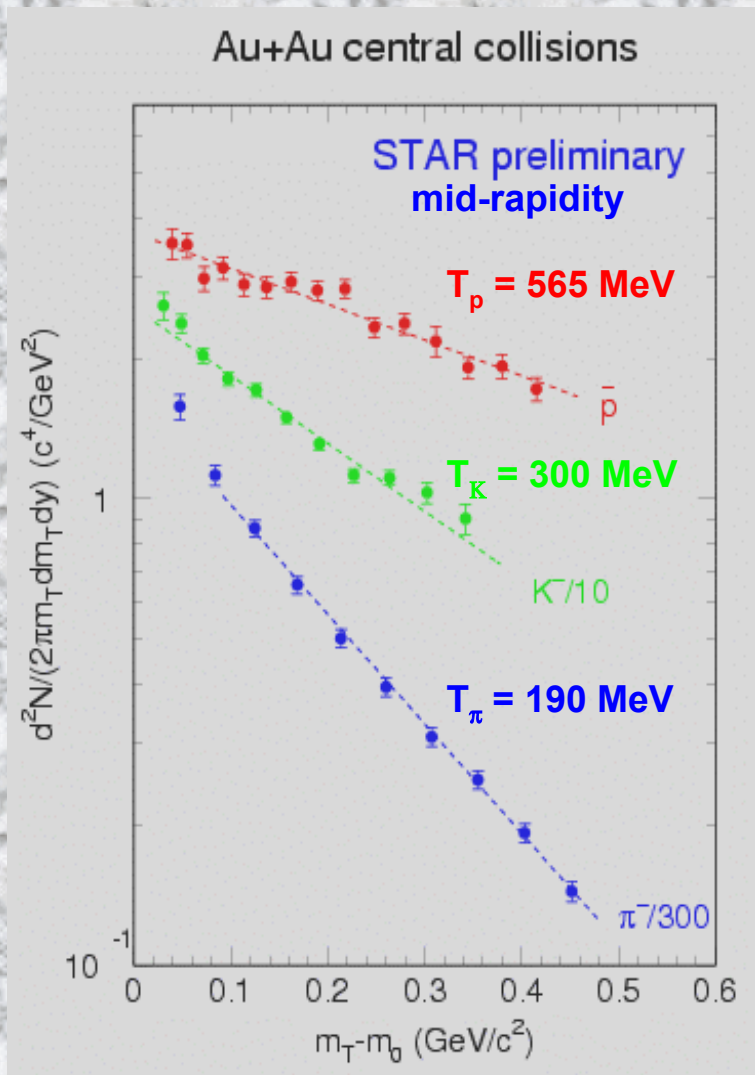
Pressure gradient  
→ Anisotropic flow



$$v_2 = \langle \cos 2\phi \rangle$$

$$\phi = \text{atan} \frac{p_y}{p_x}$$

- Freeze-out temperature



$$T = T_{fo} + \frac{1}{2} m \langle V_{\perp} \rangle^2$$

$$T_{fo} (\text{RHIC}) \sim 140 \text{ MeV} \quad \langle V_{\perp} \rangle (\text{RHIC}) \sim 0.52 c$$

$$T_{fo} (\text{SPS}) \sim 140 \text{ MeV} \quad \langle V_{\perp} \rangle (\text{SPS}) \sim 0.4 c$$



- Strangeness enhancement
- Two pion correlations (HBT)
- Event by event fluctuations
  - Nucl-ex/0203015 & 0203014
- Single electron / charm production
  - Nucl-ex/0202002
- Others ?...



