Charged-particle dN/dη from PHOBOS

A. H. Wuosmaa
(Argonne National Laboratory)
for the PHOBOS Collaboration

Quark Matter 2001

The PHOBOS Collaboration

ARGONNE NATIONAL LABORATORY

Birger Back, Nigel George, Alan Wuosmaa

BROOKHAVEN NATIONAL LABORATORY

Mark Baker, Donald Barton, Alan Carroll, Stephen Gushue, George Heintzelman, Robert Pak, Louis Remsberg, Peter Steinberg, Andrei Sukhanov

INSTITUTE OF NUCLEAR PHYSICS, KRAKOW

Andrzej Budzanowski, Roman Holynski,, Jerzy Michalowski, Andrzej Olszewski, Pawel Sawicki , Marek Stodulski, Adam Trzupek, Barbara Wosiek, Krzysztof Wozniak

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Wit Busza* , Patrick Decowski, Kristjan Gulbrandsen, Conor Henderson, Jay Kane , Judith Katzy, Piotr Kulinich, Johannes Muelmenstaedt, Heinz Pernegger, Corey Reed, Christof Roland, Gunther Roland, Leslie Rosenberg, Pradeep Sarin, Stephen Steadman, George Stephans, Gerrit van Nieuwenhuizen, Carla Vale, Robin Verdier, Bernard Wadsworth, Bolek Wyslouch

NATIONAL CENTRAL UNIVERSITY, TAIWAN

Willis Lin, JawLuen Tang

UNIVERSITY OF ROCHESTER

Josh Hamblen, Erik Johnson, Nazim Khan, Steven Manly, Inkyu Park, Wojtek Skulski, Ray Teng, Frank Wolfs

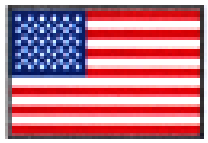
UNIVERSITY OF ILLINOIS AT CHICAGO

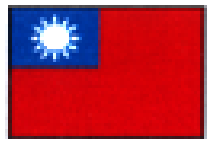
Russell Betts, Clive Halliwell, David Hofman, Burt Holzman, Wojtek Kucewicz, Don McLeod, Rachid Nouicer, Michael Reuter

UNIVERSITY OF MARYLAND

Richard Bindel, Edmundo Garcia-Solis, Alice Mignerey

* spokesperson



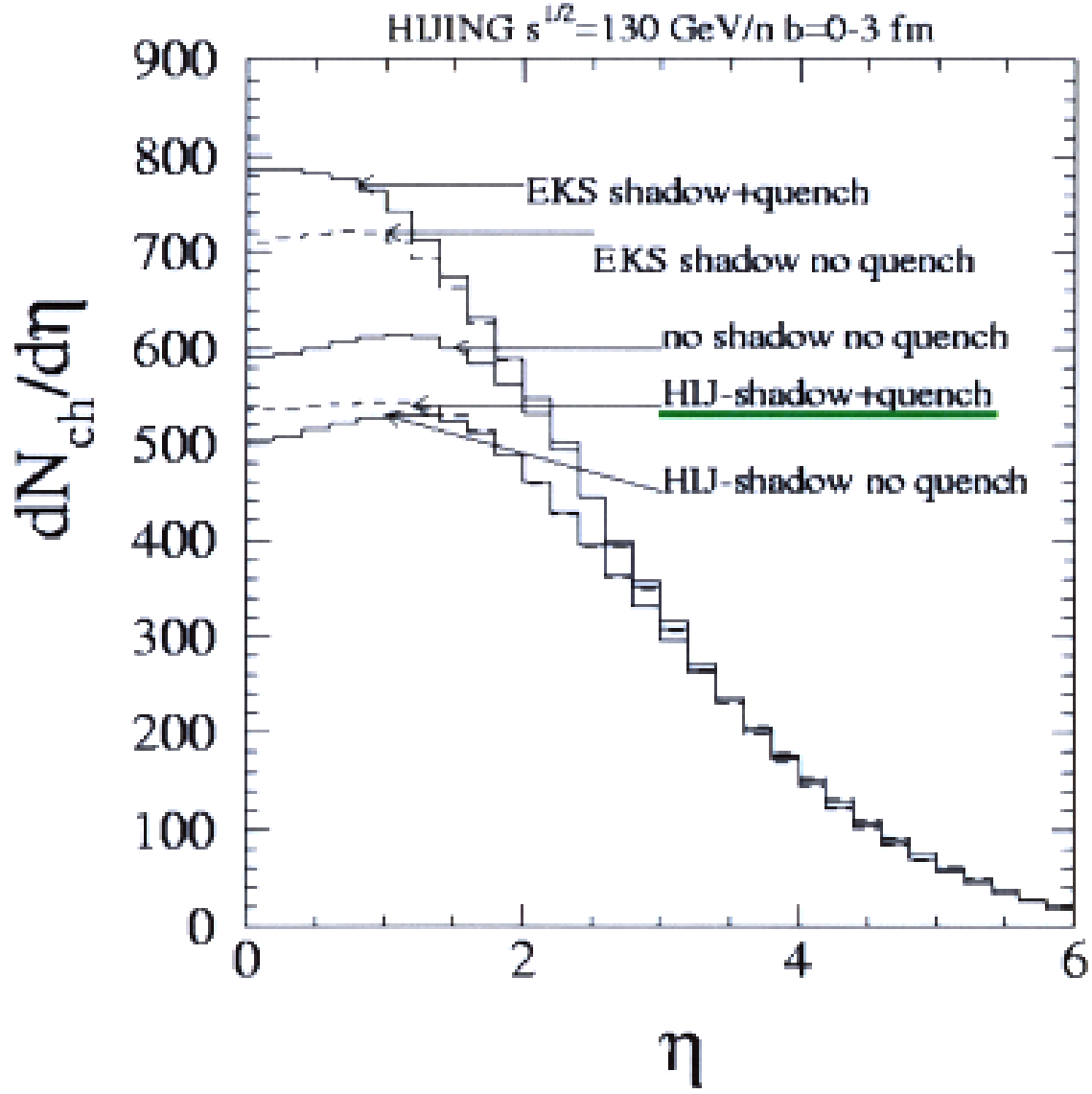


Why study $dN_{ch}/d\eta$?

