Chapter 7. Conclusions

Proton rapidity distributions and transverse momentum spectra of hadrons at around the central rapidity have been measured for symmetric heavy-ion collisions S+S and Pb+Pb in NA44 at SPS. The nuclear stopping power was found to increase with the size of the colliding system by the amount of the observed stopped protons at mid-rapidity and the shape of the rapidity distributions of protons. We observed the systematic increase of the slope parameter with the particle mass and the colliding system, which had not seen in binary proton on proton collisions as seen from the summary plot of the fitted slope parameters. These phenomena are intuitively suggesting the hydro-dynamical transverse flow, which explains the measured slopes with one fixed freeze-out temperature and one fixed maximum flow velocity and the mass difference of the secondary particles for each colliding system. An increase between two colliding systems is explained by an increase of the flow velocity in this picture. We conclude that by using the symmetric collision from p+p, S+S to Pb+Pb, the existence of the higher degree of nuclear stopping power is proved at SPS energy and NA44 data are consistent with the following scenario that the high nuclear stopping power creates the large transverse flow in heavy ion collision and its increase with the colliding system.

Two particle interferometry measurements for pions and kaons with 200 AGeV/c S+Pb collisions are done around central rapidity. Measured transverse size of pion at high P_T region and that of kaon, where transverse momentum distributions are well explained by the same freeze-out conditions for all hadrons as mentioned above, are found to be similar and smaller than that of pion at low P_T region, where there is a large low P_T rise caused by the heavy resonances contribution. This is also consistent with the picture that the freeze-out happens at the same temperature and with the same transverse volume and the same transverse flow velocity for all hadrons, suggesting that a thermalization might be already achieved locally in the heavy-ion collisions and the locally thermalized fire ball is expanding collectively.

The cascade model RQMD reproduces the global trend of the M_T slopes and dN/dy for proton in the measured experimental data, although pion spectra at low P_T region deviates from the experimental measurement. This tells that the cascading process in the RQMD simulation makes the collective effect described by the hydro-dynamical model. This hydro-dynamical flow effect is found to increase with the size of the colliding system, because of the larger re-scatterings during the collisions caused by the higher baryon stopping at mid-rapidity in truly larger heavy-ion collisions.

Acknowledgements

The NA44 Collaboration thanks the staff of the CERN PS-SPS accelerator complex for their excellent work. We thank the technical staff at CERN and the collaborating institutes for their valuable contribution. We are also grateful for the support given by the Science Research Council of Denmark; the Japanese Society for the Promotion of Science, and the Ministry of Education, Science and Culture, Japan; the Science Research Council of Sweden; the US Department of Energy; and the National Science Foundation.

I would like to thank to Prof.M.Yonezawa and Prof.O.Miyamura for their helpful encouragements, to Prof.Y.Sumi, Prof.T.Sugitate and Dr.A.Sakaguchi for their continuous advices and discussions, to Dr.S.Nishimura for teaching me a lot about hodoscopes, to Prof.H.Boggild, Prof.C.W.Fabjan, Prof.T.Humanic, Prof.B.Jacak, Prof.B.Lorstad and Prof.W.Willis for their advices, to Dr.A.Franz for working with me in the experimental zone and counting house and for inviting me for party in his house, to Mr.K.Bussmann for his help on hardwares and spectrometer movement and for giving me several cups of coffee, to Mr.G.DiTore for his helping on electronics especially for DanPhysic high voltage, to Dr.G.Poulard for his managing the NA44 software, to Dr.F.Piuz and Prof.G.Paic for their skill to make TIC work, to Mr.N.Maeda for working with me on a lot of experimental works and living with me at St.Genis apartment and his skillful driving, to Dr.H.Kalechofsky for teaching me single particle analysis, to Dr.S.Pandey for teaching me two particle correlation and for inviting me to his wild party, to Mis.R.Jayanti for discussing with me a lot and for helping me to start up hodoscopes, to Dr.J.Dodd for climbing mountains with me, to Dr.J.Sullivan for teaching me RQMD and working with me on the tracking software and inviting me for dinner at his home several times, to Dr.H.van Hecke for teaching me database, to Dr.N.Xu for his helpful advices and for living and drinking and discussing with me about physics and life and oriental philosophy in the apartment at Los Alamos, to Dr.D.Fields for discussing with me several things, to Dr.J.Simon-Gillo for organizing analysis group, to Dr.M.Murray for his helpful discussions, to Dr.A.Miyabayashi for training me to do weight lifting, to Mr.A.Medvedev for helping me on the calibration and teaching me how to drink vodka, to Mr.M.Potekhin for discussions, to Mis.B.Holzer for teaching me how to climb a precipice, to Mr.M.Spegel for working with me on the tracking chamber software, to Mr.J.Sorensen for working with me on the TIC detector, to Mr.N.Matsumoto and Mr.H.Ohnishi and Mr.K.Kaimi for their help and discussions, to Mr.M.Kaneta for working with me on TIC software and for teaching me how to use scanner to make one on the figure in this thesis, to Mr.H.Shiota for working with me on TIC software and installing NA44 library into alpha osf and for proving us there is no difference between iteration and mapping if we do right, to all colleagues in hadron and high-intermediate energy laboratory for valuable and helpful discussions, to all my fiends who I have ever met for being as they are, to my parents and my sister and my grand mather and my relatives for their continuous support, and I would like to dedicate this thesis to my wife and coming our baby.

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