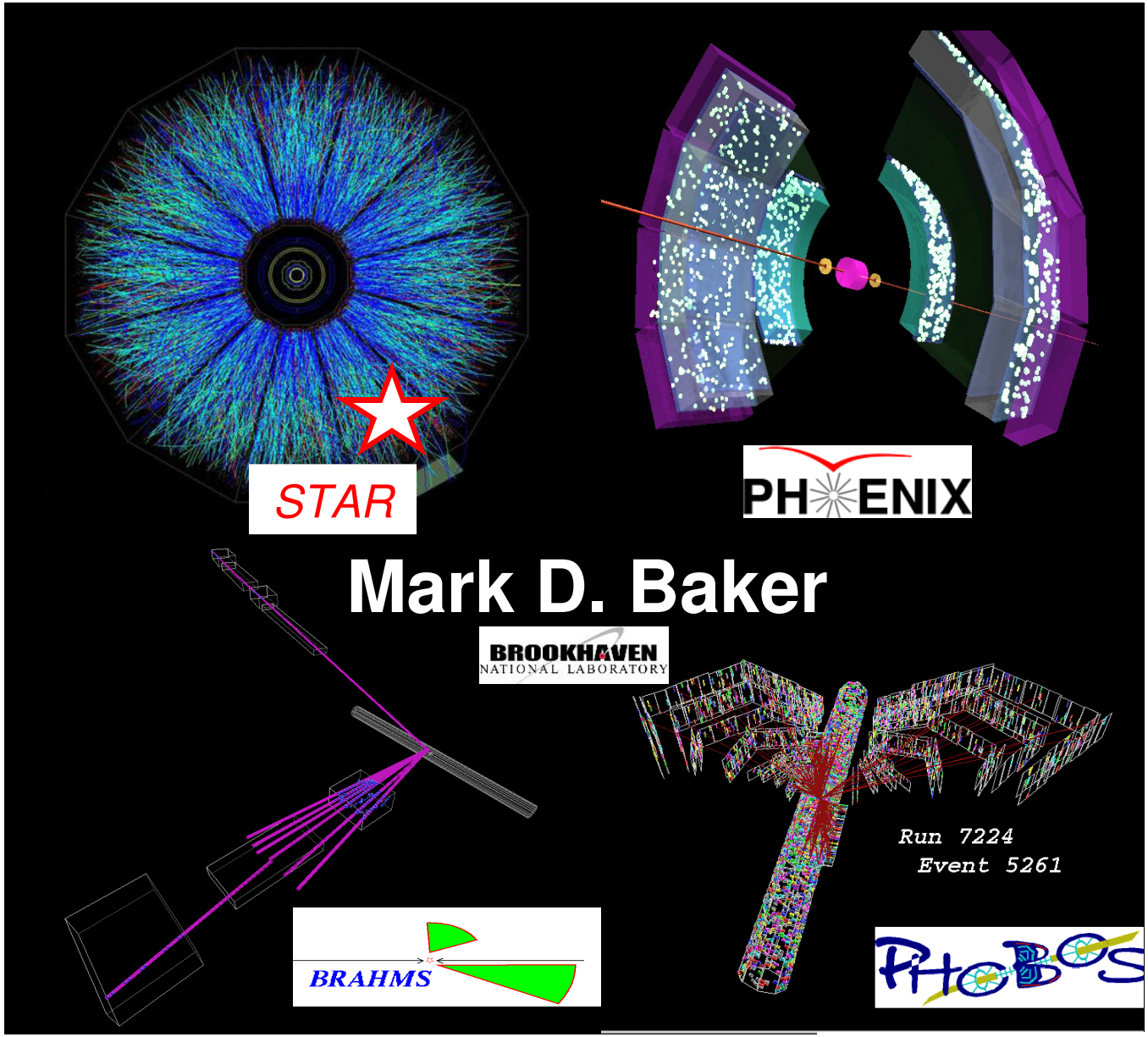
Lessons from d-A physics @ RHIC



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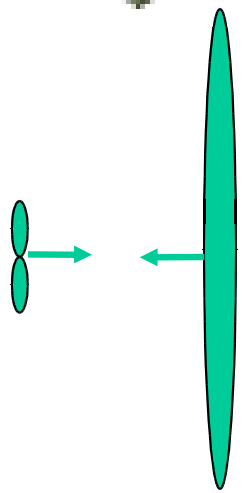
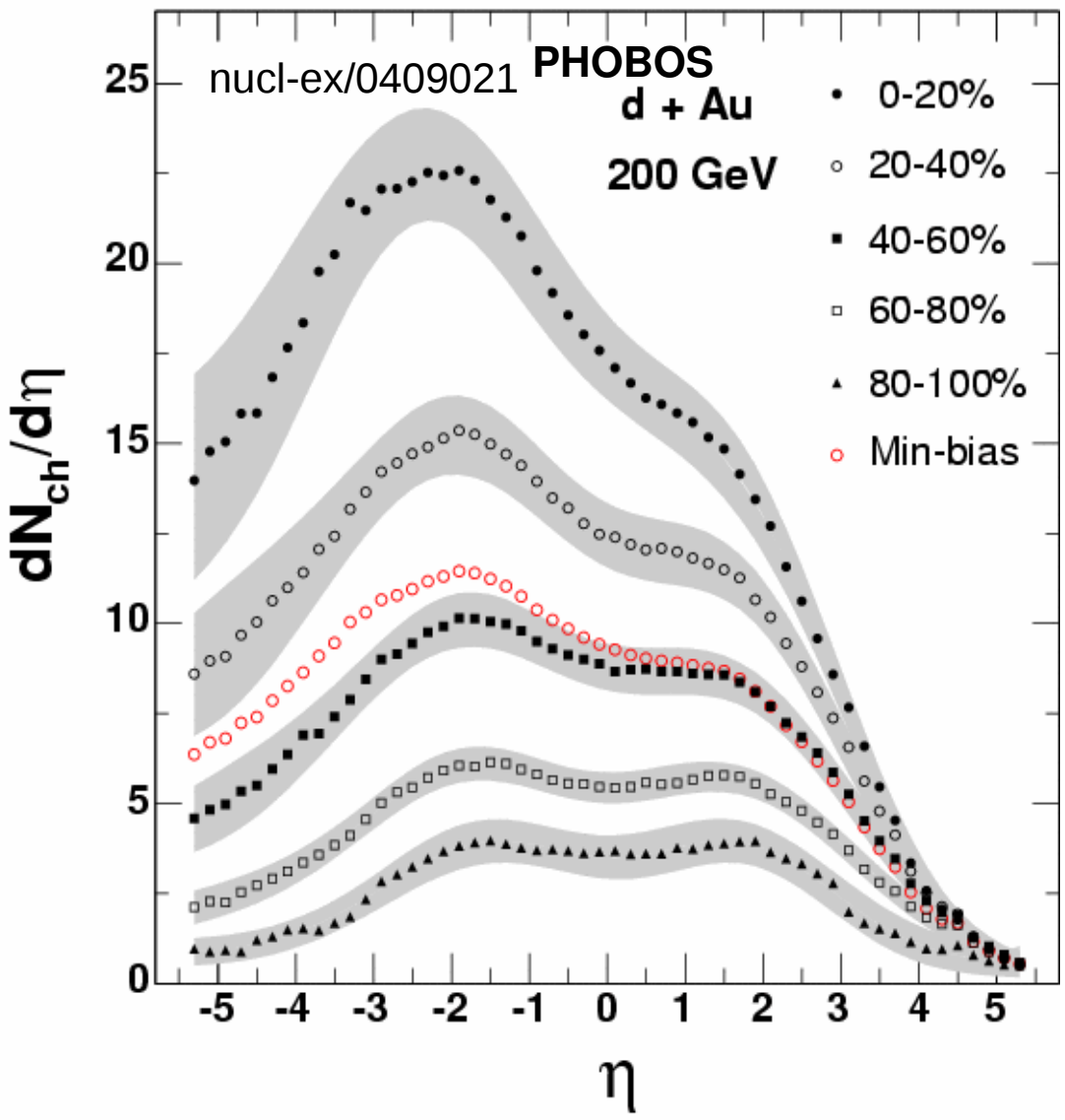
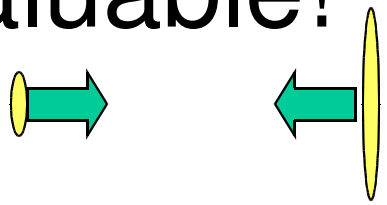
Lessons Learned?



- Centrality in d(p)+A
  - Very valuable!
  - Tricky to do right!
  - Detector implications
- Do hard particles see “the bulk”?

Centrality in dA is valuable!



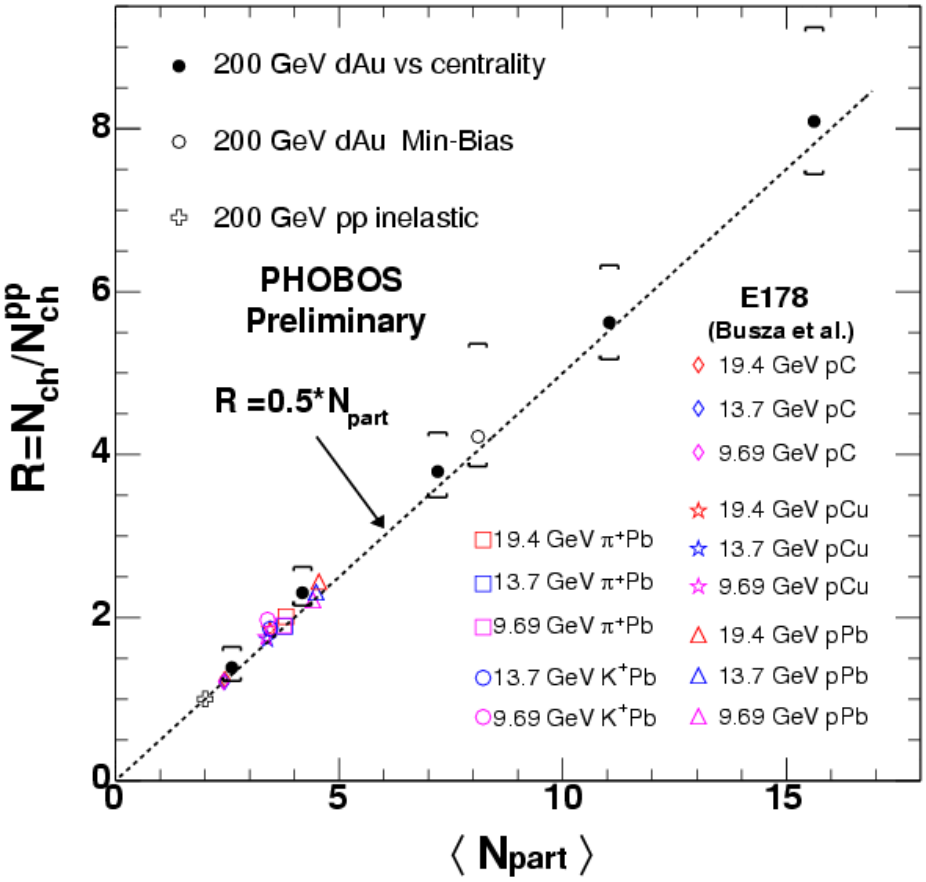


Centrality (%)	N_{part} (total)	N_{part} (Au)	N_{part} (d)	ν_{eff}
0-20	15.5	13.5	2.0	6.8
20-40	10.8	8.9	1.9	
40-60	7.2	5.4	1.7	
60-80	4.2	2.9	1.4	
80-100	2.7	1.6	1.1	1.5
			Minbias:	3.9

