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Transition-Edge Sensors in Quantum Land

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During the last years, Transition-Edge Sensors (TESs) have found an ever more growing number of applications as single photon number resolving detectors in fields as quantum optics [1][2], telecommunication [3][4][5], quantum metrology [6][7][8] and quantum technologies [9].
The most important TES characteristics for the quantum land's inhabitant are the negligible numbers of dark-counts, the discrimination of the number of impinging photons on a detector, the high energy resolution and furthermore the possibility to fabricate devices with a very high quantum efficiency.
In particular, is possible to fabricate devices with quantum efficiency (QE) over 90%, very attractive for performing detection loophole free tests of contextuality, steering and eventually, Bell's inequalities.
In this work we present the first results obtained with INRIM TESs in the quantum land during the last two years. We proposed an innovative absolute calibration technique for photon number resolving detectors, using a pulsed heralded photon source based on parametric down conversion. The technique, being absolute, does not require reference standards and is independent upon the performances of the heralding detector [7][9].
The second order correlation function at time delay zero of non-classical light emitted by nitrogen vacancy (NV) centers in nano-diamonds has been studied and measured with our TES and compared with standard methods [8].
We implemented also the first experimental reconstruction of the positive operator-valued measure (POVM) describing the operation of a TES and, in turn, the first demonstration of the binomial assumption [11]. Well characterized photon number resolving detectors are a requirement for many applications ranging from quantum information and quantum metrology to the foundations of quantum mechanics.
Finally, the last results concerning the optimization of important parameters as energy resolution, time response and quantum efficiency of a very fast TES measured at AIST in Japan are present.

Refernces

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[5] "Sub-shot-noise-limit discrimination of on-off keyed coherent signals via a quantum receiver with a superconducting transition edge sensor", Tsujino Kenji et al., Optics Express, 18 8107 (2010).

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[9] "Ti/Au TES as superconducting detector for quantum technologies", Lolli L., et al., International Journal of Quantum Information, 9 405 (2011).

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