

**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) FY15, not applicable

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

The work proposed includes producing a prototype system to allow for benchmarking performance and to begin the optimizations required to maximize the performance of the devices. This work will proceed using existing CCD testing capabilities. A next step would then to be design and fabricate a custom flex circuit to provide appropriate packaging for the skipper CCD in an experimental configuration. Optimization using different amplifier designs will be performed along with testing and characterization using x-rays from an iron source. The final steps that continue into FY17 will be to install the apparatus in a configuration in the MINOS underground cavern where there is some suppression of cosmic particles and the opportunity to operate the newly developed detectors in a typical experimental environment. Results will be published and presented at scientific and instrumentation conferences.

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

<b>Prior year(s) costs</b>	<b>FY16</b>	<b>FY17</b>	<b>FY18</b>	<b>Total</b>
N/A	71,881	85,317	--	157,198

Project Start Data: 1/01/2016 Total Approved Project funds: \$ 157,198