Wideband Receiver Upgrade for the Submillimeter Array (SMA)

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**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.

**200 GHz SIS Receiver**

- 3 junction array
- \( J_c \) 7 kA/cm\(^2\)
- \( \Phi_{SIS} \) 1.7 µm
- \( c J_c R_n \sim 3 \)
- \( C_{IF} \sim 0.25 \) pF

**Laboratory Performance**


- 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.

**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 correlator.
- Continuous IF coverage will be provided by upcoming SWARM digital backend.

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