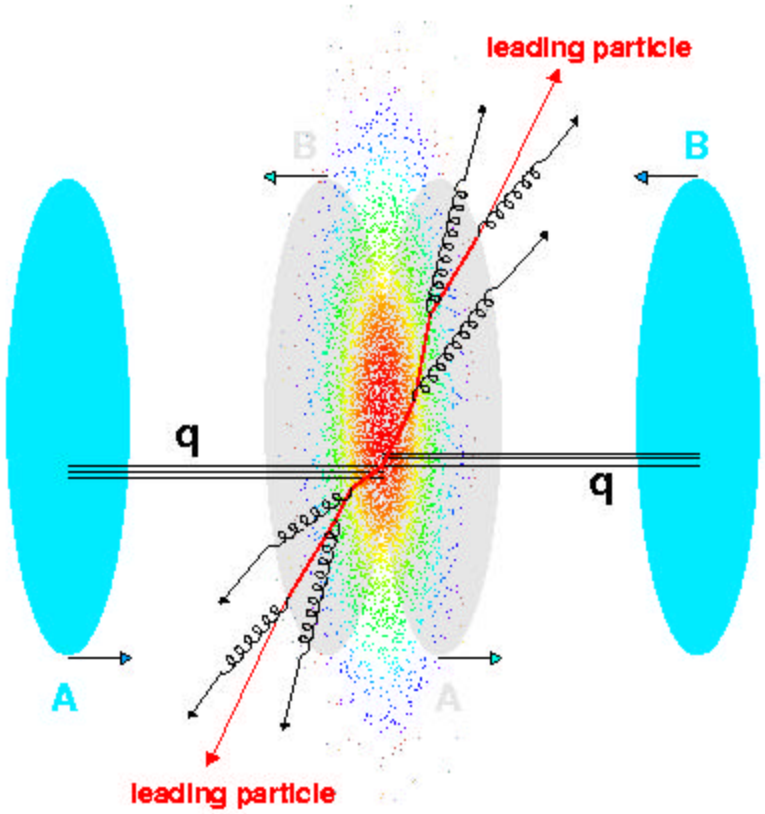
# High transverse momentum charged particles azimuthal correlations in PHENIX

Jan Rak *for* PHENIX *collaboration*

- Hard scattering in nuclear collisions.
- Signals of hard scattering in *AA* collisions
  - inclusive particle yields
  - two particles correlations.
- Azimuthal correlation function
  - various sources of two particle correlation.
- Year 1 PHENIX azimuthal correlations @ $\sqrt{s}$ = 130 AGeV
  - centrality dependence
  - $p_{\perp}$ -dependence.
- Summary & outlook.

# Hard scattering in Heavy Ion collisions

schematic view of jet production




## Jets:

- primarily from gluons at RHIC
- produced early ($t<1fm$)
- sensitive to the QCD medium (dE/dx)

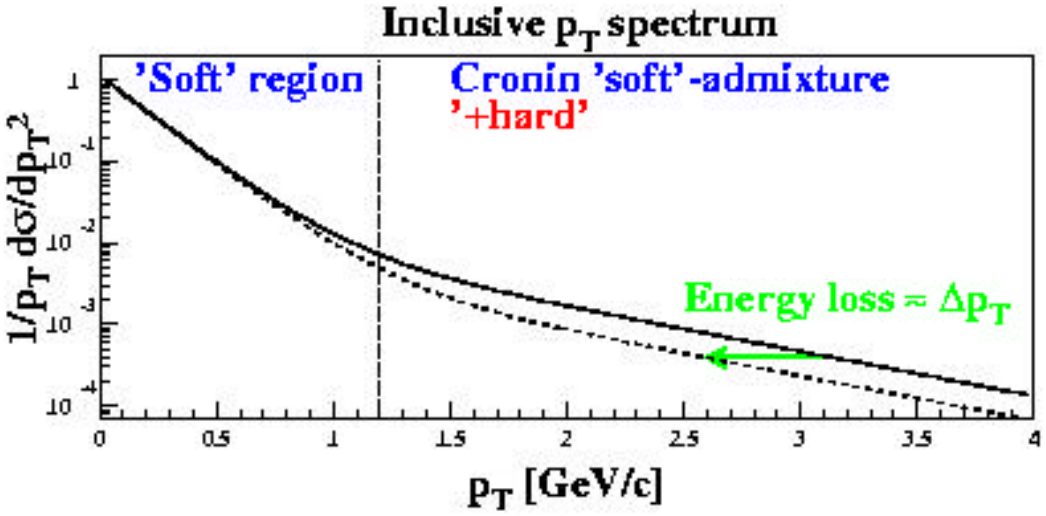
## Observed via:

