Development of Suitable Technologies for Heterodyne W-Band Focal Plane Arrays

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Focal Plane Arrays

We present the ongoing efforts of the MillimeterWave Laboratory at the University of Chile to develop suitable technologies for focal plane arrays. We have focused our work in W-band heterodyne receivers and we cover the following areas of development:

- Optical systems for cameras
- Compact feeds and orthomode transducers (OMT)
- Low noise amplifiers (LNA)
- Wideband subharmonic mixers

Optical System, feed and OMT

Optical System

- Designed for a 12m ALMA-type antenna.
- Array of receivers of 7 pixels extendible to 19.
- Intermediate optics comprised of a Gaussian beam Telescope

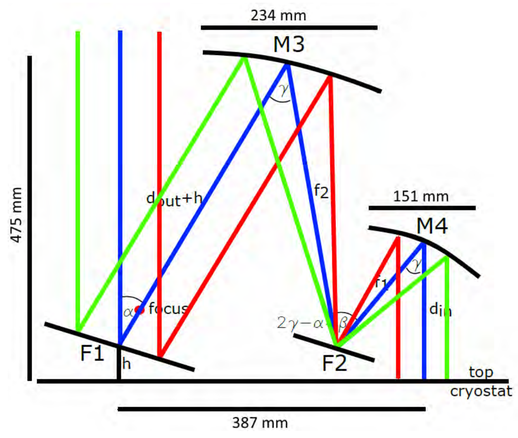


Figure 1: GBT designed for ALMA.

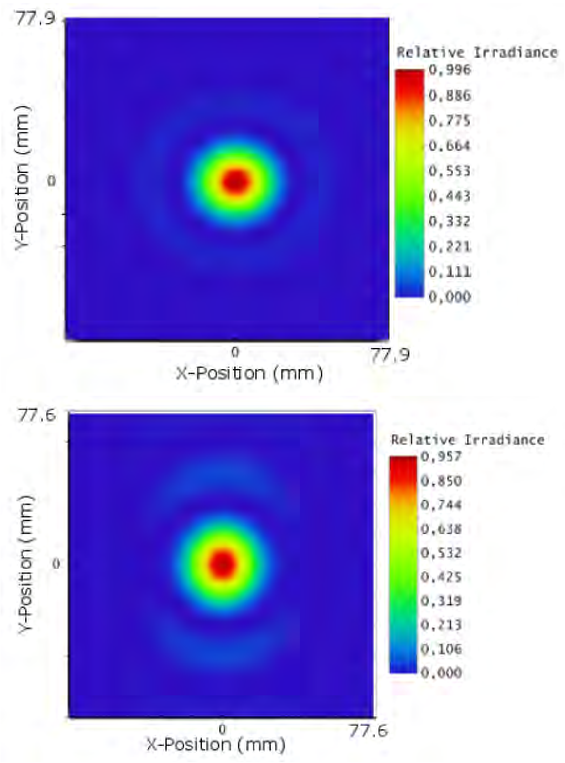


Figure 2: Huygens PSF for the central and outter pixel to evaluate the image quality.

Feed System and OMT

- Corrugated and smooth-wall horns.
- Dual polarization scheme.
- Compact turnstile OMT. Feasible to incorporate several units in a single block.

Figure 3: Constructed horn and OMT.

Tapered Slot Antennas

- Easier integration with integrated circuits.
- Greater compactness than horn antennas.
- Broad bandwidth.

