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Scintillator Phase Deployment of the 'Laserball' Optical Calibration Source in SNO+

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The SNO+ experiment is a multi-phase, kilotonne-scale neutrino detector located 2km underground at SNOLAB in Sudbury, Ontario. SNO+ has an extensive physics program, where the primary objective is a search for neutrinoless double beta decay ($0\nu\beta\beta$) in ^{130}Te. To achieve the physics goals, it is essential to have a thorough understanding and calibration of the detector response and optics.
The 12m diameter acrylic vessel (AV) is currently filled with 780 tonnes of liquid scintillator, linear alkylbenzene (LAB), doped with the fluor 2,5-diphenyloxazole (PPO). The detector is viewed by approximately 9400 photomultiplier tubes (PMTs) and surrounded by a shielding volume of ultra-pure water (UPW). In SNO+, a photon from a physics event is subjected to optical processes on its trajectory from the interaction vertex to the PMTs. These optical processes include scattering, absorption, and re-emission from the scintillator, acrylic, and external water; and reflection and refraction at media boundaries. Both the optical processes and PMT response are position, energy and wavelength dependent. An ideal optical calibration source, the Laserball, was developed, which produces quasi-isotropic light at well-defined wavelengths, and can be deployed throughout the detector.
The SNO+ scintillator Laserball, constructed from compatible materials, improves on predecessor designs. The earlier, SNO+ water phase Laserball measured the acrylic and external water attenuation lengths as well as the PMT angular response. Building from this, the scintillator Laserball measures the scintillator attenuation length and the PMT angular response. This talk presents the first deployment of the SNO+ Laserball in the scintillator phase, highlighting the hardware, scintillator optics and a contributing analysis.

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