- $dN_{ch}/d\eta$ is sensitive to all aspects of charged-particle production in heavy-ion collisions:
  - Interplay between hard and soft processes
  - Effects of shadowing, jet quenching
  - Reaction dynamics, re-scattering
  - Full distribution reflects a time integral of particle production throughout the collision and total entropy production
- Lots of existing data for pp, pA, AB,AA
  - How do RHIC data fit into this picture?

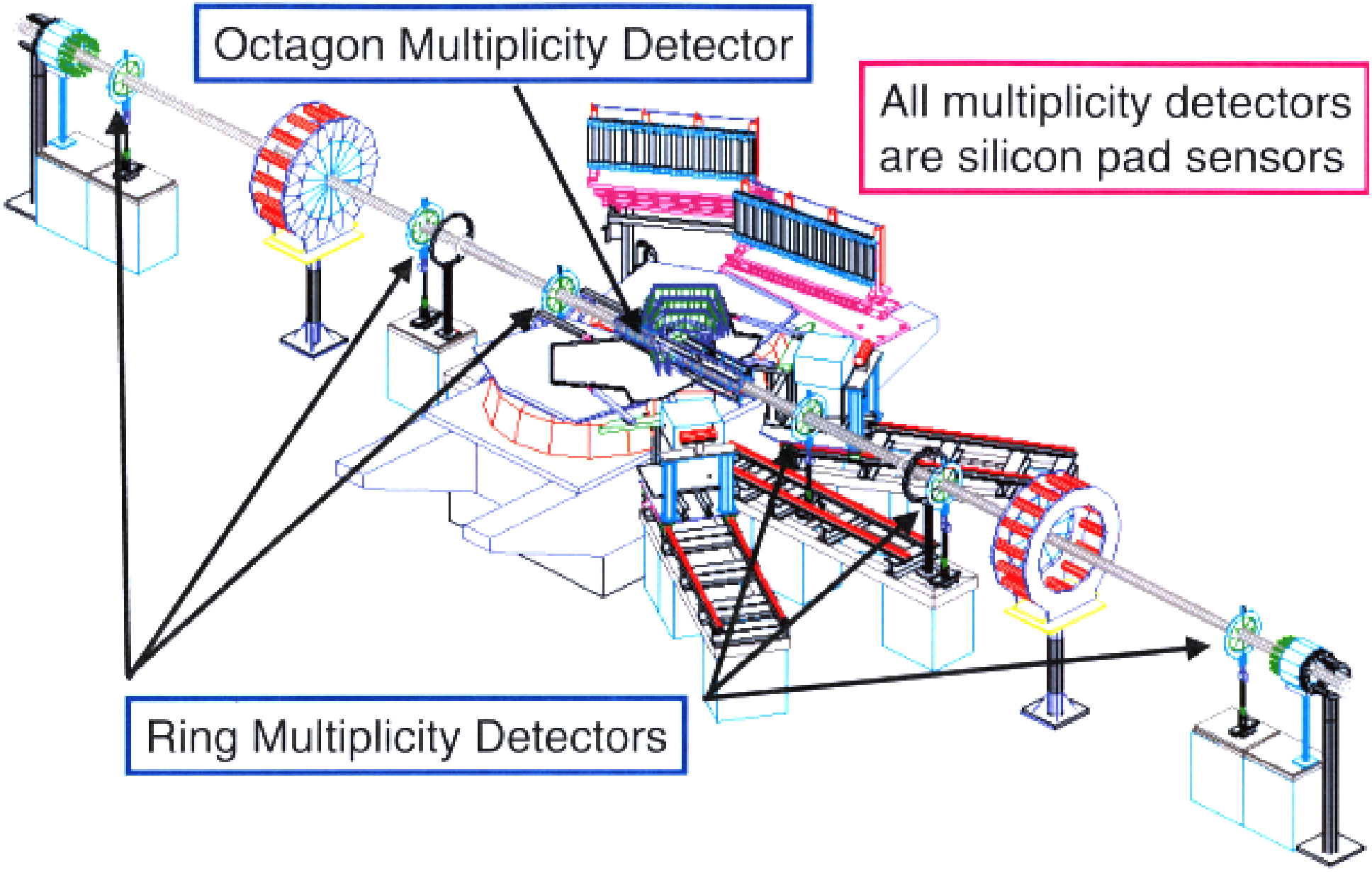
Charged-particle Multiplicity in Au-Au at RHIC Energies ($\sqrt{s_{NN}} = 130$GeV)

Influence of various physical effects on $dN_{ch}/d\eta$ in very central collisions:



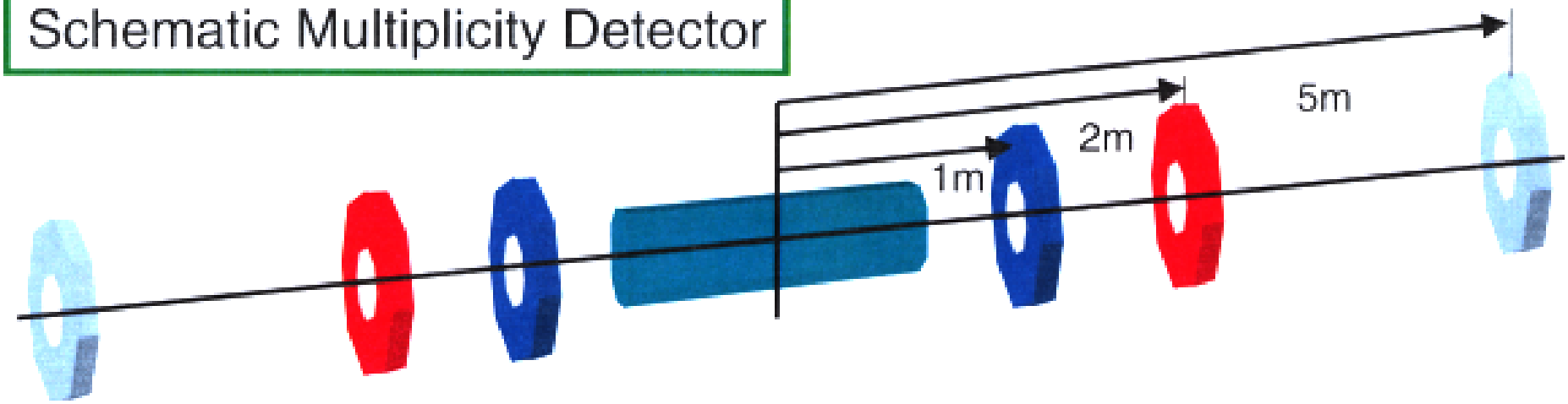
(Wang & Gyulassy, Private communication)

