Net Charge Fluctuations at Mid-rapidity in Au+Au Collisions at $\sqrt{S_{nn}} = 130$ GeV

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PHENIX Collaboration

Net charge fluctuations a signal for QGP?

(S. Jeon & V. Koch PRL 85(2000)2076)

(M. Asakawa, U. Heinz, B. Müller, PRL 85(2000)2072)

Expected fluctuations in net charge, Q (= N_+ - N_-) :

Hadron gas : $$\frac{\langle Q^2 \rangle}{\langle N_{ch} \rangle} = 1$$

(A reduction is expected due to global charge conservation and resonances, depending on the acceptance.)

QGP : $$\frac{\langle Q^2 \rangle}{\langle N_{ch} \rangle} \approx 0.20 - 0.25$$ (S. Jeon & V. Koch PRL 85(2000)2076)

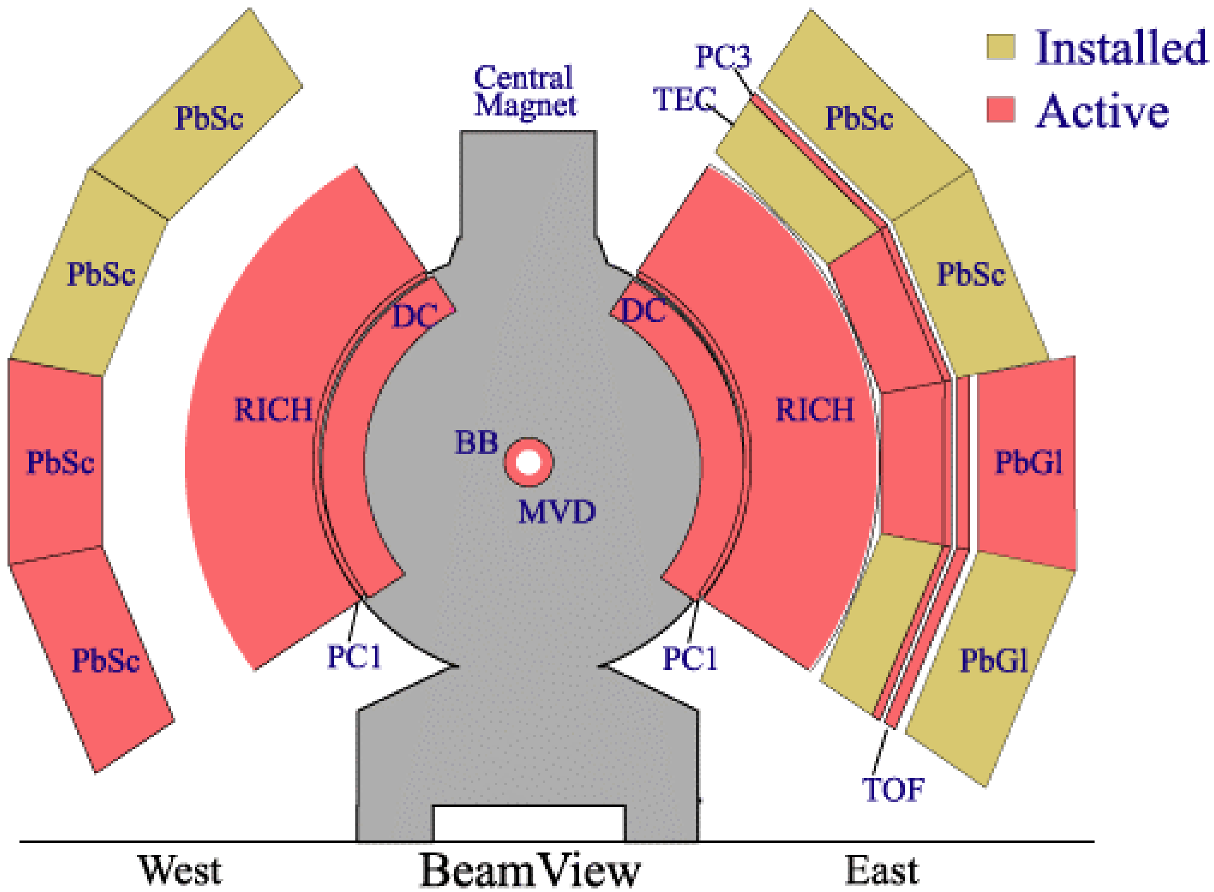
Are the fluctuations preserved?

