A Low-Power Compact Millimeter-wave Radiometer for a Weather Cubesat

Sean Bryan[*], Philip Mauskopf[1], and Christopher Groppi[1]

[1]*Arizona State University, Tempe, AZ, 85281, USA*
[*]Contact: sean.a.bryan@asu.edu

Abstract—Millimeter-wave atmospheric sounding satellites measure the temperature, humidity, and oxygen content across the globe and in profiles resolved by altitude. Considered separately from calibration or modulation subsystems, current heterodyne radiometer technology has significant power and size requirements. This either requires a large satellite such as ATMS, or limits the channel count and frequency coverage of small satellites or cubesats such as MicroMAS-2. In this talk, we present a significantly improved radiometer system based on patent-pending technology developed at ASU, and sensitivity forecasts used to optimize the design for collecting weather data. Using a millimeter wave LNA as the first element in the radiometer system, followed by a millimeter-wave filter bank and power detectors, has several advantages. Since the system does not use a local oscillator, power requirements are reduced. Since the passband of each channel is defined by its filter bank cavity, the system will naturally have high frequency stability, unlike an LO-based system that could require temperature stabilization. Also, since the channelization is accomplished with physically small millimeter-wave filters instead of potentially larger IF lumped element filters, more channels with finer resolution are possible in a small space. We have already successfully built prototype filter banks in the context of developing the WSPEC instrument for astronomy, and are now working towards an integrated prototype of a full LNA/filter-bank/detector system in the context of future cubesat development.