SBN Progress – October 2016

Robert Cooper, William Louis, Geoff Mills, Keith Rielage, & Richard Van de Water

I. SBND Photon Detection System Mechanical Design

Figure 1 shows the latest design of the SBND Photon Detection System (PDS) with the readout ports above. The PDS has 144 TPB-coated Hamamatsu R5912 8" phototubes (PMTs). The PMTs will be grouped in 24 modules with 6 PMTs pe module. Figure 2 shows the latest design of a PDS PMT cable port. There will be 2 ports with each port having 80 isolated SHV feedthroughs. In the center of the port are 10 PDS calibration fiber optic feedthroughs.

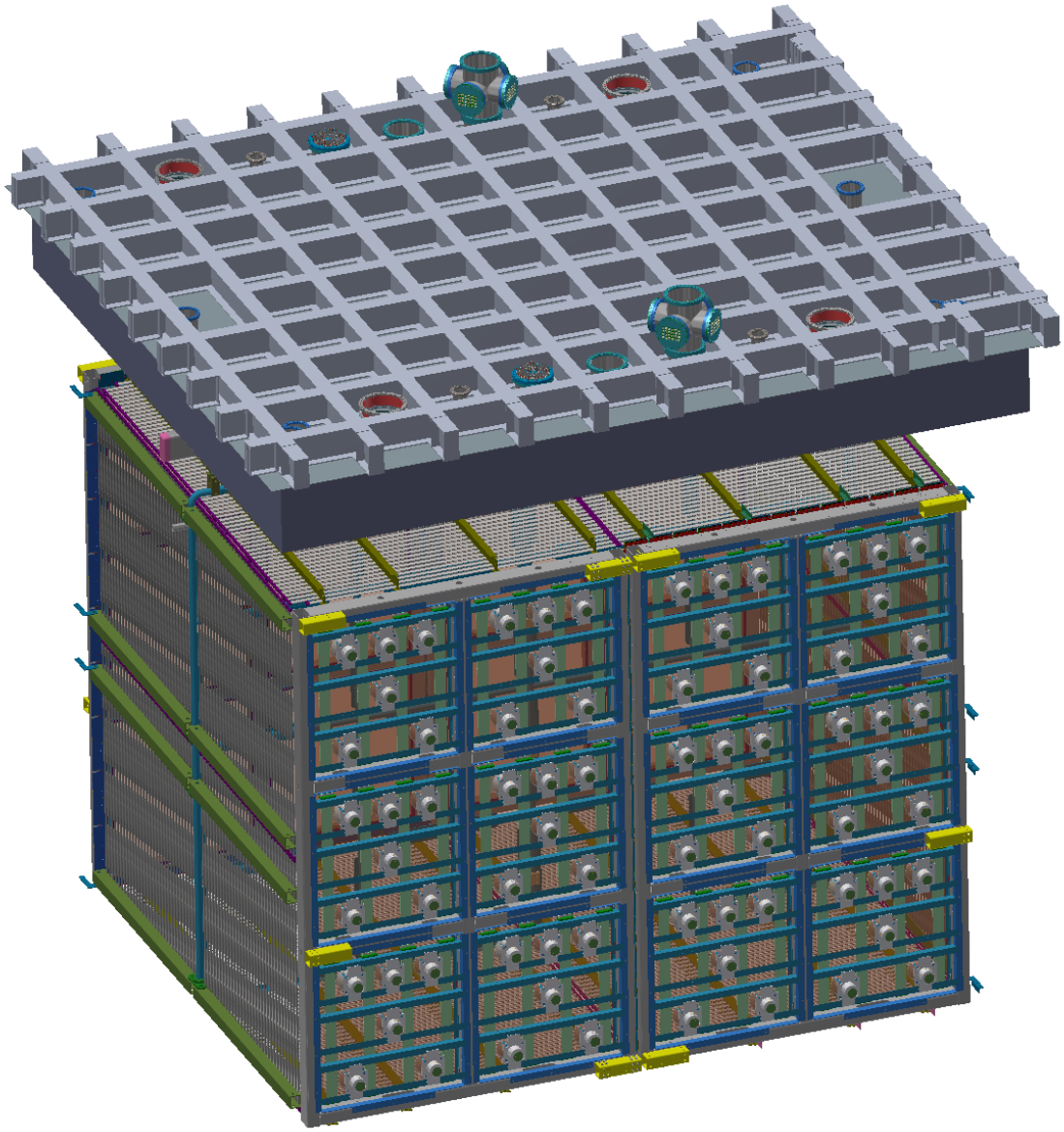

Figure 1: The latest design of the SBND Photon Detection System (PDS) with the readout ports above.

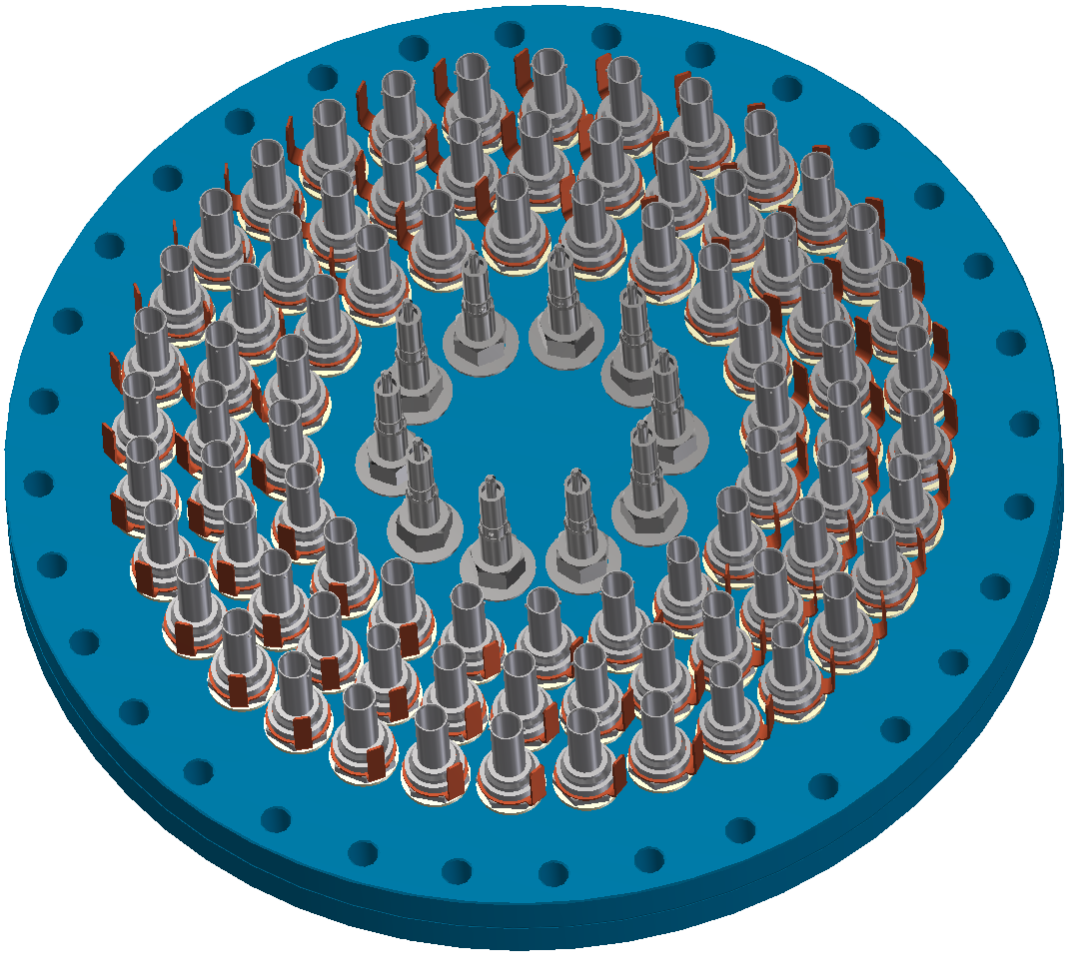

Figure 2: The latest design of a PDS PMT cable port. There will be 2 ports with each port having 80 isolated SHV feedthroughs. In the center of the port are 10 PDS calibration fiber optic feedthroughs.

