PHOBOS Results and Perspective

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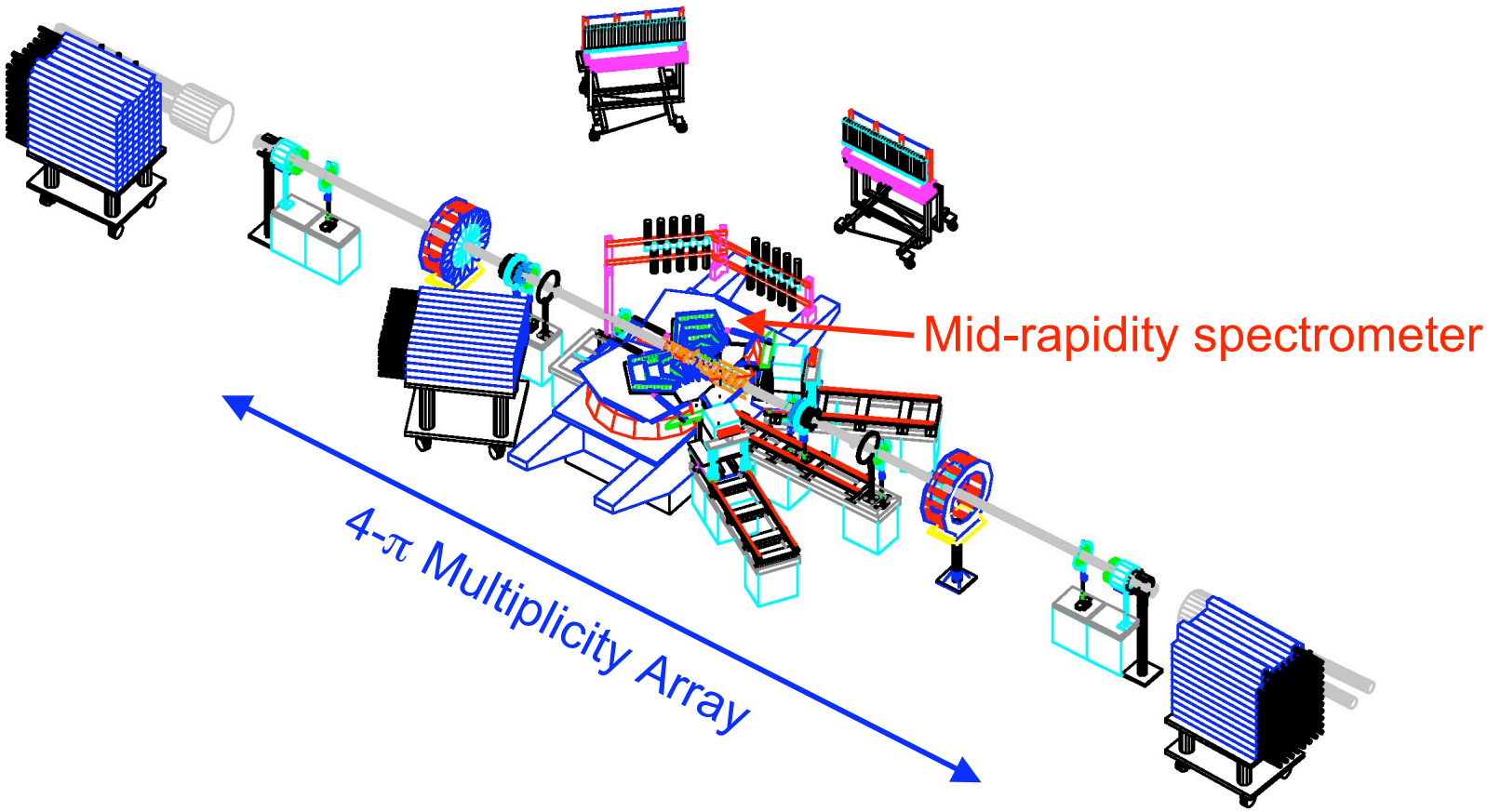
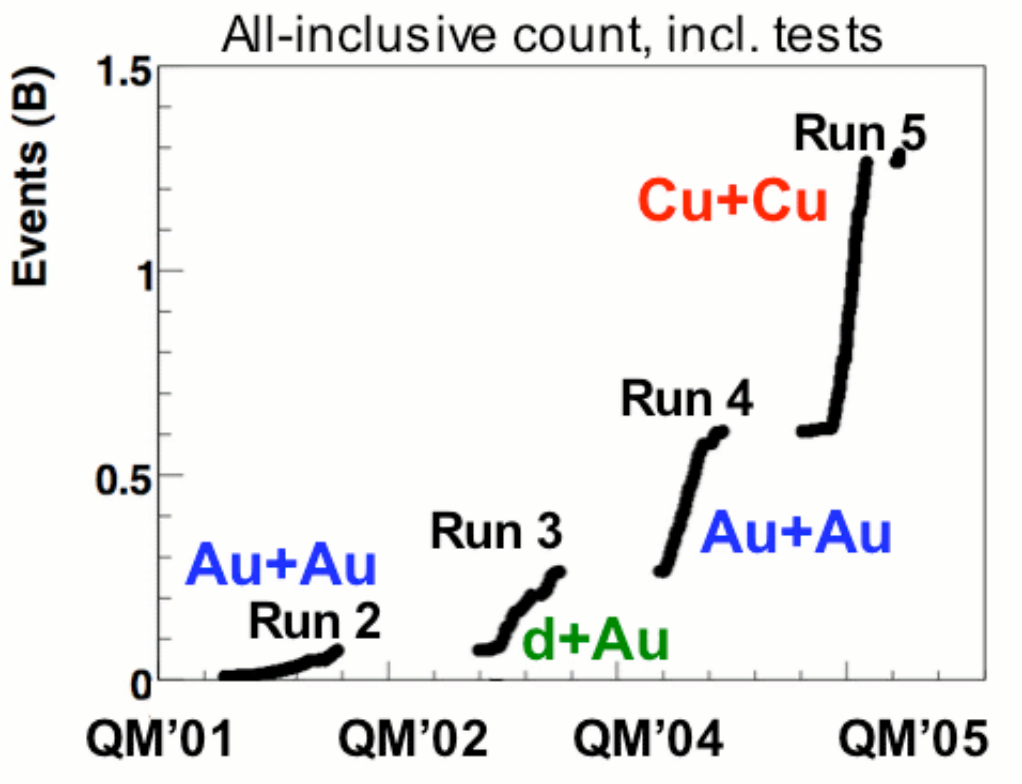
PHOBOS Experiment - Run 5



