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Abstract Title: Development of 200 GHz to 2.7 THz Multiplier Chains for Submillimeter-wave Heterodyne Receivers.

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Abstract: Several astrophysics and Earth observation space missions planned for the near future will require very high frequency heterodyne receivers. More specifically, a mission like the Far Infrared and Submillimeter Telescope (FIRST) will perform high-sensitivity, high-resolution spectroscopy in the 400 to 2700 GHz range with a seven channel superconducting heterodyne receiver complement. The two highest frequency channels will utilize HEB (hot electron bolometer) receivers for the initial RF detection and downconversion, while the remaining mixing elements will be implemented with ultra-low-noise SIS (superconductor-insulator-superconductor) junctions. The local oscillators for all these downconverter channels will be constructed around new GaAs power amplifiers in the 71 to 115 GHz range, followed by a chain of two or more planar Schottky diode multipliers. The use of power amplifiers, rather than traditional Gunn diode oscillators, greatly increases the fix tuned bandwidth and available drive power for the multiplier chains. The multiplier circuits themselves must be reliable, relatively easy to assemble, and most importantly must provide up to 20% fixed-tuned bandwidth to avoid using an excessive number of RF channels to cover the desired frequency range.

The Jet Propulsion Laboratory is responsible for developing the multiplier chains for the 1.2, 1.7, and 2.7 THz bands. This talk will focus on the designs and technologies being developed to enhance the current state of the art, which is based on discrete planar Schottky devices mounted in waveguide blocks. This technology becomes difficult to implement with increasing frequency, due to tolerances and handable device chip dimensions. We are proposing a number of new techniques to implement multipliers at these high frequencies. Approaches include substrate-less, framed-GaAs-membranes and frameless membrane circuitry with single and multiple planar integrated Schottky diodes. Circuits include 200 and 400 GHz doublers and 1.2 and 2.7 THz triplers. Progress to date, with the implication of this technology development on future Earth and space-borne instruments, will be presented.

Key Words: Local Oscillators, Multipliers, submillimeter.

Biography: Dr. Jean Bruston received his Ph.D. in Space Instrumentation for Astrophysics in 1997, from University of Paris. He joined the NASA-Jet Propulsion Laboratory in 1995, where his current work includes development of the Local Oscillator Sub-System for the Heterodyne Instrument for FIRST, and research on submillimeter multipliers and mixers from 400 GHz to 2.5 THz.