The use of $R = N_+ / N_-$ is proposed.

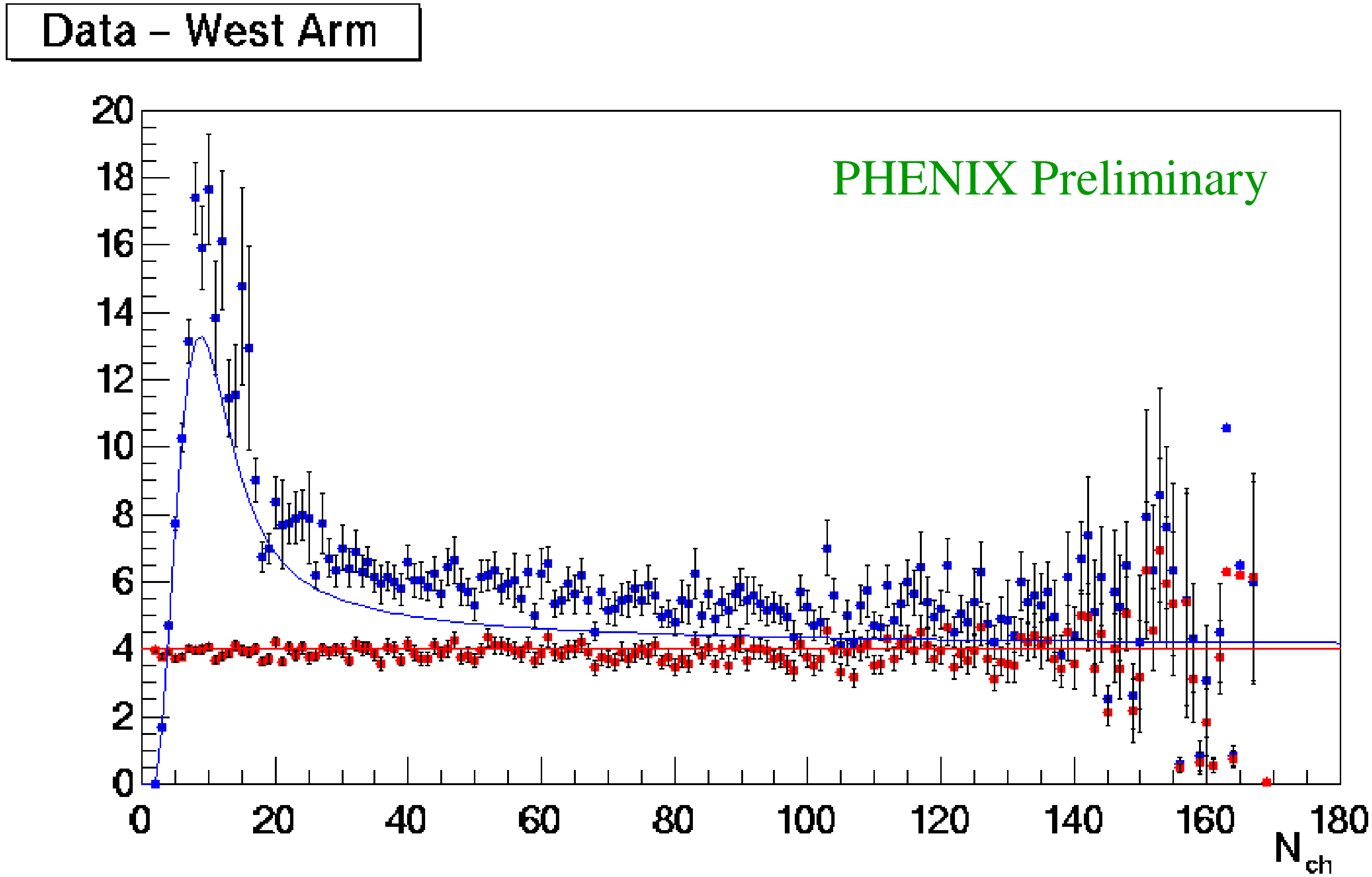
Asymptotically, for large N_{ch} :

$$\langle N_{ch} \rangle \langle R^2 - \langle R \rangle^2 \rangle \approx 4 \frac{\langle Q^2 \rangle}{\langle N_{ch} \rangle}$$

