

A Compact 340 GHz Receiver Array Front-End

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Abstract—This paper presents the design and measured performance of a compact 8-element Schottky diode-based heterodyne receiver array front-end. The work has been undertaken to address the growing interest in multi-pixel sub-millimetre wave instrumentation for remote sensing of the Earth. The array specification is based on the requirements of the STEAM-R instrument concept, part of the payload of the PREMIER Earth Explorer 7 candidate mission. STEAM-R, a limb-sounding radiometer operating in the spectral band 320-360 GHz, is designed to monitor the upper troposphere and lower stratosphere of the Earth's atmosphere with high vertical resolution from low Earth orbit. The instrument employs an array of receivers to provide 14 simultaneous closely-spaced views through the atmospheric limb. The receivers are accommodated in the instrument front-end in two sub-sets of 7 receivers, with each set detecting orthogonal polarisations. The spatial viewing requirements of the instrument, and a preliminary analysis of the instrument fore-optics, show that a feedhorn spacing of about 11 mm is required. An 8-element receiver array front-end, presented in Fig. 1, has been developed to demonstrate a compact receiver array suitable for STEAM-R.

The array's 8 receivers are configured in two 4-element linear sub-arrays, each of which is made from four miniature mixer blocks. Each block incorporates a diagonal feedhorn, a sub-harmonically pumped mixer and a low noise intermediate frequency amplifier. The mixers employ anti-parallel pairs of GaAs Schottky diodes fabricated at the Rutherford Appleton Laboratory and an Avago AMMC-6222 chip is used for the amplifier. This operates over the frequency band from 7 to 21 GHz with a noise figure of 2.4 dB. All mixers are pumped from a single W-band local oscillator source: the signal, nominally 83 GHz, is first divided into two using an E-plane waveguide splitter. Each output is then frequency doubled. The 166 GHz power passes to a 4-way H-plane waveguide splitter to provide the required local oscillator input to the mixers. Each WR10 to WR5 frequency doubler employs GaAs Schottky diodes, which were also fabricated at the Rutherford Appleton Laboratory. The varactor diodes, in anti-series configuration, have been transferred to a quartz substrate to improve the power handling and conversion efficiency.

Preliminary testing of the array has demonstrated a double sideband receiver noise temperature in the range 2200-2600 K. Each mixer required an LO pump power of 2 mW. Full test results will be provided in the presentation and final paper.

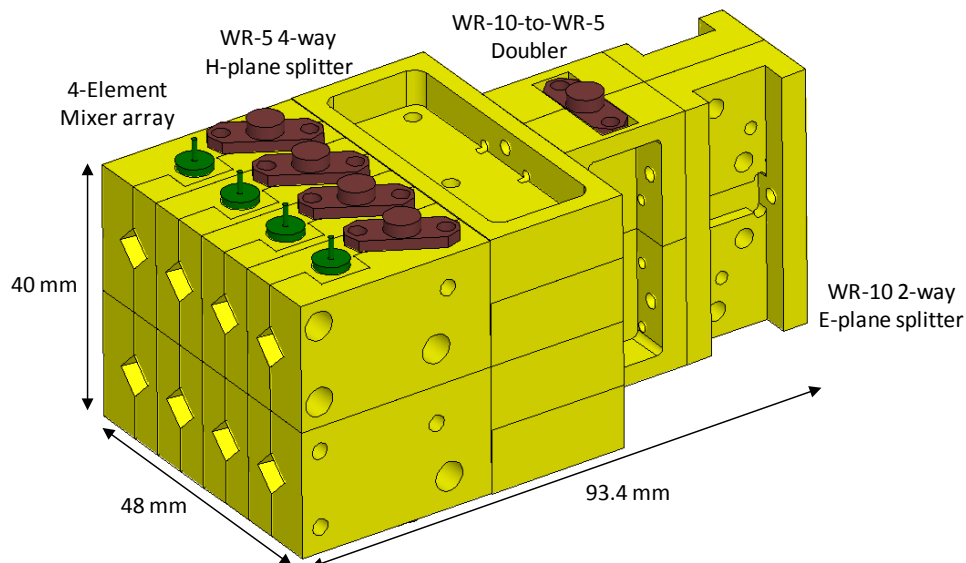


Fig. 1: 8-element receiver array front-end for frequencies around 340 GHz