The PHOBOS Detector

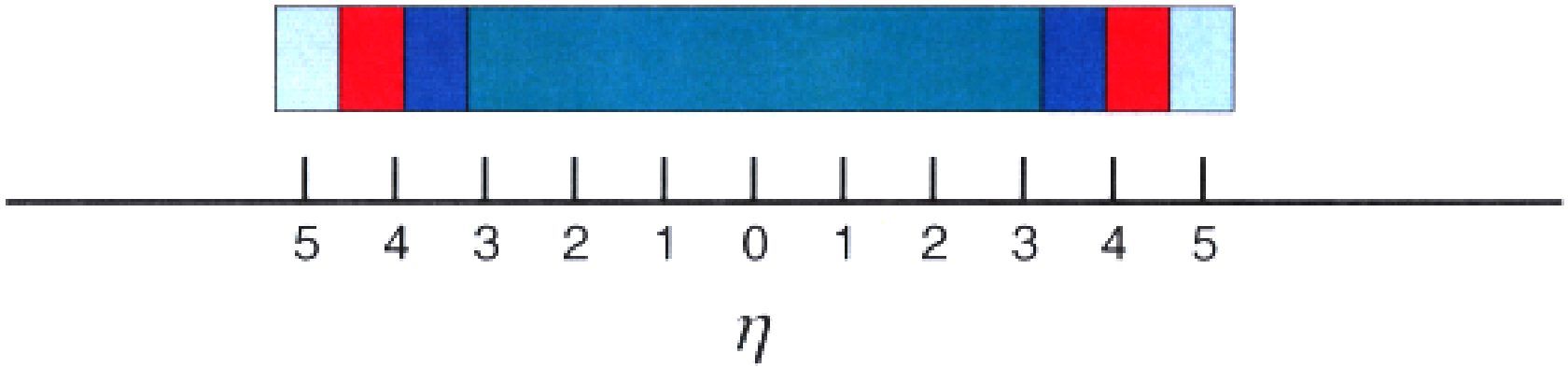


Coverage of multiplicity detectors in η

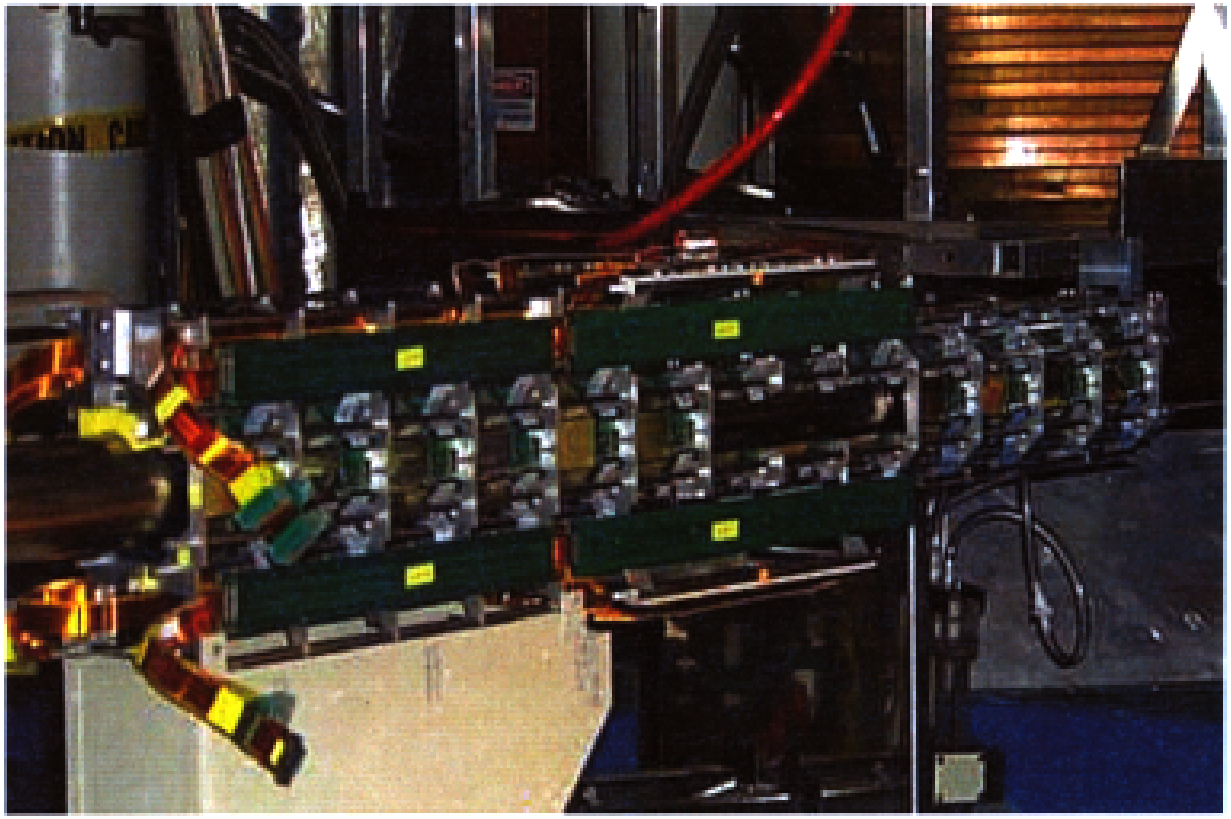
Schematic Multiplicity Detector



η coverage for vertex at Z=0.