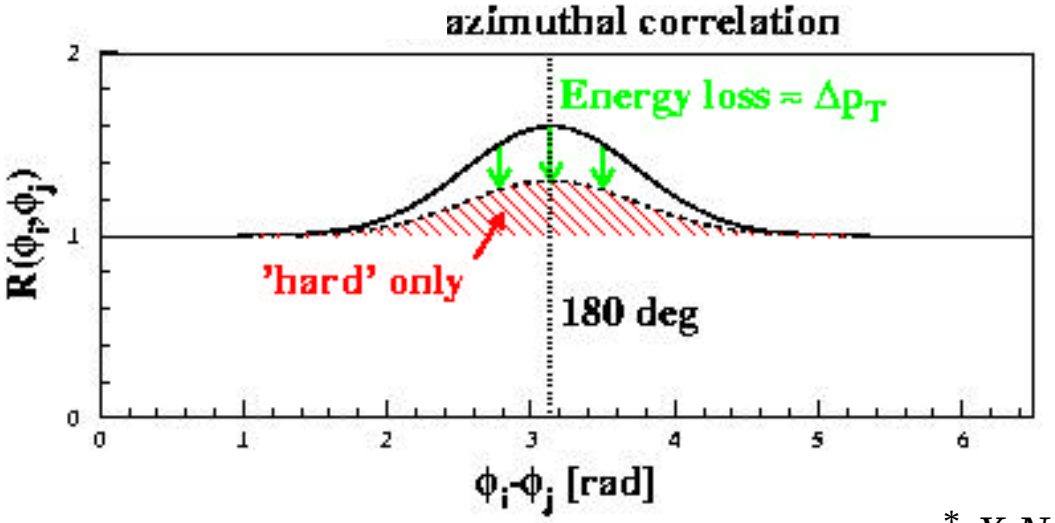
- fast leading particles or
- azimuthal correlations between them

Mechanisms of energy loss in vacuum (*pp*) is understood in terms of formation time and static chromoelectric field regeneration* . Any nuclear modification of this process could provide a hint of QGP formation.

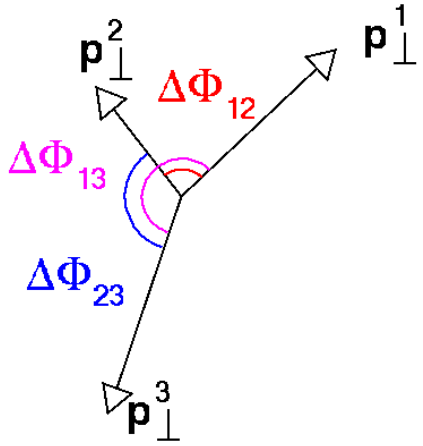
* *F.Niedermayer, Phys.Rev.D34:3494,1986.*

# Hard scattering signals




Hard scattered partons should fragment into two back-to-back particles in azimuth.




Partonic energy loss may*

- reduce the back-to-back peak
- modify the fragmentation function - near angle peak