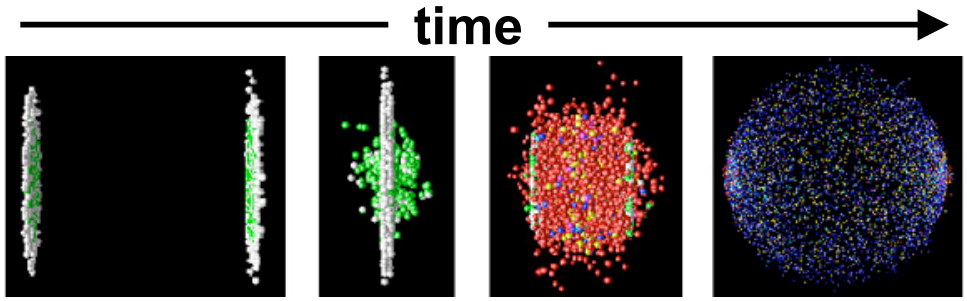
PHOBOS Experiment - now

PHOBOS Experiment - Data sets



Results and Perspective

Overview

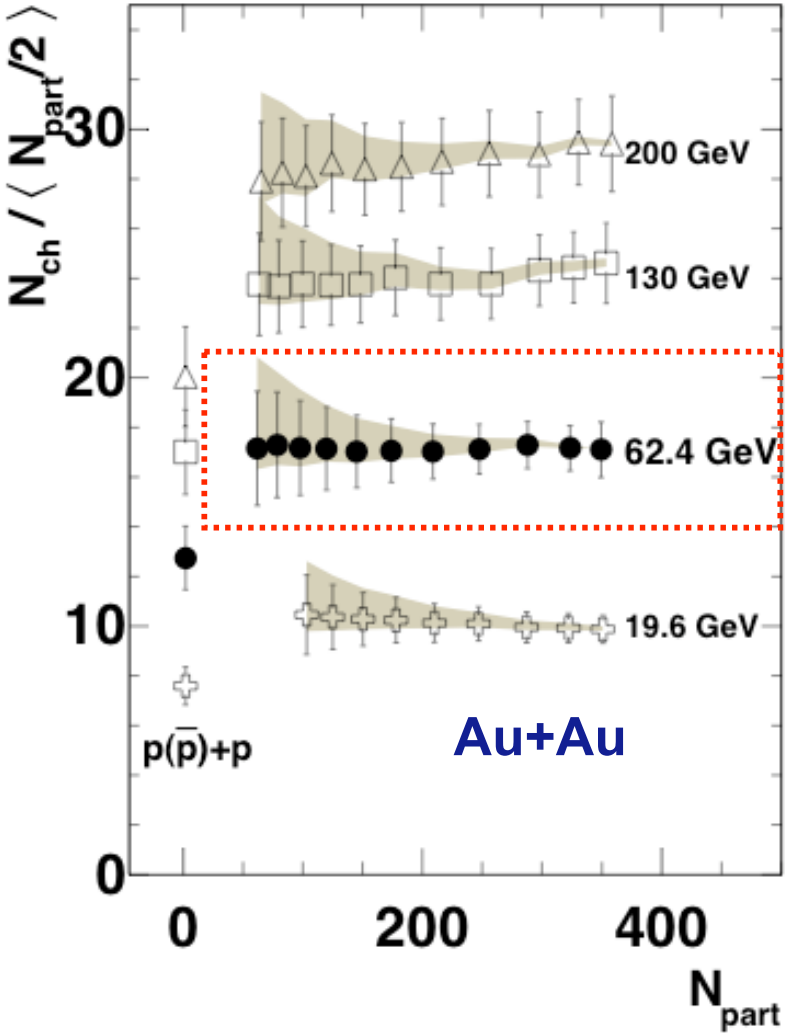


- Multiplicities
- Multiplicity Fluctuations
- Charged Hadron Spectra
- Elliptic Flow

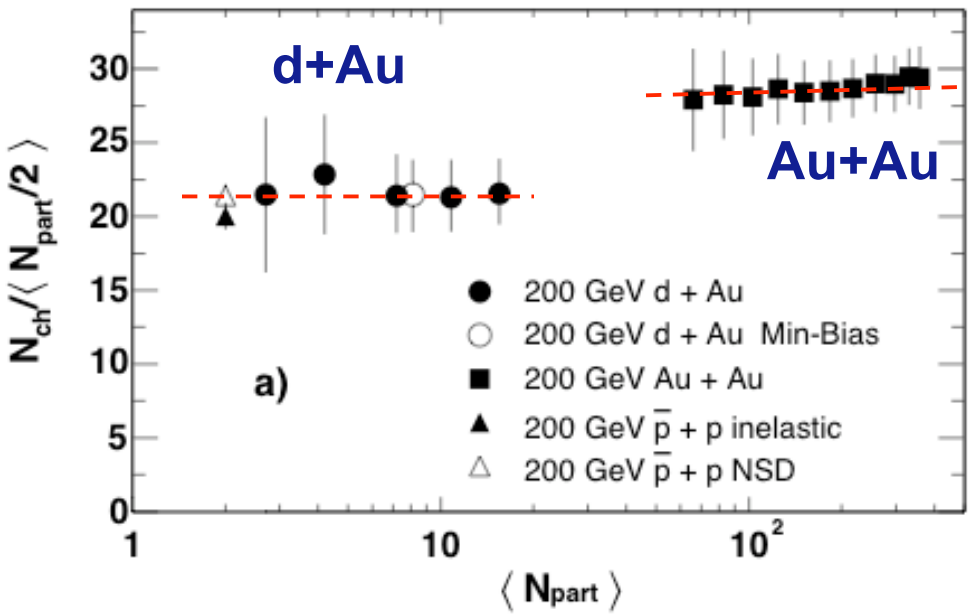
- Results: What have we learned?
- Perspective: What is left to do?

Multiplicity Results: N_{part} Scaling

nucl-ex/0509034, submitted to PRC



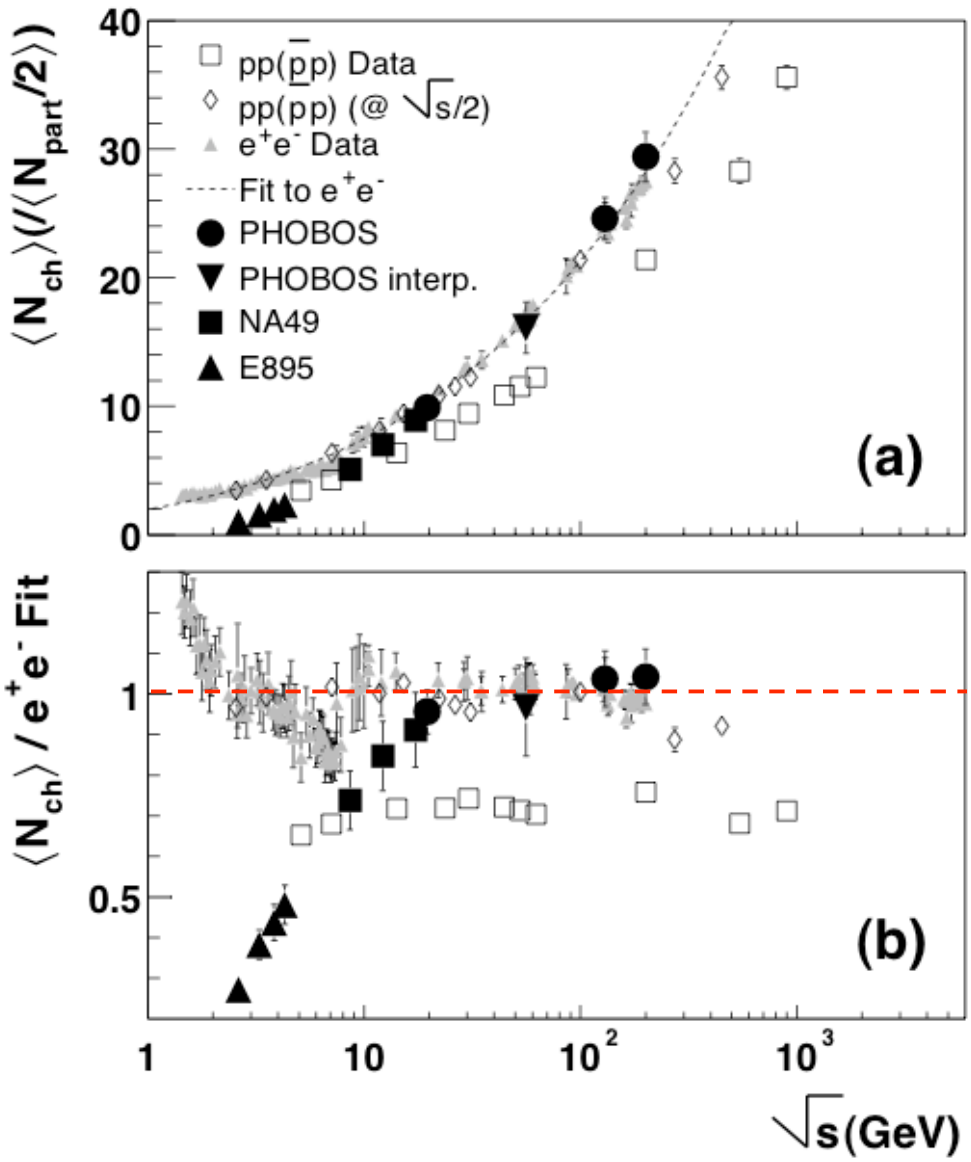
PRC C72 031091 (2005)



Total multiplicity in proportional to N_{part}

N_{part} scaling in Au+Au *and* d+Au

Multiplicity Results: Total Multiplicity vs sqrt(s)

