

Northwestern Quantum Week Opening Science Workshop: Superconducting Qubits for Quantum Computing

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Robert McDermott is a superconducting qubit experimenter. He received his PhD from Berkeley in the group of John Clarke and he joined the physics faculty at the University of Wisconsin-Madison in 2006. He has contributed to understanding fundamental sources of decoherence in superconducting qubits, and he has developed novel tools and techniques for scalable control and measurement of ultralarge qubit arrays. In 2022, he and John Martinis co-founded Madison-based superconducting quantum computing company Qolab.

Next-generation Josephson Junctions for Scalable Superconducting Qubits

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Abstract: In the span of four decades, quantum computation has evolved from an intellectual curiosity to a potentially realizable technology. However, entangling gate fidelity remains too low for utility-scale applications. For superconducting qubits, fidelity is limited by coupling to defects that are intrinsic to the academic-style fabrication processes used to construct the circuits. In particular, we show that the dominant contributors to loss are discrete defects from liftoff residues located within 1 micron of the Josephson junction. We describe an alternative approach to junction fabrication that avoids liftoff, and we present a path to scaling based on a systems engineering approach that leverages existing state-of-the-art semiconductor technology.