

Fermi National Accelerator Laboratory

LDRD Project Data Sheet - FY18

Project ID: FNAL-LDRD-2018-052

Project title: Understanding Dark Matter with the Faintest Galaxies

Principal investigator: Alex Drlica-Wagner

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

This project seeks to perform a feasibility study using the Dark Energy Survey (DES) to detect the most diffuse and dark-matter-dominated galaxies. Recently, new telephoto arrays have detected a new class of ultra-diffuse, ultra-dark-matter-dominated galaxies (e.g., van Dokkum et al. 2015). These galaxies represent extreme outliers in the conventional mapping between the visible properties of galaxies and the dark matter halos that they inhabit. We will develop novel image processing and machine learning algorithms optimized for the detection of ultra-diffuse galaxies. The resulting sample of galaxies can be uniquely combined with state-of-the-art galaxy shear measurements from DES to perform a stacked weak lensing measurement of dark matter in these galaxies.

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

Understanding the fundamental nature of dark matter is one of the primary missions of the Cosmic Frontier of the US HEP program. By better measuring the distribution of dark matter and the connection between dark and visible matter, we can test particle properties of dark matter. For example, by studying dark matter on the smallest astrophysical scales we can constrain the minimum mass of a thermal dark particle and search for signatures of dark matter self-interaction and other non-standard couplings in the dark sector.

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

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

The proposed work for the project for FY18 will be to systematically search the DES Y3 data for the population of previously undetected ultra-diffuse galaxies. We will develop novel image reduction, source extraction, and machine learning algorithms to optimize our sensitivity to these low-surface brightness galaxies. If successful, this program will provide a systematic sample of ultra-diffuse galaxies that can be used to target a stacked weak lensing measurement of dark matter halo parameters.

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

Prior year(s) costs	FY18	FY19	FY20	Total
N/A	13,000	35,000	--	48,000

Project Start Data: 8/1/2018 (est)

Total Approved Project funds: \$ 57,000