

**Fermi National Accelerator Laboratory
LDRD Project Data Sheet - FY17**

Project ID: FNAL-LDRD-2017-011

Project title: LArCADE: Liquid Argon Charge Amplification Devices

Principal investigator: Dr. Angela Fava

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

The LArCADE Project aims at exploring the possibility to dramatically lower the energy threshold of liquid argon TPC detectors by a factor 100, making them sensitive to energy depositions of O(10 keV). The proposed approach is to multiply electron charge, generated by ionizing particles passing through liquid argon, directly in liquid at the end of the drift path. The feasibility of this idea will be investigated by:

- identification, through simulation, of the requirements for needle tip structures to generate the electric field needed for multiplication;
- experimental characterization of the behavior of the tips in liquid argon, exploiting small drift chambers available at Fermilab and properly modified.

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

Provided that the multiplication will be observed, the final deliverable will be the design of an anodic plane with Micro-Strip electrodes to be applied to LAr-TPCs in place of the conventional wire-array plane. This would lead to a new generation of detectors, to be used in Dark Matter and low energy neutrino experiments, as well as in many interdisciplinary applications.

Previous year's accomplishments: (as applicable)

N/A. The project is waiting for a post-doc to be hired before starting. Some initial work has been done to investigate whether quality tips can be manufactured in-house.

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

Simulation work using COMSOL will be performed to determine starting parameters for the design of the needle tip. Sub-micrometer tips will be fabricated and measured resulting in a selection of tips to be used for experimental measurement in a liquid argon purity monitor. The key measurement will be the multiplication of ionization electrons in order to determine the appropriate aspect ratio for a micro-strip anode plane.

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

Prior year(s) costs	FY17	FY18	FY19	Total
N/A		100,000	109,956	209,956

Project Start Data: 3/01/2017

Total Approved Project funds: \$ 209,956

