

Engineering Quantum Systems of Superconducting Qubits

William D. Oliver

*Department of Electrical Engineering and Computer Science,
Research Laboratory of Electronics, and MIT Lincoln Laboratory
Massachusetts Institute of Technology
Cambridge, MA 02139*

william.oliver@mit.edu
equs.mit.edu

Quantum computers are fundamentally different than conventional computers. They promise to address problems that are practically prohibitive and even impossible to solve using today's supercomputers. The challenge is building one that is large enough to be useful. In this talk, I will discuss aspects of engineering high-performance superconducting qubits, with an eye toward extensible applications. After a brief introduction to superconducting qubits [1] and 3D integration of high-fidelity devices [2], I will discuss the impact of ionizing radiation on qubit performance [3], and (time permitting) experimental results of waveguide quantum electrodynamics with giant artificial atoms [4].

References

1. P. Krantz, M. Kjaergaard, F. Yan, T.P. Orlando, S. Gustavsson, W.D. Oliver, "A Quantum Engineer's Guide to Superconducting Qubits," *Appl. Phys. Reviews* 6, 021318 (2019) | arXiv:1904.06560
2. D.W. Yost, M.E. Schwartz, J. Mallek, D. Rosenberg, C. Stull, J.L. Yoder, G. Calusine, M. Cook, R. Das, A.L. Day, E.B. Golden, D.K. Kim, A. Melville, B.M. Niedzielski, W. Woods, A.J. Kerman, W.D. Oliver, "Solid-state qubits integrated with superconducting through-silicon vias," *npj Quantum Information* 6, 58 (2020) | arXiv:1912.10942
3. A.P. Vepsalainen, A.H. Karamlou, J.L. Orrell, A.S. Dogra, B. Loer, F. Vasconcelos, D.K. Kim, A.J. Melville, B.M. Niedzielski, J.L. Yoder, S. Gustavsson, J.A. Formaggio, B.A. VanDevender, W.D. Oliver, "Impact of ionizing radiation on superconducting qubit coherence," arXiv:2001.09190 (accepted to Nature)
4. B. Kannan, M. Ruckriegel, D. Campbell, A.F. Kockum, J. Braumueller, D. Kim, M. Kjaergaard, P. Krantz, A. Melville, B.M. Niedzielski, A. Vepsalainen, R. Winik, J. Yoder, F. Nori, T.P. Orlando, S. Gustavsson, W.D. Oliver, "Waveguide quantum electrodynamics with giant superconducting artificial atoms," arXiv:1912.12233 (accepted to Nature)