Fermi National Accelerator Laboratory
LDRD Project Data Sheet - FY15

Project ID: FNAL-LDRD-2015-009
Project title: High Energy Physics Pattern Recognition with an Automata Processor
Principal investigator: Michael Wang

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

Develop a proof of concept demonstrating that an Automata Processor (AP) is ideally suited to fast high energy physics (HEP) pattern recognition applications and can provide an off-the-shelf alternative to demanding online applications traditionally addressed by custom hardware solutions. An AP algorithm will be developed for track pattern recognition problems based upon the Compact Muon Solenoid (CMS) pixel detector and Liquid Argon time projection chambers (LArTPCs) for future neutrino experiments.

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

Experiments at all the frontiers of high energy physics require efficient solutions to pattern recognition problems. The Automata Processor has promise to deliver superior performance for such problems and may enable new investigations at future experiments that would otherwise not be possible.

Previous year's accomplishments: (as applicable)

A software toy detector approximating the CMS phase-1 pixel detector has been developed with the ability to simulate events, have the particles tracked, and record generated pixel hits. The simulation now includes up to 140 pile-up event. An Automata Processor algorithm has been designed to represent unique track patterns. This algorithm and tools have been implemented in the AP emulator. The testing of the toy detector is completed and results have been presented and published in a NIM article. With a non-disclosure agreement in place, feedback has been given to Micron to help shape the next generation of automata processor.

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

Work on the second phase of the project for waveform recognition in liquid argon TPCs will be completed. It is possible that this device might be useful of a supernova trigger in a future LArTPC. The project will be completed and follow-up discussions will continue with intensity frontier collaborations to see if this device will become a useful piece of a future project.

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

Prior year(s) costs	FY15	FY16	FY17	Total
	158,929	230,073	50,000	439,002

Project Start Data: 2/1/2015 (est)   Total Approved Project funds: $ 443,960