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Using 60Co as a high precision calibration device for the SNO+ detector

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Is the neutrino its own anti-particle? The SNO+ detector at SNOLAB is set to join the international competition of experiments seeking to answer this fundamental question. Its sheer size –a 12 m diameter acrylic sphere holding 780 t of liquid scintillator containing more than 2 t of dissolved tellurium and observed by nearly 9500 photomultiplier tubes –puts SNO+ among those experiments with the best estimated sensitivity to observing the hypothesized rare process of neutrinoless double beta decay. Precisely understanding the signature of this decay in the detector is critical to making any statement regarding whether an operating SNO+ detector has indeed recorded a neutrinoless double beta decay signal. This requires an extensive calibration program. A suite of radioactive calibration sources are designed to investigate properties of the tellurium-loaded liquid scintillator. One such device already constructed contains 60Co, which decays with an output energy very near the total energy released in a 130Te neutrinoless double beta decay, making this calibration source invaluable in understanding this signal region of interest. The source is designed such that all 60Co decays are flagged, enabling the unique identification of calibration events. These events may assist in the study of subtleties of the optical properties of the liquid scintillator.

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