Performance and surface wave reduction in large monolithic kinetic inductance detector arrays

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Abstract— Microwave kinetic inductance detector (MKID) technology is quickly becoming the main choice for very large focal plane arrays for radioastronomy due to combination of high quantum efficiency, low noise and large multiplexing rations (>1000) due to inherent frequency domain readout. We are developing MKID arrays for APEX MKID instrument, a dual frequency camera with total pixel count of 25000 and 1 f λ sampled field view of 16 x 16 arcmin.

The low frequency band of AMKID covers 350 GHz atmospheric window It consists of four monolithic detector chip tiled in the instrument cold focal plane. Each chip consists of monolithic silicon lens array, glued to a silicon substrate containing 880 MKIDs which are coupled to printed double slot type planar antenna. This design demonstrated high optical efficiency and low noise performance but it contains naturally a parasitic cross talk path, where radiation can travel from one array pixel to another through silicon substrate and monolithic lens array. The latter gives rise to a surface wave and produces spurious response at spatial position where detector is not present. For monolithic detector arrays, this effect has been found to be significant to affect the astronomical observations.

In this contribution we report the MKID array design, analyze the origins and effect of surface wave. We will present laboratory measurements and analysis clearly demonstrating existing effect. We were able to reduce the surface wave significantly by implementing carefully designed absorption mesh layer in the detector structure. We will report on mesh design and laboratory measurements. Finally, we will present laboratory sensitivities and yields of latest generation MKID chips.