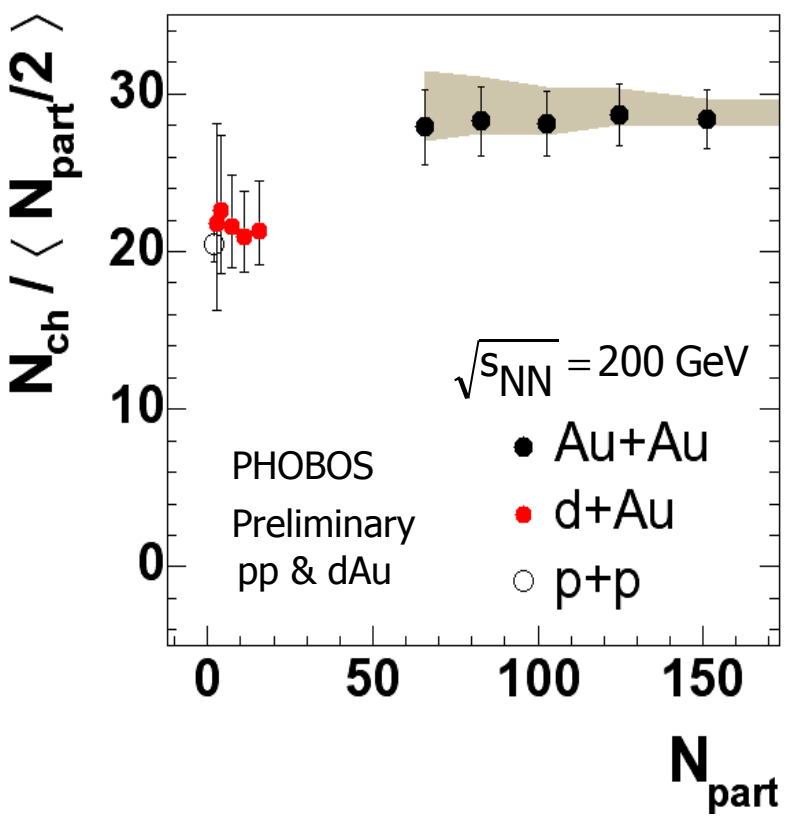
Minbias d/p+A with ν~6.8:
A>1000!

Npart scaling of Nch

- Evolution of N_{ch}/N_{pp} ratio vs N_{part}



- Evolution of $N_{ch}/(N_{part}/2)$ vs N_{part}



Similar to lower energy, lower ν, pA

See nucl-ex/0409021, nucl-ex/0301017

Effective ν is meaningful

- Compilation of world pEmulsion N_s + N_g data

N_{part} Selection:

p

1

Em

2.4

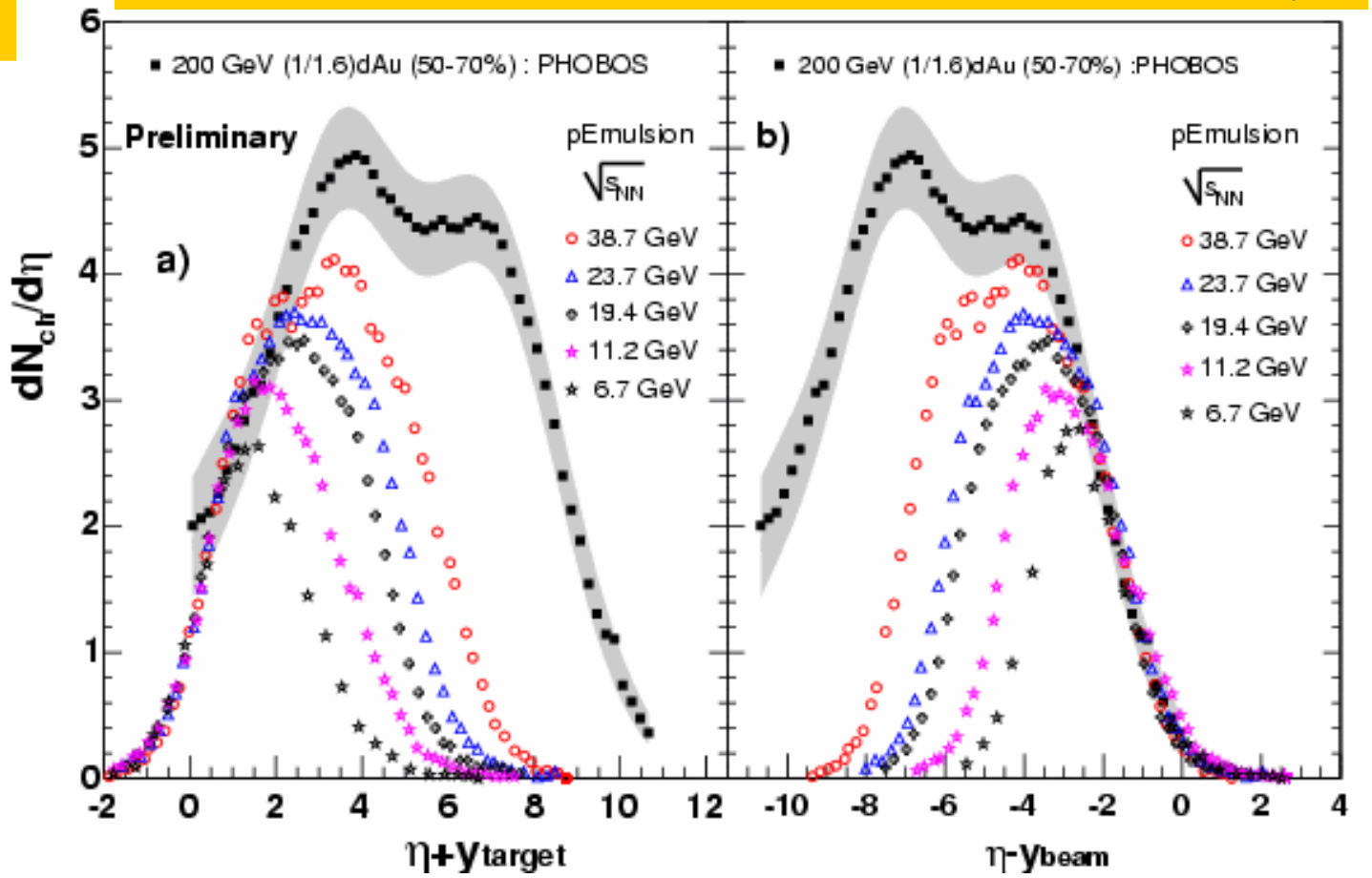
d

1.6

Au

1.6x2.4

- dAu & pEmulsion per incident nucleon and approx. same N_{part}



See nucl-ex/0409021

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Effective ν is meaningful

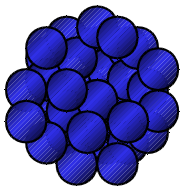
- dAu & pPb per incident nucleon and approx. same N_{part}

N_{part} Selection:

