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A dual polarization, background limited Kinetic Inductance Detector operating between 1.4 and 2.8 THz

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Future space-based observatories for the far infrared and sub-mm wave radiation, such as SPICA and the OST telescope, will need ultra-sensitive background limited detectors at frequencies above 1THz. We develop a KID that combines photon noise limited performance, high optical efficiency, broad band and dual polarization radiation coupling operating between 1.4 and 2.8THz, with a NEP below $3 \times 10^{-19} \text{W/Hz}^{1/2}$, and good agreement between the measured and expected optical efficiency. The fractional power ratio between the powers received by the dual polarized detector and by the single polarized counterpart is a factor 2.

The detector consists of a hybrid NbTiN/Al Kinetic Inductance Detector, fabricated on a Si substrate. Radiation coupling is achieved using a leaky lens antenna fabricated on a suspended SiN membrane. The radiation is coupled to the leaky lens antenna using a Si lens placed on top of it at a distance of $6 \mu\text{m}$. The absorbing section of the KID is fabricated entirely from Al, and integrated with the antenna to absorb power from both polarizations directly in the KID. The device shows photon noise limited performance with a NEP below $3 \times 10^{-19} \text{W/Hz}^{1/2}$ around 1.55THz with the expected optical efficiency. The dual polarized device receives twice as much power from an incoherent source than the single polarized one. Additionally, we measure the antenna beam pattern at the same frequency band and find a good match between the measured and simulated beams in reception. Standard transmission simulations are not fully correct due of the intrinsic multi-moded nature of the antenna. To verify the frequency coverage, we measure the frequency response using a Michelson interferometer to find broad band coupling in matching our simulations.

The presented design is upgradable to frequencies up to 10THz using e-beam lithography. These results indicate that broad band, dual polarization radiation coupling above 1THz is feasible using antenna coupled KIDs.

Less than 5 years of experience since completion of Ph.D

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