Single-shot correlations and two-qubit gate of electron spins in a double quantum dot

K. C. Nowack[a], M. Shafiei[a], G. Prawiroatmodjo[a], L. R. Schreiber[a], W. Wegscheider[b], and L. M. K. Vandersypen[a]

[a]Kavli Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands
[b]Solid State Physics Laboratory, ETH Zurich, Zurich, Switzerland

We have realized an independent single-shot read-out of two electron spins in a double quantum dot. The read-out method is all-electrical, cross-talk between the two measurements is negligible and measurement fidelities are about 80% on average. This allows us to directly probe the anti-correlations between the spins when they are prepared in an entangled spin singlet state. Furthermore, we use the independent read-out capability to demonstrate the operation of the two-qubit exchange gate[1] on a complete set of basis states. This work opens the way to the realization and efficient characterization of multi-qubit quantum circuits based on single quantum dot spins.

[1]J. R. Petta et al., Science 309, 2180 (2005).