



University of Maryland College Park  
University of Maryland, Baltimore County  
Universities Space Research Association

# UNDERGRADUATE & GRADUATE STUDENT RESEARCH OPPORTUNITIES

at the NASA/Goddard Space Flight Center's Observational Cosmology Laboratory and the Center for Research and Exploration in Space Sciences and Technology

- Development, testing and operations for balloon, sounding rocket, and space-borne instrumentation
- Modeling, analysis and interpretation of astrophysical phenomena and observational data

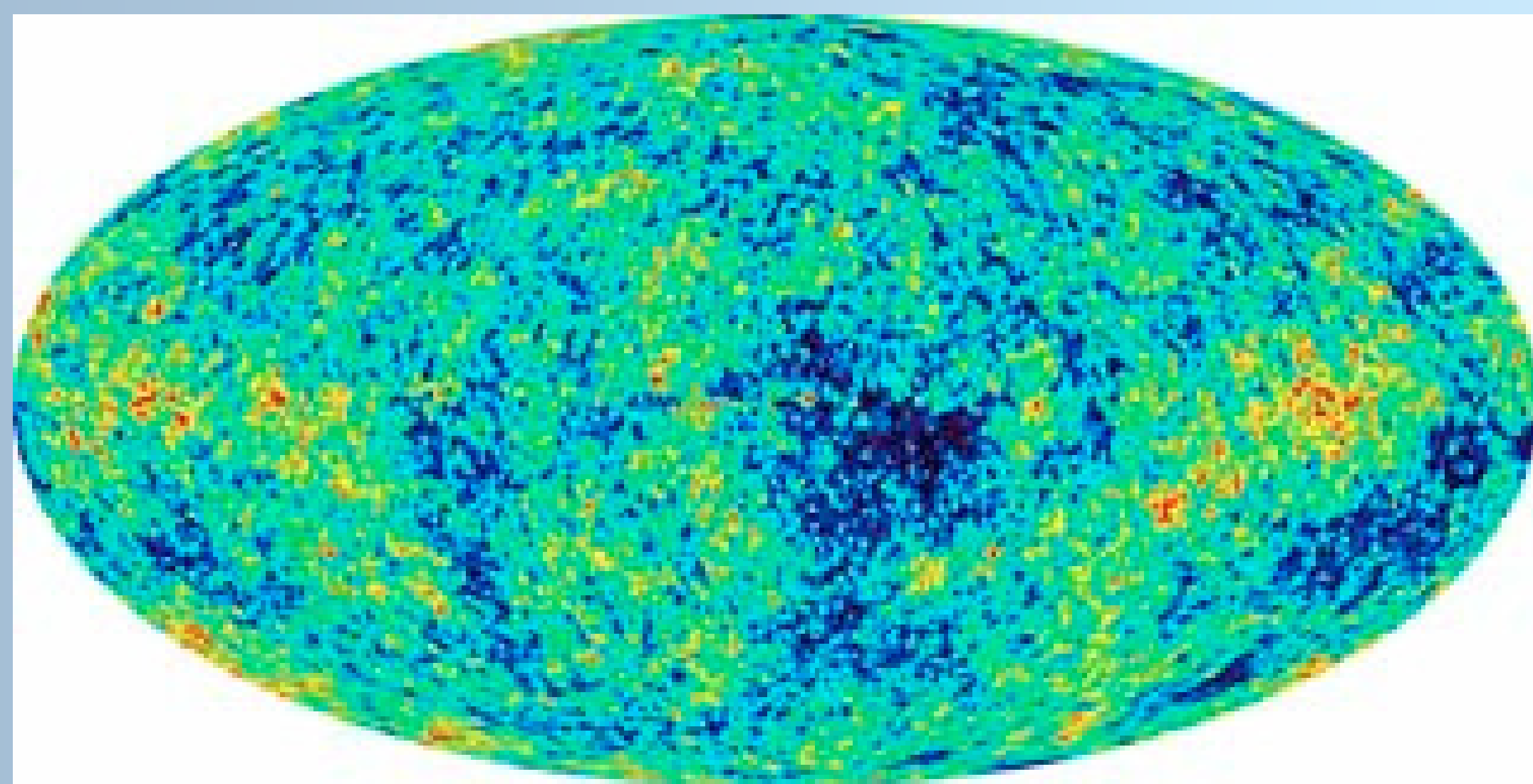
## BACKGROUND

**CRESST** brings together NASA/Goddard researchers and scientists from the University of Maryland campuses and USRA to build upon the many capabilities and strengths in space science of the participating organizations. CRESST researchers are integrally involved in various research activities ongoing within Goddard's Astrophysics and Solar System Sciences Divisions. CRESST also works to increase the involvement of minority and women scientists in space science research and to facilitate university student participation in such research.

The Goddard **Observational Cosmology Laboratory** conducts research to improve understanding of the origin, evolution and ultimate fate of the universe. Specific issues under investigation include what powered the Big Bang; the size, shape, and matter-energy content of the universe; when the first stars and galaxies appeared and their evolution over cosmic time; and the nature of the mysterious dark energy that is driving the universe apart.

