Near-angle, high-$p_\perp$ two-particle correlations at $\sqrt{s}$ =200AGeV measured in the PHENIX experiment

Paul Constantin

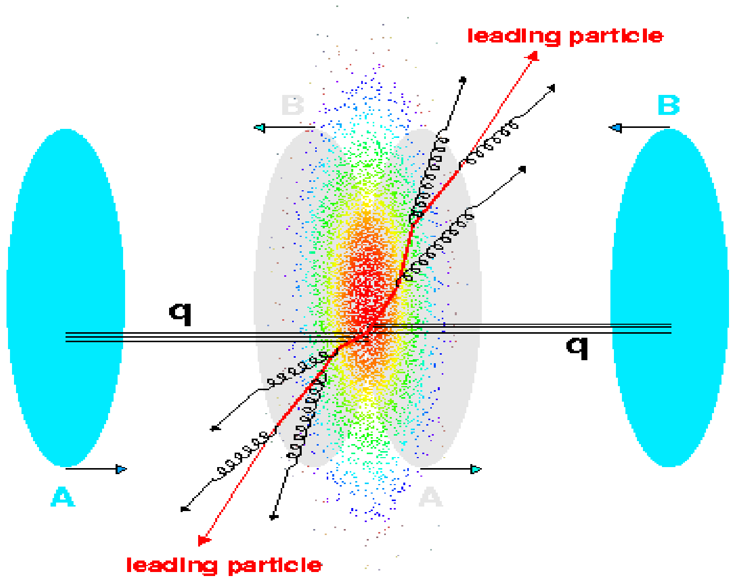
(Iowa State University)

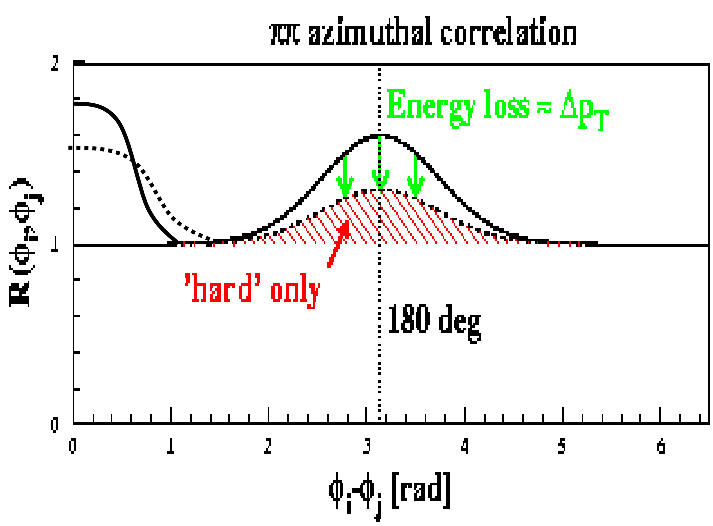
for the PHENIX collaboration

Outline

- Main sources of two-particle correlations
  - parton fragmentation – jets
  - elliptic flow
- Extraction of the correlation function
- Jet signatures in the data:
  - centrality and $p_\perp$ dependence of relative yield
  - $j_\perp$-scaling of near-angle width
- Conclusions and outlook

Correlations induced by jets





Hard scatterings:

- high Q^2 transfer - small α_s (pQCD)
- early in collision - probe early stages
- energetic partons: probe the partonic density of the hot QCD medium (QGP) via dE/dx (gluon radiation)

Produce jets of hadrons :

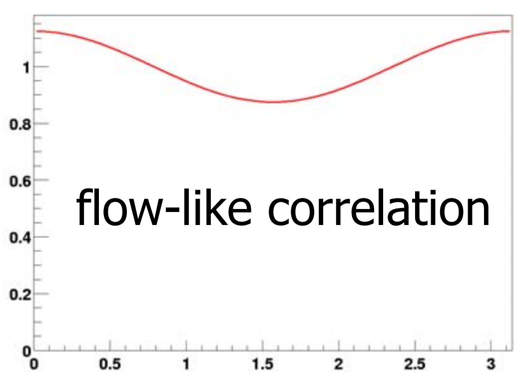
- monojets - near-angle azimuthal correlations
- dijets - back-to-back azimuthal correlations
- broadening by interaction with nuclear medium*

