

Polarization filter for microstrip lumped-element kinetic inductance detectors

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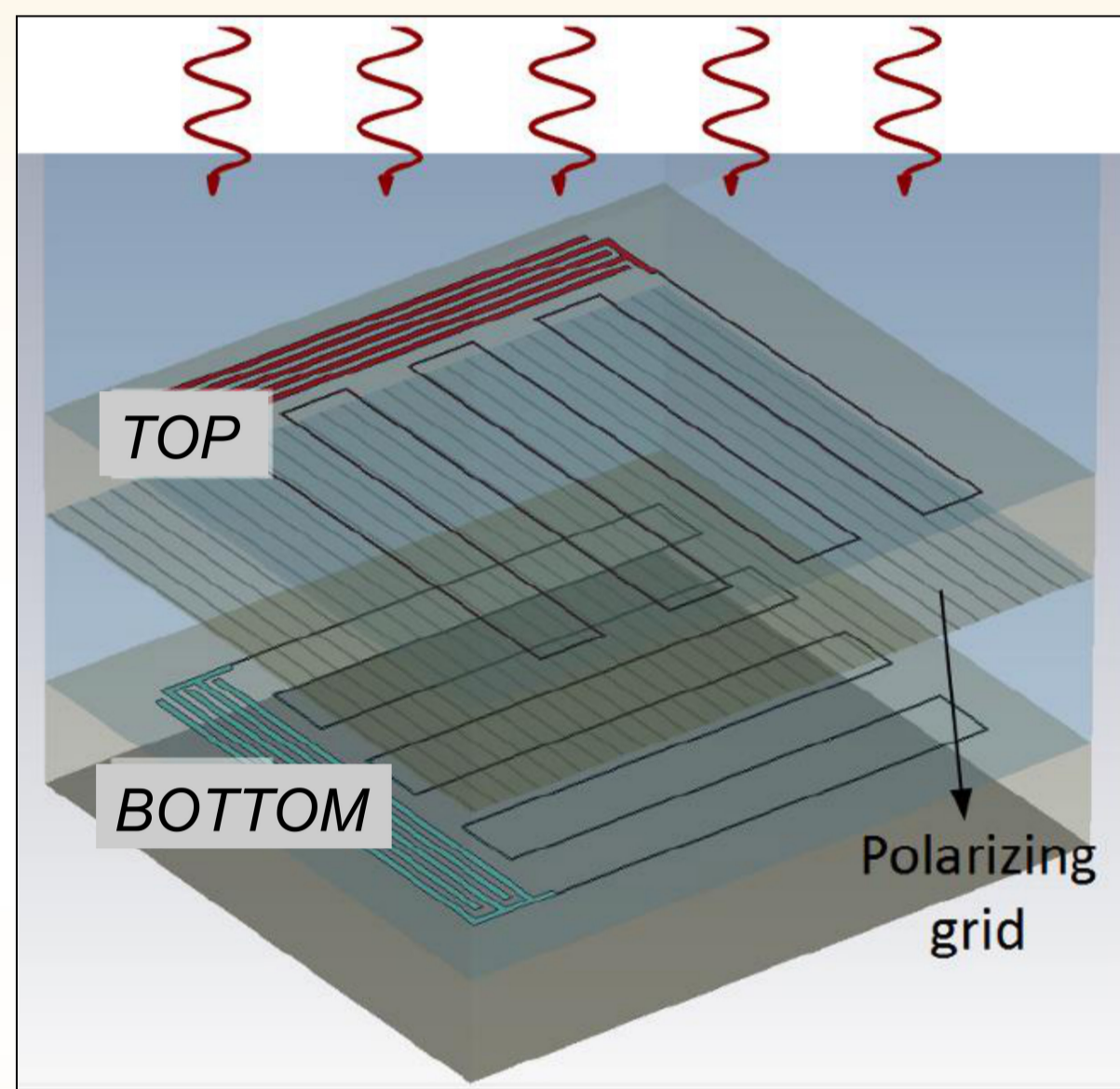
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Abstract