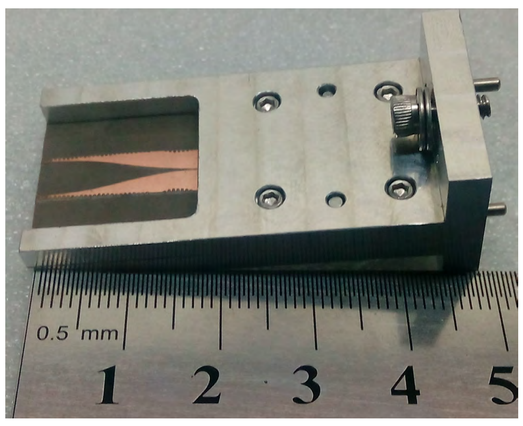


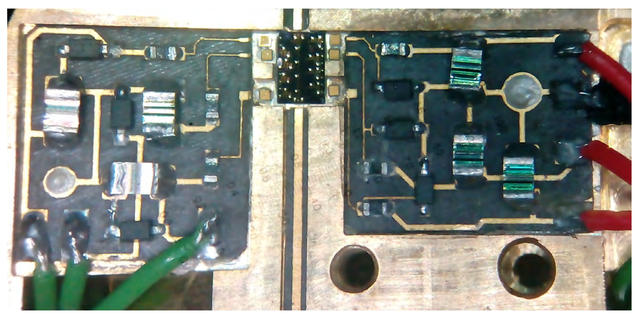
Figure 4: Mounted TSA.

LNA and Downconverting Stage

Low Noise Amplifier

The LNA design is based on a hybrid concept: a single transistor mounted before a commercial MMIC.

- Cryo 3 single transistor
- CGY2190 from OMMIC Foundry
- Low Power cosumption
- Gain above 18dB
- Noise below 100K



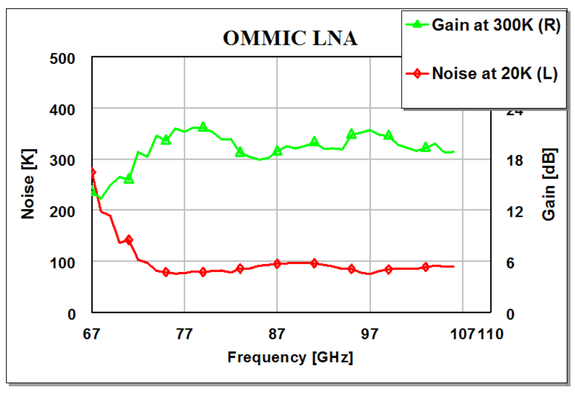
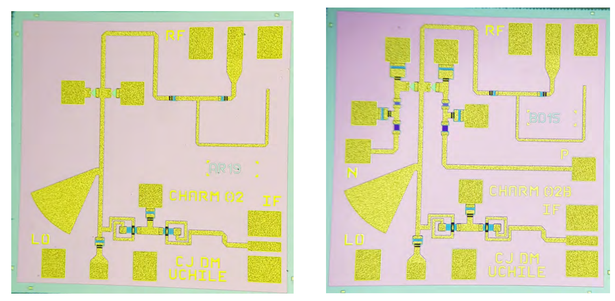


Figure 5: Mounted LNA MMIC and measurements.

Sub Harmonic Mixers

In a focal plane array it is very important to have enough power available to pump the mixers. We have designed biased sub harmonic mixers based on Schottky diodes using MMIC technology.

- Conversion loss below -15 dB
- LO power needed: 0 dBm
- Extended bandwidth



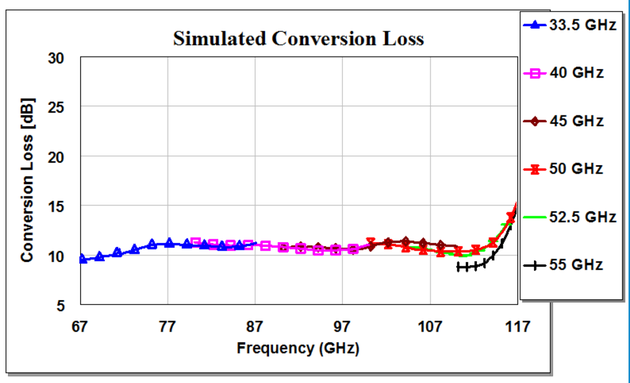


Figure 6: Mixer designs and simulations.

Future Work

- Integration of the LNA and mixer MMICs in a single and compact block expected to be completed at the end of this year.
- Focus on reducing the size of the OMT using a 2D vertically stacking scheme or a planar technology.
- Development of techniques with FPGAs to process large data output and enhance the receiver performance.

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