Final Report on DOE GRANT DE-FG03-95ER40933
TAMU RF 8991
Kaon and Pion Interferometry

Michael Murray Cyclotron Institute Texas A&M University

December 11, 1998

Abstract

This report summarizes the work done under DOE GRANT DE-FG03-95ER40933 1998. The papers published are listed in the bibliography.

1 Major Achievements

Both NA44 and EOS continue to publish high quality data on relativistic heavy ion collisions. The next leap in energy will be provided by BRAHMS at RHIC.

1.1 Experiment NA44

Experiment NA44 has measured particle correlations of $\pi^{\pm}$, K^{+} and protons and single particle distributions of $\pi^{\pm}$, $K^{\pm}$, $p, \bar{p}, d$ and $\bar{d}$, see for example [1, 2, 3, 4] for pA, SA and $PbPb$ collisions at $450GeV/c$, $200A{\cdot}GeV$ and $158A{\cdot}GeV$ for the p, S and Pb beams respectively. When the spectra are fitted to an exponential in m_T, the inverse slopes increase as the system gets heavier and with increasing particle mass, [6]. For larger systems the baryon density at mid-rapidity increases [1] implying more secondary collisions. These fuel a collective expansion and a boost in transverse momentum proportional to the mass as seen in our data.

Hydrodynamic calculations show that radial expansion causes a strong m_T dependence of the HBT radii due to correlations between position and momentum. A decrease proportional to $1/\sqrt{m_T}$ was predicted and HBT measurements from NA44 have confirmed this, [3]. In a coalescence model a gaussian radius R_G can be extracted from proton and deuteron spectra, [5]. Figure 1 compares R_G with R_{side} from the 3 dimensional HBT analysis. (R_{side} reflects the transversal size.) Since R_G was obtained in a 1d analysis, it is divided by $\sqrt{3}$ for comparison. The radii fall as $1/\sqrt{m_T}$ but increase by $\approx 35\%$. from SPb to $PbPb$.

An alternative method of studying the system at freezeout is to simultaneously fit the one and two particle spectra to a hydrodynamical model. An expanding

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dose. Since we expect a dose of 1 KGr in 5 years of RHIC running we are confident that the ZDCs will not suffer significant radiation damage.

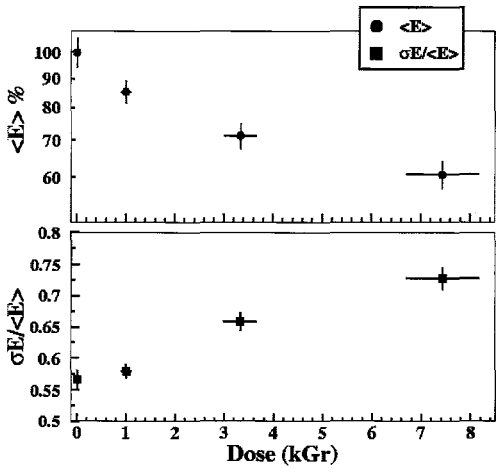

Figure 2: Mean signal and resolution for muons as a function of radiation dose.

Currently the calorimeters are under construction and we plan to ship them to BNL in January 1999 in order to be ready for the RHIC engineering run in March 1999. Although it is not expected that their will be $PbPb$ collisions at this time the calorimeters will detect beam-gas collisions which will be very useful for RHIC tune up.

2 Conclusions

The imminent startup of RHIC is a time of great excitement for the relativistic heavy ion community. A decade of work at lower energy is about to come to fruition. The simplicity and broad acceptance of the BRAHMS experiment will allow us to react quickly to glimpses of new physics. The TAMU group is ready to exploit this opportunity.

3 Talks

I have given the following talks this year.

- Proton Source Sizes & HBT Radii ACS Symposium in Honour of Kevin Wolf, Dallas Texas, March 1998
- Source Sizes, Spectra & Freezeout APS Division of Nuclear Physics meeting, Santa Fe, New Mexico, October 1998

References

[1] "Proton & Antiproton Distributions at Midrapidity in Proton-Nucleus and Sulphur-Nucleus Collisions" Bearden, I.G. et al.; Phys. Rev. C57 837 (1998)

[2] "Charged Kaon & Pion Production at Midrapidity in Proton-Nucleus and Sulphur-Nucleus Collisions" Bøggild, H. et al.; Accepted by Phys. Rev. C59 1 January (1999)

[3] "High Energy Pb+Pb Collisions Viewed by Pion Interferometry" Bearden, I.G. et al.; *Phys. Rev. C58* 1656 (1998)

[4] "Two-Proton Correlations near Midrapidity in $p + Pb$ & $S + Pb$ Collisions at the CERN SPS", Bøggild, H. et al.; Submitted to Phys. Lett. B, CERN preprint: CERN-EP/98-155

[5] Murray, M. "Protons, Deuterons & Flow" 3rd International Conference on Physics and Astrophysics of Quark-Gluon Plasma March, 1997, Jaipur

[6] "What Invariant One-Particle Multiplicity Distributions & Two-particle Correlations Are Telling Us About Relativistic Heavy-Ion Collisions" Nix, J. R. et al, Advances in Nuclear Dynamics 4, Proc. 14th Winter Workshop on Nuclear Dynamics, Snowbird, Utah, 1998 (Plenum Press, New York, 1998).

[7] "Multifragmention of the Remnant Produced in the Reaction of 1A GeV Gold with Carbon" Hauger, J.A. et al.,*Phys. Rev. C57* 764 (1998).

[8] "Dynamics of Radial Collective Energy in Near Central Collisions for 1A GeV Au+C" Lauret, J. et al,*Phys. Rev. C57* 1051 (1998).

[9] "Proposal to Build Forward Calorimeters for the RHIC Heavy Ion Experiments" qCal Collaboration,www.rhich.bhl.gov/~swhite/zcal/index.html August 1997,

[10] "The ZCAL Conceptual Design Review" Angelika Drees www.rhich.bhl.gov/AP/ap_notes/RHIC_AP_167.ps October 1998