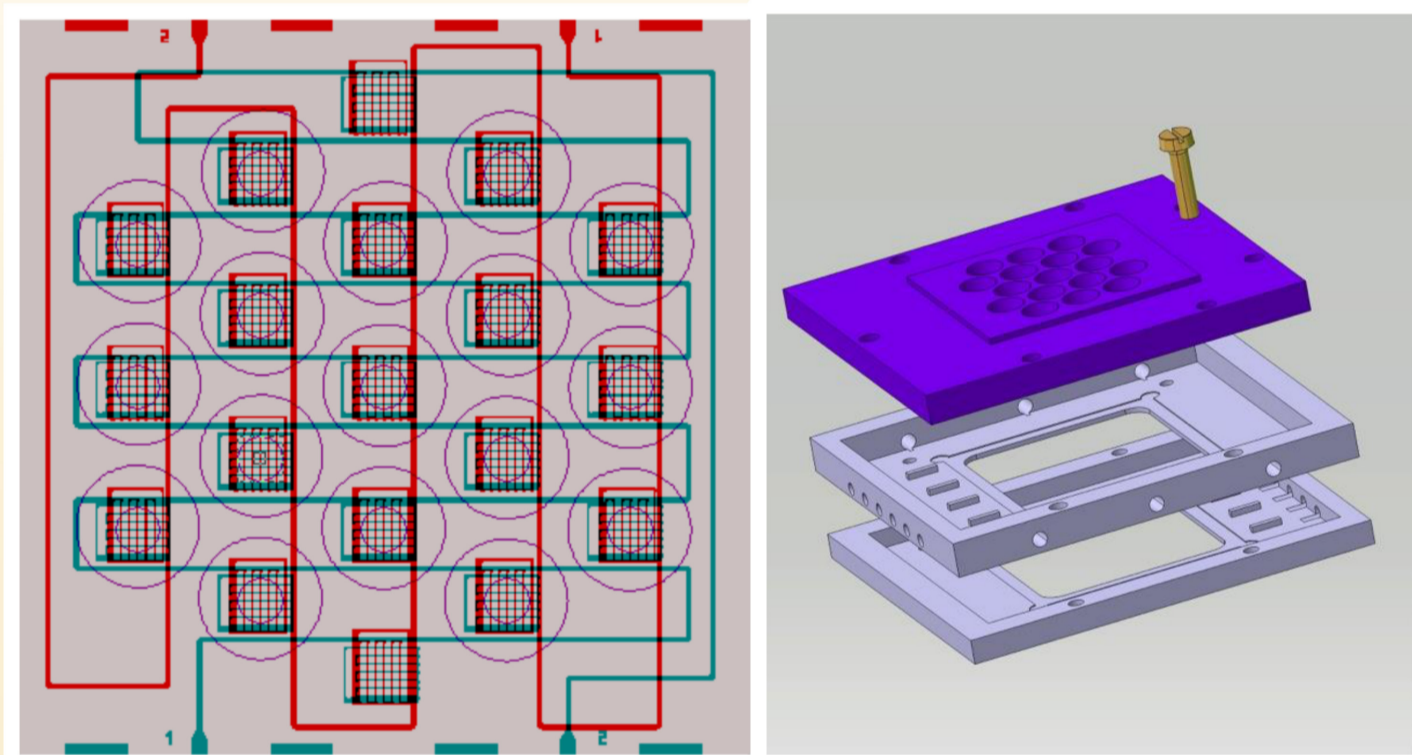
Lumped Element Kinetic Inductance Detectors (LEKIDs) have a broad potential for their future use in Cosmic Microwave Background radiation (CMB) experiments. However, for these experiments, polarization sensitivity is a major requirement and LEKIDs based on meander inductors usually exhibit a cross polarization around 30%. Microstrip (MS) configuration, which consists on shield loops around each resonator and a ground plane on the bottom side of the wafer, has already shown good performance (see NIKA2 Instrument). In this work, continuous ground plane of the MS has been replaced with parallel lines in order to be used as a polarizing grid. Preliminary experiments show a reduction of the cross polarization to 2%.

