EXCERPT

Physics Advisory Committee

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Comments and Recommendations

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The composition of cosmological dark matter is one of the outstanding mysteries in physics today. Such a particle might produce low-energy nuclear recoils in bulk matter, and several experiments have searched for this signature using a variety of techniques. The Laboratory has provided support to the CDMS experiment, which looks for recoils in cryogenic Ge and Si. CDMS has been extremely successful, and currently provides the best limit on dark matter cross sections. However, Supersymmetry provides a natural dark matter candidate (the SUSY Lightest Supersymmetric Particle) that could require a ton-scale experiment to produce a measurable event rate. Various alternative technologies for dark matter searches, which might be practical on a ton scale, are being pursued in the community.

The Committee heard a presentation on COUPP (Chicagoland Observatory for Underground Particle Physics). This effort of the University of Chicago and Fermilab, currently working as T-945, together with Indiana University/South Bend, is developing a WIMP detector based on a heavy liquid bubble chamber (currently CF_3I). Excellent progress has been achieved in the past year. The bubble chamber is inherently insensitive to electrons, and the collaboration has achieved a minimum-ionizing-particle rejection factor of $>10^9$, operating with a 2-kg chamber in the NuMI tunnel. A good effort is underway to reduce the limitations imposed by background radioactivity. The high spatial resolution of this approach is very powerful. This effort is currently focusing on producing competitive sensitivity, especially on spin-dependent couplings, a particular strength of this technique. However, they need, at the same time, to address the needs for the large one-ton chamber to remain competitive with other approaches.

The group has proposed to Fermilab to build a 60-kg chamber, which could achieve competitive spin-independent sensitivity, and give information on the background rate, as well as experience in background reduction needed to assess scalability to one ton. Significant resources are requested from the Laboratory to realize this plan. The physics goals are compelling, and the technology looks very promising. The Committee notes that several related efforts are also underway, and are being formally reviewed by the HEPAP Dark Matter Scientific Assessment Group. It is advisable for Fermilab to be cognizant of these other approaches.

The Committee recommends that the Laboratory provide the resources requested for the modest initial phases of this promising effort on WIMP detection. The proposed effort for FY07 is well fleshed out, while the plan for FY08 will need input from the FY07 results. The proponents should be encouraged to report progress as input to decisions about future support from the Laboratory.