Detecting spins by their fluorescence with a microwave photon counter

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Single-photon counters are essential for detecting weak incoherent electro-magnetic radiation.
In the optical domain, they are widely used to detect spontaneous emission from individual quantum systems, with applications in fluorescence microscopy, and in numerous areas of quantum technologies. In the microwave domain, operational single-photon counters have just recently been developed using superconducting quantum circuits [1], offering novel opportunities for detecting fluorescence or spontaneous emission at microwave frequencies. Here, we demonstrate the use of a microwave single-photon counter to detect the photons spontaneously emitted by a small ensemble of electron spins coupled to a superconducting micro-resonator [2]. In this novel spin detection scheme, each click of the detector reveals the quantum jump of an individual spin from its excited to its ground state. Besides their fundamental interest, our results also constitute a novel methodology for Electron Spin Resonance spectroscopy, it paves the way toward the readout of individual electron spins for quantum sensing at the single molecule level and quantum computation with highly coherent electron spins [3] and their nuclear registers.

Figures

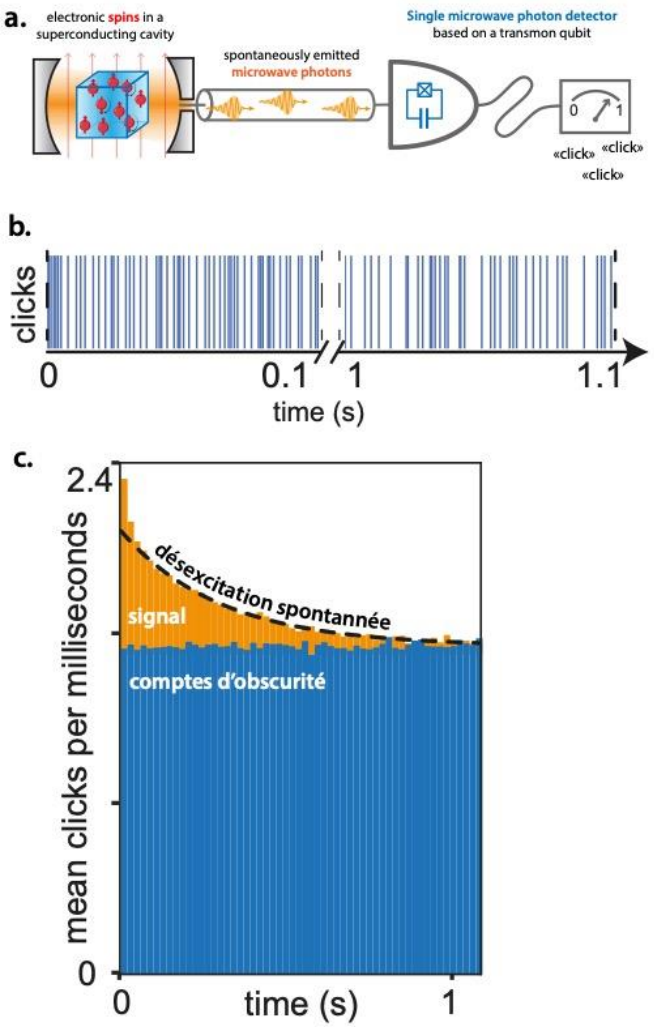

Figure 1: a) schematics of the experiment b) Instance of a measurement record of the spin fluorescence by microwave photon counting c) Average measurement, the excess counts measure the spin ensemble decay time.

References

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