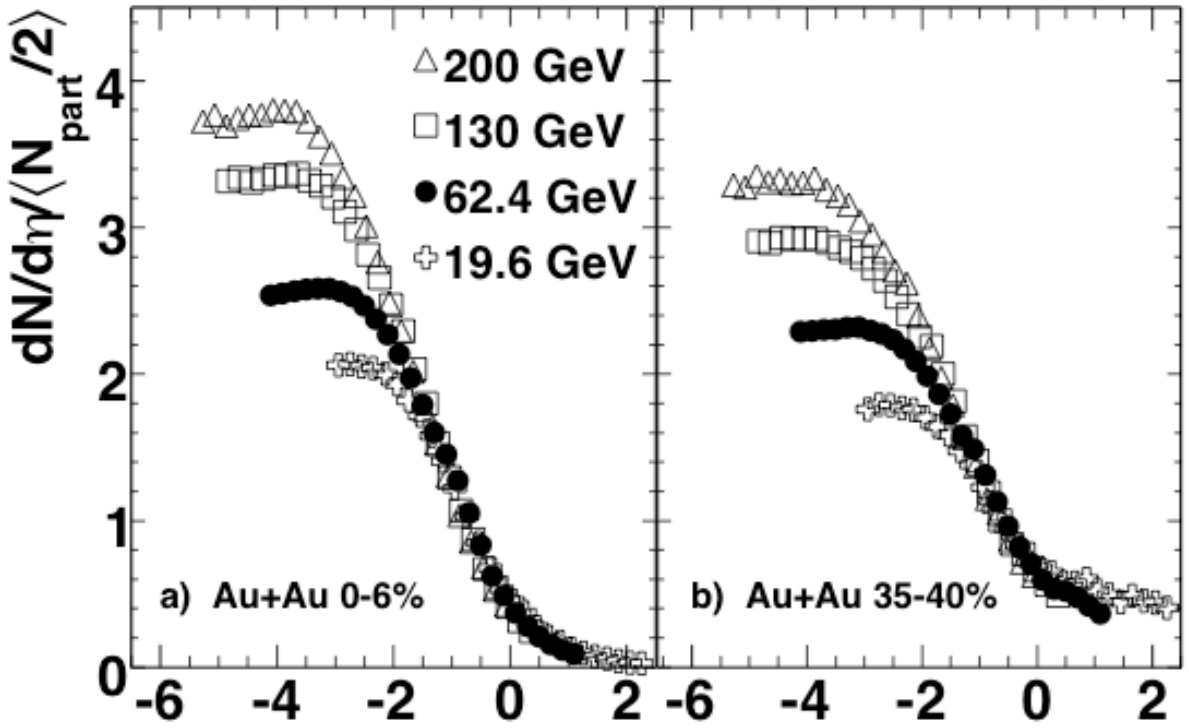


nucl-ex/0301017
Submitted to ~~PRL~~ PRC

"Universality" of total multiplicity in Au+Au, p+p, e^+e^-

Multiplicity Results: Limiting Fragmentation

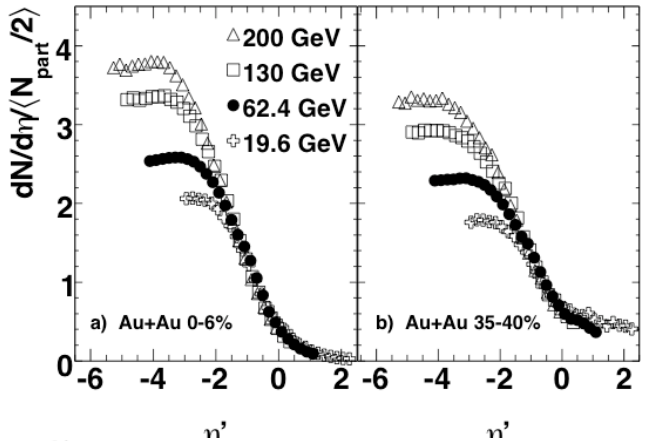
PRL 92 052303 (20, 130, 200 GeV) "Significance of the fragmentation region in ultrarelativistic heavy-ion collisions"
nucl-ex/0509034, submitted to PRC

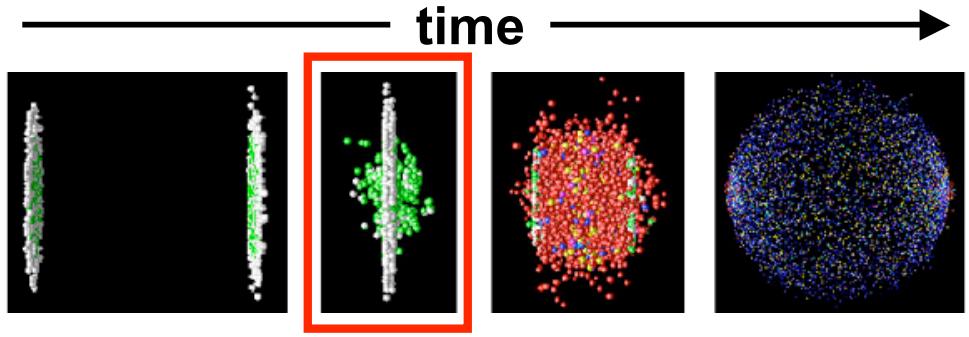


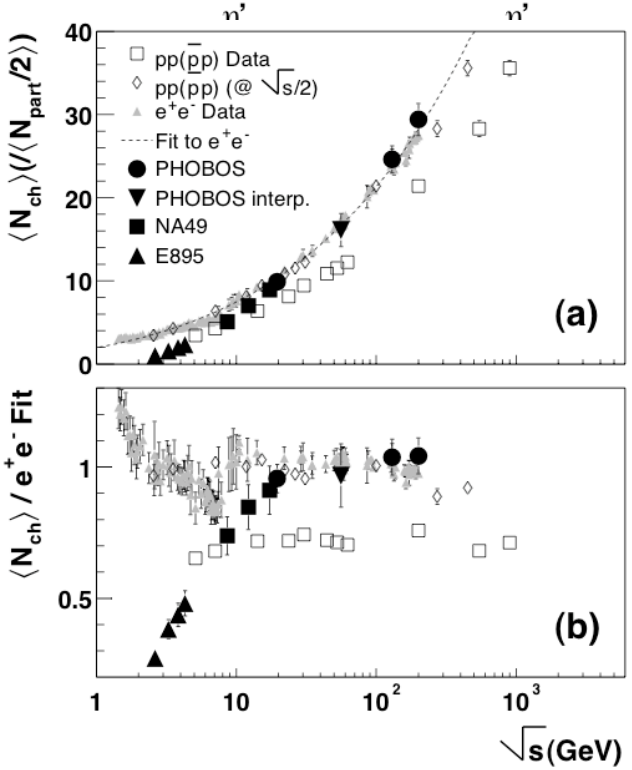
$\eta' = \eta - y_{beam}$ $\eta' = \eta - y_{beam}$

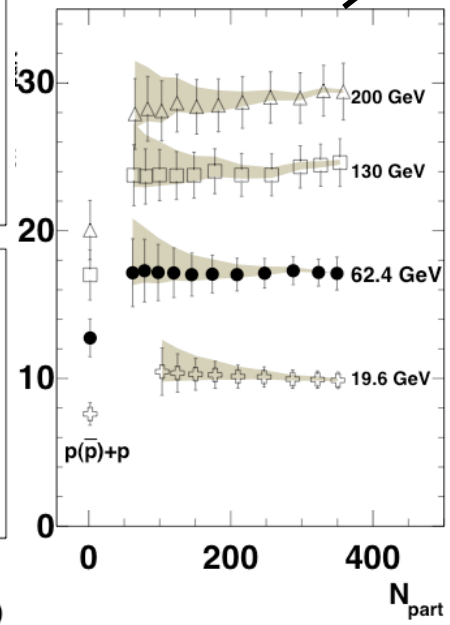
Also seen in: p+p, e^+e^-, d+Au (PHOBOS QM'04), **Cu+Cu** (PHOBOS QM'05)
Also seen in: Elliptic flow, directed flow for Cu+Cu and Au+Au

Multiplicity Results: Early stage entropy?









