# Trapping and counting photons without destroying them: a new way to look at light

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Detecting photons is essential to many data acquisition and communication procedures. Usual photo-detectors can count photons one by one, but they do it by brute force, the light being absorbed in the process. Like the marathon soldier, photons seem condemned to die upon delivering their message. This fate, though, is not imposed by quantum theory, which tells us that transparent detectors registering photons without destroying them are possible. We have demonstrated such a procedure and realized a non-demolition photo-detection at the quantum level. A microwave field is stored between two highly reflecting superconducting mirrors for a time interval exceeding a tenth of a second. A stream of excited atoms behaving as microscopic clocks whose ticking rate is affected by light pass, one at a time, between the mirrors. By measuring the clocks' delay, we extract information from the field without energy absorption and the light progressively collapses into a state of well-defined photon number. Residual absorption or emission by the mirrors results in quantum jumps, recorded as sudden and random changes of the photon number. This new way to "look" at light opens many promising perspectives for the control, manipulation and reconstruction of trapped photonic states. I will conclude the talk by briefly describing how we have used the non-demolition photon counting procedure to generate field state superpositions known as "Schrödinger cats", to fully reconstruct their quantum state and to record their decoherence. This experiment can be viewed as a direct exploration of the boundary between the quantum and classical worlds.

**Figure caption:** Microwave photons trapped between superconducting mirrors are counted without being destroyed.