

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

Project ID: FNAL-LDRD-2017-027

Project title: Silicon precision timing detectors for minimum ionizing particles

Principal investigator: Artur Apresyan and Lindsey Gray

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

We plan to develop over two years the technology that achieves the level of 20-30 psec for single minimum ionizing particle detection, and implement it in a "large system" detector, comprised of around 30 individual readout channels. This detector will be placed in the Fermilab Test Beam Facility (FTBF), as part of permanent installation. As such, the outcome of this project will provide a facility enhancement for FTBF, as well as a technology demonstrator for future experiments.

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

The importance of advances in fast-timing technologies was highlighted in the Coordinating Panel for Advanced Detectors (CPAD) report [1], and marked as a priority in the 2013 Snowmass report [2]. Silicon precision timing is a new line of research with applications in both calorimetry as well as our interest in timing of single minimum ionizing particles. Among many advantages of the silicon based MIP timing solutions are their high radiation tolerance, capability to operate in high magnetic field, fine-pixelated devices, fast signal response, no need for vacuum-sealed devices (as in MCPs), and small material budget in collider detectors.

Previous year's accomplishments: (as applicable)

A readout board to characterize LGAD was manufactured and use in a test beam campaign. A number of studies were made and a publication has been submitted to Nucl. Instrum. Meth. A. Measurements included a first ever look at the behavior between pixels to improve the fill factor. The uniformity of the time resolution was studied for different sensors before and after irradiation.

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

A test box and radioactive source collimator is being designed. New sensors with new pixels will be manufactured. A beam test will begin this year with a larger system.

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

Prior year(s) costs	FY17	FY18	FY19	Total
N/A	107,939	283,054	100,000	490,993

Project Start Data: 3/01/2017

Total Approved Project funds: \$ 528,840