STRATOSPHERIC WATER OBSERVATION WITH A BALLOON BORNE SPECTRALLY DISPERSED CMOS BASED HETERODYNE RADIOMETER

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The deployment of millimeter wave and terahertz heterodyne radiometers has traditionally been reserved for large flagship space missions (e.g., Hershel HIFI, UARS MLS) owing to the size, weight, and power requirements associated with this class of remote sensing instrumentation. Ongoing efforts at the Jet Propulsion Laboratory aims to reduce system complexity by utilizing high speed phase-lock loops embedded in CMOS process integrated circuitry for use as a local oscillator to pump an on chip downconversion mixer. The noise temperature of the resulting CMOS-based mm-wave heterodyne receiver system (180-190 GHz) can be reduced with custom designed InP low-noise amplifier stages to values sufficiently low (T_{sys}=800 - 1000 K) to allow for remote molecular detections with sub-second integration times. A deployable system, having a form factor commensurate with a 6U cubesat, can be realized by pairing this receiver with a purpose design and built 6 GS/s real-time ADC/FFT integrated circuit chip to process the intermediate frequency signal generated by the frontend receiver.[a]

An engineering test flight of this system was completed as part of the Fort Sumner, NM Fall 2019 stratospheric ballooning campaign. This talk will discuss instrument performance including pre-flight laboratory testing and molecular detections observed in the radiometrically calibrated data recorded at an altitude of 38 km (125000 ft).

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[a] Y. Kim *et al.*, "A 183-GHz InP/CMOS-Hybrid Heterodyne-Spectrometer for Spaceborne Remote Sensing," *IEEE Trans. THz Sci. Technol.*, vol. 9(3). pp. 313-334, 2019