* *X.N. Wang, Phys.Rev.Lett.81:(1998)2655*

Correlations induced by azimuthal anisotropy

$$\varepsilon = \frac{\langle y^2 - x^2 \rangle}{\langle y^2 + x^2 \rangle}$$

$$v_2 = \frac{\langle p_x^{\;2} - p_y^{\;2} \rangle}{\langle p_x^{\;2} + p_y^{\;2} \rangle}$$



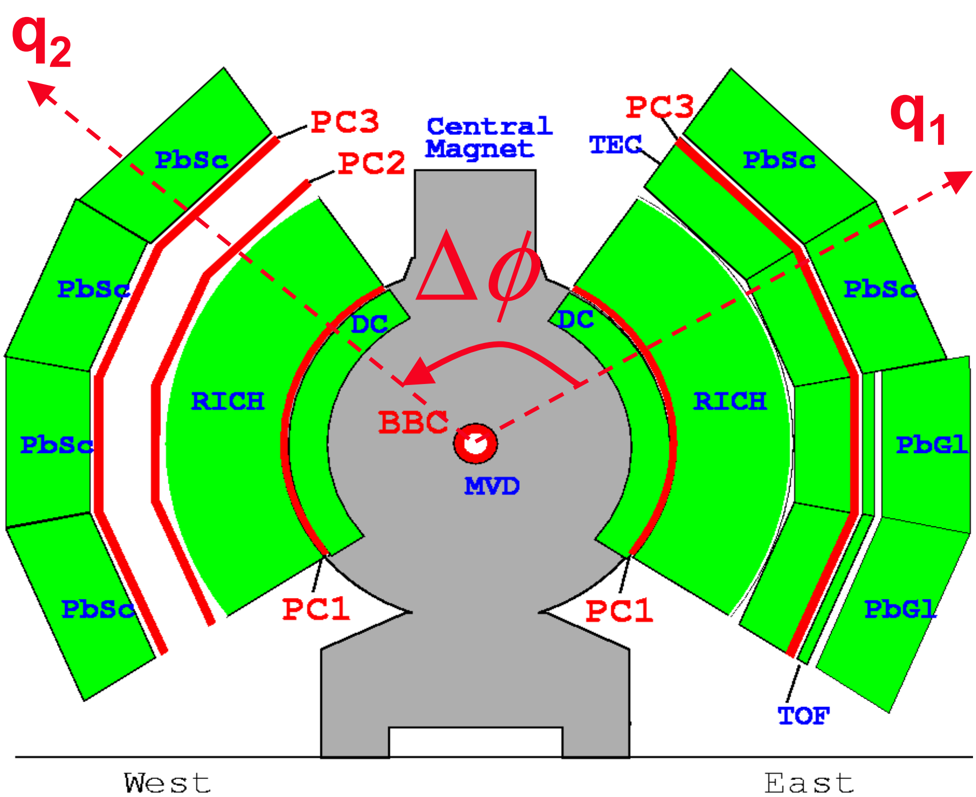
Spatial azimuthal anisotropy in the initial state

→ pressure gradients →

elliptic flow momentum pattern in the final state

$$C(\Delta\phi)_{flow} \propto (1 + 2\,v_2^{\,2}\cos(2\Delta\phi))$$

Details of the analysis



PHENIX Run2 Detector

30M min-bias events analyzed

Contributions to the near-angle peak (other than jets):

- conversion $e^{\pm}$: efficiently reduced by the RICH veto.
- weak decays (K^0_S, Λ): not significant in the $p_\perp$ region presented here. Also, they produce a narrower peak than jets.
- random background: reduced by the outer detector (PC3) tight matching.

