

Final Report on Project “Ton-scale Germanium: Beyond Zeptobarn WIMP Cross-section”

The DOE CAREER proposal primarily focused on establishing a modern semiconductor detector fabrication facility that would provide significant improvement in the cost profile and performance of the cryogenic semiconductor detectors used by the CDMS experiment so as to enable a next generation ton-scale experiment. The proposal also included significant work on performing data analysis on the Soudan experiment.

This final project report details the outcome of this funded project.

1) Demonstration of dramatically improved detector performance, cost of fabrication and throughput compared to the CDMS project. This has been documented in the NIM article: ***CDMS Detector Fabrication Process and Recent Improvements – Published in NIM A772 (2014) 14-25***

2) The success of the dedicated fabrication facility established by the PI has allowed the group to develop and fabricate the SuperCDMS SNOLAB detector payload jointly with SLAC. The TAMU group will produce 1-2 towers worth of detectors, with the exact number to be determined based on the project needs, schedule and available funding.

3) The data analysis effort on the CDMS experiment in Soudan produced a world first search for Lightly Ionizing Particles (LIPs) with fractional charges well below 6, the lowest charge searched thus far. This work was published in Physics Review Letters: ***First Direct Limits on LIP with electric charge $< e/6$ – Published in Phys. Rev. Lett. 114 (2015) 11, 111302***

4) The detector development effort at TAMU has produced cutting edge detector performance for high voltage detector, with the demonstration of world-best energy resolution of 7 eV in a large mass Ge detector. This work has been submitted for publication: ***Toward Single Electron Resolution Phonon Mediated Ionization Detectors – arxiv:1510.00999***

5) The group is investigating use of such ultra-low threshold detector technology in other related HEP experiments, in addition to the primary goal of performing low-mass WIMP search as part of the SuperCDMS SNOLAB project.