Design of BiKIDs structure

Limitation on the number of pixels available for the low frequency bands (<100 GHz) in CMB experiments requires the development of on-chip polarization sensitivity. For this purpose, we propose a BiKIDs structure which consists on two arrays superposed and separated by a polarizing grid.

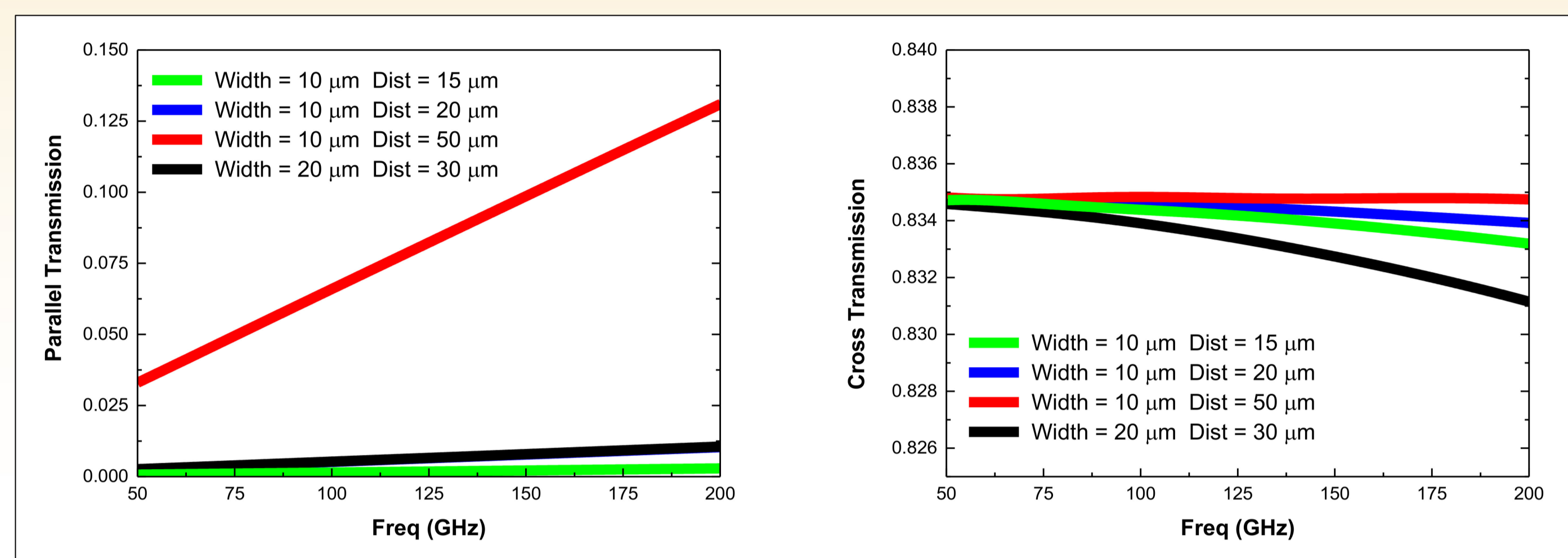


Incoming radiation is coupled from feed-horns to both arrays. Pixels of both arrays (TOP and BOTTOM) are aligned with the center of the feed-horn. A special holder to ensure the alignment has been fabricated.

