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Acceleration and twisting of neutral atoms by laser fields

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The spatial inhomogeneity \mathbf{kr} in the electromagnetic wave and the magnetic component in it lead to nonseparability of the variables of the electron and the center-of-mass in the hydrogen atom interacting with the laser pulse, and, as a consequence, to the acceleration of the atom [1,2]. We have shown that the influence of the laser polarization on the excitation, ionization and acceleration of the hydrogen atom is insignificant in IR, optical and UV region. However, the transition from linear to circular laser polarization leads to the twisting of the atom. We have also established a mechanism for n-photon resonant twisting of an atom with the transfer of helicity of photons of a circularly polarized laser field to it [3]. This alternative way for twisting of neutral atoms may be of interest for a number of promising applications.

[1] V.S. Melezhik, J. Phys A 56, 154003 (2023).

[2] V.S. Melezhik and S. Shadmehri, Photonics 10, 1290 (2023).

[3] V.S. Melezhik and S. Shadmehri, J. Chem. Phys. 162, 174304 (2025).

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