Sudbury Neutrino Observatory, Monte-Carlo Simulations and Data Analysis

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SNOMAN is the principal the Monte-Carlo simulation and data analysis program for the Sudbury Neutrino Observatory (SNO). The code is being developed by the many of the institutions participating in SNO. The LBNL group plays a major role in the development of this 110,000 line code and this effort has increased as our hardware responsibilities have been met.

One significant LBNL contribution to SNOMAN has been the graphical display package. During the past year we developed a user interface for SNOMAN using the Windows Motif package. The user interface will also help in the comparisons between different SNOMAN runs at different institutions, since it records all the run-dependent input parameters in a standard format.

Other LBNL contributions to SNOMAN have been made in photon transport, neutron code verification, detector geometry, input parameters for radioactive decay schemes and reaction cross-sections, and the generation, propagation and detection of high energy γ rays. The goals of these contributions have been to provide accurate and detailed treatments of i) backgrounds from radioactivity in the photomultiplier support structure and other components, ii) calibration sources, in particular the $^{16,\,17}N$ calibration sources which are being developed at LBNL, and iii) backgrounds generated from the cavity walls.

On the data analysis side several event fitters [1] are being developed using neural network, maximum likelihood and other techniques. The aim of these fitters is to reconstruct event position and direction as well as to provide some particle identification capabilities.

An analysis of MSW distortions of the charge current spectrum was made. It is clear that the experimentally favored 'small-angle MSW, or nonadiabatic' solution to the solar neutrino problem produces a measurable distortion of the charge current spectrum[2]. However, this distortion occurs mostly at low energies where it is obscured by n-capture events on deuterium. To remedy this problem we propose to introduce 30 Kg of ^{6}Li (in the form of lithium carbonate) into the D_2O in order to capture >99% of the free neutrons on ^{6}Li and reduce the rate of capture on deuterium by a factor >25 [3].

A 2 m diameter test detector was built in Seattle with 128 PMTs. The mini-SNO detector is used to test the electronics and DAQ system and also to exercise the MC simulation and analysis chain with real events from calibration sources which will be used in SNO[4].

Footnotes and References

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1. SNO-STR-95-042 Grid fitter for reducing tails in spatial distributions M.E. Moorhead and LBL-33634 Neural Network for Recognizing Cerenkov Radiation Patterns Dawei W. Dong, Y.D. Chan, M.T.F. da Cruz, A. Garcia, R.M. Larimer, K.T. Lesko, E.B. Norman, R.G. Stokstad, F.E. Wietfeldt, and I. Zlimen.

2. See also Bahcall, Krastev, Lisi IASSNS-AST 96/43

3. SNO-STR-95-056 Li-6 neutron poison for SNO M.E. Moorhead

4. SNO-STR-95-041 Mini-SNO geometry M.E. Moorhead, M.Isaac and K.T. Lesko