SLAC COLLOQUIUM SERIES

Connecting quantum systems – through optimized photonics

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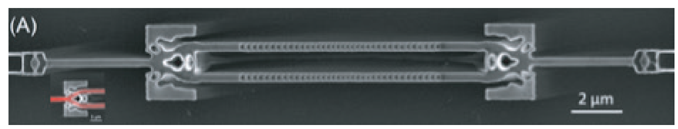
Abstract:
Color centers in wide bandgap materials, such as silicon vacancies (SiV) in diamond and (VSi) in silicon-carbide (SiC), represent a promising platform for implementation of quantum technologies: they exhibit a small spectral inhomogeneity and a minimal sensitivity to environment, which facilitates their incorporation in scalable devices. Excellent SiV- and VSi-photon interfaces have been demonstrated (by embedding them in cavities) with large cooperativities and Purcell enhancements. We have also demonstrated cavity enhanced Raman scattering from a single SiV for detuning of up to 100GHz - well beyond 30GHz of spectral inhomogeneity observed for SiVs embedded in structures, which enables experiments incorporating multiple SiVs. However, in addition to high quality qubits interfaced to photons, successful implementation of quantum technologies also requires photonic circuits that are scalable, robust to errors, and exhibit minimal losses. Our recent work on inverse design in photonics offers a powerful tool to design and implement photonic circuits with superior properties, including robustness to errors in fabrication and temperature, compact footprints, novel functionalities, and high efficiencies. We have applied this approach to diamond and SiC quantum hardware, leading to greater than an order of magnitude of improvement in efficiencies and a dramatic reduction in experimental times, thereby opening opportunities for new experiments, including implementation of solid state quantum simulators.



January 14, 2019, Kavli Auditorium, refreshments start at 3:15 and colloquium at 3:30 pm