Parametric amplification and squeezing with ac- and dc-voltage biased superconducting junction

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Résumé

In this talk I will introduce a new near-quantum-limited parametric amplifier based on the non-linear dynamics of quasiparticles flowing through a superconducting-insulator-superconducting junction. I will first show how photon-assisted tunneling, resulting from the combination of dc- and ac-voltage bias, gives rise to a strong parametric interaction for the electromagnetic modes reflected by the junction coupled to a transmission line. Then, I will show that the device can be tunned to work as both phase-sensitive or phase-preserving amplifier, together with single- and two-mode squeezing. For an Aluminum junction pumped at 8 GHz, narrow-band phase-sensitive amplification of microwaves signals to more than 30 dB, and broadband phase-preserving amplification larger than 15 dB over a 4 GHz band is predicted. I also show single-mode squeezing reaching -20 dB and two-mode squeezing of -14 dB over a 4 GHz band. A key feature is that the device parameters can be tuned in-situ by the applied dc- and ac-voltage biases.

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