Microwave photon-number amplification

Joël Griesmar*[1,2], Romain Albert[3], Florian Blanchet[3], Ulrich Martel[4], Nicolas Bourlet[5], and Max Hofheinz[2]

[1]Laboratoire PMC – Ecole Polytechnique, Centre National de la Recherche Scientifique – Route de Saclay 91128 PALAISEAU CEDEX, France

[2]Institut Quantique [Sherbrooke] – Université de Sherbrooke 2500, boulevard Université Sherbrooke (Québec) Canada J1K 2R1, Canada

[3]INAC-PHELIQS – Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA) - Grenoble – 17 Avenue des Martyrs, 38000 Grenoble, France

[4]Institut Quantique [Sherbrooke] (UdeS) – Université de Sherbrooke, 2500, boul. de l'Université, Sherbrooke, Québec J1K 2R1, Canada

[5]Institut Quantique [Sherbrooke] – Université de Sherbrooke, 2500, boul. de l'Université, Sherbrooke, Québec J1K 2R1, Canada

Résumé

Current microwave photon detectors struggle to measure weak signals accurately: single-photon detectors are binary and lose detailed photon information, while bolometers are too noisy for single-photon detection. This gap limits our ability to measure photon number in quantum states, creating a need for new solutions in microwave quantum sensing. In this talk, we present a novel microwave photon-multiplication scheme based on inelastic Cooper pair tunneling that amplifies incoming photon counts by an integer factor, combining the sensitivity of single-photon detectors with the versatility of power meters. Our first experimental implementation demonstrates a three-fold multiplication with 69% efficiency over a 116 MHz bandwidth, managing input photon rates up to 400 MHz-seamlessly, with no dead time or time binning required. While this approach loses phase information, it enables continuous detection. Looking ahead, we anticipate that optimized cascading of these multipliers could allow for precise, low-dark-count, number-resolving photon measurements, unlocking powerful applications in quantum sensing and quantum computing.

*Intervenant