Prospects for the calibration of cosmics in SNO

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FIG. 1: View of the chambers from IUCF currently being tested at LBNL and to be assembled into a tracker configuration.

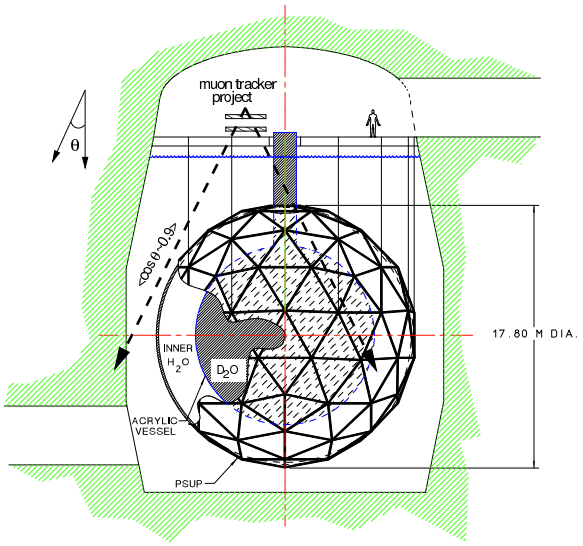

FIG. 2: Schematic view of the SNO detector and cavity 6800 ft underground. A proposal for the installation of a muon tracker is being discussed. Illustrated is a setup consisting of two chambers of approximate size 2.5×2.5 m^2 and 2 m apart.

Atmospheric neutrino studies in SNO require a good knowledge of the muons traversing the detector.

The track reconstruction algorithms currently in use have been developed out of a Monte Carlo simulation of muons that is assessed on regular data. Since no independent calibration data is available for cosmics the reconstruction of muons relies on the trust one has that the simulation effectively describes the quantities involved. In particular, it has been shown that biases as low as 2–3 degrees in the track direction reconstruction would significantly impair SNO's sensitivity to the atmospheric neutrino oscillation parameters [1].

The recording of a sample of cosmic muons as small as 100 events with an independent setup running in conjunction with the SNO detector would already suffice to confront the Monte Carlo predictions and measure significant angular or radial biases. On the other hand no energy measurement is considered, as it would require an important setup of equipment.

Tracking chambers previously used in test beam runs for high energy physics experiments (CDF, STAR) have been found at the Indiana University Cyclotron Facility (IUCF) and shipped to LBNL for suitability assessment. The chambers consist of an array of drift tubes filled with $ArCO_2$, as shown on Figure 1. Front-end electronics perform discrimination and preamplification in a single embedded chip. Based on the characteristics of these chambers, a proposal for the realization and installation of a muon tracker at SNO is currently being discussed in the SNO collaboration [2].

The space available on the deck above the detector at SNO is limited by various hardware and support structures. One candidate location on the deck distant from existing equipment has been identified that could accommodate such a tracking device. A strawman design consisting of two chambers of size 2.5×2.5 m^2 and mounted 2 m apart depicted on Figure 2 shows that impact parameters values covering the whole SNO detector assembly would be accessible. The flux of cosmic muons being strongly attenuated at SNO's depth — 6800 ft — a running period of 3 months or more is planned in order to collect large enough a sample, at a rate of 2–3 muons/day with the design under consideration.

The DAQ system will be essentially independent from the SNO one, sharing only the trigger timing information. Spare electronics parts from SNO can be directly integrated into the tracker DAQ system.

The current efforts aim at providing a work plan for deployment and operations of these chambers that would disrupt as little as possible the ongoing SNO data taking.

[1] C. Currat, communication to the SNO board (3/2005).
[2] C. Currat, J. Formaggio, and K. Lesko, SNO internal document (4/2005).