PHENIX Detector - First Year Physics Run



Drift chamber and pad chamber 1 in west arm



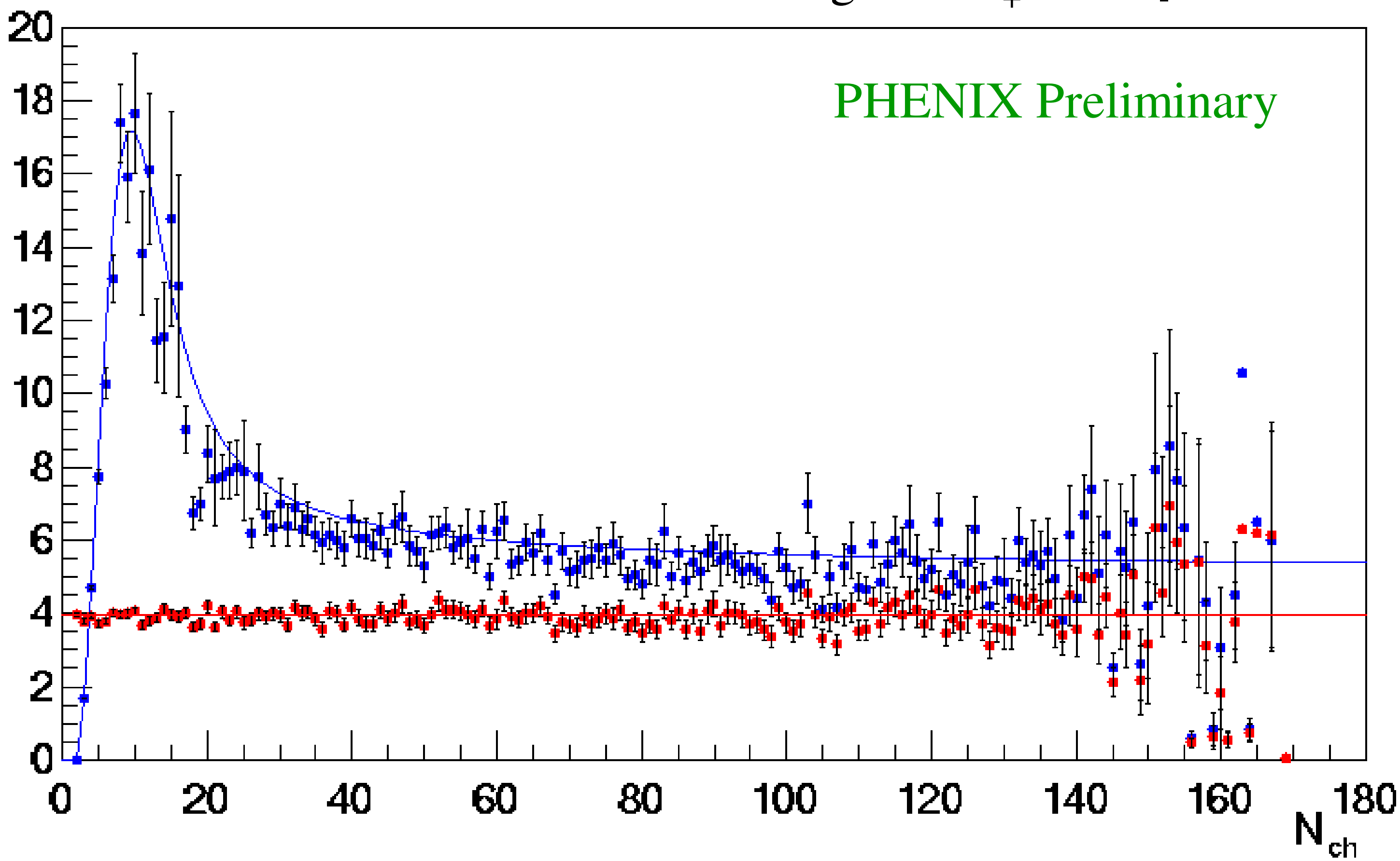
$(\langle R^2\rangle - \langle R\rangle^2) * N_{ch}$ $\quad$ $(R = N_+/N_-)$

