IAF SYMPOSIUM ON FUTURE SPACE ASTRONOMY AND SPACE PHYSICS MISSIONS (A7)
Science Goals and Drivers for Future Exoplanet, Space Astronomy and Space Physics (2)

Author: Dr. Giuseppe Cataldo
National Aeronautics and Space Administration (NASA), Goddard Space Flight Center, United States

Dr. Emily Barrentine
United States
Mr. Nicholas Bellis
National Aeronautics and Space Administration (NASA), Goddard Space Flight Center, United States
Dr. Thomas Essinger-Hileman
National Aeronautics and Space Administration (NASA), Goddard Space Flight Center, United States
Mr. Luke Lowe
National Aeronautics and Space Administration (NASA), Goddard Space Flight Center, United States
Dr. Philip Mauskopf
Arizona State University, United States
Dr. Anthony Pullen
United States
Dr. Eric Switzer
NASA, United States

OVERVIEW AND STATUS OF EXCLAIM, THE EXPERIMENT FOR CRYOGENIC LARGE-APERTURE INTENSITY MAPPING

Abstract

The EXperiment for Cryogenic Large-Aperture Intensity Mapping (EXCLAIM) is a balloon-borne far-infrared telescope that will survey star formation history over cosmological time scales to improve our understanding of why the star formation rate declined at redshift $z < 2$, despite continued clustering of dark matter. Specifically, EXCLAIM will map the emission of redshifted carbon monoxide and singly ionized carbon lines in windows over a redshift range $0 < z < 3.5$, following an innovative approach known as intensity mapping. Intensity mapping allows measuring the statistics of brightness fluctuations of cumulative line emissions, as opposed to detecting individual galaxies, thus enabling carrying out a blind, complete census of the emitting gas. To detect this emission unambiguously, EXCLAIM will cross-correlate with a rich spectroscopic galaxy catalog.

The EXCLAIM mission will use a cryogenic design to cool the telescope optics to approximately 1.5 K. The telescope will feature a 90-cm primary mirror to probe spatial scales on the sky from the linear regime up to shot-noise-dominated scales. The telescope optical elements will couple to six Micro-Spec spectrometer modules, operating over a 420-540-GHz frequency band with a spectral resolution of 512 and featuring microwave kinetic inductance detectors (MKIDs). In the baseline design, the MKIDs will be read out with a Reconfigurable Open Architecture Computing Hardware 2 (ROACH2) system. The cryogenic telescope and the sensitive MKID detectors will allow EXCLAIM to reach high sensitivity in spectral windows of low emission in the upper atmosphere.

Here, we present an overview of the mission design and development status since the start of the EXCLAIM project in early 2019.