

Super-compact Submillimeter-wave Array Receivers for Space Applications

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ABSTRACT: Successful implementation of single-pixel tunable frequency-multiplied sources for the 1-2 THz regime was an enabling feature for the HIFI instrument onboard the Herschel Space Observatory. Single pixel passive, as well as active systems, start to hit fundamental limits when used in a scanning or imaging mode. The next generation of heterodyne instruments that have been proposed or are under consideration will rely on array receivers to increase science return but will still require broadband performance. However, extending the approach towards a large pixel systems based on the current state of Submm-wave components is not practical or even feasible. We present a novel approach that utilizes silicon micro-machining along with 3-D interconnect technology to fabricate complete Submm-wave radiometers on a stack of semiconductor wafers. The individual semiconductor wafers in the stack allow one to optimize and select the most appropriate technology thus enhancing system-level performance. The basic concept along with preliminary results and designs from 100 to 600 GHz will be presented. This technique allows one to package GaAs Schottky diodes, InP based power amplifier MMICs, and novel micro-lens based antennas all in a stack of thin wafers enabling a low-mass super-compact radiometer. The talk will focus on presenting some of the challenges and opportunities in developing this technology.



Imran Mehdi (BSEE 1985, MSEE 1986 and Ph.D 1990, University of Michigan) is a Senior Research Scientist at the Jet Propulsion Laboratory, California Institute of Technology. He joined JPL in 1990 and is currently a Group Supervisor in the Instrument Electronics and Sensors Section. His responsibilities include developing THz components, technologies and subsystems for current and future NASA missions. These devices and components were implemented on several space instruments such as MLS, MIRO and HIFI. From 1999 he led the effort of developing broadband solid-state sources from 200 to 2500 GHz for the Heterodyne Instrument for Far Infrared (HIFI) on the Herschel Space Observatory, a cornerstone European Space Agency mission. He is an IEEE Fellow and serves as a topical editor for the IEEE Transactions on THz Science and Technology. His current interests include millimeter and sub-millimeter-wave devices, high-frequency instrumentation, and heterodyne receivers for miniature systems.