

PROJECT SUMMARY

Development of SuperCam, a Submillimeter-wave Superheterodyne Camera for the Heinrich Hertz Telescope

Funds are requested to develop the world's most powerful, submillimeter-wave heterodyne array receiver for use at the Cassegrain focus of the 10-meter Heinrich Hertz Telescope (HHT). The array will operate in the astrophysically rich $870\ \mu\text{m}$ atmospheric window, where the HHT has the highest aperture efficiency of any submillimeter telescope in the world and excellent atmospheric transmission more than 40% of the time. The proposed Superheterodyne Camera (SuperCam) will be an 8×8 , integrated receiver array fabricated using leading-edge mixer, local oscillator, low-noise amplifier, cryogenic, and digital signal processing technologies.

What is the intellectual merit of the proposed activity?

SuperCam will be an order of magnitude larger than any existing spectroscopic imaging array at submillimeter wavelengths. The exceptional mapping speed that will result, combined with the efficiency and angular resolution achievable with the HHT, will make SuperCam the most uniquely-powerful instrument for probing the history of star formation in our Galaxy and the distant Universe. SuperCam will be used to answer fundamental questions about the physics and chemistry of molecular clouds in the Galaxy and their direct relation to star and planet formation. Through Galactic surveys, particularly in CO and its isotopomers, the impact of Galactic environment on these phenomena will be realized. These studies will serve as "finder charts" for future focused research (e.g. with ALMA) and markedly improve the interpretation, and enhance the value of numerous contemporary surveys. Application of the SuperCam spectrometer system to the existing 7-pixel DesertSTAR array will allow application of these studies to the realm of external galaxies. These developments will put the HHT, and astronomy in Arizona, at the forefront of research & technology in this wavelength regime for years to come.

What are the broader impacts of the proposed activity?

The proposed 345 GHz array will become a facility instrument on the HHT, available to all users. A key project for the instrument will be to conduct sensitive, high resolution CO and ^{13}CO $J = 3 \rightarrow 2$ surveys of the Galactic Plane. Definitive and comprehensive science products from that survey and its many synergistic collaborations will be made available to the astronomical community via the Web in a timely manner. A Guest Observer Program will be established to facilitate use of the array by outside users. Finally, as was the case with DesertSTAR, the design and fabrication of the SuperCam array 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 success not only within astronomy, but society as a whole.