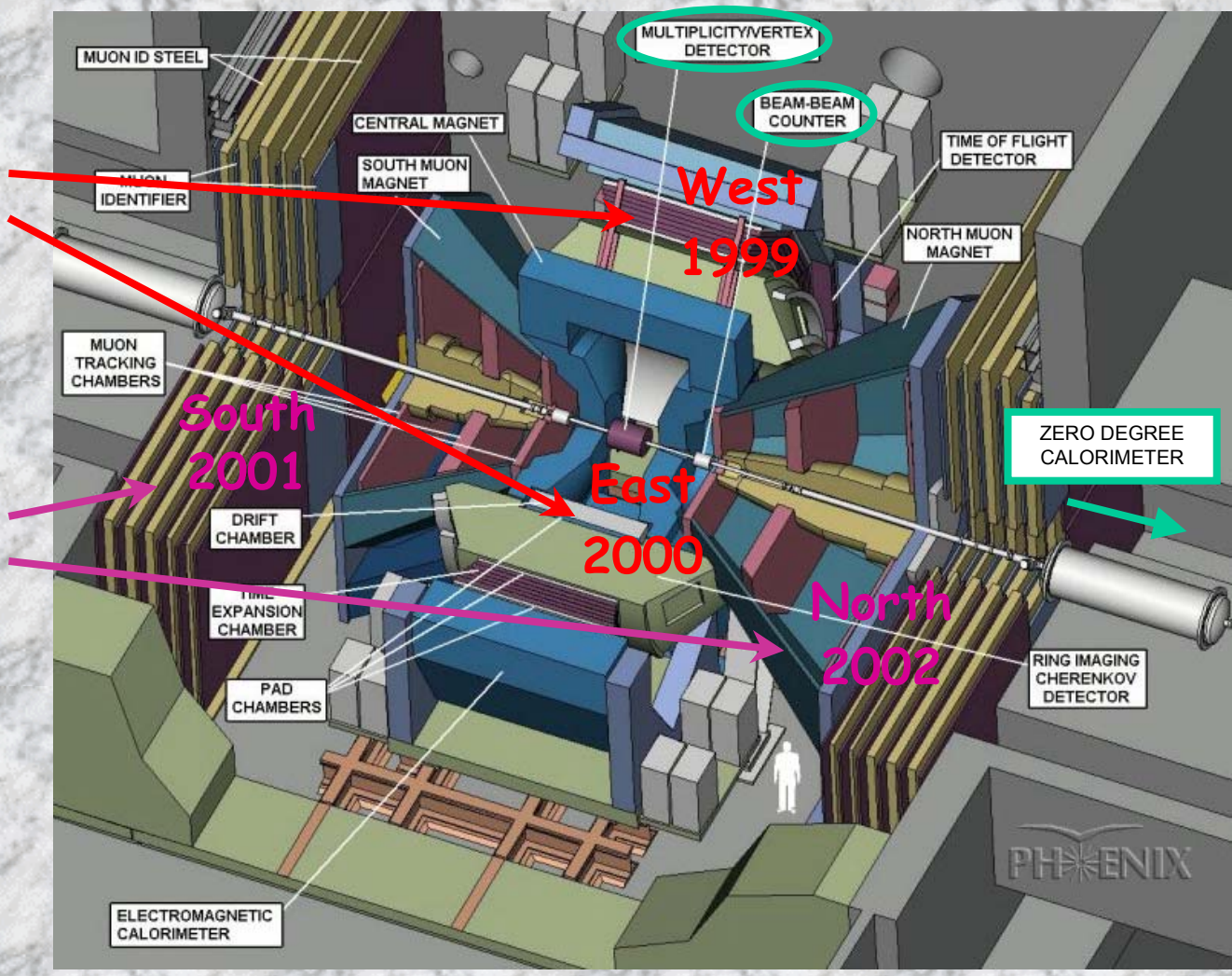
# 3. PHENIX



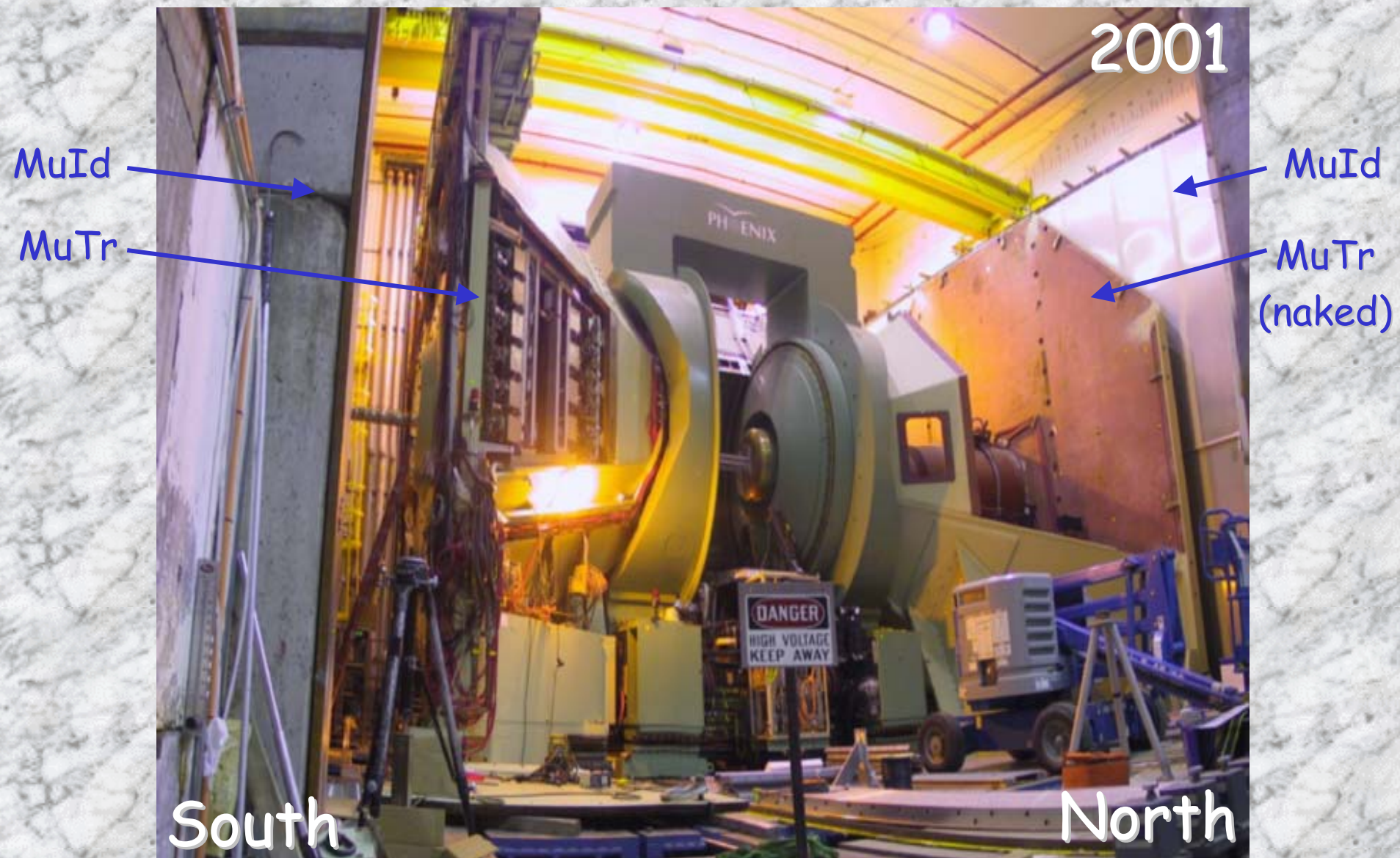
Two central spectrometers

Two forward spectrometers

Three global detectors









## Phenix France provides the north arm electronics

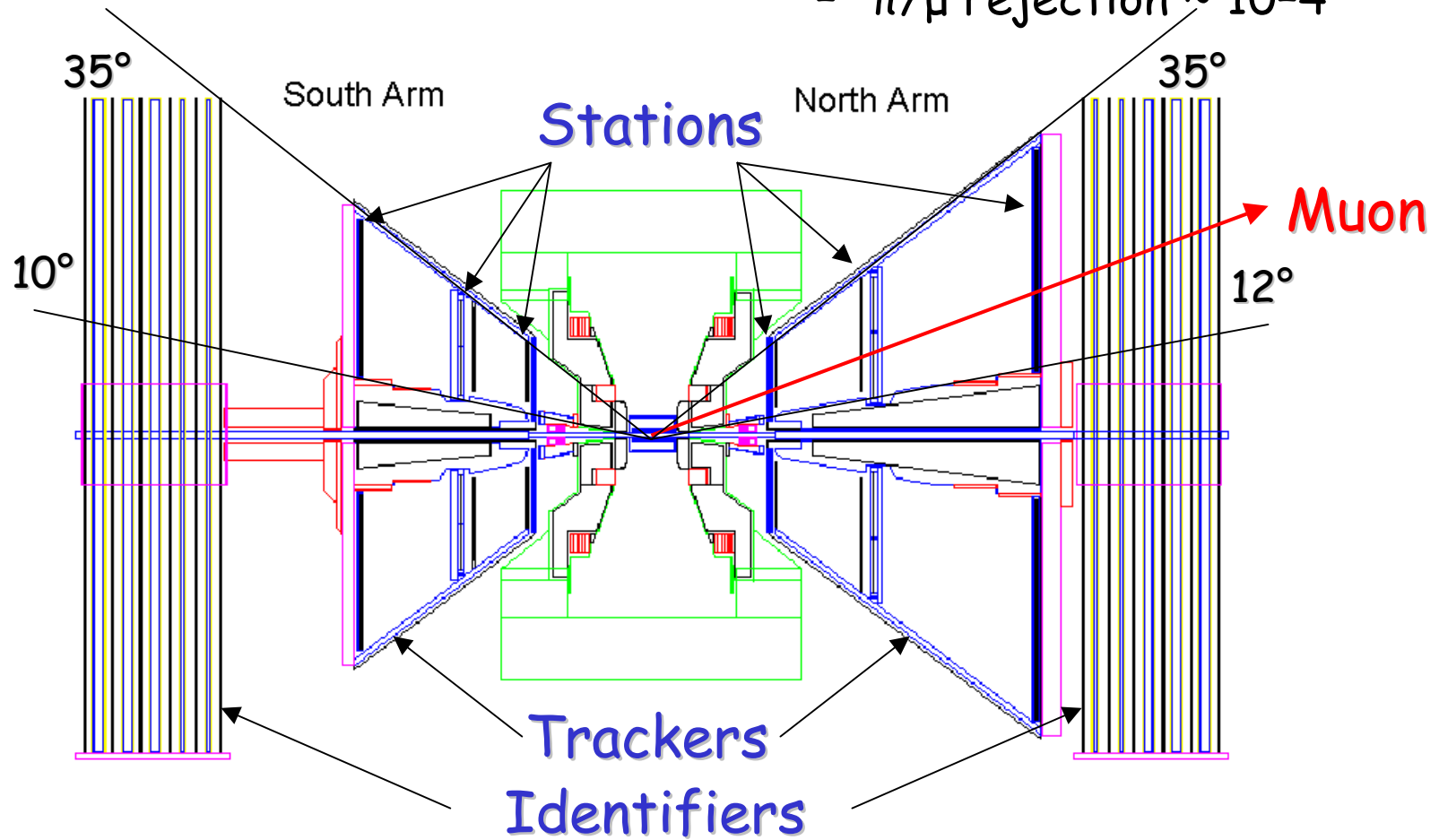
- LPC-Clermont
  - Subatech-Nantes\*
  - IPN-Orsay
  - LLR-Palaiseau
  - CEA-Saclay
  - 3 Corean labs
- joined phenix  
in 2000

(\* before for  
photon physics)

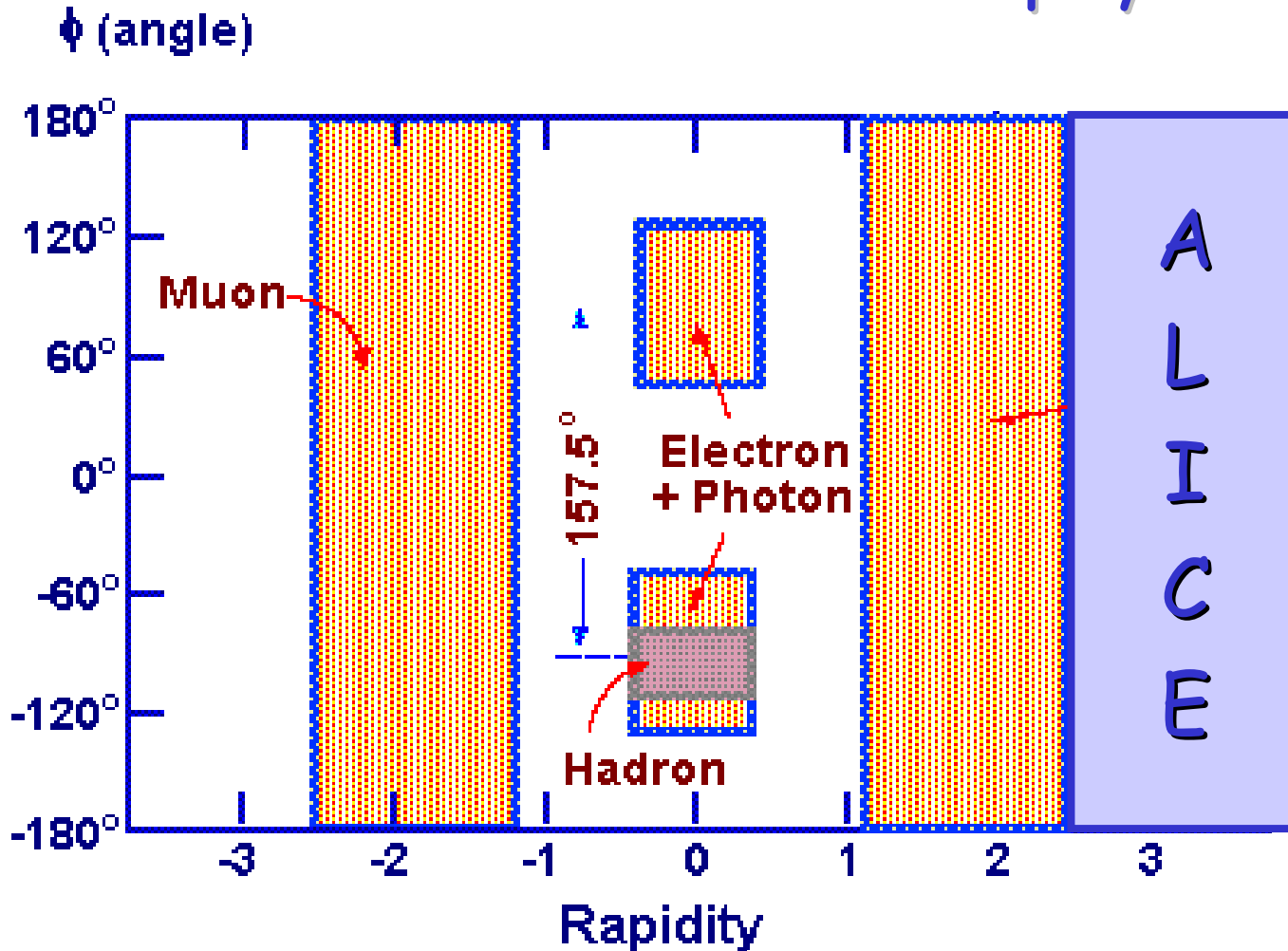




- 2 Trackers = 2x3 stations
- 2 Identifiers = 2x5 planes
- $\pi/\mu$  rejection  $\sim 10^{-4}$



