Fermi National Accelerator Laboratory
LDRD Project Data Sheet - FY17

Project ID: FNAL-LDRD-2017-028
Project title: Increasing the photon detector light efficiency in a liquid argon detector by an order of magnitude
Principal investigator: Gustavo Cancelo

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

This proposal seeks to achieve a photon detection efficiency higher than 1% in LAr scintillating detectors using a novel light trapper and active ganging structure of silicon photo-multiplier devices (SiPMs).

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

The photon detection efficiency is a key parameter that determines the degree of science to be obtained by a liquid argon detector. This R&D will look at a novel option to improve the photon detection light efficiency compared with baseline technologies selected for the DUNE project. If the high efficiency can be demonstrated, there can be improvements in selecting non-beam events for proton decay and supernova.

Previous year's accomplishments: (as applicable)

A data collection run was made using the TallBo cryostat where both ARAPUCAs and light collection bars were inserted. This allowed many measurements including one showing a gain of 4.5 with ARAPUCAs. Work was done on active ganging of SiPMs and measurements with 48 SiPM show good discrimination of the 1st and 2nd photoelectron peaks with room for improvement but no significant degredation in S/N.

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

The key result of the LDRD is that ARAPUCAs and active ganging will go into the DUNE TDR as the high risk project becomes programmatic. There are a few final tweaks of the disgn and ganging to obtain a better idea of what an implemented real detector would give in performance.

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

Prior year(s) costs	FY17	FY18	FY19	Total
N/A	128,374	127,971	100,000	356,345

Project Start Data: 3/01/2017 Total Approved Project funds: $ 400,000