II. SBND PDS DAQ

The PDS DAQ will readout CAEN VX1730 digitizer boards, which have 16 channels per board and operate at 500 MHz with 14 bit optical readout. Figure 3 shows the layout of the DAQ, where the digitizer boards will have direct optical link to

computers through A3818 PCIe cards. The VME crates will do no communication and will only provide power, monitoring, etc.

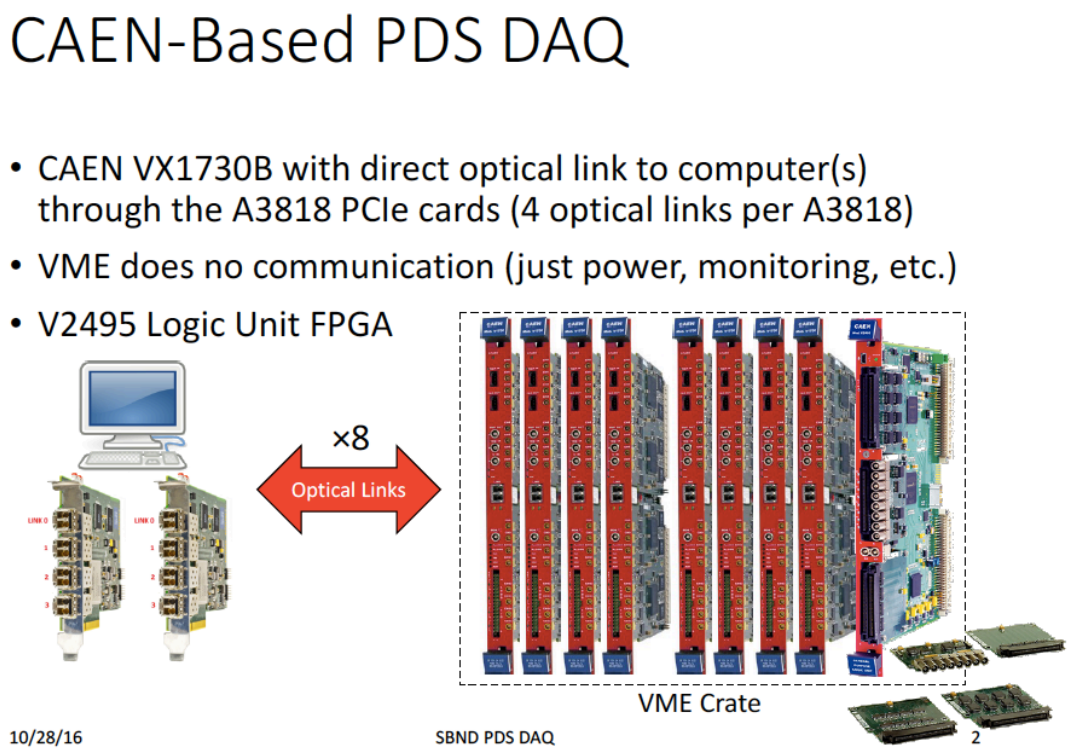

Figure 3: The layout of the PDS DAQ system.

III. SBND PDS Calibration System

The SBND PMTs will be calibrated by sending laser light by optical fiber to diffusers mounted on each side of the cathode plane. Figure 4 shows a preliminary design of the PDS calibration system, showing the location of the 5 diffusers on one side of the cathode plane (right) and a detail of one of the diffusers (left).

