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Using solitons for manipulating qubits

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Many proposals for quantum devices are based on qubits that are physically realized by the spin magnetic moment of some quantum object. In this case, one of the most often adopted strategies for manipulating qubits is that of applying external magnetic fields. However, selectively apply a field just to one qubit may be a practically unattainable goal, as it is, for instance, in some solid-state based set-ups. In this work we present a proposal for using non linear excitations of solitonic type to accomplish the above task. Our scheme entails the generation of a dynamical soliton in a classical spin chain which is locally coupled with one qubit: as the soliton runs through, the qubit behaves, due to its interaction with the chain, as if it were subject to a magnetic field with a specific time dependence that depends on the soliton's features. We will present results for the time evolution of the qubit density-matrix elements induced by the overall dynamics of the above scheme.