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Multiplexed photon number measurement

When a two-level system – a qubit – is used as a probe of a larger system, it naturally leads to answering a single yes-no question about the system state. This talk will present an experiment where a single superconducting qubit is able to extract – not a single – but more than 3 bits of information about the photon number of a microwave resonator using continuous measurement. By recording the fluorescence emitted by the qubit reflecting a frequency comb, we implement a multiplexed photon counting experiment where the information about each Fock state – from 0 to 8 – is simultaneously encoded in independent measurement channels. Direct Wigner tomography of the quantum state of the resonator evidence the back-action of the measurement as well as the optimal information extraction parameters. Our experiment unleashes the full potential of quantum meters by replacing a sequential quantum measurements with simultaneous and continuous measurements separated in the frequency domain.