Pion Interferometry Relative to the Reaction Plane

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ABSTRACT

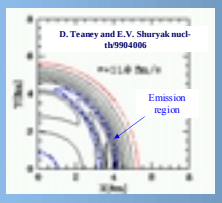
Measurements of particle correlations in non-central heavy ion collision[1] provide unique information of the geometry of the emission region. In combination with measurements of spatial tilt[2] the structure of the emission source can be connected with the physics of anisotropic flow.[3] We will present preliminary results of pion interferometry relative to the reaction plane in Au + Au collisions at RHIC.

Motivation:

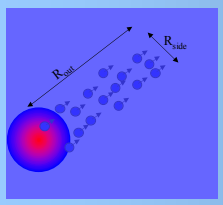
HBT gives a geometric view of the emission region. An analysis done with respect to the reaction plane can probe the spatiotemporal geometry and anisotropic flow.

Novel emission regions may be found in non-central events at RHIC

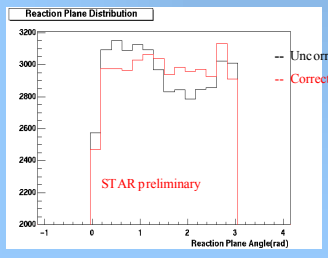
Model calculation shows possible "nutcracker" scenarios for the emission region in non-central collisions at RHIC.



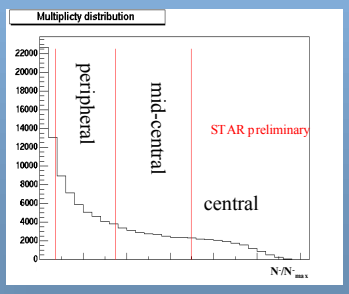
This analysis was done with Pratt-Bertsch decomposition(R_{long}, R_{side}, and R_{out}). R_{long} is defined as the beam direction. R_{out} is the direction of the pair transverse momentum. R_{side} is the direction perpendicular to both R_{long} and R_{out}.

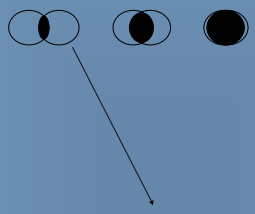


As seen in this picture showing the R_{out} and R_{side} decomposition of the momenta, R_{side} contains geometric size information and R_{out} contains information on both the geometric size and the emission timescale. In this view, R_{long} is out of the poster.

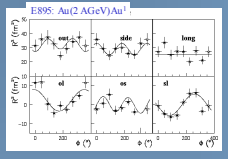


Shown below is the multiplicity distribution showing event classes. This analysis was done using peripheral and mid-central events which provide oblate emission regions as well as high enough multiplicities to allow the determination of the reaction plane.





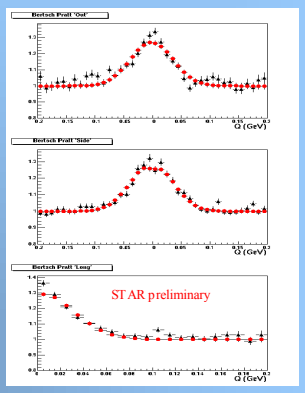
At the AGS…



Shown above are results from the AGS which show an almond shape overlap region as well as a tilt relative to the beam direction.

To correct for detector acceptance, events are binned according to their respective reaction planes and only events with similar reaction planes are mixed.

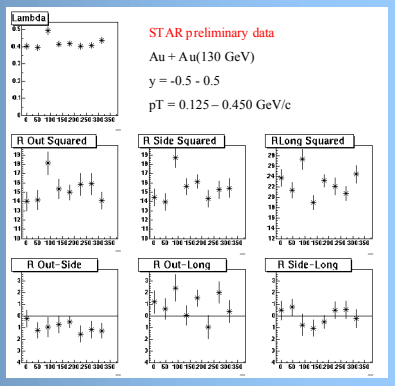
At the left is the second order reaction plane distribution with and without a phi acceptance correction. The correction is used to flatten the reaction plane distribution for a given collection of events[4]. STAR measures the second order reaction plane to within 25°.



Projections of Pratt-Bertsch parameterization of 3D pion correlations for pair emission angle relative to RP of 45^0 +/- 22.5^0. Black triangle are data and red circles are fit points.

Data is fit using the full 6 dimensional radii:

$$C = 1 + \lambda \exp - \sum_{i,j=o,s,l} q_i q_j R_{ij}^2$$



Shown above is the azimuthal dependence of the HBT radii.

Future

- Present analysis was done with most of the August run. Including the September data with increase statistics by at least 20%.
- Include Reaction Plane resolution effects
- Explore phase space

REFERENCES

1. M.A. Lisa and the E895 Collaboration Phys. Lett. **B496** 1 (2000).
- M.A. Lisa, U. Heinz, and U. Wiedemann Phys. Rev. Lett. **85**, 940 (2000).
- S.A. Voloshin, W.E. Cleland, Phys Rev C. **52**, 2694 (1995).
- C. Adler, et al, (STAR Collaboration) Phys. Rev. Lett. **86** 402 (2001).