Double quantum dot with integrated charge sensor based on Ge/Si heterostructure nanowires

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SUPPLEMENTARY FIGURES

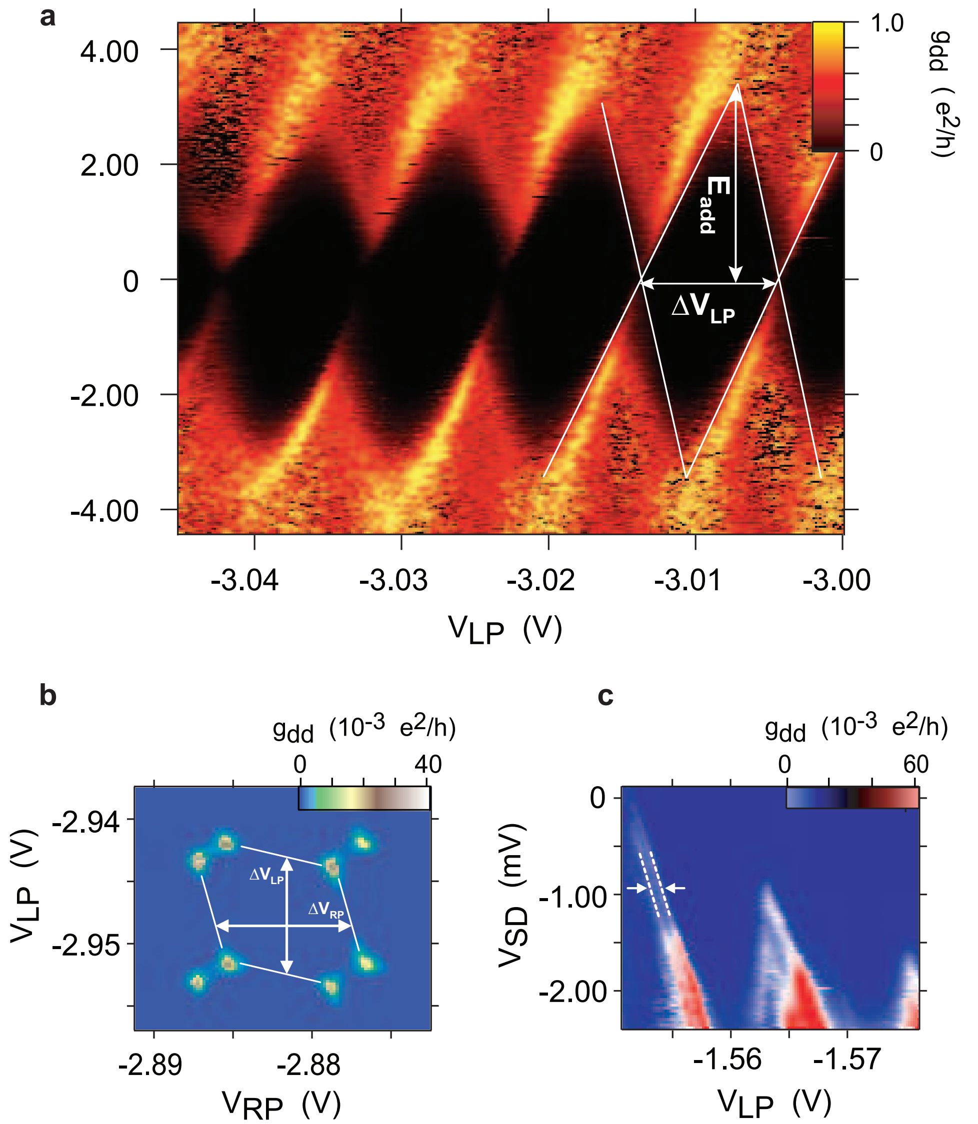

Figure S1: **Extraction of single dot parameters**. **a** With only the left dot of the DQD formed using gates L and M, differential conductance as a function of V_{SD} and V_{LP} shows Coulomb diamonds. Assuming the addition energy $E_{add,L}$ and charging energy $E_{C,L}$ are approximately equal, we extract from the diamonds a left dot charging energy $E_{C,L} = e^2/C_{\Sigma,L} \sim E_{add,L} = 3.1$ meV, where the total capacitance for the left dot $C_{\Sigma,L} = e^2/E_{C,L} \sim 52$ aF. The plunger gate lever-arm $\eta = E_{add}/e\Delta V_{LP} \sim 0.32$, where $\Delta V_{LP} \sim 9.6$ mV is the average peak spacing. We assume η to be approximately equal for both plunger gates LP and RP which have nearly identical widths. The left plunger gate capacitance $C_{LP} = e/\Delta V_{LP} \sim 17$ aF. **b** From the stability diagram (taken from Fig. 2a), we find the average peak spacing for the right dot $\Delta V_{RP} \sim 8.2$ mV, total capacitance $C_{\Sigma,R} = C_{\Sigma,L}\,(\Delta V_{LP}/\Delta V_{RP}) \sim 61$ aF, right plunger gate capacitance $C_{RP} \sim 20$ aF, and charging energy $E_{C,R} \sim 2.6$ meV. The interdot capacitance is calculated to be ~ 15 aF. **c** Higher-resolution plot of left dot diamonds for less negative V_{LP} compared to **a**, showing excited states (indicated with arrows) from which a single-particle level spacing ~ 250 μeV is extracted. The relation of capacitances to stability diagram dimensions follows Ref. [S1].