Scaling laws connect A+A and elementary systems

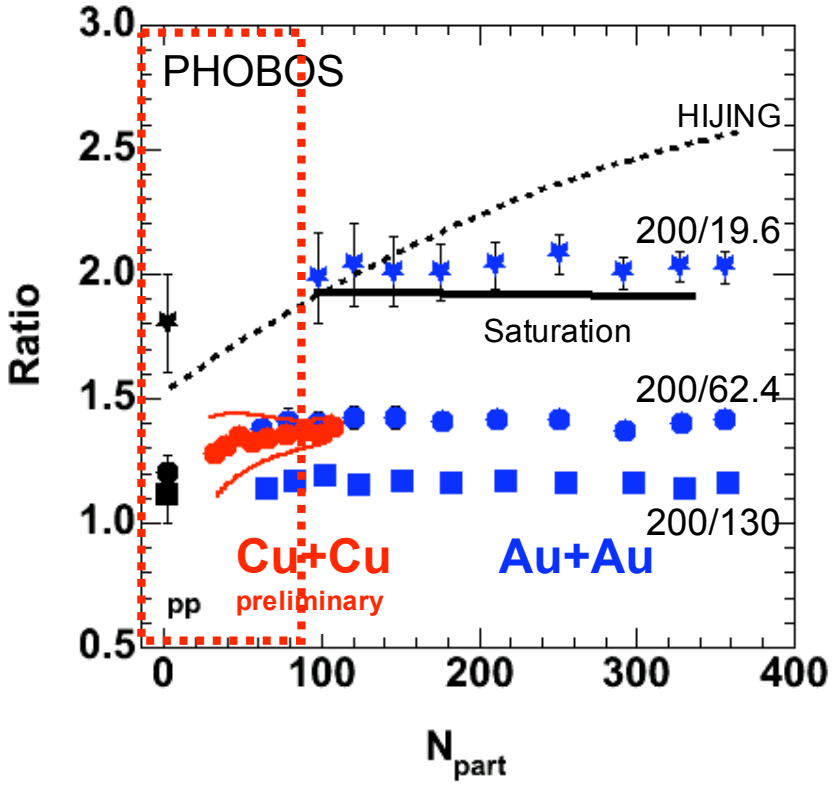
Definition of multiplicity in initial stage?

c.f. CGC/Parton Saturation

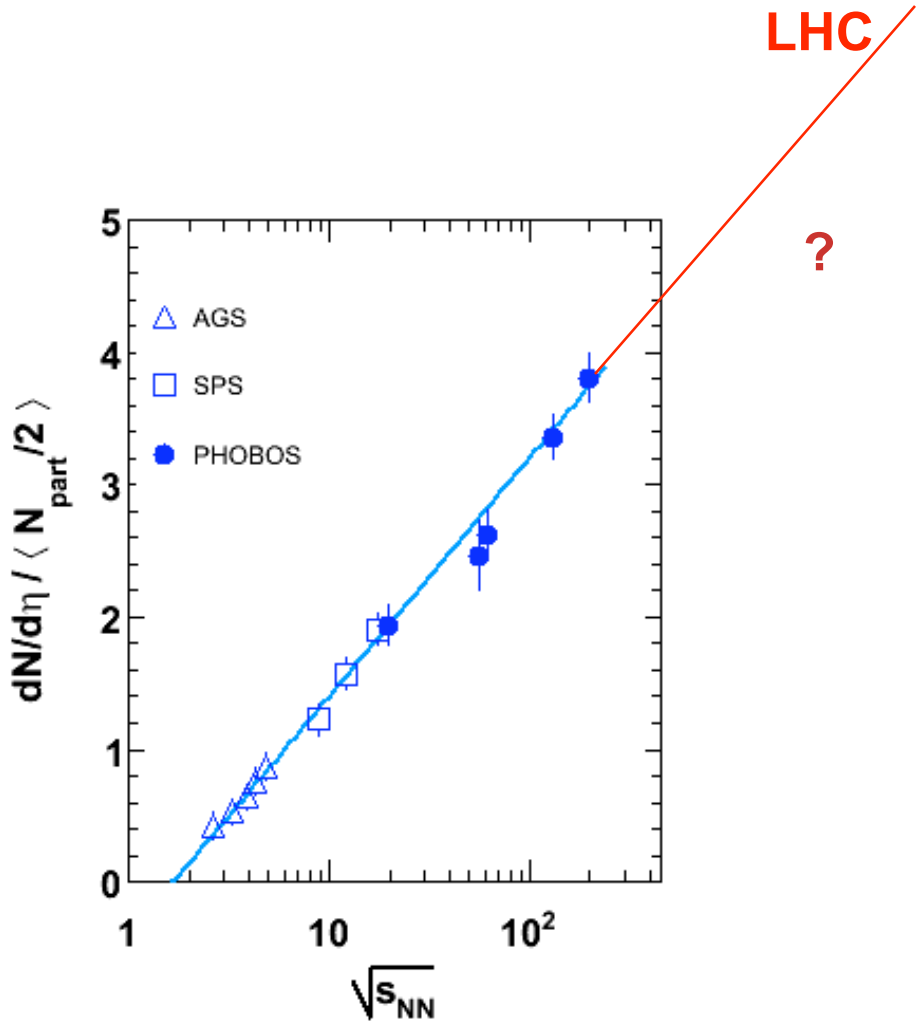
Multiplicity Perspective: Small systems and large energies

nucl-ex/0509034, submitted to PRC

Ratio of dN/dη @ η=0 relative to 200 GeV vs centrality



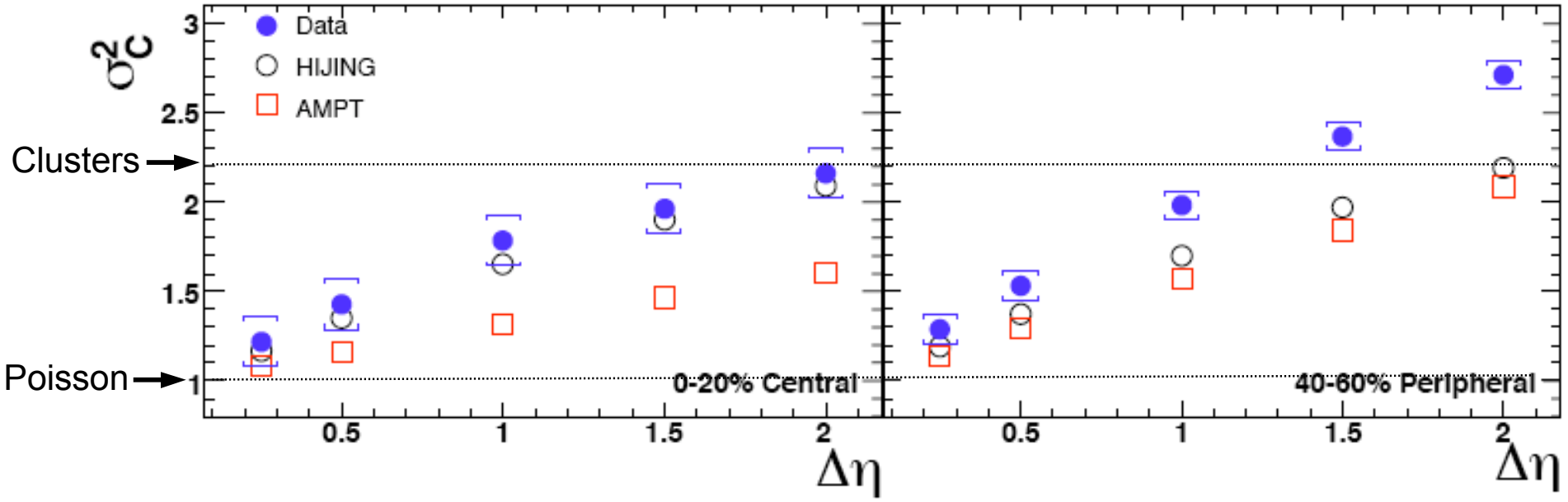
Study scaling for small N_{part} in Cu+Cu and Au+Au

