Collaboration achieves record level of radio frequency signal synthesis with quantum-based accuracy

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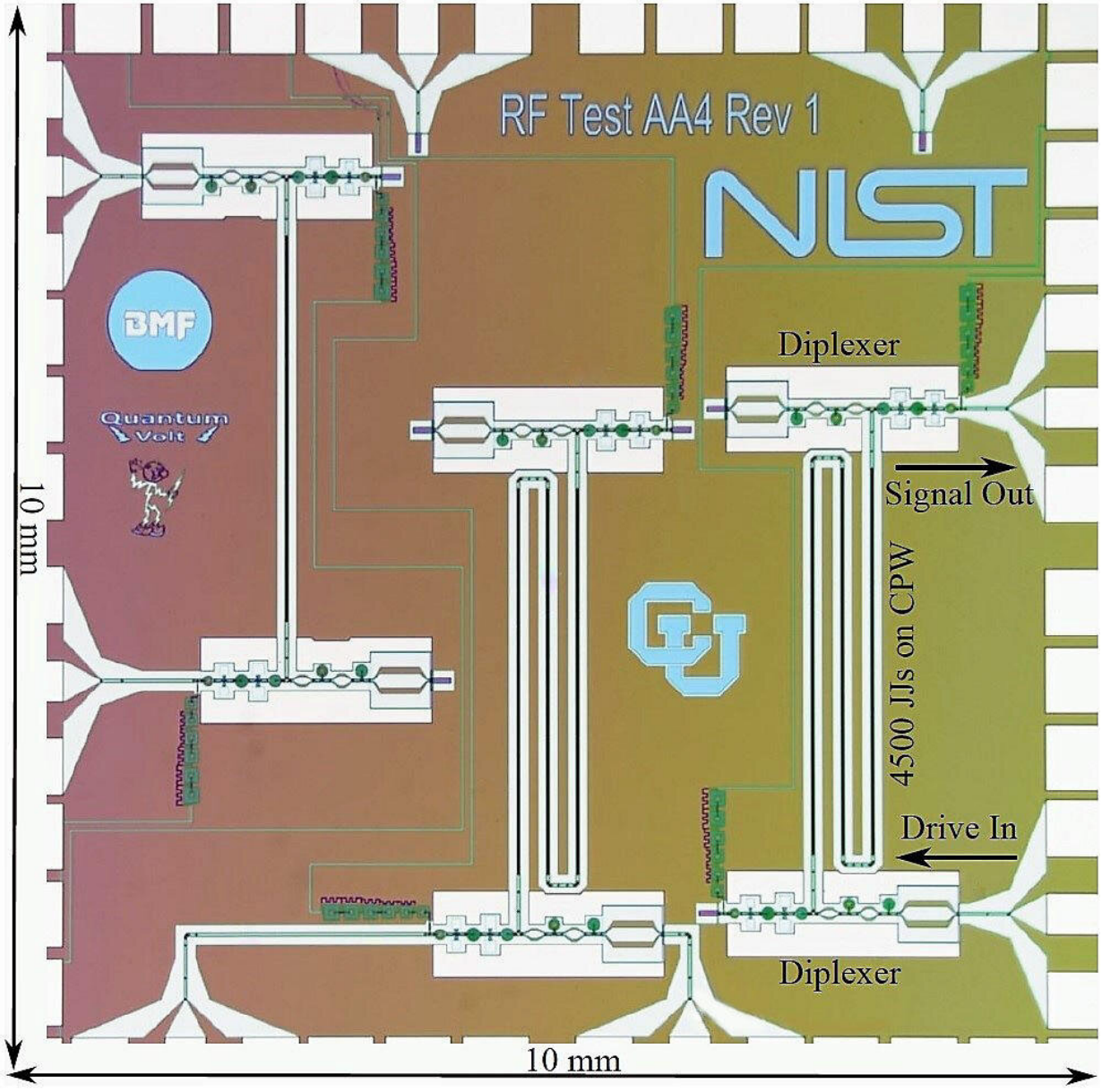

Credit: National Institute of Standards and Technology

NIST, in collaboration with CU Boulder faculty, published a paper titled: "RF Josephson Arbitrary Waveform Synthesizer with Integrated Superconducting Diplexers" demonstrating results that show a significant step toward a broadband, integrated, quantum-based microwave voltage source with useful power above -30 dBm.

This milestone creates new opportunities for improving measurements of high-accuracy RF voltage and power for modern high-speed communications components and instruments.

NIST's goal is to advance quantum-based standards for RF communications to eliminate costs and overhead in calibration and traceability chain measurements by providing self-calibrated, quantum-based standards and automated measurement capability to communication and instrument manufacturers.

The team is developing a quantum-defined superconducting programmable voltage source for generating microwave-frequency waveforms. The voltage source is an RF Josephson arbitrary waveform synthesizer (RF-JAWS) that utilizes a superconducting integrated circuit that is cooled to 4 K and is composed of an array of 4,500 Josephson junctions.

The researchers incorporated on-chip superconducting diplexers and integrated them with the RF-JAWS circuit to achieve an open-circuit signal of 22 mV rms at 1.005 GHz, which is a 25% increase in state-of-the-art. The use of integrated filtering enables 25% larger microwave

amplitudes compared to the state-of-the-art thanks to a broader passband and lower loss.

Measurements of the new circuit showed that it correctly synthesized the RF waveform with a signal amplitude that was based on quantum effects .

The paper is published in *IEEE Transactions on Applied Superconductivity*.

More information: Akim A. Babenko et al, RF Josephson Arbitrary Waveform Synthesizer With Integrated Superconducting Diplexers, *IEEE Transactions on Applied Superconductivity* (2022). DOI: 10.1109/TASC.2022.3201188

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