

Abstract

"Nuclear fragmentation cross-section measurements and development of new beam detectors for future experiments"

This thesis presents the results of the research tasks conducted during the PhD study of the author. The main part of the thesis presents the result of the analysis of measurements of nuclear fragmentation cross-sections conducted by the NA61/SHINE experiment. The second part focuses on the author's involvement in the upgrade of the detector system during the Long Shutdown 2 in the CERN facility.

NA61/SHINE is a fixed-target experiment located in the North Area of the CERN Super Proton Synchrotron (SPS). NA61/SHINE physics program focuses on studying the QCD phase diagram and conducting a series of reference measurements for neutrino and cosmic-ray experiments. Nuclear fragmentation measurements are part of the experiment's cosmic rays program. The aim of the project is to measure the cross-sections for the nuclear fragmentation process of the light and intermediate nuclei. These are essential parameters in modeling the propagation of cosmic rays through the Galaxy. Cross-sections calculated in this work are charge-changing cross-sections for three beam ions: boron, nitrogen, and carbon at a beam momentum of 13.5A GeV/c. Cross-sections were calculated for interaction with two types of target carbon and polyethylene, and from the results, the cross-section for interaction with proton was calculated.

The second part of the thesis focuses on the development of new beam position monitors for the NA61/SHINE experiment. Detectors were developed and tested during Long Shutdown 2. Detectors are based on the single-sided silicon strip detector (SSD). Si strips produced by Hamamatsu (S13804) were used, where the pitch has a width equal to 190 μm . The detector's readout allows for saving waveform for each strip, and it is based on DRS4 chips. The detector was successfully used during three data-taking campaigns with the lead beam at a beam momentum of 150A GeV/c.

Both tasks were necessary in the context of preparation for measurements after Long Shutdown 2, which includes fragmentation measurements planned for autumn 2024.