PROJECT SUMMARY

Overview:

Based on the results of an NSF-funded design study in 2006 and successful deployment in 2012, we propose to continue operating a robotic, 0.6-meter THz observatory at the summit of the Antarctic plateau with the dual purpose of performing site testing and leading-edge terahertz astronomy. The High Elevation Antarctic Terahertz (HEAT) telescope operates from 158 to 609 microns, and observes the brightest, most diagnostic spectral lines from the Galaxy. The (first) telescope was deployed in 2012 with the University of New South Wales' PLATeau Observatory (PLATO-R) to Ridge A, the driest, calmest and clearest point on the summit. The facility operates with no direct human contact for a year at a time between servicing missions, with commands and data being transfered to and from the experiment via satellite daily. The site is truly exceptional, and HEAT has made the most sensitive large-scale maps in the 370 micron line of neutral carbon, unveiling a substantial number of 'CO dark' molecular clouds and candidate regions in which molecular clouds may be forming. With an established facility and forward momentum, we propose here to operate the current instrument suite for one additional year, with a followup year devoted to data analysis, data dissemination, and publication. This effort is part of a longer term plan for the facility & site.

Intellectual Merit :

The HEAT telescope forges entirely new capabilities for ground based infrared and submillimeter astronomy which otherwise would be unachievable except via expensive airborne or space-based platforms. HEAT and PLATO-R represent a new generation of polar instrumentation that permits the excellent conditions available from remote sites like Ridge A to be harnessed without the costs and hazards associated with manned operations. The unparalleled stability, exceptional dryness, low wind and extreme cold make Ridge A a site without equal for astronomy at infrared and submillimeter wavelengths. HEAT operates in the atmospheric windows between 158 and 609 microns, in which the most crucial astrophysical spectral diagnostics of the formation of galaxies, stars, planets, and life are found. HEAT is in the process of addressing timely and fundamental questions about the evolution of the interstellar medium and star formation. In particular, through large-scale Galactic surveys, the measurement and impact of the Galactic environment on the life cycles of interstellar clouds and their relation to star formation are gradually being realized. Future upgrades of mixer, local oscillator, low-noise amplifier, cryogenic, and DSP technologies are planned and will play essential roles in future Terahertz observatories. This pioneering mission paves the way for future astronomical investigations from the high plateau.

Broader Impacts :

HEAT's key project is to map, with great sensitivity and precision, portions of the Southern Galactic Plane in the spectral light of the dominant coolants of the interstellar medium. Definitive and comprehensive science products from the survey and its synergistic collaborations are being made available to the astronomy & aeronomy community with no proprietary period. These survey products enhance the value of numerous contemporary surveys. Beneficiaries include Legacy programs from the Spitzer Space Telescope, Key Projects from Herschel, the most recent HI and CO surveys of the Galactic Plane, and the 2MASS & UKIDSS infrared sky surveys. The wide-field terahertz surveys provided by HEAT place Herschel, ALMA, SOFIA and balloon-borne observations in a broader, richer context. Thus, HEAT will serve both as a scientific and technological pathfinder for contemporary and future suborbital and space-based missions. As a portable, accessible terahertz observatory, HEAT transforms into an outstanding educational and outreach tool. The HEAT project uniquely captures the kind of high adventure spirit that attracts many to science in the first place, and we aim to provide video and photographic documentation of our experience for everyone, via PBS's NOVA program. Finally, the design and fabrication of HEAT has been an interdisciplinary team effort involving students from astronomy, optical sciences, and electrical engineering. Astronomical instrumentation is becoming ever more complex, requiring the talents of many individuals to bring them to fruition. Providing students with both technical training and team-work experience increases their probability of success, both in science and in society.