## PHENIX can make dimuon physics

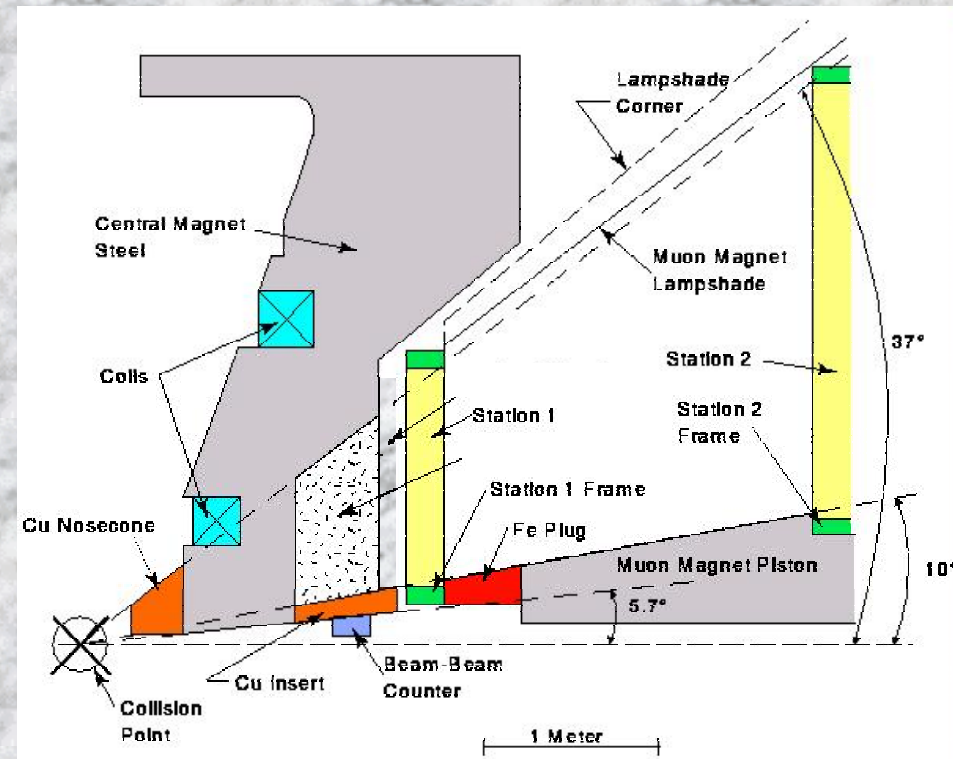
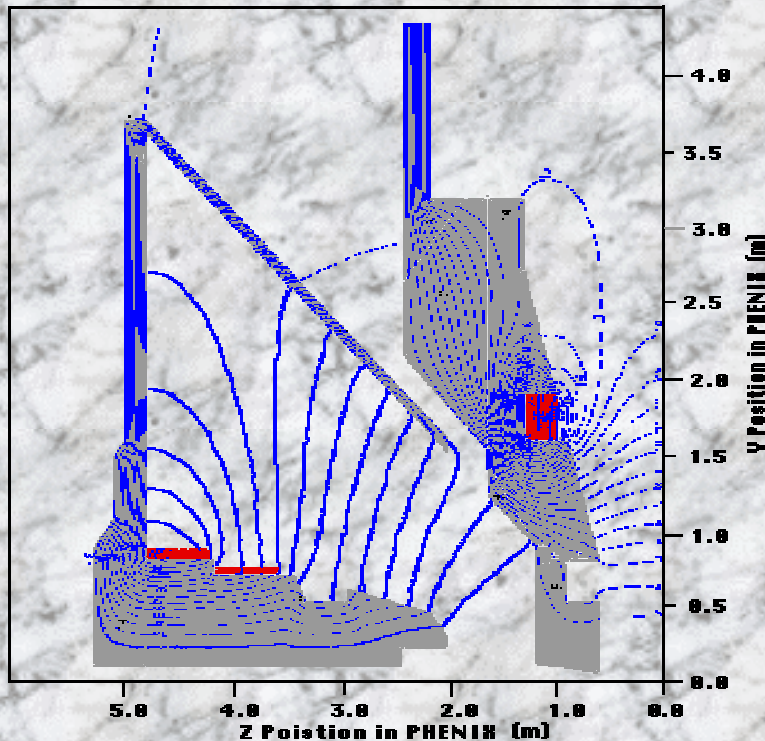




- $Ar:CO_2:CF_4 = 50:30:20$
- Radial field
  - Bending vs Phi
  - Field integral : 0.8 T.m

## Absorption

- Steel from magnet (3.6  $\lambda$ )
- Copper nosecone ( $\downarrow \pi, K$ )

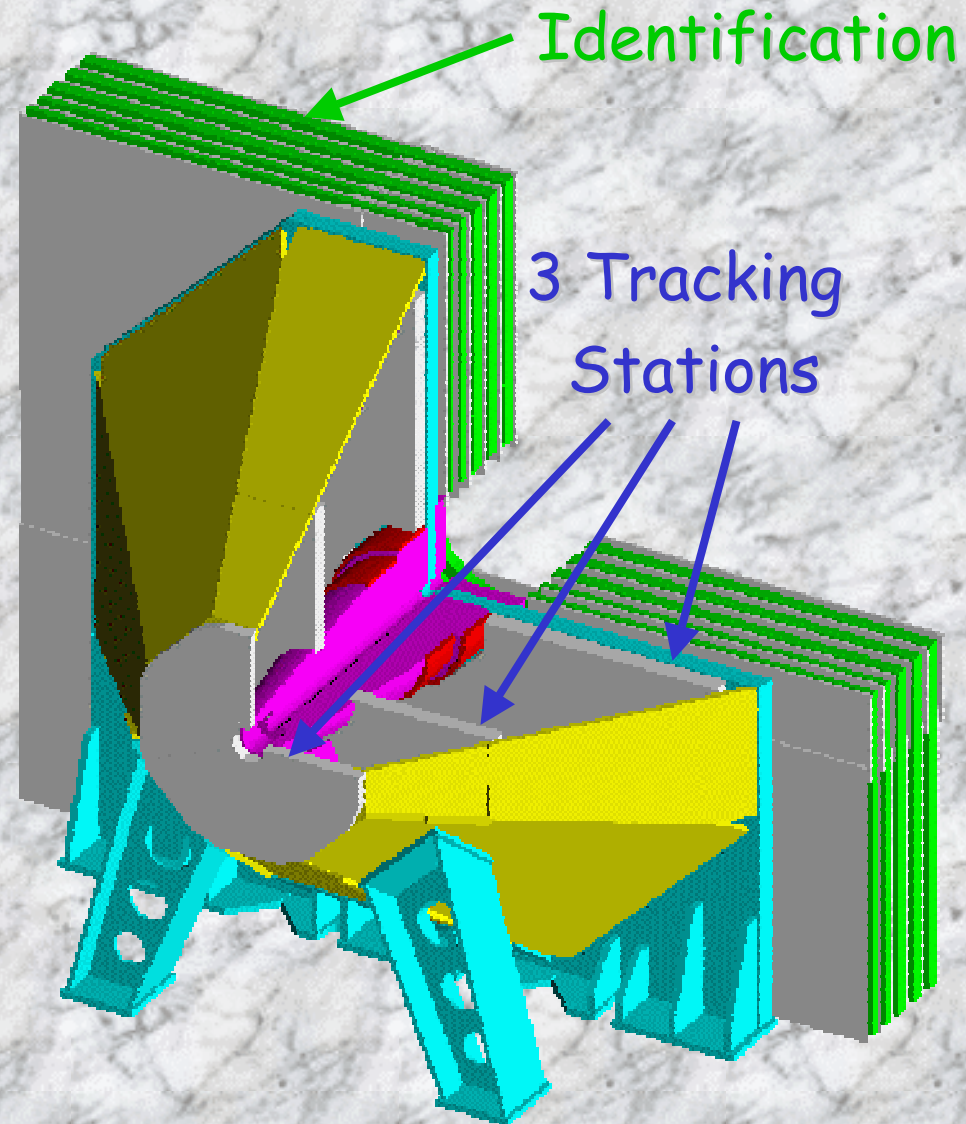




# Three tracking stations



- Octagonal shape

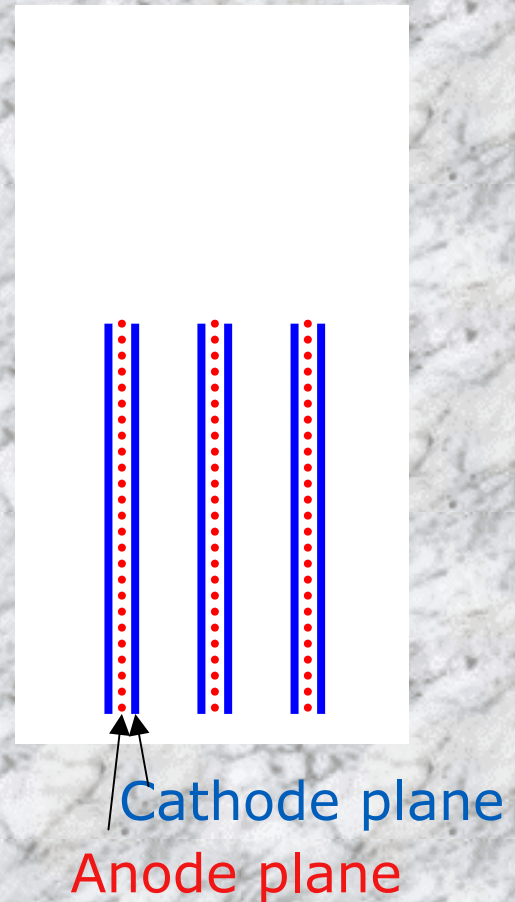
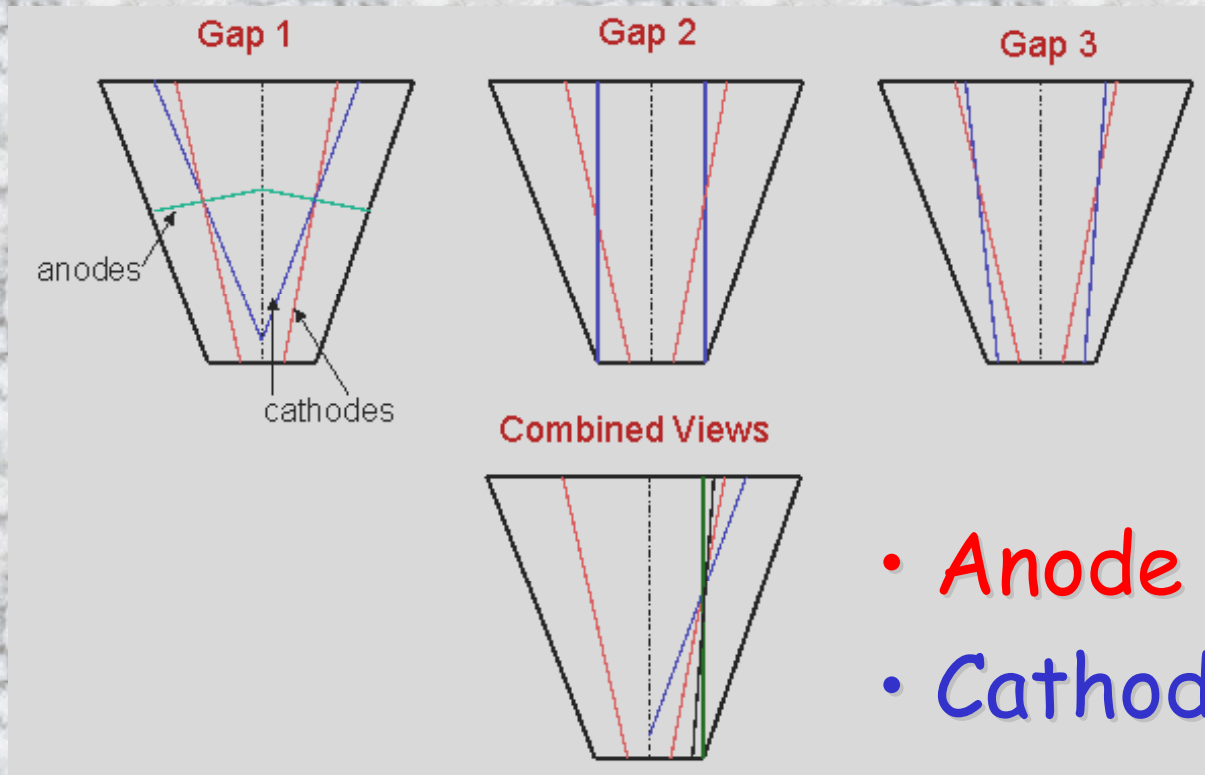