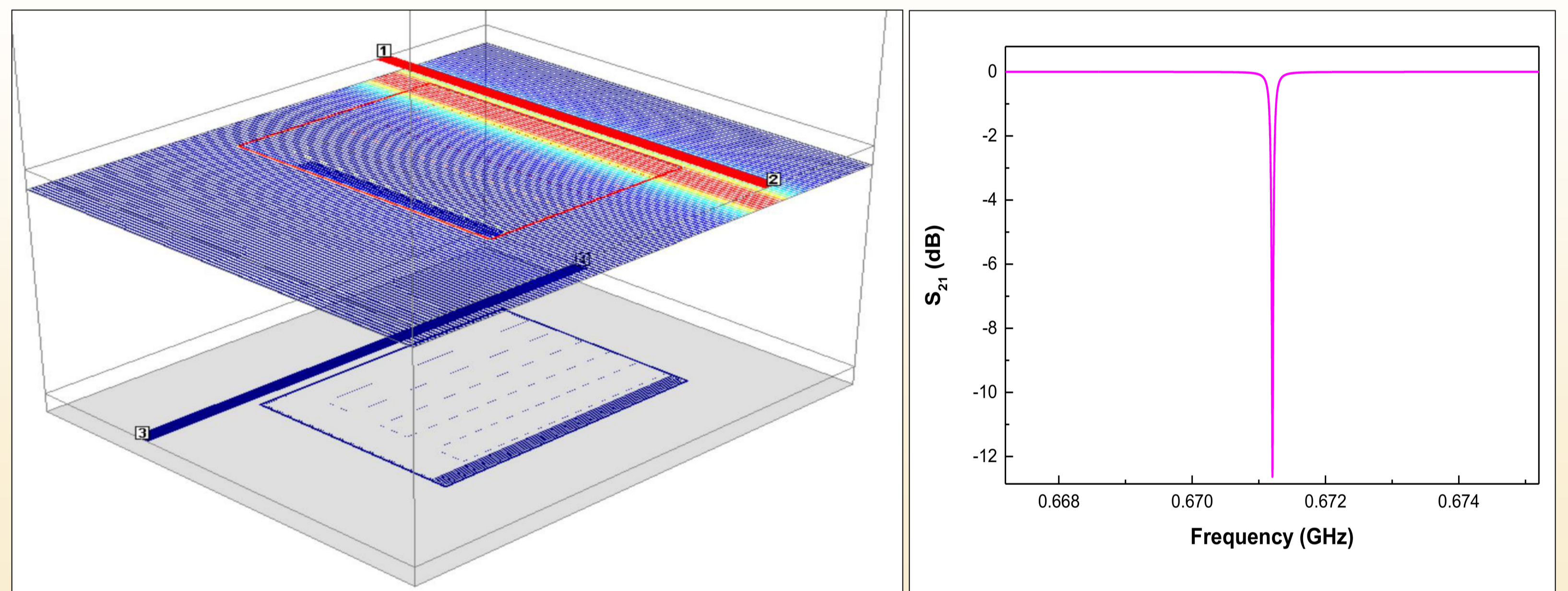


Polarizer simulations

Electromagnetic simulation of a perfect electric conductor (PEC) polarizer as a function of wire width and distance. As shown in figure, for lower spacing between lines, polarizer exhibits better performance, specially at low frequencies. Polarizer of 10 μm width and 15 μm of distance (5 μm spacing) is chosen for the preliminary experiments.

