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A semiconductor nanowire Josephson junction microwave laser[1]
MAJA CASSIDY, WILLEMIJN UILHOORN, JAMES KROLL, DAMAZ DE JONG, DAVID VAN WOERKOM, QuTech, Delft University of Technology, Delft, The Netherlands, JESPER NYGARD, PETER KROGSTRUP, Center for Quantum Devices, Niels Bohr Institute, Denmark, LEO KOUWENHOVEN, QuTech, Delft University of Technology, Delft, The Netherlands — We present measurements of microwave lasing from a single Al/InAs/Al nanowire Josephson junction strongly coupled to a high quality factor superconducting cavity. Application of a DC bias voltage to the Josephson junction results in photon emission into the cavity when the bias voltage is equal to a multiple of the cavity frequency. At large voltage biases, the strong non-linearity of the circuit allows for efficient down conversion of high frequency microwave photons down to multiple photons at the fundamental frequency of the cavity. In this regime, the emission linewidth narrows significantly below the bare cavity linewidth to < 10 kHz and real time analysis of the emission statistics shows above threshold lasing with a power conversion efficiency $> 50\%$. The junction-cavity coupling and laser emission can be tuned rapidly via an external gate, making it suitable to be integrated into a scalable qubit architecture as a versatile source of coherent microwave radiation.

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