$4(\langle Q^2\rangle - \langle Q\rangle^2) / N_{ch}$ $\quad$ $(Q = N_+ - N_-)$

Theoretical curves calculated for fixed values of N_{ch}
using a binomial distribution and $\langle Q\rangle = 0$
(assuming no global charge conservation and stochastic emission of particles)

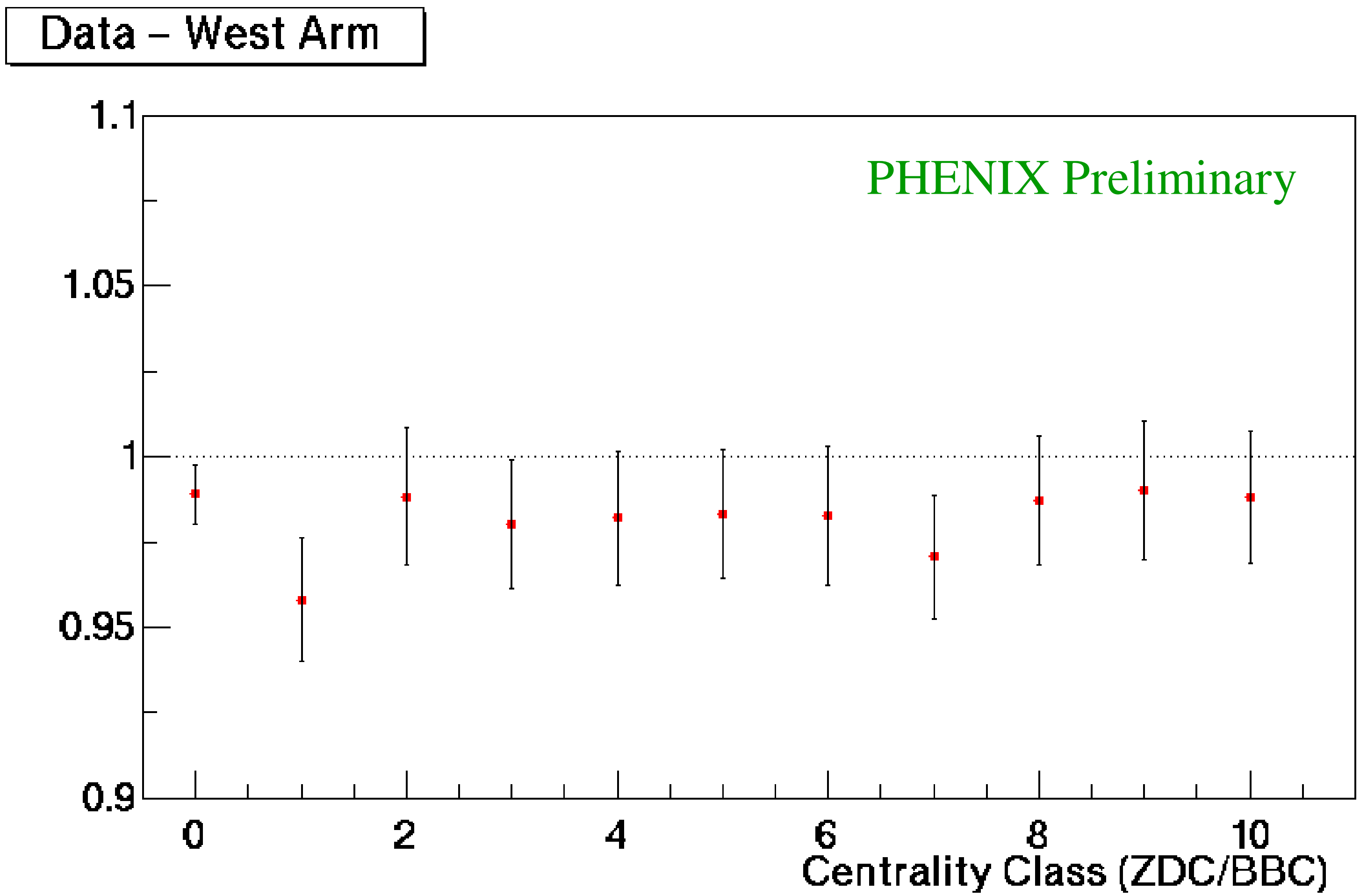
The fluctuations in R depend on N_{ch} , and they are sensitive to relative fractional changes in N_+ and N_- .

