



Seminar/Talk

Hybrid optomechanical and superconducting quantum circuits

Oskar Painter

Caltech

Host: Quantum Seminar

I will present recent ideas and developments involving the integration of optomechanical crystals, which couple light and sound [1], and electronic superconducting quantum circuits which have large quantum nonlinearities that can be exploited for quantum information processing applications [2]. Utilizing the silicon-on-insulator (SOI) wafer platform, we have made key advances in the fabrication and integration of extremely low-loss microwave phonon structures and low-loss microwave superconducting resonators. These technical advancements offer several intriguing opportunities for quantum information processing and networking with phonons, photons, and electrons in an integrated, wafer-scale platform. After providing an introduction to optomechanical crystals, the focus of my talk will be on three recent highlights of our work in this area: (i) nonreciprocal photon transport and amplification arising from synthetic magnetic flux and reservoir engineering in an optomechanical crystal circuit [3], (ii) demonstration of a hypersonic (GHz) silicon optomechanical crystal resonator with Q-factor = 40 billion at mK temperatures, and (iii) development of transmon qubits on SOI with excellent coherence properties ($T_1 = 3.5\mu\text{s}$, $T_2 = 2.2\mu\text{s}$). [1] M. Eichenfield, J. Chan, R. Camacho, K. J. Vahala, and O. Painter, Optomechanical Crystals, *Nature*, doi:10.1038/nature08524, October 19 (2009). [2] M. H. Devoret and R. J. Schoelkopf, Superconducting Circuits for Quantum Information: An Outlook, *Science*, doi:10.1126/science.1231930v339, March 8 (2013). [3] Kejie Fang, Jie Luo, Anja Metelmann, Matthew H. Matheny, Florian Marquardt, Aashish A. Clerk, and Oskar Painter, Generalized non-reciprocity in an optomechanical circuit via synthetic magnetism and reservoir engineering, *Nature Physics*, doi:10.1038/nphys4009, January 16 (2017).

Thursday, September 14, 2017 11:00am - 12:30pm

Big Seminar room Ground floor / Office Bldg West (I21.EG.101)



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