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

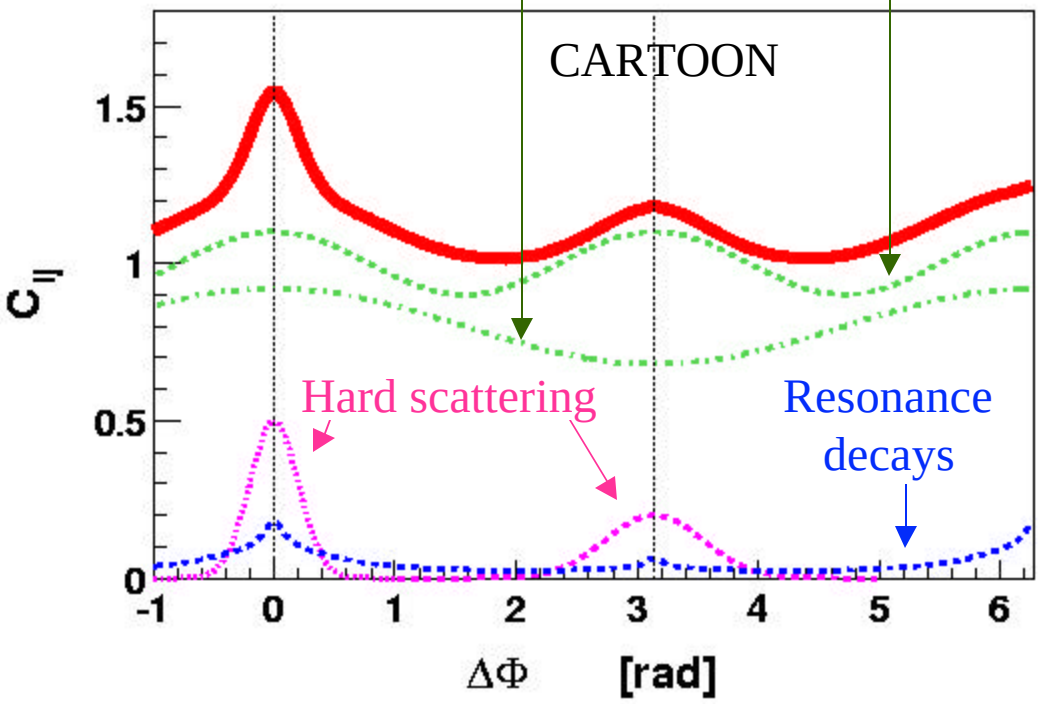
# Correlation function

$$C(\Delta\phi) = \frac{N_{real}(\Delta\phi)}{N_{mixed\ events}(\Delta\phi)}$$

$$\Delta\phi = \phi_i - \phi_j$$

Directed flow | Elliptic flow

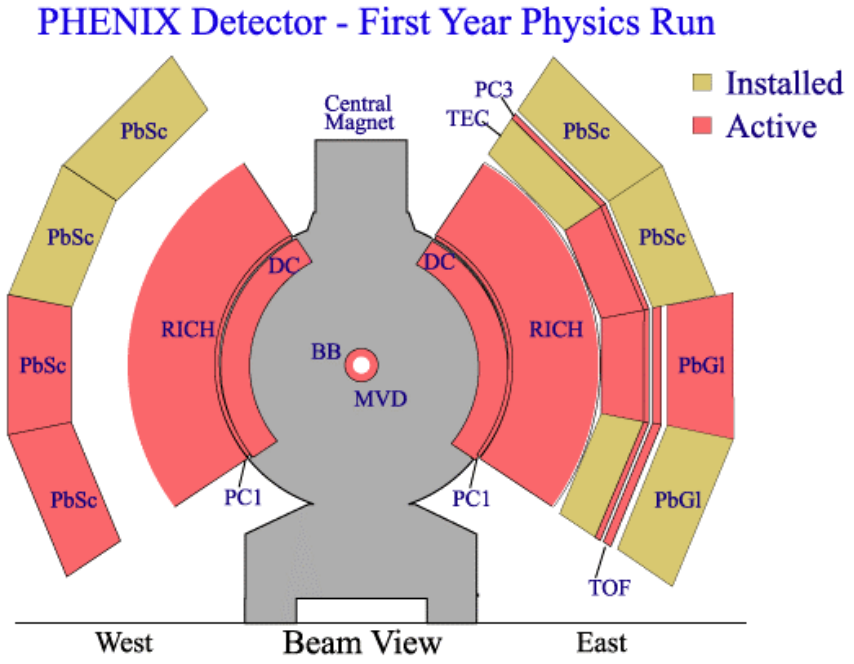
$$C(\Delta\phi)_{flow} \propto (1 + 2v_1^2\cos(\Delta\phi) + 2v_2^2\cos(2\Delta\phi))$$




Even @ RHIC energy, flow phenomena still dominates over signals from hard scattering.

