from: XENON COLLABORATION

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RE: INITIAL RESPONSE LETTER HOMESTAKE DUSEL
XENON COLLABORATION

Dear Kevin,

In response to the SDSTA request for initial response letters for proposed experiments at Homestake we would like to provide the following information relating to future evolution of a liquid Xenon (LXe) based dark matter search experiment. The XENON Collaboration is currently constructing a 10 kg fiducial LXe detector at Gran Sasso National Laboratory, Italy, that will begin operation and a search for dark matter in early 2006. The experiments discussed below would be larger scale 100-1000 kg LXe based detectors that could be located at the 4850 ft level at Homestake in 2007/8.

Title of your proposal: XENON100/1000

List of participants: (partial) It is expected that the signatories to this letter (XENON10 Collaboration) will be closely involved in the next generation experiments. It seems probably that given the likely scale of these proposed projects that additional groups will also be involved in the future program.

A brief description of your proposed program:
The XENON experiment's main goal is to search for signals arising from WIMP (weakly interacting massive particle) recoil events in a liquid xenon target. A total target mass of up to 1000 kg would permit clear WIMP detection for candidates with a normalized WIMP-nucleon interaction cross-section as low as 10^{-46} cm, which correspond to ~1 events/100 kg/year in a LXe target (with a threshold of 16 keVr). This would permit a search of the parameter space that is strongly favored by Supersymmetric Models.

A rough estimate of your space requirements and specific or unusual technical issues involved in your proposal:
The total volume for the 1000 kg of fiducial LXe is relatively modest at ~0.35 m^3. The space requirements will be dominated by the low background shielding required to reduce the external gamma and neutron fluxes incident on the fiducial detector volumes. With current detector designs a single 100 kg detector would be enclosed by a 2.5 m x 2.5 m x 2.5 m shield (external dimensions) constructed of Pb and Polyethylene. (Additional LXe adjacent to the fiducial region, and plastic scintillator surrounding the passive shielding are also employed for background rejection, acting as anticoincidence vetoes.) The building for housing a single 100 kg detector and shield would be 6 m x 6 m x 7 m. One way of achieving a 1000 kg fiducial mass would be to replicate 100 kg detector modules within a single shielded volume.

The total footprint of the shield would be ~10 m x 8 m x 3 m height. The building (which would permit environment control ~ class 2000-5000) in which a shield that could accommodate 10x100 kg modules would be housed would be ~14 m x 12 m x 7 m height. A crane of ~5 tonnes rating would be required to manipulate the shield components.

A possible alternative is the use of a water shield (instead of Pb/Poly). This could be constructed at lower cost than the conventional Pb/Poly shield, however, additional studies still need to be completed to look at the feasibility of this solution. In this case, a cylindrical tank of the order of 12 m diameter, with a depth of 10 m would be required to house up to 10 detectors.

Additional staging areas below ground would be required for detector assembly, servicing, and xenon gas recirculation (purification and krypton removal). Also huts for electronics, cryogenics and analysis huts. This would require an addition 150 m^2 of space.

Backup systems would be in place to ensure that the LXe (-100 degC) could be recovered and kept in liquid form, in the event of a power outage. However, a full safety analysis would be necessary focusing on the possibility of a significant fraction of Xe liquid being released into the caverns. 100 kg of liquid Xe corresponds to ~20 m^3 of heavier-than-air gas.

An estimate of when you will require access to the underground facility
The existing XENON10 detector is expected to be operated through 2006 and possibly part of 2007. Funding proposals for future XENON experiments would be expected to be submitted before Sept. 2006, and so construction could begin in 2007, with operation expected in 2008.

Any other general requirements or questions for the experiment, research, or outreach activities.
Staging and office areas would be required above ground. The collaboration would wish to be actively involved in the wider physics/outreach mission of the new Homestake lab.

Yours sincerely,

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