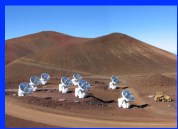


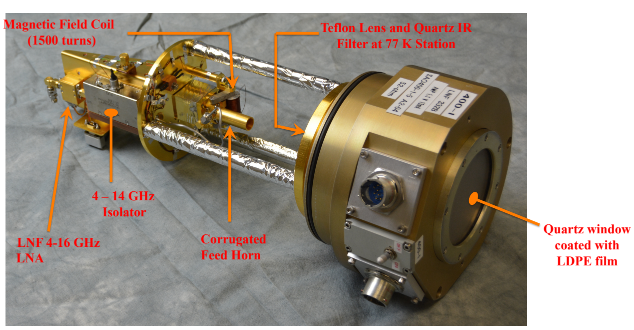
Wideband Receiver Upgrade for the Submillimeter Array (SMA)

C.-Y. Edward Tong[a], Ray Blundell[a], Chih-Chiang Han[b], Tse-Jun Chen[b], Wei-Chun Lu[b], and Ming-Jye Wang[b]

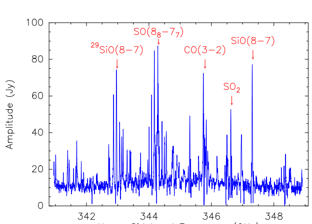
Summary

- First generation SMA receivers employed *end-loaded stub* type single junction SIS mixer with large IF output capacitance (> 0.3 pF) .
- Original IF for the SMA was 4 – 6 GHz, but later expanded to 4 – 8 GHz.
- Gain compression was observed when the receiver was terminated with an ambient calibration load.
- Second generation SMA receivers are based on series-connected distributed SIS mixers with lower IF capacitance.
- The upgraded SIS mixers employ junction arrays made up of 2 – 4 SIS junctions to provide usable photon step width of ~ 3 mV. This increases both the dynamic range and the IF bandwidth of the receiver.
- SMA receivers can currently be operated over an IF of 4 – 12 GHz. Future goal of operation is 4 – 16 GHz.
- Wideband receivers for 200 and 300 GHz bands have competitive on-sky noise performance and they are currently used for routine astronomical observations in the SMA.
- SMA Wideband Astronomical ROACH2 Machine (SWARM) correlator will unleash full bandwidth capability of the SMA wideband receivers.

SMA Receiver Insert

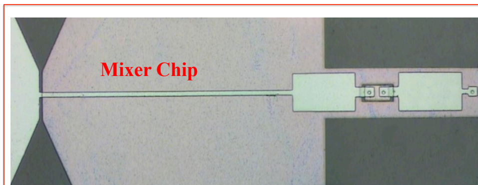


Spectrum from Orion BN/KL



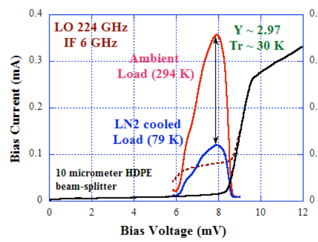
- Dec. 2013 Test observation.
- LO frequency 337 GHz.
- USB spectrum from a single baseline.
- IF 4 - 12 GHz, constructed from 2 GHz scans provided by current SMA corrrelator.
- Continuous IF coverage will be provided by upcoming SWARM digital backend.

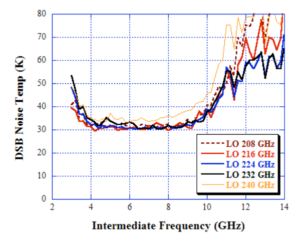
200 GHz SIS Receiver



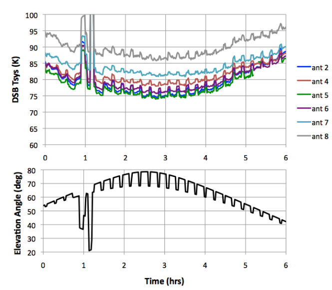
- 3 junction array
- J_c 7 kA/cm^2
- Φ_{SIS} 1.7 µm
- $\omega C_j R_n \sim 3$
- $C_{IF} \sim 0.25$ pF

Laboratory Performance



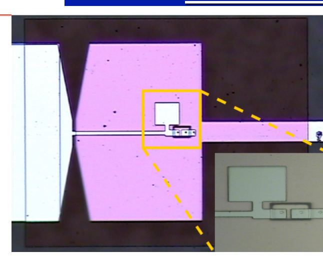


On sky performance of receivers on Jan 10, 2014.
Opacity @ 225 GHz ~ 0.05 (good weather)



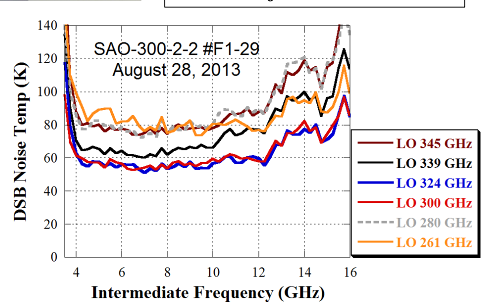
- Actual IF BW ~ 11 GHz
- Min Tsys ~ 75 K (DSB)
- Sub-mJy sensitivity easily achievable
- Pending upgrade to 4-junction array and LNF 4-16 GHz amplifier

300 GHz SIS Receiver



- Use of 4-16 GHz LNA in conjunction with lower IF capacitance allows broader IF bandwidth, BW bottleneck is then the isolator.
- The SIS junction array is tuned by the CPW connecting the first 2 junctions.

- 3 junction array
- J_c 7 kA/cm^2
- Φ_{SIS} 1.5 µm
- $\omega C_j R_n \sim 4.5$
- $C_{IF} \sim 0.18$ pF



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