PHOBOS Multiplicity detectors



Octagon

1 of 6 Rings

What I will **not** discuss:

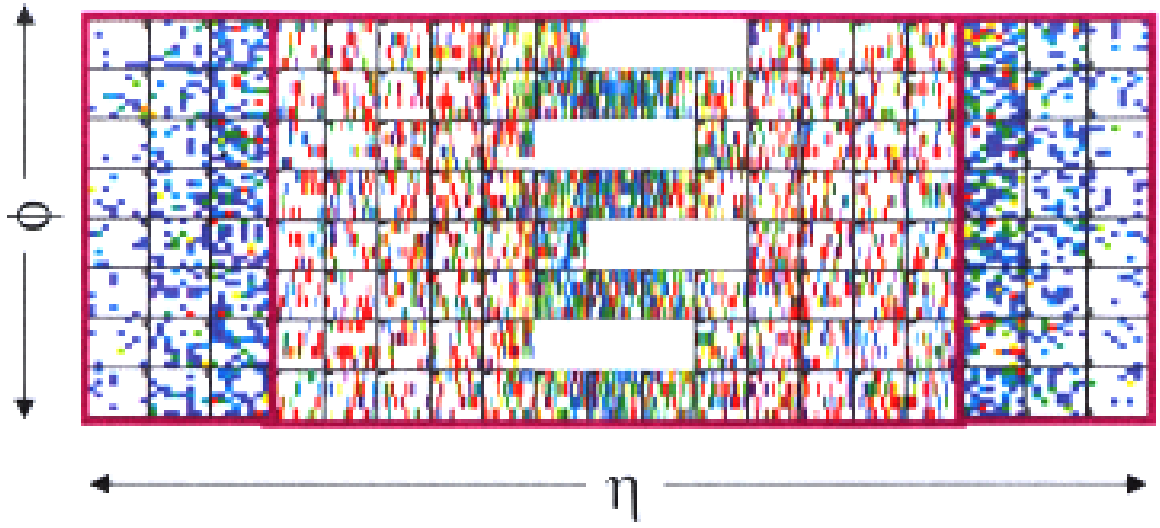
- Event Selection
- Vertex Determination
- Centrality Determination

⇒See Talks by:

- R. Pak, Tuesday 3:20
- J. Katzy, Wednesday 4:40

⇒And see Poster by:

- P. Decowski



ΔE deposition in multiplicity detectors for 1 event.

1 Count hits binned in η, centrality (b)

2 Calculate acceptance $\boldsymbol{A}(Z_{VTX})$ for that event

3 Find the occupancy per hit pad $\boldsymbol{O}(\eta,\boldsymbol{b})$

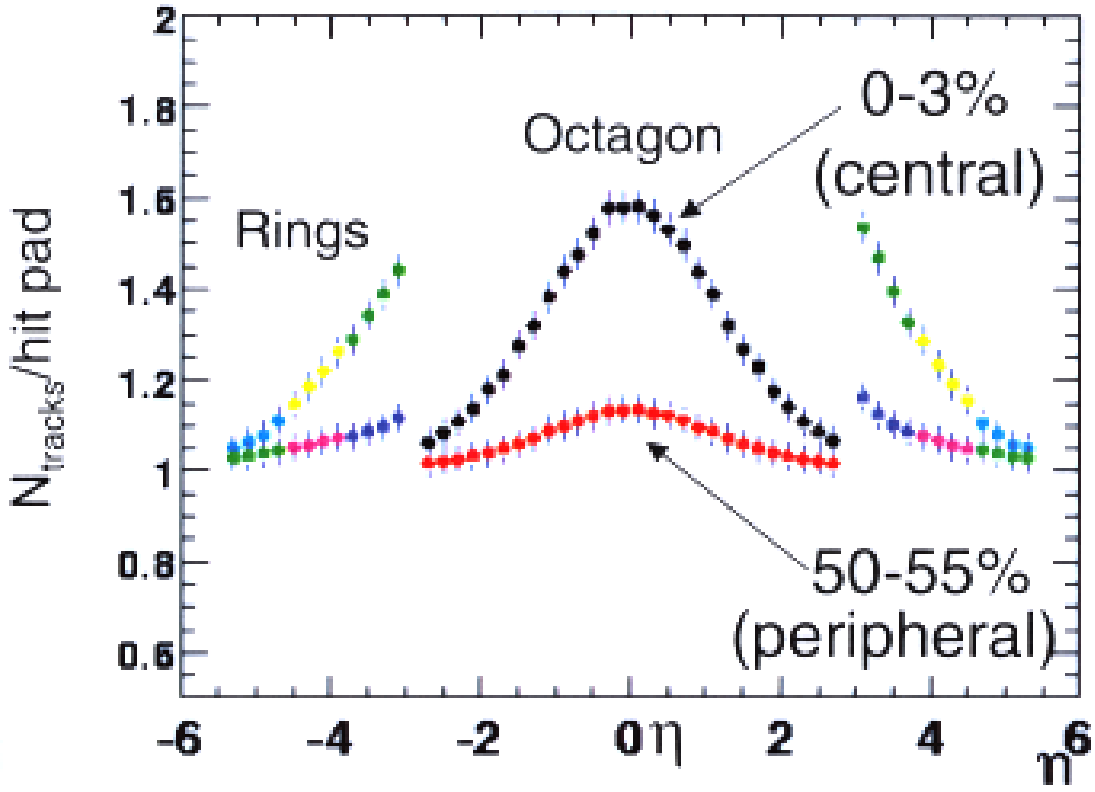
4 Fold in a background correction factor $\boldsymbol{f_B}(\eta,b)$

$$\frac{dN_{ch}}{d\eta} = \sum_{hits} \frac{O(\eta,b) \times f_B(\eta,b)}{A(Z_{VTX})}$$

