A 14: Interaction with strong or short laser pulses

Time: Wednesday 10:45–12:15 Location: H1

Invited Talk A 14.1 Wed 10:45 H1

Improving the scaling in many-electron quantum dynamics simulations — •Michael Bonitz[1], Niclas Schlünzen[1], Jan-Philip Joost[1], and Iva Brezinova[2] — [1]Institut für Theoretische Physik und Astrophysik, Universität Kiel, Leibnizstr. 15 — [2]Technical University Vienna

The accurate description of the nonequilibrium dynamics of correlated electrons in atoms under laser excitation remains a key topic in many fields. Among others, the nonequilibrium Green functions (NEGF) method has proven to be a powerful tool to capture electron-electron correlations [1]. However, NEGF simulations are computationally expensive due to their T^3 scaling with the simulation duration T. With the introduction of the generalized Kadanoff-Baym ansatz [2], T^2 scaling could be achieved for second order Born (SOA) selfenergies [3], which has substantially extended the scope of NEGF simulations. Recently [4], we could achieve linear scaling within SOA and even the GW and dynamically screened ladder approximations which is a breakthrough for simulating the correlated electron dynamics. After demonstrating the linear scaling behavior we will discuss prospects for simulating the laser ionization dynamics in atoms [5].

[1] K. Balzer and M. Bonitz, Lect. Notes Phys. **867** (2013)
[2] P. Lipavský *et al.*, Phys. Rev. B **34**, 6933 (1986)
[3] S. Hermanns *et al.*, Phys. Scripta **T151**, 014036 (2012)
[4] N. Schlünzen *et al.*, Phys. Rev. Lett. **124**, 076601 (2020); Joost *et al.*, Phys. Rev. B **101**, 245101 (2020)
[5] F. Lackner *et al.*, Phys. Rev. A **95**, 033414 (2017)

Invited Talk A 14.2 Wed 11:15 H1

Imaging anisotropic dynamics in superfluid helium nanodroplets — •B. Langbehn[1], K. Sander[2], Y. Ovcharenko[1,3], C. Peltz[2], A. Clark[4], M. Coreno[5], R. Cucini[6], A. Demidovich[6], M. Drabbels[4], P. Finetti[6], M. Di Fraia[6,5], L. Giannessi[6], C. Grazioli[5], D. Iablonskyi[7], A. C. LaForge[8], T. Nishiyama[9], V. Oliver Álvarez de Lara[4], P. Piseri[10], O. Plekan[6], K. Ueda[7], J. Zimmermann[1,11], K. C. Prince[6,12], F. Stienkemeier[8], C. Callegari[6,5], T. Fennel[2,11], D. Rupp[1,11,13], and T. Möller[1] — [1]TU Berlin — [2]Univ. Rostock — [3]European XFEL — [4]EPFL Lausanne — [5]ISM-CNR Trieste — [6]Elettra-Sincrotrone Trieste — [7]Tohoku Univ. Sendai — [8]Univ. Freiburg — [9]Kyoto Univ. — [10]Univ. di Milano — [11]MBI Berlin — [12]Swinburne Univ. of Tech. — [13]ETH Zürich

Intense short-wavelength light pulses from free-electron lasers (FELs) enable the study of the structure and dynamics of nanometer-sized particles in the gas phase using coherent diffraction imaging methods. In our experiment, we explored the light induced dynamics of xenon doped helium nanodroplets. We used intense near-infrared pulses to ignite a nanoplasma inside the droplets. After a variable time delay of up to 800 ps, we imaged the dynamics triggered by the nanoplasma using extreme ultraviolet pulses from the FERMI FEL. The recorded scattering patterns exhibit pronounced directionalities that can be attributed to anisotropic changes of the droplet surface. A possible connection of these directed dynamics to the droplet's vortex structure will be discussed.

Invited Talk A 14.3 Wed 11:45 H1

Fragmentation of HeH^+ in strong laser fields — •Florian Oppermann[1], Philipp Wustelt[2], Saurabh Mhatre[3], Stefanie Gräfe[3], Gerhard G. Paulus[2], and Manfred Lein[1] — [1]Institut für Theoretische Physik, Leibniz Universität Hannover, Appelstr. 2, 30167 Hannover, Deutschland — [2]Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Deutschland — [3]Institut für Physikalische Chemie, Friedrich-Schiller-Universität Jena, Helmholtzweg 4, 07743 Jena, Deutschland

Our previous study of ionization and double ionization of HeH^+ in strong 800 and 400nm laser pulses has shown the important role of nuclear motion before and during the electron removal [1]. Here we move our focus to laser parameters where both dissociation and ionization are of comparable probability. According to simulations, this implies wavelengths around 1 to 2μm. For fixed molecular orientation the ratio ionization/dissociation can be controlled (sometimes even reversed) via the relative phase in a collinearly polarized ω-2ω laser pulse.

A Keldysh parameter can be defined not only for the ionization of HeH^+ but also for the dissociation process [2]. The ratio of the two Keldysh parameters is roughly 10, i. e. one pathway can be placed in the multi-photon regime while the other one is in the tunneling regime. Thus by changing the two-color delay on a subcycle scale the dominating process can be switched from multi-photon to tunneling and back.

[1] Wustelt et al., Phys. Rev. Lett. 121, 073203 (2018)
[2] Ursrey et al., Phys. Rev. A 85, 023429 (2012)