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Qubit switching using STIRAP in trapped-ion quantum states ZACH MANSON, CHITRA RANGAN, University of Windsor, Department of Physics — Trapped-ion quantum states are well-known to be good candidates for qubits in quantum computing. We study the application of an adiabatic method known as STIRAP to achieve qubit switching. Stimulated Raman Adiabatic Passage (STIRAP) is method of quantum control that utilizes a specific atomic structure known as a 3-Level Lambda System (3LLS). The system consists of two ground states that are coupled to an intermediate excited state via two counter-intuitively ordered pulses known as the Stokes and pump pulses. STIRAP is a notable method of population transfer because not only is it robust against small experimental variations, but it also has the unique property to allow the complete transfer of population between the two ground states without loss of population due to spontaneous emission from the excited state. STIRAP can be extended to other chain-wise connected multi-level systems such as those that are present in the trapped-ion. In this study, we numerically determine the optimal pump and Stokes pulses that will maximize qubit switching in 3, 5, and 7-quantum states of the trapped-ion. We find that the overlap between the two pulses increases as the number of chainwise-connected states increase. We discuss the potential applicability of this method in quantum computing.

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