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High-Sensitivity Charge Detection with a Single-Lead Quantum Dot for Scalable Quantum Computation[1] MATTHEW HOUSE, IAN BARTLETT, PRASANNA PAKKIAM, MATTHIAS KOCH, ELDAD PERETZ, JOOST VAN DER HEIJDEN, TAKASHI KOBAYASHI, SVEN ROGGE, MICHELLE SIMMONS, Centre for Quantum Computation and Communication Technology, School of Physics, UNSW Australia — We report the development of a high sensitivity semiconductor charge sensor based on a quantum dot coupled to a single lead, designed to minimize the geometric requirements of a charge sensor for scalable quantum computing architectures. The quantum dot is fabricated in Si:P using atomic precision lithography and its charge transitions are measured with rf reflectometry. A second quantum dot with two leads placed 42 nm away serves as both a charge for the sensor to measure and as a conventional rf single electron transistor (rf-SET) with which to make a comparison of the charge detection sensitivity. We demonstrate sensitivity equivalent to an integration time of 550 ns to detect a single charge with a signal-to-noise ratio of 1, compared with an integration time of 55 ns for the rf-SET. This level of sensitivity is suitable for fast ($< 15\,\mu$s) single-spin readout in quantum information applications, with a significantly reduced geometric footprint compared to the rf-SET. [Phys. Rev. Applied 6, 044016 (2016)]

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