*J.Y.Ollitrault, nucl-th/0004026*

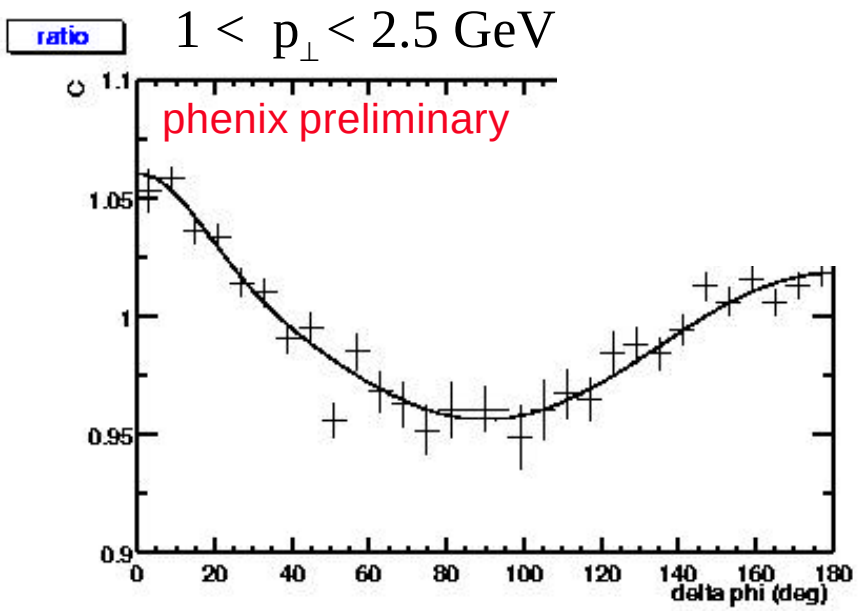
# RUN1: summer 2000 ~5M events



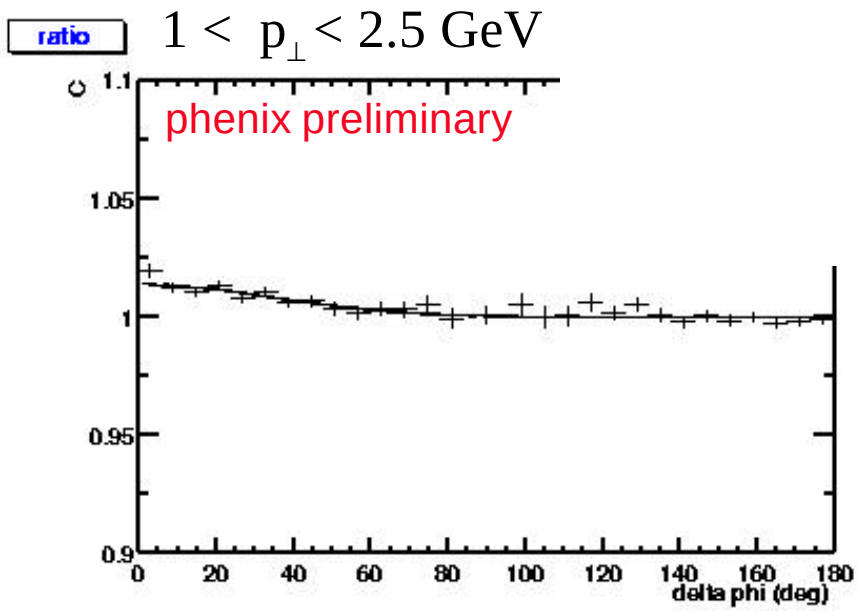

- 1.5M events analyzed
- -20 < collision vertex < 20 cm
- Central arm tracks
  - momenta from drift chamber tracks
  - 1 < pt < 2.5 GeV
- Correlation functions
  - mixed events from similar beam-vertex, centrality

# Correlation function Au+Au ös = 130 AGeV

40 to 92%



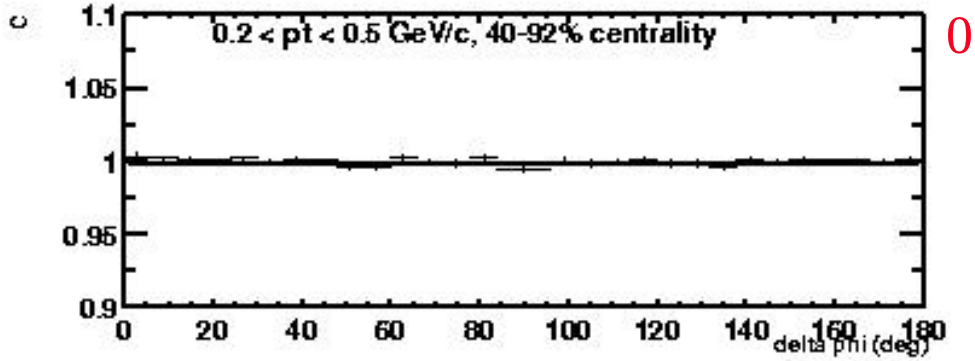

0 to 5%



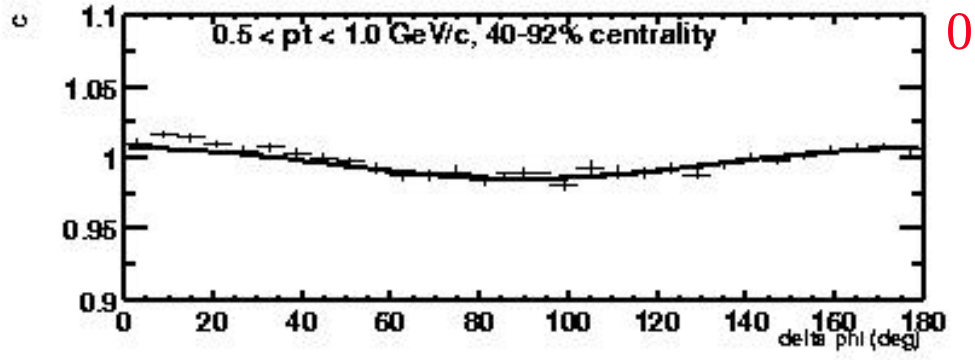

—— $C(\Delta\ddot{o}) = \ddot{e}.e^{-0.5(\Delta\varphi/\sigma)^2} + 2\,v_2^{\,2}\cos(2\Delta\ddot{o}) + \text{offset}$

- Near-angle correlation is stronger than back-to-back.
- Both correlations diminish in central collisions.