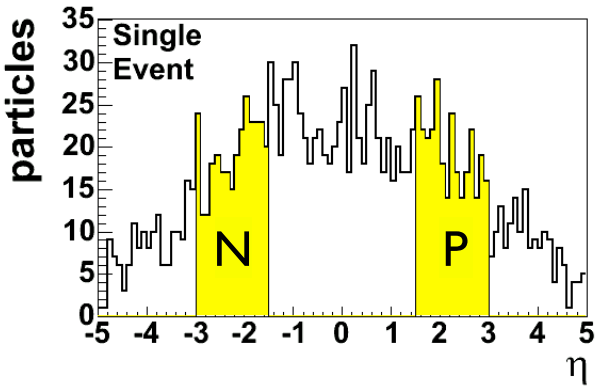


Definitive answer from LHC

Fluctuation Results: Forward/backward correlations

nucl-ex/0603026, PRC RC in press





$$C = \frac{P - N}{\sqrt{P + N}}$$

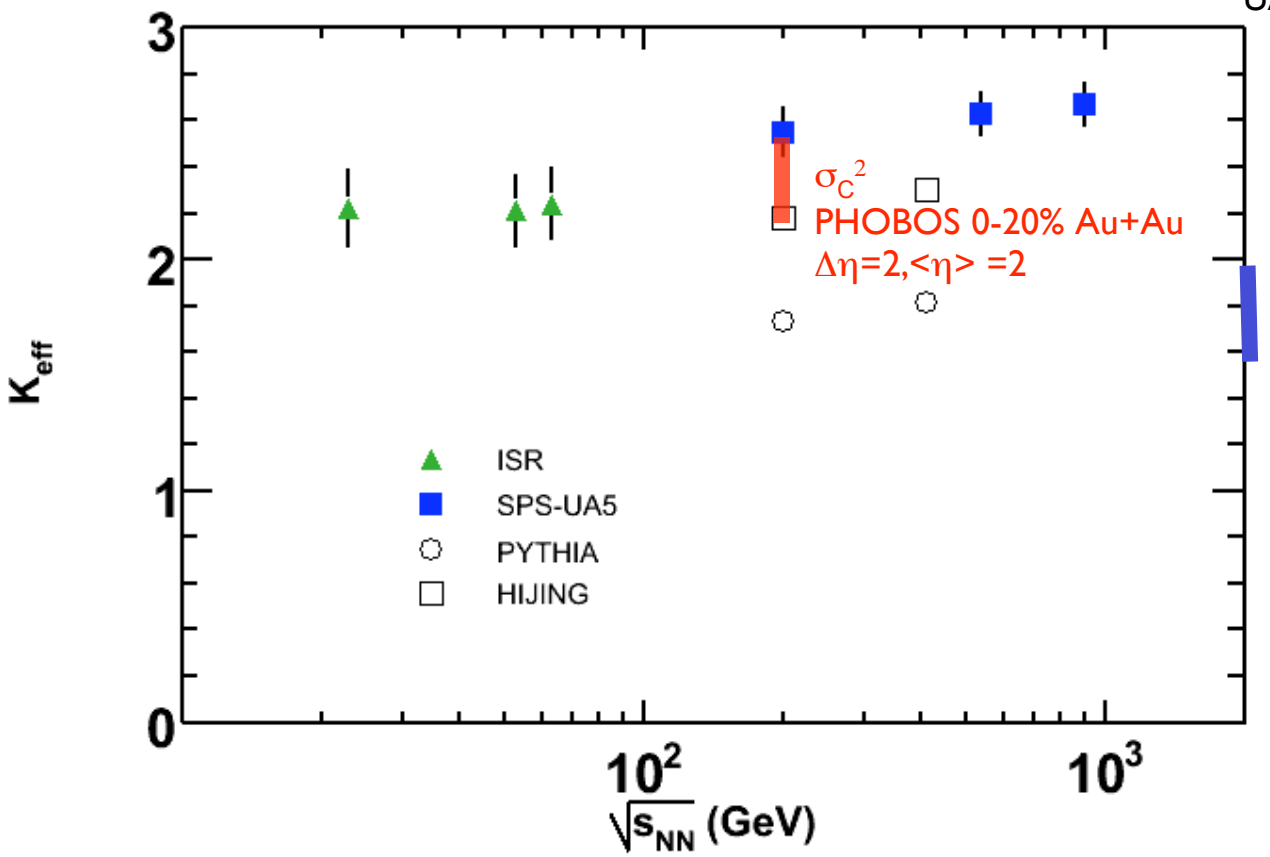
$\sigma_C^2 \sim \langle K_{eff} \rangle$

Cluster size K

Particles are produced in clusters (~2-3 hadrons/cluster)

Fluctuation Results: Comparison to p+p

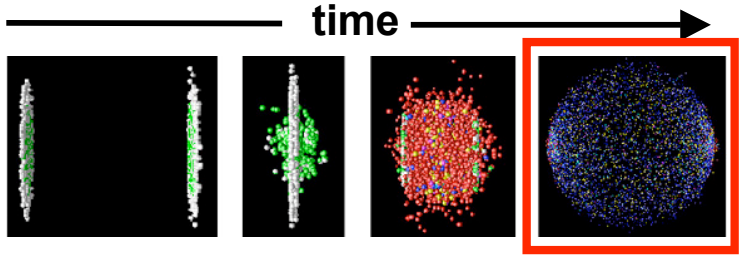
UA5: Phys.Lett.B123:361,1983



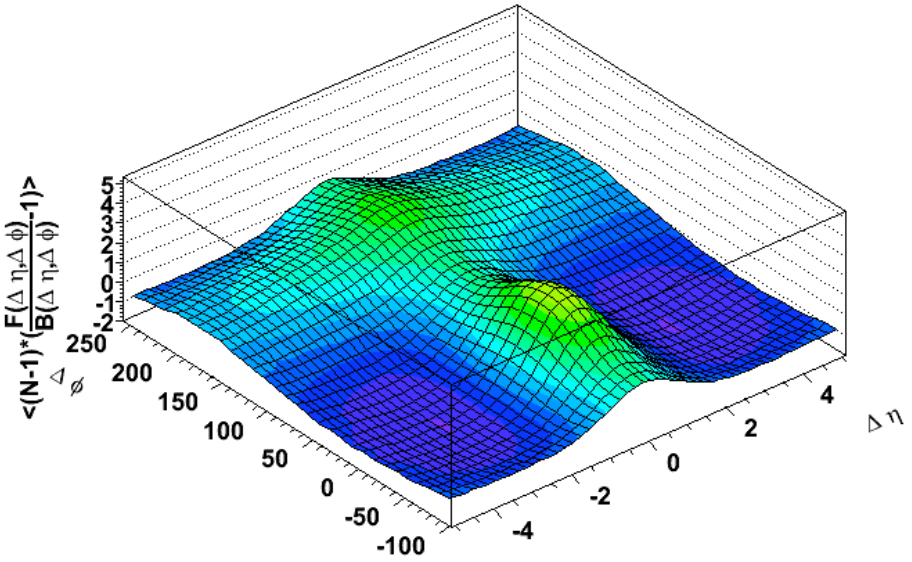
Clusters from Resonances (c.f. UA5)

Cluster "size" in Au+Au similar to p+p

An effect of hadronization?



