USC Viterbi School of Engineering

MORK FAMILY DEPARTMENT OF CHEMICAL ENGINEERING AND MATERIALS SCIENCE

Distinguished Lecture Series

presents

"A New Paradigm for On-Chip Scalable Quantum Photonics"

by

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Abstract:

On-chip quantum photonic circuits generating single and entangled multiphoton states are highly sought to enable compact quantum information processing systems for secure communication, Heisenberg uncertainty limited metrology / imaging, sensing, materials simulations, and computation. At the heart of realizing such circuits is the ability to have single photon sources at pre-specified locations on chip and manipulate the single photons generated deterministically to interfere/ entangle. Elegant work has been done in demonstrating single photon source performance and photon interference based dominantly on finding a suitable source from a random ensemble. The major obstacle to the field is the lack of scalable on-chip architectures.

In this talk, I will present our work in overcoming this obstacle by providing a scalable starting source array. Our proposition and continuing efforts to realize the needed photonic chip is based upon our demonstration of a unique class of on-chip integrable spatially ordered and spectrally uniform GaAs/InGaAs quantum dots (QDs) as single photon sources (SPSs). These QDs exhibit single photon emission purity >99% and an unprecedented spectral non-uniformity down to 1.8nm (< 2meV) in 5×8 array distributed over 1000μm^2. Strikingly, several pairs of the *as-grown* QDs emit within 300μeV, within the range of established on-chip local tuning methodologies to bring them "on resonance" for creating multiphoton entangled states from distinct QDs. Following planarizing overlayer growth, the demonstrated buried QD SPS arrays provide the essential scalable platform for subsequent integration, using lithographic fabrication process, of co-designed light manipulating units (LMUs) that provide essential functions such as enhanced emission rate and controlled emission direction, state-preserving propagation beam-splitting, and combining to create controlled interference. This new paradigm of planarized ordered and uniform SPSs array enables the on-chip scalable realization of photon interference and entanglement between photons from distant sources, a step that moves the status closer to realizing quantum photonic optical circuits.

Tuesday, April 20, 2021
4:00p.m.

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