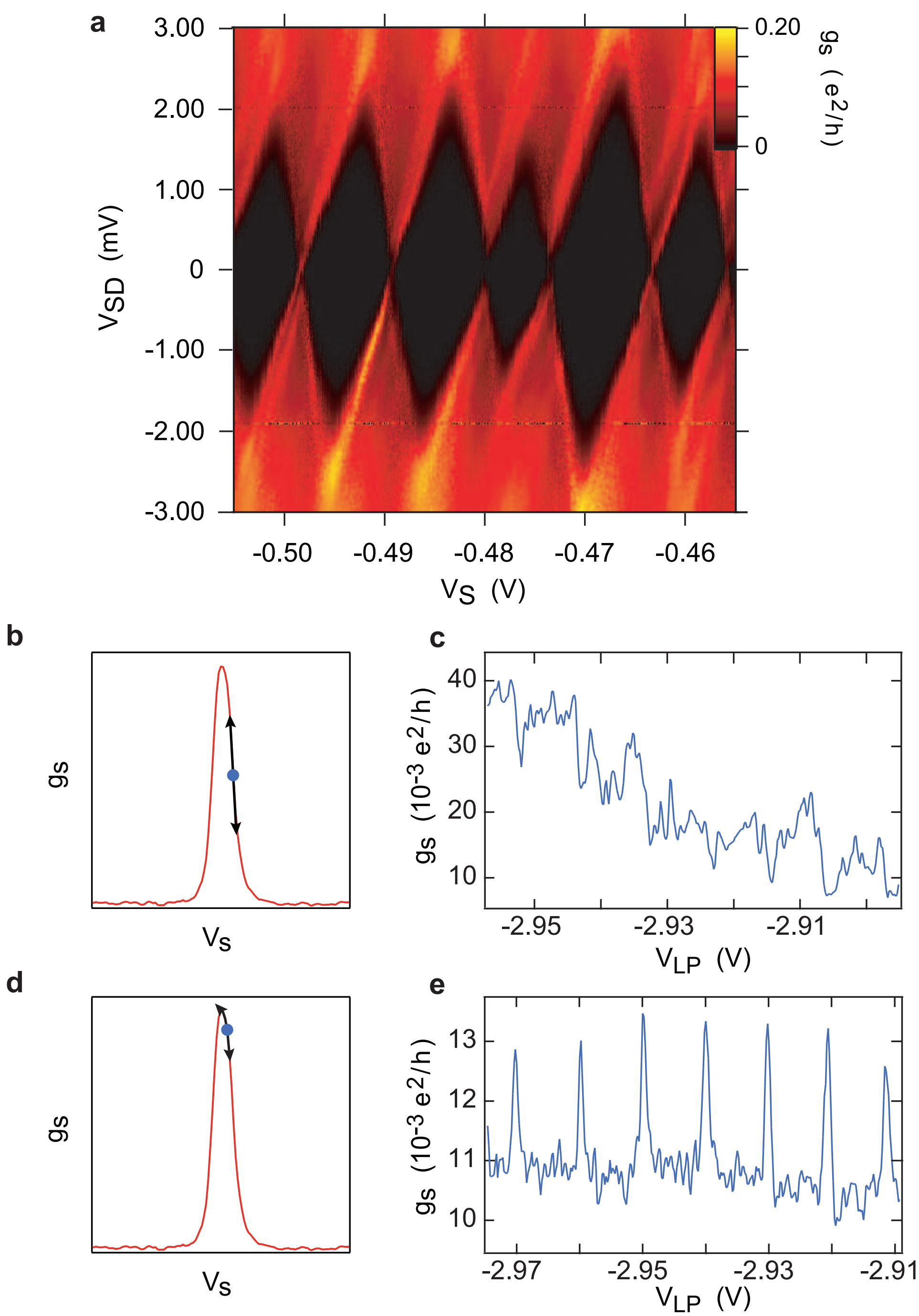

Figure S2: **Characterization of sensor dot and illustration of charge sensing.** **a** Coulomb diamonds for sensor dot. **b** and **c** Schematic sensor dot bias position and sensor response to charge transitions for the conditions of Fig. 3b. The sensor operates by gating the sensor dot with the changes in electrostatic potential associated with charge transitions in the DQD. When the sensor dot is biased in the linear regime of the Coulomb blockade peak (as shown in **b**), a sawtooth-like sensor signal is observed as in **c** (one-dimensional slice taken from Fig. 3b). In contrast, when the sensor dot is biased near the top of the peak (as shown in **d**), the response is nonlinear, and a sharp peak may be observed at the charge transitions as in **e** (one-dimensional slice taken from Fig. 3a).

[S1] W. G. van der Wiel, S. De Franceschi, J. M. Elzermann, T. Fujisawa, S. Tarucha, and L. P. Kouwenhoven. Electron transport through double quantum dots. Rev. Mod. Phys. **75,** 1 (2003).