Development of a Total-Power Radiometer comprising a 340 GHz High-Resolution Sideband-Separating Schottky Receiver

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This abstract presents the recent development of an instrument breadboard comprising a 340 GHz sideband-separating receiver with high spectral resolving capability. Such a receiver configuration is a high-priority option for STEAM-R, a millimetre-wave limb -sounder originally proposed within the scope of ESA's Earth Explorer 7 candidate mission PREMIER. This receiver topology is of interest for atmospheric spectroscopy as wide spectral coverage can be achieved in a single-sideband configuration, thus eliminating issues associated with spectral fold-over in a conventional double-sideband heterodyne receiver. Characterization of the instrument, a total-power radiometer, is complete and deployment at the High Altitude Research Stations Jungfraujoch and Gormergrat (HFSJG) in the Swiss Alps is planned for February 2014.

In addition to the development of the instrument breadboard, the MARSCHALS airborne limb-sounder shall be upgraded with a similar receiver configuration in preparation for deployment in a tropical field campaign in 2015 within scope of the StratoCLIM project. The instrument breadboard is therefore an excellent test-bed for the more complex upgrade of MARSCHALS.

The sideband-separating receiver comprises two key enabling pieces of technology:

1: Sub-harmonic Image-Rejection Mixer (SHIRM)

2: Wideband Spectrometer v2 (WBS II)

The SHIRM is the key front-end component in the sideband-separating receiver. It comprises two 340 GHz DSB Schottky mixers and relevant passive waveguide elements providing the down-converted upper and lower sidebands in phase-quadrature at the two IF outputs of the device. Sideband separation is completed after passing the IF signals through an external quadrature hybrid. Several SHIRM topologies have been optimized in previous work [1, 2], demonstrating ~20 dB of sideband rejection. The WBS II is a digital -FFT spectrometer which utilizes IQ input sampling to maximize bandwidth. A maximum sampling rate of 3 Gs/s provides up to 3 GHz bandwidth from a single unit. The spectrometer performs a 2048-point complex FFT thus achieving a resolution of order 1-2 MHz depending on sampling rate. Two WBS II units are employed in the instrument breadboard and configured to provide a total of 4 GHz bandwidth. A detailed description of the instrument together with results from the characterization tests and deployment shall be presented at the conference.

References

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