Dressed state analysis of population inversion in a 4-level system comprised of hyperfine states in Rb interacting with a single nanosecond, chirped pulse\textsuperscript{1} GENGYUAN LIU, SVETLANA MALINOVS\textsuperscript{KAYA}, Stevens Institute of Technology — Ultracold alkali atoms have been conventionally used for quantum operations. In the previous work, a semiclassical model of a single pulse interacting with the hyperfine states of 5S_{1/2} and 5P_{1/2,3/2} in Rb is presented revealing quantum control parameters that provide population inversion within 5S_{1/2}. Here, to understand the mechanism of two-photon adiabatic passage induced by a single narrow-band pulse, we analyze the dressed state picture in the four-level system. We also perform a comparative analysis with a three-level \Lambda system that works as a good approximation within a certain range of parameters. We study the dressed states evolution when the key field parameters, the peak Rabi frequency, the chirp rate and the pulse duration, induce both the adiabatic and nonadiabatic regime of light-matter interaction. The analysis reveals the mediating role of the excited state manifold in adiabatic passage.

\textsuperscript{1}This work was sponsored by NSF.

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Date submitted: 30 Jan 2014

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