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Quantum Microwave Radiometry with a Superconducting Qubit

The interaction of photons and coherent quantum systems can be employed to detect electromagnetic radiation with remarkable sensitivity. We introduce a quantum radiometer based on the photon-induced-dephasing process of a superconducting qubit for sensing microwave radiation at the sub-unit-photon level. Using this radiometer, we demonstrated the radiative cooling of a 1-K microwave resonator and measured its mode temperature with uncertainty ~0.01 K. We have thus developed a precise tool for studying the thermodynamics of quantum microwave circuits, which provides new solutions for calibrating hybrid quantum systems and tracing candidate particles for dark matter.