"Measuring" the occupancy

Method: Assume Poisson statistics

$$P(N) = \frac{\mu^N e^{-\mu}}{N!}$$

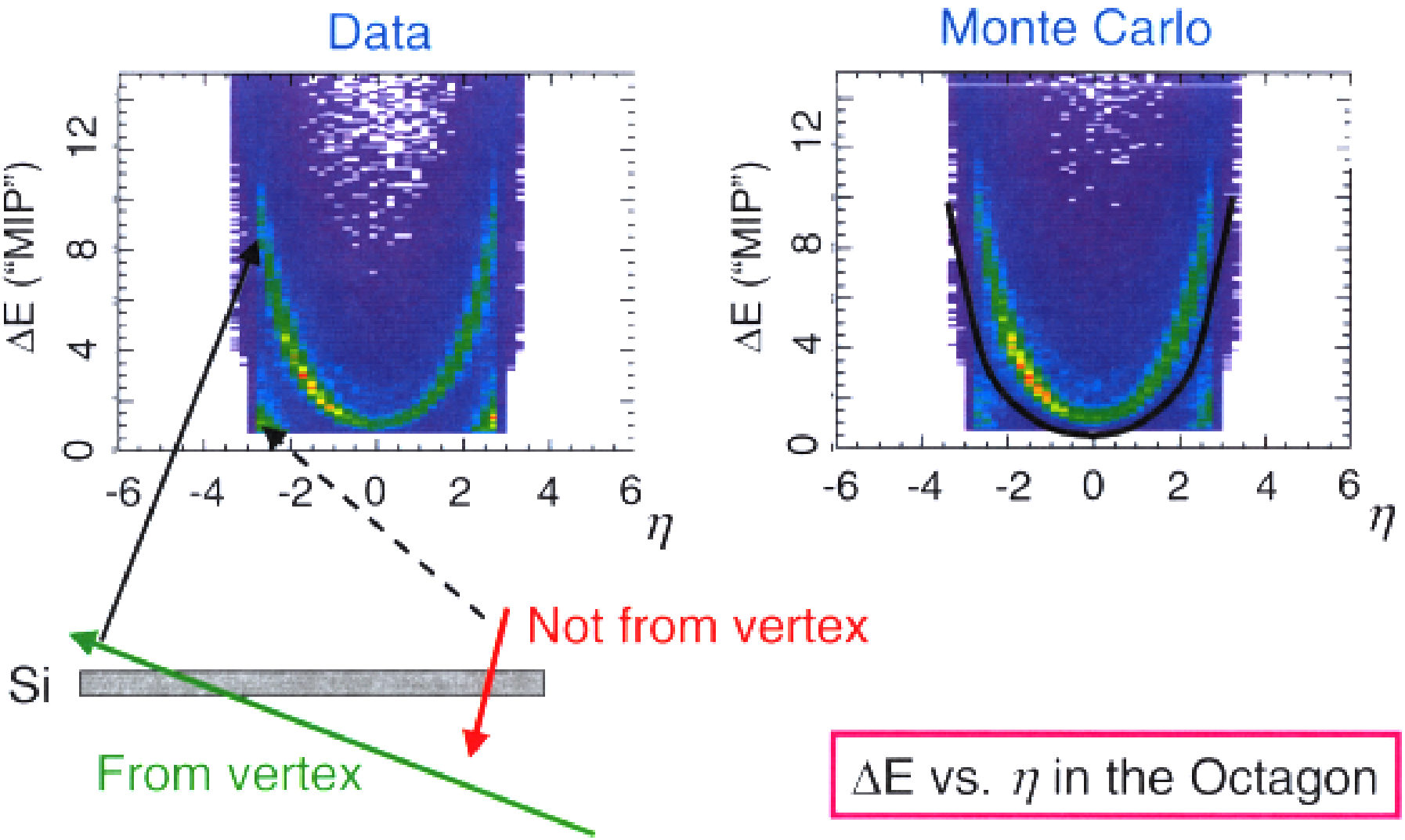


N=number of tracks/pad

μ =mean number of tracks/pad

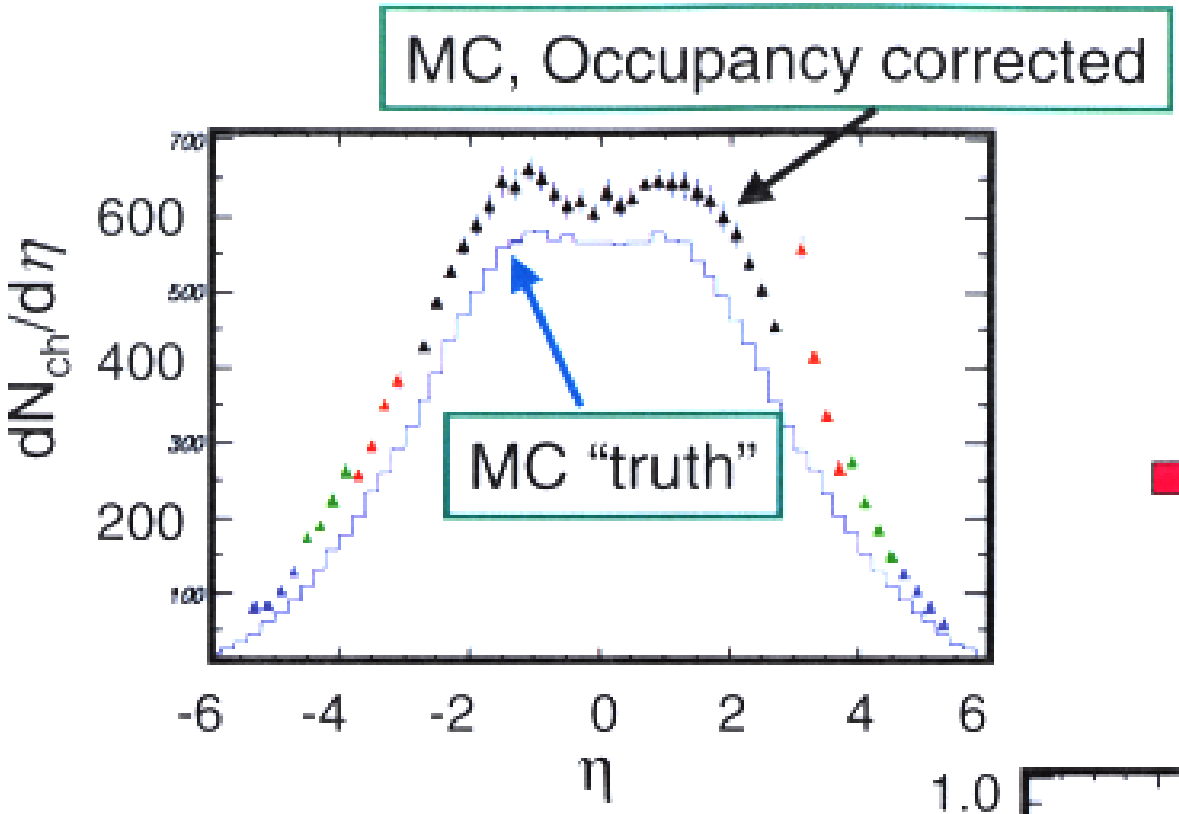
The numbers of empty, and occupied, pads determine the occupancy as a function of η, b

