**A Search for Tau Neutrino Appearance with IceCube-DeepCore**

**Neutrino have been known to oscillate between the three flavors since the first discoveries two decades ago.Over that time, our knowledge of the parameters which govern these oscillations has improved significantly.The largest remaining uncertainties in the measurement of neutrino oscillations are those that govern the tau neutrino.In this thesis, a direct measurement of tau neutrino oscillations is performed with the IceCube Neutrino Observatory located in the ice deep beneath the South Pole.**

**The measurement of atmospheric tau neutrino appearance requires a precise understanding of backgrounds. In order to perform the measurement, improvements to the modeling of the detector noise have been performed, reducing the uncertainties in the noise model used in IceCube significantly. Additional improvements to the simulation efficiency investigated during this thesis reduce the computational requirements of atmospheric muon background events by more than three orders of magnitude. These improvements allow, for the first time, the use of simulation of background events in oscillation measurements performed by IceCube.**

**Using the DeepCore detector, a densely instrumented infill of IceCube located in the clearest ice of the Antarctic glacier, a new selection of events has been created in the search for tau neutrino appearance from atmospheric oscillations. Tau neutrino appearance and muon neutrino disappearance were measured imultaneously with the new sample from 5.6 to 56~GeV from data collected over a period of 968 days.The best fit values, $N^{CC}\_\tau=0.566^{+0.356}\_{-0.303}$ for the charged current exclusive channel and $N^{NC+CC}\_\tau=0.733^{+0.305}\_{-0.243}$ for the neutral current inclusive channel, improve upon previous measurements set by other experiments.**