Effect of nuclear spin dynamics on quantum computing operations in spin based qubits

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A promising implementation of quantum computing algorithms uses as qubits the spin degrees of freedom of electrons confined in quantum dots. At low temperature, the hyperfine interaction of a confined electron with the nuclei in III/V material nanostructures is the dominant factor limiting the reliability of quantum computing operations. Particularly sensitive is the tuning process required prior to initiating the quantum computing operations to satisfy the ESR resonance condition. We have calculated the impact of the nuclear spin dynamics on the tuning process and more generally on the accuracy of quantum computing operations. We describe the electron and nuclear spin dynamics with equations of motions for the average spins and the two-operator correlation functions. The temporal and spatial fluctuations of the magnetic field generated by the nuclear spins are shown to affect the quantum computing operations only within the inaccuracy allowed by error correction schemes.