USC Viterbi
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Photonics Seminar

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On-Chip Scalable Ordered Single Photon Sources: A Step Closer to Quantum Optical Circuits

Tuesday, October 12, 2021
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1:30 PM – 2:30 PM
Zoom Link:
https://usc.zoom.us/j/91808071892?pwd=VUwyK3NSNW5rSzVLQzFKSGdPc05yUT09

Abstract: On-chip quantum photonic circuits generating single and entangled multiphoton states are highly sought to enable compact quantum information processing systems for linear optical quantum computing, quantum metrology and quantum imaging. Yet no such quantum photonic circuits have been demonstrated. The bottleneck has been the lack of an approach to realizing single photon sources (SPSs) with all the characteristics (bright, pure, and highly visible) necessary and in a spatially uniform scalable arrays and with as-synthesized sufficiently uniform spectral emission characteristics amenable to established local-tuning techniques to enable creation of coupled SPSs networks.

In this talk I will present one such approach dubbed substrate-encoded size-reducing epitaxy (SESRE) that shows considerable promise to provide the break-through needed to enable the long-awaited step towards quantum optical circuits. The SESRE based spatially regular arrays of mesa-top single quantum dots (MTSQDs) have been demonstrated to emit highly uniform, bright, pure, and indistinguishable single photons through systematic quantum optical studies. Such MTSQD array can enable creation of on-chip coupled SQD circuits/network operating at single and multiphoton level through deterministic integration with light control units. Such circuits/network can be realized with MTSQD arrays hybrid integrated with the highly advanced silicon-based SOI photonic platforms including fast modulation capabilities while and also with monolithic integrated systems exploiting photonic 2D crystal technologies for control and manipulation of the emitted photons to affect optical circuits. 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.

Work carried out with Swarnabha Chattaraj, Qi Huang, Lucas Jordao, & Anupam Madhukar of USC and Siyuan Lu of IBM, Supported by AFOSR and ARO.

Biography: Dr. Jiefei Zhang is a Research Assistant Professor at University of Southern California. She received her B.A. with honors in Applied Physics from Tongji University (China) and her Ph.D in Physics from the University of Southern California in 2017 with ground breaking work on on-chip single photon sources for quantum optical circuits. Her research interest and efforts are focused on Quantum Photonics, in particular on generating and harnessing single and multiple photon quantum states, dubbed NOON states, in on-chip circuits for Heisenberg-limit metrology, communication, and computation.

Hosts: Faculty-Wade Hsu, Mercedeh Khajavikhan, Michelle Povinelli, Constantine Sideris, and Wei Wu
Students-Max Lien and Raymond Yu
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