

DEPARTMENT OF PHYSICS  
COLLEGE OF ARTS AND SCIENCE

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

FOR APPLICATION YEAR: 2024

PROJECT TITLE: Visualization of high energy particle collision simulations

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**Project Description**

High energy particle physics (HEP) explores the laws of nature at the shortest experimentally accessible distances, attempting to answer such fundamental questions as: what are the building blocks of the material world; what is dark matter; why is there more matter than anti-matter in the universe? State-of-the-art theoretical predictions accurately describe interactions of particles at very short distances ( $10^{-19}$  meters) and model how these short distance systems evolve to the longer-distance bound states of quarks and gluons ( $10^{-15}$  meters), e.g., protons and neutrons, which are the basis for all known matter. Current visualization tools in HEP focus on how particles interact with detectors, rather than how particles are produced in theory calculations. This project will focus on building a visualization tool for the popular event generator Pythia ([pythia.org](http://pythia.org)). Students will also have the opportunity to work with the MLhad group, which is using machine learning to describe how quarks and gluons produce bound states ([gitlab.com/uchep](http://gitlab.com/uchep)).