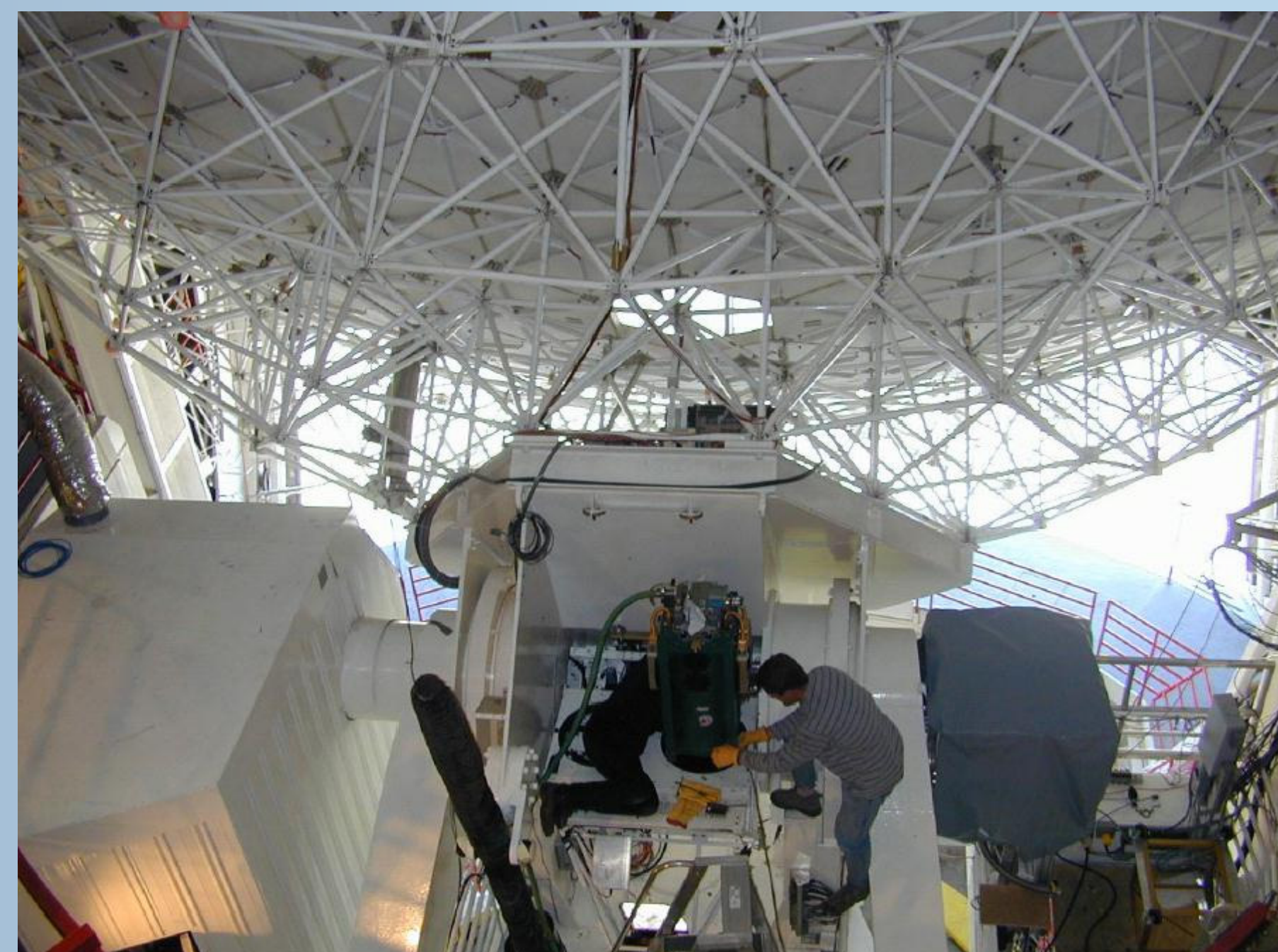
## RESEARCH OPPORTUNITIES

**PIPER** (Primordial Inflation Polarization Explorer) is a balloon-borne instrument to measure the polarization of the cosmic microwave background (CMB) at millimeter wavelengths. It will search for the signature of gravity waves excited in an inflationary epoch shortly after the Big Bang. PIPER uses 5120 superconducting detectors viewing the sky through twin telescopes cooled to 1.5 K. PIPER is a collaboration with Johns Hopkins University and the National Institute for Standards and Technology. Student opportunities include mechanical engineering for the balloon gondola, cryogenic hardware and payload electronics development, as well as ground station programming.



Sky map of CMB temperature anisotropy from NASA's Wilkinson Microwave Anisotropy Probe mission. PIPER and PIXIE will measure the polarization with unprecedented precision.

**PIXIE** (Primordial Inflation Explorer) is a satellite instrument intended for low-Earth orbit to measure the polarization and blackbody spectrum of the cosmic microwave background and astrophysical foregrounds. PIXIE combines Fourier Transform Spectroscopy with multi-moded cryogenic optics to achieve extraordinary sensitivity using only 4 semiconductor bolometers. Student opportunities include testing prototype detectors, optics, and control systems as well as modeling the diffuse foreground emission from our Galaxy.