Data – West Arm



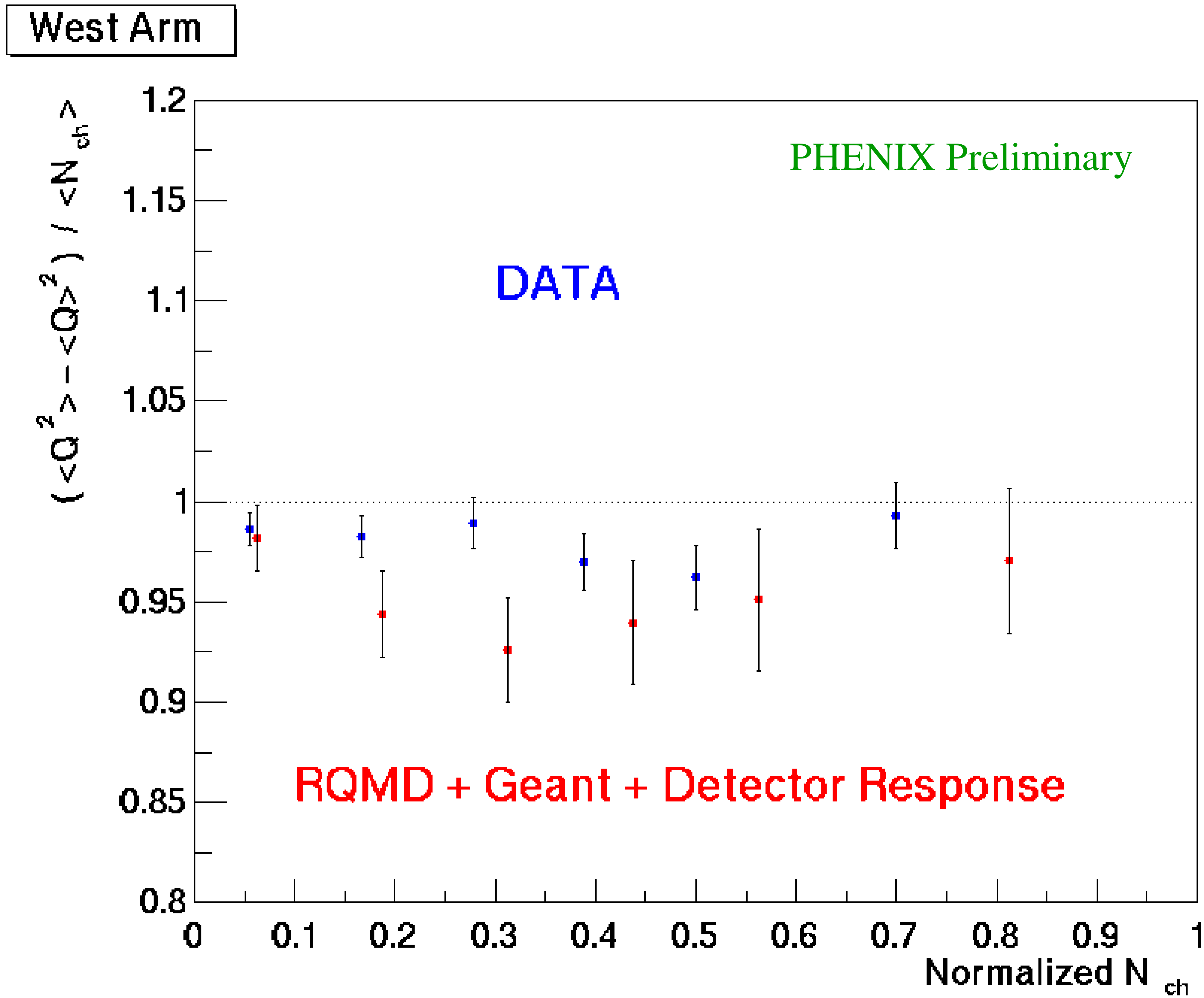
$(\langle R^2\rangle - \langle R\rangle^2) * N_{ch}$ $\quad (R = N_+/N_-)$

