Seminar

Quantum optics with propagating microwaves in superconducting circuits

[illegible]

Time: 2:30 pm, Sept.24, 2014 (Wednesday)
2014 9 24 2: 30
Venue: Conference Room A (607), No. 5 Science Building
607

Abstract

In recent years, much effort has been invested to using superconducting artificial atoms to explore quantum optics in new parameter regimes. In this talk, I will address advances on quantum optics with propagating microwaves [1]. In the first sets of experiments, we embed a transmon artificial atom in an open transmission line. When a weak coherent state is on resonance with the atom, we observe extinction of up to 99% in the forward propagating field. We also study the statistics of the reflected radiation, and we demonstrate photon antibunching in the reflected signal by measuring the second-order correlation function [2]. By applying a second control tone, we observe the Autler-Townes splitting and a giant cross-Kerr effect [3]. Furthermore, we demonstrate fast operation of a single-photon router [4] using the Autler-Townes splitting. In the second sets of experiment, we embed a transmon at a distance from the end (mirror) of a transmission line[5]. By tuning the wavelength of the atom, we effectively change the normalized distance between atom and mirror, allowing us to effectively move the atom from a node to an antinode of the vacuum fluctuations. We probe the strength of vacuum fluctuations by measuring spontaneous emission rate of the atom.

In order to have long term development of quantum optics with superconducting circuits, a broadband, high saturation power and low noise (quantum limited) amplifier, is needed. I will describe a phase-insensitive microwave amplifier based on SQUIDs to fulfill these requirements. At the end, I will propose promising experiments using the SQUID amplifiers.

[1] I.-C. Hoi et al. New Journal of Physics 15, 025011 (2013)
[2] I.-C. Hoi et al. Physical Review Letters 108, 263601 (2012)
[3] I.-C. Hoi et al. Physical Review Letters 111, 053601 (2013)
[4] I.-C. Hoi et al. Physical Review Letters 107, 073601 (2011)
[5] I.-C. Hoi et al. in preparation (2014)

About the Speaker

Dr. IO CHUN, HOI got his Bachelor degree from National Chiao Tung University, Taiwan in 2007 and his master degree from Chalmers University of Technology, Sweden in 2008. In 2013, he finished his Ph.D education at the same university in Sweden. Since 2013 to present, he has been the Postdoctoral fellow at University of California, Santa Barbara. His research is Experimental quantum optics and quantum computing with superconducting circuits.