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The gatemon: a transmon with a voltage-variable superconductor-semiconductor junction[1]

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We have developed a superconducting transmon qubit with a semiconductor-based Josephson junction element.[2,3] The junction is made from an InAs nanowire with *in situ* molecular beam epitaxy-grown superconducting Al contacts. This gate-controlled transmon, or gatemon, allows simple tuning of the qubit transition frequency using a gate voltage to vary the density of carriers in the semiconductor region. In the first generations of devices we have measured coherence times up to $\sim$10 μs. These coherence times, combined with stable qubit operation, permit single qubit rotations with fidelities of $\sim$99.5 % for all gates including voltage-controlled Z rotations. Towards multi-qubit operation we have also implemented a two qubit voltage-controlled cPhase gate. In contrast to flux-tuned transmons, voltage-tunable gatemons may simplify the task of scaling to multi-qubit circuits and enable new means of control for many qubit architectures.

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[2]T.W. Larsen *et al.*, Phys. Rev. Lett. **115**, 127001 (2015).

[3]G. de Lange *et al.*, Phys. Rev. Lett. **115**, 127002 (2015),