Classical and quantum correlations in the dynamics of donor-based charge qubits

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The dynamics of decoherence [1, 2], entanglement [3] and classical vs. quantum correlations between two qubits [4] is shown for the case of phosphorous impurities embedded in a silicon substrate. Here the qubits are constituted by the presence or absence of electrons bound to the impurity sites.

The main decoherence mechanism affecting these types of qubits is provided by the coupling of the phosphorous impurities to the acoustical vibrations of the silicon lattice. Due to that, the observed effects crucially depend on the temperature of the substrate and, depending on the initial quantum state of the qubits, three different dynamics can be found. These are characterized by the number of abrupt changes in both classical and quantum correlations, as shown in Fig. 1.

Furthermore, it is shown that the correlations on the long term reach stationary values and therefore do not vanish. Moreover, before the classical correlations reach their stationary values, they may experience successive abrupt changes between constant values associated with the apparition of metastable pointer-states bases. Finally the stationary value is attained when the preferred pointer-state base is established

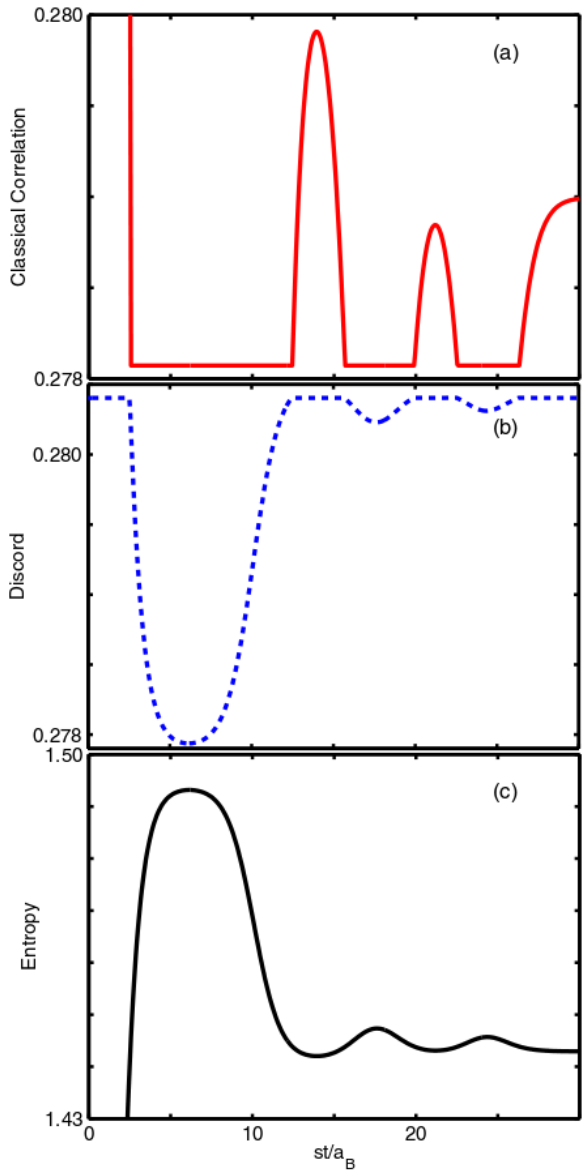

FIG. 1. Classical correlation, discord, and entropy as a function of time.

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