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Cross-coupling in a KID array caused by the thickness variations of the superconducting metal

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NIKA (New Instrument of KID Array) is a new generation of astronomy camera working in the 150 GHz (2mm) and 240 GHz (1mm) bands. This instrument is constructed so as to be more sensitive. For this reason, the photonic detectors used by NIKA are made of a large number of pixels, typically, 1000 pixels and 2000 pixels for the 2 mm and 1 mm bands respectively. The detectors are arrays of KIDs (Kinetic Inductance Detectors). The KID array is an array of superconducting resonators working in the microwave range (from 1 to 3 GHz) and fed by a single transmission line. Basically, when a KID detects a photon at mm-waves, it changes the impedance of its superconducting metal. Consequently, the frequency and the shape of its resonance are modified by this impedance variation in the microwave range. The analysis of this behaviour using an electronic read out, then, permits to make astronomical observations. However, because of the networking of a high number of pixels, the cross-coupling between the resonators in the KID array inevitably induces an inhomogeneous frequency comb, i.e., the resonances are randomly separated and their quality factors are not constant. This phenomenon necessarily reduces the quality of the photonic detection in the camera. For this reason, the different studies performed till today to resolve this problem, have shown that the response of the KID array can be ameliorated if the design of the

resonators and its feed line are modified. Unfortunately, our experiments have shown that these studies give inadequate solutions, because they do not take into account the thickness variations of the superconducting metal caused by the fabrication process. In this paper, a study based on the simulation and low temperature measurements is presented to show how the variations of the metal corrupts the repartition of the frequency comb and how the metal inhomogeneity induces the resonance-to-resonance cross-coupling. Some solutions are then proposed to take into account these metallic variations when designing the KID array.