**Thesis Outline**

A Study of Solar Neutrinos and External Backgrounds for the SNO+ Experiment

**1 Introduction**

A short introduction to the solar neutrinos, the already measured results and the demanding for precise measurements of the low energy solar neutrinos.

A short summary of the SNO+ phases and its goals for studying unknown neutrino properties.

**2 Neutrino physics**

2.1 Neutrinos as the Standard Model Particles

2.2 Neutrino Flavor Mixing and Conversion

2.2.1 Solar Neutrinos

2.2.1.1 Matter Effects

2.2.2 Atmosphere Neutrinos

2.3 Double Beta Decay

2.4 Current Status of the Neutrino Research

**3 The SNO+ Detector**

3.1 The SNO+ Detector

3.2 Physics Goals

3.3 Electronics

3.4 Optics

3.5 Calibration

**4 Reconstruction of the SNO+**

4.1 SNO+ Official Reconstruction Algorithms

4.1.1 Vertex Reconstruction

4.1.2 Energy Reconstruction

4.2 An Alternative Vertex Reconstruction Algorithm for SNO+

4.2.1 Ideas and Framework of the MultiPath Fitter

4.3 Reconstruction for the SNO+ Water Phase

4.3.1 Position-time Reconstruction

4.3.2 Direction Reconstruction

4.4 Reconstruction for the SNO+ Partial-fill Phase

4.5 Reconstruction for the SNO+ Scintillator Phase

4.6 Extracting Fitter Resolution by Using 16N Calibration

4.6.1 Vertex Resolution

4.6.2 Direction Resolution

4.6.3 Uncertainties

**5 Solar Neutrino Analysis**

5.1 A description of the SNO+ Data

5.2 Signal Extraction for Solar Neutrinos in SNO+ Data

5.3 Backgrounds

5.4 Wave-length shifter study

5.5 Results

**7 Towards the SNO+ Future Phases**

7.1 Partial-fill Analysis

7.2 Solar neutrinos in the scintillator phase

7.3 The light yield measurements of the Te-loaded scintillator samples

**8 Conclusions**