

Abstract: Improving dark-matter detection through calibrations and automated data quality efforts, Y1

I am requesting a JetStream startup allocation to prototype analysis software and analysis methods for the Super Cryogenic Dark Matter Search (SuperCDMS). SuperCDMS is a direct-detection dark matter experiment with sensitivity to low-mass, weakly-interacting dark matter. I am requesting resources to analyze CDMS data using the JupyterHub environment to analyze processed data. Specific projects I intend to use JetStream for are related to (1) exploratory calibration studies and (2) exploratory studies for automated data quality monitoring.

Calibration (1) at the low energies of interest to dark matter searches are difficult because calibration sources typically interact with electrons, while dark matter is expected to interact with nuclei. While it is possible to create mono-energetic neutron sources - neutrons, like dark matter, interact predominantly with nuclei - analysis of the data is complicated by neutrons that scatter multiple times in the detector. I propose to determine if it is possible to identify these multiple-scatter events; if such identification is possible, it would be a valuable improvement to the SuperCDMS calibration analysis.

Automated data quality monitoring (2) has the potential to provide rapid feedback to SuperCDMS shifters and to improve the overall percentage of science data. This is particularly critical for the SuperCDMS experiment as our primary signal is small and fluctuations in the noise environment can make data unsuitable for our flagship low-threshold and annual modulation analyses. I propose to use machine learning algorithms to classify the data and determine if this classification is useful for assessment of the noise environment.

In addition to these analysis projects, I wish to use this Jetstream allocation to better understand the Jetstream ecosystem and determine if the system would be appropriate for broader analysis efforts and outreach efforts.