Introduction

Since their discovery neutrino oscillations have become one of the most direct evidence of the fact that the Standard Model of particle physics is not a complete theory. Many of the parameters that control the phenomenon have been accurately measured by a variety of experiments, exploiting either the natural neutrino fluxes from the Sun and atmospheric cosmic rays or artificial ones produced by nuclear reactors or particle accelerators.
The Deep Underground Neutrino Experiment (DUNE) will be a next generation neutrino oscillation Long Baseline accelerator experiment. The experiment is set to reach new levels of precision, allowing for the first time a definitive measurement of the neutrino oscillation CP-violation and of the neutrino mass ordering.
DUNE will be composed of a Near Detector (ND) system located a few hundred meters from the neutrino source at Fermilab, and a Far Detector (FD) system composed of three multi-kiloton Liquid Argon Time Projection Chambers (LArTPC) located at 1300 km from the source. The ND system will be composed of three individual detectors: ArgonCube, HPgTPC (High Pressure gas TPC) and SAND (System for on-Axis Neutrino Detectin). While the first two will be movable and both based on Argon, the SAND design considered in this thesys (one of a few still in consideration) will take a totally different approach by implementing a modular Straw Tube Tracker (STT), integrating many different nuclear targets. SAND will also be the only detector in DUNE to re-use parts from an older detector: it will implement the electro-magnetic calorimeter, magnet and iron structure from the KLOE (K-LOng Experiment) detector.
SAND's main purpose will be to provide constraints on all the systematic uncertainties relevant for the oscillation analysis. These include measurements of interaction cross sections, physics and detector responses and neutrino flux spectrum, composition and spread.
One of the main tasks related to the flux measurements include beam monitoring: using the flux information from the ND measurements to spot potential anomalies in the beam production. The purpose of this thesis is to

study the beam monitoring capabilities of the SAND detector, via neutrino flux and detector simulations. The text is divided into five chapters:

- *Chapter 1*: Summary of the history of neutrino physics and its future prospects, and brief theoretical overview of the neutrino oscillation phenomenon;
- *Chapter 2*: Description of the DUNE experiment components and facilities and its physics goals;
- *Chapter 3*: Description of the SAND detector and its main purposes and experimental physics opportunities;
- *Chapter 4*: Overview of the software and data used for the DUNE neutrino flux and detector simulation;
- *Chapter 5*: Description, analysis and results of the beam monitoring study;