Hyperon production in p-Be interactions at 158 GeV/c per nucleon at the WA97 CERN experiment

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Synopsis

Strange particle production is one of the most useful probes of matter under extreme conditions of temperature and density. Due to the differences between quark masses in a Quark Gluon Plasma and hadron masses in a hadron gas scenario, there is a significant difference in the equilibration times for strange quark production under these two mechanisms. This difference in equilibration times will manifest itself in a much greater yield of strange particles from a QGP with respect to a hadron gas. It is believed that collisions of heavy ions at high energy may provide sufficient conditions for a QGP to be formed.

The aim of the WA97 experiment is, therefore, to investigate relativistic heavy ion collisions at the CERN OMEGA Spectrometer, following on from the work of the WA85 and WA94 collaborations. Using a lead ion beam from the CERN Super Proton Synchrotron and a lead target, data were taken in both 1995 and 1996. As a control, in the autumn of 1995, data were also taken using a proton beam incident on a lead target. In 1996 the control was changed to a proton beam incident on a beryllium target. Significant enhancements in strange particle yields had already been seen when going from the p-Pb data to the Pb-Pb data. However, the lack of symmetry in the p-Pb collisions could, in theory, give misleading results and so analysis of the more symmetric p-Be data was needed in order to confirm these enhancements. The analysis of the data from the 1996 proton-beryllium run therefore forms the basis of this thesis.

By observing the weak decays of the strange Λ, $\overline{\Lambda}$, Ξ^-, $\overline{\Xi}^+$, Ω^- and $\overline{\Omega}^+$ hyperons, the yields per interaction and transverse mass spectra can be determined. The results from the p-Be data are then compared with the results for the p-Pb and Pb-Pb data. The inverse slope parameters from the tranverse mass distributions give an indication of the temperature reached in the collisions, and a clear increase can be seen in this quantity as the size of the collision system increases. Yields are studied as a function of the number of nucleons participating in the collision, N_{part}, which is estimated using the Glauber model for the Pb-Pb data, and by averaging over impact parameter for the proton beam data. From the proton data to the Pb-Pb data, the yields per participant increase substantially. The enhancement is in agreement with QGP theory, in that it becomes more pronounced with the strangeness content of the particle, and exceeds an order of magnitude for the Ω.