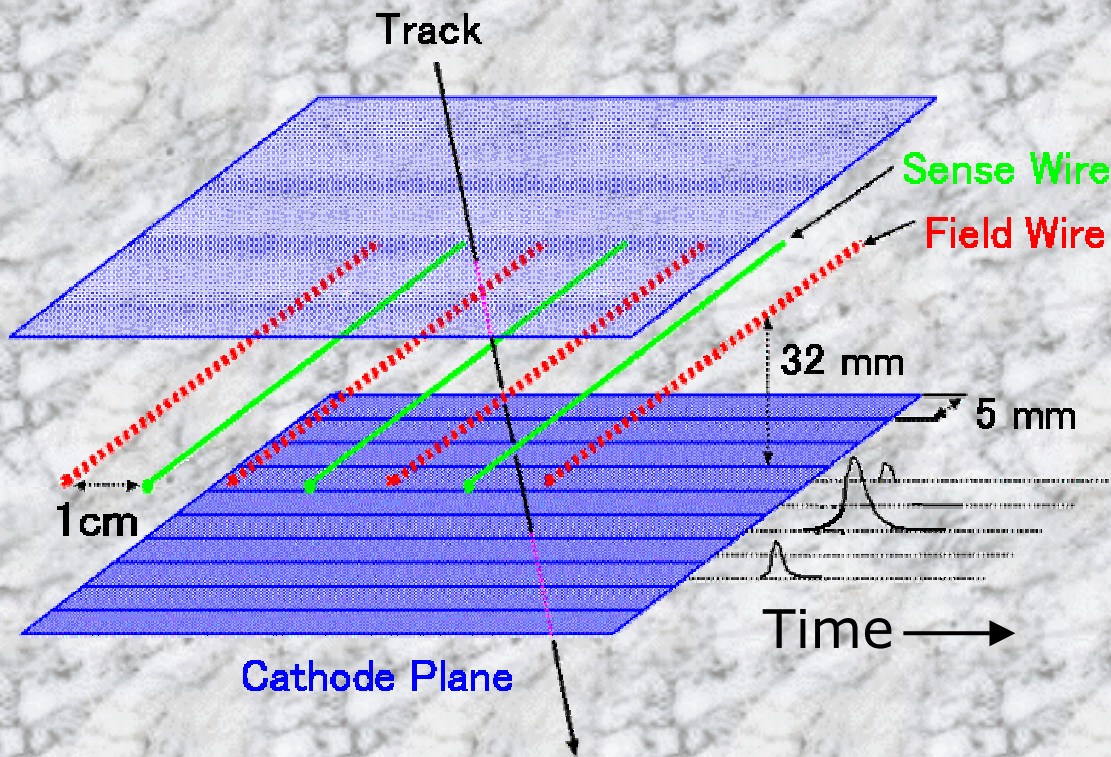
# Within a station



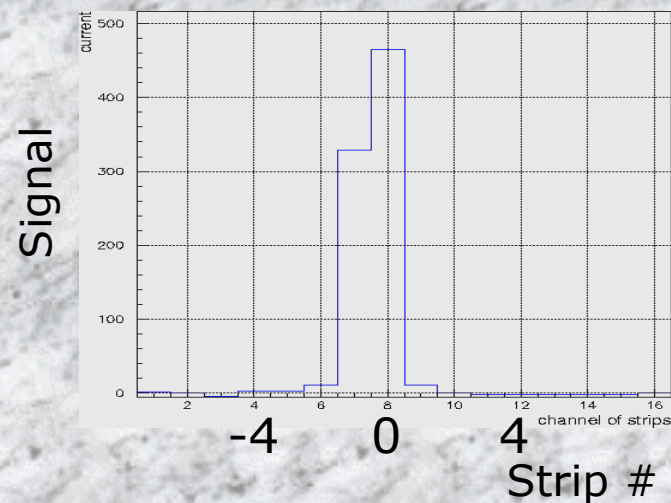
- 2 gaps in station 3
- 3 gaps in stations 1 et 2
- 1 gap = 2 cathodes + 1 anode



- Anode wires (HV)
- Cathode strips (read)



## Strip Signal

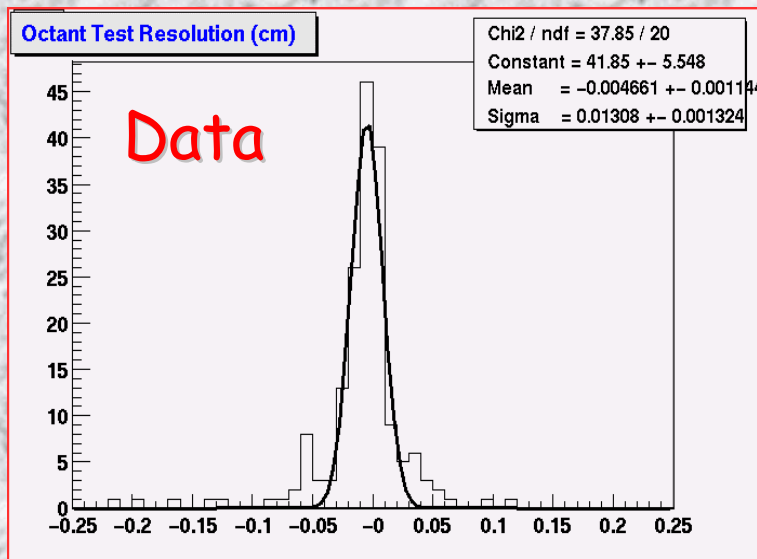


# of strips/track ~ 2.4

- Read Out gap = 1cm
- Noise/signal < 1 %

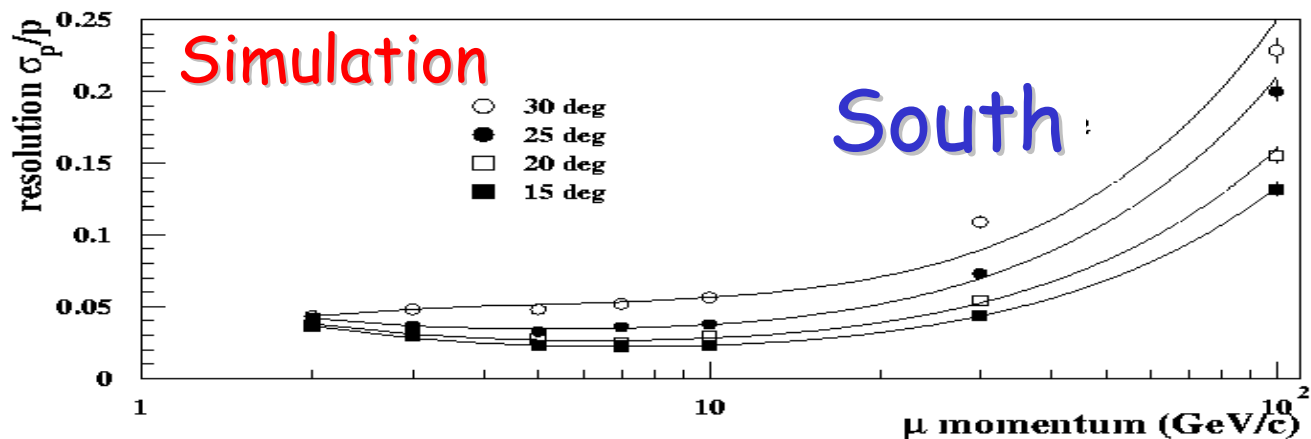
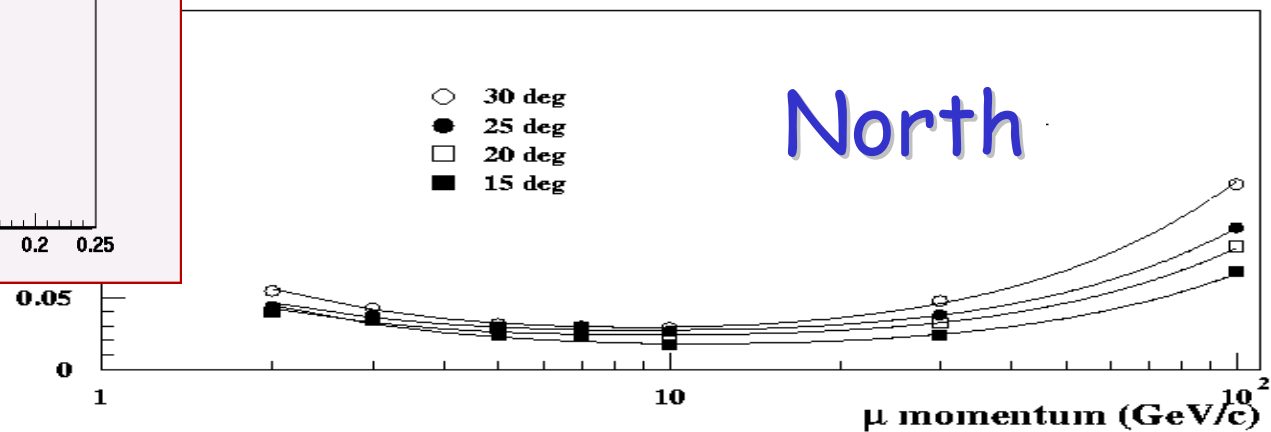
Designed for a  
100  $\mu\text{m}$  resolution