p

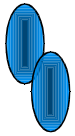
1

Pb



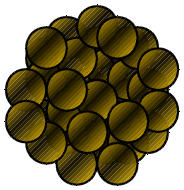
3.5

d

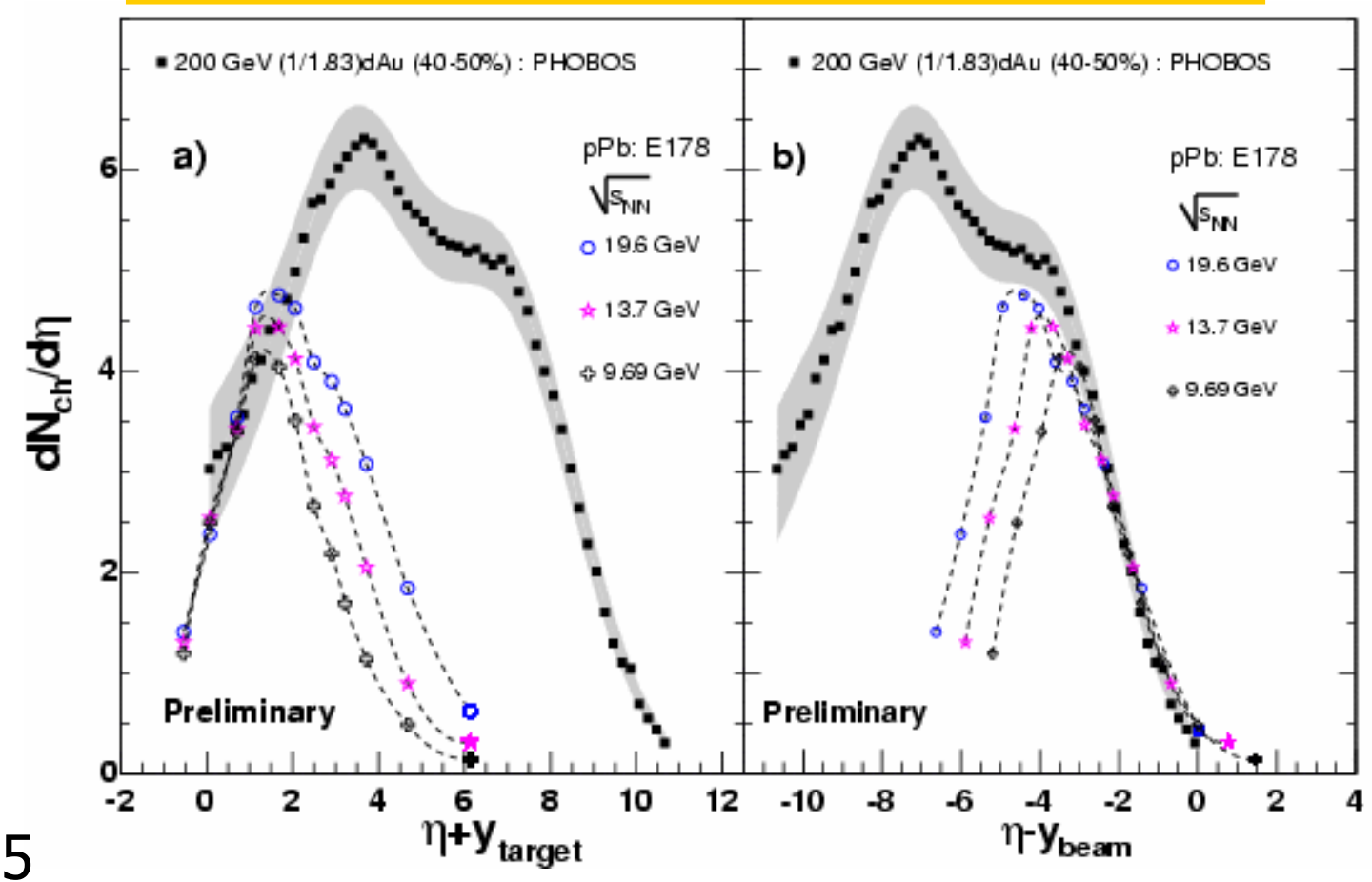


1.83

Au



1.83x3.5



See nucl-ex/0409021

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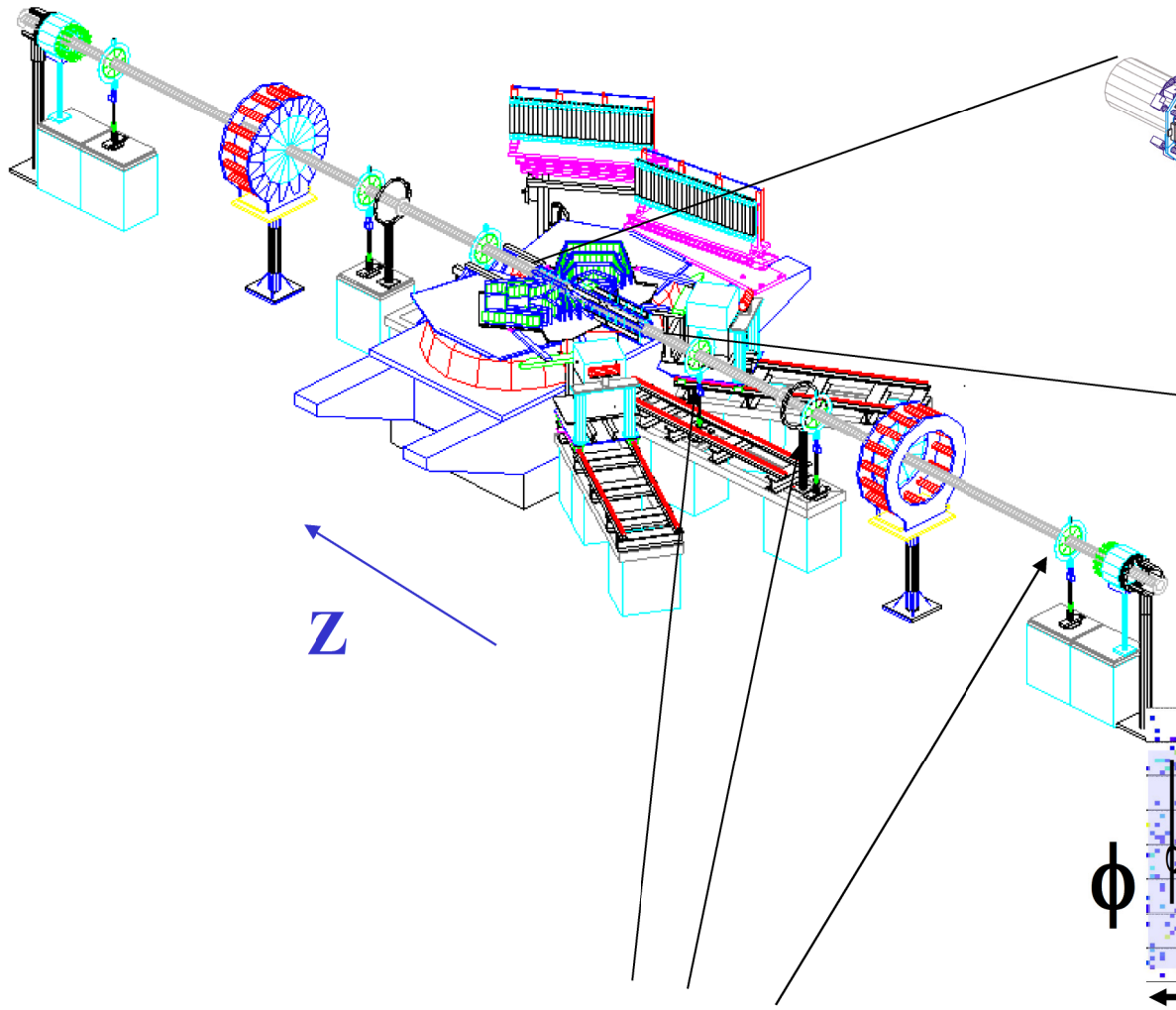
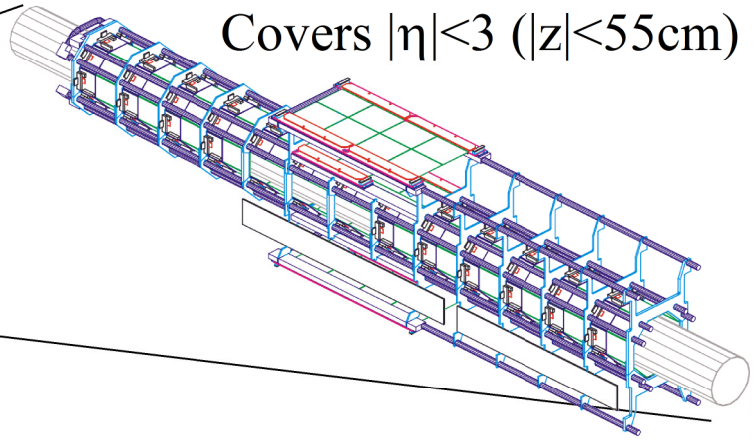
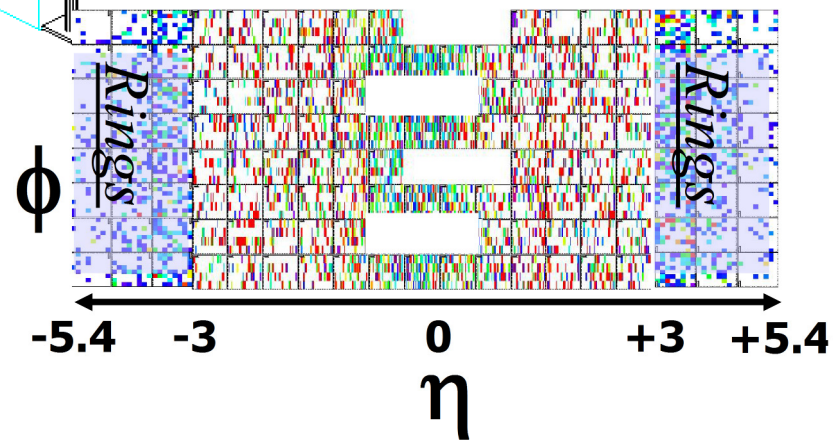
Hardware:

Octagon Detector (Silicon Pads)

Covers |η|<3 (|z|<55cm)



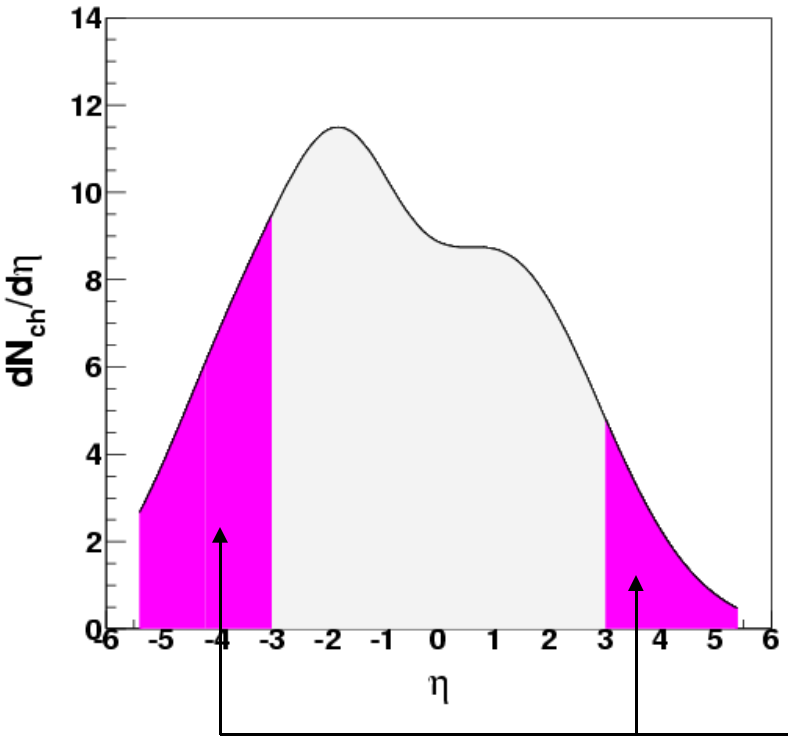




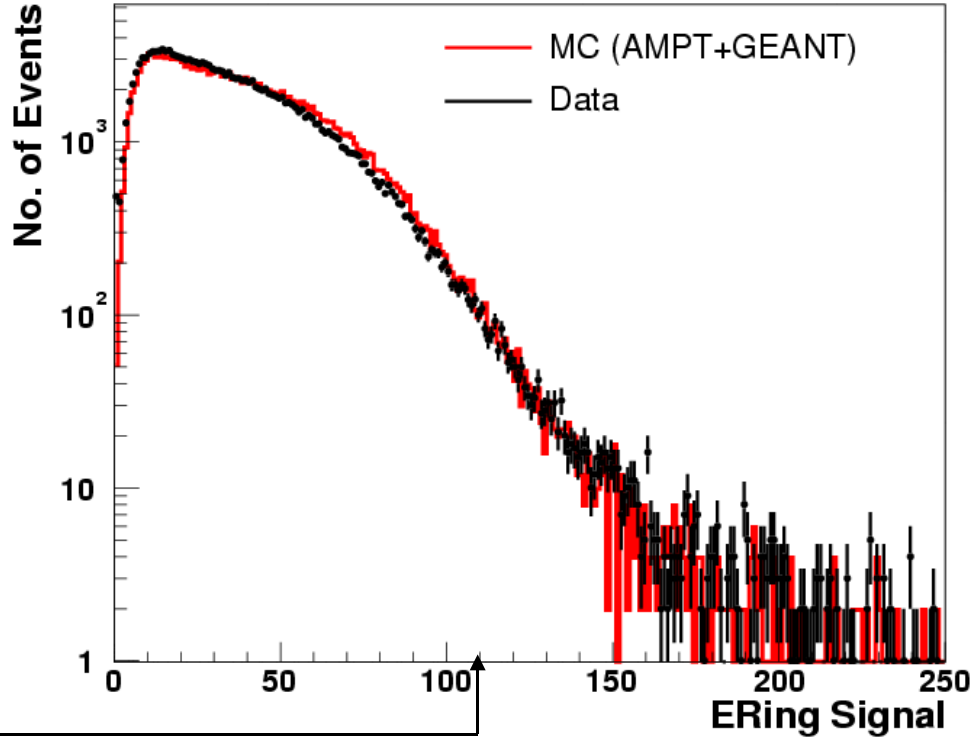
Ring Detectors (Silicon Pads)

Phobos centrality method

ERing method
3 <|η| < 5.4

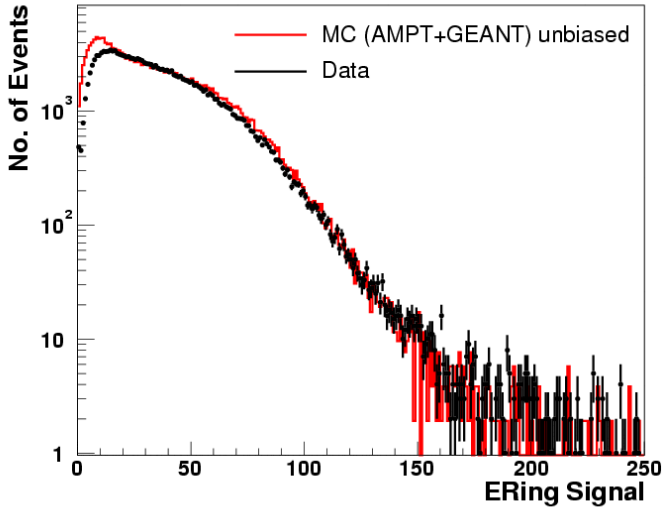


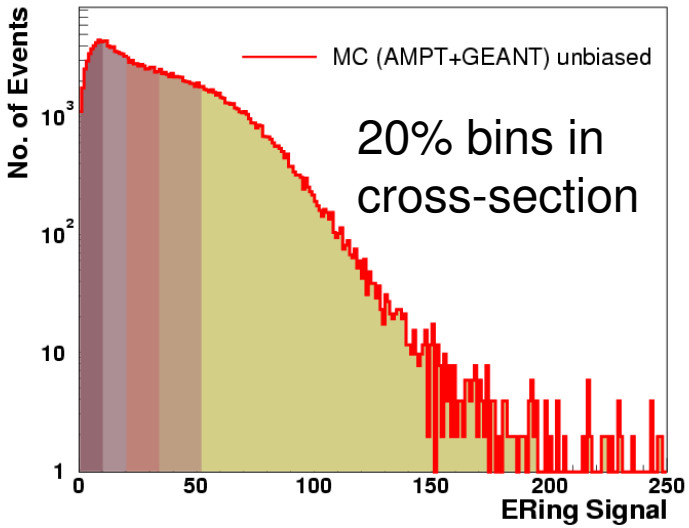
Comparison of the signal distributions from Data and MC (AMPT + Geant)



