Fermi National Accelerator Laboratory
LDRD Project Data Sheet - FY16

Project ID: FNAL-LDRD-2016-007
Project title: Tuning Axion Detectors with Non-Linear Dielectrics
Principal investigator: Andrew Sonnenschein

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

The project seeks to characterize dielectric materials that can be used to tune resonant microwave cavities through an DC electric field. A novel aspect of the project is that for the application of axion detectors, these materials will require characterization at low-temperatures and in the presence of high magnetic fields. The "tunability" and "loss tangent" are two parameters that describe this use of dielectrics. This project will also study how to implement (i.e. mechanical aspects) using these dielectrics to control an array of cavities, which are required to be kept matched in phase using the tunable dielectrics for the axion experiment.

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

The experimental search for dark matter is a prime goal of High Energy Physics experimentation as the nature of dark matter is one of science drivers of the field. The axion, which can leave a signal in a resonant microwave cavity, is a promising candidate and has been selected by DOE as the subject one of the three generation 2 dark matter programs. Specifically, Fermilab has joined the Axion Dark Matter eXperiment (ADMX) to contribute laboratory expertise and capabilities to achieve the scientific goals of the experiment. These goals may include eventually hosting a future generation of the experiment at Fermilab. In addition, the techniques developed under the LDRD may have application to accelerator-based cavities as well.

Previous year's accomplishments: (as applicable) FY15, not applicable

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

The initial year will be to perform room temperature measurements and begin to produce and study dielectric materials. This work will then lead to the study of the materials at low temperature and in a magnetic field. Finally, a test of using these materials will be made by studying the use in a cryogenic cavity in a magnetic field.

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

Prior year(s) costs	FY16	FY17	FY18	Total
N/A	145,000	300,000	--	445,000

Project Start Data: 12/15/2015 Total Approved Project funds: $ 445,000