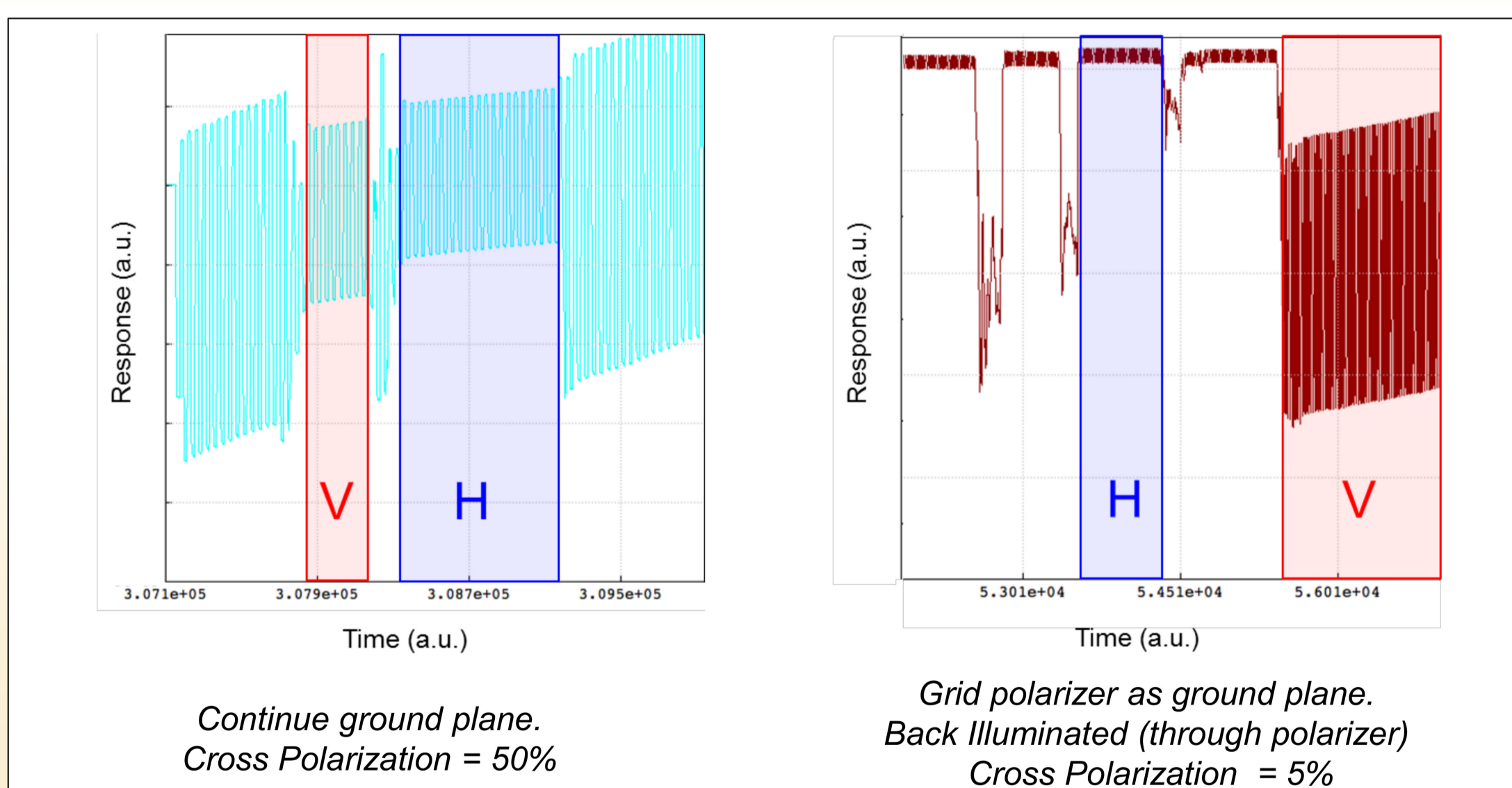


Sonnet simulation of the BiKID structure is shown below. If the spacing between lines is small enough, compared to the resonant frequency wavelength, the wire polarizer acts as an effective ground plane with no influence on the electromagnetic performance.



