

Dec. 11, 2005

Kevin Lesko
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South Dakota Science and Technology Authority
P.O. Box 8329, Rapid City, SD 57709

Dear Kevin,

In response to the SDSTA request for initial response letters we would like to provide the following information relating to the mini-CLEAN experiment.

Title of your proposal: Mini-CLEAN

List of participants:

Daniel McKinsey, Yale University
Ed Kearns, Boston University
Andrew Hime, Los Alamos National Laboratory
Kevin Coakley, National Institute of Standards and Technology
Mark Boulay, Queen's University

It is expected that additional groups will also be involved by the time we are ready to bring mini-CLEAN underground. In particular we would welcome groups that are familiar with Homestake, as well as groups interested in designing and building the room temperature shielding required for mini-CLEAN.

A brief description of your proposed program:

CLEAN is a detector concept based on roughly 100 tons of liquid neon viewed by immersed photomultipliers, with the goal of simultaneous real-time measurement of the pp neutrino flux and a search for WIMP dark matter. A staged approach to CLEAN is clearly necessary to properly establish the engineering design for a full-sized CLEAN. For this reason, we plan to first build an intermediate-sized detector (dubbed mini-CLEAN), containing 100 kg of liquid neon or liquid argon. From Monte Carlo simulations and preliminary measurements confirming excellent pulse-shape discrimination between gamma rays and nuclear recoils, it appears that mini-CLEAN will also be highly sensitive to WIMP dark matter. The capability to exchange scintillation liquids in mini-CLEAN will allow better understanding of radioactive backgrounds and different sensitivity to WIMP dark matter. Exchanging the active cryogenic liquid would require essentially no modification in the experimental hardware, as the same photomultipliers, wavelength shifter material, and refrigerator could be used with each of these liquids.

A rough estimate of your space requirements and specific or unusual tech-

nical issues involved in your proposal:

A total of 1000 square feet of clean (class 10,000) laboratory space would be required for both the mini-CLEAN dewar and associated equipment, including gas handling systems and electronics.

The most natural approach to shielding mini-CLEAN from radiation from the cavern would be by immersing the dewar in a large water tank. This tank would be cylindrical, with a diameter of roughly 15 feet and a height of about 16 feet. The mini-CLEAN dewar would be lowered into the water tank with a 2-ton crane, and 24 feet would be needed from the bottom of the crane hook to the laboratory floor in order to fully remove the dewar from the water tank. We are investigating the possibility of instrumenting the water tank to allow it to serve as an active veto for fast neutrons, perhaps augmenting the gamma energy from neutron capture by doping the water with boric acid or gadolinium trichloride.

In mini-CLEAN, the dewar will have a 10-cm diameter tube leading from the liquid neon volume. Should the neon overpressure, a burst disk would break, and the neon would be removed from the experimental area through an evacuation tube. Design of the neon evacuation system will be the subject of a detailed engineering study before installation in Homestake. The 100 kg of liquid neon contained in mini-CLEAN corresponds to about 4000 cubic feet of neon gas.

An estimate of when you will require access to the underground facility:

We plan to commence construction of mini-CLEAN at Yale University in Summer 2006. Following initial testing at the surface, we would begin building the infrastructure and shielding at Homestake in late 2007, followed by commissioning of mini-CLEAN underground in mid-2008.

Any other general requirements or questions for the experiment, research, or outreach activities:

Office space would be required above ground. The mini-CLEAN collaboration would like to be actively involved in the wider physics/outreach mission of the new Homestake lab.

Sincerely,

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