
Counting propagating microwave photons and generating single phonons

Göran Johansson*^{†1}

¹Chalmers University of Technology (Chalmers) – Chalmers University of Technology SE-412 96
Gothenburg Sweden, Sweden

Abstract

In this talk, I'll discuss the physics of microwave photons moving in a coplanar waveguide (1D transmission line) interacting with one or more artificial atoms. Compared to the optical regime, the microwave regime allows for strong and stable coupling of the photons to (artificial) atoms. In particular, I'll discuss the possibility of using the giant cross-Kerr effect for QND detection of propagating microwave photons. Motivated by recent experiments, I'll also discuss what happens when the microwave photons are replaced by surface acoustic wave (SAW) phonons. The phonon velocity is five orders of magnitude slower, implying also that the atom is now substantially larger than the wavelength for its spontaneous emission.

The presentation is primarily based on the following references:

- "Detecting itinerant single microwave photons", S. R. Sathyamoorthy, T. M. Stace, G. Johansson, e-print arXiv:1504.04979
- "Non-absorbing high-efficiency counter for itinerant microwave photons", B. Fan, G. Johansson, J. Combes, G. J. Milburn, T. M. Stace, Phys. Rev. B **90**, 035132 (2014).
- "Quantum nondemolition detection of a propagating microwave photon", S. R. Sathyamoorthy, L. Tornberg, A. F. Kockum, B. Q. Baragiola, J. Combes, C.M. Wilson, T. M. Stace, G. Johansson, Phys. Rev. Lett. **112**, 093601 (2014).
- "Quantum Acoustics with Surface Acoustic Waves", T. Aref, P. Delsing, M.K. Ekstrom, A.F. Kockum, M.V. Gustafsson, G. Johansson, P. Leek, E. Magnusson, R. Manenti, e-print arXiv:1506.01631
- "Propagating phonons coupled to an artificial atom", M.V. Gustafsson, T. Aref, A.F. Kockum, M.K. Ekström, G. Johansson, P. Delsing, Science **346**, 207 (2014).
- "Designing frequency-dependent relaxation rates and Lamb shifts for a giant artificial atom", A.F. Kockum, P. Delsing, G. Johansson, Phys. Rev. A **90**, 013837 (2014).

*Speaker

[†]Corresponding author: Goran.L.Johansson@chalmers.se