Extraction of the near-angle peak

Correlation function (mixed event technique):

$$C(\Delta\phi) = \frac{N_{real}(\Delta\phi)}{N_{mixed\ events}(\Delta\phi)}, \quad \Delta\phi = |\phi_1 - \phi_2|$$

Fit with a flow-like term and a jet-like term:

$$N\left[1 + 2v_2^2 \cos(2\Delta\varphi)\right] + \sqrt{\frac{\pi}{2}}\frac{NY}{(1-Y)\sigma} e^{-\frac{1}{2}\left(\frac{\Delta\varphi}{\sigma}\right)^2}$$

- *Y is the relative yield* → gaussian area / total area
- *σ is the width* of the near-angle peak
- *v_2 is the elliptic flow coefficient*

Cuts to enhance the jet contribution:

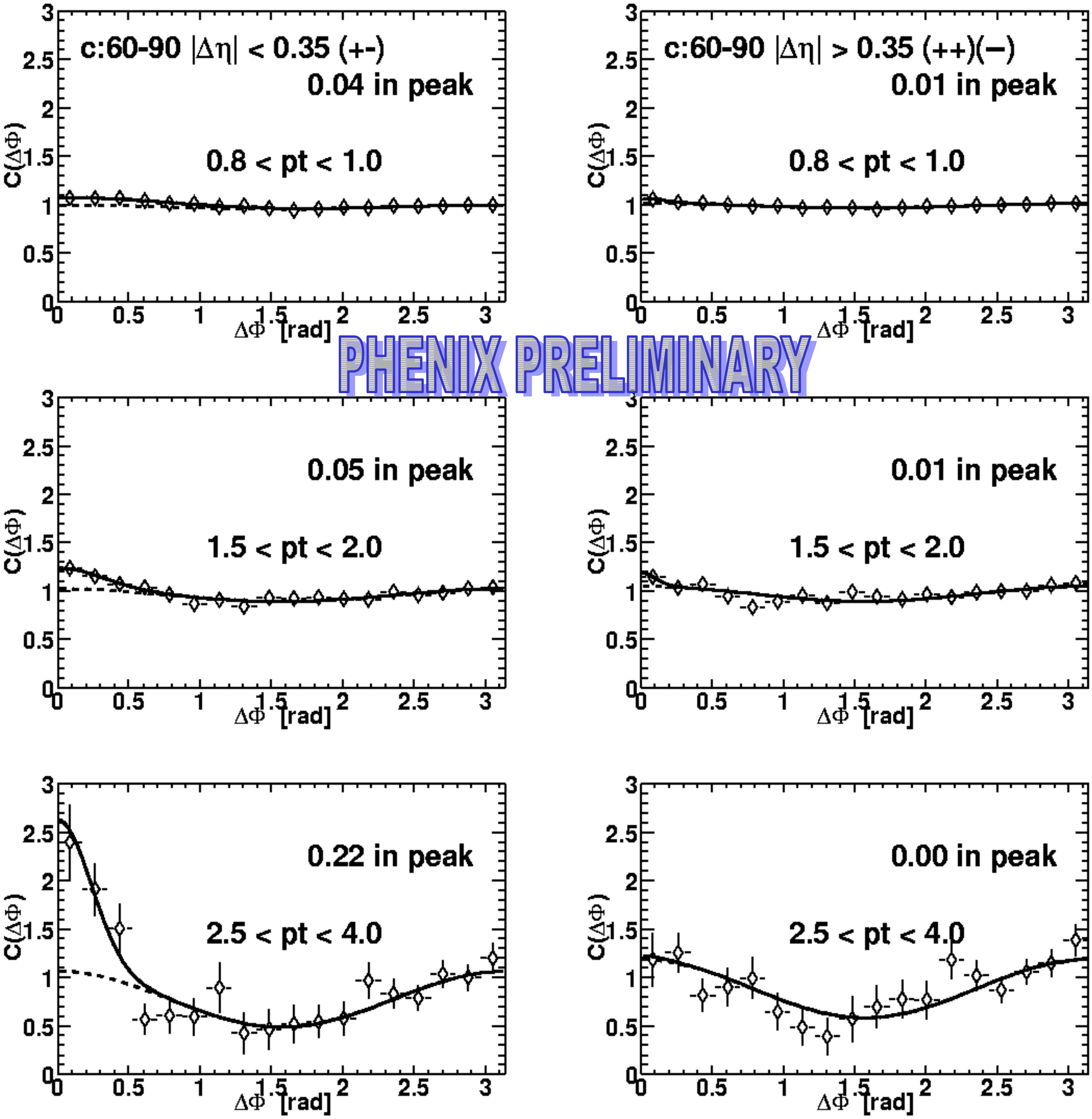
- Small rapidity gap, opposite charge ($|\Delta\eta|<0.35$, $(q_1q_2)=(+\,-)$)
  - kinematically favoured jet-like near-angle
- Large rapidity gap, same charge ($|\Delta\eta|>0.35$, $(q_1q_2)=(+\,+)(-\,-)$)
  - kinematically disfavoured jet-like near-angle