Discriminating background with ΔE

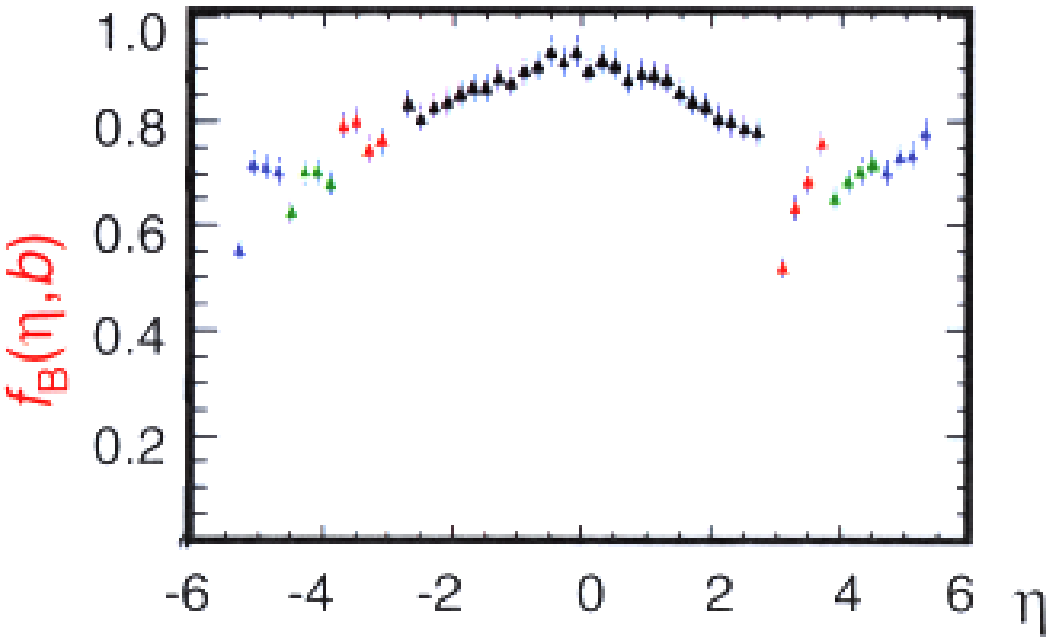


ΔE vs. η in the Octagon

Estimating remaining backgrounds

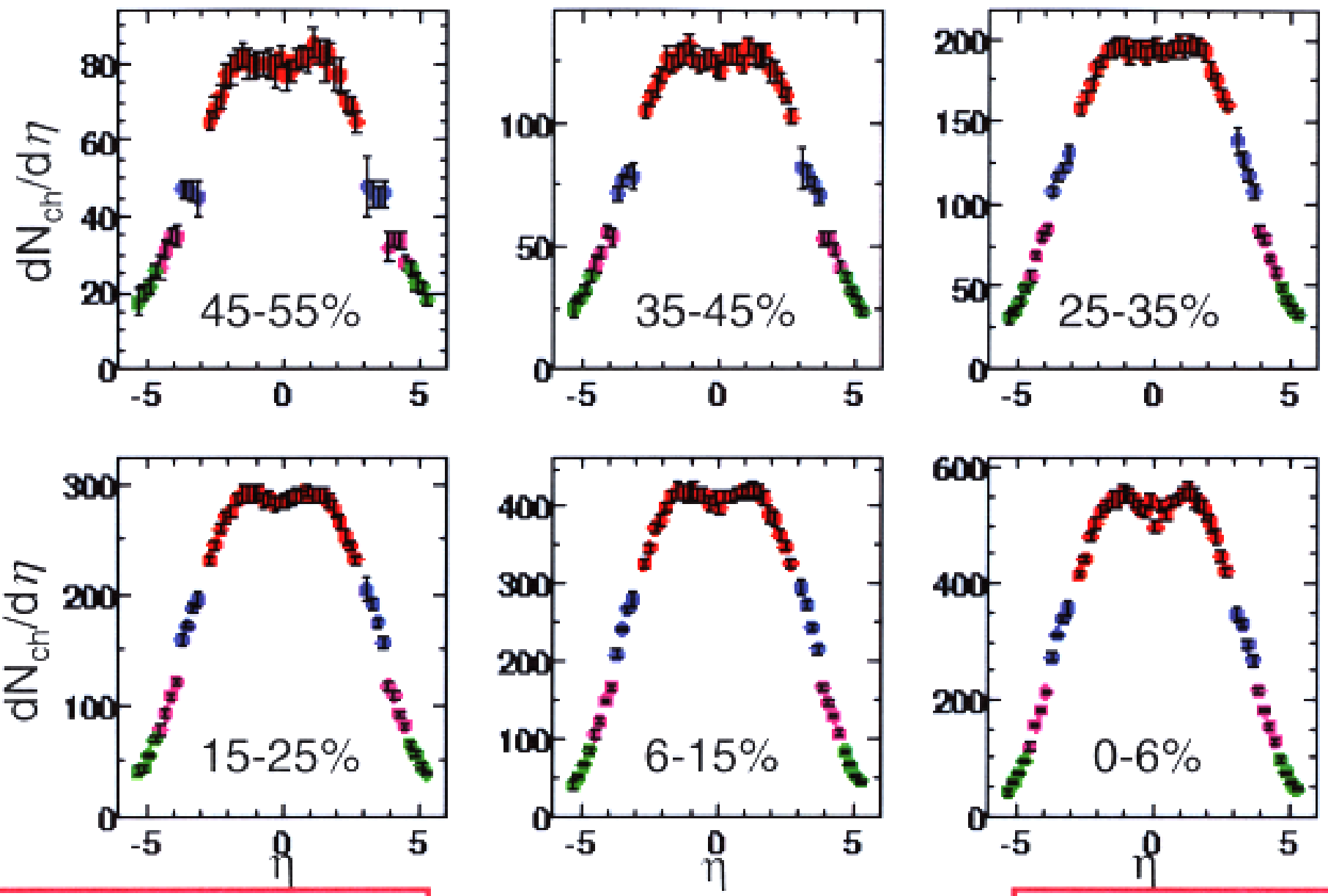


$f_B = MC_{Truth}/MC_{Occ}$

