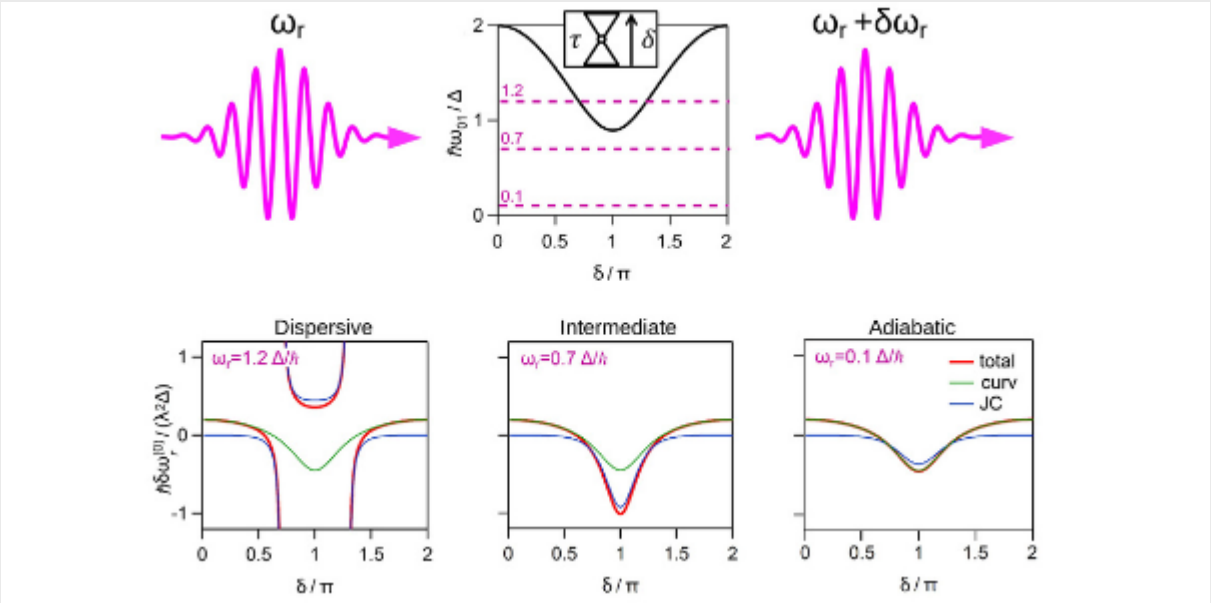
From adiabatic to dispersive readout of Quantum Circuits



Article: Published, in Physical Review Letters by Sunghun Park and Alfredo Levy Yeyati, members of the Theoretical Condensed Matter physics Department.

Circuit quantum electrodynamics (QED) allows to readout the state of a qubit or a quantum circuit by monitoring the resonance frequency shift induced in a microwave resonator coupled to it, achieving regimes and phenomena which cannot be reached within the realm of quantum optics. For the interpretation of circuit QED experiments, two disconnected theoretical approaches exist depending on whether the detuning with respect to the microwave resonator frequency is small or large. We here show that a unified description of both the large and small detuning regimes, referred to as adiabatic and dispersive regimes, respectively, and provide an expression for the resonator frequency shift up to second order in the coupling between a resonator and a quantum circuit. We further provide a set of simple examples where we illustrate the need of the full theory to account for the resonator frequency shift for a wide range of system parameters. [Full article]