INTERFEROMETRY RESULTS FROM Pb COLLISIONS AT 158 GeV/NUCLEON

WA98 Collaboration

(For a complete list of authors, see article "CERN WA98 Experiment.")

The study of Bose-Einstein correlations between pairs of identical hadrons is an essential tool to get information on the space-time evolution of extended hadron sources created in heavy-ion collisions [1]. In particular, a strong correlation between the momenta and the correlation radii deduced from HBT analyses of the particles suggests expanding sources as predicted by hydrodynamic models [2]. The dynamical evolution of such systems can then be studied with interferometry via selection on the transverse momenta and rapidity of the correlated particle pairs.

Figure 1 shows the Monte Carlo-generated p_T-rapidity acceptance for π^- in the WA98 spectrometer. The acceptance ranges from y = 2.1 to 3.1 with an average at 2.75. The momentum resolution of the spectrometer was $\Delta p/p = 0.005$ at $p = 1.5$ GeV/c, resulting in an accuracy of better than or equal to 10 MeV/c for all the Q variables used in the interferometry analysis; $\sigma(Q_{inv}) = 6.5$ MeV/c, $\sigma(Q_{TO}) = 10.0$ MeV/c, $\sigma(Q_{TS}) = 4.8$ MeV/c, $\sigma(Q_L) = 3.7$ MeV/c.

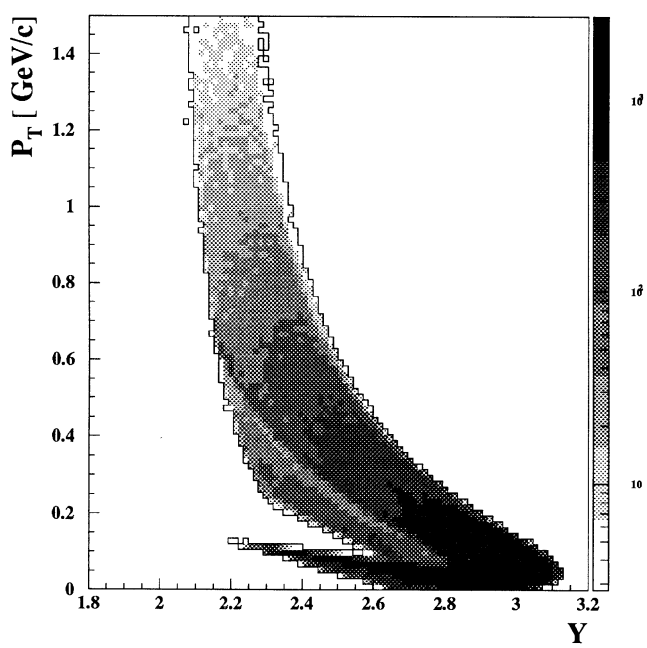

Figure 1: p_T-rapidity acceptance.

The one-dimensional $\pi^- - \pi^-$ correlation as a function of Q_{inv} is presented in Fig. 2 for central Pb+Pb collisions. The data were Coulomb corrected in an iterative way using code supplied by Scott Pratt [3]. The Gamov correction was abandoned since it overcorrects the

data for Q_{inv} in the range of 0.1 to 0.3 GeV/c. A fit of the form $1+\lambda\exp[-Q_{inv}^2 R_{inv}^2]$ was made to the Q_{inv} correlation function yielding $R_{inv} = 6.71 \pm 0.18$ fm and $\lambda = 0.274 \pm 0.013$. However, the Gaussian fit is not perfect, especially in the Q_{inv} range of 40 to 80 MeV/c where the tail of the experimental distribution shows an excess which is not well reproduced by the fit. Different radii are obtained for different starting points of the fit because the shape of the distribution is not Gaussian. This effect is independent of the severity of the track selection and is, therefore, not due to spurious tracks. As a function of increasing lower bound of the fit, there is a statistically significant drop of the extracted radius when using a Gaussian fit. A similar behavior is observed when, instead of Q_{inv}, $Q_3 = \sqrt{Q_x^2 + Q_y^2 + Q_z^2}$ is used, calculated in the longitudinally comoving system (LCMS) and fitted with $1 + \lambda\exp[-Q_3^2 R_3^2]$. If, instead, an exponential fit of the form $1 + \lambda_e\exp[-2Q_{inv}R_e]$ (where the factor 2 is added to make the radius R_e more comparable with R_{inv}) is used, the results show better stability. Figure 2 directly compares the Gaussian and exponential fits for Q_{inv}. Although the Gaussian fit still gives an acceptable χ^2/d.o.f., the exponential fit is better everywhere. A similar conclusion is reached when the first data point is excluded from the fit.

This quasi-exponential behavior is expected by different models including resonance decays [4]. As a consequence, small acceptance experiments may obtain a larger radius if a Gaussian fit is used because they are less sensitive to the high Q tail. On the contrary, large acceptance experiments have higher statistics at large Q values, and the Gaussian fit will yield lower values of the radius. Further analyses are in progress to study the correlations in multidimensions as a function of the transverse momenta of the pairs and as a function of centrality.

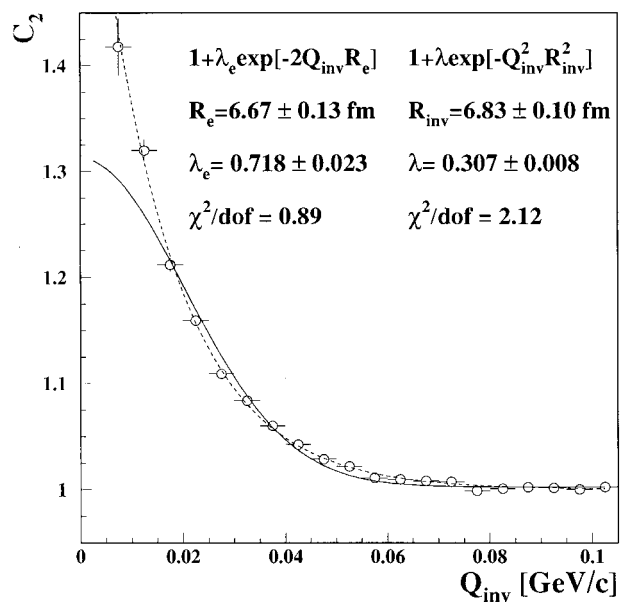

Figure 2: Q_{inv} distribution with the Gaussian fit (full line) and the exponential fit (dashed line).

[1] W. Zajc et al., *Phys. Rev. C* **29**, 2173 (1984), and references therein.

[2] T. Csörgő et al., *Phys. Lett. B* **347**, 354 (1995); T. Csörgő et al., *Phys. Lett. B* **338**, 134 (1994).

[3] S. Pratt et al., *Phys. Rev. C* **42**, 2646 (1990); these calculations were made with a Fortran program supplied by S. Pratt.

[4] S. Padula and M. Gyulassy, *Nucl. Phys. A* **525**, 339 (1991); U. A. Wiedemann et al., *Phys. Rev. C* **53**, 918 (1996).