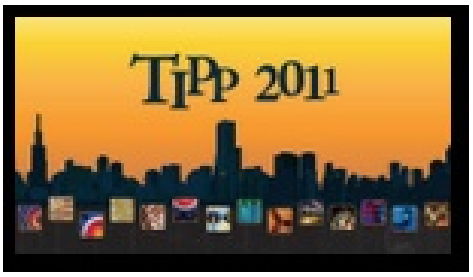

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Large Diameter Cryogenic Germanium Detectors for Dark Matter Direct Detection Experiments

Saturday 11 June 2011 16:00 (30 minutes)

Weakly Interacting Dark Matter (WIMP) interactions with ordinary matter are characterized by very low rates and extremely low energy depositions. A leading technique in dark matter detection is the use of cryogenic single-crystal Germanium (Ge) detectors that simultaneously measure the crystal lattice vibrations (phonons) and ionization produced by nuclear recoils. To increase the sensitivity of future experiments, we have investigated the use of 100mm diameter 33mm thick Germanium crystals that significantly increase the target mass per crystal. High purity Ge crystals of this size have been obtained in both [100] and [111] orientations. The detector readout is obtained by photolithographic deposition of phonon sensors and charge collection electrodes on the two faces of the Ge crystal. Commercial semiconductor fabrication equipment has been modified to accommodate these large detectors and the first such detector has been fabricated with ionization electrodes to study the charge collection properties in large Ge detectors. The performance of this detector at the base operating temperature of 50mK has been characterized using a dilution refrigerator equipped with mechanical and readout systems adapted from those used by the Cryogenic Dark Matter Search (CDMS) experiment. Preliminary results on the charge collection properties of this detector will be reported and future plans for the development of large diameter cryogenic Germanium detectors will be described.

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