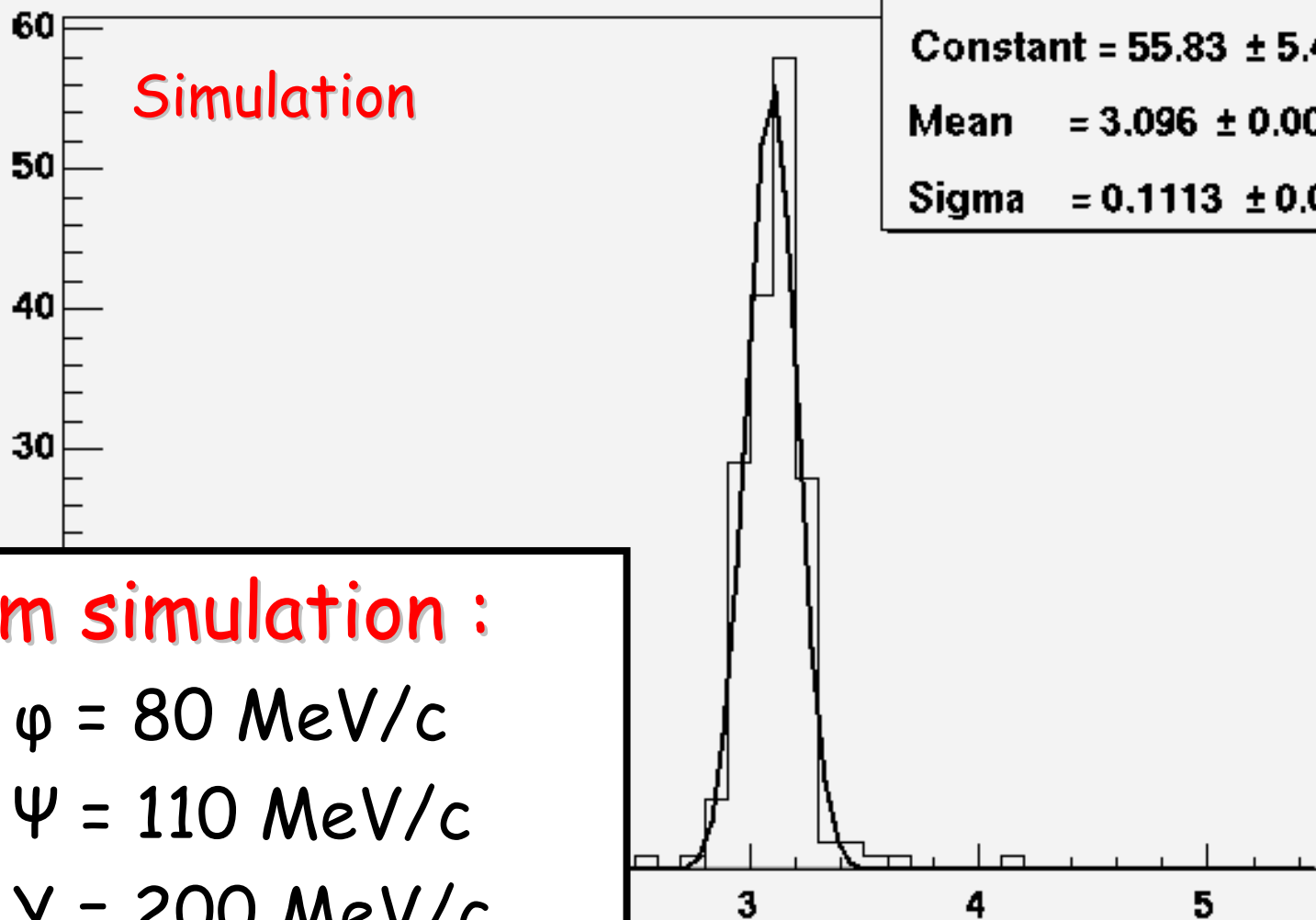


Spatial resolution = **90  $\mu\text{m}$**   
In cosmic test

Momentum  
Résolution  
 $\Delta p/p \sim 3\%$   
@ 3-10 GeV



Reconstructed invariant mass spectrum for 1000 JPsi events



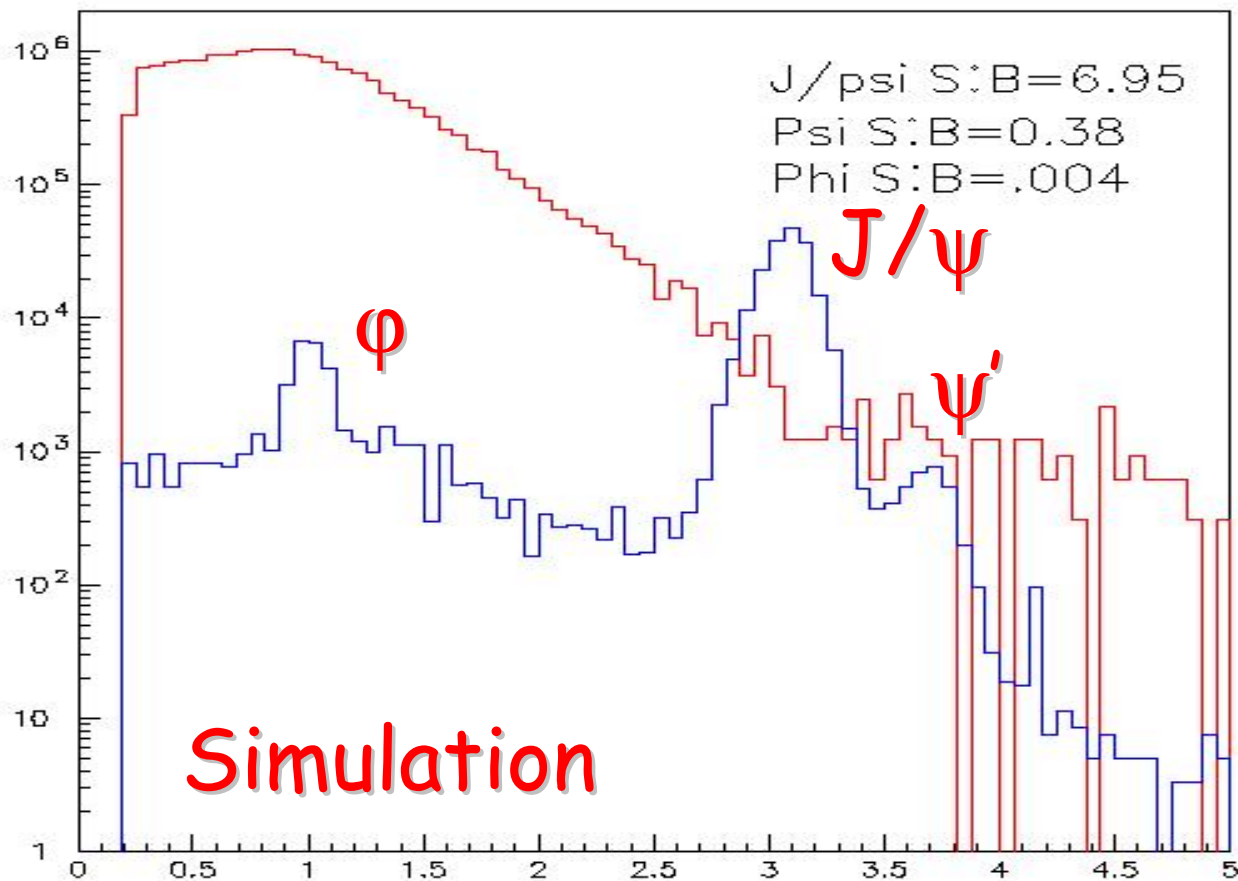
From simulation :

- $\varphi = 80 \text{ MeV}/c$
- $\Psi = 110 \text{ MeV}/c$
- $\Upsilon = 200 \text{ MeV}/c$



