Electronic Supplementary Information

Realization of a Quantum Hamiltonian Boolean logic gate on the Si(001):H surface

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Calculation details. The Heisenberg-Rabi oscillations were calculated by solving numerically the time dependent Schrodinger equation:

$$i\hbar\frac{d}{dt}|\psi(t)\rangle = H(\alpha,\beta)|\psi(t)\rangle$$

Using the unitary transformation T which diagonalizes the Hamiltonian H (i.e. $T^+HT = D$), the Schroedinger equation can be rewritten as:

$$i\hbar\frac{d}{dt}|\theta(t)\rangle = D|\theta(t)\rangle$$

where $|\theta(t)\rangle = T^+|\psi(t)\rangle$. Starting at time $t=0$ from the state $|\varphi_a\rangle$, the wave function of the system is given by:

$$|\psi(t)\rangle = T\,exp\left(-\frac{i}{\hbar}Dt\right)T^+|\varphi_a\rangle$$

The probability to reach the target state $|\varphi_b\rangle$ at time t is then given by the projection:

$$P_{ab}(t) = |\langle\varphi_b|\psi(t)\rangle|^2 = \left|\left\langle\varphi_b\left|Texp\left(-\frac{i}{\hbar}Dt\right)T^+\right|\varphi_a\right\rangle\right|^2$$

This procedure was practiced for all the logical input status used in Fig.2.

Scanning tunneling spectroscopy measurements performed at liquid helium & liquid nitrogen temperature.

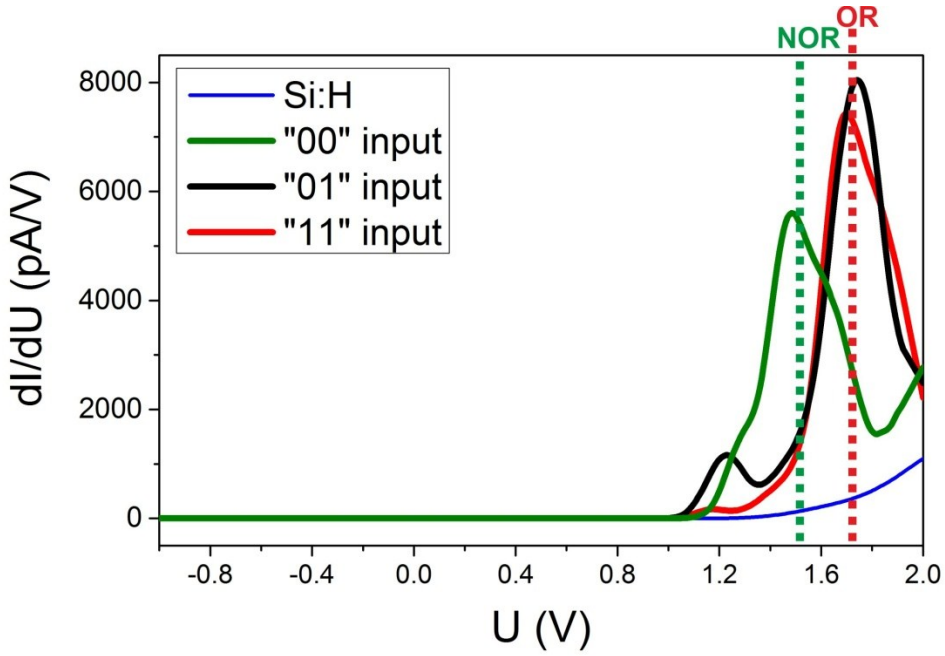

Figure S1. dI/dU STS results recorded over the logic gate at liquid nitrogen (77 K) temperature.

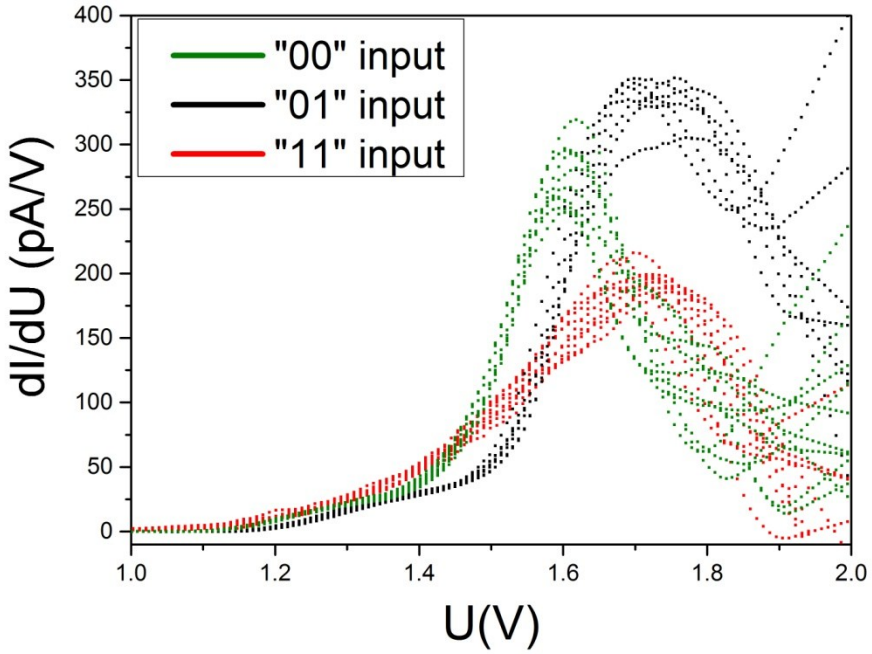

Figure S2. dI/dU STS results recorded over the logic gate in several measurements at liquid helium temperature (4.5 K).