Superconducting Parametric Amplifiers for 100-300GHz applications

Main author:

OBRIENT Roger

Co-authors:

Day Peter, Jet Propulsion Laboratory

Leduc Henry, Jet Propulsion Laboratory

OBrient Roger, California Institute of Technology

Zmuidzinas Jonas, California Institute of Technology/ Jet Propulsion Laboratory

Our team is developing superconducting parametric amplifiers that exploit the nonlinear kinetic inductance of NbTiN CPW transmission lines to induce four-wave mixing. We have previously discussed 10GHz amplifiers that provide 20dB amplification while adding no more than 3 photons of noise above the quantum limit over an octave bandwidth. In this talk, we will describe on-going measurements of a 100GHz amplifier and discuss designs of a 300GHz amplifier, commenting on measured noise levels, and gain stability. Having no dissipation mechanism, these amplifiers provide much lower noise temperatures (ideally 8K at 300GHz) than HEMTs or MMICS. Since they are traveling wave amplifiers with no intrinsic scale, they have wider bandwidth (nearly an octave) than SIS-junctions. We envision using these parametric amplifiers as front ends for Cosmic Microwave Background radiometers that could function as spectroscopic dust monitors. Such an application would allow a satellite mission with high-frequency sensitivity (beyond W-band) with lower-risk cryogenics that need only be cooled to 4K, and I will comment on plans to test a prototype receiver at OVRO in Owen's Valley. We also envision using these to construct lower noise and wider bandwidth receivers for spatial interferometers such as ALMA or EHT.