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Two-photon adiabatic passage for excitation of Rydberg states[1]
CHAO TIAN, Stevens Institute of Technology, ELENA KUZNETSOVA, ITAMP, Harvard-Smithsonian Center for Astrophysics, SVETLANA MALINOVSKAYA, Stevens Institute of Technology — Strong dipole-dipole interaction between atoms in Rydberg states is promising for many applications, from quantum computation to novel many-body effects. An atom can be transferred to the Rydberg state with a two-photon π-pulse, which requires a precise adjustment of the pulse Rabi frequency and pulse duration. A more robust approach is to excite the atom using a chirped pulse via rapid adiabatic passage. We describe a technique to realize adiabatic passage in a cascade three level system using a single and a pair of linearly chirped pulses. Modeled with the Rubidium atom, the pulse carrier frequency starts from the resonance with the frequency difference between state 1 and 2, and then is chirped to achieve zero detuning between state 2 and the Rydberg state. By applying the pump and Stokes Rabi frequencies at variable ratio, the complete population transfer to the excited Rydberg state may be achieved. We demonstrate that by slightly changing such ratio, the adiabatic passage can be dynamically switched on and off, corresponding to full population transfer or no transfer at the end of pulse. Since modulation of beam intensity is much easier and faster comparing to modification of chirp and pulse delay, this method opens a door to gain a simpler and better control over system response.

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Chao Tian
Stevens Institute of Technology

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