THz SPECTROSCOPY WITH TELESCOPES: ASTROPHYSICAL PUZZLES, LABORATORY CHALLENGES

GEOFFREY A. BLAKE, *Division of Geological & Planetary Sciences, California Institute of Technology, Pasadena, California 91125.*.

Recent advances in superconducting mixer fabrication and coherent oscillator technology have combined to produce terahertz (THz, or $\nu = 0.1 - 10 \times 10^{12}$ Hz) heterodyne receivers that operate with nearly quantum-limited sensitivities. In general, THz frequencies are suitable for probing low energy light-matter interactions, such as rotational transitions in molecules, phonons in solids, plasma dynamics, electronic fine structure in atoms, thermal imaging of cold sources, and vibration-rotation-tunneling behavior in weakly bound clusters. For remote sensing, spectroscopy at THz frequencies holds the key to our ability to remotely sense environments as diverse as primeval galaxies, star and planet-forming molecular cloud cores, comets, and planetary atmospheres. This talk will review the recent progress in our understanding of the star and planet-formation process, progress that has been driven by molecular spectroscopy. New technologies in upcoming missions, such as the Stratospheric Observatory For Infrared Astronomy (SOFIA), the Far-Infared Space Telescope (FIRST, an ESA mission with NASA participation), and the Earth Observing System (EOS), will open up the THz region to high resolution spectroscopy for the first time. Proper use of their new capabilities will require an aggressive program in laboratory spectroscopy, and examples of the spectroscopic challenges presented by these new missions will be provided.