$4(\langle Q^2\rangle - \langle Q\rangle^2) / N_{ch}$ $\quad (Q = N_+ - N_-)$



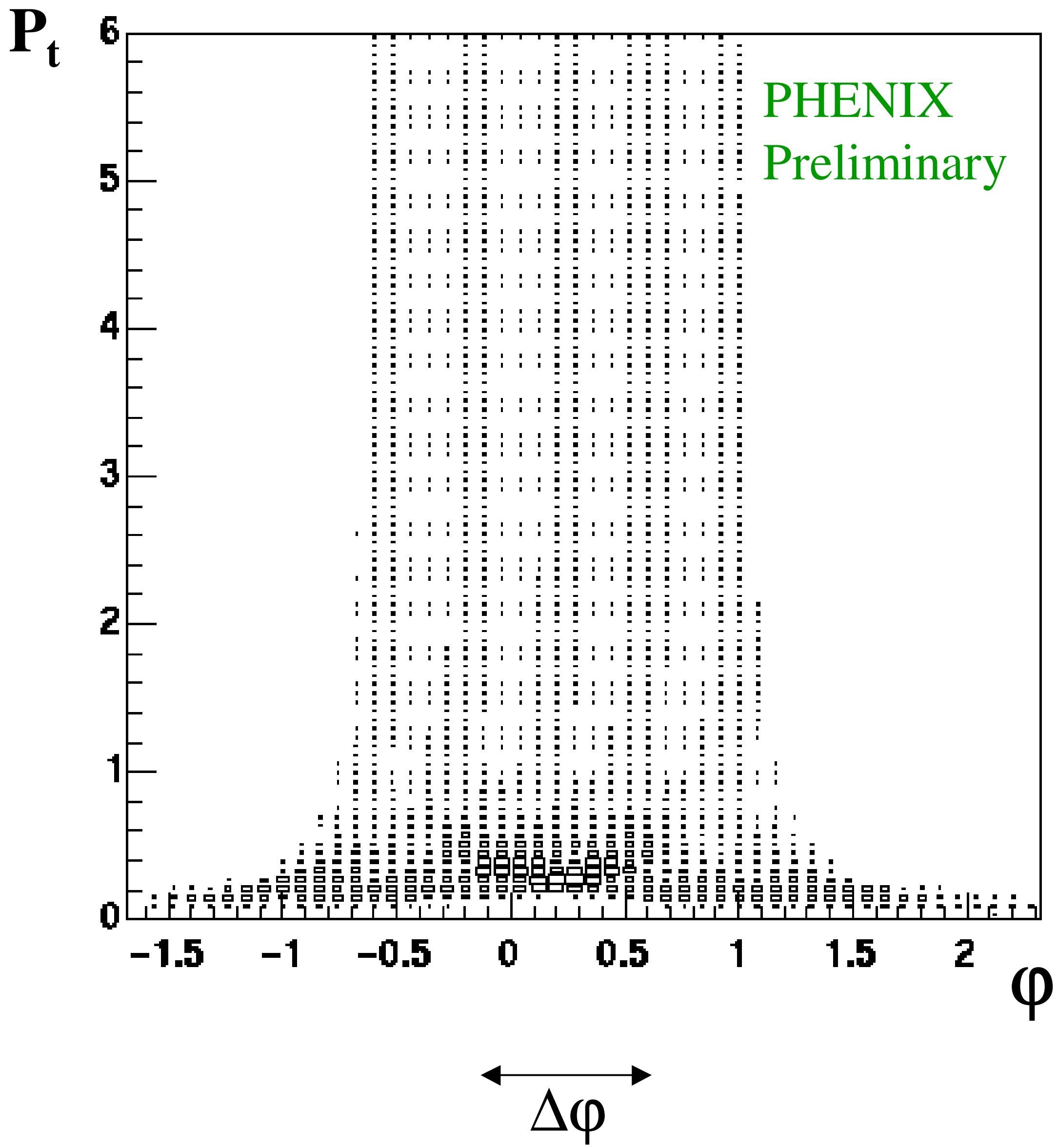
centrality class	% most central collisions
0	50-100
1	45-50
2	40-45
:	
9	5-10
10	0-5

