Friday Morning, January 20, 2023

AVS Quantum Science Workshop
Room Redondo - Session AQS-FrM2

AVS Quantum Science Workshop: Novel Materials for Quantum Computing

Moderator: Ron Walsworth, University of Maryland

10:35am **AQS-FrM2-23 A Neutral Atom Quantum Processor Supporting Long Coherence Times***, **Kristen Pudenz**,* Atom Computing **INVITED**

Atom Computing is creating a quantum processing platform based on nuclear spin qubits. The system makes use of optical tweezers to assemble and individually manipulate a two-dimensional register of neutral strontium atoms. We demonstrate the robustness of these systems by characterizing their coherence times. While other systems have shown impressive coherence times through some combination of shielding, careful trapping, global operations, and dynamical decoupling,we achieve comparable coherence times while individually driving multiple qubits in parallel. The talk will also explore progress on a 100 qubit hardware platform and the potential of the technology to create scalable quantum computing solutions.

11:15am **AQS-FrM2-31 Scalable Integrated Quantumdotnetworks and Nanophotonic Neuromorphic 'Brain-Inspired' Computing***, J. Grim, A. Bracker, J. Hart,* Naval Research Laboratory*; S. Carter,* Laboratory of Physical Sciences*; C. Kim,* Naval Research Laboratory*; M. Kim,* Jacobs*; I. Welland, K. Tran, I. Vurgaftman, T. Reinecke, **Andrew Yeats**,* Naval Research Laboratory **INVITED**

I will show progress from our quantum optics team toward creatingscalable integrated semiconductor quantum dot (QD) networks. This work is motivated by the prospects of photonic quantum computing, simulation, communication, and sensing. We use InAs QDsthat are embedded in GaAs photonic crystal membranes thatcan host electron/hole spin qubitsand can be connected with 'flying qubit' single photons. Although QDs have become very advanced with numerous demonstrations ofhighphoton indistinguishability, quantum transistors, and spin-spin entanglement, these efforts have been limited to one, and at most, two QDs (a limitation shared by all solid-state single photon sources). Our team has recently made a breakthrough with a technique that enablesscalable tuning of QDs into resonance. We have leveraged this technique to perform a demonstration of an entangled, superradiant state from multiple QDscoupled tothe same photonic crystalwaveguide1. We have also used this technique to realize collective scatteringof laser light from two QDs, and have observed an enhanced optical nonlinearity at the few-photon level2.I will also present our workin the area ofneuromorphics ('brain-inspired' computing), where we aim to use the nonlinear dynamics ofnetworks ofnanolasers for low size, weight, and power machine learning.

1.Grim, J. Q. *et al.*Scalable in operando strain tuning in nanophotonic waveguides enabling three-quantum-dot superradiance. *NatureMater.***18**, 963–969 (2019).

2.Grim, J. Q. *et al.*Scattering laser light from two resonant quantum dots in a photonic crystal waveguide. *Phys. Rev. B***106**, L081403 (2022).

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