

In-flight performance of the BLAST-TNG Kinetic Inductance Detector arrays and Readout Electronics

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The BLAST-TNG experiment consists of a 2.5 meter Cassegrain telescope that feeds a cryogenic three-color submm imaging polarimeter [1],[2]. The receiver contains three arrays of superconducting kinetic inductance detectors (figure 1) observing in photometric bands centered at wavelengths of 250, 350 and 500 μm . The detectors are coupled to circular waveguides that feed profiled horn antennas. Each horn couples to two detectors designed to absorb radiation in orthogonal polarizations.

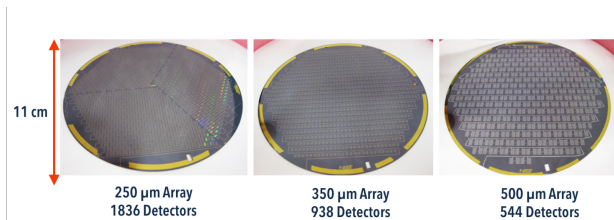


Fig. 1. The three arrays of kinetic inductance detectors in the BLAST-TNG receiver.

The readout electronics consisted of 5 ROACH2 FPGA boards with ADC/DAC boards from Techne Instruments. The electronics are custom modified for the balloon environment by the use of heat pipes to cool the FPGA chips and microprocessors [3].

BLAST-TNG had a stratospheric flight from Antarctica in January, 2020. During the line of sight period of operation, we performed diagnostics of the receiver. We were able to read out approximately 3000 detectors over the three arrays.



Fig. 2. BLAST-TNG ready for launch.

The readout electronics worked well in flight and we monitored the temperature at float. We will report on the results of the receiver calibration from flight skydips and observations of bright submillimeter sources.

REFERENCES

- [1] N. Lourie, et al., “Preflight characterization of the BLAST-TNG receiver and detector arrays,” *Proc. SPIE*, 10708, 2018..
- [2] N. Galitzki, et al., “The next generation BLAST experiment,” *Journal Astr. Instr.*, vol. 3, pp. 1440001, 2014.
- [3] S. Gordon, et al., “An Open-Source FPGA-based LeKID readout for BLAST-TNG: Pre-flight results,” *Journal Astro. Instr.*, vol. 5, 1641003, 2016.

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