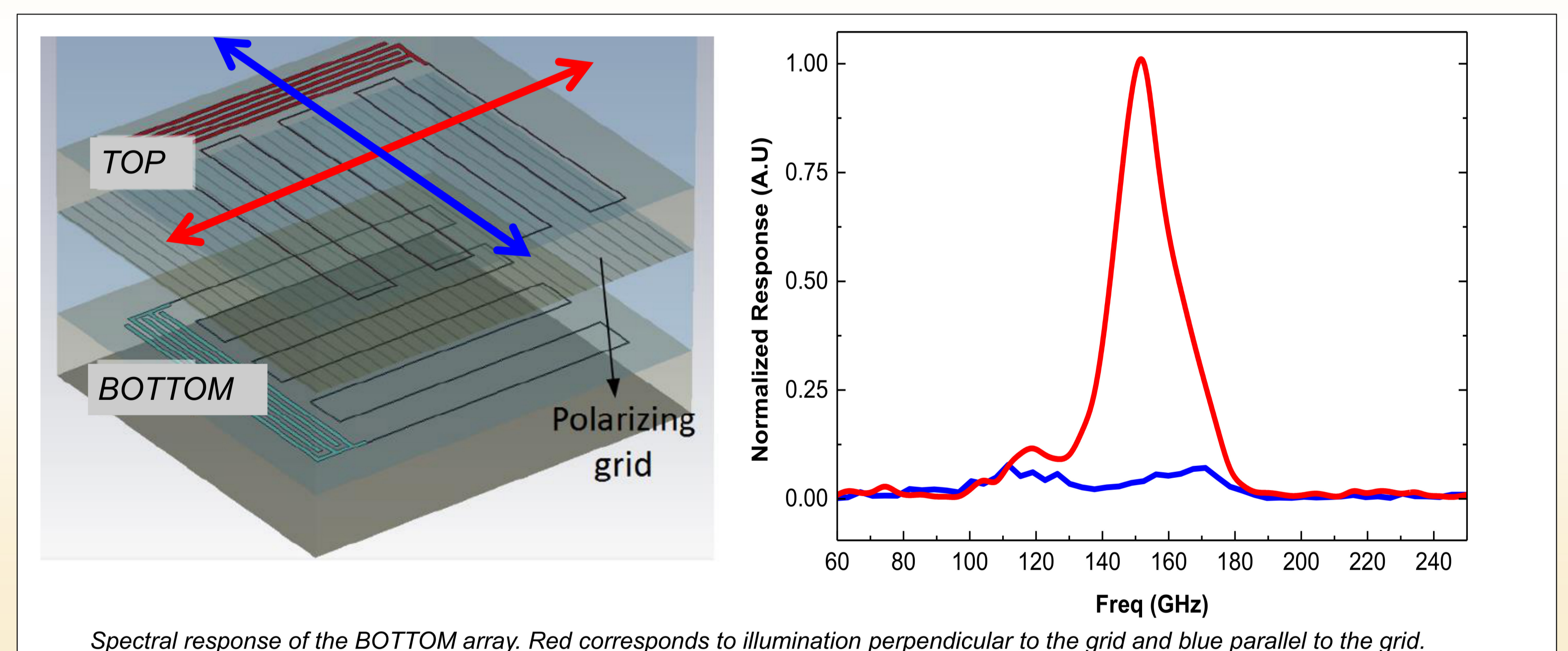
Hilbert LEKID geometry: Polarizer testing

Inductor with Hilbert geometry is used in order to test the polarizer performance. Figures below show the responsivity of a traditional Hilbert LEKID without (left) and with (right) polarizer grid acting as a ground plane. As observed, cross polarization (CP) is reduced from 50% to 5% by adding the polarizer.



BiKIDs Response: Polarization tests

The spectral response of the BiKIDs is obtained using a Martin-Puplett Interferometer. The response is obtained for both parallel (blue) and perpendicular (red) polarization with respect to the polarizer for both arrays (TOP and BOTTOM). Even though the TOP array remains with a significant amount of cross polarization (0.1), the second one is sensitive to the polarization perpendicular to the grid with a cross polarization of 2%.



Summary

- ❖ BiKID structure which consists on two arrays superposed and separated by a polarizing grid is proposed.
- ❖ In order to improve polarization sensitivity, continuous ground plane of the MS is replaced with a polarizing grid.
- ❖ Polarizer grid acts effectively as a ground plane with no influence in the electromagnetic performance.
- ❖ Preliminary experiments show a reduction of the cross polarization to 2%.
- ❖ Further characterization of the polarizers and the BIKID structure will be performed.