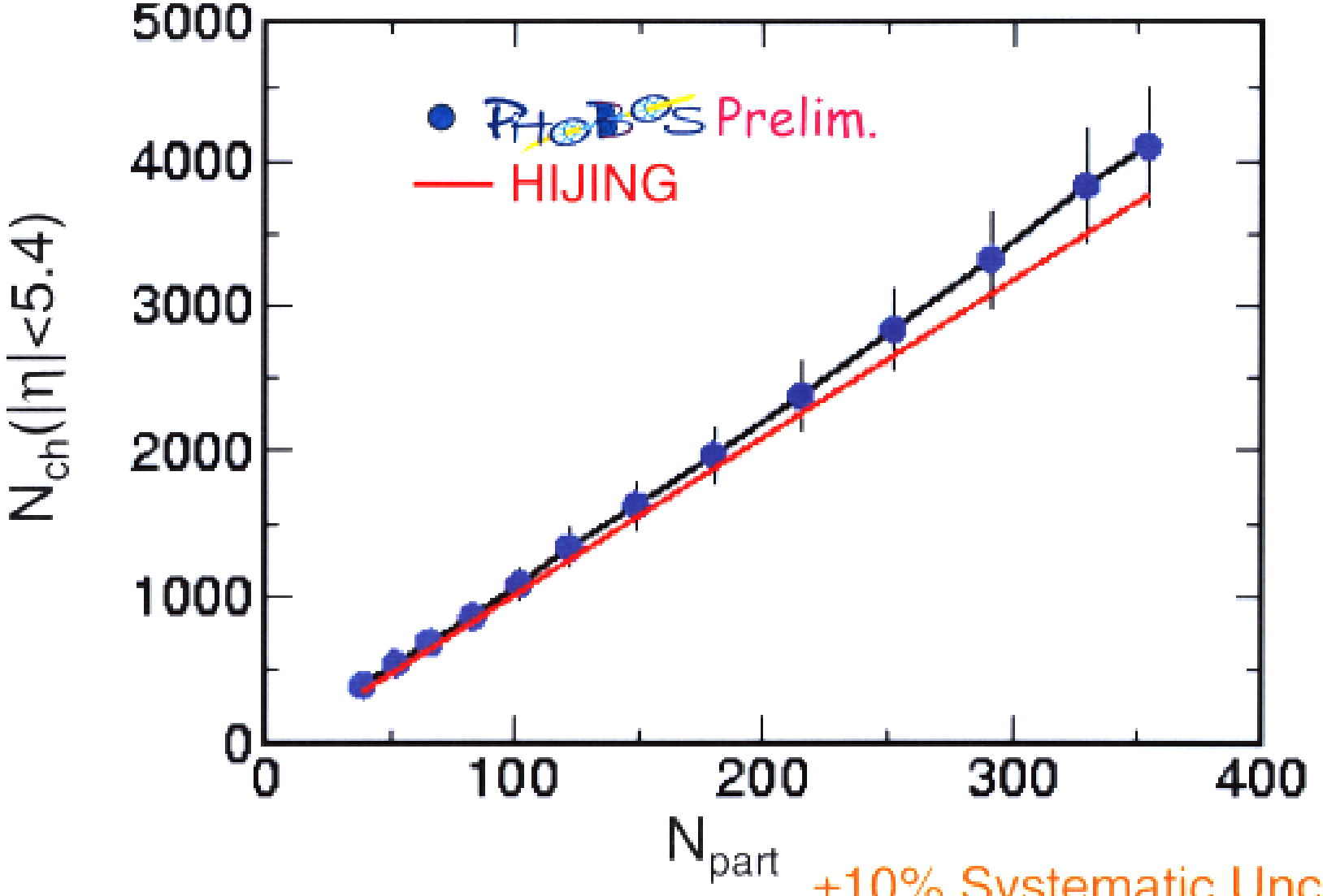


Compare PHOBOS Monte Carlo "data" analyzed using occupancy corrections to "truth" - the difference gives corrections for remaining background.

