

**Grant Title:** Explorations in high energy physics at the Large Hadron Collider with the ATLAS experiment

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The ATLAS Experiment is one of the four major experiments at the Large Hadron Collider (LHC) at CERN and is located just outside of Geneva, Switzerland. It is a general-purpose particle physics experiment run by an international collaboration is designed to exploit the full discovery potential and the huge range of physics opportunities in studying the proton-proton collisions provided by the LHC at the highest energies achieved in a laboratory. The goal is to advance scientific exploration using precision measurements to push the frontiers of knowledge by seeking answers to fundamental questions such as: What are the basic building blocks of matter? What are the fundamental forces of nature? Could there be a greater underlying symmetry to our universe?

ATLAS physicists and engineers are tasked with maintaining and upgrading the detector and its support electronics as well as performing rigorous data analysis on the very large data sets and simulations results to test the predictions of the Standard Model of particle physics, which encapsulates our current understanding of what the building blocks of matter are and how they interact.

Through the Sacramento State ATLAS group, students work on projects ranging from writing analysis code (in C++, python, Bash, XML) to hardware projects to improve the functionality of the current ATLAS detector and prepare for upgrades that will be installed in the years to come. Since 2014, 10 Sacramento State Students have traveled to CERN during the summer and worked with international experts in the field of High Energy physics on projects that give them valuable, real-world experience that is applicable across the STEM fields. In addition, students work at Sacramento State throughout the year on research projects related to searches for new types of elementary particles and improvements in tracking algorithms used to measure the physical quantities of particles produced in high energy proton-proton collisions that occur in the center of the ATLAS detector 40 Million times per second.

