SAND2011-5375C

Sensitivity of charge detection techniques in electrostatically defined MOS quantum dots

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Charge sensing is an important technique for implementing spin-based qubit approaches. We present charge sensing results for electrostatic gated quantum dots with adjacent point contact charge sense channels in silicon. The conductance of the point contacts exhibits a number of resonances that allow high sensitivity in a narrow range of device operation. Either direct (ac voltage applied to an ohmic) or differential (ac voltage applied to a depletion gate) lock-in techniques are employed to measure the charge sense signal. For direct measurements, long lock-in time constants are not as effective as multiple measurements with short time constants. The differential technique allows the most rapid measurement. To charge sense over a wide range of device operation, a combination of Fourier transform filtering and several discrete point contact configurations is used. We observe an abrupt transition from detecting single electron events to no further detection for more negative plunger gate voltages.