

**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)

Readout boards were used for a test beam run of low gain avalanche detectors and the NIM article was published with excellent reviewer comments. New sensors were tested this past year with Ga and carbon doping and measurements were made. 30 psec resolution up to  $1.5 \times 10^{15}$  ncm<sup>2</sup> was achieved. New sensors have been produced both at HPK and CNM.

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

The delivery of the HPK sensors is imminent and testing these sensors will be the first task for a new postdoctoral researcher. The PI of the project has received an ECA for future electronics development. The research part of the project will end after the sensor testing.

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

Prior year(s) costs	FY17	FY18	FY19	Total
N/A	107,939	334,581	50,000	492,520

Project Start Data: 3/01/2017

Total Approved Project funds: \$ 528,840