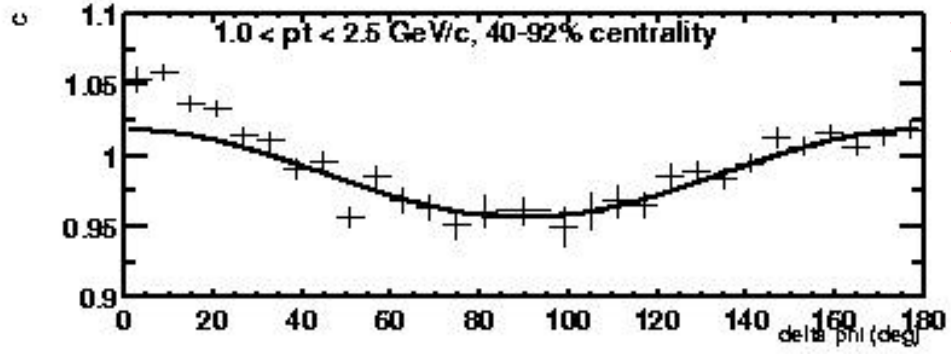
# $p_\Lambda$-dependence




$0.2 < p_\perp < 0.5$ GeV




$0.5 < p_\perp < 1.0$ GeV

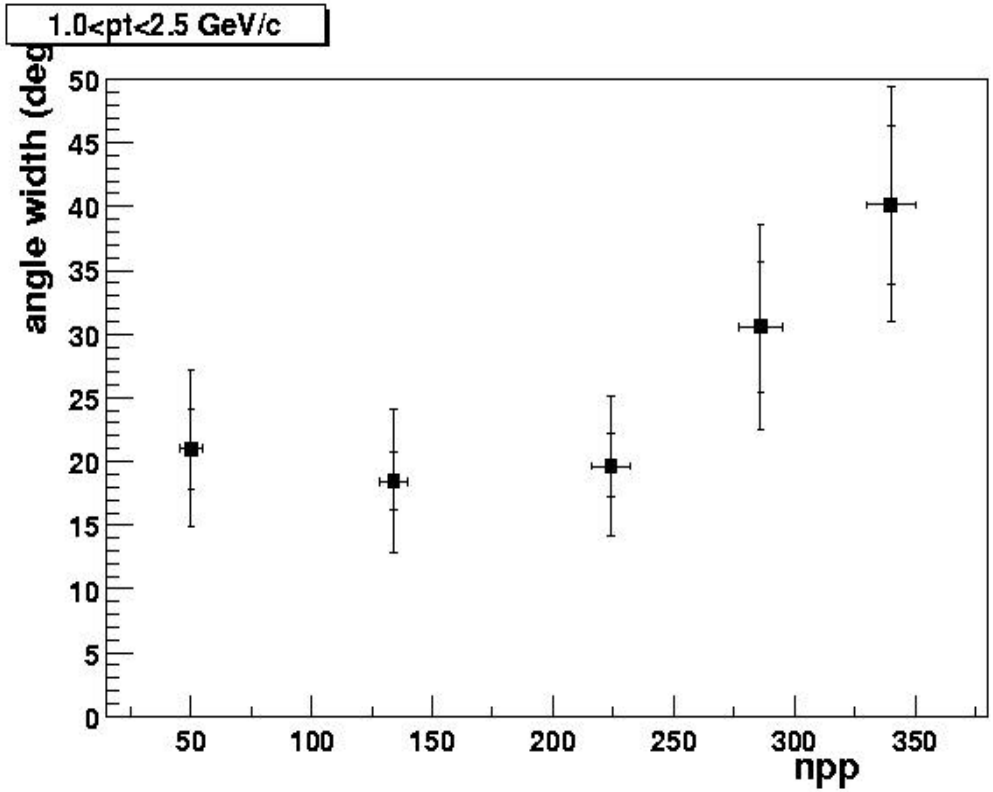



$1.0 < p_\perp < 2.5$ GeV

$x_i$ near-angle

Grows with $p_\perp$, near-angle stronger than back-to-back correlations.