PHENIX

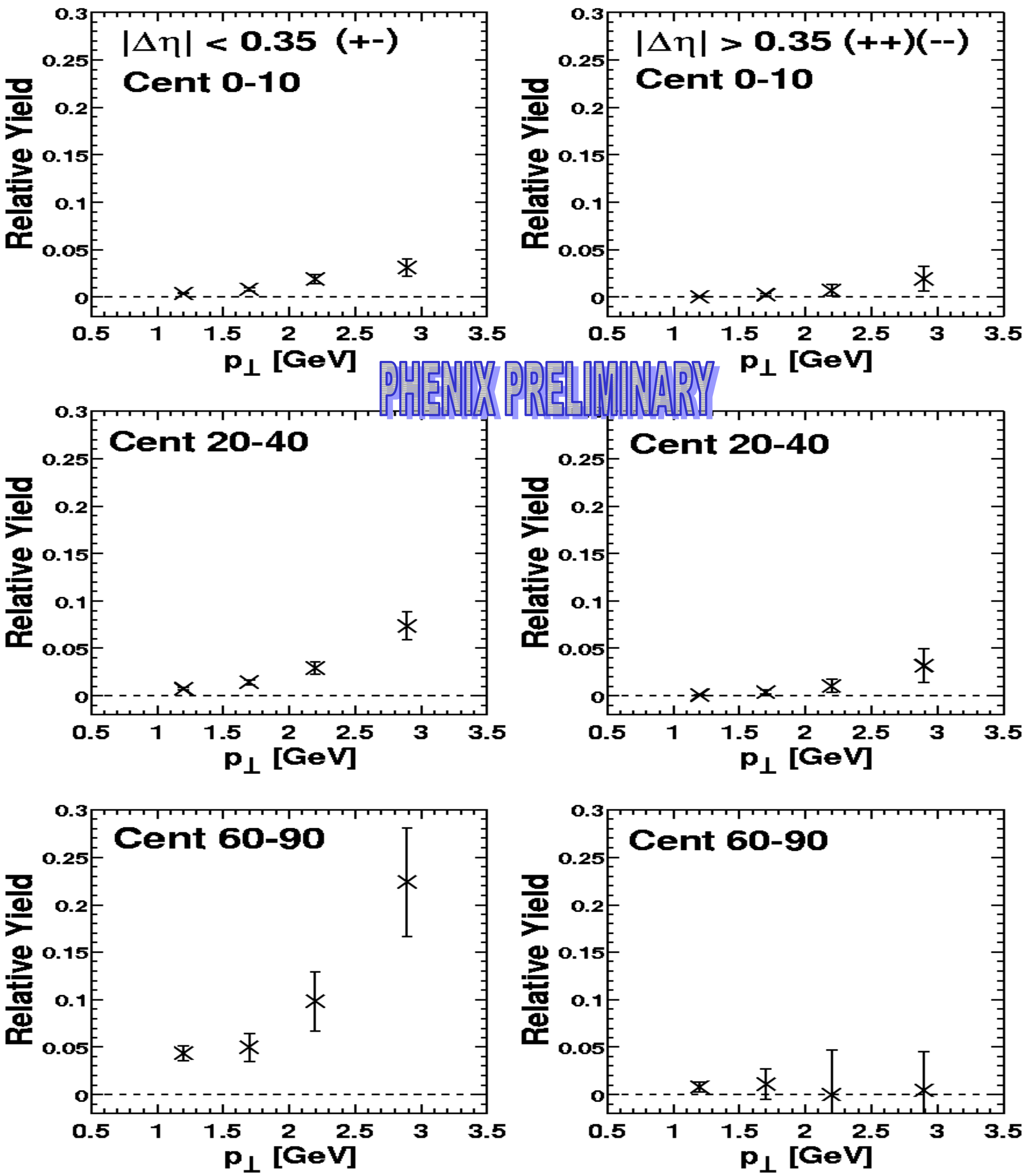
Peripheral Fixed $p_\perp$ Correlation Function

