AVS Quantum Science Workshop (ALL-INVITED SESSION)
Room 304 - Session AQS-SuA

AVS Quantum Science Workshop Session (ALL-INVITED SESSION)

Moderators: Ekta Bhatia, NY CREATES, **Dave Pappas**, Rigetti Computing, **Charles R. Eddy, Jr.**, Office of Naval Research Global - London, **Aranya Goswami**, Nokia Labs

3:00pm **AQS-SuA-1 Fabrication of Superconducting Qubits: Challenges and Opportunities in Scaling of Quantum Computing Circuits***, Hossein Taghinejad,* Rigetti Computing **INVITED**

Building fault-tolerant quantum computers requires scaling quantum processors from tens to ultimately millions of qubits while maintaining exceptionally low error rates and high gate fidelity. Achieving this goal is not simply a matter of increasing qubit count; it demands a level of fabrication precision, process uniformity, materials control, and manufacturing yield that far exceeds what is required for small-scale quantum devices. Among the leading hardware platforms, superconducting qubits based on Josephson junctions (JJs) offer a compelling path toward large-scale systems. At the same time, the extreme sensitivity of JJs to nanometer-scale variations in dimensions, tunnel-barrier quality, interfaces, and materials presents formidable challenges to achieving wafer-scale uniformity, high-yield fabrication, and precise qubit frequency control. In this sense, the future of superconducting quantum computing is increasingly a manufacturing problem rather than solely a qubit-physics problem.

In this talk, I will discuss the fabrication of superconducting JJ qubits from the perspective of scalable manufacturing. Particular emphasis will be placed on two major fabrication approaches: single-step shadow (angled) evaporation and multi-step normal-angle deposition. I will examine the advantages and limitations of each approach, focusing on key scaling metrics including qubit frequency variability, junction yield, process reproducibility, and compatibility with large-scale circuit integration. I will further discuss the importance of frequency allocation and precise frequency targeting in multi-qubit processors, highlighting post-fabrication tuning techniques such as alternating-bias-assisted annealing (ABAA) and laser trimming.

* Rigetti Computing Team:

Hossein Taghinejad (Presenter: htaghinejad@rigetti.com), David P. Pappas, Pradeep Manandhar, Cameron Kopas, Xiaqia Wang, Hilal Cansizoglu, Kameshwar Yadavalli, Andrew Bestwick, Josh Mutus.

3:30pm **AQS-SuA-3 Quantum Transduction for Heterogeneous Integration of Quantum Information Systems***, Matthew LaHaye,* Air Force Research Laboratory, Information Directorate **INVITED**

The Quantum Information Sciences and Technology (QIST) branch at the Air Force Research Laboratory's Information Directorate (Rome Lab) performs cutting-edge experimental and theoretical research in a multitude of topics at the frontiers of quantum computing and quantum networking. Conducted in support of Air Force strategic objectives in quantum information processing and entanglement distribution, the QIST branch has numerous active research efforts in quantum algorithms and quantum technologies such as trapped-ion systems, integrated quantum photonics, and superconducting quantum circuitry. In this talk, I will give an overview of the research efforts at Rome Lab to develop quantum interconnects between the different quantum technologies (a.k.a. heterogeneous quantum interfaces) and highlight plans to establish a quantum networking testbed for fundamental investigations of entanglement distribution and heterogeneous network design.

4:00pm **AQS-SuA-5 The Capital of Quantum***, Corey Stambaugh,* Capital of Quantum **INVITED**

Quantum innovation is increasingly shaped by strong regional ecosystems that contribute to national progress and global momentum. The *Capital of Quantum* represents one such hub: a coordinated Maryland-based ecosystem linking universities, startups, established industry, and government partners. This presentation will situate the Capital of Quantum within the broader U.S. and international landscape, highlight emerging opportunities, and examine how regional strengths can accelerate scalable quantum technologies.

4:45pm **AQS-SuA-8 Benchmarking Progress Toward 'Useful' Quantum Simulations***, Andrew David Baczewski,* Sandia National Laboratory **INVITED**

Quantum simulations of interacting electrons are among the 'killer apps' for quantum computers. Noisy intermediate-scale quantum processors have been a training ground for developing this application, but elements of quantum error correction and fault tolerance are now possible. While these technologies are essential for continuing to improve the capabilities of quantum processors to reach the qubit counts and error rates required for the most impactful applications in simulation, the overheads of the first fault-tolerant quantum computers might make them seem less capable. I will share work that we are doing to track progress towards useful quantum computation through the phase transition that is fault tolerance, with an eye toward enabling first-principles electronic structure simulations with super-classical accuracy.

5:15pm **AQS-SuA-10 AQS Panel Discussion and Reception**

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