Fermi National Accelerator Laboratory
LDRD Project Data Sheet - FY18

Project ID: FNAL-LDRD-2018-053
Project title: Verification of Planck Scale Correlations in the Reconfigured Fermilab Holometer
Principal investigator: Craig Hogan

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

Over the last ten years our team has built an apparatus unique in the world, called the Fermilab Holometer, designed to measure a broadband spectral density of universal position noise smaller than a Planck time. Signals of two Michelson interferometers are cross correlated at high frequency to reveal ``spooky" spacelike quantum correlations in the fabric of space and time, analogous to those of entangled particle pairs. The first configuration yielded a photon-statistics-limited upper bound, ten times smaller than Planck scale projections. After a recent reconfiguration designed to respond to exotic rotations, a broad band noise correlation with a 90 degree phase was detected with high significance. This potentially transformative result has yet to be verified and requires careful validation and testing. The current project will develop and implement a series of additional tests to confirm that the exotic signal in the apparatus arises from a universal behavior of quantum geometry and not a more conventional source.

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

The experiment directly and uniquely addresses a foundational connection between matter, energy, space and time. The experiment can currently only be done at Fermilab.

Previous year's accomplishments: not applicable

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

Lasers will be refurbished to original specifications. Injection optics will be realigned and output optics optimized for better performance. Some aging components of the data and control systems will be replaced and/or updated. New systems will be developed for systematics tests. About 300 hours of science quality data will be obtained and analyzed, and the results will be published.

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

Prior year(s) costs	FY18	FY19	FY20	Total
N/A	5,000	20,000	--	25,000

Project Start Data: 8/1/2018 (est) Total Approved Project funds: $ 35,000