Quantum Information Processing with Spins and Photons in Semiconductor Circuits

The field of quantum optics offers new ways to compute, communicate, and measure with quantum states. Recent advances in quantum control and semiconductor nanofabrication now open the prospect for scalable quantum technologies using solid-state quantum systems. In particular, photonic integrated circuits (PICs) now allow us to route photons with high precision and low loss, and atom-like systems in semiconductors enable spin-based quantum memories that can be coupled to photons. The first part of this talk will review our recent progress in adapting one of the leading PIC architectures—silicon photonics—for various quantum secure communications protocols. The second part of the talk will consider how PIC technology, integrated with quantum memories, can extend the reach of quantum communications using quantum repeater networks.

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