Studying photon statistics and noise with quantum sensors

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We present the results of investigation of quantum sensors for THz and microwave frequency range receivers for radioastronomy and dark matter search. The first considered type of sensors are cold-electron bolometers (CEBs) [1,2] that show record sensitivity due to direct electron cooling of an absorber thanks to the use of hybrid superconducting/ferromagnetic structures. The CEBs demonstrate both background limited operation and also record cosmic rays immunity due to tiny volume of an absorber and decoupling of electron and phonon subsystems. Another important advantage of these bolometers is due to their micron size, which allows design and fabrication of multi-absorber receiving pixels [1,3]. We demonstrate the results of design and investigation of different types of receivers with samples, fabricated in Nizhny Novgorod [3,4]. The first one is a metamaterial based on ring antennas with CEBs, operating in a broadband frequency range from 150 to 550 GHz [3]. The second one is the two-bolometer system in a coplanar line, reaching a high sensitivity of 6×10^{-18} W/Hz$^{1/2}$ at 300 mK [4]. We also perform investigation of photon noise from a broadband Josephson junction source, using multi-absorber receivers with CEBs.

Also, the current progress of microwave single photon detectors for dark matter search will be outlined [5,6]. As a source of microwave photons, classical sources are used. We will present the detection results of strongly suppressed signal from the synthesizer, giving Poissonian photon statistics. Another source is the microwave cavity, heated from 20 to 80 mK, that shows super-Poissonian photon statistics, this confirming detection of thermal photons [6].

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