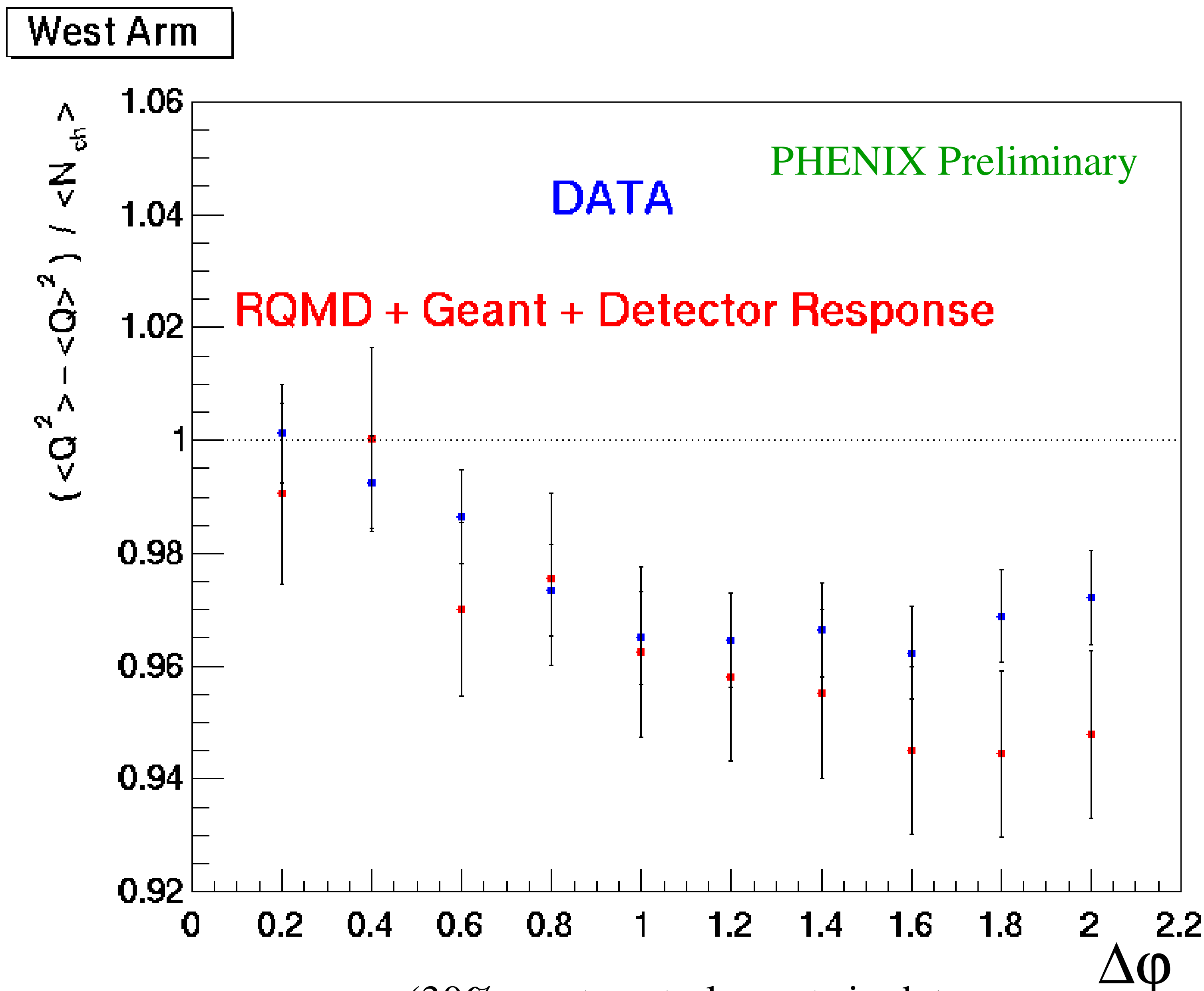
$(\langle Q^2 \rangle - \langle Q \rangle^2) \,/\, \langle N_{ch} \rangle$ $\quad (Q = N_+ - N_-)$



West Arm
PHENIX Preliminary
DATA
RQMD + Geant + Detector Response
(<Q^2> - <Q>^2) / <N_ch>
Normalized N_ch
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

West arm





(30% most central events in data
30% highest multiplicity events in simulation)

Conclusions

- Results obtained using the R variable has to be interpreted with care. (The variance of R is sensitive to the total multiplicity and the relative fraction of positive and negative particles.)

- Slight deviation from statistical fluctuations in west arm consistent with RQMD.
  (global charge conservation, resonances)

- The proposed plasma signal is not observed in the presented data set.

- The fluctuations scale with the acceptance, as expected.