Quantum fluctuation relations. Overcoming the two-measurements issue

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In the last two decades the field of nonequilibrium statistical mechanics has received a renewed and intense momentum in its development due to the discovery of exact results, known as fluctuation relations, which are valid independent of how far a system is driven out of equilibrium. These relations offer a powerful tool for the investigation of thermodynamic properties of nano-system even in the quantum regime [1,2]. One major obstacle to the experimental verification of quantum fluctuation relations comes from the requirement of performing two projective measurements on the system (or on the system plus environment, if the system is open) at the beginning and end of the driving protocol. We discuss two strategies to overcome this difficulty. The first strategy is based on the observation that fluctuation theorems are robust to intermediate, possibly weak, measurements [3]. Its application to bi-directional electron counting statistics will be illustrated [4]. The second strategy employs an interferometric measurement on an ancilla-qubit appropriately coupled to the system [5,6]. We will discuss its advantages and its implementation in a circuit QED set-up [7].

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