Separate  $\phi$  %  $\rho+\omega$  ;  $J/\psi$  %  $\psi'$  ;  $Y'$  %  $Y$

Good enough signal/background

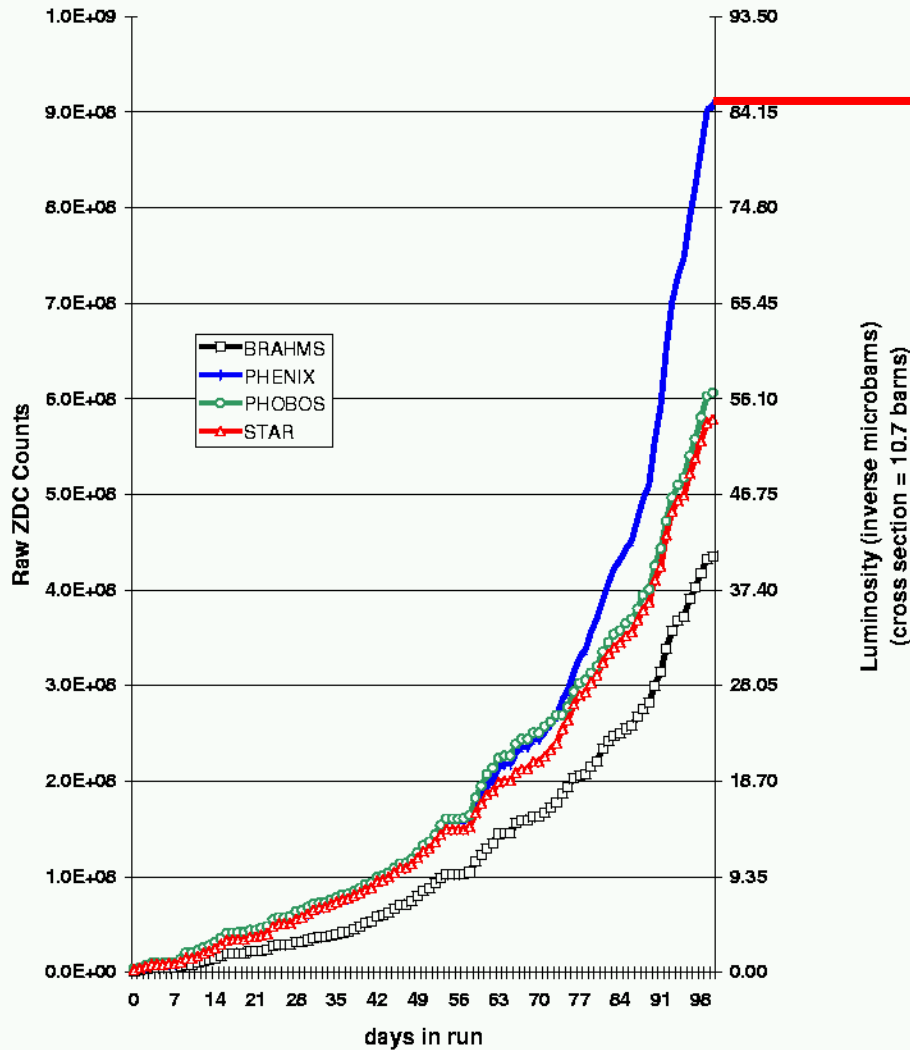


Gold+Gold  
standard  
year  
in RHIC

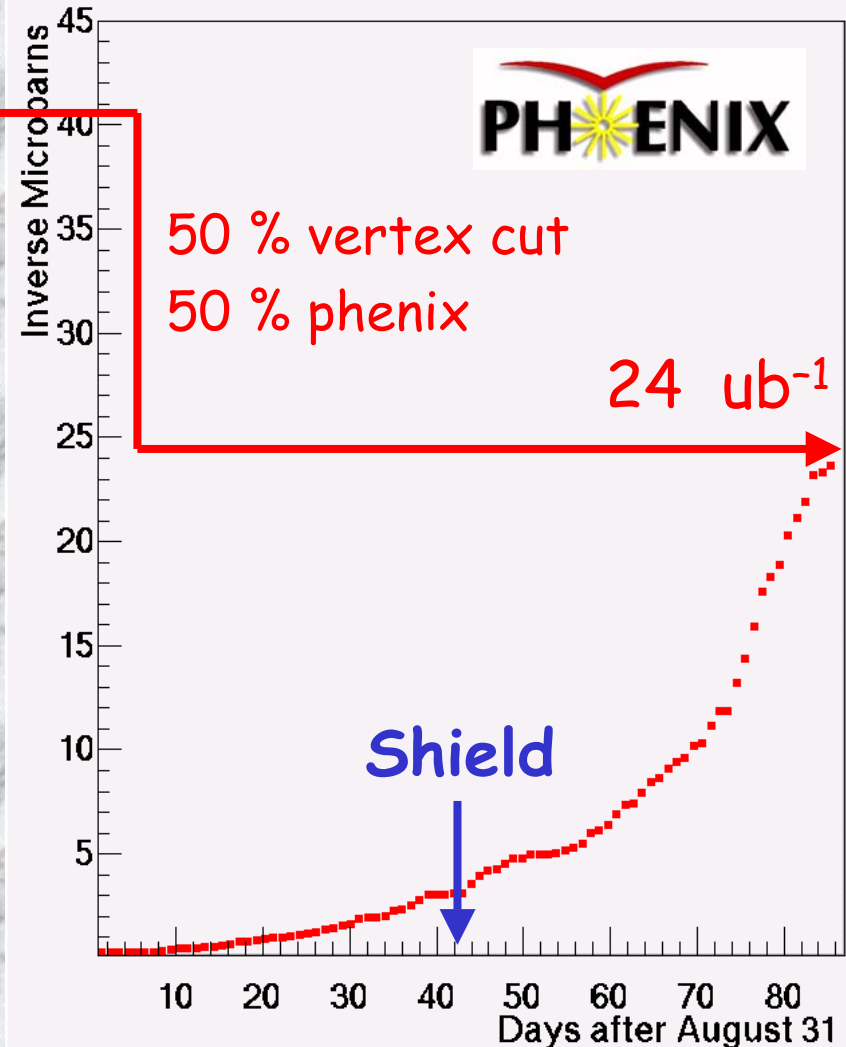
$2.16 \times 10^{33} \text{ cm}^{-2}$

# 4. Run 2 status

FY 01/02 RHIC Experiment ZDC Counts  
0001 hrs 8/17 to 0600 hrs 11/25



PHENIX Daily Cumulative Recorded BBLL1 Luminosity



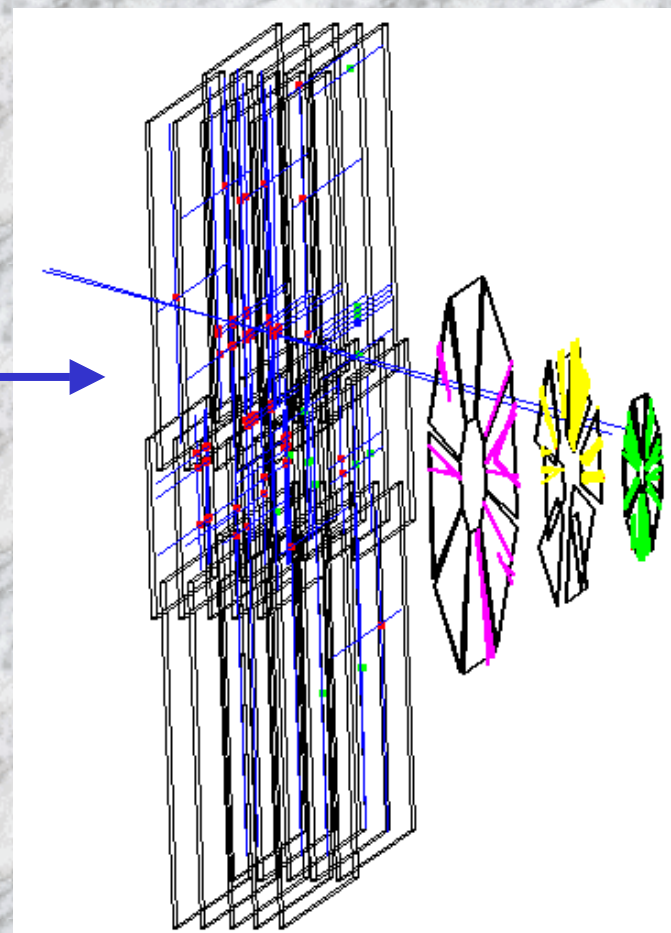


## + 15 weeks in Gold+Gold @ 200 GeV

- Designed luminosity achieved (2 weeks)
- Int. Lum. =  $24 \mu\text{b}^{-1}$
- 170 Mevents recorded
- Commissioning the south arm
- First muons seen !