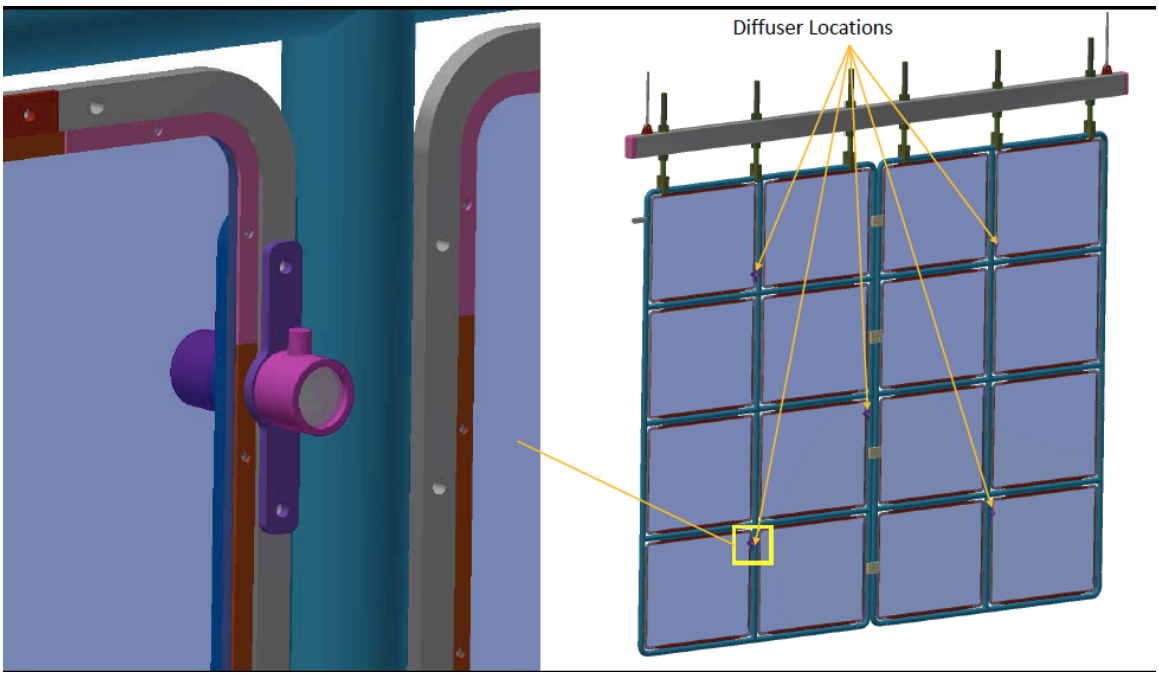

Figure 4: A preliminary design of the SBND PDS calibration system.

IV. MiniBooNE Search for Light Dark Matter

The MiniBooNE experiment reported first results at a Fermilab Wine & Cheese seminar on September 19, 2016 of its search for light dark matter from the beam-dump data run in 2013-2014, where dark matter particles can scatter off nucleons and electrons. The search employed a double ratio of neutral-current elastic events in beam-off target mode compared to beam-on target mode, divided by charged-current quasi-elastic events in beam-off target mode compared to beam-on target mode. As shown in Figure 5, no significant excess of events was observed. This allowed stringent limits to be placed on a leptophobic model for dark matter masses less than 1 GeV, as shown in Figure 6. Analysis is continuing on dark matter scattering into pion and electron final state channels, which will be significantly more sensitive to the recently completed nucleon channel. Results are expected in six months.

