Optical dipole force on ladder-like three-level atomic systems driven by chirped few-cycle-pulse laser fields

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We report a study on the optical dipole force in a ladder like three level atomic systems in the context of coherent population transfer with the chirped few-cycle-pulse laser fields. The phenomenon of coherent population transfer is investigated by numerically solving the appropriate density matrix equations beyond the rotating wave approximation. On the other hand, optical dipole force is calculated by numerically solving the force equation and density matrix equations self-consistently. By analysing the centre-of-mass motion, it is shown that the optical dipole force with chirped pulses may be used for focusing and defocusing of atoms in an atomic beam similar to the near or non-resonant optical dipole force. Moreover, the robustness of the population transfer against the variation of the pulse parameters and the effect of the variation of the Rabi frequencies and the chirp rates on the optical dipole force are also investigated. The proposed scheme may open new perspectives in the focusing and de-focusing of atoms and molecules in an atomic beam, since this scheme mitigates the demand for the generation of transform-limited pulse laser fields at arbitrary frequencies.

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