Coherence effects in laser-induced ultrafast response of complex atoms

Yongqiang Li[*1] **and Jianmin Yuan**[†2]

[*] Department of Physics, National University of Defense Technology, Changsha 410073, People's Republic of China
[†] Department of Physics, National University of Defense Technology, Changsha 410073, People's Republic of China

Synopsis A general approach based on quantum master equation is developed for real (not models) open quantum systems by including more than a thousand states. X-ray laser interaction with atomic gas and attosecond XUV pulse absorption are two examples, which are most interested and researched by peoples recently, and we studied by using our new approach.

Both coherent pumping and energy relaxation play important roles in understanding physical processes of ultra-intense coherent light-matter interactions. Here, using a large-scale quantum master equation approach [1], we describe dynamical processes of practical open quantum systems driven by both coherent and stochastic interactions. As examples, two typical cases of light-matter interactions are studied. First, we investigate coherent dynamics of inner-shell electrons of a neon gas irradiated by a highintensity X-ray laser along with vast number of decaying channels. In these single-photon dominated processes, we find that, due to coherence-induced Rabi oscillations and power broadening effects, the photon absorptions of a neon gas can be suppressed resulting in differences in ionization processes and final ion-stage distributions. Second, we take helium as an example of multiphoton and multichannel interference dominated electron dynamics, by investigating the transient absorption of an isolated attosecond pulse in the presence of a femtosecond infrared laser pulse.

References

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[1]E-mail: li_yq@nudt.edu.cn
[2]E-mail: jmyuan@nudt.edu.cn