Solid State Technology and Devices Seminar

Engineering (Useful) Quantum Systems

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Abstract: Quantum technologies have the potential to revolutionize sensing, communication, and computation. To realize this potential, it will be necessary to scale the size and complexity of engineered quantum systems by several orders of magnitude without sacrificing coherence or fidelity. Trapped ion qubits provide unparalleled coherence and are a leading platform for current small-scale quantum technology demonstrations. Optical addressing of individual ions with low crosstalk enables high-fidelity single and multi-qubit gates, and ions trapped in the same potential naturally allow for all-to-all connectivity. However, free-space control and routing of these optical control fields presents a scaling challenge. I will focus on requirements for a deployable trapped-ion quantum sensor and introduce an integrated photonics control platform for parallel laser delivery which will increase stability, reduce size, and allow us to increase the number of sensors measured in parallel without sacrificing fidelity. Finally, I will present a path towards a modular trapped-ion quantum processor with active integrated photonics for control within each module, and high fidelity physical and optical links between modules.

Bio: Dr. Sara Mouradian is an Intelligence Community Postdoctoral Fellow at the University of California, Berkeley in the Ion Trap Group working to build useful quantum technologies based on trapped ions. She is interested in building robust and scalable infrastructure for the large-scale quantum technologies that are necessary for the next generation of computing, communication, and sensing. She received her PhD in Electrical Engineering and Computer Science in the Quantum Photonics Laboratory at MIT working on scalable integrated architectures and diamond nanophotonics for quantum information processing with nitrogen vacancy centers in diamond. Her thesis won both the Dmitris N. Chorafas and the MIT Microsystems Technology Laboratory Dissertation Awards. Her master’s work was done in the Optical and Quantum Communications Group at MIT where she built the first demonstration of quantum illumination in the optical domain.