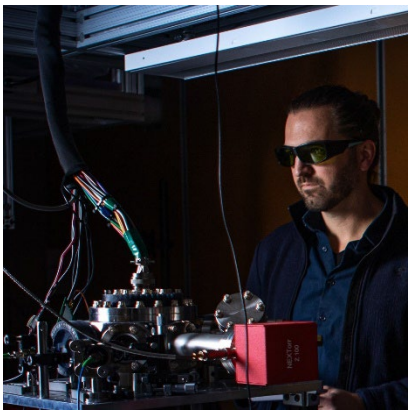
UCONN
COLLEGE OF ENGINEERING
ELECTRICAL & COMPUTER ENGINEERING

ECE Fall 2024 Colloquium Series



Friday, November 15, 2024
11:15 am ITE 336
(Refreshments in ITE 301 at 11 am)

Integrated Photonic Control of Trapped Ions

Prof. Robert Niffenegger

Abstract:
Integration of control technologies like photonics into trapped ion chips is critical for advancing quantum information sciences and improving scalability and portability. Trapped ions are a leading approach for high-fidelity quantum computing, high-accuracy optical clocks, and precision quantum sensors. However, current ion-based systems rely on bulky, lab-scale precision lasers and optical stabilization cavities for optical clock and qubit operations, constraining the size, weight, scalability, and portability of atomic systems. Chip-scale integration of ultra-low noise lasers, reference cavities, and delivery optics, operating directly at ion optical transitions and capable of qubit and clock operations, will represent a major transformation in atom and trapped ion-based quantum technologies. However, this goal has remained elusive. In this talk I will report our progress utilizing integrated photonic laser sources to control trapped ion qubits and perform clock operations. We have also designed dual-layer grating couplers for violet light with arbitrary targeting and focusing to accommodate the geometry constraints of a trapped ion surface trap for improved qubit gate fidelity and to address multiple ion qubits within a chain while minimizing crosstalk. I will discuss prospects for addressing individual physical qubits within a chain to encode and control a logical qubit with integrated photonics.

Bio:

- *PhD - Purdue University - Quantum Simulation with BECs*
- *Industry – Intel4 CPU process development*
- *Postdoc - MIT Lincoln Laboratory - Trapped ions and integrated photonics*
- *Assistant Professor –UMass Amherst - Trapped Ion lab - ECE & Physics*

https://blogs.umass.edu/rniffenegger/