$dN_{ch}/d\eta$ for different centrality bins

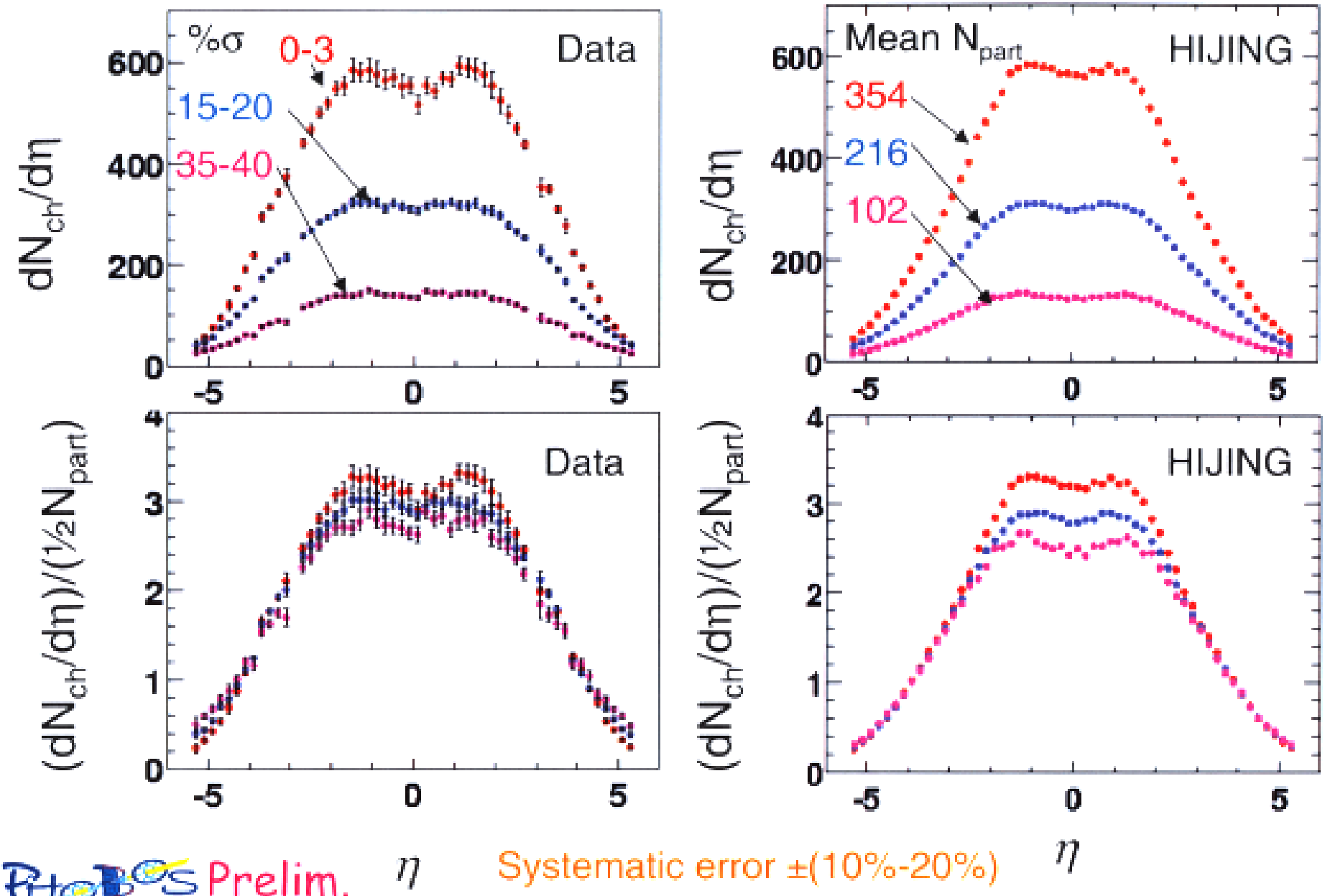


Centrality Dependence of $N_{ch}(|\eta|<5.4)$



±10% Systematic Uncertainty

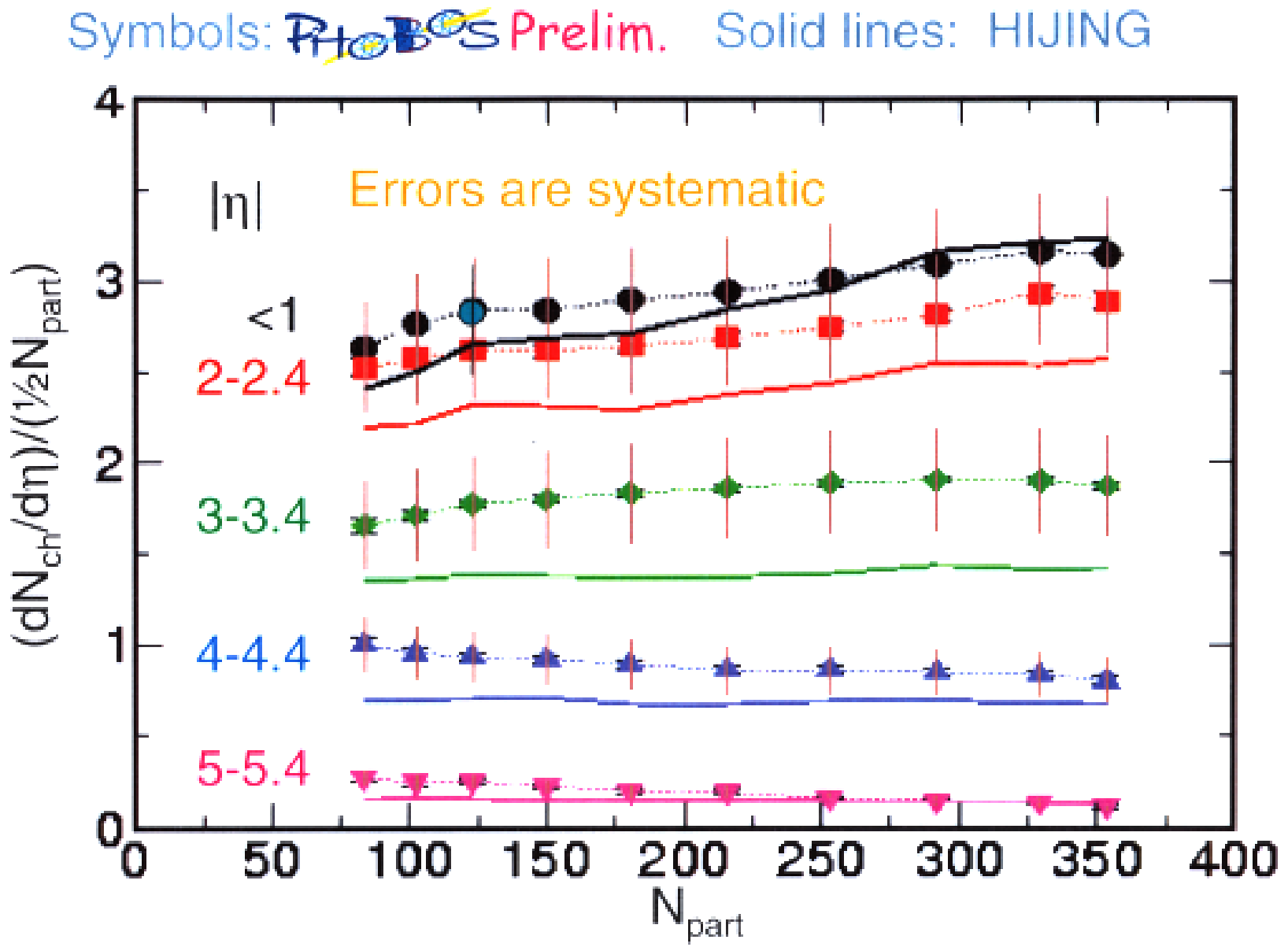
Shapes of $dN_{ch}/d\eta$ for different N_{part}



PHOBOS Prelim.

Systematic error ±(10%-20%)

Centrality dependence of $dN_{ch}/d\eta|_{\eta}$



Summary

- First multiplicity distributions over 4π now available at $\sqrt{s_{NN}} = 130\text{GeV}$ for wide range of impact parameters
- $N_{ch}(|\eta|<5.4)=4100\pm410$ for the 3% most central collisions
- Distributions are somewhat wider than predicted by some models
- $(dN_{ch}/d\eta)/(\frac{1}{2}N_{part})$ in fragmentation region drops by ~½ from $N_{part}=100$ to 350
- Outlook: coming analyses: EbyE, $d^2N/d\eta d\phi$ (I. Park, Wed. 5:55)

PHOBOS