The SNO ^{3}H$(p,\gamma)^4$He 19.8-MeV γ-Ray Source

A. W. P. Poon, Y. Kajiyama, K. T. Lesko, Y. D. Chan, X. Chen, A. D. Marino, E. B. Norman, C. E. Okada, Y. Opachich, S. Rosendahl and R. G. Stokstad

In order to understand the SNO detector's energy response at an energy beyond the ^{8}B solar neutrino endpoint, a 19.8-MeV γ-ray source was deployed. This pT source is the first self-contained, compact, and portable high energy gamma-ray source (E_γ >10 MeV) in the world and employs the $^3H(p,\gamma)^4He$ reaction to generate the high energy γ rays. Figure 1 is a picture of this source.

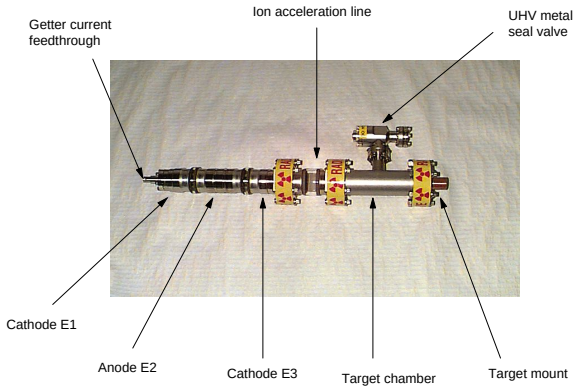

Figure 1: The SNO pT source. The permanent magnet for providing the axial field in Penning discharge is not shown this figure.

The detector response as modeled in the **SNO** **M**onte Carlo **AN**alysis (SNOMAN) program is tuned on the ^{16}N (E_γ = 6.13 MeV) calibration data. The systematic uncertainty of the linearity of the detector response is established by comparing the pT source data and the simulated response. Figures 2 and 3 show the correspondance between the pT data and the simulation. The systematic uncertainty on the charged-current and the elastic scattering reaction rates due to energy non-linearity are estimated at ±0.5% and ±0.4% respectively.

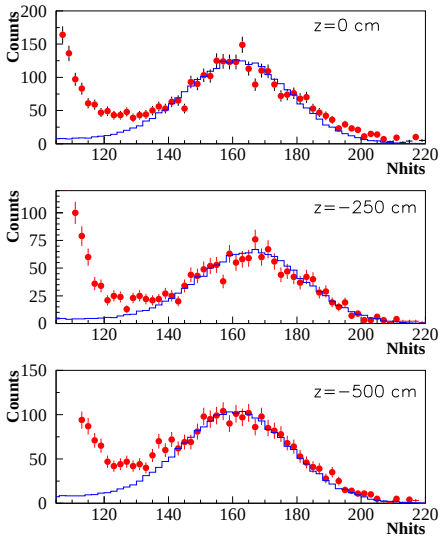

Figure 2: Comparing the pT data (data points) and simulated energy response at three different source positions (z=0 cm is the center of the detector). Nhits is the number of fired photomultiplier tubes in an event.

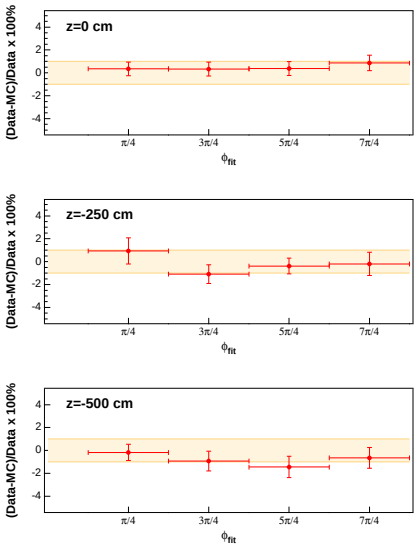

Figure 3: Fractional difference between the pT data and simulated energy response in different planar angle (θ=0) bins