Invited Talk

Large format, background limited arrays of Kinetic Inductance Detectors for sub-mm astronomy

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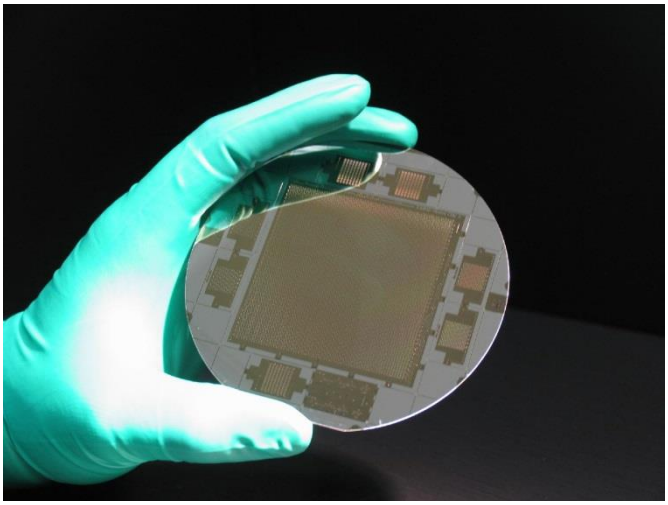
Kinetic Inductance detectors have held a promise for the last decade to enable very large arrays, in excess of 10.000 pixels, with background limited sensitivity for ground- and Space Based sub-mm observatories. First we present the development of the detector chips of the A-MKID instrument: These chips contain up to 5400 detector pixel divided over up to 5 readout lines for the 350 GHz and 850 GHz atmospheric windows. The individual detectors are lens antenna coupled KIDs made of NbTiN and Aluminium that reach photon noise limited sensitivity at sky loading levels in excess of a few fW per pixel using either phase readout or amplitude readout. The ability to use phase readout is crucial as it reduces the requirements on the readout electronics of the instrument. Cross coupling between the KID resonators was mitigated by a combination of numerical simulations and a suitable position encoding of the readout resonance frequencies of the individual pixels. Beam pattern measurements are performed to demonstrate the absence of any cross talk due to resonator-resonator cross coupling. Second we present experiments on individual lens-antenna coupled detectors at 1.5 THz that are made out of aluminium. With these devices we have observed, as a function of the irradiated power at 1.5 THz, the crossover from photon noise limited performance to detector-limited performance at loading powers less than 0.1 fW. In the latter limit the device is limited by intrinsic fluctuations in the Cooper pair and quasiparticle number, i.e. Generation-Recombination noise. This results in a sensitivity corresponding to a NEP = $3.8 \cdot 10^{-19}$ W/√(Hz).



A 100 mm wafer with in its center a 5400 pixel array of background limited NbTiN-Al antenna coupled KIDs. Clearly visible are the 10 bond pads used to connect the 5 lines that connect to 1080 pixels each.