Abstract

"Measurements of strangeness production in heavy-ion collisions in the NA61/SHINE experiment"

The primary goal of studying high-energy heavy-ion collisions at facilities such as the Super Proton Synchrotron (SPS), Relativistic Heavy Ion Collider (RHIC), and the Large Hadron Collider (LHC) is to investigate the properties of the quark-gluon plasma (QGP). Particularly, strangeness production in heavy-ion collisions is a long-standing and actively researched topic, offering crucial insights into the properties of strongly interacting matter.

This thesis presents a study of strangeness production in heavy-ion collisions, concentrating on Λ baryon production in central ^{40}Ar+^{45}Sc collisions. The data analyzed in this analysis was acquired by the NA61/SHINE experiment at CERN. The analysis was performed for three beam momentum values: 40A, 75A, and 150A GeV/c ($\sqrt{s_{NN}}$ = 8.77, 11.94, and 17.3 GeV, respectively). It is the first measurement of Λ baryon production in Ar+Sc collisions in the SPS energy range.

Λ baryons are neutral particles; thus, they are typically studied via their charged decay products. In this analysis, Λ baryons are identified by their weak decay channel $\Lambda \longrightarrow p + \pi^-$ with a branching ratio of 63.9%. The analysis is based on reconstructing the invariant mass of particle pairs considered as potential decay products. The results are corrected for losses due to the geometrical acceptance of the detector, reconstruction inefficiency, selections applied in the analysis, branching ratio and feed-down from the decays of heavier hyperons, using detailed Monte Carlo simulation. The quality of the analysis is confirmed by the dedicated checks, e.g., mean lifetime measurement.

The main outcomes of this thesis are the double-differential spectra of Λ baryons produced in central Ar+Sc collisions in rapidity-transverse momentum phase space as well as rapidity spectra and mean multiplicities. The obtained experimental results are compared with selected particle production models and available world data from proton-proton and nucleus-nucleus collisions.