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Energy dependence of negatively charged pion production in proton-proton interactions at the CERN SPS

Abstract

This thesis presents inclusive spectra of the negatively charged pions produced in inelastic proton-proton interactions measured at five beam momenta: 20, 31, 40, 80 and 158 GeV/c. The measurements were conducted in the NA61/SHINE experiment at CERN using a system of five Time Projection Chambers. The negatively charged pion spectra were calculated based on the negatively charged hadron spectra. Contribution of hadrons other than the primary pions was removed using EPOS simulations. The results were corrected for effects related to detection, acceptance, reconstruction efficiency and the analysis technique.

Two-dimensional spectra were derived as a function of rapidity and transverse momentum or transverse mass. The spectra were parametrised by widths of the rapidity distributions, inverse slope parameters of the transverse mass distributions, mean transverse masses and the total pion multiplicities.

The negatively charged pion spectra in proton-proton interactions belong to a broad NA61/SHINE programme of search of the onset of deconfinement of strongly interacting matter in collisions of light and intermediate-size ions. Spectra from this thesis were compared with the pion spectra in Pb+Pb collisions at the same beam momenta per nucleon measured by the NA49 experiment. The results, in particular the energy dependence of the mean pion multiplicity, support the interpretation of the onset of deconfinement in heavy ion collisions in the SPS energy range. However, unexpected similarities in energy dependences of the shapes of the spectra obtained in proton-proton interactions and Pb+Pb collisions are revealed.

Results presented in this thesis will serve for comparisons with other ongoing NA61/SHINE measurements of hadron production in p+p, Be+Be, Ar+Sc and Xe+La collisions. They widely extend the numerous, but mostly not detailed, low statistics existing p+p data.