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Physics : Quantum Information Technology, Spintronics

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Towards a Spin-Ensemble Quantum Memory for Superconducting Qubits

Design and Implementation of the Write, Read and Reset Steps

- Nominated as an outstanding Ph.D. thesis by the University Paris VI, France
- Received Madeleine Lecoq Price 2015, awarded by the French Academy of Science for one of the best Ph.D thesis of the year
- Provides a comprehensive introduction to spin-based hybrid quantum circuits
- Includes a detailed description of the theoretical aspects

This work describes theoretical and experimental advances towards the realization of a hybrid quantum processor in which the collective degrees of freedom of an ensemble of spins in a crystal are used as a multi-qubit register for superconducting qubits. A memory protocol made of write, read and reset operations is first presented, followed by the demonstration of building blocks of its implementation with NV center spins in diamond. Qubit states are written by resonant absorption of a microwave photon in the spin ensemble and read out of the memory on-demand by applying Hahn echo refocusing techniques to the spins. The reset step is implemented in between two successive write-read sequences using optical repumping of the spins.

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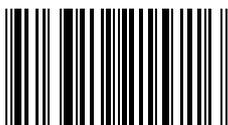
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