Coupling microwaves and optical light

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At UC Santa Barbara, we have been developing a new quantum optomechanical device which allows the direct control of an optical signal at 1550 nm with a microwave-frequency electronic signal. This for example can be used to encode the electrical signal on the optical signal, by generating optical sidebands at the electronic drive frequency, thus providing a type of microwave-to-optical frequency up-conversion. This is achieved using a photonic one-dimensional optomechanical crystal fabricated from a piezoelectric material, the latter converting electrical signals to phonons; the phonon mode is co-localized with the photonic mode, giving strong optomechanical coupling between the two modes.

We plan to use this device to generate optical-frequency entangled sideband photons using a superconducting qubit as a source of entangled microwave frequency photons, thus enabling the coherent transfer of quantum information from a millikelvin cryostat to a fiber optic transmission line, with the potential of coupling hybrid quantum systems.

I will report on our progress in developing this novel device.