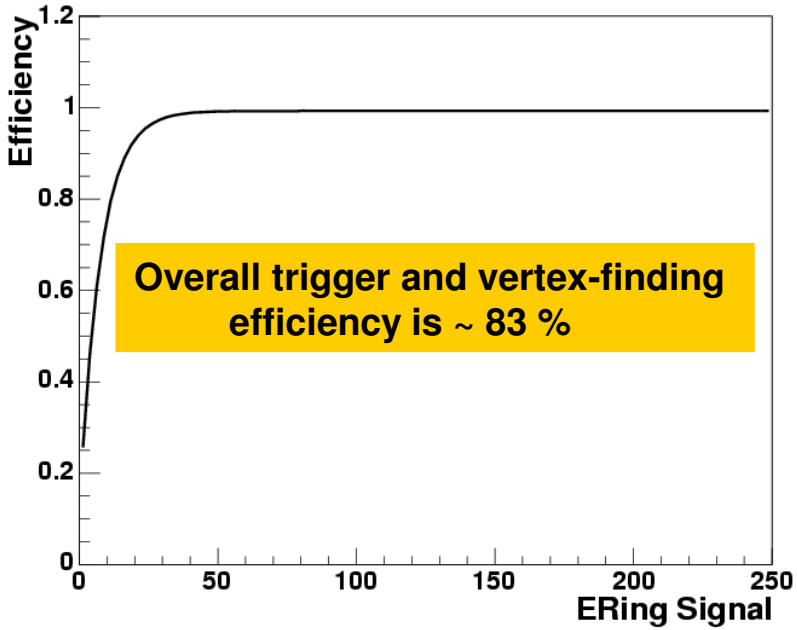
- Compare data to fully simulated & reconstructed AMPT + Geant including trigger and event selection effects

Phobos centrality method



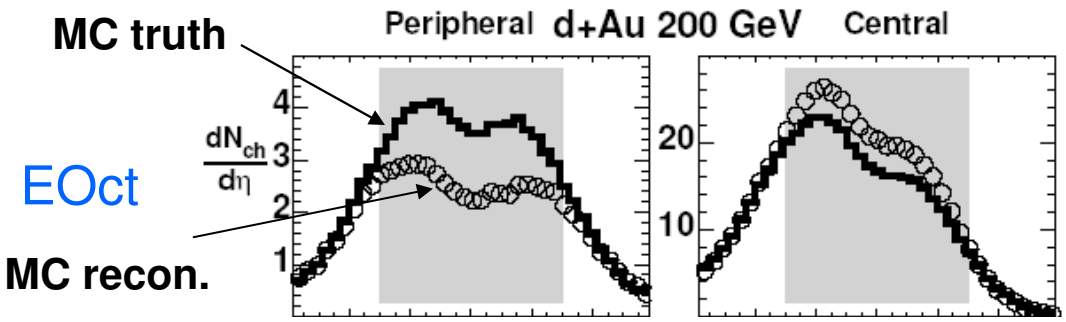


"ERing"



Overall trigger and vertex-finding efficiency is ~ 83 %

It is tricky. Why ERing?

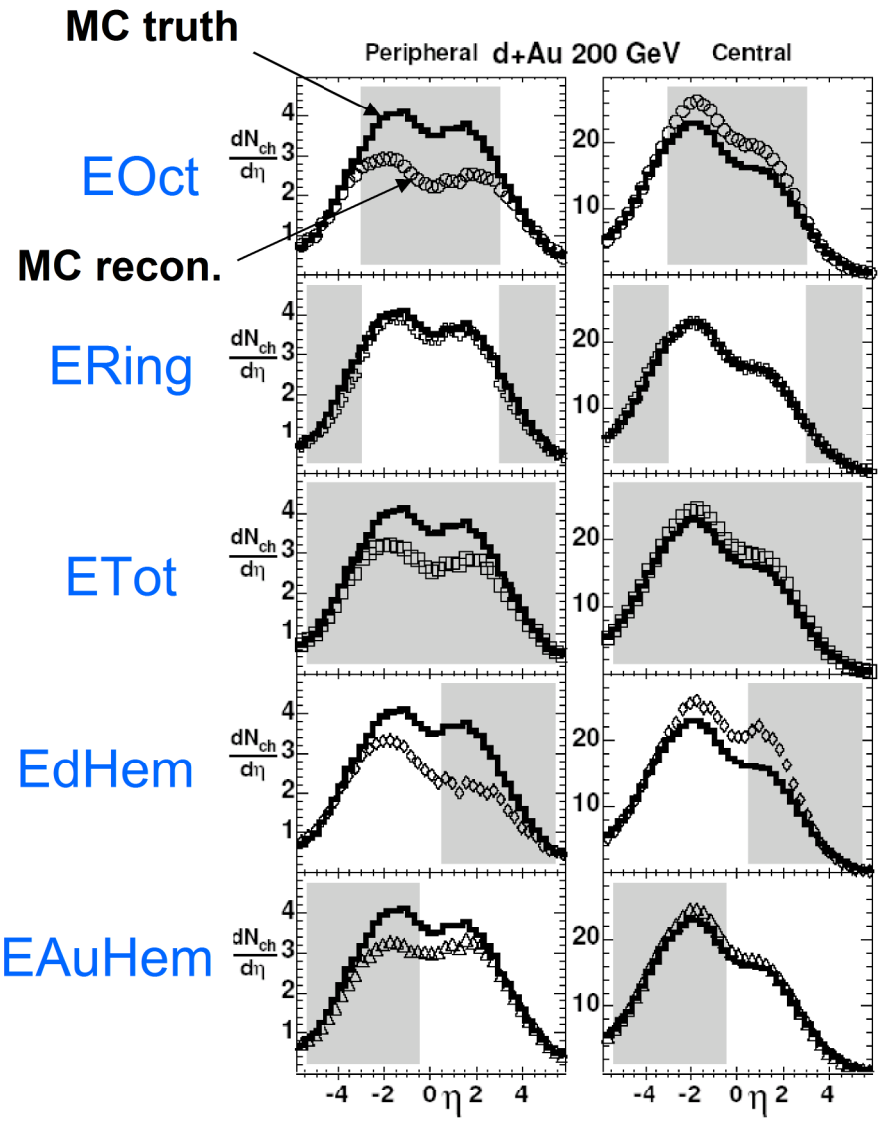


EOct is biased

Nucl. Phys. A (in press), nucl-ex/0410022

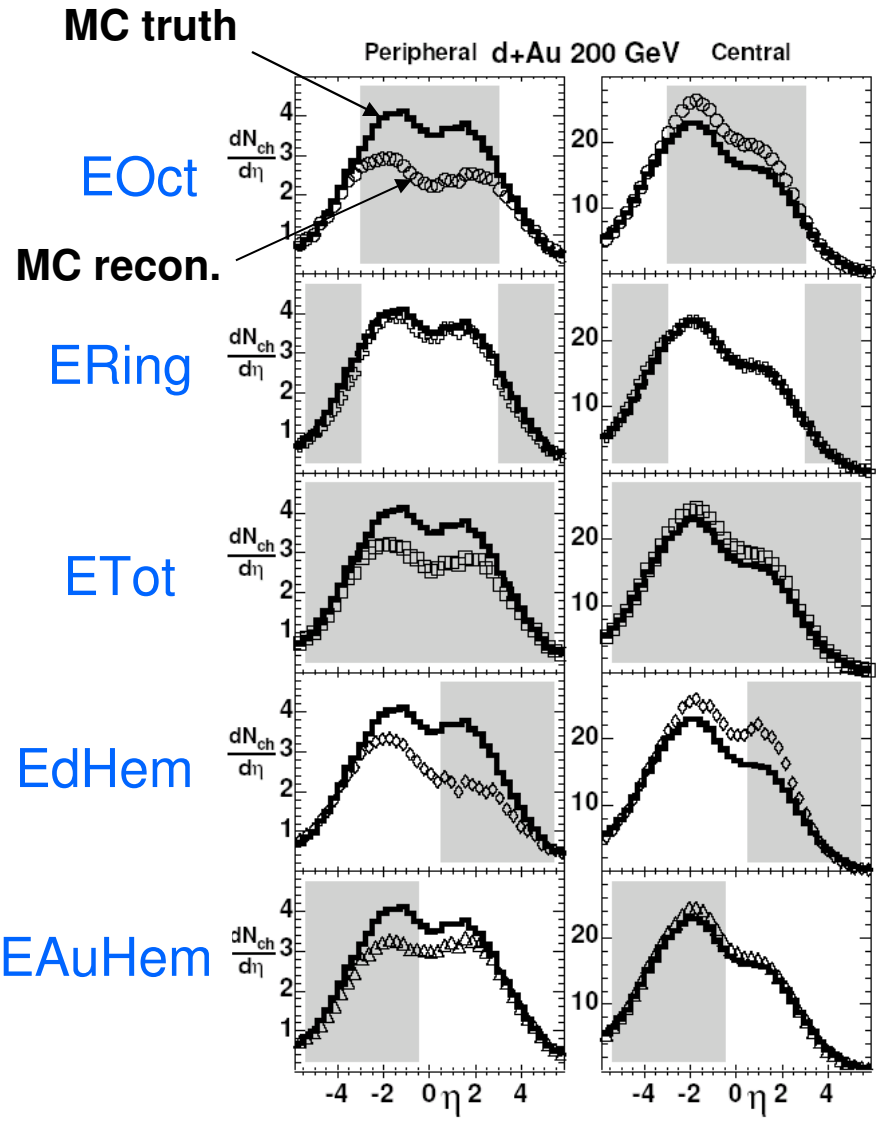
M

It is tricky. Why ERing?

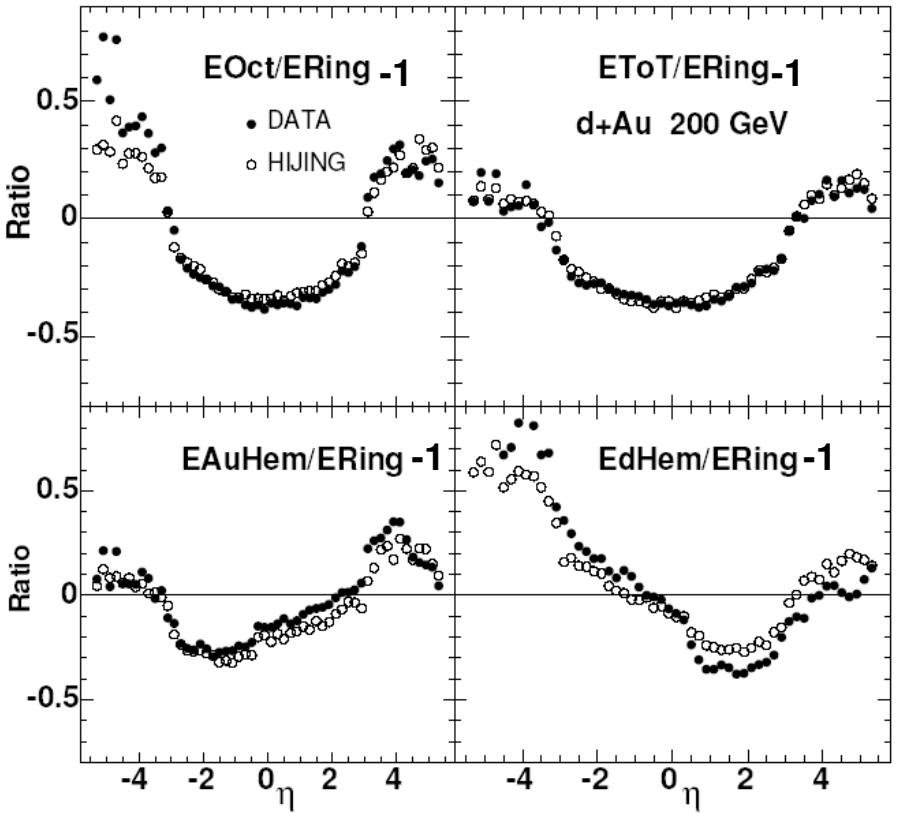


Nucl. Phys. A (in press), nucl-ex/0410022

It is tricky. Why ERing?

