

Fermi National Accelerator Laboratory LDRD Project Data Sheet - FY16

Project ID: FNAL-LDRD-2016-004

Project title: Development of an ultra low energy threshold particle detector

Principal investigator: Javier Tiffenberg

Project description: (short description and explanation of cutting edge, high-risk, high-potential science or engineering)

This project is to develop a CCD-based detector with an energy threshold near the silicon band gap (1.1 eV) and a readout noise of 0.1 electrons using a new generation of “skipper CCD” already developed by LBNL. The project will develop the capabilities to make use of the device as a particle detector.

Tie to Mission: (explain the project’s relevance or anticipated benefits to Fermilab’s and DOE’s missions)

If successful, the development of the readout of the ultra low energy threshold particle detector could probe low mass dark matter candidates, push sensitivity of coherent neutrino-nucleus interactions into new regions of parameter space, allow for measurement of low-energy nuclear recoils at unprecedented levels. All of these explorations are consistent with the laboratory mission of scientific research.

Previous year’s accomplishments: (as applicable) An instrument has been built incorporating the skipper CCD. A paper has been accepted for publication in PRL. Measurements have shown a breakthrough in readout noise from a typical 3.5 e value in a standard CCD to 0.06 e in a skipper CCD. Installation of the detector underground in the MINOS tunnel has been accomplished and background rates have been measured.

Work proposed for current fiscal year and anticipated / desired results:

The skipper CCD and the measurements show a breakthrough result that has attracted over a \$1M award from a private foundation to proceed to a post-LDRD phase of the project to build a larger, more massive detector.

Project funding profile: (costs, budgets, projected budgets, and total)

Prior year(s) costs	FY16	FY17	FY18	Total
N/A	72,237	96,543	13,000	181,780

Project Start Data: 1/01/2016

Total Approved Project funds: \$ 182,198(*)

(*) includes approved authorized \$25,000 budget increase