Sudbury Neutrino Observatory High Energy Event Analyses

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Although the primary goal of the Sudbury Neutrino Observatory (SNO) is the measurement of neutrinos from the Sun, there will be a sizable number of events from muons and neutrinos produced in the atmosphere. These events can help us check a number of features of the detector including detection efficiency, reconstruction and energy calibration.

During the air–fill runs, several days of data was collected to assist in the development of the DAQ, calibration, and general operation of the detector. In this data, several atmospheric muons were detected. In the air–filled detector, the muons produce arcs instead of the cone– or ring–like patterns that are expected in the completed detector. This is a result of two effects:

1. Cherenkov light is produced when a muon crosses the acrylic heavy water containment vessel (AV).

2. The angle for total internal reflection at the acrylic–air interface is smaller than the Cherenkov light angle.

Because this represents such an unusual detector configuration, automatic muon detection and reconstruction algorithms were not developed for the air–fill data. However, hand–scanning was employed to get an estimate of the muon event rate. In this manner, a number of muons were found, including one, at a zenith angle of $\sim 86°$, which was likely due to an atmospheric neutrino. Based on the data from the air–fill period, we estimate a muon flux of 1×10^{-10} muons $\mathrm{cm^{-2}s^{-1}sr^{-1}}$. Although this has not been corrected for the angular distribution of the events, the detector acceptance, or the detection efficiency, the measured flux compares reasonably well with the expected flux at 6000 meters water equivalent[1] of 5×10^{-10} muons $\mathrm{cm^{-2}s^{-1}sr^{-1}}$.

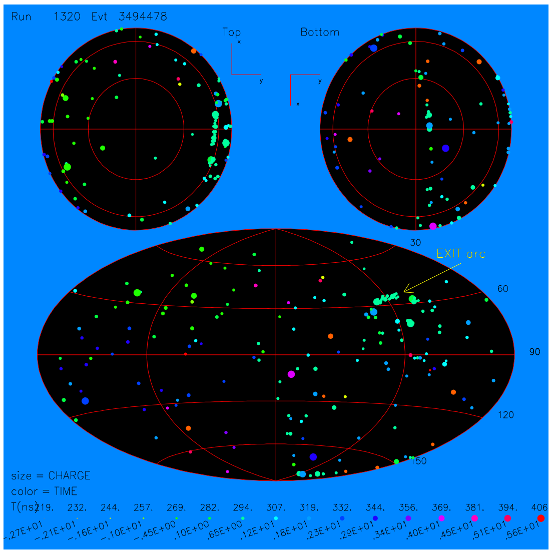

Figure 1: Event display of an neutrino-induced event. The lower half shows the sphere unrolled. A strong arc in the upper right of the unrolled sphere marks the muon exiting the AV. A diffuse arc passes from upper left to lower right and marks the muon entering the AV.

Data has also been collected during periods of partial water fill. Muon seen during this stage look much more like what will be seen in the final configuration. Hand–scanning was employed to extract muons detected during this time. These events are being used to develop and test detection and reconstruction algorithms being devised by the Berkeley group. There is a lot of variety seen among the muon event collected during this time because of the large range of pathlengths the muons can take through the water. The muon flux estimated based on the events collected in this stage matches the flux measurement in the air–fill.

Footnotes and References

[1] M. Ambrosio, *et al.*, Phys. Rev. **D56**, 1407 (1997).