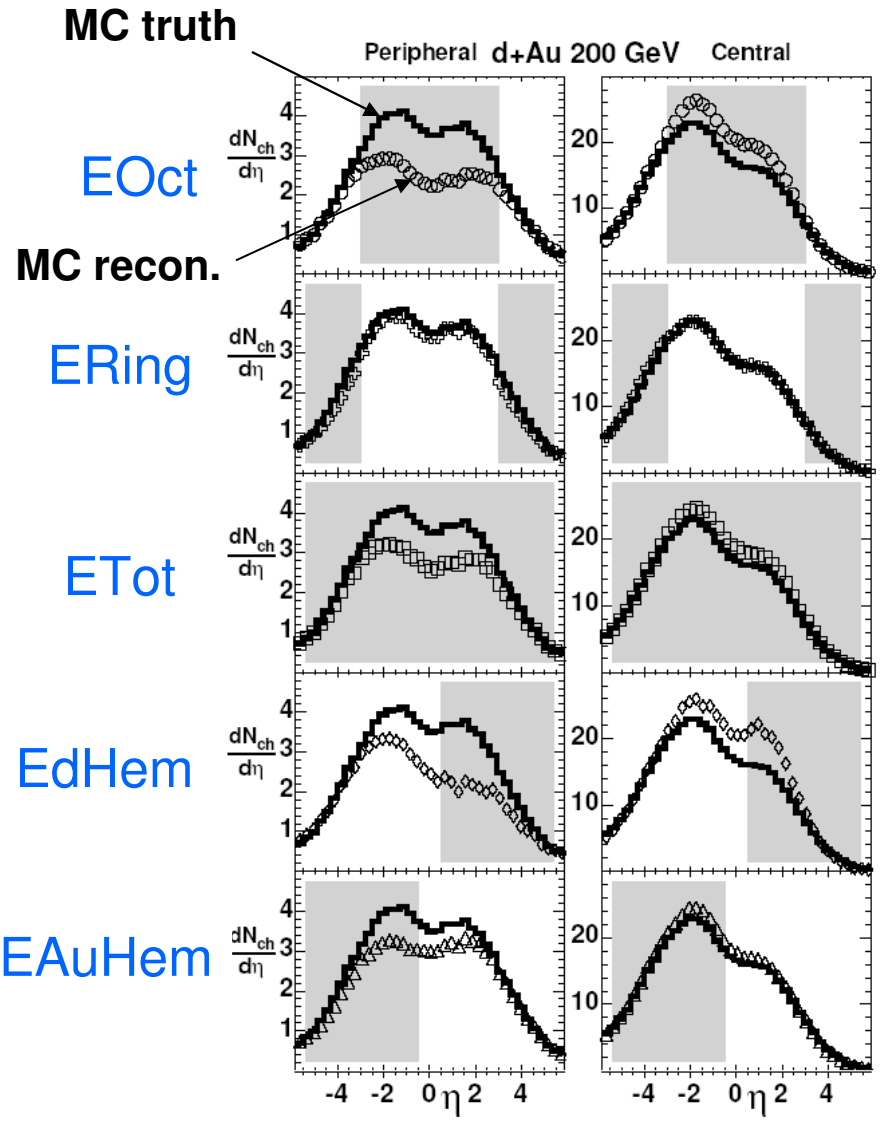


Data ratios validate MC study
E.g. Most peripheral 10%:



Nucl. Phys. A (in press), nucl-ex/0410022

It is tricky. Why ERing?



Data ratios validate MC study

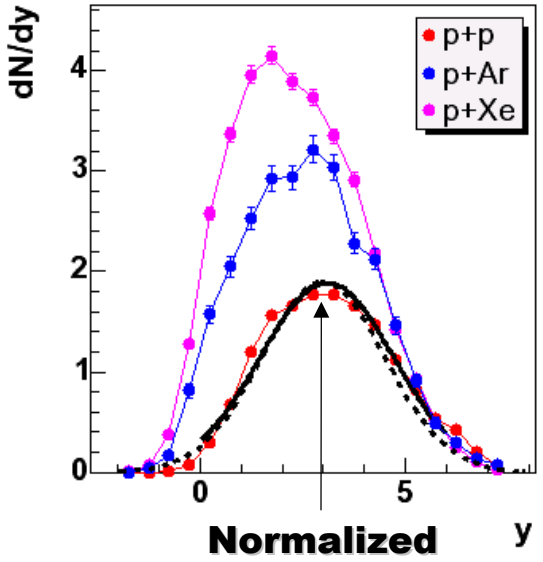
Conclusion:

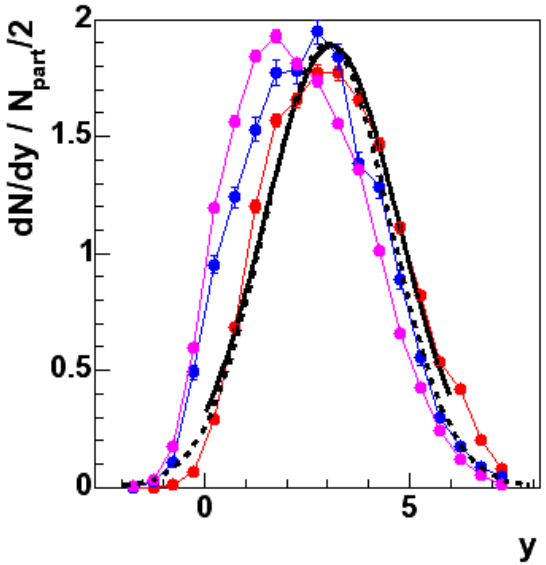
- d+Au centrality must be measured using $|\eta|>3$
- mid-rapidity measures are biased!

- PHOBOS: OK
- BRAHMS: BIASED for $dN/d\eta$
- PHENIX: OK
- STAR: OK

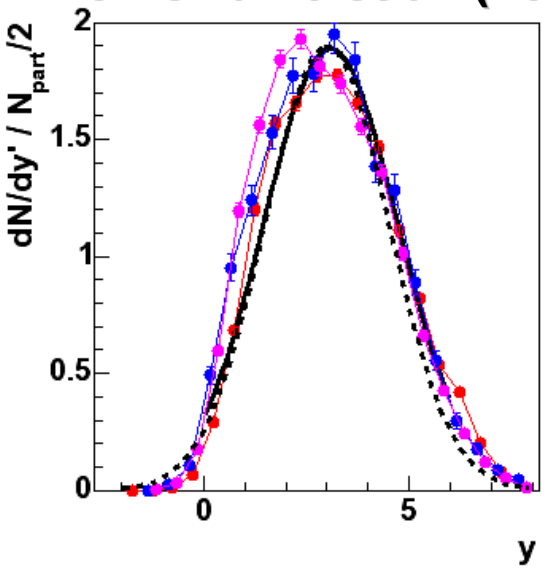
Nucl. Phys. A (in press), nucl-ex/0410022

Bulk dynamics in p+A





NA5 DeMarzo et al. (1984)



Raw dN/dy

dN/dy
$N_{part}/2$

dN/dy'
$N_{part}/2$

--- **Prediction**
— **Fit**

$$\sigma = \sqrt{\ln\left(\sqrt{s}/2m\right)} \qquad y' = y + \ln\left(\sqrt{\nu}\right)$$

Steinberg, INPC2004

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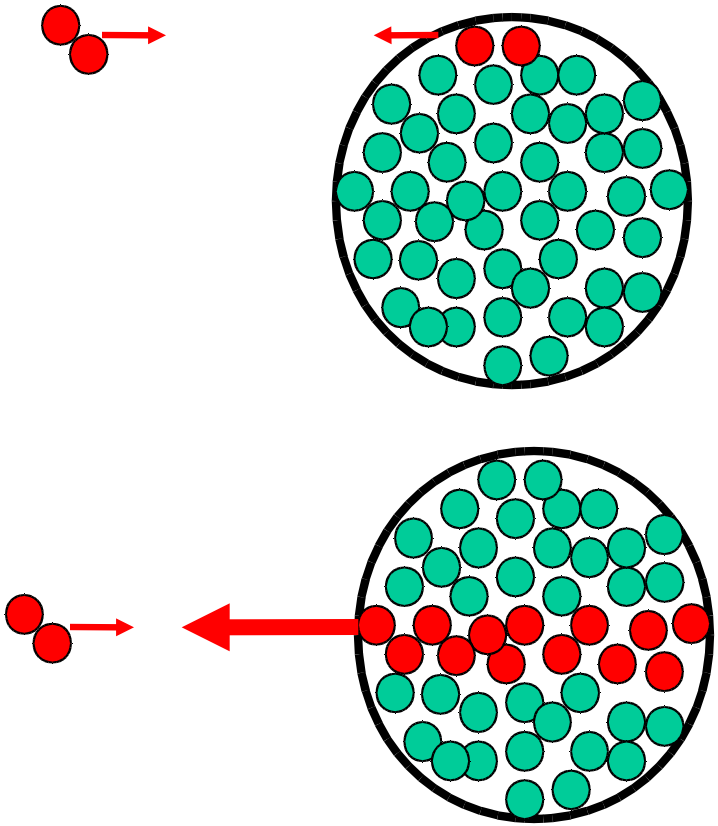
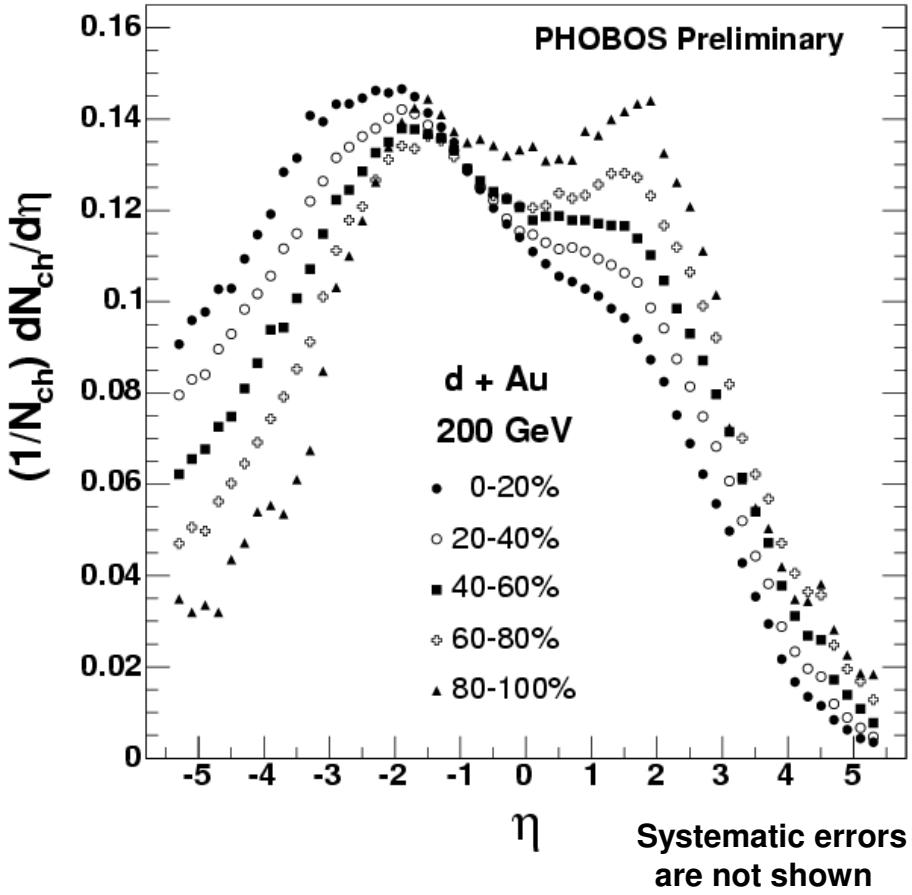
Soft & hard production...

