An In-situ Measurement of the SNO Neutral Current Detector Background

A. W. P. Poon, K. T. Lesko, R. G. Stokstad and the SNO NCD Collaboration

The SNO detector is sensitive to all flavors of neutrinos through the neutral–current (NC) channel:

$$\nu_x + d \rightarrow n + p + \nu_x.$$

By comparing the charged–current (CC) signal, which is contributed solely by ν_e, to this NC signal, the SNO detector can test the neutrino oscillation hypothesis in a model independent way. Because of the importance of this NC measurement, SNO has developed two independent techniques with different systematics for observing the free neutron: radiative capture on $MgCl_2$ salt added to the D_2O, and an array of ^{3}He proportional counters. Unlike the dissolved salt scheme, the NC and the CC events are recorded separately and can be distinguished event by event in the second method. This Neutral Current Detector (NCD) array consists of 96 strings of ^{3}He proportional counters deployed on a square lattice of 1 meter spacing. The body of the counters is made up of chemical vapour deposited (CVD) nickel, which has an ultra–low radioactivity. Each of these strings is a concatenation of one or more individual ^{3}He counters.

An *in–situ* experiment is being planned to measure the intrinsic U and Th contents of the NCDs. In this **C**onstruction **H**ardware **I**n–situ **M**onitoring **E**xperiment (CHIME) seven individual counters arranged in a close–packed configuration are deployed into the SNO detector. The radiopurity of these CHIME counters can be deduced from the β-γ signal originating from the counter bodies. These CHIME counters are constructed using the same material and techniques as the real NCD counters, although the designs are different in order to satisfy the negative buoyancy requirements of the CHIME counters. Because of this difference in mechanical design the CHIME counters are not active neutron counters. The construction of each of the individual counters in the septet is identical. One of these counters is shown in Figure 1.

We have made significant contributions to this CHIME experiment by designing the counters. We also performed a Monte Carlo study of "backgrounds" that are external to the CHIME measurement. These backgrounds include mis–reconstruction of β-γ events originating from the PMTs, the inner H2O, and the acrylic vessel of the SNO detector. The CHIME septet has been constructed and delivered to SNO.

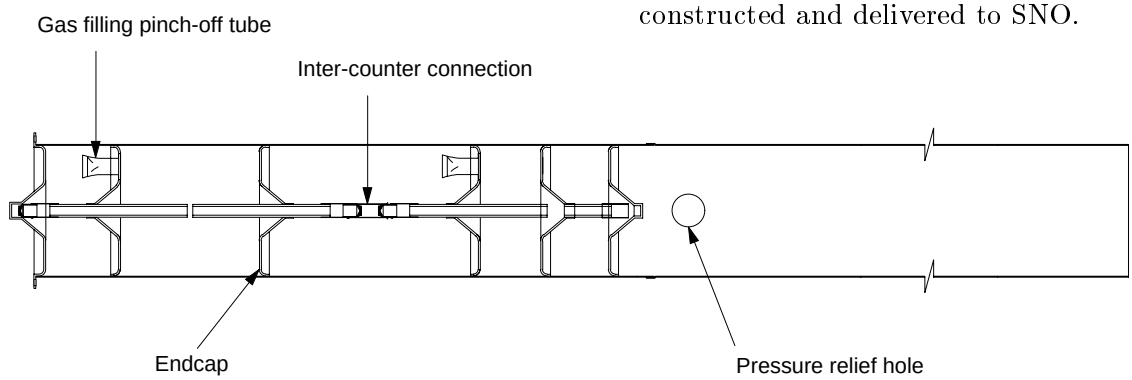

Figure 1: Side view of a CHIME counter. The length of this counter is ~45 inches.