



# GRADUATE STUDENT RESEARCH OPPORTUNITIES

within **NASA/Goddard Space Flight Center's  
Observational Cosmology Laboratory**

through the  
Center for Research and Exploration in Space Sciences and Technology

## THE LAB AND CRESST

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

**CRESST** brings together NASA/Goddard researchers and scientists from the University of Maryland campuses and Universities Space Research Association (USRA) to build upon the many capabilities and strengths in space science of the participating organizations. CRESST researchers are integrally involved in 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.

## WHO WE ARE LOOKING FOR

### Graduate Students:

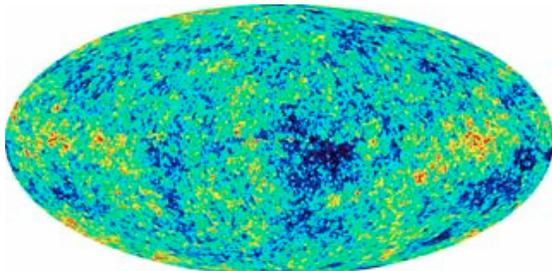
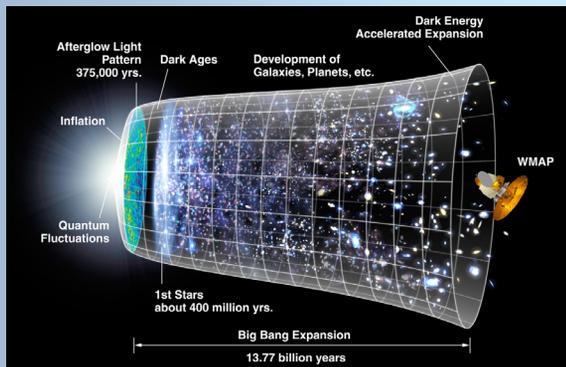
- Enrolled at the University of Maryland College Park or Baltimore County campus
- Seeking degrees in the departments of **Astronomy**; **Physics**; or **Mechanical, Aerospace, or Electrical Engineering**
- With interests in scientific instrumentation, data analysis, computer modeling/simulations, or theoretical research in space science
- Able to spend a significant fraction of time working on-site at NASA/Goddard Space Flight Center in Greenbelt, MD

**Graduate students seeking short-term or long-term Ph.D./M.S. research projects are encouraged to apply.**

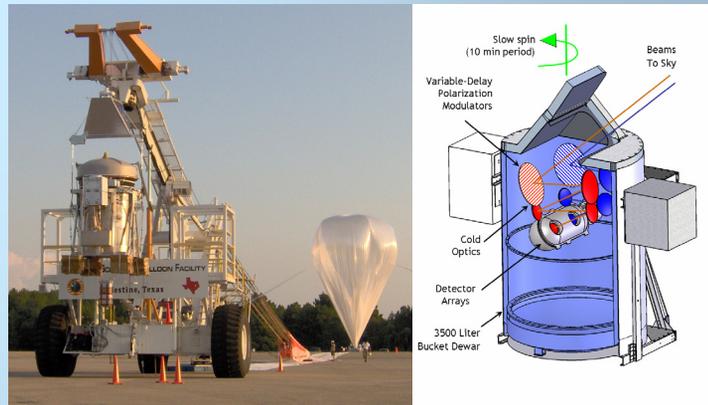
## RESEARCH OPPORTUNITIES

**PIXIE** (Primordial Inflation Explorer) is a satellite instrument to measure the polarization and blackbody spectrum of the cosmic microwave background and astrophysical foregrounds. PIXIE combines Fourier Transform Spectroscopy with multi-mode cryogenic optics to achieve extraordinary sensitivity using only four semiconductor bolometers. Student opportunities include testing the detector and calibrator systems as well as developing precision motion control using superconducting voice coil drives.

**PIPER** (Primordial Inflation Polarization Explorer) is a balloon-borne instrument to measure the polarization of the cosmic microwave background at millimeter wavelengths. It will search for primordial inflation shortly after the Big Bang to test physics at energies a trillion times beyond those accessible to particle accelerators. PIPER uses 5120 superconducting detectors viewing the sky through twin telescopes cooled to 1.5K. Student opportunities include mechanical engineering for the balloon gondola, cryogenic hardware and payload electronics development, as well as ground station programming.



Sky map of the cosmic microwave background's temperature anisotropy obtained from NASA's WMAP (Wilkinson Microwave Anisotropy Probe) mission. PIPER and PIXIE will measure the polarization with unprecedented precision.



[Left] The filling of the balloon for the launch of the ARCADE 2 (Absolute Radiometer for Cosmology, Astrophysics, and Diffuse Emission) instrument as it sits in a crane-like launch vehicle in NASA's Columbia Scientific Balloon Facility in Palestine, TX. [Right] PIPER payload showing the twin telescopes mounted inside a 3500-liter liquid helium bucket dewar, the same dewar used for ARCADE 2 shown to the left. 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.

**Suborbital payload development** is a major emphasis in the laboratory, with instruments launched on high-altitude research balloons from sites in Texas, New Mexico, and the Australian outback. We are looking for students with interests in hardware or instrumentation to work in an exciting laboratory environment featuring frequent flight opportunities.

## GODDARD COSMOLOGY LAB CONTACT

For specific information on these research opportunities, please contact:

**Dr. Alan Kogut**  
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NASA/Goddard Space Flight Center  
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## UNIVERSITY CAMPUS CONTACTS

For information on how to apply, please contact the representative for your campus:

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