Soft particles see full participant zone



See nucl-ex/0409021



Hard, rare partonic collisions should just see NN frame

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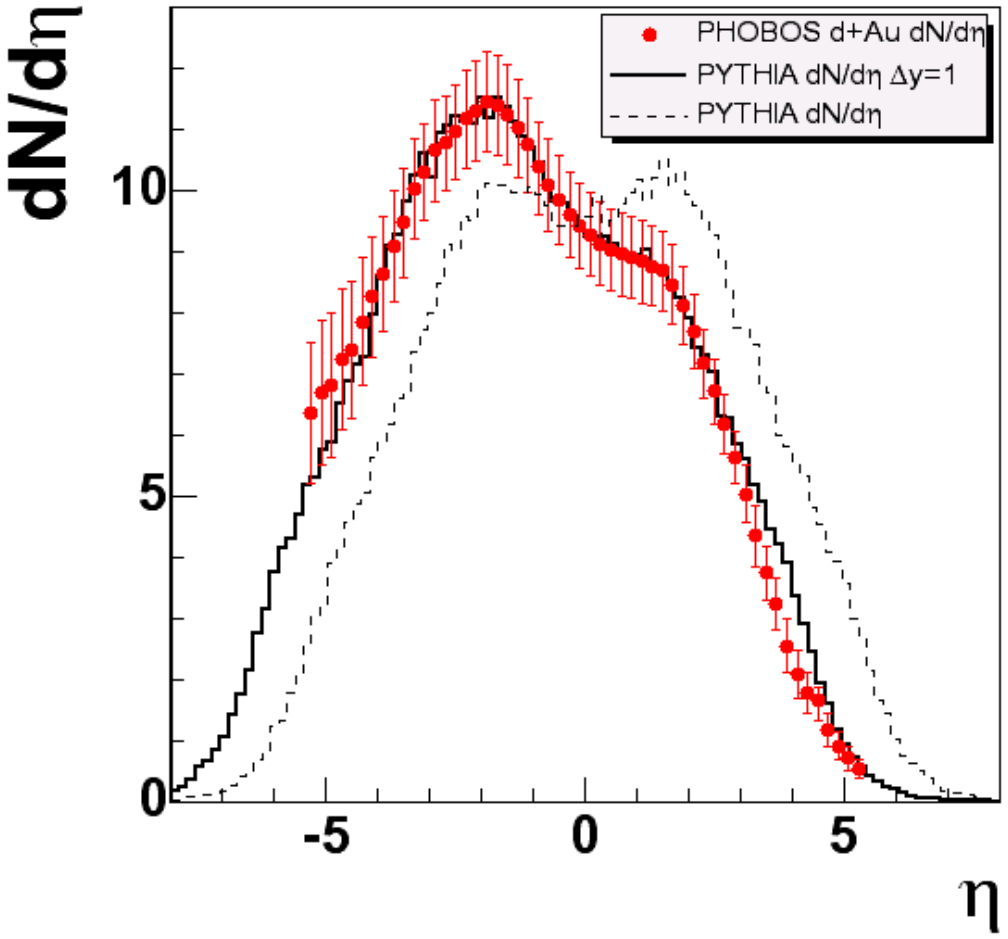
RHIC d+A is also a shifted symmetric distribution



Let's play a game:

Shift PYTHIA dN/dy by $\Delta y = 1$

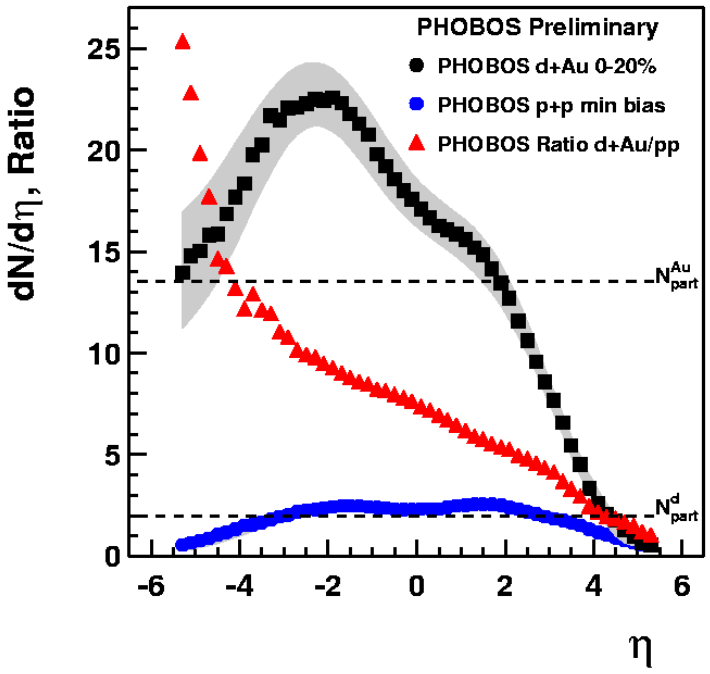
Scale up by $N_{part}/2$

Recalculate dN/dη

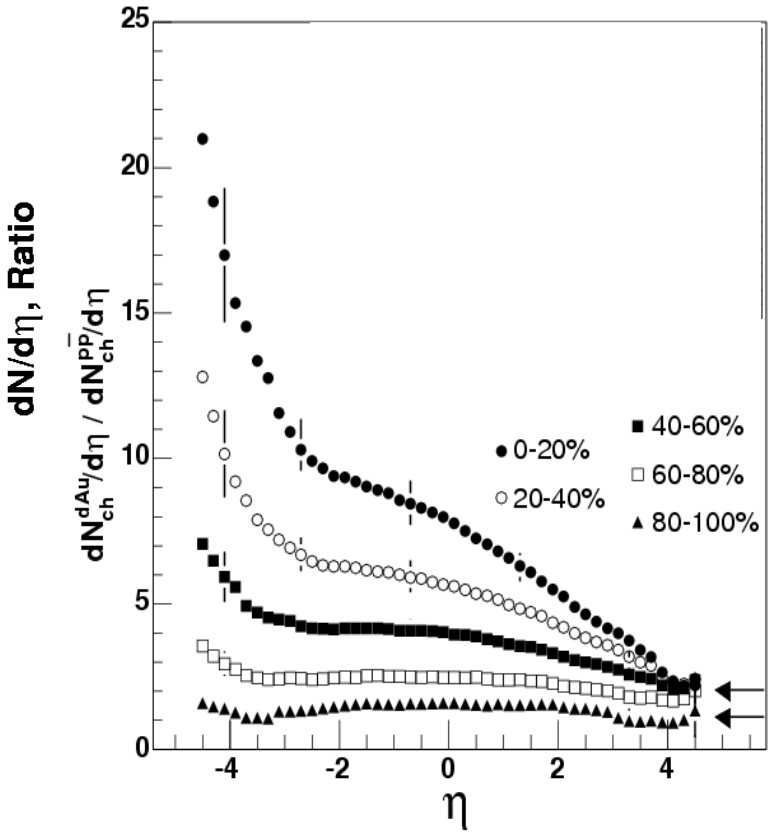
Similar shapes (violates energy conservation ☹)

Steinberg (for Phobos), QM2004

The bulk “triangle”



arXiv:nucl-ex/0403033



arXiv:nucl-ex/0409021

AS SEEN IN p+A AT F.T. ENERGIES 50-200 GeV

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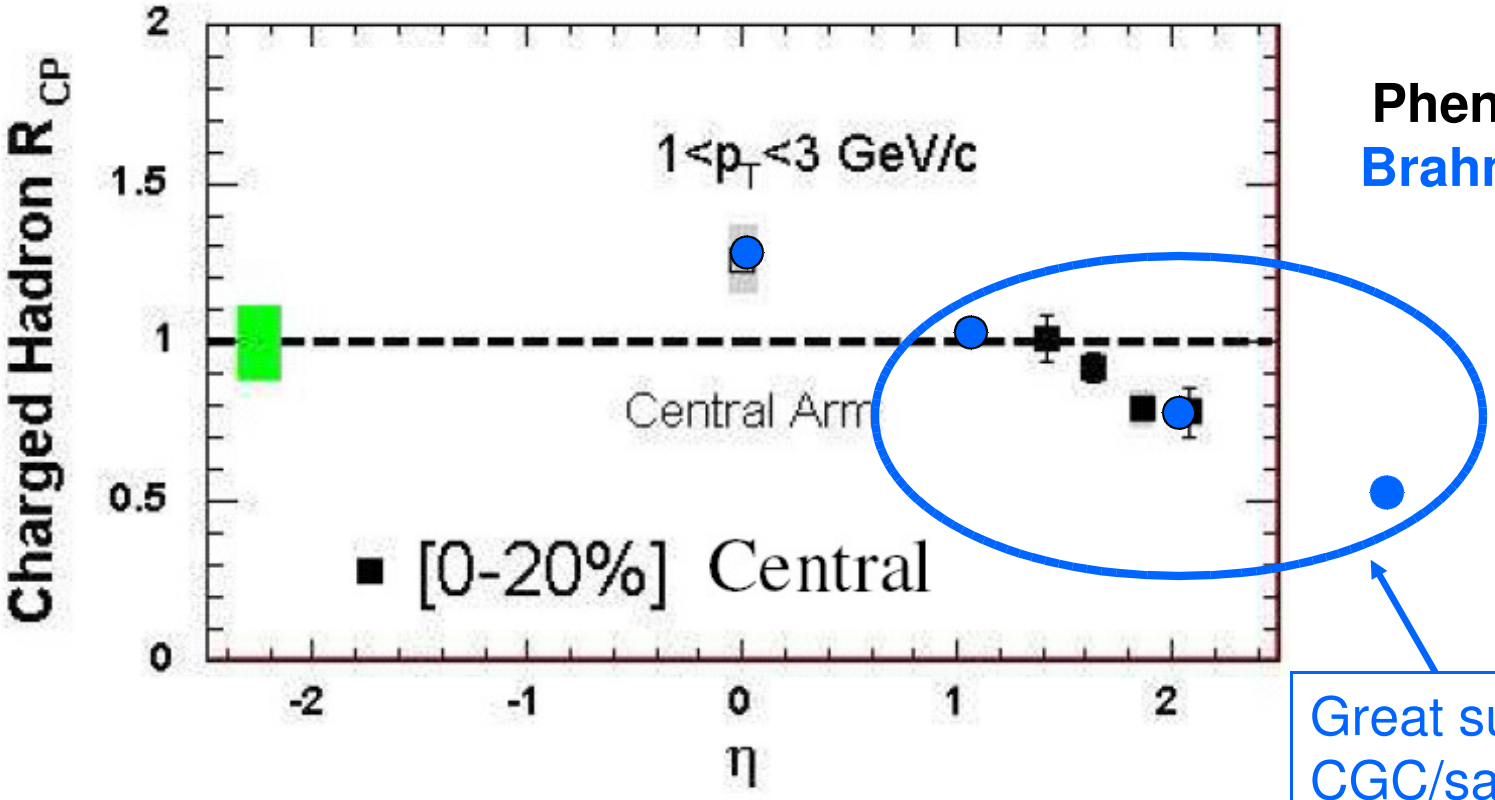
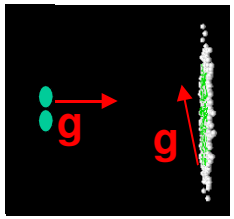
What about “hard” particles?



