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Planar-Diode Mixers and Multipliers for Spaceborne Submillimeter-Wave Radiometry

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ABSTRACT

The submillimeter-wave or THz frequency bands, from 300 GHz to 3 THz (1 to 0.1 mm wavelength), are some of the least explored and yet information rich regions of the electromagnetic spectrum. Applications include Earth atmospheric chemistry to monitor ozone depletion, global warming and thermal radiation balance; planetary remote sensing of water and other chemical species in the atmospheres of Mars, Venus, Europa as well as cometary bodies; and astrophysics observations to detect a wide variety of interstellar and intergalactic atoms, ions and molecules as tracers for cosmology, galactic structure and stellar evolution. The development of technology specifically aimed at remote sensing of chemical species that thermally emit in the submillimeter wavelength range has been a major NASA thrust area for more than 10 years. Over this time, enormous progress has been made at JPL/Caltech in both heterodyne and direct detection THz sensor technology. Significant developments include the realization of near quantum limited superconducting mixers up to 1 THz, less sensitive but ultra high frequency (600 GHz-2.5 THz) ambient temperature semiconductor mixers, helium cooled hot-electron bolometer mixers which will work all the way up to far infrared wavelengths (10 THz) and most recently, solid-state submillimeter-wave sources capable of driving semiconductor and superconducting downconverters [1,2,3,4]. Recent advances in planar-integrated GaAs semiconductor device technology has helped support this renaissance in space qualified submillimeter-wave heterodyne systems due to new robust, flexible circuit topologies that have replaced less reliable, circuit-limiting, whisker-contacted diode detectors. This talk will focus on the specific semiconductor device, circuit and antenna technology enhancements that are being deployed to meet the needs of current NASA submillimeter-wave instrument programs and highlight potential future technology directions.

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