

Fermi National Accelerator Laboratory

LDRD Project Data Sheet - FY14

Project ID: FNAL-LDRD-2014-028

Project title: Deployment and operation of prototype CCD array at Reactor Site for detection of Coherent Neutrino-Nucleus Interactions

Principal investigator: Juan Estrada

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

The project is to measure detector performance and background rates with an eye towards conducting an experiment to detect, for the first time, direct evidence of coherent neutrino scattering with nuclei. The project will first deploy an existing 10g CCD array, composed of 250 μ m thick sensors and operated with low noise and hence very low threshold energy, next to the existing Angra nuclear reactor in Brazil from which low energy neutrinos are emitted. The novel nature of the CCD and its readout scheme is to have a low energy threshold by about a factor of 100 smaller compared with typical particle detectors. If successful, a second array composed of more novel 650 μ m thick detectors would be similarly deployed as these thicker devices would be required for a full experiment.

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

Coherent neutrino scattering with nuclei is an expected phenomenon within the Standard Model and quantum mechanics but has been experimentally elusive. A number of initiatives world-wide have sought to observe the effect but success has been limited due to experimental considerations such as a high energy threshold for detection. If successful, a new window into studying low energy neutrino effects will be opened. The project will also demonstrate the ability to detect the presence of low energy neutrinos.

Previous year's accomplishments: (as applicable)

After a successful deployment of an engineering array at the reactor site, reliable operation has also been demonstrated. The engineering array has taken data with a key focus being to measure the level of backgrounds so that an appropriate scaling can be made when a full ray of thicker detectors is installed in anticipation of making a measurement. It was found that studying the shielding impacts were more important than the upgrade from 250 μ m to thicker sensors. A reconfigured and improved shield was installed late in FY15. This should allow for final measurements to be made as the LDRD work will be declared complete at the end of the FY. The result is for a paper to be submitted by the end of the year.

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

This LDRD project is complete. A Final Report will be included in Fermilab FY16 LDRD Annual Report.

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

Prior year(s) costs	FY14 actual	FY15 through 8/15	FY16 budgeted	Total
N/A	70,518	111,363	2,057	183,938

Project Start Data: 7/15/2014

Total Approved Project funds: \$ 181,000