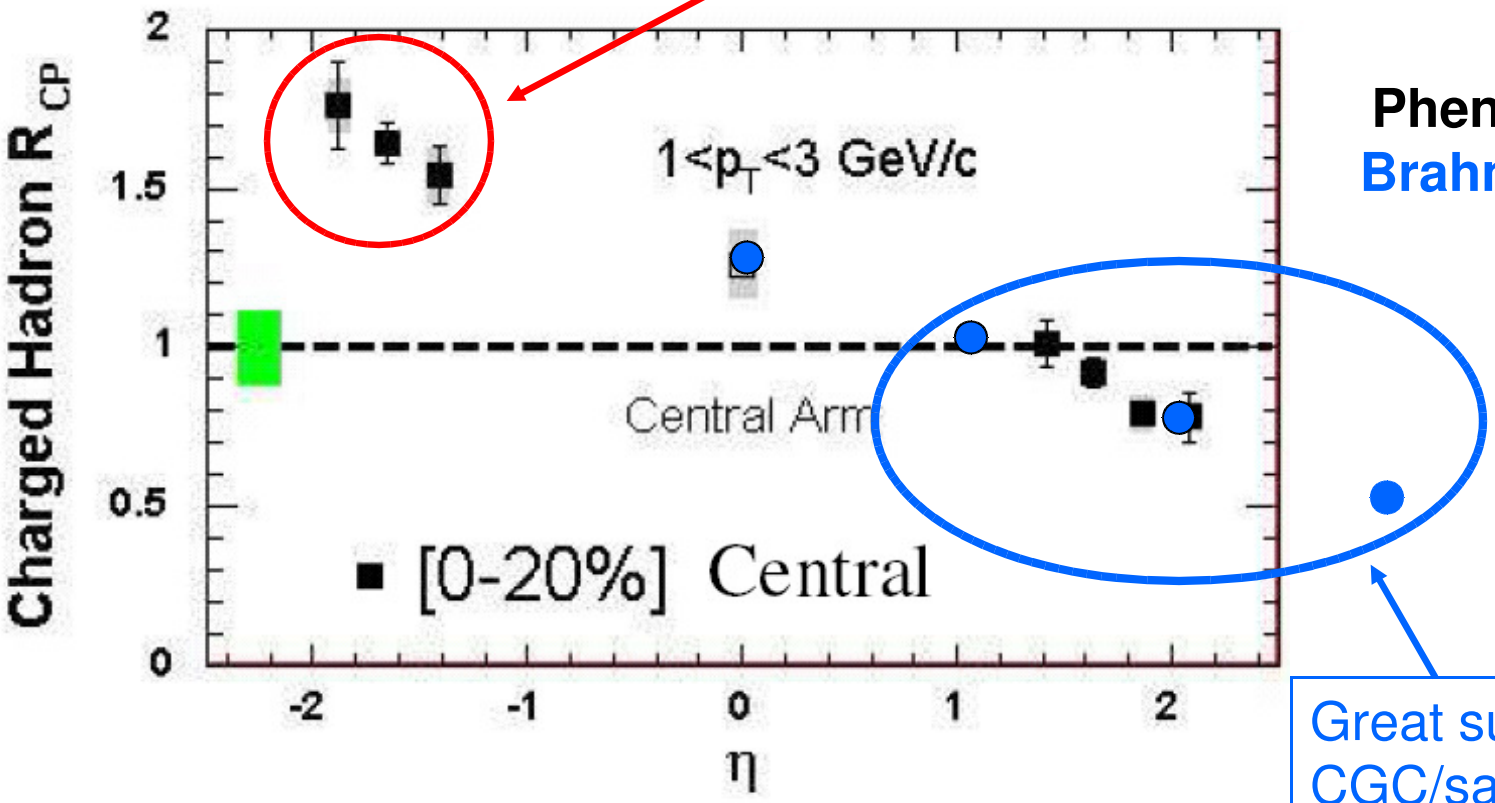
Phenix
Brahms
QM2004



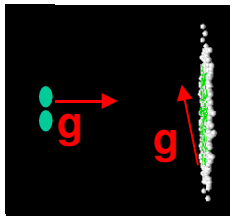
Great success for CGC/saturation?

See PHENIX, arXiv:nucl-ex/0411054
& BRAHMS, PRL 93 (2004) 242303
for latest data

Who ordered that?



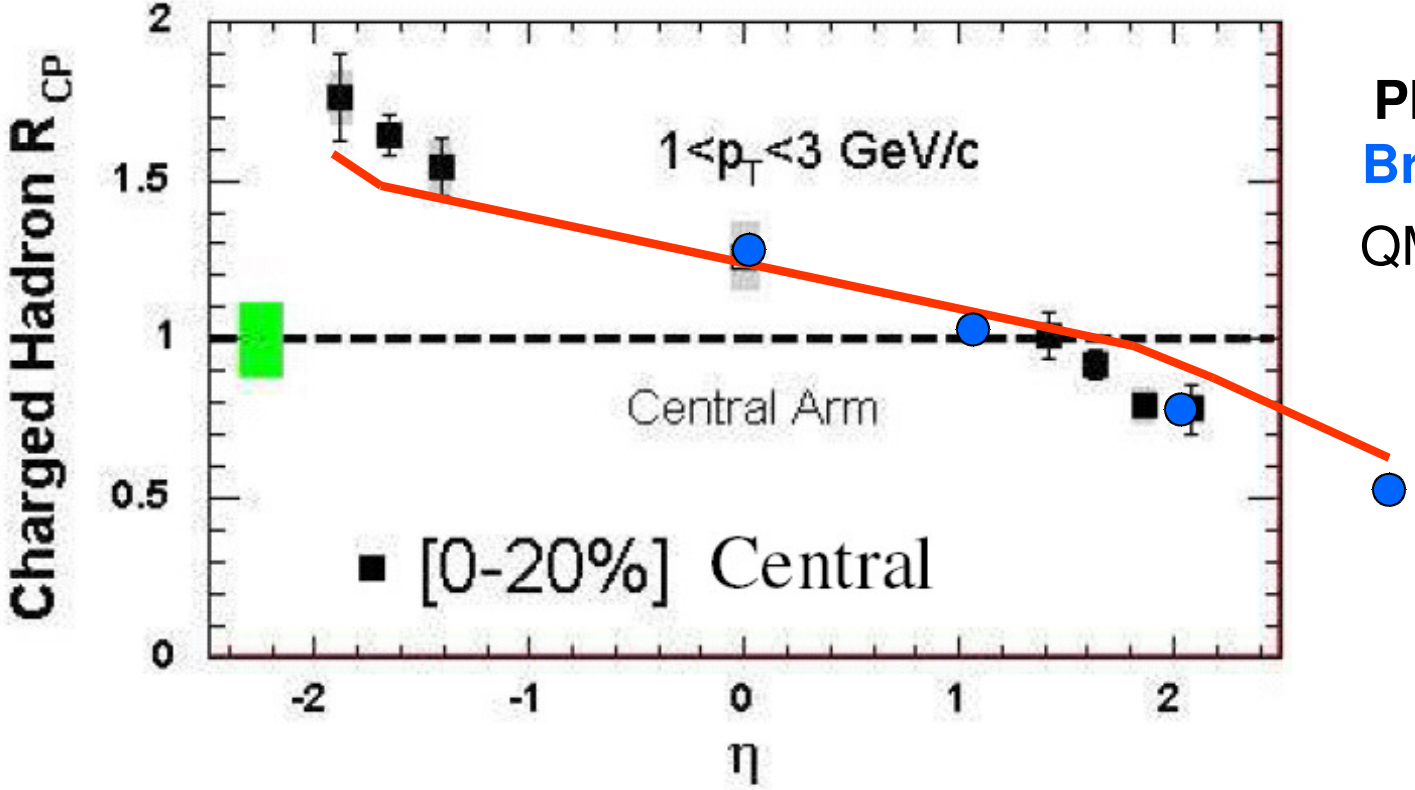
Phenix
Brahms
QM2004



Great success for CGC/saturation?

See PHENIX, arXiv:nucl-ex/0411054
& BRAHMS, PRL 93 (2004) 242303
for latest data

“Hard” & “soft” particles behave similarly



Phenix

Brahms

QM2004

Phobos dN/dη dA/pp scaled by 1.4 /(N_{part}/2)

MDB, EIC workshop, March 2004, JLab

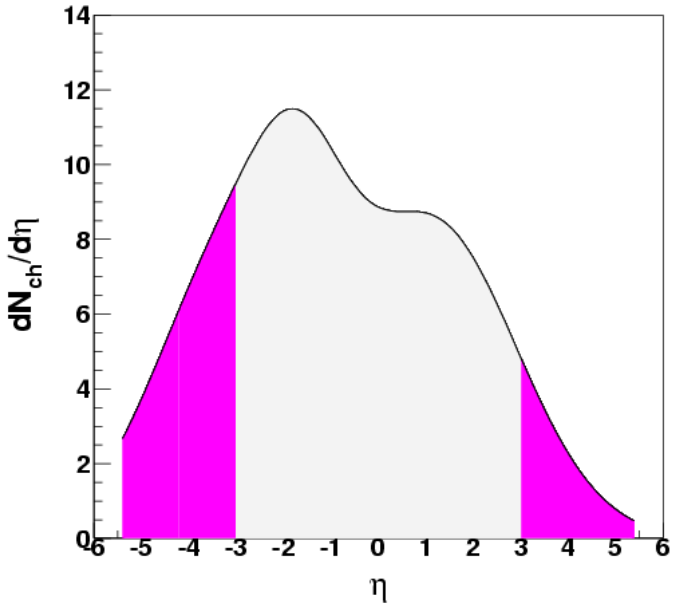
CGC suppression & enhancement pattern

OR

Scattering from the shifted bulk (clue to Cronin?)

Lessons Learned?

- Centrality in d(p)+A
  - Very valuable!
  - Tricky to do right!
  - Detector implications
- Hard/soft boundary is subtle
  - Do hard particles see the bulk?

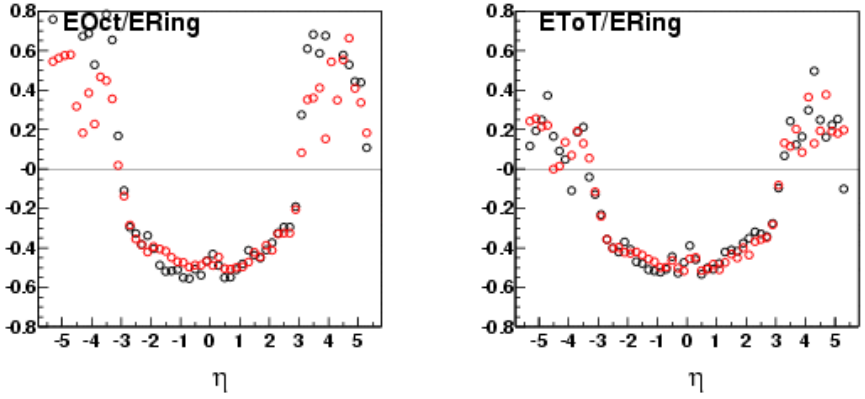


Extras...

Does HIJING Reproduce the Relative Bias like Data?

