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Manipulation of ultracold rubidium atoms using a single linearly chirped laser pulse[1] SVETLANA MALINOVSKAYA, THOMAS COLLINS, Stevens Institute of Technology — At ultracold temperatures, atoms are free from thermal motion, which makes them ideal objects of investigations in the fields of high precision spectroscopy, metrology, quantum computation, producing Bose condensates, etc. The quantum state of ultracold atoms may be created and manipulated by optical pulses of rather low intensity and by making use of quantum control methods. Here, we discuss how the field phase variation, pulse duration and intensity, when perform in conformity, may yield a desired population distribution within the hyperfine structure of alkali atoms. We theoretically investigate ultracold Rb vapor using picosecond chirped pulses of kW/cm^2 beam intensity and show a possibility of controllable population transfer between hyperfine levels of $5^2S_{1/2}$ state through Raman resonances. Satisfying the one-photon resonance condition with the $5^2P_{1/2}$ or $5^2P_{3/2}$ state allows us to enter the adiabatic region of population transfer at very low field intensities, such that corresponding Rabi frequencies are less or equal to the hyperfine split. This methodology provides with a robust way to create a specifically designed superposition state in Rb in the basis of the hyperfine levels and perform state manipulation.

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Svetlana Malinovskaya
Stevens Institute of Technology

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