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

April 20, 2026 | Northwestern University

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Michael Hatridge is an Associate Professor of Applied Physics at Yale University. He received his B.S. from Texas A&M University, Ph. D. from U.C. Berkeley under the supervision of John Clarke, and was a postdoctoral fellow at Yale under the supervision of Michel Devoret. His work focuses on the use of parametric drives to generate quantum controls, including single- and multi-qubit gates and engineered baths. His lab builds a range of superconducting quantum circuits, including quantum-limited parametric amplifiers and modular quantum computers. He is a recipient of the Michelson postdoctoral fellowship, the NSF Career Award, the Sloan Research Fellowship, and the University of Pittsburgh's Chancellor's Distinguished Research Award.

Applications and limits of parametric driving in superconducting circuits

Abstract: Parametric driving has long been used in very low quality factor, weakly nonlinear superconducting circuits to create nearly quantum-limited 'parametric' amplifiers, which are in wide use for the readout of superconducting qubits. However, the off-resonant terms we can activate with parametric driving are ubiquitous in Josephson-junction based circuits, and are increasingly used for a variety of gates and other controls in superconducting quantum information processors. In this talk, I'll focus on an important outstanding issue, which is our ability to explain and predict how hard we can parametrically drive our circuits before they break. I'll show recent results on matching theory and experiment on transmon qubits as parametric couplers, and discuss the prospects for extending this work to more complicated couplers and gates