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Optimizing fidelities of quantum dot hybrid qubits¹

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The quantum dot hybrid qubit, which can be viewed as a hybrid between a spin and charge qubit, has an attractive combination of speed and fabrication simplicity. The initial experiments implementing this qubit yielded process fidelities of $\sim 88\%$ [1] and $\sim 93\%$ [2] for pulsed-gating and ac-gating, respectively. We present experimental evidence that these fidelities were limited by charge noise, and we present theoretical and experimental evidence that the sensitivity of qubit operations to charge noise can be reduced substantially by appropriate adjustment of the tunnel couplings. Our work indicates that, with suitable optimization, this qubit can achieve gate fidelities of well over 99%. [1] D. Kim et al., *Nature* **511**, 70 (2014). [2] D. Kim, et al., *npj Quant. Inf.* **1**, 15004 (2015).

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