Receiving mechanism of array fed by multiple feed points networks : degradation of performance

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This work is part of a collaboration between TNO (Netherlands Organization for Applied Scientific Research) and SRON (Netherlands Institute for Space Research) for the development of technology for the future space mission SPICA proposed by the Japanese Space Agency. The aim of this mission is to observe the formation of galaxies and stars and to investigate the Cosmic Microwave Background (CMB). Observation of the THz spectrum can give insight in these phenomena. Kinetic Inductance Detectors (KID) are high-sensitivity detectors that can be effectively used for imaging at THz frequencies (P. Day, et. al., *A broadband superconducting detector suitable for use in large arrays*, Nature, vol. 425, no. 6960, 2003). KIDs are realized with superconductors and their behavior is strictly linked to the power they absorb at THz frequencies. To effectively couple the incoming signal to the detector, an antenna is connected to the CPW (quarter wavelength) resonator at GHz frequencies that constitutes the KID (Fig.1). In turn the KID is connected to a CPW through line for read-out purposes. The S_{21} parameter of the through line shows a dip at the resonance frequency of the resonator coupled to it. A THz signal received by the antenna breaks the Cooper pairs in the superconductor; this changes the characteristic impedance of the line and consequently the resonance frequency. The frequency shift is a measure for the intensity of the incoming radiation. For coupling the incoming THz radiation, arrays can be also used instead of a single antenna to achieve higher directivity, but the presence of multiple feed points in the lossy corporate feeding network (Fig.2) can result in a degradation of the overall performance of the antenna with respect to the lossless case. An array antenna exhibits a large gain if the contributions received by each array element add up coherently. However, the absorption associated to the breaking of Cooper pairs could be such that the contributions from the physically separated antennas add up incoherently. Consequently, a larger number of elements in the array may not improve the performance. Aim of this work is the investigation of the receiving mechanism to provide a criterium to determine the maximum number of array elements that can be used, depending on the expected loss.

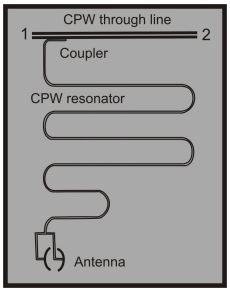

Figure 1: Example of a KID coupled to an arced twin slot antenna.

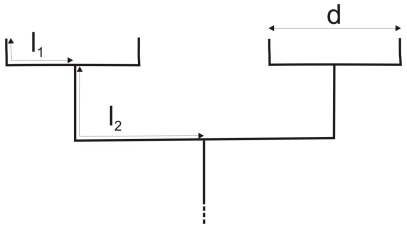

Figure 2: Feeding line for a linear array of 4 elements.