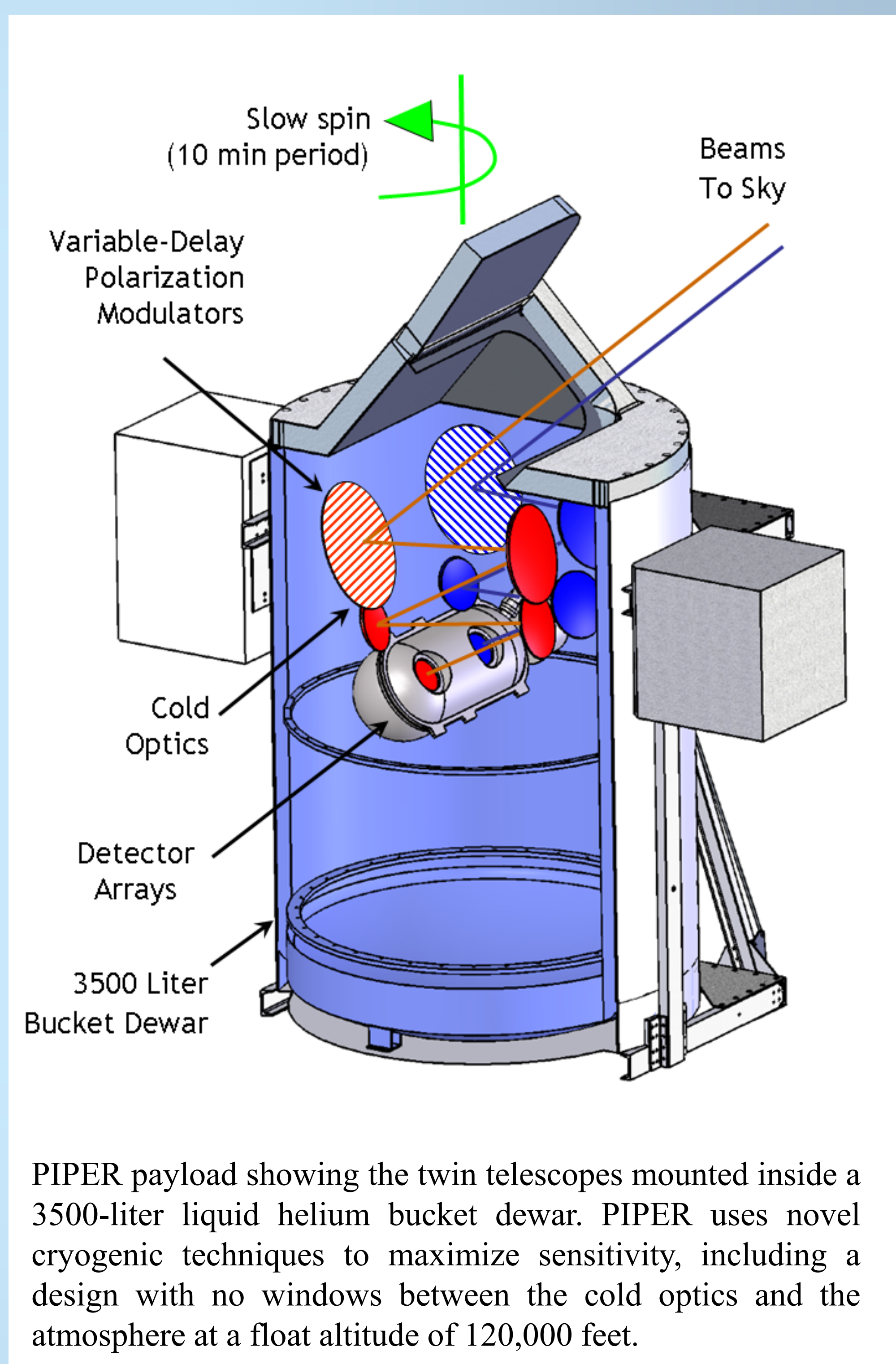
**Development of various microwave instrumentation and techniques** is also conducted in the laboratory. Examples include the development of low-power cryogenic phase switches using Micro Electro-Mechanical Systems (MEMS) technologies, development of precision quasi-optical polarization modulators, and development of both free-space and waveguide loads as precision calibration targets. We are looking for students with interests in hardware or instrumentation to work in an exciting laboratory development environment.

## WHO WE ARE LOOKING FOR

### Graduate and Upper-Level Undergraduate Students:

- Enrolled at the University of Maryland College Park and/or Baltimore County Campuses
- Seeking degrees in the departments of **Astronomy**; **Physics**; or **Electrical, Mechanical, and Aerospace Engineering**
- With interests in scientific instrumentation, data analysis, computer modeling/simulations, and/or theoretical research in space science

**Graduate students seeking second-year or Ph.D. projects, and/or junior- and senior-level undergraduate students looking to establish long-term research collaborations with the Goddard Observational Cosmology Laboratory, are especially encouraged to apply.**



PIPER payload showing the twin telescopes mounted inside a 3500-liter liquid helium bucket dewar. PIPER uses novel cryogenic techniques to maximize sensitivity, including a design with no windows between the cold optics and the atmosphere at a float altitude of 120,000 feet.

## GODDARD COSMOLOGY LAB CONTACT

For information on research opportunities:

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## UNIVERSITY CAMPUS CONTACTS

For information on how to apply:

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