Kinematically favoured near-angle peak

Kinematically disfavoured near-angle peak



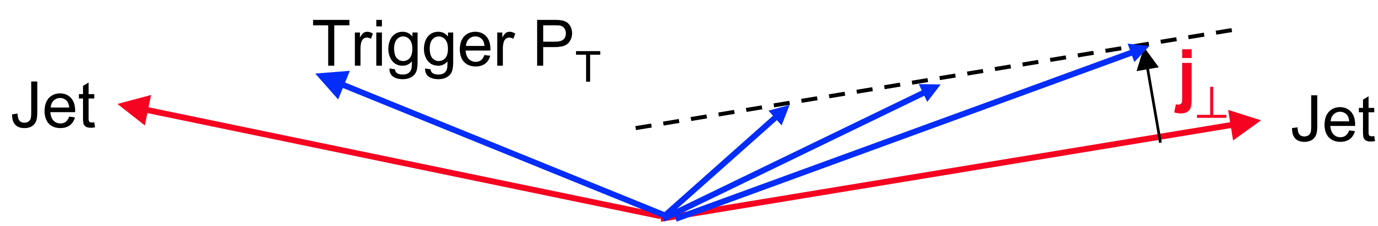
Relative Yields

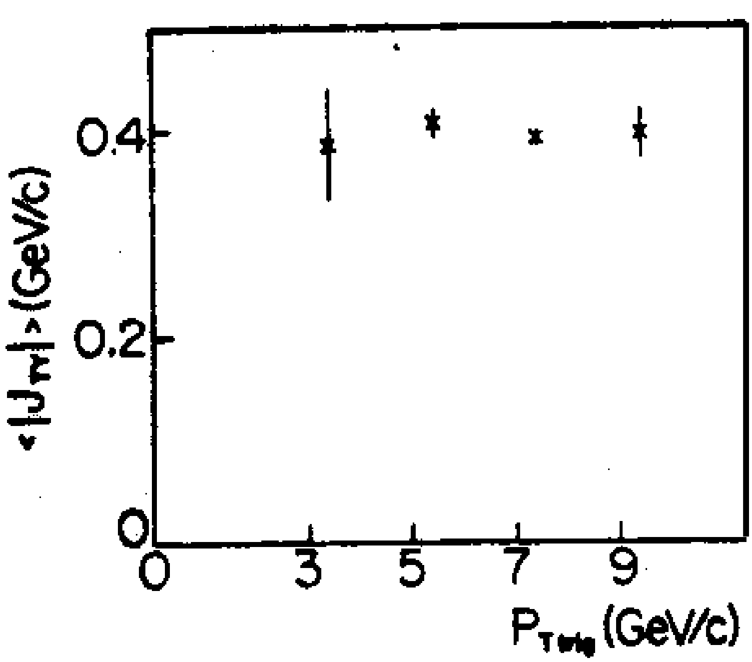


Centrality and $p_{\perp}$ dependence indicative of jet-like source

pQCD parton fragmentation in p-p collisions

$j_\perp$ is the transverse momentum with respect to "jet" axis



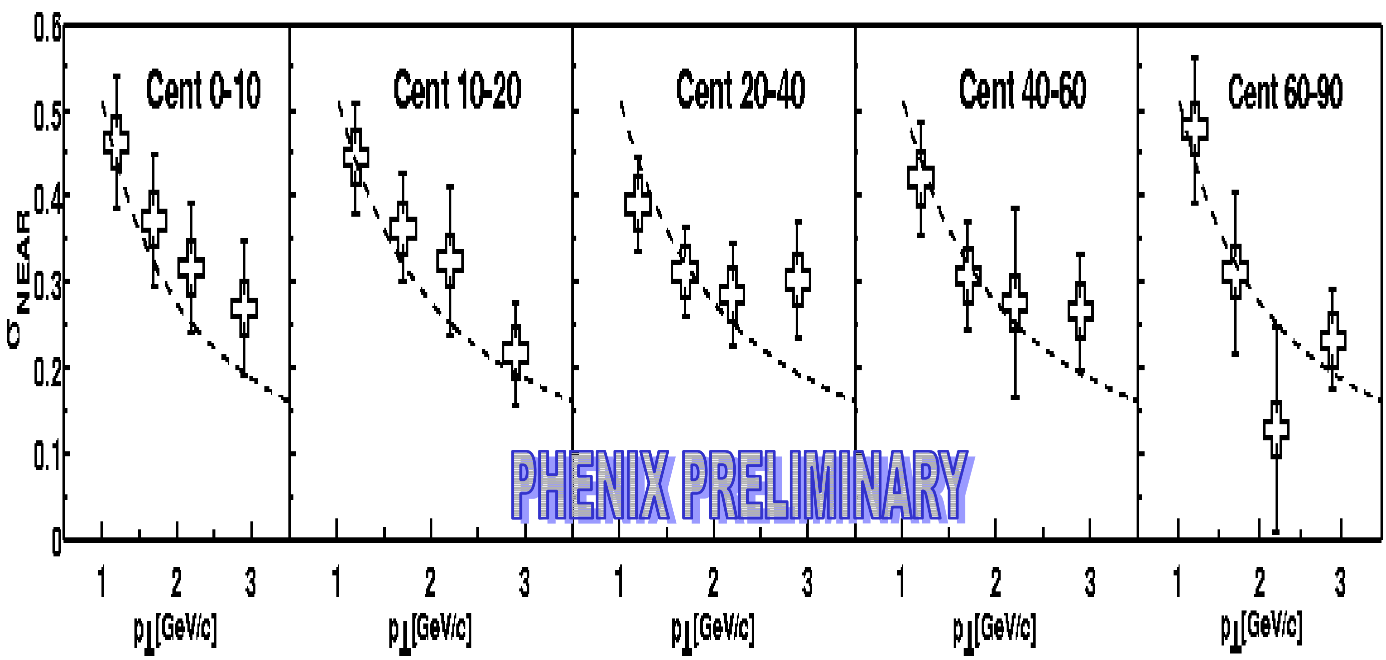


<|j_T|> = 400 MeV/c,
independent of $p_{\perp Trig}$
for $\sqrt{s} = 31, 45, 62\ GeV$

CCOR Collaboration
Phys. Lett. 97B, 163 (1980)

Near-Angle Widths

The extracted width of the gaussian term (the dashed line - not a fit - corresponds to a constant $j_{\perp}$=400 MeV):



Within the present errors, no evidence of broadening

Conclusions and Outlook

- Jet-like near-angle structure is observed in two-particle correlations in Au-Au collisions at $\sqrt{s} = 200 AGeV$
- The relative yield decreases with centrality and increases with $p_\perp$.
- Near-angle widths also show a $p_\perp$ dependence characteristic for jets. No centrality dependence.
- Comparison with PHENIX p-p data at the same collision energy will be added soon.
- The study of the near-angle peak in other channels than $h^{\pm}$-$h^{\pm}$ (like π^0-$h^{\pm}$) will allow us a better extraction of its properties.