Progress towards fully integrated quantum optics in the silicon-on-insulator platform

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Photons possess many ideal qualities as quantum information carriers and consequently integrated quantum optics is an increasingly investigated approach to on-chip quantum information processing. This approach requires the integration of electronics, linear optics, single photon detectors and nonclassical light sources. Silicon is a versatile platform for integrated electronics and photonics, and is particularly attractive due to the availability of foundries that now provide low-cost, custom integrated silicon photonic and electronic systems for fast research and development. Silicon-on-insulator (SOI) therefore merits investigation as an integrated quantum optics platform. The major drawback to using silicon as the platform for quantum optics, as compared to GaAs or InP, is the lack of epitaxial emitter and absorber layers at the operating wavelength of around 1.55 micrometers.

In this poster, we present progress on hybrid solutions to integrating single photon sources and detectors in SOI. Included are (1) development of small-footprint, silicon-integrated, high-efficiency superconducting single photon detectors, (2) modeling and measurements of colloidal quantum dots -- established single photon emitters -- in and out of silicon photonic circuits, and (3) development of silicon photonics for more efficient extraction and manipulation of single photon emitters.