A Direct Detection Receiver at 660 GHz

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Submillimeter-wave radiometry provides a variety of benefits for remote sensing on small satellite platforms. First, a rich variety of absorption lines are present in the submillimeter wave range. Second, measurements at multiple quasi-window frequencies between these absorption lines permit sensing of cloud ice through scattering, thereby allowing retrieval of total ice water content and cloud ice particle size information. Therefore, measurements in this range will enable new, precise observations of the upper troposphere and lower stratosphere needed for atmospheric science. Finally, the short submillimeter wavelengths have the benefit of achieving reasonable spatial resolution on the Earth with reduced aperture size. Therefore, the compact size of submillimeter wave radiometers makes them highly suitable for small satellite or CubeSat platforms.

However, there are still significant challenges for incorporating submillimeter-wave radiometer systems on these platforms. In particular, traditional architectures for submillimeter-wave radiometers typically use a GaAs Schottky diode based heterodyne mixer, multiplier chain to drive the mixer, and an on-board oscillator to drive the multiplier chain. This configuration consumes a minimum of several watts of power, and as high as a dozen watts as the operating frequency approaches 1 THz. This high DC power consumption per receiver limits the number of receivers and bands that can be covered by the instrument, substantially reducing instrument capabilities.

Alternatively, InP HEMT technology has demonstrated significant capabilities for low noise amplification at submillimeter wave frequencies. In this talk, we present a 660 GHz direct detection receiver consisting of packaged low noise amplifiers, waveguide bandpass filters, a GaAs Schottky detector and video amplifier circuit. This receiver shows good sensitivity and low DC power consumption (<250 mW), making it an excellent candidate for small satellite and CubeSat platforms.