SEMICLASSICAL TWO-STEP MODEL FOR STRONG-FIELD IONIZATION: FURTHER DEVELOPMENTS AND APPLICATIONS

N. I. SHVETSOV-SHILOVSKI

Institut für Theoretische Physik, Leibniz Universität Hannover, D-30167, Hannover, Germany
E-mail nikolay.shvetsov@itp.uni-hannover.de

Abstract. Trajectory-based semiclassical models are widely used in strong-field, ultrafast, and attosecond physics. The semiclassical models apply classical mechanics to describe the electron motion in the continuum. The semiclassical two-step model (SCTS) allows to describe interference effects in above-threshold ionization and accounts for the ionic potential beyond the semiclassical perturbation theory (Shvetsov-Shilovski et al. 2016).

We discuss the application of the SCTS model to the new and promising method of time-resolved molecular imaging – strong-field holography with photoelectrons (Huismans et al. 2011, Walt et al. 2017, Shvetsov-Shilovski and Lein 2018). We modify the SCTS model to account for a multielectron polarization-induced dipole potential (Shvetsov-Shilovski et al. 2018). Thus, we analyze the imprints of multielectron effects in the electron momentum distributions from ionization by a linearly polarized laser pulse. We predict narrowing of the distributions along the laser polarization direction due to electron focusing by the induced dipole potential. It is also found that the polarization of the core modifies the interference patterns in the photoelectron momentum distributions: The number of fanlike interference structures in the low-energy part of momentum distributions may change. Furthermore, we extend the SCTS model to strong-field ionization of the hydrogen molecule (Shvetsov-Shilovski et al. 2019).

Finally, we present the further development of the SCTS model: semiclassical two-step model with quantum input (SCTSQI) (Shvetsov-Shilovski and Lein 2019). In the SCTSQI model the initial conditions for classical trajectories are governed by the exact quantum dynamics. As the result, the SCTSQI corrects the inaccuracies of the SCTS model and other trajectory-based models in description of the ionization step. For ionization of a one-dimensional model atom the SCTSQI model yields quantitative agreement with the direct numerical solution of the time-dependent Schrödinger equation.

References

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