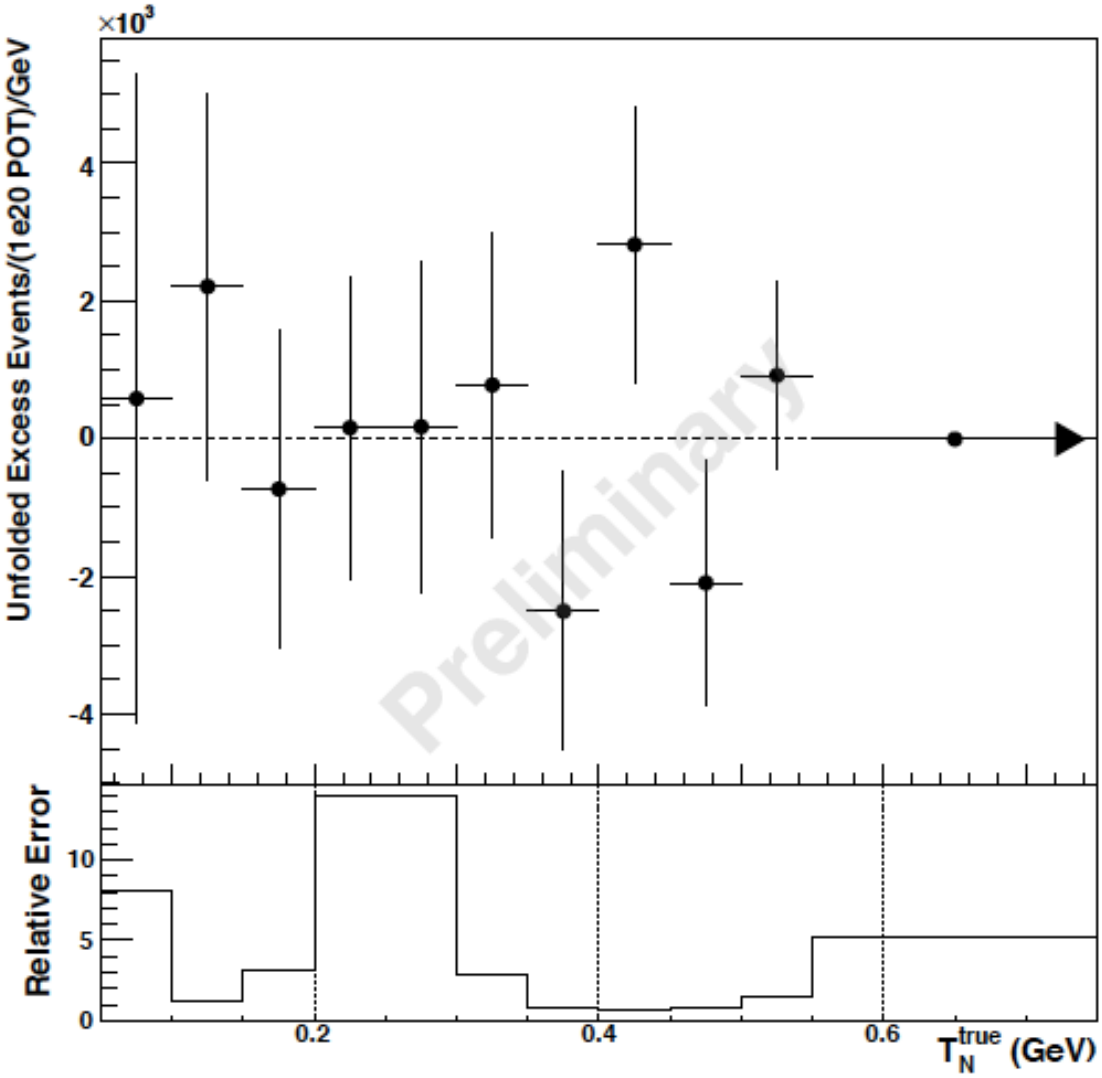

Figure 5: The excess of neutral-current elastic events as a function of recoil nucleon energy observed by MiniBooNE in its beam-dump run.

