

DEPARTMENT OF PHYSICS  
COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

FOR APPLICATION YEAR: 2024

PROJECT TITLE: Resolving the Distant Universe with JWST

Matthew Bayliss,  
Department of Physics  
Geo/Physics Building  
345 Clifton Court  
Cincinnati, OH 45220  
baylismb@ucmail.uc.edu  
Phone: 513 556 0637

### Project Description

NASA's James Webb Space Telescope (JWST; Gardner et al. 2006) launched in Dec 2021 and completed its successful commissioning in June 2022 (Rigby et al. 2023). JWST is a revolutionary telescope that is >100x more powerful than all previous facilities that operate at similar wavelengths (optical through mid-infrared). However, we are in the early days of analyzing JWST data. The complexities of the observatory and its many instruments, modes, and configurations present a major challenge for calibrating the data and there is still a huge amount of work to be done to understand how to generate robust, "science-ready" data products. The many challenges posed by JWST data also present an exciting opportunity to engage students in the process of understanding the instruments, their calibrations, and developing the software pipelines required to optimally use JWST data.

The UPRISE student will get hands-on experience working with data from NASA's newest flagship astrophysics research observatory. Specifically, the UPRISE student will work as a part of a cohort to use and troubleshoot JWST data analysis pipelines and contribute to writing new guides and other resources intended to help junior scientists work with JWST data. The student will also help to develop new analysis tools to make science measurements from the JWST data, which consist of spatially resolved imaging and spectroscopy of distant star-forming galaxies that are highly magnified by strong gravitational lensing.

The day-to-day work on this project will involve a lot of computational work using Python, which will include both running scripts/pipelines and developing new Python software to explore new ways to implement existing pipeline packages. Prior experience with programming, especially in Python, and using command line (unix/linux) operating systems is not strictly

required but would be hugely beneficial. Completion of astronomy/astrophysics coursework is also strongly desired. In addition to astrophysics content, the project will also involve a significant amount of statistical analysis and error propagation.