Fluctuations Perspective: 2-D Angular Correlations

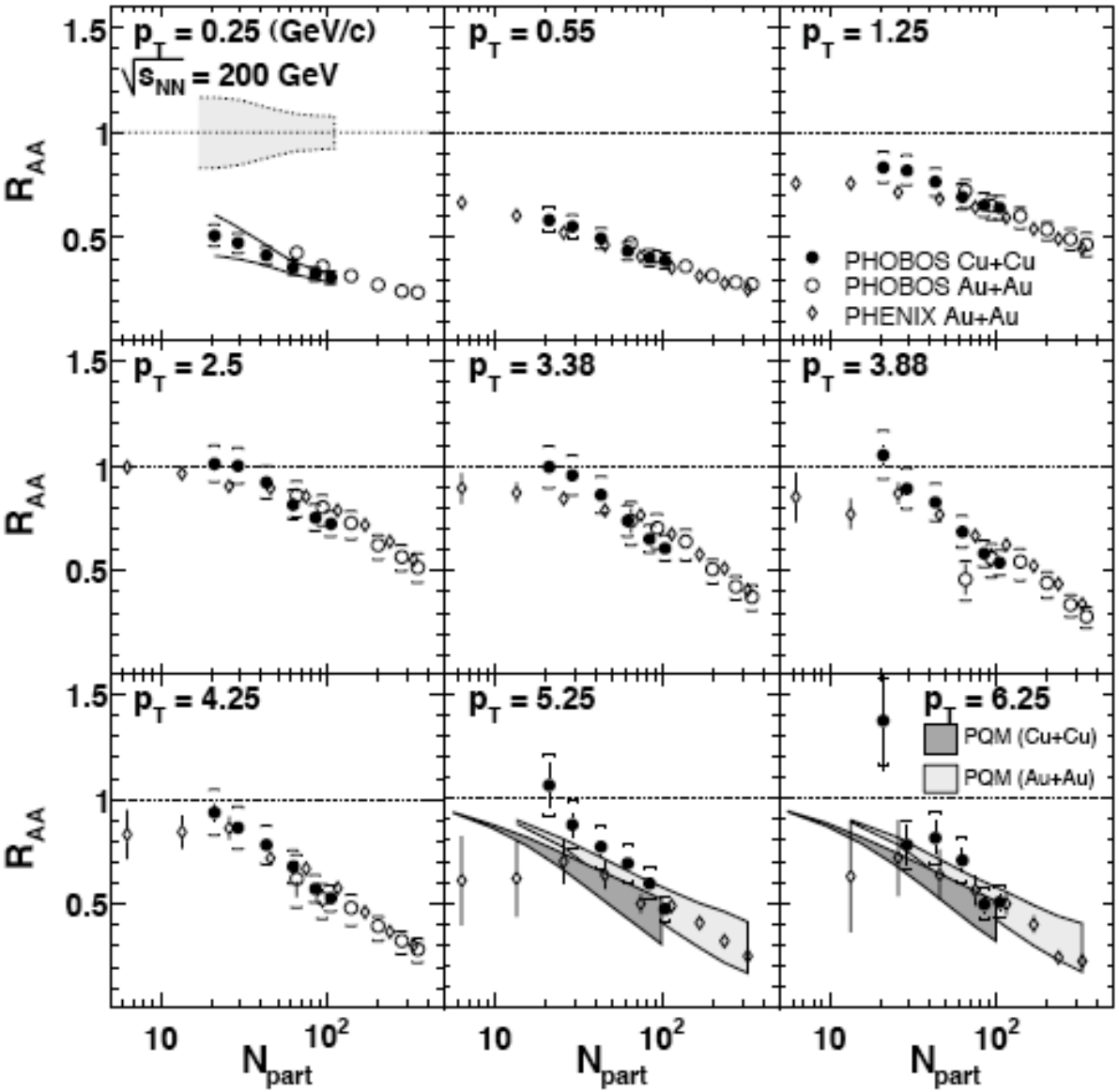


"Clusters" in Δη,Δφ space via
2-particle correlations
(Pythia p+p @200 GeV, η<3)

Comprehensive study of angular correlations in p+p, d+Au, Cu+Cu, Au+Au vs energy, centrality

Disentangle hadronization, mini-jets, flow

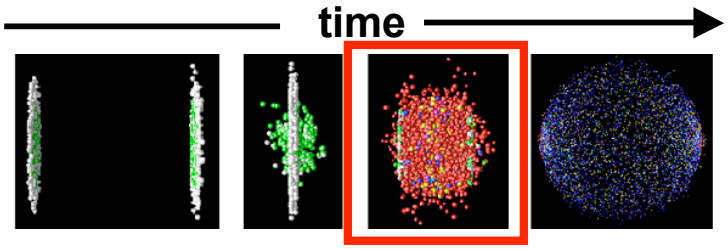
Spectra Results: System-size Scaling



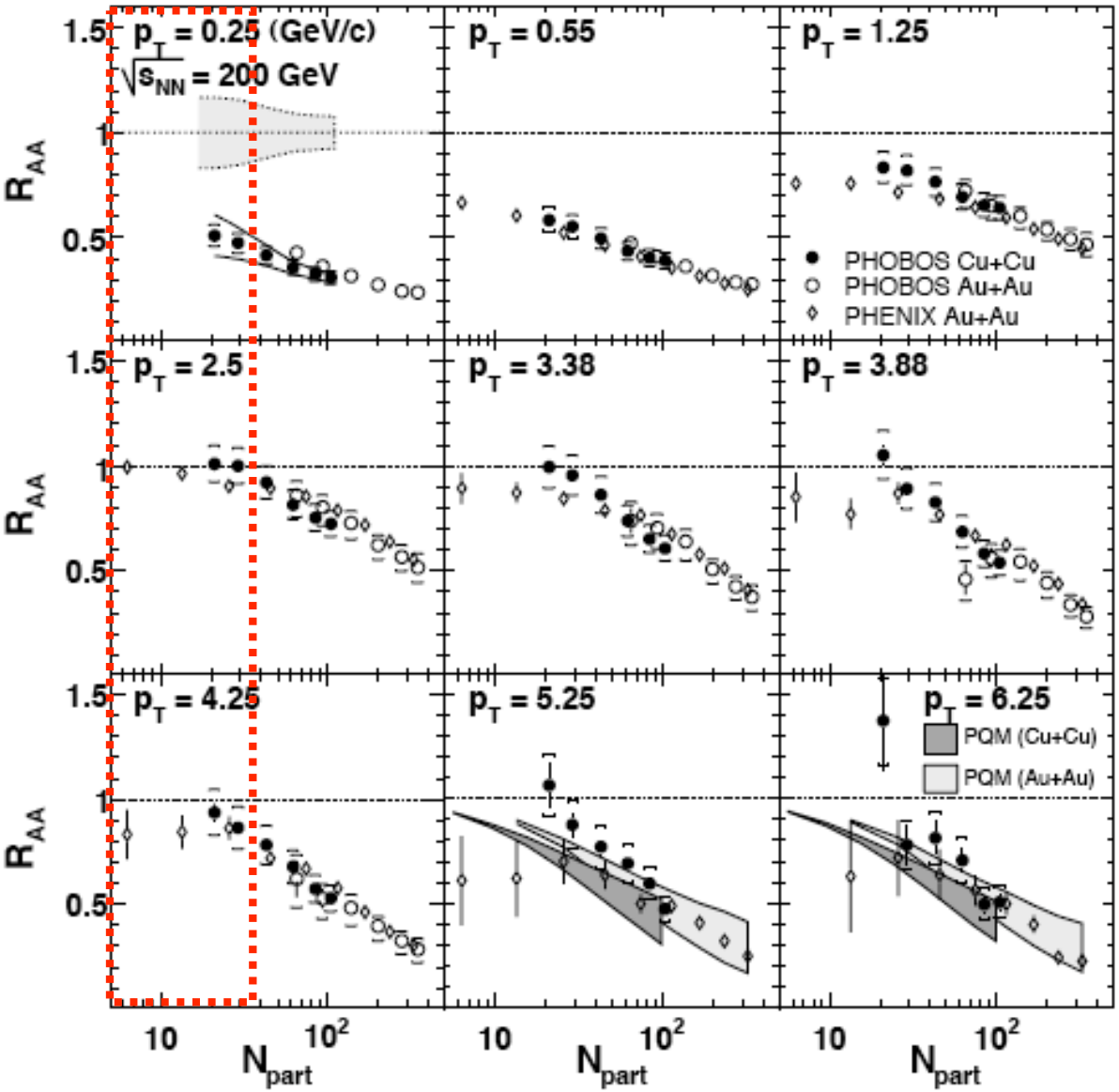
PRL 96 212306 (2006)
[first RHIC paper from Cu+Cu run]