## + 5 weeks in Proton+Proton

- Luminosity =  $0.15 \text{ pb}^{-1}$
- 3.7 Bevents recorded

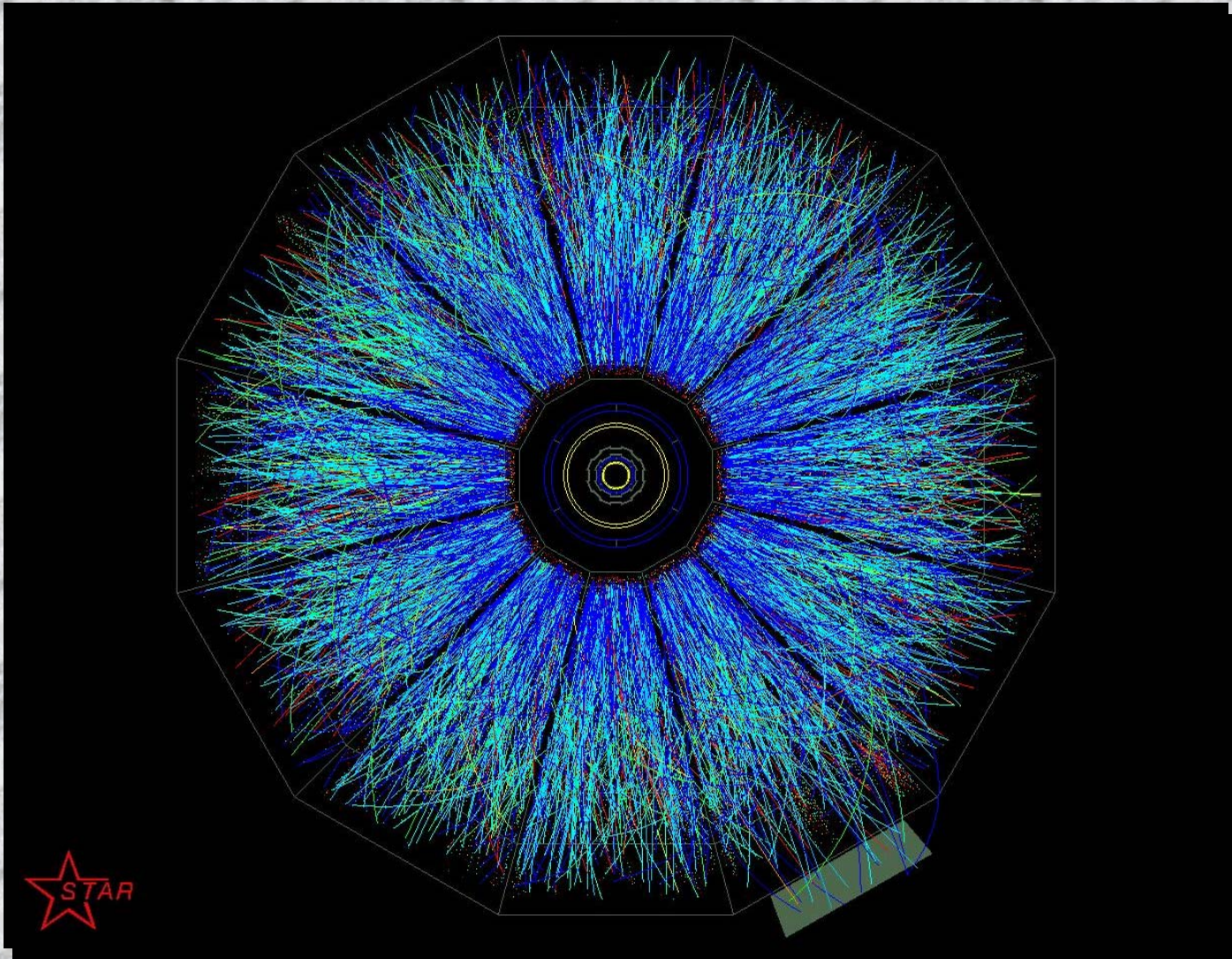




# In the central arms





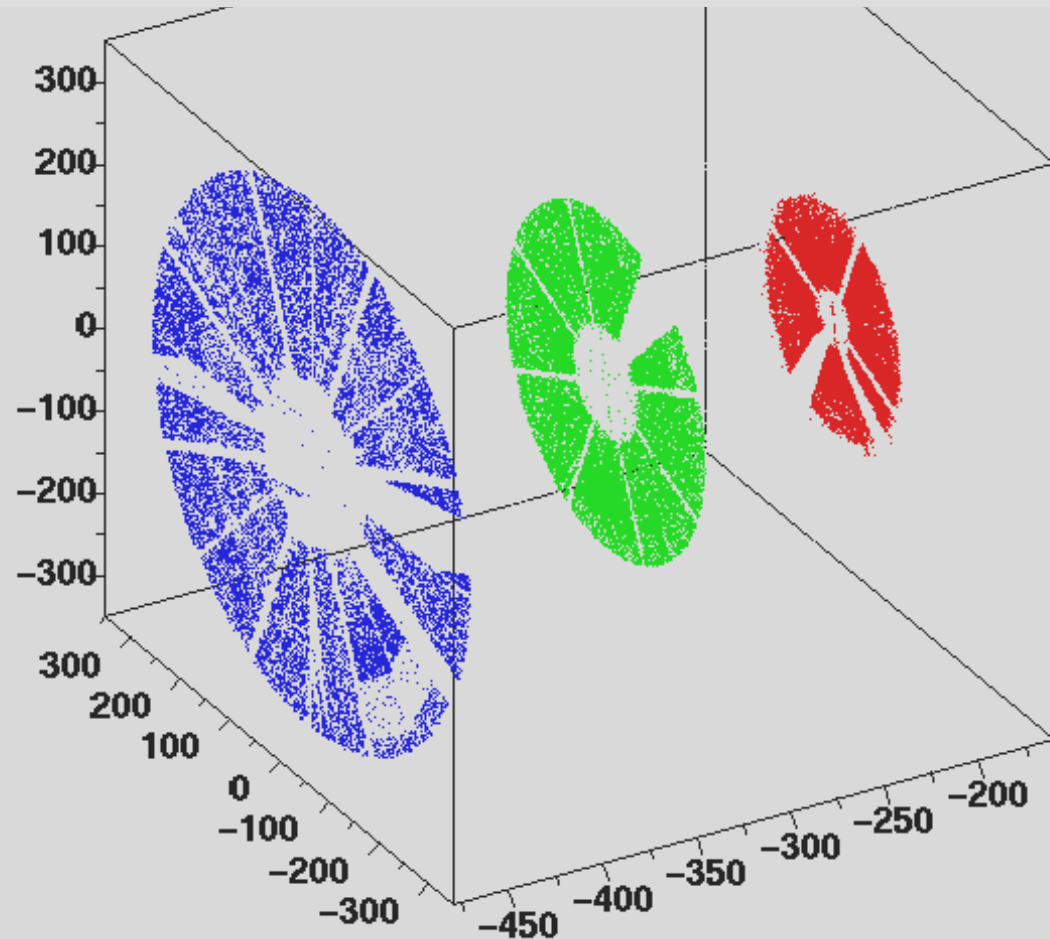




## Few parts missing

- HV not standing humidity
- Weak cables

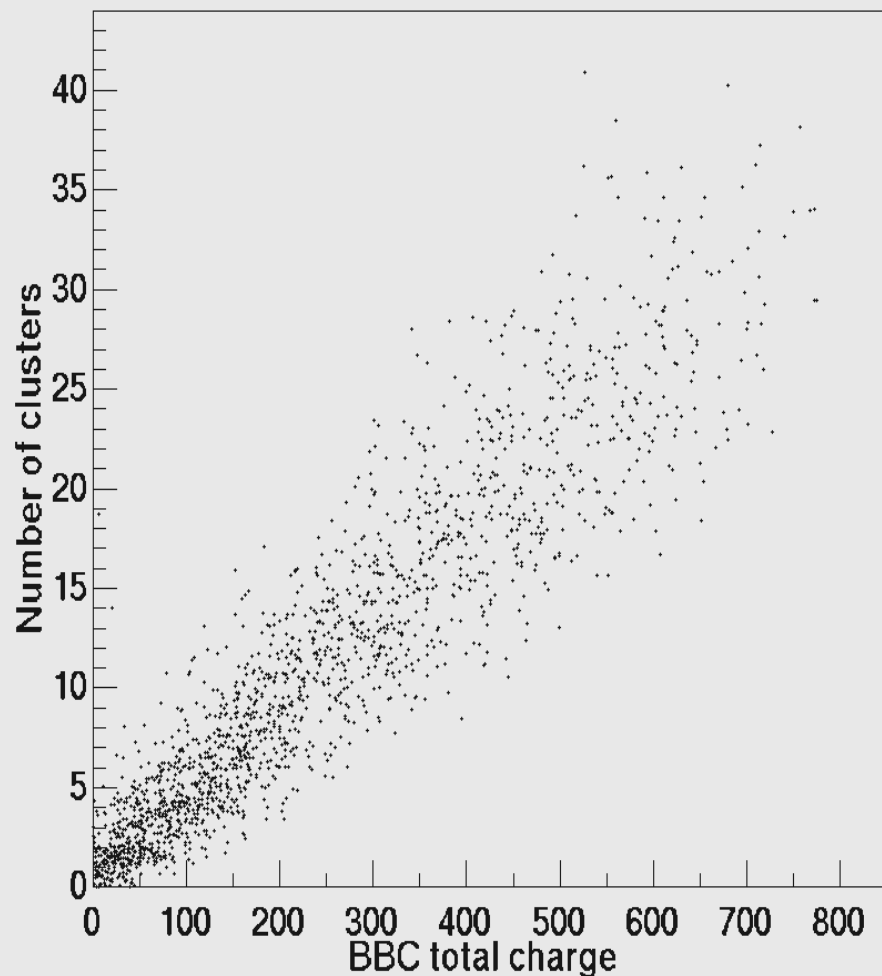
Being fixed  
for next run



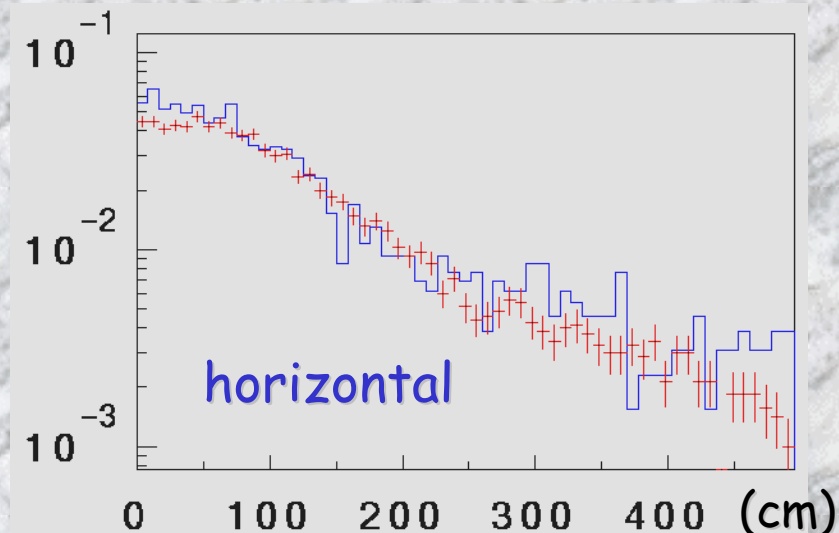
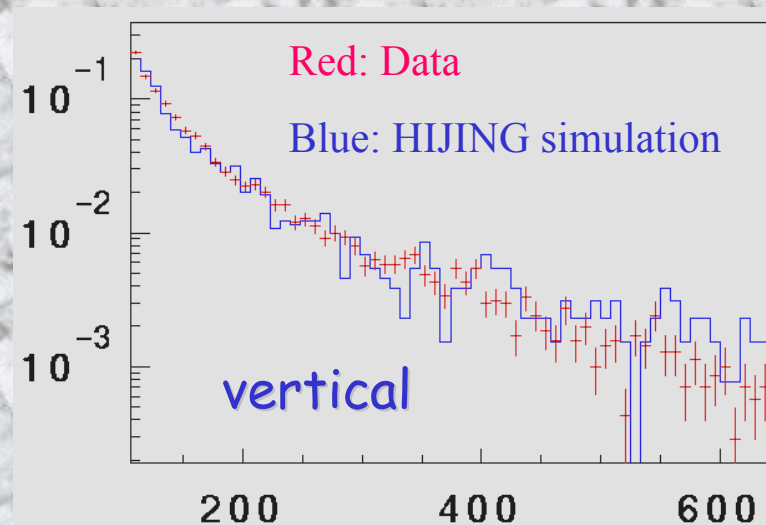


## • MuTr clusters

Station 1 multiplicity vs. Total BBC charge



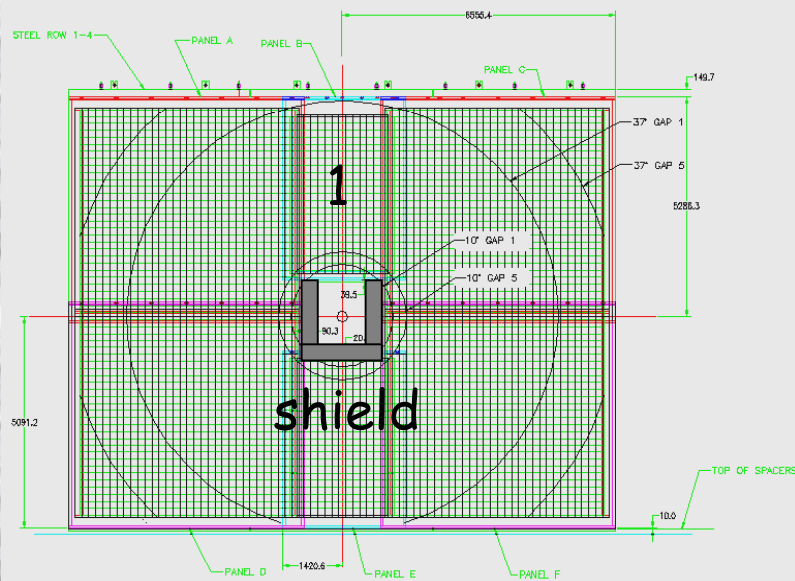
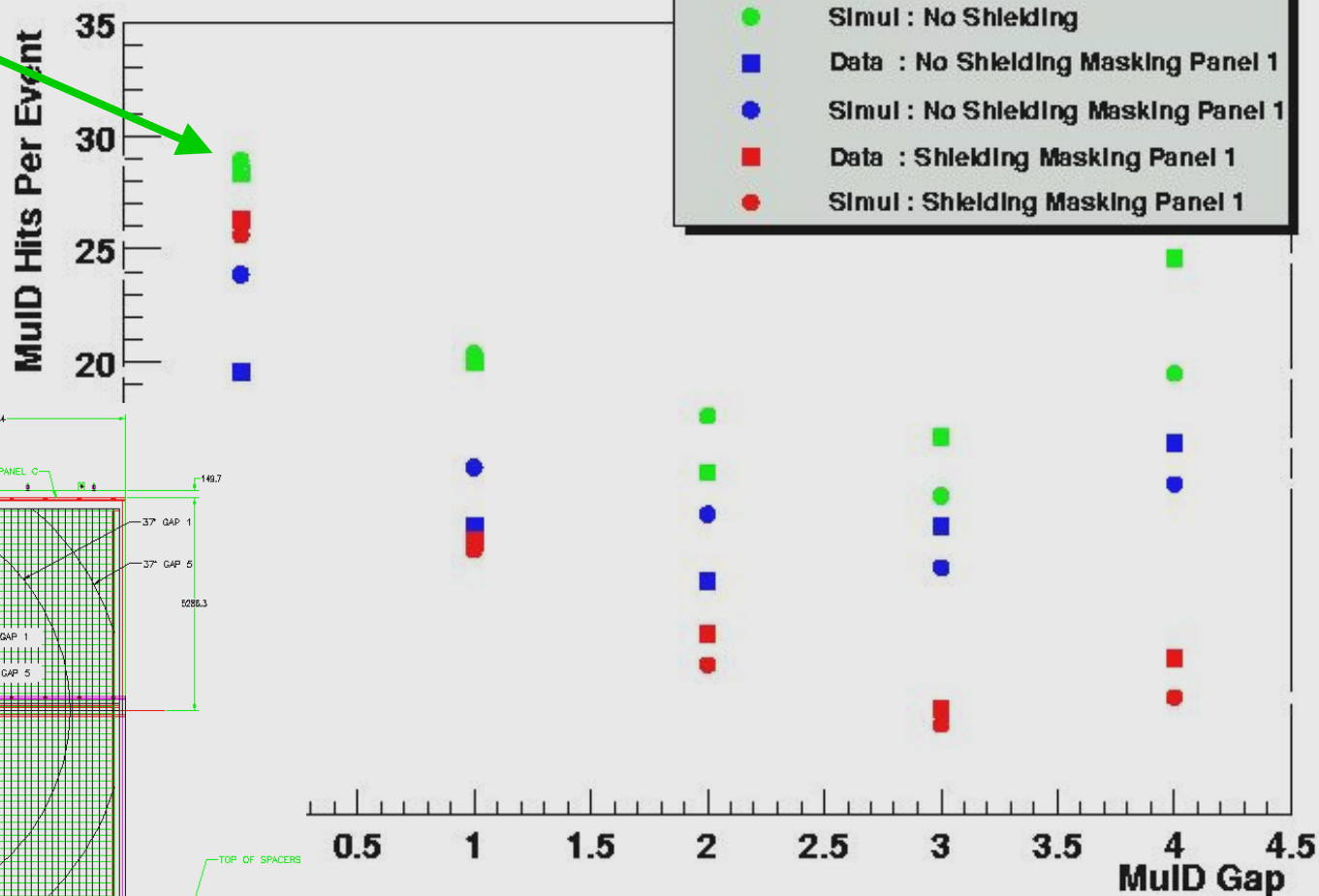
## • MuId hits/events



# MuId backgrounds

- Unexpected rates (x2 exp.)
- Install shield (90% run 2)
- Complete shield for run 3

Number Of Hits Per Gap



- Update simulation : low angle particles leaking beam pipe



We are analyzing data...

