PROJECT SUMMARY

HEAT: the High Elevation Antarctic Terahertz Telescope

Based upon the results of a design study funded by NSF-OPP in 2006, we propose to develop and deploy an automated, 0.5-meter THz observatory for remote operation at the summit of Dome A, the highest point on the Antarctic plateau. The High Elevation Antarctic Terahertz Telescope (HEAT) will operate from 158 to 372 μm, and observe the brightest and most diagnostic spectral lines from the Galaxy. It will follow Pre-HEAT, an NSF-funded 450 μm tipper & spectrometer that will be deployed to Dome A in 2007-8 with the University of New South Wales' Plateau Observatory (PLATO). A 1.5 THz (200 μm) receiver channel will be initially installed onto Pre-HEAT in Austral summer 2008-9. The full HEAT telescope will be transported to Dome A one year later (2009-10) for integration with PLATO. Together, HEAT and PLATO will operate autonomously from Dome A for up to a year at a time, with commands and data being transfered to and from the experiment via satellite daily. At Dome A, HEAT will see excellent atmospheric transmission at $200^{+}\mu$m during much of the winter, and good transmission in the pivotal 160 μm window for $\sim$20% of the winter. The HEAT heterodyne instrument package will utilize established mixer, local oscillator, amplifier, cryogenic, and digital signal processing technologies. HEAT is the Dome A component of the multinational "AstroPoles" program which has been offically endorsed by the Joint Committee for the upcoming International Polar Year (IPY).

What is the intellectual merit of the proposed activity?

HEAT will forge entirely new capabilities for ground based infrared and submillimeter astronomy which otherwise would be unachievable except via expensive airborne or space-based platforms. HEAT (with PLATO) is a new generation of polar instrumentation that permits the excellent conditions available from remote sites like Dome A to be harnessed without the costs and hazards associated with manned operations. The unparalleled stability, exceptional dryness, low wind and extreme cold make Dome A a ground-based site without equal for astronomy at infrared and submillimeter wavelengths. HEAT will operate in the atmospheric windows between 158 and 370 μm, in which the most crucial astrophysical spectral diagnostics of the formation of galaxies, stars, planets, and life are found. HEAT will answer 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** will finally be realized. The receiver system itself serves as a flexible testbed for heterodyne Terahertz components. Future upgrades of mixer, local oscillator, low-noise amplifier, cryogenic, and digital signal processing technologies are planned and will play essential roles in future Terahertz observatories. This pioneering mission will pave the way for future astronomical investigations from Dome A.

What are the broader impacts of the proposed activity?

HEAT's key project is to map with great sensitivity and precision, 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 many synergistic collaborations will be made available to the astronomical community via the Web in a timely manner. These survey products will enhance the value of numerous contemporary surveys. Beneficiaries include the GLIMPSE and "C2D" Legacy programs from the Spitzer Space Telescope, the most recent HI and CO surveys of the Galactic Plane, and the 2MASS infrared sky survey. HEAT will serve both as a scientific and technological pathfinder for future suborbital and space-based missions. Finally, the design and fabrication of HEAT will be 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 of success not only within astronomy, but society as a whole.