Same R_{AA} in Cu+Cu and Au+Au for same N_{part}

From p_T = 0.25 GeV/c to 6.25 GeV/c



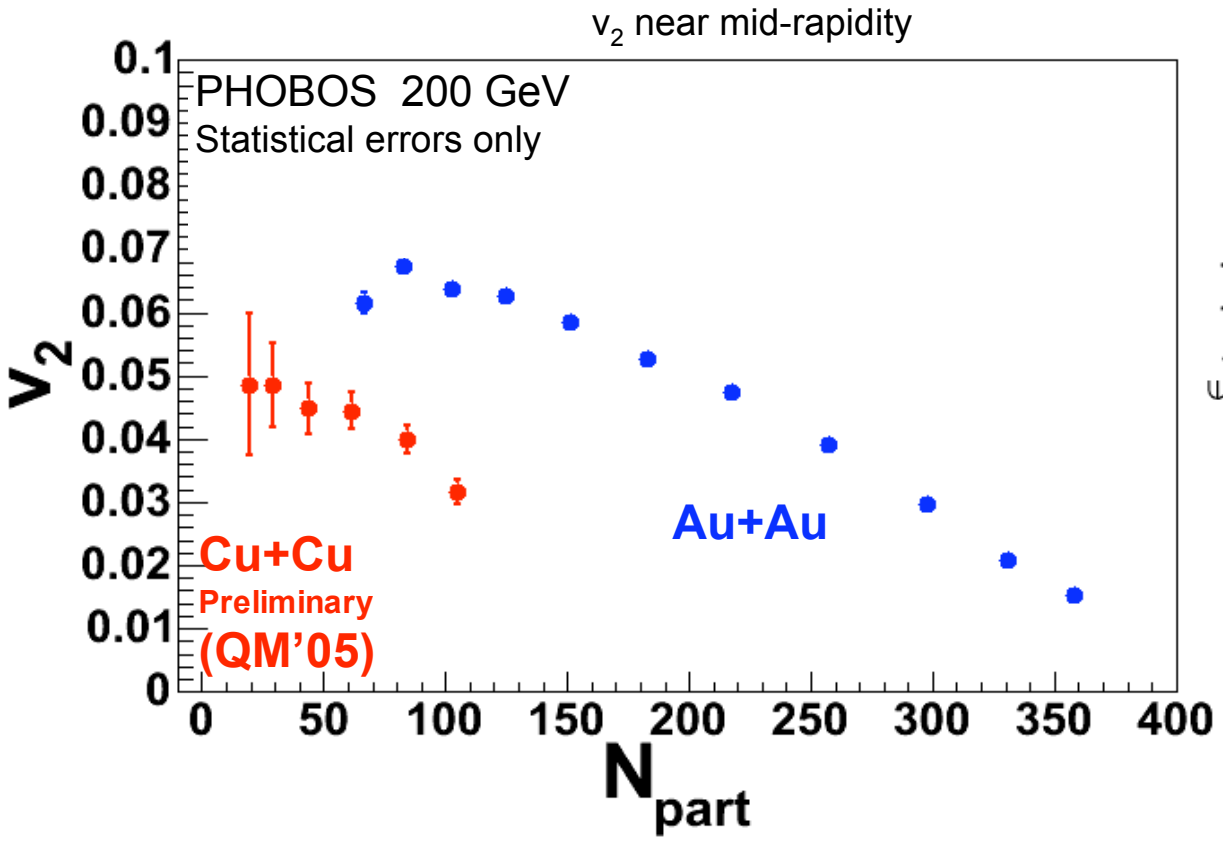
Spectra Perspective: Small systems - very peripheral Au+Au

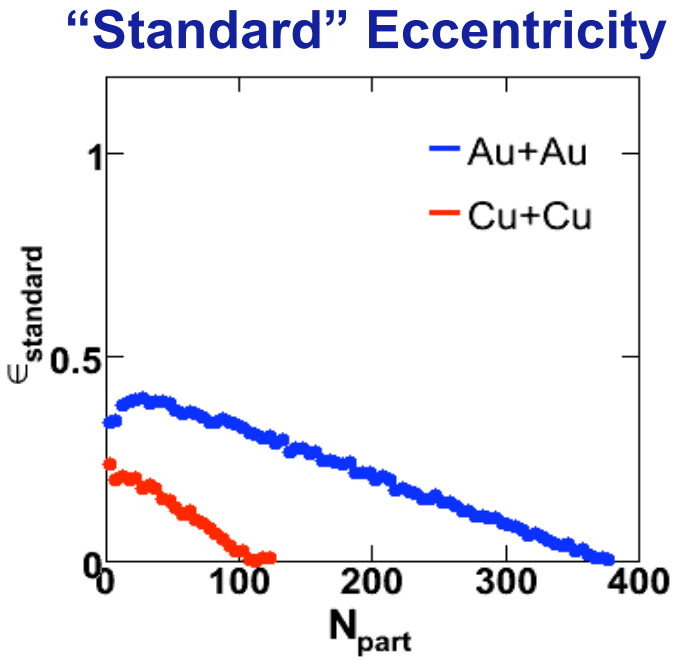


Extend centrality range in Cu+Cu and Au+Au

Turn on of N_{part} scaling and energy/centrality factorization

Elliptic Flow Results: Centrality Dependence

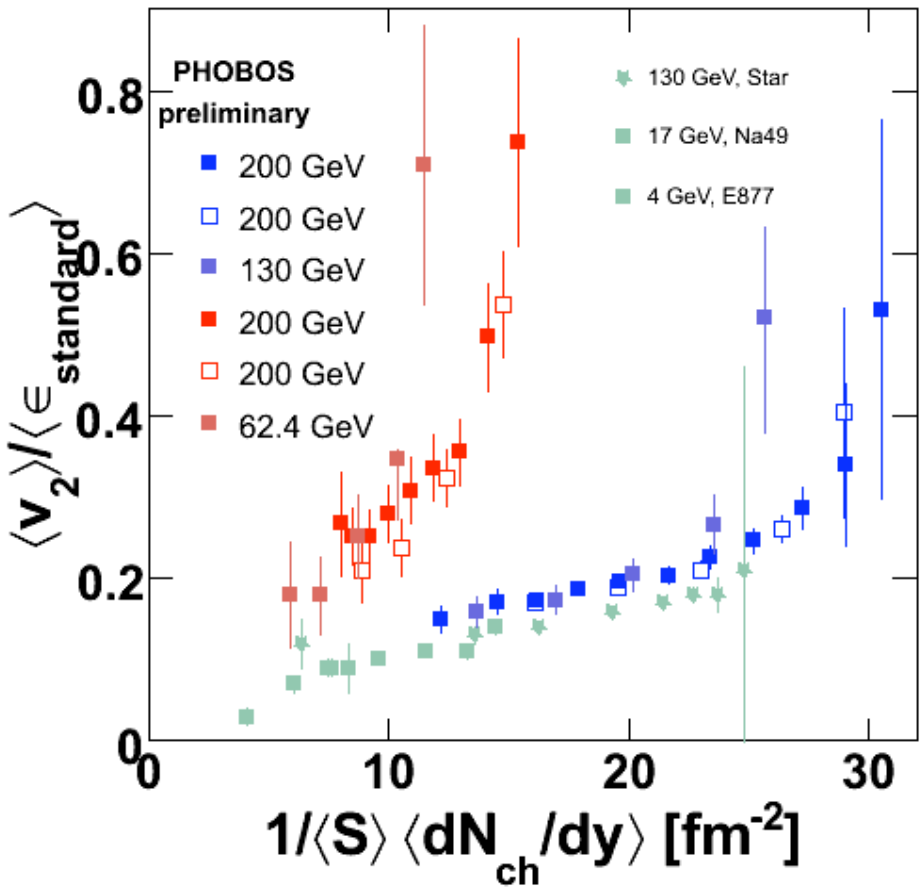




Large v_2 signal for Cu+Cu, even for central events

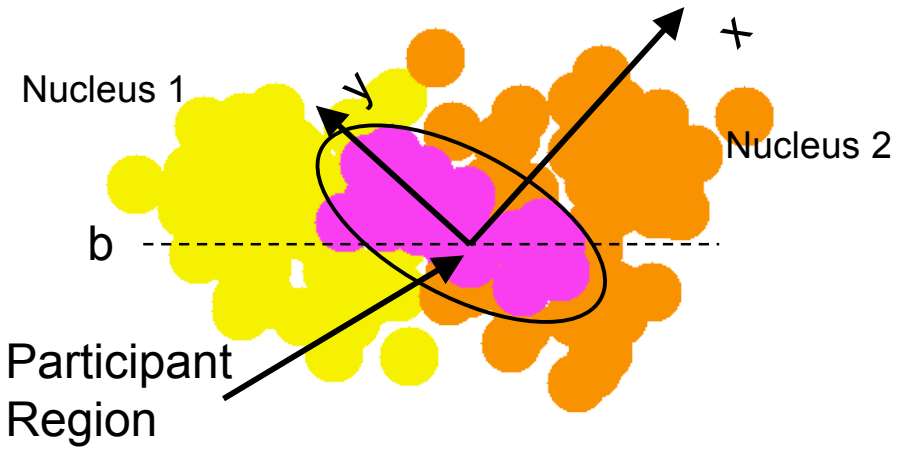
Elliptic Flow Results: Eccentricity Scaling

