Low loss microstrip materials with MKIDs for microwave applications

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Introduction

Future measurements of the millimeter-wavelength sky require a low-loss superconducting microstrip coupling the antenna to detectors typically made from niobium and silicon-nitride.

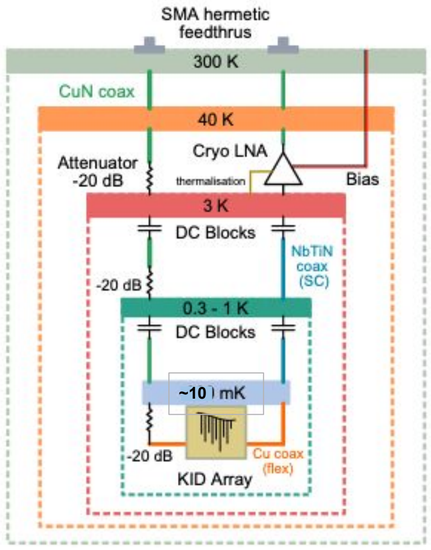
Our Proposal

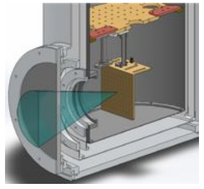
We look to make a simple device for characterizing these low-loss microstrips at 150 GHz. In our device we illuminate an antenna with a thermal source and compare the measured power at 150 GHz transmitted down microstrips of different lengths. The power measurement is made using Microwave Kinetic Inductance Detectors (MKIDs) fabricated directly onto the microstrip dielectric, and comparing the measured response provides a direct measurement of the microstrip loss.

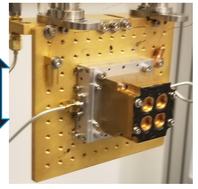
Proposed Experiment

Our proposed structure provides a simple device for characterizing the dielectric loss of various microstrip materials and substrates.

Testing setup

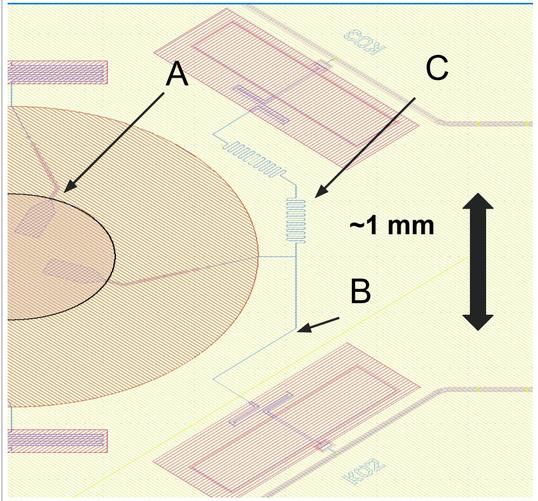




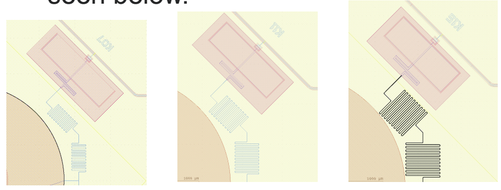


- Blue Fors cryostat internal setup up with sample placement identified as KID Array.
- image of sample box while mounted inside of cryostat.
- SolidWorks drawing of the optical window of our cryostat.

OMT/ pixel structures

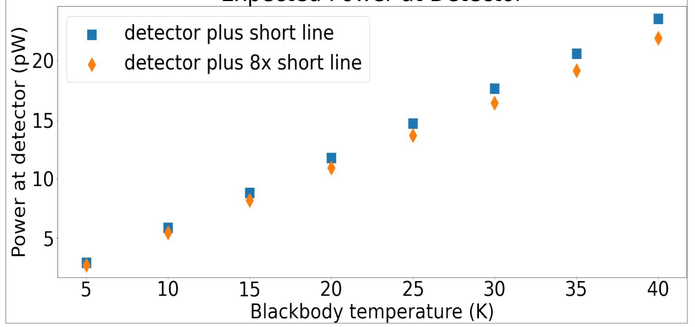


A. OMT window with antennae probes
B. Short microstrip leg to MKID detector.
C. Microstrip feedline “long” leg length(factor of 2 longer). This leg length varies across multiple devices ranging from a factor of 2 - 8 times the length increasing by a factor of 2 as seen below.



Forcasted Results

Assuming a dielectric loss tangent of 2.5×10^{-3} and Rayleigh Jeans approximation for the blackbody temperature, here we show a forecast of the expected power at each detector.



Next steps

Testing

We will continue testing devices until we are able to produce high yield results. Until then we will continue to revisit the fabrication of these devices to determine the best method of producing the expected results.

Acknowledgements

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