# Angular width

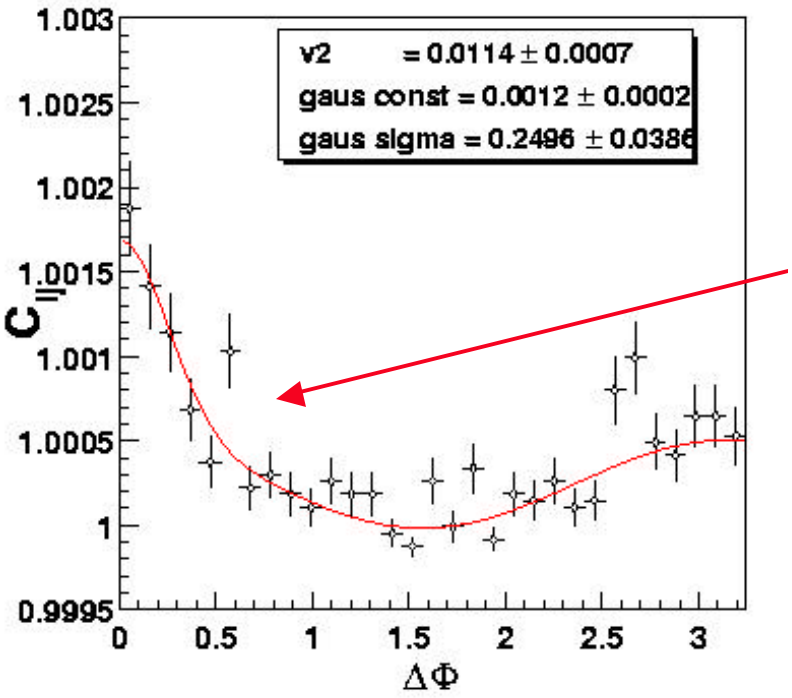



- Not modified jets would have an angular width ≈ 20 deg.
- Nuclear modification (dE/dz) could lead to the broadening of the correlation peak.
- This broadening should be stronger in central collisions. Do we see this?

The $p_{\perp}$ dependence of angular width should provide stringent test of presence of jet signals. More statistic needed.

# Possible sources of angular correlation

UrQMD Monte-Carlo

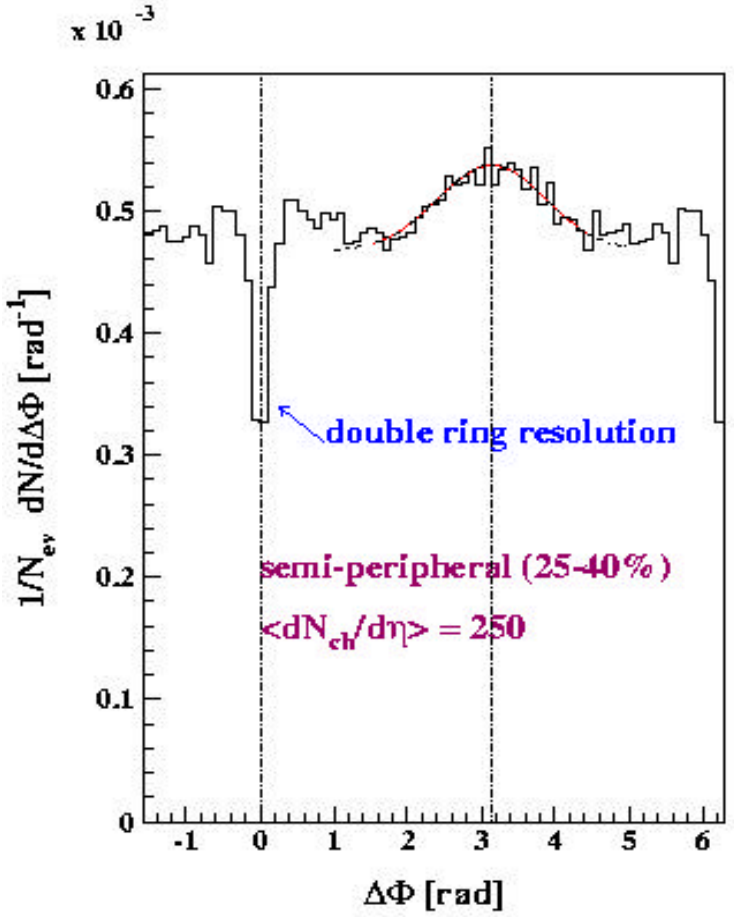



- Flow:
  - shape of the correlation is given by cos(ΔΦ) term. The relative contribution could be fixed by use of different techniques (reaction plane analysis).
- Resonance decay: (UrQMD simulation)
  - $p_\perp$-cut removes large fraction.
- Weak decay:
  - Long lived particles ($K_S^0$ $c\tau$=2.7cm, $\Lambda$ $c\tau$=7.9cm) decays in the mag. field and the daughters look like high-$p_\perp$ particles.

