Non-Local Quantum Gates: a Cavity-Quantum-Electro-Dynamics implementation

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The problems related to the management of a large quantum register can be by-passed in the context of distributed quantum computation. Unitary non-local transformations among spatially separated local processors are realized performing local unitary transformations and exchanging classical communication (LOCC). Optimal protocols for some quantum gates have been recently demonstrated. We propose a scheme for the implementation of universal non-local quantum gates such as a CNOT and a controlled-quantum phase gate (CQPG). The scenario chosen for their physical implementation is a cavity-QED system formed by two spatially separated microwave cavities and two trapped Rydberg atoms. We describe the procedures to realize each step necessary to perform a specific non-local operation.

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