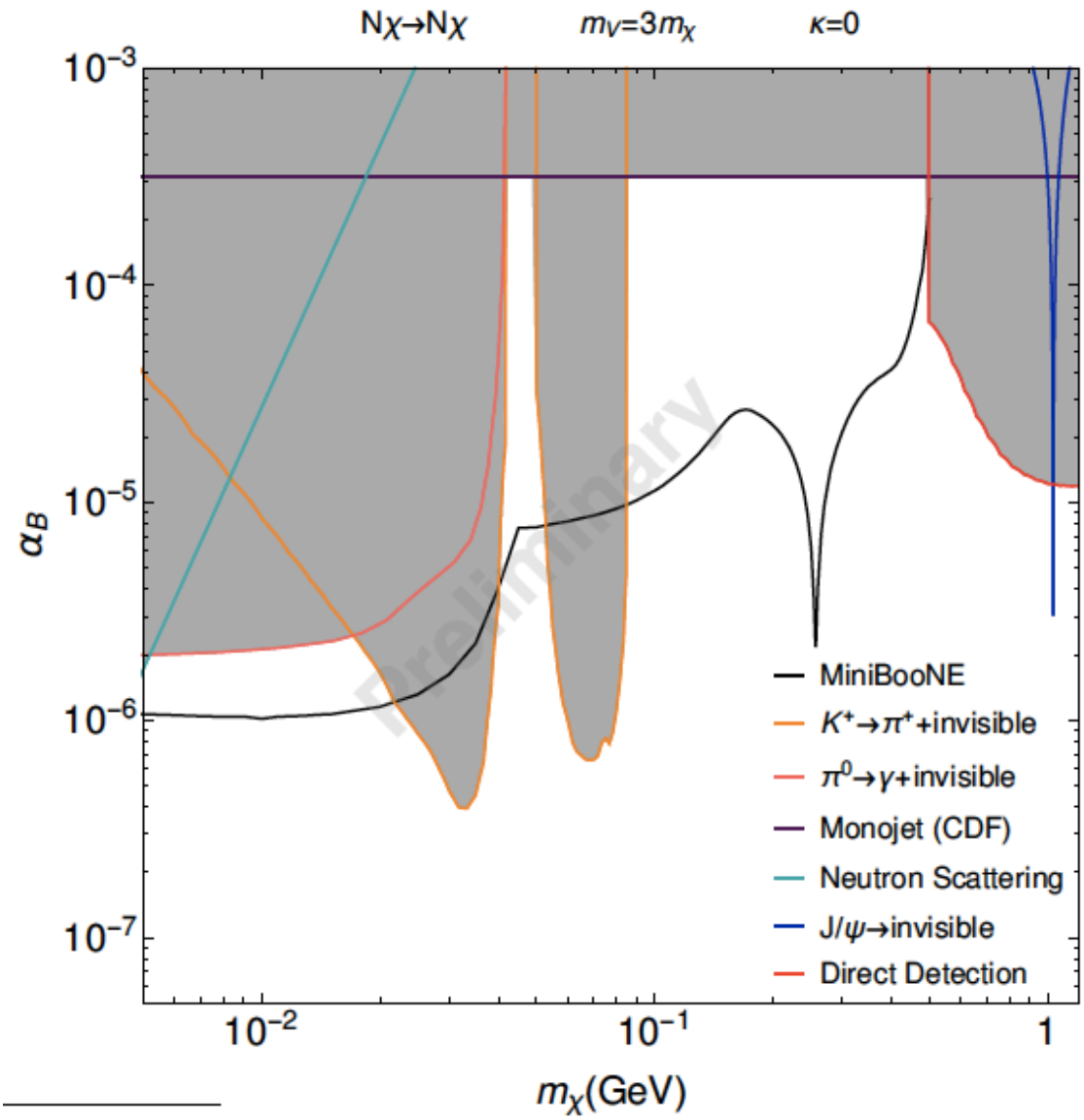

Figure 6: Limits placed by MiniBooNE's beam-dump run on a leptophobic model for dark matter masses less than 1 GeV.