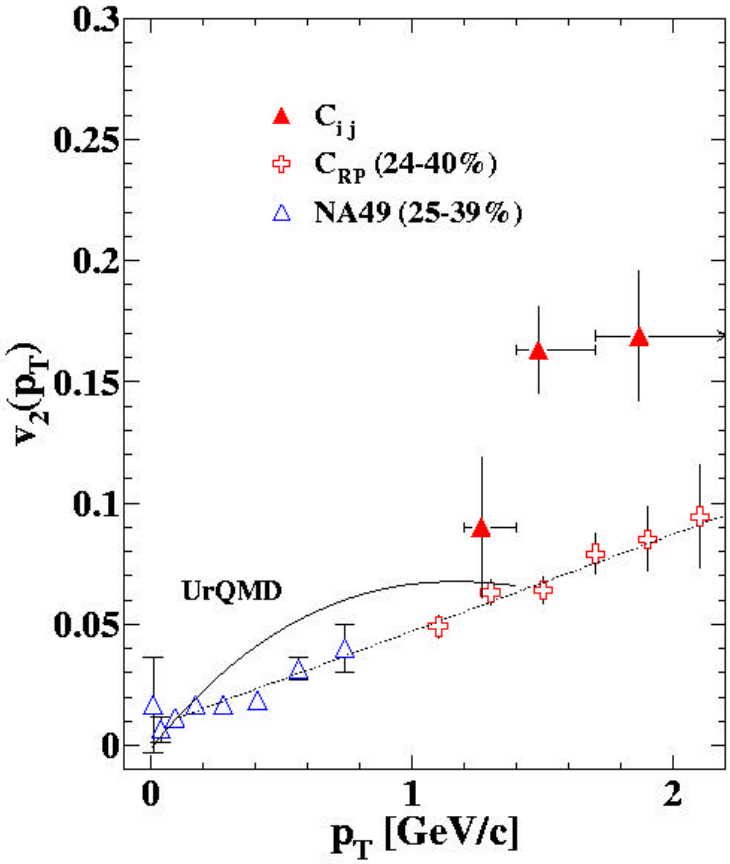
# SPS high-$p_\wedge$ pions correlations

CERES experiment $\sqrt{s}$ = 17 GeV/c  Identified $\pi^{\pm}$

Back-to-back more pronounced




$v_2$ like analysis



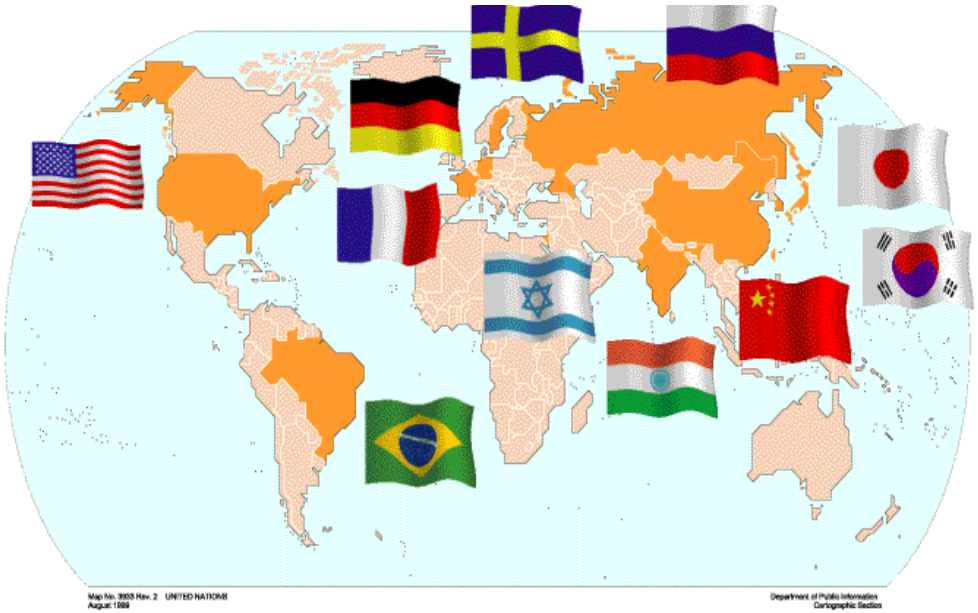
# Summary & outlook

- Angular correlations seen in PHENIX data are in accord with elliptic flow measurement. Small excess at near-angle correlations above the flow contribution is observed.
- This excess grows with $p_\perp$ .
- The angular width is rather constant with centrality, but starts to grow for most central bins.
- Not all possible sources of observed correlation are understood. The main remaining worry concerns the weak decays in magnetic field. Detailed Monte-Carlo simulation is in progress.