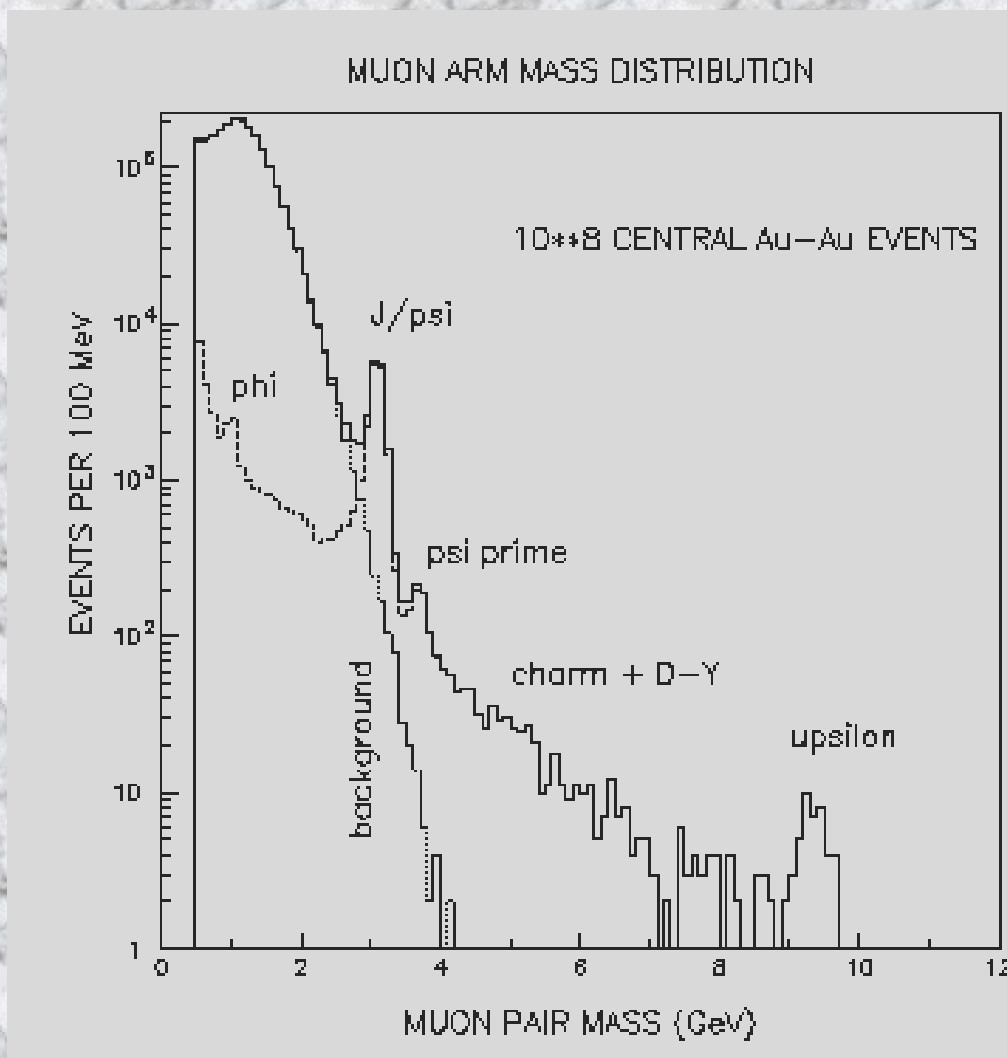
- Tracker alignment
  - Field off p+p data
- Look for  $J/\Psi$  peak in p+p run
- Estimate efficiencies / acceptance with run dependent simulations

Too bad we had p+p at the end

# 5. Future plans



Reach a « standard » year of Gold+Gold data





## Rough estimate

x Integrated luminosity =  $2 \text{ nb}^{-1}$

(36 weeks @ luminosity, df 50%)

x **Acceptance** = 4.3 % + 4.5 %

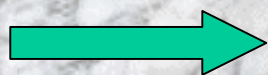
(South + North arms)

x  $B(\psi \rightarrow \mu\mu) = 6 \%$

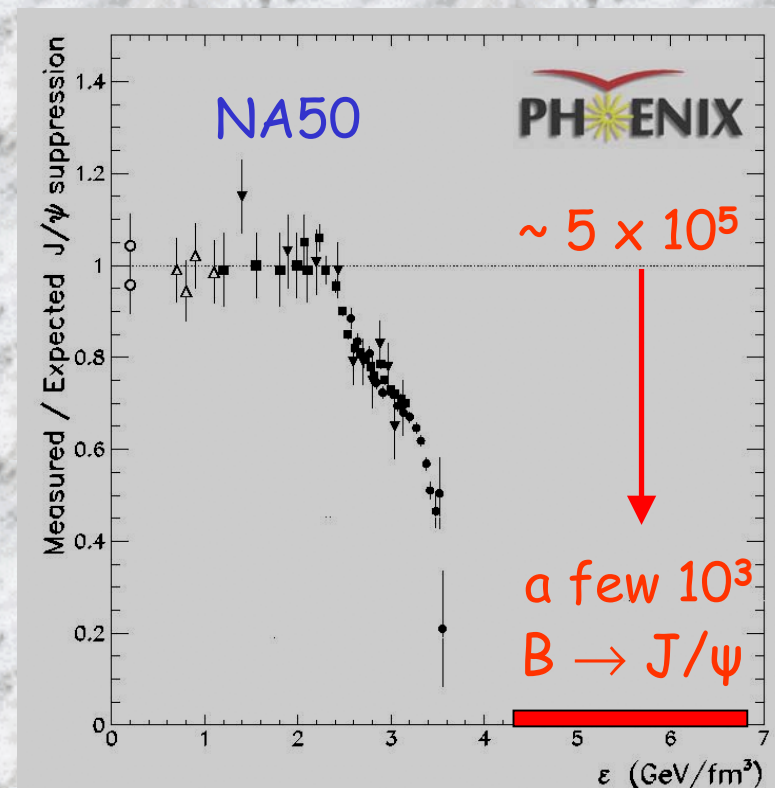
x  $\sigma^{NN}(\psi) \sim 3 \times 10^{-6} \text{ b}$

(extrapolation, to be measured)

x  $(197 \times 197)^{0.92}$



$N(\psi) \sim 5 \times 10^5$  / year in Gold Gold  
 $[N(\psi') \sim 9 \times 10^3]$  if not suppressed!



## Rough estimate

- × Int. lum. =  $2 \text{ nb}^{-1}$
- × **Acceptance** = 6 %
- ×  **$B(Y \rightarrow \mu\mu)$**   $\sim 2 \%$
- ×  $\sigma^{NN}$  (all  $Y$ )  $\sim 3 \times 10^{-8} \text{ b}$
- ×  $(197 \times 197)^{0.92}$

$N(Y) \sim 1200$  / Au+Au year

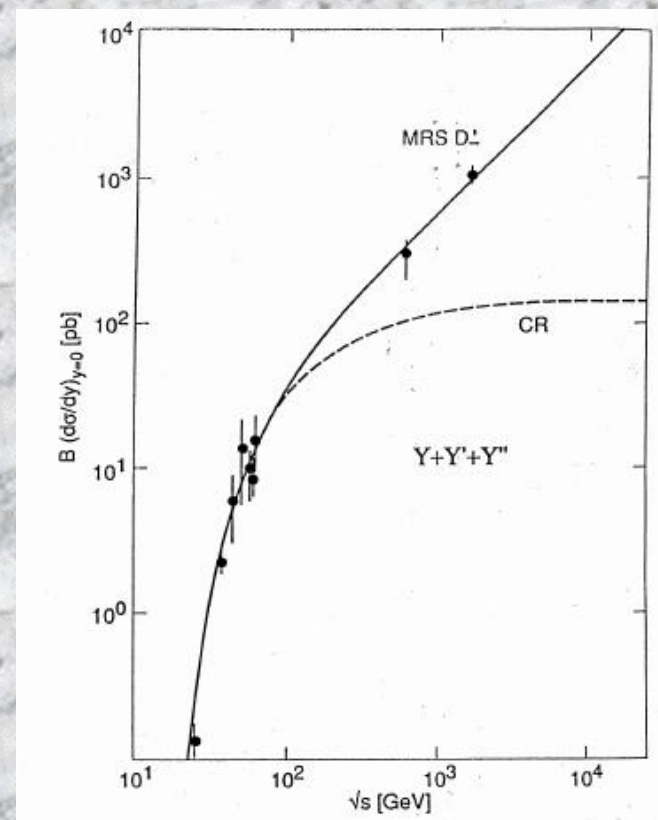
$N(Y^*) \sim 400$

Also screened in Cu+Cu

$N(Y) \sim 15000$  / Cu+Cu year

$N(Y^*) \sim 5000$

Upsilon too linked to be screened  
 $Y'$ ,  $Y''$  should be suppressed ( $Y^*$ )  
Upsilon can serve as reference





## First results from run 2 @ QM 2002

- Higher  $p_T$  reach (jet quenching)
- First glimpse @ muons

## Phenix next runs will provide exciting dimuon results

- Gold+Gold @ high luminosity  $J/\Psi$ ,  $\Psi'$
- p+p, d+A to set references
- Lighter ions (higher luminosity) for  $\Upsilon$ ,  $J/\Psi$ ,  $\Psi'$

And then ALICE will reach another step...