Methods for Reducing Decoherence and Sesign Constraints in Solid-State Quantum Computers

Daniel Lidar (dlidar@chem.utoronto.ca)
University of Toronto
Chemistry Departement
80 St-George Street
Toronto , ON M5S 3H6, Canada

Abstract. All solid-state quantum computer proposals suffer from two main problems: decoherence and stringent design constraints. Decoherence can be tackled with encoding methods such as quantum error correction and avoidance (decoherence-free subspaces), or suppressed using decoupling pulses. We have recently developed a theory which combines all these methods with the selective recoupling technique (well-known in NMR), in order to simultaneously overcome both the decoherence and design problems. The theory points to a simple encoding, using between two and four qubits to represent a single logical qubit, as a promising way to construct robust and naturally manipulable solid-state quantum computers. The encoding provides a decoherence-free subspace or a quantum error correcting code, which is further stabilized using decoupling pulses. Quantum computation is carried out using only the naturally available interactions (e.g., without certain difficult-to-implement single-qubit operations), which implement encoded logical transformations. This talk will present an overview of these results.

References

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