## Outlook

- New data @ 200 GeV is coming with better efficiency and much higher statistics.
- High- $p_\perp$ level-2 trigger is operational – allows to study the correlation in much higher $p_\perp$ range.

PHENIX



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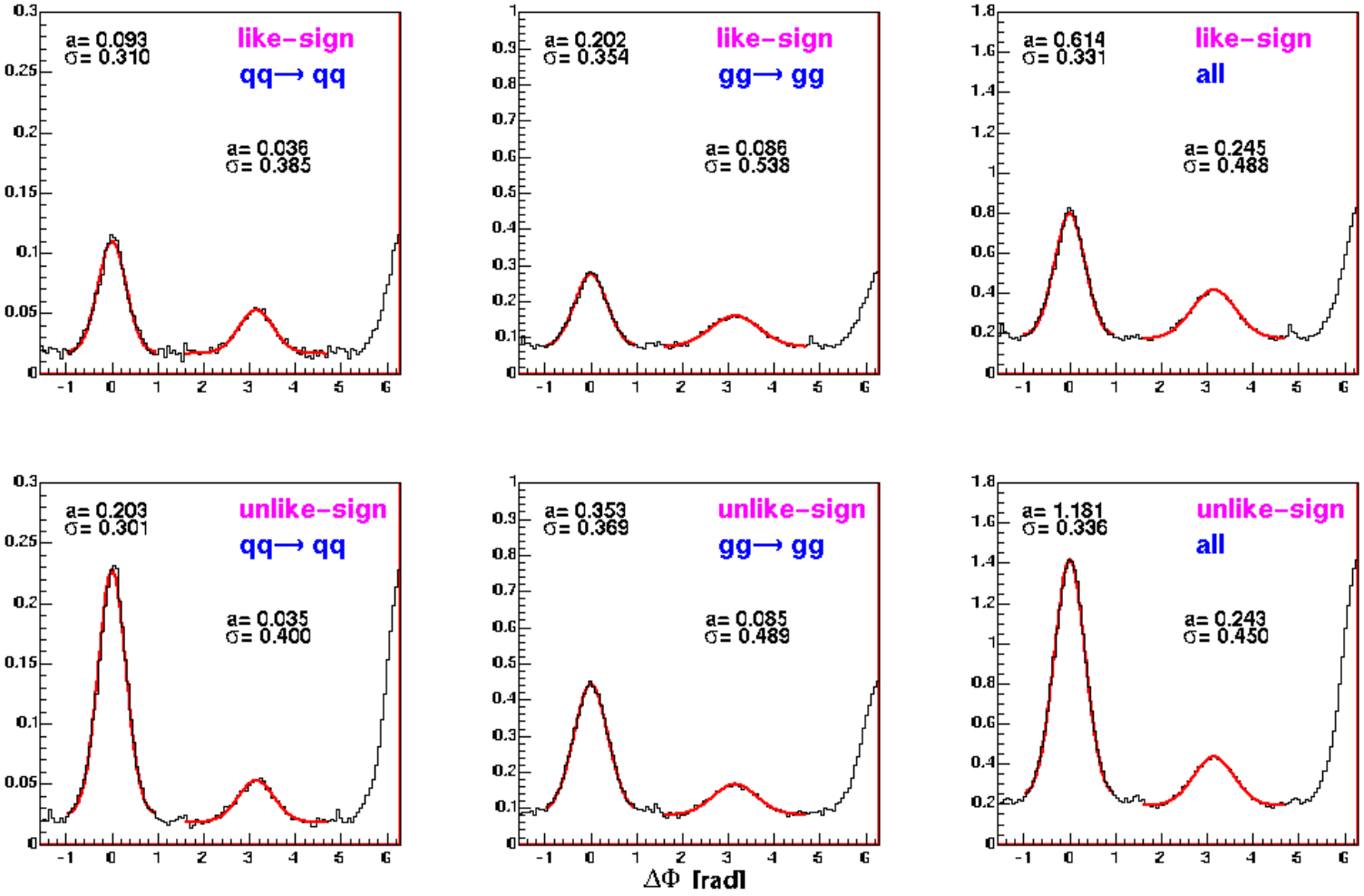
# Pythia *pp* ös = 130 AGeV



# Pythia *pp* ös = 130 AGeV

Angular width with $p_\perp$