Sudbury Neutrino Observatory, Development of the LED optical calibration devices mounted on the PSUP

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Various calibration devices are being designed and installed in SNO. These devices will calibrate the energy, timing, attenuation coefficients, scattering properties, and background properties of the detector. We propose an additional device based on a fast-pulsing blue LED to assist primarily in the time and geometric calibration of the detector. The electronic design is adapted from one originated at LBNL for the AMANDA project. Using the narrow beam of the LEDs we can investigate scattering and reflection properties of the acrylic and water media and serve as an important method of confirm the properties extracted from other sources with independent experimental uncertainties.

1. Electronical characteristics

For the test measurements two types of circuits were used: one was free-running which was used for the spectroscopy measurements and the second one with a trigger output signal. The self-triggering device had a frequency of 10.68kHz. The devices being provided for SNO will be triggerable. That is, SNO electronics can control the frequency (up to 1kHz) of the light output. All LEDs mounted on the PSUP will be controlled by the DAQ and SNO electronics.

2. Light spectroscopy

Scanning the light spectrum as a function of wavelength a non-pulsed circuit with a blue GaN LED was used. The average wavelength is 480nm. For the device tested we recorded $2.1 \cdot 10^7$ photons/pulse or $2.2 \cdot 10^{11}$ photons/sec. Due to the high number of emitted photons from the LED we propose to use neutral density filters to reduce the amount of light emission. The LED device will hold an optical filter 03FNG269 with a diameter of 2.54cm and a thickness of 0.3cm in front of the diode behind an acrylic window.

3. Mounting Positions for the PLEDs

The requirements for the PMT timing of the laserball reconstruction impose conditions on the placement of the PLEDs. The LED mounted on PSUP layer 9 (near south pole hub) is carrying a wide angle LED (45°) which allows us to cover the complete φ-range in a θ-range of about 0. *to* 0.6. The wide angle LED on layer 6 provides an overlap for the θ-range of layer 9 and provides an additional wide field of PMT subsets. This LED on layer 6 is distributing light within a cone of 45°. To avoid a focused spot location in a selected φ-area on the PMT array we will mount additional 30°-LEDs on the layer 6. The wide angle LED on layer 3 with a cone of 45° generates a large spot and provides a subset of calibration points on the lower hemisphere. Fig. 1 shows the LED spots in the Lambert projection of the PMT array.

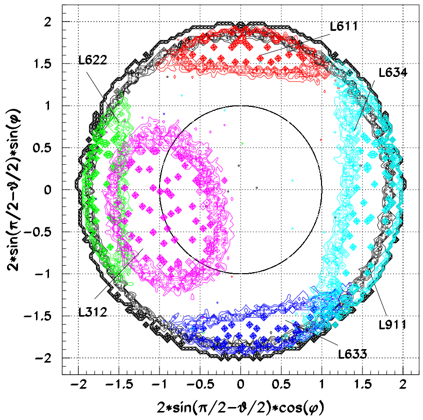

Figure 1: Lambert projection of the PLED spots

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