Demonstration of a single-photon router in the microwave regime

Io-Chun Hoi[a], C. M. Wilson[a], G. Johansson[a], T. Palomaki[a], B. Peropadre[b], P. Delsing [a], and **P. Delsing** [a]

[a]Chalmers University of Technology, Gö teborg, Sweden
[b]Instituto de Fisica Fundamental Serrano, CSIC, Madrid, Spain

We have embedded an artificial atom, a superconducting "transmon" qubit, in an open transmis- sion line and investigated the strong scattering of incident microwave photons ($\sim\uparrow$ 6 GHz). When an input coherent state, with an average photon number $N \ll 1$ is on resonance with the artificial atom, we observe extinction of up to 99.6% in the forward propagating field. We use two-tone spectroscopy to study scattering from excited states and we observe electromagnetically induced transparency (EIT). We then use EIT to make a single-photon router, where we can control to what output port an incoming signal is delivered. The maximum on-off ratio is around 99% with a rise and fall time on the order of nanoseconds, consistent with theoretical expectations. The router can easily be extended to have multiple output ports and it can be viewed as a rudimentary quantum node, an important step towards building quantum information networks.