Standard Eccentricity

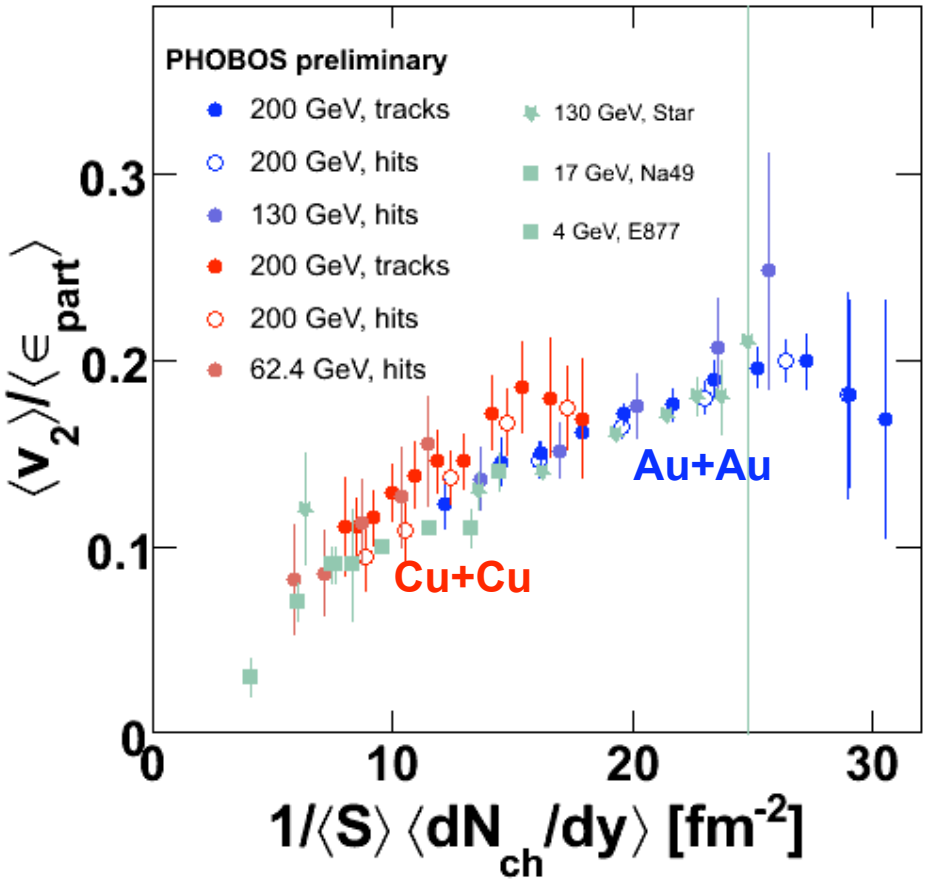


Elliptic Flow Results: Eccentricity Scaling

Participant Eccentricity

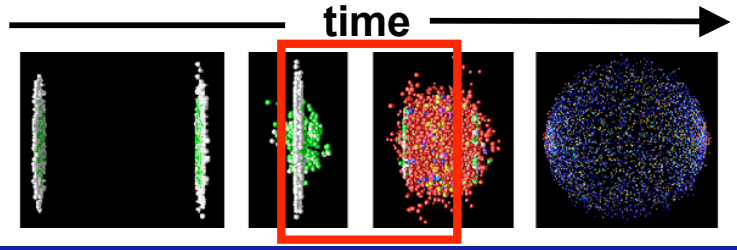


Participant Eccentricity



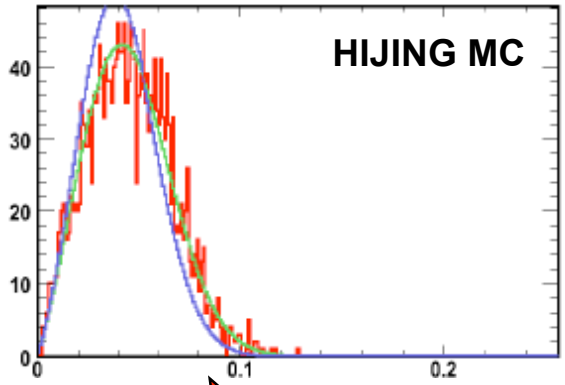
Event-by-event shape of participant region drives v_2

Unified description of v_2 vs geometry in Cu+Cu and Au+Au

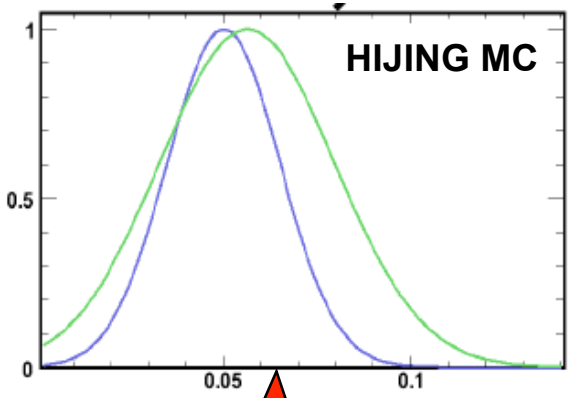


Elliptic Flow Perspective: Event-by-event Fluctuations

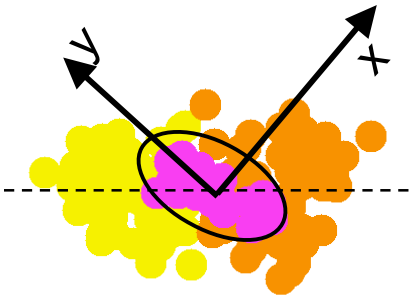
Observed v_2 Fluctuations



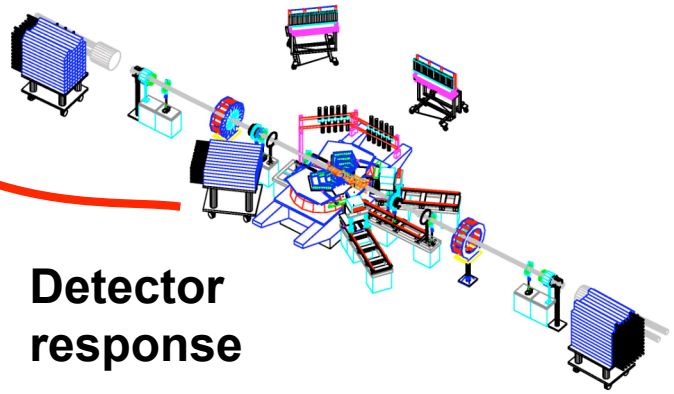
True v_2 Fluctuations



ε_{Part} Fluctuations



$$g(u) = \int_0^\infty K(u, v_2) f(v_2) dv_2$$



Detector response

Study higher moments beyond <v_2>

Event-by-event v_2 fluctuations

2-D angular correlations

Summary

Results and Perspective:

- Comprehensive multiplicity systematics
  - Initial stage entropy production
- Onset of scaling behavior for peripheral events?
- Connection of multiplicity fluctuations and hadron clusters
  - Clusters at hadronization (resonances)
- Comprehensive study of angular correlations
- Elliptic flow in small systems; connection to initial geometry
  - Coupling of initial geometry and hydro evolution
- Elliptic flow fluctuations

See you at QM '06!