Most peripheral: 90-100%

Bin = 0

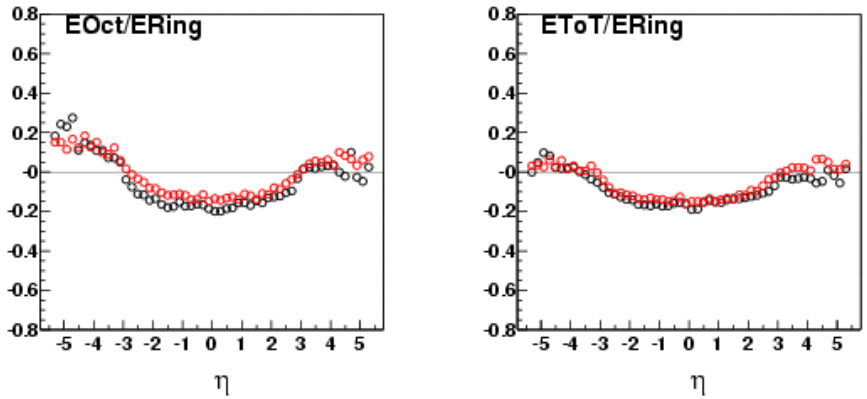


Data

HIJING

Peripheral: 60-70%

Bin = 3



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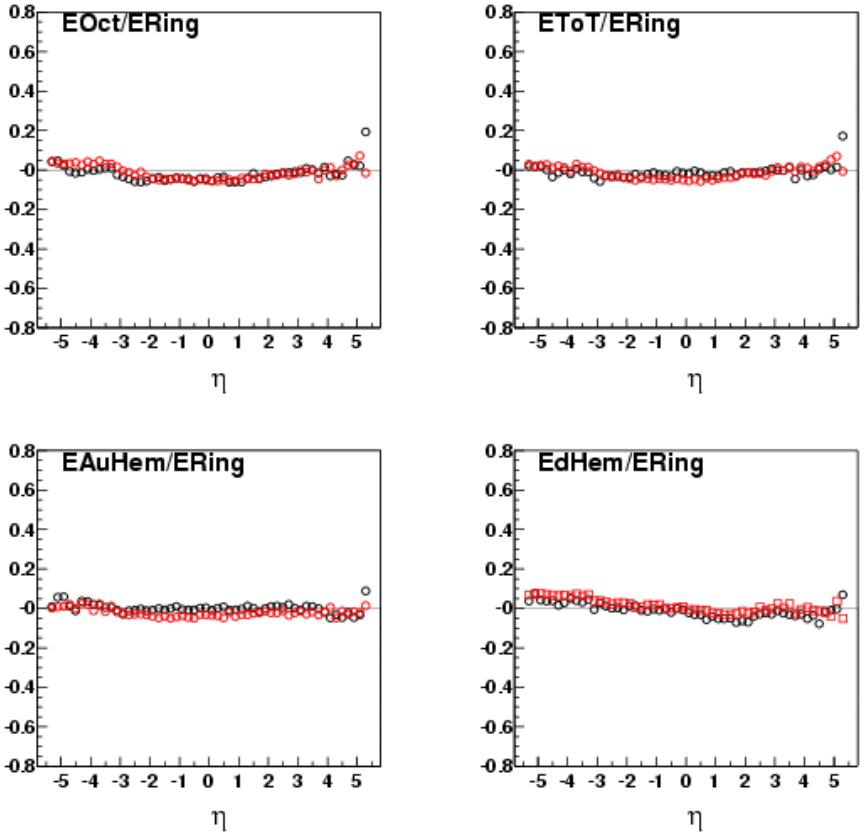
Does HIJING Reproduce the Relative Bias like Data?

Mid-Central: 30-40%

Bin = 6

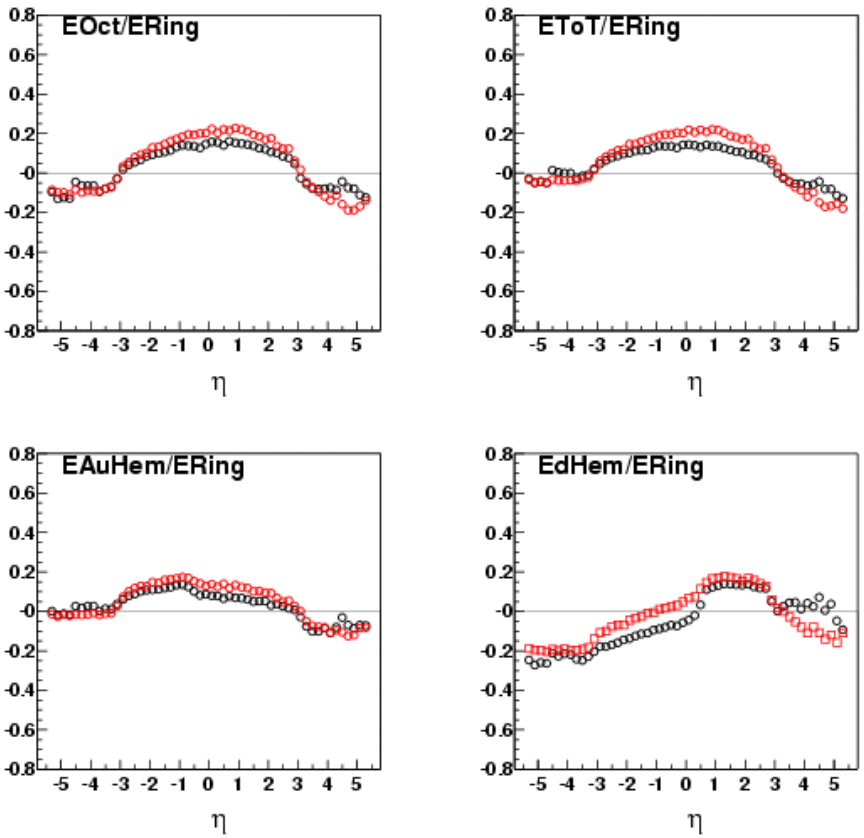


Data

HIJING

Central: 0-10%

Bin = 9

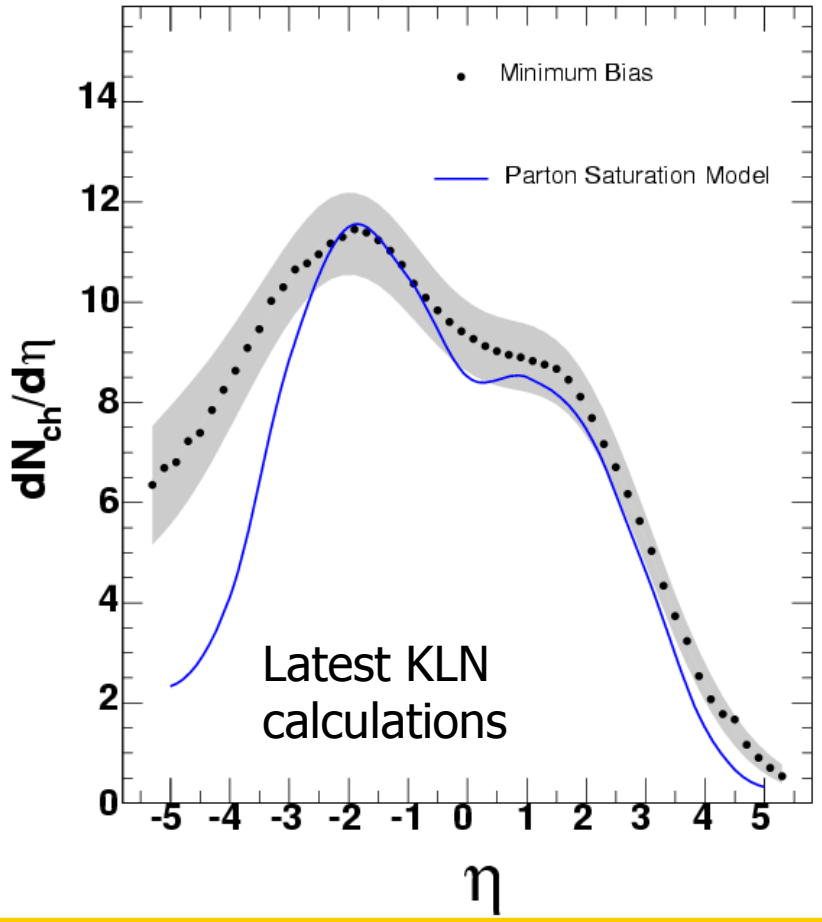


Answer:

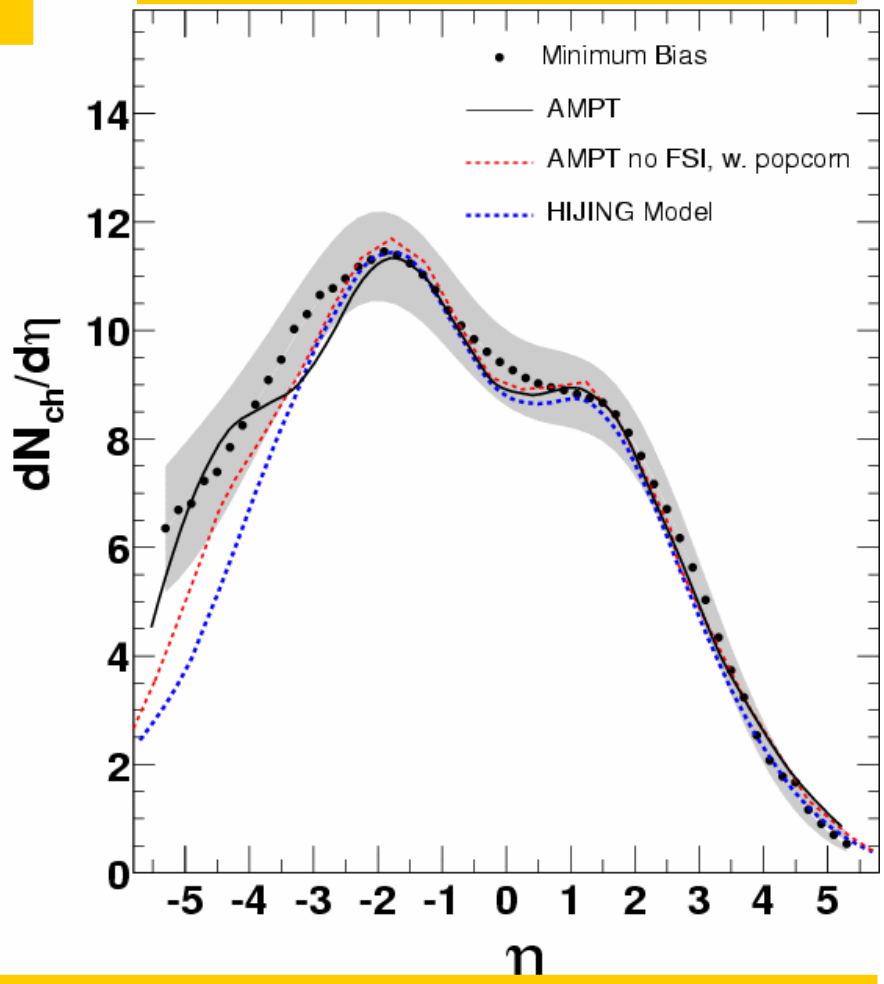
Yes, HIJING Reproduces the Relative Bias as Data

Comparison dAu Minimium-bias to Parton Saturation (KLN), RQMD, HIJING and AMPT Models

Data and Parton Saturation model



nucl-ex/0311009 and Submitted to PRL



- The centrality dependence in d+Au is crucial for testing the saturation approach

D. Kharzeev et al., arXiv:hep-ph/0212316

RHIC pA/eA Workshop, May 2004