Fermi National Accelerator Laboratory
LDRD Project Data Sheet - FY14

Project ID: FNAL-LDRD-2014-010
Project title: Cosmic Microwave Background Detector Development at Fermilab
Principal investigator: Bradford Benson

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

The project proposes R&D to establish a high-throughput, high-quality characterization, packaging, and testing of prototype transition edge sensors (TES) and arrays of sensors at a scale never before performed for demonstration towards meeting the requirements of the next generation cosmic microwave background (CMB-S4) experiment that will have greater than 10 times the scale and sensitivity compared with current experiments.

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

The proposed work is related to transformative science in particle physics as affirmed recently as Recommendation 18 from the P5 report: "Support CMB experiments as part of the core particle physics program." The CMB detector development will ultimately enable experimentation that aims to answer some of the most exciting questions in cosmology including inflationary physics at grand-unified theory energy scales, measure the sum of the neutrino masses, constrain the relativistic energy density of the universe and determine any "dark radiation" component.

Previous year's accomplishments: (as applicable) FY14, not applicable

Work proposed for first year and anticipated / desired results:

The project proposes to build and outfit a 250 mK cryostat for high-throughput characterization of sensor wafers. For the first year, the cryostat will be commissioned with a ^{3}He-based closed cycle refrigerator and a SQUID readout system. With this initial system, the uniformity of TES properties across the prototype detector wafers will be measured. If successful, Fermilab will have a unique facility to perform the measurements at the scale appropriate for high-throughput characterization.

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

Prior year(s) costs	FY14	FY15	FY16	Total
N/A	545.3K	818.5K	820.0K	2183.9K