**Artificial atoms interacting with light and sound**

We study propagating photons and phonons at the quantum level by investigating their interaction with artificial atoms in the form of superconducting qubits.
In the photon experiments, a transmon qubit is coupled to a superconducting 1D transmission line. Strong interaction between the artificial atom and photons is revealed in the reflection of the propagating microwaves. 99.6% extinction of the transmission has been observed. A number of different effects based on the scattering properties of the qubit is discussed, including an experiment where the qubit is placed in front of a mirror.
We also present a new type of mechanical quantum device, where propagating surface acoustic wave (SAW) phonons couple to a superconducting qubit through the piezoelectric effect. Four different experiments are presented: i) Exciting the qubit with an electromagnetic signal we can “listen” to the SAW phonons emitted by the qubit. ii) Reflecting a SAW wave off the qubit, we observe a nonlinear reflection with strong reflection at low power and low reflection at high power. iv) nonexponential decay from a giant atom.